# Modern Steel Construction

August 2023

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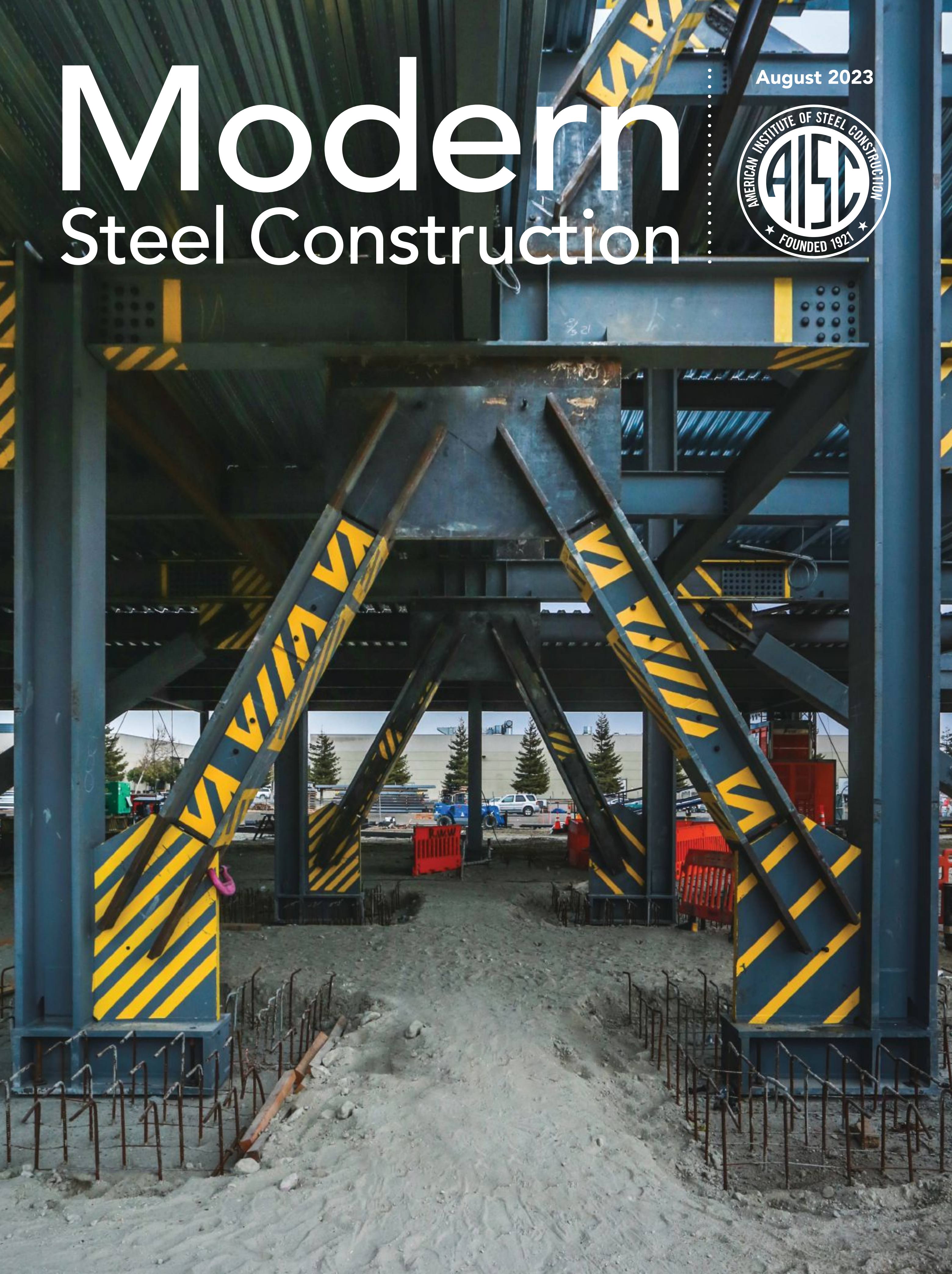


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# Modern Steel Construction

August 2023


## in every issue



## features



## columns



**ON THE COVER:** The seismic-resistance system for a new Bay Area medical office building totally rocks, p. 26. (Photo: Tipping Structural Engineers)

MODERN STEEL CONSTRUCTION (Volume 63, Number 8) 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.



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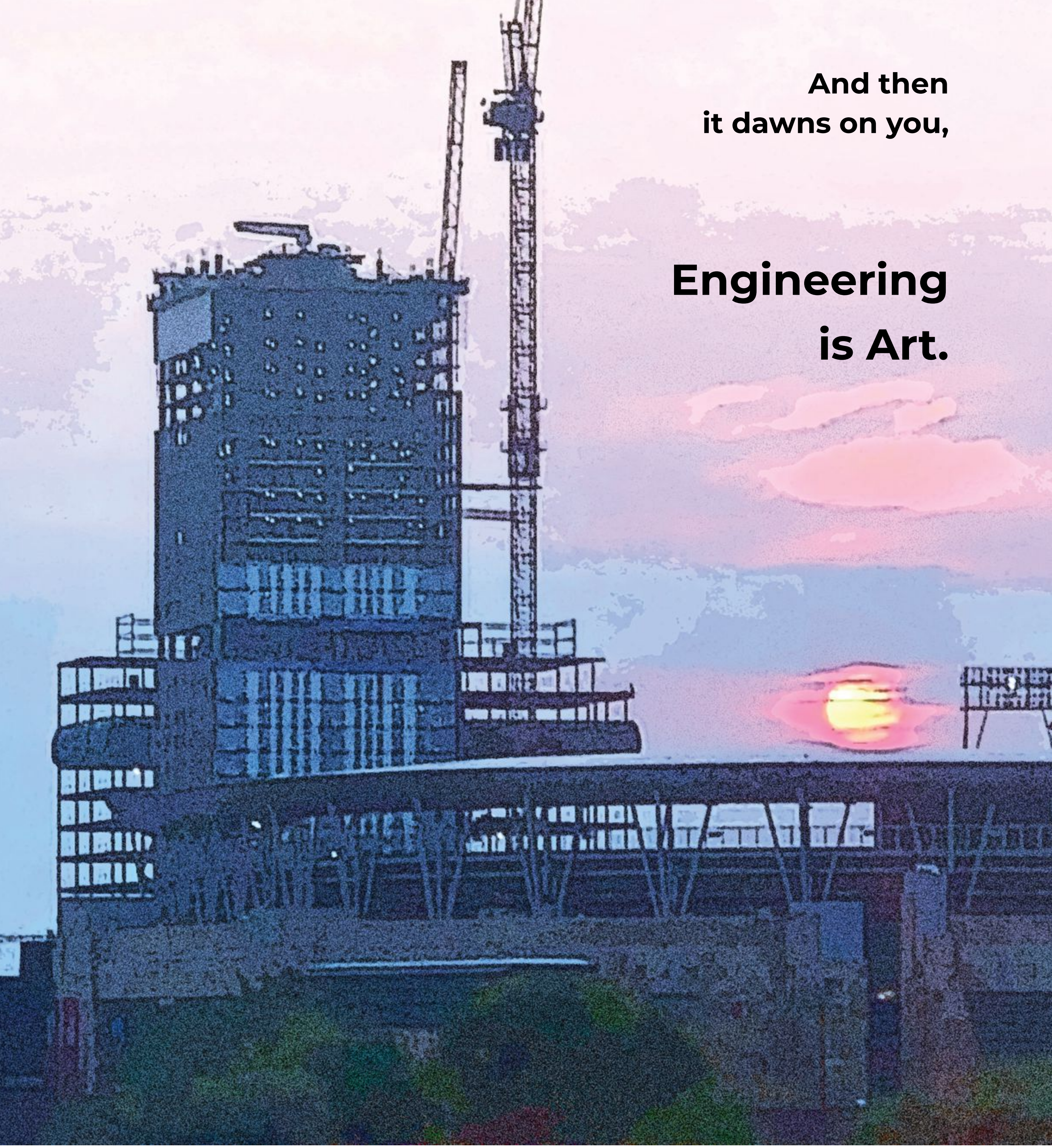
And then
it dawns on you,
Engineering
is Art.

# editor's note

Why am I standing next to the Cat in the Hat? Because there's a statue of him, along with his creator, Theodor "Dr. Seuss" Geisel, on the University of California San Diego (UCSD) campus.

(Geisel spent much of his life in San Diego, and the school's main library was posthumously renamed after him.)

Why was I at UCSD? Because I was serving as a construction judge for the 2023 Student Steel Bridge Competition.

Why was I doing this? Well, why not?

I've been to multiple SSBC National Finals in the past, once even as a lateral load judge, but never as a construction judge. Not only was it a fun, engaging experience, but it was also really neat to see the variety of strategies that teams employed to build their bridges.

The competition hosted 43 teams, all of which performed their builds in one of five lanes. I was assigned to Lane 1, along with fellow AISC staff member Maureen Steffey and three other volunteer judges from the structural engineering world. For each of the nine bridges that came through our lane, we performed a checklist of pre-build items, including ensuring that all bridge components were magnetic, all components and tools could fit in the 4-in. by 6-in. by 3-ft, 6-in. box (which I dubbed "The Box of Judgment"), all bolts were the proper length, and no holes on the components were threaded.

During the bridge portion, we called out every time a team member dropped a nut, bolt, or member, stepped in the river, or wandered out of bounds and any time a bridge footing slid off a pier (there were lots of exclamations of "Footing!" and "Nut in the water!"). Once a bridge was built, we made sure the dimensions and clearance were within the acceptable range, the top of the deck was level, all fasteners were in place and tightened, and all connections had no more than two faying surfaces. Any violations were reflected as penalties, which translated to additional time and cost for a team's bridge.

During each build, the next team staged its materials and tools at each end of the lane and awaited my fair but strict judgment, er, their chance to put their bridge together as quickly and with as few penalties as possible. Once a bridge was completed and inspected, it moved on to the next station—lateral loading—and the next team prepared for its build.

Each lane included a "river" in the middle, and every team began its build on both sides, often meeting in the middle over the river. As long as a build method didn't violate the rules, it was acceptable, and it was fascinating to see how the teams came up with different methods. One team constructed and then "unfolded" both sides of its superstructure over the river, multiple teams used temporary, movable hangers to hold their components in place and slide them over the river, and other teams welded hooks to certain members to temporarily hold other members or tools.

And when it came to those teams that used the tried and true method of reaching components across the river to each other, they typically employed the tallest team members with the longest wingspan—some of them stretching so far that they were within an inch or so of simply falling into the river. Oh, and that's another rule. A team member could stretch as far as they could without putting a hand, foot, or knee in the water, and they could support themself on a bridge, but they had to keep one foot on the floor (like playing pool).

In addition, it's important to note that there is a cost associated with each builder (more builders = a more expensive bridge). Teams not only have to figure out their construction method but also how many builders they want to use (the maximum is six, but some teams were able to build their bridges with only two).

If you want to read more about and see some photos of the competition, check out "Third Time's the Charm" on page 56. You can also see even more photos in the Project Extras section at **www.modernsteel.com**.

Congratulations to all of this year's participants and winners!

Geoff Weisenberger
Editor and Publisher


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If you've ever asked yourself "Why?" about something related to structural steel design or construction, *Modern Steel*'s monthly Steel Interchange is for you!

Send your questions or comments to **solutions@aisc.org**.

## Fillet Weld Available Strength Determination

**Section J2.4(b) in the 2016 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) permits users to take the maximum available strength as determined from Equations J2-6a and J2-6b. Why is the maximum value taken rather than the minimum value?**

$$R_n = R_{nwl} + R_{nwt} \quad \text{(J2-6a)}$$
$$R_n = 0.85R_{nwl} + 1.5R_{nwt} \quad \text{(J2-6b)}$$

**$R_{nwl}$ and $R_{nwt}$ as defined in Figure 1**

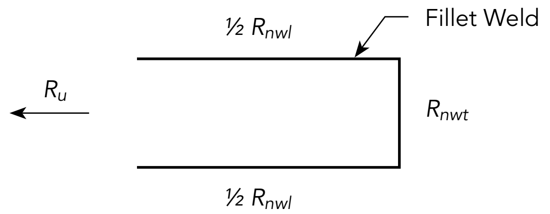


Fig. 1. Fillet weld pattern.

This provision can be traced back to the 2005 *Specification* in its current form, and its roots stem from both historical design practice and work contributing to the instantaneous center of rotation method for weld design.

Equation J2-6b best represents the nominal capacity of the weld group and satisfies deformation compatibility between the longitudinal and transverse welds. Figure 8-5 of the AISC *Steel Construction Manual* shows the normalized deformation versus normalized load for welds loaded at different angles. When, at the same normalized weld deformation, a weld loaded at 90°—i.e., perpendicular to its length—reaches its ultimate strength at a normalized load of 1.5, a weld loaded at 0°—i.e., parallel to its length—reaches a normalized load of about 0.85. This is reflected in the factors in Equation J2-6b.

Equation J2-6a simply sums the capacity of each weld segment without considering directional increases or decreases. This represents the historical practice of weld design prior to the consideration of weld deformation. There has been no evidence that this practice has produced unsafe designs, so it remains an option for design when using the 2016 *Specification*. However, in the 2022 AISC *Specification*, this method has been placed in a User Note, and only the equation using deformation compatibility (Eq. J2-6b above) is presented, thus implying a preferred methodology.

The two equations result in the same capacity when equal-length longitudinal welds are 1.67 times the transverse weld length assuming the weld size is consistent. Thus, Eq. J2-6b will be most beneficial when the transverse weld is longer than the longitudinal welds. Even when the ratio of longitudinal to transverse weld length is high—say, five to one—the results of the two equations differ by only 10%. The Committee on Specifications is aware of this and has concluded that both models are sufficient for design.

*Christopher H. Raebel, SE, PE, PhD*

## Extended Single-Plate Connection Weld Size Uncertainty

**I am designing an extended single plate for a beam-to-girder connection using the recommended design procedure included in Part 10 of the 15th Edition AISC *Manual*. I have calculated a required plate thickness of 1 in., which would require a ⅝-in. fillet weld size based on the ⅝ × thickness of plate criteria on page 10-87 of the *Manual*. The web thickness of the girder is 0.35 in. thick. Is using a much larger fillet weld size on a thinner girder web, such as described above, permitted?**

Yes. The AISC *Specification* does not prohibit you from placing a ⅝-in. fillet weld on a girder web that is 0.35 in. thick. The ⅝ × thickness of the single plate recommendation exists to address concerns with ductility, not strength. The AISC *Engineering Journal* article "Design of Unstiffened Extended Single-Plate Shear Connections" (second quarter 2009) provides further discussion about the overall intent.

*Larry Muir, PE*

## Calculating the A/P Ratio for HSS Fire Protection

**How are the *A/P* values for rectangular and square hollow structural sections (HSS) in Table 1-46 of AISC Design Guide 19: *Fire Resistance of Structural Steel Framing* determined? I have calculated values that are close, but I would like to learn how to get values that match those shown in those tables.**

The *A/P* ratio provides a measure of the relationship between the steel section's area and its perimeter. As indicated in Section VI.7 in Design Guide 19, this ratio can be used to evaluate HSS members. The rate of temperature change in a steel member is tied to the

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

member's mass and surface area that is exposed to elevated temperatures, where a larger $A/P$ ratio would result in a slower "rate of temperature change."

The values that are provided in Table 1-46 (see Figure 2) can be calculated using the equations and procedure in the example below:

Variables:

$H$ = long side of HSS (20 in. for an HSS20×12×5⁄8, for example)

$B$ = short side of HSS (12 in. for an HSS20×12×5⁄8, for example)

$r = 2 \times t_{des}$ (2 × 0.581 in. = 1.162 in. for an HSS20×12×5⁄8, where $t_{des}$ is taken from Table 1-12 in the 15th Edition AISC *Steel Construction Manual*).

Case A

$P = 2(H - 2r) + (B - 2r) + 2\pi r$

$P$ = 2(20 in. – 2 × 1.16 in.) + (12 in. – 2 × 1.16 in.) + (2π × 1.16 in.) = 52.3

$A/P$ = 35.0 in.²/52.3 in. = 0.669

Case B

$P = (H - 2r) + 2(B - 2r) + 2\pi r$

$P$ = (20 in. – 2 × 1.16 in.) + 2(12 in. – 2 × 1.16 in.) + (2π × 1.16 in.) = 44.3 in.

$A/P$ = 35.0 in.²/44.3 in. = 0.790

Case C

$P = 2(H - 2r) + 2(B - 2r) + 2\pi r$

$P$ = 2(20 in. – 2 × 1.16 in.) + 2(12 in. – 2 × 1.16 in.) + (2π × 1.16 in.) = 62.0 in.

$A/P$ = 35.0 in.²/62.0 in. = 0.564

Case A: Shape perimeter minus one short surface.
Case B: Shape perimeter minus one long surface.
Case C: Shape perimeter.

You can also use the surface area values provided in Table 1-12 of the AISC *Manual* to verify the Case C values. A surface area of 5.17ft²/ft is given for an HSS20×12×5⁄8. Multiply this by 12 to get the perimeter in inches, which equals 62.04 in. Use this to calculate an $A/P$ = 35.0 in.²/62.0 in. = 0.564. The equations above can be added to AISC's Shapes Database v15.0 (the database is available at **aisc.org/manual15**) to quickly calculate all of these values for every rectangular and square HSS shape size.

*Carlo Lini, PE*

**Table 1-46.**
**Rectangular (and Square) HSS**
**Surface and Box Perimeters, Area-to-Perimeter Ratios, and Surface Areas**

| Shape | Case A | | | Case B | | | Case C | | |
|---|---|---|---|---|---|---|---|---|---|
| | Perimeter, in. | A/P Ratio | Surf. Area, ft²/ft | Perimeter, in. | A/P Ratio | Surf. Area, ft²/ft | Perimeter, in. | A/P Ratio | Surf. Area, ft²/ft |
| HSS20×12×5/8 | 52.3 | 0.668 | 4.36 | 44.3 | 0.789 | 3.69 | 62.0 | 0.564 | 5.17 |
| ×1/2 | 52.3 | 0.542 | 4.36 | 44.3 | 0.640 | 3.69 | 62.4 | 0.454 | 5.20 |
| ×3/8 | 52.2 | 0.413 | 4.35 | 44.2 | 0.487 | 3.68 | 62.8 | 0.343 | 5.23 |
| ×5/16 | 52.2 | 0.346 | 4.35 | 44.2 | 0.409 | 3.68 | 63.0 | 0.287 | 5.25 |

Fig. 2. Portion of Table 1-46 from AISC Design Guide 19.

**Chris Raebel** (raebel@aisc.org) is vice president of engineering and research and **Carlo Lini** (lini@aisc.org) is director of the Steel Solution Center, both with AISC. **Larry Muir** is a consultant to AISC.

# steel quiz

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**.

We all like new things, right? How about when we combine something new with something old? This month's Steel Quiz focuses on a new AISC specification that's all about the seismic evaluation and retrofit of existing buildings. You can find clues in this new document, *Seismic Provisions for Evaluation and Retrofit of Existing Structural Steel Buildings* (ANSI/AISC 342-22), which is available for free at **aisc.org/specifications**. You can also learn more about the specification's development in the May 2023 SteelWise article "Seismic Shift" (**www.modernsteel.com**).

1 Existing structural steel buildings previously subjected to ground shaking are required to be inspected by a registered design professional to determine the extent of damage to existing components when the peak ground acceleration has been equal to or greater than which value?

**a.** 0.1 g  **c.** 0.2 g
**b.** 0.15 g  **d.** 0.25 g

2 Which of the following factors is used in *Seismic Provisions for Evaluation and Retrofit* to reduce the component strength based on the level of knowledge obtained for individual components during data collection?

**a.** Component capacity modification factor, $m$
**b.** Knowledge factor, $\kappa$
**c.** Ratio of the expected yield stress to the specified minimum yield stress, $R_y$
**d.** Strain-hardening adjustment factor, $\omega$

3 **True or False:** Default material properties are given in *Seismic Provisions for Evaluation and Retrofit* for historic structural metals.

4 Which of the following technical improvements are included in this first edition of *Seismic Provisions for Evaluation and Retrofit* from ASCE 41-17?

**a.** Provisions for making new welds to existing steel
**b.** Provisions for column splices
**c.** Improved provisions for fully restrained and partially restrained moment frame connections
**d.** All of the above

5 **True or False:** Component-related requirements for members and connections are generally spread throughout the various chapters on structural systems (moment frames and braced frames) in AISC *Seismic Provisions for Evaluation and Retrofit*.

6 **True or False:** Framing that includes existing components of cast iron, wrought iron, or both is not permitted to participate in resisting seismic forces under any circumstance.

TURN TO PAGE 14 FOR ANSWERS

STEEL SOLUTIONS CENTER

1 **c.** 0.2 g. Section A4.2a of *Seismic Provisions for Evaluation and Retrofit* states: "Existing buildings that have been subjected to ground shaking with a peak acceleration of 0.2g or greater, where g is the acceleration of gravity equal to 32.2 ft/s$^2$ (9.81 m/s$^2$), shall be inspected by a registered design professional to determine the extent of damage to existing components." Additional guidance and explanation behind this requirement are provided in the Commentary.

2 **b.** Knowledge factor, κ. The knowledge factor is defined in the Glossary of *Seismic Provisions for Evaluation and Retrofit* as the "factor used to reduce component strength based on the level of knowledge obtained for individual components during data collection" and refers the user to ASCE/SEI 41 Section 6.2.4 to determine the knowledge factor. As stated in *Seismic Provisions for Evaluation and Retrofit*, Section B1.1, "The data collected, condition assessment, and materials testing shall be used to determine the knowledge factor."

3 **True.** Section A5.2 includes default material properties that may be used where permitted by Section 6.2 of ASCE 41 or AISC 342. See the Commentary to Section A5 of AISC 342 for additional background on historic metals from different time periods.

4 **d.** All of the above. This first edition of *Seismic Provisions for Evaluation and Retrofit* includes several technical improvements from ASCE 41-17. Some of the significant improvements are added provisions for making new welds to existing steels, provisions for column splices are incorporated, and provisions for fully restrained and partially restrained moment frame connections are improved.

5 **False.** Component-related requirements for members and connections are extracted from the sections on structural systems (moment frames and braced frames) into one chapter, Chapter C. As stated in the May 2023 "Seismic Shift" SteelWise article, "This format minimizes cross-referencing of components between systems and maximizes flexibility for modeling and evaluating the entire structural system that resists seismic forces and deformations (this was done in recognition of the fact that existing buildings may not contain a 'designated' seismic force-resisting system)."

6 **False.** As stated in Chapter I of *Seismic Provisions for Evaluation and Retrofit*, "Framing that includes existing components of cast iron, wrought iron, or both is permitted to participate in resisting seismic forces in combination with concrete or masonry walls." This limitation arises from the unreliable nature of historical cast iron in tension and the lesser tensile properties of historical wrought iron in its through-thickness direction. See the Commentary to Chapter I for more information.

