Modern Steel Construction

May 2025

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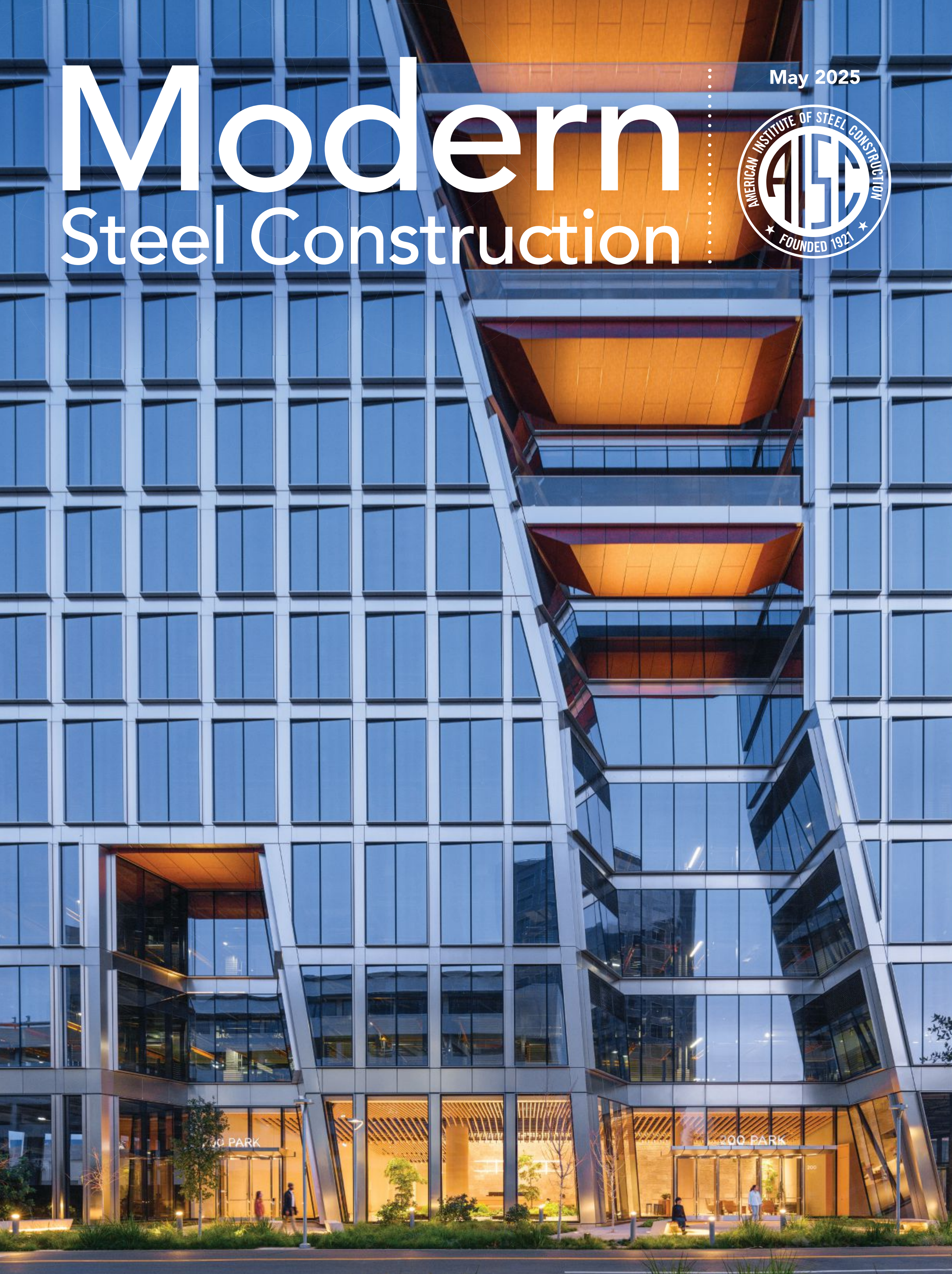


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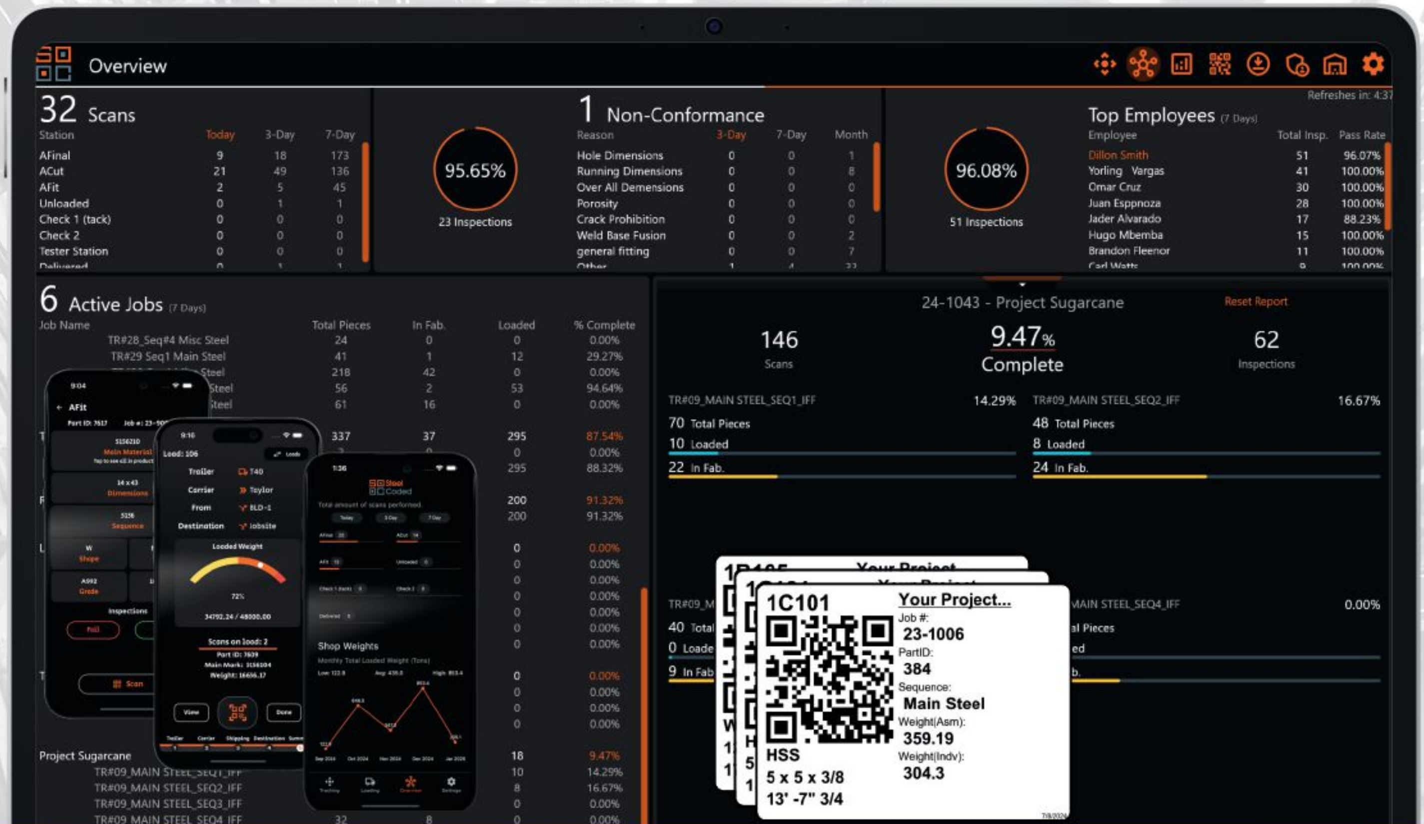

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Modern
Steel Construction

May 2025

in every issue

features

columns

ON THE COVER: An office building in California is the second U.S. structure designed and built with SpeedCore, p. 24. (Photo: Jason O'Rear)

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editor's note

For some, travel is a luxury. For others, it's constant to the point of being mundane. For me, it seems to happen in fits and starts—which perhaps is one thing that makes me enjoy and appreciate it and not take it for granted.

In last month's editor's note, I reminisced about a recent trip to New York City. You saw me standing on one of the most famous steel bridges in the world—the Brooklyn Bridge—and above, you can see me at Madison Square Garden, "The world's most famous arena." Next week (as of this writing), I'll be heading to the Pacific Northwest for our son's spring break. Immediately following that, it's off to Louisville for NASCC: The Steel Conference, then to Pomona, Calif., for a regional Student Steel Bridge Competition event.

You can take you own coast-to-coast tour of the U.S. starting on page 24. This trip takes the form of AISC's 2025 IDEAS^2 Award winners. Back in the Big Apple, head up to the Top of the Rock, high atop 30 Rockefeller Plaza, where you can experience renovations to the observation deck, including an opportunity to recreate the famous 1930s "Lunch Atop a Skyscraper" photograph. From there, you can skip across town to PENN 2, which sits adjacent to—wait for it—Madison Square Garden. The updated 1960s office building sports a new 75-ft by 450-ft addition that's held aloft by a series of sloped columns configured around an existing trainshed.

The American Southwest boasts two winners, one functional and efficient yet also an aesthetic outlier for a community college, and the other a glittering statement in a city of glittering statements. The first is the Advanced Manufacturing Center at Pima Community College in Tucson, Ariz., a new industrial learning facility whose classrooms and labs open to the outdoors to extend spaces for project-based learning. The building's structural highlight is a 10-ton underslung bridge crane that transverses the building's length.

Heading over to Las Vegas, you can visit Sphere—which, honestly, might have taken over as the world's most famous arena. The opulent orb is a 17,600-seat performing arts center and is structurally defined by a curved hollow structural section (HSS) exoskeleton that supports 580,000 sq. ft of programmable LED lighting.

Finally, the Bay Area—specifically downtown San Jose—is home to the world's second SpeedCore project (the first being Rainier Square in Seattle), 200 Park. The 19-story, 300-ft-tall office tower is the city's tallest building, and if you're wondering why the SpeedCore system was chosen, well, the answer is in the name; the building was completed three months faster than it would have been had a traditional frame been used. If you'd like to learn more about SpeedCore, head to **aisc.org/speedcore**.

All five winners demonstrated an exemplary fusion of structural engineering and architecture in their own ways and set the tone for future top-tier steel projects. Congratulations to this year's winners!

Geoff We—

Geoff Weisenberger
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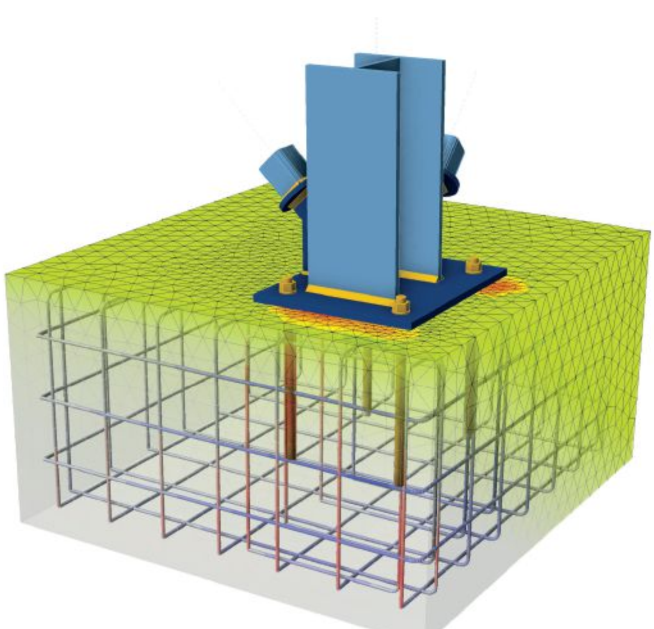
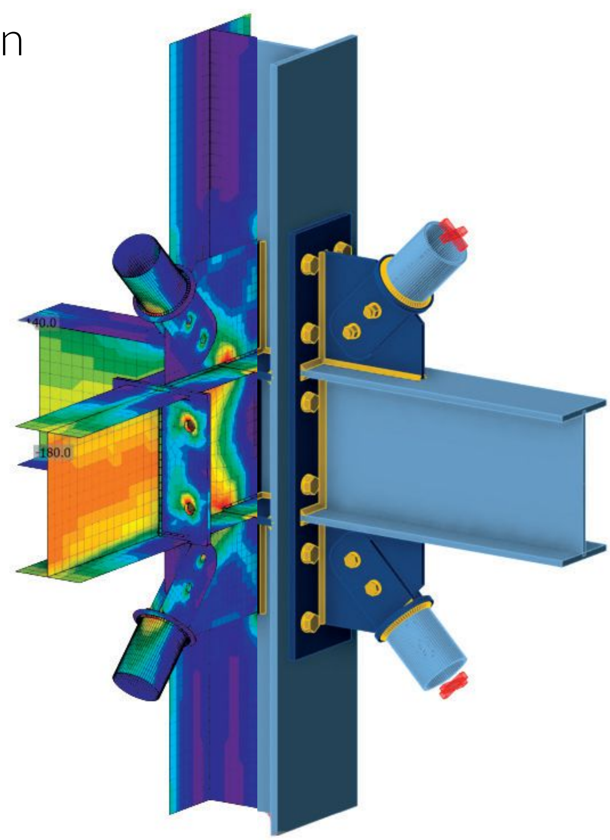


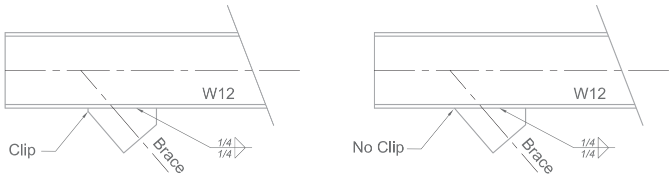


If you've ever asked yourself "Why?" about something related to structural steel design or construction, *Modern Steel*'s monthly Steel Interchange is for you! Send your questions or comments to **solutions@aisc.org**.

Gusset Plate Geometry

For welding a gusset to a beam flange, as shown in the figure below, is it more common to provide a clip or to leave the gusset with a knife edge?

Common practice would be to clip the gusset plate (1-in. clip, for example). However, providing no clip and leaving it as a knife edge is acceptable.



If no clip is provided, the ¼-in. fillet weld will only be effective if there is room to deposit the ¼-in. legs of the fillet weld. Once the knife edge is reduced beyond this, the fillet welds are no longer fully effective.

Figure 8-13 in the 16th Edition AISC *Steel Construction Manual* provides recommended minimum shelf dimensions for fillet welds. For a ¼-in. fillet weld, the recommended minimum shelf dimension, b, is equal to the fillet weld size plus ¼ in. or ½ in. One does not need to be concerned about the shelf dimension or the effectiveness of the weld when a clip is provided.

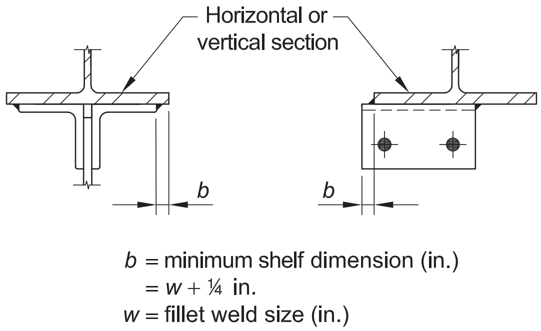


Fig. 8-13. Recommended minimum shelf dimensions for fillet welds.

Larry Muir, PE

Structural Engineer Becoming a CWI

Is becoming a certified welding inspector (CWI) practical for a structural engineer? Is the time and cost associated with getting certified worthwhile for a design structural engineer?

Yes. There are some engineers who are also CWIs. Generally, any knowledge and skill can be useful, sometimes in ways not considered when the knowledge or skill was obtained. Having a CWI might help engineers dodge disputes that arise from welding issues or a lack of understanding about welding.

Additionally, an engineer who is a CWI could perform more of the work involved with special inspections. I know some engineers have found special inspections to be viable revenue streams.

Larry Muir, PE

Effects of Deck Shrinkage

The AISC *Steel Bridge Design Handbook* mentions that AASHTO assumes "minor slip at the steel-concrete interface" and, as a result, shrinkage is disregarded in the negative moment region.

I'm conducting an elastic analysis for a three-span bridge and am encountering significant bending moments over the supports due to secondary shrinkage (differential shrinkage). The strength load combination includes a 1.25 CR and SH factor, which I haven't seen applied in any examples by AISC, FHWA, or similar references.

I would like to understand the reasoning behind this, and whether it is appropriate to assume minimal effects based on the assumption of minor slip and cracking.

In typical continuous and composite steel girders, the effects of concrete deck shrinkage tend to counteract the negative moments over interior supports (concrete deck shrinkage induces compression in the top flange). Also, as indicated in the *Steel Bridge Design Handbook* (download for free at **aisc.org/sbdh**) shrinkage forces are assumed to be partially or fully ineffective due to minor slip at the shear connectors and cracking in the concrete deck. Once slip or cracking occurs, shrinkage stresses are relieved. The analysis should be reviewed to determine if the effects of slip at the deck-girder interface and shrinkage cracking are being appropriately captured.

Similar guidance to Chapter 4 of the *Handbook* is provided in the reference manual for NHI Course 130081: LRFD for Highway Bridge Superstructures (herein NHI Reference Manual). Section 6.4.2.3.2.2 of this reference manual discusses the effects of creep and shrinkage for steel girder superstructures. Within this section, it states, "Shrinkage stresses cannot exceed the modulus of rupture of the deck concrete."

In other words, concrete shrinkage can only impose stresses up to the point of concrete cracking. Furthermore, the same section of the NHI Reference Manual states, "In the negative moment regions of a girder, the deck is considered ineffective by the fact that it is assumed cracked." This is consistent with the requirements in the AASHTO *LRFD Bridge Design Specifications*, where the concrete deck is neglected when determining the girder's flexural resistance in the negative moment region.

As far as load combinations, the AASHTO *Specifications* do not explicitly include creep and shrinkage loads (CR and SH) for the design of composite steel girders. This applies to the 9th Edition of the AASHTO *Specifications*, which the *Handbook* is based on, and the recently released 10th Edition. The one exception to this, as stated in Article 3.4.1 of the AASHTO *Specifications*, is when "prestressed components are used in conjunction with steel girders, the force effects from the following sources shall be considered as construction loads, EL: …the effects of differential creep and shrinkage of the concrete."

This is discussed further at the end of Section 6.3.3 of Chapter 4 of the *Handbook*. In no case is the load factor for CR and SH taken as 1.25 for steel superstructures in the AASHTO *Specifications*, as noted in Table 3.4.1-3.

Travis Hopper, PE

Travis Hopper (hopper@aisc.org) is a bridge steel specialist in AISC's Steel Solutions Center. **Larry Muir** is a consultant to AISC.

steel quiz

This month's quiz investigates the newly released Design Guide 16: *Assessment and Repair of Structural Steel in Existing Buildings*. This Design Guide fills an empty spot in AISC's Design Guide Series; the prior Design Guide 16 has been superseded by Design Guide 39: *End-Plate Moment Connections*. Download or order your copy at **aisc.org/dg**.

1 The *International Existing Building Code (IEBC)* defines "dangerous" conditions as which of the following:
- **a.** The building or structure has collapsed, has partially collapsed, has moved off its foundation, or lacks necessary support of the ground.
- **b.** There exists a significant risk of collapse, detachment or dislodgement of any portion, member, appurtenance, or ornamentation of the building under service loads.
- **c.** (**a.**) and (**b.**)

2 Liquid penetrant testing, electromagnetic testing, magnetic particle testing, and ultrasonic testing are all examples of ______.
- **a.** Destructive testing
- **b.** Chemical analysis techniques
- **c.** Nondestructive testing
- **d.** Quality control procedures

3 **True or False:** Cast iron is more ductile than wrought iron.

4 What is the most common form of corrosion on exposed and unprotected steel?
- **a.** Galvanic or dissimilar metal corrosion
- **b.** Atmospheric corrosion
- **c.** Pitting corrosion
- **d.** Microbial corrosion

5 What are the common methods for removing existing rivets in a structure?
- **a.** Water jet
- **b.** Chipping
- **c.** Torching
- **d.** (**a.**) and (**b.**)
- **e.** (**b.**) and (**c.**)

6 **True or False:** If steel in an existing structure was produced before 1930, the steel is considered weldable and metallographic examination is not recommended.

7 **True or False:** The suggested minimum inside radius for cold bending ASTM A36/A36M steel with thickness, $t \leq 2$ in. is $1.5t$.

8 Field straightening of anchor rods should be limited to those that are 36 ksi or less and with a bend angle of ______ degrees or less.
- **a.** 15
- **b.** 30
- **c.** 45
- **d.** 60

TURN TO PAGE 12 FOR ANSWERS

steel quiz | ANSWERS

Answers reference AISC Design Guide 16: *Assessment and Repair of Structural Steel in Existing Buildings* unless specified otherwise.

1 **c.** both (a.) and (b.). The *IEBC* defines dangerous conditions as those conditions where: the building or structure has collapsed, has partially collapsed, has moved off its foundation, or lacks necessary support of the ground and/or there exists a significant risk of collapse, detachment, or dislodgement of any portion, member, appurtenance, or ornamentation of the building under service loads. More information on building code requirements related to condition assessment and repair are found in Section 2.3.

2 **c.** Nondestructive testing. Types of nondestructive examination common in field applications include visual testing, liquid penetrant testing, electromagnetic testing, magnetic particle testing, ultrasonic examination, and hardness testing. Weld and nondestructive testing should be performed by inspectors qualified to applicable American Welding Society (AWS) or American Society for Nondestructive Testing (ASNT) standards. Condition assessments and the different types of common, and some uncommon, nondestructive examinations are presented in Chapter 3.

3 **False.** Wrought iron is inherently more ductile than cast iron. Wrought iron was used in structural applications in the 1870s through the 1890s, with limited use as tension rods continuing through the 1930s. To avoid the potential for brittle failure, historical cast iron should only be used in compression with appropriate consideration of the possible effects of eccentricity. See Section 4.1 for more information on historic structural metals and their properties.

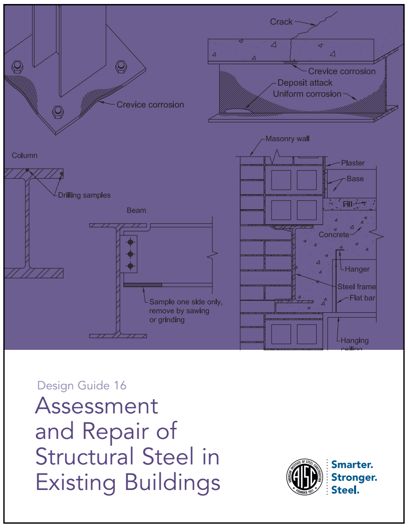
4 **b.** Atmospheric corrosion. Atmospheric corrosion is the most common form of corrosion on exposed and unprotected steel. Atmospheric corrosion is typically caused by wetting of surfaces in humid conditions, creating an electrolyte that enables a corrosion shell. Atmospheric corrosion may be accelerated by chlorides in marine environments and in areas where deicing salts dissolve as aerosols. It is more severe in frequently wetted areas or in areas with inadequate slope to drain. Section 5.4 discusses the evaluation of corrosion and provides equations for evaluating members with section loss.

5 **e.** both (b.) and (c.). Rivets are commonly removed by chipping or, where conditions allow, torching. It is important to avoid causing damage to the base metal. Rivets are commonly replaced with bolts. For more guidance on repair considerations, see Chapter 8.

6 **False.** There is a significant probability that existing steel produced before 1930 may include significant inclusions, such as stringers, that could lead to lamellar tearing at welded joints. Such inclusions may occur frequently, and may be relatively large. Other soundness concerns may also be present. Nondestructive examination of the welded area or metallographic examination of the existing steel should be undertaken to examine for the presence of inclusions and other soundness concerns. If inclusions or other soundness concerns are present to an extent and severity such that susceptibility to lamellar tearing is heightened, mechanical connections should be considered. Table 8-2 contains guidance for steel examination and soundness concerns for different vintages of existing steel.

7 **True.** Table 8-8 provides the suggested minimum radii of cold-bent members based on a recent experimental program accounting for the tensile strength of higher-strength plates. For more information on cold bending, as well as heat straightening, see Section 8.5.

8 **d.** 45°. As discussed in AISC Design Guide 1: *Base Connection Design for Steel Structures*, Third Edition, field straightening of rods should be limited to those that are 36 ksi material or less and with a bend angle less than 45°. The maximum temperature for hot bending ASTM F1554 Grade 36 material is 1,200 °F. Guidance on repairing damaged anchor rods is found in Section 8.5.3, and further guidance is available in Design Guide 1, Section 4.6.



