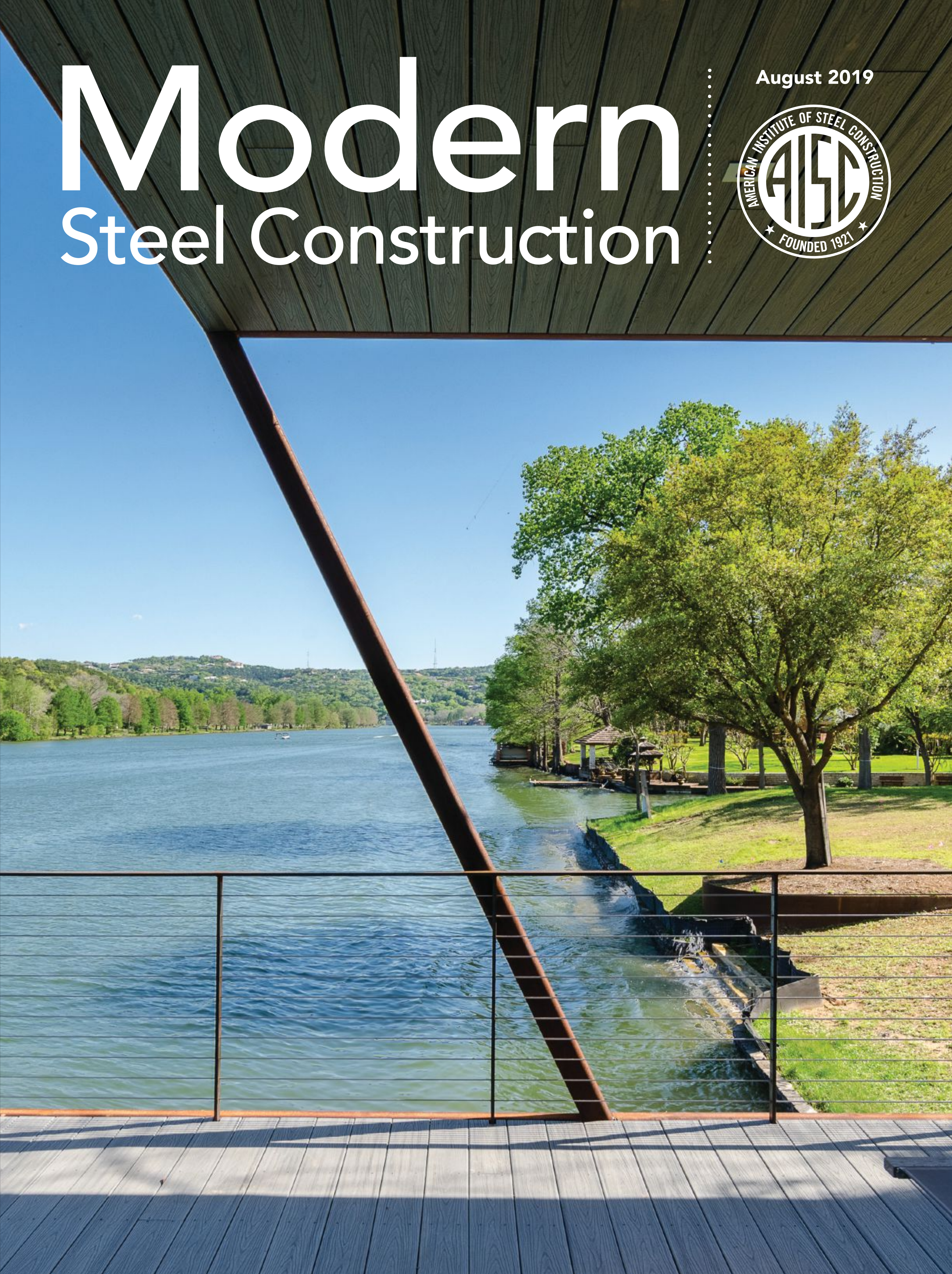
Modern Steel Construction

August 2019

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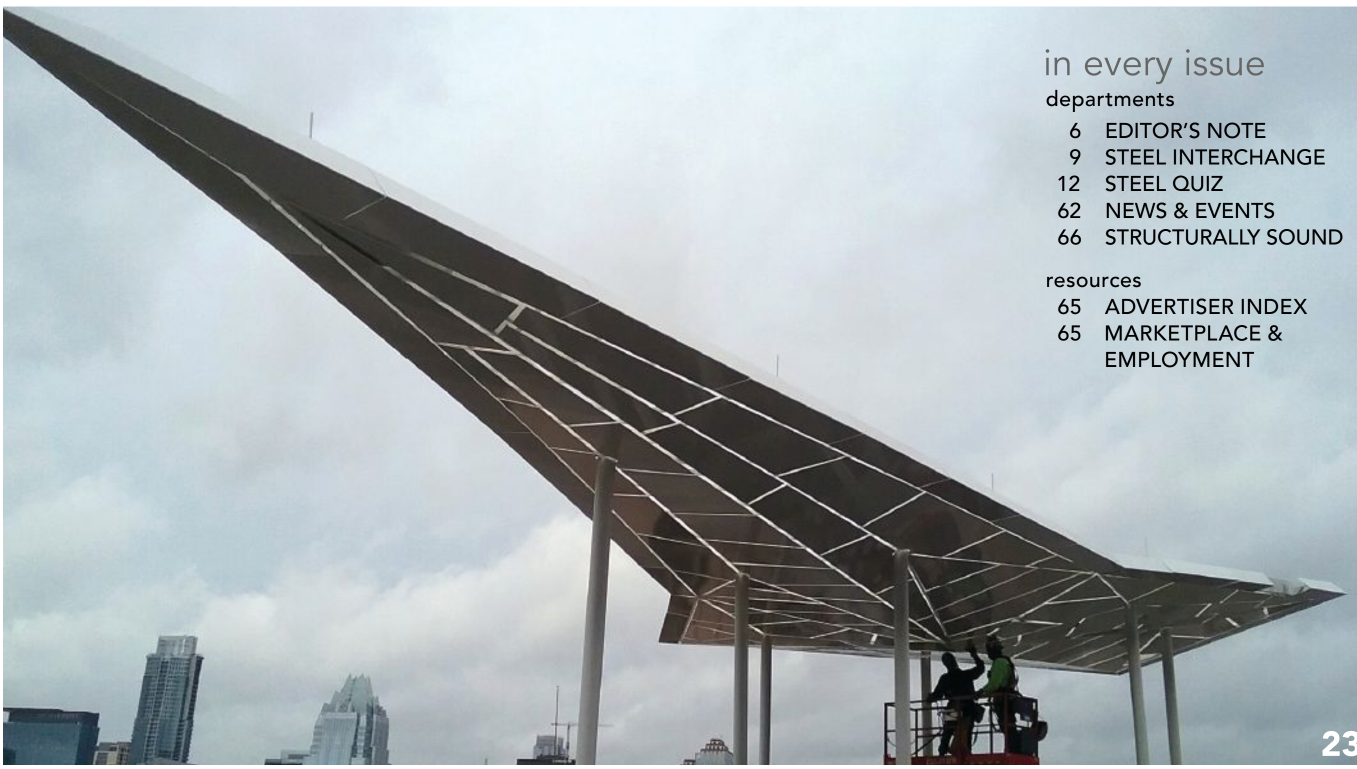

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ON THE COVER: Angled steel turns a boat dock into a lakeside sculpture, p. 23. (Photo: Sergio Reza)

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editor's note

One of the things I'll miss now that my daughter, Julia, has graduated college (with high honors—sorry, proud parent moment!) is visiting her. Sure, now that she's back home I see her every day, but somehow, no matter how great that is, it's not as exciting.

It also means one less trip and one less excuse to stop in and visit some of our member fabricators. If you've never visited a structural steel fabrication shop, it should definitely be on your bucket list (and if it's been more than a few years since you've visited one, you should check out how they've changed).

Seeing how steel goes together in a fab shop can be eye opening. From the seeming ease with which large pieces of steel are moved to the speed at which automated machinery can cut and drill thick pieces of iron, it's clearly not your father's fabrication facility (to get an idea of what a modern facility looks like, check out Geoff Weisenberger's fantastic look at Dave Steel in the December 2013 issue in the *Modern Steel* archives at **www.modernsteel.com**).

Frankly, I wish every engineering and architecture student—and every engineering and architecture professional, for that matter—had the opportunity to visit a shop. Oh, wait. They do! We call it SteelDay and we're celebrating this annual event this year on September 27.

SteelDay is the annual celebration of the structural steel industry sponsored by AISC and hosted by its members and partners. It's the industry's largest educational and networking function, with events occurring all over the country. The events range from site tours to seminars to shop visits. Depending on where you're located (or how far you're willing to travel) there's an opportunity to visit a steel mill, a galvanizer, a service center, or a fabrication shop.

If you're wondering what's going on in your area (or on a national scope), simply visit **aisc.org/steelday**. You can check out what's happening, sign up for one of the free events, and get all the details (such as a requirement to wear long pants and long-sleeve shirts, for example).

And when you're at the event, make sure you take pictures. You can post them using the hashtags #WeAreSteel or #SteelDay or just email them to **salisbury@aisc.org**.

I hope to see you on SteelDay!

Scott Melnick
Editor

Modern
Steel Construction

Editorial Offices
130 E Randolph St, Ste 2000
Chicago, IL 60601
312.670.2400

Editorial Contacts
EDITOR AND PUBLISHER
Scott Melnick
312.670.8314
melnick@aisc.org

SENIOR EDITOR
Geoff Weisenberger
312.670.8316
weisenberger@aisc.org

DIRECTOR OF PUBLICATIONS
Keith A. Grubb, SE, PE
312.670.8318
grubb@aisc.org

PRODUCTION COORDINATOR
Erika Salisbury
312.670.5427
salisbury@aisc.org

GRAPHIC DESIGN MANAGER
Kristin Hall
312.670.8313
hall@aisc.org

AISC Officers
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ACCOUNT MANAGER
Renae Gurthet
231.995.0637
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312.670.2401
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Reprints
Erika Salisbury
312.670.5427
salisbury@aisc.org

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**.

steel interchange

All AISC Design Guides mentioned can be found at ***aisc.org/dg****, and all* Engineering Journal *papers can be found at* ***aisc.org/ej****. All other AISC publications, unless noted otherwise, refer to the current version and are available at* ***aisc.org/specifications****.*

Fixed Ladder OSHA Requirements

We came across some information that cages are no longer considered compliant fall protection in newly installed ladders. However, we are still seeing caged ladders on new construction. Do you know where I can find these requirements?

OSHA provides requirements for fixed ladders that extend more than 24 ft in Section 1910.28(b)(9)(i). For new ladders that extend more than 24 ft, caged ladders on their own would not be sufficient for fall protection. A personal fall arrest system or ladder safety system needs to be provided. Section 1910.28(b)(9)(i)(B) states that for new fixed ladders, "Each fixed ladder installed on and after November 19, 2018, is equipped with a personal fall arrest system or a ladder safety system."

Per the OSHA Standard Section 1910.28(b)(9)(i)(D), "On and after November 18, 2036, all fixed ladders are equipped with a personal fall arrest system or ladder system." This is a final deadline to bring existing fixed ladders extending more than 24 ft up to current OSHA requirements.

In March of 2018, we presented a safety webinar titled "Ladder Safety: One Rung at a Time." In that webinar, the OSHA regulation change concerning caged ladders was presented. You can view this webinar for free at **tinyurl.com/cagedladdersafety**. You can also view the OSHA standards delineating the elimination of cages on ladders, as well as find the sections discussed above, at **www.osha.gov**.

Larry Kruth, PE

Flexural Strength of a Coped Section

When checking the flexural strength of a coped beam section using Part 9 of the 15th edition AISC *Steel Construction Manual*, Equation 9-9 provides the critical stress, F_{cr}. A similar equation was provided in the 13th edition and 14th edition *Manual*. The 13th and 14th editions both indicate that we can use the more precise dimension, h_1, instead of h_0 in this equation, but the 15th edition does not. Can we use h_1 instead of h_0 in equation 9-9 of the 15th edition *Manual*?

The use of h_1 in lieu of h_0 in the new design procedure in the 15th edition *Manual* can be unconservative. The development of the new design procedure is detailed in the fourth quarter 2018 AISC *Engineering Journal* paper "Strength of Single-Coped Beams." For copes stressed into the inelastic range, the neutral axis shifts closer to the flange, making any explicit consideration of the neutral axis location excessively complicated for design. Although Equation 9-11 uses h_0 for the web slenderness calculation, as discussed in the paper, the neutral axis location was considered in the development of l_r and l_p. Because there are several variables affecting the buckling strength, it may be best to review the experimental results, which are shown in Figure 6 of the paper. From this, it is clear that any upward shift of the nominal strength curve would cause some non-conservatism.

Bo Dowswell, PE, PhD

Washer Requirements

We always provide washers for all of our typical bolted assemblies, but was recently told there has been a change and that washers are not always required. Is this true and if so, where can I find more information?

Section J3.2g of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) states: "Washers shall be provided in accordance with the *RCSC Specification* Section 6…" Therefore, Section 6 of the *RCSC Specification* (**www.boltcouncil.org**) governs the use of washers. It appears that you may not have been interpreting the requirements of the *RCSC Specification* correctly.

I believe that originally (1951), a washer was always provided under both the head and the nut. This obviously simplified the decision-making process, but added to the cost of the fastener assembly. By 1962, bolted joints were permitted without any washers in some instances. Today, washers are rarely required for snug-tightened joints and most connections in buildings are permitted to be snug-tight. This means most connections today do not require any washers.

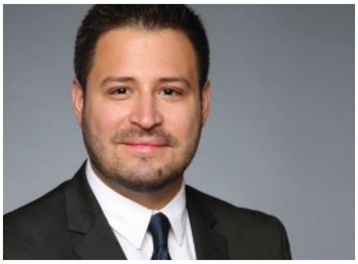
Larry Muir, PE

Different Color Manuals

I recently bought a used copy of the first edition of the AISC *Load and Resistance Factor Design Manual* from a third party. The manual I ordered showed a red cover and the one I received had a blue cover. Are there two versions?

The first edition *LRFD Manual* had a blue cover, and there is only one color selected for each edition of the *LFRD Manual.* It is likely that the picture on the third party site was incorrect. I am not sure what you were shown, but do note that the 8th edition *ASD Manual* is red and the 13th edition AISC *Steel Construction Manual* is burgundy.

Jonathan Tavarez, PE



Larry Kruth (kruth@aisc.org) is AISC's vice president of engineering and research. **Jonathan Tavarez** (tavarez@aisc.org) is a staff engineer with AISC's Steel Solutions Center. **Brad Davis** with Davis Structural Engineering, LLC, **Bo Dowswell**, principal with ARC International, LLC, and **Larry Muir** are all consultants to AISC.

Beam Bearing Plates

For beam bearing plate design, I typically follow the design methodology as shown in Part 14 of the AISC *Manual*, which assumes that the bearing plate distributes the beam end reaction uniformly to the concrete as a uniform bearing pressure by cantilevered bending of the plate. A contractor has decided to supply a larger bearing plate than what I had originally specified. This increases the cantilever distance and bending forces on the bearing plate such that the original bearing plate thickness is no longer adequate. Are you aware of any other design methods for the beam bearing plate? It seems unconservative to just ignore the larger dimension of plate that has been added.

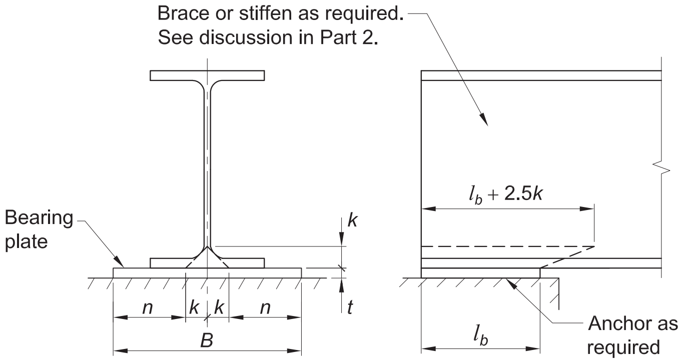


Fig. 14-1. Beam bearing plate variables.

The procedure in Part 14 of the *Manual* (illustrated above) is only one way to approach this problem. Keep in mind that it is part of the *Manual*, not the *Specification*. The governing provisions in the *Specification* are Section J4.5 for plate bending and Section J8 for concrete crushing. The analysis can be carried out by any rational engineering method as long as the "forces and deformations used in the design of the connection is consistent with the intended performance of the connection and the assumptions used in the design of the structure as required in Section B3.4.

If the original base plate design worked for a given beam end reaction, then it would make sense that simply increasing the size of the bearing plate while keeping the same plate thickness would not decrease the strength of this connection. Thus, I would consider neglecting the steel that is outside the original plan dimensions.

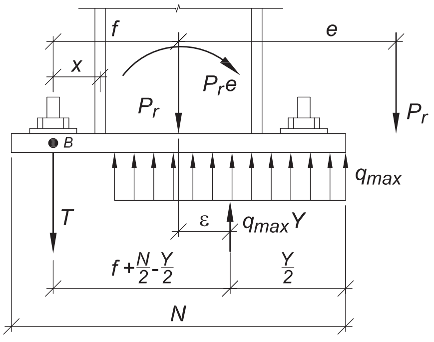


Fig. 3.4.1. Base plate with large moment.