# Student Steel Bridge Competition

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- Funding for competition host schools
- Travel assistance for teams in the rebuilding process to attend the national finals to learn and boost their performance next year

Each year, the competition continues to grow, and we can't thank you enough for your commitment to fostering the next generation of creative and practical engineers.

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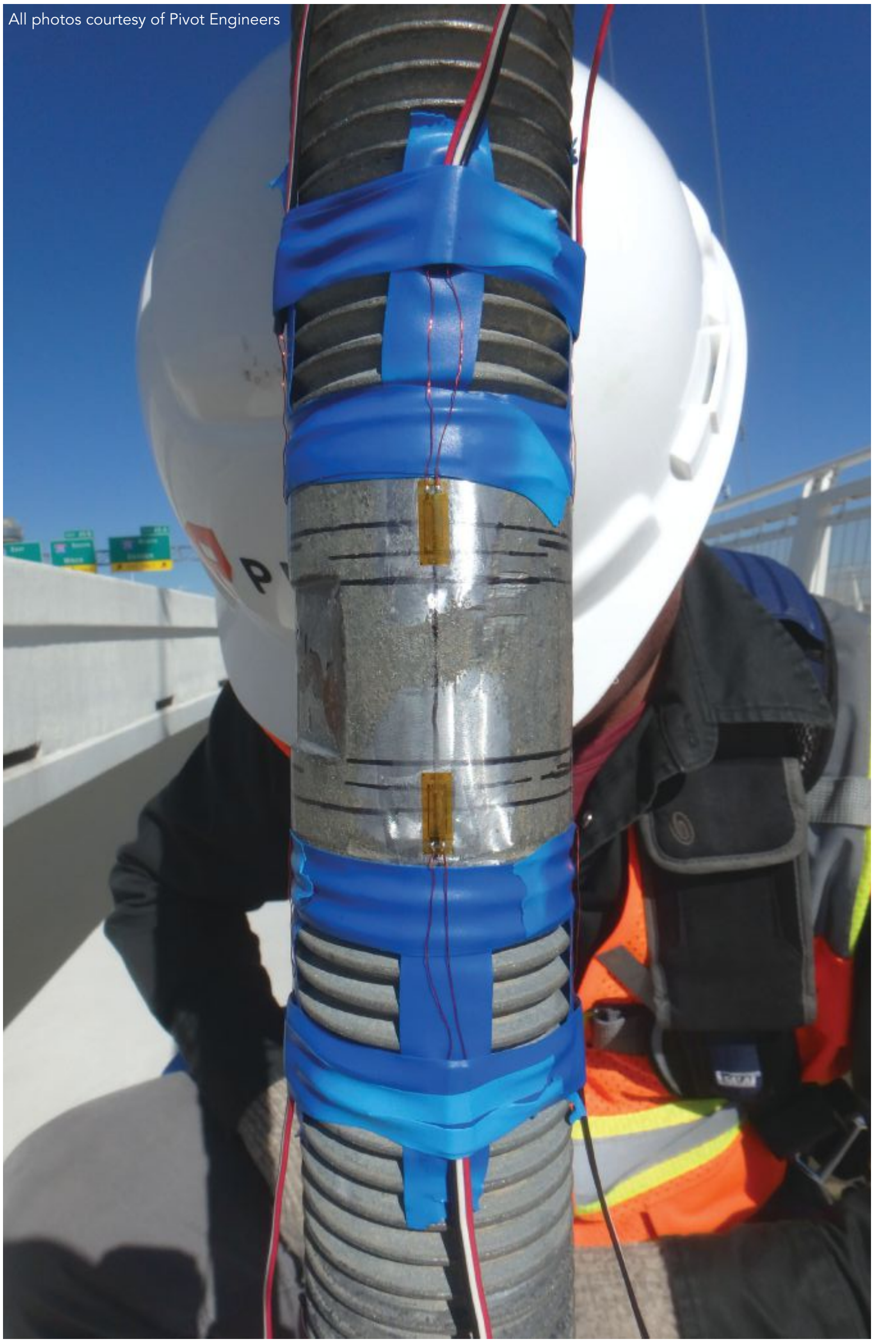
# To Test or Not To Test?

BY KERRY KREITMAN, PE, PHD

Here are a few important considerations when structural testing is required on a project.

All photos courtesy of Pivot Engineers



Strain gauges were installed on the bridge cable anchorages prior to testing to determine stresses induced by vibrations and static loading.

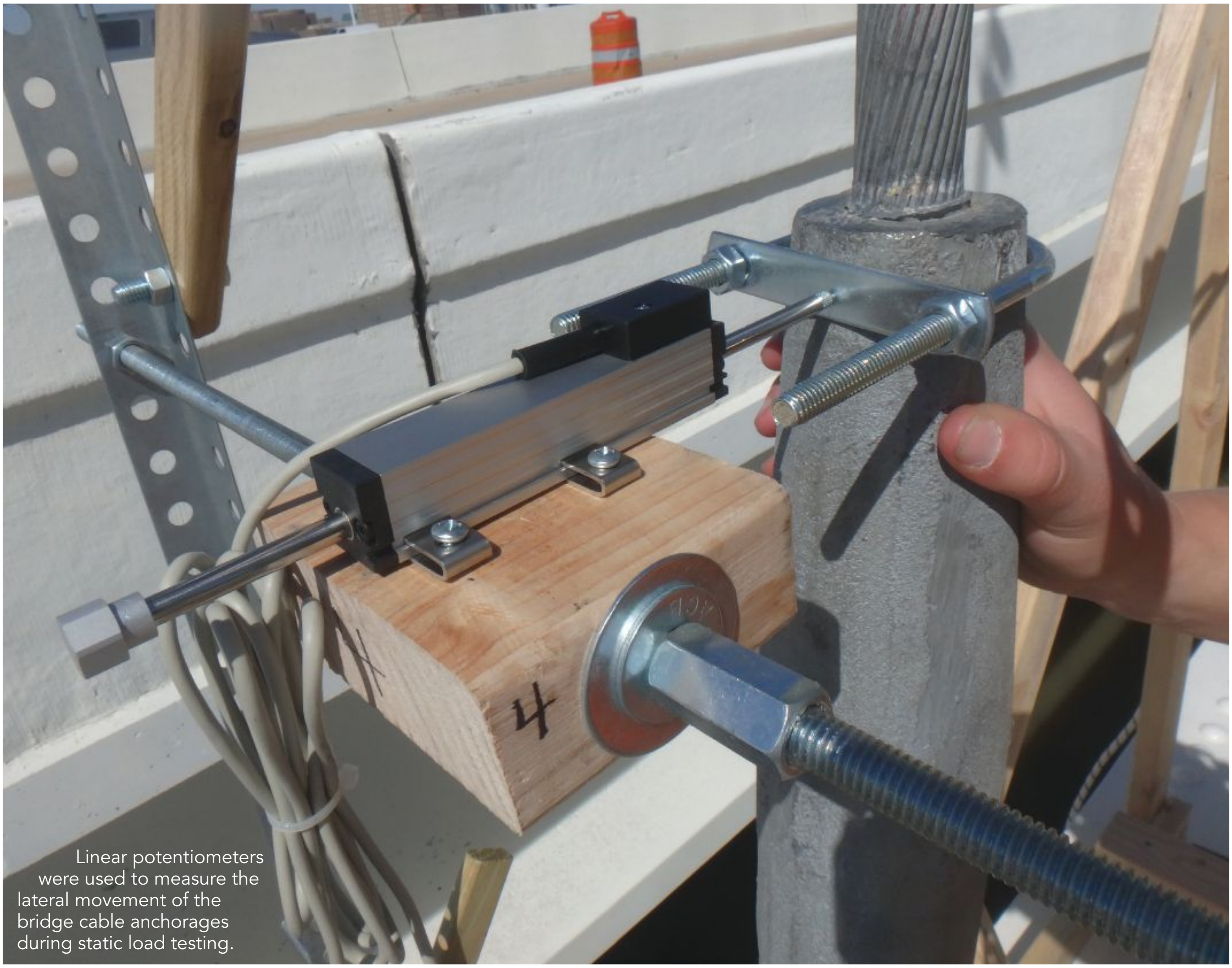
**IT'S GOOD** practice to expect the unexpected.

Although we design our structures using carefully studied factors of safety to protect against the uncertain and the unknown, it is inevitable that unexpected conditions will arise from time to time that call into question the safety or performance of a structure.

Some examples of such conditions include unanticipated or larger-than-anticipated loading, material deterioration, construction or design errors, and generally unexpected behavior. As engineers, understanding and solving problems like these often requires us to "sharpen our pencils" and perform a structural evaluation that extends beyond our typical design practice.

In many cases, this means refining an analytical model to add more detail or to remove simplifying assumptions. However, analytical methods are not always able to estimate structural behavior with the necessary level of accuracy for an engineer to confidently provide practical and economical solutions when such problems arise. In these situations, physical testing of a steel structure or a component of a structure may be able to provide valuable information regarding the structural behavior, reduce risk and uncertainty, and lead to potential structural solutions while also minimizing the use of simplifying analytical assumptions. Some examples where testing can help in solving problems that may arise with steel structures include:

- Collecting data to better understand the structural behavior and to aid in developing repair or maintenance recommendations
- Performing validation testing of one or multiple proposed repair methods prior to implementing the repair on a large scale
- Evaluating the performance of a structure built out of conformance with design documents, or observed to be exhibiting distress, to potentially prevent or minimize costly repairs



Linear potentiometers were used to measure the lateral movement of the bridge cable anchorages during static load testing.

Structural testing consists of measuring the response of a structure or component to an applied load. Generally, structural testing is performed in one of two manners: in-situ testing of a structure or a portion of a structure or testing of structural components in a test setup external to the structure. Loads can be applied using hydraulic rams, heavy objects (such as bricks or concrete blocks), ballast (such as sand or water), or other means. Alternatively, the "load" may be ambient, such as traffic, temperature, or wind. Commonly measured structural responses include deflections, rotations, strains, and accelerations. These responses can be measured using many different types of analog and digital instruments.

Structural testing can be used to assist in evaluating any type of steel structure regarding all types of potential problems. Although each structure and problem will have its own unique challenges, two instances in which testing was implemented to evaluate steel structures—one related to the vibration of bridge cables and the other related to hollow structural section (HSS) splice connections—are described here to illustrate some potential applications for testing steel structures.

## Bridge Cable Vibrations

In the first scenario, which involved the construction of a steel arch bridge, wind-induced vibrations of the vertical hanger cables led to fatigue concerns for the cable anchorages. Given these vibrations, the long-term fatigue performance of the cable anchorages was evaluated by performing a reliability analysis. In this type of analysis, the reliability is calculated by representing both the fatigue stresses (demands) and fatigue capacities probabilistically. The resulting reliability is then compared to standard industry-accepted values to evaluate the long-term fatigue performance.

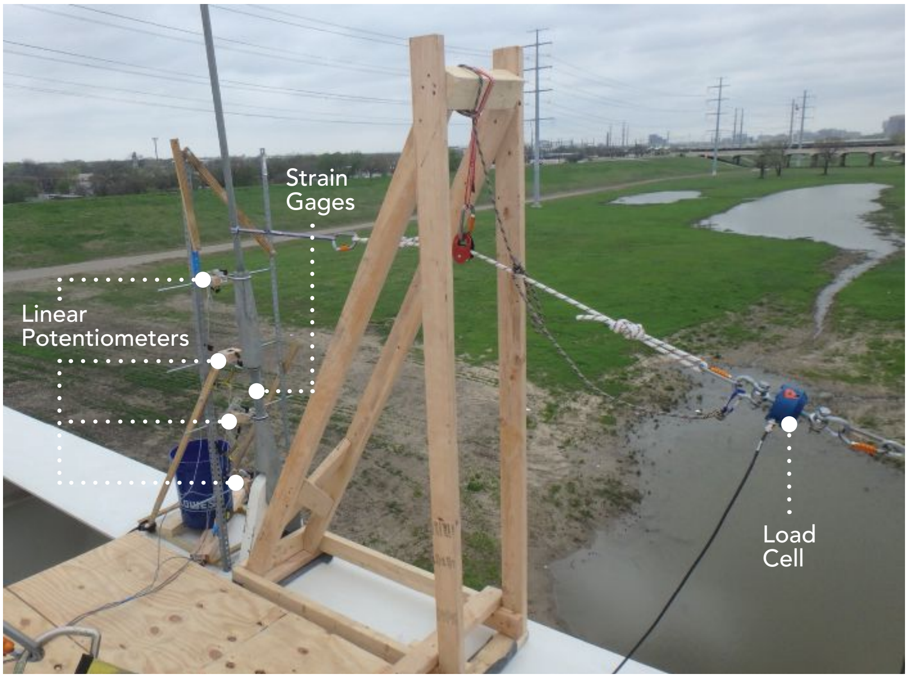
The wind-cable interaction behavior is highly complex and challenging to model analytically. Determining fatigue stresses by modeling would have required several assumptions, including idealized boundary conditions, in-situ cable tensions, selection of critical wind conditions, and more. Furthermore, because of varying cable lengths, tensions, and support conditions, unique dynamic behavior was expected for each of the approximately 200 cables on the bridge. Therefore, a more direct approach was taken to understand the behavior: in-situ testing and monitoring of the cable anchorages. Testing performed on select cables on the bridge included: (1) monitoring anchorage accelerations and strains under a variety of ambient wind conditions to directly evaluate the effects of the wind-induced vibrations; (2) monitoring anchorage accelerations under forced impact excitation of the cables to evaluate the dynamic response of the anchorages; and (3) monitoring anchorage strains and deflections under static lateral loading of the cables to evaluate the anchorage boundary condition. Each type of evaluation was performed on carefully selected cables with varying lengths and tensions to provide data across the full spectrum of cable properties. Site wind conditions were continuously monitored during testing.

The collected data was used in conjunction with historical wind data from the area to estimate the fatigue stresses in the cable anchorages due to repeated vibrations over the service life. The reliability of the cable anchorages was calculated based on the collected data and was found to be unacceptable. New cables with larger diameter anchorage components were installed to reduce fatigue stresses and improve reliability.

## HSS Splice Coupler

In the second example, damage occurred during a windstorm at a utility-scale solar power facility with rows of elevated solar panels that rotate to track the sun. The panels in each row are supported by horizontal square HSS members, which are typically spliced in two locations on each side of the drive arm. The low torsional stiffness of the coupler used to splice these HSS members together was identified as a significant contributing factor to the damage, and thousands of couplers needed to be remediated. Two retrofit couplers were proposed for repair, and the choice between the two was based on two competing factors: improvement in structural performance and installation cost. The force transfer in the splice connection is complex and challenging to model, as it involves slip, bearing, prying, and friction. Thus, the original and the two retrofit couplers were tested in flexure and torsion to evaluate their behavior.

A test setup was constructed in an open area at the power facility by casting concrete slabs on the ground and erecting steel loading and reaction frames. HSS members and couplers from the site were used as test specimens, and other components of the




left: Static load testing of the bridge cable anchorages was performed using a system of ropes, pulleys, straps, and turnbuckles to pull the cable laterally just above the anchorage. Instrumentation consisted of strain gauges, linear potentiometers, and a load cell.

Rows of solar panels, with a few panels blown off the supporting structure by the windstorm.

system were used to create realistic boundary conditions. Load was applied using hydraulic rams and was measured using load cells and pressure transducers. The resulting deflections, rotations, and strains were monitored throughout the tests using string potentiometers and strain gauges.

The data showed significantly improved flexural and torsional stiffness of one of the retrofit couplers, while the other provided only minimal improvement over the original coupler. Based on these results, the more structurally effective solution was implemented to reduce the risk of future damage, which would exceed the cost premium over the other retrofit coupler.

## Considerations

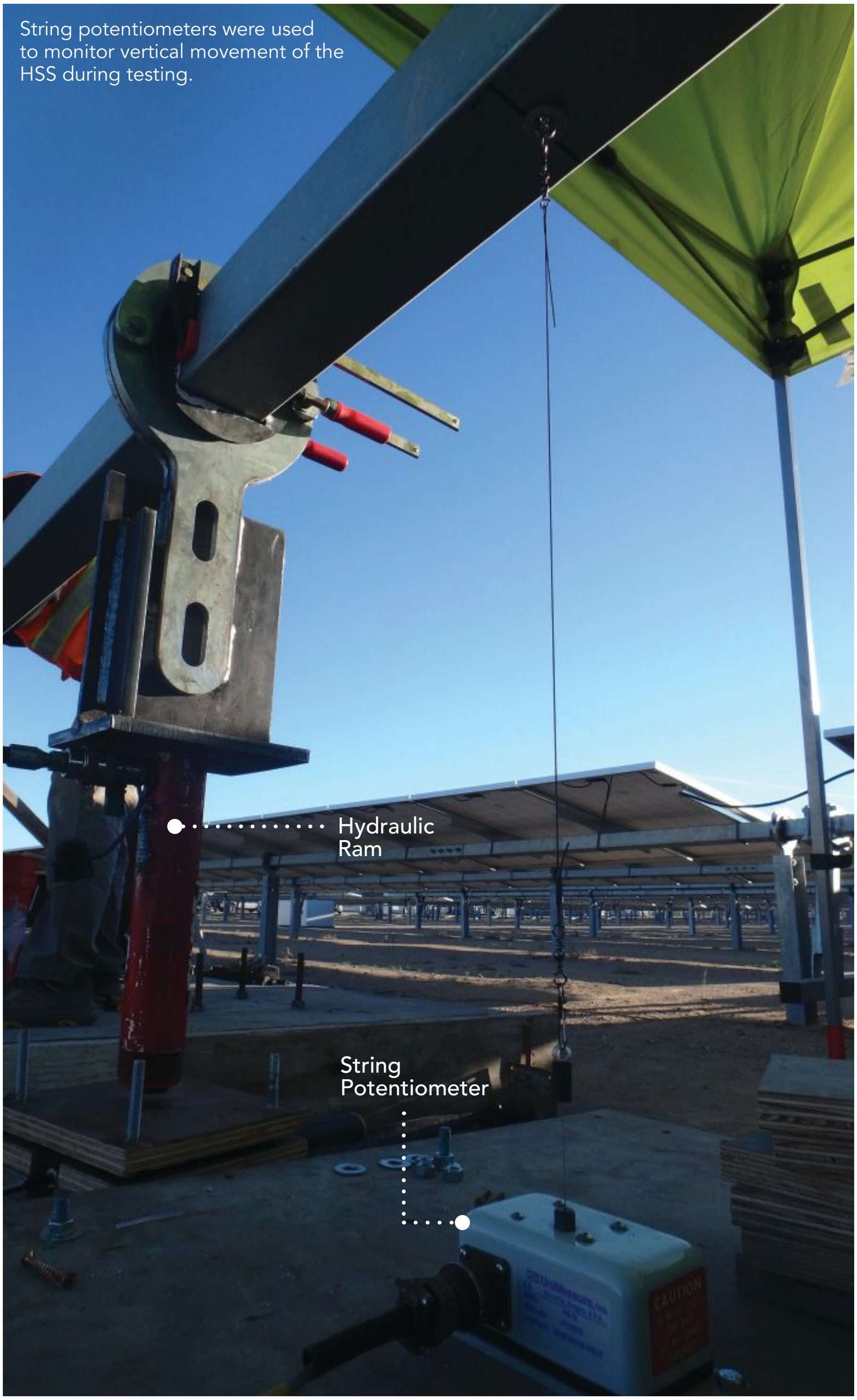
Here are some general considerations when contemplating structural testing as a solution to your next structural problem:

**Benefits.** In nearly all situations that structural engineers encounter, structural behavior can be reliably predicted by analytical methods. However, a structural problem may arise that extends beyond our industry's analytical capabilities or requires the use of too many unknowns or assumptions to have the necessary level of confidence in the analytical predictions. In this case, structural testing can be considered to directly indicate how the structure will respond under a particular set of loads. Testing can reduce uncertainty in the results, leading to a solution that reduces risk and increases reliability. Consider what properties or behavior can be evaluated through testing that cannot be reliably assessed using analytical methods. If the answer to any of the following questions is yes, then structural testing may be appropriate:

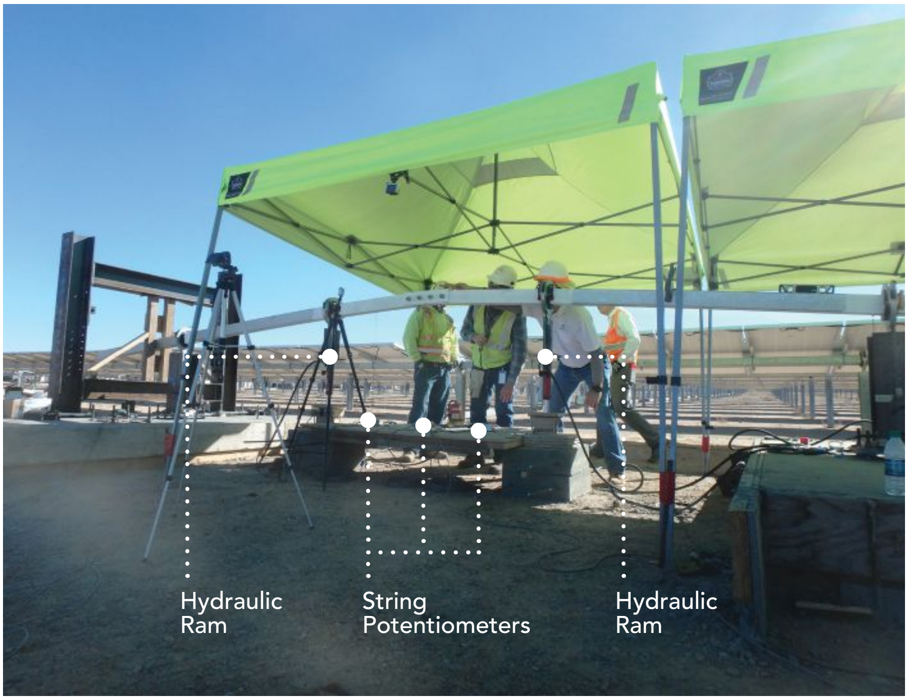
- Are there conditions present that cannot be reliably known or considered in an analytical model but are expected to drastically impact the outcome?
- Is analytical modeling unable to attain the required accuracy or precision?
- Can structural testing provide additional relevant information beyond analytical methods?

**Costs.** In many cases, structural testing may be a cost-effective solution compared to developing a complex analytical model or to implementing potential solutions to a particular structural problem. Testing can also aid in optimizing a retrofit design, which can be particularly economical for repetitive retrofits, where small changes can have a significant impact on the total cost. Additionally, the high level of certainty in the outcome of structural testing often results in a well-defined up-front cost, while the cost of an analytical approach may be less certain. If the answer to any of the following questions is yes, then structural testing may be appropriate:

- Do the benefits of structural testing outweigh its costs?
- Is structural testing a cost-effective solution compared to possible alternate approaches?

