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November 2021

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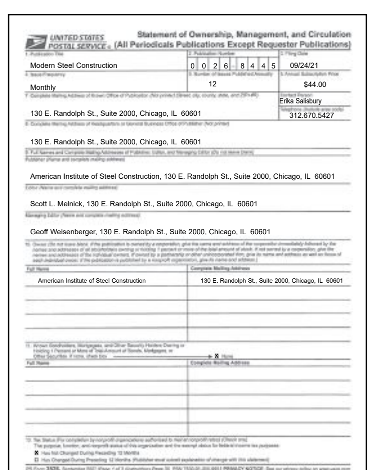

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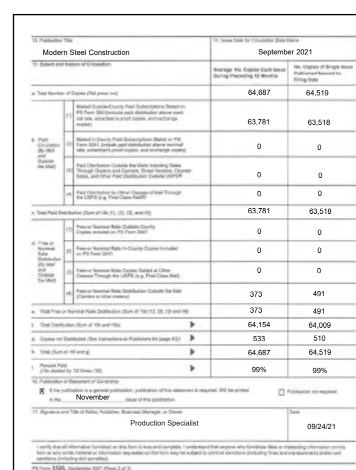

Modern Steel Construction	September 2021	
a.	64,687	64,519
b. (1)	63,781	63,518
(2)	0	0
(3)	0	0
(4)	0	0
c.	63,781	63,518
d. (1)	0	0
(2)	0	0
(3)	0	0
(4)	373	491
e.	373	491
f.	64,154	64,009
g.	533	510
h.	64,687	64,519
i.	99%	99%

X November

Production Specialist | 09/24/21

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ON THE COVER: 200 Park in San Jose, Calif., is the second West Coast SpeedCore project to be built, p. 16. (Photo: Level 10 Construction)

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editor's note

My daughter, Julia, recently turned 25, and she was freaking out about being a quarter of a century old.

But in the steel world, 25 years is just a drop in the bucket. In fact, this year marks AISC's centennial celebration, and we have members who were founded far earlier. And while it's easy to look back at all AISC and the steel industry have accomplished in the past century (check out our ongoing series of interactive timelines at **aisc.org/legacy** and our bridge timeline at **aisc.org/timeline**), I'm more interested in looking ahead.

Too often, steel is mistaken as an old rust-belt industry doing the same things it's done for years and years. But nothing could be farther from the truth. Whether you're looking at a mill or a fabrication facility, you're looking at a highly automated, high-tech work environment. Steel mills today are over ten times more efficient than they were when I was growing up, and thanks to cutting-edge robotic equipment that is becoming increasingly common in fabrication shops, assemblies that used to take four hours to complete can now be achieved in as little as 15 minutes!

Here are just a few of the cool things happening *right now*:

- If you think SpeedCore is an exciting development (and who's not excited about a system that shaves more than 40% off the erection time of a modern high-rise), wait until you see SpeedFloor. While still in the conceptual phase, this modular floor deck offers a double-panel system that provides a stiff floor without the need for a concrete topping and increases erection speed by nearly 50%. (Learn more about AISC's Need for Speed initiative by visiting **aisc.org/needforspeed**.)
- Speaking of floor systems, early next year AISC will introduce a new Design Guide showcasing hybrid steel/wood systems. Primarily designed for residential construction, these steel-framed buildings use wood floor systems to reduce costs, improve aesthetics, and speed up construction. (Get a sneak peek at what we're talking about by visiting **aisc.org/educationarchives** and searching for "Odeh".)
- The newest development is an announcement of net-zero steel by Nucor, the nation's largest producer of structural steel. Through the use of 100% renewable energy and the purchase of carbon offsets, beginning next year Nucor will offer some of their range of products as net-zero (they're calling the product Econiq). The net-zero product will initially be used by GM, but they anticipate offering it to the construction market as well. And Nucor isn't the only steel mill enhancing its earth-friendly attributes. For example, Gerdau has partnered with 174 Power Global and TotalEnergies to develop an 80-megawatt solar facility (including 231,000 solar panels) adjacent to the company's Midlothian, Texas, steel mill. The project will provide reliable, green power directly to the mill and offset the emissions of more than 13,000 average Texas households. And Steel Dynamics, Inc., has pledged a 20% reduction in carbon emissions by 2025 and to be carbon-neutral by 2050. American steel mills have long been the world's cleanest, with all domestic wide-flange coming from EAF mills using more than 92% scrap as a raw material—and now the domestic steel industry is further reducing its carbon footprint through the use of renewable energy.
- Atlas Tube has just opened its expanded mill in Blytheville, Ark.—which not only doubled its capacity but is also specifically designed to produce jumbo HSS. What do we mean by jumbo HSS? Squares up to 22 in., rounds up to 28 in., and rectangles up to 34 in. by 10 in.

Want to know more about the future of steel? Mark your calendars for March 23–25, 2022, when NASCC: The Steel Conference returns as a live event in Denver. I hope to see you there!

Scott Melnick
Editor

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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**.

steel interchange

All mentioned AISC codes, standards, and manuals, unless noted otherwise, refer to the current version and are available at ***aisc.org/specifications****, AISC Design Guides are available at* ***aisc.org/dg****, and* Engineering Journal *articles are available at* ***aisc.org/ej****.*

ASTM A770 and Thick Base Plates

I have a condition where a W14×120 column is attached to a 2½ in. base plate. This seems to be a great candidate for requiring A770 through-thickness testing to ensure that there are no problems with the delamination of the base plate. However, the fabricator has indicated that they have not encountered this requirement before. Is this requirement reasonable or overkill?

For typical structural steel buildings, requiring A770 through-thickness testing would be unusual, especially given the modest size of the elements we are talking about. This would tend to indicate that most engineers do not feel it is necessary. Neither the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) nor the *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341) contain requirements to perform ASTM A770 testing on any materials. ASTM A770 is mentioned (but not required) in a User Note to the *Specification for Safety-Related Steel Structures for Nuclear Facilities*. It is also mentioned in the AISC *Steel Construction Manual*. As it is not required by any AISC design standards, this would tend to indicate that several committees have decided (through formal consensus processes) that is not generally necessary for structures within the scopes of those standards. There may be some unusual aspect of your application that would make it prudent to require this testing. Ultimately, you must use your own judgment.

ASTM A770 is sometimes specified due to concerns about lamellar tearing—and this is, in fact, the reason stated in ASTM A770 for the test. As stated in AISC Design Guide 21: *Welded Connections—A Primer for Engineers*: "Current steel-making practices have helped to minimize lamellar tearing tendencies." In this statement, "current steel-making practices" implies current steel-making practices in the U.S.

Lamellar tearing tends to be (in the rare instances where it occurs) a fabrication issue. This is also indicated in Design Guide 21: "Unlike hydrogen-related cracking which is typically delayed, lamellar tearing usually occurs while the weld is cooling and shrinking." This means if it occurs, it will usually be picked up when the weld is inspected, though—"in other cases… lamellar tearing may occur well after the weld has solidified and cooled due to additional shrinkage stresses that result from welding on another part of the assembly." At base plates, there will typically not be the restraint necessary to cause this sort of delayed lamellar tearing "due to additional shrinkage stresses that result from welding on another part of the assembly."

Keep in mind that fabricators do not want welds to crack (due to lamellar tearing or any other cause) because the cracks will have to be repaired, which will cost the fabricator time and money. Therefore many fabricators do more than simply satisfy the minimum requirements in order to prevent welds from cracking.

Generally, far more can be done to prevent lamellar tearing when the detail is configured than will be accomplished by the type of testing we are discussing. Let's say we have material that is very susceptible to lamellar tearing (material produced by something less than "current steel-making practices"). The detail can be configured in a manner that will significantly reduce the likelihood of lamellar tearing, or it can be configured in a manner that will substantially increase the probability of lamellar tearing. This, in my mind, represents a very rational and effective approach to the concern. Design Guide 21 again provides some good advice to avoid problems through rational measures.

It may not be possible to purchase plate tested to ASTM A770 from a service center. If you get the plate from a mill, the scale and schedule of the project would have to be consistent with the mill order. The other option would be to purchase the material and then test it. For those who consider this option, I would encourage them to read ASTM A770 carefully. The standard is chockful of caveats about the subjectivity inherent in the test and its limitations to catch or prevent potential lamellar tearing.

Given that A770 is somewhat subjective, the project team would probably need to decide what the response would be if a plate fails. Note that the failure of a single sample is not a failure of the plate but rather a cause for another sample to be tested. Would you require that a "failed" plate be discarded? Who is responsible for paying for a new plate? What about any delays caused by having to reorder the plate?

I have never had to address a lamellar tearing issue on any project I have been directly involved with, and I have worked on many projects involving weldments of thick elements. I am not aware of any in-service problem that has been attributed to lamellar tearing in the last 30 or so years. In some industries, it is my understanding that it is common to ultrasonically examine thick base plates to ASTM A578. More than one fabricator has told me that in several decades of performing such tests, they have never uncovered a problem. This is further evidence in my mind that the value of such testing may be minimal.

Larry Muir, PE

Bo Dowswell, principal with ARC International, LLC, and **Larry Muir** are both consultants to AISC.

Weak Axis Loading of Single-Plate Connection

In industrial structures, it is common that the beams are subjected to not only vertical loads but also horizontal loads in the minor axis direction. The AISC *Steel Construction Manual* does not provide any provision for single-plate type connections designed to resist horizontal shear forces (i.e., shear in the out-of-plane direction of a single plate). Do you have any recommendations on how to design a single-plate connection for a horizontal shear force?

Generally, single-plate connections (shear tabs) can resist only small forces in the horizontal direction. A design procedure for this condition is not available; therefore, you should use your own judgment to determine an appropriate design method. As with any connection design, all elements in the load path must be evaluated for the required loads, including:

- local strength of the beam
- bolts
- plate
- welds
- local strength of the supporting member

The laws of statics require that the plate is subjected to both shear and flexure about both the strong and weak axes. Interaction of biaxial bending and shear on the plate can be performed with a strength-of-materials approach or with the plastic interaction equations included in the first quarter 2015 *Engineering Journal* article "Plastic Strength of Connection Elements." For extended single-plate connections, you may want to consider modifying the 15th Edition *Steel Construction Manual* Equation 10-5 because it implicitly limits the twisting deformation caused by the torsion from the horizontal offset between the plate and the beam web. If the plastic interaction equations are used for the extended configuration, torsion should be considered explicitly, as discussed in the second quarter 2019 *Engineering Journal* article "Torsion of Rectangular Connection Elements."

Bo Dowswell, PE, PhD

HSS Weld Seams and AESS

We are using HSS braces on a project, and a question has come up regarding the visible weld seams on the HSS shape. For AESS Category 4, can the weld seam be left alone as is?

No. The weld seam will require modification. Section 10.4.12 of the AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303) states: "For Categories AESS 1 and 2, seams of hollow structural sections shall be acceptable as produced. For Category AESS 3, seams shall be oriented as specified in the contract documents. For Category AESS 4, seams shall be treated, so they are not apparent."

More information and visual samples are available on our website at **aisc.org/aess**.

Larry Muir, PE

STEEL SOLUTIONS CENTER

Steel Interchange is a forum to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Contact Steel Interchange with questions or responses via AISC's Steel Solutions Center: 866.ASK.AISC | **solutions@aisc.org**

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steel quiz

This month's Steel Quiz takes an architectural approach. The answers can be found in the AISC document *Designing with Structural Steel: A Guide for Architects* (available at **aisc.org/architects**).

The questions and answers were developed by Maysaloon Abugrain, an AISC intern who recently received her master's degree in structural engineering from Oregon State University. (Thanks, Maysaloon!)

1 **True or False:** When a tension-only cross-braced system experiences a horizontal force in one direction, only the brace loading in tension is counted on to provide resistance.

2 Which type of brace contains a specifically designated "link" that provides the ductility required when designing for a seismic region?
a. Chevron bracing
b. Cross bracing
c. Eccentric bracing
d. Vertical bracing

3 Structural steel retains _____ of its ambient temperature yield strength at 1,000 °F.
a. 20% **b.** 30% **c.** 45% **d.** 60%

4 **True or False:** Adding lightweight mineral aggregates can decrease the effectiveness of gypsum-based fire protection systems.

5 Which of the following is the most widely used fire-protection material for structural steel?
a. Mineral fiber
b. Gypsum
c. Intumescent coatings
d. Masonry

6 What is the noise reduction coefficient for a 1-in. fabric-wrapped glass fiber panel when determining the sound level in steel buildings?
a. 0.04 **b.** 0.10 **c.** 0.80 **d.** 1.0

7 When using a concrete masonry unit as a backup system for masonry details, a possible disadvantage is that the weight of the overall system would bear directly on the perimeter footings. This can create the need for:
a. A larger foundation
b. Larger steel members
c. Lighter steel members
d. None of the above

TURN TO PAGE 14 FOR THE ANSWERS

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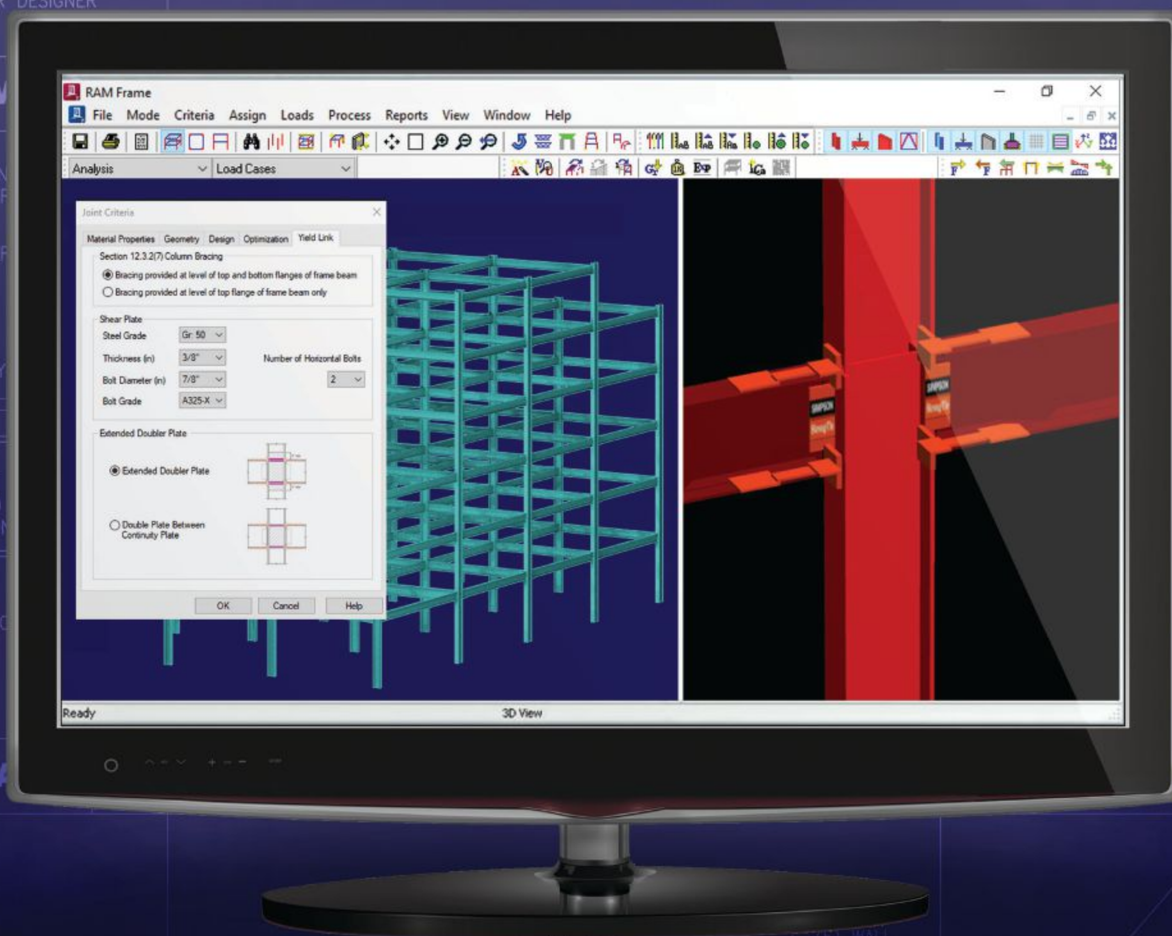

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steel quiz ANSWERS

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1 **True.** Cross-braced bays make the most of steel's strength in tension to efficiently use small structural shapes. When a tension-only cross-braced system experiences a horizontal force from wind or a seismic event, only one leg of the cross brace will provide resistance. When the load comes from the opposite direction, the other leg will become active in its place. (See page 27 of the guide.)

2 **c.** Eccentrically braced frames are very similar to chevron-braced frames. In both systems, the general configuration is a rotated "K" shape with the brace connected to a column and the beam/girder at the level above. However, brace members intersect at the same point in a chevron-braced frame; that is not the case in an eccentrically braced frame. The segment of beam/girder located between the diagonal bracing member is designed to "link" the diagonal braces and help the system resist lateral loads caused by seismic activity. An eccentrically braced system is typically more expensive than a traditional chevron brace system because it uses larger beams and girders and because the brace connections are more complex. (See page 29 of the guide.)

3 **d.** Even non-combustible materials such as steel can be affected by high temperatures. In general, structural steel retains 60% of its ambient temperature yield strength at 1,000 °F. (See page 34 of the guide.)

4 **False.** Adding lightweight mineral aggregates such as vermiculite and perlite can significantly increase the effectiveness of gypsum-based fire protection systems. Gypsum plaster can be applied over metal or gypsum lath. If your project uses gypsum plaster, the contractor must be sure to install the lath properly, then apply the required thickness of the properly proportioned mix. (See page 35 of the guide.)

5 **a.** The most widely used fire-protection materials for structural steel are mineral fiber and other cementitious materials that are sprayed directly onto the contours of beams, columns, girders, and floor/roof decks. These materials are proprietary, so it's essential to mix and apply each product according to the manufacturers' instructions. UL publishes fire-resistant designs with different types and thicknesses of material. (See page 36 of the guide.)

6 **c.** Referring to Table 3-1: Sound Absorption of Common Building Finishes found in AISC Design Guide 30: *Sound Isolation and Noise Control in Steel Buildings* (**aisc.org/dg**), the noise reduction coefficient is 0.80. (See page 40 of the guide.)

7 **a.** Typically, the brick and block enclosure system completely bypasses the floor slab, perimeter beam flanges, and column flanges (see Figure 1 on page 59 of the guide). If the masonry enclosure system bypasses the slab edge, then the perimeter steel members do not support the load of the masonry at each floor, and therefore those steel members may be lighter and shallower. The disadvantage of such an arrangement is that the weight of the entire enclosure system would be supported directly on the perimeter footings or grade beams. This may require a larger and more expensive foundation. In addition, the columns would project more into the interior spaces because they wouldn't be buried in the enclosure system at all. (See page 58 of the guide.)

Everyone is welcome to submit questions and answers for the Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or **solutions@aisc.org**.

steelwise

AGAINST THE WIND

BY SOHEIL SHAFAEI, PHD
DEVIN HUBER, PE, PHD
AND AMIT VARMA, PHD

A look at wind design considerations for the SpeedCore system.

Soheil Shafaei (**sshafaei@purdue.edu**) is a postdoctoral scholar with Purdue University's Bowen Laboratory. **Devin Huber** (**huber@aisc.org**) is AISC's director of research. **Amit Varma** (**ahvarma@purdue.edu**) is the Karl H. Kettelhut Professor of Civil Engineering and director of the Bowen Laboratory at Purdue University.

SPEEDCORE IS MAKING ITS WAY down the West Coast.

The first project to use SpeedCore—the less cumbersome name for the composite plate shear walls/concrete-filled (C-PSW/CF) system—is Rainier Square in Seattle, which was completed last year. And now, a second SpeedCore project, 200 Park in San Jose, is presently under construction. Magnusson Klemencic Associates (MKA), which developed the SpeedCore system, served as the structural engineer for both projects.

The two buildings were designed and detailed in seismic regions (although Rainier Square is a wind-controlled structure), and the May 2021 article "SpeedCore: Seismic Advantages" highlighted some of the key features of designing C-PSW/CF systems in seismic regions (you can read it in the Archives section at **www.modernsteel.com**). However, several buildings are currently being considered for use in wind-controlled, non-seismic regions.

This raises a question: Do the same requirements apply to C-PSW/CF systems in wind regions as seismic regions? While some of the design requirements are the same between wind and seismic, many are not. Here, we'll explore some of the fundamental concepts for design in a non-seismic region and delineate the differences from seismic-controlled regions. Note that many of these concepts will be included in the upcoming 2022 version of the AISC *Specification for Structural Steel Buildings* (AISC 360-22, **aisc.org/specifications**). In addition, prescriptive wind design procedures for C-PSW/CF systems will also be included in the upcoming AISC Design Guide 37: *SpeedCore Systems for Steel Structures*, which is expected to be available by the end of 2021.

