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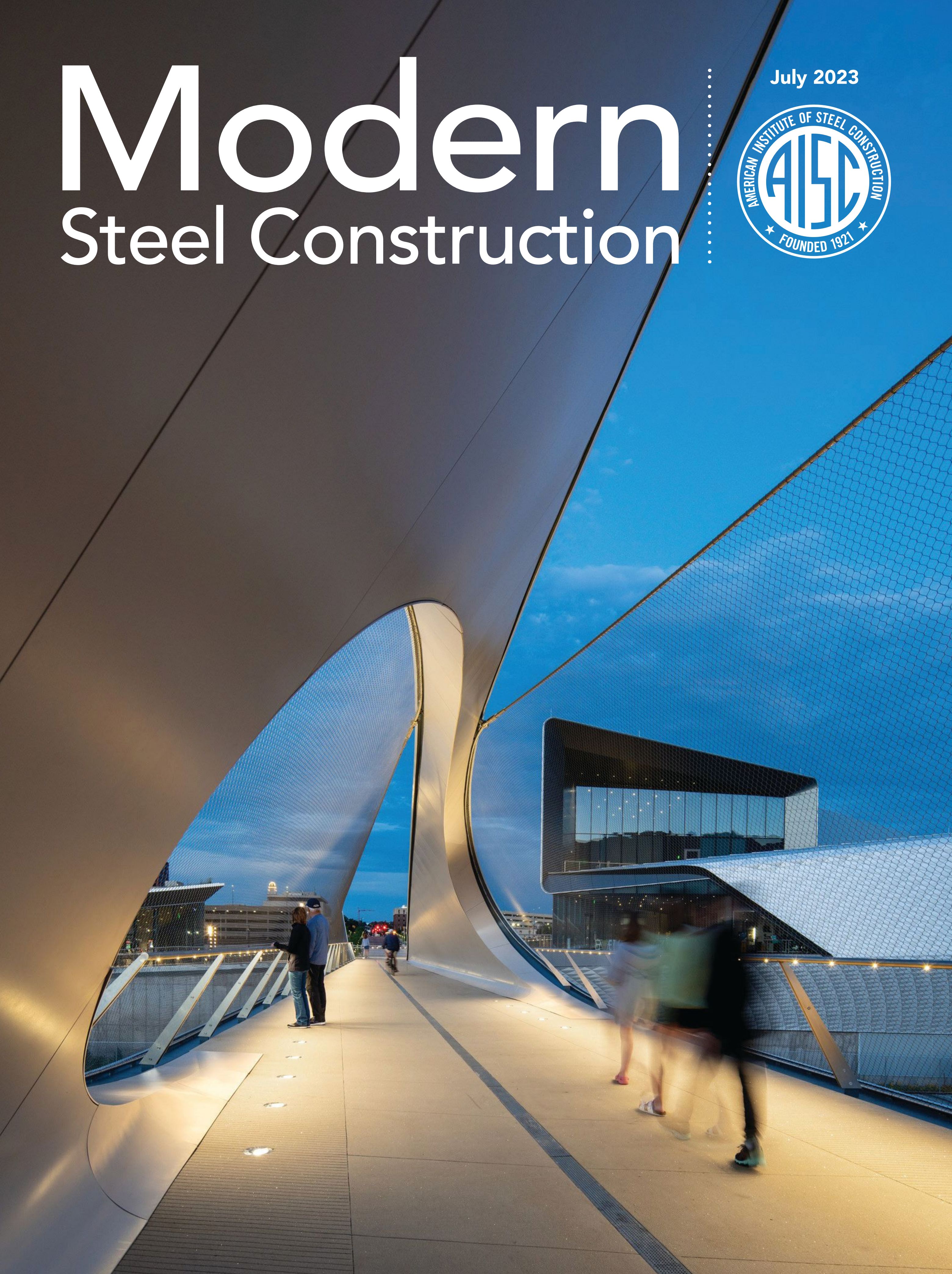


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ON THE COVER: A stylish new bridge adds some steel flair to downtown Colorado Springs, p. 26. (Photo: © Jason O'Rear)

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editor's note

The last time I was in Southern California, I saw the Millennium Falcon.

I should explain. This was at the Star Wars-themed Galaxy's Edge section at Disneyland, which immerses you in the Star Wars universe (there's even a replication of the Mos Eisley Cantina!) and includes a full-sized version of the Falcon in a docking bay.

Like many people from my generation (and, let's be honest, plenty of other generations as well), I've been infatuated with that bizarre-looking yet beautiful fictional starship ever since I first saw it. (My dad took me to see *The Empire Strikes Back* in the theater when I was six, and it was by far the best movie I'd ever seen in my young life—and decades later, it's still near the top for me.)

Besides the iconic cockpit, the lounge area where C-3PO advises R2-D2 to "let the Wookiee win" during a game of dejarik, the smuggling compartments, the hyperdrive, the gun turrets, and the satellite dish, I just love the ship's construction, especially the hull and the seemingly endless array of exposed conduit and piping. It's a marvel of engineering, thanks in part to a few modifications Han Solo made himself.

I'm heading back to Southern California again this week, though not for more Star Wars-related activities (as fun as that would be). This trip will involve a different type of construction: steel bridges built by college students—not quite the ship that made the Kessel Run in less than 12 parsecs, but impressive in their own right. The occasion is, of course, the AISC/ASCE Student Steel Bridge Competition—specifically the National Finals. Student steel bridge teams from nearly 50 colleges and universities will converge at the University of California San Diego to construct their bridges as quickly as possible—maybe not light speed, but it's not uncommon for the fastest teams to construct their bridges in under four minutes. The competitors were narrowed down from hundreds of teams at 20 regional competitions across the country. In addition to construction speed, the bridges will be judged on aesthetics, stiffness, lightness, economy, cost estimation, and efficiency, with the overall rankings being based on these individual categories and expressed as cost. Speaking of judging, the various categories are judged by an army of volunteers—and among them this year is, well, me. I've witnessed the build portion of the competition many times but never as a judge, and I'm looking forward to being in the thick of things (hopefully without getting in the students' way). See next month's issue for our full coverage of the event, and check out "Building Bridges in Blacksburg" in the August 2022 issue for a recap of last year's SSBC at Virginia Tech (**www.modernsteel.com**). *And* you can also watch a video about the competition at **youtube.com/watch?v=ivYSsZweC2g**.

If you want to read about two real-life steel bridges—one a stunning pedestrian bridge in Colorado Springs and the other a rapid reconstruction project in Tennessee that takes advantage of press-brake-formed tub girders—check out "Elevated Experience" on page 26 and "Fast-Acting Tub Girders" on page 46, respectively. And if you're considering constructing a new Death Star, er, building at light speed, check out the SteelWise article "Designed for Speed," which describes AISC's new Design Guide focused on the revolutionary SpeedCore system, on page 16.

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Editor and Publisher

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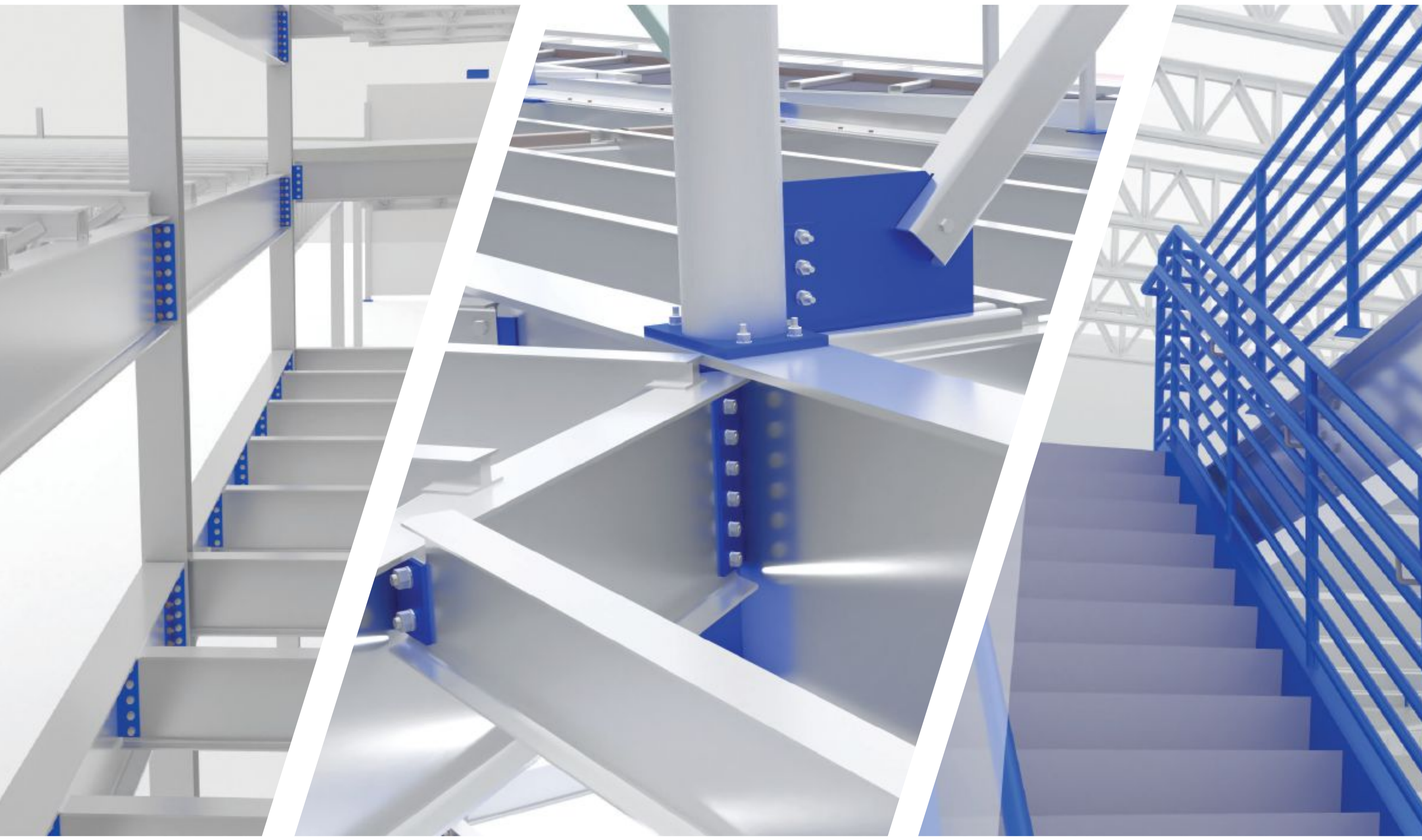
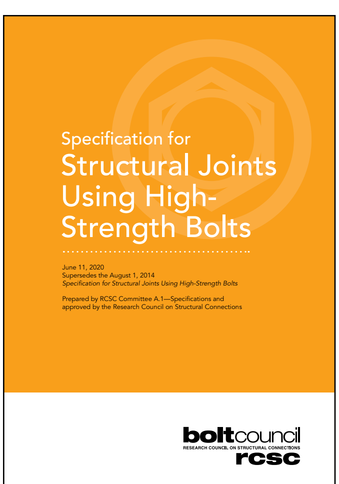


If you've ever asked yourself "Why?" about something related to structural steel design or construction, *Modern Steel*'s monthly Steel Interchange is for you! Send your questions or comments to **solutions@aisc.org**.

Minimum Thread Requirement within the Bolt Grip

We have a project using high-strength ASTM F3125 Grade A325 bolts. We are pretensioning these bolts using the turn-of-nut method per the 2020 *RCSC Specification for Structural Joints Using High-Strength Bolts* and are seeing a high rate of broken bolts. The material test report (MTR) shows that the bolts meet the requirements of F3125. I suspect that the reason for the high rate of failed bolts is that the nut is too close to the bolt shank leaving fewer threads in the bolt grip and reducing ductility. Do you think this could be one of the reasons for breaking? And do you see any issues with specifying a minimum number of threads—say, three to five—to be provided within the bolt grip, particularly when the turn-of-nut method is used?

While having too few threads in the grip of a pretensioned bolt may reduce ductility, causing bolts to break, the most common cause of bolts breaking during installation is overlubrication. The process of pretensioning bolts using the turn-of-nut method requires that the bolts are first installed to a Snug-Tight Condition. A Snug-Tight Condition is defined as "The joint condition in which the plies have been brought into firm contact and each bolting assembly has at least the tightness attained with either a few impacts of an impact wrench, resistance to a suitable non-impacting wrench, or the full effort of an ironworker using an ordinary spud wrench." It is not uncommon that the full effort of an ironworker in installing the bolt to the sung-tight condition may fully tension the bolt. If the bolt is overlubricated, the process of using the turn-of-nut method of pretensioning after sung tightening could potentially cause the bolt to break.



You state that you have a "high rate of broken bolts." Are all the bolts from the same lot? Did any of the bolts break during Pre-Installation Verification (PIV) testing? Are the bolts galvanized?

If the bolts that are breaking are from the same lot, it is likely that the manufacturer overlubricated the bolts. Usually, this is discovered in PIV testing. If that were the case, the lot of bolts should be returned to the manufacturer for replacement. If the bolts did not break during PIV testing, it is not unusual for the bolts to be lubricated by ironworkers in the field during installation, causing the bolts to become overlubricated.

If the bolts are galvanized, the ductility of the bolts will be reduced, and that may account for the bolts breaking. Again, this is usually discovered during PIV testing.

Some have expressed concerns that if some bolts are breaking and others that are installed are not breaking, are the bolts that are installed that did not break on the verge of breaking with minimal load? You cannot overtighten a bolt. The process of pretensioning a bolt brings all the faying surfaces into sufficient contact so that the load from the connection is resisted due to the friction in the faying surfaces. The friction of the faying surfaces does not permit the load in the connection to reach the bolt itself; therefore, if the bolt did not break during installation, the connection would be safe during service.

More information on bolts can be found in "Guide to Design Criteria for Bolted and Riveted Joints," a free download at **www.boltcouncil.org**.

Larry Kruth, PE

Roughening Galvanized Surfaces

I am confused about the requirements to roughen galvanized faying surfaces in slip-critical connections. The 2014 *RCSC Specification* indicated that for Class A surfaces, hot-dipped galvanized pieces needed the faying surfaces to be roughened. However, FAQ 6.7.4 indicates that this is no longer required. Is the FAQ correct, and if so, do you know why this change was made?

The FAQ is correct, and it reflects the provisions of the 2020 *RCSC Specification for Joints Using High-Strength Bolts* and the 2022 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360). Both of these are available as a free download at **aisc.org/publications**.

The 2020 *RCSC Specification for Joints Using High-Strength Bolts* states: "Galvanized faying surfaces shall be hot-dip galvanized in accordance with the requirements of ASTM A123. Power or hand wire brushing is not permitted. Galvanized faying surfaces are designated as Class A for design."

All mentioned AISC publications, unless noted otherwise, refer to the current version and are available at **aisc.org/publications**. *Modern Steel* articles can be found at **www.modernsteel.com**.

In 2014 Research was done at the University of Texas at Austin (Donahue et al., 2014) that demonstrated that the practice of hand roughening as-galvanized faying surfaces through wire-brushing results in no significant improvement to the performance of galvanized slip-critical connections. This research is available as a free download at **aisc.org/technical-resources/research/researchlibrary/slip-coefficients-for-galvanized-surfaces/**.

The 2022 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) states in Section J3.9 that for Slip-Critical Connections, the faying surfaces can be as-galvanized or hand roughened. 'As-galvanized' in this context means a hot-dipped galvanized surface with no supplemental treatment or coating applied to the zinc surface.

Since some people have grown accustomed to hand wire brushing these surfaces, it seems likely that this practice will continue for some time as people get used to the change. Also, a prohibition would imply that there is something wrong with existing conditions that met the previous provisions that required hand roughened surfaces. The AISC committees did not feel that there was anything wrong with these existing conditions.

There are slightly different requirements in the AISC *Specification* than what appears in the *RCSC Specification*. AISC *Specification*, Section J3.2, states: "Use of high-strength bolts and bolting components shall conform to the provisions of the *RCSC Specification*, except where those provisions differ from this *Specification*. This *Specification* governs where provisions differ from the *RCSC Specification*." Therefore, hand roughening (hand wire brushing) is neither required nor prohibited.

There is a strong desire to have consistency between the AISC and *RCSC Specifications*. As more people become aware that there is no longer a need to hand roughen galvanized faying surfaces, the two *Specifications* hopefully will have this language difference resolved before the 2027 AISC *Specification for Structural Steel Buildings* is published.

Larry Muir, PE

Larry Kruth is AISC's former vice president of engineering and research and is now a consultant to AISC. **Larry Muir** is also a consultant to AISC.

Everyone is welcome to submit questions and answers for the Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or **solutions@aisc.org**.

This month's steel quiz is all about SpeedCore. You can find clues in the newly released AISC Design Guide 38: *SpeedCore Systems for Steel Structures* (**aisc.org/dg**) or the newly released 2022 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360, **aisc.org/specifications**). And if you want to learn more about Design Guide 38, check out this month's SteelWise article "Designed for Speed" on page 16.

1 **True or False:** SpeedCore is a proprietary system.

2 Which of the following is/are required in a SpeedCore system?

a. Tie bars
b. Steel headed stud anchors
c. Steel reinforcing bars
d. All of the above

3 The stiffness and stability of a SpeedCore module (i.e., the steel plates, tie bars, and steel headed stud anchors, if used) before concrete filling is governed by:

a. Diameter of the tie bars
b. Spacing of the tie bars
c. (a) and (b)
d. None of the above

4 What is the minimum recommended plate thickness for SpeedCore walls?

a. $\frac{3}{16}$ in.
b. ¼ in.
c. $\frac{5}{16}$ in.
d. ⅜ in.

5 **True or False:** The steel plates in a SpeedCore wall must be non-slender.

6 Modules that meet the plate slenderness requirement in the 2022 AISC *Specification* can typically be cast with a concrete placement height of:

a. 15 ft **b.** 20 ft **c.** 25 ft **d.** 30 ft

7 Compared to a traditional reinforced concrete core wall, SpeedCore reduces the construction schedule by:

a. Eliminating rebar cages and related activities
b. Eliminating falsework and formwork for core wall construction
c. Simultaneous construction of the core walls and gravity system
d. Reductions in tolerance issues between the gravity system and core walls
e. All of the above

8 **True or False:** When implementing a SpeedCore system, vent holes are recommended to relieve the build-up of steam between the steel plates and concrete due to the evaporation of water from concrete drying at elevated temperatures.

TURN TO PAGE 14 FOR ANSWERS

steel quiz ANSWERS

1 **False.** Composite plate shear walls—concrete filled (C-PSW/CF) and coupled composite plate shear walls—concrete filled (CC-PSW/CF), also referred to as uncoupled and coupled SpeedCore systems, are nonproprietary.

2 **a.** Tie bars. A SpeedCore system consists of a sandwiched panel of steel plates that are subsequently filled with concrete. Regularly spaced tie bars connect the steel web plates together. No additional reinforcing bars are needed in SpeedCore systems; the steel plates provide all the reinforcement needed to resist axial, flexural, and in-plane shear forces. Steel headed stud anchors can be added on the internal surface of the plates to anchor the plates to the concrete infill, but they are not required. The addition of steel headed stud anchors along with tie bars reduces the slenderness and improves the stability of the steel plates after concrete placement (Design Guide 38, Chapter 1).

3 **c.** (a) and (b). The stiffness and stability of steel modules before concrete filling is governed by the diameter and spacing of the tie bars. The tie bar requirement can be found in the 2022 AISC *Specification*, Section I1.6b.

4 **d.** $\frac{3}{8}$-in. A plate thickness of at least $\frac{3}{8}$ in. is recommended for handling the panels. A plate thickness of less than $\frac{3}{8}$ in. is impractical for most fabrication and assembly activities. In most design cases, particularly for nonseismic load combinations, a plate thickness of $\frac{3}{8}$ in. to $\frac{5}{8}$ in. will be more than adequate to resist the calculated demands (Design Guide 38, Chapter 2).

5 **True.** The steel plates in a SpeedCore wall are required to be nonslender (i.e., yielding in compression must occur before local buckling). The plate slenderness requirement can be found in Section I1.6a. of the 2022 *Specification*. For seismic design, additional slenderness requirements must be met per the 2022 AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341, **aisc.org/specifications**).

6 **d.** 30 ft. After assembly and before concrete casting, the empty modules provide structural support for construction activities, loads, and the steel framework connected to them. Research indicates that modules that meet the plate slenderness requirement of Section I1.6b of the 2022 *Specification* can be typically cast with concrete placement heights of up to 30 ft without significant influence of induced deflections and stresses on the compressive strength or buckling of the steel plates (Design Guide 38, Chapter 2).

7 **e.** All of the above. SpeedCore systems are being considered and designed as an alternative to conventional reinforced concrete shear walls and core wall structures. One of the primary advantages of the SpeedCore system over a traditional reinforced concrete core wall is a reduction in the construction schedule. The reduction in construction schedule results from 1) the elimination of rebar cages and related activity, 2) the elimination of falsework and formwork for the construction of the core walls, 3) simultaneous construction of the core walls and the gravity system, and 4) a reduction in tolerance issues between the gravity system and core walls due to misaligned embedment plates (Design Guide 38, Chapter 1).

8 **True.** Like any system, design for fire loading is an important consideration. The existing water in the concrete infill of SpeedCore walls evaporates at elevated temperatures. The faceplate surrounding the concrete infill can trap vapor between faceplates and concrete, and the wall can act like an enclosed vessel during a fire event. The temperature rise builds up pressure between faceplates and concrete. This pressure can build up to large values, resulting in yielding of the steel plates. Providing vent holes can help to release the built-up pressure (Design Guide 38, Chapter 6).

STEEL SOLUTIONS CENTER

Designed for Speed

BY AMIT H. VARMA, PHD, MORGAN BROBERG, SOHEIL SHAFAEI, PHD, AND ATAOLLAH ANVARI

A new AISC publication provides guidance on designing buildings with the SpeedCore system.

THE SPEEDCORE SYSTEM is emerging as a valuable lateral force-resistance system option for mid- to high-rise buildings.

As part of AISC's Need for Speed initiative, this innovative, alternative to conventional reinforced concrete shear walls has shown promise and real-world results in reducing construction costs and schedules. And now the newest volume in AISC's Design Guide series, Design Guide 38: *SpeedCore Systems for Steel Structures*, is available to assist engineers with implementing this amazing new system. The publication covers design considerations, specifications, step-by-step design procedures, and detailed design examples for SpeedCore projects.

What is SpeedCore?

SpeedCore is the trade name for composite plate shear walls—concrete filled (C-PSW/CF). This nonproprietary core wall type can be used as the primary lateral force-resisting system in buildings, particularly in high-rise buildings as the elevator core structure or as individual shear walls in low-to-mid-rise buildings. The system consists of steel modules with steel plates connected using tie bars, with optional steel headed stud anchors, that are infilled with concrete. The components of a typical SpeedCore wall system are shown in Figure 1. SpeedCore systems can be used in both nonseismic and seismic locations; nonseismic design is actually a wind-controlled design where special seismic detailing is not required. Design methodologies for both environments are discussed in the new guide.

