

PROFESSIONAL ISSUES

issues affecting the structural engineering profession

Façade Attachments

Who is Designing Them?

By Filippo Masetti, P.E.,
Milan Vatovec, P.E. and
James C. Parker, P.E., S.E.

Filippo Masetti, P.E., Senior Staff II at Simpson Gumpertz & Heger Inc. Mr. Masetti has been involved in numerous design, investigation, and rehabilitation projects involving concrete, steel, masonry, and wood structures. He may be reached at fmasetti@sgh.com.

Milan Vatovec, P.E., Senior Principal at Simpson Gumpertz & Heger Inc. Mr. Vatovec is the head of structural engineering in the firm's NY office. He may be reached at mvatovec@sgh.com.

James C. Parker, P.E., S.E., Senior Principal at Simpson Gumpertz & Heger Inc. Mr. Parker is the head of structural engineering in the firm's LA office. He may be reached at jcparker@sgh.com.

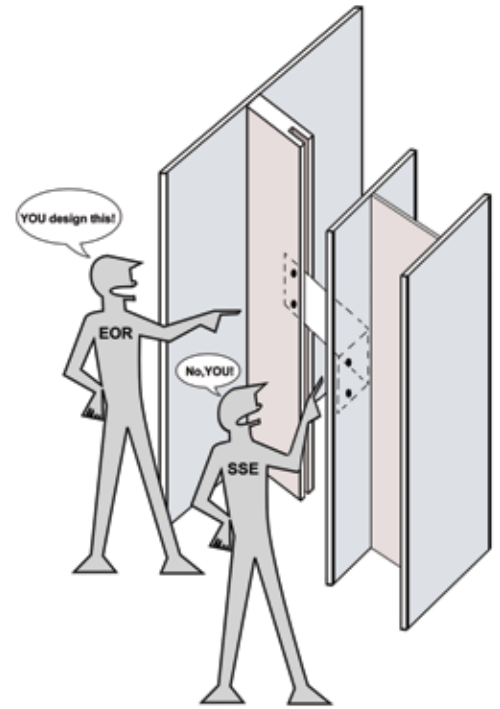


While some of the more complex design, detailing and critical coordination on a building construction project occur at the interface of the structure and the building enclosure, building design teams often consider façade-system attachments as ancillary components of the project. In fact, design, fabrication, and erection of façade systems are often subcontracted out to a specialty contractor, who is part of the construction team. The specialty contractor's team also typically includes façade system manufacturers, erectors, designers, detailers, and sometimes other various consultants.

As a result of this arrangement, the project design team often delegates the façade-system and associated connection design work to the specialty contractor's team. This allows the specialty contractor to consider efficiency and cost effectiveness of fabrication and erection in their design methodology. However, the specialty contractor is typically required to adhere to the overall design intent outlined in project specifications and contract documents developed by the design team; this direction

may include specific requirements relative to overall system performance, loading, etc. The design team's documents typically also provide guidance on submittal and review procedures, as well as general design-responsibility delineation; the design documents often also define specific portions of the design work that is delegated. Many project documents, however, come a bit short and end up with general façade-related requirements that are a mix of prescriptive direction (e.g. where the façade is in plan and where it gets attached to the structure) and performance-specified direction (e.g. loads and deflection limits for façade elements and their attachments).

Due to the delegated design arrangement, coordination is vital between the design professionals for the overall building project and the design professional that performs the delegated design of the façade systems. Without sufficient clarity and information in the design documents, as well as coordination and follow-through during submittals, the design-responsibility demarcation line is often blurred, and project deliverables, schedule, and overall quality can suffer; in worst cases, failures can ensue. This article provides a summary review of the current industry documents and their guidance on the topic, discusses the importance of clear delineation of design responsibility for façade-system connections and associated components, and provides some insight on how to potentially improve coordination between the design and construction professionals. In the upcoming sequel to this article, the authors plan to expand upon the topic, focus in some depth



on specific issues, and discuss upcoming industry changes with respect to design (delegation) of facade attachments.

Review of Current Industry Standards

The following industry references provide broad information on the subject:

- 1) PCI Architectural Precast Concrete MNL-122, Third Edition, 2007
- 2) PCI Design Handbook MNL-120, Seventh Edition, 2010
- 3) PCI Connections Manual for Precast and Prestressed Concrete Construction MNL-138-08, First Edition, 2008
- 4) AISC Design Guide 22, 2008 – Façade Attachments to Steel-Framed Buildings
- 5) AAMA CWG-1-89 – Installation of Aluminum Curtain Walls, 1989

The majority of the industry reference documents emphasize the importance of coordination between the design professional (Engineer of Record – EOR, or Structural Engineer of Record – SER) and the design professional performing the delegated design (Specialty Structural Engineer – SSE).

