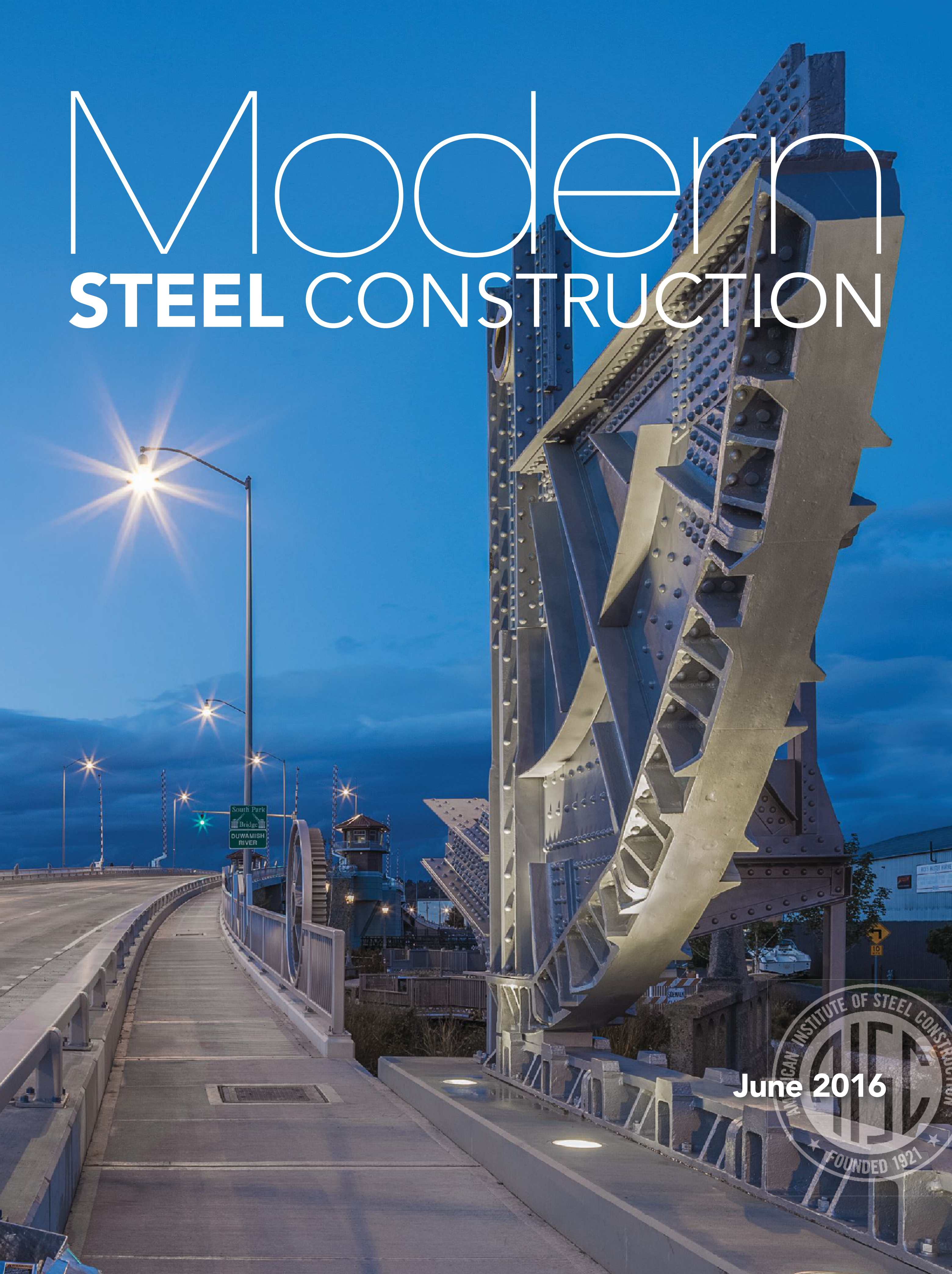
Modern STEEL CONSTRUCTION



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Modern
STEEL CONSTRUCTION | June 2016

columns

features

in every issue

ON THE COVER: A rocker on Seattle's South Park Bridge, a 2016 Prize Bridge Award winner (coverage starts on p. 21). Cover credit: © Barbara Grygutis, South Park Bridge, 2014, Powder coated steel and historic elements, King County Public Art Collection, Photo by Andrew Pogue

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editor's note

ONE OF THE CONSTANT THEMES OF DONALD TRUMP'S PRESIDENTIAL CAMPAIGN IS TO "MAKE AMERICA GREAT AGAIN."

He points to a weakened military—especially the navy. (How weak is our navy? It currently has more aircraft carriers than the rest of the world combined. If it was an air force, it would rank #2 worldwide in the number of military aircraft.) And he points to a weakened manufacturing sector, with the steel industry as his poster child for a once-mighty industry now in decline. Along with his rivals in both parties, he tours Pennsylvania and Ohio and points to shuttered behemoths. Where once there was a roar of furnaces and billows of smoke, today there is silence.

But rather than a sign of a weakened America, the steel industry should be looked at as a crowning example of American exceptionalism.

America's steel industry hasn't declined and it hasn't disappeared. Rather, it's changed, evolved and become greater. Where Bethlehem Steel took 12 man-hours to produce a ton of steel in 1980, today Nucor produces a ton of stronger steel in less than 0.6 man-hours. Where we once boasted about 36-ksi steel, today we commonly specify 50-, 65- and even 100-ksi steels. Today, more than 90% of the wide-flange used in our buildings comes from the big three domestic manufacturers: Nucor-Yamato Steel, Gerdau and Steel Dynamics. They have major wide-flange mills in Blytheville, Ark., Columbia City, Ind., Petersburg, Va., and Midlothian, Texas.

And it's not just wide-flange. More than two-thirds of the HSS members used in our buildings comes from two major U.S.-based companies: Atlas Tube and Independence Tube. Arcelor-Mittal, Nucor and SSAB produce more than 700,000 tons of plate a year in the U.S. for use in our nation's bridges.

The 2,300 firms in the domestic steel industry (producers, fabricators, service centers and erectors) employ more than 160,000 highly skilled and well-compensated workers.

However, Trump is right about one thing. America's manufacturing sector—including the steel industry—is under attack, and the war is not being conducted fairly. Foreign governments blatantly engage in currency manipulation and unfair subsidies. In addition, most of the leading foreign steel exporters fail to follow the health, safety and environmental demands we correctly impose on our manufacturers.

As election season continues, our question shouldn't be how do we make America great again; instead we should be asking every candidate for every office what they'll do to keep America great. We should be asking what they'll do to strengthen our workforce, our educational system and our industrial base.

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

steel interchange

Composite versus Non-composite Beams

I have recently noticed engineers specifying headed stud anchors for shorter span and infill beams, which have sufficient strength when designed as non-composite. I thought that shear studs are only useful when designing longer-span beams and/or girders. Are there advantages to providing shear studs for shorter span and infill beams?

The use of studs on steel beams to develop composite members can be advantageous to the beam design regardless of the beam span or the building occupancy type, unless the beams are very short. The use of shear connectors and composite beams in commercial building designs has become the norm for steel construction for the last few decades; it's not a recent change in practice.

Some beams, including short ones, also may have studs because they collect the loads from the diaphragm and deliver them to the lateral framing system.

Sometimes, even if the non-composite beam has sufficient strength, the use of shear connectors to make the member composite can provide significant additional stiffness and allow the floor system to perform better from a deflection perspective. I have worked on industrial projects where I elected to design the beams non-composite due to the abundance of floor penetrations but still provided shear connectors to take advantage of the additional stiffness wherever possible.

There are almost always multiple ways a structure can be designed and sometimes one way may be just as good as another. Nuances of the design or criteria may not be apparent to someone other than the original designer. You might ask the engineer who designed the structure about it the next time you see it. You might learn why, or he or she might learn a better way from you.

Susan Burmeister, P.E.

Alternate Fastener Grades

I have a project where ½-in.-diameter ASTM A490 bolts have been specified for slip-critical connections. I have been told that these bolts are not produced. Is it possible to substitute grade-8 bolts for the A490 bolts? If it is possible, can you provide any guidance on the use of grade-8 bolts in structural applications?

The AISC *Specification* recognizes that engineers will sometimes need to use materials not specifically approved by the *Specification* in their designs. Though not directly addressing fasteners, the Commentary to Section A3 of the *Specification* states: "There are hundreds of steel materials and products. This *Specification* lists those products/materials that are commonly useful to structural engineers and those that have a history of satisfactory performance. Other materials may be suitable for specific applications, but the evaluation of those materials is the responsibility of the engineer specifying them." Evaluation of alternative bolts and fasteners is the responsibility of the engineer specifying them.

Since the *Specification* does not directly address your condition, you'll have to use your own judgment. The *Specification* does address the use of bolts larger than those permitted by ASTM A325 and A490. These provisions might be used as a guide relative to your condition. Section J3.1 states: "When ASTM A354 Grade BC, A354 Grade BD or A449 bolts and threaded rods are used in slip-critical connections, the bolt geometry including the thread pitch, thread length, head and nut(s) shall be equal to or (if larger in diameter) proportional to that required by the RCSC *Specification*. Installation shall comply with all applicable requirements of the RCSC *Specification* with modifications as required for the increased diameter and/or length to provide the design pretension."

Therefore, there is some precedent for using bolts outside the range permitted under A325 and A490. It seems A354 Grade BD bolts are readily available in ½ in. in diameter. This would be a more common substitution for structural applications. A354 is also specifically addressed in the *Specification*, though only for larger, not smaller, diameters. A354 allows the bolt geometry including the thread pitch, thread length, head and nut(s) to be specified so as to be equal to or proportional to that required by the RCSC *Specification*.

Larry S. Muir, P.E.

There are Many Ways to Pretension a Bolt—but Only Use One at a Time

When installing twist-off-type tension-control (TC) bolts, must the torque and rotation be monitored? Should bolts rotated beyond the rotations listed in Table 8.2 of the RCSC *Specification* be rejected and replaced? Is there a maximum permitted torque for TC bolts?

The answer to all of your questions is "No."

The RCSC *Specification* provides the following pretensioning methods:

- Turn-of-nut pretensioning
- Calibrated wrench pretensioning
- Twist-off-type tension-control bolt pretensioning
- Direct tension indicator (DTI) pretensioning

Each method can be used to achieve the required pretension in the joint. Turn-of-nut installation involves applying a specified rotation beyond snug-tight. Calibrated wrench installation involves the determination and application of a torque. TC bolt installation relies on a specially configured bolt and wrench. DTIs involve depressing indicators on a specially made washer.

Some people subscribe to the "more is better" concept—in the case of bolt pretensioning believing that if one criterion is good then requiring multiple criteria must better ensure proper pretensioning. This is not consistent with the intent of the RCSC *Specification* and rather than ensuring proper pretension has been achieved, this practice will likely result in confusion or worse.

The idea that our methods are so exacting that the spline on the TC bolt will break just as the DTI washer flattens and the calibrated wrench shuts off at a specified rotation is unrealistic. While it may be possible to continue turning a bolt past one indicator and then force another indicator in the series, this does not mean the installation is superior. In fact, some installation methods are clearly incompatible.

The fact that the RCSC *Specification* does not provide a maximum installation torque and rotation is not a cause for rejection in the TC bolt pretensioning method.

Carlo Lini, P.E.

Engineer in Training

I recently received my degree in civil engineering and am working for an engineering consulting company. I am being asked to solve design problems the likes of which we never saw in school. I have found the AISC *Manual*, Design Guides and online videos quite helpful. However, sometimes I find I do not fully understand the decisions that are being made or the concepts being applied and am simply plugging values into equations. Up to this point, I have assumed that there is only one correct approach to a given problem and only one acceptable solution. As my work progresses, I am discovering this may not be true. How do I know whether a given approach is suitable to a given situation?

First, I am glad you have found these resources to be helpful. You have listed a number of different sources of information, and it is important to understand the intent of each. The August 2013 issue of *Modern Steel Construction* contained an article entitled "Says Who" that provides an informal overview of the various sources (you can find it in the Archives section at **www.modernsteel.com**).

The online videos you refer to are typically recorded sessions from NASCC: The Steel Conference and can be treated as proceedings. The information provided reflects the opinions of the presenters, who are selected based on their knowledge and expertise, so the information provided is sound. However, engineering involves judgment. Often, presenters will address specific conditions and apply analysis and design methods that the presenters feel are applicable to the conditions they are envisioning. Deciding whether another condition is similar to the one presented involves the application of engineering knowledge and judgment. Both AISC and the presenters intend engineers to exercise their own judgment.

As an engineer in training just beginning your career, you are not permitted to practice engineering independently. All states require qualifying engineering experience under the supervision of a professional engineer before one can become a professional engineer (or a structural engineer in some states). Ultimately, it is the engineer of record (EOR) who is responsible for the design and the assumptions made in the course of the work. In other words the design must reflect the experience and judgment of the engineer of record, not that of AISC or the presenters—or even you. Your supervisor should be keeping up with the assumptions you are making and the design procedures you are employing. You should reciprocate by actively informing your supervisor of your decisions.

As for your question on whether a given approach is suitable to a given situation, the EOR must be satisfied based upon his or her judgment. Note that practice is limited to areas in which the engineer is competent, and so engineers must self-regulate. As you gain experience and knowledge, you will likely be better prepared to make such decisions. In the meantime, you should pass all of your assumptions through your supervisors and let the EOR make the decisions.

Larry S. Muir, P.E.

The complete collection of Steel Interchange questions and answers is available online. Find questions and answers related to just about any topic by using our full-text search capability. Visit Steel Interchange online at **www.modernsteel.com**.

Larry Muir is director of technical assistance and Carlo Lini is a staff engineer—technical assistance, both with AISC. Susan Burmeister is a consultant to AISC.

If you have a question or problem that your fellow readers might help you solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact Steel Interchange via AISC's Steel Solutions Center:

866.ASK.AISC • **solutions@aisc.org**

steel quiz

This month's Steel Quiz takes a look at how to use Tables 3-22b and 3-22c in the 14th Edition AISC *Manual* to perform a quick analysis for continuous and cantilevered beams.

1 Using Table 3-22c, calculate the maximum positive and negative moments and the maximum shear (LRFD) for each span shown in Figure 1. The beam is continuous, and you should assume 1.2D + 1.6L is the controlling load combination for the loading shown.

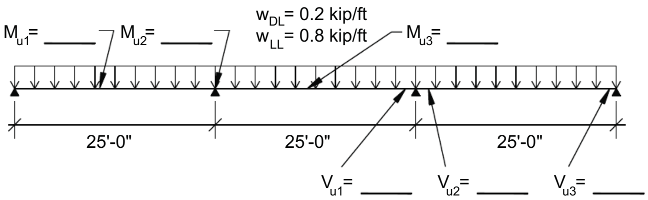

Figure 1

2 Using the maximum required flexural strength from the analysis in question 1, select the lightest size from the following shapes: W14×22, W12×26, W16×31 or W18×35. Assume that C_b = 1.0, that w_{DL} accounts for the self-weight of the beam and that the unbraced length is equal to 12 ft, 6 in.

3 Use Table 3-22b to calculate the maximum positive and negative moments (LRFD) for each span and the reaction shown in Figure 2. The beams on the exterior bays cantilever over the interior supports.

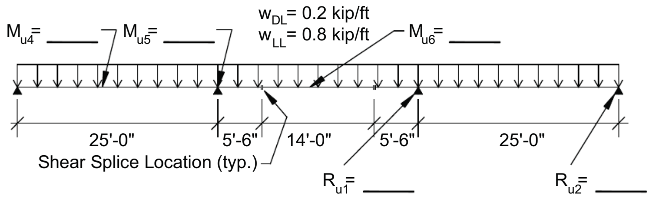

Figure 2

4 Repeat question 2 based on the results from Figure 2 and using the same assumptions.

TURN TO PAGE 14 FOR ANSWERS

steel quiz ANSWERS

1 The maximum required flexural strength is equal to 95 kip-ft (see calculations and Figure 3 below). To save space, only the maximum load calculation is shown.

w_u = 1.2(0.20 kip-ft)+1.6(0.8 kip-ft) = 1.52 kip-ft

Per the coefficients in Table 3-22c:

M_{u2} = -0.10(1.52 kip-ft × (25 ft)²) = -95.0 kip-ft

$V_{u2} = \frac{6}{10}$(1.52 kip-ft × 25 ft) = 22.8 kip

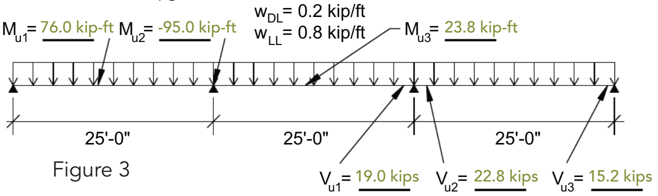

Figure 3

2 Use Table 3-6 in the 14th Edition AISC *Manual* to determine the available strength.

W14×22, ϕR_n = 79.8 kip-ft < 95 kip-ft (NG)
W12×26, ϕR_n = 89.4 kip-ft < 95 kip-ft (NG)
W16×31, ϕR_n = 130 kip-ft > 95 kip-ft (OK)

Select a W16×31. Shear check OK by inspection of the values provided at the bottom of the table.