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

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BRONZE

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Bendco Houston Pipe Benders | Big B Crane
BLM Group USA | Bull Moose Tube
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Infra-Metals | MCL Hangers | Merrill Steel | SEAA
Southern Steel Engineers | Steel Service
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ELEVATE

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Entering the Mainstream

BY FRANK ARTMONT, PE, PHD, JUSTIN DAHLBERG, PE, TERRY LOGAN, RONNIE MEDLOCK, PE, AND SOUGATA ROY, PHD

A new guide explains why orthotropic steel deck bridges are a sound option in most applications.

Justin Dahlberg

ORTHOTROPIC STEEL DECK (OSD) bridges have been successfully used worldwide in new construction and rehabilitation projects since the 1940s. Their safety, redundancy, efficiency, and durability successes are undeniable.

OSD applications in the U.S., though, have long faced higher costs in advanced analysis and fabrication, which has focused their use on long-span and signature structures.

But with a greater emphasis on life-cycle cost optimization for bridges, OSD bridges' proven longevity and the simplification of details make them a cost-effective and resilient deck solution for commonplace, non-marquee bridges.

In 2012, the Federal Highway Administration (FHWA) introduced a manual outlining three design levels for OSD bridges, with Level 1 being the least advanced, relying on OSD details proven through experimental testing or historical performance. As a follow-up, the FHWA recently published a complimentary resource, *Guide for Orthotropic Steel Deck Level 1 Design*, to simplify OSD bridge design through the AASHTO Level 1 approach. It offers general information and suggests details for closed- and open-rib systems, making OSDs more commonplace, reducing fabrication costs, and simplifying the design process while providing a 100-year-plus deck solution. It also covers deck plate, wearing surface, and floorbeam or diaphragm web details derived from a comprehensive review of successful in-service bridges.

The guide also includes short summaries highlighting key performance aspects for engineers, designers, owners, and fabricators. Here, we'll focus on the notable points and guidance.

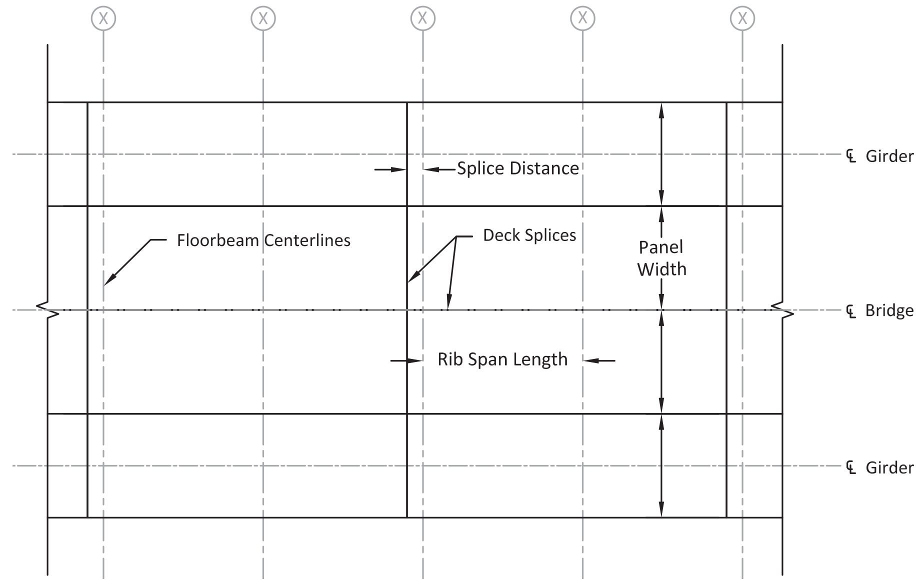
Closed-Rib Deck Systems

Closed-rib OSD systems, offering inherent flexural and torsional rigidity, have demonstrated successful performance in numerous in-service bridges. The closed-rib design efficiently distributes loads transversely across the deck. The guide recommends trapezoidal-shaped ribs, which are simpler to fabricate than other closed shapes and perform equally well. The connection between ribs and deck plates is achieved through partial joint penetration (PJP) groove welds, and recent research suggests potential improvements in constructability and reduction in cost can be achieved by reducing the minimum weld penetration to 50%.

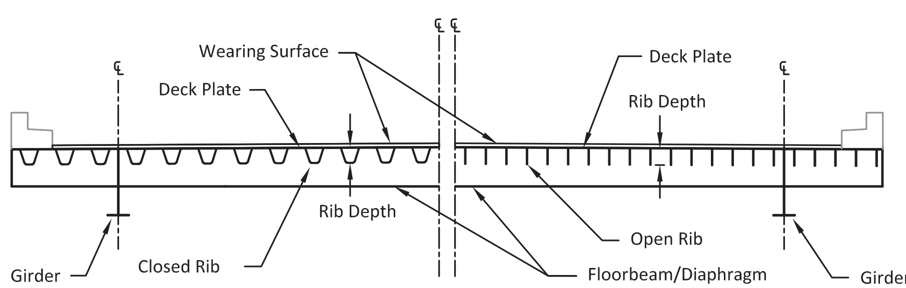
However, the connection is only observable from the rib exterior, limiting the ability to ensure penetration during fabrication and confirmatory inspections. Field splices between deck segments can be more challenging to complete compared to an open-rib system. Achieving proper fit requires stricter tolerances during fabrication and erection. Rib splices are typically assembled using bolts accessed through handholes in the bottom of the rib, further contributing to the complexity of fabrication. Detailing of the connection of ribs to floorbeam webs is more advanced than in open-rib systems, requiring extended cutouts that may necessitate increased depth of floorbeams.

Welding considerations include targeting a minimum penetration for rib-to-deck plate welds while accepting some melt-through for improved constructability. Ribs are tightly fitted to deck plates, maintaining a fit-up gap of no more than 1⁄50 in. to minimize melt-through and facilitate sound welds. Fabricators have the flexibility in determining edge preparation and fit-up tack weld requirements, while all other welds in OSD design are comprised of conventional/prequalified welds with access to both sides of the connection and, depending on plate thicknesses, may predominantly be fillet welds.

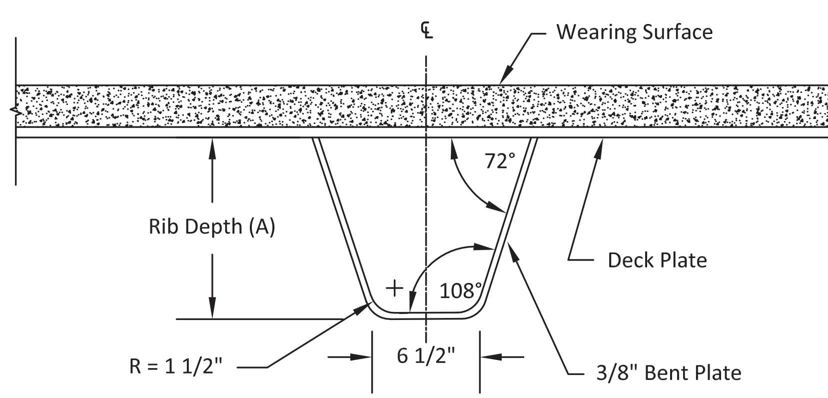
Concerns regarding fully fitted connections between closed ribs and floor beams (without extended cutout) have been addressed through extensive research, indicating potential root cracks under high loads and cycles beyond targeted fatigue life simulations. To mitigate stress and fatigue cracks, various cut-out details in the floorbeam near the bottom of the closed rib have been developed and tested. Fully fitted connections are appealing for fabrication simplicity, and ongoing research aims to reduce potential issues at weld terminations, particularly in redecking applications where structure depth is limited. With the minimum floorbeam depths and Level 1 typical details indicated in the guide, lower stress levels are expected, and fully fitted connections are allowable.



OSD plan view.



OSD plan view with rib options.



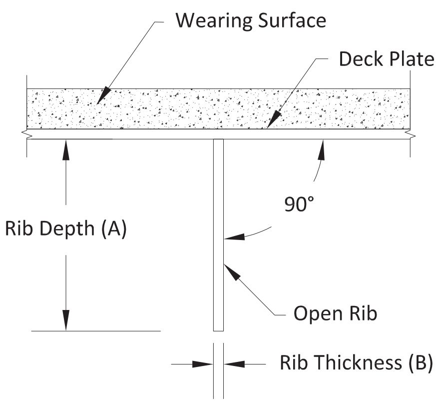
A typical closed-rib detail.

The guide provides typical rib dimensions for closed-rib systems, offering two size options with specified span lengths and maintaining a consistent rib spacing of 2 ft, 2 in. The constant rib geometry encourages OSD fabrication in line with Level 1 design principles.

Open-Rib Deck Systems

Open-rib deck systems, primarily fabricated using flat plates and occasionally rolled shapes, offer several advantages over closed-shaped ribs in simplifying fabrication. Using flat plate shapes as ribs instead of more advanced alternatives can make manufacturing easier. Fillet welds between the deck plate and the ribs simplify fabrication by reducing the need for extensive weld preparation (associated with the PJP welds for closed-rib decks) and testing. They also ease inspection, because accessibility to these weld areas is not restricted.

The connection of continuous ribs at the floorbeam or diaphragm is simpler and more easily accomplished than closed-rib connections. Bolted rib splices are fully accessible, contributing to straightforward connections. Open-rib systems tend to be more cost-effective concerning fabrication, labor, and quality assurance and control than equivalent closed-rib systems.



A typical open-rib detail.

However, open-rib systems have less torsional rigidity than closed-rib systems, resulting in less efficient transverse load distribution. To offset this, closer rib spacing and/or floorbeam spacing is required, leading to increased welds (but conventional fillet welds). Additionally, open-rib systems' depth and rib thickness are typically greater than the depth of closed-ribs with equal spans, resulting in heavier decks. Overall, the open-rib system cost is competitive when considering the broader aspects of each system, particularly when applied to systems with closely spaced sub-floorbeams that provide greater system rigidity.

The guide presents rib dimensions and details for open-rib systems, showcasing two rib size options with maximum span lengths and a typical rib spacing of 1 ft, 3 in. The rib geometry remains constant for simplicity.

Deck Plates

Varying deck plate thicknesses are in active bridges, with a minimum thickness of ⅝ in. recommended for Level 1 typical OSD plate details. Thicker deck plates (¾ in.) can improve fatigue performance and wearing surface durability. The guide presents design options using ⅝-in. and ¾-in. deck plates based on rib spacing and span lengths. The wearing surface selection, influenced by consultation with manufacturers and bridge owners, can impact deck flexibility. While thin and thick overlays have shown successful performance, preferences vary based on ease of application, longevity considering weather and traffic demands, and deck weight considerations.

Welded deck plate splices are common and perform well. Bolted splices, though, can offer field erection and fit-up advantages, particularly where only short-term closures are available, potentially leading to cost savings. Bolted deck splices require accommodating bolt heads by using countersunk bolts and/or a thicker wearing surface. The guide provides typical details for bolted and welded deck splices in closed-rib and open-rib systems. The engineer may choose either option or both, considering erection procedures and wearing surface preferences.

Deck Joint Tolerance and Backing

A ¼-in. maximum tolerance for deck joint vertical alignment is suggested in an unclamped condition so when clamps are used, the *Bridge Welding Code* (AWS D1.5) alignment tolerance of ⅛ in. is satisfied. Suggestions for welded field splices include removing longitudinal backing, allowing transverse backing, using non-steel backing, and accepting mixed welding processes (such as FCAW or SMAW root pass followed by SAW fill). Complete joint penetration (CJP) groove welds with steel backing are recommended for deck plate splices, facilitating clamping and field welding.

While removing steel backing, back gouging, and rewelding from the root side may improve fatigue resistance, backing at the transverse deck plate splices should be left in place due to the difficulty of removing them, back gouging, and rewelding in an access-limited under-deck region interrupted by ribs. Options for removable backing include copper or ceramic backing, but remedial work is often necessary.

An alternative approach involves initiating the weld pass on the underside of the joint, followed by back gouging to the root from the top and completing the weld from the top side. This approach may be suitable for longitudinal deck joints but not for transverse joints if the presence of ribs limits access to the underside of the joint. As permitted by AWS D1.5, mixed welding processes are common.

Wearing Surfaces

Wearing surfaces on OSD bridges serve multiple purposes, including corrosion protection, improved ride quality, and enhanced rigidity and load distribution. Historical selection and performance of wearing surfaces vary based on factors like steel deck plate thickness, traffic volume, truck traffic, and climate. Bituminous and polymer surfacing systems are common.

Considered a thick wearing surface (2 in. or greater), bituminous systems can reduce live-load-induced stresses in the deck plate. However, this is typically not considered in the design due to the uncertainty associated with the temperature-dependent rigidity of the systems. These systems perform well on rigid OSD systems but are sensitive to temperature effects, exhibiting issues like rutting, shoving, and tensile cracking in the presence of significant traffic volume.

Polymer systems are considered thin-wearing surfaces (limited to ½ in.) and contribute minimally to dead load. While they don't add deck stiffness and have exhibited durability issues due to improper application or flexible deck plate, recent advancements have reduced delamination and aggregate loss issues.

Before applying any surfacing system, the OSD undergoes cleaning and shot blasting to remove contaminants. A zinc-based primer is often used for corrosion protection. Bituminous surfaces involve multiple layers of bond coats and epoxy asphalt concrete, compacted with rollers. Polymer systems are installed by multi-coat or slurry methods, with the former involving the spread of polymer resin and aggregate layers and the latter incorporating a polymer concrete slurry.

Floorbeams

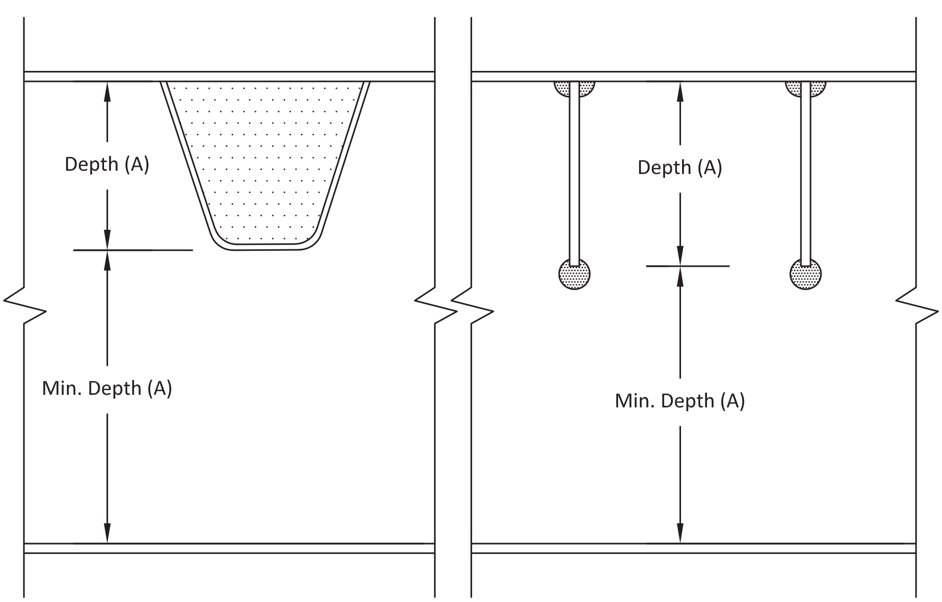
U.S. retrofit applications have successfully employed OSDs despite structural depth restrictions limiting the depth of the floorbeam or diaphragm, though a refined analysis and additional connection detailing efforts were needed in these cases. For new structures, the depth may be increased, which enhances system stiffness, simplifies rib connections, and allows for optimization of the floorbeam or diaphragm depth.

The guide includes OSD systems that maintain a minimum floorbeam or diaphragm depth. If the depth is lesser than the recommended values, the designers should consider the potential need for extended cut-outs at the rib-to-floorbeam connection. Normal shop tolerances for rib-to-floorbeam or diaphragm fit-up are common and easily achieved, particularly for shorter spans where the rib distortions can be more easily controlled after welding to the deck plate.

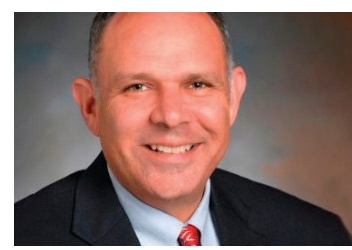
Excessively tight tolerances are unnecessary (and difficult to achieve) and can pose fabrication challenges. When the floorbeam or diaphragm depth is not limited, fillet welds between the rib and floorbeam or diaphragm are recommended. In instances where fit-up gaps exceed 1⁄16 in., AWS D1.5 permits addressing this by appropriately increasing the fillet weld size, if necessary.

Learn More

The *Guide for Orthotropic Steel Deck Level 1 Design* is available at **www.fhwa.dot.gov/bridge/steel.cfm** and is free to download. It contains everything you need to ease the design process for OSD systems and make them a compelling choice for your next bridge project. ■



A floorbeam and diaphragm depth detail.



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Achieving a Dream

INTERVIEW BY GEOFF WEISENBERGER

Growing up near Philadelphia helped shape Jill Lavine's childhood architectural aspirations. Decades later, she's a prominent figure in the area's architecture scene.

JILL LAVINE envisioned and wrote about her architect aspirations in elementary school. Decades later, she's fulfilling those dreams beyond anything envisioned back then.

Lavine is a founding partner with FIFTEEN Architecture + Design in Philadelphia, her most enriching adventure so far in her architectural career. Eight years after co-founding the firm, she has helped design several important buildings in Philadelphia—the same city that helped inspire her childhood career dreams. She was also a 2025 AISC IDEAS^2 award judge (read more about the 2025 IDEAS^2 winners on page 24). She spoke with *Modern Steel Construction* about her career, being an IDEAS^2 judge, and more.

Where are you from and where did you grow up?

I'm a New Jersey native. I grew up in a small town in New Jersey halfway between Philadelphia and the Jersey Shore, on the edge of a suburban area and rural area.

When did you decide on architecture as a career path?

I was in fourth grade when I declared I wanted to be an architect. That steered my trajectory and influenced the classes I took in high school and the colleges I considered. I went to Virginia Tech; I was looking for an architecture degree, and to practice professionally, you need an accredited degree. There aren't many accredited degree architecture programs in the country, let alone in New Jersey, so I ended up at Virginia Tech.

I loved being there. I started in the architecture program during my freshman year. It was a five-year program, and I graduated with a bachelor's in architecture, which meant I could get my license without needing a master's degree. That was one of the drivers for me. I wanted to get my degree, get my license, and go to work.

What made you attracted to architecture at such a young age?

I used to love looking through floor plans in the back of my mom's *Country Living* magazines. I also remember my dad doing woodworking and building a deck in our backyard. I took all the scrap wood and made little cityscapes out of it. I was really into building stuff, urban places, and cities. Since I lived near Philadelphia, fun day trips to the city were common.

In fourth grade, I had to write a report about what I wanted to be when I grew up, and I wrote about being an architect. Now, I find it amazing I knew that in fourth grade. I have kids of my own now, and they're right around that age. They're way more open-minded about what they'll pursue when they grow up than I was. I wrote a book report about Frank Lloyd Wright, who was probably the only architect I had heard of at that time.

In high school, I did a research papers n the historic architecture in Philadelphia and traveled to Spain with my Spanish class in my junior year. That trip opened my eyes to architecture in other countries and its cultural meaning. It solidified my decision and drove my college search.

So far, what project would you say is your most memorable?

I've been practicing architecture for almost 20 years, and I've had great experiences all over the map: residential scale, small retail, large corporate headquarters, research facilities, and higher education institutions.

Recently, FIFTEEN has a project in Philadelphia I'd call the most memorable to date. It's one of the most complex projects I've worked on, and its mission is important to me, to the organization, and to Philadelphia.

The original building was a hospital in West Philadelphia. One of our existing clients, who we had designed a number of outpatient primary care and mental and behavioral health facilities for, joined forces with two other healthcare institutions and purchased an old hospital building from another entity after a wave of hospital closures in the area. This hospital was on the verge of closure. We started the project during the pandemic and are slowly turning that building into a public health and wellness campus.

It's a 400,000-sq.-ft facility built in 1915. As a hospital, that's pretty old. There is no shortage of aging infrastructure hurdles to work through, plus the regulatory process of converting a hospital to a public health campus with multiple entities was intense. It's in a community that desperately needs those services. It's ongoing. It's still an operating hospital, so the project is happening in phases. We're proud of it, and it has been a large part of my professional life over the last five years.

The final active phase right now is in construction. The building is undergoing some exterior, security, and garage upgrades. Most of the inside is complete. It houses the University of Pennsylvania Hospital System's emergency department, among a few other facilities for them. Children's Hospital completed renovations on multiple floors for a pediatric behavioral health facility. Our client integrated a dental clinic, an outpatient health center, and a health and wellness facility hub. We've completed ADA upgrades, entrance improvements, and an additional accessible entrance vestibule to the original historic façade. Right now, it's in the last leg of exterior improvements and security upgrades.

What compelled you to start FIFTEEN and what's the genesis of the name?

Four founding principals came together to start it in 2017. We had all worked together previously at a large architecture and engineering firm in Philadelphia, but by 2017, we had all gone our separate ways into other opportunities. As it turns out, all of us were looking for something more fulfilling in our professional lives.

One of our partners was the center point for all four of us. She gathered us together in 2017 and said she wanted to start a firm and wanted us to do it with her. Her initials are XV, which is 15 in Roman numerals. She collected me and two other women. At the time, there were so few women in leadership positions in architecture firms in Philadelphia. We did our research, and at the time, around 2% of the roughly 500 firms in Philadelphia were women-owned, and maybe one of them was fully women-owned. We decided the data was unacceptable and wanted to change it together.

We have five partners now and have grown from a team of four to 18 full-time folks. We have a network of collaborators who support our work that's more than 30 people. Our goal was and is to provide a culture where everyone's voice matters and women don't feel like they must leave the profession to support their families.

We're a very flexible environment, and we're doing our part to support our community through design and making a name for ourselves as a firm that works with clients to help them realize their vision through partnership. It has been ever-evolving since 2017, but it has been great so far.

Our office is in Old City, which is obviously the old part of Philadelphia. It's funny that I work here now years after doing historic architecture research on Christ Church and Independence Hall in high school.

You lead the sustainability and building performance side at FIFTEEN. How did you get into that niche and was it a passion?

I was at another firm for about 11 years that integrated architecture and engineering. Our project work was hand-in-hand, and I learned a lot about system efficiency and renewable energy from the engineers. I was also taught by LEED and sustainability early adopters. It was an integral part of our project work.

I worked on a couple LEED Gold corporate headquarters around the region. I became very interested in the details and providing efficient envelope systems that will make our buildings more energy efficient. I was exposed to a lot of it and have maintained interest in it. Today, there are so many tools and analyses that we can do. It's a big focus for FIFTEEN, and we now have a champion on our team to make sure we continue to advance.

You were an AISC IDEAS^2 Award judge this year. What was that experience like for you?

I had so much fun. I flew to Chicago, stayed one night, and hung out in AISC headquarters for the day. The submissions blew me away. I was interested in the engineering behind a lot of them and the complexity and the coordination that I imagine took place during construction. I was ready to go and prepared. I had my top three to put forward for the different categories.

Another architect—from AISC—was on the jury (Nima Balasubramanian), plus a structural engineer, a general contractor, and a fabricator. We had all these different perspectives at the table. I went into it thinking my picks were a clear winner, but I was blown away when I heard someone else's perspective about why they chose the same project or a different project.

For example, the general contractor had a favorite project because of the staging and coordination. The fabricator had a different position and choice based on iconography that put steel in the best light. The structural engineer was taken by the structure with crazy engineering. I was so fascinated to hear everyone's perspective. We debated and we couldn't come to full agreement on everything, so we voted and even created a new category this year (the Presidential Award for Engineering Design and Construction), because one project was in a league of its own and had to get a special award.

