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Special Inspection and Multi-Family Structures

Constructability of the Slab Edge Joint

Gypsum Shaftliner Panels Offer Fire Resistance, Sound Control and Ease of Construction in Multi-Family Dwellings.

The Development of Perimeter Fire Containment

FCIA
Firestop Contractors International Association

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CONSTRUCTABILITY OF THE SLAB EDGE JOINT

Early in my career as a practicing architect, I never gave proper attention to the slab edge breach protection at exterior walls and curtainwalls that fly by, or bypass, the floor slab. It was just a breach making a joint that needed to be filled, typically by the curtainwall and exterior wall contractors.

I expected to receive a submittal that noted testing was performed by an accredited tested agency, in accordance with ASTM E2307, *Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers using Intermediate-Scale, Multi-story Test Apparatus*, as required by the International Building Code (IBC), and some material product data sheets.

As a designer, I was not taught about the joint, what questions to ask, or my responsibilities. I did not know what actually went into the joint design and what trades might be affected by the installation. Fast forward 30+ years, and I am amazed how little emphasis is paid to such an important joint that will typically run around the building on multiple floors.

JOINT CONSTRUCTABILITY

Before work begins, it is important to ensure the breaches made for the perimeter joints are constructed properly and that the trades involved in the project coordinate the work effectively. Proper coordination will help prevent the need for rework or, in some cases, joint re-engineering.

First, identify the many different façade element substrates, such as

- Curtainwall
- Cold formed metal framing (CFMF)
- Precast Concrete
- Metal Panel
- Concrete masonry units (CMU) or Masonry
- Glass Fiber Reinforced Concrete (GFRC) or similar
- Roof construction

Next, determine if a tested perimeter fire barrier joint is required and whether the façade "flies-by" the slab edge and leaves a gap or breach of any size or if the façade is attached from floor to floor.

FLY-BY FAÇADE

Typically, when the façade element "flies-by" the slab edge, the façade element could either be attached to each floor slab edge or skip every other floor. When the façade element is not attached to the floor, there are different coordination items to consider with the joint, such as:

1. **Floor-horizontal assembly slab.** Floor slab live load deflection (up and down movement), is determined by the Structural Engineer of Record for the building and has a code maximum of L/360 (L= length between supports in inches). Most engineers try to limit the slab edge live load deflection to around ½" maximum; however, confirmation of the deflection should always be requested unless it is clearly stated in the Contract Documents. It is a best practice for the team to ask in a request for information (RFI) soon after the project is awarded.

2. **Roof.** The live load deflection (up and down movement) at a roof condition is determined by the Structural Engineer of Record for the building and has a code maximum of L/240 (L= length between supports in inches). Like the floor slab, most engineers try to limit the slab edge live load deflection to around ½" maximum; however, confirmation of the deflection should always be asked unless it is clearly stated in the Contract Documents. Again, this can be confirmed in an RFI soon after the project is awarded.

3. **Gaps.** It is important to confirm expectations about the minimum and maximum distance of the gap between the floor slab and the façade element. Making sure that the joint is constructable

based on the joint width, access to the joint, and ability of the fire-resistance-rated joint to accept the expected movement in the joint width.

4. **Lateral deflection** (in and out movement). The lateral deflection should be defined by the Structural Engineer of Record for the façade element at the unattached floors. Lateral deflection should also be confirmed with the minimum and maximum slab gap provided. The materials for the joint should accommodate the compression and extension of the joint within the limits provided. The materials might need to change, or in some cases, the slab edge gap might need to be increased to accommodate the movement and the materials filling the gap. It is critical to understand this movement early in the design stages to prevent extensive rework of the slab edge.

Example of a wind connection of the curtainwall system. Zussman Photo.

5. **Seismic drift.** Detailing is needed and should be accommodated in the overall design.

6. **Façade element.** The façade element that will be against the fire-resistance-rated joint should be determined. For example, a curtainwall will likely need a back-pan of a certain gauge, possibly back-pan reinforcement depending on the size of the back-pan, and other back-pan installation requirements per the tested assembly of the joint.

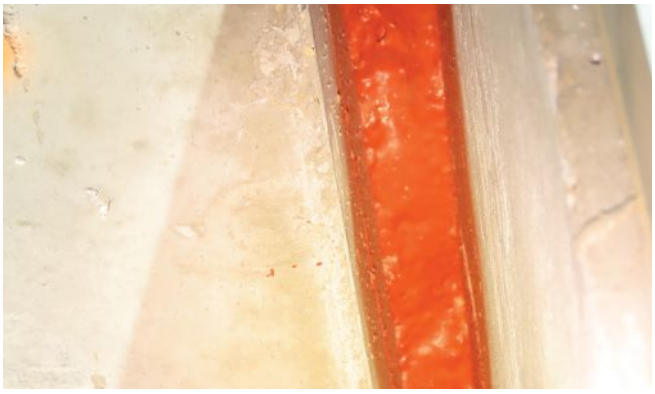
7. **Waterproofing, smoke rating, or other penetrating conditions.** Knowing the performance of the joint is important to understand as soon as possible, as it will better define the design and materials used for the joint.