Wind Behavior of C-PSW/CF Systems

It is important to have a basic understanding of some of the configurations that C-PSW/CF systems can have in a given building and their underlying behavior when subjected to wind loading. In mid- to high-rise buildings, planar (uncoupled) or coupled C-PSW/CF systems can be selected based on the architectural plan to resist wind loads. See Figure 1 for several examples of typical uncoupled and

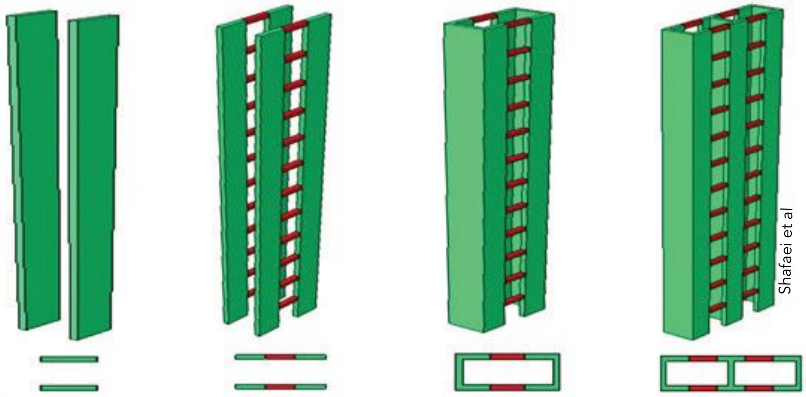
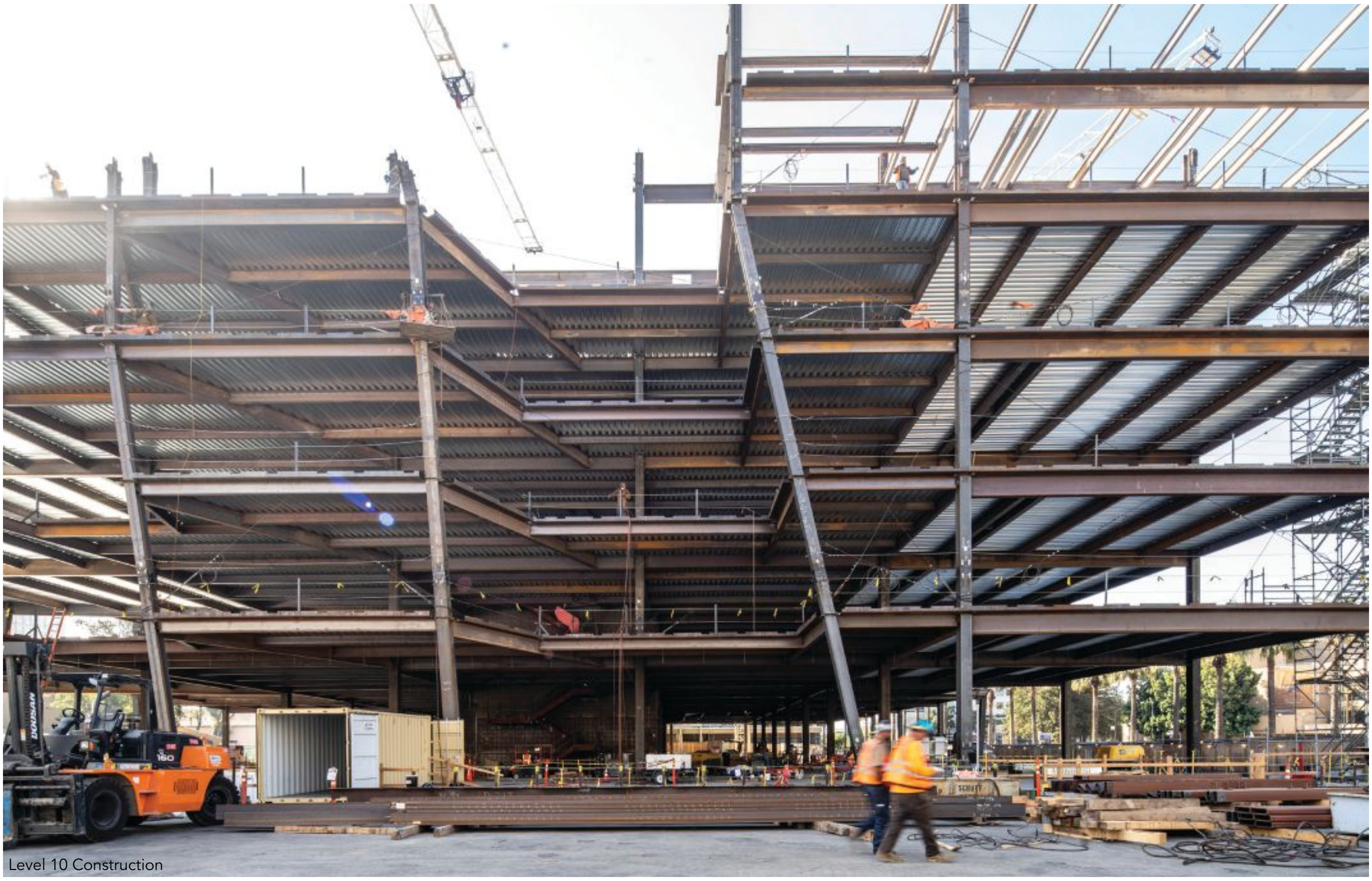


Fig. 1. From left to right: planar (uncoupled) walls, coupled planar walls, coupled C-shaped walls, and C-shaped walls coupled to an I-shaped wall.



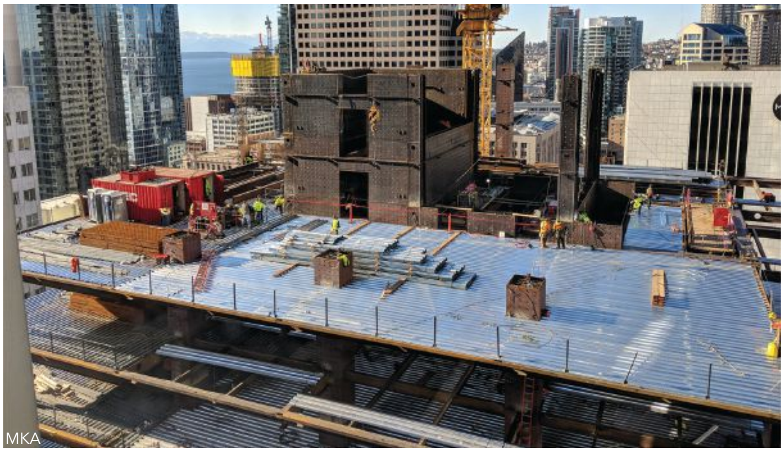
Level 10 Construction

coupled C-PSW/CF core wall structures. As shown in the figure, coupled systems consist of two (or more) individual C-PSW/CFs connected by coupling beams (link beams) along the height of the structure. Individual C-PSW/CFs, either with planar, C, U, I, or T shapes, are used to make coupled C-PSW/CF core wall systems. In general, for wind design, uncoupled C-PSW/CF systems are used in low- to mid-rise applications or up to around 15 stories. For buildings that would be considered mid- to high-rise (say, greater than around 15 stories), coupled configurations are more common.

The reasoning for why uncoupled configurations can be used in lower-height buildings and coupled systems in taller buildings comes down to the architectural considerations and their structural behavior. Figure 2 illustrates idealized responses of uncoupled and coupled shear wall systems under wind loading. When an uncoupled C-PSW/CF system is used, the wall resists the lateral load like a cantilever, as shown in Figure 2(a). The lateral load response is therefore governed by in-plane flexural behavior. This behavior implies that the connection flexibility at the base can play an important role, and drift limits become more difficult to meet as the building becomes taller.

above: Framing for 200 Park in San Jose, Calif., the second project to implement the SpeedCore system.

below: Rainier Square in Seattle, the first SpeedCore project. MKA was the structural engineer for both buildings.


MKA

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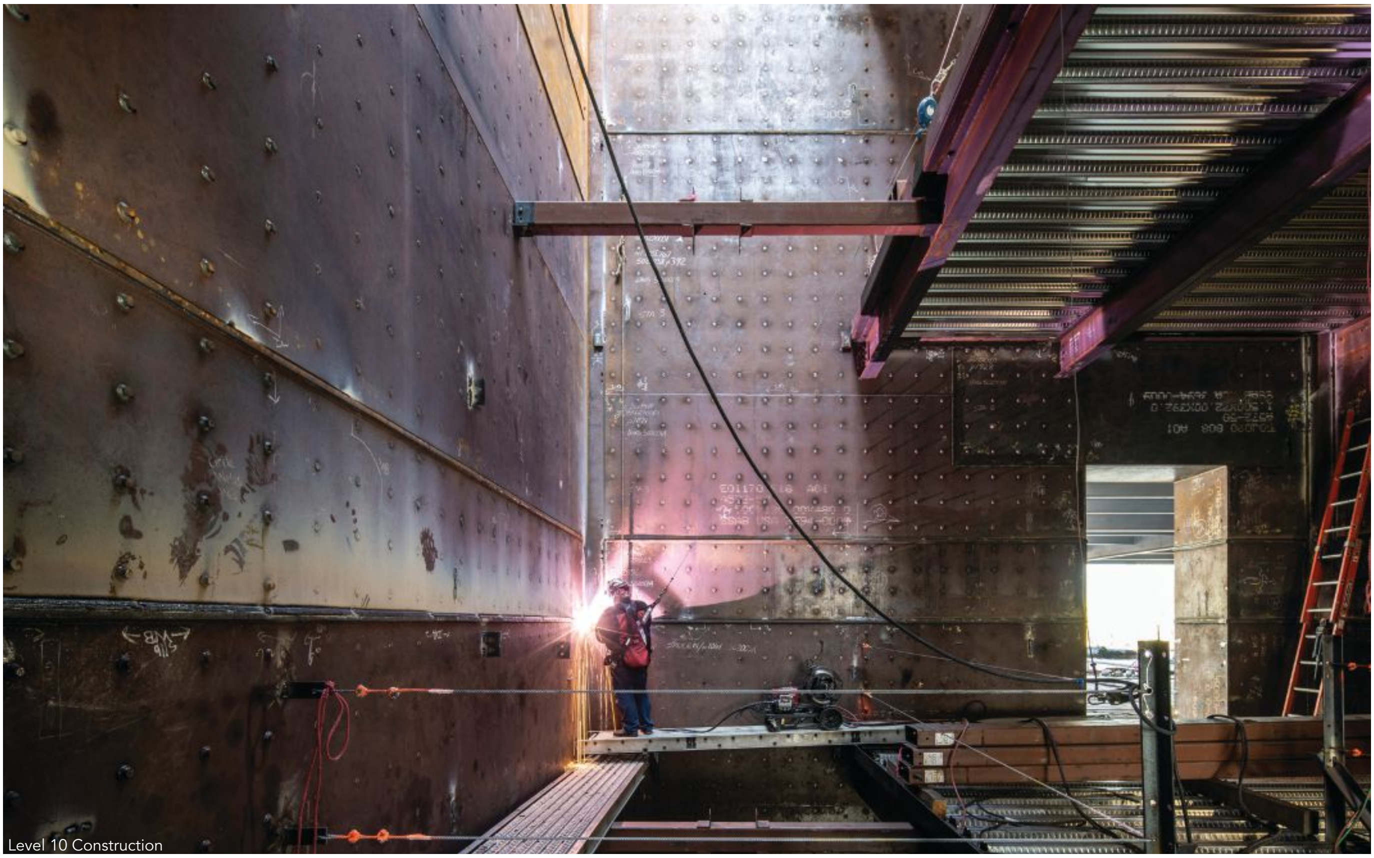


Level 10 Construction

To date, fully welded connections have been used for C-PSW/CF systems built in seismic regions. However, for wind regions, bolted connections are being considered and are also the subject of ongoing research at Purdue University and the University at Buffalo.

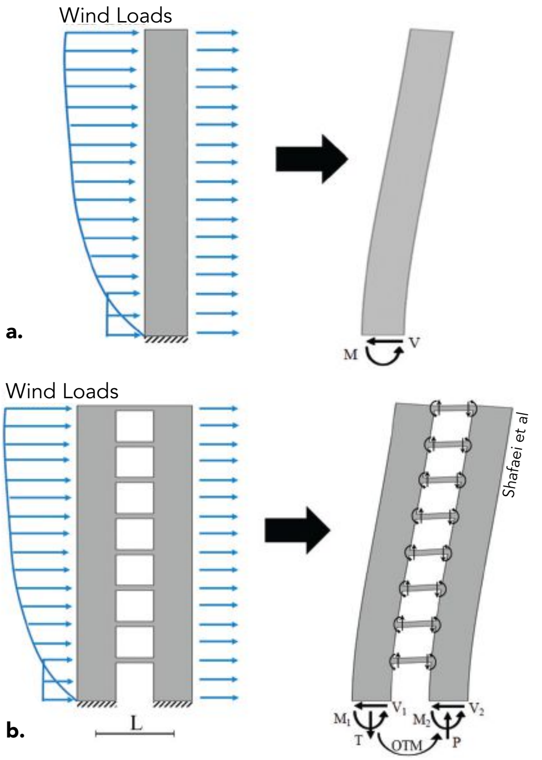


Fig. 2. Idealized shear wall systems deformed under wind loading: (a) planar C-PSW/CF (b) coupled C-PSW/CF.

Figure 2(b) illustrates the behavior of an idealized coupled C-PSW/CF system deformed under wind loading. Wind loading results in an overturning moment (OTM) at the base. This OTM is resisted by the flexural resistance (M_1 and M_2 in Figure 2b) of the individual walls and the axial force couple (coupling action) produced by the equal and opposite axial forces (P and T) in the walls. These axial forces in the walls are the sum of the coupling beam end shears, as shown in Figure 2(b). The contribution of the axial force couple to resisting the OTM is referred to as the coupling ratio. This behavior implies that the overall stiffness of the coupled wall system is much higher than the cantilever stiffness of the uncoupled walls. Consequently, the use of coupled wall systems becomes increasingly more efficient as the building height increases.

Wind Design Requirements of CPSW/CF Systems

In addition to specific (prescriptive) requirements for the wind-governed design of uncoupled and coupled C-PSW/CF wall systems being included in the upcoming Design Guide 37 and the 2022 version of the *Specification*, it is also important to note that welded and bolted connections used with C-PSW/CF systems can be designed in accordance with Chapter J the current *Specification*. In general, the requirements for wind design and how they compare to seismic design are shown in Table 1. One of the main differences is that for wind design, the structural components (walls, coupling beams, etc.) and their connections and splices are all designed for calculated force demands, whereas for seismic design, the structural components and their connections are designed using capacity-based principles with more stringent detailing requirements aligned with the corresponding seismic design R factors (6.5 for uncoupled walls and 8 for coupled walls) for the system. Wind-governed design does not require this more stringent (seismic) detailing, generally leading to more efficient and economical designs for fabrication and erection. Other requirements for wind governed design and how they compare to seismic requirements are highlighted here.

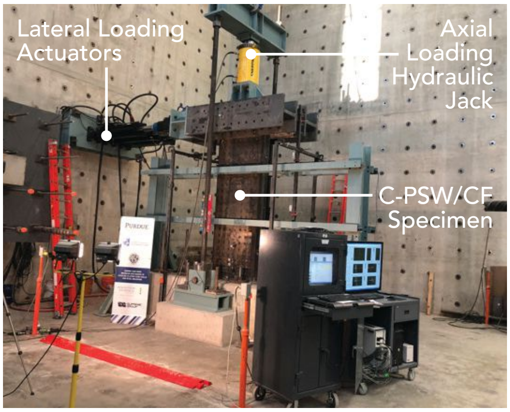
Splice design requirements. The splices that connect wall modules together are critical to the overall performance of C-PSW/CF systems. For wind design, these splices need to be adequate to resist the calculated force demands while also ensuring deformation compatibility (i.e., the wall deforms as a single unit). For seismic design, the splices in the protected zones are required to develop the expected yield strengths of the steel plates. Thus, the splices designed for wind governed regions will likely be more economical than those designed for seismic governed regions. To date, fully welded connections have been used for C-PSW/CF systems built in seismic regions. However, for wind regions, bolted connections are being considered, and it should be noted that bolted connections are also the subject of ongoing research at Purdue University and the University at Buffalo.

Plate slenderness requirements (tie-bar and shear stud spacing). The steel plate slenderness ratio of composite C-PSW/CF walls is calculated as the plate unsupported length b (between tie-bars and/or shear stud spacing) divided by the plate thickness t. These steel plates are required to be non-slender—i.e., yielding in compression must occur before local buckling. The slenderness check for the plate to be non-slender in wind governed (non-seismic) regions is as follows:

$$\frac{b}{t} \leq 1.2\sqrt{\frac{E_s}{F_y}}$$

Where F_y is the yield stress of steel in ksi, b is the largest clear distance between rows of ties or studs in in. or mm, and t is the plate thickness in in. or mm. This plate slenderness requirement is more stringent for seismic design, particularly in areas where significant yielding is expected.

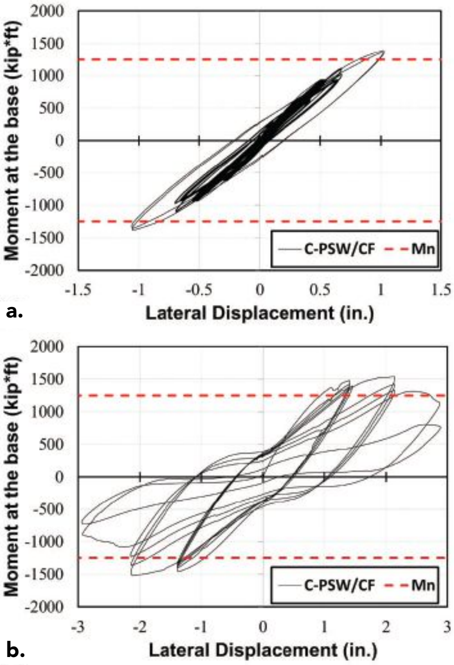
Background and Research



Research for developing design provisions for wind design of C-PSW/CF systems has been underway for several years at Purdue University, with the University at Buffalo performing some additional studies. To date, two large-scale planar C-PSW/CF specimens have been experimentally tested for wind behavior at Purdue's Robert L. and Terry L. Bowen Laboratory for Large-Scale Civil Engineering Research.

One of the two specimens uses 3⁄16-in.-thick faceplates and is approximately 10 ft tall and 3 ft wide, with an overall wall thickness of 9 in. For the experimental testing, the specimen is subjected to a constant axial compression force and cyclic lateral loading intended to simulate wind and seismic loading and examine the overall structural behavior. To achieve this type of loading, the specimen is first subjected to a constant axial compression force, and then the cyclic lateral loading is applied. In wind loading, numerous elastic cycles of low amplitude lateral loading are applied to the specimen, including 500 cycles at 25% of the nominal lateral load capacity (H_n = nominal moment capacity divided by the height), 500 cycles at 50% of H_n, and 75 more cycles at 75% of H_n. After conducting elastic cycles, the specimen is then loaded at higher lateral loads (nonlinear cycles) with fewer cycles, including five cycles at the yield displacement level of the specimen, two cycles at 1.5 times the yield displacement, and then five more cycles at the yield displacement. This is then followed by hundreds of more elastic cycles at lower lateral load levels (75 cycles at 75% H_n, 500 cycles at 50% H_n, and 500 cycles at 25% H_n) to investigate the effects of nonlinear cycles on wind behavior and lateral stiffness degradation of the specimen. Subsequently, after resisting 2,162 cycles of wind loading, seismic cycles are applied to the specimens until its failure to investigate the seismic response of the system.

The wind specimens proved to be suitably strong and adequately stiff for the applied loading and were able to achieve their nominal strength and ductile behavior when the additional load cycles simulating seismic effects were applied. The overall moment-rotation behavior (for both wind and seismic behavior) of the specimen shown in the lateral response charts indicates that nominal capacity was reached with more than adequate ductility in the system. The data from these specimens, along with learnings from other previous research, has allowed for the development of various prescriptive design requirements for C-PSW/CF systems.



A lateral moment-displacement response of a C-PSW/CF specimen subjected to (a) 2,162 cycles of wind loading and (b) seismic loading cycles after wind loading.

Stability of empty steel module (tie-bar diameter and spacing). Empty steel modules (before concrete casting) have to be designed and checked for construction loads, concrete casting hydrostatic pressure, etc. The structural stiffness and stability of the empty steel modules are governed by the spacing and diameter of the tie bars. Therefore, minimum tie bar spacing and diameter are specified to provide adequate structural stiffness and stability, as shown below:

$$\frac{S_t}{t} \leq 1.0\sqrt{\frac{E_s}{2\alpha + 1}}$$

$$\alpha = 1.7\left[\frac{t_{sc}}{t} - 2\right]\left[\frac{t}{d_{tie}}\right]^4$$

Where E_s is the Young's Modulus of steel in ksi, S_t is the clear spacing of the ties in in. or mm, t is the plate thickness in in., t_{sc} is the overall thickness of the wall in in., and d_{tie} is the effective diameter of the tie-bar in in. This equation is the same for both wind design and seismic design. It is important to note that this requirement has to be used along with the plate slenderness requirement (in the composite phase) mentioned earlier. If needed, the stiffness and stability of the empty modules can be enhanced by providing closer spacing and/or larger diameter tie bars using equations provided in the upcoming Design Guide 37 and 2022 *Specification* Commentary.

Wall-to-foundation connection and drift. The non-seismic design of the wall-to-foundation connections for the C-PSW/CF system is done in accordance with the calculated force demands (required strengths). The foundation connections need only be strong enough to resist the calculated moments and forces at the base of the system. For uncoupled walls, the rotational stiffness of the wall-to-foundation connections has an influence on the calculated drifts. Drift requirements often govern the design of uncoupled systems as the wall essentially acts as a cantilever. Consequently, the C-PSW/CF wall strength can be notably higher than the calculated demand.

For coupled wall systems, the rotational stiffness of the wall-to-foundation connection has little influence on the calculated drifts. Design is usually governed by the flexural stiffness of the composite walls and the flexural strength of the composite coupling beams. When drift requirements govern the design, the composite wall strength can be considerably higher than the calculated force demands. For both uncoupled and coupled systems, drift checks can be performed for service level wind loading while using effective stiffness properties (again, provided in the 2022 *Specification*) for the composite walls and coupling beams. These effective stiffness properties conservatively account for the extent of concrete cracking. For composite walls with significant overstrength with respect to the calculated force demands, the extent of concrete cracking can be much less for service level wind loading, and the 2022 *Specification* recommended effective stiffness value may be too conservative. In such cases, the *Specification* permits the calculation of secant stiffnesses that are more representative of the extent of concrete cracking in the composite walls.

In seismic applications, the wall-to-foundation connections are designed to develop plastic hinges at the base, and the connection is designed to carry this developed force (the expected strength of the composite wall) to the foundation—potentially leading to very stout connections at the base. Research into wall-to-foundation connections for wind applications is ongoing, and the envisioned details for wind design are comparatively simpler than the details for seismic design and include connections consisting of rebar dowels from the reinforced concrete foundation embedded into the composite walls; see Figure 3. Note that selecting the wall-to-foundation connection type also depends on the required strength for the connection and constructor preferences.

Coupling beam design. With respect to the coupling beam design for wind, the design strength of the coupling beam-to-wall connection need only be greater than the calculated force/moment demands. From a practicality standpoint, in wind-designed regions

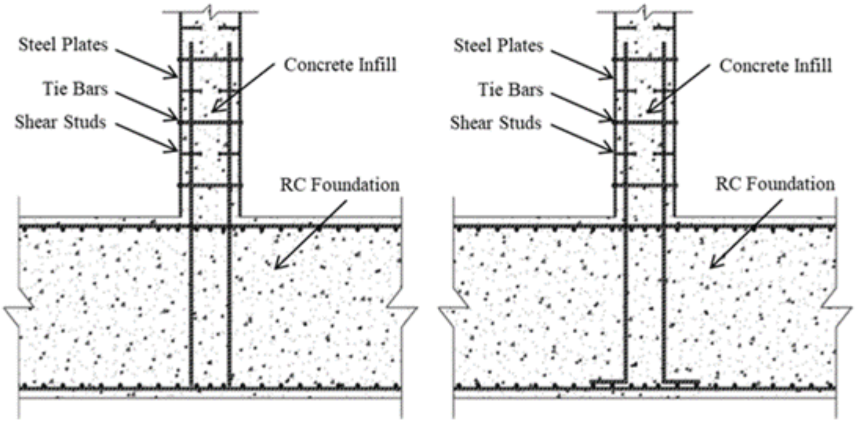


Fig. 3. Schematic of a wall-to-foundation connection using rebar dowels.

right: An embedment frame at Rainier Square.

it is possible to use wide flange or built-up steel sections for the coupling beam. This is in contrast to seismic applications, where composite coupling beams are required to be flexure-critical, steel box sections filled with concrete, and the coupling beam-to-wall connections are required to develop the expected flexural strength of the coupling beam while providing specific ductility and rotation capacity.

