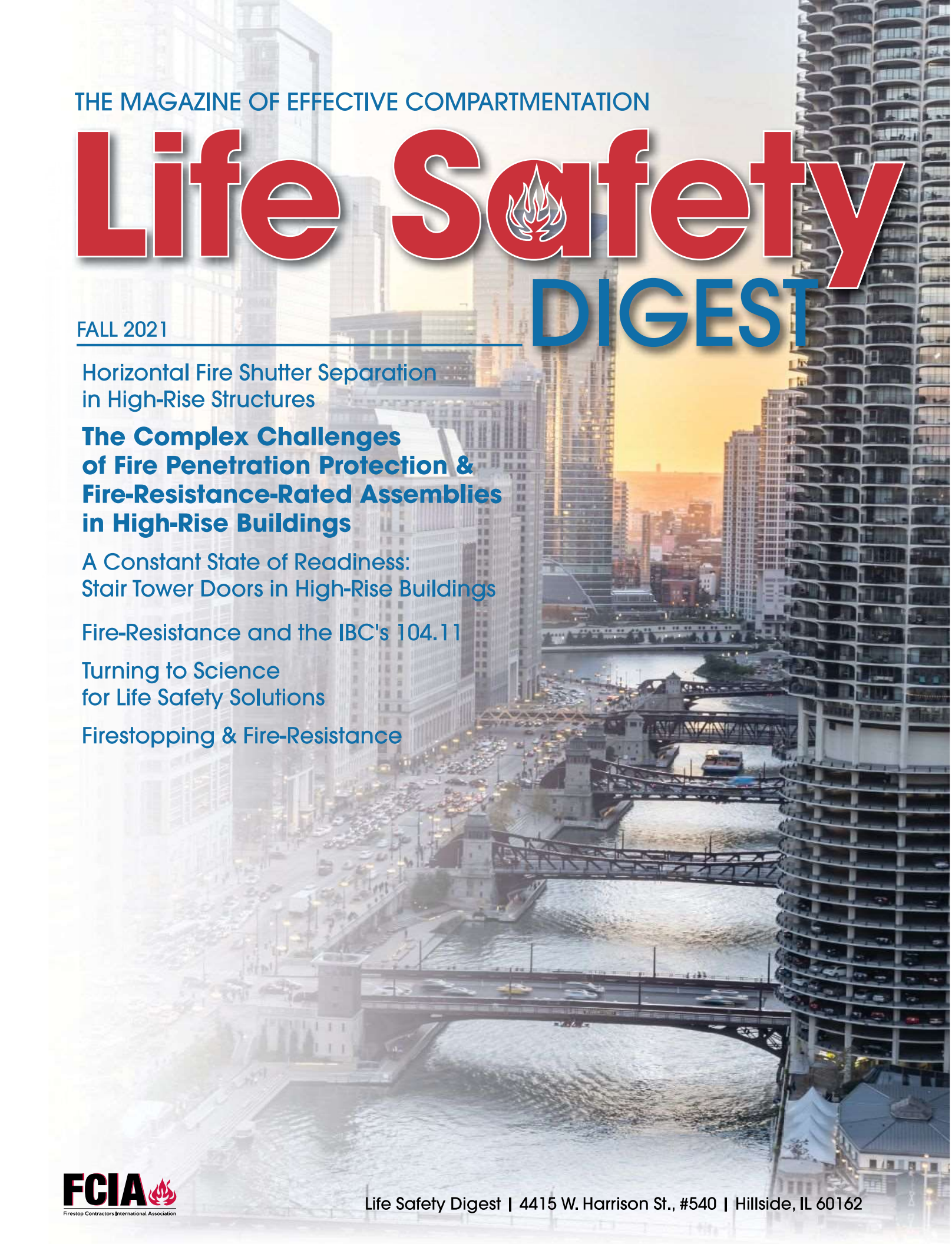
THE MAGAZINE OF EFFECTIVE COMPARTMENTATION