- As referenced in The PCI Design Handbook: “Coordination and communication between the [...] SER and the [...] SSE are of paramount importance. This aspect and its importance are recognized on the national level by the Council of American Structural Engineers (CASE): ‘The primary failure in projects involving SSE is the lack of coordination

and delineation of responsibility. When interfacing with the SSE, the SER should always be the one who delineates responsibility for the various structural requirements.” (Para 14.5.4.3).

The industry references describe the architect and/or the EOR (the design team) as those responsible for delineating the delegated work, for providing all design requirements relative to the delegated work, and for overall coordination between the delegated work and the rest of the project. The contract documents (drawings and specifications) are the means to convey this information. The following list of selected excerpts summarizes specific industry guidance on the topic:

- The PCI Architectural Precast Concrete MNL-122 states: “The design team should provide complete, clear, and concise drawings and specifications. Contract documents should clearly define: (1) precast concrete components that are to be designed by the precaster (state who takes responsibility for design of elements at interfaces with other parts of the structure, such as secondary steel bracing of the structure, to prevent rotation of beams or columns); (2) details or concepts of supports, connections, and clearances that are part of the structure designed by the design team and that interface with the precast concrete components; and (3) permissible design load transfer points and indicate generic connection types to avoid having the precaster make assumptions on connection types and piece counts during bidding and design. It is preferable to leave specific panel and connection design to precasters so they can design details and connections suitable for their production and erection techniques.” (Para 4.1.2)
- The PCI Design Handbook MNL-120 states: “A critical function of the contract documents is to clearly define responsibility among involved design professionals.” (Para. 14.5.3)
- The AISC Design Guide 22 states: “The structural drawings should delineate the structural steel elements from the attachment elements to be designed by the Specialty Engineer.” (Para. 3.3)
- AISC Design Guide 22 also states: “The following is a list of potential

problems that designers should be aware of and avoid when designing the support and anchorage systems for precast concrete wall panels... Lack of clarity in the division of responsibilities for designing and providing attachment and support components. Responsibility for the design of miscellaneous angles, embedment plates, and similar items must be clearly indicated in the contract documents.” (Para. 8.10)

The references above also point to the EOR to review the submittals relative to the delegated work for completeness and coordination with the contract documents. The following list of selected excerpts summarizes the guidance relative to the submittal review process:

- The PCI Architectural Precast Concrete MNL-122 states: “The Engineer of Record (EOR) has the responsibility of reviewing the precast concrete design work for compatibility with the overall structural design and structural stability. This does not, however, relieve the EOR from the overall design responsibility for the safety and proper performance of the completed structure. The Engineer of Record (EOR) should determine and

show on the contract documents the locations for supporting the gravity and lateral loads of the precast concrete units, including intermediate lateral (tieback) connections, if necessary. The EOR’s review of the erection drawings confirms that the structure is adequate, within defined deflection limitations, to resist the anticipated loads and forces from the precast concrete, and verifies that the magnitude and location of the loading points on the structure agree with the original design intent.” (Para. 4.1.3)

- The PCI Design Handbook MNL-120 states: “[...] This does not relieve the EOR from reviewing the designs, ensuring that the designated loading requirements have been properly interpreted and interactive forces with other construction are fully coordinated.” (Para. 14.5.3)
- The AISC Design Guide 22 states: “The EOR reviews submittals by the Specialty Engineer and the facade contractor specifically for the effect of the facade and its attachments on the primary building structure.” (Para. 3.3)
- AISC Design Guide 22 also states: “The SER normally has the design



VisualAnalysis

Structural Software Designed for Your Success



- * Easy to Learn
- * Analyze Anything
- * Design for:
 - + Steel
 - + Wood
 - + Concrete
 - + Aluminum
 - + Cold-Formed
- * Friendly Support



www.iesweb.com

Free 30-Day Trial

IES, Inc. | 519 E Babcock St. Bozeman MT 59715
800-707-0816 | info@iesweb.com



ADVERTISEMENT-For Advertiser Information, visit www.STRUCTUREmag.org

responsibility for the following: ... The review and approval of shop drawings and field erection drawings for the effect of precast panels and attachments on the primary building structure.” (Para. 8.4)

Finally, the references generally agree that the SSE is responsible for the design of the delegated system, but that this design is subject to review by the EOR. However, the design responsibility for the physical connections between the delegated system and the primary building structure varies among the reference publications. Examples of the industry’s attempts to draw the demarcation line between the delegated and the non-delegated components are summarized below:

- The PCI Architectural Precast Concrete MNL-122 indicates that the design of these interface connections is the responsibility of the delegatee: “The precaster designs the precast concrete panels and connection hardware for the design loads defined by the EOR and is responsible for selecting, designing, and locating hardware and panel reinforcement or items associated with the precaster’s methods of handling, storing, shipping, and erecting the precast concrete units. (Para. 4.1.5)
- The PCI MNL-138-08 design guideline provides design examples for numerous types of precast-panel connections to the main structure. All the examples show a list of the components of the connection for which design checks are performed. In particular, the list of Example 6.5, *Bolted Tieback to Concrete or Steel Beam*, includes the precast-panel embed insert, a connection rod connected to a steel angle, in turn welded to a plate embedded in the cast-in-place concrete. This example considers the plate embedded in the cast-in-place concrete (part of base building) to be part of the precast-panel connection.
- The AISC Design Guide 22 states: “The Specialty Engineer is the design professional responsible for the design of the facade and/or its attachments to the structural frame. [...] The Specialty Engineer prepares calculations and drawings for submittal in accordance to the project specifications. The Specialty Engineer is responsible for the design of the attachments.” (Para. 3.4)
- The AISC Design Guide 22 also states: “The SER normally has the design responsibility for the following: The design of the primary building

structure, including the slab, slab edge detail, column, spandrel beam, roll beams, kickers, embedded bearing plates, etc., to support the forces imposed by the precast concrete panel system with due consideration to stiffness requirements... The precast manufacturer and SSE normally have responsibility for the following: ...

The precast panel bearing and lateral connection design, including all supplemental hangers, kickers and other structural steel elements required to support the panels.” (Para. 8.4)

- Finally, the AISC Design Guide 22 states: “The curtain wall manufacturer and the Specialty Structural Engineer “normally have responsibility for ... [t]he design of the curtain wall frame and its attachments to the primary building structure” and “[t]he preparation of shop drawings including details of all attachments to the primary building structure, types and locations of anchors clearly noted, and installation procedures and potential difficulties with field attachment considered and addressed in the shop drawings”. (Para. 9.4)
- The AAMA CWG-1-89 states: “Adequate anchor design is more likely to be attained if the curtain wall designer follows the load along its path from ‘start’ (e.g. glass or infill panel) to ‘finish’ (i.e. floor slab or spandrel beam). Often this tracking process will disclose potentially weak parts in the trial design.” (p. 26).

Conclusions

In summary, the industry points to the design team as the responsible party to safeguard adherence to the intent and requirements in the design documents, which includes compliance to the submittal-review protocols. In addition, the design team is expected to define, through their contract documents, which professional is responsible for what portion of the facade design, including its connections. In the absence of a clearly defined line of demarcation in the contract documents, the industry attempts to provide guidance to “fill the gaps” but, based on the authors’ experience, these attempts are often not sufficient to avoid potential miscommunication or issues on deliverables, schedule, and overall quality of the project.

Situations where controversy can arise are usually related to different interpretations between the EOR and the SSE on where

the facade components stop, and where the original building structure starts; for example, when facade-system anchors are embedded or post-installed into a column or slab of the main building structure, or when customized attachments connect a curtain wall to the main building structure. Based on the authors’ experience, as well as the authors’ interpretation of the intent of industry standards, the SSE (construction team) would be responsible for all facade-related connection design. Furthermore, the SSE’s design responsibility should include examining the ability of not only the connections themselves to resist loads at the actual point of attachment, but also to examine that the loads get into the building structural component (through the connection) without detriment to the structure. In other words, the SSE should examine the entire load path from the facade component through (and into) the building structural component. The SSE’s responsibility, however, should not include confirming that the base-structure component is able to resist the design loads in the ‘global’ sense (e.g. the overall bending moment, shear, and torsion demands on say a perimeter beam or column due to the facade-attachment loads); this responsibility remains with the design team. Unfortunately, unless the contract documents are very specific on defining the delineation between the responsibilities to this level of detail, room for interpretation remains, and potential for problems exist.

Design gaps and/or blurred responsibility situations would generally be avoided if the design team would list (or indicate) in the contract documents all the items and components that are part of the delegated work, the performance and design criteria that the delegated work must satisfy, and all the submittals and associated procedures required for the delegated work. Design-delegation clarity would be further improved if, during the course of the project, the design team would also verify that all components of the delegated work are addressed by the construction team, and that reviewed submittals satisfy the performance and design criteria indicated in the contract documents. It is the authors’ opinion that an owner should always be able to rely on the experience and thoroughness of the design team to lead this process, even if the above arrangement is not required by the code or written into the design contract with the owner. In general, the design professionals should always strive to identify and prevent potential areas of controversy in the design documents, regardless if they are related to facade attachments or any other component of building design. ■