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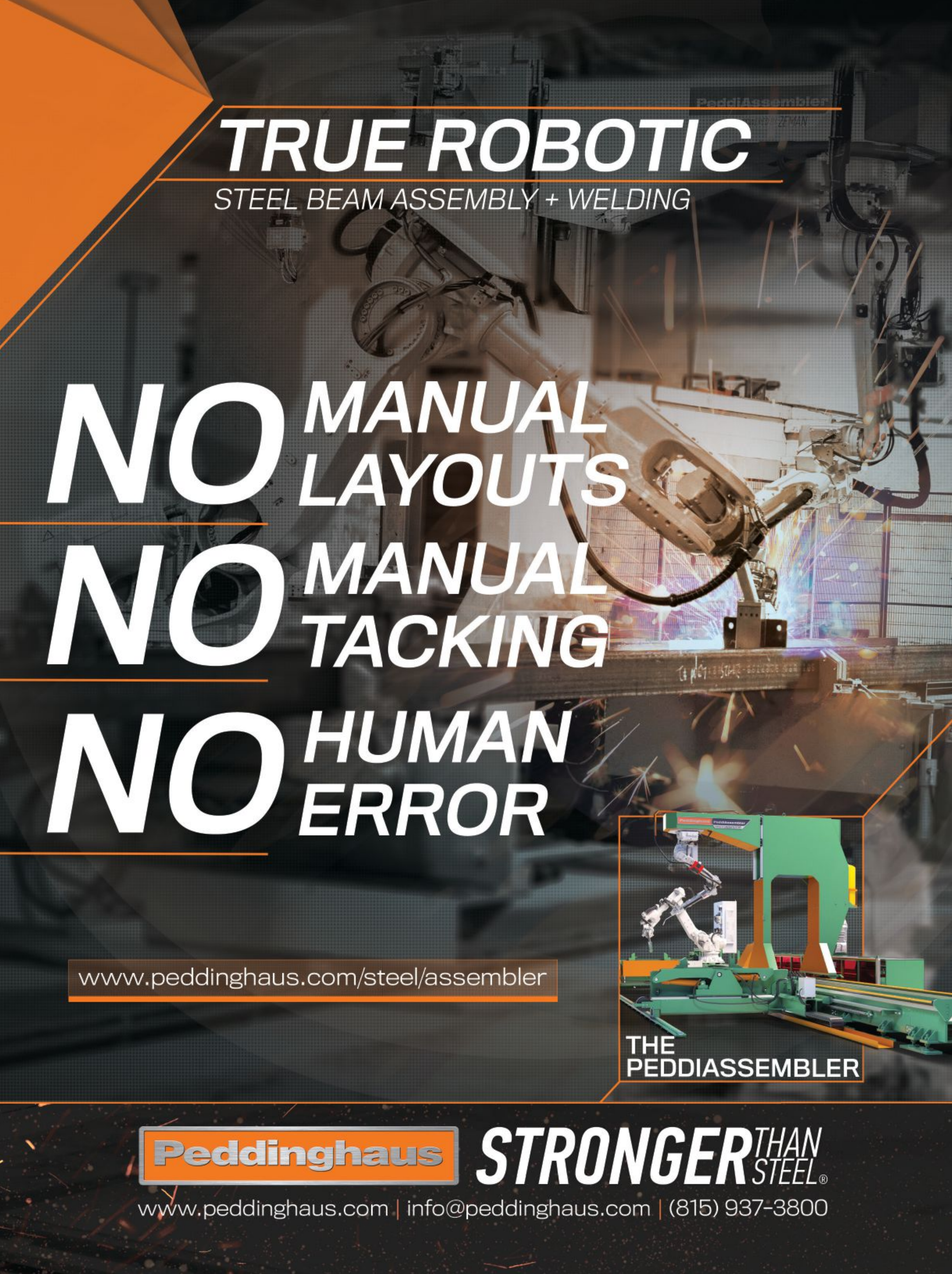
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ON THE COVER: A new steel office tower and surrounding development look to revitalize an old steel mill town near Philadelphia, p. 32. (Photo: © Connor Mayer)

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ROBOTIC WELDING OF STRUCTURAL STEEL IS HERE NOW!
IT'S TIME TO EMBRACE THE FUTURE!
CHALLENGER

editor's note

Happy new year!

Pretty cool speaker wall I'm standing in front of, right? Right? I feel like a rock star!

Ha, ha, just kidding. Those aren't speakers. What you're seeing is a large weld fume control system, which collects particulates from indoor welding operations. The "speakers" are actually filters that can be removed and emptied.

Many of you have probably seen such a machine. I hadn't—or at least I hadn't noticed them in previous shop visits. This one was at the Ironworkers Local 5 training facility just east of Washington, D.C., a stone's throw from FedEx Field, where the Washington Commanders play. The facility hosted 20 Howard University students for AISC's 2022 SteelDay celebration this past October and was one of a dozen IMPACT (Ironworker Management Progressive Action Cooperative Trust) SteelDay events that took place across the country (you can read more about these and other SteelDay events on page 52).

Finding out what a weld fume control system is and does was just one thing I learned at the event. SteelDay is all about providing awareness of the domestic structural steel industry and educating attendees on how the various components of the steel supply chain work, from early design to final construction. Every year, it offers hands-on opportunities like the IMPACT events (where attendees were able to try tasks like climbing a column, rigging and bolting beams, welding, and cutting steel with a torch), fabrication shop visits, construction site tours, and presentations and webinars.

Another educational opportunity, one that packs presentations, an exhibit hall full of product and service providers, and plenty of networking opportunities all under one roof, is NASCC: The Steel Conference. The Steel Conference is the premier educational and networking event for the structural steel industry, bringing together structural engineers, structural steel fabricators, erectors, detailers, and architects.

In addition to nearly 200 practical seminars on the latest design concepts, construction techniques, and cutting-edge research, the conference also features 250+ exhibitors showcasing products ranging from structural design software to machinery for cutting steel beams. One low registration fee gains you access to all of the technical sessions, the keynote addresses, the T.R. Higgins Lecture, and the exhibitor showcase. This year's conference takes place in Charlotte, April 12–14, and will incorporate the World Steel Bridge Symposium, QualityCon, Architecture in Steel, SafetyCon, the SSRC Annual Stability Conference, and the NISC Conference on Steel Detailing.

Registration opens on January 23, when the fee for AISC members is $405 (with discounts available for additional registrants from the same firm). The fee increases by $15 each week, so be sure to register early! Attendees can receive up to 17 PDHs. Full registration also includes lunch on Wednesday and Thursday, the Welcome Reception on Wednesday evening, and the conference dinner on Thursday.

You can learn more about the conference at **aisc.org/nascc** (and also in the conference program packaged with this issue). We hope you'll join us in Charlotte this spring!

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Deloitte Summit Tower, Vancouver
Detailed in SDS2 by Supermétal Structures
Photo courtesy of Westbank

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**.

F3148 Fasteners

We traditionally use A325/A490 bolts for the connection design. However, we have received a request from our construction group to consider using bolting assemblies manufactured to the ASTM F3148 standard. Do you have any information you can share about this new bolt standard?

An additional bolt standard, ASTM F3148, was added to the 2022 AISC *Specification*, which will be released in early 2023. ASTM F3148 has a tensile strength of 144 ksi and is an applicable material for spline drive bolts where the spline is used to pretension the bolt but does not twist off. (More details are available in the June 2022 *Modern Steel* Steelwise article: "Are You Properly Specifying Materials," which can be read at **modernsteel.com/archives**.)

The AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) lists materials that are approved for use in Section A3, including A307, A353, A449, F3043, F3111, and F3125. The User Note in this section states: "ASTM F3125 is an umbrella standard that incorporates Grades A325, A325M, A490, A490M, F1852, and F2280, which were previously separate standards."

For background, when tension-control (TC) bolts were introduced into the structural steel industry, they did not have an ASTM standard number. They needed to be approved on each project as an alternative design fastener. Over time, more manufacturers began producing their version of TC bolts with some variations. Each manufacturer also began either producing or marketing their installation tools. As time progressed, TC bolts obtained ASTM standard numbers F1852 and F2280 (now F3125 Grade F1852 and F2280). With ASTM issuing an ASTM standard for TC bolts, they are now in common use and produced by many manufacturers with proprietary tools for installation.

ASTM F3148 bolts are in a similar state that TC bolts were when they obtained their ASTM standard number. They are presently only produced by one manufacturer and require proprietary installation tools. Both the 2020 *RCSC Specification for Structural Joints Using High-Strength Bolts* and the upcoming 2022 AISC *Specification* recognize ASTM F3148 bolts for use. As pointed out in the article, F3148 bolts are produced from 144 ksi material, which is stronger than F3125 Grade F325 and F1852 bolts produced with 120-ksi material and only slightly less strong than F3125 Grade A490 and F2280 bolts produced with 150-ksi material. The advantage of F3148 bolts over F3125 Grade A490 and F2280 bolts is that they can be mechanically galvanized. You will find many references to F3148 in the 2020 *RCSC Specification*. There are a few things to consider when using a manufactured matching bolt/nut assembly. More information on topics such as ordering bolts or handling and storage that pertain to F3148 can be found in FAQ 6.2.3 and FAQ 6.4.1 at **aisc.org/steel-solutions-center/engineering-faqs**.

Yasmin Chaudhry, PE

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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**.

STEEL SOLUTIONS CENTER

Steel Interchange is a forum to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Contact Steel Interchange with questions or responses via AISC's Steel Solutions Center: 866.ASK.AISC | **solutions@aisc.org**

The complete collection of Steel Interchange questions and answers is available online at **www.modernsteel.com**.

HSS Corner Radius

I have an ASTM A500 HSS6×6×5⁄16, and I want to make sure that I miss the corner radius with a drill penetration for a self-drilling/self-tapping screw. Can you tell me the outside radius dimension for the corner?

The corner radius of a hollow structural section (HSS) can vary. Per ASTM A500, the corner radius cannot exceed three times the specified (nominal) wall thickness. You could conservatively use this value. You could also measure the actual dimension of an existing piece.

If you need to miss the corner radius with a drill penetration for a self-drilling/self-tapping screw, then you need to stay in the middle 4⅛ in. of the face.

The workable flat is somewhat larger—4⅝ in., as shown in Table 1-12 of the AISC *Steel Construction Manual*. This value, while likely closer to what you may actually get, is not guaranteed. As discussed in the *Manual* on p. 1-6: "In the tabulated workable flat dimensions of rectangular (and square) HSS, the outside corner radii are taken as $2.25t_{nom}$. The term workable flat refers to a reasonable flat width or depth of material for use in making connections to HSS. The workable flat dimension is provided as a reflection of current industry practice, although the tolerances of ASTM A500 allow a greater maximum corner radius of $3t_{nom}$." (See Figure 1.)

Larry Muir, PE

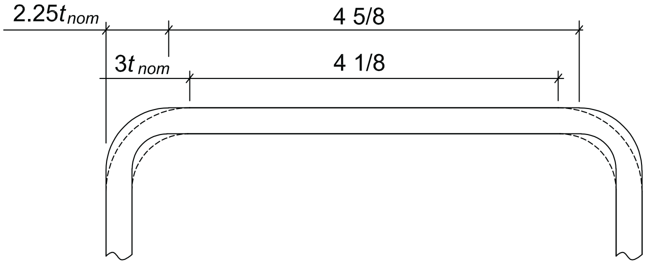

Fig. 1. Corner radii dimensions for square HSS (flat dimensions for HSS6×6×5⁄16).

Single-Plate Beam-to-Girder Connection

If you have a beam-to-girder-web connection on only one side of the girder, is there a requirement to use a full-height stiffener instead of a single-plate connection at this location?

There is no requirement for a full-height stiffener to be used in this scenario. That said, a full-height stiffener instead of a single-plate connection (see Figure 2) at beam-to-girder-web connections on only one side of the girder is fairly common. In my experience, it is specified somewhat less than 50% of the time, though it is probably used even less often in construction because fabricators often suggest the use of a single-plate connection instead of full-height stiffeners. This request is often accepted by the engineer of record (EOR).

When engineers are asked why they specify full-height stiffeners in lieu of single plates, responses vary—e.g., a common explanation is that the end of the supported beam wants to rotate, and providing a full-depth shear stiffener helps to prevent the spandrel from twisting. However, this explanation is inconsistent with both the theoretical model and observed behavior.

A full-depth stiffener does little to increase the torsional strength and stiffness of a spandrel beam and does little to resist end rotation of the supported beam under gravity loads. It seems that the full-depth stiffener ensures compatible (rigid body) movement between the end of the supported beam, the stiffener, and the spandrel beam. Rather than preventing twist in the spandrel, the arrangement seems more likely to exacerbate twist in the spandrel—and speaking to erectors and fabricator field representatives, this seems to be the effect in practice.

Larry Muir, PE

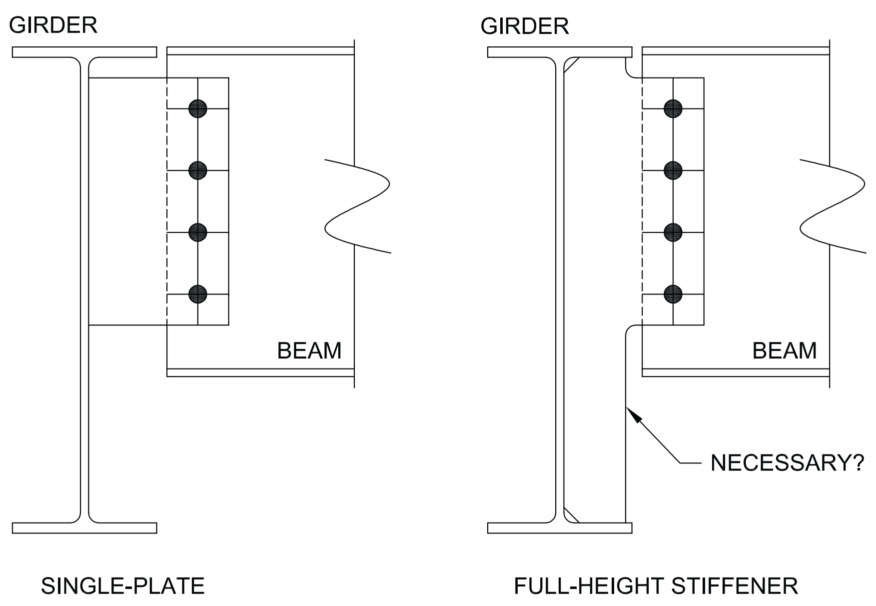

Fig. 2. Single-plate connections vs. full-height stiffeners.

STEEL SOLUTIONS CENTER

Happy New Year! We are excited about many things as we look forward to the year ahead—including the release of the 2022 *Specification for Structural Steel Buildings* (AISC 360-22)!

AISC has dedicated the 2022 *Specification* to longtime volunteer and structural behavior research pioneer Theodore (Ted) V. Galambos (see more in the News section on page 64). In honor of Galambos, often known as the "father of load and resistance factor design (LRFD)," this month's steel quiz tests your knowledge of LRFD.

1 What year was load and resistance factor design (LRFD) introduced into the AISC *Specification*?
a. 1978 **b.** 1986
c. 1989 **d.** 1993

2 In LRFD, the margin of safety for the loads is contained in load factors and resistance factors, Φ, to account for unavoidable variations in:
a. materials
b. design equations
c. fabrication
d. erection
e. all of the above

3 **True or False:** Allowable strength design (ASD) is an elastic design method based entirely on a stress format without limit states, and LRFD is an inelastic design method based entirely on a strength format with limit states.

4 **True or False:** A high resistance factor, Φ, indicates a larger variability in test data for a given nominal strength.

5 How can LRFD design strength be quickly converted to ASD allowable strength, based on the 2016 AISC *Specification*?
a. multiply by 1.7
b. divide by 1.7
c. multiply by 1.5
d. divide by 1.5

6 **True or False:** Given a specific dead load and live load on a beam, that beam designed using LRFD load combinations will have greater nominal strength, and thus greater capacity, than if the ASD load combinations had been used.

7 **True or False:** A fundamental difference between LRFD and ASD is that ASD employs one factor (i.e., the factor of safety), while LRFD uses one factor with the resistance and one factor each for different load effect types.

TURN TO PAGE 12 FOR ANSWERS

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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**.

Clues can be found in the 2016 *Specification for Structural Steel Buildings* (AISC 360-16) or the AISC *Steel Construction Manual*, both available at **aisc.org/publications**.

1 **b.** 1986. Ted Galambos is often referred to as the "father of load and resistance factor design (LRFD)" thanks to his pioneering research that led to the introduction of LRFD in the 1986 AISC *Specification* (take a walk down memory lane and download the historic 1986 *Load and Resistance Factor Design Specification for Structural Steel Buildings* at **aisc.org/publications/historic-standards**).

2 **e.** all of the above. In LRFD, the margin of safety for the loads is contained in the load factors and resistance factors, Φ, to account for unavoidable variations in materials, design equations, fabrication, and erection. Learn more about nominal strengths, resistance factors, safety factors, and available strengths in Part 2 of the AISC *Manual*.

3 **False.** It is commonly believed that ASD is an elastic design method based entirely on a stress format without limit states, and LRFD is an inelastic design method based entirely on a strength format with limit states. This is false for several reasons. Traditional ASD was based on limit-states principles too. Either method can be formulated on a stress or strength basis, and both take advantage of inelastic behavior. Design, according to the AISC *Specification*, whether it is according to LRFD or ASD, is based on limit states design principles, which define the boundaries of structural usefulness. Learn more about the design fundamentals of LRFD in Part 2 of the AISC *Manual*.

4 **False.** The resistance factors, Φ, in the AISC *Specification* are based upon research and the experience and judgment of the AISC Committee on Specifications. The higher the variability in the test data for a given nominal strength, the lower the Φ factor will be. For example, $\Phi = 0.9$ for limit states involving yielding, and $\Phi = 0.75$ for limit states involving rupture. Learn more about resistance factors in the Commentary to Chapter B of the AISC *Specification*.

5 **d.** Divide by 1.5. The ASD method provided in the *Specification* recognizes that the controlling modes of failure are the same for structures designed by ASD or LRFD. In developing appropriate values of Ω for use in the *Specification*, the aim was to ensure similar levels of safety and reliability for the two methods. The general relationship between the safety factor, Ω, and the resistance factor, Φ, is $\Omega = 1.5/\Phi$ (this relationship is described further in the Commentary to Chapter B of the *Specification*). Thus, a design strength ΦR_n can be quickly converted to an allowable strength R_n/Ω simply by dividing by 1.5.

6 **False.** The nominal strength of the beam is not dependent on the load approach used in the design. Only the resistance factor applied for LRFD and the safety factor applied for ASD differ. Depending on the relative intensities of the dead and live loads, the LRFD or ASD approach may produce a more efficient design. They are essentially equivalent at a live-to-dead-load ratio of 3 for the load combination that considers dead plus live loading.

7 **True.** Ted Galambos stated the following in the *Engineering Journal* article "Load and Resistance Factor Design," which appeared in 1981: "The fundamental difference between LRFD and the allowable stress design method is, then, that the latter employs one factor (i.e., the Factor of Safety), while the former uses one factor with the resistance and one factor each for the different load effect types. LRFD, by employing more factors, recognizes the fact that, for example, beam theory is more accurate than column theory…, or that the uncertainties of the dead load are smaller than those of the live load.… LRFD thus has the potential of providing more consistency, simply because it uses more than one factor."

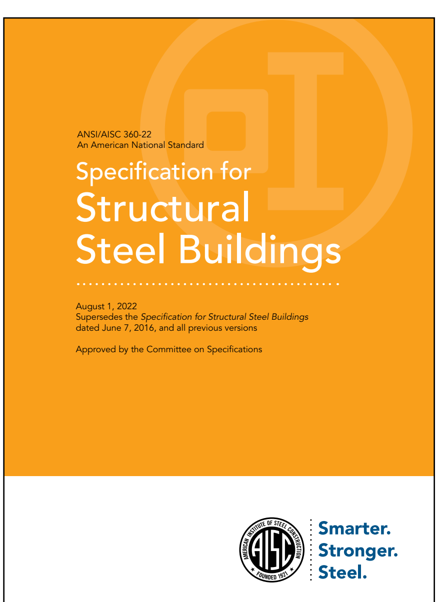
Advances in Composite Construction

BY CHRISTINA HARBER, SE, PE, JEROME F. HAJJAR, PE , PhD, AND W. SAMUEL EASTERLING, PE, PhD

Chapter I of the upcoming 2022 AISC *Specification* includes expanded options and upgrades related to composite construction.

THE INTEGRATION of steel and concrete in composite construction continues to increase in use in the U.S. and around the world.

New structural systems, higher-strength materials, and advanced design procedures that bring increased efficiencies are all driving innovation and popularity in the use of composite steel-concrete construction. As a result, some of the steel industry's most anticipated additions to the 2022 set of AISC standards are in the realm of composite construction, and designers will appreciate expanded options and upgrades in Chapter I of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-22). Two new design options include a new composite wall system and a performance-based alternative for shear connections for use in composite beams. Other areas of improvement include a new shear strength equation for filled composite members and more direction on reinforcing steel detailing for composite members.



SpeedCore

After a rigorous research and approval process, provisions for SpeedCore, the nickname for the revolutionary concrete-filled composite steel plate shear wall system, have finally made it to the *Specification*. This wall system consists of structural steel plates connected with tie bars and (optionally) with steel-headed stud anchors on the interior surfaces to develop composite action between the steel plates and concrete infill (see Figure 1). Chapter I of the *Specification* contains provisions for stiffness calculations, requirements for minimum steel, slenderness of plates, and tie bar detailing as well as determination of axial, flexural, and shear strength.

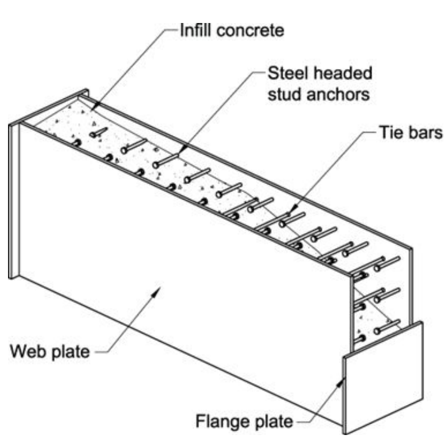


Fig. 1. A typical SpeedCore wall.

