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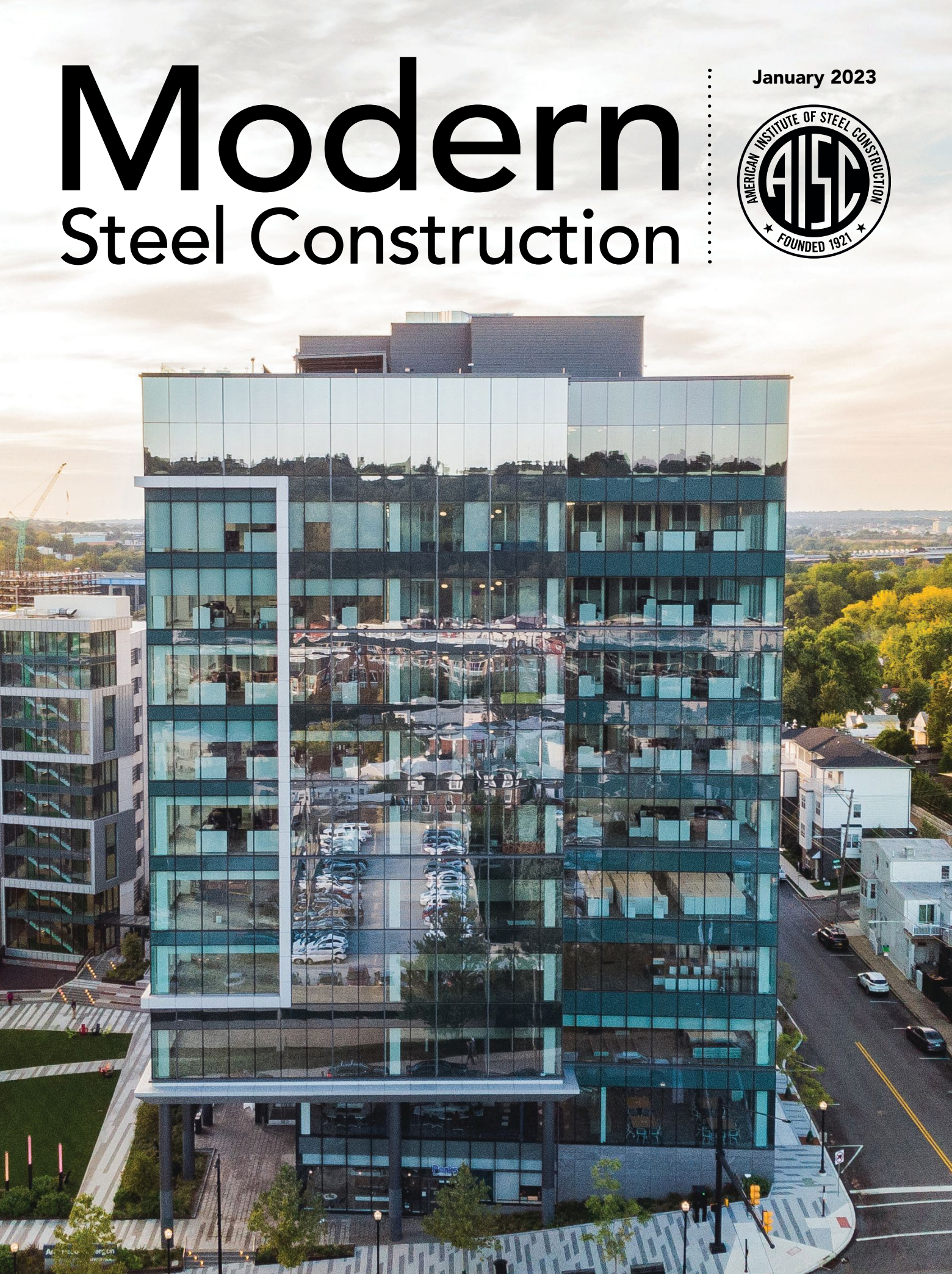


Going Big with Castellated Beams

BY JULIE LOW

AT A TIME when steel joists were experiencing longer-than-usual lead times, castellated beams provided an excellent alternative for a new facility in Georgia, the country's largest known castellated beam project ever built.