Practical considerations. In many cases, the plate thicknesses for C-PSW/CF walls are often governed by constructability considerations, especially with respect to the minimum plate thickness required. In a wind-controlled region, calculations may show that very thin faceplates (≤¼ in.) will satisfy design requirements. However, using these thin plates is not practical for fabrication, erection, and handling. Therefore, for practical considerations, ⅜-in.- or ½-in.-thick plates would likely be the minimum specified. As an example, for the Rainier Square project, a ½-in. minimum plate thicknesses was used and was handled without issue in the field. The limits on plate thickness for practical considerations often result in C-PSW/CF systems being greatly overdesigned from a strength standpoint, particularly for wind designs.

Wind Ready

In exploring design requirements for SpeedCore (C-PSW/CF) systems in wind-governed regions, it's clear that a fundamentally different design procedure is needed than what is used in seismic-governed regions. The conventional approach of designing for the calculated force demands (for the applicable load combination) is adopted for wind design as compared to the elaborate capacity-based design principle adopted for seismic design. This difference allows for certain efficiencies and economies to be gained with respect to various components that form the C-PSW/CF system, including splice designs, wall-to-foundation connections, coupling beams, and beam-to-wall connections.

In addition, practical considerations for fabrication, erection, and handling govern the minimum plate thicknesses that can be used for SpeedCore walls, which can lead to some inherent overstrength. Ultimately, uncoupled or coupled SpeedCore systems can be specified in either seismic or wind regions and appropriately engineered to speed up your next project—and appropriate guidance will be available soon in Design Guide 37 and the 2022 version of the *Specification*. ■

Table 1: Comparison of Requirements for Wind and Seismic Design of C-PSW/CF Systems

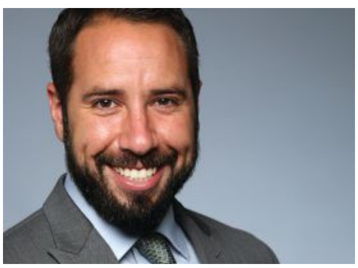
Design Consideration	Design Requirement	
	Wind	Seismic
Basis of Design	Calculated force demands	Capacity based design
Special Detailing Requirements	Typical detailing to provide adequate strength for calculated force demands	Detailing to develop full capacity of various components (designated fuses) and meet ductility requirements. Specifically defined and detailed protected zones
Minimum Area of Steel (Faceplates)	1% to 10% of the total composite cross-sectional area	Same as wind
Splice Design Requirements	Design for demands (ensure deformation compatibility)	Develop full capacity of steel plates at splices in protected zones
Tie Bar Connections to Steel Plate	Develop full yield strength of the tie bar in axial tension	Same as wind
Plate Slenderness (Tie Bar Spacing)	$\frac{b}{t} \le 1.2\sqrt{\frac{E_s}{F_y}}$ Required to be non-slender, yielding in compression must occur before local buckling	$\frac{b}{t} \le 1.05\sqrt{\frac{E_s}{R_y F_y}}$ Required to be non-slender, yielding in compression must occur before local buckling More stringent requirements in areas of flexural yielding (i.e. at the base of the wall)
Stability of empty modules during the construction	$\frac{S_t}{t} \le 1.0\sqrt{\frac{E_s}{2\alpha + 1}}$ $\alpha = 1.7\left[\frac{t_{sc}}{t} - 2\right]\left[\frac{t}{d_{tie}}\right]^4$	Same as wind. For both wind and seismic, the stability of empty modules during construction often governs the tie bar diameter and spacing
Wall-to-foundation Connection	Design for calculated force demands	Design for the expected flexural capacity of wall
Drift check	Check drift for service level wind loading Considering wall-to-foundation flexibility and using effective stiffness of wall and coupling beams	Check drift for design basis earthquake loading Using effective stiffness of wall and coupling beams
Coupling Beam Requirements	Design for calculated force Demands (steel or composite sections)	Flexure-critical. Connections develop Expected strength of coupling beams and provide specific rotation capacity (composite sections required)
Practical limits on plate thickness	For erection and handleability it is recommended to keep plate thicknesses ⅜ in. or greater	Same as wind

data driven

BACKLOGS BOUNCE BACK

BY JOE DARDIS

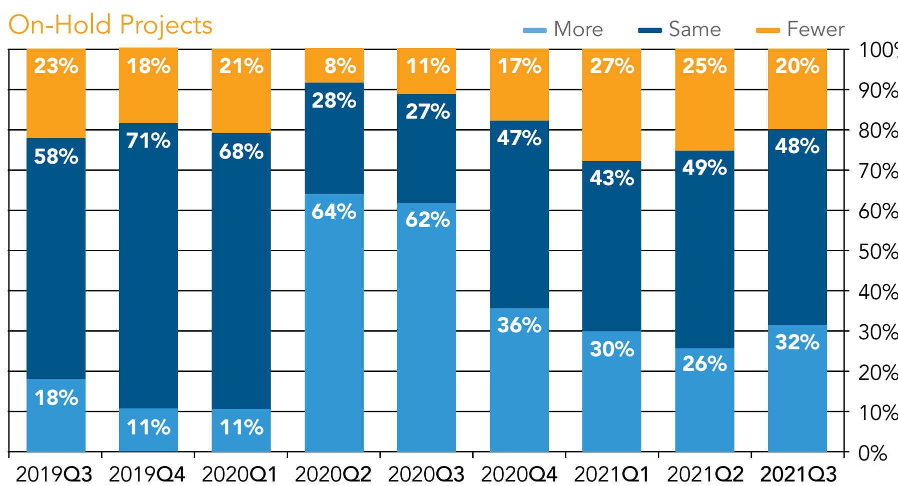
AISC member fabricators provide some insight on how they've been faring in the current construction climate. Long story short: Backlogs are up, but labor remains a challenge.



Joe Dardis (**dardis@aisc.org**) is AISC's senior structural steel specialist for the Chicago market.

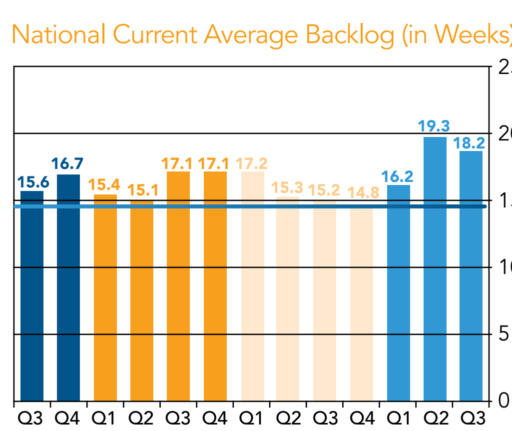
WHERE PREVIOUS DATA DRIVEN COLUMNS have focused mostly on the health of the overall economy and the construction market, this month's edition focuses on fabricators.

Several hundred AISC member fabricators have provided feedback on how they've been weathering the COVID storm. At the onset of the pandemic, AISC members reported a surge in on-hold projects, with 64% of respondents indicating that more projects were put on hold in the second quarter of 2020. Since then, this number has drastically decreased, with only 32% of respondents indicating more on-hold projects in the third quarter of 2021.



The majority of respondents (48%) reported no change in the number of projects being put on hold. Some 32% of respondents reported putting more projects on hold—a 6% increase over the last quarter. Accordingly, only 20% respondents reported putting fewer projects on hold (down 5% from the previous quarter). Rising material costs may be driving this shift. Note that this particular statistic is only reported nationally, not broken down by region or market sector.

Having more projects in the marketplace is certainly a plus for our fabricators, and the evidence of this benefit can be seen in the average backlog that has been reported. Average backlog dropped from 17.2 weeks pre-COVID to a low of 14.8 weeks in the fourth quarter of 2020. However, backlog has surged back, and in the second quarter of 2021, AISC members reported a backlog of 19.3 weeks—the largest backlog ever reported in the AISC Business Barometer.



A healthy backlog means shops are busy. In fact, 57% of AISC respondents are working at 90% of shop capacity or above, while a year ago this number was only 40%.

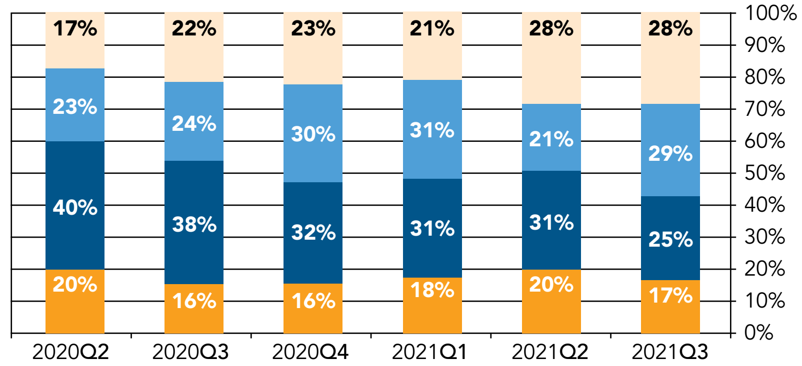
Despite business conditions looking up, there is still one challenge most of our members continue to face: labor, or rather a lack thereof. A large majority of AISC member fabricators (78%) are looking to hire, and 28% of them are looking to increase their workforce significantly (by over 15%). It may be easy to conclude that this is obvious with the backlog and shop capacity numbers reported, but this isn't new. Even during the height of COVID, 75% of AISC members were trying to increase their workforce.

With the construction recovery not fully complete yet, it's a very positive sign that shops are still staying busy. And business conditions *should* get even better as most indicators point to more project square footage coming online in the next few years. But from what is being reported, labor may very well be the limiting factor in allowing fabricators to take advantage of an increasingly healthy construction market.

On that note, what are *you* doing to attract and retain talented people? Let us know by emailing me at **dardis@aisc.org**. ■

Shop Capacity (Average of All Responses)

Which of the following best describes your firm's shop capacity situation? (Shop capacity is defined as a company's booked production labor hours compared to the available labor capacity.) Here's what our members said:



Working at or above 100% of shop capacity Could not increase current level of fabrication work without significant increase in investment/outsourcing/hiring to meet any increase in demand *(robust conditions)*

Working at 90-99% of shop capacity Small amount of available capacity to increase fabrication work above current level *(steady and healthy conditions)*

Working at 70-89% of shop capacity More sizable amount of available capacity to increase fabrication work above current level *(actively searching for opportunities to increase current conditions)*

Working at 40-69% of shop capacity *(Desperate to increase backlog or consolidate business)*

field notes

THREE DEGREES OF ENGINEERING

INTERVIEW BY
GEOFF WEISENBERGER

Larry Muir took an unorthodox path to get his various engineering degrees. But it has led him to connection design and consulting success.

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

YOU'VE PROBABLY HEARD OF LARRY MUIR. After all, he answers questions monthly in our Steel Interchange section (turn to page 9 of this issue to see his advice on working with thick base plates).

He's also served as the director of technical assistance for AISC's Steel Solutions Center, won a T.R. Higgins Award (in 2014), started his own consulting company, served as chief engineer for a major AISC member steel fabricator, and earned three degrees in various engineering disciplines—albeit not quite in the order you'd expect.

But all of this almost never happened. Read on to learn more about Larry's path to connection design and engineering prominence, as well as how the typical stock market advice of "buy low" led to his enduring guitar hobby.

Where did you grow up?

I am from and grew up just outside of Chicago in the suburbs, in a huge subdivision called Boulder Hill out in a town called Oswego. My family lived there all the way from the time I was born until I had started college. And then in 1990, we moved to the Atlanta area.

Speaking of college, where did you end up going to school?

I started out at a school up in Illinois, which was called Illinois Benedictine College at the time, as a chemistry major because I had worked at the Amoco Research Center in Naperville, Ill.; my dad had worked there. But it didn't work out for me, and I came pretty close to dropping out of school. Then my parents moved down to Georgia, and I came with them and went to Southern Polytechnic University, which is now part of Kennesaw State University. I got my bachelor's degree there in engineering technology, and then I got a master's degree at the University of Tennessee up in Knoxville.

And then I went to work for Cives and had some issues getting licensed because my first degree was an engineering technology degree. The way state laws are written, they wouldn't allow me to get licensed, so then I went back to Knoxville and got a second bachelor's degree—after having obtained a master's degree.

How did you get from chemistry to buildings?

My dad had this idea that if you're going to go to college, you get a degree in the sciences because you're more likely to get a job. And that kind of set some parameters on what I was going to be looking at. So I went from chemistry to chemical engineering. And then I decided I really didn't want to be in chemical engineering, so I switched over to mechanical engineering very briefly and didn't do well, and I was heading down the path of dropping out of college. My dad begged me to stay in, and I decided to give it one last shot. His advice to me was that I didn't want to leave, not knowing whether I could do it.

So I literally took the coursebook for Southern Tech, flipped the pages, stuck my finger in, and landed on civil engineering. That's how I ended up in civil engineering. I took some basic structures courses and I sort of clicked with those, and I found that I enjoyed structural engineering. Part of it was that structural engineering seemed to be the more difficult specialization, and people tended to avoid those classes. And I figured if I went into structural engineering, then there'd be less competition.

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

My first job offer after graduating with my first bachelor's degree was designing mostly smaller-scale buildings. It was a small engineering firm, and I decided to go there because it was a smaller group, and I figured I'd have more opportunities to learn and be involved in a wider range of aspects of the projects. And in that process, I realized that there were these things called shop drawings that came from the fabricator, and I was the least experienced person in the office but was often assigned to review shop drawings.

So when I went to get a master's degree, I went in with the idea I was going to come out and work for a fabricator. When I got out of the University of Tennessee with that master's degree, I found that a lot of fabricators didn't have people on staff who did connection design. But I had read some papers by Bill Thornton, who at that time was chief engineer at Cives Steel. And rather than applying to the company through the normal process of writing a letter with my resume and all that, I actually wrote a letter to Bill and applied to him directly. Fortunately, even though they weren't really in the market for a new employee, it prompted them to hire me. And that's how I got into the fabrication side of things.

I went to work for Cives, and I got along with Bill well. We thought about problems in similar ways. He got to the age where he was looking to scale back some and Cives was going to be looking for a replacement for the chief engineer position, and I sort of fit into that mold. That was part of what prompted me to go back and get the second bachelor's degree because as chief engineer, I was going to need to be licensed in several states, and I think I was licensed in 34 states by the time I was done.

You've been a consultant to AISC's Steel Solutions Center for quite some time and were also once our director of technical assistance. Do you think your role in answering engineers' questions has made you a better engineer?

Yes, it's definitely made me a better engineer. I think any time you have to explain something to another person, essentially teach somebody something, you're going to learn the topic better. And that's the way I approach the work at the Steel Solutions Center. If there's something that is specifically addressed in the *Specification*, I obviously want to point them to that. But beyond that, if they've got a situation that's not specifically addressed or is a little bit different, I want to give them thoughts on how they can adapt what's in the *Specification* to what they're doing. And in order to do that, I oftentimes have to dig pretty deep into, you know, where did this come from, what was the research, what was the analysis, and how did it change over time in the *Specification*, so that I can understand it and then convey that information. And when I became the "boss," I was responsible for answering or reviewing everything. I had to get more into the provisions on designing beams and columns and stability on frames and things that I really hadn't had to deal with very much in my life as a connection designer for a fabricator. So yes, it's definitely made me better and given me a broader scope.

Can you tell me a little bit about starting your company, The Steel Connection, and going out on your own, so to speak?

I think it was Mike Tyson that said something like, "Everybody's got a plan until they get hit in the face." Cives was a very demanding job, and I had a new family and wanted to spend more

time with them. And that was what led to my decision to leave, and I really didn't know what I was going to do. But I knew I was going to be involved in structural engineering and probably connection design in some form, so I started The Steel Connection when I left Cives. As it turned out, I just happened to be at a committee meeting, and I think I was standing in the lunch line with Charlie Carter. He mentioned this thing called the Steel Solutions Center and that they needed a consultant, and he wanted to know whether I was interested—and I was! That gave me a baseline income, but I wasn't sure what the rest of my work was going to look like.

I left Cives around 2008 when the economy sort of shrank considerably. And what happened during that period was that a lot of engineers and fabricators became desperate for work and started taking on work that wasn't familiar to them, and that resulted in a lot of problems that had to be resolved. And that's sort of where I found my niche. I started getting questions from people. Sometimes they'd follow up, and usually the way it would work is that the second or third time they followed up, I would say, "OK, this is getting a little bit beyond what I can do for free."

OK, let's get away from connections and engineering and degrees and talk about guitars. (I ask because I hear you play the guitar.)

I do play guitar, and I enjoy it. I wouldn't say that I play well. The way I like to put it is if there was a big storm coming and you had a choice between listening to Eric Clapton play guitar in a building he designed or listening to me play guitar in a building I designed, I think you would rather listen to me than him. I started when I was in high school. I worked in a department store that was going out of business, and they had, well, not very good guitars, but cheap ones. And when they got down to 80% off or so, I and some of my buddies bought them and began to learn, and we learned at very different rates. There was one guy who got very good very quickly, and I was a bit slower. But I'm passable, I guess. ■

To hear more from Larry, including a harrowing case of mistaken identity on a business trip, some of his favorite projects, and what he enjoys most about Atlanta, check out the full Field Notes podcast at ***modernsteel.com/podcasts****.*

business issues

CHECK IN ON YOUR PURPOSE

BY DAN COUGHLIN

Purpose checks are more powerful than paychecks.

Since 1998, **Dan Coughlin** has provided individual and group coaching to improve leadership and management performance. His topics are personal effectiveness, interpersonal effectiveness, leadership, teamwork, and management. Visit his free Business Performance Idea Center at **www.thecoughlincompany.com**.

Dan has also presented several presentations over the past few years at NASCC: The Steel Conference. To hear recordings of them, visit **aisc.org/education-archives** and search for "Coughlin."

PAYCHECKS ARE VERY IMPORTANT.

Paychecks help us get the essentials: food, a place to live, a car to drive, and so on. Paychecks help us to gain a sense of financial independence, which allows us to make choices. And that financial independence can grow to pay for a house, some fun vacations, our retirement, our kids' college tuitions, and care for our aging parents.

However, on the road to earning paychecks, there is another factor to keep in mind if you truly want to be effective. And that other factor is purpose.

Your purpose is *why* you do *what* you do for a living.

If you ignore your purpose in the pure pursuit of bigger paychecks, something very counterproductive may very well start to happen. You might look at the same paycheck as the month before and see it as much smaller. You might start to think, "Is that it? Is that all I'm getting for my efforts?" And then either the paycheck has to grow consistently and quickly larger and larger, or the disappointment you feel will quickly grow larger and larger.

And if a few decades go by without a sense of purpose in your work, then no matter how big the paycheck becomes, the sense of loss, frustration, and disappointment can grow exponentially larger.

What is Your Purpose?

Seriously, what is the purpose that you want to fulfill in your work?

Take your time and write down your answer thirty times on thirty different Post-it notes. Each time you write it down, turn the last Post-it note over so you can't see it. Your purpose will become more refined and clearer each time you write it down. By the 30th time, I believe you will land on your purpose, which is the reason why you want to do the work that you do.

If you are a full-time employee in someone else's organization or even in your own organization, you will work for about 80,000 hours in your lifetime, give or take a few thousand hours (40 years of 40 hours a week for fifty weeks a year; you do the math). In that time, you will pile up a lot of paychecks. That's the tangible part.

But what about the intangible part? Are you fulfilling your purpose? At the end of a month or year, can you look back and say whether or not you fulfilled your purpose (acknowledging, of course, that purposes can evolve, grow, or even change over time)?

Imagine that in addition to your paycheck, you have another way of accounting for the work you did. You go back through every day of your work for the past month, and you ask yourself, "What did I do that day to fulfill my purpose?" And then add up everything you wrote down and call it your "purpose check."

A paycheck is tangible and important. A purpose check is intangible and even *more* important.

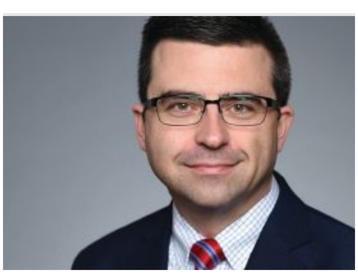
Try that for one month. And then try it for another month. And then another.

Purposechecks can fuel you to keep going even when the paycheck no longer feels sufficient. In the end, the two ideas can merge together until you are receiving purposeful paychecks. ■

Repaired and Reopened: Rapidly

BY BRANDON CHAVEL, PE, PHD

A partial fracture takes a steel Interstate bridge out of commission—but only briefly, because it's a *steel* Interstate bridge.



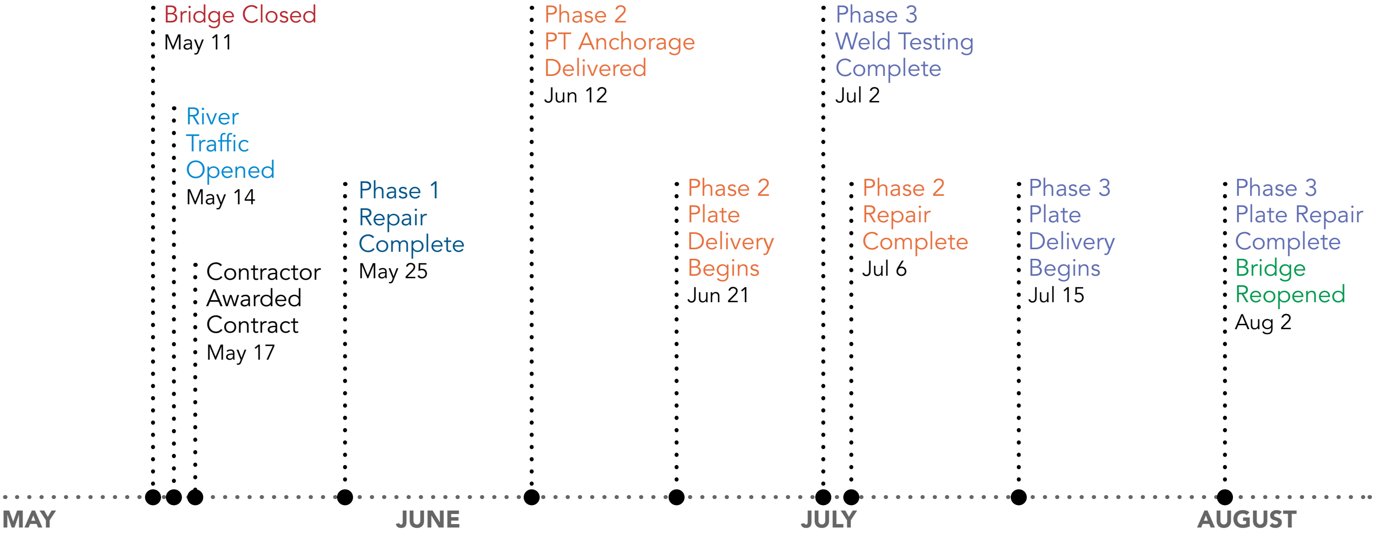
Brandon Chavel (**chavel@aisc.org**) is NSBA's director of market development.

