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December 2022

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December 2022

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ON THE COVER: The hollow steel spire at the top of San Francisco's Transamerica Pyramid recently received a structural makeover (page 27). Photo: Olson Steel/Degenkolb Engineers

MODERN STEEL CONSTRUCTION (Volume 62, Number 12) ISSN (print) 0026-8445: ISSN (online) 1945-0737. Published monthly by the American Institute of Steel Construction (AISC), 130 E Randolph Street, Suite 2000, Chicago, IL 60601. Single issues $8.00; 1 year, $60. Periodicals postage paid at Chicago, IL and at additional mailing offices. Postmaster: Please send address changes to MODERN STEEL CONSTRUCTION, 130 E Randolph Street, Suite 2000, Chicago, IL 60601.

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NEED FOR SPEED

editor's note

Back in early October, I went to the Iowa-Michigan football game in Iowa City.

The game didn't go as I'd hoped, but it definitely went as I'd expected. We lost, I don't want to talk about it and, really, it's not important anyway.

What *is* important is how we go there. Normally, I'd drive to Iowa City from my house in Chicago, a trip that, if you drive fast (but not fast enough to make the news), can be achieved in three hours or so. Not terrible. Back in the day, before the Interstate system was implemented, I imagine it would have taken longer—and longer still in the early days of the automobile. And longer *still* before cars, though I don't think people typically traveled that far for football games back then.

But you know what's faster than driving? Flying—perhaps, say, in a private propellor plane. But that's still too slow, so we flew to the game on a private jet. Long story short, this elevated travel experience was courtesy of a friend of a friend (and a huge Michigan fan who works in the finance world). Five of us piled into his Cirrus, and off we went. What would take three or so hours on the ground took only 40 minutes in the air. Not to brag (ha, ha, just kidding, of *course* I'm bragging), but it was a pretty cool experience. Ironically, once we landed, we walked to the football stadium from the Iowa City airport (it was only about a 30-minute walk versus waiting 20 minutes for an Uber, and it was 70 °F).

But bragging about my (once-in-a-blue-moon) jet-setting ways is only part of the reason I mention all of this. The main point is that things that already seem fast can *always* be faster. Travel, computing power, internet speeds, steel projects.

NEED FOR SPEED

When it comes to the latter, AISC, as you may have heard, implemented its Need for Speed (N4S) initiative a couple of years ago, with the goal of increasing the speed by which a steel building or bridge can be designed, fabricated, and erected by 50% by 2025.

Of course, I'm happy to point you to our N4S web page—it's **aisc.org/needforspeed**—for more information. But you can also read all about speed-related initiatives in this very issue, including research endeavors, bridge-related resources, a conversation with Ron Klemencic—one of the champions of the SpeedCore system—and testimonials from approximately 70 companies about what they're doing to speed up their individual contributions to bringing structural steel projects to life.

All of this has swelled our page count to what has basically become a double issue of *Modern Steel*. Our goal is to highlight the multitude of successes and opportunities up and down the steel supply chain to tighten up steel project schedules from conception to completion. Some, like SpeedCore, can cut months off a project schedule while others, like a software update, can reduce design or detailing time in small increments. But they all add up.

And if you have a speed-related story from your own experience as an engineer, detailer, fabricator, erector, contractor, or other player on a steel project team, let me know! We want to continue to highlight opportunities to speed up steel projects in 2023 and beyond.

Geoff Weisenberger
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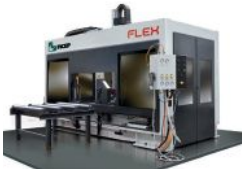

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If you've ever asked yourself "Why?" about something related to structural steel design or construction, *Modern Steel*'s monthly Steel Interchange is for you! Send your questions or comments to **solutions@aisc.org**.

Base Metal Check

I am a college student, and in my steel design course, I encountered a fillet T-joint welded connection, as shown in Figure 1, and a lap joint, as shown in Figure 2. I have performed all of the checks as taught, but my professor mentioned that explicit checks (for T-joints that have a tensile load applied perpendicular to the fillet welds) of the base metal shear rupture and yielding do not have to be performed. Similarly, with lap joints, failures at the indicated shear locations on the base metal also do not need to be checked. Why are these checks not typically performed?

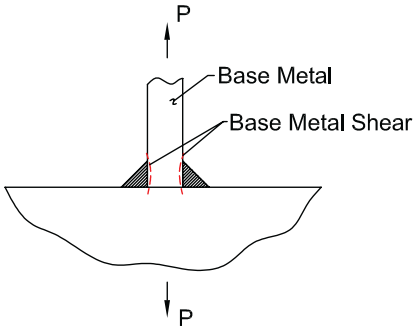

Fig. 1. A T-joint.

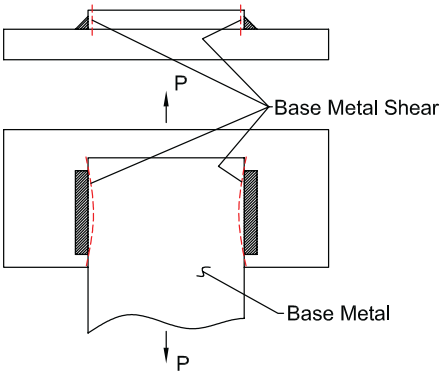

Fig. 2. A lap joint.

The AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) requires the base metal to be checked, stating, "The design strength, ϕR_n, and the allowable strength, R_n/Ω, of welded joints shall be the lower value of the base material strength determined according to the limit states of tensile rupture and shear rupture… as follows… For the base metal $R_n = F_{nBM} A_{BM}$." This needs to be considered (though not necessarily checked) in order to satisfy the *Specification*. It does not need to be checked if we know it will not govern. For fillet welds, we know it will not govern.

How do we know the base metal will not govern at fillet welds? There are two factors: 1. The AISC *Specification* limits the relative strengths of the base metal and weld metal. For fillet welds, Table J2.5 states, "Filler metal with a strength level equal to or less than matching filler metal is permitted." 2. At this point, I suspect we have thousands of physical tests, and to my knowledge, none (that satisfy the *Specification*) have ever failed in the base metal.

I suspect that when you did your check, you assumed that A_{BM}, the cross-sectional area of the base metal, was based on the theoretical leg of the fillet weld and that the strength was the strength of the base metal. This is a conservative assumption. At the theoretical leg of the fillet weld, the weld metal and base metal will be mixed, so the tensile strength is not F_{nBM}, the nominal stress of the base metal, in this area; it is something greater. At some point (at the edge of the fusion zone), the tensile strength will be F_{nBM}, the nominal stress of the base metal, but we do not know what this area is, but we know it is larger than the area at the theoretical leg. What we do know is that the base metal does not govern.

However, we must be careful. Can the base metal ever govern the strength of a fillet weld? Yes. If we use a "filler metal with a strength level" greater "than matching filler metal," then it is likely that the base metal will govern. However, this is a condition that is not addressed by the *Specification*. It is a condition for which the *Specification* should not be assumed to be applicable and, more importantly, for which our knowledge about matching fillet welds is not useful.

Might you ever encounter such a weld? Yes. If you ever interact with engineers in Canada (or engineers outside the structural steel construction industry), then you might. Historically, the Canadian steel code does not limit fillet welds to "a strength level equal to or less than matching"—though my understanding is that in practice, the AISC limit is often satisfied. Therefore, one should check the base metal. How? Probably the way you did on your assignment. In practice, engineers often must address conditions that are not addressed in design standards and may not be well-defined or well-understood. When this happens, what can they do? They can and should apply engineering judgment based on first principles and make likely incorrect but certainly conservative assumptions. No one knows (in a useful way) where the mixing of the base metal and weld metal ends or how it is mixed, so it is best (and easiest) to assume lower bound values—which are the values you likely assumed in your check.

Larry Muir, PE

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

SpeedCore Reinforcement

With the SpeedCore system, do the inner and outer steel face plates, along with the tie bars, replace the steel reinforcement that is normally placed in a reinforced concrete wall?

The SpeedCore (composite plate shear walls–concrete filled) core wall system consists of a sandwich panel made of two steel plates connected by tie bars and filled with concrete. Shear studs may also be added to further attach the steel plates to the concrete fill. You are correct; no rebar (or formwork) is needed. The steel acts as wall reinforcement and the primary resistance to tension and shear demands on the lateral system. The concrete infill, working compositely with the steel faceplates, provides overall flexural and shear stiffness to the structure, with the confined concrete having the ability to resist larger overturning compressive loads under lateral demands.

You can find a lot more information about SpeedCore at **aisc.org/speedcore**. A SpeedCore Design Guide will also be published in the near future. In addition, you can read more about the system in the Need for Speed section, as well as the Field Notes column, in this issue.

Yasmin Chaudhry

WT Reinforcement Stabilizer Plates

I watched both parts of your "Design of Reinforcement for Steel Members" webinar (aisc.org/learning). You mentioned the possible need for stabilizer plates (see Figure 3) when reinforcing a beam with WTs, but you didn't go into how one might evaluate the reinforcement for it. Is there a reference that might show an example calculation?

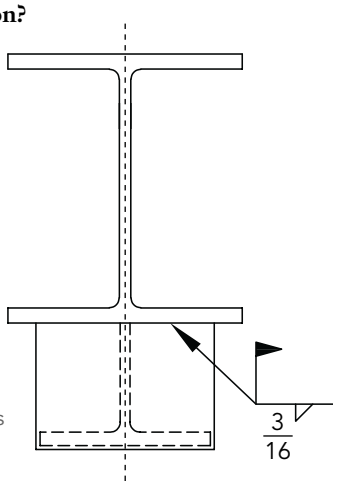

Fig. 3. Consider Stabilizers at the ends of WTs.

The presentation did not include a method to evaluate the need for stabilizer plates or a method to design them (if needed). In practice, these decisions are typically based on judgment.

On previous projects where partial-length reinforcement was used, I typically provided stabilizer plates only at the ends of the WT. These plates can be useful during construction to ensure proper alignment, minimizing the effects of weld shrinkage distortion. The plate thickness was approximately equal to the WT flange thickness, with a size equal to the WT width and depth plus about 1 in. for welding. Those plate sizes are likely conservative but practical. A disadvantage to adding stabilizer plates is the effect of welding perpendicular to the flexural pre-load stress in the existing beam (as indicated in Part 2 of the webinar). In these cases, the reinforcement cutoff point can usually be moved to a location of low stress. Where full-length reinforcement is used, the WT can be connected to the supporting member.

Your question made me think about how I made these decisions on previous projects. For beams with $L_b > L_p$, where lateral-torsional buckling can be a controlling limit state, a pertinent requirement is in AISC *Specification* Section F1(b): "The provisions in this chapter are based on the assumption that points of support for beams and girders are restrained against rotation about their longitudinal axis." Although the WT is usually subjected only to tensile stresses, twisting of the reinforced member must be restrained at the support, which requires a torsional end moment. Using the 2016 AISC *Specification* Appendix 6 Equation A-6-9, this torsional end moment, M_{br}, is 2% of the maximum moment in the beam, M_r. As in Appendix 6 Equation A-6-7, M_{br} can be converted to a couple by dividing by h_o, where h_o is the distance between flange centroids and P_{br} is the required horizontal restraint force acting at the centroid of each flange.

As mentioned previously, I have never seen this calculated in practice. However, based on the discussion in the previous paragraph, it is my opinion that stabilizers can be designed using a notional horizontal restraint force, P_{br}, equal to 2% of the axial force in the WT caused by flexure of the reinforced member. A conservative estimate based on full plasticity of the reinforced member is $P_{br} = 0.02F_yA$, where A is the sectional area of the WT. Assuming this force is located at the WT centroid, a required shear force and moment can be calculated for the stabilizer plate. As always, the design methods and decisions for your structure should be based on your judgment.

Bo Dowswell, PE, PhD

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We can all appreciate that stability is important when designing steel structures—but do you know how to appropriately apply the stability-related provisions of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360)? This month's steel quiz will help you understand some of the basics—and nuances—when it comes to designing for stability.

1 **True or False:** Structural components (e.g., frames) in series are stiffer than components in parallel.

2 **True or False:** You must use one of the methods listed in Chapter C of the AISC *Specification* to design for stability.

3 **True or False:** Both the direct analysis method and the effective length method require consideration of second-order effects.

4 **True or False:** In the direct analysis method, the column out-of-plumbness imperfection is considered explicitly.

5 **True or False:** The non-sway amplification factor B_1 is not included in the calculation of required beam-column moments in the first-order analysis method.

6 **True or False:** The use of $K = 1.0$ is allowed in the direct analysis method when calculating the in-plane column strength, P_c, within the beam-column interaction equations of Chapter H.

7 **True or False:** Stiffness reductions of components that contribute to the stability of a structure are not required in the calculation of required strengths when using the effective length method.

8 **True or False:** The requirements of Appendix 6 are not applicable to bracing that is included in the design of the lateral force-resisting system of the overall structure.

9 **True or False:** The direct analysis method can only be applied for elastic analysis.

TURN TO PAGE 14 FOR ANSWERS

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The answers reference the 2016 AISC *Specification*, which is available for free at **aisc.org/specifications**. AISC has many excellent resources on designing for stability, including Design Guide 28: *Stability Design of Steel Buildings*, which contains a detailed discussion of the different methods presented in the AISC *Specification* along with example problems. You can access it at **aisc.org/dg**.

1 **False.** When a system of structural components is in series, the system stiffness is less than the smallest of any component stiffness. When structural components are in parallel, the system stiffness is greater than the smallest of any component stiffness. Structural components in parallel are much stiffer than components in series. This fundamental concept is described in the on-demand course "Structural Stability–Letting the Fundamentals Guide Your Judgement," presented by Ronald Ziemian (available for free at **aisc.org/learning**).

2 **False.** Section C1 of the AISC *Specification* states, "Any rational method of design for stability that considers all of the listed effects is permitted; this includes the methods identified in Sections C1.1 and C1.2." Section C1 lists five effects that must be considered on the stability of the structure and its elements. The AISC *Specification* presents methods of satisfying these requirements but does not limit the designer to these methods, provided the general requirements in Section C1 are satisfied.

3 **True.** Per Section C1 of the AISC *Specification*, second-order effects (including P-Δ and P-δ effects) shall be considered on the stability of the structure and its elements regardless of the method used. In the direct analysis method and the effective length method, any method of second-order analysis that properly incorporates both P-Δ and P-δ effects is allowed, including procedures such as the amplified first-order analysis method (using B_1 and B_2 multipliers) specified in Appendix 8. The analysis requirements for the direct analysis method are described in Section C2.1. The analysis requirements for the effective length method are described in Section 7.2.2 with reference to Section C2.1.

4 **True.** As stated in the commentary to Section C2 of the AISC *Specification*, "The direct analysis method allows a more accurate determination of the load effects in the structure through the inclusion of the effects of geometric imperfections and stiffness reductions directly within the structural analysis." Geometric imperfections include joint-position imperfections, which in typical building structures refer to column out-of-plumbness. The column out-of-plumbness imperfection is considered explicitly in the direct analysis method through direct modeling (Section C2.2a) of this imperfection or by the application of notional loads (Section C2.2b).

5 **False.** The first-order analysis method is defined in Appendix 7 of the AISC *Specification*. Section 7.3.2(b) states, "The non-sway amplification of beam-column moments shall be included by applying the B_1 amplifier of Appendix 8 to the total member moments."

6 **True.** Section C3 of the AISC *Specification* states, "For the direct analysis method of design, the available strengths of members and connections shall be calculated in accordance with the provisions of Chapters D through K, as applicable, with no further consideration of overall structural stability. The effective length for flexural buckling of all members shall be taken as the unbraced length unless a smaller value is justified by rational analysis." Since the direct analysis method directly models effects known to impact system, member, and cross-section instability, simplifications such as the use of $K = 1.0$ in calculating the in-plane column strength, P_c, within the beam-column interaction equations of Chapter H are granted. This is a significant simplification in the design of steel moment frames and combined systems and demonstrates one of the key advantages of the direct analysis method.

7 **True.** The effective length method is a permitted alternative method for the design of structures for stability, defined in Appendix 7 of the AISC *Specification*. It is permitted for structures that satisfy the limitations specified in the appendix. Section 7.2.2 states, "The required strengths of components shall be determined from an elastic analysis conforming to the requirements of Section C2.1, except that the stiffness reduction indicated in Section C2.1(a) shall not be applied; the nominal stiffnesses of all structural steel components shall be used." See the commentary to Section C2 and Appendix 7 for additional information.

8 **True.** Section C3 of the AISC *Specification* states, "Bracing intended to define unbraced lengths of members shall have sufficient stiffness and strength to control member movement at the braced points." The user note in Section C3 states, "Methods of satisfying this bracing requirement are provided in Appendix 6. The requirements of Appendix 6 are not applicable to bracing that is included in the design of the lateral force-resisting system of the overall structure." The commentary to this section states, "Where beams and columns rely upon braces that are not part of the lateral force-resisting system to define their unbraced length, the braces themselves must have sufficient strength and stiffness to control member movement at the brace points (see Appendix 6). Design requirements for braces that are part of the lateral force-resisting system (i.e., braces that are included within the analysis of the structure) are included within Chapter C." Similar statements can be found in Appendix 7. See Appendix E of Design Guide 28 for additional information.

9 **False.** Section C1.1 of the AISC *Specification* states, "The direct analysis method of design is permitted for all structures and can be based on either elastic or inelastic analysis." This is just one of the many advantages of the direct analysis method. For design using inelastic analysis, see Appendix 1 of the AISC *Specification*.

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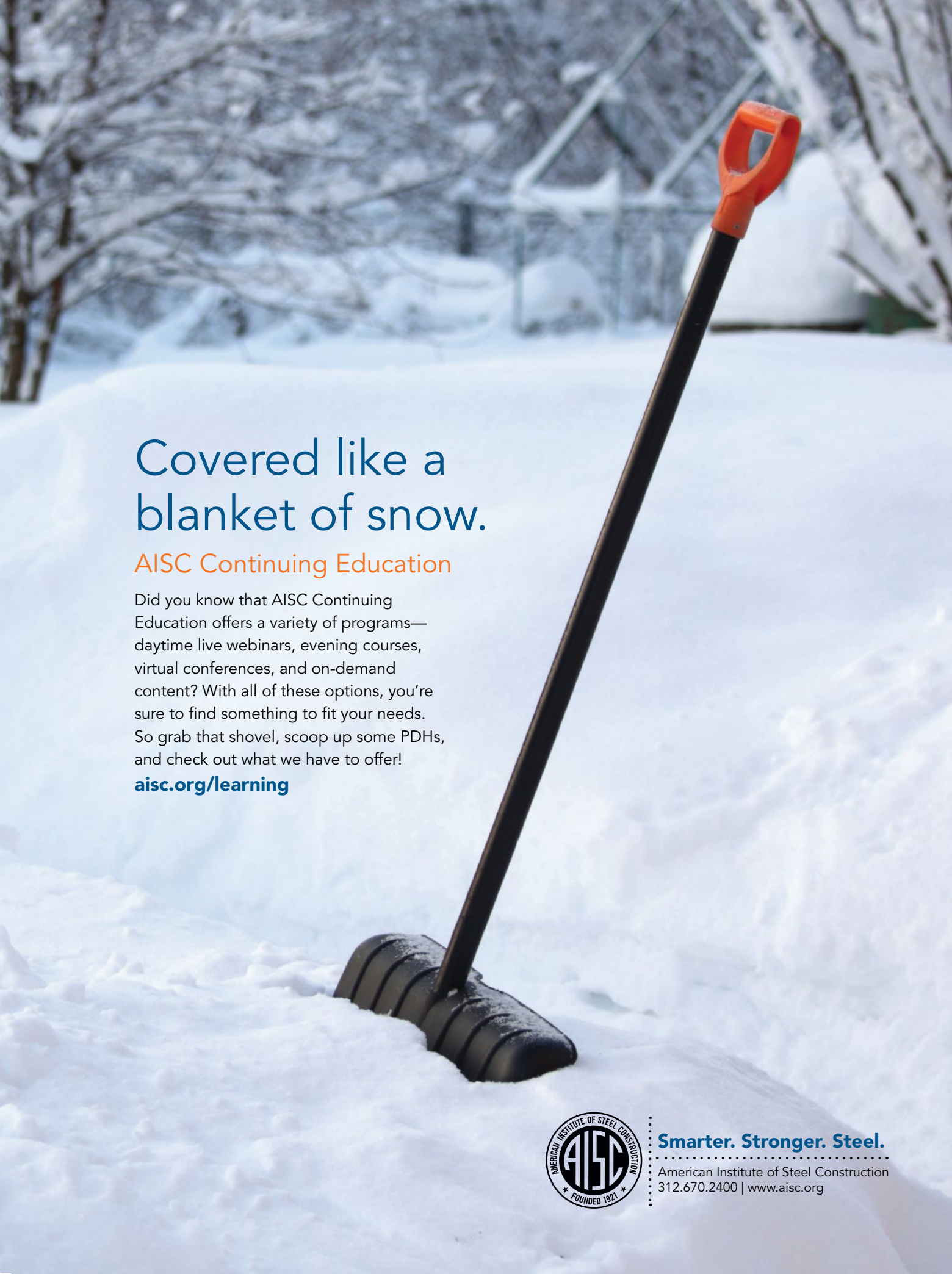
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Shaking Up the Approach to Nonlinear Analysis

BY JOHN D. HOOPER, SE, PE

A new appendix to the AISC *Seismic Provisions* provides clarity on nonlinear analysis for steel structures in high-seismic areas.

LOOKING FOR CLEARER INFORMATION on the use of nonlinear response history analysis for the design verification of steel and composite steel structures that are subjected to seismic events?

Good news: The upcoming AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-22) contains a new section—Appendix 1—providing just that.

Beginning with the 2010 *Seismic Provisions*, Chapter C has allowed nonlinear analysis to be performed in accordance with Chapter 16 of ASCE/SEI 7: *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* to satisfy its requirements. Unfortunately, Chapter 16's cumbersome requirements meant the process was seldom implemented. Projects using nonlinear analysis relied on more manageable procedures found in publications such as the Pacific Earthquake Engineering Research Center's *Guidelines for Performance-Based Seismic Design of Tall Buildings* or the Los Angeles Tall Buildings Structural Design Council's *An Alternative Procedure for Seismic Analysis and Design of Tall Buildings Located in the Los Angeles Region*.

But this could change. Recently, Chapter 16, titled "Nonlinear Response History Analysis," was completely rewritten as part of the updated seismic requirements in ASCE/SEI 7-16. Here are three reasons why this is important:

- It allows nonlinear response history analysis (NLRHA) to be performed as part of any structure's design
- A structure's performance can now be assessed at the risk-targeted maximum considered earthquake (MCE_R) level to be consistent with the target reliabilities indicated in Section 1.3.1.3 of ASCE/SEI 7 ("Performance-Based Procedures")
- It has led to the increased use of NLRHA of structural steel buildings as allowed by Chapter C

In addition, Chapter 16 now includes five main sections that clearly specify the requirements for a successful NLRHA. The main sections are as follows:

- 16.1 General Provisions
- 16.2 Ground Motions
- 16.3 Modeling and Analysis
- 16.4 Analysis Results and Acceptance Criteria
- 16.5 Design Review

Of particular interest is 16.4, which defines element-level acceptance criteria by stating that "all element actions shall be evaluated either as forced-controlled or deformation-controlled." This requirement is further refined in ASCE/SEI 7-22, which reads: "All element actions shall be classified either as force-controlled or deformation-controlled, in accordance with ACI 318 for reinforced concrete elements or ASCE 41 for elements of other materials."

Per ASCE/SEI 7, force-controlled and deformation-controlled actions are defined as follows:

- **Forced-Controlled Actions:** Any element actions modeled with linear properties and element actions not classified as deformation-controlled
- **Deformation-Controlled Actions:** Element actions for which reliable inelastic deformation capacity is achievable without critical strength decay

Along with these definitions, actions are defined by three levels of criticality: critical, noncritical, and ordinary. In addition to providing these definitions, ASCE/SEI 7 points to other codes and standards to assign these component actions for the members included in the NLRHA, as previously noted.

Chapter 16 of ASCE/SEI 7 is not the only standard that was revised recently. While updating ANSI/AISC 341-22, an Ad-hoc Task Group on Seismic Analysis was formed to address the following scope-of-work item:

> "Develop provisions or guidelines for modeling that would assist engineers in applying the requirements of ASCE/SEI 7-16, Chapter 16 (NLRHA) to steel buildings. The guidelines may take the form of commentary, a new chapter in the Specifications, or some other format that the committee recommends."

The group decided a new appendix (Appendix 1) to the *Seismic Provisions* would be the preferred deliverable. Titled "Design Verification using Nonlinear Response History Analysis," it provides information for select structural steel and structural steel acting compositely seismic force-resisting systems outlined in ANSI/AISC 341-22. The appendix's preamble states that the document aims to provide requirements for using NLRHA for the design verification of steel and composite steel-concrete structures subjected to earthquake ground shaking.

Over time, the ad hoc group developed the following outline for the appendix:

- 1.1 Scope
- 1.2 Earthquake Ground Motions
- 1.3 Load Factors and Combinations
- 1.4 General Modeling Requirements
- 1.5 Member Modeling Requirements
- 1.6 Connection Modeling Requirements
- 1.7 System Requirements
- 1.8 Global Acceptance Criteria

As noted in the Scope (1.1), the NLRHA is to be performed according to the requirements stipulated in the applicable building code, which, in turn, refers to Chapter 16 of ASCE/SEI 7. So as not to duplicate the information contained in ASCE/SEI 7, several sections of the appendix simply point to the "applicable building code," including Earthquake Ground Motions (1.2), Load Factors and Combinations (1.3), and Global Acceptance Criteria (1.8). In addition, the Scope

limits the systems for which the appendix applies to the systems specified in System Requirements (1.7). These systems are:

- special moment frames (SMF)
- special concentrically braced frames (SCBF)
- eccentrically braced frames (EBF)
- buckling-restrained braced frames (BRBF)
- special plate shear walls (SPSW)
- composite plate shear walls – concrete filled (C-PWS/CF)—aka SpeedCore

As described in the appendix's commentary, these systems are chosen for several reasons, including:

- The systems are typically designed and evaluated using NLRHA
- The modeling of these systems, while complex, exhibits behavior that is reasonably well replicated by analysis

Furthermore, results of robust research and testing are available to develop calibration models, and recent guidelines on nonlinear modeling are available to provide the necessary modeling and acceptance criteria. Other systems could be added in future editions of the *Seismic Provisions*. System-specific modeling requirements would need to be added for systems where behaviors are not reasonably well replicated by analysis.

The General Modeling Requirements section (1.4) defers to ASCE/SEI 7 for most of the modeling requirements and includes modeling inelastic hinges, initial geometric imperfections, use of expected material properties, and approaches for including the gravity system—all modeling requirements important to steel and composite steel-concrete structures.

The Member Modeling Requirements section (1.5) is organized by member types and includes the following subsections:

1. Beams
2. Links
3. Columns
4. Braces (except buckling-restrained braces)
5. Buckling-restrained braces
6. Steel plate shear walls
7. Composite plate shear walls and composite coupling beams

Specific modeling requirements for each member type are provided in these subsections, which are invoked by the applicable requirements in each system as specified in the System Requirements section (1.7). This section's commentary references the 2022 *Seismic Provisions* because it provides the most up-to-date nonlinear modeling and acceptance criteria. If member tests are available,

Table A-1.7.1
Requirements for Special Moment Frames (SMFs)

Item	Action	Force or Deformation Controlled	Criticality
Beam	Flexure	Deformation	Ordinary
Beam	Shear	Force	Critical
Column with $P_G/P_{ye} \leq 0.6$	Axial	Force	Critical
Column with $P_G/P_{ye} \leq 0.6$	Flexure	Deformation	Ordinary
Column with $P_G/P_{ye} > 0.6$	Axial, Flexure	Force	Critical
Column	Shear	Force	Critical
Panel Zone	Shear	Deformation	Ordinary
Column Base	Flexure	Deformation	Ordinary
Column Base	Axial, Shear	Force	Critical

P_G = axial force component of the gravity load, kips (N) | P_{ye} = expected axial yield strength, kips (N)

John D. Hooper is a senior principal at Magnusson Klemencic Associates and the firm's director of earthquake engineering.

using these results is encouraged. Specific requirements based on the member modeling approach (e.g., concentrated hinge, fiber-type hinge, or distributed plasticity models) are provided for each member type.

The section entitled Connection Modeling (1.6) includes specific requirements for the panel zones, partially restrained connections, column bases, and brace gusset plates. As with the model for members, reference is made to the 2022 *Seismic Provisions* for specific modeling and acceptance criteria information.

The component actions for the specified lateral force-resisting systems are defined in the System Requirements section (1.7). Each component and its associated action(s) are defined as either force-controlled or deformation-controlled, and the associated action's criticality is provided. Table A-1.7.1: Requirements for Special Moment Frames is representative of the tables included for specified lateral force-resisting systems.

This section also includes requirements associated with the gravity system. As noted in the General Modeling Requirements section (1.4), the gravity system should be modeled unless it can be demonstrated to not significantly contribute to the structure's seismic force and deformation demands. Table A-1.7.7 lists the specific requirements for gravity connections.

In summary, Appendix 1 of the *Seismic Provisions* was developed to provide requirements for the NLRHA of steel and composite steel-concrete structures compatible with the requirements in Chapter 16 of ASCE 7-16 and ASCE 7-22. And this new appendix will progress as ASCE is updated and new systems are added. ■

Barometric Readings

BY JOE DARDIS

AISC's latest Business Barometer indicates a strong rebound from the early days of COVID but apprehension about the coming years.

Fig. 1.
National Business Conditions Survey

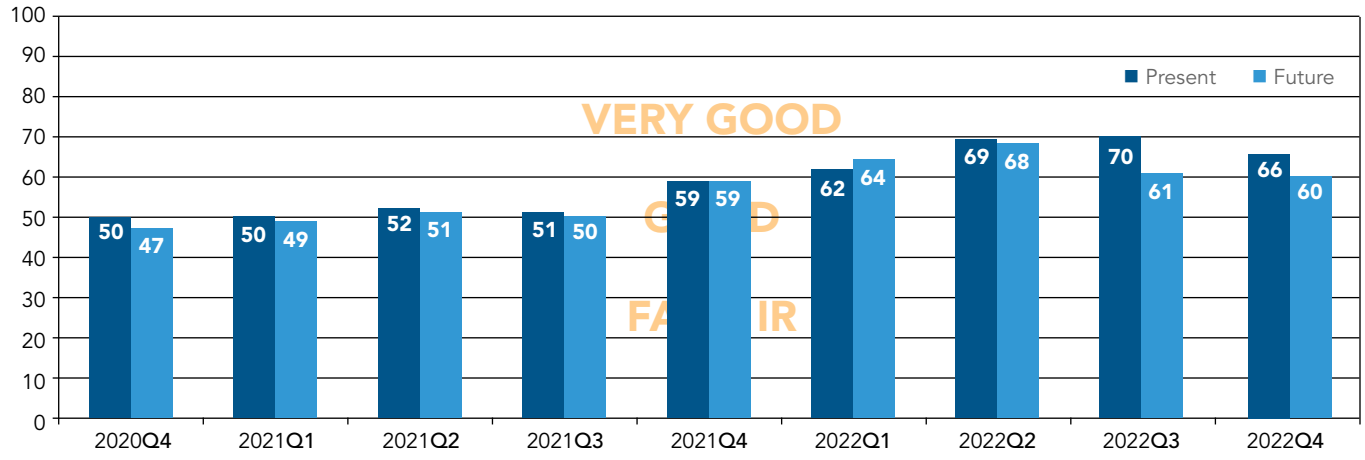
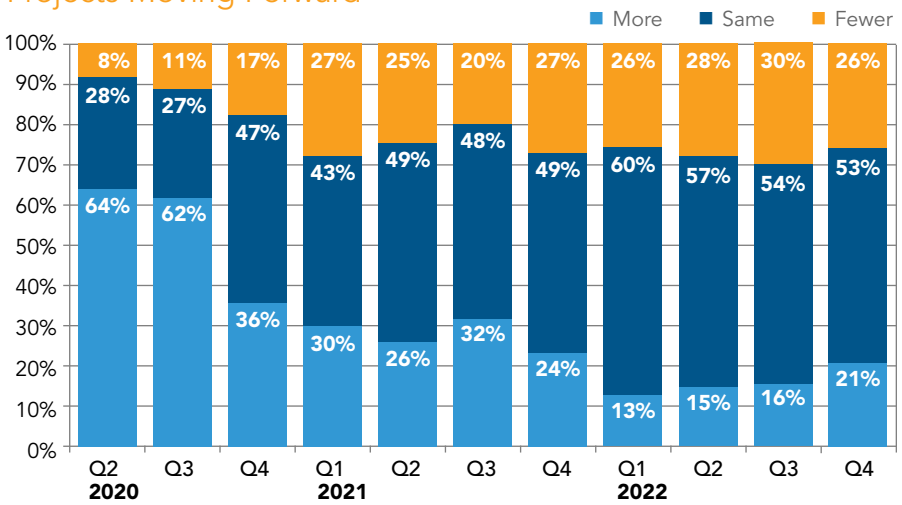


Fig. 2.
Projects Moving Forward



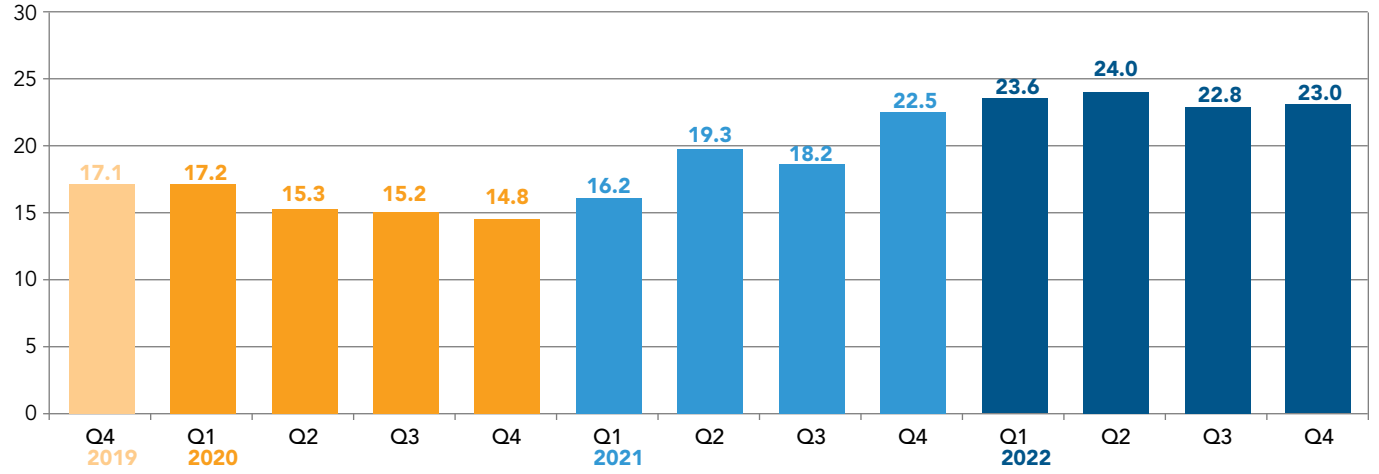
AFTER A FEW CRAZY YEARS and a recent turn for the worse in terms of economic conditions, it's important to check in and see how AISC member fabricators are feeling about their businesses and what they think the future holds.

AISC currently has approximately 950 member fabricators, which is a lot of phone calls. Luckily, we also have the AISC Business Barometer.

The Business Barometer is a quarterly survey sent to all AISC full member fabricators, asking questions about business conditions, lead times, on-hold projects, labor issues, and more—and we receive hundreds of responses every quarter.

The most recent Business Barometer indicates that fabricators are continuing to feel pretty good about current business conditions, an attitude that, for the most part, has been growing steadily more positive over the last couple of years (see Figure 1). However, their thoughts on future business conditions dropped a bit between the second and third

Fig. 3.
National Current Average Backlog (Weeks)



quarters of 2022, thanks to rapidly rising interest rates and a reduced outlook on construction demand over the next year.

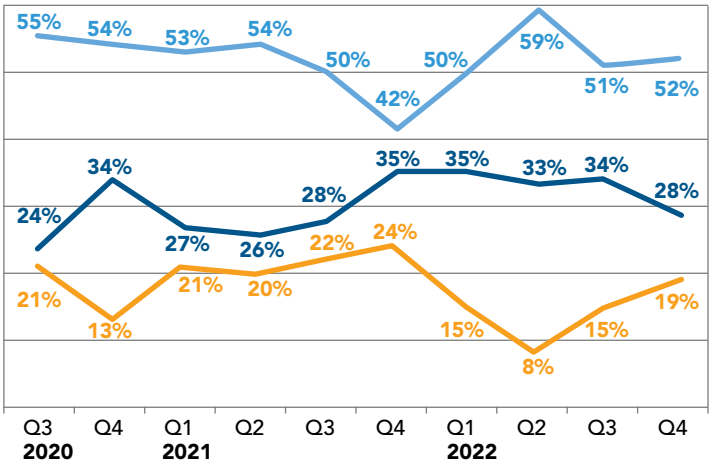
The number of on-hold projects also steadily diminished since the second quarter of 2020 (see Figure 2) following a huge surge of on-hold projects being reported in the prior quarter due to the onset of COVID. Better yet, in the third quarter of 2022, 30% of respondents reported fewer projects being put on hold, which is the largest figure reported in recent history, though that number has crept back down slightly in the fourth quarter.

Continuing with the positive vibes, fabricator backlogs remain at record-high levels (see Figure 3), with average backlogs staying north of 22 weeks since late 2021. With the expectation of decreasing construction activity over the next year or two, backlogs will likely decrease, but the current workload remains very positive.

Despite the positivity on business conditions, projects moving forward, and backlogs, one thing that continues to be a challenge for AISC member fabricators is labor. Figure 4 shows that 80% of fabricators are currently hiring, with 28% indicating that they would like to grow their workforce by more than 15%. While the number of fabricators looking to hire has dropped from the previous quarter (85%), there is still a huge gap to fill, and this will remain one of our industry's biggest challenges moving forward.

This is just a snapshot of what is captured every quarter in the AISC Business Barometer. AISC member fabricators can access the full report at **aisc.org/industrystats**. And if you are an AISC member fabricator, we want to include your input! Make sure to keep an eye out for the quarterly Business Barometer survey so we can continue to improve the accuracy and comprehensiveness of our data. ■

Fig. 4.
Labor Capacity



We can hire/invest/create increased labor capacity by **1% to 15%**.

We can hire/invest/create increased labor capacity by **15% or more**.

We **cannot hire** more staff or have **no interest** in growing beyond our current labor force to meet potential increased demand.

Joe Dardis is a former AISC senior structural steel specialist and is now with Arcelor Mittal.

Unconventional Wisdom

INTERVIEW BY GEOFF WEISENBERGER

Ron Klemencic's habit of questioning the answers has led him to play an integral role in developing the revolutionary SpeedCore high-rise core wall system.

FROM HIS DAYS IN THE SANDBOX to his current role as chairman and CEO of Magnusson Klemencic Associates in Seattle—a company he's been with for 30 years—Ron Klemencic, SE, PE, Hon. AIA, has always been interested in how things are built—and how they can be built better.

In a recent conversation, we discussed, among other things, how he decided to become an engineer, the challenges of bringing an innovative new structural engineering concept to market, the rise of Legos, and Danish Kringles.

Where are you from originally?

I grew up in Racine, Wisc., which is about an hour north of Chicago on Lake Michigan. And its claim to fame is that it's the headquarters for the SC Johnson and Sons Company. The family members were patrons of Frank Lloyd Wright, so my hometown is filled with buildings he designed. When I was a kid, I didn't really know what any of that meant, but later in life, I learned to appreciate it immensely.

When I think of Racine, I think of Danish Kringles.

Yes, I still order them to this day.

What's your favorite Kringle bakery?

It's O&H Danish Bakery.

That's my favorite too!

Yeah, here in Seattle, I can get it in 24 hours. My favorite flavors are almond and cherry. Anyone who's listening, go online and order an almond one. You won't be disappointed.

Can you tell me a bit about what made you want to get into buildings and structural engineering?

When I was a kid, I would build cities in my sandbox with my Matchbox cars and my buckets and shovels, and then I would destroy them and then keep building and destroying them. Building cities was fascinating to me. We had a lot of family in the Chicagoland area and would go down and visit them with some frequency, and my dad would take me downtown occasionally. And when I was maybe eight years old, they were building the Sears Tower, and I was just totally blown away by its construction. Then in middle school, I thought that all meant being an architect, so I started drawing pictures of houses and buildings and floor plans and convincing myself that I needed to be an architect. And then it turns out I had two uncles that were both civil engineers, and they sat me down—I think it was in early high school—and explained to me what an architect did and what an engineer did and kind of how the whole building industry worked. And it was with that kind of guidance that it became pretty clear to me that my brain was wired for science and math and technology and not so much for art. So I chose the engineering path in tenth or 11th grade. At that point, I pretty much knew I wanted to design tall buildings, and I set off to be an engineer. And then the rest is history.

I went to Purdue University and graduated with a bachelor's degree in civil engineering and then went on to get my master's degree in structural engineering at the University of California Berkeley straight away. I did the one-and-done program, which was coursework only with a comprehensive exam at the end, and graduated with a master's in one year.

It sounds like it was fortuitous that you had family members that were into civil engineering and could explain that there's more to buildings than just architecture.

Yeah, it was fantastic. It may sound geeky, but when I got into high school calculus, I was so excited to understand that you could explain the world through math—that, through equations and mathematics, you could explain the physical world. I thought that was so cool.

Back to your story about the sandbox, it seems that you figured out the whole concept of design iterations at an early

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

age. A lot of young kids would build something and want to leave it alone, but your approach was, let's take this down and build it again and make it better.

What's telling about that whole story is that it's from the pre-Lego era. A lot of young people that we hire out of school have a Legos story. Well, when I was a kid, there weren't any Legos. Sandboxes were the tool of choice. We'd go to the supply store and buy a couple of 50-lb bags of sand, and it was so exciting to get the sand and haul it home and fill up the sandbox for the year. And then I saw Legos for the first time. I was just blown away.

Speaking of mind-blowing concepts, let's talk about SpeedCore. How did the idea come about?

Sure, for the last several decades, we've been designing tall buildings with a reinforced concrete core that acts as the bracing system and then is surrounded by structural steel floor framing, and there's a long story as to why that's even the case. But anyway, if we take that as a baseline, what we know from building these all over the world is that the construction schedule is impacted significantly by the cycle time of the concrete core construction. And on most projects, steel erection is delayed in order to get the concrete core out far enough ahead so that the structural steel erection wouldn't catch it. And we took that on as a problem statement—like, how do we change that? How do we fix that? How do we make it go faster and avoid having this scheduled lag at the start of steel erection? And that was the impetus behind SpeedCore—to come up with a steel-based structural system that offered the strength, stiffness, and architectural and dimensional parameters that we needed for these taller buildings but that also afforded the speed.

As you may know, it's a modular wall system with two steel plates separated by a field of cross-tie rods—although they don't need to be rods; they can be flat bars or pipes or anything that interconnects the two plates. And if you take the analogy of an ice cream sandwich, the chocolate cookies are the steel plate, and the ice cream is concrete—and you get a composite section wall panel that ultimately braces the building. There's no formwork there, no reinforcing steel, and no embed plates to place in the formwork. It's a much, much simpler and faster system to erect.

New concepts can always be met with skepticism. How did you get all related parties on board with the idea?

It required a lot of tenacity and sheer will. I often reflect on the forefathers in our company. Decades ago, when they came up with a new structural engineering idea or concept, they'd do all the math and the physics, and they proved it out to themselves. And occasionally, they'd actually do some physical testing mock-ups, but mostly just for themselves. And then they designed the building, and they'd build it. These days, you can't do that anymore because of the approvals processes and the litigious world in which we live. We've got to have everything kind of buttoned down before we do anything new. That means you need to do a whole pile of physical testing and research before you implement anything new.

We came up with the initial concept in the early 2000s, but it was about 2005 when we first decided to launch a research program. We knew we needed to get in the lab and prove this all out. We did all the math and ran all the computer models, but we needed to confirm our calculations with physical testing. So that's when we launched things at Purdue to do the testing in a lab. And so here we are, 17 years later. We're still in the lab, making it better. Of course, we designed a couple of buildings and got them approved and built. The approvals process through the building officials and peer review panels was pretty rigorous—not unusual in today's world, but because it was a brand-new system, it was even more rigorous than normal.

In the case of Rainer Square, a 58-story building with seven basements, we had taken a traditional reinforced concrete core into design development. It wasn't a complete design, but it was a pretty advanced design with a traditional system when we all decided, along with our client, that we needed something better, faster, and cheaper. And that's when we started studying SpeedCore as an alternative system, and then we went through a very rigorous analysis with the contractor and the subcontractors. We saw value there, and our early predictions indicated that it would be cost-neutral and that it was going to save about eight months. And the owner decided to proceed. When all was said and done, it was indeed cost-neutral, and it ended up saving ten months on the schedule.

The second SpeedCore project, 200 Park in San Jose, is 19 stories, and we ended up saving about $10 million in cost and three months on the schedule—which was actually the prediction from the contractor.

That's incredible. Are there other SpeedCore projects on the horizon?

