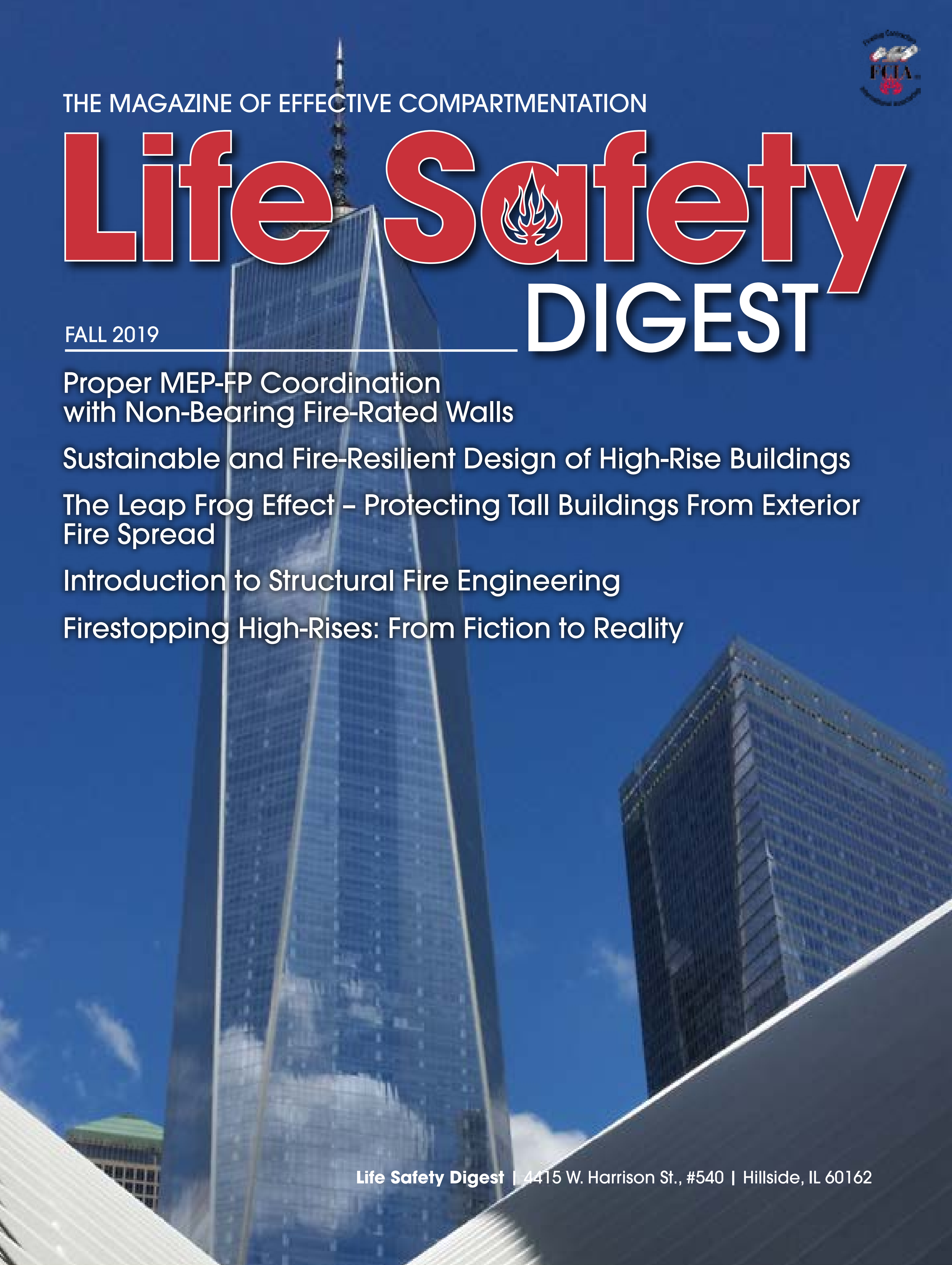

THE MAGAZINE OF EFFECTIVE COMPARTMENTATION

Life Safety DIGEST

FALL 2019

Proper MEP-FP Coordination with Non-Bearing Fire-Rated Walls

Sustainable and Fire-Resilient Design of High-Rise Buildings

The Leap Frog Effect – Protecting Tall Buildings From Exterior Fire Spread

Introduction to Structural Fire Engineering

Firestopping High-Rises: From Fiction to Reality

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Seattle Skyline. Photo by Brian Meacham

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FALL 2019

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LIFE SAFETY DIGEST

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ON THE COVER:

Freedom Tower and WTC Transportation HUB, Brian Meacham photo

EDITOR'S MESSAGE

Life Safety Digest's purpose is to provide a fire-resistance educational resource to Building Code Officials, Fire Marshals, Specifiers, Architects/Engineers, Firestop and Barrier Management services Contractors and Special Inspection Agencies, and Building Owners and Managers.

This issue of *Life Safety Digest* comes through with more cutting-edge educational material than ever before.

Kevin LaMalva from Simpson, Gumpertz & Heger provides an article on Performance Based Fire-Resistance Design Standard from ASCE7's Appendix, where he served as Chair.

Tony Crimi, Chair of the ASTM E05 Task Group on "Leap Frog" effect for the exterior skin of buildings, fills us in on the new E2874, *Standard Test Method for Determining the Fire-Test Response Characteristics of a Building Spandrel-Panel Due to External Spread of Fire.*

Consultant and SFPE Past President Brian Meacham provides insight into the issues of sustainability and the importance of fire-resistance in green building design.

But the content doesn't end there. This issue really is chock-full of great information. It truly is designed to be an excellent resource for you to reference – and pass on – today and tomorrow.

Check out these and other articles in *Life Safety Digest*. Past issues can be found online at www.fcia.org/magazine.htm. All copies of the publication are archived for research, another FCIA Resource.

Thank you for your continued interest in and support of *Life Safety Digest.*

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WRITTEN BY **COREY ZUSSMAN**

PROPER MEP-FP COORDINATION WITH NON-BEARING FIRE-RATED WALLS

What's more important than life-safety? I remember my first AHJ inspection at a hospital that I worked for in Chicago. I was relatively new to the position and thought that firestopping was something that we just used to close the hole in the wall. I learned a lot that morning, gaining a better appreciation for the little details that could give occupants more time to escape - or even save a life.

We should not take for granted the passive fire-resistance-ratings of our Mechanical, Electrical, Plumbing (MEP)- Fire Protection (FP) penetrations in fire barriers, fire walls, fire partitions, smoke barriers, and smoke partitions. That's why at Pepper Construction, we are making sure that each construction discipline understands how to properly detail their penetrations in the wall, including ensuring they stay out of the fire-resistance-rated head-of-wall joint.

Firestop installation takes effort to be installed properly. MEP-FP penetrations require coordination by all parties, and many tools can be utilized to assist with this effort. The installations must meet building requirements such as specification, tested assembly, and Manufacturer requirements for the specific piping components and other systems in the building, such as the fire-resistance-rated assembly, head-of-wall, and framing members, to name a few. They must also comply with Building Owner and Building Code requirements. As such, coordination is every party's responsibility and not just the individuals installing the firestopping products. It's essential that all coordinate to review and verify that all locations are correctly installed and verified by a trained individual.

Oftentimes, firestopping appears to be an afterthought during the bidding process that must then be dealt with, rather than properly budgeted for and coordinated with all the construction disciplines ahead of time. It seems that the work is passed off to the lowest paid individual who might not be properly trained to install the complex firestop systems, creating a potential life-safety hazard for the Building Owner and the occupants.

A one-hour Manufacturer-led review of the products and installation is not adequate training. Instead, the design to restore the hourly-ratings of the fire-resistance-rated assemblies should be discussed before bidding, and only properly trained individuals should work with the tested and listed assemblies and rated barriers, both horizontal and vertical.

SO, HOW DO WE CHANGE THIS?

No preconceived ideas. The team must be open to understanding the requirements, which may be new to the team, for the exact products that are being installed to become systems or the adjacent systems, as well as the specific building components.

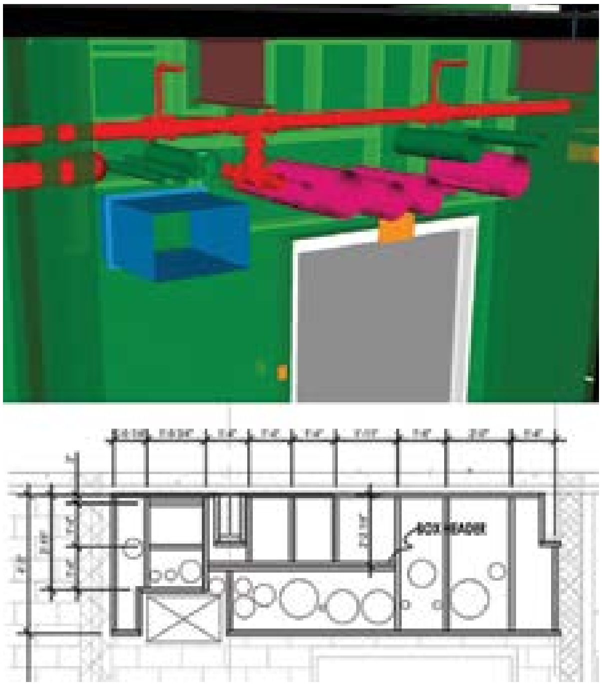
- Tested assemblies should be submitted and reviewed ahead of time.
- A pre-installation meeting should be held.
- A mock-wall installation should be considered.
- First-work-in-place protocol should be established.
- Assemblies should be specific to the project and not just a Manufacturer's sample assembly book and material data sheets.
- Finally, thought must be given to the installations and the other components of the building, such as the head-of-wall / "no fly zone" requirements for each location.

Mock-up models set the tone for acceptability.
Zussman/Pepper Photo

Once the Firestop Installation Contractor is let, a process to restore the hourly fire-resistance-rating to the assembly once a breach is made should be identified per construction discipline:

1. Review fire-resistance-rated wall/horizontal-floor assembly locations
2. Identify the materials being used to penetrate the membrane of either wall or floor
3. Identify the "no fly zone" at the head-of-wall
    a. If this is not clearly identified in the project drawings or specifications, an RFI should be written requesting the "no fly zone" for each location.
4. Plan/design the firestop systems to be used
5. Installation of firestop systems by a qualified team
6. Inspection of the installation by a qualified Special Inspection Agency
7. Owner to maintain the systems

Planning the systems ahead of time will better prepare the construction discipline installing the penetrating items and firestop products and the General Contractor or Construction Manager for proper coordination with other disciplines. It will also help guide the Building Information Modeling that is likely happening on your project.



Planning where penetrations are to occur speeds the process. Zussman/Pepper Images

HEAD OF WALL AND NO FLY ZONE

Along with the penetrations, it is equally important to understand and coordinate the head-of-wall for the fire-resistance-rated wall assemblies. I tend to get blank stares when I talk about the head-of-wall and the "no fly zone". The head-of-wall will determine the "no fly zone" for the MEP-FP trades.

The "no fly zone" is the area from the bottom of the deck above to the point at which the MEP-FP item could be located. In general, MEP-FP items should not go through the head-of-wall joint unless specifically tested and if the system design allows for the required movement of the system. Many tested MEP-FP items going through the head-of-wall have very limited movement ability - typically far less than what is needed for the system.

"No Fly Zone". Zussman/Pepper Photo

MEP Penetrations through head-of-wall joints should be avoided unless systems allow for fire-resistance and movement expected. Zussman/Pepper Photo

When I start talking about "no fly zones", I observe six stages to the Contractor's reaction:

The 6 Stages of Head-of-Wall Firestopping:

1. Shock
2. Denial
3. Anger
4. Bargaining
5. Depression
6. Acceptance

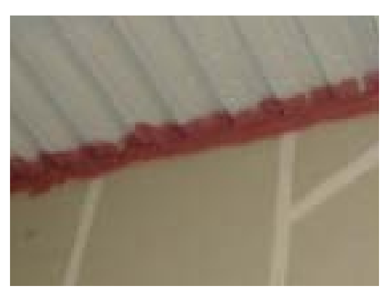
It's best to get through all six stages before the letting of the contract, otherwise the process might be a surprise and create a longer process of understanding, or worse, incorrect installation. Once the Contractor understands, typically the MEP-FP installation is lowered from the bottom of the deck to below the "no fly zone."