SpeedCore walls are very versatile in shape. Depending on the needs of the project, they can be planar, C-shaped, or I-shaped. Some standard shapes of SpeedCore systems are shown in Figure 2. Each wall segment is made up of parallel steel web plates along the length and boundary elements at the ends. Boundary elements for planar walls can be rectangular plates, semi-circular, or circular concrete-filled steel hollow structural sections (HSS).

Similar to reinforced concrete walls, the SpeedCore system can be either coupled or uncoupled. It is also possible to have a structural system with uncoupled walls in one direction and a coupled system in the orthogonal direction. Coupled systems consist of SpeedCore walls connected by ductile coupling beams, which may be either composite concrete-filled box sections or steel beams. The response of these structures varies based both on the type of loading—e.g., wind or seismic—and the type of wall, coupled or uncoupled, as shown in Figure 3. The Design Guide details all four of these scenarios, as well as designing a SpeedCore system for fire loading.

The Design Guide also walks users through the expanded provisions for SpeedCore found in the recently released AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-22) and *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-22); both are available at **aisc.org/standards**.

Relevant sections of the *Specification* include:

- Chapter I, which includes the design of uncoupled or coupled SpeedCore walls for nonseismic applications
- Appendix 4, which covers designing SpeedCore walls for fire loading

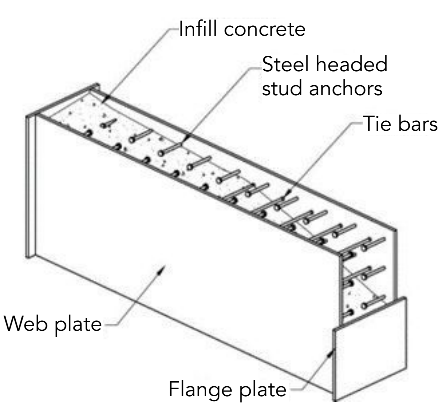


Fig. 1.
Typical components of a SpeedCore wall.

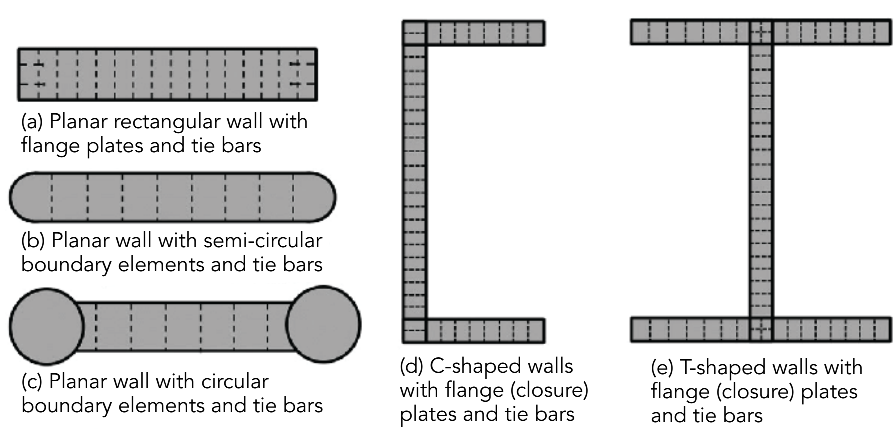


Fig. 2.
Possible SpeedCore wall shapes.

Relevant sections of the AISC *Seismic Provisions* include:

- Section H7, which covers seismic design provisions for uncoupled SpeedCore walls
- Section H8, which covers seismic design provisions for coupled SpeedCore walls

Why Use SpeedCore?

SpeedCore offers a number of benefits over typical reinforced concrete walls. The modular design allows for the prefabrication of steel modules, making the on-site construction process faster and more efficient. The steel modules are manufactured in a steel fabrication shop, then shipped to the project site where they are either welded or bolted together, depending on the application, to form the system. These systems also eliminate the need for rebar cages and falsework, reducing the construction schedule by an estimated 40% to 50%. This allows for the simultaneous construction of the core walls and the gravity system.

SpeedCore systems also address construction tolerance issues that often occur when embedded plates are used for combined steel and concrete construction by allowing the steel connection (embed) plates to be welded directly to the wall panel. These features result in a significant increase in construction efficiency compared to that of reinforced concrete cores, which require more labor for construction and longer wait times for concrete curing at each level. SpeedCore systems also do not require close reinforcement spacing, facilitating easier concrete placement than reinforced concrete walls with significant reinforcement ratios.

When it comes to load resistance, there is no need for additional reinforcing bars. Instead, the outer steel plates provide all the reinforcement necessary to resist axial, flexural, and in-plane shear forces. The steel plate thickness and tie bar spacing are selected to meet stability requirements during transportation, erection, and concrete casting.

SpeedCore is commercially appealing for its advantages in reducing the construction schedule and improving the overall project economy. The system is ideal for use in building projects where construction time is a critical factor. A recent example of its application is the Rainier Square project in downtown Seattle. This project used SpeedCore systems and achieved a more than 40% reduction in the construction schedule compared with a conventional cast-in-place reinforced concrete core. A 3D rendering of Rainier Square can be seen in Figure 4, and typical floor plans for this project containing SpeedCore systems are shown in Figure 5. Another SpeedCore

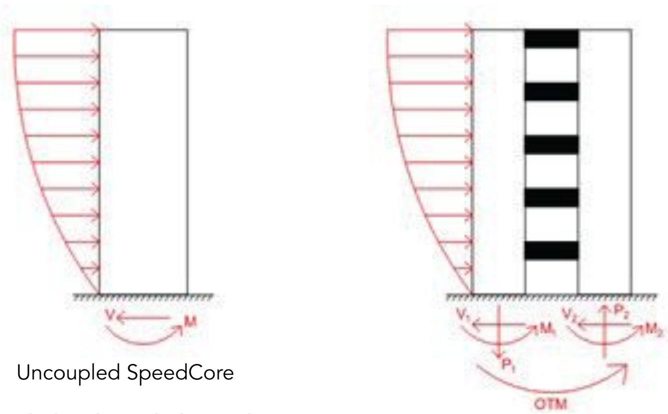


Fig. 3. Uncoupled and coupled SpeedCore systems subjected to lateral loading.

Fig. 4. A 3D rendering of Rainier Square, designed by Magnusson Klemencic Associates (MKA), in Seattle. You can read about the project, a 2022 AISC IDEAS[2] Award winner, in the May 2022 issue (**www.modernsteel.com**).

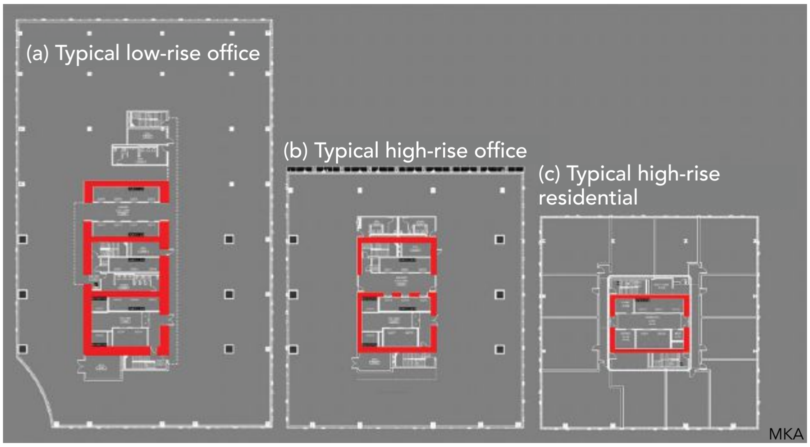


Fig. 5. Floor plans of the Rainier Square Project showing SpeedCore walls.

Fig. 6. 200 Park in San Jose, also designed by MKA, is the second building to implement the SpeedCore system.

project, 200 Park Avenue in San Jose, Calif., is nearly completed (Figure 6) and newer projects in Boston and New York are currently underway.

Organization and Design Examples

The Design Guide covers design specifications and commentary based on up-to-date and relevant research, along with flowcharts for design procedures and calculation examples for SpeedCore walls in nonseismic, seismic, and fire-resistance applications. Each example was done in PTC Mathcad, and the examples follow the flowchart procedures from the Design Guide, such as the one seen in Figure 6, and are available for download at the following link: **https://purr.purdue.edu/publications/3753/2**.

The guide is organized as follows:

Chapter 1 introduces SpeedCore systems, their components, and practical applications.

Chapter 2 discusses the wind design of uncoupled and coupled SpeedCore wall systems, covering wall section geometry and detailing, stiffness, strength, and connections for both coupled and uncoupled systems. Diaphragms, collectors, and chords of the lateral force-resisting system for wind design are also covered. Design examples in this chapter cover the wind design of a 15-story structure with uncoupled and coupled SpeedCore systems, along with a 22-story structure using coupled C-Shaped SpeedCore walls.

Chapter 3 discusses the seismic design of uncoupled SpeedCore wall systems. The connection requirements and demand critical welds, along with system requirements, are covered in this chapter. Design examples in this chapter cover the seismic design of a six-story structure using uncoupled SpeedCore walls and the seismic design of an 18-story structure using uncoupled C-Shaped SpeedCore walls.

Chapter 4 discusses the seismic design of coupled SpeedCore wall systems. Requirements for coupled SpeedCore walls with flange (closure) plates and composite coupling beam connections are covered in this chapter. Other connections, such as coupling beam-to-wall and composite wall-to-foundation connections, are also covered. Discussions of the strength of both the composite walls and coupling beams are included, as are design examples on the seismic design of an eight-story structure using a coupled planar SpeedCore system, a 22-story structure using coupled C-Shaped SpeedCore walls, a continuous web plate connection for a coupling beam-to-SpeedCore wall connection, and a lapped web plate connection for a coupling beam-to-wall connection.

Chapter 5 summarizes the results from the seismic performance evaluation of SpeedCore wall systems. This chapter touches on the material models, finite element modeling approach, and fiber-based modeling approach used to obtain results. It also discusses the seismic performance of coupled SpeedCore systems for nonlinear pushover analysis and nonlinear time history analysis.

Chapter 6 discusses the design of SpeedCore walls for fire resistance, including thermal and structural response performance under fire loading. Discussion of fire resistance ratings is included in the design requirements and procedures, as is an example of fire design for SpeedCore walls.

Appendix A shows the equations used for the nominal flexural strength of SpeedCore walls and composite coupling beams using the plastic stress distribution method. The strength calculations include that for both planar and C-Shaped SpeedCore walls subject to flexure, tension, and compression.

AISC Design Guide 38 provides comprehensive information on designing with SpeedCore and can help you determine whether the system is a good fit for a future project—and, if so, how to successfully implement it. You can download it at **aisc.org/dg**. You can also find more information on SpeedCore at **aisc.org/speedcore**.

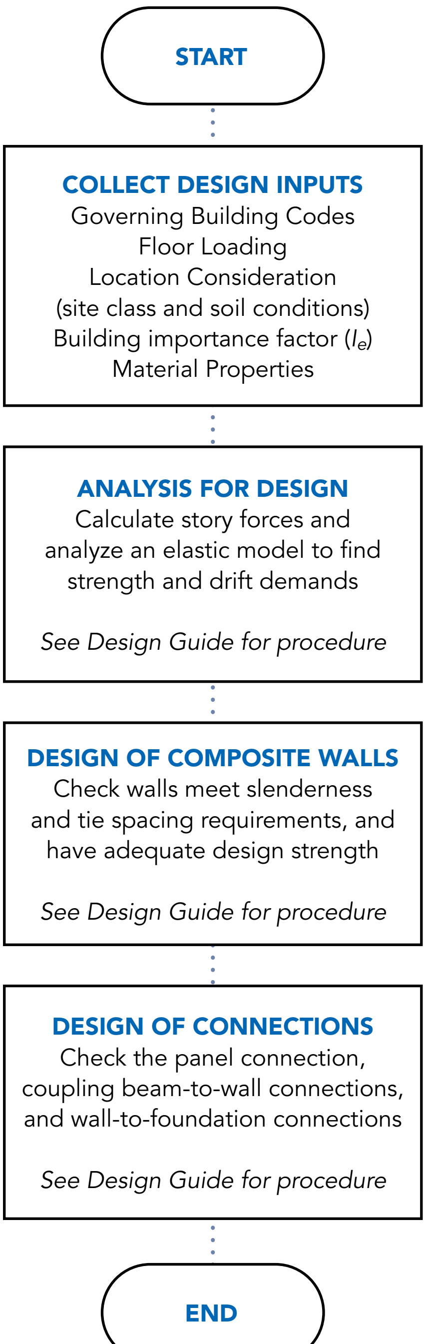
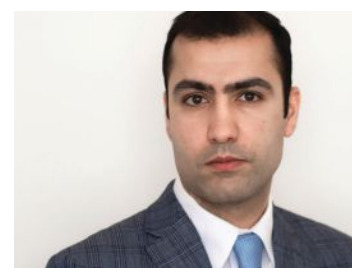


Fig. 7. Sample Design Guide flowchart

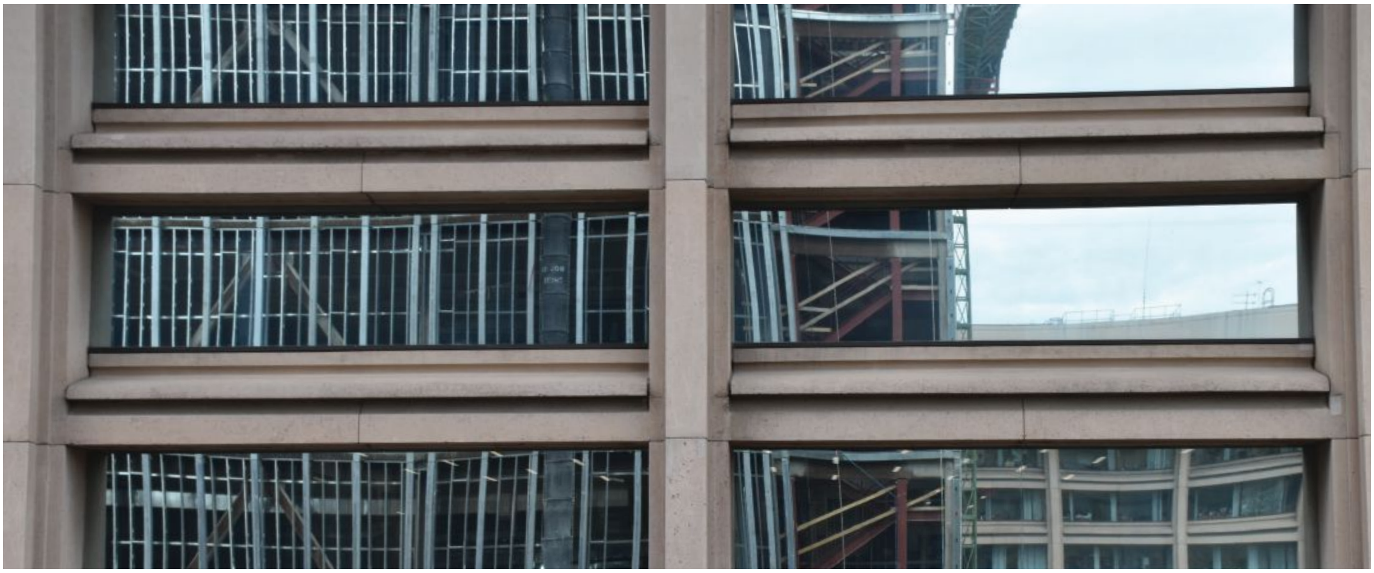


Amit H. Varma is the Karl H. Kettelhut Professor and director of the Bowen Laboratory for Large-Scale CE Research, **Morgan Broberg** is a PhD candidate, **Soheil Shafaei** is a post-doctoral researcher, and **Ataollah Anvari Taghipour** is a PhD candidate, all at the Lyles School of Civil Engineering at Purdue University in West Lafayette, Ind.

Quantifying Resilience

BY BRIAN RAFF

Insurance rates reflect the superiority of steel construction.



STEEL IS A BIG PART of the solution when it comes to resiliency—and one way to think about resiliency and value is to examine insurance costs.

If you look at a typical commercial building (e.g., a five-story office building) in an average city in the U.S. (e.g., Indianapolis, which doesn't have seismic threats or issues with hurricanes or wildfires), insurance rates for concrete structures are typically 50% more than for steel construction, and insurance rates for wood construction are typically 150% more than for steel construction.

This means if an owner or developer pays $1,000 per $1 million of coverage for a steel building, they'll be paying $1,500 for a concrete building and $2,500 for a wood structure. The difference represents the relative resiliency of the different types of construction based on insurance companies' actual loss experience with each type.

Here's a bit more insight: Insurance companies regularly assess the loss records of buildings subject to both anticipated and extreme events. It is from those actuarial studies that insurance rates are set. For a given set of risks, a lower rate means less damage and a lower cost of repair. For the same building in the same location framed with different building materials, current insurance rates per $100 of value in today's market for Builder's Risk (insurance insuring the building during construction) and All Risk (insurance purchased by the owner insuring the building after occupancy) will be in the ranges seen in the table below.

Obviously, these rates will change based on project location and the particular risks associated with that locale or if the project has a specialized feature or aspect. But the general trend is the same. All risk insurance rates for wood buildings and concrete buildings are at least 2.5 and 1.4 times higher, respectively, than for structural steel-framed buildings. The difference is not the level of risk to the building from an extreme event but rather the resilience of the building in responding to that event.

It's important to remember that this isn't just an empty claim but rather one supported by actuarial data—steel is critical to enhancing the resilience of buildings and minimizing repair costs in the face of unforeseen circumstances. If you'd like to learn more about steel and resilience, contact AISC's structural steel specialists at **aisc.org/whysteel**.

	Builder's Risk During Construction	All Risk After Occupancy	All Risk Comparison
Wood	$.23–$.28	$.25–$.30	≥ 2.5x
Concrete	$.15–$.19	$.14–$.17	≥ 1.4x
Steel	$.09–$.13	$.09–$.12	1

Current insurance rates per $100 of value in today's market for Builder's Risk and All Risk (table provided by Greyling Insurance Brokerage and Risk Consulting).

Brian Raff (**raff@aisc.org**) is AISC's vice president of market development, marketing communications, and government relations.


2023 IDEAS² National Award
Federal Reserve Building Seattle
Photo: Clarity Northwest Photography

Rebuilding a Business

INTERVIEW BY GEOFF WEISENBERGER

Nearly two decades ago, David Zalesne left a successful legal career in Philadelphia to revive a steel fabrication shop in South Carolina—and he's never looked back.

FORMER AISC BOARD CHAIR DAVID ZALESNE was once a lawyer with the U.S. Attorney's office in Philadelphia.

But he always had an interest in the business world, and in 2004 had the opportunity to get into the steel industry. His wife's family had a fabrication business in South America and knew the prior owners of Owen Steel Company, located in Columbia, S.C. The company had been unable to recover from the post-9/11 slowdown in the New York high-rise construction market, so the family was able to negotiate favorable purchase terms for the business. David went to Columbia to do the legal work on the acquisition but ended up staying there. Now, nearly 20 years later, the company has two plants and a backlog of work into 2026.

In April, I caught up with David, who serves as the president of Owen Steel, at the 2023 NASCC: The Steel Conference in Charlotte, where he was honored as the recipient of the Robert P. Stupp Award for Leadership Excellence winner—only the 10th winner since the program's inception in 1998.

Field Notes is *Modern Steel Construction's* **podcast series**, where we interview people from all corners of the structural steel industry with interesting stories to tell. Listen in at **modernsteel.com/podcasts**.

You've taken a very different path to getting into the steel industry than most folks I've talked to. Can you walk us through that?

I grew up in Philadelphia and went to college there. I went away to Atlanta for law school but then came back to Philadelphia and practiced law for a while. I was in the U.S. Attorney's office and then in private practice, doing a mix of business litigation and some white-collar criminal defense work. But I've always liked the business world. I had a nice practice but sort of teetered on the edge of working in-house with a client or being in a business. And my wife's family, who has been in the steel fabrication business for many years, knew of the opportunity to buy Owen Steel at a time when it was having some trouble after the New York high-rise market shut down due to 9/11.

So I went down to Columbia, S.C., to do due diligence on a potential acquisition, and I kind of fell in love with it and had the opportunity to get more fully involved. And 19 years later, I'm still doing it and still loving every day of it—almost! It was an unexpected route, but I've now been in the steel business longer than I practiced law.

That's quite the path. I know a lot of Owen's work is in the Northeast, so I'm guessing you get to head back up there somewhat regularly.

Right, we get the best of both worlds. We live in a really nice environment. All three of my kids were raised in South Carolina, and one of them is working with me now, living in New York. And it's one of the greatest construction markets in the world.

We have built a lot of high-rises and other infrastructure projects there. Owen has had five or six contracts at the World Trade Center site, so we were heavily involved in rebuilding that very high-profile area. We've also done a lot of work at airports in the New York region and a lot of other high-profile and complex projects. And in addition to the primary plant in South Carolina, we also have a great plant in Wilmington, Delaware.

Speaking of projects, you've obviously done a lot at this point. Looking back, what was your experience like when you first started in the fabrication business?

So when I got into the business in 2004, Owen had a reputation for high-rise work in New York, but there had not been many high-rises built in New York City since 2001, and the market at the time had shaken out as several other fabricators serving that market had also gone out of business. When we first started, we planned to start with smaller projects. I think our first order was a truss for a church in Columbia. But soon after that, contractors in New York started calling again, and fairly soon, we were doing work on the New York Times tower. A few months later, we were the successful bidder on the Bank of America Tower. So fairly quickly after coming to Owen, we were back into the New York high-rise market. And we've had some really great projects since then. We had a nice run in that market for a very long time and have been fortunate.

That's a pretty quick turnaround!

It helped that we had the physical capacity in our plants, as well as experienced senior management teams and skilled workforces in the plants. We still have a lot of people who have been at Owen for the 19 years I've been there—and many who have been there a lot longer than that, both in the shop and in the office. So it wasn't like we were building a startup from scratch. We were taking over a company that already had a really good legacy and trying to restore that. But the physical capacity of the plants, the quality of the workmanship, and the talent of the people—from engineers to estimators to project managers—were all there. The company had gone through a rough financial period, but we were able to recapitalize it. And once the market took off again, we had plenty of opportunities. Of course, we still go through typical market cycles and have other issues, but for the most part, we've been pretty fortunate.

Speaking of New York and Philadelphia, and just large cities in general, when COVID hit and people found they could work from home, has that affected high-rise construction in urban centers?