Life Safety DIGEST

FALL 2021



Horizontal Fire Shutter Separation in High-Rise Structures

The Complex Challenges of Fire Penetration Protection & Fire-Resistance-Rated Assemblies in High-Rise Buildings

A Constant State of Readiness: Stair Tower Doors in High-Rise Buildings

Fire-Resistance and the IBC's 104.11

Turning to Science for Life Safety Solutions

Firestopping & Fire-Resistance

FCIA
Firestop Contractors International Association

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Life Safety DIGEST

COVER STORY

When I was in college and working for an architecture firm in Chicago, my first projects included high-rise apartment buildings in Houston and Chicago. I was tasked with performing a code review of the floors, identifying the fire-resistance-rated assembly locations and turning my findings over to the lead architect for review. It seemed simple at the time: read the code, review the drawings, and define the locations of the assemblies and the ratings that were needed. At that time, I did not understand the complex dance that followed my initial review by many different individuals from multiple disciplines.

FEATURES:

DEPARTMENTS:

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THE COMPLEX CHALLENGES

OF FIRE PENETRATION PROTECTION & FIRE-RESISTANCE-RATED ASSEMBLIES IN HIGH-RISE BUILDINGS

When I was in college and working for an architecture firm in Chicago, my first projects included high-rise apartment buildings in Houston and Chicago. I was tasked with performing a code review of the floors, identifying the fire-resistance-rated assembly locations and turning my findings over to the lead architect for review. It seemed simple at the time: read the code, review the drawings, and define the locations of the assemblies and the ratings that were needed. At that time, I did not understand the complex dance that followed my initial review by many different individuals from multiple disciplines.

Whether mixed-use, office, apartment, or municipal buildings, mid- and high-rise buildings are all similar in the basic components of passive fire protection. Over the years, I have learned the complexity and challenges involved in coordinating all the teams needed to make sure that occupants are safe -- providing the appropriate time for occupants to escape or use shelter-in-place strategies, designing the building to have properly compartmentalized spaces, and ensuring all the components are appropriately designed to work as intended throughout the life of the building.

While all buildings are complex in one way or another, mid- and high-rise construction adds another layer of complexity that must be addressed early when it comes to passive fire protection. These buildings are different than most buildings because of the complex forces on the building, including wind, sway, deflection, and the multitude of systems needed to achieve the life-safety requirements. Some of the common items that need to be considered and coordinated include:

- Shaft walls floor-to-floor installation and support. Generally, shaft walls are not stacked unless engineered.
- Elevator shaft coordination and fire-resistance-rated assemblies.

Photo of elevator shaft, which the shaftwall needs to be coordinated to be properly supported. Corey Zussman photo

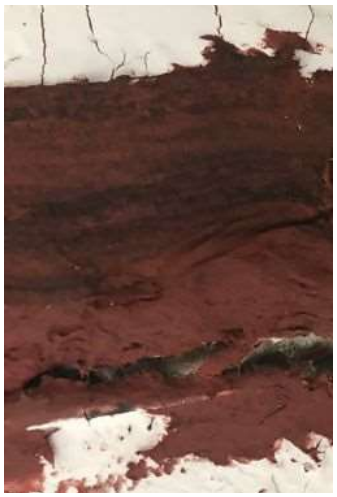
- Elevator height restrictions for material delivery and the floor-to-ceiling height requirements for studs. Stud splice requirements and fire-resistance-rated assembly designs.
- Sound/Smell
    - Uneven surfaces that prevent a good seal / protection of the underside of the deck.
    - Typical room to room.
    - Penetrations in the fire-resistance-rated assemblies and pipe layout within the walls.
    - Sound from materials in contact with another because of improper annular space and building movement or expansion.
    - Potential air movement concerns in ducts, shafts, elevator/stairways, and even typical partitions if not properly compartmentalized within the units.

