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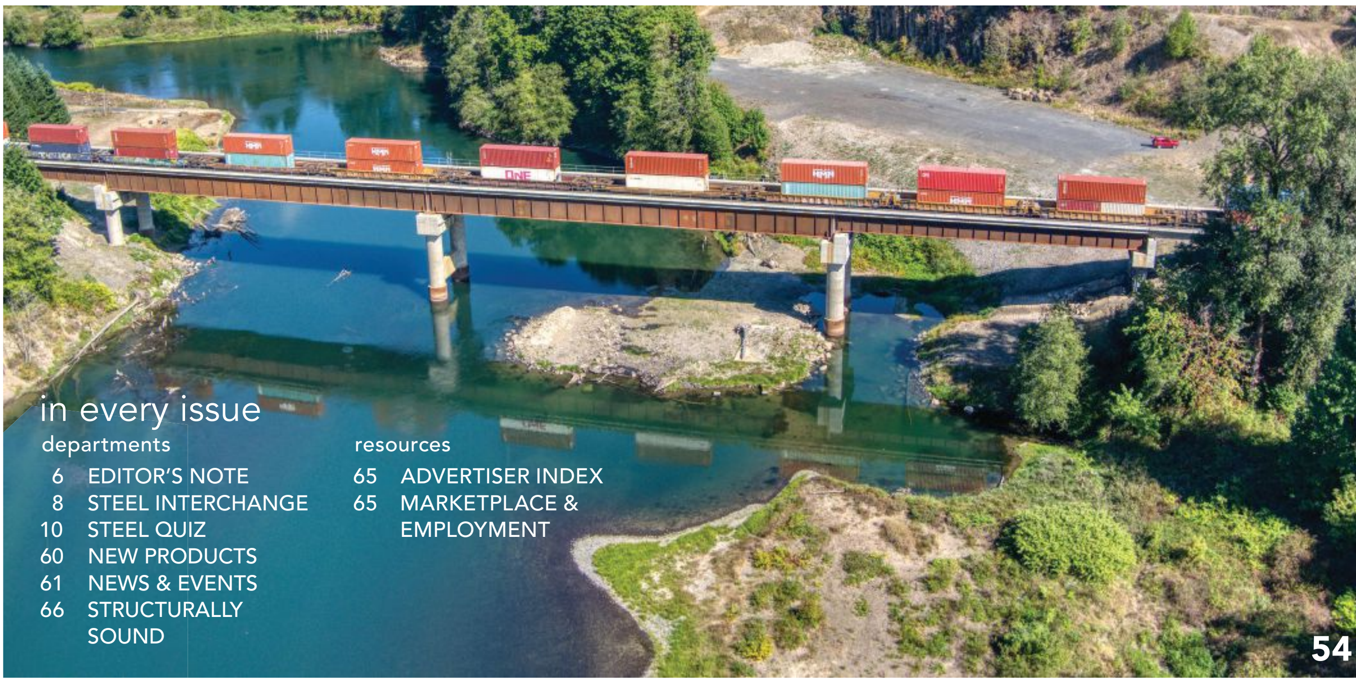

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ON THE COVER: A 32-ft by 32-ft steel sculpture is a new standout feature of a growing Nashville neighborhood, p. 22. (Photo: Blessing Hancock)

MODERN STEEL CONSTRUCTION (Volume 64, Number 12) ISSN (print) 0026-8445: ISSN (online) 1945-0737. Published monthly by the American Institute of Steel Construction (AISC), 130 E Randolph Street, Suite 2000, Chicago, IL 60601. Single issues $8.00; 1 year, $60. Periodicals postage paid at Chicago, IL and at additional mailing offices. Postmaster: Please send address changes to MODERN STEEL CONSTRUCTION, 130 E Randolph Street, Suite 2000, Chicago, IL 60601.

editor's note

My eldest child, Julia, is a middle school teacher by day and a full-time grad student by night.

In addition to the incredible time demands, there is a considerable financial burden. Teachers are not well compensated, and her Ivy League program is anything but cheap. She manages to pay for it, however, through a combination of loans, weekend babysitting (yes, ad hoc childcare pays, on an hourly basis, more than her teacher's salary), and a few scholarships.

The scholarships she receives are not through her university; rather, she searched online for different groups offering to help with higher education, applied, and was occasionally successful. I admire and marvel at the people who donate to these programs. They don't know the recipients, they don't benefit from making the donations, but they do it because they want to support teachers and the education system.

The AISC Education Foundation is similar. The program is managed separately from AISC and has its own board consisting of engineers, educators, and fabricators. Some of its funding comes from an annual contribution from AISC. However, most of the scholarship and program money comes from individual donations.

If you're not familiar with the foundation, it annually provides more than a quarter million dollars in scholarships to engineering students. In addition, it has programs to introduce students to the professional world by funding travel to AISC Specification Committee meetings, NASCC: The Steel Conference, and other events. It provides money for undergraduate research fellowships and faculty-led field trips. And it provides support to young up-and-coming faculty. (You can find out more about the education foundation programs at **aisc.org/giving**.) Best of all, AISC pays all of the administrative and overhead costs for the foundation—so every dollar contributed goes into a fund to support scholarships and programs.

Most donations are simply made to the foundation's general fund (last year, 72 students received scholarships). And occasionally, an individual, company, or family will contribute enough to create a named scholarship. For example, steel icon Reidar Bjorhovde's family and friends started a scholarship program through the foundation to honor an outstanding young professional, and friends and colleagues of Professor Steven J. Fenves donated to start a scholarship. One of the foundation's oldest scholarships is given in the name of Fred R. Havens, the legendary patriarch of the Havens Steel Company. Recently, his family added $150,000 to that fund, tripling the number of Havens scholarships presented each year.

December is often a time of giving. To tip the field for anyone on the fence about making a donation, the AISC Board of Directors is providing a $50,000 matching donation for the first $50,000 given from now until the end of the year. Whether you can donate $10 or want to write a check for the full $50,000, there's never been a better time to make your donation count. Please visit **aisc.org/giving** and make the holiday season even more special.

Scott Melnick

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

Bolt Tension and Shear Interaction

The 2022 AISC *Specification for Structural Steel Buildings* Section J3.8 provides an adjustment in bolt nominal tensile stress modified to include the effects of shear stress (i.e. from F_{nt} to F'_{nt}). When this tensile stress is modified to include the effects of shear stress, must the tensile strength and shear strength also satisfy the interaction equation in the *RCSC Specification for Structural Joints Using High-Strength Bolts* Section 5.2 (Equation 5.2a)?

$$\left[\frac{T_u}{(\phi R_n)_t}\right]^2+\left[\frac{V_u}{(\phi R_n)_v}\right]^2 \le 1 \qquad \textbf{(Equation 5.2a)}$$

where:

T_u = required strength in tension (factored tensile load) per bolt, kips
V_u = required strength in shear (factored shear load) per bolt, kips
$(\phi R_n)_t$ = design strength in tension determined in accordance with Section 5.1, kips
$(\phi R_n)_v$ = design strength in shear determined in accordance with Section 5.1, kips

No. The AISC *Specification* (free download at **aisc.org/specifications**) Section J3.2 states, "Use of high-strength bolts and bolting components shall conform to the provisions of the *RCSC Specification for Structural Joints Using High-Strength Bolts*, hereafter referred to as the *RCSC Specification*, except where those provisions differ from this *Specification*. This *Specification* governs where provisions differ from the *RCSC Specification*." Thus, the AISC *Specification* governs.

Larry Muir, PE

Weathering Steel: SMAW Electrodes

We have an outdoor pavilion designed with weathering steel shapes (A847, A588). The contractor is asking to use E8018-C3 electrodes as the welding rod. Is that an acceptable choice, or should the contractor use E7018 for SMAW welding?

Both E7018 (with restrictions) and E8018-C3 electrodes are suitable for welding weathering steels. E8018-C3 may be more suitable for multi-pass welds and maintains a better weathering color match. E7018 may be more suitable for single-pass welds and where either the weathering color match is not important or the weathering steel will be painted.

Section 5.4.1 of AISC Design Guide 21: *Welded Connections—A Primer for Engineers*, 2nd Edition (download for free at **aisc.org/dg**) addresses welding requirements for weathering steels. It states:

> "When welding on weathering steels, filler metals must be selected to ensure the weld has atmospheric corrosion resistance equal to that of the base metal. Several approaches may be taken. First, all welds on weathering steel structures may be made with alloy filler metals that deposit weld metal with a sufficient alloy content so that the deposit has a weathering composition. While a variety of alloys may be used, a common choice is to use nickel-bearing filler metals, typically with a nominal nickel content of 1% or greater. Filler metals prequalified for weathering steels are listed in AWS D1.1, Table 3.4 [Note: this references the 2015 edition of AWS D1.1, the table being referenced is Table 5.6 in AWS D1.1-2020].
>
> "A second approach involves the use of carbon steel filler metals for single-pass welds of a restricted size. During welding, some of the weathering steel base metal melts and becomes part of the weld deposit (alloy pickup). Smaller single-pass fillet welds, for example, experience sufficient admixture to introduce enough alloy into the resulting weld to have weathering characteristics. The level of admixture depends in part on the welding process and the size of the weld that will be made. AWS D1.1 prescribes the conditions by maximum weld size and by process under which this approach may be used (see Section 3.5.2 of this Guide). It may allow the contractor to employ filler metals that are used for standard carbon steel applications. The carbon steel materials are less expensive to purchase; more importantly, it is not necessary to reconfigure the welding equipment with different filler metals as jobs of different steels flow through a shop."

AWS A5.5/A5.5M is a specification for low-alloy steel electrodes for shielded metal arc welding. Based on Table 5.6, E8018-C3 is suitable for applications to weathering steel (See Annex L of AWS D1.1). The "-C3" indicates it nominally contains 1% nickel. Note also that Table J2.5 in the 2022 AISC *Specification* states in footnote [b]: "Filler metal with a strength level one strength level greater than matching is permitted."

E7018 electrodes without any additional alloy designation (-B2L, etc.) is a carbon steel electrode (AWS A5.1/A5.1M) and does not comply with the "low-alloy steel" requirements in Table 5.6. However, several exceptions to this table are listed in AWS D1.1. Clause 5.6.2.1 and 5.6.2.2 in AWS D1.1 2020 permit single-pass groove and single-pass fillet welds using any filler metals for

Group II base metals. This would permit E7018 to be used with weathering steel for single-pass groove and single-pass fillet welds. For fillet welds, there are size restrictions given in Clause 5.6.2.2.

This size restriction is also referenced in Design Guide 21. Section 3.5.2 states:

> "The third maximum fillet weld size provision involves welding on weathering steel, such as ASTM A588, and the use of carbon steel electrodes (rather than alloy electrodes that replicate the weathering characteristic of the steel). AWS D1.1, clause 3.7.3.2 [clause 5.6.2.2] lists the maximum fillet weld size that can be made under such conditions: ¼ in. (6 mm) for SMAW and 5⁄16 in. (8 mm) for FCAW, GMAW and SAW. This size limitation only precludes the use of the nonalloyed electrodes for these situations: It does not apply where nonweathering steel is used, where weathering steel is painted, or where alloyed electrodes are used."

Heather Gathman

Standard Shear Connection Setback Distance

What is the maximum allowable setback distance for a shear connection? I see it is typically shown as ½ in. Can this vary, and if so, are there any limits?

The setback can vary. A setback of ½ in. is very common, and ¾ in. is typically the maximum setback used for a shear connection in practice. The 2022 AISC *Specification* does not specify a maximum allowable setback distance. However, limits apply to design procedures and tables for specific connection types.

Part 10 of the 16th Edition AISC *Steel Construction Manual* provides recommended design procedures for many common types of shear connections, sometimes referred to as "standard shear connections." The recommended design procedures describe the limitations for each connection type including any limitations related to or affecting the setback dimension.

For example, for double-angle shear connections the *Manual* states on page 10-10, "The eccentricity on the supported side of double-angle connections may be neglected for connections with a single vertical row of bolts through standard or short-slotted holes with dimension a [see Figure 10-4(a)] not exceeding 3 in." The discussions of the tables also describe limits. For example, the discussion for Table 10-1 on page 10-11 states, "The horizontal edge distance is assumed to be 1⅜ in." The *Specification* also contains minimum edge distance requirements.

Larry Muir, PE

Heather Gathman (gathman@aisc.org) is a staff engineer in AISC's Steel Solutions Center. **Larry Muir** is a consultant to AISC.

steel quiz

This month's steel quiz is all about the impressive sustainable aspects of domestic structural steel and the American steelmaking industry. Make sure to check out the AISC Sustainability page (**aisc.org/sustainability**) to learn more.

1 **True or False:** A new structural steel member in the U.S. contains on average 50% recycled content.

2 **True or False:** Steel produced using the electric arc furnace method has 75% less emitted CO_2 than traditional steel making methods.

3 **True or False:** The recycled content of structural steel shapes in the U.S. can only come from recycled structural steel elements.

4 **True or False:** Structural steel can be reused in a structure without having to recycle the material first.

5 **True or False:** The American steel industry is the least carbon-intensive of all major steel producing countries.

6 **True or False:** You can access environmental product declarations (EPDs) for hollow structural sections, plate, and hot-rolled structural sections directly on the AISC website.

7 **True or False:** Steel loses its metallurgical properties when it is recycled.

8 **True or False:** The percentage of structural steel products that reach the end of their life and then are recovered for recycling is 70% by weight.

TURN TO PAGE 12 FOR ANSWERS

STEEL SOLUTIONS CENTER

Answers reference the AISC Sustainability page, **aisc.org/sustainability**, as well as the "Sustainability by the Numbers" article in the May 2023 issue of *Modern Steel Construction* (read at **modernsteel.com/archives**).

1 **False.** A new structural steel member produced in the U.S. contains on average 93% recycled content and is 100% recyclable, making it a material that is circular for generations.

2 **True.** Electric arc furnace (EAF) steelmaking has 75% less emitted CO_2 than traditional steel making. Most of the emissions related to EAF steel production come from the power grid itself. All structural hot-rolled shapes produced in the U.S., including common wide-flange beams and columns, are made using the EAF method.

3 **False.** The recycled content of structural steel in the U.S. is not limited to steel that was previously structural steel. Electric arc furnaces use electricity to melt cars, refrigerators, decommissioned bridges, and other miscellaneous scrap into new steel.

4 **True.** Structural steel can not only be recycled, it can be reused without recycling. Currently, only a small amount of recovered structural steel is refabricated and directly reused in new building projects. Appendix 5 of the *Specification for Structural Steel Buildings* (ANSI/AISC 360-22, download for free at **aisc.org/specifications**) contains the testing requirements evaluation of the properties for steel being recovered and reused.

5 **True.** Of the seven largest steel-producing countries, the U.S. has the lowest CO_2 emissions per ton of steel produced and the lowest energy intensity.

6 **True.** AISC works with all of the largest mills in the country to develop accurate industry-average environmental product declarations (EPDs) that consider a number of environmental impacts related to the manufacture of steel, including global warming potential, ozone depletion, acidification, eutrophication, and ozone creation. You can find EPDs for hot-rolled sections, plate, hollow structural sections, open-web steel joists, and metal deck on our website. The AISC website (**aisc.org/epd**) also includes bottom-line summaries of all mill and manufacturer specific GWP values and links to their associated EPDs.

7 **False.** Through the EAF method of production, there is no loss of the steel's material properties. Steel is 100% recyclable and can be recycled an infinite number of times without loss of strength, durability, or flexibility.

8 **False.** 98% of structural steel at the end of its service life gets recycled into new steel. In fact, 81% by weight of all steel products (including automobiles, appliances, containers, reinforcing bar, and structural steel) reaching the end of their life are recovered for recycling.

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**.

No Single Rule

BY LARRY S. MUIR, PE AND NATHANIEL GONNER, SE

A change in the 2022 AISC *Specification* has sparked a discussion of single-sided welds.

ENGINEERS HAVE LONG been taught to avoid single-sided welds, but a change in the 2022 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) has sparked discussion on exceptions.

As described in the list of "significant technical modifications" in the *Specification* preface, "the directional strength increase for transversely loaded fillet welds is rewritten and prohibited for use in the ends of rectangular HSS." The change occurs in Section J2.4, which now reads:

For fillet welds

$$R_n = F_{nw}A_{we}k_{ds} \qquad \text{(J2-4)}$$

…

(1) For fillet welds where strain compatibility of the various weld elements is considered

$$k_{ds} = (1.0 + 0.5\sin^{1.5}\theta) \qquad \text{(J2-5)}$$

(2) For fillet welds to the ends of rectangular HSS loaded in tension

$k_{ds} = 1.0$

(3) For all other conditions

$k_{ds} = 1.0$

For the most part, the change is editorial: The directional strength increase factor has been given the symbol k_{ds}. That symbol designation perhaps provides some editorial clarity, but users of the *Specification* have long been able to take advantage of the additional strength due to the angle between the line of action of the required force and the weld longitudinal axis, q, with the expression now in Equation J2-5, so long as they account for strain compatibility. (Note: F_{nw} is the nominal weld stress of the metal and A_{we} is the effective area of the weld in Equation J2-4.)

But the part of the change that has caused confusion is technical and is found in item (2). The factor k_{ds} is limited to 1.0 for fillet welds to the ends of rectangular HSS loaded in tension. This article aims to alleviate the confusion over the change in the context of an old rule.

The Familiar Rule

The old (and still current) rule is to avoid single-sided welds. If you want to keep your life simple, stick to that age-old advice.

Engineers have long been cautious about the use of single-sided fillet and partial-joint-penetration (PJP) groove welds—and they should be. Rotation about the root can lead to failure under some load that is less than the design strength calculated per the *Specification*. Or an incidental load during construction may act on the weld in a transverse direction never conceived by the engineer.

Such concerns predate the 2022 *Specification* and are widely discussed in AISC publications.

The Commentary to the *Specification* states, "The use of single-sided PJP groove welds in joints subjected to rotation about the toe of the weld is discouraged" and "The use of single-sided fillet welds in joints subjected to rotation around the toe of the weld is discouraged."

AISC Design Guide 21: *Welded Connections—A Primer for Engineers*, 2nd Edition expounds further: "Single-sided PJP groove-welded joints should be checked to ensure that rotation about the root of the joint cannot occur, regardless of the loading conditions. Like single-sided fillet welds, single-sided PJP groove welds can readily tear from the root when rotated about this location" and "Because fillet welds do not fuse the cross section of the joint, there will always be an unfused plane under the root of a single-sided fillet or, in the case of double-sided fillets, between the two fillet welds. Single-sided fillet welded joints should be checked to ensure that rotation about the root of the joint cannot occur, regardless of the loading conditions."

The 16th Edition AISC *Steel Construction Manual* states, "when lateral deformation is not otherwise prevented, a severe notch effect can result, as illustrated in Figure 8-10. The use of a single-sided fillet or PJP groove weld in joints subject to rotation about the toe of the weld is discouraged. Using a weld on each side will eliminate this condition." (See Figure 1.) A figure has been added to the 2022 *Specification* that illustrates a similar point and applies to the fillet welds at the end of a rectangular HSS. (See Figure 2.)