If you'd like some theoretical backing for the approximate manual approach, then I would point you to the lower bound theorem of limit analysis which allows us to assign a statically admissible stress field and compute the ultimate strength, which is either the actual ultimate strength or a conservative lower bound. This theorem is why AISC Design Guide 1: *Base Plate and Anchor Rod Design* assigns a rectangular stress block of length Y and intensity q_{max}, as shown in Figure 3.4.1 in the guide (at left); the actual pressure distribution is unknown. In your case, I would assume the statically admissible stress field is uniform over the original intended bearing area and zero outside that, which would also be consistent with your original design assumption. Note that AISC Design Guide 29: *Vertical Bracing Connections—Analysis and Design* provides a good discussion on the lower bound theorem in Section 1.2.

Brad Davis, SE, PhD

steel quiz

This month's Steel Quiz focuses on just a few of the many recent innovations in structural steel. The answers can be found in Design Guide 31: *Castellated and Cellular Beam Design* (**aisc.org/dg**), our webpage dedicated to SpeedCore (**aisc.org/speedcore**), and other resources found at **www.aisc.org**.

1 The SpeedCore system is expected to allow a response modification coefficient (*R*) of what value?

2 **True or False:** Placing utilities in a SpeedCore system/module is more of a challenge than in a conventional reinforced concrete shear wall.

3 Which of the following is *not* an advantage of ASTM A1085 compared to ASTM A500 Grade C?

- **a.** ASTM A1085 provides tighter wall thickness and corner radii.
- **b.** A maximum yield strength of 70 ksi for ASTM A1085 HSS will lead to a reduced over-strength factor.
- **c.** ASTM A1085 is available as seamless to avoid the welded seam.
- **d.** There is a minimum Charpy V-notch material toughness requirement in ASTM A1085 but not in ASTM A500 Grade C.

4 Which of the following are advantages of castellated and cellular beams compared to traditional I-shaped sections?

- **a.** Long-span capability allows for fewer columns and footings
- **b.** The ability to run utilities and ductwork directly through the web openings.
- **c.** More flexibility in terms of beam sizes.
- **d.** Excellent vibration resistance with deeper cross sections.
- **e.** Open-web sections allow light transmission through the web openings
- **f.** All of the above

5 At approximately what height can splices be made above the finished floor in a SpeedCore system module?

6 Which of the following is the most appropriate way to connect the slab to a SpeedCore wall module?

- **a.** Weld reinforcing bar to the faceplate of the wall module.
- **b.** Connect the slab and the wall with ledge angles and shear connectors.
- **c.** Pre-drill holes in the module, into which reinforcing bars may be inserted prior to the casting of walls and slabs.
- **d.** All of the above.

7 Why is castellated beam use limited in areas with significant dynamic effects?

8 In which of the following areas is the SpeedCore system beneficial when compared to a conventional reinforced concrete shear wall?

- **a.** Fire resistance (with protection coating)
- **b.** Site labor cost
- **c.** Impact resistance
- **d.** Design schedule of the project
- **e.** a and b
- **f.** c and d
- **g.** All of the above

9 **True or False:** The process by which castellated and cellular beams are fabricated is similar but not identical. The time needed to produce a castellated beam is slightly greater than that of a cellular beam.

TURN TO PAGE 14 FOR THE ANSWERS

1 ***R*=8.** This will be the highest factor for a shear wall system of any material. This has been confirmed by a FEMA P695 study, approved by the Provisions Update Committee of the Building Safety Seismic Council, and also approved by the Building Safety Seismic Council to be submitted to ASCE 7 for potential inclusion in the next edition. Note, however, that in the analysis for the Rainier Square project in Seattle—designed by Magnusson Klemencic Associates and which uses the SpeedCore system—*R*=6.5 was used in accordance with ASCE 7-10 Table 12.2-1 because the structure is governed by wind loading.

2 **False.** It is easier to place utilities in a SpeedCore module due to the lack of lack of interference with internal reinforcing. Openings can be placed anywhere as required in the SpeedCore wall, with reinforcing welded to the external steel plate if needed.

3 **c.** This is only applicable for ASTM A500. A500 is available as welded or seamless. A1085 is only available as welded. Additional information on these and other material specifications can be found in the April 2018 SteelWise article "Are You Properly Specifying Materials?" (available at **www.modernsteel.com**).

4 **f.** All of the above. (More advantages can be found in Chapter 2 of Design Guide 31: *Castellated and Cellular Beams*, available at **aisc.org/dg**.)

5 **4 ft.** Splices are located a minimum of 4 ft above the finished floor in a SpeedCore module, as required by OSHA 1926 Subpart R: Steel Erection for Columns.

6 **d.** All of the above.

7 The re-entrant corners at the openings of castellated beams provide a location of stress concentration, which may limit their use in applications where dynamic effects are significant.

8 **d.** All of the above.

9 **False.** Cellular beams have round openings in the webs and castellated beams have hexangular openings. In order to achieve the repeating circular cutting pattern for cellular beams, two cutting passes are required (see Figure 1). Only one pass is required by castellated beams, as shown in Figure 2. As a result, the time to produce a cellular beam is slightly greater than that of a castellated beam. More information can be found in AISC Design Guide 31.

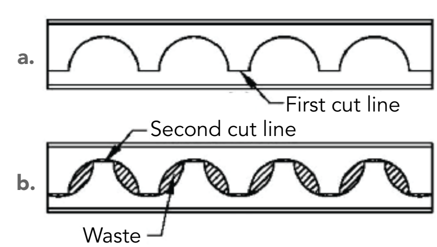


Fig. 1.

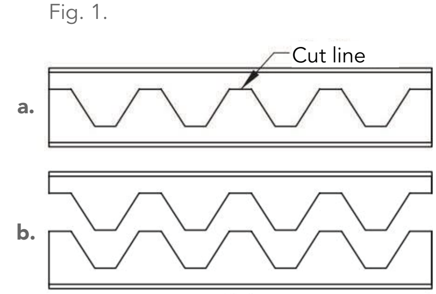


Fig. 2.

This month's questions and answers were contributed by Yishan He, a masters student at Northwestern, and Bhavnoor Dhaliwal, a masters student at the University of Illinois at Chicago; both are interns at AISC. Thank you, Yishan and Bhavnoor!

STEEL SOLUTIONS CENTER

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**.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INDUSTRIOUS INDUSTRIAL DESIGN

BY JAMES M. FISHER, PE, PHD

The third edition of AISC's Design Guide 7 on industrial buildings provides helpful tips and design advice on tackling your next industrial design project.

James Fisher (**jfisher.florida@gmail.com**) is emeritus vice president of CSD Structural Engineers in Milwaukee. He is the author of Design Guide 7 and a past winner of AISC's T.R. Higgins Award for his work on industrial building design. He has also received AISC's J. Lloyd Kimbrough Award in recognition of his contributions to structural steel design.

INDUSTRIAL BUILDINGS ARE BOTH simple and complex.

On the surface, they may appear to be relatively pared-down structures, devoid of the fixtures and features standard in offices, residences, schools, or commercial spaces. But while their basic structural and architectural components are often relatively simple, combining all of the related elements into an economical, functional building can be a complex task.

Like any building type, each industrial facility is unique and must be planned and built according to specific usage, the processes taking place within, specific owner requirements and preferences, site constraints, cost, and building regulations. The third edition of AISC's Design Guide 7: *Industrial Building Design* offers expert guidance on achieving a balance between all of these factors to create efficient industrial buildings.

The purpose of the first and second editions of Design Guide 7 was to provide engineers with guidelines and design criteria for designing industrial buildings without cranes and those with light-to-medium-duty cranes. The third edition continues to present advice based on the historical guidelines but also updates the information based on current analysis and design methodology. Here's a brief look at this latest edition.

Buildings without Cranes

The guide continues to be presented in two parts. Part 1 deals with general topics on industrial buildings, and Part 2 covers structures containing underhung and overhead cranes. Both parts include a discussion on the establishment of load conditions and load combinations (Chapters 1 and 12.) However, the new edition has been updated for use with the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-16) and the 15th edition AISC *Steel Construction Manual* (both are available at **aisc.org/publications**). The following updates and additions are presented in the third edition:

- New information on steel deck
- Additional material on ponding stability
- A new example on truss stability bracing
- A revised diaphragm design example
- Updated material on fatigue
- A new discussion on load combinations
- Updated design examples for runway girders
- Updated examples for frames and columns
- Additional material on underhung cranes

An important part of industrial building design is owner-established criteria. Unlike projects with criteria developed by architects, industrial buildings are more often driven by the building's use and the industrial processes within. Establishing this criteria requires active owner involvement, which is the focus of Chapter 2. The owner must communicate all of the building's specific requirements to the designer team.

These requirements include:

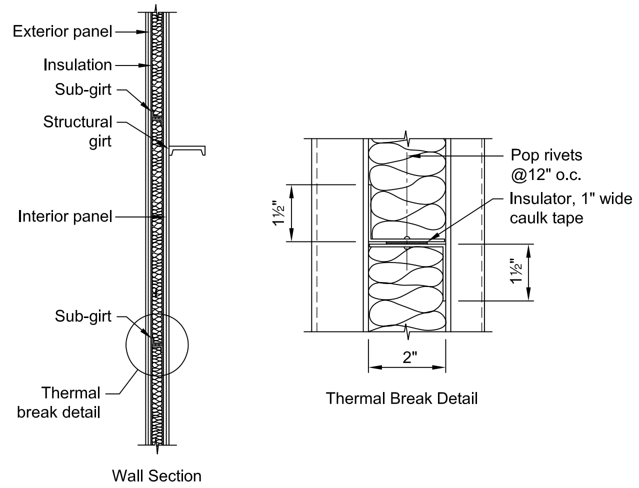
- Area, bay size, plan layout, aisle location, and future expansion provisions
- Loads
- Clear heights
- Relations between functional areas, production flow, and acoustical considerations
- Exterior appearance
- Materials and finishes
- Machinery, equipment, and storage method

Chapters 3 and 4 focus on roof systems and roof trusses, and different types of roofing systems and the pros and cons of each are discussed. A big question pertaining to industrial roofs is when expansion joints are needed and determining how far apart to place them. Chapter 3 answers this question and also addresses concerns about roof drainage and roof penetrations. Chapter 4 provides guidance on designing economic roof trusses, as well as truss stability, and a roof truss stability bracing design example is included.

Choosing a wall system in an industrial building is also an important decision. Many options exist, and you can find a discussion on all of them in Chapter 5. In addition, the cost of the wall system can vary by as much as a factor of three, depending on the material used, field or factory assembly, and other factors. Are you trying to determine the best shape to use for wall girts? Chapter 5 covers these considerations and provides design criteria.

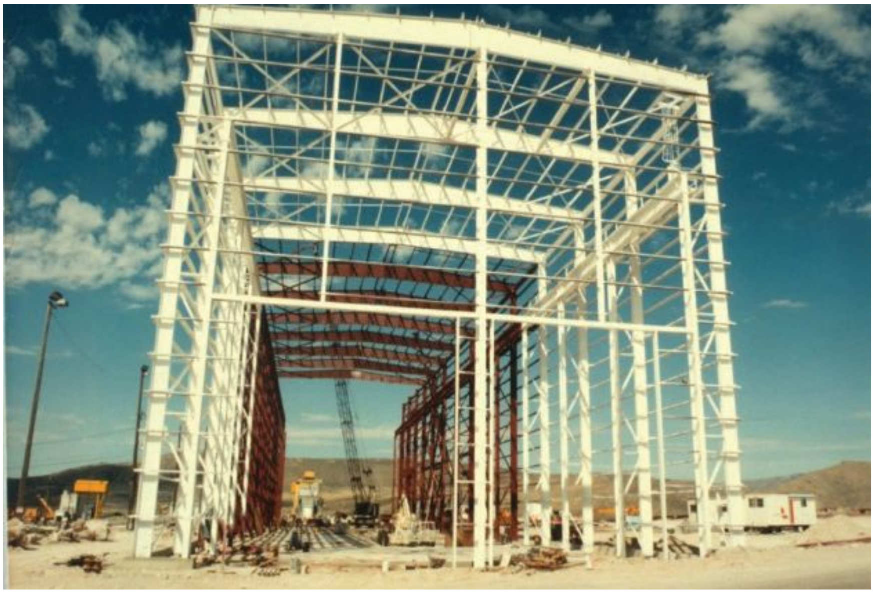
Chapter 6 offers guidance on choosing a framing scheme, and Chapter 7 explores different bracing systems, both vertical and horizontal. Chapter 8 discusses the topic of column anchorage.

The establishment of loading conditions provides a structure of adequate strength; a related set of criteria are needed to establish the serviceability behavior of the structure. Serviceability design considerations, discussed in Chapter 9, are a large part of designing industrial buildings. Included in this chapter are helpful discussions and guidance on deflection, drift, and the relation of the primary and secondary structural systems and elements to the performance of nonstructural components such as roofing, cladding, and mechanical equipment. Keep in mind that serviceability is not a strength issue, but rather a maintenance and human response consideration.



above: Fig. 5-1. Wall thermal break detail.

below: Part 2 covers industrial buildings with underhung and overhead cranes.



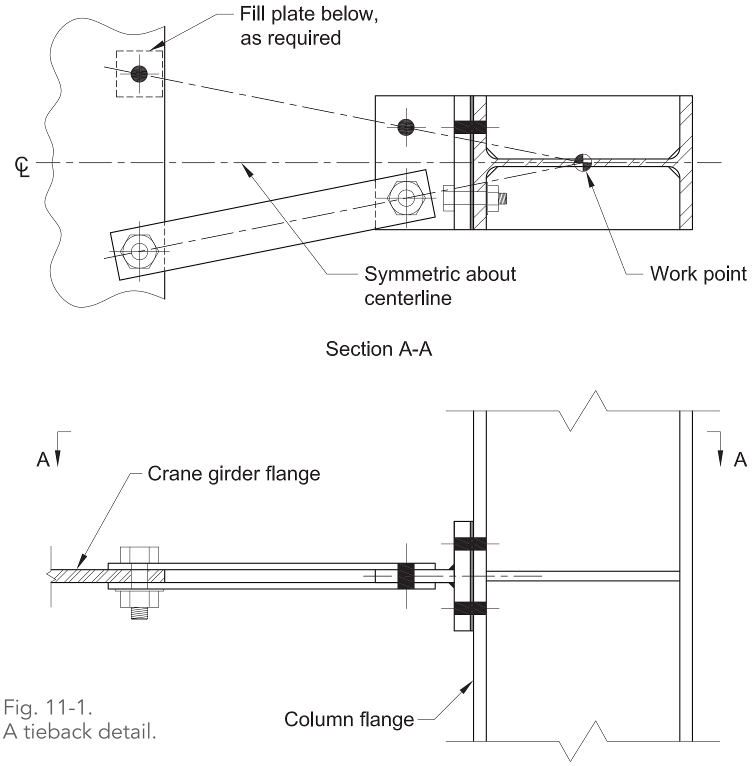


Fig. 11-1.
A tieback detail.

Buildings with Cranes

Part 2 of the guide deals with crane building considerations and begins with Chapter 10. Crane buildings should be classified for design purposes according to the frequency of the crane loading. These classifications are established in AIST TR-13 *Guide for the Design and Construction of Mill Buildings*, and crane classifications are established in the Crane Manufacturers Association of America's (CMAA) *Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes—No. 70*. Both of these publications are referred to in Chapter 10.

One of the most important considerations in a crane building is fatigue. The runway design must account for the fatigue effects caused by the repeated passing of the crane. Guidance on fatigue design considerations can be found in Chapter 11, where the AISC *Specification* fatigue provisions are discussed in terms of their application to crane design considerations. Connection considerations such as web-to-flange welds, tiebacks (Figure 11-1 in the guide), and bearing and intermediate stiffeners, as well as the advantages or disadvantages to using cap channels and cap plates, are also discussed.

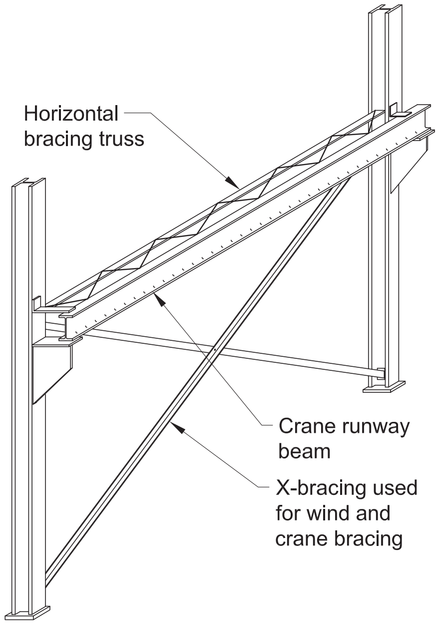


Fig. 13-5. Wall bracing concept for cranes.

Industrial buildings with cranes present the unique challenge of considering the movement and forces imparted by the crane onto all of the buildings systems: roof, walls, and framing. These structural systems are discussed in Chapter 13, where guidance is provided on controlling the frame and bracing stiffness, using roof bracing to distribute crane-induced loads, and special considerations for wall systems. Helpful details such as Figure 13-5, illustrating a wall bracing concept, are provided.

Chapter 14 explains crane runway design topics ranging from designing the crane runway beam and runway bracing concepts to crane stops and crane rail attachment considerations, and design examples for crane runway girders with and without cap channels are included. Chapter 15 offers crane runway fabrication and erection tolerance information.

Chapter 16 outlines crane column design practices, focusing on topics such as base fixity and load sharing, as well as different column design options such as stepped and bracketed columns. Economic considerations are discussed and column design examples are included.

Chapter 17 discusses miscellaneous topics such as outside and underhung crane considerations as well as maintenance and repair. Chapter 18 finishes up with a design procedure summary for a crane column building, and the appendix offers helpful design property information in a handy tabular format.