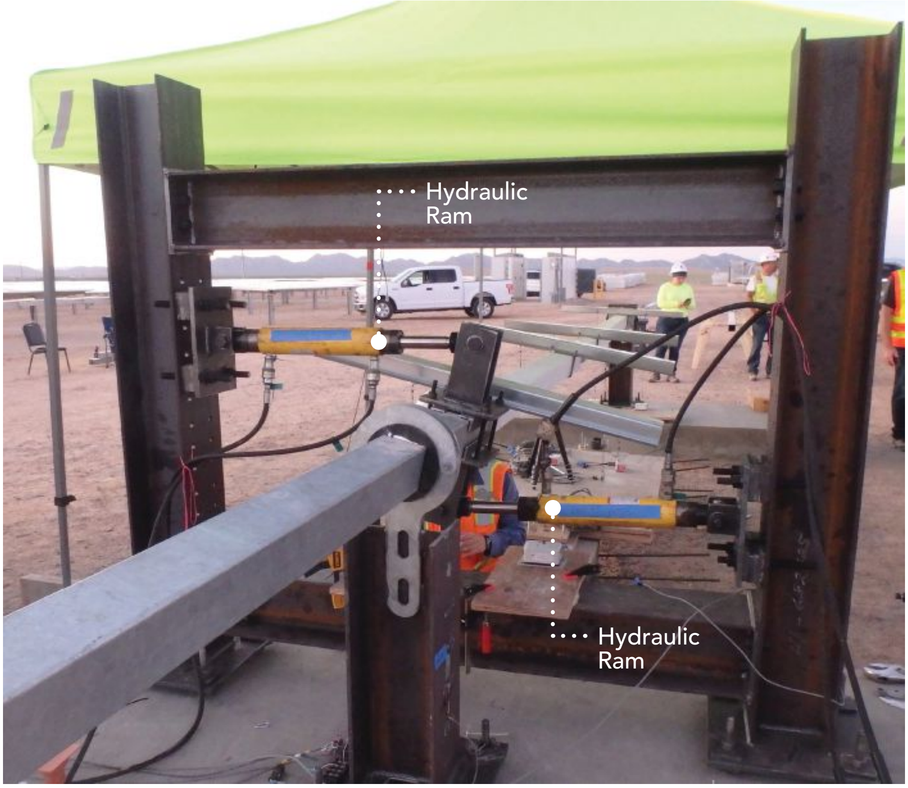


String potentiometers were used to monitor vertical movement of the HSS during testing.




above: Flexural testing of the HSS coupler was performed under four-point bending, with the loads applied upwards using hydraulic rams. The coupler was in the constant-moment region between the applied loads, and deflections were measured with string potentiometers at several locations along the length, as shown in the picture on page 19.

below: Torsional testing of the HSS coupler was performed by applying a torque at one end of the tube with hydraulic rams (near end in the photograph) with a fixed support at the other end (far end in the photograph). Twist of the tube was measured by string potentiometers (shown on page 19) at four locations along the length—two on each side of the coupler.




- Can structural testing help optimize a retrofit design in an economical manner?

**Time.** Although structural testing does involve a preliminary planning phase, the entire process—from planning to testing to reporting results—can often be done in a similar amount of time as developing a complex analytical model and evaluating the results. The high level of certainty in the outcome of structural testing generally also results in a well-defined timeline up front for determining a solution to a particular structural problem. Note that testing may not be suitable for emergency situations that require immediate action. If the answer to any of the following questions is yes, then structural testing may be appropriate:

- Can structural testing help provide a solution to the problem in the timeframe needed?
- Is structural testing a time-efficient solution compared to possible alternate approaches?

Finally, it should be noted that structural testing is rarely the only approach taken to solve a structural problem. Evaluating the results from structural testing, along with information from construction documents, visual observations, analysis, etc., can lead to a practical and economical solution to your next challenging structural problem. AISC has resources that provide insight if you are considering a testing program to evaluate an existing structure, including Appendix 5: Evaluation of Existing Structures in the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) and AISC Design Guide 15: *Rehabilitation and Retrofit* (both are available at **aisc.org/publications**). As we know, there's always a solution in steel, and that solution is sometimes best developed or evaluated via structural testing. ■

**Kerry Kreitman**
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is a project engineer with
Pivot Engineers in Austin.

# Best Bridges

BY CHRISTOPHER GARRELL, PE

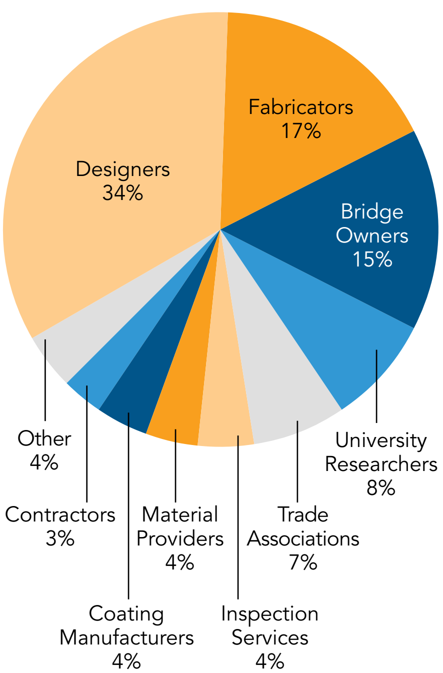
## Building a steel bridge? Collaborate with us!

**WANT TO** learn about creating the best possible steel bridges?

Come to an AASHTO/NSBA Steel Bridge Collaboration meeting! You'll gain plenty of insight into making your next bridge project run more smoothly.

A joint effort between the American Association of State Highway and Transportation Officials (AASHTO) and the National Steel Bridge Alliance (NSBA), the Collaboration includes representatives from state departments of transportation, the Federal Highway Administration, academia, and various industry groups related to steel bridge design, fabrication, and inspection. The mission is to provide a forum where professionals can work together to improve and achieve the quality and value of steel bridges through standardization of design, fabrication, and erection.

### AASHTO/NSBA Collaboration Attendee Composition




And the Collaboration holds several meetings throughout the year in different locations around the country. While there is a core group of attendees that travels from meeting to meeting, the goal is to attract a large local attendance as well and keep the group viable into the future as people retire.

The most recent Collaboration meeting took place in late April, comprising 16 smaller meetings over 37 hours and hosting roughly 120 industry participants. That's a big deal! When people registered, NSBA asked them if this was their first time attending a Collaboration meeting. Almost 25% of attendees said yes. And even if a participant never attends another meeting in person again, they are one more person that now knows about the Collaboration documents, had a positive interaction with the steel industry, and are more likely to design a (better) steel bridge. If you were to track the actual breadth of the Collaboration's reach, it would be far beyond just the headcount at a single meeting.

Design consultants have always made up the vast majority of attendees, but the effort has been bringing additional owners and fabricators. The most recent meeting even attracted a couple of software vendors to help with the BIM efforts (see the chart to the left for the makeup of the most recent meeting).

You can find information on upcoming meetings and access all free Collaboration documents at **aisc.org/collaboration** (and see the sidebar to the right for a list of these documents). We'll see you at the next meeting! ■

**Chris Garrell** (**garrell@aisc.org**) is NSBA's chief bridge engineer.

### Collaboration Docs

The documents the Collaboration develops and publishes provide a wealth of value and information to the entire bridge design and construction community.

The Collaboration has 17 publications available at **aisc.org/collaboration** and also via the AASHTO Bookstore at **store.transportation.org**.

The five specification "S" documents cover:

- steel bridge fabrication
- the application of coating systems
- the application of thermal spray coatings
- hot-dip galvanizing
- steel bridge erection guide specification

And the 12 guideline "G" documents cover:

- Shop drawing review/approval for fabricated structural steel
- Design drawings presentation
- Shop detail drawing presentation
- Design details
- Resolution of steel bridge fabrication errors
- Steel bridge fabrication QC/QA
- Qualifying structural bolting inspectors
- Sample owner's quality assurance manual
- Steel bridge bearings
- Design for constructability and fabrication
- Steel girder bridge analysis
- Addressing fatigue cracking and details at risk of constraint-induced fracture

In addition, there are currently 22 documents in various stages of development, and while these include updates to existing publications, several are new and fill existing gaps in knowledge.

# Quality Time

INTERVIEW BY GEOFF WEISENBERGER

Quality assurance expert Cliff Schwinger has spent a career helping designers and detailers improve their designs and view mistakes as learning experiences.

**CLIFF SCHWINGER** learned all about structural engineering fundamentals at an early age.

He just didn't know it at the time.

But his time spent putting together model airplanes as a young boy prompted him to study civil engineering in college and eventually led to his nearly four decades with The Harman Group (now IMEG) and his status as one of the preeminent quality assurance experts in the structural engineering world.

In April, I chatted with Cliff, a senior structural engineer with IMEG, at the 2023 NASCC: The Steel Conference in Charlotte, where he was honored as one of this year's AISC Lifetime Achievement Award winners thanks to his contributions to the development of the AISC *Steel Construction Manual* and his work in advancing the understanding of high-quality structural steel engineering drawings, delegated connection design, and quality assurance. We discussed his career, how he became a QA expert, and his love for the historic buildings of Philadelphia.

**How long have you been in the industry, Cliff?**

Since 1976! The first couple of years, I was working for a company that designed equipment for sewage treatment plants, and I actually learned a lot about steel detailing. I sat next to a retired Bethlehem Steel detailer—he'd worked there since World War II—and he taught me all about detailing. It was a fantastic learning experience. He taught me how to draw welds, how to call out dimensions, sizes, everything. That was really a great opportunity, but then I wanted to get into building design, so I left after a couple of years, wandered around a couple of different consulting firms, wound up at The Harman Group, and have been there ever since. It's going on 37 years there. Sometimes, I look at some of the younger engineers and realize I've been at The Harman Group longer than they've been on the earth.

**That's one way of looking at it! What got you interested in engineering in the first place? Was it a childhood dream?**

When I was a little kid, I wanted to be an aeronautical engineer. I lived and breathed airplanes. I also watched every NASA launch. And I built model airplanes. All kids should have the opportunity to build balsa wood model airplanes. They're simple stick-built models, and I learned about velocity, acceleration, and center of gravity but also about trusses, cantilevers,

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**.

joints, and the importance of good connections. I didn't realize at the time that I was learning any of this stuff because it was just fun to me. I was a little kid, but I learned all this stuff before I had any physics classes, and I learned as much building model airplanes as I learned in any of my structural engineering courses in college. You build a fuselage on an airplane and make sure it's torsionally stiff. You build a wing, which is a cantilevered beam. You learn the importance of efficiency of design because if you make an airplane too heavy, it won't fly, right? And that's sort of how I wound my way into structural engineering.

I went to Lehigh University. I was completely clueless when I started out as an undergrad, but they had this really incredible laboratory, Fritz Lab, and some of my professors were the greatest teachers. There was one professor, Dr. John Fisher, who was so patient. He's one of the reasons I became a structural engineer. After undergrad, the chair of the civil engineering department tried getting me to stay for graduate school, but I just wanted to get out there and earn a paycheck. I eventually realized that learning is a lifelong thing. You're always learning, and the older I get, the more I realize how little I know. So I try to keep learning, attend seminars, and listen to people when they speak, which you can't take for granted. I always try to pick up one tip I can take back to the office from any presentation that I attend.

**Good to hear. And that's an interesting point about learning engineering basics from models. I put together a Millennium Falcon model once. It was very intimidating, but I took my time and put the whole thing together, and I was very proud of myself. I want to switch topics and talk about quality assurance, which I understand is a big part of your career. How did you get into that role? Did you go looking for it, or did you kind of fall into it?**

Kirk Harman, who was the president of the Harman Group when there were only a dozen or so of us working there, decided to hire a full-time quality assurance manager. His first quality assurance manager was there for about a dozen years. I remember the first time he did a QA review of one of my projects, and he basically bled all over the drawings with a red pen. And I already had ten years of experience at the time. I wondered how that was possible—all these mistakes, all these red marks—but they were all valid comments. And when that QA manager retired, Kirk asked me if I wanted the role. I said, "Yes," because I was always focused on the details and putting together a good set of drawings. So I became the QA manager, which also involved developing typical details and training young engineers. The QA review is really just a part of our overall QA program. The review catches mistakes—but it also alerts the firm as to where the weaknesses are in the overall program. There's training, there's a knowledge base, and there's a library of 1,000 typical details, and all that stuff comes together to create the QA program. My goal has always been to eventually do a QA review with no red marks.

The trouble is that things are going in the opposite direction. Schedules are being accelerated, software is getting more and more sophisticated, and younger engineers are getting much greater responsibility earlier in their careers. So we have to train our engineers on how to put together good details. But there's a learning curve. It's not as though you simply follow a checklist and become an expert detailer. So part of my QA review process involves picking up a lot of mistakes and making it a learning experience. We review everything with the engineer, and they learn from their mistakes, and their mistakes are caught before the drawings go out. So that's how I bumbled my way into the QA arena, and I love it!

**Sounds like it's been a rewarding career. Switching gears from engineering, tell me about Philadelphia, which is where you're currently based.**

Yeah, I was born and raised in Philadelphia. I lived in the city until my 30s, and then I moved literally across the street to a suburb called Cheltenham, Pa. I still ride my bike in the city all the time. I love the architecture and just wandering the city. There are so many things you can see on a bicycle that you don't see when you're driving in a car. About ten years ago, we started doing some façade inspections—although we don't do them anymore. For every project, I would have to research the history of the building, and I learned about the fascinating history behind these thousands of old buildings in Philadelphia. And they all need façade inspections if they're more than 75 ft tall. I learned who the architects were, who the engineers were, and what was in these buildings.

And it evolved from there, and I started giving these tours of the city with a local bike club. And instead of showing people well-known architectural landmarks, I instead focus on stuff that's completely unknown. I actually have a ride called "Cliff's Decaying Infrastructure Bike Ride." There are a lot of really decaying old bridges and buildings in Philadelphia and, really, in all big cities, and it's the kind of stuff you don't notice until you read in the paper that a piece of terracotta fell and hit somebody in the head. But again, I love "discovering" old buildings and then going online and figuring out what they were originally used for. There are so many hidden treasures. ■

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

**Geoff Weisenberger**
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editor and publisher of
*Modern Steel Construction.*

# Forging Loyalty

BY CHRISTIAN CROSBY, PE

There's no magic bullet when it comes to recruiting and retention. But tracking the process and focusing on the "why" can help you find—and retain—a dedicated, high-quality workforce.

**PEOPLE.**

We, my friends, are in the people business. Sure, we can talk about steel, drawings, fabrication plans, and erection plans for hours, but at the end of the day, we need people. Anyone who understands what we do—design and build with structural steel—realizes that without people, we are not able to design or build one stick of iron.

Sure, we have new technologies borne out of "necessity." As someone who works on the fabrication side of things, I have used these new technologies, and not one of them allows for a fabrication shop to run "lights out." As far as erection goes, I have yet to evaluate a new technology that has replaced a raising gang. We still need people. People in the shops, people in the field, and people in the offices.

## Recruiting

Let's not kid ourselves. Finding people is difficult. Finding *good* people is nearly impossible. I wish I had some super-secret words of wisdom on where to find people that are dedicated to a career in the steel business, but, alas, I don't. We are all looking in the same place: direct advertising, trade schools, referrals, word of mouth, rehires, recruiting agencies, temp agencies, job fairs, career fairs, etc. Each one of these has its merits and its challenges. I could go on and on about the pros and cons of each one of these options, but to what end? How would this aid in your efforts? Instead, I would like to ask, "How are your recruiting efforts going?" Where are you having success finding quality candidates? Each market across the country is different, and while someone is having success with career fairs, another is finding success with trade schools.

To understand where you are having success, I recommend tracking your efforts. Recruiting is expensive. From wages for internal recruiters to "finder's fees" from external recruiters to the cost of postings to job boards to fees for job fairs, all these costs add up quickly, and tracking the outcomes will provide you with the data you need to maximize your return on investment. It's like the old saying from Peter Drucker: "What gets measured gets improved."

Developing and implementing a system to track your recruiting efforts does not need to be expensive or elaborate. I have worked for several fabricators that used a simple spreadsheet to track these efforts. Nothing expensive or complicated, just a simple spreadsheet log. Another quote, this one from Kelly Johnson, often comes to mind when I think about "systems" in our business: "Keep it simple." All you are looking for with this log is a way to record your activities, costs, and outcomes.

Another recommendation for increasing your success in recruiting is to ensure that your recruiting efforts are aligned with the organizational strategy. Now, I realize this sounds simple and straightforward, but I can't count how many times I've witnessed organizations having a knee-jerk reaction to an employee leaving, only to run out to hire the first person that responds to their online ad. They have now filled the position but have failed to ensure that this role is in alignment with the needs and goals of the organization. Did they review the job description and ensure it's up to date with the strategy, or did they just dust off the "old one" and recycle it? Did they sit down for a moment to discuss what is best for the organization, or did they just start running ads? Is this position part of the organization's long-term strategic plan, or is it a short-term fix until they execute their reorganization plan? Do they need an experienced team player, or do they have an opportunity to develop an entry-level employee?

One final recommendation for recruiting is to focus on the quality of the candidates. Sure, I get it. Candidates are not beating down the door to come work in our industry. However, I have seen firsthand too many organizations settling for the first applicant through the door instead of evaluating the quality of the individual. Once this candidate is able to find another organization willing to pay a slight increase in compensation, they are out the door, and the process has to start all over again.

There is no "easy button," but focusing on several key points will go a long way to increase your success rate with recruiting. Do you know where to look to fill this position? Are you clear on the position you're recruiting for? Are you focused on a *quality* candidate?

## Onboarding

Your organization has just spent a sizable amount of time and money to recruit your new employee, and now you want to set them up for success both from their perspective and from your perspective. The new team member wants to start their new position and contribute to their new team as quickly as possible. You would also like them to contribute to the team and continue to do so for an extended period of time (i.e., *retain* them). An intentional onboarding process can increase your probability of success for both the new employee as well as your organization. Onboarding is the bridge between recruiting and retention.

Onboarding starts on day one and is more than just signing compliance paperwork, which is important but not the main goal of the process. It is merely the starting point of building a sense of belonging for the new employee, an opportunity to make them feel welcome. Keep in mind that changing jobs can be one of the most stressful events in life. If they are relocating for the position, moving is also highly stressful. If your organization can be intentional in helping new employees connect with colleagues and management quickly, you can help to make this transition not only smooth but also successful. Positive engagement with the new team member will help stave off any feelings of "buyer's remorse."

Another key to a strong onboarding process is to assign an existing employee as a resource person for the new employee. The resource person should be available to help with sharing company norms, values, stories, etc. Someone to share all the "unwritten rules" of the organization (with the new person). Each company has these unwritten rules, and the quicker the new employee can figure them out, the better the chances of success.

Here are several mistakes to avoid for a successful onboarding process:

- Being unprepared for the first day. Who is responsible for the meeting? Do you have a conference room available for the meeting? Is the current slide deck ready to go?
- Not having equipment for the new team member. Are their tools ready to be issued when they start? It might seem like a small item, but having their tools ready sends a strong message to the new employee.
- Not having the workspace ready.
- Skipping all the introductions to their team.
- Supervision/management being too busy to be bothered with meeting the new person.
- Defaulting to the tried and true "sink or swim" philosophy.

## Retention

Research shows that 40% to 70% of your current employees are actively looking for employment elsewhere. While you are digesting this statistic and arguing with me, let me ask: How is your retention? What do your numbers say? Why are your employees leaving? What do your surveys say? What do your exit interviews say? I ask about your metrics because, again, "What gets measured gets improved." Employee surveys and exit interviews are excellent sources of data on why your employees are leaving and can be implemented with minimal cost and effort. Understanding the "why" can be priceless.

Research tells us these are the top reasons employees are looking and leaving: wages, benefits, management relationships (communication, treatment, culture), and work-life balance.

Now that we know why your employees are leaving, what can you do to keep the best players on your team? Again, it starts with hiring practices and onboarding. Are you recruiting high-quality candidates? Are you accurately matching the needs of the organization with the needs of the candidate? Is your onboarding process setting up both the new team member and the organization for success?

Another big one: Are you offering fair compensation and benefits? You can research our industry at the Bureau of Labor Statistics. There is a lot of data here, but with time and determination, you can discover where your compensation falls within our industry. On the subject of compensation, Julia Dhar with the Boston Consulting Group surveyed 4,700 people in early 2023. In a nutshell, they discovered that during a face-to-face exit interview, the exiting employee would list their top reasons for leaving as better pay, work-life balance, and better benefits. However, when the exiting employee was allowed to answer anonymously, their reasons for leaving were negative treatment by supervisors, a bad relationship with their boss, and not being valued and respected by the organization.

Understanding why employees are leaving will allow your organization to address these issues. If the reason is work-life balance, then you can review employee workloads and make adjustments as needed. If the reason is management relationships, then you will need to address these issues with training for your workers' supervisors or even, in some cases, by replacing specific managers that don't value their staff. While this might seem extreme, the data will point out your employees' challenges, and corrective action can be taken. Keep in mind that sometimes, organizations can move in a positive direction through the action of subtraction.

People. We need them in our shops, on our project sites, and in our offices. We are neither fabricating nor swinging iron without them. Sure, they can be difficult to find, but being intentional with our recruiting and onboarding processes, along with addressing the reasons why people are leaving, can improve our retention and improve our teams. ■

**Christian Crosby** (**christian.crosby@schuff.com**) is senior vice president of fabrication with Schuff Steel.

In a Bay Area business park geared toward innovation, a new life sciences headquarters building features a forward-thinking seismic-resistance system.

# Rocking the Boat

BY LEO PANIAN, SE, GINA BERETTA, SE, AND ISAAC WILLIAMS


**A NEW OFFICE BUILDING** in Alameda, Calif., was built to fight cancer in new innovative ways—and its framing system takes a similar approach to fight seismic forces.

This new four-story structure at 1951 Harbor Bay Parkway serves as the headquarters for a growing oncology-focused life sciences company. Both the developer and tenant desired a cost-effective structure with an open plan across the 220,000 sq. ft floor area. The result is a 60-ft-tall steel-framed structure with a rectangular footprint measuring 384 ft by 141 ft. A regular 32-ft by 25-ft column grid is arranged around the central core area to provide efficient span arrangements and floor assemblies.

While seismic resilience was a high priority to reduce the likelihood of damage and limit downtime for repairs, it had to be achieved without adding a significant cost premium. Structural steel was selected because it was less costly and faster to build than other structural materials and could also facilitate long spans (up to 37 ft) that lend flexibility in programming, a must for the owner. While the facility doesn't currently house any laboratories, the team at Tipping Structural Engineers designed the floor system with a higher live load rating so it can easily be converted into lab space as needed in the future. The steel system was also significantly lighter than a comparable concrete structure, resulting in less load on the foundations, which was especially important thanks to the project's location on a soft-soil site.

