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Project Profile

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FCIA
Firestop Contractors International Association

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HIGH-RISE BUILDINGS FIRESTOPPING CHALLENGES

LESSONS LEARNED TO MINIMIZE REWORK FOR AN ARCHITECT, GENERAL CONTRACTOR, AND FIRESTOPPING CONTRACTOR

As a QA/QC professional for a general contractor, one of my most important responsibilities is ensuring that all life-safety components inside buildings follow the architect's Life Safety drawings and are appropriately planned, executed and verified.

In high-rise construction, this job is more challenging because of construction tolerances, building movements, and sequencing of the fast-paced work. It is essential to get ahead of the construction and the Mechanical Electrical Plumbing – Fire Protection (MEP-FP) systems, so proper room is given to install and verify the firestopping installation.

Over the years, I have learned many lessons regarding firestopping and passive life safety. The most important lesson is asking the right questions upfront. Is there enough room for installation? Based on the construction type, the sequence of material installation, and the construction schedule, what information is needed to install the firestopping correctly, once? What information is needed to verify the installation?

We review our firestopping through an independent third party inspection agency when required and with our trained in-house team when we do not have a contractual obligation or feel that it is necessary to hire a third party. In either case, we follow ASTM E2174 *Standard Practice for On-Site Inspection of Firestop Systems* and ASTM E2393, *Standard Practice for On-Site Inspection of Fire-Resistive Joint Systems and Perimeter Fire Barriers* for our on-site inspections. The installation cannot be known without verification of installation, type, and quality of work. A first-work-in-place program is recommended to review and confirm installation, before subsequent penetrations are installed across multiple floors. In high-rise construction, the risks of repeating an error multiple times throughout the building is exaggerated, making a first-work-in-place program essential.

It is also important to remember that firestopping information is a two-way street. The firestopping installer (Firestop Installation Contractor) needs information to install the firestopping materials correctly, and the building contractors need to know the proper size and shape, as well as if extra framing or other materials are needed, for an overall successful installation.

CHECKLISTS

To help the team work together and get the answers they need, I use a checklist of questions to ask the architectural and construction team. This checklist has become a list of lessons learned to refer back to at each project start. I update my checklists frequently, so I do not lose lessons learned from previous projects.

Developing and maintaining checklists can be a daunting task – and may seem like enough to stop you from even starting. What is too much information, what is relevant information, and what is the best way to describe a previous issue concisely? The key is to start with the basic information needed for the project and add to the checklist over time. I like to pair our questions or lessons learned with photographs of the concern or the proper installation. We have found that nothing beats photographs for getting the point across, as photographs transcend language barriers that might exist.

GETTING STARTED WITH THE RIGHT INFORMATION: SAMPLE QUESTIONS AND CHECKLIST ITEMS

(SPECIFIC TO HIGH-RISE CONSTRUCTION)

1. **Do you have the most updated drawing set… and how do you know?**
   The construction industry faces this widespread concern across projects. Many computer programs manage construction documents well, but without a proactive construction team following up and confirming the most updated drawing set is being used at all times is challenging. Placing the drawing set date/number on the submittals and shop drawings is the first step in ensuring up-to-date compliance with the documents. Also, following through and confirming before the first-work-in-place is needed and questioning the documents frequently during installation, will give the team a better grasp on up to date drawings.

2. **What is the construction type of the structure?**
   Concrete (post-tensioned, void forms, precast concrete, or other), structural steel, both, CFMF, (Cold Formed Metal Framing) timber, wood, etc. Each of these construction types will likely change how the project is approached. Construction sequencing starts with the type of construction of the building frame. For example, a post-tensioned concrete high-rise structure might have a floor turn-over rate of 3 or 4 days, which impacts the placement of in-floor systems and piping.

   Knowing if the building is post-tension construction is vital to understand because of the limitation of adding concrete cores in the floors. Should sleeves be added, and should the confirmation of the location of the sleeves be triple-checked with all trades, including the MEP-FP and the partition contractors, to confirm wall layout based on actual installation materials? Are the drawing dimensions referencing the studs, the drywall, or the final finish on the wall, or in some cases, both?

   With precast concrete, ask questions about the type of floor being installed and, specifically, if it is planks. When the joints of the planks run perpendicular to the fire-rated wall, there will be a gap in the planks above the head of wall detailing. How are the joints of those planks being addressed? The placement of the joints is a common oversight.