I think New York was always going to have a little pullback anyway, as commercial office space was getting a little overbuilt anyway pre-COVID. A lot of really great class-A office buildings have come to market in the last few years, some of which weren't fully leased when they were completed. And COVID certainly hasn't been great for urban office markets. But these are market swings. I certainly don't think that cities are dead by any means. They survive by adapting and bouncing back. There are also public-sector building and infrastructure projects, the "Med and Ed" sectors like healthcare and education, and eventually, the demand for commercial office and even retail space will come back. And while New York is relatively slow, there is growth in other cities. People may be working more at home, but many people want to have their homes in cities where they can eat, play, and connect without cars. I still think people naturally want to be together, so I am optimistic about the future of American cities. We're in a little bit of an unprecedented political time when it seems like people who don't live in cities are rooting for cities to fail, and people who live in cities are rooting for other communities to fail. Hopefully, we can get past that and find a way to let cities do what cities do well—connecting people to work along with arts and entertainment in environments with beautiful architecture and beautiful skylines.

Absolutely. Looking back to when you entered the steel business nearly two decades ago, was there anything that surprised you the most about steel fabrication?

I think what surprised me most was how addictive this business is. People get into the steel industry and don't leave. I have had the opportunity to work with the AISC Board of Directors for a long time and have been able to meet and learn from some real legends in the industry. I was able to overlap with people who had built the modern steel fabrication industry to what it was and then help transition it to the next generation. And what's so interesting is how many families have built their lives around steel fabrication. Many people in this industry could do many other things, but I think once you get into this business and you find a niche in it and you like it, it's really an addictive, all-encompassing, satisfying industry. And the other neat part about it is that when you're done with something, you have a really cool building there. There's a sense of legacy and permanency to your work and a sense that you've built something that will be there for a long time. Through AISC, I've gotten to know so many of the people in this industry all across the country and have a lot of really good friends in the industry. Even though we're competitors, the friendships and the relationships, both personal and professional, have been really gratifying. We're all doing the same kind of thing in our respective markets, but we also have common interests and want a successful, healthy, profitable steel industry. ■

This column was excerpted from my conversation with David. To hear more from him, check out the July 2023 Field Notes podcast at ***modernsteel.com/podcasts****. In addition to David, I interviewed several other AISC award winners at the Steel Conference in Charlotte, and we'll be featuring them throughout the year. You'll also be able to see short videos of the interviews on AISC's YouTube channel,* ***youtube.com/@aisc****.*

Geoff Weisenberger (**weisenberger@aisc.org**) is editor and publisher of *Modern Steel Construction.*

Engaging in Ethics

BY KYLE PAYNE, PhD

Unethical behavior can send a company's upward trajectory into a tailspin. Learning to understand and address it can help you strengthen the trust of your employees and customers.

EVEN THE BEST-PLANNED construction projects can run into issues that delay or increase costs.

But in addition to the "typical" complications that a building or bridge schedule and budget might face, there's another issue that can hold not only projects back but also an entire organization: unethical behavior. It can be extremely costly for companies in both the short and long runs.

Consider Volkswagen. Following its use of so-called "defeat devices" to manipulate emissions tests, the German auto manufacturer has paid over $33 billion in fines, penalties, settlements, and buyback costs. In another example, banking giant Wells Fargo has paid over $5.7 billion to settle civil and criminal suits related to employees setting up phony customer accounts.

The structural steel industry is not immune. Like these high-profile cases in other industries, we face direct costs if and when unethical behavior occurs. And we must also consider an indirect—and perhaps even more significant—cost: erosion of the public's trust.

Unethical behavior doesn't just happen—and it's not always rooted in ill intent. As an employee of a civil and structural engineering firm (who recently completed a doctorate in human capital management), I was curious to dive deeper into this topic and attempt to get to the "why." To understand what motivates workers to do unethical things, particularly when they believe they are acting in their employer's best interest, I surveyed 300 professional engineers, asking them about circumstances that make them more likely to engage in unethical behavior at work. Other questions dealt with how much they identify with their organization, their profession, or being considered a moral person, and how much meaning and purpose they find in their work. You can view the report, *Doing Bad Things for Good Reasons: An Examination of Unethical Pro-Organizational Behavior Among Professional Workers*, on ResearchGate at **tinyurl.com/badgoodeng**.

The results contradicted previous research on "unethical pro-organizational behavior." It found no relationship between professional engineers identifying with their employer and doing unethical things on their behalf. Similarly, identifying with their profession did not predict that they would prioritize professional ethics over the perceived interests of their employer. Instead, the results suggest that much of what predicts unethical behavior at work concerns the excuses we make for ourselves when we contemplate or reflect on unethical behavior. In social psychology, we call this process "moral disengagement."

Each of us morally disengages to some extent when we face an ethical dilemma. We might shift our focus to the benefits of an unethical act, such as productivity or profit, or how the bad deed we did pales in comparison to the many good deeds we have done. We might use euphemistic language, perhaps treating deception as "telling the client what they need to know." We might point the finger at an authority who influenced our decision or peers who would have done the same thing in our shoes. We might also distort the harm that could result from our actions, or we might blame the victim or belittle their concerns. Human beings are storytellers by nature, and moral disengagement is about telling stories that make it easier to cope with doing something we know we should not.

Fortunately, we have tools available to mitigate the risk of professional engineers morally disengaging and putting clients and communities at risk. It starts with balancing the content of existing training on ethics, which focuses on what we ought to do, with an awareness of the excuses we make for straying from those standards. My approach is to use documented case studies of ethical dilemmas and ask participants to consider what mechanisms of moral disengagement they would lean on in each situation. Effectively, I'm asking what excuses participants would make for themselves. Or what excuses might their peers use to justify looking the other way. Then, we discuss our habits to identify what mechanisms of moral disengagement we tend to use most often when facing ethical dilemmas in our own work.

This approach to training requires trust and support, and it requires a highly qualified facilitator. Executed effectively, it opens opportunities for one-on-one coaching on what ethical dilemmas we are facing day-to-day and how to navigate them effectively. I encourage managers, just as you would check in with a direct report about an assigned project to help with clearing obstacles, to ask their employees, "Can you tell me about any ethical dilemmas that have come up for you lately? Any situations where you were not sure about a judgment call?" If we expect our people to be reflective practitioners and consistently make the right call under pressure, we need to normalize conversations about ethical dilemmas and provide support and feedback.

In addition to training and coaching, the study pointed to implications for storytelling. It found that professional engineers are less likely to morally disengage if being a moral person is an important part of their identity and if they find meaning and purpose in their work. Because of these findings, I have begun pursuing opportunities,

both as a scholar and as a practitioner, to help professional engineers tell their stories, particularly when they were able to do the right thing despite pressure to do otherwise. In my research, I refer to these individuals as "ethical followers," which means that they find constructive ways to resist when they feel pressured to do something unethical.

There are other pieces to the puzzle, including how well ethical standards are understood and agreed upon, how consistently they are enforced, and how relevant they are to the ethical dilemmas we face on the ground. However, this study shed light on a few steps we can take in the structural steel industry to mitigate the risk of unethical behavior at work and avoid the associated direct and indirect costs. The most important are:

- Train our workers on moral disengagement
- Highlight stories of ethical followership
- Help them prepare for the ethical dilemmas they are sure to face—and teach them how to address them

Ethical questions and dilemmas are bound to happen in everyone's career. But training employees how to recognize and appropriately address them can help them become more empowered, more trusting and trustworthy, and more engaged while also minimizing risk to your company. ■

Kyle Payne
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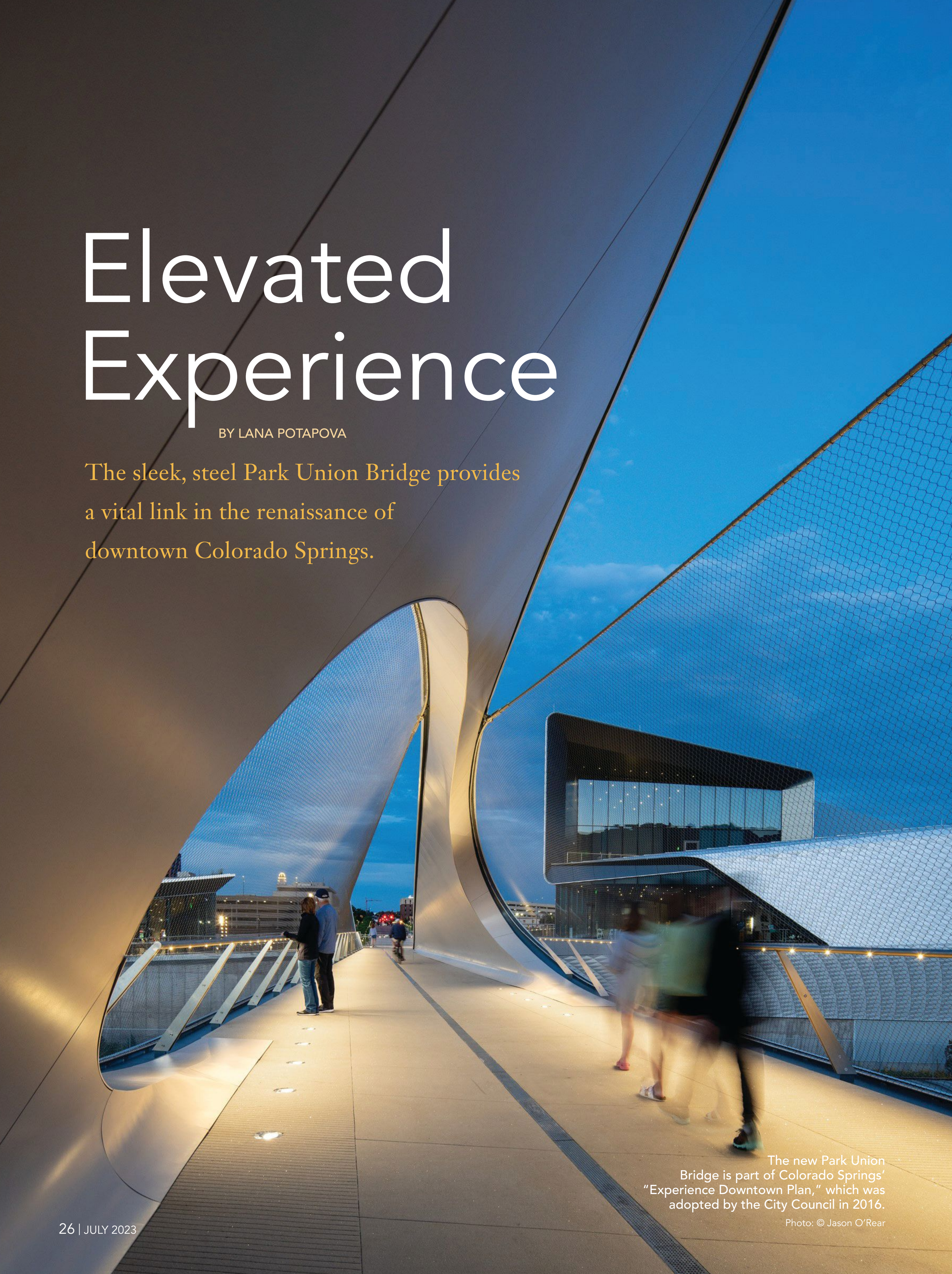
is a talent development manager at Collins Engineers in Chicago.

Elevated Experience

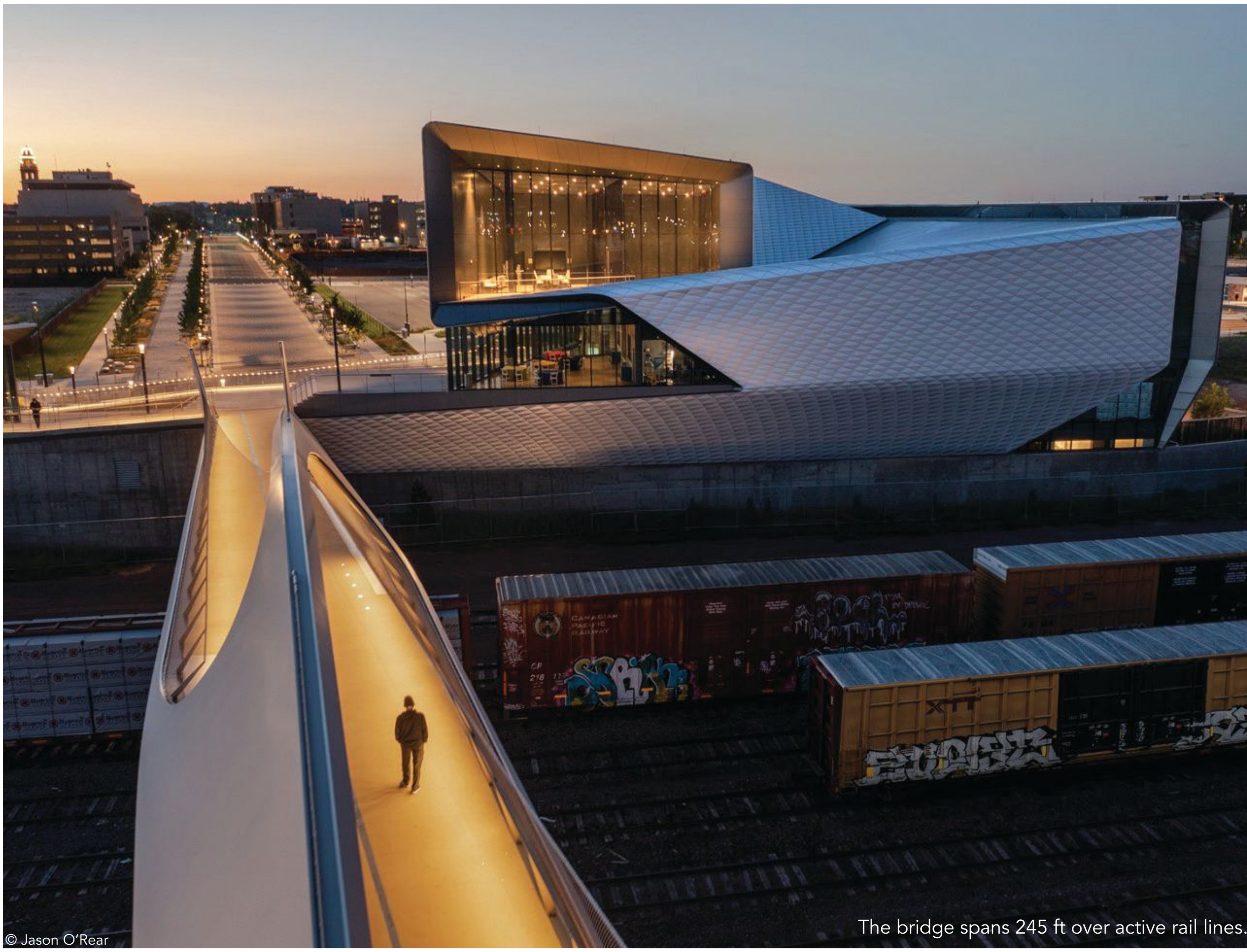
BY LANA POTAPOVA

The sleek, steel Park Union Bridge provides a vital link in the renaissance of downtown Colorado Springs.



The new Park Union Bridge is part of Colorado Springs' "Experience Downtown Plan," which was adopted by the City Council in 2016.

Photo: © Jason O'Rear



© Jason O'Rear

The bridge spans 245 ft over active rail lines.

COLORADO SPRINGS, COLO., has always been known for its natural setting in the shadow of the Rocky Mountains—but the central business district didn't always share the same impressive reputation.

So the city decided to change that. Beginning in 2015, city officials and a diverse group of stakeholders worked together to update the city's 2009 Imagine Downtown Master Plan. The "Experience Downtown Plan," which was adopted by the City Council in November 2016, used significant public input, subject matter experts, and numerous recently adopted city-wide plans to create a market-based, tactical plan that will lead the desired renaissance downtown. Central to the goals were maintaining the downtown core as the economic and cultural heart of the region, creating a diverse and inclusive place to live, integrating the central business district with adjacent neighborhoods, celebrating and connecting with outdoor recreation and the city's exceptional natural setting, facilitating healthy and active lifestyles, creating a walkable and bike-friendly center connected through safe and accessible multimodal networks, offer visitors an unforgettable experience, and serve as an example of innovative urban design and sustainability.

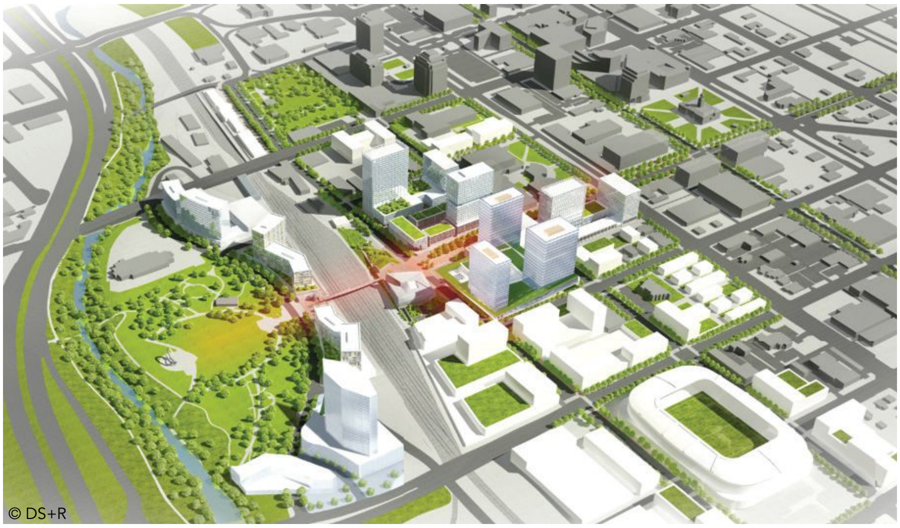
At the heart of this initiative was the Park Union Bridge. In addition to serving as a destination for a reimagined downtown Colorado Springs, the steel pedestrian bridge was sculpted to integrate into the overall vision of the city's U.S. Olympic and Paralympic Museum grounds and form a vital iconic connection and spans 245 ft over active rail lines (this museum was one of AISC's 2022 IDEAS^2 Award winners, and you can read about in the May 2022 issue at **www.modernsteel.com**). Designed by Diller Scofidio + Renfro (design architect) and Arup (engineer of record), the bridge is now open to pedestrians and is known as the "rip curl" for its cresting design.

Bridge Design

This structure demonstrates the close relationship between architecture and bridge engineering, where every aspect was sculpted as a joint effort to create a structure that appears to defy gravity. However, all robust bridge requirements were met through ingenious solutions.

The inspiration for the bridge form was drawn from a desire to express the link between the park and the museum in Olympic imagery. The early sketches of the bridge were derived from two links interlocked together like Olympic rings. The final bridge echoes this interlocking in elevation views, and the superstructure is composed of the steel shell, floor beams, and concrete on stay-in-place (SIP) metal deck. The SIP form spans longitudinally to the transversely spanning steel floor beams, which are spaced every 7 ft and supported by the steel shell. The steel shell is further rationalized into three elements: the edge girder, the asymmetrical arch, and the stiffened steel web (stressed skin) linking the two.

The deck system hides bolted transverse splices in the floor beams that were used to simplify the transportation of the bridge. To facilitate visible complete-joint-penetration (CJP) field welding



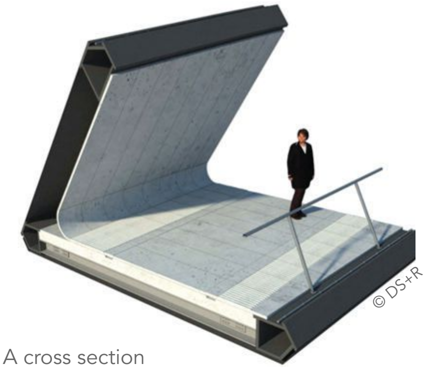
above: A master plan rendering showing the bridge's location in downtown Colorado Springs.

above and below: Erecting the bridge via SPMTs.

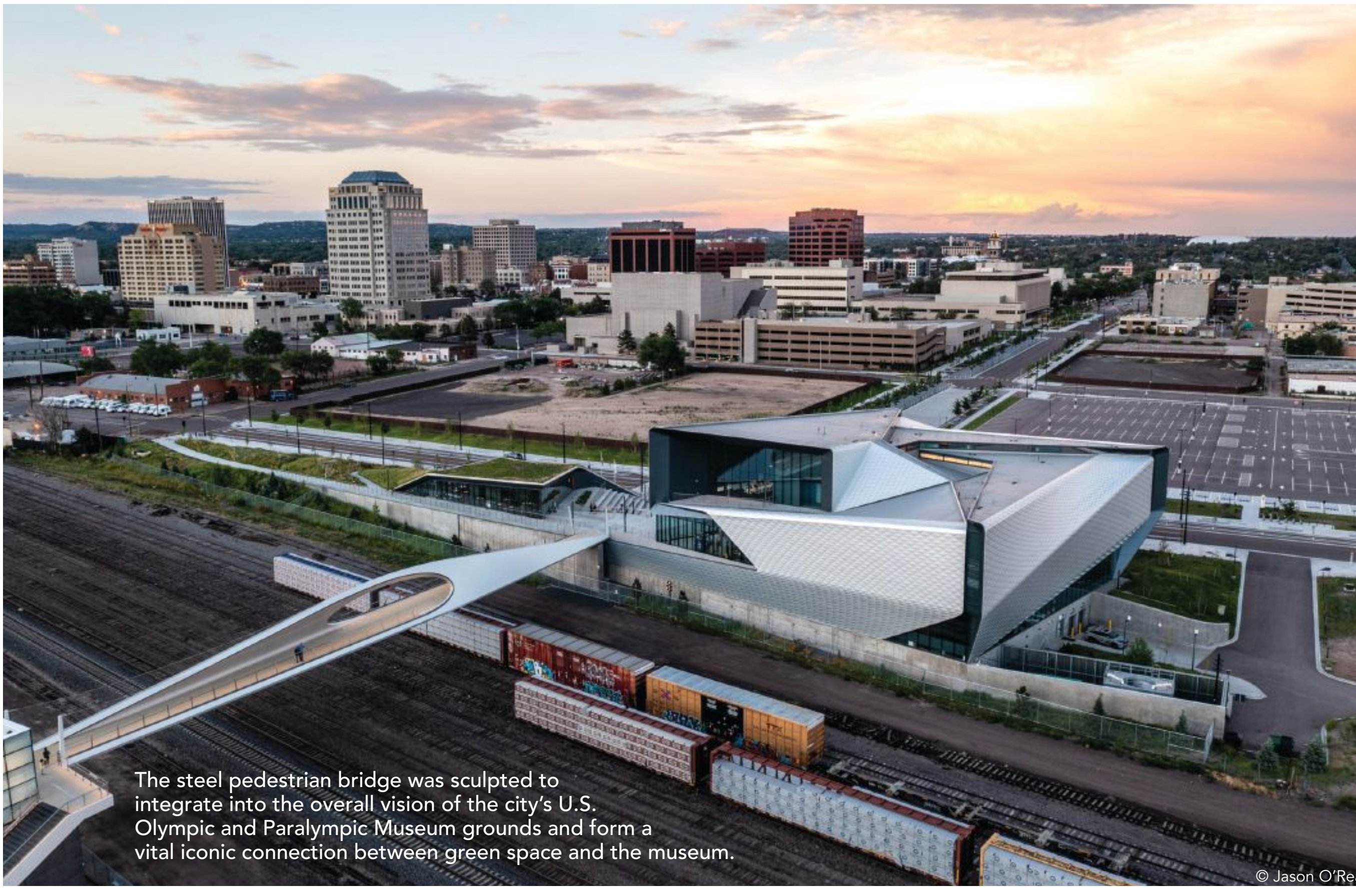
within bridge welding code requirements, the team employed techniques such as phased array ultrasonic testing (PAUT) to check the integrity of the welds. Unique weld sequencing was used to complete splices in geometrically challenging locations. Typically, welds are tested with radiography which has a significant perimeter of impact from X-ray waves and requires access which the unique geometry did not permit. But in the case of the Park Union Bridge, Arup engaged internal steel fabrication experts and approved PAUT, a method that provided confidence in welding and had a secondary benefit of improving worker safety.