The language in these passages varies slightly—sometimes it is described as rotation about the toe, sometimes about the root—but the rotation of concern is the same: the rotation causes tensile stress at the root of the weld. No matter the description, the message is the same: single-sided welds are discouraged.

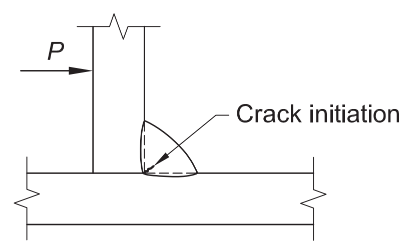


Fig. 1.

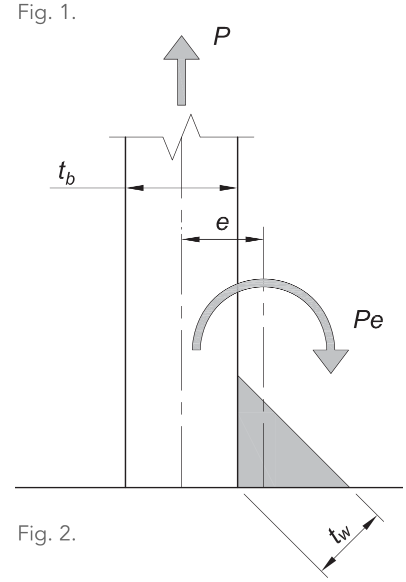


Fig. 2.

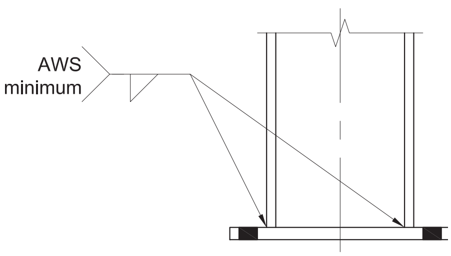


Fig. 3.

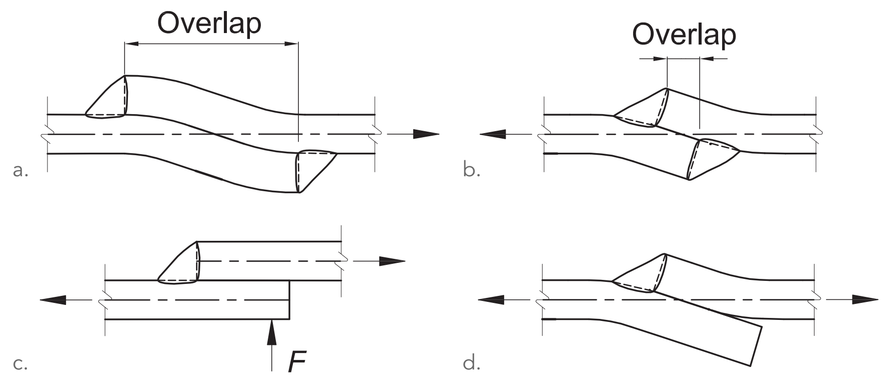


Fig. 4.

An Exception that Proves the Rule

The welds addressed in Item (2) in the revised Section J2.4, fillet welds to the ends of rectangular HSS, are inherently single-sided. If single-sided welds are discouraged, what should an engineer to do? Sometimes practices that are generally discouraged are the best choice given the alternatives.

Perhaps one day an intrepid innovator will create welding nanobots, but until something like that occurs, the insides of HSS are inaccessible. Complete-joint-penetration (CJP) groove welds are an option—but perhaps not the best option. CJP groove welds require a groove detail that can be complex and backing, back-gouging and rewelding, or open-root welding with associated welder qualification requirements. Some of these complications can result in surprising expenses.

Given these challenges, welds that are generally discouraged—one-sided fillet welds—are probably the best option. Experimental testing and numerical studies in the 2016 and 2017 editions of the ASCE *Journal of Structural Engineering* examining fillet-welded joints to the ends of HSS members indicate single-sided welds to a tension-loaded HSS wall element are partially unrestrained and are prone to local bending about the axis of the weld that causes tension at the root.

The directional strength increase associated with transversely loaded fillet welds is not reliably developed for fillet welds to the ends of rectangular HSS, leading to the requirement of k_{ds} = 1.0.

More Exceptions

Engineers may encounter situations where single-sided welds seem to be commonly used, which may cause further confusion. Generally, single-sided welds should be avoided, but engineers can apply judgment. Here are some common conditions where they are used.

Base plates. One of the most common applications for single-sided welds in structural steel construction involves column bases. AISC Design Guide 1: *Base plate and Anchor Rod Design*, 3rd Edition states, "for most wide-flange columns subject to axial compression only, welding on one side of each flange [See Figure 3] with the minimum AWS fillet weld size will provide adequate strength and the most economical detail. When these welds are not adequate for columns with moment or axial tension, consider adding fillet welds on all faces..."

The compression will tend to close (not open) the root of the weld, and the design intent is usually to transfer the compression through direct steel-on-steel bearing rather than through the welds. The welds simply hold the parts together.

Built-up beams. Another relatively common application for single-sided welds in structural steel construction involves built-up beams. AISC Deign Guide 25: *Frame Design Using Nonprismatic Members*, 2nd Edition states, "the automated equipment used by metal building manufacturers to join the flanges with the web typically places the web-to-flange welds from one side only…The one-sided automated welds used in tapered member production in the metal building industry have a long history of satisfactory performance. Two-sided welds are not employed unless the required weld strength exceeds the strength of a one-sided weld."

In this case, it's hard to argue with success. Single-sided web-to-flange welds have been evaluated for built-up members of similar proportions and applications as metal building frames. It would be up to the engineer to conduct a thorough evaluation of other uses. As noted in Design Guide 21, one must "ensure that rotation about the root of the joint cannot occur, regardless of the loading conditions."

Lap joints. Welded lap joints—especially those involving only welds transverse to the direction of force—can present similar challenges. (See Figure 4.) If insufficient overlap does not exist and the joint is not sufficiently restrained, rotation about the root of the weld can significantly reduce the strength of the weld. However, by providing a minimum lap of five times the thickness of the thinner part of a lap joint but not less than 1 in. (25mm), as is required by *Specification* Section J2.2b(f), the nominal strength provided in Section J2.4 can be justified.

Additionally, transverse welds must be provided along the ends of both lapped parts, or longitudinal welds should be provided. It is common to provide longitudinal welds. Alternatively, the joint can be restrained to prevent opening. However, quantifying the restraint available and the restraint required can be challenging.

Other conditions exist where the use of single-sided welds may be appropriate, but engineers are encouraged to apply good judgment.

Common Questions

Here are two common *Specification* user questions on the directional increase restriction on fillet welds to ends of rectangular HSS loaded in tension.

Is the rectangular HSS weld change true even if the weld is "all around?" In this case, the load is applied concentrically to the weld group.

Yes, the limit of k_{ds} = 1.0 for fillet welds subjected to tension at the ends of rectangular HSS applies even if the weld is all around. The eccentricity that causes the opening at the root of the weld is a local one—it occurs where the tension in one wall of the HSS is transmitted to the one-sided fillet weld (see *Specification* Commentary Figure C-J2.12). Even if there is a weld all around such that there is no global eccentricity on the full cross section, this local eccentricity still exists and prevents you from counting on a k_{ds} greater than 1.0.

If the k_{ds} factor for rectangular HSS is 1.0 because of the effects of a one-sided fillet weld, would this same logic apply to round HSS or pipes? Should k_{ds} equal 1.0 for all one-sided fillet welds?

The limit on k_{ds} in the *Specification* is for fillet welds subjected to tension at the ends of rectangular HSS. Research has demonstrated that you cannot depend on a directional strength increase for this common weld configuration. Some tests have shown that the directional strength increase factor can more reliably be met for fillet welds to the ends of tension-loaded round HSS, so they have not been included in the k_{ds} limit. But there may be limitations to those findings—perhaps large-diameter HSS with thin walls would have less restraint against rotation.

As always, the engineer needs to exercise judgment for conditions not specifically addressed in the *Specification*. The use of one-sided fillet welds is generally discouraged, especially when resisting tension when there is nothing restraining the element being joined from rotating about the root of the weld. ■

Larry Muir (**larrymuir@larrymuir.com**) is a consultant to AISC and **Nathaniel Gonner** (**gonner@aisc.org**) is the director of specifications for AISC.

At Home in Academia

INTERVIEW BY GEOFF WEISENBERGER

Joshua Schultz entered the AEC world with visions of becoming an architect, but he has found his fit in academia after nearly a decade at Gonzaga University.

THE ALLURE OF DESIGNING striking structural aesthetics drew a teenage Joshua Schultz to the AEC world, specifically to the first letter. Schultz wanted to be an architect and even began working for an architecture firm during his final year in high school. Over time and with more classwork, though, he found engineering was a better path to entry.

After three degrees and one full-time job at an engineering firm, he landed in the niche that fits him best: academia. Schultz is an associate professor of engineering at Gonzaga University, where he has taught undergraduates and graduate students in a range of courses. Away from the classroom, he has been involved in several research projects and, most recently, teamed up with AISC for one of them. He is one of the two inaugural 2024 AISC Innovation Scholars, a program that boosts collaboration on a steel-focused project that mixes the scholar's goals and AISC's needs.

Schultz spoke with *Modern Steel* about his career path, teaching career, work as an innovation scholar, and more.

Where are you from and where did you grow up?

I was born, raised, and went to school in central Wisconsin, not too far from the Illinois border. Most people in the Midwest know Madison and Milwaukee, but halfway between them is Oconomowoc. I grew up near there in the farmland outside of Oconomowoc.

I completed my undergraduate and master's degrees at Milwaukee School of Engineering (MSOE). When I finished those, I wasn't ready to be done with school yet. I enjoyed learning and I wanted to keep going, so I looked into PhD programs. I applied to several different places and ended up going just a few miles down the road to Marquette University.

What put you on that path to engineering?

Originally, I wanted to be an architect. I've always been attracted to aesthetics and was interested in buildings and architects like Frank Lloyd Wright. My dad worked in the construction industry, and because of those connections, I landed an internship during my senior year of high school at an architecture firm.

At that internship, I was the gopher—"go for this, go for that"—but it was really useful because it exposed me to architecture and the AEC world. It let me see what the day-to-day looked like compared to what 16-year-old me imagined.

For a variety of reasons, architecture wasn't a perfect fit. But by luck (if you call it that), I discovered architectural engineering. I wanted to influence the broad design, and structural engineers have profound influence on the structure, the layout, and the topology of buildings. That led me to MSOE for architectural engineering.

Did you ever work for a firm before going into academia?

I did and still do. Every academic has a unique approach to research and teaching. I've worked in AEC since my senior year of high school. I worked all the way through MSOE and my PhD. I was working at a firm called Stutzki Engineering in Milwaukee doing a lot of glass façades, cable nets, and lightweight structures.

When I finished my PhD, I applied to several companies and landed at Skidmore,

Owings & Merrill in Chicago. It was a full-circle moment from wanting to be involved in architecture and being involved in it as a structural engineer. I worked there for a few years and liked it. A little later, my wife and I moved to Washington, where she grew up, and ended up at Gonzaga.

What made you decide that you wanted to get into teaching?

I didn't get a PhD because I initially thought I wanted to teach. Personal life things led me to academia. I had gotten married, had kids, and wanted to be close to family. I wanted to find a work-life balance where I could still be involved and do meaningful work. My wife suggested I apply for some teaching jobs because I had a PhD. I picked Gonzaga and started there in 2015.

What was it like talking to a class for the first time?

I remember it vividly. I had a great deal of nerves standing up before the students for a couple of reasons. I desperately wanted to do a good job. For me, there's a difference between knowing engineering stone cold and articulating it in a way that is useful and tractable for people.

There were some nerves, but mostly a lot of enthusiasm. I love teaching. I enjoy

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**.

the chance to work with students. I've been largely blessed to interact with just some fantastic students. That experience is valuable. The main thing I like about academia is the opportunity to teach and mentor and to learn with and from students.

But Day 1 was a lot of nerves. On my third day, I had a lecture prepped and wanted to make sure I knew it perfectly. I was terrified of getting a question I wouldn't know how to answer. I don't worry about that anymore, largely because I don't need to have people think I know the answer to everything, which I certainly don't! But in that first lecture, a student asked a question, and I had no idea about the answer. I said it was a great question and I'd come back with an answer.

What advice do you usually give students embarking on their engineering careers?

I have two main pieces of advice, one practical and one philosophical. The philosophical one is early in your career—this goes back to not having every answer—if you don't know something, ask the questions. No one expects you to know all the answers early in your career. It would be embarrassing not to ask that question and still have that question ten years later when you're expected to know the answer. Your education sets you up for a great start, but no employer worth working for expects you to know everything.

The practical one, in my experience as a consultant and academic mentor, is learning the perfect blend between knowing when to ask for help and how to ask for help. Some of the best young engineers I've mentored don't ask you something every 30 minutes. They sit, work, spin, and get stuck, but have a proposed solution.

There are two extremes to avoid: asking questions every 30 minutes or spinning a circle for two days and not accomplishing anything. Once you're out of school and working in an office, it's about finding the balance of when to ask for guidance. That comes with time.

What courses do you teach at Gonzaga, and are you involved in research?

It's primarily teaching undergraduates, which I love, with a research component of ensuring I'm teaching what's current.

This fall, I taught an upper-level foundations design course and then a couple of materials labs. I've taught statics, mechanics of materials, advanced structures, analysis courses, and steel courses. It's a lot of teaching. But you learn something new when you have to prepare it for teaching. You can design a steel building, but simplifying that design and then communicating it is a skill.

What drew you to the Innovation Scholars program?

I found out about the program through a colleague on LinkedIn. It looked like a good fit for the timing and topic.

My specialty is industry-focused, widely applicable research. You do consulting, and it informs your research and teaching. That's how it was for me. With the program, I'm working on simplified design aids for teaching and for practicing professionals. There is awesome work out there solving fourth-order partial differential equations. That's important, but as a practicing engineer, I don't solve many of those. As an academic, I do.

If you can take the extra step by taking complex things and simplifying them in the form of simplified equations, design charts, or rules of thumb, that's valuable. Is it the 100% perfect solution? No. But it's good enough to get you through schematic design and design development and get 95% of the way there.

That's my focus as an Innovation Scholar—in the context of steel, of course. I'm doing various steel shapes: some atypical ones, 3D curved steel, and tapering steel. They're atypical scenarios where an engineer's default thought is to put it in software, and the software will create a solution. That's valid, but we can do that for everything. We have beam tables for a reason. As engineers, we have to be able to do basic design and have a physical intuition of how structures behave. Hopefully, these simplified equations and charts will help develop that.

What do you enjoy about living in Spokane?

It's fantastic. It's a relatively small city, but it has almost everything. It has a Pacific Northwest vibe, and there is everything you could ever imagine doing outside. We have mountains, skiing, lakes, biking, and running. I'm big on the outdoors. It's nice to be in a place that has stimulated my career and engineering interests but also be an hour from the ski slope or the lake.

Spokane still has the four seasons, but they're tilted in my preference because the winters are a little milder than the Midwest. It doesn't get as cold. We still get snow, and the summer is sunny every day. ■

*This interview was excerpted from my conversation with Joshua. To hear more from him, listen to the December Field Notes podcast at **modernsteel.com/podcasts**, Apple Podcasts, or Spotify.*

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

Delivered Differently

BY ANGIE ALDERMAN, PE

Integrated Steel Delivery can help your project by bringing the structural team under one umbrella, with the fabricator leading the way.

INTEGRATED STEEL DELIVERY (ISD) has the power to speed up a project and save money if done right.

ISD is a design-build method that brings the entire structural team—the engineer, steel fabricator, steel detailer, and steel erector—into one partnership. It has saved millions of dollars on past projects and slashed construction schedules. In integrated steel delivery, the engineer performs the structural steel design, or redesign, while the steel fabricator manages the entire steel contract and hires the steel detailer and erector (if the fabricator does not provide those services itself).

The structural engineer is involved earlier in the design process so it can mold the structure as the architectural design evolves. First, the fabricator hires the structural engineer. If a structural engineer of record (EOR) previously hired by the architect has already designed the structural components, then the ISD structural engineer will value-engineer the original design to reduce material and schedule. The fabricator then hires the detailer and erector.

Because the structural engineer is hired by the steel fabricator in ISD, the engineer has a direct incentive to save the provider money. In a bid-build environment where the engineer works for the architect, building a cohesive partnership between the fabricator and engineer requires more effort and time. ISD brings them together earlier and begets cohesion.

ISD's savings potential is substantial. I've seen it shave 25% off the steel package cost. I've seen a $4 million steel structure reduced by $1 million using ISD, and that's not including cost savings from the accelerated design and construction schedule. The structural steel industry is not one to overlook even small costs like $2,000 change orders, so any significant cost savings avenue is worth exploring and helps a business survive.

I firmly believe that with ISD, a project has a greater chance of saving time and material.

I formed my ISD conclusion while working on a steel-framed school that was a bid-build project. I'm a structural engineer, but at the time, I managed the steel contract for a new public school. I didn't consider the other parties when I directed the detailer to use shear tabs instead of double angles for all simple shear connections. I was thinking of it from a cost perspective; I knew shear tabs would reduce material cost, fabrication time, and field time.

During the shop drawing review, though, the EOR said he dislikes shear tabs. His preference quickly turned my anticipated cost and time savings into extra expenses and more days. The detailers quoted $42,000 to revise the drawings. The erector said double angles would take an additional five minutes to install per connection—for all 1,400 simple shear connections.

I called for a meeting with the structural EOR to discuss a path forward. I came to the meeting with my AISC *Steel Construction Manual* in hand, ready to explain why I chose shear connections. I was, frankly, overprepared. But it didn't matter. The EOR simply said he didn't like shear tabs and "was too old to change." The bid-build structural EOR nixed our steel schedule and budget—which wasted six figures of taxpayer money—all because he doesn't want to use a commonly used, perfectly safe connection.

ISD would've prevented the whole thing.

ISD creates a more cohesive steel team that produces project steel more efficiently. The steel detailer learns how to detail steel to best fit the fabrication shop's production techniques on design-build teams. A structural engineer with ISD experience is more familiar with how to deliver an effective budget to the steel fabricator in the preliminary design process because that engineer is likely to have a stronger knowledge of readily available steel and the fabricator's costs. By working with the same structural companies, the ISD team becomes a more integrated and fast-moving design-build partnership.

Not all design-build teams use ISD. Sometimes, the structural engineer isn't working for the steel fabricator or even the general contractor in design-build. The only way an ISD structural engineer can realistically design an efficient structure is to work directly for the steel contractor or, at minimum, the general contractor.

ISD is a key asset all the way through construction. When the structural engineer gets an RFI on an ISD project, it knows how to respond quickly with the most efficient solution (for example, minimize welds when bolts can be used).

Project team cohesion from ISD will also easily move Building Information Modeling (BIM) through the design and fabrication stages of the project steel. Like a bid-build project, a 3D structural model created in software such as RAM Structural System can be uploaded into a 3D steel detailing software like SDS2 or Tekla. In the final stages, the same BIM model can be integrated into fabrication software such as FabSuite.