Once the Contractors reach acceptance, the head-of-wall for non-bearing walls needs to be determined. Load bearing walls are static and do not have a head-of-wall joint.

When possible, ask four questions up-front, during bidding to properly identify the requirements of the system for the restoration of the fire-resistance-rated wall assemblies.

1. **What is the structural live-load deflection?**
   It is critical to determine the correct value for the up and down movement of the structure based on the live-load, not wind pressure. The code maximum is generally L/360, where L equals the distance in inches between the columns. Most buildings are designed stiffer than code maximums, but this is a good guide if a deflection cannot be determined.

2. **Is there spray fireproofing on the beams and deck?**
   If there is, it will bring down the head of wall using z-clips on the top track, which will also increase the "no fly-zone."



Spray fireproofing (SFRM) on deck. Fire Stop Technologies Photo

3. **What type and size of head track are being installed?** Slotted track, deep leg, intumescent, mechanical type, etc. The size of the head track correlates with the deflection due to the requirement of the stud to be within the top track. The calculation for the head track on floors that are not on grade is 2x deflection + 1 inch. On grade, the head track must be a minimum 1x deflection + 1 inch (always a minimum 1" into the track).

4. **What is the type of firestopping for the head-of-wall?** Is it a sealant, spray, intumescent, mechanical, etc.? Sealants are the most restrictive and will likely only be good for static conditions unless the movement is less than ¼". Spray movement ability will vary considerably and needs to be carefully reviewed. Movement ability is approximately between 15-50% for spray and generally 80-100% for intumescent. Mechanical type is the most restrictive for height. This type will create the deepest "no fly zone." The system could have a depth of 8-15" or more depending on the deflection.

The live-load deflection generally applies to both directions (up and down), unless you are on the ground floor or basement level. Also, note that the deflection of the floor above is down on the floor below.

Firestop spray system at head of wall. Zussman/Pepper Photo

Even older buildings are subject to deflection. It is good practice to ask for the deflection and "no fly zone" as soon as possible to properly begin to coordinate your MEP-FP systems.

CALCULATING THE "NO FLY ZONE"

The "no fly zone" is calculated with the deflection requirement of the assembly (hold down of the drywall), plus spray fireproofing, plus the overlapping requirement of the firestopping (if a firestop system rather than mechanical type), plus the annular space and sealant installation of a penetration firestop system or a flange depth in HVAC.

For example:

1. Building deflection: 1" deflection on the 2nd floor
2. 1" of spray fireproofing on the beams and deck
3. Head track type is deep leg
4. Firestopping is a spray joint

The assembly has 1" spray fireproofing. The system could have a drywall hold down of 2" (based on 50% movement of the spray type system (1"/50%=2")), plus ½" overlap onto the drywall, plus a 2" flange on the HVAC and ½" annular space. The "no fly zone" would be at least:

1" (spray fireproofing)

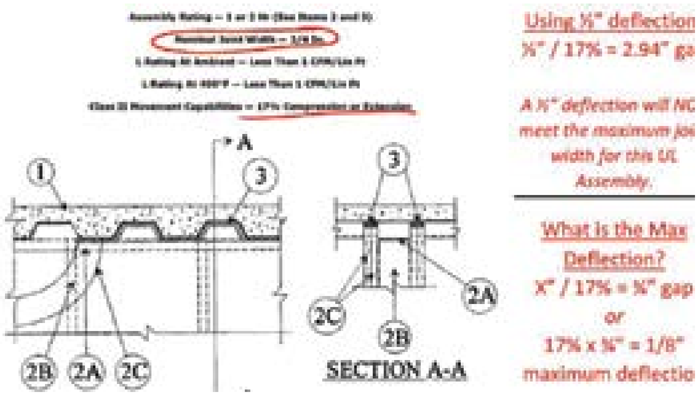
+ 2"(drywall hold-down)

+ 1/2"(overlap)

+ 2"(HVAC clip)

<u>+ 1/2" (annular space)</u>

6" no fly zone from the steel or deck for the HVAC.



Visual deflection calculation. Zussman/Pepper Image

THE INSTALLATION PROCESS

The installer must follow the "no fly zone" under all obstructions, including the beams, joists, angles, etc. For example, the MEP-FP cannot be directly under a beam going through a fire-resistance-rated assembly; it must be under the "no fly zone" for the beam.

So, how do we go from reacting to firestopping installation to proactively discussing the installation with the entire team?

Talk to the installers about the different installations and requirements of the system and the building. Make sure that the "no-fly zone" is given before the design of the HVAC-FP systems. As a team, go over the basic installation requirements for the systems, get the Manufacturers involved and make sure that the installers understand and know how to read the tested and listed assembly instructions and install the products.

The Manufacturers, testing agencies, and verification team should be visiting the individual companies and training centers installing these products to go over the process from beginning to completion. Installers should ask the right questions before work begins:

1. What is the deflection?
2. Do we have spray fireproofing on the beams or deck?
3. What is the "no fly zone?"
4. Which Manufacturers should be used based on specifications or Owner requirements?
5. When will the pre-installation meeting take place to go over the project and installation?
6. Are we installing a firestopping mock-up?
7. What are the "first work-in-place" procedures to ensure the entire team understands at the very beginning of the installation?

THE BENEFITS OF TECHNOLOGY

The current state of HVAC-FP firestopping systems and where they'll be headed soon is very exciting. Augmented reality (mixing live interaction with the future construction of the project) allows installers to see the building walls and the "no fly zone" in front of them while walking around, providing a better understanding of the difficulties of installation, sequencing needs due to obstructions, and the general flow of construction.

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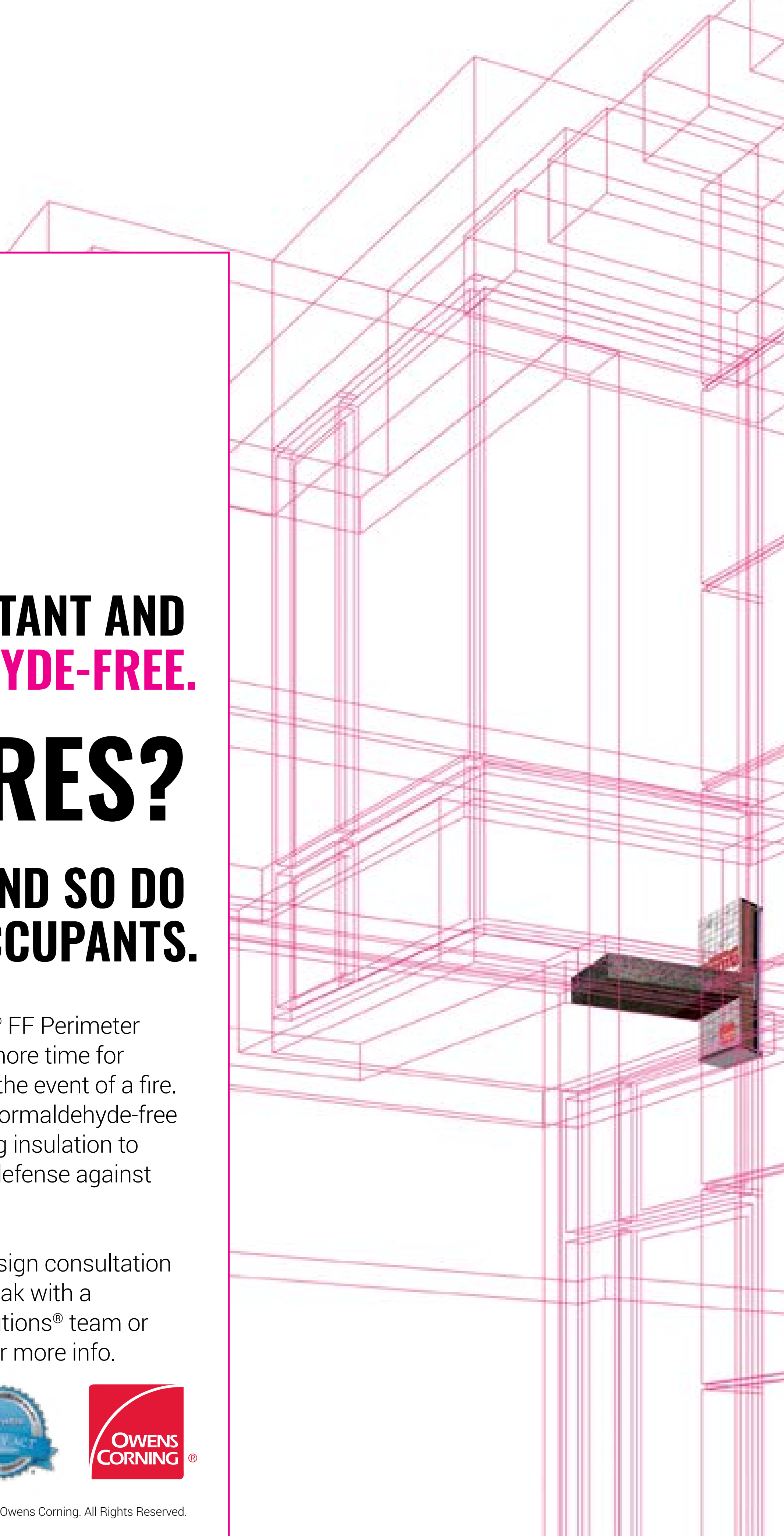

Augmented reality and BIM help with planning locations of penetrations below the head-of-wall. Zussman/Pepper Photo

Technology will also allow for better review of the wall for bond beams or door king studs when managing the design of the HVAC-FP systems. It can identify sleeve size and location ahead of a concrete pour, which facilitates better coordination for the concrete Contractor and verifies the proper size and location of materials ahead of time with the entire team. The use of augmented reality is still in its infancy and is just beginning to show the benefits for better firestopping coordination.

A successful project clearly identifies the fire-resistance-rated wall assemblies and identifies critical building elements that are not easily seen on the architectural and MEP-FP drawings. With better coordination through Building Information Modeling (BIM), the installer could easily coordinate and navigate through a wall of studs before the installation of either takes place. Moving the HVAC-FP or building studs before anything is installed is a time saver for the entire team.

When the tested and listed firestopping systems are reviewed in the pre-installation meeting with the team, the framing Contractor should be aware of any special framing requirements for the systems being used, such as:

- Added boxouts for rows of conduit
- Sequencing issues for the framer regarding the need to firestop the penetration when it goes from an interior of a fire-resistance-rated wall through to an adjacent non-rated wall (the fire plane turns with the wall-rating).
- MEP-FP item penetrates through a shaft wall and the need to firestop within the shaft wall cavity prior to closing up the wall system.

I have worked with many MEP-FP Contractors and Specialty Firestop Contractors over the years. When the Contractor gets more involved and informs the team of their requirements early in the process, the project's passive life-safety components and the entire project team as a whole, benefit greatly.

Corey is a registered Architect in several states, practicing for more than 29 years. He specializes in building envelope, restoration, preservation, life-safety, and interior finishes. Corey is currently the Director of Quality Assurance for Pepper Construction Company in Chicago, where he has promoted a formal quality program for more than seven years. He can be reached at czussman@pepperconstruction.com

SIDEBAR

In Chicago, specifications for FM 4991 Approved and or UL Qualified Firestop Contractors appear a lot in super high-rise construction, healthcare and other occupancies. FCIA has heard that almost 75% of the super high-rise buildings are using FM 4991 Approved or UL Qualified Firestop Contractors on these projects. Special inspection does take place in Chicago, but is not mandated by the Municipal Building Code of Chicago.

When utilizing a FCIA Member, FM 4991 and/or UL Qualified Firestop Contractor, the process Mr. Zussman describes gets easier. One single firestop installation contractor to deal with, one workforce, consistent product and systems selection, all result in an easier process to manage for the construction team.

Finally, the "Inventory of Firestopping" is something firestop installation contractors do routinely, and means it's just about automatic – setting up the building owner and managers process for maintaining the systems installed.