- Water concerns during construction when the exterior is open to the elements and prevention of moisture entering the interior is necessary.
- Water concerns after construction, such as utility closets with floor penetrations.
- Flexibility of the floors and the requirement for fire-resistance-rated assemblies' compartmentalization for the building. How is this properly identified and maintained for the life of the structure?
- Floor-to-ceiling height design that considers the need for a proper head of wall design and a no-fly-zone.
- Deflection concerns and site-lines of the walls.
- Will the underside of the deck become the ceiling for the space? How is deflection and the head of wall designed to take this detailing into account?
- Design of the perpendicular walls to the curtainwall or exterior wall, taking into account the wind load and sway?
- Quick turnaround (3+ days) of concrete floor and the coordination needed for floor penetrations.
    - Verifying most updated coordination drawings on site and programed into equipment.
    - Verifying locations twice on a second construction point before concrete placement.
    - Verifying sleeve size (and type) is correct for the pipe and fire-resistance-rated assembly and building movement.
    - Contingences for misplaced sleeves in the floors.
    - Contingences for relocated walls during construction by the Owner or Design teams.
- Coordination of different construction types (concrete, steel, cold formed metal framing, etc.) within the same building for fire-resistance-rated assemblies, head of wall design, and penetrations.
- The need for Engineering Judgements (EJ) / Equivalent Fire-Resistance-Rated Assemblies (EFRRA) and a defined process in place to reduce the time they take to obtain.
- Coordination for priority walls and sequencing of rated walls.
- Perimeter Fire Barrier (Edge of slab and curtainwall) firestopping design and installation.

This challenging construction type led me to develop the *Seven Stages of Firestopping and Fire-Resistance-Rated Assembly Constructability*.

1. Preconstruction/ Initial BIM Phase
2. Bidding
3. Pre-Installation / Submittals & Review
4. Coordination (BIM Phase)

Photo of firewall and curtainwall joint that allows for lateral movement. Corey Zussman Photo



Movement issues found at an existing head of wall. Corey Zussman photo.

5. Installation Training / Mock-up / First Work-in-Place
6. Installation / Verification
7. Turnover / Maintenance

This article will not expand on head of wall and MEP-FP no-fly-zones. To better understand the complexities and requirements for the head of wall and MEP-FP coordination in fire-resistance-rated assemblies, please refer to my article in Life Safety Digest Fall 2019, "Proper MEP-FP Coordination with Non-Bearing Fire-Rated Walls".

PRECONSTRUCTION / INITIAL BIM PHASE

A few years ago, I reviewed a project for an interior buildout on the 37th floor of a high-rise building. The existing space was being remodeled, and the project team wanted help reviewing and identifying an existing condition. The acoustical ceiling tile and grid were damaged in the hallway by the outside offices. It turned out that the perpendicular walls at the perimeter glass did not properly allow for lateral deflection on the curtainwall and the wall pushed into the hallway and damaged the ceiling.

In my career, I have tried very hard to learn from previous experiences, apply what I've learned to my current projects and to offer my team, owners and architects the best possible solutions. Being proactive with firestopping concerns saves time and money because we are able to identify cost concerns early and identify the trades that will be needed for proper installations.

When renovating an existing high-rise space, I suggest a site visit to review the conditions to look for present signs of distress and other concerns with regard to the fire/smoke compartmentalization.

While not all concerns can be addressed during the site walk, the following Top Ten List is a good start:

1. Identify the compartmentalization of the building and floors.
2. Identify the fire-resistance-rated assemblies required, including Mechanical/Electrical/Plumbing (MEP)-Fire Protection (FP) locations that will affect the installation of an assembly going to the underside of the deck. Placing a large HVAC duct in the middle of the wall (possibly a fire-barrier) will likely create installation issues and be a hidden extra cost.
3. What is the live load deflection and the potential lateral movement on each floor?
4. Determine the type of top track that will be utilized at fire-resistance-rated assemblies.
5. Once the deflection and type of track is determined, a no-fly-zone for MEP-FP installation could be calculated.
6. Verify size and extent of MEP-FP items in the fire-resistance-rated assemblies to verify clearances in and adjacent to structural and other items. Make sure that installation of MEP-FP items will create a condition that will not allow the Owner to properly maintain their firestopping assemblies, as required by the applicable fire code.
7. Determine the type of flooring system being utilized. Do we have a raised access floor system? How will the fire-resistance-rated assemblies by addressed?
8. Verify the type of penetrants being used on the projects, such as steel, plastic (type), copper, etc.
9. Start to identify the need for certain floor penetration resistance types, such as a W or T rating – in addition to F ratings.
10. Start the EJ / EFRRA process early to identify extra work by others within the assembly.