   Understanding the construction type also means knowing the other trades' construction tolerances so that the firestopping installer can adjust and anticipate those tolerances. For example, what is the expected minimum or maximum gap for the slab edge firestopping installation, and will that fire-rated joint properly perform with those dimensions? Incorporate this understanding into the plan to minimize rework. Another question I ask is: Does the construction type have column or wood shortening that needs to be addressed in the firestopping systems?

3. **Is spray fireproofing (sprayed fire-resistive materials - SFRM) or intumescent fire protection (intumescent fire-resistive materials-IFRM) protection being used?**
   These follow up questions will help determine how the project should be approached.

   Does the building have any fire-resistance rated wall assemblies below a fireproofed beam?

   Will the spray fireproofing need to be installed thicker at the web to limit heat transfer from one side of the beam to another – as it is now acting as a wall?

   Do we need to install metal clips for the drywall framing?

   Do we need to install steel stabilizer or break-a-way clips for CMU walls, etc.?

4. **What are the selected fire-barrier, smoke barrier, firewall and fire-partition, smoke partition system types?**
   The building could have drywall, concrete masonry units (CMU), concrete, or other partition types, which will change the chosen firestopping systems. For example, does the building have shaftwall, one-sided construction access, or something else? The systems will direct the detailing of the firestopping system.

   Is the building under a seismic design that will change the annular space for fire protection pipes through a rigid wall type, such as concrete or CMU? Or, will the pipe installation need to change based on the same requirements because the annular space in the wall was not addressed (which is more expensive)?

5. **What is the construction sequencing of the partitions?**
   When installing shaftwall, for example, the firestopping will likely be needed on both surfaces, the shaftboard and the finish board. Typically, there is a long pause in the construction of the shaftwall, where the shaft board of the wall might be sitting for several weeks or months before the finish drywall is installed. The installer of the firestopping head-of-wall or penetration system will have to return to install the firestop system in the breach made in the finish drywall.

Fire-rated penetration at a fire-rated room perimeter wall. Corey Zussman photo

Another location of construction sequencing concern is a fire-resistance rated room in the middle of the building. A fire-resistance rated room will be drywalled, and non-rated walls will be installed against the fire-resistance rated room's outside drywall. The conduit or plumbing penetration within the wall that passes through the fire-resistance rated room will need to be firestopped before the non-rated stud/wall is installed.

It is important to discuss these types of sequencing and location concerns to avoid removing drywall for proper access to install the firestopping.

6. **What deflection concerns affect firestopping?**
   One of the important considerations is live load deflection and building drift. To properly design the head-of-wall for all partition types, live load deflection must be understood. Are we installing a slotted type head track or an overlapping drywall type system? The head track information will determine the location of the MEP-FP items, and conversely, the height of the floor will decide which system is viable based on the room in the interstitial ceiling space. Understanding drift will allow the firestopping design to accommodate the lateral movement of the structure, when needed. Lateral or drift is a concern when we install our edge of slab firestopping.

   Deflection will also determine a "no-fly zone" for MEP-FP items. For proper firestopping installation and performance, the top of the MEP-FP item cannot be located in the no-fly zone. When discussing a no-fly zone, the MEP-FP contractor must include the hub/connection overlap for pipes, the flanges for ductwork, and the insulation thicknesses required on the pipes or ductwork.

7. **What is the location and construction sequencing of priority walls?**
   Location of priority walls is important because there must room to install the firestopping products with confidence and to verify the installation before the MEP-FP installation. The installation of priority walls, or walls that must be installed as soon as possible, starts with construction sequencing of the floors. Therefore, the priority walls might be typical for each floor, or they might be completely different depending on the project. Do not assume that the priority walls are all the same because the building is a high-rise.

8. **Do we have enough room in the wall for MEP-FP items?**
   An issue that is commonly found too late is not enough room in the partition to accommodate all MEP-FP items, including plumbing, electrical, HVAC, plumbing carriers, etc. There is only so much room for the crossing of items, hub, and connection overlapping, pipe supports, etc. Asking what is in the typical wall for a bathroom or kitchen is a good question for the entire team to confirm and potentially model to verify assumptions. If walls need to be thicker, the locations of penetrations will likely change, and firestopping might be modified based on final locations.

