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May 2021

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# Modern Steel Construction

May 2021

## in every issue



28

## features



## columns



**ON THE COVER:** The Watershed Building, a 2021 IDEAS² Award winner, excels at managing water and light, p. 28. (Photo: Built Work Photography)


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# editor's note

Spring is in the air. (Just a few weeks ago, winter was on my roof. I learned firsthand about the concept of ice damming. If you're not familiar with that term, Google it.)

Living in Chicago, there are many harbingers of spring that I look forward to every year. St. Patrick's Day weekend (including dying the Chicago River a vibrant green), the first plants to pop out of the ground (typically crocuses), March Madness (my bracket was a dumpster fire after the very first round), and preparing the May issue of *Modern Steel*, which is typically my favorite issue of the year.

Why? Because it features the winners of our annual IDEAS² Awards, which always involve a dazzling array of beautiful, innovative, architecturally significant projects of various sizes and budgets—and are accompanied by a feast of design eye candy. This year's winners range from a simple sculpture with a powerful meaning in Des Moines to a cavernous rodeo arena in Ft. Worth to a former warehouse in San Francisco that was transformed into offices for one of the world's top ride-sharing companies to a layered school in Virginia to a business retreat center in North Carolina that blurs the lines between the built environment and its wooded surroundings. You can read about and see fantastic images of all the winners, starting on page 28.

And you can also hear from one of this year's IDEAS² judges, Anders Lasater. The CEO of Anders Lasater Architects and a native and current resident of Southern California (he doesn't have to worry about ice damming), Anders is the subject of this month's Field Notes podcast column. Years ago, he had to choose between architecture and music as a profession, but he's found a way to keep practicing both. You can read about him on page 22 and also hear his entire interview at **modernsteel.com/podcasts**.

Another spring ritual of sorts is, of course, NASCC: The Steel Conference, which typically occurs in April. Normally, we'd all be basking in the afterglow of a successful in-person NASCC. But for the second year in a row, it wasn't meant to be. The good news is that we're able to celebrate a successful virtual version of the conference. Taking place the week of April 12, this year's conference featured more than 150 sessions and more than 200 exhibitors and offered up to 23 PDHs. And as always, you can watch videos of the sessions at **aisc.org/nascc** roughly 45 days after the conference.

This spring in particular is bringing hope that the world will soon return to pre-COVID days. Part of this hope centers on the development and distribution of vaccinations. As more and more people have been receiving vaccinations every day, the question has arisen about whether employers can mandate that their employees are vaccinated before returning to work in person. The article "Vaccination Considerations" on page 58 offers some insight on the topic.

Enjoy this issue of *Modern Steel* and this spring!

Geoff Weisenberger
Senior Editor

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# steel interchange

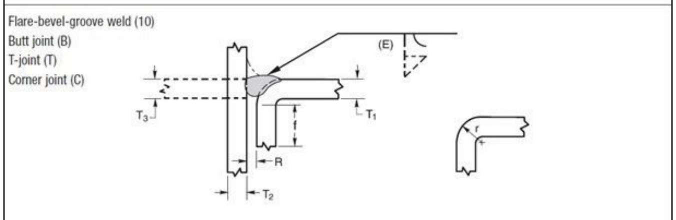
*All mentioned AISC codes, standards, and manuals, unless noted otherwise, refer to the current version and are available at* **aisc.org/publications***. AISC Design Guides are available at* **aisc.org/dg***, and* Modern Steel Construction *articles are available at* **www.modernsteel.com***.*

## Flare-Bevel Groove Welds

**I am designing a flare-bevel groove weld to connect to a rectangular A500 Gr. C HSS shape. For the Flare-Bevel Groove Welds illustrated in Table 8-2 of the 15th Edition AISC *Steel Construction Manual*, what thickness should be used for T1 to determine the effective weld size: the nominal thickness or design thickness as provided in Table 1-11 of the *Manual*?**

Table 8-2 (continued)
**Prequalified Welded Joints**
**Flare-Bevel Groove Welds**

**FLARE**




The design thickness should be used. The effective throat (E) is based on the bend radius, and the bend radius is a product of the actual thickness of the HSS member. Table J2.2 of the AISC *Specification* also provides the effective throat of flare groove welds consistent with Table 8-2 in the *Manual* and uses the design thickness. Section B4.2 of the AISC *Specification* defines the design wall thickness for HSS shapes produced to standards approved for use under the AISC *Specification*, including A500 Gr. C.

**TABLE J2.2**
**Effective Throat of Flare Groove Welds**

| Welding Process | Flare Bevel Groove[a] | Flare V-Groove |
|---|---|---|
| GMAW and FCAW-G | $5/8R$ | $3/4R$ |
| SMAW and FCAW-S | $5/16R$ | $5/8R$ |
| SAW | $5/16R$ | $1/2R$ |

[a] For flare bevel groove with $R < 3/8$ in. (10 mm), use only reinforcing fillet weld on filled flush joint.
General note: $R$ = radius of joint surface (is permitted to be $2t$ for HSS), in. (mm)

*Carlo Lini, PE*

## Changes between the 14th and 15th Editions

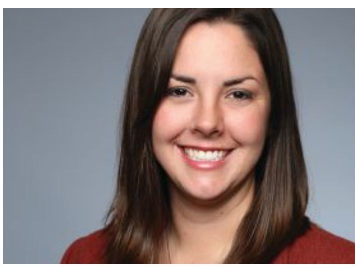
**I am studying for the PE exam and have a question regarding the AISC *Manual*. The exam is based on the 14th Edition *Manual* (and 2010 *Specification*), but I only have a copy of the 15th Edition *Manual*. Is there a document that lists the sections that are new or different between these two editions?**

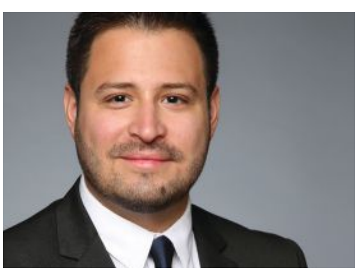
You can find a list of significant changes in the Preface of the 15th Edition *Manual* on page vii. There, you will find the following significant changes and improvements listed:

- All tabular information and discussions are updated to comply with the 2016 *Specification for Structural Buildings* and the standards and other documents referenced therein.
- Shape information is updated to ASTM A6/A6M-14 throughout this *Manual*. Larger pipe, HSS, and angle sizes have also been incorporated into the dimensions and properties tables in Part 1.
- The available compressive strength tables are expanded to include 65- and 70-ksi steel for a limited number of shapes.
- In Part 6, a new design aid is included that provides the width-to-thickness slenderness limits for various steel strengths.
- In Part 6, a new design aid is included that provides the available flexural strength, available shear strength, available compressive strength, and available tensile strength for W-shapes in one table.
- In Part 9, a new interaction equation is provided for connection design based on a plastic strength approach.
- In Part 9, a new approach to designing coped beams is presented based on recent studies. In addition, many other improvements have been made throughout this *Manual*.

The January 2018 *Modern Steel* article "Making the Most of the *Manual*" provides more discussion. You can also consult a document that discusses the changes between the 2010 and 2016 *Specifications* (that are included in the 14th and 15th Editions of the *Manual*, respectively) via the link "Comparison to ANSI/AISC 360-10" under the *Specification* section at **aisc.org/specifications**. In addition, the December 2016 *Modern Steel* article "What's New in the Spec?" summarizes the main changes in the latest *Specification*. Finally, you may want to borrow a copy of the 14th edition from your friend or purchase a copy for taking the test from the AISC bookstore at **aisc.org/publications**.

*Jonathan Tavarez, PE*





**Carlo Lini** (**lini@aisc.org**) is director, **Jennifer Traut-Todaro** (**trauttodaro@aisc.org**) is a senior staff engineer, and **Jonathan Tavarez** (**tavarez@aisc.org**) is a staff engineer, all with the AISC Steel Solutions Center. **Larry Muir** is a consultant to AISC.

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

## Notional Loads and Serviceability

**Do notional loads, as covered in Chapter C of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360), need to be included in serviceability load combinations?**

For most cases, no. Requirements for notional loads are provided in Section C2.2b of the AISC *Specification*. Notional loads can be used to account for initial imperfections in steel structures. The commentary provided to Section C2.2 states: "The *Specification* requirements for consideration of initial imperfections are intended to apply only to analyses for strength limit states. It is not necessary, in most cases, to consider initial imperfections in analyses for serviceability conditions such as drift, deflection and vibration."

This is also consistent with the following guidance provided in AISC Design Guide 28: *Stability Design of Steel Buildings*: "In addition, note that the service drift analyses should not include any of the stiffness reductions or notional lateral loads associated with the DM [Direct Analysis Method] strength analysis and design procedures."

*Jennifer Traut-Todaro, SE*

## Shear End-Plate Connection Gaps

**We are an erector working on a project that requires shear end-plate connections. I do not see this type of connection detail often. Can you provide information on how to address tolerances and gaps for these types of connections?**

AISC's *Detailing for Steel Construction* states: "The main objection of some fabricators to this connection is that the beam must be cut square on both ends and to accurate length. Other fabricators, however, are equipped to square-cut beams accurately and favor using end plates. This connection does not handle beam camber well unless the connection is a very shallow end plate. Sometimes, the beams are purposely detailed and fabricated short for erection purposes and must be shimmed, when required, to maintain the desired building dimensions."

The 15th Edition AISC *Manual* states:

> "When framing to a column web, the associated constructability considerations should be addressed (see the preceding discussion under 'Constructability Considerations')."
>
> When framing to a column flange, provisions must be made for possible mill variation in the depth of the columns and tolerance in column/foundation placement, particularly in fairly long runs (i.e., six or more bays of framing). The beam length can be shortened to provide for mill overrun with shims furnished at the appropriate intervals to fill the resulting gaps or to provide for mill underrun. Shear end-plate connections require close control in cutting the beam to the proper length and in squaring the beam ends such that both end plates are parallel, particularly when beams are cambered."

Some fabricators tend to avoid the use of shear end-plate connections. In their experience, buildings tended to "grow" when end plates were used, meaning that the beams tended to keep the columns apart and made it difficult to plumb the building. I believe this is commonly addressed, as discussed in the above references, by detailing some of the beams somewhat shorter and providing shims to the erector. The shims would have to be no more than ¼ in. thick to avoid reductions in bolt strength per the requirements in AISC *Specification* Section J5.2. Fabricators and erectors who are used to working with end-plates successfully plumb buildings on a regular basis, and many indicate a preference for end plates over other connection types because they feel the use of the shims provides better control over the tolerances. I believe the detailing practices vary.

*Larry Muir, PE*


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# steel quiz

This month's quiz focuses on AISC Design Guide 34: *Steel-Framed Stairway Design*, which is available as a free download for members at **aisc.org/dg**. The other mentioned AISC publications can be found at **aisc.org/publications**.

1 **True or False:** Industrial class stairs serve chiefly a functional purpose and are usually located in enclosed stairwells and provide a secondary or emergency means of travel between floors.

2 **True or False:** A 42-in.-tall cantilevered guard post supporting a handrail at a height of 34 in. has a live load deflection of 0.6 in. This satisfies the recommended deflection limits in the design guide.

3 **True or False:** Steel stairs are considered structural steel components and shall abide by the design requirements of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) and the AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303).

4 **True or False:** Both the sloping beam and horizontal plane stringer design methods produce acceptable results and similar strength and deflection estimates.

5 Which of the following lateral bracing options would be useful for tight locations but may lead to higher drift and more complex connections?

**a.** Tension-compression bracing
**b.** Moment frames
**c.** Tension-only bracing

6 **True or False:** Standard connections found in the AISC *Steel Construction Manual* are only reserved for structures falling within the scope of the *Specification* and the *Code* and should not be used for stairs.

7 Which non-AISC standard provides the specifications for testing a guard and handrail system attachments to stair stringers to ensure it meets the governing building code?

**a.** *NAAMM Pipe Railing Systems Manual Including Round Tube*
**b.** ASTM A53
**c.** ASTM E935
**d.** ASTM E894

8 **True or False:** During delegated design of steel-framed stairs, it is not recommended to require the specialty structural engineer (SSE) to sign and seal each sheet of the shop and erection drawings produced by the fabricator.

TURN TO PAGE 14 FOR THE ANSWERS

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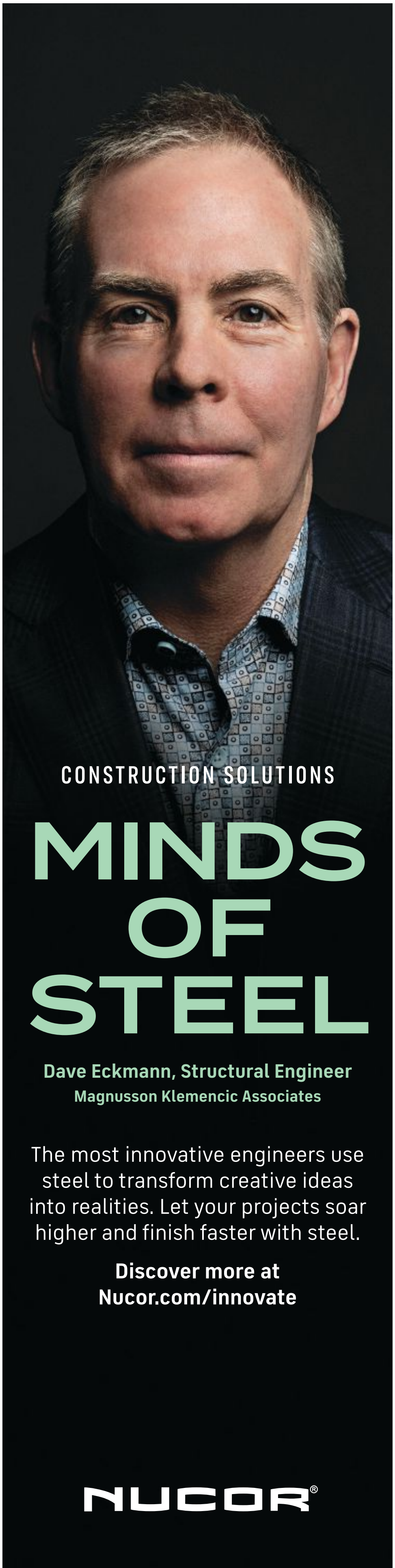



# steel quiz ANSWERS

1 **False.** The above describes service class stairs. Industrial class stairs are also purely functional in character but are designed for either interior or exterior use in an industrial building and are similar in nature to light steel construction. (See Section 2.2.)

2 **True.** Table 3-6 of the Design Guide provides the deflection limit for the cantilever post supporting the handrail. Calculating this limit using this height yields (42 in.)/60 = 0.7 in., which is higher than the actual deflection. Note that Section 3.3.1 states that *IBC* does not explicitly provide requirements for guard and handrail deflection limits.

3 **False.** Section 2.1 of the AISC *Code* lists steel-framed stairs as "other steel items" that fall outside the scope of the *Specification* and *Code*.

4 **False.** Due to the additional length of a sloping member, actual vertical deflections will range from 1.1 to 2 times greater than deflections determined using the horizontal plane method. Accurate deflections should be calculated using the sloping beam method to ensure the stair design meets the required serviceability criteria. (See Section 4.3.2)

5 **b.** Moment frames. Table 5-1 of the design guide is useful when determining which solution would work well in various conditions.

6 **False.** First, note that the *Manual* only provides guidance and design tools and may be adapted to various conditions based on engineering judgment. Standard connections have the added benefit in that they are typically familiar to engineers, steel detailers, fabricators, and erectors.

7 **d.** ASTM E894: Standard Test Methods for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.

8 **True.** The SSE is recommended to seal the calculations and the stair drawings, but the shop and erection drawings are not recommended to be sealed. Responsibilities related to submittals and shop drawing review are reviewed in Section 9.3 of the design guide.

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**.

steelwise

# TENSION MEMBER DESIGN: A PRIMER

BY RICHARD M. DRAKE, SE, AND ERIK ESPINOZA, SE

Getting back to the basics of tension member design.

**Richard M. Drake** (**rick.drake@fluor.com**) is a senior fellow in structural engineering, and **Erik Espinoza** (**erik.espinoza@fluor.com**) is a director in structural engineering, both with Fluor Enterprises, Inc.

**TENSION AND** compression are two of the most fundamental concepts in structural engineering. While this is common knowledge, let's take a minute to go back to the beginning and review the elements of tension member design.

Here, we'll discuss key steps in designing tension members in accordance with the provisions of the AISC *Specification for Structural Steel Buildings* (ANSCI/AISC 360, **aisc.org/specifications**).

A tension member is any structural member that is loaded with an axial tension load. Tension members are commonly located in structural bracing, roof trusses, towers, and utility supports. Figure 1 shows sections commonly used as tension members.


Fig. 1. Common tension members.

When evaluating a member's tension strength, the *Specification* refers to different tension member cross-sectional areas in order to quantify the nominal strength of various tension limit states.

## Cross-Sectional Areas

**Gross area.** *Specification* Section B4.3a defines the member gross area ($A_g$) as the total cross-sectional area. Simply speaking, the gross area is the total cross-sectional area of a tensile member taken perpendicular to the load, where no holes are provided.

To demonstrate this, consider a plate used as a tension member spanning between two columns, bolted to gusset plates at each column, as shown in Figure 2. The gross area is shown by cutting Section a-a perpendicular to the tension load away from the ends of the tension member.

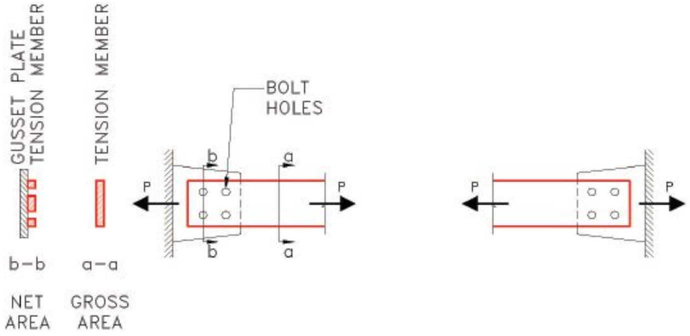



Fig. 2. Tension member gross and net area.

The full gross area is available to resist tension loads. The average stress is equal to:

$$f_{avg} = \frac{P}{A_g}$$

**Net area.** *Specification* Section B4.3b defines the member net area ($A_n$) as the sum of the products of the thickness and the net width of each element of the tension member. Simply speaking, the net area is the gross area of a tensile member taken perpendicular to the load, minus something for holes.

To demonstrate this, consider the same plate used as a tension member spanning between two columns, bolted to gusset plates at each column—again, as shown in Figure 2. The net area is shown by cutting Section b-b perpendicular to the load at the location where bolts transfer the tension load from the tension member to the gusset plate.

The bolt holes reduce the cross-sectional area available to resist tension loads. The average stress is equal to:

$$f_{avg} = \frac{P}{A_n} > \frac{P}{A_g}$$

Assuming that the tension load is the same at both the gross and net area, the stress will be higher at the net area.

*Specification* Table J3.3 defines nominal bolt hole dimensions. For bolt diameters 7⁄8 in. and smaller, standard bolt holes are punched or drilled 1⁄16 in. larger than the bolt diameter. For bolt diameters 1 in. and larger, standard bolt holes are punched or drilled 1⁄8 in. larger than the bolt diameter.

*Specification* Section B4.3b further states that in computing the net area of tension members, the width of the bolt hole should be taken as 1⁄16 in. greater than the nominal bolt hole dimension.

Remember: The net area is the gross area minus something for the holes.

For bolt diameters of 7⁄8 in. and smaller, the bolt hole net area reduction is equal to the bolt diameter plus 1⁄16 in. for the standard hole plus another 1⁄16 in. for damage incurred making the hole. The net area is defined as:

$$A_n = A_g - n\left(d + \frac{1}{8}\right)t$$

For bolt diameters of 1 in. and larger, the bolt hole net area reduction is equal to the bolt diameter plus 1⁄8 in. for the standard hole plus another 1⁄16 in. for damage incurred making the hole. The net area is defined as:

$$A_n = A_g - n\left(d + \frac{3}{16}\right)t$$

Where:
- $n$ = number of bolt holes in cross-section taken perpendicular to the load
- $d$ = bolt diameter, in.
- $t$ = material thickness, in.

Note that stresses tend to concentrate at bolt holes, and the maximum stresses are usually much higher than predicted by the average stresses. The material does not rupture because of its material ductility.

$$f_{max} >> f_{avg} = \frac{P}{A_n}$$

The *Specification* accounts for these stress concentrations by considering an effective net area.

**Effective net area.** A structural shape consists of rectangular elements that make up its shape, as indicated in Figure 3.

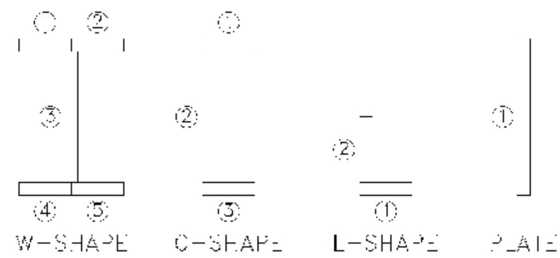


Fig. 3. Shape elements.

A W-shape consists of five elements, two elements for each flange and one web. A C-shape consists of three elements, one element for each flange and one web. An L-Shape consists of two elements, one element for each leg. A plate consists of one element.

When some but not all of the cross-section elements are used to transfer tension forces between a member and a connection, not all of the net area is effective for tensile rupture. The member is not being very efficient at the connection.

*Specification* Section D3 uses a *shear lag factor* for both welded and bolted connections in tension members to account for this inefficiency. The shear lag factor addresses whether the transfer of tension loads from a structural shape to a fastener involves all or some of the cross-sectional elements of that shape. If the distance to transfer the tension load between the tension member and its end connection is short, then the internal shear forces cannot be efficiently distributed from the entire cross section (all the elements) to the reduced cross section (some of the elements) at the connection. This shear lag is accounted for by reducing the net area to an effective net area.

$$A_e = A_n U$$

Where:
- $A_e$ = effective net area, in.$^2$
- $U$ = shear lag factor, unitless
- $A_n$ = net area, in.$^2$

Shear lag factors are based on empirical testing and are summarized in *Specification* Table D3.1. Eight (8) cases are included in the table, but the most commonly used are Cases 1 and 2.

**Case 1:** When the tension load is transmitted directly to each of the cross-sectional elements by fasteners or welds (see Figure 4). This case does not apply when loads are transmitted by longitudinal welds only (Case 4) or for hollow structural sections (HSS) (Cases 5 and 6).

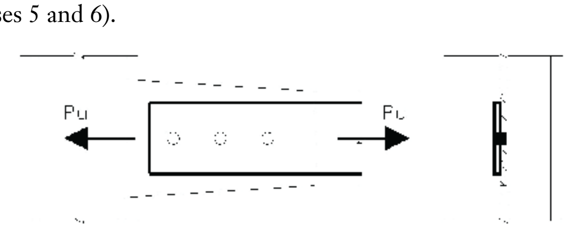


Fig. 4. All elements bolted (or welded).

**Case 2.** When the tension load is transmitted to some but not all of the cross-sectional elements by fasteners or by longitudinal welds in combination with transverse welds (see Figure 5). This case does not apply to HSS (Cases 5 and 6).

$$U = 1 - \frac{\bar{x}}{L}$$

Where:
$\bar{x}$ = connection eccentricity, in.
$L$ = connection length in the direction of loading, in.

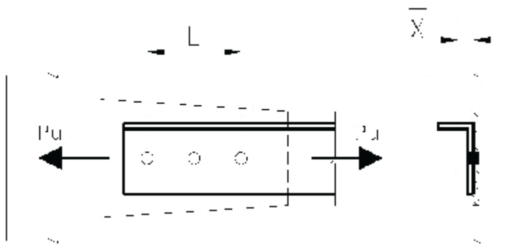



Fig. 5. Some elements bolted (or welded).

If applying Case 2 when only W-shape flanges are connected, determine the $\bar{x}$ from the WT-Shape (i.e., $\bar{y}$ value from WT section properties) cut from the W-Shape (see Figure 6).

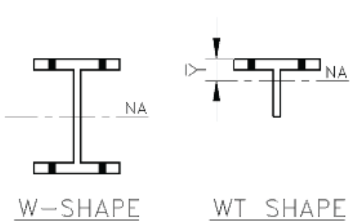



Fig. 6. Eccentricity for W-shape flanges.