Industrial buildings offer many challenges to designers, and the new, third edition of Design Guide 7 is a fantastic resource to prepare you for every one of them. The updated publication is available as a free download for AISC members at **aisc.org/dg**, along with the entire library of AISC Design Guides. ■

business issues

GET INVOLVED

BY ANNE SCARLETT

Tips for marketing leadership to make your firm's involvement with nonprofits and other charitable organizations easy and effective.

Anne Scarlett is president of Scarlett Consulting, a Chicago-based company specializing in AEC-specific strategic marketing plans, marketing audits and coaching. She is also on the adjunct faculty at Columbia College of Chicago and DePaul University. She can be contacted via her website, **www.annescarlett.com**.

WE OFTEN HEAR that "everyone in the company is a marketer."

For those of us who are marketing professionals, we must provide "everyone else" with tools and guidance to best support the firm's marketing efforts. Visibility is an essential marketing ingredient, so it's no surprise that active exposure within nonprofit organizations—community, professional, and social—is an excellent way for an engineer to contribute to the firm's overall marketing activity.

To make this happen, review your firm's existing organizational involvement program, or consider spearheading a new initiative. Based upon your firm's available resources, size, and structure, you may opt to collaborate with another department such as human resources in order to ensure the effort remains robust and permanent.

Easy and Effective

Here are some ways to make organizational involvement both easy and effective.

Emphasize the merits. Active involvement in organizations offers life balance, rewards, and satisfactions that are highly personal in nature. Less obvious, but equally valuable, are the professional benefits. Not only is organizational involvement a way for the individual—a representative of your firm's brand—to be visible, but that person also has great opportunity to grow themselves and their careers. They become more confident, self-fulfilled, productive, and well-rounded. Interestingly, senior positions in both business and non-profit organizations involve similar tasks: setting policy, long-term strategy, networking, and organizational structure. So a junior or mid-level engineer can step into leadership roles within organizations in order to develop, practice, and sharpen their skills at rapid speed. In other words, nonprofit organizations can serve as training and proving ground for those who want to stretch explore, and experiment—often within roles beyond those available within their own firms. In addition, organizational involvement allows individuals to demonstrate their true character in a non-selling, non-business scenario. Later, this same character may be remembered, and sought out, by business prospects and colleagues.

Help with assessments. Provide a tool to promote self-reflection within each individual. Facilitate a group discussion or meet with them one-on-one to discuss their answers to these questions: Motivation to get involved? Skills you offer? Skills you want to develop? Interest in community, professional, or social organizations? Hours you are available to dedicate per month (1-2; 3-7; 8-12; and so on)? Level of involvement desired: member/volunteer, committee, board? Core interests: environmental; foreign relations; animal welfare; health; elderly; children; disabled; women; underprivileged; arts and culture?

Provide ideas to get them started. Opportunities are abundant, and could become overwhelming. To help, compile a focused list of local organizations as a starting point. Make special note of places where employees are currently involved, as strength in numbers can be motivating. Coach them to conduct informal conversations with an organization to find the best fit. Make them mindful that some organizations provide certain marketing benefits (e.g., including the company names of board members on letterhead or bartering sponsorship spots in exchange for volunteering.)

Offer an alternative team approach. Some individuals may not have availability to commit to an organization. Yet they may be willing to participate in occasional one-off events. Identify an enthusiastic person in your firm to organize a finite number of firm-wide volunteer activities per year (e.g., Saturday afternoon cleaning up a community park within a low-income neighborhood).

Remember, it's their choice. You cannot force anyone to perform *really well* if they are not truly open and interested. Plus, this is their personal time, beyond work. Encourage, rather than pressure.

Track it. Monitor who is involved in which organizations. If possible, encourage extending the efforts to various organizations for wider visibility. On a micro level, track each individual's involvement during annual reviews, and discuss how the firm could further support their efforts.

Encourage *active* participation. Becoming a volunteer/member is good; serving on a committee or board is excellent. Like anything, the more energy one puts into it, the more personal and professional benefits one will reap in return.

Support it. Allow them schedule flexibility, as appropriate. In addition, have a modest budget to support the organizational involvement of your staff. Maybe they need a sponsor. Maybe they need to buy a table. Maybe they need T-shirts (with your firm's logo) for a specific community event. Invite staff to come forth with their pitch on the value behind financial contributions.

Equip with communication tools. The top priority is for the individual to genuinely grow. The potential benefit is the visibility and networking for your firm. Give these individuals the tools they need (e.g., help with articulating your firm's value proposition) to feel comfortable as an "ambassador" if and when appropriate.

Lead by example. If you expect others to be involved, then you too must be involved. Make sure that the marketing team, along with the firm's leadership, is committed to external organizations. Otherwise, any organizational involvement initiative may be received by the staff with skepticism, even criticism.

Applaud it. Without going overboard, make others aware of accomplishments of staff within their organizations. Perhaps it's a brief article for social media feeds, a website, or a newsletter. Show admiration and appreciation for those who have decided to offer themselves up for the win-win-*win* benefit.

And just what makes organizational involvement a triple-win? One, the nonprofit organization itself wins, and enthusiastic volunteers and members are heartily welcomed. Two, the individual wins, with opportunities like none other to grow personally and professionally. And three, your firm wins, boasting happier and more talented employees with an enhanced sense of purpose, along with stronger visibility.

"Make sure that the marketing team, along with the firm's leadership, are committed to external organizations. Otherwise, any organizational involvement initiative may be received by the staff with skepticism, even criticism."

Facilitation of Organizations

In April's Business Issues article "Forging a Framework for Facilitating" (**www.modernsteel.com**) we focused on the overarching techniques for facilitating meetings. If you're looking for places to hone your facilitation abilities, joining an organization at the committee (or board) level is a perfect opportunity. (Note that the organizations below are all in Chicago, where I'm located. Similar organizations no doubt exist in your neck of the woods.)

Perhaps you want to stick with what you know: engineering. If so, you could get involved with a program like Chicago's Project Exploration, where you can educate Chicago minority middle school students on what's cool about our profession.

On the flip side, you may want to steer clear of the "usual," and opt for something that aligns with your personal causes and passions. National organizations like Volunteer Match will help you identify local options in a wide range of categories, from animals to the arts to the environment (and much more.)

But maybe you just want a taste for now. Organizations like Chicago Cares have a robust website that even includes a calendar of volunteer opportunities with specific one-off projects. Did a window of time in your busy schedule suddenly open up? Jump on their site and see what's needed!

Perhaps you'd prefer to join a social or sports related club. That's relevant! There are abundant opportunities to casually network, and they also have committees if you opt to get more actively involved.

Maybe you've volunteered for a while, and you're ready to take a higher step: becoming a board member. Chicago's Arts and Business Council actually offers an On Board program (requires a financial investment) to train people to become board members for arts organizations.

The bottom line is this: If you're willing to make the time to get involved, you'll be expanding your mind, your network, and your impact. And in the process, you might just contribute to your company's marketing efforts in a new and rewarding way! ■

Does your company encourage involvement with nonprofit organizations on an individual or companywide scale? If so, we'd love to hear about it. Send a note to ***weisenberger@aisc.org****.*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Every year, *Modern Steel* presents a compendium of fun projects—typically smaller buildings or structures or additions to larger ones—showcasing the cool use of steel.

What's Cool in Steel

This year's list includes a new pedestrian bridge at the world-famous San Diego Zoo, an open-air display case for a massive prehistoric skeleton in West Texas, a colorful canopy at an Upstate New York airport, and a minimalist sculpture with big meaning in Des Moines.

Cool Zoo View

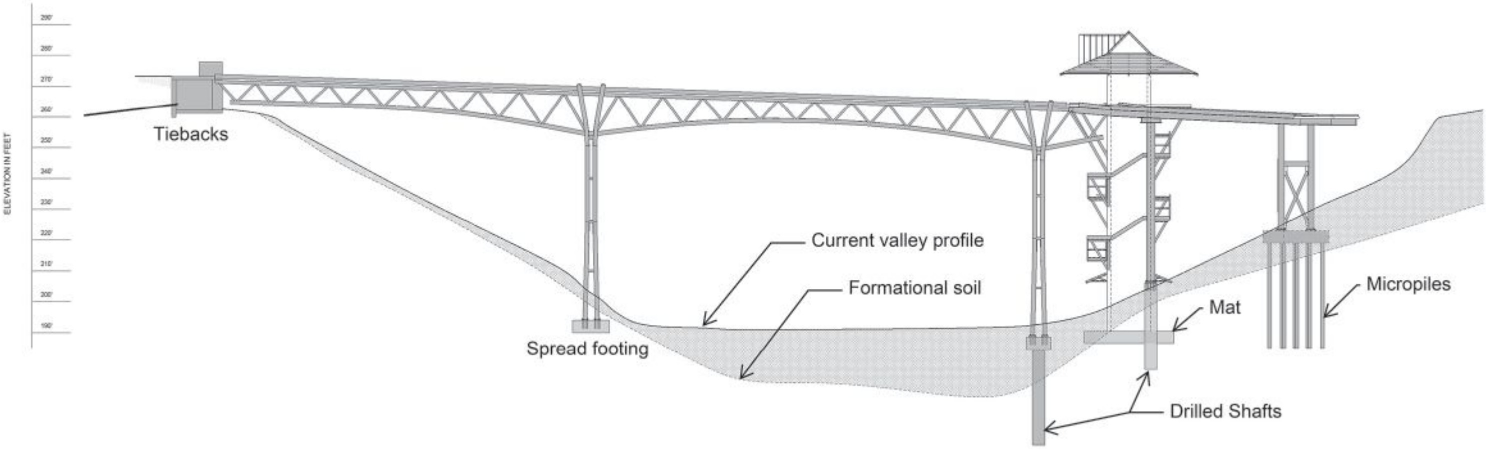
The designers of the new 400-ft-long Bashor Bridge wanted to create a span worthy of its home at one of the world's most famous places to see animals, the San Diego Zoo.

Designed by Architects HGW and KPFF Consulting Engineers—with AISC member Clark Steel Fabricators handling steel fabrication and AISC member bender-roller Albina Co., Inc., rolling the curved sections—the 15-ft-wide steel multi-span steel pedestrian bridge, whose longest span is 145 ft, crosses a 90-ft-deep canyon using tapered steel trusses varying in depth from 8 ft to 15 ft with a triangular cross section. It is primarily supported by two 90-ft-tall built-up hollow structural section (HSS) columns and terminates at an exterior composite steel deck surrounding a concrete elevator shaft high above the canyon floor. From the elevator deck, wide-flange girders on column bents made up an elevated walkway continuing through immovable old grown trees to an existing outdoor café. The project used 226 tons of structural steel in all.

The primary lateral force-resisting elements are the concrete elevator tower and the abutment. The elevator tower is detailed as a special concrete shear wall core and rests on a mat foundation. The abutment is a heavy concrete box anchored back to the earth with post-grouted tie-backs, and the bridge superstructure is fixed to the abutment with thick embed plates.

The bridge uses five different foundation types tailored to the unique constraints at each location, including service roads, steep slopes, existing foundations and utilities, large tree roots, and a soft alluvium layer of variable thickness in the canyon. Underneath the existing café, overhead clearance only allowed access for a micro-pile drill rig. Other foundations include 48-in. drilled shafts, tie-backs, a mat, and spread footings. In terms of initial analysis, early collaboration with the geotechnical engineer helped define a range of soil-structure assumptions and springs, which were incorporated into a SAP2000 model.

Heavy chord and drag elements were required along the bridge to deliver lateral force to the lateral-resisting elements, and complex built-up plate connections were used at intersecting elements. Deformation compatibility required additional strength from the columns and treetop bents. A



range of soil spring and cracked section properties was explored to assess demands on the various elements. There is only one expansion joint on the bridge, at the existing café interface, and it is designed to accommodate 3D movement (including deck twisting) due to temperature, pattern live loads, wind, and seismic behavior.

Design did not end when construction began, and KPFF was retained by the contractor and steel erector to design for various phases of partial construction and temporary bracing. Because of limited space for construction at the site—particularly around the plaza area and panda enclosure—the bridge was completely assembled at Clark Steel's facility and shipped to the site in five sections. With the panda enclosure being directly below the center portion of the bridge, the only location for shoring towers to be placed was on each end, which forced the erection team to set the bridge sections from each end toward the center. In addition, a cruciform bolted connection section was used to minimize crane time and eliminate full-penetration welds. Zoo guests were able to pass beneath the bridge throughout most of construction—and more critically, the sensitive giant pandas below were kept happy and healthy.

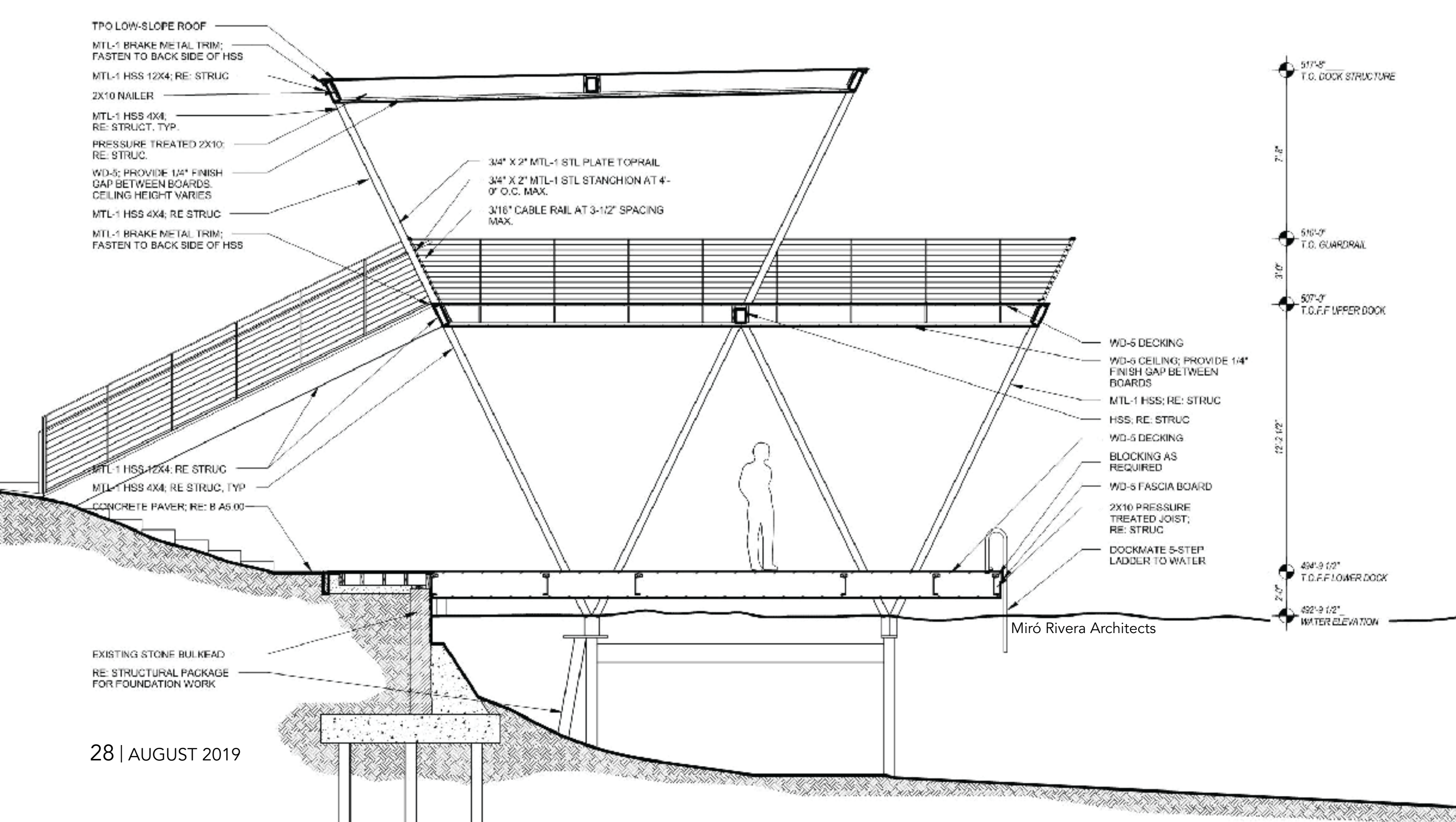
As pedestrian bridges can be sensitive to vibration, accelerations, velocities, and displacements were evaluated for vertical and lateral excitations due to footsteps, lock-in effects, and wind—and the team consulted AISC Design Guide 11: *Vibrations of Steel-Framed Structural Systems Due to Human Activity* (**aisc.org/dg**) as well as other publications for vibration considerations. In addition, the zoo crafted a nightly event that included a dance party on the bridge. While the design live loads would not be exceeded, a unique vibrational analysis was performed to evaluate rhythmic excitation induced by as many as 1,000 people in unison (shoulder to shoulder), and fatigue principals were applied to critical elements using finite element analysis of welds and plates. (As an indicator of how unique such an event is for a pedestrian bridge, commentary in AASHTO bridge design standards specifically excludes human live loads from fatigue requirements.)

Cool Lakeside Spot

Perched at the edge of Lake Austin in Texas' capital city is the structurally and aesthetically elegant W Dock, a light, economical structure whose reedy, triangular steel frames reduce the number of required support piles while creating the sensation that the dock is balanced "just so."