A couple more here on the West Coast, in the Bay Area, and we also have a building designed, reviewed, and permitted in Boston all set to go. The only thing holding it up is that it's a spec office building, and the developers are still in lease negotiations with a would-be tenant. It's a question of not if but when it's going to happen—hopefully shortly. And we have a couple more buildings in Boston that we're designing right now that have SpeedCore elements as part of the design. My distinction there is that the systems in those buildings are mostly structural steel with ordinary concentric braced frames, but because of some unique geometries, we're using a couple of singular SpeedCore shear walls to help stiffen the system. And this brings up a good point that while the name suggests that it's specific to cores in its application, it's really not limited to just that. It can be used in part or in whole and in a variety of geometries. ■

This column was excerpted from my conversation with Ron. To hear more from him, including how he feels the engineering profession has changed over the years, the temporary nature of his company's name, and his thoughts on Seattle, sunglasses, and Eddie Vedder, check out the December Field Notes podcast at ***modernsteel.com/podcasts****. And to learn more about SpeedCore, check out* ***aisc.org/speedcore*** *and* *"Increasing Speed through Research" on page 112.*

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

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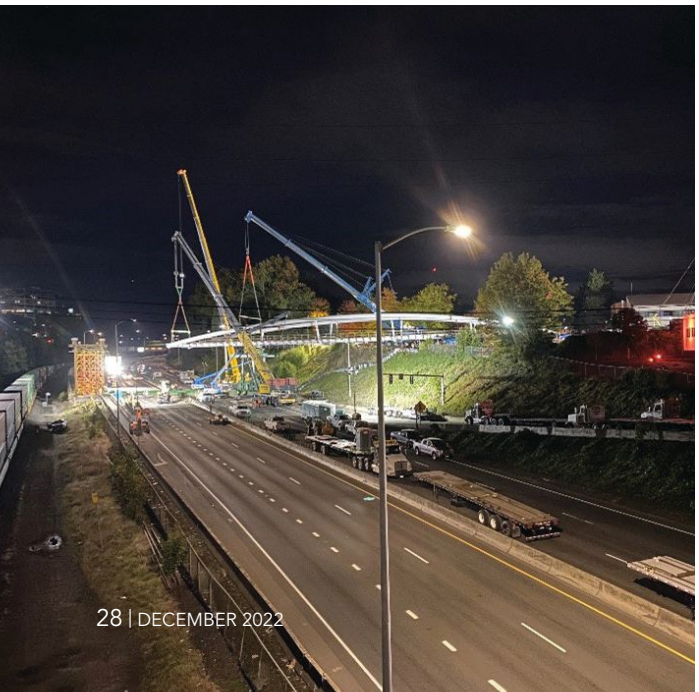
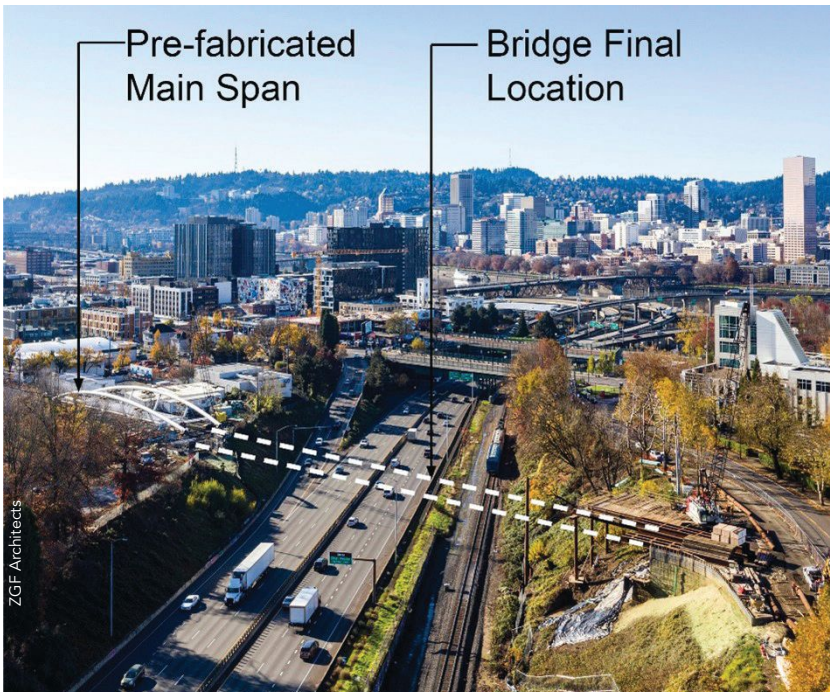
What's Cool in Steel

Every year, *Modern Steel* presents a compendium of fun projects—typically smaller or more sculptural and sometimes temporary—showcasing the cool use of steel.

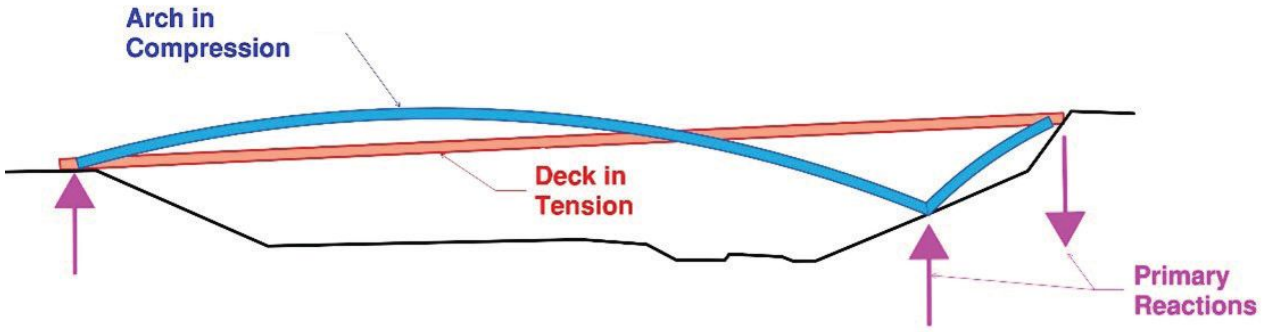
THIS YEAR, our list includes a steel "bubble" over an iconic steel chapel in Colorado, a renovation at the top of what was once the tallest building on the West Coast, a curving steel trail through a zoo habitat in St. Louis, the restoration and expansion of a historic iron works facility in North Carolina, and a pedestrian and cyclist gateway over a highway in Portland, Ore.


Trey Senatore





ZGF Architects



Cool Green Path

PORTLAND, ORE., has a new link in its green chain.

The city's newest car-free bridge, the Congressman Earl Blumenauer Bicycle and Pedestrian Bridge (or "Blumenauer Bridge") celebrated its grand opening this past summer. This $19 million project spans 435 ft, with a 380-ft clear span across Interstate-84 (I-84) and Union Pacific Railroad (UPRR) at the east entrance to downtown Portland.

Named after Oregon congressman and bike enthusiast Earl Blumenauer, founder of the "Congressional Bike Caucus," the elegant new bridge is a key link in the city's "Green Loop," a planned six-mile linear park around the heart of Portland comprising lush, tree-lined pedestrian and bicycle paths and crossings that link together to connect both sides of the Willamette River and major destinations in the city. The project also removes a significant obstacle in the city's renowned network of bikeways. Congressman Blumenauer, a resident of Northeast Portland, has historically advocated for public transportation and biking, both in Portland and in the public infrastructure across the U.S.

"What we're doing here today is celebrating [our children's] future," he said during a speech on the new bridge's opening day.

In addition to providing an important cyclist and pedestrian crossing, the seismically resilient bridge will also serve as a backup route for emergency vehicles over I-84 in the event of a large earthquake damaging other bridges over I-84, which were all constructed prior to the implementation of modern seismic design codes.

Owned by the Portland Bureau of Transportation (PBOT), the bridge was designed by KPFF Consulting Engineers, who provided structural and civil engineering and surveying services and overall design team management, and architect Architectural Applications P.C. HP Civil, Inc., served as the construction manager/general contractor, Smith Munroe and Gray provided construction engineering services, and the project's steel fabricator was AISC member Thompson Metal Fab, Inc., with AISC member DBM Vircon as the steel detailer and AISC member Paramount Roll and Forming performing some of the steel curving work (the project incorporated 375 tons of structural steel in all).

Developing a design that could be fabricated and erected efficiently and safely on a constrained urban site with minimal impacts to adjacent businesses, I-84, and the railroad was no small task. Multiple bridge types and span configurations were considered to achieve the necessary 380-ft clear span over both the interstate and railroad right-of-way, and the final bridge design was chosen based on cost and extensive public input. The asymmetrical tied arch configuration made the best use of the PBOT-owned right-of-way by implementing a support near the base of the railroad cut and taking advantage of the inherent efficiency of a tied arch structure for spans of this length.

Another benefit of the asymmetrical arch configuration was that preassembly of the main span over the interstate was possible on the PBOT city street south of the bridge site. The 60-ft width of the city's street right-of-way did, however, lead to a very constricted preassembly site for the main span, which is 45 ft wide at the top of the arches. The temporary "traditional tied arch" geometry of this portion of the span meant it was sufficiently stable to support its own weight over the interstate with a temporary shoring tower placed between the interstate and railroad right-of-way, which allowed the entire span to be lifted into place over a single weekend closure of I-84, minimizing the resulting disruptions to city traffic which are caused by closing a major interstate freeway into and out of the core of the city.

Placing an intermediate support on the steep railroad cut presented multiple technical and logistical challenges for the design team and CMGC contractor. Soft soils at the site required deep foundations at all three bridge supports. The access requirements for traditional driven piles or drilled shafts made both options extremely costly, so the team chose steel-encased drilled and grouted micro-piles, which could be installed with small rough-terrain, track-mounted drill rigs. However, while these piles provided significant compression and tension capacity (510 kips and 365 kips factored, respectively), their $9\frac{5}{8}$-in. steel casing diameters provide little lateral stiffness. Therefore, to supplement in the longitudinal direction, a 32-ft wide by 6-ft deep concrete deadman anchor was buried 40 ft south of the south abutment and tied to the abutment with concrete grade beams.

The architectural design of the bridge called for the arches to be splayed outward to present a more open feeling for users. This elegant modification to traditional arch construction presented the designers and steel detailers with a number of geometrical challenges. In order to better communicate the geometrical complexities, axonometric diagrams were included in the contract drawings to illustrate the required angles and curvatures.

The minimal profile of the tied arch structure required careful consideration of tolerances and opportunities for field adjustability. The bridge's unique geometry and its erection and connection sequence resulted in a hybrid of a continuous bridge with a simple-span, cantilevered structure. This required nonlinear and linear buckling analyses using second-order analysis, as well as modeling the geometric imperfections of the pipe arches to quantify the behavior and stresses in the arches throughout construction. The team surveyed the arch pipe members at each stage of the construction to determine if the as-built condition of the arch pipe was within the limits of the assumed geometric imperfections.

Detailed architectural design consideration was given to all aspects of the bridge. One significant feature was the lightweight railing system that had to meet both the railroad and highway departments' requirements of being an anti-climb/throw barrier while maintaining an open, comfortable environment for bridge users. Various railing configurations were considered, and public input was solicited using mock-ups at the project open houses. The final design achieved the various goals by using preassembled 10-ft by 8-ft stainless steel fencing panels attached to splayed steel bent plate posts on the edges of the bridge deck.

The overall result, using approximately 425 tons of fabricated steel, is a graceful gateway structure over the "entrance" to downtown Portland that puts sustainable transit at the forefront and on full display.

Cool Steel Bubble

THE UNITED STATES AIR FORCE CADET CHAPEL has been a modern design icon on the USAF Academy campus in Colorado Springs, Colo., for nearly 60 years.

Built as a multi-denominational facility, the historic building has experienced a significant amount of water damage and deterioration over the years. In 2019, a long-overdue restoration was finally proposed and placed in the hands of contractor J.E. Dunn Construction, whose main goal was determining the best and most efficient approach to what has been deemed the country's most complex modernist preservation effort.

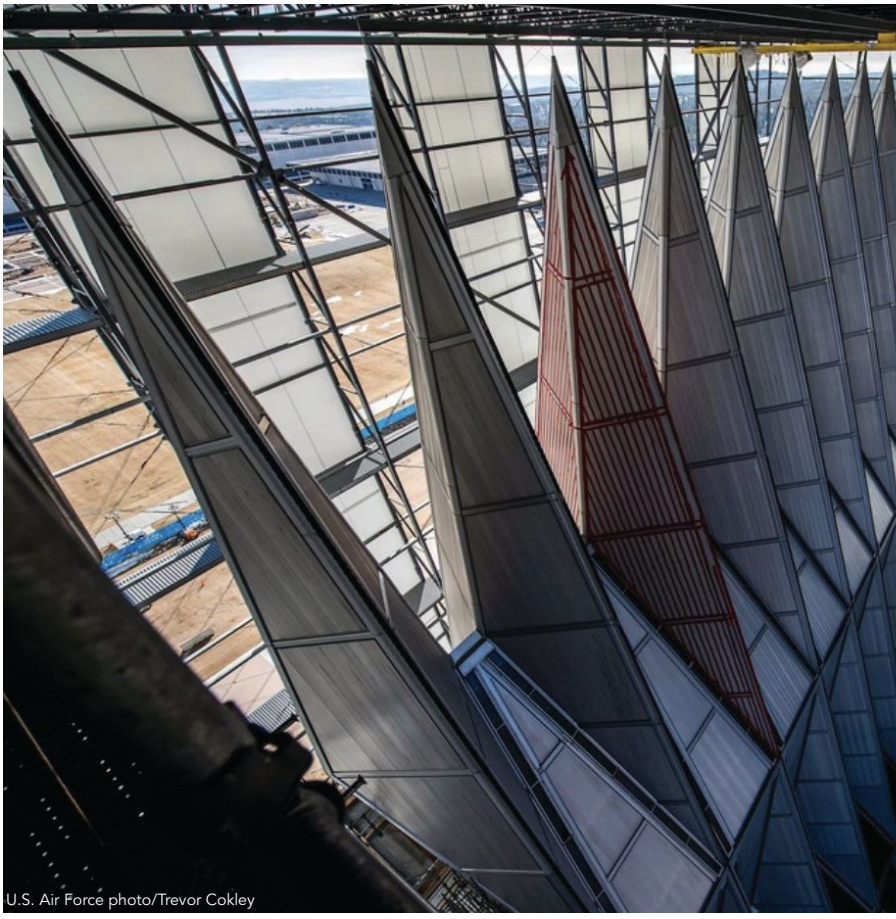
The project called for the complete removal of the building's exterior to replace its original components. To execute this multi-year process while controlling the removal environment during the region's inclement weather, the project team determined that a protective steel-framed "bubble" using industrial Serge Ferrari fabric panels would be necessary.

The original project design called for steel joists placed vertically every 7 ft down the entire perimeter of the building. To improve project efficiency and safety, AISC member fabricator Basden Steel recommended a truss system instead. Through a collaborative effort and multiple design revisions, the initial vertical joist plan evolved to implementing 9-ft-wide wide-flange trusses with angle and hollow structural section (HSS) infill members.

At the request of Deem Structural Services (sister company to Basden Steel and an AISC member erector), platforms were added with a pinned deck at two elevations to allow for storage locations, additional rigidity, and landing points for the personnel climbing the ladders and shoring to stop for rest as needed. Other means of egress included massive 200-ft boom lifts to allow ironworkers easier access to the higher steel. In all, the bubble frame is made up of 715 tons of structural steel.

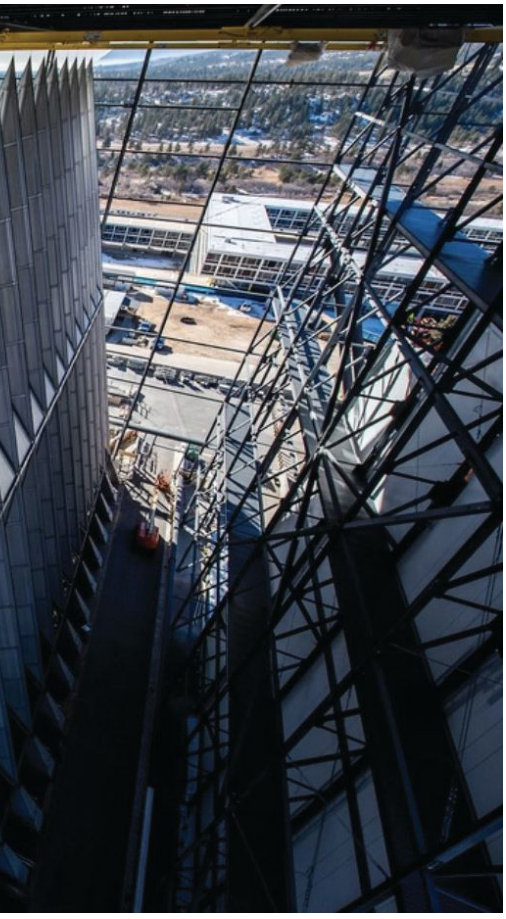
Workers installed the temporary cocoon-like steel bubble—which measures more than 250 ft long, 160 ft wide, and 180 ft tall—in five months. The 52,000-sq.-ft chapel roof is being dismantled piece-by-piece to be restored along with many other significant aspects of the structure, including the pipes of the two pipe organs, stained glass windows, and wood pews.

Given the temporary nature of the repair structure, the plan called for all connections to be bolted, which will facilitate easier disassembly as welds will not need to be cut—which will eliminate damage to the newly refurbished chapel in the form of sparks. The combined Basden and Deem team is slated to return to the site and begin demolition of the bubble near the end of 2025, and the chapel is expected to fully reopen in 2026, bringing an end to a historic preservation effort for a historic steel structure.



U.S. Air Force photo/Trevor Cokley

U.S. Air Force photo/Trevor Cokley



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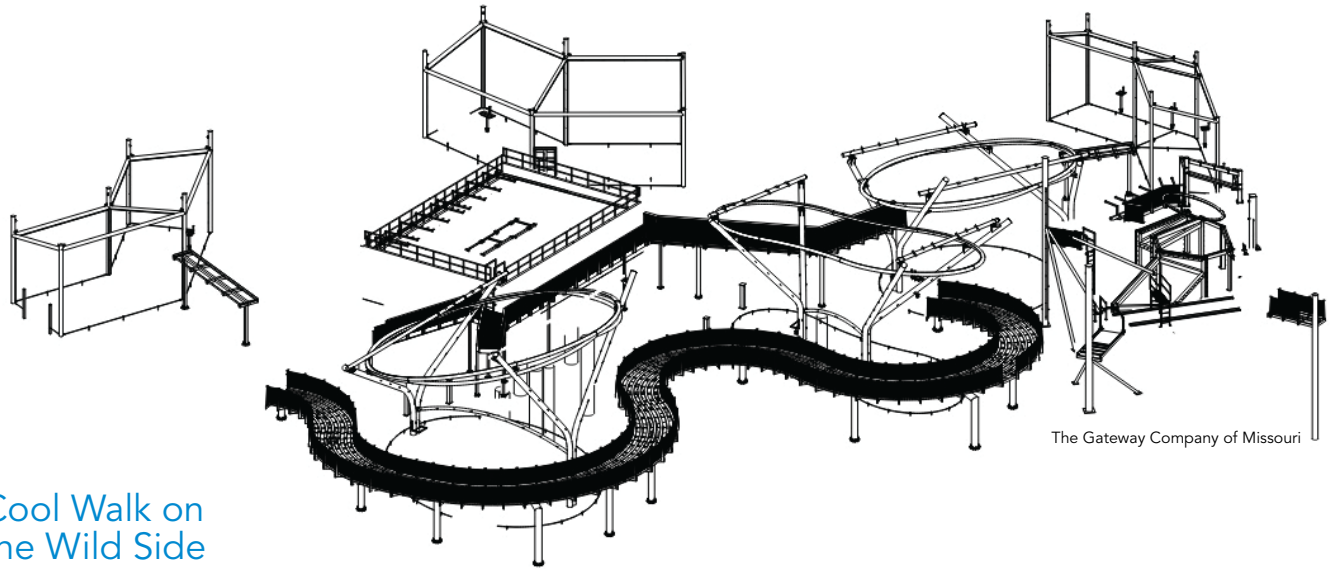


The Gateway Company of Missouri

Cool Walk on the Wild Side

WANT TO GET up close and personal with lemurs?

The Michael and Quirsis Riney Primate Canopy Trails feature at the St. Louis Zoo presents a good option.

Designed by architect PGAV Destinations and structural engineer Leigh and O'Kane, the new interactive 35,000-sq.-ft outdoor primate exhibit immerses visitors in the enclosure, starting with a walk through the forest floor via a steel-framed see-through tunnel and working up to the treetops via an elevated winding steel boardwalk that was designed to meet ADA requirements. The exhibit contains enrichment play areas as well as shelters for the animals in eight different habitats that house Old and New World monkeys and lemurs. Climbing steel elements intertwine with live trees to create an environment that displays industrial might beautifully interwoven with nature.

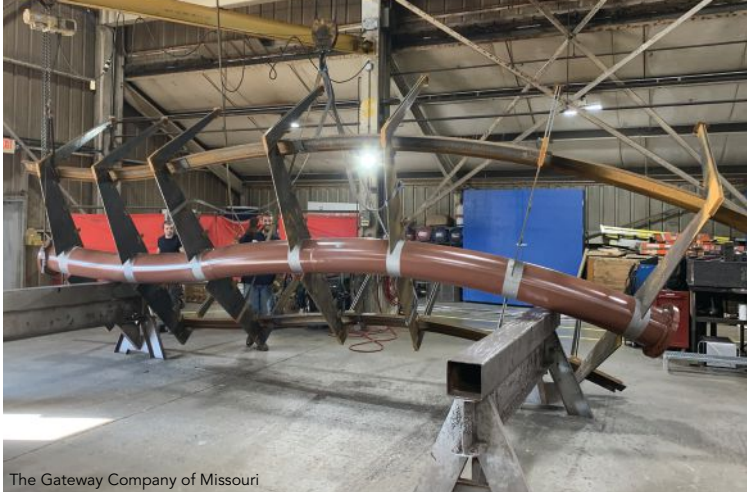
The upper boardwalk consists of a painted and curved round hollow structural section (HSS) that acts as a spine. This spine supports weathering steel plates, channels, and mesh as it winds throughout the exhibit. Originally, the entire project was to be constructed with weathering steel, but due to sizing restrictions, the design was adapted such that anything that was too big for small-quantity ordering of weathering steel was changed to standard carbon steel, which was painted with a high-performance coating to match the weathered steel look. The habitat structures were also fabricated with weathering steel, including 16 steel boxes that provide shelter from the sun and inclement weather and heat in the winter. The exhibit incorporates approximately 150 tons of steel in all.

The trails' framing included complex curves (achieved by AISC member bender-roller Max Weiss Company) and elevation changes throughout, and the boardwalk was fabricated in 15 separate pieces. Each section had a unique curve and elevation, creating challenges when it came to ensuring that the bolted connections of the spine aligned and also with the straight mesh panels that lined the boardwalk. To address these challenges, the project's steel fabricator, AISC member The Gateway Company of Missouri, hand-torched the ends to the correct pitches and angles. Each cut was unique to each piece of the boardwalk at each end, which the team achieved through complex modeling using SDS2 software and extensive manual layouts in the fabrication shop, as well as through sustained communication with the detailers, AISC member Pan Gulf Technologies and Joe Nicoloff (deceased) of Nicoloff Detailing.

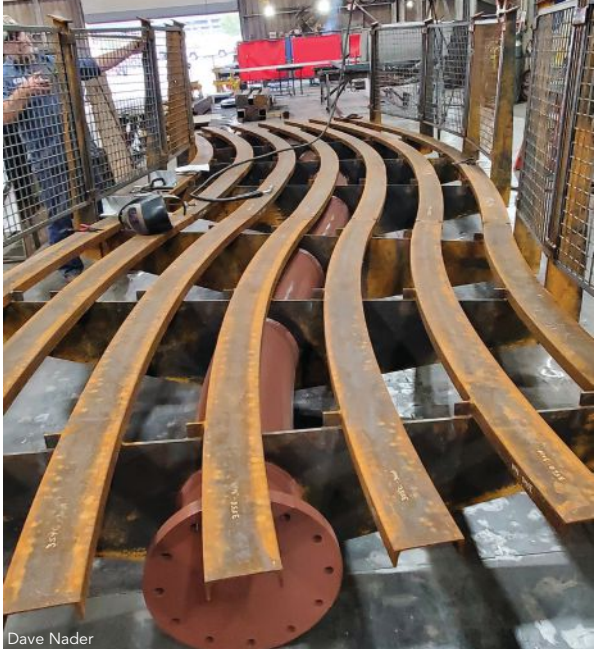
The handrail and mesh panels that lined each boardwalk piece were also custom-fit in the fabrication shop to ensure that the straight panels could follow the curve and pitch of each section of the boardwalk. Curved members were also used to create steel "trees" in three of the habitats, which required the brackets attached to these members to be precisely fabricated to match the curve of the HSS. Each of the curved steel member trees includes a variety of welded-on D-rings that were used to tie off anything from fire hoses to ropes to allow the primates different enrichment activities.

The design also included three steel "halos" attached to hold a mesh netting that encloses the habitat, with each one being a different size and shape and needing to be fabricated to a different radius. The brackets attaching them to the curved steel trees also had to be modeled and fabricated to the proper angle to ensure that erection in the field (by AISC member Acme Erectors) could be performed without hitting the existing sycamore and blue ash trees. During the process of erecting these pieces, the trees couldn't be touched or damaged, so each angle and radius had very little room for movement. These elements were laid out in the field using GPS coordinates from the detailer's models. Communication between the fabricator, erector, detailer, and general contractor Tarlton Corporation, as well as meticulous placement of the members by the ironworkers, ensured the trees' safety.

The detailers and fabricator worked together to solve a variety of challenges regarding the curve and elevation complexities of the design. Once the pieces made it to the job site, the superintendent worked with the fabricator's project manager as well as the ironworkers. The collaboration did not end with phone calls and often included site visits from the fabricator's project manager as well as the detailer and fabricator's shop foreman to ensure that the owner's and zookeepers' design intent was attained. This made what was a very challenging job for the superintendent and erector go as smoothly as possible, given the sophisticated design. The fabricator was heavily involved with other subcontractors on the job to make sure the custom sail shades could connect as needed to the steel—and also with the bender-roller to ensure that the radius of each member was in accordance with the design.



The Gateway Company of Missouri



Dave Nader

The Gateway Company of Missouri

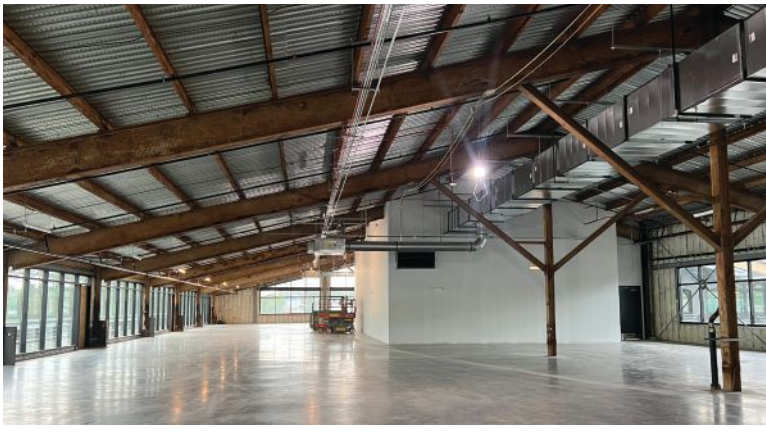
The Gateway Company of Missouri

Dave Nader

Emi Lampman

Cool Rejuvenation

Photos this page: Lynch Mykins



JUST A FEW MILES NORTH of downtown Raleigh, N.C., sits Raleigh Iron Works, a project that restores the past and forges the future.

Raleigh Iron Works was also the name of a steel fabrication company that helped bolster the local economy during World War I. After the war, the company was purchased by James M. Peden. During the height of the depression in 1931, the company became Peden Steel and kept up with government contracts through World War II, becoming an integral piece of infrastructure for the city. And today, thanks to a rehabilitation project that leverages existing steel framing and augments it with new steel elements, the company's former facility lives on as a new mixed-use development.

Local developers at Grubb Ventures teamed with international developers at Jamestown to bring this transformative vision to reality. Grubb and Jamestown hired S9Architecture as the design architect, LS3P as the architect of record, and Lynch Mykins as the structural engineer, with Brasfield and Gorrie serving as the general contractor. The vision was to create a mixed-use development that both honored the raw history and bones of the buildings while bringing new and creative life to the spaces.

One of Peden's most prominent structures was a double-gable steel building designed in the mid-1950s by a locally known architect named Leif Valand. Thankfully, the adaptive-reuse design team and the steel fabricator for the rehabilitation project, AISC member North State Steel, were able to access the original shop drawings (AISC member Cistron Technologies served as the building's steel detailer). The original building consisted of 13 bays of single-story wide-flange columns forming a double-gable roof structure—which comprises Z-shaped purlins and a standing seam metal roof—with a moment-framed lateral system. A lean-to low-roof structure lived on the east side of the structure, and crane rails ran down each grid line along the eaves of the gables.

Before the double-gable building was created, its neighbor, a bow truss building, was situated in a different part of Raleigh but was disassembled, put onto truck beds, and driven a few miles north to the site where it currently sits—nearly 30 years after its initial construction—where it became the welding shop for Peden Steel before eventually being expanded. This building consisted of a single-story barreled bow truss roof structure with a clear span of 75 ft. Lean-tos existed on both sides of the bow truss building, similar to the double-gable building, and crane rails were supported by 21WF72 columns on either side of the bow truss span. Between the approximately 25-ft bays were wide-flange purlins supporting corrugated metal roof decking. Miscellaneous X-bracing consisting of tie rods and steel angles braced the bottom chords of the trusses, and cross-bridging, consisting of angle bracing, supported the trusses from rollover. Although this was a one-story space, the bottom truss elevation was nearly 40 ft above the existing slab-on-grade, leaving a lot of flexibility for the vision held by the developers and architects.

The team performed a conditions assessment to ensure the existing steel fabrication drawings from the double-gable building were accurate and that the existing structure was in good condition. However, existing foundation drawings for the building were not available, so the construction manager completed select excavations to provide existing foundation dimensions prior to design. And since existing drawings of the bow truss structure were lacking detail, the team planned to survey the bow truss roof structure via a lift. However, accessing the existing roof structure was a challenge due to an active tenant, plus the existing ceiling tiles were part of the building's active fire-protection system. As such, fitting a lift

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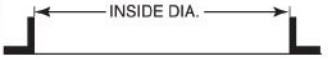
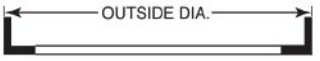
1 Angle Leg Out


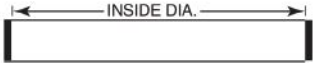
10" x 10" x 1" Angle

2 Angle Leg In


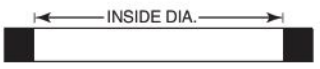
10" x 10" x 1" Angle

3 Flat Bar The Hard Way


24" x 12" Flat

4 Flat Bar The Easy Way


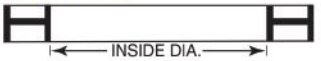
36" x 12" Flat

5 Square Bar


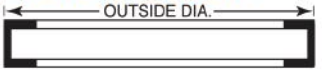
18" Square

6 Beam The Easy Way (Y-Y Axis)

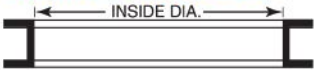

44" x 335#,
36" x 925#

7 Beam The Hard Way (X-X Axis)


44" x 285#

8 Channel Flanges In


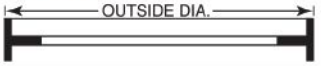
All Sizes

9 Channel Flanges Out


All Sizes

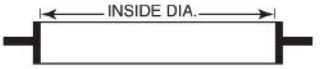
10 Channel The Hard Way (X-X Axis)


All Sizes

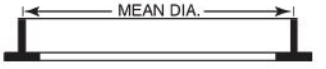
11 Tee Stem In


22" x 142½# Tee

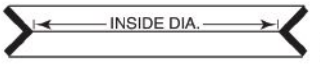
We bend ALL sizes up to:

12 Tee Stem Out


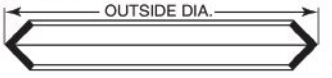
22" x 142½# Tee

13 Tee Stem Up


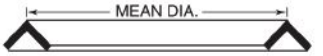
22" x 142½# Tee

14 Angle Heel In


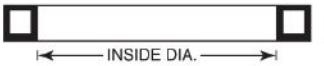
8" x 8" x 1" Angle

15 Angle Heel Out


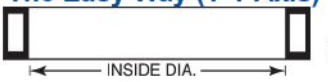
8" x 8" x 1" Angle

16 Angle Heel Up


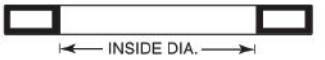
8" x 8"x1" Angle

17 Square Tube


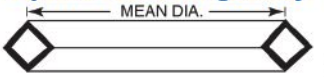
24" x ½" Tube

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


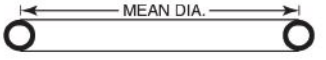
20" x 12" x ⅝" Tube

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


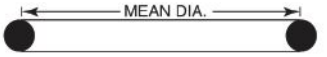
20" x 12" x ⅝" Tube

20 Square Tube Diagonally


12" x ⅝" Square Tube

21 Round Tube & Pipe


24" Sched. 80 Pipe

22 Round Bar


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Courtesy of Brasfield and Gorrie


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through the existing cross bracing at the bow truss' bottom chord elevation was not possible during design, so the team waited until the tenant's lease ended to perform point cloud scans of the building, and the ceiling tiles were demolished. The team also removed and weighed samples of the existing roof structure to verify the existing roof's structural capacity. (North State Steel and Cistron fabricated and detailed the new steel for this building as well.)

The design for the updated double-gable structure included adding an elevated floor to the existing one-story structure. The existing bays were large, which allowed for additional columns to be added within them, which in turn facilitated a reduction in the existing loads on the columns and the new loads on the existing structure to be smaller as well. The existing crane rails were removed to allow space for the second-floor structure, which consists of a composite beam system, and a 6½-in. normal-weight slab was chosen due to the existing grid spacing and fire rating.

The addition of the second floor and the removal of the existing roof allowed for a better lateral system, which consisted of exposed braced frames. Roof platforms were added for mechanical access for future tenant requirements. Since the existing roof structure was designed for the existing column span, new columns do not continue through the second floor, except at braced frame locations, allowing for much more open space on the elevated floor and drawing the eye to the existing roof structure, which remains exposed. An exterior terrace occupies the space that was once the lean-to structure, and a courtyard and exterior stair welcome tenants to the second-floor space.

The design for the updated bow truss structure included the addition of two elevated floors. Like the double-gable structure, two intermediate column grids were added to divide the seventy-five-foot existing structural span, and the lateral system was converted to braced frames, a few of which are exposed. The team designed a 5¼-in. lightweight slab for this building to reduce the impact on existing foundations since two floors were added in this building instead of just one, as was done in the double-gable structure. In addition, lower impacts on the existing foundations resulted in reduced necessary excavations of the existing slab-on-grade for foundation modifications. Close collaboration between Brasfield and Gorrie and the steel erector during design facilitated significant cost savings on the new roof decking, and the curvature of the bow truss roof was slight enough to allow for a 1-in. corrugated roof deck that did not require rolling. The lean-to on the east side of the structure was demolished, and the lean-to on the west side was preserved and transformed into an exterior passageway between retail tenants on the first floor. The exterior walls of the bow truss structure were brought in by one bay on each end of the structure, exposing the trusses and allowing for multiple terraces. Finally, a steel bridge through the center of the structure features terraces with skylights that draw in natural light that cascades into the spaces below. New structural steel for the double-gable building totaled approximately 340 tons, and the bow truss building included approximately 370 tons of new structural steel.

The double-gable building and bow truss building are part of phase 1 of the development, which includes 219 units of multifamily apartments, 184,000 sq. ft of office space, 65,000 sq. ft of retail space, and a 683-space parking deck (plus approximately 275 surface parking spaces). The next phase of the development will add another 350,000 sq. ft of office space and more multifamily space.

Raleigh Iron Works represents a vision of innovated, curated, and dynamic spaces that unite talent and communities. It connects Raleigh's industrial past with its innovative future, creating a dynamic environment where deep steel roots meet modern steel flair.

Cool Pyramid Point

SAN FRANCISCO'S TRANSAMERICA PYRAMID is one of the world's most unique and recognizable high-rises—and a recent structural overhaul to its architectural spire will ensure that it stays in tip-top shape.

The tapered shape of the steel-framed skyscraper rises from an arcade between levels two and five and comes to a point at the top of a ten-story architectural steel spire above the 50th floor. Aluminum louvers enclose the spire above floor 50, which is otherwise exposed to the elements.

With 2022 marking 50 years since the building first opened, SHVO, the real estate investment and development firm that acquired the Transamerica Pyramid in 2020, announced a $250 million renovation of the building in partnership with acclaimed architect Foster + Partners earlier in the year.

Over the years, the steel framing in the spire experienced localized corrosion. While not a significant issue to the overall stability of the spire, SHVO chose to undertake a major project to address all the corrosion in the spire and provide new corrosion-resistant coatings on all of the steel. SHVO chose an integrated project approach and retained Degenkolb Engineers to lead the design team and Hathaway Dinwiddie Construction to oversee the construction team. Recognizing the significant structural steel component to the project, Hathaway Dinwiddie engaged AISC member Olson Steel as the steel fabricator (Olson Steel also served as the steel erector and detailer) at the outset of design, enabling early and ongoing direct communication between Olson Steel and Degenkolb—a crucial element to the project's success.

Part of the spire restoration project involved adding permanent platforms at each level in the spire to aid in performing this restoration and any future maintenance. The new platforms were created by adding infill framing between existing beams at each level and topping the framing with fiberglass grating. Installing new platforms necessitated additional lateral bracing in the spire due to the added loads, consisting of tension-only angles in an "X" configuration, which significantly reduced the demands on the spire's one-bay moment frames. Tension-only braces were chosen because the braces would need to be brought up in segments.

In addition to augmenting the strength of the spire to receive the platforms, the X-bracing served as a voluntary strengthening measure to reduce damage to the spire. Since the columns' wall thickness cannot accommodate inter-story drift that occurs with strong ground shaking, X-bracing was employed to minimize this drift.

The added bracing was designed to be a tension-only mechanism, so an X-brace was used to create symmetric resistance in each direction. Placing a braced frame system on top of a moment frame system is unconventional due to the inherent stiffness difference in these systems, but with a low spire mass, this scheme is possible without creating any structural irregularities. The structure at this height is very light because there are no concrete floor slabs, and the façade consists only of lightweight metal louvers. Therefore, the brace sections can remain small enough to mimic the stiffness of the moment frames at floors 45 through 50 below.

While planning the spire project, SHVO chose to also perform a voluntary structural strengthening project on floors 45 through 50. On the 45th floor, the lateral force-resisting system abruptly changes from a three-bay moment frame in four directions to a one-bay moment frame in two directions due to the tapered shape of the structure. Degenkolb's analysis showed that this change in strength, stiffness, and loss of redundancy would lead to a disproportionate amount of damage above floor 45 in a seismic event. It also determined that retrofitting the beam-column connections and column splices on floors 45 through 50 and the column splices in the spire and adding the tension-only braces in the spire would significantly reduce the expected damage.

The existing beam-column moment connections are standard pre-Northridge welded unreinforced flange with bolted web (WUF-B) that exhibited unanticipated fracture of the weld between the beam flange and the column flange in the 1994 Northridge Earthquake. With careful planning, communication, and coordination, the beam-column connections were retrofitted to update them and bring them close to a welded unreinforced flange with welded web (WUF-W) connection per AISC's *Prequalified Connections for Special and Intermediate Steel Moment Frames For Seismic Applications* (ANSI/AISC 358-16 with ANSI/AISC 358S1-18 and ANSI/AISC 358S2-20). The existing beam-flange-to-column welds were back-gouged out and replaced with demand-critical welds, the existing weld access holes were altered to conform to the geometry requirements in *Prequalified Connections*, and the shear tabs were welded to the beam webs.

The column splice retrofit detail is a complex configuration of plates designed to span over the splice partial penetration weld between column ends and protect that fracture-prone region. The existing splice weld is susceptible to fracture because of the structural detailing common during original construction. The weld material used in the late 1960s and early 1970s does not have the toughness characteristics modern welding wire does, which prevents cracks and imperfections in metal from rapidly propagating when subjected to tensile force. The original detailing of these welds only called for less than 50% of the flange thickness to be connected. The unwelded half becomes a large existing crack in the splice from which a fracture could propagate. To restrain this fracture, the supplemental plates added to the splice are sized to be significantly stiffer than the column walls in axial and flexural, thereby attracting force out of the column before the force reaches the splice weld.

The splice repair was further complicated by the constricted working environment on the two exterior faces of the columns. The field welders could not fit between the column wall and the inside face of the corner cladding. Removing the cladding was not a practical option 800 ft above the ground, so Degenkolb and Olson Steel worked together to sequence the splice plate assembly construction using a mock-up, building from the exterior-most corner back towards the interior corner in a manner that only required the welder to reach an arm into the tight space.

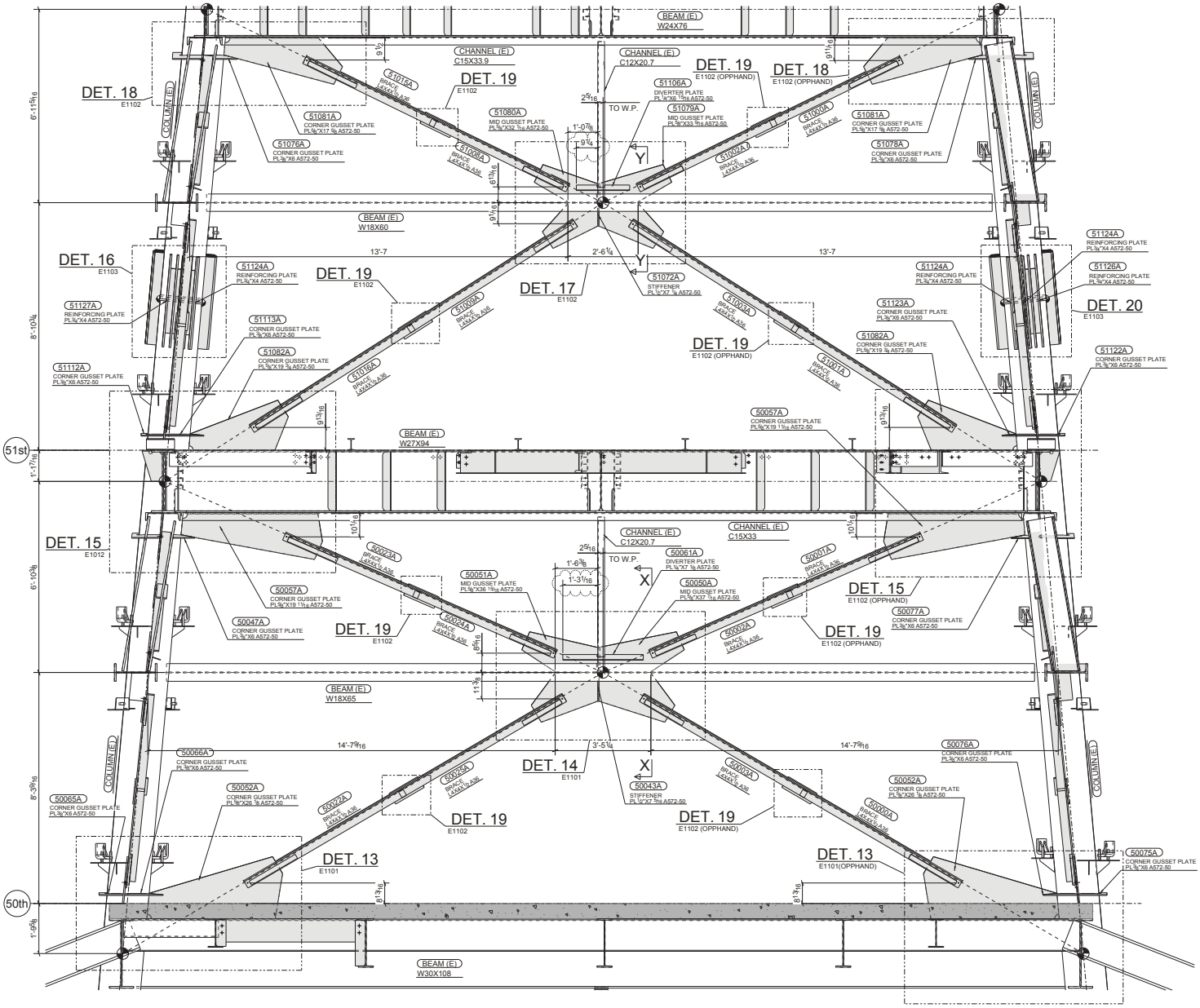
All images: Degenkolb Engineers/Olson Steel unless otherwise noted

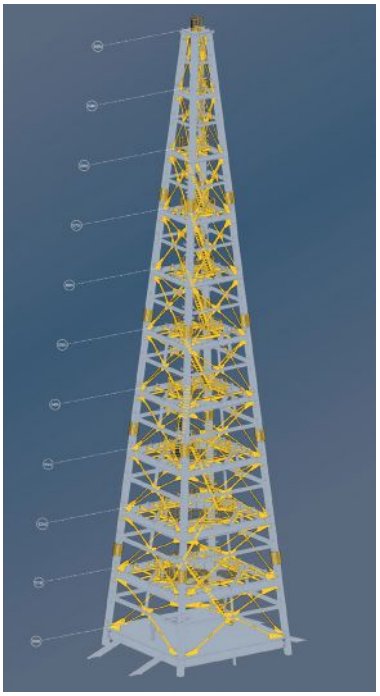
(Early in the design phase, SHVO and the rest of the design and construction team determined that creating a mock-up of the most constraining existing conditions could provide valuable information to all stakeholders, so Olson Steel constructed a full-scale mock-up of a box column and added a metal panel around the column to simulate the precast column that wraps the building.)

The primary objective was for Olson Steel to confirm the constructability of Degenkolb's plated column splice design. However, the final objective included every stakeholder reviewing and testing install methods, identifying access issues, and serving as a teaching object for all that joined the team after the mock-up phase concluded to understand what was occurring at the top of the spire. The design was confirmed with minor adjustments to some of the weld details, allowing for singled-sided welds for improved access and a system of installation that allowed for partial shop fabrication of some plates. This process also answered a fundamental question about ventilating welding fumes. Because the air intake for the Transamerica Pyramid is in the spire, concerns arose about preventing the smell from reaching tenants. What was determined is that a system of fans could be set up below the welder and use the existing precast column wrap to create a chimney effect for any smell that was created in the welding process. This determination also confirmed ample fresh air was available to the worker, and welding in a respirator was not required. The splice detail sequencing required choreography between the welders and inspectors to pre-heat, weld, cool, inspect and repeat with each of the four preassembled reinforcing plates on each face of the column that would not have been possible to accomplish without the full-scale mock-up.