FCIA has noticed that the 'DIIM' of Firestopping solves many of the issues mentioned in this article. Through a clear 07-84-00 Firestopping Specification, a FCIA Member, FM 4991 Approved and or UL Qualified Firestop Contractor, Inspection by IAS AC 291 Special Accredited Inspection Agencies who employ Inspectors who have passed the FM or UL Firestop Exam and IFC's Firestop Exam, the construction is built right so the building owner can maintain it right.

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WRITTEN BY **BRIAN MEACHAM**

SUSTAINABLE AND FIRE-RESILIENT DESIGN OF HIGH-RISE BUILDINGS

Seattle Skyline. Photo by Brian Meacham

Sustainability and resiliency are terms one often hears today in discussions about the built environment. While some use the terms interchangeably, they embody different concepts, which sometimes align, but in other cases, can result in competing objectives. Good building design should address both sustainability and resiliency concepts as part of a holistic approach. This is especially important for high-rise buildings, for which energy demands can be significant and life-safety requirements are paramount.

SUSTAINABILITY AND RESILIENCY

The word sustain comes from the Latin word to uphold or continue. The concept of a sustainable built-environment was born out of concern over the potential depletion of earth's finite resources and the potential for irreversible damage to the environment as a result of growing industrial activity, energy demands and transportation needs, and the desire to find ways to address both as part of continued expansion of the built-environment.[1]

Early focus for sustainability within buildings was related to energy consumption and material usage. This gave rise to materials, technologies and design concepts aimed at reducing energy demands, carbon emissions, and material use.

Resiliency comes from the Latin word to rebound or bounce back. The term is broadly used to describe the ability to return to normal after suffering some type of loss. With respect to the built-environment, it describes the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.[2]

With respect to buildings, the general focus is on designing to withstand normal and extreme loading conditions, providing safety to the occupants. Resiliency has long been an aspect of structural and fire protection design, but gained additional attention following the tragic events of September 11, 2001, storms such as Hurricane Katrina and Superstorm Sandy, and, more recently, the extensive wildland fires. Today, much of the focus is on resilience to extreme weather events and climate change adaptability. However, resilience to fire remains a broad societal objective and should be considered as part of a multi-hazard assessment and design approach.

"Green" Building in Singapore. Photo by Brian Meacham

SUSTAINABLE DESIGN CONCEPTS

As stated in the *Whole Building Design Guide,*[3] the main objectives of sustainable design are: to reduce, or completely avoid, depletion of critical resources like energy, water, land, and raw materials; to prevent environmental degradation caused by facilities and infrastructure throughout their life-cycle; and to create built-environments that are livable, comfortable, safe, and productive. Many of the core principles of sustainable design focus on reducing or optimizing energy, resource and material usage. This can be seen in the US Federal Government's *Guiding Principles for Sustainable Federal Buildings*.[4] These Guiding Principles include several factors associated with energy-efficiency, ventilation, lighting, and material usage, including:

Marina Bay Sands Hotel, Singapore. Photo by Brian Meacham

- For new construction, ensure energy-efficiency is 30% better than the current American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 Standard (or alternatives listed).
- Evaluate and implement, where appropriate, life-cycle cost-effective renewable energy projects on-site; consider long-term off-site renewable sources and renewable energy certificates (RECs); and utilize clean and alternative energy where possible.
- Maximize opportunities for daylighting in regularly occupied space, automatic dimming controls or accessible manual controls, task lighting, and shade and glare control.
- Procure products that meet the following requirements where applicable: Resource Conservation and Recovery Act section 6002, Federally recommended specifications, Standards and ecolabels or are on the Federal Green Procurement Compilation for other green products, as appropriate.

There are also Principles related to indoor air quality, safety, and climate adaptation, among others. Principles such as these can lead to a variety of design features that may be considered. Some sustainable design concepts for high-rise buildings include:

- Significant use of day lighting
- Double-skin façade systems for heating, cooling, and ventilation
- Natural ventilation schemes (vertical, e.g., atria, and horizontal)
- Increased thermal insulation
- Lightweight, high-strength materials
- Local alternative energy generation and storage systems (for normal and emergency power)
- Vegetative features (e.g., shading, walls, roofs)

FIRE, HIGH-RISE BUILDINGS, AND FIRE-RESILIENT DESIGN CONCEPTS

No buildings are free from the risk of fire. High-rise buildings present unique fire protection challenges. They have limited routes for occupant egress and fire service access. Stack effect can influence vertical smoke movement. Structural stability can be impacted by large fires burning for long periods of time in concentrated areas or as they travel around open plan spaces. Buildings over 1000 feet in height are almost commonplace, and in some locations, 'super-tall' buildings are nearing or exceeding 2000 feet. As urban environments expand due to population growth and migration from the countryside into cities, the number of high-rise buildings is increasing. They are becoming 'self-contained communities', incorporating retail, transit, schools, businesses, and more.

Burj Khalifa.
Photo by Brian Meacham

With the number of people at risk and the challenges for fire service personnel, it is critical to have well-designed and properly performing passive and active fire protection systems working in a holistic and integrated manner. Gaps or failures in either can lead to serious consequences. This has unfortunately been witnessed in several historic high-rise fire events in the USA and worldwide. Some examples include[5]:

- August 15, 1970, One New York Plaza, steel frame, 50-story office building (New York, NY). Consequences of this fire led to the elimination of call buttons that could be activated by fire effects, elevator recall, firefighter's elevator service, and need for durable fire protection of steel members.

- November 21, 1980, MGM Grand Hotel, concrete, 85 deaths and more than 500 injuries (Las Vegas, NV). This tragic fire led to numerous changes, many focused around limiting vertical spread of smoke. Changes included requirements for seismic joints to be protected against fire and smoke spread between floors; precautions against storage of combustible materials in concealed spaces; the need to protect vertical openings, including stairways and elevator shafts, against smoke and fire spread between floors; protection of HVAC systems to limit fire and smoke; stairway doors should allow reentry to floors at no more than five floor intervals.

- May 4, 1988, First Interstate Bank, concrete, 62-story office building (Los Angeles, CA). Consequences of this fire led to local requirements for sprinklers in all high-rise buildings, including existing buildings; protection of curtain walls to limit fire and smoke spread at the gap from the fire-resistance rated horizontal assembly and exterior wall between floors; fire-resistance rating of all stairway doors; the need for very tall buildings to have a pre-fire emergency plan.

- February 23, 1991, One Meridian Plaza, steel frame, 38-story office building (Philadelphia, PA). This fire, another high-rise fire in a building being retrofit with sprinklers, also experienced other fire suppression system challenges. This fire led to recommendations concerning the need for redundant firefighting water supplies; protection of curtain walls to limit fire and smoke spread at the exterior wall gap between floors; zoning of combined sprinkler and standpipe risers such that pressure reducing valves (PRVs) are not needed at standpipe hose valves; annual inspection and testing of the PRVs; connection of fire alarm systems to a supervisory service or directly to the fire service; primary and secondary power should be routed independently.

- September 11, 2001, World Trade Center Towers, steel frame, 110-stories each, more than 3000 deaths (New York, NY). This horrific event spawned several investigations and consideration by the community of the extent to which fire-resilience in the face of attack should be considered. Many recommendations resulted from this event, including the need for redundancy of structural framing; better understanding of structural connection performance; adhesion of SFRM fireproofing under realistic impact and fire conditions; the need to have access to a highly reliable water supply for structural fire-resistance ratings that are based on the use of sprinklers; redundancy and robustness of means of egress; opportunity for elevators for occupant evacuation.

- February 12, 2005, Windsor Tower, concrete, 32-story office building (Madrid, Spain). A concrete building with a reinforced concrete core, whose original design included unprotected perimeter columns and internal steel beams, no protection of vertical openings, no firestopping at the gap between the fire-resistance rated horizontal assembly (floor slabs) and the exterior wall, and no sprinklers. As with earlier fires, this fire led to recommendations concerning the need for redundant firefighting water supplies; protection of curtain walls to limit fire and smoke spread at the gap between the fire-resistance rated horizontal assembly and exterior wall between floors; and the need to protect vertical openings, including stairways and elevator shafts, against smoke and fire spread between floors.

- February 9, 2009, Mandarin Oriental Hotel, 520-foot hotel (Beijing, China). The building caught fire around 8:00 pm and was engulfed within 20 minutes, due largely to the combustible exterior façade. Despite the fact that the fire extended across all of the floors for a period of time and burned out of control for hours, no significant portion of the structure collapsed. This fire was instrumental in highlighting that high-rise buildings using combustible components in the façade can pose unreasonable risks for significant fire spread along the exterior of a building, and that exterior fire spread characteristics need to be understood and may need to be substantiated by large-scale tests.

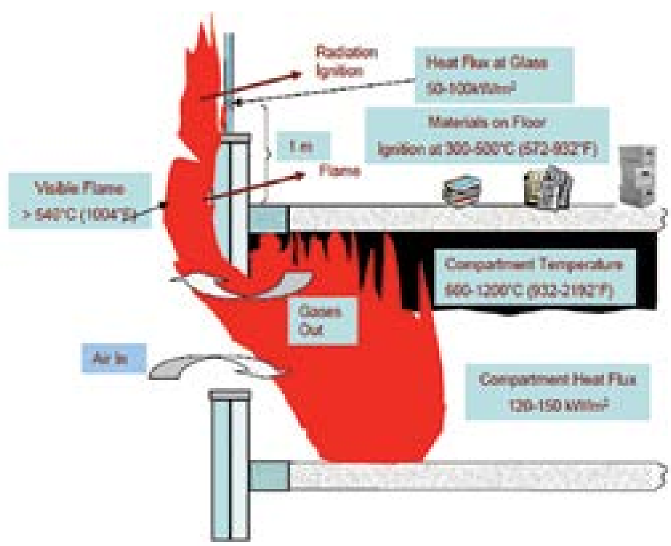
These events and others have been instrumental in increasing the fire-resilient design of high-rise buildings. Some of the key fire-resilient design concepts for high-rise buildings that we have adopted include:

- Adequate and durable fire-resistance rated protection of structural members, shaft walls, and compartment barriers.
- Protection of vertical openings, including stairways and elevator shafts, against smoke and fire spread between floors.
- Protection of HVAC system and components to minimize smoke and fire spread between floors.
- Protection of curtain walls to limit fire and smoke spread at the gap between the horizontal fire-resistance rated assembly and the exterior wall between floors.
- Non-combustible or limited-combustible exterior façade and wall systems.
- Adequate number, appropriate location, proper separation, reliability, and redundancy of means of egress.
- Reliable and redundant sprinkler, standpipe, and water supply systems.
- Consideration of fire protection systems performance and ability to meet design objectives following other events (e.g., earthquake, explosion).

AREAS OF POTENTIALLY COMPETING OBJECTIVES

We have learned much from 'fires past' events and have adopted good fire-resilient design strategies. However, new technologies, new materials, and new performance objectives for high-rise buildings can present new risks. Some of these can be related to implementation of sustainable design concepts. If an integrated design approach is not taken, some potentially competing objectives can result.

If one looks to the research literature, there are studies that point to a wide range of potentially competing objectives,[6] including fire and health hazards due to the flammability of thermal insulating materials, fire and smoke spread potential through the use of double-skinned exterior wall façades, fire hazards and impediments to emergency responders associated with interior and exterior use of vegetation, photovoltaic panels, and other 'green' features and elements.



Fire and façade interaction. Source: SFPE (5) and Aon – reprinted with permission

Furthermore, finding a suitable balance between sustainability and fire-safety objectives can be particularly complex due to the multi-dimensional aspects of each. Timber is 'sustainable' but is also combustible, so if not addressed appropriately, it can present a significant fire-safety hazard. Lightweight high-strength concrete requires less material and is more sustainable than regular strength concrete but can be highly susceptible to spalling during a fire. Insulation and alternative energy sources are good for sustainability, but photovoltaic panels, which can cause an ignition, and flammable insulation material can be a catastrophic combination.