The building, a 1.1-million-sq.-ft cross-deck Ace Hardware distribution center in Jefferson, Ga. (roughly 40 miles northeast of Atlanta), was designed when steel joists were experiencing longer-than-usual lead times. Facilities of this type typically employ joists for roof framing, but as other major retailers had soaked up standard premanufactured joist and deck supplies in their numerous ongoing facility projects, costs had risen dramatically, and those material types had become scarce. This scenario, coupled with a condensed schedule, created a significant challenge at the project's outset.

On top of that, COVID shutdowns were common at the time. Personnel were routinely out sick, truck drivers were scarce, and even sourcing paint was arduous. Still, the client had a deadline, and should the deadline have been a roadblock, the project would have been dead in the water—so the head-scratching began. The project's steel fabricator and erector, Cobb Industrial, had successfully completed large projects for years, but none had presented challenges of this magnitude. As such, the team looked to castellated beams as a solution.

Ultimately, the project came down to a cost versus time scenario. "We work a lot with Cobb Industrial as a company nationally," explained John Lichtenwalter, division manager for Catamount, Inc., the project's general contractor. "Gabe Hrib [a principal with Cobb] and I discussed ways to beat this. He had been using this castellated beam approach on smaller projects, so we worked with him to put together a value engineering solution. It raised the price slightly from what we would traditionally expect joist to come in at, but it successfully cut back the schedule. We proposed that idea to [owner/developer] Trammell Crow, and they accepted it." Thus, the country's largest castellated beam project was born.

Thanks to schedule and supply chain challenges, a new distribution facility in Georgia becomes the country's largest known castellated beam project.