3 The maximum required flexural strength is equal to 81.7 kip-ft (see calculations and Figure 4). To save space, only the maximum load calculation is shown.

Per the coefficients in Table 3-22b:

$P = w_u \times L$ = 1.52 kip-ft × 25 ft = 38.0 kips
$M_{u4} = M_{u5}$ = 0.086 × PL = 0.086(38.0 kips × 25 ft)
= 81.7 kip-ft
R_{u1} = 1.086 × P = 1.086 × 38.0 kips = 41.3 kips

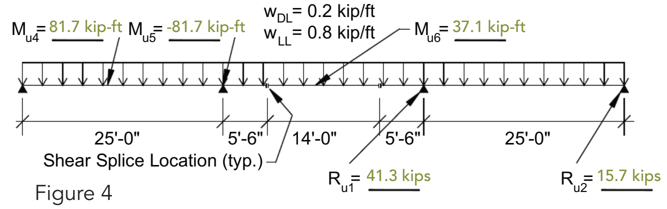

Figure 4

4 Use Table 3-6 in the 14th Edition AISC *Manual* to determine the available strength.

W14×22, ϕR_n = 79.8 kip-ft < 81.7 kip-ft (NG)
W12×26, ϕR_n = 89.4 kip-ft > 81.7 kip-ft (OK)

Select a W12×26. Shear check ok by inspection of the values provided at the bottom of the table.


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business issues

SIX MYTHS OF EMPLOYEE ENGAGEMENT

BY MAGI GRAZIANO

WITH TODAY'S GLOBAL ABILITY to produce carbon copy technology and business models, people truly are a company's *only* competitive advantage.

Businesses that want to accentuate and optimize their competitive talent advantage focus on employee engagement strategies that improve overall workforce productivity and return on staffing investments.

A major disruption to employee engagement is the adverse impact of the unhappiness epidemic across many companies.

When employees are disengaged or disenfranchised with their work situation, performance plateaus or greatly diminishes. But when there is awareness about what causes unhappiness at work, a company can do something about it.

The drivers of employee engagement rely greatly how an employee feels about work and feels at work. It begins with the employee feeling connected and invested in the company mission and direction and continues with their having trust in the company's leadership.

The first step in creating and inspiring engagement in the workforce is to debunk the pervasive and misleading myths about employee engagement. Here are six myths disrupting companies' ability to keep people engaged:

1. A flexible work environment always fosters productivity. While remote work opportunities reduce the carbon footprint and avert hours wasted in traffic, more often than not companies do a poor job of looping remote workers into the day-to-day activities of the business.

Unfortunately, a very typically adverse impact of remote work for the employee is out of sight, out of mind. Research shows that remote workers and workers with flex time schedules receive less coaching and mentoring and miss out on the institutional knowledge-sharing and socialization that happens in the typical course of a shared workspace.

2. Strong paychecks always equal strong loyalty. Not all people are primarily motivated by money, and more often than not, fair and sustainable pay is not a motivator; it is a table stake. For years, company leaders have approached solving the employee retention problem through monetary rewards and incentives. While this economic motivator works for 20% of the population, most organizations are finding that employee spiffs and salary increases alone are insufficient in reversing the turnover trend.

For the other 80% of the working population, the money is not a lever that leads to engagement and buy in. Around 40% of people want workplace rewards in terms of more educational opportunities, rewarding and challenging projects and a sense that they can further their knowledge and career path as a result of working with a specific company or in a certain role. The other 40% want to feel emotionally connected to the mission and service of the organization and to the customers they serve. Increasing their customer-facing opportunities is much more rewarding than a few extra bucks in their paycheck or a receiving a gift card for coffee.

If money is the only mechanism to get people to stay, it leads people using money to create to bidding wars between current and future employers.

3. Employee independence is always necessary for performance. One pervasive myth is that all employees need autonomy and independence, and the more hands-off that management is the better the employee will perform.

The reality is that autonomy and independence are not values that everyone shares. To one employee, being left alone can be a true benefit and they may thrive when left up to their own devices. To others it is a recipe for feeling disconnected, isolated and ignored.

4. A job is just a job. Today's workers, and human beings in general, are much more evolved and present to work life fulfillment than ever before. Employees today fundamentally want and need so much more than a job for a paycheck. A striking majority of workers have said they want purpose and meaning in the work they do, and that they feel happier at work when they know that what they do matters to the success of the organization.

5. Employees should be satisfied with their current position. High-performing people need to see a pathway for themselves in the role they own and in the company they work in.

Magi Graziano is the CEO of Conscious Hiring and Development, a speaker, an employee recruitment, an engagement expert and author of *The Wealth of Talent*. Through her knowledge and presentations, Magi provides her customers with actionable, practical ideas to maximize their effectiveness and ability to create high-performing teams. For more information on Magi, please visit **www.keenalignment.com**.

Engagement research shows that when people see a pathway for their growth and development, they provide a higher-level of consistent results for the team. When employees feel that a company is invested in their growth, they are more committed to their role and more connected to how they impact the success of the company.

6. Your company is enough to keep the employee. The sixth myth is that people go to work for a company and their loyalty to the company and brand is enough to keep them engaged and retained. What has become painfully apparent over the last decade is that people don't leave companies; they leave managers. When a good employee does not have a strong relationship with their manager, no incentive or brand loyalty will keep the employee fully engaged. People need to feel appreciated, respected, acknowledged or important. When their direct manager does not provide meaningful assignments, regular feedback and mentoring, engagement is thwarted.

While all of these perceived solutions are good ideas as components of an effective employee engagement program, alone they are insufficient means to drive employee connection and engagement. When carrots like money, time off, autonomy and a clear career path are not coupled with alignment, good people management and "match fit," those incentives wind up costing companies millions and derive little to no benefit in the long run.

A well thought-out, conscious employee engagement program considers who people are as individuals and allows for customization in the approach to assigning work and giving feedback. Individualization is a 21st century shift from the one size-fits-all management of the 80s. A main component of a well-built employee engagement program includes highly competent management team who embraces coaching and mentoring their people.

When a manager takes the time to offer professional development opportunities, communicate how the employee's role contributes to the overall organizations success and provides rewards for great performance, employees feel valued and appreciated and engagement soars. ■


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NSBA 2016 Prize Bridge Awards

THE COUNTRY'S BEST STEEL BRIDGES have been honored in this year's Prize Bridge Awards competition. Conducted every two years by the National Steel Bridge Alliance (NSBA), the program honors outstanding and innovative steel bridges constructed in the U.S. The awards are presented in several categories: major span, long span, medium span, short span, movable span, reconstructed, special purpose, accelerated bridge construction and sustainability. This year's 16 winners, divided into Prize and Merit winners, range from a mammoth marquee Mississippi River crossing to the country's first steel extradosed bridge. Winning bridge projects were selected based on innovation, aesthetics and design and engineering solutions, by a jury of five bridge professionals.

This year's competition included a variety of bridge structure types and construction methods. All structures were required to have opened to traffic between May 1, 2013 and September 30, 2015.

The competition originated in 1928, with the Sixth Street Bridge in Pittsburgh taking first place, and over the years more than 300 bridges have won in a variety of categories. Between 1928 and 1977, the Prize Bridge Competition was held annually, and since then has been held every other year, with the winners being announced at NSBA's World Steel Bridge Symposium. The following pages highlight this year's winners. Congratulations to all of the winning teams!

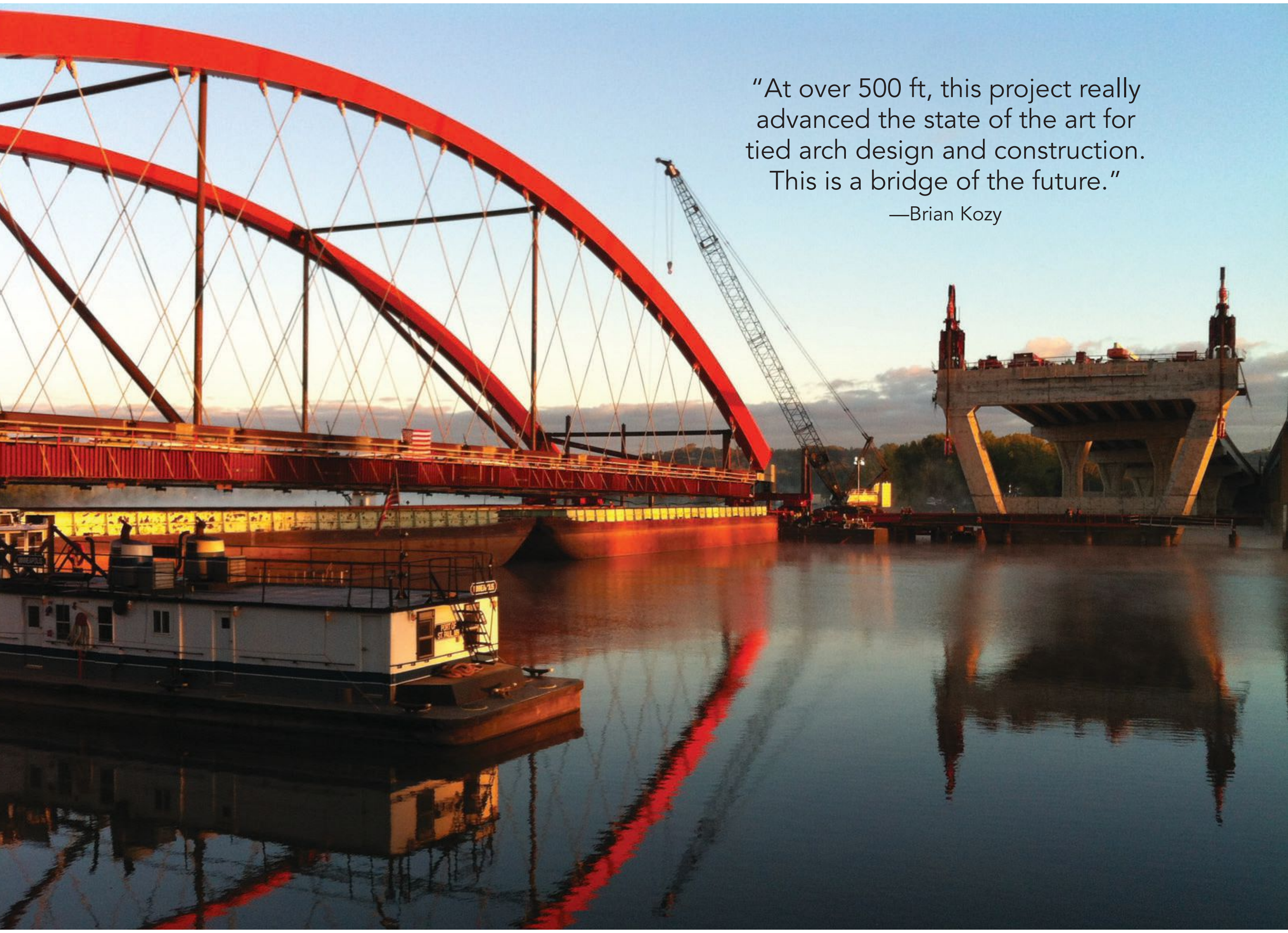
And check out past winners in the NSBA archives at www.steelbridges.org.

2016 Prize Bridge Awards Jury

- **David Spires**, P.E.
  Senior Engineering Manager with WSP Parsons Brinckerhoff
- **Michael Culmo**, P.E.
  Vice President of Transportation and Structures with CME Engineering
- **Brian Kozy**, P.E., Ph.D.
  Structural Engineering Division Team Leader with FHWA
- **Steve Jacobi**, P.E.
  State Bridge Engineer for the Oklahoma Department of Transportation
- **Carmen Swanwick**, S.E.
  Chief Structural Engineer for the Utah Department of Transportation

PRIZE WINNER: MAJOR SPAN

Hastings Bridge, Hastings, Minn.



"At over 500 ft, this project really advanced the state of the art for tied arch design and construction. This is a bridge of the future."

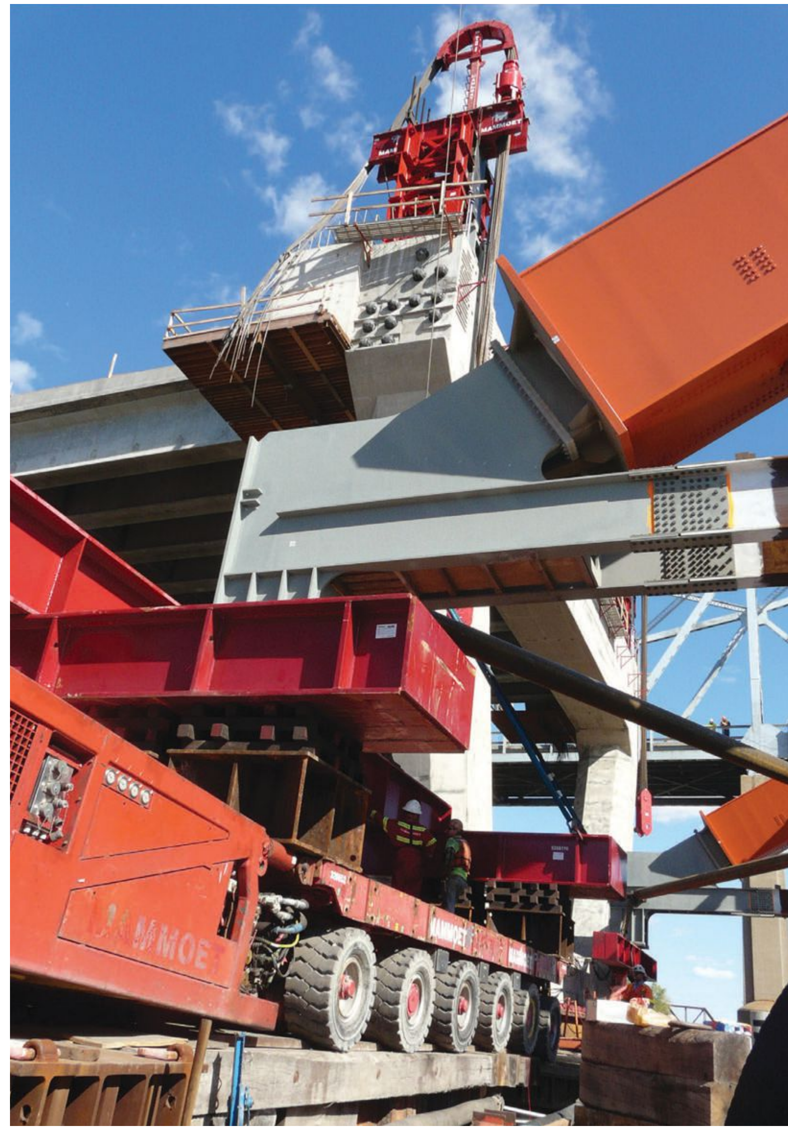
—Brian Kozy

THE HASTINGS BRIDGE over the Mississippi River in Hastings, Minn., is a record-breaker.

Built as a replacement for the functionally obsolete Hastings High Bridge (built in 1950), the new 1,938-ft-long bridge—with a 545-ft main span—is the longest freestanding tied-arch bridge in North America. The overall project was accelerated through MnDOT's Chapter 152 Bridge Improvement Program following the I-35W bridge collapse. MnDOT identified this route as critical to the mobility and commerce of Minnesota because it carried the highest daily traffic volume of any two-lane trunk highway in the state.

The bridge was constructed using design-build procurement and required accelerated bridge construction (ABC) technology to meet the demanding schedule and limit impacts on the travelling public. The tied-arch structural system is comprised of two freestanding vertical structural steel arch ribs with trapezoidal cross sections and variable depth. Post-tensioning steel strands were used to resist the arch thrust and encased in cast-in-place concrete tie girders and knuckles. The structural steel floor system consists of a grid of floor beams, full-depth longitudinal stringers and secondary longitudinal stringers all made composite with a cast-in-place concrete deck. The knuckles and deck are integral with the piers, creating a fully framed system. A network of structural strand hangers is used to suspend the floor system from the arch ribs.

All structural tension members are load-path redundant for fracture at any point in a single member or connection subject to tension under permanent loads and vehicular live load. Consequently, there are no fracture-critical bridge elements on the structure. The structure was analyzed for fracture of all tension members using a 3D time-history analysis to determine appropriate dynamic effects. The transverse floor beams and full-depth longitudinal stringers form a grid floor system, which allows load transferring in both the longitudinal and the transverse directions. This structural steel grid forms a redundant system with the primary load path through the transverse floor beams. The full-depth longitudinal stringers provide multiple supports, which minimize



deflections from the potential fracture of a floor beam and significantly reduce the resulting fracture energy release and dynamic impact.

The design-build team determined very early that the traditional methods of erecting the arch off-site on high towers and floating it in over the piers was too risky due to the high center of gravity and variability of river water elevations, which could delay move-in. Therefore, the team elected to erect the arch on land, transfer it onto barges with self-propelled modular transporters (SPMTs), float it in low, position it between the piers using a skid rail system and lift it into place with strand jacks on top of the piers.