As an example of what can happen if fire-resiliency is not adequately addressed along with sustainability objectives, consider the tragic Grenfell Tower fire in London, a high-rise residential tower where more than 70 residents died when fire engulfed the building. Similar to the Mandarin Oriental Hotel fire in Beijing, the Grenfell Tower had a combustible exterior wall façade system, which included a combustible exterior layer, combustible insulation, a large air space, and combustible rainscreen.[7] In this case, however, the building was occupied. It was also not sprinklered and had only a single exit stairwell. In addition to the combustible exterior, contributions to the loss include inadequate compartmentation, firestopping, and fire-resisting door systems. As the fire began spreading on the exterior, it ignited materials inside of the building due to open windows and window-system failures.

If we look to high-rise buildings, we can identify areas of potential competition that need to be addressed as part of a holistic design approach.

FIRE-RESILIENCY OBJECTIVE	SUSTAINABILITY OBJECTIVE	POTENTIAL FOR COMPETITION
Adequate and durable fire protection of structural members, shaft walls and compartment barriers	Reduced materials (e.g., lightweight high-strength concrete); use of sustainable materials (e.g. timber)	If not properly fire protected, materials could be more susceptible to fire, failing earlier and catastrophically
Protection of vertical openings, including stairways and elevator shafts, against smoke and fire spread between floors	Reduced materials (e.g., lightweight high-strength concrete); use of timber; green walls (vegetative)	If not properly fire protected, materials could be more susceptible to fire, failing earlier and catastrophically
Smoke exhaust system to minimize smoke and fire spread between floors	Double-skin façade systems for heating, cooling and ventilation; natural ventilation	If not adequately protected, void space could facilitate fire and smoke spread
Protection of the gap at floors and exterior curtain walls to limit fire and smoke spread at the exterior wall between floors	Double-skin façade systems for heating, cooling and ventilation	If not adequately protected, void space could facilitate fire and smoke spread
Non-combustible or limited-combustible exterior façade and wall systems	Increased thermal insulation; integration of local alternative energy sources and storage	If combustible or not adequately protected, can result in significant fire spread
Limit on combustible materials and sources of ignition	Integration of local alternative energy sources and storage	Could present ignition source; batteries present challenges
Reliable and redundant sprinkler, standpipe, and water supply systems	Water conservation	Reduced mains and risers for conservation cannot override fire suppression needs

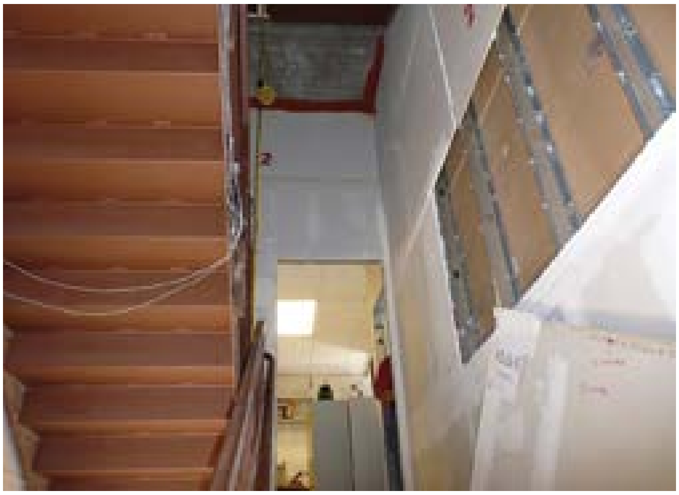
These potentially competing objectives can all be addressed – if considered as part of an integrated design approach.

NEED FOR MULTI-HAZARD RESILIENCY PERSPECTIVE

Finally, it is not enough to focus just on fire-resiliency objectives, but to consider a broader set of resiliency objectives as part of a holistic, integrated, multi-hazard approach.

In particular, consideration should be given to potential building damage associated with high-winds and earthquakes. Wind and earthquake loads are considerations for high-rise buildings in areas prone to those events. However, the structural design codes do not fully consider multiple event occurrences, such as fire following hurricane or earthquake. While the risk of having sequential events may be low, damage from such events, including broken windows / façade systems, separation between floor slab and wall systems, damage to interior compartmentation systems, damage to doors, stairwells and elevators, and impacts to active fire-safety systems have been observed in real events and experimental research.[8] This is particularly concerning for high-rise buildings for all of the reasons identified above.

Damage to stair system from 5-story specimen earthquake test. Photo credit – Pantoli et al., 2013



Damage to fire compartment barrier from 5-story specimen earthquake test. Photo credit – Pantoli et al., 2013

FIRE-RESILIENCY OBJECTIVE	EVENT DAMAGE	POST-EVENT FIRE CONCERN
Adequate and durable fire protection of structural members, shaft walls and compartment barriers	Damage to or loss of fire protection; openings in fire-resistance rated walls; breaches in shaft walls; damage to firestopping	If fire protection is not as designed, structure and barriers could be more susceptible to fire, failing earlier and catastrophically
Protection of vertical openings, including stairways and elevator shafts, against smoke and fire spread between floors	Loss of fire protection; openings in fire protective walls; damage to shaft walls; damage to firestopping; damage to fire protection; window breakage / façade damage	If fire protection is not as designed, structure and barriers could be more susceptible to fire, failing earlier and catastrophically
Smoke exhaust system to minimize smoke and fire spread between floors	Damage to ducts; damage to plenum barriers; damage to dampers	If fire protection is not as designed, damaged HVAC, void space could facilitate fire and smoke spread
Protection of gap between horizontal assemblies and curtain walls to limit fire and smoke spread at the exterior wall between floors	Damage to exterior wall systems; broken windows; damage to curtain walls	If fire protection is not as designed, openings could facilitate fire and smoke spread
Adequate number, appropriate location, proper separation, reliability and redundancy of means of egress	Damage to doors, corridor walls, exit stairwells, and elevators	Loss of protected means of escape can delay / impact egress and firefighter access
Reliable and redundant sprinkler, standpipe, and water supply systems	Damage to water supply, risers, branch lines or related	Reduced water supply / loss of sprinklers impacts fire suppression capacity

As with the observation about sustainability and fire objectives above, these issues can all be addressed – if considered as part of an integrated design approach. Use of a risk-informed performance-based approach can be helpful in identifying issues and mitigation options and making inform decisions as to which combinations of events should be considered and how.

CLOSING THOUGHTS

We have a good, recent history of managing fire impacts in high-rise buildings. This is because we have learned from past events and from research and have continuously updated our Building Codes, design approaches, and fire protection technologies. Changes to the model Building Codes[2] and design guidance focused on fire-resilience of tall buildings is of great help.[5] We have a well-educated and well-trained workforce across the fire protection community. Our professional Associations and Societies are actively involved in continuing to provide technical resources and training to keep the community up to date.

However, sometimes decisions occur, priorities shift, and events occur that are not fully addressed in an integrated manner. When this occurs, potential failure modes can be introduced. This is of particular concern in high-rise buildings, due to occupant loads, difficulty in fighting fire, and more. The moves to make buildings more sustainable can introduce challenges for fire-safety. These can be addressed if considered in a holistic manner.

As we move to resilient design, we need to take care that fire-safety stays on the agenda as well, so that buildings remain resilient to fire, as well as to other hazards.

Brian is Managing Principal of Meacham Associates. He is the 2019 President of the Society of Fire Protection Engineers, Secretary of the International Association for Fire Safety Science, Chair of the NFPA Technical Committee on Fire Risk Assessment Methods, and member of the US TAG to ISO TC92 SC4 – Fire Safety Engineering. He is a licensed Professional Engineer in Connecticut and Massachusetts, a Chartered Engineer and Fellow of the Institution of Fire Engineers in the UK, a Fellow of the Society of Fire Protection Engineers, and a Fulbright Global Scholar. He can be reached at Brian.Meacham@meachamassociates.com.

REFERENCES:

1-See for example, "*History of Sustainability*", Chapter 2, Sustainability and the U.S. EPA, National Academies Press, Washington, DC, 2011.

2-See for example, Meacham, B.J., *Building Community Resilience through Modern Model Building Codes*, International Code Council, Washington, DC, 2018.

3-Whole Building Design Guide, National Institute of Building Sciences, available at https://wbdg.org/design-objectives/sustainable

4-*Guiding Principles for Sustainable Federal Buildings*, Council on Environmental Quality, available at https://www4.eere.energy.gov/femp/requirements/guidelines_filtering

5-SFPE Engineering Guide to Fire Safety for Very Tall Buildings, Society of Fire Protection Engineers, Bethesda, MD, 2013

6-See for example, discussion in Meacham, B.J., Sustainability and resiliency objectives in performance building regulations, Building Research & Information, 44(5-6), 474-489, DOI: 10.1080/09613218.2016.1142330, 2016, and Meacham, B., Poole, B., Echeverria, J. Cheng, R., Fire Safety Challenges of Green Buildings, Fire Protection Research Foundation, 2012 (https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Building-and-life-safety/rffiresafetygreenbuildings-(2).ashx?la=en)

7-Seethevariousgovernmentandotherreportsthathavebeenpublished following the Grenfell Tower fire, including expert witness reports for the government inquiry, being led by Sir Martin Moore-Bick (available at https://www.grenfelltowerinquiry.org.uk/about/expert-witnesses)

8-See for example, Pantoli E, Chen M, Wang X, Astroza R, Ebrahimian H, Mintz S, Hutchinson T, Conte J, Restrepo J, Meacham B, Kim J-K, Park H (2013) BNCS Report #2: full-scale structural and nonstructural building system performance during earthquakes and post-earthquake fire—test results, University of California, San Diego, and Meacham, B.J., "Post-Earthquake Fire Performance of Buildings: Summary of a Large-Scale Experiment and Conceptual Framework for Integrated Performance-Based Seismic & Fire Design," Fire Technology, Vol.52, Iss.4, pp1133–1157, DOI:10.1007/s10694-015-0523-9, July 2015.

WRITTEN BY **TONY CRIMI**

THE LEAP FROG EFFECT-PROTECTING TALL BUILDINGS FROM EXTERIOR FIRE SPREAD

Fires can spread vertically via the exterior of buildings even without the involvement of the exterior building cladding system. Globally, there are numerous examples of fire-spread from the room of origin to the room above via vertically adjacent windows, but until recently, most have caused only property damage. Most deaths or injuries on floors other than the fire floor are the result of smoke inhalation. However, more innovative ways to insulate buildings to improve their sustainability and energy-efficiency are changing the external surfaces of buildings. The result is an increase in the volume of potentially combustible materials being applied and different construction techniques being utilized which favor energy performance.

As multiple recent high-rise fires around the world have demonstrated, it is critical that we remain vigilant against potential fire hazards, particularly as we transition to tighter and more energy-efficient buildings, and we need to adapt our traditional perceptions to these new methods of construction.

The opening at the exterior wall and the horizontal (floor) assembly provides several different paths for vertical fire-spread in buildings at the building's perimeter. To prevent the spread of fire, based on the various possible paths, the US Building Codes establish different requirements for each of these potential paths. Each of these paths is addressed by different test Standards. The intent is to confine a fire to the story of origin and prevent propagation to adjacent areas above the room of fire origin.

Real fire experience has taught us that ineffective curtain wall design, perimeter void fire protection, or inadequate spandrel protection can allow fire to spread through the space between floors and walls, the window head transom, and the cavity of the curtain wall. This can occur either by ignition of the exterior building cladding materials, through window glass breakage, or around melted aluminum spandrel panels. Conceptually, the easiest way to look at the three paths for the fire to spread from a room below to adjacent floor levels at the exterior wall are:

1. Through Voids: Fire spreading within the building through the void or opening space created between the edge of the horizontal floor assembly and an exterior curtain wall. These are protected by perimeter fire barrier systems. This includes an assembly fire tested to ASTM E2307, *Standard Test Method for Determining Fire-Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus,* for system design specification, and ASTM E2393, *Standard Practice for On-Site Inspection of Installed Fire-Resistive Joint Systems and Perimeter Barriers*, for proper installation. Installation by an FM 4991 Approved or UL Qualified Firestop Contractor helps ensure proper installation of these perimeter fire barrier systems.