8. **Joint filler.** Typically comprised of mineral wool, the joint filler should have a defined compression and mineral wool grain orientation. If the slab edge gap exceeds a defined dimension, a slab edge mineral wool will need to be reinforced within the mineral wool, in accordance with the tested assembly – without deviations from the listing. This prevents the mineral wool from falling out during the deflection cycling of the joint. The reinforcement within the mineral wool should be considered for installation constructability.
   - What is the reinforcement material?
   - What is the reinforcement orientation?
   - How is the reinforcement attached? Can we get a drill, PAF gun, etc., within the gap minimum dimension?

Do we need to change anything about the reinforcement to make it constructable for the project (i.e., have an Engineering Judgment (EJ) designed for the exact conditions of the project)?

Example of mineral wool support at CFMF due to slab edge gap size. Zussman Photo.

9. **Access.** Sometimes access is not possible from the top side, and an underside fire-resistance--rated joint installation will be necessary, based on the constructability of the joint. Always confirm access ensure the tested joint accommodates what is needed for the project.



Example of underside edge of slab fire stopping installation due to sequencing and coordination. Zussman Photo.

10. **Façade and adjoining conditions.** Consider the following questions.
    - Will an interior wall be installed against a façade element, such as a partition with insulation in the cavity?
    - Where will the interior wall be installed in relation to the backside of the façade element?
    - How will the interior wall accommodate the deflections of the floor and lateral movement of the façade element? Make sure that movement is taken into consideration by the interior wall and does not disrupt the fire joint at the slab edge in any way.

11. **Compatibility.** The joint material and the flooring compatibility will likely need to be coordinated. For proper installation of a sprayed joint, the fire joint material will need to be applied to the horizontal plane of the slab edge. Consider the following questions.
    - What product will be in contact with the fire joint material?
    - Will the flooring be floated with a floor leveling product such as a cementitious or gypsum-based material?
    - Will there be another building element against the fire joint, such as a mechanical system?

12. **Slab edge fire joint.** If the slab edge fire joint needs to be protected with a cover, it is important to ask the following questions:
    - How will the cover be installed without damaging the fire joint?
    - Will the cover need to accommodate the slab live load deflection? (meaning it will not be attached to the exterior façade element)
    - What is the material and thickness of the cover?

13. **Construction sequencing.** For floor or roof joints, a detail should be sequenced with all associated trades to confirm constructability. A 4D model may be warranted (3D + time sequence). The sequencing should include inspections as required to confirm the installation. Doing this sequencing early is ideal; however, it should happen no later than the Building Envelope Coordination Meeting. (see "Building Envelope Coordination Meeting" section for further description and constructability concerns).

14. **Mock-up or "First-Work-In-Place."** Some type of physical representation of the work is always recommended to confirm design and sequence assumptions. "First-Work-In-Place" confirms installation understanding and techniques. Both mockups and first work reviews and procedures are a cornerstone of an established quality program.

Example of a first work-in-place inspection of the mineral wool. Zussman Photo.

ATTACHED FAÇADE

When the façade element is attached to or near the floor, the joint has different considerations In addition to items #3-14 previously addressed.

Load types. It's important to understand if the attachment type is either a dead load or lateral load type.

- Dead load type attachments are where the attachment is transferring the dead load of the façade element as well as the lateral load of the façade. There will not be any live load deflection or lateral load deflection with these types of attachments.
- Lateral load types are where the attachment is transferring wind load (or possibly seismic) only; live load deflection will need to be accommodated with these types of attachments.

Attachment location. The location of the attachment will determine what, if any coordination will be needed with the slab edge fire joint. Is the attachment at the top of the slab, slab edge, a nearby beam, or a nearby column?

Suppose the façade attachment element is at the floor. In this case, coordination at the floor elevation will be needed for multiple adjacent materials, such as flooring, walls, cabinets, HVAC elements, etc., all of which might eat into the space or room interior that the design team or owner might not have anticipated.

Connection Type. The type of façade element connection will also determine the coordination needed with the slab edge fire joint.

- For example, a connection at the top of the slab will need a coordinated slab embed plan and details from the Structural Engineer of Record to accommodate the slab edge forces being transferred to the slab. When the connection element is at the floor or a little above the floor, the installation coordination of the slab edge fire joint will be imperative to ensure that the edge joint is properly installed without voids. The connection element might need to be raised for edge joint access, or a tested design might need to include the attachment element.