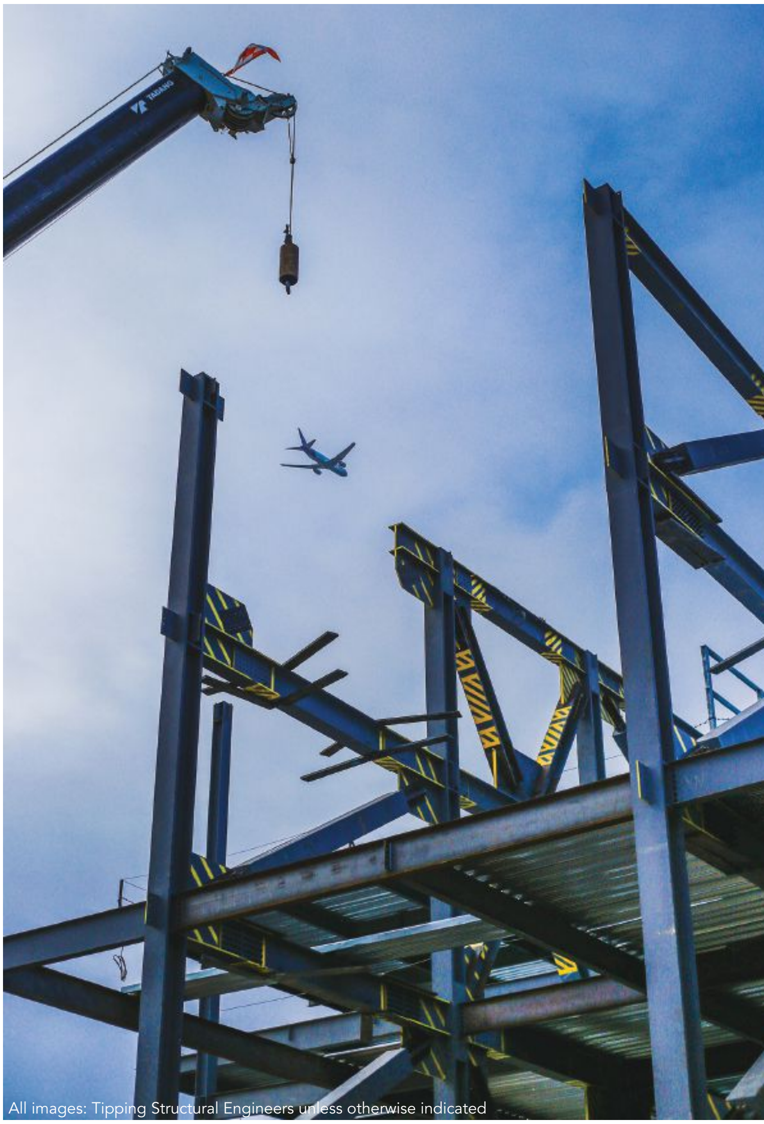
## Enhanced Seismic Resilience

To balance economy and performance, the design team specified special concentrically braced frames (SCBFs) using buckling-restrained braces (BRBs) for the seismic load-resisting system. And in an effort to provide an even higher level of seismic resilience, the BRB frames incorporate a rocking mast or strong-back in order to reduce the anticipated drift and eliminate weak story response.


Kyle Jeffers

left: The new four-story structure at 1951 Harbor Bay Parkway serves as the headquarters for a growing oncology-focused life sciences company and sits on a rectangular footprint measuring 384 ft by 141 ft.

below: To balance economy and performance, the design team specified special concentrically braced frames (SCBFs) using buckling restrained braces (BRBs) for the seismic load-resisting system.

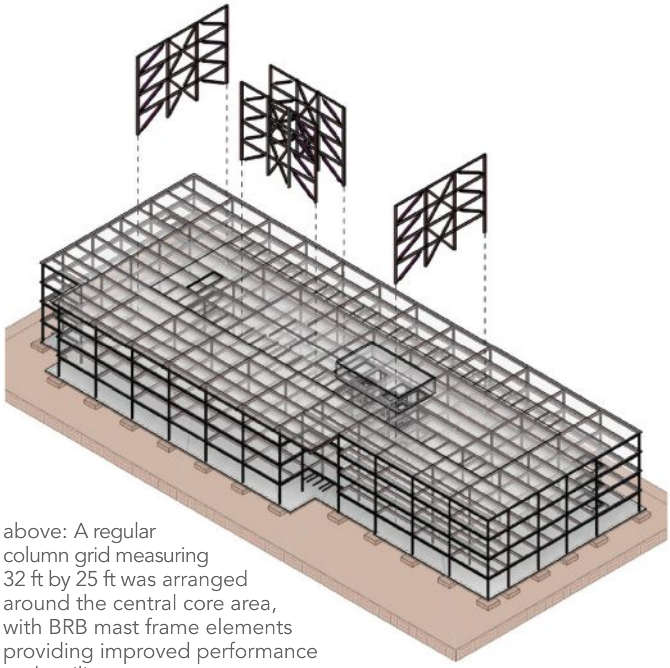

All images: Tipping Structural Engineers unless otherwise indicated

For mid-rise steel structures in high-seismic areas, SCBFs offer one of the most efficient solutions for resisting lateral loads. The ductility and controlled response of the BRB devices provide an effective means to improve the performance and reliability of SCBFs, allowing the structure to be designed for reduced seismic loads. However, under high seismic loads, these systems can experience large drifts and weak stories that can damage the structural frame, exterior cladding, interior construction, stairs, and elevators, limiting the building's ability to function following a large earthquake. Moreover, the full benefit of the more costly BRB devices is not effectively harnessed since the overall strength of the frame is limited by just a few critically loaded members.

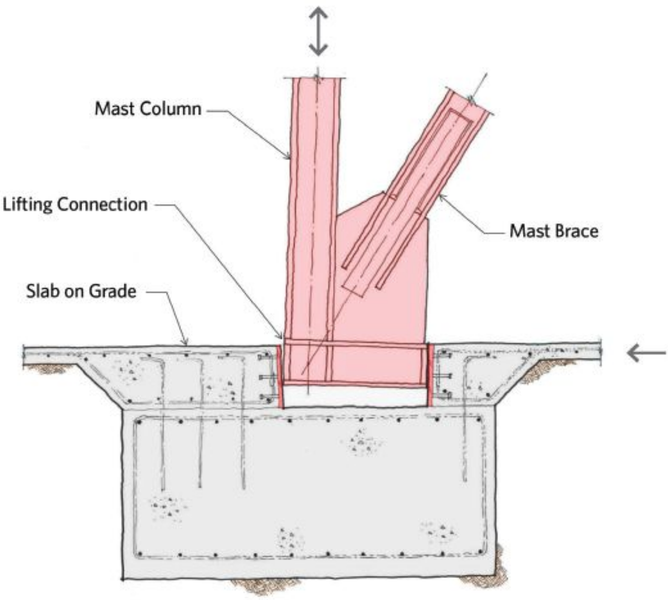
Luckily, improving resilience in an SCBF system can be achieved by limiting the overall drift of the system and distributing that movement uniformly over the height of the structure. The key is to design the frame for rocking rather than racking (i.e., concentrating damage/deformation at a single story) under inelastic response. The rocking mechanism is achieved by introducing a stiff elastic mast into the frame that is capable of distributing forces between stories to create a more uniform drift profile.

The mast, also referred to as a strong-back, is essentially a vertical truss that extends up the height of the structure and interconnects the BRBs to form an integral framework. The rocking vertical mast is made of conventional steel members and is designed to remain elastic during an earthquake. The concentrically braced mast frame occupies the same footprint and extent as a conventional frame but uses fewer BRB members. The mast effectively forces all BRBs in the system to work together to resist movement at any story, which fully mobilizes the BRB elements' deformation capacity and increases the system's inherent redundancy.

1951 Harbor Bay Parkway incorporates four BRB mast frames symmetrically arranged around the central core. Each frame

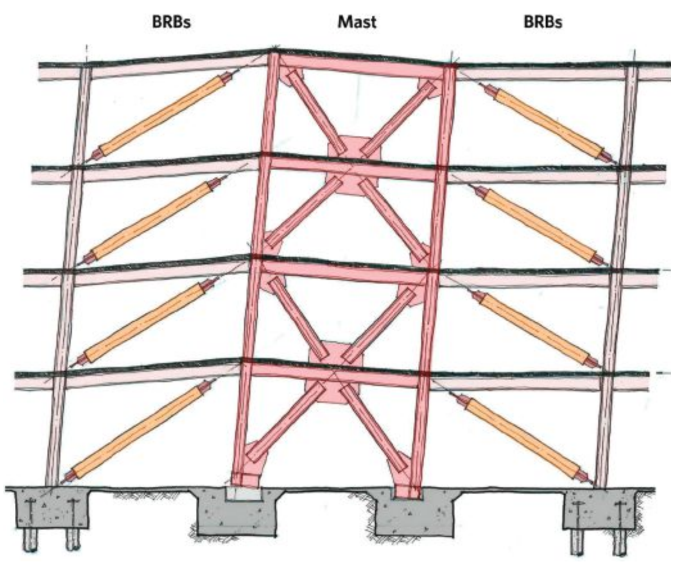


above: A regular column grid measuring 32 ft by 25 ft was arranged around the central core area, with BRB mast frame elements providing improved performance and resilience.

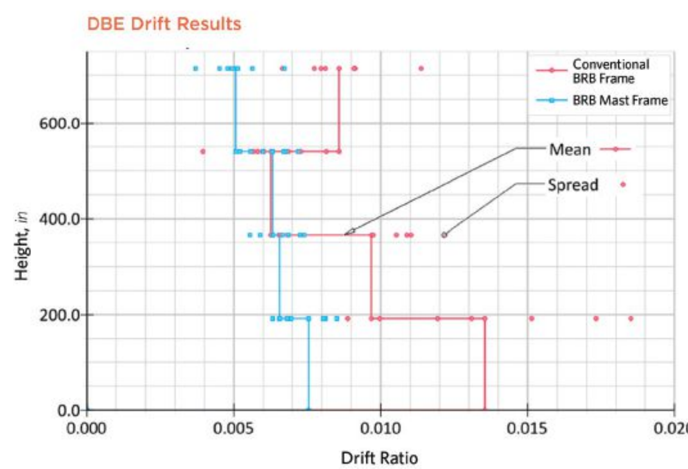



above: A detail of a mast frame base. Connections to the foundation elements are detailed to facilitate rocking behavior by allowing the base of the columns to lift within a recessed pocket in the spread footing.

below: Confirmed through a suite of dynamic performance analyses, the BRB mast frame is lar less sensitive to variation in ground motions and results in 50% less story drift and displacement than those resulting from a conventional SCBF.




below: This plot of the drift response from the non-linear history analysis demonstrates significantly reduced drifts, a uniform drift profile with no weak stories, and more tightly clustered results indicating less sensitivity to ground motions.



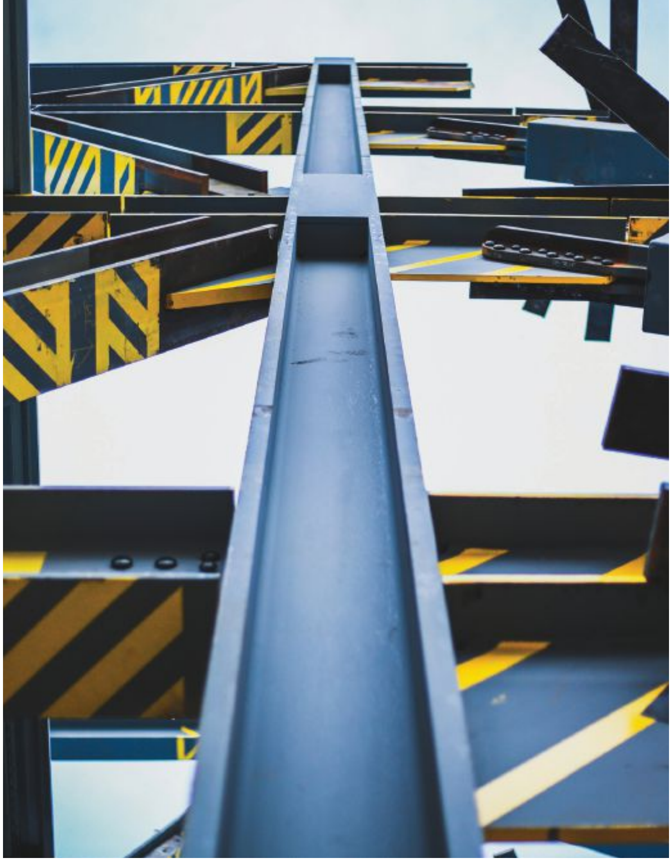

consists of a three-bay arrangement, with the central bay forming the mast and the flanking bays containing the BRBs. The frames consist of W14×233 diagonals, W14×283 columns, and uniformly sized 650 kip BRB elements.

The mast frame's rocking behavior is key to achieving the desired mode-shaping effect. The mast frames are detailed to allow a rocking response by permitting the base of the columns to uplift within a recessed pocket in the spread footing. The mast resists a portion of the lateral force but is designed to remain elastic, while the yielding BRBs provide all of the ductility and energy dissipation for the system.

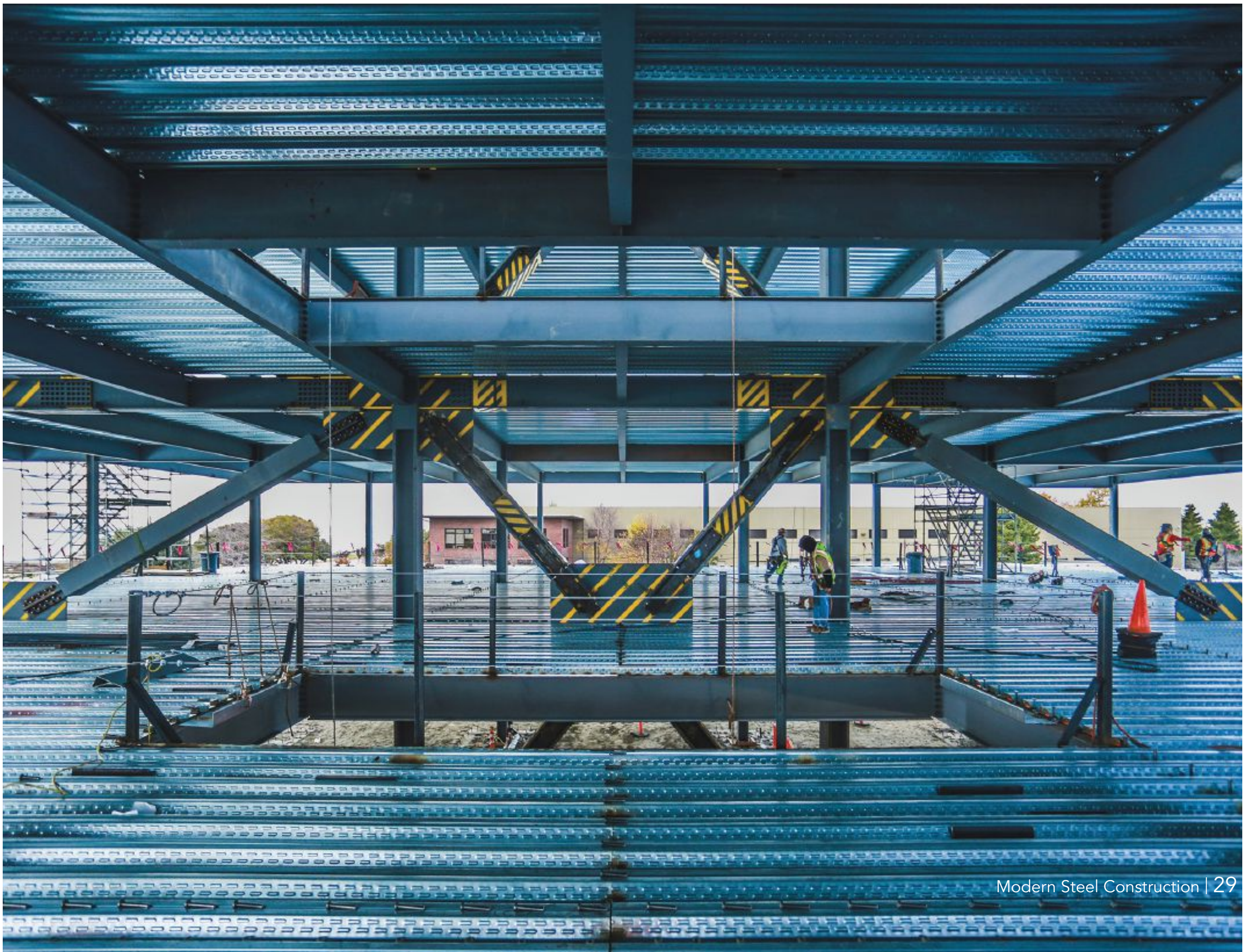
## Dynamic Performance Analyses

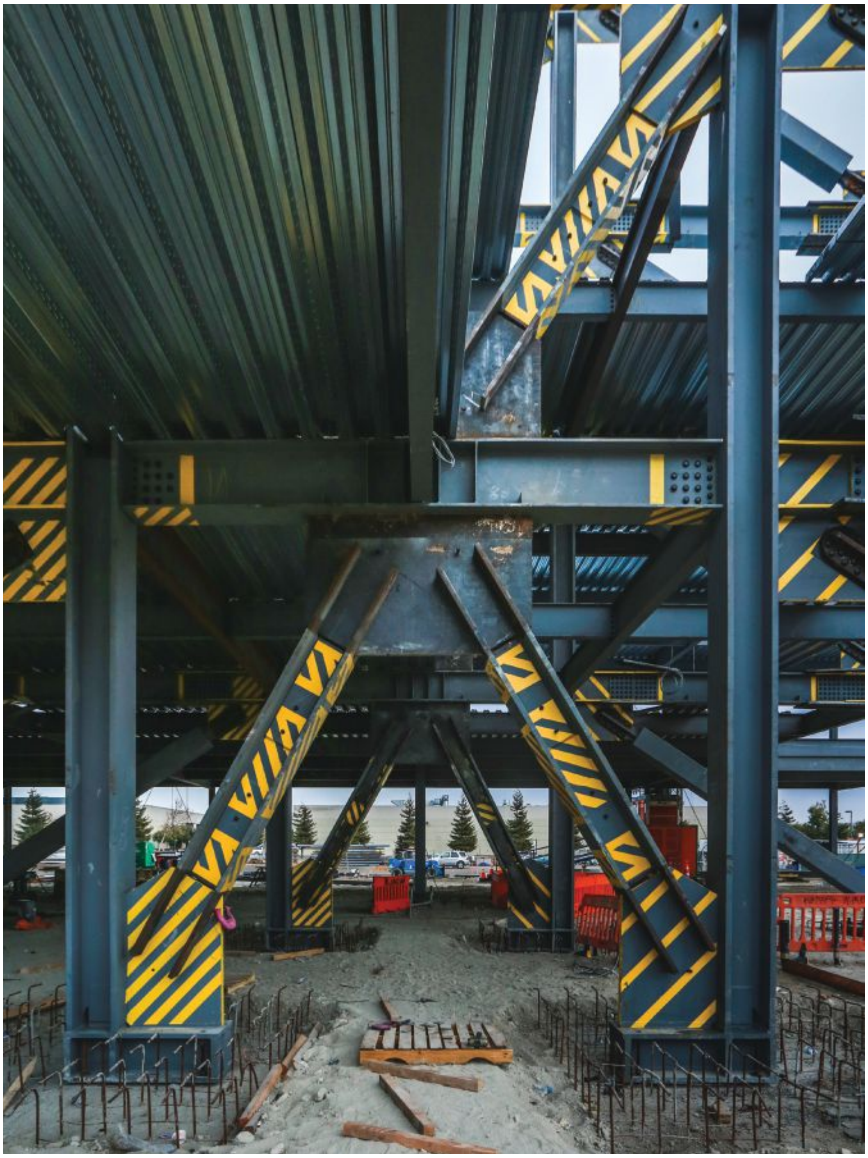
The seismic system's performance was evaluated using different analytical approaches. In addition to the standard equivalent lateral force (ELF) and response spectrum analysis (RSA) methods, nonlinear static analyses and dynamic shaking simulations were used to gauge performance and validate design assumptions, and cost estimates tracked steel tonnage and BRB quantities.

The nonlinear shaking simulations demonstrated that the mast frame produced lower maximum story drifts and displacements than a conventional SCBF by up to 50%. The mast frame approach also provided an essentially uniform drift profile without any major drift concentrations or weak stories typical of conventional frames, and the analyses showed that the response of the mast frame was far less sensitive to variations in ground motions. Furthermore, the mast frame promoted full use of the uniformly sized BRBs and resulted in less strain demand, improving the economy and reliability of the system. While there was an additional cost for building the vertical mast, it was effectively offset by an overall reduction in the number of BRBs.



The connections of the members within the mast frame relied on compact gusset plates that were designed to develop the strength of the members. Unlike gusset plate connections for conventional SCBFs, the mast connections were simplified, since buckling and out-of-plane behavior of the gussets were not a factor.





Erecting a mast frame is similar to erecting a more conventional steel frame, with the key difference being the gussets. Because of the compactness, they require careful detailing with appropriate tolerances for fit-up.

## Future Implications

While the chosen seismic-resistance system proved to be an economical and effective option, the team's approach to creating it was crucial to its success. Tipping and steel fabricator and detailer Prospect Steel collaborated on atypical details related to mast frame systems in an effort to reduce issues that might arise during fabrication and erection. Despite the unfamiliar approach, Prospect and Tipping collaborated throughout the detailing process to ensure the system choice didn't adversely impact the desired construction sequence and timeline, and the mast frame braces were detailed to be field-erected between shop-installed gussets, similar to standard BRBs. Prospect also eased the process by providing pricing feedback early on to facilitate informed decision-making regarding design changes for the building owner. In addition, tolerances for the mast frame system were tighter than typical framing, resulting in a more challenging process for steel erector JD2 and necessitating some field modifications. The team took a more conservative approach when implementing the strong-back system on this building, but the hope is that more flexibility can be built into the design with future projects incorporating the system.