While the perimeter bracing and column splice strengthening was constructed, the interior floors and ladders in the spire were replaced to improve the usability of the space. The previous interior was merely a steep staircase with minimal landings at each level, and the improved floor is a complete perimeter grating platform so the building engineers can access nearly all the spire. Steep ship ladders were still required between platforms due to the story aspect ratio, and a central opening remains up to floor 56 for a future lift.

The unique shape of the Transamerica Pyramid's spire and the complications that come with working in an existing structure were indicators that complex geometry and detailing would be ever present in the retrofit phase of this project. A specific challenge in the





Transamerica Pyramid modeling was the sloping elements, both new and existing. The primary supporting elements of the pyramid, the perimeter box columns, are sloped in both plan directions at each corner of the spire. The floor-level beams and mid-story wind girts are not on the same sloped plane as the columns, so the retrofit bracing needed to span between the columns and work with or around the mid-story girts. Modeling and connecting these sloping components brought light to the uniqueness of each floor early in the design phase so the engineer could avoid unacceptable structural conflicts in design rather than in the field.

During preconstruction, the design and construction team evaluated the existing conditions to understand the working environment but had not fully captured the existing conditions and layout of the top 10 floors. As a result, the team determined that a point cloud 3D scan would be the best course of action, and Olson Steel hired a third-party surveyor to perform the data collection and model processing. Though the data collected only took a day to capture, the results provided months of valuable data during the design and construction phases.

A detailed 3D model based on the scan, which the team worked with directly in Tekla, helped to identify conflicts early in the process and alter the design as needed. One significant conflict involved the existing façade connections for the louvers and the precast elements with the new braces and gussets. These connections were not apparent on the original drawings but picked up in the 3D scan, and modeling these secondary elements from the beginning allowed the design team to create a retrofit scheme that minimally disturbed the existing structure—an excellent example of how a 3D model can allow the full team to work through a constructability issue before submitting for permit rather than in the field.

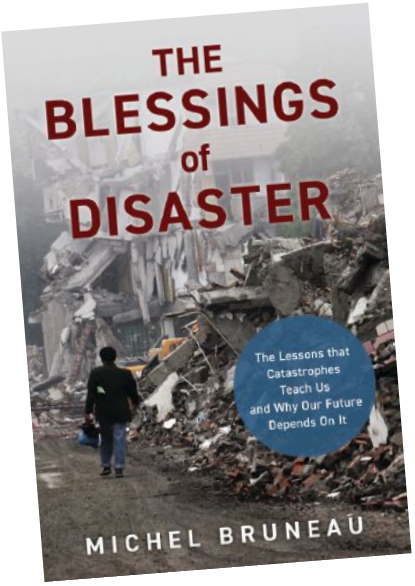
A major constraint for the project was the ability to transport material and tools into the spire. The spire starts as a concrete floor on floor 50 (accessible only by a ship's ladder), floor 49 is a tight mechanical floor, and floor 48 is a future occupant space and is the highest level accessible by elevator. The elevator bank is split into high and low floors, connected at floor 27, and no elevator was large enough to hold some of the longest steel members required for the project. Luckily, the service elevators have a point load capacity of 600 lb, substantially increasing the number of small pieces and reassembly of parts once they reach the spire. The longest piece that could be transported via elevator was 8 ft, and the heaviest was 291 lb. In all, 4,000 individual plate parts and 1,000 new beam, angle, and channel pieces, totaling 95 tons, were transported up through the building to the spire and installed.

On top of all the new construction, the initial purpose of this project was to address the corrosion in the spire. Corrosion can feel overwhelming as the extent and intensity of the damage is rarely visibly apparent. With over 2,500 linear ft of steel in the spire exposed to the elements for nearly 50 years, this could have been a daunting task. But after numerous planning sessions, each member of the design and construction team came together to methodically repair the spire corrosion.

First, the steel surfaces were abated and cleaned. Degenkolb followed, observing and measuring material loss in all areas exhibiting corrosion. Where material loss exceeded allowable values, Degenkolb, Olson Steel, and the other design consultants worked together closely to develop repair details appropriate for each unique site condition.

The ultimate example of this collaboration was the replacement of a full moment frame beam. Initial site investigations did not show the extent of the corrosion found on the westernmost beam at floor 58 of the spire due to an existing platform it was supporting. Once it was cleaned and measured, it became apparent the entire member needed to be replaced. Without derailing the schedule, Degenkolb and Olson Steel coordinated to design and install a temporary framing member above the existing one while the existing corroded beam was removed and replaced.

From corrosion to retrofit and back again, SHVO has been thoughtful and forward-thinking with their desire to preserve and protect this iconic structure. Their willingness to see the benefits of careful planning, full team collaboration, and the use of new technologies saved countless amounts of time and headaches in the long run and resulted in a beautiful update of the Transamerica Pyramid's spire. ■



Learning from Disaster

INTERVIEW BY GEOFF WEISENBERGER

A new book from an AISC Lifetime Achievement Award winner explores disasters and how they can influence improved resiliency in structures.

IS DISASTER EVER A BLESSING?

On the surface, perhaps not. But disasters—natural, human-made, or otherwise—can bring attention to a long-overlooked issue and help us do a better job of preparing for the next time it occurs. In the case of buildings, a prominent example is that of a devastating earthquake pushing designers to create buildings that are more capable of withstanding major seismic events.

This is the theme of a new book by Michel Bruneau, *The Blessings of Disaster*. Bruneau, a SUNY Distinguished Professor in the Department of Civil, Structural and Environmental Engineering at the University at Buffalo and the recipient of the 2019 AISC Lifetime Achievement Award, is known for his decades of research on enhancing the performance of steel structures during extreme events, as well as for his pioneering work on the topic of resilience. His new book illustrates how our future successes and failures in dealing with existential threats can be predicted by observing how we currently cope with and react to natural and technological disasters. While written for the general public, it should be of particular interest to structural engineers and others involved with creating today's modern buildings and infrastructure.

A recent conversation with Bruneau provided an overview of the new book and what it tells us, whether directly or indirectly, about the role of steel structures in achieving resilient communities that are less prone to disasters.

In a nutshell, what is the book about?

It tells the very real story of our relationship with disasters and how it can provide insights into our future as a civilization. It includes enough arguments to tickle both optimists and pessimists alike. It brings together and connects knowledge from many disciplines to paint a global picture, it comingles judgment and insights to assess the significance of it all, and it does so in bright colors to keep the reader's mind focused, mixing fictitious examples to make some points and painfully real disaster examples to anchor them with facts. And while this exploration of human nature and society is framed in an informative and entertaining format targeting a general audience, early reviews confirm that the book has enough thought-provoking and debate-igniting ideas for engineers, scientists, and other professionals from many disciplines to also have a blast reading it!

Why is this book important to the construction industry?

If the goal is to achieve a resilient society, then everybody should be aware of the complex factors that make it so difficult for society to prepare against disasters and of the patterns of human nature and technology that will ensure that these disasters will—or will not—repeat themselves.

You mentioned resilience. Can you elaborate?

"Resilience" has become a buzzword. We live in an era where folks have gone as far as advertising some automobiles as being the "most resilient cars"—whatever that could possibly mean. I wouldn't be surprised if resilient refrigerators are next! But resilience is essentially and fundamentally the quality of being able to return quickly to a previous good condition after problems have occurred. The faster the recovery, the more resilient something is. Of course, deeper dives from the normal usually entail longer recoveries too, and thus less resilience.

As such, when referring to anything as being resilient, there first has to be a "baseline" that defines some original condition as a starting point before a disaster. Second, there must be something measurable that is lost and to be recovered, a specific drop of "functionality" at the onset—which can be quite sudden in the case of, say, an earthquake—that is gained back over time as things are repaired and return to normal.

How can steel structures contribute to achieving resilient cities?

Well-designed steel structures that are capable of withstanding extreme events can be repaired more rapidly, thus making them more resilient. Case in point: After the 2011 earthquakes in Christchurch, New Zealand, much of the central business district was demolished, and a new city has emerged in its place. From a structural engineering perspective, the new "heart" of Christchurch is quite different from the old one. Where reinforced concrete buildings once dominated the urban landscape—with almost all multistory buildings relying on concrete frames or walls to resist earthquake shaking—the emerging Christchurch has a variety of structural forms, an extensive amount of steel structures, and a number of structural systems introduced to make the new buildings more seismically resilient. Given the heavily promoted fact that the two tallest steel structures in Christchurch exhibited satisfactory seismic performance and were reopened relatively fast, the perception of many tenants and owners following the Christchurch earthquake has been that steel structures are preferable. This created a massive change in momentum at a time when engineers were looking for solutions that would allow a rapid return to service—by being rapid to repair—while being at a lower cost than other strategies like base isolation.

So it's a simple solution, right?

Unfortunately, no. For example, as stated by the governor of Utah, Spencer Cox, during the kick-off session of the recent 12th National Conference in Earthquake Engineering in Salt Lake City, nobody cares about the work of earthquake engineers–until the earthquake happens. And then everybody cares a lot. Thankfully, when it comes to earthquakes and other hazards, many engineers and other professionals have been silent heroes, investing time and efforts over decades to slowly and progressively create a world that is more resilient to disasters and moving the needle to some degree, one nudge at the time. However, as for all hazards, nothing is as effective as a disaster by itself. It not only moves the needle, but it also puts jet engines on it! A disaster is a truthful and reliable messenger.

Are we doomed?

The answer is in the book. Those who get the urge to jump off a cliff each time they read end-of-the-world stories on the internet may find some comfort in it. But then again, maybe not. ■

You can find The Blessings of Disaster *at any online or in-store book retailer. And to find out more about steel and resiliency (and its counterpart sustainability), check out* ***aisc.org/sustainability****.*

The Three Little Pigs Redux

In the well-known tale *Three Little Pigs*, the first little pig builds a straw hut, and the second one a house of sticks. This is expeditious and leaves plenty of time for frivolous play, as well as to ridicule the third little pig, who labors to build a resilient brick building. And we all know what happens from there. The big, bad wolf shows up and blows away the first two structures, sending the first two pigs scrambling to find refuge in the fortress of the compassionate third little pig. The moral of the story is that hard work pays off and—evidently, at least in this case—that the third little pig is a better engineer.

One of the most important points, but one that is not stated, even though it is at the root of countless decisions, is that if no wolf ever came, the first two pigs would have won, so to speak, with more free time to enjoy life and dollars to spare—which is essentially counter to the lesson underscored by the story. Likewise, when it comes to earthquakes or other extreme events, investments in protection measures may never actually provide any return on investment in the lifetime of the investor if no damaging event occurs. Therein lies the dilemma. As such, at any point in time, depending on circumstances and timing, everybody can be any one of the three little pigs, which makes preventing disasters an uphill battle.

That being said, it remains true that good engineering makes a difference. A steel building designed to resist extreme events—hurricane winds, severe earthquakes, etc.—has a better chance of standing up to any big, bad wolves that nature or humanity can throw at it. And it can be more resilient than the alternatives!

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

Moving at the Speed of Steel

NEED FOR SPEED

At varying scales and every step along the way, speed-related improvements to the steel design and construction process are combining forces to help bring steel projects together faster than ever, now and in the future.

FROM INITIAL CONCEPTION to completion in the field, steel framing systems come together quickly relative to other options.

That's always been the case.

There are plenty of reasons for this, which we do our best to highlight on a monthly basis in *Modern Steel Construction*.

But this month, we're focusing even more on how steel projects can become (and are already getting) even faster.

Introduced in 2019, AISC's Need for Speed (N4S) initiative is intended to recognize, demonstrate, and further encourage efforts to accelerate steel projects—with an overall goal of increasing the speed at which a steel building or bridge can be designed and constructed by 50% by 2025.

But how is the industry making this happen? Gains of this magnitude aren't achieved with the flip of a switch—at least not entirely.

But what if that switch helped stabilize a heavy crane load via a high-flying load-stabilization solution? Or allowed a load to be released hands-free from that crane via remote control? Solutions like this are not only faster but also safer.

Or what if there was a rapidly deployable steel bridge system that could be installed following bridge damage or even on a permanent basis? Or resources to guide you to faster bridge design and fabrication?

Or what if there was a steel grade that reduced welding preheat times?

Or a system that speeds up bolting by employing bolts in areas that were previously inaccessible? (And just imagine if such a product were to be applied to the SpeedCore system!)

Or steel panelized wall and roof systems that can reduce onsite steel-related labor hours by up to 40%?

Or combination design-analysis software that can reduce data input by a quarter and cut results interpretation times in half?

Or systems that can increase fabrication productivity tenfold thanks to automated options that can be applied to nearly every shop process?

Or software that allows you to model stairs up to two to three times faster?

Or a bolted plate connection system that can save six weeks on a major hospital project versus a typical concrete shear wall system?

Or even a simply more streamlined process for ordering steel deck, thanks to a smart, widespread distribution network?

Good news: All of these solutions—and plenty more—already exist and are helping speed steel projects up *today*.

In addition, AISC and its partners are involved in several ongoing research projects exploring options to further increase steel's speed at every corner of the industry. These include leveraging existing power source feedback technology from welding machines to speed up nondestructive testing, developing an accelerated steel flooring system for office and multistory residential buildings, creating floor systems using asymmetric shapes to provide erection speed advantages in project types that have traditionally proved elusive to steel, a crowdsourcing challenge to create faster steel connections, leveraging augmented reality (AR) technology to overlay design elements onto steel shapes in the fabrication shop in an effort to speed up fitting and assembly operations, and ongoing research into the SpeedCore system to optimize it for wind and seismic behavior and fire design, as well as expanding bolting options.

You can learn about all of these accomplishments, opportunities, and initiatives on the following pages. Keep reading to see how AISC and others have been feeling the need for speed—and working to create tangible results.

A Brief (and Recent) History of Steel and Speed

While we've worked to collect dozens of speed-related efforts and successes into one issue, we've also been working to better tell the speed tale regularly over the past couple of years.

- "Teaming Up" in the September 2022 issue tells the story of how an integrated team effort helped bring together a Philadelphia hospital project quickly. In the same issue, "Come Together" highlights another hospital project (in Denver) that took advantage of the SidePlate system to accelerate the erection process.
- "Facilitating Faster Framing" in the August 2022 issue highlights the finalists of AISC's SpeedConnection Challenge. Also in that issue, "No Paint? No Problem" serves as an important reminder about how a significant portion of structural steel framing doesn't need to be painted or primed, thus saving money and time.
- "Faster and Faster" in the June 2022 issue details the expedited erection of 200 Park in San Jose, Calif., which is the second building to incorporate the SpeedCore system.
- The May AISC IDEAS^2 Awards coverage provides a look at SpeedCore's first implementation, Seattle's Rainier Square.
- The April 2022 New Product section highlights several speedy software solutions.
- "Augmented Approach" in the March 2022 issue elaborates on AR and how it can speed up the steel fabrication process.
- "Early Integration" highlights how Qnect software is helping designers create connections faster than ever.
- "Evolutionary Optimization" in the December 2021 issue focuses on a design data tactic that can move projects forward faster. And in that same issue, Jon Magnusson provides his observations on how the engineering profession has consistently accelerated in "The Times, They've Always Been a-Changin'."
- "Against the Wind" in the November 2021 issue focuses on wind design for the SpeedCore system.
- "Nearly 360 Degrees of Separation" in the October 2021 issue features testimonials from early adopters of robotic fabrication equipment.
- "Intuitive Details" in the August 2021 issue demonstrates how factoring in constructability early in the design process can make erectors' jobs easier—and faster. "Coat of Arms" in the same issue focuses on speed successes for KTA-Tator's new headquarters building.
- You can probably guess what "Accelerated Welding: Part Two" in the July 2021 issue, written by welding experts (including Duane Miller) at Lincoln Electric, is about.
- Every part two needs a part one, and the June 2021 issue includes "Accelerated Welding: Part One" as well as "Augmenting Productivity," another AR-focused article.
- "SpeedCore: Seismic Advantages" in the May 2021 issue details seismic considerations and implications for the SpeedCore system.
- "Inside Job" in the April 2021 issue highlights the expansion of Seattle's marquee basketball arena into a stunning, modern venue. "Driving Innovation" in the same issue ponders how the steel industry can elevate its "innovation" status. Also in that issue, "Moving Bridges Forward" details how press-brake-formed tub girders can speed up bridge construction.
- "Super Fast, Super Tall" in the March 2021 issue documents how Manhattan's supertall One Vanderbilt opened early thanks to an innovative connection design and modeling process. "Core Value" in the same issue tells the origin story of SpeedCore.

And don't be fooled. We only started applying the N4S label to articles in the past couple of years. There are countless other examples over the years in *Modern Steel* of how design, fabrication, detailing, erection, and other tactics have helped bring a building together faster than other material options and previous steel projects.

You can find all of these articles in the Archives section at **www.modernsteel.com**.

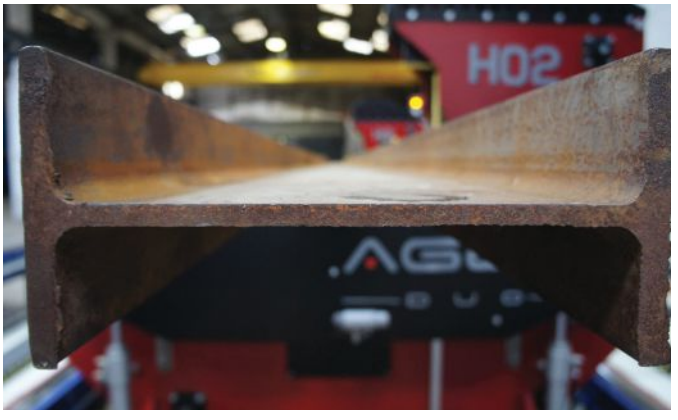
Just Hit "Start"

Finding qualified fitters and welders will become increasingly difficult in the next decade and beyond, thus increasing labor costs for fabrication companies.

There are two major ways for such facilities to become more profitable: increase capacity or reduce costs. Ideally, both can happen at the same time. How? Automation.

Not only does it help with output and budget, but also accuracy, quality, and, most importantly, speed.

It's well known that structural steel fabrication is largely nonrepetitive relative to industries like automotive. Every project or assembly is different. The good news is that it is becoming increasingly easier to weld using robotics. No wait times, no breaks, and no holidays. And while robots are currently limited to simple- to medium-difficulty assemblies, shops can continue to produce more complex assemblies with existing personnel. This flexible approach also extends to using robots for assembly and assigning all welding to shop personnel, or delegating assembly to a day shift and welding to a night shift.

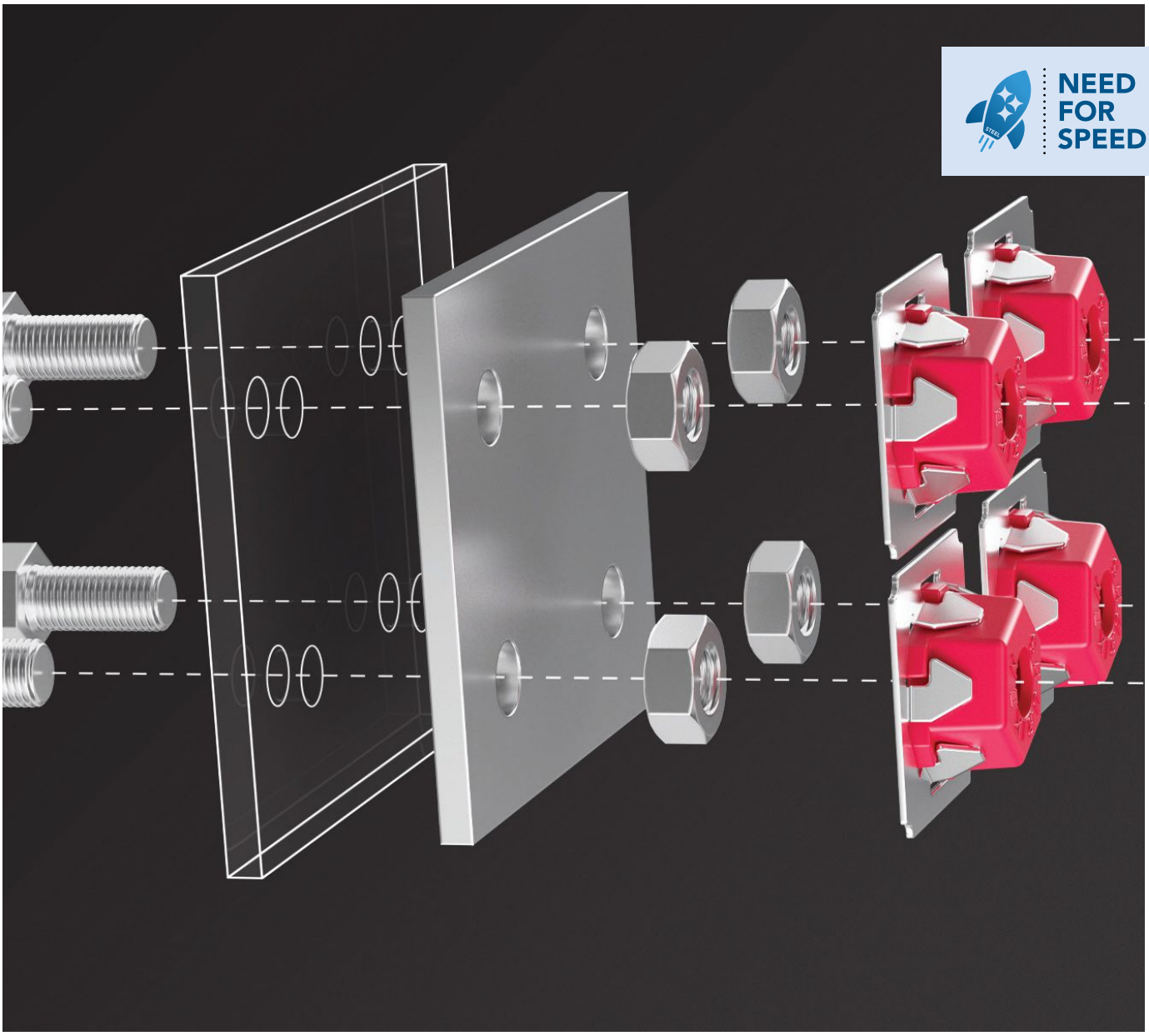


Depending on the size and weight of the assembly, robotic solutions can work up to five times faster while assembling and up to two times faster while welding compared with conventional methods. Considering the ability of lights-out and remote manufacturing, automation makes the difference.

The Abka Automation Robotic Structural Steel Assembler (Agen or Assembly Generator) can help shops be customized to any of these scenarios and fabricate jobs as quickly as possible, turning nonrepetitive production into mass production. The system fully supports SDS2 and Tekla Structures, and work orders, including magnet, tack, and weld positions, are generated automatically with just a few clicks.

The system starts with two industrial robots and can go up to six robots—the more robots, the shorter the time cycle. The robots can assemble and weld parts within a tolerance of 0.05 in, and the base configuration can handle profiles up to 43 in. wide and 39 ft, 4 in. in length. The system's beam rotators can rotate up to 6 tons and allow the robots to reach all sides of an assembly. And with the aid of infeed and outfeed conveyors, just one operator is adequate to fill a full shift. Just hit "Start" and let the robots do the work.

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



Bolt where You Can't Reach

Bolting is faster than field welding; that's not news.

But until now, if you couldn't reach it, you couldn't bolt it. Atlas' Shuriken™ bolted connections change that with a built-in wrench that lets you bolt where you can't reach, eliminating field welds, reducing the number of inspections, and shortening schedules. Originally developed to simplify and speed up HSS splices, Shuriken can save time and reduce costs wherever connection access is tight.

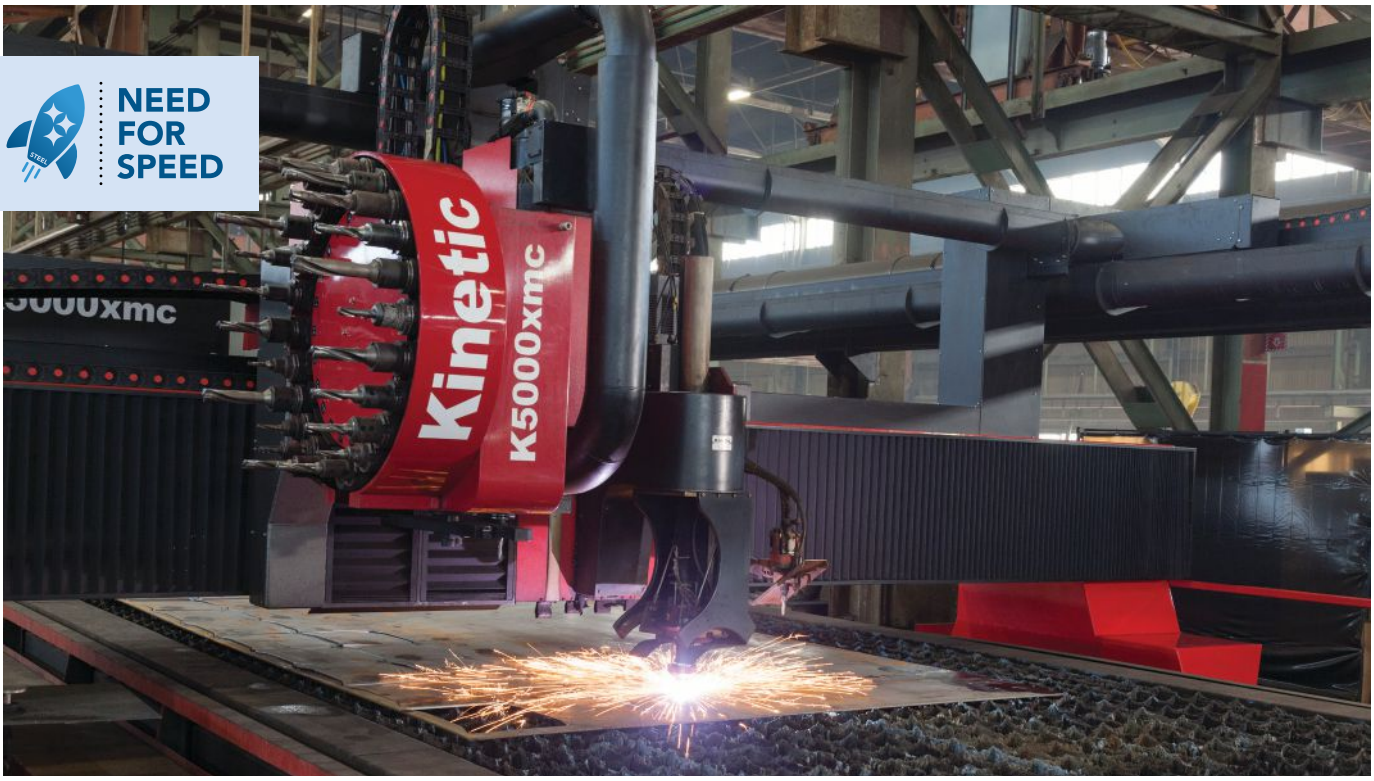
So how does it work? Shuriken is installed in the shop with tack welds and holds a standard nut in place on the back side of a bolt hole. Standard A325 and A490 bolts are then installed from the accessible side in the field. Shuriken is flexible enough to maintain installation tolerances, yet robust enough to handle the torque from pretensioning A490 bolts. The use of standard hardware also means design values come straight from the AISC *Steel Construction Manual* (**aisc.org/manual**).

No application exemplifies Shuriken's potential to accelerate steel construction better than SpeedCore, the most exciting new system in building construction today, with the proven ability to cut months from high-rise schedules. But in the absence of an economical one-sided bolting solution, SpeedCore projects have traditionally required miles of field welds. If the Shuriken system were to be implemented on a SpeedCore project, it could eliminate these time-consuming and labor-intensive welds by allowing builders to easily install high-strength bolts from one side. It's a simple and cost-effective possibility for further accelerating SpeedCore erection and expanding its applicability to more projects.

Just as field welding pops up in all sorts of applications, so do the opportunities to eliminate it with Shuriken. Whether it's HSS connections, new framing against an existing wall, a tightly spaced pair of beams, or an architecturally exposed detail, Shuriken enables field-bolted connections with less labor and simpler inspection.

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

NEED FOR SPEED



Single Setup Solution

In today's fast-paced economy, fabrication shops and equipment makers are forced to maximize every dollar—and every minute. That's why it is important to invest in a machine that does more than just cut plate. Kinetic's all-in-one CNC plasma-cutting systems are designed to help businesses maximize profitability and productivity by helping them find ways to boost output, save time, and save money.

By combining plasma and oxy-cutting technology with vertical machining functions, Kinetic machines perform multiple processes in a single setup, eliminate moving work in progress between stations, and reduce labor needs. In fact, these machines can save time from start to finish—and they just might mean the difference between keeping up and getting ahead.

Work faster with multiple processes in a single setup. Businesses that are looking to save time can benefit from a plasma-cutting system that performs multiple processes in a single setup. Kinetic CNC plasma-cutting machines with integrated cutting, milling, and drilling capabilities eliminate the need to move workpieces from station to station, allowing fabricators to drastically reduce the amount of time and handling it takes to complete a run of parts. In fact, engineering time studies have shown a 95% reduction in time to fabricate a part using Kinetic's combination machines.

Speed up production with automated part unloading. Busy fabricators and OEMs benefit from plasma-cutting systems that save time by processing plate *faster*. With automated part unloading, Kinetic plasma-cutting machines can unload and organize parts based on a specific part number or work order number. They can also select individual parts from a group nested in a single sheet—and then sort them onto pallets based on different criteria. This automation allows Kinetic machines to cut at one end of the table while unloading at the other and produce parts with minimal downtime.

Save money with reduced labor hours. When a shop's technicians can rely on a machine to do more on its own, the business can reduce its labor needs. With part marking, cutting, milling, drilling, tapping, and more, a Kinetic machine can form multiple fabrication processes in one step and save businesses time and labor. Not only can it eliminate or reduce the time and labor needed to move parts for downstream processes, but it can also reduce the labor hours needed to clean and service machines, thanks to its automatic chip, dross, and waste collection and coolant recycling.

A smarter, faster investment. When it comes to investing in a new combination plasma-cutting, milling, and drilling machine, the right device will ultimately save your business time and boost your bottom line without slowing it down. Thanks to a variety of time-saving and productivity-enhancing features, including automated part unloading, easy-to-use software, better workflows, and the ability to perform multiple processes in a single setup, Kinetic machines can help you save time, reduce labor hours, and ramp up production.

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

NEED FOR SPEED

Reduced Preheat Times, Increased Project Speed

The steel construction industry is becoming increasingly comfortable using ASTM A913 high-strength structural steel (recently branded as Aeos™ by Nucor) for its ability to support larger loads with less material. However, an often-overlooked attribute of Aeos—one that is directly beneficial to the structural fabrication community—is the weld preheat reduction inherent to ASTM A913 steel, which can result in time, material, and energy savings. As an approved base metal, grades 50, 65, and 70 are classified as Category D materials meeting prequalified preheat requirements per AWS D1.1, when a minimum base material temperature of 32 °F is met and appropriate weld filler materials are used. This weld preheat reduction was capitalized upon by AISC member fabricator Cives Midwest when fabricating the structural steel elements on the Salesforce Tower project in Chicago. Cives team members noted that they were able to realize a preheat time savings of between one to three hours per joint when splicing Aeos grade 65 members together. This resulted in significant overall time savings both in their shop and on the jobsite. Nucor is proud to announce its new *Aeos Welding Guideline*, which will prove to be a reliable resource for the fabrication, design, and construction community when questions arise regarding welding process, filler materials, and preheat requirements for Aeos. To get your copy of the new guideline, visit **nucor.com/aeos-welding-guidelines** or use the QR code below.

In addition, as Nucor's new plate mill in Brandenburg, Ky., comes online in late 2022, trials will begin to produce ASTM A1066 grade plate material. It is anticipated that this grade will show similar higher strength and weldability properties to the wide-flange ASTM A913 product. This one-two punch of high-performance beam and plate materials will give designers and fabricators two new innovative tools to push the steel industry forward faster than ever before.

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

NEED FOR SPEED

Build and—when Needed—Repair Quickly

There are numerous conflicting demands when designing and constructing buildings in regions with the potential for significant seismic activity.

The design and construction industries are constantly striving to minimize initial investment while maintaining construction quality and facility operation throughout the life cycle of the structure. This places sustainability at odds with designing and constructing buildings that contribute to a resilient community. Finding a speedy solution that meets sustainability and resilience objectives is ideal.

DuraFuse Frames are newly prequalified, high-ductility steel moment frames that provide speedy fabrication, speedy erection, and speedy repair following a significant seismic event. Full-scale laboratory and shake-table testing has proven the performance and repairability of the connections.

In developing this moment frame connection, the idea was to create an economical structural system without sacrificing critical structural elements. During connection development and testing, fabricators and erectors were engaged to ensure the connection would be easy and quick to fabricate and erect. The field-bolted connection eliminates field welding and the associated inspections.

On a recently erected project in San Diego, the steel erector indicated that the DuraFuse connections were the "most erector-friendly moment connections" they had ever used. One additional erection benefit is that DuraFuse Frames do not require seismic lateral bracing. This reduces the number of bottom flange brace points by about 70% on typical projects, contributing further to reduced cost and time of fabrication and erection.

The speediness of DuraFuse does not stop at the frame's topping out. The inherent repairability adds another dimension to the speed benefits. DuraFuse connection design focuses the damage from a significant seismic event into a bottom flange fuse plate rather than the beam. The combination of the bottom flange location and the bolted connection makes the post-event repairs drastically simpler. Simply unbolt the damaged fuse plate and replace it with a new one. Independent research indicates at least a 60% reduction in post-event repair time and cost (FEMA P-58 methodology) following a major earthquake.

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

NEED FOR SPEED

Far Reach, Fast Delivery

Columbia Safety and Supply, an outfitter of fall protection, safety equipment, and gear for at-height workers, accelerates the purchasing process through its online Columbia Safety PRO platform. The system empowers customers to seamlessly integrate management, accounting, and procurement needs into a single easy-to-use system.

PRO's robust purchasing approval system allows companies to set up purchasing controls based on their policies and lets them create and schedule custom reports, monitor purchasing trends, uncover cost-saving opportunities, identify process inefficiencies, and control employee spending. And the company's national distribution footprint means that for 91% of the U.S., orders can be delivered in two days or less.

For more information, visit **colsafety.com/iron-steel-construction**.

NEED FOR SPEED

Direct Tension = Faster Tightening

Want to speed up bolting installation? Applied Bolting's direct-tension indicators (DTIs) can help.

DuraSquirt® DTIs reduce bolting installation, marking, and inspection to a single-step process by following Section 2.12 of the *RCSC Specification*. Each bolt is tightened until the orange indication media is expelled, letting the installer know that the operation is complete. There is no need for checking the wrench's calibration or hash marking, such as when using the turn-of-nut, or harried installation before the fastener's lubrication deteriorates, as with twist-off bolts.

One testimonial, from a Canadian mod yard, indicated that DuraSquirt DTIs are four times faster than a comparable turn-of-nut operation. Another, from a New York bridge project, relayed that instead of going with a turn-of-nut option on a bridge project, where tightening 12 bolts took 11.5 minutes, they could tighten 12 DuraSquirt bolts in just 2.5 minutes.

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

NEED FOR SPEED

Ordering Overhaul

AISC member service center Infra-Metals is leading the industry with technology solutions that not only enhance the customer experience but also improve the bottom line and accelerate projects.

We have long been invested in continuous process improvement both in our distribution centers and digital environments, and we bring value to the often-overlooked procurement life cycle through data integration. Our approach focuses on two areas: producing electronic information and delivering that information.

Infra-Metals has integrated the ability to import a customer's project files into our ERP system using several file types, the most notable being SteelXML. With the integration of SteelXML, whether you're a fabricator, supplier, or software vendor, you will incorporate a standardized file format designed to facilitate the entire process of buying and selling steel. Our inventory management and sales tools allow us to import a request for quotation, determine the best use of purchasable sizes and lengths, and respond to the request in minutes rather than hours, all while virtually eliminating human error and reducing material waste. Furthermore, SteelXML has many other opportunities to exchange information, such as purchase orders, mill test reports, advanced shipping notices, and invoices.

In addition to supporting files using SteelXML, we also have the ability to import many other file types, including KSS and CAD drawing files. We employ the latest processing equipment and staff that can import and optimize your drawing file directly to our machinery in any of our locations across the country.

To effectively deliver this transactional information, we rely on our customer portal, a customized resource for all things pertaining to orders, designed to provide real-time information and save customers time and money. The portal allows users access to open orders, purchases, shipments, mill test reports, LEED documentation, and account information from a browser. Customers can search for documentation, including mill test reports, dating back years. We've found that our online portal serves as a personal filing cabinet as many customers elect to only download mill test reports as needed.

Looking toward the future, Infra-Metals strives to keep pace in this ever-changing digital world—and rest assured, there is more to come.

For more information, visit **www.infra-metals.com**.

NEED FOR SPEED

Lightning-Fast Layout

The Lightning Rail® Automated Layout System from Automated Layout Technology, LLC™, uses a simple DXF file exported from a fabricator's detailing/design software to eliminate the countless manual labor hours involved in laying out handrails, stair stringers, trusses, and more.

In comparison to traditional methods, the Lightning Rail system will have a handrail drawn on the work surface before your fabricator has their drawings, tape measure, and soapstone in hand to begin the layout process. This results in time savings of an hour or more on every handrail and stair stringer they fabricate—an hour that can then be used for productive, value-added processes. The system also results in a more accurate layout, drastically reducing rework and erection time. In addition, the layout will not move, flicker, shutter, or shake, and fabrication is still performed on a rigid steel frame table. All in all, the combination of time savings, error reduction, and enhanced ergonomics can help reduce handrail and stringer fabrication time by up to 50%.

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

NEED FOR SPEED

Fast Fasteners

The Birmingham Fastener family of companies manufactures standard, non-standard, and custom fasteners and operates the highest volume distribution center of nuts, bolts, and standard fasteners in the U.S.—and is the country's largest distributor of A325 and A490 bolts. In addition to standard manufacturing and distribution, Birmingham Fastener offers state-of-the-art specialty manufacturing capabilities and custom packaging and kitting services.

With current issues in the supply chain, lead times have lengthened significantly for most of the prominent structural bolt manufacturers. Due to Birmingham Fastener's vast inventory levels, we are typically able to offer significant time savings by having the largest structural inventory in the nation.

In recent years, Birmingham Fastener has grown its family of companies to include Atlanta Rod and Manufacturing Inc., K-T Bolt Manufacturing, and Champion Manufacturing. This diversity provides customers with the strategic advantages of certified quality, superior service, and fast delivery.

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

NEED FOR SPEED

Fine-Tuning Shop Processes

Steel Projects offers software solutions that speed up the production process for steel fabricators. Together with our parent company, Ficep, we have developed the "Intelligent Steel Fabrication Concept," which can be partially defined by the following features.

Automatic and advanced integration with detailing software. Doing more than just dealing with traditional DSTV files, the software allows users to manage more advanced formats such as IFC, which include more information that can be used on the shop floor later in the process. For example, including assembly information enables marking parts' locations and IDs on the CNC machines with scribing technology, eliminating the need for operators on fitting stations to measure since all the crucial information is marked directly on the parts—which also helps eliminate errors.

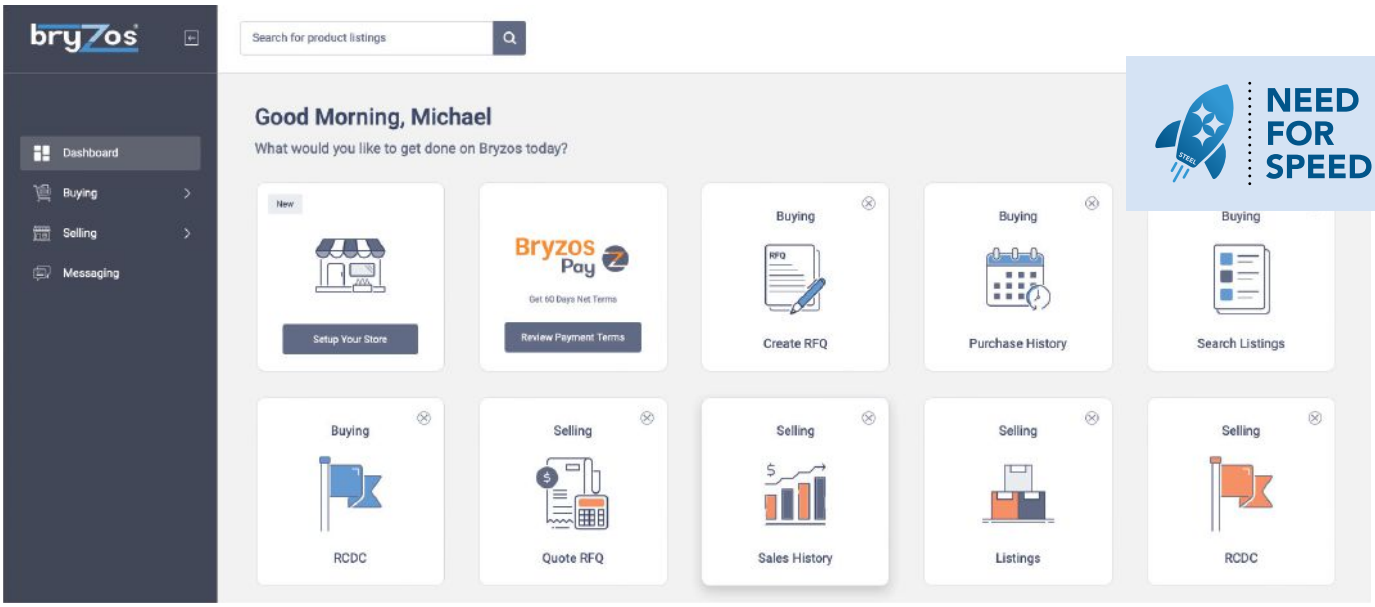
Part checking and validation. After importing drawings that have been designed by the detailing office, the software automatically checks what has to be produced. From here, the software can match the necessary tooling operations with ones that are actually available on the shop floor and automatically flag any mismatch. It will also detect any errors that may have been designed by the detailing office. Only compliant parts are sent to production, saving time dealing with potential errors.

Section and plate nesting. Nesting is performed automatically, rapidly, and according to preferred parameters, allowing fabricators to save significant time and steel on an annual basis. In addition, the beam nesting is designed not only for procurement but also for actual production, meaning complex parts such as haunches can easily be handled. In addition, the plate-nesting engine allows users to maximize sequences—again, saving time.

Automatic CNC data creation (both CNC machines and automatic conveyors). The software automatically creates the required CNC data not only for individual parts but also for automatic conveyors, resulting in a seamless handling process.

Mobile management of manual workstations. The solution features a dedicated mobile application to operate physical workstations that are not automated, such as fitting, welding, or painting. Work orders can be sent digitally to operators, who can input production feedback to track and analyze production later.

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



NEED FOR SPEED

Prompt Purchasing

Bryzos is revolutionizing the way steel buyers and sellers trade online.

The steel-trading software has simply taken the traditional methods of buying and selling—and the processes associated with them—and made them digital. Built on top of time-tested financial technology (fintech) processes, the platform's technology streamlines the buy-sell process, thus creating more value while taking less time. For example, a buyer can submit an RFQ and receive multiple quotes less than two hours later. The full purchase process can take less than 24 hours, from creating an RFQ to receiving quotes to credit approval to finalized purchase. The software uses its BryzosPay aggregator to process cards, ACH, wire transfers, and checks and offers free Net 60 payment terms to its buyers while guaranteeing Net 30 payment to sellers.

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

NEED FOR SPEED

Efficiency through Panelization

The last two years have been a pressure cooker.

In an environment that includes COVID, skilled labor shortages, supply chain problems, and cost challenges, we've all felt a need for solutions that make our efforts better, faster, and more efficient. That need is recognized by construction decision-makers around the world. A recent McKinsey study called *The Next Normal in Construction* shows 60% of executives believe major shifts will occur within our industry in the next five years and claims that "those willing to innovate and disrupt have $265 billion in annual profits awaiting them."

One of the most beneficial improvements in steel construction is panelization, a process designed to increase speed and safety. The term is usually defined as a prefabrication technique that allows for the offsite assembly of wall panels or roof panels in a controlled manufacturing environment. The finished panels are then shipped to the building site for installation.

BZI (Building Zone Industries) is taking panelization further. We use onsite assembly to mitigate the costs of freight that are incurred with offsite work, which drives a faster and safer manufacturing assembly production workflow. Most importantly, our panelization innovations and process improvements significantly reduce the amount of aerial time on a project, effectively engineering out fall hazards associated with roof, floor, and wall installation.