The design team collaboratively massed, rationalized, and managed the steelwork 3D model in Tekla Structures and Rhino with a Grasshopper parametric plug-in, which allowed for fast updates to multiple structural analysis models as the design evolved and facilitated rationalizing the steelwork. This approach strengthened the collaborative approach and allowed the team to efficiently arrive at a holistic solution. While the rip curl geometry's unusual form is captivating, the shape was rationalized to be predominantly built from flat and single-curvature plates, which was key to simplifying fabrication.

The derivation of the asymmetrical arch box required close collaboration with the architect. The arch carries approximately 5,000 kips in compression, and the size of the arch box directly influenced head heights and internal cladding requirements. In order to minimize the overall size and plate thickness of the most heavily loaded member on the bridge, ASTM A709 Grade 70 steel was used in the arch section, allowing plate thicknesses to remain at 2 in., thus rendering welding and building the section more cost-effective.



A cross section of the new bridge. Thanks to its use of ASTM A709 Grade 70 steel, the design team was able to keep the plate thickness to 2 in.



The steel pedestrian bridge was sculpted to integrate into the overall vision of the city's U.S. Olympic and Paralympic Museum grounds and form a vital iconic connection between green space and the museum.

© Jason O'Rear

Built with 450 tons of steel and 15 linear miles of welding, the bridge was created to be two mirror-image halves with an overhead arch that forms an oculus—an oval-shaped window—in the center.

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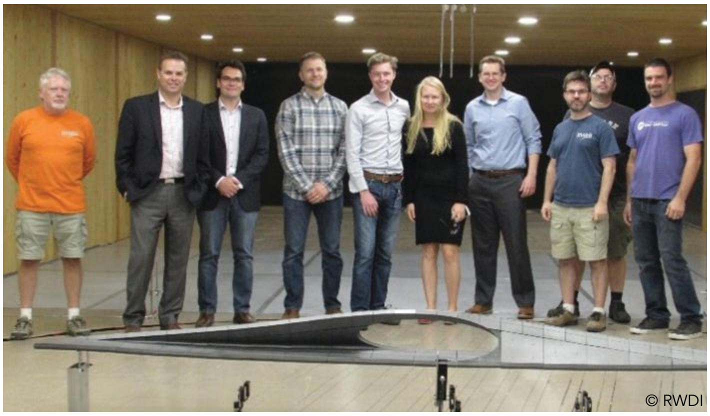

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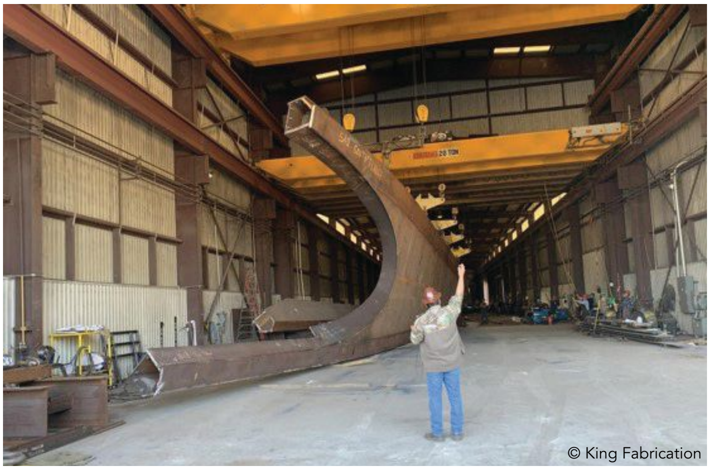
above: Testing a model of the bridge in a wind tunnel.

left: The bridge's highly complex geometry necessitated fit-up at King Fabrication's shop in Houston prior to transportation to Colorado. Tolerances were halved to meet architectural requirements.



© King Fabrication

Shallow box construction was crucial to achieving the architectural vision while providing a robust structural solution. The arch measures just over 2 ft, 10 in. by 1 ft in its tightest location at midspan (oculus), and the edge girders are approximately 1 ft, 6 in. by 1 ft, 11 in. deep (outside plate dimension). The edge girder and arch sections were essentially assembled as a lidded box, with three pieces being built up first and then followed by the final capping plate being welded on from the outside. Fillet welds were used where possible to minimize welding requirements. There were a number of welds for the capping beams that would have been overhead welds, but steel fabricator King Fabrication instead assembled major portions of the structure upside-down.

When it came to wind design, Rowan Williams Davies and Irwin, Inc. (RWDI) was commissioned to design and build an aeroelastic model that was used to evaluate the wind-induced responses of the bridge. The testing of the aeroelastic model in a fully turbulent boundary layer wind tunnel that accurately simulates the approaching wind conditions was observed by Arup to determine that the bridge was aerodynamically stable.

Bridge Fabrication and Construction

Built with 450 tons of steel and 15 linear miles of welding, the bridge was created to be two mirror-image halves with an overhead arch that forms an oculus—an oval-shaped window—in the center. King doubled the size of its working "burn" table to 80 ft because the sheets of steel were 80 ft long by 12 ft wide. King performed a full fit-up of the structure in its shop, which helped ensure geometry control prior to shipping it to its final destination in Colorado Springs. The arch and shell were shipped in two pieces, and the edge girders were shipped in three pieces. This segmentation minimized field assembly improving quality control.

One of the key project successes for the design team was producing a design that struck a balance between achieving the aesthetic vision and minimizing the impact on the railroad tracks that run beneath the bridge. In addition, the design team strategically located bolted splices in the floor beams and permitted welded field splices in the arch and edge girders to facilitate transportation to the site and final assembly. Once the superstructure was assembled in a staging area adjacent to the railyard, the concrete deck was cast, and the 550-ton bridge was lifted by self-propelled modular transporters (SPMTs) and driven into its final position in under five hours, ahead of the allowed railroad outage. Track protection was provided for the drive to ensure railroad infrastructure was not damaged by SPMT wheel loads, and the bridge was then fit out from the inside, minimizing any additional railroad closures.

The gravity-defying bridge enhances the landscape of Colorado Springs, and the collaborative approach and thoughtful design and construction tactics ensured a proper balance between the aesthetic goals and pragmatic construction over active railroad tracks. ■

Owner
City of Colorado Springs, Colo.

General Contractor
Kiewit

Architect of Record
Anderson Mason Dale

Design Architect
Diller Scofidio + Renfro

Structural Engineers
Arup (superstructure)
KL+A (abutments, as a sub-consultant to Arup)

SPMT Contractor
Mammoet

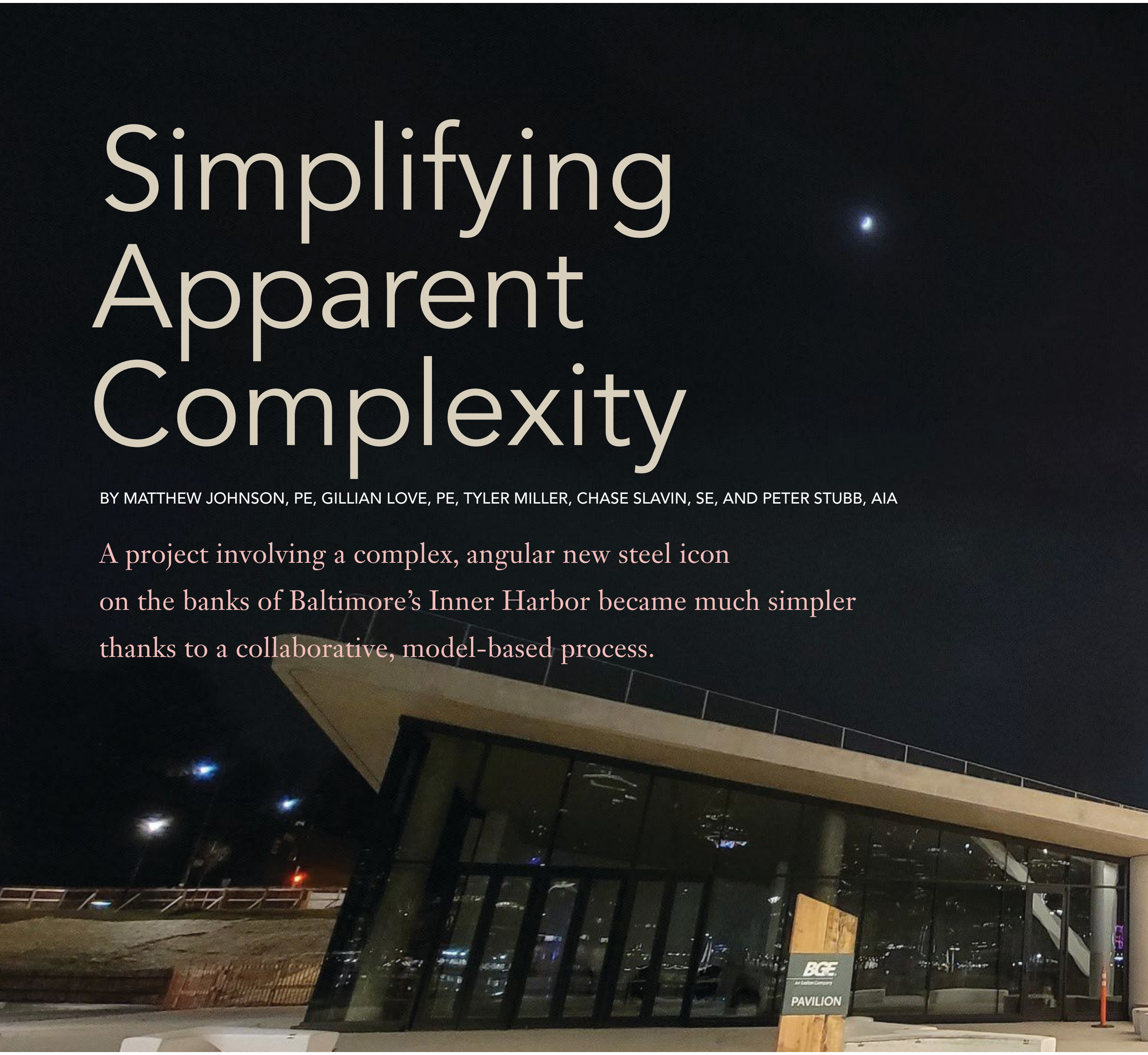
Steel Fabricator and Detailer
King Fabrication, LLC AISC CERTIFIED FABRICATOR, Houston

Lana Potapova is an associate in the New York Bridge and Civil Structures Group of Arup.

Simplifying Apparent Complexity

BY MATTHEW JOHNSON, PE, GILLIAN LOVE, PE, TYLER MILLER, CHASE SLAVIN, SE, AND PETER STUBB, AIA

A project involving a complex, angular new steel icon on the banks of Baltimore's Inner Harbor became much simpler thanks to a collaborative, model-based process.



BALTIMORE'S INNER HARBOR has long been a draw for visitors and locals.

But it wasn't always that way. Historically, the area was a story of industry and manufacturing defined by large ships, major industrial facilities, and a bustling environment of productivity that precluded any thought about serene waves and thriving wildlife, let alone humans enjoying their symbiotic place within the ecosystem.

With the historic industry long gone, the city worked to redefine itself and develop the Inner Harbor into the thriving urban asset it is today. The latest component is the re-envisioning of Rash Field, a high-profile green space on the harbor's south bank. Waterfront Partnership of Baltimore, which manages Baltimore's public waterfront and initiated this project, challenged the design team to embrace forward thinking and bring to life a space that celebrates the area's native ecosystems and updates this parcel of land.

While the park itself is a rising and falling tapestry of native plants and playgrounds, there remained the need for an iconic structural element calling out to visitors, inviting everyone around the Inner Harbor to the newly reimagined park. The design team took inspiration from shorebirds calmly rising with the ever-evolving topography of the water beneath them. The challenge became creating a structure that was large enough to be iconic but delicate enough to "float" over the landscape of the park. Achieving this vision is custom

Rash Field's new BGE Pavilion shade structure and adjacent café.

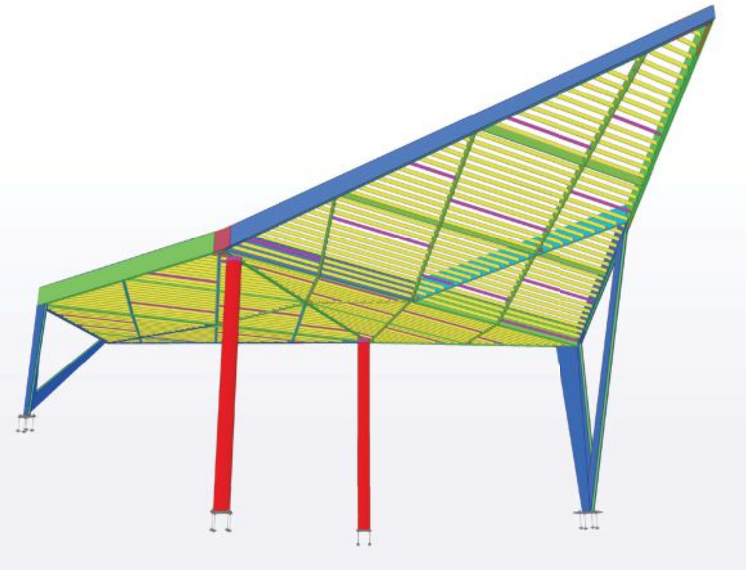
fabricated folded plate steel frame with tapered columns touching down delicately in the plantings and on the café building, accented by aluminum that creates a sense of ethereal lightness and thoughtfully provides shade during critical hours of the summer months.

Built from roughly 32 tons of steel and called BGE Pavilion, the structure's complex geometry required various software and process solutions to communicate the design intent between parties, perform the structural analysis and design, and ensure compliance of the construction with the design intent.

During the early project phases, the design team rapidly iterated the structural geometry to optimize the location of the shade structure's columns. Using a software link between 3D geometric modeling program Rhinoceros, Grasshopper (the visual programming language and environment for Rhinoceros), and SAP2000 allowed analysis to be automated for evolving structural geometries. This process empowered the design team to select an efficient configuration from hundreds of parametrically defined iterations.

Once the primary structure geometry was selected, the team used SAP2000 to analyze and design the structure. The structural analysis model included non-prismatic frame elements to capture the varying properties of the tapered built-up box girders and columns.

The coordination of the intricate interfaces between structural components and integration of the structure with the adjacent building and landscape retaining walls posed challenges for the



The cantilevered shade structure mimics the shape of an adjacent café building.

above: An aerial view of the folded plate steel shade structure at Rash Field.

left: A digital mockup showing each member type in a different color.

design team. Architect Gensler and structural engineer Simpson, Gumpertz and Heger (SGH) coordinated the structural design primarily through 3D Revit and Rhinoceros models, supplemented by schematic 2D sketches. This strategy enabled the design team to accurately communicate complex 3D geometry among all the project partners. The team also used these models to reconcile the differing construction tolerances between differing materials.

When it comes to designing an iconic project, particularly one where the geometry is so distinct from traditional steel design and fabrication, graphically articulating the design with the goal of simplifying the apparent complexity goes a long way to help the detailer and fabricator more rapidly understand the project and how they can fabricate and assemble the project. BGE Pavilion, despite the non-parallel structure and sharp angles, is an assembly of ¾-in.-thick flat plate. A typical structural steel framing plan is represented by single lines, but taking the same approach for the shade structure would have significantly misrepresented the project. The results could have been disastrous, resulting in bids substantially higher than necessary to detail and fabricate the project, value engineering suggestions that might undermine the architectural design intent, or bids with unreasonable and/or unresponsive qualifications.

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1	Angle Leg Out	INSIDE DIA.	10" x 10" x 1" Angle
2	Angle Leg In	OUTSIDE DIA.	10" x 10" x 1" Angle
3	Flat Bar The Hard Way	INSIDE DIA.	24" x 12" Flat
4	Flat Bar The Easy Way	INSIDE DIA.	36" x 12" Flat
5	Square Bar	INSIDE DIA.	18" Square
6	Beam The Easy Way (Y-Y Axis)	MEAN DIA.	44" x 335#, 36" x 925#
7	Beam The Hard Way (X-X Axis)	INSIDE DIA.	44" x 285#
8	Channel Flanges In	OUTSIDE DIA.	All Sizes
9	Channel Flanges Out	INSIDE DIA.	All Sizes
10	Channel The Hard Way (X-X Axis)	INSIDE DIA.	All Sizes
11	Tee Stem In	OUTSIDE DIA.	22" x $142\frac{1}{2}$# Tee
12	Tee Stem Out	INSIDE DIA.	22" x $142\frac{1}{2}$# Tee
13	Tee Stem Up	MEAN DIA.	22" x $142\frac{1}{2}$# Tee
14	Angle Heel In	INSIDE DIA.	8" x 8" x 1" Angle
15	Angle Heel Out	OUTSIDE DIA.	8" x 8" x 1" Angle
16	Angle Heel Up	MEAN DIA.	8" x 8"x1" Angle
17	Square Tube	INSIDE DIA.	24" x $\frac{1}{2}$" Tube
18	Rectangular Tube The Easy Way (Y-Y Axis)	INSIDE DIA.	20" x 12" x $\frac{5}{8}$" Tube
19	Rectangular Tube The Hard Way (X-X Axis)	INSIDE DIA.	20" x 12" x $\frac{5}{8}$" Tube
20	Square Tube Diagonally	MEAN DIA.	12" x $\frac{5}{8}$" Square Tube
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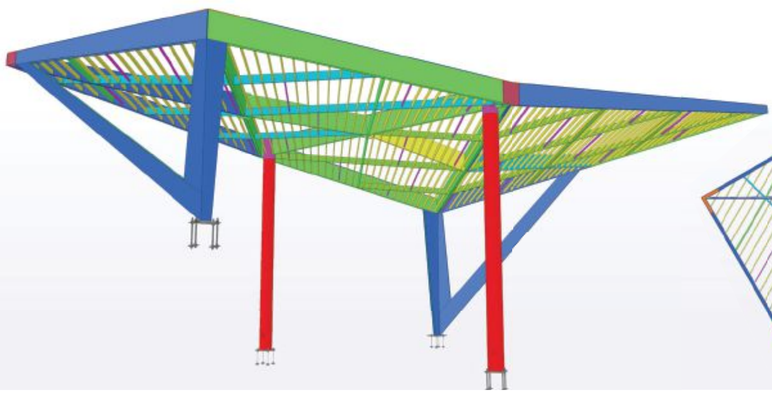
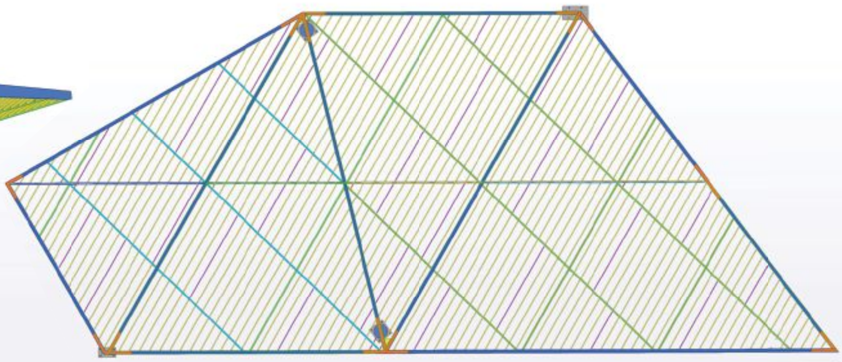
Built-up tapered columns and roof members of the shade structure.

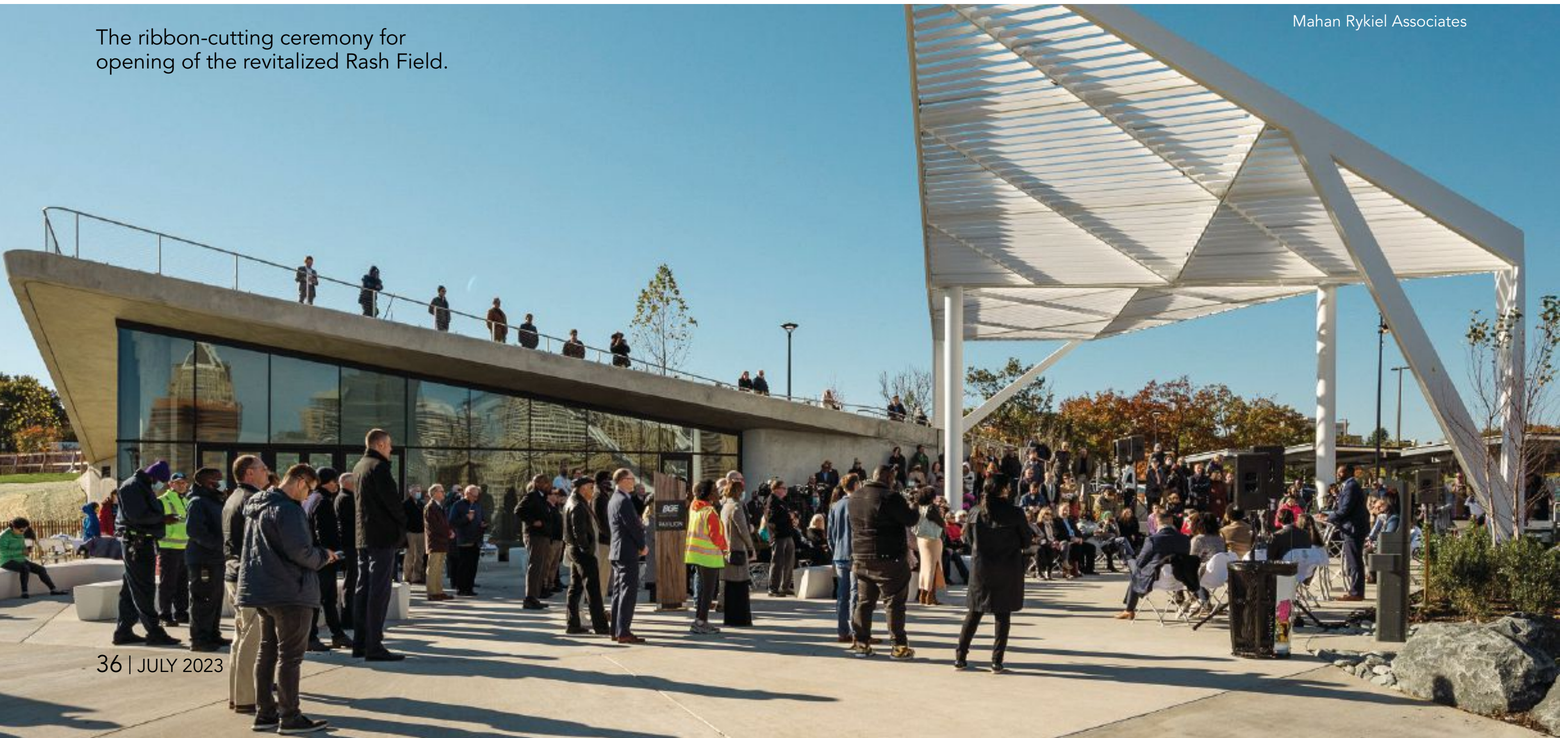
Cantilevered shade structure over Baltimore's Inner Harbor.