Designed by Miró Rivera Architects and Architectural Engineers Collaborative, the structure's minimalist form and desire for a clean, unobtrusive look drove the project. The angled columns combine the lateral and gravity structural systems, allowing for a more visually consistent structural scheme than vertical columns and braces would have provided. The hollow structural section (HSS) framing—fabricated by AISC member Patriot Erectors, Inc.—permitted clean, simple moment connections that create an exposed moment frame system, and this system is hardly noticeable as it runs parallel to the shoreline. In fact, the moment frame works in concert with the steel tread stair that ties the

Sergio Reza



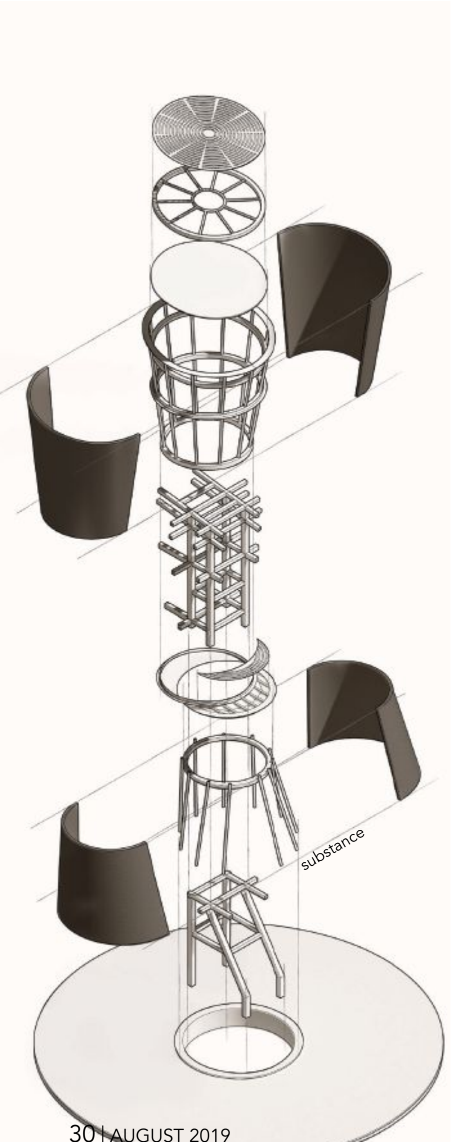
Miró Rivera Architects

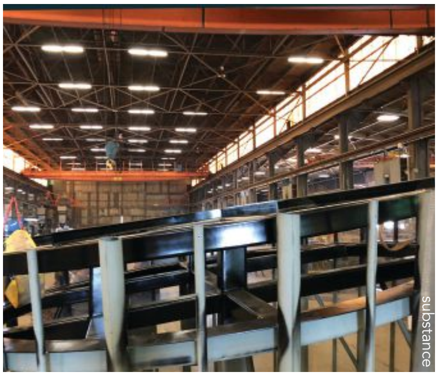
dock to the shoreline, increasing the stiffness of the dock. While the lake level remains mostly constant year-round, construction was timed with a periodic lowering of the waterline, allowing connections that would typically be submerged to be made without resorting to underwater welding. The dock uses 16 tons of steel in all.

Viewed from farther inland, the slender columns of the angled frames almost disappear, and the boat dock manifests as a series of floating planes—thus preserving views through the structure. At the upper level, the deck and roof planes frame a line of wooded cliffs across the water while catching breezes and providing shade.

The decision to emphasize the horizontal lines of the dock and omit vertical elements such as walls allowed for higher story drifts than are typically permitted, which made the described moment frame system more feasible. The engineers also took steps to limit deflections in these horizontal members without relying on bulky, tall sections. First, the longer-spanning beams were cambered to ensure that no visible sagging would be present under the weight of the structure. Second, HSS were "nested" inside each other to provide a much stiffer member without adding depth to the structure. The nested sections were joined to the main members with spacer plates to ensure composite action.

The project's stripped-down form meant that many nonstructural decisions were effectively already made for the designers. Incorporating functional elements such as lighting, speakers, and handrails became a matter of finding the least intrusive solutions in order to preserve the integrity of the essential design intent. Emphasis was placed on details like angled handrails and a diving gate, which lends an air of playfulness on a hot summer day. Meanwhile, the exposed, weathering steel communicates a rustic appearance while providing a perfect solution to the area's high-corrosion environment.





Cool Monument

A Monumental Journey, a Des Moines sculpture by renowned artist Kerry James Marshall, celebrates the legacy of African American lawyers, who, in 1925, founded the National Bar Association, which is dedicated to civil rights, justice, and equality in the legal system.

Marshall collaborated with Substance Architects to achieve the colossal, geometric sculpture. The shape is inspired by the form of the African talking drums with one drum precariously stacked upon the other, representing the notion of communication among diverse people and a legal system that, while not perfect, strives to be balanced. The sculpture stands 30 ft tall, embodying a sense of monumentality.

The sculpture is clad in bricks to represent the feeling of weight and balance expressed in the piece. The manganese iron spot brick that comprises the piece displays a rich texture and tones of gray with a subtle shine due to the iron in the clay.

An impressive steel frame (16 tons in all) was fabricated to support the brick within this complicated tapered and suspended shape. The frame—designed by KPFF and fabricated by AISC member fabricator Johnson Machine Works, with curved elements rolled by AISC member Albina Co., Inc.—provided two main advantages in the overall process: It allowed the masonry contractor to have a frame to follow while laying the bricks, and it gave a high level of precision since the structure was built off-site in sections. In addition, steel also facilitated a fast-paced fabrication and erection schedule, especially impressive given the sculpture's intricate geometry.

A detailed 3D model of the frame was shared between Substance, KPFF, and Johnson Machine Works. Because of the cantilevered and heavy nature of the sculpture, multiple coordination meetings were set up to discuss challenges such as how to divide the structure and how to achieve an uncomplicated expression of details and connections.

The sculpture's middle truss provides the main point of attachment, and special contour plates were designed to create a continuous frame on the exterior. The top section supports ring metal plates that are aligned flush to the top edge of the sculpture.

The ring plates were the only visible element at the start and the end of the brick construction. They were laser-cut and made of galvanized steel, as was the rest of the frame. At the interconnection between the two volumes, a thin sheet of brushed stainless steel was attached underneath the upper drum. All the visible details—where the steel and brick meet each other—were kept to a simple and effective aesthetic. The exterior structural frame was made of round tubes that followed the general geometry of the sculpture. The frame was then wrapped in a perforated sheet metal on which bricks were set against.

To coordinate brick installation, each brick was modeled into drawing software that explored the best pattern solutions and laying starting points, and every brick was custom made and hand-cut. The short edges of the brick were shaved to follow the circular configuration of the bricks, while the corner edge was trimmed to smooth the exterior geometry of the piece.

substance

substance

substance

Cool Pterosaur Display Case

One of history's largest flying animals, a pterosaur known as Quetzalcoatlus, was first discovered in Texas' Big Bend National Park in 1971.

But until recently, there wasn't a great way to display this fossil evidence or tie it and other fossils to the surrounding geology of the park. Thankfully, the new park's steel-framed Fossil Discovery Exhibit does both.

The concept of this project involved simple, repetitive architectural forms and very few materials to provide deep shade and minimal shelter for visitors to the exhibit. The scale of the building was driven by the 33-ft wingspan of the aforementioned prehistoric skeleton, resulting in a large central span that tapers out from 30 ft to 40 ft wide, with a lower 28-ft-wide roof on each side. These forms, combined with the unstaffed nature of the exhibits and the unforgiving heat and sun of the area, led the design team of Lake Flato Architects and Datum Engineers to consider the industrial qualities of a steel superstructure, employing AISC member Rocky Mountain Steel to fabricate the project's steel.

One might easily default to galvanized finishes for metal exposed to the elements, but the owner and design team were concerned that a shiny metal structure would be a distraction to hikers in this serene desert landscape with muted colors. While the site was an ocean floor 130 million years ago, then a salty coastal floodplain that would have quickly consumed uncoated steel a mere 80 million years ago, it is presently far from the coast and gets less than 13 in. of rain each year. Considering the park's present arid environment, the team researched corrosion potential and concluded that the dry, inland environment would lead to less than 0.001 in. of material loss per year. The thinnest of the structure's materials, the roof decking, was therefore specified as weathering steel, and the balance of the steel members are uncoated structural steel.

While refining the structural system, the team was inspired by the lightness and structural efficiency of the pterosaur skeleton itself, particularly the 9-ft span of its fourth finger. The roof structure consists of $\frac{7}{8}$-in.-deep 22-gauge corrugated weathering steel deck fastened to HSS4×2 tube-steel purlins. Those purlins are in turn supported on HSS4.5 members supplemented with a castellated WT4×9 for increased strength and stiffness. At each end of the central space, this castellated member becomes the top chord of a flat-bottom pipe truss. In the smaller spaces, the lateral system is composed of diagonal rod bracing integrated with the exterior perforated wall panels. In the central space, paired diagonal pipes combine with the columns and beams to create visually open, three-pin rigid frames. The cladding is perforated metal panel, and the building skirt is corrugated steel, similar to the roof.

Casey Dunn

Ridgway Valley Enterprises, Inc.

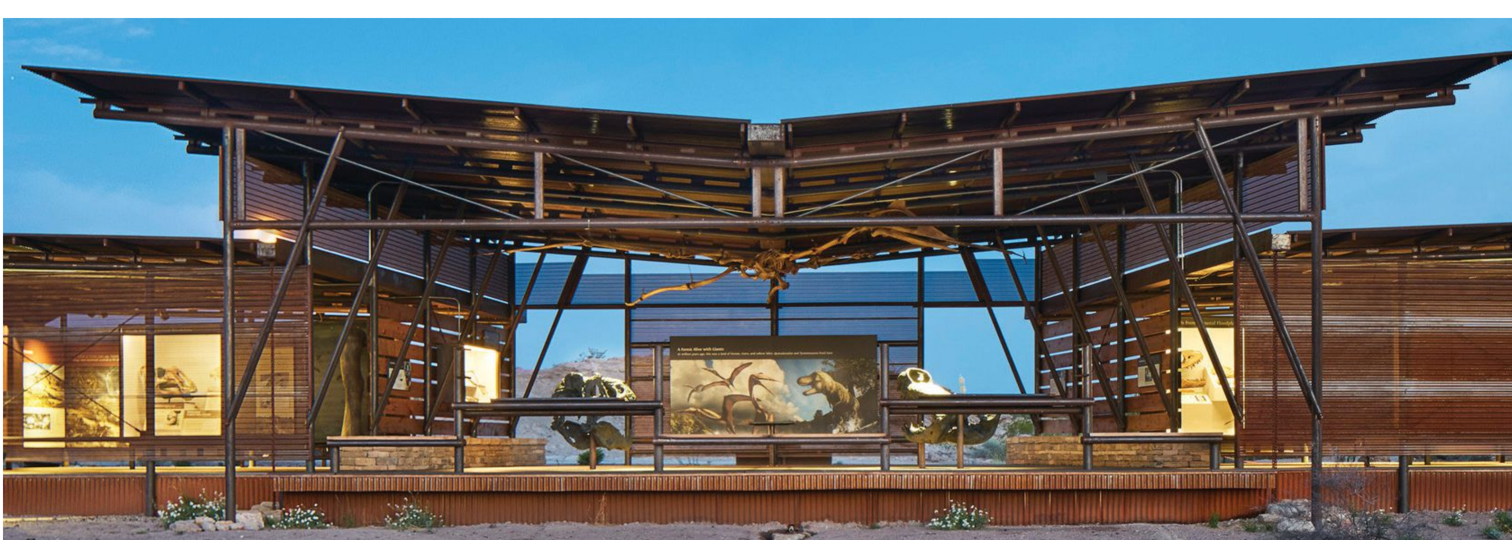
Casey Dunn

Casey Dunn

In addition to the rugged environment, the project's location is, in a word, remote—57 miles from the nearest town (Marathon, Texas, population 470). This lonesome location is an incredible luxury to stargazers, but a significant hurdle for construction. For this reason, the design team prioritized prefabrication and ease of field assembly. Deck connections used self-tapping screws, purlins were bolted to prefabricated tab plates, and diagonals were connected with bolted gussets and through-bolts. Furthermore, the designs accommodated a mid-span splice in the castellated beams over the central space and included a bolted erection sleeve to the columns, to be welded at the erector's leisure after fit-up. Frame elevations showing the assembly sequence were provided on the design documents to illustrate this vision, just to make sure everyone knew how simply it could be done.

The Quetzacoatlus now hangs from the roof, showing off its amazing wingspan. Bronze castings of two huge prehistoric skulls are perched on steel posts through the floor. Other life-sized (gigantic) fossils are arranged throughout. Visitors can snap QR codes with their phones and bring up information about the exhibits or gaze out at the Sierra del Carmen Mountain range and imagine it throughout the ages. Ross Maxwell, the Park's first superintendent, is said to have imagined the potential for the park to be a geological wonderland. The success of this pavilion is that it highlights the park, and the designers think Maxwell would be pleased.

Lake Flato Architects



Casey Dunn

Todd Holdsworth

Mahan Rykiel Associates

Mahan Rykiel Associates

Cool Community Focal Point

Eager Park, a 5.5-acre public space in East Baltimore, Md., is the centerpiece of a larger 88-acre mixed-used development containing offices, retail, graduate student housing, an elementary school, a biotech park, and a multi-family residential component. The park celebrates the history of the area and its proud residents and serves as a recreational anchor for economic growth. The first major community park to be constructed in Baltimore in decades, the development is a public-private partnership.

Between weaving pathways at the center of the park sits the new steel-framed T. Rowe Price Pavilion, which serves as a venue for performances while also providing an iconic gathering space that dynamically looks towards the future. The design goals for the structure were to: display historical significance via steel, create an aspirational and uplifting icon, achieve programming flexibility, and most importantly weave communities together. A symbol of progress and unity, it provides shade and retreat as well as an iconic focal point.

The zig-zag structural configuration, while designed for efficiency, generated a woven, stitch pattern that reflected the notion of connecting communities, and the canopy framing was shipped in two complete 20-ft by 80-ft sections. The pavilion responds to the landscape, inviting people under its canopy from a high point at the east, and dropping down to a more human scale on its west side. The canopy is covered by an ethylene tetrafluoroethylene (ETFE) membrane, attached to the main steel framing via welded custom lightweight steel "fins" designed to extend the cover created by the canopy and allow the roof plane to visually float above the structural form. Baltimore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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
18. **Rectangular Tube The Easy Way (Y-Y Axis)** — INSIDE DIA. — 20" x 12" x 5/8" Tube
19. **Rectangular Tube The Hard Way (X-X Axis)** — INSIDE DIA. — 20" x 12" x 5/8" Tube
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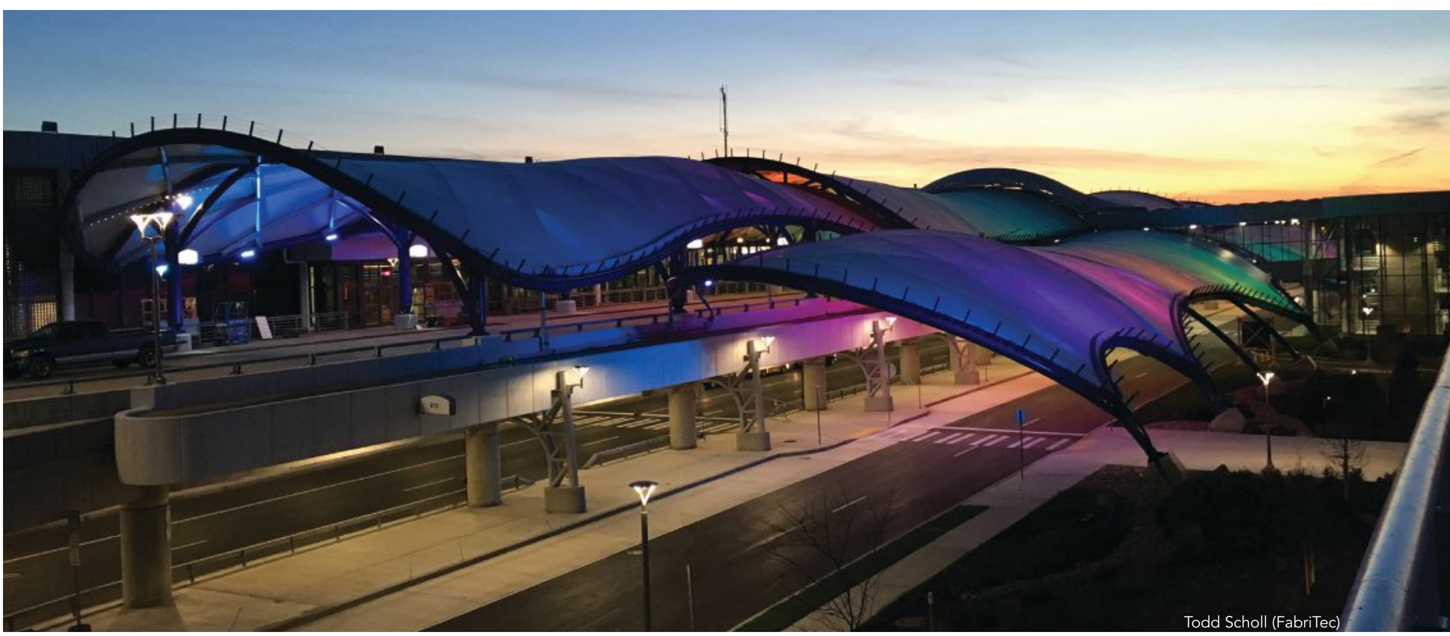
Steel Erectors (an AISC member fabricator) served as the steel fabricator.