MEP-FP priority wall reason Corey Zussman photo

Mock-up for a head of wall when the bottom of the structure is the ceiling of the room. Corey Zussman photo

9. Is aesthetic a concern in high-rise construction for an apartment or condominium building?

In high-rise buildings such as these, typically the bottom of the structure and the top of the ceiling can be seen in the living units. When we have this condition, the head-of-wall joint is exposed and part of the finish system. Do we need to change the head-of-wall to accommodate this aesthetical concern? Will it be a hybrid of materials from different contractors, such as a fire joint that has been inspected and covered with drywall tape to hide the fire-rated joint?

10. What types of penetrants, head of wall, perimeter joint, and finish materials are needed?

Different types of firestopping materials are needed based on whether or not the firestopping will be exposed or painted, if it will be subjected to construction or permanent water conditions, or how it is compatible with other construction trade materials. A common example is fire sprinkler piping materials. To give the installers the correct block-out sizing, it is also important to understand if the penetrant is clustered and, if so, to what extent.

11. Are there horizontal movement joints in exposed areas?

These types of joints, such as in a stairwell that follows the structure of the space, can be forgotten by the design team and the contractor. A deflection joint is needed at the bottom of the structure, which might not be at a consistent elevation within the stairwell. Having an early discussion about these types of joints is important to manage expectations and provide time for the designers to come up with a suitable aesthetic look to cover these types of joints. Alternatively, they may consider changing the size of the steel around the stairwell to be the same size, for aesthetic reasons.

12. What types of ratings are needed (F, T, L, W, etc.)?

How will the building be built? Typically, we see a need for water-tight joints every couple of floors (W-Water Resistance Rating) for laundry rooms, IT closets and during construction, etc. Where the path of the piping penetrates the floor dictates if a T-(Temperature transmission) rating is required, and potentially if a wider core hole in the floor is needed to accommodate the added material around the piping.

T-rated firestopping needed, which will need a large core through the floor. Corey Zussman Photo

13. What are the sound and smell considerations?

Asking about sound might seem like a question not in the firestopping installer's purview; however, sound and smell issues will happen from unit to unit or floor to floor if the wrong type of firestopping system is installed. The correction to address the sound and smell condition will be highly intrusive for a finished high-rise building. For example, using a prefabricated sleeve, with room in the sleeve that closes up when a fire is present, might work for the firestopping system complying with the building code, but it will also allow sound and smells to bypass the system.

14. What type of firestopping will be used?

Out of the four categories of firestopping (fill/void and cavity materials, pre-installed, forming/backing materials, and duct wrapping materials), which one will best serve the building or which is needed based on the room or type of space? The firestopping category will also dictate the opening size for the penetration or slab edge. The opening size is important to transfer to the building wall or floor installers to correctly install the block-out sizes for the installation of firestopping.

15. **Is there a backup plan?**
What happens when a pipe is halfway in a fire-rated wall, or a T-rated system is now needed because the penetrant is no longer within the wall cavity? We have all seen these types of issues in the field, and having a detailed contingency plan is helpful and appreciated by all trades.

16. **What is the environment required for proper installation of materials?**
In my experience, I have found that this question is one of the most forgotten questions when building a high-rise. Sometimes, the high-rise will be built in the fall, which means some of the firestopping is installed during winter. Will it be cold in the building? Is the General Contractor planning on installing heat on the floors when the firestopping installation is starting? What is the minimum temperature required for installation and for how long does it need to remain at that minimum temperature? Is there an in-service minimum temperature for the firestopping product?

COMMON CHALLENGES AND LESSONS LEARNED

High-rise construction has many components, forces, and trades working together. As such, it can be hard to remember and address all facets of the work. Creating a checklist of items, which includes lessons learned from past projects, will make the firestop installation process more efficient for the entire team.

The questions posed here are intended to start the conversation and should not be considered an all-encompassing list of questions and concerns. There are different ways to present this information to your teams, as well as the architect, owner, contractor, and subcontractors.

The presentation should cater to the audience and might be the same or different based on your experience working with these construction players. Allow enough time to address these and other questions on your project correctly, and do not assume that each project is the same, even with the same architect, owner, or contractor.

For example, I have built two identical-looking high-rises with different construction superstructures and different forces on the building, based on the site orientation.

Firestopping contractors are in an excellent position to become an asset to the project team by asking questions and giving the team time to think about those questions, which will properly address the concerns for all trades and impact the success for all parties.

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