In ISD, though, communication between the engineer, detailer, and fabricator is naturally more streamlined because they all answer to the steel contractor. BIM integration proactively resolves all communication and time bottlenecks that are more likely to occur when everyone isn't partnered.

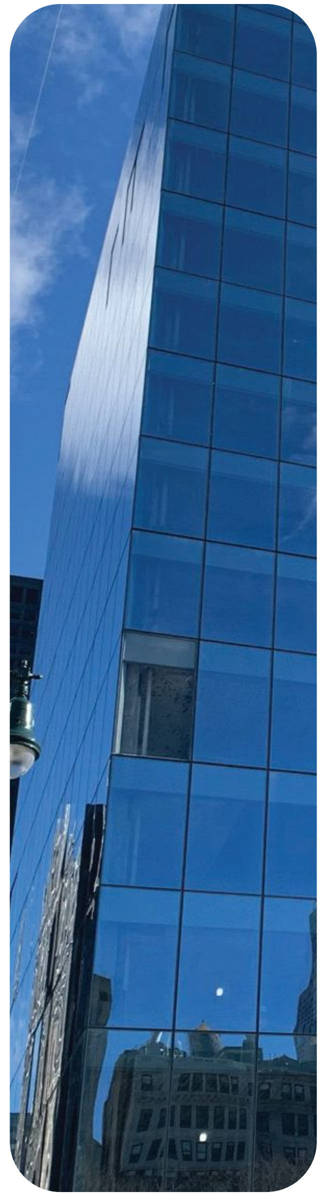
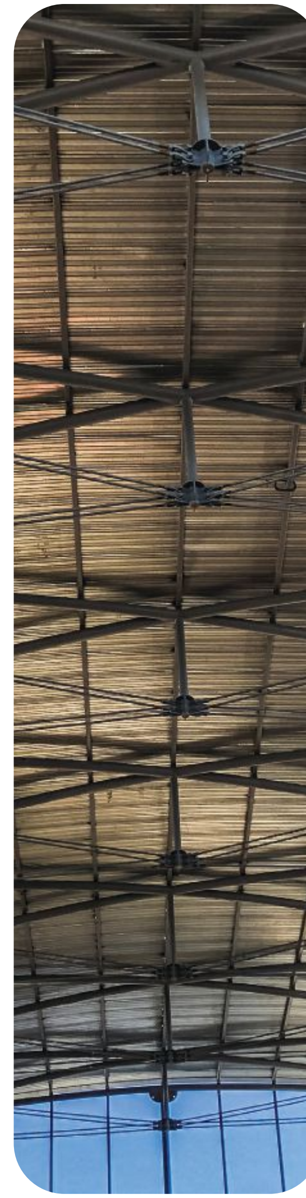
The key to cost and schedule success on today's building projects is a structural team with engineering IQ and business savvy that will keep a design-build team ahead of the learning curve. The structural design and fabrication need to be strategically aligned, because owners need a team that can design their structure better and build it faster than anyone else in the industry. I've found ISD to be a reliable method for finding that alignment. ■

Angie Alderman is a client manager and senior structural engineer at Bennett & Pless.

Modern Steel's annual roundup of recent smaller-scale projects goes coast to coast with a look at structures, sculptures, renovations, and even a book about a landmark building's second life.

What's COOL in Steel



This year's list includes a roof over an Illinois high school's new student commons, an outdoor performance center on a West Coast college campus, a urban fishing platform and scenic overlook on a river, a sculpture that captures Nashville's spirit, a Midwest rest area that honors its location, and more.

COOL Sculpture

Steel Speaks Volumes

Blessing Hancock has designed sculptures all over the world.

AT ITS CORE, Nashville's newest—and arguably grandest—piece of public art is a community speaking to itself and visitors. It does not, though, involve anything audible.

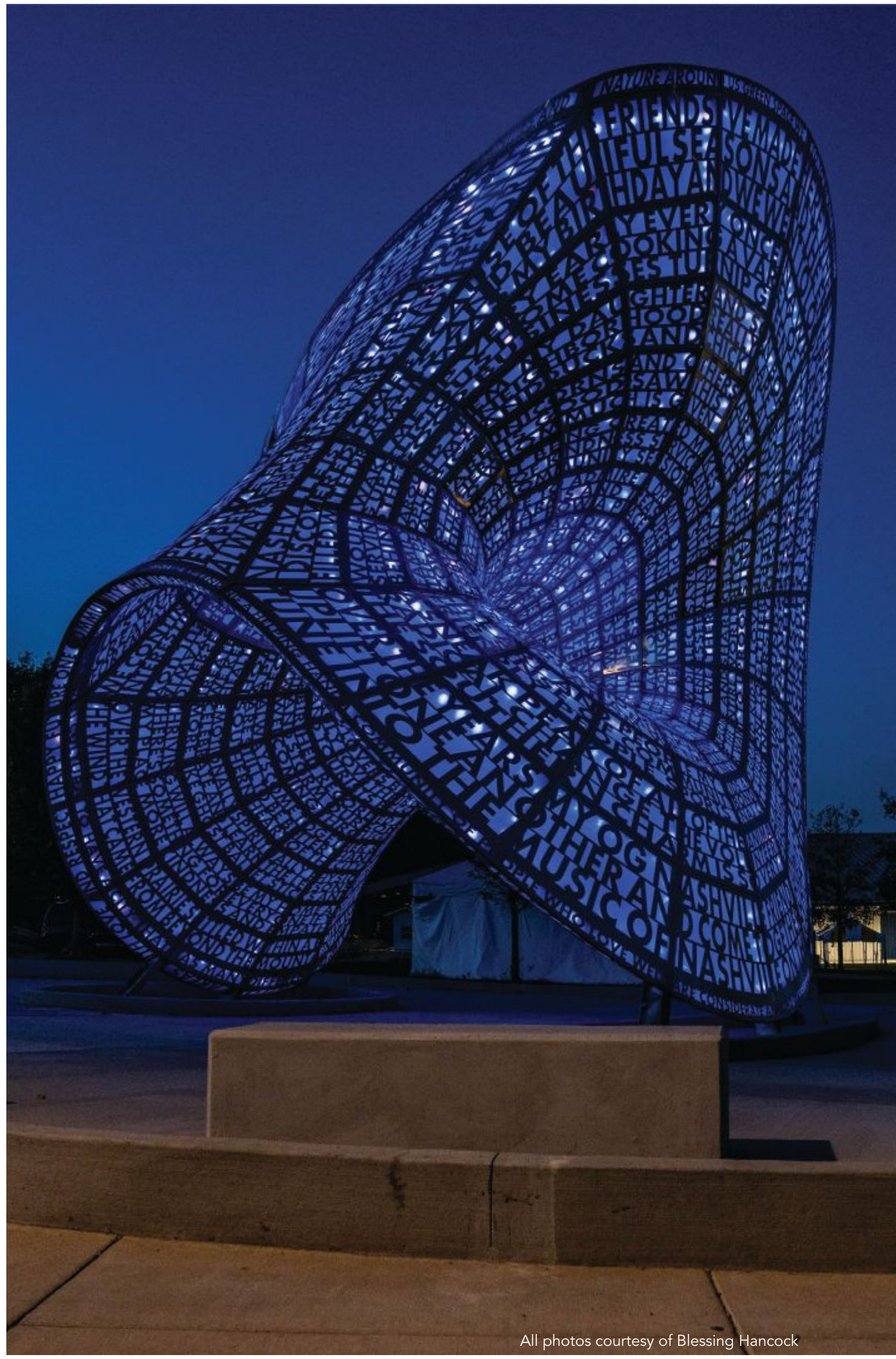
Instead, more than 400 Nashville residents communicate with their peers and visitors through an appropriately named steel sculpture unveiled in September.

Loqui, a 32-ft by 32-ft illuminated sculpture, sports a stainless steel exterior with words and phrases carved into it. The voices behind them range from people age 5 to 85 and represent transplants and residents, immigrants and United States citizens, the wealthy and the working class, and several racial backgrounds. They're all on a sculpture whose name is the Latin word that means "to speak" and is shaped like a megaphone—fitting for a city best known for its music scene.

"Nashville's identity is self-expressive," said Blessing Hancock, Loqui's designer. "It's about calling out, listening, and having a voice within the community. All the words on the surfaces were collected from the community."

A three-story structure's worth of words, to be exact.

The City of Nashville commissioned Hancock to design Loqui, which sits in The Fairgrounds Nashville, an entertainment venue in an ascending neighborhood also occupied by GEODIS Park, a 2024 AISC IDEAS^2 Award winner (read the May 2024 issue at **www.modernsteel.com**) and home of Nashville's Major League Soccer team. Hancock, a sculpture artist for nearly 20 years with 50 public sculptures across the world, called it her most innovative piece yet. It's her largest by size and steel weight (12 tons) and has a dual-megaphone shape with two



All photos courtesy of Blessing Hancock

cone-like structures connected with a bridge.

"It's very amorphous, and like a lot of my work, it involves a lot of curves," Hancock said. "That's one of the more technically challenging things you can do with steel."

The frame is ASTM A36 steel, with thickness ranging from $3/16$ in. to ¼ in., and it's clad with polycarbonate and stainless steel. About 20 large sections comprise the frame, and those sections are cellular components of the mild-grade steel plate welded into beam components.

"It's like a web and flange-type structure that's boxed," Hancock said. "That allowed the curves to be faceted so they're all straight segments."

Months of meticulous fabrication work preceded Loqui's unveiling, as is common with most of Hancock's sculptures. Each is a unique shape with little or no precedent for a fabrication plan. Gizmo Art Production, though, has fabricated many of Hancock's sculptures over the last two decades and understands her mission.

"They're one-of-a-kind, so sometimes you don't know the conditions you'll be facing," Hancock said.

Hancock begins discussions with Gizmo and the engineer (for Loqui, Bryan Starr of Tarantino Engineering Consultants) long before fabrication starts. Their collaboration is a give-and-take. Hancock wants to push boundaries, but understands the structure must be constructable. They used Rhinoceros 3D to design the frame.

"I'm always fighting for the aesthetic," Hancock said. "I want the message to be clear. It's abstract and emotive. I don't want the design to lose some of the artistic qualities. But I'm working with technical experts, and there are limits on what the materials can do. I set the vision, but everyone else makes sure it's practical."

Welding the box cells and turning them into sections was a key element of fabrication, and an engineer's inspection of the welds called for additional welds. All told, the frame surpassed a mile of welds. Holes for the cladding needed to be pre-cut, but the number of holes was limited because of stability concerns, and lining them up with the panels is tricky.

"It's like moving something from your imagination to reality or from the computer to physical," Hancock said. "It's hard to build in a lot of tolerances on a shape like this. There will be little distortions and things when you set it up. We had some flexibility built in."

The entire structure was pre-assembled in Gizmo's Bay Area shop, then deconstructed into about 20 large sections that were transported by truck to the jobsite. Erecting the sculpture took about three months and began with attaching the sections.

The sculpture has two touchdown points tied to underground foundations. The bottom arch supports the rest of the piece and was erected first in two large sections, then bolted together. The erector began with the arch, then the core on top of the arch. The bridge that attaches the two megaphone shapes was the final piece. No on-site welding was required.

The frame also accommodates the wiring and lights. After the frame was erected, lighting and wiring were strung through it. The polycarbonate and stainless steel layers followed.

"Steel works well to encapsulate the lighting within it, and the lighting brings it alive," Hancock said. "Steel is like the skeleton, and the lighting is the heartbeat."

And the words are the meaning.

Hancock enlisted Nashville-based community liaison Miriam Speyer to handle local outreach to all demographics of Nashville residents, and they delivered several hundred expressions that grace the sculpture. Some are one-word phrases: "Vibrant," "UNITY," "Home," and "Evolving." Others are longer and illustrate the wide scope of contributors, including: "I hope to leave Nashville better than I received it," "Tennessee born and raised," and "Something good is always just around the corner."

Many of the expressions are visible to anyone who walks through Loqui. And the ability to walk through it is the core of appreciating its essence.

"It lets you open your mind," Hancock said, "to being different and being changed by the artwork."

A 4,465-sq.-ft balcony was constructed within The Avenue Church's existing worship space.

All photos courtesy of KMV

COOL
Church
Balcony

Tight Squeeze

THE AVENUE CHURCH in Waxahachie, Texas, had two options for a much-needed overhaul to accommodate its growing congregation: construct a new $20 million worship center or undertake an innovative, cost-effective interior structural steel expansion.

The expansion option involved steel erection while the church was open, adding logistical hurdles, but its plan to use structural steel to grow the existing building's capacity vertically through a balcony saved $14 million and dramatically increased its seating and interior footprint. The accelerated erection options and lower cost that steel presented were major components of the cost savings.

Originally, the church was about 8,900 sq. ft, with seating for 900 community members. After the expansion, the church grew to 13,305 sq. ft with space for 1,450 members. The main piece of the transformation was a new 4,465-sq.-ft balcony providing 487 additional seats—an increase of more than 50% from the original worship center capacity. KMV, the structural engineer of record, designed the 70-ton steel balcony, which AFC Steel detailed and fabricated. Integrating the new structure into the existing space required detailed planning.

The church aimed to maximize sightlines, increase capacity, and retain functionality for its congregation. Achieving those goals meant finding solutions to several major project components:

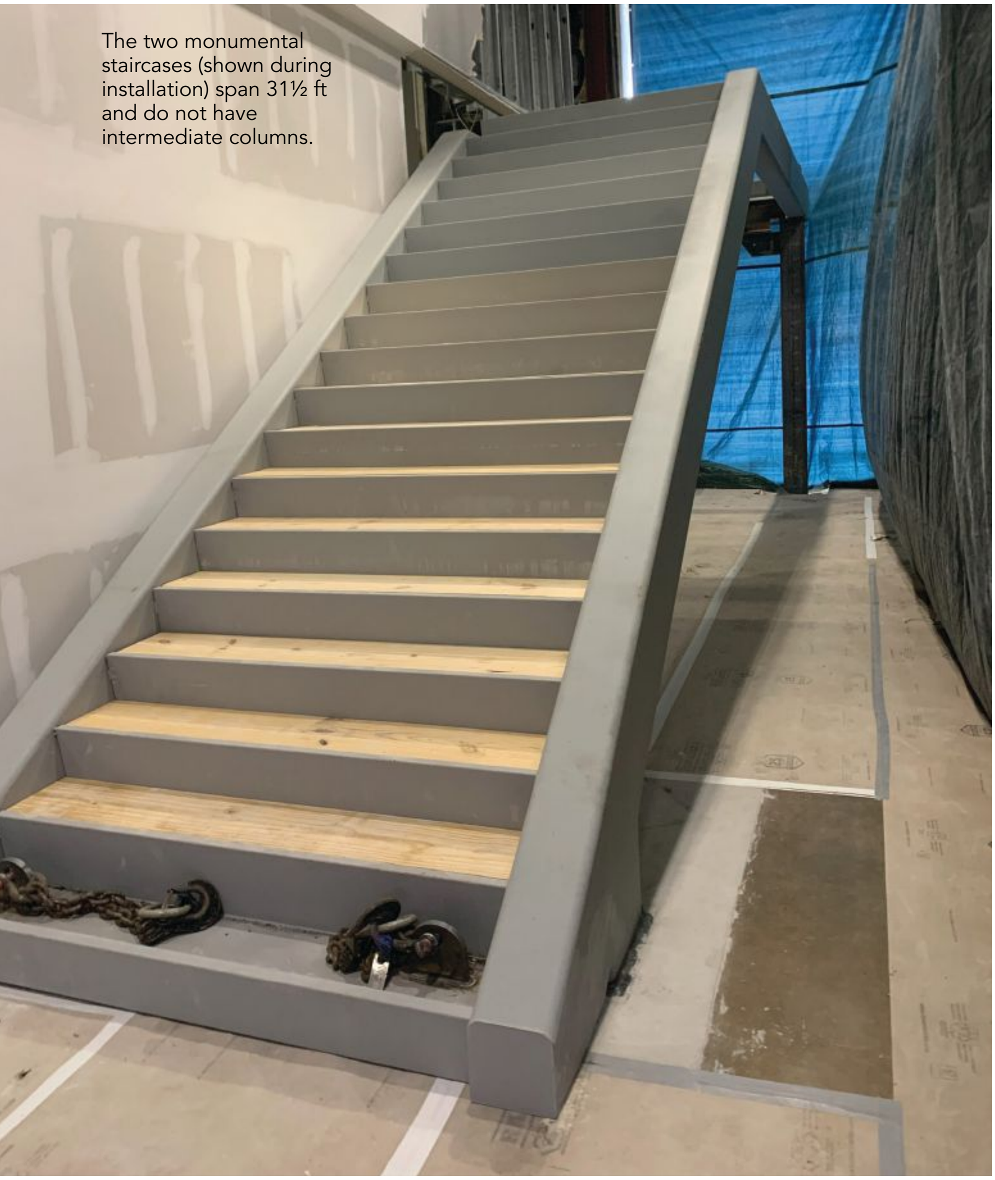
Balcony Integration. The balcony needed to fit seamlessly into the existing worship center without obstructing sightlines, an effort that required precise coordination between architect BOKA Powell and KMV. The design team chose W24×131 raker beams spaced 30 ft apart with 11½-ft cantilevers to expand the seating without taking up valuable floor space.

Minimizing Columns. To maintain clear views and maximize seating, only three columns were placed in critical sightlines, despite the structural complexity of supporting the large balcony.

KMV and BOKA Powell conducted sightline studies to ensure an optimal experience for all congregants above and below the balcony. The studies identified critical areas where columns had to be avoided and identified that clear spans needed to be at least 45 ft long. The clear spans use raker girder trusses (W24×131 top chord, W14×90 bottom chord, and HSS webs) on either side of the balcony. The trusses serve dual purposes; they support a lower corridor with the bottom chord and the upper seating area with the top chord.

Structural Support and Vibration. The 11½-ft cantilevers and 45-ft girder trusses were essential in supporting the balcony's span while minimizing vibrations for a stable, safe environment. AISC Design Guide 11: *Vibrations of Steel-Framed Structural Systems Due to Human Activity* helped determine the acceptable tolerance for the acceleration of the performance of the balcony. Various partial and

The balcony has 45-ft clear spans.



The two monumental staircases (shown during installation) span 31½ ft and do not have intermediate columns.

full-scale finite element vibration models were created to evaluate the performance of the balcony. Due to the balcony's complexity from compounding vibration, the full-scale model proved beneficial for determining the structure's performance.

The balcony's long cantilevers and long trusses were designed iteratively to determine the member sizes that would provide vibration performance tolerable and comfortable for the occupancy. Additionally, the composite beams supporting the balcony steps create a unique Z-section with the composite concrete deck used to enhance the members' vibration performance. These members spanned between raker girders, and once the vibration performance was analyzed, the final member was determined as W21×44, which was an increase from the initial preliminary gravity analysis of the member.

Elsewhere, two monumental staircases spanning 31½ ft without intermediate columns are a striking feature of the expansion. These staircases serve a functional purpose and enhance the aesthetic appeal of the space, and careful attention to vibration control ensured that they remained visually impressive and structurally sound. Design Guide 11 aided the staircase analysis from the descending walking excitation from individuals and groups of the congregation.