The steel floor beams and longitudinal stringers were erected on land in the staging area by the river bank with temporary supports. A temporary tension tie system, consisting of two W36 sections to resist the thrust of each arch rib, was used to facilitate the erection and served to stabilize the floor system and support the formwork for the cast-in-place tie girder. A steel lifting connection served as a temporary knuckle connecting the arch rib with the temporary tie. Finally, the hangers were installed between the arch rib and the ends of each floor beam. The arch ribs were braced during erection, and the entire system was framed using the temporary rib bracing, floor system and the lower lateral bracing system.

After completing the steel member erection on land, eight 16-axle SPMTs were brought in and situated with two under each of the corners of the arch system. The vertical lifting ability of the SPMTs was used to lift each of the four corners of the arch in unison, bringing the arch off of its support towers and the floor system off the temporary supports. The total vertical lift was approximately 6 in. to account for the deflection of the arch and elongation of the tie as the arch picked up the weight of the floor system. The wheels of the SPMTs at one end of the arch were rotated 90° to allow them to roll with the elongation of the temporary tie girder. After a successful lift-off, the wheels were rotated back to prepare for the move down the slope to the river bank, while all the temporary supports and towers were taken down.


TRAIL
CLOSED

The SPMTs under the corners at each end were connected together to act in unison for moving the arch system transversely down to the river bank and over a trestle onto barges. Water level monitors at each corner of the arch were used to check the slope between the ends of each arch and the SPMTs were adjusted vertically to maintain a constant slope between the arches and avoid twisting the floor system as they marched the arch down a 3.5% slope to the river and onto the barges.

One barge was positioned at each end of the arch to allow each 104-ft-wide end to roll onto the barge from one end toward the center until both sides of the arch were positioned in the center of the two barges. The barges were constantly monitored and re-ballasted as the SPMTs rolled each end of the arch onto the barges. The total move onto the barges took about 12 hours.

The arch was floated down stream to the bridge site and positioned adjacent to the piers. Due to the curve in the river bank and the south piers' position on the river bank, the arch was skidded south off the south barge onto the river bank with a skid track system until it lined up with the horizontal skid rails that were positioned between the piers. Once in position on the south end, the support was transitioned from longitudinal to transverse skid shoes. The north end of the arch was unloaded off the barge onto the skid rails during the transverse slide with the help of SPMTs on the barge. Once positioned between the piers, the arch was ready for lifting.

The lifting frame supporting the strand jack system was anchored directly to the top of the pier. The strand jack system was connected to the arch system-lifting connection and hoisted 55 ft onto the top of the piers. Pier deflections were monitored and checked to ensure clearance after liftoff from the skid rails. Once in place, a support frame was moved into position under the temporary knuckle and the bridge was lowered into its final position. The lifting connection and support frame were cast into the permanent concrete knuckle. The concrete tie girder and knuckle were post-tensioned sequentially as the knuckle, tie and deck concrete were placed. To compensate for creep, shrinkage and shortening, the piers were jacked apart 6 in. before casting the knuckle, and the temporary arch bracing remained in place until the deck was cast. The deck was placed in a single pour, beginning at the center of the bridge. Hanger adjustments for geometry and stress were made by modifying the heights of the shim packs at each hanger. The float-in and lift process for the 3,300-ton arch steel structure was completed within a 48-hour window to limit the amount of time the Mississippi River navigation channel was closed.

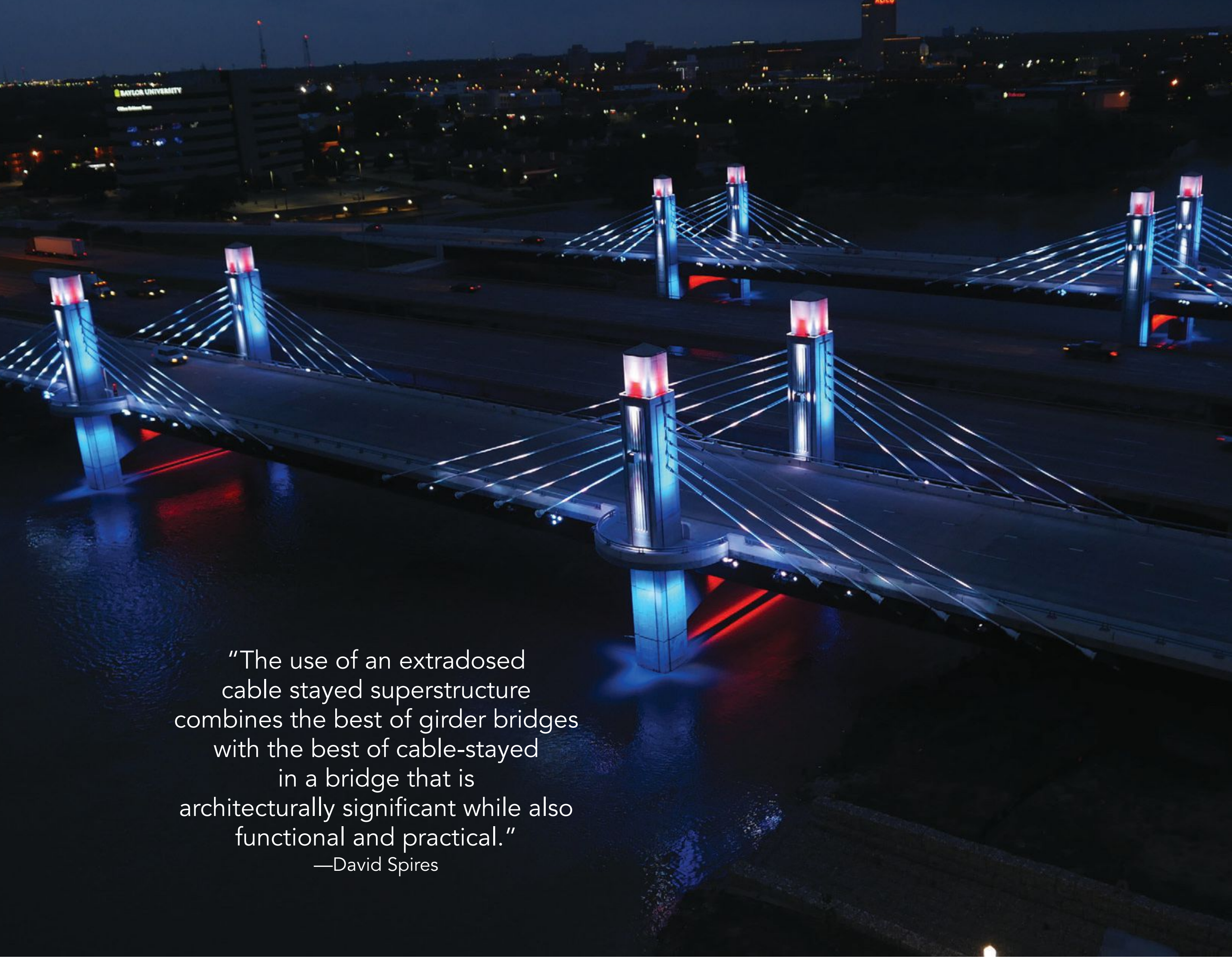
Owner
Minnesota Department of Transportation, St. Paul

Designer
Parsons Corporation, Chicago

Contractor
Lunda Construction Company, Rosemount, Minn.

Steel Fabricator
Veritas Steel, Eau Claire, Wis.

Steel Detailer
Candraft Detailing, Inc., New Westminster, B.C., Canada



> "The use of an extradosed cable stayed superstructure combines the best of girder bridges with the best of cable-stayed in a bridge that is architecturally significant while also functional and practical."
> —David Spires

PRIZE WINNER: LONG SPAN

IH-35 Bridges over the Brazos River, Waco, Texas

TEXAS, LIKE MANY OTHER SOUTHERN STATES, has seen substantial population growth recently.

This growth is one of the key drivers for expanding Interstate capacity, particularly in cities like Waco. I-35 meanders through the east Texas city, home of Baylor University, and the Waco District of the Texas Department of Transportation (TxDOT) wanted to do more than just add capacity with the $17.3 million IH-35 frontage road bridge project. It wanted to make a statement. By pioneering the application of extradosed bridges in the U.S., the city of Waco and TxDOT did just that (see sidebar for a description of extradosed bridge design).

Spanning the Brazos River and parallel to the existing mainline I-35 bridges, the new IH-35 frontage road extradosed bridges are 620 ft long and are the first extradosed cable-stayed bridges in the U.S. to use a steel superstructure. Traffic on each bridge is one way, with the new bridges placed to the outside of the mainline bridges. The existing mainline bridges will soon be replaced with new steel box-girder bridges as part of the IH-35 corridor improvements. In the final configuration, both the northbound and southbound frontage road bridges will be separated horizontally some 60 ft from the corresponding mainline bridges.

The roadway for each frontage road bridge carries three traffic lanes with shoulders, as well as a 10-ft, 6-in.-wide sidewalk for pedestrians and cyclists. In addition, scenic overlooks providing unobstructed river views are incorporated into the pylons to enhance the bridge experience for pedestrians. Each of the new twin structures is a three-span bridge with a 250-ft center span and 185-ft side spans. Matching the span configuration of the proposed new mainline bridges, this configuration aligns the piers within the river for all the bridges in their final condition.

Each bridge's superstructure consists of 6-ft, 6-in.-deep steel trapezoidal box edge girders, 3-ft, 6-in.-deep steel-plate I-girder floor beams and 10.5-in. cast-in-place concrete deck. Transverse floor-beam spacing varies from 13 ft, 3 in. in the end region of the side spans to 15 ft in the regions near the pylons. The trapezoidal box edge girders are composed of ¾-in. web plates, with 2-in.-wide top flange plates and a 5-ft-wide bottom flange plates. Top flange plate thickness varies

An Extra Dose of Strength

Unlike traditional cable-stayed bridges, extradosed bridges use a combination of superstructure as well as cable stays to support the loads. These bridges have a distinguishing feature from traditional cable stayed bridges in that the tower height is much shorter in proportion to the main span. While cable-stayed bridges typically have tower heights around one-fourth to one-fifth of the main span length, extradosed bridges have tower heights equal to approximately one-tenth of the main span length. The shorter tower height results in shallower cable angles that in turn increase the axial compression in the superstructure and decrease the vertical stay forces that act as supports in a conventional cable-stayed bridge. In other words, cables on an extradosed bridge serve a prestressing function.

Also, due to the additional support of the cables, an extradosed bridge may have a shallower superstructure depth relative to a traditional girder bridge. The span-to-depth ratio of extradosed bridges is typically on the order of 35-to-1 versus approximately 20-to-1 to 25-to-1 for typical girder bridges. However, an extradosed bridge still acts as a girder bridge, so the superstructure depth is greater than a conventional cable-stayed bridge, with a typical span-to-depth ratio of approximately 100-to-1. In addition, due to an extradosed bridge's relatively stiff superstructure, which resists a majority of live-load forces (rather than having the stays carry the load), these bridges also are often characterized by low live-load stress ranges in the stay cables.

from a typical 1 in. up to 3 in. for the regions over the bearings at the pylons, and the bottom flange plate varies from a typical 1¼ in. to 3 in. over the pylons. The box edge girders are continuous for the entire length of the bridge, supported on single disc bearings at the abutments and pylons. The transverse I-girder floor beams consist of ½-in. web plates with 1-ft, 6-in.-wide by 1-in.-thick top and bottom flange plates. Each H-shaped pylon consists of two 9-ft, 3-in. by 9-ft, 3-in. rectangular towers with a haunched 5-ft, 3-in.-wide crossbeam that supports the superstructure.

The project team chose a steel-girder composite cross section for the design. While a concrete cross section is typical for extradosed bridges, TxDOT preferred steel girders with concrete decks because of its familiarity with this superstructure scheme. In addition, structural engineer AECOM evaluated the use of a cast-in-place concrete box girder superstructure but determined it to be economically untenable. In addition, the project team used a steel trapezoidal box section for the edge girders, rather than a steel-plate I-girder section more commonly used on composite cable-stayed bridges, in order to provide greater superstructure stiffness and less reliance on the cable stays. The team also wanted to visually match the new mainline bridges, which will be steel box-girder bridges. The cable system consists of a single plane of five cable stays at each pylon supporting the edge girders (a total of 20 stays for each bridge). The cable stays are anchored at the deck level to the web of the steel box girder and pass through cable saddles in the pylons. With 12 strands per cable, the stays are composed of 0.62-in.-diameter, seven-wire, low-relaxation strands. For improved corrosion resistance, each strand is coated with wax and encapsulated inside high-density polyethylene (HDPE) sheathing. The strand-bundled stays are further protected by an outside HDPE pipe.

Since an extradosed bridge has two load-carrying systems, cable support can be provided for only a portion of the span. Consistent with the geometry of many extradosed bridges, the first stay for the IH-35 frontage road bridges is offset from the pylon by approximately 20% of the main span. From this first stay, the cable support points are spaced 14 ft, 9 in. along the edge girder, for a total of 59 ft. This results in approximately 50% of the main span being cable supported, which is consistent with most existing extradosed bridges that have cables distributed across approximately 60% of the span.

Due to the use of the relatively more flexible steel superstructure (supported at the pylons by bearings), the resulting live-load stress range in the stays was greater than the Post-Tensioning Institute's (PTI) limit that would allow the stays to be designated as low-fatigue. The stress variation caused by live loads (AASHTO HL-93 live load with no pedestrians) varied up to approximately 15 ksi versus the 6.75 ksi limit for the stays to be considered extradosed. So the stays were designed accordingly, using the same provisions in the PTI manual as for conventional cable-stayed bridges.

A complete erection scheme was also developed during the design of the bridge to inhibit both cracking of the concrete deck during construction and slippage of the stay strand through the saddles. Further, the cable-stay and saddle system chosen was specified to allow for the installation and replacement of stay strands on an individual strand-by-strand basis. This was no small consideration since the ability to replace strands on an individual basis will allow future bridge maintenance workers to pull and inspect strands without needing to replace the entire stay. Stay strands will be placed within individual holes in the cable saddle, significantly reducing the risk of fretting corrosion and facilitating strand-by-strand replacement. Although using saddles is a common practice elsewhere in the world, it is relatively new in the U.S. and only a few bridges have been designed with this system.

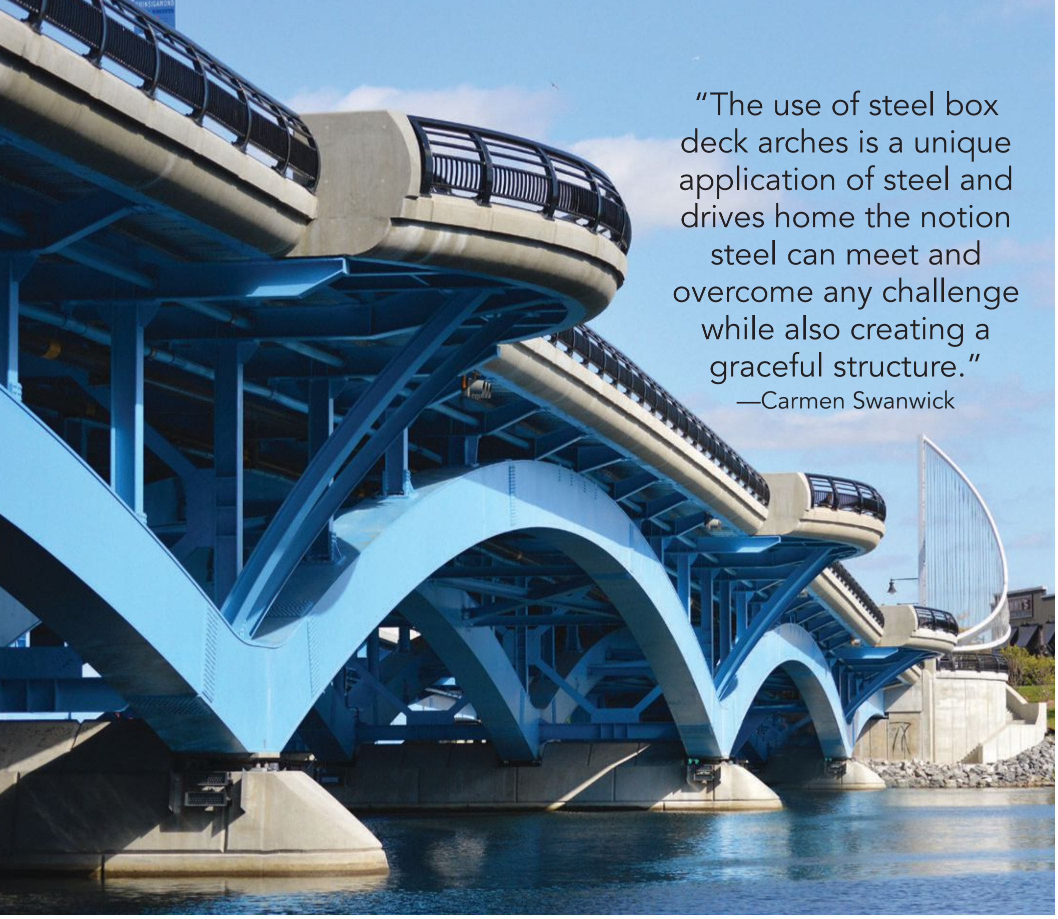
Not only was this the first use of a steel extradosed bridge in the U.S., but the project also had to content with heavier-than-usual deadline pressure thanks to Baylor announcing that it would be constructing its new Lane Stadium football facility adjacent to the bridges, with an opening date of August 31, 2014. Nevertheless, the bridges were delivered 4.5 months ahead of the original schedule and opened to traffic that July.