- If the attachment element is attached to a nearby beam or column, the connection of that element might need to be installed before the spray, or intumescent fireproofing material. Otherwise, coordination to patch the spray or intumescent fireproofing material might be needed. Weather conditions at the time of installation or patching might also have an impact on the coordination.

WHO IS PART OF COORDINATION

Proper installation begins with proper coordination of all parties involved so that all points of view are accounted for during coordination. For the connection elements, start coordination as early as the 50% design development phase, depending on the complexity of the connections. A Building Envelope Coordination Meeting is a good place for final review and buy-in to the design, for final coordination. The meeting will confirm the assumptions by other trades, confirm the construction sequencing, ensure that the installation is constructable by all parties, and should include the following participants:

- Façade contractor
- Firestopping contractor
- Manufacturer of the firestopping perimeter fire barrier joint protection system
- Flooring contractor
- Floor structure contractor (concrete, wood, steel, etc.)
- Architect
- General Contractor (PM and Superintendent at a minimum)
- 3rd Party testing agency
- AHJ as required

CONSTRUCTABILITY CONSIDERATIONS

Depending on the façade element, some additional constructability items might need to be coordinated:

- **Curtainwall.** Curtainwall constructability includes items such as the slab edge embed coordination, how the attachment element can accommodate construction tolerance and differential movement between façade elements and encroachment into the space or room and coordination of walls and millwork. Consideratioin should also be given to the elevation of the attachment element with relation to the floor and constructability of the slab edge joint, any mullions that need to be protected to a certain height and back-pan construction coordination.

- **Cold formed metal framing (CFMF).** CFMF is a complex and repetitive shape, and the cost to install the edge of the slab joint needs to be considered in the bid. The gap for the mineral wool will need to include the CFMF width, which is typically 6" to 8". The attachment of the mineral wool clip support could be at the floor slab edge or the CFMF itself, and the constructability of the clip installation must be considered. Each CFMF component will be clipped back to either the floor slab edge or a nearby beam. Depending on where the slab edge firestop is installed, the clips might be within the joint. They must be accommodated in the tested assembly, and depending on the clip type (load bearing or lateral clip), the system might need to accommodate either live load deflection and/or lateral deflection.

  The configuration of the CFMF might include multiple layers of vertical CFMF, potentially closing off the area for access. Coordination will be needed to confirm access and direction of the studs. Finally, CFMF has pre-punched holes at a certain distance. Coordination will be needed to ensure that the pre-punched holes do not fall within the required slab edge firestopping or a design should be provided to correct the condition.

Example of CFMF slab edge detailing and sequencing and coordination of installation. Zussman Photo.

- **Precast Concrete.** Precast concrete requires slab edge embed coordination. Other considerations include how the attachment element can accommodate construction tolerance and differential movement between façade elements; encroachment into the space or room and coordination of walls and millwork; and elevation of attachment element with relation to the floor and constructability of the slab edge joint. The connection element will likely be larger than most of the other façade elements because of its weight. Steel shapes such as tubes, might be used, and they should be reviewed for thermal and condensation potential concerns.

Coordination of attachment of dead load clip at precast and curtainwall to raise the support for better access of the slab edge fire joint. Zussman Photo.

There are several other considerations to review when it comes to this slab edge joint.

- AHJ approval and/or 3rd party testing will likely need to be accomplished, and the sequencing of the review will be imperative for proper review and installation. It is a good idea to add the inspection in the sequence sketch/4D drawing to ensure that the time needed to review is accounted for in the construction.
- Review and confirm the location of the vapor retarder, how that is being made continuous on the interior, and if the slab edge joint is interrupting this membrane.
- Review the accessibility at the building corners behind columns. This location will be difficult to coordinate and should be reviewed early to determine if a design modification is needed for constructability access.
- The depth of the floor might be an issue depending on the joint width. The floor needs to be confirmed for thickness and the design of the slab edge joint. The thickness of the slab or an extension at the edge might need to be adjusted to accommodate a proper thickness for the joint requirements.
- Mechanical, electrical, plumbing, and fire protection (MEP+FP) elements cannot go through the edge of slab joint and will need to be coordinated in the building modeling phase (BIM).

Planning and coordination are paramount for a properly detailed and complex perimeter fire barrier protecting the breach between the exterior wall and the edge of slab – horizontal assembly. Knowing what questions to ask, when to ask them, and who to ask are key to a successful design and installation.

We could do better as an industry, taking the time to teach not only that a fire-resistance-rated perimeter fire barrier joint is needed but what goes into the design of that fire joint and what should be carefully planned and coordinated.

Sometimes, the manufacturer will not understand the full complexities beyond the joint itself. This is understandable, and it is something that, as a team, we can work together to define the full requirements of the joint, including the down-the-line decisions for all trades involved.

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