Logistical Challenges. The existing church remained partially operational throughout the project, which resulted in limited access to the interior and made steel erection difficult. An enclosed interior jobsite was the biggest hurdle, and the only construction access to the interior was an existing double door that was removed. Those space constraints required low-clearance equipment to erect the steel. The equipment limitations were an additional constraint for bringing materials into the building, and offsite fabrication of structural elements had to be coordinated with the access constraints. KMV understood the steel erection constraints when designing and acted with them in mind to create an innovative and constructable design. KMV also coordinated with the fabricator and erector to determine desired splice locations that allowed the structural steel to fit through the lone entry point and be efficiently erected.

Accelerated Schedule. The project adhered to an aggressive timeline that called for completing the design phase in three months and construction in seven months. Integrated project delivery methods achieved the narrow design window and included an accelerated steel package

The project had a seven-month construction timeline.

ahead of the entire design team. The accelerated steel package allowed the fabricator to begin work ahead of schedule and provide the steel for erection at the completion of the contract documents.

Integration provided valuable acceleration needed to achieve such a tight deadline, but it required a complete design team understanding of the complication with accelerating the steel. By initiating steel fabrication earlier, the entire team had to be comfortable with the design and well-coordinated with all parties to lock in the steel locations and avoid potentially costly change orders.

The response to the completed project from the Avenue Church leadership and congregation was overwhelmingly positive. By providing a cost-effective solution that significantly increased the seating capacity and saved $14 million, the church can now better serve its growing community. The new balcony and improved interior layout allow for a more inclusive worship experience, ensuring that all attendees have clear views and a comfortable environment.

Owner
The Avenue Church

General Contractor
WCA Construction

Structural Engineers
Krieger, Maines and Vicars Consulting Engineers, LLC

Architect
BOKA Powell LLC

Steel Team

Fabricator and Detailer
AFC Steel (AISC Certified Fabricator)

Erector
LRS Construction Services LP (AISC Associate)

COOL Roof System

Remarkable Roof

THE LEARNING COMMONS at Downers Grove North High School in Downers Grove, Ill., turned an unused courtyard into the center of student life.

The commons is a flexible educational space with a welcoming, bright atmosphere where students and staff can socialize and collaborate. But natural light, a key to creating brightness, can only enter the space from above due to the school buildings on all four sides of the space. The roof—the primary part of the Learning Commons project—needed to allow for maximum light and minimum disruption to the existing school buildings.

Through an integrated design and delivery approach, Wight & Company—the architect, engineer, and construction manager—developed a roof system with a unique framing aesthetic and simplified assembly and erection. It used a “design thinking” process that fits solutions to a context in a human-centric way. The process included empathetic understanding, defining problems, developing, prototyping, and testing each solution for conformance to the design philosophy and construction constraints.

First, though, the roof system had to sit atop buildings constructed in 1928 and 1956. Any disruption to them beyond minimal would strain an older structure or lead to costly strengthening of existing columns and foundations. A lightweight roof would avoid those hurdles, and structural steel was the optimal solution to reduce the imposed weight while staying within the aesthetic parameters.

The structural scheme is a series of eight identical custom-framed king post trusses to span the courtyard. The trusses are comprised of HSS5.000x0.500 sections and steel rods, creating a clean and light appearance while providing a well-defined solution. The eight trusses are supported by a perimeter steel frame, elevating them above the roof line and creating a floating look. The perimeter frame successfully forms a simplified truss support structure and a transition structure to the existing buildings below.

Structural steel also allowed the engineers to use their creativity and avoid a mundane approach, which was displayed in combining tubular sections and tension rods to form an arched roof shape through the eight trusses. Thin purlins on top of the trusses provide a simplistic linear rail support for the glass and steel roof panels.

Steel won constructability considerations as well. A constant focus on constructability was a critical driver in the project’s success. Truss assembly in a fabrication shop provided the aesthetic quality needed for the project, and repetitive, identical trusses are economical to fabricate, bend, and assemble. The perimeter support frame also allowed the trusses to be dropped into place easily.

Concrete was never seriously considered. The large, heavy concrete sections required to span the courtyard would have created a utilitarian appearance and blocked natural light. A concrete roof would also require significant retrofitting and reinforcement of the existing buildings. Similarly, engineered wood framing needed large sections that would have limited natural light and were more expensive.

Fine Fabrication

Original structural drawings were not available for the existing buildings, so Wight & Company undertook a selective demolition, site survey, and material testing program to understand their properties and structural capacity. Once the capacity was confirmed, the team developed a structural steel perimeter frame to transfer the new roof loads directly to existing columns and foundations. The frame aligned with the existing support columns below while providing flexibility to place the eight roof trusses in a consistent and repetitive alignment.

The frame and roof trusses bridge an expansion joint between the 1928 and 1956 buildings. Thus, the frame over the 1928 building was fully isolated from the frame over the 1956 building. In addition, trusses over the 1928 frame used slide bearing assemblies to allow horizontal movement across the expansion joint.

All trusses are exact duplicates to maintain repetitiveness in geometry and materials. Architecturally exposed structural steel (AESS) requirements were only specified on the underside of the trusses, and because of the height, were specified to AESS Category 2 (feature elements not in close view). All field connections are located on the truss top surface and not exposed to view. Trusses were fully assembled in the shop and delivered to the site in one piece, reducing field erection time. AISC member bender-roller Chicago Metal Rolled Products curved the steel.

The trusses and their connections’ complex geometry needed expert fabrication work. Detailing was crucial to ensure the geometry from the 3D models transferred correctly to the 2D fabrication drawings. The layout of the first truss and building a jig to replicate the geometry for the other trusses was especially difficult. Fitters at AISC member fabricator K&K Iron Works spent several days laying the rolled material on the shop floor, checking the radius, and then tweaking each tube with a hydraulic bender to make sure each radius matched. The tie rods at the underside were adjusted to avoid distorting the curvature.

A partial and full-scale truss mockup helped develop the fabrication procedures, along with the confidence of the inspection and testing results. The precision shop fabrication and surveying were crucial to a smooth erection sequence.

Process of Precision

The coordination of the design and construction phases between fabricators, inspectors, and erectors added confidence the project could meet the budget, constructability and quality challenges. Discussions with K&K Iron Works ensured high-quality expectations would be achieved in the fabrication shop, with a rigorous focus on bending the tubular members, consistency of truss fabrication, and the welded connections of intersecting members.

Fit-up is a critical component of tubular connection welding. Groove angle gauges were created to verify each joint’s groove angle dimensions, allowing the crew to verify geometry prior to final welding. Joint information was marked on each piece to aid in fit-up operations and assist the technician in ultrasonic testing and

The completed Learning Commons roof and interior.

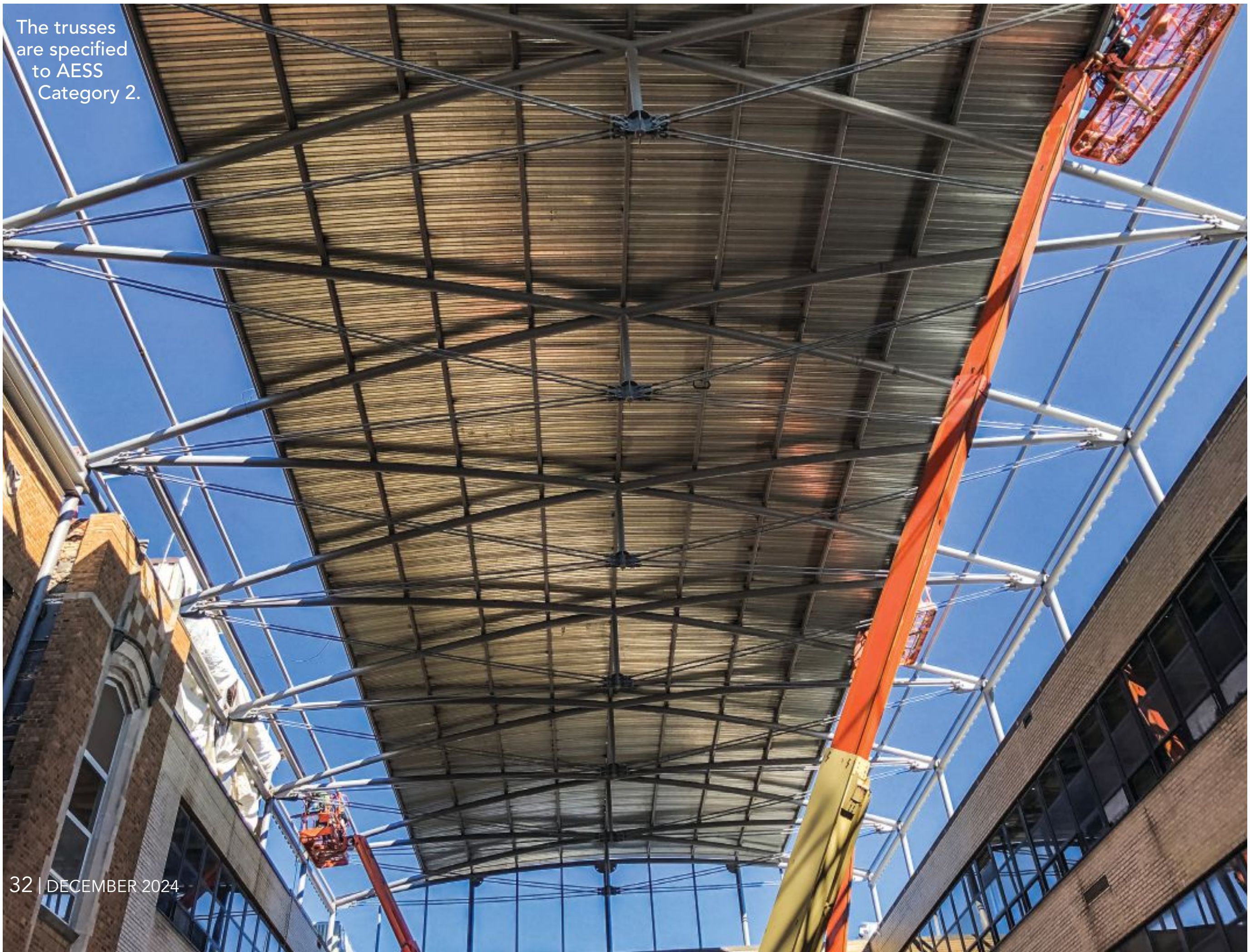
Connor Steinkamp Photography

The courtyard that was converted into the Learning Commons

A saddle connection in the roof system.

All photos courtesy of Wight & Company unless otherwise noted

Tubular sections and tension rods form an arched roof shape through the eight roof trusses.



The trusses are specified to AESS Category 2.

prevention of false rejections. All inspections and ultrasonic testing were performed according to AWS D1.1 2020 Clause 10.

The most acute dihedral angle at the intersection of the top chord X-connection was on the order of 28°. To ensure acceptable CJP weld sizes are produced, an acute heel test plate was utilized during inspection operations. The test fixture was welded, and the welding variables were recorded. The fixture was then cut at three distinct locations and macrotech testing was performed, which aided welder preparation, determined appropriate gas cup sizes, and shielded gas flow rates.

Once everyone was confident in the welded connections, a full-scale production mockup of a truss was completed for design team review. Trusses were observed for conformance with the design intent, aesthetics, and AESS quality expectations prior to assembling the remaining trusses and delivery to the project site.

The completed truss was initially confirmed to fit on a delivery truck, avoiding any field assembly. The jobsite's location in a residential area with narrow streets complicated the process, but did not force a change of transport plans. Navigating the access for the semi and extended trailer while the truss was on the trailer gave the driver almost no room for error, but the truss reached the site without issue. The truss was transported upside-down and re-orientated at the site before erection and placement.

On site, underground hazards and other trades' presence limited crane placement options. An initial site survey estimated a potential crane location and compilation of the dimensions needed to generate an accurate representation in 3D Lift Plan. The crane vendor brought a drone, which provided an accurate bird's eye view of the site that was imported into the lift plan.

Communal Space

The Learning Commons extends learning beyond classroom walls and a class period. It's a community space that aims to enable students to be more active participants and owners of their education.

The custom configuration of the roof structure aims to inspire young minds to think differently and exceed basic expectations. Expression of the physical structure through a creative approach emphasizes the rewards of thoughtful risks and persistent problem-solving within a creative and analytical process.

COOL
Rest Stop

All photos courtesy of Zac Leeson

The rest stop framing is primarily comprised of rectangular HSS.

Honoring Roots

VISITORS AT A REST STOP along Interstate 65 in Northern Indiana can see several references to the region's landmarks just by looking at the building's exposed steel members.

The rest stop—located just north of State Route 10 (Exit 230) near De Motte—opened in late 2023 and has a lengthy amenity list: ADA-compliant and energy-efficient bathrooms, murals, walking trails, a boardwalk, and play areas. Its 116-ton frame is primarily comprised of rectangular HSS, which the design team chose to help meet requirements for Architecturally Exposed Steel Category 3 (feature elements in close view).

The frame's tubular members were designed to be rolled on radii resembling the rolling waves and sand dunes of nearby Lake Michigan. Round HSS12.750×0.500 and HSS8.625×0.625 were used for the columns, HSS16×8×½ were picked for the horizontal framing exposed to view, and HSS12×2×¼ and HSS8×4×3/8 were chosen for the rolled members. HSS18×6×5/16 were used for the low room beams to carry the wood timbers. W14 and W16 horizontal beams tie the tubular "goal posts" together.

Meanwhile, the roof resembles wind turbine blades when viewed from above, a nod to the cluster of wind farms that line I-65 in nearby Benton and White counties. In addition to waves, the steel and masonry resemble dunes, a tribute to the Indiana Dunes.

The rotunda area is comprised of rolled HSS members laid out in a circle, with intersecting rolled HSS members connecting from perpendicular directions. Many of the members in the rotunda and main structure are rolled to various radii and assembled in a structural system that carries the roof. The design team and fabricator contracted bender-roller Chicago Metal Rolled Products to bend those members to the desired look.

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The rest stop framing has several types of rolled HSS.

Interfacing rolled HSS members with wood beam construction and masonry was among the most challenging aspects of the project and required thoroughly planned coordination with other trades and team members. The column caps included brackets on compound miters to receive the wood beam roof framing. One of the most time-consuming fabrication features was aesthetically softening the transition from the rectangular tubes to the cylindrical columns with the ground and blended welds.

Processing AESS means additional attention to every fabrication stage, from hole layout to fitting and welding. All require special attention to fit and finish. Mill marks are positioned away from view in the final location, and welds are ground flush and made to look seamless. Shipping is the final stage, and the steel must be handled delicately to avoid any damage before installation. The project schedule, though, allowed for proper time to fabricate and deliver AESS-quality product.

The roof resembles a wind turbine blade.

Owner
Indiana Department of Transportation

Architect
Fosse & Associates Architects

General Contractor
Hasse Construction Company, Inc.

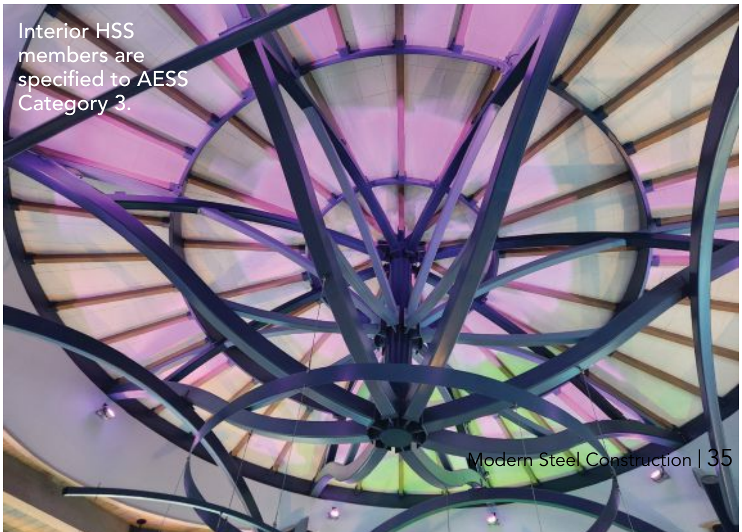
Structural Engineer
Janssen & Spaans Engineering

Steel Team

Fabricator
Synergy Steel Structures, Inc. AISC CERTIFIED ERECTOR

Detailer
Arteras, Inc. AISC DETAILER

Bender-Roller
Chicago Metal Rolled Products AISC ASSOCIATE



Interior HSS members are specified to AESS Category 3.

COOL
Performance
Venue

Setting the Stage

The Drollinger Family Stage began hosting events in 2022.

LOYOLA MARYMOUNT UNIVERSITY sought to stun with its new outdoor stage. It wanted a design with striking looks but functionality to match any other performance venue.

The Drollinger Family Stage on LMU's Los Angeles campus, opened in 2022, is a versatile 1,600 sq. ft open-air venue equipped for theatrical performances, outdoor teaching, film screenings, and myriad other campus and community events.

Its sleek steel design instantly catches visitors' eyes. As visitors enter the campus, the stage's roof appears as a floating plane above the contours of the landscape. The structure's open, delicate form defines a bustling central plaza and curving natural amphitheater, flanked by formal plantings, academic buildings, and pedestrian walkways.

By embracing subtle architectural expression, minimizing structure and mass, and eliminating visual clutter, the design seeks to enhance the theatrical capacity of the space. The gently raked aluminum-clad steel roof appears as a suspended, dimensionless form, further articulating the minimalist aesthetic of the architecture.

The design cannot lack functionality, though. Stages have sound, lighting, and audio-visual (AV) systems that require significant wiring a design must accommodate. And aesthetically pleasing designs must conceal them. Every structural design choice placed equal weight on aesthetics, functionality, and cost efficiency.

The key component was the venue's slender columns and a roof structure of cellular steel beams. Those columns hold the roof aloft while also mirroring the form and spacing of the nearby palm tree trunks. Similarly to the trees, the slender columns are efficiently designed to handle the high seismic loads of Los Angeles via flexible behavior as a cantilevered column system. The thin-as-possible roof integrates all infrastructure—such as mounting lattice—and AV equipment into the cellular framing structure, while its wide metallic overhangs provide the proper gravitas and shading for daytime stagings. The metallic palette was selected to be unobtrusive during dramatic nighttime shows.

The stage capitalizes on Los Angeles' almost-always-sunny climate and warm evenings that are ideal for outdoor lingering. The outdoor setting is comfortable and practical—the latter due to the lack of need for HVAC. The most efficient HVAC system is, after all, no system at all.

As universities adapt to changing public health and environmental needs, outdoor classrooms are an intelligent and low-cost way to create gathering spaces. When the stage is not actively engaged for performance, education, or ceremony, it continues to function passively as a shady space where students can convene.

The flat, thin roof system was designed to be supported by slender cantilever columns. Los Angeles is a high seismicity zone, and the heavier the roof, the more lateral seismic force the columns need to resist. Structural engineer Skidmore, Owings & Merrill

The stage is in the middle of Loyola Marymount University's campus.

The roof has 10-ft typical cantilevers and a 12½-ft corner cantilever.

The lateral system consists of 6-in.-diameter steel pipes.

All photos courtesy of Dave Burk © SOM unless otherwise noted

(SOM) chose steel because it has relatively low self-weight, high strength, and high ductility.