*Specification* Section D3 also permits the shear lag factor for open sections (i.e., sections that are not HSS or plates) to be limited to no less than the gross area of the connected elements divided by the gross area of the entire section.

$$U \geq \frac{\text{Gross Area Of Connected Parts}}{\text{Gross Area Of Entire Section}}$$

**Tension Limit States:** *Specification* Section D2 requires that the design tensile strength $\phi_t P_n$ (LRFD) and the allowable tensile strength $P_n / \Omega_t$ (ASD) be the lesser of the limit states for tension yielding in the gross section and tension rupture in the net section.

**Tension yielding in the gross section.** A tension member can become unserviceable if it stretches so much over its length that loads cannot transfer between the member and the rest of the structure. In this limit state, it is prudent to limit the member elongation over its entire length to the yield strain ($\varepsilon_{yield}$), the strain when the tension member gross area reaches the material yield stress ($F_y$) (see Figure 7).

$$\Delta_{yield} = \varepsilon_{yield} L_{member}$$

$$\sigma_{yield} = \frac{P}{A_g} \leq F_y$$

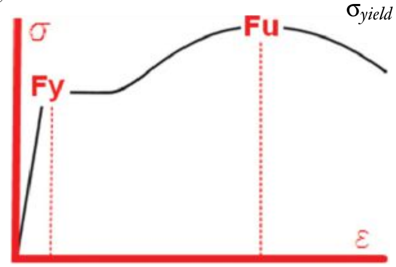



Fig. 7. Stress-strain relationship.

The nominal strength ($P_n$) to limit yield at the gross section (Section a-a) can be expressed as:

$$P_n \leq F_y A_g$$

*Specification* Equation D2-1 uses this approach to define the tension yielding in the gross section limit state.

$P_n = F_y A_g$

$\phi_t = 0.90$ (LRFD) $\Omega_t = 1.67$ (ASD)

**Tension rupture in the net section.** A tension member can become unserviceable if it stretches so much at bolt holes that loads can't transfer between the member and the rest of the structure. In this limit state, it is prudent to limit the member elongation at the bolt holes to the rupture strain ($\varepsilon_{rupture}$), the strain when the tension member effective net area reaches the material tensile strength ($F_u$) (again, see Figure 7).

$$\Delta_{rupture} = \varepsilon_{rupture} L_{holes}$$

$$\sigma_{rupture} = \frac{P}{A_n} < F_u$$

The nominal strength ($P_n$) to limit rupture at the net section (Section b-b) can be expressed as:

$P_n \leq F_u A_n$

*Specification* Equation D2-2 uses this approach to define the tension rupture in the net section limit state, using the effective net area ($A_e$).

$P_n = F_u A_e$

$\phi_t = 0.75$ (LRFD) $\Omega_t = 2.00$ (ASD)

**Block shear.** *Specification* Chapter D includes a User Note that Section J4.3 for block shear might also apply to tension members.

As indicated in Figure 8, for certain connection configurations, a segment or "block" of material at the end of a tension member can tear out. This limit state is a combination of shear failure in the direction of the load and tension failure perpendicular to the load.

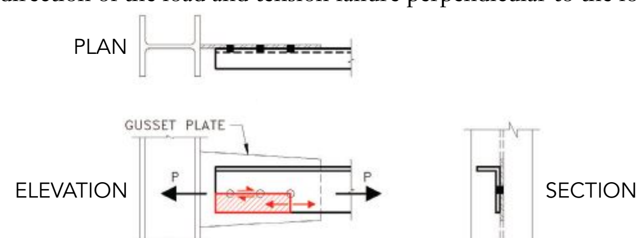



Fig. 8. Block shear failure of a tension member.

*Specification* Equation J4-5 defines the Block shear limit state.

$$R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt} \leq 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$$

Where:

$R_n$ = nominal shear rupture strength, Kips

$\phi$ = resistance factor, unitless

$F_u$ = specified minimal tensile strength, ksi

$F_y$ = specified minimum yield stress, ksi

$A_{gv}$ = member gross shear area, in.$^2$

$A_{nv}$ = member net shear area, in.$^2$, the gross shear area minus something for the holes

$A_{nt}$ = member net tension area, in.$^2$, the gross tension area minus something for the holes

$U_{bs}$ = block shear reduction coefficient, unitless, equals 1 for most tension member cases.

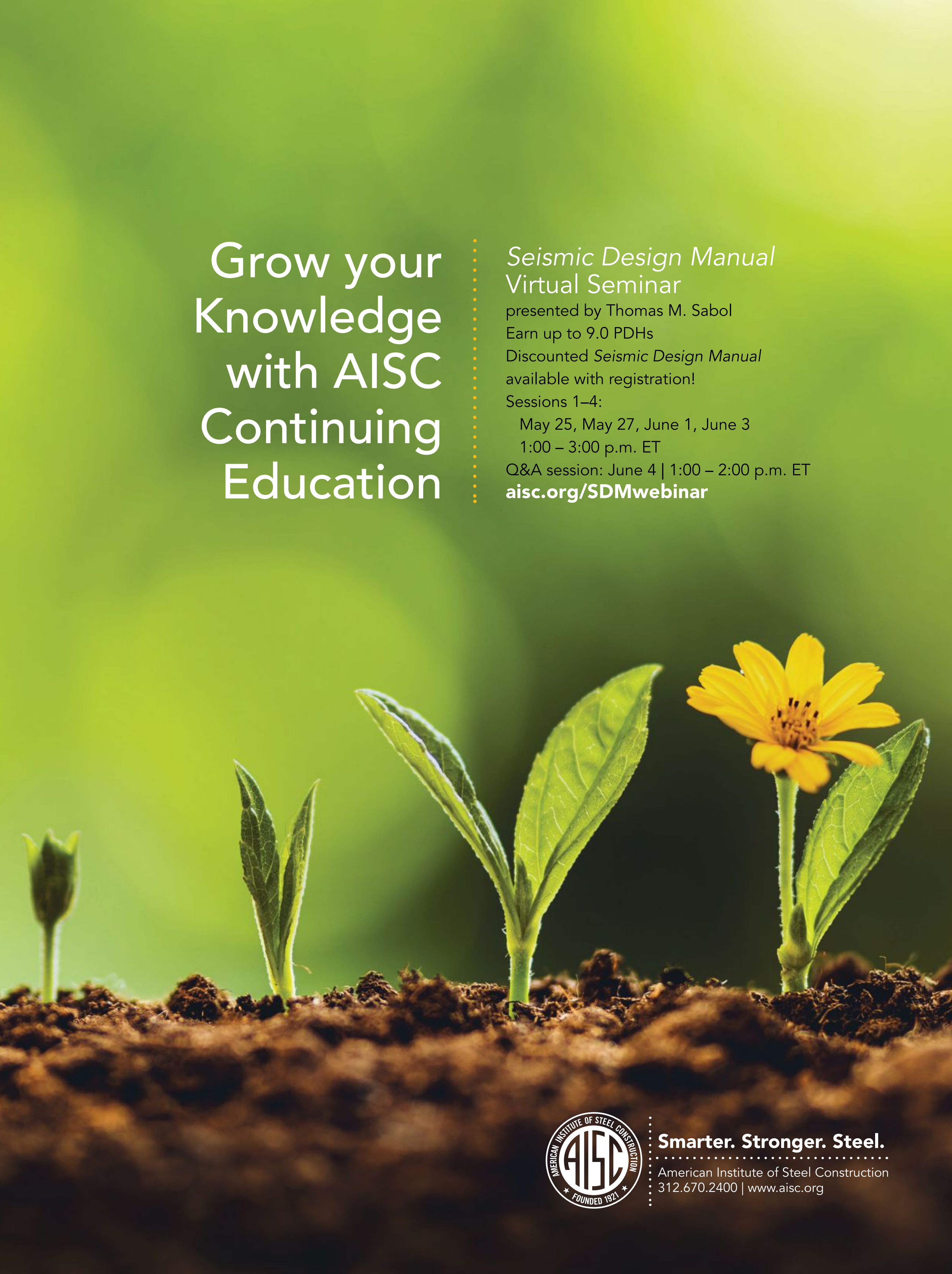
Block shear can also occur in welded connections.

$$A_{nv} = A_{gv}$$
$$A_{nt} = A_{gt}$$

In some cases, the block shear limit state will be less than the limit states for tension yielding in the gross section and tension rupture in the net section and will govern the strength of the tension member.

In the words of the great TV detective Columbo, "Just one more thing." Although this primer is intended to summarize the nominal tension strength requirements in the *Specification*, the designer is cautioned that the choice of member cross-section and connection detail may introduce an eccentricity and moment to the design of tension members. In those cases, the designer should consult *Specification* Chapter H for combined Flexure and Axial Force.

And keep an eye out for an upcoming SteelWise on tension's structural counterpart, compression. ■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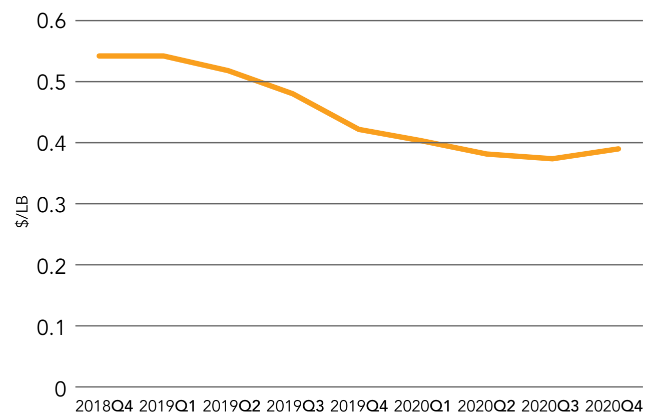
Data Driven highlights market trends, economic forecasts, or other relevant numbers that affect steel design and construction. This month's data focuses on price fluctuations in the steel market.

# data driven

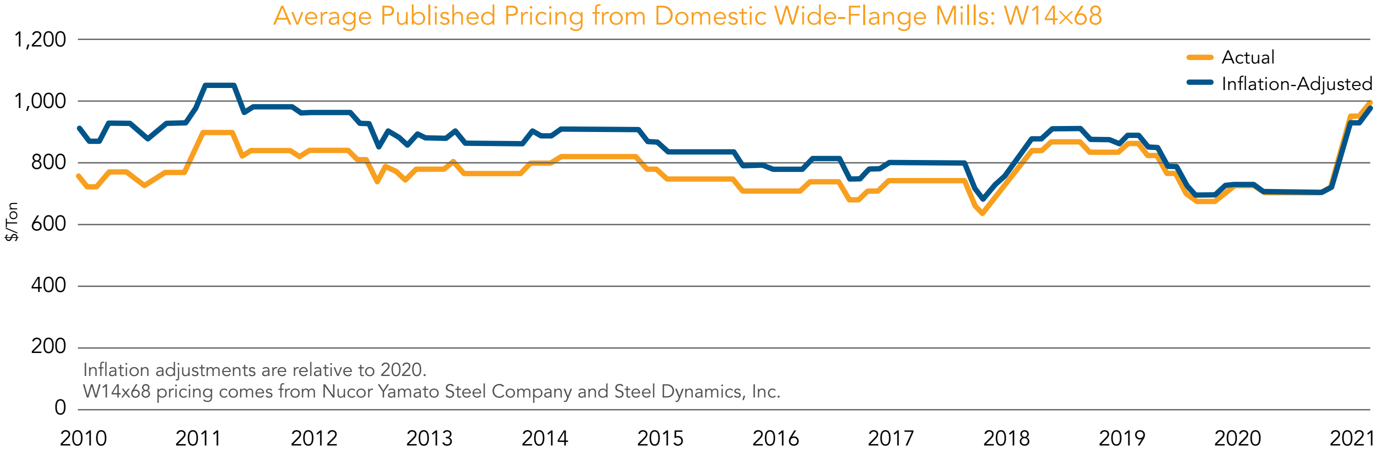
**PRICE FLUCTUATIONS** in the steel market have certainly been making headlines lately. Just as COVID-19 slowed construction activity in the second and third quarters of 2020, it also reduced demand for steel products in other industrial areas like automotive production. Although the demand decrease caused a short-term softening of prices, it also caused a contraction in supply—and as economies began to open again, steel and scrap demand quickly outpaced inventory levels and production. This has caused longer lead times and increased prices for raw scrap and steel products.

To keep things in perspective, it's good to have a long-term view, as well as pricing for other materials for comparison. Charts on this page show pricing information for a common wide-flange size, from 2010 to the present, and a sample plate size, from late 2018 to the present. Also included is pricing for structural lumber, concrete, and steel products, according to the Price Index from the Federal Reserve Economic Data (FRED), over the last decade. You'll notice that all construction materials—not just steel—have been similarly impacted by the pandemic.

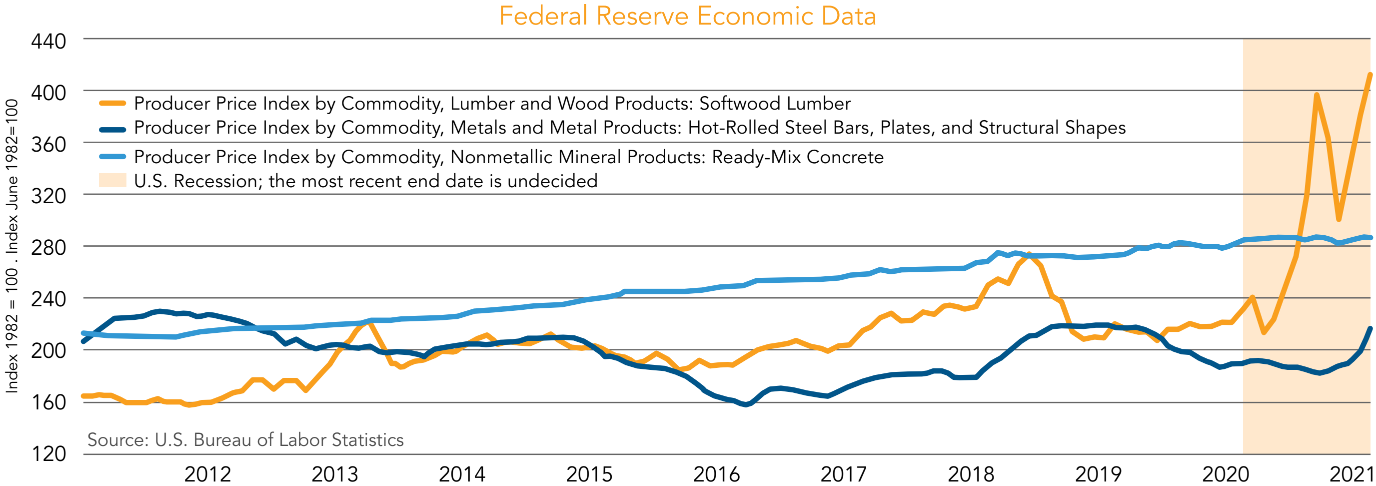
Combination of Prices from U.S. Plate Mills
A709-50W 1½ in. thick × 96 in. wide × 636 ft long




Average Published Pricing from Domestic Wide-Flange Mills: W14×68




Federal Reserve Economic Data




You can find regularly updated versions of all this data at **aisc.org/economics**. ■

field notes

# STEADY BEAT

INTERVIEW BY
GEOFF WEISENBERGER

Southern California architect Anders Lasater has found the perfect balance between designing buildings and banging drums.

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

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

**ANDERS LASATER APPRECIATES STRUCTURE—**not just when it comes to buildings but also its role in music.

The founder of Anders Lasater Architects in Laguna Beach, Calif., he first made the connection between a design drawing and a final product in his high school woodshop class. In this month's Field Notes podcast interview, he talks about why he loves California, his experience as a judge for this year's AISC IDEAS$^2$ Awards competition, starting his own firm, and the connection between architecture and music.

**I understand your firm is in Laguna Beach. Are you a SoCal native?**

I am! It seems folks move out here for the weather, and I guess that's one of the reasons I've never left. It's hard for me to think of living somewhere else. I've made my career working in coastal Orange County. There's something particularly special about the sunlight in this area, and that's what makes being an architect here especially exciting.

**Speaking of architecture, when did you start on that path?**

I think an awareness of the built environment is something that doesn't come naturally to anyone. But when you become aware of how you can look at the built environment and begin to understand your relationship with it, an entirely new world of opportunity is awoken in you. That really began for me in seventh-grade woodshop class, where we were first taught how to do some basic mechanical drawing, like drawing a circle with a compass. And then you would take that drawing over to the woodworking machine and cut out a wheel for what would ultimately become a little wood truck planter to give your mom on Mother's Day. And so that kind of relationship between the act of drawing something, being able to create something from the drawing, and then being able to see the reaction that you elicit from someone you gave it to was so powerful, and it left in me this really strong desire to be a creator. And from there, as I grew up, I realized that I had an ability to draw, and architectural drawings became fascinating to me. I learned how to relate to the built environment and how to see buildings in a more specific, more intentional way, and I realized that's really what I wanted to be, an architect. It was either that or a rock-and-roll drummer, which I was pretty serious about, but I decided architecture was probably the better way to have a more regular paycheck.

To be a professional in the music business was another level of existence that I realized I probably couldn't attain, whereas architecture felt like a natural extension of me. I could think and be and act like an architect fairly naturally. So that was where I made the decision to pursue it as my primary career and let music be that thing that I could always fall back to and get instant gratification from. Being an architect, it takes years sometimes to develop buildings and to see the fruits of your labor, but it takes mere minutes to turn around and pick up a guitar or sit down at the piano or behind the drums and bang out something for your own instant gratification. Music is a great counterbalance to my architecture.

**Do you feel like the two disciplines are related?**

Music has an internal structure. There's dynamic and there's deviation from the norm, from a datum point, and great architecture is similarly based on order and rigor and dynamic and all of the things we find in a great piece of music. The two are so closely related and yet they're also very far apart. Architecture exists in three dimensions all at once, where music is temporal. It starts and it has a finish. They don't exist in the same kind of dimensional plane, but they have very similar qualities.

Igor Stravinsky was a great musician, but I consider him a great designer as well. He designed the most avant-garde music of his time. He used to say that the greater the restrictions he placed upon himself, the more creative his response, and I think that message resonates with architecture as well. I often find that the projects that are harder for me are the ones where I am given no limits. We're doing a mountain house now in the Lake Tahoe area on a very large piece of property. I can basically put the house anywhere I want, and the shape of the house can be basically anything I want because there are no physical limitations governing my choices there, and to be frank, it actually makes my job a lot harder. I really like when I have restrictions like a small lot or a lot that has a particular shape, whether it's long and narrow or maybe it's got a curve on one side, because what I find is that those limitations begin to influence my response, and that results in a unique and very site-specific kind of architecture.

**Tell me a bit about starting your own firm.**

As I was finishing graduate school at UCLA, I was working for an architect in Orange County named Mark Singer, who was doing some really wonderful modern homes here in the Laguna Beach area. Under his tutelage, I learned how to create buildings, how to interact with clients, how to create contracts—the kinds of things that an architect needs to know not only to be a good designer but also a good businessperson. Eventually, it was time for me to step out on my own, and I remember the day it happened. It was the end of March in 2006, and I woke up on a Saturday, realizing that I'd quit a well-paying job with great clients, doing awesome projects, and I had to figure out what to do next. I had two kids and a wife at home staring at me, going, "OK, smart guy. You wanted it your way or the highway, now you've got it. What are you going to do about it?" I don't think there's a more motivating thing than waking up in the morning, realizing you don't have a job and you've got three hungry mouths to feed. But you've got talent and ability and you need to go put it to work, and I remember getting out of bed that morning practically sobbing in my coffee, and then by noon that day I had already reached out to a dozen different contacts, and the question they all asked was, "What took you so long?" I had the good fortune of having a great network of people that I was connected to, and those people did an exceptional job of helping me accelerate my firm. Pretty quickly, we were off and running, and I haven't looked back.

**That's great to hear! Switching gears, can you tell me about your experience judging the IDEAS$^2$ Awards?**

I really enjoyed being on the jury and looking at the vast differences between the project types and sizes. The winners all used steel in a way where it is celebrated and allowed to become greater than just a support role. One of the things that I say all the time is that a great building will look as good when it's under construction as it does when it's finished. I often find that buildings in their construction stage exhibit a really inherent beauty. They have rhythm and order, they have rigor, and they have a logic to them that oftentimes gets covered up with the finish materials. But with all the winners, not only was the steel elegantly exhibited during construction but also in the finished project.

**Switching gears *again*, when did the drumming begin?**

Some of my earliest memories were sitting on the kitchen floor in front of the kitchen cabinets, having pulled out all the pots and pans and just sitting there banging away with wooden spoons. I remember even hanging the metal lids for the pans with string off the handles of the cabinets to create my cymbals. I became infatuated with what the drums looked like, how they sounded, the idea of sitting behind them and commanding them, and creating this driving force behind the music. When I was in third grade, I remember we had a little snare drum marching group in our school, and then I started drum lessons and eventually piano lessons as well. I taught myself guitar and now I play the bass guitar too. But with the drums, I can create the foundation, the driving structure, and rhythms that support the other parts of the music. ■

*This article is excerpted from my conversation with Anders. To hear our chat in its entirety, including Anders' goal of visiting all 50 states, his band, and his admiration for Ringo Starr and Lars Ulrich, visit* ***modernsteel.com/podcasts****.*

business
issues

# ENGAGING EGO

BY DAN COUGHLIN

Tips for reducing the negative control of your ego—and not taking things so personally.

**Dan Coughlin** provides individual executive coaching and group coaching programs on management, leadership, and teamwork. To visit his Free Business Performance Idea Center, go to **www.thecoughlincompany.com**.

Dan was also a presenter at this year's NASCC: The Virtual Steel Conference. Visit **aisc.org/nascc** roughly 45 days after the conference to view a video of his presentation.

**EGO IS A TOUGH THING** to define and an even tougher thing to grapple with.

I'm a big fan of understanding the *self*, which I believe consists of our purpose, character strengths, values, morals, talents, passions, idea processor (introvert or extrovert), temperament, decision-making approach, and sources of self-confidence. When we each understand ourselves, we can leverage what we have within us to make a positive difference in the world. When we allow ourselves to go unexamined and unchecked, we can subconsciously move forward in a way that may hurt other people.

And then there is our *ego*.

Ego is a very important aspect of our self, and it requires extra attention. It can drive both healthy and unhealthy behavior.

Our ego can be the container of our self-esteem, and it can also be the container of our selfishness. Our ego can help drive us to do what we didn't know we were capable of doing in a meaningful and positive way. Our ego can also help drive us to do cruel and mean-spirited things we didn't know we were capable of doing.

To me, our ego is an organ like our heart or brain. It's part of who we are, it's essential to who we are, and yet we have choices for how we develop it, just like we have choices for how we develop our heart and brain. We can choose to make it healthier or unhealthier by what we feed it. And this is where the work really begins.

## Healthy Ways to Interact with Our Ego

A healthy approach to interacting with our ego depends on staying conscious of what *is* happening within us and what we *want* to happen. Are we basing our self-esteem on how we see ourselves rather than depending on how other people react to us or behave near us?

Here are some questions I encourage you to think about. Then I encourage you to write down your answers.

1. What do I see that is good and not so good within my thoughts?
2. What do I see that is good and not so good within my intentions?
3. What do I see that is good and not so good in my efforts?
4. What do I see that is good and not so good in my behaviors?
5. What do I want my thoughts to be about in the future?
6. What do I want my intentions to be for the future?
7. What do I want my efforts to be about in the future?
8. What do I want my behaviors to be like in the future?

Now I know that's a lot of "I" statements, but they're necessary when talking about our ego.

## Unhealthy Ways to Interact with Our Ego

The unhealthy ways to interact with our ego all depend on subconscious messages we receive, or think we receive, from other people that we don't filter through. Are we basing our feelings and beliefs about ourselves on what other people say and do rather than depending on how we see ourselves?


Here are some questions I encourage you to think about. And again, I encourage you to write down your answers.