Overall, it was amazing and has stayed with me. We were talking about a project in our office a couple weeks ago, and we do these design charrettes around a particular topic. I referenced one of the submissions that stuck with me, and the things I loved about it were so relevant to what we were discussing in the office. ■

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

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

Specifying Sustainability

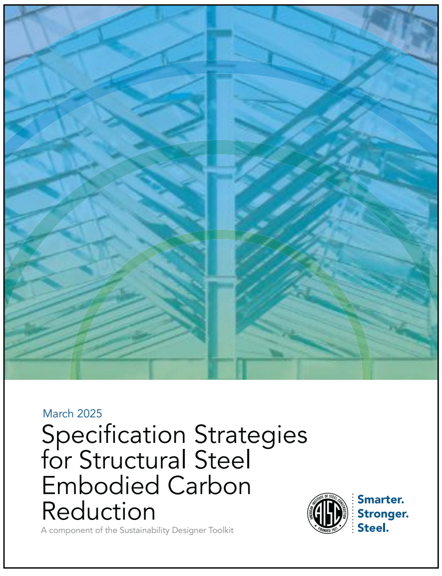
BY MAX PUCHTEL, SE, PE

A new AISC publication provides strategies for specifying structural steel embodied carbon reduction—helping achieve your project's sustainability goals.

SPECIFIERS HAVE A powerful new tool available to help them take direct sustainability action on their projects, but it helps to take a step back and appreciate why this publication is so important.

In my role as AISC's director of sustainability and government relations, I've witnessed a surge of environmental attention on the domestic construction industry. Not only is attendance growing in spaces devoted to sustainability such as green-focused conferences, seminars, and workshops, but also, the sustainability of construction materials is increasingly a topic in non-traditional spaces. I've seen this trend at events devoted to global trade and economics, professional licensure, structural engineering standards, and life safety-related building codes.

For construction materials, the term "embodied carbon" refers to the quantity of greenhouse gases (GHGs) associated with the activities required to produce the materials. The largest sources of embodied carbon associated with steel are the GHG emissions occurring during the iron- and steel-making stages, such as from the reduction and refinement of iron ore and from non-renewable electricity generation.



What's The Goal?

In the U.S., the attention I see from construction sector stakeholders (engineers, architects, general contractors, clients, policymakers, regulators) has the same goal: reduce the embodied carbon of a construction project's structural steel package to meet regulatory statutes, earn green building rating system credits, or achieve the sustainability goals of a private owner. While many approaches exist for embodied carbon reduction, such as design changes, loading interrogation, and refraining from over-specifying coatings; the most common question I receive is, "How can I specify lower-embodied carbon steel?"

AISC has an answer: a publication titled *Specification Strategies for Structural Steel Embodied Carbon Reduction*. The publication, found at **aisc.org/sustainability-toolbox**, summarizes all embodied carbon reduction strategies I've seen in the marketplace, with commentary, recommendations, and sample specification language. It's my desire that these strategies find their way into every construction specification in the U.S.

Will Specification Language Be Effective?

The publication presents six strategies for a specifier to consider, and each of them claim to reduce embodied carbon to some degree, but embodied carbon—or even more colloquially, carbon footprint—is a tricky concept. The real goal is to reduce GHG emissions into our atmosphere, which is not quite the same thing. It's important to understand the real-world situation behind these strategies and use them in a way that aligns with their efforts to accomplish the real-world goal.

Sustainability-minded designers are familiar with commercial carbon accounting tools, and they often think counting up all the project's carbon is all they need to make project decisions on embodied carbon reduction. But just like in structural engineering, one must have an appreciation for what's happening inside the black box to make meaningful decisions The methodological framework used to develop assertions about a product's embodied carbon, Life Cycle Assessment (LCA), is a well-established and reputable practice, but it's often assumed to do and say more than it does, as problems persist in the representation quality of the output and its causal connection to the real world.

For example, if a facility-specific environmental product declaration (EPD) reports that the hot-rolled sections GWP used on a given project is 0.686 kg CO_2eq / kg steel, that value is often used directly in a project team's calculations to represent the precise amount of GHG emissions released into the atmosphere due to the production of their project's steel. The project team can present that conclusion to achieve auxiliary project goals such as regulatory compliance, green building rating system credits, or just flashy marketing.

Sadly, that approach has significant flaws. While an LCA is the best available methodology for determining a product's environmental impacts, its assertions are highly (and rightly) caveated. ISO literature is full of warnings and disclaimers on how one should practically consider LCA assertions. Significant uncertainties exist due to varying primary and background data sources, calculation methodologies, data collection time frames, among other factors. It would be more appropriate to consider EPD results as a best available attempt to assess a product's historical environmental impacts during one snapshot in time. That might not sound as satisfying, but it's true.

Second, what real-world effect occurred? In the scenario above, the project team can hold up a document that says their project is *associated with* less embodied carbon emissions due to their procurement decisions. But the decisions on that single project alone didn't affect the market or the amount of GHGs emitted. All the products available to be procured—both high and low carbon—were made anyway, rendering the project team's accomplishment much less meaningful. Additionally, it is possible a net increase in transportation emissions occurred due to the project team's actions to artificially reallocate products within the market.

Of course, change is possible and already happening. But for the steel industry, it happens on a scale much larger than one construction project. The industry serves many markets: automotive, aerospace, naval, machinery, appliances, and more. Like any business, steel mills monitor external market signals and simultaneously work to improve their internal operations. As large industrial facilities, they keep a close eye on their operations and constantly strive for efficiency and energy reduction, which helps their bottom line and reduces their carbon footprint. Don't get distracted thinking about the decarbonization of a particular piece of structural steel on your project. To be blunt, the steel industry is a lot bigger than you.

Here's the crux of the matter: for each strategy in the publication that claims to reduce embodied carbon, the question should not be how you can display on paper the sustainable performance of your project alone. Rather, focus on how well your project's specification actions add to and support the collection of sustainability market signals being sent to the steel industry from many directions.

That's it. That's all you need to do. You will likely not see the change occurring on the scale of your project, but you'll be contributing to a growing wave of signals that tells the steel industry that embodied carbon reduction is a valued performance metric, which incentivizes broad steelmaking decarbonization.

Companies exist to compete for your business and deliver products the market wants. You are the market, it's your job to signal your values, and AISC's *Specification Strategies for Structural Steel Embodied Carbon Reduction* empowers you to do so. ■

Max Puchtel (puchtel@aisc.org) is the director of sustainability and government relations at AISC.

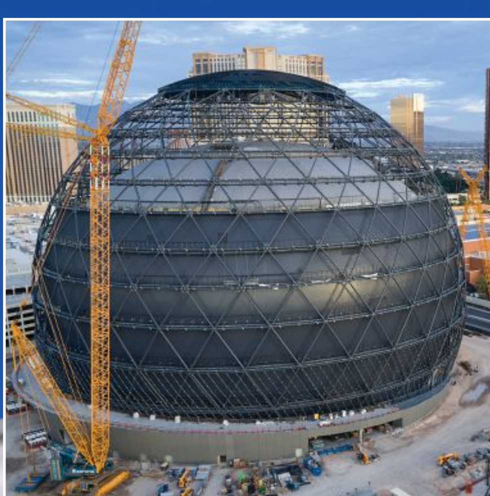
2015 AIA Distinguished Building Award - HSS 8” pipe featuring an ellipse curvature with multi-radius bends for the structural ribs for CTA Cermak-McCormick Place Station. Chicago, IL

2012 IDEAS² Merit Award - 133 tons of 16” pipe curved for the Rooftop Tiara of the Great American Tower at Queen City Square. Cincinnati, OH

2020 IDEAS² National Winner - 920 pipe members rolled from 1300 tons of 14” pipe creating 38 super-trusses for the iconic canopy at Hartsfield-Jackson Atlanta Intl Airport. Atlanta, GA

2007 NSBA Special Purpose Prize Bridge Award - 152 tons of 18” pipe curved in our Kansas City plant for the Highland Bridge. Denver, CO

2024 IDEAS² Excellence in Engineering Award - Curved W36x182 beams the hardway against their strong axis and W36x135 members in a complex compound reverse s-curve (multi-radial) easyway against the weak axis at the Nashville International Airport. Nashville, TN



2025 IDEAS² Presidential Award Winner - 690 tons of curved 8” pipe and 7.5” tube, totaling 1,160 pieces for the MSG Sphere. Las Vegas, NV

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Fab Five


Kyle Zirkus


courtesy of Tishman Speyer

2025 IDEAS² AWARDS

EXCELLENCE IN ARCHITECTURE

Pima Community College – Advanced Manufacturing Center
Tucson, Ariz.

EXCELLENCE IN ADAPTIVE REUSE

Top of the Rock Redevelopment
New York

2025 IDEAS² AWARDS

A college building with a teaching tool as a design feature, a 1960s office building modernized with new steel elements, and the world's largest spherical structure are among the 2025 IDEAS² award recipients.

FIVE RECENT PROJECTS have earned one of the steel industry's most notable honors: an Innovative Design in Engineering and Architecture with Structural Steel (IDEAS²) award.

AISC annually presents the IDEAS² awards to projects that illustrate the many possibilities of building and designing with structural steel. The awards display innovative steel use in:

- the accomplishment of the structure's program
- the expression of architectural intent
- the application of innovative design approaches to the structural system
- leveraging productivity-enhancing construction methods

All IDEAS² entries and winners must have met these criteria:

- New buildings, expansions, and renovation projects (major retrofits and rehabilitations) are eligible. There is also a category for sculptures, art installations, and non-building structures.
- Building projects submitted for 2025 IDEAS² awards must be in the U.S. and must be completed between Jan. 1, 2023, and Aug. 31, 2024.
- A significant portion of the framing system of a building must be wide-flange or hollow structural steel sections (HSS).
- Most of the steel used in the project must be domestically produced.
- Pedestrian bridges entered in the competition must be an intrinsic part of a building and not standalone structures. Members of project teams for standalone bridges are encouraged to enter their work in the 2026 National Steel Bridge Alliance's Prize Bridge Awards.


Jason O'Rear


Severud Associates


Severud Associates

EXCELLENCE IN CONSTRUCTABILITY

200 Park
San Jose, Calif.

EXCELLENCE IN ENGINEERING

PENN 2 Redevelopment
New York

PRESIDENTIAL AWARD FOR ENGINEERING DESIGN AND CONSTRUCTION

Sphere
Las Vegas

Like last year, the IDEAS^2 jury honored projects that took full advantage of specific benefits—sustainability, cost, speed, reliability, and resilience—that make structural steel the best choice for designers, rather than award projects by budget category like in previous years. Many IDEAS^2 winners are landmark structures, but the program also honors smaller, less visible projects. No matter the project size or fame, all IDEAS^2-winning structures share a commitment to innovation and imaginative design.

The five winners were in five different award categories: excellence in engineering, excellence in architecture, excellence in adaptive reuse, excellence in constructability, and a special honor: a presidential award for engineering design and construction.

Three IDEAS^2 recipients are new structures. One is an office building in San Jose, Calif., that became the second-ever project to use the composite SpeedCore system and is now the city's tallest building. Another—and perhaps the most recognizable—is the world's largest spherical structure that's already a prominent U.S. event venue. The third new building is a community college addition incorporating a hands-on learning tool as a design feature.

Elsewhere, two midtown Manhattan buildings added new steel elements. A 1960s office building gained a steel addition that provides valuable space, adds natural light, and connects the building with the neighborhood. One of Manhattan's more iconic buildings added two rides to its scenic rooftop, supported by new steel.

"Innovative breakthroughs happen at intersections, whether they're meetings of minds, changes in a structure's needs, or a challenge to build something that will make people stop and take notice," AISC Senior Vice President Scott Melnick said. "Each of these projects found themselves at the right intersection with the right team at the right time."

A five-person jury decided on this year's IDEAS^2 award recipients:

- Jill Lavine, AIA, LEED AP, founding principal, FIFTEEN Architecture + Design
- Jeremy Loebs, business development executive, Schuff Steel
- Rob Martinelli, senior vice president, operations, Pepper Construction
- Fraser Reid, PE, CEng, MICE, associate principal, Buro Happold
- Nima Balasubramanian, AIA, NOMA, director of architecture, AISC

Read on to learn more about this year's winners.

2025
IDEAS²
AWARD

EXCELLENCE IN ARCHITECTURE

Pima Community College – Advanced Manufacturing Center

Tucson, Ariz.

"The Advanced Manufacturing Center is an excellent example of seamless integration between building design, building purpose, and defining structural elements. The elevated crane bay connecting the length of the building puts the structure on display and becomes this iconic and unifying feature that reinforces the idea of bringing partners together in education, industry and community. The attention to detail carries through each structural element and exemplifies the spirit of the project."
—Jill Lavine


Kyle Zirkus

AN ARIZONA COMMUNITY COLLEGE'S new campus centerpiece incorporates key learning tools into its design, an architectural and engineering innovation only possible with a structural steel system that helped complete the project under budget.

Pima Community College in Tucson, Ariz., invested in significant campus additions in hopes of helping solve the shortage of qualified workers in local industries. The main component is the Center of Excellence for Applied Technology, a collection of academic and technical buildings offering transportation/logistics, advanced manufacturing, and infrastructure studies. It will provide formal degree and certificate programs, plus short-term training opportunities.

The Center of Excellence has two main buildings: the 43,000-sq.-ft Transportation Center Building (TCB) focusing on automotive training and the 95,000-sq.-ft Advanced Manufacturing Building (AMB). The latter is a three-story industrial learning facility with space to teach welding, machine tools, mechatronics, and CAD, among other trades. It also has a workforce development incubator, a flexible industry training lab, administrative offices, and a rooftop patio for outdoor learning and events.

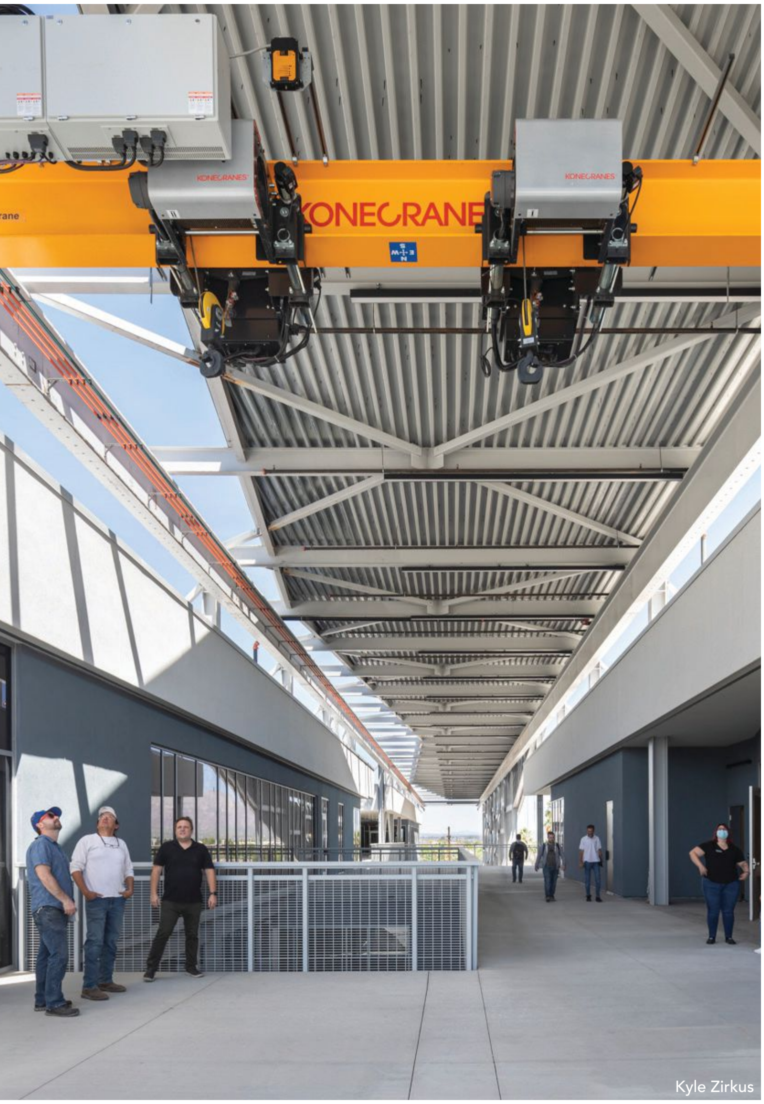
The AMB promotes flex learning by providing classrooms and labs that open and connect to outdoor areas to provide extended spaces for project-based learning. This centralized circulation spine is connected visually and functionally by a 10-ton underslung bridge crane, which transverses the entire building length above the exterior walkways and connection spaces. The crane, which can transport materials throughout the facility, provides a visual cue for students to see and understand the connections between the various learning pathways.

A Clear Choice

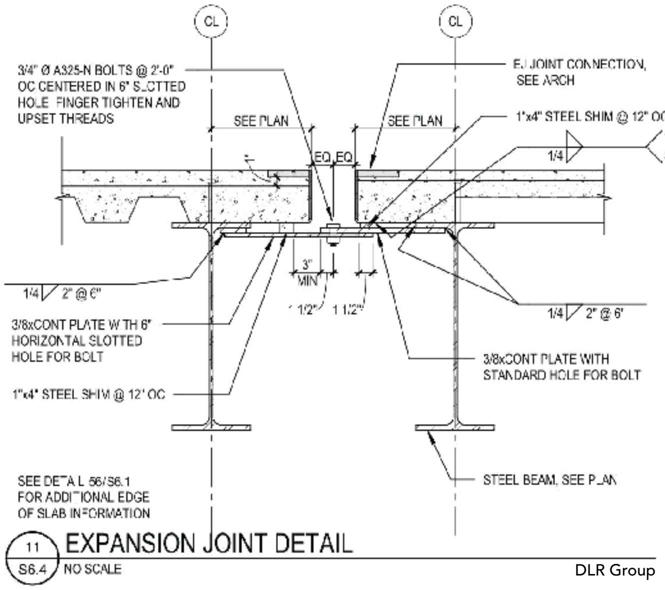
The main structural system is comprised of composite floor deck supported by wide-flange steel beams and columns, as well as metal roof deck. Hollow structural sections (HSS) braced frames comprise the lateral load system. The crane runway beam is supported by the main building columns instead of a separate supporting structure. The structural steel system was the only choice for this unique design because of its economy, aesthetics, and flexibility.

A building this large and complex can often go above the initial construction budget. The steel structure helped ensure that the superstructure was designed as efficiently as possible so other supplementary items, such as the metal screens and façade elements, were not value-engineered out of the project. The column grid system was studied intensely during the schematic design phase to find a bay size that was wide enough to maximize the floor framing capacity but not too wide to cause too much vibration.

After finding the right bay size for the loading and massing of the building, the structural engineers worked closely with the architects to limit changes during design development. The outcome was a project built for less than $400 per sq. ft and $3 million under budget.



Kyle Zirkus



DLR Group


Kyle Zirkus

The learning spaces' manufacturing focus warranted a more industrial building aesthetic, resulting in lots of exposed structural steel. The exposed structure contributed to the design aesthetic of the interior spaces, such as classrooms and lab spaces, and significantly drove the exterior design. In addition, the metal screens along the building's south and east sides contribute to the façade design while also reducing the building's cooling loads and providing shaded outdoor learning environments. The screens were constructed of exposed wide-flange and HSS steel framing, with a perforated metal B-deck as the screen element.

Pima Community College wanted the AMB to adapt to changes brought on by evolving student needs and allow a wide range of industry partners to lease the space. These requirements meant selecting a structural system that could be easily modified to support new hanging loads of ducts, pipework, and equipment, and be easily reinforceable if future equipment loading exceeds the current structure capacity.

Crafting the Crane

To reduce the additional cost of the crane, the building superstructure resists the gravity and lateral loads of the crane. Having the building superstructure support the crane structure allowed the building's braced frames to support the lateral loads. However, this support plan proved to be challenging in the transverse direction. The crane structure was elevated approximately 8 ft above the surrounding roof diaphragms, and a braced frame could not be placed in the crane bay without obstructing the crane travel. The solution was to provide knee braces from the crane columns down to the roof beams below to transfer the lateral loads directly from the crane assembly to the roof diaphragm, which would then transfer the lateral forces to the superstructure's braced frames.

The knee-brace geometry was carefully considered with input from the architect so the crane roof could still appear to be floating above the roof and provide the required lateral support. The brace was kinked so that the portion that went through the roof assembly became vertical, ensuring an easier condition for the roof contractor to install around and properly waterproof.

Additionally, the crane needed to traverse the building's expansion joint. Introducing an expansion joint is not a typical detail in the design of a crane runway beam, so a custom connection was designed. A crane has severe limitations when sloped, so the engineering team collaborated with the crane manufacturer to handle an increased slope of ⅜ in. per ft. The resulting detail is a steel bent plate that covers the 5-in. gap that is fixed on one side and can slip on the other. The plate tapers from ⅜ in. down on either side so that the crane can move across the expansion joint while allowing the two structures on either side to move independently.


Matthew Winquist


Kyle Zirkus


Kyle Zirkus

The crane has a 28-ft cantilever on both ends of its runway, allowing it to pick up equipment directly from truck beds. The cantilever's stringent deflection requirements were difficult to achieve, especially with the required depth restrictions so that the crane could travel above the building's parapet. The design solution was to weld a 1-in. plate top and bottom to the crane runway beam and to provide in-plane HSS bracing, which stiffened the runway beams and delivered the lateral load back to the columns.

Pondering Key Placements

The building's length required an expansion joint to divide it into two, and the natural joint placement was at the bridge between the main volumes on either side. A double framing line at the expansion joint was implemented, providing a separation solution for the gravity system. However, the real challenge came when considering how to stabilize the floor diaphragm laterally at that same spot.

Due to the program layouts and limitations, the AMB offered few locations where braced frames could be added to support the east-west lateral loads. Furthermore, the crane runway occurred from the north to south ends of the structure, eliminating a whole bay to place a braced frame. A braced frame on the expansion joint's north side stabilized the edge of the northern massing of the structure, but one could not go on the south side to provide stability for the bridge's floor diaphragms.

During design, the structure was analyzed to determine if the floor structure could cantilever the 57 ft from the next brace frame located on the opposite side of the bridge. The overall movement at the north edge of the bridge structure created a need for lateral support along the expansion joint boundary. The solution was to provide a steel plate connecting the diaphragms across the expansion joint, allowing the required movement in the north-south direction but translating the lateral load from the bridge diaphragm across the joint into the braced frame line to the north. The carefully detailed custom connection provides the lateral support for the bridge floor diaphragms and the crane roof diaphragm above.

Indoor and outdoor spaces are intertwined throughout the AMB. There are multiple locations where an outdoor walkway or patio occurs over conditioned spaces below, which meant the outdoor walkway system had to act as a roof, thus requiring the continuous insulation mandated by the energy code and design lanes for proper drainage.

The drainage issues were solved by stepping the floor diaphragm 12 in. to allow for 3 in. to 6 in. of rigid insulation sloped to internal drains with 3 in. of wearable concrete slab on top. The steel structure easily allowed for the diaphragm steps to occur. The structural engineers worked closely with the architects to align the building steps at column grids for efficiency. When alignment was not possible, the steel detailing's inherent flexibility allowed the steps to be located where needed.

Steel as an Aesthetic Staple

While the exposed structural steel and perforated steel screens enhance the overall building aesthetics, steel contributed to the architectural expression of two other primary areas: the west façade and the connection from campus to the TCB.

The west façade is the new entrance to the campus block, and architects wanted a striking design. The architects created exterior installation and finish blocks dubbed “the French fries” that alternately project and recess from the plane of the façade, creating a dynamic effect above the lower level’s concrete masonry unit exterior. Hidden behind the finish material, the French fries’ massing is cold-formed metal framing attached to HSS frames.

Constructing the entire assembly of structural steel had several advantages. Notably, having one materiality in the assembly ensured the frame construction was one subcontractor’s responsibility and facilitated quick and easy installation. Once the structural steel was erected, the metal stud fabricator provided the intermediate framing later when the exterior wall framing was installed and did not become a pinch point for the construction timeline.

The campus block to TCB connection was accomplished at the AMB by separating the building’s massing so visitors could still see the TCB from the AMB’s east side. The AMB’s two masses were connected at the second- and third floor-bridge and with the crane overhead.

On the AMB’s east side, an egress stair from the third-floor patio to the second-floor bridge became a challenge for the structural engineers. Avoiding support columns at the landing maintained the strong visual connection to the TCB under the bridge and stairs. Vibration was a major concern because the single run of stairs was long, and it was supported at the top by a cantilevered beam and at the bottom by a long-span beam. Without proper support, the assembly would have been noticeably bouncy. Two rods at the stair landing hung from the crane roof provided additional stability without visually blocking the view.

The $29 million project opened in time for the 2023–24 academic year. Pima Community College has been a staple in the Tucson area’s skilled trade education since its founding in 1969, and the AMB has positioned it to remain that way for the next 50 years and beyond.

Owner
Pima Community College, Tucson, Ariz.