2. Through Cavity: Fire spreading through a void or cavity within the exterior curtain wall. In this situation, fire would spread by a path within the concealed space of the exterior wall, or along the outer surface of the exterior wall. These are protected by NFPA 285 compliant assemblies, which evaluate flame propagation due to combustible materials used in exterior wall assemblies. *(NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components)*

3. Leap-frog: Fire spreading to the exterior and then impinging on an opening in an upper level. This is a lower-window-to-upper-window "leap-frogging" mechanism where combustible materials behind an upper window are ignited as a result of the intense heat from flames projected out of a lower window. This mechanism is currently addressed prescriptively using spandrel panels or sprinkler protection. The first edition of ASTM E2874, *Standard Test Method for Determining the Fire-Test Response Characteristics of a Building Spandrel-Panel Due to External Spread of Fire*, was published in 2019, following many years of research and development.

Figure 1: Pathways for Vertical Exterior fire-spread. Thermafiber, an Owens Corning Co. Image

Flame extension and heat fluxes to the window areas above an opening can be expected to be greater where combustible claddings are used in lieu of traditional US Code-prescribed fire-resistance-rated spandrel panels, due to the contribution of combustible cladding or insulation materials immediately above a window opening. The construction of the spandrel panel, along with the perimeter fire barrier joint system, are important factors in determining the ability of the exterior wall to protect against vertical fire-spread. Typical aluminum framed curtain walls using spandrel glass require that any glass installed in the spandrel area immediately above openings be appropriately protected. Additionally, the aluminum mullions require insulation protection; otherwise, the aluminum frame will melt and no longer support the wall system. These measures will help keep the glass spandrel panel, and any associated fire barrier system, intact.

EVOLUTION OF CURTAIN WALL FAÇADE CONSTRUCTION

Curtain wall design became common in commercial construction over the past 40 years. Cladding is often used because it is attractive and can be easy to clean. For example, it was installed on the Grenfell Tower, a 24-story mid-1970s structure in the UK, to provide a more modern look and an energy-efficiency upgrade. With many combustible materials being used today in commercial exterior wall assemblies to improve energy performance, reduce water and air infiltration, and allow for aesthetic design flexibility, the combustibility of the assembly components has been known to directly impact the fire hazard to buildings.

Cladding has played a contributing role in numerous fires worldwide. The aptly named "Torch Tower", a high-rise building in Dubai, UAE, has seen two major cladding fires in the past 3 years. The Torch Tower first went up in flames back in February 2015. More than 1,000 people were evacuated from the 1,105-foot tall, 87-story building. The building was repaired, but it experienced a second cladding fire on August 4th, 2017. While there were no reported deaths, Dubai Civil Defense reported 38 apartments were damaged in the fire, and 64 floors were affected by the blaze.

Experts also cited cladding as a factor in similar fires in which flames raced along the sides of buildings, including: a high-rise fire in a building undergoing renovation in Shanghai in 2010 that killed at least 58 people when it re-entered the building on multiple floors; a 2015 apartment fire in Azerbaijan that left 16 people dead; and a 2009 fire at Beijing's TV Cultural Center that killed a firefighter.

Similarly, in Australia, more than 400 people were evacuated from the Lacrosse Tower on November 25, 2014, when a discarded cigarette on a balcony started a fire that very quickly spread up the face of the building. While there were no fatalities, owners of the Lacrosse tower are claiming more than $12 million in damages, and lawyers for the owners are claiming almost $1 million in lost rent, money spent on emergency accommodation during the fire emergency, and compensation for an increase in insurance premiums since the blaze.

The 2014 fire at the Lacrosse tower in Melbourne's Docklands spread across the facade in a matter of minutes. Gregory Badrock/ Metropolitan Fire Brigade Photo.

During the One Meridian Plaza fire in 1991, flames broke through several windows around a major portion of the fire floor, exposing the floor above to auto-exposure from flames lapping up the side of the building. Additional alarms were called to bring personnel and equipment to the scene for a large-scale fire suppression operation. As the fire developed on the 22nd floor, smoke, heat, and toxic gases began moving through the building. Vertical fire extension resulted from unprotected openings in exterior wall gap, linear gaps, floor and shaft assemblies, severe deflection of the floor assemblies, and the lapping of flames through windows on the outside of the building.[1]

Most recently, the tragic fire in the 24-story Grenfell Tower in West London on June 14, 2017 killed at least 72 people, but police said only 21 of those victims could be formally identified. The fire spread rapidly up the exterior of the building, circumventing the interior fire protection features, with flames re-entering from the exterior and eventually consuming every floor.

What all of these fires have in common is that the fire was able to spread by one - or more - of the three mechanisms described above: perimeter voids, wall cavities, and/or leap-frog.

The Grenfell Tower Fire is believed to have started on the 4th floor of a 27-story high-rise in the UK in June 2017. Ultimately, fire spread to every floor and had tragic consequences. Source: BBC News, https://www.bbc.com/news/uk-40301289, June 2018

PROTECTING AGAINST "LEAP-FROG"

Initially, US legacy model Building Codes of the time included only cursory mention of fire protection of exterior curtain walls and floor-to-wall perimeter voids, or spandrel construction. Consequently, Architects, Designers, Contractors, and Code Officials often adopted untested and uncertain solutions. Later, more effective products were developed and tested for curtain wall fire protection in accordance with ASTM E119, *Standard Fire Tests for Building and Construction Materials*, and NFPA 285.

However, because neither of these test Standards specifically evaluate vertical fire spread via leap-frog, Codes only partially addressed the fire risk by requiring minimum vertical separation of openings, or full sprinkler protection of the building. Employing prescriptive minimum vertical spacing requirements between openings limits design flexibility. While sprinkler systems are very effective at controlling interior fires, studies have reported that, globally, the percentage of exterior wall fires occurring in buildings where fire suppression sprinkler systems have been installed ranges from 15-39% for the building height groups considered. This may be due to either external fire sources, or failure of sprinklers.[2]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Up until 2019, there has been a void in the fire testing community when it comes to identifying and protecting against this exterior fire-spread phenomenon, both with respect to Code Requirements and Test Standards. Chapter 7 of the International Building Code (IBC), Fire and Smoke Protection Features, requires the fire-resistance-rating of building elements, components, or assemblies be determined in accordance with test procedures set forth in ASTM E119 or UL 263, *Standard Fire Tests for Building Construction and Materials*. The IBC's Chapter 7, Section 715.4 further details the description and procedures for Fire and Smoke protection at the perimeter void between the Exterior Curtain Wall and Floor Intersection. This specific section focuses ONLY on the required protection for the perimeter void between the floor slab and the interior face of a curtain wall. ASTM E2307 is the test method that was specifically developed to evaluate the ability of perimeter fire barrier joint systems to prevent the interior spread of fire through the perimeter void into the room above.

The spread of an interior fire venting through the broken glass and up the exterior face of a building (the Leap-Frog Effect) is a unique fire condition. When ASTM first published its *Standard Test Method for Building Perimeter Fire Barrier Systems*, ASTM E2307, in 2004, it was acknowledged that an additional test method was needed to mitigate the effects of fire exposure on the spandrel and vision glass area from the exterior of the building. This condition represents a significant fire exposure created when the magnitude of flame and hot gasses escaping through a window opening is sufficient to cause the re-entry of the fire, or ignite combustible materials, in the room above the story of fire origin.

This can occur when fire spreads vertically up the exterior of the building, circumventing the interior perimeter fire barrier joint system, any inherent fire-resistance of the exterior wall assembly, or a sprinkler system. When this mechanism of fire-spread occurs at any floor, it has the potential to repeat via the same mechanism to every floor above it. This phenomenon is often referred to as the "Leap-frog" effect. This new test method is intended to simulate the fire exposure from a post-flashover compartment fire venting through an opening onto the exterior spandrel area, or portion of the exterior cladding immediately above a window opening. The test is intended to evaluate the effectiveness of exterior spandrel areas above the opening and any glazing.

The Parque Central was a 56-story government office building in Caracas, Venezuela. The Oct 14, 2004 fire started on the 34th floor and climbed to the 47th floor. Source: NFPA Journal® March - April 2005

In 2019, ASTM Committee E05 on Fire Standards published a new test method, ASTM E2874, T*est Method for Determining the Fire-Test Response Characteristics of Spandrel-Panel Assemblies Due to External Spread of Fire*. This test method is designed to evaluate the fire performance of the portion of an exterior wall assembly directly above an opening, principally the building spandrel-panel system, with or without glazing, to assess the ability to impede the spread of fire to the interior of the room or the story immediately above it via fire-spread on the exterior of a building.

A Task Group at ASTM's E5 Committee, Subcommittee .11, was charged with developing a test method that would evaluate the performance of this unique construction detail that is not addressed by any other fire test method. For example, features that form vertical channels on a building facade, such as vertical shades or a recess in the facade, increase the hazard of high fire exposure to the facade. Features that disrupt vertical air movement along the facade, such as balconies, protect the facade above these features from high fire exposure.

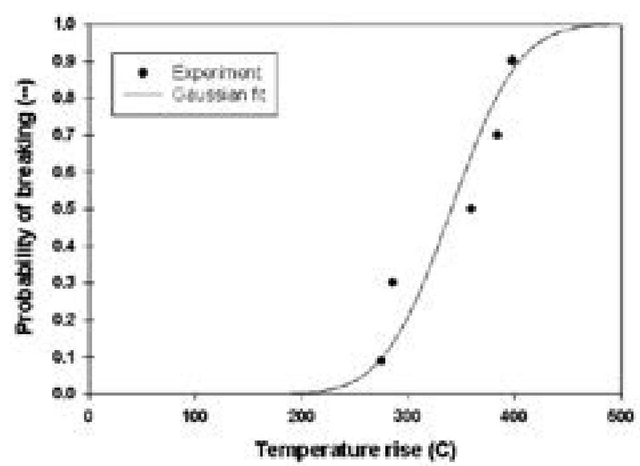

Figure 2: Probability of Glass Breaking Out vs Temperature. Tanaka, T., Performance-Based Fire Safety Design of a High-Rise Office Building -1998 Image.

Literature reviews and independent research have been used to help develop the criteria for the current ASTM draft Standard. Studies have confirmed that in 6mm (.236) float glass, first cracking occurs when the bulk glass temperature reaches around 110°C (230°F). This corresponds to a heat flux of around 3 kw/m^2. In this same study, glass fell out when the exposed surface temperature reached 415 - 486° (779 - 907°F) or heat flux of around 35kw/m^2.[3]

To verify that the proposed apparatus provides adequate flame exposure to evaluate leap-frog, additional research was also conducted by students at Worcester Polytechnic Institute (WPI)[4]. This report included a literature review and computer modeling conducted using the exposure conditions and configuration of ASTM E2307. The project reviewed varying window dimensions and conducted heat flux calculations, both at various heights on the exterior wall above a window opening and at the flame propagation on the exterior wall.

The new ASTM E2874 Standard uses the same aparatus and fixed window opening size as ASTM E2307 and NFPA 285 to create the fire exposure on the exterior side of the spandrel panel or curtain wall. The WPI research report concluded that the level of the fire exposure (Time-Temperature Curve/ Burner) is sufficient to provide:

- Incident heat flux of 35 kW/m² at a height of 3 ft. above the head of the window opening
- Incident heat flux of 9 kW/m² at a height of 10 ft. above the head of the window opening

Based on this, the "opening" was selected to be 30 inches high and 78 inches wide. In addition to the WPI research findings, research testing of a typical aluminum curtain wall system with a 36-inch spandrel height was conducted. Instrumentation was installed to provide a temperature profile and incident heat flux measurements, both vertically and horizontally, during the test. The flame temperatures and heat fluxes were determined to be consistent horizontally across a 24-inch width, when measured at 12-, 24-, 36- and 48-inches above the openin

Window Size	Flame Height (ft.)	Flame Profile	Height above window with heat flux greater than 9 KW/m² (ft.)	Height above window with heat flux greater than 35KW/m² (ft.)
ASTM Standard (2.5x6.5 ft.)	5.5	Against wall	10+	3
3x3 ft. Square	3.8	Slightly away from wall	3.5	1.25
2.125 x 4.25 ft.Wide	4.5	Against wall	10+	3
4.25 x 2.125 ft. Tall	3.4	Far away from wall	3	0
3.18 x 6.37 ft Wide.	6	Against wall	10+	3
6.37 x 3.18 ft Tall.	3.5	Far away from wall	2.5	0

Figure 3. Window Burner Results from WPI Research Report Number ME-GT-FR09 Dated Apr. 12, 2010. WPI Image.

