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January 2024

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Modern Steel Construction

January 2024


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features

columns

ON THE COVER: The largest steel frame in America's largest city will house up to 14,000 JP Morgan Chase employees, p. 26. (Photo: Michael Young (Instagram @mchlanglo793) via Banker Steel)

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editor's note

Happy New Year!

I hope 2023 ended well for you and that 2024 will be even better!

Like many of you, I hosted a tall, green house guest, festooned with lights and ornaments and sporting a triangular profile, for the last month of the year. You know the type. They typically find their way into homes immediately following Thanksgiving (despite the retail industry's push to get them in even earlier) and are often seen in topping out ceremonies for steel buildings (to learn more about that, see "Why a Christmas Tree" in the December 2000 issue, available at **www.modernsteel.com**).

Speaking of Thanksgiving, my family and I made our annual trek to Iowa to visit my mom that weekend. There was food. There was football. There were friends and festivities. There was lots of gravy and LOTS of pie. It was nice. It always is.

All of this leads to the above picture, which was taken two days after Thanksgiving. There are a couple of things going on here. One, I'm at a Christmas tree farm, about to cut down a tree. Two, there's a (weathering) steel sculpture of a moose behind me. While it wasn't my first time seeing a steel sculpture, it *was* my first time cutting down a tree. It was fun. I felt like a lumberjack! Cue the Monty Python song. (And yes, the tree we picked was indeed the mighty Scotch pine!)

But I must admit, part of me wondered, "Should I be doing this?" which led me to ponder the eternal debate over real versus fake trees. I justified it by acknowledging that we get a real tree every year anyway (despite my pleas for a fake one), it was cheaper (and fresher) than one from a big box store, and the trees at the farm were specifically grown for that very purpose.

The steel moose wandering the rows of trees also made me think of a similar "versus" question: Are steel buildings more sustainable than wood ones?

That's a big question. The wood industry will tout its material as a renewable, low-carbon resource. But that simple answer leads to more questions, such as: Are your sustainable forest management practices certified by a reputable source, or are they business as usual? Does your carbon accounting include all forestry impacts, such as soil disturbance and ecological damage, or do you only consider sawmill processes? (In the case of the tree farm, the sawing process was me with a bow saw, which is about as low-carbon as it gets.) I'd also add that the steel industry is working to get even better when it comes to lowering its own environmental impact.

In fact, steel producer Nucor recently announced a plan for reaching net-zero emissions for its steelmaking process by 2050 and an interim target for 2030, aligning with the Global Steel Climate Council's (GSCC) "Steel Climate Standard" similar target date for emissions reduction across the steel industry. To learn more about this initiative, see the related news item on page 64. You can also take a tour of Nucor's new plate mill in "State of the Art" on page 42. And to learn more about steel and sustainability, visit AISC's recently revamped sustainability page at **aisc.org/sustainability**.

Lastly, you can attend one of the sustainability-related sessions at the 2024 NASCC: The Steel Conference March 20–22 in San Antonio (they're listed in our Advance Program, which is packaged with this issue). Did I mention that registration opens January 3? I didn't? Well, it does! Visit **aisc.org/nascc** to register and learn everything you need to know about the structural steel industry's premier annual event.

Geoff Weisenberger

Geoff Weisenberger
Editor and Publisher

Modern Steel Construction

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

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

ASSOCIATE EDITOR
Patrick Engel
312.550.9652
engel@aisc.org

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

GRAPHIC DESIGN MANAGER
Kristin Hall
773.636.8543
hall@aisc.org

EDITORIAL DIRECTOR
Scott Melnick
312.804.1535
melnick@aisc.org

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

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

Avoid Single-Sided Welds

Section J2.4 in the 2022 AISC *Specification* (see text below for *Specification* requirements) now explicitly prohibits the use of the 50% increase for weld strength under tension loading for fillet welds to rectangular HSS ends. Is the intent to allow single-sided fillet welds universally if the directional strength increase is not included (k_{ds} = 1.0)?

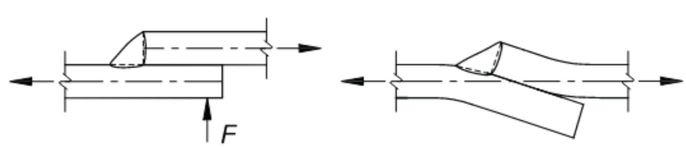
> 2022 AISC *Specification* Requirements
> Section J2.4 Strength
>
> The design strength, ϕR_n, and the allowable strength, R_n/Ω, of welded joints shall be the lower value of the base material strength determined according to the limit states of tensile rupture and shear rupture and the weld metal strength determined according to the limit state of rupture as follows.
>
> For fillet welds
>
> $$R_n = F_{nw} A_{we} k_{ds} \quad \text{(J2-4)}$$
>
> where
> A_{we} = effective area of the weld, in.^{2} (mm^2)
> F_{nw} = nominal stress of the weld metal, ksi (MPa)
> k_{ds} = directional strength increase factor
>
> (1) For fillet welds where strain compatibility of the various weld elements is considered
>
> $$k_{ds} = (1.0 + 0.50 \sin 1.5\theta) \quad \text{(J2-5)}$$
>
> (2) For fillet welds to the ends of rectangular HSS loaded in tension
>
> $$k_{ds} = 1.0$$
>
> (3) For all other conditions
>
> $$k_{ds} = 1.0$$
>
> θ = angle between the line of action of the required force and the weld longitudinal axis, degrees

No. That is not the intent.

Historically, engineers have avoided using single-sided welds and were cautious when single-sided welds could not be avoided. Fillet welds at the ends of HSS were viewed as an exception to the rule that was justified because of testing and some degree of restraint against rotation about the weld. In general, single-sided welds should be avoided, as indicated in various statements made in AISC documents.

The commentary to Section J2.1b states, "The use of single-sided PJP groove welds in joints subjected to rotation about the toe of the weld is discouraged."

The commentary to Section J2.2b states, "The use of single-sided fillet welds in joints subjected to rotation around the toe of the weld is discouraged" and "Fillet welded lap joints under tension tend to open and apply a tearing action at the root of the weld as shown in Figure C-J2.3(b), unless restrained by a force, F, as shown in Figure C-J2.3(a)."



(a) Restrained (b) Unrestrained

Fig. C-J2.3. Restraint of lap joints.

Section 3.4.3 of Design Guide 21: *Welded Connections* states, "Single-sided PJP groove-welded joints should be checked to ensure that rotation about the root of the joint cannot occur, regardless of the loading conditions. Like single-sided fillet welds, single-sided PJP groove welds can readily tear from the root when rotated about this location."

Section 3.5 of Design Guide 21 states, "Because fillet welds do not fuse the cross section of the joint, there will always be an unfused plane under the root of a single-sided fillet or, in the case of double-sided fillets, between the two fillet welds. Single-sided fillet welded joints should be checked to ensure that rotation about the root of the joint cannot occur, regardless of the loading conditions."

Page 8-20 of the 16th Edition *Steel Construction Manual* states, "When lateral deformation is not otherwise prevented, a severe

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

notch effect can result, as illustrated in Figure 8-10. The use of a single-sided fillet or PJP groove weld in joints subject to rotation about the toe of the weld is discouraged. Using a weld on each side will eliminate this condition."

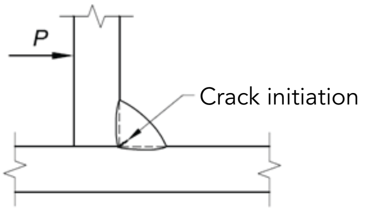
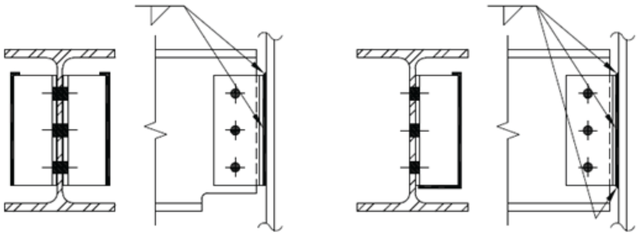


Fig. 8-10. Notch effect at one-sided weld.

Page 12-2 of the 16th edition states, "Figure 12-2 illustrates examples of simple shear connection types not well suited for resisting combined shear and axial forces. Double angle and single angle connections with welds on outstanding legs provide minimal strength due to the flexural loading that is applied about the longitudinal axis of these welds."



(a) Bolted/welded double angle, angles welded to support

(b) single angle

Fig. 12-2. Examples of shear connections not well suited for resisting axial forces.

As indicated in Design Guide 21, it's important to consider rotation about the weld regardless of the loading conditions, not just the final in-service condition. For example, unanticipated rotations about single-sided fillet welds during erection could represent a significant safety hazard to workers on the jobsite.

In summary, the "For all other conditions, k_{ds} = 1.0" is not intended to indicate that all possible fillet weld configurations are acceptable when a kds value of 1.0 is used. One should still consider the overall joint configuration and make sure unanticipated rotations about single-sided fillet welds cannot occur.

Carlo Lini, SE, PE

Heat-Assisted Stud Bend Testing

Can I use heat to assist in the bend test of welded studs? Can I also use heat to assist in straightening bent studs after testing?

Heat should not be used to assist in the bend test of welded studs, nor should it be used when straightening bent studs after testing. Applying heat to assist in stud bending could subject the welds to less force during the test thus defeating the purpose of having the test done in the first place. AISC Design Guide 21: *Welded Connections* (a free download at **aisc.org/dg**) states, " To ensure that proper procedures are used, AWS D1.1 requires that at the beginning of a production shift or before welding with a given equipment set-up, the first two studs are tested by mechanically bending them over to an approximate 30° angle from the original stud axis. This is accomplished by striking the stud with a suitable hammer, or by inserting a pipe or other hollow device around the stud and bending it. A good weld will allow for such deformation and will not break. Poor procedures will typically cause the stud to break from the beam in the weld region."

Article 9.7.1.4 in *AWS D1.1/D1.1M:2020* addresses bend and torque tests for production control. This section states, "In addition to visual examination, the test shall consist of bending the studs after they are allowed to cool, to an angle of approximately 30° from their original axes by either striking the studs with a hammer on the unwelded end or placing a pipe or other suitable device over the stud and manually or mechanically bending the stud. Alternatively, for threaded studs, the torque test of Figure 9.3 may be used instead of bending. Testing performed at temperatures below 50 °F shall be done by continuous slow application of load." It clearly states that "the test shall consist of bending the studs after they are allowed to cool."

Note that bent studs can be left in the bent position as indicated in Section 9.8.3. However, there may be cases where the stud is required to be straightened. This is also addressed in Section 9.8.3, which states, "When bent studs are required by the contract documents to be straightened, the straightening operation shall be done without heating, and before completion of the production stud welding operation."

Yasmin Chaudhry, PE

Carlo Lini (**lini@aisc.org**) is the director and **Yasmin Chaudhry** (**chaudhry@aisc.org**) is a staff engineer, both in AISC's Steel Solutions Center.

steel quiz

Happy New Year!

What better way to start it than by testing yourself about quality? Specifically, do you know the difference between quality control (QC) and quality assurance (QA)?

For each question, determine if the description is associated with QC or QA (as defined by the AISC *Specification for Structural Steel Buildings*).

TURN TO PAGE 14 FOR ANSWERS

QC	QA		
☐	☐	1	Provided by the fabricator and erector.
☐	☐	2	Provided by others when required by the authority having jurisdiction (AHJ), applicable building code, purchaser, owner, or engineer of record (EOR), and when required, responsibilities shall be specified in the contract documents.
☐	☐	3	Procedures that are established, maintained, and implemented by the fabricator and erector are part of this program.
☐	☐	4	Nondestructive testing (NDT) is performed by the agency or firm responsible for this, except as permitted in accordance with Section N6 of the *Specification*.
☐	☐	5	Inspection of mill material as required by the AISC *Code of Standard Practice for Steel Buildings and Bridges* is performed as part of this.
☐	☐	6	Includes tasks that influence quality or are performed to measure or confirm quality.
☐	☐	7	Includes tasks intended to provide a level of assurance that the product meets the project requirements.
☐	☐	8	Includes special inspections, as required by the applicable building code or AHJ.

Answers can be found in the 2022 AISC *Specification for Structural Steel Buildings* and the 2022 AISC *Code of Standard Practice for Steel Buildings and Bridges*, both a free download at **aisc.org/standards**.

1 **QC.** Chapter N of the *Specification* defines when QC and QA are required to be performed and by whom. Section N1 states that quality control shall be provided by the fabricator and erector.

2 **QA.** Section N1 of the *Specification* states that QA shall be provided by others when required by the AHJ, applicable building code, purchaser, owner, or EOR, and when required, responsibilities shall be specified in the contract documents.

3 **QC.** Section N2 of the *Specification* requires the fabricator and erector to establish, maintain, and implement QC procedures to ensure that their work is performed in accordance with the *Specification* and construction documents.

4 **QA.** Section N1 of the *Specification* states that nondestructive testing (NDT) shall be performed by the agency or firm responsible for QA, except as permitted in accordance with Section N6 of the *Specification*.

5 **QC.** Per Section 8 of the *Code*, visual inspection of material received from the mill is required as part of the fabricators' quality control.

6 **QC.** The Commentary to Chapter N of the *Specification* provides helpful guidance to the QA/QC requirements. The Commentary states that QC includes tasks performed by the steel fabricator and erector that influence quality or are performed to measure or confirm quality.

7 **QA.** The Commentary to Chapter N of the *Specification* states that QA tasks performed by organizations other than the steel fabricator and erector are intended to provide a level of assurance that the product meets the project requirements.

8 **QA.** The Commentary to Chapter N of the *Specification* describes QA tasks as inspections often performed when required by the applicable building code or AHJ, and designated special inspections, or as otherwise required by the project owner or EOR.

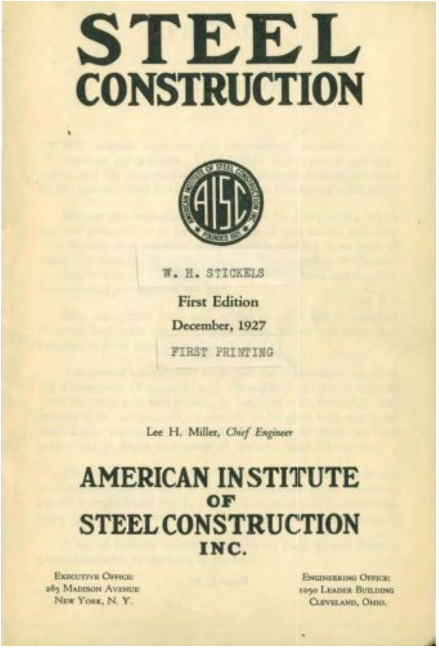
STEEL SOLUTIONS CENTER

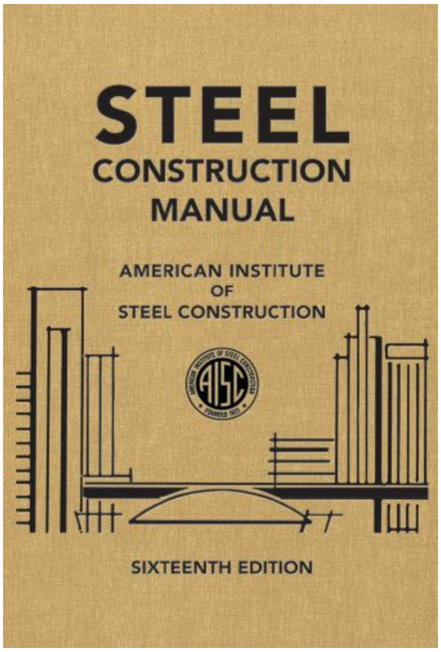
Everyone is welcome to submit questions and answers for the Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or **solutions@aisc.org**.

Sweet 16

BY ERIC BOLIN, YASMIN CHAUDHRY, PE, AND MARGARET MATTHEW, PE

At nearly 100 years old and now in its 16th edition, the *Steel Construction Manual* remains the gold standard for structural steel design.





IN 1927, AISC published the first edition of the *Steel Construction Manual* on regular book paper. It was about an inch thick. Nearly a century later, the 16th edition is printed on "dictionary paper" and is almost 2½ inches thick.

While much has changed with the design of structural steel in the last century, one constant has remained—the *Manual* still provides state-of-the-art resources to design and fabricate structural steel. The 16th edition *Manual* continues the legacy with brand-new content. Here's a look at some of the changes in the 16th edition, which can be purchased at **aisc.org/16thedition**.

New Standards and Codes

Like all previous editions, the most notable update in the 16th edition is the latest standards and codes applicable to the design and fabrication of structural steel. Use of the new *Manual* ensures compliance with the most up-to-date design provisions.

For ease of reference, Part 16 of the *Manual* contains the 2022 AISC *Specification for Structural Steel* (ANSI/AISC 360-22), the 2022 AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303-22), and the 2020 *RCSC Specification for Structural Joints using High-Strength Bolts*.

The 16th edition has also been updated to the latest ASTM A6/A6M standard for new structural shapes, AWS D1.1/D1.1M:2020 for the latest welding provisions, and ASCE/SEI 7-22 for design loads.

New Member Design Resources

New Shapes

Part 1, Dimensions and Properties, starts with frequently referenced tables that give the dimensions and properties of structural products commonly used in steel building design. The shape information has been updated to ASTM A6/A6M-19, *Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling* to be consistent with the 2022 AISC *Specification*.

The *Manual* has 222 new shapes, including six W-shapes (W44×408, W44×368, W36×387, W36×350, W36×318, and W36×286) and six WT-shapes made from the W-shapes (WT22×204, WT22×184, WT18×193.5, WT18×175, WT18×159, and WT18×143). The remaining 210 shapes include square, rectangular, and round HSS shapes. Among the new HSS shapes are thicker walled sections up to 1 in. thick, rectangular shapes with depths up to 34 in., square sections up to 22 in., and round HSS up to 28 in. diameter. Alternate lines of shading were added in the Part 1 tables to aid readability.

Preferred Material Specifications

Part 2, General Design Considerations, includes a wide range of guidance applicable to the design and construction of steel buildings. Significant changes were made to the tables that help guide users when specifying material: Table 2-4 includes the available grades of standard structural shapes, Table 2-5 includes available grades of plate and bar material, and Table 2-6 includes available grades of structural fasteners.

In addition to available material grades, the tables go one step further and show preferred grades for different components. For every new *Manual*, AISC reviews the materials commonly used in steel construction to develop a list of preferred materials that reflect factors like ready availability, ease of ordering and delivery, and pricing. Using preferred materials will help avoid material procurement issues and the potential for added cost.

Preferred does not mean required—any other applicable material specifications can be used successfully on a project, but engineers should confirm with the fabricator the availability and cost-effectiveness of grades other than the preferred material specification prior to their specification.

Here are the major changes in the tables:

- The preferred material specification for M-, S-, and L-shapes has been updated to ASTM A572/A572M Grade 50 from ASTM A36/A36M.
- The preferred material specification for C- and MC-shapes has been updated to ASTM A992/A992M from ASTM A36/A36M.
- The preferred material specification for round HSS is still ASTM A500/A500M Grade C, however, the yield strength has increased from 46 ksi to 50 ksi.
- The preferred material for plates and bars up to 4 in. thick has been updated to ASTM A572/A572M Grade 50 from a dual preference of ASTM A572/A572M Grade 50 and ASTM A36/A36M. There is now a row in Table 2-5 listing ASTM A36/A36M as a preferred material specification for "All other applications." This classification is intended for elements like toe-kicks, edge plates, and other miscellaneous steel where the additional yield strength of A572 Grade 50 is not necessary.

The design tables in the *Manual* are built around the preferred material grades, so many tables show increased material strengths from 36 ksi to 50 ksi for members and connecting elements.

New Guidance for Corrosion Protection

Part 2 of the 16th edition includes expanded guidance for corrosion protection. A section on galvanic corrosion and a table were added to help identify situations where galvanic corrosion may be an issue when joining dissimilar metals. That section lists conditions where galvanic corrosion is unlikely and where risk is high. The new Table 2-8 shown in Figure 1 provides a matrix of common construction metals and their steady-state electrode potential to help identify the potential for galvanic corrosion.

Interpolation, Stability, and More

There are a few additional changes in Part 2. A new section, Using the *Manual* Tables, alerts users about interpolation within design tables. Guidance is also now provided throughout the *Manual*, so read the design table discussion before using any tables.

The section on Simplified Determination of Required Strength toward the end of Part 2 also has been updated. It simplifies the effective length method when a quick, conservative solution is desired.

When preparing contract documents, start with the updated section on Contract Document Information, which summarizes the requirements from the AISC *Specification*, the AISC *Seismic Provisions*, and the *Code*.

Structural Analysis Benchmark Solution

Solutions for a first- and second-order analysis of two beam-columns are provided in Part 6. The new Table 6-5 shown in Figure 2 conveniently includes benchmark solutions for bending moments and deflections of a simply supported beam subjected to an axial load and transverse uniform load (Case 1), and a cantilevered member subjected to an axial force and transverse point load (Case 2).

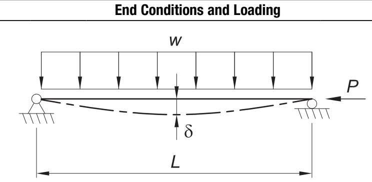
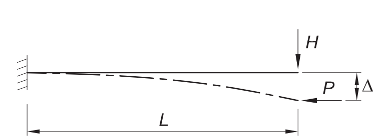
Table 2-8
Galvanic Corrosion Potential Between Steel and Common Construction Metals

Member Material	Fastener Material					
	Stainless Steel	Copper	Brass	Carbon Steel or Iron	Aluminum	Galvanized Steel (Zinc)
	Electrical Potential[a], volts					
	−0.05 to −0.25	−0.36	−0.25 to −0.4	−0.61	−0.79	−1.03
Carbon Steel or Iron	Member may corrode	Member may corrode	Member may corrode	–	Fastener may corrode	No significant corrosion
Galvanized Steel (Zinc)	Member may corrode	Member may corrode	Member may corrode	No significant corrosion	No significant corrosion	–
Stainless Steel	–	No significant corrosion	No significant corrosion	Fastener likely to corrode	Fastener likely to corrode	Fastener likely to corrode

– Indicates similar metals; galvanic corrosion is generally not a concern for this condition.
[a]Electrical potential values from the ASM Handbook, Volume 13 (ASM, 2016)

Fig. 1.

Table 6-5
Beam-Column Structural Analysis

Case	End Conditions and Loading
1	
2	

Case	First-Order Deflection	First-Order M_{max}	Second-Order Deflection	Second-Order M_{max}
1	$\delta = \frac{5wL^4}{384EI}$	$\frac{wL^2}{8}$	$\delta = \frac{5wL^4}{384EI}\left[\frac{12\left(2\sec u - u^2 - 2\right)}{5u^4}\right]$	$\frac{wL^2}{8}\left[\frac{2\left(\sec u - 1\right)}{u^2}\right]$
2	$\Delta = \frac{HL^3}{3EI}$	HL	$\Delta = \frac{HL^3}{3EI}\left[\frac{3\left(\tan 2u - 2u\right)}{\left(2u\right)^3}\right]$	$HL\left(\frac{\tan 2u}{2u}\right)$

Note: For all cases

$$u = \frac{\pi}{2}\sqrt{\frac{P}{P_{eL}}}$$

$$P_{eL} = \frac{\pi^2 EI}{L^2}$$

Fig. 2.

These solutions are intended to validate solutions from computerized structural analysis or compute required forces and deflections during design when the member configuration matches the given configurations.

New Connection Design Resources

Updated Connection Materials

All shear connection design tables in Part 10 have been updated from 36 ksi to 50 ksi connection material. Designers can consult the tables to aid the design of typical shear connections with higher-strength materials that are regularly used today.

The 2022 AISC *Specification* and 2020 RCSC *Specification* have adopted a new bolt specification, ASTM F3148. This new bolt grade has a tensile stress of 144 ksi, which puts its strength between Group 120 and Group 150 bolts. These new Group 144 bolts are an option in the shear connection tables throughout Part 10.

Regarding bolt nomenclature, the previous AISC *Specification* and *Manual* used the term "Group A" to identify ASTM F3125/F3125M Grades A325 and F1852 bolts, "Group B" to identify ASTM F3125/F3125M Grades A490 and F2280 bolts, and "Group C" to identify ASTM F3111 and ASTM F3048 bolts.

That terminology has changed in the latest *Specification* and *Manual* from Group A, Group B, and Group C to Group 120, Group 150, and Group 200, respectively. The new ASTM F3148 bolts are referred to as Group 144. The new group nomenclature is based on the bolt's tensile stress and should provide better transparency in the bolts being specified.

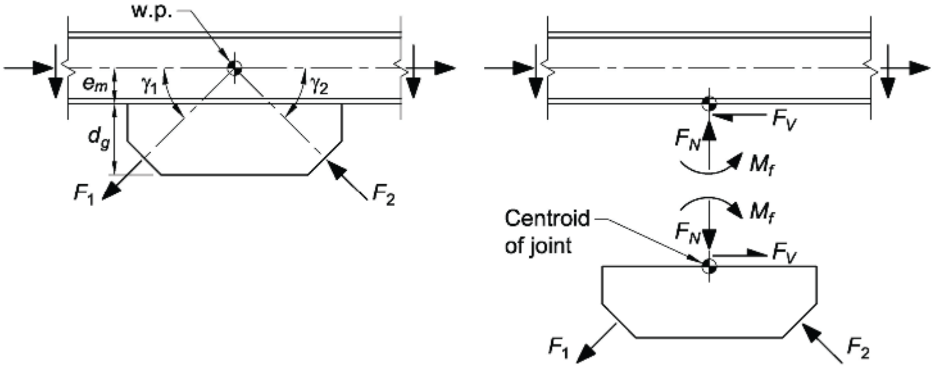


Fig. 3.

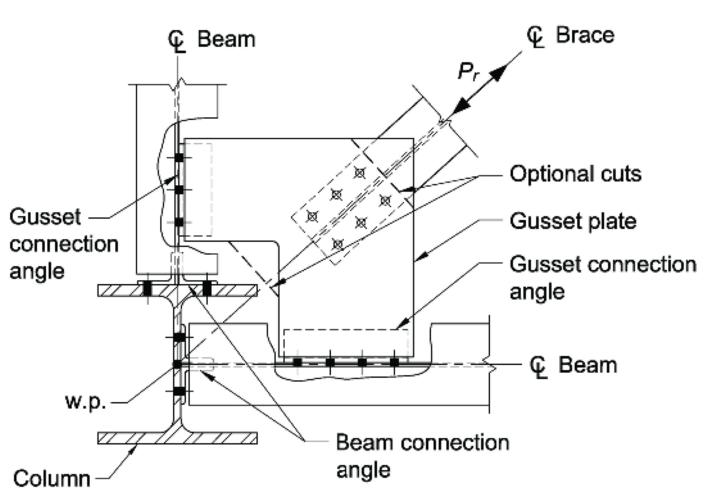


Fig. 4.

New Shear Connection Table Format

Four shear connection tables in Part 10 received a major revamp; Table 10-1 (All-Bolted Double-Angle Connections), Table 10-4 (Shear End-Plate Connections), Table 10-10 (Single-Plate Connections), and Table 10-12 (Bolted/Welded Single Angle Connections).

Each table is split into three subtables—one to verify the connection material strength, one to verify the shear transfer strength at the bolt holes, and one to verify the strength of the supported member when coped. A separate article covering all the details of the new Part 10 tables will be published in the February issue of *Modern Steel Construction*.

Consolidation of Moment Connection Parts

Part 11 in previous editions contained information for partially restrained (PR) moment connections, and Part 12 included information for the design of fully restrained (FR) moment connections. In the new *Manual*, these two parts merged into the new Part 11, Moment Connections. There are no major changes to the content of these parts, just a reorganization.

New Design of Simple Connections for Combined Forces

With the reorganization of moment connections into Part 11, Part 12 is now Design of Simple Connections for Combined Forces, which provides guidance on the design of typical shear connections subjected to axial or torsion forces in addition to shear forces. Part 12 includes a discussion of two of the most used shear connection types to resist shear and axial forces—double-angle and single-plate connections.

New Bracing Connection Discussion

Part 13, Design of Bracing Connections and Truss Connections, has several updates in the 16th edition. The Uniform Force Method has been expanded with a new "Special Case 4." This new special case utilizes a single plate at the column connections, which is useful where braces framing into the column web can create erection difficulties in the field, especially when columns have stiffener (continuity) plates in the web.

Part 13 has a new section covering chevron bracing connections, which require special consideration during both member and connection design due to the "Chevron Effect." The layout and force distribution for a typical chevron connection is shown in Figure 3. The new *Manual* provides extensive discussion of this effect and methods for design.

Lastly, Part 13 also includes new material covering the design of horizontal bracing connections. A horizontal brace connection, such as the one shown in Figure 4, will have a layout and design procedure that differs from other bracing connections. Part 13 now has guidance on the design of this connection type, including a new table aiding the design of horizontal brace "wrap around" type gusset plates.

New Table for Coped W-Shapes

Part 9, Design of Connecting Elements, has a new "Plastic Section Modulus for Coped W-Shapes" table. This new table is a companion to the previous editions' coped beam elastic section modulus table. The procedure for checking the available flexural strength of a beam with a cope at the top flange provided in Part 9 requires calculating the plastic bending moment of the coped section. This calculation is simpler using the coped beam plastic section modulus taken directly from the new table.

Increased Weld Strength for Double-Angle Connections

Tables 10-2 and 10-3 are used to design bolted/welded or all welded double-angle connections. For the weld between the angles and the support ("Welds B"), the weld design method was changed from the elastic method to the instantaneous center of rotation method. The updated design method will provide higher connection strengths. Additionally, these tables have a new weld geometry ("Welds C") that includes additional lines of weld at the bottom of the angles, providing additional connection strength where needed.

Dedication

The AISC Committee on Manuals has dedicated the 16th edition to William (Bill) A. Thornton, former Chairman and longtime committee member. Bill served as committee chair from 1985 until 2011 and oversaw the development of numerous *Manual* editions, including the First edition LRFD *Manual* and the 14th edition *Manual*. The 16th edition is only the second *Manual* to be dedicated and honors Bill's many contributions to our industry.

Manual Resources

Accompanying the 16th edition's release are several free resources available at **aisc.org/manualresources**.

Manual Companions

The new version 16.0 *Companion to the AISC Steel Construction Manual* is a two-volume set containing nearly 1,800 pages of supplemental material.

The v16.0 *Manual Companion*, *Volume 1: Design Examples*, includes complete illustrations of commonly used provisions in the 2022 AISC *Specification* and the 16th edition for designing members, connections, and structural systems. The new v16.0 has several improvements over the previous version, including a new example demonstrating the design of partial-joint-penetration groove welds, examples illustrating the use of the new shear connection tables in Part 10 of the 16th edition, a complete building design following the design requirements outlined in ASCE/SEI 7-22, and more.

The v16.0 *Manual Companion*, *Volume 2: Design Tables*, contains 20 design tables that supplement the *Manual* with additional material grades, including ASTM A913 Grades 65 and 70 W-shapes and ASTM A1085 HSS members. This new version has expanded tables with the 210 new HSS shapes added to the 16th edition for A500 Grade C and ASTM A1085 material.