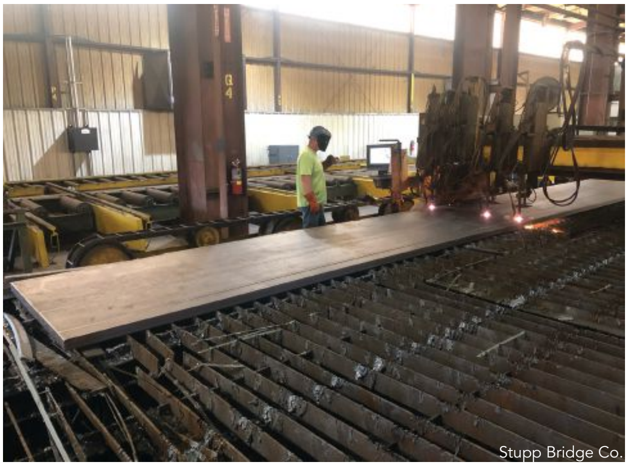
AT THIS VERY MOMENT, traffic is crossing the I-40 Hernando DeSoto Bridge in Memphis.

This may seem quite ordinary but is, in fact, a remarkable achievement, given that the bridge reopened less than three months after a routine inspection found a partial fracture of a steel tie-girder.

The 48-year-old bridge, which typically carries 60,000 vehicles a day over the Mississippi River, was closed on May 11, 2021, and fully reopened to vehicular traffic on August 2. The project once again demonstrated the ease and speed at which steel bridges can be inspected and repaired, as well as their superior resilience, thus bolstering the case for their continued use as critical pieces of infrastructure.

Memphis' I-40 Hernando DeSoto Bridge was closed on May 11 following the discovery of a partial fracture of a steel tie-girder.





above: Phase 1 steel being fabricated at Stupp's shop.

right: Fabrication of steel repair plates by W&W | AFCO Steel.

The main portion of the bridge consists of a continuous two-span steel tied-arch truss; each span is 900 ft long. The tie-girder box beam is comprised of four Grade 100 steel plates with 32-in. by 1⅜-in. web plates and 25-in. by ½-in. top and bottom flange plates, and the fracture impacted 100% of the outboard web plate, 100% of the top flange plate, and approximately 20% of the bottom flange. The steel type used in the tie-girder box-beam, commonly referred to as "T-1" steel, is no longer used in modern-day bridge applications. It should be further noted that the bridge was designed and constructed well before the material and fabrication requirements of the AASHTO/AWS *Fracture Control Plan* were adopted by the industry in 1978.

On May 22, just 11 days after the bridge's closure, Tennessee Department of Transportation (TDOT) crews picked up nearly 16.5 tons of steel repair plates fabricated by Stupp

Bridge Company. General Contractor Kiewit Infrastructure South Co. worked around the clock installing the fabricated steel plates on each side of the fractured member to secure the bridge, completing Phase 1 of the repair on May 25, exactly 14 days after inspectors discovered the fracture.

In Phase 2 of the repair, crews installed temporary threaded post-tensioning bars and weldments/anchors to facilitate the removal of the fractured section and installation of the final steel repair plates in the area of the fractured section. The weldments/anchors for the threaded post-tensioning bars were delivered to the project site during the weekend of June 12, 32 days after the bridge was closed, and installation began almost immediately.

At the same time, W&W | AFCO Steel fabricated 54 tons of HPS70W steel strengthening plates and splice plates for the Phase 2 permanent repair of the 150-ft long section that contained the partially fractured box member. The first Phase 2 permanent repair plates arrived on site the week of June 21, 41 days after the bridge was closed. By June 25, four of the eight permanent plates were in place, and on July 2 only some final bolt installation remained to secure the structural and splice plates.

Near the end of May, while crews performed Phase 1 and 2 repairs, the Phase 3 investigation began a process of inspection and ultrasonic testing of all tie girder welds—nearly 500 weld locations. The draft report submitted to TDOT on July 2 (52 days after closure) identified 17 locations of particular interest. Although none of these locations had cracks, they did have weld anomalies that would


W&W|AFCO Steel

above: A single repair plate drilled and cut from a larger steel plate.

W&W|AFCO Steel

left: Repair plates being secured for shipping.


TDOT

right: The W&W | AFCO repair plates installed on the bridge.

need full height repair plates on the outside of the vertical faces of the tie-girder.

W&W | AFCO Steel once again quickly responded to TDOT's needs, delivering the first six Phase 3 HPS70W steel repair plates on July 15, just 13 days after TDOT received the draft inspection report, and Kiewit began to install the plates the very next day. Installation of the Phase 3 repair plates involved not only drilling and bolt installation but also the removal of the lateral bracing, modification of the gusset connection plate, and reinstallation of the lateral bracing. By July 26, less than a month after the inspection report, all the repair plates had been installed, and only a small amount of final bolting remained. In all, W&W | AFCO Steel provided nearly 100 tons of steel for the Phase 2 and Phase 3 repairs on the bridge.

Just two days after that, on July 28, TDOT load-tested the bridge with trucks of known weight, using existing sensors to monitor how the forces transferred through the bridge system. And finally, on the evening of July 31—only 81 days after the bridge closed—the Eastbound lanes of the I-40 Hernando DeSoto Bridge reopened to all vehicular traffic. Kiewit removed all its equipment from the bridge to reopen the Westbound lanes on August 2. According to local media, an Arkansas Department of Transportation (ADOT) official estimated that the repair, engineering, and inspection had cost about $9.5 million at that point.

While uncovering a critical finding like the one on the I-40 Hernando DeSoto Bridge is never a good day, the steel bridge industry responded with deliberate speed, efficiency, and safety by developing and fabricating repair components that could be quickly installed on this crucial bridge, allowing it to open back up safely and quickly—a happy ending to a thankfully short story. ■

Owners
Tennessee Department of Transportation
Arkansas Department of Transportation

General Contractor
Kiewit Infrastructure South Co.

Engineering Consultants
Michael Baker International and HNTB

Steel Fabricators
Stupp Bridge Company (AISC Certified Fabricator)
W&W | AFCO Steel (AISC Certified Fabricator)

Cantilevering Over COVID

BY BRYAN COVINGTON, PE

Collaboration and cantilevers define a new North Carolina community college classroom building.

IF THERE'S ONE FACT that has been reinforced throughout the events of the past year, it is the importance of cutting-edge training for the developers of tomorrow's biopharmaceutical vaccines.

As the largest community college in North Carolina, Wake Tech Community College (WTCC) heard the call and responded in a powerful way. The new state-of-the-art RT2 Classroom Building at the school's Research Triangle Park (RTP) campus in Morrisville opened its doors in August for the fall 2021 semester, welcoming the next generation of researchers and pioneers into an environment that inspires the innovation our world's health depends upon.

The three-story, steel-framed facility features cleanrooms, laboratory spaces, open collaboration areas, and a towering glass-clad central atrium that greets students and faculty with an abundance of natural light upon entrance. Lynch Mykins, a Raleigh-based structural engineering firm, began design collaboration on the 66,000-sq.-ft structure with the architecture firm O'Brien Atkins Associates in early 2017.

Staying Nimble

Just as the design was being completed in late 2019, the college experienced a significant transition in leadership. The new leadership had a unique and exciting vision to reprogram one of the building's floors into an integrated Wake County Early College space for high school students. This presented the design team, general contractor Rodgers Builders, and steel fabricator Sanford Steel with a significant challenge: how to maintain the building's delivery date while providing the owner and design team with the time required to work through the design changes. The onset of COVID-19 occurred almost simultaneously with this change, pushing all of the construction administration activities and coordination meetings into the virtual world.

Lynch Mykins rose to these challenges by collaborating closely with Sanford Steel and Rodgers to stage fabrication processes as portions of the greater team's redesign were completed. This allowed for all design changes to be communicated and picked up in the initial fabrication of the steel. Furthermore, it allowed for all

Images courtesy of Lynch Mykins

Various construction phases of Wake Tech Community College's (WTCC) new RT2 Classroom Building, which met its original schedule despite the COVID-19 pandemic.

of the project's 306 tons of structural steel to be delivered on time and erected within eight weeks, meeting the project's originally identified topping-out date.

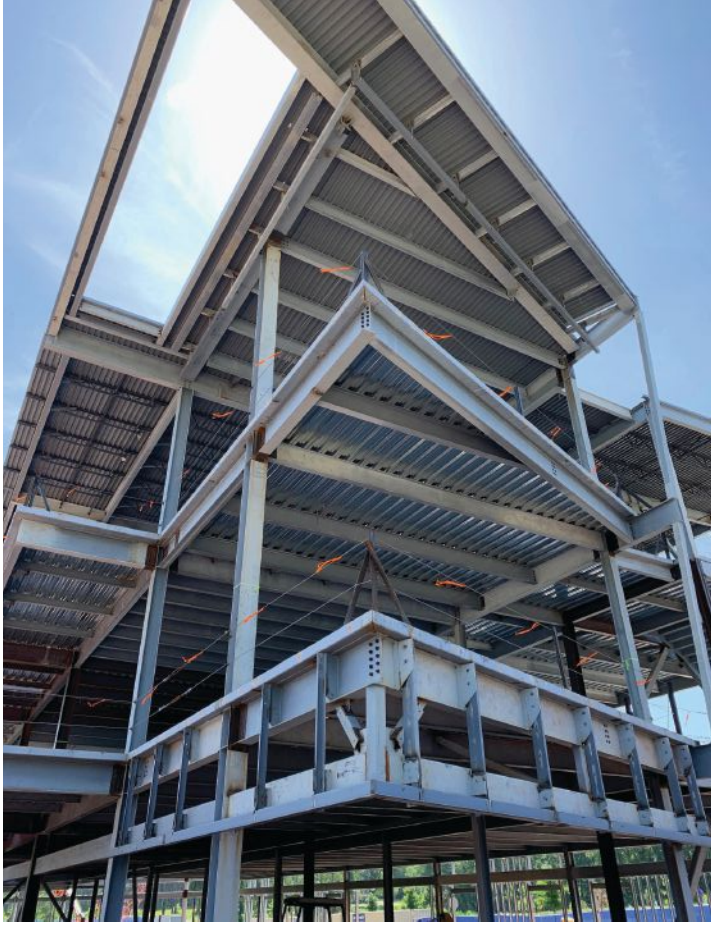
During early foundation installation, redesign developments, and steel erection, the team participated in nearly daily Microsoft Teams video calls to sketch together and have open discussions. Perhaps the most notable observation from all team members was how the ease of virtual meetings caused collaboration to increase when compared to previous projects.

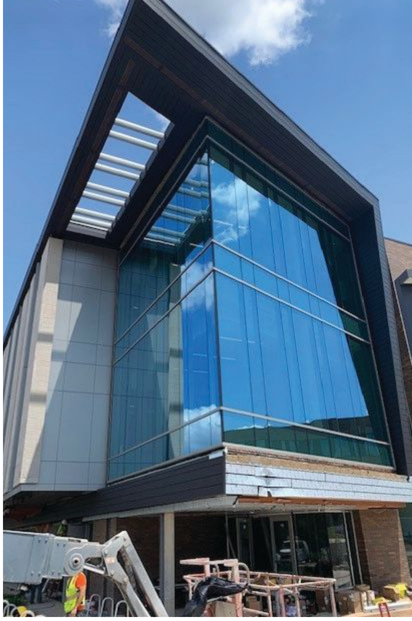
Cantilevers on Cantilevers

O'Brien Atkins' vision called for a building that would express WTCC's commitments to inclusion and accessibility. To communicate these concepts architecturally, the three-story structure was designed to cantilever in two different directions at each end of the building, which required moment connections designed for up to 725 kip-ft. The two cantilevered ends are clad primary in glass curtainwall, requiring tight deflection criteria to be maintained throughout the structure.

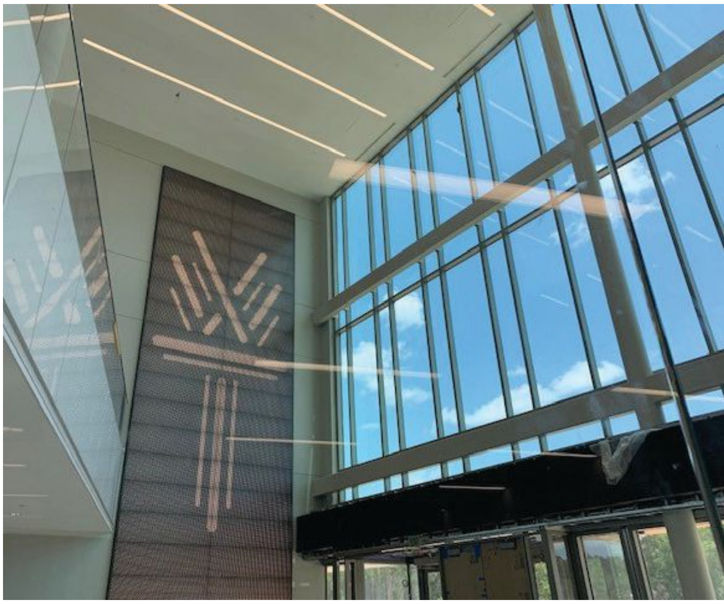
With multiple locations featuring members cantilevering from other cantilevers, it was critical that compounding deflections were accounted for correctly. As a quality control measure, Lynch Mykins performed the structural analysis

Bryan Covington
(**bcovington@lynchmykins.com**)
is a project manager with
Lynch Mykins Structural Engineers.





above, left, and right: The three-story structure was designed to cantilever in two different directions at each end of the building.



above: Both of the primary building entrances lead staff and students into a 50-ft-high, 75-ft-wide open atrium.

above and below: The new building incorporates more than 300 tons of structural steel in all.

and framing design of these building ends in multiple programs, closely studying and checking the results for accuracy. In addition, the engineers worked closely with connection designer Ferrell Engineering to develop solutions that would achieve the design loads while not impacting the interior aesthetics of these highly visible areas.

Welcoming Spaces

Both of the primary building entrances lead staff and students into a 50-ft-high, 75-ft-wide open atrium. Floor-to-ceiling glass curtainwall provides this area with an enlightening atmosphere, fostering and encouraging collaboration between classes. Exposed round steel hollow structural section (HSS) columns and rectangular HSS beams support the curtainwall segments. These exposed elements were finished to an architecturally exposed structural steel (AESS) Category 1 (Basic Elements) designation (for details on the various AESS categories, see "Maximum Exposure" in the November 2017 issue, available in the Archives section

Grading on the Curve

Chicago Metal Rolled Products curved 40 tons of structural steel members (TS 16” x 8” x .500” wall and TS 10” x 4” x .375” wall material) the hard way for the framing of the Cottrell Hall dome.

Eight of the TS 16 x 8 x .500’s “ribs” were detailed with a single radius; the tightest outside radius being 25ft 5.6875in. The other eight TS 16 x 8 x .500 “ribs” did not have a specified radius, but instead had specified points along the arc which the tube needed to hit. CMRP calculated multiple, specific radii to roll the tubes to in order to match the curvature defined by the multiple points required – without any costly splices.

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2	Angle Leg In	OUTSIDE DIA.	10" x 10" x 1" Angle
3	Flat Bar The Hard Way	INSIDE DIA.	24" x 12" Flat
4	Flat Bar The Easy Way	INSIDE DIA.	36" x 12" Flat
5	Square Bar	INSIDE DIA.	18" Square
6	Beam The Easy Way (Y-Y Axis)	MEAN DIA.	44" x 335#, 36" x 925#
7	Beam The Hard Way (X-X Axis)	INSIDE DIA.	44" x 285#
8	Channel Flanges In	OUTSIDE DIA.	All Sizes
9	Channel Flanges Out	INSIDE DIA.	All Sizes
10	Channel The Hard Way (X-X Axis)	INSIDE DIA.	All Sizes
11	Tee Stem In	OUTSIDE DIA.	22" x 142$^1/_2$# Tee
12	Tee Stem Out	INSIDE DIA.	22" x 142$^1/_2$# Tee
13	Tee Stem Up	MEAN DIA.	22" x 142$^1/_2$# Tee
14	Angle Heel In	INSIDE DIA.	8" x 8" x 1" Angle
15	Angle Heel Out	OUTSIDE DIA.	8" x 8" x 1" Angle
16	Angle Heel Up	MEAN DIA.	8" x 8"x1" Angle
17	Square Tube	INSIDE DIA.	24" x $^1/_2$" Tube
18	Rectangular Tube The Easy Way (Y-Y Axis)	INSIDE DIA.	20" x 12" x $^5/_8$" Tube
19	Rectangular Tube The Hard Way (X-X Axis)	INSIDE DIA.	20" x 12" x $^5/_8$" Tube
20	Square Tube Diagonally	MEAN DIA.	12" x $^5/_8$" Square Tube
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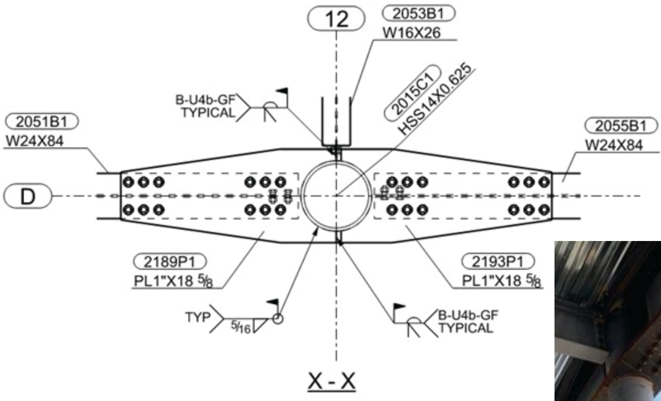


above and right: A bolted plate connection around an HSS column.

Framing for one of the corner cantilvered roof sections.

above, below, and right: The two cantilevered ends are clad primarily in glass curtain wall, requiring tight deflection criteria to be maintained throughout the structure.

at **www.modernsteel.com**). In addition, two steel-framed mezzanine levels were constructed in the atrium to connect the two primary programming spaces within the building. The atrium's elegance is topped off with a steel-framed monumental stair that is suspended from the mezzanine levels, extending to the ground floor below.

The new RT2 Classroom Building was entirely bid, built, delivered, and opened during a global pandemic. While the devastating effects of COVID can't be overstated, it brought the project's design team closer together. The various team players didn't shun the "weirdness" of video-chatting but rather leaned into it. It became something everyone wanted to do. The project was a shining example of perseverance and the importance of collaboration, regardless of the circumstances, and it resulted in a welcoming facility geared toward inspiring innovation. ■

Owner
Wake Technical Community College

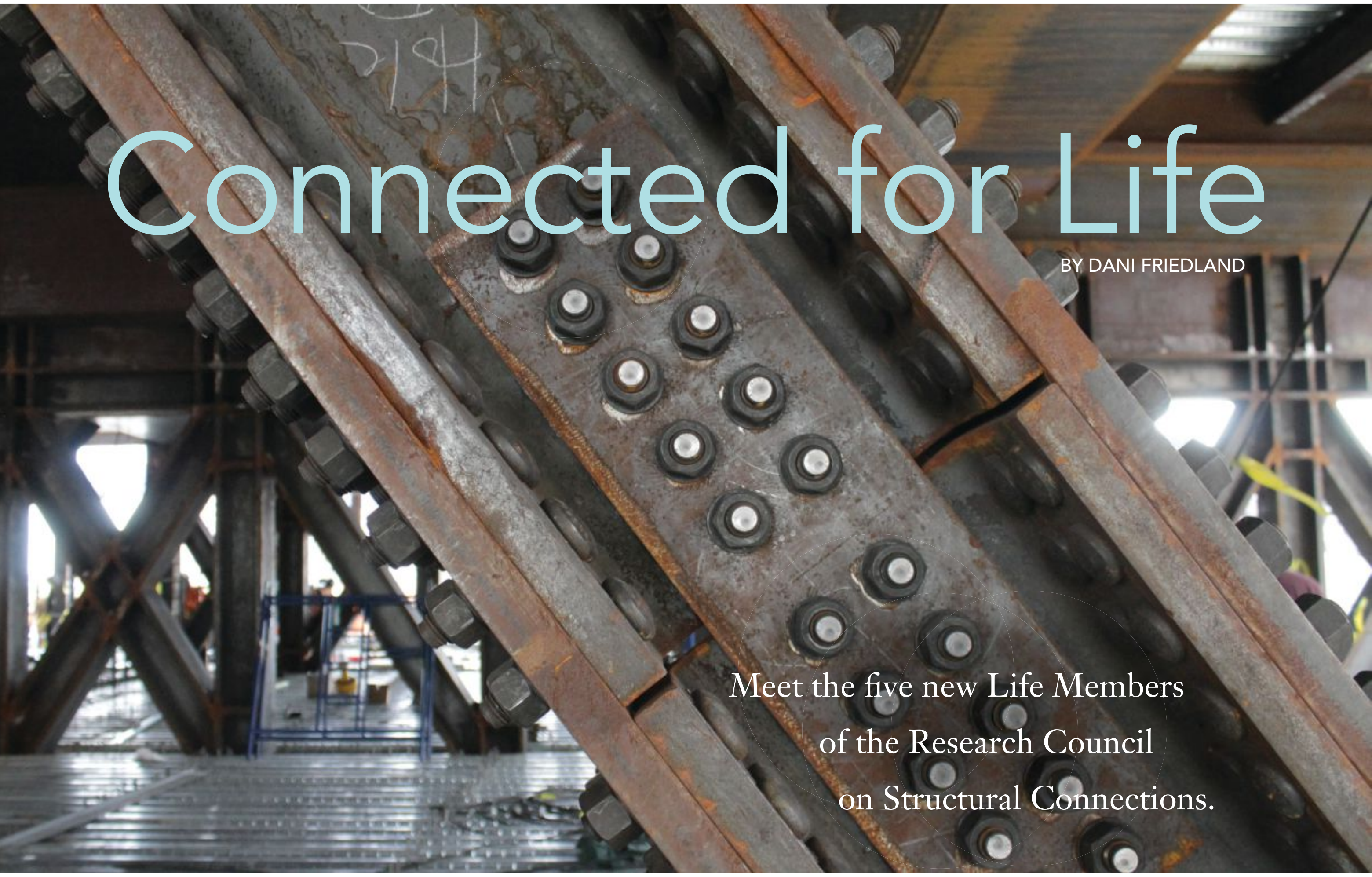
General Contractor
Rodgers Builders

Architect
O'Brien Atkins

Structural Engineer
Lynch Mykins Structural Engineers

Connection Designer
Ferrell Engineering

Steel Fabricator
Sanford Steel Corp. AISC CERTIFIED FABRICATOR, Goldston, N.C.

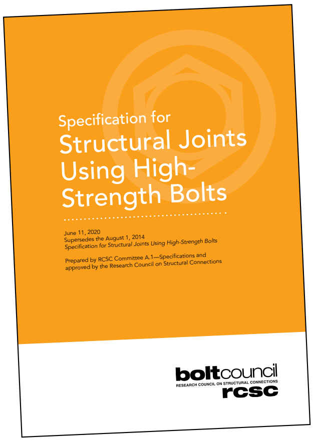


Connected for Life

BY DANI FRIEDLAND

Meet the five new Life Members of the Research Council on Structural Connections.

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



THE NEXT TIME YOU LOOK at a bolted connection, be sure to take a moment to thank Larry Kloiber, Tom Murray, Bill Thornton, Ray Tide, and Joe Yura.