Owner
Texas Department of Transportation, Austin

Designer
AECOM, Glen Allen, Va.

Contractor
The Lane Construction Corporation, Lorena, Texas

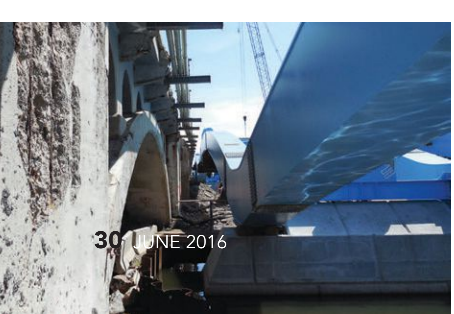
Steel Fabricator and Detailer
Hirschfeld Industries, San Angelo, Texas



"The use of steel box deck arches is a unique application of steel and drives home the notion steel can meet and overcome any challenge while also creating a graceful structure."
—Carmen Swanwick

PRIZE WINNER: MEDIUM SPAN

Kenneth F. Burns Memorial Bridge, Worcester/Shrewsbury, Mass.



AFTER NEARLY A CENTURY OF USE, the Kenneth F. Burns Memorial Bridge had run its course.

The multi-span concrete deck arch was an appreciated part of the landscape, but it had become too narrow for modern traffic needs and was deteriorating and due for retirement. Replacing it are two separate bridges, carrying eastbound and westbound traffic, that reflect on the old bridge's grace, but with a modern update using sweeping, sleek, steel box deck arches in place of concrete framing.

Construction staging required maintaining traffic flow on the original bridge, which carries Route 9 over Lake Quinsigamond between Shrewsbury and Worcester, while the new bridge was built around it. The design team developed a unique solution for the new low-rise arch spans: full-bridge-length post-tensioned arch ties. The bridge was designed and constructed as a tied deck arch. Tension ties were placed at the deck level and included full-length bridge post-tensioning, with two ducts per steel box beam. Post-tensioning was performed twice during construction to balance moments and compression forces.

To reduce impacts at the approaches in Worcester and Shrewsbury, vertical grade changes on Route 9 were minimized, which led to a relatively low rise. The resulting arch structures behaved as hybrid arch/continuous beams structures. The team optimized the design by balancing moments, axial compression and tension, using the post-tensioning to reduce maximum moments and carefully coordinating and iterating the analysis with construction staging.

The piers are comprised of steel pipe piles, with a precast soffit and cast-in-place concrete formed above the soffits. The construction of perched piers largely out of the water avoided the need for difficult and expensive sheeting and dredging in Lake Quinsigamond, and improved requirements for environmental permitting in the lake, resulting in better water quality and less disruption for boaters.

The design team developed a complex construction staging model using CSI Bridge, augmented by customized pre-processors and post-processor programs and sheets developed specifically for the project. The staging model matched construction means and methods and was frequently called upon to evaluate conditions in real time during construction. The model was verified during construction by matching predicted deflections with actual measurements at various stages of the work. In addition to the global model, detailed finite element models of complex steel connections were prepared to evaluate special conditions and framing.

Animation was used extensively to evaluate bridge aesthetics. For example, the team was concerned that the post-tensioning ducts on the fascia box beams might look like hanging utility pipes. It was initially thought that shadows from the overhanging decks might minimize the problem, but an animation with sunlight angles estimated from the end of December (with the most direct southern light) clearly showed otherwise. Based on this result, the team moved the ducts up onto the fascias, requiring special steel framing details but greatly improving the appearance of the bridge.

Owner
Massachusetts Department of Transportation, Worcester

Designer
Stantec, Boston (formerly FST)

Contractor
The Middlesex Corp, Littleton, Mass.

Steel Fabricator
Casco Bay Steel Structures, Inc., South Portland, Maine

PRIZE BRIDGE: SHORT SPAN
ACCELERATED BRIDGE CONSTRUCTION COMMENDATION
Wampum Bridge, Lawrence County, Pa.

IN AN ALL-TOO FAMILIAR STORY, a bridge in Wampum Borough of Lawrence County, Pa., had fallen on hard times and wasn't going to get better.

The severely deteriorated existing concrete arch carried SR 288/Main Street over Wampum Run and provided a vital connection for both residents and the local trucking industry. The failing structure had previously been reduced from two lanes to one bidirectional lane, and its weakening condition would have eventually warranted a full closure in the near future, thus requiring a 22-mile detour that was viewed as both costly and extremely inconvenient for local travelers. Either way, the bridge would need to be repaired or replaced.

Conventional phased construction methods for maintenance of traffic were considered but would have required extensive and costly repairs to the arch, thus prompting both the Pennsylvania Department of Transportation (PennDOT) and designer Johnson, Mirmiran and Thompson (JMT) to take the replacement route. Project stakeholders wanted a reduced construction time frame and minimal inconvenience for travelers following the lengthy detour, and JMT and PennDOT agreed that this could be accomplished by using accelerated bridge construction (ABC) techniques.

Preliminary design began with research and discussions with engineering professionals from various states with bridges successfully built using ABC. JMT reviewed these other states' standards and special provisions, and discussed design and construction methods used on their successful ABC projects. As a result of this research, JMT presented a report concluding that a cost-effective structure could be completed in less than a month.

Various superstructure options were considered including multi-girder bridges with full-depth precast concrete decks, partial-depth precast concrete deck panels, adjacent butted beam superstructures, modular prefabricated superstructures and parallel beam superstructures with a conventional deck. PennDOT District 11-0's preference was to avoid post-tensioning and construct a joint-less structure using integral abutments. All stakeholders agreed that the best option was a 78-ft steel beam structure on integral abutments. The pile caps, wing walls, cheek walls, back walls, approach and sleeper slabs were designed to be precast units while the steel beams were to have the deck and barrier cast to them off-site using conventional methods to create three modular units. The initial construction schedule for this structure type was estimated to take 15 days to construct.

"This project is the model for ABC construction using steel."
—David Spires

The geotechnical findings showed that the piles could be driven, but they would have to be re-struck after 48 hours. Due to the uncertainty of the foundation of the portions of existing arch structure that were left in place, predrilling was required to avoid striking the remnants of the arch during the pile driving operation. Adding predrilling and the waiting period of the re-strike affected the initial schedule, and several production activities were rescheduled to occur during the re-strike waiting period to maintain efficiency. The changes to the schedule increased the allowable timeframe to 17 days. Confident that the bridge could be open to traffic within this time frame, Road User Liquidated Damages (RULDs) were calculated and an incentive/disincentive of $36,000 per day was added to the construction contract.

Due to the accelerated design schedule, coordination with the railroads and limiting impacts to the adjacent railroad property were critical for the project's success. Both CSX and Norfolk Southern have property within the project limits, and the roadway tie-ins were designed to ensure the required right-of-way was minimal on the CSX property and was not necessary on the Norfolk Southern property. Additionally, through coordination with CSX, the necessity for flaggers was eliminated by providing construction fence to prevent the contractor from accessing railroad property.

Another challenge was coordinating the relocation of Columbia Gas Transmission's line in a narrow time window. The existing gas transmission line crossed the roadway less than 15 ft behind the existing abutment, and because the gas line was so close to the structure and the project used integral abutments, it was impossible to avoid impacting the line. It had to be relocated prior to construction and the design had to be expedited in comparison to a typical project due to the condensed design schedule. Through extensive coordination between JMT and Columbia, a relocation route was developed, avoiding the proposed abutments, drainage structures and guiderail posts as well as roadway excavation. The roadway was closed for seven days, the new bridge was constructed in 7 days and the overall project was open to traffic on August 24, 2014, well ahead of the September 21, 2014 milestone date.

Owner

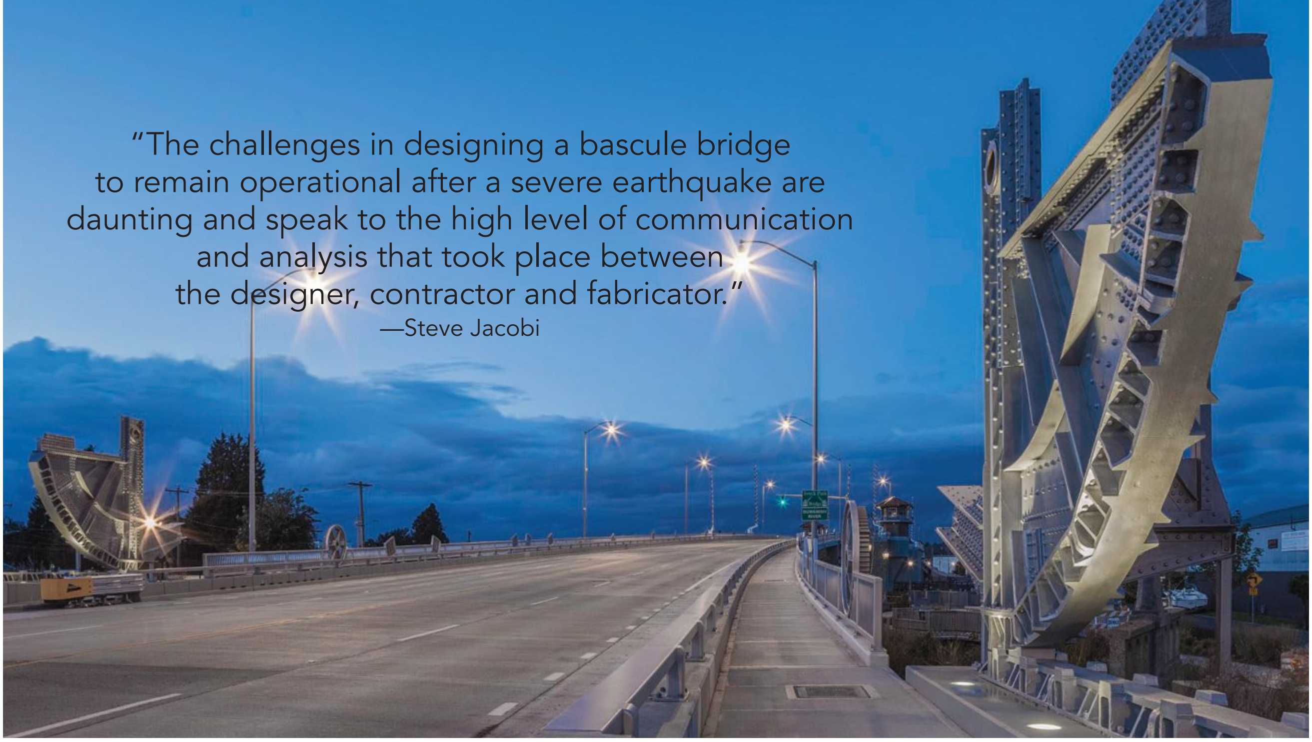
Pennsylvania Department of Transportation, Bridgeville

Designer

Johnson, Mirmiran and Thompson, Inc., Moon Township, Pa.

Contractor

Joseph B. Fay Company, Tarentum, Pa.



PRIZE BRIDGE: MOVABLE SPAN

South Park Bascule Bridge Replacement, Seattle

THE SOUTH PARK BRIDGE is a first-of-its-kind "trussed" plate girder design.

Designed and built to survive a major seismic event with minimal damage, the replacement bridge is a community lifeline, improving freight mobility and providing better regional access to downtown Seattle and the adjacent industrial area.

The original bridge was one of the few working examples of a rolling lift bascule Scherzer bridge. There was significant public agency and community interest in preserving its character and significance, as it was listed on the National Register of Historic Places and officially designated a historic landmark by the King County Landmarks Commission. The new bridge was designed to emulate the overall look and feel of the original bridge by incorporating truss-like features in the girders without incorporating the disadvantages of a traditional truss design. The fascia girder treatments off the main span were selected to honor the approach trusses on the original structure and to improve aesthetics. Economy in the design of the girder yielded a shallower structure, providing the desired waterway clearance improvements while minimizing the overall height of the bridge so it did not appear to tower over the surrounding community.

While a beloved community landmark, the original bridge's gusset-plated joints were numerous and sizable. Multiple large plates and fasteners intersecting at various angles created geometrically complex regions at every panel point. These joints acted like pockets, accumulating dirt, debris, moisture, guano and other substances detrimental to the steel bridge's long-term reliability. Designer HNTB's innovative main girder design of a continuous welded plate eliminated the problem-prone areas of traditional gusset-plated joints and two time-consuming steps common in its construction: match-drilling and field installation of thousands of bolts. With those steps gone, the "trussed" plate girder design—the first known use of this girder type—sped fabrication, shop assembly alignment and erection.

The bascule leaves are connected at the tips by span lock bars that will keep the leaves together vertically and transversely during a seismic event. However, there are no longitudinal restraints between the two leaves. During a seismic event, the joint will experience separation and closure of up to 18 in. of total movement. If the leaf superstructure was allowed to collide longitudinally, the impact load would have been very large, and the loads would have been transferred back to the span-supporting trunnion frames, requiring a more robust frame.

HNTB's solution was to design the draw span superstructure with 19 in. of separation and include a collapsible center joint. During a seismic event, only the leaf tip joint assemblies would collide, thus preventing large load transfers back to the trunnion frames. The collapsible joint was detailed so that steel components on tapered shims would shear off when displaced, resulting in damage that would be easily detectable and repairable.

Several solutions were incorporated in order to meet stringent seismic performance requirements, including sunken caisson foundations, isolated trunnion frames and a collapsible center joint on the lift spans. The bridge was designed to remain fully functional in the aftermath of an Operational Earthquake Level (108-year return period), and only moderate, but repairable, damage was permitted as the result of a Design Earthquake Level (975-year return period).

A citizens advisory group of diverse stakeholders met often and conveyed an important public perspective, which was incorporated into the bridge's design during the eight-year environmental documentation phase. One of the more notable action items was the group's request to include many of the original bridge's architectural details in the new bridge's design, as well as to salvage and display more than 100 original bridge parts at the project site. Gears from the operating machinery were artistically incorporated in the sidewalk railing. The track-and-rocker assemblies, the historical features from the original Scherzer bridge were transformed into gateway monuments at each end of the

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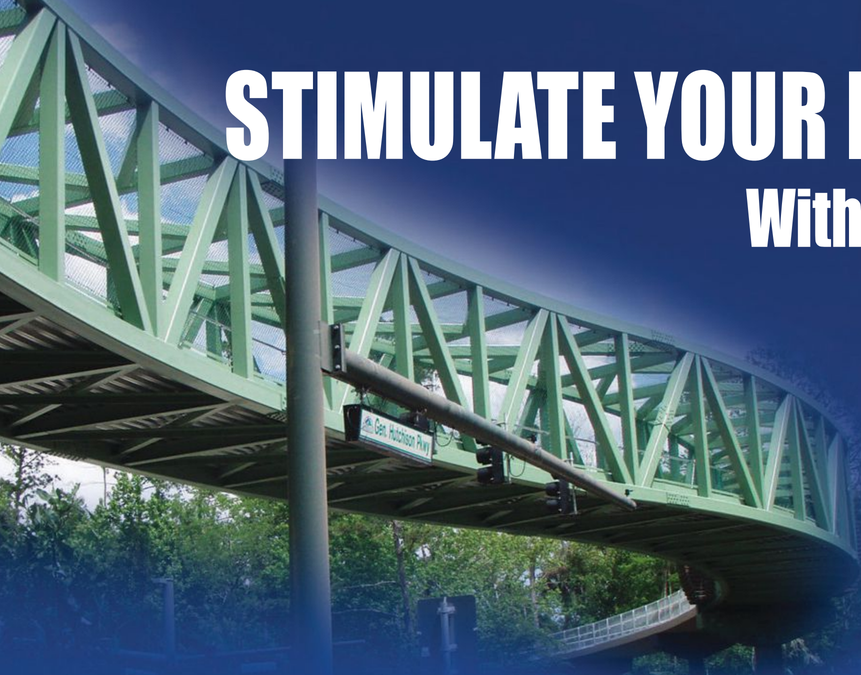

◀ 17-92 Pedestrian Bridge (Longwood, FL)

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Highland Bridge (Denver, CO) ▶

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◀ Tempe Town Bridge (Tempe, AZ)

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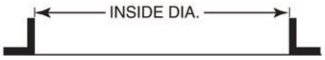
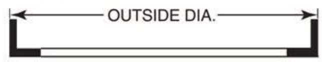
1 Angle Leg Out