A timber roof was also considered as an option. However, the project had strict roof depth requirements, and the timber structure would require more depth than steel to form the 45-ft-long main span and 10-ft cantilevers.

The foundation system is made of reinforced concrete strip footings. Slab-on-grade on top of rigid foam creates the stage's elevation. The strip footings link the slender columns to distribute lateral and vertical loads evenly. The rigid foam supporting the middle platform also provides flexibility for the CMEP conduits to go under the stage when necessary.

Creating a theater-in-the-round stage outfitted with lighting and audio equipment required a high degree of coordination. For maximum visibility of the stage, the columns needed to be thin while still carrying the mass of the roof and the concealed AV systems. That required reducing mass to make the slender cantilever columns work without frame action for the Design Earthquake Event in a zone of high seismicity.

Cellular beams serve as the gravity system. The round holes not only reduce the self-weight, but also create pathways for the architectural and lighting components. The opening pattern changes density as needed following the stresses in the steel webs, with more openings at mid-span and smaller and fewer openings near the beam-to-column connections for the primary north-south beams. The largest span of the roof in that primary direction is 45 ft with almost 10 ft typical cantilevers. The corner cantilever is about 12½ ft. The total structural depth of the roof system is 24 in. with all the light grids incorporated, tapering to only the ½-in. flange thickness at the edges to produce the floating plane effect.

A cantilever column system resists the lateral load, and the lateral system consists of 16 6-in.-diameter steel pipes. The roof beams' perforation and resulting light weight made the design of the slender columns possible. The gravity beams in two directions also work as the diaphragm of the roof system to distribute the lateral load evenly.

Detailed finite element models were built to design the special components and connection details. Both global and local analysis models were used for the perforated beam checks.

All team members collaborated to create a plan for concealing conduits within columns and connections, maintaining the facility's clean aesthetic. All the architectural components are also incorporated into the structural components. The openings of the perforated beams create space for the light grid pipes, and all the drainage pipes and conduits from roof to underground are hidden in the 6-in.-diameter steel pipes.

Base plates and connections were designed with enough openings and tolerance for the future installation of the architectural

The outdoor setting meant the stage roof did not need to house an HVAC system.

Lucas Blair Simpson © SOM

Perforated beams reduce the roof weight.

Drain pipes and roof-to-floor conduits are hidden in the steel pipes.

The columns work without frame action, even in a high seismic zone.

components, drainage and conduits, and were concealed with appropriate joints under the slab-on-grade for aesthetic reasons. In this way, the required stiffeners, anchor rods and nuts that transfer the loads to the foundation remain visually hidden. The ends of the cantilevered beams are tapered to accommodate the cladding's sharp edges.

Overall, the steel design details focused on constructability, ultimately expediting the speed of erection on site to a couple hours. The whole roof system was shop fabricated and shipped to the site for the final installation, and installation tolerance was accommodated with bolted connection design for the webs and welding only for the flanges. Minimum welding was required on site, making the erection of the structure quick and efficient.

Owner
Loyola Marymount University

General Contractor
W.E. O'Neil

Architect and Structural Engineer
Skidmore, Owings & Merrill

Steel Fabricator, Erector, and Detailer
Plas-Tal Steel Construction AISC CERTIFIED FABRICATOR

COOL
Photo Book

Stunning Steel Shots

SANDRA STEINBRECHER was among the many Chicagoans thrilled to hear that one of the city's beloved landmark buildings found a second life that squashed concerns about its future.

In 2019, a new ownership group announced plans to turn the recently closed Morton Salt warehouse and packaging facility into a music and event venue, now known as the Salt Shed. The nearly 100-year-old building and its iconic roof—visible from the Kennedy Expressway with "Morton Salt" and its Umbrella Girl logo emblazoned on white panels—would have new life and still honor Chicago's industrial past.

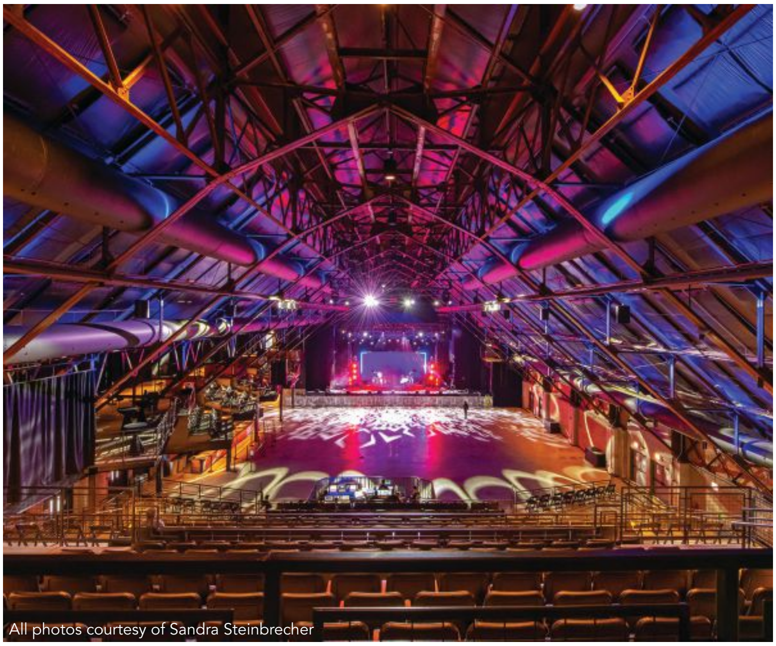
The indoor performance space holds 3,600 people and opened in February 2023, following the completion of a 5,000-person outdoor section called The Fairgrounds in August 2022. But Steinbrecher, a documentary photographer, visited long before then. One trip with her camera to capture the project's progress became an endeavor to share the building's journey from salt storage site to social space. Steelwork and steel workers are a central component of it.

"It was powerful to see a structure taken apart and rebuilt," Steinbrecher said. "I kept thinking it would be intriguing for other people to see this."

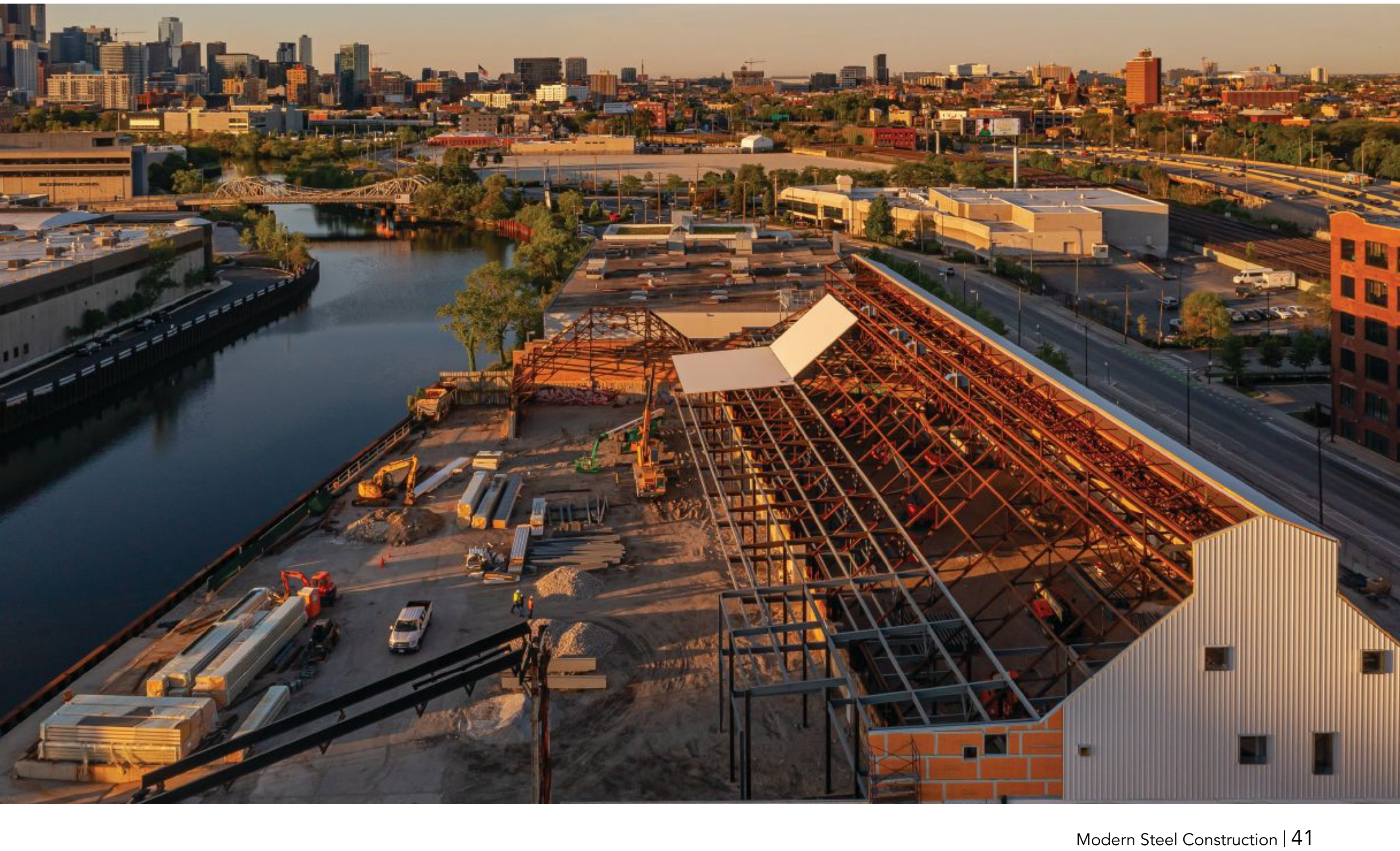
Steinbrecher frequented the jobsite three to four times a week, and her visits spanned almost two years. Along the way, she settled on the proper outlet for documenting them. Her book, *The Salt Shed: The Transformation of a Chicago Landmark*, was published in September 2024 and is available at **www.trope.com**. Its 144 pages and more than 130 photos recognize the people, the effort, the work, and the material behind the restoration and ensure they're not forgotten as the shed thrives in its new life.

"I wanted to show the invisible work of tradespeople," Steinbrecher said. "Often, they're doing the underground or behind-the-walls work that gets covered with layers of cement, rocks, gravel, and finishes. Not everyone knows what it took to create a space like this. I really wanted to show what it takes to do this kind of work and the process. It's not a how-to, but it's about the project's beauty and power."

One of the most important parts of the work was restoring and rehabilitating the warehouse's steel-framed roof. The sights, sounds, and smells of ironworkers cutting, scraping, and handling 100-year-old steel greeted Steinbrecher on her first visit to the site.



All photos courtesy of Sandra Steinbrecher

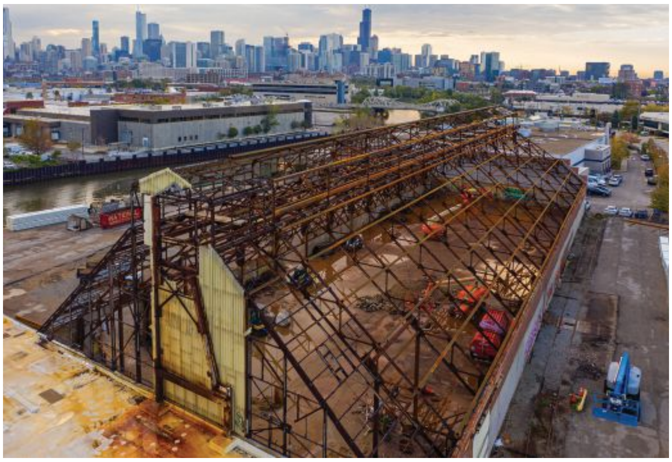


At that time, half the building's signature white roof panels had been removed to grant unobstructed access to the steel frame, and the fall sunrise cast an orange, red, and pink glow on the beams while a cloudless sky filled the space between them. It made for a stirring introduction to steel's aesthetic appeal that Steinbrecher deftly captured through her camera lenses.

"I don't know how long I was there—I just lost track of time," Steinbrecher said. "It was so beautiful and compelling. I asked if I could come back. The stories started coming, and the visuals were exciting and dramatic."

As were her discoveries about the work itself.

"We think of modern construction as machine-made with giant cranes bringing in heavy steel beams, but so much work is still done by hand," Steinbrecher said. "You have to place the beams, weld them, align them, and work together."



Soon after, the people on the jobsite became part of the story. Steinbrecher met and interviewed ironworkers, plumbers, painters, electricians, machine operators, sheet metal workers, and many other types of trade workers. They are more than photo subjects; they're creators of something that will outlive them and impact countless lives. As Steinbrecher interviewed more people, she found many pursued skilled trades to be part of building structures that might become community staples and memory-makers.

"Most people really like working with their hands and working outside," Steinbrecher said. "They felt like they were contributing to something bigger and building something. It's a positive thing to do with your life. You're building something together with other people. We've done that for thousands of years. There's a sense that you're contributing to life and society."

R2 Companies acquired the building after Morton Salt closed it in 2015. Developer Blue Star Properties, hospitality group 16" On Center, and HBRA Architects conceived, designed, and built the venue. Steinbrecher interviewed employees from each, in addition to engineers from Chicago-based Forefront Structural Engineers who were also crucial to the restoration.

The engineers surveyed all existing steel, measuring its thickness with calipers and checking that connections were still in place. Inspection came after all members were sandblasted to remove corrosion and salt buildup, which exceeded 2 in. on some pieces. Exposure to salt's corrosive powers for 85 years cast uncertainty on the steel's condition, but upon sandblasting, all original trusses were deemed viable. Members with deterioration were replaced.

The original steel's overall strong condition assured the development team that the project would not require a new roof frame. A 40° angle original roof to accommodate salt piles, a column-free interior, 100-ft spans, and a ventilated, light-filled interior were necessary for a salt storage facility. They also lent themselves to life as a music and event venue.

The restoration was navigable, but as Steinbrecher observed, it's still painstaking. The challenge is worthwhile, though, for the team undertaking the job and the people it will benefit. Any adaptive reuse is a sustainable solution. And in this case, it keeps a landmark that can't be replaced and is as much a piece of art as it is a structure. Steinbrecher hopes her book helps show the ambition to undertake difficult restoration can be rewarding and has benefits long after construction.

"Not everything can be saved, but [historic preservation] has real-life impact," Steinbrecher said. "It can keep neighborhoods to human scale. It can be sustainable, promote a sense of community, culture, and pride, and it can be fun to find a second life for a building that has outlived its original intent."

***Sandra Steinbrecher** is a Chicago-based documentary photographer. Find her work online (www.sandrasteinbrecher.com) and on Instagram (@sandysteinbrecherphotography).*

COOL
Trail Structures

A fishing platform is part of a recent Schuylkill River Trail extension.

Steel on the Schuylkill

All photos courtesy of Pennoni

THE FOCAL POINT of a riverfront trail extension in Philadelphia is a pair of new steel structures.

The Schuylkill River Trail follows its namesake waterway in several separate sections, starting in Reading, Pa., and ending in Philadelphia near the Center City neighborhood. One of its recent extensions goes from 56th Street to 61st Street in Philadelphia, and it includes a steel fishing platform at water level and a steel overlook that cantilevers over the river.

Site constraints, constructability, and reliability were among the reasons steel was the clear choice for both structures.

The clear spans and cantilevers for each structure could be best achieved with structural steel sections. Both are positioned over a steep riverbank and water, and the platform sits above the remains of a prior platform that was abandoned and later removed. Neither location was conducive to formed, cast-in-place concrete. Structural steel members were easily erected using cranes, and the desire for open decking on both could only be accomplished with grating supported by structural steel members. Galvanized structural steel also had a durability advantage over wood framing.

The most complicated parts of the overlook's structural design were the foundations next to the river edge and limiting the deflection of the cantilevered platform. Design development included several iterations, starting with a single outboard post with kicker braces in the direction of the cantilevered platform. But due to the desired length of extension over the water and preference to avoid placing foundations or steel supports in the river, the cantilever length was reduced by placing the outboard columns in a diagonal position over the river from the landside foundations.

As a result, the design required opposing sloped columns extending up from the foundation to resist the horizontal thrust reaction at the base of the outboard column, which also extended into the cantilever back span.

Once the geometry of the main support columns was set, the horizontal structural members were designed for lateral and gravity loads. To resist the controlling lateral seismic forces, the entire platform was designed as a horizontal truss cantilevering from the inboard concrete abutments at the start of the structure interface with the grade trail. The design was made feasible by installing horizontal diagonal bracing immediately below the open steel grating, which engaged the main gravity support beams as chords for the required horizontal resistance.

The walkway to the viewing end used diagonal braces in a modified warren truss geometry to dissipate the load into each walkway abutment, avoiding sloped column supports for any lateral support.

The new fishing platform, meanwhile, is located above an existing low deck timber structure near the shore originally used as a loading dock for a former U.S. Gypsum facility. A low deck structure is like a relieving platform in a bulkhead finger platform, except the low deck platform is suspended above the low water line, which supports an outboard cast-in-place concrete quay wall and the associated retained fill. Typically, a bulkhead retaining wall is located only along the inboard edge of the platform.

The fishing platform straddles the bulkhead structure and stabilizes it by providing support for the existing gravity and lateral loads. The new platform is supported by steel pipe piles, and it consists of W12 steel beams supported by W24 steel girders that clear span over the existing platform. The 16-in.-diameter piles were installed in one row immediately outboard of the existing quay wall, while another row is located inboard of the existing timber bulkhead.

The W24 girders are spaced at 20 ft on center, while the W12 beams are spaced at approximately 7 ft on center and support a 2½-in.-deep open aluminum ADA-specified Wheels n' Heels grating from Ohio Gratings, Inc., a durable, non-slip material that drains easily. The client preferred the aluminum over timber decking because of fire damage to other timber decks along the trail. Horizontal diagonal steel angle bracing located directly below the grating provides the lateral diaphragm action required to distribute all the imposed lateral load (seismic controlled over the wind) to the new steel pipe piles, which have a lateral resisting capacity of about 2 kips each.

The timber piles in the low deck platform were a failure risk. If they failed, they would collapse the concrete quay wall and damage the new structure. To avoid failure concerns, the design team provided supplemental vertical support for the quay wall from the new structure. The supports consist of vertical steel rods epoxy anchored into the wall below, which are suspended from double steel channels spanning between the main girders. To prevent horizontal movement of the quay wall, tie rods encased in protective ducts were placed through the existing concrete and extended to a buried steel sheet pile deadman located inboard of the existing fishing platform structure.

Pennoni's geotechnical team completed a comprehensive soil study consisting of Standard Penetration Test (SPT) borings to evaluate the subsurface conditions at the proposed fishing platform and lookout platform locations. A total of 17 borings were drilled: six from 35 to 45 ft deep for the fishing platform and three from 40 to 55 ft deep for the lookout platform. The remainder of the borings were advanced to a depth of 10 ft for site features such as retaining walls and pavements.

The borings performed closest to the river for the fishing platform were advanced by the pre-existing bulkhead and timber low deck. Below the low deck, erosion caused voided areas approximately 10 ft deep with river silts, which were observed to be soft and offered little to no resistance when setting the drilling rods for the split spoon sampling down to 30 ft below the existing grade. Similarly, the borings adjacent to the river performed for the lookout platform revealed soft soils extending from the existing grade to depths between 35 and 38 ft.