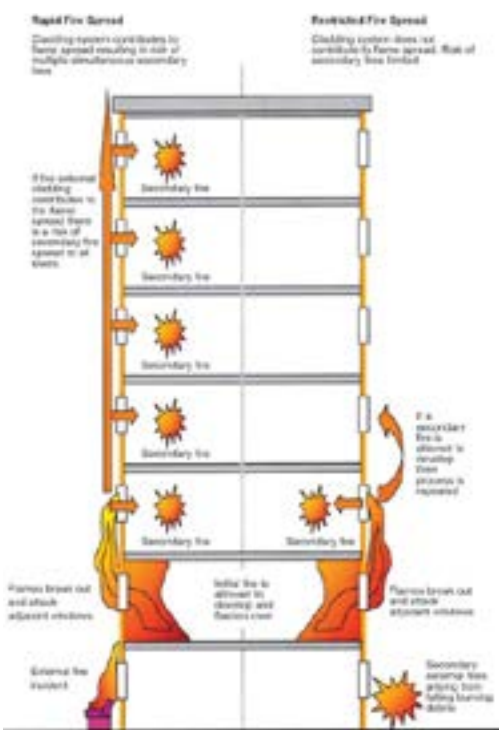

Figure 4: Exterior Curtain Wall and Floor Fire Exposure Mechanism. Source: Building Research Establishment (BRE) 135:2013, Classified external cladding systems

The ASTM E2874 Standard utilizes the approach of measuring the incident heat flux behind the exterior wall on the floor above the burn room. The choice of Pass/Fail criteria was selected based on the level of heat flux required for unpiloted ignition of easy-to-ignite combustible materials and glass breakage. Those heat flux limits are consistent with the normal temperature rise limits imposed by ASTM E119 when determining fire-resistance-ratings of assemblies (i.e. a maximum average temperature rise of 250°F, together with a maximum individual temperature rise of 325°F). These represent an incident heat flux of 1.8 to 2.6 kW/m² at the measurement location. (See Figure 4)

CONCLUSION

Our understanding of exterior fires and their mechanism of spread in buildings has been researched and reported. However, the risks of fire spread, particularly as related to high-rise buildings and their facades, can still present unacceptable levels of risk to building occupants.

Current Code practices recognize the successful record of full sprinkler-protected high-rise buildings and only require that the void space between the curtain wall and the floor slab be resistive to fire spread using a perimeter fire barrier system. However, as the desire to improve energy-efficiency becomes increasingly urgent, more innovative ways to insulate buildings and improve their sustainability and energy-efficiency are changing the external surfaces of buildings with an increase in the volume of potentially combustible materials being applied. Several significant fires, such as those discussed previously, have demonstrated the potential risks.

The current Code requirements focus on the fire testing of specific assemblies that may not necessarily be consistent with the goals of the Architect, yet the larger concern is the associated risk of vertical fire-spread. A review of the history of significant high-rise fire losses where the leap-frog effect was evident shows that the hazard is real and can be catastrophic. Key factors that impact a curtain wall's fire-resistance are being addressed in the new ASTM E2874, *Standard Test Method for Determining the Fire-Test Response Characteristics of Spandrel-Panel Assemblies Due to External Spread of Fire*. This Standard can be useful when there is a need to provide enhanced protection or evaluate a curtain wall spandrel-panel's potential performance when subject to flame exposure.

It is also critical to recognize that mitigating the fire risk for high-rise buildings requires the consideration of several factors that include the engineering design of the sprinkler systems, fire department response capabilities, the occupancies and associated fire loads, the building's evacuation approach, compartmentation features, and security threat assessment scenarios. With appropriate consideration and evaluation of these risk factors, it is possible to select a building envelope and spandrel design that satisfies both the esthetic goals and fire-safety objectives for any building.

Mr. Crimi is a Registered Professional Engineer, and founder of A.C. Consulting Solutions Inc., which specialize in Building and Fire related Codes, Standards, and product development activities. He has over 30 years of experience in Fire Protection. Mr. Crimi participates in a wide range of Codes and Standards development activities in the US, Canada, and Europe. He has Chaired numerous Standards & Code development Committees, and is an active participant on ASTM, NFPA, ICC, and UL Standards Technical Panels and UL Canada Standards development Committees, as well as several ISO Standards development. Mr. Crimi chaired the ASTM Subcommittee that developed ASTM E2874. He can be reached at tcrimi@sympatico.ca.

REFERENCES:

[1-]U.S. Fire Administration-FEMA Technical Report Series, Highrise Office Building Fire One Meridian Plaza, Philadelphia, PA, USFA-TR-049/February 1991. https://www.usfa.fema.gov/downloads/pdf/publications/tr-049.pdf

[2-]National Fire Protection Research Foundation (NFPA FPRF), Fire Hazards of Exterior Wall Assemblies Containing Combustible Components, Nathan White CSIRO Highett, VIC, (Australia), Michael Delichatsios FireSERT, (University of Ulster Jordanstown, Northern Ireland) © June 2014 NFPA Fire Protection Research Foundation. https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Building-and-life-safety/

[3-]Summary of Fire and Glass in High Rise Buildings, Dr. Vytenis Babrauskas, Glass breakage in Fires, Fire Science and Technology Inc. 2005. https://www.thermafiber.com/wp-content/uploads/2013/11/Summary%20of%20Fire%20and%20Glass%20in%20High%20Rise%20Buildings.pdf

[4-]Worcester Polytechnic Institute (WPI), Project Number ME-GT-FR09 dated April 12, 2010, WPI Report Project Number ME-GT-FR09. https://web.wpi.edu Pubs/E-project/Available/E-project-042910-100106 unrestricted/ASTM_Leap_Frog_Effect-RPR-ERS.pdf

SIDEBAR

When considering floor-to-floor fire spread via openings (e.g. windows), the nature of exterior wall/ curtain wall designs is a critical factor that will dictate the relative capability to resist floor-to floor fire spread. Key factors that impact curtain wall resistance to vertical fire-spread, which need to be evaluated by testing, can include:

- Full height or partial height vision glass or spandrel panel design
- Nature of the glass used to construct glazing system
- Nature of the curtain wall components (e.g. framing, spandrel panels, rain screen, air gap)
- Vertical or horizontal projections on exterior that may deflect or enhance flame behavior
- Building geometry at curtain wall – inclined, staggered, sloped, etc.
- Operable windows/openings – size and orientation
- The vertical alignment of windows/openings

Among its other functions, a spandrel-panel assembly impedes the vertical spread of fire via exterior fire-spread from the floor of origin to the floor immediately above. Failure to impede the vertical fire-spread via exterior openings can lead to the processes repeating and fire "leap-frogging" one story at a time.

WRITTEN BY **KEVIN J. LAMALVA**

INTRODUCTION TO STRUCTURAL FIRE ENGINEERING

Why do we thermally insulate structural systems? Structural fire protection addresses the low-probability and potentially high-consequence event of uncontrolled fire exposure within the built environment. The onset of fire in engineered buildings is most often controlled by fire sprinkler systems, which are widely implemented in the United States. Fires may also be controlled by direct intervention from building occupants and/or fire department personnel. If these active measures were invariably effective, applied structural insulation would serve no purpose. In reality, fire sprinkler systems have performance limitations, and direct intervention may be hindered by logistical obstacles (e.g., fire department aerial hose spray limitations during high-rise building fires)[i]

Fire sprinkler systems are generally intended to control a single fire that grows naturally and involves ordinary combustibles. Accordingly, the hydraulic capacity of a fire sprinkler system is designed based on the potential activation of a small cluster of contiguous sprinkler heads (e.g., 6 sprinkler heads) at a single and hydraulically-remote location of the system[ii]. This standardized design method allows for efficient control of ordinary fires using practically-sized sprinkler piping. Consequently, the effectiveness of a fire sprinkler system decreases precipitously when the number of sprinkler heads that activate significantly exceeds its design basis (e.g., 10 or more sprinkler heads)[iii]. For this reason, fire sprinkler systems may not be effective at controlling extraordinary fires, such as those resulting from arson, terrorism, or other rare events (e.g., fire in multiple locations simultaneously). Hence, structural fire protection serves as an integral fire-safety system that becomes critical in the rare case that active systems are rendered inoperative or are insufficient for a specific hazard.

Structural fire protection is most commonly specified using the long-standing prescriptive design method, in which the fire-resistance of structural components is qualified through standard fire testing with a specific heating exposure (e.g., ASTM E119[iv] time-temperature curve) and acceptance criteria. In essence, the prescriptive design method is an empirical indexing system (i.e., generalized classifications) that promotes construction that is generally robust to fire exposure; however, the actual anticipated structural system performance under fire exposure is not confirmed or quantified. Hence, the prescriptive design method can be readily executed by many design professionals, most often by Architects. In certain cases, fire-resistance "equivalency" can be achieved if the designer is able to demonstrate that a protected structural component would achieve equivalent or better performance during a standard fire test when compared to a qualified listing. This task is often conducted by a Fire Protection Engineer at the request of an Architect or Contractor. Overall, the prescriptive design method endeavors to reduce the heating of individual structural components with the intent of mitigating the risk of structural failure under fire exposure. Accordingly, the vulnerability of buildings to structural failure from fire is presumably variable across different jurisdictions which have varying structural design requirements for ambient loads[v].

Historically, Structural Engineers have remained outside the fray of structural fire protection practice. However, a fast-growing segment of the structural engineering community in the U.S. has become more assertive that their involvement and assimilation into structural fire protection practice is very much needed in the context of nuanced structural designs that have evolved well beyond those that were in place when the furnace testing standards were first implemented[vi]. The emerging field of structural fire engineering involves the explicit design of structural systems to adequately endure thermal load effects from uncontrolled fire exposure. Within this framework, thermally-induced forces and degraded material properties from fire exposure can be limited by means of rationally-allocated structural insulation, and the ability of a structural system to endure fire effects can be enhanced by means of specific member sizing, connection/reinforcement detailing, and/or other measures to provide added structural robustness[vii].

Structural fire engineering essentially approaches structural fire protection from both the demand (heating) and capacity (structural response) sides of the equation, instead of solely focusing on the demand side, as is traditionally done. Unlike the prescriptive design method, structural fire engineering cannot be executed by any type of design professional. Rather, structural fire engineering explicitly requires the participation (or more ideally the responsible charge) of a Structural Engineer in all cases[viii]. For instance, Figure 1 illustrates structural modeling of a composite steel/concrete floor system under realistic fire exposure using the software SAFIR [ix].

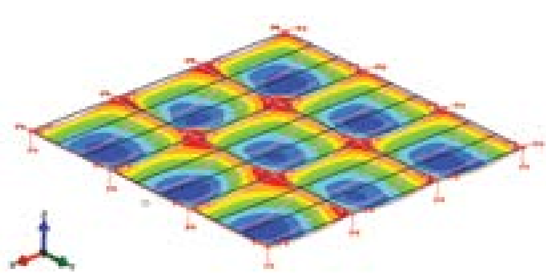

Figure 1 – Modeling Structural Behavior Under Fire Exposure (Vertical Displacement Contour Plot), Simpson Gumpertz & Heger Inc. image

In cases where an alternative to the prescriptive design method is sought, the U.S. has lacked an industry consensus on the matter until recently. As a result, structural fire protection variances have historically exhibited a wide variation in engineering rigor and conservatism, with most tending toward less rigor/conservatism out of convenience[x].

The Structural Engineering Institute (SEI) of the American Society of Civil Engineers (ASCE) publishes ASCE/SEI 7[xi], which is the parent standard for structural engineering for the International Building Code (IBC)[xii]. It now contains guidance that addresses structural fire protection variances. ASCE/SEI 7 Section 1.3.7 stipulates that structural fire protection design shall be conducted in accordance with the prescriptive requirements of the applicable Building Code (without extrapolation), or in accordance with the performance-based design requirements of ASCE/SEI 7 Appendix E (per the discretion of the building Authority Having Jurisdiction).