10" x 10" x 1" Angle

2 Angle Leg In

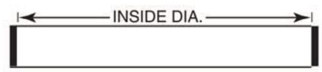


10" x 10" x 1" Angle

3 Flat Bar The Hard Way

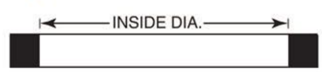
24" x 12" Flat

4 Flat Bar The Easy Way



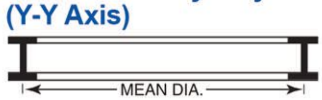
36" x 12" Flat

5 Square Bar



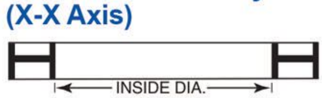
18" Square

6 Beam The Easy Way (Y-Y Axis)



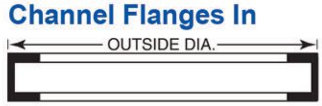
44" x 335#, 36" x 925#

7 Beam The Hard Way (X-X Axis)



44" x 285#

8 Channel Flanges In

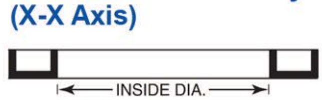


All Sizes

9 Channel Flanges Out

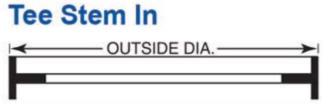
All Sizes

10 Channel The Hard Way (X-X Axis)



All Sizes

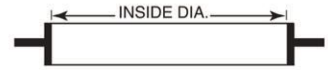
11 Tee Stem In



22" x 142 1/2# Tee

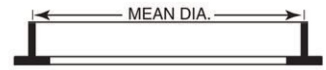
We bend ALL sizes up to:

12 Tee Stem Out



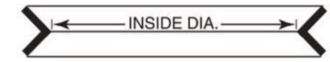
22" x 142 1/2# Tee

13 Tee Stem Up



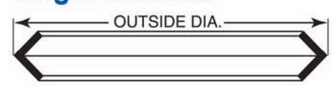
22" x 142 1/2# Tee

14 Angle Heel In



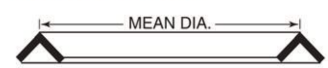
8" x 8" x 1" Angle

15 Angle Heel Out



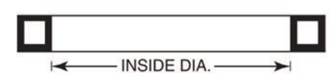
8" x 8" x 1" Angle

16 Angle Heel Up



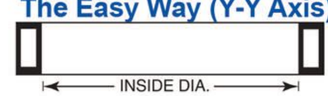
8" x 8"x1" Angle

17 Square Tube



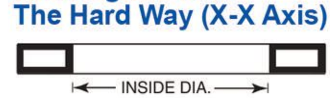
24" x 1/2" Tube

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



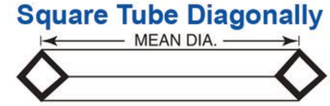
20" x 12" x 5/8" Tube

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



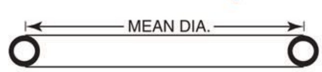
20" x 12" x 5/8" Tube

20 Square Tube Diagonally



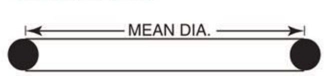
12" x 5/8" Square Tube

21 Round Tube & Pipe



24" Sched. 80 Pipe

22 Round Bar



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bridge. The decorative light posts, decorative railing panels, cast concrete railing, old bricks, decorative rail posts and deck grating were used to embellish the site around the bridge.

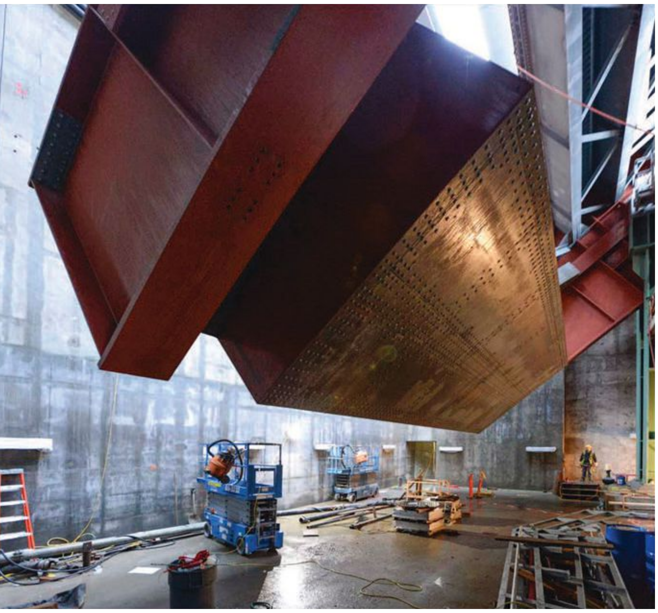
In addition, the design features a decorative rain garden that serves as landscape art while also collecting and naturally treating storm water runoff from the bridge prior to discharging it into the waterway, thus eliminating the need for a huge and expensive underground detention vault. The bridge was also engineered with an energy-efficient drive system that can operate each 1,500-ton draw span with approximately the same horsepower needed to drive a Toyota Prius.

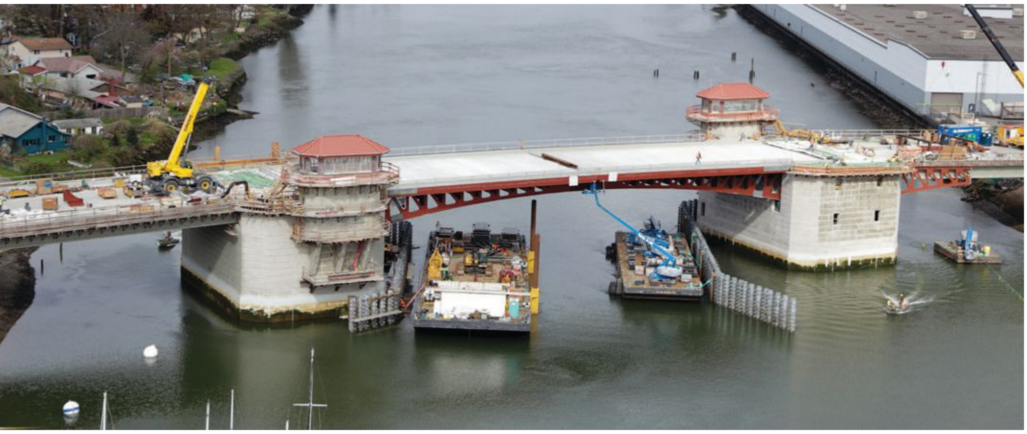
Owner
King County Department of Transportation, Seattle

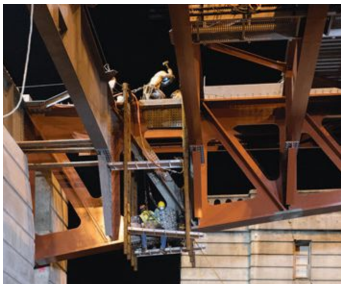
Designer
HNTB Corporation, Bellevue, Wash.

Contractor
Kiewit-Massman (JV), Federal Way, Wash.

Steel Fabricator and Detailer
Stinger Bridge and Iron, Coolidge, Ariz.







PRIZE BRIDGE: RECONSTRUCTION SPAN

Alexander Hamilton Bridge, New York

ALEXANDER HAMILTON IS NOT ONLY the star of Broadway's current smash hit, but also a star of the New York metro area's transportation infrastructure.

The $413 million Alexander Hamilton Bridge (AHB) Rehabilitation Project rejuvenates a major link in the area, leading to enhanced mobility throughout the region, improved safety and a structure that was designed to endure for generations. The project also restored existing recreational facilities and constructed new ones in the park land within the project to provide safe gathering areas for local communities.

The original AHB consisted of two separate superstructures with a longitudinal open joint along the centerline of bridge. The asymmetrical shifting of traffic lanes and cutting of the existing bridge cantilever brackets required extensive implementation of temporary and permanent bracing between the two superstructures to resist the unbalanced loadings during construction and in the final condition.

The weight of the new widened AHB and the modifications of existing bridge superstructure for the elimination of deck joints (transverse and longitudinal) required the strengthening of the existing four 505-ft-long deep steel-box arch-ribs that span between the Harlem river. Detailed step-by-step procedures were developed and provided in contract document for the pretensioning and installation of the new reinforcing top and bottom cover plates.

The superstructure of the new bridge is composed of a girder-floor beam-stringer system. For the strengthening of existing floor beams and the introduction of new retrofit girders between the existing girders under live loads, detailed analyses were performed and complex details were developed for the safe cutting and temporary support of the existing floor beams. For the new widening, the existing cantilever brackets along the fascia of AHB were replaced with longer (57-ft) cantilever brackets, almost twice the original length. To strengthen and replace corroded sections, temporary support and bracing details were developed and provided in contract documents for the partial disassembled of long and slender composite box-sections under heavy loads.

For more on a different award-winning portion of the Alexander Hamilton Bridge project, see the "Ramp TE Over I-95" write-up in the 2014 Prize Bridge Awards feature in the June 2014 issue, available at www.modernsteel.com.

Owner
New York State Department of Transportation, Long Island City

Designer
Jacobs Engineering, New York

Contractor
Halmar International, Nanuet, N.Y.

Steel Fabricator and Detailer
Canam-Bridges, Claremont, N.H.

"This project is as complicated as it gets. Where it was possible, the superstructure was salvaged, resulting in a revitalized link that will carry over 200,000 cars per day for the next 100 years."
—Michael Culmo

PRIZE BRIDGE: SPECIAL PURPOSE

The 606 - Milwaukee Avenue Bridge, Chicago

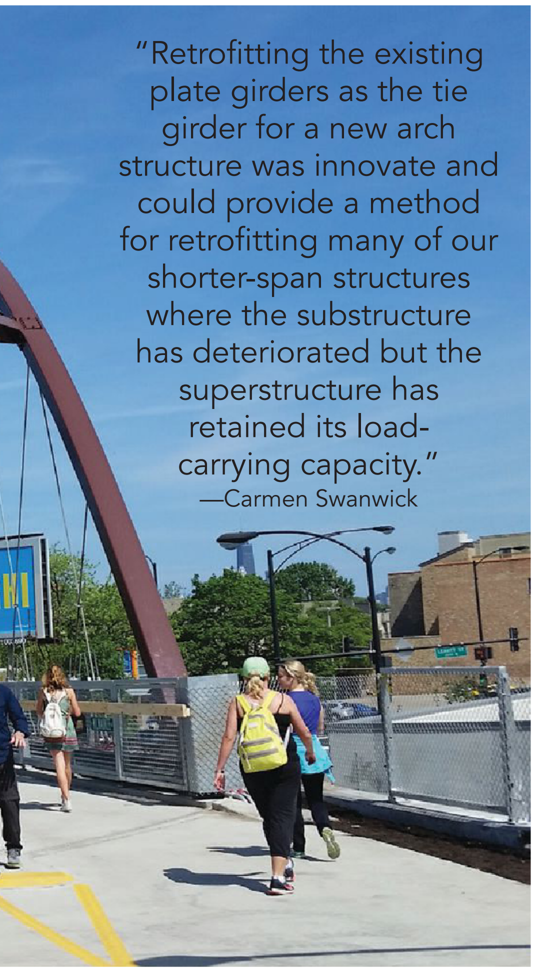
CHICAGO'S LATEST HIGH-PROFILE PARK rises above it all.

The 606, named for the first three digits of the city's zip codes (and also known as the Bloomingdale Trail), is a 2.7-mile-long former elevated train line that was converted into a new park and pedestrian trail on the city's north side.

Often seen as the centerpiece of the project, one of the park's bridges—over Milwaukee Avenue—was transformed from a four-span, low-clearance structure with three piers that obstructed traffic below, to a single-span tied-arch structure that allowed street traffic to flow unobstructed and with improved sight lines and vertical clearances.

In order to reuse as much of the structure as possible, the team proposed transforming the existing superstructure into a tied-arch bridge while reusing the existing plate girders as the tie girder and installing new curved rectangular HSS arches that provide support to the new single 98-ft, 2-in. span. LUSAS and CSiBridge modeling software were used to analyze the structure, including modal and dynamic analysis. The existing girders were spliced together at the piers for continuity and retrofit steel was added to the existing plate girders where needed due to the deterioration that had taken place over the past 100 years. Lateral earth loads were reduced by the use of geo-foam, allowing the existing abutments to be completely reused.

The skew of the bridge provides for unique perspectives of the structure from different vantage points. Motorists below see three staggered arches that appear tall and steep, while train riders above, from a view perpendicular to the arches, see them as long and shallow. Pedestrians passing through the arches see the unique angles and elevation changes of the bracing and arch members provided by the 45° skew. With limited space due to nearby Chicago Transit Authority (CTA) Blue Line elevated train structural support columns, creating access at the west side of Milwaukee Avenue forced the designers to think outside the box. The solution was to have the access ramp cut through the existing retaining wall, starting outside the elevated portion of



"Retrofitting the existing plate girders as the tie girder for a new arch structure was innovate and could provide a method for retrofitting many of our shorter-span structures where the substructure has deteriorated but the superstructure has retained its load-carrying capacity."
—Carmen Swanwick

the trail at Milwaukee Avenue and moving inward and upward until access to the trail was gained. Tied-back steel sheet pile wall was incorporated to accomplish this feat.

Owner
Chicago Department of Transportation, Chicago

Designer
Collins Engineers, Chicago

Contractor
Walsh Construction Company, Chicago

Steel Fabricator
Prospect Steel Company, Little Rock, Ark.

Steel Detailer
Weaver Bridge Corporation, Granville, Ohio

MERIT AWARD: MAJOR SPAN

Stan Musial Veterans Memorial Bridge, St. Louis/St. Clair County, Ill.

TOO MANY INTERSTATES ON ONE BRIDGE were causing quite the traffic nightmare over the Mississippi River near downtown St. Louis.

The Poplar Street Bridge, which carries Interstates 55, 64 and 70 as well as U.S. 40, was overburdened with traffic, so the decision was made to build a new crossing for I-70, the Stan Musial Veterans Memorial Bridge. The bridge features two 400-ft towers above the third-longest cable-stayed bridge in the United States.

Currently carrying four lanes, the design allows for the addition of two lanes through re-striping and can accommodate a future adjacent four-lane bridge. Traffic is now able to flow at posted speeds adjacent to downtown St. Louis between Missouri and Illinois, which reduces congestion, enhances air quality and aids in interstate commerce. Designer HNTB co-located with owner and FHWA representatives to solve problems in real time, thus delivering a buildable, economical design in one year—half the typical time for similar bridges.

To optimize materials, the team chose steel floor beams and edge girders composite with precast concrete panels for the superstructure, which made it easier to erect. The design eliminated the tedious job of constructing concrete corbels for the upper cable anchors and incorporated steel anchor boxes to reduce the amount of post-tensioning around pylons. The decision to fabricate the boxes in the shop made them safer and more precise while eliminating significant amounts of work 300 ft or more above the river. The steel anchor boxes incorporated a bolted connection between the anchor beam and anchor box, which allowed the fabricator to precisely locate the anchorage before bolting it permanently into position. The lower cable anchorages were steel weldments bolted to the side of the edge girders. By locating the these anchorages alongside the edge girders as opposed to on top of them, the length needed between the strand anchor and top end of the guide pipe could be obtained such that smaller more compact friction cable dampers could be used. In addition, HPS70W steel was used in the edge girders to reduce the overall weight of the superstructure.

The superstructure was designed to be redundant and able to withstand the loss of any cable without significant damage to the bridge. The cable spacing was optimized to assist with the load transfer in the superstructure under the cable-loss scenario. Various details were incorporated into the design of the bridge to address security measures important in today's world.

Because of the bridge's location in a high-seismic zone, the magnitude of the span and the soft soils and potential for liquefaction during a seismic event, HNTB tapped researchers at the University of Illinois and University of California-Berkeley. They analyzed the design using a conditional mean spectrum (CMS) approach, which had never before been used for bridge design. The approach considers the most expected response spectrum of a structure under different ground motions rather than aggregating multiple ground movements from various potential seismic events. The analysis revealed realistic demands on the bridge and eliminated potential for lateral spreading and the need for any associated ground improvements. To further test its effectiveness, HNTB performed dual-level seismic checks to ensure the bridge would be in service after a 1,000-year event and suffer only minimal damage at the 2,500-year maximum credible event. The process confirmed that the CMS approach reduces costs, and its successful implementation points to future value for the engineering profession.

For more on this project, see "Thinking Inside the Box" in the November 2013 issue, available at ***www.modernsteel.com****.*

Owner
Missouri Department of Transportation, Jefferson City

Designer
HNTB Corporation, Kansas City

Contractor
MTA (JV), Kansas City

Steel Fabricator
W&W | AFCO, Little Rock, Ark.





MERIT AWARD: LONG SPAN

(I-270 over) Chain of Rocks Road Canal Bridge, Granite City, Ill./Bellefontaine Neighbors, Mo.

STRUCTURALLY DEFICIENT AND FUNCTIONALLY OBSOLETE (technical terminology for "way past its prime") is the best way to describe the twin truss bridges that carried I-270 over the Chain of Rocks Canal near Granite City, Ill.