1. Am I getting negatively emotional over how another person speaks to me or ignores me?
2. Am I getting negatively emotional when another person criticizes me or ignores me?
3. Am I getting negatively emotional if another person wholeheartedly disagrees with me?
4. Am I getting negatively emotional over how another person runs a meeting or an organization?
5. Am I getting negatively emotional because another person has a different temperament, height, body shape, or salary than I do?
6. Am I getting negatively emotional because another person is seemingly more popular, better-looking, or more successful than I am?
7. Am I getting negatively emotional because it appears that my sibling is getting more praise than I am?
8. Am I getting negatively emotional because it appears that another's person's future is brighter than mine?

Notice that all of these "I" questions are about our thoughts regarding other people.

Here is the great irony. When we focus on our own thoughts and actions, we can usually make healthy decisions regarding our own egos. When we focus on other people's words and actions, we often tend to make unhealthy choices regarding our egos.

## Sometimes Feedback Hurts and Helps at the Same Time

One period in my life where my ego ran amok was when I served on a variety of volunteer boards, councils, and committees. I found myself getting into an endless number of arguments and experiencing multiple intensely negative emotions in my interactions with other people. It was almost like another person took over my body.

During that time, I heard two comments that were very painful to hear but also very helpful. Here they are:

> "Dan, you are not effective in these meetings because you take everything way too personally."

> "Dan, you made the meeting all about you."

While that hurts a lot to recall, it is also a very helpful reminder. Recalling that feedback reminds me of the very stark difference between healthy ways and unhealthy ways of interacting with our ego.

A healthy way to interact with our ego is when we set aside time to have a conscious reflection within ourselves regarding our thoughts, intentions, efforts, and behaviors in a given situation. We are consciously discerning what can be learned from the situation.

An unhealthy way to interact with our ego is when we have an immediate subconscious reaction to other people's words or actions or the lack of their words and actions. We are subconsciously assuming things about the other person's intentions, which may or may not be true at all, and those assumptions instantaneously interact with the fragile parts of our ego.

Healthy ways to interact with our ego take conscious effort over an extended period of time, while unhealthy interactions happen subconsciously and instantly. Like anything, practice makes perfect—and so does patience. Take the time to consciously, positively interact with your ego, and you'll see positive results. ■

# Winners Choose Chicago Metal TO Curve Steel

**2015 IDEAS² Merit Award** - 73 pieces of curved 8” sch 40 pipe totaling 35 tons for Circuit of the America Observation Tower. Austin, TX

**2014 SEAOI Best Project** - Elliptically curved trusses rolled from 5” and 8” diameter AESS pipe for Institute of Environmental Sustainability at Loyola University. Chicago, IL

**2007 IDEAS² National Winner** - 400 tons of 12” square tubing curved for the retractable, lenticular room trusses at the University of Phoenix Stadium. Phoenix, AZ

**2005 EAE Merit Award** - 570 tons of 12”, 14”, 16”, 18” and 20” pipe curved for the Jay Pritzker Pavilion. Chicago, IL

**2003 IDEAS² National Winner** - 300 tons of 5” square tubing curved 45° off-axis for the Kimmel Center. Philadelphia, PA

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# 2021 IDEAS$^2$ AWARDS

**WHAT DO** a factory-turned-office-building, a training facility with a C-suite-worthy treehouse, a state-of-the-art rodeo venue designed for today's cowboy, and a stacked school have in common?

They're all steel-framed, they're all beautiful, and they're all winners. Specifically, these four projects, as well as six others, are winners of the 2021 AISC IDEAS$^2$ Awards.

Why "IDEAS$^2$?" Because the program recognizes Innovative Design in Engineering and Architecture with Structural Steel. Awards for each winning project are presented to the project team members involved in the design and construction of the structural framing system, including the architect, structural engineer of record, general contractor, owner, and AISC member fabricator, erector, detailer, and bender-roller.

New buildings, as well as renovation, retrofit, and expansion projects, are eligible, and entries must meet the following criteria:

- A significant portion of the framing system must be wide-flange or hollow structural sections (HSS)
- Projects must have been completed between January 1, 2018 and December 31, 2020
- Projects must be located in North America
- Previous AISC IDEAS$^2$ award-winning projects are not eligible

This year's five judges considered each project's use of structural steel from both an architectural and structural engineering perspective, with an emphasis on:

- Creative solutions to the project's program requirements
- Applications of innovative design approaches in areas such as connections, gravity systems, lateral load-resisting systems, fire protection, and blast protection
- The aesthetic impact of the project, particularly in the coordination of structural steel elements with other materials
- Innovative uses of architecturally exposed structural steel (AESS)
- Advancements in the use of structural steel, either technically or in the architectural expression
- The use of innovative design and construction methods such as 3D building models, interoperability, early integration of steel fabricators, alternative methods of project delivery, and sustainability considerations

The entries were placed in four categories according to their constructed value in U.S. dollars:

- Less than $15 million
- $15 million to $75 million
- $75 million to $200 million
- More than $200 million

National and Merit honors were awarded in the Less than $15 million and $15 million to $75 million categories, and National awards were given in the $75 million to $200 million and More than $200 million categories. In addition, Sculptures/Art Installations/Nonbuilding Structures National and Merit winners were also selected, and one project won a Presidential Award for Excellence in Adaptive Reuse. Congratulations to all of this year's winners!

## Stephanie J. Hautzinger, SE, AIA
### Associate Vice President, CannonDesign, Chicago

Stephanie, a structural engineer in the Chicago office of CannonDesign, has 25 years of experience in the design of healthcare, corporate, and education projects. During her career, she has made significant contributions to unique and award-winning buildings such as the University of Chicago Gerald Ratner Athletics Center and the Kline Center Addition at Dickinson College. Stephanie is a graduate of the University of Illinois, with a Bachelor of Science in architectural studies and a Master of Architecture in the structures option. Stephanie is active in the engineering community, serving as vice president of the Structural Engineers Foundation. She is also a proud member of the Structural Engineers Association of Illinois and the American Institute of Architects. Stephanie has been published on multiple occasions, particularly related to architectural engineering collaborations and the use of exposed structural steel.

## Mark V. Holland, PE
### Chief Engineer, Paxton and Vierling Steel Co., Omaha, Nebraska

Mark is the chief engineer for Paxton and Vierling Steel Co. in Omaha, Nebraska. Mark is an active member of the AISC Committee on Specifications, Chairman of the Committee on Stainless Structures, Chairman of the AISC Manual Committee, and a registered professional engineer in nine states. From 1986 to 2013, Mark was responsible for connection design, material procurement, detailing, shop scheduling, project management, and change order management. From 2013 to the present, he has been mentoring the next generation of steel fabricators. Mark is a regular speaker at NASCC: The Steel Conference as well as several other industry events on subjects related to fabricated structural steel and connection design.

## Maysa Kantner
### Atlanta Structural Steel Specialist, AISC

Maysa Kantner is an AISC structural steel specialist serving the greater Atlanta market. She earned her Bachelor of Science and Master of Science in civil engineering from the Georgia Institute of Technology. After graduation, Maysa started her career with Uzun+Case, where she worked on a wide variety of projects, including the new UGA Indoor Athletic Facility. She has five years of previous experience as a structural engineer and has since found her passion in the marketing and business development aspects of the structural steel industry.

## Anders Lasater, AIA
### CEO and Principal Architect, Anders Lasater Architects, Los Angeles

By the time he was ten years old, Anders knew he'd grow up to be either an architect or a heavy metal drummer. But, by the 1990s, grunge and alternative pushed heavy metal out of the spotlight, so he shifted focus from the practice studio to the architectural studio and began working for some of the best architects in Orange County. After finishing two degrees in architecture and design theory, he opened the doors to his own firm in 2005, where he and his staff focus on innovative designs for residential, restaurant, retail, and hotel projects. He's fortunate to have a diverse group of passionate architects working for him who finds the same joy in making thoughtful architecture as he does. Much to his wife's chagrin, he still lives out his rock-n-roll fantasy with his band, Thunderhose.

## Wanda Lau
### Editor, Technology and Practice, *ARCHITECT* magazine

Wanda covers technology, practice, and op-eds at *ARCHITECT* magazine, the journal of the American Institute of Architects. Based in Washington, she has won more than 30 national and regional awards for editing and writing stories examining everything from building codes to firm culture. She is also a host, producer, and editor of the *ARCHITECT* Podcast Network. Wanda has spoken regularly on building technology as well as on diversity, equity, and inclusion in professional practice, contributed to publications on high-performance design, and served on studio and award juries across the country. Her wide range of interests is reflected in her multidisciplinary background. A first-generation college graduate, she holds a Bachelor of Science in civil engineering with high honors from Michigan State University, a Master of Science in building technology from MIT, and a Master of Arts in journalism from Syracuse University. Prior to joining *ARCHITECT*, she worked for a decade in the AEC industry as an owner's representative, engineer, and communications director—but not all at once.

**NATIONAL AWARD** Greater than $200 Million

# Dickies Arena, Fort Worth, Texas

**FOR MORE THAN 80 YEARS,** Will Rogers Coliseum served as the host of the Fort Worth Stock Show and Rodeo and also as a key architectural landmark for Fort Worth. Designed in the Southwest Art Deco style, the 1930s-era arena features an exposed structural steel barrel-vaulted roof crowned with a cupola. The coliseum's efficient and purposeful form created an intimate atmosphere for an immersive rodeo experience.

It also served as the inspiration for its replacement, the new Dickies Arena. However, it also represented the challenges of incorporating the deep history and intimacy of the Coliseum environment at a larger scale while creating the flexibility to be able to host other non-rodeo events. The architectural design team embraced this challenge and developed a roof shape that would reflect the original coliseum.

The new 14,000-seat, 715,000-sq.-ft multipurpose Dickies Arena features unmatched amenities and accommodations to host not only the Stock Show and Rodeo but also hockey games, concerts, conventions, and private events. A new icon for Fort Worth, the arena offers the community three spectacular entrances: a grand north stair connecting to the cultural district and the revered Will Rogers campus, a monumental stair linking to downtown Ft. Worth, and an ornate pedestrian bridge extending to the new parking garage. These stunning entryways draw patrons into a meticulously landscaped plaza. Like the arena, this three-acre space was designed in a Southwest Art Deco style to pay homage to the city's architecture and the region's cowboy culture.

This exceptional facility had three architects working collaboratively to create a cohesive design, and the structural team partnered with them to bring the design to life. Design architect David M. Schwarz (DMS) focused on the detailing and aesthetics of every space, sports architect and architect of record HKS prioritized the function of the arena and how it appealed to fans, including the sightlines and acoustics, and Hahnfeld Hoffer and Stanford, the architect for the arena support building, focused on the functionality and flexibility of that space. The Walter P Moore structural team worked closely with the architects to create innovative solutions for each space and function of the complex.

Even in a market dominated by concrete construction, some structures present themselves with challenges that can only be solved with steel, and Dickies Arena is a perfect example. The dominant structural form of the arena is the 420-ft by 280-ft clear-span roof that arches over the event space. Structural steel trusses with a shallow depth of 14 ft and generous spacing of 15 ft make the roof seem light and airy, as only steel can do. In addition to steel being the logical and appropriate choice for this element of the structure, the project's design architect envisioned exposed structural steel in various areas of the structure to complement the 1930s cowboy culture feel of the facility.

The exposed structural steel long-span roof was key to creating this feel visually and acoustically. While the barrel-shaped, double-arched roof form was chosen to pay homage to the original Coliseum roof, a tighter roof truss spacing was desired architecturally to create a regular rhythm and pace for the space. Most modern arenas use larger and deeper trusses spaced further apart to leverage the deck span capabilities and much lower piece counts. While Dickies Arena's tighter truss spacing is unique in modern arenas, the inherent structural efficiency of arched roof form allowed for lighter and more shallow truss elements to be used.

WT top and bottom chords and double-angle web members allowed the exposed roof structure to express its connections cleanly and elegantly, and an architectural review of the structural connection details was integrated into the design process to ensure that the design intent was met. The truss spacing created an expansive and highly flexible rigging environment with over 800 potential attachment areas and without a visually imposing rigging grid.

Exposed structural steel was also used extensively in the pavilion arena and the prominent pedestrian bridge. The bridge brings the architectural and structural beauty and practicality of steel outdoors for both event-day patrons and every-day passersby to experience, and also serves as a key entrance to the facility, welcoming visitors to the expansive elevated upper plaza on which the arena sits.

Not all structural steel on the project was exposed. Four geometrically-expressed grand stairs (two elliptical and two octagonal) cantilever off the main structure with steel framing and offer the impression that the spiraling stairs are dramatically floating above the grand lobby below. As with other areas of the facility, steel allowed strict adherence to architectural geometric constraints that could not have been accomplished with other materials.

**Owner**
Trail Drive Management Corporation, Fort Worth, Texas

**Owner's Representative**
The Projects Group, Fort Worth

**General Contractors**
Beck Group, Fort Worth
Austin Commercial, Dallas

**Architects**
HKS, Inc., Dallas
David M. Schwarz, Washington, D.C.
Hahnfeld Hoffer and Stanford, Fort Worth

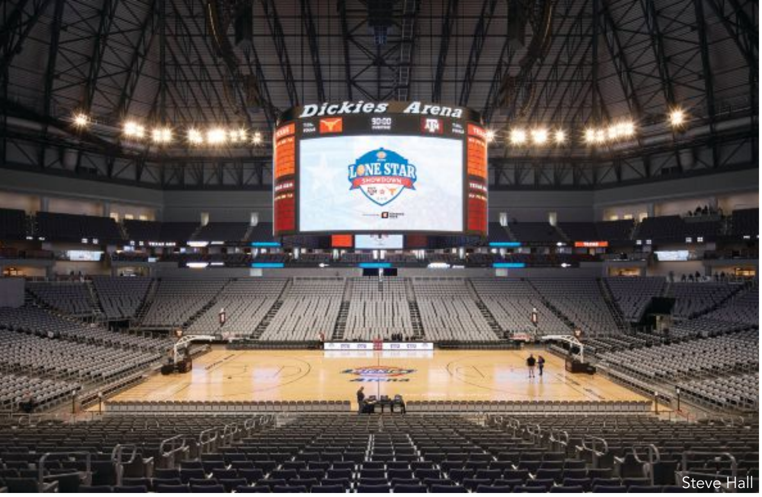
**Structural Engineer**
Walter P Moore, Dallas

**Steel Team**

**Fabricator and Detailer**
W&W/AFCO Steel (AISC Certified Fabricator), Oklahoma City

**Erector**
Bosworth Steel Erectors (AISC Associate, AISC Certified Erector), Dallas

**Bender-Roller**
Max Weiss (AISC Associate), Milwaukee




Steve Hall

Steve Hall

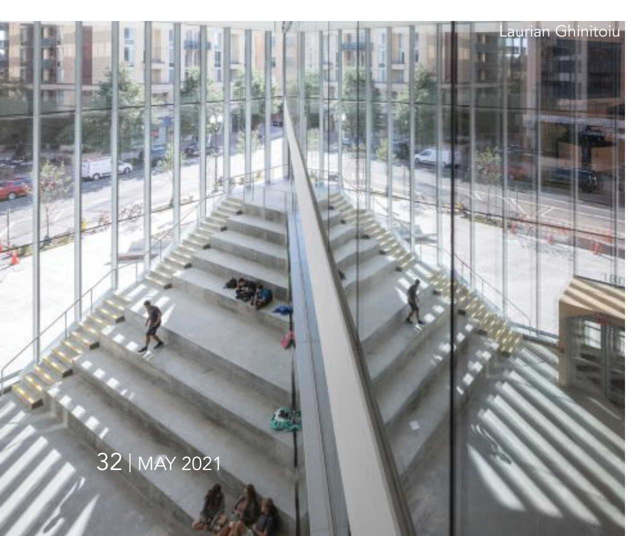
The arena design complements the area's vernacular architecture while its striking roof design leverages the strengths of steel and post-tensioned concrete to help create a versatile, column-free arena for a vast array of rigging configurations and events.
—Wanda Lau


Arcpoint Studios

Steve Hall

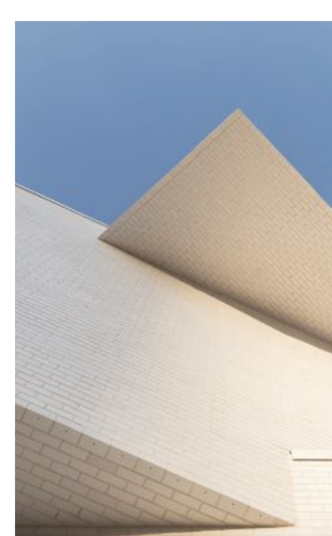
Laurian Ghinitoiu

The ambiguity of how this building is supported is one of the most fascinating features of the structure, and it is all due to the structural steel trusses behind the scenes.
—Maysa Kantner



Laurian Ghinitoiu

Bjarke Ingels Group



Laurian Ghinitoiu

Laurian Ghinitoiu

Laurian Ghinitoiu

**NATIONAL AWARD** $75 Million to $200 Million

# The Heights School, Arlington, Va.

**THE HEIGHTS SCHOOL BUILDING** in Arlington, Va., serves as the home for two educational programs: the Eunice Kennedy Shriver Program, which educates students best served in a specialized environment, and the HB-Woodland Program, which teaches self-motivation by making students accountable for their choices.

Due to the co-location of the two programs, careful planning to accommodate diverse technical requirements was paramount. As such, Arlington Public Schools set the goal for the design of creating the most cutting-edge 21st-century learning environment.

The concept for the five-story above-grade vertical urban school is based on the idea of using the building itself as a teaching tool. Outdoor classrooms, collaboration niches, writable vertical surfaces throughout, flexible classrooms, specialized maker spaces, advanced technology, supportive programming, and many other amenities make the Heights School learning environment unlike any other in the United States. The school is an excellent example of optimizing functional space to directly address user requirements.

The vertical design of the school creatively responds to site constraints and meets the main goals of providing a central space that connects the building levels and also giving access to outdoor spaces at all levels. The design team developed a scheme that creates separate classroom blocks that are all adjacent to terraces, which provides unique activities corresponding to their adjoining programs.

The new school, which opened in time for the 2019-20 academic year, consists of five stacked steel-framed "bars" that fan around a pivot. This fanning gives the feel of a one-story school building while also creating large open volumes beneath the bars. Fanning the bars around a pivot led to the development of an innovative load path concept using floating buttresses to support the corners of each bar.

The pivot was a natural location for vertical circulation and distribution of services, so a concrete core was designed to resist torsional, lateral, and gravity forces. The bars create floating corners on each side, and multiple structural concepts were evaluated to facilitate this design scheme, including cascading cantilevered steel beams with column transfers, cantilevered trusses parallel to each bar, and helical columns. Ultimately, the floating buttress design evolved from the helical column concept, where each column leans as the bar fans out. This created one helical load path at each corner that, while beautiful in structural elegance and simplicity, created sloped columns that occupied valuable interior space that couldn't be lost. To preserve this space, the helical columns were pushed out to the perimeter walls, forming a truss and floating buttress system framed with W12 and W14 sections. Each truss uses standard bolted gusset connections and bearing plates, and the buttresses use welded connections. The floating buttress resulted in additional out-of-plane forces, which are resisted by horizontal diaphragm framing that transfers diaphragm forces back to the core.

To simplify erection, each truss was designed to be fully erected into place by putting an upper truss on the truss below it, using a few shoring posts for stability during erection. Where trusses intersected in plan, the chords simply passed over one another in elevation. Structural engineer Silman collaborated with steel fabricator Banker Steel to simplify load-path continuity through geometrically complex connections at critical locations.

The framing above the gym, library, and atrium are all standard or built-up sections, and the framing over the theater uses shallow trusses. Trusses were not feasible for the available space above the gym, so plate girders and heavy W36 sections were used to transfer the columns from above, supporting bar floor and terrace framing, and double-W24 sections ended up being the most economical solution over the atrium. A dramatic cantilever over the atrium reaches toward Wilson Boulevard to the south.

To achieve the shallow floor depth, as well as the aesthetic desires of the project's architects, Leo A Daly and Bjarke Ingels Group, a dapped-end 24-in.-deep built-up double-web plate girder was used for the soffit. Due to the large terrace load from above and the short back span of this cantilever, the plate girder was anchored with a tension column in bar five. Above the theater, trusses were the optimal solution to meet the needs of potential future expansion, MEP routing, column transfers for the crossing bar above, and allowable floor depths.

Throughout the design process and especially early on, meetings between Silman, Banker Steel, and general contractor Gilbane were essential to ensuring economical solutions and constructability throughout design, as well as coordinating steel availability with the construction schedule, erection methods, preferred connection types, and site logistics. Some standard sections were changed to plate girders through this collaboration, while others remained heavy W36 beams spliced together in the field.

*For more on this project, see the December 2019 article "Pivot Point" in the Archives section at* ***www.modernsteel.com****.*

**Owner**
Arlington Public Schools, Arlington, Va.

**General Contractor**
Gilbane, New York

**Architects**
BIG – Bjarke Ingels Group, Brooklyn, N.Y.
Leo A Daly, Washington

**Structural Engineer**
Silman, Washington

**Steel Team**

**Fabricator**
Banker Steel AISC CERTIFIED FABRICATOR, Lynchburg, Va.

**Detailer**
Sanria Engineering AISC DETAILER, San Jose, Calif.

**NATIONAL AWARD**

$15 Million to $75 Million

## Truist Leadership Institute Greensboro, N.C.

**THE TRUIST LEADERSHIP INSTITUTE** is a cluster of five buildings comprising 60,000 sq. ft, all nestled on a narrow, sloping, wooded site in Greensboro, N.C. The owner desired a retreat-like, holistic design that blurred the boundary between the natural world and the built environment. Steel made it all possible and is part of the "soul" of the building, which follows the shape and form of the wooded landscape.

The $35 million project includes two three-story corporate training and conference facilities and two 24-person guest wings for overnight accommodations. It also features a multipurpose "treehouse," nestled some 20 ft high in the treetops among three large oaks. Each building provides open, sweeping views of the woods and a nearby lake. Floor-to-ceiling glass, open stairs, and wide decks blend the inside with the outdoors, and steel-supported walkways connect the buildings, providing a welcoming entry point for guests.

Steel was central to the project aesthetic and is exposed both inside and outside. Approximate 430 tons worth of steel was used, much of which met architecturally exposed structural steel (AESS) requirements. Architect Jeffrey Sowers notes, "Sometimes people think of steel as cold and hard. But in this project, it is just the opposite. Steel helped us make it warm, fuzzy, and inviting." He adds that the intent was for the vertical steel structural columns to feel like trees married to heavy timber-framed roof trusses that act as branches—with a large roof overhang becoming the "tree" canopy. The first floors of the buildings are elevated over the steel foundation framing, which makes the multistory buildings seem to "float," minimizing site disruption and creating a sense of drama.

It took careful planning during the design and engineering phase to marry blue laminated steel with exposed timber-frame beams, aligning weight-bearing points and connections to transfer the sizeable load from the timbers through the steel and onto the supporting footings. In the guest wings, the challenge was even more complex, involving the perfect alignment of timbers and structural steel columns. The use of moment connections eliminated the need for brace frames and contributed to the openness of the building.