There are additional system requirements that appear in Chapter H of the *Seismic Provisions for Structural Steel Buildings* (AISC 341-22). Engineers will be able to find more information on the system, including design examples, in AISC Design Guide 38: *SpeedCore Systems for Steel Structures*, which is now available. (You can also learn more about the system at **aisc.org/speedcore** and in the December 2022 articles "Unconventional Wisdom" and "Increasing Speed through Research," both available in the Archives section at **www.modernsteel.com**. And you can access all AISC Design Guides at **aisc.org/dg**.) With successful projects such as Rainier Square Tower in Seattle and 200 Park in San Jose already constructed using the SpeedCore system, a surge in future projects using this highly efficient and rapid-to-construct structural system can be expected.

Performance-based Shear Connection Design

In the 2022 version of the *Specification*, designers may now determine the flexural strength of composite beams with shear connection configurations outside of the standard range of steel deck, concrete slab, and shear connector geometries and material properties. This can be done following the new provisions in Section I8.4, which outline the performance-based alternative for designing shear connections.

Strength, reliability, ductility, and stiffness criteria are determined for the assembly that comprises the shear connection through physical testing. If threshold criteria are met, the shear connection can be used in design and is deemed equivalent in performance to the conventional shear connection methods provided in Section I8.2. This makes it feasible to analyze a composite beam with non-standard as-built conditions or to adopt a new innovative deep deck system for design. (See "Composite Beam Possibilities" in the August 2022 issue for details on how to use these new provisions.)

Detailing Concrete and Steel Reinforcement

Structural steel, concrete, and reinforcing steel can be combined in a variety of applications for structural members in new and existing construction. Structural members, including concrete-encased and concrete-filled columns, beams, and beam-columns can be classified into three broad groups according to how the load is resisted:

- Group 1: Load is shared between steel, concrete, and reinforcing steel as a composite member
- Group 2: All load is carried by the steel member
- Group 3: All load is carried by concrete and reinforcing steel

The 2016 *Specification* focused on the strength design of members in Group 1 as indicated in Commentary Section I1. General Provisions: "The provisions of Chapter I address strength design of the composite sections only." Only the limitations and general detailing requirements of these composite members were specified. Any limitations and detailing requirements for Group 2 and Group 3 members were not specified and left to the judgment of the designer. It was stated that for Group 1 members, ACI 318: *Building Code Requirements for Structural Concrete* should be referenced for member detailing requirements, such as maximum and minimum longitudinal steel limits, transverse steel reinforcement (stirrups, ties, spirals, etc.), spacing, and concrete cover for steel reinforcement and for anchorage and splice lengths of reinforcing steel. Most designers also referred to ACI 318 for detailing requirements for Group 2 and Group 3 members, as was implied in the *Specification*.

The new 2022 *Specification* broadened the application to include specific member limitations and general detailing requirements for all three groups. This was based on many questions coming into the AISC Steel Solution Center for guidance on requirements for Group 2 and Group 3 and because the AISC *Specification* has become the single source standard for composite design in the United States. The broader application was acknowledged in the new Commentary Section I1.1 General Provisions, which states: "Structural steel and reinforced concrete are sometimes combined in practice for applications in columns and beams where the resulting member does not strictly qualify as a composite member according to the provisions."

Examples of structural members included in the three groups are shown in the following figures: Figure 2 shows composite members in Group 1, where an encased composite column or a filled composite column is often used in mid-rise and high-rise composite frame construction. Note that using internal reinforcement in the concrete-filled composite column is optional for the designer. Figure 3 shows a common application of an encased steel floor beam in Group 2, where the concrete encasement is provided for architectural cover, steel fireproofing, and/or corrosion protection. Figure 4 shows a filled composite column in Group 3, where the steel shell serves as a form only, with all the load carried by the internal concrete and steel reinforcement. The concrete and reinforcing steel are designed according to ACI 318 requirements. The new *Specification* now addresses member detailing requirements for concrete and steel reinforcement for all three groups used in practice. In all cases, ACI 318 is required to be referenced for concrete and steel reinforcement detailing not specifically addressed in the new *Specification*.

The provisions in Chapter I are organized into sections classified by loading type, either axial (Section I2), flexure (Section I3), shear (Section I4), or combined flexure and axial force (Section I5). The limitations and detailing requirements for concrete-encased and concrete-filled members are now addressed in each of these sections in the new *Specification*. Refer to Chapter I for specific requirements applicable to each member type in each of the three groups and for each type of load. The common application of composite beams and girders with steel-headed stud anchors used with metal deck or solid slab construction is covered in the 2022 version (Section I3), just as it was in the 2016 version.

Shear Strength of Filled Composite Members

Nominal shear strength of filled composite members gets a boost in the new *Specification*. Section I4.2 has been updated based on research showing how the steel section and concrete infill jointly contribute to the shear strength of the member.

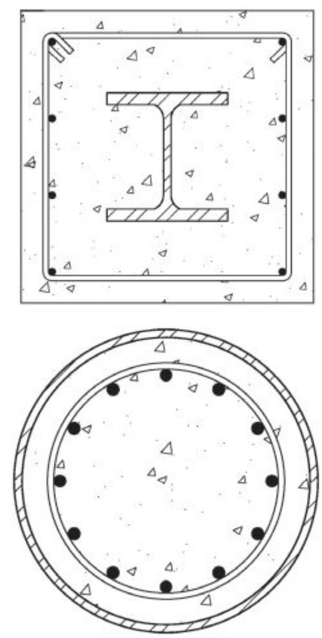


Fig. 2. Group 1 example: encased and filled composite column in composite frame construction.

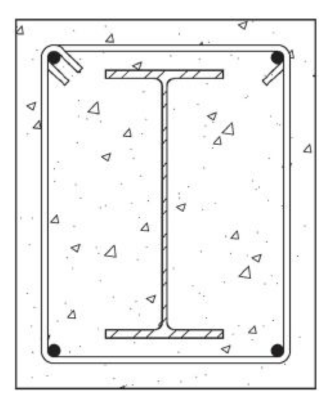


Fig. 3. Group 2 example: steel floor beam wrapped in concrete.

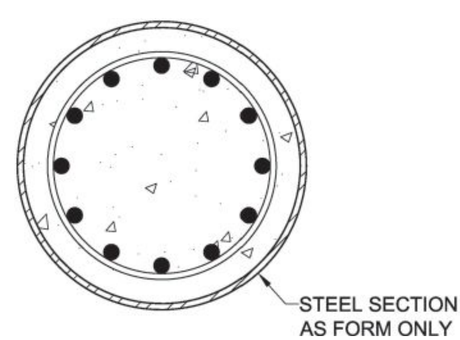


Fig. 4. Group 3 example: encased reinforced concrete column.

$$V_n = 0.6A_vF_y + 0.06K_cA_c\sqrt{f_c'} \qquad \text{(I4-1)}$$

where

A_v = Shear area of the steel portion of a composite member. The shear area for a round section is equal to $2A_s/\pi$, and for a rectangular section is equal to the sum of the area of webs in the direction of in-plane shear, in.² (mm²)

A_c = Area of concrete infill, in.² (mm²)

K_c = 1 for members with shear span-to-depth, $(M_u/V_u)/d$, greater than or equal to 0.7, where M_u and V_u are equal to the maximum required flexural and shear strengths, respectively, along the member length, and d is equal to the member depth in the direction of bending

K_c = 10 for members with rectangular compact composite cross sections and $(M_u/V_u)/d$ less than 0.5

K_c = 9 for members with round compact composite cross sections and $(M_u/V_u)/d$ less than 0.5

K_c = 1 for members having other than compact composite cross sections, for all values of $(M_u/V_u)/d$

Linear interpolation between these K_c values shall be used for members with compact composite cross sections and with $(M_u/V_u)/d$ between 0.5 and 0.7.

Fig. 5. The new Equation I4-1 in the 2022 *Specification.*

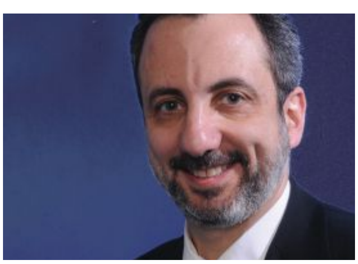
The 2016 version permitted three options to calculate shear strength. This included the available shear strength of the steel section alone, the available shear strength of the reinforced concrete portion as defined by ACI 318, or the nominal shear strength of the steel section plus reinforcing steel. In many cases, these three options produced overly conservative nominal shear strengths.

The new Equation I4-1 in the 2022 *Specification* (see Figure 5) takes into account both the plastic shear strength of the steel tube and the contribution of the concrete infill factored by K_c, which depends on shear span-to-depth ratio, cross-section shape (rectangular or round), and composite compactness. Reinforcing steel was not found to have a significant contribution to the strength and is therefore neglected for simplicity. The bottom line is that designers will be able to get substantially more shear strength out of filled composite members.

Composite construction offers cost-effective design approaches that provide the opportunity to harness the most valuable characteristics of steel and concrete for structural systems. The integration of expanded provisions on composite construction in the AISC *Specification* and the AISC *Seismic Provisions* opens up new opportunities related to composite design. Through ongoing work, it is anticipated that new provisions in the next cycle of these documents will continue to expand the scope of opportunity to design using composite steel-concrete structural systems. ■

You can find the AISC Specification *and* Seismic Provisions *at* ***aisc.org/specifications***.

The authors would like to thank the members of AISC Task Committee 5 on Composite Design for their contributions to the new provisions on composite construction in the 2022 versions of the AISC Specification *and* Seismic Provisions.



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Talking through the *Code*

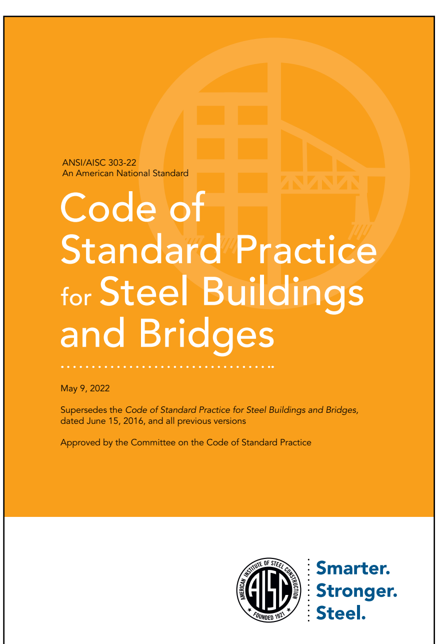
BY BABETTE FREUND, BILL ANDREWS, PHILIP TORCHIO, AND JONATHAN TAVAREZ

A "conversation" between an engineer, a fabricator, and an erector provides a look into the latest version of the AISC *Code of Standard Practice*.

LONG GONE ARE THE days when the AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303) was considered the "fabricator's handbook."

As the construction industry has evolved, so too has the *Code* into a framework for the entire project team: the owner, structural engineer, fabricator, and erector to successfully deliver structural steel projects. It can be said that the *Code* serves as the structural steel Rules of Engagement. As business management author Patrick Lencioni once penned, "If you could get all the people in an organization rowing in the same direction, you could dominate any industry, in any market."

The new 2022 *Code* addresses several areas of concern in the industry while also providing clearer harmonization with the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360). There are three important perspectives from which the *Code* can be considered: the engineer, the fabricator, and the erector. Let's listen in on this hypothetical interview as these three parties share their thoughts on the major revisions incorporated in the latest version.



Section 1.1

Section 1.1 provisions were revised to strengthen the *Code* and provide clear requirements when specific instructions to the contrary are included in contract documents.

ENGINEER: Understand that the provisions of the *Code* will govern unless the owner's designated representative for design (ODRD) provides alternate instructions for the design and structural engineer of record (SEOR) in the contract documents. When the ODRD/SEOR provides "instructions to the contrary" in the contract documents, they must 1) be specific as to what is in variance (a tolerance on fabrication or erection, submittal requirements, QA/QC requirements, etc.), 2) not violate the *International Building Code (IBC)* by modifying provisions of the *Code*, which are incorporated by reference into the *IBC*, either directly or indirectly through the *Specification*, and 3) maintain consistency with the other provisions of the *Code*.

FABRICATOR: One of the many challenges that the *Code* in general, and more specifically, Fabricators, have faced is a lack of compliance among trades with the provisions contained in the *Code*, especially when specific instructions to the contrary are cited in a scope of work discrepancy, and those specific instructions have not been clearly noted and/or easily identifiable.

Section 1.1 has been revised to specifically address this challenge. The 2022 *Code* now clearly states, as part of the *Code* language (not Commentary), that the *Code* shall apply to all projects that involve fabricated structural steel. Further, unless specifically noted in the contract documents, all provisions apply. Specific instructions to the contrary shall not violate any provisions of the building code, and the contract with the fabricator or erector shall identify by *Code* section number any specific instructions to the contrary not contained in the design documents or specifications. If specific instructions to the contrary have not been provided as required, the provisions of the *Code* shall apply.

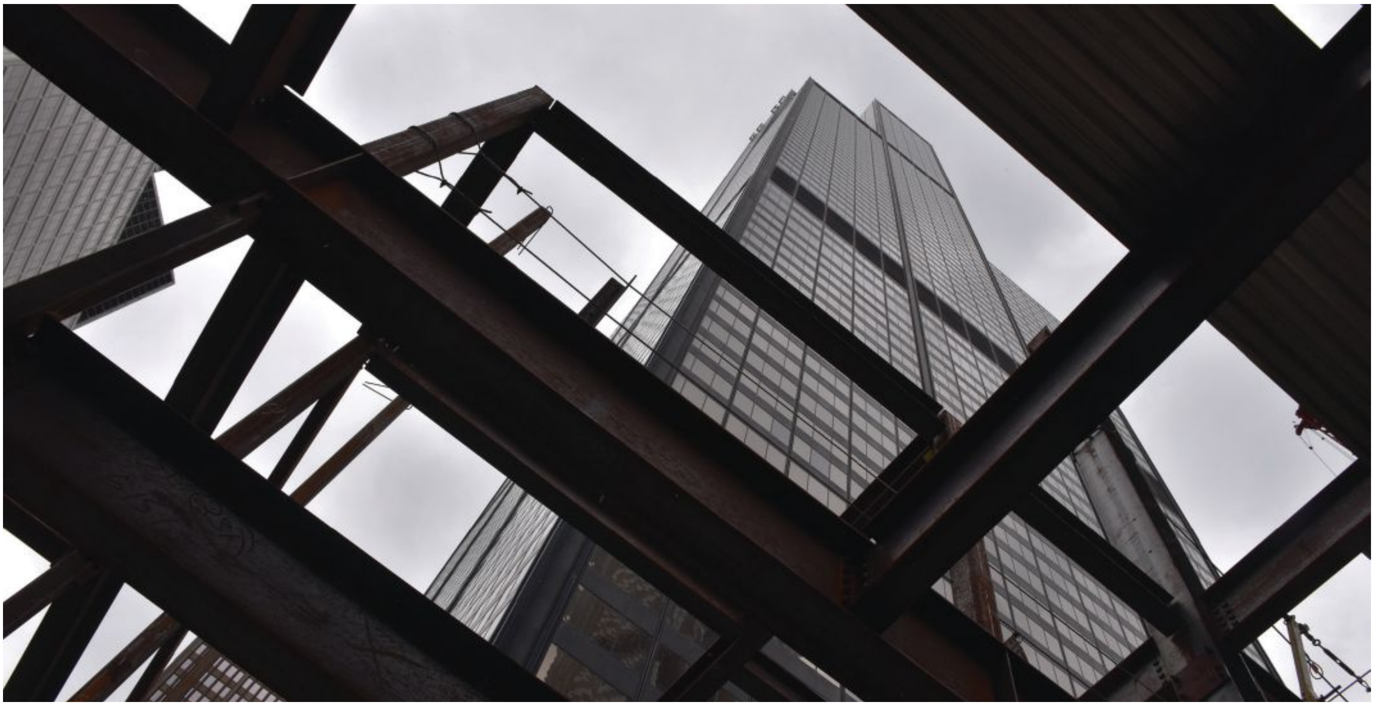
This revision provides a greater level of understanding among all parties as to what the project and scope expectations are and how those expectations shall be achieved. This benefits not only fabricators but rather all parties involved in the project. A common understanding of the responsibilities and expectations of each party is the first and most important step in delivering a project on time and within the specification requirements. Time spent previously debating the scope of work and assigning responsibility can now be spent fulfilling project requirements.

ERECTOR: A major change in the *Code* is the requirement for any instructions to the contrary to reference the *Code* section that is to be excluded. If not, the *Code* stands as written for any project that involves fabricated structural steel regardless of delivery method. The Commentary then suggests, regardless of delivery method, that the parties discuss the scope prior to document release for construction to ensure an understanding of the responsibilities of the parties and any instructions to the contrary.

The Commentary to Section 1.1

The Commentary to Section 1.1 was expanded and clarified to achieve a common understanding of the responsibilities and expectations of each party.

ENGINEER: The Commentary has been expanded to emphasize the value of communication and collaboration between all project stakeholders prior to the design



documents being released for construction. There is a recommendation to conduct a preconstruction meeting with the key stakeholders in the structural steel delivery—the owner's designated representative for construction (ODRC), ODRD, fabricator, erector, and detailer. View it as an opportunity to create clarity in the project requirements while reducing risk. A sample meeting agenda could discuss some or all of the following:

- Project schedule
- Material availability
- Substitutions
- Submittal process
- Variances from Code provisions
- Delegated connection design
- Use of the ODRD's 3D model
- Special erection procedures
- Testing and inspection
- AESS and painting
- Value engineering opportunities
- Timing of SEOR site visits

New: Section 1.7

A new Section 1.7 was added with provisions on construction scheduling.

FABRICATOR: What's a fabricator's first question (beyond "how many tons")?

"When do you need steel"?

Typically, the answer is verbal and is seldom accompanied by a project schedule that enables the fabricator to understand the timeframe of preceding trades to understand the schedule goals.

Changes to Section 1.7 now address that challenge. The change requires the ODRC to provide a construction schedule in the bid documents. Further, the performance period by the steel fabricator and erector shall be *mutually* agreed upon before awarding the contract.

This section is extremely helpful to fabricators. Many fabricators have multiple projects running through their shops at once. As a result, the ability to accurately schedule and shop load while implementing timely updates is critical. Scheduling and shop loading as soon as a bid is committed are extremely important in planning for labor and materials and ensuring timely ordering, fabrication, and delivery.

ENGINEER: The ODRD should request a copy of the ODRC's construction schedule to inform their work planning for submittal reviews and the timing of site visits.

ERECTOR: A construction schedule has been added as a requirement for the ODRC to include in the bid documents. Further, the agreement of the fabricator and erector to the proposed schedule is required before the contract award. The mutual agreement is crucial as we have all seen schedules change with every activity except the end date!

Section 2.2

Steel used as piling or other piling accessories was added to Section 2.2 as "other steel, iron, or metal items."

ENGINEER: The SEOR shows all the structural elements in their design documents according to their contract with their client, including steel items that the *Code* may classify as "other steel." Suppose the SEOR intends that these items, such as steel piling, be treated as structural steel. In that case, these items need to be specified explicitly in the contract documents as structural steel. This is an opportunity to exercise the "instructions to the contrary" provision of Section 1.1. The ODRC must discuss with their trade partners who will provide the "other steel" and according to which standard, if not specified in the contract documents.

FABRICATOR: Fabricators are often asked to provide material for a project that does not fall within the scope of structural steel. One such material often in question is steel used as piling or piling accessories.

The 2022 *Code* has been updated to clearly note that steel used as piling or piling accessories does not fall within the category of structural steel, and is not the responsibility of the fabricator, unless specifically addressed and agreed upon contractually.

Section 3.0 and its Commentary

Section 3.0 and its Commentary were revised to coordinate with the *Specification*.

ENGINEER: In probably the most significant Code update in recent editions, Section 3 has been significantly revised, introducing new terminology of "issuing" design documents by the ODRD and "releasing" design documents by the ODRC along with the purposes of these actions. This parallels the revisions in Section A4.2 of the *Specification*, which are referenced in the Commentary of Section 3. See Table 1 for a summary of these terms.

FABRICATOR: The 2022 *Code* clearly addresses the difference between issuing design documents and releasing design documents (and specifications), as well as who is responsible for each. This will serve to help eliminate the question of what should be done with design documents when received and whether the design documents were received based on issuance or a release.

Great care has been taken to coordinate the 2022 *Code* with the 2022 *Specification*. Terminology has been harmonized, and redundancy between publications has been eliminated. It is important to remember that the *Specification* is incorporated in the *IBC*, and, therefore, the 2022 *Code* is now incorporated by reference.

Section 3.1

A new Section 3.1 was added with provisions on structural design documents and specifications issued for construction. This section also contains updated requirements and guidance on painting responsibilities.

ENGINEER: Section 3.1 defines the requirements of structural design documents "issued for construction," a new term defined in the glossary. The detailed requirements and the associated Commentary have been moved to Section A4 of the *Specification* and are incorporated here by reference. This list in Section A4 will look familiar to the SEOR, as it was found in prior editions of the *Code* in Section 3.1. New to the list of requirements for structural design documents is (c) Shop Painting and Surface Preparation Requirements. The SEOR's designation of structural design documents as "issued for construction" indicates they are authorized to be used to construct the steel structure. It follows the SEOR's traditional use of this term on their documents that the design is complete, approved by the government AHJ (authority having jurisdiction) with a building permit, and the documents possess a PE seal from the engineer-of-record. The fabricator can then use these documents for ordering steel and detailing.

ERECTOR: In Section 3.1(c)(6), the party responsible for field touch-up and repair of shipping and handling damage must be specified in the structural design documents and specifications issued for construction. The sentence following directs the erector/fabricator to omit this scope from the bid if not specified, and when the requirements are furnished, the contract price and schedule shall be equitably adjusted. Section 3.1(d) requires members to be handled as AESS and be designated in the construction documents.

FABRICATOR: Section 3.1 now refers to the *Specification* for the requirements of what should be included in the design documents. Since the *Specification* is fully incorporated into the *IBC*, there is now no question as to what is required to be shown for trades to accurately provide bids without assumptions.

Further, Section 3.1 now clearly requires that when painting is required, the following must be provided:

- Specific members identified
- Surface prep clearly noted
- Paint specifications and manufacturer product identification, including color
- Minimum dry film shop coat thickness
- Shop- and field-applied paint system compatibility
- Party responsible for touch-up, including repair of shipping and handling damage after shop application

If this information is not available at the time of the bid, the fabricator is entitled to an equitable contract price and schedule adjustment.