We have developed specialized equipment that improves the panelization process, enabling onsite production and efficiency gains—all while improving project delivery timelines, safety, and financial risk. Here are three of our patented innovations:

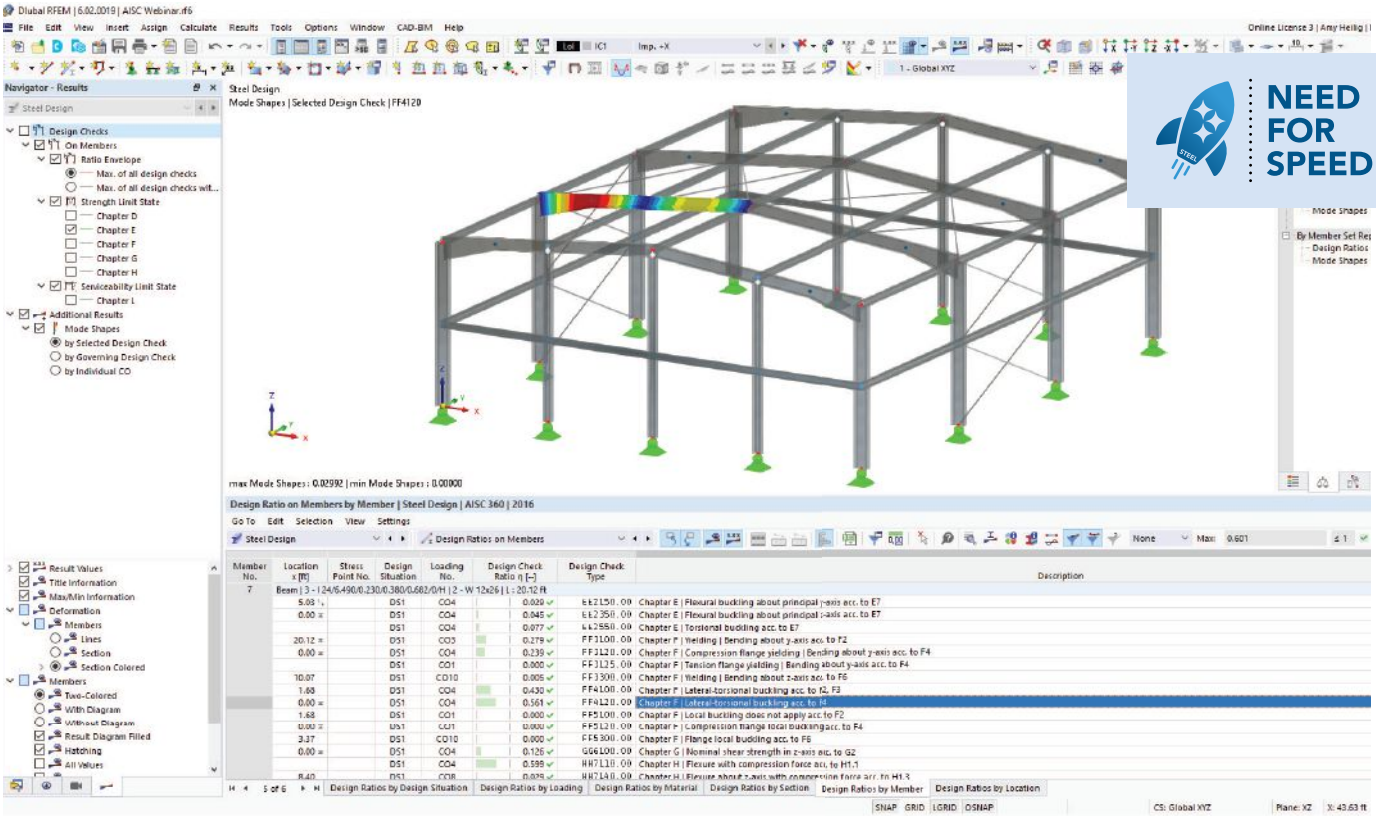
Panel Table. Consists of two work platforms below 6 ft that allow workers to quickly assemble wall and roof panels on the ground. These modules can then be transported or lifted into place to complete the structure. A self-contained unit while in transport or stow mode, the Panel Table system is much safer than working in the air and can be deployed anywhere in the nation.

MezzMaster. With the panelizing activity completed at the table and ready to be placed within the building structure, the MezzMaster enables teams to safely lift and install completed wall or roof panels directly from the table—rather than assembling them in the air, one piece at a time—providing faster results while increasing safety.

Wall Master. The Wall Master builds on our existing panelizing technology and processes to handle and transport large wall panel assemblies from the table to their wall installation locations.

With these panelization technologies, we have reduced onsite labor hours by up to 40% and are continuing to make improvements daily in terms of design, delivery, and safety.

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



NEED FOR SPEED

Analysis + Design = Speed

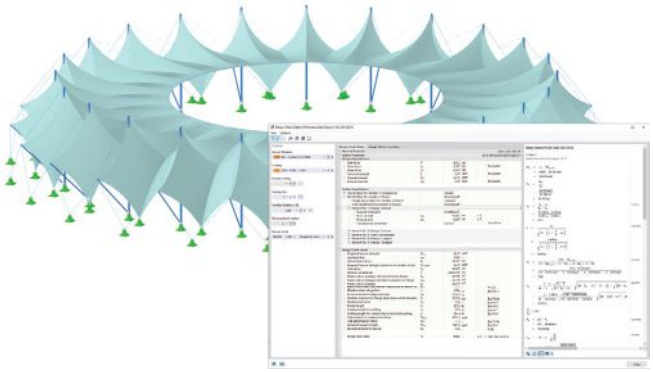
Dlubal's recently released RFEM 6, along with the Steel Design add-on, is a 3D finite element analysis (FEA) program that combines steel analysis and design into a single workflow. This new version uses the computer's multi-core processor to simultaneously solve hundreds of load combinations for an efficient calculation process, potentially cutting design and analysis times in half.

Incorrect input for a member's unbraced length considering flexural buckling, torsional buckling, and lateral torsional buckling could drastically affect the design output. While this information is rather straightforward for cantilevers or simply supported members, many members fall outside these simple applications.

RFEM 6 can automatically detect intersecting nodes along the member length. At each node is the ability to set intermediate restraints based on four independent degrees of freedom (DOFs), including eccentricity options for top or bottom flange bracing only. These settings will directly calculate the unbraced lengths for the member stability checks. The assigned intermediate restraints are also graphically displayed along the member for clarity.

AISC's Direct Analysis Method requirements, such as member stiffness reduction, are automatically calculated and applied based on the member's axial force and provisions for slender vs. non-slender sections. Member imperfections such as out-of-plumbness or out-of-straightness can also be included in all analysis conditions.

The RFEM steel design results include detailed output such as all variables, formulas, and code references directly from the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360, **aisc.org/specifications**) used in the calculation. These detailed results provided in RFEM can be efficiently and easily followed for transparency avoiding the "black box" methodology. Additionally, the table result output includes all applicable chapters from the AISC for each member or member set beyond



displaying only the controlling chapter provisions. Table output can be filtered or directly exported to Microsoft Excel for further postprocessing.

Lastly, the program printout report is completely customizable with default or user-defined template options. Quickly add or delete relevant model data, analysis result information, or design output. Insert external PDFs internally in the report or add photorealistic renderings of the structure geometry or results. The ability to work concurrently in the program is available, with all printout report data and graphics updating in real-time with any model modifications.

The result is a program that can reduce data input by 25% compared to similar packages—and by 50% or more when it comes to results interpretation, since the new version now outputs all design equations, code references, variables, and complete step-by-step formulas, eliminating the need for engineers to go through the results in detail and trying to determine how the program came up with the values.

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

NEED FOR SPEED

Boosting Barcoding

Working towards the goal of increasing the speed at which a steel project can be fabricated and erected, P2 Programs' newest product, STSX, is revolutionizing the steel industry!

STSX provides fabricators, painters, galvanizers, and erectors with extreme mobility in barcoding using phones, tablets, and other devices. STSX is a web-based application that brings instant, real-time tracking information to your fingertips to significantly reduce decision-making time.

Barcoding with STSX increases the speed of your existing processes and negates the inefficiencies that have been accepted as standard operating procedure (SOP) for far too long within the steel fabrication industry. The benefit is clear: STSX will improve production by reducing decision-making time and errors while also providing a reduction of needed manpower and manhours. All the above leads to a decrease in hours and an increase in productivity.

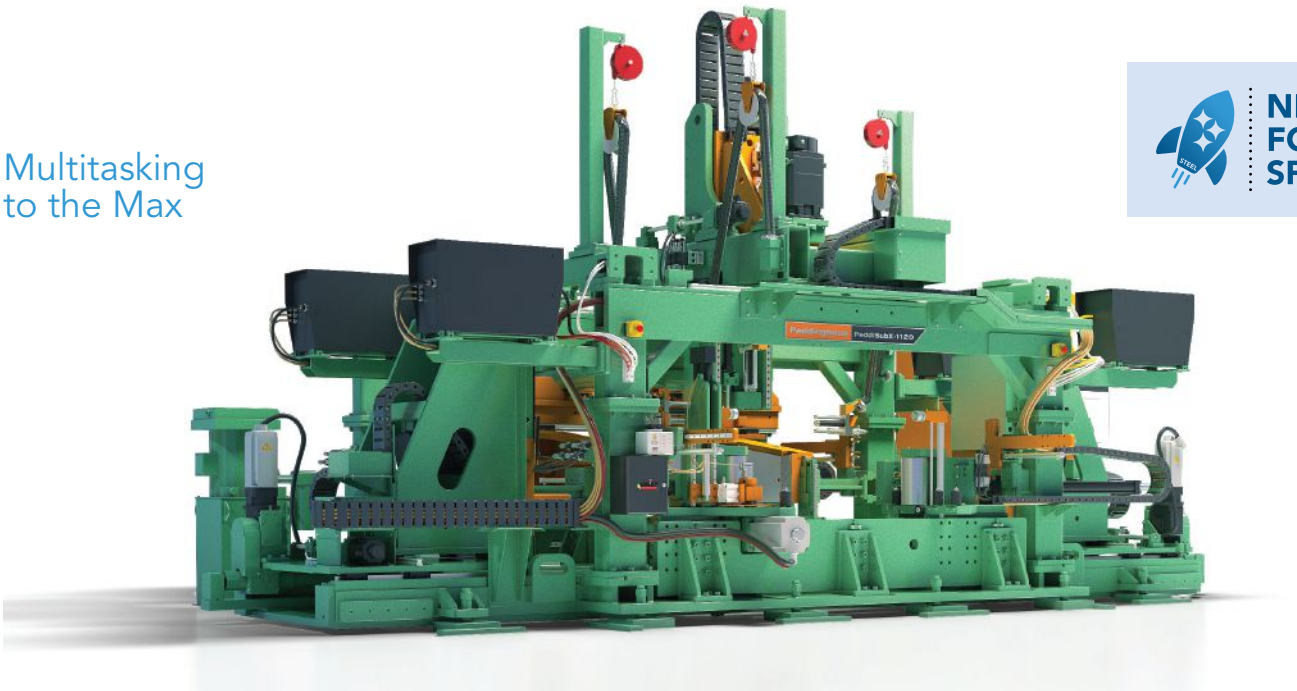
Starting with your raw material inventory, STSX can help you with the receipt of that material, its heat traceability, and its location in the yard. The speed at which you can process a cut list with full heat traceability from the raw material to the final piece mark is unmatched. When it comes to inventory audits, these become simple and fast. Instead of a biannual or yearly audit of your inventory, it can be accomplished in minutes so you can "audit" sections of your inventory more often. This inventory traceability alone can cut many hours and even days out of the manufacturing process because you now have confidence in your inventory!

We have all experienced delays in trying to determine the location and/or status of a piece mark on the shop floor. Hours are spent looking through paperwork to determine if all the piece marks passed quality control (QC) before being loaded. And what about the hours spent double-checking that the required piece marks made it onto the load? Hours upon hours are spent on these activities and others on a weekly basis.

Using STSX barcoded steel provides for a virtually error-free data collection environment while saving money and employee time with a return on investment of approximately one year.

For more information, visit **www.p2programs.com**.

Multitasking to the Max



What motivates a steel fabricator who's already heavily vested in current machine technologies to invest in a new fabrication system that promises unlimited potential?

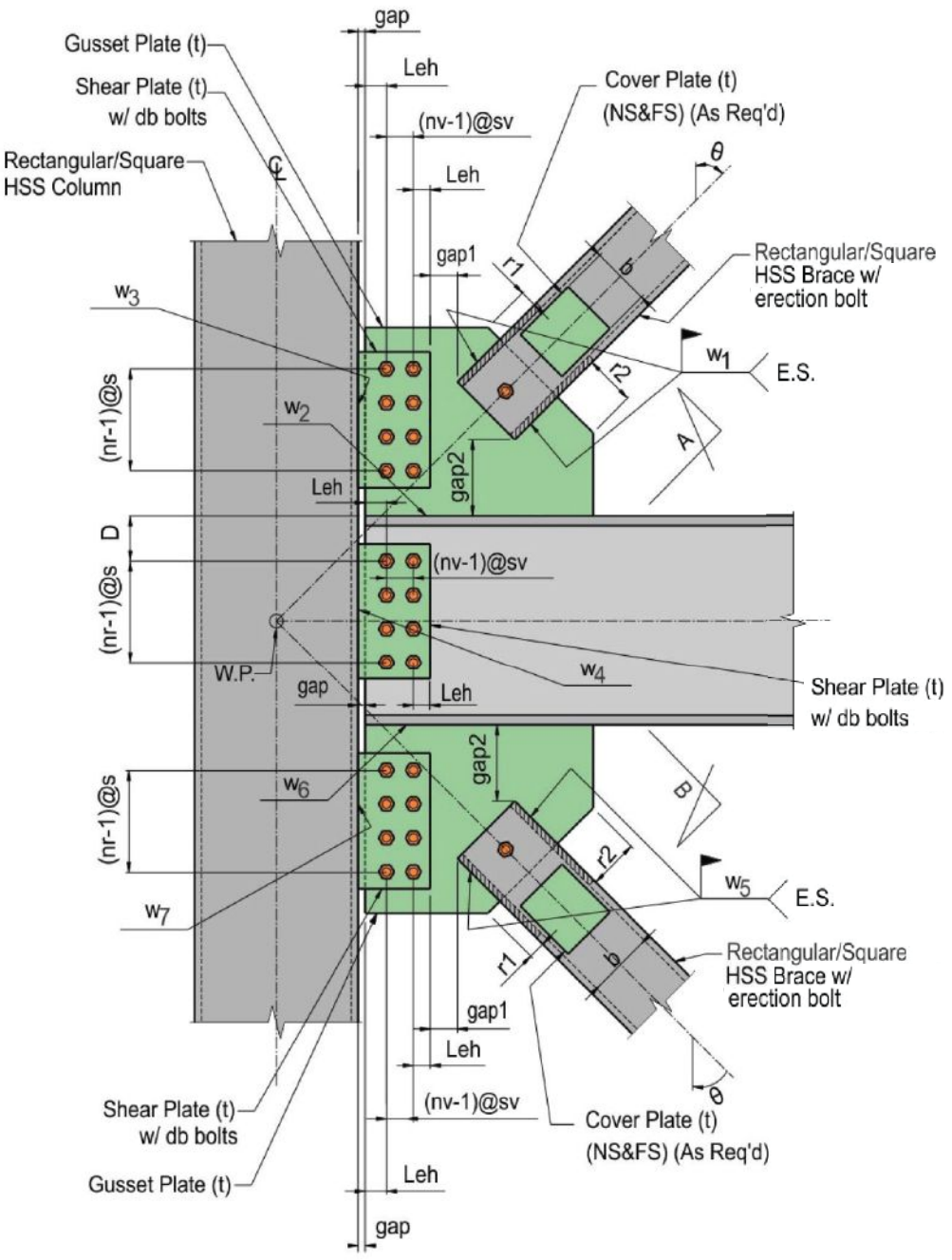
When you can process holes, copes, flange thins, weld preps, rat holes, plasma marks, scribes, and even tool changes simultaneously, there's no going back. Meet the machine that does it all, the PeddiSubX-1120.

The PeddiSubX-1120 takes on the challenge of efficiency by using independent Sub-X axis spindle movement and powerful carbide technology to maintain speed and accuracy throughout the processing of each piece of material. With each axis operating independently, drilling and milling functions can be performed simultaneously at triple the speed of average drill lines. By rapidly decreasing the time it takes to process profiles, steel fabricators are able to keep production timetables far ahead of schedule.

Next to accuracy, speed is one of the most important conditions in the steel industry. The sheer speed of the PeddiSubX-1120 has rewritten the book on innovation. Imagine processing a beam with milled block copes on both flanges in just 90 seconds without any rework or touching a grinder. By eliminating the need for grinding or any other type of post-processing, employees are freed up for other processes, and profits are maximized. No other beam drill line can complete drilling, milling, coping, and layout marking within an impressive $19^{11}/_{16}$-in. operating window in a matter of seconds.

For more information and to watch the PeddiSubX-1120 in action, visit **www.peddinghaus.com/videos**.

NEED FOR SPEED



Cutting Connection Time

It's no secret that the world is moving faster than ever, and the construction industry is no exception.

At Giza, we've developed a connection design software package that streamlines the design process by as much as 80%. It supports countless connections as well as full Tekla integration, which makes it a popular choice among steel detailers and engineers. We've also found that fabricators enjoy using our software to aid with the estimation process.

With accurate calculations and automatic joint remodeling, the software eliminates common errors and oversight and delivers clear and efficient results in record time. If your connection isn't working, Giza will not only tell you that the connection failed but will automatically offer solutions to fix the issue—even for the most complex connections.

Recently, we added a revolutionary function that allows connection designers to build a personal library of connections. Once shared with the detailer, the connections can be uploaded directly into the project model. Time is no longer spent creating sketches and tables to send to the detailer.

Most users find that connection design is completed in half the time they'd normally spend on calculations. Brittani Cahill, PE, with Keystone Structural Solutions shares, "I've designed extended shear tabs both by hand and with Giza, and Giza might save me 25% or 50% of my time than doing it by hand. There are other connections that I save 400% time by using Giza."

As industry professionals, we understand that saving time on the front end during the design process translates to faster builds and a quicker ROI for all stakeholders. That's why we are dedicated to developing and maintaining this connection design software that's proven to speed up the connection design process and increase accuracy. We regularly add new connections and features to our software, and we have a dedicated development team that updates and maintains our software.

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

NEED FOR SPEED

Streamlining Ordering and Production

Gerdau is working to advance the speed of steel with new digital tools to streamline the purchasing process as well as operational improvements at the mill level.

Earlier this year, we introduced the Quick Quote Tool, which eliminates the burden of converting an advanced bill of materials (ABM) into mill orders for fabricators across North America. It allows customers to better use their time by not having to check rolling schedules/inventory availability or adjust material lists to meet mill requirements. By simply uploading an ABM into the tool (combined or uncombined), customers quickly receive a proposal with the best available options to meet their needs. After choosing between options, a quote is immediately generated, allowing the customer to place an order in record time.

The idea is to disrupt the current purchasing approach, bringing the burden of making production decisions back to the mill and streamlining the buying process while presenting new supply options.

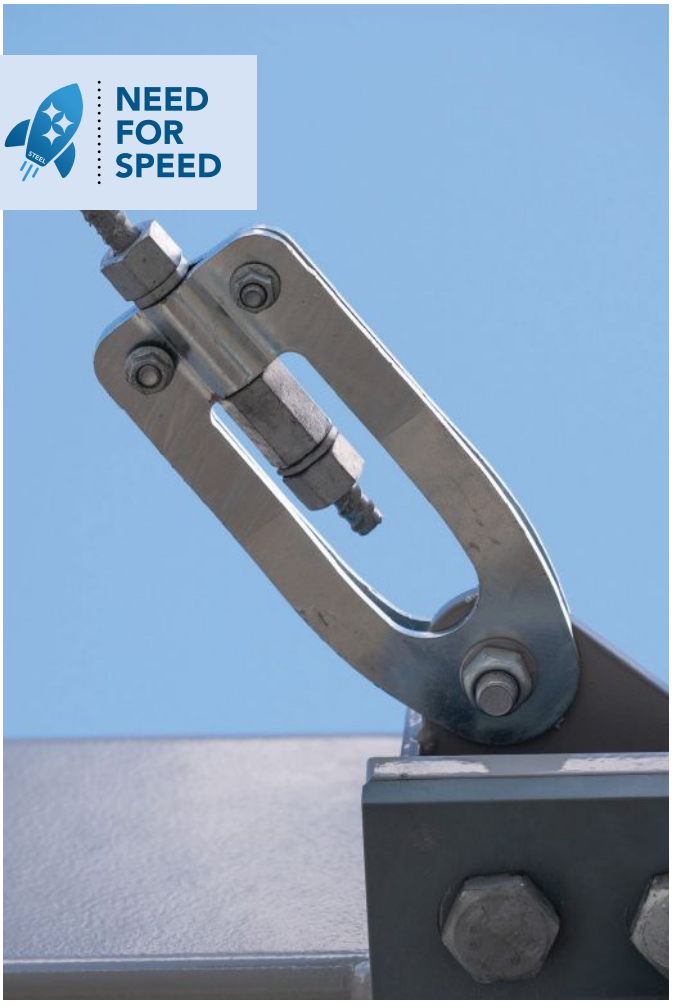
Gerdau recently announced a $55 million project at our structural mill in Midlothian, Texas, which will allow for an increase in EAF heat size, providing productivity, time, and efficiency improvements. The EAF heat size project is the next stage in Gerdau's optimization of the Midlothian mill, which, through a series of investments, will expand product offerings, modernize the melt shop and rolling mills, improve efficiencies, and increase crude steel production capacity.

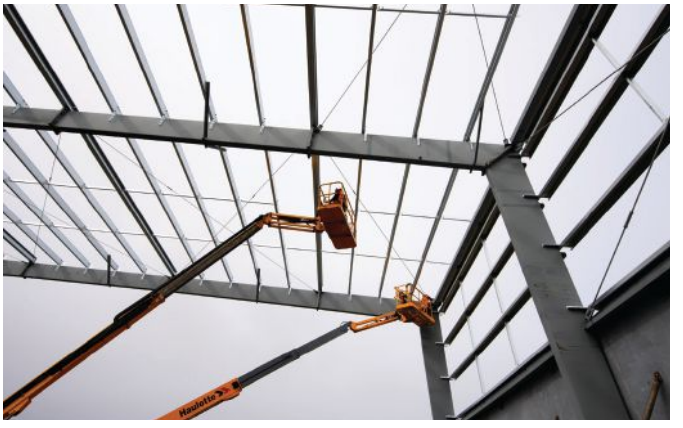
In addition, we recently completed significant rolling mill upgrades at our structural mills in Petersburg, Va., and Cartersville, Ga. The Petersburg project involved a variety of upgrades, including the installation of two additional rougher stands. The Cartersville project enhanced the location's beam range, adding flexibility between Gerdau's structural steel mills.

These complementary projects were designed to improve capacity, productivity, and product offerings, providing customers with greater flexibility and reliability from Gerdau's network of mills and supporting more efficient project completion.

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

NEED FOR SPEED





Bracing for Faster Erection

Building a more efficient future starts with incremental improvements across every element of the building process. Donovan Group looked for a better solution to bracing that would offer material, time, and cost efficiencies.

Bracing can absorb hours of precious time to specify and install. The standard bracing process requires a new set of specifications for every build. Manufacturers then produce unique frames for the building, and installers organize on-site fabrication, welding, and painting to prepare the system for erection. As an essential part of the building process, any hiccups along the way can cause costly project delays.

As a construction company with over 60 years of experience, Donovan Group saw the opportunity to speed up this process by creating an off-the-shelf bracing system. Starting with our own building projects, we engineered a more lightweight, efficient system: DonoBrace.

Developed to provide high-capacity bracing for metal buildings, the system is a compliant, tension-only rod brace designed for a more streamlined process from planning to installation. We've created comprehensive documentation for multiple sizes of DonoBrace, each with known and extensively tested capacities and properties. Structural engineers simply select and place the preferred DonoBrace size into structural drawings using compatible drafting software. The system comes with the learning curve associated with any new product. However, once a structural engineer becomes familiar with it, they can use it to finalize a structure's bracing in just a few minutes.

As an off-the-shelf system, DonoBrace is the same product every time. Typical bracing systems require multiple transits to prepare the system for installation, including welding and painting, but DonoBrace has cut out these stages for a time-efficient process on-site.

While developing DonoBrace, we worked closely with erectors and builders to make the system as user-friendly as possible. Bracing kits are packaged in separate bags with a full installation guide to help facilitate quick assembly, and the system is designed without large rigid lengths of steel for easy handling. Installers simply cut the lengths to size.

Unlike most bracing systems, installing DonoBrace doesn't require complex temporary bracing to achieve plumb framing. Using direct-action tension, a rod is connected through the DonoBrace and then tightened to pull the portal legs to a square position. This avoids having to rework or cut the bracing length if the portal legs are slightly off-plumb at the time of installation. DonoBrace can also be tensioned from just one side, making it a single-person effort. While most bracing methods require four to five installers, DonoBrace typically requires just two, and implementing it can be up to 30% to 50% faster when compared to a conventional bracing system. In addition, installing DonoBrace does not require temporary bracing.

For more information, visit **donovangroup.com/donobrace-system**.

Double Dragon

The newest version of the Bend-Tech Dragon A400 CNC plasma tube- and pipe-cutting machine is doing double time.

For many customers, the production efficiency of the Dragon is twice as fast (or even faster) than their previous process. Most Dragon customers see a return on their investment around 12 months after delivery, with some as early as their first project; all are able to eliminate production bottlenecks.

NEED FOR SPEED

Its powerful CAD/CAM software makes it easy to import and design single parts or full assemblies, and the Tekla and SDS2 plugin makes for a seamless transfer of full building design files between those programs and the machine.

For more information, visit **www.bend-tech.com**.

Easy Maneuverability Leads to Easy Time Savings

Charles "Papa Charlie" Capone began fabricating ornamental iron in 1956 as a side business to support his family of six in Winthrop, Mass. What started over 60 years ago as a way to bolster his family's financial security would grow into an American success story leading to the modern-day Capone Iron Corporation (an AISC member fabricator), led by brothers Stephen and Gary Capone. Located in Rowley, Mass., and Berlin, N.H., the company has gotten a lift in its operations by multi-directional forklifts known within the company as "Big Bird," "Green Giant," and "Little Sprout"

"We used to beat up our warehouse with straight mast forklifts," said Stephen J. Capone, Capone's president. Stephen and his three brothers grew up in the world of steel fabrication and understand the need for safety, quality, and efficiency. As president of the company, Stephen is tasked with continuous improvement. His search for better ways led him to a cornfield in Iowa. There he found a Combilift C26000 parked by the side of a barn for over a year. The Company's first "Green Giant" multi-directional forklift was converted to a C30000 and began a series of improvements for Capone Iron.

Affectionally named by the company's operators, five Combilift forklifts now help provide improved safety, storage space, and productivity for the routine 50,000-lb loads of structural I-beams and columns. Capone points out that Combilift offered its expertise and assisted in planning the design and layout of the yard space. With a push of the button, the forklift operators can turn 90° and 180°.

The results are both measurable and realized daily. "We've cut our operational time by 75%," noted Capone. "What used to take four hours to unload now takes us one hour." As a result of the increased business and operational improvements, the company has ordered its sixth Combilift and looks forward to continued growth and expansion.

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

Integrated for Acceleration

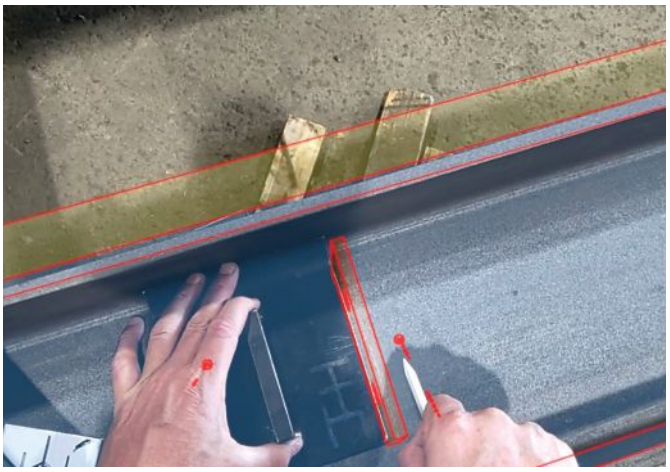
RISA delivers a suite of integrated software design solutions and technical support services that enable structural engineers to quickly and easily model, analyze, and design myriad steel structures.

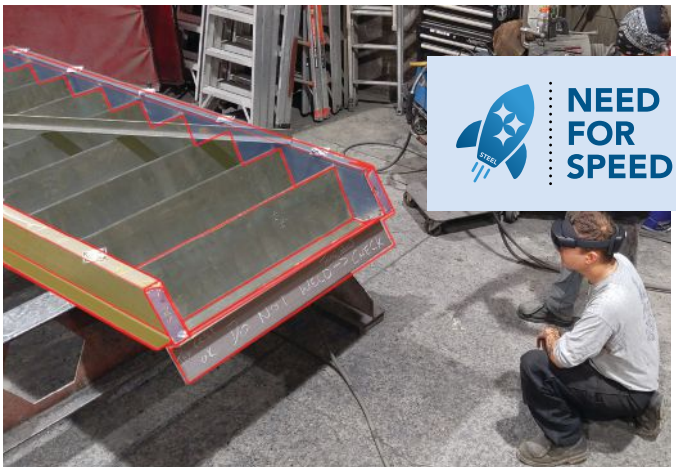
Once main structural components are designed, engineers can directly integrate model information, including member end reactions, with RISAConnection for steel connection design, which features full 3D visualization and expandable reports for every limit state. The integration and efficiency of RISA products is demonstrated in the following customer case studies:

Frozen Fortress by Epiq Structural Solutions. This 30-ft-tall temporary structure sits at the center of an ice-skating rink and includes a spiral staircase in the middle, as well as two 70-ft-long by 6-ft-wide pedestrian bridges that span over the rink. The main structure includes a modular, hot-rolled steel system (HSS and wide-flange) that is designed to be easily erected and then taken apart, shipped, stored, and ready for the next use. RISA-3D's ease of use and superior reporting allowed the project's engineers to accelerate the modeling and analysis of the entire modular structure with specific attention paid to the pedestrian bridges and typical steel connections, which were designed in RISAConnection.

Mobile Stacker Reclaimer by Richmond Engineering Works. The mobile stacker reclaimer uses a rotating bucket wheel to process large amounts of material at port facilities. Due to a large amount of complex geometry, tricky equipment placement, and a tight project schedule, structural steel was used to support the loading conditions as well as the typical operating requirements. The engineering team used RISA-3D to model, analyze, and design the machine's geometry, including a 50-ft cantilever supported by 40-in.-deep tapered steel trusses. Additionally, the software's flexibility allowed for the machine's structure (where the boom sections are effectively "hung," causing the model to be unstable) to be quickly analyzed and designed.

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





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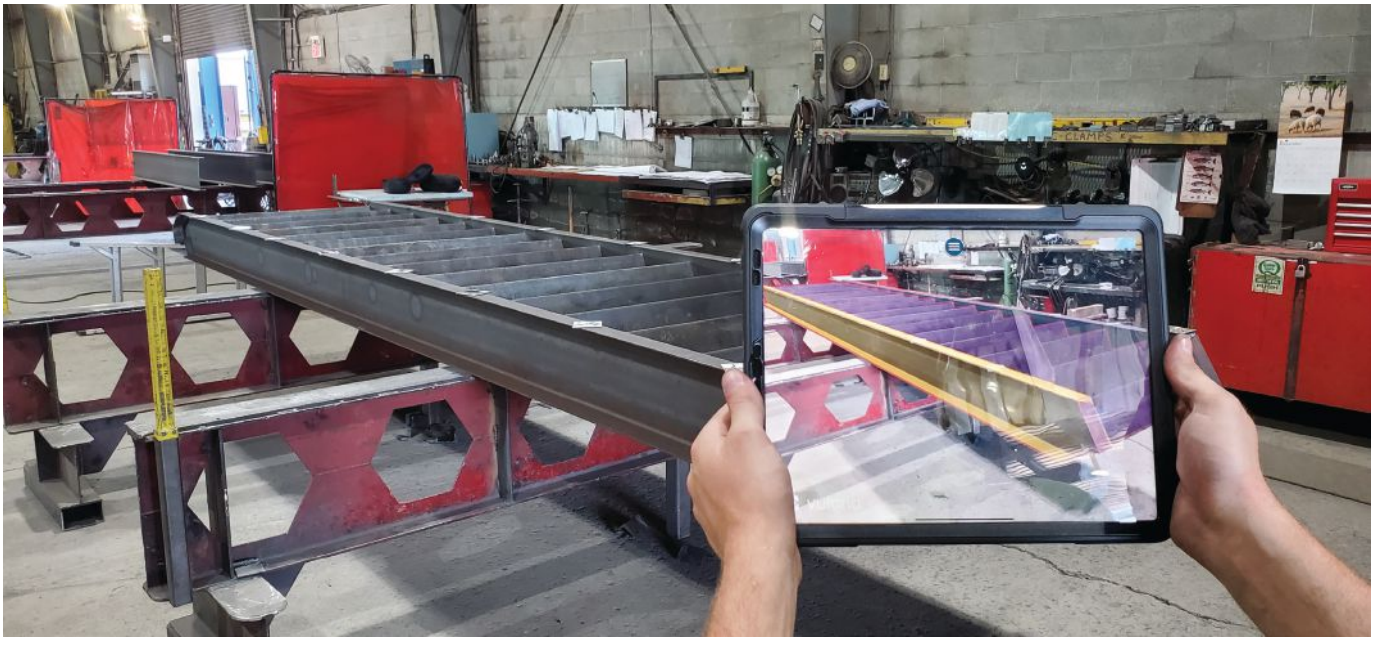


Augmented Reality, Actual Time Savings

What are some of steel construction's low-hanging fruit when it comes to bringing increased efficiency and accuracy to steel fabrication?

Some say automation and machines. This is certainly part of the solution. But others would argue that a bigger push toward BIM collaboration and 3D design will give more clarity on design and better inform stakeholders about potential issues before they become a problem. This is true in the office and in the field, but it is especially true on the production floor.

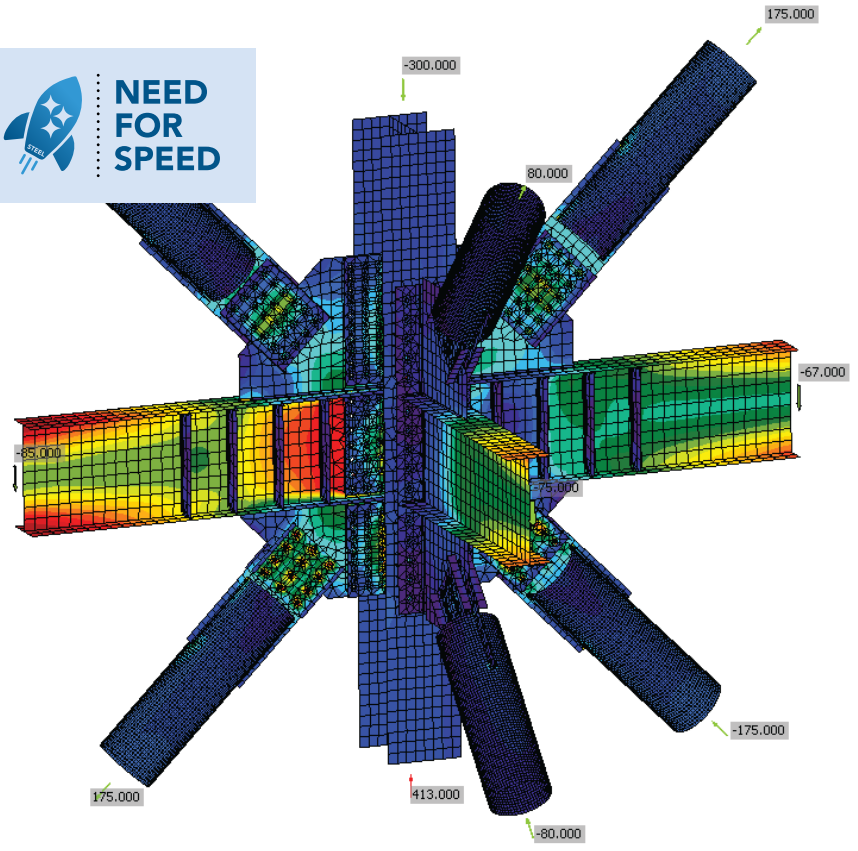
One of steel construction's oldest problems is how to depict steel design accurately and with enough information to be constructable and, more importantly, understandable. 2D drawings have been that method for many years, but it requires years of practice to become proficient at reading them. However, we are starting to see that change with the continued rise of BIM and 3D design.

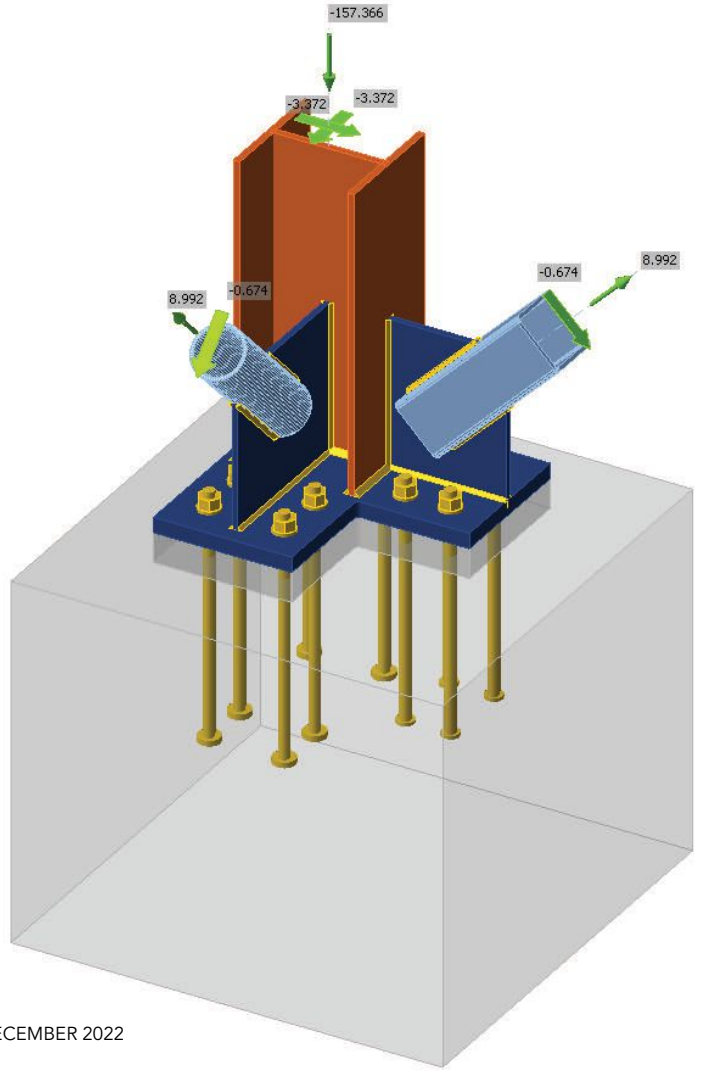
But how do we move 3D models from the office to the plant in a meaningful way? Augmented reality (AR) is the answer. AR offers the potential to take existing 3D design and bring it to the fabricator to use as a 3D drawing or digital template to construct their components from. And yes, this would be an appropriate time to use the words "bringing steel construction into the Industrial metaverse."

Eterio Realities is blazing the trail toward that reality. Through our AR tools, you are not only building exactly what you see, but you are also able to eliminate the guesswork when interpreting 2D drawings. Having complete information at your fingertips and placing parts exactly where they are displayed virtually seems like something far off into the future. However, technology is moving fast, which is making this a reality today.

With an accuracy of $\frac{1}{16}$ in. over 30 ft, Eterio's FabStation-STEEL digital AR overlay system, using Microsoft's HoloLens, is the perfect solution if you want to speed up layout, automate inspections and be able to build from the models that your detailers have created. In addition, we have paired your tablet or smartphone to the HoloLens to make it as easy to use as, say, your smartphone is. Fabricators aren't the only ones to benefit from these tools. The front office is able to see reported production progress and analytics to make informed scheduling decisions and identify problems *before* they are problems, a clear time-saver. In fact, the technology can help achieve up to a 25% reduction in layout time for experienced fabricators—and up to 40% for newer employees—and up to a 50% reduction in QC time.

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





Concentrating on Connections

When it comes to steel connection design, there are many great tools out there to help save engineers' time.

Currently, it only takes about 20% of the overall connection design time to complete 80% of the connections on a project. The other 80% of the connection design time is spent on the remaining 20% of the connections. These are going to be the more complicated connections that typically cannot be designed with the engineer's current toolkit, so they must revert to good old hand calculations or possibly spreadsheets, as well as engineering judgment.

But there is a connection design software package that can quickly manage these more complex connections as well as the simple ones: IDEA StatiCa. What makes IDEA StatiCa different is that it performs finite element analysis (FEA) on the connection, meaning there are no limitations on connection geometry or structural sections. Instead of having to create individual models for each plane of the connection, the software allows you to look at the entire joint at one time and understand how it will behave. We have heard from our users that they are not merely saving hours but rather days on their connection projects. In addition, IDEA StatiCa works with many structural analysis tools (RAM, RISA, TSD, ETABS, etc.) as well as BIM and detailing software packages, allowing designers to easily integrate connection details with an existing model.

As engineers look to meet faster and faster schedules for their projects, some that have previously delegated connection design have started to consider bringing it in-house as an opportunity to speed up the construction administration phase of a project, potentially saving several weeks on a single project. If an engineer that has been working on a project for months or even years were to design the connections prior to the construction documents being released, it could save time in terms of construction administration and also allow fabricators to provide more accurate bids with fewer RFIs.

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

NEED FOR SPEED

Quick is the Name of the Game (and the Frame)

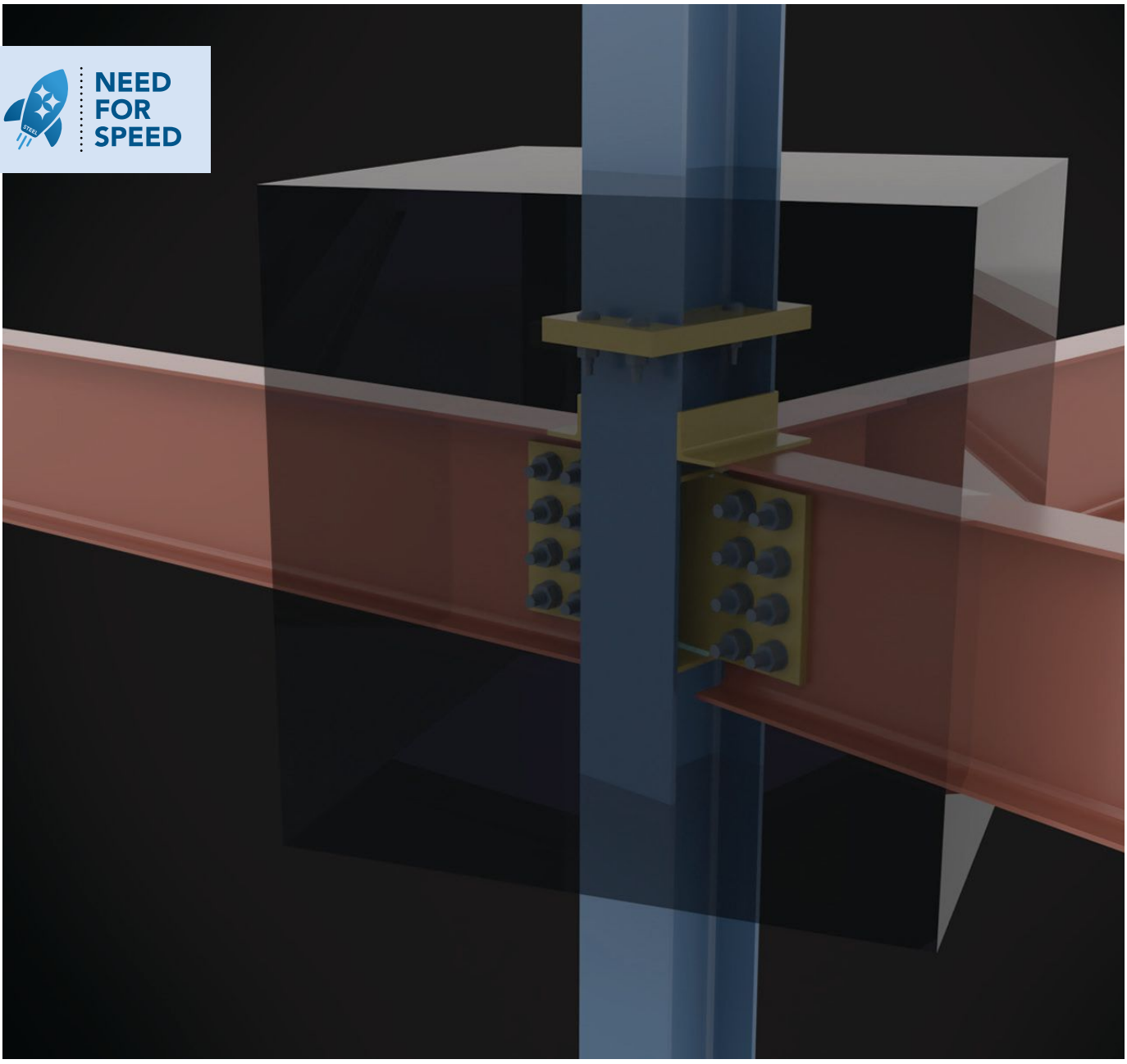
Designed as the modern alternative to welded-in, angle iron frames, QuickFrames engineered, structural roof frames are bolt-on, adjustable, and true to their name from beginning to end.

The speed that QuickFrames brings to new construction and tenant improvement jobs is hard to beat, starting even before the ordering process begins. With traditional steel angle roof frames, customers previously had to wait for mechanical locations before they could even place an order. But thanks to QuickFrames' adjustability and bolt-on nature, this is no longer the case. Customers can order as soon as they know the rough dimensions they need, starting the project without delay. QuickFrames also keeps a variety of sizes of frames in stock at its manufacturing plant, meaning they're often ready to ship the next day.

Once onsite, QuickFrames continue to help expedite a project. They can be installed by one person (with just a ¾-in. impact driver and no training) within 15 to 20 minutes apiece, whereas angle iron roof frames require a skilled welder and at least one or two more people, taking two to three hours for installation per frame. As an example of the impact this can make, a customer recently calculated that QuickFrames' easy installation translated into a 92% time savings on their project. Furthermore, if locations change, QuickFrames can simply be removed in about 10 minutes and then reinstalled quickly, versus having to be cut out or abandoned like welded-in angle iron frames are (and then replaced with new frames).

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

NEED FOR SPEED



Accelerate Fabrication with More Buildable Designs and Better Material Handling

Improving efficiency through fabrication and erection is the key to reliably speed up steel projects across the board. Regardless of the equipment you have on the shop floor, with better design and better planning, you can minimize labor and deliver projects faster every time.

SDS2 by ALLPLAN can help on both fronts. Its signature steel detailing software not only gives you an accurate 3D model, but it can also help you design smarter connections—the most time-critical element of any structural design.

As you model, SDS2 considers the entire 360° framing condition to automatically deliver connections that eliminate clashes in the field—such as clearances and opposing connections—and caters to the strengths and needs of the fabrication shop, whether you are running a manual operation or automating production with the industry's most powerful CNC equipment.