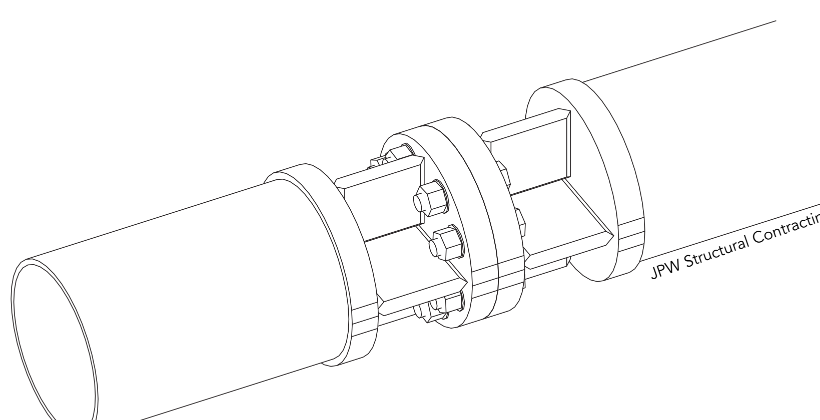
While structural analysis is typically performed by the structural engineer, finite element-analysis software Karamba3D allowed designer Gensler to test for structural solutions within the parametric environment. By integrating this fully parametric structural analysis tool into the workflow, the team was able to quickly iterate design options and share structural observations with structural engineer Carroll Engineering.

Todd Scholl (FabriTec)



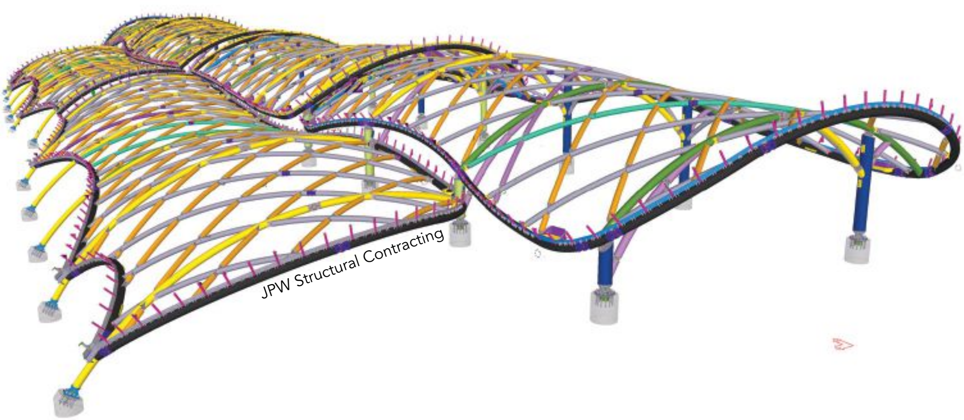
Todd Scholl (FabriTec)

Joe Woznica (JPW Structural Contracting)

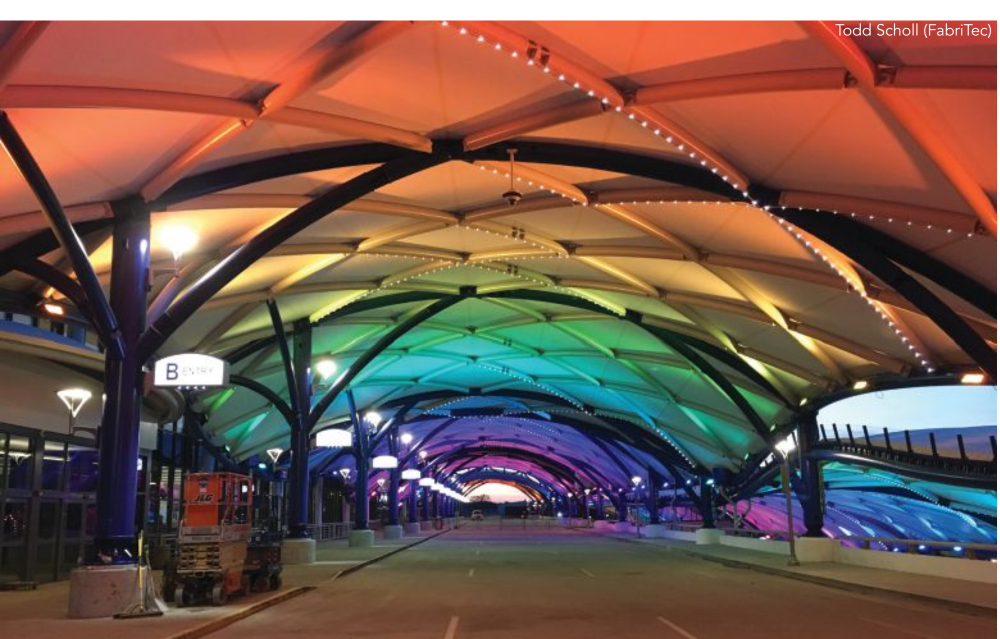


JPW Structural Contracting

Joe Woznica (JPW Structural Contracting)



JPW Structural Contracting



Todd Scholl (FabriTec)

Cool Gateway

The 2.4 million annual travelers to and from Greater Rochester International Airport in Rochester, N.Y., can now arrive and depart from its terminal in style thanks to a colorful new steel-framed canopy.

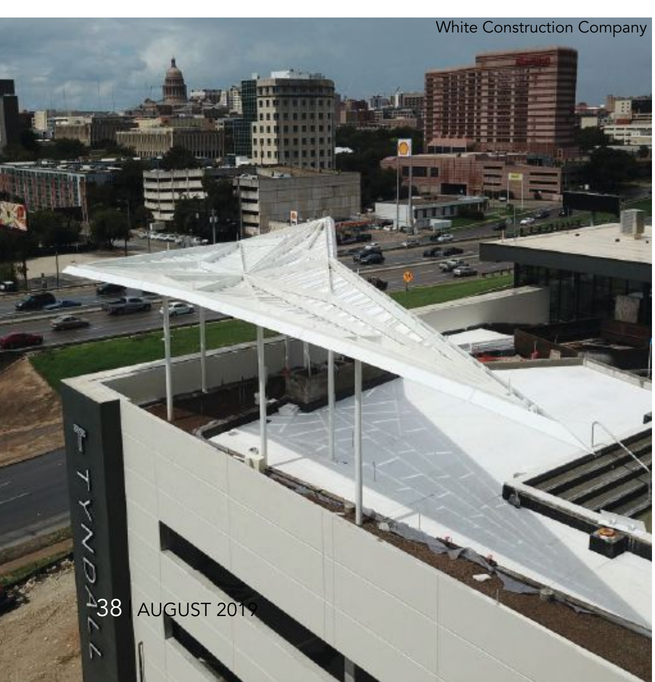
Built as part of a $79.4 million redevelopment project for the airport and completed this past fall, this tensile structure canopy soars over the existing departure viaduct and arrivals roads, providing passengers with sheltered access to and from the terminal from both the parking garage and the curbside drop-off and pick-up area.

Designed by architect Passero Associates and structural engineer Ysrail A. Seinuk P.C., the hollow structural section (HSS) frame is covered in a translucent fabric, designed to look like wings, around a covered walkway made of glass and solar panels. The steel arch members are comprised of 16-in.-, 14-in.-, and 10-in.-diameter HSS, while the columns are 24-in.-diameter HSS—all of varying schedule types. Each steel arch spans 80 ft and weighs approximately 6.5 tons. The entire canopy structure uses 420 tons of curved steel (fabricated by AISC members FabriTec Structures and JPW Structural Contracting and curved by AISC member bender-roller Greiner Industries) in all mounted under a tensile membrane fabric covering 75,000 sq. ft. In addition to sheltering passengers and drivers from the weather, the canopy also supports intelligent video and other security surveillance apparatus like cameras, license plate readers, and luggage motion-sensing devices, thus providing an important function in passenger and employee security and safety. And in addition to these security benefits, it also supports solar panels, a 40,000-gallon rainwater collection system for landscaping and irrigation on airport property, and LED lighting that turns the canopy into a colorful canvas.

All of the steel is exposed, and Passero initially specified an architecturally exposed structural steel (AESS) requirement. However, as the project began to come together in the field, time and budgetary restraints made them rethink this requirement. Passero representatives came to fabricator JPW's shop to inspect the first few assemblies and were pleased with how the welds looked—so pleased, in fact, that they allowed JPW to continue with its current practices and actually removed the AESS requirement.

White Construction Company

Valmont Industries



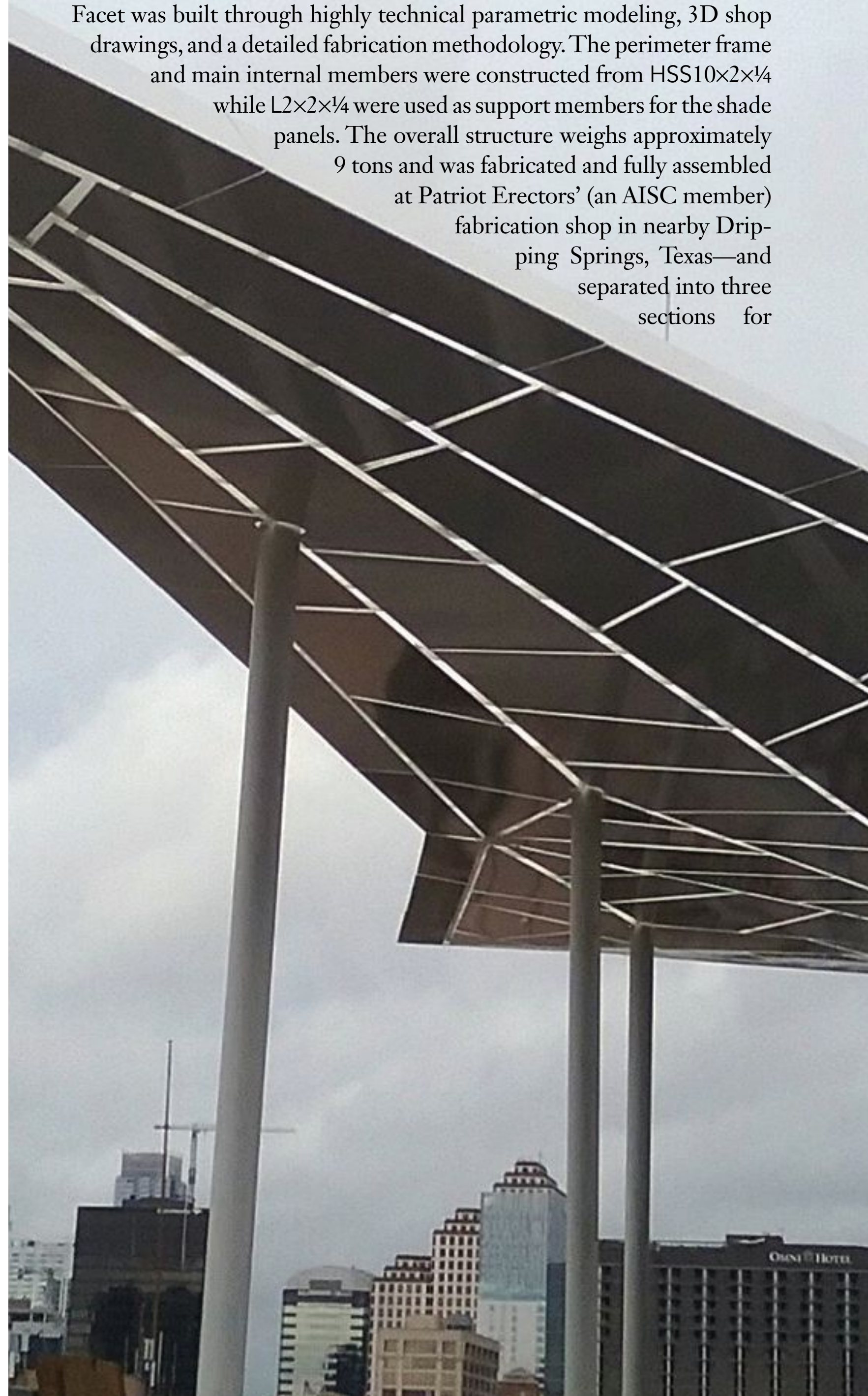
White Construction Company

Cool Wedge

A custom-designed shade structure, fondly named "Facet" by its design team, provides an iconic visual element that helps set the Tyndall at Robertson Hill condominium development in downtown Austin apart from its neighboring structures. The shape of the piece was derived from the wedge of space outside of the city's Capitol View Corridor that passes through the site.

The limitations of the location, combined with the need for shade and the desire to frame the amazing views of downtown, provided the design team—including engineer Leap! Structures and architects Humphreys and Partners, LP, and dwg—with the inspiration to design this unique, triangular-shaped element, creating an "eyebrow" effect to define the skyline views of the pool deck. The steel-framed shade structure is intended to dynamically react with light, both day and night, emphasizing the seams between each of the structure's shade panels that cover the underside of the structural members. When the sun shines through the piece, a linear "hyperspace" shade pattern is projected on the ground, fusing art with its landscape.

Facet was built through highly technical parametric modeling, 3D shop drawings, and a detailed fabrication methodology. The perimeter frame and main internal members were constructed from HSS10×2×¼ while L2×2×¼ were used as support members for the shade panels. The overall structure weighs approximately 9 tons and was fabricated and fully assembled at Patriot Erectors' (an AISC member) fabrication shop in nearby Dripping Springs, Texas—and separated into three sections for



relocation and reassembly to facilitate shade panel preparation and galvanizing. While in the shop, the frame was fitted with temporary stub columns, enabling it to be flipped and reassembled outside in order to more easily enable pre-fitting of the ¼-in. aluminum shade panels.

Light-gauge steel templates were made for each of the 99 shade panels, and each was individually fitted and marked for hole locations along with appropriate notations to help ensure fit. The templates were then transferred into the model for the final aluminum panels. The frames used an aluminum edge cap, and the request of the architects Patriot devised an attachment system that would allow both vertical and horizontal adjustment, intentionally locating the seat angle low and providing the need for adjustment in only one direction. Long horizontal slots were used to achieve horizontal adjustment, which proved to be a very efficient installation; a 4-in. gap was incorporated at the top to allow access as well. The finish was hot-dipped galvanized and topped with a white field-finish coat. Due to the complexity of the structure, a high level of model coordination between the detailer and the aluminum panel provider was essential. Out of the total 127 fabricated aluminum panels, only one required remake due to field fit issues, and the project was completed in nine months.

Patriot Erectors, LLC

Cool Place to Rock Out

The small Appalachian town of Middlesboro, Ky., now has a special place for residents to come together and tap their feet to the music on hot summer evenings, thanks to a grant from Los Angeles-based Levitt Foundation to support an annual summer music series.

Along with funding to bring in talented musical acts, the Levitt Foundation strongly encourages the concept of place-making, pushing the community to develop an underutilized space for the concert series. In Middlesboro's case, a gravel-covered vacant lot in the downtown section of Main Street—the previous location of a store that had been destroyed by a tornado in the 1980s—fit the bill.

The community initially planted a lawn and put together a small wooden stage on the site—but knew they eventually wanted something more permanent and also hoped to raise the profile of what has become known as the Levitt AMP Middlesboro Music Series. As such, local steel fabricator J.R. Hoe (an AISC member) committed to building a larger, structural steel stage.

The stage surface height was calibrated so that concert-goers from the front to the back of the lawn and on the street could view the concert easily. To accommodate mounting fixtures such as lights and speakers, bolt holes were added in the columns, beams and bracing. J.R. Hoe's 110-year history includes extensive experience with truss structures, so it designed and built an exposed steel truss as the main support across the front of the stage. As the finishing touch, the company used its plasma table to build a backlit Levitt Foundation sign to mount to the top center of the stage.

The Levitt AMP Middlesboro Music Series is entering its fifth year, and the recent upgrade of the stage has added to the continued success of this small town revitalization project. As a reward for these efforts, the Levitt Foundation has extended Middlesboro's grant for the next three years, beginning this year. ■

Future engineers proved their "metal" at the 2019 AISC Student Steel Bridge Competition.

Trussed to the Nines

BY DANI FRIEDLAND

Steve Buhman, New Leaf Studio

THERE'S ONLY ONE THING that could bring together a placid if slightly confused retired racing camel named Big Al, a pack of dignified dogs bred to hunt with Egypt's pharaohs, and hundreds of the nation's most promising and dedicated engineering students: steel.

Steel bridges, to be precise. Forty-one student engineering teams made it to the national finals of AISC's Student Steel Bridge Competition (SSBC) on the campus of Southern Illinois University (SIU) in Carbondale, Ill., at the end of May.

These teams came from as far south as Puerto Rico and as far north as Alaska—and they all came out on top in the 17 regional competitions that preceded the national event. Their challenge: build a scale bridge that can support a load of 2,500 lb. This year's competition had the additional challenge of an offset footing on one bank of the "river."

Top Dog

For the second year in a row, Easton, Penn.-based Lafayette College took first place overall. Lafayette also won first place in the categories of construction economy, stiffness, structural efficiency, and construction speed—winning the latter with a staggering time of 3.8 minutes from start to finish. To give you an idea of how fast that is, the second-fastest speed was 5.03 minutes and the 20th-fastest was 12.22 minutes. (For more information on the various categories and scoring, visit **aisc.org/ssbc**).

Lafayette's faculty advisor, Stephen Kurtz, PE, PhD says the competition is the ultimate framework in which to teach students an organized way to make engineering decisions. Every year, as the team gets its bridge planning underway in August, Kurtz tells them, "If you systematically make engineering decisions, and if you try to make everything you do an engineered decision, you'll be

above: The University of Oklahoma team arrived in style.

below: AISC president Charlie Carter with a couple of Salukis, host school SIU's mascot. Salukis were originally bred in the Fertile Crescent, and the school is located in a portion of Southern Illinois informally known as "Little Egypt" due to its proximity to the Mississippi River floodplain and its similarity to the fertile Nile River valley.

above: Students came from all across the country to participate in the national event.

opposite page: Arkansas State at work during the build portion of the competition.

below: Members of The Catholic University of America team pose with their bridge.

Steve Buhman, New Leaf Studio

successful. To actually win, you'll need to do these things to perfection."

