Modern Steel Construction

November 2025

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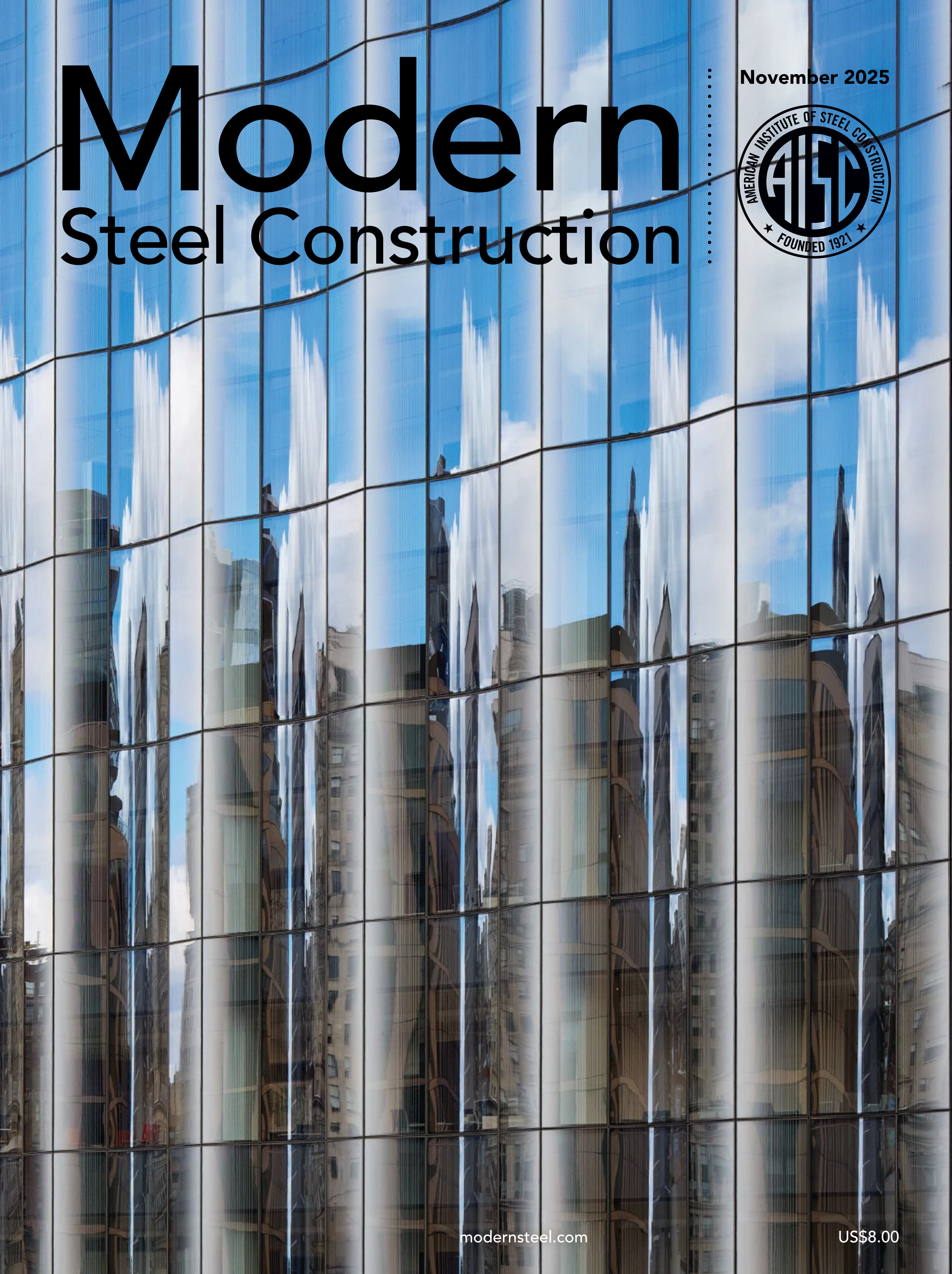

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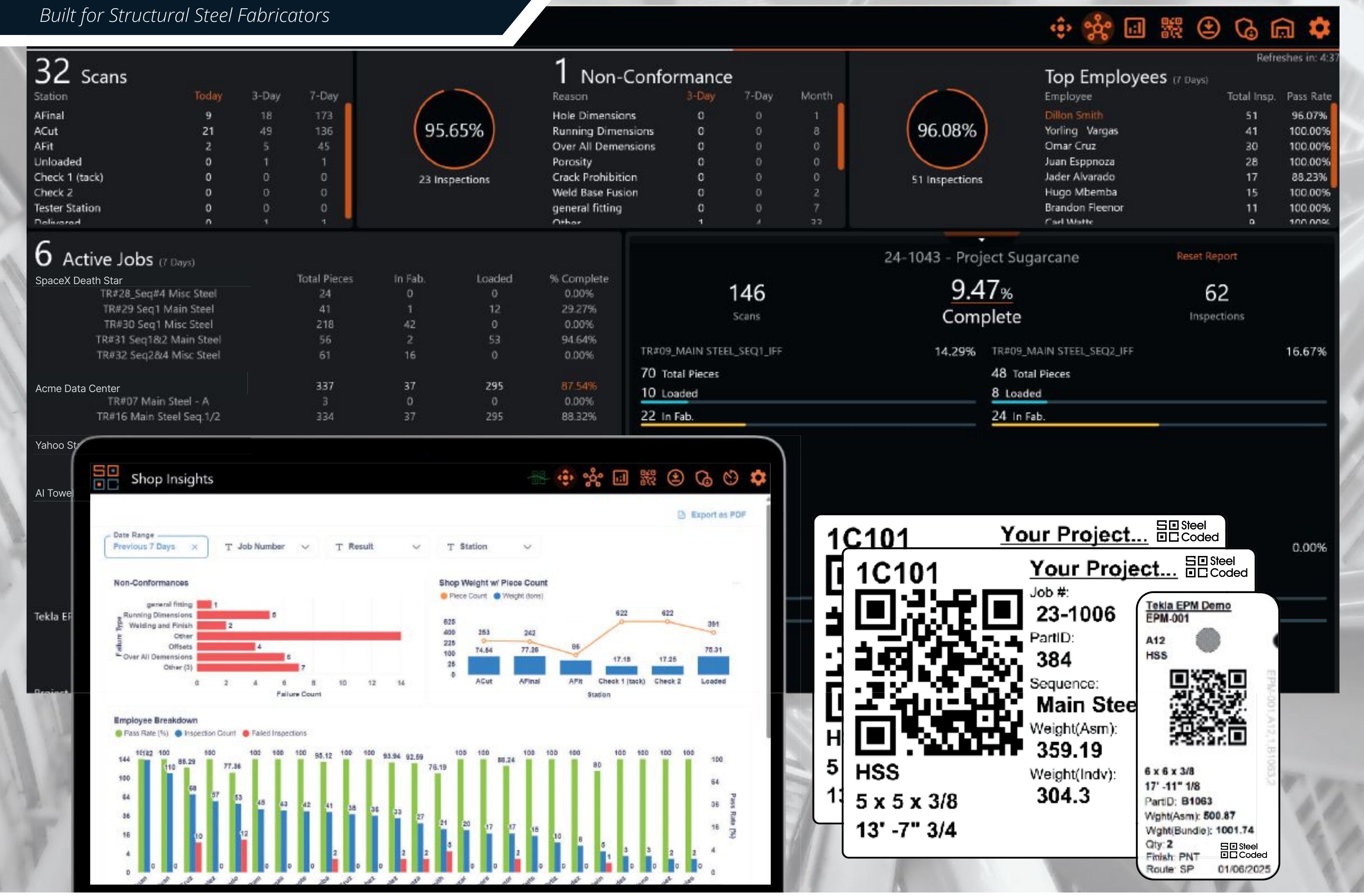

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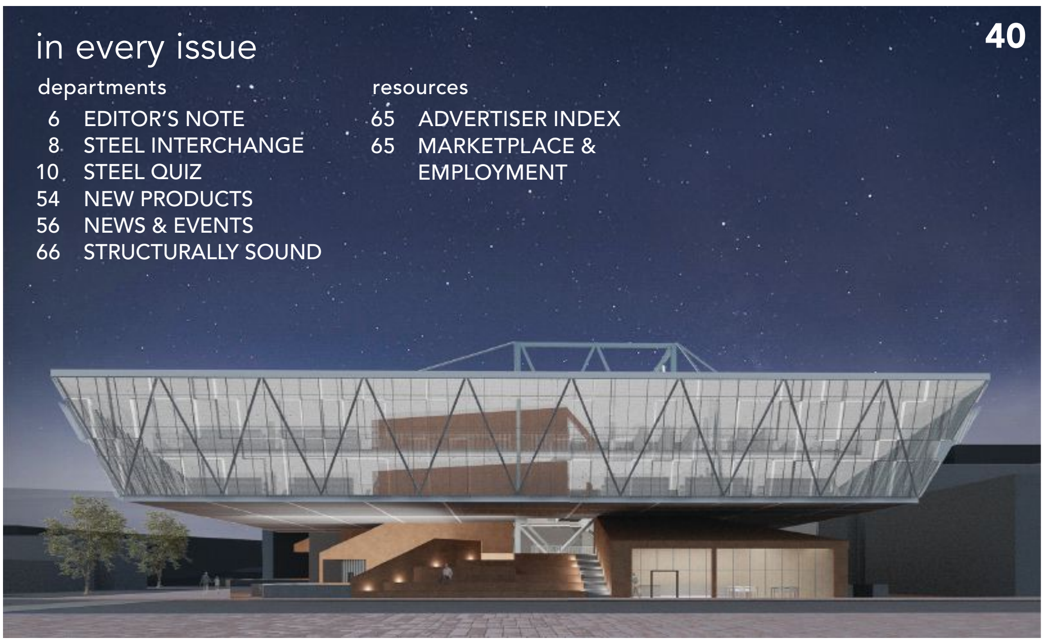

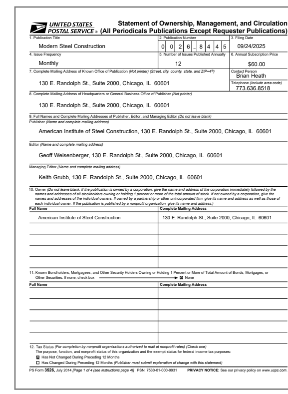

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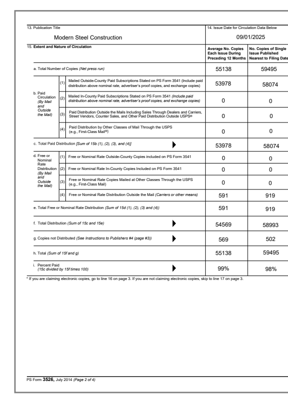

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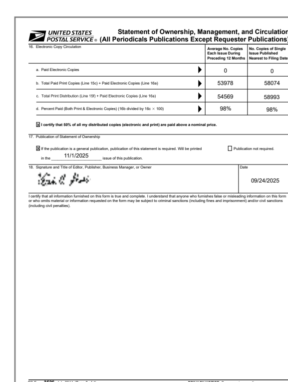

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ON THE COVER: A Philadelphia medical center project found fabrication and design time savings with steel, p. 24. (Image: Bruce Damonte)

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editor's note

Imagine, if you will,
a steel bridge.

A steel pedestrian bridge.

Perhaps over a picturesque river in a small town in the Canadian Rockies, perhaps originally built in the 1890s by the Canadian Pacific Railway on a railway spur to service, perhaps, a coal mine.

OK, yes, this theoretical bridge is the one in the photo. It's the steel-framed Canmore Engine Bridge, which spans the Bow River in the mountain town of Canmore, Alberta.

The bridge became familiar to me as a memorable setting from the first season of the HBO Series *The Last of Us*, based on the video game of the same name, when the two main characters cross it despite warnings of certain death. (If you enjoy post-apocalyptic drama, fungal zombies, and Pedro Pascal, you should give the show a try. Keep in mind that it is by no means lighthearted and can get pretty gory; viewer discretion is advised.)

To put it mildly, it's one of the most scenic bridges I've ever walked (or driven or biked) across, thanks to the wide-open, majestic views and the juxtaposition of the clean, industrial lines against the colorful, jagged backdrop of the Rocky Mountains, the high-altitude foliage, and the unspoiled clarity of the rushing river below. And it's allegedly the second iteration of a previous bridge built in 1880, a two-span Whipple truss that was altered to become a single span—an early example of steel's salvageability, adaptability, and longevity. (Thanks to **www.historicbridges.org** for the history lesson and facts.)

You can check out the Project Extras section at **www.modernsteel.com** to see more photos of the Engine Bridge. And for a look at several historic American steel bridges that have stood for more than a century, visit **aisc.org/timeline**.

While the Engine Bridge facilitates a stroll back through steel history, another steel span—featured on page 32—looks to the future. Initially built as the feature element for AISC's booth at this year's NASCC: The Steel Conference in Louisville, the 36-ft-long, 3D-printed steel pedestrian bridge provides a real-life example of connections and geometries that are possible with steel 3D printing. From there, it has become the center of an ongoing load-testing research project.

And speaking of looking to the future, you can read about and view renderings of the winners of this year's Steel Design Student Competition, starting on page 40. Administered by the Association of Collegiate Schools of Architecture (ACSA) and sponsored by AISC, the competition challenges college students to consider issues related to steel design and construction and create their own steel visions of tomorrow. The main category changes every year, and this year's task was to come up with a design that "addresses how a library can contribute to the community as a more integral part of the civic fabric"—in other words, a "library+." And every year, the competition also includes an open category in which students can use steel to design any other type of building.

The design proposals are always awe-inspiring and forward-thinking, and this year's winners include a hybrid library and kitchen communal space in a Georgia farming community, a combined public library and reintegration/transitional employment program, a library serving as an "urban node" in Manhattan, and a Northern California command center and training facility for wildfire response teams that uses reservoir and rainwater collection for drought-resilient water storage.

And if you want yet another example of steel innovation—or rather a steel innovator—check out this month's Field Notes podcast column on page 20, where you can hear from Matt Reiter, a professor of practice in Cornell's School of Civil and Environmental Engineering and a 2025 AISC Innovation Scholar.

Whether looking at the past, present, or future, steel innovation and vision can be found everywhere—at conferences, in classrooms, in the minds of the next generation of designers, and even in small mountain towns.

Geoff Weisenberger
Editor and Publisher

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

Editorial Contacts
EDITOR AND PUBLISHER
Geoff Weisenberger
312.493.7694
weisenberger@aisc.org

ASSOCIATE EDITOR
Patrick Engel
312.550.9652
engel@aisc.org

SENIOR DIRECTOR OF PUBLICATIONS
Keith A. Grubb, SE, PE
312.804.0813
grubb@aisc.org

DIRECTOR OF GRAPHIC DESIGN
Kristin Hall
773.636.8543
hall@aisc.org

EDITORIAL DIRECTOR
Scott Melnick
312.804.1535
melnick@aisc.org

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

Shop-Applied Intumescent Paint

My experience with intumescent paint is that it is applied in the field. Can it be shop-applied?

Yes, some intumescent paint formulations are commonly shop-applied.

Shop-applied intumescent paints are typically epoxy-based, which differ from the water- and solvent-based products often applied in the field. Epoxy-based formulations are known for their exceptional durability, which is a significant advantage. These coatings can successfully make it to the job site and be erected with minimal touch-ups. This practice is common in the hydrocarbon, oil, and gas market and EV battery plants. Its use is growing in other building sectors.

This topic is gaining traction as more applicators become equipped to handle shop-applied intumescent paints and as a wider variety of products enter the market. There are numerous products available, each with unique advantages and limitations. Engaging with a well-versed applicator early in a project can provide solutions for a particular application.

Many fabricators are not taking on the shop-applied intumescent scope themselves. Instead, the service is often handled by a third-party applicator, similar to the galvanized steel model. These specialized applicators have the necessary equipment, space, and trained personnel. While physically transporting steel from the fabricator to the applicator is the most common method, this does add transportation costs. Therefore, the location of applicators relative to fabricators and project sites is a factor.

Some applicators have also explored creative application methods that fit the project needs, including:

- Application at the fabricator's shop: If a fabricator has the space but lacks the expertise or personnel, or simply chooses not to take on this scope, some applicators will send their equipment and a trained crew to apply the coating at the fabricator's facility, therefore avoiding transporting to an offsite facility.
- Application at the project site (pre-erection): Applicators can set up a temporary, enclosed area (like a tent) on the construction site to apply the coatings on the ground before erection, provided the project site has the space.

Melissa Gradecki, SE, PE

Charpy V-Notch Requirements for W14 Columns with Welded Paddle Plates

There are large W14 columns that have flange thicknesses that exceed 2 in. thick. Beams are moment connected to the W14 columns using paddle plate connections where the paddle plates are CJP groove-welded to the W14 column flanges. Per Section A3.1d in the 2022 AISC *Specification for Structural Steel Buildings*, do the W14 columns require Charpy V-Notch testing?

For the scenario presented, no. However, there may be other reasons why Charpy V-Notch testing is required on the same member.

Specification Section A3.1d explicitly states, "Where a rolled heavy shape is welded to the surface of another shape using groove welds, the requirements apply only to the shape that has weld metal fused through the cross section." For the paddle plate welded connection to the W14 column flange, the welds do not fuse through the cross section of the W14 columns, so the CVN requirement does not apply to the W14 columns, unless elsewhere CJP welds are used that do fuse through the cross section of the W14 columns. For example, this could occur if the W14 columns are spliced using CJP welds.

Larry Muir, PE

Deep W14 Shapes

The W14×873 column has an overall depth of 23.6 in. Why is it designated as a W14?

Each family of wide-flange sections is grouped by inner roll dimensions. While the first number in the wide-flange designation is typically referred to as the nominal depth, the actual depth, d, can vary significantly from this for heavier sections with thick flanges. For more common sections, the inner web dimension plus the fillet radii and flange thickness is approximately equal to the first number in the designation (for example, 14 for a W14).

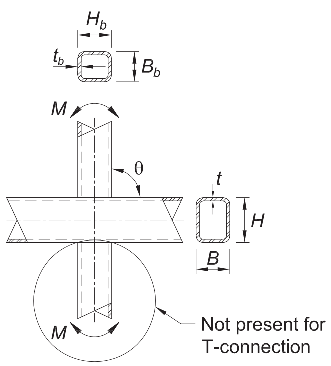
In the AISC 16th Edition *Steel Construction Manual* (order at **aisc.org/publications**), wide-flange shapes are grouped by the same inner web dimension, "T," exhibiting less variability within each family. From a manufacturing perspective, this corresponds to the size of the inner roll. For designers and detailers, considering members grouped by their inner web dimension can be beneficial, particularly when detailing member end connections.

Heather Gathman

HSS-to-HSS Moment Connection Design Discrepancy

Why is the limit state check for sidewall local yielding provided in Table K4.2 of the 2022 AISC *Specification for Structural Buildings* (Equation K4-8) not consistent with the equation 10-4 shown in AISC Design Guide 24: *Hollow Structural Section Connections*, Second Ed.? Why does the *Specification* multiply F_y by 0.8, but Design Guide 24 takes the full value?

HSS-to-HSS moment connections



2022 AISC *Specification*
Limit state: sidewall local yielding

$$M_{n\text{–}ip} = 0.5F_y^*t(H_b + 5t)^2 \qquad \text{(K4-8)}$$

$F_y^* = F_y$ for T-connections and $0.8F_y$ for cross-connections.

AISC Design Guide 24
Limit state 4: Local yielding of the chord sidewalls

$$M_{n\text{–}ip} = 0.5F_yt\left(\frac{H_b}{\sin\theta} + 5t\right)^2 \qquad \text{(10-4)}$$

Limit state 5: Buckling of the chord sidewalls

$$M_{n\text{–}ip} = 0.4F_yt\left(\frac{H_b}{\sin\theta} + 5t\right)^2 \qquad \text{(10-5)}$$

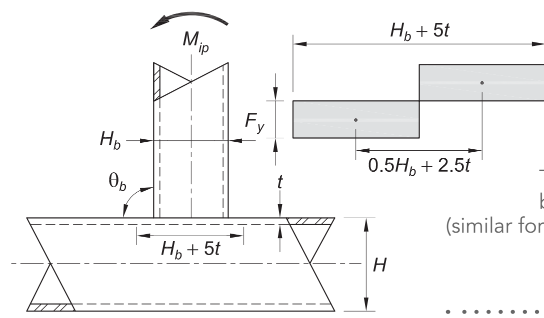
Design Guide 24 (download or order at aisc.org/dg) and the 2022 AISC *Specification* (download or order at aisc.org/specifications) treat this limit state equivalently, but it is presented in a different manner in each document.

The *Specification* consolidates both chord sidewall local yielding and chord sidewall local buckling into a single limit state "sidewall local yielding," which is checked with Equation K4-8.

Design Guide 24 treats these as two distinct limit states which are both presented in Table 10-2 as: limit state 4 "Local yielding of the chord sidewalls" and limit state 5 "Buckling of the chord sidewalls." These are evaluated using Equations 10-4 and 10-5, respectively. Both equations also refer to Equation K4-8 in the *Specification*.

As noted on page 304 of Design Guide 24, limit state 5 is only a potential limit state for cross-connections and, therefore, wouldn't be applicable for T- or Y-connections.

Limit states 4 and 5 are applicable for cross-connections; however, limit state 5 will always control over limit state 4. Both equations for these limit states are identical in form except for the leading coefficient. From page 304, "…it has been suggested that the failure stress in the model of Figure 10-7 be reduced to $0.8F_y$ and treated as local yielding." Thus, Equation 10-5 has a coefficient of 0.4 rather than 0.5, which is used in Equation 10-4.



Chord side wall local yielding model for a rectangular HSS-to-HSS T-connection under branch in-plane bending (similar for chord sidewall buckling).

Michael Desch, PhD

Melissa Gradecki (gradecki@aisc.org) is AISC's senior engineer, innovation, and **Michael Desch** (desch@aisc.org) and **Heather Gathman** (gathman@aisc.org) are staff engineers in the AISC Steel Solutions Center. **Larry Muir** is a consultant to AISC.

This month's quiz is all about the second edition of AISC Design Guide 6: *Composite Column Design*. This newly updated edition offers expanded guidance on the design of encased composite columns and now includes guidance for designing filled composite columns. Download or order a copy today at **aisc.org/dg**.

1 **True or False:** Composite columns generally have a smaller required cross-section compared to conventional reinforced concrete columns.

2 **True or False:** For the determination of axial compressive strength, the nominal flexural stiffness of encased and filled composite members subjected to net compression is calculated using the gross cross-sectional properties.

3 **True or False:** Direct bond interaction is not a permitted force transfer mechanism for encased composite members.

4 **True or False:** In simple connections where a steel beam is connected directly to the steel section of an encased composite member, rotational restraint provided by the concrete is generally neglected in the beam design.

5 **True or False:** For both encased and filled composite members subjected to axial force, a minimum amount of longitudinal reinforcement is required.

6 **True or False:** When casting the concrete in filled composite members, square and rectangular steel shapes are more susceptible to bulging under the hydrostatic pressure than round shapes.

7 The design tables included in the first edition of Design Guide 6 have been replaced in this edition with a companion Composite Column Program implemented in Microsoft Excel. This program can be used to calculate member strengths for which of the following type(s) of composite members?

a. Encased composite members
b. Square and rectangular filled composite members
c. Round filled composite members
d. All of the above

TURN TO PAGE 12 FOR ANSWERS


SPEED. QUALITY. RELIABILITY. PERFORMANCE.
Ready To Bolt

steel quiz ⋮ ANSWERS

Answers reference the second edition of AISC Design Guide 6: *Composite Column Design*.

1 **True.** One advantage of composite columns is that a composite column will generally result in a smaller cross-section than required for a conventional reinforced concrete column. Other advantages and some limitations of composite columns are discussed in Section 1.2.

2 **False.** The key difference between composite structures and steel structures in the determination of required strengths is the determination of the various stiffnesses. For example, the nominal flexural stiffness, *EI*, of a structural steel member is the modulus of elasticity of steel multiplied by the gross moment of inertia in the plane of bending. Composite columns, however, include concrete that cracks at low levels of tensile stress and has a relatively low proportional limit in compression. To determine the axial compressive strength of composite columns, the nominal flexural stiffness must be reduced from the gross cross-sectional properties. This reduced value, referred to as the effective stiffness, $(EI)_{eff}$, is defined in Section I2 of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-22) (Section 2.2).

3 **True.** Direct bond interaction is only applicable to filled composite members, not encased composite members. The strength for this transfer mechanism is limited but does not require the installation of any component, which can be highly beneficial, especially for smaller filled composite sections (Section 3.1).

4 **True.** Simple connections between a beam and an encased composite member can be made directly to the structural steel section within the composite member using conventional simple connections such as single-plate shear connections, single- or double-angle connections, or shear end-plate connections. Rotational restraint of the beam provided by the concrete is typically neglected, and the beam is designed conservatively as a simple span member (Section 3.2).

5 **False.** For encased composite members, *Specification* Section I2.1a(b) requires that the detailing and placement of longitudinal reinforcing conform to ACI 318. The area of continuous longitudinal reinforcing must be at least 0.4% of the gross area of the encased composite member per *Specification* Section I2.1a(c). Conversely, filled composite members do not require longitudinal reinforcement per *Specification* Section I2.2a, although it can be used for additional strength. If longitudinal reinforcement is provided, a minimum amount of transverse reinforcement must be provided (Section 4.2).