Because of the importance of steel to this project, the design team worked closely with fabricator SteelFab to develop two custom AESS finish categories that balanced aesthetic concerns with budget realities. These custom categories combined selected requirements from AESS categories 1 through 4 (for details on the various levels of AESS, see "Maximum Exposure" in the November 2017 issue, available

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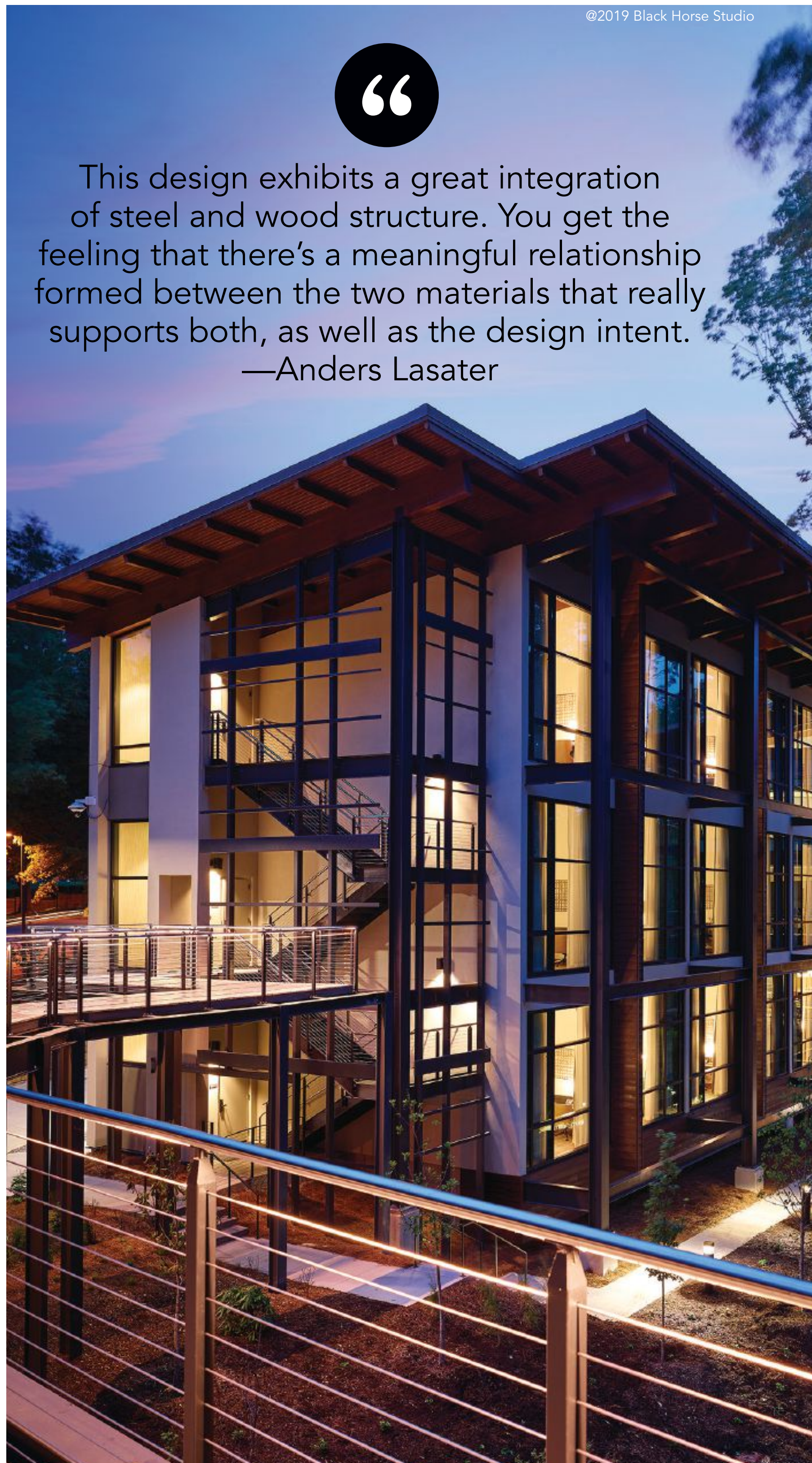
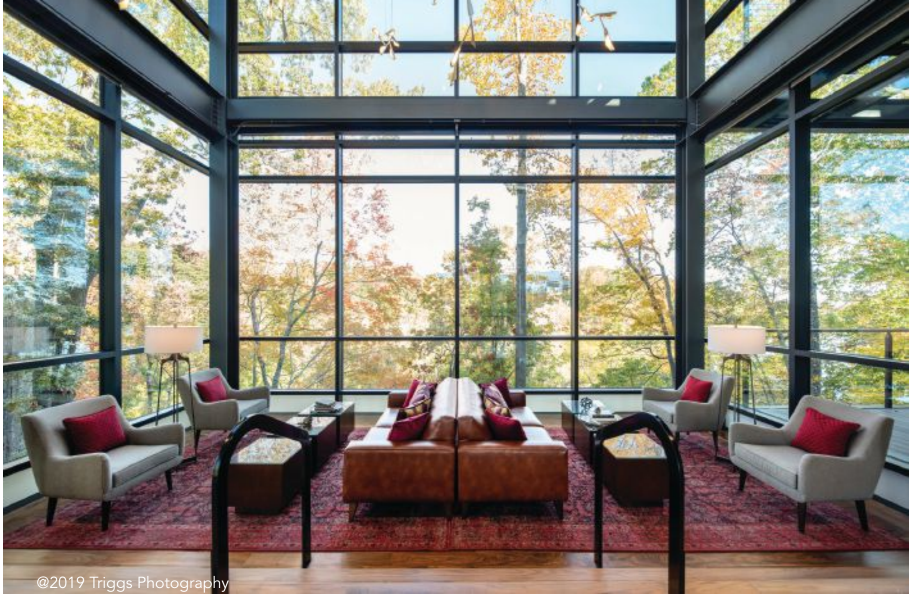
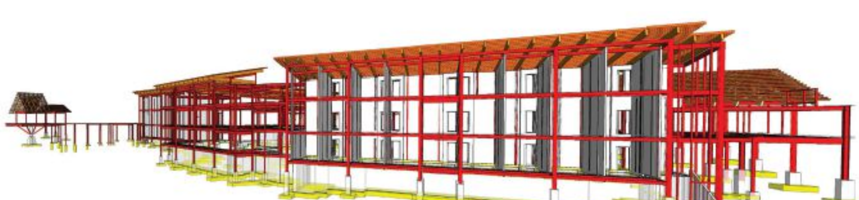


@2019 Black Horse Studio

"This design exhibits a great integration of steel and wood structure. You get the feeling that there's a meaningful relationship formed between the two materials that really supports both, as well as the design intent.
—Anders Lasater








at **www.modernsteel.com**). A more refined finish was used where the steel would be most visible, and a less refined finish was employed in areas where the structure would not be viewed up close. Close attention was required at the connections to ensure proper finishing of the welds, which was also addressed by the custom AESS categories.

The most unique of the five buildings in the project is the "treehouse," a multipurpose facility connected to the main campus by a steel pedestrian bridge. The building uses a single, central column to act as a "tree trunk," with steel braces extending like branches for support. The building appears to float in the treetops, with floor-to-ceiling glass providing 360 ° views while the forest floor below remains exposed and undisturbed.

The team at Fluhrer Reed used RAM Structural System and RAM Elements to create an analytical model that was transferred into the 3D building information model (BIM). The software was used to create a 3D model of the skeleton of the building, and the architectural "skin" and building systems were then created and applied, facilitating simpler planning of these systems around steel beams and heavy timbers.

Thanks to early collaboration between the design team and fabricator, including making upfront decisions about finishes and moment welds, the team was able to truncate timelines, control costs, and expedite construction. The early collaboration also allowed general contractor Frank L. Blum to place a mill order several months before issuance of construction documents.

The project is targeting LEED Silver certification and is designed for energy conservation and reduced water use. Low- and no-VOC materials are used throughout, and trees that were taken down were salvaged and repurposed as patterned walls, panels, and doors. And of course, the project's steel is contributing to the sustainable cause, thanks to its high recycled content and cradle-to-cradle characteristics.

*For more on this project, see the June 2020 article "Seeing the Forest for the Trees" in the Archives section at* ***www.modernsteel.com****.*

**Owner**
Truist Leadership Institute, Greensboro, N.C.

**General Contractor**
Frank L. Blum Construction,
Winston-Salem, N.C.

**Architect**
CJMW Architecture, Winston-Salem, N.C.

**Structural Engineer**
Fluhrer Reed, PA, Raleigh, N.C.

**Steel Fabricator**
SteelFab, Inc. (AISC Certified Fabricator), Raleigh, N.C.

**MERIT AWARD** $15 Million to $75 Million

# Watershed Building, Seattle

**PRODUCING A SUSTAINABLE OFFICE BUILDING** to appeal to high-tech businesses was one of the main drivers for designing and constructing Seattle's 61,000-sq.-ft Watershed Building.

The other was to be recognized by Seattle's Living Building Pilot Program (LBPP), a prestigious green building program that measures building performance for at least 12 months after occupancy. Participating in the program gave Watershed 15% additional developable area and 20 ft of additional building height beyond the current zoning allowance for commercial office buildings. To meet the program requirements, the entire design team contributed solutions for the program's material, place, and beauty requirements, which included that materials must be sourced from a 500-mile radius of the project site and cannot be listed on the program's red list of harmful materials. Steel was able to contribute positively to the program's goals, as the building includes four steel-framed above-grade levels atop three levels of cast-in-place concrete and post-tensioned concrete levels.

Structural engineer DCI Engineers considered how its designs could contribute to the project's sustainability efforts via the framing system. The solution was in castellated steel beams, which provided an opportunity to bring in more natural light for the interior office spaces. The deeper castellated beam sections also provided better floor performance with their increased strength and stiffness. In addition, the depth of the castellated beams offers more layout framing options, thus a more flexible design to accommodate value-added requirements such as the tenant mechanical ducting, unobstructed views, and cantilevered building features. The reduced weight of the castellated beams also translated to a reduction in the seismic mass carried by the steel lateral framing system. The estimated 20% to 30% of savings in the weight of the beams resulted in smaller lateral system elements, which worked well with the desire to minimize structural impacts on the southerly lake and city view.

In addition to its structural advantages, the exposed castellated beam concept is aesthetically pleasing and gives the sense of higher ceilings, with light funneling through the hexagon cut-outs of the beams. For the Watershed Building (a Type III construction), fireproofing spray is not needed to cover these beams, so a simple coat of paint over the beams provides a clean, exposed look.

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Built Work Photography LLC

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On Level 7, there is a balcony for tenants to enjoy views of nearby Lake Union's marina waterway. In order to accommodate the required paver walking surface, the framing design incorporates a step in the castellated beams and metal deck. DCI's engineers detailed the castellated beam connections to accomplish the stepped feature by splicing a plate girder section into the castellated beam section. Proper column locations, customized cut beams, castellation patterns (infills were required at specific locations), and precise dimensioning all worked together to provide a flawless balcony installation in the field.

The engineers used braced frames for the building's lateral system to provide improved performance during earthquakes. To minimize the impact of the braces on building occupants' view, they positioned an X-brace frame further inside the building layout, and the lower portions of the braced frame were integrated through the lower concrete portion of the brace frame to the foundation level. The brace frame columns were then encased with concrete.

Watershed's location next to the Aurora Bridge gives the building an added opportunity to become a stormwater management solution. The building's steel gutter system, landscaping, and bio-retention vault direct toxic stormwater runoff from Highway 99, which is carried by the bridge, through a downward-slope filtration system to treat the polluted water before it reaches Lake Union. Watershed can clean 400,000 gallons of stormwater annually, helping to protect the water quality for a major salmon migration route that passes through Lake Union. Throughout the public walkways around Watershed, there are educational signs for passersby to learn about the bio-retention and natural stormwater filtration processes. In addition, Watershed's overhanging roof itself is designed for on-site rainwater harvesting, with rainwater being carried through the sculptural gutter system into an oversized steel scupper before it is stored in a 20,000-gallon concrete cistern for non-potable uses, such as the building's low-flow toilet fixtures and irrigation options (about half of the rainwater collected on-site will be reused in the building).

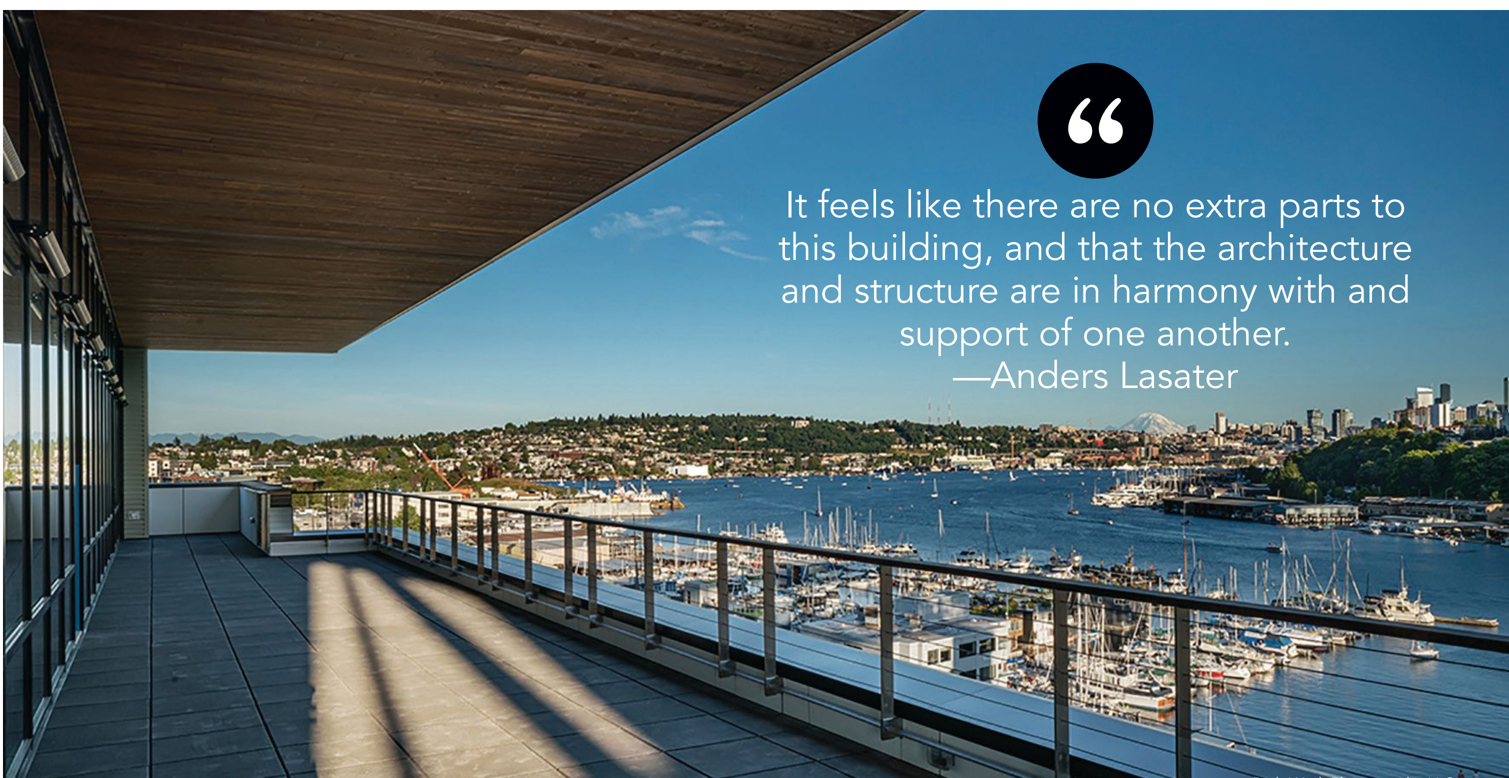
**Owner**
COU, LLC, Seattle

**General Contractor**
Turner Construction Company, Seattle

**Architect**
Weber Thompson, Seattle

**Structural Engineer**
DCI Engineers, Seattle

**Steel Fabricator and Detailer**
Metals Fabrication Co., Inc. (AISC Certified Fabricator), Airway Heights, Wash.

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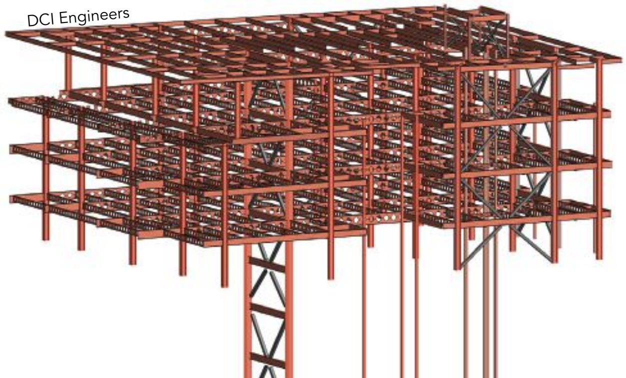
DCI Engineers



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**NATIONAL AWARD** Less than $15 Million

## Jacksonport State Park Visitors Center, Jacksonport, Ark.

**SITUATED AT THE CONFLUENCE** of Arkansas' White and Black Rivers, Jacksonport was a thriving port town in the 1800s, serving steamboats that held up to 200 passengers.

It's a place of contradiction geographically and historically, where the Mississippi Delta meets the mountains. Because of its accessibility to the Arkansas and Mississippi Rivers, Jacksonport was a Civil War strategic stronghold, being held five different times by Union and Confederate forces and serving as both generals' headquarters. Most importantly, Jacksonport was the location of the Confederacy's surrender of Arkansas.

In 1872, a beautiful courthouse became the town's centerpiece and county seat. But when the railroad eventually bypassed Jacksonport and river commerce waned, the town suffered. Devastating floods led to levee construction that forever separated the town from the river. In the 1960s, to save the historically significant courthouse from demolition, a new state park was established. Visitors, however, were still separated visually from the river. The new Jacksonport State Park Visitors Center was designed to remedy this situation.

While the design team was tasked with making a functional facility, the real challenge was to create a stage to experience and engage both river and town, past and present. The center creates three distinct second-level exhibit experiences: the river gallery overlooking the port, the town gallery overlooking the park/courthouse, and the inner exhibit gallery sheltering light-sensitive displays. The visually simple but rigorously detailed glass enclosure creates an elegant platform that recedes into the levee from the park's historic structures. A berm acts as a lawn theater for reenactments, while the entrance plaza's grove of six trees represents the almost 6,000 Arkansans whose war ended in this place.

Steel was the only logical choice for the delicate, light spans needed to create a column-free environment, which greatly helped with the interior planning of the exhibits. When researching the historic boats that once graced the port area, it was discovered that steel with wood decking and railing details was prevalent. In fact, the hull and much of the structure of the *Mary Woods II* steamship, a prominent feature of the park for years, were steel. The bridge leading to the boat from shore was a steel truss, and it served as the inspiration for the new building's "reunification" bridge that spans between two glass forms. Steel also offered the ability for authenticity in expression, facilitating the all-glass exterior cladding, and moment frames eliminated bracing, except for where it was desired at the bridge.

all photos courtesy of Timothy Hursley

With the building being next to a levee, coordination with the Corp of Engineers established exact parameters for placement of the footprint. Establishing a 15-ft setback from the levee toe to the road embankment that leads over the levee created the opportunity to make the building look like it was part of the levee by establishing a berm-theater on the opposite side of the road. This decision, and the challenge of anticipating a catastrophic flood possibility, led to the decision to use a combination of concrete and steel at level one behind the earth berms, but all-steel rising above at the second level. The solution tricks the eye into seeing a building sitting on top of the levee while actually concealing almost 50% of the building's mass.

Keeping the building as narrow as possible allowed the structural system to span the entire width of the building. However, the park's requirement for a hipped roof led to the unique idea of using a repetitive system of tension rods, a nod to the use of cables in steamships. The resulting trusses are beautiful in their simplicity and repetition, extending within the enclosures and across the outdoor spaces.

For a building that features the structure so prominently, early design charettes with the structural engineer were critical, especially when coordinating other trades such as mechanical and electrical paths as well as fire sprinklers. Revit was used extensively to model all conditions and contributed to animations that helped sell the idea to the client via flyovers and walk-throughs that took the path of the visitor from car to the exhibits.

The visually simple but rigorously detailed glass enclosure creates an elegant 360° viewing platform that recedes into the levee from the park's historic structures. Every part of the building and site tells a story, one that was lost for decades as the existing building deteriorated. The levee wall, plus the loss in recent years of *Mary Woods II* to a fire, damaged one of the most historically significant sites in the entire state, limiting the ability to tell its story properly. When the structures are gone, the stories, and history, tend to fade away. The visitor center's design solution restored the ability to learn through experiential education, attracting all ages to the park.

**Owner**
Arkansas State Parks, Little Rock, Ark.

**General Contractor**
Tate General Contractors, Jonesboro, Ark.

**Architect**
Polk Stanley Wilcox Architects, Little Rock

**Structural Engineer**
Engineering Consultants, Inc., Little Rock, Ark.

> To see a major corporation push to construct a net-zero restaurant reaffirms the importance of the environment. And to have structural steel play such a big role in this movement is fantastic. It allows the world to start viewing steel as the sustainable material.
>
> —Maysa Kantner

**MERIT AWARD** Less than $15 Million

## McDonald's Net-Zero Quick-Service Restaurant Rebuild, Kissimmee, Fla.

**McDONALD'S IS SERVING UP** a flagship Quick-Service Restaurant in Kissimmee, Fla.

The project, a rebuild/remodel of an existing facility, will create one of the world's first net-zero fast-food restaurants. The 8,000-sq.-ft facility incorporates key strategies for sustainable design, such as solar panels, living walls, natural shading elements, solar lighting, innovative heat reduction techniques, and structural steel framing. Steel was chosen not only to create an efficient structural frame to support the weight of the solar panels and wind forces in Florida, but also to enhance the architectural features that the owner was looking for.

The design intent was to provide a facility in which all the heavy structural elements support the project's net-zero goal without compromising aesthetics. As part of this goal, the steel-framed building was designed to blend in with the surrounding natural environment. The living walls were attached to the steel frame in a manner that would soften the appearance of the facility as well as add a more natural aesthetic to the architecture. In addition, the design allows the wood louvers and photovoltaic cells to be integrated into the glazing of the building.

The location of this project, on Disney's property near Orlando, demanded a landmark type of structure that could hold its own with the countless eye-catching theme-park structures in the area. Structural steel was the perfect material for these conditions because of the endless possibilities in shapes and configurations that could be achieved by using structural hollow structural sections (HSS) and wide-flange members.

The project came with several early challenges, such as attaching the solar panels to the roof, lateral drift due to wind forces, and building the 35-ft cantilever for the roof. But the most significant challenge was building this impressive structure within an existing building that was partially demolished. The team used steel brackets welded to the wide-flange beams to support the solar panels and all electrical wiring. It also designed two braced frames with

all photos courtesy of Tyler Carr Southland Construction

round HSS to control lateral drift and used moment connections with plates and bolts for the long-span cantilever beams.

Using steel framing facilitated longer spans without multiple support columns, allowing the interior and exterior to capture an open-air feel as well as allow for more light capture within the facility. This was important as it was a critical aspect of lowering power consumption by reducing the need for artificial lighting.

The structure was designed to efficiently transfer all lateral and gravity loading in a direct load path from the roof diaphragm supporting the solar panels to the braced and unbraced steel frames. The combination of lateral and gravity loads, transferred through the braces and columns to foundations, generated high-magnitude reactions at the ground supports, which consist of 36-diameter cast-in-place caissons.

The critical path of the construction schedule required materials to be delivered to the site as soon as initial foundations were ready for erection. All critical structural elements arrived on-site fabricated, painted, and ready for immediate installation. It was important for the steel infrastructure to appear minimal to emphasize the louvered wood cladding of the exterior walls as well as the outdoor canopy, which is covered with transparent photovoltaic solar panels.

The overall structural steel system supports 1,066 solar panels spanning more than 18,000 sq. ft of roof space, 800 sq. ft of solar glass panels covering the outdoor seating area, and 600 sq. ft of louver windows that push the heat out and keep the cool air in.

Using steel supported every major building element and aesthetic desire, resulting in a sustainable structure that will educate and be admired long into the future.