A digital mockup highlighting tapered column and roof member geometry. Pink members identify shallower shade fins used to support light fixtures.



A plan view of the mockup. Top plates at major beam intersections were conceived as separate pieces to aid in connection fabrication.



Mahan Rykiel Associates

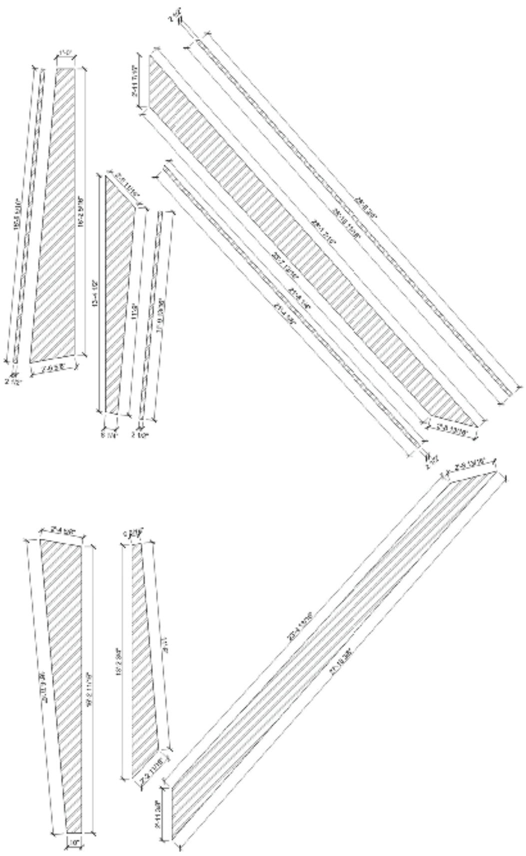
The ribbon-cutting ceremony for opening of the revitalized Rash Field.

As engineers that work with and for steel detailers, fabricators, and erectors, we are keenly aware of the risks of graphically underrepresenting steel detailing for complex assemblies.

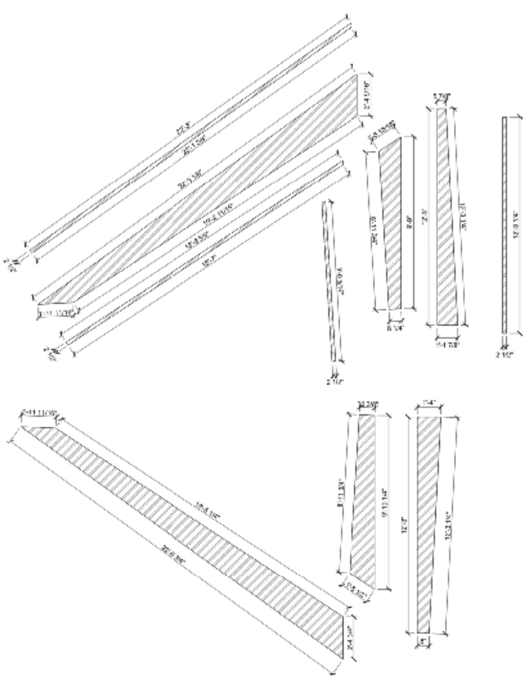
The approach for the pavilion structure was to develop the structural construction drawings as if they were fabrication-level erection and detail drawings to demonstrate that the apparently complex geometry was, at the member level, primarily standard shapes or custom shapes fabricated from flat plates. Traditional single-line diagrams identified the structure's members in plan and in a column schedule. The roof's structural members are rectangular built-up elements, designed with constant width and varying depths, and the columns were tapered in two axes along the members' lengths. The planning schedule identified all members and noted whether a member is a standard AISC shape or a custom built-up shape. For the latter, the plate size and thickness were specified. Further, every connection between primary members was detailed in plan, with each detail including the primary member interconnection details, member plate splices, and sequential assembly/welding details to demonstrate the means for fabrication. The columns were the most geometrically complex members, as they tapered in two directions perpendicular to their longitudinal axis. In addition to a traditional single-line column schedule, the drawings indicated a dimensioned plan for each plate in a column assembly.

While there is still substantial welding to assemble the final custom plate shapes, fillet and partial-joint-penetration (PJP) welding was used where feasible. The approach was validated by the fabrication drawings, which bore substantial similaritites to the construction drawings. In addition to the design drawings, the design team also produced a 3D Revit geometric model depicting the shade structure's full geometry.

Based on these design outputs, the steel fabricator created a detailed model of the structure, including each column, girder, joist, shade fin, and plate (more than 1,600 components in all), which served as a digital mockup. This allowed the design team to confirm the fabricator's and detailer's understanding and interpretation of the design drawings and enabled clear and rapid communication between the design and construction teams. This model also assisted in planning the construction sequence and identifying potential fabrication and erection challenges. In addition to the digital



COLUMN C-2



COLUMN C-3

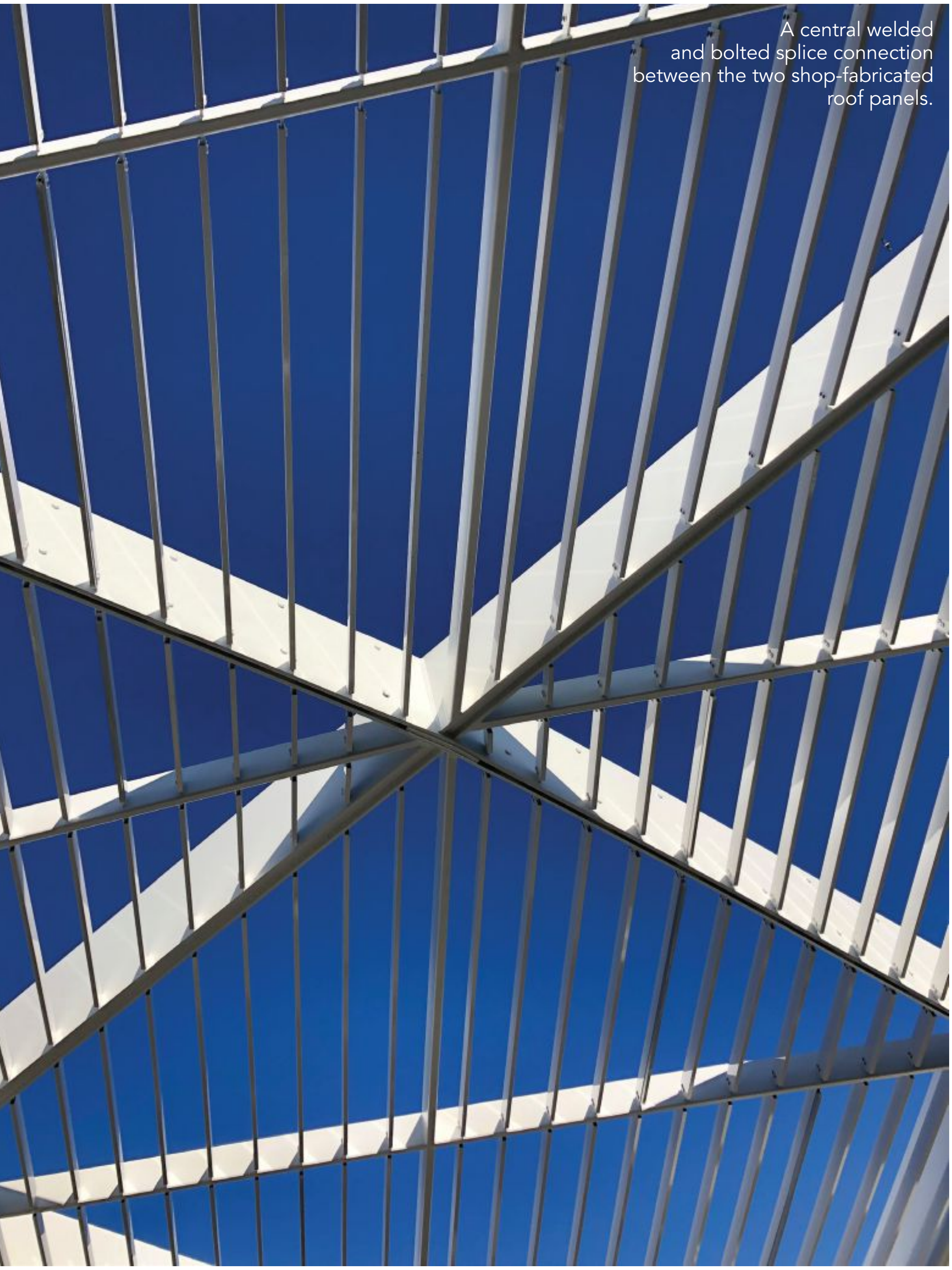
Detailed piece drawings of built-up tapered columns.

The folded plate shade structure was inspired by shorebirds rising over the water.

The completed roof structure is 32 ft wide and 80 ft long.

mockup, the fabricator further confirmed their understanding of the geometric and finish requirements by creating full-scale welded mockups of the most complex connections.

Given the structure's scale, the finish requirements posed a significant challenge to the construction team. The entire shade structure is architecturally exposed structural steel (AESS) and takes advantage of a high-performance epoxy coating paint system, stringent requirements that encouraged shop fabrication to the greatest extent possible. (Most steel elements were specified as AESS Category 1: Basic Elements, though there were a couple of columns designated as Category 2: Feature Elements not Close in View; for details on the various AESS levels, check out "Maximum Exposure" in the November 2017 issue, available at **www.modernsteel.com**.) However, at nearly 32 ft wide and 80 ft long, the complete roof structure was too large to fully fabricate in the shop and ship to the site in one piece. The team solved this challenge early in the design process by working closely with the fabricator, erector, and general contractor to limit the overall structure width and incorporate a field splice through the middle of the structure to allow for two 16-ft-wide roof panels that could be fully shop fabricated and shipped to the site. While the team maximized the amount of shop fabrication, some



A central welded and bolted splice connection between the two shop-fabricated roof panels.

connections still required field welding, and the high-performance coating system had to be omitted from field-welded areas and applied after the welds were completed.

Clear and frequent communication between the design and construction teams enabled the successful completion of this iconic project. This effort was aided by comprehensive design drawings and 3D models to communicate the feasibility of a geometrically complex structure and minimize the potential for "fear-of-the-unknown" pricing. Additionally, the inclusion of both a digital mockup and selected full-scale mockups at critical connections helped to confirm the fabricator's and general contractor's understanding of the project goals, resulting in an eye-catching new symbol at the heart of Baltimore's Inner Harbor. ■

Owner
Waterfront Partnership of Baltimore

General Contractor
Whiting-Turner Contracting

Architect
Gensler

Structural Engineer
Simpson Gumpertz and Heger (SGH)

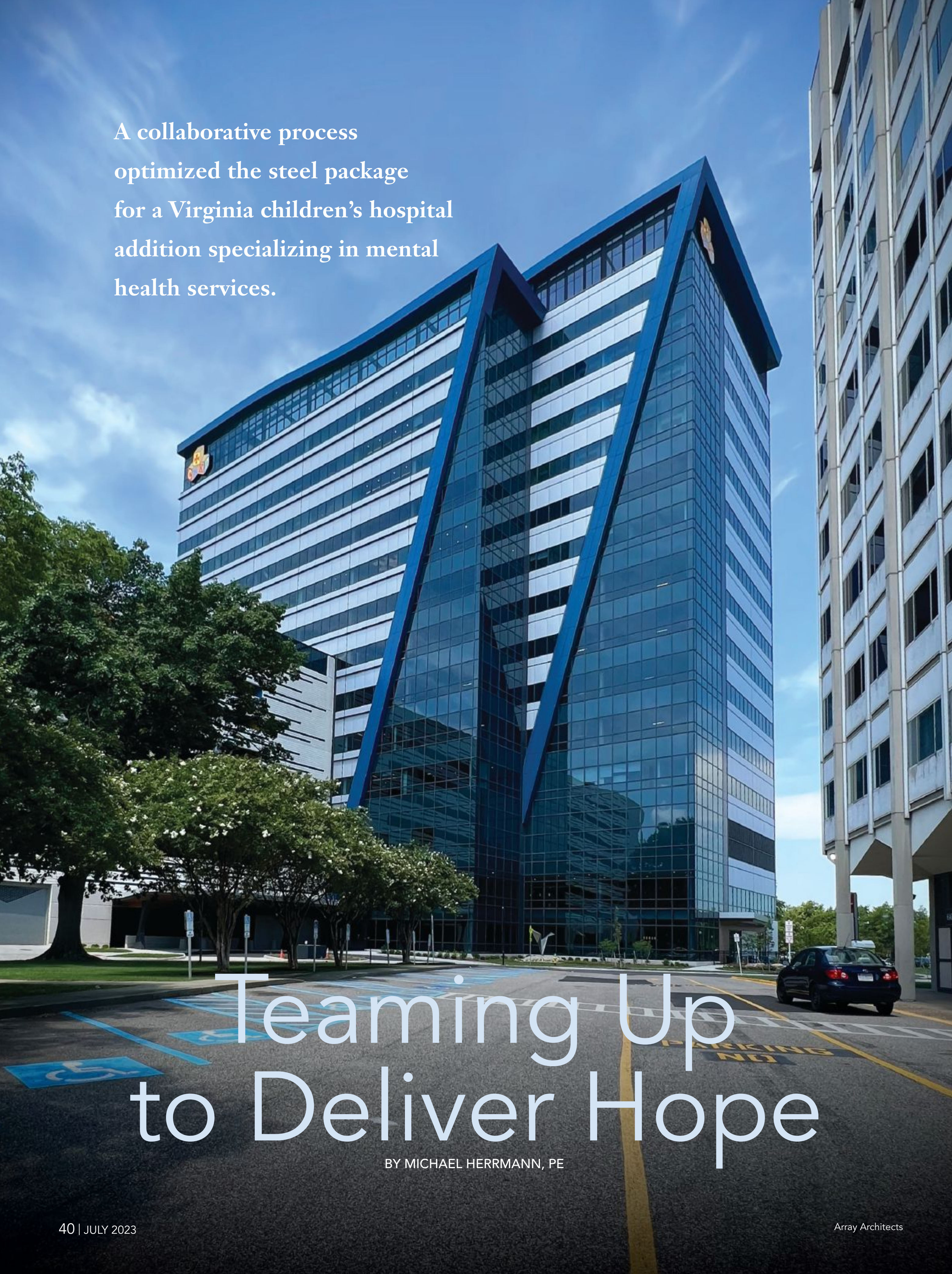
Steel Fabricator, Erector, and Detailer
Baltimore Steel Erectors (AISC),
Rosedale, Md.

Matthew Johnson is a principal at Simpson Gumpertz and Heger (SGH), **Gillian Love** is a senior project manager at SGH, **Tyler Miller** is an associate at Gensler, **Chase Slavin** is senior consulting engineer at SGH, and **Peter Stubb** is principal at Gensler.

A collaborative process optimized the steel package for a Virginia children's hospital addition specializing in mental health services.

Teaming Up to Deliver Hope

BY MICHAEL HERRMANN, PE



Array Architects

opposite page: The new $224 million Pavilion was built to increase statewide access to pediatric mental health services.

All photos, unless otherwise indicated: O'Donnell and Naccarato

Children's Hospital of the King's Daughter's new Pavilion is a 14-story, 364,000-sq.-ft steel-framed building designed to admit approximately 2,500 children for inpatient treatment annually.

CHILDREN'S HOSPITAL OF THE KING'S DAUGHTER'S (CHKD) new addition was built to fill a gap.

In 2019, the hospital reported a 300% increase in outpatient therapy visits and mental health consultations among children, a need that has only increased in the three years since the onset of the COVID-19 pandemic—which greatly exacerbated an already deepening crisis. And the new Pavilion, located on the CHKD campus in Norfolk, Va., increases statewide access to pediatric mental health services.

The only free-standing children's hospital in the state, the 14-story, 364,000-sq.-ft steel-framed building was designed to combine the power of art and healing in a sun-drenched environment that offers hope and inspiration to all who walk through its doors. Dedicated last fall, the Pavilion is expected to admit approximately 2,500 children for inpatient treatment annually while also providing 48,000 outpatient therapy appointments and adding 400 new jobs in the region.

The new $224 million facility offers a family-centered design, with 60 private inpatient beds, behavioral and specialty clinics, a multi-sensory room, an indoor gym, family lounge areas, and an expansive rooftop recreation and horticultural center. It also features a data center, mechanical penthouse, and intermediate mechanical floor to support the buildings detailed operations. O'Donnell and Naccarato provided structural engineering services for the project in partnership with Array Architects and construction manager W.M. Jordan Company. The team delivered the project using a construction-manager-at-risk methodology but incorporated many of the approaches used within an integrated project delivery method, a collaborative approach that ensures timeliness and efficiency at all phases of design, fabrication, and construction.

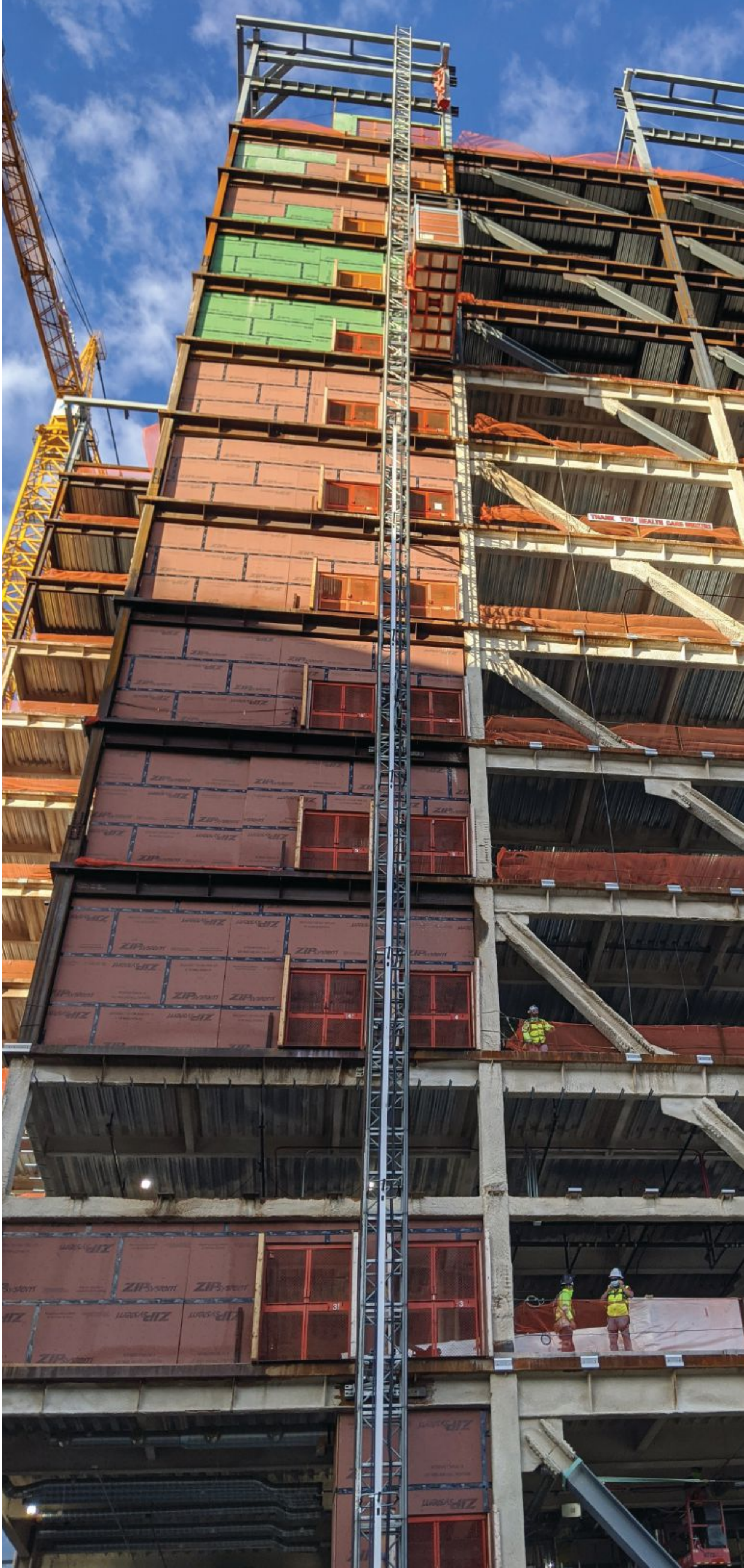
Why Steel

The Pavilion's framing system consists of structural steel beams, girders, and columns and employs a lateral-resistance system of steel braced frames designed to counter the hurricane wind loads common to the Eastern Seaboard (125 psf basic wind speed per the *Virginia Uniform Statewide Building Code*, Exposure C, Risk Category III). Wide-flange brace elements ranged in size from W14×145 at the base to W14×90 at the top, and the layout and orientation of the braces were based on the architectural floor plans.

Future flexibility was one of the reasons the team chose the steel option. As time goes by, healthcare institutions often adjust their programs to incorporate new technologies and changes in the way care is provided—and coring through slabs on metal deck is less intrusive than coring holes through cast-in-place concrete slabs, especially since these cores typically want to be drilled adjacent to columns. It is also a more straightforward process to reinforce individual members in a steel frame to account for increased equipment loads over time.

The building's typical bay size is 29 ft, 8 in. by 30 ft, the typical interior beams are W16×26, and typical girders are composite W25×55 with a 3.25-in. slab on 3-in. composite floor deck. W14×370 interior columns are used within the braces, and W14×211s are used for interior columns that aren't in braces. In addition, the team consulted AISC Design Guide 11: *Vibrations of Steel-Framed Structural Systems Due to Human Activity* (**aisc.org/dg**) to address vibration issues in the sensitive medical environment.

The structural design team determined the locations of the wide-flange steel braces in close coordination with the architect and interior designers to best meet the aesthetic and programmatic requirements. The optimal solution was to locate some braces along the exterior walls and others surrounding the core elements, which resulted in an efficient transfer of lateral loads to the ground. In addition, special considerations were made regarding the size and layout of the gusset plates to accommodate the programming. Due to the significant



The building's framing system employs a lateral-resistance system of steel braced frames designed to counter the hurricane wind loads common to the Eastern Seaboard.