The Research Council on Structural Connections (aka the Bolt Council) recently named them Life Members—i.e., active Council members whose extraordinary contributions have earned them honorary memberships for life. RCSC has now bestowed this honor upon only eight individuals, total.

"We write a document that's fundamental to steel construction," said RCSC Chair Salim Brahimi, PEng, PhD, who is also director of engineering and technology at the Industrial Fasteners Institute. "It's a very important document, way beyond our immediate vision in North America or in the U.S. The contributions of these five new Life Members have to be seen as foundational to the bolting aspect of steel construction."

And that foundational document covers a lot of ground. Each new version of its specification tackles not only technological innovations—recent changes have involved coatings and a new tightening method—but also constant efforts to refine the existing code to make it more helpful.

"We continually try to look at issues that happen on the job and try to clarify and write more stringent code to reduce the problems that happen in the shop and in the field," said RCSC director and AISC chief of engineering staff Tom Schlafly. "These five members have all worked on various AISC committees and task forces throughout the years, contributing to several key specifications, and several of them have won AISC's highest honors."

"Building things is often taken for granted," said Brahimi. "We've taken for granted the fact that we can build our roads, our bridges, anything—just building, making things—is such a basic thing. It doesn't happen without a lot of expertise and work. It's not just worthwhile. It's a noble thing to do, to be the builders in our society. These people are among the leaders of that field."

Read on for profiles of each of the five new RCSC Life Members.

The University of Iowa's Carver-Hawkeye Arena, for which Larry Kloiber received the James F. Lincoln Arc Welding Foundation Merit Award in 1982.

Lawrence A. Kloiber, PE,
Former Chief Engineer and
President, LeJeune Steel Company

Larry Kloiber has been involved in designing, fabricating, and erecting structural steel for over 55 years, first as an AISC engineer and then with the LeJeune Steel Company as chief engineer and president. While at LeJeune, he directed connection design and fabrication on projects such as the Minneapolis Convention Center and the Mall of America, along with work on numerous high-rise office buildings, arenas, and industrial buildings.

Larry is the author of numerous papers on the design, fabrication, and erection of structural steel and has lectured in more than 50 cities in the U.S., Canada, and Europe. He is a co-author of the *Handbook of Structural Steel Connection Design and Details* as well as the second edition of AISC Design Guide 1: *Base Plate and Anchor Rod Design* and AISC Design Guide 36: *Design Considerations for Camber* (**aisc.org/dg**).

Larry's outstanding work has been recognized by different engineering societies and organizations. In 1982, he received the James F. Lincoln Arc Welding Foundation Merit Award for the fabrication of the University of Iowa's Carver-Hawkeye Arena, and in 1998 ASCE presented him its "Certificate of Recognition of Outstanding Service as Practitioner" in recognition of his long association with and service to the University of Minnesota's Department of Civil Engineering. In September of 2002, AISC presented Larry with a Lifetime Achievement Award in "special recognition for many years of service to the structural design, construction, and academic communities" and, in 2004, its T.R. Higgins Lectureship Award for the best paper on structural steel design for his paper "Design of Skewed Connections."

Larry received his BS in Civil Engineering from Marquette University and became a licensed professional engineer in several states. During his professional career, he worked on many committees, including the AISC Specification Committee and the Task Committee on Connection Design, the RCSC Specification Committee, the Design Task Group of the AWS D1.1 Code Committee, the ANSI Specification Review Committees for both the Steel Joist Institute and the Steel Deck Institute, and the SEI Committee on the Design of Steel Building Structures.

Thomas M. Murray, PE, NAE, PhD, Emeritus Montague-Betts Professor of Structural Steel Design, Virginia Tech

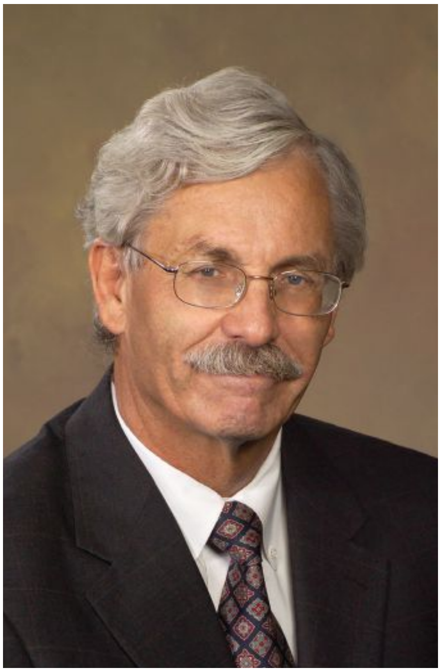
It's not a stretch to say that Tom Murray's work has improved the safety, economy, efficiency, and predictability of every building, bridge, and other structure that has been designed or built since he began his career.

Bolts were almost always a feature of Tom's research, and he has personally created the bases upon which we have advanced the design rules for bolts in the RCSC and AISC *Specifications;* bolted connection design recommendations in the AISC *Steel Construction Manual*, AISC *Seismic Design Manual*, and several AISC Design Guides, including a number that bear his name as author; and many other publications and resources used every day in steel design and construction. Of particular note, Tom contributed directly to:

- Expanded capability to use snug-tightened joints instead of pretensioned and slip-critical joints.
- Rigorous, streamlined, and simplified design procedures for every connection provided in RCSC and AISC literature, thanks in no small part to his pioneering development of expert-system connection design software in parallel with his research.
- The viability and usefulness of bolted moment end-plate connections for a wide variety of applications in both R=3 and high-seismic applications.
- A steady and regular improvement of the completeness and ease of application of language in RCSC and AISC standards and publications.
- The education of the profession and the industry through countless seminars, webinars, and workshops.

Tom joined the Virginia Tech staff in 1987 after 17 years at the University of Oklahoma, the last year of which was spent as a Distinguished Visiting Professor at the U.S. Air Force Academy. A specialist in structural steel research and design, Tom was responsible for the construction of large laboratories at the University of Oklahoma and Virginia Tech. His research and teaching interests include steel connections, serviceability, pre-engineered building design, and light-gauge design.

Tom has served with distinction as a member of the Research Council on Structural Connections and its Specifications Committee; a member of the AISC Committee on Specifications, AISC Committee on Manuals, and the AISC Connection Prequalification Review Panel; and as a lead researcher involved in the SAC Steel Project following the Northridge Earthquake. At Virginia Tech, he was named the Montague-Betts Professor of Structural Steel Design, and in 2006 he received the Outstanding Faculty Award from the State Council of Higher Education in Virginia. Tom has also received several AISC awards: the T.R. Higgins Lectureship Award in 1991, a Lifetime Achievement Award in 2007, and the Geerhard Haaijer Award for Excellence in Education in 2010. He was elected to the National Academy of Engineering in 2002 and became a Distinguished Member of ASCE in 2012.

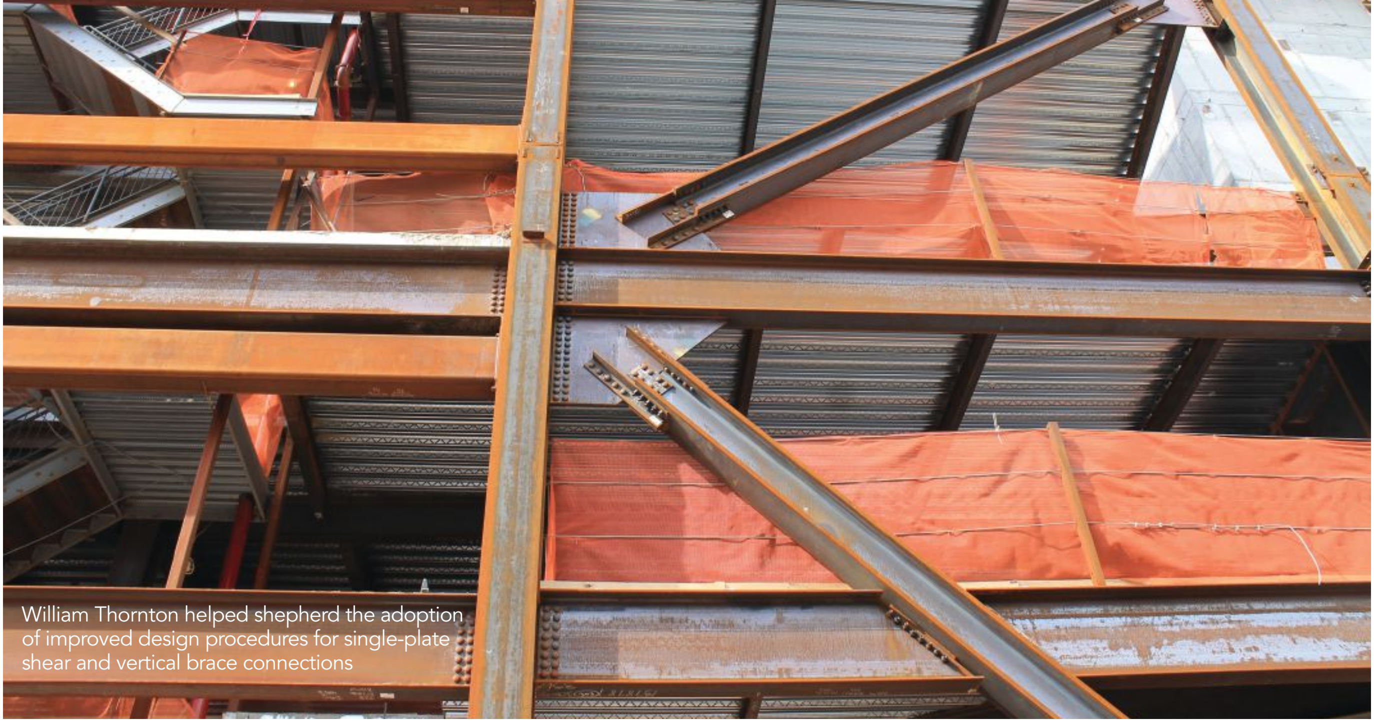


William A. Thornton, PE, NAE, PhD, Former President of Cives Engineering Corporation

Bill Thornton's greatest impacts on the bolting industry arguably result from the 26 years he spent as chair of the AISC Committee on Manuals and Textbooks (from 1985 to 2011). During this time, the coverage of connection design- and bolting-related topics in the AISC *Steel Construction Manual* expanded significantly. Under Bill's stewardship, the *Manual* focused on providing simple and practical guidance related to many common bolted connections that remain firmly rooted in first principles. This work influences thousands of engineers and likely millions of tons of structural steel.

Beyond providing a guiding hand for the industry, Bill also contributed directly to the body of knowledge by formalizing the treatment of prying action for both bearing and slip-critical connections, developing procedures to evaluate the rotational ductility of bolted simple beam end connections, and shepherding the adoption of improved design procedures for single-plate shear connections and vertical brace connections. If not for Bill's work, high-strength bolted connections would be less efficient, safe, and prevalent than they are today.

As president of Cives Engineering, Bill was responsible for all structural design performed by Cives Engineering and served as a consultant to the six divisions of Cives Steel Company in matters relating to quality assurance, connection design, and fabrication practices. He has nearly six decades of experience in teaching, research, consulting, and practice in the area of structural analysis and design. He won AISC's 1995 T.R. Higgins Lectureship Award, a 2003 AISC Lifetime Achievement Award, and the 2004 Craftsmanship Award of the General Society of Mechanics and Tradesmen of the City of New York. He was inducted into the National Academy of Engineering in 2013. Bill has also, obviously, been a longstanding member of the Research Council on Structural Connections.



William Thornton helped shepherd the adoption of improved design procedures for single-plate shear and vertical brace connections

Raymond Tide, PE, PhD, Principal, Wiss, Janney, Elstner Associates, Inc.

If you were to walk into Ray Tide's office at WJE, you would sense that he is a real steel lover. His bookshelves are filled with references and reports that encompass structural steel and bolting over the past sixty years.

He joined RCSC in 1982, serving on the Council's Executive Committee multiple times and as Chair of the RCSC from 2000 to 2006. His participation on the Council resulted in significant improvements in our understanding of bolt design provisions, including his work in long joints that yielded more economical connections. He led committees on research needs as well as bolts under tension and prying action and has also been an active member of the Specifications Committee.

He is a registered professional engineer in multiple U.S. states and Canadian provinces. In addition to his long history with AISC and RCSC, Ray has been closely involved with the development of the American Welding Society's (AWS) D1.1 *Structural Welding Code – Steel* and the American Society of Civil Engineers (ASCE) Subcommittee on Structural Connections, as well as the Structural Engineers Association of California (SEAOC) and Applied Technology Council (ATC) following the 1994 Northridge earthquake.

A University of Manitoba and Lehigh University graduate, Ray served three years as an officer in the Canadian Army Corps of Engineers, spending some time abroad on the Sinai Peninsula. He joined AISC in Minnesota as a technical representative after completing his doctoral studies at Washington University in St. Louis in 1971. While at AISC, he is credited with compiling the first version of the steel shapes database in 1980, in conjunction with the release of the 8th edition *Manual of Steel Construction*. From AISC, he moved on to become manager of engineering for Paxton Vierling Steel, where he was responsible for design, fabrication, and quality control. During this time and until his retirement to emeritus status in 2014, Ray was actively involved in numerous AISC technical, special task force, and ad hoc committees. Ray joined WJE in 1982, bringing his background in structural steel to the practice of failure investigations and rehabilitation designs.

Joseph A. Yura, PE, NAE, PhD, Emeritus Professor in Civil Engineering, The University of Texas at Austin

Joe Yura's meticulous research and skill transforming that research into practice by crafting clear specification requirements have greatly advanced the use of bolted connections in buildings, bridges, and ancillary structures. Joe stands out as a leader in developing the understanding of connection behavior and translating that knowledge through the RCSC and AISC specifications.

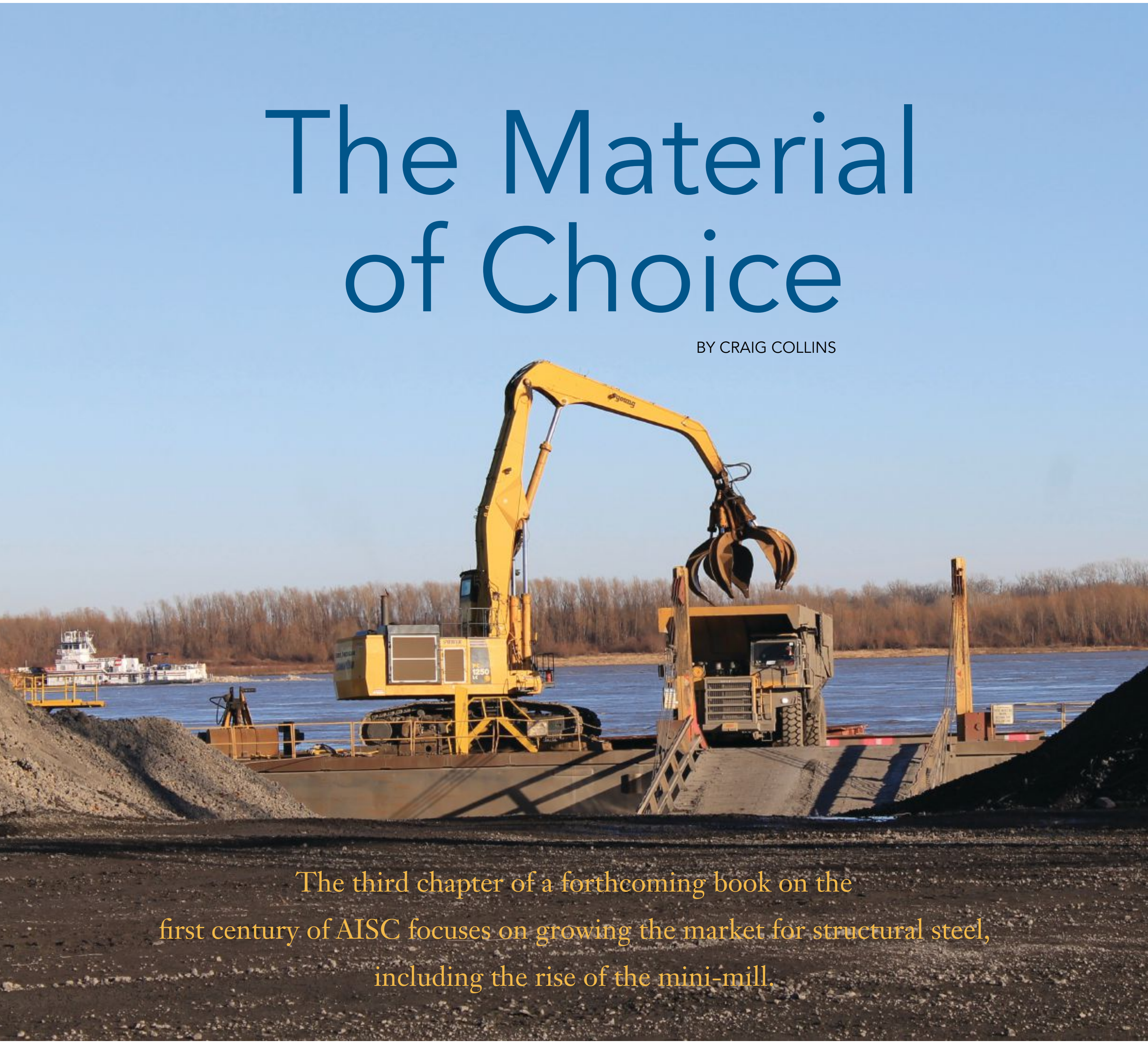
Besides his contribution to the design of bolted connections, Joe was very active in the development of bracing provisions for columns and girders as well as composite construction, offshore tubular structures, and elastomeric bearings. He also served as director of the Ferguson Structural Engineering Laboratory.

In 2000, he was elected to the National Academy of Engineering for his work in the stability and bracing of steel structures. His research in bolted connections improved understanding and design of double row shear web connections and block shear behavior of connections in coped beams. He also developed the bearing deformation limit in bolted connections, the effect of fillers upon the shear strength of bolted connections, the method for testing the slip behavior of coated surfaces, including galvanized surfaces, and the effect of lubrication and thread fit upon the tightening behavior of coated fasteners.

He served 32 years as a member of the AISC Specification Committee and has received a Lifetime Achievement Award and Geerhard Haaijer Award for Excellence in Education from AISC, as well as the T.R. Higgins Lectureship Award in 1974. He also received ASCE's Shortridge Hardesty Award in 1997 and SSRC's Lynn S. Beedle Award in 2006. ■

The Material of Choice

BY CRAIG COLLINS



The third chapter of a forthcoming book on the first century of AISC focuses on growing the market for structural steel, including the rise of the mini-mill.

Craig Collins is a California-based freelancer who writes about science, technology, and government.

IN THE SUMMER OF 1984, when Neil Zundel was elected the new president of AISC, the structural steel industry was undergoing a change so radical it wasn't fully appreciated yet.

Things were clearly going badly: The national economy was in a recession brought on by an inflation crisis, a circumstance particularly acute in a U.S. structural steel sector already losing market share to foreign competitors who undercut American companies on price, often by "dumping" their exports at below-market prices.

"AISC was really in some tough spots because funding was pretty restrained and costs were rising, and it was a transitional period for the steel industry," said current AISC president Charles Carter, who joined AISC as a staff engineer in 1990. "A lot of our members were not able to support the institute. Some went out of business, frankly, in the eighties."

All photos in this article were taken by Geoff Weisenberger at the Nucor-Yamato Steel mini-mill in Blytheville, Ark. For a complete "tour" of that mill, see "Keep on Rolling" in the February 2014 issue, available in the Archives section at **www.modernsteel.com**.

opposite page: Scrap, arriving at a steel mill via barge, is is transferred, via trucks, to the proper scrap pile to await melting.

The resulting decline in membership was so severe that AISC's survival was, for a while, not a sure thing. Its board members understood that the problems faced by the industry and the institute that existed to support and promote it required a fresh set of eyes.

"Neil Zundel brought a whole new mindset to AISC because he hadn't been from the steel industry," said David Ratterman, who began his own career as AISC's general counsel during Zundel's presidency. "I remember him telling me, fairly soon after I started at AISC: 'The electric-arc mills, the mini-mills, are going to put the big mills out of business. They're going to eat their lunch.'"

right and below: Graphite electrodes melt the steel scrap at temperatures approaching 3,000 °F in the electric arc furnace.

Remaking the Steel Industry

Steel industry insiders will immediately grasp the shrewdness of Zundel's prediction, but outsiders may appreciate a brief history lesson from Ratterman, one of AISC's best storytellers: The "big mills"–huge steelmakers such as U.S. Steel and Bethlehem Steel–were already struggling when Ratterman joined AISC in 1988. Bethlehem Steel, which had been the world's largest corporation at its World War II peak, employing nearly 300,000 people, had nearly gone bankrupt in the late 1970s.

Such big producers were called "integrated" mills, Ratterman explained, because they controlled every event in the lifetime of a piece of steel.

"They had thousands of employees," he noted. "They had tens of thousands of square feet of production facility; they had a supply chain that went all the way from the ore mines on through to the job sites. So they controlled things."

And they weren't the largest entities in terms of production but also when it came to fabrication. By mid-century, the two largest fabricators in the nation were subsidiaries of U.S. Steel (American Bridge Co.) and Bethlehem Steel (Bethlehem Construction). The innovative wide-flange "Bethlehem beam" featured prominently in many iconic skyscrapers of the early 20th century.

"They made the raw steel themselves, and then formed it into beams, and then fabricated the beams and columns, and then erected them on the job site," Ratterman said. "They did the whole thing, even the detailing, from beginning to end."

For decades, the size and scope of integrated mills was a huge advantage over other American fabricators—but proved too cumbersome to handle the rising costs of steelmaking, such as inputs and labor. Steel had become a commodity, and American mills had difficulty competing with the inexpensive foreign product that began entering the U.S. market in the 1960s.

Smaller, independent steel fabricators saw their opening. They outbid the steel giants for the opportunity to fabricate beams, columns, and plate used to frame the towers of the original World Trade Center, completed in 1972 and 1973, using imported steel.

"That was sort of the harbinger of what was to come," said Ratterman. "It was probably a decade or so after that, that U.S. Steel and Bethlehem Steel exited the fabrication industry. They continued to make columns and beams for structures, but they no longer fabricated steel."

above: Transporting molten steel throughout a mini-mill.

below: Beam blanks after being cut by the oxygen torch.