6 **True.** When wet concrete is placed in the steel shape of filled composite members, the concrete introduces hydrostatic pressures on the walls that can deform the steel shape. In high-rise buildings, concrete pouring for several stories is common to speed up the construction process; however, the magnitude of hydrostatic pressure resulting from the wet concrete increases with pour height. The hydrostatic pressure is not critical for round HSS due to shape efficiency. However, for square and rectangular shapes, the outward pressure can cause bulging of the walls of the steel shape. Temporary braces or lateral reinforcement, such as those shown in Figure 4-5, can be added to minimize bulging (Section 4.3).

7 **d.** All of the above. The Composite Column Program, implemented in a Microsoft Excel macro-enabled workbook, is available for free download at **aisc.org/dg**. The workbook contains worksheets for round filled composite members, square and rectangular filled composite members, square and rectangular filled composite members constructed with high-strength materials, and encased composite members. The workbook computes axial compressive strength, axial tensile strength, flexural strength, shear strength. It also has interaction diagrams for combined axial compression and flexure. Refer to the notes in the "Information" worksheet for assumptions used by the program.

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**.

STEEL SOLUTIONS CENTER

Mindful of Movement

BY BRAD DAVIS, SE, PE, PhD

Recreational and sports facility design comes with many vibration challenges. These tips, equations, and tables cover many of them.

MODERN RECREATIONAL AND SPORTS FACILITIES are designed to accommodate a wide range of activities. Most have spaces for running, sprinting, rhythmic group exercises, and dropping barbells—all of which present unique and difficult vibration engineering challenges in design.

Vibration often controls design in recreational and sports facilities, so the framing might need to be stiffer than normal. In some cases, framing is atypical, so manual calculation methods do not apply, and a finite element modeling approach is needed. Some situations require special systems to result in satisfactory vibration levels. AISC Design Guide 11: *Vibrations of Steel-Framed Structural Systems Due to Human Activity* (download or order at **aisc.org/dg**) provides evaluation criteria for running and rhythmic group exercises, but not for sprinting and barbell impacts. This article provides recommendations for the latter two and highlights the necessity of considering acoustics. (Equations from Design Guide 11 are noted with a DG11 prefix).

Evaluation Criteria

For building design scenarios related to human comfort, the predicted sinusoidal peak acceleration, a_p, must not exceed an appropriate tolerance limit, a_o. This comparison expressed as acceleration ratios, is:

$$\frac{a_p}{g} \leq \frac{a_o}{g} \tag{1}$$

The limit represents a vibration level below which complaints are unlikely but not the threshold of perception, which is much lower. Design Guide 11 recommends limits for various occupancies. The limit is strongly influenced by whether the occupants are sitting or standing, what the occupants are doing, and the surrounding motion and noise. For example, in an office, occupants sit and work at computers, other occupants are mostly stationary, and background noise level is low. Thus, the limit is stringent: 0.5%g. In contrast, participants in an aerobics class are moving and the environment is noisy. They are likely to accept 4–7%g, eight to 14 times what office occupants typically accept.

Chapter 4 mentions a 3 Hz natural frequency lower limit to prevent vandal jumping, when mischievous occupants generate greater vibrations on purpose. For some activities, the recommended lower limit is higher, 4 Hz or 5 Hz. When this limit is violated, the first harmonic can cause resonance, so the typical acceleration prediction equations do not apply. Also, the acceleration is likely to be high unless the structure is massive and has high damping.

Design Guide 11 provides manual calculation methods in Chapters 3 through 6 and finite element analysis (FEA) methods in Chapter 7. The manual methods are typically used because they are easier to implement, and the design community has three decades of successful experience with them. FEA methods are used when the scenario is outside the scope of the manual methods or when they result in significant savings. Both frequently occur in recreational and sports facilities.

Recreational Tracks

Recreational facilities often include tracks for walking and running that are often elevated above sports courts. In some cases, the track is supported by bay framing with beams and columns. More often, the inside edge of the track is supported by hangers from long-span open-web steel joists to create a larger clear area below. An example is shown in Figure 1.

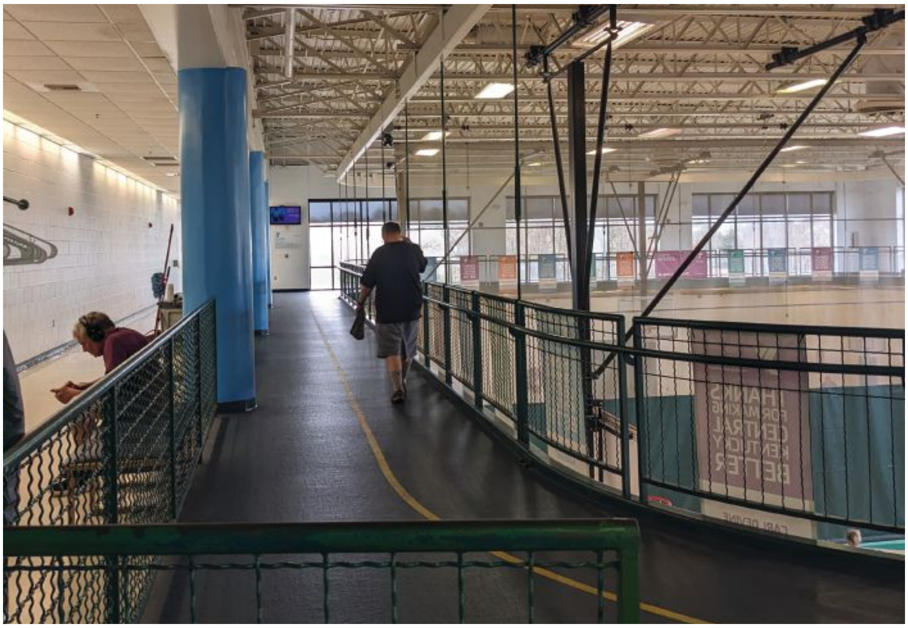


Fig. 1. Recreational track

Recreational tracks are like indoor pedestrian bridges, so the same limit, 1.5%g, is recommended. In some cases, other nearby occupancies could be affected, so appropriate limits should be determined. For example, the recommended limit in an adjacent office would be 0.5%g.

Recreational track dynamic forces are represented by the following Fourier series, which is used in Design Guide 11.

$$F(t) = Q + \sum_{i=1}^{N} \alpha_i Q \sin(2\pi i f_{step} t - \phi_i) \quad \text{(DG11 Eq. 1-1)}$$

where

Q = bodyweight, lb

i = harmonic number

N = number of harmonics considered

α_i = i^{th} harmonic dynamic coefficient

f_{step} = step frequency, Hz

ϕ_i = phase lag, radians

Design Guide 11 Tables 2-1 and 2-3 list harmonic frequency ranges and dynamic coefficients for walking and running, respectively, as shown in Table 1. The frequency range and dynamic coefficients for running are approximately double those for walking, so running is a more severe analysis case. Thus, if running is evaluated, it is not necessary to evaluate walking.

The first harmonic of the running force has a high dynamic coefficient (1.4). To prevent it from causing resonance, structures supporting running have a recommended natural frequency lower limit of 4 Hz.

When the track is supported by bay framing and the natural frequency is at least 4 Hz, the acceleration is predicted using Equation 2-16:

$$\frac{a_p}{g} = \frac{0.79Qe^{-0.173f_n}}{\beta W} \quad \text{(DG11 Eq. 2-16)}$$

where β is the damping ratio, f_n is the fundamental natural frequency, and W is the effective weight. For recreational tracks, Q is taken as 168 lb, a typical reference bodyweight in the design guide.

When the track is supported by the roof, a finite element model (Figure 2) is needed. The model is developed following the recommendations in Chapter 7 and used to compute natural modes and frequency response functions (FRFs). Often, the roof joist along the shorter segment of track, shown doubled in Figure 2, needs to be much stiffer than the other joists.

Preferably, all natural frequencies should exceed 4 Hz. In some hanging track scenarios, the vibrating mass is large due to the contribution of the roof, and the evaluation might be satisfactory even if the frequency is below 4 Hz.

The predicted acceleration due to one runner is:

$$a_p = FRF_{max} \alpha Q \quad (2)$$

where FRF_{max} is the maximum magnitude of the FRF in %g/lb.

If the natural frequency is below 4 Hz, the first harmonic can cause resonance, so α = 1.4. Otherwise, the dynamic coefficient is the following, which is a curve-fit of the second through fourth harmonic dynamic coefficients:

$$\alpha = 1.13e^{-0.173f_n} \quad \text{(DG11 Eq. 2-15)}$$

Group running amplifications are not usually considered for recreational tracks. If engineering judgment dictates that a closely spaced group of runners should be considered, then the acceleration can be predicted using:

$$a_{p,group} = a_p\sqrt{n} \quad (3)$$

where n is the number of runners in the group.

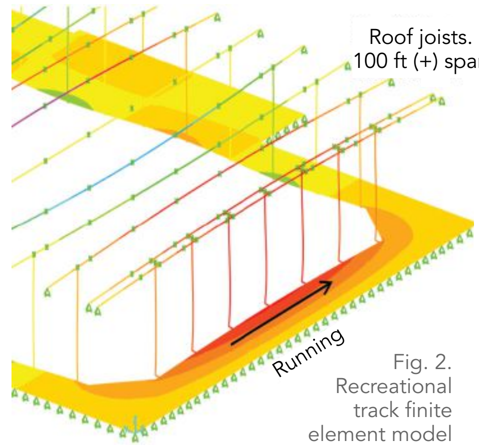


Fig. 2. Recreational track finite element model

Table 1. Fourier series parameters

i	Walking		Running		Sprinting*		Aerobics	
	if_{step} (Hz)	α_i	if_{step} (Hz)	α_i	if_{step} (Hz)	α_i	if_{step} (Hz)	α_i
1	1.6 – 2.2	0.5	1.6 – 4	1.4	4 – 5	1.9	2.0 – 2.75	1.5
2	3.2 – 4.4	0.2	4 – 8	0.4	8 – 10	0.9	4.0 – 5.50	0.6
3	4.6 – 6.6	0.1	8 – 12	0.2	12 – 15	0.5	6.0 – 8.25	0.1
4	6.4 – 8.8	0.05	12 – 16	0.1	—	—	—	—

* Based on limited data.

Athletic Tracks

Sports facilities sometimes include athletic tracks for elite athletes. In many respects, these are like recreational tracks, except scaled up. Athletic tracks can be hung from the roof to create a large clear area below for a sports practice field, resulting in roof truss spans of 200 ft or longer.

Athletic tracks are evaluated using Equation 1. The tolerance limit depends on the affected occupancies. Stationary occupants on the track are likely to tolerate accelerations slightly higher than the limit for an indoor pedestrian bridge (1.5-2.5%g). Seated occupants in quiet areas such as adjacent offices would probably only tolerate 0.5%g.

The acceleration is predicted for the anticipated events: middle-distance races and sprinting. In middle-distance races, the forces are similar to regular running, so the above equations for running apply. Athletes are closely spaced during competitive races, so group amplifications should be considered. The group size, n, is the number of runners in the inside lane in the high mode shape value area, such as the one shown in Figure 3, or the maximum number of runners in a race, whichever is fewer.

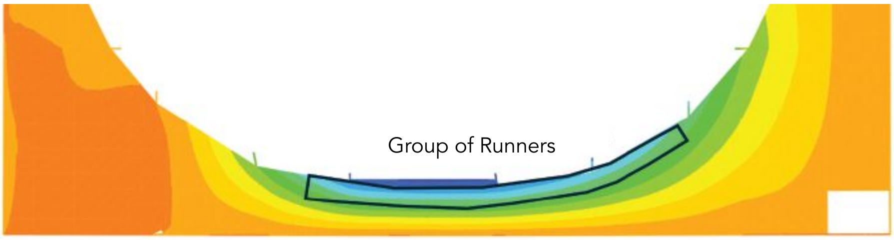


Fig. 3. Middle distance running group amplification

During races such as the 60-meter and 100-meter dashes, elite sprinters achieve high speeds primarily because they apply higher forces, but also because their step frequencies are higher. As shown in Table 1, the dynamic coefficients for sprinting are significantly higher than those from running.

The natural frequency should be high enough to prevent the first harmonic from causing resonance, so it should be at least 5 Hz. Interestingly, the second harmonic can only excite natural frequencies between about 8 Hz and 10 Hz, so there is a gap between 5 Hz and 8 Hz. To excite natural frequencies in this range, the step frequency would have to be between 2.5 Hz and 4 Hz, so the activity would be running instead of sprinting. A similar gap exists between 10 Hz and 12 Hz. This can be considered in the acceleration predictions.

Design Guide 11 does not include a prediction equation for sprinting. When the track structure has bay framing, the predicted acceleration due to one sprinter can be predicted using the following manual calculation equation, with α taken from Table 1.

$$a_p = \frac{R\alpha Q}{\beta W} \qquad \text{(DG11 Eq. 2-3)}$$

When the track structure is supported by hangers and roof framing, the manual methods do not apply, so a finite element model must be used to determine modal properties. The acceleration caused by one sprinter is computed using Equation 2 with α from Table 1. For sprints, group amplifications should be considered using Equation 3. Each athlete must stay in his or her lane, so n is the number of lanes.

Gyms with Sports Courts

Recreational centers and schools often include gyms for basketball, volleyball, for physical education classes. Some gyms have bleachers for seated audiences, and some share framing with offices or other quiet areas. These gyms are occasionally on framed floors, making vibration an important consideration. Potential activities are walking, running, rhythmic group "lively concert" in the bleachers, and rhythmic group exercises—listed in ascending order of severity. If the gym floor might include group exercises, such as a group of students performing jumping jacks, then the floor should be checked for an aerobics class loading using Chapter 5 or 7. The evaluation is satisfactory if Equation 5-1 is satisfied.

$$\frac{a_p}{g} = \frac{\sum a_{p,i}^{1.5}}{g} \le \frac{a_o}{g} \qquad \text{(DG11 Eq. 5-1)}$$

The limit, a_o, depends on the affected occupancies. In the example shown in Figure 4, there are several affected occupancies with different limits. Exercise participants in the gym are likely to tolerate high accelerations (4–7%g), but occupants of the offices to the plan-west would likely only tolerate 0.5%g. The collaborative learning area to the north does not correspond to a category in Design Guide 11, but from my judgment, 1%g is a reasonable limit.

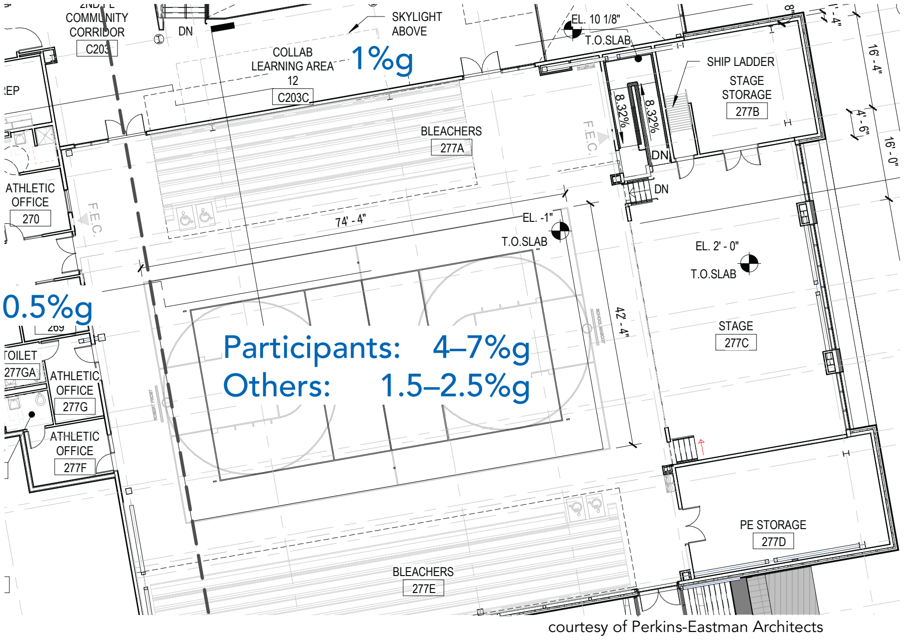
The predicted acceleration caused by each harmonic can be computed manually using Equation 5-2, which is specialized for regular framing. Another option is to use a finite element analysis approach and Equation 7-9.

$$\frac{a_{p,i}}{g} = \frac{1.3\alpha_i w_p / w_t}{\sqrt{\left[\left(\frac{f_n}{if_{step}}\right)^2 - 1\right]^2 + \left(\frac{2\beta f_n}{if_{step}}\right)^2}} \qquad \text{(DG11 Eq. 5-2)}$$

$$a_{p,i} = FRF(if_{step})\,\alpha_i w_p \qquad \text{(DG11 Eq. 7-9)}$$

where w_p is the weight of class participants and w_t is the total weight of the floor plus participants, both in psf, and $FRF(if_{step})$ is the FRF magnitude in %g/psf at the harmonic frequency if_{step}.

The step frequency range and dynamic coefficients for aerobics are summarized in Table 1. The first and second harmonic forces, $w_p\alpha_1$ and $w_p\alpha_2$, are high, so preventing them from causing resonance is important. The force due to the third harmonic is six times lower than the force due to the second harmonic.



courtesy of Perkins-Eastman Architects

Fig. 4. Gym floor plan

The second harmonic can only reach up to approximately 5.5 Hz. Thus, a floor design is a lot more likely to have a satisfactory vibration evaluation if the natural frequency exceeds approximately 6 Hz. With rhythmic groups, natural frequency is the overwhelmingly dominant parameter, so it is important to avoid long spans. Consider a design that needs a natural frequency of at least 6 Hz. If the span increases from 30 ft to 50 ft, the framing must be almost eight times stiffer. The FEA method in Chapter 7 results in higher predicted natural frequencies, so it can result in significant savings in these analyses.

If bleachers are present, especially in a school gym, events such as pep rallies could cause significant vibrations. These should be evaluated as a "lively concert" using Chapter 5 or 7. When the floor will not be subjected to rhythmic groups, it should be evaluated for running using the method in the "Recreational Tracks" section. If the floor is evaluated for rhythmic groups or running, there is no need to evaluate it for walking.

Acoustics is a critical consideration for gyms, especially multi-story facilities with classrooms or offices above. If the basketball goals are supported by the floor framing above, basketballs striking the backboard or rim would cause structure-borne noise in the spaces above. Without a special acoustic design, the low-frequency transient noises might be intolerable.

If a quiet space is below the gym, preventing noise in those areas from basketballs bouncing on the gym floor might require a special ceiling design. A gym floor subject to rhythmic groups might cause ceiling movements that occupants below can detect, and prevention might require supporting the ceiling by light framing between the columns rather than suspending it from the gym floor. If doubt about sound transmission exists, an acoustics consultant is a valuable team addition. AISC Design Guide 30: *Sound Isolation and Noise Control in Steel Buildings* (**aisc.org/dg**) is also a helpful resource for this subject.

Gyms with Barbell Impacts

Gyms with barbells have been around for decades, but new exercise trends and

Fig. 5. Barbell plates (a.) standard barbell plate (b.) bumper plates

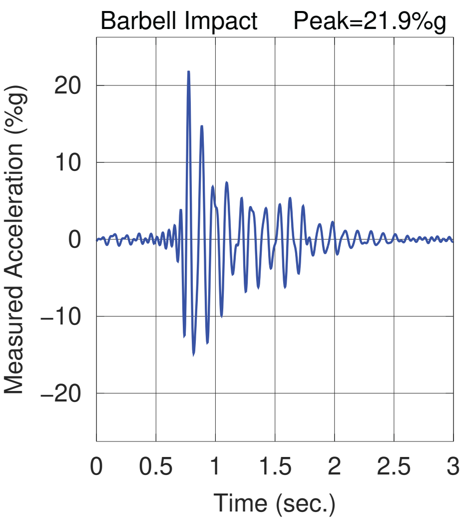


Fig. 6. Example acceleration due to barbell impact

gym equipment have introduced challenges. Previously, gym occupants used standard uncoated barbell plates (Figure 5a) or plates with a thin rubber coating. These plates are rarely dropped hard onto the floor because the sharp edges could damage the flooring, the noise would be very loud, and the plates or bar could be damaged. In the last two decades, though, gyms have provided "bumper plates" with thick rubber coatings (Figure 5b). They are designed to be dropped from overhead without damaging gym flooring, and the resulting noise is loud, but not extremely loud.

Some gyms include slightly raised platforms for these activities. Some offer group classes with several members lifting and dropping barbells repeatedly, sometimes dozens of times during a 30-minute session. Vibration and noise due to barbell impacts must be considered when designing these gyms.

Barbell impacts cause impulse responses (Figure 6). Design Guide 11 does not include tolerance limits for impulse responses to barbell impacts, so these are my recommendations for them based on limited research data: Class members tolerate high accelerations, perhaps up to 30%*g* (instantaneous peak). They are on their feet participating in the activity. Occupants in quiet areas such as offices are likely to accept only about 0.7%*g*.

The response in Figure 6 was caused by a 245-lb barbell dropped from shoulder height onto a framed floor with a 90-psf self-weight and approximately 30-ft square bays. The impact caused an impulse response with an instantaneous peak acceleration of about 22%*g* and a very loud noise. Gym occupants would probably consider this response acceptable, but in offices two or three bays away, the peak acceleration would be around 2–3%*g*—which would not be considered acceptable.

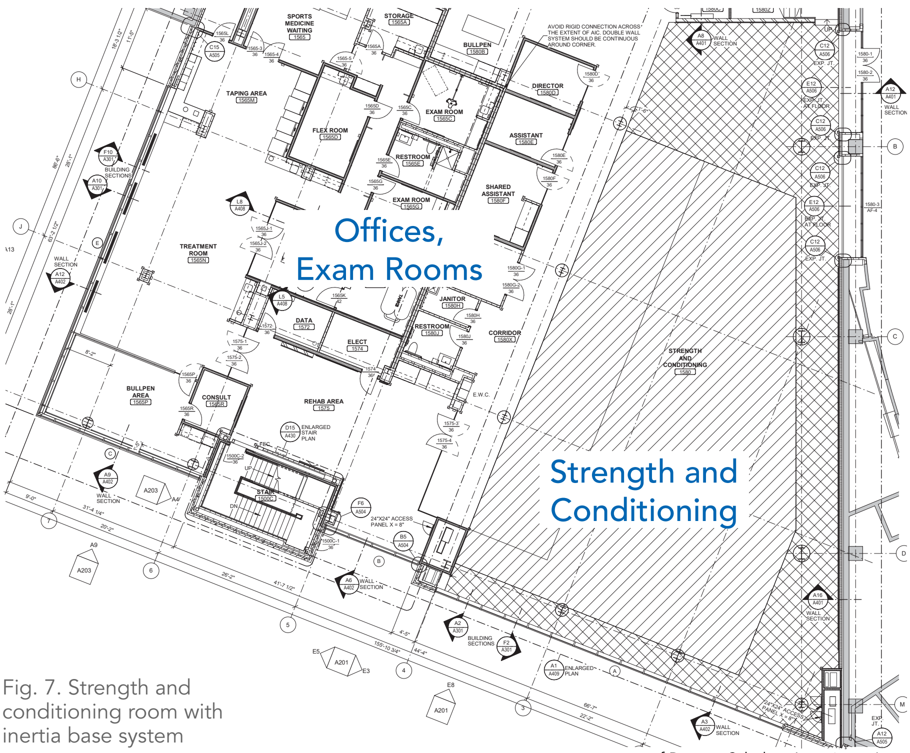
Because human ears are sensitive, especially to low-frequency transient noises, acoustic design for barbell impacts is likely to be even more challenging than vibrations. Airborne vibration is relatively easy to address in the design of partitions and ceilings. Structure-borne vibration is another story. Barbell impacts cause vibrations that are in the audible range, starting at about 20 Hz. These vibrations propagate through the structure. When the vibrations reach other areas of the building, they cause structure-borne noise that is transient and low frequency. Even if the noises are below the background noise level, occupants might find them objectionable.

Ideally, if barbell impacts will be a regular activity in the gym, and there will be more sensitive occupancies in the building, the gym should be supported by a slab-on-grade. If the gym will be on an elevated floor, the team should consider a structural separation to prevent vibration from propagating from the gym to quiet spaces.

Structure-borne noises can propagate through "acoustical short circuits." For example, if there is a structural separation in the floor, vibrations might be transmitted up the columns, into framing above, and propagate to other areas. Similarly, vibration might even be transmitted through non-structural components such as ceilings and partitions. This illustrates the importance of having an acoustics consultant on board.

Another option for an elevated floor is a specialized inertia base system. Figure 7 is a partial floor plan of a university athletic training facility with a strength and conditioning area adjacent to offices and other sensitive occupancies. The shaded area is an inertia base system with a recessed structural slab, an air gap with helical steel springs, and a floating 10-in.-thick normal weight composite slab. The massive floating slab absorbs much of the energy of barbell impacts and limits the forces transmitted to the structural slab, thus decreasing vibrations and structure-borne noise propagating to the quiet areas. In this example, the inertia base slab, springs, and airgap were selected by a vibration isolation specialty designer. I developed a SAP2000 model using the recommendations in Chapter 7 to evaluate the applicable analysis cases.

These three barbell-drop design options are much more likely to be feasible if they are presented to the owner and architect early in the design process. Because acoustics will likely present challenges, an acoustics consultant should be a part of the design team.



courtesy of Berners Schober Associates, Inc.