The clarity provided concerning coatings in this section will further strengthen the understanding of all contracting parties as to which parties are responsible for what scope of work items. Field touch-up has always been a contentious issue and has often resulted in costly back-charges as a result of a lack of clarity in the contracting process.

Table 1: Structural Design Documents and Specifications

Term	Issuing Entity	Receiver	Purpose	Design Complete?	2022 AISC-303 Ref.
Released for Construction > *no change from the 2016 edition*	ODRC (Owner, CM, GC)	Fabricator	To Establish a Steel Contract; Ordering steel, detailing, and fabrication	Yes	Glossary; 303-4.1; 303-5.1
Released for (any other purpose) > *new in 2022 edition*	Owner, CM, GC	GC, CM, Cost Est., Peer Rev.	As stated in the Structural Documents (Cost Estimate; Bidding; GMP; Peer Review; Constructability Review)	No—Qualified by "Purpose of Drawings" Statement	Glossary; 303-3.2.2; 360-A4.2
Issued for Construction > *new in 2022 edition*	ODRD (SEOR)	Owner and GC	Construction	Yes; PE Seal, AHJ approval with building permit	Glossary; 303-3.1; 360-A4.1
Issued for (any other purpose) > *new in 2022 edition*	ODRD (SEOR)	GC, CM, Cost Est., Peer Rev., AHJ	As stated in the Structural Documents (Bidding; Cost Estimate; GMP; Owner or Peer Review; AE Coordination; Constructability Review, AHJ Permit)	No (*unless issued for Permit Review by AHJ*)—Qualified by "Purpose of Drawings" statement	Glossary; 303-3.2; 360-A4.2

Section 3.2

A new (Section 3.2) was added with provisions for structural design documents and specifications issued as contract documents.

ENGINEER: Section 3.2 introduces new provisions for design documents issued by the ODRD as contract documents. These new provisions differentiate between issuing design documents as a basis for contract documents under the traditional design-bid-build delivery method and issuing drawings as the basis for a contract under an alternate project delivery method. These alternate delivery methods may include design-build (stipulated sum or progressive), integrated project delivery (IPD), construction-manager-at-risk, P3, lease-leaseback, negotiated GMP, and others. Section 3.2.2 further states that when an alternative project delivery method is used, the release of the structural design documents is for the expressed purpose stated on the drawings issued by the SEOR, as stated in Section 3. The benefit to the SEOR is that for many years, structural design documents have been issued for some purpose other than for construction—for pricing, bidding, owner review, GMP, etc. The *Code* now explicitly acknowledges these alternative project delivery methods where the SEOR defines the purpose for which documents are being issued and the responsibility of the owner and ODRC to release them only for that stated purpose. A good, descriptive "purpose of documents" statement is essential for design documents issued for any purpose other than for construction.

Section 3.2 further states that when structural design documents are issued as contract documents and do not include all the information required for a complete design as defined in Section 3.1, allowances for items not defined in partially complete design documents are to be provided in the contract with the fabricator. Nonetheless, the structural design documents must convey the "character, quantity, and complexity of the structural steel to be fabricated and erected" so that the Fabricators have a rational basis for developing bid prices.

The revised Section 3.2.2 provides enhanced guidance to the entire project team on effectively using allowances and the subsequent equitable adjustments to contract price and schedule.

Revisions in Section 3.2.3: Requirements for Connections – Option 3 clarified that the SEOR is required to show project-specific connection detail concepts and not just "typical" details, which may not be directly applicable. The robust Commentary to Section 3.2.3 now includes a discussion of transfer forces and the SEOR's responsibility to specify them.

ERECTOR: Section 3.2.2: The major changes in this edition of the *Code* focus on alternative delivery methods for construction. This method now comprises most of the structural work and provides the greatest opportunity for a highly efficient project or, if not implemented correctly, problems for all the parties involved. The erector being the tail that wags the dog, often has the least contract protection being a third-tier subcontractor subject to the pass-through contract requirements of the owner to the ODRC to the fabricator, often with no bond protection, and being the last entity to touch the structure is often looked at as the proximate cause of late delivery or quality issues. The new changes in the *Code* provide the best framework of *Code* and Commentary to level the field and ensure a chance for success. It focuses on communication between the parties and mutual agreement on what is shown and what is not. Section 3.2.1 lists the information critical for preparing a complete bid for the work. Then when any of the information is not specified, the fabricator and erector shall provide allowances per section 9.1.5, which says, "When an allowance for work is called for in the contract documents, and the associated work is subsequently defined as to the quantity, complexity, and timing of that work after the contract is executed, the contract price for this work shall be adjusted by change order." This clearly means that when the work to be done is defined, the allowance will be adjusted to reflect the work required.

The Commentary further urges the parties to work together to identify work not shown in the released contract documents, mutually agree, and document this work so it can be priced as the design is completed. The Commentary also reminds the owner that alternative delivery methods may speed the process, but this benefit may be offset by cost and schedule impacts as the unknown requirements are revealed.

FABRICATOR: For alternative delivery methods, the 2022 *Code* requires that the contract documents convey the character, quantity, and complexity of the structural steel to be fabricated and erectors. This allows the fabricator and erector to provide bids that are accurate and complete, without assumption. It is essential for everyone to understand the list of the minimum requirements, (a) through (g), that must be included in the design documents and specifications. This creates an even playing field for all involved in the bidding process.

Section 4.5

In Section 4.5, requirements were added for the review of fabrication and erection documents, including additional commentary guidance.

FABRICATOR: Many fabricators contract to fabricate structural steel from fabrication documents that are not furnished by the fabricator. When the fabrication documents are furnished by others, changes to the 2022 *Code* require that these documents be reviewed and approved by the ODRD. As a result, the fabricator is not responsible for the coordination or accuracy of the fabrication and erection documents that were furnished, nor is the fabricator responsible for the general fit-up of the members that are fabricated, as long as fabrication is in accordance with the documents provided.

This section now also requires that these documents be delivered to the fabricator in a timely manner.

ERECTOR: Section 4.5: Fabrication and/or Erection Documents not Furnished by the Fabricator provides cautionary language regarding the preparation of fabrication and erection drawings by a party other than the fabricator. If the owner or ODRC does direct another party to prepare fabrication documents, the *Code* now requires the ODRD to review and approve the submitted documents. Further, the fabricator and erector shall not be responsible for any failure of the material fabricated and erected in accordance with the furnished documents.

The Commentary then lists in 14 bullet points, enumerating most of the potential issues with using this method.

Section 6.1

In Section 6.1, preferred material specifications were updated to parallel the 16th Edition AISC *Steel Construction Manual*.

ENGINEER: The revisions to "shop standard material" in Section 6.1.1 are coordinated with similar revisions to Table 2-4 in the 16th Edition *Manual*. Updates to the shop-standard material for channels, angles, plates, and other shapes are based on an extensive survey by AISC of fabricators and mills of steel materials in production and readily available. Material availability can always be verified through the AISC website at **aisc.org/steelavailability**.

FABRICATOR: This section has been updated to coordinate with the 16th Edition *Manual* to eliminate any confusion or discrepancy when specifying and ordering materials.

Section 6.4

In Section 6.4 the paint and steel cleaning provisions were expanded.

FABRICATOR: Field touch-up and handling damage has been an area of contention over the course of many projects and can result in extensive cost. Disputes may arise when responsibilities are not clearly defined in the contract documents. Additions and changes to Section 6.4 of the 2022 *Code* have been made to help minimize or eliminate the dispute.

Additional clarification regarding paint and steel cleaning has been added to the 2022 *Code*. Section 6.4.4 specifically notes that the fabricator is not responsible for the deterioration of the shop-applied paint where the paint is exposed to atmospheric conditions or corrosive conditions that are more severe than the intended use of the paint. Further, the fabricator is not responsible for deterioration when painted members are stored for unanticipated durations due to project delays not caused by the fabricator.

Handling damage or damage during transportation is not the responsibility of the fabricator unless the painted material is under the direct control of the fabricator or a subcontractor of the fabricator.

Unless specifically provided for in the contract documents, the properties of the optional shop coat are at the discretion of the fabricator. Touch-ups and abrasions caused by shipping and handling after painting shall be the responsibility of the contractor that performs the touch in the field or field painting.

Section 7.10

In Section 7.10, there is added Commentary to clarify shoring requirements.

ERECTOR: These requirements would not be apparent to the erector and must be provided by the ODRD, and reference to Section A4 of the *Specification* for cantilever conditions is provided. Section 7.10.3 expands the requirements for the erector to determine the need and to provide all temporary structures, shoring, framing, and cabling to facilitate the erection of the structure. This will include the design of these items. This design shall adequately support the structure for erection forces and environment, including wind.

Section 7.13

Section 7.13 clarifies that the ODRC shall determine that the steel is acceptable for plumbness elevation.

ERECTOR: This requirement also includes ensuring alignment and the steel is in accordance with the *Code*, *Specification*, and project specification and provides the erector with timely notice thereof.

Section 10.3

Section 10.3 now states that the ODRD is not responsible for job site safety during erection.

ERECTOR: The new Commentary notes that the erector is primarily responsible for the safety and stability of the structure during erection unless this responsibility is assigned to another party in the contract. This Commentary reminds the ODRC that it has legal responsibility for safety-related site conditions under the OSHA *Steel Erection Standard* (CFR 1926.750). Further, the engineer is reminded of his responsibilities to provide information regarding the structure's stability as required in section 7.10.1.

Section 10.4

In Section 10.4, the AESS fabrication requirements were updated.

ENGINEER: Revisions to Section 10: Architecturally Exposed Structural Steel are primarily clarifications, enhancements, and transfers of the footnotes from Table 10.1 into the body of the *Code*. These revisions also bring greater alignment between the *Code* text and the content of Table 10.1.

In Section 10.4, revisions to the requirements for the removal of weld backing and run-off tabs now refer to the AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341) and the applicable AWS welding standard for compliance.

Also, in Section 10.4, language was added to clarify that the requirement for bolted connections to have bolt heads on the same side of the connection and consistency between connections does not extend to matching the "clocking" orientation of all the bolt heads. Suppose AESS requirements for bolted connections are invoked by the AESS category specified. In that case, the SEOR is responsible for providing those requirements in the design documents, such as "all bolted connections shall have bolt heads on the north and east sides of the connections."

Table 10.1

Table 10.1 was revised to align with Section 10.4 AESS requirement revisions.

ENGINEER: Revisions to Table 10.1: AESS Category Matrix harmonize the requirements and text of the table with the *Code* language, including the transference of the (previously hard to read) table footnotes into the body of the *Code*. A column was added to the table providing reference to the applicable *Code* sections for each AESS characteristic; this is highlighted in Table 2.

FABRICATOR: The *Code* continues to address and clarify the expectations for AESS. Changes to the 2022 edition of the *Code* further clarify fabrication requirements, weld access holes, and *Code* language harmonization with the table. These changes continue to ensure that the expectations of all parties are clearly agreed upon and can be met within the contracted scope of work.

ERECTOR: In Section 10, AESS requirements have been clarified. Specifically, Category C is defined as custom requirements that may be stricter than AESS Categories 1 through 4 and must be clearly defined in the contract documents. Category C has been removed from Table 10.1. Table 10.1 has been revised to state the requirements for each category clearly.

Section 10.6

A new Commentary was added to Section 10.6 to provide guidance on weld access holes.

ERECTOR: Fabrication requirements are listed separately from erection requirements to ensure that each party's responsibilities are understood. The erector is required to remove all weld backing and run-off tabs on field welded connections. For AESS Category 4, open holes shall be filled. Weld access holes are not to be filled with weld. Weld access holes shall only be filled using non-weldable material such as body filler. The Commentary refers the erector to the requirements of AWS D1.1 D1.8 and the *Seismic Provisions* with particular attention to the seismic requirements contained in these documents.

TABLE 10.1
AESS Category Matrix

ID	Characteristics	Reference Section	Category			
			AESS 4 Showcase Elements	AESS 3 Feature Elements in Close View	AESS 2 Feature Elements not in Close View	AESS 1 Basic Elements
1.1	Butt and plug weld reinforcement limited to 1⁄16 in. (2 mm)	10.4.9			•	•
1.2	Surface preparation to meet paint specification	10.4.11	•	•	•	•
1.3	Sharp edges eased	10.4.7	•	•	•	•
1.4	Continuous weld appearance	10.4.8	•	•	•	•
1.5	Consistent bolt appearance	10.4.1(g)	•	•	•	•
1.6	Weld spatters removed	10.4.8	•	•	•	•
2.1	Mock-ups	10.1.2	•	•	Optional	
2.2	The fabricated product shall have one-half the applicable ASTM or AWS straightness tolerance	10.4.3(b) & 10.4.5	•	•	•	
2.3	Fabrication, and erection marks not visible	10.4.2	•	•	•	
3.1	Mill marks not visible	10.4.2	•	•		
3.2	Butt and plug welds ground smooth and filled	10.4.9	•	•		
3.3	HSS weld seam oriented for reduced visibility	10.4.12	•	•		
3.4	Cross-sectional abutting surfaces aligned	10.4.3(a)	•	•		
3.5	Joint gap tolerances minimized	10.4.6	•	•		
4.1	HSS seam treated to comply with mock-up	10.4.12	•			
4.2	Welds contoured and blended	10.4.8	•			
4.3	Surfaces filled and sanded	10.4.7	•			
4.4	Weld show-through to meet acceptance criteria established by mock-up	10.4.10	•			

Table 2: AESS Category Matrix Found in Table 10.1 of the *Code*

Notes:
1. AESS C are custom elements with characteristics described in the contract documents.
2. Standard structural steel contains no AESS characteristics.

ENGINEER: The new commentary language to Section 10.6 limits the filling weld access holes to only use non-weldable material such as body filler and references welding standards AWS D1.1 and D1.8 for additional Commentary as to why filling weld access holes with weld metal is prohibited.

Section 11

Section 11 was added to compile all fabrication and erection tolerances in one location. This addition also included the removal of Sections 6.4 and 7.13 from the 2016 *Code*.

FABRICATOR: Section 11 has been added to the 2022 *Code* to incorporate all required tolerances into one section. Camber tolerances are now included, along with additional guidance in the Commentary. This section provides essential guidance to fabricators to ensure that the fabricated structural steel is in conformance with all fabrication tolerances and allows for proper planning and execution.

Section 11.2

Section 11.2 includes new and expanded fabrication tolerances, including those applicable to camber. Additional guidance was also added to the Commentary.

ENGINEER: There is a new Commentary in Sections 11.2 and 11.3 directed at the SEOR for fabrication and erection tolerances, respectively. Suppose the SEOR determines tolerances in addition to those specified in the *Code* are required by the design concept. In that case, those tolerances (fabrication or erection) need to be identified in the contract documents, and they should be expressed in terms consistent with those found in Section 11.

Section 11.3

Section 11.3 includes new and expanded erection tolerances.

ERECTOR: Erection tolerances remain basically the same, with Commentary supplementing the *Code* and providing a better explanation of the requirements. This Commentary includes the issue of column splice elevations and floor elevation variations that results from fabrication and erection tolerances that accumulate coupled with possible differential shortening of the structure. The Commentary states that the construction team should determine performance requirements that should be addressed in the contract documents. Means of elevation measurements, reporting, noncompliance, and remediation should be addressed by pre-planning and mutual agreement prior to the commencement of fabrication and erection. Pre-detailed adjustable floor connections, column splice details, and field fix details should be considered, as should their effects on cost and schedule.

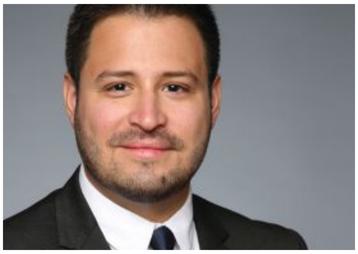
Complex structures are also discussed, with an emphasis on erector-braced and shored material that is subsequently lowered per the erection plan and will result in the deflection of connected material. Commentary suggests that the ODRD provides a 3D design model to aid the fabricator and erector in achieving an erection plan that will accommodate the shoring and bracing movement in the unloading operation. Agreement on the sequence and schedule of lowering of shoring and removal of bracing between the fabricator, erector, and the ODRC is recommended. A further agreement on the actual tolerances of the unloaded structure must be mutually agreed upon when they may differ from the *Code* requirements.

Final Thoughts

In addition to the information conveyed in this "interview," it should also be noted that all the tolerance figures in the new Section 11 were updated to align with the code language revisions and glossary terms, and the entire *Code* has been editorially revised for consistency with current terms and other related documents. While the 2022 *Code* will not be adopted by the *IBC* until 2024, this should not discourage users from referring to specifying this current version. Through the feedback loop provided by our committee volunteers, this cycle added a lot of value that will greatly benefit the industry.

At this point, we hope you have a better understanding of the updates to the latest version of the *Code*. And if you want to be part of the process, most AISC committees are open to guests, and we welcome all to attend who are interested. Committee rosters run on a two-year cycle, and staff is continuously seeking interested and active volunteers to join as members. If you are interested in applying for a position on one of our committees, please complete the application found at **aisc.org/technical-resources/committee-application/**, and reach out to Martin Downs (**downs@aisc.org**) to be added to the guest list.

You can find the mentioned AISC publications at ***aisc.org/specifications****.*



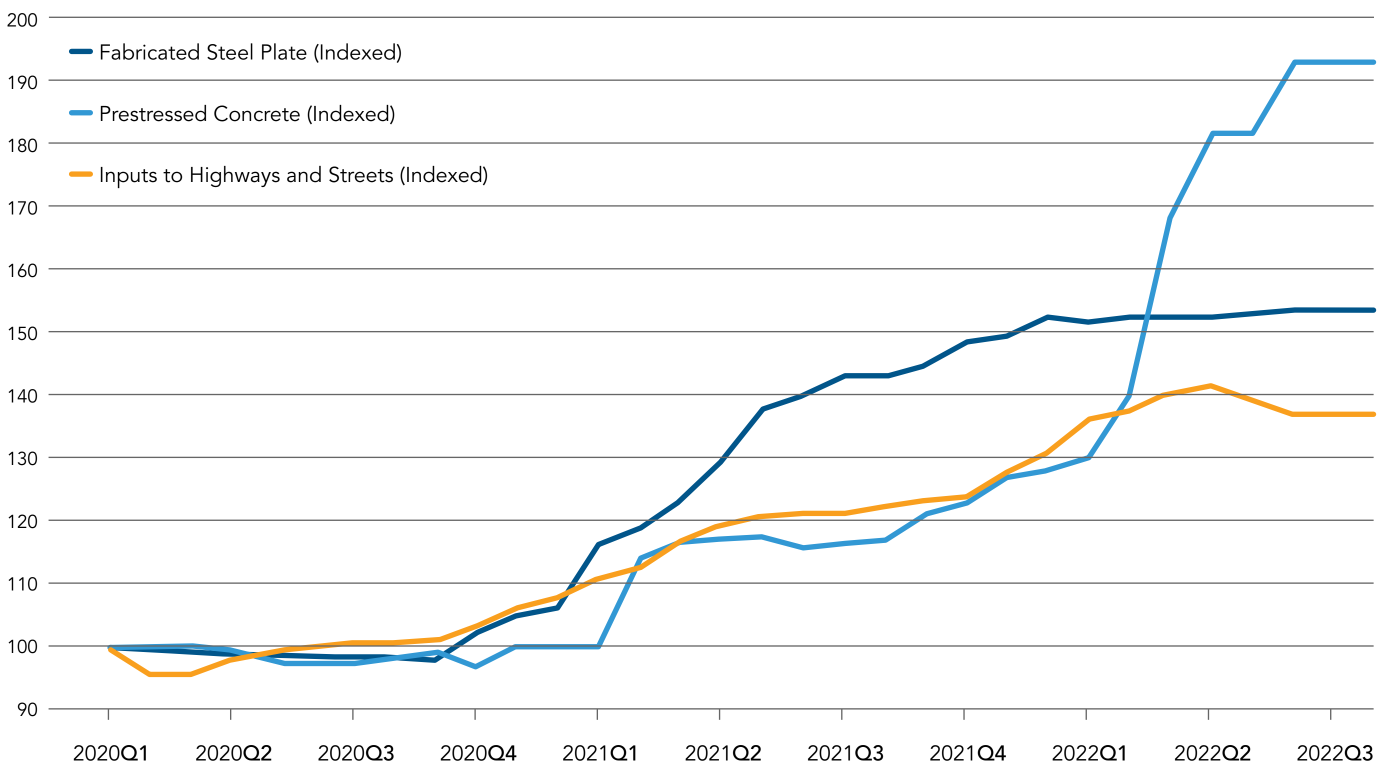
Babette Freund is executive vice president of Dave Steel Company, Inc., **Bill Andrews** is an associate principal with Buehler, **Philip Torchio** is the retired CEO of WEOGA, and **Jonathan Tavarez** is AISC's New York structural steel specialist.

New Year, New Outlook

BY JEFF CARLSON

While bridge construction costs rose significantly over the past couple of years, things appear to be leveling off, and steel bridges are positioned for a strong 2023.

Fig. 1.
Producer Price Index – Highway and Street Construction



Source: ARTBA (and U.S. Bureau of Labor Statistics) since March 2020 (updated on November 21, 2022)

THERE'S NO GETTING AROUND the fact that construction costs have risen significantly in recent years.

The Producer Price Index (PPI) for "Inputs to Highways and Streets," as reported by the American Road and Transportation Builders Association (ARTBA) and the U.S. Bureau of Labor Statistics, illustrates an increase in construction costs of approximately 37% since the beginning of the COVID-19 pandemic (March 2020 to October 2022), though these costs appear to be leveling off as of the last few months (see Figure 1). In these uncertain inflationary times, it is important to remember a few key points related to the steel bridge industry.

First, the time it takes from when an order is submitted to a steel bridge fabricator to when it is ready for delivery (aka lead time) is generally back to pre-pandemic levels. Due to various economic factors, lead times did go up during the pandemic but have generally reverted back to "normal." NSBA recommends contacting a local steel bridge fabricator to get up-to-date lead time information. (Visit **aisc.org/nsba/get-involved/certified-bridge-members** for a map of AISC certified bridge members.)

Next, the implementation of the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) will certainly have an impact on the trajectory of the entire infrastructure sector, including the bridge industry. Proper implementation of this new legislation will directly affect the capacity of the steel bridge industry and also the aforementioned lead times. The steel bridge industry has the capacity to handle the increased workload from the IIJA and IRA, but bridge owners are encouraged to roll out new projects on a systematic basis to ensure that the industry doesn't get overloaded and therefore drive up lead times.