When the above items are found after the bidding period, there can be extra costs associated with the construction of fire-resistance-rated assemblies and fire penetration protection. Talking to the architect, construction manager, and general contractor as part of the team putting together the initial documents and starting the discussions early will prevent surprises and disappointments.

BIDDING

To minimize excessive questions and confusion and improve accuracy, the design and construction team should ensure that all teams who are bidding on the work have the information gathered during the preconstruction phase in a clear and concise format. Bidders should look for the information provided in the Top Ten List when putting together their costs.

In addition to the ten-item list, fire resistance trades should look for required training, mock-ups, and testing to confirm that the bidding documents are complete enough for a proper bid on the required systems to be installed. If the information is missing, it should be requested for everyone to properly bid. It's important that all bidders have the same information for the entire project to bid successfully, with few surprises after award.

COORDINATION (BIM PHASE)

Building Information Modeling (BIM) should have started during the pre-construction phase of the project. I use a BIM checklist that we created, which identifies many of the items previously discussed. To proactively address typical concerns that may get missed by the MEP-FP teams, I suggest having the stud and drywall contractors at these meetings, as well as the firestopping contractor. Potential concerns and items that cannot be installed should be addressed by the design team. Doing this early at this forum will also streamline the coordination meeting between all of these trades.

PRE-INSTALLATION / SUBMITTALS & REVIEW

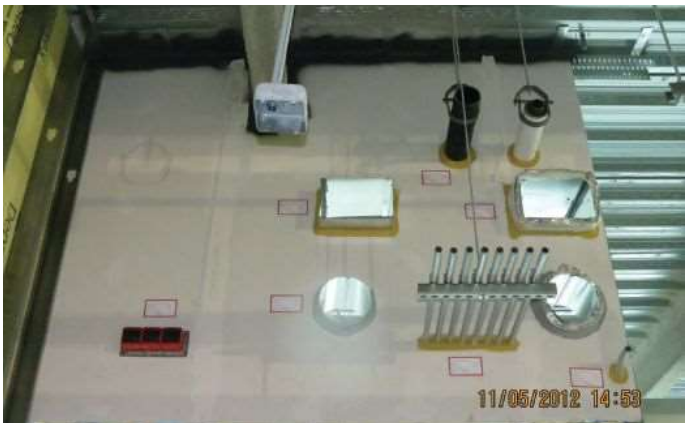
Life Safety is paramount to construction, both during and after the project is complete. Making sure that all components of the fire-resistance-rated assemblies and penetrations are properly designed, reviewed, and confirmed will give the entire project team the confidence it needs to turn over the building safely.

I prefer to hold two types of pre-installation meetings. A series of separately held meetings with the individual contractors going over general trade-required items and making sure that submittals are complete and are being processed. After these meetings, I suggest a combined meeting with the trades to coordinate, review and confirm installation requirements and concerns. The pre-installation and coordination meetings could take several hours at a time, so getting the basic information out of way from each contractor's scope of work prior to the coordination meeting assists with reducing the overall time the multi-trade coordination meeting will take. The following trades should be addressed:

- Framing and drywall (gypsum panel) contractors, including the head of wall contractor
- MEP-FP contractors
- Firestopping contractor(s)

I create very detailed agendas with example photos to ensure that all items have been understood, addressed and that any lessons learned from previous projects or information gathered are not forgotten. This type of format also serves as a forum for sharing lessons learned. Just going through the drawings, specifications, and submittals might not be enough to be proactive in catching preventable and costly mistakes.