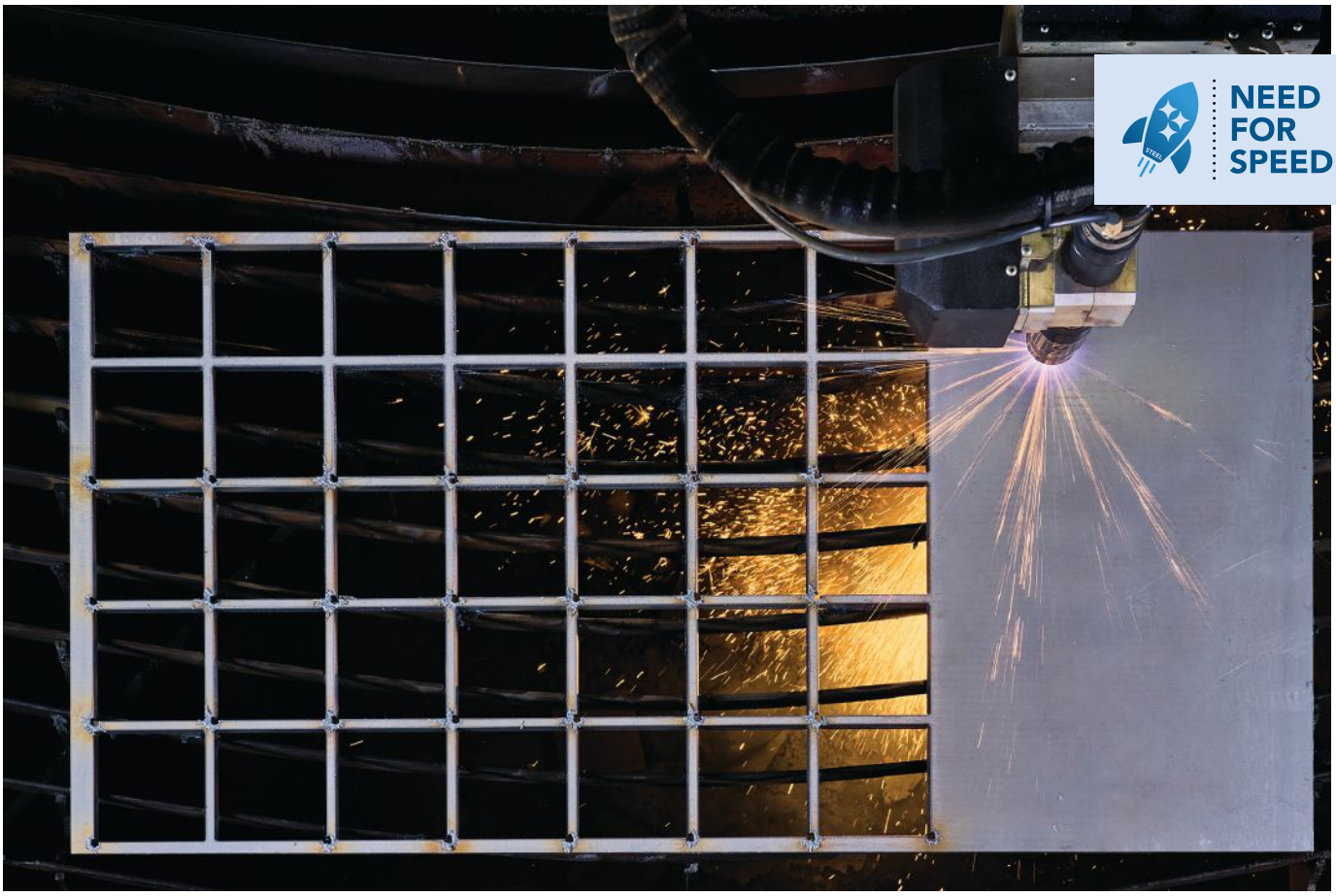
With more efficient design comes streamlined RFIs and fewer errors—the time savings stack up quickly. In one user survey, 93% of respondents said they could complete projects at least 25% faster with SDS2, and some said more than 100% faster.

Of course, that's not SDS2's only advantage. It also helps you increase efficiency in all your processes, from esti-modeling and model review to site planning and—with its latest product—steel shipping and delivery.

SDS2 Load Planning lets you transform almost any IFC building model and plan out perfectly balanced and optimized trailer loads. This eliminates the typical trial-and-error loading process and has helped customers improve loading times by 25% to 50%.

It will help speed up the entire fabrication plan, helping you plan by erection sequence and trailer load, reducing congestion in the shop and at the site, and minimizing material handling throughout the whole project for faster delivery.

For more information, visit **www.sds2.com**.



NEED FOR SPEED

Cutting Steel, Space, Money, and Time

Plasma is widely used in steel construction because it is a fast and efficient way of cutting metal—from steel plate, to rods, tubes, and pipes. The process is known for helping companies complete jobs on time and on budget.

In fact, one Hypertherm X-Definition or high-definition system from Hypertherm Associates can replace up to seven individual fabrication machines. Instead of separate machines for beveling, sawing, marking, coping, drilling, punching, and shearing, all you need is one Hypertherm system. This can save floor space and, more importantly, can reduce material handling needs helping to make the fabrication process faster and more efficient.

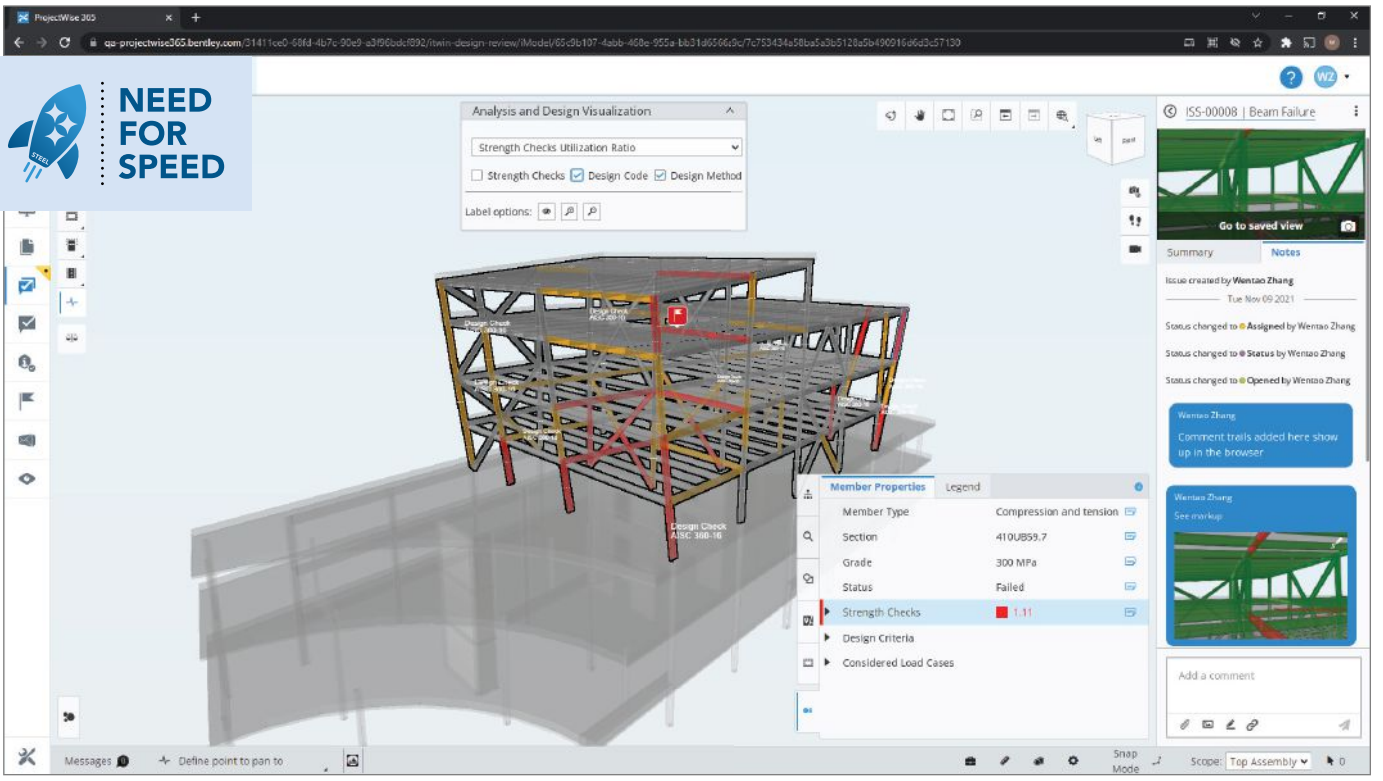
In addition to making precise cuts on just about any type of metal, many do not realize that recent technological advances mean Hypertherm plasma systems can also cut beveled edges in one pass and create bolt-ready holes. There's no need to move parts and plate around the facility.

One customer, a major steel building system producer, considers plasma vital to its production process. When the company's current plasma system started to show its age, managers were worried, as a single issue—even a small one—with its plasma system can impact up to 40 downstream welders.

Its solution was to replace its old plasma system with a Hypertherm HyPerformance HPR260XD, a high-definition plasma system. The new machine has given the company flexibility to alleviate production bottlenecks and even bring back work it was previously outsourcing. The company says it can now complete jobs in just two days that previously would have taken two weeks and has seen a 40% cost savings from bringing production of just one product back in-house.

Steel companies are also completing work faster and more efficiently by using Hypertherm's software. For example, a construction products company in Iowa was struggling with dramatic price increases for metal steel plate. Instead of absorbing that additional cost, the company turned to ProNest nesting software from the Hypertherm Associates Software Group, which helped the company use steel plate more efficiently. By squeezing more parts onto a plate, the shop was able to use fewer plates, thus saving time and money. And as the company learned, even a modest increase in plate usage can lead to significant savings. By using 5% fewer plates, the company was able to save $50,000 a year on material alone and another $31,000 a year by streamlining its programming process.

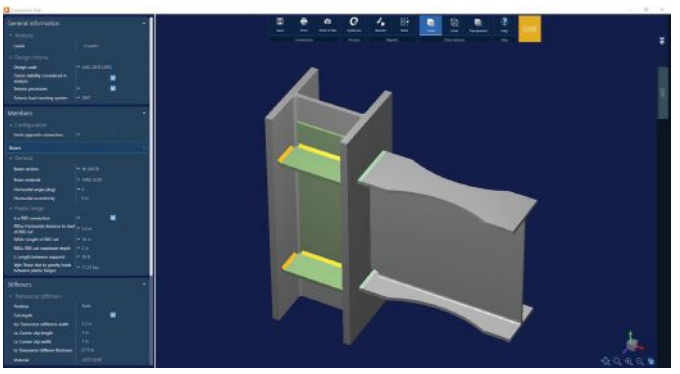
For more information, visit **www.hypertherm.com**.



A Continuing Revolution

When RAMSTEEL, the forerunner of RAM Structural System software, was first released in 1990, it revolutionized the steel building design industry. What once took days or weeks using manual calculations and design charts and aids—standard practice at the time—could be accomplished in hours. And ever since then, the software's design capabilities have been enhanced, including the addition of steel joists and joist girders, beams with web openings, floor vibration analysis, and much more. The philosophy behind RAM Structural System and the whole suite of Bentley's structural software has always been to automate the most tedious and time-consuming tasks, providing fast, reliable designs, potentially saving weeks or even months when compared to doing the same work via in-house spreadsheets or other design alternatives.

RAM Structural System has powerful and robust capabilities for generating code-specified wind and seismic forces and then performing the necessary static and dynamic analyses. Of particular note is the extensive implementation of the seismic design requirements of the AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341) for moment and braced frames, including SMF, SCBF, EBF, and BRBF frames. Requirements for limiting width/thickness ratios, stability bracing of beams, column-stronger-than-beam checks, capacity design, and web plate and stiffener plate requirements can all be investigated.



When it comes to steel connections, RAM Connection can design a wide variety of configurations and conditions, from common gravity beam connections and column splices to braced frame and welded and bolted moment frame connections. RAM Connection can be launched from RAM Structural System, with the geometry, sizes, and design forces extracted for all the connections in the entire model. Connection design is very tedious and repetitive, and this integration eliminates mistakes and allows connections to be designed quickly and thoroughly, including quick turnaround when the inevitable modifications to the framing are made due to owner, architectural, or construction requirements.

RAM Structural System also works with BIM programs like Revit and Bentley OpenBuildings Designer through the recently implemented Bentley iTwin technology. The iTwin Analytical Synchronizer manages the creation of the iTwin, which can be done either on the local drive or in the cloud for access by the entire team.

And the time savings are real. When designing a 62-story steel tower in London, structural engineer WSP was able to perform 70 design iterations in just 44 weeks, cutting overall design time by 40% by integrating RAM Structural System with Revit. In another project, the Steven Tanger Center for the Performing Arts in Greensboro, N.C., engineer SKA saved about three months in design time by linking RAM Structural System and Revit. And on another project, the Pavilion at Penn Medicine (a 17-story hospital project that appeared on the cover of the September 2022 issue, available at **www.modernsteel.com**), engineer HDR and the PennFirst Team were able to complete the foundation and steel superstructure design in less than a year with RAM Structural System and RAM Elements 3D finite element analysis software.

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

NEED FOR SPEED

Rapid Deployment

Acrow has been serving the transportation and construction industries for more than 70 years with modular steel bridging solutions engineered for a broad range of permanent and temporary applications. Widely recognized as a key element of accelerated bridge construction, prefabricated modular steel bridge systems significantly reduce on-site construction time and decrease overall project duration.

Compared with the more traditional phased approach, one of the most critical benefits of modular steel bridging is the ease and speed at which it can be installed, which helps to minimize costs and ensure the project is delivered on schedule. Precision fabrication in a controlled facility enables the delivery of components ready for immediate installation with no requirement for field welding and minimal skilled labor or construction equipment. This reduction in on-site construction time increases safety for workers and motorists while decreasing the risk of delays, labor or equipment shortages, disruptions to traffic, and impact on the environment.

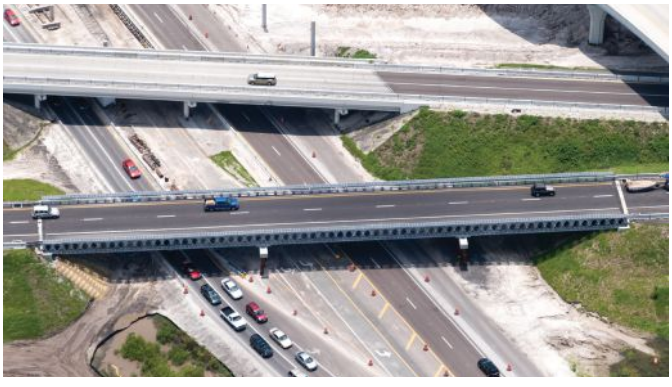
Acrow's high-quality pre-engineered components are expertly manufactured with a proprietary blend of U.S. steel from ISO-certified mills and galvanized to eliminate corrosion for a virtually maintenance-free service life of 75 to 100 years. The length, width, and strength of each structure are easily customizable, and components are conveniently transported to the most remote or restricted locations where fast assembly and installation require only minimal equipment.

These durable, permanent structures are frequently installed as temporary detours during bridge rehabilitation or replacement projects. Available for rent or purchase, they provide project owners an excellent option for heavily traveled or critical routes where mitigating construction site impact is prioritized. Acrow's rapidly mobilized and easily installed structures are also ideal for restoring damaged or destroyed infrastructure in the wake of emergencies and are quickly and simply disassembled for storage and future use.

Acrow's flagship 700XS panel bridge is robotically manufactured in the U.S. and features robust orthotropic deck panels designed to handle heavy wheel loads. Available in single-lane, two-lane, or three-lane widths, the panel bridge is used by contractors all over the world to accelerate bridge construction in both permanent and temporary detour applications and has been used on successful large-scale bridge infrastructure programs globally and is frequently used in emergency applications and for humanitarian aid and disaster relief.

For short spans, the Acrow Beam Bridge is an economical and versatile modular solution for permanent or temporary projects requiring rapid access. Capable of supporting a wide variety of highway loadings and vehicle types, Acrow's Beam Bridges are well-suited for short-span vehicular and pedestrian applications. Available in standard lengths and widths with a variety of decking options, they are delivered to a site complete, ready to lift into place, and installed within hours using minimal equipment and labor—and can be expedited for delivery from inventory staged throughout North America.

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



NEED FOR SPEED

Staying Close to the Source

On sprawling structural job sites, welding often happens hundreds of feet from the power source—and sometimes up many levels of scaffolding or stairs. Traditional welding equipment wastes hundreds of work hours and thousands of dollars every year by forcing operators to walk to the power source multiple times a day for each adjustment.

ArcReach technology from Miller Electric Mfg., LLC, eliminates that nonproductive time by allowing operators to change weld parameters from the weld joint with the wire feeder or stick/TIG remote and without a control cable. ArcReach technology can save 250 hours on average per operator per year by eliminating the need to walk back to the power source to adjust parameters. Apex Steel, an AISC member fabricator based in Kirkland, Wash., saved up to two hours per welder every day with a switch to ArcReach products on the job site, helping them complete jobs faster.

ArcReach accessories are compatible with numerous Miller plug-in welding power sources and engine-driven welders/generators, so contractors can easily integrate the technology into their fleets to maximize productivity and save money.

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

Smarter, Speedier Coating Solutions

A safer environment, a faster build, and a simpler process: That's what Sherwin-Williams Construction Solutions helps owners, general contractors, and engineers achieve during construction, offering versatile solutions that touch every aspect and phase of steel construction projects.

The Sherwin-Williams Construction Solutions team focuses on results. One of our recently completed steel projects involving fire protection coatings resulted in a 33% reduction in total erection schedule when compared to its sister build by simply changing the PFP coating from a cementitious SFRM coating applied on-site to an epoxy intumescent coating applied in the shop. By offering seemingly small adjustments in process or sequence, we can help significantly reduce the bottom line and optimize project timelines.

From specification to installation, our products, services, and collaboration help deliver projects that are safer, faster, and simpler.

Safer. Construction sites are inherently hazardous. Hundreds of workers, constricted areas, overhead operations, and dangerous equipment create an environment filled with risks associated with injuries and delays. By moving much of the coatings process to the fabrication shop, project owners can mitigate those risks for safety, lower the cost of surface preparation and coatings application, and ensure that coatings are applied at the required film thickness.

Faster. Sherwin-Williams Construction Services collaborates with owners, architects, engineers, and construction firms to select coating systems designed for durability and speed by looking at schedules associated with individual sequences. By leveraging innovative products and processes, we can help save time through increased throughput, rapid return to service, and ease of installation.

Simpler. Our expertise makes the entire construction process easier, and we're determined to make sure our products perform throughout the life cycle of the structure. We also ensure the products applied during construction can also be applied during maintenance, keeping your facility in operation.

For more information, visit **https://industrial.sherwin-williams.com/na/us/en/protective-marine/services-tools/engineering-design-services.html**.

Speedy Slab

The need for speed has been synonymous with Girder-Slab since its first project was completed in 1997, and the company was introduced to the industry in the September 2000 issue of *Modern Steel Construction*.

But it wasn't just about speed. It was about producing a "manufactured construction" product that could be assembled onsite with one team of skilled tradespeople. This nonproprietary process allows for both the steel "D Beam" (dissymmetric beams) and precast hollow-core slab units of the Girder-Slab to be fabricated indoors and delivered to the project from local producers. It also allows for both cold weather construction and open bidding, which results in both time and cost savings. However, the benefits don't end here. The Girder-Slab steel and precast hollow-core units are about 30% to 45% lighter than cast-in-place flat plate, offering more flexibility on both foundation and podium construction. Setting the hollow-core slab units on the web of the D Beam provides a slim floor profile, eliminates wasted space, and can create additional floors in limited elevation. As the Girder-Slab System is assembled onsite, only a small crew of skilled workers is necessary. These benefits work together to provide all project stakeholders with both time and cost savings.

For example, the Hamilton Phase II mixed-use high-rise in Philadelphia was fully completed in just 15 months using the Girder-Slab system—twice as fast as its Phase I counterpart, which used a conventional floor system. Another Girder-Slab project, Troy Boston, topped out ahead of schedule and within ten months of the construction start. (You can read about the former project in "Take Two" in the July 2021 issue and the second one in "First on the Block" in the April 2015 issue, both available at **www.modernsteel.com**).

For more information, visit **www.girder-slab.com**.

NEED FOR SPEED

Building in the Blink of an Eye

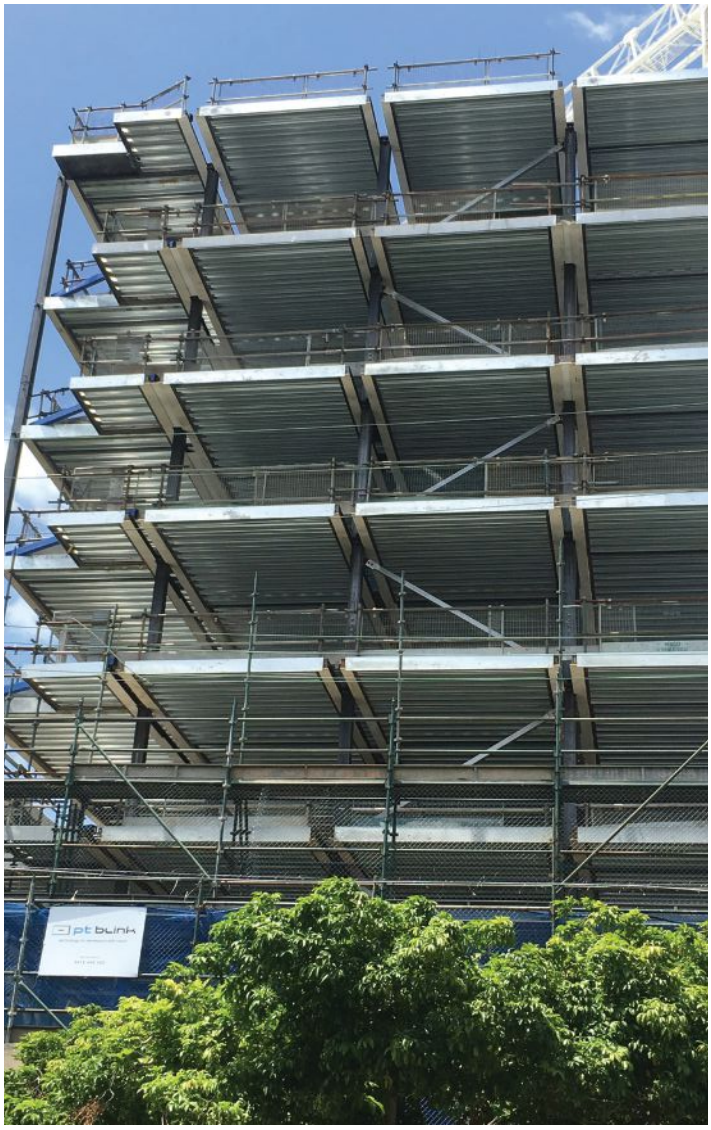
With PT Blink's Blink DMI™ (design, manufacture, integrate) process, nonstructural prefabricated building components (such as bathroom pods, kitchen pods, facades, internal walls, stairs, etc.) are integrated with the geometrically accurate and offsite-fabricated structural steel backbone, which acts as the "chassis" of the building.

This structural steel chassis, the Blink Backbone™, is a patented framing system that leverages post-tensioned steel beams assembled into steel floor trays (up to 12 ft × 50 ft) to significantly increase the speed of erection and reduce site labor requirements by allowing significant work (rebar, MEP penetrations, façade attachments, etc.) to be performed offsite. This helps to remove the superstructure from the critical path of the project, allowing concurrent manufacturing of the structural and nonstructural components, which can then be integrated quickly onsite using just-in-time principles.

The speed advantages are significant, with the company expecting to save around 40% of total project time from its technology and methodology. We aim to reduce project costs by 5% to 10% as a direct result of the time savings but believe the biggest impacts come in the form of dramatic improvements in the internal rate of return, return on capital equity, or return on investment, depending on the metrics used by owners and developers. In relative terms, the time savings can can double the internal rate of return.

In one case study, the Fells Apartments in Queensland, Australia, the Blink Backbone enabled seven floors to be erected in just 11 days, compressing the total project time from 16 months to 8 months.

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



NEED FOR SPEED

Strong and Speedy

Building owners and others along the design and construction supply chain have a vested interest in completing projects quickly and optimizing building occupancy. At the same time, the demand for new construction continues to outpace the availability of skilled-trade workers, such as welders. With these factors in mind, the engineers at Simpson Strong-Tie designed the Yield-Link moment connection, Yield-Link brace connection, and Edge-Tie system to be installed with bolts instead of field welding. In addition to simplifying design and detailing, bolted connections save time and effort during installation while reducing testing, inspection costs, and overall project schedules.

The Yield-Link moment connection (YLMC) is precision-made to meet the tough demands of structural steel construction. From building owners to engineers, to contractors and fabricators, the Yield-Link moment connection design saves time and money while providing a connection that keeps structural steel buildings strong and safe.

The Yield-Link brace connection (YLBC) connects brace frames in structural steel buildings. It has bolted connections that simplify design and detailing. No field welding is required, saving time and effort while reducing testing and inspection costs. During extreme seismic or high-wind events, the Yield-Link brace connection isolates damage to the connection only, allowing the brace frame to remain intact.

The Edge-Tie system is a revolutionary way to design and install cladding and curtain-wall connections for structural steel. Designed with a unique, extruded shape and pour stop, it provides more strength than traditional bent plates. This innovative solution utilizes bolts that are adjustable, so installers can easily place and reposition anchors along a continuous slot fabricated into the beam. By eliminating field welding, the Edge-Tie system speeds up building enclosures while saving time and labor costs.

For more information, visit **go.strongtie.com/structuralsteel**.

Ready, Set, Core

Conventional core construction can be challenging, costly, and unpredictable, thanks to curing delays, inclement weather, and tolerance issues.

Eliminating these issues is RediCor, a factory-built, steel modular stay-in-place concrete form system that stacks like building blocks, virtually eliminating traditional wooden formwork to create faster, straighter, and less labor-intensive multistory stair and elevator cores.

The system accelerates and simplifies core construction because the modules can be quickly craned off the truck and into place. The prefabricated modules maintain near-zero-inch tolerances, and the pre-engineered embeds accept a variety of structural connections, including steel joists and wide-flange beams.

"We saved three months on our schedule by incorporating RediCor," said Mason Jones of Gilbane Building Company. "The primary benefit of RediCor versus a traditionally built concrete core is that it goes up with the steel erection. Another key aspect is just-in-time delivery of the RediCor modules, which prevents slowdowns while not taking up valuable construction staging space."

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

Rapid Review

The first question steel and construction companies need to ask about applying new digital technologies is, "What is the real, definable change we're looking to make?"

According to our customers, it's ultimately all about efficiency. It's about reducing time spent on specific tasks. It's about automation.

On top of our investments in Bluebeam Revu, which allows users to access construction documents anywhere and any time, we've recently focused our product development around mobile, cloud-based solutions that solve real-world problems, drive projects forward, and improve a company's ability to deliver for their clients—quickly. Our customer surveys have shown that digital solutions have a huge impact on both task and project efficiency, with 82% of Bluebeam users surveyed reporting saving time using our solutions, 71% reporting saving more than an hour a day, and 88% reporting seeing a measurable improvement in work quality. And our work partnering with these customers has shown that digital solutions provide far more value than just being the quickest way to solve a problem. With centralized, cloud-based approaches like the one we're taking with the all-new Bluebeam Cloud working with Bluebeam Revu, organizations can leverage the power of project data to improve outcomes company-wide.

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

NEED FOR SPEED

Cobot Revolution

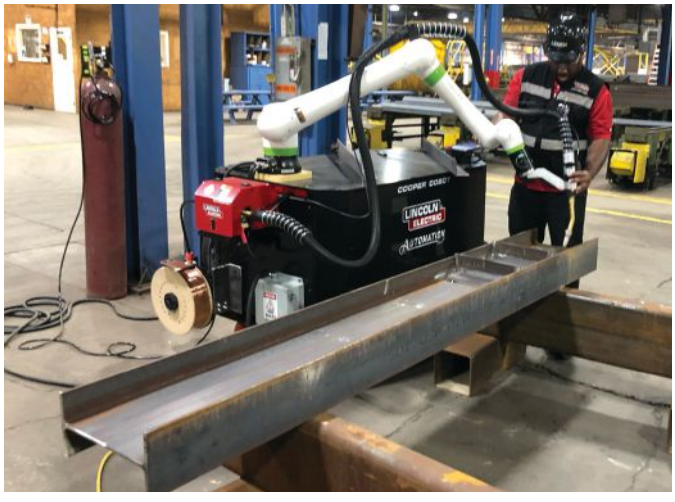
With skilled labor being in short supply in today's market, robots present a viable alternative. While most robotic solutions are fully automated with no human interaction, there is a hybrid approach: the cobot (collaborative robot) is a robot that is intended for human interaction. While more traditional robots used in manufacturing are suited for repetitive tasks, cobots are ideal for tasks that are of a unique and perpetually changing nature. Traditional robots used in manufacturing have little interaction with the operators and are often isolated from individuals by safety fences and laser guards to ensure high-speed robots do not hit or hurt a person. A cobot is quite different in that the robot partners with the operator to achieve the specified task. Recently, cobots designed explicitly to weld have been introduced by several manufacturers, including Lincoln Electric's Cooper™ Cobots.

Employing cobots can reduce the number of qualified welders required in a fabrication shop and assist less experienced welders to consistently produce high-quality welds. They are also able to exceed the welding speed and endurance of semi-automatic welders. Using semi-automatic welding methods, the maximum speed an experienced welder can consistently weld in a day usually does not exceed 18 in. per minute, whereas a cobot can attain travel speeds that are bound only by the physics of arc welding. The operator can measure and tack up the next weld while the welding cobot is making the previously programmed weld, which can significantly increase the overall speed at which a project is completed.

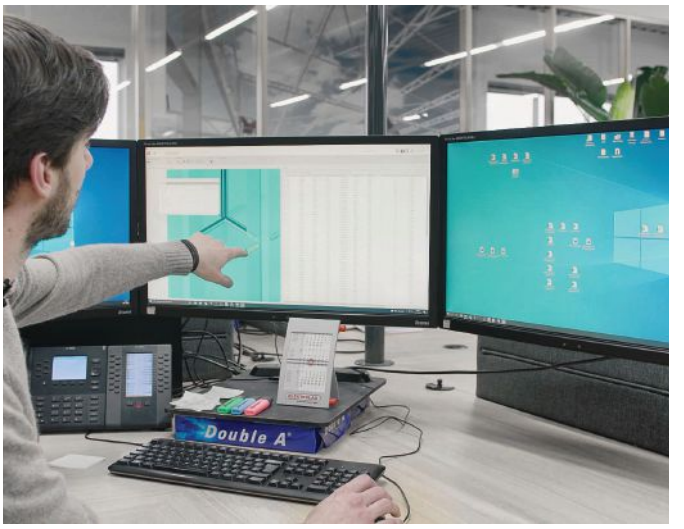
The cobot welding operator guides the robotic arm along the desired weld location path using "touch points," where the end of the welding wire is touched to multiple points along the desired weld path. The operator then selects which type of weld should be delivered along the path that was designated using an intuitive, hand-held, user-friendly interface, and then the cobot executes the weld along the selected path made from the touch points. The travel between touch points can be linear or radial—e.g., hollow structural sections (HSS), either round or rectangular with radii at the corners, can be welded to a base plate continuously all around the perimeter.

A cobot can also be used with various types of welding processes, with FCAW-G being the most common. It is capable of making all types of single- or multi-pass welds in all positions while creating any type of joint. A weave, box, z-pattern, or other travel technique can easily be programmed, as can sequences such as back-stepping, cascading, or intermittent welds. The maximum length of the welds is only governed by the radial reach of the cobot arm—e.g., the Fanuc CRX-10iA/L has a maximum radial reach of just over 4.5 ft in any direction. In addition, a cobot can be mounted on a push-cart, making it extremely mobile, as opposed to a traditional robotic system where the part to be welded on needs to be brought to the robot.

For more information, visit **lincolnelectric.com/cobots**.



NEED FOR SPEED



Connecting (and Speeding Up) Shops

Voortman Steel Machinery is a leading supplier of state-of-the-art CNC-controlled machinery for steel beam and plate processing industries. Our multi-system approach to automation centers around all systems in the production line connecting to one another to boost shop speed, efficiency, and output.

Complicated logistics are a thing of the past. Raw lengths go on the infeed, and fully processed products come off the outfeed. The machines communicate with each other, and each one is capable of producing unmanned for long periods, with a single operator being able to oversee several machines at once. Profiles are transported to the machines at 200 ft per minute and are continuously buffered towards the datum line. With automated buffering in between machines, bottlenecks are eliminated if one process is faster than the other.

But getting the highest output and using maximum uptime isn't just due to automation and innovative machinery. Rather it's a combination of several elements that reinforce each other. One of our top priorities is to support your operator. We believe that providing the right (predictive) information at the right moment will help them use our automated processes to their best advantage. Our machines have the largest touch panels in the market, and an easy-to-use interface makes it easy to navigate through them. But what really sets our machines apart is what's under the hood: One-button automation means that even the toughest processes can be carried out by anyone—even if they have never done it before.

A shortage of skilled workers was a driving force behind our decision to automate fitting and welding operations. We are the only company to have automated the entire integration of automated welding for structural applications, from preparation to finished product.

In addition, the steel construction industry suffers from incomplete and incorrect information in 3D structural models—and we've worked to avoid situations where the hours that were freed up at the back of your shop are once again needed at the front. As such, we've developed cloud-based software that provides 3D models with all the correct welding information, both automatic and manual. The software then immediately checks which profiles are suitable for automatic welding and which products are to be welded manually, saving both time and effort.

For more information, visit **www.voortman.net**.

Advanced Planning = Accelerated Pace

With more architects and structural engineers tasked with mitigating thermal bridging through the building envelope to comply with tightening building codes, it becomes increasingly important to incorporate structural thermal breaks efficiently, with minimal impact on the design process and schedule.

Structural thermal breaks are positioned where balconies, canopies, sunshades, beams, rooftop equipment connections, or other steel elements penetrate the insulated building envelope, reducing heat loss by up to 75%, while preventing condensation and mold from forming in interior cavities where temperatures might otherwise fall below the dew point.

When designing with structural thermal breaks, advance planning between the supplier, architect, structural engineer, and contractor helps to streamline the process and reduce delays. As with the design-build approach, involving the thermal break supplier early in the design process and planning for their inclusion with the contractors and trades offers all partners the upfront information they need to complete their part of the process as expeditiously and effectively as possible, setting the project up for greater success.

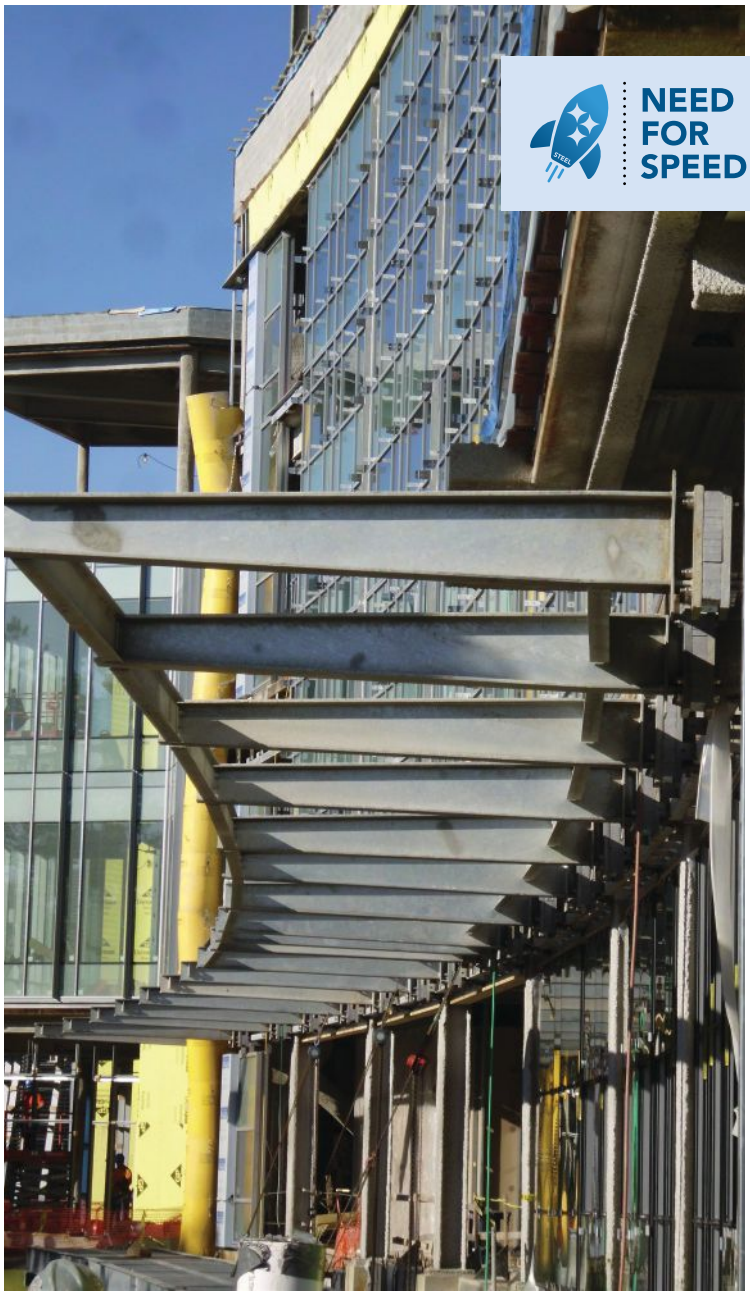
Ideally, an initial discussion takes place between the design team and the manufacturer's sales engineers to obtain advice on the best thermal break solutions. Preliminary budget pricing and layout information can be prepared by the supplier based on project details, including where the project is located, the number of connections to be insulated, and approximate load requirements. A preliminary proposal of the project will analyze its feasibility and approximate the number and cost of the designed thermal break connections.

For a more precise and final technical proposal, the supplier will need dimensioned floor plans and section details of the component(s) to be thermally separated, plus beam sizes and quantities and the design loads at the connection (ULS factored). The proposed design will then be supplied to the engineer of record to ensure that it properly addresses all thermally broken connections and loads.

For contractors needing a quotation, the supplier will likely ask for the project drawings (both architectural and structural) showing beam sizes (along with connection locations) and the design loads at the connections. Once the plans are set and the materials are delivered to the work site, the installation of the structural thermal breaks is straightforward. In the simplest terms, the units are bolted in place according to the design drawings on the head plate of the steel beam within the interior building frame. Then the exterior steel beam is guided with the head plate towards the connection and fastened in place.

Incorporating structural thermal breaks into your construction process simply requires some planning and coordination at the onset of the design process, well in advance of groundbreaking—and getting an early jump on the planning will result in much faster implementation.

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



NEED FOR SPEED

Serving Up a Side of Speed

SidePlate connections are much stiffer than other moment connections, improving the entire lateral system and making a SidePlate design different—and faster—than a conventional moment frame or braced frame design.

During the design through detailing phases of a project, our team of engineers saves design hours for the structural engineer of record by assisting with the overall lateral analysis and design. We save time for bidding fabricators by delivering a complete takeoff of all the SidePlate components on the project, and we provide detailers with a project-specific digital XML file that assists in modeling the SidePlate pieces and parts in either SDS2 or Tekla, saving them the time of having to manually detail connections.

Because there is no field welding required, SidePlate projects are extremely fast to erect. Industry feedback has been that a SidePlate bolted joint takes approximately 20 to 30 minutes to fully bolt up and detail versus four to eight hours per moment connection when welding and ultrasonic testing a complete joint penetration (CJP) welded joint. Some recent project examples of this construction speed in action include the following:

Denver Health. SidePlate saved six weeks of construction schedule versus a concrete shear wall design for this hospital project. (You can read about it in the September 2022 article "Come Together," available in the Archives section at **www.modernsteel.com**.)

A five-story medical center in New York. Structural steel for the project was erected in only 26 days, about half the time that the general contractor had budgeted.

A large industrial project in Indiana. Structural steel erection beat the proposed installation schedule by seven weeks. Despite losing over a month of schedule due to foundation problems, the speed of steel made up for that lost time plus more.

A large hospital in the Midwest. The project lost over 30 days of installation work due to high winds but was still completed ahead of the proposed schedule. An ironworker on the project commented, "I don't know why SidePlate isn't on every project."

That being said, SidePlate isn't for every job. Our team of regional engineers is your best resource to consult on your project specifics (find them at **www.sideplate.com/contact**). There is no obligation for us to evaluate a possible project, and our licensing fee is paid during construction, typically by the project's steel fabricator.

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

NEED FOR SPEED

Bolting Ahead

St. Louis Screw & Bolt's steel fabricating customers have needed expanded inventory to cover project needs faster than ever before. Many times, structural fastener lists come in just before bolts are needed onsite.

To meet this demand, we have decreased the amount of time needed to pack orders by implementing inventory, manufacturing, and packaging improvements.

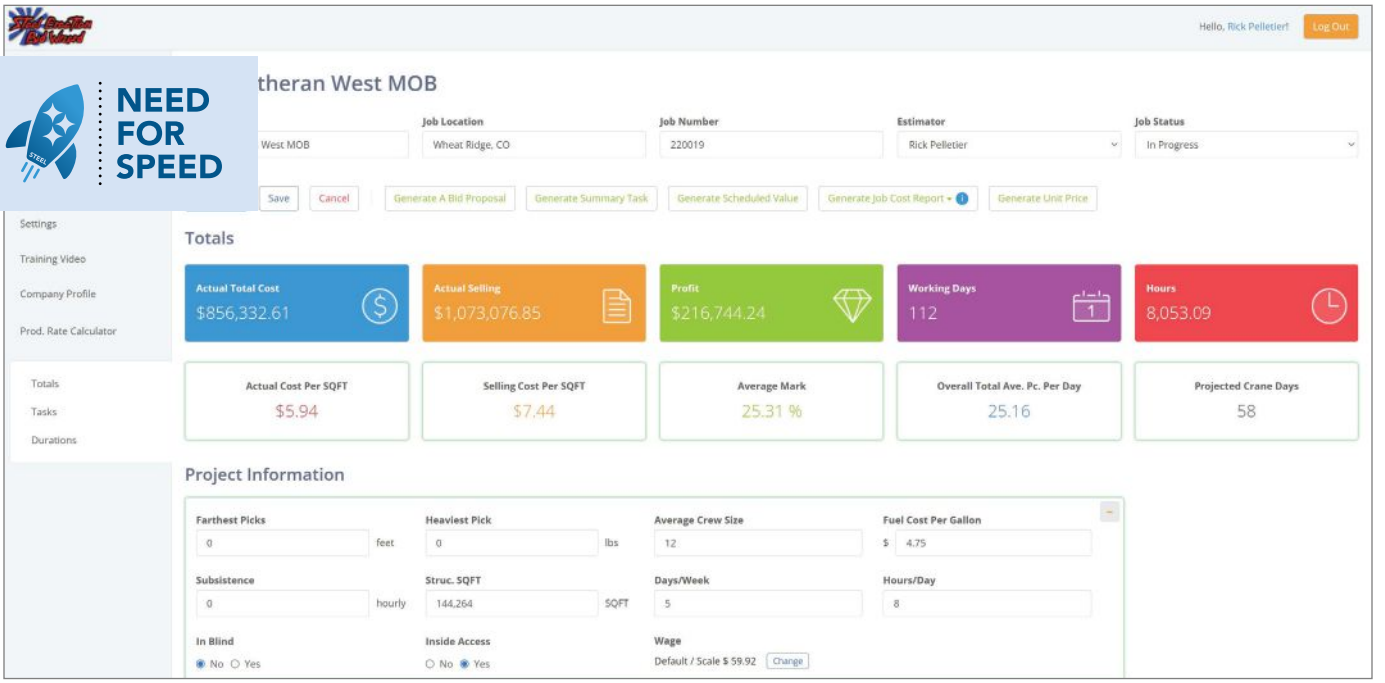
How? For one thing, we've increased bolt production by 30% in the last year by adding three new machines and automated conveyor systems. Not only does this increase production volume but also our size and length capabilities. One of these new bolt-making machines produces 76% more bolts per hour than our older equipment, achieving 5,280 parts per hour, and another machine has increased length capabilities by 40%, forming lengths up to 14 in. Our expanded machine capacity has also cut our lead times from six to eight weeks down to two to four weeks. All of our headers have monitors that record downtime, changeovers, and setups and provide statistical data in real time to management and operators.

In addition, our fully automated packaging line has increased keg-packing capabilities by 50%. Our two new automated lidding machines can put a lid on a keg in two seconds, something that took eight to ten seconds via the old manual method. And our new automated shrink-wrapping machine not only wraps pallets over the top, which is much stronger, but it also wraps them five times faster than standard pallet-wrapping equipment.

We also performed a statistical analysis of the previous two decades to determine trend-based inventory needs. As a result, we increased our strategic inventory by more than 35% over the last two years in an effort to provide our customers with the right parts at the right time. In addition, we've grown our packing capacity by 12% per year over the last two years during the challenges of COVID. We also added six new electric forklifts and four new packaging stations with weigh-count scales. And we've developed strategic partnerships with key vendors to supplement inventory as needed in order to overcome supply chain shortages.

All of this has resulted in more on-time shipments. In 2022, so far we're shipping 97.1% of our orders to customers at their requested delivery times. This is a 4.6% increase from last year. Our goal for 2023 is to increase the rate to 99%.