Kurtz praised this year's team for their dedication to disciplined decision-making right up until the end. After winning the Mid-Atlantic Regional competition in mid-April, the team ran 28 additional laboratory tests to investigate whether the benefit of an additional member in the top chord was worth the extra cost in construction time. After they had added the member, additional load testing and analysis showed that the extra member's usefulness outweighed its costs in only one of the six randomly selected load-testing scenarios the bridge might encounter in competition. "It was not worth it for five of six [potential testing conditions]," Kurtz said. "They literally cut it off." (For more on the Lafayette's recipe for success, see the "Nerves of Steel" sidebar.)

Best-Laid Spans

This year's student engineers showed remarkable innovation and ingenuity.

One team member from The University of Akron summed up the whole process: "It's really fun to make things out of steel and hope they don't break—and let other peoples'

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

Steve Buhman, New Leaf Studio

above: The Clarkson University team used a deck truss design to handle the challenge of an offset footing.

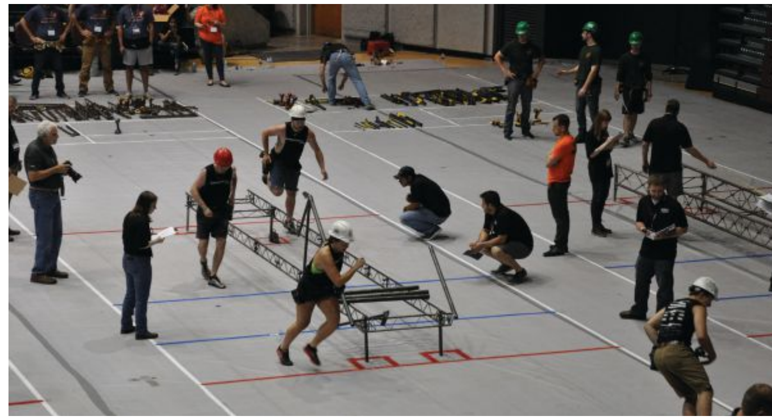
right and below: The Catholic University of America team supported one another and met in the middle—both quite literally.

Steve Buhman, New Leaf Studio

break." The team's faculty advisor, David Roke, PhD, quickly corrected that statement, adding, "and engineer it so it won't break. Less hoping, more engineering and knowing that it won't fail. You learned something in the classroom!"

Of course, plenty of learning took place outside the classroom, too. "The most valuable thing I learned is that there is no such thing as a bad idea," said Lafayette College's Kari Schultheis. "Everything about our bridge was designed and optimized, but so much had to start with somebody putting forth an idea that seemed unconventional or even intuitively silly. There was no such thing as a bad idea unless someone proved it was bad (and even that wasn't a permanent verdict), and no such thing as a good idea unless someone proved it was the best (which was also always up for healthy debate)."

After all the work that teams put into their bridges, it's not uncommon to develop an affection for them. The Christian Brothers University team even named their bridge. "Her name is Bridget," said junior Grettio Rivas. "Because she's a bridge."



above: Lafayette College assembled their bridge in under four minutes.

left: The Kansas State team, leaning in.

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above: A College of New Jersey team member keeps her eye on the prize.

right: The University of Alaska Fairbanks placed third in structural efficiency.

below: The University of Oklahoma team connects over the river.

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Over Troubled Waters

As if this year's bridge requirements, with a longer span and offset footing, weren't challenging enough to meet, several teams also faced quite a few logistical challenges.

For some, it was a matter of sourcing the raw material for their bridges—no easy task when you're somewhere like Alaska. "You can't just go to the store and pick up any size you want," said University of Alaska Anchorage team captain Aaron Murph. "Half your bridge [design process] is pretty much 'What metal can we find?'"

Once they had the steel, though, the team's location worked to their advantage. "In Alaska, there's not a lot of construction going on because it's all frozen, so the [local] fab shops are kind of like, 'Yeah, come on in!'" Murph recounted. (For more on the University of Alaska Anchorage team's path to the finals, see "Wild Ride to Carbondale" on page 52.)

At the other end of the geographical spectrum, the University of Puerto Rico Mayagüez had trouble simply packing up their bridge for competitions. They couldn't find any boxes in the sizes they

Steve Buhman, New Leaf Studio

above: Spectators and fellow team members cheered on their schools.

above and below: South Dakota State's bridge, decked out in school colors.

Steve Buhman, New Leaf Studio

above: Purdue University Northwest won the Robert E. Shaw, Jr., Spirit of the Competition Award.

below: The Case Western Reserve team, putting the finishing touches on their bridge.

above: Brigham Young University makes the crucial cross-river connection.

below: A Michigan Tech student prepares for the build portion.

Steve Buhman, New Leaf Studio

Steve Buhman, New Leaf Studio

sizes they needed in Puerto Rico, so they had to build their own. "At the Regional, it got destroyed by the plane traveling and all that so we had to buy new ones [online] and fix our bridge," team captain Sofia Boscio said. "That slowed us down a little bit but we were able to fix it at the end." (Last year's University of Puerto Rico Mayagüez team also had to contend with Hurricane Maria; see the "Force of Nature" sidebar in the August 2018 article "Reigning in Champaign," accessible at **www.modernsteel.com**.)

Some teams had an agonizingly slow start to the competition—and, in one case, experienced a frustrating lesson in the world of construction. The University of Akron team's donated steel didn't show up in time (and in fact, the team was still awaiting delivery as of the National Finals). So in mid-January, they decided to recycle an older bridge and soon found that there was a silver lining. "We already knew how to put the bridge together so our construction time didn't take a huge hit," said the team's captain, William Shea. "We already knew 80% of the bridge."

Meanwhile, The Cooper Union's bridge nearly ended up underwater—literally. "Our school flooded and we lost two entire weeks of fabrication time," recalled team member Candy Liu. "The members we made were fine... it's a little bit rusty but it's fixable. Our lab was dry but some of our stock just got super rusted at that time."

The Utah State University team found themselves hard at work in the shop the night before Regionals after a miscommunication with their fabricator, and Drexel University also found itself scrambling when their first bridge failed load testing just a few days before the regional competition. (Like The University of Akron, they also ended up revising a previous bridge.) The team faced additional pressure because the school uses a quarter system. "I have finals coming up," said team member Noelle Kownurko at the National Finals. "We had midterms during Regionals."

Looking to a Bright Future

Of course, there's more at stake for these students than just the satisfaction of a job well done. Several cited their participation in a bridge team as a benefit when it comes to job hunting.

A student from the University of Connecticut reviews a judge's notes.

Steve Buhman, New Leaf Studio

Monica Moody, who just graduated from The University of Akron, drew a direct line between her experience in the competition and her new job. "The reason I got the job is that they saw that I was involved with something like this," she said. "They had been involved with it when they were in school, so it was a good networking connection."

Christian Brothers University's Rivas got a lead on a potential internship at the event itself, during the networking session. "You never think that this would be very impactful on your career, but once you attend the event it really does open many doors for you," he said. "It really takes you places."

Structural Connections

For many participants, the ability to meet other likeminded students from across the country is the best part of the competition.

"Prior to the competition, you don't really call up your competitor and be like, 'Hey how's your bridge going? What kind of challenges are you facing?'" University of Alaska Anchorage's Murph said. "But as soon as you get here, everybody's friends. You can kind of go around and be like, 'That's a really cool connection! What was your idea behind that?'"

Others appreciated the leadership opportunities that the competition brings to the college experience. University of

Steve Buhman, New Leaf Studio

The University of Wisconsin – Madison team carrying their completed bridge to the next station.

High-fives all around for the University of California, Berkeley, team.

above: Oregon Institute of Technology's team showed off some stylish PPE.

below: Host team SIU, testing their bridge's load capacity.

Nerves of Steel

Lafayette College's rigorous preparation program includes some unusual elements.

The first is an intramural bridge competition in which all juniors studying civil engineering participate. This event is based on the rules for the actual Student Steel Bridge Competition (SSBC) that year. Students on both the intramural and competition teams do all the fabrication work themselves in Lafayette's steel shop.

The competition team almost always consists exclusively of seniors. By the end of the first semester of their junior year, the team's faculty advisor, Stephen Kurtz, PE, PhD, says he has generally identified the students who are particularly passionate and work well in a team environment. But being chosen for the competition team isn't a guarantee. "They can get cut [from the team] and they do," Kurtz said. "If any team member is really not operating at an elite level, then I ask them to find something else to do." (A particularly unusual personnel shift this year brought two promising juniors onto the competition team after the first semester.)

But it's not just Kurtz who's evaluating the students' performance. The night before Lafayette's big rivalry football game each year, the team must present their ideas and their first bridge design to dozens of steel bridge alumni. It's an interactive process, to say the least—and Kurtz has a warning for the students beforehand: "Don't expect polite golf claps, because the alumni are absolutely vicious," Kurtz said. "Usually, the main objection that the alumni can have is if they perceive that the seniors do not possess a level of commitment."

This year's team had a particularly rough experience in November 2018, when they presented a bridge that had poor P-delta performance. "The alumni tore them apart," Kurtz recalled. "I expect them to have quite a lot of attitude and swagger when they walk into the room in November for their first alumni presentation. I just hope there aren't any fights."

Traditionally, though, the hard feelings don't last long. Seniors traditionally go to a bar with the alumni after the presentation, Kurtz said, noting that things get patched up. The alumni have a secret Facebook group as well, where alumni who never knew one another when they were students develop friendships based on their common experience with the steel bridge team.

Lafayette College won four categories as well as the overall prize.

The presence of a camel (named Big Al) at the competition is an homage to SIU's location in an area known as "Little Egypt."

The University of Puerto Rico at Mayagüez took second place in structural efficiency and third place in lightness.

California, Berkeley's, team impressed Sarah Cook. "I went to a couple different meetings for competition teams," she said. "I really vibed with the people from Steel Bridge. I thought they were really friendly, really intelligent role models. As I got older, I wanted to be a role model to younger people as they were to me, too." (Cook is now the team's project manager.)

Several students remarked on the presence of women on this year's teams. "I love how our team has maintained a 50/50, male/female ratio," said Lafayette College's JoAnna Ast. "Honestly, I love seeing all the women on the teams here, seeing a female name as the captain of a team. In civil engineering, I hope to see more of an equal balance in the future."

"I'm the only girl that's here at nationals that's on my team right now; you've just got to work with boys, I guess," said The Cooper Union's Liu. "I feel like me. Being me is great, and I love that my team just accepts it and they listen to me. I've got a great team."

"I don't think there is any reason that the SSBC shouldn't draw the attention of bright engineering women at any college—quite the opposite, in fact," said Lafayette's Schultheis. "Creating an atmosphere on every team where these women can feel welcomed and valued does more than just allow them the opportunity to gain valuable engineering skills and participate in a fun competition. It also brings more bright minds to the table and it makes for more innovative bridges and a more powerful competition."

When all was said and done, it was an epic weekend that underscored both the promise of the next generation of civil engineers and the innovation that's possible with structural steel. That said, I am sorry to report that Big Al remained unmoved by the spectacle. When asked about the advantages of steel bridges, he declined to comment. He did, however, attempt to eat my audio recorder. ■

Student Steel Bridge Competition

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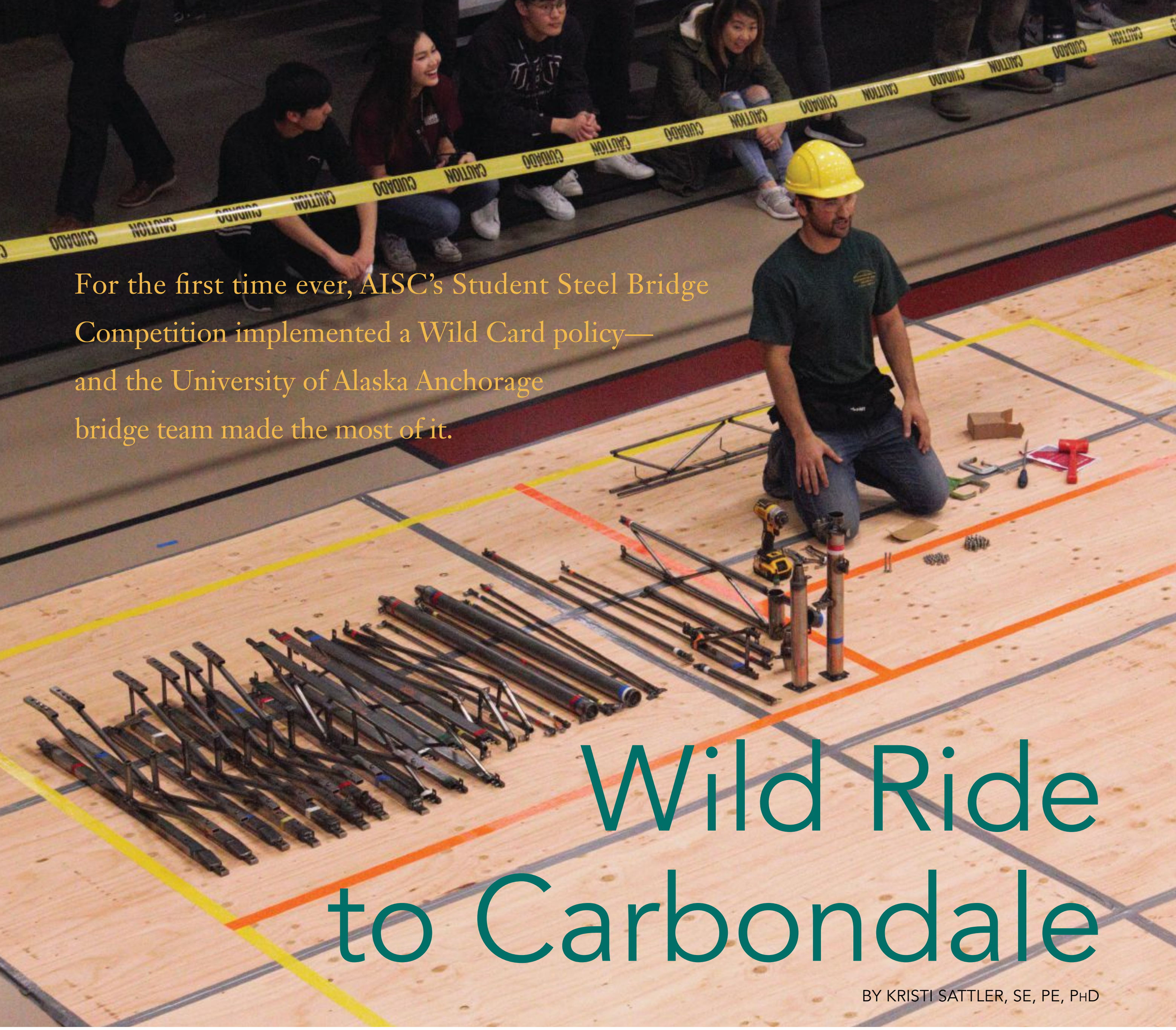


For the first time ever, AISC's Student Steel Bridge Competition implemented a Wild Card policy—and the University of Alaska Anchorage bridge team made the most of it.

Wild Ride to Carbondale

BY KRISTI SATTLER, SE, PE, PHD

Kristi Sattler (sattler@aisc.org) is a senior engineer with AISC's University Relations group.

IN LATE APRIL, Aaron Murph called a mandatory meeting for the steel bridge team at the University of Alaska Anchorage (UAA).

The team had recently placed third at the Pacific Northwest Regional Event, barely missing an opportunity to attend the Student Steel Bridge Competition (SSBC) National Finals. Based on the number of teams who participated in their region, two teams qualified for the National Finals, leaving the UAA team as the runner-up—and without a spot on the national stage.

As the team gathered for what they thought was going to be a clean-up day, Murph, the team's captain, instead informed everyone that he had an important announcement—and shared a letter from AISC, inviting the team to the National Finals as a Wild Card participant. (In a new twist to the competition, four runner-up teams from this year's 17 Regional Events were selected at random to receive an invite to the National Finals.) The unsuspecting UAA team erupted in excitement.

"Everybody was just super excited, and there were high-fives going around and there was shouting," recalled Murph. "It was great."

Back in the Saddle Again

UAA has participated in the SSBC intermittently over the competition's 32 year history, though not much in the last decade, and the school's last trip to the National Finals

above: The build team for the University of Alaska Anchorage.

opposite page: Preparing to build at the Pacific Northwest Regional Event.

was in 2004. With close to no recent collective knowledge of the competition, UAA rebooted its team in 2016 with a new faculty advisor and a new set of students.

"From three years ago to now, we've really advanced up the learning curve, passing the knowledge along to the next year's team," explained Murph.

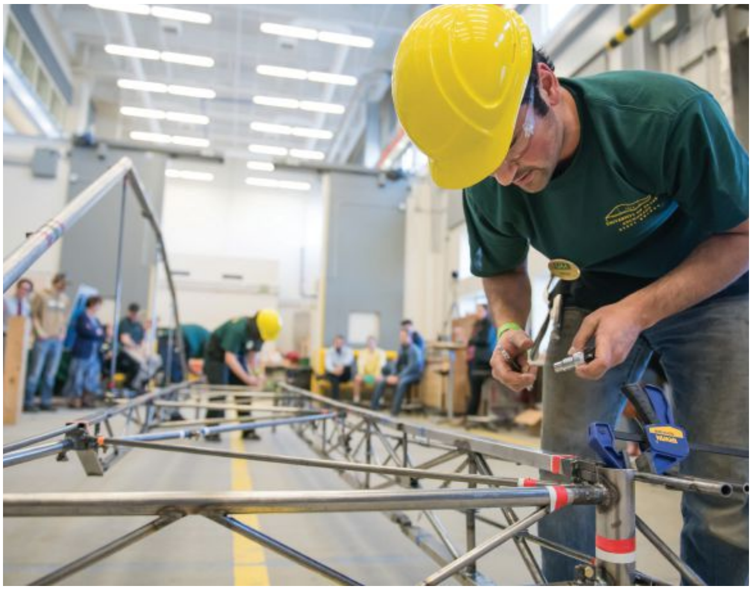
The team's somewhat unconventional journey to the National Finals highlights its resiliency, creativity, and enthusiasm to overcome challenges associated with being a newer team from a smaller program while also being located outside of the contiguous 48 states.