General Contractor
Chasse Building Team, Tucson, Ariz.

Architect and Structural Engineer
DLR Group, Phoenix


Kyle Zirkus

2025 IDEAS² AWARD

EXCELLENCE IN
ADAPTIVE REUSE

Top of the Rock Redevelopment
New York

courtesy of Tishman Speyer

AN ICONIC NEW YORK CITY BUILDING added attractions to its popular rooftop observation area, and the project's new steel elements facilitated disruption-free work and success on a tight rooftop jobsite.

The Top of The Rock on the 67th, 69th, and 70th floors of 30 Rockefeller Plaza in midtown Manhattan is a popular tourist destination, and the owners wanted to bring new interactive experiences to the observation deck portion. One is called The Beam and allows patrons to recreate the famous "Lunch Atop a Skyscraper" photograph from the 1930s. The other, the Skylift, is a telescoping platform that rises 30 ft above the 70th floor and rotates 360° to provide panoramic city views. The rides lift out of the roof deck and, when not operating, look like natural observation deck features.

The observation deck could not close during construction of both rides and the frame adjustments to accommodate them, and work could not interrupt the building's elevators despite a lack of freight elevator access to Top of The Rock. Luckily, choosing steel for the additions and modifications allowed structural engineer Gilsanz Murray Steficek (GMS) to work more efficiently with Rockefeller Center, which was constructed with a steel frame. The range of available steel shapes and sizes allowed for creative use of new sections and reinforcement, and any other material choice for a ride that pays tribute to a photo of ironworkers constructing Rockefeller Center would have felt wrong.

Not So Spacious

Space and access constraints were the building's biggest hurdle. The 67th and 69th floors are roughly 60 ft wide and the 70th floor is only about 20 ft wide, with elevator machine rooms and other base-building mechanical systems occupying nearly all the space along the core.

Keeping the observation deck open meant that most work occurred between midnight and 8:00 a.m. when it was closed. While portions of the deck could close during the day, jobsite space on the deck never exceeded 2,000 sq. ft.

Mike Pugliese

Mike Pugliese

Early design phases brought frequent coordination calls and design submissions to the ride manufacturer to understand its restrictions and requirements. Gantry cranes on the roof were used to install both rides, and nearly every cubic inch of space was accounted for and needed in the Skylift motor room and the suspended pits for The Beam.

GMS had the building's original 1932 erection drawings and an incomplete set of drawings from the 2004 renovation project that included substantial observation deck work. There were numerous instances where the conditions on site did not match any drawings, leading to probes of existing conditions to finalize the design. Steel's design flexibility was crucial for incorporating new information and the resulting design tweaks.

Building up The Beam

The backbone of The Beam's support system is a new W36×150 that spans approximately 28 ft between two existing girders, which needed extensive reinforcing. When the ceiling below the 69th floor was removed, the team discovered a 30 in. by 18 in. web opening had been cut into the west existing girder. The web opening was at a high-shear area and did not comply with proportioning and spacing recommendations in AISC Design Guide 2: *Steel and Composite Beams with Web Openings*.

The W36 would connect approximately 6 in. from the nearest edge of the opening, and it could not be moved without moving the location of The Beam, which was not an option. A surplus of utilities—including approximately 12 antenna cables owned and operated by NBC, the New York Police Department, and the FBI—were crammed within the web opening.

GMS created extensive finite element analysis models to explore all options to avoid moving the cables. None were viable, though, so the solution was to cut and reroute the antenna cables, partially reduce the web opening size, and add a doubler plate.

Skylift Substructure

The Skylift's substructure has four static guideposts connected to the 70th-floor framing at the 12, 3, 6, and 9 o'clock positions. The project phasing relied on GMS completing the base-building work at the motor room and roof opening and turning over a turn-key space that would accept the Skylift equipment. The location, elevation, and configuration of the base-building structure at these four connection points along the 70th floor were hyper-critical. The new beam at the 3 o'clock position was the last project hurdle.

The new Skylift motor room is a former gift shop that occupied half a column bay, and at first, the team had limited access to survey details concealed by finishes. To stay on schedule, Skylift fabrication began before the gift shop was gutted. Gutting revealed the space's east-west dimension was approximately 1 ft smaller than initially thought based on prior renovation drawings and initial surveys. Recovering the lost space by setting the existing structure 3 ft lower cost nearly all the extra pit floor space allotted for tolerances. It also meant the new beam along the 70th-floor east edge would be partially within the elevator machine room in the other half of the bay.

The two new girders that support the Skylift are each 28 ft long, weigh about 2 tons, run east-west between existing columns, and are set directly below the original 69th-floor framing. Originally, the girders would frame into the existing columns' centerline, but that would put the east half of the girders partially within the 900-ft-tall elevator shaft. Moving them outward from the shaft would encroach more within the elevator machine room, which didn't have space for rigging and installation

Four disconnect panels were along the demising wall's north end, and critical electrical cabinets were along the south end. In that condition, the new beam would pass directly behind the disconnect panels and inches above the electrical cabinets. Furthermore, existing east-west beams into the Skylift motor room would have to be shored, cut, and reconnected to the new beam after the roof slab above the motor room was demolished. In response, all steel work was scheduled in coordination with a separate elevator upgrade project because it included temporarily relocating the electrical cabinets.

GMS worked with the contractor to develop a shoring sequence and reconnection detail that would fit into the constantly changing conditions. The final detail is like an inverted beam hanger where the vertical straps are in compression, a design that allowed all work to occur on one side of the demising wall without impeding building operations.

"Top of the Rock embodies the adaptive reuse that's possible with steel. It's not easy to rig an amusement ride at the top of an existing 90-year-old building. The ride captures the spirit of steel and the ironworkers who have brought it to life through the ages to celebrate the connection between a community and the structures that define it."
—Jeremy Loebs

Nick Zickgraf


courtesy of Tishman Speyer

Brian Bansrupan

Piecing Things Together

Given the lack of freight elevator access, each 28-ft-long girder had to be delivered to the site as four pieces, each about 7 ft long. Each piece traveled to the 67th floor in a recently refinished passenger elevator and was rigged up to a temporary work platform, which was built above the elevator staging area via an access hatch purposefully set where the Skylift installation team could later rig up materials from 67 to 70.

Once on the work platform, a system of carts on channel tracks maneuvered each 1,000-lb girder piece to its staging area on the west side of the work platform, and then the girder pieces were fit up and CJP-welded on a workbench hung from the 69th-floor framing. After the splice was completed, inspected, and ultrasonically tested, the workbench doubled as a track for pulling the girder to the east to allow for the next piece to be fit up in an assembly line-like fashion.

After all segments were spliced, shelf angles were welded to the column faces so the girder could be jacked into final position. The connections at the girders' eastern ends were designed to require access only from one side and required partial installation and inspection before the girder was pulled into its final location.

Both rides opened to the public in December 2023 and are a testament to steel's adaptability, even in the face of inconvenient jobsite constraints, and also demonstrate that steel frames can be adjusted later in their lifespan to serve a purpose never even considered during their initial design decades earlier.

The Top of the Rock project would have been easier to execute if the observation deck could have closed for a few months to accommodate blowing out existing bays and bulkheads and replacing them with a purpose-built frame, but it wasn't an option. Deliberate coordination, creative engineering, and working with an adaptable material resulted in a project whose original structure, designed for one purpose, could be elegantly altered for a completely new one.

Owner
Tishman Speyer, New York

General Contractor
Gilbane Building Company, New York

Architect
Montroy DeMarco Architecture LLP, New York

Structural Engineer
Gilsanz Murray Steficek, New York

Attraction Consultant
THG Creative, Pasadena, Calif.

Steel Team

Fabricator and Detailer
North American Manufacturing Corp.
Maspeth, N.Y.

Erector
Maspeth Welding, Inc., Maspeth, N.Y.

2025
IDEAS²
AWARD

EXCELLENCE IN
CONSTRUCTABILITY

200 Park
San Jose, Calif.

Jason O'Rear

"The SpeedCore system really set 200 Park apart in constructability. SpeedCore offers schedule efficiency and reduction of fireproofing based on the system thickness. More importantly, it offers a reduced level of high-risk safety activities associated with traditional concrete cores, because the preassembled steel frames are prefabricated and sequentially installed versus a concrete core rising in advance of the steel sequences."
—Rob Martinelli

THE TALLEST BUILDING in San Jose, Calif., is also the state's first of its kind. The 19-story, 300-ft office tower known as 200 Park became the first California building—and second anywhere—to use the SpeedCore structural system when steel erection began in 2021.

Steel was the unquestioned choice to achieve the building's open layout, which includes outdoor terraces on about half the levels and natural light pathways at almost every turn. SpeedCore emerged from the project team's studies and early considerations as more cost-effective than a traditional braced frame or reinforced concrete core. SpeedCore could also be erected faster—three months faster than a traditional reinforced concrete core. Additionally, its substantial shear capacity reduced wall thickness by up to 18 in. (up to 30%) compared to a concrete core wall.

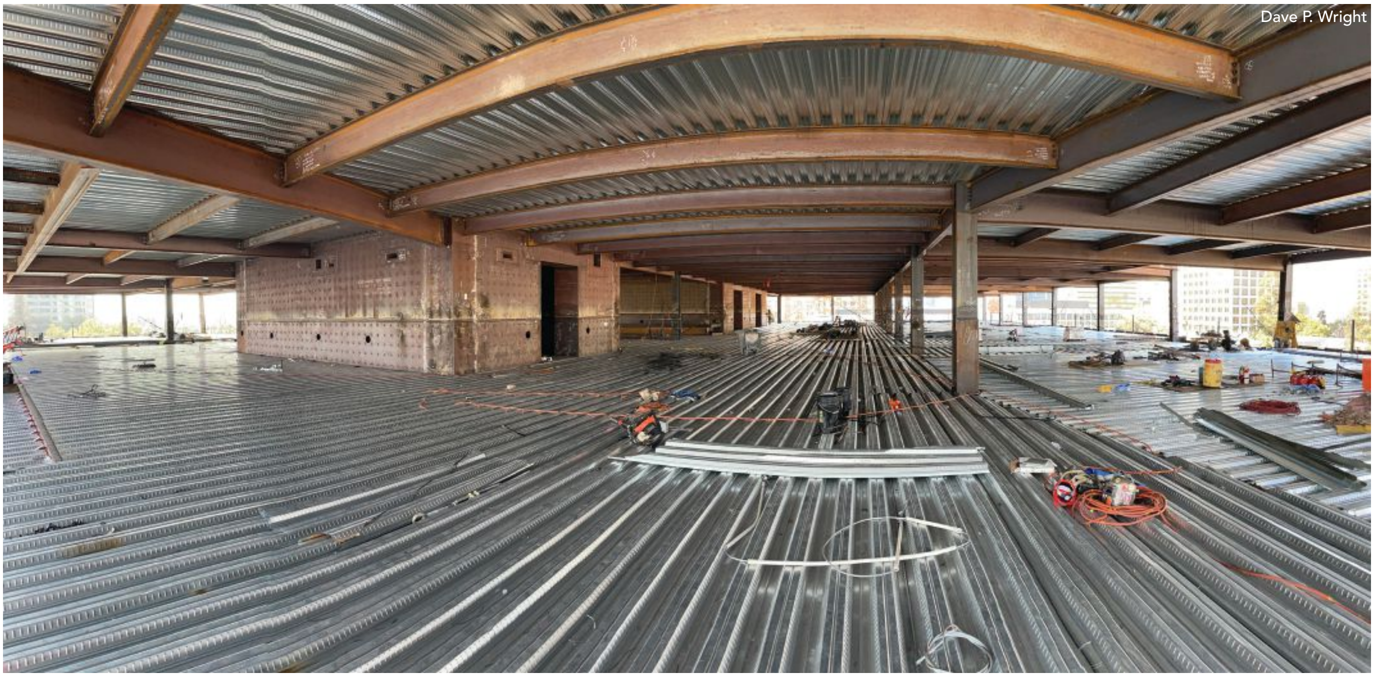
The $500 million building's framing system has 10,000 tons of structural steel. The tower's SpeedCore system—also known as composite steel plate shear wall/concrete-filled (C-PSW/CF)—accounts for roughly 4,000 tons of the total steel package. All told, it features nearly 1 million sq. ft of technology-driven Class A office space, four underground parking levels, ground-level retail, a 20,000-sq.-ft fitness center, and three above-ground stacker parking levels that can be converted into office space. Its oversized floor plates average more than 54,000 sq. ft—twice the size of typical San Jose office buildings.

Two-story outdoor terraces create light canyons that allow natural light to travel deep into each floor while providing desirable outdoor access at each level. The total terrace area exceeds 26,000 sq. ft. The owner and architect wanted the terrace floor framing levels to be as slim as possible, requiring thin custom-tapered shaped beams and girders and sloping steel columns that frame out these openings. Without steel, these key architectural features would not have been economically viable, even though steel is not visible in the final condition.

The tower has two composite cores, ranging from 60 ft by 42 ft for the two-cell core and 40 ft by 32 ft for the single-cell core. Nominal wall thicknesses range from 24 in. to 42 in. and decrease in size as the building rises. The heaviest prefabricated core modules weighed more than 17 tons and were about 38 ft long, 14 ft wide, and 3½ ft thick. The cores contain more than 65,000 welded cross ties, and onsite core filling uses a special 10,000-psi grout.

Most of the SpeedCore elements are ASTM A572 Grade 55 plate with a specified limit to control yield strength, helping to ensure the as-fabricated materials closely matched the designers' performance expectations. The tie rods were designed using weldable 55 ksi round bars. Heavy gravity columns were designed using A913 Grade 65 to help reduce size where possible. The SpeedCore plate is ½ in. thick, and cross ties in the core have a 1-in. diameter.

Unique leaning gravity columns scattered throughout the structure required heavy diaphragm bracing at certain floor levels, which included back-to-back steel angle members configured in a horizontal truss fashion. In some cases, large L10×10×1⅜-in. angles were used.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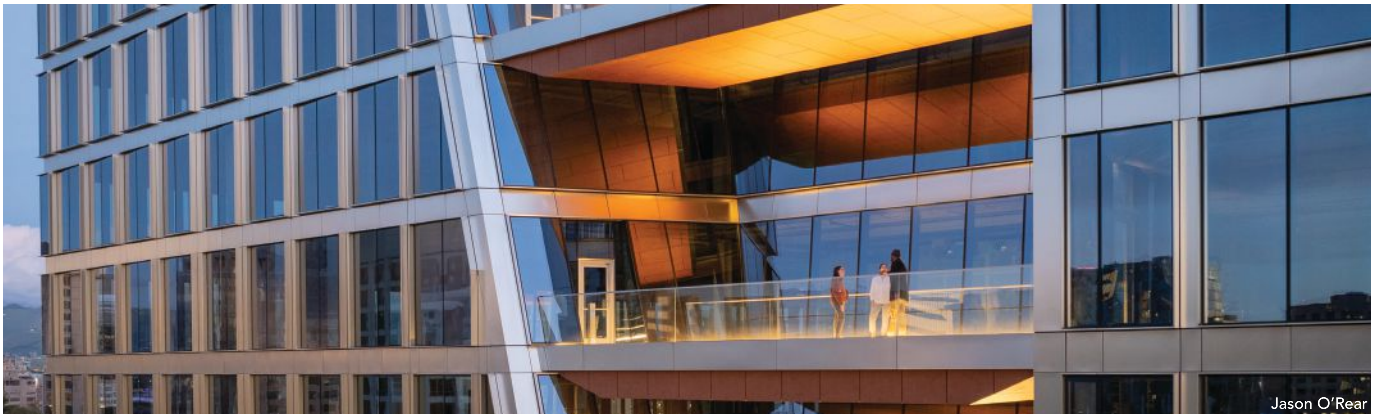

Jason O'Rear

Design Savings

While the project was still early in the design process, Purdue University's Applied Research Institute—which helped create SpeedCore alongside Magnusson Klemencic Associates (MKA) CEO Ron Klemencic—confirmed most fireproofing could be eliminated from the core. The testing showed that walls at least 24 in. thick easily exceeded the three-hour rating. The project team presented the discovery to local building officials and was permitted to eliminate most spray-on fireproofing from the SpeedCore faces, saving the owner additional time and money.

Another pre-fabrication cost-saver was a reduction in through-tie rods within the SpeedCore coupling beams. Additional research and testing at Purdue showed internal headed shear connectors could be used within specific zones on the coupling beam instead of through-tie rods that required connections to each face of core panel. The use of shear connectors simplified the fabrication and assembly of the coupled wall panels.

Research after the design of Seattle's Rainier Square Tower—the first-ever SpeedCore project—showed designers could reduce overall cross-tie quantities in the SpeedCore panels by increasing the spacing of cross-ties at certain regions of the cores (from 12 in. to 18 in.). This innovation helped lower overall fabrication costs and material quantities, as well as improved constructability.

The 200 Park project was the first time a SpeedCore-type system was used with a partial-height concrete core below grade. The first three basement levels used concrete shear walls before transitioning directly into SpeedCore. Interface with the concrete shear walls below and the significant quantity of reinforcing bars required extensive use of a building information modeling (BIM) approach by the design team and construction trades to ensure the two systems fit as planned.

At the ground level, where base shear is the most demanding, MKA devised a creative way to transfer the large diaphragm loads from the SpeedCore system into the heavy Level 1 concrete slab by using custom built-up plate girder drag elements integrated within the SpeedCore wall and column elements, along with threaded rebar couplers preinstalled to core modules.

About 15 column grids in the gravity-framed system incorporated slanted leaning columns to varying degrees and located at different elevations through the height of the building. Those helped define the light canyons and non-symmetrical building façade features. They introduced some large horizontal loading into the structure that was resolved by a horizontal bracing system located within the depth of the Level 5 framing that could transfer the loads back to the SpeedCore panels. This approach to transferring horizontal forces eliminated the complex interface of a steel-to-concrete or embed-plate construction and differing tolerances.

Constructability from Shop to Site

The prefabricated SpeedCore components are large and relatively thin, meaning tight tolerances must be maintained during fabrication to ensure field installation goes quickly and accurately. The fabrication process used specialized fixtures and jigs to help control distortion and ensure accuracy throughout manufacturing. It also required the fabricator to consider numerous operations for handling the oversized steel weldments during transportation to the job site, along with various erection activities before final welding and grouting.

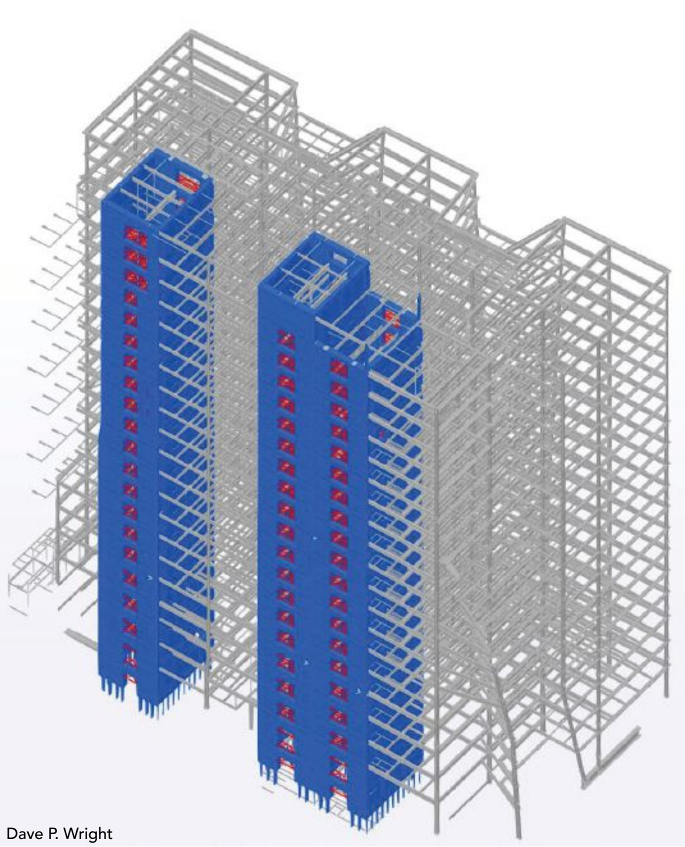
MEP penetrations through the SpeedCore system were critical considerations during the design planning. The location of reinforced sleeved penetrations through the core elements is important to the system's structural performance and efficient prefabrication before erection and core grouting. Several project stakeholders collaborated during the steel detailing and modeling phases to coordinate the layout and sizes and to ensure MEP designers had necessary passageways without jeopardizing structural performance. The collaborative efforts were rewarded with zero penetration modifications, additions, or location changes.

SpeedCore's swift erection timeline meant fabricator Schuff Steel needed to maintain a full pipeline of prefabricated core components and surrounding gravity framing to allow both crane hooks to erect steel without interruption. Schuff divided the work among five of its primary fabrication facilities—two produced the SpeedCore elements, while the other three focused on the non-lateral elements.

Schuff worked closely with MKA for all the lower-level specialized SpeedCore elements, which required heavy outrigger drag elements to interface with the core, and developed creative ways to configure them to optimize modularization. Thus, the difficult connections and weld joints could be fully completed in the fabrication shop, and field connections were simple. Schuff also worked with well-known welding expert and engineering consultant Bob Shaw to optimize welds, develop qualified weld procedures, and explore the best options for field welding to mitigate possible shrinkage or distortion in the core.

The building is about three miles from San Jose Mineta International Airport and under a primary flight path, which capped the structure and crane height. After discussion with airport officials, the FAA, general contractor Level 10 Construction, and crane suppliers Bigge Crane and Rigging Company and Bragg Companies, tower cranes were placed at the north and south ends.

An LR1300 crawler crane replaced the north tower crane for erecting the northmost steel on Level 18 through the penthouse. It could boom down in an emergency and be stowed after hours to suit U.S. Standards for Terminal Instrument Procedures (TERPS)


Dave P. Wright


Jason O'Rear


Dave P. Wright

Dave P. Wright

Jason O'Rear

requirements. The erection sequence for the north portion of the top two floors, roof, and penthouse left steel out of perimeter bays to allow for a shallower boom angle for erecting the balance of the structure without impacting the overall schedule.

The tower cranes were not freestanding and required lateral support via tie-ins to the primary structure. The structural general notes clearly defined requirements for the state of the structure at the time of tower crane jumps and tie-ins. Specifically, the cores had to be grouted to the level of the tower crane tie-in before any jumping operations. In general, the SpeedCore notes required that the grout within the core walls be placed so that the elevation of the grout is always greater than the elevation of the last poured floor.

To overcome the tie-in challenge and create flexibility, Level 10 Construction engaged erection engineer Simpson Gumpertz & Heger (SGH) to analyze an un-grouted core's behavior. The results of a detailed finite element analysis of the cores relaxed the constraints so deck pours could occur before the grouting operations for a maximum of one floor, in addition to allowing the tower cranes to be jumped and tied in at a steel framed and decked level, even if the core had not yet been grouted up to that level.

A tight job site meant prefabricated SpeedCore panels were often hoisted directly from the delivery trucks, staged on the working floors, and eventually re-erected into their final position. The extra step required detailed structural analysis from SGH to help ensure local stability and loading on the partially completed framed and decked floors.

All field splices between the SpeedCore elements had to be welded, and the project team developed a plan for welders to stay closely behind the core erection teams to keep the process moving and avoid delays to trades working below.

The building was completed in May 2023, and SpeedCore was the primary reason behind its three-month time savings compared to a traditional frame. It finished a month earlier than the initial SpeedCore schedule. It was speculatively designed, making it an attractive space for a wide tenant range now and in the future.

SpeedCore was also used in Seattle's Ranier Square office building, which opened in 2021 and shaved 10 months off design and construction time using SpeedCore. In 2023, AISC published Design Guide 38: *SpeedCore Systems for Steel Structures* (download or order at **aisc.org/dg**) to help engineers harness SpeedCore's benefits.

Owner
Jay Paul Company, San Francisco

General Contractor
Level 10 Construction, Sunnyvale, Calif.