**Owner**
McDonald's Corporation, Chicago

**General Contractor**
Southland Construction, Inc., Apopka, Fla.

**Architects**
CPH, Inc., Sanford, Fla.
Ross Barney Architects, Chicago

**Structural Engineer**
CPH, Inc., Sanford, Fla.

**Steel Fabricator**
P&A Welding and Machine, Inc., Mulberry, Fla.

**MERIT AWARD** Less than $15 Million

# Ballston Quarter Pedestrian Walkway Arlington, Va.

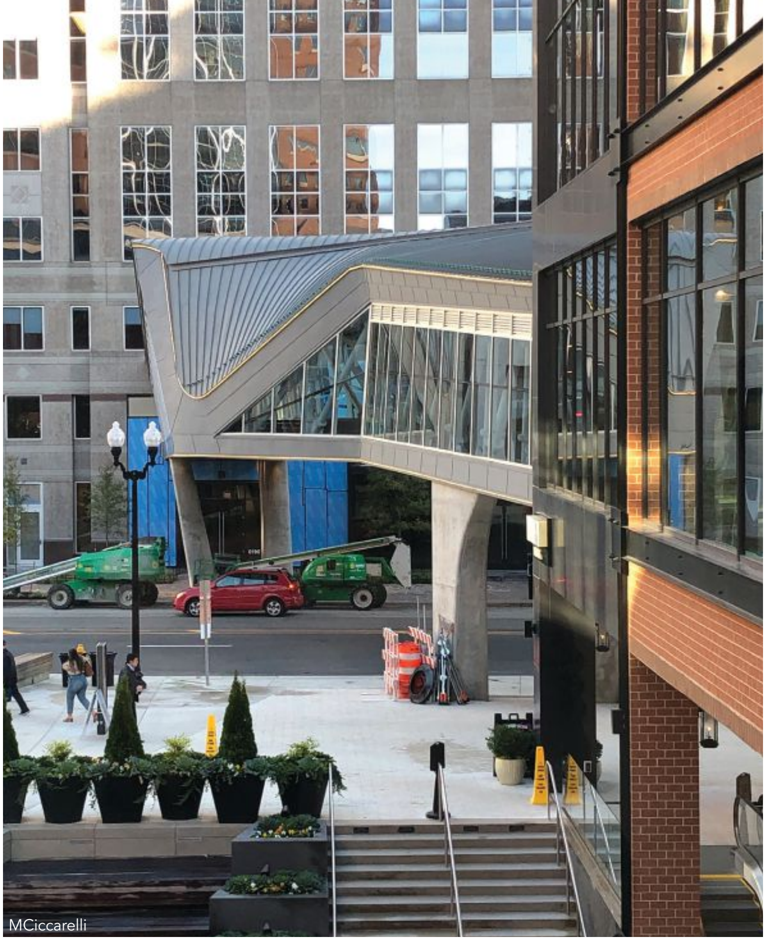
**THE BALLSTON QUARTER** pedestrian walkway is intended to be an iconic structure while also blending into the surrounding streetscape in Arlington, Va.

The design features a direct geometric approach, where the eccentric structure of the walkway oscillates between the wall and roof. The lines that comprise the structure and the transparent glass planes of the walkway engage the occupant, allowing an exploration of the transcendence of line and plane to provide a minimal sense of enclosure. This planar convergence transforms the experience of crossing the street, establishing unique view corridors and allowing participants to both observe and be observed as they move from private space to the public realm. Additionally, the walkway provides a direct connection to the DC Metro system, allowing people of all ages and physical abilities to access public transportation.

The steel-framed pedestrian crossing's design began with the investigation of various arrangements and configurations while crossing Wilson Boulevard and the way it connects the two buildings on the north and south ends. The entrances into the terminal buildings were approximately 155 ft apart and were offset from each other. The main goal was to avoid a design whose axis would be at a distinctive angle to the Wilson Boulevard. Therefore, the axis of the overpass required a crossover segment near its mid-span. The concept from the beginning was to enclose the overpass with glass and expose as much of the structure as possible. The decision was made to use round hollow structural sections (HSS) for the superstructure, both for their aesthetic value and also for their ability to resist the complex torsional, shear, and bending stresses in addition to all gravity loads.

The project site crosses one of the most heavily traveled streets in Arlington County, Va., and early on, the County placed significant restrictions on any closure of the street to vehicular traffic, which effectively eliminated the opportunity for the walkway to be constructed on-site. The site was also challenging due to the lack of a laydown area adjacent to the walkway location. These conditions required the design and construction teams to implement a design strategy that allowed the walkway to be fabricated, disassembled, shipped to a closed public park two blocks away, reassembled, and moved through the city streets as a single structure into its permanent position.

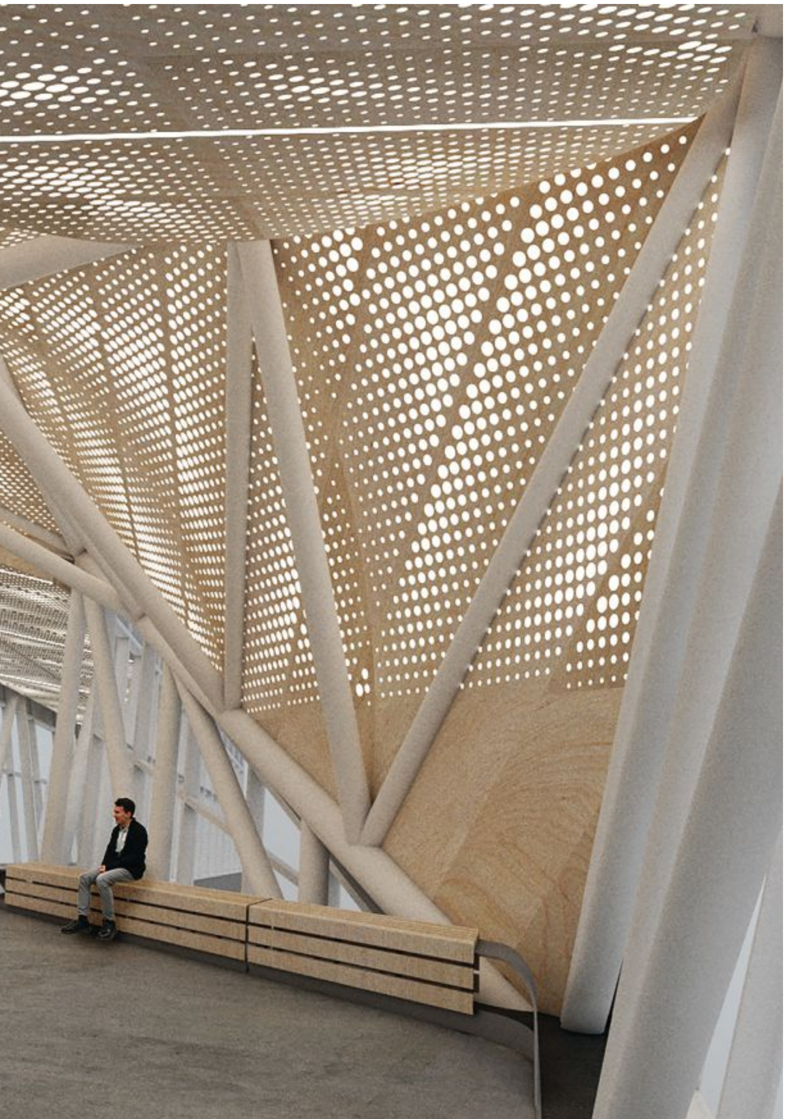
Additional challenges were presented by the building at the north terminal of the walkway, which had several levels of underground parking. A successful design solution required the walkway to impose no soil pressure on the foundation wall, as well as the development of a structural solution that allowed the walkway to rest with almost no imposed load on the two adjacent structures. Underground electrical duct banks feeding the majority of the adjacent buildings also limited the placement and design of the foundation system. A structural steel frame on concrete piers was the only solution that allowed the project to cantilever to the existing buildings, impose minimal loads, and maintain the necessary rigid-


MCiccarelli


studioTECHNE


The crossover segment at mid-span creatively addresses the offset entrances of the connected buildings, and the steel HSS frame is an ideal choice to resist the complex forces of this innovative bridge design. The resulting structure has a sculptural quality that is visually captivating from both the exterior and interior.
—Stephanie Hautzinger

MCiccarelli



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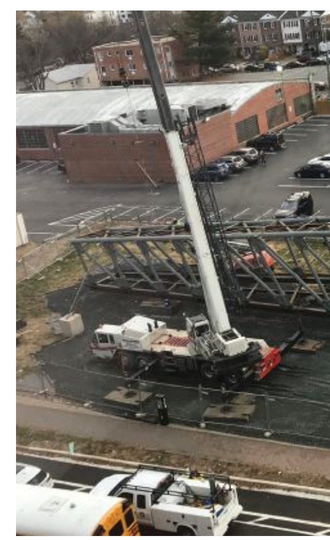
ity to minimize deflection and bounce for pedestrians traversing the walkway.

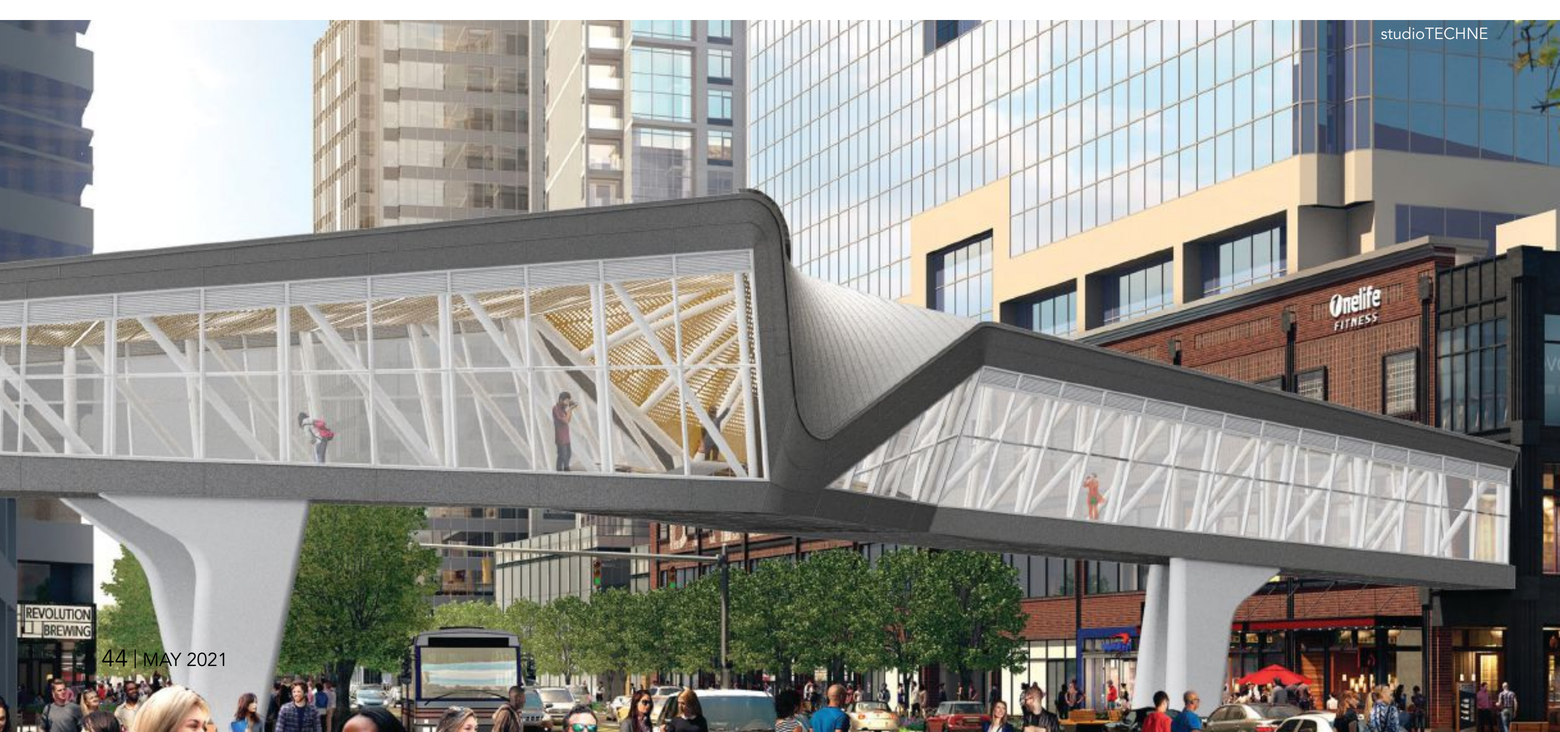
Expansion and deflection of the 155-ft-long walkway were also concerns. The calculated ideal air temperature for the final tightening of the bolts at the bearing points was 70 °F, which occurred a few weeks after the hoisting of the frame, at which time all bolts were tightened and welding at the bearings was completed. The casting of the concrete floor slab followed, and the deflection of the frame was monitored; it ended up matching the deflections predicted by the design calculations. Construction continued by architectural, mechanical, and electrical trades, and the iconic overpass began to take on its final appearance.

studioTECHNE Architects established the preliminary shape of the superstructure by defining the 3D locations for the main geometrical nodes. The geometry was subjected to large overall bending moments, shear, and torsional forces generated by gravity loads, wind pressures, and seismic forces that the individual members had to safely resist. The overall deflection was minimized to allow as much clearance as possible underneath the overpass for vehicular traffic on Wilson Boulevard. The unconventionally large floor area of the overpass and the large volume of the expected pedestrian traffic over made it necessary to structurally minimize perceptible vibration of the floor deck and to minimize wind-induced lateral movement on the entire superstructure. The four leaning concrete piers created some additional reactions on the superstructure and also imparted reactions into the superstructure, requiring fixed connections between the piers and the superstructure. In addition, thermal expansion and contraction had to be resisted by the same connections.

A "spine" was designed to act as a main supporting element that extended in a straight line in plan between the north and south ends of the superstructure, which became the largest steel element. Several other key elements were attached to the spine. The floor deck consisted of wide-flange girders along the two edges of the floor and beams with a composite metal deck and a concrete slab. The floor deck was designed as a diaphragm span from end to end and to resist the lateral wind and seismic loads and the associated torsional, shear, and bending stresses in addition to all gravity loads. Multiple rectangular rigid frames were designed to provide the required lateral stability of the superstructure's cross section against lateral loads. The roof structure, consisting of HSS and wide-flange purlins as well as steel angle cross bracing, acts as a supplemental

Williams Industries





studioTECHNE

diaphragm maintaining horizontal stability of the roof and equalizes lateral loadings. The two wide-flange edge girders were designed to resist thermal and seismic forces in the length-wise direction of the floor diaphragm. The large dimensions of the superstructure required bolted moment connections for assembly consisting of circular plates with bolts.

To facilitate transportation and erection of the completed bridge assembly, LIDAR scanning was used to digitally scan the entire site and develop a 3D model of the existing conditions. This permitted the construction team to test a number of lift and placement scenarios through which the entire 140-ton structure would be picked and lifted into position. The design team provided a complete 3D model of the structure, which the construction team used to develop sophisticated computer simulations to test a series of possible angles of arrival, tilt, and yaw required for placing the walkway, finally settling on a single crane to make the lift.

Fabricator Crystal Steel completely assembled the walkway in its shop, and the bridge was scanned to ensure the control points, with the tolerances matching what was required. The walkway was disassembled, shipped to the site, and reassembled two blocks from its final destination. The erector was given the calculated location of the assembled segment's center of gravity for proper hoisting and placement. Motion and deflection sensors were connected to the walkway to monitor movement, and it was then picked up, placed on Goldhoffer trolleys, and transported on the street to its final location. Owing to the precision of the planning and fabrication, the lift was executed as simulated, with perfect alignment of the walkway to the bearing plate assemblies.

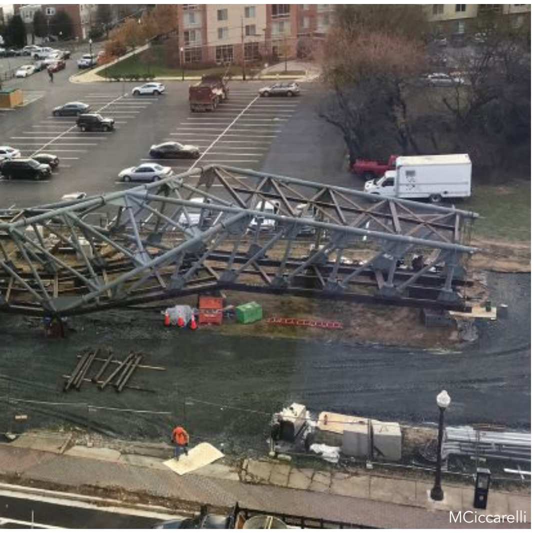
**Owner**
Brookfield Development, Washington, D.C.

**General Contractor**
Clark Construction, Bethesda, Md.

**Architect**
studioTECHNEarchitects, Cleveland

**Structural Engineer**
Peller + Associates, Westlake, Ohio

**Steel Fabricator and Detailer**
Crystal Steel Fabricators (AISC Certified Fabricator), Arlington, Tenn.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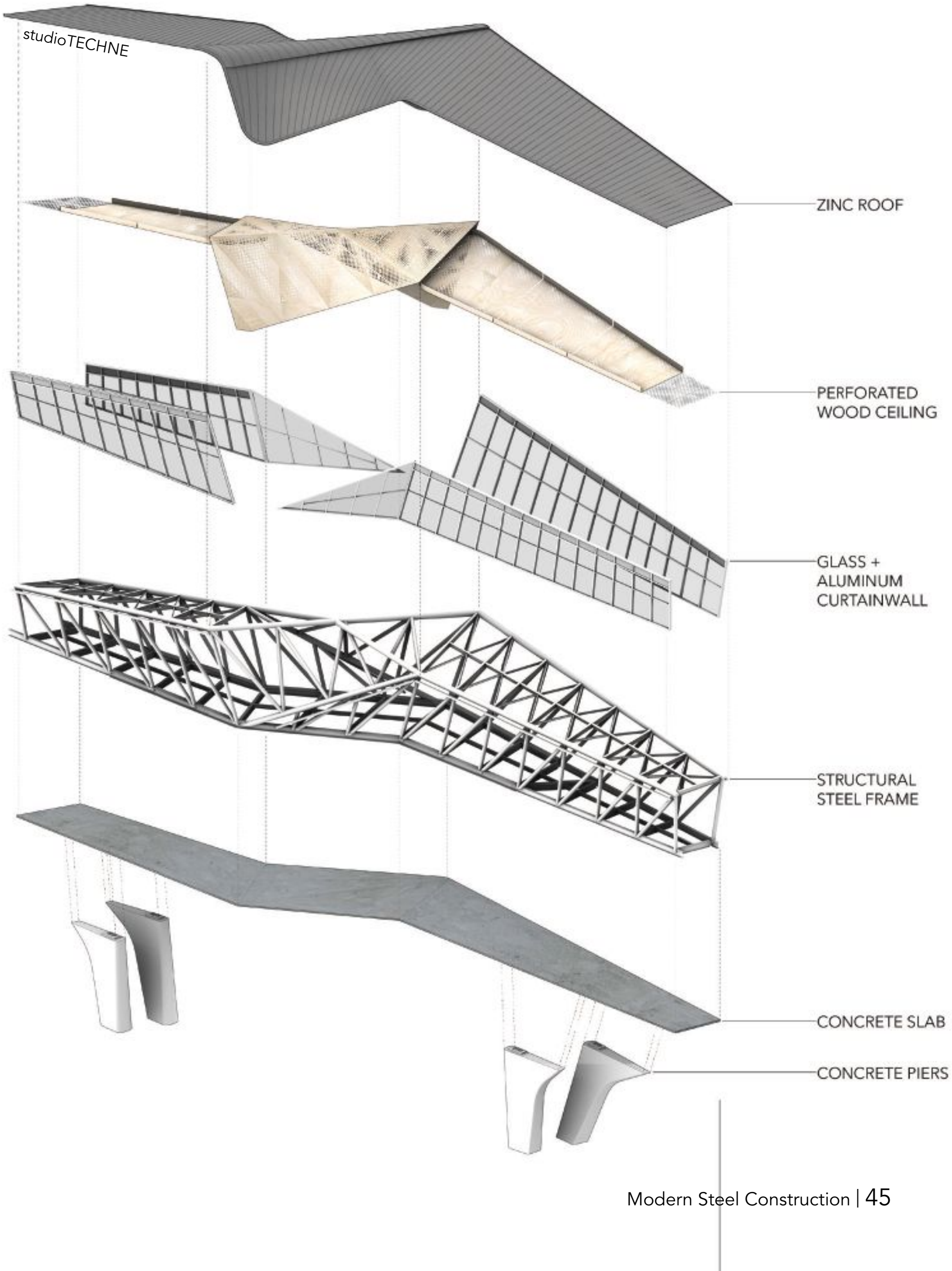


**NATIONAL AWARD** Sculptures/Art Installations/Nonbuilding Structures

# Moscone Center Expansion—Pedestrian Bridges, San Francisco

**THE MOSCONE CENTER** is one of San Francisco's key economic drivers and serves as a jewel box for the city.

A recent expansion of the center provides a collection of light-filled spaces that accommodate a variety of convention-related activities, vastly improving the facility and its campus while allowing it to meet the evolving needs of a modern city. The project includes two new pedestrian bridges, enhances its lively neighborhood, and attracts both residents and visitors alike with a pedestrian-friendly design that connects the adjacent Yerba Buena Garden's new and existing open spaces, parks, and cultural facilities.

For the East Bridge and its tapered roof, steel box girders were the only solution that allowed for the required stiffness while achieving a narrow and tapering profile. The profile of the steel roof system was carefully studied, considering both structural and aesthetic drivers, with taper angles designed to minimize the visual profile of the bridge when viewing it from the street. Steel became a key part of the architectural expression of the East Bridge, and the steel rods and gusset plates were exposed in the bridge but also delicately integrated into the faceted glass enclosure.

The East Bridge was constructed on-site and then lifted into place in one day with limited street closures. The enclosed walkway is suspended by hanger rods from a built-up steel plate roof box girder, which achieves the 150-ft span while maximizing traffic clearance below and providing unobstructed views through the bridge along Howard Street. The bridge is seismically separated from the new building superstructure and includes its own steel concentrically braced frame and steel moment frame lateral system on the south side of Howard Street.

The final structure of the East Bridge uses a single optimally shaped, primary-load-bearing built-up steel plate box girder located along a central spine at the roof level. The bridge is integrally connected to the new Moscone South building structure and spans 150 ft to a buckling restrained braced frame (BRBF) on the north side of Howard Street. A system of hollow structural section (HSS) outriggers cantilevers from either side of the girder to support hanger rods at 6 ft on center along both sides of the bridge, and the bridge width varies from 30 ft at the ends to 23 ft at mid-span. The rods support 10-in.-deep rolled steel beams spanning the width of the bridge at Level 2, which act compositely with a 5-in.-thick composite metal deck slab, producing a floor structure of minimal depth.

In addition to the optimally shaped box girder, using HSS for the outrigger cantilevers maximizes the headroom under the bridge by transmitting gravity loads up to the roof level box girder and minimizing the thickness of the structure at the walking level. The width of the bridge is minimized at the center of the span, thus minimizing loads at the location of the maximum moment. These innovations, in combination with the lightweight cladding and finishes, make for a light and aesthetically elegant bridge whose form facilitates the flow of its users between the two buildings.

The West Bridge replaces an existing pedestrian bridge and connects Yerba Buena Gardens and the Children's Garden. The wide pedestrian deck is supported on two tapering structural steel box girders and stands as a sculptural, open-air walkway that passes over the southwest end of Howard Street, with public art and landscaping to act as a continuation of the adjacent park and plaza spaces.

The West Bridge is also a steel structure, comprising a pair of long-span built-up tapered steel box girders. These girders support conventional rolled steel beams that span between them and cantilever beyond. The beams support a conventional slab on a metal deck, and the bridge is supported by an existing steel structure, with a sliding connection to create a seismic joint. The south end of the bridge is supported by a braced frame and is supported by the reinforced concrete substructure of Moscone South. This bridge was also constructed on the ground and raised into place on one weekend day to minimize the impact on traffic. Similar to the East Bridge, it is seismically separated from the Moscone South structure.

Pedestrians around the Moscone Center now enjoy the mid-block lights they'll see on Howard Street. These lights change 30 times a second, turning red, yellow, green, orange, blue, purple, pink, and lavender. The idea is to celebrate the design of the bridge, activating the convention center and the surrounding area equally. The permanent LED light show is called *Point Cloud* and was installed by artist Leo Villarreal, who in 2013 turned the Bay Bridge into a nightly display of constantly shifting white lights. Similarly, *Point Cloud* is intended to be seen not only from up-close but also from afar, up and down Howard Street, from the nearby San Francisco Museum of Modern Art, and also from the buildings in the Yerba Buena district. The East Bridge also has a daytime presence, thanks to its enclosed steel and metal panel finishes and glass on both sides, adding a unique experience for conventioneers while creating an iconic reflective sky bridge above Howard Street.