It's an appropriate system for a building like 1951 Harbor Bay Parkway, whose tenant is focused on the future of tumor research, as it illustrates an innovative approach for seismic bracing in future projects that require enhanced seismic performance. This significant improvement in seismic design provides a replicable example that can be readily adapted by structural engineers to create safer and more resilient buildings in the future. ■

**Owner**
srmERNST Development Partners, Oakland

**General Contractor**
Pankow, Oakland

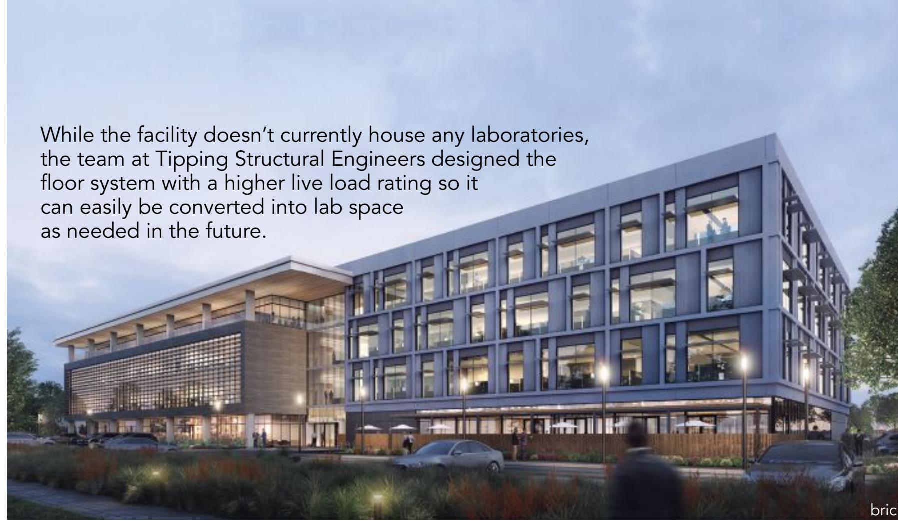
**Architect**
brick., Oakland

**Structural Engineer**
Tipping Structural Engineers, Berkeley, Calif.

**Steel Team**

**Fabricator and Detailer**
Prospect Steel Company, A Division of Lexicon, Inc., Little Rock, Ark.

**Erector**
JD2, Inc., Auburn, Calif.



While the facility doesn't currently house any laboratories, the team at Tipping Structural Engineers designed the floor system with a higher live load rating so it can easily be converted into lab space as needed in the future.

brick.

**Leo Panian** is a principal, **Gina Beretta** is an associate, and **Isaac Williams** is a senior project engineer, all with Tipping Structural Engineers.

# Framing the Front Door

BY DARIUSZ KLIMEK


**DRIVING ON INTERSTATE 35** through Waco, Texas, it is impossible to miss Baylor University's latest addition.

Scheduled to open in the fall, the new 120,000-sq.-ft building, the Mark and Paula Hurd Welcome Center, is punctuated by four light towers and was designed as a front door for the school, inviting visitors to explore, experience, and enjoy the campus, which sits adjacent to I-35. Located in the building's 70-ft-tall Grand Hall, the light towers extend from the floor all the way through the roof to a height of 96 ft, providing beacons of light that draw the eye and act as lighthouses of a sort. Though complex in design, careful coordination between the steel fabricator and the steel detailer facilitated their easy erection.

The building's exterior façade is a combination of glass, masonry, and metal panels, and interactive technology within the Grand Hall creates an immersive experience for visitors. In addition, the Center also features a 1,000-seat ballroom with folded partitions for flexible space arrangement, a fan-themed spirit shop with Baylor apparel and merchandise, a restaurant, a 250-seat auditorium cantilevered from the back of the building, and office space for university operations.

## Cantilevers and Trusses

The structural framing system for the building incorporates approximately 1,400 tons of structural steel, metal deck, and miscellaneous metals. This includes the light pillars, which are constructed of curved round hollow structural sections (HSS) and are covered with light-transmitting panels, with each tower weighing 21.5 tons. The roof of the Grand Hall is impressive in its own way, incorporating eight unique steel trusses, each over 100 ft long. Seven of these trusses were built with chords made from WT members and steel angle diagonals, and the remaining truss consists of horizontally oriented welded wide-flange sections welded together. Each truss was divided into three segments with bolted splice plates to facilitate transportation to the site from Alamo Structural Steel's fabrication shop.

The Grand Hall's roof is sloping and tapered in plan from front to back of the building, and the spacing of secondary beams spanning between the roof trusses is uneven due to the towers projecting through the roof, prompting structural engineer Walter P Moore to brace the trusses with chevron angle braces. The

Baylor University's stunning new welcome center is anchored by four signature steel towers that came together perfectly thanks to precision detailing and fabrication.

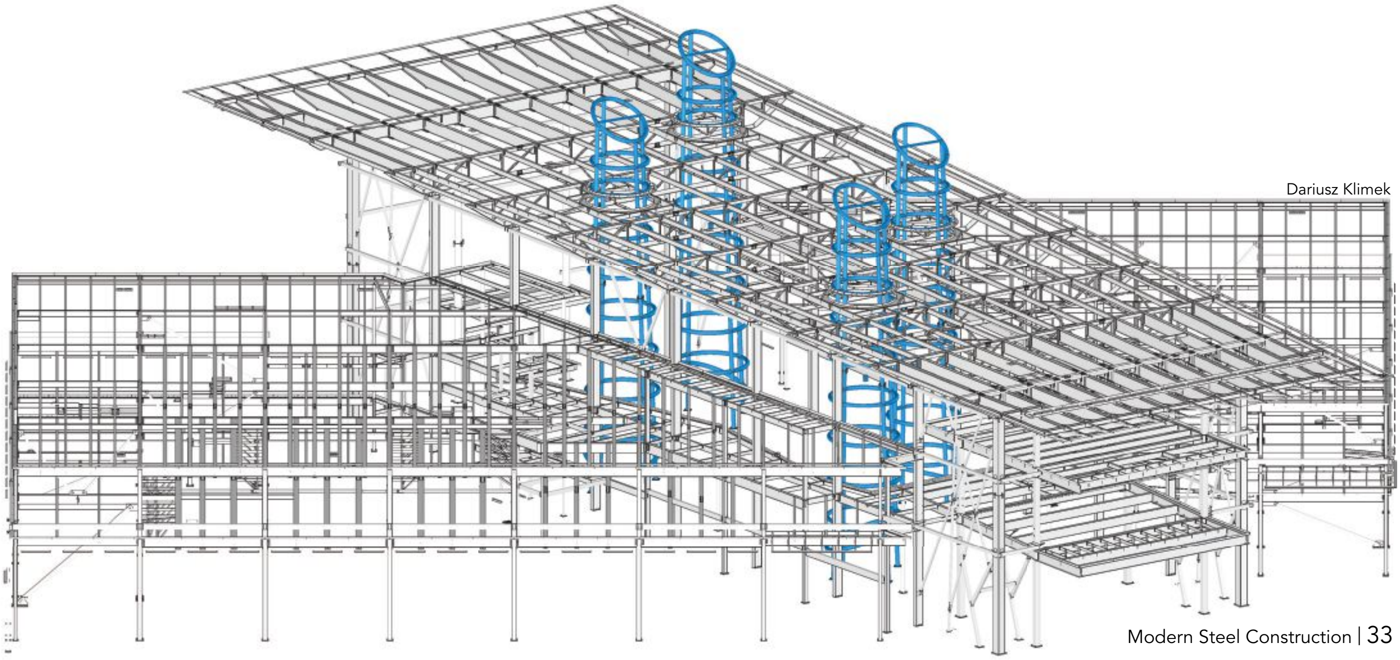
Dwayne and Marcie Reed

Reed Davidson/Perry and Perry

above: The steel light towers extend from the floor all the way through the roof to a height of 96 ft.

left: Baylor's new 120,000-sq.-ft Mark and Paula Hurd Welcome Center serves as a new "front door" for the University.

below: A structural model of the building, highlighted by the rings of the four steel towers.



Dariusz Klimek


Dwayne Reed

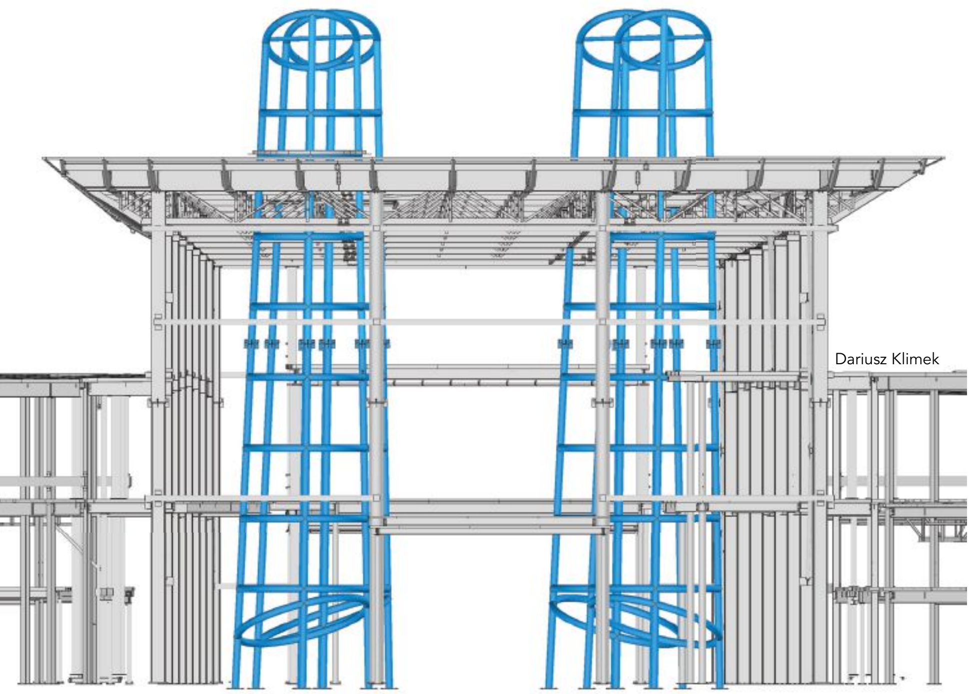
Keegan FischerAlamo Steel

above: A tower ring on the fabrication shop floor.

left: The building's exterior façade is a combination of glass, masonry, and metal panels.

below, left: Framing for the Grand Hall.

below, right: Connecting HSS elements in a tower assembly.



Dariusz Klimek

Keegan FischerAlamo Steel

roof is also supported by 60-ft-tall 24-in. by 24-in. box columns made of 1-in. plate and HSS18×18×½. Projecting 45 ft from both the front and back of the Grand Hall are two entrance canopies supported by W36 roof beams. The auditorium provides another cantilevered element, projecting 20 ft beyond the façade thanks to W27 members, and two-story steel-framed wings extend from either side of the Grand Hall.

## Unique Perspectives

The four light towers aren't just decorative. Visitors can actually enter each one for a unique perspective. Each tower is 20 ft in diameter at the bottom and 14 ft at the top—essentially a tilted oblique cone. The structural framing for each consists of four sloping columns, and the columns are connected by ten rings. All of these elements are made of 12-in.-diameter HSS, with the middle eight rings in each tower being round and the top and bottom rings being oval.

Due to the sloping nature of the columns, the rings are not perpendicular to the columns, and the entrance to each tower is oriented differently, so the bottom ovals are unique for each tower. Since towers penetrate the roof, they require plate collars with oval-shaped fitted cut-outs to support the roof deck. While the geometry for these elements is complex, Steelweb's team was able to detail each tower with all pipes intersecting precisely at centerlines and create 2D drawings for the rolled pipes cut in all three dimensions. Any misalignment would result in an incorrect pipe cut-out shape, which would result in difficulties when welding the pipes.

## Fabricating the Towers

From the very beginning, it was obvious that fabricating the towers would be a more involved process than most simple stick-built projects. To streamline the process of rolling the HSS and ensuring precise cutting, fitting, and welding and to meet scheduled dates, the material was ordered well in advance and delivered

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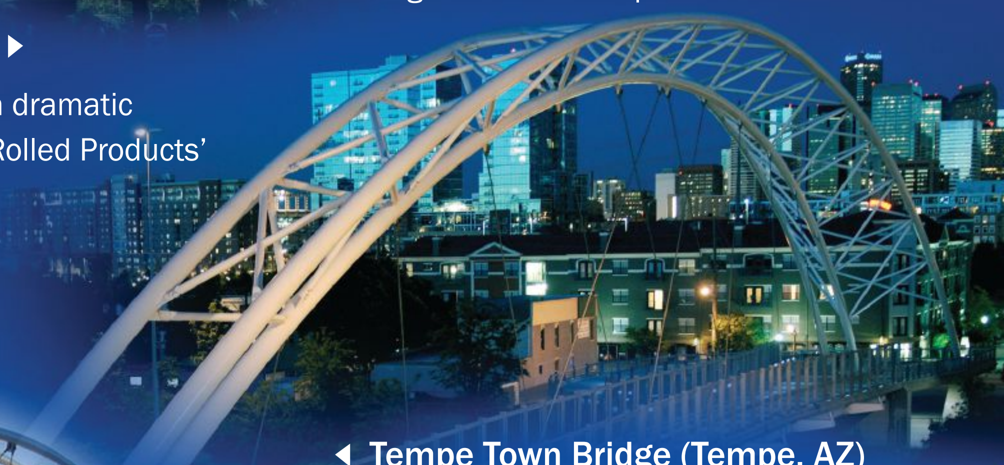

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| 13 | Tee Stem Up | MEAN DIA. | 22" x 142 $^{1}/_{2}$# Tee |
| 14 | Angle Heel In | INSIDE DIA. | 8" x 8" x 1" Angle |
| 15 | Angle Heel Out | OUTSIDE DIA. | 8" x 8" x 1" Angle |
| 16 | Angle Heel Up | MEAN DIA. | 8" x 8"x1" Angle |
| 17 | Square Tube | INSIDE DIA. | 24" x $^{1}/_{2}$" Tube |
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Despite Alamo Structural Steel having a shop in Waco, where the project is located, it fabricated the towers at its larger shop in Victoria, Texas, since the team wanted to test assemble the towers before shipping them to the site.

Keegan FischerAlamo Steel

Keegan FischerAlamo Steel

to the bender as early as possible. Creating shop drawings for so many curved elements becomes a much more involved process, given that once a member is rolled to its desired radius, there is no turning back. Unlike a straight member that could potentially be modified, it has one specific place and way it can fit into the structure. If it doesn't, it becomes scrap and must be replaced—which, of course, requires additional material and the time and money spent recurving it.

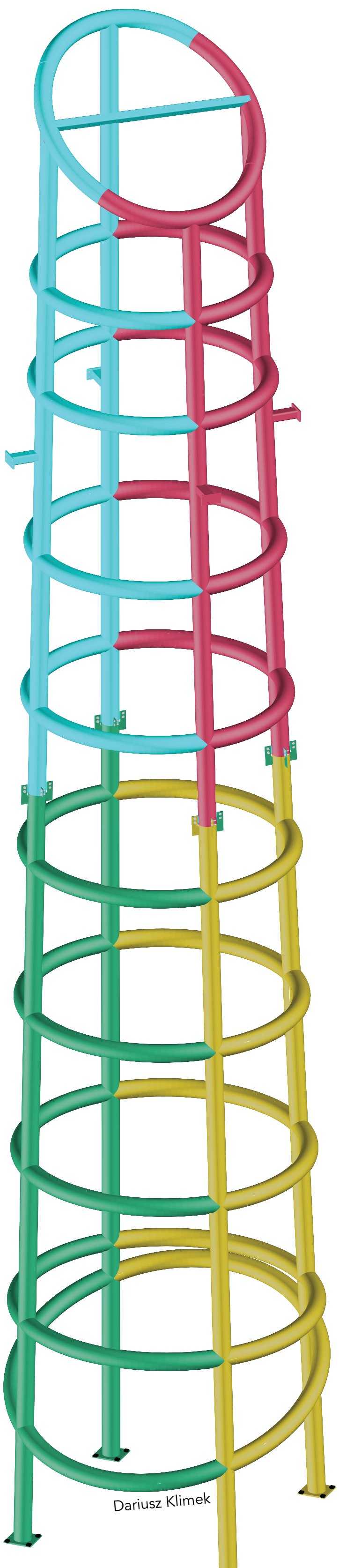
As such, any structural issues had to be spotted early in the process, especially when it came to splice details. Initially, the towers were divided into eight segments, but this design was revised to remove difficult field-bolted splices with two through plates at the midpoint of each ring to avoid cumbersome cut-outs. Instead, the team implemented field-welded splices and divided each tower into four segments. In this updated design, each segment consisted of two columns and half of a ring, with one end prepared to fit with the column.

The transition from a virtual model to reality with such complex detailing was challenging. The towers were drawn horizontally and rotated to be square with the fabrication shop floor, and each HSS ring had to be torch-cut to fit precisely to a column, which required paper templates to lay down the cutting line. However, due to the curved shape of the rings, the HSS couldn't be drawn as an unfolded surface. In order to print the templates from an unfolded surface drawing, the team needed to model additional elements and match each one with its corresponding ring end. In the end, the designers created and printed 40 templates at a 1:1 scale and wrapped them around the HSS ends.

Despite Alamo Structural Steel having a shop in Waco, it fabricated the towers at its larger shop in Victoria, Texas, since the team wanted to test-assemble the towers before shipping them to the site. And even at the Victoria shop, it was a tight fit. Once the tower was fabricated and assembled in the shop, the clearance to the underside of the gantry crane was a mere 2 ft.

right: A look inside the lobby and one of the light towers, which were all clad with light-emitting panels.

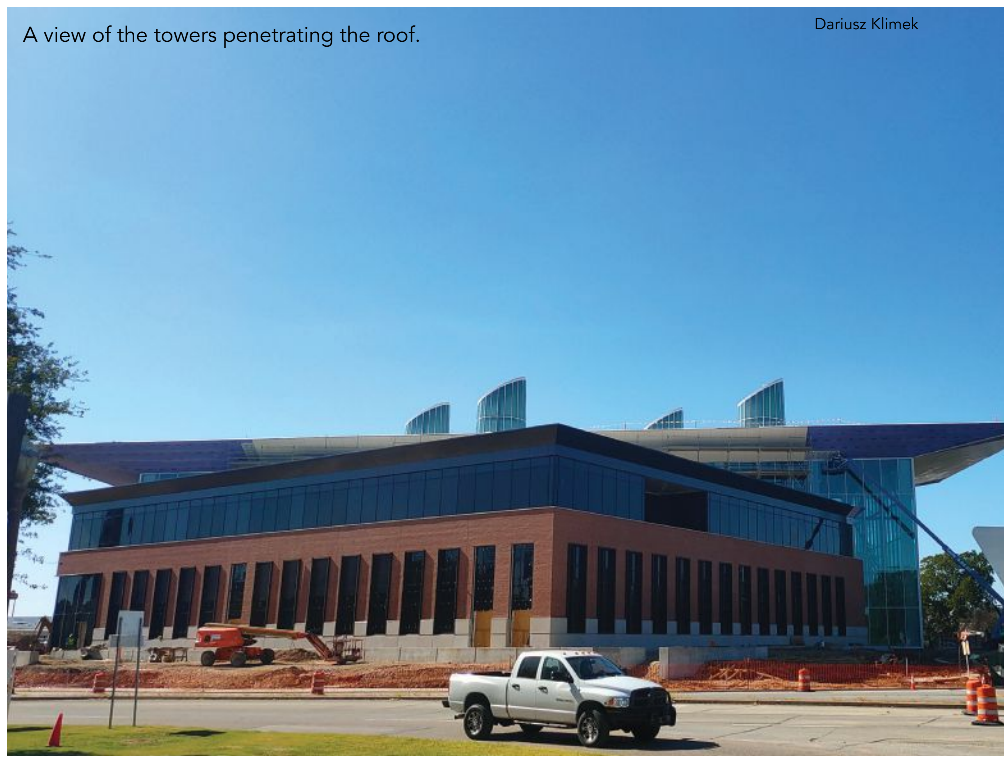
below: The structural framing for each tower consists of four sloping columns, and the columns are connected by ten rings.



Dariusz Klimek

Dwayne Reed


Dwayne Reed



A view of the towers penetrating the roof.

Dariusz Klimek


The Grand Hall roof incorporates eight unique steel trusses, each over 100 ft long.

Reed Davidson/Perry and Perry

The towers were fabricated via jigs, with sloping columns oriented horizontally. To ensure a tower was locked in place and would not move, Alamo ordered and implemented custom U-shaped bolts to fit the HSS. The copes on the ring-to-column connections were not symmetrical due to the tower tapering in diameter from bottom to top, so shop fitters had to ensure the ribs were oriented in the correct direction to avoid large gaps between the elements. Since the connections were detailed and cut very precisely, the fitters had to beat the rings into place with sledgehammers from both ends. Installing the ribs required special rigging straps because chains would not keep the round HSS from slipping. Once the rings were fitted in place, they could be welded.

Since the top ring on each tower is on a pitch, it is an oval rather than perfectly round. The top ring assembly was fabricated flat on the shop floor and then rigged up and hung. The ring had to be located perfectly to fit the top of all four columns snugly in the copes, which required significant crane time—rigging up and fit testing, lowering, adjusting straps, and refit testing until the connection was snug. The same challenge and sequence occurred with the bottom rings, which were also skewed and oval.

After a tower was welded, it was separated into four sections per the revised design (two sections each for the top and bottom half), and each tower section lift required two operators and two cranes. Prior to separating the tower at the splice locations, Alamo had to weld wide-flange bracing across the assembly (widthwise). This bracing served two purposes: it kept the ribs/rings from pulling inwards after welding and also created a flat surface that would sit on the deck of the trailer during transportation.

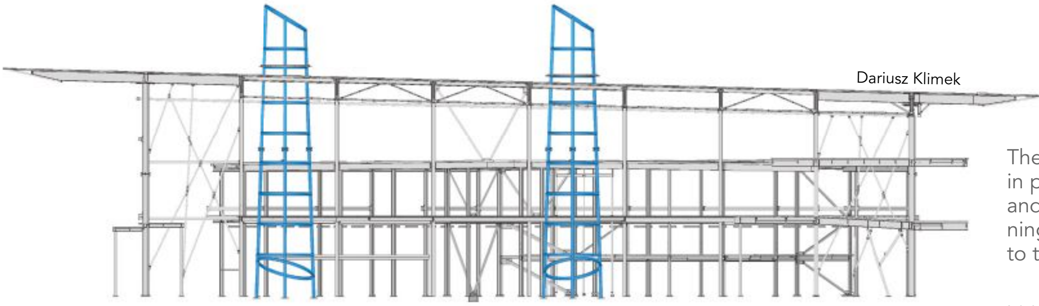
## Building the Towers

Thanks to the precision detailing and fabrication, including test assembly in the shop, the erection process became easier than anticipated. The anchor bolts were dead on, the erection aids and HSS were coped perfectly, and everything went into place as intended, with no costly field adjustments.

"There aren't any complaints from the erection side at all," noted Reed Davidson, project manager for one of the project's right and below: Framing for the light towers during construction.