AISC Shapes Database and Historic Shapes Database

The v16.0 Shapes Database is a Microsoft Excel spreadsheet that compiles the dimensions and properties of all shapes printed in Part 1. Information for the 222 shapes added to the 16th edition is now included in v16.0, along with several useful non-tabulated properties not published in the *Manual*.

The new v16.0H Historic Shapes Database is updated with all dimensions and properties consistent with the 15th edition *Manual*. This resource provides a complete list of historical shape information recorded from 1873 to 2016.

Basic Design Values Cards

The Basic Design Values Cards are a set of pocket-sized cards presenting frequently used limit state equations for checking members and connections from the 2022 AISC *Specification* in an abbreviated format. The cards are small enough to keep on a desk or in a field notebook for use when the available strengths for members and connections are needed quickly.

Interactive Reference List

The Interactive Reference List contains all the references found in the 2022 *Specification* and 16th edition. Many of the references are available from the AISC website, while others are linked to the outside organization where the listed publication can be accessed or purchased.

Eric Bolin (**bolin@aisc.org**) is a senior engineer in AISC's Engineering and Research department, **Yasmin Chaudhry** (**chaudhry@aisc.org**) is a staff engineer in AISC's Steel Solutions Center, and **Margaret Matthew** (**matthew@aisc.org**) is the AISC Director of Manuals.

Service to Steel

INTERVIEW BY GEOFF WEISENBERGER

AISC volunteer Steven J. Fenves has helped propel the steel industry forward for more than half a century.

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**.

STEVEN FENVES ushered in one of structural steel's most important 20th-century innovations.

Fenves was a pivotal figure, if not the leading voice, behind shifting structural steel design from slide rules and mechanical calculators to computers in the mid-to-late 1900s. His contributions don't stop there. He also helped develop the load and resistance factor design (LRFD) method. He has volunteered with AISC for more than 50 years, including aiding in devising standards found in building codes nationwide and making the AISC *Specification for Structural Steel Buildings* more accessible.

Elsewhere, the 92-year-old Fenves has been an active member of the Committee on Specifications for several years, including a stint as chair of the editorial task committee. He received his bachelor's, master's, and PhD from the University of Illinois and was a civil and environmental engineering professor at Carnegie Mellon University from 1971 until 1999.

Now, he's the namesake of a new AISC scholarship: A $50,000 anonymous donation to the AISC Education Foundation in Fenves' honor created the Steven J. Fenves Scholarship in 2023.

Fenves spoke with *Modern Steel Construction* about his career, involvement with AISC, impact on the steel industry, and more.

What got you interested in engineering, and how did you get to where you are now?

I was interested in art and architecture from my early days. My mother was a graphic artist, and she influenced me greatly. I was also interested in math and physics in high school. I read a catalog of an exhibition in the New York Museum of Modern Art that presented bridges as architecture and art. That influenced me to go into civil engineering. I intended to become a bridge designer and design sleek bridges.

I got derailed from that my first year in graduate school. I helped a community transition from the slide rule age to the computer age, and that's the route in which I connected with AISC. I'm not a steel person. I'm not a member of AISC. But I became deeply involved.

I'm also a Holocaust survivor. When I was 13, I was in two ghettos, three concentration camps, and two railroad transports—locked boxcars with no food, no drink, no sanitation for days after days.

Eventually, I was liberated from a camp called Buchenwald in 1945. I returned to Yugoslavia, which by then was a worker's paradise. I was told that because of what I suffered, I would be allowed to complete high school, but under no condition would I be accepted into any university in the country because I was not the son of the proletariat. I was the son of the bourgeoisie, and universities were open only to sons and daughters of proletariat workers.

My sister and I and two of our cousins escaped, wound up in France, spent three years in France, and finished high school before we came to the United States. When we arrived in the States, we were greeted by many people who had known my parents. I was also warmly greeted by the Selective Service, and I was drafted into the U.S. Army.

I was sent back to Europe and to Germany, which was an interesting experience. But I could support myself afterward and go to college with the G.I. Bill (formally called the Servicemen's Readjustment Act of 1944). I went to Illinois and got my three degrees.

I had great success very early in my professional life. After earning my PhD, I received an offer to spend a year working at Massachusetts Institute of Technology. Three of my colleagues at MIT and I developed a language and program for structural analysis called Structural Engineering System Solver (STRESS). It included all framed types and had a communication language at the level of the engineer rather than putting in code numbers that you forgot as soon as you put them in, and that created quite a change.

I also studied and read articles on decision logic tables, a way of tabulating if-then logic statements in an organized manner. I did a paper for an early ASCE computer conference describing the method by illustrating some engineering calculations by decision tables. It showed that when you tabulate, a lot of the entries are blank. I asked in the paper, what does that mean? Is that a logical impossibility? Or is it something not done in practice and can be avoided? Or is it a combination that the committee has simply forgotten about?

Steve Fenves and his sister, Estera, in 1940.

United States Holocaust Memorial Museum, Courtesy of Steve Fenves

Shortly after publication, I got a call from T.R. Higgins, the director of research at AISC at the time, asking if I would come to a meeting where people and companies would present proposals to computerize the *Specification*. This was in the early 1960s. I went and wrote a critique saying all these people will be incorporating individual interpretations of the *Specification* buried in deeply in the code. Neither AISC nor any individual user will ever be able to find out what assumptions have been built into it.

And I suggested an alternate approach—tabulate all these decision points and let each programmer pick whatever part they want. Higgins gave me my first contract with AISC afterward. It led to a significant restructuring of the *Specification*.

Ted Galambos' groundbreaking work on LRFD provided the determination of nominal strengths and the identification of the appropriate limit states for all structural components. My intention throughout was to complement it by providing a rational, logically organized presentation.

That's an impressive story. Thinking from your teaching role, what do you think is the most important thing or most important message that you put out there for the next generation of designers?

The most important thing to instill in young people is ambition. I don't think we do enough. They come in expecting to become engineers. We train them to be good technicians, but usually that's all.

Then I have always maintained that changing jobs—moving from a civil job to an office job—is a vital ingredient in civil engineering. I didn't do it, but I always encourage students to do that.

With that comes the training and indoctrination to think of higher principles: sustainability, energy conservation, environmental, sanitation, and maintenance. That's hard in introductory courses. But it's important, wherever possible, to introduce these considerations that used to be external when I was an undergraduate student and now are becoming the key issues—not the technical issues of what 14-in. wide-flange section to use for a column. That's no longer a difficult decision to make.

What does the scholarship mean to you, knowing it was put together in your name?

My own story illustrates the meaning. My career was immensely accelerated by the Tau Beta Pi Fellowship I got for my

Miriam Lomaskin/United States Holocaust Memorial Museum

first year of graduate school. I could take a full load of courses and prepare for the rest, as opposed to immediately accepting a research assistantship, which reduces the number of courses you can take in a semester.

I have progression charts of where I got and when, while classmates who started at the same time as me took three years to catch up on the coursework.

I feel great sympathy for these young people who must take out loans and start the most forward-looking years of their lives under the weight of debt. The fellowship is an immediate, enormous help to young people to free themselves from these very prying constraints and concentrate on doing what they want to do.

I feel honored that this fellowship was established, and that's why I'm thrilled for the young people who get it, because it really is an accelerated path to their future they wouldn't have otherwise.

You've dedicated a lot of time to speaking about being a Holocaust survivor. Given your experience and in the context of this scholarship, what does giving back mean to you?

I think every person has a great deal of responsibility to every other person. Whatever good has been bestowed on you, it's an obligation to attempt to return multi-fold that good to others. It's an important aspect—the calibration of your debts and commitments to humanity and how you respond to the gifts that you have received.

In my mind and the minds of many survivors I know, "Do I do enough in return?" is an important question. I try to live by that.

What do you consider to be your legacy, professionally or personally? What do you want it to be?

Ivan Viest was a professor at Illinois and later was with Bethlehem Steel. His contribution to the *Specification* is much larger than mine because he single-handedly initiated the concentration of composite construction. At dinner one day, he sent me a note he thought should be the epitaph for my tombstone: "He eliminated the cost of design as a consideration in making design decisions."

You may remember reading about the Quebec Bridge collapses in 1907 and 1916, where the bridge was extended, widened, and extended in length, and loads increased. They did not have the time or money to recompute the stresses and resize the members. Halfway through constructing the cantilever arms, the whole thing collapsed.

That was not uncommon, though maybe that's a stark example. Can we afford to analyze, or should we just depend on our sense of how the structure behaves? That was a burning question in any designer's mind. I can't say I eliminated that, but certainly, I shaped computing that eliminated it. That's one measure of legacy.

I think I have contributed greatly to maintaining and enhancing the dignity of structural engineering by sweeping out needless detailed computations as a criterion for performance as a structural engineer and allowing people to move up.

That's my professional sense of legacy. Personal sense is different. There's no question my four children are the greatest things that I produced, and it goes on to the next generation. After the events in Gaza and Israel, three of the oldest of my seven grandchildren wrote me fantastic letters about how they feel and the obligation they feel as a grandchild of a Holocaust survivor. That was very moving.

Have any of your four children decided to become engineers?

My son Gregory was head of the department of civil engineering at UC Berkeley and the dean of engineering at the University of Texas. He became the president of Texas and is now the president of Emory. At his Texas inauguration, he joked that I still don't understand where he went wrong by giving up the comfortable job of being a professor of civil engineering and now taking on the thankless job of worrying about the football team's performance.

I had lots of people ask, "Did you influence your son?" Neither my wife nor I influenced our children into anything. We attempted to provide an environment where they could find themselves, define themselves, and choose whatever they thought was appropriate for them. I'm proud of that.

What did earning the 50-year certificate for your volunteer work mean to you?

Getting the 50-year certificate was a very moving thing. It was by far the most intense immersion into the profession, apart from the abstractions encountered in the classroom and real-world stuff where people resigned from the committee because one provision interfered with their way of life and their way of business.

I'm very grateful for AISC. I have attempted to influence other organizations in the same way. I was never as successful as I've been with AISC, so I'm grateful that I could do it there.

This article was excerpted from my interview with Steven. To hear more from him, find the January 2024 Field Notes podcast at ***modernsteel.com/podcasts****.*

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

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A Gen Z Blue-Collar Boom?

BY JASON LAMONICA

The trade industry's opportunities are a great match with many Gen Z job seekers' priorities.

THERE HAS BEEN a noted uptick in interest in blue-collar jobs from a new demographic: Generation Z.

A recent survey conducted by *Intelligent* found that 32% of Gen Z respondents intended to enter the blue-collar workforce, despite the push for the younger generation to enter STEM-aligned positions that require higher education.

Each generation has opinions that often disparage the generation coming up behind them. Some may not want to work as hard or aren't as interested in getting their hands dirty and learning a trade as their predecessors were.

However, any preconceived biases about Gen Z—people born between 1996 and 2010—are likely far off base and disconnected from reality. The new blue-collar working world is ready to accept Gen Z and everything it can bring. Gen Z is bringing tech savvy, new ideas, and innovation to trades long mired in traditional approaches, upending many industries and changing them for the better.

Embracing the new blue-collar worker

The job market can be challenging, especially for someone who is not a traditional college-track student. However, a return of interest to the trades has allowed members of Gen Z to forge a path to financial security and stability. While the tech sector has remained infamously volatile in recent years, blue-collar jobs have provided excellent, stable opportunities.

Gen Z job seekers will be more open to exploring blue-collar work if they feel the industries are ready to accept them—and perhaps be open to what they can bring to these trades. The rising cost of four-year college degrees and a promise of a steady paycheck with benefits could bring Gen Z knocking at the doors of business owners seeking work.

It is time for the manufacturing and trades sector to reach out to these workers and bring them into the fold. According to a study by Deloitte, an estimated 2.4 million manufacturing jobs could go unfilled by 2028 due to a skills gap. Some high schools and technical colleges have attempted to fill those skill gaps by offering training for some blue-collar positions, like welding, CNC machinery, carpentry, or auto mechanics. In addition, the more education Gen Z receives about the trades' financial upside, the more apt they will be to consider that line of work.

Many blue-collar positions may have a marketing disconnect with Gen Z. They need to go where these workers are—online—and entice them with all the positives that blue-collar jobs offer.

Digital fluency and adaptability

A significant factor that makes Gen Z appealing for work in the trades is their digital fluency. Automation, AI, drone use, and software integration are just a few of the tech improvements to the trades that have emerged in the last decade.

Gen Z job seekers are digital natives who have only lived in a time when digital technology was ubiquitous. This generation grew up using computers, saw the rise of smartphones during their formative years, and only knows a world with the internet. They are social media savvy and constantly connected, and these positive aspects of this hyper-connectivity need to be leveraged by employers and coworkers.

Gen Z can quickly learn and adapt to technology, making any change within a job easy for them to take on and master. Although some may fear that increased innovation and tech advancements may jeopardize blue-collar jobs, the opposite seems to be true.

More automation creates new opportunities for tech-savvy blue-collar workers—largely Gen Z and millennials to join the ranks and flex their digital fluency skills. Gen Z can be what the trades need to fill digital skill gaps, keeping their organizations competitive as tech innovations keep coming.

Valuing Diversity

To attract the valuable skills that Gen Z can bring to the trades, managers and business owners must appeal to what Gen Z holds as important. Money still matters, of course. A 2022 survey from early career job platform Handshake found that 74% of Gen Z workers said stable and robust pay is the most important aspect of work. But more than two-thirds of them cited diversity, equity, and inclusion (DEI) as a crucial job priority in a 2023 University of South Florida survey. They will notice fair hiring and labor practices, and companies that recognize the importance of DEI initiatives and fair hiring will likely see better returns on labor investments and productivity from their Gen Z hires.

Gen Z is entering the workforce in droves, with many choosing to forgo college to learn a trade and enter the blue-collar workforce. By striving to understand this generation and what they can bring to the trades, Boomer, Gen X, and Millennial leaders in the blue-collar sector can reap the benefits of their tech-savvy approach and values that lead to business growth. ■

Jason Lamonica is the CEO of Spec On The Job, a staffing company focused on blue-collar industries.

New York City's largest steel frame
is a futuristic corporate headquarters built on a constraint-filled site.

The framing system for JPMorgan Chase's New York City office incorporates 94,000 tons of steel.

Michael Young (Instagram @mchlanglo793) via Banker Steel

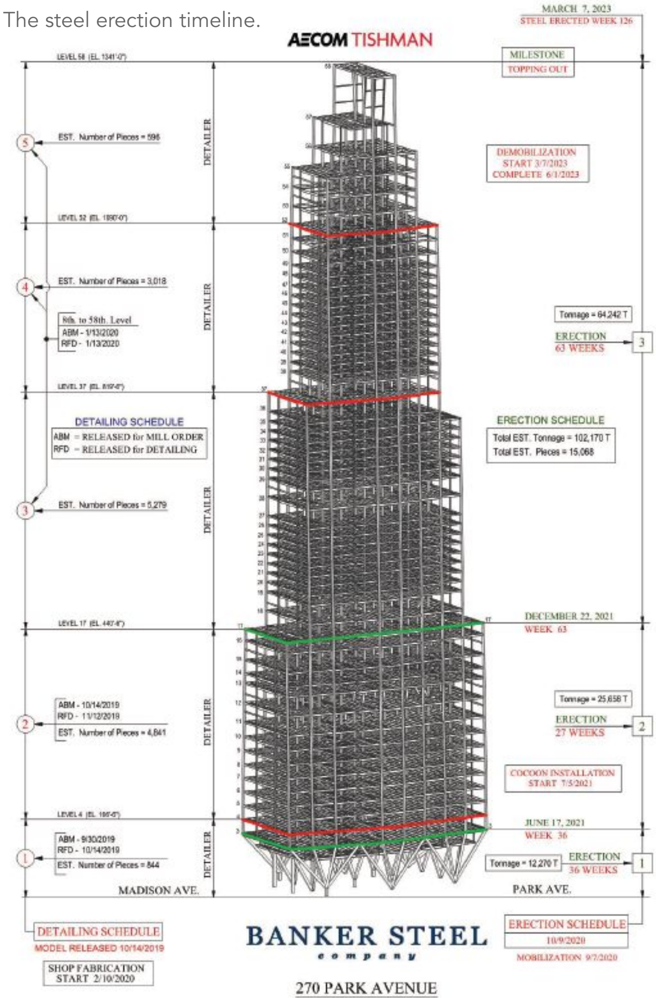
Building Big

BY EDWARD M. DePAOLA, PE, AND FORTUNATO ORLANDO, PE

A rendering of 270 Park Avenue.

DBOX for Foster + Partners

The steel erection timeline.



BY SEEKING CONSOLIDATED OFFICES for its New York workforce, financial giant JPMorgan Chase embarked on a design that would eventually feature New York's largest steel frame.

The company decided the most logical location for the sole New York City office it desired was its existing headquarters at 270 Park Avenue, and the choice made sense. The full-block site is deep in the heart of Midtown Manhattan, bounded by Madison Avenue to the west, Park Avenue to the east, and East 47th and 48th Streets to the south and north, respectively. It has the necessary footprint for a high-occupancy office building and boasts numerous connections to public transportation and other urban amenities.

The idea had one hurdle, though. A rather significant one.

The existing 50-story building, originally constructed for Union Carbide and completed in 1960, was intended for only 3,500 employees, a quarter of JPMorgan Chase's desired maximum. Furthermore, the building's close column spacing and low ceiling heights were not conducive to modern office layouts even after several interior upgrades. Studies concluded that renovation and overbuilding would be costly and impractical.

The conclusion was clear: If JPMorgan Chase wanted to house up to 14,000 New York City employees at 270 Park Avenue, it had to demolish and replace the existing building. And that undertaking carried complications of its own, inherent challenges of building in ultra-dense Manhattan aside.

The most significant site challenge was the Park Avenue side's base. All but the western quarter of the 200-ft by 400-ft site sits over tracks and platforms of Grand Central Terminal, which in turn bears over portions of the recently opened Grand Central Madison. The tracks run north and south and are typically paired with a platform between them—an east-west spacing of about 60 ft—leaving only the gap between adjacent tracks for support. The structure supporting the trainshed roof occupied much of that gap, and the Union Carbide building's foundation further congested it.

All told, a teardown and rebuild was a daunting, complex task. But a skilled design team navigated its hurdles to construct a 94,000-ton steel building without significantly disrupting or altering the train tracks and stations below.

The design team, led by architects Foster + Partners and structural engineers Severud Associates, worked closely with the Metropolitan Transportation Authority (MTA), which operates the Metro-North Railroad and Long Island Rail Road tracks below the Park Avenue side of the site, to determine acceptable areas where new structure could be erected. They started by examining the narrow space between dynamic envelopes, which are often no more than 48 in. wide. Additionally, they had to work around existing power, signal, and other utilities that could not be interrupted or relocated without prohibitive cost. Only a few lines of potential bearing were identified, and along them, only a handful of locations were deemed feasible.

The west quarter of the site—roughly 200 ft by 100 ft along Madison Avenue—is much less obstructed than the Park Avenue side. It has more direct support on bedrock, which gave the designers greater flexibility. They concluded that the building's elevator and service cores should be located at that end. The architects, though, desired an externally symmetrical design and chose column locations that mirrored the supports located along the east side.

Subway tracks below the building site necessitated a two-story-high arrangement of steel transfer girders called the Tabletop.

DBOX for Foster + Partners

Severud

The Tabletop exterior looking southwest.

The Tabletop

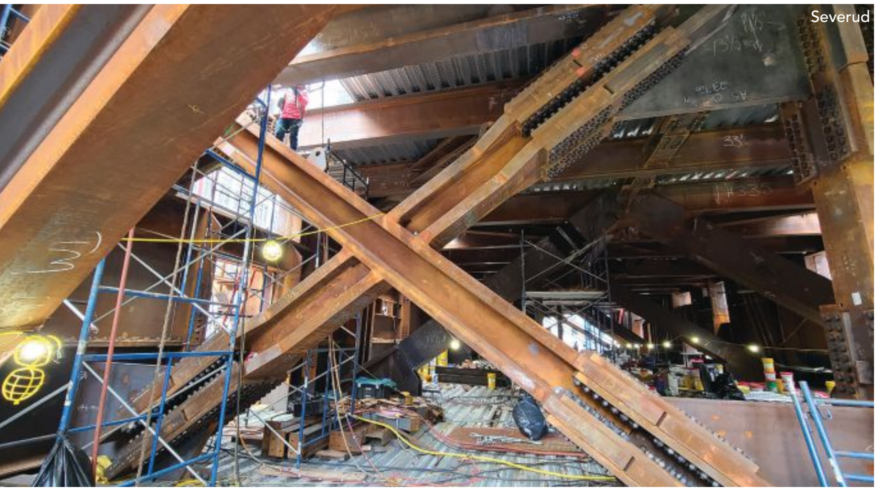
Collecting the gravity and lateral loads from the tower columns—spaced at 40 ft east to west and up to 66 ft north to south—and delivering them to the selected points required an extensive transfer system. The design team studied several schemes for it before arriving at a two-story-high arrangement of steel transfer girders and sloping super-columns that came to be known as the Tabletop.

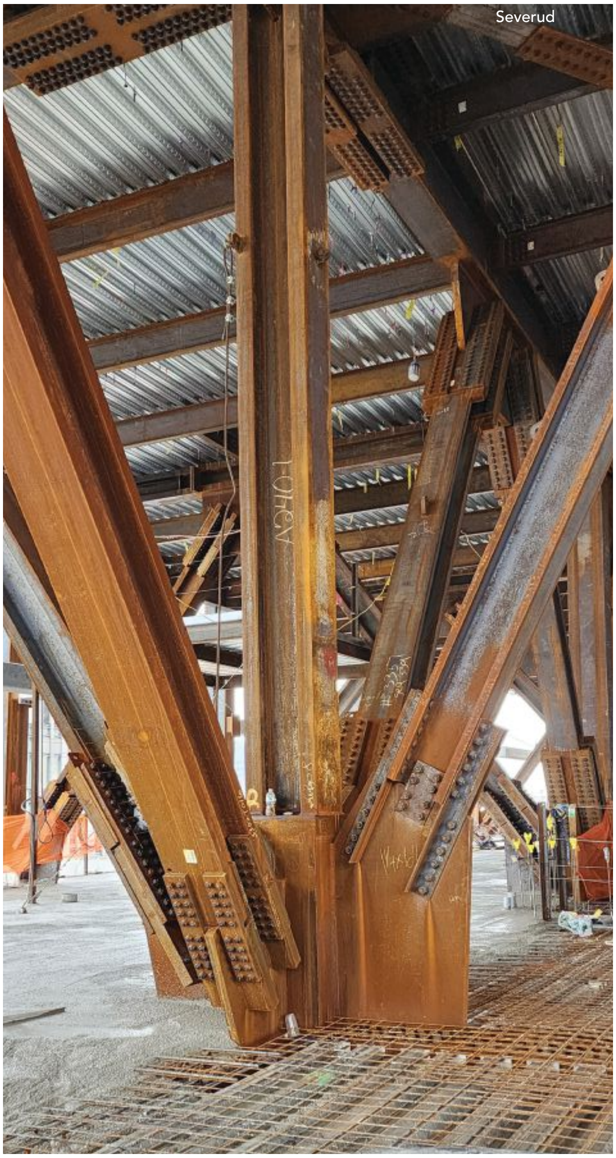
Along the north and south elevations, groups of four adjacent exterior columns slope inward and toward each other to create three fan-shaped sub-structures. Longitudinally, two 25-ft-deep plate girders span the length of the building to transfer the interior columns. The girders, which also carry the second and third floors, are each supported by V-shaped columns. Together, the girders and columns form two vertical planes down the center of the structure. At the east end, two super-columns slope from the building's mid-point to the base of the easternmost fan columns. Additional vertical and near-vertical columns at the west end integrate the girders with the core framing.

The diagonals are box sections up to 48 in. wide by 34 in. deep, formed from plate up to 8 in. thick and capable of carrying up to 30,000 kips of axial load each. Despite their size, their sparse arrangement and length—on the order of 100 ft—make them appear graceful, with an obvious sense of the smooth flow of force from top to bottom. The Tabletop's 86-ft height allows for an open and spacious lobby that affords views through the building from Park to Madison Avenues.

The office tower springs from the Tabletop and seems to float above the lobby. Architecturally, it is a vertical "book," the pages of which are composed of nine rectangular extrusions of the longitudinal column bays. The east- and west-most column bays terminate at the 17th floor, creating roof setbacks. The next column bays drop off at the 38th, 52nd, and 58th floors. From the 58th floor to the peak at 1,388 feet, the building is only 40 ft wide.

Starting in the cellars, the elevators are in the western quarter of the footprint to avoid bearing on the underground trainshed. At the 14th floor, the shafts shift eastward to the center of the floor plate in a more traditional layout. Here, the multiple-floor transfer, known as the sky lobby, creates a livable space at the center of the building with a conference center and recreational facilities. Moving up the building, the low- and mid-rise elevators terminate as the floor plate reduces in size.

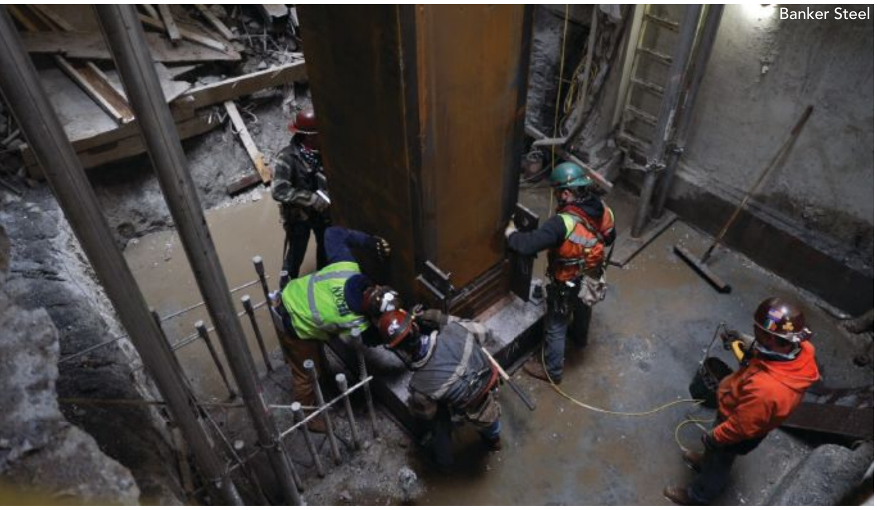




above: Braced frames and connections.

right: Outrigger truss connections.

below: Setting the first column.



Foundation and Lateral System

The trade-off of having relatively few support points is an elegant building with tremendous demands on its foundation. The loads at each super-column base are almost 100,000 kips, while the area available at each support is only about 60 sq. ft. Access was constrained by the underground location and the MTA's desire to protect the trainshed roof and minimize track outages. Steel base plates up to 33 in. thick accommodate the loads, but below ground level, a concrete solution was needed to create a path to bedrock.

The concrete had to be stronger than the 14,000-psi mix successfully used on Severud's One Vanderbilt Avenue project nearby. Higher strength concrete mixes were not readily available, so the design and construction team developed one themselves. After many iterations, they crafted a mix that, by the end of the project, had an average strength of nearly 20,000 psi and a maximum strength of 23,000 psi.

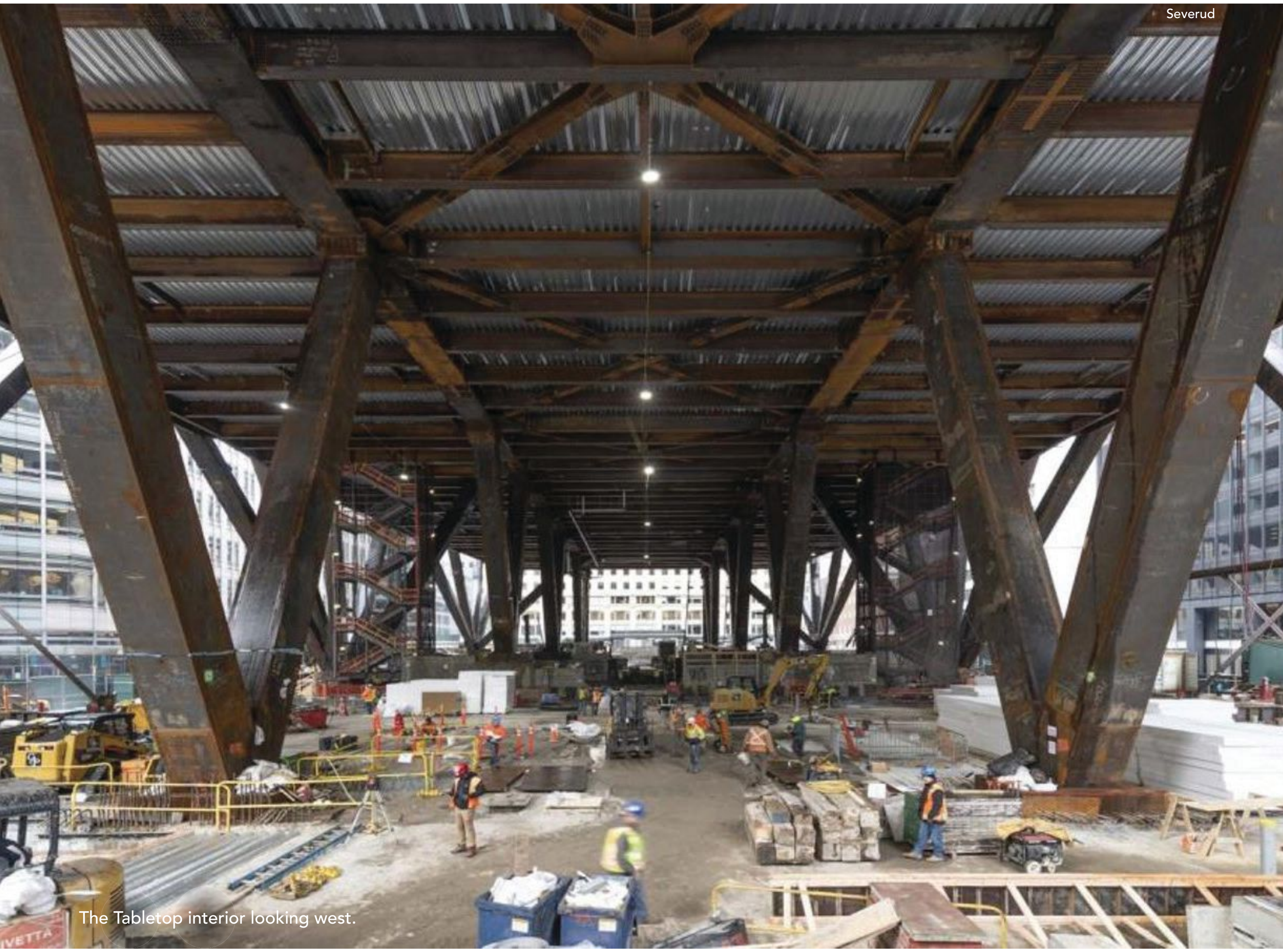
The lateral system of the office tower is simple yet elegant. In the east-west direction, concentric and eccentric braced frames, moment-resisting frames, special braced-moment frames, and outrigger trusses are spread between two column lines. In the north-south direction, concentrically braced frames combined with outrigger trusses and macro bracing on the east and west facades provide the necessary lateral stiffness and strength. The macro braces form a diamond shape on the face of each building setback, creating distinctive façade elements while providing supplemental lateral bracing.