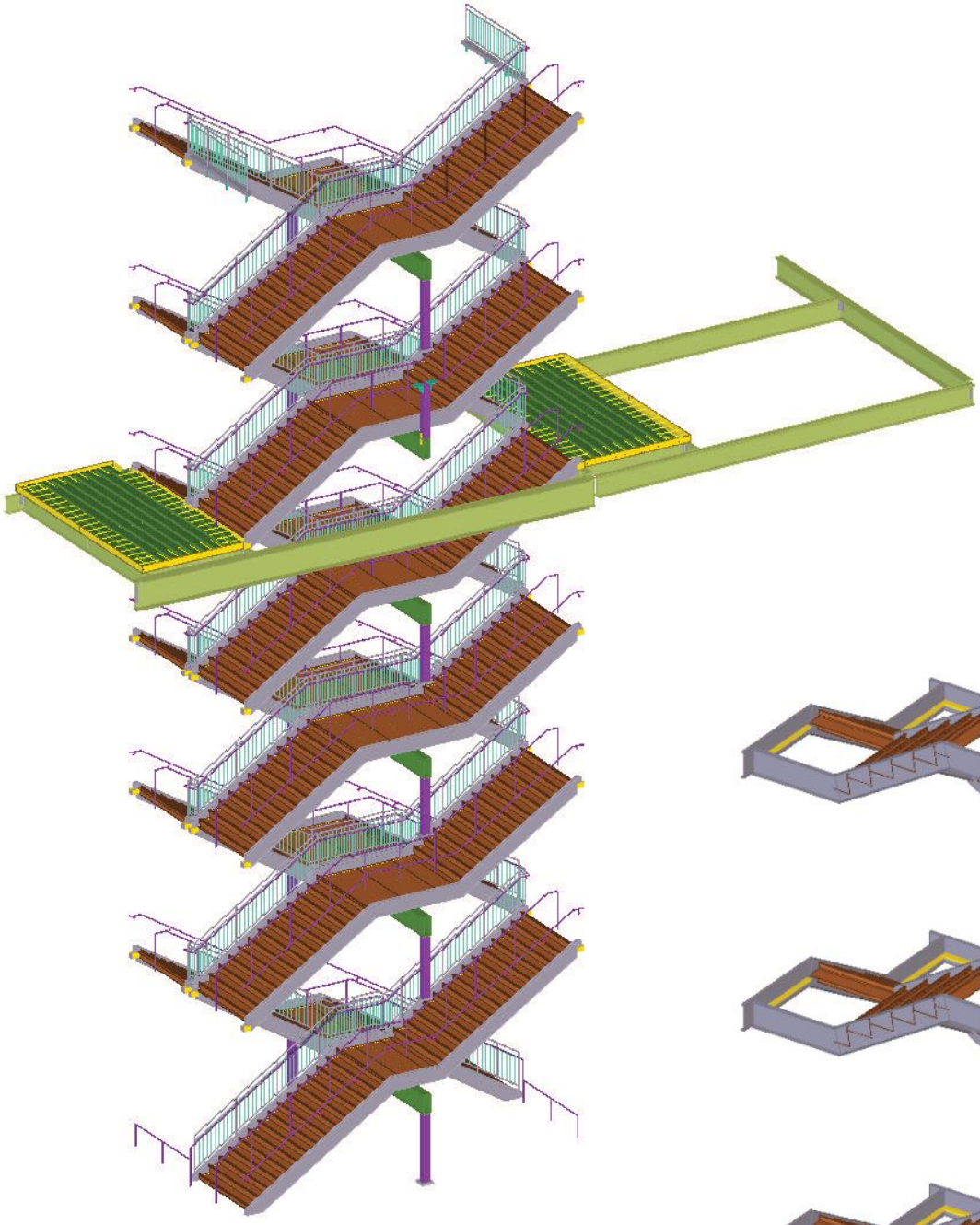
For more information, visit **www.slbolt.com**.

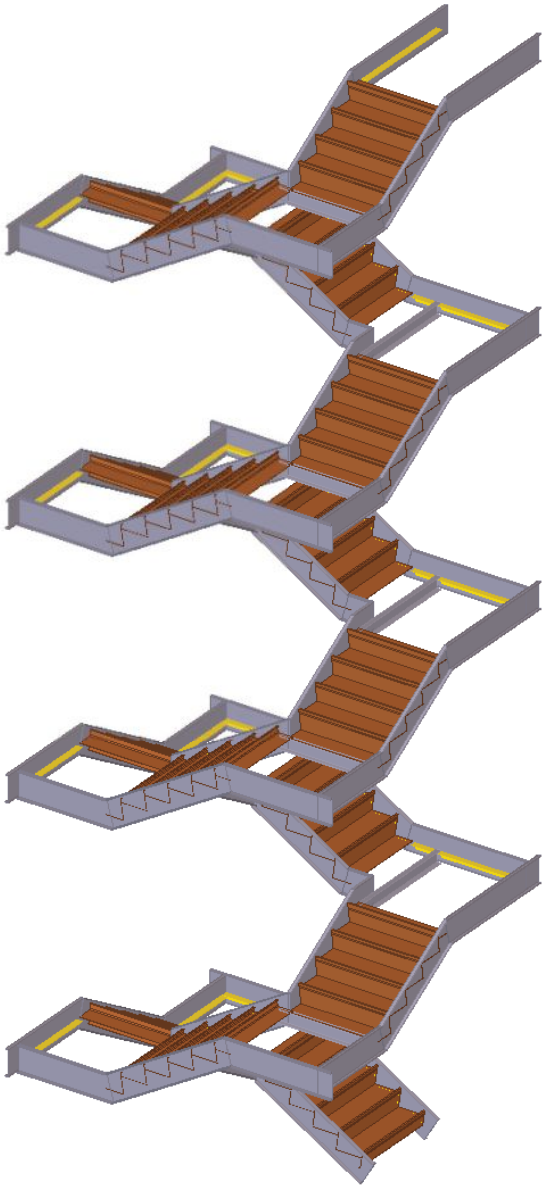


Accelerating Estimation

Steel Estimating Solutions' Steel Erection Bid Wizard allows you to estimate steel erection projects with speed, accuracy, and confidence. Designed to help companies get all estimators on the same page and significantly reduce errors in calculations, it integrates with many current digital takeoff and modeling software packages. By making the estimation process digital, a company can complete an estimate from takeoff to price 40% to 50% faster.

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





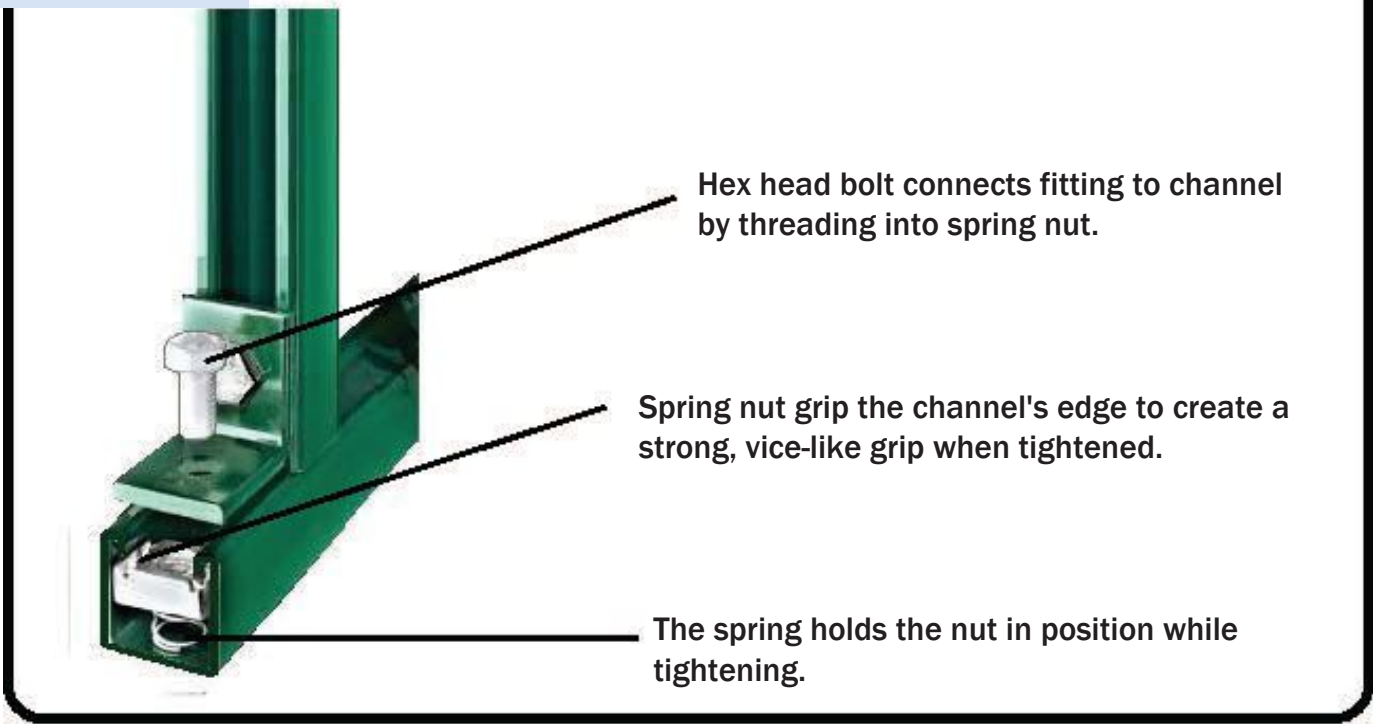
Maximizing Miscellaneous Metals Modeling

Steel Tek Unlimited, LLC, creates plugins for Tekla Structures to automate modeling and drawing processes, specifically for the miscellaneous metals industry, focusing on stairs, picket rails, multi-line rails, cable rails, and wall rails. Automating the drawing process for these elements helps to increase steel fabrication and detailing productivity by minimizing the number of modeling tasks, thus making changes and edits quicker and easier. Detailers have reported that they are able to model stairs up to two to three times faster and railings up to five to ten times faster. For example, editing stairs and rails for design changes or field conditions has always been a major headache for detailers, but our tools allow them to be performed in minutes, with the railings adapting automatically to changes in stair dimensions. Stringer and railing drawing assembly automation provides even more productivity, and drawing procedures for these elements in Tekla that used to take between 15 and 45 minutes can now be done in one to five minutes.

For more information, visit **steelteku.com/software**.

NEED FOR SPEED

UNISTRUT: The Weldless Connection

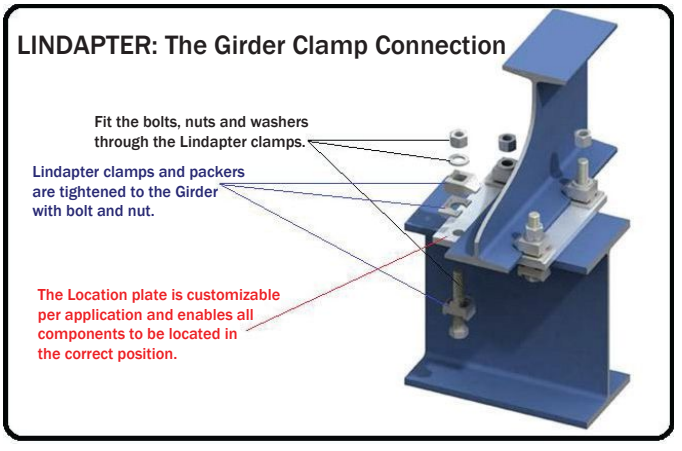


Supplying Speed

Commercial projects, consisting of either structural steel connections or basic steel connections, are now being completed on expedited "fast-track" time schedules. This requires an expedited parts procurement process and steel distributors to have the necessary parts in stock at any given moment, lest they disrupt the speed at which construction projects are completed.

Strut and Supply, Inc., works with unique suppliers that offer an assortment of products that require no welding and are fully adjustable, which saves time and money for both the supplier and the end user.

Atkore (Unistrut), the inventor of the fully adjustable strut channel metal framing system, offers Erector-Set type metal framing products. With the use of only a channel nut and bolt, Unistrut metal framing can easily be assembled, disassembled, and adjusted for infinite configurations. Lindapter, the inventor of high-quality structural steel clamping solutions, offers a complete line of high-strength, innovative products for steel-to-steel connections and Girder Clamps. No welding is required—just a location plate, clamps, and fasteners. Both companies offer complete technical assistance and engineered technical drawings free of charge through Strut and Supply, which can assist in speeding up project design.



The advantage of using weldless and adjustable steel products to speed up steel construction is two-fold:

1. **No welding required.** Welding is time-consuming and permanent, which makes adjusting and realignments extremely difficult. Unistrut channel connections provide the strength of welding but can easily be taken apart. Lindapter structural steel girder clamp connectors provide a faster, cost-effective alternative to drilling or welding. They are designed to reduce installation time and costs while providing a high-strength, secure connection.
2. **Fully adjustable approach.** Our weldless products are adjustable and, in certain cases, can be reusable so that a single product can satisfy multiple designs. This eliminates the need to stock several sizes of a single item. If a change of plans or requirements calls for alteration or rebuilding, you simply loosen the connection and relocate to the desired position.

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

NEED FOR SPEED

Fast and Fluid

The Taylor Damped Moment Frame™ (TDMF™) is a lateral system using steel special moment frames with supplemental damping supplied by Taylor's fluid viscous dampers.

A key element that makes the TDMF procedure fast and easy is the decoupling of the moment frame design from the damper frame design. In traditional damper design, the engineer must use an iterative process whereby the stiffness of the moment frames impacts the damper sizes and the amount of damping provided impacts the force and deflection of the moment frame. Iterations with nonlinear time history analysis (NLTHA), required to capture the nonlinear behavior of the dampers, can take significant time. With the TDMF procedure, engineers design the moment frame using the modal response spectrum analysis (MRSA) procedures of ASCE 7 Chapter 12, but with modifications to the design factors (C_d = 4.5 and MRSA base shear is scaled to $0.75V_{ELF}$), which account for the benefits of the damping. Computer models don't use damper elements and therefore don't necessitate NLTHA.

The damper frame is designed separately, using a prescriptive approach to simplify the selection of damper properties. Fluid viscous dampers are governed by the force-velocity relationship $F = CV^{\alpha}$, where F is the output force, C is a damping constant, V is the velocity and α is the damping exponent. In the TDMF procedure, alpha is fixed at 0.4, velocity is approximated using the first mode of the structure, and so the only design variable is C. In the TDMF procedure, a closed-form approach for determining C is presented, which is primarily a function of the moment frame stiffness. The engineer chooses C values that fall within a range of the calculated value (-10%, +30%), which allows for smoothing of the damper design over several stories, increasing efficiency and cost savings. The load path of the dampers is then designed using an overstrength factor on the damper velocity, paralleling the use of overstrength factors in Chapter 12.

The TDMF procedure removes three major barriers to the design of new damped systems:

1. complication of the iterative moment frame-damper design process
2. the requirement of NLTHA
3. the requirement of peer review

This procedure makes the design of new steel moment frames with supplemental damping quick and easy, shortening design times and making system comparison easier where schematic-level decisions are being made.

Furthermore, the TDMF procedure will open the door for damper design to engineers who may not be familiar with NLTHA, broadening access to achieve better building performance and cost savings.

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

Connected Construction Solutions

Accelerating steel project delivery begins with connected construction solutions that bring people, technology, and information together. Trimble's Tekla software solutions automate workflows and connect people and data across every project phase, from planning, design, and engineering to detailing, fabrication, erection, and beyond.

Tekla Structural Designer combines design and analysis into one easy and efficient single model-based process. Working with one model within one product, from scheme design all the way to detailed design, allows engineers to work faster by eliminating the need to switch between multiple software packages. With accurate and reliable structural simulations, it only takes seconds to automate a rationalized design. Calculation reports are linked directly to the model, so they update automatically for instant change management, while integration with Tekla Structures maintains quality, reduces rework, and drives seamless collaboration. Analysis, design, and BIM form a seamless process as the design model created in Tekla Structural Designer is then passed to Tekla Structures for detailing.

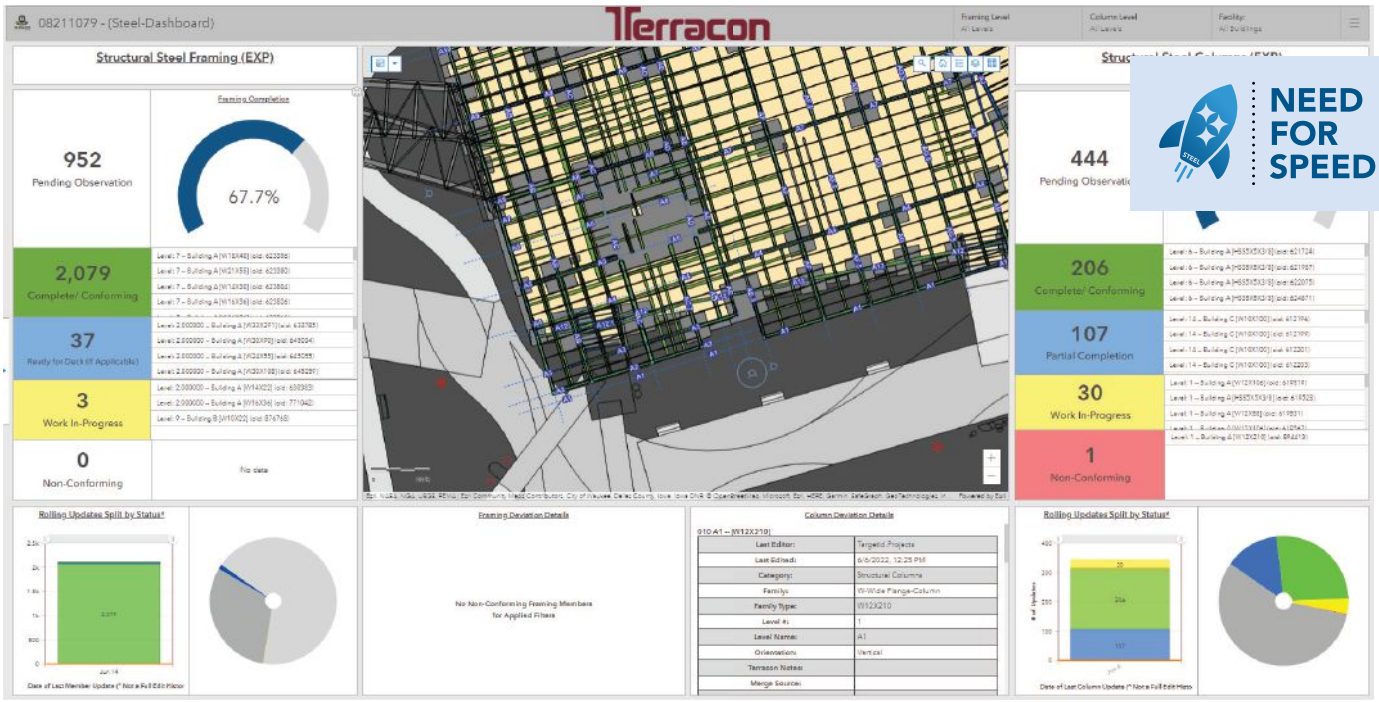
Data-rich models created in Tekla Structures' constructable BIM software drive faster decision-making and provide everything needed to coordinate design, optimize, and automate fabrication and plan site operations. As a central source of accurate, up-to-date information, the Tekla Structures model empowers structural engineers, designers, detailers, fabricators, and project managers to work from a single source of connected information. Throughout every project phase, the data created, captured, and managed in Tekla Structures models drives value downstream. Detailing model data flows seamlessly into Tekla PowerFab, eliminating re-entry for efficient fabrication management.

Created specifically for steel fabricators, Tekla PowerFab delivers complete and connected steel fabrication management through the real-time flow of project information from start to finish. In combination with Tekla Structures and the Trimble Connect collaboration platform, Tekla PowerFab gives project teams visibility into the status of components at every stage of fabrication—from model-based estimating to site delivery. Model-driven data ensures error-free purchasing and brings schedules, job progress, drawing control, and change management together in one easy-to-access system.

With PowerFab Go, fabricators can visualize project progress in 3D on tablets for quick decision-making on the shop floor—all without sifting through paper or mounds of data. Real-time access to project information from anywhere and at any time, whether on the shop floor or the job site, accelerates workflows while data-rich Tekla Structures models drive robotic welding machines for faster, accurate, and automated fabrication.

A connected model-based workflow eliminates costly errors and rework and accelerates steel project delivery with automation and real-time access to data-rich constructable models that drive decision-making and collaboration.

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



NEED FOR SPEED

Targeting Speed

Traditional methods of reporting and accessing materials inspection, testing, and results are no longer sufficient for today's large-scale construction projects. With hundreds, even thousands of reports generated on a single project, our clients need a solution to quickly find and view specific data to make timely, informed decisions.

Terracon has the answer: TARGETID is an unprecedented technological advantage in the industry, leveraging geospatial information to collect, communicate, and report materials testing results through a map-centric, highly visual, and interactive interface.

Terracon takes the design plans and places them right where they belong: in a GIS system. This allows our teams to add information like material tests and observations directly onto the plan while in the field. Our field professionals can input their tests and observations in the exact correct spot on the plan, which you can then see in real time. This includes the data most important to you (test locations and observations, their status, pictures, and other attributes).

Through TARGETID's dashboards, clients and project stakeholders can quickly and easily identify, assess, and address any deviations to keep the project on schedule.

What can TARGETID do for you?

Save time. Instantly find the data you need in a highly intuitive way. Tests and observations are accurately placed because the inspectors know they are in the right location—no more investigating misplaced or mislabeled tests.

Provide peace of mind. Whether remote or in the field, keep track of any materials testing or inspection-related deviations so they can be quickly resolved to avoid delays.

Save money. See on an interactive project map whether the work has been accepted before you place material orders, and efficiently communicate test results among stakeholders to keep projects moving faster than ever before.

Protect your investment. Accurate data and visuals are captured as part of a permanent digital record that can help with asset management (an as-built plan like never before).

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

NEED FOR SPEED

threadline

Culture of Speed

How does Threadline meet customers' need for speed when sourcing fasteners for commercial construction and infrastructure projects? It's a combination of factors, ranging from the competency and expertise of our people to our equipment and processes, as well as our secret ingredient: our culture.

Our industry often moves in a framework of demanding timelines, and we've found that our efforts to keep up with the needs of our customers must remain continuous, however difficult the work may be at times. We are always deploying evolving fabrication and manufacturing processes, new equipment, estimating methods, and other purchasing tasks that allow us to increase delivery speed to the customer job site.

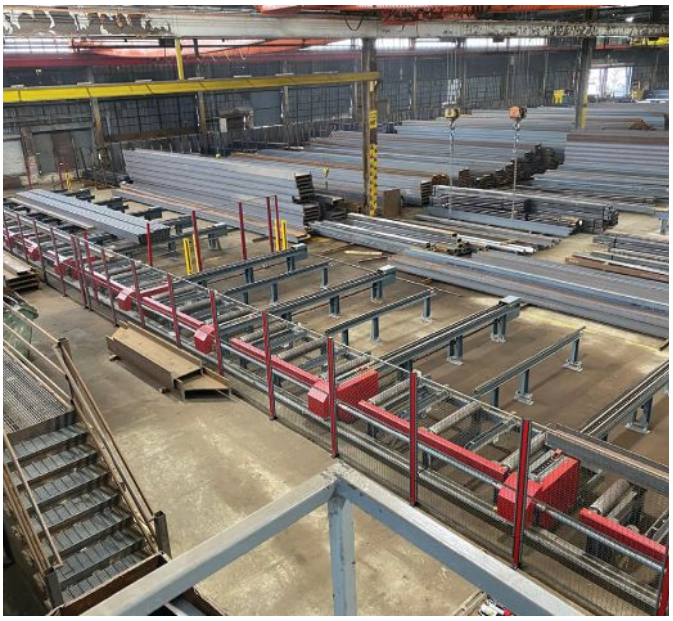
But the most important asset we have in our quest to always get faster is our people. On average, our shop employees–both fabricators and our shipping specialists–have years of experience at Threadline and/or in the industry, with our sales team averaging 25 years of experience per person. When you have a culture of continuous improvement, and that culture is populated with people at these experience levels, doing things right and doing things quickly go hand-in-hand.

While we cherish the tenure of our people, we are always adding to our bench and keeping a fresh outlook on our processes and how we can improve. Being fast at delivering fasteners to the job site is a never-ending process, much like how a track star has to train every day to improve her speed. Just as elite athletes work to get that little bit better each day, even a 1% improvement repeated over and over in our industry can result in big productivity gains.

Another of our core values for each team member is to always be improving and adapting, and we know that market leaders in this industry must have a culture of speed. To equip that culture properly, we have invested in specific equipment and workflow strategies, strategic inventory decisions, and a paperless office, and we have eliminated repetitive and slow steps—all in the name of speed. Our team has a high sense of urgency and customer care, and we demand that from our suppliers as well. Speed cultivates speed!

Our process, from working with suppliers to estimating and production, is influential in improving speed without sacrificing quality. We systematically and ruthlessly identify and eliminate bottlenecks during our production cycle, as well as strategically maintain emergency-ready inventory for our customers.

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



NEED FOR SPEED

Speeding Up Service

How can a steel service center help speed up steel projects?

Great question!

Triple-S Steel is helping our customers by modernizing our equipment and how we process material before it leaves our facility.

For example, Intsel Steel (a Triple-S subsidiary) is adding speed to the job site in the Northeast through a new Gasparini Deck Former. This $5 million investment reduces changeover and setup time between deck profiles from eight hours down to just 30 minutes. This machine allows our team to be more responsive to ever-fluid customer erection schedules.

The tooling technology reduces setup times when switching profiles of steel deck. Traditional roll-formers require manual changeovers and often entail crane handling of rafted tooling. Our line is the first of its kind in the U.S. with automated revolving tooling, and a complete changeover can be performed in about ten minutes. This allows Intsel to service our speedy urban markets and meet their 24- to 48-hour delivery requirements.

In addition, new front-end entry equipment on our line has increased our flexibility. We have implemented a Delta Steel Technology turnstile, which allows our operators to stage up to seven coils and plan for multiple shifts without constant crane attention.

Another example is our Voortman Sawing Systems and associated productivity. Over the past several years, we have added Voortman Sawing Systems to several of our U.S. facilities as they provide faster per-cut sawing times than our traditional saws. However, the biggest advantage is the ability to stage nested products on the infeed and run the saws automatically. As a result, we have at least doubled our production rates in most cases, thereby getting steel to our customers that much faster.

For more information, visit **www.sss-steel.com**.

Boosting Productivity

Vectis Automation designs and integrates cobot fabrication solutions to help manufacturers boost productivity amid the skilled labor shortage—by reducing the risk, learning curve, and cost of implementing automation. Our 150+ years of cumulative experience in the robotic fabrication industry enables us to provide substance from cradle to grave.

Numerous structural steel fabricators are leveraging Vectis tools to make precise cuts on 3D shapes, lay down heavy welds with confidence and ease, and boost productivity—often by three times or more. Our 30-day return policy, rent-to-own program, and fast lead times provide you with peace of mind to quickly start automating simple, repetitive parts, freeing up your team for more complex weldments or other value-add tasks.

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

NEED FOR SPEED

Rapid Rigging

It takes steel erectors one to two minutes per lift to release the rigging from the load and to get it ready for the next lift.

That translates to several hours per day. In addition, connectors working on the steel must release the rigging manually, putting the ironworker at risk each time. This process costs erectors between $30,000 and $100,000 per crew per year.

An alternative that speeds up the process and reduces risk is to use remotely controlled lifting hooks from OTH Pioneer Rigging. With unlimited hooks synchronized on the same remote, users can design their own setup. Both LudwigHook models (4,400-lb and 11,600-lb working load limits) work with vertical, basket, or choker setups and any kind of attachment (wire rope, nylon rope, chains, eye bolts, etc.) to lift up to 100,000 lb.

For a high-cycle like steel erection, this can save up to four hours per day just by cutting the amount of time it takes to release loads. In these applications, the average time for contractors to see a return on their investment is less than ten weeks.

The remote control is color-coded to coordinate with hooks, which can be opened all at once or one at a time. With a range of 200 ft, the remote control triggers an opening mechanism, and a two-button release sequence is required to open the hook. This below-the-hook lifting device features a mechanical fall protection design that switches off the opening mechanism of the hook during the lift.

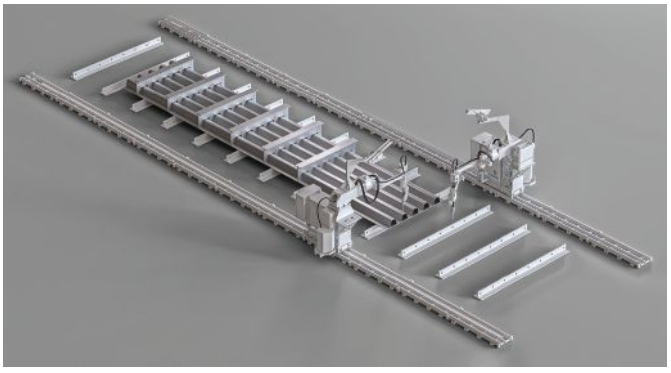
The rugged design and streamlined shape of the hook are designed for work in harsh environments, and the hooks feature long-lasting battery life, capable of making more than 100 lifts per day for a full week before recharging is required. The hook remains locked if the battery is fully discharged.

Erectors placing trusses, columns, and even panelized joists have all experienced success with the LudwigHooks. Jeremy Ratledge, a project manager with AISC member fabricator Piedmont Structural Company, shared his experience using the lifting hooks to lift panelized joists method using their custom lifting frame.

"This was awesome!" he said. "Workers on the ground can prep the joists for hoisting in a few seconds. Once the panel is in place and secured by bolted connections or welds, a simple push of two buttons released all 10 Ludwig hooks at once."

"It has always been our belief that any task that can be performed on the ground prior to the lift reduces risk for the ironworkers in the air," he continued. "Using these hooks permits the bay of panelized joists to be erected without an ironworker walking out to release them and reduces the possibility of 'pinch points and crushed by' resulting from ironworkers positioning themselves in a boom lift platform between each joist to release rigging. It also speeds up production by eliminating open hooks from becoming entangled in bridging and joist members, and it satisfies the general contractors who are looking to eliminate open hooks on job sites."

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



Bridging the Robot Gap

The main driver of robotization has always been the automotive industry. For a long time, it was believed that robots were fit only for mass production, where thousands of identical products are produced. The problem was in the robot programming.

Let's look at a real-life example of what difficulties a bridge fabricator with non-serial production can face. Imagine a 60-ft-long steel bridge deck with 80 welds. Before finishing welding, it was pre-assembled by people. This often means there are small deviations that meet the requirements of production but at the same time, change the task for robots. Also, due to the length, the structure during welding can be slightly deformed when heated, which also requires correction of the trajectories of the robots. In other words, every bridge deck from the point of conventional robotics view will be unique and require programming. The current programming methods—teach pendant or offline system programming—require a highly paid programmer and at least two to three days of their time. It's easier to keep welding parts manually. However, the shortage of welders is only getting worse.

For robots to become effective in the non-serial market, you need to solve two problems. First, stop programming. Second, be able to adapt to all possible deviations in the physical world. ABAGY's software enables autonomous welding and overcomes both challenges. The system generates robot trajectories on the fly and automatically adapts to deviations of the part or its position in the robotic cell.

Here's an example of an existing ABAGY setup with machine vision and software installed. Picture a robotic cell with two robots on two tracks in a working area of 46 ft by 9.8 ft by 4 ft. The fabricator uploads a 3D model of the product, and then their welding specialist sets the welding parameters. The rest happens automatically. In this case, the robot operator does not require special qualifications, and the process is fully automated. By using the ABAGY system, the fabricator was able to increase production from five different assembly types a month to 50 types of assemblies and easily switch from one assembly type to another.

The fabricator's first experience with an ABAGY robotic cell was a success, so they decided to install a second one—this time, using a robot with a gantry. (Note that ABAGY's system is compatible with all major robotic equipment manufacturers and can also integrate with various welding technologies.) The company has over 200 welders on staff but constantly faces shortages. But their new robotic cell has been able to perform the work of five to ten welders, increasing the arc time from 15% to 70% between manual welding and robotic welding. In addition, they've seen a 30% reduction in grinding time, a 10% reduction in wire usage, and a 10% reduction in gas usage. They've also seen a reduction in assembly defects because the parts were scanned prior to welding, greatly reducing rework time.

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

Augmenting Automation

NEED FOR SPEED

The steel fabrication industry has experienced a labor shortage for years, and recent inflationary pressures have made the situation more dire, pushing fabricators and erectors to seek out higher productivity without additional labor. One solution is to add automation and mechanization to the welding process. But in the structural steel industry, hard automation systems are not always the best solution for every application, thanks to limited working envelopes and, in some cases, require additional material handling to move the weldment to the cell.

The Steelmax portfolio of welding and cutting mechanization solutions provides many of the same benefits of hard automation solutions—but without the same capital and operator skill requirements. Plus, they are flexible enough to be used on multiple applications throughout the facility. These travel carriages are lightweight and portable and use magnetic or vacuum adhesion to the part, which reduces material handling and speeds up the entire operation. These carriages also have a virtually unlimited working envelope, so they can be easily implemented in structural beam and girder applications.

In a recent case, a fabricator customer implemented the Steelmax Rail Runner Gen III to its welding process and was able to cut the weld time down by a factor of eight when compared to its typical hand-welding method. This mechanized solution uses the same semi-automatic MIG process used when welding by hand but with increased travel speeds and a significant reduction in the number of required starts and stops. In addition, the system minimizes over-welding, with the regulated travel speed of the carriage producing the exact weld bead geometry required by the project specification, and can reduce filler metal and shielding gas usage by as much as 60%.

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

Control Tension, Accelerate Bolting

As a major supplier of structural fasteners for the North American market, we are frequently asked, "Are there options to reduce cost or time (really, the same thing!) on my project?"

The simple answer is: "Yes!"

Infasco services both the U.S. and Canadian markets. In Canada, our structural bolts are almost always supplied as a bolt, nut, and washer assembly. This is almost never the case for the U.S. market, where a bolt and nut combination is the prevalent product. But why is that? Probably because "it's always been that way."

So where is the savings? Infasco assemblies are preassembled and, in the case of galvanized products, come with a material test report with rotational capacity test results included. Without assemblies, this test must be performed onsite for each and every bolt, nut, and washer combination used. That's not cheap. So the option is there to save on labor to assemble lots as well as on performing the required rotational capacity test.

But there's a better way: tension-control (TC) bolts.

When using TC bolts, you have to look not only at the cost of the fastener itself but rather the total cost of bolting the connection. Typically, hex bolts would require two ironworkers to install, one on the head of the bolt holding it from rotation and the second driving the nut. But the single-sided tightening aspect of TC bolts requires just a single ironworker for installation. Although the cost for a TC bolt is approximately 20% higher than the hex equivalent, our studies have indicated the total cost of the bolting operation to be 50% less expensive.

Another bonus for TC usage is that they are quick to install—typically 33% to 50% faster than standard bolts—which adds the benefits of cranes being released sooner and the entire project being completed earlier. And it's a very simple system to employ. As you would with any bolted connection, ironworkers snug-tighten all TC bolts, seat the shear wrench on the nut, and pull the trigger until the tip shears off. Simple, quick, efficient, and, in most cases, foolproof.

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

NEED FOR SPEED

Reduce Waste, Increase Production Speed

Waste is an inherent problem in many industries, and welding is no different.

Every year, steel manufacturing and fabricating operations lose millions of dollars in profits. With rising materials costs and a continued deficit in the welding workforce, among other contributing factors, many welding operations are looking for ways to manage their production costs more closely. Almost all are considering implementing some form of lean management practices.

The term "lean management" has become ubiquitous in manufacturing. A quick search for the term online will generate all kinds of references, and it quickly becomes apparent that it's not about producing smaller quantities based on materials availability or cost. It's about finding efficiencies to stretch existing resources, including time, materials, and labor.

In the welding industry, unqualified welders and welding practices that impact production speed, the attrition of our more skilled welding workforce, the increasingly relentless pace of product manufacturing, inefficient inventory usage, and improper cost calculations can quickly impact the bottom line and reduce profit margins.

Going lean in welding is unique, so AWS has created a "Productivity Solutions Bundle" featuring virtual, instructor-led, and on-demand courses that cover how to improve production speed by mitigating waste and costs and providing tips for implementing lean management in a welding operation. The AWS Productivity Solutions Bundle is comprised of three courses that cover how welding operations can apply lean management processes, techniques, and principles on materials and labor resources to increase output speed and positively impact the bottom line.

- **Economics of Welding.** Learn to identify, measure, and manage production costs to reduce expenses and ensure quality. Topics of this self-paced course include welding process variables, weld procedure specifications, calculating weld metal volume and deposition rates, and managing the costs of labor, materials, equipment, and overhead.
- **Lean Management for Productivity.** A powerful resource for business owners looking to improve their processes and increase profits. This online, self-paced course differentiates value-added and non-value-added activities and their impact on manufacturing processes and applies learned principles to true-to-life scenarios.
- **Webinar:** How to Increase your Facility's Productivity. This virtual, instructor-led course breaks down the lean process and other project management principles that guarantee waste reduction and improved productivity. You'll learn how to identify waste types, understand lean means, set up a pilot program, and work with management to continue lean principles in your field.

It's easy to get trapped in the "but we've always done it this way" or "if it's not broken, don't fix it" mindset. But every welding facility has opportunities for process improvement to increase productivity. Change isn't easy, and adopting new practices throughout the organization will rock its boat more than a few times as they're implemented. But the long-term benefits of diligence and attention to detail now will reap more rewards over today's avoidance of addressing serious issues.

For more information, visit **aws.org/psb**.

NEED FOR SPEED

Deck Delivered Quickly

Need metal deck—quickly? A.C.T. Metal Deck Supply can help in multiple ways when speed is a factor.

Regional access and immediate availability. We have 15 locations in 11 states with a complete inventory of metal roofs, forms, and composite floor deck in stock for immediate use. Many fabricators will use our inventory for a complete project to avoid long lead times or fill in gaps on large projects due to change orders, damaged material, mistakes, etc. Material can be picked up or shipped within hours or cut to size and ready often within a day.

Established relationships. Since we've been in the metal deck business since 1970, we've developed many collaborative and long-term relationships with Steel Deck Institute member manufacturers, which affords us a much larger network of options and solutions than most project managers have at their fingertips. Engaging us often saves thousands of dollars in delays and lost labor hours while freeing up project managers to focus on the steel.

Project management. Prior to being a metal deck supplier, we were a metal deck subcontractor for 37 years, supplying and installing metal deck with our own crews of sheet metal and ironworkers. We gained the expertise needed to project manage jobs anywhere. We can do everything except the installation, including takeoffs, drawings, cut lists, accessories, submittals, scheduling, and delivery. Our team can identify potential mistakes on drawings prior to submittal, saving valuable time in revisions. Managing all the aspects of the metal deck, again, frees up the fabricator to focus on the steel.

Joist conversion to wide-flange beams and deck shortages. Many projects since 2021 that were designed with bar joists have been converted to wide-flange beams due to the dramatic delays when it comes to joists. The building frame schedule was solved, but there were also never-before-seen shortages on deck. We were able to help many of these jobs that were delayed months stay on track by either supplying deck from inventory or because we knew of and had relationships with the only plants that had available steel.

Rapid replacement. Remodeling, repair, and replacement constitute a large part of our industry. Some project requirements are not exactly known until demolition or the existing structure is opened. These scenarios often lead to urgent material requirements at some point to keep the job moving. We work daily with contractors needing to identify and match existing obsolete deck profiles to cover in-fills, tie into an existing structure, and even replace material that Mother Nature removed.

"You are on the fastest route." Working with metal deck daily for over 50 years, our customers know they can count on us as a resource even if we don't end up selling a product or service. A great business partner should be like a good navigation system. Sometimes there are no faster options available but knowing you have an expert advisor who can confirm that "you are on the fastest route" can be invaluable.

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

NEED FOR SPEED

Double Time

Founded in 1975 as TC Bolt Corporation, GWY, LLC, has grown to be a global leader specializing in bolting tools, services, and expertise. We provide several product lines equipped to handle the most demanding industrial applications and projects from all over the world.

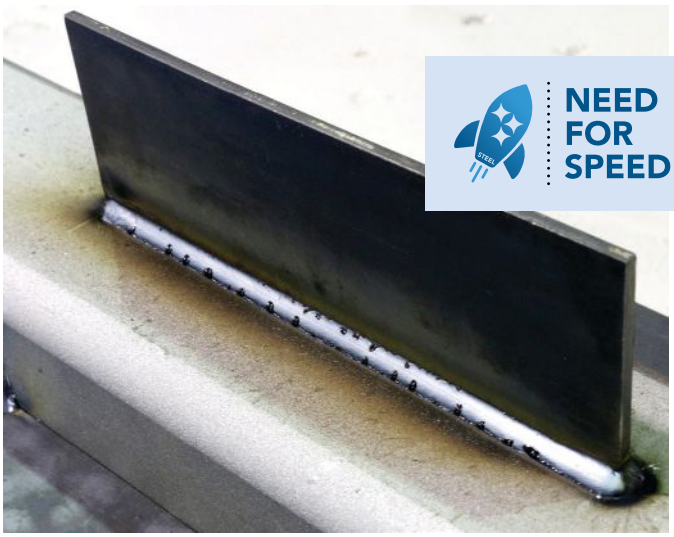
Our tools gained popularity with a local construction company when they observed two iron workers using a specialized turn-of-nut wrench while simultaneously having a conversation on a Monday morning. Prior to these wrenches, productivity was greatly impacted by these verbal exchanges between each bolt installment.

Compared to slow hydraulic and loud pneumatic wrenches, which are accompanied by large systems such as hoses, compressors, and pumps, electric wrenches provide an easier setup with access to a sufficient power supply. The tools we offer present several other benefits over other application methods, including higher accuracy, minimal noise levels, and lighter weight. There are even cordless and manual options for better access and maneuverability around the job site.

Regardless of the application, there are plenty of tool solutions that deliver the right amount of power from a project's inception to its completion. Our expansive product line consists of shear, torque, and turn-of-nut wrenches, as well as calibration, hydraulic, and rebar-tying tools. Our selection of tools provides multiple user-friendly features and advantages to make a day's worth of work less physically demanding.

We provide a large selection of corded electric turn-of-nut wrenches available in standard and minimal clearance models. These wrenches include interchangeable bar sockets with reaction arms that automatically tighten the bolt assembly to the preset rotation every time. The installation reaction is absorbed by the wrenches' reaction arm instead of the worker, resulting in less fatigue. The wrenches don't require job site calibration and are compliant with international standards using the turn-of-nut method of installation, which tightens bolts 100% more efficiently, allowing workers to tighten twice as many bolts in a shift over the conventional process.

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



NEED FOR SPEED

Smart Software, Rapid Robots

One of the final automation frontiers to be tackled has been the welding of structural steel attachments.

Historically, robotic welding required an investment of time to teach the robot what to do, and while that paid massive dividends in high-volume repetitive production environments, such as automotive manufacturing, it never made sense for structural steel, where every component can be totally unique.

However, all this has changed with the incredible advancements in software. And today, Ocean Machinery's manufacturing partner AGT's software, Coretex, can analyze an entire Tekla or SDS2 3D model and automatically generate the movement and welding paths for the precise, repeatable welding of every attachment, with no programming or teaching necessary—a total game changer.

This has translated into significant real-world productivity enhancements observed by all our customers in multiple ways. For example:

- AISC member fabricator McCombs Steel Company in North Carolina, which now has three robots, was immediately able to reduce the welding time for a warehouse column from 90 minutes to 17 minutes.
- AISC member fabricator Mid-City Steel in Wisconsin observed that its Challenger robot was laying down welds at a rate of 500 lb of wire per month compared to the typical manual welder rate of around 150 lb per month.
- Another structural fabricator, in Texas, with multiple robots—and one of only a few companies to measure arc-on time—reports that its robot was performing at 33% arc-on time compared to a typical welder of 7% to 8%.

All of these real-world observations indicate productivity of three to five times better on a single shift and significantly better when running multiple shifts. This allows fabricators to fabricate steel accurately, hour after hour, shift after shift, at a rate that they had never been able to achieve before.

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

NEED FOR SPEED

Durable Identification Saves You Time

A quick Google search estimates that Americans spend a collective *54 million hours every day* looking for stuff.

If that stuff is structural steel, that time can quickly add up and slow down a fabrication or construction project. Effective identification makes traceability possible, so the time spent on important projects is spent moving them forward.

Effectively identifying the components of fabrication and construction projects isn't as simple as slapping on a sticky label. Steel requires durable identification as it is subjected to reheating, rolling, pickling, painting, galvanizing, and other processes. While the exact conditions for every component of a project vary, the need for durable identification remains.

InfoSight provides durable identification for materials that are subjected to harsh environments. InfoTag High Temp was the first tag introduced by InfoSight to survive extremely high temperatures. Fabricators typically choose ShotTag™, PaintTag™, the new PowderCoat Tag™, and KettleTagPLUS®. These tags allow fabricators to identify pieces of steel with traditional or 2D barcodes (like QR or DataMatrix) and track their pieces through processes that destroy lesser identification.

Barcodes are powerful identification tools that allow quick access to information. AISC member Central Texas Iron Works was the first major American structural steel fabricator to use InfoSight tags to track each member through production, completion, loading, shipment to galvanizers, and tracking to the end user at a job site. The barcoded tag provides easy access to all the information associated with the piece as it goes through production, such as weight, size, the project PO number, and the area number where it will be delivered—essentially a billboard of information. This tracking process reduces paperwork and errors and saves time. One example of how CTIW uses InfoSight Tags to save time and money is shipping. As each piece is loaded onto a truck, it is automatically added to a bill of lading. Tracking the weight ensures a full 20 tons of steel is loaded onto a truck. A CTIW manager says, "InfoSight barcoded tags are a *tool* that allows us to keep up with the faster-moving manufacturing process. This tool is important to the whole process."

InfoSight continually improves our products so that our customers can create unique identification tags faster. The LabeLase®1000 small desktop laser metal tag printer was developed specifically for fabricators to create on-demand unique barcoded tags for their pieces. Our latest printer models continue to lead the market with three to five times faster print cycles. The free LabeLase Producer Software enables customers to create unique tag layouts, provides advice to optimize print times, and now controls up to four printers from one PC. The lineup of tags continues to expand with new features and benefits that make them easier and faster to create than ever before.

Traceability saves time, and identification is critically important to traceability. It must be legible by both people *and* barcode scanners until the very end.