Reed Davidson/Perry and Perry


Dariusz Klimek

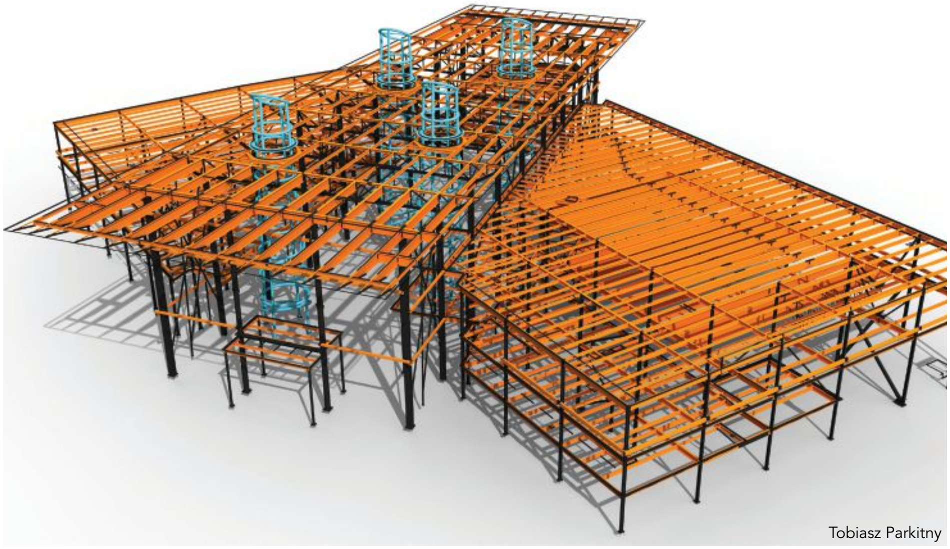


Dariusz Klimek

The Grand Hall's roof is sloping and tapered in plan from the front to back of the building, and the spacing of secondary beams spanning between the roof trusses is uneven due to the towers projecting through the roof.

Dwayne Reed

The Center features a 1,000-seat ballroom, a fan-themed spirit shop, a restaurant, a 250-seat auditorium cantilevered from the back of the building, and office space for university operations.



Tobiasz Parkitny

The building incorporates 1,400 tons of structural steel framing in all.

general contractors, AISC-certified erector Perry and Perry Builders. "I was dreading the towers at the beginning of the project, but once the first one was up and put together, it made us all more comfortable in the field. Looking back, I don't believe there is anything that we all could have done differently to make this easier and/or a better product for the customer. That's what happens when you have a great team that works together with the detailing team and fabricators that know what they are doing."

The lightness of the towers belies their complex planning, detailing, and fabrication, but that's exactly as it should be. And these signature elements, as well as the rest of the Grand Hall and the facility as a whole, create a stunning new first impression and front door to Baylor to welcome students, faculty, and visitors to its campus. ■

**Owner**
Baylor University, Waco, Texas

**General Contractors**
Vaughn Construction and Perry and Perry Builders, Inc.

**Architect**
Populous, Kansas City, Mo.

**Structural Engineer**
Walter P Moore, Houston

**Steel Team**

**Fabricator**
Alamo Structural Steel (AISC Certified Fabricator), Waco

**Detailer**
Steelweb, Inc. (AISC Detailer), Coral Springs, Fla.

**Dariusz Klimek** (dk@steelweb.com) is a detailing team leader with Steelweb, Inc.

An innovative new construction technique safely speeds up steel building erection—in reverse order.

# Top to Bottom

BY MARK TAMARO, PE, AND DOUGLAS SCHWEIZER, SE, PE

LIFTbuild

LIFTbuild

Unlike the famous "Lunch atop a Skyscraper" photo, the ironworkers on a LIFTbuild project are much closer to the ground.

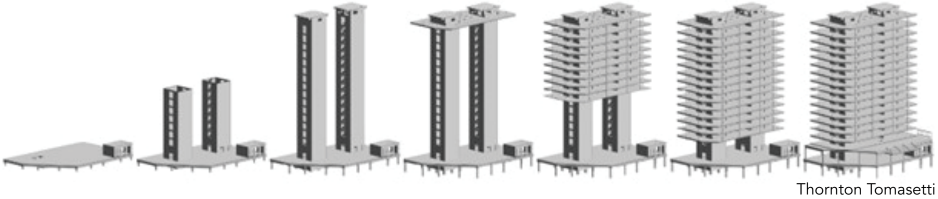
**DETROIT'S NEWLY CONSTRUCTED** Exchange building stands out in its neighborhood.

The steel-framed residential tower, located in the city's Greek Town neighborhood, rises 16 stories and 207 ft high, an eye-catching structure compared to the surrounding low-rise buildings. The new tower, which opened in June, is also notable for another reason: It's the first project in the U.S. to be built using the LIFTbuild delivery method.

What is LIFTbuild? It's a new process that focuses on completing most of the construction at ground level and then using strand jack lifting technology to raise each completed floor to its final elevation. Simply put, building assembly is completed from top to bottom. After the vertical cores are constructed, the roof floor plate, followed by each consecutive floor below it, is assembled on the ground and raised into place. Because the curtain wall is installed at ground level, each floor is fully enclosed when lifted and permanently locked into position. This affords the builder the opportunity to begin the final fit-out of the interior spaces while the subsequent lower floors are still being assembled. The Exchange project, constructed by Barton Malow subsidiary, LIFTbuild, Inc., and engineered by Thornton Tomasetti, Inc., implemented the LIFTbuild methodology for 14 floors and the roof level, followed by constructing a conventional steel-framed podium with a larger footprint.

With a nod toward Detroit's automotive industry, LIFTbuild is much like an assembly line. Unlike traditional construction methods, which require erection, labor, and materials to all follow the building upward as floors are built, the LIFTbuild approach completes the steel erection, deck and floor plate installation, façade attachment, building services and systems, and interior build-out out within 6 ft of the ground. Time spent hoisting materials and tradespeople and navigating the critical paths of tower crane hook time, as well as the associated safety concerns, are all eliminated when activities occur at ground level, and the repetitive nature of the work can improve efficiency and production with each subsequent floor assembly.

Exterior fall protection on the lifted floors is unnecessary since the permanent façade is already in place. Because assembly is performed with small cranes and erection aids and much of the material is placed directly from the delivery truck to the floor deck (prior to lifting), the risks associated with thousands of high lift or blind crane picks are eliminated. Additionally, once the floor plate is locked into place at the final elevation, the floor is weather-tight and conditioned, allowing for an early fit-out of the interior spaces. The Exchange project also used other pre-fabrication technologies, such as unitized long-panel façade elements, to further facilitate speed and quality of construction.



Thornton Tomasetti

opposite page: The LIFTbuild method focuses on completing most construction at ground level and then using strand jack lifting to raise each completed floor to its final elevation.

above: A step-by-step look at the LIFTbuild process.

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LIFTbuild

above: Floor framing with integrated MEP systems. Because the cores support the full gravity loads of each floor, the interior space and perimeter can be column-free, and foundations are primarily centered beneath the cores.

below: The completed building.

LIFTbuild

As with any project using new construction technologies, the Exchange project involved challenges to overcome and lessons to be learned. However, the success of this vertical manufacturing can be evidenced by a significant reduction in construction time for each completed floor as the approach was fully calibrated.

## LIFTbuild Basics

The structural system relies on interior cast-in-place concrete cores, which function as both the primary lateral and gravity-resisting systems. Constructing the cores precedes floor construction and is accomplished via traditional slip-forming or jump-forming methods. The cores are sized to accommodate stairs and elevators as well as other permanent building services and back-of-house spaces. Because the cores support the full gravity loads of each floor, the interior space and perimeter can be column-free, and foundations are primarily centered beneath the cores. This is particularly beneficial for sites constrained by adjacent properties, and it eliminates risks associated with foundations at or near the property lines that could conflict with neighboring structures; the Exchange project had such a constraint due to the proximity of the Detroit People Mover elevated train system, which straddles the property line of the site. The centrally located cores concentrated the new building loads in the middle of the site and away from the People Mover foundations.

Each floor was supported by two primary girders that are permanently attached to the core and cantilever across the length of the building. The remainder of the floor framing was supported by these girders, and cantilevered beams extended toward the building perimeter. In lieu of labor- and fabrication-intensive moment connections, the design team implemented pass-through connections using wide-flange-shaped penetrations in the primary girders, allowing the secondary members to pass through them. The cantilevered beam connections greatly simplified steel erection and eliminated the need for field-installed moment connections. Floor cambering was set at ground level before the floor plate was poured, and then the façade was installed and adjusted vertically to accommodate any variation in the final camber. In addition, the team optimized steel splice locations to achieve efficient steel member lengths and simplify the camber and erection process.

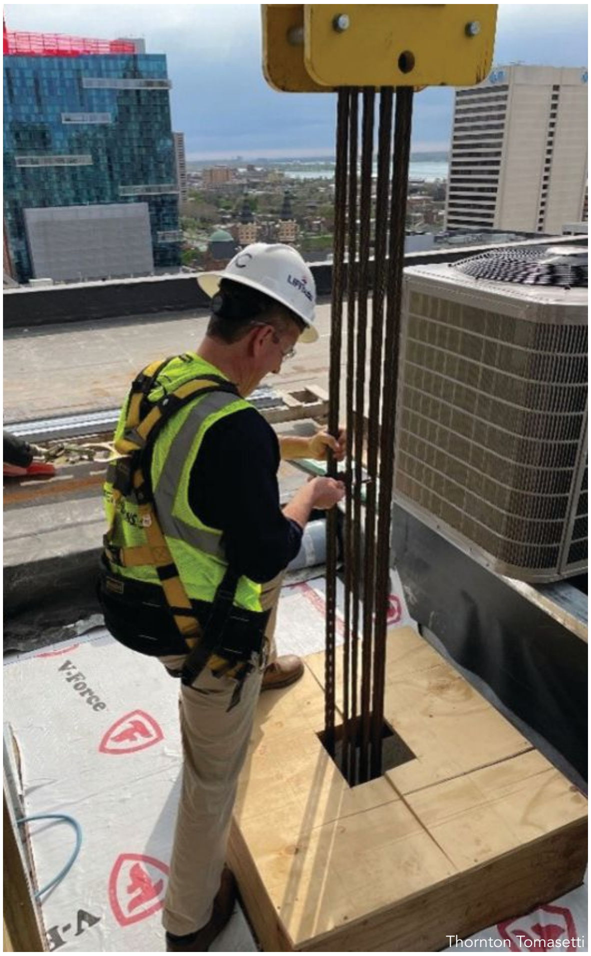
The design incorporated a wide-flange steel boundary element at each corner of the cores to permit a reliable steel-to-steel connection capable of transferring floor plate loading directly to the cores. The connection was designed and detailed to accommodate steel tolerances and allow for adjustment and quick fit-up prior to locking in the floor.

The steel framing was fit up and connected at ground level in approximately two days with a single steel erection crew of fewer than ten people. Additional tolerance was incorporated into the connection designs where the primary girders were permanently connected to the steel embedded in the cores. As each floor was locked in its permanent position, final adjustments to the façade were accomplished from the interior space, which ensured that all façade panels were sealed correctly and could accommodate the appropriate amount of in-service live load floor deflection. Coordination between the structural and curtain wall engineers was critical to establishing the design values for the curtain wall joints and to build in suitable tolerances at the column-free perimeter.

Speaking of coordination, it is critical between the general contractor, designers, and subcontractors for the successful planning and construction of a LIFTbuild project. LIFTbuild (a Barton Malow subsidiary), along with Ghafari Architects and structural engineer Thornton Tomasetti (which also performed steel detailing), participated in numerous planning and design charrettes with lifting subcontractor Engineered Rigging, the steel fabricator, and Contract Glaziers Inc., the curtain wall supplier. Because of the unique construction sequencing, all parties weighed in on potential risks and improvements to the process. Preconceived concepts of how a building is normally built had to be reconsidered, and these early planning steps also led to improvements in connections and contractibility. With the entire team focused on increasing efficiency and quality, each trade's workflow was evaluated. As the floors were raised, improvements were suggested and incorporated, resulting in a fully closed-in and conditioned floor completed every ten days. Interior core and shell fit-out was taken off the critical path and was completed from the penthouse downward well in advance of completion of the lowest levels.

With the LIFTbuild approach, Exchange was able to successfully achieve its schedule and safety goals. Equally important, it demonstrated the potential of this innovative alternative delivery method—which is clearly on the way up. ■

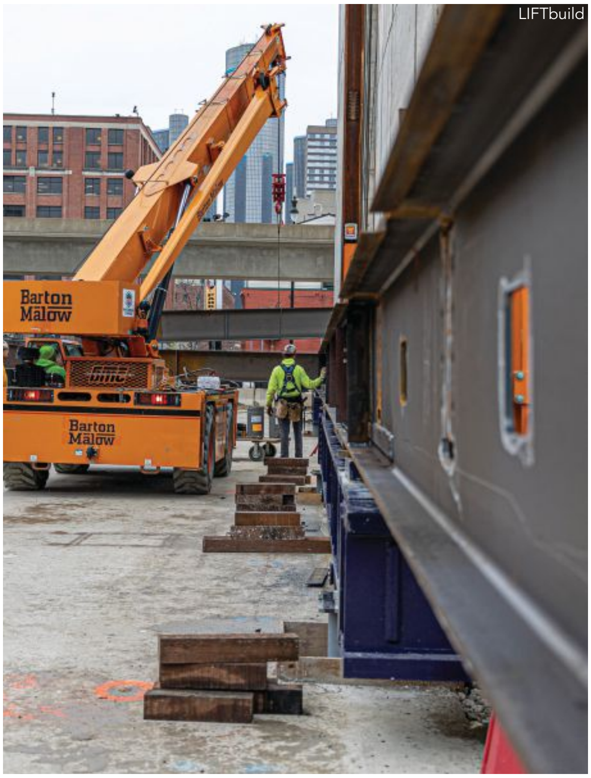
**Mark Tamaro** (**mtamaro@thorntontomasetti.com**) is a managing principal and the Mid-Atlantic South region leader, and **Douglas Schweizer** (**dschweizer@thorntontomasetti.com**) is an associate, both with Thornton Tomasetti.



Thornton Tomasetti

above: Jack lifting equipment.

below: Steel framing was fit up and connected at ground level in approximately two days with a single steel erection crew of fewer than ten people.




LIFTbuild

Industry partnerships between colleges and fabrication facilities can provide crucial experiential learning, as illustrated by a recent endeavor in St. Louis.

# Partnering Up

BY J. CHRIS CARROLL, PE, PHD

Hillsdale Fabricators

**ST. LOUIS HOLDS HISTORICAL SIGNIFICANCE** to the civil engineering community as the home of two historic steel landmarks: the Eads Bridge and the Gateway Arch.

The city is also home to an abundance of civil engineering-related industry that provides opportunities for various forms of collaboration, from site visits to internships and more. Recently, Saint Louis University's (SLU) Civil Engineering Program—with its strong focus on experiential learning—partnered with AISC member Hillsdale Fabricators, a Division of Alberici Constructors, which is located about five miles from campus, for two new opportunities for SLU students. The first was a site visit to Hillsdale's shop along with a welding tutorial, and the second was an opportunity for student teams in the "Introduction to Structural Design" course to work with certified welders at Hillsdale to fabricate their own steel plate girders.

## Site Visit and Welding Tutorial

For the site visit and welding tutorial, groups of SLU students visited Hillsdale's shop, which began with an introduction to the company and an overview of its recent and current steel-related projects. Hillsdale personnel then led small groups of students through the facility, where they learned about the logistics and processes of steel fabrication, including moving steel into the shop from the staging yard, how the facility uses automated processes to prepare members for fabrication, how detailed fabrication takes place within the shop, and how steel members are prepared for transportation to the project site. Each group of students also completed a welding tutorial in preparation for their plate girder project.

Hillsdale Fabricators

Tyler Warren/Alberici

## Plate Girder Project

The structural design course and its concurrent lab component include both reinforced concrete and steel design. The steel portion of the lecture course covers flexural members, compression members, beam-columns, and tension members and connections. The material is presented in a different order than in traditional steel design courses because of the time needed for the plate girder design and fabrication. Likewise, the second half of the lab section focuses on the plate girder project, which has been an annual class project competition in its current form since the spring of 2019. The purpose of the project is for students to connect the concepts from mechanics and steel design, with a primary focus on shear flow and its importance when creating a built-up section along with the various failure modes of I-shaped members. The objectives of the plate girder project are to:

1. Design a built-up steel beam using various sizes of steel plate
2. Calculate the capacity of a built-up steel beam using the AISC *Steel Construction Manual*
3. Fabricate a built-up steel beam
4. Test a built-up steel beam subjected to a single-point load

**Specimen specifications and design.** The length of the steel plate girder must be 10 ft, 9 in.; the ends of the plate girder must accommodate a standard shear tab connection; and the height and width of the cross section may not exceed 7 in. and 6 in., respectively (see figure on page 46). The section must include a bottom flange and top flange along with a single web, and the dimensions


Tyler Warren/Alberici


Tyler Warren/Alberici

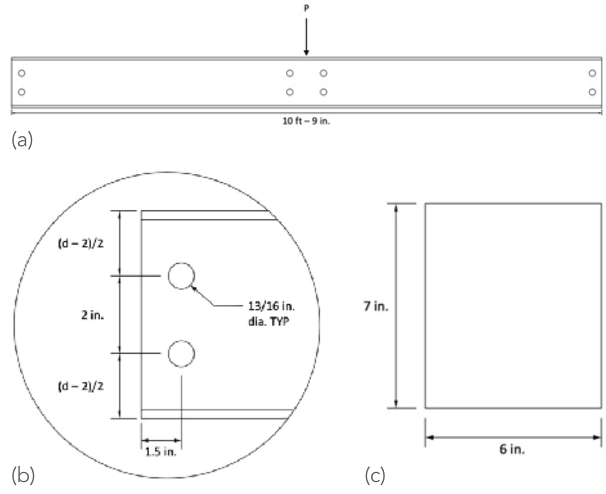



Plate girder details: (a) elevation view of plate girder, (b) detailed view of end connection, and (c) plate girder envelope.


Tyler Warren/Alberici

of each flange and the web may vary based on the available plate sizes. The plate thicknesses available for the flanges and webs are ⅛ in., $^3/_{16}$ in., ¼ in., and ⅜ in. (using 50-ksi steel plate). The plate widths available are 1½ in., 2 in., 3 in., 4 in., 5 in., and 6 in. However, the web must be at least 4 in. deep. The maximum weight of the plate girder is limited to 110 lb, including any weld material.

The student groups had approximately two weeks to design their plate girder following the presentation of flexural design, shear, shear flow, and weld design. The students first selected the size of their three plates to make up their I-shape. While nearly all groups designed a symmetrical section, they were not required to have the same top and bottom flanges. Students next calculated the predicted capacity and failure mode of their section, taking into consideration the yielding of the plastic section, elastic and inelastic lateral torsional buckling, and local flange buckling. After determining the predicted failure mode, students then checked shear strength and designed the weld required to join the web and flanges, which generally resulted in a staggered weld pattern along the top and bottom of the web intersection to the flanges. Students were cautioned to space their welds to avoid compression flange buckling between the welds. After students completed their designs, the specifications were sent to Hillsdale Fabricators, who created shop drawings for the students to review and check.

**Fabrication.** The Hillsdale team supplied the steel plate for each team and pre-drilled the holes in the web plate prior to arrival for the support connections and attachment to the gravity load simulator required for testing. Each student group was paired with a welder upon arrival at Hillsdale's shop. Students first prepped their steel plate by grinding the scale off the surfaces that would eventually be welded together. Students then used chalk to mark where their welds would be. The Hillsdale personnel helped students place their webs onto the first flange to ensure a square connection and tack weld them in place. The process was then repeated for the top flange. Next, the students took turns welding the flanges to the web. In total, the fabrication process took about four hours to complete, and Hillsdale delivered the beams to campus a few days later.

**Testing procedures.** The testing process took about one hour per beam, including setup, testing, and takedown. Each beam was weighed to ensure it did not exceed the allotted 110 lb. Each beam was then placed in the test setup and tested one at a time with a single point load applied at mid-span of a 10-ft, 6-in. center-to-center span using a gravity load simulator bolted to the web of the beam. Each plate girder was required to support a minimum of

Tyler Warren/Alberici

## Acknowledgments

The author would like to thank Hillsdale Fabricators and Alberici Constructors, specifically Kenny Flowers, Tony Diebold, Thomas Milleville, Ryan Schroeder, John Robertson, Louis Terbrock, Seth Moore, and Geoff Wick. While the steel plate girder project was not directly related, the ability to test the plate girders is a direct result of work supported by the National Science Foundation under Grant No. 1726621. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation. The author would also like to thank AirGas and Lincoln Electric for their academic discounts on welding equipment.

Tyler Warren/Alberici

Chris Carroll

5,000 lb, and failure to support that load would result in disqualification and zeroes for the competition portions of the grade. The competition portion of the project included class rank in two categories: ultimate load supported and structural efficiency. Students were also evaluated on the accuracy of their load predictions. In total, performance was worth 20% of the overall grade.

The 2022 and 2023 competitions featured a total of seven teams, and each team successfully predicted their failure mode: one elastic lateral torsional buckling, two inelastic torsional buckling, and four local flange buckling. The maximum load supported ranged from 8,500 lb to 11,500 lb, and the strength-to-weight ratios ranged from 84.2 to 109.1. Students submitted a final calculation package that included their design specifications and drawings, ultimate load prediction, discussion of results, and lessons learned. The students were encouraged to be creative and innovative and to learn from failure without fear of repercussions. In the event a team did poorly in the project's overall performance, they could make up for it in the lessons learned section of the final project report. Lastly, team member evaluations were also included to account for how well individuals functioned in a team. ■

**J. Chris Carroll** (chris.carroll@slu.edu) is an associate professor and chair of the Department of Civil, Computer, and Electrical Engineering at Saint Louis University's School of Science and Engineering.

# Elevating Electric Vehicles

## This year's Forge Prize winner looks to a perhaps-not-so-distant future in which typical gas stations become electric vehicle charging stations that double as steel works of art.

**A CONCEPT THAT WOULD USE** structural steel to reinvent the gas station experience for the EV age has won AISC's 2023 Forge Prize.

The annual competition celebrates emerging architects who create visionary designs that embrace steel as the primary structural component while exploring ways to increase project speed.

LVL (Level) Studio collaborators Jeffrey Lee, Christopher Taurasi, and Lexi White won the $10,000 grand prize, collaborating with Schuff Steel senior vice president Christian Crosby to refine their Electric Oasis vision and make the process of bringing it to life in steel more efficient.

The judges were particularly impressed by the team's thoughtful approach, which turns a banal task into a destination event.

"You've taken something very mundane that we give not a second thought to usually and injected a certain level of magic—not just waiting for the charging, but also what you can do with that time," said Forge Prize Judge Melanie Harris, AIA, LSSYB, NCARB, who is the national healing practice director at BSA LifeStructures. "We're all looking for efficiencies in our life these days, and the last thing we want to do is wait around and do nothing while we wait for our cars to charge."

The time it takes to recharge, the team noted, is one of the primary differences between a gas and electric vehicle.

"On average, a gas stop takes around seven minutes to refill a tank," Lee said. "A level-two charging station, which is the most common type, takes upwards of four and a half hours for a full charge. We have an opportunity to reimagine the gas station typology into something that can revitalize the local economy."

So what to do with that time? In their vision, motorists would relax, work, play, shop, or perhaps even get healthcare while their vehicles charge—all activities that offer new economic opportunities for small communities around highway interchanges.

These charging stations are defined by striking steel canopies that offer shade. In their primary use case, for a site within the average EV range of both Los Angeles and San Francisco, a pathway winds through the canopies, offering vistas and an engaging space in a loop that takes about 15 minutes to explore.