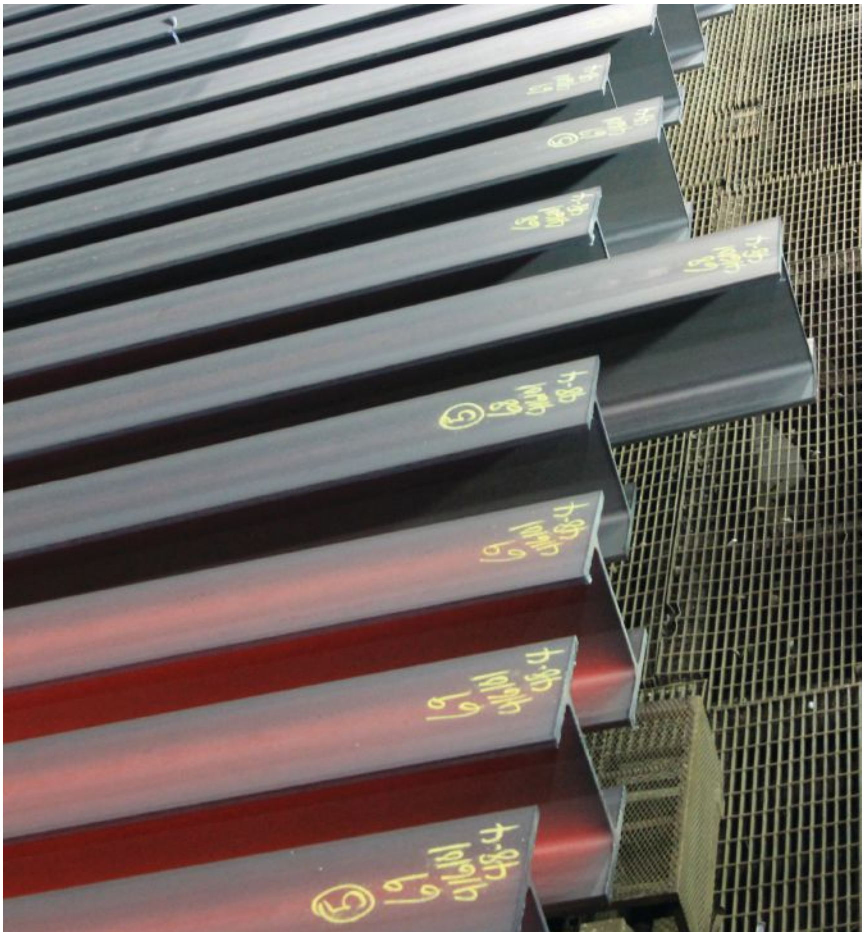
above: After cooling, beam blanks are often stored outside before they are ready to be reheated and rolled into shape.

below: Steel being rolled in a universal rougher/edger mill.

above: Steel on its way from rolling to final cutting.

below: Two circular saws (approximately 84 in. in diameter) perform the final cutting.

below: Now final products, steel members cool before they are stored outside and eventually shipped to customers.



The industry was ripe for change, and its disruptor emerged in the form of F. Kenneth Iverson, the president of Nucor, a conglomerate with a division that produced steel joists and girders. Iverson, a trained metallurgist-turned businessman, saw disadvantages to both domestic and imported steel—so he decided to make his own. But instead of stretching his supply chain all the way back to iron ore mines, Iverson relied on scrap steel—mostly from used automobiles—as his raw material. Melted in an electric arc furnace (EAF), which uses a combination of electrical energy and chemical energy (i.e., carbon and oxygen injections), this steel could be alloyed, refined, shaped into billets, and then reheated and transferred to a rolling mill for processing.

Making steel in a truncated mill, or "mini-mill," was revolutionary. It was a self-contained, clean, energy-efficient process that Iverson claimed could produce steel more inexpensively and profitably than both domestic and foreign mills. By 1975, Nucor was operating mini-mills in South Carolina, Nebraska, and Texas. In 1981, the *New York Times* reported that 45 companies were operating 65 mini-mills that accounted for 15% of total U.S. steel production.

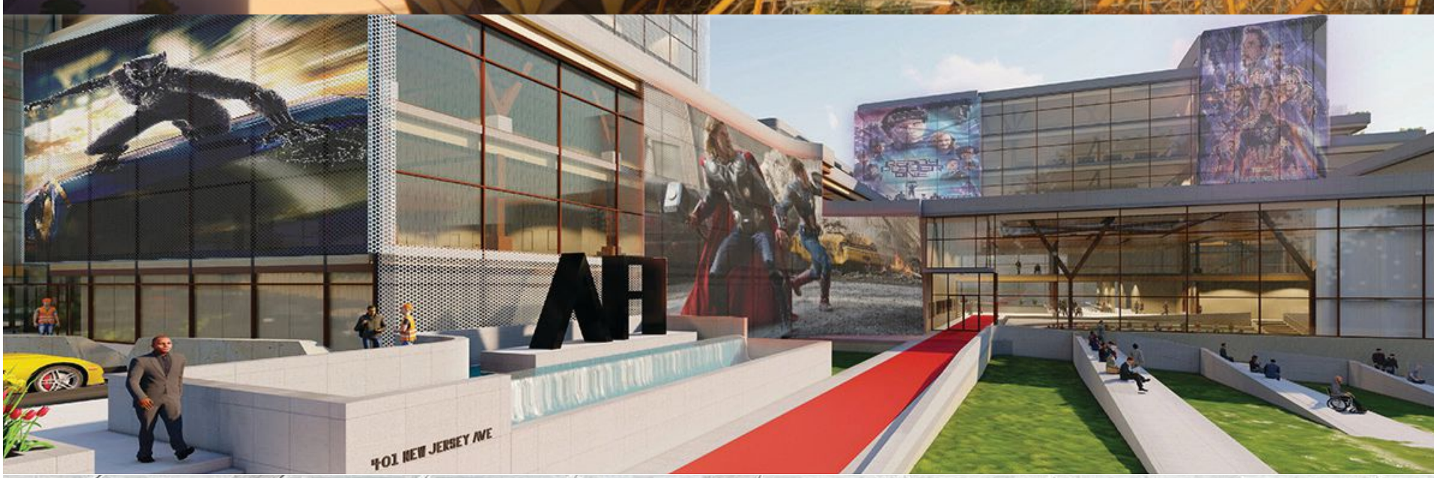
"The truncated steel mill," reported the *Times*, "is to the integrated steel mill what the Volkswagen was to the American auto industry in the 1960s: smaller, cheaper, less complex and more efficient."

In a dizzyingly short period of time, fabrication had become an arena of wide-open competition. According to John Cross, AISC's vice president of special projects, the integrated mills took several decades' worth of structural steel marketing expertise with them when they left the fabrication business.

"U.S. Steel and Bethlehem Steel had, between them, probably a hundred field sales engineers out there banging on doors," said Cross, who served for 15 years as AISC's vice president of market development. "When they started leaving the structural market to the organizations like Nucor and Northwestern Steel and Wire, and eventually Gerdau, which was Chaparral Steel at the time; those mills really didn't do marketing, other than selling their material to service centers or fabricators. They weren't out talking to architects or engineers. So that left AISC to pick up the marketing side of the equation." ■

This article was excerpted from the third chapter of a forthcoming book documenting the first 100 years of AISC's existence. The book will be available at ***aisc.org/legacy*** *this fall. Check out the September and October issues for excerpts of the first and second chapters.*

Post-Pandemic Possibilities



The winners of this year's Steel Design Student Competition anticipate and design for a post-pandemic world.

WHAT WILL WORKING in the post-pandemic era be like?

We're not quite there yet, but hundreds of students from dozens of colleges and universities around the country have presented some excellent, attractive options.

Their ideas came about via the 2021 Steel Design Student Competition, sponsored by AISC and the Association of Collegiate Schools of Architecture (ACSA). This year's edition had over 1,200 participants from more than 60 colleges and universities, and students could compete in two separate categories. Category I challenged students to rethink the nature of working in a post-pandemic era and design for holistic physical and mental wellness for all the building's inhabitants. Category II was open, offering students the opportunity to select a site and building program using steel as the primary material.

Eleven winning projects—including first, second, and third place winners and multiple honorable mentions in both categories—explore a variety of design issues related to the use of steel in design and construction and were chosen by a panel of distinguished jurors:

Category I: Workplace Wellness Jury
- Sara Carr, Northeastern University
- Aki Ishida, Virginia Tech
- Shaina Saporta, Arup, New York

Category II: Open Jury
- Emily Guglielmo, Martin/Martin Consulting Engineers
- Dana Gulling, North Carolina State University
- Jin Young Song, University at Buffalo, SUNY

Read on to learn about—and see fantastic conceptual design illustrations of—this year's winners, which range from a fully autonomous urban food hub to a new take on the public bathhouse to a hybrid library and student union building on an abandoned pier.

CATEGORY I: WORKPLACE WELLNESS
Winners

The students considered the perspective of this building from the occupants' point of view, which added an authentic human-scale element. The thoroughly documented process of steel use and intricate drawings bring the overall design to a cohesive and well-thought-out design.

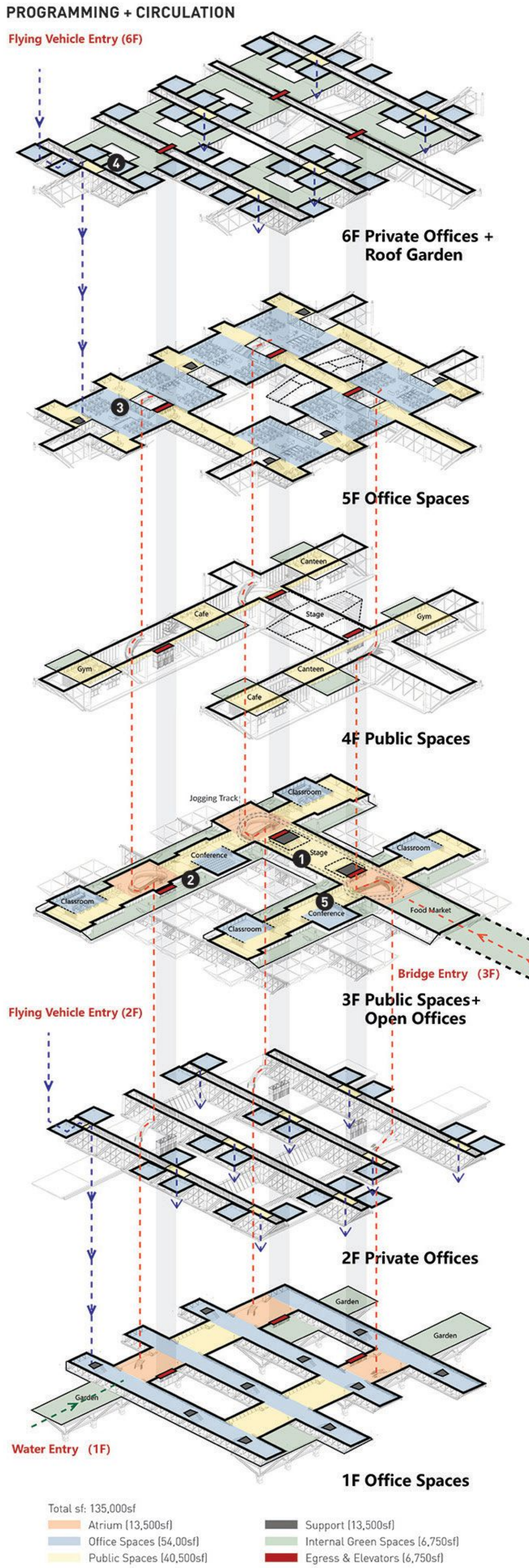
1st

Immersive Workplace

Students: Moises Lio Can, Zaw Latt, Yaning Zhang, and Ming Xu
Faculty Sponsor: Clark E. Llewellyn, FAIA
Institution: University of Hawai'i at Manoa
Collaborators: Marion Fowlkes, FAIA, and Stephen S. Huh, FAIA

Facing the challenge of designing a post-pandemic workplace, selecting a site that reflected a "working" and "innovative" culture was essential. Our driving design principles for Immersive Workplace focus on not only the workplace itself but also on a vision that acknowledges the challenges of communication, transportation, climate change, identity, and community.

We questioned the purpose of the physical workplace in the future. To create a built environment that develops a much-improved lifestyle, the design reimagines the future of the workplace by emphasizing the integration of public spaces, healthy environments, and transformable spaces. The design integrates both existing and emerging technologies to create a vision for the future. Healthy collaborative spaces integrate the unique social bonding of the culture and the demanding work environment

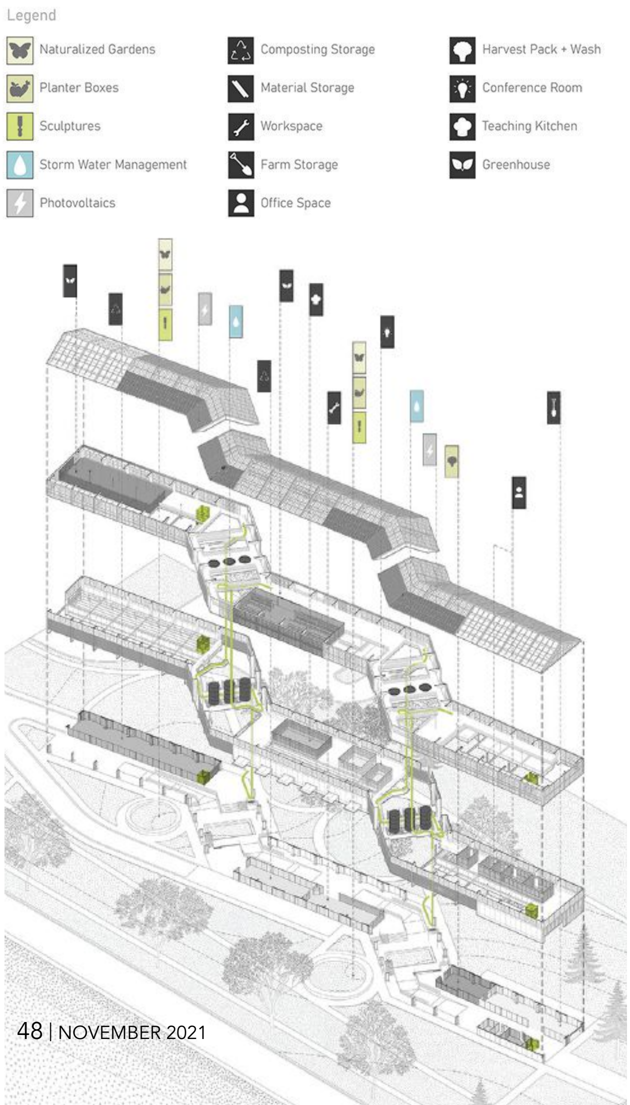


to overcome many of the traditional work/life challenges, and healthy spaces for public and social events create opportunities for employees to collaborate informally and share spontaneous ideas.

Using a repetitive steel structure module inspired by fractal patterns with "self-similarity" allows the exploration of repetition and growth at different scales to design flexible and healthy working environments that can adapt to the changing future—one where flying vehicles and autostereoscopic technologies are common. The primary access is through the green roof where drones dock. Inhabitants descend to engage in the varied building programs, and offices and public spaces embrace natural and mechanical strategies to improve all inhabitants' wellbeing, while active design promotes physical movement and interaction.

Through the site and diagrams, this design represented a soothing, sensitive, and clean approach to sustainability. The use of a steel system, which harkens back to agricultural structures, feels appropriate to how the building is intended to be used.

CATEGORY I: WORKPLACE WELLNESS
Winners



Waste[USE]-full

2nd

Student: Dylan Roth
Faculty Sponsors: Soo Jeong Jo, Kristopher Palagi, and Tara Street
Institution: Louisiana State University

Waste[USE]-full is an exploration into the development of a fully autonomous urban food hub distribution center for the Baton Roots Urban Agriculture initiative in Baton Rouge, La. The form of the building is conceived as a single linear extrusion, a simple pavilion divided into three sections and tweaked slightly to produce exciting architectural moments.

The first level/section includes the three main import/export operations of the urban food hub: composting storage, planter construction, and farming operations. These sections are separated by outdoor classrooms that are embedded into the ground and double as a form of stormwater infrastructure. These junction points also house the main circulation corridors for each section, highlighting and celebrating the physical use of stairs while still allowing accessible lift options for those who require them.

On the second level, overlooking the planter box workspace, a teaching kitchen where Baton Roots chefs can teach classes on how to cook different and possibly unfamiliar food types in a healthy way. The kitchen also has the potential to act as a reservable commercial kitchen space for locals to prepare goods to sell at Scotlandville Saturdays. Next to the kitchen are both a small and large conference room to be used when needed by Baton Roots administrative staff or as a reservable space for community members to hold interviews, conduct meetings, and collectively study. On the far end of the second level, above the farming storage and harvest pack+wash, are private office spaces for all of Baton Roots' administrative needs. The third level consists of greenhouse and lath house spaces to strategically take advantage of solar heat gains.

The variation in material and well-detailed steel connections with cross-laminated timber are well communicated. There is a clear understanding of the relationship between the street and site design.

3rd

Holographic Headquarters

Student: John Iacobacci
Faculty Sponsor: Jodi La Coe
Institution: Marywood University

The American Film Institute's new Holographic Headquarters, seated above the Capitol South Metro Station in Washington, D.C., is designed through speculating on the future of the film industry as foreshadowed through the increased use of computer-generated special effects and holographic projections. The building is equipped with a steel superstructure supporting cross-laminated timber (CLT) panels standing as a showcase of the correspondence between programmatic environments the grid of The Spirit of Justice Park within the broader urban fabric.

The incorporation of local flora and fauna evokes a feeling of wellness and relaxation while experiencing diverse adaptive work environments from immersive recessed lounges to the lobby amphitheater. Immersion in nature is amplified by interior and exterior screens that both project film images and grant shade to the interior. These screens project the emotion and empowerment of films such as Black Panther and Wonder Woman to the city.

In contrast to the opaqueness of the adjacent Federal-style buildings, Holographic Headquarters uses steel, timber, concrete, and glass to create a sense of transparency and openness. The exterior glazing and strategic floor openings display the steel and CLT structure. The structural spans are supported by tree-like, branching steel columns to symbolize a pedestal to support the life of the occupants and the native flora on the roofscapes.

CATEGORY I:
WORKPLACE WELLNESS
Honorable Mentions

Floating Oasis

Students: Ge Tian, Dong Cao, Zhiyu Feng, and Dongyan Jiang
Faculty Sponsor: Clark E. Llewellyn, FAIA
Institution: University of Hawai'i at Manoa
Collaborators: Marion Fowlkes, FAIA & Stephen S. Huh, FAIA

The urban center selected for this study is considered one of the most vibrant and active in the world. Shanghai, a city of 25 million, has over 700 regional headquarters. The city's contemporary architecture is often adventuresome, experimental, and open to technological innovation. While our project remains committed to Shanghai's iconic architecture, it also builds a healthy and active relationship with pedestrians and nearby neighborhoods.

Opening edges along all sides of the building allows the public, and the office building, to flow into and through the site. Sunken plazas, green spaces that continuously flow from the ground into architecture, help blur the line between architecture and landscape. Workers can move from office space to urban space to enjoy fountains designed for civic recreation. Additionally, the lower levels are integrated into the upper urban spaces, allowing retail, food vending, and additional commercial spaces to share the urban landscape.

The traditional elements of light, ventilation, and greenery are employed throughout for occupant wellness. Two large steel and glass cores flood all spaces with quality light, clean air, and luscious greenery. Connecting slabs, suspended by steel cables, are active green spaces that dilute the boundaries between inside, outside, and the core. The environment is healthy and active.

Occupant activity and distancing are emphasized through extending pedestrian routes and integrating a running ramp through the gardens and other areas. By enlarging the pedestrian traffic areas, these become spaces for socializing, sharing ideas, and creating visions of the future. Flexibility to adjust to time and activities is supported by systems that allow offices to be divided into smaller or larger spaces by a variety of users. Most public and private spaces are multi-dimensional and interactive and are designed to encourage many levels of communication and collaboration while keeping the spaces healthy.

Floating Oasis employs an innovative structural steel system used in the service of healthy biophilic design. The relationship between the site and open public plaza is much appreciated.

Howard University Center for Inclusive Design

Students: Christine Griffith and Kyle Martin
Faculty Sponsor: Farhana Ferdous
Institution: Howard University

Located at the corner of Georgia Avenue and W Street in Washington, D.C., the Howard University Center for Inclusive Design is a mixed-use development affiliated with the Department of Architecture. The center is dedicated to enhancing the experiences of people of all ages, abilities, and cultures through excellence in design. The center offers services through education, consultation, design, and research.

Our building acts as a gateway between the campus and the broader Georgia

Avenue community. The aim was to create a structure that not only serves the campus functionally but also acts as a symbol for the university. The building's form was designed to pay homage to the inclusive theme of the project's function, with a curved form that eliminates the concept of "an edge," helping create a friendly, welcoming experience.

The project receives an honorable mention for its approach to its urban site and emphasis on accessibility. The steel structure and terra cotta panels communicate sensitivity to human scale, light, and air.

Re(IN)Vent

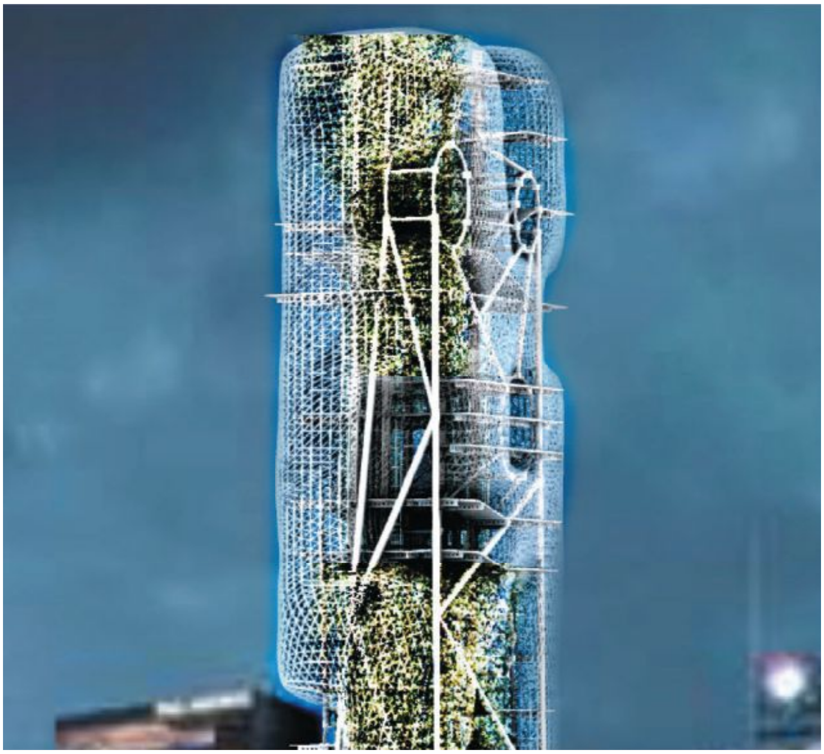
Students: Josue Alvarez Perez and Jose Montano
Faculty Sponsor: Gerard Smulevich
Institution: Woodbury University

Using architecture to reimage the way the skyscraper fits in the new era of airborne viruses can be challenging. The once highly densified workplace has proven to be a breeding ground for such viruses due to the proximity of its inhabitants. Re(IN)Vent was designed to promote social distancing all while providing visual connections, thus keeping a sense of unity in the work environment. The high ceiling and open wind corridors ensure the proper amount of passive airflow throughout the building to disperse any air particles. These architectural moves are key in our ability to rehabilitate the high rise safely.