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

NEED FOR SPEED

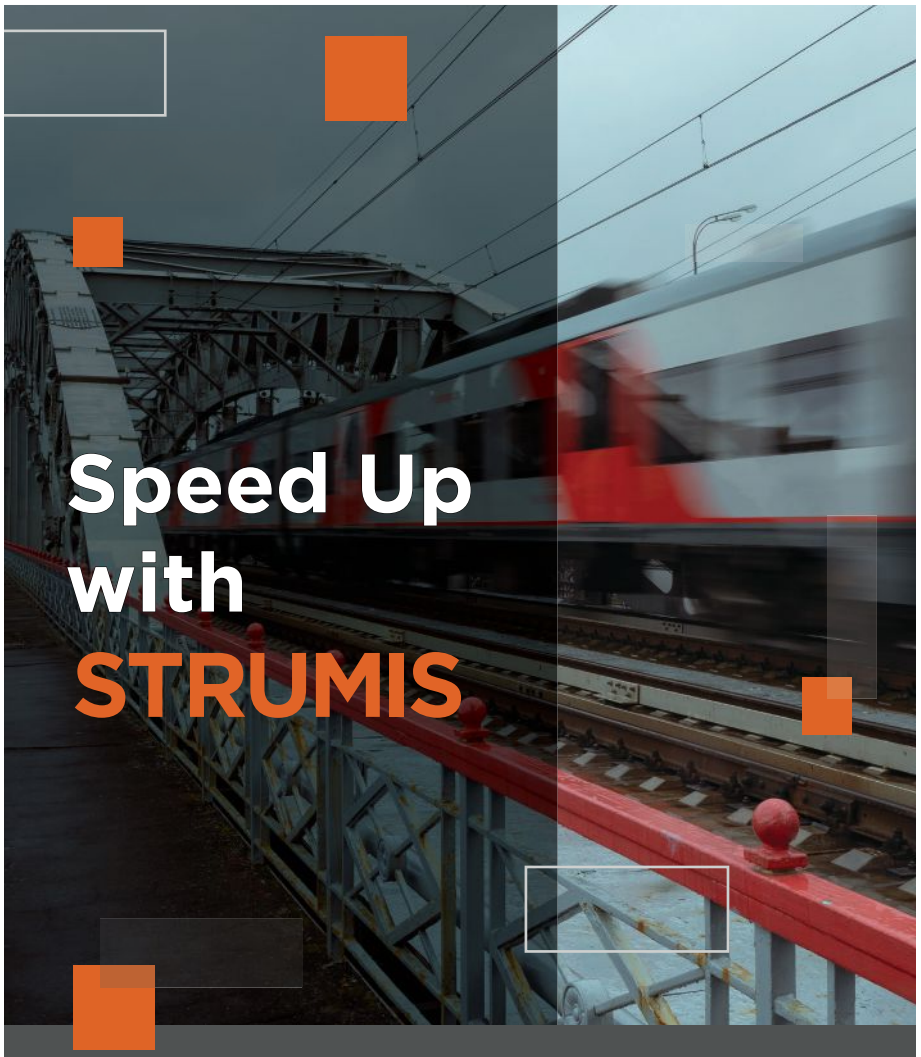
A Streamlined Shop

STRUMIS is an easy-to-use, all-in-one management information software solution for the steel fabrication industry. Designed with speed and efficiency in mind, STRUMIS streamlines fabrication shop processes from start to finish, reducing waste (by an average of 5% to 10% annually!) and costs while maximizing productivity and schedule.

The package is designed to be comprehensive enough to manage every detail of a project at any stage—whether estimation, document management, or production—while also offering inventory and procurement management. For STRUMIS to function as the backbone of your entire shop, it needs to do everything you do, and the simple implementation process customizes STRUMIS to replicate your workflow with our dedicated team. It conveniently integrates with your existing accounting and ERP systems to create a more unified digital environment and also provides seamless integration using bi-directional sync with popular CAD systems like Tekla, SDS2, SolidWorks, Inventor, and Advance Steel. Additionally, it connects to CNC machinery directly using NC files coded to your specifications, allowing your CNC machinery to push progress updates back to STRUMIS to track your production speed.

In today's busy and hyperconnected world, the option of using your business software remotely is essential. We understand the importance of mobility and meeting fast-paced demand, which is why you can access STRUMIS through any web browser using STRUMIS Vision and take advantage of our barcoding functionality by using our free and unlimited Mobility App. All of these factors add up to a software solution that can accelerate a steel fabrication project.

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



When everything in your steel fabrication shop is working together, you see less waste and more product, and you see it faster than before.

All it takes is a comprehensive steel MRP software solution that brings every aspect of your shop into tight formation. By integrating production control, material usage, and traceability, STRUMIS is that software solution

Backed by nearly four decades of hands-on experience in the steel industry, STRUMIS was designed with your shop's success in sight.

Ready to get more out of your production floor? Visit strumis.com/msc

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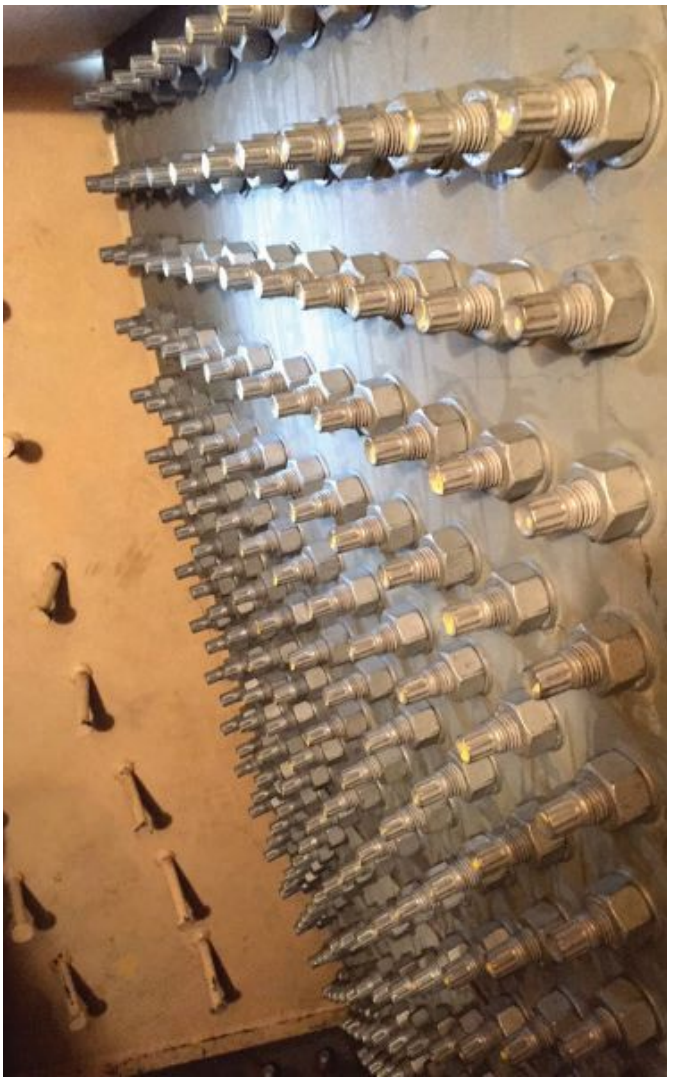


Stronger and Speedier

As supply chain issues continue to inflate material and labor costs, they can also derail carefully crafted schedules. A new structural fastening system helps to keep costs on track and schedules moving forward quickly.

Manufactured as ASTM F3148 144-ksi fixed-spline fastener assemblies, the new structural fastening solution provides a 20% increase in tensile strength and a 25% increase in minimum pretension when compared to Group 120 bolts (Grade A325 and F1852). The higher strength not only retains the inherent benefits of A325—low cost, ductility, and reliability—but also adds the potential for significantly reduced hole and bolt counts. The result? Less steel fabrication time and fewer bolt installations. The 144-ksi strength level is the perfect complement for higher-strength steels, increasing overall joint efficiency and doing it safely.

The new fastener system uses the combined method of pretensioning, recently approved and added as an installation method in the 2020 edition of RCSC *Specification for Structural Joints Using High-Strength Bolts* (**aisc.org/specifications**). The combined method uses torque for initial tightening and angle (degree of rotation) for final pretensioning, all done using a single tool and operator from one side of the connection. The result is significant installation savings when compared to traditional pretensioning methods like turn-of-nut.

Not limited to pretensioned applications, F3148 assemblies can be cost-effectively used in bearing connections and easily installed to the snug-tight condition using the "initial" or "snug" setting on the tool. And since the bolts are only sold and shipped as preassembled and pre-tested assemblies, life at the job site is considerably simplified. When preinstallation verification testing is required, the fixed spline on the bolt and the reversible tool make quick work of what can be a tedious process with other methods. No more loud impact guns or bouncing on a cheater bar.

How many hours (or days) and dollars have been lost to bolt failures and the associated arbitration inspection, retesting, and even bolt replacement? The new fastening system considers the fastener assembly, the installation tool, and the method of installation and brings pretensioning reliability to a new standard, designed and integrated from the ground up to provide reliability through topping out.

ASTM F3148 is marketed by LeJeune Bolt Company as the TNA Torque + Angle Fastening System, bringing with it a promise of fast, safe, and cost-effective bolting—and the lowest cost per kip.

For more information, visit **www.tightenright.com** or **www.lejeunebolt.com**.

NEED FOR SPEED

Clamping Down, Speeding Up

In 2017 the Las Vegas (formerly Oakland) Raiders announced plans to build a world-class stadium in Las Vegas and move from their old stadium in Oakland. Construction of Allegiant Stadium began in November 2017 and was completed by the summer of 2020 (and its steel was fabricated by AISC member Hershberger Bros. Welding, Inc.). The stadium is one of the most impressive, high-tech, and expensive sports venues on the planet, with a final cost of $1.9 billion.

One of the distinctive features of the stadium is the huge 275-ft electronic media mesh video screen on the exterior. During construction, it looked like a delay in connecting the steel framework for the screen would occur because the original connection method did not meet the authority having jurisdiction's (AHJ) requirement that proprietary connectors should have third-party approval. The contractor contacted a local Lindapter distributor to see if they had a solution to this problem and avoid costly delays.

Naturally, the local building authority insisted that the clamping system must be independently approved, so it was quickly reassured after reviewing ESR-3976, which is published by the International Code Council Evaluation Service and approves the use of Lindapter Girder Clamps to resist wind and seismic loads in all seismic regions. (Using Lindapter Girder Clamps has demonstrated the ability to be 50% faster than field welding applications and 28% faster than drilling and bolting.)

After receiving details of the structural columns used in the stadium construction and the expected load demands of the screen's steel framework, Lindapter's technical support team was able to propose a solution. Several connection details were designed, incorporating steel brackets and plates connected to the structural steel using Lindapter Type AAF adjustable high-slip-resistance girder clamps. The design included Type AAF clamps with ½-in.-diameter grade A325 bolts in standard two-bolt and four-bolt configurations.

The contractor ended up using 4,200 Type AAF Girder Clamps to connect the brackets and plates to the structural columns. Installation was quick and easy as the connection assemblies could be positioned close to where they were needed before final adjustments were made and the clamps fully tightened. Before the electronic media mesh video screen was installed, the clamps and assemblies were all painted black to match the color scheme of the stadium.

Type AAF Girder Clamps provided a drilling and weld-free connection that was quick and easy to install while working at height. They also satisfied the AHJ requirements as the Type AAF girder clamps have independent technical accreditations, including ICC-ES approval for structural and seismic design.

Recently, some adjustments to the LED panels were needed. Fortunately, Girder Clamps can be easily removed and then reused. Had the display been welded, the time and cost to break, grind, and then reweld (once again hanging and continuously moving the protective thermal blankets) would have been enormous.

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

NEED FOR SPEED

Rapid Remote, Robotic Repair

Every day in the United States, 188 million vehicles pass over structurally deficient bridges. Each year, hundreds of injuries and even deaths occur from decaying infrastructure. In the coming years, the Infrastructure Investment and Jobs Act will invest nearly $27 billion into repairs. Along with that, labor shortages are affecting contractors' abilities to keep up.

As a result, more and more steel bridge repair project teams are turning to Brokk remote-controlled demolition machines and Aquajet (a subsidiary of Brokk) hydro-demolition robots as solutions. These remote-controlled and robotic machines provide more safety, productivity, and efficiency for removing concrete around rebar on steel bridge deck than handheld tools, mini-excavators, and backhoes—and without damaging the steel superstructure below.

As an example, hydro-demolition robots can remove as much as 800 sq. ft of bridge deck at a depth of 4 in. in just an hour, a fraction of the time it would take a crew of workers with jackhammers. They also virtually eliminate the possibility of micro-fracturing and unintended damage during bridge repair or rehabilitation. The 20,000-psi water jets target the bridge deck surface, quickly removing layers of concrete but leaving the rebar unscathed and clean. There's no need to spend extra time carefully avoiding rebar because the high-pressure water, though devastating to concrete, doesn't damage the metal bars.

Alternatively, a remote-controlled demolition machine equipped with a breaker attachment and controlled by an operator and one spotter can break up 2 sq. ft of steel bridge deck concrete in 15 minutes. The same area in the same amount of time would require three workers with handheld tools. These machines drop labor costs by 33%, accomplish the job faster, and greatly reduce the risk of injury. Plus, it's a lot easier to recruit young workers to run these remote-controlled machines and hydro-demolition robots as opposed to handheld tools.

With the passing of the Infrastructure Investment and Jobs Act, the contractors that prepare, plan and incorporate technology solutions into their business will be able to successfully, efficiently, and profitably address bridge repair needs.

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

NEED FOR SPEED

To the Skies!

A friend's death during a rescue operation—with a helicopter close but unable to stabilize due to weather and terrain—was the impetus for Caleb Carr to found Vita Inclinata in 2015. The company's industrial arm, Vita Industrial, manufactures systems that are designed to control chaotic swinging and spinning in heavy crane lifts, enhancing precision, efficiency, and safety for lifting operations. Under Vita Aerospace, the company also offers load stabilization technology for helicopter rescue (hoist) operations.

Vita Industrial's chief product, the Vita Load Navigator, is a remotely operated, suspended load system that implements load stabilization technology. The device uses an aviation sensor suited to sense position and motion and automatically stabilizes loads, ensuring high-precision lifts in even the most challenging environments. The Navigator captures well over 1,000 data points per second and feeds the motion control engine to dynamically adjust to load sizes, crane movement, and environmental conditions. Four independent electric thrusters' pulse vectored air to reorient the load either autonomously or by a user via the single-hand control pendant. Depending on the complexity of the lift, the system can save minutes to hours on a per-lift basis. Internal trials have registered, on average, a 20% to 50% increase in efficiency. In addition, weather conditions that would have slowed down operations can be significantly mitigated using the system.

The Navigator can continually hold loads with up to 1° precision, also enabling the operator to position and reorient a load within 1° of accuracy, and can handle loads of up to 40 tons. The wireless system has a handshake feature that enables one operator to pass control to another operator in a different position that is optimally situated to place a load due to their line of sight. Remote control response time is under a second, allowing for fast reactivity and reorientation.

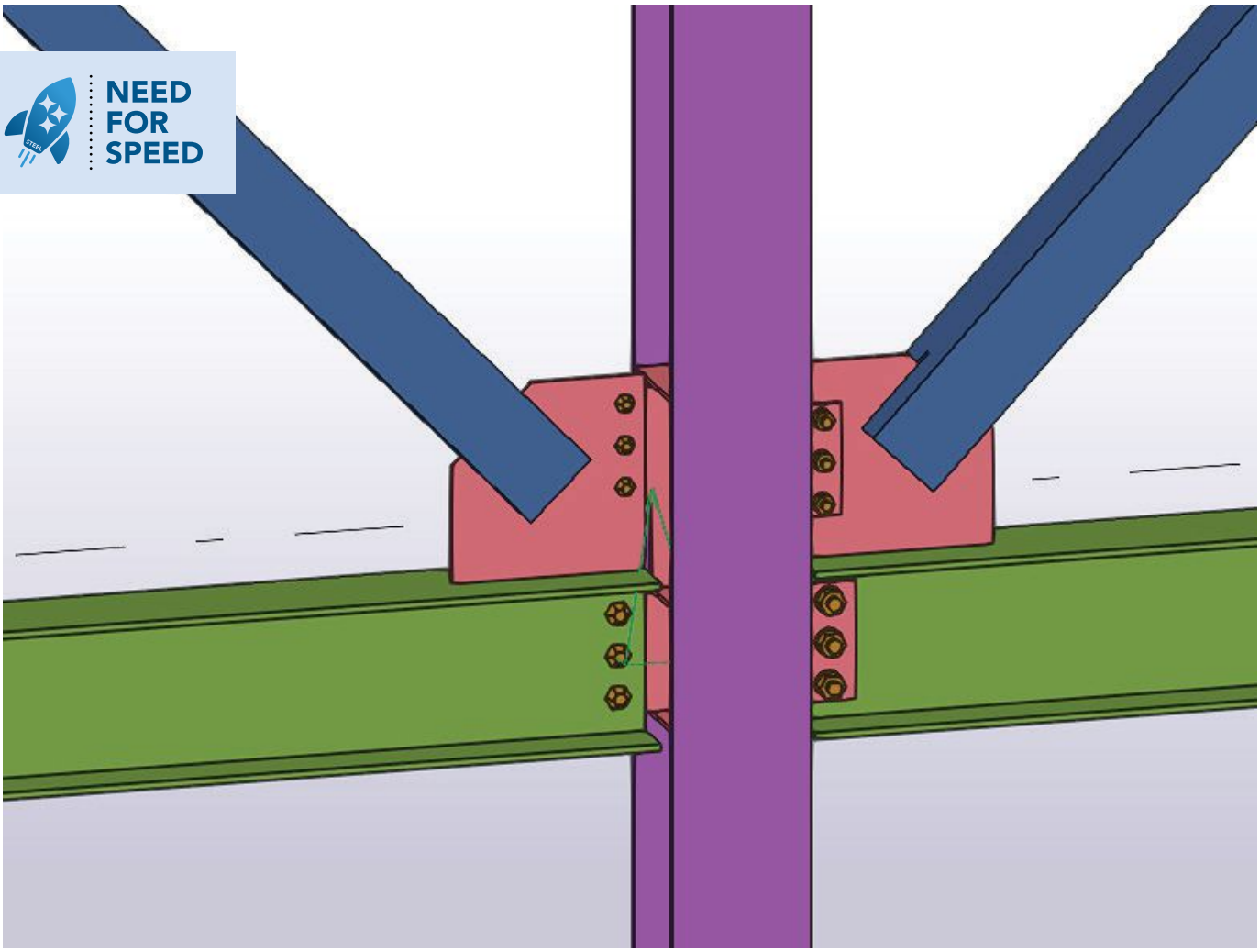
High wind speed exerts a large force on loads. This makes the crane use some of its load capacity to withstand this force and reduce its effective capacity. Neglecting the effect of high wind could lead to miscalculation of the crane capacity and raise serious safety concerns on the job site. High wind could also cause load spinning, which leads to job site accidents. The thruster technology in the Navigator stabilizes loads and enables control in wind gusts as high as 30 knots. This increase in wind envelopes allows the crane to operate on more occasions, thus increasing crane usage and expediting construction progress.

When it comes to taglines, they are inefficient, unstable, and, more importantly, dangerous. With the Navigator, loads remain stable, in a pre-set orientation, despite wind impacts on the load. This eliminates the need for long taglines and significantly enhances operational efficiency and safety. Load stabilization technology enables crews to place loads exactly where they want without running a tagline at the ground level. Not only is this a much better use of space and labor, but it's also much safer.

Navigators are already being used at construction sites. For example, Creative Lifting Services has tested the Navigator for a tower crane erection on a busy city block in Boulder, Colo., and was impressed by the performance. There is a Navigator deployed on a wind farm in Texas for tower construction and another helping with construction at an oil refinery. According to Vita Industrial, customers are happy with the increased efficiency and safety they are seeing so far.

For more information, visit **www.vitaindustrial.co**.

NEED FOR SPEED



Connect, Quickly

As an industry, we need speed. But we can't sacrifice quality or cost to get it.

QuickQnect connection software delivers hyper-speed while improving quality and lowering cost simultaneously.

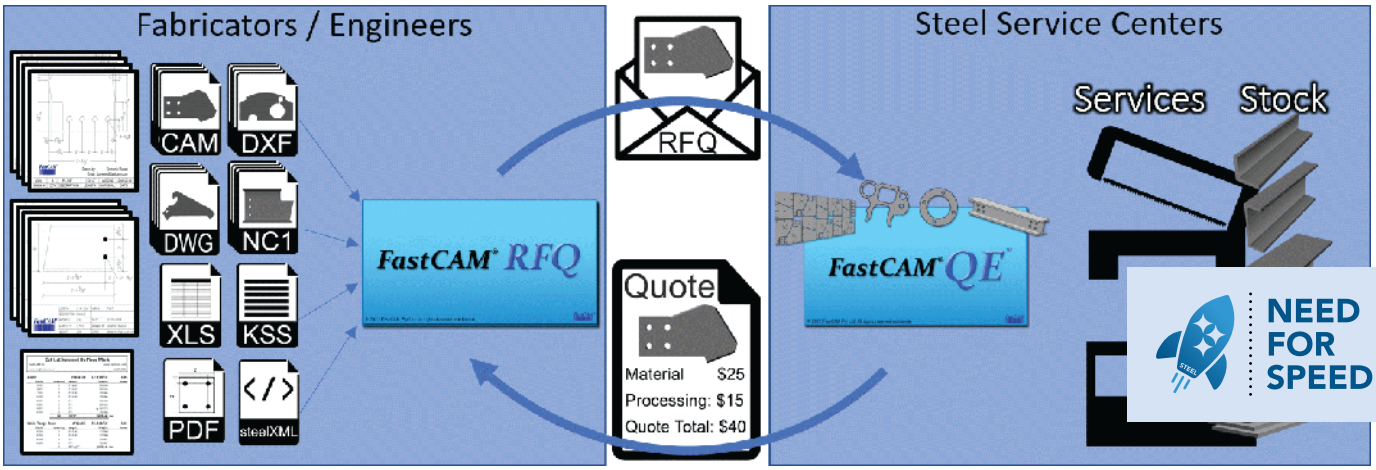
We do this by leveraging all of the software advances from the last 50 years. We deploy software shortcuts, machine learning, auto-scaling of servers, the most modern database system, integration of our detailing with our engineering services, communication maps and reports to analyze data, a review/approval process, near-instant calculations to determine the lowest-cost connections, revisions, cloud-based data crunching, and tech support—all with unusual speed.

All of this results in three things:

1. Schedule compression. Qnect offers an "integrated steel delivery" process (ISD) that allows the model to be 100% connected much earlier than conventional processes, leaving more time for design development and RFI avoidance. By using speed to Qnect the model, we can now hit earlier mill roll dates and determine exact steel lengths, eliminating shop floor "drop" waste and uncertainty. The time (and cost) for revisions and for review/approval drops significantly. All connection codes are placed on the shop drawings, and we have a special tool to quickly and easily approve connections.
2. Material reduction. By optimizing the bolt spacing using a patented, iterative process, Qnect is often able to reduce excess bolts by two to four bolts per ton. Weld and plate costs go down too. By Qnecting the project ten times, we can now maximize efficiency by exploring what the best connection type is, the best bolt size, the best bracing system, etc. It's also critical to have early, fast knowledge of the high-cost, complex areas in a building to ensure that we have maximum time to fix and value-engineer such trouble spots. Ultimately, this will lead to faster, better construction.
3. Quality improvements. All these speed benefits ultimately lead to a better project overall. Fewer doublers, fewer bolts, less labor, less steel, shop assemblies versus field work, less embedded carbon due to less steel, and early BIM coordination.

In the face of labor shortages and demands for high-quality and efficient construction, the steel industry needs all the help it can get. Qnect's speedy automation of engineering, detailing, optimizing, and analyzing helps counter the challenges of structural steel construction—quickly.

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



Expediting Your Order

Developments in computing power, 3D design tools, and internet communications have driven faster innovative steel designs. But like a freeway project, overall speed is limited by the slowest links in the steel supply chain, including the traditionally manual process of getting quotes for materials.

Quote requests typically include a combination of spreadsheets, PDFs, and CAD files. Spreadsheets are used for stock orders, while DXF files are used for parts cut from plate. Structural sections are defined using NC1 files. Individual DXF or DWG files don't include electronic properties to convey material, thickness, or quantity, which often leads to a separate bill of material containing the missing information.

Naming the material presents its own unique challenges and often results in many names existing for the same item—e.g., a Square hollow structural section measuring 6 in. by 6 in. with a ½-in.thick wall may be expressed as HSS6x0.500 or HSS6x6X1/2.

Steel vendors receiving these quote requests must visually review these disparate formats and naming conventions, then organize and sort stock and part requirements in what is often a lengthy manual data-entry process, which can range from hours to days.

But the business of requesting pricing doesn't have to be a weak link.

FastCAM® RFQ™ (Request for Quote) is free software that enables steel buyers to create detailed quote requests for stock and processed parts, including plate and structural sections.

FastCAM RFQ includes a comprehensive catalog using AISC's standard naming convention for structural steel products and instantly calculates part weights. Import existing CAM, DXF, DWG, NC1 (DSTV), and KSS files—or simply cut and paste or enter data and requirements for each part. FastCAM RFQ electronically saves material and quantities with each part's true shape geometry, including profiling, internal penetrations, beveling, drilled holes, and marking, and even includes details on mitres, drilled holes, and robotic copes. All information is saved in a single electronic file that can be emailed directly to steel vendors.

Steel vendors can quote directly from RFQ files using FastCAM QE™ rapid-response quotation software. With no need to retype part requirements or perform manual take-offs, even complex quotes requiring value-added processing can be completed in minutes.

This new standard of trading in RFQ files digitally transforms what has long been a cumbersome process into one of the strongest and fastest areas of the steel supply chain.

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

NEED FOR SPEED

More Fits and Cuts in Less Time

Efficient material handling is one of the main schedule challenges with structural steel fabrication, and therefore any reduction in handling positively affects the bottom line and improves throughput and speed.

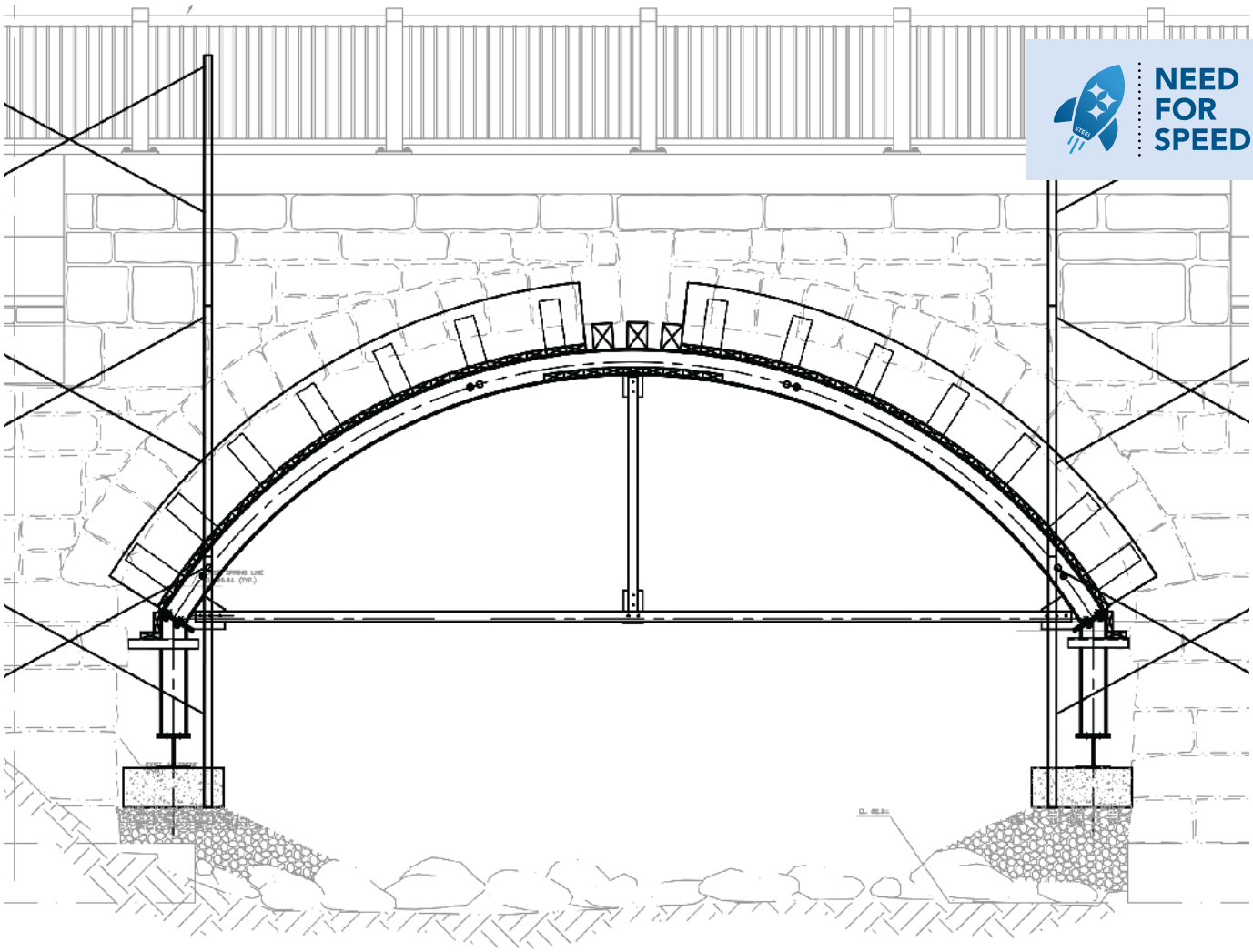
An increasingly popular method for enhancing material handling is implementing robots for plasma-cutting operations. Prodevco Robotic Solutions' systems have helped structural steel fabricators complete more than 200 projects via its specialized robotic equipment, which incorporates laser-measuring technology to maximize precision.

The company's PCR42 and PCR41 robot plasma cutting systems increase productivity by allowing the fabricator to handle the members just once to prepare the subassemblies for final fitting and welding. From there, the robotic cell performs cuts, copes, bevels, holes, and scribing functions in one pass, and the through-feed process minimizes handling and allows for continuous production. The result is up to a tenfold increase in productivity when compared to individual manual processes, as well as a significant decrease in the number of costly fitting errors.

The user-friendly interface uses DSTV(NC1) files and accepts them directly from 3D detailing software. The machines are also equipped with a laser measuring system and rotary encoder that can determine material length and deviations, resulting in optimal cutting accuracy. The PCR42 model includes a seventh rotary axis that adds the capability of two-zone processing, which helps to reduce material indexing time.

In addition to the PCR models, Prodevco has also recently introduced the Profitter 2, a fitting station that allows an operator to fit up assemblies without needing in-depth fitting knowledge. The assembly drawings are projected onto the structural members with ease and accuracy, allowing a worker with minimal training to perform the function of a fitter and allowing a fabricator to increase volume and speed up the production without competing for skilled labor.

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



NEED FOR SPEED

Rolling Along (Faster)

When it comes to successful steel projects, speed is key.

In order to keep up with demands and help assist with steel design and construction in the detailing office, in the fabrication shop, and on the job site, you need to have the assurance of a reliable partner—especially when it comes to curved steel.

With over 100 years of combined experience in curving steel of all shapes and sizes, Chicago Metal Rolled Products (CMRP) take pride in the expertise of our employees, the advancement of our state-of-the-art equipment, and our cost-effective and error-free steel bending process—and we know how to collaborate with customers to shorten project schedules.

One example involved a general contractor working on the renovation and expansion of a car bridge over the Charles River at the Needham-Newton border in Massachusetts. The contractor needed to figure out a way to build a temporary arch support for the existing stone arches that could support the working load of two Komatsu PC490 LC-10 excavators. This support structure was to be positioned under the north and center spans of the bridge to help complete the construction of the cantilevered sidewalk system on both sides of the bridge. Being tasked with finding the "biggest, strongest beam" that could be curved to a 14-ft radius without any structural damage to the beam, CMRP came up with a design that used eight pieces of W10×68 and 16 pieces of W8×31 curved on the strong axis to the requested radius.

Typically, a general contractor will send architectural/structural drawings to fabricators, who will then get pricing from a bender-roller at bid time, and then a fabricator will be awarded the project (usually based on lowest price). The fabricator will then produce detailed fabrication drawings that they will send to the bender-roller when they are ready to order—a process that can take over a year. On this project, CMRP circumvented this scenario and delivered a finished product to the job site in just 30 days. How? By proactively providing an accurate solution in the initial design phase, expediting our curving production, and pulling in one of our trusted customers to fabricate the curved beams. Without these temporary steel support beams, construction could not start, as the bridge would not have been able to hold all the heavy excavators traveling over the bridge.

If you're considering curved steel for a project, much like consulting a steel fabricator early, you should engage a bender-roller as early as possible. You can see a map and contact information for AISC member bender-rollers at **aisc.org/benders**.

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

NEED FOR SPEED

Faster Computing, Faster Projects

Year after year, Graitec's software releases bring new user-centric features based on customer requests and the industry's ever-increasing need for faster projects.

Our BIM Connect technology lets engineers and steel detailers accomplish their work faster and avoid errors by working in an ecosystem that connects, exchanges, and leverages structural modeling, analysis, and detailing information from design to fabrication. And the latest edition of Advance Design (2023) brings several changes that result in a significant decrease in the time required for calculations:

- **Improvements to our calculation solver and program architecture.** These have helped to increase the speed at which finite element method (FEM) calculations can be made.
- **Changes in how results for combinations are calculated.** Previously, the results for each linear combination for each node were determined and saved to a file during the calculation. Now, the results are calculated while displaying the results, which has dramatically reduced the size of the project's electronic footprint as well as significantly reduced computation time.
- **Optimization of verification procedures for steel elements.** These changes are related to the design procedures for steel members according to the AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303) and other standards and result in a significant reduction in design time.

The cumulative effect of these changes is a 60% reduction in FEM calculation time and a 70% reduction in steel design time.

In addition, Graitec also offers the PowerPack add-on to Autodesk's Advance Steel software. It boosts productivity by providing a wide range of commands to automate repetitive tasks. With special extensions for stairs and railings, users also have access to a library with a variety of parametric and intelligent advanced connections. According to customers, it reduces the average design time on a project from 25% to 50%.

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

Fewer Steps, Faster Tech, Less Downtime, More Digitalization

Steel construction has a lot of advantages over other building types, especially when it comes to the speed at which a building can be constructed. Yet even steel construction projects can be made more productive, and there are tangible ways to help get more efficiency on job sites.

Reduce the number of steps to complete the same job. To speed up the installation of anchors, for instance, it is possible to eliminate the separate step of cleaning the holes. The next generation of the Hilti SafeSet system helps improve the additional steps of anchor installation. By eliminating hole cleaning with the Hilti vacuum cleaners with hollow drill bits or onboard dust removal systems, up to 60% of installation time is saved.

Another example is eliminating time spent moving generators around a jobsite. Hilti's new all-in-one cordless tool platform, Nuron, brings together all of the tools, technology, and services needed to help keep projects on schedule.

Adopt a faster technology. The labor-intensive and slow welding work for metal deck can be replaced with mechanically attached metal sheets. Hilti mechanical fasteners for metal decking offer significant advantages, including rain-or-shine installation, simple visual inspection, and a reliable connection that meets or exceeds codes code requirements.

Another tool that can help speed up onsite work is Hilti's cordless impact wrench SIW 6AT, which, combined with the SI AT module, speeds up mechanical anchor installations when compared to manual torque wrenches. This system also helps avoid over and under-torquing anchors. Simply point the module's barcode reader at the box of Hilti anchors being installed and pull the trigger.

Reduce downtime. Hilti Tool Services, including Tool Fleet Management, focuses on delivering greater productivity gains, better cost control, and simplified solutions to help manage the workforce and the job site. And with Hilti Replenish, there is no need to slow down the project while waiting for tool consumables to be restocked. Lastly, Hilti Smart is a fixed-rate subscription that combines flat-rate freight with other services designed to boost efficiency, productivity, and safety. Instead of emergency trips to a store, items are delivered to the job site at no extra cost (not available in all bundles).

Digitalize the operation. Fieldwire by Hilti is a leading job-site management platform for construction that makes it easy for contractors to coordinate crews in the field on large construction operations, improving trade productivity by more than 12% on average. The platform has already been used by general contractors and specialty contractors alike on more than 1,000,000 projects worldwide in 100 countries and is known for its field-first approach to productivity.

Further digitizing job-site operations, Hilti's ON!Track is digital asset management, which is built for contractors and includes the hardware, software, and support needed to cut expenditures on physical assets, free up hours to use where they're needed most, and help eliminate job-site delays by staying compliant with up-to-date certifications and records.

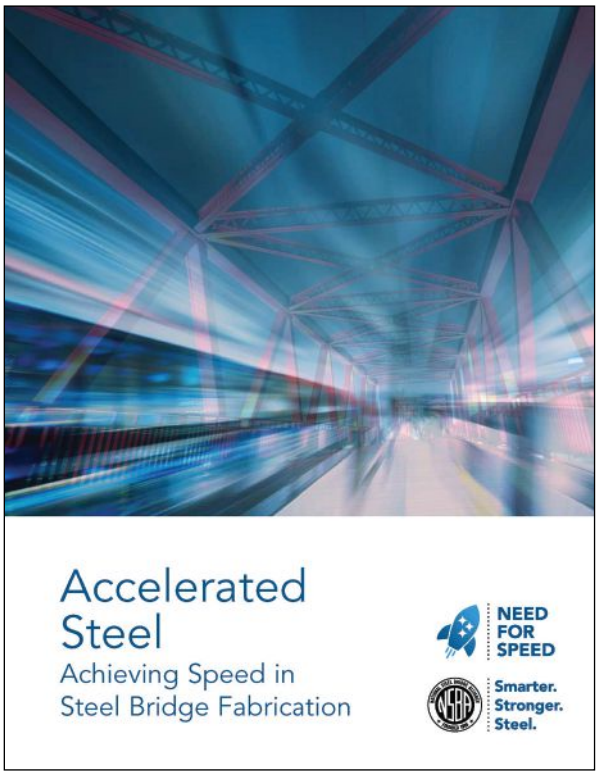
For more information, visit **www.hilti.com**.

Company Index

You are on the Fastest Route

BY CHRIS GARRELL, PE

If you're feeling the need for speedy bridges, NSBA has some new and soon-to-be-released resources that can help you accelerate your next bridge project.



WHEN IT COMES TO increasing the speed of steel bridge design and construction, there are a handful of new NSBA (National Steel Bridge Alliance) publications to turn to.

Accelerated Steel: Achieving Speed in Steel Bridge Fabrication

Achieving speed in fabrication is only partly associated with the time it takes for shop activities, such as cutting, fitting, welding, drilling, cleaning, and coating. It is also about the time related to shop support activities, like obtaining materials, producing shop drawings, developing procedures, and shop inspection. All these activities bring significant time-saving opportunities—as well as the potential for significant delays.

The key to accelerated steel bridge fabrication is seamless teamwork between the fabricator, owner, engineer, and contractor, and NSBA's brand-new guide is designed to help you do just that. *Accelerated Steel: Achieving Speed in Steel Bridge Fabrication* describes how each of these roles affects critical shop support activities, which can make or break the fabrication schedule.

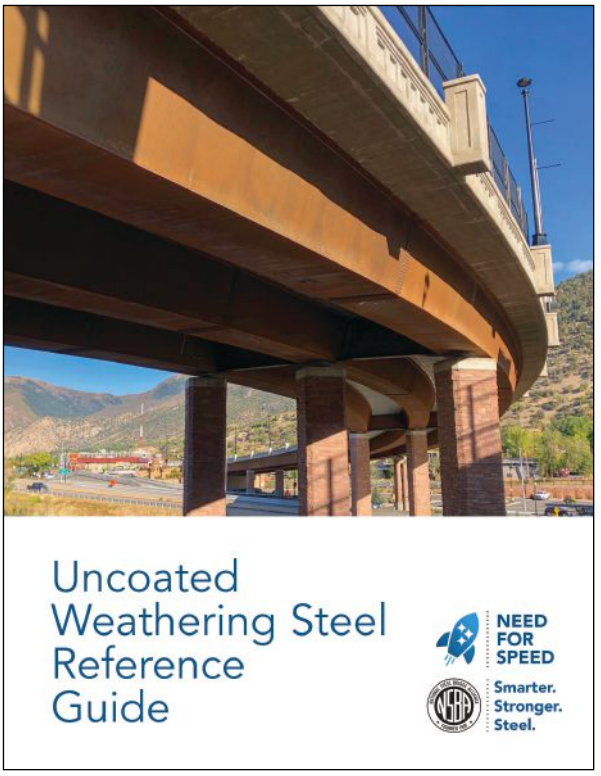
Starting with a comprehensive overview of the steps involved in the fabrication of a bridge, the guide is organized by role, with chapters focusing on best practices for owners, designers, and general contractors.


Kiewit Infrastructure

Uncoated Weathering Steel Reference Guide

Designing with uncoated weathering steel (UWS) is the least-expensive and fastest-to-fabricate method for achieving corrosion protection when it comes to steel bridges. UWS reduces the time necessary to fabricate structural steel and offers the benefits of reduced cost, both in terms of initial fabrication and construction costs as well as long-term maintenance (life-cycle) costs.

NSBA's new *Uncoated Weathering Steel Reference Guide* provides guidance for bridge owners and designers regarding when it is appropriate to specify UWS in bridge applications. It also discusses how to design, detail, fabricate, construct, inspect, preserve, maintain, and repair weathering steel bridges. Essentially, it consolidates all the information and best practices for specifying the use of UWS on steel highway bridges in a single reference.

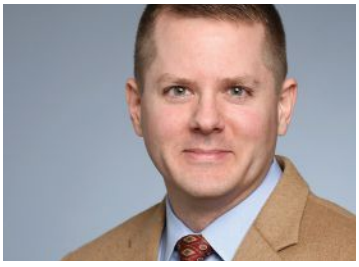


Standard Designs for Straight Steel I-Girder Bridges

Using steel for a bridge project provides great flexibility in the design of girder flanges, webs, stiffeners, field splices, and cross-frames. However, designers are routinely confronted with repetitive design decisions regarding material thickness and sizes for the routine steel I-girder bridges. In fact, two designers could design a steel I-girder bridge for the exact same span lengths and bridge width with girders that have completely different flange and web sizes, as well as differing cross-frame layouts and member designs.

The objective of this project is to develop straight steel I-girder bridge standards for single-span bridges as well as two-, three-, and four-span arrangements that are optimally cost-efficient when considering design, material selection, fabrication, and construction. Achieving this objective can make the I-girder bridge design process faster—and as a byproduct of careful consideration when sizing members, it can also make the fabrication process more efficient and cost-effective.

These standards optimize and standardize web, flange, stiffener, and field splice plate sizes that can be readily obtained by fabricators from typical mill plate widths and thicknesses. They also provide cost-efficient diaphragm and cross-frame standards for the entire suite of identified bridges. Keep an eye out for these standards later in 2023. ■



Chris Garrell
(garrell@aisc.org)
is the chief bridge engineer for NSBA.

Increasing Speed through Research

BY DEVIN HUBER, PE, PHD

Research is a crucial component of accelerating steel projects—and AISC has several projects that are geared toward speeding up multiple links in the steel supply chain.

THERE ARE COUNTLESS OPPORTUNITIES for speed-related improvements all along the steel supply chain.

At the core of any of them are innovative thinking, trial and error, and research.

As part of its Need for Speed effort, AISC has facilitated and funded dedicated research and consultant projects focusing on specific key areas where the maximum impact on the steel design and construction schedule can be achieved.

It's important to remember that each research project is a collaborative effort between the researchers, industry oversight panels, project sponsors, and other project supporters, such as steel fabricators, who donate their time and expertise when it comes to creating the required test specimens for these various endeavors.

Following is a look at a handful of the most significant speed-related research projects that AISC is currently involved with.

Faster Building Cores

By now, you've likely heard of the SpeedCore system, whose success has already been proven by a pair of West Coast projects. (To learn more about SpeedCore, visit **aisc.org/speedcore** and also take a look at this month's Field Notes column, which highlights Ron Klemencic of MKA and his work on the system, on page 22.) The primary objective of the SpeedCore 2.0 initiative is to optimize the system and encourage more extensive implementation in multistory steel structures. This objective is being met through a series of research projects focusing on areas where the system can be further improved, including:

- optimizing various connections such as panel-to-panel splices and more construction-friendly wall-to-foundation details to enhance seismic and wind behavior
- the behavior of bolted splices
- gaining a better understanding of the behavior of SpeedCore-panel-to-steel-framing connections subjected to elevated temperatures (fire)

Seismic and wind behavior. This research, the first major SpeedCore project AISC has participated in, is being performed at Purdue University and the University at Buffalo. Ongoing since 2016 and expected to conclude next year, it has involved much of the foundational research to help develop prescriptive SpeedCore design provisions, with recent efforts shifting to refining SpeedCore for constructability, and has led to SpeedCore to being implemented into real-world projects—both designed by Ron Klemencic's team at MKA. These buildings included the game-changing Rainier Square, an 850-ft-tall, 58-story mixed-use skyscraper in Seattle, and 200 Park, a 300-ft-tall, 19-story office building in San Jose, Calif. (fabricated and erected by AISC Member Schuff Steel). So, was SpeedCore faster when compared to a comparable concrete core? Quite simply, yes. It saved ten months on Rainier Square and three months on 200 Park, a roughly 43% time-savings on both projects.

The work at the University at Buffalo is now complete and featured some of the largest SpeedCore tests done to date, including C-Shaped and T-Shaped walls. Michel Bruneau, who led the research in Buffalo, shared a fascinating revelation about SpeedCore and its benefits beyond just the speed of using the system.

"The Christchurch [New Zealand] earthquake revealed how difficult it can be to repair reinforced concrete structures after

NEED FOR SPEED

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

an earthquake [most were demolished after the earthquake instead of being repaired], he noted. "A few years later, someone shared with me a picture showing the massive amount of horizontal and vertical reinforcement in a concrete shear wall in seismic regions, and, with the Christchurch earthquake in mind, it was clear that replacing the damaged rebar in the plastic hinge region of such thick and heavily reinforced walls after an earthquake would be a major challenge. This prompted us to repair and retest one of our SpeedCore specimens to show how simple it can be to repair the plastic hinge region of a SpeedCore wall after a severe earthquake. Considering that a major dimension of resilience is how fast a building can return to service, our validated repair scheme demonstrated that using a SpeedCore wall is a viable solution to meet resilience objectives."

