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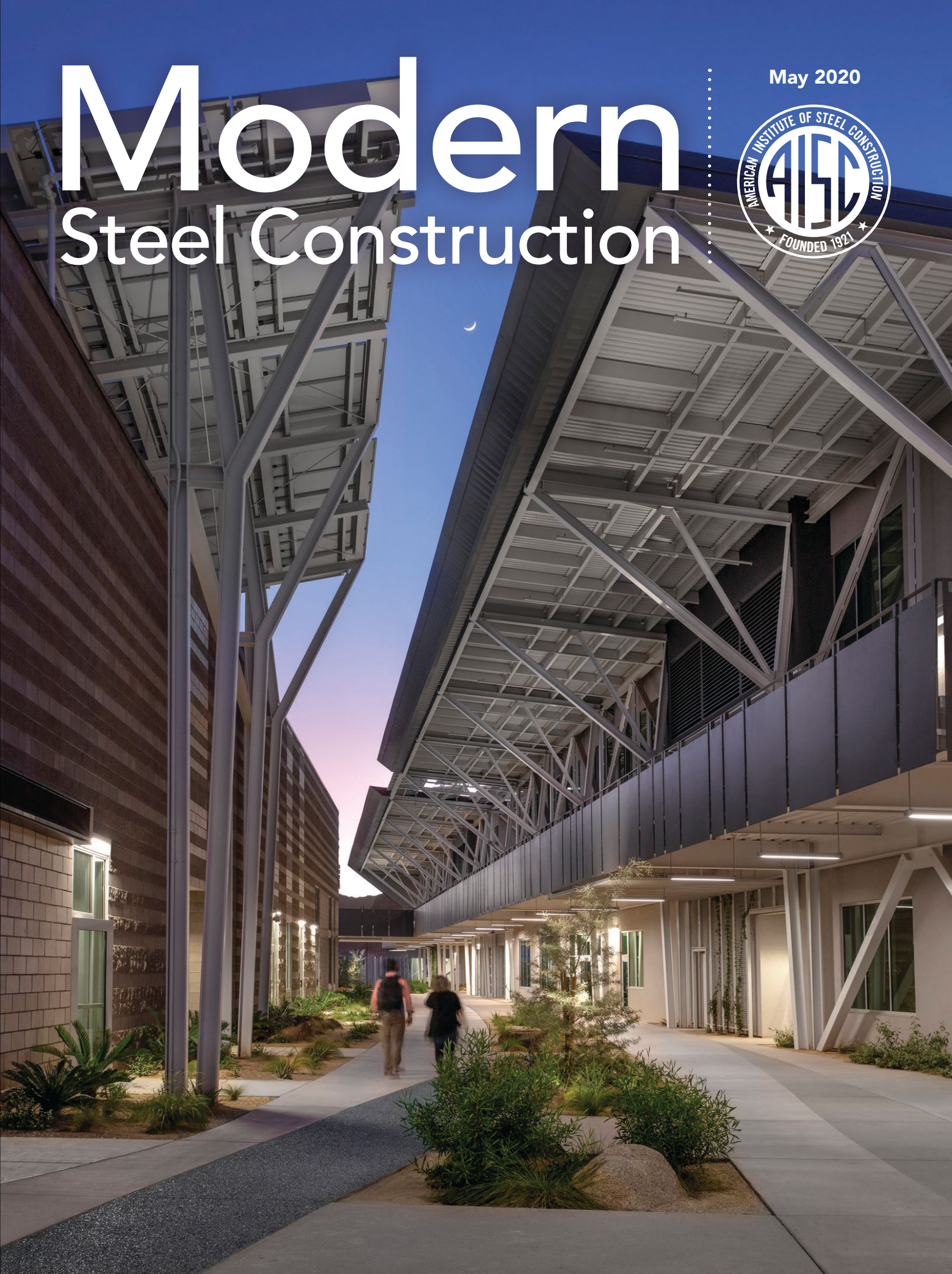


California Dreaming

INTERVIEW BY GEOFF WEISENBERGER

Geoff Weisenberger (**weisenberger@aisc.org**) is senior editor of *Modern Steel Construction*. **Nicholas Zacher** is a project manager with TrueNorth Steel.

AN ADDITION to Long Beach, California's Aquarium of the Pacific undulates like the sea itself.