The tower uses a system of intersecting columns that join with the air corridor structure to ventilate floor areas that connect to the air corridors, allowing for greater natural air circulation within these areas. The relationships that these elements share create a unique high-rise experience that reshapes what a conventional high rise looks like today.

The program is largely composed of workspaces divided by public, open, and entertainment areas. It uses large, ventilated areas to introduce a hybrid office concept, which takes advantage of the best of enclosed and open space environments. These office spaces benefit from the tower's dynamic façade, which has a mixture of large exterior surface areas that soak up heat and create pockets of cool exterior areas which benefit from 100% natural ventilation.

The truss structure concept uses different types of connections to cross-brace several members at different angles. It employs these air corridors to provide points where structural members can connect to overcome span limitations, while at the same time creating lobbies that serve as safe distribution points for individuals that use the quarantine-sized elevators.



Re(IN)Vent is an original concept for fresh air ventilation in a skyscraper. The bold concept of the building structure shows a fun approach to how steel could be used in the future.

Clouds Over Regent Park is an ambitious structure with an overall design that comes together to achieve a large urban impact. There's a great balance between innovative systems from a structural perspective and aesthetic.

Clouds Over Regent Park

1st

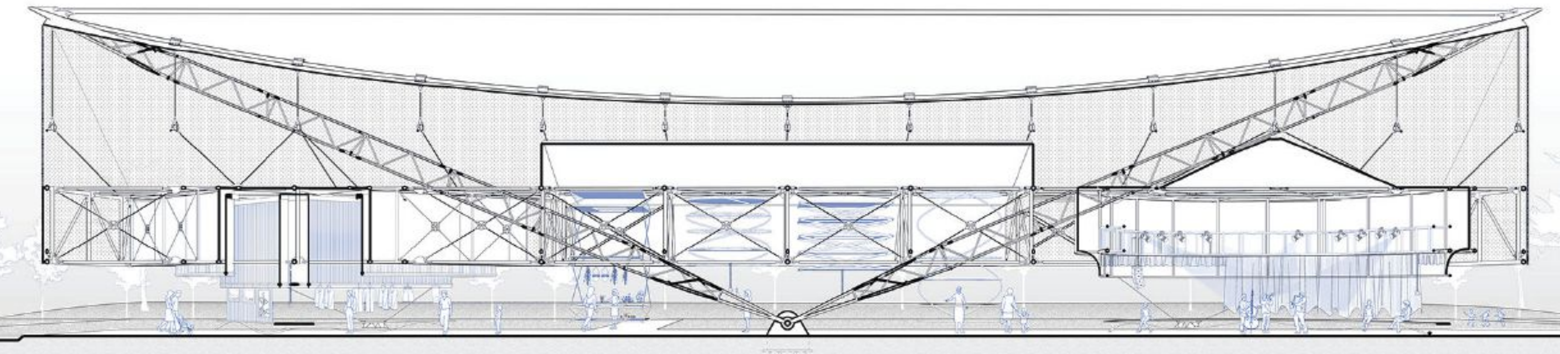
Student: Thomas Gomez Ospina
Faculty Sponsor: Vincent Hui
Institution: Ryerson University

As a failed social housing experiment that implemented post-war modernist ideals, the violent history of Toronto's Regent Park resonates to this day. However, the momentum behind a new era for this community is reaching an apex as city leaders expedite the final phase of the area's celebrated revitalization plan. Clouds Over Regent Park is a project that intends to drive this momentum forward through the design of a grand canopy that will bring the entire community under a single roof.

The design of this canopy can mold, react, and respond to the engagement from the community. The concept of several canopies within a canopy is explored to create a space in which members of Regent Park's diverse community can congregate flexibly and spontaneously underneath a modular structure that serves the user's needs. As opposed to dictating a single framework for its use, several different frameworks are incorporated to host activities such as farmer's markets, performances, shows, exhibitions, and more.

The entire structure is elevated by two V-shaped masts that allow the space underneath to remain column-free. This gives the canopy an ephemeral lightness that allows it to remain unobtrusive to its natural context while also remaining flexible and welcoming to all members of the community.

Finally, a permeable stainless steel chainmail mesh wraps the structure and its non-permeable inner canopies like a soft veil. Aside from providing passive shading, this chain is tethered to the steel frame to provide lateral bracing. Conceptually, the mesh provides the final embrace to the structure, giving the canopy an organic formlessness that alludes to its ever-changing functionalities.



sectional perspective

This sectional perspective illustrates how the structure and detailing of the canopy is carefully integrated with the specific functionalities of the canopy and with its initial concept.

Hot Cold Warm displays an efficient use of steel and is elegant in terms of how the exposed structure is presented. The students' drawings showcase their technical understanding and depict the structure in a sophisticated and believable manner.

Hot Cold Warm

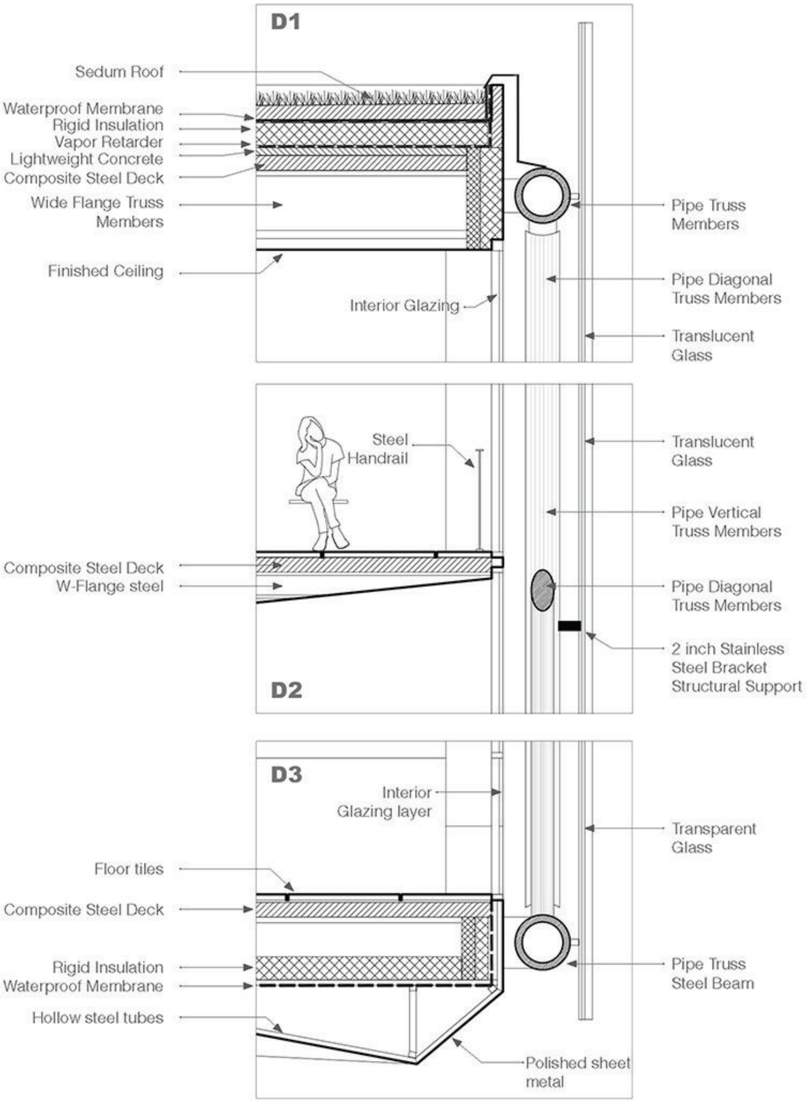
2nd

Student: Uran Sokoli
Faculty Sponsor: Ahmed Ali
Institution: Texas A&M University

Hot Cold Warm aims to reintroduce the public bathhouse to American society. Located in Austin, Texas, the project builds on the historical role of this typology in addressing public health and wellbeing. In a time when preventive medicine has gained traction in maintaining one's wellbeing, bathhouses could find their way back into the routine activities that people perform. The hot, cold, and warm represent the main spaces within bathhouses, referring to the different temperatures of each respective space.

The design comprises a pedestrian bridge that serves the public and the bathhouse on top of it. The steel truss structure plays a primary role in the design. All its elements are left visible in the interior and exterior. To address different programmatic needs, three different concave glass panels come together to enclose the building. The top panels are mostly opaque and translucent, helping to provide privacy while also serving as a shading element.

Transparent glass is used at the lower part of the façade to allow for a visual connection with the surrounding landscape. These glass panels are suspended from stainless steel brackets cantilevered off the main structure, and another transparent glazing layer is employed in the interior. The structure lives between the interior glass and exterior concave panels, with this cavity acting as a double-skin façade for the building so that it does not become overheated.



CATEGORY II: OPEN
Winners

3rd

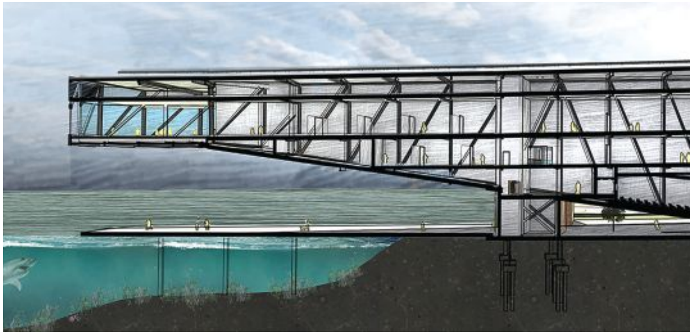
North End: Storytelling. Immigrant Museum on Boston Waterfront.

Student: Ekaterina Siemoneit
Faculty Sponsors: Jerolim Mladinov and David Foxe
Institution: Boston Architectural College

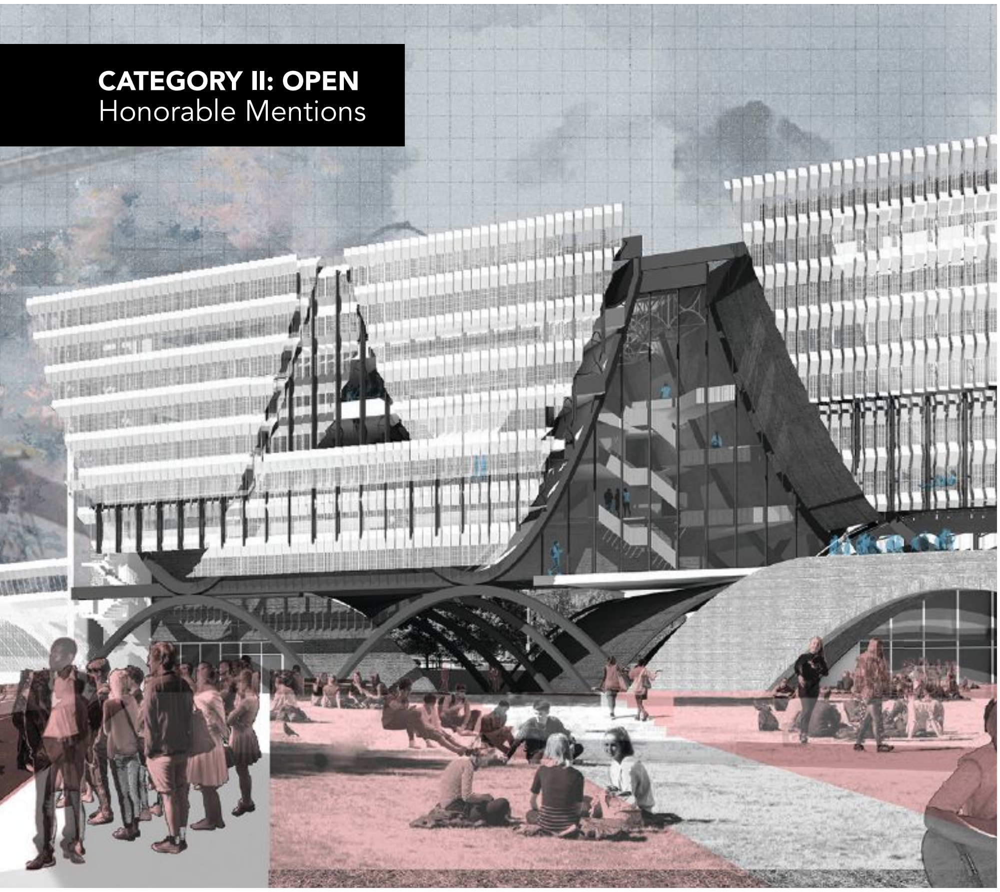
Boston's North End neighborhood has incalculable reasons to be celebrated and protected, with some of the oldest buildings in Boston, historical significance dating back to pre-1776, and a bustling hub of activity and social interaction. However, the true value of the North End is the preservation of over 300 years of continuous European colonization, the vast tapestry of cultural integration and inclusion, and its population fluctuation over the decades.

This design is a monument to the importance of the immigrants and settlers who constructed and expanded the North End from too few residents to warrant their own church to the thriving cultural and historic landmark it is today. The goal is to protect the culture and history of the North End neighborhood founders and residents by ensuring their stories are passed along.

The museum takes visitors on a journey through the extensive history of this neighborhood and the city as they rise through the building, watching the growth and expansion of the North End through records and memories. The structure inhabits a waterfront building typology in a new progressive way, attracting tourists and locals alike.



CATEGORY II: OPEN
Honorable Mentions



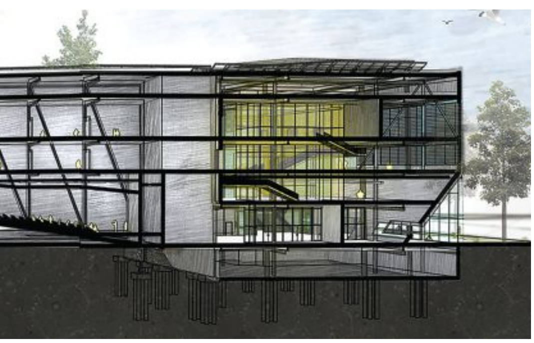
Above & Below [the Veil]

Student: Kaiyan Chen
Faculty Sponsor: Thomas Fowler
Institution: California Polytechnic State University

Above & Below is a hybrid library and student union building of a newly proposed historically black college and university (HBCU) at an abandoned pier of Port of Los Angeles. The school is designed for 1,000 students, with six colleges, a stadium, and other supporting buildings.

The design started with the transformation of a cultural map of Los Angeles called Biggie, Biggie, Biggie by Black artist Mark Bradford. We understand the painting as a cityscape with two contrasting layers sitting above and below the grade. Combined with W.E.B. Du Bois' theory about the "Double-Consciousness" within African Americans, we determined that each layer represents one state of mind, and the grade is the discriminating "veil" that prevents the two from being seen as one. "Above" represents a desire to acquire knowledge to earn social status and consists of academic spaces, while "Below" represents the ongoing fight and includes programs such

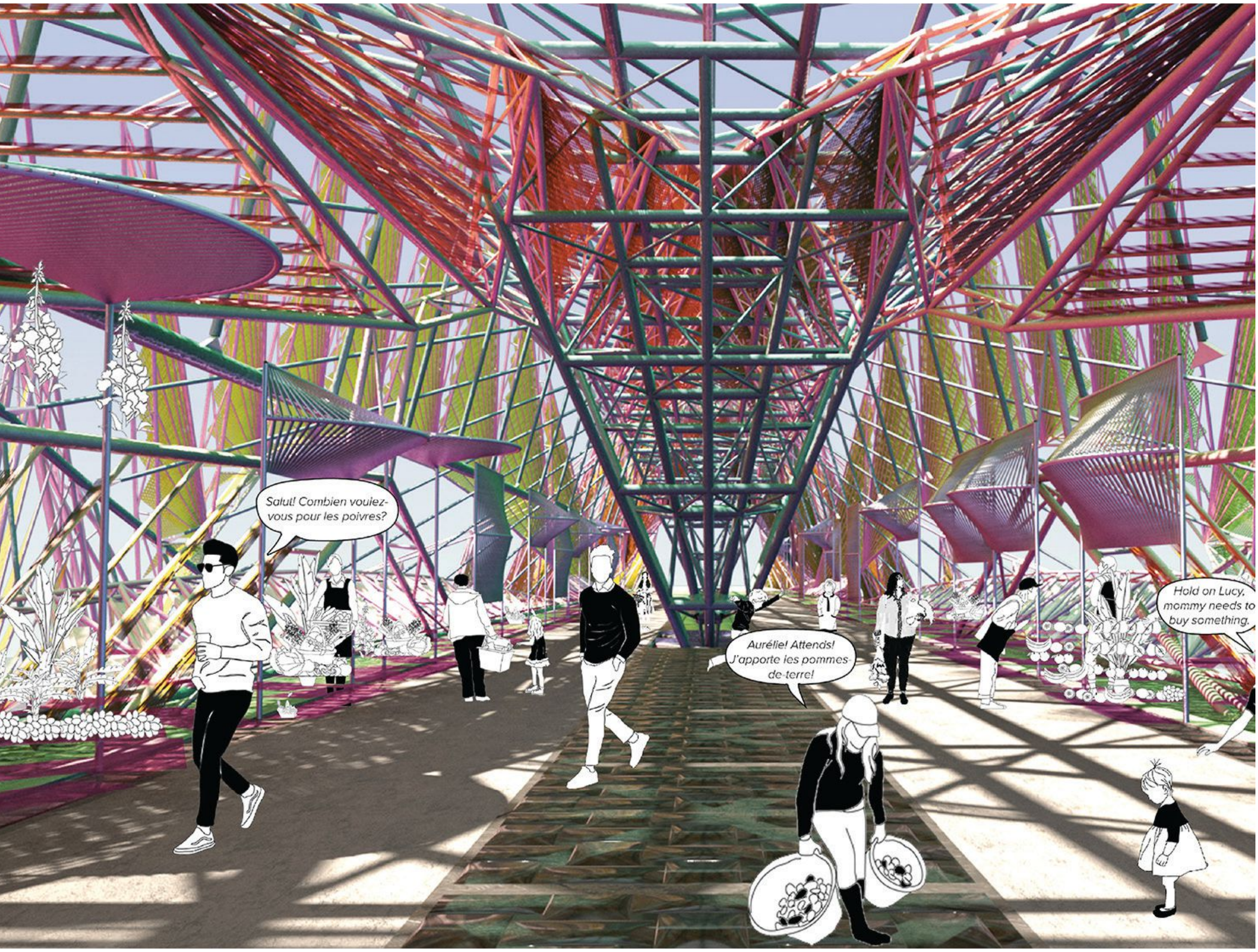
This project's truss structure design could be implemented on a large urban scale. The program celebrates the idea of the immigrant story through impeccable drawings and designed storytelling.



as club services and a café. The library-student union locates at the meeting plane of Above & Below for its hybrid nature. It sits among the six colleges while defining the important HBCU tradition of the "quad." The library's atrium connects the campus' general-public access plane and the Above and Below levels.

The building structure is comprised of steel "chromosome" columns. Each column is made of two parabolic arches joined at their crowns, spanning 72 ft. The opposite growing directions of arches reify the Double-Consciousness concept, becoming the basic module of this structural system. The module is repeated to form 4-ft-deep exposed warren trusses. The Above envelope is a perforated metal screen on a polycarbonate curtain wall, expressing the structure through controlled transparency, while the Below envelope is a stucco rain screen wall.

Above & Below [the Veil] uses a unique truss design. From a structural perspective, the students fully grasp ideas on how trusses can be optimized.



CATEGORY II: OPEN
Honorable Mentions

Marché du Pont

Student: Tatiana Estrina
Faculty Sponsor: Vincent Hui
Institution: Ryerson University

Marché du Pont is commendable for its ornamental use of steel.

Marché du Pont is proposed to be implemented in Montreal in order to rejuvenate the northern tip of the Île Notre Dame and the Île Saint-Helene. The element of the market, or "bazaar," on the bridge would serve as a community space, serving as a place for sellers throughout Montreal to rent booths to distribute their goods.

Locating Marché du Pont on the Expo Express bridge remnant is intended to spur the passage of Montrealers between the Île Notre Dame and the Île Saint-Helene, catalyzing not only on beautification and reunification efforts but also the restoration of Expo 67 pavilions and artworks remaining on the site.

In anticipation of Expo 67, Montreal not only created the islands in the center of the city and built pavilions on them, but also built a monorail bridge, the Expo Express, which crossed over the water to the islands which then turned around at "La Ronde." In the years following the event, much of the architecture and infrastructure was either deconstructed or left in disarray, including the Expo Express, which was largely dismantled except for a portion that became the "Pont de la Concorde" and another bridging portion that remains abandoned in the water.

Although the Île Notre Dame has since become a rowing and racing facility for the Olympics as well as a casino, and Île Saint-Helene houses the biodome and an amusement park, both islands fail to satisfy the everyday needs of the population. Except for special occasions, the islands remain largely deserted, especially the northern portion of Île Notre Dame, which serves as a stockyard. ■

This month's offerings include a new service geared toward optimizing steel construction projects, an environmentally conscious forklift, and an ergonomic and smart console for steel-bending operations.

new products

Nucor Construction Solutions

Nucor Corporation has announced its new Construction Solutions service, which helps professionals in all stages of the construction process with proactive services tailored to their unique challenges. The team is available to answer any questions and address any challenges that may arise during a project, with the goal of helping customers optimize their steel projects from design to completion. The service includes structural evaluation and supply chain optimization at the earliest stages of design, as well as access to leading experts on steel and sustainability.

Visit **www.nucor.com/construction-solutions** for more information.

Combilift Combi-XLE

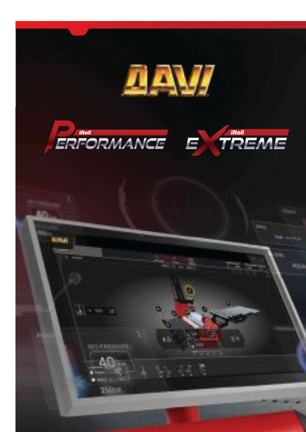
In line with the growing demand for electric-powered equipment, the Combi-XLE multidirectional forklift, with a 5-ton lift capacity, combines emissions-free operation with powerful performance for a wide range of industries and applications, including steel-related facilities. The new machine incorporates up-to-the-minute technology, such as patented all-wheel traction that reduces tire wear and load swing and enhances braking. Other features include large, cushioned front and rear tires to provide high ground clearance, and a spacious cab, allowing smooth operation on semi-rough terrain. The truck incorporates Combilift's newly developed, patented Eco-Steer System, which provides a smaller turning radius and an improved user experience. With sustainability ever higher on the agenda, Combilift further helps customers achieve environmental goals with its "three-forklifts-in-one" models, which work inside and out, reducing fleet size and carbon footprint.

Visit **www.combilift.com/xle** for more information.

DAVI iRoll eXtreme

The iRoll eXtreme introduces enhanced ergonomics to the control console for DAVI's steel-bending equipment. The console features a large, high-resolution industrial panel with an advanced touch screen for an intuitive, smartphone-like experience with a 3D Machine Interface, and the structure is designed to guarantee functionality and durability in heavy-duty workshops. The PLC and graphic engine are independent of the monitor; if needed, the system can be mirrored and operated on devices such as smartphones and tablets. Operators can take advantage of the unique 3D system's interactive pre-production simulation, ASME Tolerances Compliance System ("Apple-Shape" Calculator), Multi-Pass Aided Program, real-time correction for multi-radius jobs, self-adjusting AI to generate fine-tuned programs based on historical parameters collected during the fabrication of similar parts, and a fully customizable widgets sidebar. All the features are available on-board and offline (in case of remote use).

