

conference preview

FUN IS IN THE DETAILS

BY TERRI MEYER BOAKE

When leaving structural steel exposed to view, clean connection details make a difference.

THE EXPOSED STEEL DETAILING that was the basis of the innovative high-tech movement of the 1970s and 1980s, as characterized by the work of Foster, Rogers and Piano, is now mainstream.

Expressed and exposed steel is now a part of many construction projects, ranging from big-box stores to airports. The connection concepts that were developed by these early pioneers have been refined and developed for widespread incorporation into contemporary projects. Current detailing software that feeds into improved fabrication technologies has encouraged this shift in design thinking when it comes to structural steel.

A Clean Connection

What sets architecturally exposed structural steel (AESS) well apart from almost any other type of application of structural steel is the focus on connection detailing and design. From the simplest uses of AESS that might incorporate standard structural shapes, HSS and slightly cleaner and more fastidious alignments, to more complex designs comprised of highly customized elements, the design of the connections is critically important to the aesthetics of the design.

AESS detailing uses a combination of bolted and welded connections in ways that can challenge the design team. A high level of communication is required between the architect, engineer and fabricator to ensure a successful project outcome. Established best practices in AESS connection detailing acknowledge three primary factors that impact detailing choices: use of the building, viewing distance and coatings. (This is covered in detail in my book *Architecturally Exposed Structural Steel: Specifications, Connections, Details*, published by Birkhäuser in 2015.)

Yet AESS connection details are based on standard connection strategies. These routine practices are modified, enhanced or streamlined to leverage the fabrication to a level of artfulness that can indeed be “fun” when aesthetics are driving the project, even when answering to structural requirements. Because the resulting structures tend to have a higher level of articulation, designers must make an effort to maximize the amount of welding that is done in the shop if control and outcomes are to improve. Many innovative bolted connections have been generated to answer to erection issues for connections that for many reasons must take place on-site. These bolted connections can be seen as a design enhancement and not simply a way to avoid site welding.

Here are my top 10 favorite exposed connections from an aesthetic and structural standpoint.

- ▼ The detailing of the large arched trusses that span the departures hall of this airport is playful. The members have been chosen to highlight their tensile versus compressive function. Pin connections are extensively used to attach the tension members while plates inserted into the round tubes that comprise the compression members create a visual contrast.



Terri Meyer Boake
(tboake@uwaterloo.ca) is a professor of architecture at the University of Waterloo in Waterloo, Ontario, Canada.





- ▲ Instead of attempting to make a continuous weld (not structurally required) or use filler to mimic one, the intermittent welds have simply been aligned with the bolts. This looks better (in my opinion) than what might have been more routinely done.
- ▼ The design of the tapered ends of these tubular struts has become the standard way of gracefully handling the pin attachment of tubes to plates. A higher level of AESS is needed as the parabolic plate inserts do require that the welds be ground in order to achieve visual smoothness. The stainless steel connectors used in place of standard structural bolts give the finishing touch to the detail.



- ▲ Galvanized steel, being rougher in appearance, seems to demand details that are more rugged. This structure of square HSS tubes was shop welded into larger chaotic looking arrays and bolted on-site. The simple use of side plates on the bolted connections created a very trim appearance yet with a texture that suited the overall aesthetic of the structure.



- ▲ Even something as simple as a bolted beam-to-column connection can be elevated to artistry if the bolts are carefully located with geometry and symmetry in mind.
- ▼ This structure uses an artful combination of wide-flange shapes and round tubes. The tapered ends of the side plates used to shop weld the wide-flange makes for a trim appearance. The site-connected round struts use pin connections, with the round ends of these elements making a purposeful contrast with the rectilinear aesthetic of the primary trusses.



conference preview



- ▲ This connection showcases a high level of thought in accommodating the transition from the small diameter of the cable to the attachment of about 20 plates to a mast. The thickness of the plate at the pin connection has been increased to resist pull-through forces. The thickened element tapers down to meet the primary plate, whose purpose is to transfer loads to the mast. It widens to provide adequate transfer via its fillet welds. There is just enough room between the many plates to do the welding (although I expect it was tight!).
- ▼ This colorful structure makes use of pin connections to address assembly on-site. Clevises have been used with the narrower members and simple plate extensions are used to connect the wide-flange members.



- ▲ Discreet site bolted connections can be beautiful. The connections that were shop welded to the ends of each of the (many) connecting round HSS tubes in this transit hub allowed for quicker erection and also added a level of visual interest to the structure that would have been quite plain and more expensive if invisible tube-to-tube welds had been requested.
- ▼ Joining multiple members at a point of focus is always a geometric challenge. The tapered end connections on these round HSS tubes not only respond to the geometry but also provide a simple bolted connection.



This article is a preview of Session N28 “Fun is in the Details” at NASCC: The Steel Conference, taking place April 13–15 in Orlando. Learn more about the conference at www.aisc.org/nascc. ■