"UAA has a small Civil Engineering program that grants about 25 bachelor's degrees per year," said Scott Hamel, associate professor in the Department of Civil Engineering at UAA and the team's faculty advisor. "Despite being a small group and new to the competition, these students invested thousands of hours into their design, drawings, fabrication, and practice."

The current team is composed entirely of undergraduate students, many of whom have not yet taken a steel design class. The remaining few finished up their first steel design class during the fall semester leading up to the competition. Murph noted that having a team with limited technical experience encouraged the students to keep things simple. They relied on basic principles and their own intuition, occasionally bouncing ideas off of their faculty advisor.

A Unique Design

The problem statement for the SSBC changes every year, and students are challenged to design a bridge that meets the set of specifications. This year, the piers at one end of the bridge were required to be offset by 3 ft. This resulted in the two main stringers having unequal span lengths, which encouraged teams to consider the effects of the asymmetric geometry.



above and below: Building the bridge at the regional event. The team received one of four random Wild Card bids to attend the National Finals.

above: Assembling a truss during the fabrication stage.

below: Grinding away.

New twists encourage new design thinking, and these offset piers sparked the UAA team's idea to use different structure types for the two main longitudinal stringers. They hoped to account for the different span lengths while optimizing the tradeoffs among several categories of the competition. Murph noted that arch designs tend to be stiffer but can be more difficult to build, while deck truss designs are less stiff but can be easier to build. The final bridge featured an underside truss for the shorter span and a single, unbraced tied arch for the longer span, and the team designed the two sides of the bridge to deflect similar amounts during loading, with the intent to minimize the introduction of eccentricities.

The single, unbraced arch did present some stability concerns for the team, which they approached using a combination of structural analysis and load testing.

"Our stability challenges are really something, trying to figure out how to keep that from buckling and keep the whole thing from caving in on itself," Murph said. The team developed the initial concept and modeled the bridge using structural analysis software. They also conducted component-level compression tests at the school's structures lab to understand the buckling capacity of the tube member that was used for the main arch.

Ronald Ziemian, a civil and environmental engineering professor and associate dean of the College of Engineering at Bucknell University—and this year's AISC T.R. Higgins Lectureship Award winner (based on his paper on structural stability)—was impressed with the design. "This is definitely a simple looking but actually a very complex structure, and one that requires some deep thinking," he said. "The unbraced arch supporting the longer span required the team to seriously consider the challenges of designing a stability sensitive system. Clearly their use of tubular members and rigid connection at the base of the arch indicates that they learned how to meet this challenge. This bridge goes well beyond the use of a traditional steel design approach, so it is exciting to see that the students were creative and provided a clever solution to a challenging problem."

The students fabricated the entire bridge themselves, but they needed some help finding the raw materials. Murph explained that the relatively smaller steel pieces required for the bridge were not readily accessible in Alaska, so the team partnered with a local fabricator, who donated the materials and coordinated the pieces to be shipped in tandem with one of their larger structural steel orders from the contiguous United States. The company also provided the students with access to a space in their shop, where the team was able to cut, weld, and assemble all of the pieces for their bridge.

The team completed fabrication in time to conduct load testing prior to the Pacific Northwest Regional Event, which took place at St. Martin's University in Lacey, Wash., in April. During the preliminary load test, they observed more than 2 in. of lateral deflection, well over the 1-in. limit for the competition. Murph explained that this observation helped the team recognize that imperfections in real-world construction can introduce eccentricities that are not always accounted for in a model. They used the les-

Going low to do some intricate fabrication work.

The team, buckling testing their arch.

son to improve their design, resorting to the structural analysis model and some trial-and-error to mitigate the problem, eventually adding lateral bracing in the plane of the deck to help provide additional lateral stiffness.

Travel Adventures

When it came to traveling from Alaska to the annual Regional Event and to the National Finals, the cost could have been a burden. But luckily, UAA has a team of students dedicated to fundraising efforts, giving presentations to local groups and focusing on building relationships with professionals in the design and construction industry. And the group works hard throughout the year to raise enough funds to send a limited number of team members to the actual competitions.

Before embarking on their journey to the Regional Event in Washington State, the team hosted a send-off party in appreciation of their sponsors. As part of the event, the team showcased the final bridge in conjunction with elements of the overall competition, such as building and load testing the bridge. Not only does this "trial run" give the team more practice but it also gives the sponsors an opportunity to see and understand the competition in action.

"They get to come check it out and see what the students are learning—and see where their money's going," said Murph.

In terms of physically transporting the students and their bridge to the competition, the somewhat unusual cargo of steel bridge components added an extra preflight element: The team had to fabricate custom plywood boxes in order to take the bridge on commercial flights, with Murph noting that it was a challenge to keep the weight of each box below the airline's 50-lb weight limit. In the end, the team used eight boxes and one duffle bag to transport their 231-lb bridge, tools, and gear.

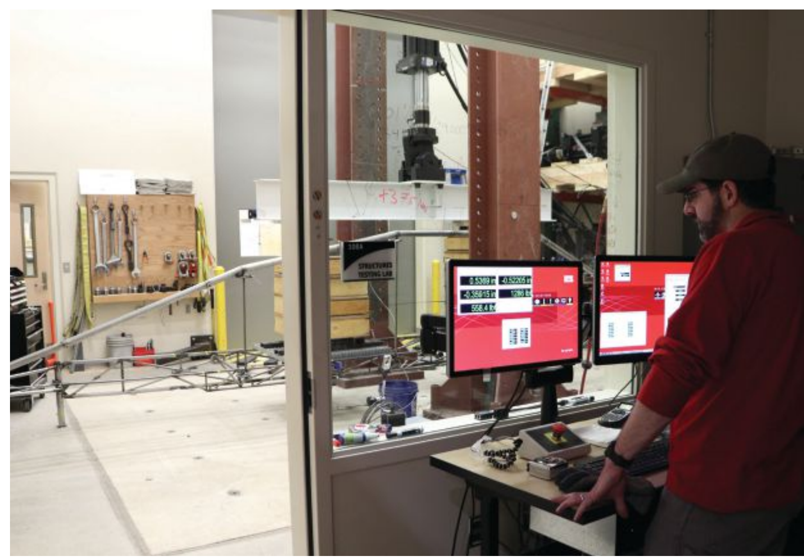
"We usually get a bunch of odd looks and questions as we're slogging through the airport," noted Murph. "It is rather nerve-racking giving the bridge to the airlines in hopes that it all makes to the destination and isn't damaged."

Following the Regional Event, one member of the UAA team had an exciting journey home. While the team was enjoying dinner after the competition, he received a call from his pregnant wife, telling him that she had gone into labor a couple of weeks early. After quickly making arrangements to catch a late night flight from Seattle to Anchorage, he successfully arrived at the hospital for the birth of his second child—with only three hours to spare.

When it came time to travel to the National Finals at Southern Illinois University in Carbondale, Ill., the UAA team had perfected packing their "luggage"—and no one was called back for a birth. The team finished 16th overall (out of 41 teams) and they were also the winner of the Frank Hatfield Ingenuity Award for their unique and innovative design and construction process to address this year's asymmetric bridge requirement.

"We were all extremely impressed by the quality of the competition at Carbondale," said Murph. "None of us have ever been to the national event and were completely blown away."

After a decade of being outside looking in, the team hopes to make the trip from Alaska on a regular basis. ■



above: Observing the buckling testing operation.

below: At the airport with custom-built boxes to transport the bridge elements.

Hot Products are here!
These products were all on display at the 2019 NASCC: The Steel Conference this past April in St. Louis and represent the wide range of machinery, technology, and other products and services that bolster the structural steel industry.

2019 NASCC Hot Products

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

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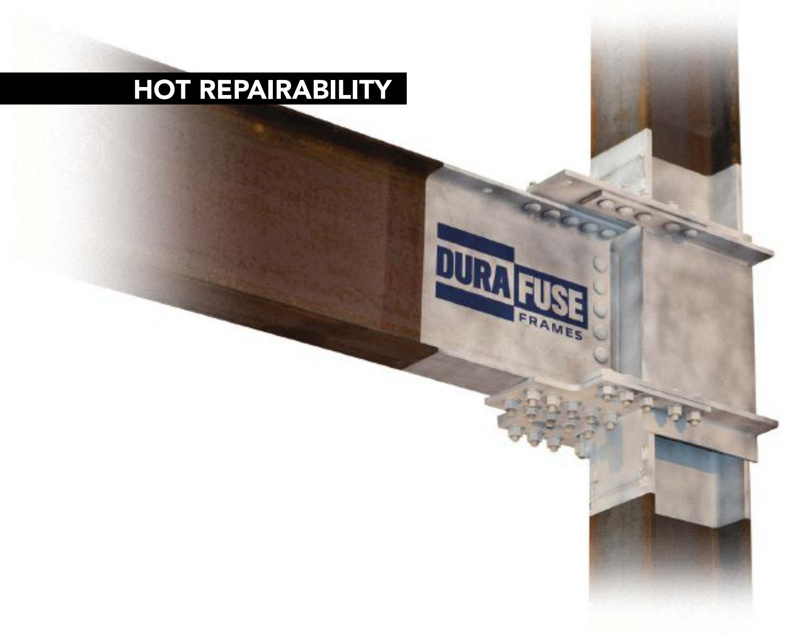

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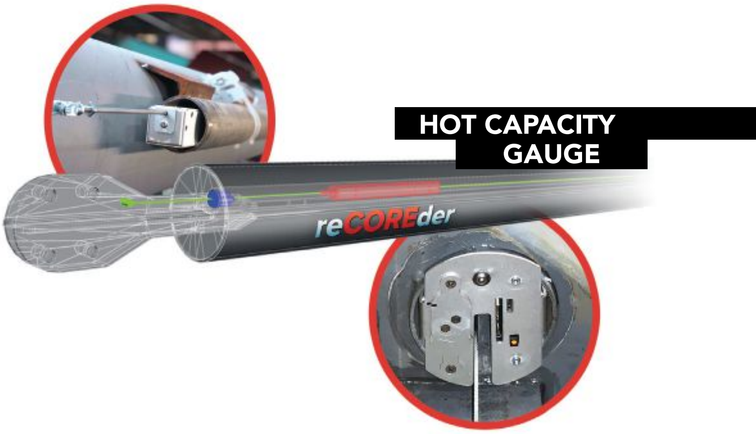
CoreBrace's new Self Contained Displacement Transducer (SCDT) is the next step in achieving smart, resilient structures via buckling restrained braces (BRBs). The data stored in the device, together with the results from a recently completed BRB fatigue testing, program, can provide engineers and owners with reliable means to determine the remaining capacity of BRBs after an earthquake or other significant event. This customizable technology is available for both new construction and as a simple upgrade to existing BRBs, and can assist in post-event evaluations and increase understanding of a structure's life cycle.

For more information, visit **www.corebrace.com** or call 801.280.3970.



Industry Lift

Skilled trade jobs are a gateway to rewarding careers, yet evidence shows that many potential workers are not aware of the various career and salary opportunities or how to access well-paying trade jobs. As baby boomers and career tradespeople retire and fewer young people are encouraged to pursue high-paying skilled trade opportunities through traditional channels, many industries are burdened with employee shortages and increased costs. Enter Industry Lift, an organization geared toward helping organizations develop collaborative connections and partnerships that facilitate increased productivity and successful business solutions. And it harnesses the power of virtual and augmented reality (VR and AR) to entice the next general of potential tradespeople into rewarding construction and manufacturing careers.

For more information, visit **www.industrylift.org**.

Anatomic Iron Steel Erection Training Simulation

Anatomic Iron's erection training simulator, a VR product created by Virtual Image and Animation, provides training for the steel industry, including students, detailers, fabricators, and erectors. Most of us are unable to "walk the steel" since we do not work for erectors and have not completed the required safety certifications. This simulation provides this experience in a safe and fun environment, teaching detailing staff about steel erection and why it's important that the drawings are correct. Staff can experience the height and restricted environment where connections must work the first time. In the simulation, the "player" walks out on a beam to reach and secure a connection. The first stage of the simulation takes place at ground level, then the second takes place on the 80th floor on a beam at the edge of the building—with the idea of helping the trainee overcome any fear of heights in a safe environment before potentially performing the tasks in real life.

For more information, visit **www.anatomiciron.com** or **www.virtual3dstudio.com** or call 604.779.3800.

HOT SPLICE

CAST CONNEX Diablo Bolted Splices

CAST CONNEX Diablo Bolted Splices are cast steel fittings that enable unobtrusive field bolted splices in circular hollow structural sections (HSS) or pipe members. The fittings are designed such that the bolted connection is inboard of the outer diameter of the member. Using the fittings, splices can be sheathed in thin-gauge plate for concealment or can be left uncovered for a sleek, technical connection aesthetic. The splices are currently available to fit round HSS or pipe in the following outer diameters: 6.625 in., 8.625 in., 10.75 in., and 12.75 in. The connectors include weld preps and can be easily welded to the end of a square-cut HSS or pipe member of any typical wall thickness. The cover plates (sold separately) can be secured over the fittings in the field using low-profile screws.

For more information, call 416.806.3521 or visit www.castconnex.com.

Tnemec Company, Inc., Series 945 Aerolon Tape

HOT INSULATING TAPE

Series 945 Aerolon Tape is a self-adhesive insulating tape for controlling condensation and thermal bridging on building and industrial applications, thanks to a proprietary blend of insulative particles that result in exceptionally low thermal conductivity. The thermal properties of Aerolon Tape reduce condensation caused by the difference in the temperature between the two sides of a surface. Available in multiple widths that are 30 ft long and 1.5 mm thick, the tape can be applied in multiple layers to achieve desired thickness or in combination with Series 971 Aerolon Acrylic, a fluid-applied thermal insulating coating for use on a variety of substrates.

For more information, call 816.326.4281 or visit www.tnemec.com.

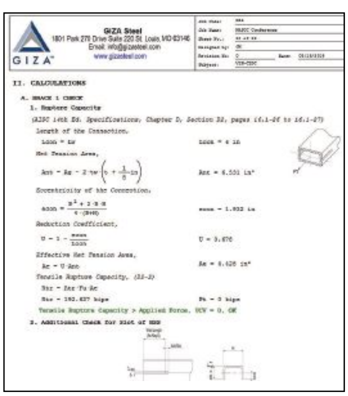
Software offerings at NASCC included efficiency-oriented updates, easier interfaces, and increased capabilities.

HOT SOFTWARE

Hilti PROFIS Engineering Suite

In PROFIS Engineering Suite, Hilti has developed a comprehensive fixture design platform that takes the guesswork out of LRFD and ASD anchor calculations, making designs more accurate, reliable, and faster (a free trial is available). In addition to the company's existing cracked/uncracked concrete modules, users can now experience simple and fast anchor design in new base material modules like concrete-over-metal-deck and a variety of masonry materials. Hilti has enhanced the ways users can input loads into their design by featuring a new Load Engine that now includes the ability to import spreadsheets of factored load output—or let PROFIS Engineering do the factoring for you by selecting applicable IBC load combinations. And it can run multiple load combinations simultaneously. In addition, fixture plate analysis is included directly into the interface using either AISC Design Guide 1: *Base Plate and Anchor Rod Design* (**aisc.org/dg**) calculations or finite element analysis.

For more information, visit **www.hilti.com/profisengineering** or call 877.749.6337.



GIZA Lite

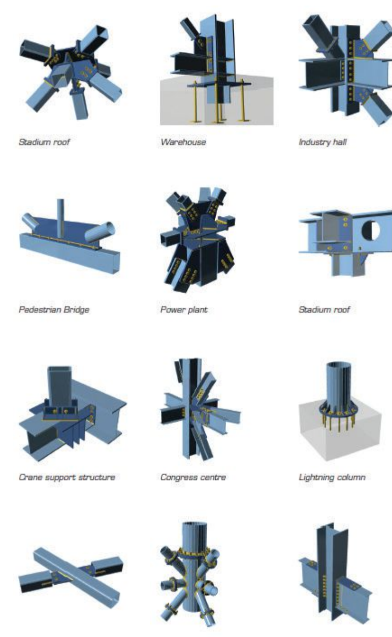
GIZA Lite, a pared-down standalone version of GIZA Connection Design Software (version 19), was created based on direct feedback from the design community. It can design connections on 206 different framing conditions within the shear, moment, and vertical bracing groups. Even better is its ability to work with 330 different design configurations including combination loads and New York City design codes. It offers a quick ROI along with clear and concise calculation reports for every connection.

For more information, visit **www.gizasteel.com** or call 314.343.7212.

IDEA StatiCa Connection

IDEA StatiCa Connection was created to be the first software that can code-check steel connections of all topologies and loading in a matter of minutes. It is based on a unique component-based finite element method. The new Version 10 brings full capacity design to deal with seismic checks for all steel connections and joints—and a free 14-day trial is available. Hundreds of predefined connection templates (topology, design, loading, etc.) are available in four clicks, and overall check, stress and strain analysis, capacity design, buckling, and stiffness analysis are determined as well. And all of this is synchronized with your models in Tekla, SAP2000, and other applications.