Architect
Gensler, San Francisco

Structural Engineer
Magnusson Klemencic Associates (MKA), Seattle

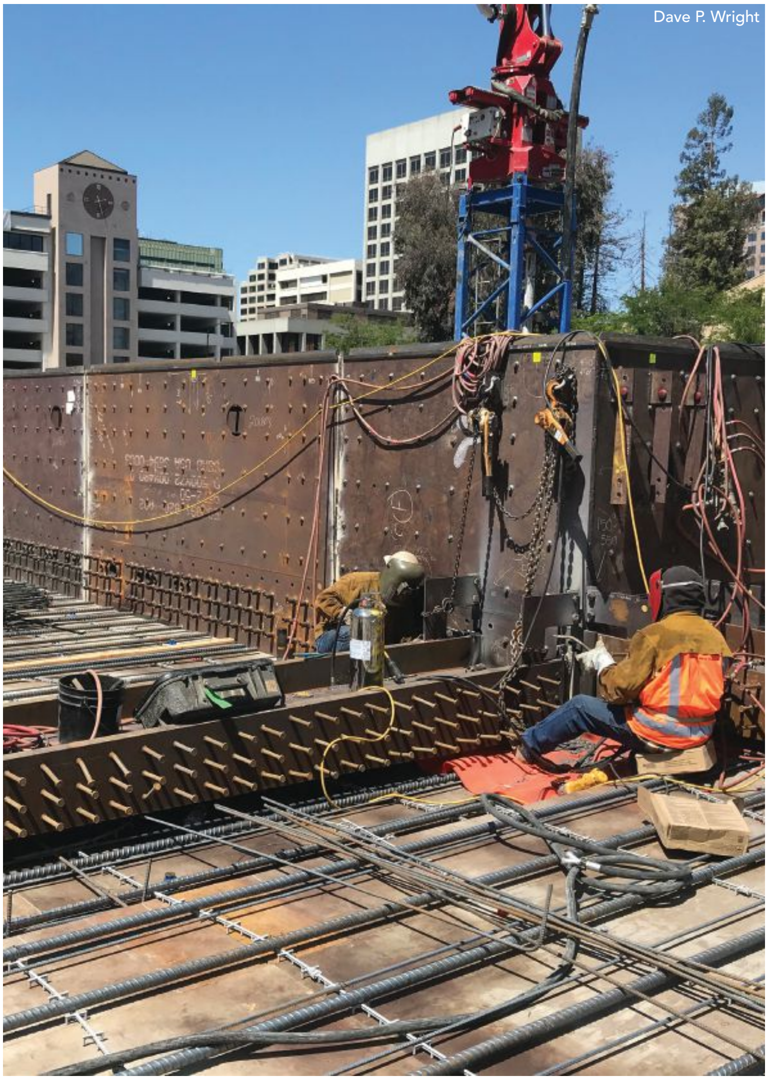
Steel Team

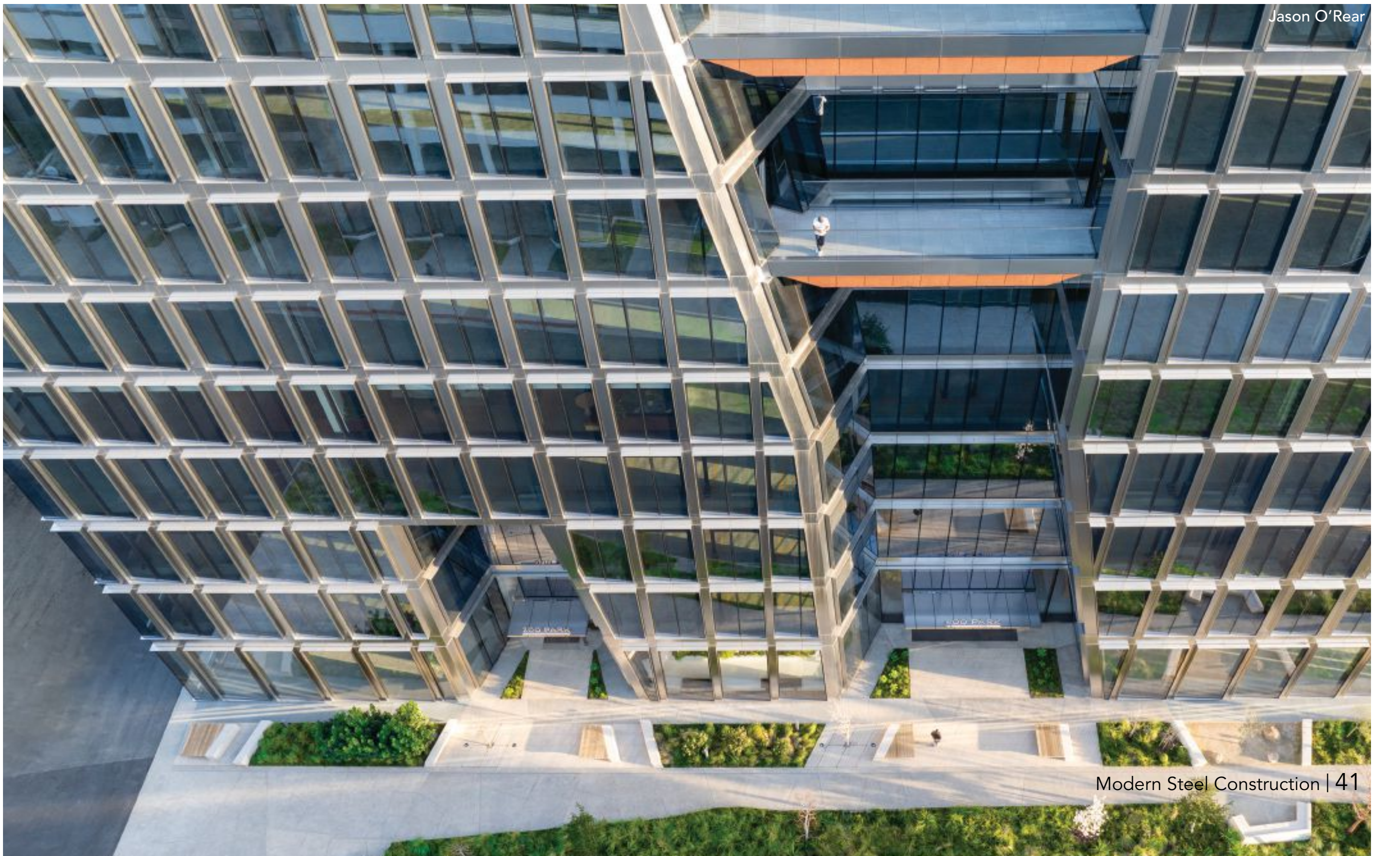
Fabricator and Erector
Schuff Steel Company, Phoenix

Detailer
DBM Vircon, Tempe, Ariz.

Erection and Construction Engineers
Hassett Engineering, Castro Valley, Calif.
Simpson Gumpertz and Heger (SGH), San Francisco

Connections Consultant
Steel Structures Technology Center, Inc., Howell, Mich.


Dave P. Wright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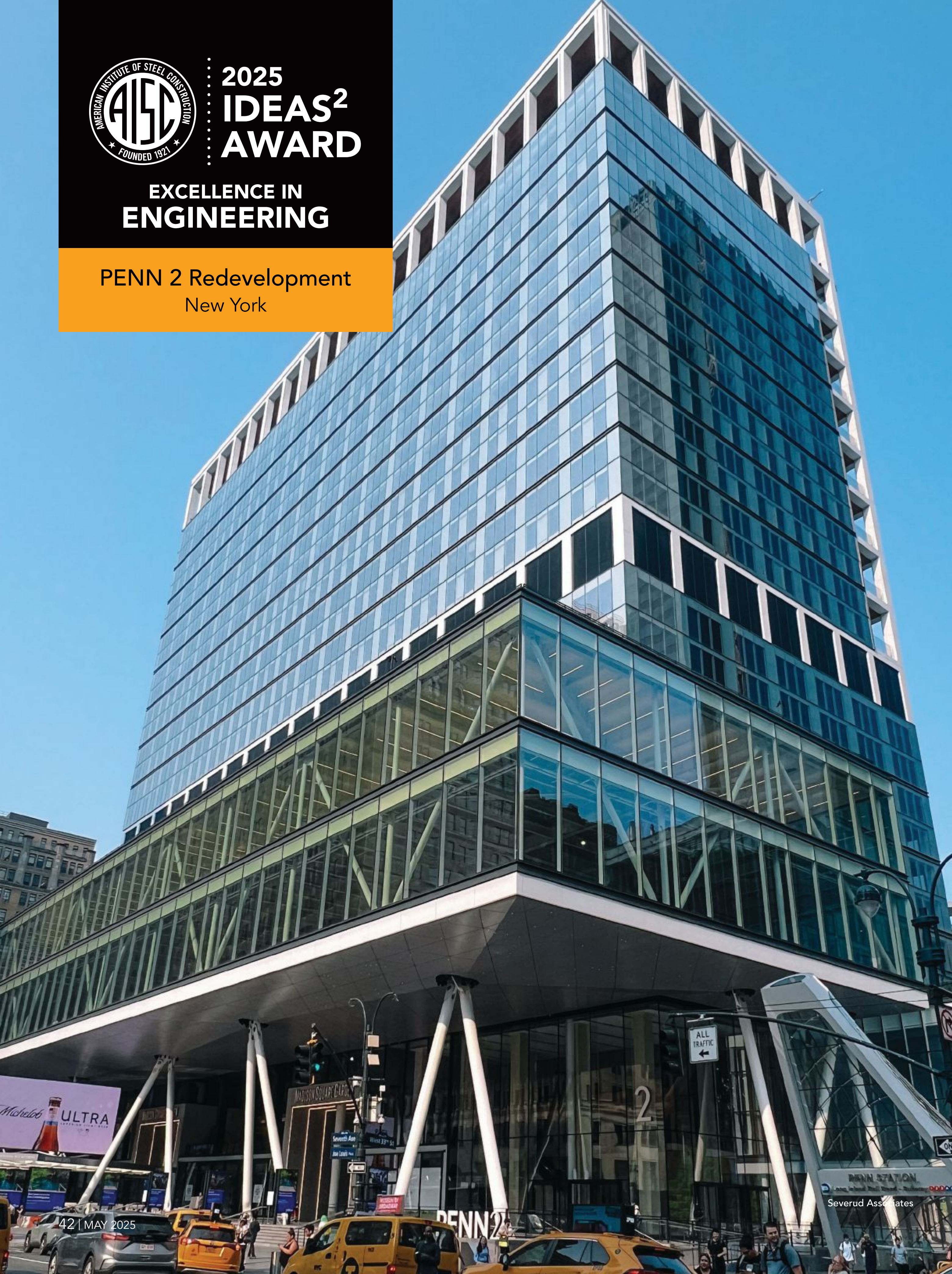


2025 IDEAS^2 AWARD

EXCELLENCE IN ENGINEERING

PENN 2 Redevelopment

New York

Severud Associates

Severud Associates

A MIDTOWN MANHATTAN OFFICE BUILDING needed a boost from its original 1960s form, and its steel frame lent itself to adaptation and longevity despite its age.

New steel elements incorporated at PENN 2 created a 75-ft by 450-ft addition called the Bustle that hovers 50 ft above the sidewalk on 14 dramatically sloped columns configured around an existing trainshed. Creative connections ensured the existing structure and addition do not transfer significant lateral load to each other.

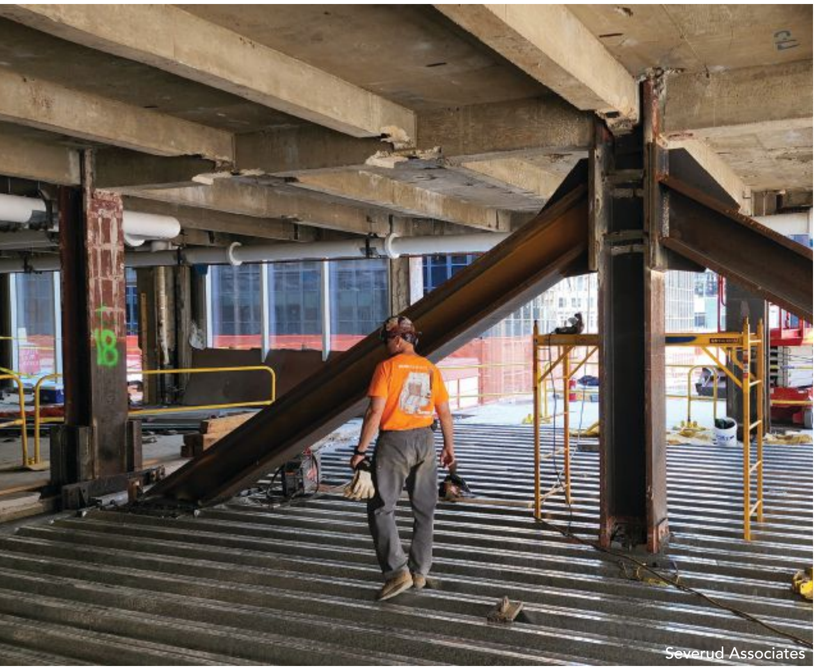
Redeveloping PENN 2, formerly Two Penn Plaza, added inviting public spaces, improved office facilities, modern worker amenities, and updated aesthetics to the Penn District neighborhood and reconnects the building with street life. The 32-story building was constructed in 1968 following the original Penn Station's demolition, replacing a monumental public space on a double-wide block on the west side of Seventh Avenue between West 31st and 33rd Streets.

The Bustle goes from the fourth to 10th floor and provides 100,000 sq. ft of double-height, column-free office space, 43,800 sq. ft of roof terraces, and an expansive, protected public plaza adjacent to Seventh Avenue. It takes advantage of the existing building's setback from Seventh Avenue by using space not embraced in the 1960s design.

The addition stretches the width of the double block, extending almost 40 ft beyond the north and south ends of the tower, which are also set back from the sidewalk. The massing honors the former Penn Station but adds slender, widely spaced columns that replace the former station's dense and regimented colonnade.

Smaller additions at the north and south ends are supported both by existing columns and new columns bearing over the existing trainshed framing. The north addition includes the column-free, double-height Town Hall between the second and fourth floors that accommodates up to 280 people and supports a future pedestrian bridge spanning over PLAZA 33 to PENN 1. Other features include a triple-height entrance lobby, double-height corner loggias, a rooftop pavilion, and terraces.

Several years of conceptual studies and design development resulted in minimal disruption to the existing transit facilities and the hundreds of thousands of travelers who use them daily. Documentation of existing structures, including field surveys and material testing, combined with sophisticated analysis and advanced materials, allowed a modern addition to be built atop a century-old trainshed structure.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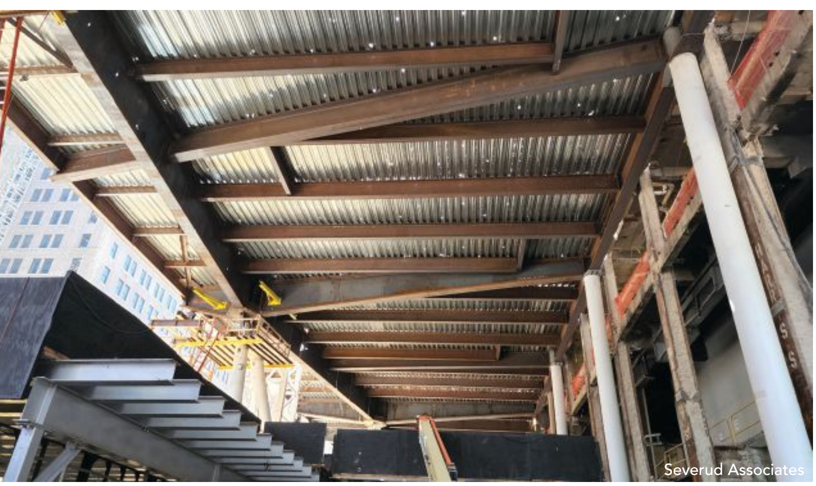
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Severud Associates

Adding Steel

Structural steel was the natural choice for the project. The original building is framed entirely in steel, with cinder concrete slabs and beam encasement to increase allowable stresses. That system is a precursor of today's composite steel and concrete-filled metal deck and was easy to design and construct.

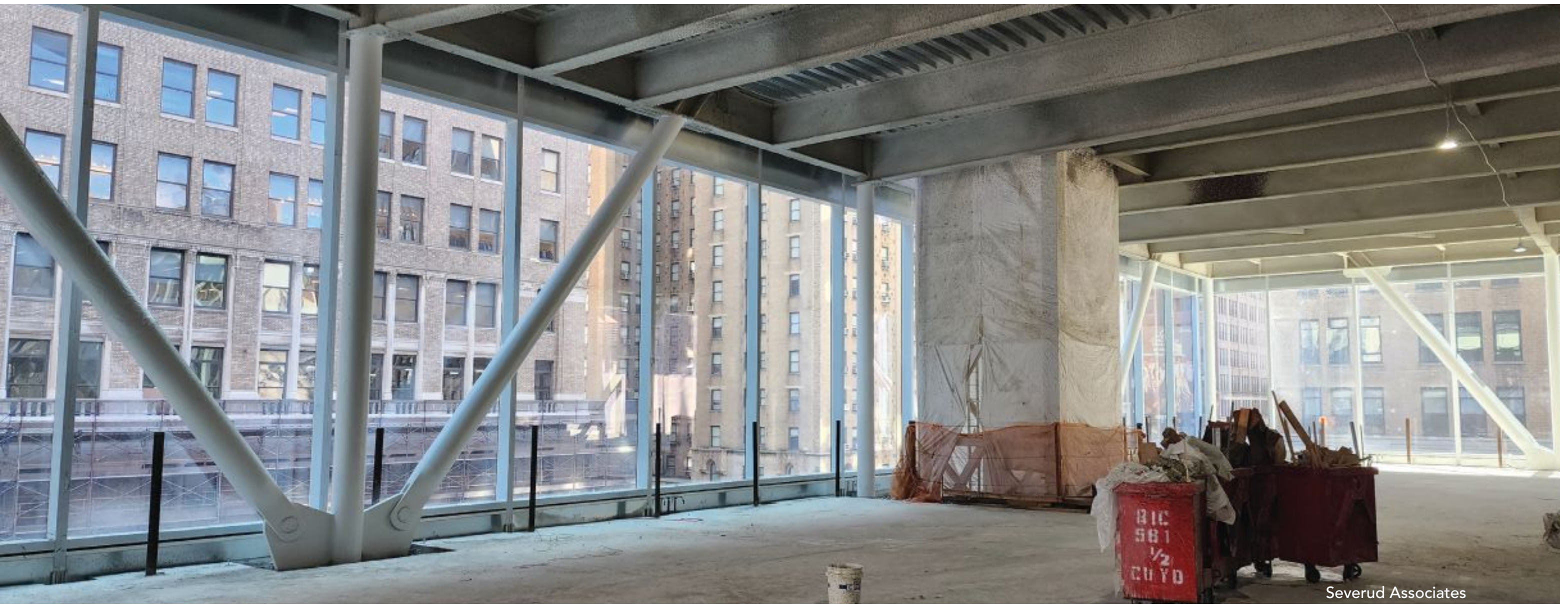
The triple-height entrance lobby, double-height corner loggias, and roof terrace and pavilion were created by selectively demolishing entire framing bays—except for members bracing existing columns—and reinforcing the columns for the increase in unbraced length. New infill framing was erected and the temporary bracing beams were removed.

Structural steel, even if more than a century old, can have remarkable reserve capacity. Engineers determined older steel locations where coupons could be cut and tested for tensile properties, chemical composition, and base metal notch toughness, per Appendix 5 of the AISC *Specification for Structural Steel Buildings* (AISC 360-22). Rivets were also tested.

The primary types of steel on the original structure were Penn Station's 1906 ASTM A7/A9 60-ksi tensile strength (average) with a 30-ksi yield point and Two Penn Plaza's ASTM A36 58-ksi tensile strength (minimum) with a 36-ksi yield point. Tests on both showed they met or exceeded current standards for ASTM A36. Some steel contained high concentrations of sulfur or silicon and was coated with lead-based paint, which was abated wherever necessary. Nevertheless, additions and reinforcement with steel were practical, efficient, and economical.

Steel's aesthetic advantages were also important. MdeAS Architects desired an expansive protected public plaza beneath the Bustle and slender, widely spaced columns to support it. The sloped columns' arrangement and their cast steel end connections' simplicity perfectly matched the architect's and owner's visions. The sloped columns, other round columns, truss diagonals, pin connections, and supporting gussets were all considered showcase elements and were fabricated, shipped, and erected to architecturally exposed structural steel (AESS) Category 4 (showcase elements).

Aesthetics were crucial in the Bustle framing as well. Tapered plate girders at the Bustle's lowest level create an LED-lit faceted soffit, adding captivating visuals. The widely spaced perimeter columns and compact floor framing maximize the open feeling of the office space from inside and outside. The perimeter truss diagonals provide the necessary load transfer and stiffness while minimizing obstructed views through the two-story curtainwall.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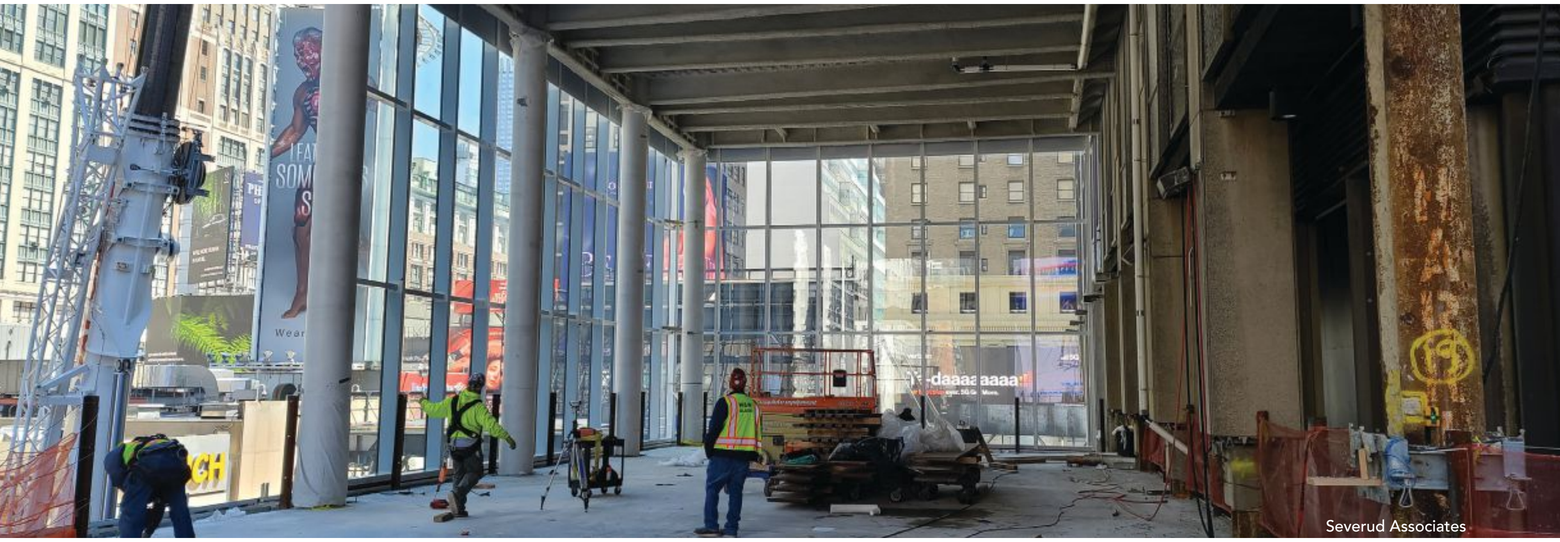

Severud Associates

Trainshed Tactics

The north, south, and east building expansions are supported on the original Penn Station trainshed. The station's above-ground portions were demolished in the 1960s to make way for Madison Square Garden and Two Penn Plaza and the below-grade structure remained mostly intact, with excess structural capacity due to the removal of the above-ground structures.

The original columns and foundations were used to their fullest extent to limit existing structure reinforcement within the trainshed and corresponding train service disruptions. Consequently, the sloped column locations were meticulously calibrated to land in specific locations on the sidewalk-level transfer structures to distribute the loads to the existing columns without exceeding their capacity. A new column to carry the load to bedrock was needed at only one location.

The transfer structures consist of plate girders and heavy wide-flange sections divided into seven individual platforms that bear directly on the trainshed roof, which simplified installation and precluded disturbing the tracks below. The framing is integrated into the elevated plaza—constraining its depth and arrangement—and encased in concrete for stability and weather protection.

Working above and within Penn Station and the trainshed required coordinating with multiple agencies, primarily Amtrak. With the trainshed's tight clearances and an order to minimize service disruptions and track outages, the structural design had to be as compact as possible, with work performed from above wherever practical.

The only existing structural drawings available for Penn Station and the trainshed were not original; they had been redrawn in the 1940s. Field investigations and condition surveys were performed as needed to verify critical existing structures affected by the work.