Capping it off, an opposing pendulum tuned mass damper sits on the 55th floor and is suspended from the 57th floor to assist in the control of building accelerations. The 280-ton damper will keep wind-induced accelerations within the desired comfort level for one- and ten-year events.

The north-south lateral system delivers loads directly to the supporting concrete walls, even those located between train tracks. With few closely spaced supports, however, the uplift forces generated are extremely high, on the order of thousands of kips. The foundation walls are anchored using 13.5-in. diameter caissons, drilled into bedrock from the lowest track level and post-tensioned with three No. 32 Grade 75 threaded bars.

Anchoring the column bases two levels above, though, required a more innovative solution.

The traditional approach is to install prestressing tendons from the caisson cap or the bottom of the wall and post-tension them from the ground level. The design team chose this route, but was



The Tabletop interior looking west.

concerned that if a dead-end anchor failed during prestressing or in service, it might not be repairable or replaceable at track level.

Instead, engineers devised an ingenious modification: U-shaped ducts for the tendons, with both openings at ground level, that dip to the bottom of the caisson cap to engage the rock anchors. Tendons of 27 strands each were fished through the ducts, passed through holes in the massive column base plates, and tensioned with a jack at each end, working simultaneously.

In the east-west direction, the train tracks and platforms prevent the transfer of lateral load from ground level to foundation for most of the building's length. Consequently, the ground floor slab is used as a gigantic drag strut to deliver the lateral forces from the columns bearing over the trainshed to the western portion of the foundation. The 16-in. thick slab has a concrete strength of 10,000 psi and is post-tensioned with four groups of four tendons aligned with the column bases. The tendons are composed of 55 strands each and required specialized jacks from France to be tensioned.

Vibration Control

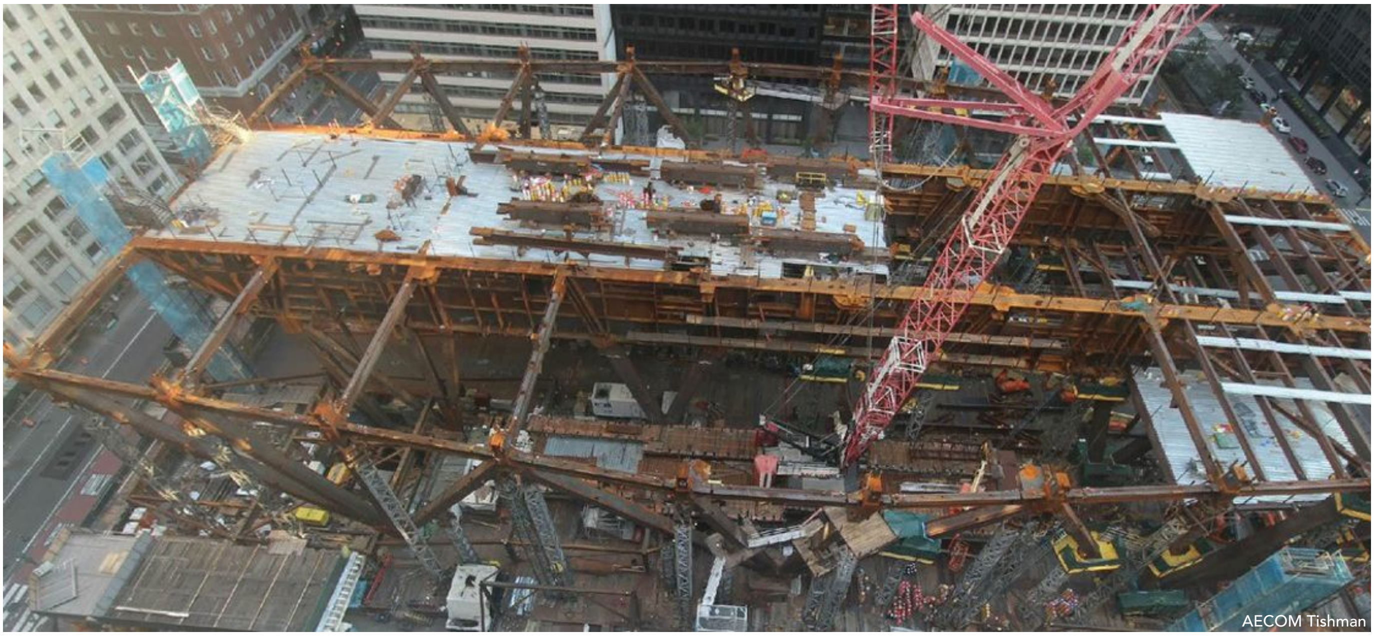
The building shares its foundation with two dozen railroad tracks, therein subjecting it to intense vibration with each passing train. At minimum, several trains travel the tracks underneath the building every hour, and even more during rush hours. That was not the only vibration challenge. JPMorgan Chase desired stricter perceptibility limits for its building's occupants, choosing values normally used for residential uses.

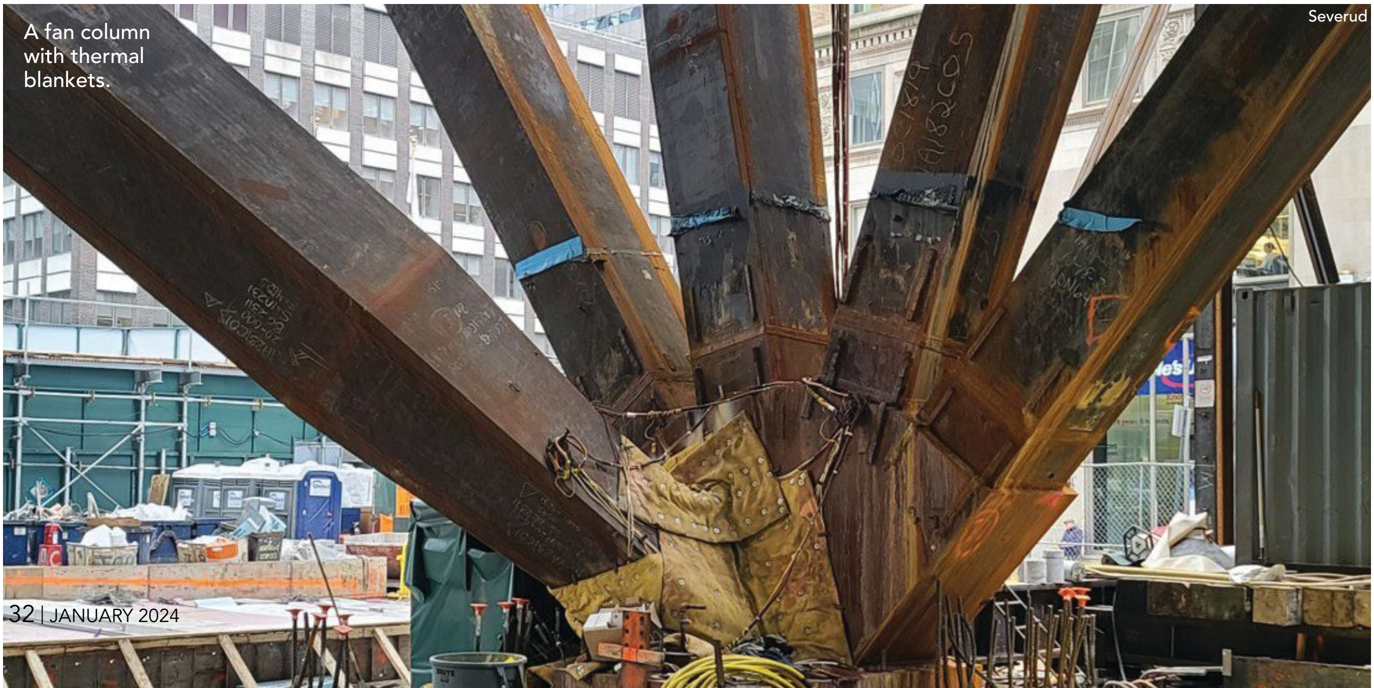
Severud engineers worked with wind tunnel and micro-climate consultant RWDI to tackle the vibration demand, starting by developing a vibration monitoring protocol and an initial forcing function. Using an analysis model of the Union Carbide building, the trial function was applied and its response predicted. The trial accounted for the subgrade modulus of the supporting rock, the travel path of vibrations from the track support framing to the building foundation and up through the building columns, and the proportion of dead load participating in the response.

Analysis predictions were then compared to measured responses in the building. Using the observed measurements, the forcing function was recalibrated accordingly and re-applied to the analysis model. After more than 150 iterations, a forcing function that produced responses in good agreement with measured vibrations was established and applied to an analysis model of the new building.

above: A Tabletop fan column.

below: An aerial view of the partially erected Tabletop.





A fan column with thermal blankets.

Tabletop Erection

As design of the building—and the Tabletop in particular—developed, construction manager AECOM Tishman brought in steel contractor Banker Steel and erector NYC Constructors, both DBM Global companies, to address fabrication, logistic, and erection issues and to ensure that the steel component of the project remained economical, constructable, and timely.

The Park Avenue site's central Midtown location presented another significant challenge: Access for material delivery and storage, cranes, and other construction equipment. In fact, loading restrictions barred contractors from using Park Avenue for this phase of the project. The options were Madison Avenue and two narrow side streets.

After performing an analysis of the load capacity of the existing roadways, AECOM Tishman and Banker Steel devised a logistics and erection plan. It accommodated and maintained access to public transportation and other necessary traffic, and diverted pedestrians. The plan also included delivery and storage areas on 47th and 48th streets that allowed the roads to remain open to other vehicles. The plan's most critical feature, however, was its methodology for erecting the Tabletop.

The Tabletop's two longitudinal transfer girders, located roughly at the third points of the building's width, and the two lines of fan columns create three natural east-west traffic lanes through the site. Banker Steel envisioned placing crawler cranes in the north and south lanes, which could pick up and place members delivered via the center lane. Temporary elevated runways were designed and installed starting at Madison Avenue—where material deliveries are allowed—and progressing to the east. A temporary protection platform, with a capacity of 600 lb per sq. ft, was also installed over the entire building footprint to protect the trainshed below and support shoring loads.

Working independently, the cranes erected the fan columns and their temporary supports. Working in tandem, they erected the transfer girders—the segments of which exceeded a single crane's capacity. Framing between the girders was also erected as the cranes moved eastward, creating a stable sub-structure. An additional advantage to this erection scheme was that could start while demolition of the Union Carbide building and construction of the foundation walls were still in progress.

By the time the cranes reached mid-block, demolition of the existing building had been completed and the cranes continued east to Park Avenue. From there, they backed out the way they came in, erecting the framing between the fan columns and transfer girders and setting the four tower cranes that would erect the remainder of the building. The temporary runways were also removed as the crawler cranes made their exit. The elegance and efficacy of this erection scheme contributed to the building topping out ahead of schedule.

Tabletop Connections

Collaboration between Severud, AECOM Tishman, and Banker Steel—based on close relationships strengthened during their work together on One Vanderbilt Avenue—also led to significant improvements in connection designs. This was especially critical for the Tabletop, where at each of the selected support points, up to five massive members converge at a single point.

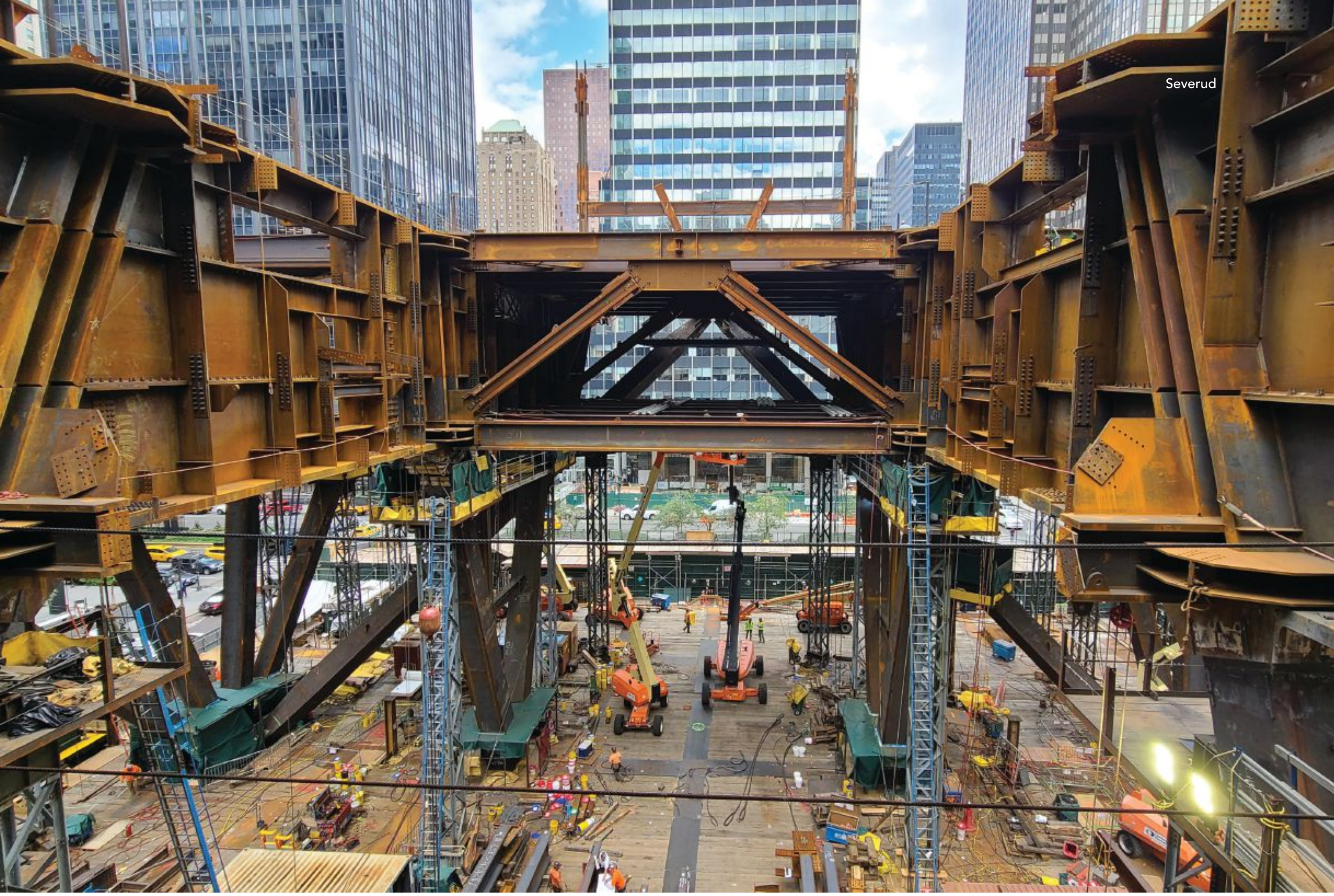
The traditional approach is to create nodes using welded plates, but that presented daunting constructability issues, mainly due to large, multi-pass welds and the likelihood of heat distortion. The potentially unfavorable aesthetics of the exposed connections were an additional liability.

Instead, the team proposed nodes fabricated from forged steel to reduce fabrication issues and better accommodate the three-dimensional stress field acting on the nodes. It is a simple but brute force solution—the forgings are essentially huge blocks of solid steel—and also a sophisticated one. Using the results of advanced finite element modeling that determine detailed 3D stress distributions, metallurgists chose an appropriate alloy and proscribed a process of heat and mechanical treatments to fabricate weldable nodes that safely transmit high stresses delivered to the node at several locations and in different directions.

Once forged, the nodes were milled using CNC equipment to generate multiple bearing surfaces with small tolerances, thereby reducing the risk of fit-up issues in the field. Milling was also used to smooth the exposed surfaces. Another advantage of forgings is that there are no extraneous plates or angles that might interfere with the architect's desired appearance.

The forgings solved several problems, but their size—the largest are up to 12 ft wide by 7 ft high by 4 ft thick and weigh up to 75 tons—created another set of challenges. The first was transportation. Trailers with up to 19 axles were needed to move the nodes by road and keep within load limits. Trucks had to wait at the George Washington Bridge until the middle of the night to cross into Manhattan before being escorted to the Madison Avenue site entrance.

Another consideration was heat capacity. Welding such massive sections requires pre-heating that reduces temperature differentials between the weld and base materials to minimize residual stresses and potential crack formation. The forgings acted as heat sinks and took several hours to warm up. While manageable in the shop, controlling pre-heat was difficult in the field, especially in winter. In some cases, stubs of the fan column sections were shop-welded to the nodes to move the field-welded section away from the node and reduce pre-heat demands on site. In all cases, heavy insulating blankets were used to prevent the members from cooling too quickly.



The partially erected Tabletop looking east.

New York's Largest Steel Frame, By the Numbers

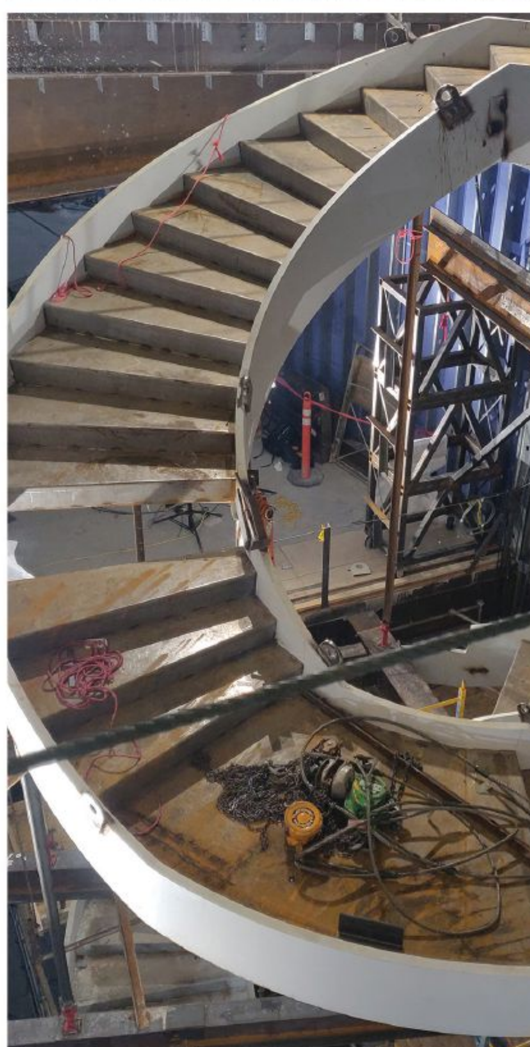
Entire Building	
Steel	94,000 tons
Field Welds	85 tons
Field Bolts	1 million
Metal Deck	2.6 million sq. ft
Headed Studs	400,000 (field-welded)
Connections	20% of overall tonnage
Tabletop	
Steel	15,600 tons
Shop Welds	250 tons
Temporary Steel	4,000 tons
Heaviest Member	136 tons (segment of plate girder)
CJP Weld	
Thickest Material	8 in.
Length	248 in.
Field Weld	
Largest	1,050 lb (Tabletop Column)
Time to Complete	6 weeks (two welders)
Largest Connection	1,026 high-strength bolts (4-sided column-beam-diagonal connection)

Plate Girders

The plate girders that form the backbone of the Tabletop are the building's largest single elements. Spanning the 360-ft length of the building, the girders are 25 ft deep—the full height of the second floor. Their flanges are 5 ft wide, with plates that vary from 4 to 8 in. thick. The webs vary from 2 to 6 in. thick. Their total weight is on the order of 1,800 tons each. Again, close coordination between Severud and Banker Steel produced fabrication and connection details that facilitated shipping and erecting these gigantic elements.

As a starting point, the girders were divided depth-wise into three stacked sections. Each 8-ft, 4-in. deep section could be shipped upright, allowing greater flexibility in their lengths, and then bolted to each other in the field using 30-in. wide intermediate flange plates. Banker Steel suggested locations for vertical splices, picked with the total tonnage in mind and the allowance of stiffener plates, connection material—including forgings, in some instances—web openings, and other appurtenances.

Severud reviewed the splice locations and adjusted them based on stresses in the affected areas, with a goal of using bolted connections wherever possible. When the process was completed, each girder had been divided into about 20 individual pieces, which varied in weight from 86 to 136 tons. Due to their heft, these pieces were subject to the same shipping methodology as the forged nodes. However, the weight of some sections exceeded the George Washington Bridge's load limits and were instead ferried across the Hudson River by barge.



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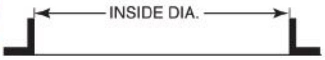
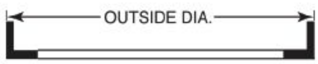


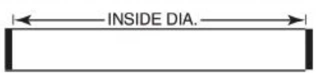
10" x 10" x 1" Angle

2 **Angle Leg In**


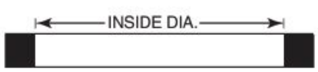
10" x 10" x 1" Angle

3 **Flat Bar The Hard Way**

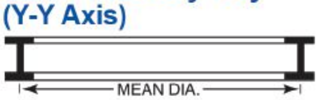

24" x 12" Flat

4 **Flat Bar The Easy Way**


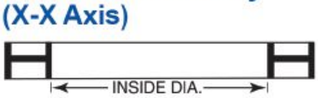
36" x 12" Flat

5 **Square Bar**


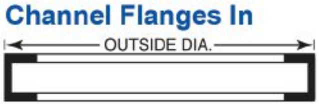
18" Square

6 **Beam The Easy Way (Y-Y Axis)**


44" x 335#, 36" x 925#

7 **Beam The Hard Way (X-X Axis)**


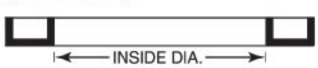
44" x 285#

8 **Channel Flanges In**


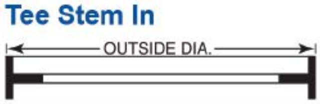
All Sizes

9 **Channel Flanges Out**


All Sizes

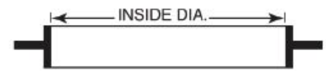
10 **Channel The Hard Way (X-X Axis)**


All Sizes

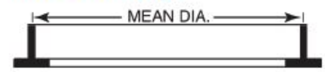
11 **Tee Stem In**


22" x 142½# Tee

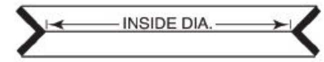
We bend ALL sizes up to:

12 **Tee Stem Out**


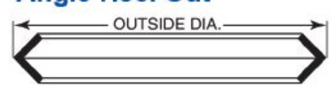
22" x 142½# Tee

13 **Tee Stem Up**


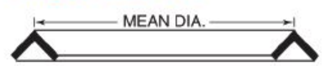
22" x 142½# Tee

14 **Angle Heel In**


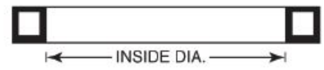
8" x 8" x 1" Angle

15 **Angle Heel Out**


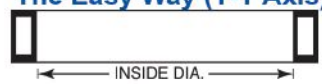
8" x 8" x 1" Angle

16 **Angle Heel Up**


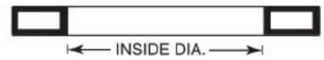
8" x 8"x1" Angle

17 **Square Tube**


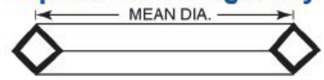
24" x ½" Tube

18 **Rectangular Tube The Easy Way (Y-Y Axis)**


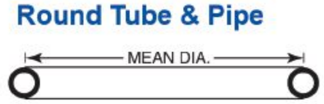
20" x 12" x ⅝" Tube

19 **Rectangular Tube The Hard Way (X-X Axis)**


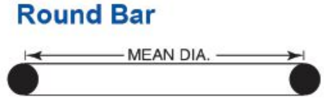
20" x 12" x ⅝" Tube

20 **Square Tube Diagonally**


12" x ⅝" Square Tube

21 **Round Tube & Pipe**


24" Sched. 80 Pipe

22 **Round Bar**


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A lobby and street-level rendering.

DBOX for Foster + Partners

The Future of the Building

JPMorgan Chase envisions 270 Park Avenue as a model for the 21st century workplace with its sustainability features such as all hydro-electric infrastructure, zero net operational emissions, and best-in-class air quality. The building will also feature intelligent, sensor-based controls, efficient water usage and storage, and high-performance glazing. The construction employed a high proportion of low-carbon materials, including substitution of ground glass pozzolans for up to 47% of the cement in all structural concrete except the 16,000-psi mix. Remarkably, 97% of the demolished existing building was reused, recycled, or upcycled.

The building also serves as a model for how modern workplaces can be designed and constructed. Collaboration among all parties from the earliest stages of design development through construction allowed everyone to focus on critical issues and continually refine and improve the building. This was especially true of the structural steel component, where teamwork by the structural engineer and steel contractor simplified fabrication and erection of a complex structure with accompanying cost and schedule savings. ■

Owner
JPMorgan Chase & Co.

Development Partner
Tishman Speyer

Design Architect
Foster + Partners

Executive Architect
AAI Architects

Structural Engineer
Severud Associates Consulting Engineers, PC

Construction Manager
AECOM Tishman

Steel Team

Fabricator
Banker Steel (AISC Certified Fabricator)

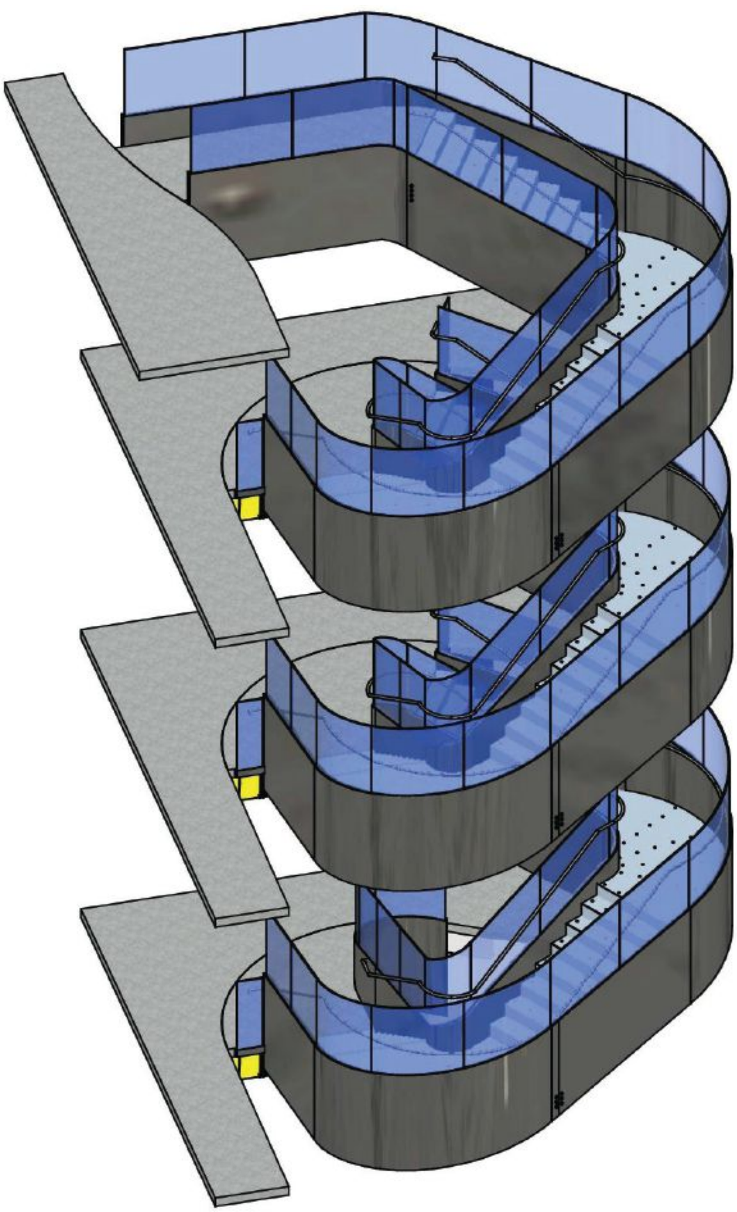
Erector
NYC Constructors (AISC Associate; AISC Certified Erector)

Edward M. DePaola (**edepaola@severud.com**) is president and CEO, and **Fortunato Orlando** (**forlando@severud.com**) is associate principal, both with Severud Associates. **Chet McPhatter**, president of Banker Steel, **Ritchie Bhaskaranand**, vice president of Banker Steel, and **Barry King**, president of NYC Constructors, also contributed to this article. **Andrew Mueller-Lust**, a former principal of Severud Associates, contributed to the writing.

Careful analysis and thoughtful steel details made a new monumental staircase an architectural and serviceability success.

Stunning Stair

BY PAUL KASSABIAN, PE, PAUL ROSENSTRAUCH, PE, HARRY DODAKIAN, AND MICHAEL CHASE



MONUMENTAL STAIRCASES add a signature element to a building—but also an element of complexity.

Such a scenario can be found in Cambridge, Mass.: the three-story staircase in The Ragon Institute of Mass General, MIT, and Harvard's soon-to-be-opened 323,000-sq.-ft headquarters. The stair posed several structural challenges, the most prominent being its triangular helix geometry and the base landing on structural steel framing rather than a slab on grade.

The new building will be a collaborative research center that brings together scientists, clinicians, and engineers from diverse fields to harness the immune system to combat and cure human disease. The stair will connect these various disciplines and foster collaboration.

The stair is comprised of three runs from the second to the fifth floor. Its geometry is a single helix that, when viewed from above or below in plan, forms a triangular shape. It is supported at one point of the triangle at each floor level. The interior and exterior stringers are ¾ in. thick by 5 ft deep ASTM A572 steel plates. The width of the stair is 5 ft, 2 in. Treads and risers are comprised of ⅜ in. steel plates supported by HSS4×4×¼ beams spanning between stringers and will be covered by a terrazzo finish. The stair will support glass guardrails at both stringers.