All images courtesy of Cobb Industrial

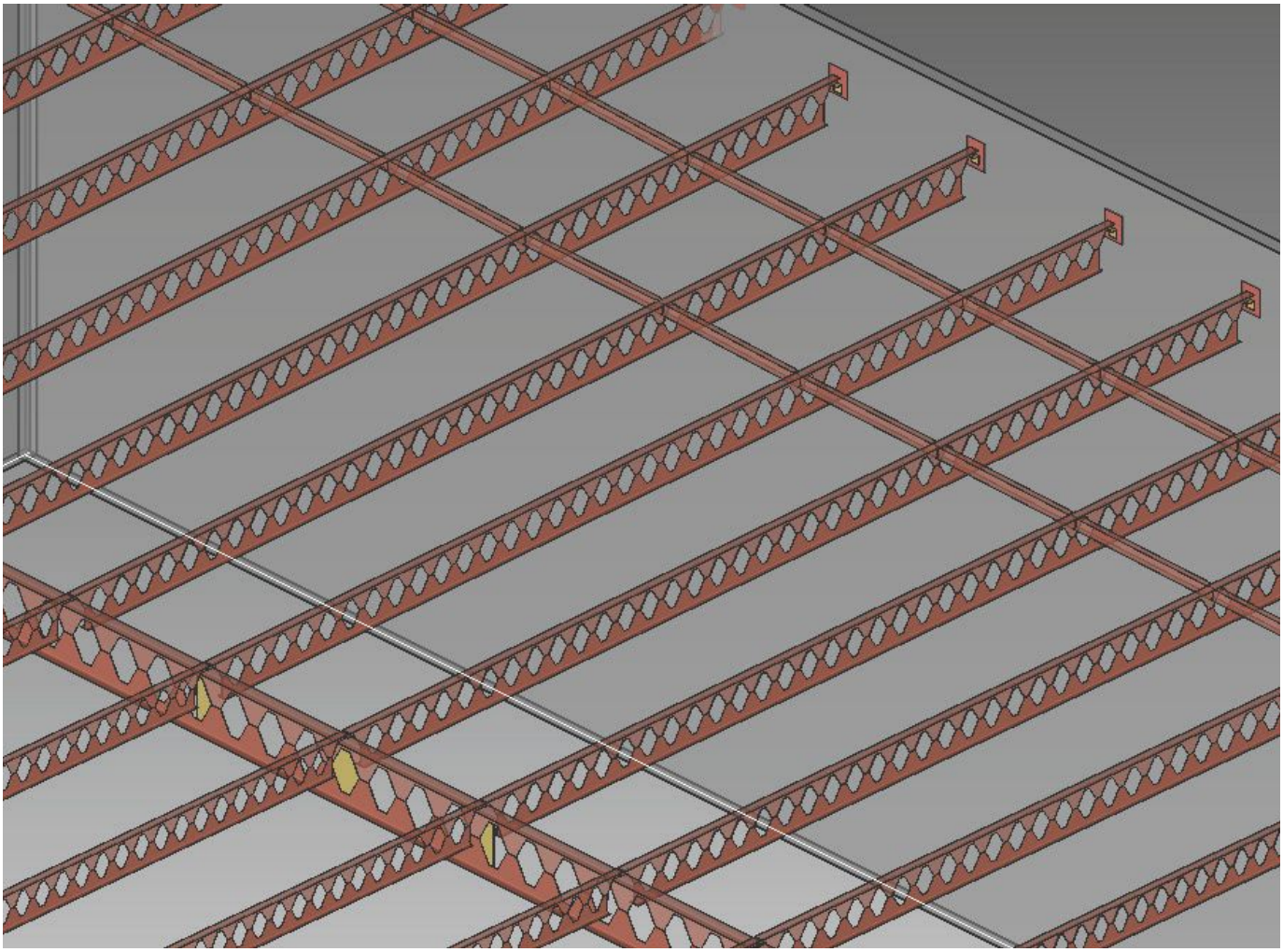
The Planning

"We were excited to be part of this historic project," said Cobb's president, Mike Hrib. "As far as we know, this is the largest castellated beam project ever completed in North America—or possibly anywhere." Gabe Hrib credited problem-solving in coordination with the team of engineers for making the impossible possible. Additionally, top-notch structural engineering trimmed approximately a year of design time from the project.

Cobb performed extensive research to figure out how to "wrestle this dragon," as Mike Hrib put it. Typically, castellated beams are modeled for small quantities, but this massive project presented nuances that were tied to the need to expedite the schedule. Even before the contract agreement, Trammell Crow provided some limited notices to proceed and released Cobb and Catamount Constructors for design and fabrication and coordinated closely with the design team of record, Haines Gipson and Associates, to change the entire roof system and support structures from typical joist and deck. Haines Gipson provided the proof of concept and made plan modifications to the building's structure, including columns and footings, to accept the castellated beams, which ended up being shallower than the originally designed joists. The new design also used fewer castellated beams than the original number of joists, allowing spacing between the beams to be increased—and the deck gauge thickness was also increased to accommodate the new spacing.

"We talked to a few people in the industry, and all of them had done it the old way—and not to this scale," commented Mike Hrib. "Therefore, we had to engage other technology companies with the goal of ensuring the entire structure was modeled in 3D to verify that beams would fit like a glove." Success hinged on the coordination between engineers, architects, machine manufacturers, and others involved. Building efficiencies into the process was also paramount. Working with its engineering staff, Cobb set the

A 3D model of the castellated beam roof framing.



goal of using an existing standard for all the seat depths so they would conform to industry standards and ultimately create a familiar detailing scenario.

"We try to execute projects with as much automation as possible," said Mike Hrib. "We try to avoid the human input in machines because there's always the chance for error, which gets expensive."

In the drawing process for the project, there was no clear way to create a template that would autofill a castellated beam. The ultimate linchpin was figuring out how to model the project in 3D with the ability to put two DSTV files in a single piece, as well as how the machine would run the project. It took trial and error and close teamwork with the steel detailer and the equipment manufacturer, Lincoln Electric.

Lincoln's PythonX SPG eight-axis plasma cutter and tech support were critical to the solution, and Cobb worked with Lincoln to develop a widget for the machine that allowed canceling cuts within 0.25 millimeters from a previous cut. This was important as it allowed cutting in a single run.

Another project nuance involved fire protection. High-bay warehouse architecture typically assumes a dispersion through the joists since the joists are open, allowing fire-protection lines to basically be located anywhere. However, with castellated beams, the high deluge heads would need to be installed between the beams. Anticipated water blowout would, of course, be unobstructed front and back, but to the sides, water had to get through the castellated beams.