Lastly, the U.S. steel industry is the cleanest in the world and should only get better in the future. A November 9, 2022, *New York Times* article ("Who's Driving Climate Change? New Data Catalogs 72,000 Polluters and Counting") discussed an analysis of greenhouse gas emissions by a nonprofit coalition of environmental groups called Climate TRACE. The author of the article postulates that emissions can be tracked down to the individual power plants and manufacturing sites around the world–and that emissions from U.S. steel manufacturing facilities are at least three times less than those from around the world.

Taking a look at the overall picture, U.S. infrastructure and the steel bridge industry are poised to make tremendous strides in the coming years. New legislation and the ever-changing economic landscape will have an impact that is sure to grow the industry. Steel bridge pricing appears to be stabilizing, lead times are back to "normal" levels, and the steel industry is leading the way to create the most sustainable construction material. All of this points to a strong 2023 for the steel bridge industry despite the rise in overall construction costs. ■

Jeff Carlson (carlson@aisc.org) is NSBA's senior director of market development.

Lifelong Learner and Teacher

INTERVIEW BY GEOFF WEISENBERGER

Chris Raebel's life thus far has been a fruitful and varied journey, all without having to stray from the city he loves—Milwaukee—for too long.

YOU COULD SAY that Chris Raebel's professional life has, by design, taken place in distinct phases.

After graduating with an architectural engineering degree from Milwaukee School of Engineering (MSOE), he practiced engineering for a while, earned a master's degree, dabbled in college instruction to the point where he knew he wanted to do it full-time, earned a PhD, then returned to MSOE as a professor for nearly two decades, where he eventually became the chair of the Department of Civil and Architectural Engineering and Construction Management and the director of the Architectural Engineering program. And his drive to teach and learn more pushed him to become AISC's vice president of engineering and research this past summer, succeeding Larry Kruth (now vice president of special projects).

We recently discussed the details of his career path, what made him shift his focus from architecture to engineering at an early age, how being a professor is as much about learning as it is teaching, his advice for students embarking on their careers, and his lifelong passion for karate and how it has pushed him to turn his black belt white again.

Where are you from originally?

I'm from a suburb of Milwaukee, Franklin, Wis. I lived there for my entire childhood, and I've been in the Milwaukee area most of my life, with a short stint at Penn State.

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**.

Chris with his wife, Mary, in historic Cedarburg, Wis.

I love Milwaukee. And it's easy to get to from Chicago. Tell me about how you got into the world of buildings.

I've always liked architecture, even as a younger child. I think I just liked the concept of buildings and enclosed spaces and trying to make something functional. And when I got to high school, I took several drafting classes. I enjoyed the drawing part and I took mechanical drafting and architectural graphics, and I liked the architectural graphics more than the mechanical drafting. So when I started thinking about universities, I talked to my high school drafting teacher and asked him whether I should go into engineering—because I enjoyed math as well—or architecture. And he asked me a very good question: "Do you like money?" I said, "Sure, I like money. Everybody likes money." And he said, "You're good at math. Go be an engineer. You'll make more money being an engineer." And that's kind of how I got into architectural engineering. I was able to get the best of both worlds.

I graduated from MSOE in 1994 and practiced engineering for several years before I went on to get my master's degree at Penn State. I ended up working at a small firm in Milwaukee. I learned something interesting from the project manager there, and it's a quote that's always stuck with me because he was the person that would deal with the general contractor. So he would take the heat sometimes when something was lagging, the schedule or whatever the reason was, and his quote was, "I don't mind having a little bit of egg on my face as long as I've learned something new." And I've always taken that to heart. He was willing to take a little heat if something wasn't going the way it was supposed to so that he could redirect it. I really appreciated his approach.

That's a great attitude! Switching gears a bit, what made you want to transition from the design world to academia?

In the early 2000s, 2002 or so, I had this interest in teaching. I had returned to MSOE a few times to judge some senior project presentations and whatnot, and I just enjoyed being in that atmosphere. So I taught a class once a quarter or a few times a year, and I found that I really enjoyed teaching and working with students and getting the aha moments from them more than I enjoyed some of the daily doldrums of practice. At that point, I'd finished my master's degree, and shortly thereafter, the MSOE department chair at the time asked me if I'd ever be interested in being a full-time faculty member. At the time, I was still happy where I was and told her I enjoyed teaching on a part-time basis but wanted to stay in practice for the time being. And about a year later, around 2005, she asked me the same question, and I thought that, yes, the next direction for me was to go through the process of becoming a full-time faculty member, and I was fortunate enough to be hired.

One of the stipulations was that most faculty at universities have a doctoral degree, and I didn't. So MSOE told me to find a university and enroll in a doctoral program, and they'd pay for it. (Thank you, MSOE!) I went to Marquette University, and it was a fantastic program, a smaller program, with great faculty. I ended up finishing the program in five years.

That's great to hear. What was it like teaching your first class as a professor? I suppose the prior teaching experience helped prepare you for it.

Yes, the previous experience helped. Classroom instruction is an interesting thing. The first class that I taught was actually a graduate-level steel design class, so the students already had a good understanding of engineering. Many of those students were in practice or working on a master's degree part-time. So going back to that quote, you have to train yourself to have a little egg on your face and learn from it. And sometimes the people teaching you something are your students. And that's a good thing. I learned in that first class and all throughout my teaching career that some students were smarter than me in a lot of different ways, and I could learn from them. You just need to be smart enough to know when to get out of their way. You have to help feed them with the knowledge you have, and they're going to go off and do great things. I've had some students whose titles are now vice president. It's just fantastic to see that happen.

That's got to be very rewarding. On that note, aside from teaching students about engineering, do you have some go-to advice you provide when they're about to go out into the real world?

One thing that's been a constant theme from me—and this is painting in very broad strokes—is that engineers feel like they need to know everything at all times. They can't have a wrong answer or can't ask a question. I've met a lot of students that had that feeling, and I've met a lot of practicing engineers with the same attitude. And what I've tried to impart to students is that you're not going to know everything, and the person you're talking to might know the things you need to know that you don't. I have been in that position quite a bit in the fabrication world. When I talk to a fabricator, I don't pretend to know their job. But what I can do is throw some questions and comments out there, things that hopefully bring the design to a better place. Something else that I've tried to impress upon students is that engineers are not supposed to simply go into a dark room with a flickering fluorescent light and run calculations and not talk to people. If you're going to be successful in this business, you have to be able to talk to people, and you have to be able to make sure that your design is not just seen but also heard, and that can only be done with a conversation. Students already have technical acumen, but what they sometimes lack is the ability to present their designs and ideas. And that's also a matter of gaining confidence and understanding that there will sometimes be difficult conversations, but you'll learn from them.

That's a great point. And it's really a good lesson for all areas of life. Let's talk about a different sort of confidence builder. I understand you've studied martial arts for most of your life.

I started studying Okinawan Shōrin-ryū karate when I was 12 years old. And the reason why is because I got beat up. So in trying to figure out what the remedy was, I started taking martial arts. It was kind of an interesting time because this was around 1984, and there weren't a lot of kids involved in martial arts in my area at that time. Martial arts training has grown a lot since then, but back then, it was a dark, dingy place where you worked out with some tough guys, some of them fighting full contact. But there was a mentality that we're here for a reason; we're here to learn how to defend ourselves and to fight effectively. It's one of those things that I grew an interest in, a passion for, and it's really helped me in a lot of aspects of life because it's not just about fighting. It's about being resilient; it's about having a strong mental attitude, especially when things aren't going well. I haven't done it formally for a few years now just because other things in life take precedence, but the lessons I've learned along the way feed me to this day. And my instructor is still teaching. The place is still open, and it's wonderful to see that it's remained successful all these years.

One thing that my instructor told me, and I took this to heart—and it kind of aligns with what we've been talking about regarding education and going into practice—is that the easy part is to make your belt turn black, but the hard part is making it turn white again. You become a black belt, which is about a five-year process in our system. So if you look at a lot of people that have been doing martial arts for 40 or 50 years, their belts are tattered and there might still be some strands of black, but most of it is white because it's frayed and the dye has gone away. In other words, the goal isn't to get the black belt, the goal is to get back to having a white belt, and that takes your entire life.

This column was excerpted from my conversation with Chris. To hear more from him, including his involvement in steel research, the balance of architectural engineering, why he loves Milwaukee, why he came to work for AISC, a funny story about breaking boards, and, of course, the Green Bay Packers, check out the December Field Notes podcast at ***modernsteel.com/podcasts****.*

Geoff Weisenberger (**weisenberger@aisc.org**) is chief editor of *Modern Steel Construction*.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Focusing Outward

BY DAN COUGHLIN

Inner focus is essential, but so is focusing on the needs of others. If you provide value to others, everyone eventually wins.

AS INDIVIDUALS, we don't live in a vacuum or on an island.

In past articles, I've focused on what happens inside of you—your focus, your ability to say no, your mental development, your purpose, and your ego. And there's always more internal work to be done. But let's take a minute to focus on you focusing on other people.

To be personally effective means to achieve the desired result. Again, it's not about living in a vacuum or on an island. It's about moving toward the desired outcome. Being effective with other people means helping them achieve what they want to achieve.

Here are two of my favorite quotes on creating value for other people: Jackie Robinson said, "A life is not important except in the impact it has on other lives."

And Zig Ziglar said, "You can have everything in life you want if you will just help enough other people get what they want."

No matter how much we develop ourselves, it won't matter unless we take the value we have generated and contribute it to other people. This is true in our personal lives and in our professional lives.

Value

So what is value? Value is anything that increases the chances that a person will have what he or she wants to have.

Make a list of what people want in every aspect of their lives. Start with yourself and write down what you want. Seriously, give this a try. Next to each category, write down what you want:

- Mentally
- Physically
- Socially
- Professionally
- Financially
- Spiritually
- Familywise
- Friend-wise
- When it comes to your community

And now, think about what other people want in each of those areas. Write down what comes to mind.

Value is anything that increases the chances that a person will have what they want to have. Make a list of what would be of value to other people in helping them to have what they want.

You might write down a comfortable car to get them where they want to go, a smile to brighten their day, a word of encouragement, someone who really listens to them, a piece of knowledge they need to get what they want, a warm coat, and an opportunity to show what they are capable of doing, etc. Then keep writing. Keep adding to your list.

Pretty soon, you'll realize that there is an infinite number of tangible and intangible things that can be of value to other people.

Create Value for Other People

Now make a list of what you specifically can create, do, or improve that would be of value to other people.

Possible items might include a handwritten letter of appreciation to someone in your life, an improved skill that can add value at work, a follow-up phone call with a customer, an innovative product that you could design, really listening empathetically to someone in a meeting, or a well-organized report that can help people to understand what has been done and what could be done (better) in the future.

As with the previous list I suggested, you'll quickly notice that you could create, do, or improve an almost infinite number of things that could be of value to other people. I encourage you to focus on just a few, maybe five to seven, ways that you can be of value to other people. Get really good at adding value in those ways, but also be open to adding value to other people in other ways as you move throughout your day.

Contribute what Value You Can

Don't just be a value creator. Be a value contributor. There is so much value that you can contribute to other people, and the key is to *actually contribute it*. At times, this may be uncomfortable or difficult. Sometimes people will reject the value that you have to offer, or they will insult you for the value that you tried to contribute. Or they will laugh at you, or they will say negative things to other people about your efforts.

That's okay. Keep contributing. Maybe you need to make an adjustment to what you are delivering or how you are delivering it or to whom you are delivering it. Keep refining your efforts as a value creator and contributor, but please don't ever stop trying to contribute value.

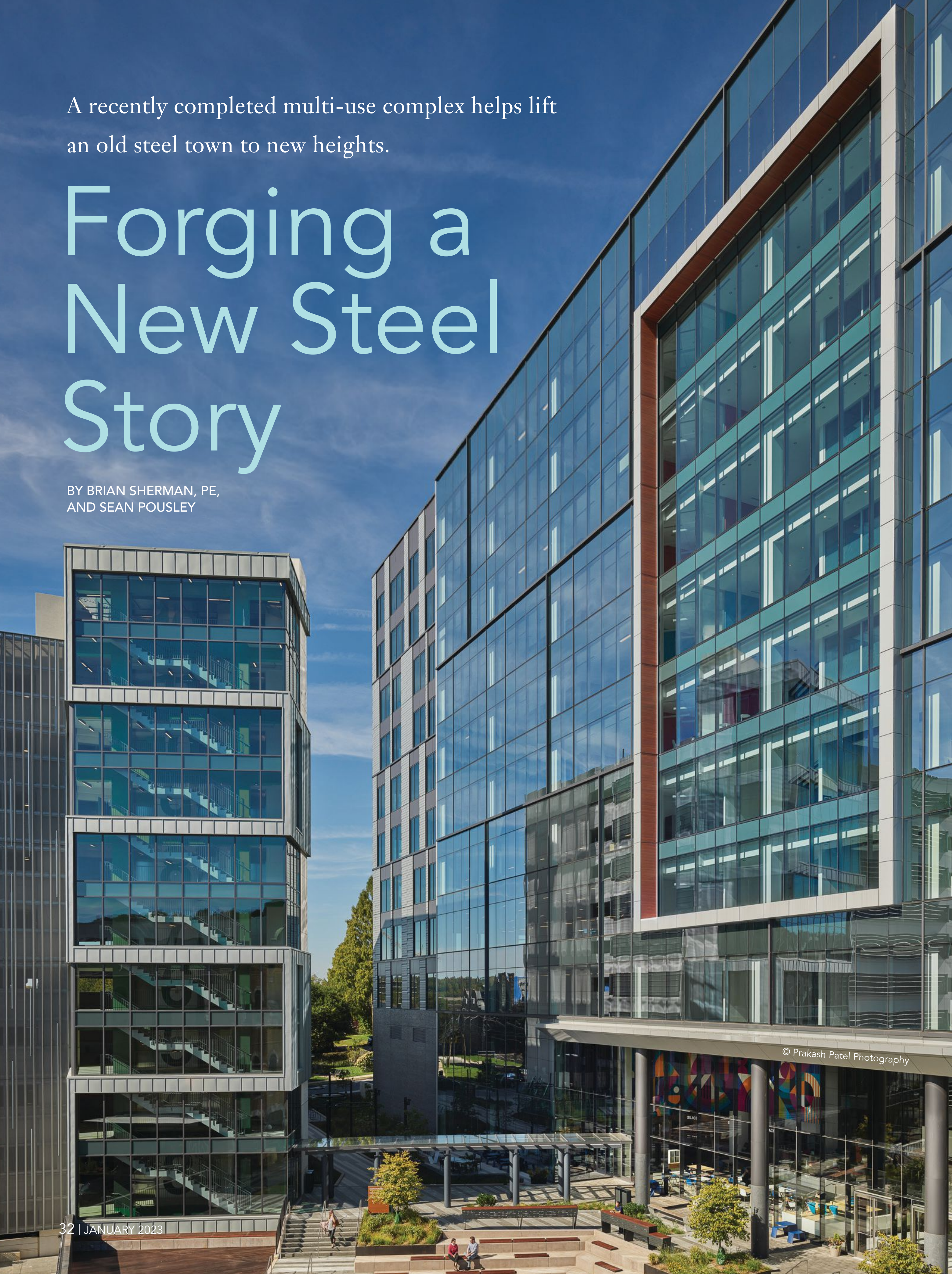
It is in creating and contributing value that our lives gain meaning and significance. And somewhere along the way, you will receive value for the value you contribute. That value can be in the form of stronger relationships, a greater sense of self-worth, and/or material gains. Give some of your focus to value contribution rather than just to your personal rewards, and life has a way of sending value back to you. ■

Since 1998, **Dan Coughlin** has worked with business leaders to consistently deliver excellence, providing coaching and seminars to executives and groups, as well as guiding strategic decision-making meetings. And now he is also focused on helping people on their inner journey to excellence. Visit his free *Business Performance Idea Center* at **www.thecoughlincompany.com**. Dan has also given presentations in at NASCC: The Steel Conference. To hear recordings, visit **aisc.org/education-archives** and search for "Coughlin."

A recently completed multi-use complex helps lift an old steel town to new heights.

Forging a New Steel Story

BY BRIAN SHERMAN, PE, AND SEAN POUSLEY



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opposite page: The completed 14-story, 524,838-sq.-ft SORA West office building (at right in photo).

below: Five braced frames were used to laterally brace the 184-ft-tall structure.

ONCE A THRIVING STEEL MILL TOWN, Conshohocken, Pa., has long been an area in transition.

Its proximity to Center City Philadelphia—a 15-minute drive—and accessibility to mass transit has perpetually made it an attractive commercial hub, but up until recently, growth had been haphazard. "Conshy," as the locals call it, lacked a town center, and little thought had been given to walkability or parking.

Keystone Development + Investment had a vision to change that and proposed SORA West, a multi-use complex that includes a new 14-story office building, a hotel, a parking garage, and a historic firehouse adapted into a restaurant, all built around a public plaza that hosts concerts and other events.

At the same time, pharmaceutical distributor AmerisourceBergen wanted to combine two locations into a single headquarters and increase its brand identity. The company, with a top ten ranking on the Fortune 500 list, studied labor conditions, trends, and workplace dynamics and chose Conshohocken and SORA West as its new corporate home.

The company's 1,500 Pennsylvania-based employees have recently moved into the 14-story, 524,838-sq.-ft office building, which was completed in late 2021. The space offers 11 floors of collaborative office space, including the lobby and ground-floor amenities; a two-level, 76,372-sq.ft basement parking facility with 173 parking spaces; a 16,000-sq.-ft rooftop terrace with a mechanical, electrical, and plumbing penthouse; and a high roof.

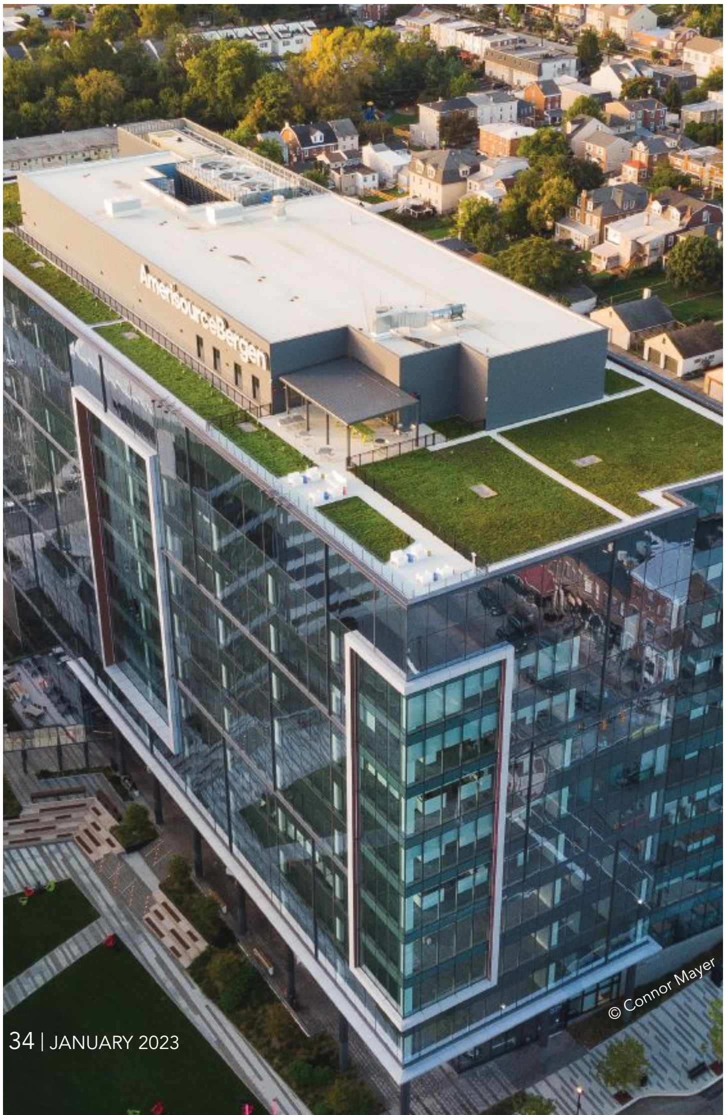
The chosen framing material for a project that reimagines a steel town? Steel, of course—3,500 tons of it.

"Structural steel allowed earlier design of the base structure so an early bid package could be issued," said Mal Bland, PE, principal and project executive/operations manager for IMEG (formerly The Harman Group), the structural engineer of record for the core and shell. "This allowed the structural steel fabricator to begin their work earlier. The base structure is normally on the critical path, so accelerating the steel fabricator and detailer results in an earlier turnover to the developer. In turn, this allows the developer to deliver the core and shell of the building to the corporate tenant sooner."

"The use of steel allowed an efficient column grid of 30 ft by 45 ft that works well to maximize the efficiency of office layouts for corporate office buildings," Bland continued. "And the use of structural steel resulted in approximately $20-per-sq.-ft savings in the structural cost."

The site presented several challenges that the design team of IMEG, architect Gensler, and general contractor Intech were able to solve using the structural steel with slab on metal deck building, including working with a difficult slope and maintaining the durability of the steel-framed parking levels in the basement.

Five braced frames were needed to laterally brace the 184-ft-tall structure—three in the long direction and two in the short direction. The braced frames, mostly made up of W14 wide-flange chevron braces, were strategically placed within the interior of the floor plates, next to the stairs/elevators, to maximize open floor space and to offer unobstructed views around the perimeter of the building. To limit the lateral drift, moment frames were placed at the far ends of the building. These frames used partially restrained beam-to-column moment connections to keep service-level wind drift values within a code limit of H/400.



Steel for the project's framing system totaled 3,500 tons. One of the design team members commented that using structural steel allowed earlier design of the base structure so an early bid package could be issued.

Steel Parking

The team chose to frame the underground parking structure with structural steel as well. The two parking levels comprise one slab-on-grade level, one slab-on-metal deck level, and a parking speed ramp to access it from one level higher due to the steeply sloping terrain.

Vehicles can track in water and deicing salts, which puts the supported parking levels at risk for deterioration and corrosion. During the steel detailing stage, the team paid particular attention to the durability considerations highlighted in AISC Design Guide 18: *Steel-Framed Open-Deck Parking Structures* (**aisc.org/dg**) and ACI 362.1: *Guide for the Design and Construction of Durable Concrete Parking Structure* in an effort to limit stagnant water, protect the slab from water seeping in, and supply a path for water to exit.

The first step was for the steel framing and slab on metal deck to slope to drains in two directions rather than building a flat slab with varying thicknesses, which helped reduce the weight of the slab. The minimum design slope of the slab is 1.5% or $^3/_{16}$ in. per foot diagonally, which allowed for a minimum of 1% due to construction tolerances and beam camber and helped avoid any potential water ponding.