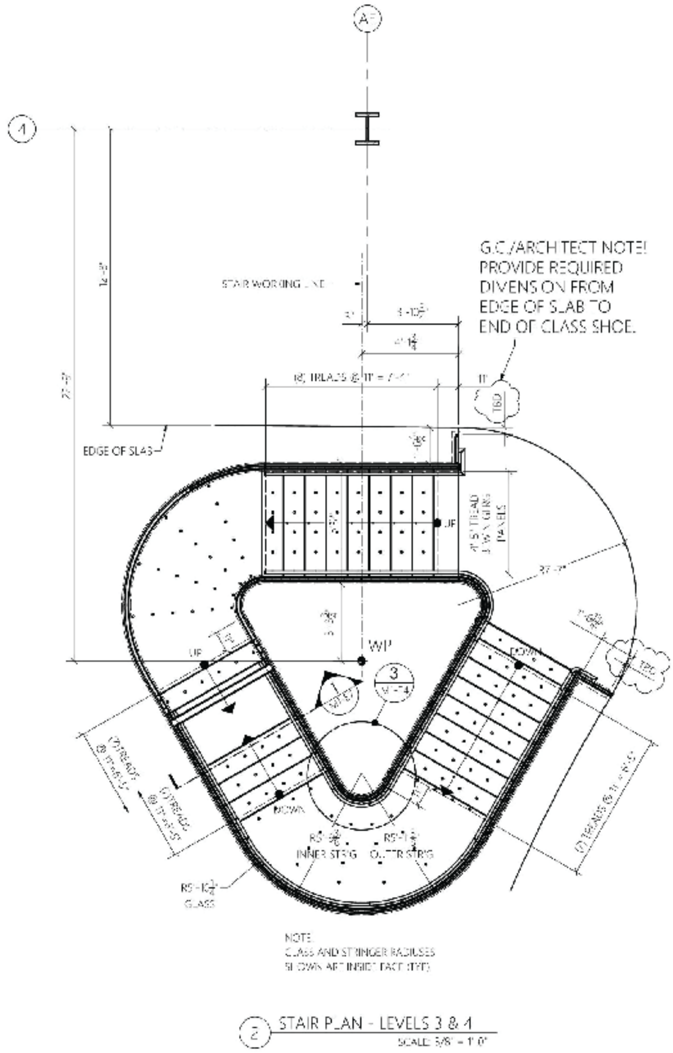
Stair and Building Structure

The stair's structural interaction with the building structure was one of the major design challenges. The bottom of the stair starts at an elevated level, removing considerable stiffness associated with stairs bearing on grade. The stair is anchored into each floor level at the middle of the floor plate within 35 ft column bays. The floor construction is 3¼-in. lightweight concrete slab on 2-in. composite metal deck—40% less stiff than a typical 6¼-in. total depth composite deck.

left: A model of the staircase.

opposite page: The completed staircase

All photos courtesy of SGH.



left: Dimensions of the stair at Levels 3 and 4.

below: Looking upward from directly below the stair.

Even though the stringers are 5 ft deep, the structure depth for connections was limited to 16 in. due to architectural constraints. Each stair anchorage point at Levels 2 through 4 is cantilevered 13 ft, placing base building support beams in negative flexure and removing the stiffness benefit of their composite action. The Level 5 cantilever is more pronounced and extends 18 ft from the girder that spans between building columns.

Vibration

Although the stair stringer's 5 ft depth is significant, analysis early in the design process indicated that vibrations of the stair-and-building system would drive the design. The building's overall flexibility and the location of the stair mass within the building bay compounded the vibration challenges.

During the design phase, the team consulted AISC *Facts for Steel Buildings* Number 5 (**aisc.org/facts**) and AISC Design Guide 11: *Vibrations of Steel-Framed Structural Systems Due to Human Activity* (**aisc.org/dg**), both of which recommend a vertical frequency minimum of 5 Hz for monumental stairs. Modal analysis of framing local to the monumental stair indicated the building could achieve a natural frequency of 6.25 Hz.

However, the stair as originally designed was attached with bolted shear connections (standard for a steel stringer stair) and could only achieve a fundamental frequency of just under 3 Hz—unsuitable for user comfort when combined with the large associated period. In response, the design team explored options to stiffen the system and achieve a fundamental frequency that exceeded 5 Hz.

The first step in stiffening was to update the spandrel beams within the atrium from W16×26 to HSS16×12×3/8 sections, which could resist torsional moments. The Simpson Gumpertz & Heger (SGH) design team modeled rigid attachments to these spandrels, which led to some beneficial stiffening but did not sufficiently raise the frequency. The team also proposed stiffening kickers, but head clearance and visibility constraints rendered it an unviable option.

The design team focused on two areas to solve the vibrations: the Level 5 support and the connections between the stairs and the structural frame.

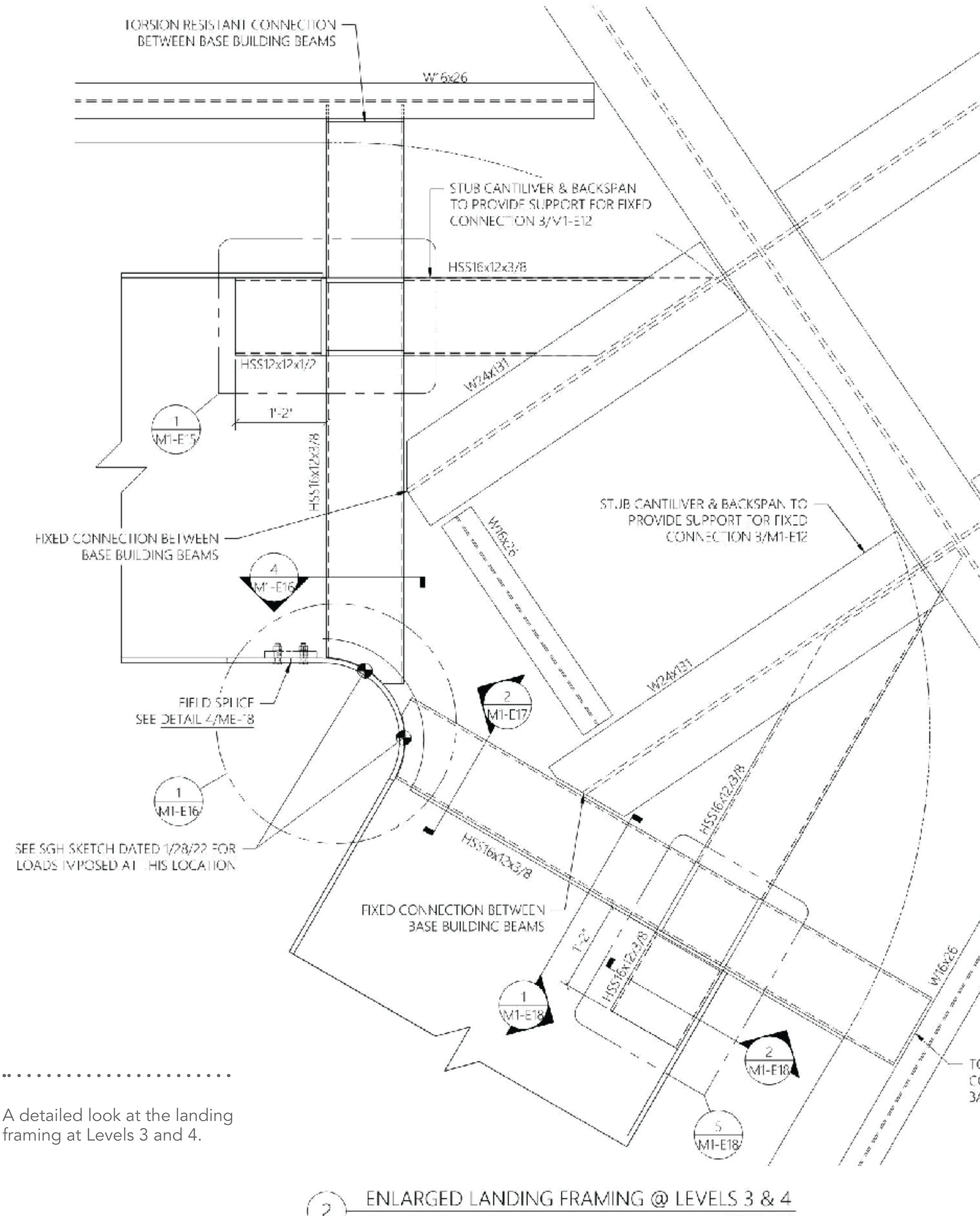
The Level 5 support exhibited the most vibrational excitement in modal analysis. The structure supports the stair in this area with cantilevered W24×162 beams, which are large but still flexible given the cantilever distance. To stiffen the region, the design team extended the stair stringer along and parallel to these cantilevered beams, increasing the stiffness by a factor of 3.6 to 18,000 in.^{4}

The plate continued to the edge of the floor deck, but the deck prevented it from continuing into the steel structure. A lower plate was added across the two W24×162 beams, stiffening the cantilevers 1.3 times to 6,600 in^4. Incorporating these stiffness adjustments increased the frequency to 4.75 Hz.

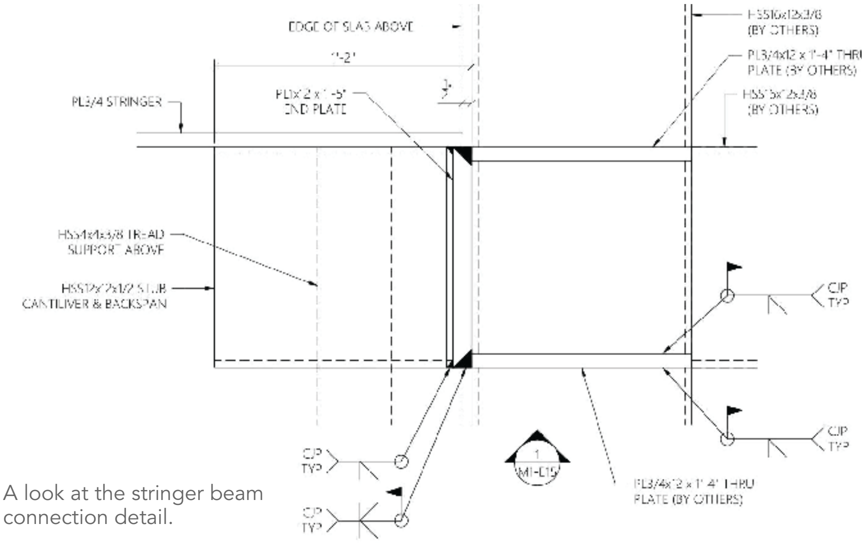
At Levels 2 through 4, the design team incorporated fixity into the connection between the stair and the structure and added supplemental framing. The supplemental framing—made of additional cantilevers and backspans—provided additional rigidity at the connection points and helped engage the base building stiffness beyond the spandrel area with the stair connections.

To model the size and rigidity of the connections, the team used constraints in the analytical model to tie stringer shell element nodes to the supporting beam element nodes. The number of nodes selected for the constraints in the stair corresponded to the size of the base building beam. These modeling choices returned a fundamental frequency of 5.2 Hz.

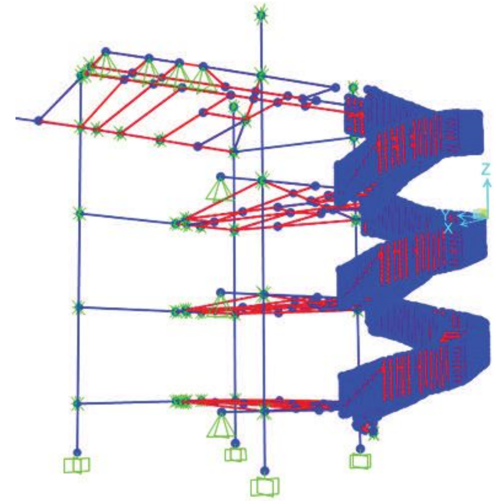
The design team recognized that linear analysis would not capture the local behavior of thin plate elements, which can buckle under nonlinear instability. In response, the team performed a nonlinear buckling analysis to determine an alpha value: a number representing a multiple of the applied load at which the model becomes unstable. The loads applied included the self-weight of the stairs and terrazzo finish, the dead load of the handrail, and the 100 psf occupancy live load for assembly areas required by ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*.



A detailed look at the landing framing at Levels 3 and 4.

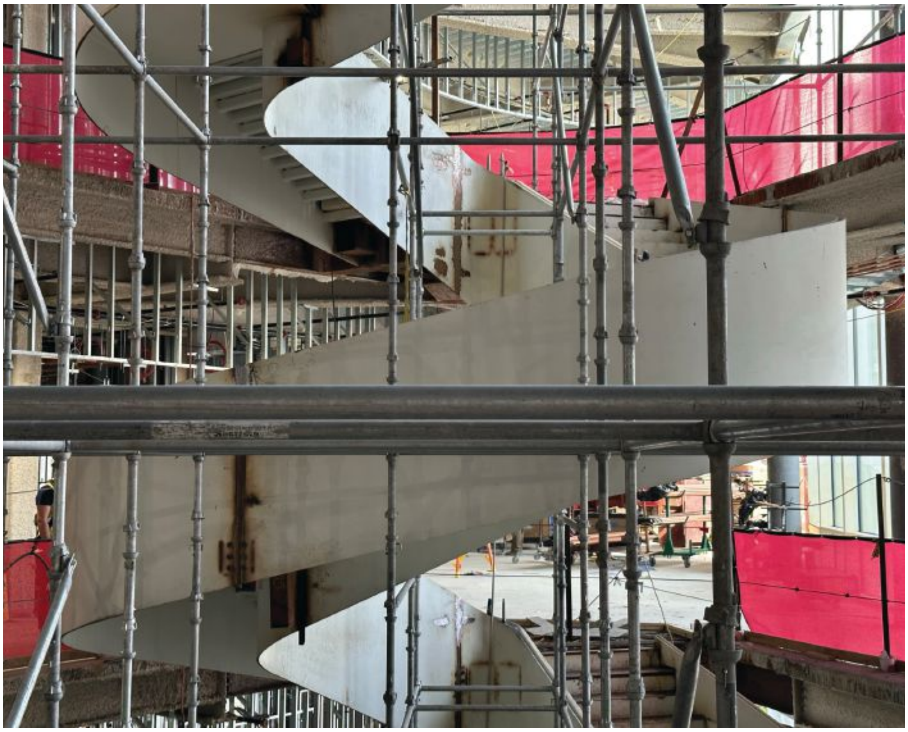


A look at the stringer beam connection detail.



The finite element analysis model of the stair.

The stair's stringer beams are 5 ft deep.



Fabrication and Installation

Each of the three stair runs were fabricated in three individual segments. Each segment weighed approximately 4 tons, with nine total segments that resulted in 36 tons. Of the three segments, two end segments anchor directly into the base building at the lower floor and upper floor, respectively, and the middle segment anchors between the end segments.

Temporary bolted connections capable of transferring the stair segment's self-weight were incorporated into the steel's stringers to provide mechanical connections.

Crane time came at a premium, so fabricator DeAngelis Iron Work asked SGH to design a temporary rigging frame. SGH recognized the challenge of temporarily supporting the three tiers of the stair during erection. SGH and detailer Drafting One, LLC designed a temporary frame that would support the stair segments during erection and created a concept that erected and bolted the stair in place before fully welding the connections.

The stair was erected from Level 2 up to Level 5, lifting the segments sequentially from the crane. The first segment on the lower run was lifted and bolted to the base building at the low end and supported on the temporary frame at the other. The stair was not designed to support levels above, so the frame remained in place throughout the segment erections.

The temporary frame incorporated braces between levels and fixed moment connections around the stair, as the frame needed to be stable and accommodate the stair itself passing through it.

The final product is a self-supporting stair consisting of 36 tons of steel and 15 tons of terrazzo and other finishes. The stair adds a dramatic structural element to the new Ragon Institute building entrance and, just as importantly, showcases the collaborative achievement that can be realized when fabricators and engineers work closely with each other on unique projects. ■

Owner
The Ragon Institute

General Contractor
Consigli

Stair Design Engineer
Simpson Gumpertz & Heger, Inc. (SGH)

Architect
Payette

Structural Engineer
Arup

Steel Team

Fabricator and Erector
DeAngelis Iron Work, Inc. AISC CERTIFIED FABRICATOR

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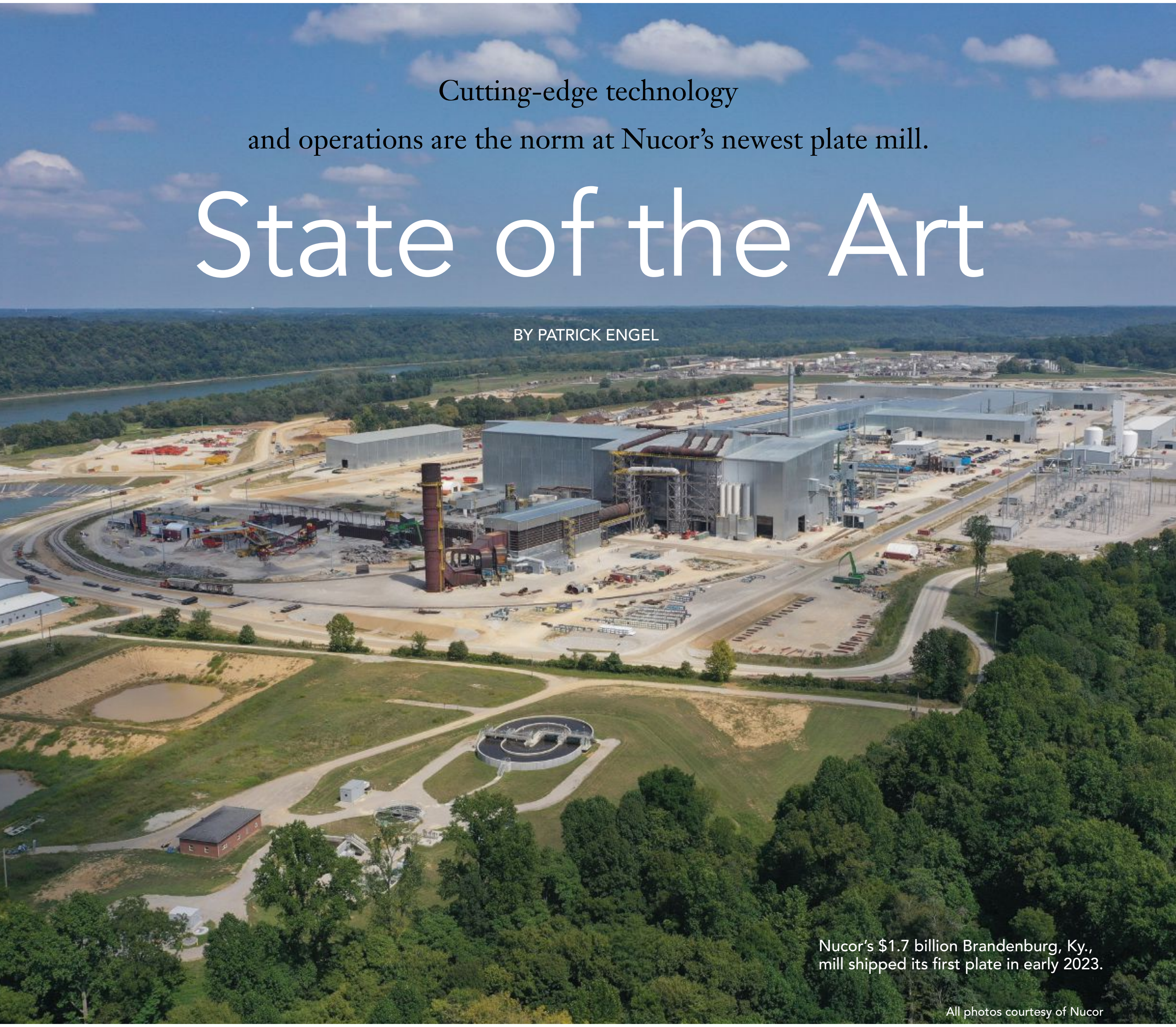
Paul Kassabian (**PEKassabian@sgh.com**) is a principal and **Paul Rosenstrauch** (**PLRosenstrauch@sgh.com**) is a project engineer, both with SGH. **Michael Chase** (**mac@deangelisiron.com**) is a project engineer and **Harry Dodakian** (**hmd@deangelisiron.com**) is a project executive, both with DeAngelis Iron Work.

Cutting-edge technology and operations are the norm at Nucor's newest plate mill.

State of the Art

BY PATRICK ENGEL



Nucor's $1.7 billion Brandenburg, Ky., mill shipped its first plate in early 2023.

All photos courtesy of Nucor

NUCOR OBSERVED a gap in the steel plate market in the late 2010s and felt compelled to fill the need. Its response to that void has accomplished even more.

The company built a $1.7 billion mill in Brandenburg, Ky., that rolled its first plate in December 2022 and shipped its first product to customers in early 2023. The mill manufactures a wider range of steel plate products than any other in the United States. Its continuous slab caster can produce slabs up to 12 in. thick and 124 in. wide.

The Nucor team saw and heard an unmet need for heavy, wide, and long plate in the U.S., a demand driven by construction, military, energy, and transportation markets.

All told, the Brandenburg mill meets those market demands with a product mix of 3⁄16-in.- to 14-in.-thick, 60-in.- to 170-in.-wide, and up to 1,550-in.-long discrete steel plate with a 50-ton maximum weight. When it reaches peak operational capacity, that thickness will grow to 18 in., allowing the mill to produce 99% of the domestically available plate portfolio. It can make up to 1.2 million tons of steel annually and produce about 300 grades.

Within construction, Nucor wants to produce much of the estimated millions of tons of plate required to replace or repair the 45,023 U.S. bridges in poor condition. In energy, it plans to make material that will continue the growth of the country's onshore and offshore windpower infrastructure. The Brandenburg mill, with its several pieces of unique-to-the-industry manufacturing equipment, will be a major part of that effort. Last fall, Nucor hosted *Modern Steel Construction* and about 50 people from various steel industry sectors for a tour to learn about the mill's capabilities and the manufacturing process.

left and below: Scrap metal is melted in the electric arc furnace.

Why Brandenburg

The mill is about 40 miles southwest of Louisville along the Ohio River on an 840-acre site and is accessible via three transportation methods. Interstate 65 is nearby, train tracks run through the property, and barges can load and unload on-site. The rural location provided ample space to build the facility.

Brandenburg was not unique in that regard, but it's close enough to greater Chicago and Texas/Oklahoma, the two largest markets for steel plate consumption. Serving those areas with a mill in the Northeast or west of the Rocky Mountains would have been illogical.

The Brandenburg area felt the mill's impact before it broke ground. Constructing the mill added more than 2,000 temporary jobs, and Nucor now has more than 400 full-time employees working there.

Mastering the Mix

A location with several transportation options is as crucial for inbound material shipment as it is for outbound plate. The Brandenburg plant uses up to 90% scrap metal and recycled material to make steel plate, and much of it arrives on barges.

Scrap is tested for radioactivity before it's unloaded from a barge. If it passes, an independent scrap metal contractor unloads it and groups it into one of the three main scrap recipes based on the desired copper content target of a melt. From there, those recipes are placed in a scrap bin the size of a multi-story house, the first step in the steelmaking process.

The mill is divided into two main parts: the melt shop and the rolling mill. The former is named quite literally. In it, scrap metal and a small amount of imported pig iron are melted into liquid steel, which is cast into slabs. Melting starts with the 200-ton electric arc furnace (EAF), the largest at any Nucor plant. The metal mix is dumped into the furnace and heated to 3,000 °F. Each heat takes about 40 minutes and is overseen by a three-person EAF team. The furnace can do 17 heats in a 12-hour shift.

Think of the melting process as making soft-serve ice cream. The scrap bin is akin to the bowl where all the ice cream ingredients are dumped. The EAF makes a vanilla base. Once the steel is melted, a ladle transfers it to the ladle metallurgy furnace (LMF). In the ice cream analogy, the LMF turns the vanilla base into a different flavor.

A robot takes a lollipop-looking sample from the LMF, and a worker tests the sample's chemical properties and adds any alloys to the liquid steel needed to reach a specification. Everything is made to a specification, such as ASTM A572 or ASTM A588. No spot in the steelmaking process is a better reminder that chemistry is at the center of producing quality plate. For example, excess alloy content in lower strength grades could raise mechanical properties above specification ranges, and too little alloy could fail to achieve properties in higher strength grades.

"The LMF is like the stage of making cookies where you stick your finger in to see if it tastes right," said Jason Lloyd, Nucor's bridge and infrastructure solutions manager.

The LMF reheats the liquid steel and, when necessary, sends it to the vacuum tank degasser (VTD). The VTD sucks dissolved gasses from the liquid. The amount of gas retracted and left in depends on the grade and specification.

As with steel fabrication shops, automation has permeated mills. It can help save time, but it's also important for melt shop safety. Liquid steel exceeds 3,000 °F and, for obvious reasons, should be kept far from workers.

With safety in mind, Nucor installed robots in the most dangerous parts of the process at the new mill. The Brandenburg site is its only mill with a magnetic stirrer in the ladle. Robots in the EAF and LMF take temperatures, measure gas and copper content, and open the taphole at the bottom of the furnace to alleviate clogging. All the robots aid Nucor's push for zero safety incidents on the job.

Even with automation, the melt shop has 20 crew members—the same as the rolling mill. The melt shop and rolling mill have four crews at full capacity, each working a 12-hour shift. Crews work 12 hours on and 12 hours off, half during the day shift and half a night.

A-List Caster

The ladle takes refined liquid steel to the caster, the final piece of the melt shop, and creates the end usable product: the slab. The caster makes slabs 8, 10 and 12 in. thick by 60 to 124 in. wide by 104 to 600 in. long—the largest slab range in the Western Hemisphere—and has an annual capacity of 1.45 million tons per year.

The caster is the core piece of making the heavy plate Nucor wanted to produce in Brandenburg. It's a single-strand continuous caster, meaning it produces one slab of molten steel at a time and never shuts down unless turned off. It's like a reservoir that might have varying water levels, but is never dry or empty. Steel is guided into it one perfect strand at a time. Mold powder in the caster lubricates the liquid steel as it solidifies, ensuring it does not stick to the sides of the caster.

Steel leaves the caster as an orange-hot rectangle, the first time it resembles a finished plate. It's immediately cut with a torch upon exiting the caster, then goes to a de-burring box that removes the rough-cut edge from the torch. The slab then goes to a quench box that blasts it with water to ensure a high-quality surface condition as it cools.

All told, the time frame from melting scrap to exiting the quench box is about 90 minutes. Once a slab leaves the quench box, it's ready for the rolling mill.

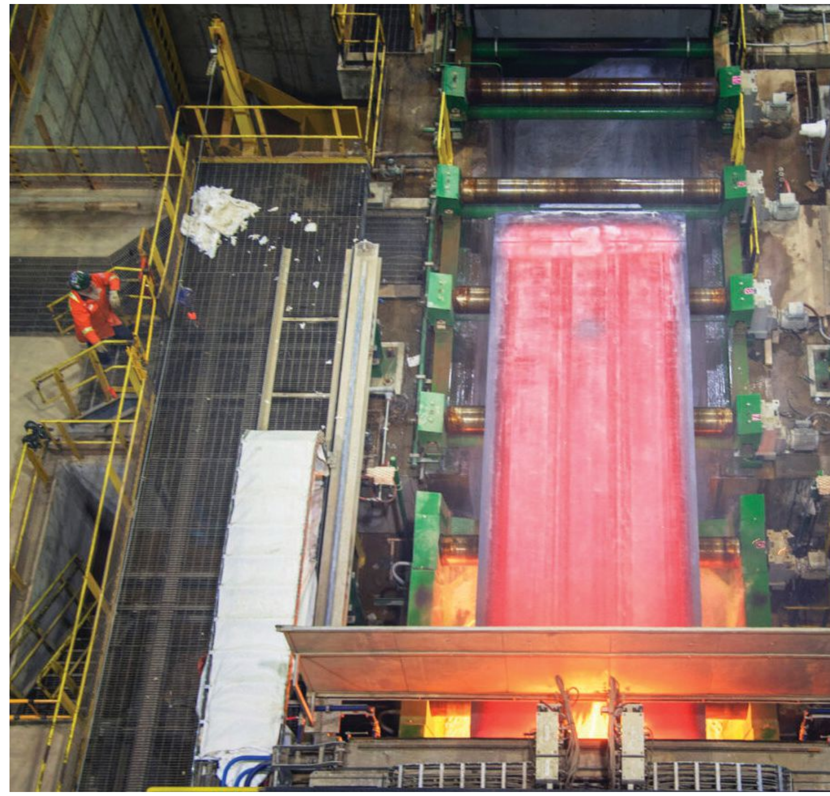
Rolling On

Steel must be hot to begin the rolling process, which reduces a slab to its final size. The rolling mill continuous line begins not with rollers, but a reheat furnace that warms the slab to about 2,200 °F. All slabs from the melt shop start here, as do ingots shipped to Brandenburg from outside sources.

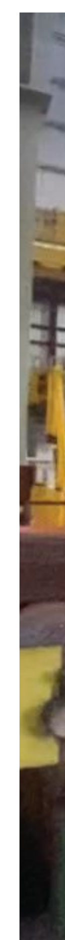
The slab exits the reheat furnace and heads to the de-scale box, which blasts the slab with 3,200 psi of water pressure to remove furnace oxidation and ensure a high-quality surface finish. A slab oxidizes when it's reheated to high temperatures, leaving a coat of scale on the outside. The de-scaler hits the slab's top and bottom with water pressure that matches a power washer to create a smooth rolling surface. It's essentially a car wash that could make a mud-caked vehicle spotless.

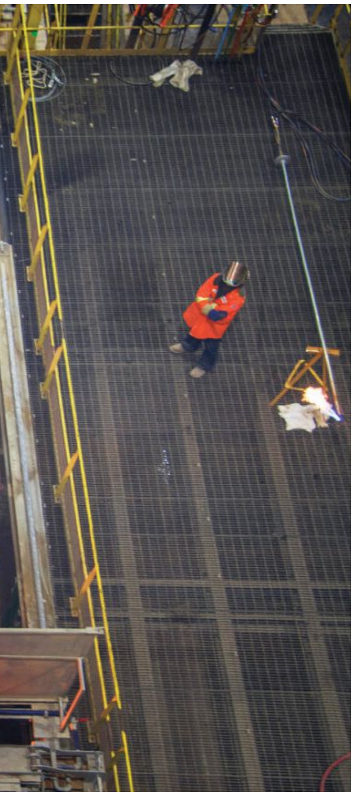
The slabs leave the de-scaler and head through the roughing mill and Steckel mill, though the process will not always involve both. The finish gauge determines which mill treats a plate.

An orange-hot slab exits the continuous caster.

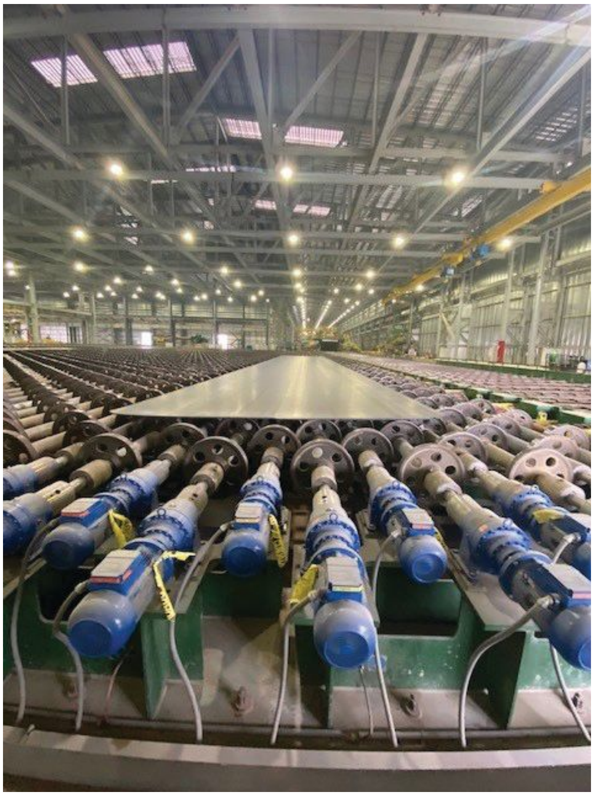


Slabs and ingots are reheated at the start of the rolling mill.