While Bruneau's work on this particular project has wrapped up, work at Purdue, led by Amit Varma, is still ongoing. Recently completed tests as part of this project showed that greatly simplified wall-to-foundation details can be used through the SpeedCore module directly bearing on the concrete, with rebar dowels extending into the module over their required development length based on the bar diameter. The last phase of testing will build on the idea of improved structural details and look at two scenarios:

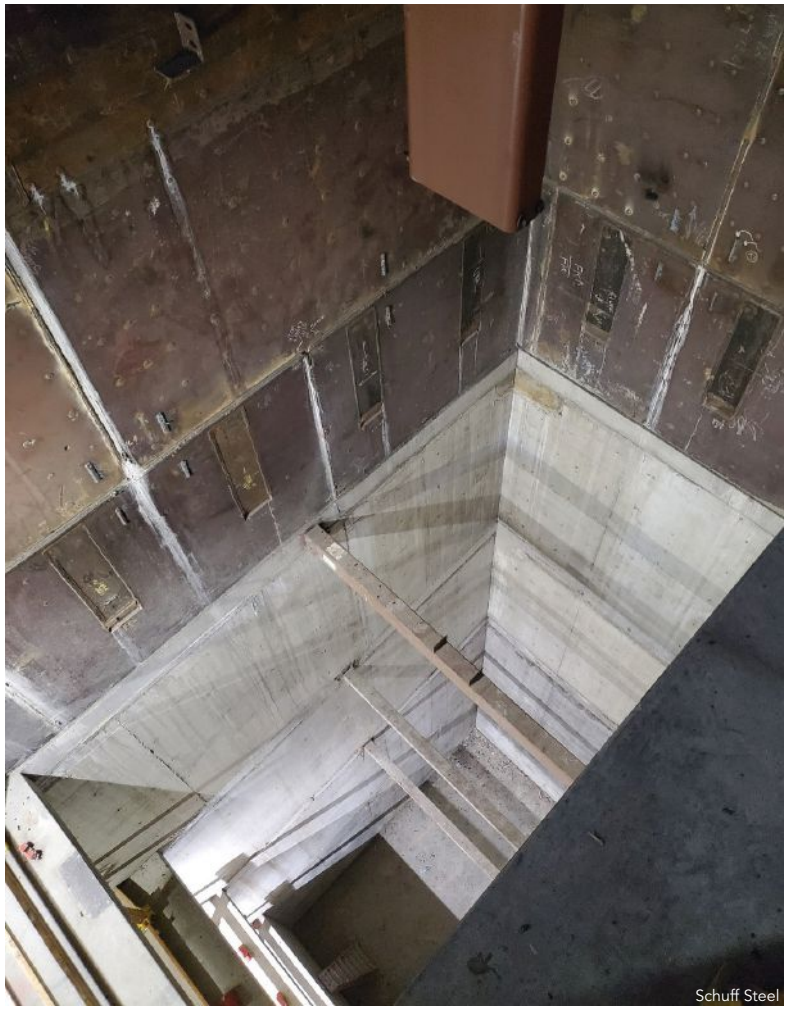
1. The use of bolted splices near the plastic hinge regions of SpeedCore walls, which would greatly simplify the detail in this often-congested region of the structure.
2. Splicing a SpeedCore module to a concrete wall using a simplified splice detail. Note that this situation was encountered on the 200 Park project, where SpeedCore spliced into a reinforced concrete underground parking structure. Practitioner feedback indicates this happens fairly frequently when they are asked to consider SpeedCore on new projects.

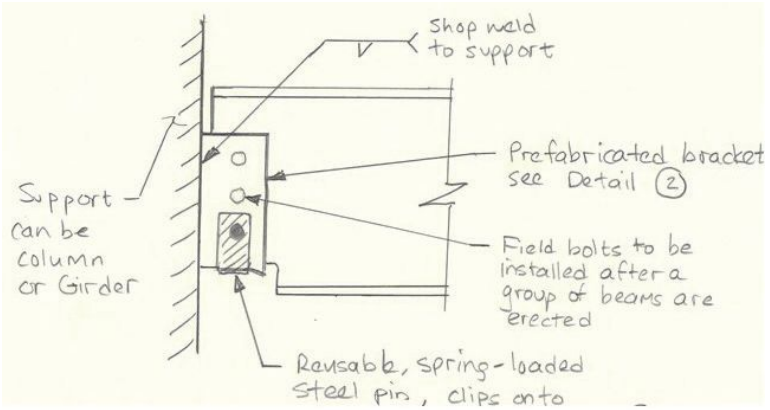
These tests are expected to be completed in mid-2023, and a final report summarizing the project's overall findings will be made available shortly after testing is completed. (For more on SpeedCore and seismic and wind considerations, see "Against the Wind" in the November 2021 issue and "SpeedCore: Seismic Advantages" in the May 2021 issue.)

Performance-based fire resistance and design. The motivation for this project, also being performed at Purdue University, is to determine fire protection needs in connection areas between SpeedCore walls and adjacent steel framing. Its goal is to develop performance-based fire-resistant design provisions for the complete floor system consisting of composite floors, SpeedCore walls, and wall-to-floor connections. The design provisions will consider both standard and design fire scenarios. Design methods will account for the complexities of behavior, including thermal

above: Former PhD student (and current structural engineer with Thornton Tomasetti) Emre Kizilarslan and SUNY Distinguished Professor Michel Bruneau proudly displaying their T-shaped SpeedCore test specimen at the University at Buffalo.

below: SpeedCore in place at 200 Park in San Jose.





above: A sample SpeedConnection design.

below: Various bolted splice tension specimens prior to placement in their test fixtures on a SpeedCore sample.

deformations (expansion/contraction and bowing), restraints including axial and flexural deformations and forces induced in the connections, and connection limit states, including fracture failure. The primary connection types to be investigated in this research are simple shear tab connections consisting of a shear tab plate welded to the outer SpeedCore wall and then bolted to the adjoining wide-flange beam or girder framing.

The project involves extensive analysis and verification testing to calibrate models for parametric studies to be conducted. Currently, test specimens are being fabricated by AISC member Lexicon, with testing expected to commence in early 2023. Once testing is completed, the results will be integrated into developed models to help determine what, in any, fire protection requirements are needed in these connection areas.

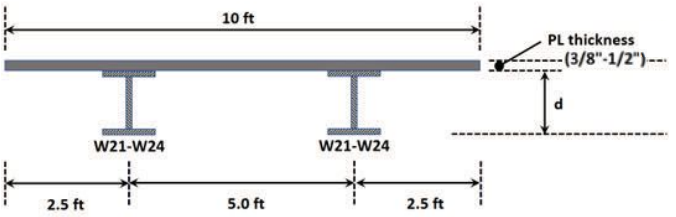
Bolted splice details. This project is investigating the use of bolted splices in lieu of welding in SpeedCore systems and is being conducted at the University at Buffalo and led by Michel Bruneau. The primary focus is bolted splices in non-seismic regions, but some developed bolted concepts will consider potential use in seismic areas as well.

Several different bolted splices are being investigated, with smaller-scale tests focused just on the connection area that will include both tension tests and shear tests of the connections. Upon completion of these tests, at least one larger-scale test will be conducted to consider the overall behavior of a wall section. Connections being tested include one-sided bolted splices using a conventional structural bolt with either a welded "captive" nut or an Atlas Shuriken connection (you can learn more about Shuriken on page 45); through-rods within steel "sleeves" (for round HSS) that effectively clamp the walls together; and one concept that takes advantage of concrete and relies on a load path that develops compressive diagonal struts to contribute to the strength of the splice. The test specimens representing these concepts were fabricated by AISC member Banker Steel.

The eventual goal is to develop design samples with design calculations for each connection type and potential design provisions to implement into relevant standards and specifications, as well as to provide other design options for engineers, fabricators, and erectors working with the SpeedCore system.

Future SpeedCore research. Based on these projects, future SpeedCore research could potentially focus on a wide variety of items, such as:

- Constructability-related issues involving wide-flange or built-up I-section coupling beams, which are designed for high-wind regions and high-seismic regions. SpeedCore modules with coupling beams are often more difficult to fabricate and ship to the site, and research would explore options for simplifying these steps.
- Evaluating SpeedCore for seismic resiliency, including exploring fragility and enabling seismic-resilient design using FEMA P-58/SP3 for SpeedCore.



above: A FastFloor office design option with tight beam spacing and deep beams to help mitigate floor vibrations.

right: A FastFloor residential test assembly in the lab.

Faster Floor Systems

This project builds on the core principle that has made SpeedCore successful—offsite fabrication of panelized modules to speed up erection in the field—and applies it to floor systems in steel buildings. There are two ongoing research projects as part of this initiative, one focusing on the multistory commercial/office markets (40-ft to 45-ft spans) and the other on the multistory residential market (15-ft to 25-ft spans).

Commercial office option. Taking place at Northeastern University and headed by Jerome F. Hajjar—with assistance from West Virginia University, Iowa State University, Johns Hopkins University, and Virginia Polytechnic Institute and State University (Virginia Tech)—this project's goal is to create a primarily steel and predominantly offsite-fabricated modular floor system that can be erected 30% to 50% faster than traditional concrete-on-metal-deck systems. The central idea is that the panels can be lifted and quickly set in place with simple optimized connections.

The concept to be tested is a refinement of an all-steel system MKA had previously proposed for a project. The concept is simple and involves 10-ft-wide panels consisting of steel plate supported by wide-flange shapes welded to the plate. Inter-panel connections are envisioned to be simple lap plates using either field stitch welds or powder-actuated fasteners where holes are pre-placed in the lap plate to allow proper placement of the fasteners. These panels would be dropped in place, secured, and interconnected, and then a raised floor would be added to complete the system. Thus far, the analysis indicates that the FastFloor system could be installed 30% quicker than the typical floor system. The project has extensive fabricator and erector oversight, as the success of the system will greatly depend on constructability issues being resolved, including efficient lifting and placement of the modules and serviceability issues related to acoustics and floor vibration.

Residential option. The primary objective and motivation for this project are essentially the same as the office version, except that the target spans are those commonly encountered in multistory residential applications, typically 20 ft to 25 ft. This non-proprietary floor system uses primarily metal deck components with a thin (¾-in.) cementitious board screwed to the top flange of the metal decking. The initial pilot study (Phase I) was conducted at Johns Hopkins University under the guidance of Ben Schafer and looked at a system that connected two 3-in.-deep metal deck roof panels with one profile inverted and connected underneath the top deck. These deck profiles were topped with pre-cast concrete subfloor panels screwed to the metal deck. The testing was performed on 16-ft-long by 2-ft-wide beam specimens (note that in real life, these profiles would be connected to form wider panels—8 ft to 10 ft—that would be lifted and set in place within structural steel framing.

The results from the initial testing were promising and showed measured capacities and stiffnesses could be reasonably predicted using established calculation procedures developed by the research team. Phase II will look at the serviceability aspects of the system and potential connection details, including inter-panel connections.

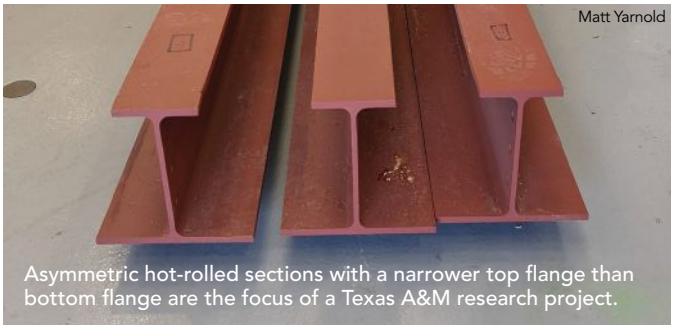
Faster (Asymmetric) Steel Shapes

The overall goal of this effort is to use mill-rolled asymmetric shapes in conjunction with framing that would allow for floor slab components to rest on the bottom flange of these shapes to increase steel's presence in areas that have traditionally proved elusive, such as multistory residential and low-clearance-height office markets like Washington, D.C. The work for this effort is part of an AISC Milek Fellowship awarded to Matt Yarnold at Texas A&M University in 2021.

The impetus is to improve the economy and speed of steel buildings by doing the requisite research to develop optimized asymmetric steel sections that can be rolled by domestic steel producers. These asymmetric shapes would incorporate a narrower and thicker top flange with a thinner and wider bottom flange. Ultimately, these shapes could be produced regularly enough that they could be listed like other products, such as wide flange shapes, channels, etc., in the AISC *Steel Construction Manual* (**aisc.org/manual**).

Allowing floor slab components to rest on the bottom flange and using framing where filler beams are not required would be achieved by spanning the asymmetric shapes between only the columns and having the flooring system—which could be pre-cast planks, composite steel deck, or even mass timber planks like those described in AISC Design Guide 37: *Hybrid Steel Frames with Wood Floors* (**aisc.org/dg**)—spanning the other direction and resting on the bottom flange of the asymmetric beam.

This idea is not necessarily new, as the idea of asymmetric beams began in the late 1980s in the U.K. when Corus Steel (now



Asymmetric hot-rolled sections with a narrower top flange than bottom flange are the focus of a Texas A&M research project.

Leveraging Power

Nondestructive testing (NDT) of structural welds is time-consuming but, for obvious reasons, necessary.

Most visual welding QA/QC turns up nothing, while ultrasonic testing (UT), magnetic particle testing (MT), and x-ray testing aren't much better and can actually be even more time-consuming. Welding inspectors spend incredible amounts of time performing NDT of welds to find discontinuities and defects in (perhaps) 1% to 3% of all welds. The good news is that we very likely have the technology to perform NDT with equal rigor to any of these methods—but in a fraction of the time.

How? By leveraging existing power source feedback technology from welding machines, which can capture data on welding current, voltage, wire feed speed, and current/voltage interaction with relative ease, and leveraging the amperage-voltage relationship to assess the stability (or instability) of the arc.

This is the idea behind an ongoing research project related to AISC's Need for Speed initiative. One of the key goals of the project is to establish the positive correlation of this data to conditions where weld defects are created. This is what will give us the ability to greatly reduce the amount of NDT needed to ensure sound welds.

What does reducing this NDT look like? Conceptually, it may be possible to produce an ideal "electronic fingerprint" indicating acceptable or problematic discontinuities in welds, which could potentially reduce or even eliminate NDT requirements. Alternatively, rather than performing NDT on 100% of the welded connections, a portion of the welds with a less-than-ideal "electronic fingerprint" could be identified or pinpointed for inspection.

This might even give us the ability to be alerted in real time when defects or discontinuities occur. This not only could create the ability to know where to focus NDT but also potentially establish real-time alerts for manual or automated welding if and when some parameter is exceeded and likely resulting in discontinuities or defective welds.

There are several possible discontinuities (17, according to the American Welding Society) that can lead to a defective weld. More than likely, this project will initially zero in on only a small number of these discontinuities to assess whether power source feedback data can indeed be correlated. While the end goal is to reduce the more intensive UT-type testing, initial studies may focus only on discontinuities that are visually detectable before eventually being expanded to investigate other defects like wormholes and porosity that are detected using UT.

So what are the benchmarks and objectives of this project? First, collect and assess data. We've already gathered a small amount of raw data from the industry and some existing data from academia. In the coming year, we'll be gathering more industry-generated data as well as lab-generated data to validate existing systems, such as Weldscore and Power Core. Professor Patricio Mendez, PhD, at the University of Alberta will lead the initial investigation in 2022 and 2023, and the initial parsing of available data is currently underway.

Next, we'll investigate, evaluate, and identify methods for obtaining data on additional parameters, such as travel speed and torch angle, that can cause welding discontinuities and are currently difficult to track. The ability to eventually track and assess these parameters will be crucial to success.

Eventually, we'll be able to produce a number of welds using idealized welding parameters as well as sub-optimal conditions to intentionally produce discontinuities. From there, we'll use visual inspection and UT to compare the electronic fingerprints of good and bad welds. Subsequently, in a blind test, we'll produce welds with both acceptable and unacceptable electronic fingerprints, then validate the findings with conventional NDT such as UT.

If this hypothesis is validated with robust data, we'll then develop and propose code language for Chapter N of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) or for AWS codes that would allow for this alternative method of NDT.

What's the potential impact? In scientific terms, we spend loads of time on NDT of welds. A conservative estimate is that 3% to 5% of fabrication costs associated with bridge girders is spent on NDT and slightly less than that amount for buildings—and the time and expense associated with NDT can be viewed as non-value-added time. Certainly, when the quality of welding is such that no defects are detected by NDT, it is difficult to assign value to such activities. Using electronic fingerprints to accept welds with a high probability of acceptable quality could reduce these non-value-added inspection costs considerably. Identifying welds via the electronic fingerprint that are likely to have quality problems and designating those welds for NDT would result in resources being directed to specific welds in an intelligent, objective, quantifiable manner. The overall goal is to get to a point where only the defective weld gets the NDT.

—Luke Faulkner, AISC director of technology integration

Tata Steel) began developing technology to roll asymmetric shapes like the Slimflor® beam. In the U.S., the most similar type of steel shape/system is Girder-Slab, which uses an asymmetric built-up shape known as a D-Beam that consists of a T-Section cut down from a wide-flange shape such that openings exist on the web once a flat bar is welded atop the web of the T-Section. The D-Beam supports hollow-core pre-cast planks resting on the bottom flange and is designed as a composite system. (See page 74 for more on the Girder-Slab system.)

For this project, the focus is on optimizing the geometry of the asymmetric shapes such that:

- they can be rolled by domestic mills, which may require some upgrades to existing rolling infrastructure at certain mills
- the shapes are optimized to adequately resist applicable limit states at various spans and assumed floor system type—e.g., deep decking or pre-cast plank—Including construction loading and composite phase loading
- serviceability limits are met, including deflection and vibration criteria

Dr. Yarnold has actively been developing custom software to optimize the shapes and holds regular meetings with both the project oversight group and domestic steel producers to discuss his findings and get direction for the project.

The end goal of the project is to provide recommended asymmetric shape geometries that can be rolled by domestic producers with minimal investments into their existing infrastructure. These shapes will also be optimized for desired span lengths and load scenarios to allow for them to be used in as many structures as possible. Market studies are also planned to demonstrate the anticipated usage of these shapes to provide motivation to producers to roll them. Ultimately, AISC and Yarnold are hopeful that producers will buy into the concept of rolling asymmetric shapes and will continue to engage and work with them to ensure success.

Faster Connections

SpeedConnection broadly defines the effort AISC is making to investigate potential time-saving steel framing connection schemes to speed up the erection of steel buildings. Traditional approaches for connections between the various building elements, such as beams-to-girders, girders-to-columns, column splices, etc., are shown to be reliable but are often the most time-consuming effort in steel framing. There have been several efforts AISC has undertaken over the past two years related to this initiative. These efforts include:

- a fabricator and erector survey on connection preferences and perceived issues with existing connection types
- a series of crowdsourcing challenges that allowed the public to submit their ideas for potential new connection types for a cash reward
- a request for proposals (RFP), issued by AISC, to conduct large-scale research projects on faster steel connections

Through this RFP effort, nine excellent proposals were evaluated by an expert panel of AISC staff, steel fabricators, engineers, and researchers (see "Facilitating Faster Framing" in the August 2022 issue, at **www.modernsteel.com**, for details on the finalists). Three of these proposals will be funded to varying levels, with some receiving all requested funding per the proposal and others receiving portions of funding based on AISC's specific interests and needs. Further, AISC's Technology Integration group will choose an additional proposal for further development. Keep an eye out for the winning proposals in an upcoming issue.

Faster Fabrication and Welding (through Augmented Reality and Leveraging Existing Data)

Technology Integration (TI) into the Need for Speed endeavor is a natural fit. Numerous potential projects could be undertaken with respect to TI, and two topics with the potential for big gains are:

- using smart glasses and augmented reality to aid in the fabrication and inspection processes
- reducing the amount of nondestructive testing (NDT) in welding for steel fabrication through the use of welding signal analysis (see the "Streamlining for Speed" sidebar)

Augmented reality. This project started off as a small pilot study in late 2020 with Hannah Blum at the University of Wisconsin-Madison to evaluate if augmented reality (AR) technology (specifically the HoloLens 2 AR headset) could be appropriate for use in a steel fabrication shop to both enhance productivity and aid in the QA/QC process. This pilot study, which was a collaboration between Blum and the University of Wisconsin Web and Mobile Solutions (WaMS) team, showed that the Hololens 2 is capable of obtaining accuracy within $^1/_{16}$ in. and that holograms of steel components can be effectively overlaid on real steel components.

Following the success of the pilot study, a larger second phase kicked off in September 2021 and is ongoing until late 2023, further refining some identified desired features should AR technology be used in a fabrication environment. This second phase of the study includes several ongoing tasks:

- optimizing the graphical user interface (GUI) within the Hololens to allow capturing dimensions from a design file that can be overlayed onto steel parts and assembled
- providing a step-by-step tutorial on how a complex fabrication process is completed
- updating the current program to show weld information and size
- automatically bringing in dimensions and information from a model file from commercial software such as Tekla or SDS2
- validating the developed program on two fabricated steel connection types, one representative of buildings and one for bridges
- integrating the HoloLens built-in microphone to convert speed to text and hands-free photos

Through the completion of the above tasks, we'll have a better understanding of the full capabilities of AR technology in steel fabrication. Also, upon completion of the second phase of the project, AISC will continue to evaluate the potential use cases for AR technology for steel fabrication activities, including fit-up and assembly, QA/QC, and training shop personnel to be able to interpret drawings so they can properly interact with parts and assemblies to be fabricated. Should the technology continue to show the potential we believe it has, it is very likely that this research will continue beyond 2023.

These research efforts represent just one aspect of AISC's Need for Speed initiative. We will continue to advance these research initiatives and look to expand on them as opportunities present themselves. And we look to you, the industry, to provide ideas and examples to continue accelerating the speed of steel. ■

Devin Huber (**huber@aisc.org**) is AISC's director of research.

IN MEMORIAM

Raymond H.R. Tide Dies at 83

Raymond H. R. Tide, PE, PhD, former principal at Wiss Janney Elstner, died October 7, 2022, at the age of 83.

Tide worked as an AISC regional engineer before becoming manager of engineering for Paxton Vierling Steel and then joining WJE in 1982. He was widely recognized as an expert on collapses, material deterioration, fatigue, brittle fracture, welding, mill-rolling defects, fire exposure, and structural damage.

He also conducted load tests on bridges, industrial structures, and commercial buildings. In 2014, he received AISC's Lifetime Achievement Award.

"Ray was a purposeful volunteer and leader in the technical activities of AISC, RCSC, and other organizations," said Charles J. Carter, SE, PE, PhD. "He always had things he wanted to accomplish, and rarely did he fail. More personally, I remember how encouraging he was early in my career that I should pursue and achieve licensure as a PE and SE."

While at AISC, he is credited with compiling the first version of the steel shapes database in 1980 in conjunction with the release of the eighth edition of the AISC *Manual of Steel Construction*. Tide was assigned the responsibility of producing the column charts for variable braced lengths. After he realized that no help was coming from the steel mills, he decided to handle the massive amount of work by generating the data through the use of a computer program.

Working with IBM cards, he did his best to get as much data as possible on each individual card. "All computer-generated data had to be plotted and then professionally drafted," Tide noted. "We did not have the current graphics capabilities. I had to program the computer to move the ink pen to form the dashed lines, etc. We didn't have automated graphics programs."

Tide's love of steel continued throughout his career. At WJE, his bookshelves were filled with references and reports that encompass structural steel and bolting over the past 60 years.

He joined the Research Council on Structural Connections in 1982, serving on the Council's Executive Committee multiple times and as Chair of the RCSC from 2000 to 2006. His participation on the Council resulted in significant improvements in our understanding of bolt design provisions, including his work in long joints that yielded more economical connections.

He led committees on research needs as well as bolts under tension and prying action and has also been an active member of the AISC Specifications Committee. He also served on the FEMA-sponsored SAC Joint Venture seismic investigations of weld fractures after the Northridge Earthquake.

He was a registered professional engineer in multiple U.S. states and Canadian provinces. In addition to his long history with AISC and RCSC, Ray was closely involved with the development of the American Welding Society's (AWS) D1.1 *Structural Welding Code – Steel* and was part of the American Society of Civil Engineers (ASCE) Subcommittee on Structural Connections as well as the Structural Engineers Association of California (SEAOC) and Applied Technology Council (ATC) following the 1994 Northridge earthquake. A University of Manitoba and Lehigh University graduate, he served three years as an officer in the Canadian Army Corps of Engineers, spending some time abroad on the Sinai Peninsula.

"Throughout the years, Ray mentored many of us through his example of active membership. He set a standard for technical leadership for all Council members to follow," said RCSC Chair Salim Brahimi, PEng, PhD. "Personally, I am forever grateful for Ray's support of my research initiative on hydrogen embrittlement, especially during the early days (2003–2005) when support by RCSC was a crucial piece of the collaborative fundraising puzzle."

People & Companies

AISC member fabricator **Atlas Iron Works** just turned 100. Founded in October 2022, the company joined **AISC** in January 1924. "We've made it a century now!" said **Stephanie Green**, Atlas' CFO and vice president of operations. "As we celebrate 100 years, we are more excited for the future than ever before after reaching this monumental milestone. Weathering the ups and downs in horse and buggy and Model-T Fords—in the times before the internet, refrigerators, microwaves, computers, GPS, and the national anthem—we've made it through the Great Depression, Prohibition, World War II, and more. As we look back on where we've been and where we're going, one thing is clear: We couldn't have accomplished any of this without the everlasting support of our community, employees, vendors, colleagues, and subcontractors!"

Michael Gustafson has joined **Qnect, LLC**, as vice president of strategy and business development. In his former roles as a product manager with Trimble and an industry strategy manager with Autodesk, Michael has been identifying and directing new technologies for 17 years. He also formerly served as a regional engineer with AISC.

Nucor Corporation announced that its new steel plate mill being built in Brandenburg, Ky., has publicly registered to pursue LEED v4 for Building and Design certification. **Nucor Steel Brandenburg** is the first steel mill in the world to pursue certification under LEED v4. The specific LEED features of Nucor Steel Brandenburg include the preservation of a large portion of forested area on the property, lighting reduction strategies, reduced parking footprint, support for green vehicles, and water and energy efficiency measures. Expected to begin production at the end of 2022, the new $1.7 billion facility will produce 1.2 million tons of steel plate annually.

MEMBERSHIP

AISC Board Announces New Members

The AISC Board of Directors has approved the following companies for AISC Full or Associate membership.

Full

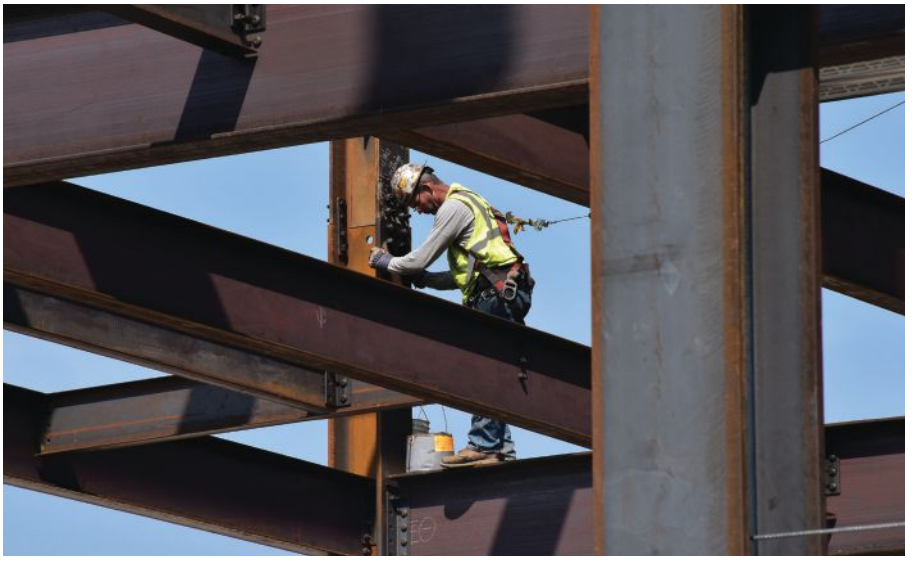
AspiredX, LLC, Dalton, Ohio
Byers Industrial Services, LLC, Franklinville, N.J.
Coenen Mechanical, LLC, Appleton, Wisc.
High Impact Sign and Steel Specialties, North Las Vegas, Nev.
KMK Construction, Inc., Jacksonville, Fla.
Mast Farm Service, Ltd., Millersburg, Ohio
Quality Welding and Fabrication, Elida, Ohio
Roma Iron Workers, Inc., Brooklyn, N.Y.
Suwanee Iron Works, O'Brien, Fla.
TEEMS Manufacturing, LLC, Amarillo, Texas

Associate

3 Axial Steel Detailing Services, Bangalore, India, *Detailer*
Bristol Machine Co., Ontario, Calif., *Bender-Roller*
CadZeal Engineering Services, Inc., Plano, Texas, *Detailer*
Corona Steel, Inc., Lakewood, Wash., *Erector*
Cutting Edge Detailing, LLC, Trafford, Ala., *Detailer*
Donovan Group, Whangarei, New Zealand, *System Supplier*
Drafting One, LLC, San Antonio, Texas, *Detailer*
DTD Steel Detail, Katy, Texas, *Detailer*
JLO Steel Detailing, Inc., Lincoln, Neb., *Detailer*
Qubatic Steel Detailing, Charlotte, N.C., *Detailer*
SKSAP Detailing Team, Bangalore, India, *Detailer*
Starlit Detailing Services, Visakhapatnam, India, *Detailer*
Sublime Structures, Coimbatore, India, *Detailer*
Technosys, Sangli, India
VRS Estructuras, Zapopan, Jalisco, Mexico

SAFETY

AISC Now Accepting Annual Safety Awards Submissions



To a customer, visiting an unsafe shop or job site is like visiting a messy house. Even if safety is not an explicit requirement, its absence leaves a bad impression. On the other hand, seeing a shop or job site where the organization achieves a commendable level of safety gives a good impression. It is reasonable to think that a company managing safety is also successfully managing production and quality. This, of course, is in addition to the fact that safety management is an increasingly important part of many customers' selection criteria, and it is the law. AISC encourages you to manage safety to achieve that commendable record, and we want to help you display your success with an AISC Safety Award.

AISC member steel fabricators and erectors are eligible and encouraged to submit their company's safety record for AISC's annual Safety Awards. The awards, given in the Fabricator Category and Erector Category, include the Honor Award (DART=0)—the Institute's top safety award, presented for a perfect safety record of no disabling injuries—the Merit Award (0<DART≤1) and Commendation Awards (1<DART≤2).

"AISC's annual Safety Awards program recognizes excellent records of safety performance, and we commend these facilities for their effective accident prevention programs," said Tom Schlafly, AISC's director of safety. "Periodic recognition of safety in the workplace has been demonstrated to provide worker incentive and a reminder of the importance of safe practices."

"Owners and clients pay attention to these awards," notes Kathleen Dobson, safety director for Hillsdale Fabricators/J.S. Alberici Construction (AISC member/certified). "They want to know that a fabricator or erector is proud of their safety records—and just as important, it means a lot to the workforce to see that their efforts are recognized by an industry leader like AISC."

The AISC Safety Awards program is open to all full fabricator members and erector associate members of AISC. An email with submission information will be sent to the Primary and Safety Contacts of eligible members in mid-December. All applications are due to AISC by the end of January, when OSHA Form 300A is required to be posted.] For more information about the program and safety resources for the fabricated and erected structural steel industry, please visit **aisc.org/safety** or contact **safety@aisc.org**.

2022 SAFETY AWARD

HIGGINS AWARD

Corrosion Researcher Wins 2023 AISC T.R. Higgins Lectureship Award

AISC is proud to announce the 2023 T.R. Higgins Lectureship Award winner: Jennifer McConnell, PhD, of the University of Delaware.

Each year, AISC's T.R. Higgins Lectureship Award recognizes an outstanding lecturer and author whose technical paper or papers, published during the eligibility period, are considered an outstanding contribution to the engineering literature on fabricated structural steel. Winners receive a $15,000 honorarium and will present their lecture, upon request, at professional association events.

McConnell has conducted groundbreaking research into the performance of uncoated weathering steel (UWS) in bridges. Her work incorporates long-term field data on the performance of steel structures and corrosion protection methods in various environments and includes an analysis of practical design strategies that improve corrosion resistance.

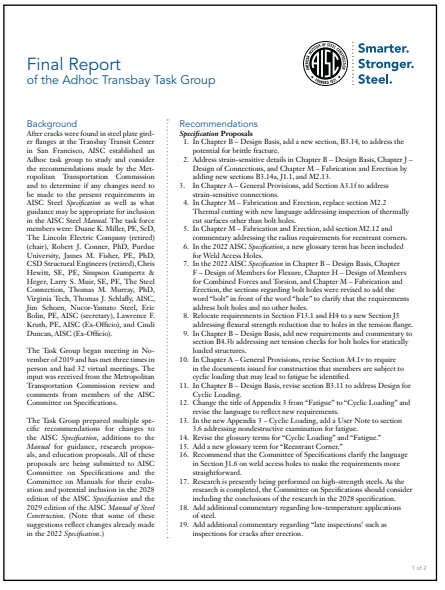
"Dr. McConnell's research is essential to ongoing work to update Federal Highway Administration guidelines for the application and maintenance of uncoated weathering steel--which date all the way back to 1989," said AISC Vice President of Engineering and Research Christopher H. Raebel, SE, PE, PhD. "Research like this ensures that departments of transportation throughout the country will be able to take full advantage of this uniquely sustainable, economical, and durable structural material."

McConnell is the Bentley Systems Career Development Professor at the University of Delaware, where she also directs the Center for Innovative Bridge Engineering. She has over 20 years of research experience in bridge behavior, laboratory testing, field evaluation, inspection, long-term performance, design, and analytical modeling of bridges. She is a member of the National Steel Bridge Alliance Oversight Committee, the American Iron and Steel Institute (AISI) Steel Bridge Task Force, the AISI Corrosion Advisory Group, and the Transportation Research Board Committee on Steel Bridges.

McConnell will present "Steel Structures to Withstand the Elements: What Structural Engineers Need to Know About Corrosion" as the final keynote of NASCC: The Steel Conference in Charlotte, N.C., next April. She will repeat the presentation at other events throughout the year.

TECHNICAL ISSUES

Transbay Study Group Makes Recommendations



Final Report
of the Adhoc Transbay Task Group

Smarter. Stronger. Steel.

Background

After cracks were found in steel plate girder flanges at the Transbay Transit Center in San Francisco, AISC established an Adhoc task group to study and consider the recommendations made by the Metropolitan Transportation Commission and to determine if any changes need to be made to the present requirements in AISC Steel *Specification* as well as what guidance may be appropriate for inclusion in the AISC Steel *Manual*. The task force members were: Duane K. Miller, PE, ScD, The Lincoln Electric Company (retired) (chair), Robert J. Connor, PhD, Purdue University, James M. Fisher, PE, PhD, CSD Structural Engineers (retired), Chris Hewitt, SE, PE, Simpson Gumpertz & Heger, Larry S. Muir, SE, PE, The Steel Connection, Thomas M. Murray, PhD, Virginia Tech, Thomas J. Schlafly, AISC, Jim Schoen, Nucor-Yamato Steel, Eric Bolin, PE, AISC (secretary), Lawrence F. Kruth, PE, AISC (Ex-Officio), and Cindi Duncan, AISC (Ex-Officio).

The Task Group began meeting in November of 2019 and has met three times in person and had 12 virtual meetings. The input was received from the Metropolitan Transportation Commission review and comments from members of the AISC Committee on Specifications.

The Task Group prepared multiple specific recommendations for changes to the AISC *Specification*, additions to the *Manual* for guidance, research proposals, and education proposals. All of these proposals are being submitted to AISC Committee on Specifications and the Committee on Manuals for their evaluation and potential inclusion in the 2028 edition of the AISC *Specification* and the 2029 edition of the AISC *Manual of Steel Construction*. (Note that some of these suggestions reflect changes already made in the 2022 *Specification*.)

Recommendations

Specification Proposals

1. In Chapter B – Design Basis, add a new section, B3.14, to address the potential for brittle fracture.
2. Address strain-sensitive details in Chapter B – Design Basis, Chapter J – Design of Connections, and Chapter M – Fabrication and Erection by adding new sections B3.14a, J1.1, and M2.13.
3. In Chapter A – General Provisions, add Section A3.1f to address strain-sensitive connections.
4. In Chapter M – Fabrication and Erection, replace section M2.2 Thermal cutting with new language addressing inspection of thermally cut surfaces other than bolt holes.
5. In Chapter M – Fabrication and Erection, add section M2.12 and commentary addressing the radius requirements for reentrant corners.
6. In the 2022 AISC *Specification*, a new glossary term has been included for Weld Access Holes.
7. In the 2022 AISC *Specification* in Chapter B – Design Basis, Chapter F – Design of Members for Flexure, Chapter H – Design of Members for Combined Forces and Torsion, and Chapter M – Fabrication and Erection, the sections regarding bolt holes were revised to add the word "bolt" in front of the word "hole" to clarify that the requirements address bolt holes and no other holes.
8. Relocate requirements in Section F13.1 and H4 to a new Section J5 addressing flexural strength reduction due to holes in the tension flange.
9. In Chapter B – Design Basis, add new requirements and commentary to section B4.3b addressing net tension checks for bolt holes for statically loaded structures.
10. In Chapter A – General Provisions, revise Section A4.1v to require in the documents issued for construction that members are subject to cyclic loading that may lead to fatigue be identified.
11. In Chapter B – Design Basis, revise section B3.11 to address Design for Cyclic Loading.
12. Change the title of Appendix 3 from "Fatigue" to "Cyclic Loading" and revise the language to reflect new requirements.
13. In the new Appendix 3 – Cyclic Loading, add a User Note to section 3.1 addressing nondestructive examination for fatigue.
14. Revise the glossary terms for "Cyclic Loading" and "Fatigue."
15. Add a new glossary term for "Reentrant Corner."
16. Recommend that the Committee of Specifications clarify the language in Section J1.6 on weld access holes to make the requirements more straightforward.
17. Research is presently being performed on high-strength steels. As the research is completed, the Committee on Specifications should consider including the conclusions of the research in the 2028 specification.
18. Add additional commentary regarding low-temperature applications of steel.
19. Add additional commentary regarding "late inspections' such as inspections for cracks after erection.

1 of 2

AISC's ad hoc task group on Transbay has wrapped up its work and made its recommendations to the AISC Committee on Specifications. The group was formed after cracks were discovered in steel members in the newly opened Transbay Transit Center in San Francisco. It's expected the report will lead to several changes in future steel specifications.

"The task group presented a holistic set of proposals dealing with fracture toughness, sharp discontinuities, stress levels, and inspection practices while also considering practical commercial issues," said AISC vice president of special projects Lawrence F. Kruth, PE.

The recommendations ranged from defining minimum radii dimensions for weld access holes to adding additional information on how to design to resist brittle fracture, including a suggestion for AISC to produce a design guide on the subject. The group also recommended AISC add new sections on fracture control and redundancy to the AISC *Steel Construction Manual*. In total, the group made 44 specific recommendations and offered 33 proposals for modifications to the *Specification for Structural Steel Buildings* (ANSI/AISC 360), which will now be considered by the AISC Committee on Specifications. They also identified areas for potential additional study—e.g., the impact of thermal cutting on heavy plates. You can view the report at **aisc.org/transbay**.

Kruth stressed that brittle fracture is not simply a material-only issue but is instead related to a variety of factors, including design, details, fabrication, materials, inspection, and loading. Accordingly, the task group has considered the interaction of material properties, stress concentrations, and loading conditions, which all contribute to the fracture resistance of steel.

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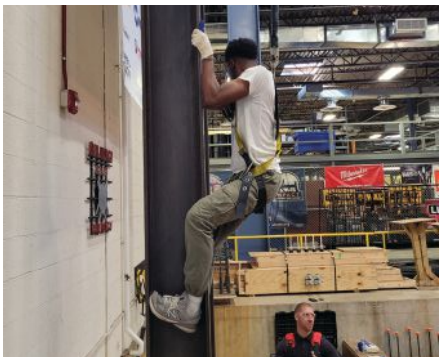

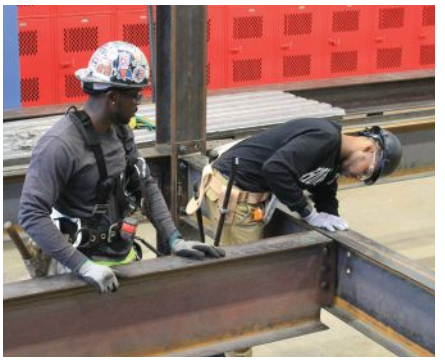

Up on the Iron

ON A BEAUTIFUL FALL DAY in late October, around 20 Howard University civil engineering students made their way to the Ironworkers Local 5 training facility, located just east of Washington, D.C., in Maryland.

The excursion was part of this year's SteelDay—actually, Steel Week, as events took place throughout the week. Now in its 14th year, SteelDay, sponsored by AISC and its partners, aims to educate engineers, architects, students, and others about the domestic fabricated steel industry through steel facility tours, project site visits, online seminars, and hands-on events like visiting an ironworker training facility.

As students who will eventually become structural or civil engineers, the Howard group got to take a look at another side of the steel industry—ironworking—to gain a better appreciation for how their future designs will come together in the field. They also got to try their hand at several ironworking disciplines, including welding, cutting plate with an oxygen-acetylene torch, rigging and connecting beams, tightening and untightening bolts with a spud wrench, and even climbing a steel column. Everyone cheered each other on, especially when it came to the climbing portion, which, despite all the requisite safety equipment, was clearly the most daunting of all the activities.

And the Howard students weren't the only ones who got to partake in such a visit. As a matter of fact, a dozen local ironworker events—sponsored by IMPACT (Ironworker Management Progressive Action Cooperative Trust)—took place across the country throughout the week.

Check out the January issue for a wrap-up of this year's SteelDay/Week activities, and visit **aisc.org/steelday** for more information about our annual celebration of the U.S. structural steel industry.

INFRA-METALS

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- Purchases
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- Multiple File Types Supported
- Improve Accuracy and Efficiency
- Excellent Turnaround Time
- Minimize Scrap

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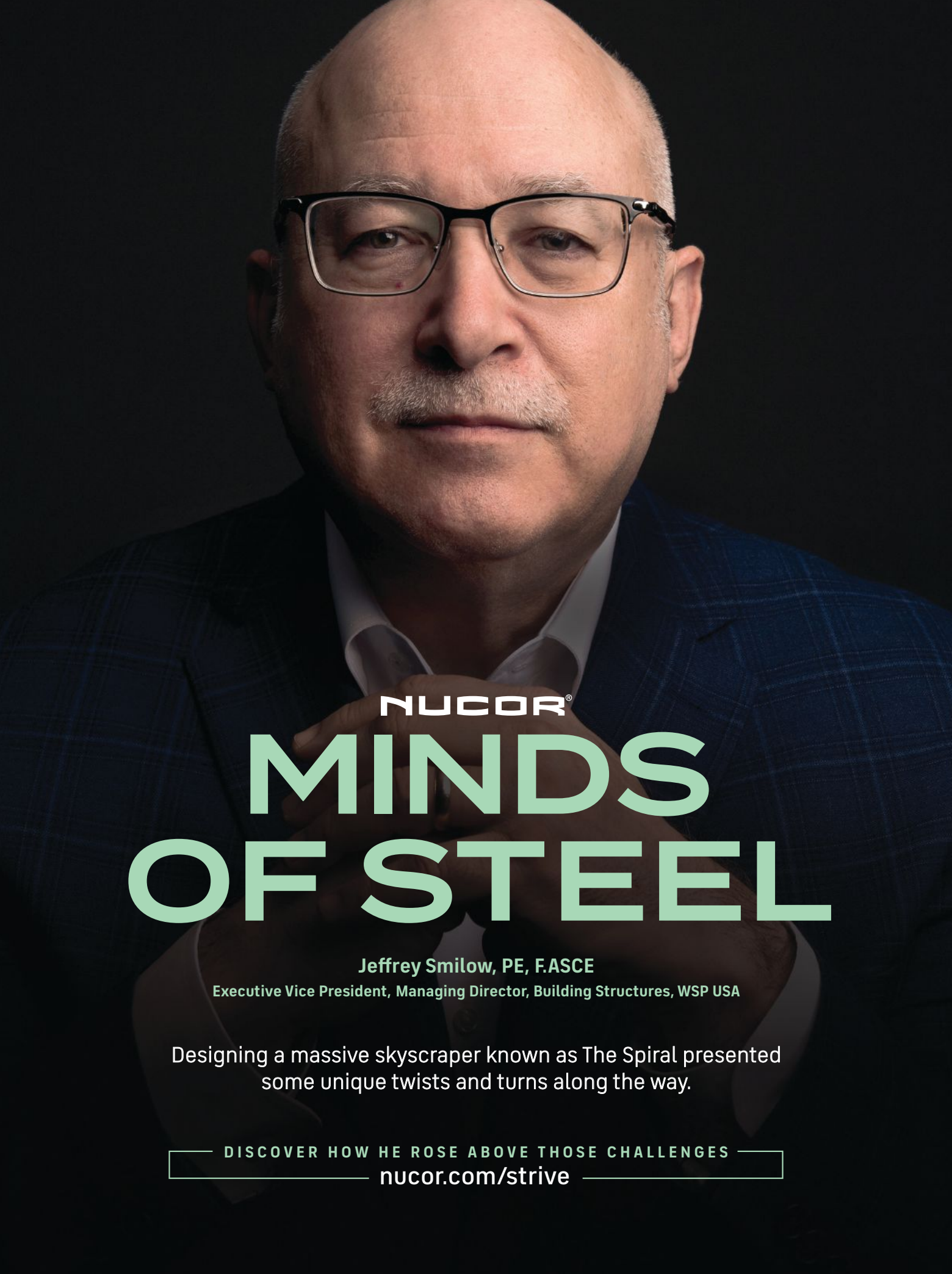
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