Fig. 7. Strength and conditioning room with inertia base system

Early involvement benefits often extend beyond recreational and sports facilities with weightlifting spaces. Communication with the owner and architect when design begins and effective consideration of vibrations and acoustics should result in a successful project with satisfied occupants. ■

Brad Davis (**bradd@davisstructures.com**) is the owner of Davis Structural Engineering and an associate professor in the Civil Engineering Department at the University of Kentucky.

A Taste for Teaching

INTERVIEW BY GEOFF WEISENBERGER

A chance to fill in as an adjunct professor pulled Matt Reiter toward a full-time academic career. Five years in, he teaches various design classes and is developing guiding principles for an engineering buzzword.

MATT REITER has achieved a lot in his nearly five years as a full-time engineering professor at Cornell University.

Reiter, a professor of practice in Cornell's School of Civil and Environmental Engineering, is the faculty director for the university's structural master's of engineering program. In 2025, he was an AISC Innovation Scholar, a program where chosen educators collaborate with AISC staff on a steel-focused project, largely during a two-week residency at AISC headquarters.

None of it happens without the opportunity to teach, which came about because he was in the right place at the right time. Reiter came to Cornell for a technical position, and nearly 10 years after arriving, he was asked to teach a steel design class when a faculty member went on sabbatical. He was hooked after one semester and shifted career gears to academic when the chance arose. He spoke with *Modern Steel Construction* about his career, pivoting to academia, his Innovation Scholar project, and more.

Where are you from and where did you grow up?

I was born in Joliet, Ill., and raised a few towns over in New Lenox. The Innovation Scholar residency at AISC headquarters in Chicago was like coming home. Almost everyone in my family is still there, including my mom and siblings.

Were you set on engineering right away?

I loved physics in high school, which set me up for engineering. I love thinking about how things are put together and built. I originally went to college focusing on mechanical engineering and then shifted into civil engineering halfway through my undergraduate work at Villanova University, where I earned my bachelor's and master's. After various internships and work opportunities, I decided I didn't enjoy heat transfer or thermodynamics and found my way into structures and civil engineering. I really liked the practical aspect of building.

Has academia been your career focus?

I was a practicing structural engineer for a while. My first job was in Chicago for the city's bureau of bridges. I worked on the city's 37 bascule bridges as a field engineer. From there, I volunteered internationally in Honduras for a nonprofit organization building a school at a home for children. It was all masonry and concrete construction. There isn't a lot of steel construction there, although we did use light-gauge steel trusses as the roof system. I next transitioned to Thornton Tomasetti in its Philadelphia office. That was my first consulting experience and formative for my career.

Do you have a memorable steel project from your career that was an important learning experience or a point of pride?

I took a lot of pride working with the trades on Chicago's bridges as my first job. My most memorable was one of my first projects at Thornton Tomasetti: Miller

Park (now American Family Field) in Milwaukee, Wisc., where the Milwaukee Brewers play. It had already been built, but I helped with repairs on its movable roof, which was having some problems. That was neat to jump into a building that wasn't performing as intended. It has long spans, heavy steel, and a 10-million-lb roof system that moves on a pivot and drive mechanism. It was inspiring to see the possibilities with steel.

What led you to academia?

I started at Cornell in a non-teaching role. I've been there for 14 years, but the first 10 were in the facilities engineering department, an in-house architect engineering firm that supports the university from the owner's perspective on all their projects. It involved taking care of building maintenance needs, developing standards and reviewing projects.

In that role, I had the opportunity to teach a steel class as an adjunct professor when one of the faculty members went on sabbatical. It was the pandemic year, so my first teaching experience transitioned to virtual mid-semester. But I loved it. What inspired me was being around a lot of talented engineers and builders in my previous experiences and having the opportunity to think about what separates the good from the best. I felt like I could distill some of those qualities and skills for the students. I put a lot of thought into that and was really energized by it. A couple of years later, a full-time teaching track position came open, I applied, and I was hired.

What was it like getting in front of a classroom the first time?

It's nerve-racking. Even now, in my fifth year of teaching, I get nervous before teaching. Sometimes I get really quiet the night before I teach. My kids wonder, "What's wrong with dad? Oh, he's teaching tomorrow." I liken it to the kickoff of a football game. There are all the nerves and anticipation for that moment, but that's good because it keeps me energized.

The students keep me on my toes. They ask such good questions and are so engaged. I feel like they bring out the best in me. They challenge me to explain things better and to deepen my own understanding.

My current course load has two classes in the fall and three in the spring. My fall classes are a combined reinforced concrete and reinforced masonry class and a structural steel and concrete systems class. The spring teaching load is a timber class, undergraduate steel design, and a master's project class. I have the most experience teaching steel, and I think it's my strength.

How did you find out about the Innovation Scholar program and what led you to apply?

AISC provides so many great educator resources. I heard about the Innovation Scholar program when it first launched in 2024, applied then, and wasn't selected. I talked to AISC vice president of engineering and research Chris Raebel to get some feedback on my proposal, which gave me a year to think about what I would do differently. I thought about my proposal as a way to help my students, other educators, and the industry, but also help me personally. I was inspired to apply by an idea I've thought about for a while, and the opportunity to work with AISC to deepen it and push it further was compelling.

What idea did you prepare and how did collaborating with AISC help?

The idea I proposed is resiliency. It's a buzzword I see all over the industry and in academia, but I don't think there's a well-defined use of resiliency or how we can implement it. I wanted to take those 10,000-ft ideas about resiliency and bring them down to something practical that can be implemented.

I attempted to develop a framework where engineers, contractors, and building owners can take the idea of resiliency and implement it with practical steps. I didn't know what to expect coming in, but I met with 18 mostly technical AISC staff over two weeks in small-group meetings to talk about this idea of resilience and their perspective on it. Where do they see it? Where are the opportunities? Where do they see the flaws? That was an incredible opportunity to take an idea, push it, form it, and challenge it.

What are your thoughts on the future of civil and structural engineering, and do you have advice for students going down that path?

I've noticed a big push toward students pursuing computer science and computer engineering. I'll be curious if that shifts with the development of AI. But the civil engineering students I've met and taught are so driven to make an impact. I think our future is in good hands. They're hands-on problem solvers, and they're looking to make a difference. I feel like the role of structural engineers is front and center helping our world navigate challenges with sustainability considering embodied carbon or resiliency to make our structures last as long as they can.

What have you enjoyed about living in Ithaca, N.Y.?

It's in the middle of the Finger Lakes region, so there are a lot of outdoor activities. People say you really need to embrace winter. That means finding an outdoor hobby, whether it's snowshoeing or cross-country skiing. It's also known for beautiful waterfalls.

Anyone who loves architecture would really enjoy Cornell's campus. It has two hidden gems. I would suggest going to the A.D. White Library, a multi-story old-fashioned library with brass railings. It's an idyllic place to study and read a book. Myron Taylor Hall, the law school library, is what you'd envision in Harry Potter with big wood ceilings and green desk lamps. It's a steel structure, even though you wouldn't know it from how it was originally built with transitional masonry.

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

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

Drilling Down on Documentation

BY BAILEY LACKEY

These documentation tips will help quality assurance remain a priority and point of pride for steel fabricators and erectors as their workforce evolves.

THE FIRST THOUGHT associated with documentation is often a negative one. For many, it conjures thoughts of paperwork, checklists, and administrative follow-ups after completing work. If documentation is done on paper, it's easy to wonder if it's obsolete. But it remains important and relevant, whether it's on paper or digital. Documentation is how steel fabricators and erectors demonstrate that work was done correctly, safely, and to specification.

Documentation isn't optional for fabricators and erectors working under AISC certification—it's embedded in the process. Material receiving records, fit-up inspections, weld maps, and bolt tension logs are not just tasks on a checklist. They are the verifiable trail of quality.

The challenge now is generational. As newer tradespeople enter the workforce, many traditional documentation methods like clipboards, paper forms, and handwritten notes feel outdated and inefficient. Younger workers are accustomed to digital tools, mobile interfaces, and real-time communication. To build a culture of quality that lasts through multiple workforce generations, fabricators and erectors must evolve their methods for documenting work. It's not about chasing trends or adding complexity. It's about making documentation accessible, relevant, and integrated into the work.

Start with the Why

Before implementing new systems or tools, it's important to reshape how teams perceive documentation. Too often, it's viewed as an administrative burden done after the fact to satisfy a third party. But when done well, documentation has two essential purposes: protect the fabricator and erector and affirm quality of the work.

If a weld fails after installation, proper documentation shows it was completed according to procedure. If material is rejected on-site, the receiving log verifies it was inspected and accepted at delivery. If bolt tensions are questioned during final inspection, torque tool records and check sheets provide assurance.

Documentation is part of professional pride. Company leaders should frame it as such when discussing it with their employees and implementing new documentation procedures. When teams understand that it's a reflection of their craft and a safeguard for the company, they engage with it differently and bring a sense of urgency rather than view it merely as busy work. Toolbox talks that share real-world examples where documentation prevented rework or protected the company during a dispute resonate with employees far more than policy reminders.

Modernize the Tools

One of the simplest ways to improve documentation is to move away from paper-based systems. Traditional forms are prone to damage, loss, or retroactive completion, which undermines their purpose. Today's crews are equipped with smartphones and tablets, and younger workers are highly technology-literate. Documentation systems should reflect that reality. These tools can help modernize documentation:

Google Forms or Microsoft Forms. These are customizable checklists that can be completed on any device.

Field management platforms like Procore, Raken, or Fieldwire. These are ideal for larger operations requiring integrated quality assurance and quality control tracking.

Markup tools like Bluebeam. Allow teams to annotate PDFs, add photos, and record notes directly in the field.

Make Visuals Part of the Process

For many teams, visual information is faster to process and more effective than written descriptions, especially when on the jobsite or in the shop. Incorporating photos and video into documentation eliminates ambiguity and supports better decision-making.

Universally applicable visual quality assurance strategies can include taking photos of material tags during receiving, documenting fit-up conditions and bolt patterns before and after installation, marking issues directly on images, and including "OK" or "Needs Correction" notes.

Short training and verification videos can demonstrate procedures such as torque wrench calibration, weld prep, or proper bolt installation. These can be recorded on a smartphone and stored in a shared drive, creating a valuable internal reference library that's easy to consume and use away from a desk. Visual documentation improves consistency, reduces misinterpretation, and reinforces expectations across the team.

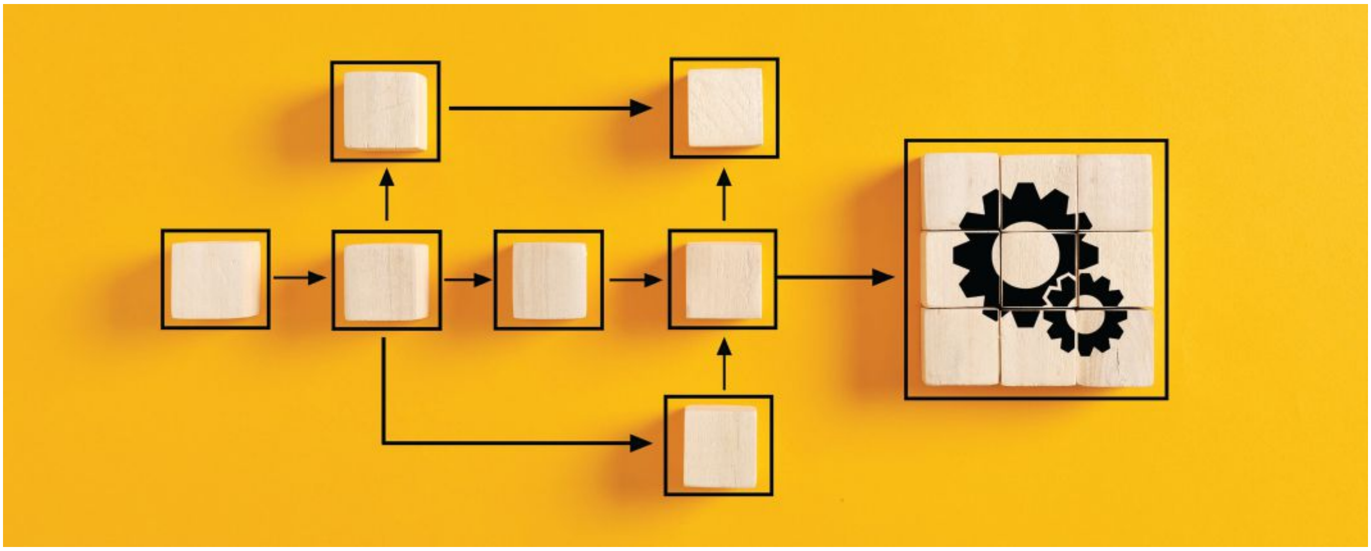
Build Better Templates

I have often seen quality assurance forms that feel like they were designed for engineers, not field personnel. If you want employees to engage with documentation, give them simple, clear, functional, and intuitive tools and templates.

Effective template design is mobile device-compatible, has checkbox and dropdown formats, contains space for notes and photos, and is written in straightforward, task-focused language.

Examples:

- Weld Map Log: Weld ID → Welder → WPS # → Result → Photo
- Fit-Up Log: Joint ID → Gap size → Inspector initials → Notes
- Bolt Record: Bolt type → Lot Number → Torque value → Wrench ID → Date → Visual confirmation



Consider involving your field crews in template design. It will give them a sense of empowerment and ensure the final template is easy for them to use. Ask what would make documentation easier or faster without disrupting their workflow. Their input will improve adoption and quality.

Integrate Documentation into the Workflow

Documentation should be part of the process, not a laborious process to be completed at the end of the shift. If you want accurate, real-time records, make it easy for crews to document as they work. Effective in-process quality assurance can be taking photos of steel tags during offload, recording welder info before striking an arc on a critical connection, or logging bolt tension values during installation, not after the fact. Use visual boards or tablets at workstations to track tasks in real time. Crews can mark progress without leaving their station, reducing downtime and improving accuracy.

Training and Recognition

Quality assurance records aren't just about compliance. They're also valuable to workforce development and new employee training, especially for entry-level workers. Effective training with documentation strategies include reviewing previous quality assurance records to show examples of good and poor practices, using checklists to teach expectations during layout, welding, and assembly, or posting reference images or annotated drawings near workstations as visual reminders. For example, consider creating a "Fabrication Standards Board" featuring photos, diagrams, and notes highlighting key quality criteria. A resource like this reinforces expectations and helps standardize training.

Recognize Quality and Accountability

If a company wants to build a culture of quality, recognition matters. When documentation is consistently accurate, thorough, and timely, it should be acknowledged.

Recognition tactics can be highlighting standout documentation during weekly safety or quality assurance meetings, offering small incentives (such as gift cards, team lunches) for consistent performance, or featuring a "Quality Contributor of the Month" to reinforce positive habits. When teams see that quality documentation is noticed and valued, it becomes part of the professional standard, not just a task to complete.

Prepare with Confidence

Whether you're already AISC-certified or preparing for your audit, your documentation system will be reviewed. But that doesn't need to be a source of stress. If you've built a culture of quality, the paperwork will reflect it.

AISC auditors look for consistent, traceable quality records, templates aligned with your written procedures, evidence of real-time documentation, and crews who understand and follow a company's quality management system. For more tips when preparing for an AISC certification audit, read the "At Ease" article in the January 2025 issue at **modernsteel.com/archives**.

Start by auditing yourself monthly. Look for gaps, inconsistencies, or areas where clarity could improve. Use those insights to refine your process. Unplanned internal audits are an effective addition to an internal audit system. They can be performed when you have identified a breakdown in your systems or a trend in identified nonconformances.

See it and Show it

Documentation doesn't have to be tedious or disconnected from the work itself. When done right, it's a powerful tool for protection, accountability, and pride. By modernizing tools, simplifying templates, and integrating quality assurance into the daily workflow, fabricators and erectors can create a culture where documentation is part of how the job gets done and done well.

Bailey Lackey (**bailey.lackey@trcfab.com**) is a quality assurance manager at TRC Fabrication, an AISC full member and AISC-certified fabricator in Idaho Falls, Idaho.

Steel on Schedule

BY TODD R. CAMPBELL, PE AND CHRIS GOTTSCHALL

Close coordination between project team members maximized structural steel's cost and construction speed advantages.

Bruce Damonte

opposite page: The 20-story Honickman Center had a rigid five-year schedule from design to opening.

SPEED
FEATURE STORY

The pleated glass façade is the building's signature element.

Bruce Damonte

A MEDICAL CENTER in Philadelphia had a non-negotiable budget and five-year schedule, and choosing structural steel for its frame helped the architect and structural engineer adhere to both.

The project team for the Jefferson Health Honickman Center, a 20-story, 450,000-sq.-ft medical building, leaned on tight coordination and leveraged partnerships to find schedule savings and stay within the budget. Design began in 2019, and the key schedule-reducing measures—and by extension, cost reductions—came in design and fabrication. More than 5,700 tons of steel were included in the bid, and the mill order was fast-tracked using quantities from the 100% design development drawing package. The design team simultaneously worked towards producing the 100% construction documents, all with the aim of reducing the overall schedule and procuring steel ahead of the economic challenges of COVID.

Structural engineer of record IMEG and fabricator Cives Steel collaborated to complete all connection design. Cives hired IMEG to design non-major connections that were part of the fabrication package rather than hiring another engineer to design and stamp those connections for IMEG to then approve. By hiring IMEG for all parts of connection design, Cives received connections optimized for its shop standards and enhanced by IMEG's knowledge of the building design. Their partnership helped avoid costly RFIs and delays, reinforcing the time- and budget-conscious approach throughout construction.

The Honickman Center's success also hinged on structural steel's unmatched ability to address the building's robust programming scope. The building brings together 19 previously dispersed specialty clinics—including oncology, urology, cardiology, and digestive health—into one integrated hub. It had a demanding structural program, including rigorous serviceability criteria for imaging and procedure spaces and similarly demanding criteria to meet acoustics privacy needs, complex truss transfers, high floor-to-floor levels and challenging façade support requirements. Steel's high strength-to-weight ratio enabled longer spans and minimized the number of columns, allowing for larger, open clinical areas that support project goals like flexible room layouts and future reconfigurations.

Philadelphia zoning rules meant the building had to keep a sightline to City Hall.

Bruce Damonte

Framing and Vibrations

Zoning requirements mandated the building have vertical setbacks to keep a sightline to Philadelphia's historic City Hall. This meant IMEG's structural design needed to accommodate building setbacks with transfer beams and special detailing to horizontally transfer some of the building's lateral force-resisting frames. The architect used one of the setback areas as an outdoor roof terrace space at the 15th floor, which required IMEG to provide special support details for an 8-ft-tall glass screen wall.

The superstructure design implemented structural steel with a minimum LOD of 350 as the basis of design instead of typical industry standard LOD of 300. Due to intense mechanical, electrical, and plumbing systems, gusset plates, bolts and angles for truss and braced frame connections were 3D-modeled to coordinate with those systems. The coordinated model saved time by discovering potential conflicts during design, avoiding costly field conflicts and modifications. High ceiling heights meant beam web penetrations and beam end notches were required in Level 2 beams to allow for MEP distribution.

IMEG

The truss framing system without the façade (above) and with the façade (right) on the third floor is part of a cantilever over the entrance driveway. HSS outriggers for façade support are visible in the framing photo.


IMEG


Bruce Damonte


Bruce Damonte

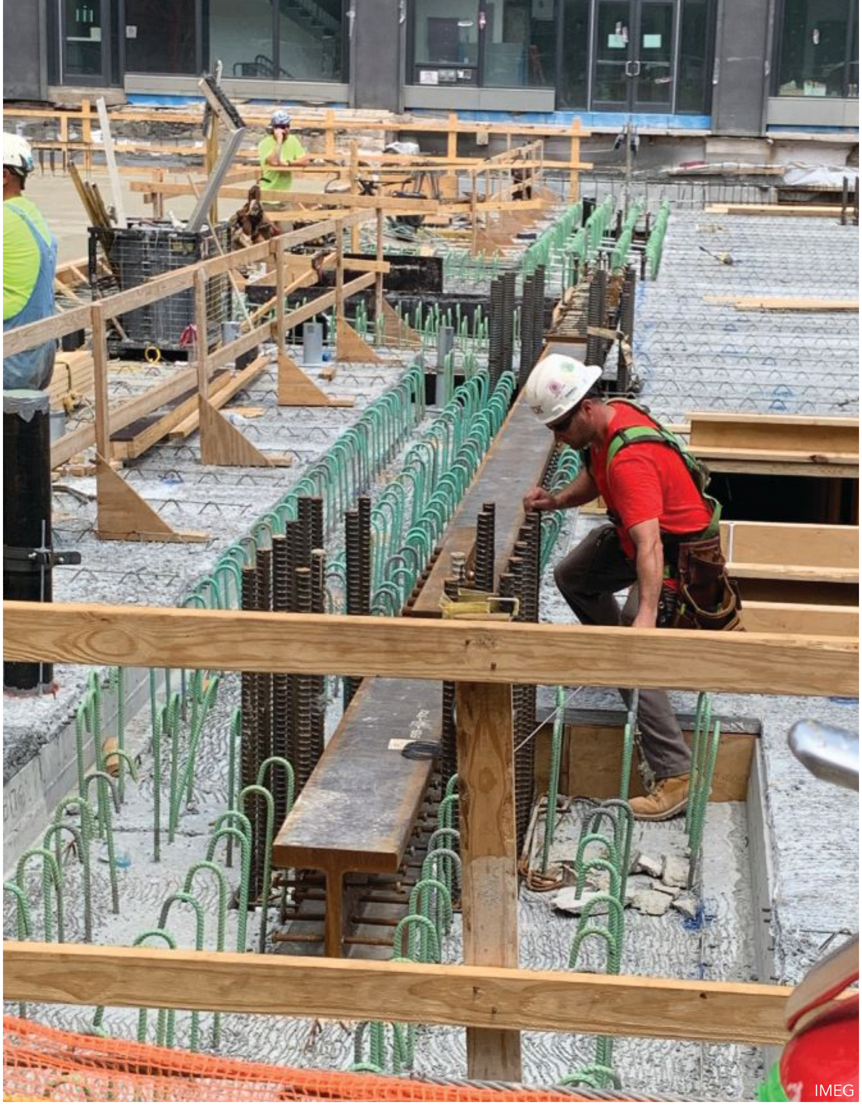
above: A 42-ft-deep mechanical well required vertical truss frames to support mechanical screen walls and shield large rooftop equipment.

left: The Honickman Center has about 5,700 tons of steel.

IMEG also undertook vibration analysis to ensure imaging, surgical, and exam floors met Facility Guidelines Institute (FGI) guidelines for outpatient facilities. The steel design needed to meet strict vibration criteria, especially for imaging floors with MRI and CT scanners, which are located over a mechanical room of 2,000 μ-in. per second. IMEG provided criteria on the structural drawings to restrict the direct attachment of mechanical systems to the fourth floor's steel.

The rooftop mechanical systems needed catwalk framing at the roof and within the mechanical rooms. A 42-ft-deep mechanical well required vertical truss frames to support the tall mechanical screen walls and shield large rooftop equipment such as emergency generators and cooling towers sitting on dunnage framing.

Eight transfer trusses supporting Level 4 range from 15 ft to 30 ft deep and transfer columns above, accommodating an open ground-level lobby. Likewise, the rooftop mechanical penthouse and third-floor mechanical room demanded careful integration of steel framing and building systems to support heavy equipment and meet acoustic performance targets.



above: An embedded W-shape in the concrete garage structure is part of the transfer system for the building's shear forces.

Garage Transition

The building rests atop the concrete columns and walls of a 120,000-sq.-ft, three-level, below-grade cast-in-place concrete garage. The transition from concrete to steel required meticulous structural planning, including the use of a full-building mat foundation up to 8 ft thick. IMEG developed details to transfer gravity and lateral loads into the concrete structure, using embedded W12×279 members as drag struts for the transfer.

The building's western plaza was also designed with adaptability in mind. The below-grade structure includes overbuild capacity on its west side for future office or residential space, along with a connecting bridge, a strategic investment in long-term flexibility. Above this base, structural steel provided the versatility and ease of integration that enabled the team to overcome both technical and spatial constraints.

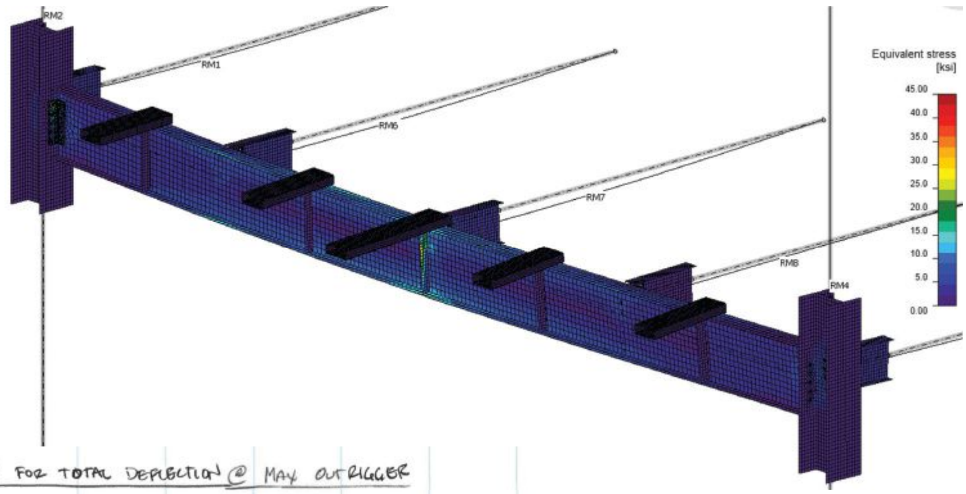
Grade 65 steel was used for W-shape columns, ranging from W14×90 through W14×730 sections. Because of high loads from transfers and tall floor heights at ground level, the largest-rolled W14 columns were not sufficient at all column locations. Box columns weighing more than 1,000 lb/ft were built-up from plates to support the loads at a few locations. Plates were up to 6 in. thick in the built-up shapes and some baseplates. IMEG also provided built-up I-shaped columns as alternatives to W14×808 and W14×873 sections. All plate thicknesses were sourced as grade 50 A572.