Nucor makes plate from $3/16$ in. to 18 in. thick.



A slab enters the roughing mill.

Slabs are reheated to begin the rolling process.

Steel slabs are still orange-hot when they begin the rolling process in the roughing mill.

The roughing and Steckel mills mark the start of thickness reduction with reversing passes through their rolls. The number of passes through either depends on the plate's eventual thickness. For example, plate that will be $\frac{3}{16}$ in. thick when it's shipped won't be $\frac{3}{16}$ in. thick when it leaves the roughing mill, but plate that will have a 14-in. finished thickness might be 14 in. after only a few passes in the roughing mill.

Lower-gauge plate (like $\frac{3}{16}$-in.) reaches its final dimensions in the Steckel mill, the formal name for the reversible finishing mill. It's about two or three football fields long. Two coilers—one at the entrance and one at the exit—guide the plate through the mill as many times as needed to reach the designated thickness. A Steckel drum on each side accepts the slab, coils it, spits it out to uncoil it, and sends it to the other drum. The drums have burners to keep the plate hot, because low-gauge or wider plate loses significant heat when traveling through the mill.

Next, plate is treated based on final specification and a customer's desired parameters, not the finish gauge. Some plate may undergo thermomechanical control process (TMCP) treatment, a meticulous process of heat control combined with continuous rolling to final dimensions that heightens strength. Plate for structural or bridge applications and carbon grades is often treated using TMCP, as is Nucor's branded product "Elcyon" for offshore and onshore windpower structures. The Brandenburg mill is the only one in the Western Hemisphere that can make the plate required for offshore wind towers.

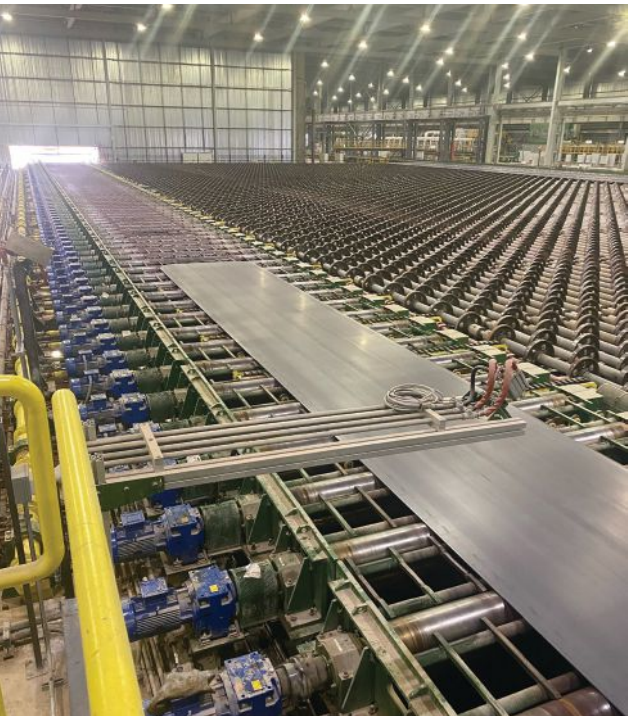
The final step on the rolling mill line for all plate is the cooling bed. Some plate might be ready to test, cut, and ship from there. Other plate might need heat treatment, which is also determined based on specification and customer requests.

Heat treatment is done by quenching and tempering (Q&T) or normalizing. Q&T starts after the desired thickness is reached, and its first step is the austenitizing furnace. There, steel is heated to a uniform temperature in preparation for quenching. It goes from the austenitizing furnace to a direct quench box, where it's dunked into water or high-pressure sprayed top and bottom to reach specified strength or hardness requirements.

The tempering furnace follows quenching by reheating the steel to below critical temperatures, allowing high-thickness steel to go through a flattening press. That removes some strength and hardness in exchange for toughness and ductility. Think of it like flexing and relaxing the biceps muscle. Quenching is like maximum flexing to show off the strength and hardness. Tempering is like relaxing until it reaches the right strength, hardness, ductility, and toughness for the intended purpose.

High-strength, abrasion-resistant plate for cranes and heavy equipment (such as dump trucks) are often quenched and tempered to achieve their properties. Q&T helps create improved properties that result in high-toughness, weldable and formable steel.

Plate rests on a cooling bed.



The Brandenburg mill sits on an 840-acre site adjacent to the Ohio River.

Normalizing is a slow air-cooling process that aims to create more consistent properties (such as strength and ductility) throughout the plate. It involves heating steel to an elevated temperature (around 700 °F to nearly 1,000 °F) and then letting it naturally reach room temperature. Rail car and pressure-vessel applications are among the steel types that receive normalized treatment.

After TMCP, Q&T, or normalization, the plate is cut to length and passes through a leveler that maximizes flatness, then travels to the cooling bed.

The cooling bed is a relative term. Steel that leaves it can be around 500 °F when it goes to the finishing line and through the cold shear, which cuts to the designated length and width. Plate is visually inspected on the top and bottom before the cold shear and marked with another machine. Small pieces called "coupons" are cut on the finishing line for lab testing to confirm final properties meet customer requirements.

Passing the Test

The finished product must be tested before it's shipped. While chemical testing takes place in the EAF, material testing occurs in a lab at the end of the roll mill. The coupons go through two types of tests: Charpy V-notch (CVN) and tensile.

CVN measures energy absorption, and by extension, toughness. The test takes a small sample the size of a pinky finger that is precision machined to include a notch on one side, puts it into an enclosed space and impacts it with a calibrated pendulum hammer. The more energy absorbed during the test, the higher the steel's toughness.

Tensile tests are pull-apart tests that measure yield and tensile strength, elongation, and ductility when stretched at both ends. Other tests, such as ultrasonic, are more inspections than tests and confirm the plate's internal soundness. Nucor has the requisite testing equipment to perform the wide range of tests needed to produce 99% of the domestically available plate inventory.

One failed test for some specifications or grades means a plate is unusable. Others have more lenient retest parameters. If the plate does not meet specifications, it can be downgraded to a grade where it meets the requirements, sold as secondary (non-grade) plate, or in rare cases, re-melted with scrap.

Powering Up

The steelmaking process is extensive and by extension, expensive. Heavy machinery is a significant investment, as is the energy required to power a mill. That's true of any mill.

The Brandenburg team estimates the mill will use tens of thousands of kilowatt hours monthly. For comparison, the average U.S. household used about 889 kWh in 2022, according to the U.S. Energy Information Administration.

Nucor tries to balance its usage with other green initiatives, though. The Brandenburg plant is aiming for LEEDV4 certification and would be the first manufacturing facility in the world to earn it. Nucor is also among the top five recyclers in the world and recycled 23 million tons of scrap metal in 2022. Recycling has kept its greenhouse gas emissions intensity three times lower than the average extractive steelmaking process that uses a blast furnace.

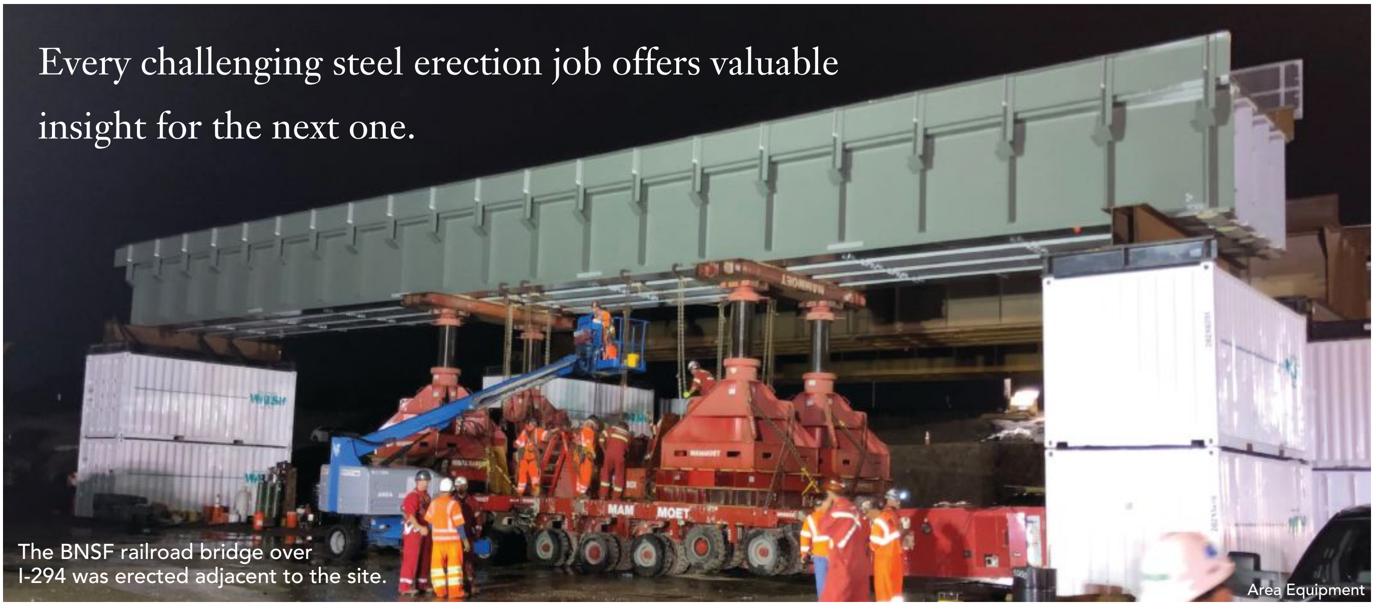
Just like it built a plant that reset the standard, the company plans to be on the cutting edge of creating one that rethinks sustainability. ■

Patrick Engel
(**engel@aisc.org**)
is the associate editor
of *Modern Steel
Construction.*

Complex Construction

BY MATTHEW HELLENTHAL, SE, PE

Every challenging steel erection job offers valuable insight for the next one.



The BNSF railroad bridge over I-294 was erected adjacent to the site.

Area Equipment

AS THE DEMAND for accelerated construction schedules on complex infrastructure projects increases, it magnifies the challenge of maintaining structural adequacy and proper geometry control during construction. An upcoming 2024 NASCC: The Steel Conference session will present four case studies on complex girder erection, rigging, and temporary works.

Each case study illustrates unique erection challenges and the development of solutions, with a focus on structural behavior and design requirements for that type of construction engineering work.

Burlington Northern Santa Fe (BNSF) Railroad over the Central Tri-State Tollway (Interstate 294) – Hinsdale and Western Springs, Ill.

The bridges carrying BNSF tracks over I-294 needed to be reconstructed in a short outage window to mitigate rail and roadway traffic impacts. Construction crews' solution was to erect the 78-ft., 6-in.- and 108-ft, 6-in.-long steel plate girder spans adjacent to the site on shipping containers used as shoring towers before they were rolled into place using self-propelled modular transporters (SPMTs). Key considerations during the move, including forces and geometry control, will be discussed.

Metra Milwaukee District West Line over the Fox River – Elgin, Ill.

The Milwaukee District West Line carries Metra rail commuters over the Fox River, with U.S. 20 passing at a skew overhead. To accommodate the unique geometric constraints of the site, the contractor erected four 137-ft-long steel plate girder spans on temporary shoring towers in the nearby commuter parking lot and rolled the spans into position using SPMTs.

A freight train derailment into the site damaged and shifted the spans on top of the temporary shoring. Although this project also used SPMTs, the discussion will focus on the evaluation and repair of the temporary and permanent structure after the derailment.

30 Crossing – Little Rock, Ark.

The 1,366-ft, 6-in.-long river unit carries eastbound and westbound I-30 over the Arkansas River using 126-in.-deep steel plate girders. The erection plan utilized various temporary works, including bents and pier brackets with drop-in segments. This case study will cover various means of managing structural behavior, including in- and out-of-plane deflections, rotations, and static indeterminacy, to achieve a constructable and efficient erection sequence.

Marseilles Dam Repairs – Marseilles, Ill.

Several runaway barges damaged the Marseilles Dam due to strong currents from heavy rainfall. The Army Corps of Engineers issued a contract to replace three of the tainter gates and repair two others.

A utility bridge carries power and fiber optic lines over the center of gravity of each gate. That required a unique C-shaped rigging beam to be designed and detailed to pick the 80-ton gates without relocating the utilities. Average and local stress assessments, buckling analysis findings, ductility considerations, and load testing will be presented.

These four projects involved demanding and complex erecting processes. Any such job is a valuable resource when planning a roadmap for the next challenging erection process. ■

This article is a preview of the 2024 NASCC: The Steel Conference session "Case Studies of Complex Girder Erection and Temporary Works." To learn more about this session and others, and to register for the conference, visit ***aisc.org/nascc****. The conference takes place March 20–22 in San Antonio, Texas.*

Matthew Hellenthal (**mhellenthal@benesch.com**) is a technical manager and senior associate with Benesch.

Crucial Combination

BY ADAM T. SANCHEZ, PE AND DAVE ECKROTE, PE

Harnessing finite element analysis in delegated design of connections has been a structural engineering revolution.

THE DELEGATED CONNECTION DESIGN PROCESS needed a jolt.

It has been largely effective throughout its history, but engineers widely agreed by the 2010s that the tools and methodologies available had limited its helpfulness.

Finite element analysis (FEA) has provided that jolt and sparked a transformative shift in that domain. FEA's advanced computational capabilities offer a more detailed, precise, and efficient approach to connection design. It allows engineers to model and analyze intricate geometries, diverse load conditions, and complex interactions between structural elements with unparalleled precision. That level of detail ensures every facet of the design is optimized, balancing both performance and cost.

FEA acts as a unifying platform in delegated design, where specific design responsibilities are entrusted to different parties. It ensures seamless collaboration between all parties by inputting their requirements and constraints into a shared design model. That expedites the design process and ensures that the final design is a culmination of collective expertise, leading to efficient and innovative structures.

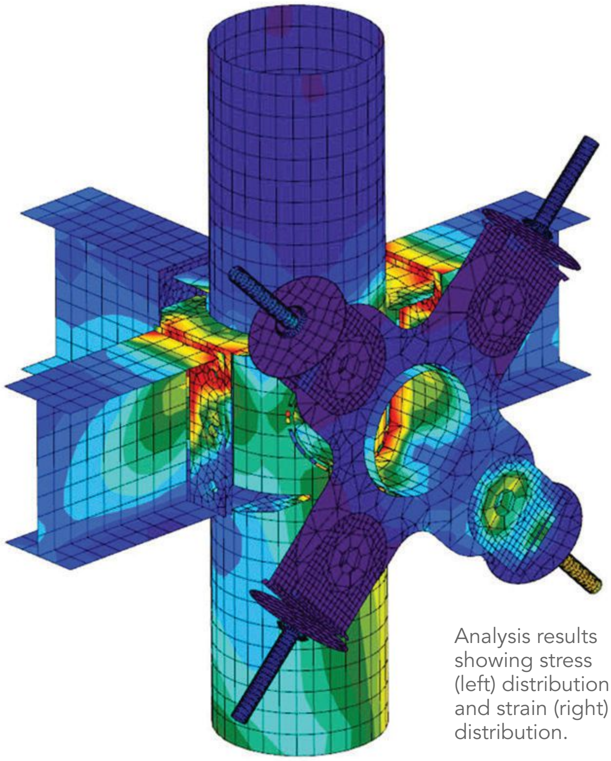
How does FEA enhance the design process? Here are some of its benefits:

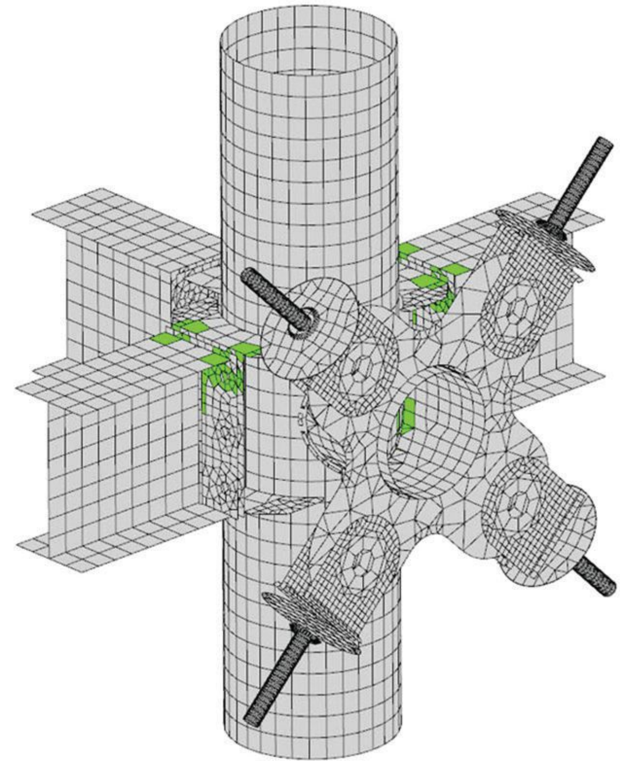
- Enhanced design possibilities: With finite element software, engineers are no longer restricted by the limitations of manual calculations. They can explore a broader spectrum of design possibilities, leading to innovative solutions that traditional methods might have deemed unfeasible.
- Real-time analysis and feedback: One of the standout features of modern finite element software is its ability to provide real-time feedback. As engineers make changes to the design, the software instantly analyzes the impact of these changes, offering insights into potential issues or areas of optimization.
- Optimized material usage: The precision offered by finite element software ensures that designs are structurally sound and optimize their material usage. The result is often significant cost savings, especially in large-scale projects.
- Collaborative design environment: Modern design is often a collaborative effort involving multiple stakeholders. Finite element software provides a platform where architects, engineers, contractors, and other stakeholders can collaborate seamlessly, ensuring that the final design incorporates collective expertise.

Delegated design, in its essence, is a collaborative approach to structural engineering. Specific design responsibilities, traditionally reserved for the project's primary structural engineer, are entrusted to another party. Delegation can be to a contractor, a fabricator, or a specialist engineer, each bringing a unique set of skills and expertise. The primary objective is multi-fold:

- Expertise utilization: By delegating specific design tasks, the project can harness the unique expertise of each party involved in the construction process. For instance, a fabricator might have insights into material properties and manufacturing techniques that a general structural engineer might not know.
- Efficiency and cost-effectiveness: By allowing specialists to handle specific design elements, the overall design process can be expedited, leading to cost savings.
- Tailored solutions: Every construction project has its own set of challenges and requirements. Delegated design ensures that the final design is efficient and tailored to meet the project's specific requirements. This bespoke approach can lead to innovative solutions that might not have been possible with a more generalized design approach.

The concept of delegated design is elevated when integrated with finite element software's advanced modeling and analytical capabilities. Stakeholders can input their requirements and constraints directly into the design model, ensuring real-time collaboration that speeds up the design process and that design elements are in harmony with each other.





Analysis results showing stress (left) distribution and strain (right) distribution.

Furthermore, the software provides a platform where all stakeholders can visualize the entire design, understand its intricacies, and provide feedback. The iterative approach ensures that the final design is a harmonious blend of the collective expertise of all parties involved, leading to structures that are not only robust and safe, but also cost-effective and efficient.

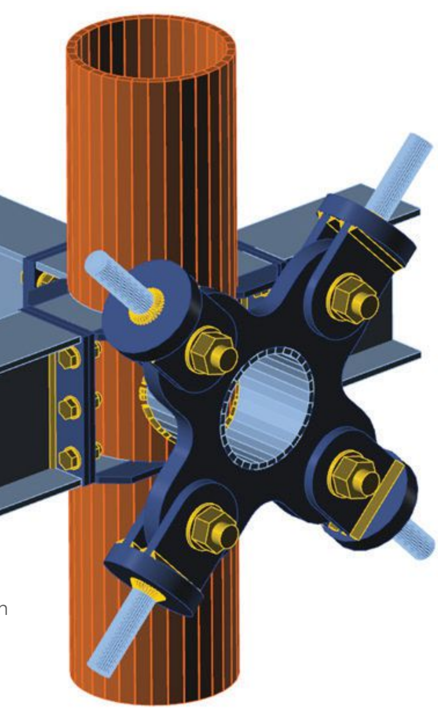
When it comes to connection design, software that provides seamless transitions between linear and nonlinear analyses (such as IDEA StatiCa) can allow engineers to choose between the most appropriate method for their specific design challenge. That's particularly beneficial in delegated design, where different parties might have different design requirements and constraints.

As delegated design gained momentum, it ushered in the need for standards and guidelines to ensure uniformity in its application. AISC was among the organizations to step in and define these guidelines.

The ANSI/AISC 303-22 *Code of Standard Practice for Steel Building and Bridges* is a testament to these efforts. Its latest iteration has nuanced guidelines that streamline the delegated connection design process. Engineers of record (EORs) who adhere to the *Code* often experience a smoother design process, with fewer iterations an greater accuracy.

The Coalition of American Structural Engineers (CASE) has also been proactive, offering EORs a plethora of guidelines to help them navigate the complexities of delegated design. Some key documents in this context include:

- 962 National Practice Guidelines for Structural Engineers
- 962-B National Practice Guidelines for Specialty Structural Engineers
- 962-D Guidelines Addressing Coordination and Completeness of Structural Construction Documents



A connection at a hospital project.

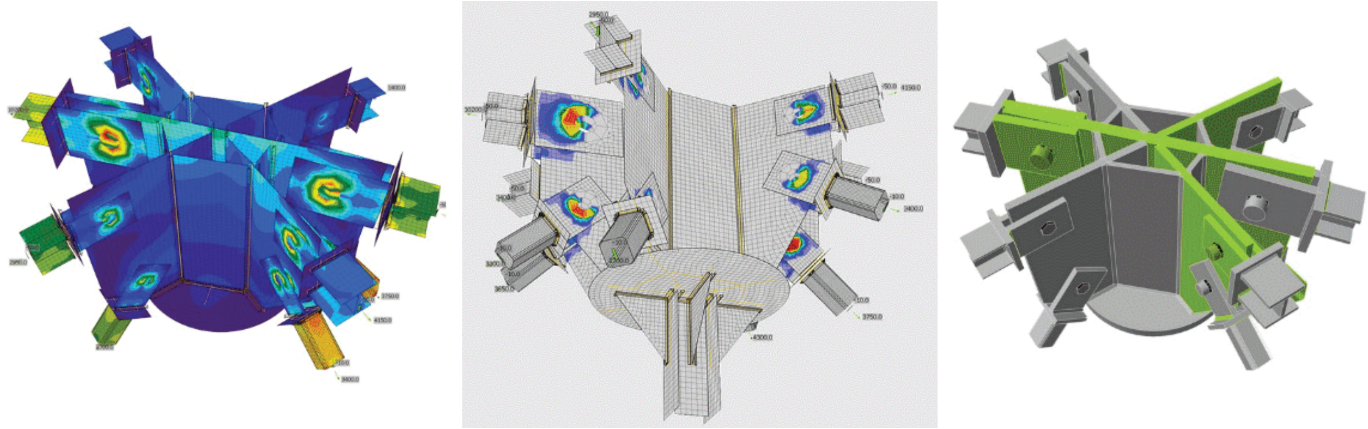
Novum Structures

Advanced Applications of FEA in Delegated Connection Design

FEA's advanced capabilities are particularly beneficial in the delegated design of connections. Whether it's modeling the response of connections under dynamic loads, understanding how connections behave under temperature variations, or predicting the lifespan of connections under cyclic loads, FEA has several ways to ensure that delegated designs are both innovative and robust:

- Dynamic analysis: In the real world, structures are rarely subjected to static loads. They often have to withstand dynamic loads, which can vary in magnitude and direction over time due to natural events like earthquakes or man-made scenarios like vehicular traffic on a bridge.
- Modeling seismic loads: Earthquakes pose a significant challenge to structures, especially in seismically active regions. The primary concern is the structure's ability to absorb and dissipate the energy imparted by the seismic waves without collapsing. FEA allows engineers to model the response of connections under seismic loads and see if they can redistribute forces without failing.
- Wind-induced vibrations: Tall structures, like skyscrapers or transmission towers, are particularly susceptible to wind-induced vibrations. FEA can model how connections within these structures respond to such dynamic loads.
- Thermal analysis: Temperature variations can have profound effects on structural connections. As materials heat up or cool down, they expand or contract. These differential expansions can lead to significant stresses in a structure where multiple materials might be connected.
- Modeling temperature-induced stresses: FEA allows engineers to understand how connections behave under varying temperatures. For instance, in a steel-concrete composite beam exposed to sunlight, the steel might heat up and expand faster than the concrete. FEA can model these differential expansions, ensuring the connection can handle the induced stresses.
- Extreme thermal conditions: Structures might be exposed to extreme thermal conditions, such as industrial settings or areas with drastic temperature fluctuations. FEA can model how connections behave under these extremes.

Models of a connection at Curragh Racecourse (above): stress distribution (below left), strain distribution (center) and overall check (below right).




Kiernan Structural Steel

A column being fabricated for use at Curragh.


Kiernan Structural Steel

A column from Curragh Racecourse.

- Fatigue analysis: Every material has a fatigue limit—beyond which it starts to degrade and can eventually fail. In structures subjected to cyclic loads, like bridges with vehicular traffic or wind turbines with rotating blades, connections can experience repeated load cycles.
- Predicting lifespan: FEA can predict the lifespan of connections under cyclic loads. By modeling the repeated stress cycles a connection undergoes, engineers can determine when it might fail due to fatigue and when to replace or reinforce it before it poses a risk.
- Understanding failure modes: Different materials and connection types can have different fatigue failure modes. FEA can model these modes, allowing engineers to design connections that resist fatigue-induced failures.

The role of FEA in structural engineering will likely grow more significant in the future. Its capabilities will continue to evolve, offering even more advanced tools and methodologies for engineers to harness. In this ever-changing landscape, one thing remains certain: FEA, with its transformative capabilities, will be at the forefront of the next wave of the industry's innovations. ■

This article is a preview of the 2024 NASCC: The Steel Conference session "Delegated Design of Connections: A Comprehensive Exploration Using Finite Element Software." To learn more about this session and others, and to register for the conference, visit ***aisc.org/nascc****. The conference takes place March 20–22 in San Antonio, Texas.*

Adam Sanchez (**adams@apexeng.org**) is the president of Apex Steel Design and Engineering, LLC. **Dave Eckrote** (**david.eckrote@ideastatica.com**) is the director of IDEA StatiCa US, LLC.

New Tools

BY MICHEL BRUNEAU, PEng

Structural systems geared toward resiliency are an important addition to an engineer's toolbox.

IT'S IMPORTANT to keep your design toolbox updated.

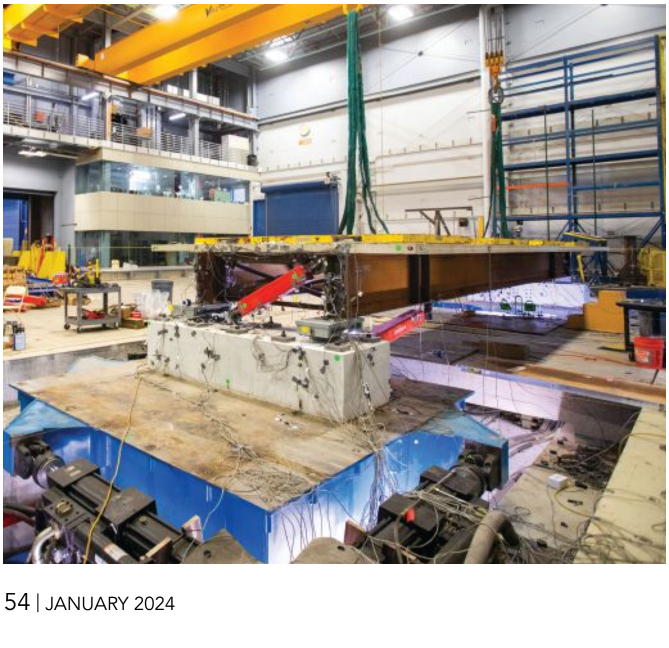
In 2012, I delivered an AISC T.R. Higgins Lecture built on the premise that new structural systems and concepts can add to a structural engineer's toolbox and provide an ever-increasing range of solutions to meet increasingly complex design challenges. It focused on steel plate shear walls (SPSWs), perforated SPSWs (PSPSWs), tubular eccentrically braced frames (TEBFs), concrete filled steel tubes (CFSTs), structural fuses (SFs), rocking frames (RFs), and self-centering SPSWs (SC-SPSWs).

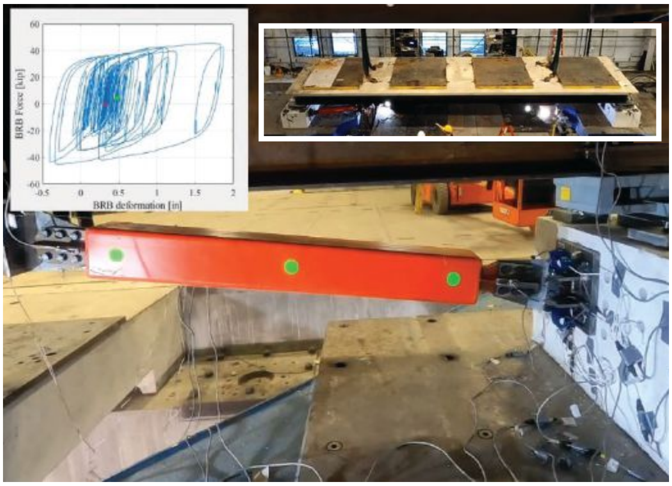
The first three have been implemented in ANSI/AISC-341: *Seismic Provisions for Structural Steel Buildings*, along with new clauses on shear strength for CFSTs. The toolbox is larger now, which is a good thing. (Even if a hammer is your favorite tool, trying to fix everything with a hammer can be limiting.)

Fast-forward to today: Resilience has become a topic of nationwide interest and has caught the attention of the structural engineering community. Googling "resilience" these days returns about 1,260,000 results (which is more hits than "motherhood" or "apple pie" and both combined), although much of it is pure confusion. However, when respecting the true meaning of resilience—defined as "the quality of being able to return quickly to a previous good condition after problems"—steel structural systems can be effectively designed to provide resilience. In fact, they can excel at resilience.