An intermediate sand and gravel layer with a thickness that varies from 5 to 10 ft sits between the river silt and decomposed mica schist bedrock. The further inland borings revealed similar conditions. However, the soft and compressible silt layer was generally 10 ft thick, and there were thicker layers of sand and gravel. The steel pipe piles could bite into the decomposed bedrock to maximize their lateral load-carrying capacity. They could also be driven through voids and not adversely impacted by unsupported sections

Grading called for 2 to 4 feet of new fills above the existing grade. However, the surcharge from the new fill would result in settlement of the deadman, which would induce bending stresses in the tieback anchors. Tieback anchors perform well in tension but poorly due to bending; therefore, to eliminate the settlement concern, a surcharge program was designed to limit post-construction differential settlements. The surcharge was laterally extended and placed at the retaining wall locations to minimize post-construction movement at the same locations. The contractor installed settlement plates and filled the site to its final grade elevation. The plates were monitored for five months, and settlements between 1 to 4 in. were observed at the plate locations.

A customized stainless steel railing with integral lighting was installed at the exterior sides of the fishing platform and overlook. All new steel supporting the structures was hot-dip galvanized for durability. The overlook and fishing platform opened in the fall of 2021, giving Schuylkill River Trail users a perch for skyline views of City Center and a spacious fishing spot in the middle of an urban area.

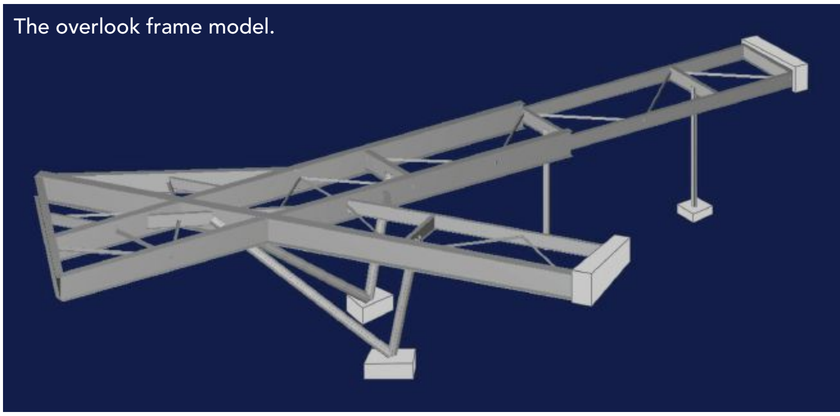
Owner
Schuylkill River Development Corporation

Architect and Structural Engineer
Pennoni Associates

General Contractor
Seravalli, Inc.

Fabricator
Independence Steel AISC ASSOCIATE


The overlook offers views of downtown Philadelphia.


The overlook frame model.


The overlook cantilevers over the river.


The overlook at fishing platform opened in 2021.

COOL Adaptive Reuse

Tricky Transfer

All photos courtesy of GMS Engineers and Architects

Two Bryant Park's new exterior.

THE COMMERCIAL BUILDING now known as Two Bryant Park in Midtown Manhattan has grown accustomed to adaptations and changes in its 118 years. Its third adjustment, a repositioning, is the most complex one yet—and a strong testament to adaptive reuse's feasibility.

Repositioning the building—formerly called 1100 Avenue of the Americas—included relocating its front entrance, prompting the address change. The project was completed in April 2022, and it revitalized the building's curtainwall, interior, and public plaza.

To understand the renovation approach, it's important to comprehend the building's history. The original building has six stories and a basement and was constructed in 1906 using cast-iron columns, steel beams, terra cotta floors, and masonry façade that helped resist heavy forces. In 1925, the building was enlarged to 15 stories, with steel framing and lateral bracing at the core.

A 1982 renovation strengthened the structure, infilled light wells, added elevators, and replaced the masonry façade with a glass and aluminum curtainwall. It also added braced frames in the north-south direction and stiffened connections to create moment frames in east-west direction.

The building's steel past made steel the only feasible material for the latest renovation. It provided the strength and fabrication and erection flexibility necessary to adapt to unknown field conditions. Steel could also easily accommodate the building's new energy-efficient curtain wall, be easily used to reinforce the roof level, and create an occupiable terrace amenity space for the office tenants.

The renovation moved the lobby to the middle of the building and removed the floor above the lobby to create a double-height space. The floor removal required extracting nine columns to create a passage through the building and adding transfer girders and columns to carry the 380,000-sq.-ft building's gravity loads to the foundation. An updated lateral load resisting system, new mechanical and electrical systems, and a new energy-efficient curtain wall replaced systems last updated in the mid-1980s.

Transferring columns is inherently complex, and pre-existing archaic materials like cast iron and terra cotta floors multiplies the complexity. The chosen approach was developed through careful study, several iterations of computer model sequencing, and rigorous documentation and communication of the proposed technique.

Temporary horizontal bracing was installed above the third floor, and 19 new columns between the foundation and the third floor were delivered 5 ft too tall to meet the temporary bracing level. The cast iron columns were strengthened using hollow structural sections (HSS) sliced in half and reconnected after surrounding the cast iron column. Special details at the floor levels allowed existing beams to remain connected to the cast iron columns, and the strengthening ensured the steel reinforcing could accommodate the loads if the cast iron cracked due to the jacking.

Removing the second-floor to create a double-height lobby effectively cut the building into two halves. To replace the stiffness lost and tie the two halves of the tower back together, the third-floor framing was replaced with new beams and horizontal bracing. The terra cotta floors on floors two and three were selectively removed to allow installation of new steel and maintain a working platform. The new third-floor framing included the necessary transfer girders surrounding the existing columns, allowing them to be cut out from below once the load was transferred via the jacking procedures.

Construction proceeded from foundations up to the third floor and from north to south, incorporating the new lateral system elements and new framing. The lateral system is composed of shear walls up to the first floor, braced frames along several north-south column lines, and moment frames in the east-west direction around the core. Foundations were carefully located and constructed around pre-existing grillages that remain in place, requiring strut and tie reinforcement.

New diaphragm steel on the third floor was connected after all columns were transferred and cut. Next, the second-floor diaphragm and remainder of columns below could be removed. Sequencing and design loads were shown on the contract documents, along with jacking requirements, a strain monitoring plan (four strain gauges per column to be transferred) and an optical monitoring plan capable of measuring movements to an accuracy of $1/100$ in.

The project design team at GMS Engineers and Architects worked with Wind Tunnel to quantify the wind forces on the main lateral load resisting system, to reduce the cladding pressures required for the new curtain wall, and to improve understanding of the wind hazards and the behavior of the lateral load resisting system. The wind tunnel data allowed the team to optimize a structure that had already evolved from 1906 to 1925 to 1982 to meet current codes and client expectations.

By relocating the lobby and main entry to 42nd Street, the building now faces Bryant Park and provides a through-block connection to Grace Plaza on 43rd Street. The improved access and additional retail at a busy intersection provides social and economic benefits. New storefronts, additional entrances, an occupiable roof terrace, and a davit-based window washing system were also part of the redevelopment.

Two Bryant Park and its three redevelopments are a testament to steel's resilience, long life, sustainability, and adaptability. The developer quickly leased all the office space to a single tenant, and retail tenants began their fit-outs shortly after. The project was designed and constructed on time, and its $120 million cost was within budget.

Reusing the building and improving its energy efficiency through state-of-the-art building systems and new curtain wall met the developer's sustainability goals, and the project is certified LEED Gold and 2022 WELL Health-Safety rated. ■

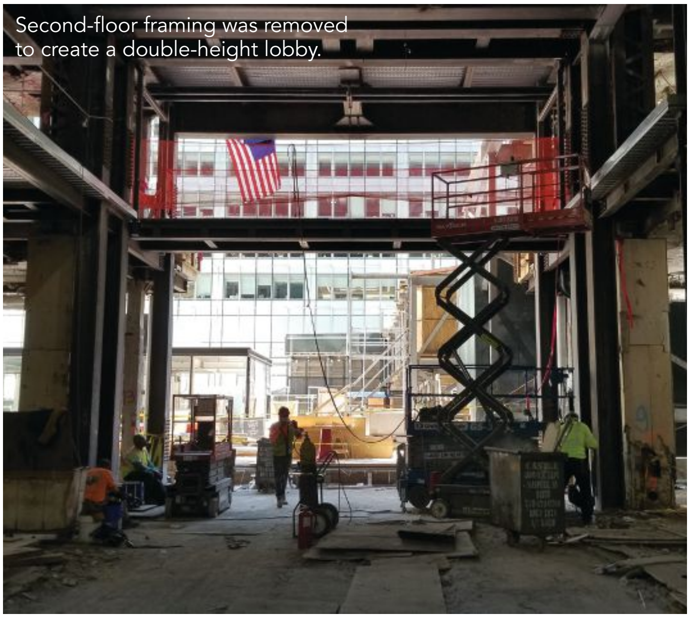
Owner
Brookfield Properties

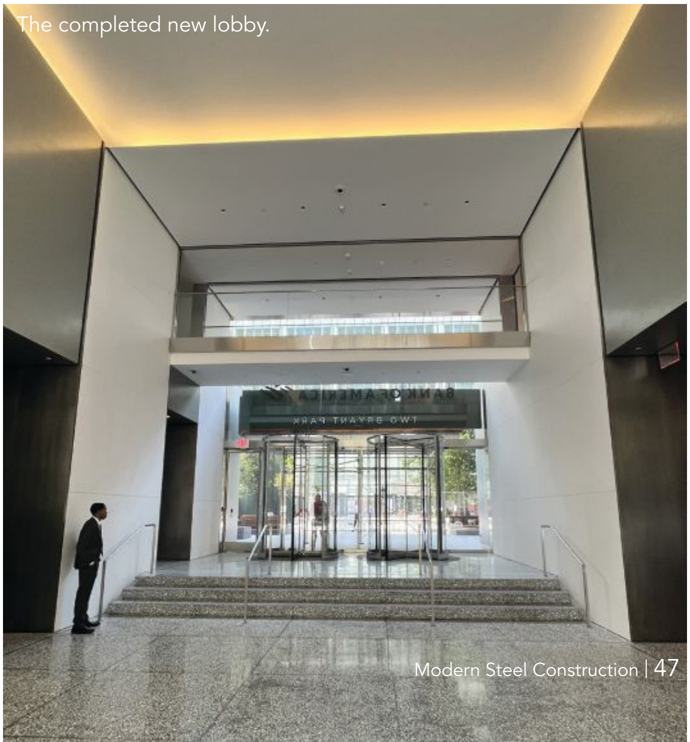
Architect
MdeAS Architects

Structural Engineer
Gilsanz Murray Steficek Engineers and Architects

Fabricator, Erector, and Detailer
Orange County IronWorks LLC AISC CERTIFIED FABRICATOR


Column jacking was a crucial part of transferring the load during the renovation.


Second-floor framing was removed to create a double-height lobby.


The completed new lobby.

Truss the Process

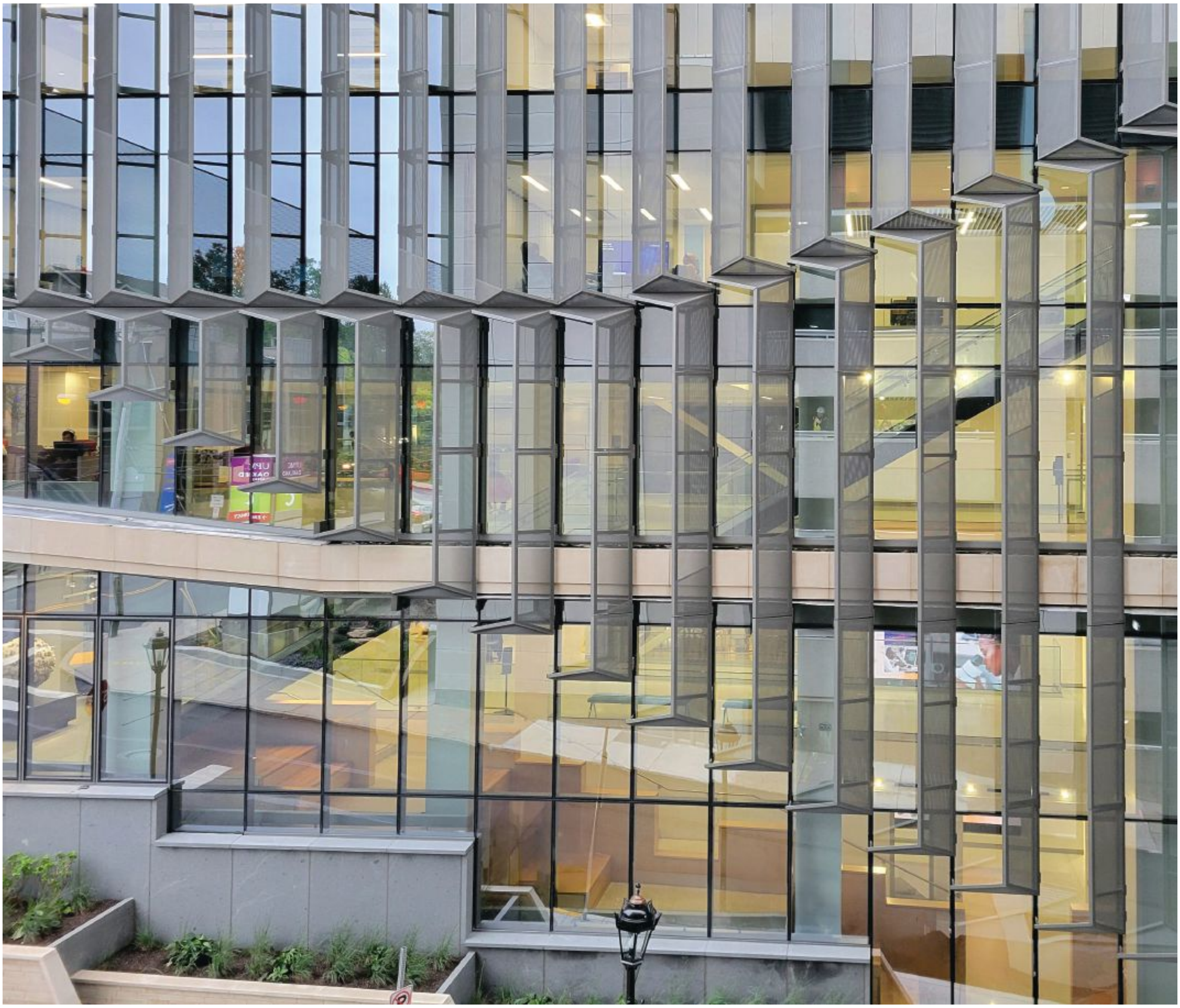
BY DEREK M. JOHNSON, PE
AND ALEC S. ZIMMER, PE

Structural steel facilitates complex geometry and dramatic cantilevers on a compact urban site.

All photos courtesy of SGH

opposite page: The Scaife Hall addition's cantilevered lecture hall.

below: The addition's Lothrop Street façade.



ALAN MAGEE SCAIFE HALL has housed the University of Pittsburgh School of Medicine since it was constructed in 1956 and has undergone several renovations and modifications since then. By 2020, though, its lecture and teaching spaces were becoming less conducive to modern medical education, and smaller-scale renovations wouldn't address the issue completely. The university understood the facilities needed to be modernized and upgraded, and it embarked on a bold project that replaced the building's west wing with a new addition.

The west wing addition is situated on the corner of Lothrop and Terrace streets, within a dense urban campus, and the UPMC Presbyterian Hospital flanks its southern end. The site slopes steeply in the north-south direction, with the north entrance at Level 4 and the south entrance at Level 2M—a grade change of nearly 24 ft over 160 ft along Lothrop Street.

The 111,000-sq. ft west wing addition houses classrooms, laboratories, a 600-seat lecture hall, a gross anatomy lab, the medical library, and collaborative learning spaces for 150 students. A monumental stair adjacent to the five-story Lothrop Street curtain wall links Levels 2M and 7 to the Level 4 entrance at Terrace Street. The building is crowned with two large mechanical floors required to meet the modern MEP demands of the addition and serve portions of the original 1956 building.

Integrating a new structure and an existing building imposes numerous challenges, one of the most critical being matching the existing floor-to-floor heights. A combination of closely spaced columns and pre-modern MEP demands allowed the original building's story heights to be as short as 11 ft. In contrast, the addition's program dictates larger, highly irregular bay sizes with many cantilevers.

While a cast-in-place concrete flat plate system could have accommodated the short stories, structural steel more economically achieves the large bay sizes the program requires and, more importantly, provides adaptability to accommodate the School of Medicine's future needs. To meet the structural depth limitations imposed by the existing story height, the design team took advantage of composite action and camber. The team carefully coordinated duct, pipe, and conduit routes with the steel framing to meet the program's stringent mechanical requirements and minimize the number of beam web penetrations.

Every floor level of the addition is unique.

The Basics

Every floor of the west wing addition is unique—no floor level resembles another. The structural layout is matched to the function of each of its 10 levels. The footprints of the floorplates change dramatically through the building's height. The lower levels are partially below grade and recessed into the hillside, resulting in slab-on-grade floors in some areas and elevated steel framing in others to match the sloping site.

While Levels 2, 2M, and 3 are nominally rectangular in footprint, the complexity of the structure becomes apparent at Level 4, the lowest floor entirely above grade. Here, the building's footprint becomes L-shaped, with a 50-ft-long cantilever overhanging UPMC Presbyterian Hospital's loading dock and below-grade generator vault.

Level 5's north end features an elevated student lounge supported on vertically kinked, cantilevered steel that rises above the main entrance on Terrace Street. The south end of Level 5 accommodates 6,000 sq. ft of column-free space for the team-based learning rooms.

The academic program in the southern half of Levels 6 and 7 requires a clear span of about 50 ft, but the building's short floor-to-floor heights limit beams to a maximum depth of about 24 in. The most effective solution for minimizing structural depth in these areas was to hang Levels 6 and 7 from Level 8, where the ceiling heights allowed for 70-in.-deep composite steel trusses. The chord and web members of the Level 8 trusses consist of W14 column sections oriented so their flanges align with the vertical plane of the truss, which allows the chords and web members to be connected through gusset plates bolted to the flanges.

The massing of the west wing addition also changes above Level 8, transitioning to an oval-shaped footprint for the lower and upper mechanical levels. To accommodate the mechanical levels' perimeter setbacks, a network of transfer girders on Level 8 supports the columns above.

While the building may display every known seismic irregularity that would be discouraged in a high seismic region, it fortunately bears on rock in an area with very low seismicity. The building is assigned to Seismic Design Category A, and wind loads exceed the seismic loads in both primary directions. The structure's lateral load-resisting system is a combination of braced frames around the elevator core, cantilever trusses along the building's southern flank, and moment frames at its north end. In total, the building's frame required approximately 1,346 tons of structural steel.

Trusses and Cantilevers

The building's defining structural elements are the two trusses that cantilever 50 ft over UPMC Presbyterian Hospital's generator vault and loading dock. The trusses contribute to the building's lateral-load-resisting system and support half the 600-seat sloped lecture hall and the six stories above it. Although the trusses posed an interesting structural challenge for the design team and made the building's program possible, architectural finishes conceal the structure.