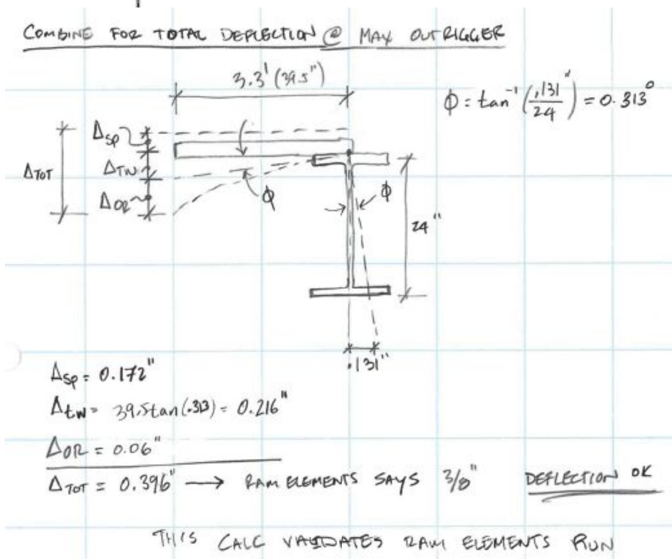
Fitting the Urban Fabric

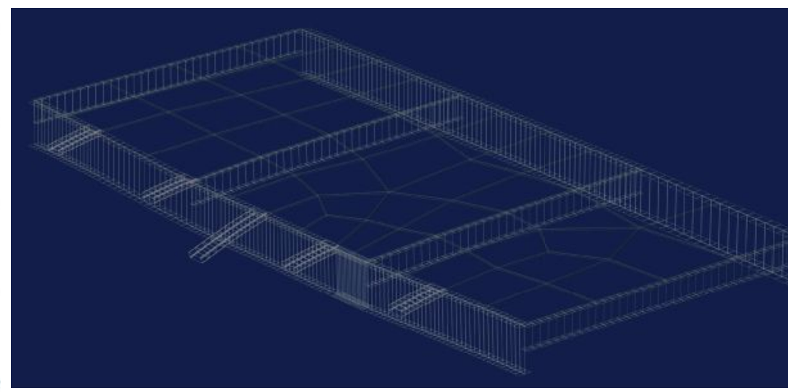
Architecturally, the building's sculpted glass façade—resembling pleated fabric—pays tribute to Philadelphia's textile heritage. The façade design choice enhances the urban skyline while also improving thermal performance through strategic fritting and shading.

IMEG studied multiple design options to support the curved curtain wall façade, including straight slab versus faceted slab edges, rotation of floor deck at the perimeter, "diving board" plate detail, and the chosen scheme, HSS outriggers off spandrel beams. Due to the curved nature of the curtain wall façade system, more than 1,000 HSS outriggers of various lengths and miscellaneous bracing were required. Estimated tonnage for façade support steel was over 50 tons.

A typical façade support with curtain wall connections.







above: Analyzed façade support spandrel beams with FEM models and hand calculations validating torsional capacity and stiffnesses.

below: A typical HSS outrigger support for the façade.


IMEG

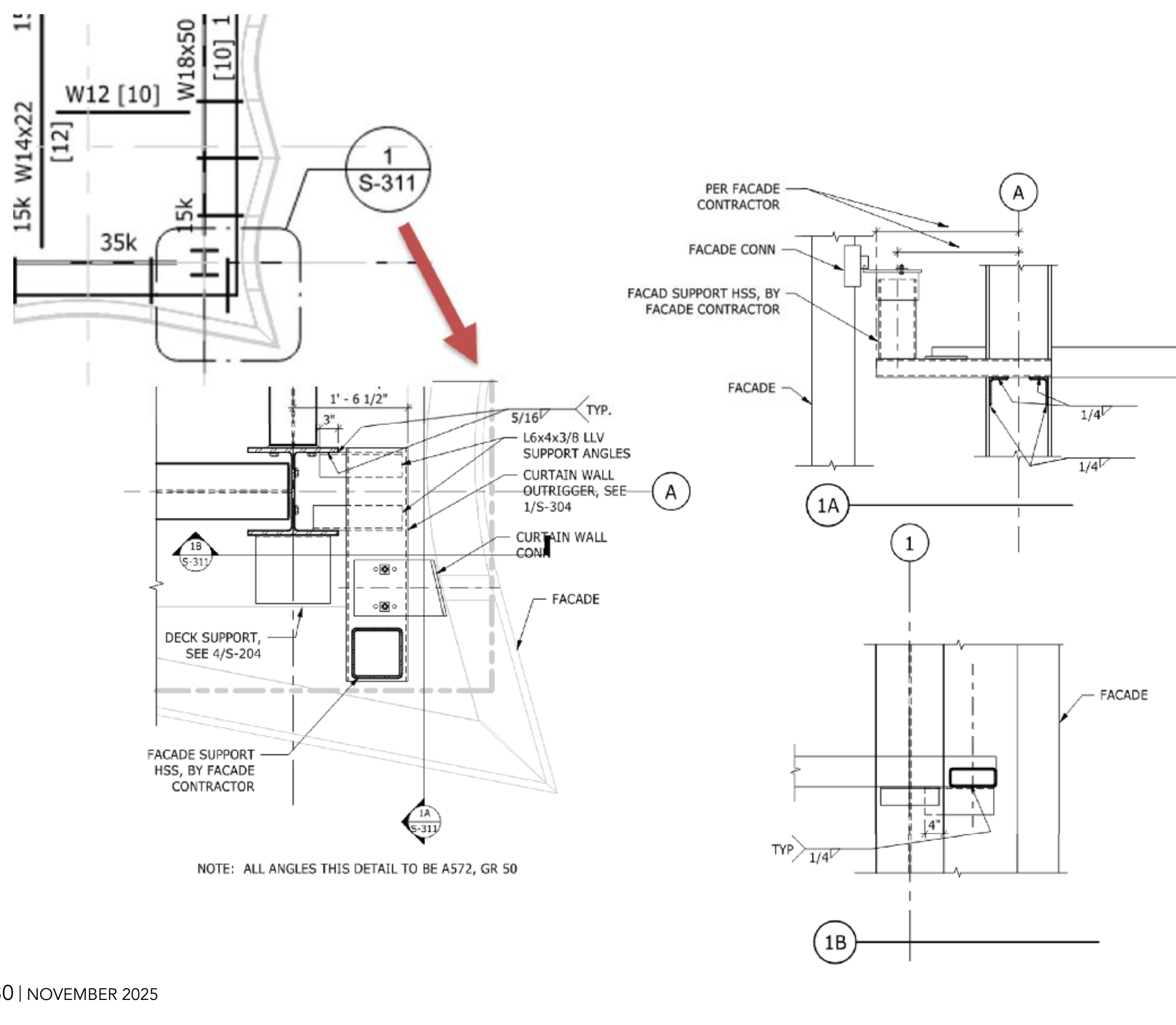
Design of the spandrel beams to support the façade required careful analysis, as the curved nature imposed significant torsional moments on W-shape beams. IMEG used finite element and hand calculations to size spandrel members for strength and stringent deflection limits.

Coordination of this façade system required significant effort with tower architect Ennead Architects, envelope consultant Heintges, and design assist façade contractor New Hudson Facades. IMEG participated in more than 80 coordination meetings for the façade and developed more than 20 unique perimeter support details.

Inside, the structural layout enabled design elements, such as expansive “sky lobbies” featuring natural light, floor plate transitions to preserve city views, and garden-integrated oncology suites.

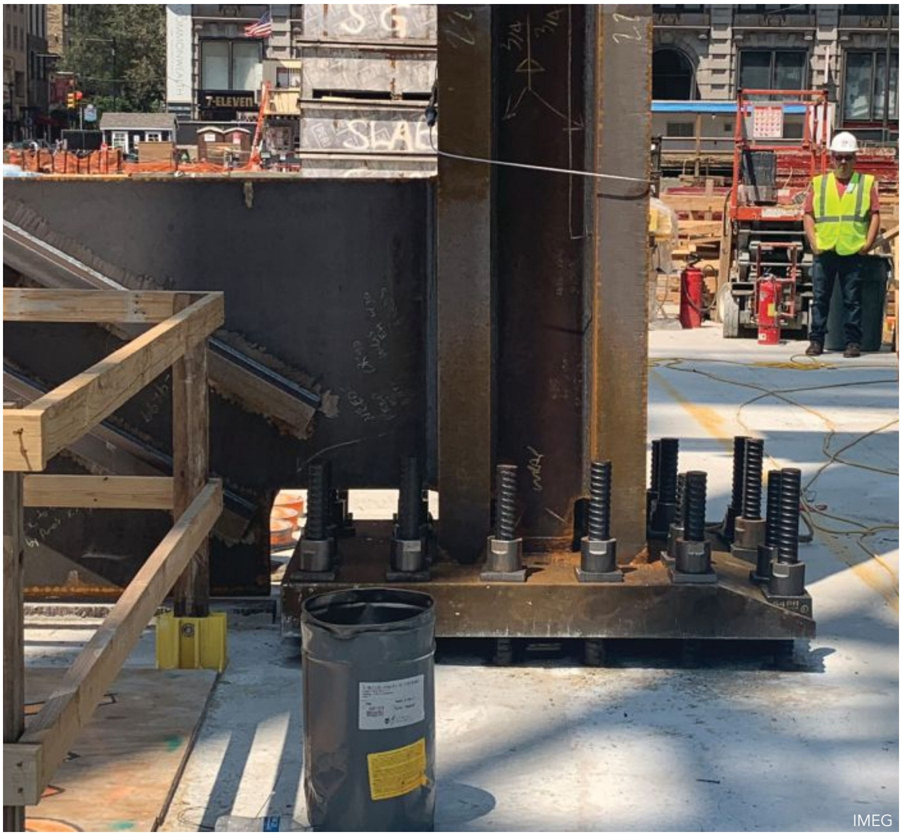
right: The HSS outrigger façade support system at a corner.

below: The detail for the façade corner support, which was one of 20-plus perimeter support details.



above: The transfer truss in the third-floor mechanical room over the entrance lobby.

below: One of the first column lifts was installed with a tapered base plate to coordinate with architectural finishes.



SPEED
FEATURE STORY

These elements could only be realized with steel's flexibility and spanning capabilities.

The Honickman Center opened in March 2024—meeting the five-year-schedule—as the final piece of a $1 billion East Market redevelopment in the heart of Philadelphia. Through early collaboration and strategic structural design, the project team delivered a high-performance healthcare facility symbolizing how steel can turn ambitious visions into reality on time, on budget, and with enduring quality.

Owner/Tenant
Jefferson Health

Architect of Record
Ennead Architects

Garage/Master Plan Architect
Perkins Eastman

Construction Manager
LF Driscoll/Hunter Roberts (joint venture)

Structural Engineer
IMEG

Steel Fabricator
Cives Steel Company

Todd R. Campbell (**todd.r.campbell@imegcorp.com**) is an associate principal and structural technical standards manager, and **Chris Gottschall** (**chris.c.gottschall@imegcorp.com**) is an associate and senior project manager, both at IMEG.

Hot Off the Printer

BY JUSTIN BINDER, PEng, AMANDA DODGE, DAVE ECKMANN, SE, PE, FAIA, ELOY RODRIGUEZ, AND RYAN SHERMAN, PE, PhD

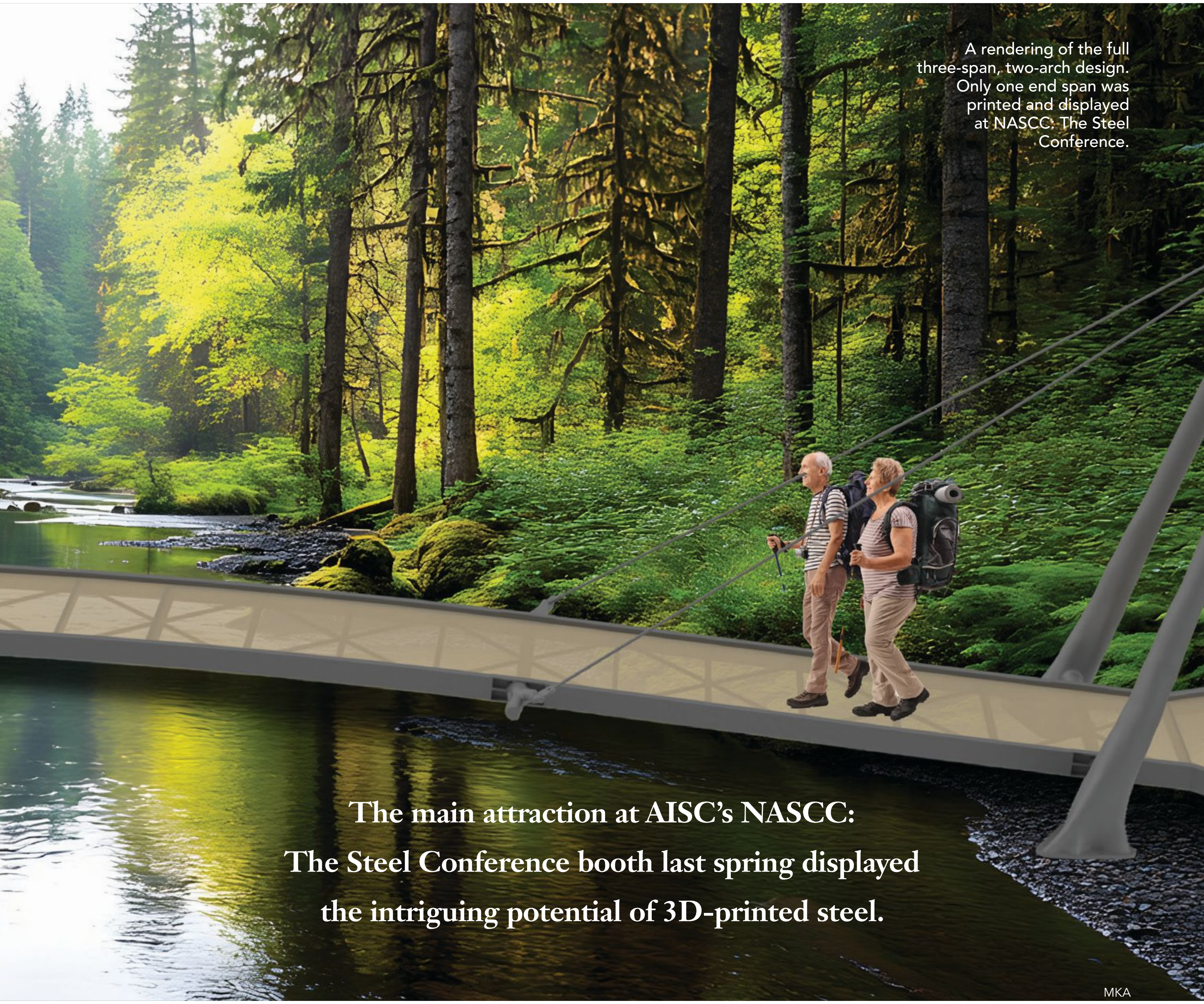
ONE OF THE MOST EXTENSIVE 3D-printing steel bridge projects in the U.S. was constructed to be an exhibit. Not in a museum or on display in a real-world setting, but as a main attraction at 2025 NASCC: The Steel Conference in Louisville, Ky.

AISC made a 36-ft-long 3D-printed steel pedestrian bridge the centerpiece of its booth at the conference as a showcase for the type of connections and geometries possible with steel 3D printing. Following its display at The Steel Conference, it became part of a load testing research project that ventured into new territory and remains ongoing.

Steel additive manufacturing (AM), otherwise known as 3D printing with steel weldment, is a new tool in an engineer's toolbox that opens the door to new design possibilities. The AISC bridge demonstrates AM's potential when used in combination with standard structural shapes. AM can be most beneficial when complex geometries are not physically possible to construct with traditional structural sections, or when a desired component or connection geometry is not available as a standard rolled shape.

AISC engaged a group of AM industry leaders to design and construct a full-scale structure for display as proof of concept for AM's design, fabrication, and aesthetic possibilities. While many proof-of-concept ideas were discussed, a pedestrian bridge with a 3D-printed arch was chosen because it is a horizontal structure that can be easily seen, touched, and experienced in an exhibit environment. The full design is a modular 50-ft structure that could be erected and disassembled in segments, but only one end span of the bridge was built for display at The Steel Conference. The 50-ft design is a three-span bridge, with the middle span supported by two end spans with backstays.

Because the pedestrian bridge is an educational exhibit and not designed for a specific site, a hypothetical river within a wooded site was selected as its home. The bridge aimed to integrate organic



A rendering of the full three-span, two-arch design. Only one end span was printed and displayed at NASCC: The Steel Conference.

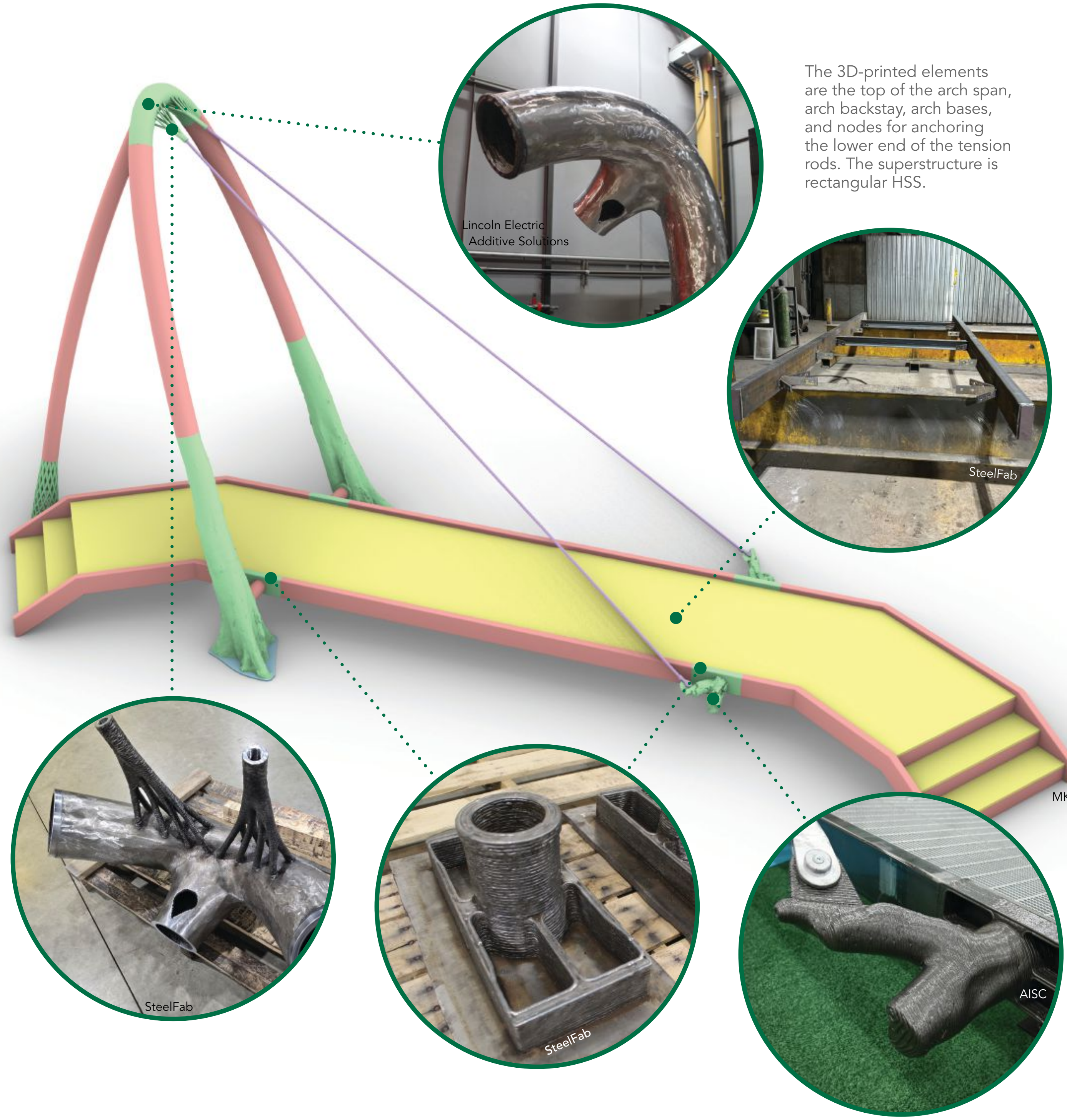
MKA

The main attraction at AISC's NASCC: The Steel Conference booth last spring displayed the intriguing potential of 3D-printed steel.

forms found in the forest into a slender steel bridge. Canted arches that anchor each end of the bridge symbolize leaning trees at the river's edge. Steel tendrils extend from the arches, morphing into steel tension rods that gracefully support the curved bridge deck. Arch backstays with bases that resemble wetland reeds disappear into the forest floor. Temporary supports below the bridge were added to meet the exhibit hall floor loading limitations and because the arch's backstay couldn't be bolted to the exhibit floor. Without the temporary support, the backstay would be in tension and need to be anchored to a foundation.

Tapering branches and tree trunks from actual trees were scanned and converted into digital files. As a result, lead designer Magnusson Klemencic Associates' vision of tree trunks morphing into bent 8-in.-diameter round HSS could be printed and incorporated as structural components within the bridge. The 17-ft-high, 10-ft-wide arch's narrow geometry was achieved by 3D printing the top of each arch to a tighter radius than possible if using advanced HSS bending procedures. The printed arch base and top components were then welded to standard HSS bent to varying radii. To show various finishing options, the tree trunk arch bases were left as printed, and the top of the arch was ground smooth. Ends of printed shapes attached to standard structural shapes were milled smooth.

The bridge was analyzed using a conventional structural analysis program. The analysis model defined the tapered arch geometry and associated wall thicknesses. Components were optimized and required only the minimum amount of material. Since only a third of the bridge was going to be constructed for the exhibit hall, several load combinations for the full bridge and partial bridge were analyzed. The primary structure forces were then shared with the specialty engineers responsible for analyzing and reinforcing the individual AM components.



The 3D-printed elements are the top of the arch span, arch backstay, arch bases, and nodes for anchoring the lower end of the tension rods. The superstructure is rectangular HSS.

Print the Parts

AISC associate member CAST CONNEX engineered the AM parts, including detailed part shaping, connection calculations, finite element analysis (FEA), and development of manufacturing shop drawings. The AM part design process began with receipt of the architectural and engineering design inputs, rough 3D models representing the aesthetic design intent, and loading from the global structural analysis model.

For each part type, CAST CONNEX prepared part models ready for AM manufacturing by working collaboratively with the design team (MKA), manufacturer (Lincoln Electric Additive Solutions), steel fabricator (SteelFab), and various machine shops to develop the geometries. It considered a multitude of design constraints: engineering (stiffness and strength); architectural (part shaping, surface finish); AM manufacturing considerations (minimum printable thickness, limits on overhangs); and fabrication and erection decisions (choice of shop-welded and field-bolted joints).

The AM components were engineered using a combination of conventional code-based calculations considering typical connection limit states as outlined in the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-22). FEA was leveraged to analyze the complex 3D shapes. Load combinations were extracted from the global structural analysis model and applied as boundary conditions to local 3D FEA models of each connection type. These models confirmed that the load path through the connections met the design intent and that the magnitude of any stress and strain risers within the parts were within code-consistent acceptance criteria. Stiffness studies were also performed to ensure that the AM components were not more flexible than the frame elements used in the structural analysis of the overall bridge structure.

The final connection geometries exemplify AM's ability to integrate functional structural details into single components that simultaneously solve architectural-, structural-, fabrication-, and erection-related challenges. The following examples highlight some of these unique connection features:

Incorporating build plates into final part geometry. The 3D printing build plates upon which the layers of weld are deposited were intentionally incorporated into the final design of the parts (the base plates for the trunk and spiral components, and the connection side wall for the deck nozzle and deck branch connections). As the build plates were susceptible to warping under the heat of welding, CNC machining of the underside of the plates after printing was used to ensure dimensional conformance of the final components.

Internal AM features for structural stiffness and strength. Initially, the trunk component was conceptualized as a thin-shelled connection that transitioned from the HSS wall thickness into the tree-like curving geometry at the base plate. FEA highlighted the need for increased connection stiffness at the interface of the primary member to the secondary HSS connection. Thus, an internal stiffener feature was incorporated into the final part geometry, which addressed the part stiffness issue while minimizing the weight of additional material. Similarly, the arch component was internally thickened in the overlapped connection region to improve stiffness and strength, efficiently adding material only where it was required.