The team chose G-90 vented galvanized metal decking for the slab-on-metal deck. The decking is a stay-in-place form only, with the slab having top and bottom reinforcing steel, and the perforations in the decking allow trapped water to be released from above the decking. The slabs were designed as continuous spans with negative

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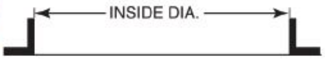
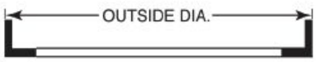
1. **Angle Leg Out** — 10" x 10" x 1" Angle

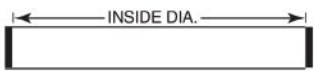


2. **Angle Leg In** — 10" x 10" x 1" Angle

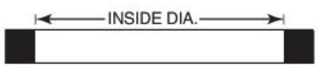


3. **Flat Bar The Hard Way** — 24" x 12" Flat

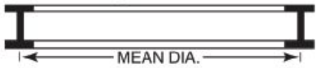
4. **Flat Bar The Easy Way** — 36" x 12" Flat



5. **Square Bar** — 18" Square

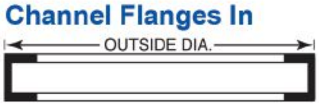


6. **Beam The Easy Way (Y-Y Axis)** — 44" x 335#, 36" x 925#



7. **Beam The Hard Way (X-X Axis)** — 44" x 285#

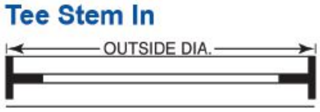
8. **Channel Flanges In** — All Sizes



9. **Channel Flanges Out** — All Sizes

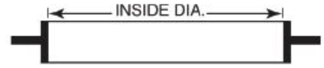
10. **Channel The Hard Way (X-X Axis)** — All Sizes

11. **Tee Stem In** — 22" x $142\frac{1}{2}$# Tee

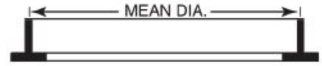


We bend ALL sizes up to:

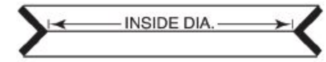
12. **Tee Stem Out** — 22" x $142\frac{1}{2}$# Tee



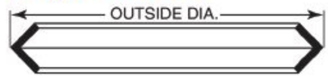
13. **Tee Stem Up** — 22" x $142\frac{1}{2}$# Tee



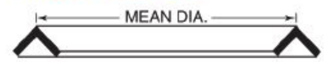
14. **Angle Heel In** — 8" x 8" x 1" Angle



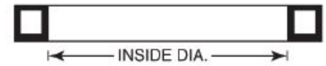
15. **Angle Heel Out** — 8" x 8" x 1" Angle



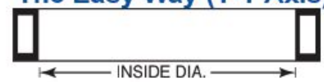
16. **Angle Heel Up** — 8" x 8"x1" Angle



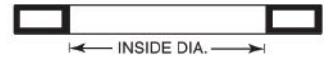
17. **Square Tube** — 24" x $\frac{1}{2}$" Tube



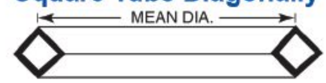
18. **Rectangular Tube The Easy Way (Y-Y Axis)** — 20" x 12" x $\frac{5}{8}$" Tube



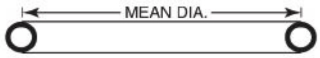
19. **Rectangular Tube The Hard Way (X-X Axis)** — 20" x 12" x $\frac{5}{8}$" Tube



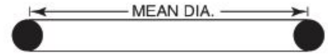
20. **Square Tube Diagonally** — 12" x $\frac{5}{8}$" Square Tube



21. **Round Tube & Pipe** — 24" Sched. 80 Pipe



22. **Round Bar** — All Mill Produced Sizes



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bending reinforcing over the supports, with detailing that included additional top reinforcing over all the supports and at slab edges to minimize cracking above the supports. All reinforcing steel in both the supported slab on metal deck and slab-on-grade was epoxy coated. Additionally, slab on metal deck is susceptible to cracking, which gives water an entryway into the slab, so a urethane traffic membrane coating was applied throughout the supported parking levels to bridge the cracks and protect the slab.

The perimeter of the structure has a 3-ft-wide, 2-in.-tall concrete wash that slopes the top of the concrete away from the edge of the slab. The wash keeps water from the edge of the structure, walls, and façade elements and also prevents water from entering the elevator lobby.

Another challenge with the garage was the perimeter retaining walls. In a typical underground structure, the slab and steel framing resist the soil loads and pass the loads through the diaphragm to the opposite side. Because of the ramping on this structure, each bay of the parking level is split and does not present a direct load path from one side to the other. In addition, the building sits on a sloping site with a two-story retaining wall on one side and a three-story retaining wall on the opposite side. Lastly, a parking access ramp spans almost two-thirds the length of the building next to the three-story retaining wall that drops down two stories. This required several split diaphragms with unique details in order to transfer lateral loads from soil loads to the braced frames and surrounding walls.

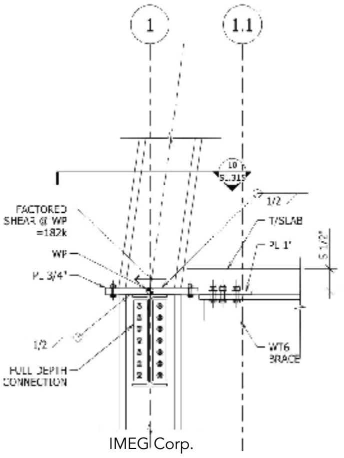
right: Topping out.

below: The building sits on a sloping site with a two-story retaining wall on one side and a three-story retaining wall on the opposite side.


Mal Bland


Mal Bland

Mal Bland

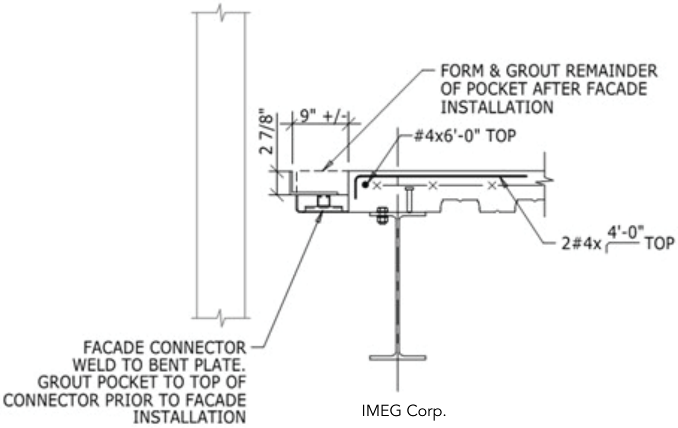


IMEG Corp.

above: An in-plane galvanized steel truss was used to distribute the nearly 2,400 kips of soil load from the retaining wall at the north through the 24-ft-wide ramp slab and into the floor diaphragms at Level 1 and the lower parking level.

left: To accommodate a 2-ft setback in the curtainwall at the south face of the building, the design team introduced a sloping column between Levels 3 and 4.

right: A connection detail for the façade.



IMEG Corp.

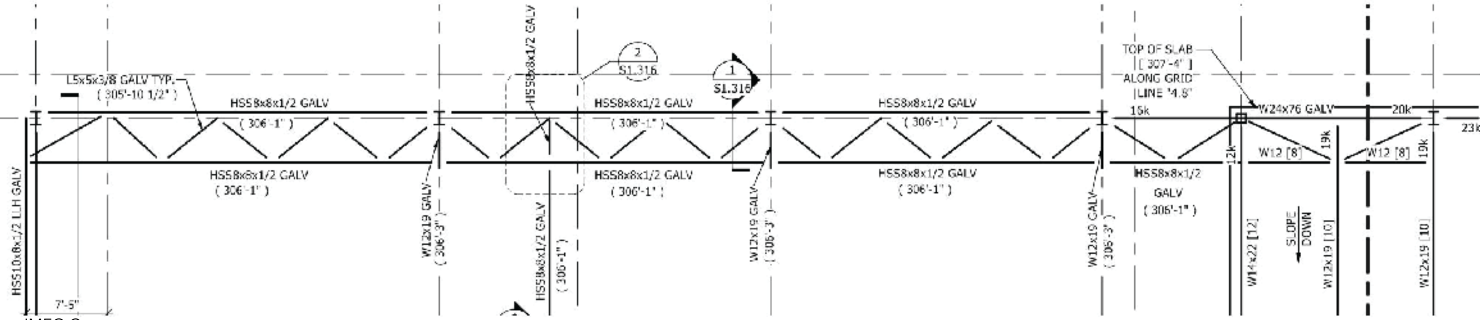
To access the underground parking levels, a structural speed ramp on the north side of the building slopes down from the entrance at Level 2, through the Level 1 slab, to the first level of underground parking. The ramp bisects the Level 1 floor diaphragm below grade, leaving nothing to resist the soil pressures retained by the three-story basement retaining wall. Ultimately, the speed ramp itself was used to resist these soil forces. An in-plane galvanized steel truss was used to distribute the nearly 2,400 kips of soil load from the retaining wall at the north through the 24-ft-wide ramp slab and into the floor diaphragms at Level 1 and the lower parking level, where the load is eventually counteracted by the passive soil pressure formed at the south side of the building.

Plate Girders and Sloping Columns

There were varying layouts at the upper office levels and lower parking levels, so several columns had to be transferred out at the ground level. A series of 58-in.-deep to 68-in.-deep built-up steel plate girders were used to transfer out four columns with a range of factored loads from 1,800 kips to 2,250 kips. The heaviest of these plate girders weighed nearly 8.5 tons and was made of 3.5-in.-thick Gr 50 steel flange plates.

The south face of the building has a setback in the curtainwall façade, a prominent architectural feature that affected the structural steel framing. To accommodate this 2-ft setback, a sloping column was introduced between Levels 3 and 4. The gravity load in this column of more than 1,200 kips translated into nearly 200 kips of horizontal thrust at each level. To resolve these forces, a series of diagonal WT braces were installed between the primary floor beams, from the work points at the top and bottom of the sloping column to the nearest braced frames. These forces were combined with the overall lateral forces in the building and incorporated into the final design of the braced frame elements.

The façade is a single-story glass curtain wall system attached to the top of the slab at the perimeter. Block-outs were provided in the slab on metal deck at the curtain wall mullions and infilled with grout after façade installation. It is easiest to connect the façade to the top of the slab, but this can cause a detailing problem with the finishes, so IMEG included a pocket within the concrete slab edge



IMEG Corp.

above: A drawing of the 20-ft-tall, nearly 110-ft-wide rooftop screen wall, which hides mechanical equipment from view.

below: In addition to the 14-story office building (tallest building at center of photo), the SORA West complex includes a hotel, a parking garage, and a historic firehouse adapted into a restaurant, all built around a public plaza.

© Connor Mayer

to hide the connection, which was grouted over after installation to be flush to the surrounding slab.

At the top of the building, the rooftop mechanical units reside behind a 20-ft-tall screen wall nearly 110 ft wide, braced on either side by two penthouses with individual braced frames. Since the wall did not align with the columns below, kickers could not be used. The team solved this issue with a horizontal ring truss at the top of the wall, and the lateral load from this truss transferred directly into the braced frames or into the slab on metal deck diagram of the penthouses.

From top to bottom, the development pays homage to steel history with modern steel framing, thus continuing the town's steel story into the future. ■

Developer
Keystone Development + Investment

Owner
SORA West Ou Owner, LLC

General Contractor
Intech

Architect
Gensler

Structural Engineer/Parking Planning and Design
The Harman Group, now IMEG

Steel Team

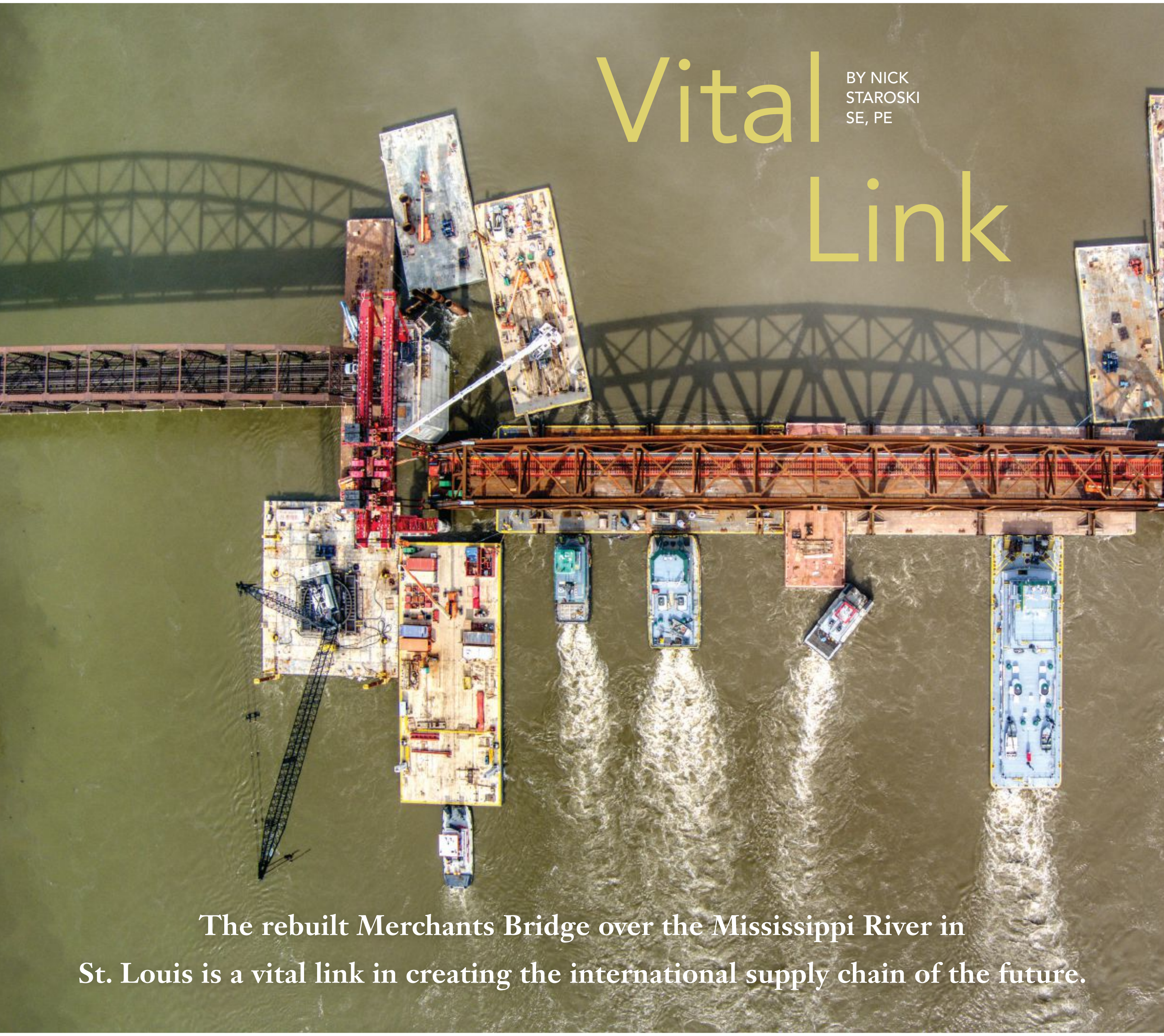
Fabricator and Detailer
Cives Steel Company (AISC Certified Fabricator)

Erector
XLE Metals/Independence Steel (AISC Associate)

Brian Sherman and **Sean Pousley** are both project engineers – structural with IMEG.

Vital Link

BY NICK STAROSKI SE, PE



The rebuilt Merchants Bridge over the Mississippi River in St. Louis is a vital link in creating the international supply chain of the future.

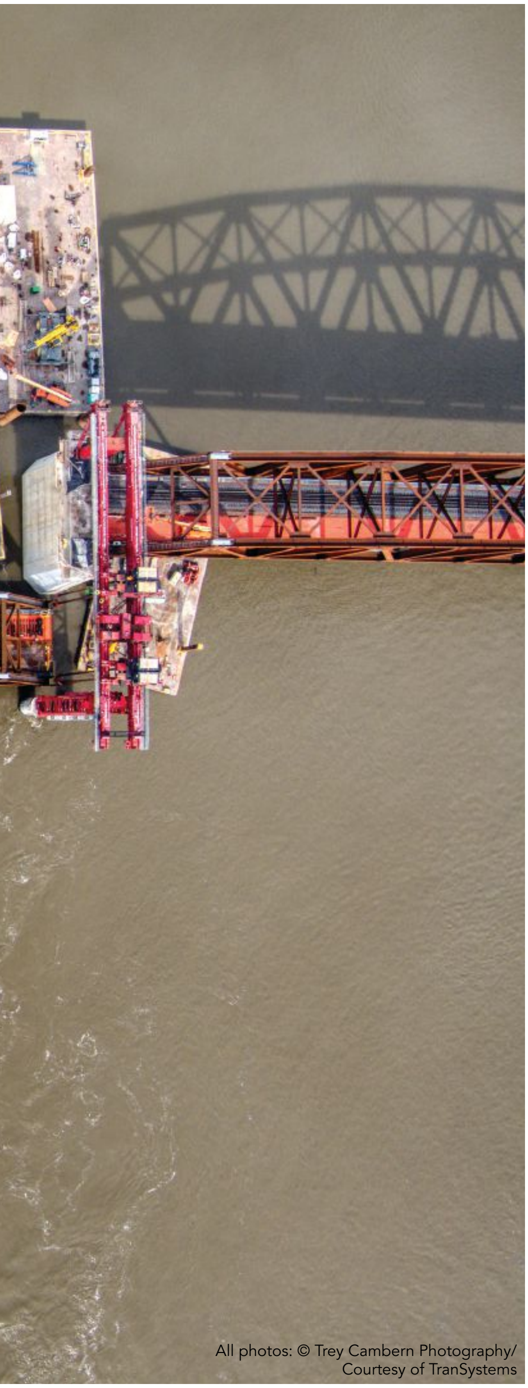
THE ORIGINAL MERCHANTS BRIDGE had a good, long run.

With current-day rolling stock and locomotive loads, the second-oldest bridge over the Mississippi River in the St. Louis region had exceeded its design life. The main span truss members were built in 1890, and the girders and floor beams ranged in age from 114 to 127 years old. As a result, one of the nation's primary east-west rail corridors was operating under a variety of speed, clearance, and load restrictions.

Crossings were limited to one train at a time. Meets and passes were prohibited for six-axle locomotives and for any railcar or piece of equipment weighing in excess of 286 kips. Crossings by loaded short-wheel-base ore cars were also prohibited. Train speeds were limited to 20 miles per hour, but the speed limit itself was optimistic. Operating as a single-track bridge often meant congestion on both sides of the river and much lower train speeds. The 12-ft spacing of the lines also restricted the number, type, and weight of trains permitted to cross.

The bridge was down to an average of 38 train crossings per day, and the operational limitations resulted in increased costs for the owner, Terminal Railroad Association of St. Louis (TRRA), as well as for the six Class I freight railroads that relied on the crossing.

All of these factors pointed to the bridge needing to be replaced, and a reconstruction effort commenced in 2018. The three main aspects included the removal and replacement of the three 520-ft through trusses over the river, seismically retrofitting the four existing river piers, and significantly improving the east approach.



All photos: © Trey Cambern Photography/ Courtesy of TranSystems

The Merchant Bridge's original main span truss members were built in 1890, and the girders and floor beams ranged in age from 114 to 127 years old. As a result, one of the nation's primary east-west rail corridors was operating under a variety of speed, clearance, and load restrictions. Crossings were limited to one train at a time, and meets and passes were prohibited for six-axle locomotives and for any railcar or piece of equipment weighing in excess of 286 kips.

The project also called for:

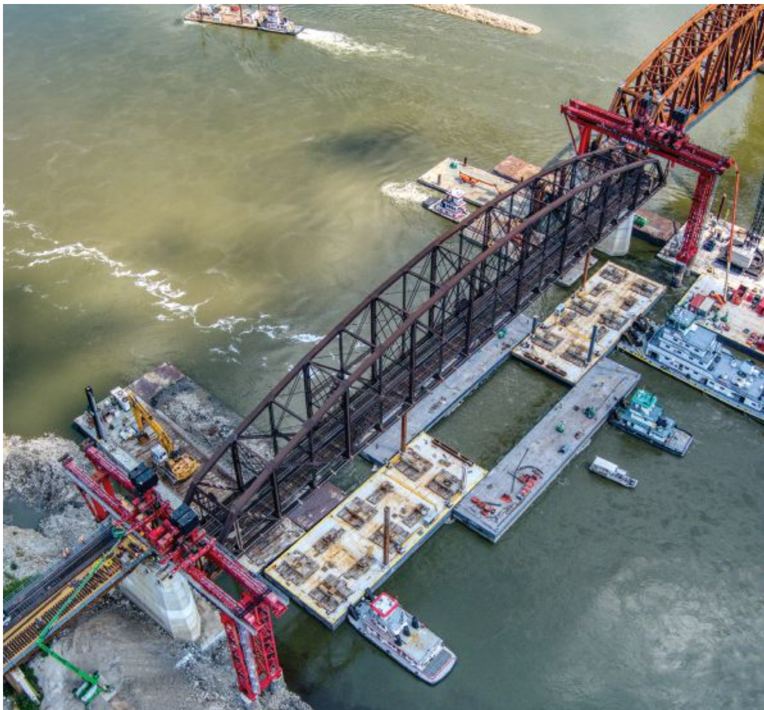
- Replacing the existing open timber deck on the approach deck plate girder spans with a new ballasted steel deck to accommodate a double-track configuration on 15-ft track centers
- Replacing the east approach steel girder trestle spans with a combination of cast-in-place concrete culverts and lightweight cellular fill
- Removing the electric utility towers attached to the bridge
- Building walkways on either side of the bridge deck at track level and access to the main pier tops
- Installing an under-span traveler to facilitate inspections
- Installing systems for communications, signaling, navigational lighting, and surveillance

The new crossing, which opened this past September, doubles the capacity of the original bridge and is expected to serve at least 70 crossings a day as well as meet the projected future freight and passenger rail demand.