The solution involved an exhaustive study to maximize the free area in a coordinated manner so that all the holes would align and water could pass through. While this presented some difficulty because the beams changed based on their location in the building and individual loading characteristics, lining up the holes ended up minimizing the number of fittings needed, which reduced cost. As Cobb produced fabrication drawings, many coordination meetings took place with the fire-protection subcontractor. Fortunately, 3D modeling allowed quick coordination that made changes and decisions much faster than a traditional 2D engineering drafting approach.

The Production

The job's scale required increasing staffing and executing production to roll differently than previous projects. Welding processes, along with minimized handling, turning, and flipping, were carefully gauged, and it became a lesson in material handling and trying to do as many processes as possible without manipulating more than was necessary. To gain efficiencies, Cobb initially rearranged its shop to reverse the flow of material from one direction to the other and moved a 300-ton hydraulic press brake and large shear, and also took down and rearranged overhead cranes to improve workflow. Cobb also set up an extra paint line and fabricated and installed 400 ft of roller conveyor. These lines were portable and remote-controlled

The 1.1-million-sq.-ft distribution center is the nation's largest known castellated beam project.

such that operators could relocate them without having to move and walk the steel pieces through production.

Castellated beams are typically fabricated by cutting on a plasma table in a 2D format, reassembled, and then put into a drill line, then a coping line, and then sent on to final fabrication. This job was just shy of 3,000 I-beams, all longer than 60 ft, which would require three to four times more handling time on every single piece. But by implementing the PythonX and building nine 65-ft-long hydraulic clamping jigs (eliminating the need for typical clamps), Cobb was able to speed up production.

After all the planning, moving, and shuffling was complete, it was time to run. Cobb walked some initial pieces through the process only to find some warpage, so they designed and built fixtures to straighten the warpage. Cobb also changed the procedure to fit beams with a predetermined amount of curve that was dependent on the profile to be welded. In the end, instead of warping, the beams settled straight.

Cobb detailed the steel for the roof in-house and worked with a partner detailer to detail the columns, beams, and other main structural elements. Special attention was paid to this stage to ensure coordination, and both detailing teams worked on the same models and shared information back and forth to make everything come together properly. Cobb produced the castellated beams well before they were needed in the building process. In fact, production was moving so fast that the steel couldn't be stored at the shop, so the beams were transported to the field months before they went in the air.

The Build

Cobb's philosophy is that precision shop work helps a job go together quickly.

"I've had superintendents call me and ask, 'Why is it that when your guys are here putting the building together, I don't hear any noise?'" he recalled. "'You don't hear grinding or hammers.' To which I reply, 'Because the beams just go together.' It has to do with our quality process. We design projects so that there is no adjustment."

The planning and modeling ultimately proved to be the most significant contribution to the project's success. By using 3D modeling, the accuracy of the roof was superb. The job involved 100% bolted connections, and the team's diligence resulted in

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The project used 4,000 tons of structural steel in all.

no misconnections. Additionally, the modeling process allowed the team to accomplish all the steps that would typically have been achieved via multiple handling processes, like reassembly, drilling, and coping, to be done in one handling instead of two.

The Future

Everyone involved in this endeavor started with a clean slate. This unusual project, a 4,000-ton steel frame implementing castellated beams on an immense scale, beat the odds and rose to become an enormous yet efficient accomplishment—and it demonstrated a viable steel design alternative that came with unexpected advantages.

Since the project's completion, the price of typical joist has dropped, as have delivery time frames. However, now that the team has the data and experience with the castellated beam option, if delivery timeframes squeeze and supply chains spike again, they'll be ready to move—quickly. ■

Owner/Developer
Trammell Crow Atlanta Development, Inc.

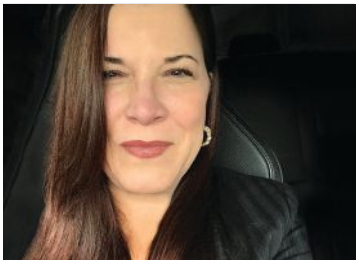
Structural Engineer
Haines Gipson and Associates

Architect
Pieper O'Brien Herr Architects

General Contractor
Catamount Constructors, Inc.

Roof System Engineer
Forsite Group

Steel Fabricator, Erector, and Detailer
Cobb Industrial, Inc. AISC CERTIFIED FABRICATOR
Holly Springs, Ga.



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