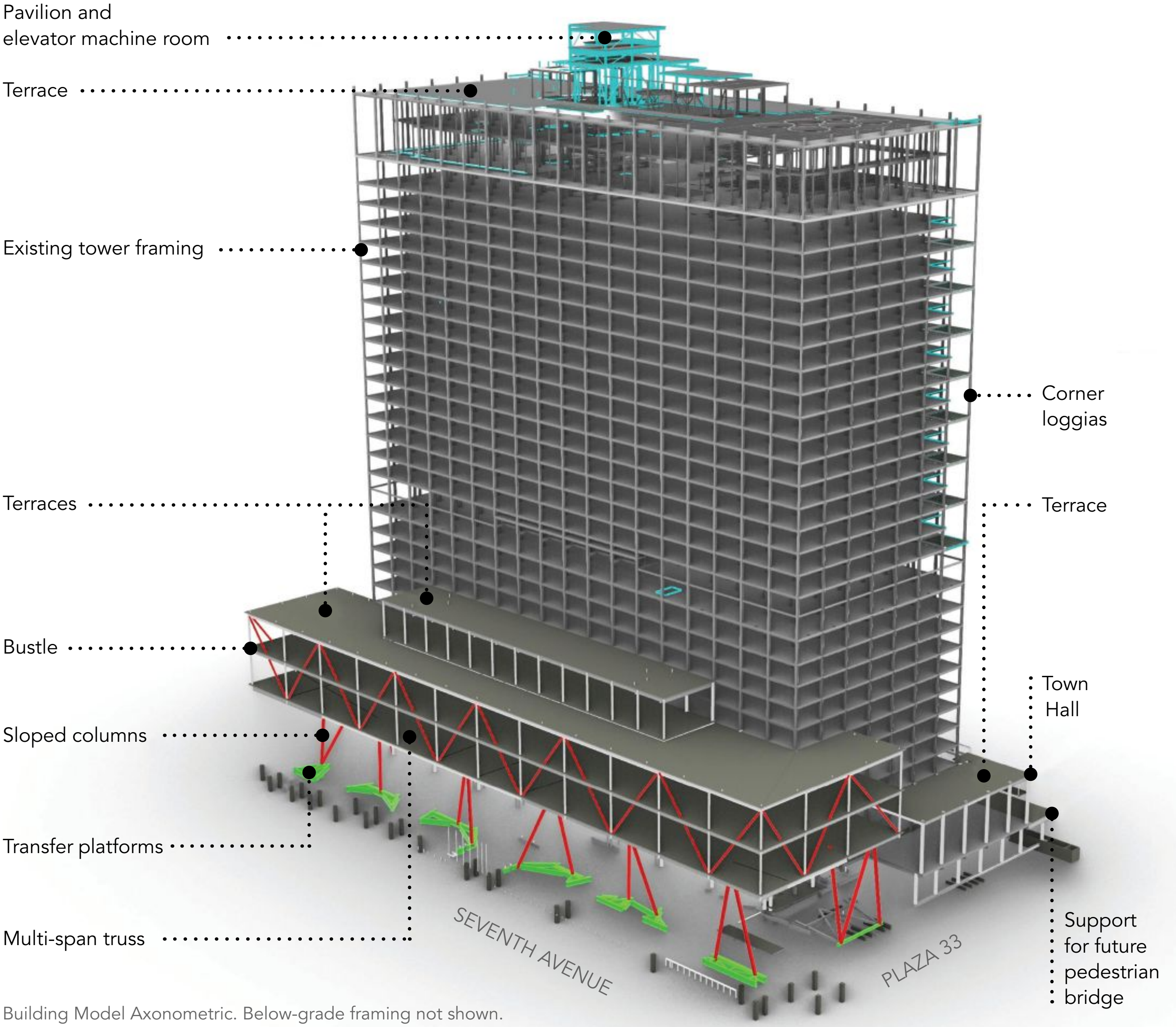
Load Management

The sloped columns support the east and north sides of the Bustle; one sloped and six vertical columns support its west edge, adjacent to the tower. Brackets field-welded to existing steel columns support the Bustle at the building center, and field-welded steel plates increased their load capacity.

All sloped columns are 24-in.-diameter HSS with a cast steel pin connector at both ends. The complete end connections, including clevis, pin, and gusset, were fabricated in the shop and the gussets field-welded to accommodate their tight tolerances better. A high-performance coating system protects the columns from weather.

“The engineering team overcame so many intricate and complex design challenges while working within the constraints of the existing structure. The multi-story sloped columns configured around an existing trainshed were also used to laterally brace the new structure. The strategically placed connections between the addition and the existing structure ensured a balanced lateral system without transferring significant load between either system.”

—Fraser Reid



Building Model Axonometric. Below-grade framing not shown.

Severud Associates

The Bustle’s lowest level is framed as a cantilevered tabletop. Steel plate girders span east to west from the face of the tower and over the top of the sloped columns to the exterior. In the north-south direction, a line of plate girders snakes across the tops of the sloped columns, cantilevering at their ends. The Bustle exterior is diagonalized between the fourth and eighth floors to form a multi-span truss to collect vertical loads tributary to the plate girders and their supporting columns. The diagonals are 14-in.-diameter hollow structural sections (HSS) with cast steel pin connectors.

Laterally, the Bustle and other additions are self-supporting to avoid triggering an upgrade to the lateral force resisting system of the existing tower—which was designed well before modern wind and seismic design codes were developed. All loads required are per the current building code, and loads on the existing building were not increased beyond the level that would trigger an upgrade to the building’s lateral force-resisting system.

All column-to-beam joints incorporate moment connections, and the sloped columns act as diagonal braces. Connections at the sixth, eighth, and 10th floors ensure stability without transferring significant lateral load. At the fourth floor, an isolation joint uncouples the existing building from the addition and prevents lateral load from flowing to the sloped columns. The brackets that vertically support the Bustle allow horizontal slip for the expected deflections.

The additional lateral loads are resisted by existing north-south concrete retaining walls in the trainshed and existing east-west moment-resisting frames in PENN 2. The plaza concrete slab and girder encasement are reinforced for the additional shear. At sidewalk level, steel plates were anchored to the trainshed roof and spliced together to form a load path from the plaza framing to the resisting elements. A reinforced concrete slab to transfer the loads at sidewalk level would have been too thick.

Removing an existing column between the ground and fourth floors further opened the lobby. New columns added one bay to either side and bear on new girders below the ground floor. Existing fourth-floor framing was replaced with beams spanning between the new columns on both sides. Diagonal members between the fourth and fifth floors create a truss to transfer load to the new columns. The 6-ft-deep ground floor plate girders transfer load back to the original location. This double-cantilever girder acts like a well-balanced seesaw; the tips are braced laterally but free to deflect vertically.

After the truss connections were locked in, jacks relieved load from the existing column. The new columns were shimmed tight and the existing column removed. When the jacks were released, the load transferred to the new columns and back to the existing column, leaving the distribution of vertical load essentially unchanged.

Columns and Conversions

Columns spring from the tabletop's perimeter to create a column-free interior. Along the tower's face, wide-flange columns align with the existing columns at about 20 ft on center. On the exterior, the 14-in.-diameter HSS columns are spaced at about 36 ft. They support beams spanning east-west at the sixth and eighth floors, creating the double-height volumes.

The triple-height lobby was created by removing second- and third-floor bays. Eliminating beam-to-column joints redistributed lateral load and required reinforcement of existing moment connections around the lobby. Removing the existing framing of the north- and southwest corner bays between the 14th and 29th floors created the double-height loggias. On even-numbered floors, new framing supports the increased dead and live loads of the terraces. On odd-numbered floors, the corner columns were reinforced for the resulting increase in unbraced length, prior to removal of the spandrel beams.

Converting the tower's roof to terrace space and adding a multi-purpose pavilion required reinforcing the existing framing. New beams were added between existing beams, and existing girders were augmented with tee sections field-welded to their bottom flanges. Extending the high-rise and freight elevators was also required. The existing machine room was demolished, the shafts extended, and a new machine room was constructed. Existing columns were reinforced as needed.

Construction Considerations

Studying existing structures helped plan the Bustle's steel erection sequence. The long spans, cantilevers, double cantilevers, and multiple levels of supporting steel could deflect, shift, or vibrate during erection. That meant tolerance issues for fitting up the steel framing, curtain wall, and finishes were considered.

Temporary supports were installed for the tabletop using the permanent transfer platforms, other existing trainshed columns, and the existing concrete retaining wall. Temporary girders were installed where needed for two tower cranes.

The tabletop framing was erected using tower cranes, with supports at the cambered tips of the cantilevers. Next, the concrete fill on metal deck was placed. Concurrently, the sidewalk steel plates were installed and the plaza concrete completed. Once the tabletop steel had been checked and adjusted and the concrete had cured for 28 days, the temporary supports were removed. The tower cranes then erected the remainder of the Bustle using the tabletop as a stable platform.

Throughout the design process, the construction manager brought together the structural engineers and contractors to evaluate the work and suggest modifications to streamline fabrication, delivery, site logistics, erection, and connections to best use the shop's methodologies and personnel. Engaging the steel casting supplier resulted in simpler connections to fabricate and erect and satisfied the aesthetic vision.

PENN 2 steel work was completed in December 2023. The $650 million building opened in 2024, satisfying its stakeholders' stringent requirements and meeting budget. The redevelopment is a sustainability win by reusing an existing facility. A complete demolition and rebuild would have been easier but would have increased waste, new material creation, and train station impact. Instead, the project team adapted a 20th-century building to attain 21st-century environmental performance.

Owner
Vornado Realty Trust, New York

General Contractor
Turner Construction Company, New York

Architect
MdeAS Architects, New York

Structural Engineer
Severud Associates Consulting Engineers, New York

Steel Team

Fabricator and Detailer
Crystal Steel Fabricators (AISC Certified Fabricator), Delmar, Del.

Erector
Skanska USA Civil Northeast, Inc., East Elmhurst, N.Y.

Casting Supplier
CAST CONNEX (AISC Associate), Toronto

2025 IDEAS² AWARD

PRESIDENTIAL AWARD FOR ENGINEERING DESIGN AND CONSTRUCTION

Sphere
Las Vegas

Severud Associates

THE LARGEST SPHERICAL STRUCTURE IN THE WORLD is a display of groundbreaking steel innovation that has helped redefine the immersive entertainment experience. Sphere, the next-generation music and performing arts venue just east of the Strip in Las Vegas, is a 516-ft-diameter semi-spherical building rising 366 ft above ground. It encloses a bowl-shaped theater for 17,600 guests seated beneath a domed roof and a suspended media plane.

Sphere visitors first encounter the exosphere, the venue's outer latticed grid shell composed of steel pipe sections and cast steel connecting nodes and covered with 580,000 sq. ft of programmable LED lighting. Starting from a traditional geodesic arrangement—a "Bucky dome," as envisioned by architect Buckminster Fuller—Severud Associates structural engineers employed parametric design and optimization to determine the sphere's lightest tessellation. The engineers also found significant benefits with cast steel nodes, a crucial project component.

Inside the venue, the lower seating bowl framing, stage and proscenium, and back-of-house components are concrete bearing on piles and mats. The upper seating framing and perimeter concourses are structural steel in a barrel-shaped arrangement. All seats are supported on precast concrete stadia, and 10,000 of them are immersive and include haptic systems. An optimized steel-framed dome tops off the theater.

The project also includes a separate collar structure with the loading dock and other back-of-house facilities, plus a 1,200-ft serpentine pedestrian bridge framed with steel box trusses that connects the venue to a convention center. A bridge building provides a transition to the venue. The bridge and collar buildings are isolated from the exosphere.

> "It's an engineering and architectural marvel that redefines immersive entertainment. It combines a stunning LED-clad exosphere with groundbreaking steel innovations to create the largest spherical structure in the world. Detailing in two dimensions is already complicated, but bringing to life this three-dimensional geometry was even more commendable. This project exemplifies the kind of creativity and collaboration that will set the standard for future wonders like this one."
>
> —Nima Balasubramanian

Sphere Entertainment Company

Steel Solutions—and Conversions

The exosphere shape is critical to Sphere's aesthetics and its exterior LED displays. A sphere is one of nature's most stable shapes, but wind load, thermal expansion, and acoustics made it a completely isolated structure. Constructing a free-standing sphere in any other material would have been essentially impossible.

Sphere's multi-sensory theater experience requires a huge column-free space, clear sightlines to the stage, and an expansive media plane. Maintaining the proper focus for 17,600 guests made the shape of the venue—a sphere within a sphere—a natural choice. As with the exosphere, structural steel was the best material to carry the roof and rigging loads efficiently without adding significant dead load.

Formwork for a concrete roof dome would have been extensive, costly, and time-consuming and would have interfered with other trades. The roof dome framing was prefabricated in sectors—including intermediate framing—that were easily erected and required only one center temporary support tower. A 10-in.-thick concrete slab on metal deck provides permanent stability and acoustic damping.

The venue's exterior walls (immediately behind the exosphere) are barrel-shaped to maximize internal space, and the resulting double-curvature was easily framed with curved hollow structural section mullions and girts. The mullions are supported laterally by the cantilevered slabs at each concourse level and vertically only at the third level. Slip connections allow the other floors to deflect independently without inducing loads in the wall framing.

Steel fabrication's flexibility and its ability to coexist with other materials were critical to Sphere's construction. The ground through fifth floors are framed with concrete slabs, beams, and columns, while the rest of the floors are steel.

Early in the pre-construction phase, Severud flipped the sixth floor and above from concrete to steel. The switch allowed the steel contractor to start detailing and fabricating at about the same time as the superstructure concrete contractor. When the concrete contractor approached the fifth floor, the steel contractor was prepared to start erection as soon as the concrete was placed. That quick transition saved about six months on the overall schedule and facilitated all following work by eliminating several levels of shoring.

The seating is supported by raker beams carrying the precast concrete stadia. Four concrete shear wall cores combine with concrete walls that wrap around the stage to provide lateral support for the entire venue.

Diurnal temperature ranges are as high as 100° in the summer and vary from one side of the structure to the other. The exosphere is self-supporting and isolated from the rest of the building; it rests on its own ring of pile caps and grade beams. The separation allows the exosphere to expand and contract in or out up to 2 in. without restraint from the venue within, which is insulated and less thermally variable.

Castings Bring Savings

The project team's solution for the lightest constructable and transportable tessellation was 14 horizontal latitudes of continuous ring members and crisscrossing diagonal geodesic elements, continuous between the pile-supported grade beam at its base and a latitudinal ring near the crown. The topmost framing, known as the Oculus, is framed radially. This configuration resulted in a slightly higher tonnage, but at a lower cost because it could be erected with minimal shoring.

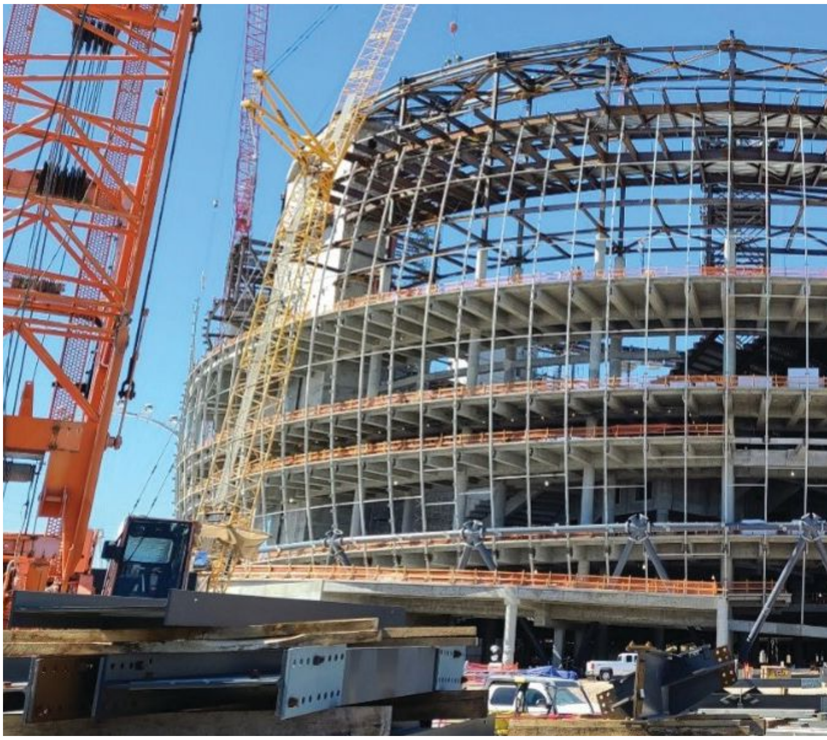
The team next studied node connection details, bringing in CAST CONNEX to advise on cast steel nodes. Two designs based on welded plates were compared to castings with flanges, with a focus on cost and schedule. Extensive analysis revealed that built-up plate nodes presented daunting constructability issues.

Cast steel nodes, though, offered significant advantages in material optimization, improved tolerances, and reduced construction risk. They resulted in a 40% reduction in weight compared to built-up nodes because they did not need stiffener plates and other appurtenances. Further, they occupy a quarter of the surface area, which afforded significant savings in the exosphere's three-part, high-performance weatherproof coating.

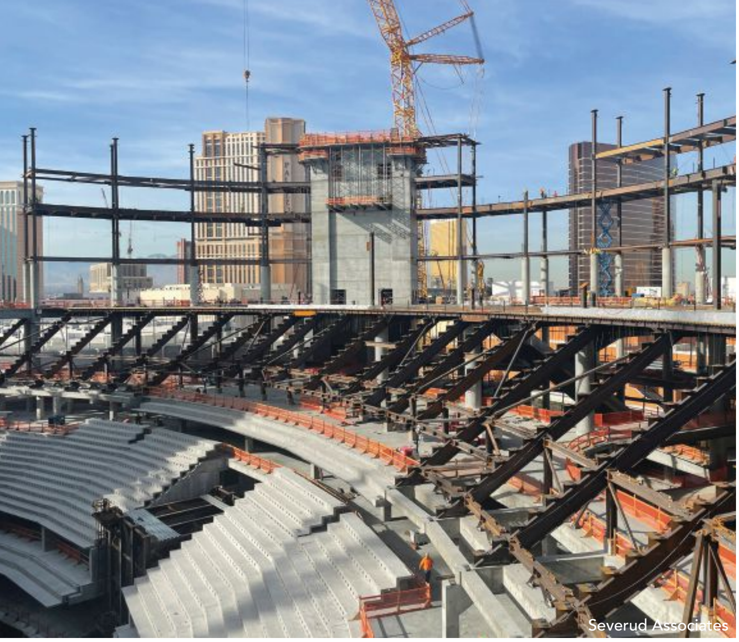
All the castings are essentially identical, eliminating concerns about fabrication tolerances. Grid shell structures are sensitive to angular variations at the nodes and length variations of the members. Cast nodes with CNC machining of the flanges increased precision, while bolted end-plate connections allowed shim packs to accommodate variations in the length of the members, which were fabricated slightly short. The cast nodes' geometry was an order of magnitude smaller than that of built-up nodes.

The system provided greater overall geometry control during erection, which reduced construction risk by simplifying erection and minimizing the potential for out-of-tolerance errors, resulting in further cost savings.


Severud Associates




Severud Associates


Severud Associates


Severud Associates


Severud Associates

Dome and Concourses

The steel-framed top dome is 400 ft in diameter, and it's designed to optimize depth, radial arches, and compression rings. Pairs of adjacent half-arches, intermediate framing, and a temporary tie rod were prefabricated into units and lifted into place between the perimeter columns and a temporary center shoring tower.

The flat roof of the concourses is incorporated into the dome framing and acts as a tension ring to resist the dome's thrust; only vertical forces are delivered to the supporting columns under gravity load. The connections to the columns allow the dome roof to move radially without restraint under most conditions. The dome's shape and location within the exosphere minimize wind load; therefore, it is only under seismic load that the columns are engaged laterally.

The double ring of perimeter columns supports the concourse levels. A combination of slabs, metal deck, and diagonal braces provide the strength and rigidity necessary to collect lateral loads from the entire venue (except the self-supporting exosphere) and deliver them to the cores and stage walls.

Two composite steel and concrete girders span across the stage to transfer roof columns and support the fly tower. The increased stiffness—roughly three times what it would be with concrete-only or steel-only designs—keeps deflections small and mitigates concerns about possible adverse impacts from the augured pile foundation's differential settlement.

All dome field connections were bolted—there was no field welding. Fabrication and erection tolerances were expected to be on the order of 3 in., but fabricator W&W|AFCO delivered the dome to about 1 in. of ideal geometry. The 160,000-sq.-ft media plane required tolerances down to ⅛ in.

A steel roof dome and grillage system allowed for adjustments at several stages needed to create a nearly spherical surface. The grillage, which supports rigging and catwalks, hangs only from the dome to avoid bridging systems that behave differently. It transitions from the dome geometry to the media plane configuration while maintaining the 1-in. tolerance. Erecting the primary framing that hangs from the grillage involved jacks to adjust elevation and reduce tolerance to ½ in. The secondary framing included attachment clips that allowed ¼-in. precision. LED tile connections to the secondary framing created a spherical surface within ⅛ in. of theoretical.

Construction Considerations

A staged construction analysis showed the exosphere could be cambered by adjusting member lengths. As erection progressed, the framing settled into proper alignment. The first ring cantilevered from the foundation. Once fully bolted, a ring could support the next ring's framing up to the Oculus, which was erected in a single unit. Finite element modeling also achieved a higher level of confidence in the roof dome's structural behavior.

Additionally, multiple daily surveys aimed to predict structural displacements and assess conformance to tolerances at regular intervals. Consequently, large framing sections were pre-deformed to fit the structure's surveyed shape. Large racking frames introduce forces into the structural members and balance the additional deflections to meet the LED systems' stringent tolerances.

Structural systems were chosen with contractor availability and expedited construction in mind. Some systems were changed pre-pandemic and early in the pandemic to keep the project moving. Sphere's successful and timely completion relied heavily on its structural steel components and their integration with other trades.

courtesy AISC

A Venue for the Future

Sphere's commitment to sustainability began with its design and construction. Parametric structural optimization, a cutting-edge algorithm-based design approach that seeks reduction in materials and costs as a goal by iterating structural properties such as the number, arrangement, type, and depth of structural members, led to significant tonnage reductions for the exosphere and the venue's roof dome.

All concrete substituted supplementary cementitious materials for up to 20% of standard cement and used reinforcement made from nearly 100% recycled steel. The structural steel framing contains over 90% recycled material.

Sphere is also committed to sustainability in its operation and hopes to set a new standard for environmentally responsible energy use by entertainment venues. The venue intends to source approximately 70% of its electricity from solar power facilities and is pursuing a long-term agreement with its local electric utility.

Sphere's exterior and interior lighting is composed entirely of LED systems that are among the most energy-efficient lighting available today. Its advanced heating and cooling systems avoid wasteful reheating. The central plant is comprised of high-efficiency chillers and condensing boilers and is also used to cool distributed kitchen equipment loads. The facility's data center conforms to state-of-the-art efficiency standards, using hot-aisle containment and directing cooling where needed.

Although Sphere is composed of distinct structural systems, they are all interconnected to form a cohesive, balanced, efficient, and elegant superstructure. Sphere aimed to create a fully immersive experience and elevate in-person entertainment to new levels. The $2.2 billion facility took five years to construct and opened in September 2023. ■

Owner
Sphere Entertainment Co., New York

General Contractor
MSG LV Construction, LLC, Las Vegas

Architect
Populous, New York

Structural Engineer
Severud Associates Consulting Engineers, New York

Steel Team

Fabricator and Erector
W&W | AFCO Steel (AISC Certified Fabricator & Erector), Oklahoma City

Detailer
Pro Draft, Inc. (AISC Detailer), Surrey, B.C.