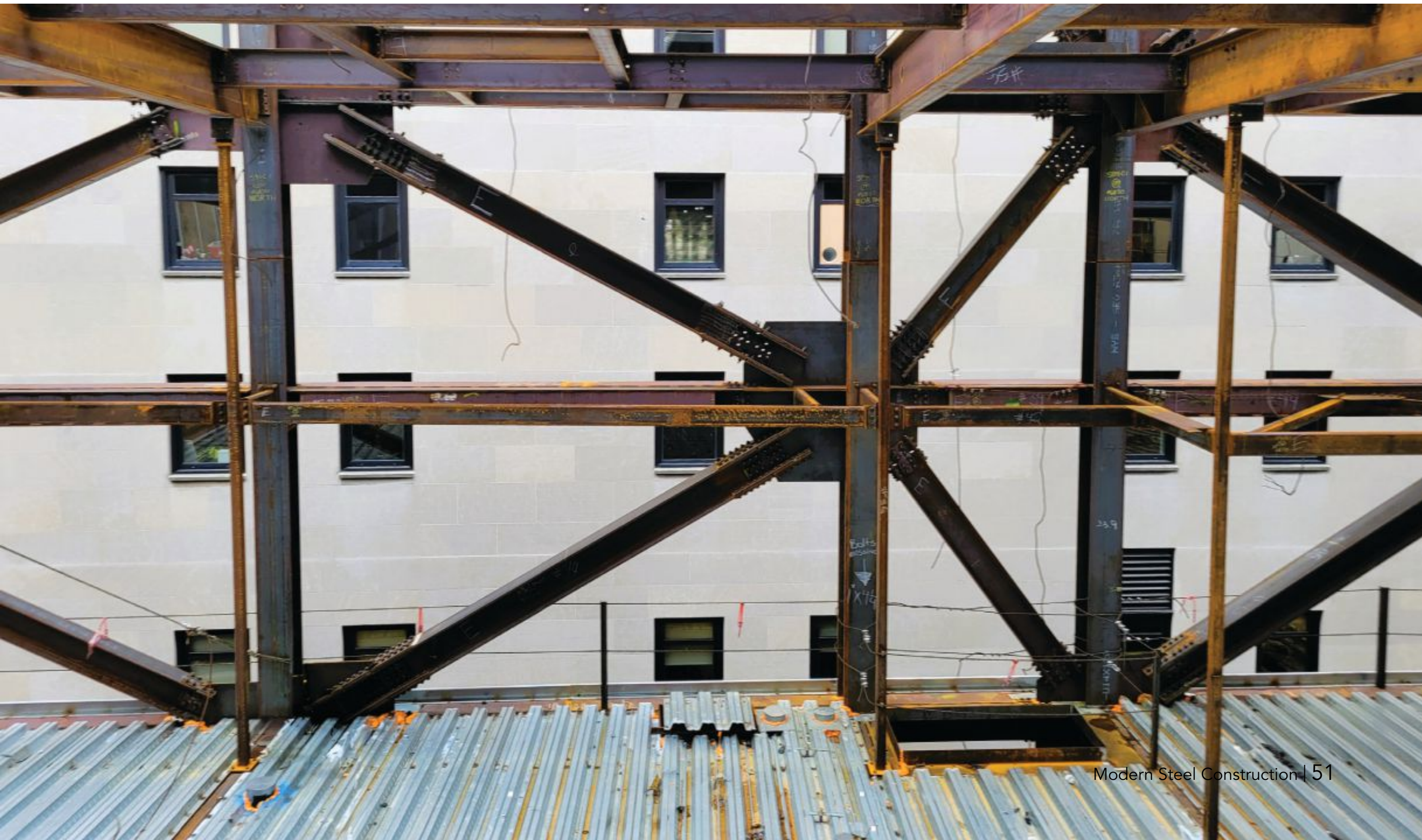
Achieving the imposing overhang while maintaining serviceability requirements was no simple feat. A vertical truss system appeared necessary, and fortunately, the architecture did not greatly restrict using vertical braces along the north and south edges of the lecture hall. The design team considered many brace configurations to optimize the system's efficiency and reduce the total steel tonnage—often resulting in larger, stiffer tension members and smaller compression members.

Column sizes in the trusses range from W14×53 near the top to W14×283 at the lowest level. The most heavily loaded diagonals are W14×132, while more lightly loaded diagonals are W14×53. Horizontal truss members—some of which support floor framing—vary from W14×53 to W14×90. Some of the horizontal members are boxed with steel plates to resist out-of-plane wind loads.

While the construction documents delegated the connection design to the structural steel fabricator, the design team provided enveloped design forces for the braces and horizontal members on the drawings. Determining the axial member loads in the trusses was critical. If the analysis does not accurately consider the in-plane stiffness of the diaphragm, the designer may underestimate the axial load in the beams. That's especially true for buildings modeled with rigid diaphragms in which the slab elements are disproportionately stiff compared to the steel beams to which they're connected.

above: Hanging Levels 6 and 7 from Level 8's 70-in.-deep composite steel trusses allowed those levels to satisfy the program's shallow ceiling requirements.

below: Column sizes in the vertical cantilever trusses range from W14×53 near the top to W14×283 at the lowest level.



Unless the designer explicitly considers the axial forces in the slab design, the designer should decouple the slab-to-beam interaction to ensure the horizontal truss members receive the appropriate axial demands. That process is particularly important when calculating transfer forces (also called pass-through forces) across the columns. By leaning on the tools and methods described in AISC Design Guide 29: *Vertical Bracing Connections – Analysis and Design* (download for free at **aisc.org/ dg**), the design team analyzed each beam-to-column connection to establish its respective transfer force.

Taking advantage of a stiff structural system is not the only way to mitigate deflections. To minimize the impact of vertical deflections caused by the structure's self-weight on floor levelness and façade joints, the design team cambered the cantilevered portions of the trusses. In addition, the design team worked closely with the steel fabricator, erector, and construction manager to coordinate the construction sequencing and minimize excessive deflections and safety risks.

The design anticipated that the erector would use temporary columns at four locations, two at each cantilever. The erector used hydraulic jacks to control the release of axial load in the temporary columns. Since the system relies on the back span beyond the cantilever and the composite action of steel members, the design team coordinated with the erector to wait until all concrete floor diaphragms up to Level 8 (the lower mechanical floor) had reached their design compressive strength before removing the temporary columns. The result was a maximum deflection of less than $^3/_8$ in. after the erector removed the shoring.

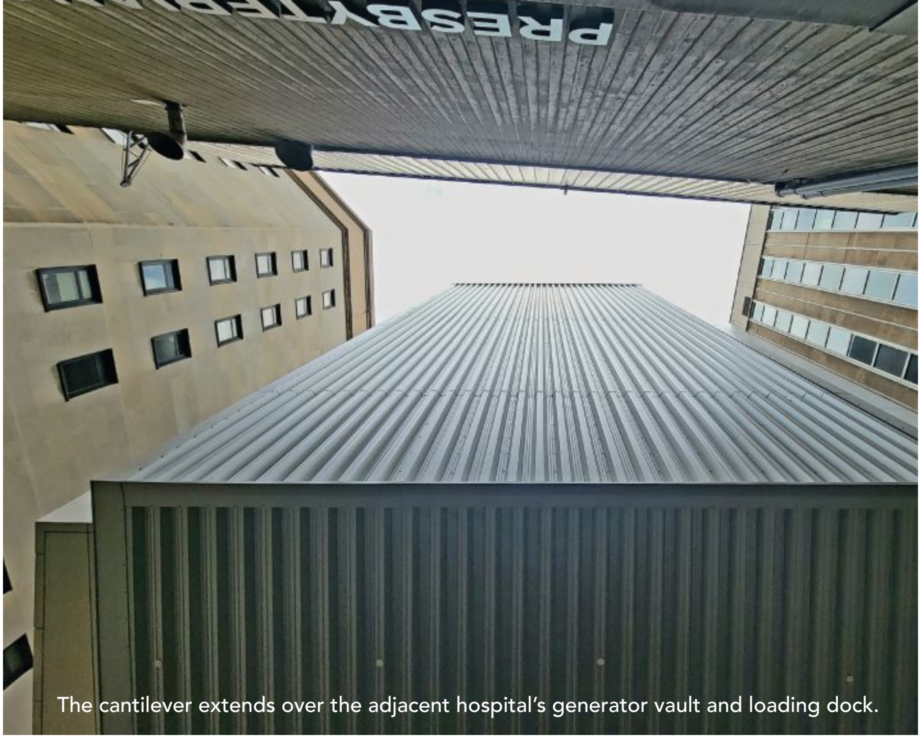
Inspiring Façade

Truss complexity aside, supporting the various façade elements was the most challenging component of the design. The west wing addition's exterior features full-height limestone panels, stepped canopies supporting stone and glass, and a multi-story curtain wall with perforated aluminum sunshades.

Supporting the full-height stone panels required vertical and horizontal field adjustability, achieved using erection bolts in long-slotted holes with field welds after setting the shelf angle positions. The design team used stainless steel for all elements outside the insulation plane because of its lower thermal conductivity and durability. The stainless steel shelf angle was bolted to carbon steel elements inboard of the insulation plane. Following the guidance in AISC Design Guide 22: *Façade Attachments to Steel-Framed Buildings* (**aisc.org/ dg**), the designers carefully considered the vertical and torsional deflections of the steel beams supporting the stone.

above: Temporary columns supported the 50-ft cantilever during steel erection.

below: The west wing addition opened in 2023.



The cantilever extends over the adjacent hospital's generator vault and loading dock.

The canopies wrapping the north and west façades at Levels 5 and 8 posed additional engineering challenges. They project 5 ft from the primary perimeter framing, supporting a limestone fascia and a narrow roof. In many cases, the cantilevered steel framing supporting the canopies is lower than the adjacent floor framing, requiring either a significant cope or an underslung beam, depending on the level. At Level 8, the cantilevered steel supports not only the canopy, but also a stone parapet and stud framing above and below, adding to the complexity.

Since its opening in 2023, the Scaife Hall west wing addition has become a landmark on the University of Pittsburgh's evolving campus, showcasing a blend of architectural and engineering ingenuity. Its adaptable steel frame will allow the university to support advances in medical education for decades to come.

Owner
University of Pittsburgh School of Medicine

Construction Manager
PJ Dick

Architect of Record
MCF Architecture

Associate Architects
PAYETTE
Moshier Studio

Structural Engineer
Simpson Gumpertz & Heger Inc.

Steel Fabricator and Detailer
Amthor Steel Co.

Derek M. Johnson (**dmjohnson@sgh.com**) is a consulting engineer and **Alec S. Zimmer** (**aszimmer@sgh.com**) is an associate principal, both at Simpson Gumpertz & Heger.

Replacing a century-old rail bridge in a rural area required a creative and complex construction plan that steel made easier.

Remote Replacement

BY TEMPLE OVERMAN, PE

All photos courtesy of Trey Cambern via HNTB

IN SOME BRIDGE PROJECTS, planning the construction process is just as challenging as designing the bridge itself. Replacing a 110-year-old railway river crossing in rural Washington was not elementary engineering, but determining how to access the site, deliver materials, and erect steel proved no less challenging.

Steel proved to be the only material that made construction on the site viable.

Nestled in the tranquil heart of the Pacific Northwest, the BNSF Bridge 81.4 in Vader, Wash., stands as a testament to engineering excellence and a commitment to connectivity. The bridge crosses the Cowlitz River and is a critical commercial and freight rail infrastructure link in a remote area. It carries 40 to 50 trains per day, and by 2020, the original steel bridge built in 1910 had reached the end of its service life. Replacing it meant planning a remote construction project, and the challenges the site presented were as much of a consideration in material selection as the length and engineering considerations.

Despite its remote setting, the bridge is a vital conduit for passenger and freight rail traffic in the BNSF rail network. Trains did not have a nearby alternate north-south route during construction, and the high daily train volume meant any train stoppage due to construction would impact railroad operations. The bridge was replaced in an offline alignment to reduce the impact on train traffic.

Design Phase

The original 663-ft bridge consisted of a 250-ft-long pin-connected truss for the main span with 102-ft-long deck plate girder spans for the approaches. It was constructed in 1910 and did not meet current load demands in the AREMA *Manual for Railway Engineering*.

BNSF elected to replace the bridge to provide a more reliable and lower maintenance structure. Furthermore, the condition of the existing substructure did not provide sufficient strength to resist seismic events and the current AREMA

More than 40 trains per day cross the BNSF bridge over the Cowlitz River near Vader, Wash.

The bridge is just under 1,100 ft long.

longitudinal forces. The project team used steel to achieve a larger opening over the Cowlitz River comprised of four long deck plate girder spans ranging from 143 ft to 207 ft long. The spans are supported on large-diameter drilled shafts with rock sockets and box beam approach spans supported on H-piles. The total length is just under 1,100 ft.

Early in the process, designer and construction manager HNTB considered using prestressed concrete beams for the main spans of the bridge. To limit the environmental impacts, the design team used longer spans to reduce the number of foundations in the river. However, the bridge's 207-ft and 143-ft main spans needed to be transported in pieces. Steel proved to be the preferred choice of material for the main spans during the design phase due to the bridge's remote location.

Steel offered a constructability advantage because it can be spliced in the field, allowing smaller sections to be transported to the site and assembled on location. Those smaller sections were within size restrictions for highway transportation and easier to haul on the steep access road through a rock quarry adjacent to the bridge.

Vader frequently experiences extreme weather, including heavy rains and winds. Weathering steel requires low maintenance compared to a painted structure and provides long-term corrosion protection, making it the best option for withstanding the climate.

Dynamic analysis was thorough. Sensors were placed on the new 207-ft, 6-in. steel spans, and movement was monitored during various train speeds. The sensors' findings and the condition state index (CSi) model concluded that the steel spans were stable and showed no excitation as a train moved across the bridge. The sensors and model also confirmed that the maximum live load deflection was less than the Cooper E80 live load deflection used during design.

The replacement bridge exploration began in 2013, even though the construction phase didn't start until 2020. The planning process included coordinating the diverse interests of various stakeholders, which mandated close coordination with local permitting agencies and an outstanding commitment to respecting the rights and interests of the local indigenous tribes whose ancestral lands were near the project.

Early and consistent engagement with tribal representatives by the project team allowed for a comprehensive understanding of potential impacts on tribal land, fishing access, and historical and cultural resources. The collaborative approach adopted during this phase sets a commendable standard for bridge projects in sensitive environments.

The bridge's spans range from 143 to 207 ft long.

The spans are supported on large-diameter drilled shafts with rock sockets and box beam approach spans supported on H-piles.

A lengthy substructure information gathering process preceded drilling sockets for the H-piles.

The bridge opened to train traffic in March 2023.

Access Efforts

Transporting the spans in smaller segments made the shipment from Vigor's steel fabrication shop in Vancouver, Wash., possible. The site, though, was not immediately next to a road. The contractor, Hamilton Construction, built a temporary road through a rock quarry to provide access to the bridge, which was pivotal in the safe and efficient transportation of the steel components. A temporary work bridge facilitated the precise placement of steel girders and foundations. The team chose steel for the work bridge due to its durability and reusability for future projects.

Once the work bridge was complete, construction involved individually erecting the components onto temporary foundations positioned in the river, followed by splicing to seamlessly integrate the structure.

The remote jobsite location initially made gathering substructure and geotechnical information challenging. The location is virtually inaccessible without rail, and it was not possible to drill borings in the river without suitable access, which was unavailable until the temporary work bridge was built. But design began long before work bridge construction, which meant HNTB's team had to make assumptions about foundation design for the piers in the river.

The team based its assumptions on information available from borings drilled along the banks of the river, which showed the basalt layers drastically varied across the length of the bridge. On the south end of the bridge, the rock was several hundred feet deep; on the north end, rock was visible at the ground surface. The team planned to get additional confirmation borings when the work bridge was installed to confirm rock elevations at the proposed pier locations.

However, once team members had site access, they found that the basalt rock layer was higher than expected on the north

end. The team rapidly made foundation design changes in coordination with Hamilton Construction.

Among those changes was placing rock sockets into the basalt rock layer. Boulders were prevalent at the site, making it difficult to drive H-piles. To work around the boulders, the design and contracting teams drilled sockets for the H-piles, using steel H-piles for the approach foundations and steel casings for the drilled shafts that supported the main span.

The new bridge opened to train traffic in March 2023. Passenger rail services rely on it to connect communities and provide an eco-friendly alternative to road travel. Meanwhile, the bridge plays an essential role in the transportation of goods, contributing to the economic vitality of the entire region. ■

Owner
BNSF Railway

General Contractor
Hamilton Construction

Design and Construction Manager
HNTB Corporation

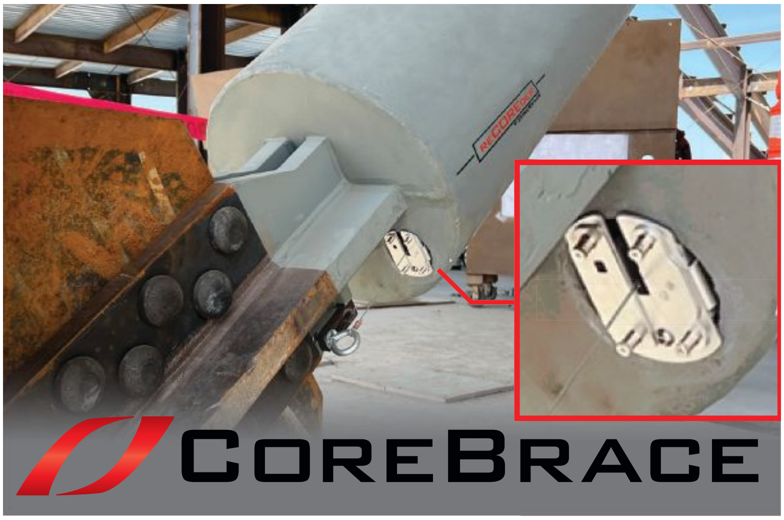
Steel Fabricator and Detailer
Vigor AISC CERTIFIED FABRICATOR

Temple Overman is a construction project manager at HNTB.

This month's new products include a monitoring system to gauge remaining capacity in braces, viscous dampers, and a new multi-process welder.

CoreBrace ReCOREder

The CoreBrace reCOREder monitoring system provides invaluable information for a building owner after a seismic event. The data quickly acquired by a reCOREder during an event aid in a post-earthquake residual capacity assessment of instrumented buckling restrained braces (BRBs) to expedite the building evaluation assessment. The data also allow owners and engineers to make a decision quickly on the safety of re-occupying the building after a seismic event. The state-of-the-art reCOREder can be used in new construction or added to existing structures and are fully adjustable for various project conditions. To learn more, visit **www.corebrace.com/products**.



Enidine Viscous Dampers

For more than 25 years, Enidine has been an expert in providing protection for critical infrastructure and a trusted source for customer-focused and value-driven solutions to the infrastructure protection industry. The company's viscous dampers are well-suited for large displacement and large load applications such as bridges, buildings, and other large structures.