Regular "pull plan" meetings (involving plenty of sticky notes) were held throughout the design and construction schedule, with a goal of streamlining tasks and eliminating wasted efforts such as redesign. The team also held weekly check-ins to ensure that the appropriate benchmarks were met and to coordinate construction efforts between the lower and upper floors.

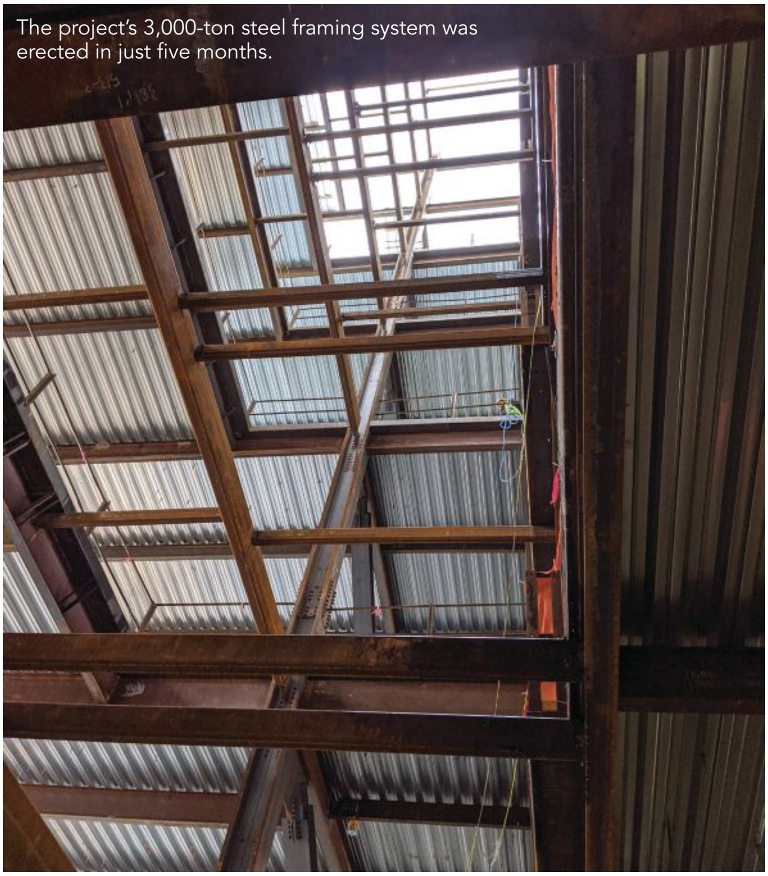
brace loads, large gusset plates were required to transfer the forces. These gusset plates needed to be reviewed on an individual basis to ensure the architectural layout was not affected.

The main building and an adjacent new precast parking garage share foundations along their common grid line. The team evaluated the use of traditional auger-cast piles and displacement piles, which both limit the vibration transmitted to surrounding structures in a sensitive healthcare environment. Displacement piles were ultimately selected due to their increased capacity and ability to minimize drilling spoils during installation. All 548 piles were installed within two months of mobilization.

Working through a Pandemic

Initial design contracts for the project were signed in August 2018, the groundbreaking took place in October 2019, and the first steel was placed on March 12, 2020—just four days before the pandemic shutdowns halted work across the country. The health crisis forced all industries, construction included, to adapt and find new ways of working safely to ensure the virus spread was mitigated. Thankfully, CHKD was designated as an "essential facility," and construction was allowed to continue throughout the public health crisis. WM Jordan quickly enacted COVID protocols, which maintained the safety of the workers in the field while adhering to the construction schedule. Fabricator SteelFab worked with AISC-certified erector Mid-Atlantic Steel Erectors to plan the steel sequencing early and with precision. Given the small laydown area, there was constant communication regarding what would fit best in a sequence. Mid-Atlantic worked five days a week, ten hours a day—and often on Saturdays—to stay on schedule to erect the project's 3,000 tons of steel on time in just five months.

Regular "pull plan" meetings were held throughout the design and construction schedule with full team participation. Pull plans are a key part of the Lean Design Methodology, which incorporates input from all stakeholders to create a dialogue among partners that aims to eliminate 'waste' during design and construction. The goal of a pull plan is to streamline tasks and eliminate wasted efforts such as redesign, which can be caused by not having all of the information required to efficiently complete the design the first time. The team held weekly check-ins to ensure that the appropriate benchmarks were met and to coordinate between outpatient construction on the lower levels and behavioral health on the upper floors. Steel topped off on the structure in August 2020, and the Pavilion officially opened to patients in October 2022.



The project's 3,000-ton steel framing system was erected in just five months.

This life-changing project will impact countless children Virginia and across the region. The construction of the structural components went smoothly, and the time spent during the design-assist period was incredibly beneficial to the end product. The steel framing system provides flexibility and resilience in this high-wind market, and the hospital will continue to serve families with compassion for many years to come. ■

Owner
Children's Hospital of the King's Daughter

Construction Manager
W.M. Jordan Company

Architect
Array Architects

Structural Engineer
O'Donnell and Naccarato

Steel Fabricator
SteelFab of Virginia, Inc., AISC Certified Fabricator Emporia, Va.

Michael Herrmann is a principal with O'Donnell and Naccarato.

A press-brake-formed tub girder solution comes to the (speedy) rescue to replace a washed-out bridge in Tennessee.


Valmont Industries

Fast-Acting Tub Girders

BY GUY NELSON, SE, PE

"WATER IS THE DRIVING FORCE OF ALL NATURE," said Leonardo da Vinci.

Although the element sustains life, it has a destructive side as well. When bridges collapse during a flood, for example, it usually isn't the pressure of the water that causes failure. Instead, the water erodes the ground surrounding a bridge's supporting structure, causing it to wash out.

In the summer of 2022, authorities in Sevier County, Tenn., announced that Jones Cove Road (State Route 339) near Wilhite Road would be "closed indefinitely" because of a washed-out box bridge. Parents worried that children wouldn't make it to school before the bell on rerouted buses, and residents mapped out new, significantly longer commutes to work. The bridge was long overdue for repair, rated by the National Bridge Registry with a score of 22.9 out of 100—the second-lowest-rated bridge in the country.

"Indefinitely," however, takes on a whole new meaning with the help of innovative bridge-building technologies like steel press-brake-formed tub girders (PBFTG), originally developed by the Short Span Steel Bridge Alliance, led by the American Iron and Steel Institute (AISI) and the National Steel Bridge Alliance (NSBA).

Exceeding Expectations

After the Jones Cove Road bridge failed in 2022, officials sprang into action, immediately meeting with suppliers to determine the best solutions, completing surveys, geotech drilling and environmental reports, and submitting permits. Initial estimates indicated a full repair of the bridge would extend into 2023. However, implementing a PBFTG system—specifically, the U-BEAM system developed by fabricator Valmont Industries (see sidebar)—the beams were designed by the Tennessee Department of Transportation (TDOT) and supplied within six weeks, and the bridge reopened a mere three months later. The new 52-ft-long span comprises two 10-ft-wide travel lanes, one in each direction, with 5-ft shoulders on either side. This superstructure required five Valmont U18 U-BEAMs, using ⅜-in.-thick galvanized steel plate. These shallow beams also allowed for increased under-clearance for future flooding concerns.

Not only are the U18 U-BEAM tub girders shallow, but they are also very light. The five girders were delivered with two standard-sized truck trailers and required no special freight permits for oversized or overweight loads. Once they arrived at the job site, all five were simply installed with a small crane in a single day.

opposite page: This superstructure required five steel tub girders built from 3⁄8-in.-thick galvanized steel plate.

All photos: Charles Blalock and Sons unless otherwise indicated

The new 52-ft-long Jones Cove Road bridge comprises two 10-ft-wide travel lanes, one in each direction, with 5-ft shoulders on either side.

"TDOT has been a proponent and leader in accelerated bridge construction (ABC) for several years," said Ted Kniazewycz, director of TDOT's Structures Division, noting that U-BEAM's development coincided with the development of the ABC philosophy. "With the Valmont fabrication facility opening in Tennessee at the time of this project being developed, U-BEAM was an obvious choice for consideration. We had reached out to several different fabricators who could supply various beam systems for this location, but Valmont was by far the only fabricator who could deliver its system on an accelerated schedule to meet our project needs." In addition, TDOT was able to design the abutments in-house and use standard design tables for the beams, with the standard details being furnished by Valmont.

Kniazewycz explained that the aggressive schedule was a direct result of the lengthy detour forced upon the community.

"The contractor was able to deliver the project several days ahead of schedule, which provided savings for the department and reduced the roadway user costs and inconveniences to the traveling public," he noted. "The simplistic design, ease of erection, and overall stability of the structural system all helped shorten the project delivery time."

"Some common misperceptions of steel bridge beams is that they are expensive, require a lot of maintenance, and have a long lead time," said Guy Nelson, product development director at Valmont. "We have eliminated all of those concerns with our dedicated PBFTG steel fabrication plant that has a fast turnaround and a very large capacity. Standard lead times are as little as ten weeks. We delivered the PBFTGs to the Tennessee DOT in only six weeks after shop drawings were approved."

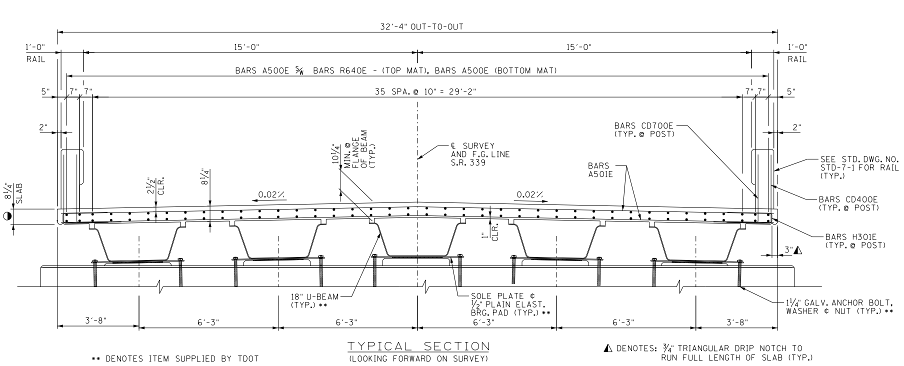
Valmont also has simplified and automated fabrication procedures to not only fabricate faster but also cheaper by eliminating or reducing expensive manufacturing processes like welding, and its PBFTG system also features a maintenance-free hot-dip galvanized coating, allowing the system to last up to 100 years with little to no maintenance.

Looking Ahead

The U.S. economy relies on infrastructure—roads, bridges, rail, ports, electrical grids, and internet connections—but many of these systems were built decades ago, and rising maintenance costs are holding communities back. As a result, many economists forecast that the foreseeable future will be focused on upgrading infrastructure. An early 2023 Brookings Institution report, "The start of America's infrastructure decade: How macroeconomic factors may shape local strategies," noted that currently, "most of the $1.25 trillion in infrastructure spending approved by Congress and signed into law by President Biden is still sitting in the federal government's bank account waiting to strengthen and modernize

above: Tub girders being produced in Valmont's facility.

below: A typical section view of the bridge, showing all five tub girders.



Valmont Industries

The bridge replaces a previous span that was washed out in the summer of 2022.

Challenge Accepted

In 2009, the Federal Highway Administration (FHWA) challenged the North American steel industry to develop a cost-effective short-span steel bridge with modular components. The Short Span Steel Bridge Alliance organized the Modular Steel Bridge Task Group, which comprised 30 organizations, to develop ideas to meet this challenge. In 2011, Karl Barth, PE, PhD, a professor of civil and environmental engineering at West Virginia University, and the rest of the group determined that technology featuring a shallow steel press-brake-formed tub girder (PBFTG) was the best choice to meet the FHWA's goals for economic value and innovation. The idea went from concept to reality in just three years.

Standard PBFTG shapes can be designed by any qualified engineer and manufactured by any qualified fabricator. Executives at Valmont Industries, the fabricator for the Jones Cove Road bridge, saw a lot of promise in the PBFTG, drawing on their existing knowledge of state DOT regulations and experience manufacturing products for the lighting, transportation, and wireless communication industries. The company now operates a purpose-built plant for production of its own PBFTG products, which bear the U-BEAM trade name. These bridge systems use a performance-proven cold bending method that is approved for both state DOT and FHWA–funded projects. The girders can also be hot-dip galvanized to protect from corrosion and reduce maintenance needs.

"The U-BEAM was developed to allow local agencies, such as counties and municipalities, to save bridge replacement funds," noted Guy Nelson, product development director at Valmont. "This was done by reducing material price to allow the agencies to purchase the beams directly from Valmont and then save installation costs by building the bridges themselves. However, since its inception, and many very successful local agency projects, it has also been found to be a cost and time-saving product for state DOTs and bridge contractors because it eliminates welding in the field for shear studs and eases formwork installation, reducing labor and equipment costs."

In addition, the system's light weight contributes to significant savings in transportation and installation. The beams can be delivered using national freight carriers, with up to six beams on one standard trailer, are easily unloaded with light rubber-wheeled equipment, and can be set into place with small cranes or track hoes. They even can come with a concrete deck pre-installed to accelerate construction and improve site safety.

The company has developed design guidelines for the product, including a selection chart that calculates the distance each beam can span—anywhere from 20 ft to nearly 100 ft. For standard highway vehicle loading, a U12 can span up to 45 ft, a U18 up to 65 ft, a U24 up to 75 ft, a U30 up to 85 ft, and a U33 up to 95 ft.

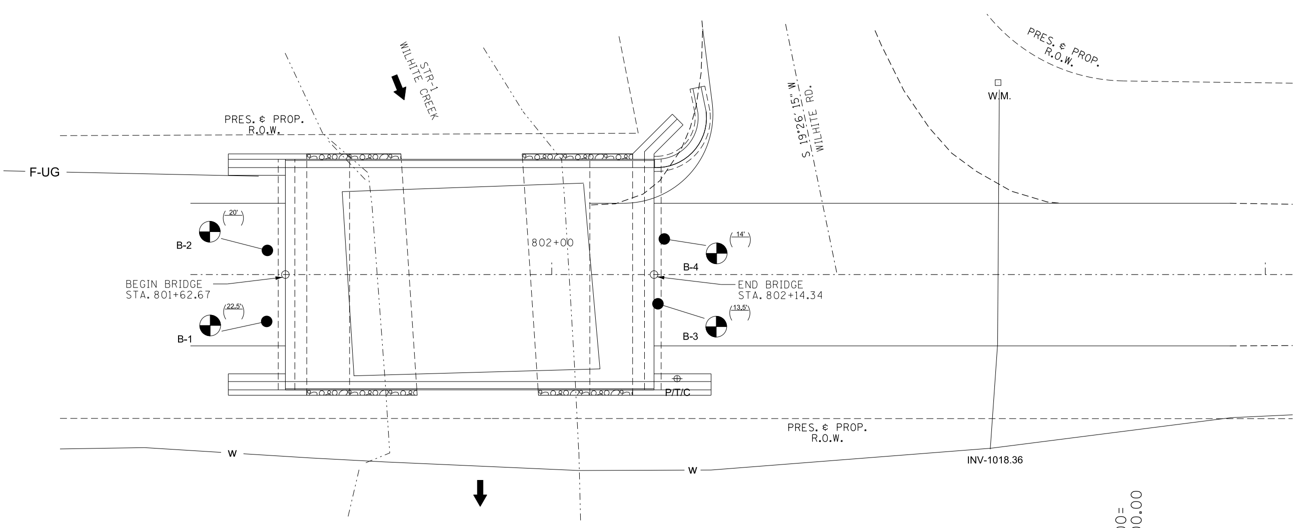
TDOT is developing new standard drawings with NSBA allowing the use of tub girders for future state bridge projects.

The tub girders can be delivered using national freight carriers, with up to six beams on one standard trailer.

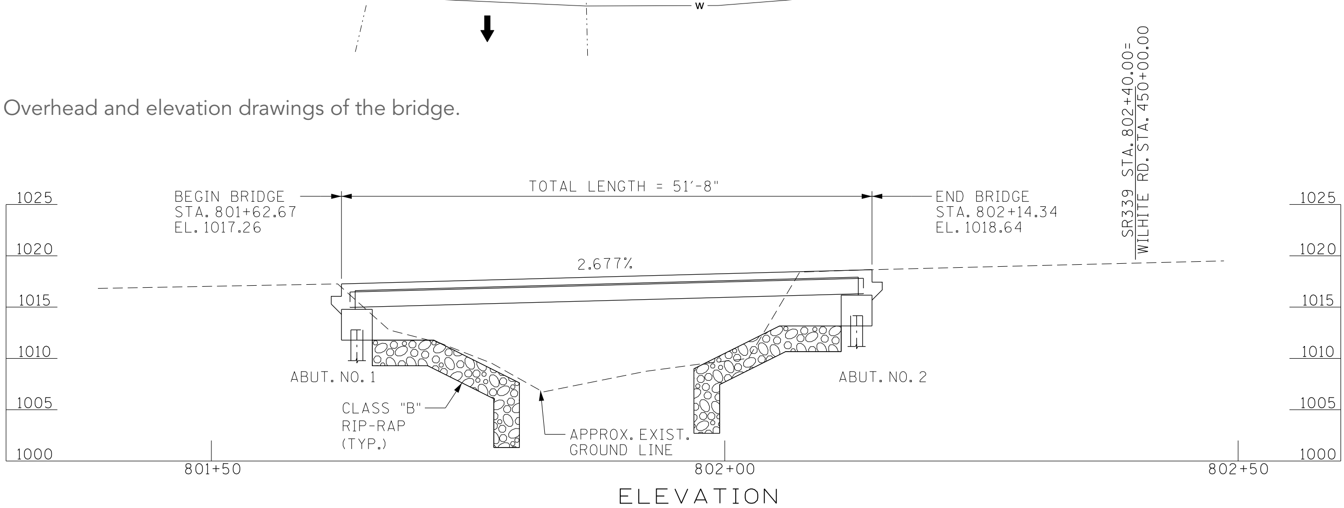
the country's economy and communities. Yet, even at this early stage, governments and their industry partners have little time to get their infrastructure plans in place. Achieving their goals won't be easy—any one of multiple challenging economic conditions could limit the number of projects that get completed."

As the Jones Cove Road project illustrates, PBFGTs present an excellent option for state DOTs when it comes to knocking out projects quickly and staying two steps ahead of any changes to economic stability. Kniazewycz noted that TDOT plans to continue the system for future projects.

"TDOT is developing new standard drawings with NSBA that will allow local governments the opportunity to use these types of beams for bridges for which they have ownership and maintenance responsibility," he noted. "These beams should be competitive



Overhead and elevation drawings of the bridge.



The team was able to deliver the project several days ahead of schedule, which provided savings for TDOT.

The tub girders were hot-dip galvanized to minimize maintenance needs.

with other steel and concrete beam types, which should help keep overall costs competitive."

Owner and Structural Engineer
Tennesee Department of Transportation

General Contractor
Charles Blalock and Sons, Inc.

Steel Fabricator and Detailer
Valmont Industries (AISC CERTIFIED FABRICATOR), Jasper, Tenn.

Guy Nelson (**guy.nelson@valmont.com**) is a product development engineer with Valmont Industries.

Every year, NASCC: The Steel Conference's exhibit hall includes the latest innovative solutions for creating and building successful structural steel projects.

2023 Hot Products

This year's NASCC: The Steel Conference, which took place in April in Charlotte, was the biggest yet, bringing together nearly 6,000 industry professionals. It also featured more than 300 exhibitors who brought an array of useful products, services, equipment, and machinery designed to make one or multiple steps in the steel supply chain easier, more efficient, and faster. Following are some of the innovative offerings from the show.

All product, software, and service information was submitted by the manufacturers/developers/providers. This list does not constitute an endorsement by *Modern Steel Construction* or AISC.

Hot Layout System

Precision Steel Systems' PLS-624 railing and miscellaneous metals layout system offers unmatched line quality and a price point to get the rapid return-on-investment fabricators need from new equipment. With effortless design translation from CAD file to layout table, you can build error-free designs more quickly, dramatically reducing production time, all while allowing your most talented fabricators to use their valuable time and effort elsewhere. The PLS-624 was designed by fabricators with an ergonomic profile that allows rail layout all the way to the edge of the table while leaving the cables tucked underneath to avoid a trip hazard. The entire system can be placed and running in a day and is powered by a single 110-volt outlet. For more information, visit **www.precisionsteelsystems.com**.

Hot Sustainable Jumbo Sections

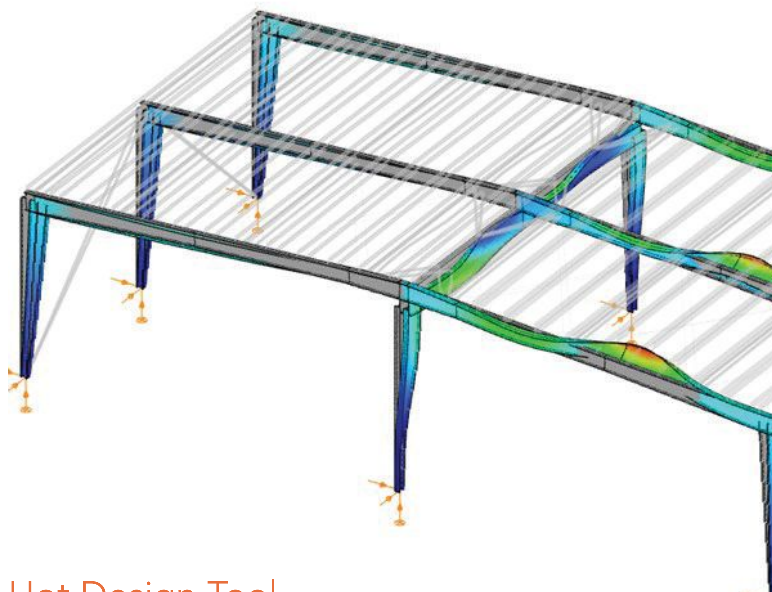
Nucor's W44×368, W44×408, W40×655, W27×539, and W14×808 structural steel sections are now available in both ASTM A992 and Aeos™, the producer's ASTM A913 high-strength structural steel. Nucor is currently the only domestic producer of these sections. Melted with over 95% recycled content using low-carbon EAF technology, Aeos is an ideal solution for both the design and sustainability challenges of modern steel construction. Aeos is the only domestically produced ASTM A913 in North America, providing stakeholders with reliable access to the structural steel they need. In addition to its high strength-to-weight ratio, it also boasts substantially reduced preheat requirements compared to A992, making it an efficient and cost-effective material. For more information, visit **nucor.com/aeos**.

Hot Identification

InfoSight's KettleTag PLUS EZ (patent pending) is a metal identification tag designed specifically to identify steel throughout the galvanization process. It is "EZ" because, unlike other galvanizer tags, it doesn't need to be laminated after it is printed to survive the galvanizing process. The tag is 3 in. wide with a customizable length—typically 1 in. to 6 in.—and is available on 300-ft rolls with precut holes and slots. A LabeLase30XX printer is recommended for printing the tags with custom messages that can include barcodes, QR codes, alphanumeric characters, and graphics. For more information, visit **www.infosight.com**.