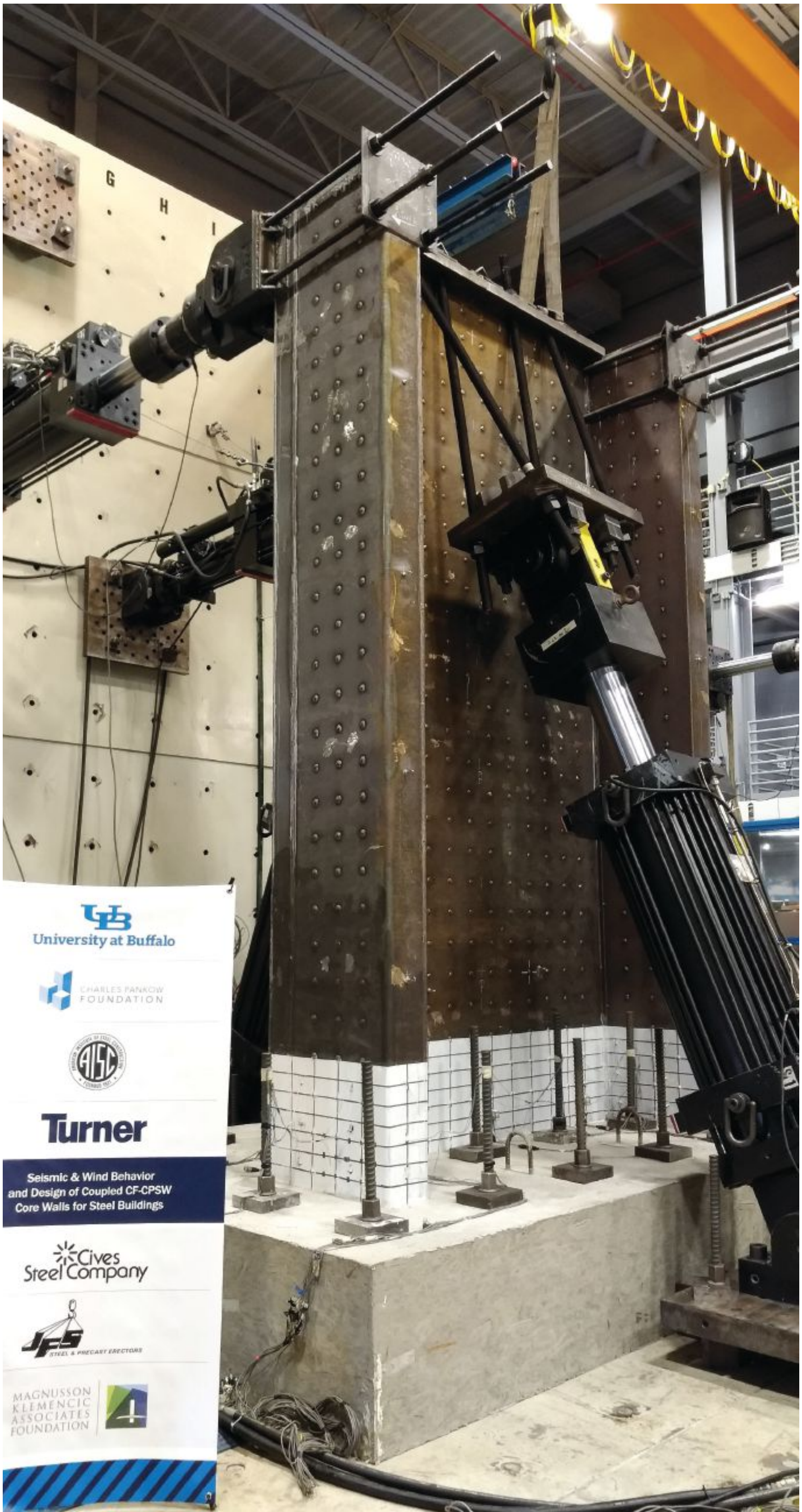
Take earthquakes, for example. The current design philosophy in all modern buildings codes internationally is one of "life safety," meaning that ductile response is used to absorb the energy of the earthquake in a stable manner, preventing collapse and allowing safe egress of the occupants. However, ductile response is damage, and that may require repair.

In that perspective, a resilient system will allow a relatively faster repair and return to service, as some structural steel systems have already demonstrated. One example is the Christchurch earthquake in New Zealand, after which the buildings with steel lateral-load resisting systems were repaired and rapidly returned to service while hundreds of reinforced concrete buildings were deemed too expensive to repair and were demolished. Likewise, as recently demonstrated in a research project I conducted with University





Resilient bridge concept with bi-directional diaphragms tested on two shake tables at the University at Buffalo.



A SpeedCore specimen being tested at the University at Buffalo.

at Buffalo PhD student Emre Kizilarslan, post-earthquake repair of SpeedCore walls can be relatively easy, requiring only replacement of locally bucked plates and a small amount of locally crushed concrete all from the outside and without obstruction from rebars, which might not be the case for comparable reinforced concrete walls.

Eliminating damage to allow immediate return to service following an earthquake is another way to achieve resilient design, which can also be done cost-effectively using steel. In another project, University at Buffalo PhD student Homero Carrion-Cabrera and I used buckling restrained braces (BRBs) connecting floating spans to their adjacent abutments and pier caps to achieve resilient bridges that remain fully open to traffic following an earthquake.

Other strategies also exist to eliminate damage altogether, such as rocking frames and self-centering systems. All of these resiliency strategies will be covered in my presentation at 2024 NASCC: The Steel Conference. Come listen, learn how a disaster-resilient infrastructure benefits us all, and share it with non-engineers, because as demonstrated in my book *The Blessings of Disaster*, (learn more about it in "Learning from Disaster" in the December 2022 issue in the Archives section at **www.modernsteel.com**) a knowledgeable public is necessary to achieve a resilient society. ■

This article is a preview of the 2024 NASCC: The Steel Conference session "Adding Resilient Structural Systems to the Engineer's Toolbox." To learn more about this session and others, and to register for the conference, visit ***aisc.org/nascc****. The conference takes place March 20–22 in San Antonio, Texas.*

Michel Bruneau (**Bruneau@buffalo.edu**) is a SUNY distinguished professor in the civil engineering department at the University at Buffalo.

Dedicated to Steel

BY PATRICK ENGEL

SteelDays, AISC's annual event dedicated to highlighting the U.S. steel industry, once again provided an inside look at the various links in the steel supply chain to students, construction professionals, and others.

ONE BY ONE, ten University of Texas at Tyler Houston Engineering Center students summoned their inner Spider-Man.

They did not wear red and blue or try to form webs. Rather, they attempted to ascend a seemingly unclimbable steel column at the Iron Workers Local Union #84 Joint Apprenticeship and Training Center in Houston. Ironworkers effortlessly scale 30-ft columns several stories above ground on jobsites, channeling years of practice at training sites like this one.

With every futile bare-handed attempt to gain traction, students learned that perfecting girder climbs indeed takes time (and proper equipment). Some made it a foot or two off the ground. A couple reached the halfway mark of the multi-story practice column, only to walk right out of their shoes on the way down.

"One of the most difficult feats I've ever attempted," said UT-Tyler student Alexander Carranza, who ascended about 20 ft up the column.

Even the humbling part of an afternoon spent in an ironworker's boots, though, was an enjoyable learning experience. Each clamber brought collective laughs and smiles from attendees. That followed two hours of hands-on welding, cutting, and steel erecting training.

"It was nice to see what we as engineers draw and analyze every day, along with the amount of labor, safety precautions, and coordination it takes to complete one task," UT-Tyler student Erica Green said. "As an engineering student enrolled in concrete and steel and structural analysis courses where we analyze the strength of structural members and connections, it was great to see the techniques for welding a connection at any angle to ensure it is secured."

Added Carranza: "My visit instilled a profound admiration for ironworkers' skill, dedication, and courage. I departed with a newfound appreciation for the intricate dance of steel and human ingenuity that underpins the very foundations of our modern society."

The Houston event was one of several student trips to an Iron Workers Local training facility across the country in mid-October, all part of AISC's 15th annual SteelDays, which aims to educate students, engineers, architects, and others about the domestic fabricated steel industry. SteelDays ran from Oct. 16–20, with events nationwide that included ironworker training site visits, fabrication shop tours, project site visits, online seminars, and other hands-on training opportunities.

Other Iron Workers Local training center visits took place in Boston, Denver, Phoenix, San Diego, Astoria, N.Y., La Palma, Calif., Largo, Md., and Baton Rouge, La. Some were exclusively for students. Others were open to anyone. All of them allowed attendees to experience an ironworker's job. AISC and the Ironworker Management Progressive Action Cooperative Trust (IMPACT) combined to host them.

"We deliver a safety-trained, highly skilled, and productive workforce to our union employers," said Lee Worley, Iron Workers International executive director of apprenticeship. "SteelDays is a chance for others to see what our training centers across North America do every day."

Students climb a column in Phoenix.

above: UT-Tyler students get hands-on experience erecting steel.

below: They also learned how to cut steel.

Students learn about erecting steel (above) and climb a column (below) at Iron Workers Local Union #623 training center in Baton Rouge, La.

UT-Tyler engineering students get hands-on experience erecting (above) and cutting steel (left) at the Iron Workers Local Union #84 training center in Houston.

above and below: North Carolina State University steel design students toured Gerdau Steel Mill in Petersburg, Va.

Shop Stops

Several AISC member fabricators and mills hosted student groups or the general public for tours during SteelDays. AISC offered grants to fund students' trips.

North Carolina State University engineering professor Steve Welton took 27 students from his steel design class and the ASCE chapter at N.C. State to Gerdau Steel Mill in Petersburg, Va. The group saw firsthand how steel is recycled and reused—melting, forming, shaping, rolling, and straightening. Later, Gerdau staff outlined the technical part of the process students had just witnessed.

"Touring a steel mill gave me a greater appreciation for the structural members I have been specifying in my senior design project," N.C. State student Alec Spano said. "This trip helped to contextualize the strengths and dimensions found within the AISC *Steel Construction Manual*."

The tour came together because one of Welton's students knows a worker at Gerdau, maintenance improvement facilitator Jacob Dubois. Dubois reached out to Welton with an offer to host students.

"They really appreciated the scale of the steel industry," Welton said. "We talked about that in design class, and they've done that on a small scale with the Student Steel Bridge Competition. But the day we were there, they were rolling W21 beams. To see the scale of that and watch the furnace be loaded was a pretty memorable thing."

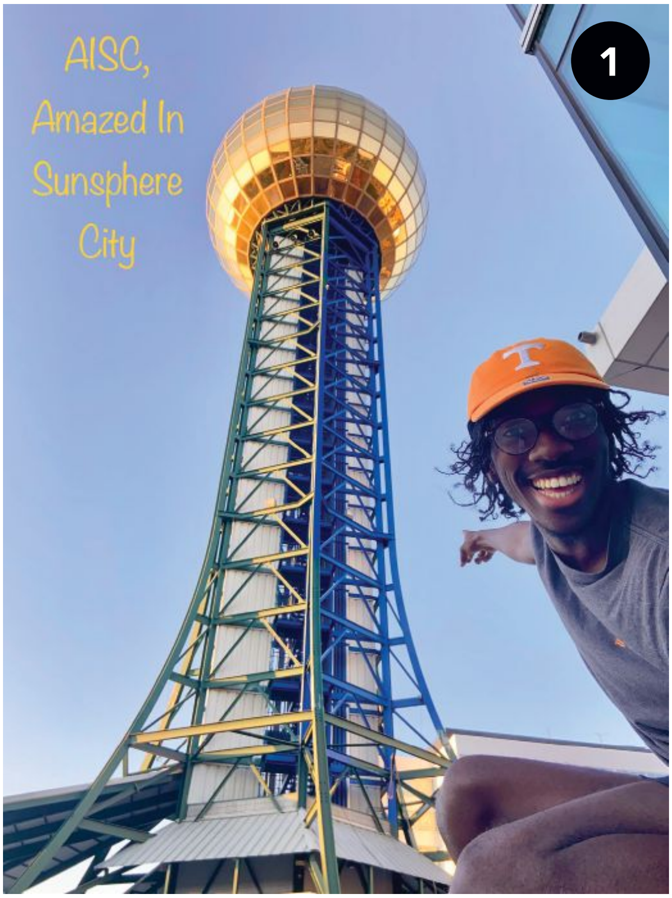
Elsewhere, several AISC member fabricators hosted student tours: Basden Steel in Burleson, Texas, SteelFab in Roanoke, Ala., Hancock Steel in Findlay, Ohio, SL Chasse in Hudson, N.H., and Tarrier Steel in Columbus, Ohio. Garbe Iron Works in Aurora, Ill., was among the AISC members to host a non-student tour group.

Garbe Iron Works in Aurora, Ill., hosted a tour group.

Steel and Smiles

Not every SteelDays event was at a designated site. The SteelDays Student Photo Contest challenged students to submit a photo of themselves with structural steel in the background.

Three winners were selected: University of Tennessee student Caleb Napper's photo won first place, Oregon State University student Paige Dieckmann won second place, and Johns Hopkins University student Jessalyn Wright took third.



Alex Azero of Severud Associates gives New York AEC professionals a tour of Moynihan Train Hall.

Severud accepted its 2023 IDEAS[2] award for the Moynihan Train Hall project.

above and below: Tour groups at the National Medal of Honor Museum jobsite.

Stunning Sites

Most SteelDays events offered a look into the pre-construction stages of the steel industry. A few, though, were displays of the finished (or nearly finished product). The engineers and architects of two 2023 AISC IDEAS^2 award-winning projects hosted a tour and accepted their awards. Severud Associates designed the Moynihan Train Hall in New York and hosted a tour and celebration. Martin/Martin took visitors through the Orange County Art Museum in Costa Mesa, Calif.

SteelDays also featured site tours of three ongoing projects: The National Medal of Honor Museum in Arlington, Texas, a life science building in Philadelphia, and the 1900 Lawrence office building in Denver. The first two were also topping-out ceremonies.

W&W|AFCO fabricated the National Medal of Honor Museum, Owen Steel was the fabricator for the life sciences building, and Puma Steel fabricated the girders for 1900 Lawrence. (For a more detailed look at the 1900 Lawrence project, see the November issue of *Modern Steel Construction*).

If you missed the 2023 SteelDays events, there's no need to wait until 2024 for an up-close look at the domestic structural steel supply chain. Interested in a fabrication shop tour? Contact a local member (find information at **aisc.org/aisc-membership/member-directory**). Want to visit an Iron Worker training facility? Contact IMPACT (**www.impact-net.org**). They'll happily demonstrate their role in the American structural steel supply chain. ■

Patrick Engel (**engel@aisc.org**) is the associate editor of *Modern Steel Construction*.

new products

This month's new products section features a powerful laser cleaning service, an updated construction management software and a powerful portable weld fume extraction vacuum.

Nuwave Laser Cleaning

Laser cleaning is a non-contact method of removing surface contaminants, such as rust, dirt, dust, and oxidation, from a variety of materials, including steel. It uses a focused beam of light energy to vaporize and remove the contaminants without causing damage to the underlying substrate. Laser cleaning produces zero chemical waste, making it an environmentally friendly option. It's highly precise and can target specific areas without affecting surrounding areas. Additionally, it's a fast and efficient process that can save time and labor costs compared to traditional cleaning methods.

Nuwave Laser Cleaning offers laser ablation and laser cleaning services. The laser technology distributes thousands of focused laser pulses per second onto contamination layers. The laser's light absorbs the contaminants, changes the state to a gas, and captures it, making it the ideal way to move contaminants without damaging the substrate.

The laser is a safe, variable power unit that can be precisely manipulated to clean challenging surfaces without water, chemical, or abrasive materials. It leaves the existing irregular or flat substrates, such as welds or gasket surfaces, in their original state. Visit **nuwavelaser.com** to learn more.

RedTeam Flex Preconstruction Capabilities

RedTeam Software announced major enhancements to the preconstruction capability for RedTeam Flex, its cloud-based solution for end-to-end construction management.

The latest updates promise to save time, improve efficiency, and reduce risk for contractors and owners from preconstruction through project closeout. They benefit general contractors and provide unique support to those overseeing Construction Management at Risk (CMAR) projects by facilitating real-time collaboration and financial transparency.

RedTeam Flex's new preconstruction functionality and enhanced features are fully collaborative. The capabilities support the new innovative workflow designed to enable those running CMAR projects and those looking to streamline their suite of preconstruction software tools. Access to project information and the ability to work simultaneously on documents extend beyond the general contractor's estimating team to architects and engineers, subcontractors, and project owners. Visit **redteam.com** for more information.

RoboVent ProCube II

RoboVent has made high-vacuum dust and fume extraction more versatile than ever with its newest product, ProCube II. The company has upgraded its hi-vac weld fume extraction unit with more extraction power and better maneuverability to create ProCube II, its most powerful portable cleaner yet.

ProCube II has 4 HP of extraction power, supports two fume guns or a light-duty robotic welder using tip extraction, and is operable with only a plug into the wall. It's 270 pounds, 42.8 in. high, 23.5 in. long, 22.25 in. wide, and sits on four wheels, making it easily operable for one person. Its heavy-duty casters and handle allow a single welder to move it—an ideal choice for high-mobility welding applications that use fume guns. It generates 82 dB(A) while in use, making it one of the quietest high-vacuum units on the market. Visit **robovent.com/air-filtration-equipment/procube** to learn more.

NASCC

Registration for NASCC Opens January 3

NASCC: The Steel Conference is heading to San Antonio, Texas, from March 20–22.

Register today to get the best price on the industry's top education event, featuring more than 230 technical sessions full of must-have practical information that you can implement as soon as you get home, an exhibit hall packed with 280-plus innovations you need to know about right now, and a chance to network with thousands of the world's best designers, fabricators, erectors, and other steel fans.

The Steel Conference is the must-attend educational event of the year and focuses on providing actionable information you can put into practice right away while earning up to 16 PDHs.

The Steel Conference also incorporates six specialty conferences: the World Steel Bridge Symposium, QualityCon, Architecture in Steel, SafetyCon, SEICon24, the SSRC Annual Stability Conference, and the NISD Conference on Steel Detailing. For more details on the Steel Conference and these specialty conferences—and to register—visit **aisc.org/nascc**.

BRIDGES

New Section of I-95 Bridge in Philadelphia Reopens After Crash, Subsequent Collapse

An I-95 overpass in northern Philadelphia reopened with permanent lanes about five months after it collapsed due to a tanker fire.

Six lanes—three on each side—paved over steel girders reopened to traffic November 6, marking the completion of the first of two phases to repair the overpass near Cottman Avenue that partially collapsed June 11 when a tanker lost control while exiting the highway, crashed under the bridge, and caught fire. The crash collapsed the six northbound lanes (including shoulders) and rendered the six southbound ones unsound.

High Steel Structures was tapped as the fabricator for the new bridge in the days following the crash. It fabricated 16 106- to 108-ft girders, the first of which arrived on site in late August. Eight support the newly constructed lanes, which opened ahead of schedule.

"High Steel Structures has had the honor of helping Pennsylvania recover from the I-95 bridge collapse in Philadelphia," High Steel President John O'Quinn said. "When emergencies like that happen, our team and the steel industry step up and deliver. From the moment the word of the accident hit the news, the industry's collaboration and sense of urgency to assist in any manner possible became the ultimate focus. "The steel mills, suppliers, and even our everyday competitors were all reaching out immediately with the collective goal of providing whatever resources were required to get I-95 opened back up as quickly as possible. It's a true testament to our industry's ability to mobilize quickly and efficiently in these emergency situations."

The other eight girders will be installed in the second phase of the project, which will reconstruct the other six lanes and reopen the road underneath the bridge. That part is expected to be finished in 2024.

"This is yet another example of structural steel getting drivers back on the road quickly," said National Steel Bridge Alliance senior director of market development Jeff Carlson, PE. "The industry has a history of rallying to get emergency repairs off the ground at lightning speed, and I'm proud that steel has come to the rescue yet again."

I-95 initially reopened 12 days after the crash with a temporary six-lane roadway made of recycled foamed glass aggregate fill. That allowed traffic to flow on the innermost six lanes while construction crews placed girders and paved the road on each side. The second phase began with the removal of the temporary road and installation of the last eight girders in its place.

People & Companies

Two notable structural engineering firms are combining forces. San Francisco-based **Degenkolb Engineers** and Michigan-based **Ruby+Associates** announced a purchase agreement and acquisition that took effect November 1. Degenkolb has taken on Ruby+Associates' 55 employees and, with the acquisition, now has more than 330 employees in 10 offices across the country.

"I have known leaders at Ruby for more than a decade, and we have partnered in different aspects of our business for multiple years," said Degenkolb President and CEO Stacy Bartoletti, who is keeping his role post-merger. "Our cultures align around giving opportunities to our employees and providing exceptional client service. The combined firm will grow more together than each firm would have on its own."

Ruby+Associates is now known as Ruby+Associates, a Degenkolb Company. Tricia Ruby, its CEO since 2011, is a principal and group director at the newly combined firm and will remain in charge of its Michigan staff. Her father, Dave, founded the company in 1984, and it has primarily focused on steel construction and construction engineering. The firm holds engineering licenses in 42 states, the District of Columbia, and three Canadian provinces. Degenkolb's acquisition of Ruby+Associates' geographical reach expanded its footprint beyond the western United States for the first time since its 1940 founding.

"We are both proud of the firms that we've built," Tricia Ruby said. "Our people are invested in our identities. The opportunities that this will provide our existing employees and new hires are incredible. There will be flexibility in location, in markets to serve, and in clients to work with in the future."

Ruby appeared in the September edition of the *Modern Steel Construction* Field Notes podcast, found at **modernsteel.com/podcasts**.

ENGINEERING JOURNAL

First-Quarter 2024 *Engineering Journal* Now Available

AISC members can view the following *Engineering Journal* papers at **aisc.org/ej**.

Seismic Design and Performance of Composite Coupling Beam-to-SpeedCore Wall Connections
Amit H. Varma, Mubashshir Ahmad, Soheil Shafaei, and Ron Klemencic

This paper presents the details and design of four composite coupling beam-to-composite plate shear walls—concrete filled (C-PSW/CF) connection configurations. Six connection specimens representing four connection configurations were designed and tested. The lateral force-displacement and moment-rotation responses of the specimens are summarized. All six composite coupling beam-to-C-PSW/CF wall connection specimens developed and exceeded the plastic flexural capacities of the coupling beams calculated using the plastic stress distribution method. They also developed chord rotation capacities greater than 0.03 radian before their flexural strength degraded to 80% of the plastic moment capacity.

Inelastic Deformation and Local Slenderness Requirements for Rectangular HSS Braces
Dawn Lehman, Charles Roeder, William Bergendahl, Joseph Kaldestad, Andrew Sen, and Jeffrey W. Berman

Rectangular hollow structural sections (HSS) are commonly used as bracing in concentrically braced frames (CBFs) designed and detailed for seismic design requirements. Until 2013, they were produced to meet ASTM standard A500/A500M. Since 2013, they also meet ASTM A1085/A1085M standards.

A recent research study investigated the response of ASTM A1085/A1085M tubes using the response of ASTM A500C tubes as their reference. The study investigated the impact of width-to-thickness ratio, global slenderness, and displacement history on the response of the braces. The data show that the current AISC 341-22 high-ductility slenderness limit for special concentrically braced frame (SCBF) braces is slightly conservative. The data also suggest that the moderate ductility slenderness limit used for ordinary concentrically braced frame (OCBF) braces is significantly more conservative than required for consistent seismic safety.

Four-Bolt Unstiffened End-Plate Moment Connections with 36-in.-Deep Beams for Intermediate Moment Frames
Maria A. Mercado-Celin, Matthew R. Eatherton, and Thomas M. Murray

Previous testing has shown that four-bolt extended, unstiffened end-plate moment connections can be used with beams up to 24 in. deep and develop sufficiently ductile performance to satisfy seismic qualification. Extending the depth limit allows for deeper beams for intermediate moment frames (IMFs). Three 36-in. specimens with a four-bolt extended, unstiffened end-plate moment connection were tested to determine if they satisfy the intermediate moment frame qualification criteria given in AISC 341-16. The results of these tests support current moderately ductile limits associated with lateral bracing and cross-section slenderness. It was concluded that four-bolt extended, unstiffened end-plate moment connections satisfy intermediate moment frame requirements with a beam depth of 36 in. and that a modification is needed for beam web to flange welds in built-up sections near the moment connection.

NUCOR

Nucor Announces Emissions Reduction Plan

Nucor has unveiled a plan for reaching net-zero emissions within 30 years.

The company announced November 13 a goal to achieve net-zero greenhouse gas output by 2050 and an interim target for 2030, aligning with the Global Steel Climate Council's (GSCC) "Steel Climate Standard" similar target date for emissions reduction across the steel industry.

The targets include scopes 1, 2, and 3 emissions from hot-rolled steel production as defined by the GSCC. In setting them, Nucor became the first diversified steelmaker in the U.S. to establish greenhouse gas reduction targets across all three scopes. The new targets are more rigorous than Nucor's 2021 goals, which called for a 35% reduction in steel mill scope 1 and scope 2 greenhouse gas intensity by 2030.

Nucor plans to achieve its net-zero emissions goals by using more clean electricity, carbon capture and sequestration, and near-zero greenhouse gas iron making. It will also invest in technology to reduce its injection and charge carbon consumption and natural gas usage in its steel production processes.

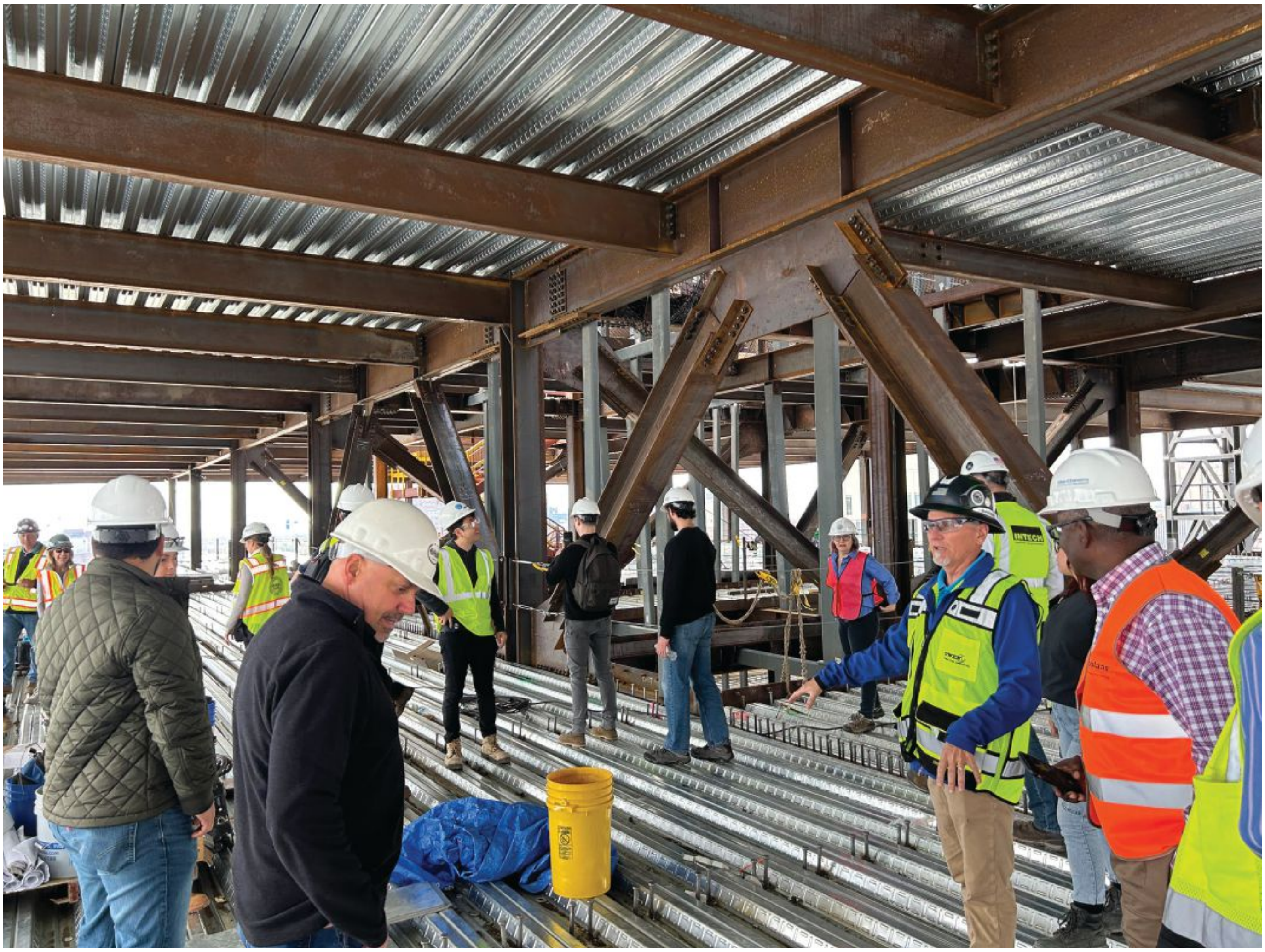
"These targets further highlight our leadership role in developing clean solutions for the entire steel industry, as well as empowering our customers to meet their business and environmental goals successfully," Nucor president and CEO Leon Topalian said. "In recent years, we have made purposeful investments to increase the availability of carbon-free electricity and to support other emerging technologies that will help lead the way to a clean industrial future."

Nucor is one of the cleanest steel producers in the world. Its circular production process uses about 80% recycled scrap metal (and around 93% recycled content for wide flange products) and produces one-third the greenhouse gas emissions intensity as a traditional steelmaking process using a blast furnace.

To advertise, contact Geoff Weisenberger: 312.493.7694 | **weisenberger@aisc.org**. Search employment ads online at **www.modernsteel.com**.

advertiser index

Tim Bradshaw of Owen Steel Company leads a tour through 3151 Market Street, a new life science building going up in West Philadelphia.



Supporting Science

PHILADELPHIA'S LIFE SCIENCES SCENE is booming.

Drive down Market Street in Center City and University City, and you'll spot at least three under-construction buildings that will soon house life sciences companies.

One of them is a 14-story steel structure that topped out this past October and is slated to open by early summer. Located mere steps from the city's 30th Street SEPTA Station and a block from Drexel University, the building will be among the newest additions to a life sciences market that's the fourth-largest in the nation and second-largest on the East Coast behind Boston, according to Brandywine Realty Trust.

That building, located at 3151 Market St., is a ground-up, purpose-built structure housing 417,000 sq. ft of office and laboratory space. It has options for full intensive chemical and biological lab floors, including the potential for good manufacturing practice systems and vivarium functions, and will also contain lower-level parking and ground-floor retail and active space.

AISC member Owen Steel Company fabricated the steel for the project, which was designed by architect Gensler and Associates and structural engineer LERA. Brandywine developed the building as part of its $3.5 billion, 14-acre Schuylkill Yards multi-use project in the area.

The building's bays are 45 ft long by 33 ft wide by 15 ft high—dimensions well-suited for a wide range of life sciences tenants. In addition, the 10 office and lab levels have a 100-psf live load, including 20-psf partition allowance.

Look for a feature article on the completed project later this year. ■


NASCC: THE STEEL CONFERENCE
World Steel Bridge Symposium
QualityCon
Architecture in Steel
SafetyCon
SEICon24
SSRC Annual Stability Conference
NISD Conference on Steel Detailing
HENRY B. GONZALEZ CONVENTION CENTER | SAN ANTONIO
MARCH 20–22, 2024
Advance Program
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NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995
SEI ASCE
STRUCTURAL STABILITY RESEARCH COUNCIL SSRC FOUNDED 1944
NATIONAL INSTITUTE OF STEEL DETAILING NISD Founded 1969
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MARCH 20–22, 2024

BIGGER AND BETTER!