If the project team has not set up these meetings, I suggest contractors request these meetings prior to the work starting. It is in everyone's best interest to properly coordinate to avoid unnecessary rework.



Firestopping mock-up. Corey Zussman photo

TRAINING / MOCK-UP

Proper training is a must for anyone performing the work of the fire penetrations and fire-rated assemblies in these types of buildings. I believe that the firestopping manufacturer training is not enough to make sure we are setting the team up for sustained success. Training of management, foremen, superintendents and workforce under the management system of FM 4991, *Standard for the Approval of Firestop Contractors or UL's Qualified Firestop Contractor Program*, provides confidence that the right questions are being asked and the appropriate follow-up installations are being performed throughout the facility.

Creating a mock-up early in construction can confirm installation sequencing and complexities, as well as construction installation techniques and expectations. If there are locations where the firestopping is exposed to rain, weather, etc., (head of wall or penetrations), this needs to be addressed on the mock-up. A mock-up will also confirm information discussed in the coordination meeting.

INSTALLATION / FIRST WORK-IN-PLACE / VERIFICATION

After all work has been coordinated and verified with a mock-up, a first work-in-place should be performed with each installer employed by a firestop installation company. This process will ensure that all the discussions held with the team members are properly transferred to the actual installer(s). Reviewing the work of each installer is paramount to verify proper installation success.

When superintendents, project managers and foremen have been trained on the installation of their projects through the pre-installation and coordination meetings, during installation, they are able to walk the site and identify concerns for re-review, whether by the contractors and/or the quality team. Our quality team also performs weekly or bi-weekly inspections of the work. The program is designed to be proactive during the inspection and discovery of any deficiencies to minimize rework.

Reviewing the stud and drywall placement and confirming continuity is critical to review early in the wall installation process. Make sure that the installation meets the tested assemblies presented and if any unforeseen details arise, a proper process for Engineering Judgements are followed.

I just reviewed a project where the stud and drywall contractor installed a wall at a column that was not originally reviewed in the design because of late modifications. The installer did not review the change with the firestopping contractor/installer and after the installation was in process, it was determined that an EJ/EFRRA would be needed for the condition. Producing EJ's takes time, and having a professional firestopping installer on the project made the request faster and more precise the first time.

All installations should be tracked by the installers. This is extremely important for mid- and high-rise construction. Although in different locations throughout the building, multiple floors, many different conditions, and similar installations make documentation critical for the verification and maintenance of the systems installed.

TURNOVER / MAINTENANCE

One of the key factors that sometimes gets missed is the ability for the building owner or manager to maintain the fire-resistance systems – including firestopping. We need to make sure that we have access to view the systems and make any corrections when needed. If the system is no longer accessible or hidden by obstacles – and not installed properly or disturbed, penetrated or breached, we are handing over a potentially dangerous and non-code compliant installation.

Having accurate and complete documentation and locating the penetrations with the correct label is important for the next team to take over and maintain what has been installed. There are several ways that this could be accomplished. Some manufacturers and firestop installation contractors have sophisticated programs that track and document assemblies, or a simple document with photos might be enough depending on the project and owner.

The specifications should identify the level of documentation needed at turnover. If it does not, the fire assembly contractors should ask what is needed. Since maintenance is required to confirm the life safety of the systems installed throughout the life of the building, and since it is a code required item, we must all do our part in that process.

More than most types of construction, life safety is critically important for the occupants of mid- and high-rise buildings. Making sure everyone has enough time to escape, has an appropriate amount of time to shelter in-place, and allowing first responders time and pathways to access the building safely, is a priority and needs to be treated as such.

Everyone has stories, lessons learned, and experiences that shape their knowledge and understanding. Sharing that information is the trick and the goal for our industry. As a quality director for a large construction company, I'm often asked how we reduce construction defects. I typically respond that it takes a lot of work, effort and collective experiences by everyone on the team.

Furthermore, understanding what questions to ask and what concerns to look for are key to reducing costs and time delays. Understanding the process and sharing the information learned about the project along with well-defined actions that people can apply will establish the framework for a successful plan.

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