**Owner**
City and County Of San Francisco
San Francisco Department of Public Works
San Francisco Travel

**General Contractor**
Webcor Builders, San Francisco

**Architect**
Skidmore, Owings, and Merrill LLP (SOM), San Francisco

**Structural Engineers**
SOM
SOHA Engineers, San Francisco
Tipping Structural Engineers, Berkeley, Calif.

**Steel Team**

**Fabricator and Erector**
SME Steel Industries AISC CERTIFIED FABRICATOR & ERECTOR, West Jordan, Utah

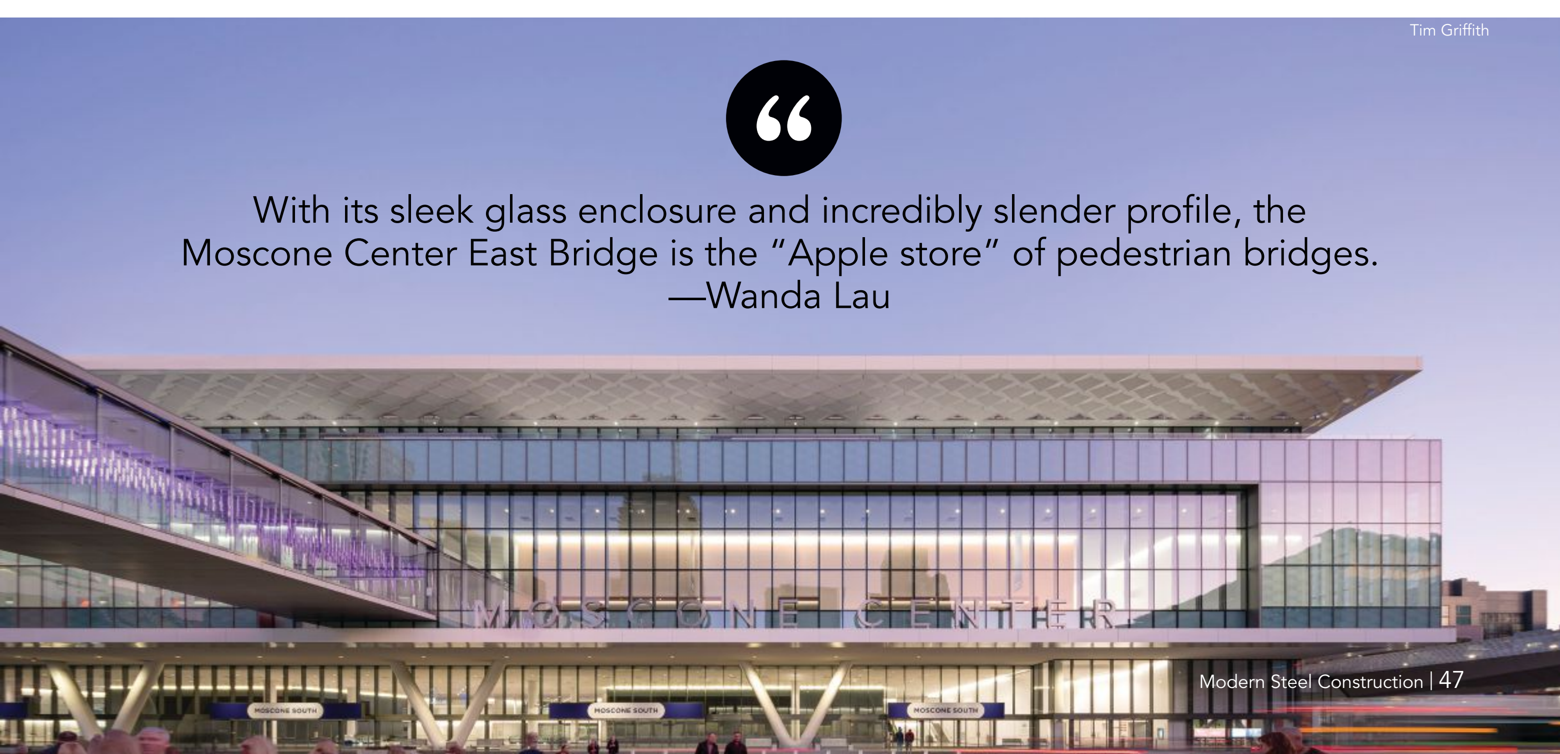
**Detailer**
Pro Draft, Inc., Surrey, B.C., Canada


Matthew Millman


Matthew Millman

Matthew Millman


Matthew Millman



Tim Griffith

> With its sleek glass enclosure and incredibly slender profile, the Moscone Center East Bridge is the "Apple store" of pedestrian bridges.
> —Wanda Lau


> Although steel is doing the heavy lifting in this monument, there is a greater message that is meant to be the focus, that of civil rights, justice, and equality.
> —Maysa Kantner

**MERIT AWARD** Sculptures/Art Installations/Non-Building Structures

## A Monumental Journey, Des Moines, Iowa

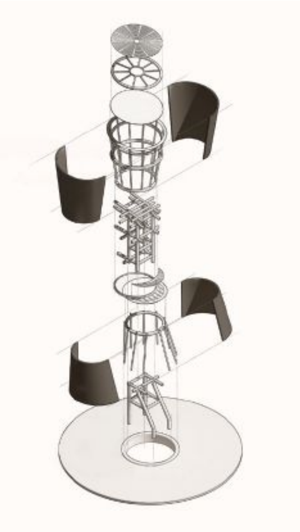
**A MONUMENTAL JOURNEY**, a sculpture by renowned artist Kerry James Marshall, celebrates the legacy of African American lawyers, who, in 1925, founded the National Bar Association, dedicated to civil rights, justice, and equality in the legal system.

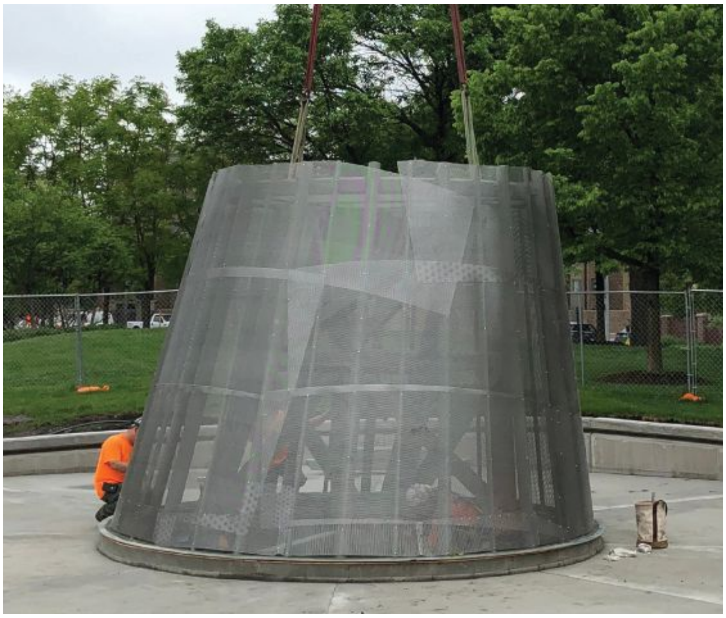
The architect collaborated with artist Kerry James Marshall to achieve the colossal, geometric sculpture. The shape is inspired by the form of the African talking drums, with one-drum precariously stacked upon the other, representing the notion of communication among diverse people and a legal system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

Located in Des Moines, Iowa, the sculpture is made of bricks to represent the feeling of weight and balance expressed in the piece. The stacking method of laying bricks also relates to the overall composition. The manganese iron spot brick chosen has a rich texture and tones of grey with a subtle shine due to the iron in the clay.

An impressive steel structure was fabricated to support the brick within this complicated tapered and suspended shape. The steel structure provided two 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.

A detailed 3D model of the steel structure was shared between the architect, engineer, and steel fabricator. 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. Ultimately, the structure was modeled in three sections. The middle truss provides the main point of attachment, and special contour plates were designed to create a continuous frame on the exterior. The last section is the only exposed steel construction since it extends above the roof of the sculpture. The





top section also 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 end of the brick construction. They were laser-cut and made of galvanized steel, as was the rest of the overall structure. 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 is made of round hollow structural sections (HSS) that follow the general geometry of the sculpture. Finally, the frame is wrapped in a perforated sheet metal against which the bricks were set.

To coordinate brick installation, each brick was modeled into a drawing software that explored the best pattern solutions and laying starting points, and each was custom-made and hand-cut in order to be used in this application. The short edges of the bricks were shaved to follow their circular configuration, while the corner edges were trimmed to smooth the exterior geometry of the sculpture.

Steel facilitated fast-paced fabrication and erection, meeting the requirements for such an intricate geometry in a timely manner. And all parties involved in the construction were local, making the project a success story for the regional construction community.

*For more on this project, see the August 2019 article "What's Cool in Steel," available in the Archives section at* ***www.modernsteel.com****.*

**Owner**
Greater Des Moines Public Art Foundation, Des Moines, Iowa

**General Contractor**
Neumann Brothers, Des Moines

**Architect**
substance, Des Moines

**Structural Engineer**
KPFF Consulting Engineers, Des Moines

**Steel Team**

**Fabricator**
Johnson Machine Works AISC CERTIFIED FABRICATOR, Chariton, Iowa

**Bender-Roller**
Albina Co., Inc. AISC ASSOCIATE, Tualatin, Ore.

PRESIDENTIAL AWARD FOR EXCELLENCE IN ADAPTIVE REUSE

# Uber Advanced Technologies Group R&D Center San Francisco

**UBER ADVANCED TECHNOLOGIES GROUP** is a self-driving technology engineering team whose Research and Development Center is housed within Pier 70 in San Francisco. The center's four massive buildings, derelict and inaccessible for decades, now extend the site's legacy of transportation endeavors into the 21st century.

The approach was to retain and repair salvageable elements. If unsalvageable, the replacement element or material was specified to be historically compatible and environmentally benign. In addition, the project's conservation and environmental strategies included maximizing daylighting through skylights and windows, enhancing natural ventilation, providing radiant heating, and specifying permeable concrete at exterior paving. Elements like skylights, curtain walls, steel stairs, and others involved close design involvement between architect and developer, with shop drawings being regularly reviewed by the design team.

Thanks to their industrial beginnings, steel was already part of the language of these historic edifices. Original steel components were left natural or treated with transparent coatings, while new steel structural reinforcements are painted to draw a clear visual distinction between new and old. Steel and concrete mezzanines act as structural diaphragms to reinforce the buildings, which is especially crucial in the unreinforced masonry structures. Demising steel and glass walls echo the original steel windows and skylights and allow access between tenant spaces while preserving the large interior volumes.

It is to be expected that a 19th-century building in San Francisco was not designed for earthquakes. However, the Pier 70 buildings' vulnerability was exacerbated by many years of vacancy, during which vandalism, the stripping of materials and artifacts, and weather intrusion occurred. An egregious example: The exposed masonry at Building 113 had deteriorated to the point of crumbling to powder. During construction, the safety of the workers tasked with transforming the buildings was paramount. Before the new structural system was complete, protected zones were built within the complex so that construction crews could retreat to safety at the first hint of an earthquake tremor.

The design team developed a building within-a-building concept that preserves the historic perimeter brick walls, reduces the cost of temporary shoring, and retains the open volume in the 62-ft-tall space. The updated complex is designed to resist a 500-year-recurrence seismic event while also optimizing space. Steel columns and braces are strategically located along the existing building structure to minimize visual impact. New concrete mezzanines not only add leasable area but also brace the historic brick walls at mid-height. Full-height walls have upper portions sheathed in clear, multi-wall poly-carbonate to maintain the building's original site lines. Steel and glass walls preserve the spatial character of the industrial buildings for the client and its neighbors. Conference rooms and other program functions are free-standing elements within the large volumes. Lab, shop, and kitchen spaces are located under mezzanines, allowing for sound isolation, temperature control, and dust containment. In addition, natural ventilation teams up with ceiling fans and radiant heat systems to condition the cavernous spaces. ■

*This project was featured in the December 2020 article "What's Cool in Steel," which is available in the Archives section at **www.modernsteel.com**.*

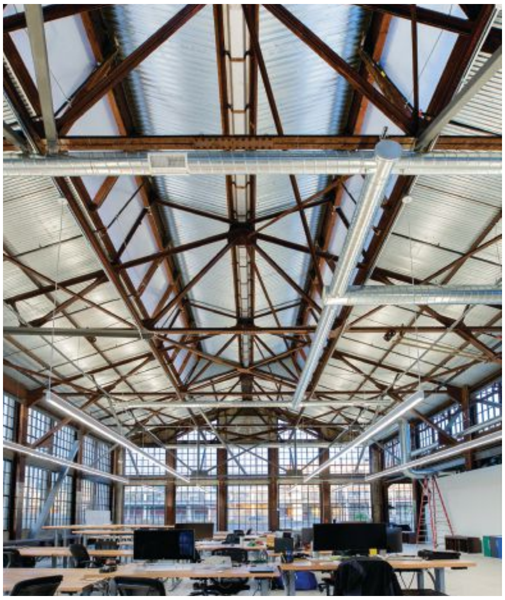
**Owners**
Orton Development, Inc., Emeryville, Calif.
Port of San Francisco

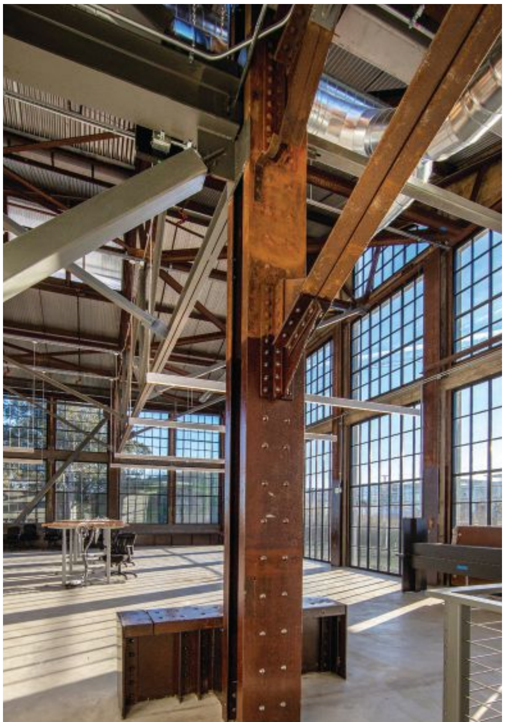
**General Contractors**
Novo Construction, San Francisco
Nibbi Brothers, San Francisco

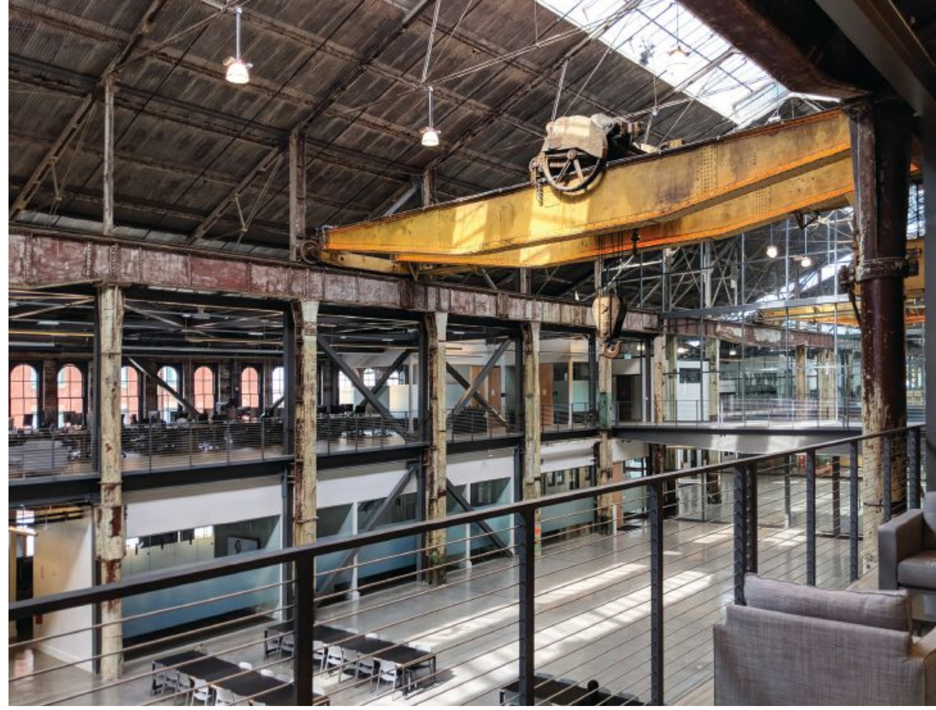
**Architect**
Marcy Wong Donn Logan Architects, Berkeley, Calif.

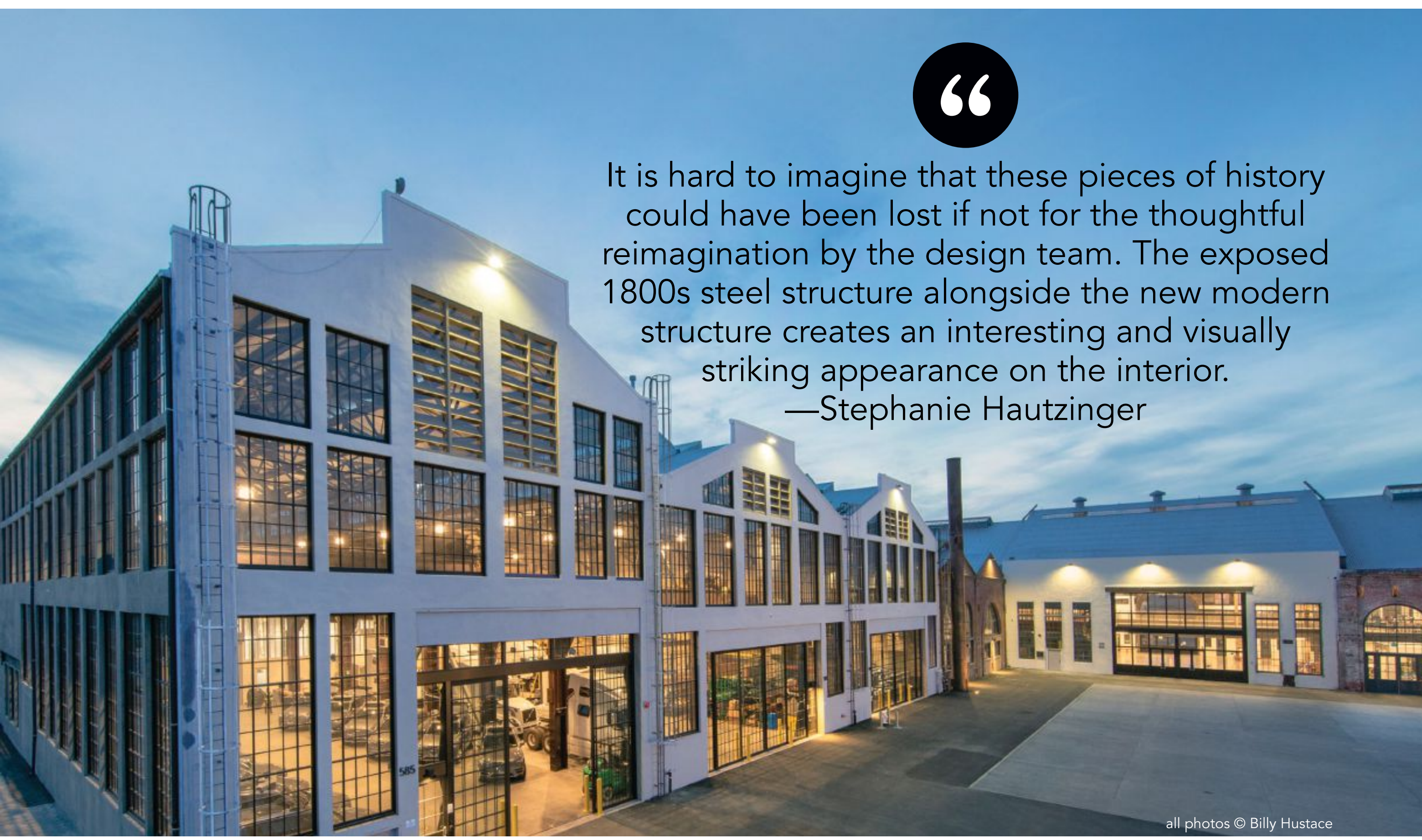
**Structural Engineer**
Nabih Youssef Associates, San Francisco

**Steel Fabricator, Erector, and Detailer**
Kwan Wo Ironworks, Inc. (AISC Certified Fabricator & Erector), San Francisco



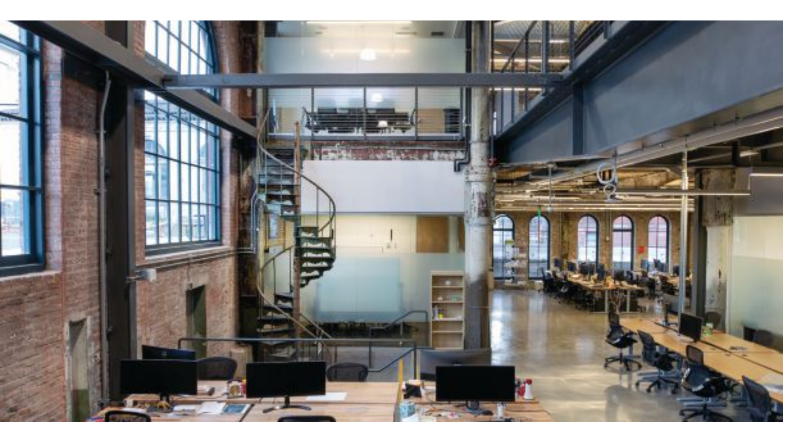


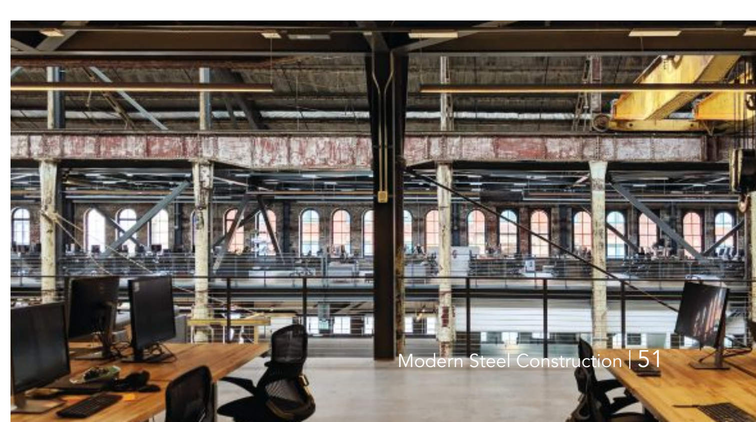




It is hard to imagine that these pieces of history could have been lost if not for the thoughtful reimagination by the design team. The exposed 1800s steel structure alongside the new modern structure creates an interesting and visually striking appearance on the interior.
—Stephanie Hautzinger

all photos © Billy Hustace





# SpeedCore: Seismic Advantages

BY MICHEL BRUNEAU, PhD, AMIT VARMA, PhD, SOHEIL SHAFAEI, PhD, AND DEVIN HUBER, PE, PhD

What to know when considering a SpeedCore system for its seismic properties.

**SPEEDCORE'S MAIN ADVANTAGE,** as its name suggests, is its ability to be erected quickly.

But it can also bring seismic advantages to a project.

The first article in this series on SpeedCore panels—"Core Value," which ran in the March 2021 issue and is available at **www.modernsteel.com**—provided a general overview of the system [SpeedCore's technical name is composite plate shear walls/concrete-filled (C-PSW/CF) or coupled composite plate shear walls/concrete-filled (CC-PSW/CF) for coupled systems]. Here, the focus is on design considerations for using the system in a seismic-governed region, specifically seismic response modification factors in both uncoupled and coupled SpeedCore installations.

Three seismic factors are at the core of all seismic design provisions:

- The seismic response reduction factor ($R$) accounts for system-level ductility and inelastic behavior. In a general sense, the seismic design forces calculated assuming elastic behavior are reduced by this seismic response reduction ($R$) factor, which accounts for the system level ductility and inelastic behavior. The higher the system-level ductility, the higher the $R$-factor; However, ASCE 7 limits the largest $R$-factor to 8.
- The overstrength factor $\Omega_o$ accounts for the overstrength in the system between the assumed onset of inelasticity and the formation of the complete plastic (failure) mechanism due to material overstrength, structural redundancy, and other contributing factors.
- The displacement amplification factor $C_d$ accounts for the amplification of the calculated elastic story drift of the lateral force system due to inelastic behavior.

Representing these factors in terms of the base shear to story drift, they can be represented as shown in Figure 1. Values applicable to the C-PSW/CF system will be addressed after the following summary of the system's seismic performance.