Viscous dampers features:

- In-line, self-contained, maintenance-free
- Diagonal or chevron brace mounts
- Forces up to 2,000 kips
- Strokes up to 60 in.
- Alpha .1 to 2.0, lock up

Learn more at **www.enidine.com/infrastructure**.

Miller Electric XMT 400 ArcReach

Miller Electric Mfg. LLC has launched the Miller XMT 400 ArcReach multi-process welder. As the lightest and smallest machine in its amperage class, the XMT 400 ArcReach helps fleet managers and operators tackle more jobs efficiently with just one welder.

The XMT 400's ArcReach technology provides remote control of the power source without a control cord. That saves operators from walking back and forth to the welder, which keeps the operator welding at the weld joint. Additionally, dedicated weld processes like gas-shielded flux-cored, TIG, self-shielded flux-cored, stick and gouge allow operators to dial in whatever they need.

Among the XMT 400 ArcReach capabilities:

- Auto-line technology: Allows the welder to be plugged in to any primary voltage power from 208V to 575V single- or three-phase and engine-driven generators.
- Higher duty cycle: A rating of 400 amps at 60% duty cycle achieves bigger and longer welds with a larger diameter wire and rods.
- Cable length compensation: Provides consistent weld quality by automatically compensating for voltage drop over long weld cables.
- Gouging capability: Gives operators the ability to gouge with a dedicated gouge that allows them to upsize a carbon diameter, rated for $\frac{5}{16}$ in.
- Front panel lockout: Disables the power source interface when connected to an ArcReach accessory to avoid inadvertent changes to the power source.

Visit **www.millerwelds.com** for more information.

EDUCATION FOUNDATION

AISC Board to Match $50,000 in Year-End Gifts to Education Foundation

For the first time in AISC's history, the AISC Board of Directors has authorized a match of up to $50,000 in donations to the AISC Education Foundation through the end of the year.

To provide support for as many scholarship and grant applications as possible, the Foundation will use every gift—coupled with its dollar-for-dollar match from the board—where it will make the most impact rather than restricting funds to one program.

"I am deeply thankful for the support of AISC's Board of Directors and the generous $50,000 in matching funds they have pledged to the Education Foundation to propel our fundraising efforts this year," said director of foundation programs Maria Mnookin. "I am confident that our donors will take advantage of this doubling effect so we can further expand our reach and provide more life-changing support to the future change-makers of our incredible industry."

It has been a busy, exciting year for the Foundation and an especially meaningful one for Foundation-supported students, educators, and young professionals. This academic year, AISC administered scholarships totaling $357,250 to undergraduate and master's-level students—a feat that would not have been possible without support from donors.

Throughout 2024, gifts to the Foundation also brought students to industry events across the country, from task committee meetings and faculty-led field trips to NASCC: The Steel Conference and beyond—covering every cost for them.

Your donation, which will be doubled if you give by December 31, will not only give the invaluable gift of industry exposure; it will make its way to the person or program it will benefit most, whether that's a student needing financial support to attend college, a faculty member planning an educational field trip, or our next cohort of Innovation Scholars traveling to AISC's Chicago headquarters.

If you would like to contribute and see your gift doubled, please make checks payable to the AISC Education Foundation and mail them to 130 E. Randolph St., Chicago, IL, 60601—or donate online at **aisc.org/giving**. Checks must be postmarked by December 31 to qualify for matching funds. Gifts are 100% tax deductible, and every penny supports students, educators, and education programs.

AISC

Nucor's Zach Moon Joins AISC Board of Directors

Nucor Corporation vice president and general manager Zach Moon has been elected to the AISC Board of Directors.

"We're pleased to have Zach as the newest member of our Board of Directors," said AISC President Charles J. Carter, SE, PE, PhD. "His background and experience make him a great fit, and he'll enhance the breadth and depth of the group."

Moon started at Nucor in 1998 as a caster inspector and has been with the company since then. In that time, he's worked his way up through supervisory and managerial positions at both Nucor-Yamato Steel in Blytheville, Ark., and Nucor Steel Berkeley in South Carolina. He also spent two years as vice president and general manager of California Steel Industries.

Moon also serves on the Los Angeles Branch Board of Directors for the Federal Reserve Bank of San Francisco. He holds a bachelor of science in business administration from Missouri Baptist University and a master's in operations management from the University of Arkansas Fayetteville.

ARCHITECTURE

AISC Launches Online Architecture Center

For more than a century, designers working on steel buildings have relied on the design guidance and specifications created by AISC. But with more than 30,000 pages of technical data available, it's difficult for architects to quickly and conveniently access the information they need to complete their designs. AISC's new Architecture Center is designed to cater to the unique needs of architects by curating and making our resources more accessible.

AISC aims to spark creativity to inspire great designers. The Architecture Center offers architects the resources to save time and money, reduce risk, and achieve their project goals. We're devoted to providing fellow architects with accurate and concise resources to make designing with steel easier, faster, and more cost-effective, no matter the project type.

Your voice is vital to present and future dialogues, and we want to help you achieve your vision for tomorrow. We love showing the world what you do. Through design competitions like the Forge Prize and the Innovative Design in Engineering and Architecture with Structural Steel (IDEAS²) Awards, we partner with distinguished juries to honor the incredible design teams behind the one-of-a-kind structures changing America's cityscapes.

Visit **aisc.org/architecture** for an in-depth look at all of our tools and resources for architects, or go right to the (human) source at **architects@aisc.org**.

AWARDS

Bridge Fabrication Expert Selected for 2025 Higgins Award

Ronnie Medlock, PE, of High Steel Structures LLC has received AISC's 2025 T.R. Higgins Lectureship Award for his contributions to the Federal Highway Administration's *Bridge Welding Reference Manual*.

"Simply put, Ronnie Medlock is an icon within the bridge fabrication and construction world, and the impact of his contributions to the standards that guide the industry cannot be overstated," said AISC vice president of engineering and research Christopher H. Raebel, SE, PE, PhD. "He has changed the way bridges are fabricated and constructed in the U.S."

"Ronnie Medlock is without a doubt the face of steel bridge fabrication, period," wrote Robert J. Connor, PE, PhD, the Purdue University Jack and Kay Hockema Professor in Civil Engineering and the director of CAI and S-BRITE.

Connor underscored Medlock's crucial role in developing first the Texas Steel Quality Council (an interdisciplinary group that became the model collaborative innovation) and then what is now the AASHTO/NSBA Steel Bridge Collaboration.

"It is not an overstatement to say that the documents he has led the development of and shepherded through publication touch every aspect of steel bridge design, fabrication, and erection," Connor wrote.

Medlock will give the final keynote address at the 2025 NASCC: The Steel Conference, where he will also receive the $15,000 honorarium. He will also present his work on request throughout the country over the course of the year. Organizations interested in hosting a T.R. Higgins Lecture in 2025 can contact AISC senior director of education Christina Harber at **harber@aisc.org**.

Medlock is vice president of technical services at High Steel in Lancaster, Pa. He is responsible for quality control and for fabrication and inspection technology advancements at High Steel, which produces fabricated steel for steel railroad bridges and other types of steel bridges.

Prior to joining High Steel in 2006, Medlock worked for the Texas Department of Transportation, starting in 1988. Originally from El Paso, Texas, Medlock is a licensed professional engineer in Texas and earned bachelor's and master's degrees from the University of Texas at Austin. He received an AISC Lifetime Achievement Award in 2020.

The T.R. Higgins Lectureship Award recognizes an outstanding lecturer and author whose technical paper or papers, published during the eligibility period, are considered an outstanding contribution to the engineering literature on fabricated structural steel.

The award is named for Theodore R. Higgins, the former AISC director of engineering and research who was widely acclaimed for his many contributions to the advancement of engineering technology related to fabricated structural steel. The award honors Higgins for his innovative engineering, timely technical papers, and distinguished lectures.

The 2025 T.R. Higgins Lectureship Award jury awarded Medlock with the honor. The jury's members are Jordan Jarrett (Colorado State University), Mike Kempfert (CSD Structural Engineers), Brett Manning (Schuff Steel Company), Jason McCormick (University of Michigan), Thomas Murphy (Modjeski & Masters, Inc.), and Brian Volpe (Cives Steel Company).

People & Companies

Adam MacDonald, previously of AGT Robotics, is now the vice president of operations at AISC full-member fabricator **Steelworks of the Carolinas** in Powdersville, S.C. His focus is to streamline workflows and create a lean manufacturing environment that attracts and retains talent. Steelworks aims to leverage data and integrate advanced technologies that align with the skills and experiences of the incoming workforce while fostering a culture of individual growth.

Steelworks is also committed to using the AISC Fabricator Education Training Program (learn more at **aisc.org/fabricatortraining**) to educate and empower its employees to reach their full potential. It also offers a graduate program that gives recent college graduates a one-year rotational experience through its manufacturing process, helping them find office roles where they can excel.

Qnect was awarded a $1.9 million grant by the U.S. Army to develop a groundbreaking cost vs. carbon analysis for steel buildings. This tool will empower structural engineers to evaluate the trade-offs between construction costs and carbon emissions during the design phase of projects. Integrating sustainable decision-making into Qnect's **Autodesk Revit** aims to drive the Army's initiatives towards reducing embodied carbon using sustainable building materials and technologies.

Acrow recently installed a modular steel bridge in Wellfleet, Mass., to provide access during the Herring River Restoration Project, Massachusetts' largest estuary repair.

The single-lane Acrow 700XS solution chosen has four spans and is 320 ft long. The curb-to-curb width of the structure is 13 ft, 7 in. with a 5-ft pedestrian footwalk cantilevered on one side. The bridge has TL-3 guide rails with 2-in. asphalt overlay on the deck.

GALVANIZING

AGA Releases Updated Design Poster For Fabricators

The American Galvanizers Association (AGA) recently released an update to its *Fabrication & Design Details for Galvanizing* poster, a resource targeted to steel fabricators. The poster—available for free to fabricators upon request—offers essential guidelines and considerations for designing steel products to be hot-dip galvanized (HDG), ensuring optimal quality and corrosion protection.

Hot-dip galvanizing is a highly effective method for protecting steel from corrosion, extending the life and durability of steel structures. However, achieving the best results with HDG steel requires certain design considerations. The poster simplifies the HDG process, providing clear and comprehensive guidance to ensure that steel products are properly prepared for galvanizing. It's 21 in. by 25 in. and can easily be hung on a shop or office wall, making it an essential quick reference guide for fabrication shops, engineering offices, and other specifiers of HDG steel.

Hot-dip galvanizing involves immersing steel in a bath of molten zinc, which forms a metallurgically bonded coating that protects the steel from corrosion. The process is known for its durability, low maintenance, and cost-effectiveness. To maximize these benefits, it's crucial to incorporate specific design details into steel products before galvanizing.

Communication between the architect, engineer, fabricator, and galvanizer is a key component in promoting a high-quality galvanized coating. Opening the lines of communication early in the design and fabrication process can eliminate potential costly pitfalls later in the project. Understanding the various aspects of the galvanizing process and how they can affect the coating and finished product's outcome will help ensure everyone's expectations are met and may optimize turnaround time and minimize costs.

Key Design Considerations

The updated design poster emphasizes several key design considerations that are essential for the hot-dip galvanizing process. These include:

1. Venting and Drainage: Proper venting and drainage are critical to ensure that molten zinc can flow freely into and out of hollow structures, preventing defects and ensuring a uniform coating. The poster provides detailed diagrams and explanations on the optimal placement of vent and drain holes for various assemblies, including tube and pipe fabrications, enclosed and semi-enclosed fabrications, end plates and stiffeners, gussets, and webs. If needed or desired, holes can be plugged after galvanizing.

2. Welded Assemblies: For welded assemblies, it is important to use the appropriate welding techniques and materials to ensure that the entire structure can be uniformly galvanized. Using uncoated electrodes is recommended to avoid flux residues, and anti-spatter sprays should be avoided. Seal welding is preferred wherever possible to avoid trapping cleaning solutions, which may be converted to steam at galvanizing temperatures and affect coating quality around the weld. If skip-welding is used, a gap between the steel surfaces of at least $3/32$ in. must be maintained to allow for cleaning solutions and the molten zinc to penetrate and coat all areas. For steel assemblies with overlapped surfaces greater than 16 sq. in., additional vent holes may be required and are outlined on the poster.

3. Identification Markings: It is important to consider the identification of parts throughout the fabrication and galvanizing process. Parts are marked to ensure they are not lost during processing and to identify the project, customer, and assembly in which they belong. Temporary identification in the form of detachable metal tags (metal barcode tags are also available) or water-soluble paint or markers is commonplace. Permanent identification recommendations include stamping, weld beads, and deep stencil marking. Oil-based paint markers or spray paint are not recommended, because they may interfere with the formation of the galvanized coating and may not be visible after coating application.

4. Threaded Parts: Nuts, bolts, or studs to be galvanized should be sent to the galvanizer disassembled. Bolts are completely galvanized, but internal threads on nuts must be tapped oversize after galvanizing to accommodate the increased diameter. To remove excess bolt zinc, small parts are centrifuged in special equipment when removed from the galvanizing bath.

Other Design and Handling Considerations

Designing steel products with handling in mind can prevent damage during galvanizing and provide a higher-quality coating. These design factors include incorporating lifting points and considering the overall size and weight of the assembly. Where possible, lifting points should be provided at the quarter points for symmetrical parts to avoid chain or wire marks on the sides of the parts. Holes may be included in the design to allow the galvanizer to hang materials from overhead fixtures. Permanent or removable bracing may be required on some designs to provide stability during the thermal expansion and contraction cycle.

Request a Free Copy

Steel fabricators and engineers can request a free copy of the poster by visiting the AGA's website at **www.galvanizeit.org/designposter**. Once requested, the AGA will mail a copy.

Embrace the benefits of hot-dip galvanizing with confidence by incorporating the expert guidance provided in the updated design poster. Ensure your steel products are designed for optimal performance and longevity and join the many fabricators who rely on this essential resource to achieve superior results.

SSBC

2025 SSBC Rules and Guidelines Released

Officials want to add a bridge over the Skunk River Water Trail to better connect the park's walking trails without disturbing a mid-river haven for wildlife, and they've turned to students at colleges and universities to make it happen.

The situation is hypothetical, but the ingenuity and skill are real. AISC and the American Society of Civil Engineers have released the rules for this year's Student Steel Bridge Competition (SSBC), which gives the next generation of structural and civil engineers a challenge like this one every year.

To solve it, students must design a bridge, analyze and optimize their design, then fabricate it in steel so it can be constructed and tested in real life. They will go head-to-head with other teams at 20 regional competitions in spring 2025, and the top contenders will meet at Iowa State University for the National Finals May 30–31, 2025.

"Every single year, students tell us that it was the best part of their college experience, and many go on to design bridges as practicing engineers," said AISC senior director of education Christina Harber, SE, PE. "The Student Steel Bridge Competition is one of our flagship programs—and frankly, a personal favorite for a lot of the staff, many of whom participated when they were students."

The University of Florida currently holds the crown after taking the top prize at the 2024 National Finals, their fourth straight first-place finish.

Student Steel Bridge Competition

The 2025 Challenge

The Skunk River Water Trail winds lazily through a peaceful corner of Story County, Iowa. It's a popular spot for paddlers to enjoy a day on the water, admiring the wildflowers, aquatic wildlife, and birds like Eastern Bluebirds and Wood Ducks.

The River Trail is part of Peterson Park, and officials want to add a bridge over the River Trail to better connect the park's walking trails. This won't be the first bridge over the Skunk River; the remains of abutments on its shores tell the story of a long history of human activity. Local Native Americans used it as a hunting and fishing ground; more recently, it has powered a mill.

This will, however, be the first bridge designed to enhance its surroundings, with particular emphasis on protecting the local flora and fauna.

Officials have chosen a site with a sandbar that forms an island in the middle of (and parallel to) the river. The island, which is a haven for local wildlife, is strictly off-limits for people or construction. Skunk County Conservation will, however, allow barges in the river during construction (at added cost).

Story County Conservation requests that designers use steel to take full advantage of the material's design versatility, ease of prefabrication, ability to erect it rapidly, superior strength-to-weight ratio, durability, and high level of recycled content.

SAFETY AWARDS

AISC Accepting Annual Safety Awards Submissions

To a customer, visiting an unsafe shop or jobsite is like visiting a messy house. Even if safety is not an explicit requirement, a business can leave a bad impression with its absence. The opposite is also true—a business can give a good impression by showing a shop or jobsite with a commendable level of safety.

It's reasonable to think that a company managing safety is also successfully managing production and quality. Safety is also increasingly becoming an important part of many customers' selection criteria. AISC wants to encourage you to achieve that commendable record of safety and show off your clean house with an AISC Safety Award.

AISC member steel fabricators and erectors are eligible and encouraged to submit their company's safety record for AISC's annual Safety Awards. The awards, given in the Fabricator Category and Erector Category, include the Honor Award (DART=0)—AISC's top safety award, presented for a perfect safety record of no disabling injuries—the Merit Award (0<DART≤1), and Commendation Award (1<DART≤2).

"AISC's annual Safety Awards program recognizes excellent records of safety performance, and we commend these facilities for their effective accident prevention programs," said Tom Schlafly, AISC's director of safety. "Periodic recognition of safety in the workplace has been demonstrated to provide worker incentive and a reminder of the importance of safe practices."

"Owners and clients pay attention to these awards," said Kathleen Dobson, safety director for Hillsdale Fabricators/J.S. Alberici Construction. "They want to know that a fabricator or erector is proud of their safety records—and just as important, it means a lot to the workforce to see that their efforts are recognized by an industry leader like AISC."

The Safety Awards program is open to all AISC full-member fabricators and erector associate members. An email with submission information will be sent to the Primary, Secondary and Safety Contacts of eligible members in mid-December. All applications are due to AISC by the end of January, when OSHA Form 300A is required to be posted. For more information about the program, as well as safety resources available for the fabricated and erected structural steel industry, please visit **aisc.org/safety** or send an email to **safety@aisc.org**.

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Connected Healthcare

ON A BEAUTIFUL, cloudless mid-October day, 30 people filled the conference room at AISC member fabricator SteelFab's headquarters in Charlotte, N.C., to learn about a new steel-framed 12-story bed tower on the vast Atrium Health Carolinas Medical Center campus a few miles away.

The group included members of the Structural Engineering Association of North Carolina (SEA of NC) and staff from project structural engineer Walter P Moore, SidePlate, and SteelFab. Following a brief presentation, the group made its way to the jobsite, where three tower cranes were at work erecting steel members.

The event was part of this year's SteelDays, AISC's annual celebration of the domestic structural steel industry where AEC professionals, students, educators, and the general public get a rare opportunity to explore the dynamic U.S. structural steel industry and witness its vital role in constructing our nation's buildings and bridges.

With a planned opening in 2027—and a planned topping out by the end of this year—the project incorporates 10,500 tons of structural steel and nearly 900 SidePlate joints. (The SidePlate system serves as a design optimization process that can reduce overall tonnage, minimize the number of needed connections, and accelerate erection times). At the site, attendees were able to get an up-close look at the steel framing and connections and talk with structural design team members.

This was just one of dozens of SteelDays events taking place across the country in October. To learn more about this annual educational promotional, and celebratory event, check out **aisc.org/steeldays**. And keep an eye out for a SteelDays roundup in the January 2025 issue.