The expansion, called Pacific Visions, opened in 2019 and houses an immersive theater, additional special exhibition and art galleries, and increased space for live animal exhibits within a curvaceous façade clad with a grid of privacy glass of various shades. It used 350 tons of structural steel and 4,831 connection bolts to hold it all together—all delivered from Minnesota in 30 truckloads.

We talked with Nicholas Zacher, a TrueNorth Steel project manager—the project's fabricator—about what it was like detailing and fabricating a project with virtually no right angles.

It sounds like the building isn't your typical "box" design.

Definitely not. There are minimal 90° angles in the design. This building is not a perfect oval or a circle but it is curved. The exterior gives the illusion of curved steel, yet we did not bend any steel in the superstructure or hire any external specialty steel contractors. The structure was completed primarily with straight wide-flange components set on a skew by the TrueNorth Steel drafting team.

So why wasn't curved steel used, given the building's clearly curved form?

Initially, we considered bringing in a specialty partner to curve the steel, which we've done before successfully. But in this case, while following the skewed connections provided by the design team, we were able to create a solution that met the desired aesthetic appeal and budget without the need for curving. That said, once we committed to the approach we wanted to take, it meant we were going to basically custom fit every beam into this nonstandard shape, all the way around.

A northern fabricator discusses the challenges and solutions of fabricating an aquarium addition in a SoCal locale.

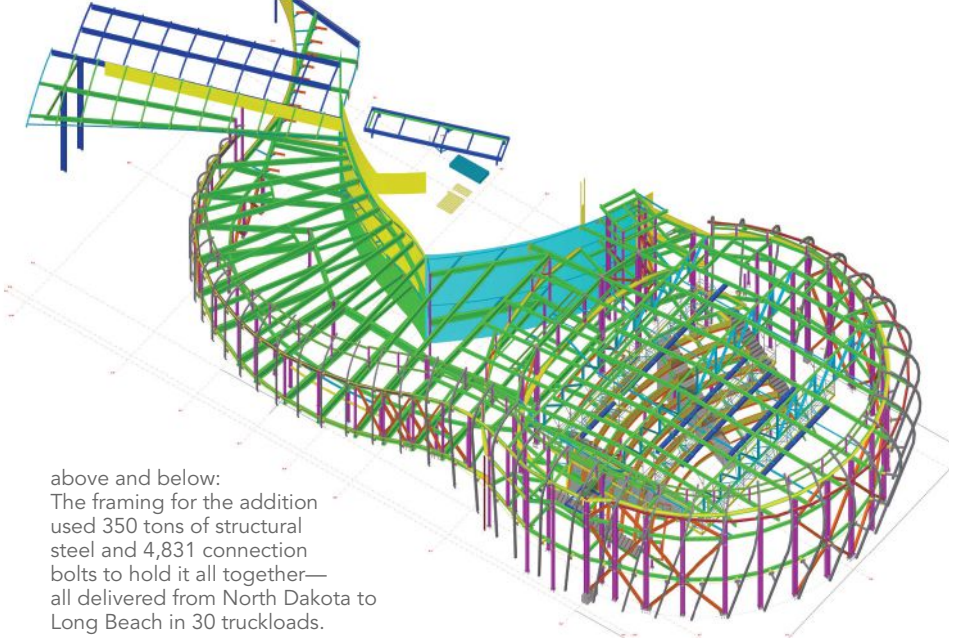
All images: TrueNorth Steel

above: Pacific Visions is a new expansion to Long Beach's Aquarium of the Pacific.

right: Right angles are virtually nonexistent in the framing, which achieves a curved aesthetic without curved steel.

Can you elaborate on how you achieved a curved look without actually curving any steel?

We've done many complicated geometry projects, but none that encompass a radius structure with no curved steel. The team took radius dimensions and installed all beam-to-beam connections to columns to create the radius. Stadiums have a radius component, but we haven't seen one made of straight connecting pieces—at least not to this extent. A lot of stadiums are oval or at least a standard "shape." This project is what we call multi-axes. It is not a constant circle. It's concave and convex as you work your way around the building. When you marry steel beams with curves, you find yourself seeking the expertise of your design team. And that's what we did. Our solution meant we had to custom fit every single beam into this non-standard shape. The only square design of this project was the elevator. Even the stairs were tied into radius requirements. Getting deep into the



above and below:
The framing for the addition used 350 tons of structural steel and 4,831 connection bolts to hold it all together—all delivered from North Dakota to Long Beach in 30 truckloads.

details prior to modeling was key to getting the 3D model dialed in correctly prior to printing drawings.