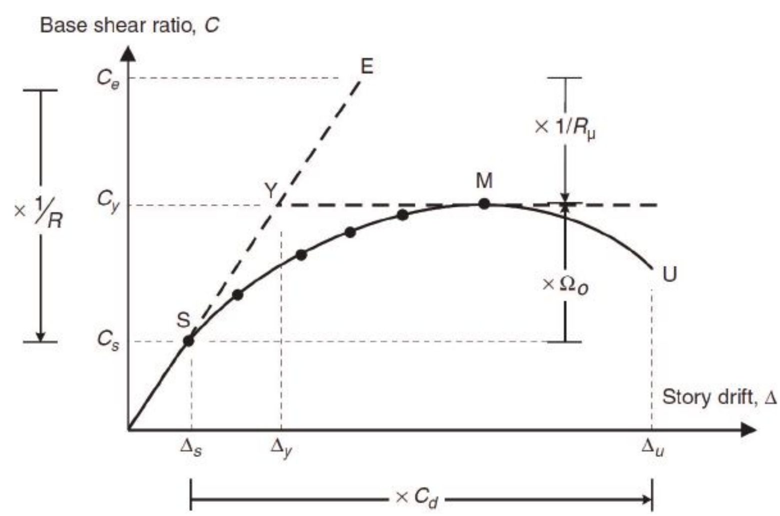



Fig. 1. Seismic response modification factors represented graphically.

## Seismic Requirements: Basis of Design

Uncoupled or coupled C-PSW/CF systems can be used to resist lateral forces (wind or seismic forces) in buildings. Uncoupled systems consist of independent C-PSW/CF modules that are not tied together by specially detailed coupling beams, whereas coupled systems consist of C-PSW/CF modules that are connected at each story level using such composite or steel coupling beams. Composite walls can be planar, C-shaped, or I-shaped walls to resist seismic loads, as shown in Figure 2. These walls consist of two steel web plates (along the length) that are connected to each other using steel shapes or tie bars. Semicircular or circular concrete-filled steel tubes can be used as boundary elements. Alternatively, steel flange plates (closure plates) can be used at the ends of uncoupled walls. The individual linear segments in C-shaped or I-shaped walls are referred to as flange walls or web walls, depending on the direction of lateral loading. In each wall segment, the steel web plates have equal nominal thicknesses. The steel plates comprise at least 1%, but no more than 10% of the wall cross section. Walls without any boundary elements or closure plates are not permitted.

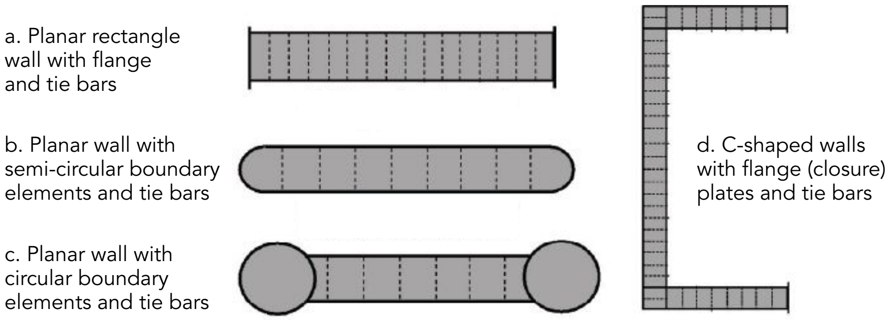



Fig. 2. Example cross-sections of C-PSW/CF walls (uncoupled).

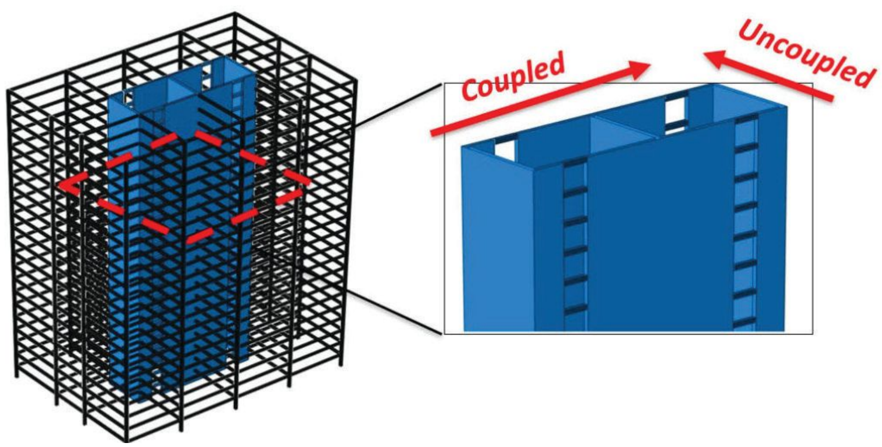



Fig. 3. Structural configuration of building with uncoupled and coupled C-PSW/CF systems in orthogonal directions.

Coupled C-PSW/CF systems are those systems in which the wall elements are tied together via ductile coupling beams, as shown in Figure 3. These coupled systems are structurally more efficient than pure planar walls and are generally used in taller buildings employing C-PSW/CF systems. They have similar design requirements to uncoupled wall systems but have slightly different seismic response modification factors (mainly the *R* factor).

## Selection Seismic Response Modification Factors

ASCE 7-2016 defines the three mentioned seismic performance factors ($R$, $\Omega_o$, and $C_d$) to represent the effects of inelastic behavior on the seismic response of the lateral force-resisting system. While values of these factors were empirically calibrated on past practice for legacy lateral load-resisting systems (such as ductile moment-resisting frames), the FEMA P-695 procedure was developed to verify the assumed values for new structural systems. This procedure is also used to evaluate and check the margin of collapse for the maximum considered earthquake (MCE) hazard and requires performing a large number of nonlinear earthquake analyses (i.e., incremental dynamic analysis; see Figure 4) for a significant set of strong earthquakes records. This procedure has been used to verify the proposed seismic performance factors for coupled C-PSW/CF walls when it was proposed to

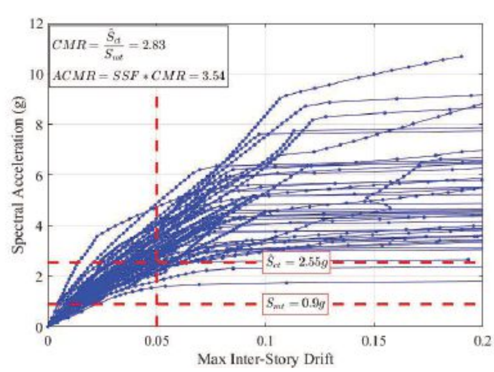



Fig. 4. Typical incremental dynamic analysis results from a FEMA P-695 procedure.

**Michel Bruneau** (**bruneau@buffalo.edu**) is a SUNY Distinguished Professor with the Department of Civil, Structural and Environmental Engineering at the University at Buffalo. **Amit Varma** (**ahvarma@purdue.edu**) is the Karl H. Kettelhut Professor of Civil Engineering and director of the Bowen Laboratory of Large-Scale CE Research in the Lyles School of Civil Engineering at Purdue University. **Soheil Shafaei** (**sshafaei@purdue.edu**) is a postdoctoral scholar, also with Purdue University's Bowen Laboratory. **Devin Huber** (**huber@aisc.org**) is AISC's director of research.


Fig. 5. University at Buffalo test Specimen for a C-shaped wall configuration.

add this structural system to the list of lateral load-resisting systems covered by ASCE-7.

Incidentally, it was not necessary to use the FEMA P-695 methodology to develop similar factors for uncoupled walls because ASCE-7 already included such factors since its 2000 Edition. These factors were generically applicable to any composite plate shear walls, although the AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341, **aisc.org/specifications**) did not provide specific design and detailing requirements for SpeedCore walls at the time. The situation was partly remedied in the 2016 Edition, when specific requirements for SpeedCore panels were added in Section H7, separately from the existing requirements for composite plate shear walls/concrete-encased (C-PSW/CE) in Section H6. Both were designated as composite plate shear walls (C-PSW) in ASCE/SEI 7 Table 12.2-1. Recent studies, including at the University at Buffalo and Purdue University, independently verified the adequacy of these seismic performance factors for uncoupled walls.

## Behavior and Capacity-Based Design Requirements for Uncoupled Walls

Comprehensive numerical investigations following the FEMA P-695 approach were conducted to verify the seismic response modification factors ($R = 6.5$, $\Omega W_o = 2.5$, and $C_d = 5.5$) for the uncoupled C-PSW/CF system. In addition to these numerical studies, there has been extensive research related to the cyclic lateral behavior, design, and analysis of uncoupled C-PSW/CF systems. In particular, experimental investigation of the cyclic lateral load behavior of planar C-PSW/CF with flange steel plates was performed at Purdue University, while experimental research on the cyclic lateral load behavior of C-shaped and T-shaped C-PSW/CF specimens was conducted at the University at Buffalo, as shown in Figure 5. Lastly, finite element models of C-PSW/CF were developed at Purdue University and the University at Buffalo to simulate the cyclic lateraling load behavior.

Note that seismic design of uncoupled C-PSW/CF systems can be conducted in accordance with the current 2016 or the upcoming 2022 version of the AISC *Seismic Provisions*, Section H7. The seismic response is governed by the inelastic behavior and formation of a plastic hinge at the base (or location of maximum moment) of the wall. This hinge develops the expected plastic flexural strength of the composite cross-section and has adequate energy dissipation and rotation capacity to warrant the seismic response modification factors ($R$, $W_o$, and $C_d$) specified in ASCE 7. The flexural capacity can be calculated using a plastic stress distribution method or fiber section analysis method. For seismic design, uncoupled C-PSW/CFs are required to be flexural critical, which can be achieved by restricting the wall height-to-length ratio to values greater than or equal to 3. The in-plane shear strength of C-PSW/CFs can be calculated using the composite contributions of the steel web plates and concrete infill. However, shear yielding of the steel web plates should not govern the behavior or design of uncoupled C-PSW/CFs.

## Behavior and Capacity-Based Design Requirements of Coupled Walls

Coupled C-PSW/CF systems consist of two or more individual composite walls connected together by coupling beams. Planar, C-shaped, I-shaped, or L-shaped walls with composite coupling beams can be used to form coupled C-PSW/CF. Comprehensive research following the FEMA P-695 approach was conducted to verify the seismic response modification factors ($R$, $\Omega_0$, and $C_d$) for the coupled C-PSW/CF system (a PDF of the research results can be downloaded from the Pankow Foundation's website at **tinyurl.com/coupledCPSWCF**). The seismic response modification factors of coupled C-PSW/CF of $R$=8, $\Omega_0$=2.5, and $C_d$=5.5 were recommended as a result of this research.

Seismic design of coupled C-PSW/CF can be performed in accordance with the upcoming 2022 version of the AISC *Seismic Provisions* (Section H8). The seismic design criteria and procedure were developed based on capacity design principles. Coupled C-PSW/CF are expected to develop significant inelastic deformations during severe earthquakes. The coupled system is designed to develop flexural plastic hinges at the ends of coupling beams along the height of the structure and flexural plastic hinges at the base (or maximum moment locations) of the wall. Composite coupling beams and walls are sized considering the strong wall-weak coupling beam design approach, which favors the formation of plastic hinges in most coupling beams along the height of the structure before the formation of plastic hinges in the walls. Figure 6 illustrates the seismic response of an eight-story coupled C-PSW/CF structure subjected to a failure level earthquake inducing a maximum inter-story drift level of about 5%. The occurrence of various events along the time history response is marked and illustrated in the figure using plastic strain (PEEQ) contour plots from a 2D finite-element analysis of the structure. The response in Figure 6 illustrates the typical representative seismic response of a coupled C-PSW/CF structure designed according to capacity design procedures.

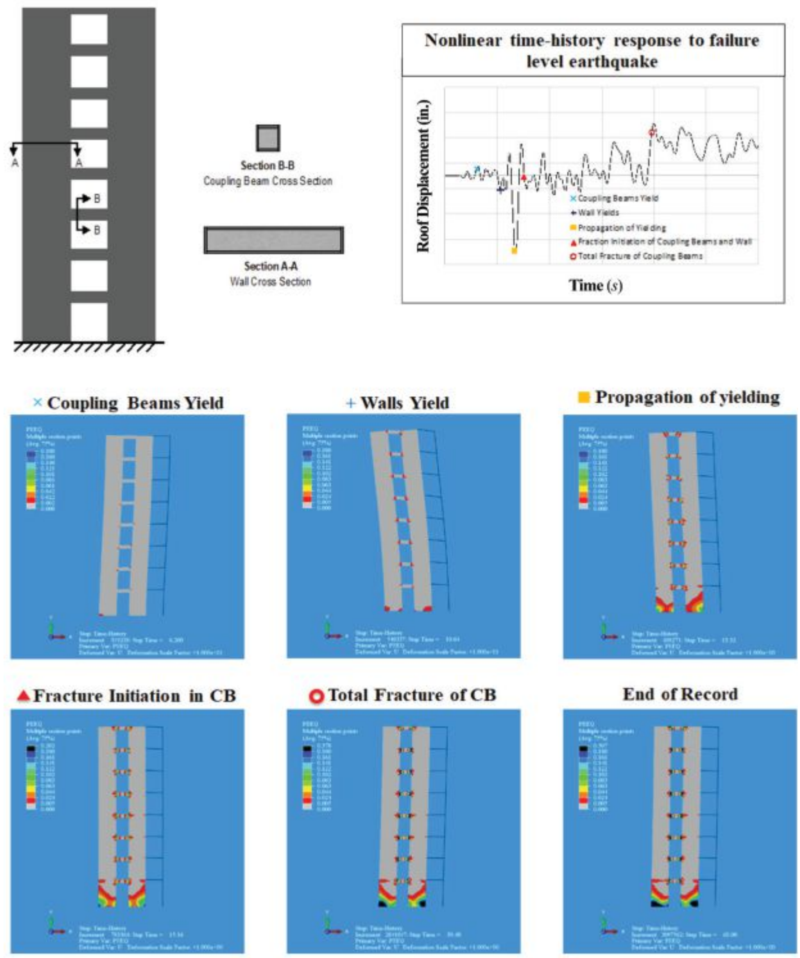



Fig. 6. Nonlinear time-history response of a coupled C-PSW system.

In addition to the design requirements for uncoupled C-PSW/CFs, coupled C-PSW/CFs are limited to walls with a height-to-length ratio greater than or equal to 4. The coupling beams are limited to length-to-depth ratios greater than or equal to 3 but less than or equal to 5. This is done to ensure flexure critical behavior in the composite walls and coupling beams because of the range of parameters and behavior considered using archetype structures in the FEMA P-695 studies.

## NEHRP Implementation

ASCE 7-16 (2016) refers to the current AISC *Seismic Provisions* for specific requirements for the use of planar composite steel plate shear walls in seismic regions. However, ASCE-7-16 does not differentiate between coupled and non-coupled walls. As previously described, coupled C-PSW/CFs consist of two C-PSW/CFs linked together by ductile coupling beams at floor levels. Coupled systems are more ductile and have more redundancy, but ASCE-7-16 currently does not assign them higher $R$-factors. As indicated above, following the FEMA-P695 procedure, work was performed to determine the appropriate value for this structural system and to formalize the design and detailing procedure for these walls (this work was jointly funded by the Charles Pankow Foundation and AISC). In addition to the Project Advisory Group assigned to this project, a specific peer-review committee was established to oversee the steps and milestones explicitly spelled-out to require such oversight by the P-695 procedure itself.

In parallel, findings from the Pankow-AISC study were presented to the Building Seismic Safety Council (BSSC) expert Issue Team-4 (IT-4), which is a standing committee tasked with investigating issues related to the design of shear walls of reinforced concrete, steel, composite (steel-concrete), timber, and masonry and making recommendations to the National Earthquake Hazards Reduction Program (NEHRP) Provisions Update Committee (PUC). This technical committee of seismic experts is tasked with identifying and recommending the most advanced seismic technology available for possible adoptions in the *NEHRP Recommended Provisions for New Buildings and Other Structures*. (This document informs ASCE 7 of desirable updates to its seismic provisions.) As such, the BSSC IT-4 and PUC provided two additional expert peer-review panels of the proposed design provisions for C-PSW/CF walls and, by introducing the structural system into the 2020 Edition of the *NEHRP Recommended Provisions*, brought it up for consideration by ASCE-7-21.

## ASCE 7-22 Implementation

As a first step following-up on the BSSC recommendations, a proposal to include coupled C-PSW/CFs with an *R*-factor of 8, as supported by the above research, as a new seismic force-resisting system in ASCE 7-22 received additional technical scrutiny by members of the ASCE-7 Technical Committee 6 (General Structural) and Main Committee. In addition, a complete set of detailing requirements was proposed for inclusion in Chapter 14 of ASCE-7-22. It has not been uncommon for ASCE-7 to include design and detailing requirements in Chapter 14 as interim measures until other provision documents (e.g., ACI and AISC) eventually integrated them. This was such an instance, given the strong interest of the practicing engineering community to implement the C-PSW/CF system in future projects within the umbrella of a soon-to-be-available code. Together, these two proposals introduce the design coefficients into ASCE 7-22 Table 12.2-1 and the detailing requirements into ASCE 7-22, Section 14.3.5. While the revisions to Table 12.2-1 adding the new structural system will remain through future editions of ASCE 7, it is intended that the detailing requirements of Section 14.3.5 will be replaced by similar requirements in the *Seismic Provisions*, with the remaining language in Section 14.3.3 of ASCE 7 redirecting the user to the *Seismic Provisions*.

## Seismic Provisions Implementation

As indicated above, the inclusion of C-PSW/CF in the 2022 *Seismic Provisions* is already underway. Article H7 has been augmented to include new detailing requirements for uncoupled walls with closing plates instead of circular boundary elements, and a new Article H8 has been provided for coupled walls. Furthermore, all design requirements generally applicable to all coupled and uncoupled walls have been located in Chapter I of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360, **aisc.org/specifications**) to equally facilitate implementation in buildings where wind instead of seismic governs C-PSW/CF design. These provisions have successfully passed the review of the AISC Technical Committee 5 on composite structures and are currently in the final stages of balloting for adoption in AISC 341-22, subsequently to the additional scrutiny of the Committee on Specifications and Public Reviews.

Benefiting from the compounding effects of all the above expert committee reviews, minor enhancements have been introduced in all steps of the process, starting from the design provision proposed during the FEMA P-695 process and culminating in the 2022 versions of the AISC *Seismic Provisions* and *Specification*. (In addition, an AISC Design Guide on C-PSW/CF is due to be published later this year.) However, the key provisions driving C-PSW/CF wall design have remained consistent throughout. These can be summarized as follows:

- A maximum plate slenderness requirement, to ensure that local buckling of the plates will not occur prior to their yielding, which is necessary to achieve ductile response.
- Equations to size the tie bars connecting the external steel plates.
- Limits on the minimum and maximum reinforcement ratio provided by the steel plates to the entire cross-section (namely 1% and 10%, respectively), to remain close to the largest values considered in past experiments.
- Limits on the minimum wall aspect ratio, to ensure flexurally dominant behavior, with ultimate strength governed by flexural hinging.
- For seismic applications, capacity design principles to design the parts of the structural system intended to remain elastic, such as to ensure the development of the intended ductile cyclic response mechanism for the wall.
- Seismic design requirements to ensure the presence of coupling beam providing energy dissipation by flexural hinging over at least 90% of the stories of the building and a requirement specifying that coupling beam-to-wall connection details must be able to develop a chord rotation capacity of 0.030 radians before flexural strength decreases to 80% of the flexural plastic strength of the beam.
- Commentaries documenting the purpose of the design requirements and providing references to substantiating documents.

Thanks to the rigorous set of peer reviews performed at all steps of the implementation process, robust design provisions are now available for engineers who wish to use the C-PSW/CF system as a lateral load-resisting system in projects with stringent seismic requirements. ■

**NEED FOR SPEED**

AISC's Need for Speed initiative recognizes technologies and practices that make steel projects come together faster. Check out **aisc.org/needforspeed** for more.

# Vaccination Considerations

BY JONATHAN LANDESMAN, ESQ., AND
HOPE STEIDLE KILDEA, ESQ.

Two attorneys weigh in on mandatory and incentive-based employer policies for COVID vaccinations.

**Jonathan Landesman** (**jlandesman@cohenseglias.com**) is a partner and **Hope Steidle Kildea** (**hkildea@cohenseglias.com**) is an associate, both with Cohen Seglias Pallas Greenhall and Furman PC, AISC's general counsel.

Jonathan was also a presenter at this year's NASCC: The Virtual Steel Conference. Visit **aisc.org/nascc** roughly 45 days after the conference to view a video of his presentation.

**FOR MONTHS NOW,** employer COVID vaccination programs have been the subject of much speculation and debate.

Most of this discussion has focused on two types of employer policies: vaccination mandates and vaccination incentive programs. Vaccination mandates, on the one hand, impose an across-the-board vaccination requirement upon all employees. Vaccination incentive programs, on the other hand, are designed to encourage vaccination by offering rewards to vaccinated employees. Generally speaking, both types of policies are legal, but they are also subject to exemptions and limitations.

Before implementing a mandatory vaccination policy or vaccination incentive program, employers should be aware of restrictions imposed by employment discrimination laws and consider the labor relations issues, administrative costs, and liability risks associated with such policies.

## Equal Employment Opportunity Laws

The Americans with Disabilities Act (ADA) and Title VII of the Civil Rights Act of 1964 (Title VII) place restrictions on an employer's ability to implement "blanket" vaccination policies for all employees. More specifically, under the ADA, an employer may need to exempt employees from a mandatory vaccination policy, where the employees have pre-existing medical conditions that would prevent them from being vaccinated. Additionally, under Title VII, an employer may need to exempt employees with sincerely held religious beliefs that are offended by vaccination. These situations must be addressed on a case-by-case basis.

In order to comply with the ADA and Title VII, employers adopting vaccination incentive programs may need to provide employees who refuse vaccination due to a medical condition or sincerely held religious belief with an alternative method of qualifying for the incentive offered. Alternative qualification methods can include: requiring the employee to undergo weekly polymerase chain reaction (PCR) tests, wear a mask and social distance while on business premises, and self-administer daily temperature checks.


## Protecting Employee Medical and Genetic Information

In addition to the equal employment opportunity laws discussed above, employers should be aware of the additional legal implications resulting from the pre-vaccine screening used to determine if an individual can receive the COVID vaccine. Under the ADA, employer inquiries that are reasonably likely to solicit information about an employee's disability must be "job-related and consistent with business necessity." The Equal Employment Opportunity Commission (EEOC) has advised that the pre-vaccine screening for COVID vaccines qualify as a disability inquiry under the ADA. As a result, employers who administer pre-vaccine screenings to employees or who contract with a health care provider to do so should be prepared to show that all disability inquiries meet the ADA's "business necessity standard" for their business.

Employers may choose to remove themselves from the prescreening process by instructing employees to get vaccinated by their personal health care provider or local pharmacy. In order to avoid implicating the ADA's "business necessity" standard, employers should warn their employees not to provide any medical information when submitting their proof of vaccination.

Similarly, The Genetic Information Non-Disclosure Act (GINA) prohibits employers from requesting medical information about an employee's genetic information, with narrow exceptions. Because it remains unclear whether pre-vaccine screenings require disclosure of genetic information, the EEOC has advised employers to refrain from administering vaccines and instead request proof of employee vaccination. The EEOC has further advised that, as long as employees are warned not to submit genetic information, any subsequent disclosure to the employer is considered inadvertent and does not impose liability under GINA.

## Additional Considerations

Although employers are generally free to encourage employees to get vaccinated, there may be limits on the value of incentives employers can offer. The issue turns on whether the EEOC decides to treat vaccination incentives as employee wellness programs, which are subject to voluntariness requirements under the ADA and GINA. Under the Trump Administration, the EEOC issued a proposed rule limiting the value of employer incentives for certain wellness programs to those of a de minimis value, such as a water bottle or a sticker. The EEOC has since withdrawn the proposed rule as part of the Biden Administration's regulatory freeze. Without any remaining regulatory guidance on the issue, it is unclear what, if any, limit applies to wellness program incentives.