The pathway connects buildings that would house retail and other spaces—with photovoltaic panels on the roof, naturally. Those hubs feature a steel scrim that is both beautiful and functional, providing shade that would reduce solar gain by up to three hours a day.

The design takes advantage of steel's unique modular potential to facilitate economical, rapid erection—and steel's unique recyclability and circular supply chain add an additional layer of sustainability while reinventing the existing infrastructure.

"This is a vehicular kind of society," noted Forge Prize Judge Rona Rothenberg, FAIA, DBIA, the 2022 president of AIA California, noting that it's applicable to a vast number of sites across the country. "This is a great way to reuse what we already have and transform it into a resilient, sustainable, and lasting solution."

What motorists may not see while they're enjoying the amenities: soil remediation. The design includes a mechanism to clean up any ground contamination left over from the site's use as a gas station.

LVL (Level) Studio was one of three finalists in the competition. First runners-up Junior Carbajal and Masamichi Ikeda (both with JRMA Architects Engineers) won praise for their Adaptive Micro Cities design, which would create a self-sustaining virtual community with separate zones where people can live, work, and play all brought together with a series of modular boxes, to revitalize a small island in a Portland, Ore., industrial zone.

The judges were also impressed by the scale of second runner-up Then Le's (Huntsman Architectural Group) Trans-connect multi-modal transportation hub and its thoughtful plan for everything from high-speed trains to electric airplanes in San Francisco.

AISC would like to thank Melanie Harris, Sean Joyner (writer and communications strategist at Perkins and Will), and Rona G. Rothenberg for serving as this year's Forge Prize judges.

LVL Studio Team

LVL Studio Team

**WINNER**

## Electric Oasis

Bowerbank, Calif.
Jeffrey Lee, Christopher Taurasi, and Lexi White, LVL (Level) Studio

AISC Member Fabricator Partner: Christian Crosby, Senior Vice President, Schuff Steel

The U.S. economy and infrastructure are at a moment of evolution as we pivot away from carbon-based fuels. The passing of the Infrastructure Investment and Jobs Act will provide funding to overhaul the nation's infrastructure, while the Inflation Reduction Act funds efforts to reduce greenhouse gas emissions. On the state level, California recently passed legislation to ban the sale of gas-powered automobiles by 2035. Incentives to reduce GHG emissions and California's efforts establish a fast-approaching deadline. At the forefront of emerging technology and ease of construction, the steel industry is prepared to meet this quickly approaching demand.

With this in mind Electric Oasis envisions a rapidly deployable steel system capable of converting existing gas stations to EV charging destinations. The current business model for gas stations is based on fast customer turnover, with profits made from the sale of fuel and snacks, with the average gas station visit lasting only three minutes. Due to the current EV charging capacities, these visits are expected to increase to at least 15 to 30 minutes. This poses an opportunity for businesses and localities to commoditize this experience by offering amenities not typically found at gas stations. Playful pathways instead provide an element of recreation with opportunities to rest amongst beautifully constructed steel "trees."

In order to demonstrate this theory, a site was selected along the interstate between Los Angeles and San Francisco, approximately 200 miles north of the former and the current limit of the average EV battery charge. The existing gas station is retrofitted with steel shading and a brown-field site remediation system that can be erected quickly. Steel helical pier footings give rise to "trunk" columns that branch into sleeves capable of spanning wide drive aisles. These cylindrical branches house lighting and provide shade for the intense California sun. The footings below are fitted with aeration branches to remediate the site from the previous ethanol contamination. Meandering walkways cantilever from the trunks, providing a winding path with overlooks to entertain patrons awaiting their charge. Amenities are housed inside solid masses that float above the ground and are clad in a steel mesh facade. The charge station of the future will be a place to grab a bite and recreate amongst a new steel-inspired landscape.

Gas station sites contain heavily contaminated soils due to leaking storage tanks, thus posing health risks to the communities they reside within, as well as to the greater watersheds and agricultural lands. The switch to EVs provides an opportunity to remove these toxins. To achieve this, Electric Oasis integrates a bio-remediating aeration system into the footings of the long-spanning steel shade structures.

LVL Studio Team

LVL Studio Team

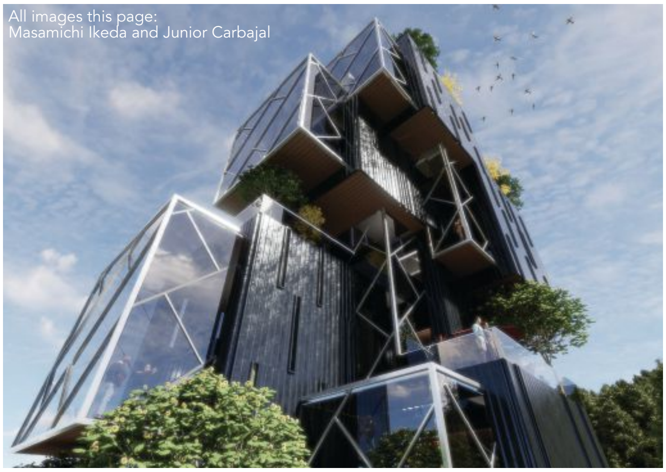
LVL Studio Team

**FIRST RUNNER-UP**

## Adaptive Micro Cities

Portland, Ore.
Junior Carbajal and Masamichi Ikeda, JRMA Architects Engineers

AISC Member Fabricator Partner: James Buchan, President and CEO, Alpha Iron



All images this page: Masamichi Ikeda and Junior Carbajal

The goal of Adaptive Mico Cities was to identify a desolate place that could be revitalized with an architectural solution driven by human energy. The proposed site—a small island located in an industrial zone next to the Willamette River in North Portland—has been slowly suffering from urban decay and abandoned heavy industrial processing facilities, resulting in a diminished human presence. We saw an opportunity to take advantage of the proximity to the river and other local amenities to create a catalyst space that, through the manifestation of people, can rejuvenate the district and enhance the community as a whole.

The solution takes the form of a self-sustaining vertical micro city housing the fundamental elements of everyday life: live, work, and play, a creation realized from the fusion of the current high-rise model, mixed-use zoning concept, and radical French urban planning notion of the modernist era. The most notable challenges with a site surrounded by water are the need for simplicity in design and constructability as well as maximizing the given space to its full potential. Our approach was to offer a modular design that could not only accommodate these demands but also be replicated under any given site constraints and conform to individualized programs anywhere.

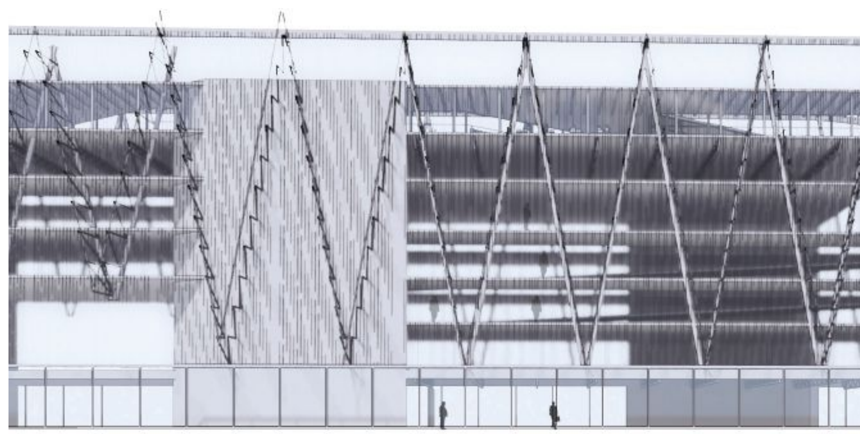
The building consists of boxes measuring 30 ft by 30 ft to provide living spaces. Each box consists of wall panels measuring 10 ft by 10 ft and 2.5-ft by 30-ft floor or roof members. The simplicity of the building's configuration can reduce the variety of member sizes, and all parts can be assembled with bolts. Selecting steel as the material for this structure allows strong connections that can be assembled and disassembled easily, and the parts are reusable for other sites if and when the structure is disassembled.

**SECOND RUNNER-UP**

# Trans-Connect

## San Francisco
## Then Le, Huntsman Architectural Group

## AISC Member Fabricator Partner: Casey Brown, President, Zimkor

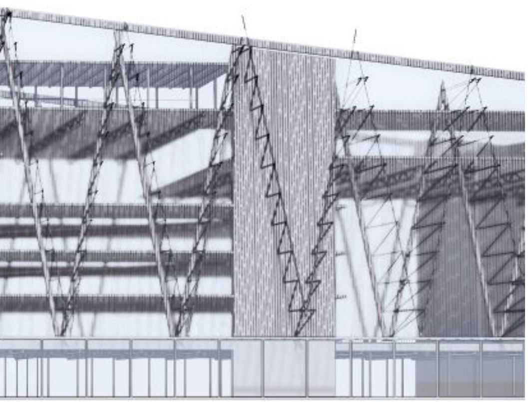


Urban areas will become denser and larger, GenslerOn forecasts, as Americans choose urban residential options over rural alternatives due to the advanced infrastructure in big cities. Transportation will become more multi-modal and less reliant on cars. Technologies are developing, even now, to improve human living conditions with new forms of transportation.

SoMa (the South of Market area of San Francisco) is the proposed location for a new center for transportation infrastructure, where people will be able to take a variety of transportation types, such as high-speed trains, shared rides, and electric airplanes for short-dis¬tance travel plans. The diversity of transportation choices will reduce real wait times for people, decreasing air pollution and creating a better urban environment.

Research has shown that SoMa can benefit from improved transportation infrastructure to reduce traffic within the local area. In this future scenario, as car ownership decreases, many areas in San Francisco will transition to other uses, such as mixed-use buildings or public spaces. Car ownership is predicted to decrease in San Francisco as on-site parking requirements are reduced or eliminated. ■

All images this spread: Then Le



# Third Time's the Charm

BY DANI FRIEDLAND

**For the third consecutive year, student engineers from the University of Florida took first place in the 2023 Student Steel Bridge Competition.**

**IT'S A THREE-PEAT** for Florida!

In 2021, the University of Florida bridge team took first place in the Student Steel Bridge Competition (SSBC), which took on a "Compete from Campus" format due to COVID. They followed it up by posting back-to-back in-person wins—last year at Virginia Tech and this year at the University of California San Diego—and becoming the first school in the competition's history to win three years in a row.

For this year's competition, AISC and the American Society of Civil Engineers (ASCE) challenged students across North America to design, analyze, fabricate, and construct a conceptual scaled steel bridge to serve as a hypothetical crossing in the San Diego National Wildlife Refuge.

The conceptual bridge would allow users to access trails on both sides of Sweetwater River and also provide better access for park service vehicles. It would be able to support the weight of pedestrians, cyclists, and equestrians as well as maintenance and park vehicles. This is a wildlife refuge, so engineers would have to respect the existing habitat—no construction activity could take place within the river.

Students rose to the challenge and put their designs to the test at 20 regional competitions at ASCE Student Symposia this spring. And in early June, the 43 top teams met at UCSD's LionTree Arena for the 2023 SSBC National Finals.

"It brings me such joy to see how the Student Steel Bridge Competition has such a positive impact on the students," said Kristi Sattler, SE, PE, PhD, AISC's university education manager. "Finals weekend was full of smiling students who were passionate about their bridges, enthusiastic volunteer judges who ensured a fair and safe competition, and sponsors who got to see firsthand the fruits of their financial contributions."

In addition to winning the overall prize (and $5,000 in scholarship money), the University of Florida had the fastest build, took first place for economy, and came in third for efficiency. They also took home the Frank J. Hatfield Ingenuity Award, which goes to the team that shows the most engineering ingenuity in the design and/or construction of their bridge based on the requirements of the competition rules.


Bob Shaw

## 2023 Winners

The final results of the 2023 SSBC National Finals are as follows:

**Overall**
University of Florida
Youngstown State University
University at Buffalo

**Speed**
University of Florida (5.80 minutes)
University at Buffalo (5.85 minutes)
South Dakota School of Mines and Technology (8.82 minutes)

**Lightness**
University of Texas at Arlington
Virginia Tech
South Dakota School of Mines and Technology

**Aesthetics**
Youngstown State University
Virginia Tech
University of Alaska Anchorage

**Stiffness**
University of California, Berkeley
University of California, San Diego
University of Wisconsin—Platteville

**Cost Estimate**
University of Alaska Fairbanks
South Dakota School of Mines and Technology
University of Arizona

**Economy**
University of Florida
University at Buffalo
Youngstown State University

**Efficiency**
University of California, Berkeley
University of California, San Diego
University of Florida

**Team Engagement Award**
University of Tennessee, Knoxville

**Robert E. Shaw, Jr. Spirit of the Competition Award**
South Dakota School of Mines and Technology

**Frank J. Hatfield Ingenuity Award**
University of Florida

**John M. Yadlosky Most Improved Team Award**
Harding University

**Video Awards**
Brigham Young University
Iowa State University
University of British Columbia


Bob Shaw

## A New Perspective

I am new to the world of steel, bridges, and students building steel bridges, and that's what made my experience in San Diego all the more exciting.

As I looked around LionTree Arena, it was bustling with life and bubbling with excitement as 43 teams took the floor throughout the day on Saturday.

The 2023 SSBC National Finals was my first-ever national competition, and while I didn't know what to expect, I'm glad I was able to witness all of the hard work come together to produce a healthy learning environment for everyone involved outside of the classroom and office space. And I saw firsthand what makes the SSBC so special to everyone involved.

The energy flowing from the students, judges, and other volunteers was infectious to everyone in the room. Whether it was in the form of silent support (a pat on the back or a fist bump) or shown in a more outspoken way (coordinated chants from classmates that came to support their team or impromptu cheers from the crowd), teams showcased their camaraderie and passion for the competition.

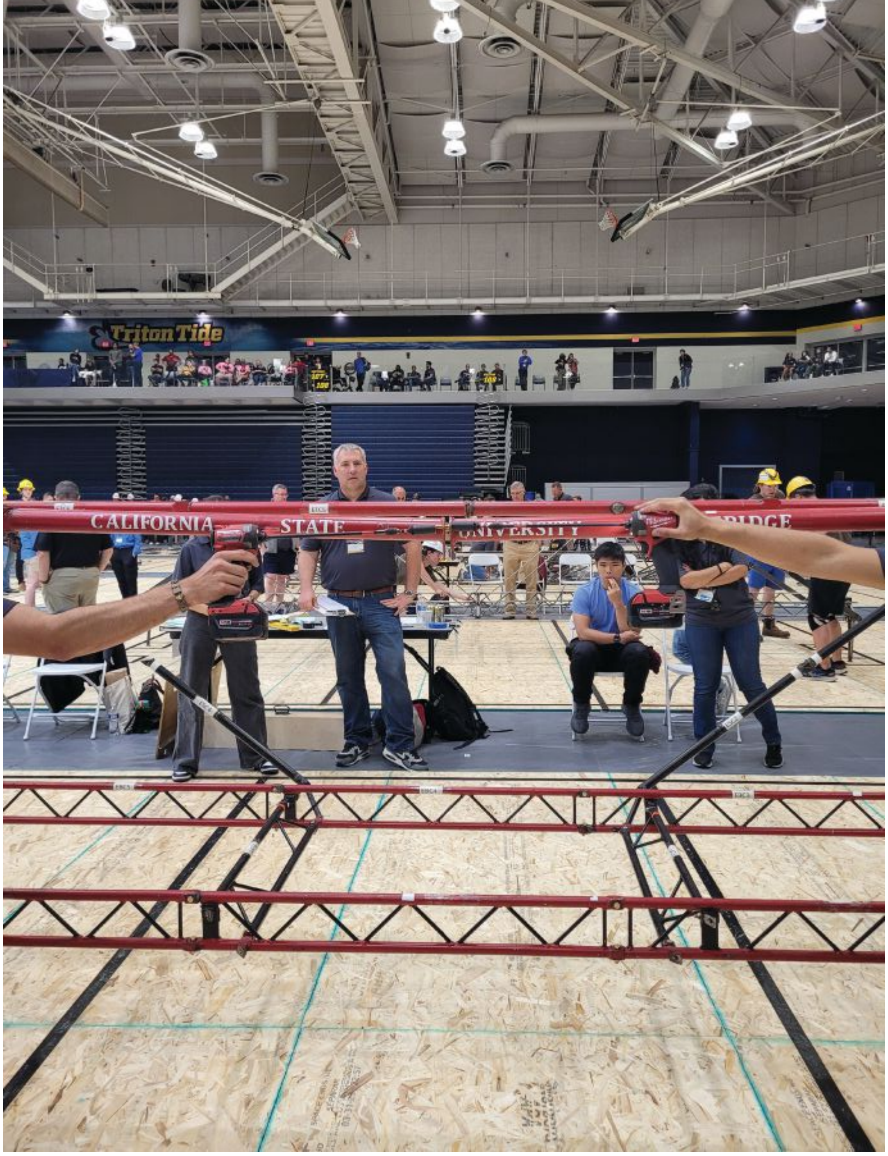
Throughout the day, first-time volunteer judges' faces lit up with smiles, adding to the lively atmosphere. There were some judges, almost on all fours, crouched down to eye level of the bridge to follow the coordinated and well-practiced movements of the team. As the competition wrapped up late in the afternoon, teams like the United States Military Academy at West Point showed a passion for the task at hand with the same enthusiasm as the first teams of the day. They never wavered, even as the arena was being stripped down and the crowd had mostly cleared.

And I can't talk about the overall spirit of the competition without mentioning the 2023 Robert E. Shaw, Jr. Spirit of the Competition award winner, South Dakota School of Mines and Technology. This award is named for the SSBC's founder and is presented to a team that demonstrates outstanding team camaraderie, professionalism, positive work ethic, and respect for their competition peers.

"They demonstrated their support of other participants by cheering on other teams and showed their appreciation of the host school by assisting them with event cleanup," said Christina Harber, AISC's senior director of education and a member of the SSBC Rules Committee. "Their support for the entire SSBC community earned them the award."

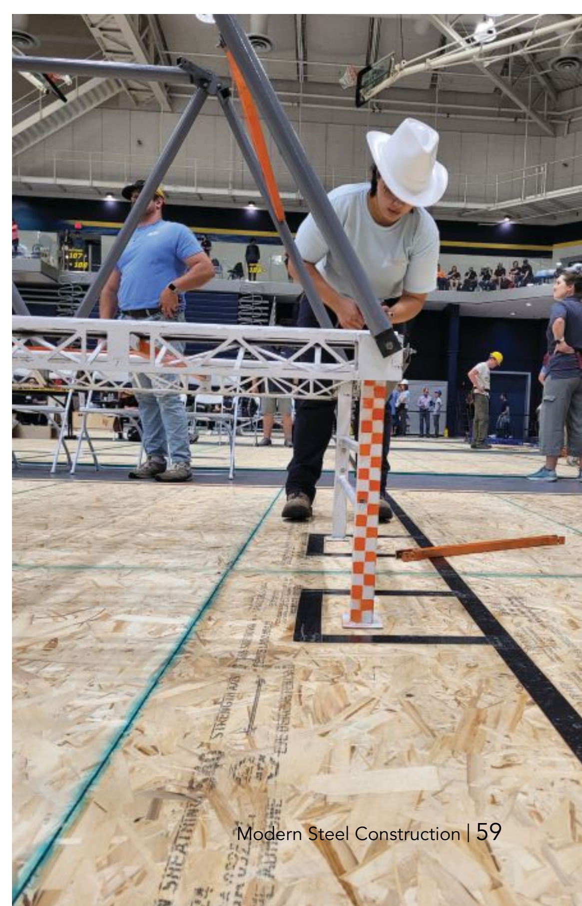
If this is what the SSBC National Finals is all about, I'm already looking forward to next year!

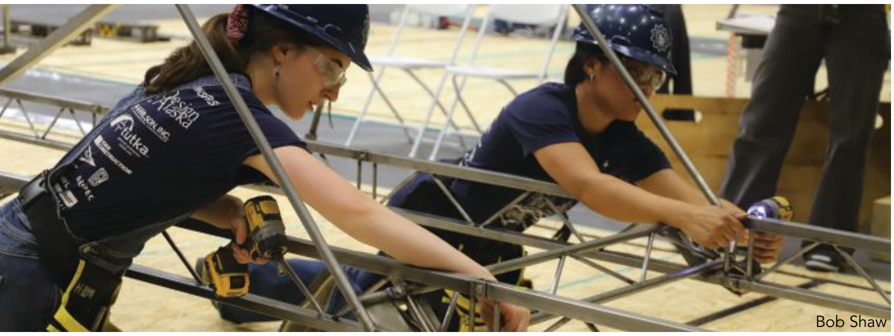
*—Raven Galloway, education assistant, AISC*

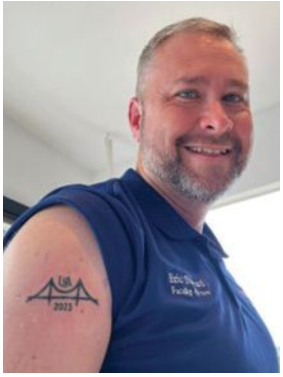


Bob Shaw




Bob Shaw


Bob Shaw



## Getting Inked in San Diego

Travelers often take home souvenirs to commemorate a vacation or special occasion, but how many people get a tattoo to mark the memory?

University of South Alabama faculty advisor Eric Steward, PE, PhD, is one of them. He proudly left the competition with a freshly inked tattoo commemorating his team's first-ever appearance at the national finals.

"I made a bet—about 11 years ago now—with my students that said if they ever made it to nationals, I would get matching tattoos with them," explained Steward.

When the team placed second at their Gulf Coast Regional Competition in March, they advanced to the 2023 SSBC National Finals, setting things in motion for Steward to fulfill his end of the bargain.

Steward and the University of South Alabama team made the journey from Mobile, Ala., to San Diego for the big event. They were one of the first teams to compete on Saturday morning, leaving plenty of time in the afternoon for Steward to head towards the beach with an enthusiastic team member to get matching tattoos.

Steward even had the chance to proudly show off his new ink at the awards banquet later that evening.

"I have the school logo at the top, the bridge logo for the SSBC, and then the year underneath it," he described.

One friendly bet from many years ago became a permanent reminder of the team's accomplishments this year, particularly their experience of competing on the national stage for the very first time.

"It generated life-long memories for us all," said Steward. "Although this was our first time attending, I assure you it will not be the last!"

*—Kristi Sattler, SE, PE, PhD, university education manager, AISC*

"It's always a year of hard work and dedication, and it's exhausting—a lot of nights and days, so it feels good to finally perform on the national level and compete for one of the top spots," said Brock Sullivan, the University of Florida's steel bridge project manager.

Youngstown State University came in second overall, winning first place for aesthetics and third for economy—as well as $3,000 in scholarship funds.

The University at Buffalo won third place overall, which comes with $2,000 in scholarship support. Their build time of 5.85 minutes was a close second to the University of Florida's winning time of 5.80 minutes, and they also took second in the economy category.