Accommodation of welded and bolted connections. AM's freedom of geometry was leveraged to enable the desired shop fabrication and field erection scheme. Connections featuring shop-welded joints were created by printing the connection nozzles with extra stock material that was subsequently CNC-machined to the required location and orientation, ensuring the final AM-connection-to-HSS welded connections could be ground smooth (for example, the bridge's spiral connection welds).

Additionally, the AM manufacturing process enabled the use of innovative bolted connections. The deck nozzle and deck branch connections feature a readily printable open section with pockets for two structural bolts designed to interface with a fabricated bolted connection. The arch connection incorporated a similar bolted end plate connection where the AM part featured a teardrop-shaped hand hole for bolt access, with the teardrop shape proportioned based on minimum overhang requirements associated with the printing process.

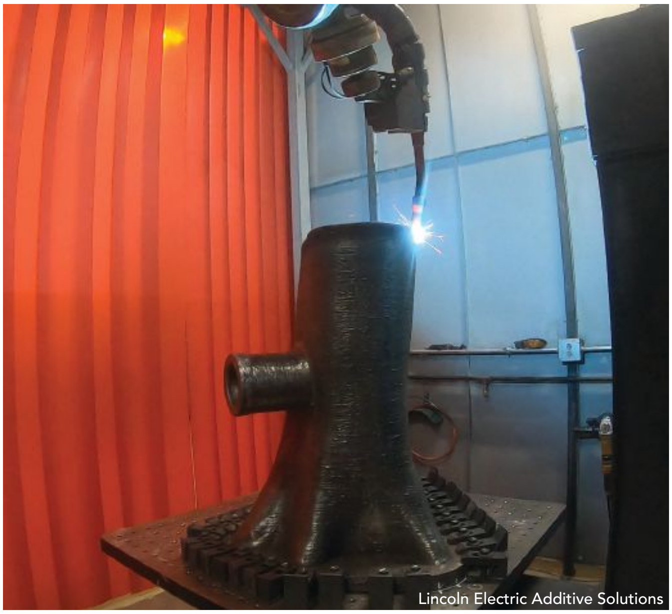
Design for sequential manufacturing. Production documents, including 2D drawings and 3D model files, were created to depict the as-printed and as-machined stages of manufacturing. These documents specify dimensional tolerances for both stages and guide balancing of the as-printed component in machining fixtures, accounting for 3D printing dimensional variations and base plate warping. For the arch component, shop drawings detailed additional surface grinding and tendril printing steps to ensure accurate positioning of drilled and tapped holes for the tension rods.

Lincoln Electric Additive Solutions (LEAS) carried out the additive manufacturing for the project. LEAS specializes in gas metal arc additive manufacturing (GMAAM), also known as wire-arc additive manufacturing (WAAM), where large-scale metal parts are built one weld bead at a time, one layer at a time, until the intended geometry is achieved. The general process involves design for AM, engineering (build strategy determination and path planning), production, and quality.

The collaborative design with CAST CONNEX streamlined the process for the bridge components because LEAS received part models for exactly what needed to be printed with the build strategy already in mind. The robotic systems have the capability to print in multiple directions, or waypoints, to minimize the need for support material and achieve aggressive overhangs. The multi-waypoint capability is possible by fixturing the print on a positioner arm with two degrees of motion to manipulate the parts throughout deposition to maintain depositing layers with gravity. Several of the bridge components used positioner motion to achieve their geometries, including both trunk pieces, the top arch, and deck branches.

The carefully crafted design of each part showcased several WAAM unique capabilities: varying thickness, complex/organic geometries, light-weighted/optimized design, coordinated motion, and integrated build plates. The LEAS production facility has 22 additive systems for GMAAM, and many of the bridge parts were printed in parallel to ensure completion in time for display.

All told, eight parts were printed on five different additive systems. Production for the components took about six weeks with about 750 hours of active print time. Over 2,000 lb of weld metal was used to print the parts, comprised of over 30,000 individual welds. After production, parts were sent to Zimmerman Metals to be partially machined for assembly.


Lincoln Electric Additive Solutions

The tree trunk arch bases were left as printed to show one finishing option. The ends of printed shapes (below) were milled smooth to acccomodate weld preparations and show another finishing option.

Fast Fabrication

Detailing the assemblies was achieved by referencing the CAST CONNEX design model for the AM parts to model the connections for the rest of the members framing into them. The CAST CONNEX team fully detailed the AM parts, not just individually to the post-machined geometry, but also located spatially in the model. The model of the regular structural steel components and the fabrication and erection drawings were provided by H&R Steel Detailing. SteelFab leveraged the model to visualize the unique connections, confirm there would be enough hand access to bolt the members, and splice the assemblies in a way requiring few temporary supports during erection.

During coordination meetings with AISC, SteelFab determined that maximizing the amount of shop-assembled material would be best for the exhibit hall at The Steel Conference, given the limited erection area and timeframe. SteelFab settled on five different shop frames for the bridge that allowed the fabrication team to erect the arch as a self-supporting "tripod" and attach the bridge walkway assemblies and stairs.

Bridge fabrication took about three weeks, starting with processing AM components, tension rods, clevises, and all other hardware. Rolled material was processed by AISC member bender-roller Chicago Metal Rolled Products and shipped early to SteelFab's shop.

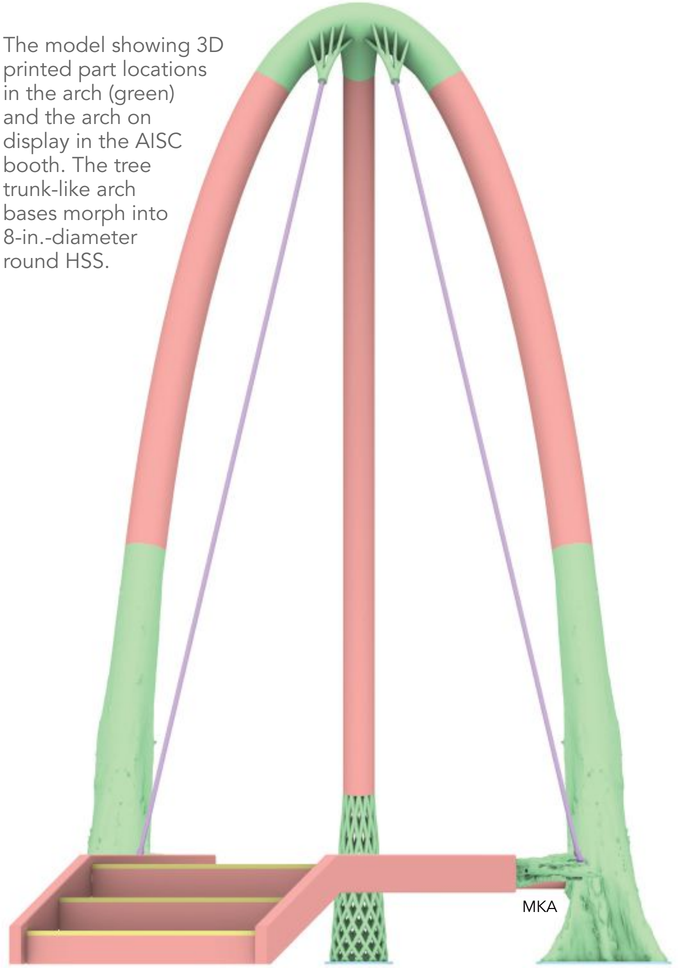
Most of the AM parts' geometries are similar to standard steel shapes, but the top U-shaped AM part was a fabrication challenge. This part was welded to the rolled tubes on two sides, and the rear connection was a through bolt to the tripod's rear leg so it could be more easily taken down and shipped.

The top part's geometry did not have any square faces or planes to use for reference. If fabricators had machined reference scribed lines or markers at the top part's key points and used the model to scribe those same marks on the rolled tubes, fit-up would have been easier to perform, especially on a PJP/CJP welded connection. SteelFab experienced similar challenges when attaching the two trunks to the rolled tubes, but used the bolt holes on the bottom of the base plate to square the part and reference dimensions.

All parts were sand-blasted individually or as finished assemblies, depending on their geometry, and the bridge received a clear coating that does not cover the details in the standard or AM parts but helps maintain the finish. MKA designed all bolted connections to use ASTM A325 hex head bolts, which simplified sourcing the hardware.

Bridge and stair grating were provided by Lichtgitter USA. The design team settled on W11-4 style grating with a serrated surface. The finish was hot-dipped galvanized, and the panels were attached to the bridge using G-Clips to facilitate multiple future assemblies. The bridge girders are 8×3 square hollow structural sections (HSS). All HSS members came from Atlas Tube.

The arch backstay resembles wetland weeds.



The model showing 3D printed part locations in the arch (green) and the arch on display in the AISC booth. The tree trunk-like arch bases morph into 8-in.-diameter round HSS.

Carrying the Load

Following The Steel Conference, the bridge was transported to the Georgia Institute of Technology for structural load testing on the full 50-ft design. The over-arching goal of the controlled load testing is to demonstrate that metallic additive manufacturing can be leveraged to support and transmit structural loads. The testing is among the first fact-finding projects for a structure that combines AM components and rolled sections intentionally designed as a system.

While AM structures' architectural opportunities are visually striking, the AM demonstration bridge also highlights some under-discussed AM structural advantages. Through controlled load testing, the bridge is expected to show it can support the full design load. Further, the controlled load testing will be used to validate the 3D FEA models CAST CONNEX created during the AM component engineering.

Temporary supports that accommodated conference center floor load restrictions were removed and the bridge was secured to Georgia Tech's reaction floor, creating the full end-span cantilever structure. Tanks placed on the bridge deck will be filled with water to simulate the design live load. At the end of the cantilever, a hydraulic cylinder will be used to apply the total load of the drop-in center span. Instrumentation to measure load, displacement, and strain will be installed throughout the bridge to monitor the AM bridge response. Digital image correlation (DIC) will be used to compare full-field strain measurements with the 3D FEA models of the AM components from CAST CONNEX. Ultimately, the controlled load test results will be physical proof that AM offers a unique structural solution to the steel industry.

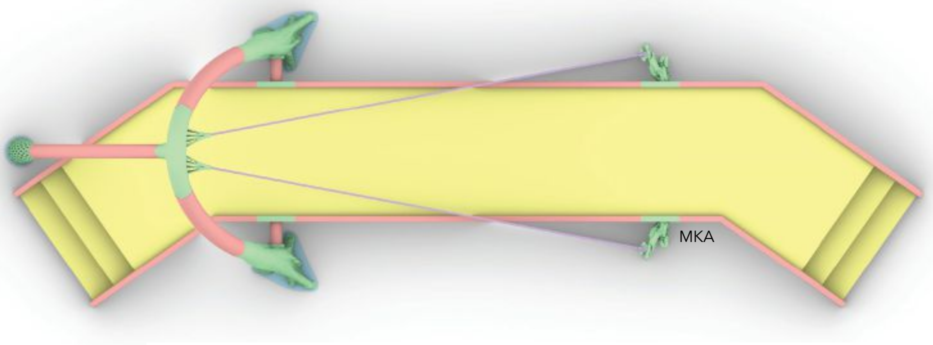
Looking Ahead

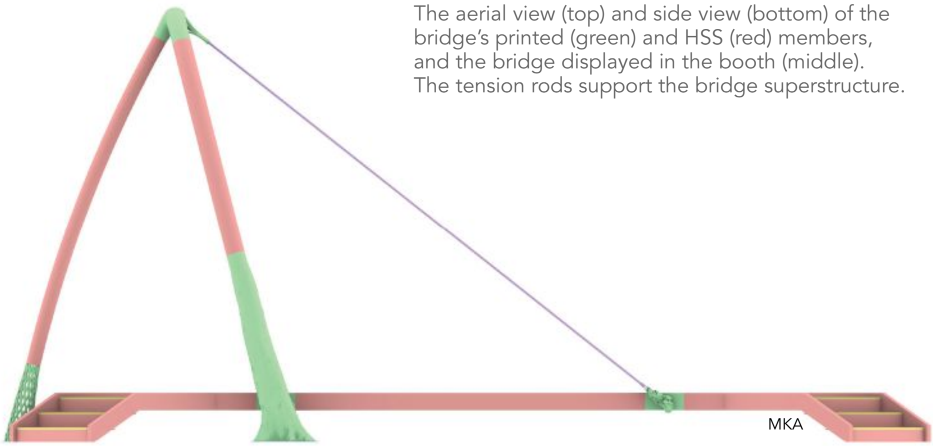
The AISC AM bridge demonstration project has yielded numerous important lessons that will help advance large-format metallic AM toward in-service implementation for structural engineering applications. After the demonstration, the AISC AM Exploratory Task Force will further document and disseminate the lessons learned from the design, fabrication, and testing processes. One of the most significant findings will be a recommended workflow for implementing AM components in the structural steel industry.

Exciting developments for AM in the structural steel industry are progressing beyond the AM bridge. An AISC Milek Fellowship continues to explore AM for use in structural steel applications. Furthermore, draft AISC *Specification* language has been prepared and balloted, paving the way for implementing AM in the structural steel industry.

Additive manufacturing offers many potential strategic benefits to the structural steel industry, including the optimization of structural components; free-form design that enhances architecturally exposed structural steel; an alternative for costly and complex fabrication; an accelerated solution for casting replacements, part consolidation, and faster connections; a novel alternative for repair and retrofit of existing infrastructure. The bridge has highlighted many of these advantages in a tangible, interactive demonstration project.

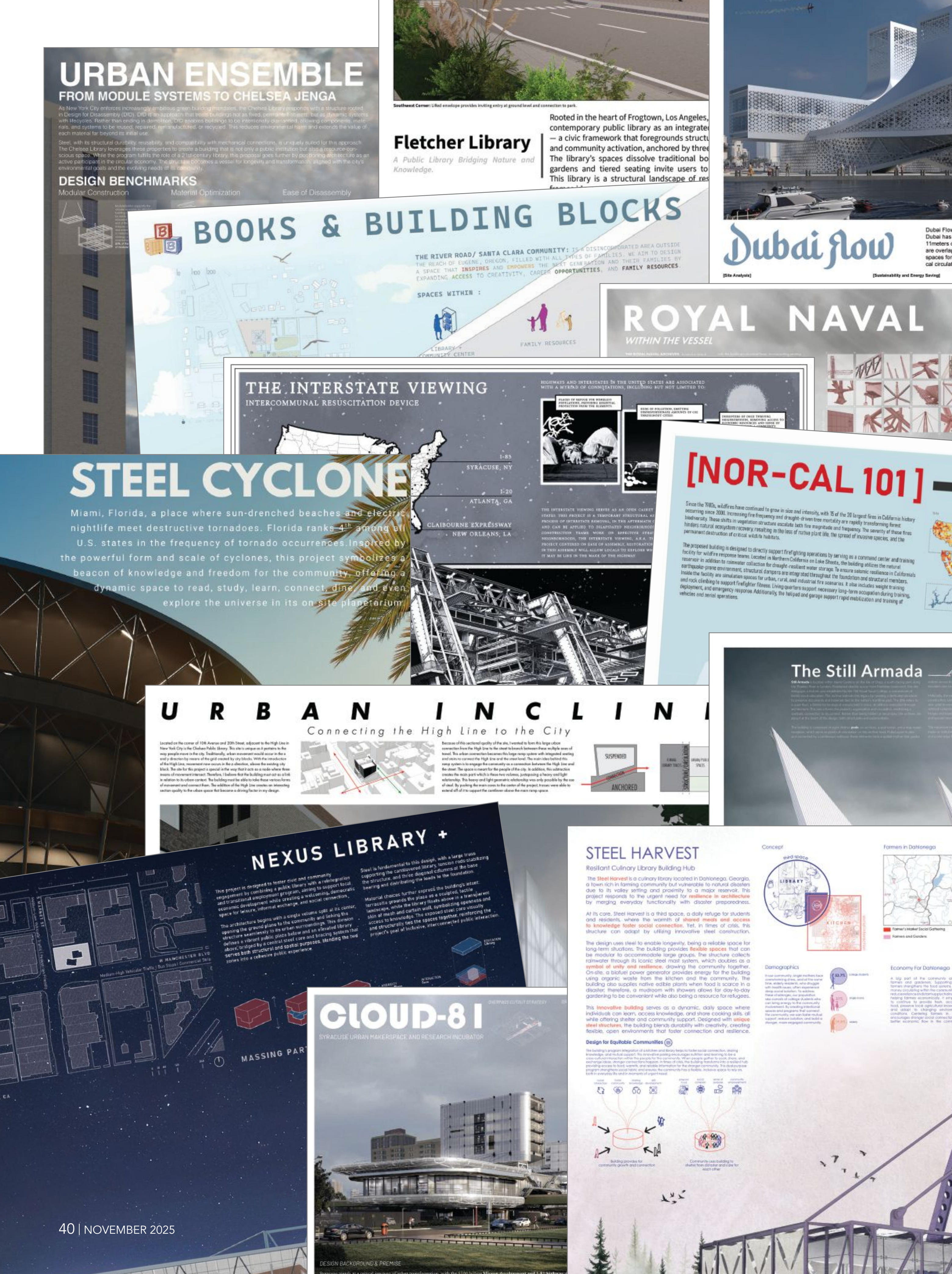
Following controlled load test completion, AISC is planning to display the bridge at conferences and trade shows throughout the country in 2026. ■





The aerial view (top) and side view (bottom) of the bridge's printed (green) and HSS (red) members, and the bridge displayed in the booth (middle). The tension rods support the bridge superstructure.

Justin Binder (**j.binder@castconnex.com**) is the engineering manager at CAST CONNEX, **Amanda Dodge** (**Amanda_Dodge@lincolnelectric.com**) is an additive engineer at Lincoln Electric, **Dave Eckmann** (**deckmann@mka.com**) is president of Magnusson Klemencic Associates, **Eloy Rodriguez** (**erodriguez@steelfab-inc.com**) is a project manager and BIM coordinator at SteelFab, and **Ryan Sherman** (**ryan.sherman@ce.gatech.edu**) is an associate professor at Georgia Tech.


URBAN ENSEMBLE
FROM MODULE SYSTEMS TO CHELSEA JENGA
DESIGN BENCHMARKS
Modular Construction
Material Optimization
Ease of Disassembly
Southwest Corner: Lifted envelope provides inviting entry at ground level and connection to park.
Fletcher Library
A Public Library Bridging Nature and Knowledge.
Rooted in the heart of Frogtown, Los Angeles,
contemporary public library as an integrated
— a civic framework that foregrounds structu
and community activation, anchored by three
The library's spaces dissolve traditional bo
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This library is a structural landscape of res
Dubai flow
[Site Analysis]
[Sustainability and Energy Saving]
BOOKS & BUILDING BLOCKS
SPACES WITHIN :
LIBRARY + COMMUNITY CENTER
FAMILY RESOURCES
ROYAL NAVAL
WITHIN THE VESSEL
THE INTERSTATE VIEWING
INTERCOMMUNAL RESUSCITATION DEVICE
I-81 SYRACUSE, NY
I-20 ATLANTA, GA
CLAIBOURNE EXPRESSWAY NEW ORLEANS, LA
STEEL CYCLONE
Miami, Florida, a place where sun-drenched beaches and electric nightlife meet destructive tornadoes. Florida ranks 4th among all U.S. states in the frequency of tornado occurrences.Inspired by the powerful form and scale of cyclones, this project symbolizes a beacon of knowledge and freedom for the community, offering a dynamic space to read, study, learn, connect, dine, and even explore the universe in its on-site planetarium.
[NOR-CAL 101]
The Still Armada
URBAN INCLINE
Connecting the High Line to the City
SUSPENDED
ANCHORED
NEXUS LIBRARY +
MASSING PART
STEEL HARVEST
Resilient Culinary Library Building Hub
Concept
Farmers in Dahlonega
Demographics
Economy For Dahlonega
Design for Equitable Communities
CLOUD-81
SYRACUSE URBAN MAKERSPACE AND RESEARCH INCUBATOR
DESIGN BACKGROUND & PREMISE

Beyond Books

The 2025 Student Design Steel Competition challenged architecture students to create a building that reimagines and expands the purpose of a structure found in most cities.

THE 2025 STEEL DESIGN STUDENT COMPETITION (SDSC) asked students to expand their definition and stretch their concepts of a familiar civic staple.

Entrants in this year's competition were tasked with designing a library that goes beyond typical library uses in ways that serve a specific community—in short, a "library+." That prompt was the main category for the 2025 SDSC, though the contest also featured an open category for students with other ideas. Students could enter submissions in one or the other.

Thirteen winners were chosen from the two categories, seven from the main category and six from the open. Students from 60 universities submitted concepts in this year's contest. The 2025 contest was the 25th SDSC, which is sponsored by AISC and administered by the Association of Collegiate Schools of Architecture. SDSC challenges undergraduate and graduate architecture students to create a design using steel as the primary structural material and containing at least one space that requires a long-span steel structure, with special emphasis placed on innovation in steel design.

The students and faculty sponsors who crafted the winning projects earned cash prizes that ranged from $500 to $4,000, with $20,000 in total prize money distributed to the 13 winners. The winners were chosen by a distinguished juror panel, one for each category:

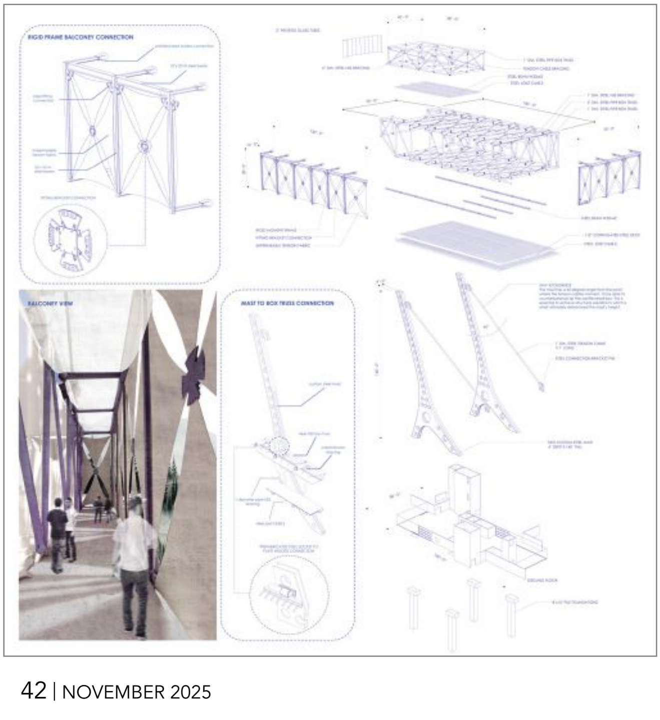
CATEGORY I: LIBRARY+

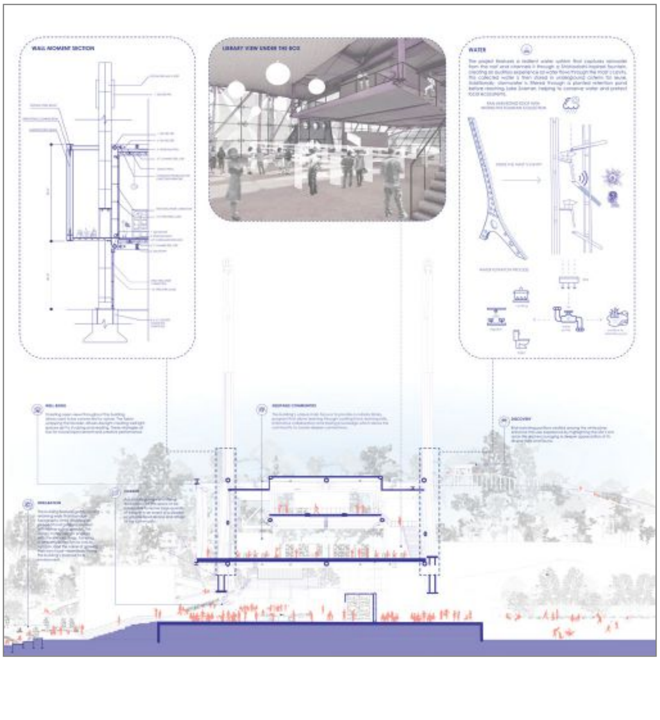
- Daniel Brown, Savannah College of Art and Design
- Cathleen Jacinto, School of the Art Institute of Chicago
- Camille Sherrod, Kean University

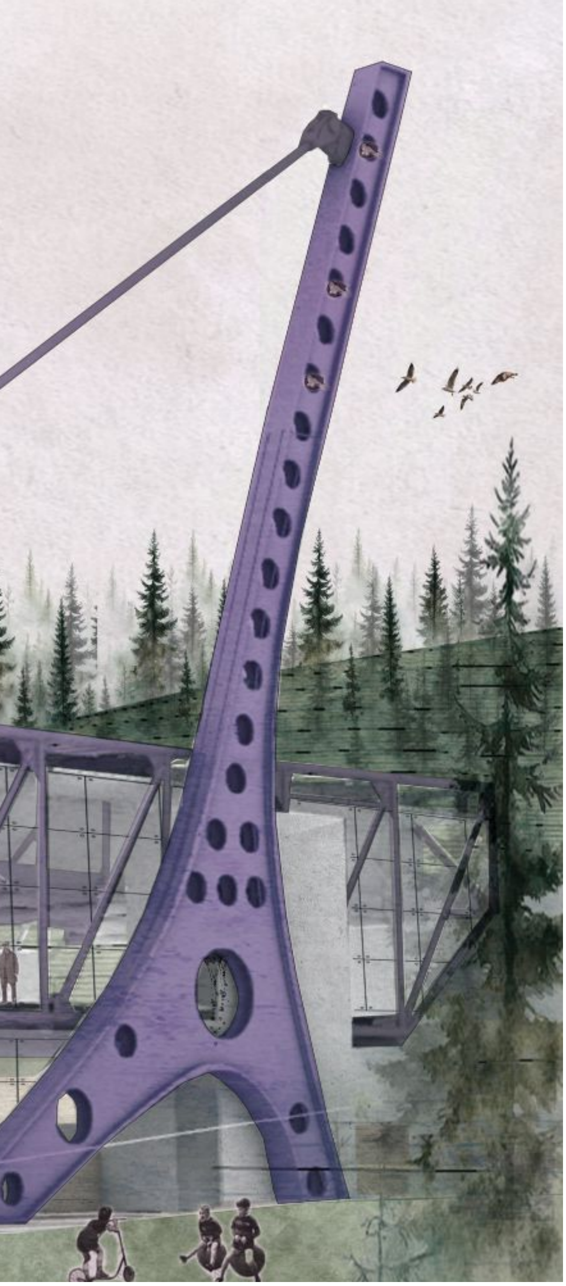
CATEGORY II: OPEN

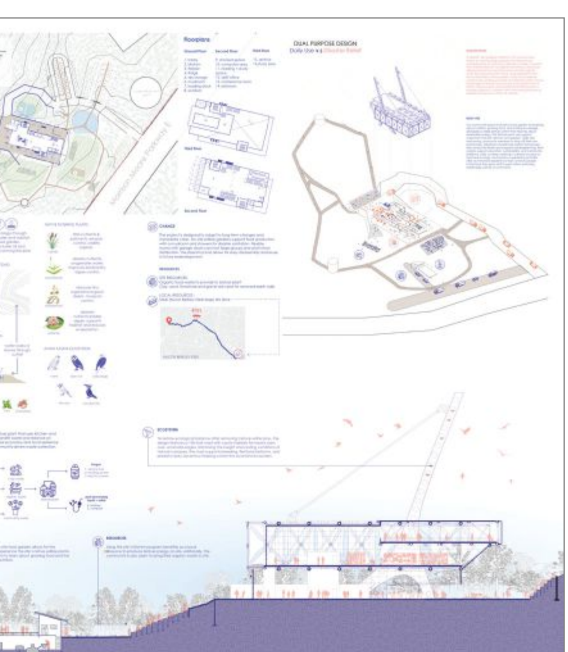
- Robert Clarke, Cal Poly Pomona
- Awilda Rodriguez, University of Oklahoma
- Jade Yang, Kennesaw State University

CATEGORY I: LIBRARY+
Winners









SDSC CATEGORY I: LIBRARY+

This category asks students to design a library in a community of their choice. Students could submit design proposals that address how a library can contribute to the community as a more integral part of the civic fabric.