NASCC: The Steel Conference, the nation's leading conference for the design and construction of steel buildings and bridges, is heading to San Antonio, Texas, on March 20–22.

The Steel Conference is the premier event for everyone involved in the design and construction of steel buildings and bridges. We feature more than 230 technical sessions (and 16 PDHs!); a giant exhibit hall showcasing over 280 products and services that can help you design and build better with steel; and the opportunity to network with more than 6,000 colleagues, including leading designers, top fabricators, and prestigious researchers at the cutting edge of today's innovation.

This year's event also incorporates the World Steel Bridge Symposium, SEICon24, QualityCon, the NISD Detailing Conference, SafetyCon, Architecture in Steel, and SSRC's Annual Stability Conference. One registration fee gets you into all of this, as well as keynote addresses, lunch in the exhibit hall Wednesday and Thursday, the welcome reception, and—of course—the famous conference dinner!

Registration and Housing

Registration opens Wednesday, January 3, 2024. Pro tip: Register early! Registration fees increase each week. Visit **aisc.org/nascc/register** to register and to book your hotel reservation.

Our official registration and housing partner is MCI USA. Visit **aisc.org/nascc/hotels** to book your discounted room in the conference block. For the best availability and rates, book by February 26, 2024. After this date, there will be limited availability through March 12, 2024.

If you have questions about registration and/or housing, please contact MCI USA:
800.830.5812 (within the U.S.) | 972.349.5930 (outside of the U.S.)
nascc@mcievents.com

What makes us different?

We carefully design our sessions to serve practicing professionals. Our goal is to provide information and skills that you can immediately put into use. While some of our sessions are developed through the traditional call-for-papers route, most are the result of our planning committee selecting relevant topics and then seeking out the top experts and engaging speakers to share their knowledge.

That's why our technical sessions consistently get rave reviews. Want to get a taste of what a conference session is like? Visit **aisc.org/learning** and watch one of the more than 2,000 posted sessions from previous conferences.

Who attends?

Our sessions are designed to cover all aspects of steel design and construction, from basic review sessions to advanced methodologies, and our audience is similarly diverse, ranging from professionals just a few months out of school to many of the top principals at the nation's leading structural engineering firms.

Last year's conference had over 5,900 participants, including structural engineers, architects, steel fabricators, detailers, erectors, academics, students, and product vendors/service providers—and we expect this year to be even bigger!

Registration includes:

World Steel Bridge Symposium

The World Steel Bridge Symposium (WSBS) brings together bridge design engineers, construction professionals, academics, transportation officials, fabricators, erectors, and constructors to discuss state-of-the-art practices that enhance steel bridge design, fabrication, and construction.

SEICon24

It's the Structural Engineering Institute's (a part of ASCE) annual conference for structural engineers, students, and academics. It's a chance to learn, engage, and network with the structural engineering community.

QualityCon

The best quality management processes don't fix problems—they prevent them. Improving your quality processes will boost your bottom line, and we've gathered experts to equip you with ideas and tools that will bring immediate value to your fabrication facility or erection jobsite, regardless of whether you hold AISC Certification.

NISD Conference on Steel Detailing

The National Institute of Steel Detailing has developed a 13-session program specifically for detailers. The program parallels the NISD Certification program and provides practical information to help make you a better detailer!

SSRC Annual Stability Conference

The Structural Stability Research Council's Annual Stability Conference has been held in conjunction with the Steel Conference since 2001. In addition to 13 sessions with more than 60 papers, the SSRC Conference includes the Beedle Award and MAJR Medal presentations. SSRC also holds its annual meeting immediately prior to the Stability Conference.

SafetyCon

Safety first! AISC's Safety Committee has developed a special slate of sessions designed to give fabricators and erectors practical guidance and useful tools to promote safety.

Architecture in Steel

Architecture in Steel is the architectural community's home at the Steel Conference. Designers—and everyone else involved in steel design and construction—can expect to hear about ingenious solutions to tough design challenges, inspiring structures that came to life in structural steel, and the innovations that will define how structural steel's impact on a greener, safer, more beautiful future.

CONFERENCE KEYNOTES

Wednesday

In 2001, at the age of 27, **Chad Hymas**' life changed in an instant when a 2,000-pound bale of hay shattered his neck, leaving him a quadriplegic. But Chad's dreams were not paralyzed that day—he became an example of what is possible. Chad is a best-selling author, president of his own communications company, and a recognized world-class wheelchair athlete. In 2003, Chad set a world record by wheeling his chair from Salt Lake City to Las Vegas (513 miles). His keynote at this year's conference focuses on safety—both at work and at home.

Do you wonder how to build an environment where everyone has safety on their minds, where safety is a natural part of the day-to-day thought process? You'll begin to view safety in a different way after hearing Chad and better understanding your personal accountability. This program challenges everyone to develop and maintain a safety mindset, the mindset of a safety professional, whether in the workplace or at home. At work or at home, it is hard to stop and take the time to do an activity safely unless we consider the possible outcome. If we are:

- Not wearing your seatbelt can have devastating results
- Leaving your safety mind at work can paralyze you
- Leaving something wet can cause a co-worker to slip and fall
- Tripping and falling down the stairs can put you in a wheelchair the rest of your life

You'll gain a new respect for safety procedures and an understanding of developing a 24/7 Safety Attitude.

Thursday

NASCC: The Steel Conference is honored to have **Jerome F. Hajjar, PE, PhD**, present on one of the hottest topics in the design and construction industry: "The Stability of Resilient and Sustainable Structures." Hajjar's presentation is a trifecta of success: first and foremost, he is the recipient of this year's Beedle Award, which is SSRC's highest honor. In addition, he is the current chair of AISC's Sustainability Committee as well as the president of SEI. When not engaged as one of the industry's most active volunteers, Hajjar is the CDM Smith Professor and Chair of Northeastern University's Department of Civil and Environmental Engineering.

Friday

Benjamin W. Schafer, PE, PhD, will present "Think Global, Buckle Local: Exploring Local Buckling in Structural Steel." Schafer is the Hackerman Professor of Civil and Systems Engineering at Johns Hopkins University and winner of the 2024 T.R. Higgins Lectureship Award. His presentation will focus on the role of local plate buckling in the global behavior of structural steel members and aims to give every designer and fabricator some degree of comfort in predicting and understanding this fascinating phenomenon. Schafer will explore the past and look toward the future, including the newest procedures, tools, software, and structural materials.

NETWORKING OPPORTUNITIES

Welcome Reception

Wednesday, March 20 | 5:30 – 7:00 p.m.
Location: Exhibit Hall

Kick off the conference with a networking extravaganza in the exhibit hall. Join us for a special preview of what exhibitors will offer and experience the latest trends in software, coatings, connection products, and more—plus refreshments, hors d'oeuvres, and excellent company!

ELEVATE

Wednesday, March 20 | 7:30 – 10:30 p.m.

Join us to celebrate the many ways our industry is working to affirm access, equity, and belonging—help us build a more inclusive profession going forward! This networking reception is a chance to come together to inspire change. Special guest speaker Shani Dellimore Barrax of Aurora Change Agency will show us how the old culture-fit hiring model evolved into the innovative culture-add approach—and how that new perspective is helping firms find and address potential missed opportunities. Separate registration is required.

Conference Dinner

Thursday, March 21 | 7:00 – 9:00 p.m.
Location: Southbank Block Party

We're taking the party to the streets—and the riverwalk! Our private block party will have three venues all to ourselves, with live music, food, and refreshments—just steps from the convention center. Mix, mingle, and experience them all! Meet friends new and old at Paesanos, Howl at the Moon, and the Hard Rock Cafe. Or, if you prefer, take in the fresh air. We're closing the street and we'll have food, drinks, and entertainment outside as well!

Cost: Included with full registration.
For other registration types, tickets are available to purchase.

NEW for 2024: Visit the Workforce Zone!

The popular Be Pro Be Proud virtual workshop will be back as the anchor of a dedicated workforce zone in the exhibit hall, where participants will also be able to try installing bolts, deck steel, and steel connections; measure members; compete in a virtual welding competition; preview AISC's new Fabricator Education Program live; and more. The goal of this space? Give conference participants ideas to connect with local schools and build their own workforce development programs. A group of San Antonio high school students will get a first-hand look at the world of structural steel fabrication with a field trip that will include career path education, industry connections, and a steel facility tour.

Fabricators and erectors will also have the ability to register for BlueRecruit, a service that matches technical job seekers with employers who are looking for a specific skillsets. AISC has partnered with BlueRecruit as a benefit for full member fabricators.

Mobile App

Put NASCC: The Steel Conference in the palm of your hand! Stay organized with the session schedule tool; navigate the exhibit hall; learn about exhibitors; and network with attendees during the conference with our custom mobile app. Visit **aisc.org/nascc** to download the app in early 2024.

Make it social by networking with attendees and joining the conversation on X and Instagram by using **#NASCC24 #AISC**

NASCC: THE STEEL CONFERENCE
2024 SESSION LIST

Business

- Building a Culture That Builds PEOPLE
- Building Relationships of Trust
- Design Assist and the Steel Fabricator
- Dynamic Leadership and Professional Development: A Guide to Success in the Architecture, Engineering and Construction Industry
- Effective Communication for Project Managers
- Find, Keep and Grow Great People
- Illusion, Deceit, Transparency, and Trust: The Ethics of Negotiation
- Leadership discussion
- Maintaining Efficiency While Growing Your Fabrication Business
- Reducing Costs by Reducing Unethical Behavior
- Resolving Organizational Conflict to Create a Learning Organization
- Storytelling for the Steel Industry Demystified
- Strengthening Your Communication: Essential Soft Skills for Business Development
- Structural Steel: An Industry Overview and Economic Forecast
- Who Is Your Replacement? Developing Leaders Within Your Organization

CAPS

- Construction Contracts 101: An Introduction to Important Contract Provisions and How They Impact Your Responsibilities
- Introduction to Career Accelerator Program for Steel (CAPS)
- Leadership Development – Creating an Environment for Team Success
- Modern Manufacturing of Structural Steel Shapes and Its Impact on Design
- What AISC Can Do for You
- What You Need to Know About the *COSP*

Case Study

- 1900 Lawrence: A Case Study in Modern Innovation
- Construction Engineering Solutions to a Unique and Challenging Structure at the Ismaili Center in Houston
- Letting the Light In With Steel: Austin City Library Design Story
- Monorail into Treetop Trail: Adaptive Reuse at MN Zoo
- Preserving the Legacy: A Case Study in Transforming Boulder County Hospital's Future
- Raising and Leveling an Existing Pedestrian Bridge at SFO
- The Spiral: Inspiring the Future of Workplaces

Connections

- Brace Yourself—HSS Brace Design and Detailing
- Connection Design Responsibility—Whose Is It?
- Connection Design – Substantiating connection information
- Connection Economy – Thoughts from a Steel Fabricator
- Delegated Design of Connections: A Comprehensive Exploration Using Finite Element Software
- Existing Steel Connection DCR > 1.0...Where to Start
- HSS – How to Splice Your Slice or Plate It
- HSS Truss Overlapped K-Connection: Fabrication and Design Developments
- Navigating Delegated Design Projects
- Seismic Design of Connections
- Shearly Perfect
- The Drive for Faster Steel Connections
- Transfer Forces: What They Are and Why They Are Important

Design & Analysis/Engineering

- 50 Tips for Improving the Constructability of Steel-Framed Building Structures
- A Fresh Look at CASE 962D
- A Steel Design Primer for Those Who Have Relied on Their Computer for Too Long
- Adding Resilient Structural Systems to the Engineer's Toolbox – Current Views from Past Higgins Winners
- Appendix 6: Effective Application of Lateral and Torsional Beam Bracing Provisions
- Beam Stability for Industrial Structures
- Blast-Resistant Design of Steel Buildings
- Case Studies on Structural Stability Failures – You Make the Call
- Cold Storage Design
- Combined and Refined. How the Industry is Bolting Forward.
- Common Sense Engineering Practices for a Practical Engineered Erection Plan
- Composite Beams – Understanding Minimum Design Limits
- Concentrated and Nonuniform Loading On Steel Deck
- Connecting the Load Path: Chords and Collectors in Steel Deck Diaphragms
- Deep Steel Deck for Composite Floor Systems
- Delegated Connection Design – Properly Specifying Connection Design Criteria
- Don't Draw the Short Straw: Effectively Considering Gravity Shortening in Fabrication and Erection
- Everything You Wanted To Know About Diaphragms... But Were Afraid To Ask
- Fast and Efficient Design for Stability
- FastFloor – The Need for Speed – Session 1
- FastFloor – The Need for Speed – Session 2
- Floor Vibrations for Sensitive Equipment
- Interactive Steel Quiz
- Is Your Industrial Building Structure Suitably Braced?
- Is Your Structure Fatigued?
- Leveraging Technologies in Structural Engineering
- Mass Timber and Steel Hybrid Construction—The Way of the Future or Is It?

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- Mission to Mars – Design of the NASA ML2 Mobile Launch Tower
- Navigating The Joist and Deck Codes of Standard Practice
- Performance Criteria for Façade Attachments to Steel-framed Structures
- Shoring and Sequencing for Two-Way Systems
- Site Observations—Don't Get Bit in the Field
- Special Profile Steel Joists For Any Application
- Stability Fundamentals and Practical Considerations—Session 1: Basic Behavior of Compression and Flexural Members (Part I)
- Stability Fundamentals and Practical Considerations—Session 2: Basic Behavior of Flexural Members (Part II) and Beam-Columns
- Stability: Applying Chapter C to Daily Engineering
- Steel Constructability from the Perspective of a Fabricator and Erector
- Structural Steel Reuse as a Cost-Effective Carbon Mitigation Strategy
- The Good, The Bad, & the Ugly—Drawing Notes
- Tips for Validating the Results of Structural Engineering Software
- Use of High Strength Structural Steels: Effects on Fabrication and Erection
- View from the Top: How an Erector Bids a Steel Project
- Welding Sound Welds to Old Structural Steel (pre-1960)
- What's Hot in Fire Engineering – Research to Practice
- What's Hot in Fire Engineering – Steel Code Advancements
- What's Wrong with This Picture?
- Wind Uplift Design For Steel Joist and Steel Deck Roofs
- Worst Mistakes I've Made with Software (and the Solution)
- Your *Code of Standard Practice* – Changes for the Design Community
- Stainless Steel Fabrication for Fabricators and Designers

Fabrication & Erection

- Case Study – Dickies Arena
- Case Study in Project Management
- Exploring the Synergy: Programming's Impact on Steel Production
- Fabricator Roundtable
- Fundamentals of Project Scheduling for Steel Fabrication
- Mission to Mars – Construction of the ML2 Mobile Launch Tower
- Project Manager Accounting—Understanding Percent Complete Accounting for a Fabricator and Erector
- Software for Success—From Estimating to Erection
- Time Waits for No One.
- Using Tekla EPM in the Field
- Your *Code of Standard Practice* – Changes for Steel Erectors
- Your *Code of Standard Practice* – Changes for Steel Fabricators

Legal

- Design-Assist: Updates from AISC and AIA Specifically for Steel Fabricators
- Recovery of Shop Fabrication Costs for Delay: Where to Start and How to Present.
- The Art of Contract Negotiation (Or Horse Trading Until You Get to Yes)
- Unveiling the Courtroom Chessboard: Legal Advocacy for and Against the Steel Fabricator Part 1 of 2
- Unveiling the Courtroom Chessboard: Legal Advocacy for and Against the Steel Fabricator Part 2 of 2

Manuals, Standards, and Design Guides

- Base Connection Design for Steel Structures—the NEW Design Guide 1, 3rd Edition
- Most Useful Design Aids from the 16th Edition *Steel Construction Manual*
- Ponding Analysis with the New AISC/SJI Design Guide
- Structural Steel Tolerances: What's Included in the *Code of Standard Practice* and What Needs to Be Specified by the EOR
- Surprise! The *COSP* is the GC's Friend
- Ten Provisions from the *COSP* for the EOR That Often Are Overlooked.
- The 2022 AISC *Seismic Provisions* and the New 4th Edition *Seismic Design Manual*
- The NEW 16th Edition *Steel Construction Manual*—The Gold Standard in Steel
- The New AISC Design Guide on Avoiding Brittle Fracture
- Torsion—Twisting the Night Away

Seismic

- Design and Detailing of Embedded Column Base Connections in High Seismic Areas
- Quality Requirements for Steel Buildings in High-Seismic Areas
- Steel Construction Trends in New Zealand in the Wake of the Christchurch Earthquakes
- Steel Seismic Design Fundamentals (for Those Who Normally Don't Design for Seismic)
- Structural Inspections for Structures Designed to Seismic Provisions

Sustainability

- Designing Green Roofs and the Impact on Embodied Carbon
- HSS and Sustainability: Removing the Myths
- Innovative Design: A Toolkit for Reducing Embodied Carbon in Steel Structures
- Optimizing Steel Design: An Integrated Approach for Lowering Embodied Carbon
- Sustainability And Beyond: The Untold Life Cycle of Steel Joist and Deck
- Sustainable Steel Projects: Case Studies and Lessons Learned
- Sustainable Steel: What Are the Mills Doing?
- Thermal Breaks in Structural Steel
- Year One of the AISC Fabricator Sustainability Partner Program

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NASCC SESSIONS

Technology

- Additively Manufacturing a Future for Structural Steel
- AI Basics and Capital Project Business Applications
- Applying AI and Advance Technology to Reduce Welding Inspection Time
- Augmented Reality in Structural Steel Construction
- Better Bridges: How Creating a Culture of Innovation and Harnessing AI Helped Aetna Bridge Streamline Quality and Certification Processes
- Database Driven Design Methods
- Engineering the AI Revolution: A Sustainable Approach to Structural Steel Design
- Leveraging Technologies in Structural Engineering

Workforce Development

- AISC Fabricator Education Training Program—Accelerated Onboarding
- Be That One Guy – Diversity, Harassment Prevention & Retention Training
- Breaking the Boundary Between the Shop and the Office: Candid Discussions on Steel Industry Career Paths
- Building on Today: Workforce by the Numbers—A Data-Driven Interactive Panel Discussion
- Do's and Don't's of Hiring in the Trades
- Effective Shop Staff Recruitment and Development: Key Collaborations and Training Program Elements that Gets Them Working on the Floor and Making Money
- Empowering Diverse Voices in Corporate Leadership: Strategies for Advancing Employee Leadership Development
- Forge Your Future: Exploring the Structural Steel Industry
- How to Attract the Next-Gen Workforce: Embracing Diversity, Equity, and Inclusion, Flexibility, and More
- Industry Collaboration to Solve a Statewide Skilled Trades Shortage
- It's OK to Use Your Hands: Elevating the Skilled Trades
- Never in My Wildest Dreams: My Story as a Young Welder Entering the Workforce
- Priming the Space for Talent Retention through Self-Reflection, Humility, and Belonging
- Revolutionizing the Workforce: Unveiling Upcoming Equipment Innovations and Their Transformative Impact
- Skilled Trades Competitions: Their Roles in Bridging the Skills Gap and Investing in Your Recruitment Pipeline
- Steel Trade Apprenticeships: Know Enough to Be Dangerous, or Really Safe, Actually

SUBCONFERENCE SESSIONS

World Steel Bridge Symposium

- 2024 Bridge of the Year Award
- AASHTO Updates
- Advancing Steel Bridges with Innovative Technologies
- Basics of Curved Steel Bridge Girder Design
- Best Practices for Galvanized Steel Bridges
- Better Bridge Bracing
- Breathing Life into Bridges Through Targeted Rehabilitation
- Challenging Construction Projects and Steel Was the Formula for a Solution
- Corrosion Resistant Materials for Steel Bridges
- Cross Frames – An Often Misunderstood Part of Steel Bridges
- Fresh off the presses – New NSBA Design Standards
- In Case of Emergency, Call The Steel Industry
- Lean-on Bracing Experiences with TxDOT
- Major River Crossings – Challenging Design & Construction
- Moveable Steel Bridges for the Heavy Lift
- New Major Steel Bridges in North America
- NSTM, IRM & SRM: Pragmatic Practices for Project Performance
- Press Brake Tub Girders
- Shear Studs – Fact or Friction
- Simple Solutions for Short Span Bridges
- Steel Bridge Industry Roundtable
- Steel Railroad Bridges
- Steel Straddle Beams in Texas
- Sustainability and How It Affects Steel Bridges
- What's happening with T1 Steel?

Architecture in Steel

- 2023 Forge Prize Live Presentations
- 3D Printed Metal Structures Using Robots
- Complex Doubly Curved Steel Works in Infrastructure and Architecture
- Fire Protection for Steel Buildings
- Houston Endowment: A Case Study for Hybrid Steel + Mass Timber
- Hybrid Structural Systems: The Design and Erection of Significant Steel Structures on Top of Tall Concrete Buildings
- Reviving the Master Builder: Computational Methods in Steel Design and Fabrication
- Shaping Visions into Reality: Parametric Modeling in Chicago O'Hare's Expansion
- Stainless Steel for Architects and Engineers
- Structural Steel as Architecture: Case Story of Snapdragon Stadium
- The AISC AESS System: Effective Applications
- The X-Factor: A Mass Customized Signature Bridge
- What's Next in Practice and Beyond

And more! Visit **aisc.org/nascc** for a full list of sessions.

NISD Conference on Steel Detailing

- 14 Things You Should Know About Detailing Steel Joists
- Connection Design Basics for Steel Detailers
- Deck Detailing Made Easy or at Least Easier!
- Elevate Your Standards
- Fabricator Tips for Selecting a Good Steel Detailer
- Help Your Client Understand the IDC Difference
- Integrated Design and Detailing
- Managing Non-Compliant Design Teams—Supporting Implementation of the AISC COSP
- What Is Wrong with my Steel Detailing?
- When Your Client Becomes Your Enemy—How to Recognize and Manage for a Successful Outcome

QualityCon

- A Nonconformance Walks into a CAR…
- Best Coating Practices: How to Avoid Failures
- Certification Forum
- Corrective Action Request vs. Nonconforming Work
- Fundamentals of Root Cause
- How Do I know my WPS or PQR is Correct? And Other Lessons Learned!
- How Do Robots Affect Your QMS—Along with Your Workforce?
- How Do You, as a Leader, Drive Results?
- How to Develop Your Quality Manager?
- Integrating Quality and Safety Management for Project Success
- Jobsite Lessons Learned: A Panel Discussion
- Lessons Learned from United States Army Corps of Engineers
- Nuts, Washers and Bolts, Oh My!
- Pitfalls to Implementing a New Quality Management System
- Shop Welding Fundamentals for D1.5
- Stump the Coatings Panel!
- Things I Wish Everyone Would Know about Chapter N (AISC 360) and Chapter J (AISC 341)
- Three More Fabricators Walk Into a Bar…
- Use of High Strength Structural Steels: Affects on Fabrication, Erection, and Your Quality
- What do DOTs have to say about Quality?

SafetyCon

- Common Rigging Mistakes and How to Avoid Them
- Construction and Suicide – How Company Policy Can Support Team Mental Health
- Developing and Executing Detailed Erection Plans for Safe and Effective Erection
- Disasters and How to Avoid Them
- Effective use of Technology in the Field to Manage Safety, Quality, Non-conformance and Schedule
- Intelligent Safety: Embracing AI for Safety Management
- OSHA Regulatory Update: How Industry Should Prepare for an Uptick in OSHA Inspections and Penalties
- OSHA Subpart R Steel Erection—Understanding, Bidding and Executing
- Productivity, Production, Quality & Safety of Human Performance
- Risk Management
- The Important Connection Between RCA and FMEA
- Top Ten Things in Crane Safety
- Turning Pain into Purpose—From Leadership Burnout to Mental Health Advocate

SEICon24

- Advancements and Challenges in Fire Engineering Codes and Standards: Implications for Practicing Engineers
- Agreement Basics for Engineers
- ASCE 41-23: A First Look
- ASCE 7 Development, *IBC* Adoption and Changes in the 2022 Standard
- ASCE at work in Washington: The Biden Administration's National Initiative to Advance Building Codes
- Blast Hardening and Environmental Sustainability
- Blast: Challenging the Standard
- Building a Better Structural Engineer—Using Improvisation to Improve Communication
- Business Issues Roundtable Discussion Hosted by CASE
- Case Studies of Complex Girder Erection and Temporary Works
- Climate Change and Structural Loads
- Considerations in Steel Modular Design and Fabrication
- Design of Safety-Related Structures
- Designing Façades for Damage—Delegated Design for Hurricane & Blast Resistance
- Development of Design Criteria for Functional Recovery: 2026 NEHRP and ASCE 7-28
- Education and CROSS a "Win-Win"
- Energy Transition Storage Challenges
- Engaging the Next Generation of Engineers
- Fastening Forward: Recent Changes, Current Gaps, and Ongoing Challenges in Concrete Connections.
- From New to Normal: Bringing Ideas to Life
- Innovations in Modular, Rapidly Erectable, and Deployable Structures
- Loads on Temporary Structures—2024 *IBC* and ASCE 7-28
- Machine Learning in Risk Analyses of Structural Engineering
- NBIS & SNBI: Implementing the New National Bridge Inspection Standards & Specifications
- New Build or Retrofit—Educating (and Education) of the Structural Engineering Profession About JEDI
- Performance-Based Design: Current State of the Art
- Reconnaissance Observations from the Kahramanmaras Turkey Earthquake Sequence
- SEI Keynote | Cities of the Future
- Sharing the Stories of Real Claims: A Panel Discussion
- Stainless Steel Design with ASCE 8-22
- Structural Reliability in Practice
- The "Customer" Speaks—Structural Engineering Education and Professional Development from the Eyes of Current Students and Recent Grads.
- The Future of the Structural Engineering Profession & Embodied Carbon Part I – Calculations with the SEI Pre-standard
- The Future of the Structural Engineering Profession & Embodied Carbon Part II – Making the Commitment with SE 2050
- The New Disproportionate Collapse Mitigation Standard
- Understanding How Your Cost Accounting and Financial Systems Change Your Organizations Behavior
- Updates to ASCE 7 Chapter 5 Flood Loads

SSRC Annual Stability Council

Session list can be found at **aisc.org/nascc**.

NASCC: THE STEEL CONFERENCE
2024 EXHIBITOR LIST
(As of November 27, 2023)

Color Key: Safety Pavilion Exhibitor
Bridge Pavilion Exhibitor

3D Engineering Global LLC
booth 1565
www.3deglobal.com

AA Anchor Bolt, Inc.
booth 1742
www.aaanchorbolt.com

Abrafast.com / The Blind Bolt Co.
booth 1928
www.abrafast.com

Acrow Bridge
booth 1764
www.acrow.com

Action Stainless & Alloys
booth 1667
www.actionstainless.com

AFF Design Services Inc.
booth 1153
www.affsteel.com

Agen – Robotic Structural Steel Assembler
booth 116
www.abkaotomasyon.com

AGT Robotics
booth 313
www.agtrobotics.com

AKS Cutting Systems
booth 1058
akscutting.com

AKYAPAK USA
booth 633
www.akyapakusa.com

Albina Co. Inc.
booth 1653
www.albinaco.com

Allegheny Coatings
booth 1665
www.all-coat.com

Allfasteners
booth 1659
allfasteners.com

Allied Machine & Engineering
booth 122
www.alliedmachine.com

All-Pro Fasteners, Inc.
booth 2029
www.apf.com

American Galvanizers Association
booth 2043
www.galvanizeit.org

American Institute of Steel Construction (AISC)
booth 1863
www.aisc.org

American Punch Company
booth 811
americanpunchco.com

American Steel Detailing, LLC
booth 1937
americansteeldetailing.com

AMPP
booth 2014
ampp.org/home

Anatomic Iron Steel Detailing
booth 1645
www.anatomiciron.com

Anthem Anchor Bolt and Fasteners, LLC
booth 1561
www.anthemabf.com

Applied Bolting Technology, Inc.
booth 1329
www.appliedbolting.com

Applied Software Graitec Group
booth 1429
www.graitec.com

ArcelorMittal International
booth 1134
www.arcelormittal.com

Armatherm Thermal Bridging Solutions
booth 1631
www.armatherm.com

Arrow Reload Systems Inc.
booth 2045
arrow.ca/reload

Arteras Inc.
booth 1830
arteras-inc.com

ASC Steel Deck
booth 2061
ascsd.com

Association of Women in the Metal Industries
booth 2065
www.awmi.org

Atema Inc.
booth 1728
www.atema.com

ATF WORLD Inc.
booth 1153
www.atfworld.com

Atlas Tube, A Division of Zekelman Industries
booth 1309
www.atlastube.com

Automated Layout Technology LLC
booth 201
www.automatedlayout.com

AYARI LLC
booth 1948
www.ayariventure.com

AZZ Metal Coatings
booth 821
www.azz.com

Baco Enterprises Inc.
booth 1446
www.bacoent.com

Bamal Fastener Corporation
booth 1754
www.bamal.com

Be Pro Be Proud, Inc.
booth 2231
www.beprobeproud.org

Beamcut Systems / Machitech Automation
booth 232
www.beamcut.com

Bend-Tech
booth 119
www.bend-tech.com

Bentley Systems, Inc.
booth 1409
www.bentley.com

Birch Hill LLC
booth 1649
birchhillco.com

Birmingham Fastener
booth 1430
www.bhamfast.com

Blackstone Group Technologies
booth 2023
bgtek.com

Blair Corporation
booth 1630
www.blairwirerope.com

Bluebeam
booth 1023
www.bluebeam.com

BlueRecruit
booth 2149
bluerecruit.us

Boss Tables
booth 751
www.bosstables.com

Bosworth Steel Erectors, LLC
booth 2052
www.bosworthsteel.com

Brainstorm Infotech
booth 2005
www.brainstorminfotech.co.in

Brown Strauss Steel
booth 1345
www.brownstrauss.com

Bryzos
booth 1660
www.bryzos.com

Bull Moose Tube Company
booth 1547
www.bullmoosetube.com

Bureau Veritas North America
booth 1826
www.bvna.com

CADeploy, Inc.
booth 1225
www.cadeploy.com

CALDIM Engineering Pvt. Ltd.
booth 1860
caldimengg.com

CAMBCO, Inc.
booth 1240
www.cambcoinc.com

Canam Group
booth 1323
www.canam.com

Carboline
booth 1364
www.carboline.com

Cascade Nut and Bolt Co.
booth 1704
www.cascadenutandbolt.com

Cast Connex Corporation
booth 1011
www.castconnex.com

C-BEAMS
booth 1858
www.c-beams.com

Cerbaco Ltd.
booth 1250
www.cerbaco.com

Chicago Clamp Company
booth 1440
chicagoclampcompany.com

Chicago Metal Rolled Products
booth 1122
www.cmrp.com

Cleveland City Forge
booth 1516
www.clevelandcityforge.com

Cleveland Punch & Die Co.
booth 927
www.clevelandpunch.com

Cleveland Steel Tool
booth 1808
www.clevelandsteeltool.com

Color Works Painting, Inc.
booth 1755
www.ColorWorksPainting.com

Columbia Safety and Supply
booth 1941
www.colsafety.com

Combilift
booth 132
www.combilift.com

COMSLAB
booth 1629
www.comslab-usa.com

Con-Serv Inc.
booth 1628
www.con-servinc.com

Controlled Automation, Inc.
booth 625
controlledautomation.com

Copper State Bolt & Nut Co.
booth 1843
www.copperstate.com

Cordeck
booth 2051
www.cordeck.com

CoreBrace
booth 921
www.corebrace.com

Crystal Clean
booth 1845
www.crystal-clean.com

CSC – Canam Steel Corp.
booth 1235
cscsteelusa.com

CSM Metal Deck
booth 2012
www.metaldecking.com

Cutting Edge Steel & Stair
booth 1947
cesteel.com

CWB Group
booth 1840
www.cwbgroup.org

D.S. Brown
booth 1746
dsbrown.com

DACS, Inc.
booth 1512
www.dacsinc.com

Daito Seiki Co., LTD
booth 942
www.daitousa.com

Danny's Construction Company, LLC
booth 1829
dannysconstruction.com

DAVI, Inc.
booth 1146
www.davi.com

DBM VirCon
booth 1613
www.dbmvircon.com

Delta Steel, Inc.
booth 1015
www.deltasteel.com

DGS Technical Services, Inc.
booth 1145
www.dgsts.com

Dlubal Software, Inc.
booth 1204
www.dlubal.com

Doerken Coatings North America
booth 2008
www.doerken.com/us/en/doerken-coatings

DOT Quality Services
booth 1728
www.dotqs.com

DuraFuse Frames
booth 910
www.durafuseframes.com

Eastern Pneumatics & Hydraulics, Inc./
McCann Equipment Ltd.
booth 1342
www.ephtools.com