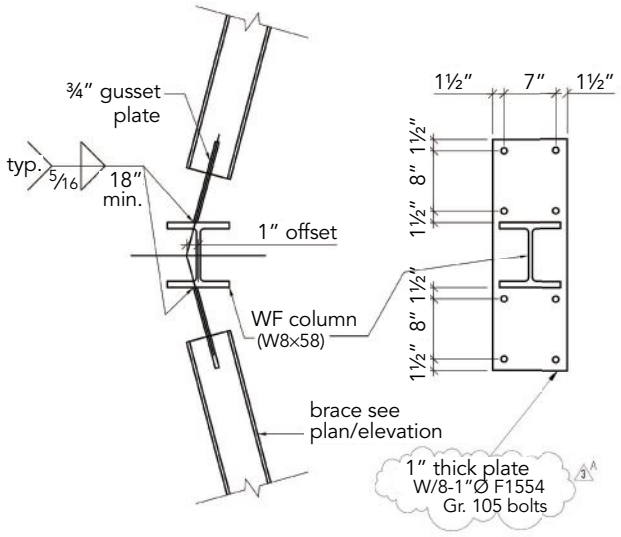
When it comes to the theater seating, it is framed with ¼-in. and ⅜-in. steel plate on steel rakers with form deck infill. This was a complex system to install as the riser plate doubled as the pour stop, so hitting elevations was critical.

Given the geometry, I'm guessing connections were a challenge.

The curvature of the building definitely created another unique problem to solve in terms of the connections. The team at the general contractor, Clark Construction, collaborated with our team on a consistent basis to make sure we were all on the same page. We had to make a structural steel connection to a glass façade that had no adjustability. Tie-in plates had an agreed-upon tie in advance. This made it tough because the outrigging connections were square. All of them had an "X," "Y," and "Z" axis that had to be coordinated.