Replacing the Truss Spans

The old truss spans weighed 1,900 tons apiece, and the new ballasted truss spans consisting of built-up H-type members each weigh 4,500 tons (unballasted) and contain 145,000 bolts. (The fabricated steel for the three spans totaled nearly 13,500 tons.) The change-out required the use of a robust gantry system with strand jacks to lift the spans and a slide system for translation. This gantry/strand jack option allowed the new trusses to be erected and floated in low on a fixed platform. Once the trusses were in

The truss change-out required the use of a robust gantry system with strand jacks to lift the spans and a slide system for translation. This gantry/strand jack option allowed the new trusses to be erected and floated in low on a fixed platform. Once the new trusses were in position, the strand jacks could lower down, grab the ends of the truss, raise, and then slide the span over into final alignment. One major advantage of this approach was that the final set-down and positioning of the new truss could occur while on strand jacks and not on barges fighting the river currents.



position, the strand jacks could lower down, grab the ends of the truss, raise, and then slide the span over into its final alignment. One major advantage of this approach was that the final set-down and positioning of the new truss could occur while on strand jacks and not on barges fighting the river currents.

Key aspects of the span change-out included strengthening the existing truss chords for removal, strengthening the existing piers for the gantry system, placing the gantry system for lifting and sliding the spans, and maintaining barge stability and maneuverability in and around obstacles in the river while positioning the truss under the gantry system. Replacing each of the trusses had to happen within its designated 10-day track outage and within two tightly focused, highly coordinated 24-hour navigation channel outages—the first one so workers could remove the old truss and the second to install the new one. To provide redundancy and protect against catastrophic failure, the bottom chord members of the trusses were designed as bolted-up steel members consisting of angles and plates. This solution provided internal redundancy that a welded built-up steel member would not.

Seismically Retrofitting Existing Piers

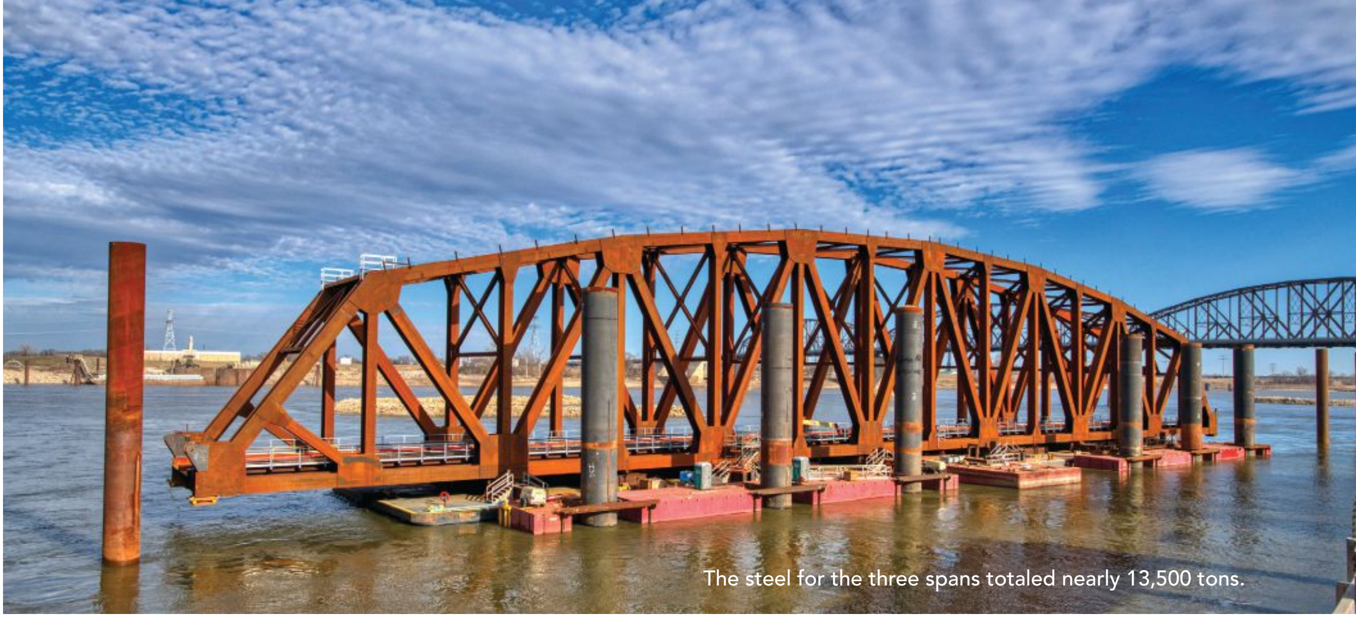
In addition to replacing the three river-span trusses, the project also focused on strengthening the four existing river piers to address increased loading and to meet standards guarding the structure against Level-2 seismic events (as defined by the American Railway Engineering and Maintenance-of-Way Association) and vessel collisions (as defined by the American Association of State Highway and Transportation Officials). To meet these standards, the piers were encased in a 3-ft minimum layer of new concrete supported on a new footing with micropiles. Dowel bars were drilled into the masonry to aid in the transfer of shear forces from the new concrete to the existing stone.

During this phase of the work, the team employed special methods for constructing cofferdams, the underwater structures needed to provide a dry work area in which construction of the concrete pier encasements could occur. Each cofferdam measured 45 ft by 90 ft and 80 ft tall and was comprised of a wall of large sheet piles, driven deep underwater, surrounding each of the piers. Dewatering pumps kept the cofferdams free from river water during construction.

The old truss spans weighed 1,900 tons apiece, and the new ballasted truss spans consisting of built-up H-type members each weigh 4,500 tons (unballasted) and contain 145,000 bolts.

above: Much of the east approach is located within the floodwall limits on the Illinois side of the river. The steel girder trestles spanning 745 ft were originally constructed in 1902, with their condition warranting annual inspection.

below: Replacing each of the trusses had to happen within its designated 10-day track outage, and within two tightly focused, highly coordinated 24-hour navigation channel outages—the first one so workers could remove the old truss and the second to install the new one.



The steel for the three spans totaled nearly 13,500 tons.

Improving the East Approach

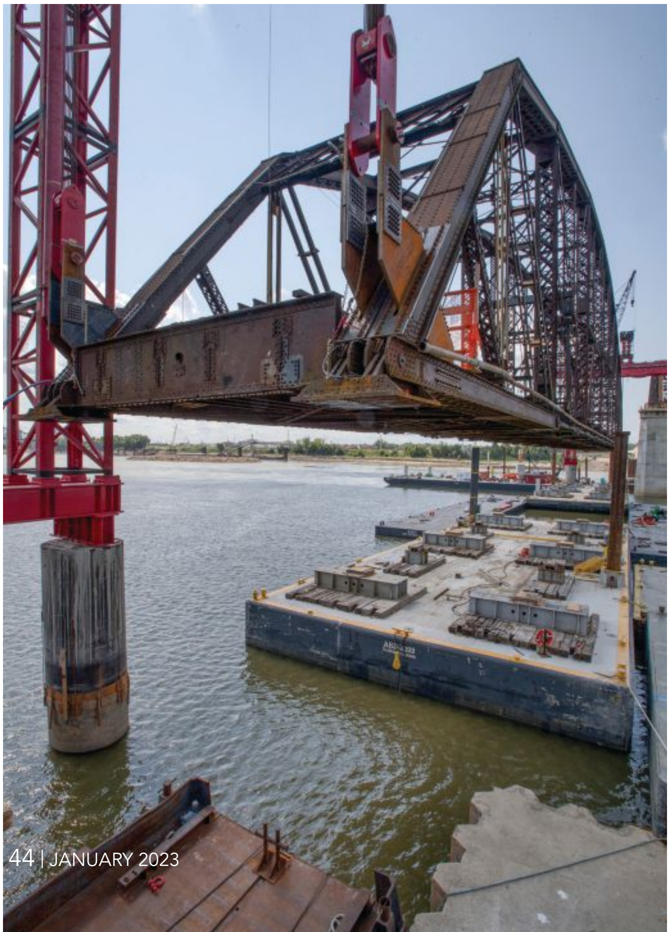
Much of the east approach is located within the floodwall limits on the Illinois side of the river. The steel girder trestles spanning 745 ft were originally constructed in 1902 (their condition warranting annual inspection), and the approach would need to be renovated and reinforced in order to keep pace with the reconstructed Merchants Bridge.

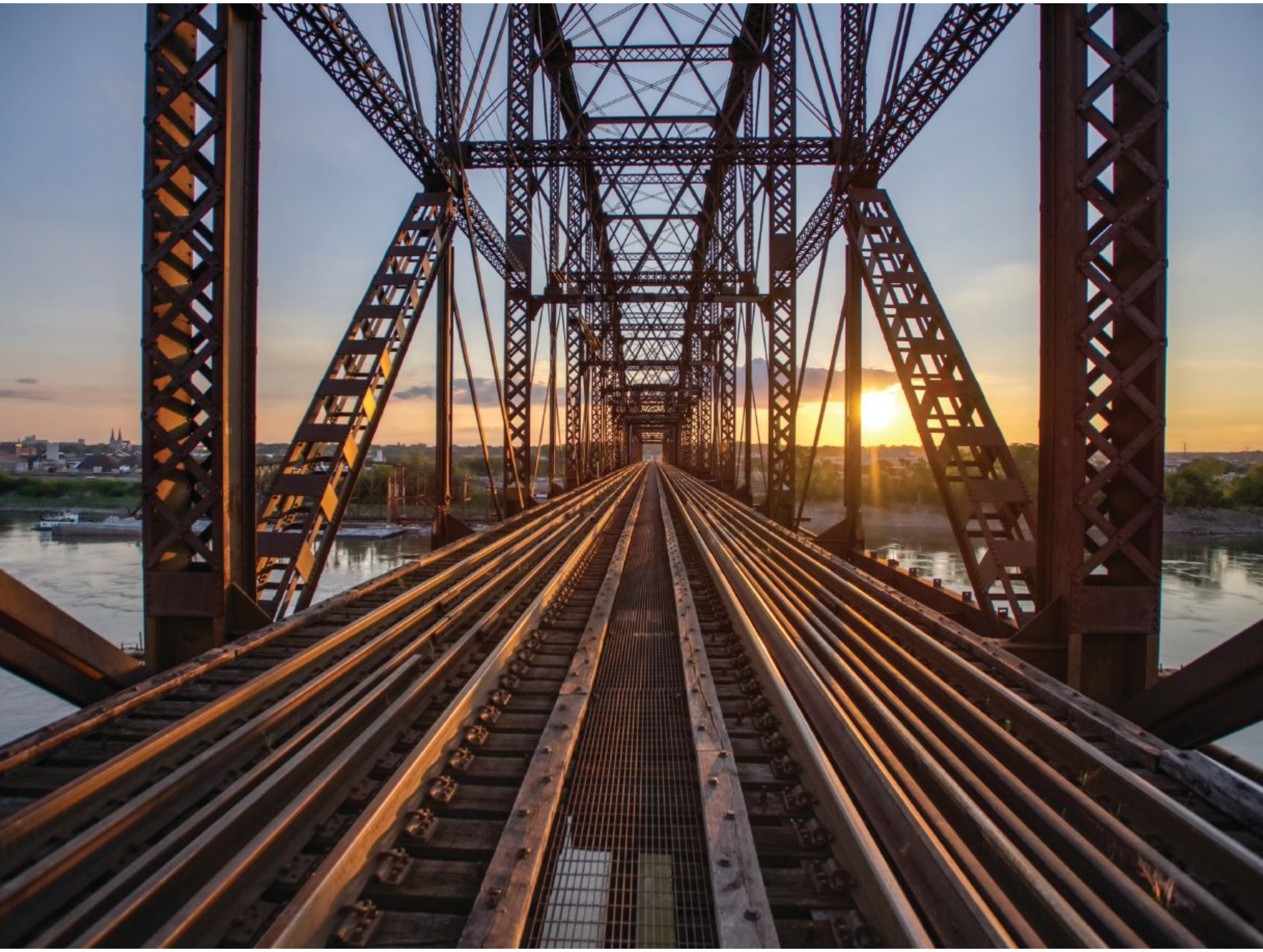
The east approach steel girder trestle spans were encased by constructing culverts in between the steel towers to allow river water to move from one side to the other during high water events. Both the culverts and steel trestles were encased with lightweight cellular concrete using MSE walls to contain the new fill. This solution eliminates many of the maintenance issues seen in aging elevated steel structures.

The existing deck plate girder spans directly adjacent to the main river spans on each approach were lowered and widened to provide 15-ft track centers (an improvement over the previous 12-ft track centers) and also for using ballasted steel decks.

A major part of this project was shifting from an open-deck structure, where the track rails rested directly on ties and the ties rested directly on the beam, to a ballasted deck structure in which the ties rest on 8 in. to 12 in. of ballast (rock aggregate) placed in new plate deck pans that rest on the beams.

Key aspects of the span change-out included strengthening the existing truss chords for removal, strengthening the existing piers for the gantry system, placing the gantry system for lifting and sliding the spans, and maintaining barge stability and maneuverability in and around obstacles in the river while positioning the truss under the gantry system.





A Local Project with International Reach

The updated bridge can now handle two modern freight trains at once and, with that new capacity, reestablish itself as a vital link in a supply chain reaching both sides of the Mississippi River, across the United States, and internationally.

Considering the growth in freight traffic in the United States in the last 50 years—and the projected growth for the next 50 years—reconstructing the bridge was an absolute priority for the St. Louis region and the nation's infrastructure. The bridge serves six Class I railroads, as well as Amtrak, and helps move freight daily to and from three West Coast ports (Long Beach, Los Angeles, and Oakland) and two East Coast ports (Newark/New York and Norfolk, Va.). The bridge's increased capacity will also provide more dependable and higher-velocity rail car movement to Canada, Mexico, and the Gulf of Mexico. ■

Owner
Terminal Railroad Association of St. Louis (TRRA)

General Contractor
Walsh Construction

Structural Engineers
TranSystems/Burns and McDonnell

Steel Team

Fabricator
Veritas Steel, LLC (AISC Certified Fabricator), Eau Claire, Wis.

Detailer
Tensor Engineering Co. (AISC Detailer), Indian Harbour Beach, Fla.

Nick Staroski is a project manager with TranSystems.

Going Big with Castellated Beams

BY JULIE LOW

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

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

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

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

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

All images courtesy of Cobb Industrial

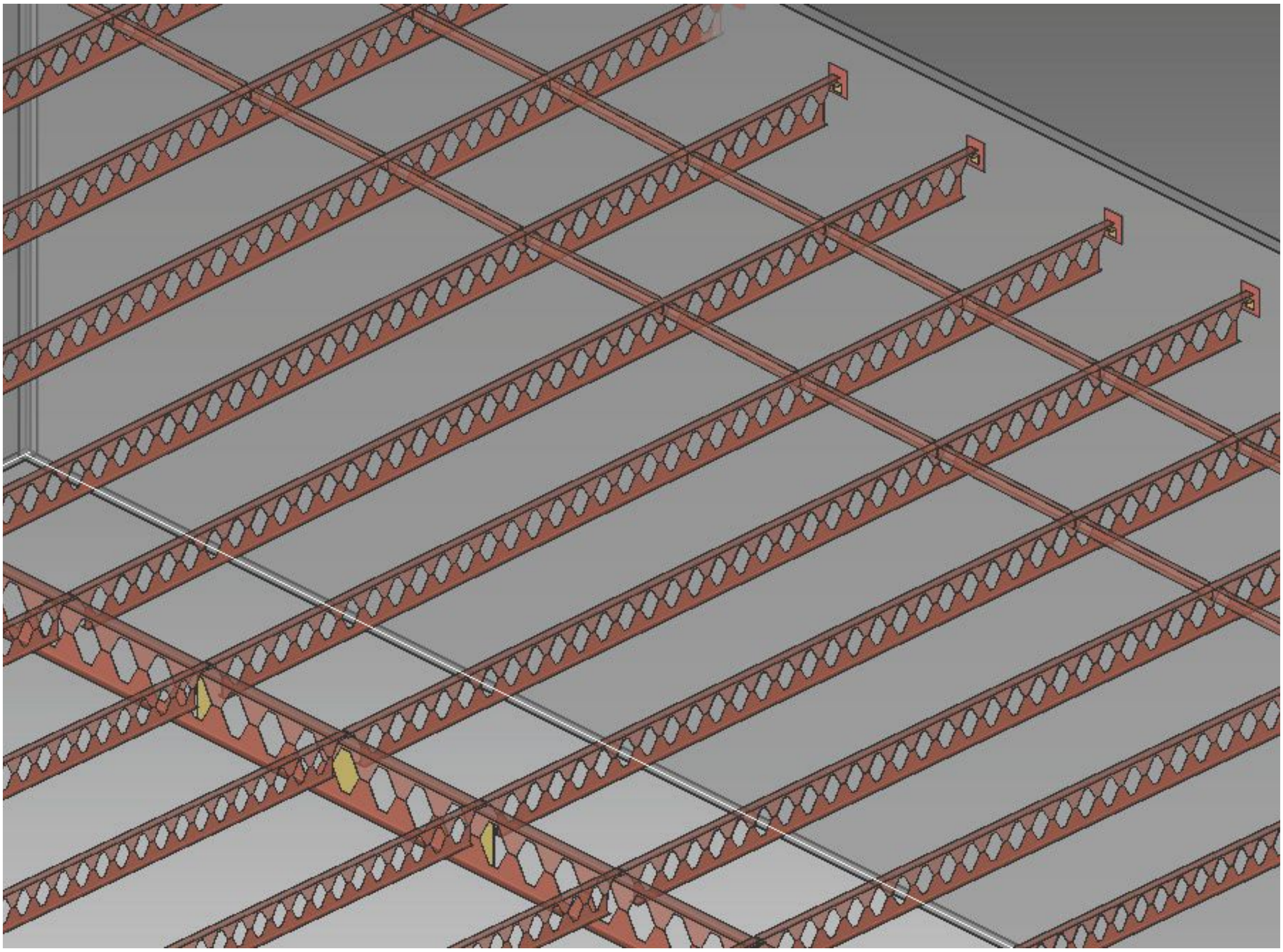
The Planning

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

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

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

A 3D model of the castellated beam roof framing.



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

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

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

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

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

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

The Production

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

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

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

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

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

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

The Build

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

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

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

Cobb produced the castellated beams well before they were needed in the building process. In fact, production was moving so fast that the steel couldn't be stored at the shop, so the beams were transported to the field months before they went in the air.

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

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

The Future

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

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

Owner/Developer
Trammell Crow Atlanta Development, Inc.

Structural Engineer
Haines Gipson and Associates

Architect
Pieper O'Brien Herr Architects

General Contractor
Catamount Constructors, Inc.

Roof System Engineer
Forsite Group

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

Julie Low (jlow@fancytheagency.com) is a principal with Fancy – The Collection.

All Hands on (Steel) Deck

BY GEOFF WEISENBERGER

Hands-on events at ironworker training facilities across the country were the name of the game for AISC's 2022 SteelDay.

WANT TO CATCH a firsthand glimpse of what it's like to be an ironworker?

Consider visiting an Iron Worker training facility. That's what hundreds of people did at a dozen such facilities from coast to coast the week of October 17, 2022, culminating in the 14th annual SteelDay celebration. Sponsored by AISC and its partners, including IMPACT (Ironworker Management Progressive Action Cooperative Trust), SteelDay's goal is to educate engineers, architects, students, and others about the domestic fabricated steel industry through steel facility tours, project site visits, online seminars, and hands-on events.

Atlanta

In the Washington, D.C., area, 20 Howard University civil engineering students visited the Ironworkers Local 5 training facility, partaking in tasks like welding, cutting plate with an oxygen-acetylene torch, rigging and connecting beams, tightening and untightening bolts with a spud wrench, and climbing a steel column.

"Watching the excitement of the Howard students as they tried some of the hands-on tasks that ironworkers perform on job sites every day was so much fun!" said Harvey Swift, regional director with IMPACT. "Everyone of the students seemed engaged and so eager to learn."

"It was amazing and more than I could have hoped for," said student Mawuko Jacquaye. "I especially enjoyed the column climb. It was fun to race my classmates to the top. I would go again if allowed the opportunity."

"It was so much fun!" added fellow student Aliyah Hamilton. "I'd do this again in a heartbeat!"

Another event, at the Iron Workers Local Union 387 Atlanta facility, attracted more than 30 attendees, including several students from Kennesaw State University. The facility expressed enthusiasm about hosting additional similar events in the future, within or outside the context of SteelDay, and also reported that it has experienced a general increase in applicants in recent months.

"The event was both informative and eye-opening," noted one attendee, Kelsey Hammond a design engineer with PES Structural Engineers. "We listened to a fascinating presentation about the apprenticeship program and then were given the chance to try a few of the skills they teach, such as flame-cutting steel, tying rebar, and even welding using VR. Not only did I have fun, but I gained an even greater respect for the people we see in the field every day working in these disciplines!"

Roughly the same number of guests attended another Iron Worker event, this one at the Local Union No. 808 training center in Orlando, Fla. The majority of the attendees were from Orange County Public Schools. And up the East Coast, in Queens, N.Y., roughly 40 guests attended an event at yet another Iron Worker training facility. Being in New York, some guests were no doubt eager to test their skills and bravery walking on a steel beam high above the city. The event offered the next-best thing (and without the need to go through rigorous training) in the form of a virtual beam walk aided by VR goggles.

Other events took place in Boston, Dallas/Ft. Worth, Las Vegas, Los Angeles, San Diego, Sacramento, Portland, and Kansas City.

Orlando, Fla.

Queens, N.Y.

SteelDay for Students

More than a dozen student groups and their faculty advisors attended events across the country in conjunction with SteelDay throughout the fall 2022 term. AISC offered grants to faculty to arrange field trips for their students to tour steel mills, fabrication shops, and iron worker training centers.

Christina McCoy, SE, RA, assistant professor of architectural engineering at Oklahoma State University, took a group of 50-plus students on a field trip to AISC member W&W/AFCO Steel's fabrication facility in Oklahoma City. She commented, "Students loved the event, and many commented that they did not realize everything that goes into steel fabrication."

William Collins, PE, PhD, associate professor at the University of Kansas, took nearly 50 of his students to the Iron Worker training center in Kansas City, where they got to experience climbing columns and frames, practice rigging and lifting with a crane, make bolted splice connections, and practice virtual and real stick welding. "This was the best SteelDay event I've been to yet, and that's saying something because we've been taking students to some great events for the past eight years!" exclaimed Collins.