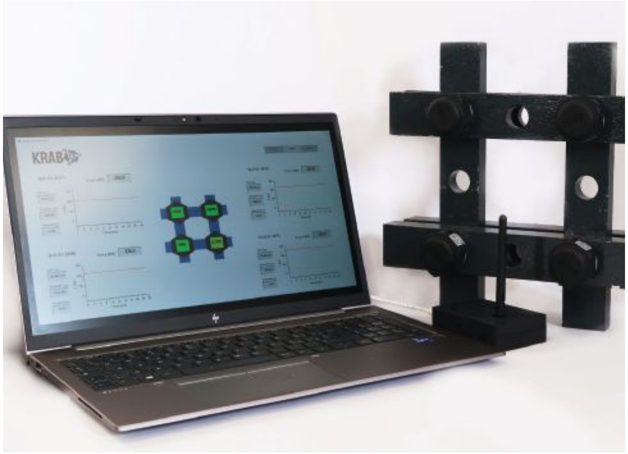
Competition organizers also unveiled the details for the 2024 Student Steel Bridge Competition National Finals: Louisiana Tech University in Ruston, La., from May 31 to June 1, 2024. ■

*For a firsthand look at being a first-time construction judge, see the Editor's Note on page 6. And check out the Project Extras section at www.modernsteel.com for more photos of the competition.*

**Dani Friedland** (**friedland@aisc.org**) is AISC's director of marketing communications.

# new products

This month's New Products include a new "networking" system for bolts, a new structural calculation software package, and a new laser cutting option for fabricators.

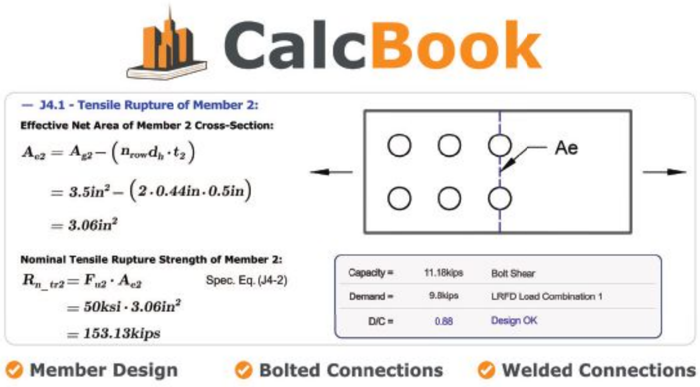


## KRABO Smart Fastening System

KRABO's smart fastening system transforms bolts into "networking bolts" via embedded load sensors and electronics on them. Any loosening or abnormal status can be detected in real time and notify the user with an alert. KRABO provides a platform where fasteners are connected and controlled in real time, enabling an easy remote load survey. The technology is completely wireless. Cables are not required to contact the bolts in order to measure performance, and users can log in to the system anywhere around the world with a PC or smartphone. The mechanical properties of the bolts and their compliance with industry standards are not impacted. The system is available in mass production and provides a real alternative to standard bolts, thus reducing inspection effort while also improving safety. For more information, visit **www.krabo.it**.

## CalcBook

CalcBook is calculation software that helps structural engineers move faster in their day-to-day work, enabling them to create structural calculations, check code compliance, and produce professional calculation books with confidence. It reduces production and review times by guiding engineers through the development of calculations with simplified user inputs and pragmatic code interpretations. The software provides a detailed line-by-line output of all calculation steps, complete with images and references. The cost-effective and intuitive package is set to become a game-changer in how structural engineers approach and produce calculations. For more information, visit **www.calcbook.com**.

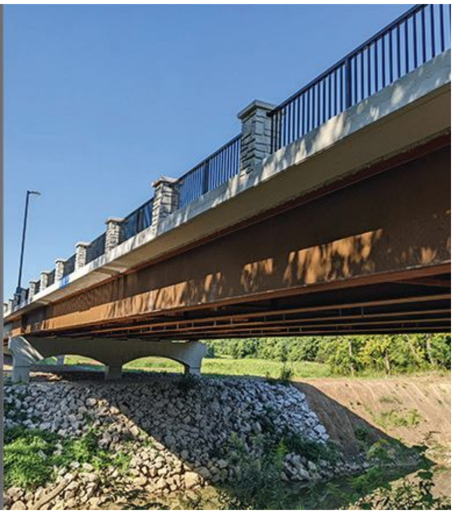



## Tecoi North America LS Mega Laser

Tecoi North America's LS Mega Laser provides steel service centers, manufacturers, and fabricators a laser cutting machine with virtually unlimited working length cutting capabilities while incorporating innovations such as a double-core fiber system, a double-head cutting technology, and automatic beveling with multi-tool drilling. The fully automated mobile system design is coordinated with the movement of the machine along its entire length. It also features an automatic production control system that enables operators to program tasks along the entire cutting area while providing maximum flexibility in all cutting dimensions with continuous non-stop production in different independent cutting areas. For more information, visit **www.tecoi.com**.

**AWARD OF DISTINCTION**

## Engineer Nitaya Chayangkura Harnesses Structural Steel's Aesthetic Advantage in Tennessee Park Project



The city of Franklin, Tenn., is well-known for its vibrant, nature-complementary streetscapes that play host to crowded festivals and parades every year. Many of its bridges incorporate shared aesthetic features that allow them to meld fluidly into their surrounding green spaces—a unique challenge for a team of Alfred Benesch and Company engineers selected to design and build an access road and bridge as part of a new park development in Franklin.

Project manager Nitaya Chayangkura, who, alongside her colleague Katie Lewis, was recently awarded an AISC Award of Distinction for her work on the Southeast Park Access Road and Bridge project, recalled that city officials had very specific requirements for the bridge's aesthetics, with a particular focus on the shape and railings--it needed to draw visual interest. "That's where steel design came in," Chayangkura said.

"To my understanding—from a structures viewpoint—the city of Franklin has kind of a similar bridge and other 'character' bridges in nearby areas with these unique aesthetics," she said. "This one had a few different challenges: It's over the Harpeth River, so it needed to have this generous span."

Chayangkura grew up in nearby Nashville, which she noted has not historically been a very pedestrian-friendly or bicycle-friendly city. Franklin's Southeast Park project stood out to her as an effort to prioritize the implementation of multi-modal pathways in an area that has seen a demand for them. In Nashville, she said, she has watched things improve slowly over the years as more people have asked for better bikeway and sidewalk infrastructure.

"This park will be something residents can enjoy and use," Chayangkura said. "Families will be able to walk along and appreciate the river, the pathway, and the park, and eventually appreciate the structure in its natural, beautiful setting of Williamson County."

Chayangkura's contribution to the Southeast Park project was only one part of what made her stand out as an Award of Distinction candidate. Her service as a role model to rising engineers has also caught the attention of structural steel industry professionals.

"I feel like today's young engineers run circles around [my generation] when we were younger," Chayangkura said. "They are really brave and taking chances—they're not afraid to get out there and be challenged. [I hope they continue] to see every project as an opportunity to collaborate with other engineers and work together toward a common goal."

## People & Companies

The **American Iron and Steel Institute (AISI)** recently named **Dan Snyder** as its new vice president of the construction program. Snyder has been a part of the program for 25 years, most recently serving as AISI's senior director of business development.

In his time at AISI, Snyder has played an integral role in several successful outreach initiatives. He was part of the team that launched the Short Span Steel Bridge Alliance (SSSBA) in 2007, and he spearheaded the BuildSteel marketing initiative to raise industry awareness of the benefits of cold-formed steel framing. Snyder also guided the creation of AISI's implementation directives for metal roofing, metal wall panels, and steel utility poles.

"During his AISI career, Dan Snyder has utilized his many years of expertise in steel construction to successfully launch and grow several of our construction initiatives. With his focus on innovation and market growth, we look forward to the continued success and dynamism of the AISI construction program," said AISI President and CEO Kevin Dempsey.

Snyder succeeds Robert J. Wills, PE, who retired in May after nearly 33 years at AISI.

"We thank Robert Wills for his many contributions to our industry," said Dempsey. "He has left a strong legacy and impact on the steel construction market, and we wish him all the best in retirement."

Learn more about Wills' legacy, not only as AISI's outgoing vice president of the construction program but in light of his career-spanning, award-winning work with building codes, in the June 2023 Field Notes podcast (**www.modernsteel.com**).

**STANDARDS**

## AISC Releases Updated Seismic Standards

The latest versions of two AISC seismic standards, AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-22) and AISC *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications* (ANSI/AISC 358-22), are now available.

The documents and accompanying commentary can be downloaded for free at **aisc.org/standards**. Both documents will provide the basis for the guidelines in the forthcoming 4th edition *Seismic Design Manual*, which is currently scheduled for publication next year.

***Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-22)**

The AISC Committee on Specifications, a consensus body of expert volunteers, developed and approved the revisions.

"The 2022 AISC *Seismic Provisions* reflect the latest research and thinking by the AISC Committee on Specifications in the area of seismic design," said James Malley, chair of the AISC Committee on Specifications and a senior principal at Degenkolb Engineers. "The 2022 update notably includes a new structural system: concrete-filled coupled composite plate shear walls (commonly known as SpeedCore). It also features a new appendix titled 'Design Verification Using Nonlinear Response History Analysis.' We are excited to bring these new provisions to the structural steel industry."

***Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications* (ANSI/AISC 358-22)**

The Connection Prequalification Review Panel developed and approved the latest revisions.

"Major updates include the addition of a new connection (the DuraFuse Frames Moment Connection) as well as expansion of the prequalification limitations on the RBS connection to permit deeper and heavier beams and deeper columns," said Jim Swanson, chair of the Connection Prequalification Review Panel and associate professor at the University of Cincinnati. "Additional changes further improve consistency and ease of use, including the consolidation of provisions related to the isolation of the concrete slab from the steel connection material, updated bolt-hole dimensions that are consistent with AISC 360, and adoption of a common check for the beam net-section in the Bolted Flange Plate, Cast Bolted Bracket, and Double Tee chapters."

**PRIZE BRIDGE AWARDS**

## NSBA Seeks America's Best Steel Bridges, Owners for 2024 Prize Bridge Awards

Designers, owners, fabricators, and contractors are all invited to enter this year's Prize Bridge Awards, sponsored by the National Steel Bridge Alliance (NSBA) and AISC. New this year is a special award to celebrate owners who are on the cutting-edge of innovation.

"We're looking for outstanding bridges that showcase and celebrate the innovative use of structural steel," said Charles J. Carter, SE, PE, PhD, president of AISC. The entry deadline is September 30, 2023, and there is no fee to enter the competition.

The panel of industry-expert judges will also consider entries in several categories defined by bridge size and function, weighing each project's innovation, economics, aesthetics, design, and engineering solutions.

"Structural steel is driving bridge innovation across the country on projects that range from grand suspension bridges to the small but vital county roads that connect communities," said NSBA Senior Director of Market Development Jeff Carlson, PE. "The Prize Bridge Awards are a showcase of the best bridge engineering and construction in our industry—and the people who make it happen every day."

This new Owner of the Year award is specifically for the DOTs, counties, cities, tollways, and other owners around the country whose innovative steel project(s) move the industry forward.

The judges will consider innovation, advancement of the industry, economics, design, design/research, engineering solutions, and project delivery methods when evaluating submissions, and they will give higher priority to projects by in-house design and/or research teams.

NSBA will also present the Bridge of the Year award to the most significant recently completed bridge in America. The judges will select three finalists from all bridges entered into the competition. The teams behind those three projects will have the opportunity to present their projects to the industry during the first session of the World Steel Bridge Symposium in San Antonio, Texas (March 20 to 22, 2024) before the audience votes to choose a winner!

**Eligibility Requirements**

Built of structural steel produced and fabricated in the United States

Located in the U.S., defined as the 50 states, the District of Columbia, and all U.S. territories

Completed and opened to traffic between September 9, 2021, and August 31, 2023.

Any team member from an eligible bridge project may submit it for award consideration.


The I-91 Interchange 29 Exit Ramp Flyover Bridge in Hartford, Conn., won both the 2022 Prize Bridge National Award, Medium Span, and Bridge of the Year.

## IDEAS² AWARDS

# AISC Shakes Up Steel Industry's Top Design Award for 2024

AISC's flagship competition for buildings is now accepting entries for the 2024 IDEAS² Awards—and this year will be different from previous years.

AISC's Innovative Design in Engineering and Architecture with Structural Steel (IDEAS²) Awards recognize outstanding projects that illustrate the exciting possibilities of structural steel. They are the industry's most prestigious design honor for building structures.

Previously, awards were given based on the size of a project. AISC has now updated the competition to focus more on innovation regardless of the project's budget.

"There's so much innovation in the design community and industry today across all budgets," said AISC President Charles J. Carter, SE, PE, PhD. "Dollars are no longer the best way to categorize structures. Instead, we're looking for the best projects in the country that highlight specific unique advantages of working with structural steel—things like sustainability, adaptability, cost, speed, reliability, and resilience."

The judges will present IDEAS² Awards for:

Excellence in Engineering - for projects that take full advantage of the flexibility of a steel structural system and demonstrate the use of new design and construction techniques

- Excellence in Architecture – for projects that use structural steel to create breathtaking structures that inspire and serve the communities around them
- Excellence in Sustainable Design and Construction – for projects that use design and construction methods that reduce a project's carbon footprint
- Excellence in Adaptive Reuse – for projects that capitalize on how easy it is to use steel to give a structure a second life
- Excellence in Constructability – for projects that utilize innovative design, project management, and construction methods that simplify, economize, and speed up the design and construction of steel buildings

What's at stake? Winners will be invited to present their project to the industry at the Architecture in Steel Conference, which is incorporated into NASCC: The Steel Conference (March 20 to 22, 2024, in San Antonio, Texas). They'll also be featured in the May 2024 issue of *Modern Steel* and in other AISC media throughout the year.

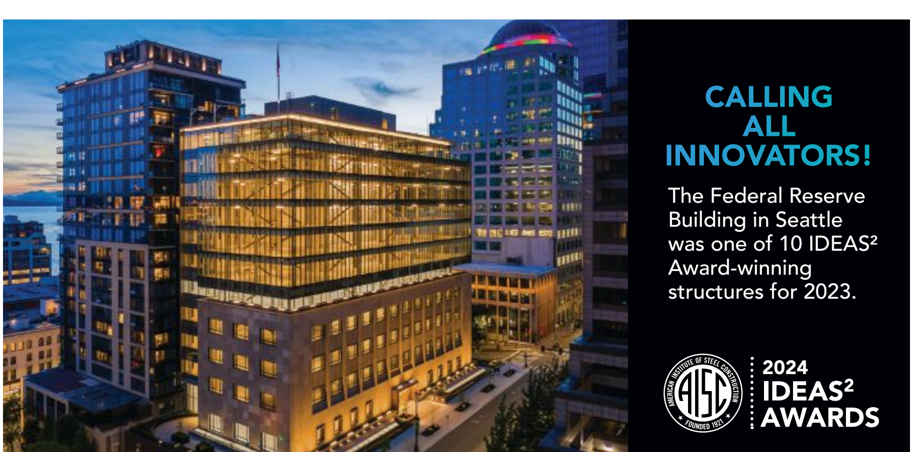
The IDEAS² Awards showcase the innovative use of structural steel in:

- the accomplishment of the structure's program
- the expression of architectural intent
- the application of innovative design approaches to the structural system
- leveraging productivity-enhancing construction methods

IDEAS² Awards don't only go to high-profile projects. In recent years, AISC has honored everything from public transit projects to monumental stairs to jaw-dropping high-rises. We're looking for innovation and imaginative design in all its forms!

Entries are due by September 30, 2023. AISC will announce finalists late this year and unveil the winners in early 2024.

Visit **aisc.org/ideas2** for more information and to enter.




**Eligibility Requirements**

New buildings, expansions, and renovation projects (major retrofit or rehabilitation work) are eligible. Sculptures, art installations, and non-building structures may also compete in the regular categories.

Building projects in the 2024 competition must be located in the U.S. and must be completed between January 1, 2022, and August 31, 2023.

A significant portion of the framing system of a building must be wide-flange or hollow structural steel sections (HSS).

The majority of the steel used in the project must be domestically produced.

The project must have been fabricated by a company eligible for AISC full membership. Projects with a unique or distinctive feature fabricated by a company eligible for AISC full membership will also be considered.

Pedestrian bridges entered in the competition must be an intrinsic part of a building and not standalone structures. We encourage members of project teams for standalone bridges to enter the NSBA Prize Bridge Awards (see related news item in this section).

# Letter to the Editor

## Not the First

I'm writing concerning the June 2023 article "Park Avenue Premiere" about the new 425 Park Avenue tower in New York (**www.modernsteel.com**). The article states:

> "425 Park Avenue is the first new full-block office tower built on Manhattan's Park Avenue in decades. And it's also the first in New York to implement ASTM A913 Grade 70 steel."

I'd like to point out an earlier use of A913 Grade 70 steel in New York. One Manhattan West (at 9th Avenue and 33rd Street), designed by SOM with steel fabrication performed by Walters Group, opened in 2019 (with the steel being erected in 2016) and used ASTM A913 Grade 70 for all of the tower gravity columns.

*—Sam Wilson, PE*
*Associate, Structural Engineering*
*SOM*

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This contract requires travel throughout North America and limited International travel. This is not a regionally based contract and a minimum of 75% travel should be expected.

Contract auditors must have knowledge of quality management systems, audit principles and techniques. Knowledge of the structural steel construction industry quality management systems is preferred but not required as is certifications for CWI, CQA or NDT. Prior or current auditing experience or auditing certifications are preferred but not required. Interested contractors should submit a statement of interest and resume to **contractor@qmcauditing.com**.



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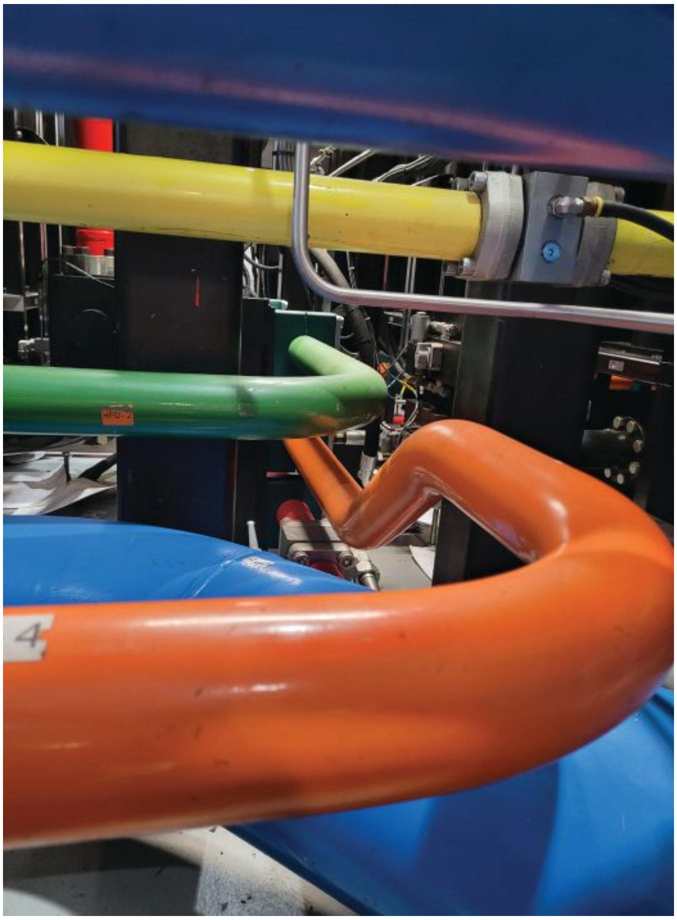

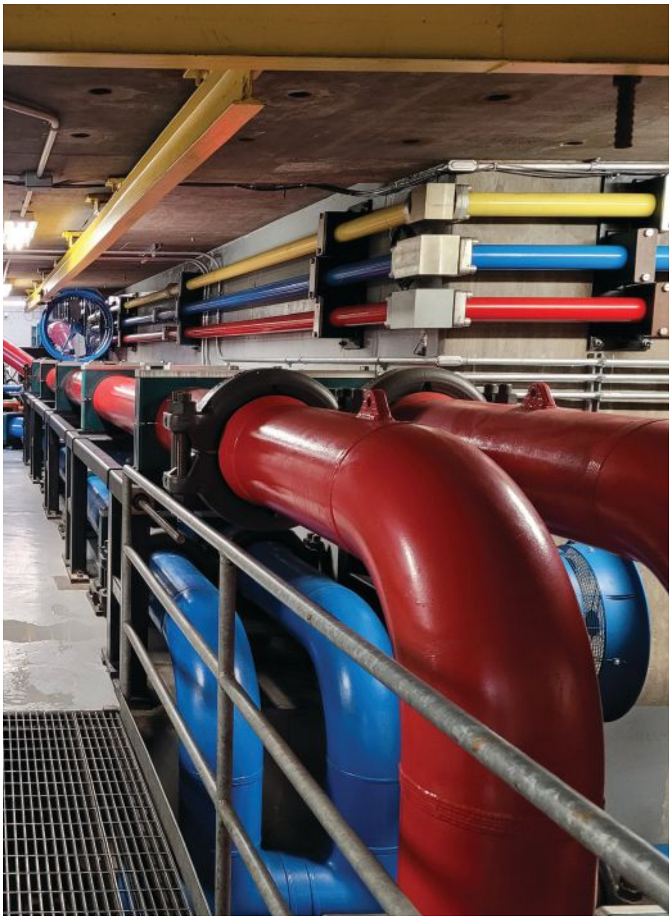

# What Lies Beneath

**HAVE YOU EVER** been on a shake table (hopefully not when it's doing its thing)?

The idea of a massive platform that simulates earthquakes—with the goal of observing how various building components, materials, and assemblies respond to artificial seismic activity—is pretty amazing when you think about it.

But it's what's underneath the table that makes all of this possible. In a recent visit to the NHERI Large High Performance Outdoor Shake Table (LHPOST6) at the University of California San Diego—a fascinating prelude to this year's Student Steel Bridge Competition (SSBC) National Finals, which UCSD hosted—a group of AISC staff got to tour the facility, which happens to be the largest outdoor earthquake simulator in the world. The tour included a walk-through of a support building adjacent to the table, followed by a descent into the bowels of the operation to see the massive pistons that make the table move.

Hydraulics, on a massive scale, is at the center of it all, and one of the most noticeable things about what might typically be perceived as a dark, dingy place was all the vibrant, color-coded piping that channels the various fluids where they need to go. The red, blue, yellow, orange, green, and black pipes were ubiquitous and evoked a subway map as they wound through the facility.

After a recent upgrade, the table now has six degrees of freedom (DOF), allowing it to move in six directions: back and forth, up and down, and left to right, as well as rotate in all three axes—which is important as such a high degree of freedom allows it to more realistically simulate a real-life tremor.

Keep an eye out for a comprehensive article on UCSD's shake table this fall. And to read about this year's SSBC National Finals, check out the Editor's Note on page 6 and "Third Time's the Charm" on page 56. ■