Bender/Rollers
Chicago Metal Rolled Products (AISC Associate), Chicago
Max Weiss Company (AISC Associate), Milwaukee

Casting Supplier
CAST CONNEX (AISC Associate), Toronto

Erection and Construction Engineer
Stanley D. Lindsey & Associates, Ltd. (SDL), Atlanta


SPHERE AT THE VENETIAN
Architect: Populous
Structural Engineer: Severud Associates | Walter P Moore | Cundall
Steel Fabricator: W&W|AFCO Steel
Photography by Mike McNulty
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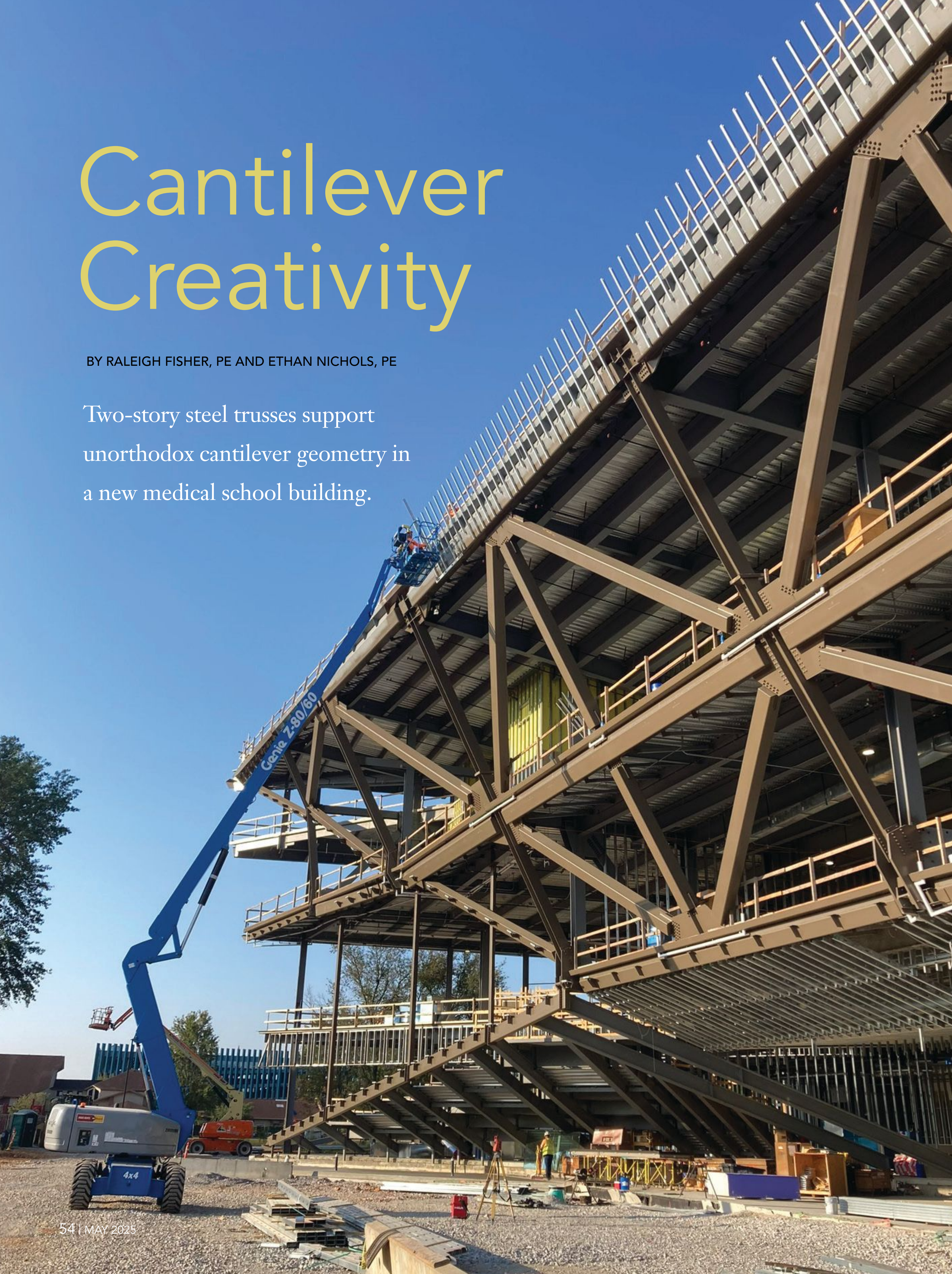
CAST CONNEX CUSTOM CASTING
PENN 2
Architect: MdeAS Architects
Structural Engineers: Severud Associates
General Contractor: Skanska USA
Steel Fabricator: Crystal Steel Fabricators
Photography by Wade Zimmerman
2025 IDEAS² AWARDS
AWARD FOR EXCELLENCE IN ENGINEERING WINNER
CAST CONNEX UNIVERSAL PIN CONNECTOR™

Cantilever Creativity

BY RALEIGH FISHER, PE AND ETHAN NICHOLS, PE

Two-story steel trusses support unorthodox cantilever geometry in a new medical school building.



opposite page:
A "super truss" and an 82-ft cantilever are defining design elements.

below:
The front cantilever mimics nearby naturally eroded escarpments.


OSD/Polk Stanley Wilcox

BENTONVILLE, ARK., is gaining a steel addition that blurs the lines between art, architecture, and nature's healing aspects. Northwest Arkansas is one of the nation's fastest-growing areas, and in 2021, philanthropist Alice Walton founded Alice L. Walton School of Medicine (AWSOM) to provide high-quality medical care and training to a quickly expanding region. The school's new campus occupies a 154,000-sq.-ft space designed to foster innovation and provide a safe environment to advance health and wellness. Its new building includes clinical teaching spaces, a state-of-the-art simulation center, healing gardens, and the largest green roof in the tri-state region—all within a 2,950-ton steel frame.

The building's form was conceived by Wesley Walls, a principal at the architecture firm Polk Stanley Wilcox. It's an abstraction of Ozark geology, with the design representing limestone bluffs in Arkansas. The building's front cantilever is designed to mimic the naturally eroded escarpments found in the surrounding hills and mountains, providing a sense of shelter and reprieve Walls found in his adventures through the area.

To stay true to the architectural form, the primary structure has a series of two-story-deep steel trusses that cantilever 82 ft and support two floors consisting of lecture halls, office space, study areas, and wellness studios—in addition to a two-acre green roof. The building began with an ambitious concept that stayed true throughout the design process. In the early concept phases, engineers at Martin/Martin picked structural steel to approach the complex geometric challenges the building form presented. Steel offered opportunities to support heavy gravity loads while maintaining large open program spaces and substantial cantilevers.

Bucking Cantilever Convention

One of the building's defining features is the front entrance. Its geometric form is covered by kinked, sloping glazing, a brass and precast concrete soffit, a precast concrete exterior wall and a rooftop garden with trees. Behind the complex façade sits a cantilever system that underwent a series of design iterations before landing on an efficient structural configuration better suited for the magnitude of loads imposed.

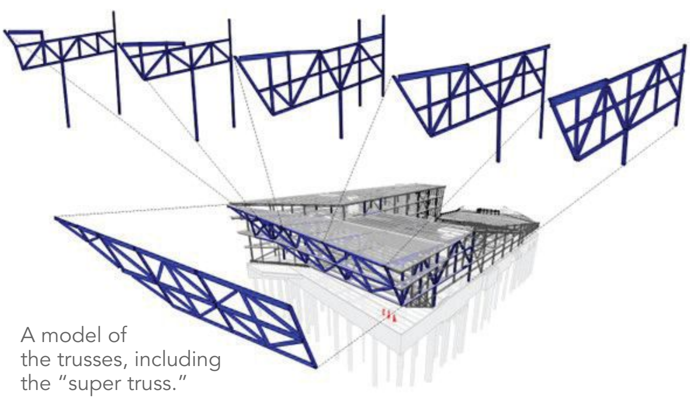
During design development, analysis models were created with single-story steel trusses made of W14 wide-flange members. These trusses were spaced at approximately 30 ft on center between Level 3 and the roof. The analysis revealed downward deflections, which were determined to be too large to camber and control effectively. Those large deflections clarified that serviceability would be a limiting factor above strength design, and another approach was required.

For the final design iteration, trusses were re-spaced at 60 ft on center, and depth for most trusses was increased to two stories. Classrooms on Level 2 were about 60 ft apart, and putting trusses between them opened the Level 3 floor plan by eliminating some diagonals. The revised design solved the deflection issues and made the structure easier to erect by reducing the number of trusses and spanning between with longer members. Camber values were provided at several panel points along the length of the cantilever, with the largest camber value being 2½ in. up for the truss with the longest cantilever. These camber values allow the trusses to deflect down under each concrete floor pour, façade installation, and green roof installation, with the goal of eventually leveling out.

The Alice L. Walton School campus map.
OSD/Polk Stanley Wilcox

Full building gravity and lateral models were built and analyzed in ETABS. The trusses were modeled in ETABS and were further broken out into SAP2000. Modeling provided an enveloped solution and created a path to design member sizes by bounding a solution of gravity loads (only) and lateral effects from tying the trusses into a rigid diaphragm.

Each truss is a different length and experiences a different amount of downward deflection at the end of each cantilever when analyzed individually. This differential deflection could have caused cracking in the composite deck over truss lines and damaged the exterior sloping glazing system. Martin/Martin engineers resolved cracking and damage concerns by conceiving an aptly named "super truss," a truss at the end of the cantilever designed to transversely tie all the trusses together, limiting differential deflections. The super truss was the interlocking system the cantilevers needed to meet serviceability requirements for the building.


A model of the trusses, including the "super truss."

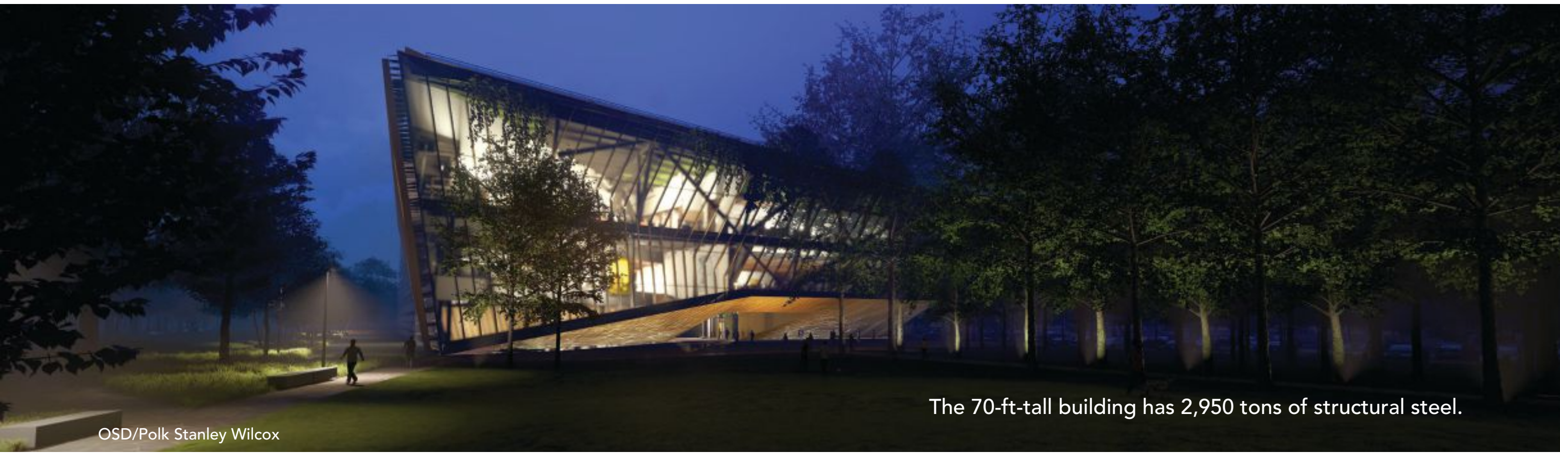
Defying Gravity

After clearing the truss design hurdle, the design team had to choose how to anchor the trusses down to the foundation. Cantilevers are often positioned using the two-thirds back-span to one-third cantilever rule of thumb. In this case, building geometry required reversing the proportions, resulting in large compression forces on the leading columns and significant tension on the trailing column. The cantilevered truss system generated a unique loading scenario for the structure where the building is constantly trying to lean over, which imposes permanent lateral loading in the structure from gravity loads alone.

The largest compression column is a W14×730 A913 (Grade 65) that resists nearly 3,000 kips of LRFD factored compression load. The tension was studied under skip loading, which results in a maximum tension force of 1,500 kips. The steel column could be designed directly for this force, but the drilled pier behavior required more thought. In the ETABS model, the drilled pier was modeled as a pinned boundary condition. One issue with assuming a pinned boundary condition is that any elongation in the drilled pier due to rebar in permanent tension would exacerbate the challenge of controlling deflections at the tip of the cantilever. Because the drilled pier was in permanent tension, there needed to be mechanically spliced reinforcing or continuous reinforcing—neither of which addressed the elongation issue.

The solution was to post-tension the drilled pier using unbonded DYWIDAG Threadbar. Post-tensioning would ensure pier rebar does not elongate, and for any deflection to occur, the tension in the column would have to exceed the post-tensioning force—similar to unseating a tendon in a post-tension concrete slab.

Trusses are spaced at 60 ft on center.



The 70-ft-tall building has 2,950 tons of structural steel.

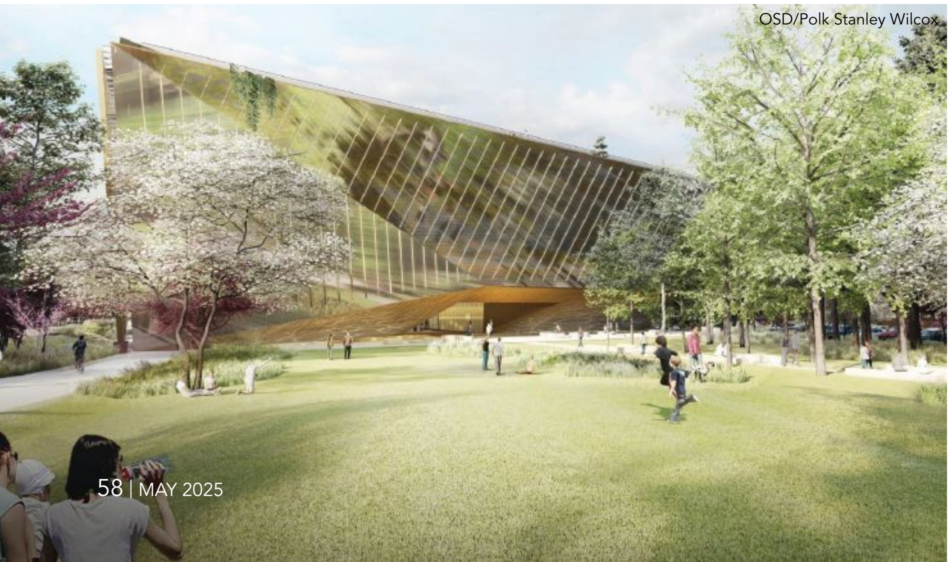
OSD/Polk Stanley Wilcox

Crossland Construction

above: Some members used in the building were repurposed from a fizzled project.

below: The building will welcome its first class of students in fall 2025.

OSD/Polk Stanley Wilcox



Repurposed Members

During design, the general contractor requested to reuse steel shapes from another project that fizzled before construction. Martin/Martin received a list of those shapes and incorporated some into the design. Some were not common and proved difficult to place, such as three W27×281s, but later proved useful by reducing the structural depth over the drive aisle in the underground parking garage, which added to the maximum vehicle driving height. The entire building sits over the parking garage, and coordinating drive line heights and reconciling the column grid with programming in the building above was critical to alleviating conflicts between structural and architectural elements.

The building is scheduled to open in summer 2025, when the Alice L. Walton School of Medicine will welcome its first class of students. When it opens, the school will have a facility that helps achieve its important mission and creates spaces for the public to enjoy its lush setting. ■

Owner
Alice L. Walton School of Medicine

Architect
Polk Stanley Wilcox Architects

General Contractor
Crossland Construction

Structural Engineer
Martin/Martin, Inc.

Fabricator
Unique Metal Fabrication AISC CERTIFIED FABRICATOR

Raleigh Fisher (**rfisher@martinmartin.com**) is an associate and the Northwest Arkansas office manager, and **Ethan Nichols** (**enichols@martinmartin.com**) is a project engineer, both at Martin/Martin, Inc.

This month's New Products include a bracing system for warehouse jobsites, accessories for elevated work platforms, and anti-vibration gloves.

BZI SkyBrace

BZI's SkyBrace offers an innovative bracing solution that ensures structural stability throughout all stages of construction. As warehouse and fulfillment centers grow in scale, traditional bracing systems have become inadequate. SkyBrace eliminates these challenges with an externally mounted rigid-brace design.

With an unmatched 80-ft length and rated at 100 kips, SkyBrace delivers superior high-leverage force at extreme heights. Unlike temporary cable bracing, it allows unrestricted access through interior bays, enhancing efficiency for all construction trades. Its multi-directional tension cables, asymmetrical struts, and versatile ground attachment options provide superior stability and adaptability at every stage of construction.

By revolutionizing structural bracing, SkyBrace sets a new industry standard for safety, efficiency, and performance. To learn more, visit **www.bzi.com**.

JLG SkyPower and SkyWelder

When you need power for specialized tasks, but don't want dangerous leads hanging over the machine rails, JLG SkyPower and SkyWelder accessories for mobile elevated work platforms can help.

The SkyPower system delivers the power needed to operate JLG accessories like SkyWelder conveniently. With the SkyPower system, you get a 7500W generator with a power cable to the machine platform, which offers flexibility for your needs at height. The system saves time and money by reducing fuel costs and removing the need to move and reposition a generator.

SkyWelder eliminates the need for a standalone welder and power supply. Built with a 280-amp Miller CSTTM 280 welder with a platform-mounted amperage adjustment, SkyWelder provides power to accommodate stick and TIG welding applications. Flux core wire feed capability is available. JLG also offers a control box console cover and fire-retardant hose sleeves to protect the controls and hosing from welding slag. To learn more, visit **www.jlg.com**

Milwaukee Anti-Vibration Gloves

Milwaukee's has released two new styles of gloves to protect from tool vibration. The Anti-Vibration High-Dexterity Nitrile Dipped Gloves provide a Cut Level 4 rating to protect from lacerations and meet safety requirements on the jobsite. With a soft and comfortable liner, the 18-gauge material provides total hand mobility when working with small fasteners. With back-of-hand protection to shield against bumps and scrapes, the long-lasting nitrile dip ensures these hold up to abusive jobsite conditions.

The Anti-Vibration Work Gloves provide full hand vibration reduction and impact protection. They are reinforced in high-wear areas, such as in the fingertips and palms, to withstand everyday use. They keep hands cool and dry throughout the day and provide exceptional dexterity and comfort with a breathable lining and a built-in terrycloth sweat wipe. To learn more, visit **www.milwaukeetool.com**.

SEAA

SEAA Celebrates Women Making Strides in Construction Industry

Six women from AISC member companies are being recognized by the Steel Erectors Association of America (SEAA) as part of its 2025 Steel Strong Women in Construction campaign. They are among 17 total honorees, and all will be recognized during the SEAA Convention and Trade Show May 6-9 in Pittsburgh. Those six are:

- Gina Hardison, vice president of purchasing, Cooper Steel
- Marta Amador, vice president, Hodges Erectors, Inc.
- Abby Stinson, business unit manager—projects, Cooper Steel
- Teri Harmon, executive assistant, Deem Structural Services
- Kate Franquet, senior safety and risk manager, S&R Enterprises
- Audrey Terwilliger, ironworker and certified welder, Pioneer Construction

Candidates were evaluated on their professional achievements, contributions to the team, leadership or mentorship, community involvement, and personal qualities.

"Our goal with this project is to provide greater visibility to the career paths women are taking in steel construction," said Tammy Dean, Gardner-Watson Decking CFO and SEAA Marketing Committee member. "It was especially interesting to see the wide variety of roles these women are filling within the industry."

Added fellow marketing committee member John Hughes, the director of business development at Industrial Training International: "Each woman nominated is exceptional in her own right. Their stories of perseverance and accomplishments are inspiring."

AWARDS

Bridge Engineering Icon Earns Major Steel Bridge Task Force Award

Renowned bridge engineer Frank Russo, PE, PhD has earned the Steel Bridge Task Force's 2025 Richard S. Fountain Award, which recognizes leadership in steel bridge research and outstanding efforts to advance AASHTO specifications.

"Frank's contributions to steel bridge engineering have been nothing short of extraordinary," said Dan Snyder, vice president of construction for the American Iron and Steel Institute (AISI). "His advancements in forensic investigations, design provisions, and girder standards have improved the way we approach bridge design and construction. His dedication to education and mentorship—through the development of curricula and his extensive teaching of National Highway Institute courses—has strengthened the knowledge base of the industry and shaped countless engineers."

Russo started Russo Structural Services in 2021 and has worked as a full-time bridge engineer since 1995. He spent 11 years at Michael Baker International before leaving to start his firm and had earlier stints at HNTB and URS Corporation. He began his career as a design engineer with the Iowa Department of Transportation. In 2023, he earned an AISC Lifetime Achievement Award.

Russo also has an extensive teaching background in academia and professional development. He has lectured on bridge design, structural analysis, and engineering principles at leading institutions and has taught over 150 NHI courses. His ability to translate complex engineering concepts into practical applications has made him a sought-after instructor and mentor in the industry.

Russo holds a PhD in civil engineering from Iowa State University, where he conducted research on bridge column performance and retrofitting for seismic loading, as well as the impact resistance of beam bridges. He earned bachelor's and master's degrees in civil engineering from Temple University. For more on Russo's career and accomplishments, see the "A Bridge Lifer" article in the October 2023 issue at **modernsteel.com/archives**.

The Steel Bridge Task Force is comprised of AISI, the National Steel Bridge Alliance (NSBA), and the AASHTO Steel and Metals Technical Committee. The Richard S. Fountain Award was established in 2001 and is named for the task force's founder.

People & Companies

The **Steel Deck Institute (SDI)** published the latest version of the *North American Specification for the Design of Cold-Formed Steel Structural Members* (ANSI/SDI AISI S100-2024). The 2024 edition replaces the 2016 editions with supplements.

In 2023, the SDI assumed responsibility for 34 cold-formed steel standards from the American Iron and Steel Institute (AISI) when AISI withdrew from supporting those important standards. In 2024, the SDI either reaffirmed, updated, or, in one case, finished the development of a new standard for 29 of the former AISI Standards. Since then, 17 standards related to cold-formed steel framing have been transferred to the Steel Framing Industry Association (SFIA) and four standards related to metal building systems have been transferred to the Metal Building Manufacturers Association (MBMA).

The 2024 edition of the S100 Standard incorporates all revisions that were approved at the time AISI withdrew from standards development. Along with the 29 other revised standards, it can be found at **www.sdi.org** for free download.

Zekelman Industries, the largest independent steel pipe and tube manufacturer in North America and an innovator in integrated real estate development, has promoted **Mickey McNamara** to president. McNamara has been with the company for 17 years and will assume some of CEO Barry Zekelman's day-to-day responsibilities. He will focus on operational excellence, technological advancements, and delivering greater value to customers. **Tom Muth** has been promoted to president of Zekelman Industries' pipe and tube business. He previously served as the executive vice president of the pipe and tube division for the last five years and joined Atlas Tube in 2005. **Barry Zekelman** will continue his role as CEO and will remain responsible for organizational performance, corporate strategy, and strategic vision.

AWARDS

Nominations Sought for 2026 Higgins Lectureship Award

Nominations are being accepted through July 1, 2025 for the prestigious T.R. Higgins Lectureship Award, which includes a $15,000 cash prize. Presented annually by AISC, the award recognizes a lecturer-author whose technical paper(s) are considered an outstanding contribution to engineering literature on fabricated structural steel. The winner will be recognized at the 2026 NASCC: The Steel Conference, April 22 to 24 in Atlanta and will also present the lecture, upon request, at various professional association events throughout the year.

Nominations should be emailed to AISC's Martin Downs at **downs@aisc.org**. Or, if you'd prefer to mail your nomination, contact Martin for mailing information. Nominations must include the following information:

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

The author must be a permanent resident of the U.S. and available to fulfill the commitments of the award. The paper(s) must have been published in a professional journal between January 1, 2020, and January 1, 2025. In addition, the winner is required to attend and present at The Steel Conference in 2026 and give a minimum of six presentations lecture on selected occasions during the year.

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

The current T.R. Higgins lecturer is Ronnie Medlock, who received the award for his contributions to the FHWA "Bridge Welding Reference Manual" and his outstanding reputation as an engineer and lecturer. If your organization is interested in hosting a T.R. Higgins lecture, please contact Christina Harber, AISC's senior director of education, at **harber@aisc.org**.

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

ENGINEERING JOURNAL

Second-Quarter 2025 *Engineering Journal* Now Available

The second-quarter issue of AISC's *Engineering Journal* is now available at **aisc.org/ej**. It includes papers on derivation of the uniformed force method, block shear of bolted connections, and an investigation of bearing and tearout of steel bolted connections. Here are some highlights.