EHS Momentum, LLC
booth 1844
www.ehsmomentum.com

EMI
booth 1158
www.emiworks.com

ENERCALC
booth 1925
enercalc.com

Engineered Rigging
booth 1709
EngineeredRigging.com

Enidine
booth 1725
www.itt-infrastructure.com

EVER Seismic, LLC
booth 1331
www.everseismic.com

Exact Detailing
booth 1433
www.exactdetailing.com

Fabreeka International, Inc.
booth 1716
www.fabreeka.com

Fabricators & Manufacturers Association
booth 124
fmamfg.org

FabStation by Eterio Realities
booth 1365
fabstn.com

FATZER AG
booth 1743
www.fatzer.com

Fenagh Engineering & Testing
booth 2036
fenaghengineering.com

FICEP Corporation
booth 425
www.ficepcorp.com

Fickett Structural Solutions
booth 1955
www.fickettinc.com

Flame On, Inc.
booth 1748
flameoninc.com

Fontana Fasteners, Inc.
booth 1617
fontanagruppoagtna.com

Gas Innovations
booth 1563
gasinnovations.com

GEKA USA
booth 743
www.gekaus.com

Gerdau
booth 1441
www.gerdau.com

GIZA
booth 1133
www.gizasteel.com

Gonza Joist
booth 1911
www.gonzajoist.mx

Grating Fasteners
booth 1822
www.gclips.com

Greenbrook Engineering Services
booth 1535
greenbrookengineering.com

GRM Custom Products
booth 1919
www.grmcp.com

GWY, LLC
booth 1434
www.gwyinc.com

Harbor Fab
booth 1151
www.harborfab.com

Haydon Bolts, Inc.
booth 1209
www.haydonbolts.com

HEICO Fastening Systems
booth 1463
www.heico-lock.us

Hercules Bolt Company
booth 1417
www.herculesbolt.com

HEXAGON
booth 1605
hexagonppm.com

Hilti Inc.
booth 1511
www.hilti.com

HI-Q DESIGN Inc.
booth 1817
www.hiqdesigninc.com

Holemaker Technology HMT
booth 1659
holemaker-technology.com

Holloway Houston, Inc.
booth 1558
www.hhilifting.com

Holloway Steel Services
booth 1910
www.hollowaysteelservices.com

HRV Conformance Verification Associates, Inc.
booth 1745
www.hrvinc.com

HYTORC
booth 1712
www.hytorc.com

IAPMO Uniform Evaluation Service
booth 1909
www.uniform-es.org

IDEA StatiCa US LLC
booth 1405
www.ideastatica.com

ideCAD
booth 2032
idecad.com

IES, Inc.
booth 1619
www.iesweb.com

IKG
booth 1834
ikg.com

Indiana Grating Pvt. Ltd.
booth 1933
www.indianagroup.com

Indiana Steel Products, Inc.
booth 1946
www.indianasteelproducts.com

Infasco
booth 1740
www.infasco.com

Informed Infrastructure
booth 2028
www.informedinfrastructure.com

InfoSight Corporation
booth 1035
www.infosight.com

Infra-Metals Co.
booth 1015
www.infra-metals.com

InnovaTech
booth 115
www.innova.tech

International Design Services, Inc.
booth 1133
www.ids-inc.net

MORE EXHIBITORS >>

<< MORE EXHIBITORS

(As of November 27, 2023)

International Zinc Association
booth 1765
www.zinc.org

Interstate Gratings
booth 1915
www.interstategratings.com

Ironworkers / IMPACT
booth 2047
www.impact-net.org

IRyS Global Inc.
booth 1905
www.irysglobal.com

ISC
booth 1908
efc-intl.com

ISD Group USA
booth 1929
www.isdgroup.us

J. B. Long, Inc.
booth 1047
www.jblong.com

JH Botts LLC
booth 1209
www.jhbotts.com

JMT Consultants Inc.
booth 1624
www.jmtconsultants.com

Kinetic Cutting Systems, Inc.
booth 432
www.kineticusa.com

Kloeckner Metals
booth 1564
www.kloecknermetals.com

Kobelco Welding of America
booth 102
www.kobelcowelding.com

Kottler Metal Products, Inc.
booth 1529
www.kottlermetal.com

KTA-Tator
booth 1733
kta.com

Lampson International
booth 1753
www.lampsoncrane.com

LAP Laser LLC
booth 1510
www.lap-laser.com

Lapeyre Stair
booth 1846
www.lapeyrestair.com

LARSA, Inc.
booth 1723
www.larsa4d.com

LeJeune Bolt Company
booth 1005
www.lejeunebolt.com

Lichtgitter USA
booth 1759
www.lichtgitterusa.com

Lincoln Electric Company
booth 712
www.lincolnelectric.com/en

Lindapter
booth 1635
www.Lindapter.com

LNA Solutions
booth 1343
www.lnasolutions.com

LS Industries
booth 1247
www.lsindustries.com

LTC Virtual Design and Construction
booth 1041
www.LTCvdc.com

LUSAS
booth 1758
www.lusas.com

Mac-Tech
booth 853
www.mac-tech.com

Magni Telescopic Handlers
booth 1833
www.MagniTH.com

Magnum Consulting
booth 1465
www.4Magnum.com

MARKO Metal Systems
booth 1942
www.markosys.com

Maruichi Leavitt Pipe And Tube
booth 1620
www.maruichi-leavitt.com

Max Weiss Co., LLC
booth 1243
www.maxweiss.com

McLaren Engineering Group
booth 1459
www.mgmclaren.com

Messer Cutting Systems
booth 215
www.messer-cutting.com

Metals USA
booth 817
www.metalsusa.com

MetFin Shotblast Systems
booth 112
www.metfin.com

Meyer Borgman Johnson
booth 1141
www.mbjeng.com

Millennium Galvanizing
booth 2011
www.millenniumgalvanizing.com

Miller Electric Mfg LLC
booth 1351
www.millerwelds.com

Miner Grating Systems, a Powerbrace Company
booth 1809
www.minergrating.com

MOLD-TEK Technologies Inc.
booth 1449
www.moldtekengineering.com

National Institute of Steel Detailing, Inc. (NISD)
booth 2063
www.nisd.org

National Steel Bridge Alliance (NSBA)
booth 1863
aisc.org/nsba

New Millennium
booth 1117
www.newmill.com

Nexus Steel Detailing, Inc.
booth 1750
www.nexus-es.com

Nitto Kohki U.S.A., Inc.
booth 1741
www.nittokohki.com

Nucor – Beam Mill Group
booths 701, 801, 901
www.nucoryamato.com; www.nucor.com/products/Steel-Beam

Nucor – Corporation
booths 701, 801, 901
www.nucor.com

Nucor – Fastener Division
booths 701, 801, 901
www.nucor-fastener.com

Nucor – Plate Mill Group
booths 701, 801, 901
www.nucorhertford.com; www.nucortusk.com

Nucor Skyline
booths 701, 801, 901
www.nucorskyline.com

Nucor Tubular Products
booths 701, 801, 901
www.nucortubular.com

Nucor Vulcraft/Verco Group
booths 701, 801, 901
www.vulcraft.com

NuWave Laser Cleaning
booth 1064
www.nuwavelaser.com

Oates Metal Deck & Building Products, Inc.
booth 2019
oatesmetaldeck.com

Ocean Machinery, Inc.
booth 512
www.oceanmachinery.com

OpenBrIM Platform
booth 1912
openbrim.org

OTH – Remote Controlled Hooks
booth 1828
othrigging.com

Ovation Services LLC
booth 1253
www.4ovation.com

P2 Programs
booth 1333
www.p2programs.com

Pacific Stair Corporation
booth 1609
www.pacificstair.com

Pan Gulf Technologies
booth 1305
www.pangulftech.com

Paramount Roll and Forming, Inc.
booth 1641
www.paramount-roll.com

PDM STEEL
booth 1664
www.pdmsteel.com

Peddinghaus Corporation
booth 400
www.peddinghaus.com

Power of Design Group, LLC
booth 1824
www.podgrp.com

PPG Protective & Marine Coatings
booth 1534
www.ppgpmc.com

Procore
booth 2009
procore.com

Prodevco Robotic Solutions Inc.
booth 832
www.prodevcoind.com

Project + Quality Solutions
booth 1955
www.projectqualitysolutions.com

Qnect LLC
booth 1009
www.qnect.com

Qualis Solutions, LLC
booth 1519
www.qualissolutions.com

Quality Emphasis Steel Solutions Pvt. Ltd.
booth 1464
www.qessindia.com

Qubatic Steel Detailing LLC
booth 1560
www.qubatic.com

QuickFrames USA
booth 1521
www.quickframes.com

R.J. Watson, Inc.
booth 1731
www.RJWatson.com

Radley LLC
booth 1105
www.radley.com/steel

Ray Fu Enterprise Co., Ltd.
booth 1953
www.ray-fu.com

Republic Steel
booth 750
www.republicsteel.com

REX Engineering Group
booth 1651
www.rexeg.com

RISA
booth 911
www.risa.com

Scotchman Industries, Inc.
booth 126
www.scotchman.com

Scougal Rubber Corp.
booth 1751
www.scougalrubber.com

SDS2 by ALLPLAN
booth 915
www.sds2.com

SE University (SEU) by SE Solutions
booth 2059
www.LearnWithSEU.com

Seismic Bracing Company
booth 2022
www.thesbcllc.com

Seyco Joist
booth 750
seycojoist.com

Shandong Hanpu Machinery Industrial Co., LTD
booth 1752
www.hanputool.com

Sherwin-Williams Protective and Marine
booth 1735
protective.sherwin.com

Shop Data Systems, Inc.
booth 1508
www.shopdata.com

Short Span Steel Bridge Alliance
booth 1762
www.shortspansteelbridges.org

SidePlate / MiTek
booth 1423
www.mii.com

Simpson Strong-Tie Co.
booth 1215
www.strongtie.com

Skidmore-Wilhelm
booth 1341
www.skidmore-wilhelm.com

Soitaab USA Inc.
booth 120
www.soitaabusa.com

South Atlantic Galvanizing
booth 1442
www.southatlanticllc.com

SprayTec Coating Solutions, LLC
booth 1747
www.sprayteccoat.com

St. Louis Screw & Bolt
booth 1209
slbolt.com

Stainless Structurals America
booth 1525
www.stainless-structurals.com

Steel and Pipe Supply
booth 1530
www.SteelAndPipe.com

Steel Deck Institute
booth 2058
www.sdi.org

Steel Dynamics Long Products Group
booth 1109
lpg.steeldynamics.com

Steel Erectors Association of America
booth 1862
www.seaa.net

Steel Founders' Society of America
booth 1466
www.sfsa.org

Steel Joist Institute
booth 1959
www.steeljoist.org

Steel Plate
booth 343
www.steelplate.us

Steel Plus Network
booth 1705
www.steelplus.com

Steel Projects Corp.
booth 425
www.steelprojects.com

Steel Tek Unlimited
booth 1346
www.steelteku.com

Steel Tube Institute
booth 1616
www.steeltubeinstitute.org

Steelmax Tools LLC
booth 126
www.steelmax.com

Steelweb Inc.
booth 2041
steelweb.com

Structural Engineering Institute of ASCE
booth 2035
www.asce.org/SEI

Structural Stability Research Council (SSRC)
booth 1864
www.ssrcweb.org

Structures Online
booth 2135
www.structuresonline.net

STRUMIS LLC
booth 1029
www.strumis.com

STRUZON TECHNOLOGIES Inc.
booth 1727
struzon.com

Stubbs Engineering, Inc.
booth 1562
www.stubbseng.com

Sugar Steel Corporation
booth 2004
www.sugarsteel.com

Sumter Coatings, Inc., an Ergon Company
booth 1923
www.sumtercoatings.com

Superior Glove
booth 1855
superiorglove.com

TDS Industrial Services Ltd.
booth 1528
www.tdsindustrial.com

Team Detailing Solutions LLC
booth 1952
teamdetailing.com

Techflow Inc.
booth 1553
www.techflowengg.com

Tectonix Steel, Inc.
booth 1359
www.tectonixsteel.com

Terracon Consultants, Inc.
booth 1811
www.terracon.com

TFe Connection Nr. America
booth 1711
www.tfeconnection.com

Threadline Products, Inc.
booth 2018
threadlineproducts.com

TorcUP Inc.
booth 1467
www.torcup.com

Totten Tubes, Inc.
booth 1662
www.tottentubes.com

Trilogy Machinery, Inc.
booth 1050
www.TrilogyMachinery.com

Trimble
booth 1123
www.tekla.com/us

Triple-S Steel / Intsel Steel
booth 1317
www.sss-steel.com

TRU-FIT PRODUCTS
booth 1950
tfpcorp.com

TurnaSure, LLC
booth 1437
www.turnasure.com

Unite3D Inc.
booth 2122
www.unite3d.com

United Structure Detailing Inc.
booth 2055
unitedstructuredetailing.com

V&S Galvanizing
booth 1034
www.hotdipgalvanizing.com

Valmont Coatings
booth 1708
www.valmontcoatings.com

Vectis Automation
booth 242
www.VectisAutomation.com

Vegazva Technologies
booth 1265
www.vegazva.com

Virtek Vision
booth 1348
www.virtekvision.com

VIRTUELE
booth 1455
www.virtuele.us

Voortman Steel Machinery
booth 125
www.voortman.net

Voss Engineering, Inc.
booth 1517
www.vossengineering.com

Whiteboard Technologies LLC
booth 1623
www.whiteboardtec.com

Working Athlete
booth 1842
www.workingathlete.com

Würth Construction Services
booth 1717
wurthindustry.com/construction

X SERIES USA
booth 642
www.xseriesusa.com

X-Steel Detailing
booth 1145
www.x-steeldetailing.com

Color Key: Safety Pavilion Exhibitor
Bridge Pavilion Exhibitor

CONNECT BY CATEGORY

Exhibitors in this list are divided by category to make it easier to find companies you'd like to connect with in the hall.

1 Bar Coding Systems and Equipment

Armatherm Thermal Bridging Solutions
EHS Momentum, LLC
InfoSight Corporation
P2 Programs
Radley LLC

2 Bender/ Roller

Albina Co. Inc.
Armatherm Thermal Bridging Solutions
CAMBCO, Inc.
Chicago Metal Rolled Products
DAVI, Inc.
Holloway Steel Services
Kottler Metal Products, Inc.
Mac-Tech
Max Weiss Co., LLC
Paramount Roll and Forming, Inc.
Trilogy Machinery, Inc.

3 Bolting and Anchoring Systems

AA Anchor Bolt, Inc.
Abrafast.com/The Blind Bolt Co.
Allfasteners
All-Pro Fasteners, Inc.
Anthem Anchor Bolt and Fasteners, LLC
Armatherm Thermal Bridging Solutions
Baco Enterprises Inc.
Bamal Fastener Corporation
Birmingham Fastener
Cascade Nut and Bolt Company
Copper State Bolt & Nut Co.
Fontana Fasteners, Inc.
Haydon Bolts, Inc.
HEICO Fastening Systems
Hercules Bolt Company
HYTORC
Indiana Steel Products, Inc
JH Botts LLC
LeJeune Bolt Company
Lindapter
LNA Solutions
Nucor – Fastener Division
Ray Fu Enterprise Co., Ltd.
Shandong Hanpu Machinery Industrial Co., Ltd.
St. Louis Screw & Bolt
Threadline Products, Inc.
TRU-FIT PRODUCTS
TurnaSure, LLC
Würth Construction Services

4 Bridge Components and Systems

AA Anchor Bolt, Inc.
Acrow Bridge
Applied Software Graitec Group
Armatherm Thermal Bridging Solutions
Cast Connex Corporation
Cleveland City Forge
Con-Serv Inc.
Controlled Automation, Inc.
D.S. Brown
DGS Technical Services, Inc.
Fabreeka International, Inc.
FICEP Corporation
GRM Custom Products
LUSAS
National Steel Bridge Alliance
Nucor – Corporation
Nucor Skyline
R.J. Watson, Inc.
Ray Fu Enterprise Co., Ltd.
Scougal Rubber Corp.
Short Span Steel Bridge Alliance
TFe Connection N America
Würth Construction Services

5 Career Services

Be Pro Be Proud, Inc.
BlueRecruit

6 Coatings and Fire Protection

Allegheny Coatings
AMPP
Carboline
Color Works Painting, Inc.
Doerken Coatings North America
International Zinc Association
Magni Telescopic Handlers
PPG Protective & Marine Coatings
Sherwin-Williams Protective and Marine
South Atlantic Galvanizing
SprayTec Coating Solutions, LLC
Sumter Coatings, Inc., an Ergon Company
Valmont Coatings

7 Cranes and Lifts

Combilift
Engineered Rigging
Holloway Houston, Inc.
Lampson International
OTH – Remote Controlled Hooks

8 Detailers

3D Engineering Global LLC
AFF Design Services Inc.
American Steel Detailing, LLC
Anatomic Iron Steel Detailing
Arteras Inc.
ATF WORLD Inc.
AYARI LLC
Blackstone Group Technologies
Brainstorm Infotech
CADeploy, Inc.
CALDIM Engineering Pvt. Ltd.
DBM VirCon
DGS Technical Services, Inc.
Exact Detailing
GIZA
Greenbrook Engineering Services
HI-Q DESIGN INC
International Design Services, Inc.
J. B. Long, Inc.
JMT Consultants Inc.
LTC Virtual Design and Construction
Magnum Consulting
MOLD-TEK Technologies Inc.
National Institute of Steel Detailing, Inc.
New Millennium
Nexus Steel Detailing, Inc.
Ovation Services LLC
Pan Gulf Technologies
Qualis Solutions, LLC
Quality Emphasis Steel Solutions Pvt. Ltd.
Qubatic Steel Detailing LLC
SDS2 by ALLPLAN
Steel Tek Unlimited
Steelweb Inc.
Structures Online
STRUZON TECHNOLOGIES Inc.
TDS Industrial Services Ltd.
Team Detailing Solutions LLC
Techflow Inc.
Tectonix Steel, Inc.
United Structure Detailing Inc.
Vegazva Technologies
VIRTUELE
Whiteboard Technologies LLC
X-Steel Detailing

9 Engineering Consulting

3D Engineering Global LLC
AFF Design Services Inc
Atema Inc.
ATF WORLD Inc.
AYARI LLC
Birch Hill LLC
CALDIM Engineering Pvt. Ltd.
CWB Group
DBM VirCon
DGS Technical Services, Inc.
DOT Quality Services
DuraFuse Frames
Engineered Rigging
Fenagh Engineering & Testing
GIZA
Greenbrook Engineering Services
GRM Custom Products
HI-Q DESIGN INC
HRV Conformance Verification Associates, Inc.
IAPMO Uniform Evaluation Service
Lapeyre Stair
Magnum Consulting
McLaren Engineering Group
Meyer Borgman Johnson
New Millennium
Power of Design Group, LLC
REX Engineering Group
Short Span Steel Bridge Alliance
SidePlate / MiTek
Steel Tube Institute
Stubbs Engineering, Inc.
Terracon Consultants, Inc.
United Structure Detailing Inc.
Vegazva Technologies
VIRTUELE
X-Steel Detailing

10 Erectors

Bosworth Steel Erectors, LLC
Danny's Construction Company, LLC
Ironworkers / IMPACT
OTH – Remote Controlled Hooks
Steel Erectors Association of America

11 Fabrication Equipment/ Tools and Accessories

Abrafast.com / The Blind Bolt Co.
AGT Robotics
AKS Cutting Systems
Allied Machine & Engineering
American Punch Company
Automated Layout Technology LLC
Beamcut Systems / Machitech Automation
Bend-Tech
Boss Tables
C-BEAMS
Cleveland Punch & Die Co.
Cleveland Steel Tool
Controlled Automation, Inc.
Daito Seiki Co., LTD
DAVI, Inc.
Eastern Pneumatics & Hydraulics, Inc./ McCann Equipment Ltd.
EMI
FabStation by Eterio Realities
FICEP Corporation
Gas Innovations
GEKA USA
GRM Custom Products
GWY, LLC
Hilti Inc.
Holemaker Technology HMT
HYTORC
InnovaTech
Kinetic Cutting Systems, Inc.
LAP Laser LLC
Lincoln Electric Company
LS Industries
Mac-Tech
Messer Cutting Systems
NuWave Laser Cleaning
Ocean Machinery, Inc.
Peddinghaus Corporation
Prodevco Robotic Solutions Inc.
Ray Fu Enterprise Co., Ltd.
Scotchman Industries, Inc.
Shandong Hanpu Machinery Industrial Co., LTD
Soitaab USA Inc
Steelmax Tools LLC
TorcUP Inc.
Trilogy Machinery, Inc.
TRU-FIT PRODUCTS
Vectis Automation
Virtek Vision
Voortman Steel Machinery
X SERIES USA

>>

12 Galvanizers

American Galvanizers Association
AZZ Metal Coatings
Doerken Coatings North America
Millennium Galvanizing
South Atlantic Galvanizing
V&S Galvanizing

13 Grating and Grating Fasteners

Grating Fasteners
IKG
Indiana Grating Pvt. Ltd.
Interstate Gratings
Lichtgitter USA
Miner Grating Systems, a Powerbrace Company

14 HSS Manufacturers

Atlas Tube, A Division of Zekelman Industries
Bull Moose Tube Company
Maruichi Leavitt Pipe and Tube
Nucor Tubular Products
Steel Tube Institute

15 Joists and Deck

ASC Steel Deck
ATF WORLD Inc.
Canam Group
COMSLAB
CSC – Canam Steel Corp.
CSM Metal Deck
D.S. Brown
DACS, Inc.
Gonza Joist
IAPMO Uniform Evaluation Service
MARKO Metal Systems
New Millennium
Nucor – Corporation
Nucor Vulcraft/Verco Group
Oates Metal Deck & Building Products, Inc.
Ray Fu Enterprise Co., Ltd.
Seyco Joist
Steel Deck Institute
Steel Joist Institute

16 Marking and Traceability

FabStation by Eterio Realities
Messer Cutting Systems
Virtek Vision

17 Materials, Engineering, Testing and Inspection

Arrow Reload Systems Inc.
ATF WORLD Inc.
Bureau Veritas North America
Carboline
Doerken Coatings North America
FabStation by Eterio Realities
Fickett Structural Solutions
HYTORC
IAPMO Uniform Evaluation Service
New Millennium
Project + Quality Solutions
Terracon Consultants, Inc.

18 Mills

ArcelorMittal International
Gerdau
Nucor – Beam Mill Group
Nucor – Plate Mill Group
Republic Steel
Stainless Structurals America
Steel Dynamics Long Products Group

19 Other

AA Anchor Bolt, Inc.
AMPP
Association of Women in the Metal Industries
Cleveland Punch & Die Co.
Crystal Clean
Cutting Edge Steel & Stair
CWB Group
DBM VirCon
Eastern Pneumatics & Hydraulics, Inc./McCann Equipment Ltd.
Fabricators & Manufacturers Association
Flame On, Inc.
Holloway Houston, Inc.
HYTORC
Infasco
Informed Infrastructure
KTA-Tator
Lapeyre Stair
Magni Telescopic Handlers
National Steel Bridge Alliance
Nitto Kohki U.S.A., Inc.
OTH – Remote Controlled Hooks
SE University (SEU) by SE Solutions
Short Span Steel Bridge Alliance
Simpson Strong-Tie Co.
Steel Erectors Association of America
Steel Plate
Steel Plus Network
Structural Engineering Institute of ASCE
Structural Stability Research Council
Superior Glove
Terracon Consultants, Inc.
Unite3D Inc.
Voss Engineering, Inc.

20 Safety Equipment

Columbia Safety and Supply
EHS Momentum, LLC
GWY, LLC
Lapeyre Stair
OTH – Remote Controlled Hooks
Skidmore-Wilhelm
Working Athlete

21 Software

Applied Software Graitec Group
Bend-Tech
Bentley Systems, Inc.
Birch Hill LLC
Bluebeam
BlueRecruit
Bryzos
Controlled Automation, Inc.
DBM VirCon
Dlubal Software, Inc.
EHS Momentum, LLC
ENERCALC
FabStation by Eterio Realities
GIZA
HEXAGON
IDEA StatiCa US LLC
ideCAD
IES, Inc.
IRyS Global Inc.
ISD Group USA
LARSA, Inc.
LTC Virtual Design and Construction
LUSAS
Messer Cutting Systems
OpenBrIM Platform
Procore
Prodevco Robotic Solutions Inc.
Qnect LLC
Radley LLC
RISA
SDS2 by ALLPLAN
Shop Data Systems, Inc.
Simpson Strong-Tie Co.
Steel Projects Corp
Steel Tek Unlimited
STRUMIS LLC
Trimble
Unite3D Inc.
VIRTUELE

22 Steel Service Centers

Action Stainless & Alloys
Baco Enterprises Inc.
Brown Strauss Steel
Delta Steel, Inc.
Infra-Metals Co.
Kloeckner Metals
Metals USA
PDM STEEL
Steel and Pipe Supply
Steel Plate
Sugar Steel Corporation
Totten Tubes, Inc.
Triple-S Steel / Intsel Steel

23 Structural Systems and Components

Agen – Robotic Structural Steel Assembler
AKYAPAK USA
Applied Bolting Technology, Inc.
Blair Corporation
CALDIM Engineering Pvt. Ltd.
Cast Connex Corporation
C-BEAMS
Chicago Clamp Company
Cleveland City Forge
COMSLAB
Con-Serv Inc.
Controlled Automation, Inc.
Cordeck
CoreBrace
Cutting Edge Steel & Stair
DGS Technical Services, Inc.
Doerken Coatings North America
Enidine
EVER Seismic, LLC
FATZER AG
Fontana Fasteners, Inc.
GRM Custom Products
Harbor Fab
IAPMO Uniform Evaluation Service
ISC
Kobelco Welding of America, Inc.
Lapeyre Stair
LS Industries
Mac-Tech
MetFin Shotblast Systems
Nexus Steel Detailing, Inc.
Nucor – Corporation
Nucor Skyline
Nucor Vulcraft/Verco Group
OTH – Remote Controlled Hooks
Pacific Stair Corporation
QuickFrames USA
Seismic Bracing Company
SidePlate / MiTek
Simpson Strong-Tie Co.
Steel Founders' Society of America
Steel Tube Institute
TRU-FIT PRODUCTS
X SERIES USA

24 Welding and Stud Material

AA Anchor Bolt, Inc.
AGT Robotics
Cerbaco Ltd.
CWB Group
Gas Innovations
Haydon Bolts, Inc.
Lincoln Electric Company
Mac-Tech
Miller Electric Mfg LLC
TRU-FIT PRODUCTS
Vectis Automation

NASCC: THE STEEL CONFERENCE

SAN ANTONIO | MARCH 22–24 | aisc.org/nascc

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NASCC: The Steel Conference

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Bray Bourne, Universal Steel
Tim Bradshaw, Owen Steel Company
Casey Brown, Zimcor LLC
Jeff Carlson, NSBA
Ken Charles, Steel Joist Institute
Erin Conaway, AISC
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CAPS

Chris Crosby (Chair), Schuff Steel Company
Glenn Tabolt (Board Oversight), STS Steel, Inc.
Todd Alwood, AISC
Luke Faulkner, AISC
Steve Davis, WEOGA / WMSI
Matt Kawczenski, Lindaptor International
Nyckey Heath, Texas DOT
Angela Cotie, Bartlett Cock General Contractors
Tim Bradshaw, Owen Steel Company

World Steel Bridge Symposium

Glenn Tabolt (Chair, Board Oversight), STS Steel, Inc.
Michel Bruneau, University at Buffalo-SUNY
Brandon Chavel, Michael Baker International, LLC
John Hastings, HDR
Matt Hebdon, University of Texas at Austin
Chris Higgins, Oregon State University
Finn Hubbard, Fickett Structural Solutions
Charles Hunley, Michael Baker International
Jason Lloyd, Nucor Steel
Natalie McCombs, HNTB
Jennifer McConnell, University of Delaware
Sean Peterson, W&W | AFCO Steel
Ryan Sherman, Georgia Institute of Technology
Geoff Swett, WSDOT – Bridge and Structures Office
Dayi Wang, FHWA
Jeff Carlson (Secretary), NSBA
Scott Melnick (Advisory), AISC

SafetyCon

John Schuepbach (Chair), Phoenix Solutions Group International
Casey Brown, Zimcor LLC
Wayne Creasap, The Association of Union Contractors
Steve Davis, WEOGA / WMSI
Kathleen Dobson, Hillsdale Fabricators, a division of Alberici
James Rivera, SME Steel Contractors
Brian Smith, SME Steel Contractors
Harvey Swift, IMPACT
Ben Thornburg, Drake-Williams Steel
Conrad Weidenkeller, Braff Companies
Scott Melnick (Secretary), AISC
Todd Weaver (Board Oversight), Metals Fabrication Company, Inc.

Architecture in Steel

Dave Eckmann (Vice Chair), Magnusson Klemencic Associates
Jeanne Homer (Secretary), AISC
Brian Burnett, Page Southerland Page
Paul Miller, Schorr Architects, Inc.
Alex Morales, Cushman & Wakefield
Hunter Ruthrauff, T.Y. Lin International
Brian Tabolt, Diller Scofidio + Renfro
Michele Van Hyfte, Michele L. Van Hyfte, AIA
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Todd Weaver (Board Oversight), Metals Fabrication Company, Inc.