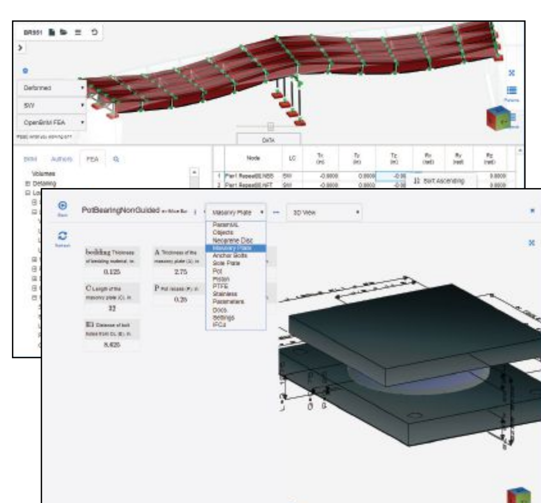
For more information, visit **www.ideastatica.com**.



OpenBrIM Platform FEA and Incubator

OpenBrIM's 3D finite element analysis (FEA) module has grown into a standalone, fully parametric application, and was created with the latest advances in structural analysis procedures including improved import/export capabilities, cutting-edge analysis techniques, and fully customizable transparent code-check and design procedures. It uses spring, beam, column, truss, cable, shell, and brick elements for modeling, and the analysis engine supports large displacements as well as inelastic capabilities through geometric and material non-linearity. Another OpenBrIM component, Incubator, is a free and open platform for creating and maintaining bridge information, allowing users to test, share, and collaborate with the engineering community. The information hosted on the Incubator is compatible with BIM/BrIM standards and easily consumable by both engineers and software applications. Due to its fully parametric nature, Incubator objects can be customized and used like Lego pieces to create complex models.

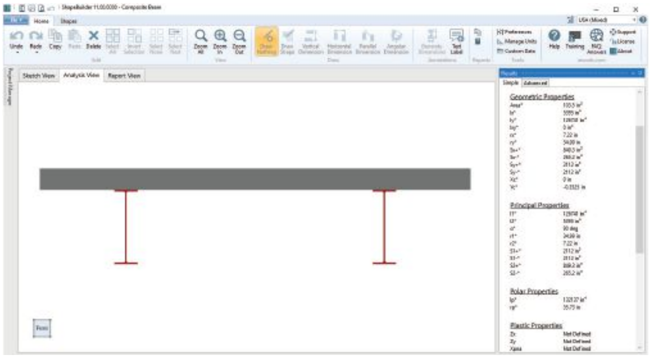
For more information, visit **www.openbrim.org** or call 212.991.8956.



IES, Inc., ShapeBuilder

ShapeBuilder is a powerful tool for calculating geometric and structural properties of steel shapes. While it has always provided the first moment of area, the latest update now also provides the actual shear flow, *f*, when a shear force is applied to the section. This helps users calculate transfer forces between the connected elements for sizing welds, shear studs, nails, screws, glue, etc.

For more information, visit **www.iesweb.com** or call 800.707.0816.



HOT SHOP EQUIPMENT

There was plenty of hot stuff for the shop as well, driven by increased automation, multiple actions at once, and more hands-free operation.

FICEP Corporation Excalibur 12

The recently introduced Excalibur 12 brings expanded milling capability to substantially increase the versatility of this single-spindle traveling column drilling line. The new milling routines are possible on the Excalibur 12 thanks to its spindle subaxis positioning. The section to be milled is rigidly clamped on the table while only the spindle moves in all axes to perform the milling process, resulting in productive milling with exceptional tool life. The machine also includes an automatic tool changer to provide a diverse assortment of tools, accommodating not only milling but also drilling, tapping, countersinking, and counter boring. The movable tower assembly houses all of the servo drives and the hydraulic power unit so only three-phase power and air are required to be delivered to the drilling assembly.

For more information, visit **www.ficepcorp.com** or call 410.588.5800.

Trilogy Machinery, Inc., Sunrise ALS

The Sunrise ALS (Angle Line System) is a complete angle processing system capable of both punching and shearing simultaneously. The fully enclosed system is driven by a powerful rack-and-pinion in-feed capable of handling up to 40 ft of material at up to 40 ft per minute. Standard features include pneumatic clamping, hydraulic plate hold-down, hydraulic stripper, touch-screen control, and dual-punches. The ALS allows hands-free operation for the complete processing of angle up to 6 in. by 6 in. by ½ in. The Dual Y-axis features a specially designed hydraulic punch driven on high-speed linear rails, allowing the operator to punch both legs an angle. The operation and programming are CNC controlled using a touch-screen control featuring operator-friendly programming with nesting capability. The operator simply positions the material on the in-feed table and initiates the pneumatic clamping, and the machine processes, punches, and shears the material automatically.

For more information, visit **www.trilogymachinery.com** or call 410.272.3600.

Soitaab USA OMNIAtech

The new OMNIAtech, designed for heavy plate, seamlessly integrates all of the fabrication processes into a unified system. It can cut, bevel, drill, thread, surface mill or hole mill, countersink, and a accomplish a wide range of marking options in one machine while meeting the highest industry standards for quality, precision, productivity, reliability and ease of use. With the most sophisticated CNC controls and software, it provides an operator-friendly, multi-process, all-in-one fabrication system.

For more information, visit **www.soitaabusa.com** or call 410.456.1335.

HGG Profiling Equipment UPC 450 Steel Profiler

HGG'S new UPC 450 Steel Profiler increases cutting and prefabrication productivity by eliminating the need to cut steel profiles from flat bars, bulbs, and angles by hand, combining steel cutting and 3D profile cutting with optional tube cutting. And its small footprint makes the most of valuable floor space. In addition, it offers full process cutting integration through the HGG ProCAM Software Suite. The machine makes it easy to load material on a cutting table and then quickly cut it within the cutting cell, cutting steel profiles from flat bars, bulbs, and angles, as well as cutting spools from tubular pipes. The cutting cell includes a cutting trolley that controls all movement and HGG's patented cutting head and biaxial cutting torch. Designed to be versatile, it can be easily configured to accommodate a variety of fabrication needs and footprint requirements, and one person can quickly and easily convert it from cutting stiffeners to cutting tubes.

For more information, visit www.hgg-group.com or call 216.314.2227.

Kinetic Automated Plasma Cutting Machine Unloader

The automated part unloading capability of Kinetic's plasma cutter can dramatically increase speed and production capacity. Users can sort parts by work order or part number, quickly and safely load multiple pallets, and maximize machine efficiency with almost continuous cutting, saving time, increasing production, and maximizing profitability.

For more information, call 800.606.2954 or visit www.kineticusa.com. ■

AWARDS

AISC/NSBA Now Accepting Prize Bridge Awards Submissions

Have you recently worked on a bridge that embodies the pioneering spirit of modern bridge-building? AISC and its bridge division, the National Steel Bridge Alliance (NSBA), want to hear about it!

We're looking for outstanding bridges that showcase the innovative use of structural steel, and our 2020 Prize Bridge Awards are now accepting entries through September 27, 2019.

Our panel of industry-expert judges will consider entries for this biennial competition in several categories, defined by bridge size and function, weighing each project's innovation, economics, aesthetics, design, and engineering solutions. Winning projects will be featured in a presentation at the World Steel Bridge Symposium at NASCC: The Steel Conference in Atlanta, April 22–24, 2020 as well as in *Modern Steel Construction*.

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

The Greenfield Arch Bridge in Pittsburgh, a 2018 Prize Bridge Award winner.

People and Companies

- **Dave Steel Company** (an AISC full member and certified fabricator) has recently announced plans to include field services and erection in its company's offerings.

  "By bringing field construction services in-house, we can now offer our clients a complete package. Being able to support both supply and install with our own forces, will allow us to create a seamless project experience," said Jeffrey Dave, the company's president and Chairman of the Board. "With a highly competitive construction market and different construction delivery systems being introduced, this added service will certainly allow us to serve different types of projects in a variety of markets."

- **PND Engineers, Inc.**, founded in Anchorage, Alaska, in 1979—only 20 years after Alaska became a state—celebrates its 40th anniversary this year. The company has designed countless projects in its four decades, including three NSBA Prize Bridge Award winners (all in Alaska):
  - 2018: NSBA Prize Bridge Award (Medium Span) – Nigliq Bridge, Colville River, Nuiqsut, Alaska
  - 2018: NSBA Prize Bridge Merit Award (Special Purpose) – Moose Run Golf Course Bridge, Joint Base Elmendorf-Richardson, Anchorage, Alaska
  - 2000: NSBA Prize Bridge Special Award – Kuparuk River Submersible Bridge, North Slope, Alaska

You check out all of our 2018 Prize Bridge Award Winners in the June 2018 issue at **www.modernsteel.com** and enter the 2020 competition at **aisc.org/prizebridge**.

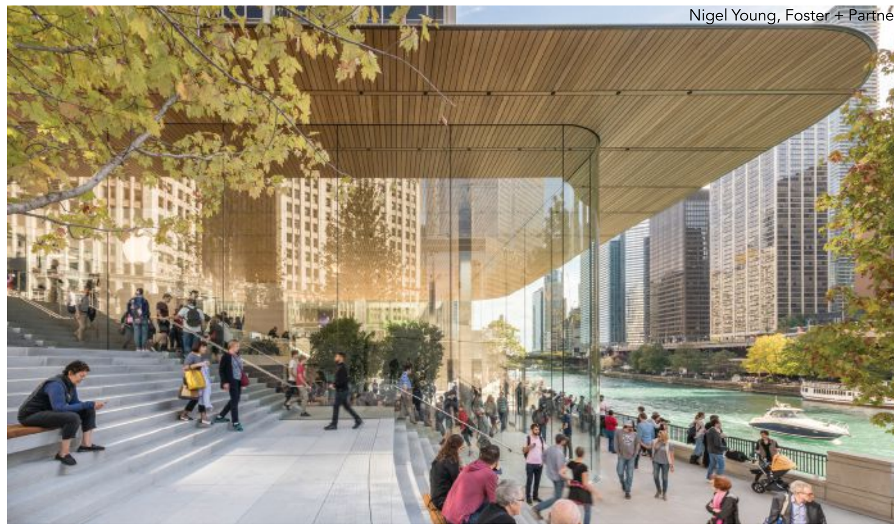
AWARDS

AISC Now Accepting IDEAS² Awards Submissions

AISC is looking for the next generation of great American landmarks built with structural steel—and our 2020 IDEAS² Awards are now open for entries.

This annual program recognizes outstanding structures that illustrate the amazing things that are possible with structural steel. Past winners include the Gateway Arch in St. Louis, One World Trade Center in New York, and the National Museum of African American History and Culture in Washington, D.C. And while these are certainly marquee projects with large budgets, the program recognizes outstanding buildings of all sizes and scopes and is organized into three total project cost categories: under $15 million, $15 million to $75 million, and more than $75 million.

Entries will be accepted through September 27 and the winners will be publicly announced in early 2020. Visit **aisc.org/ideas2** for more information and to enter.



Nigel Young, Foster + Partners

Apple's Michigan Avenue store in Chicago, a 2019 IDEAS² Award winner.

AWARDS

There's Still Time to Apply for a Milek Fellowship

University faculty are invited to apply for the 2020 AISC Milek Fellowship, a four-year fellowship given to a promising university faculty member to conduct structural steel research. The awarded faculty member will receive $50,000 per year (for a total of $200,000) as well as free registration to NASCC: The Steel Conference for the four years following their selection as an AISC Milek Fellow.

The Milek Fellowship program is designed to contribute to the research careers of young faculty who teach and conduct research investigations related to structural steel, while producing research results beneficial to designers, fabricators and erectors of structural steel.

The program is also intended to support students with high potential to be valuable contributors to the U.S. structural steel industry, and the selected faculty member is required to fund a doctoral candidate with at least half of the fellowship money.

Proposals are being accepted until August 31, 2019. For application information, visit **aisc.org/milek**.

SAFETY

OSHA Encourages Companies to Participate in Upcoming Safe + Sound Week

Every year, more than 5,000 workers are killed on the job (a rate of 14 per day) and more than 3.6 million suffer a serious job-related injury or illness.

Serious job-related injuries or illnesses don't just hurt workers and their families but can hurt business in a variety of ways. Implementing a safety and health program can improve small and medium-sized businesses' safety and health performance, save money, and improve competitiveness.

In an effort to increase safety awareness, OSHA's year-round Safe + Sound campaign encourages every workplace to adopt a safety and health program. Throughout the year, businesses can show their commitment to safety by focusing on management leadership, worker participation, and a systematic approach to finding and fixing hazards in workplaces. And this month, OSHA invites workplaces to celebrate their safety successes and efforts via Safe + Sound Week, a nationwide event celebrating the successes of businesses that have successfully implemented safety and health programs in the workplace. This year, Safe + Sound Week takes place August 12 through 18, and participants and interested parties are encouraged to use the **#SafeAndSoundAtWork** hashtag in their related social media efforts.

As a program, Safe + Sound is a way for organizations to have an effective safety and health program in their workplace. This is the third year of the program, and OSHA's efforts to promote and encourage employer participation have grown substantially. There are three major components to the program: management leadership, worker participation, and a systematic approach to finding and fixing hazards.

Successful safety and health programs can proactively identify and manage workplace hazards before they cause injury or illness, improving sustainability and the bottom line. Participating in Safe + Sound Week can help programs get started or energize existing ones.

Organizations of any size or in any industry looking for an opportunity to celebrate their commitment to safety to workers, customers, the public, or supply chain partners should participate—and participation is easy. You can host an event just for your workers or host a public event to engage your community. At the conclusion, certificates can be downloaded, and a web badge can be shared to recognize your organization and your workers.

Regardless of where your own company's occupational safety and health management system is right now, this program can help you to take a step in the right direction. Top management can demonstrate its commitment in many ways, including:

- Developing and communicating a safety and health policy statement
- Providing the resources needed to implement and operate the program
- Factoring safety and health into operational planning and decisions
- Recognizing or rewarding safety and health contributions and achievements
- Leading by example, by practicing safe behaviors and making safety part of daily conversations

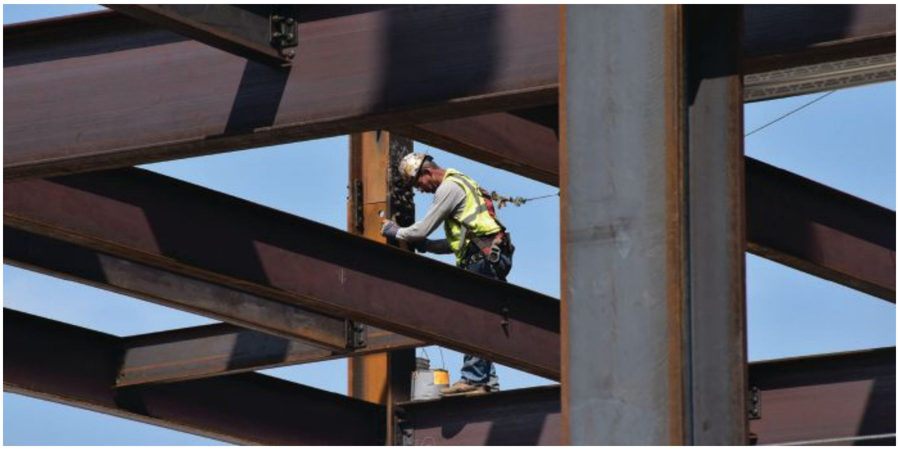
Workers can participate by:

- Developing the initial program design
- Reporting incidents (including near misses) so they can be investigated
- Analyzing hazards associated with routine and non-routine jobs, tasks, and processes
- Defining and documenting safe work practices
- Conducting site inspections and incident investigations.
- Training current coworkers and new hires.
- Evaluating program performance and identifying ways to improve it.

At the core of every effective safety and health program is a systematic process for identifying and controlling (i.e., finding and fixing) workplace hazards. Traditional approaches to finding and fixing workplace hazards are often reactive. Actions are taken only after a worker is injured or becomes sick, a new standard or regulation is published, or an outside inspection finds a problem that must be fixed. Finding and fixing hazards using a proactive approach is far more effective. Workplaces are always evolving as new technologies, processes, materials, and workers are introduced. By adopting a systematic approach, businesses can stay on top of emerging hazards that could lead to injury or illness. A systematic find and fix approach means:

- Involving workers, who often have the best understanding of the conditions that create hazards and insights into how they can be controlled
- Reviewing all available information about hazards that might be present
- Conducting inspections to identify new or emerging hazards
- Investigating incidents to identify root causes and potential solutions
- Evaluating options using the "hierarchy of controls"
- Considering how to protect workers during emergencies and non-routine activities
- Checking that existing controls are intact and remain effective

For more details about Safe + Sound, **osha.gov/safeandsound**.



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SPANNING HISTORY

SINCE 1928, AISC has recognized and showcased the strength and beauty of steel bridges across America via the Prize Bridge Awards program.

The first award went to the Sixth Street Bridge in Pittsburgh, as it embodied innovation in the steel bridge industry at the time. It was one of the first self-anchoring suspension bridges and used solid steel eye-bars for both the main suspension cables and the vertical support for the deck. Now more than 90 years old, the bridge—renamed the Roberto Clemente Bridge in 1998 after Pittsburgh Pirates Hall of Fame outfielder Roberto Clemente—has come to define a city and its history.

More than 600 bridges of all sizes from across the U.S. have been recognized and honored through the awards program since 1928. Now administered by the National Steel Bridge Alliance (NSBA), AISC's bridge division, today's Prize Bridge Award winners receive national acclaim with recognition during NASCC: The Steel Conference and the World Steel Bridge Symposium. The winning projects are also featured in *Modern Steel Construction* and showcased on the AISC website.

For more information on the Prize Bridge Awards—including information on how to enter the 2020 competition, which is open until September 27, 2019—visit **aisc.org/prizebridge**.