Technical Note

A Derivation of the Uniform Force Method for Analysis and Design of Gusset Plate Connections for Vertical Diagonal Bracing

Thomas S. Dranger and William A. Thornton

The uniform force method (UFM) for vertical diagonal bracing with gusset plate connections is a statically determinate analysis and design in which there are no moments at the interfaces between column, beam, and gusset, producing economical results. A derivation of force equations for a less constrained generalized case with only one gusset control point, rather than two, is given in Appendix A of AISC Design Guide 29: *Vertical Bracing Connections* (download or order at **aisc.org/dg**). By introducing the UFM constraint equation, the less constrained case in Design Guide 29 might be reduced to generate the UFM force equations, but that indirect proof has not been published, nor any proof until now. A short, simple, and direct derivation of the UFM force equations is presented in this paper.

Block Shear of Bolted Connections—Reliability Analysis and Design Recommendations

Bo Dowswell

Existing data from previous research projects was analyzed to determine the reliability of the block shear equations in the 2022 AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360-22). Additionally, the 1989 AISC *Specification* provisions and the design equations proposed by Driver et al. (2006), Kamtekar (2012), and Teh and Deierlein (2017) were analyzed. The analysis was limited to normal-strength steels. The data set included a total of 279 experimental tests from 25 research projects. For the data set with only U-shaped block shear patterns, the reliability analysis showed that both the 2022 AISC *Specification* and the 1989 AISC *Specification* block shear provisions are conservative.

Based on the results, revisions to the AISC *Specification* were proposed. The proposed design method combines attributes from the available design methods to develop a general design method that is applicable to several common connection types. A secondary intention is to enhance clarity and transparency, where the variables affecting the strength are included explicitly in the equations.

Steel Structures Research Update

Investigation of Bearing and Tearout of Steel Bolted Connections

Judy Liu

Recently completed research on bearing and tearout of steel bolted connections is highlighted. This study, conducted at the University of Tennessee, Knoxville, was led by Mark Denavit, PE, PhD, associate professor in the Department of Civil and Environmental Engineering. Denavit's research interests include structural steel connections, stability analysis and design, and innovative seismic systems. Among his accolades are the AISC Terry Peshia Early Career Faculty Award and the SSRC Sarada M. and Raju A. Vinnakota Award. AISC supported this research on steel bolted connections. Selected highlights from the completed work are presented.

AISC SAFETY AWARDS

More Than 180 AISC Members Receive 2024 Awards

AISC is honoring more than 180 structural steel fabricators and erectors for their outstanding safety records in 2024. About 79% of this year's 188 honorees earned the Safety Award of Honor, AISC's top safety award.

"A lot of activities occur simultaneously at structural steel fabrication shops and on jobsites, and safely doing all of them takes planning and experience," AISC senior director of engineering Tom Schlafly said. "Avoiding accidents is not a matter of luck; it's a skill that should be recognized. AISC is proud of the many member companies whose employees experienced few or no Days Away, Restricted or Transfer (DART) injuries in 2024."

AISC determines safety awards by relying on DART rates companies report to OSHA. The DART rate measures the number of recordable lost work cases per 200,000 hours worked. AISC bases the awards on cases, not days, as reported to OSHA on the 300A form, along with the hours worked in the year.

AISC presents a Safety Award of Honor to fabricators and erectors with perfect records. Those with excellent records (0<DART≤1) earn a Safety Award of Merit, and Safety Commendations recognize companies with DARTs greater than one and less than or equal to two.

The Safety Awards program is open to all AISC member fabricators and erectors. Applications for the program are solicited annually. Awards are issued separately for fabrication and erection companies. To win an award, the AISC member company must submit a copy of its OSHA 300A form for verification. For more information and resources on safety for the fabricated and erected structural steel industry, visit **aisc.org/safety**.

2024 SAFETY AWARD ★★★

Safety Award of Honor (DART = 0)

Fabricators

3 Sons' Steel, Inc., Tarboro, N.C.
AF Steel Fabricators, Chandler, Ariz.
Affton Fabricating & Welding Co., Inc., Sauget, Ill.
AOP Metal Fabricators, Crossett, Ariz.
Aristeo, Livonia, Mich.
Arlington Structural Steel Company, Inc., Arlington Heights, Ill.
ASP Structures, LLC, Selinsgrove, Pa.
Associated Steel Fabricators, Inc., Tomball, Texas
B&B Welding Company, Inc., Sparrows Point, Md.
Benchmark Fabricated Steel, Terre Haute, Ind.
Blue Atlantic Fabricators, LLC, East Boston, Mass.
Bonacio Steel, Gansevoort, N.Y.
Borrelli Steel Fabricators, LLC, Vineland, N.J.
Chesapeake Bay Steel, Inc., Norfolk, Va.
Cianbro Fabrication & Coating Corporation, Pittsfield, Maine
Conewago Manufacturing LLC, Hanover, Pa.
Construction Services, Billings, Mont.
CoreBrace, LLC, West Jordan, Utah
Covenant Steel Warehouse, Inc., Dothan, Ala.
Custom Metals, a Division of Lexicon, Inc., Little Rock, Ark.
Delta Steel Inc., Saginaw, Mich.
Design Build Structures, LLC, Peosta, Iowa
DIS-TRAN Steel, LLC, Pineville, La.
Diversatech-Metalfab, LLC, Gridley, Ill.
Dixie Metal Products, Inc., Ocala, Fla.
Dixie Southern Industrial, Inc., Polk City, Fla.
Douglas Steel Company, Lansing, Mich.
Douglas Steel Fabricating Corporation, Lansing, Mich.
East Coast Metal Structures Corporation, Riviera Beach, Fla.
Eastern Steel Works, Inc., Seagrove, N.C.
Edco, Inc., Mount Vernon, Wash.
Eddy's Welding, Inc., Ellicott City, Md.
F.A. Wilhelm Construction Co., Inc., Indianapolis
Fiedeldey Steel Fabricators, Inc., Cincinnati, Ohio
Fresno Fab-Tech, Inc., Sanger, Calif.
G2 Metal Fab, Inc., Stockton, Calif.
Garbe Iron Works, Aurora, Ill.
Genesis Ironworks, Fernley, Nev.
George's Welding Services, Inc., Miami
Gibson Industrial Inc., Richmond, Va.
GMF Steel Group, Lakeland, Fla.
Gremp Steel Company, Posen, Ill.
Hallmark Iron Works, Inc., Newington, Va.
Hamilton Iron Works, Inc., Woodbridge, Va.
Industrial Constructors / Managers Inc., Pueblo, Colo.
Intermark Steel LLC, Price, Utah
JE Dunn Construction, Kansas City, Mo.
Jeffords Steel & Engineering Co., Potsdam, N.Y.
JGM Fabricators & Constructors, LLC, Coatesville, Pa.
Larwel Industries, Bedford, Texas
Lee's Imperial Welding, Inc., Fremont, Calif.
Lincoln Contracting & Equipment Co., Inc., Boswell, Pa.
LMC Industrial Contractors, Avon, N.Y.
Lyndon Steel Company, Winston-Salem, N.C.
M&J Steel LLC, Trussville, Ala.
Macuch Steel Products, Inc., Augusta, Ga.
Marcelli Steel, Brookfield, Conn.
Mast Farm Service, LTD, Millersburg, Ohio
McClean Iron Works, Everett, Wash.
McCombs Steel Company, Inc., Statesville, N.C.
Metal Works, Oroville, Calif.
Mike Owen Fabrication, Inc., Bakersfield, Calif.
Mobil Steel International, Inc., Houston
Mound Technologies, Inc., Springboro, Ohio
NMI Industrial Holdings, LLC, Sacramento, Calif.
Nova Group, Inc., Napa, Calif.
Ogeechee Steel, Inc., Swainsboro, Ga.
Phoenix Fabrication & Supply, Inc., Peotone, Ill.
Phoenix Stair, Inc., Phoenix
Pikes Peak Steel, Colorado Springs, Colo.
PKM Steel Service, Inc., Salina, Kan.
Plyler Fabrication, Sherman, Texas
Powers Construction & Engineering, Inc., Fresno, Calif.
Premier Fabrication LLC, Congerville, Ill.
Prospect Steel, a Division of Lexicon, Inc., Armorel, Ark.
Puma Steel, Cheyenne, Wyo.
Qualico Steel Co., Inc. – Texas Division, Midlothian, Texas
R&S Steel, LLC, Rome, N.Y.
RNGD Prefab, LLC, Metairie, La.
Rochester Structural, LLC, Rochester, N.Y.
Sanpete Steel Corporation, Moroni, Utah
Schuff Steel Company, Phoenix
Schuff Steel Company, Ottawa, Kan.
Schuff Steel Company, Lindon, Utah
Shure Line Construction, Kenton, Del. »

Simko Industrial Fabricators, Chesterton, Ind.
Skanska Koch, Inc., Carteret, N.J.
SME Steel Contractors, West Jordan, Utah
SME Steel Contractors, Pocatello, Idaho
Southwest Architectural Metals, Henderson, Nev.
Spirit Fabs, Inc., Wrightstown, Wis.
Steel Service Corporation, Jackson, Miss.
Steel Specialty, Inc., Belmont, N.C.
Steward Steel, Inc., Sikeston, Mo.
Stud Welding, Inc., Centerville, Tenn.
Summit Steel Work Corp, San Jose, Calif.
Swager Communications, Inc., Fremont, Ind.
Talley Metal Products, Inc., Hagerstown, Md.
The Gateway Company of Missouri, St. Louis
Troy Industrial Solutions, Brewer, Maine
TrueNorth Steel, Mandan, N.D.
TrueNorth Steel, Rapid City, S.D.
TrueNorth Steel, Billings, Mont.
TrueNorth Steel, Fargo, N.D.
Tubal-Cain Industries, Inc., Beaumont, Texas
Turner Construction Company, Huntsville, Ala.
Twin Brothers Marine, LLC, Morgan City, La.
United Weld Services, LLC, York, Pa.
USA Structural Steel and Foundations, Sarasota, Fla.
W&W | AFCO STEEL, Lubbock, Texas
Western Slope Iron & Supply, Inc., Grand Junction, Colo.
Willamette Technical Fabricators, Portland, Ore.

Erectors
All Things Metal LLC, Phoenix
Alpha Iron, Ridgefield, Wash.
B & B Welding Company, Inc., Sparrows Point, Md.
Ben Hur Construction, Fairfield, Ohio
Conewago Manufacturing LLC, Hanover, Pa.
Dixie Southern Industrial, Inc., Polk City, Fla.
Douglas Steel Fab. Corp., Lansing, Mich.
East Coast Metal Structures Corp., Riviera Beach, Fla.
Eddy's Welding, Inc., Ellicott City, Md.
F.A. Wilhelm Construction Co., Inc., Indianapolis
Fresno Fab-Tech, Inc., Sanger, Calif.
Genesis Ironworks, Fernley, Nev.
Gibson Industrial Inc, Richmond, Va.
GMF Steel Group, Lakeland, Fla.
HME, Inc., Topeka, Kan.
Industrial Constructors / Managers Inc., Pueblo, Colo.
JGM Fabricators & Constructors, LLC, Coatesville, Pa.
JPW Structural Contracting, Inc., Syracuse, N.Y.
Marcelli Steel, Brookfield, Conn.
MECO Kentucky, LLC, Louisville, Ky.
Mid-Ohio Mechanical, Inc., Granville, Ohio
MSD Building Corp. (Fab Shop), Pasadena, Texas
NMI Industrial Holdings, LLC, Sacramento, Calif.
North Alabama Fabricating Company, Inc., Cullman, Ala.
Peterson Beckner Industries, Inc., Houston
Peterson Beckner Industries, Inc., Frisco, Texas
Pioneer Construction, Grand Rapids, Mich.
Powers Construction & Engineering, Inc., Fresno, Calif.
RNGD Prefab, LLC, Metairie, La.
Rochester Structural, LLC, Rochester, N.Y.
Schuff Steel Company, Phoenix
Schuff Steel Company, Arlington, Texas
Schuff Steel Company, Stockton, Calif.
Schuff Steel Company, Long Beach, Calif.
Schuff Steel Company, Portland, Ore.
Schuff Steel Company, Bellevue, Wash.
Schuff Steel Company – HQ, Phoenix
Shure Line Construction, Kenton, Del.
SME Steel Contractors, West Jordan, Utah
Southwest Steel, LLC, El Mirage, Ariz.
Steel Masters L.P., Houston
Stinger Bridge & Iron, Coolidge, Ariz.
Summit Steel Works Corp., San Jose, Calif.
Traylor Bros., Inc., Evansville, Ind.
United Weld Services, LLC, York, Pa.
VM Iron Works and Structural Steel Corp., Palm City, Fla.
West Coast Structural Steel, San Jose, Calif.

2024 SAFETY AWARD ★★

Award of Merit (0<DART≤1)

Fabricators
Bennett Steel Fab., Inc., Sapulpa, Okla.
Crowder Industrial Construction LLC, Spartanburg, S.C.
Drake-Williams Steel, Inc., Omaha, Neb.
Environmental Air Systems, High Point, N.C.
New Industries, LLC, Morgan City, La.
North Alabama Fabricating Company, Inc., Cullman, Ala.
Qualico Steel Company, LLC, Webb, Ala.
Reinicke Athens Inc., Athens, Ga.
Schuff Steel Company, Stockton, Calif.
Schuff Steel Company, Eloy, Ariz.
Steel Fabricators of Monroe, Monroe, La.
TrueNorth Steel, Lubbock, Texas

Erectors
Building Zone Industries, Kanarraville, Utah
Foundation Steel, LLC, Swanton, Ohio
Fowler General Construction, Inc., Richland, Wash.
Ideal Contracting, Detroit
Lexicon, Inc., Little Rock, Ark.
Schuff Steel, San Diego
W&W | AFCO STEEL – W&W Steel Erectors, New York

2024 SAFETY AWARD ★

Safety Commendation (1<DART≤2)

Fabricator
All Things Metal LLC, Phoenix
Ben Hur Construction, St. Louis
Cooper Steel, Shelbyville, Tenn.
Cooper Steel of Virginia, Monroe, Va.
Ducworks, Inc., Logan, Utah
Ennis Steel Industries, Ennis, Texas
Environmental Air Systems, High Point, N.C.
Gayle Manufacturing Co., Caldwell, Idaho
High Steel Structures LLC, Lancaster, Pa.
High Steel Structures, Inc., Williamsport, Pa.
Hillsdale Fabricators, a Division of Alberici Constructors, St. Louis
MSD Building Corp. (Fab Shop), Pasadena, Texas
Precision Build, LLC, Tampa, Fla.
Prospect Steel, a Division of Lexicon, Inc., Little Rock, Ark.
Ramar Steel Sales, Inc., Rochester, N.Y.
Schuff Steel Company, Lindon, Utah
Sefton Steel, LP, Aldine, Texas
Systems Fab & Machine, El Dorado, Ark.
The Haskell Company, Jacksonville, Fla.
Thomas Steel, Inc., Bellevue, Ohio
TrueNorth Steel, West Fargo, N.D.

Erector
AF Steel Fabricators, Chandler, Ariz.
Bennett Steel Fab., Inc., Sapulpa, Okla.
Cooper Steel, Nashville, Tenn.
March-Westin, Morgantown, W.V.
Ralph L. Wadsworth Construction, Draper, Utah
Stonebridge Inc., South Plainfield, N.J.
Structural Services, Inc., Albuquerque, N.M.
Westco Iron Works, Newman, Calif.
Williams Erection Co., Inc., Smyrna, Ga.

CERTIFICATION CORNER

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

The following U.S.-based companies were newly certified or renewed certification in at least one category from February 1 to 28, 2025.

Newly Certified Companies
(February 2025)

Capone Iron Corporation North Woods, Berlin, N.H.
FineLine Steel Fabrication, Centerville, Utah
Integrity Iron, Commerce City, Colo.
Merrill Steel, Camanche, Iowa
Specialty Fusion, Cedar City, Utah
Steel Suppliers Erectors, Inc., Wilmington, Del.

Certification Renewals
(February 2025)

Advantage Terrafab, Muskogee, Okla.
Anderson Charnesky Structural Steel, Inc., Beaumont, Calif.
Associated Steel Fabricators, Inc., Tomball, Texas
Atchley Steel Company, Inc, Salem, Ala.
B&K Installations, Inc., Homestead, Fla.
B.G. Crane Services, Inc., Catlett, Va.
BA Fabrication, Tucson, Ariz.
Bailey Bridges, Inc. dba Pioneer Bridges, Fort Payne, Ala.
Behlen Mfg. Co., Sarasota, Fla.
Bell Bros Steel, Inc, Riverside, Calif.
Bell Steel Company, Pensacola, Fla.
Bennett Steel Fabrication, Inc., Sapulpa, Okla.
Boh Bros. Construction Co., LLC, New Orleans
Bragg Investment Company, Inc., Long Beach, Calif.
C&C Organix dba Excel Bridge Manufacturing, Olancha, Calif.
C.L. Dews and Sons Foundry and Machinery, Co., Inc, Hattiesburgh, Miss.
Capitol Engineering Co., Phoenix
Carolina Fab, Inc., Mount Holly, N.C.
Carolina Structural Welding & Steel Erection Inc., Indian Trail, N.C.
Castle Steel, Inc., Phoenix
Chacon Steel Erectors Inc., Oneonta, Ala.
CHM Industries, Inc., Fort Worth, Texas
Cives Steel Co., El Mirage, Ariz.
Cives Steel Co., Rosedale, Miss.
CNC Metal Shape Construction, LLC, Oklahoma City
Coastal Metal Works LLC, Picayune, Miss.
Contractor Service & Fabrication, Inc., Decatur, Ala.
Cooper Steel South, Childersburg, Ala.
Cornerstone Building Brands, Houston
Cosmec, Inc., Athens, Texas
Covenant Steel Warehouse, Inc., Dothan, Ala.
Crystal Steel Fabricators Inc., Gallaway, Tenn.
Custom Fabricators & Repairs Inc., Bryan, Texas
Dave Steel Company, Inc., Asheville, N.C.
Dave Steel Company, Inc., Chesnee, S.C.
Dean's Certified Welding, Temecula, Calif.
DIS-TRAN Steel, LLC, Pineville, La.
Ellison Steel, Inc., Groesbeck, Texas
Encore Steel, Inc., Phoenix
Ennis Steel Industries, Inc., Ennis, Texas
Fabricari LLC, Kenner, La.
Florida Atlantic Ironworks, Inc., Umatilla, Fla.
Frontier Gratings, Fort Payne, Ala.
Garden State Iron, Inc., Ocean Township, N.J.
Gibraltar Fabrication LLC, Burnet, Texas
Greenberry Industrial, Jennings, La.
Greenberry Industrial, Sulphur, La.
GT Steel Erectors, Inc., Deatsville, Ala.
Harrison Walker & Harper, Paris, Texas
Hershberger Bros Welding Inc., Las Vegas
High Impact Signs Steel and Specialties, North Las Vegas, Nev.
HME, Inc., Topeka, Kan.
Irwin Steel, Justin, Texas
J.B. Ventures, Inc., Tucson, Ariz.
Jaysco, Inc., Yucaipa, Calif.
JBH Steel, LLC, Chattanooga, Tenn.
JE Dunn Construction, Kansas City, Mo.
KCB Towers, Inc., Banning, Ca.
Kiewit Offshore Services, Ltd., Ingleside, Texas
Larrance Steel, Lawton, Okla.
Larwel Industries, Inc., Roanoke, Texas
Las Vegas Wrought Iron & Steel, Las Vegas
Lexicon, Inc. dba Steel Fabricators of Monroe, Monroe, La.
Lyndon Steel Company, Kinston, N.C.
Lyndon Steel Company, Winston-Salem, N.C.
Matrix Service Inc., Bakersfield, Calif.
Matrix Service Inc., Catoosa, Olka.
McWhirter Steel, Lancaster, Calif.
Mechanical Industries Inc., Bakersfield, Calif.
MMI Industrial & Steel, Mesa, Ariz
Next Level Steel, Goodyear, Ariz.
Next Level Steel, Mesa, Ariz.
Nucor Corporation Vulcraft Division, Grapeland, Texas
Olson Steel, San Leandro, Calif.
Outdoor Aluminum Inc., Geneva, Ala.
Palmer Steel Supplies, Inc., McAllen, Texas
Patriot Erectors, LLC, Dripping Springs, Texas
Patriot Erectors, LLC, Trinity, Texas
PAX LLC, Deridder, La.
Pevik Construction Group Inc, Chowchilla, Calif.
Phoenix Stair, Inc., Phoenix
Plyler Fabrication, Sherman, Texas
Postel International, Inc., Porter, Texas
PVB Fabrications, Inc., Marana, Ariz.
R.K. Steel, Inc., Fredonia, Kan.
Ranburne Steel Fabrication, Ranburne, Ala.
Ropac, Inc., Deatsville, Ala.
S&H Steel Co. LLC, Gilbert, Ariz.
Skyline Steel, Inc., Gilbert, Ariz.
Sonne Steel Inc., Smithfield, Ky.
Southeast Texas Industries, Inc. (STI), Bridge City, Texas
Southeastern Construction & Maintenance, Inc., Mulberry, Fla.
Southern Steel Fabricators, Inc., Monroe, La.
Southern Structural Steel of Florida, St. Petersburg, Fla.
Southwest Steel LLC, El Mirage, Ariz.
Southwest Steel, LLC, Henderson, Nev.
Staley Steel, LLC, Pilot Point, Texas
Steel Fab, Chandler, Ariz.
SteelFab Inc., Durant, Okla.
SteelFab, Inc., Roanoke, Ala.
Stinger Bridge & Iron, Coolidge, Ariz.
Stony Brook Structures of Florida, LLC, Leesburg, Fla.
Structural and Steel Products, Fort Worth, Texas
The Shaw Group, LLC, Lake Charles, La.
Triad Steel Services, LLC, Wickenburg, Ariz.
Twin Brothers Marine, LLC, Louisa, La.
Union Erectors, LLC, Las Vegas
Valtir, LLC, Fort Worth, Texas
Woodward Steel Group, A Division of Woodward Design + Build, LLC, New Orleans
Wyatt Resources, Inc., Fulshear, Texas

advertiser index


Ho-gyeum Kim

Reimagining Rowhouses

A DESIGN CONCEPT that turns underutilized space in dense urban neighborhoods into new communities earned first place in AISC's 2025 Forge Prize.

Architect Ho-gyeum Kim of CZS tapped into the potential for rear yards of single-family homes to meet New York's housing demands. A modular system based on the average rowhouse lot width could bring duplex units with semi-private outdoor areas. Kim partnered with Ralph Barone of AISC full-member fabricator Barone Steel in Brooklyn, N.Y., to optimize the design.

The Growing Rowhouses design approaches the frequently unused and neglected rear yards of a block of traditional rowhouses as a single lot. Kim's modular system uses an 18-ft grid, keeping with average rowhouse lot width. The rowhouses's height can change according to allowable zoning. This strategy requires minimal foundations to leave the existing rowhouses untouched. That's where structural steel came into play. Steel cables on either side of the central structural core stabilize the building's lateral movement.

"Steel is the most viable solution to achieve the minimal touchdown in the centerline of the blocks," Kim said. "A prefabricated, modular construction system taking full advantage of steel's unique potential to facilitate economical, rapid erection—and steel's unique recyclability and circular supply chain add an additional layer of sustainability while preserving the existing rowhouses."

The vertical community consists of duplex units with semi-private outdoor yards. Outdoor communal spaces include a rooftop terrace and a running track. Curved hollow structural sections create a cohesive look across external stairs, roof structures, and trellis extensions—a detail that also allows for mass production.

"We think it's a robustly developed proposal with a timely architectural premise and a clear idea about how and why steel will be used to support the concept," said Forge Prize juror Matthew Marani, special sections editor for *Architectural Record*. "It has a well-considered implementation strategy, including coordination with zoning and planning constraints, market demands, and erection efficiencies. It also fits neatly into new approaches to zoning within the Department of City Planning, specifically the larger City of Yes policies that are being rolled out."

AISC established the Forge Prize in 2018 to recognize visionary emerging architects, architecture educators, and graduate students for design concepts that embrace innovations in steel as a primary structural component. The first-place finisher receives a $10,000 grand prize.

The 2025 Forge Prize jury was comprised of Marani; Emily Baker, associate professor at the University of Arkansas (and 2024 Forge Prize winner); and Parke MacDowell, AIA, associate principal and director of fabrication at Payette. Growing Rowhouses was one of three finalists the jury considered. To learn more about all three, visit **forgeprize.com**.