Built in 1963, the bridges had served as a major Interstate and St. Louis Area commuter link between Illinois and Missouri, crossing the canal that acts as a Mississippi River Bypass for all barge traffic traveling through St. Louis. Heavy existing traffic—nearly 55,000 vehicles per day—coupled with the regularly required bridge repairs caused significant congestion and delay for users and was a major source of concern and countless complaints, and the decision was made to replace the bridges.

Designer HDR's analysis showed the I-270 trusses were deficient; the structures needed serious help. Determining a remedy for the larger issue of how to design and construct a replacement bridge while keeping I-270 open to traffic quickly moved the project up on the priority list. In addition to managing preliminary engineering and final design services for the bridge replacement, HDR also inspected the bridges annually to ensure that the structural integrity of the existing bridges was sufficient during the design and construction phases. Due to the recent I-35W bridge failure, the inspections and follow-up specifically included gusset plate inspections and ratings to determine and monitor the strength of the connections in the trusses. After assessing the existing condition of the nearly 50-year old bridges, HDR identified rehabilitation requirements to keep the structures serviceable in the near term. Since construction funding was not secured at the time, HDR developed a plan to construct the bridge in phases as funding became available.

The project's Traffic Management Plan (TMP) staged construction to maintain two lanes of traffic in each direction and provided motorists with advanced warning/information of the lane closures and alternative route options, thus minimizing traffic backup lengths and using the most efficient method of construction staging to maximize safety and quality.

Due to the navigable canal and adjacent levee, the question was whether the USACE and the United States Coast Guard would issue permits in and around a levee in the "post-Katrina" environment. HDR's mutually acceptable solution involved placing suitable compacted fill to widen the levee and stabilize the area enough so that the pier location could be allowed. The bridge design could then proceed at speed.

Opened to traffic in 2014, the new I-270 bridge represents the largest steel plate I-girder bridge in Illinois. The five-span crossing, with a total length, of 1,970 ft, includes spans of 350 ft, 440 ft, 490 ft, 440 ft and 250 ft. The span arrangement was dictated by the need to span the canal and adjacent east flood protection levee and in doing so, the bridge was configured with 10 variable-depth steel plate I-girders. Given the amount of steel required, the design strived to achieve economy with regard to material, fabrication and construction. Flange plate thicknesses are repeated throughout the structure as much as possible in an effort to reduce the number of plate sizes required to be procured by the fabricator, Stupp Bridge. For the 18 girder field pieces along each girder line, only six different Grade 50W flange plate thicknesses are used, and only four different HPS70W flange plate thicknesses are used.

For more on this project, see "Increasing Spans and Possibilities" in the March 2014 issue, available at www.modernsteel.com.

Owner
Illinois Department of Transportation, Collinsville, Ill.

Designer
HDR, Inc., Chicago

Contractor
Walsh Construction, Chicago

Steel Fabricator and Detailer
Stupp Bridge Company, St. Louis (AISC CERTIFIED FABRICATOR)

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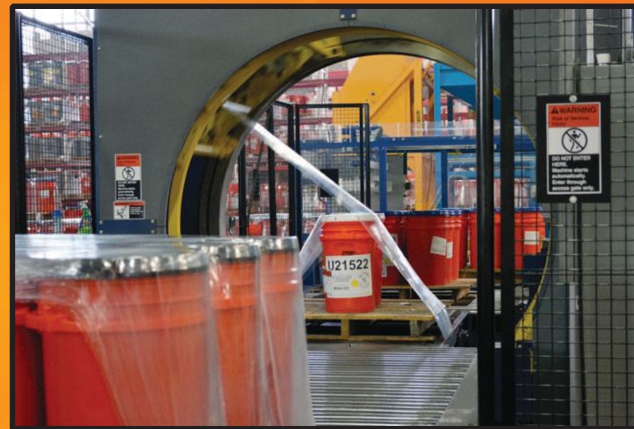

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MERIT AWARD: MEDIUM SPAN
Falls Flyover Ramp, Wichita, Kan.

FOR MORE THAN TWO DECADES, the City of Wichita, Kan., sought to relieve traffic congestion at the I-235 interchange with Zoo Boulevard, which provides access across the Wichita-Valley Center Floodway, known locally as the "Big Ditch."

The solution is manifested in the form of two structural steel plate girder bridges—2,273 ft long and 1,690 ft long, respectively—which are part of a new partial interchange with 13th Street and I-235.

Establishing the flyover bridges' span arrangement to fit the project site was challenging due to multiple constraints. The design team had to carefully locate the bridges over 1,000 ft of floodway and around its levees, as well as around I-235, other roadways, a lakeside residential development and a county park. Bridge piers were located a minimum of 20 ft from the toe of the east and west levees in order to avoid impacts to the integrity of the levee system. The U.S. Army Corps of Engineers (USACE) required a geotechnical seepage analysis be completed for bridge piers adjacent to the dry side of the levees to demonstrate they would have no substantive impact upon seepage potential through or beneath the levees.

Structural steel plate girders were chosen as the preferred structure type early in the preliminary design process due to the bridges' horizontal curvature and span lengths up to 225 ft, and weathering steel was selected to minimize future maintenance requirements. In all, the bridges use 2,875 tons of structural steel.

Both bridges are 32 ft, 6 in. wide, with four plate girders spaced at 8 ft, 8 in. apart, and the girder webs are 84 in. deep. The 45-mile-per-hour design speed was a major factor in setting the bridge's geometric features, such as longitudinal grades, super-elevation rates and curve radii. Vertical bridge profiles were set to provide for an access road on top of the levee at three crossings and an access road adjacent to the dry side of the levee at the fourth crossing.

For more on this project, see "Flying over the Floodway" in the March 2015 issue, available at ***www.modernsteel.com***.

Owner
Kansas Department of Transportation, Wichita, Kan.

Designer
HNTB Corporation, Overland Park, Kan.

Contractor
Dondlinger and Sons Construction Company, Wichita

MERIT AWARD: SHORT SPAN SUSTAINABILITY COMMENDATION
Mill Creek Bridge, Astoria, Ore.

EVER-INCREASING REHABILITATION needs for corroded steel bridges are one of the Oregon Department of Transportation's (ODOT) biggest ongoing concerns.

While high-performance steel (HPS) is an important step in increasing toughness and corrosion resistance when compared to weathering steel, it is still vulnerable in corrosive and high-humidity environments inherent to the state's coastal areas. The conventional way to accommodate bridge steel corrosion is to apply protective paint coatings and to periodically recoat the bridge during its service life. However, the lifecycle cost of this design choice can be much higher than the initial cost of the bridge. An alternative to weathering steel or HPS and painted steel girders is corrosion-resistant ASTM A1010 Grade 50 steel that needs no corrosion protection coating.

A sample steel plate girder bridge employing A1010 is the 123-ft-long, 42-ft, 8-in.-wide Mill Creek Bridge along Lower Columbia River Hwy. No 2W (U.S. 30), only the second A1010 plate girder bridge for public use in the world. The pre-purchasing contract adopted for the project divided it into two segments: contracting steel fabrication as soon as the steel design and specification was completed followed by the remainder of construction. This type contract gives the fabricator extra time for ordering steel plate, testing plate samples for compliances to the contract requirements and replacing plate that does not meet them, and helps prevent time loss from unforeseen issues that could cause delays.

For the other bridge project using A1010 Grade 50 steel, see the Dodge Creek Bridge item in the 2014 Prize Bridge Awards section (it won the same award and commendation as the Mill Creek Bridge) at www.modernsteel.com.

Owner and Designer
Oregon Department of Transportation, Salem

Contractor
Oregon State Bridge Construction, Inc., Aumsville, Ore.

Steel Fabricator
Thompson Metal Fab, Inc., Vancouver, Wash.

Steel Detailer
Candraft Detailing, Inc., New Westminster, B.C., Canada

MERIT AWARD: MOVABLE SPAN

Henry G. Gilmerton Bridge, Chesapeake, Va.

THE HENRY G. GILMERTON BRIDGE, one of five critical bridges connecting the Hampton Roads region in southeastern Virginia, is in one of the world's largest natural harbors, so it's not surprising that the bridge carries approximately one million travelers every month.

But nearly 70 years after the original bascule bridge was constructed, the Virginia Department of Transportation (VDOT) determined that it would need to replace the aging span and thus embarked on a $134 million project. The replacement, which was substantially completed in 2013, was built with the goals of reducing automobile congestion at the bridge and alternate routes, increasing clearance to accommodate marine and motorist traffic with fewer openings and increasing lane width to improve traffic flow and accommodate future widening of Military Highway—all without impacting vehicular or marine traffic, changing the existing alignment of military highway or modifying the navigational channel geometry.

In addition, the close proximity of the Norfolk Southern Railroad line to the bridge posed a significant challenge. Installation of the bridge's eight new 12-ft-diameter drilled-shaft foundations, erection of the superstructure and demolition of the original bridge all needed to be done in such a way that did not disrupt the railroad bridge or its foundations. Complicating the need for increased width is the nearby railroad bridge's right-of-way. A hard bend in the river south of the bridge eliminated the possibility of expanding in that direction, so Norfolk Southern's willingness to yield some of its right-of-way was the only way the wider bridge could be constructed; the 89-ft-wide bridge is one of the widest lift spans ever to be built.

During installation of the new drilled shafts, the team used vibration-monitoring equipment to identify potential settlement impacts to the railroad bridge foundations. Installing the foundations also presented a challenge for the construction and design teams. The Gilmerton Bridge is located in the Great Dismal Swamp, a marshy area on the coastal plains region in southeast Virginia with less than desirable soil conditions. The drilled-shaft foundations were designed to reach 120 ft below ground level, which required special equipment and a team of industry experts. The team employed a massive oscillator to drill the foundations, and the project incorporates some of the largest drilled shafts ever constructed using the oscillating method.

Because rock was too deep to rest the drilled shaft foundations on, the foundations were predicted to experience some settlement with time. Settlement can be an issue for any bridge, but is of particular concern for movable bridges because of the precise tolerances required to ensure operation without binding. Jacking brackets were designed into the towers to allow them to be jacked under full, dead load to compensate for the settlement.

The lift bridge tower legs were positioned outside and behind the existing bascule bridge piers. This allowed the new towers to be built over the existing bridge without impacting the bascule span's ability to open for marine traffic. This required the lower portion of the tower to be designed as an unbraced portal frame. The new steel towers provide the required 135 ft of vertical clearance for the 250-ft lift span. Due to the exceptional bridge width, four 15-ft-diameter sheaves, each carrying twelve 2¼-in.-diameter wire ropes, were required on each tower to support the load of the lift span and counterweights—twice as many as typically necessary.

Using accelerated construction for the lift span required that the span be floated in on barges following construction of the towers. A specially retrofitted barge was needed to carry the nearly 2,500-lb lift span. Removing the old span and floating in the new span not only required continuous collaboration of design and construction teams, but it also required very specific timing around weather patterns and the tide.

Perhaps one of the bridge's most striking features is its turquoise paint. This color was chosen by the City of Chesapeake as part of an ongoing bridge unification initiative, which calls for matching paint coatings for all of their iconic structures. Another, more functional, coating treatment can be found in the machinery room. For safety purposes, movable bridge components are coordinated using bright colors to distinguish between movable, stationary and other bridge parts. Additionally, the silhouette and form of the new Gilmerton Bridge complement the nearby railroad bridge, even when both movable structures are in the open position.

Ultimately, the bridge was built to hold six travel lanes, addressing the original goal of accommodating future growth of Military Highway. Initially, however, both outside lanes will be striped, allowing them to operate as shoulders before the necessary expansion. The new bridge's 35-ft clearance allows smaller craft to traverse under the bridge without impacting vehicular traffic and reduces openings by 40%, as well as wear on bridge mechanical components. The reduction in congestion allows a growing community easier travel, while ensuring the uninterrupted flow of commercial goods by vehicle, rail and boat.

For more on this project, see "Widening the Gap" in the January 2013 issue, available at www.modernsteel.com.

Owner
Virginia Department of Transportation, Richmond

Designer
Modjeski and Masters, Inc., Mechanicsburg, Pa.

Contractor
PCL Civil Constructions, Inc., Tampa, Fla.

Steel Fabricator and Detailer
Banker Steel Company, Lynchburg, Va.

MERIT AWARD: MOVABLE SPAN

World War I Memorial Bridge, Portsmouth, N.H./Kittery, Maine

SINCE 1923, THE WORLD WAR I MEMORIAL BRIDGE linked Portsmouth, N.H., and Kittery, Maine, providing a multimodal transportation system that enhanced commerce, tourism, community life and the historic and aesthetic character of both communities.

But in recent years, structural deficiencies led to its closing, prompting the need for a replacement crossing. The new bridge is 900 ft long and comprises three spans: two approach spans of 298.75 ft each and a lift span of 302.5 ft, with a width of 49.5 ft to 54.6 ft.

In the designing the truss, contractor Archer Western and designer HNTB hoped to explore new fabrication capabilities to avoid one of the most challenging aspects of truss design: gusset-plate connections. The demise of the existing bridge was due to corrosion and deterioration of gusseted truss connections, which are difficult to inspect, collect debris, corrode and are impossible to remove and replace without underpinning the structure. In addition to avoiding gusset plates, the team elected to fabricate the top and bottom chords much in the same way plate girders are fabricated and to use rolled wide-flange sections for the diagonals to further simplify fabrication.

For the continuous flanges, the team designed the bottom flange of the bottom chord and the top flange of the top chord to be continuous. To add the necessary area, designers made the bottom flange of the bottom chord bigger than the top flange of the bottom chord and vice versa. The result is a monosymmetric I section, where the bottom flange is wider than the top flange. This has several advantages, including: 1) the truss acts as a deeper truss; 2) it forces some of the load to transfer around the web instead of going back into the web; and 3) the bottom chord/bottom flange and the top chord/top flange are wider and heavier. While there are more than 20,000 truss bridges in service across the U.S., the design team knows of no other bridge that has used this strategy to eliminate gusset plates. It is likely that this modified truss design, using plate-girder fabrication technology, is the first of its kind in North America.

For more information on this project, see "A New Way to Connect" in the April 2014 issue, available at www.modernsteel.com.

Owner
New Hampshire Department of Transportation, Concord
Maine Department of Transportation, Augusta

Designer
HNTB Corporation, Westbrook, Maine

Contractor
Archer Western Contractors, Canton, Maine

Steel Fabricator and Detailer
Canam-Bridges, Claremont, N.H. AISC CERTIFIED FABRICATOR

MERIT AWARD: RECONSTRUCTION

Donald R. Lobaugh Bridge, Freeport, Pa.

SPANNING THE ALLEGHENY RIVER approximately 25 miles northeast of Pittsburgh, the Freeport Bridge, also known as the Donald R. Lobaugh Bridge, carries State Route 0356 and a multiuse path. Built in 1965, the bridge is vital for commerce and serves as a route for tourists and outdoor enthusiasts using the extensive nearby rails-to-trails network, including the Kiskiminetas-Conemaugh water trails.

However, recent inspections by the Pennsylvania Department of Transportation (PennDOT) indicated that emergency attention was necessary to extend the bridge's useful service life and ensure the safety of the traveling public. Several existing conditions contributed to bridge deterioration, including steady chloride-laden runoff passing through a 1-in. open median joint, leaking stringer relief joints and free-fall roadway drainage from slots at the base of the barriers. This deterioration became a prime concern for PennDOT and prompted the need for emergency repairs.

In late 2006, designer Modjeski and Masters provided PennDOT with designs and details for significant emergency repairs to temporarily prevent the bridge from being weight restricted. Had these emergency repairs not been performed, all heavy live loads, including school buses and emergency vehicles, would have been prohibited from crossing the bridge resulting in a 20-mile detour. Steel plate reinforcement of deficient portions of the truss span's floor system was complete; however, to preserve a safe crossing more extensive repairs would be required in the future.

Beyond the need for immediate structural repairs, improvement of the roadway geometry and safety features was also required. Substandard features included inadequate curb-to-curb width, outdated bridge rails, insufficient sidewalk width and lack of pedestrian protection. Design for the modernized bridge needed to address the steel corrosion and section loss issues and bring the bridge's geometric features up to current standards.

The project focus became the rehabilitation and strengthening of the three-span deck truss spans and complete replacement of the north and south approach structures, an ambitious project with an overall length of 2,443 ft from abutment to abutment when completed (a reduction of 671 ft). The deck cross section accommodates four lanes of traffic and one variable-width barrier protected multi-use path.

The first challenge related to meeting PennDOT's requirement to maintain two-way traffic during all construction phases. Due to the existing bridge deck geometry, the deck needed to be temporarily widened for the first phase of construction. This temporary widening included the removal of the existing sidewalk and barrier. The widening required several modifications to maintain structural stability and ensure safety of the construction crews and traveling public.

Due to strength issues, construction staging and PennDOT's desire for a joint-less deck, the two-span stringer units and stress relief joints on the truss spans were replaced with continuous full-length stringers. The new joint-less reinforced concrete deck will extend the service life of the bridge and minimize future maintenance requirements for PennDOT.