A group of 19 students from Georgia Tech, led by Ryan Sherman PE, PhD, assistant professor, visited a Gerdau (AISC member) steel mill in Cartersville, Ga. Sherman said the students, ranging from undergraduate to PhD candidates, were amazed to see first-hand how steel was made. "The staff at Gerdau kindly answered the multitude of questions asked by the students," he noted. "Overall, it was a fantastic experience for all. Thank you for the generous support by AISC and Gerdau for this amazing learning opportunity!"

The AISC Education Foundation plans to open a program for faculty grants to support more field trips like these throughout 2023. Contact me (**mnookin@aisc.org**) if you have any questions, and stay tuned for more information coming soon.

—Maria Mnookin, AISC education program manager

Oklahoma City

Kansas City

Cartersville, Ga.

Eau Claire, Wis.

Daytona, Fla.

"It was incredibly valuable to learn about the work that goes into fabricating and erecting the steel that we specify on our drawings," said Natasha L. Mundis, a structural designer with LeMessurier and an attendee at the Boston event. "As engineers, it's important to understand the importance of drawing clarity and coordination so the information can be conveyed correctly and smoothly. This was a fun and informative event!"

Of course, other events were on the docket as well. AISC member Veritas Steel Fabrication hosted 35 attendees in its Eau Claire, Wis., facility for a presentation and a tour featuring mammoth built-up steel plate girders. Similar AISC member fabrication shop events took place at High Steel in Lancaster, Pa., and Alpha Iron in Ridgefield, Wash. Also providing tours were AISC members New Millennium Building Systems (joist manufacturer in Butler, Ind.), Nucor (at its Tuscaloosa, Ala., mill), and V&S Galvanizing (galvanizer in Owego, N.Y.)

And in Daytona, AISC structural steel specialist Larry Flynn presented an AISC 2022 IDEAS^2 Award to ikon.5 architects and the project team of Daytona State College's L. Gale Lemerand Student Center, the new gateway to the college for its students and the city of Daytona Beach. A monumental portal and a far-reaching cantilevered eastern wing are hallmarks of the center, which incorporates 750 tons of structural steel fabricated by AISC member GMF Steel Group. Another live 2022 IDEAS^2 team event took place at Meow Wolf in Denver. (To read about these projects and the rest of the 2022 winners, see the related article in the May 2022 issue, available in the Archives section at **www.modernsteel.com**.)

In addition to these and other events, SteelDay also featured a Student SteelDay Contest, in which students were tasked with determining whether part of a hypothetical steel-framed building could support new loads for a renovation. Participants dug through historic AISC references, referred to field notes, and ran some calculations in order to answer a series of multiple-choice questions in a timed format.

"We had 65 students participate, representing 27 schools," noted Kristi Sattler, senior engineer with AISC's university relations department. "It was quite a bit different from anything we have ever done, and there was a larger turnout than any other recent SteelDay contest, which is exciting!" The top five scorers are as follows:

- 1st Place: Tessa Carty (Cornell University)
- 2nd Place: Garrett Thompson (Cornell University)
- 3rd Place: Claire Smith (University of Michigan)
- 4th Place: Pauline Wang (University of Michigan)
- 5th Place: Haimiti Atila (University of Michigan)

And remember: You don't need to be a student or prospective ironworker, and you don't need to wait for the next SteelDay (visit **aisc.org/steelday**, where we'll post updates on SteelDay 2023 in the coming months) to learn more about the domestic structural steel supply chain. Contact a local member (peruse our membership directory at **aisc.org/aisc-membership/member-directory**), contact IMPACT (**www.impact-net.org**) if you're interested in visiting an Iron Worker training facility, or even reach out to me if you want to visit a facility but need some more guidance. And we'll see you on the next SteelDay, if not before!

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

Connection Design: Do the Dos, Avoid the Don'ts

BY MARA BRASELTON, PE

There are plenty of connection design pitfalls out there. Recognizing them will help you avoid them.

WHEN IT COMES to designing steel structures, it is all about the connections.

Simple or complex, hand-drawn or modeled, the joints between members are critical to a structure's integrity. It's the connection designer's responsibility to know how to apply equations accurately in each situation.

After 18 years in the industry and more than a decade managing projects of all types and complexity, I've learned a good deal about the dos and don'ts of connection design. From reviewing connection calculations performed by engineers new to connection design and remembering back to my own experiences when starting out in the field, I've come up with a list of errors and how to avoid them, which may be of interest not only to design rookies but also to those who haven't designed a connection in some time. I'll be discussing these, as well as a wide range of technical topics with examples, in a session at the upcoming NASCC: The Steel Conference. These topics include:

Longitudinal and transverse welds used in combination. There are situations when the transverse weld increase factor per AISC *Specification for Structural Steel Buildings* (ANSI/AISC360-16) Equation J2-5 $(1 + 0.5\sin^{1.5}\theta)$ cannot be used. One such example is when a stiffener is used to transfer axial load through the column web using welds on three sides to transfer the force (see Figure 1). Do you know what equations to use for this example?

Fillers in bolted connection. When does a shim or filler cause a reduction in bolt shear capacity given in AISC *Code* Tables 7-1 and 7-3? I'll discuss such effects on bearing bolted connections with shims over ¼ in. and slip-critical A and B connections with multiple shims, as well as the tightening method used on the bolts and how it affects the bolt shear capacity.

Long end-loaded bearing bolt connections and welds. The footnote (b) in AISC *Code* Table J3.2 notes to reduce the bolt bearing capacity by 83.3% at end-loaded connections that are longer than 38 in. Does this apply to bearing and slip critical connections? I'll also touch on a similar reduction at long fillet welded connections per AISC *Code* Section J2b(d).

Net or gross section check at moment connections. Are you required to check the gross section capacity of the flanges at wide flange members with CJP welded moment connections? The answer is no (you won't be able to get it to work for members close

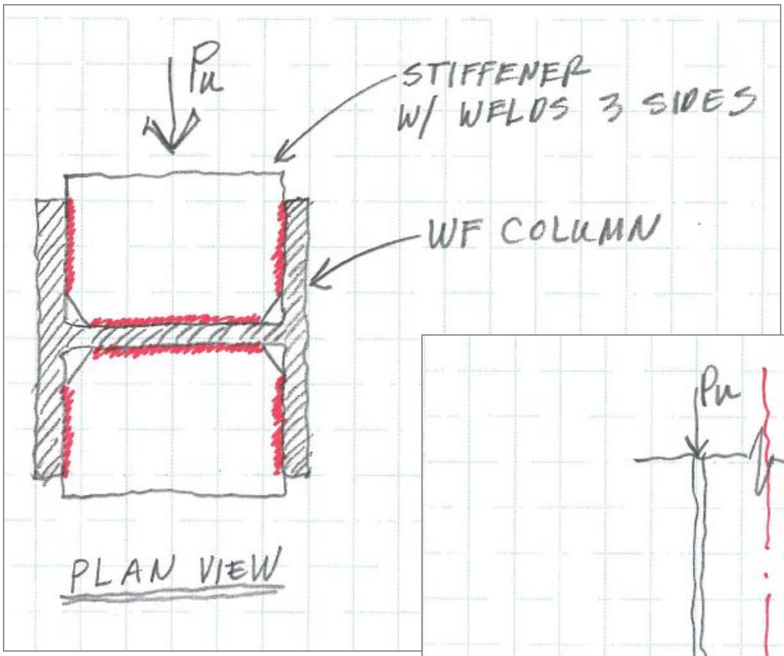


Fig. 1.

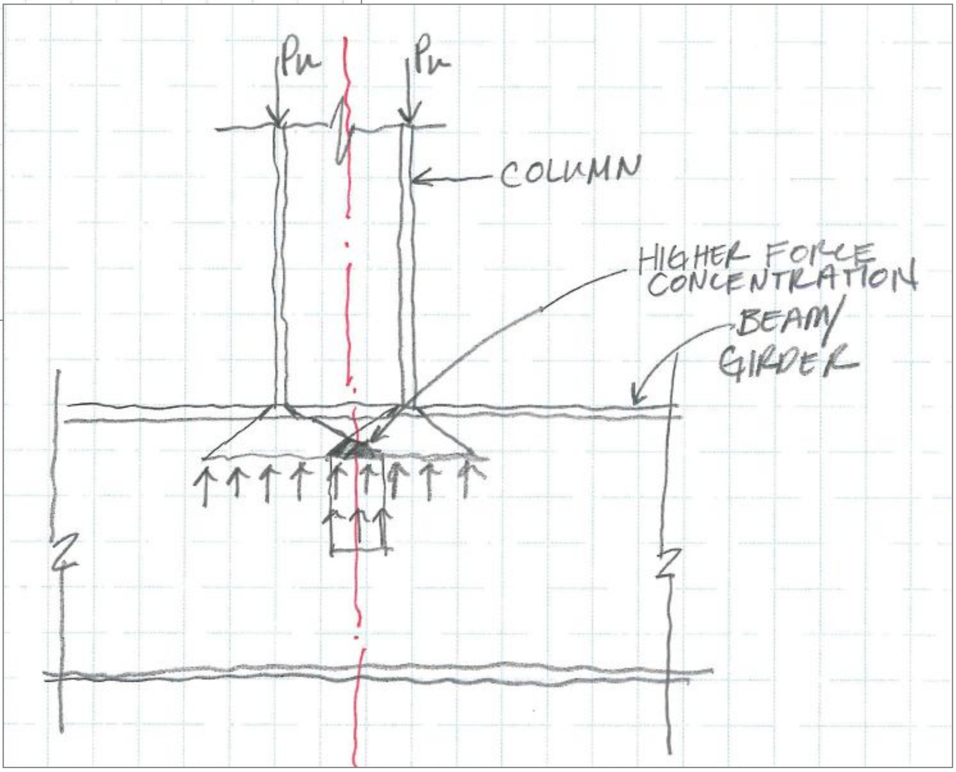


Fig. 2.

to fully stressed anyway), and I'll explain why. What about net section checks at moment connections with bolted flange plates? How do you check the net section of the flange? Do you know where to find the answers to these questions in the AISC *Code*?

Prying. I will briefly touch on prying calculations and how to carry the tributary length "p" through your calculations for checking the welds and the base material—not just prying on the plate! Also, did you know if you have prying, you most likely need to check it twice? Spoiler alert: It's once on the connecting member and on the support.

Closely spaced stiffeners. AISC *Code* Section J10 has equations for flanges and webs with concentrated loads. It is the connection designer's responsibility to know how to accurately apply these equations to their situation. I'll discuss how to handle two closely spaced concentrated loads at the center of a beam or girder, as illustrated in Figure 2.

In addition to helping connection designers at all career levels maneuver through those typical trouble spots, the session will also serve as a reminder about the provisions in Chapter J of the *Code*.

This article serves as a preview of the 2023 NASCC: The Steel Conference session "Common Mistakes Made by New Connection Designers." To learn more about this session and others, as well as to register for the conference, visit ***aisc.org/nascc****. The conference takes place April 12–14 in Charlotte, N.C.*

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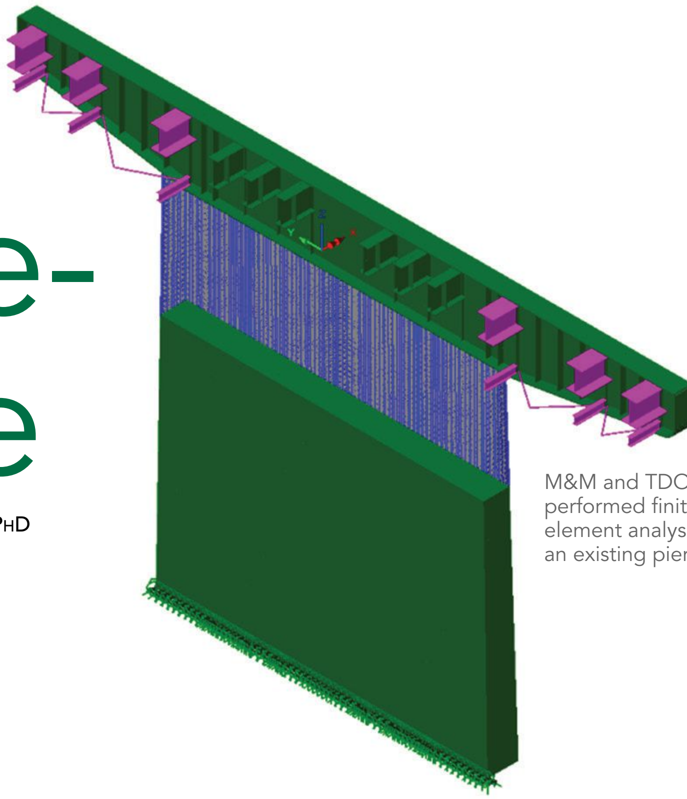
Double-Wide

BY FRANK ARTMONT, PE, PhD



M&M and TDOT performed finite element analysis of an existing pier.

A bridge team looks to a concrete-filled steel tube solution to expand the width and extend the life of a river crossing in Tennessee.

ONE OF THIS YEAR'S World Steel Bridge Symposium presentations at NASCC: The Steel Conference will provide an in-depth look at a bridge retrofit project in Chattanooga, Tenn.

The P.R. Olgiati Bridge is a 15-span steel multi-girder bridge that carries U.S. 27 over the Tennessee River. The bridge was built in 1953 and originally consisted of two side-by-side two-girder structures with an open longitudinal joint between them. The five spans over the river originally consisted of a three-span continuous structure in the center with simply supported spans on either end.

In 1998, the existing bridge was widened by adding two girders on each side. The new girders ran continuously over the five spans, and pairs of steel cap beams were added to the faces of the four existing concrete river piers, which extended transversely beyond the edges of the piers and supported the new girders. Each pair of cap beams was supported by six saddle beams that spanned between these beams and rested on the top of the piers. Once the cap beams and saddle beams were erected, the region between the cap beams on top of the piers was filled with concrete, encasing the new saddle beams. The cap beams were made long enough to support an additional girder line for a second future widening.

In 2016, a second widening was eventually planned for the bridge due to concerns that the saddle beams supporting the cap beams had become overstressed. During the design of the first widening, refined analysis was not commonly used, and reasonable assumptions were made regarding the distribution of load within the saddle beams. To determine if a second retrofit would be prudent, Modjeski and Masters (M&M) assisted the Tennessee Department of Transportation (TDOT) with a refined finite element analysis of the bridge under multiple loading conditions to assess the demands on the beams.

Installing CFST struts supporting the cap beams.

The evaluation revealed that the saddle beams might be overstressed under certain live loading scenarios. Three different retrofit options were considered, and adding diagonal struts from the ends of the cap beams to the pier edges was chosen as the most feasible option. After considering multiple steel alternatives for the struts, the team chose concrete-filled steel tubes (CFSTs) as the most viable option for the required demands as well as aesthetics. The CFSTs were designed such that they could be preloaded using hydraulic jacks, thereby redistributing dead load from the existing saddle beams and improving their performance, and the struts were installed and preloaded in 2017 and 2018.

Want to learn more about the project? Come to WSBS and NASCC! The presentation will cover the evaluation of the existing saddle beams and retrofit alternatives, the design of the CFST diagonal struts, and the installation/jacking process. ■

This article serves as a preview of the 2023 NASCC: The Steel Conference session "Evaluation and Retrofit for the Second Widening of the P.R. Olgiati Bridge." To learn more about this session and others, as well as to register for the conference, visit ***aisc.org/nascc****. The conference takes place April 12–14 in Charlotte, N.C.*

Frank Artmont
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Reliable Rigging

BY SCOTT SEPPERS

Understanding the basics of rigging is crucial to safe, efficient lifts on steel construction sites.

DO YOU KNOW what the total sling capacity of two ½-in. EIPS/IWRC wire rope slings that are double-wrapped and choked at 45° is?

More importantly, does the person rigging for you know?

At any moment during the work week in the U.S., there are countless rigging scenarios taking place. With that high frequency of overhead lifting, it is critical that the rigger has accounted for all factors—sling angles, sling tensions, and rigging capacities—in ensuring that the lift they are making is safe.

Part of making safe lifts is knowing and understanding the different types of slings and rigging configurations that are available to the rigger—as well as having a thorough understanding of how much tension/load is being applied to the rigging in a lifting scenario.

One of the reoccurring themes that I have noted over the years working with construction professionals is a lack of identifying and accounting for sling tension. Sling tension occurs when there is an angle involved with the rigging scenario, this is due to the attachment point of the sling not being centered directly in place over the rigging point of the load. Two of the most frequent rigging mistakes I have witnessed are basketed loads sharing the same attachment point and sling angle capacity errors. A great tool for correcting these errors is simple and low-tech: a journeyman riggers reference card (see Figure 1).

ITI JOURNEYMAN RIGGER'S REFERENCE CARD

Sling Capacities MECHANICAL SPLICE IN POUNDS DESIGN FACTOR 5:1 1

Wire Rope EIPS IWRC

Size in inches	VERTICAL 1.00	CHOKER .75	2 LEGS/ BASKET 90° 2.00	2-LEGS @ 60° 1.73	2-LEGS @ 45° 1.41	2-LEGS @ 30° 1.00	3-LEGS @ 60° Only when ⅓ load wt. each leg 2.60	Size in mm
1/4	1,300	960	2,600	2,200	1,820	1,300	3,300	6.4
5/16	2,000	1,480	4,000	3,400	2,800	2,000	5,100	8.0
3/8	2,800	2,200	5,600	5,000	4,000	2,800	7,400	9.6
7/16	3,800	2,800	7,600	6,800	5,400	3,800	10,000	11.0
1/2	5,000	3,800	10,000	8,800	7,200	5,000	13,200	13.0
9/16	6,400	4,800	12,800	11,000	9,000	6,400	16,500	14.0
5/8	7,800	5,800	15,600	13,600	11,000	7,800	20,000	16.0
3/4	11,200	8,200	22,400	19,400	15,800	11,200	29,100	19.0
7/8	15,200	11,200	30,400	26,000	22,000	15,200	39,000	22.0
1	19,600	14,400	39,200	34,000	28,000	19,600	51,000	25.4
1⅛	24,000	18,000	48,000	42,000	34,000	24,000	62,000	28.5
1¼	30,000	22,500	60,000	52,000	42,000	30,000	76,000	32.0
				1.00	.75	.60	← Multiplier	

Formula to find sling length: Total distance between pick points x Multiplier = Sling Length

Fig. 1.

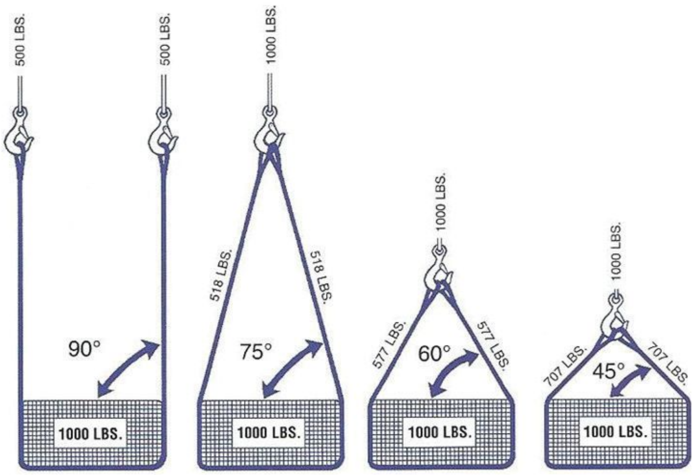


Fig. 2

Fig. 3

Let's dive a bit deeper into one of these issues: the inability of the rigger to properly assess the lifting capacity of basketed slings when lifting a load sharing the same attachment point, whether it be vertical or an angle from the center of gravity. Many riggers, when calculating the hoisting capacity of slings in a basket, simply believe that the lifting capacity is doubled because of the assigned multiplier of 2.00—but this would be incorrect if the slings are being attached to the same attachment point. When using slings in a basket hitch configuration that share the same attachment point, an angle is created in the slings and there are additional forces being applied to the slings that need to be accounted for. It is important to note that in order for basketed rigging slings to achieve twice the lifting capacity, the carrying legs of the slings to the attachment point must be 90° from horizontal, meaning straight up and down, as illustrated in Figure 2.

It is important to understand that when basketing a shared load, there are actually two sling angles to account for. The first is the slings eyes being connected to the same attachment point, and the second is the distance away from the center of gravity. The mistake occurs when the rigger takes the basketed reference capacity at face value and doesn't properly assess the angles that are in play.

In Figure 3, if the rigger were to select two EIPS/IWRC slings to lift this load and not properly account for sling angles, they might believe that the rigging is capable of lifting 31,200 lb in tandem. When accounted properly by referencing the lifting capacity of slings sharing the same attachment point at 60° and then accounting for the sling angle of 60° from the center of gravity, the actual lifting capacity is 23,528 lbs—a difference of 7,672 lb!

Let's walk through the process of determining the lifting capacity. The first step is to account for the angle that is created by the sling eyes being attached to the same attachment point. We do this by referencing the rigging capacity of the 60° angle capacity—for EIPS-IWRS, that's 13,600 lb. Next, we account for the slings attachment not being centered directly over the pick point of the load—which, again, is the 60° reference column (13,600 × 1.73 = 23,528 lb).

Here's how you determine the answer to the question that kicked off this article. Using ½-in. EIPS/IWRC wire rope slings with a choked configuration have a rated capacity of 3,800 lb. At 45°, we have a listed sling multiplier of 1.41—and 3,800 × 1.41 = a 5,358-lb combined rated lifting capacity. As you can see, there is a significant difference in actual lifting capacity and approximate capacity that can be mistakenly referenced with a lack of understanding of how to use the card.

It is imperative for those that are responsible for rigging overhead loads to have a complete understanding of how sling tension can affect the safe handling of a load. I have said the following many times in the past: A safe worker is an informed worker. Making sure your employees receive proper rigging training is vital in keeping them informed on making overhead loads as safe as possible.

*This article serves as a preview of the 2023 NASCC: The Steel Conference session "Common Rigging Mistakes." To learn more about this session and others, as well as to register for the conference, visit **aisc.org/nascc**. The conference takes place April 12–14 in Charlotte, N.C.*

Scott Seppers, a former rigger and ironworker of 20 years, is with Trivent Safety Consulting.

new products

This month's New Products section focuses on the fabrication shop and includes a new CNC angle line, a new cobot rotational range extender, a new plasma cutter consumable, and a new welding system.