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



IN MEMORIAM

Laurence "Larry" LeJeune, Former AISC Board Member, Dies at 85

Laurence "Larry" LeJeune, former AISC Board Member and owner of LeJeune Steel Company, died on August 12 at the age of 85.

Born on August 5, 1936, in Minneapolis, LeJeune met his wife, Jean, at 16, and the two were married for over 64 years. He attended the University of Minnesota and the University of St. Thomas before embarking on his career in the family business. Later in life, Larry was a founding benefactor of the St. Thomas School of Law and also chaired its Board of Governors. In addition, he and Jean became the namesakes of the school's Laurence and Jean LeJeune Distinguished Chair.

In 1967, LeJeune and his brother, Tom, purchased LeJeune Steel from their father and developed it into the preeminent steel fabricator in the Twin Cities. In 1977, Larry bought out Tom, who in turn developed a structural fastener company, LeJeune Bolt. In the 1980s, he purchased multiple car dealerships and by 1989 was managing them full-time, having left the day-to-day operations of LeJeune Steel to Lee Anderson. The company has been a longtime major contributor to AISC, assisting with research projects and devoting substantial staff time to raise the profile of fabricated structural steel, and LeJeune served as an AISC Board Member from 1981 to 1989.

"When I started with LeJeune Steel almost 60 years ago, I found Larry LeJeune to be a very organized sales-oriented manager," recalled Larry Kloiber, LeJeune Steel's chief engineer. "He taught me to evaluate costs when designing and planning steel fabrication. He understood the value of a fabricator having an in-house professional engineering staff. He also appreciated AISC's role in promoting structural steel fabrication and supported my attendance at its conferences, along with my participation on its committees and task groups.

"When he sold LeJeune Steel in 1989, the company had grown from a small shop selling house beams and one-story projects to a regional fabricator of high-rise office buildings, major arenas, and industrial buildings," continued Kloiber. "Larry, like most of us in the fabrication business, found pleasure driving around our community seeing projects his company had helped to build."

"Larry brought LeJeune through a difficult period of time in the eighties when

many of the fabricators in the Twin Cities went out of business, but LeJeune survived," noted Steve Egger, chairman of Egger Steel and a former AISC Board Member.

Larry is survived by his wife, Jean, daughters Lisa LeJeune, Laura LeJeune, Renee Hallberg, and Amy Krane, son Mike LeJeune, 13 grandchildren, 14 great-grandchildren, his brother, Tom, and sisters Rita and D'Ann.

FORGE PRIZE

AISC Announces All-Star Judge Panel for 2022 Forge Prize

AISC is delighted to reveal the jury for its 2022 Forge Prize.

The Forge Prize recognizes extraordinary emerging architects for designs that embrace steel as a primary structural component and capitalize on steel's ability to increase a project's speed. The jury is as follows:

- Evelyn Lee, FAIA, senior experience designer at Slack Technologies, founder of the Practice of Architecture website and co-host of the Practice Disrupted podcast,
- Miles Nelligan, associate principal at Diller Scofidio + Renfro, and
- Alex Bachrach, publisher of *Architectural Record*

"We couldn't be more honored to have Evelyn, Miles, and Alex on the Forge Prize jury this year," said Houston-based AISC Structural Steel Specialist Alex Morales. "They are true industry thought leaders, and I look forward to hearing their analyses of this year's visionary Forge Prize entries!"

The jury will select three finalists, who will each win a cash prize and be paired with a steel fabricator for the second phase of the competition, in which they further develop their concept before presenting to the jury live on YouTube. The winning architect(s) will then shine in an industry spotlight as they share their vision at the Architecture in Steel Conference next March—and of course take home the $10,000 grand prize!

For more information or to enter the 2022 Forge Prize, please visit **forgeprize.com**.

correction

In the September 2021 Steel Quiz, the answer to question 3, which asked which bridge was designed by Aymar Embury II, was incorrectly listed as the International Rainbow Bridge between Niagara Falls, N.Y., and Niagara Falls, Ont. In fact, Embury designed New York's Triborough Bridge. The International Rainbow Bridge was actually designed by Shortridge Hardesty and other employees of Waddell and Hardesty (now Hardesty and Hanover).

IN MEMORIAM

George Wendt, Former AISC Bender-Roller Committee Member, Dies at 73

George Wendt, former president of AISC member bender-roller Chicago Metal Rolled Products and member of AISC's Bender-Roller Committee, passed away on September 11. He was 73

Wendt, who shared a name with his famous cousin of *Cheers* fame, was a legend in his own right, thanks to his prowess in the pool. Born in 1947, he started swimming competitively at age five and was a standout on the Fenwick High School (Oak Park, Ill.) and University of Minnesota swim teams, achieving All American status at the latter.

After teaching at his former high school and then at Benedictine University in Lisle, Ill., he eventually went to work at Chicago Metal, which was started in 1908 and has been in George's family since 1923. George became the company's president in 1984 and served in that capacity until 2014.

"We struggled at first, but the fear of having our grandfather's company fail on our watch was a strong motivator to succeed," recalled Wendt in a 2012 *Modern Steel* interview (see the article "Word Class" in the May 2012 issue, available in the Archives section at **www.modernsteel.com**).

"George's contribution has left a significant mark on the company and the bender-roller industry at large," expressed Ginny Wendt, his sister, and Joe Wendt, his brother, both of whom also work for Chicago Metal. "George will be remembered as a kind, thoughtful and caring person. He will be greatly missed."

After a 16-year hiatus from swimming beginning around 1981, he started back up again in the late 1990s and began swimming competitively in the U.S. Masters Swimming program. His events included the 400-m, 800-m, 1,500-m and 5,000-m freestyle; the 100-m and 200-m breaststroke; the 200-m backstroke; and the 400-m individual medley.

"Most swimmers get slower as they age," he explained in 2012. "My goal is to get slower *slower* than the other guys."

In addition to pool races, he also competed in every Big Shoulders event on the Chicago lakefront since it was founded in 1991. It was the 2021 edition of the event where George lost his life. According to his obituary in the Chicago Sun-Times, other swimmers found him unresponsive in the water after he completed the first third of the 3.1-mile race, and a medical team was unable to revive him.

George is survived by his wife, Anne, to whom he was married for 52 years, sons Matt and Dan, daughter Kate, and nine grandchildren.

HIGGINS AWARD

Connections Researcher Amit Kanvinde Wins 2022 Higgins Lectureship Award

AISC has awarded its 2022 T.R. Higgins Lectureship Award to Amit Kanvinde, PhD, professor of civil and environmental engineering at the College of Engineering at the University of California, Davis.

Kanvinde will present "Column Base Connections: Research, Design, and a Look to the Future" as a keynote speaker during NASCC: The Steel Conference, which will take place March 23-25, 2022, in Denver. Kanvinde will share his findings from 15 years of research into the behavior, design, and structural interactions of various types of connections, including exposed, slab-overtopped, and embedded connections. The lecture will include prospective developments in base connection design, as well as insight into a revision of the AISC Design Guide 1: *Base Plate and Anchor Rod Design* (**aisc.org/dg**)

"Dr. Amit Kanvinde's research on fixed column bases is extensive and thorough. It's rare to see a collection of research that covers a topic area so comprehensively," said jury member Matthew R. Eatherton, SE, PhD, associate professor in the department of civil and environmental engineering at Virginia Tech. "Dr. Kanvinde's research on column bases has great impact and applicability since fixed column bases are widely used."

In addition to his contributions to the understanding of fixed column bases, Kanvinde is a member of AISC's Connection Prequalification Review Panel (CPRP) and the Committee on Research, as well as an ad hoc committee on box columns. In 2017, AISC awarded Kanvinde a Special Achievement Award for his research on column connection details.

"The Higgins award is well-deserved, not only because of his unique contributions to the field of steel column bases but also because he has made several significant contributions to our understanding of steel structures in his career so far," Eatherton said.

The $15,000 T.R. Higgins Lectureship Award recognizes an innovative lecturer or author whose outstanding technical writing constitutes a ground-breaking addition to engineering literature on fabricated structural steel. For more about the T.R. Higgins Lectureship Award and its past winners, please visit **aisc.org/higgins**.

EDUCATION

Annual AISC Scholarship Winners Announced

AISC has announced the winners of its 2021-2022 scholarships.

A total of $339,500 in scholarships has been awarded to 101 deserving undergraduate and master's-level students for the 2021-2022 academic year.

The AISC David B. Ratterman Fast Start Scholarships program awarded a total of $76,000 in scholarships to 23 students this year. The program awards children of AISC full member company employees who will be freshmen and sophomores during the upcoming academic year. The students may attend two- or four-year programs and may choose any area of study.

Unfortunately, the challenging circumstances surrounding the Coronavirus pandemic caused the cancelation of the annual student welding competition held at Puma Steel in Cheyenne, Wyo., where local high school students compete to win scholarships to attend the welding program at Laramie County Community College (LCCC). (We're pleased to note that the program resumed this year on SteelDay, September 24, and similar programs are starting around the country!)

The Student Steel Bridge Competition expanded in 2021 to allow for 100% remote participation in a design-only Supplemental Competition, as well as the modified Compete from Campus program (see "Embracing the Moment" in the September issue in the Archives section at **www.modernsteel.com**). AISC awarded scholarships to the top teams in both programs, as well as three team awards for spirit, ingenuity, and engagement, totaling $23,000.

Finally, the AISC Education Foundation, in partnership with several other structural steel industry associations, has awarded $240,500 to 63 students. AISC is deeply thankful for the growing support of our industry partners and offers our sincerest thanks for their generous, continued contributions.

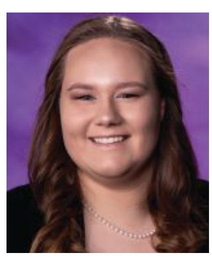
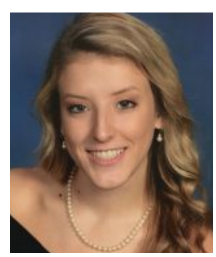
Without further ado, here are the winners of the 2021–2022 academic year AISC Scholarships.









David B. Ratterman Fast Start Scholarships

$4,000 Award Recipients

- Shahad Alfaouri, University of Arkansas
- Tatyanna Biamby, Husson University
- Madelyn Blaser, University of South Dakota
- Isabella Bounyarith *(not pictured)*, College of Charleston
- Sebastian Diaz Murillo, University of Idaho
- Ivan Duran *(not pictured)*, University of Texas at Austin
- Colton Evans, Vincennes University
- Brittney Herbe, Bowling Green State University
- Konnor Keller, Penn State University Park
- Evan McNally, Youngstown State University
- Kalib Parsley *(not pictured)*, Ball State University
- Larissa Shearer, Bloomsburg University
- Hannah Velilla, Clemson University
- Haylee Vickers, Indiana University Purdue University Indianapolis
- Kacey Weathers, Lander University

The David B. Ratterman Scholarship Jury consisted of the following individuals:

- David B. Ratterman, Scholarship Committee Chair
- Hollie Noveletsky, AISC Board Member
- Patrick Schueck, AISC Board Member
- Matt Smith, AISC Board Member
- Philip Stupp, AISC Board Member
- Glenn Tabolt, AISC Board Member
- Jacob Thomas, AISC Board Member

David B. Ratterman Fast Start Scholarships






$2,000 Award Recipients

- Tyler Acreman, Trenholm State Community College
- MaKayla Bischoff *(not pictured)*, BGSU Firelands
- Rebekah Eccles, Eastern Florida State College
- Drake Heatwole, Blue Ridge Community College
- Katherine Kimble, Orange Coast College
- Summer Lynch, Riverside City College
- Shayla Mitio, Pueblo Community College
- Anthony Najar, Tarrant County College

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

AISC/Rocky Mountain Steel Construction Association

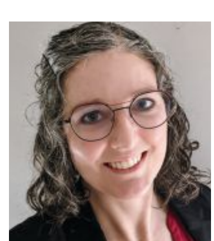
- D. Ethan Borenstein, University of Colorado-Boulder
- Trevor Valder *(not pictured)*, Colorado School of Mines

AISC/UIUC Architecture Scholarship

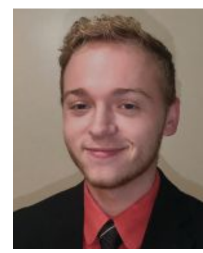
- Michelle Mo, University of Illinois at Urbana-Champaign

AISC/Ohio Steel Association

- Margaret Sullivan-Miller, University of Cincinnati



AISC/Associated Steel Erectors of Chicago






- Dawson Allen *(not pictured)*, Rose-Hulman Institute of Technology
- Jay Avitia, University of Illinois at Chicago
- Kyle Bacon, Purdue University
- Emma Brown, Northwestern University
- Lauren Conley, Rose-Hulman Institute of Technology
- Luke Greenwood, Rose-Hulman Institute of Technology
- Amanda Lefebvre, Purdue University
- Wade Misch *(not pictured)*, Purdue University
- Seng Tong Ngann, Purdue University
- Corey Phillips *(not pictured)*, Trine University

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

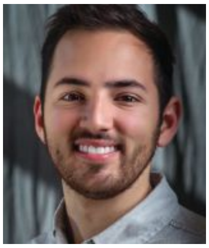
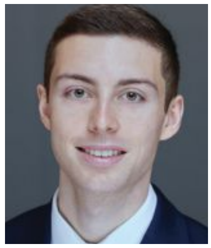
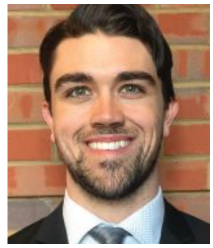
- Michelle Andrascik, The College of New Jersey
- Colin Arnold, Washington State University
- Levi Arnold, Washington State University
- Katie Augustine, Milwaukee School of Engineering
- Justin Babcock, Univ. of Minnesota – Twin Cities
- Anna Bohlmann, Virginia Tech
- Spencer Browne, University of Arizona
- Megan Catlett *(Havens Award)*, University of Kansas
- Janny Chen *(not pictured)*, Lehigh University
- Riley Conklin, Lehigh University
- Madeline Cramer, Pennsylvania State University
- Tarah Driver, New York University
- Justice Forster, Virginia Tech.
- Gwyneth Harris, SUNY University at Buffalo
- Elliot Holzhauer, Case Western Reserve University
- Vincente Johnson, The Catholic University of America
- Joe Kaldestad, University of Washington
- Myrto Kampouris, George Washington University
- Regan Kelly, Northeastern University
- Tyler Kleinsasser, South Dakota School of Mines and Tech.
- Elizabeth Laughlin, Clarkson University
- Andy LeBoeuf, University of Virginia
- Melanie Macioce, University of Arizona
- Angie Mitchell, University of Kansas
- Derek Rizzi, Georgia Institute of Technology

>>

The AISC Scholarship jury consisted of the following individuals:

- Benjamin Baer, Baer Associates Engineers, Ltd.
- David Bibbs, Cannon Design
- Christopher Brown, formerly of Skidmore, Owings & Merrill, LLP
- Luke Johnson, ECS Limited
- Steven Offringa, EXP
- Matthew Streid, Magnusson Klemencic Associates

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

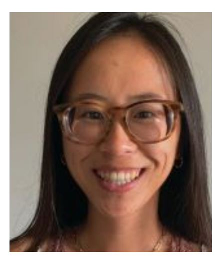

- Zach Rowley, Texas A&M University
- Paul Ryan, Florida Institute of Technology
- Andrew Shahan, University of Tennessee, Knoxville
- Colleen Sharp, Stanford University
- Luke Traverso, Case Western Reserve University
- Mary Vavruska, Cooper Union
- Jessica Viehman, Virginia Tech.
- Gregory Wikoff, California Baptist University
- Justus Williams *(W&W/AFCO award)*, Harding University



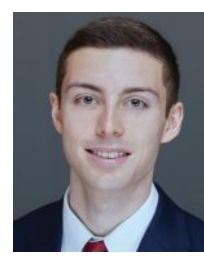

AISC/Cohen Seglias

- Simon Joyner, Clarkson University
- Timothy Kohany, Manhattan College

AISC/ Indiana Fabricators Association



- Matt Baker *(not pictured)*, Trine University
- Delaney Lewis, Purdue University
- Lauren Stevenson *(not pictured)*, University of Evansville




AISC/Southern Association of Steel Fabricators

- Paul Ryan, Florida Institute of Technology
- Kayla Truman-Jarrell, University of Tennessee, Knoxville

AISC/W&W Steel/ Oklahoma State University

seniors

- Jeffrey Collier, Civil Engineering
- Kelsey (Hooper) Corry, Construction Engineering Technology
- Kirby Lough, Architectural Engineering

juniors

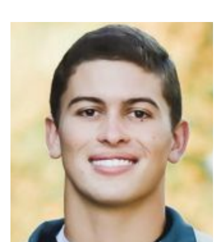
- Mason Egermeier *(not pictured)*, Civil Engineering
- Sutton Hess, Construction Engineering Technology
- Molly Hoback, Architectural Engineering

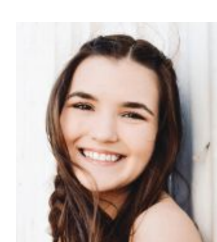
sophomores

- Koda Oller, Construction Engineering Technology
- Raphael Wall, Civil Engineering
- Skylar Waters, Architectural Engineering





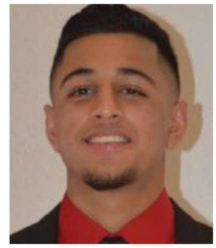





news & events

Student Steel Bridge Competition




**Recipient chose to begin their postgraduate studies at a new school. School listed does not indicate the winning SSBC team.*

Compete from Campus Program

- Riley Conklin, Lehigh University*
- Srishti Hazra *(not pictured)*, University of California, Berkeley
- Matthew Hone, Youngstown State University
- Drew House, Youngstown State University
- Huzaifa Lukmanji, University of Florida
- Hana Meroth, University of California, Berkeley
- Edgar Olet *(not pictured)*, University of Missouri at Columbia
- Brian Roche, Auburn University*
- Kenyon Shutt, University of Missouri at Columbia
- Benjamin Vanderhart *(not pictured)*, University of Alaska Fairbanks


Supplemental Competition Program

- Karoline Herkamp, Oregon Institute of Technology
- Jacob Lion *(not pictured)*, University of California, Berkeley
- Zane Schemmer, University of California, Berkeley
- Daniel Shenk *(not pictured)*, Oregon Institute of Technology
- Courtney Turkatte *(not pictured)*, University of California, Berkeley
- Alec Weitermann *(not pictured)*, Michigan Technological University

Undergraduate Research Fellowships

The AISC Education Foundation has started to expand its funding to programs outside of scholarships. Two undergraduate students have received the inaugural AISC Undergraduate Research Fellowships, which will support projects during the fall 2021 term.

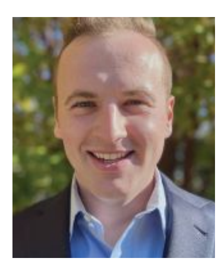
Congratulations to Edmund "Eddie" Elder and faculty sponsor Hannah Blum, PhD, from the University of Wisconsin-Madison. Elder will investigate augmented reality (AR) in steel fabrication. (And to learn about Hannah, check out the October Field Notes podcast.)

AISC also congratulates Edward Nelson and faculty sponsor Pouria Bahmani, PE, PhD, from the Milwaukee School of Engineering. Nelson will research experimental and analytical evaluation of the flexural and axial capacity of steel HSS end-plate connections.

Each recipient will receive $2,500 from the Education Foundation to conduct their research this fall.

Learn more about the selected proposals and the new fellowship program at **aisc.org/research**.

If you are interested in donating to the AISC Education Foundation to support more of tomorrow's leaders, please visit aisc.org/giving for more information.

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Prodevco PCR 42 Robotic Structural Steel Plasma Cutting System, 6-Axis Robot, XPR300, Conveyor, 2018 **#31547**

Peddinghaus FPB1500/3D Plate Punch, 177 Ton, 60" Max Width, 1.25" Plate, HT2000 Plasma, Fagor 8025, 1998 **#31514**

Pangborn ES-1533 Vertical Plate & Structural Blast Cleaner, (8) 20 HP Rotoblast Wheels, Conveyor, 1974 **#31514**

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STEEL ROCK

ROCKEFELLER CENTER comprises 19 commercial buildings in Midtown Manhattan.

But one of them stands above the rest, both in terms of height and fame. Named the Comcast Building since 2015, it was previously called the GE Building and, before that, the RCA Building. But it's always been known by its address as well—30 Rockefeller Plaza—and, colloquially, as 30 Rock.

Designed by architect Raymond Hood, the 850-ft-tall, 70-story tower opened in 1933. Steel erection began in March of 1932 and had reached the 64th floor within six months. Along with the Empire State Building and the Chrysler Building, both built in the early 1930s, it is one of the defining steel-framed Art Deco skyscrapers rising from Midtown.

It is also a symbol of the speed and economy of domestic steel construction in the first half of the 20th century—and was built not long after AISC's founding in 1921 (yes, that makes us 100 this year). For an excerpt from our soon-to-be-released book celebrating AISC's first century of existence, check out "The Material of Choice" on page 40 (and see "Steel Century" in last month's issue and "Engaging Expertise" in the October issue for additional excerpts). And to learn more about AISC turning 100 this year, visit **aisc.org/legacy**.

Join the AISC Education Foundation in

FUNDING THE FUTURE

aisc.org/giving

A scholarship can change someone's life. Meet Charlie Guyer, an architectural engineering student at Oklahoma State University who won an AISC Education Foundation Scholarship for the 2020–2021 academic year.

What inspired you to study architectural engineering?
I've always had a fascination and passion for art and science, and I really like the combination of those two fields in architectural and structural engineering. I also love problem-solving, and I love challenges, and I often face both of those in structural engineering, so I think it's perfect for me.

How has the AISC Scholarship created new opportunities for you?
For the first time since coming to campus, I've been able to take a job with fewer hours so that I can focus more on the higher-level classes that I'm taking at the end of my engineering program. I've also been able to become a teaching assistant and research assistant this year.

I do want to send an enormous thank you to everyone who's been able to make this possible, everyone at AISC and the Education Foundation. This scholarship has really been a game-changer for my undergraduate degree.

What do you hope to do after you graduate?
My dream career is to continue to do research for a higher education institution and to also be a professor for an engineering college. I would like to continue to teach people how to be structural engineers, teach them what I've learned, as well as continue to develop ways of building structures that are more environmentally friendly.

WHEN STUDENTS FEEL SUPPORTED, THEY DREAM BIG.

Each year, the AISC Education Foundation supports bright, passionate students like Charlie. If you are in a position to do so, we're asking you to help tomorrow's leaders pursue their dreams. Help us Fund the Future at **aisc.org/giving**.

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