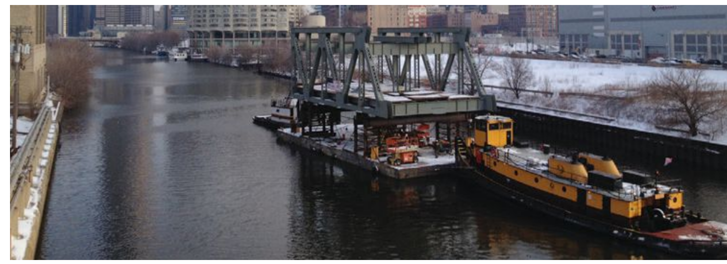
Two of the six expansion rocker bearings on the truss-spans were observed to behave abnormally—they were in their expanded position on a cold day—and PennDOT opted to replace rather than to attempt to reset them. Because of the very large vertical loads and the need to move due to thermal expansion and contraction, pot-type high-load multi-rotational bearings were selected. Since the rocker bearings do not introduce eccentricity in the end post and the end post was not designed for

such a loading, the replacement bearing configuration needed to replicate this condition. In a normal pot bearing application, the nonmoving component (the pot) is connected to the substructure. In this case, the nonmoving component needed to be connected to the end post and the sliding surface on the substructure, which could resist the additional loading due to the eccentricity. This meant that the bearings needed to be installed upside-down and protected with sheet metal covers. At six other expansion bearing locations on the truss spans, seismic retrofits were installed to improve the connection of the superstructure to the substructure in the event of an earthquake.

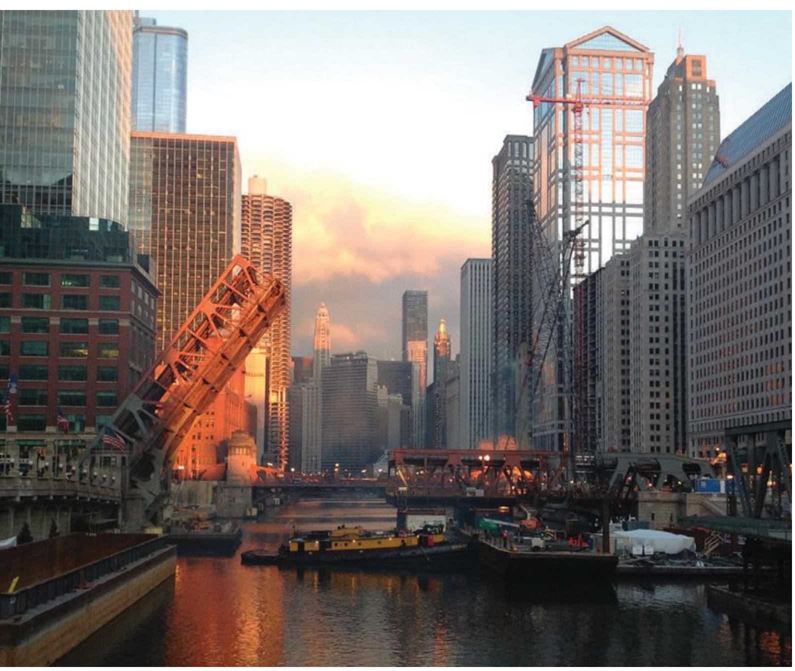
Owner
Pennsylvania Department of Transportation, Uniontown

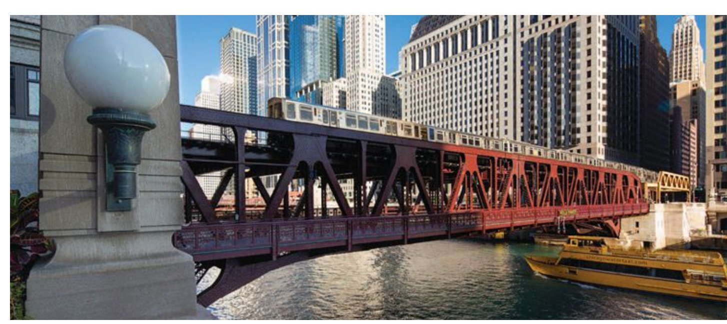
Designer
Modjeski and Masters, Inc., Mechanicsburg, Pa.

Contractor
Brayman Construction Corporation, Saxonburg, Pa.



MERIT AWARD: RECONSTRUCTION
Wells Street Bridge, Chicago





THE WELLS STREET BRIDGE is the longest double-deck, double-leaf, bascule bridge built over the Chicago River, and only one of two remaining bascule bridges in the city of Chicago that carries both automobile and transit (Chicago Transit Authority elevated trains) on two levels.

Recent in-depth inspection and analysis of the 1922-built bridge revealed that substantial structural rehabilitation was required. As the bridge carries an average daily traffic of approximately 12,000 vehicles and serves nearly 4,500 pedestrians a day on the lower level and a two major transit lines carrying 70,000 riders per day on the upper level, the crucial crossing had to be rehabilitated with minimal impact to its users.

In the initial design plan, CTA would only allow weekend shutdowns, which only provided for partial replacement of select members. To accomplish this partial replacement the rail operations would have needed to be suspended for 15 long weekends throughout the year, a situation that was deemed unacceptable. Instead, it was determined that the replacement of the truss "river arm" structure and framing would take place during two nine-day shutdowns of upper-level train traffic (two weekends and one work week).

The main span of the bridge is 345 ft long and 72 ft wide. Dual open-web trusses, as main load carrying members, support both levels of framing. Both levels of framing were entirely replaced along with major rehabilitation to the mechanical and electrical components of the bridge. Bridge houses and bridge pits, including counterweight boxes, received select repairs. Due to the bridge's historic status, most elements such as the railings, bridge houses and major structural components were replaced in-kind to preserve the historic look.

The bridge was rehabilitated one leaf at a time, providing temporary shoring under the counterweight box for the leaf under construction so train traffic could be maintained. Vehicle and pedestrian traffic was safely detoured to other local streets and bridges over the river, and working on only one leaf at a time allowed one leaf to remain operable to accommodate river traffic.

The first shutdown took place in March 2013 and another in April 2013. During each line cut, transit service over the structure was halted on a Friday evening and resumed again by rush hour on the second Monday. As CTA was planning to perform loop track repairs around the same timeframe as the Wells bridge rehabilitation—and these repairs would have required additional weekend shutdowns—the two projects were combined and resulted in minimal impact to users as well as a $500,000 savings for the city.

Construction staging was perhaps the most complex part of the work and the key to the success of the project. In addition to the limited closures for CTA trains, the Coast Guard required that one leaf be operational at all times between March and October. Because the bridge was located over a river in the heart of the city, nearby streets were not available for the staging of the material, and the project relied heavily on marine equipment for staging. Before the project was bid, an early procurement contract was awarded for the river arm structural steel fabrication. The fabricator stored the trusses and assisted the contractor in assembly of the truss/floor beam river arm that was eventually barged to the site.

Achieving bridge balance was another challenge. In order to proceed with work on the north leaf, the south leaf first needed to be operational, which required the latter to be balanced in the interim condition. To balance the bridge for operation, concrete jersey barriers were lashed to the deck toward the nose of the span. The north leaf counterweight was then shored and the construction sequence was repeated for the north leaf.

The Wells Street Bridge project demonstrates that in-situ rehabilitation of moveable structures nearing their useful life can be a viable alternative to replacement. Full-scale replacement of moveable bridges can be a long process often requiring realignment, property acquisition and displacement of people and businesses. The rehabilitation of the Wells Street structure was performed with minimal disruption to local businesses in a congested urban site.

Owner
Chicago Department of Transportation, Chicago

Designer
AECOM, Chicago

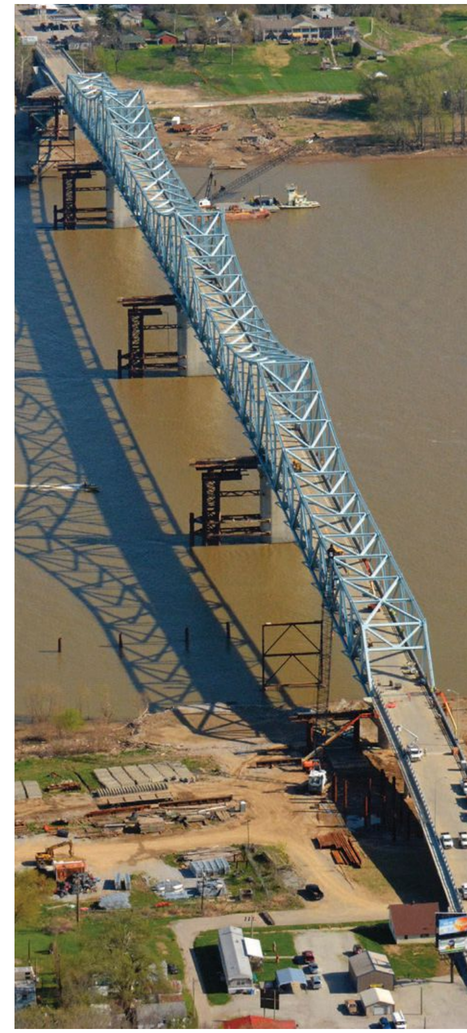
Contractor
Walsh Construction and II in One (JV), Chicago

Steel Fabricator
Munster Steel Company, Inc., Hammond, Ind.

Steel Detailer
Candraft Detailing, Inc., New Westminster, B.C., Canada

ACCELERATED BRIDGE CONSTRUCTION COMMENDATION

Milton-Madison Bridge, Milton, Ky./Madison, Ind.



SINCE ITS COMPLETION IN 1929, when America was on the brink of the Great Depression, the original US-421/Milton-Madison Bridge served as a vital link over the Ohio River between Milton, Ky., and Madison, Ind.

A structure that was designed for the occasional Model-A Ford had seen its burden grow to more than 10,000 modern vehicles per day, including semitrailer trucks loaded at full capacity. Although it was historically significant, the aging bridge had become functionally obsolete. A TIGER discretionary grant from the U.S. government became the catalyst to one of the most innovative bridge replacement project endeavors in the nation.

Using the accelerated bridge construction (ABC) method, the project began with the construction of temporary approach ramps, allowing traffic to be rerouted off of the existing approach spans to begin their unobstructed demolition and replacement. While these phasing activities were occurring, sections of the 7,200-ton truss superstructure were being preassembled on barges for the eventual float-in and strand lifting onto temporary piers, which were constructed adjacent to each existing pier stem. The temporary piers were designed to support live traffic on the completed bridge in its temporary alignment, freeing the existing structure for explosive demolition and pier cap widening. The temporary pier caps featured a key design element—the "sliding girders"—which would serve as the pathway for the record-breaking truss slide. The nearly ½-mile long completed bridge, weighing more than 16,000 tons at the time of the slide, was moved 55 ft laterally into place atop the refurbished and widened pier stems of the existing bridge. ■

For more on this project, see "Move that Bridge!" in the February 2012 issue and the item "Biggest-Ever Bridge Slide" in the News section of the August 2014 issue, both available at www.modernsteel.com.

Owner
Indiana Department of Transportation, Indianapolis
Kentucky Transportation Cabinet, Louisville

Designer
Buckland and Taylor, Ltd., North Vancouver, B.C., Canada

Contractor
Walsh Construction, Chicago

Steel Fabricator
High Industries, Lancaster, Pa.

NASCC posts near-record attendance in Orlando.

Steel in the SUNSHINE State

BY GEOFF WEISENBERGER




ARE YOU INVISIBLE?

Maybe you are, maybe you aren't—but if you are, that doesn't mean you're unimportant. In fact, you may be one of the most important people in your organization.

The concept of "invisibles" in the workplace—those that do crucial work but don't necessarily seek attention—was the focus of author David Zweig's keynote at this year's NASCC: The Steel Conference, which took place in April in Orlando.

Zweig, who once held a job as a magazine fact-checker, commented that invisibles typically aren't noticed until they make a mistake.

"No one ever told me, 'Man, that article was fact-checked beautifully,'" he laughed.

Despite this, he stressed that invisibles typically take pride in their work, noting that structural engineers are often the invisibles of the building or bridge design team. For example, when interviewing Dennis Poon, vice chairman of Thornton Tomasetti and engineer of record for the 2,073-ft-tall Shanghai Tower, for his book *Invisibles: Celebrating the Unsung Heroes of the Workplace*, he asked Poon how he handled all of the responsibility. Poon's answer: "It's an honor to do so." Zweig's message is that Poon, like many other "invisibles," performs diligent, crucial and downright difficult work not for the money or prestige, but rather for the satisfaction of the work itself and performing to the best of their abilities. (And for more on the Shanghai Tower, see Poon's article "Shanghai Sky" in the April 2013 issue, available at **www.modernsteel.com**.)

Engineers and others certainly weren't invisible at the conference, where 4,532 professionals from all across the industry congregated to view and discuss the latest technologies and ideas in steel construction. (This year's attendance was second only to last year's 4,582 in Nashville.)

"I found the program to be very well-balanced and was able to take home some technical and practical design information, which I look forward to sharing with my colleagues," said Natalie Tse, a project engineer with KPW Structural Engineers, Inc. "I also attended a roundtable discussion in which guest speakers shared some interesting insights and opinions, and there were plenty of great opportunities to learn and to network with other people in our industry."

The show also incorporated its bridge counterpart, the World Steel Bridge Symposium, which featured more than 20 sessions geared toward designers, fabricators and builders of steel bridges, as well as a screening of the film *Bridging Urban America: The Story of Master Engineer Ralph Modjeski* that drew around 400 viewers (visit **www.bridginguamericafilm.com** for more on the film).

Touching on a similar theme to Zweig's was Duane Miller, who presented a student session geared toward preparing the next generation of engineers and other professionals for the real world—part of NASCC's student track. A well-known welding guru, Miller's presentation focused not on that topic

At the Top of their Game

Fourteen leaders from across the structural steel design, construction and academic communities received distinguished awards from AISC at April's NASCC: The Steel Conference in Orlando. Duane Miller received the Robert P. Stupp Award for Leadership Excellence, one of AISC's highest honors, and John Nolan received the Chairman's Award for outstanding service as a member of the AISC Board of Directors. Gregory Deierlein, Geoffrey Kulak and James Stori were honored with Lifetime Achievement Awards, and Special Achievement Awards were presented to Glenn Bishop, Brad Davis, Larry Fahnestock, Vernon Mesler and Mark Saunders. In addition, AISC honored the inaugural recipients of its new Early Career Faculty Award (pictured at right): Caroline Bennett, Matthew Eatherton, Jason McCormick and Christopher Raebel. The winners were all recognized during the conference awards presentation and opening keynote.

For more about each winner, see the related March 28 news item at **www.aisc.org**.

but rather on the broader concept of making one's mark in the working world. He stressed that while technical know-how is what gets an employee in the door, after that, value is determined and cultivated in a much different way. It's about personality and business acumen—the type of wisdom that is valuable in any industry. A few points he touched upon were: telling a customer when they're wrong (but you'd better be right!); recognizing that selling is getting people to take actions they wouldn't have had you not showed up; the importance of first impressions; coming up with a $1 million idea not overnight but rather over the course of your career; not solving one problem by creating another; learning something from everyone you meet; taking care of other people's problems first; and not discounting instinct.

At the same time, Miller provided a valuable reminder to students—and perhaps all of us—that the portion of our industry that doesn't work in offices is equally important, and he did get in a plug for welding. "If you don't think welding is fun, then you don't know welding," he quipped, and encouraged interested students to visit his company's (Lincoln Electric) booth in the exhibition hall to test out some of what they'd learned at his presentation—and potentially launch a career.

Speaking of the exhibition hall, there was plenty of welding equipment—and plenty of other equipment, as well as heavy machinery, software, services and shop and field solutions—on display. Cloud-based information sharing was one of the recurring themes from the software vendors, as were the use of mobile apps and increased offerings for seismic applications. (For more on these trends and others observed at NASCC's exhibit hall, be sure to check out next month's "Hot Products" section.)

"Once again, NASCC was a great opportunity for us to connect with our customers and the industry to evaluate how we can better provide solutions for them," said Michael Gustafson, Autodesk's structural engineering industry strategy manager. "It was exciting to hear so many attendees talk about implementing new technologies, and we're looking forward to helping the industry ride the wave of a recovering construction economy."

For those not able to attend NASCC—or if you were there but couldn't be two places at once—AISC posts recordings of all of the sessions at **www.aisc.org/2016nascconline** about two months after the conference.

And roughly nine months after *that*—specifically, March 22-25, 2017—NASCC heads back to San Antonio, host city for the show in 2005. Between now and then, whether you're an invisible or someone who is front and center, make the best of your role in the steel construction industry. As Zweig pointed out, for invisibles (and others), it's typically the work itself that is the reward. And in the case of the steel industry, when we do our best work, we have the opportunity to reward not only ourselves but also building owners and occupants with truly amazing and efficient buildings that are anything but invisible. ■

Up on the Iron

When we think of steel erection, we often think of the big cranes that hoist beams and columns into the air but not always that people that are operating them—or in many cases literally climbing the structure.

And when we go on building site tours, while the work is ongoing, the framing and flooring is already in place—otherwise, tours might be kind of difficult. We see all kinds of workers on the site, doing what they do. But ironworkers and erectors are the ones that come in first and give everyone else something solid to work on.