Accordingly, it would be improper to intermingle aspects of the prescriptive design method with the performance-based method to justify structural fire protection variances. This key industry-adopted prohibition is explicitly stated within Appendix E, as well as the new ASCE/SEI Manual of Practice No. 138[xiii].

Appendix E only pertains to structural systems, excluding all other fire-resistance-rated assemblies (e.g., fire barriers, firestops, etc.). Such fire-resistance-rated assemblies are primarily governed by their mechanical integrity performance under fire exposure (e.g., localized deterioration under hose stream impact after a standard fire test), not their structural performance as stipulated in the new SFPE S.02 standard[xiv].

Accordingly, it is cautioned that mechanical integrity performance cannot be reliably predicted using available analytical tools in large part, and hence, the regulation of these types of fire-resistance-rated assemblies must remain within the purview of the prescriptive design method only. For instance, SFPE S.02 Section C.4.7 states that "listings define appropriate extrapolations from test conditions, such as application to heavier steel sections than tested," and the "use of fire-resistive material thicknesses outside the range included in the listing cannot be done without full scale validation testing."

ASCE/SEI 7-16 clearly differentiates between the two sanctioned design options for structural fire protection. Within the prescriptive design method, justification of code variances for structural fire protection must only be conducted *within the context of the standard furnace test and its acceptance criteria*, and not with respect to postulations of in situ thermal and/or structural performance. Accordingly, the removal of fireproofing from steel structures based solely on temperature field information (e.g., fire and thermal modeling results) is strictly prohibited. For instance, if a structural protection variance relies on an analysis of realistic fire exposures (i.e., anything other than the standard furnace exposure) and excludes structural system analyses, this is a key indication that the variance is deficient with respect to the new industry standards.

If the limitations and restrictions of the prescriptive design method inhibit the fulfillment of stakeholder design objectives, the only industry-endorsed alternative is the performance-based design approach as constituted in ASCE/SEI 7 Appendix E, which requires explicit consideration of structural system response under fire conditions per required performance objectives. This method requires a dramatically higher level of engineering rigor as compared to many structural fire protection variance approaches that have been used in practice[xv]. The removal of fire protection from structural systems should not be taken lightly and Building Authorities should feel empowered to expect more from designers when such is proposed as a variance.

Kevin LaMalva is a Consultant with dual registrations in Fire Protection Engineering and Civil Engineering. He is Past Chair (2013-2018) of the ASCE/SEI Fire Protection Committee and is a member of numerous industry Committees that conduct research and develop standards for structural fire-safety. He was awarded the distinction of 2017 ENR Newsmaker for serving the "best interests of the construction industry and the public." He can be reached at kjlamalva@sgh.com.

REFERENCES:

[i] LaMalva, K.J., "Developments in Structural Fire Protection Design – A U.S. Perspective," The Structural Engineer, Vol. 96, Issue 1.

[ii] NFPA 13: Standard for the Installation of Sprinkler Systems, National Fire Protection Association, Quincy, Massachusetts, 2016.

[iii] Hall, J., "U.S. Experience with Sprinklers and Other Automatic Fire Extinguishing Equipment," National Fire Protection Association, Quincy, Massachusetts, 2010

[iv] ASTM E119 (2016). E119-16a Standard Test Methods for Fire Tests of Building Construction and Materials, ASTM International, West Conshohocken, PA.

[v] LaMalva, K.J., "The Time is Right for Structural Engineers to Embrace Structural Fire Protection," ASCE/SEI Update, 26 April 2018

vi Ellis, A. "Unleashing the Profession: How Performance-Based Design Will Shape Our Future," STRUCTURE Magazine, March 2019

[vii] LaMalva, K.J., "Structural Fire Protection's Shifting Paradigm," Fire Protection Engineering, Q2 2017, Issue #74, Society of Fire Protection Engineers

[viii] Recommended Minimum Technical Core Competencies for the Practice of Fire Protection Engineering, Society of Fire Protection Engineers, Bethesda, Maryland, 2018.

[ix] Franssen, J.-M.; Gernay, T., SAFIR: A Thermal and Structural Program for Modeling Structures Under Fire, University of Liege and Johns Hopkins University, 2019.

[x] Jonsson, J. "Are You A Competent Practitioner," SFPE Europe, Q1, Issue 13, Society of Fire Protection Engineers, Bethesda, Maryland, 2019

[xi] ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers: Structural Engineering Institute, Reston, VA, 2016

[xii] International Building Code (IBC), International Code Council (ICC), Washington, DC, 2018

[xiii] LaMalva, K.J. (editor), ASCE/SEI Manual of Practice No. 138: Structural Fire Engineering, American Society of Civil Engineers: Structural Engineering Institute, Reston, VA, 2018

[xiv] SFPE S.02: Engineering Standard on the Development and Use of Methodologies to Predict the Thermal Performance of Structural and Fire Resistive Assemblies, Society of Fire Protection Engineers, Bethesda, Maryland, 2015

[xv] Jonsson, J. "SFPE Core Competencies: Why Do We Need Them," Fire Protection Engineering Magazine, Q1, Society of Fire Protection Engineers, Bethesda, Maryland, 2019

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WRITTEN BY **MARK W. LUND AND PAUL FANNIN**

FIRESTOPPING HIGH-RISES: FROM FICTION TO REALITY

In 1974 the disaster movie The Towering Inferno was released, about a fire that breaks out in a high-rise building. This fictional account was followed by notable real-life fires over the next few years, especially the 1980 MGM Grand Hotel fire which killed 85 people and injured 679, spurring the state of Nevada and other governments to institute major reforms to fire safety guidelines and codes. In many ways this was one of the main contributors to the birth of today's firestop industry, as industry groups worked with regulators to develop firestop requirements in commercial building codes to help improve the safety of larger buildings. Those joint efforts continue to this day.

DISASTERS LEAD TO UPDATES IN PROTECTION REQUIREMENTS

DISTRIBUTED ANTENNA SYSTEM (DAS)

One of the key learnings to come out in the aftermath of the 9/11 attacks in 2001 was the realization that first responders quickly lost radio signals and became unable to communicate with each other. The International Fire Code has been updated to say that for new buildings, radio coverage should match the level of existing coverage at the exterior of the building (IFC 510 and IFC 907). One option for doing this is to use a Distributed Antenna System (DAS), which consists of smaller antennas networked together with signal boosters. This network can provide the same coverage as a single larger antenna, but also requires that the connecting backbone cables be protected so they remain functional in a fire.

CRITICAL POWER SYSTEMS

Certain power circuits are also considered critical and require fire-resistance ratings. For high-rises, the 2018 International Building Code (IBC) includes these power systems as critical electrical circuits:

- Smoke control systems
- Fire pumps
- Emergency and standby power systems
- Fire service access elevators
- Occupant evacuation elevators

Until 2015, the IBC allowed only fire-resistive cables tested to UL 2196 for these critical electrical circuits and required a fire-resistance rating of not less than one- or two-hours, depending on the specific application. The 2018 IBC includes that Standard but adds another option: electrical circuit protective systems meeting either UL 1724 or ASTM E1725 with a fire-resistance rating of not less than one- or two-hours, again depending on the application. To put it more simply, there is now a choice to use either fire-resistive cable or conventional cable in a fire-resistive – tested fire-resistance rated - envelope.

While ceramic insulation or blankets may have specific applications for creating a fire-resistive envelope around these critical circuit installations, they can also interfere with heat dissipation, which will de-rate the ampacity of the cables. Some form of endothermic wrap may be a better solution, as it allows for more heat dissipation than other typical enclosures. These wraps have chemically bound water, which is released at high temperatures during a fire. The water absorbs heat, and thus slows heat flow to the protected area for a time. The fire-resistive duration can be adjusted by using more layers.

MEMBRANE PENETRATIONS

Elevator shaft walls are fire-resistance-rated, and the elevator call boxes are frequently located in the plane of these walls. In addition to protecting cables and junction boxes, endothermic wraps or mats can also be used to protect larger membrane penetrations, such as these elevator call boxes or electrical panels, without the need for building a fire-resistance-rated false wall around them. The fire-resistance-rating compromised by the membrane penetration is restored to the full F- (Fire) and T- (Temperature) rating mandated by code.

FUEL LINES

Another adjustment to Building Codes came about after Superstorm Sandy in 2012 when many generators in basements flooded and failed, notably causing evacuations from some hospitals, and thus potentially affecting patient care. The code changed to allow the generators to be located on higher floors, above the FEMA-designated 500-year flood line. Moving the generators is very much in the Building Owner's interest, as it assures continuity of operations, but it does require rerouting of the fuel piping serving the generator. The vertical piping is often routed in a concrete shaft, but the horizonal piping at 'cross-over floors' poses a special challenge. Enclosing the horizontal pipe in rigid fire-resistive construction is labor-intensive, bulky and heavy. Flexible wrap solutions can be a lean and effective alternative. At the time, there wasn't a Test Standard for fuel line protection. 3M approached UL about developing a Standard and conducted several phases of testing to support what became UL 1489 *Fire-Resistant Pipe Protection Systems Carrying Combustible Liquids*, the Standard referenced in the forthcoming 2021 IBC Section 2702 *Emergency and Standby Power Systems* for high-rise buildings.

OTHER CONSIDERATIONS FOR HIGH-RISES

The nature of a high-rise building also requires additional considerations due to the greater height. For instance, all buildings move due to thermal expansion and contraction, seismic activity, or changes in dynamic loading as people, vehicles, and equipment move throughout. High-rises are subject to all of these, plus another factor for movement – the curtain wall is pushed and pulled by wind forces. While building joints have certain gaps designed to allow for this movement, the gaps must be firestopped against the spread of fire. Not only must the gap be filled, but the material filling the gap must be flexible enough to move with the building while not cracking. There are many types of firestop products that are rated to perform this function when installed to a listed system design. Firestop products vary in nature. Some are easier to transport, store, install, inspect, and clean up than others.

A recurring problem in the construction industry is rogue water exposure during construction, which has the potential to wash out water-soluble firestop caulks and sealants. This can cause an issue where water might migrate through floor penetrations or joints to lower levels of buildings. This is addressed by sealing certain floors with watertight firestopping materials as part of a firestop system. Watertight firestop systems are those that have passed UL1479's water - resistance testing, and attain a 'W' Rating. Those products used in the firestop systems include firestop sealants, tapes, devices and other products.

According to the 2012-2018 International Building Code requirements, any high-rise building (75' or higher above occupied floor above lowest fire department access) requires an Authority Having Jurisdiction- (AHJ) approved Special Inspector employed by a AHJ-approved Inspection Agency to check firestopping of penetrations and joints in the building, either by watching the installation or destructive testing it afterward.

Since tested and listed systems specify a certain thickness of material to be considered a true firestop, the Inspector must test these firestop methods by cutting into them, which means even a correct installation needs to be repaired after inspection.

Finally, it's good to remember that there are different types of protection within a building. Regarding fire and smoke, here are four key designations:

- Fire-resistance-rated structural Fire Wall – continuous from the ground to the horizontal assembly being supported and is independent of the horizontal assemblies penetrating each and terminating above the roof; must maintain structural integrity in the event of collapse of the building on one side of the wall
- Fire Barrier – runs from the floor to the floor slab or roof deck above, is continuous, and must be supported by construction of the same fire-resistance-rating
- Smoke Barrier – has a minimum 1-hour fire-resistance-rating but is also designed to prevent smoke movement
- Smoke Partition – has no fire-resistance-rating but prevents smoke from moving around the building

Being at the bottom of the list doesn't mean smoke partitions aren't important – most of the deaths in the 1980 MGM Grand Hotel fire were due to smoke inhalation and carbon monoxide. This is still a situation where low-quality materials can create issues. Products that shrink too much or get dry and brittle could fall out of place due to normal, repetitive building motion and stop fulfilling their function. Materials and systems that are classified and/or rated for use in smoke partitions or smoke barriers can withstand these stresses, including products designed to stick well and maintain adhesion through anticipated building movement.