Ocean Clipper II CNC Angle Line

Ocean Machinery, together with its manufacturing partner, Peddinghaus, has created a new CNC angle line that breaks all the rules. The Ocean CLIPPER II was specifically created for fabricators desiring a competitive advantage through automation by eliminating manual layout and punching of angle and flat bar. The new machine, which includes a continuous, error-free roller feed and a Signoscript scribing tool, processes short clip angles as well as long bracing angles and flat bars (minimum 1½-in. × 1½-in. × ⅛-in. angle and 2-in. × ¼-in. flat bar and maximum 6-in. × 6-in. × ⅝-in. angle and 6-in. × ⅝-in. flat bar. The unit's precise hole placement eliminates costly field modifications, its efficient size is much more compact than other angle lines, and it's simple and easy to operate, with no computer experience required. Visit **www.oceanmachinery.com** for more information.

Hypertherm HPR

The new single-piece consumable HPR® cartridge and cutting torch are designed for use with current Hypertherm HPRXD® plasma systems and, aside from the new torch, require no changes to the system or system settings. Operators can replace both in seconds without needing tools. The cartridge replaces the traditional five-piece consumable stack-up with a perfectly aligned part that lasts longer and delivers extended high-definition cut quality. It makes consumable management and assembly much easier and eliminates errors caused by incorrect handling or installation. The HPR cartridge and torch are now available from authorized partners of Hypertherm technology brand products. The cartridge comes in three amperages: 80, 130, and 260. For more information, visit **www.hypertherm.com**.

Miller XMT 650 ArcReach

New XMT® 650 ArcReach® Systems from Miller Electric Mfg., LLC, are designed to maximize productivity in structural steel fabrication and erection welding. Point-of-use control lets users weld and gouge with a single system and easily make process changes at the feeder without a control cord. These features improve productivity and deliver cost savings while providing the robust power needed on the job site and in the shop. The system's two parts are an XMT 650 ArcReach power source and an ArcReach 16 wire feeder. Configurations are available for field and shop applications, with polarity-reversing (PR) and non-polarity-reversing power source models—both compatible with the ArcReach 16 wire feeder. For both power source models, the total point-of-use control at the feeder delivers more productivity and safety. For more information, visit **www.millerwelds.com**.

Vectis Automation Park'N'Arc

Vectis Automation recently debuted the new Park'N'Arc, a "diving board" rotational range extender that allows for the base of a cobot to be manually moved to various locations. Compared to a short linear track, the Park'N'Arc is an improved design for increasing range as the cobot base can be translated nearly 8 ft in a linear direction while maintaining simplicity, robust cable management, and portability. It's a step-change deployment option that will enable more applications to be tackled with cobots—especially in heavy industries like structural steel—and also allows for multiple fixture tables to be set up around the system for quick changeovers. Visit **www.vectisautomation.com** for more information.

SPECIFICATION

New AISC *Specification* Dedicated to Ted Galambos

In a ceremony held this past October at the University of Minnesota, AISC dedicated the 2022 edition of its *Specification for Structural Steel Buildings* (ANSI/AISC 360) to longtime volunteer and structural behavior research pioneer Theodore (Ted) V. Galambos. This dedication honors Galambos' service on the AISC Committee on Specifications and several of its Task Committees since 1956. His pivotal research and publications on the load and resistance factor design (LRFD) method transformed the AISC *Specification*, which was most recently updated in 2016.

"As a professor, Ted is a beloved teacher who instructed many future engineers in steel design with an exemplary blending of theory and practice," said Cynthia Duncan, senior director of engineering at AISC. "Ted's commitment to sharing his knowledge, his willingness to mentor several generations of young researchers, and his strong ethical standards have made him one of the giants of his generation. His contributions to the behavior of steel structures will have a lasting impact on the structural engineering profession."

Galambos, professor emeritus of the University of Minnesota's Department of Civil, Environmental, and Geo-Engineering, has been known as the "father of LRFD" ever since his groundbreaking research led to the introduction of LRFD in the 1986 AISC *Specification*. Among his numerous professional honors are the 1981 AISC T.R. Higgins Lectureship Award and the 1999 AISC Geerhard Haaijer Award for Excellence in Education. He is also a member of the National Academy of Engineering.

The dedication ceremony for Galambos followed the seminar "Getting Up-to-Date with the 2022 AISC *Specification for Structural Steel Buildings*," led by Duncan and James O. Malley, chief operating officer and senior principal of Degenkolb and chair of the AISC Committee on Specifications. In addition to Duncan and Malley, Jerome Hajjar and Roberto Leon, both members of the AISC Committee on Specifications, also shared their honors for Galambos.

"We want to thank Ted for everything that he has done for us and for nurturing entire generations of students and also researchers in steel design and construction," said Leon, D.H. Burrows Professor of Construction Engineering at Virginia Tech.

As part of the dedication, the University of Minnesota and event sponsor LeJeune Steel Company, an AISC member fabricator, raised more than $3,000 for the Theodore V. Galambos Scholarship Fund, which will support an endowed program for the University of Minnesota Department of Civil Engineering's Theodore V. Galambos Structural Engineering Laboratory.

Galambos thanked AISC and the attendees for the honor, and he drew attention to his family members in attendance, three of whom followed his lead in becoming civil engineers and one a welder.

"I think it shows that they looked and me and said, 'Look, this guy is having fun,'" he said. "I appreciate and really value AISC, and I had a good time with so many good people."

Cynthia Duncan and James O. Malley present Ted Galambos with a plaque commemorating his dedication in the 2022 edition of the AISC *Specification for Structural Steel Buildings.*

People & Companies

Walter P Moore announced the addition of **Balram Gupta, SE, PhD**, as healthcare market leader – West Coast in the firm's Los Angeles-based structural group. Gupta is an industry leader in seismic retrofit work in the California healthcare market. The firm also announced the following promotions to principal in its various offices: **Martin Augustyniak**, principal, senior specialty structural engineer/structures, Austin; **Margaux Burkholder**, principal, project manager/ structures, Los Angeles; **Yavor Cekov**, principal, design manager/structures, Houston; **Amanda Dean**, principal, senior project manager/structures, Houston; **Josh Heath**, principal, senior engineer/structures, Kansas City; **Leslie Hemby**, principal, quality engineer/structures, Houston; **Justin Lawson**, principal, design manager/structures, Houston; **Jim Maradei**, principal, project manager/structures, Tampa; **Murat Melek**, principal, design manager/ structures, Washington, D.C.; **David Moore**, principal, senior parking consultant /structures, Atlanta; **Eric Pagan**, principal, project manager/ structures, Los Angeles; **Justin Stolze**, principal, senior project manager/structures, New York; **Usnik Tuladhar**, principal, senior project manager/structures, Austin; **Amanda Welch**, principal, manager of business development support/ structures, Orlando; and **Henry Yau Zhung**, principal, project manager/ structures, Panama City, Panama.

O'Donnell and Naccarato (O&N), a structural engineering firm headquartered in Philadelphia, has acquired Miami-based **Douglas Wood Associates (DWA)** as part of its larger strategic vision to expand its footprint in key markets nationwide. Simultaneously, O&N announced the opening of an additional office in Orlando to support its rapidly expanding client base in central Florida.

SUSTAINABILITY

AISC Releases Buy Clean Guidance To Help Legislators Maximize Structural Steel's Unmatched Sustainability

Hot-rolled structural steel is the greenest structural material on the market, thanks to its unsurpassed recycled content and ability to be recycled into new steel, over and over again, with no loss of properties.

It's an obvious choice for the Buy Clean movement, which advocates for environmental properties that encourage the use of products and materials with a smaller carbon footprint. But the industry is complex. That's why AISC has released a series of guidelines to help legislators leverage everything structural steel has to offer for sustainable design and construction.

"American hot-rolled structural steel is precisely the sort of material that Buy Clean legislation is intended to promote, so it's a natural fit," said AISC's director of government relations and sustainability, Max Puchtel, SE, PE. "AISC has helped policymakers craft smart and informed Buy Clean policies since 2017, and we're proud to continue to serve as the leading expert resource for lawmakers."

The new guidelines help legislators navigate the intricacies of the larger steel industry to create policies that take full advantage of the structural steel supply chain, accurately reflect structural steel's embodied carbon potential, and evaluate all structural materials on an apples-to-apples basis to allow designers to make informed decisions.

"We support Buy Clean policies that weigh all structural materials equally—after all, we're all working toward decarbonization," Puchtel added. "We all win when designers make responsible material choices."

You can learn more and download the guidelines at **aisc.org/buyclean**.

SUSTAINABILITY

Nucor and SDI Among Founding Members of New Climate-Focused Steel Coalition

Six international steel manufacturers, including AISC members Nucor Corporation and Steel Dynamics, Inc. (SDI), have formed a new coalition to establish and promote a global steel standard that leads toward a cleaner future. The coalition, named the Global Steel Climate Council (GSCC), is a nonprofit association dedicated to sharing best practices, establishing standards, and advocating for carbon emissions reductions by members of the steel industry.

The specific purposes of the GSCC include supporting technology-agnostic reduction methods that reduce greenhouse gas emissions from the global steel industry; creating a system boundary that includes Scope 1, 2, and 3 emissions; and adopting a science-based glide path to achieve a 1.5 °C scenario by 2050.

"Steel is essential for our economies, including the world's essential infrastructure," said Mark D. Millett, chair, president, and CEO of founding member SDI. "This new standard will accelerate the actual reduction of greenhouse gas emissions and provide key decision-makers with accurate data to make informed decisions."

A central assertion of the GSCC is that any agreement should focus on the amount of emissions generated, not on how steel is made. High-emission steelmakers around the world support a "sliding scale" standard in which two steel products could be classified as equally "green," even though one created multiple times more carbon emissions than the other. The GSCC argues that such a standard would set greenhouse gas emission standards ceilings up to nine times higher for extractive versus recycled products, which they argue would ultimately penalize electric arc furnace producers and permit the erroneous labeling of higher-emission steel as "green."

"We have the technology to reduce carbon emissions in steel production by 70% today," said Leon Topalian, chair, president, and CEO of founding member Nucor. "The global industry needs to build on the innovation that has already led to cleaner steel production in the United States because the green and digital economies around the world are going to be built with steel, and the steel they are built with matters."

The GSCC includes more than 20 members and supporters who are steel manufacturers, trade associations, end users, scrap metal suppliers, and non-governmental organizations. Find out more about the coalition at **globalsteelclimatecouncil.org**.

PUBLIC REVIEW

AISC *Standard for Certification Programs* Available for Public Review

Drafts of the next edition of AISC *Standard for Certification Programs* (AISC 207) will be available for public review from January 9 through February 23, 2023; this edition is an update to the 2020 version. Please see **aisc.org/publicreview** for more information and the draft standard, along with the review forms. You can also request a hard copy—for a $35 charge—by contacting Martin Downs at **downs@aisc.org**. Submit any comments via the forms to Jeanne Homer at **homer@aisc.org** by February 23.

IN MEMORIAM

Hugh Krentz, Former CISC President, Dies at 87

Hugh A. Krentz, longtime president of the Canadian Institute of Steel Construction (CISC), passed away on November 7 at the age of 87.

A graduate of the University of Manitoba, Krentz worked as a civil engineer before joining CISC in 1960, where he served as president from 1978 until his retirement in 2001. Even after retiring, he remained active in the steel and construction communities, serving as chair of the Standards Council of Canada from 2001 to 2011, as executive director of CISC's education council from 2001–2007, and as a consultant. He was also a member of the Canadian Welding Bureau's (CWB) board of directors from 1979 through 2010. He was made an Officer of the Order of Canada by the Governor General of Canada in 2012.

"Hugh's work was instrumental in CISC's success," said Scott Melnick, senior vice president at the American Institute of Steel Construction (AISC). "Hugh was well known for his honesty and candor, as well as his dedication to Canada and commitment to the standards development process. Under his leadership, AISC and CISC worked on many projects together, including the North American Steel Construction Conference (now known as NASCC: The Steel Conference)." His memory will live on through the CISC H.A. Krentz Research Award, the CWB Welding Foundation's Hugh A. Krentz Exemplary Student Award, and the Standards Council of Canada's Hugh Krentz Award.

"Hugh A. Krentz was an exemplary leader for the steel industry," said former CISC regional director Sylvie Boulanger, PEng, PhD. "His strong technical expertise, coupled with his belief in the people he was serving, resulted in great strides in the development of standards, research, and education in Canada and internationally. He was an extraordinary engineer, mentor, and friend to so many of us. Hugh was witty, athletic, and a deeply committed family man. He will be missed."

CODE

AISC Releases 2022 *Code*

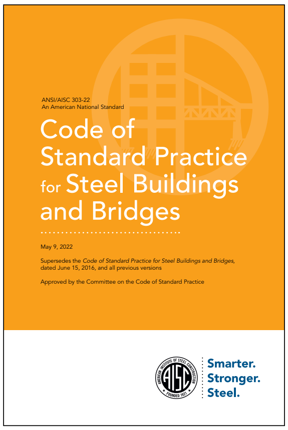
AISC has released the latest revision of one of its flagship standards, the *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303-22).

"The 2022 AISC *Code of Standard Practice* is the result of a tremendous effort by the committee over the last six years," said Babette Freund, chair of the AISC Committee on the Code of Standard Practice. "Of special note is the work of a joint task group that harmonized terminology and coordinated requirements between the 2022 AISC *Code* and the 2022 AISC *Specification for Structural Steel Buildings*, a major development in this latest edition."

The *Code* is a vital document for everyone associated with construction in structural steel—it provides a framework for a shared understanding of acceptable standards when contracting for structural steel. The trade practices that it describes are considered the industry standard and are incorporated into contracts across the country unless otherwise specified. The *Code* has governed contracts for nearly a century since its first publication in 1924.

The 2022 AISC *Code* supersedes the 2016 version (ANSI/AISC 303-16), and its preface includes a list of changes and updates. It has been approved by the AISC Committee on the Code of Standard Practice and is ANSI-accredited. The new *Code* will be included in the 16th Edition *Steel Construction Manual*, which AISC is preparing to publish this year.

Visit **aisc.org/2022code** to view and download the 2022 AISC *Code* and commentary as a PDF.



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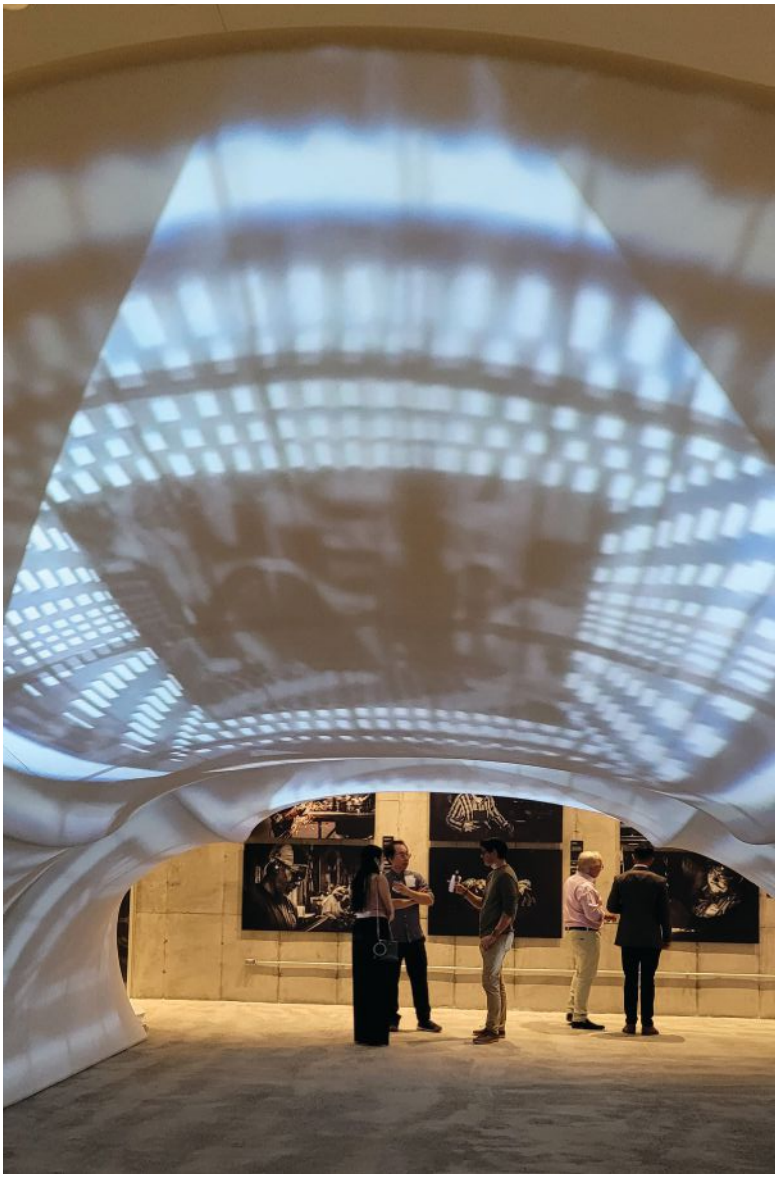


Steel as Art

PARTILLATION: VISIONS IN STEEL, a traveling art exhibition celebrating steel in the built environment, debuted in October at the Architecture Center Houston (ArCH).

Sponsored by AISC and the City of Houston through the Houston Arts Alliance, the exhibition curates photography and other work of visual artists from across the country to introduce visitors to steelworkers and their trade through portraiture, interviews, sound, and video.

The name, *PartILLATION*, is a created word that borrows from the idea of it being a mix of art and installation. Owing to the latter, the centerpiece of *PartILLATION* is a tunnel that uses video-projected images and soundscapes to immerse visitors in a steel fabrication facility and to learn from the expertise of architects through a series of interview vignettes explaining the strong ties between design and steel.

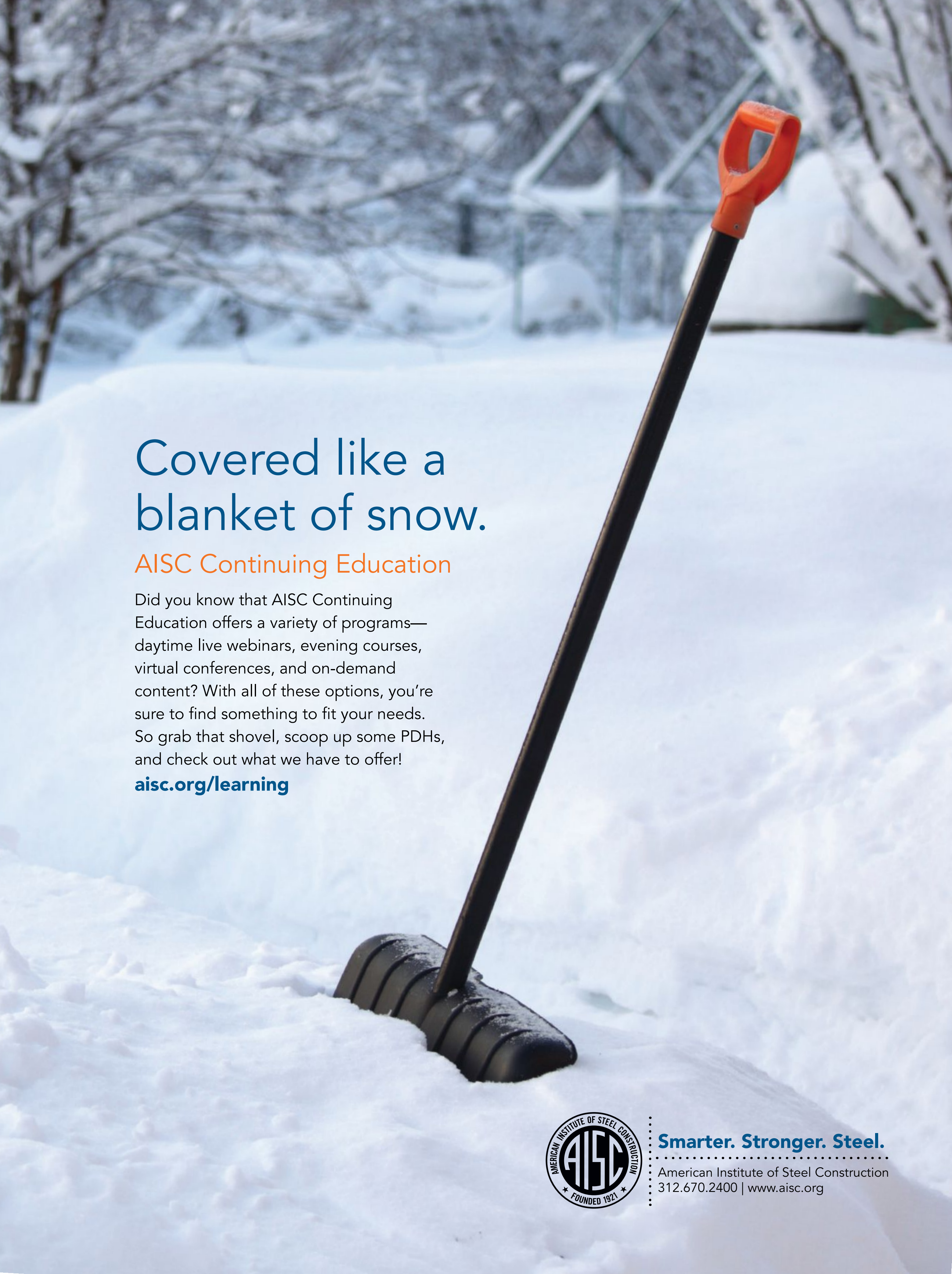
Outside of the tunnel, visitors can acquaint themselves with the people behind steel by browsing a gallery of welders and steel tradespeople portraits and quotes. Additionally, a wall featuring state-of-the-art steel projects from recent years showcases the ingenuity of steel architecture in the built environment.

"[This exhibition] accomplishes a number of things we are continually trying to do at ArCH," said Rusty Bienvenue, Architecture Center Houston's executive director. "It shows architecture and the built environment as the confluence of art and science and as a monumental representation of culture. It also seeks to recognize the craftspeople who, while so important to a project, are so often overlooked."

Alex Morales, Associate AIA, AISC's senior structural steel specialist for the Houston market, is the curator for *PartILLATION*. In creating the exhibition, Morales prioritized the themes of evolution, humanism, innovation, history, and legacy as it relates to steel and the people who create with steel.

"I was privileged to travel across the country to capture the amazing stories of craftspeople and designers who share a passion for steel architecture," Morales said. "This exhibit is not only a reminder of the legacy and innovation of steel in our built environment but also a stage that shines a well-deserved light on the role of our steel craftspeople in the design equation. Design is about the human experience, and I am proud to share this exhibit with designers across the country."

While the Houston visit is now completed, the exhibition will travel to other cities throughout the country. Keep an eye out for news of upcoming events at **www.aisc.org**. And check out the Project Extras section at **www.modernsteel.com** for more images from the debut event.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