1st

Steel Harvest

Student: Laura Murguia
Faculty Sponsor: Alice Guess
Savannah College of Art and Design

Steel Harvest is a hybrid library and kitchen communal space in Dahlonega, Ga., a rich farming community vulnerable to natural disasters due to its valley setting and proximity to a major reservoir. It meets the area's urgent need for resilience in architecture by merging everyday functionality with disaster preparedness.

People need each other when disaster hits their community. However, many communities today are disconnected, isolated by routine, distance, or a lack of a platform within the community to come together. When people know their neighbors and share meals, stories, and memories, they become stronger, more resilient, and prepared to face challenges together.

This pairing encourages nutrition and learning to be a cross-cultural interaction. Farming is a major part of the Dahlonega economy, and the area is also home to the University of North Georgia. Steel Harvest is a civic anchor designed to unite those groups and the rest of the community. Its dual use as a daily space and disaster relief hub is possible because of its innovative steel construction.

The building's expressive steel structure has a cantilevered box truss that hovers above the ground, sheltering the landscape below and symbolizing protection through unity. The truss is supported by two custom-fabricated steel masts inspired by castellated beams, a nod to steel's lightness and precision. These masts form hollow vertical spines that collect rainwater and house an auditory fountain, signaling to visitors that the building is alive and responsive to its environment.

The masts also double as vertical habitats for displaced white pines on site, reintroducing ecological care into the built environment. A wraparound rigid balcony frame along the south and west façades acts as a brise-soleil, diffusing natural light into the library and reading spaces to support comfort and well-being.

The ground level is rooted in earth, using clay, sand, limestone, and gravel for rammed-earth walls to create a warm, grounded atmosphere for the community kitchen. This tactile space invites neighbors to cook together, share recipes, and engage in hand-crafted traditions that build cultural memory and social collaboration. The building also supplies native edible plants in adjacent gardens, helpful in everyday use and when food is scarce in a disaster. A mudroom with showers allows for day-to-day gardening to be convenient while also being a resource during disasters.

The steel design enables longevity, creating a reliable space for long-term situations. The building provides flexible spaces that can be modular to accommodate large groups. It transforms into a community shelter by opening a large garage and sliding doors, creating space to welcome more people. A biofuel power generator provides energy for the building using organic waste from the kitchen and the community.

The attached kitchen and library offer internet access and communication signals while also preparing fresh meals using ingredients from the native garden. Food trucks operate continuously, picking up meals and delivering them across Dahlonega to restore food access and support those in need. These programs work perfectly simultaneously to provide a place to connect with loved ones and have a reliable food source in times of scarcity. ■

CATEGORY I: LIBRARY+
Winners

2nd

Nexus Library Plus

Students: Kimberly Yan and Shunta Abe
Faculty Sponsor: Katrin Terstegen
California State Polytechnic University, Pomona

Nexus Library Plus is designed to foster civic and community engagement by combining a public library with a reintegration and transitional employment program. That combination supports local economic development while creating a welcoming, democratic space for leisure, informal exchange, and social connection.

The building's architecture begins with a single volume split at its center, opening the ground plane to the community and linking the structure seamlessly to its urban surroundings. The divide separates the lower portion as a vibrant public plaza and elevates the upper volume as the library. Bridging these two spaces is a steel core and bracing system that serves structural and spatial functions, creating a hybrid public space throughout the building.

Steel is the essential structural framework that makes this vision possible. The cantilevered library is supported by a large steel truss running through the building, anchored to the steel core and stabilized by tension rods. The steel core is composed of vertical columns and diagonal bracing that channel the building's loads downward. All structural forces are ultimately transferred to three massive diagonal steel columns positioned at each corner of the base. The columns are the project's structural linchpins, carrying and distributing the vertical loads to the foundation.

Material choices further express the building's intent: terra cotta grounds the plaza as a folded landscape, while the library floats above in a transparent mesh and curtain wall skin, symbolizing boundless knowledge. The exposed steel core visually and structurally ties the spaces together, reinforcing the project's goal of inclusive, interconnected public interaction.

The library has a net area of 44,150 sq. ft and a gross area of 64,540 sq. ft. The five-level structure—comprising an underground floor, ground level, mezzanine, and two upper stories—offers a diverse mix of public, educational, recreational, and support spaces.

The underground floor is a vibrant anchor centered around a spacious 4,830-sq.-ft sunken plaza. It's surrounded by an auditorium, café, therapy and meditation rooms, and a reading area. On the ground floor, a welcoming lobby connects to employment assistance and a food bank. A raised plaza, storage, and a car lift support circulation and logistics. The mezzanine provides leisure space with a bookstore, karaoke room, and outdoor deck. The second floor includes an 8,430-sq.-ft reading area, archives, archive exhibit, workspace, gaming room, social stair, and restrooms. The third floor adds more reading and work areas, plus a children's area, office, and terrace. ■

3rd

Urban Incline
Student: Ayush Singh
Faculty Sponsor: Leandro Piazzi
Rensselaer Polytechnic Institute

The Chelsea Public Library, situated at the corner of 10th Avenue and 20th Street in New York City, occupies a unique and dynamic site adjacent to the High Line elevated walking trail. Traditionally, movement through Manhattan follows the X and Y axes of the urban grid, defined by intersecting streets and avenues. However, the High Line added a new dimension—movement along the Z-axis—that elevated circulation above the street level. The library site becomes a critical urban node where all three axes intersect, and the building must take these various forms of movement and connect them.

The elevated High Line introduced a sectional condition that became a driving force in the design. To address it, a ramp system stretches from the street level up to the High Line, with integrating stairs and seating along the way. The ramp acts as a public living room, encouraging community engagement and blurring the boundaries between library and city.

This gesture also defines the project's parti: two distinct volumes in contrast, one grounded and heavy, the other light and suspended. The interplay between anchored and suspended is made possible through a steel structural system. By centralizing the building's cores, trusses extend outward to support the cantilevered event space above the ramped public space. The event space is hung by tension rods that trace load back through the trusses and eventually into the cores. Also, by positioning the cores in a central location, column-free spaces are created as girders span from the core to load-bearing walls.

The relationship between the suspended volume and the ramp below emphasizes what the spaces mean in the urban realm. The event space is an almost unprogrammed area that can host formal events, but it would largely be an open space for public use. Because of the structural strategies implemented, the event space can be a full cantilever, allowing for the ramp space to exist below.

Trusses that are 14 in. deep extend off the cores to the party wall and cantilever. In this way, much of the gravitational loads are supported by the trusses. The depth is necessary for the 40-ft spans and façade expression. Suspended off the trusses are 6-in. steel rods purely in tension and used to effectively suspend the event space in a pure cantilever. Using a thin and efficient member significantly decreased cost and material use.

To complete the rest of the structure of the building, beams and girders are organized in the same grid that is denoted by the trusses and core locations. Beams span to hit girders where the girders carry load to the cores or to a party wall. ■

Books and Building Blocks
Students: Jo Herendeen, Ty Pierce, and Ivy Smith
Faculty Sponsor: Daisy Olice
University of Oregon

Books and Building Blocks reimagines the role of a civic space in Santa Clara, Ore., a family-centered unincorporated community overlooked in the broader urban development of nearby Eugene. Beyond traditional library functions, the design prioritizes two complementary programs: a family center and a youth-oriented design workshop.

The architecture is centered around visibility, structure, activity, and community life. Exposed steel framing highlights the building's structural logic, fostering transparency and inviting curiosity. The design workshop, fully visible from the public realm, puts making on display by inspiring young visitors to engage with design as a tool for self-expression and problem-solving. Makerspaces include a woodshop, fabrication lab, and textile workshop. Vibrant color is used strategically to signal zones of energy, learning, and creativity, creating a dynamic environment that reflects the pulse of its users.

A gradient from exterior to interior guides visitors through layered thresholds, where public plazas, transitional canopies, and active gathering zones ease the boundary between the neighborhood and the library. This porous edge encourages daily use and makes the building a natural extension of community life. A daycare, teen advocacy center, and the family resource center further its community-oriented program. The family resource center provides basic supplies and helps adults navigate school and legal systems.

At its core, the project aspires to create a structural feeling of place, where the steel skeleton is an expressive design element and a metaphor for support, resilience, and growth. The library is a beacon and workshop where knowledge is stored and made, families are welcomed, and young people find space to imagine and build their futures.

CATEGORY I: LIBRARY+
Honorable Mentions

Fletcher Library
Students: Wiame Rabbaa and Agustin Ochoa
Faculty Sponsor: Dylan Bachar
Woodbury University

Fletcher Library in Los Angeles' Frogtown neighborhood reimagines a public library as an integrated cultural and learning hub. Anchored by three cylindrical steel diagrid cores, the design establishes a clear structural hierarchy that supports open, transparent, and adaptable floor plates.

The concept of bridging nature and knowledge drives the project, connecting the library to its park and riverfront context while fostering civic exchange. Wide landscape-integrated stairs, open reading gardens, and tiered seating dissolve boundaries between interior and exterior, positioning the library as an architectural landmark and a resilient community framework. A lifted envelope in the southwest corner provides an inviting entry and further connection to the park. The library site is on a key civic corner, integrating river access, bike lanes, public transit, and surrounding neighborhoods into an accessible cultural hub for learning.

The library's organization is centered on three vertical steel cores that integrate circulation, structure, and services while opening the surrounding floor plans for flexible program use. Composite steel and concrete slabs span between steel ring beams and I-beams, creating rigid platforms for reading areas, gathering spaces, and cultural programs.

Externally, the diagrid steel frame provides lateral stability and defines the architectural rhythm, while secondary systems support curtain walls, stairs, and mechanical equipment. Sustainable strategies—including operable skylight voids for passive ventilation, daylight-optimized skylights, and a multi-tiered stormwater collection system—embed resilience into the design. These tectonic and programmatic strategies express a steel-and-glass structural language where program, structure, and community converge into a unified civic hub.

Steel Cyclone

Students: Mikayel Sargsyan and Vahe Shahnazaryan
Faculty Sponsor: Paul Chiu
Glendale Community College

Inspired by tornadoes' swirling power and visual dynamism, Steel Cyclone reimagines the traditional library as a spiraling beacon of knowledge, community, and resilience. Set in Miami, the building symbolizes the tension between nature's force and human creativity. Florida's No. 4 ranking among U.S. states in tornado frequency was part of the design inspiration.

The steel structure is a key part of the building's overall design. Steel columns rise from the ground and extend to the roof, following the twisting motion of the building's form. At the center of the building, a 4-ft-diameter steel pole runs vertically from the base to the top and supports a spiral ramp system and planetarium above. The vertical steel columns are connected by 1-ft H-beams that provide horizontal support across the structure.

Additional H-beams sweep around the building in a spiral pattern, linking all the vertical columns together and reinforcing the tornado-like shape. Welded steel rods are installed between these beams to increase the structural strength and stability of the frame. These elements form a series of triangular shapes that enhance the building's ability to resist forces like wind and gravity, making the design striking and structurally sound.

The interior is divided into open and private zones to balance accessibility with functionality. While design promotes openness, the layout ensures privacy for staff and focused activities. Beyond a library, the building offers a rich public experience with spaces to read, learn, gather, and dine. Floor-to-ceiling windows on the upper levels flood the space with natural light and connect users with the surrounding environment.

Urban Ensemble

Students: Qi Han Zheng and Bennard Amponsah
Faculty Sponsor: Arta Yazdanseta
Rensselaer Polytechnic Institute

Urban Ensemble is an innovative response to New York City's increasingly ambitious green building mandates. It's a library and civic hub in Manhattan's Chelsea neighborhood optimized for design for disassembly (DFD), which ensures buildings can be intentionally dismantled and allows their components, materials, and systems to be reused, repaired, remanufactured, or recycled. Steel is especially suited for this approach due to its structural durability, reusability, and compatibility with mechanical, reversible connections.

Three benchmarks ensure the design is measurable in its sustainability ambitions. The first is 80% modularity, enabling modules to be reused, refurbished, or remanufactured. The second is material optimization, achieved by designing 80% of structural elements to perform at or above 80% of their capacity. Both minimize resource use from the outset. An iterative analysis using SAP2000 sized members to ensure 80% of the members perform at least 80% above capacity, optimizing material use without overdesign. To further support circularity, member types were standardized by floor to improve repeatability and simplify future reuse, as selected standard sizes are typical for mid-rise structures in the area.

The third benchmark is ease of disassembly, assessed by limiting the number of fasteners per structural connection. With a target of five bolts per joint, the design reduces labor and complexity during construction and deconstruction. The final design achieved an average of 4.3 bolts, minimizing labor for disassembly without compromising structural performance.

The project tackles jobsite waste and limited reuse opportunities by creating a steel building that is not fixed in time, but persistent as it shifts, adapts, and endures in form and value. Modules are sized at 8½ ft wide to comply with DOT transport limits, avoiding oversized permits. Exposed connections throughout the structure simplify future disassembly, while detailed disassembly documents will be provided to guide recovery and reuse.

The library's architectural concept is grounded in the juxtaposition of formal and informal spatial programs. Classrooms, conference rooms, and study areas on the upper floors support focused, quiet activities and offer a calm atmosphere. In contrast, a skate park on the ground floor and a café connected to the High Line invite gathering and movement.

While the overall system remains 80% normative and modular, 20% of the structural framework is reserved for architectural expression. This strategy allows for larger spans, volumetric variation, and sculptural articulation in informal zones, supporting spatial flexibility and social interaction. All structural components are prefabricated with bolted connections to support disassembly and reduce welding. Each module includes a material passport and tagging system to track origin and placement.

SDSC CATEGORY II: OPEN

Students could select a site and building program using steel as the primary material. This competition category permits any building type other than a library.

1st

The Still Armada

Students: Ethan Edington and Josue Ventura Vasquez
Faculty Sponsor: Genevieve Baudoin
Kansas State University

The Still Armada, a British maritime history museum and archives, is located within Island Gardens on the Isle of Dogs, a south-facing park along the Thames River in London. The site is across from Maritime Greenwich and reengages a historic axis established by the Old Royal Naval College, a cornerstone of British naval education. The name refers to a quiet fleet, a British technological armada held in place, and its stillness is embodied through the building's architecture. The axis informs its organization and circulation, reinforcing a symbolic connection to context. Rather than being hidden or secondary, the archives are central to the design, structurally and experientially.

The building has eight distinct pods: six archives, a stair tower, and a map room/reception, each a point of orientation on the archive level. These elements are pulled apart in plan but connected by a continuous walkway, forming a spatial rhythm that guides visitors across the site. A strong axial path culminates in a framed landing, offering the first elevated view toward the archives.

The exposed steel frame and precision metal cladding draw from naval construction. Like a ship's hull protecting its cargo, each archive pod is clad in a metal skin, solid in most areas, selectively perforated to admit light, air, and glimpses of structure without compromising what lies within. Overhead, a roof structure supported by triangular trusses and tapered columns touches down lightly, reinforcing the geometry and upward momentum of the pods.

A steel connection splits the primary structure, carving a path for diffuse southern light. Angled aluminum panels scatter the light before it reaches the archives, minimizing UV exposure and preserving sensitive materials. The extended roof panels above shield the skylight from direct sun. Light is let in, but never uncontrolled.

The archives are on Level 2 and accessed by a suspended walkway system along the axis. The walkway is supported by tension rods anchored to wide-flange beams above the triangular trusses. It ramps gently beneath the archive skin, offering a moment of compression as visitors pass under the metal shell before entering the protected archive. The walkway strategy preserves openness at the ground level to frame the axial view toward the Old Royal Naval College across the Thames. Like the pods, the walkway adopts a layered language, its underside wrapped in perforated steel cladding that conceals structure while extending the skin system overhead.

A framed landing spans the axis above the walkway, offering a moment of pause upon entering the archive level where visitors gain their first elevated view of the pods rising through the roof. The archive experience is defined by quiet clarity. Visitors enter a deliberately restrained, insulated, and climate-controlled space wrapped in a protective inner shell. The archive is above ground-floor retail, elevated physically and symbolically. A glass ceiling follows the form of the outer roof, sealing the archive while revealing the substructure above. The ceiling allows visitors inside to read the steel system that supports the pod, reinforcing the idea of the archive as both vessel and artifact.

Thick walls and filtered daylight create a sense of stillness and focus. The interior experience contrasts with the openness of the surrounding building, offering a moment of isolation and reverence at the heart of the project. The archive pods and walkways are supported by helical piers, minimizing ground disturbance and eliminating the need for continuous concrete footings. This foundation strategy preserves the site's permeability and enables water collection beneath the slab. More critically, it reflects a respect for impermanence: should the archive be dismantled in the future, the site can return to parkland without the scars of deep foundations. It is a structure designed to last, but not to linger.

Beside the main stair, a floor lift in the stair tower provides universal access without disrupting the structural clarity of the archive, allowing visitors to move through the structure rather than bypass it. The stairs and floor lift take visitors to the open roof terrace, where the pods rise overhead, casting shadows, framing sky, and revealing the fleet's scale and order from above.

Though fully covered by the roof's span, the ground floor remains open-air, blurring the boundary between interior and exterior. Below the tile finish and permeable concrete slab, a rainwater collection tank captures runoff from the roof for reuse across the site. The system supports planted zones within the open-air curtain wall. Its performance is partly made possible by the elevated foundation system, which allows water to move freely through the ground below without obstruction. Roof drainage is managed through concealed gutters positioned above the circular steel beams at the base of the trusses, with downpipes distributed across the structure to direct runoff into the broader rainwater collection system below.

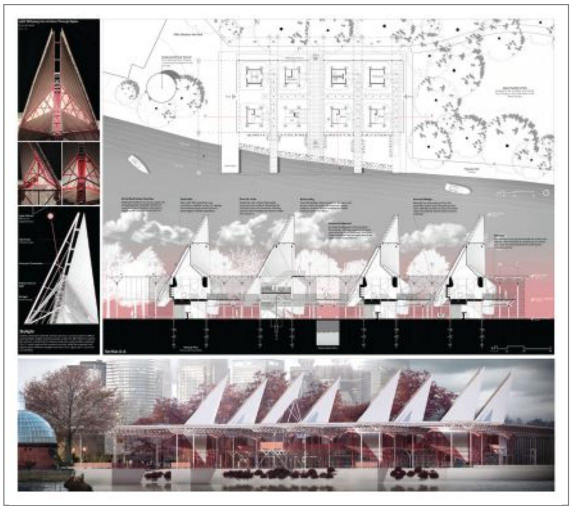
Below the roofline, the solidity of the archive skins breaks on specific planes to enhance visitor experience and enforce the steel structure's presence through increased visual connection. The steel panels have $\frac{3}{32}$-in. round holes with $\frac{5}{32}$-in. center spacing, which creates a degree of 33% openness, allowing enough visibility and light without damaging the inner archive and the materials within.

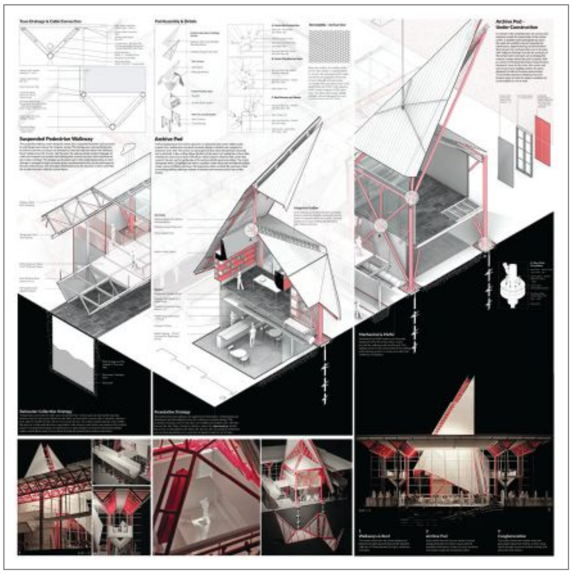
Beneath the descending archive skin, interstitial spaces open along the ground floor, offering moments of quiet and shade while revealing the layered steel structure overhead. Mechanical and HVAC systems are discreetly integrated within the archive skins, routed beneath the walkways and into the pods. This HVAC strategy preserves the visual clarity of the building while allowing services to remain accessible and continuous throughout.

Toward the river, the aluminum louver system shades the Thames Path, creating a comfortable exterior threshold for visitors. Planters step down toward the water's edge, bringing people closer to the river while softening the transition between building and landscape. As the roofline shifts toward the archive pods, the material transitions to standing seam stainless steel for greater UV protection. Where the curtain wall rises vertically, an ETFE membrane begins, enveloping the archives and reinforcing the role of the skin as the building's final protective layer.

The curtain wall plays a critical role in the project's passive strategy. Open-air and uninsulated, it allows for natural airflow across the building's footprint. Operable vents at the base bring in cool air, enabling cross ventilation and supporting the stack effect to exhaust heat that accumulates beneath the archive skins. This cavity between the archive mass and its perforated cladding acts as a thermal barrier, passively buffering the interior volumes. ■

CATEGORY II: OPEN
Winners





CATEGORY II: OPEN
Winners

2nd

NOR-CAL 101

Students: Leyton Spencer, Blayne Springer, and Matthew Wright
Faculty Sponsor: Pasquale De Paola and Kevin Singh
Louisiana Tech University

NOR-CAL 101 fire station supports firefighting operations as a command center and training facility for wildfire response teams. It's located Northern California on Lake Shasta and uses a natural reservoir and rainwater collection for drought-resilient water storage. Structural dampers are integrated throughout the foundation and structural members to ensure seismic resilience in California's earthquake-prone environment.

The building helps combat a growing issue: increased wildfire severity. Fifteen of the 20 largest fires in California history have occurred since 2000. Increasing fire frequency and drought-driven tree mortality are rapidly transforming forest biodiversity, and these shifts in vegetation structure escalate fire magnitude and frequency. Fire severity hinders natural ecosystem recovery, resulting in the loss of native plant life, the spread of invasive species, and the permanent destruction of critical wildlife habitats.

The facility has simulation spaces for urban, rural, and industrial fire scenarios. It also includes weight training and rock climbing to support firefighter fitness. Living quarters support necessary long-term occupation during training, deployment, and emergency response. Additionally, the helipad and garage support rapid mobilization and training of vehicles and aerial operations.

Triple-friction dampers are embedded in the foundation and throughout the structure, absorbing and dissipating earthquake energy to minimize structural stress. A key design feature is the hydro-load detail, where water is used as a structural element to support the building's cantilever. The water-based system also incorporates seismic dampers, combining fluid mass and energy dissipation to enhance overall stability and resilience during seismic events. Water is stored in high-capacity tanks and is always at 75% capacity, acting as a counterweight to the structure.

