Precast Concrete Façade Investigation

By Mike Hoglund

With precast concrete façade panels, how they are sealed and how they are supported are important considerations in any examination. Typically, precast concrete panels are sealed with caulk and backer rods at the joints. If the panel is exposed aggregate, and the exposed aggregate exists at the joints at the caulk bond line, consideration must be given to the effectiveness of the seal of the caulking to the aggregate.

Fig. 1: Horizontal joint with gaps in aggregate

Fig. 2: Vertical joint with gaps in aggregate

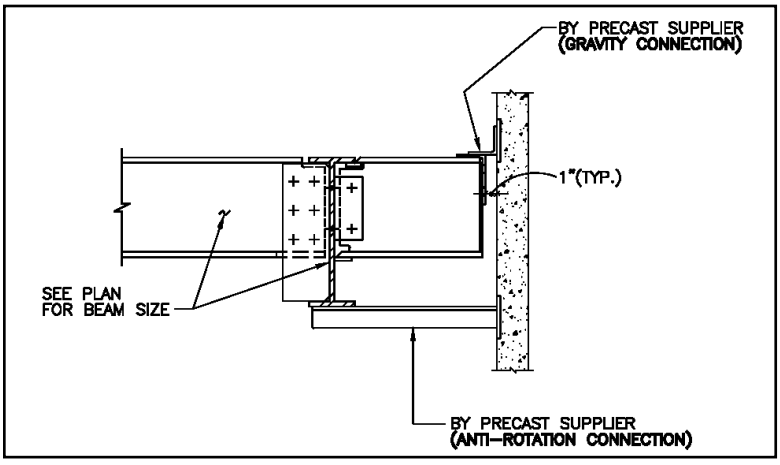

Fig. 3: Typical gravity and anti-rotation connections in a steel-framed building

If there are gaps in the aggregate, such as shown in Fig. 1 and 2, consideration has to be given to grinding of the joints to produce an effective water seal with the caulk. Additionally, consideration should be given to sequential water testing of the joint:

1. Water test as is to establish the joint leaks;
2. Replace the caulk, leaving the joint as is and water test; and
3. Grind the joint, caulk the joint, and water test.

If it does not leak during Step 2, grinding of the joints is not needed; if it leaks during Step 2, grinding will be needed. Water testing such as this will help the building owner to understand that grinding of the joints may be a necessary work item and construction cost to effectively seal the precast façade panel joints against water intrusion.

Typically, precast concrete panels are connected to the building structure at two points; one to support the gravity load of the panel and the second to prevent rotation of the panel. Figure 3 shows typical precast concrete panel connection points to a building structure. This figure is of a steel-framed building where the gravity connection is on top of the slab and the anti-rotation connection is at the bottom of the spandrel beam.

Examination of the connections requires intrusive examination. Typical damage to precast concrete façade panel connections is from water intrusion resulting in rusting of the steel connections and/or delaminated concrete surrounding the connections. A temporary support of the precast panel is required while the repairs are being made, and may consist of a simple angle bolted to the slab, steel frame support, or other more elaborate temporary support.

Figure 4 shows a repaired precast connection at a precast balcony wall panel that required a simple steel angle bolted to the slab and back of precast panel for temporary support. Figure 5 shows a repaired precast connection at a precast column cladding panel at a balcony that required temporary steel frame support. In both cases, the slab concrete at the embedded plates was delaminated and the

Fig. 4: Repaired precast wall connection on slab

Fig. 5: Repaired precast column connection

Fig. 6: Vertical crack at connection constraint

Fig. 7: Same crack leaks

exposed steel connections were cleaned and primed. Removal and replacement of the concrete masonry unit divider wall was necessary to expose the connections shown.

Precast connections are typically slotted to allow for movement from thermal expansion and contraction of the precast concrete, wind loading on the panels, and service loading of the slab causing differential movement between the slab and precast concrete. An investigative examination of the precast should be conducted to determine if the precast concrete is cracked at the connections. This may occur with panels that are long in the lateral direction and have intermediate supports to the structure in addition to the supports at the ends of the panel.

Figure 6 shows cracked precast concrete at a connection, viewed from the interior of the building. The crack is vertical, indicating lateral movement caused the crack, most likely from thermal expansion of the precast panel in the lateral direction. It is difficult to construct an absolutely restraint-free slotted connection and constraint within the slotted connection resulted in the crack shown. Figure 7 shows that water testing of the same crack revealed that the crack is a leaking crack, meaning it is a full-depth crack, and will most likely leak during wind-driven rain. Because the crack leaks, there will mostly likely be corrosion damage to embedded steel in the precast concrete from water intrusion—if not now, then sometime in the future. Therefore, the designer must consider structural repair and water tightness of the repair along with the aesthetic appearance of the repair in the exterior precast concrete face.

Investigation of precast concrete panels should include an examination of sealing the joints, intrusive examination of the connections, and examination of cracking of the precast concrete at connection points.

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