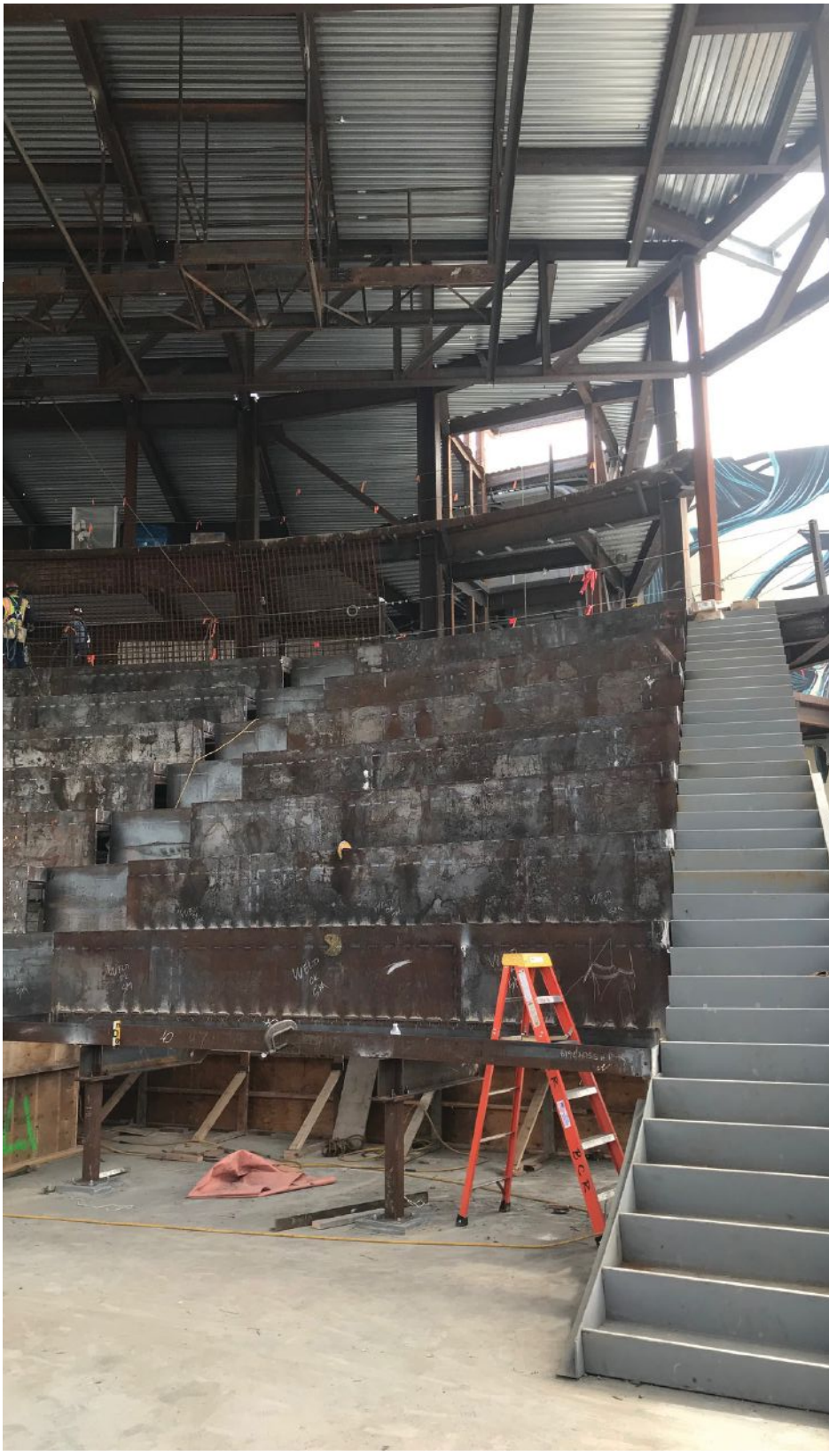
There were 96 unique outrigger connections in all. We got them set to where we believed to be right based on the information provided, but the on-site tolerances didn't agree. These were galvanized hollow structural sections (HSS) with shop-welded plate that encompassed variations in all three axes, and they had to be installed with a variation of ¼ in. maximum in the X and Z axes and ½ in. in the Y axis. We knew the variations would exist but we did not know exactly *how much* variation would exist until the building was plumb and lined up in the field. The major contributor here is heat expansion. Depending on the time of day the surveys were shot, we would see up to ⅛ in. in variation from survey to survey. Luckily, no re-fabrication was needed, but we did have to move a handful of plates and provide a few shims. Clark performed a 3D scan of the building and our drafting team extrapolated these points in space, which drove the final locations of the glass tie in outriggers, then we made the required adjustments. At the end of the day, success boils down to the partners you have on the project and your working relationship, and this was a perfect example.

left: The addition is clad in a curvaceous grid of privacy glass of various shades.



left: An example connection detail for the steel framing. All steel for the theater superstructure was detailed, fabricated, and erected on a radius with straight connecting members.

below: The theater seating is framed with ¼-in. and ⅜-in. steel plate on steel rakers with form deck infill, a complex system to install as the riser plate doubled as the pour stop.



How did a fabricator in North Dakota get involved with a project in Greater Los Angeles? Were there any challenges with transportation and erection?

We have a good relationship with Clark Construction from previous projects. As for transportation, as always, winter delays are expected in the northern states but fall on deaf ears in Southern California! Lay-down area was enough for one truck's worth of material. That was it. So just-in-time deliveries were critical, as was the need to provide smaller manageable sequences.

In the end, having accurate information at the onset and consistent on-site and off-site team collaboration with partners, especially Clark, is what drove the success of the project. And thanks to our in-house detailing expertise, our drafters had the vision and ability to draw the final requirements for what was a relatively new type of design for us. ■

For an infographic on the Aquarium of the Pacific, see the Project Extras section at ***www.modernsteel.com****.*

Owner
Aquarium of the Pacific, Long Beach, Calif.

General Contractor
Clark Construction

Architect
EHDD Architecture, San Francisco

Structural Engineer
Wheeler and Gray Consulting Engineers, Pasadena, Calif.

Steel Team

Steel Fabricator and Detailer
TrueNorth Steel, Fargo, N.D.

Steel Erector
Bragg Crane and Rigging Co., Long Beach