Employers who choose to implement vaccination policies should anticipate a flood of exemption requests from employees covered under the ADA or Title VII, as well as those with safety or ethical objections to vaccination. The time and energy associated with processing these requests and training human resources personnel to do so may be substantial. Employers should also consider liability risks associated with a vaccine policy, including liability under the ADA and Title VII for potentially mishandled exemption requests and liability for Workers' Compensation claims based on adverse reactions to an employer-mandated vaccination.

Additionally, employers with union-represented employees face additional legal hurdles under federal labor law. These employers, or the associations to whom they have assigned their bargaining rights, will generally be required to notify and bargain with union representatives before implementing vaccination policies.

Ultimately, it is up to every employer to decide what policy is right for their business and for the safety and well-being of their employees. Should you have any questions about vaccination policies or any other issues related to the COVID-19 pandemic and your workplace, please do not hesitate to contact either of us. ■

# new products

This month's offerings include a newly redesigned drilling machine that can make holes on three axes, a wearable worker health-monitoring system, and a cool C-clamp.

## Akyapak

ADM Drilling Machines offer high-quality manufacturing solutions to building and bridge steel fabrication, shipyard, and other construction operations. The ADM series is capable of drilling holes 0.40 in. to 1.57 in. (standard) or larger diameters in H, I, and U profiles. ADM Beam Drill Line models are available with one or three spindles, and the three-spindle models are capable of drilling holes in profiles from three sides independently. This independent motion ability enables combined operations—e.g., while processing one side of the flange, the machine can also perform drilling, marking, tapping, milling, etc., independently on the opposing flange and the web.

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

## Kenzen

Kenzen's health-monitoring system predicts and prevents serious health conditions, providing heat and safety monitoring of key physiological indicators for each worker, such as core body temperature, heart rate, and exertion levels via a compact, waterproof device that records biometric data from a flat surface in a highly effective, unobtrusive way. A mobile app empowers individual workers to self-monitor key physiological indicators, resulting in increased worker awareness and adoption, and a team view mobile dashboard alerts managers to deviations from baselines, allowing them to intervene, privately and quickly, with individual workers.

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

## Dimide Clamp

Dimide, Inc., has launched its ¼ Series Clamp, which combines impact-rated force and installation speed with modular versatility in a lightweight and easy-to-use clamp. The ¼ Series Clamp delivers 2,200 lb of clamp force when used with today's best ¼-in. impact drivers. The clamp provides modularity with interchangeable shoes that are secured with a ¼-in. ball spring detent pin, allowing users to make custom shoes for any job. Dimide will launch accessory shoes in the future to constantly upgrade these clamps. A copper-coated option, designed to protect the clamp from weld spatter when it's used near welding operations, is also available. The clamps have a 6-in. opening capacity, a maximum throat depth (fully open) of 4 in. and a minimum throat depth (closed) of 3 in. Each clamp weighs 2.9 lb.

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

**ERECTOR NEWS**

## SEAA Announces October Convention Plans

The Steel Erectors Association of America's 48th Convention and Trade Show, previously scheduled for April 2021 in Orlando, Fla., will now take place Oct. 12–14, 2021. The meeting will be held at the DoubleTree by Hilton at the entrance to Universal in Orlando, Fla.

"Escape to Orlando—Adventure Awaits is the theme of this year's meeting," said Carrie Gulajan, chairman of the Convention Committee. We have enhanced the schedule packed it with networking opportunities."

The Trade Show provides erectors and fabricators a chance to see the latest products, services, and innovations they need for a safer, more productive worksite. "We will have three hours of dedicated trade show time at indoor and outdoor booths, with hands-on presentations from exhibitors for a highly-engaged trade show experience," noted Gulajan.

To accommodate social distancing and small group engagement, attendees will be split into two groups. Half will visit indoor booths, while half will visit outdoor booths. Groups will rotate at the mid-point in the schedule, and the live demonstrations will be staggered between two time slots.

Education sessions include a panel discussion with SEAA Project of the Year winners and presentations focused on management topics.

Preceding the convention is the Dave Schulz Memorial Golf Tournament, supporting safety, training, and education projects. Through this event, SEAA has awarded more than $40,000 in Craft Training grants and for the development of training videos.

The Captain's Choice-style tournament will be held on October 12 and is open to members and non-members. Prizes will be awarded for first- through fourth-place teams, longest drive, closest to the pin, and more. Registration fees include green fee, cart, range balls, lunch, and beverages. Sponsorship opportunities are also available at **seaa.net/daveschulzgolf**.

Companies interested in exhibiting can take advantage of two promotions. The Early Bird Special is for exhibitors that reserve and pay for their booth by May 31. They receive one complimentary e-mail blast in SEAA's Convention Products and Services Showcase.

Attendee registration is now open. Registration discounts end August 31, and the hotel room block cutoff date is September 22. Visit **seaa.net/seaa-convention-trade-show.html** to book a booth, register to attend, and reserve a hotel room.

## People & Companies

**Kathleen Dobson**, safety director for **Alberici Constructors** (whose fabrication division, **Hillsdale Fabricators**, is an AISC member) and a member of the **AISC Safety Committee**, has been appointed to serve on the **National Advisory Committee on Occupational Safety and Health (NACOSH)**. The purpose of NACOSH is to advise, consult with, and make recommendations to the **Secretary of Labor and the Secretary of Health and Human Services** regarding the administration of the **Occupational Safety and Health Act (OSHA)** of 1970. Dobson has joined the 12-member committee as a safety representative for a two-year term. She has worked in the construction industry for more than two decades and is an advocate for workplace safety and women's representation in construction building trades. She also presented on hazards related to worker illness in steel fabrication and erection at the 2021 NASCC: The Virtual Steel Conference (visit **aisc.org/nascc** for details).

SAFETY

## AISC Announces Winners of Annual Safety Awards

More than 100 structural steel facilities are being honored with AISC Safety Awards for their excellent records of safety performance in 2020. Awards are given in the categories of "Fabricator" and "Erector" and include the Safety Award of Honor—AISC's top safety award, presented for a perfect safety record of no disabling injuries—as well as the Safety Award of Merit and Safety Commendation.

"'Stay safe' has become a favored sign-off for 2020 as COVID put an extra hazard in our safety planning," said Tom Schlafly, AISC's chief of engineering staff. "The AISC Safety Award recognizes those member fabricators and erectors that have managed their organizations safely and last year made that especially difficult and important. AISC congratulates those who achieved a commendable record of safe performance n that demanding year."

All AISC full fabricator members and erector associate members are eligible and asked to participate, and data for the program is solicited annually. In order to facilitate data collection and to make statistics meaningful in terms familiar to safety professionals, the program uses data that companies also report to OSHA. The program recognizes performance measured in terms of Days Away, Restricted or Transferred Rate (DART). The DART is a measure of the number of recordable lost work cases per 200,000 hours worked. Only the number of cases (not days) that are required to be reported on the OSHA 300A form and that cause a lost work day, as defined by OSHA, are reported to AISC, along with the hours worked in the year. AISC Safety Awards are given for perfect records (Honor, DART=0), excellent records (Merit, 0<DART≤1), and commendable records (Commendation, 1<DART≤2).

For more information about the program as well as safety resources available to the fabricated and erected structural steel industry, please visit **aisc.org/safety**. Here are the winners:

### FABRICATOR HONOR AWARD

Alamo Structural Steel
Arcosa Traffic Structures
Aristeo
B & B Welding Company, Inc.
Ben Hur Steel Worx, LLC
BENCHMARK Fabricated Steel
Blue Atlantic Fabricators, LLC
Broome Welding & Machine Co.
Center Point Contractors, Inc.
Central Minnesota Fab., Inc. (CMF)
Charleston Steel Company
Cianbro Fabrication & Coating Corporation
Con-Fab Welding, Inc., dba Con-Fab Engineering & Welding
Cooper Steel
Cooper Steel South, LLC
Cooper Steel of Virginia
Custom Fabrications and Coatings
Dixie Southern Industrial, Inc.
Doherty Steel
Eastpointe Industries, LLC
Eddy's Welding, Inc.
Extreme Precision Industrial Contactors
Fabco Metal Products
Fiedeldey Steel Fabricators, Inc.
G2 Metal Fab, Inc.
Garbe Iron Works, Inc.
GEM Ind, Inc.
George Steel Fabricating, Inc.
Gibson Industrial, Inc.
GMF Industries, Inc.
Grunau Metals
High Plains Steel Services, LLC
Industrial Resources, Inc.
J.R. Hoe and Sons
Jimco Sales & Manufacturing
Larwel Industries
Lyndon Steel Company
Maccabee Industrial, Inc.
Martin Iron Works, Inc.
McPeak Supply, LLC
Metal Solutions
Mike Owen Fabrication, Inc.
Mobil Steel International, Inc.
Moore & Morford, Inc.
NMI Industrial Holdings, Inc.
NOVA Group, Inc.
PAX, LLC
Pederson Bros., Inc.
Phoenix Fabrication & Supply, Inc.
Phoenix Manufacturing, LLC
Pikes Peak Steel, LLC
RCC Fabricators, Inc.
Red Dog Fabrication, LLC
Reno Iron Works
Richardson Steel, Inc.
Rochester Structural, LLC
S.W. Funk Industrial Contractors, Inc.
Sanford Steel Corp.
Sanpete Steel Corporation
Scott Steel Services, Inc.
Sefton Steel, LP
Shure Line Construction
SSOE, Inc.
Steel Service Corporation
Steward Steel, Inc.
Structural Steel & Plate Fabrication Co.
Summit Industrial Construction
Summit Steel Works Corp
Systems Fab & Machine, Inc.
Talley Metal Products, Inc.
The Arthur Louis Steel Company
The Gateway Company of Missouri, LLC
Trinity Fabricators, Inc.
TrueNorth Steel
Turner Construction Company
Twin Brothers Marine, LLC
USNC, LLC
Veritas Steel
Zimkor, LLC

### ERECTOR HONOR AWARD

Black Cat, LLC
Center Point Contractors, Inc.
Cooper Steel
Extreme Precision Industrial Contactors
GEM Ind, Inc.
Gibson Industrial, Inc.
GMF Industries, Inc.
High Plains Steel Services, LLC
Hillsdale Fabricators, a Division of Alberici Constructors
Martin Iron Works, Inc.
Metal Pros, LLC
North Alabama Fabricating Company, Inc.
Reno Iron Works
Richardson Steel, Inc.
Rochester Rigging & Erectors, Inc.
Rochester Structural, LLC
Shure Line Construction
SunSteel, LLC
Turner Construction Company

2020 SAFETY AWARD ★★

**FABRICATOR MERIT AWARD**

DIS-TRAN Steel, LLC
Prospect Steel, a Division of Lexicon, Inc.
Schuff Steel - Atlantic, LLC
SunSteel, LLC

**ERECTOR MERIT AWARD**

Aristeo
Ideal Contracting
Stonebridge, Inc.

2020 SAFETY AWARD ★

**FABRICATOR SAFETY COMMENDATION**

AIW, Inc.
Alamo Structural Steel
Dave Steel Company, Inc.
Ducworks, Inc.
Ford Steel, LLC
Gayle Manufacturing Company
Geiger & Peters, Inc.
High Steel Structures, LLC
Jesse Engineering Company
Kwan Wo Ironworks, Inc.
Metal Pros, LLC
Milton Steel Company
North Alabama Fabricating Company, Inc.
Padgett, Inc.
Schuff Steel Company
Shickel Corporation
Tampa Tank, Inc./Florida Structural Steel
TrueNorth Steel
Universal Steel, Inc.
Western Slope Iron & Supply, Inc.

**ERECTOR SAFETY COMMENDATION**

AIW, Inc.
Doherty Steel
Golden State Bridge, Inc.
Kwan Wo Ironworks, Inc.

**PROJECTS**

## Spiral Steel Tower Tops Out at Hudson Yards

Which tops out faster, a steel core or a concrete core? A race between two buildings on a similar construction timeline in New York City showed a clear winner: the steel core. 66 Hudson Boulevard, also known as The Spiral, reached its 66-story 1,041-ft pinnacle on January 26, three weeks before its concrete-core neighbor, 50 Hudson Yards, topped out.

Construction on 66 Hudson Boulevard started at the same time as the adjacent 50 Hudson Yards tower, which is a 58-story, 1,011-ft tower supported by a concrete core. The two towers have been close in height throughout construction, with each team hoping to beat the other. In late 2020, the domestic steel team working on 66 Hudson pulled ahead, resulting in the all-steel building topping out faster than its shorter neighbor, which finally topped out on February 12. AISC member fabricator Banker Steel fabricated 31,500 tons of structural steel for The Spiral.

When completed next year, the Bjarke Ingels Group-designed superstructure will occupy a full block between West 34th and 35th Streets and encompass 2.8 million sq. ft of office and ground-floor retail space. Owner Tishman Speyer announced nearly three years ago that biopharmaceutical company Pfizer signed a 20-year lease to move its global headquarters to the building.

CityRealty

## HIGGINS AWARD

# Nominations Sought for 2022 Higgins Lectureship Award

Nominations are being accepted through July 1, 2021, for AISC's T.R. Higgins Lectureship Award, which includes a $15,000 cash prize. Presented annually, the award recognizes a lecturer-author whose technical paper(s) are considered an outstanding contribution to engineering literature on fabricated structural steel. The winner will be recognized at the 2022 NASCC: The Steel Conference, taking place March 23–25 in Denver, and will also present their lecture, upon request, at various professional association events throughout the year.

Nominations can be emailed to AISC's Rachel Jordan at **jordan@aisc.org**. If you'd prefer to mail your nomination, contact Rachel for mailing information. Nominations must include the following information:

- Name and affiliation of the individual nominated (past winners are not eligible to be nominated again)
- Title of the paper(s) for which the individual is nominated, including publication citation
- If the paper has multiple authors, identify the principal author
- Reasons for nomination
- A copy of the paper(s), as well as any published discussion

The author must be a permanent resident of the U.S. and available to fulfill the commitments of the award. The paper(s) must have been published in a professional journal between January 1, 2016 and January 1, 2021. In addition, the winner is required to attend and present at the 2022 Steel Conference and also give a minimum of six presentations of their lecture on selected occasions during the year.

The award will be given to a nominated individual based on their reputation as a lecturer and the jury's evaluation of the paper(s) named in the nomination. Papers will be judged for originality, clarity of presentation, contribution to engineering knowledge, future significance, and value to the fabricated structural steel industry.

The current T.R. Higgins Lecturer is Purdue University's Amit Varma, PhD, who received the award for his papers on Concrete Filled Composite Steel Plate Shear Walls (SpeedCore) as well as for his outstanding reputation as an engineer and lecturer. If your organization is interested in hosting a T.R. Higgins lecture, please contact Christina Harber, AISC's director of education, at **harber@aisc.org**.

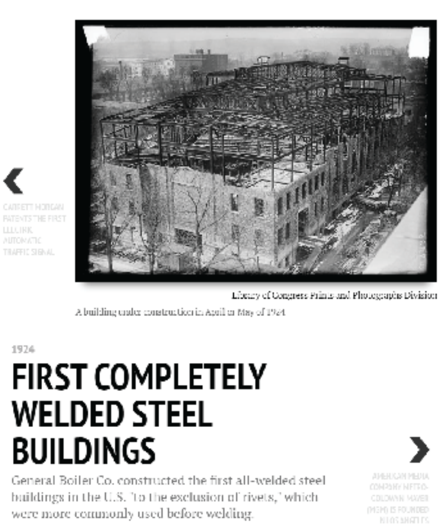
The award is named for Theodore R. Higgins, former AISC director of engineering and research, who was widely acclaimed for his many contributions to the advancement of engineering technology related to fabricated structural steel. The award honors Higgins for his innovative engineering, timely technical papers, and distinguished lectures. For more information about the award, visit **aisc.org/higgins**.

Amit Varma, current T.R. Higgins lecturer.

## 100 YEARS OF AISC

# New Timeline Depicts AISC's First Decade

AISC is celebrating its centennial this year—in true historic style!




As we look forward to the next 100 years, we're also taking a deep dive into the decades that defined both AISC and the world in general, starting with the 1920s.

A new interactive timeline from AISC places key events from the history of AISC and structural steel in context with other historical benchmarks of the 1920s.

"It's remarkable how much we've accomplished—and continue to accomplish—together," said AISC's vice president of operational engagement, Carly Hurd. "As a proud Chicagoan, I particularly enjoyed learning that the Wrigley Building and the Wells Street Bridge are almost as old as AISC!"

Some highlights of AISC's "roaring" first decade include:

- AISC's founding in 1921 under the name "National Steel Fabricators Association"
- The birth of welded steel buildings
- The first Academy Awards ceremony
- The debut of the steel bridge that would serve as the busiest border crossing into Canada until 1992

The timeline contains an array of engaging historical images and videos, as well as documents, patents, tours, and interactive present-day views of buildings built in the 1920s—even a cocktail recipe, should you want to really embrace the speakeasy spirit!

It is part of a yearlong celebration of AISC's centennial and joins a retrospective of historic articles, other interactive timelines, and more. Next up is the 1930s, which saw the construction of some of the most iconic steel buildings in the country.

The AISC 1920s timeline is available at **aisc.org/legacy/1920s-timeline**. For more on AISC's centennial and subsequent timelines, visit **aisc.org/legacy**.

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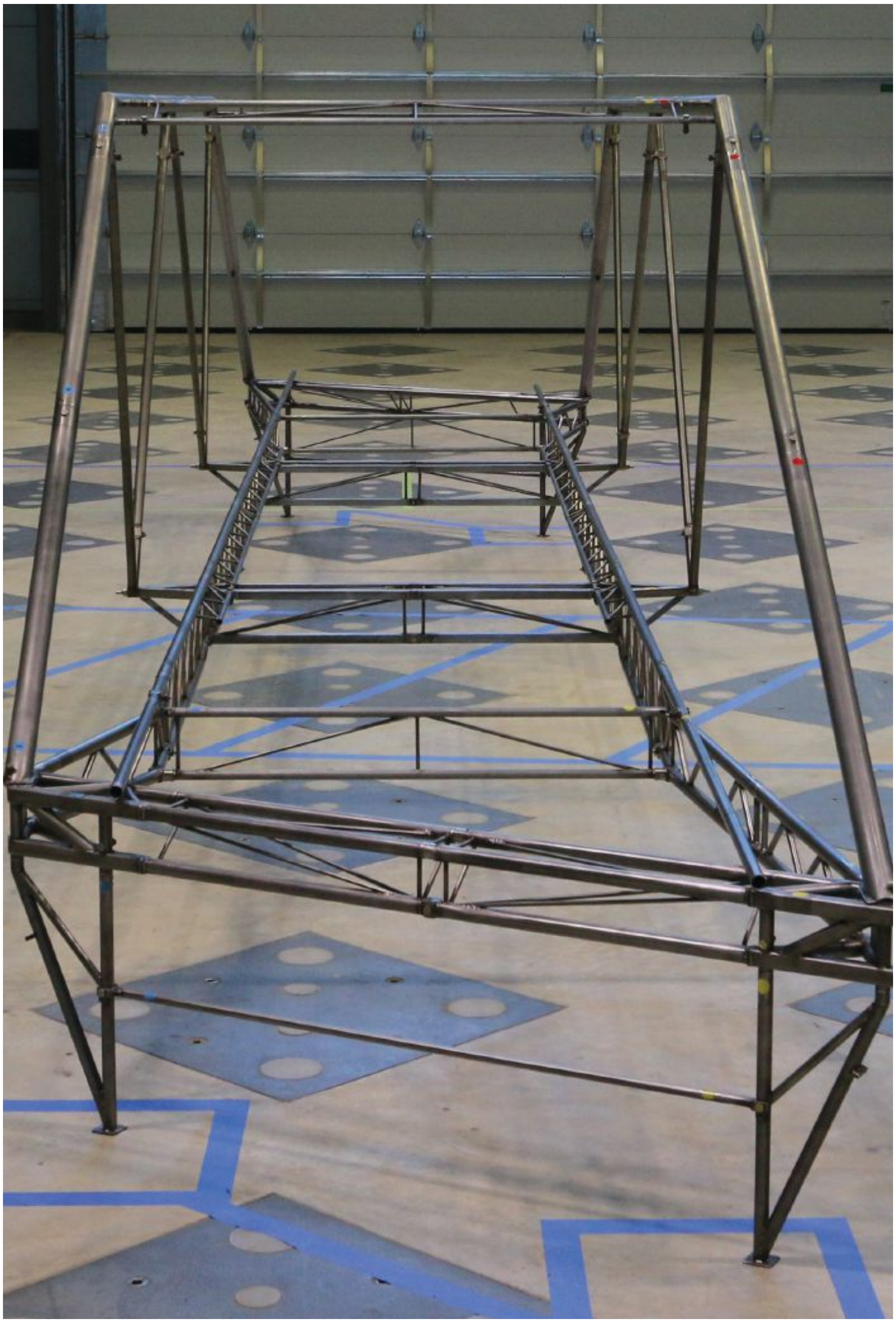


# REMOTE RACE

**BY THE TIME YOU RECEIVE** this issue of *Modern Steel Construction*, the 2021 Student Steel Bridge Competition (SSBC) will be well underway.

In normal times, AISC staff would be flying around the country during the spring to attend SSBC Regional Events. But like last year, these aren't normal times (fingers crossed for next year).

The good news is that we've had a lot more time to adjust the competition format than we did in 2020. While AISC is not holding Regional Events this year, schools are still building their bridges on their own campuses and submitting photos, videos, and scores remotely.

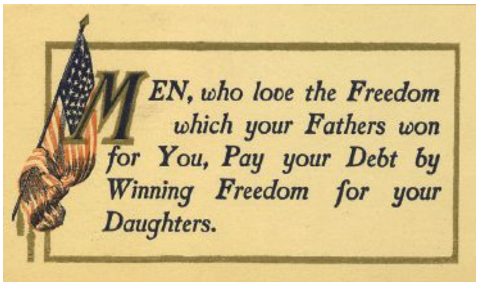
The first team to complete its bridge for this year's competition? The University of Alaska Fairbanks (UAF). And they did it in under eight minutes. For those not familiar with the competition, that is an excellent time—especially since there were only three builders! To see a video of the team building their bridge, visit the Project Extras section at **www.modernsteel.com**.

"When COVID hit last spring semester, we'd been very busy with our bridge's fabrication and had it around 50% completed," said Ben VanderHart, UAF's steel bridge team captain. "When the cancellation of the 2020 SSBC was announced, we were very disappointed that we'd have to leave the bridge unfinished. Thankfully, the SSBC Rules Committee decided to keep the 2021 rules virtually unchanged, so we didn't need to start from scratch again this year."

The National Finals awards presentation will take place June 3, and we'll have more comprehensive coverage of the SSBC in the coming months.

## 1847

Seneca Falls Convention launches women's suffrage movement.




**NINE STEEL BRIDGES** that are still in service today were open to traffic when it happened.

**5,189 SUCH BRIDGES** were already open when the Nineteenth Amendment finally granted women the right to vote in 1920.

## 1933

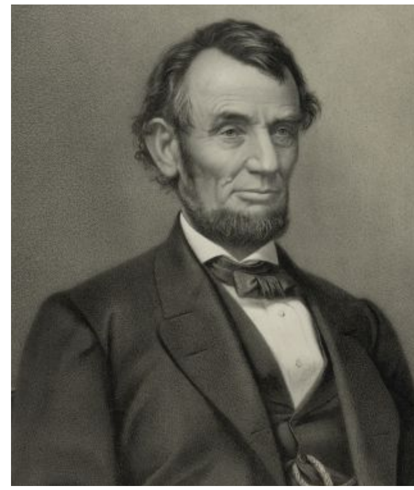
Police drag the Charles River after a "cod-napping" in the Massachusetts State House.

At least **13,525 STEEL BRIDGES** that are still in service today were already open to traffic.


Scott D Flickr


## 1863

President Abraham Lincoln delivers the Gettysburg address.



**63 STEEL BRIDGES** that are still in use today were already open to traffic.

# EVERY DAY IN THE U.S., AN AVERAGE OF 77 MILLION VEHICLES CROSS MORE THAN 25,000 STEEL BRIDGES BUILT BETWEEN 1838 AND 1938.

These are just a few of the stories these bridges could tell: dazzling innovation, events that changed the world, and quirky people being...well, quirky.

Visit **aisc.org/timeline** for more.

**Smarter. Stronger. Steel.**

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