WORKING TOGETHER TO CONTINUE IMPROVING

The firestop industry has come a long way from the early efforts of the 1980s, with vast improvements to both high-rise regulations and technologies. But we all know there is always room for improvements to these regulations and technologies, and together we can continue working with the rest of the industry to keep finding new ways to improve.

Mark W. Lund, P.E., M.Sc. 3M Senior Supervisor, Application EngineeringMark Lund leads 3M's Application Engineering group. He's worked in passive & active fire protection for 19 years and is a licensed Professional Engineer (Mechanical & Fire Protection disciplines) in the State of Minnesota. mwlund@mmm.com

Paul Fannin 3M Senior Application Engineer Paul Fannin is a Chemical Engineer by training who has 12 years with 3M. He is the construction joint specialist on the 3M Application Engineering Team and serves as the task group chairman for the ASTM E2307 (Perimeter Fire Barriers) test standard. pfannin@mmm.com

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INDUSTRY NEWS

FCIA POSITION ON NEW ASTM E3157 GUIDE, FIRESTOPPING

ASTM E3157-19, *Standard Guide for Understanding and Using Information Related to the Installation of Firestop Systems* (ASTM Guide) was published in June 2019 – developed by a task group at ASTM.

In the ASTM Guide are many recommendations - some of which could increase the cost of the project and possibly impact the schedule, along with incorrect statements and terms. The ASTM Guide presents product usage limitations NOT listed in the manufacturers' installation instructions, product data sheets, UL, FM, Intertek, or other laboratory listings, or directory guide Information.

FCIA's Standards Committee Chairs, FCIA Members and Executive Director participated in the ASTM Task Group during development. We raised objections that were NOT originally addressed in the final ASTM Guide, which has now been published and is actively being promoted by other organizations. The significant list of objections submitted were voted down procedurally without adequate discussion before publication of the ASTM Guide.

According to the Firestop Manufacturers participating at the ASTM Task Group meetings, each a member of the International Firestop Council (firestop manufacturers association), the new ASTM Guide is an OPTIONAL document and is not to be considered a mandatory document, as it is a Guide.

Therefore, FCIA does not endorse use of the ASTM Guide by Specifiers, AHJ's, Inspection Agencies, and Contractors.

FCIA recommends that firestop installation contractors consider qualifications and exclusions that specifically address the ASTM Guide. As with all contract issues, consider contacting the company attorney or legal department about your specific needs.

FCIA Members and staff remain committed to working diligently at ASTM and with the Firestop Manufacturers to make the ASTM Guide a value to the industry.

For more information, contact us at info@FCIA.org .

FCIA PRESENTS AT PFPNET CONFERENCE

This June, FCIA Executive Director, Bill McHugh, spoke at the PFPNet Conference in Manchester, England about the 'DIIM' of Fire-Resistance. PFPNet, or the Passive Fire Protection Network, is a not-for-profit organization focused on raising standards in the use of passive fire protection in industries where hydrocarbons are present. The group of Industrial Fireproofing and Firestopping Consultants and Manufacturers, along with a few Contractors, focuses on the oil and gas industries.

Bill McHugh presents at PFPNet. FCIA Photo

FIRESTOP OUTREACH IN EUROPE, IRELAND, ENGLAND AND THE UK

FCIA's Vice President, President-Elect Ben Urcavich, Past President Aedan Gleeson, and Executive Director Bill McHugh travelled to Ireland, England, UK, and Germany to visit with the Association of Specialist Fire Protection (ASFP), UL's UK/EU Personnel and Fire Test Laboratory, and FM Approval's EU Team. The trip had a wealth of information shared about firestopping and fire-resistance Standards and Codes abroad.

INVENTORY OF FIRE-RESISTANCE/FIRESTOPPING PROMOTED AT ASHE AND NASFM ANNUAL CONFERENCE

This summer, FCIA was represented at both the ASHE and NASFM Annual Conferences with highly visited booths. While there, FCIA met with many Healthcare Facility Directors and State Fire Marshals from around the country. FCIA Marketing Committee members Ben Urcavich and Aideen Gleeson reinforced the 'DIIM' message and provided a handout that focused on the 'Inventory of Fire-Resistance/Firestopping'. In fact, the phrase 'Inventory of Fire-Resistance' came from our friends at ASHE. They 'inventory' everything from power strips to x-ray machines, and that term worked best for all at ICC's Fire Code Hearings when FCIA presented the concept for the 2018 International Fire Code.

The piece reinforced the fact that it's the SYSTEM AND PRODUCTS that get ratings, not just the product. Through continuous outreach to the groups who are responsible for designing, specifying, inspecting and maintaining installed Firestop systems, FCIA will persist in advocating to build the industry and see worldwide acceptance and acknowledgement of the value and importance of the Specialty FCIA Member Firestop Contractor concept.

FCIA AT NFPA FPF MEETINGS

As a voting principal member of the NFPA Fire Protection Features Committee, Bill McHugh was able to provide testimony that it makes sense to have a quantified air leakage (L) rating for firestop systems in Chapter 8 of both NFPA 101 and NFPA 5000. Quantified values are always better than a 'best guess'.

FIRE SAFE NORTH AMERICA ANNUAL MEETING

The Fire Safe North America (FSNA) met in Chicago's suburbs Aug. 23 to talk about fire-resistance and future efforts. Speakers included Jon Narva of the National Association of State Fire Marshals reporting on Project Fail Safe and future initiatives. FSNA's staff, Bill Koffel, provided updates on many FSNA initiatives. FSNA Members, Air Movement and Control Association, STI Firestop, Rectorseal, Smoke Guard, Rockwool, and Thermafiber, attended with discussion about passive fire protection. FCIA and NFCA Executive Director Bill McHugh attended as a non-member.

FCIA, NFCA @ FSNA

FCIA/NFCA Executive Director Bill McHugh presented about the new Chicago'ized' International Building Code. Chicago's City Council adopted the IBC and will phase it in with an eventual adoption of Summer 2020. Test projects will start in 2019. A key point is that Chicago kept 1-hour fire-resistance-rated corridors in educational occupancies and did not take all the sprinkler trade-offs that are currently in the IBC. Fire-Resistance is key in Chicago, in addition to sprinklers, detection, and alarms, in conjunction with egress training for building occupants.

FCIA AT TIAC

The Thermal Insulation Association of Canada's Annual Conference took place in Montreal this year. On the technical agenda was a program on the importance of fire-resistance and of course, firestopping's 'DIIM'. We are honored to be asked to speak to many various groups, including our friends in Canada. Fire- and life-safety are worldwide foci, and FCIA is proud to be at the forefront of educating about the importance of both and the role that the 'DIIM' of firestopping and fire-resistance play in each.

FCIA AT CHES

FCIA Members Jim Smiley (ICON Insulation) and John Sharpe (Pro-Firestop) proudly represent FCIA at the Canadian Healthcare Engineering Society Convention this September. Thanks Jim and John for bring the firestopping story to CHES.

FCIA AT STATE OF NY

The State of New York's Design Teams in Albany received a special program on firestopping this September. The program, presented by FCIA's Bill McHugh, highlighted the importance of using an FM 4991 Approved and/or a UL Qualified Firestop Contractor to help make sure buildings are safe. The session also covered listings, systems selection, and analysis.

FCIA AT ICC

The ICC Annual Business Meeting, Expo, and Code Development process 'Public Comment Hearings' takes place in Las Vegas Oct. 20-30. FCIA's booth at the Building Safety & Design Conference gives us a chance to talk about the 'DIIM' of firestopping and effective compartmentation to a great audience, those who vote at the code hearings. Most of the 2021 I-codes have been completed, except for the Administrative provisions and Structural parts of the codes. The International Energy Conservation Code will also be debated in what was once 'Final Action Hearings'. We always enjoy seeing good friends at these hearings and working on behalf of FCIA Members.

FCIA AT NBC

In Canada, development of the 2020 version of the National Building Code of Canada (NBC) is winding down. After the NBC is published, provinces then either adopt or amend and adopt the Code. FCIA had some success in this Code cycle and introduced new concepts that will take time to get into the culture of the Code.

Thanks to FCIA's Canada Committee for all your work this cycle.

WEBINARS COVER FIRE RESISTANCE

The National Fireproofing Contractors Association (NFCA) and Firestop Contractors International Association (FCIA) both have a webinar series to provide education opportunities for those interested in Fire-Resistance. From Firestopping to Intumescent Fire-Resistive Materials, Sprayed Fire-Resistant Materials and more, you don't want to miss these webinars. Free registration is at www.FCIA.org and www.NFCA-Online.org.

NFCA FIRE-RESISTANCE IN BUILDINGS SEMINAR

Don't miss NFCA's Educational Program on Fire-Resistance in Los Angeles this October. Free to Specifiers with Design firms, Building Code Officials and Fire Marshals, keynote speakers include Crystal Sujeski from the CA State Fire Marshals' Office and Nancy Timmins, Chief Fire and Life Safety Officer at the OSHPD. Other speakers include UL's Rich Walke, GCP's John Dalton, Sherwin Willams' George Guanci, Hilti's Ernst Toussaint, Isolatek's Russ Harvey and Carboline's Sean Younger. Don't miss this great program…a full-day of action packed fire-resistance. www.NFCA-online.org.

AMCA FIRE DAMPER INITIATIVES

The Advocacy team at the Air Movement and Control Association is working to build the reputation of fire and smoke dampers by spreading the word on new products and designs that make the systems more reliable and better for fire- and life-safety. Check out the Advocacy Page at www.AMCA.org for info.

DHI'S FALL TECHNICAL SCHOOL

Registration is open for the 2019 Fall Technical School, Oct. 20-26 in Scottsdale, Arizona. The school will feature the quality education you've come to expect from DHI packaged in seven days of classes designed to further your career. Fire Door Education is part of this Fall DHI School. If your company wants to provide Fire Door Inspection and or Barrier Management Services, consider taking these classes. Laura Frye Weaver organizes these sessions. She's part of the FCIA/UL/TJC/ASHE Barrier Management Symposium faculty speaking on fire doors. www.DHI.org

ASHE BOOK ON FIRE DOORS

Working with Barrier Management Symposium Faculty and Door Industry Consultant Keith Pardoe, ASHE has published a book for health care professionals on doors. Buy it at www.ASHE.org.

AWCI NAMES NEW EVP/CEO

AWCI President Nancy Brinkerhoff has announced that Michael F. Stark will succeed Steven A. Etkin as Executive Vice President and CEO of the Association of the Wall and Ceiling Industry and the Foundation of the Wall and Ceiling Industry. Stark is an Association professional with 19 years Senior Management experience at three national construction Associations. Most recently, he was Vice President of Knowledge Programs and Building Markets at the Associated General Contractors of America, a position he has held since 2013.

BRIGHT IDEAS

ALBION INTRODUCES NEW FOLLOW PLATE FOR BULK CAULK LOADING

Albion is proud to introduce new model 504-G15 Follow Plate for bulk caulk loading. With its Quick Push-On, Pull-Off Seal Feature, no barrel threading is Required! This means faster, cleaner loading of caulk into all Albion 2" diameter B-Line and Professional Line Bulk Guns. The 504-G15 Follow Plate fits 3 or 5 gallon tapered or straight sided, metal or plastic pails with maximum ID of 11-3/8" and minimum ID of 9-7/8".

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FCIA INDUSTRY CALENDAR

SEPTEMBER

September 22-24
Canadian Healthcare Engineering Society (CHES) Annual Conference
Saskatoon, SK
www.ches.org

September 25-26
FCIA Canadian 'DIIM' Symposium
Montreal, Canada
www.fcia.org

OCTOBER

October 9-11
CSI CONSTRUCT
National Harbor, MD
www.constructshow.com

October 16-18
International Facility Managers Association (IFMA) World Workplace
Phoenix, AZ
www.worldworkplace.ifma.org

October 20-30
ICC Annual Conference and Public Comment Hearings
Clark County, NV
www.ICCSAFE.org

October 26-30
RAIC 2018 Festival of Architecture
Toronto, ON
www.raic.org

NOVEMBER

November 5-8
FCIA Firestop Industry Conference & Trade Show
Miami, FL
www.fcia.org

November 6-8
DHI's conNextions
Cleveland, OH
www.DHI.org