The primary structure has a tube steel framework, chosen for its high strength-to-weight ratio and clean architectural expression. Pin connections are strategically used at key joints to allow for controlled rotation and reduce internal moment forces. This approach simplifies fabrication, facilitates quicker assembly, and accommodates subtle structural movement—essential for long-span or exposed frame systems.

The building has a perforated skin, and perforations vary in density, creating a dynamic texture that filters daylight into the interior while minimizing glare. This passive design strategy reduces reliance on artificial lighting, particularly during peak daylight hours. Its modular fabrication ensures minimal onsite waste and efficient installation. The durable finish reduces maintenance requirements, enhancing the building's life cycle sustainability.

A triangulated 3D grid distributes loads efficiently across multiple nodes, minimizing the need for bulky vertical supports and enabling expansive openings in the façade design. Each space truss framing module is prefabricated offsite, promoting quality control, reducing material waste, and accelerating the construction timeline. The modularity allows for flexibility in panel integration, accommodating the perforated north screen, glazing, and sub-façade elements without requiring structural modifications.

The curtain wall system is comprised of prefabricated glass units assembled within an aluminum frame. Floor joists reset on a girder attached to the primary truss using a stiffened, bolted seat connection. The panels for the sub-layer skin slide together with a tongue and groove system, and bolts attach them to the inner space frame. The space frame is attached to a plate using mounting brackets, and the plate is secured to the primary truss.

Other spaces include a communication tower that supports firefighting operations by enabling radio, data, and emergency transmission. A rooftop rainwater collection system captures and stores rainwater for firefighter training exercises, reducing reliance on municipal water. ■

3rd

Cloud 81

Students: Zilin Jing, Jingxiang Zhang
Faculty Sponsor: Lauren Scott
Syracuse University

Cloud 81 is an urban incubator in Syracuse, N.Y., that bridges demolition, recycling, and local production. It's part workshop, part recycling center, and part marketplace that turns urban waste streams—from large-scale infrastructure teardowns to household discards—into value. Syracuse's eight-stage, four-year demolition of Interstate 81 is the project catalyst, and Cloud 81 occupies land where the highway once stood. The facility also educates on material flows and bolsters Syracuse's resilience. It embodies transitional infrastructure, turning urban evolution into an opportunity for ecological and economic regeneration.

At the city level, Cloud 81 partners with demolition projects to salvage steel, timber, and panels through selective pickup services, diverting waste from landfills and reducing transport emissions. Below-grade industrial machinery processes materials into reusable formats, while unsalvageable timber is converted into biomass fuel to heat the facility during winter.

The facility has fabrication workshops for wood, metal, textiles, and ceramics, and makerspaces that bridge traditional craft and contemporary production methods. The program emphasizes resource and space sharing through communal studios, tools, equipment, and expertise, reducing the financial barriers to entry for emerging artists and designers. It also includes private production and retail venues to provide emerging artisans with support for individual trade growth.

At the community scale, residents exchange discarded furniture, textiles, and objects for material credits, redeemable for locally made goods. The incentivized system democratizes access to artisan products, challenging mass-produced alternatives by lowering costs through recycled inputs. The makerspaces' public interface adapts seasonally: summer features open-air markets built from reclaimed materials, while winter shifts to a drive-through model to accommodate cold-weather mobility.

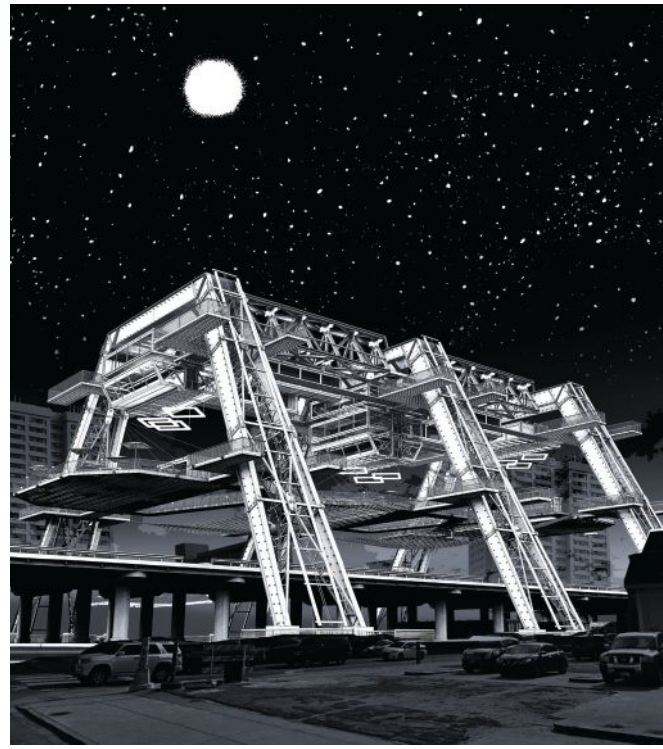
The building has flexible, intuitive spaces that empower user agency, resisting fixed functions in favor of adaptation. It also embodies rigid planning: efficient, mechanical systems prioritizing productivity and controlled flows, where economic imperatives dictate spatial logic. The design has a crucial element that mediates those two extremes: a repurposed I-81 overpass transformed into a pedestrian corridor linking downtown to the university. Reusing the overpass instead of demolishing it leverages infrastructure as a catalyst for material circularity and community connection.

A 20-ft by 20-ft layered truss grid achieves the open floor plans required for flexible workshop spaces, public ground levels, and accessible rooftop areas. Primary vertical supports are concentrated at the core with secondary perimeter columns, creating a column-free central zone for adaptable workshop use while maintaining open circulation at ground and roof levels.

The core extends upward to integrate a cable-stayed support system for structural redundancy and efficiency, reinforcing the towers. A cellular beam waffle grid is employed for floor panels, optimized for lightweight strength, while horizontal cable tension systems provide lateral stability. The hybrid approach ensures long-span flexibility, material efficiency, and structural resilience, balancing openness with load-bearing performance.

The building integrates two energy systems: geothermal and biomass. A closed-loop geothermal system handles everyday heating and cooling, while biomass (using waste timber) supplements Syracuse's harsh winters. Both systems feed a central hot liquid buffer chamber that distributes heat throughout the building. Each floor connects independently—workshops use a large heat pump in the upper mechanical chamber, while tower floors have smaller individual units. Heated liquid replaces traditional heating coils in air handlers for efficient HVAC. Polluted workshop air undergoes triple filtration with dedicated return systems. Passive strategies optimize efficiency: cross-ventilation in summer, and heat recapture from machinery in winter. ■

CATEGORY II: OPEN
Honorable Mention



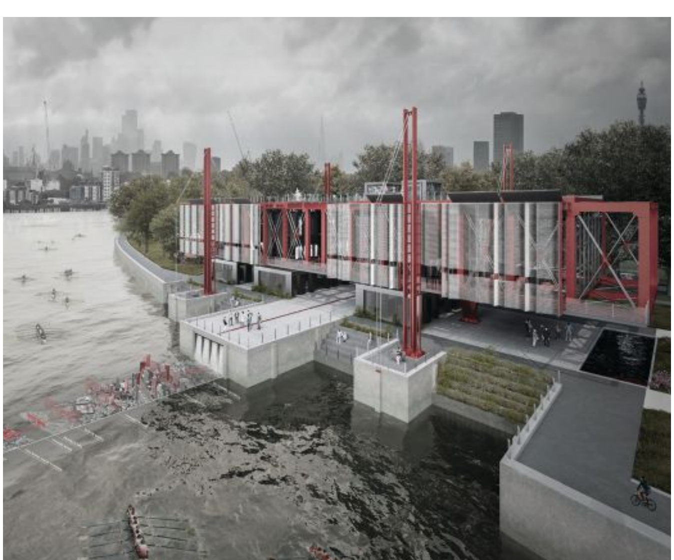
The Interstate Viewing
Student: Ta'riq Abdul-Rahman
Faculty Sponsor: Se Won Roy Kim
Ball State University

The Interstate Viewing is a reflective memorial to interstate highways throughout the United States, highlighting the destructive legacy of the Federal Highway Act of 1956 that facilitated the construction of highways through thriving Black communities. It's a temporary structural assembly aiming to provide interim relief during interstate removal. It also allows locals to envision life before the interstate and speculate on post-interstate communal features.

The project is siteless and can be applied to neighborhoods throughout the United States. It's designed as a temporary, lightweight, and site-adaptable structure centered on ease of assembly, restoration of community, and social service. Applicable uses include the ongoing Interstate 81 demolition in Syracuse, N.Y., and proposed demolitions of the Claiborne Expressway in New Orleans and a section of Interstate 20 in Atlanta. ■

Royal Naval Archives: Within The Vessel
Students: Noah Kotlinski, Shane Gallagher
Faculty: Genevieve Baudoin
Kansas State University

Royal Naval Archives: Within The Vessel, located in Island Gardens on the Isle of Dogs in London, draws from the historical context of Maritime Greenwich and the Royal Naval College. Situated along the Thames River, the building restores the axial alignment and symmetry established by the college and the original Hawksmoor axis.



The archives' layered spaces and clearly defined thresholds emulate a naval vessel's internal organization. Ships are divided into airtight layered compartments—not just for buoyancy, but also to organize function, regulate circulation, and ensure structural stability under pressure. The design layers public and private zones to reflect a similar flow.

The design integrates steel structural elements that suspend pillars from the box truss, emphasizing their form and creating a visual contrast with surrounding layers. These repeatable volumes house various archival documents and artifacts.

Two V-columns lift the building above the ground, suggesting a ship anchored within the landscape. This elevated design creates sheltered public amenities, allowing pedestrians to experience the structure from underneath. Each V-column is anchored with a pinned and hinged base and reinforced with welded steel supports, reinforcing the idea of the building as an elevated vessel within the park. The building creates a sense of lightness by reducing its ground contact to two focused points.

Four tensile masts layered into the structural system support the V-columns, while an undulating sun screen draws from the protective steel hull panels found on battleships. The mast design is inspired by the cranes used in naval shipyards to construct and stabilize warships. Beyond their structural role, the masts' placement and orientation emphasize the building's central axis and introduce a striking visual element along the river's edge.

The archives are at the core of the building. Six modules, hung from the primary structure, provide specialized storage for artifacts and documents. These self-contained units are suspended within a layered substructure pill that extends to the roof and toward the ground plane. ■

Dubai Flow
Students: Zhirun Huang and Weixia Luo
Faculty Sponsor: Fei Wang
Syracuse University

Dubai Flow is an Arab art center inspired by Dubai's traditional wind towers. The city's many wind towers are used for passive cooling, inspiring the passive ventilation strategy used in the project.

The building is generated from a 36-ft cubic module, and the modules are combined, bent, and twisted to form a single unit of the building. There are five total units, and they overlap to create the current form and serve as exhibition spaces for Arabic calligraphy, clothing, film, weaving, and ceramics. The overlapping volumes form the core of the building and serve as vertical circulation paths, guiding visitors to the different exhibition areas. The wind towers within the building also serve as exhibition spaces.

The design aimed for diversity and integration in the building's exterior form and incorporated five distinct interior design languages, each reflecting a specific exhibition theme and enhancing the audience's experience. The five interior design approaches created a rich exhibition experience, allowing visitors to discover and explore the depth of Arab culture as they move through the spaces.

These five bridges are not only the core structural elements of the building, but also symbolic bridges connecting Arab culture and art. They support and rely on one another, collectively building the cultural center's richness and diversity of experiences. ■

new products

This month's new products include a nut-side DTI, a fastening system, girder clamps, laser engraving for fastener tools, and a project dashboard for steel erectors.

LeJeune Bolt Company TNA Fastening System

The TNA Torque And Angle fastening system from LeJeune Bolt Company redefines standards in fastener reliability and assembly consistency. It delivers an advanced, data-driven method for applying the perfect clamp load in critical joints.

Using proprietary TAE Series tools, TNA combines torque and angle measurements to ensure optimal bolt stretch and clamping force. By monitoring the angle of rotation after a predetermined snug torque is reached, the system guarantees each bolt is tensioned to the correct specification. The TNA system is the simplest and most accurate means to perform the RCSC-approved Combined Method of installation. It's also the only fastening system that delivers a quantifiable snug-tight condition and the precise required angle for the perfect final pretension. In addition, the TNA bolts meet the requirements of ASTM F3148 and are 100% melt and manufacture in the U.S.

Recently, the system was used throughout construction of NASA's new Mobile Launcher 2 at the Kennedy Space Center, the ground platform used to launch rockets to the moon. For more information, visit **www.tightenright.com**.

Lindapter Type AAF Girder Glamps

Lindapter Type AAF girder clamps are a smarter way to connect steel for seismic and structural applications without welding or drilling. They can achieve a fast steel-to-steel connection where high load capacities are present in tensile, slip or combined load directions. They feature an innovative two-part design that incorporates a rocking washer to allow the clamp to self-adjust to suit a range of flange thicknesses. They are manufactured from low-temperature SG iron with a hot-dip galvanized finish to provide high performance and anti-corrosion protection in cold environments down to -76 °F.

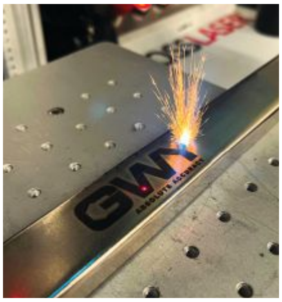
The type AAF girder clamps have full ICC-ES approval for all seismic design categories (A through F) and are fully compliant with *International Building Code*. They meet the requirements of the *Specification for Structural Steel Buildings* (ANSI/AISC 360-22), the *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341/22), and *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE/SEI 7-22).

TurnaSure ViewTite Self-Indicator

Wrought Washer Mfg., the largest washer manufacturer in the United States, recently purchased TurnaSure, a direct tension indicator (DTI) washer producer that makes the revolutionary ViewTite Nut Side Self-Indicator washer. The ViewTite Self-Indicator allows users to quickly and easily confirm bolts are properly tensioned.

During snug tightening, the hardened washer first makes contact with the indicator's protrusions, which compress linearly as bolt tension increases and snug-tightening is completed. The elastomer does not emit during snug-tightening. During final tightening, the reduced height "horseshoes" compress and release a precise measure of elastomer from multiple sides of the indicator. When the user sees green, on the nut side, the bolts are correctly tensioned. The elastomer also includes a crystallite for strong fluorescence, aiding speed and safety in nighttime inspection.

ViewTite DTIs are manufactured to ASTM F959/F959M and are suitable for bolted structural steel framing connections in accordance with the *Specification for Structural Steel Buildings* (ANSI/AISC 360-22). For more information, visit **www.turnasure.com**.



GWY Personal Laser Engraving

Bolt installation tool manufacturer GWY has expanded its in-house capabilities with precision laser engraving for tools, sockets, and other equipment. Laser engraving provides permanent, high-contrast markings that withstand wear and environmental conditions—ideal for job sites where durability and traceability are critical. It can help with GWY's observed increase in customers striking the back of their GWY tools while using them, which can damage internal gears. Laser engravings like "don't hit here" can aid strike prevention.

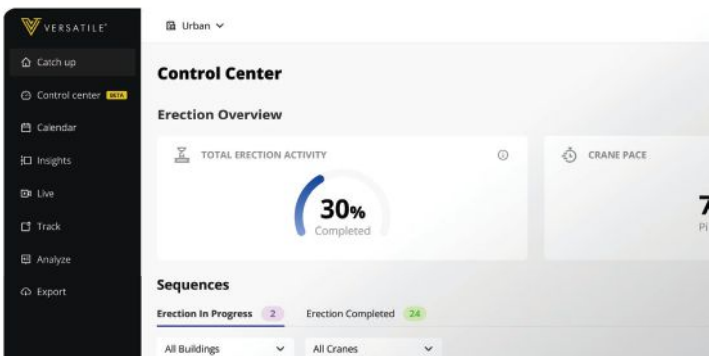
Elsewhere, laser engraving supports text, serial numbers, company logos, and even detailed images such as safety precautions, making it a reliable solution for asset identification, tool accountability, and loss prevention. Unlike paint or labels, laser markings will not fade, peel, or rub off, ensuring long-term legibility.

Whether used for compliance, inventory management, or simply keeping tools organized, laser engraving offers accuracy, consistency, and a professional finish tailored to industry demands. Add an engraving to your next purchase, repair or calibration service. For more information, visit **www.gwyinc.com**.

Versatile Control Center

Versatile, a leader in AI-powered construction technology, recently launched Control Center, the first project dashboard designed specifically for steel erectors. Control Center brings together production, schedule, and budget data into a single platform that project managers and operations leaders can use to drive performance across every jobsite.

Versatile developed Control Center to solve a problem many steel teams face daily. Project managers juggle spreadsheets, phone calls, text messages, and field reports just to understand whether a job is on track. Control Center eliminates the guesswork by delivering a consistent, clear view of jobsite health each day.



Dynamic jobsites means that schedules shift quickly and field crews often operate without digital tools necessary for today's builds. Control Center addresses these realities by automatically capturing lift data through Versatile's crane-mounted device and combining it with plan data and field inputs. The result is a dependable daily summary of jobsite activity that does not require extra work from the field and no new workflows for the team.

Key features include:

- Jobsite progress dashboard. See delivery, installation, and turnover milestones without field check-ins
- Pace and crane activity tracking. Monitor erection speed and crane utilization to identify slowdowns early
- Automated reporting. Generate daily summaries and shareable reports without manual data entry
- Resource and risk visibility. Track performance against plan and make timely adjustments

Versatile worked directly with project managers, superintendents, and operations leaders to design Control Center around their existing workflows. The goal was to provide value from day one, without adding reporting burdens or changing how teams operate. To learn more, visit **www.versatile.ai**.

FELLOWSHIPS

AISC Awards Four Ernest J. McCartney/B&B Welding Company Undergraduate Research Fellowships

AISC has awarded four students with 2025 Ernest J. McCartney/B&B Welding Company, Inc. Undergraduate Research Fellowships. The fellowship provides funding to research structural steel design and construction topics under the guidance of a faculty sponsor for a full academic year or one term. This year's recipients were given funding to conduct their respective proposed research projects during the 2025–26 academic year.

Exploratory Studies of Epoxy Adhesives in the Retrofitting of Steel Bridges
Student Name: Rebecca Bishop
Faculty Sponsor: Jose Capa Salinas
University of St. Thomas

This project aims to assess the viability and performance of epoxy adhesives in structural steel applications by investigating the structural behavior and practical implications of applying adhesives in the field. Adhesives have a well-established role outside of civil infrastructure. However, structural steel application remains relatively underexplored, especially for large-scale or retrofitting scenarios in steel bridges. This project proposes to develop a literature review on these adhesives, identify the opportunities for application in bridge retrofitting, and provide laboratory experimentation for the methodology that reflects field practices. The project's goal is to contribute to a broader initiative of exploring modern, noninvasive retrofitting techniques in aging infrastructure systems.

Investigating the Effects of Multiple Weld Repairs on Steel Fatigue Life
Student Name: Juliette Bolte
Faculty Sponsor: Ryan Sherman
Georgia Institute of Technology

This project seeks to investigate the fatigue life of ASTM A709 structural steel that has been welded and subsequently undergone one or more additional repairs. Throughout its service life, a steel bridge experiences cyclic loading from the passage of heavy vehicular traffic. As a result, fatigue is a predominant concern for steel bridge members, particularly members fabricated using welded details. Developing a complete picture of the welded A709 steel's behavior in response to repeated loading conditions can improve current knowledge and contribute to progress in structural repair, retrofitting techniques, and fabrication standards and practices.

Understanding Influences on Weldability to Reduce Preheat Standards
Student Name: Rich Calderon
Faculty Sponsor: Machel Morrison
University of California, San Diego

The objective of this project is finding the degree to which different variables affect weldability. These variables include the properties of the material and the welding conditions. Preheating guidelines for structural steel welding are specified by the American Welding Society's standards, AWS D1.1/D1.1M:2015 Table 3.2, which describes recommended preheat temperatures for different grades of steel. Improvements in modern steel manufacturing allow for the most commonly used steels to be made with a lower carbon equivalent. Similar advancements have introduced lower hydrogen welding consumables to the industry.

This project is a step in a longer-term study aimed at identifying existing fabrication conditions where preheat levels can be reduced. The goal of that study is to recommend modifications to steel specifications as defined by ASTM that would allow for lower preheat levels in welded joints widely used in current practices.

Exploration and Evaluation of Interaction Equations for Gusset Plates
Student Name: Bryan Lagunas
Faculty Sponsor: Matthew Eatherton
Virginia Tech

This project aims to propose and evaluate interaction equations for gusset plates subjected to combined loading of moment, axial, and shear forces to contribute to the creation of safer and more efficient steel structures. Steel connections frequently experience a combination of bending, axial force, shear force, and sometimes torsion, which demands reliable interaction equations to ensure safe and economical designs.

The AISC *Specification for Structural Steel Buildings* (ANSI/AISC-22) contains interaction equations that address combined loading on members. However, these equations are not specifically tailored to gusset plates, creating a gap when steel designers encounter complex loading scenarios. This project has three main objectives: to propose three new interaction equations for gusset plate behavior, to compile a comprehensive set of existing interaction equations for connection plates, and to use a finite element software to simulate gusset plate behavior under combined loading conditions based on the effects of cross-sectional plasticity. The goal of this research is to deliver practical design guidelines that are directly applicable in improving current practices in structural steel design.

AISC certification sets the quality standard for the structural steel industry and is the most recognized national quality certification program. It aims to confirm to owners, the design community, the construction industry, and public officials that certified participants, who adhere to program criteria, have the personnel, organization, experience, documented procedures, knowledge, equipment, and commitment to quality to perform fabrication, manufacturing, and/or erection. Find a certified company at **aisc.org/certification**.

The following U.S.-based companies were newly certified or renewed certification in at least one category from August 1–31, 2025.

Newly Certified Companies
(August 2025)

Bapko Metal, Inc., Orange, Calif.
Burt Steel, Inc., Montgomery, Ala.
Dave Steel, Shelby, N.C.
G.M. McCrossin, Inc., Bellefonte, Pa.
Gulf Coast Structural Steel and Fabricators, Port Arthur, Texas
ICM Metal Fab Industrial Cleaning and Mechanical, LLC, Perry, Ga.
Lawton Welding, Topsfield, Mass.
Mabe Steel Inc., Kernersville, N.C.
Mid Cities Erectors, Aurora, Texas
Nucor Towers & Structures Inc., Trinity, Ala.
RAD Fabrication, Indianapolis
Schuff Steel Company, Owensboro, Ky.
Structures America, Conroe, Texas
The Quaker Corporation, Cheshire, Conn.