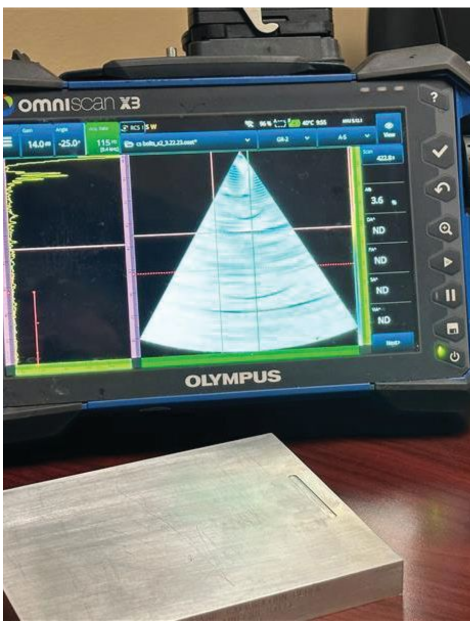
Hot Bolt Coating

Infasco's new INF3013 coating system is specifically designed for tension-control bolts. The hydrogen-embrittlement-free coating is approved for ASTM F3125 Grade A325 and is the only system approved for ASTM F3125 Grade A490 bolts. It offers superior corrosion resistance, providing 1,000 hours of salt spray protection, and the thin coating allows coverage of the threads of the nuts, providing complete protection of the fastening system. The lubricant embedded in the system produces repeatable performance regardless of environmental conditions. Wet or dry, hot or cold, the parts tension properly. The thin film coating allows for a standard socket to be used for installation, meaning no special socket is needed. In addition, it readily accepts paint, providing an enhanced finished project. For more information, visit **infasco.com/en/2023/05/31/the-next-generation-of-tension-control-bolts**.



Hot Inspection

Terracon Consultants now offers phased array ultrasonic testing (PAUT) for steel structural weld inspection, corrosion inspection, piping inspections, bolt inspections, and many other possibilities. PAUT provides faster, safer, and more accurate inspections while also being able to inspect difficult-to-access areas. For more information, visit **www.terracon.com**.



Hot Design Tool

Consteel is a cutting-edge software package designed by engineers specifically for engineers. Unlike other software that relies on traditional design procedures, it employs advanced technology to push the boundaries of design and deliver efficient and accurate results for the stability and buckling of steel structures. Consteel takes the design process to a new level, allowing users to understand their structure's stability response based on more than just deformed shapes due to loading and internal force diagrams. The software provides direct access to the results of a linear elastic buckling analysis, which is crucial in solving stability problems. This is one of the unique features of Consteel: its ability to provide previously unexplored information through elastic buckling shapes. This information is essential in understanding how to strengthen a structure efficiently. The software supports various types of steel members, including hot-rolled, welded, and cold-formed members, as well as prismatic and non-prismatic, built-up members with web tapering. This makes Consteel the only commercial software available that can perform a full 3D analysis and design of a complete pre-engineered metal building, including primary and secondary members. For further information, visit **www.consteelsoftware.com**.

Hot Welding System

The Voortman Fabricator robotic welding system offers structural steel fabricators the flexibility to choose between fitting or fitting and full welding with ease. It has been designed to help overcome the challenges of delivering projects on schedule, especially with the steady decline in the availability of skilled fitters and welders. The system comes equipped with an automated work preparation process, which is powered by innovative cloud software. It is also capable of preparing complete models instead of just modeling each assembly. The built-in software calculates the feasibility and production times based on the models and phases, using automatic sequencing for fitting and fitting and welding. It's an all-in-one package that simplifies the whole process. For more information, visit **www.voortman.net**.

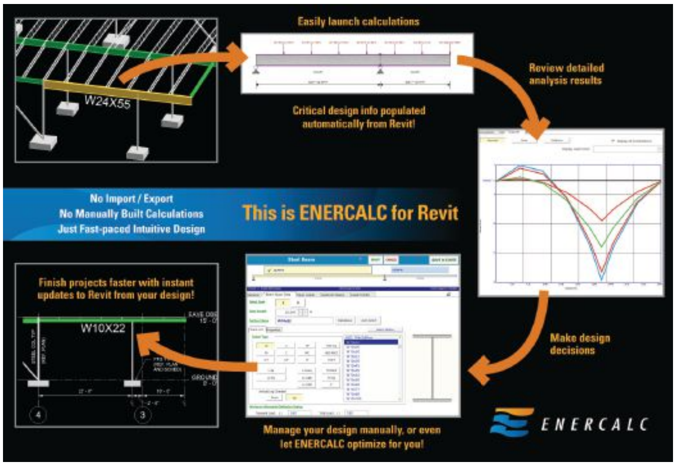
Hot Wrench

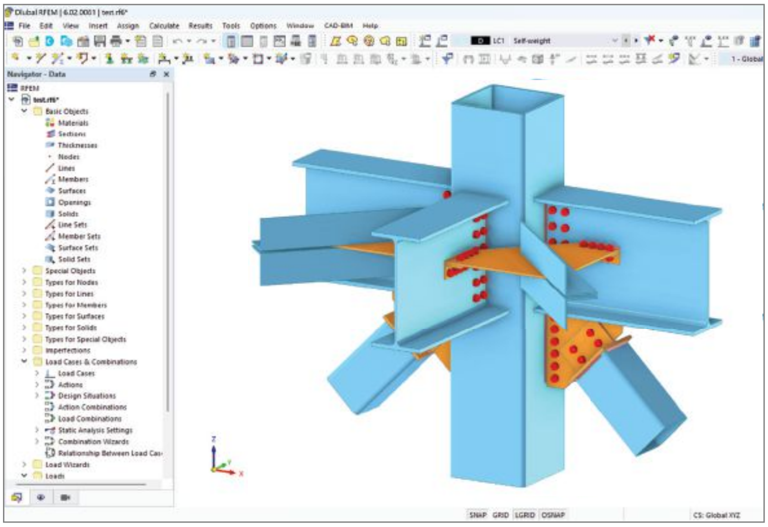
GWY's electric torque wrench line has expanded with the addition of the Cordless Nut Runner (CNR) series. With five new models available to purchase or rent, these nut runners provide enhanced user experience and mobility around the job site. Compatible with ½-in.- to 1⅛-in.-diameter hex-head bolts, the CNR series is equipped to handle any project or application with a combined controllable torque range of 110 ft-lb to 1550 ft-lb. Each wrench features a new DC brushless motor, clockwise and counterclockwise torque control, battery capacity display, torque setting dial, and LED indicator lights. Bolt installations are completed with repeatable accuracy, speed, and the ability to tighten as many as 80 to 240 bolts on a fully charged battery. These torque wrench tool kits provide efficiency and convenience with the inclusion of two powerful 36V/18V lithium-ion batteries, a battery charger, and a carrying case. Available accessories include digit torque meters, square drive sockets, and bar sockets. For more information visit, **www.gwyinc.com**.

HOT products

Hot Calculations

ENERCALC is a proven, powerful design program consisting of 40+ structural calculation modules, ranging from simple component designs to analysis (e.g., rigid diaphragm torsion), earth retention, and full 3D FEM analysis. The program's powerful capabilities and simple, intuitive interface make it ideal for the complete design of small and medium structures, as well as for spot checks, verifications, and design of miscellaneous components on large-scale projects. The latest offering, ENERCALC for Revit, brings the familiar power of ENERCALC directly into Autodesk's Revit BIM environment. Structural engineers can now create and manage calculations and update Revit models faster than ever with a seamless real-time design experience that bridges the gap between design and documentation. For more information, visit **www.enercalc.com**.





Hot Analysis

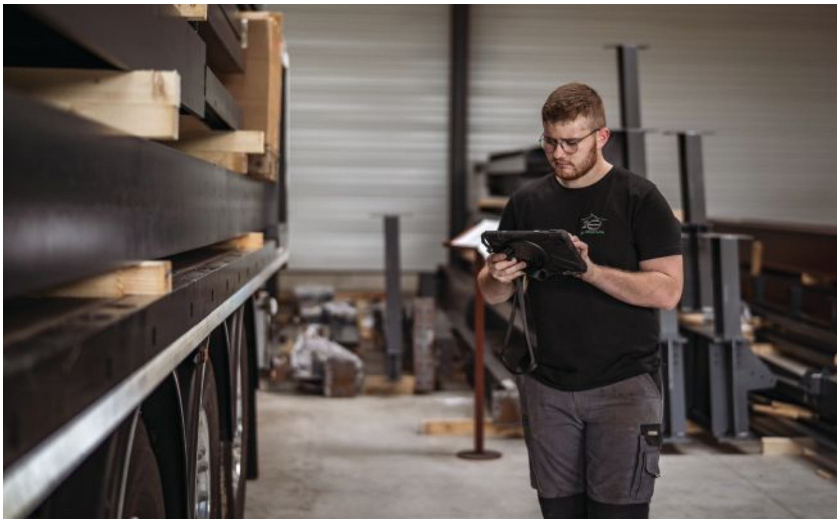
Dlubal's finite element analysis (FEA)/structural analysis software package RFEM 6 now includes AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) connection design information. Design goes beyond a standard analytical model with the automatic creation of an FEA model internally, allowing the design of unique or non-standard connections. Choose from the extensive library with predefined steel connection templates or create your own. Because the design of the global structure is possible all within the program, all member end forces are automatically considered in the steel connection design. AISC bolt, weld, and plate checks are included. A buckling sub-model is also automatically created to determine the various buckling failure mode shapes of the plate elements. For more information, visit **www.dlubal.com**.

Hot Double-Robot Welder

AGT's BeamMaster robotic welding system is now even more productive with the option to add a second robot. This new dual-robot system, the BeamMaster Twin +, enables fabricators to perform welding tasks simultaneously, increasing overall productivity while reducing downtime. With both robots working in tandem, the welding process becomes more streamlined and efficient, providing maximum productivity. The BeamMaster Twin + has also been improved with AGT Robotics' new SnapCam 3D vision system, which employs advanced sensing and imaging technologies to identify welding joints rapidly and accurately. This method improves welding efficiency by reducing joint finding times and enhancing arc-on-time production. The BeamMaster robotic welding system has grown even more powerful and precise with the addition of the SnapCam 3D, offering manufacturers a cutting-edge solution for their welding requirements. For more information, visit **www.agtrobotics.com**.

Hot Purchasing Tool

Bryzos is pioneering the revolutionary way to trade steel with its latest desktop app, "Gone In Sixty Seconds." This instant pricing tool allows buyers to purchase carbon steel and sellers to claim active purchase orders in a minute or less. No more quoting. No more waiting. Just instant transactions. This desktop app is free to use and free to download. Bryzos originally operated as a B2B online steel marketplace, facilitating trades between buyers and sellers using more traditional methods of RFQs and price negotiations. After building out the network and learning user behavior, the operational shift became obvious to set the market price to eliminate quote fatigue and dramatically accelerate the procurement process. For more information, visit **www.bryzos.com**.

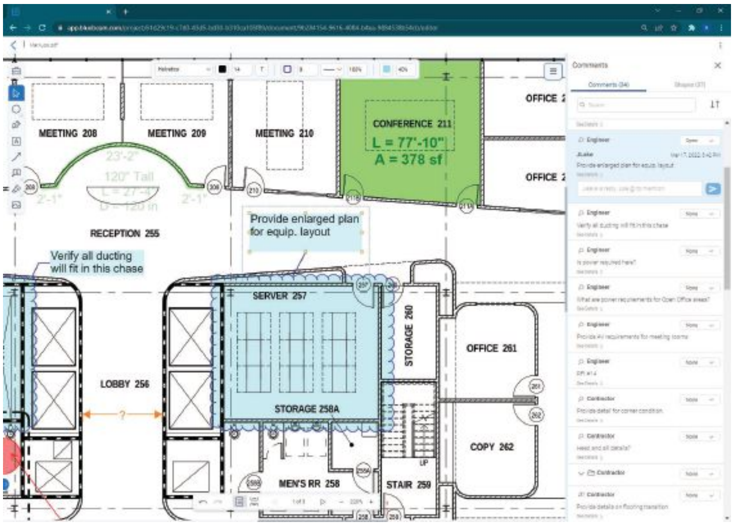


Hot Tracking

Steel Projects PLM lets users track what is happening on the shop floor at any time via live, automatic feedback from CNC machines and manual stations. Information includes whether an operator is logged in, the ability to program work orders and track those in progress, current messages and alerts, last feedback received, machine or station status (on or off), preventive maintenance information, remaining workload, and parts being loaded or unloaded on benches. Users can also check the advancement of projects at different levels thanks to color codes applied to all desired steps on the shop floor and can be applied in a 3D model. For more information, visit **www.steelprojects.com**.

Hot Review Tool

Bluebeam Cloud is a suite of mobile and browser-based solutions and an extension of Bluebeam Revu, which is now available via subscription. We want to enable our customers to tackle current challenges: rising prices, labor shortages, and a lack of productivity and collaboration. It enables them to deliver better outcomes on every project. Designed to address the connectivity needs of the construction industry in the office and the field, Bluebeam Cloud and Bluebeam's flagship desktop-based solution Revu are now bundled together in subscription plans for the first time. All subscribers will also receive unlimited data storage, an entire library of Bluebeam University on-demand training resources, plus dedicated technical support. New Bluebeam subscribers can also expect to see additional services added to the subscription offerings in the future. For more information, visit **www.bluebeam.com**.



Hot Bracing

The Simpson Strong-Tie Yield-Link brace connection (YLBC) is an innovative solution for isolating damage while ensuring braced frames within structural steel buildings remain intact during a seismic or wind event. YLBC creates a highly resilient steel braced frame system for lateral-force resistance, with performance comparable to a buckling-restraint brace frame (BRBF) system. It employs field-bolted and replaceable steel fuse plates as the brace-to-gusset connection to be the primary source of energy dissipation, thus protecting the steel beam, column, brace, and connections. With pre-designed, bolted connections, it simplifies design work, eliminates the need for field welding, and is easy to incorporate into new builds or retrofits. YLBC gives fabricators, erectors, engineers, building owners, and contractors a proven, efficient, and more economical solution for structural steel. The YLBC is supported by our connection software and design support services that provide the functionality and technical expertise to help you quickly develop, model, and document complete designs matched to your project's unique specifications—while staying on time and within budget. For more information, visit **www.strongtie.com/ylbc**.

Hot Automated Estimation

SketchDeck.ai has developed LIFT, an automated material take-off software that is changing the way estimators work in the steel industry. It is the first solution for structural steel take-offs that uses machine-learning technology to identify beams and other structural elements automatically from 2D engineering drawings. By automating the material-counting process, LIFT saves estimators valuable time that was previously spent on tedious, repetitive tasks. With LIFT, what used to take hours can now be done in a matter of minutes, reducing human error and ensuring accuracy and efficiency in the estimation process. The time saved allows estimators to bid more projects, improve their win rates, gain more confidence with their material take-offs, and build relationships with clients. For more information, visit **sketchdeck.ai**.

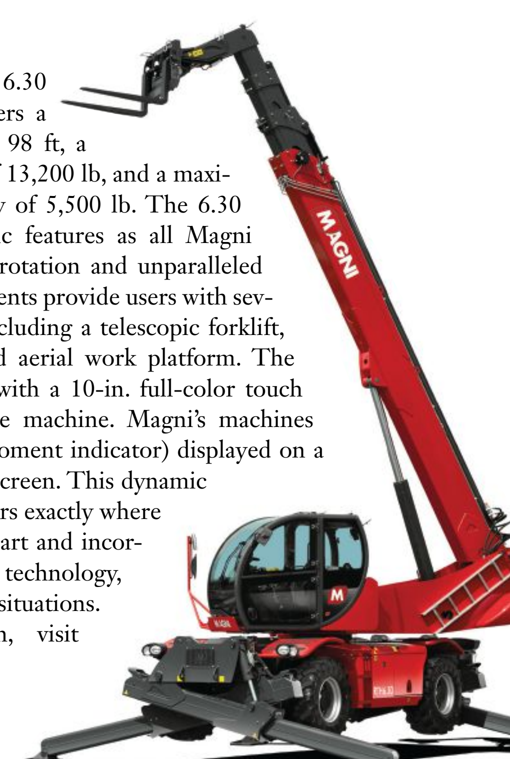
Hot Detailing Tool

SDS2 by ALLPLAN is the ultimate solution in steel detailing, covering all your project needs in structural and miscellaneous steel and automated connection design, along with seamless BIM integrations to enhance your workflows from estimating to fabrication and delivery. Our latest release delivers even more power to help you do more with less and achieve maximum efficiency. Some of the top new features and enhancements include:

- Modeling enhancements for material operations and other specialized features
- Tagging system for surface finishes
- New and refined connections, including welded HSS braces
- Display options for end reactions on member ends
- .NET API enhancements for developers and partners

For more information, visit **www.sds2.com**.

Hot Lift



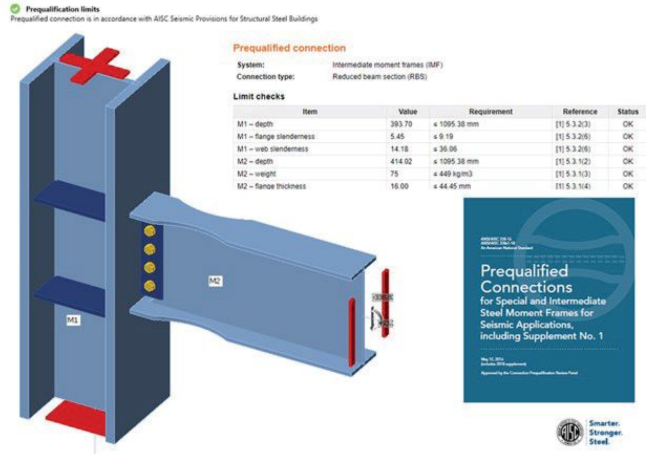
Magni's powerful RTH 6.30 rotating telehandler offers a maximum lift height of 98 ft, a maximum lift capacity of 13,200 lb, and a maximum lift height capacity of 5,500 lb. The 6.30 offers the same dynamic features as all Magni models, including 360° rotation and unparalleled safety. Over 100 attachments provide users with several machines in one, including a telescopic forklift, rough-terrain crane, and aerial work platform. The RTH 6.30 is equipped with a 10-in. full-color touch screen for operating the machine. Magni's machines have a full LMI (load moment indicator) displayed on a digital, full-color touch screen. This dynamic load chart shows operators exactly where the load is within the chart and incorporates load-limiting technology, which prevents overload situations. For more information, visit **www.magnith.com**.

Hot Barcoding

Working towards the goal of increasing the speed at which a steel project can be fabricated and erected, P2 Programs' newest product, STSX, provides fabricators, painters, galvanizers, and erectors with extreme mobility in barcoding using phones, tablets, and other devices. STSX is a web-based application that brings real-time tracking information to your fingertips to significantly reduce decision-making time. Barcoding with STSX increases the speed of your existing processes and negates the inefficiencies that have been accepted as standard operating procedures (SOP) for far too long. The benefit is clear: STSX will improve production by reducing decision-making time and errors while also providing a reduction of needed manpower and manhours. All the above leads to a decrease in hours and an increase in productivity. Using STSX barcoded steel provides for a virtually error-free data collection environment while saving money and employee time with a return on investment of approximately one year. For more information, visit **www.p2programs.com**.

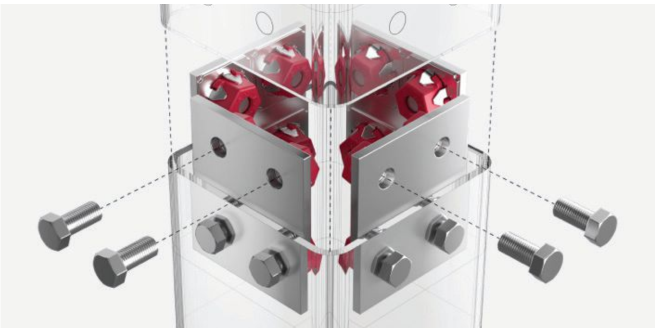
Hot Training

Worker Efficiency has created a library of 140-plus online video training courses focusing on structural steel processes from fabrication to erection process, how to read drawings, OSHA qualifications, forklift operation, and more. The videos are designed to speed up and simplify training the next generation of steel construction workers by means of an internet connection without skimping on the details of what future employees need to know. The courses are the result of two years of case studies, research, and development to make sure that the information that is taught is streamlined and accurate to modern standards. For more information, visit **www.workerefficiency.com**.



Hot Connection Design

IDEA StatiCa 23 includes several enhancements designed to help you streamline your workflows, win back valuable time and money, and eliminate risk. Significant updates for U.S. customers include the addition of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-22) and Canada's CSA S16:19: *Design of Steel Structures* as well as the addition of qualification checks for seismic prequalified moment connections, including reduced beam sections, bolted unstiffened/stiffened extended end plates, bolted flange plates, welded unreinforced flange—welded webs (WUF-W), and double-tee moment connections. For more information, visit **www.ideastatica.com**.



Hot Bolting System

Atlas Tube's Shuriken Structural Nut Keeper now allows for field-bolted HSS column splices and other connections with faster assembly and lower costs than welding. Shuriken technology makes HSS the obvious choice for structural steel projects and now includes the new 1-in. size, in addition to existing ¾-in. and ⅞-in. sizes. Shuriken holds a nut in hard-to-reach places, allowing you to bolt what you would otherwise have to weld. Simply tack weld Shuriken to metal plates in the shop, bolt to an apparatus, then field splice. Because there are no labor-intensive and time-consuming field welds, and connections are more likely to pass inspection quickly, Shuriken can significantly speed up a project's timeline. For more information, visit **atlastube.com/shuriken**. ■

ARCHITECTURAL AWARDS

Four Steel Projects Win AIA Awards for Design Excellence and Environmental Performance

Structural steel is making its mark on sustainable design, catching the attention of industry professionals who recently presented some of 2023's biggest architecture awards.

The American Institute of Architects (AIA) recognized four (and a half!) steel projects among its 27th annual COTE Top Ten Award winners, a lineup of 10 projects that integrate design excellence with environmental performance.