"We're the Marines of the construction industry," said Henry Kendrick, business manager for the Iron Workers Local Union 808 in Orlando. "We take the beach, we set the flag and then the other trades come."

The union played host to 40 or so attendees of NASCC: The Steel Conference (mostly engineers) and gave them a glimpse into what goes into becoming an ironworker. Organized by IMPACT (Ironworker Management Progressive Action Cooperative Trust), the tour provided an overview of the ironworker profession, discussed the rigorous training procedures that ironworkers must go through, let attendees walk through the training facility and even gave them the chance to test their own skills.

The Local 808 facility is one of 154 such training facilities throughout the U.S. and Canada and puts roughly 120 trainees through its apprenticeship program every year. Training is designed for working adults and encompasses four years of night classes (three hours twice a week). Among other things, it includes a minimum of 700 hours of on-the-job training for the rigging program, more than 200 hours of welding training, 80 classroom hours and a class that specializes in reading blueprints.

"We stress that 'you are not the engineer,'" says R. Reis James, industry analyst for the Southeastern States District Council, which represents 10 ironworker locals throughout Alabama, Georgia and Florida. "It's about teaching our students to correctly interpret the drawings and execute the plans—though we do encourage them to speak up when they notice possible mistakes."

James points out that the average age for a construction worker in the U.S. is 47 and that the average age for management staff is even older, so there is a never-ending push to bring younger workers into the profession. Local 808 partners with schools in Orange County (Fla.) and works to source prospective students from local technical schools. It also works through the Helmets to Hardhats program to transition veterans into ironworkers. Roughly 70% of those that begin the apprenticeship program complete the training, and most figure out whether it's the right path for them within the first year.

"We have approximately 130,000 ironworker members, including 20,000 apprentices and more than 2,000 female members," says IMPACT's director of industry liaisons and RAB V regional director, Kenny Waugh. "Not everyone is cut out for college, and potential students can come to us straight out of high school and receive a free education while working toward a great and fulfilling career. I know this firsthand as a third-generation ironworker, with my sons being fourth-generation."

Following the presentation, attendees took a tour of the training facility, and a few tried their hand at welding and even column climbing, all while donning the appropriate footwear and safety equipment (safety, safety, safety is encouraged and enforced throughout and following training). Ricardo Cantu, Local 808's organizer and QC manager, climbed the 40-ft column in a matter of seconds, which prompted several attendees to give it a shot and gain a firsthand experience of—and hopefully a newfound appreciation for—the rigorous work that goes into erecting the framing systems they design and detail.

TRADE

U.S. Steel Construction Associations Urge Enforcement of Trade Laws Against Chinese Steel

AISC and its bridge division, NSBA, recently urged U.S. Trade Representative Michael Froman to "enforce trade laws and keep the playing fields level for U.S. fabricators." In a letter to Froman, AISC leaders called out the increasing flow of fabricated steel entering the U.S. from Asia, Europe, Mexico and Canada, often at prices well below market. This unfair trade activity, including government subsidization and currency manipulation, takes jobs away from U.S. steel fabricators and their employees. The AISC/NSBA letter calls upon Froman to:

- Vigorously investigate violations of U.S. trade laws
- Promptly enforce and collect countervailing duties from importers
- Identify China as not a market economy and not deserving of full recognition under World Trade Organization (WTO) policies

AISC and NSBA represent over 900 U.S. steel producing and fabricating companies and more than 42,000 allied steel professional designers, engineers and educators, and the letter to Trade Representative Froman joins with many other voices from the steel industry and workers to use the laws on the books to remedy Chinese steel export violations.

For questions or thoughts about this matter, please contact Roger E. Ferch, AISC's president, at **ferch@aisc.org** or 312.670.5401.

BRIDGES

Preregistration Open for Inaugural World Innovation in Bridge Engineering Competition

Preregistration is open for the first World Innovation in Bridge Engineering (WIBE) competition, organized by BERD-FEUP (Bridge Engineering and Research Design and the Faculty of Engineering of the University of Porto). Entrants must submit a 10-page paper that demonstrates the greatest potential for innovation and contributes to the development of bridge engineering worldwide. The winner—selected by a jury of international associations including AISC and NSBA—will receive $50,000.

Abstracts will be accepted starting October 1. For more information about the competition and to preregister, go to **paginas.fe.up.pt/~wibe**.

CORRECTION

In the May 2016 IDEAS^2 Awards section, the detailer for National Award winner ($15 to $75 million) Nu Skin Innovation Center, Axis Steel Detailing, Inc., an AISC associate member, was mistakenly omitted.

AWARDS

Steel Companies Honored in Craftsmanship Awards

Five AISC member companies (all of which are also AISC certified) were recently honored for their structural steel framing work in the 2016 Craftsmanship Awards. Conducted annually by the Washington Building Congress (WBC), the awards recognize exceptional workmanship on building projects throughout the Washington, D.C., area.

SteelFab, Inc., was the recipient of the top award, the WBC Star Award for Craftsmanship, for its work on the National Museum of African American History and Culture (NMAAHC), Washington. Awards were also given to: Superior Iron Works, Inc., for the American Enterprise Institute for Public Policy Research - 1785 Massachusetts Avenue NW Renovation, Washington; S.A. Halac Iron Works, Inc., for the Theodore Roosevelt High School Modernization, Washington; American Iron Works, Inc., for 601 Massachusetts Avenue, Washington, and Inova Women's Hospital and Inova Children's Hospital, Falls Church, Va.; and Steel, LLC, for the Atlantic Plumbing Parcels A&B, Washington.

For more about the awards, including the full list of winners, go to **www.wbcnet.org/craftsmanship-awards**.

People and Firms

- **Robert Halvorson, S.E., P.E.**, founding principal of Chicago-based **Halvorson and Partners, a WSP | Parsons Brinckerhoff Company**, has been named winner of the Institution of Structural Engineers' 2016 Gold Medal. The award recognizes individuals who have made an outstanding contribution to the profession of structural engineering. Learn more about the award at **www.istructe.org/events-awards/gold-medal**.

- AISC member fabricator **Banker Steel** announced that it has acquired New York City-based **NYC Constructors, LLC**, and New Jersey-based **MRP, LLC** (also an AISC member fabricator), collectively referred to as NYCC. The transaction is intended to expand Banker's capabilities in the New York commercial construction market, providing its customers, many of whom are currently served by NYCC, with a vertically integrated suite of erection and fabrication services.

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NOISE CONTROL

New Sound and Noise Publication Now Available

Facts for Steel Buildings #4: *Sound Isolation and Noise Control* is now available for free at **www.aisc.org/facts**. The goal of this publication is to provide the design community with an understanding of sound isolation and noise control issues in buildings and the tools to address them.

Modern buildings must protect their occupants from excessive noise intrusion, assure their acoustical comfort and provide favorable conditions for listening and communication. In order to achieve these goals efficiently and economically, building designers need to take the relevant considerations into account beginning early in the design process and pursue their proper implementation. Acoustical objectives enter into the design of every building and recent years have seen increased stringency of acoustical requirements.

It is important to note that it is not the material types and the framing systems that establish the acoustical performance of a building, but rather how the relevant building elements are selected and assembled. Thus, the desired acoustical performance of a building can be achieved by appropriate design while framing and materials can be chosen on the basis of the usual considerations, such as structural efficiency, design flexibility, cost, schedule and environmental impacts.

More detailed information and specific design guidance may be found in AISC Design Guide 30, *Sound Isolation and Noise Control in Steel Buildings*, available at **www.aisc.org/dg** (free for AISC members). You can also read more about Design Guide 30 in "Sound Judgment" in the February 2016 issue, available at **www.modernsteel.com**.

AWARDS

AGA Announces Galvanizing Awards

The American Galvanizers Association (AGA) has announced the winners of the 2016 Excellence in Hot-Dip Galvanizing Awards, several of which employed the services of AISC associate member galvanizers. The winners showcase creative and innovative uses of the hot-dip galvanized coating, and more than 120 projects were submitted. All submissions were judged online by a panel of architects and engineers and are now featured in the AGA Project Gallery at **www.galvanizeit.org/project-gallery**.

AWARDS

2017 T.R. Higgins Award Call for Papers now Open

AISC is now accepting submissions for T.R. Higgins Lectureship Award. Presented annually, the 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.

The award is named for Theodore R. Higgins, former AISC director of engineering and research, who was widely acclaimed for his many contributions to the advancement of engineering technology related to fabricated structural steel. The award honors Higgins for his innovative engineering, timely technical papers and distinguished lectures. The current T.R. Higgins Lecturer is Maria Garlock, who received the 2016 T.R. Higgins Award at NASCC: The Steel Conference in Orlando in April.

The winner will receive a framed certificate, presented at NASCC (the 2017 conference will be in San Antonio), as well as a $15,000 cash award, and will present their lecture, upon request, at professional association events.

AISC encourages everyone involved with steel construction to submit nominations. Please include the following information:

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

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

The author must be a permanent resident of the United States and available to fulfill the commitments of the award. The paper or papers must have been published in a professional journal within a designated five-year period; eligible papers for the 2017 award must have been published between January 1, 2011 and January 1, 2016, and nominations must be received by August 1, 2016. The winner will give a minimum of six presentations of the lecture on selected occasions throughout the year. AISC reimburses the speaker's travel expenses for qualifying events. Send nominations to:

AISC
1 E. Wacker Dr., Ste. 700
Chicago, IL 60601
Attn: Janet Cummins

If your organization is interested in hosting a T.R. Higgins lecture, contact Nancy Gavlin, director of education, at **gavlin@aisc.org**. For more on the Higgins Award, visit **www.aisc.org/higgins**.

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Ficep 2004 DTT CNC Drilling & Thermal Coping Line, 78-3/4" x 24" Max. Beam, 3-Drill, Ficep Arianna CNC Control, 2003 **#20382**
Ficep TIPO A31 CNC Drill & Thermal Cutting System, 10' x 20' x 5" Max. Plate, Ficep Minosse CNC, 2009 **#25937**
Controlled Automation ABL-100-B CNC Flat Bar Detail Line, 143 Ton Punch, 400 Ton Single Cut Shear, 40' Infeed, 1999 **#24216**
Controlled Automation 2AT-175 CNC Plate Punch, 175 Ton, 30" x 60" Travel, 1-1/2" Max. Plate, PC CNC, 1996 **#23503**
Peddinghaus F1170B CNC Plate Punching Machine, 170 Ton, Ext Tables, Fagor CNC, 30" x 60" Trvl., Triple Gag Head, 2005 **#19659**
Peddinghaus FPB1500-3E CNC Plate Punch with Plasma, 177 Ton, Fagor 8025 CNC, 60" Max. Width, 1-1/4" Plate, 1999 **#25161**
Controlled Automation BT1-1433 CNC Oxy/Plasma Cutting System, 14' x 33', Oxy, (2) Hy-Def 200 Amp Plasma, 2002 **#20654**
Peddinghaus Ocean Avenger II 1000/1B CNC Beam Drill Line, 40" Max. Beam, 60' Table, Siemens CNC, 2006 **#25539**
Franklin AFC 5108x196 CNC Angle Punch & Sheer Line, 6" x 6" x 1/2", 100 Ton Punch, 196 Ton Shear, 40' Infeed, 1990 **#26122**

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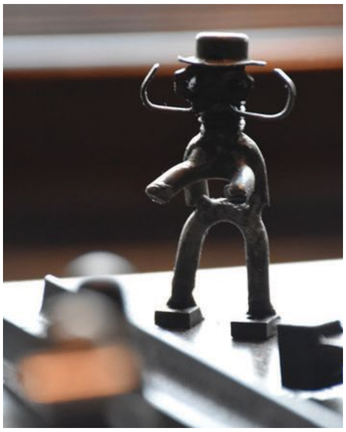
BUILDING AMERICA



THE WINNING SCULPTURE in AISC's fifth annual Steel Sculpture Competition is a symbol for the domestic structural steel industry—and it's also pretty fun.

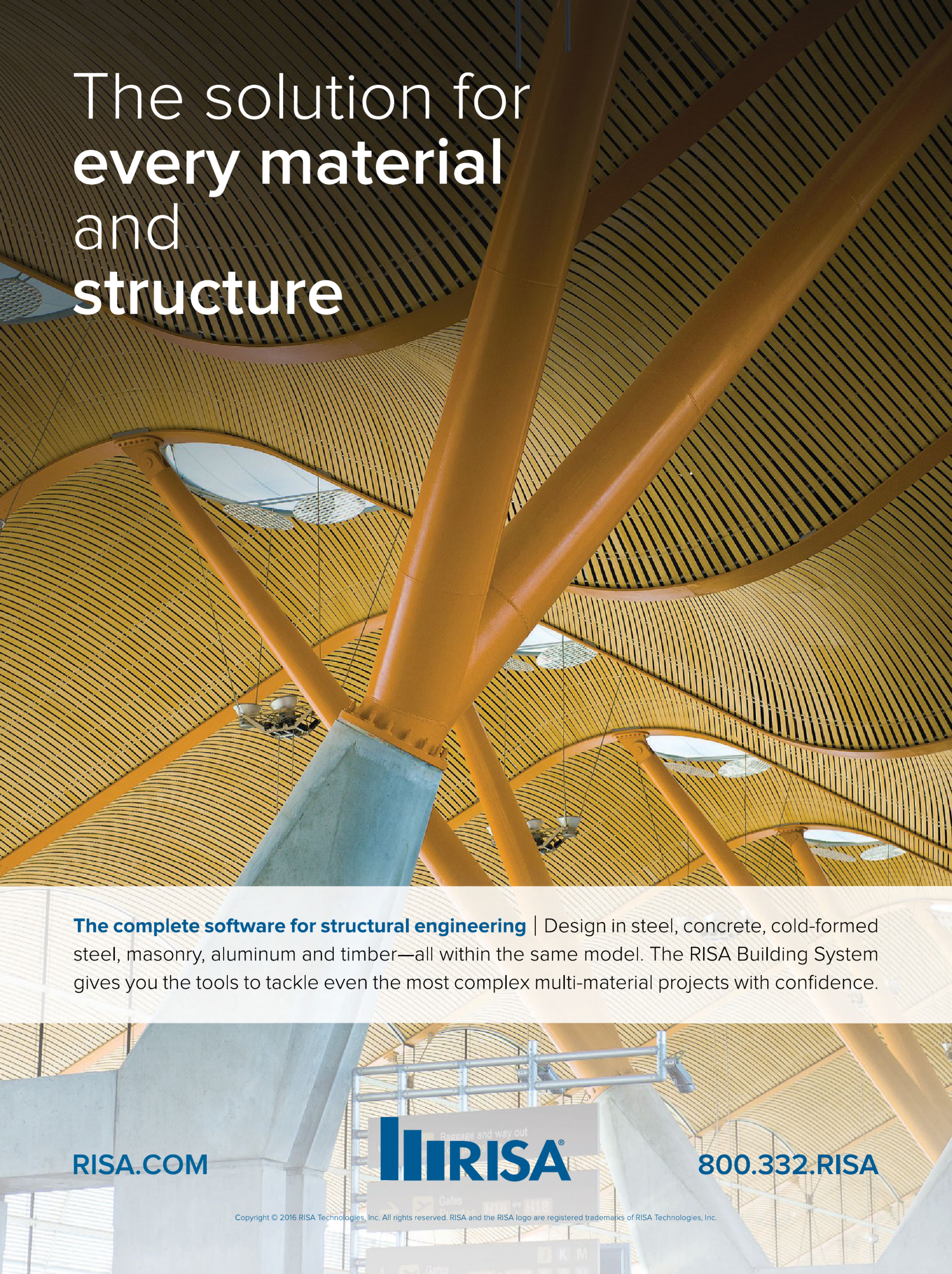
Submitted by Universal Steel, Inc. (an AISC member and certified fabricator) in Lithonia, Ga., the sculpture, *Building America*, depicts the steel construction process, complete with a multistory structural steel frame, a fabrication shop, a crane, beams being hoisted, a staircase, an American flag and multiple construction workers—in the shop, on the ground and on the iron. (One of the figures, sporting a rather prominent moustache, was based on one of Universal's longtime ironworkers.)

"We were trying to show a small portion of what takes place daily across America on job sites and in fab shops like ours," says sculptor Johnny Dillard, Universal's shop manager. "It all begins with people working together, many different trades joining to build the beautiful buildings across this country that we get to enjoy every day."

Dillard notes that it took him and another employee approximately 25 hours to design and build the sculpture. The materials came from scrap from recently completed jobs.

"We wanted to keep adding to it," he says, "but we decided to stay focused on simply showcasing what we do at Universal: fabricating stairs, railings, structural steel and much more."

Building America was one of five finalists in this year's competition. All were on display at the recent NASCC: The Steel Conference in Orlando, where attendees voted for their favorite. The only rules for the competition each year are that entrants must be AISC full or associate members, and entries must fit into a 2-ft by 2-ft by 2-ft box and be made entirely of steel. Nine sculptures were entered into the competition this year, and you can view all of them at **www.steelday.org/sculpturecompvoting**. ■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