Certification Renewals
(August 2025)

44 Iron Design, Caldwell, Idaho
Acrow Corporation of America, Milton, Pa.
Advance Industrial, Grove City, Ohio
Affordable Welding, Chicago
Allfasteners USA, LLC, Medina, Ohio
Almet, Inc., New Haven, Ind.
Amerect Inc., Newport, Minn.
American Manufacturing & Engineering Co., Inc., Cleveland
Apex Steel Corp., Raleigh, N.C.
ASP Structures LLC, Selinsgrove, Pa.
Atlas Iron Works, St. Louis
Augusta Iron & Steel Works, Inc., Martinez, Ga.
AZCO Inc., Appleton, Wisc.
Berlin Steel/FEI Ltd, Natural Bridge Station, Va.
Blattner Steel Co., Cape Girardeau, Mo.
Brakewell Steel, Inc., Chester, N.Y.
Builder's Iron, Inc., Sparta, Mich.
Canatal Steel, Roanoke, Va.
Capital Contractors, Inc., Lincoln, Neb.
Cives Steel Company, Gouverneur, N.Y.
Cives Steel Company, Idaho Falls, Idaho
CK Construction, Westerville, Ohio
Columbia Building Products Co., Inc., Olmsted Falls, Ohio
Columbus Steel Erectors, Columbus, Ohio
Contech Engineered Solutions LLC, Abington, Va.
Corsetti Structural Steel, Inc., Joliet, Ill.
CSE Incorporated, Williston, Vt.
Custom Fabrications and Coatings, Granite City, Ill.
Douglas Steel Fabricating Corp., Lansing, Mich.
Drake-Williams Steel, Inc., Omaha, Neb.
Eastern Steel Erectors, LLC, Terryville, Conn.
F.A. Wilhelm Construction Co., Inc., Indianapolis
FCC Construction, Caledonia, Mich.
Firelands Fabrication, New London, Ohio
Geiger & Peters, Inc., Indianapolis
Great Lakes Dock and Materials, LLC, Muskegon, Mich.
Gresham Steel, Norfolk, Va.
Hohl Industrial Services, Inc., Tonawanda, N.Y.
Industrial Resources, Inc., Fairmont, W.V.
Integrity Steel Supply, LLC, Mapleton, N.D.
Intermountain Erectors, Inc., Idaho Falls, Idaho
Ironfab, LLC, Columbus, Ohio
J&B Fabricators LLC, Auburn, Wash.
J.A. McMahon, Inc., Niles, Ohio
J.C. Steel Erectors Corp., Islip, N.Y.
J.L. Walter & Associates, Inc, Indianapolis
J.P. Cullen & Sons, Inc., Janesville, Wisc.
Jeffords Steel & Engineering Co., Plattsburgh, N.Y.
Jeffords Steel & Engineering Co., Potsdam, N.Y.
JL Walter & Associates, Inc, Indianapolis
Jorgensen Steel Machining and Fabrication Inc., Tekonsha, Mich.
Kiewit Corporation, Omaha
Kokosing Industrial, Inc., Westerville, Ohio
LENEX Steel Company, Indianapolis
LENEX Steel Company, Terre Haute, Ind.
Livi Steel, Inc., Warren, Ohio
Loenbro, LLC, Westminster, Colo.
Lowder Steel, Inc., Archdale, N.C.
LWI Metalworks, LLC, Morrisville, Vt.
Maico Industries Inc., Ellsworth, Kan.
Mast Farm Service, Millersburg, Ohio
Mesa Fab Shop, Inc., Pueblo, Colo.
Metropolitan Steel, Inc., Lansing, Ill.
Michelman Steel Enterprises, Bethlehem, Pa.
Mid America Steel, Inc., Fargo, N.D.
Moore & Morford, Inc., Greensburg, Pa.
Moran Iron Works, Inc., Onaway, Mich
MSSM Corp, Pueblo, Colo.
Myers & Co. Architectural Metals, Basalt, Colo.
Newport Industrial Fabrication, LLC, Newport, Maine
Northeast Structural Steel, Inc., Pelham Manor, N.Y.
Northern Machining and Repair, Inc., Escanaba, Mich.
Nova Structural Steel, Inc., Cleveland
Novel Iron Works, Inc., Greenland, N.H.
Nucor Vulcraft, Saint Joe, Ind.
Pikes Peak Steel, Colorado Springs, Colo.
PKM Steel Service, Inc., Salina, Kan.
Preston Fabrication ID LLC, Preston, Idaho
Redd Iron Inc., Brighton, Colo.
Roanoke Valley Steel, Inc., Weldon, N.C.
Rose Steel Inc., Greenland, N.H.
RPS Machinery Sales, Inc., Jersey Shore, Pa.
SA Fabrication, Woodbine, N.J.
Sanford Steel Corporation, Goldston, N.C.
Schuff Steel Company, Ottawa, Kan.
Select Steel Fabrication LLC, Wellsville, Kan.
SME Steel Contractors, Pocatello, Idaho
Spirit Fabs, Inc., Wrightstown, Wisc.
Steel Structures, Inc., Washington, Utah
Steel Supply & Engineering, Grand Rapids, Mich.
Steelhead Metal & Fab, LLC, Salem, Ore.
Structural Services, Inc, Nazareth, Pa.
Structural Steel of Carolina, LLC, Winston-Salem, N.C.
Summit Industrial Construction, LLC, Houston
Superior Iron Works, LLC, Sterling, Va.
Superior Rigging & Erecting Co. Inc., Atlanta
Synergy Steel Structures, Inc., Lansing, Ill.
Szoke Brothers, Inc, Slatington, Pa.
T&M Decking, Inc., Oxford, N.C.
Team Industries Inc., Kaukauna, Wisc.
Tech-Steel, Inc., Clearfield, Utah
The Arthur Louis Steel Co., Geneva, Ohio
The Dover Tank and Plate Co., Dover, Ohio
The Tarrier Steel Co. Inc., Columbus, Ohio
Thomas Steel, Inc., Bellevue, Ohio
Traverse Steel LLC, Windsor, Colo.
Triad Fabricators, LLC, Evansville, Ind.
Union Metal Industries Corp., Canton, Ohio
Universal Steel of North Carolina, LLC, Thomasville, N.C.
Utah Fabrication Inc., Tooele, Utah
Valmont Industries, Inc., El Dorado, Kan.
Van Dellen Steel, Inc., Dutton, Mich.
Wilson's Structural Steel, LLC, Fenton, Mo.

AISC

Northeastern's Jerome Hajjar Named Inaugural AISC Innovation Fellow

AISC welcomed Northeastern University Professor Jerome Hajjar, PE, PhD, to its inaugural Innovation Fellowship program, a collaborative research residency at its Chicago headquarters that began this fall. The fellowship, a minimum semester-long iteration of AISC's two-week Innovation Scholar summer program, aims to engage industry leaders with structural steel-focused research and provide avenues for continued collaboration.

Hajjar will work with AISC staff on a variety of initiatives during his academic sabbatical. His expertise, insight, and decades of experience researching resilient and sustainable structures will be invaluable to AISC's continued investment in creating educational and actionable sustainability resources.

"I am honored to have been invited to be the inaugural fellow," Hajjar said. "I will be interacting especially with the teams working on sustainability, research, education, and the design specifications. I have been working toward having sustainability and resilience become increasingly premier design objectives in structural engineering, underpinned by our current objectives of strength, stability, serviceability, constructability, aesthetics, and economy."

AISC intends to develop a network of connected and supportive Innovation Fellow alumni, beginning with Hajjar. AISC will select an Innovation Fellow annually through a formal application process open to university faculty, steel researchers, steel designers, recent retirees, and other eligible candidates with a desire to advance innovation in steel design and construction.

"We couldn't be more excited to welcome Jerry to Chicago and invite his wealth of structural knowledge into our research and programs," said Christopher Raebel, SE, PE, PhD, AISC vice president of engineering and research. "I look forward to seeing this program thrive."

Learn more about the program, supported by the AISC Education Foundation, at **aisc.org/innovation-fellow**.

GRANTS

New $110,000 AISC Grant to Integrate Architecture Education and Structural Steel

AISC is awarding one educator up to $110,000 over four years to introduce architecture students to structural steel in the studio or the built environment.

"Architecture students may not be familiar with structural steel's role in architecture and urbanism," said AISC architecture education manager Jeanne Homer, AIA. "They may not have spent a lot of time thinking about the impact of long spans on functional flexibility, lower carbon emissions, resilience, and the inspirational expression that steel offers. This grant will help create well-rounded architects who are fully prepared to design our future."

Funded by AISC's Education Foundation, the new grant will support architecture programs teaching students about structural steel building framework within several contexts that can include design studio, classroom courses, and school events.

The program can enhance an existing program or develop something new. Applications are due January 12, 2026, and applicants will be notified of the results by March 6, 2026. Eligibility and application requirements and instructions can be found at **aisc.org/archintegration**.

People & Companies

Zekelman Industries named **Jason Pappas** its vice president of AI and innovation, **Jeff Cole** its chief operating officer (COO) and **Chris Hoyt** the president of Atlas Tube.

Pappas' role is a new position, and he will lead the company's enterprise-wide strategy to accelerate AI adoption, strengthen operational excellence, and enhance the customer experience. Cole will oversee operations for all pipe and tube divisions, including plant operations and engineering functions. As the operations leader, he will partner closely with business unit presidents to align operational strategies and drive execution of their organizational objectives. Additionally, he will lead teams focused on operational training, project management, and continuous improvement. Hoyt succeeds Cole and will be responsible for the overall success of Atlas Tube, with direct oversight of sales, service, and production planning teams. He joined Zekelman in 2022 as Atlas Tube's vice president of sales.

Lexicon, Inc. hired **Shawn Cochran** as vice president of its new Lexicon Construction Management division and promoted **Bryan Glenn** to vice president of project management for its Fabrication Group. Cochran brings more than 16 years of expertise in operations, maintenance, engineering, environmental compliance, strategic planning, and capital project management within the steel industry. He will oversee steel construction projects from planning to completion, ensuring the projects stay on time, within budget and meet quality standards. Glenn joined Lexicon in 2020 as a sales executive and quickly advanced to director of sub-fabrication, where he expanded the group's capacity for sub-fabricating thousands of tons of steel. He will oversee operations across multiple fabrication projects, ensuring quality, efficiency and client satisfaction remain at the forefront of Lexicon's services.

ENGINEERING JOURNAL

Fourth-Quarter 2025 *Engineering Journal* Available

The fourth-quarter issue of AISC's *Engineering Journal* is available at **aisc.org/ej**. It includes papers on the Chevron Effect, embedment length of steel coupling beams, and revisiting the *P*-δ magnification factor for members subject to end moments. Here are some highlights.

The Chevron Effect Further Demystified Through the Lower Bound Theorem
Patrick S. McManus and Jay Puckett

The transfer of brace forces at braced frame connections in V-, inverted V-, and X-brace configurations is discussed. Force transfer under these configurations considers wide-flange and rectangular hollow structural sections (HSS) for the horizontal beam or strut. The analogous condition of truss web-to-chord connections using gusset plates is discussed. Analogies are expanded to address the condition of beam-to-column brace connections using a common gusset plate to receive the horizontal beam/strut and braces above and below the beam/strut. The potential to redistribute forces using the assumptions of the lower bound theorem is investigated. Additionally, the transposition of shear forces to axial forces in connections at X-brace configurations is illustrated.

Embedment Length of Steel Coupling Beams—Evaluation and Proposed Revision to the AISC *Seismic Provisions* for Ordinary Composite Coupled Walls
Sushil Kunwar and Bahram M. Shahrooz

One of the composite systems codified in the *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-2022) is composite coupled walls, which are comprised of two or more reinforced concrete structural (shear) walls linked by steel or composite coupling beams embedded in the wall piers. The embedment length is a critical factor that affects the stiffness and strength of the coupling beams, which affect the overall performance of coupled walls.

Past studies have examined the performance of special coupled walls in which the wall piers are heavily reinforced and typically have boundary elements. A recent series of tests focused on ordinary composite coupled walls demonstrated that the embedment length determined according to the 2022 *Seismic Provisions* was insufficient to develop the target member strength. The results prompted a need to reevaluate the equation by which the embedment length is determined. Using basic principles supported by experimental data, a revised equation was developed and evaluated through numerical simulations. The revised equation results in longer embedment lengths by as much as nearly 40% for cases that would likely be encountered in practice.

Revisiting the *P*-δ Magnification Factor for Members Subject to End Moments
Eric M. Lui

The 2022 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) allows member and system instability effects to be accounted for by using advanced analysis methods that model these effects directly or through the use of the B_1 (P-δ) and B_2 (*P*-Δ) multipliers. For compression members subject to end moments only, the B_1 multiplier is expressed as a function of the smaller to larger end moment ratio. This ratio is taken as positive when the member bends in reverse curvature and negative when it bends in single curvature. This code equation for B_1 often overestimates the *P*-δ effect for double curvature bending under a high axial force but underestimates the *P*-δ effect for single curvature bending under almost all values of axial force.

The reason for the overestimation is because the derivation of the B_1 equation uses the equivalent moment concept and ignores the actual location where the maximum moment occurs in the member. When this condition is taken into consideration, it is shown herein that the equation is no longer applicable for members bent in reverse curvature under any value of axial force. The reason for the underestimation is because the effect of axial force on the moment ratio is ignored. By incorporating this effect in a new equation for B_1, it is shown that this underestimation is drastically reduced. The validity of this proposed B_1 multiplier is established by comparison with the corresponding theoretical values.

Steel Structures Research Update
Additive Manufacturing for Structural Steel Applications
Judy Liu

Research on large-format metallic additive manufacturing for structural steel applications is highlighted. Ryan Sherman, associate professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, leads this study. Sherman's research on steel bridge and ancillary highway structures encompasses large-scale laboratory testing, field monitoring, material characterization, and finite element simulation. Research interests include fatigue, fracture, and additive manufacturing for civil engineering infrastructure.

An AISC Milek Fellowship awarded to Sherman in 2023 supports this research, building on work with Lincoln Electric Additive Solutions and funded by the Federal Highway Administration (FHWA). As part of that effort, AISC Undergraduate Research Fellow Shirin Raschid Farrokhi investigated fatigue performance under the mentorship of PhD candidate Hannah Kessler. Kessler, the 2025 Reidar Bjorhovde Outstanding Young Professional recipient, also conducted tension, impact, and fatigue testing for the FHWA project and, with PhD student Zachary de Haaff, has been integral to the research team. Selected highlights from completed and planned research are presented.

SCHOLARSHIPS

Annual AISC Education Foundation Scholarship Recipients Announced

The AISC Education Foundation has awarded 110 undergraduate and master's students with $410,025 in scholarships for the 2025–2026 academic year.

The AISC David B. Ratterman Fast Start Scholarships program awarded 18 scholarships totaling $90,500. The program supports the immediate family members of AISC full-member company employees who will be freshmen and sophomores during the upcoming academic year—or the employees themselves, in some cases. The students may attend two- or four-year programs and may choose any area of study.

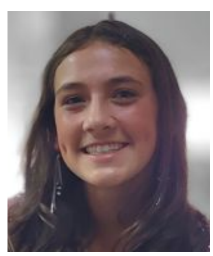
Six students in Wyoming are turning up the heat with Rex I. Lewis Fast Start Scholarships they won at the 2024 Puma Steel welding competition in Cheyenne, Wyo. They competed against other high school students to win scholarships to local welding programs. The AISC Education Foundation administered $12,275 to these six recipients.

AISC also awarded a total of $24,000 in funds to the top-scoring teams in the Student Steel Bridge Competition, plus three team awards for spirit, ingenuity, and engagement.

The AISC Education Foundation, in partnership with several other structural steel industry associations, awarded the remaining $283,250 to 74 additional students. The foundation is deeply thankful for the growing support of industry partners and all the individual contributors who help support the next generation of great thinkers. The following students will receive AISC scholarships for the 2025–2026 academic year:

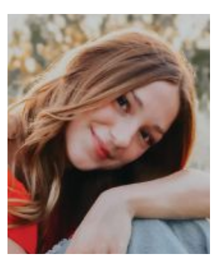
David B. Ratterman Fast Start Scholarships

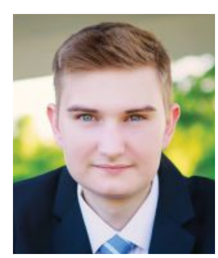




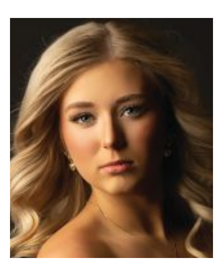
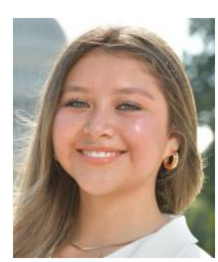










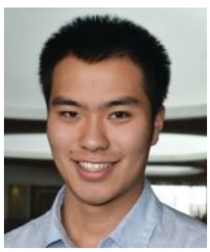





- Josue Carrillo, Amarillo College
- Isabella Contreras, The University of Texas at Austin
- Rosemarie Dangerfield, Brigham Young University
- Collin Elias, Belmont Abbey College
- Ashley Fields, University of Kentucky
- Gianna Frasher, University of Mary
- Gabriel Fusini, University of Kentucky
- Audrey Gordon, Elizabethtown Community and Technical College
- Jayden Hinds, Weatherford College
- Abby Jackan, University of Wisconsin–Stevens Point at Wausau
- Evan Jelinek, Northeast Community College
- Aubrey Johnson, Miami University
- Jacob Meyer, University of Central Oklahoma
- Max Moxley, Indiana University – Bloomington
- Michael Moyano, Thaddeus Stevens College of Technology
- Sadie Overbey, University of Mississippi
- Nathaly Santana, Duke University
- MacKenzie Smith, University of Wyoming

AISC Education Foundation Scholarships for Juniors, Seniors, and Master's Students



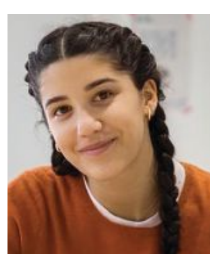


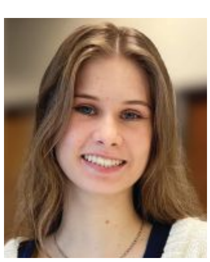





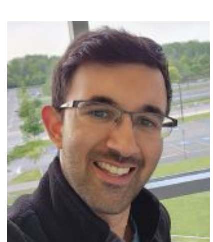







- Anne Abraham, University of California at Davis
- Ryan Bailey, Lehigh University
- Joshua Brubaker, Marshall University
- Kyle Burns, University of North Dakota
- Tyler Burns (W&W | AFCO Steel Scholarship), University of Arkansas at Little Rock
- Nathan Cao, Stanford University
- Steven Castillo, Manhattan University
- Jace Creech, Case Western Reserve University
- Hunter Desmond, Auburn University
- Ethan Druckenmiller, Bowling Green State University
- Joshua Epps (Steven J. Fenves Scholarship), The University of Texas at Austin
- Bricio Estrada Hernández, University of Illinois at Urbana-Champaign
- Maxwell Fletcher, University of Florida
- Nora Frederick, Northeastern University
- Vasiliki Hamakiotes, Cooper Union
- Grant Harrington (W&W | AFCO Steel Scholarship), Oklahoma State University
- Victoria Hay (Cohen Seglias Scholarship), Ferris State University
- Mary Helvie, The Georgia Institute of Technology
- Luke Hernandez, University of Oklahoma
- Amelia Hilterbrand, Penn State Harrisburg
- Shayla Hines, The Pennsylvania State University
- Benjamin Idler, Stanford University
- Nicholas Kallipolites, Rochester Institute of Technology
- Joshua Kates, Colorado State University

>>

AISC thanks this year's David B. Ratterman Scholarship jury for their time and dedication:

- Greg Borchardt, Infra-Metals Co.
- Kelsey DeLong, DeLong's, Inc.
- Babette Freund, The Williams Family of Companies
- John O'Quinn, High Steel Structures, LLC
- Stuart Sherrill, SteelFab, Inc.
- Corey Yraguen, Precision Build Solutions, LLC

AISC Education Foundation Scholarships (cont.)

- Charles Kissel, University of Cincinnati
- Alexander Ko (Fred R. Havens Scholarship), Kansas State University
- Sierra Krick, Lehigh University
- Konstantine Mendrinos (Cohen Seglias Scholarship), Manhattan University

- David Mitri, Northeastern University
- Cannon Moser, University of Toledo
- Lily Nagy, Sacramento State University
- Lorenzo Palazzo, University of Delaware

- Alexandra Pavlov, Northeastern University
- Albert Petry, Rochester Institute of Technology
- Haley Prey, Arizona State University
- Paul Quinn, University of Notre Dame

- Matthew Ryan, University of California, Berkeley
- Lennart-Fredrik Schmitz (Fred R. Havens Scholarship), University of Wisconsin–Madison
- Denise Steffen, San Francisco State University
- Anne Townsend, University of Virginia

- Dominic Tran, University of California at San Diego
- Rachel Truong, University of Illinois at Urbana-Champaign
- Claire Turner, Colorado State University
- Audrey Williamson, Michigan State University

- Grace Zhang, University of Washington
- Laney Zuelsdorff (Fred R. Havens Scholarship), University of Wisconsin–Madison





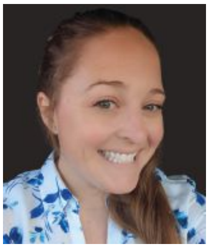

















not pictured:

- Marah Abedel, University of New Orleans
- Amelia Arteaga (W&W | AFCO Steel Scholarship), Texas A&M University at College Station
- Ryan Hennings, Brigham Young University
- Luca Vasiliu, Northeastern University

Thank you to this year's AISC Scholarship jury for juniors, seniors, and master's-level scholarships:

- Benjamin Baer, SE, PE, Sheffee Lulkin & Associates, Inc.
- Jeanne Homer, AIA, AISC
- Luke Johnson, SE, PE, Nucor
- Cristopher Montalvo, PE, Dekker
- Temple Overman, PE, HNTB Corporation
- Matt Streid, SE, PE, Magnusson Klemencic Associates
- Jaclyn Whelan, PE, Conrail
- Jacquelyn Wong, PE, California Department of Transportation






AISC/W&W | AFCO Steel/ Oklahoma State University Scholarships

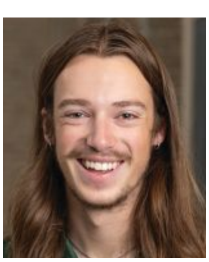
Seniors
- Joseph Black, Construction Engineering Technology
- Caitlyn Lutrell, Architectural Engineering
- Griffin Moore, Civil Engineering

Juniors
- Cadence Cross, Civil Engineering
- Alyssa Durham, Architectural Engineering
- Cade Scarbrough, Construction Engineering Technology

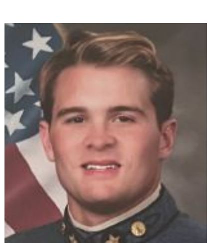
not pictured:

Sophomores
- Aaron Fiscus, Construction Engineering Technology
- Brayden Pottala, Architectural Engineering
- Evan Waters, Civil Engineering


AISC/Southern Association of Steel Fabricators Scholarships
- Hunter Desmond, Auburn University
- Maxwell Fletcher, University of Florida




AISC/Rocky Mountain Steel Construction Association Scholarships
- Joshua Kates, Colorado State University
- Claire Turner, Colorado State University

AISC/Virginia Carolinas Structural Steel Fabricators Association Scholarships
- Blaise Randy Mengue, Clemson University
- Riley Simon, Virginia Tech

AISC/Indiana Fabricators Association Scholarships

- Nomundari Battulga, Purdue University Fort Wayne

not pictured:

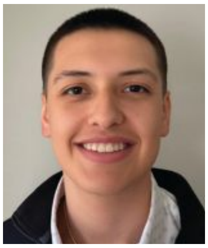
- Lainie Jadyn Gideon, Purdue University
- Tychicus Xu, Rose-Hulman Institute of Technology
- Ryan Hoak, Trine University
- Henry Hall, University of Evansville
- Lauren Kane, University of Notre Dame
- Addison Janiszewski, Valparaiso University

Virginia Carolinas Structural Steel Fabricators Association Family Scholarships

not pictured:

- Ivy Wells, Wesleyan University

AISC/Associated Steel Erectors of Chicago Scholarships






- Daniel Chaidez, Dominican University, Illinois Institute of Technology
- Maverik Davids, University of Illinois Urbana-Champaign
- Jesse Ekanya, University of Illinois Urbana-Champaign
- Matthew Fratu, University of Illinois at Chicago
- Hailey Gordon, University of Illinois Urbana-Champaign
- Kai Smith, Purdue University

AISC/Ohio Steel Association Scholarship

- Cannon Moser, University of Toledo

Rex I. Lewis Scholarships

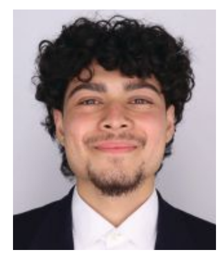

- Beau Corn, Laramie County Community College
- Hyrum Heward, Casper College

not pictured:

- Sobe Barber, Western Wyoming Community College
- Caid Graves, Laramie County Community College
- Jadon Martinez, Western Wyoming Community College
- Everett Nelson, Laramie County Community College

Student Steel Bridge Competition Scholarships







**Recipient chose to begin their post-graduate studies at a new school. The school listed does not indicate the winning SSBC team.*

- Damian Blanco, University of Florida
- Oliver Fishman, Virginia Tech
- Marvin Gomez, Virginia Tech
- Evan Marshall, Virginia Tech
- Kathryn Raynaud-Richard, University of California, San Diego
- Sean Walshe, University of Washington*
- Kathryn Wright, Georgia Tech*

not pictured:

- Waylon Ball, Lincoln Memorial University
- Marco Cruz-Coronado, Kennesaw State University
- Emma Robert, University of Florida

The AISC Education Foundation is a registered 501(c)(3) nonprofit organization. Every penny donated to the AISC Education Foundation is 100% tax-deductible and goes to students, educators, and education programs. Visit **aisc.org/giving** for more information.

advertiser index

Complex Structures Group

Hefty Hoisting

THE BIGGEST college football stadium project ever is also one of the largest active steel projects in the Midwest. The new Ryan Field in Evanston, Ill., will be the Northwestern University football team's home when it opens in fall 2026, and it has a striking steel element exposed to all visitors.

A steel truss canopy covers the entire seating area and encircles the stadium. Anyone in the seating area or on the field can see the white-painted truss members, which cantilever 115 ft along the sideline and 95 ft over the scoreboards in each end zone.

Erecting the canopy was one of the project's most fascinating steps. Nine fully modularized canopy sections were assembled on the ground and hoisted into place—all consisting of two trusses, infill, and deck. When viewed on the ground, they looked like a cut-out section of the canopy.

Modern Steel Construction visited the jobsite in late August to see AISC member Complex Structures Group erect one of the modularized sections above the scoreboard in the stadium's south end. The 86-ton piece took nine days to assemble and paint onsite before it was hoisted into place. An identical truss assembly rests over the scoreboard on the stadium's north end.

A crane hoisted the canopy section from the ground into place in about 15 minutes, but it remained rigged to the truss for a few hours while the eight connection points to the steel frame were bolted and tightened. The rigging was designed so the assembly could rotate 2° counterclockwise from its reference drawing geometry, allowing the back connection to touch down first before rotating to the front side connection. That sequence was critical for smooth installation.

The crane used to hoist the nine modularized sections and four long-span header trusses that frame the corners was the largest active crane in the Chicago area. Its lift capacity was 825 tons, and its upper jib height was 313 ft. A single crane track was 7 ft tall and 5 ft wide, and the crane took a week to build.

The stadium has 10,500 tons of steel and topped out in October. The canopy has nine modularized pieces, four header trusses, and 20 cantilevered planar trusses that frame the rest of the roof. All were assembled on the ground. AISC member LeJeune Steel is the primary fabricator on the project, and fellow AISC member Zalk Josephs is a contributor. Thornton Tomasetti is the project's structural engineer. Pat Ryan Jr., CEO of stadium owner Ryan Sports Development, is overseeing every aspect of the project. ■