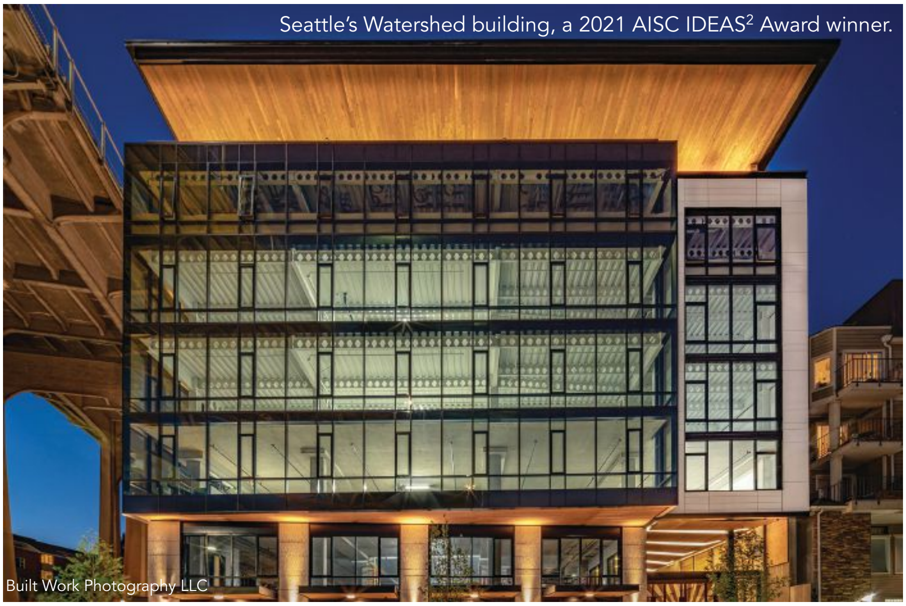
Winning steel structures included the Harvard University Science and Engineering Building, the Nueva School Science and Environmental Center, RIDC Mill 19, and Seattle's Watershed. One winning project, the Sacramento Zero Net Office Building, employs a hybrid system using both steel and cross-laminated timber.

RIDC Mill 19 in Pittsburgh, designed by MSR Design, reimagines the former Pittsburgh Jones and Laughlin Steel Company mill in the context of its new role as a research base for multiple advanced manufacturing partners—while retaining the structure's original steel skeleton! The new research center boasts the U.S.'s largest array of rooftop solar panels in addition to a rainwater recycling system.

The Harvard University Science and Engineering Building in Cambridge, Mass., designed by Behnisch Architekten, uses the existing foundation of a project whose construction was halted in 2008. The 497,000-sq.-ft steel-and-glass structure houses the John A. Paulson School of Engineering and Applied Sciences, with classrooms, research labs, and amenity spaces inside and a green courtyard outside.

The Nueva School Science and Environmental Center in Hillsborough, Calif., designed by Leddy Maytum Stacy Architects, provides an integrated education hub that focuses not only on the classroom but also on its surroundings. Flexible learning environments include outdoor spaces that extend the experience into the surrounding community while modeling healthy, low-carbon living.

Seattle's sustainability-minded Watershed building, designed by Weber Thompson, also won a 2021 AISC IDEAS^2 Award (check out the May 2021 issue at **www.modernsteel.com**). The 61,000-sq.-ft office building uses castellated steel beams to increase natural light in the interior space and contribute to the design's flexibility—while cutting 20% to 30% off the weight of the beams, which allowed the team to use smaller lateral system elements. The building's impact goes beyond its walls, as its downward-sloped filtration system can treat up to 400,000 gallons of stormwater from the adjacent highway each year, protecting the water quality in nearby Lake Union and the salmon migration route that runs through it.



Seattle's Watershed building, a 2021 AISC IDEAS^2 Award winner.

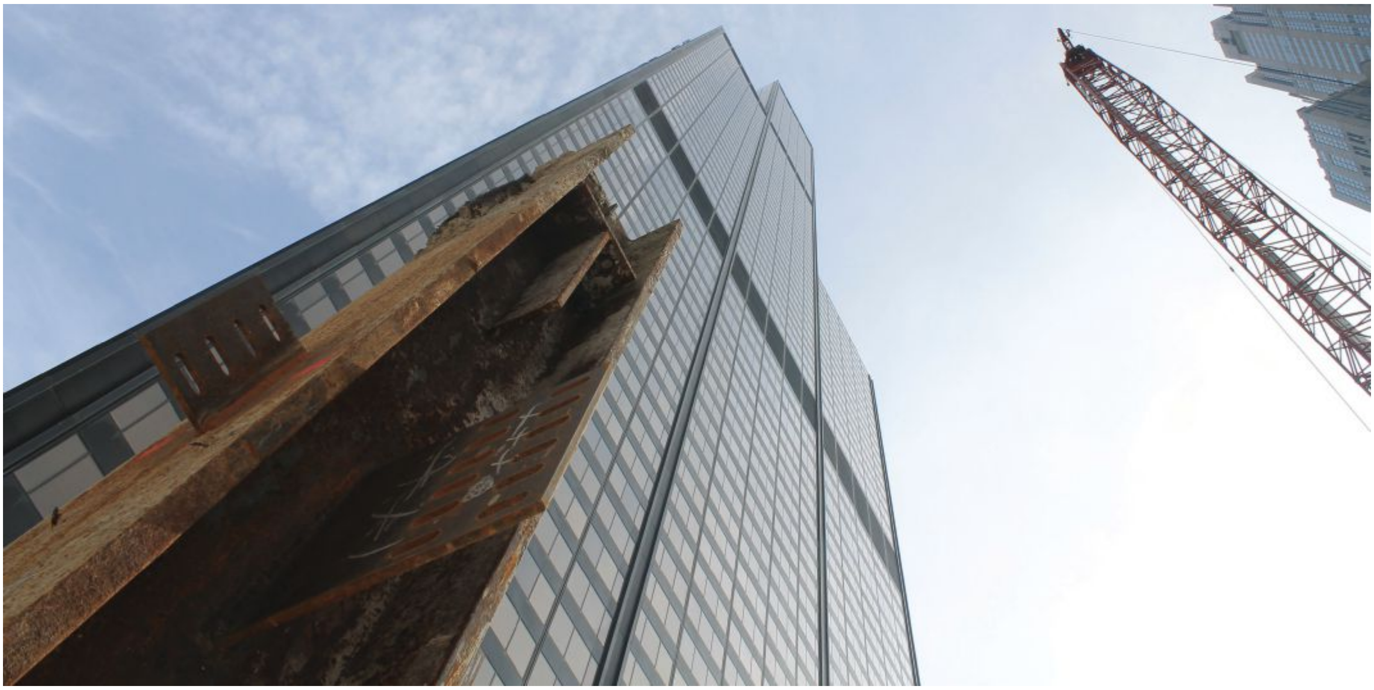
Built Work Photography LLC

People & Companies

Bob Paul recently retired from the **Steel Deck Institute (SDI)**. In May, he celebrated 50 years in the steel deck industry, the last ten of which have been as SDI's managing director. Previously, Bob spent 40 years in sales and project management for Epic Metals. Since 1991, he was also involved in the SDI as a director, committee chair, and officer. SDI has accomplished a great deal during Bob's tenure, including significant expansion of both membership and research, publication of numerous ANSI standards that have been adopted by the building codes, adoption of a plant certification process to enhance the credibility of the membership, and publication of an industry environmental product declaration. Replacing Bob as managing director is **Ken Charles**, who has served as the managing director of the **Steel Joist Institute (SJI)** for the past 12 years and will add management of the SDI to his responsibilities at SJI. Ken has been in the joist and deck industry for 46 years and through his tenure at SJI, has worked closely with many SDI members and code organizations. He will continue to advance SDI's involvement in research and look to find ways to support designers and users of steel deck.

STEEL ICONS

A Pioneer in Bundled-Tube Design, Iconic Willis Tower Turns 50



Fifty years after its opening in May 1973, Willis Tower stands tallest among Chicago's 126 skyscrapers and remains an icon in its cityscape.

Formerly named (and widely still known as) the Sears Tower, the 1,450-ft-tall building, designed by Skidmore, Owings & Merrill (SOM), revolutionized the tubular system that has continued to inform contemporary architectural design.

John Zils, a native Chicagoan and retired SOM associate partner, walked by the Willis Tower construction site every morning on his way to work in the early 1970s when he was employed as a structural engineer with the company. On his visits, Zils saw firsthand many of the intricacies—and quirks—that went into building what would be the world's tallest skyscraper for the next 22 years.

"Here was a massive building—76,000 tons of steel—and speed was essential," Zils recalled. "[The erectors] would erect two floors a week, which was very quick. The column sections were two stories high, so they would erect those columns, and when they hit two levels, then they could do the floor framing."

At 110 stories high, the structure was a feat for its time and the first to employ the bundled-tube system introduced by lead structural engineer Fazlur Khan, who was also the mastermind behind another Chicago landmark, 875 North Michigan (formerly the John Hancock Center). Khan's tubal design innovation set a precedent for SOM, and the completed Willis Tower embodied the designers' belief that a building's structural makeup should permeate its form. Khan spoke extensively with Modern Steel Construction about the bundled-tube approach back in 1972.

Willis Tower's nine steel-framed tubes allowed it to reach its envisioned height with monumental efficiency, requiring only 33 lb of steel per sq. ft (the Empire State Building, in comparison, required 66 lb per sq. ft). Each tube has 75-ft-long sides, for a total of 225 ft on each side of the building.

"It had to be more than just a tube," Zils said. "It had to be something stronger, something stiffer, and [the solution] was to bundle the tubes."

Each of Willis Tower's bundled tubes is intrinsically rigid with no internal supports, according to SOM. As Zils emphasized, speed was crucial in completing a project of this scale in a timely manner—and the contractor, Morse/Diesel (now AMEC), had to get creative to sustain that efficiency, he said. Instead of bringing all the workers down for lunch and back up again, they brought in a moveable lunch cart and hoisted it up to the level of the building at which they were working each day.

"They would stay right onsite, and it was a very efficient way to do it," Zils said. "They could eat and not lose a lot of time."

The contractor also positioned cranes on all four sides of the base of the building so that when American Bridge Company trucks brought in pieces of steel, they could be lifted directly into place on the building, Zils said. The steel never touched the ground.

"With most projects, they bring the steel to the site, and it's offloaded from the truck onto the ground or some staging area, then sorted out and lifted into place," Zils said. "Sears Tower wasn't that way."

Since 1974, visitors to Willis Tower have lined up for the ear-popping elevator ride to the 103rd-floor observation deck—the highest vantage point for 50 years of change.

Icons don't remain static, of course. Willis Tower got a new base in 2019! Learn more about it in "A Steel 'Base-Lift'" in the August 2020 issue. You can also flip through a collection of images, including a couple of animated models, in our Project Extras section (**www.modernsteel.com**).

ENGINEERING JOURNAL

Third Quarter 2023 *Engineering Journal* Now Available

The third quarter 2023 issue of AISC's *Engineering Journal* is now available (**aisc.org/ej**). This issue includes papers on fire behavior of shear tab connections, second-order analysis and stability design, cost premiums for special moment frame buildings, and chevron gussets.

Component Modeling for Fire Behavior of Shear Tab Connections
James A. Gordon and Erica C. Fischer

During a building fire scenario, the behavior and capacity of gravity connections can significantly contribute to the integrity of steel-framed building structures. Because gravity connections are subjected to axial and flexural force demands and have a limited rotational capacity due to large beam rotations during a fire scenario, a connection model is needed to simulate their behavior when using analytical models to simulate the behavior of a steel structure in fire. This study develops a component model for shear tab connections at ambient and elevated temperatures in the open source finite element program OpenSees to further enable the use of OpenSees for simulating steel structures in a fire. The developed component model is benchmarked against experimental tests of isolated connections and a structural assembly with shear tab connections subjected to mechanical and thermal loads. Through benchmarking, it is shown that (1) the developed component model could be used to simulate connection behavior during a fire scenario and (2) simulating the ductility of connections and connecting components due to damage is critical when simulating the behavior of shear tab connections exposed to fire.

Application of AISC *Specification* Requirements for Second-Order Analysis and Stability Design
Rafael Sabelli, Allen Adams, and David Landis

Design for stability is inherent in the proper design of every steel structure. As such, every engineer using the AISC *Specification* (2022) must understand the requirements for stability design and how their own methods (including computer analyses) address the relevant considerations. This discussion provides specific, concise guidance on the application of AISC *Specification* requirements for stability design and second-order analysis for the practicing engineer.

Construction Cost Premiums for Risk Category IV SMF Buildings
Paul W. Richards and Amy J. McCall

The *International Building Code* uses Risk Categories to reduce the probability of damage and collapse for certain buildings. One proposal for improving post-earthquake functional recovery is to design more buildings as Risk Category IV. The purpose of the study was to investigate the construction cost premiums for Risk Category IV buildings with steel special moment frames (SMF). Mathematical derivations were used to bind the stiffness and strength amplifications required for Risk Category IV design, accounting for period effects (as buildings are strengthened/stiffened, design loads increase). To complement this mathematical approach, twelve case study SMF buildings were designed with heights ranging from two to sixteen stories. The primary conclusion of the study is that construction cost premiums for drift-governed SMF buildings are an order of magnitude greater than for strength-governed buildings. For many strength-governed buildings, the cost premium for Risk Category IV design is around 1% of the total building cost. For drift-governed SMF buildings, the cost premiums for Risk Category IV design are 6-16% of the total building cost, with the greatest premiums for buildings around eight stories. These cost premiums should be considered when evaluating Risk Category IV design as a strategy for improving post-earthquake functional recovery.

Closure: Design for Local Member Shear at Brace and Diagonal-Member Connections: Full-Height and Chevron Gussets
Rafael Sabelli and Brandt Saxey

BRIDGES

NTSB Update on Fern Hollow Bridge Highlights Urgent Infrastructure Maintenance Needs

The 2022 collapse of Pittsburgh's Fern Hollow Bridge is a call to action: Infrastructure maintenance and repairs must be an urgent priority for the nation.

On May 18, the National Transportation Safety Board (NTSB) released a report (available at ntsb.gov/investigations) highlighting the importance of proper bridge maintenance—something departments of transportation across the country frequently need to defer due to funding constraints.

"Bridge failures are sudden, but they do not begin suddenly," said National Steel Bridge Alliance (NSBA) chief bridge engineer Christopher Garrell, PE. "We are continually reminded of the state of the nation's infrastructure, but interest is often fleeting until something catastrophic happens. All materials deteriorate, and that deterioration, when left unabated, can and will lead to failures like we saw in Fern Hollow."

AISC and NSBA applaud the NTSB for underscoring the crucial nature of bridge maintenance. As the investigation continues, we urge owners to review the condition of all bridges in the national inventory, regardless of structural material—and we urge politicians to provide owners the sustained resources they need to maintain a safe infrastructure between major funding battles.

The 52-year-old Fern Hollow Bridge was one of thousands of bridges, made from a variety of materials, that urgently need maintenance. Fern Hollow has not had an overall rating better than "Fair" since 1989 (the earliest records available in the Federal Highway Administration's InfoBridge database at **infobridge.fhwa.dot.gov**). In fact, it has had a "Poor" rating for the last ten years.

AWARD OF DISTINCTION

UH's Patrick Peters Bridges the Gap Between Architecture and Fabrication—and also the Classroom and Community

Students in any architecture program will likely learn about designing steel structures, but students at the University of Houston's Gerald D. Hines College of Architecture take it to the next level: They get to fabricate the steel used to erect their designs, then watch that steel structure make a difference to a community.

In his role as director of the UH Graduate Design/Build Studio, which he has held since 1994, Patrick Peters acquaints Master of Architecture students with the steel fabrication process to give them a more well-rounded understanding of complex design in the context of real-world community projects.

"In the process of steel fabrication and design, students learn about climate-responsive and site-responsive green building, they learn about techniques of collaboration, and they learn about the architect's role in building community," Peters said. "Hopefully, they learn about creating lasting works of architecture."

In fact, the deliberate way Peters introduces architecture students to steel fabrication inspired AISC to honor him with an Award of Distinction earlier this year.

The students working in the Graduate Design/Build Studio start by designing and modeling their projects, including creating a set of fabrication drawings. Once their drawings are complete, they have a hand in fabricating the steel for their project's structural system at the Keeland Design Lab, also at UH, as well as constructing the structure. By participating in each step of a project's creation, students gain a holistic understanding of the process of developing a steel building, which they can use on more complex projects later in their careers.

They're also getting real-world experience with a structural material that provides unique sustainability benefits. This experience will serve them well as the AEC community continues to develop with a focus on eco-friendly design and construction. American steel has a circular supply chain; it's a fully recyclable material that contains up to 93% recycled content, which makes it ideal for the buildings these students design to sustain a community.

"We provide our projects' stakeholders with a durable, elevating work of architecture that they can continue to use for many, many years," Peters said. "The Graduate Design/Build Studio has a 33-year history of designing and building permanent works of architecture for area nonprofits. Virtually all of them have been steel structures because steel constructions provide the best durability, economy of means, and responsiveness to customization as demanded by site-specific design requirements."

By overseeing architecture students as they watch their ideas evolve from initial conception to completed construction, Peters hopes his students will leave the program and embark on their careers with a wide variety of skills and values, including teamwork and community involvement.

"Ultimately, the purpose of my course is to make each student a better architect," Peters said.

(continued from previous page)

The Fern Hollow Bridge was made of uncoated weathering steel (UWS), which is a modern material that offers unique benefits—and like all steel bridges, it was more easily inspected than other kinds of bridges because its structural system was on full display.

For more than 50 years, bridge owners have relied on uncoated weathering steel to deliver excellent performance in diverse environments. UWS has inherent corrosion protection and doesn't require any coating applications, so the steel is ready for erection much faster than coated members. This shaves time off the construction schedule, and even long after construction, it minimizes traffic disruptions due to decreased maintenance needs. It is also more environmentally friendly than paint systems.

UWS requires careful detailing and runoff planning in the initial design phase. "Weather is not just precipitation," the University of Delaware's Jennifer McConnell, PhD, noted while presenting a decade of research about UWS performance at NASCC: The Steel Conference last month in Charlotte, and a free recording is now available at **aisc.org/learning**. "It's the chemical elements that make up that precipitation"—and controlling exposure to things like water and chlorides (frequently found in deicing agents and the air above saltwater) is the most important thing engineers can do to ensure that a structure reaches its target lifespan.

NSBA has recently released the complimentary *Uncoated Weathering Steel Reference Guide* (**aisc.org/nsba/design-resources**) that provides the latest guidance about site and location considerations, design recommendations, structural design, detailing, maintenance, and more.

AWARD OF DISTINCTION

Engineer Katie Lewis Breathes New Life into Hometown Landscape Through Steel Infrastructure Projects

For project engineer Katie Lewis at Alfred Benesch and Company, being a part of the Southeast Municipal Park Complex project in Franklin, Tenn., was an opportunity to give back to her hometown—and her work will be a fixture in the community.

Lewis and her team's contribution to the project was to construct an access road and steel bridge that drivers, cyclists, and pedestrians will use every day to access the park, which is wedged between the interstate and the fast-flowing Harpeth River.

AISC recently gave Lewis an Award of Distinction for not only her outstanding work on the Southeast Park project but also for serving as a role model for others entering the engineering field.

Lewis, a Franklin native, was eager to learn more about steel design, having worked almost exclusively with concrete in the past.

"We touched on steel in school, but I hadn't really used it in a practical application, so I was excited to learn something new," she said.

She also found the scale of the project thrilling. At over 500 ft in length, it was one of the longest bridges she'd ever designed.

"It was cool getting to 'nerd out' a little bit!" Lewis said. "I knew it was going to be a really large structure, and I had just gotten my professional engineer's license."

Lewis worked closely with the city of Franklin to develop an aesthetic for the bridge that would draw influence from the area's natural landscape and complement other completed projects throughout town. Their vision came to life in every element of the bridge's design, from the lighting installation to the stone-like effect on the railing.

"As a multi-use path, it needed to blend in and stand out at the same time," she said.

As a young woman who has worked on civil and structural projects in Tennessee for seven years, Lewis knows firsthand the long path ahead of the engineering industry toward improving gender diversity. The University of Tennessee at Knoxville alumna hopes to see more female representation in the next generation of engineers.

"There's not a lot of us right now," she said, "but we're making our way up, showing girls and women that it's not some big, scary industry to be a part of—that it's not a boys' club anymore."


Benesch

Letter to the Editor

Verify the Verification

I read your April article "Verifying the Verifier" (**www.modernsteel.com**) and have a few thoughts you might be interested in.

When I came out of school with a civil engineering master's degree in 1973, I was modeling structures right away after starting my first job. I was fortunate to have had a civil engineering PhD (Suresh Desai) for six months who was patient enough to help me along in learning more about modeling than what I was taught in school. Back then, we used IBM punch cards for the modeling input. (Yikes!) A lot of time was spent carefully numbering nodes and members, defining member directions and finite elements, and checking and double-checking the input information. In order to cut the models down because of run time, we sometimes used symmetrical boundary conditions. Output then was basically reams of 11×17 sheets with numbers that had to be carefully examined and verified to make sure things went right. There was no graphical input or output back then, and input had to be carefully thought out in terms of how and why, so output could be carefully checked.

I am near my 50 years as a practicing structural engineer and am now helping younger engineers. What I have found with young engineers is that if the graphical output shows green, everything is OK for them. But there are errors they don't always recognize. Even after the model shows green in code checking, I ask them the following:

- Did you test the basic model with test loads, and did the reactions and their locations look about right?
- Did you check the deflections to see if they look right from the test loads?
- How about using the right-hand rule?
- How about taking a node in the model and checking to see if the forces balance out?

Then there was a case where the model looked right and the program ran correctly for a young engineer, but something looked wrong in the numerical output. Two nodes 3 ft apart had a differential deflection of 3½ in. Come to find out, there was a modeling error where two members overlapped, passing each other. (Of course, this was not visible on the graphics.)

Then there was another case where a young engineer modeled a staircase high in the structure. The output reaction loads at the base of the structure looked unusual and did not add up to the wind loads. Turns out the staircase at the top had a fixed support and it sucked up reaction loads, which made the reaction loads at the base wrong.

These are just a few of the unusual things that I have picked up in checking young engineers' models. I'd love to see some kind of webinar on how to model structures correctly, focusing on checking models, test loading models, and understanding what good modeling practices with proper checks look like.

—Drew L. Chany, PE
Matrix Technologies, Inc.

Production Manager | QA/QC Manager

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advertiser index

Masamichi Ikeda and Junior Carbajal

Micro City, Macro Ambition

LET'S SAY you're looking to revitalize a small island in an industrial zone, perhaps in Portland, Ore.

There are plenty of paths to doing so, but likely none quite as attractive as what Junior Carbajal and Masamichi Ikeda (both with JRMA Architects Engineers) have come up with.

The two developed a plan involving a self-sustaining steel-framed vertical micro-city. The building has separate zones for the fundamental parts of everyday life—spaces in which to live, work, and play—brought to life with a series of modular boxes. Steel allows for a simple design with strong bolted connections for easy assembly and disassembly in a confined space. And the design can be customized and repeated wherever there's a need for it.

The concept wasn't designed for an actual project, though it certainly could be. Rather, it was one of this year's Forge Prize finalists. Established by AISC in 2018, the annual design competition celebrates emerging architects who create visionary designs that embrace steel as the primary structural component while exploring ways to increase project speed.

The Forge Prize is a unique opportunity to experiment with a conceptual design without limit to scope or complexity. The sky really is the limit, and Carbajal and Ikeda's design, dubbed Adaptive Micro Cities, successfully reaches for it!

To learn more about the project, as well as the other two finalists, check out next month's issue of *Modern Steel Construction*. You can also learn more about the competition at **www.forgeprize.com**.