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MODERN STEEL CONSTRUCTION

May 2009

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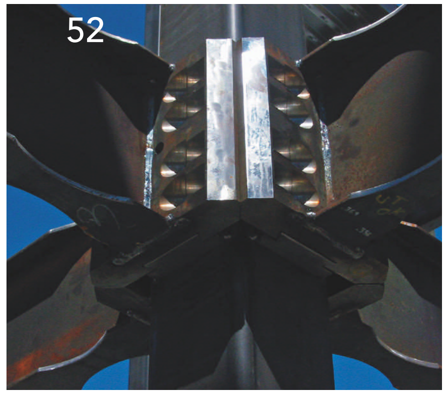

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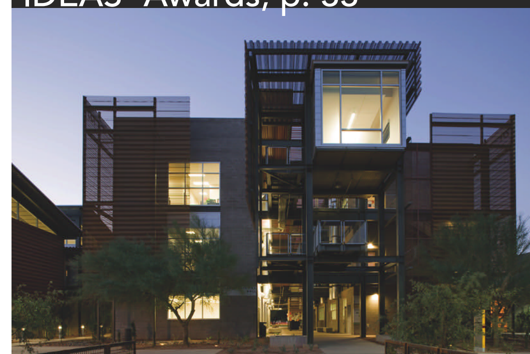

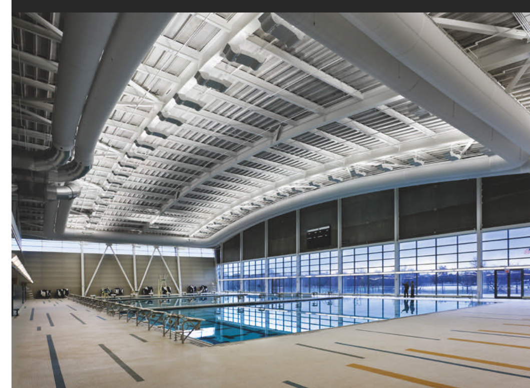

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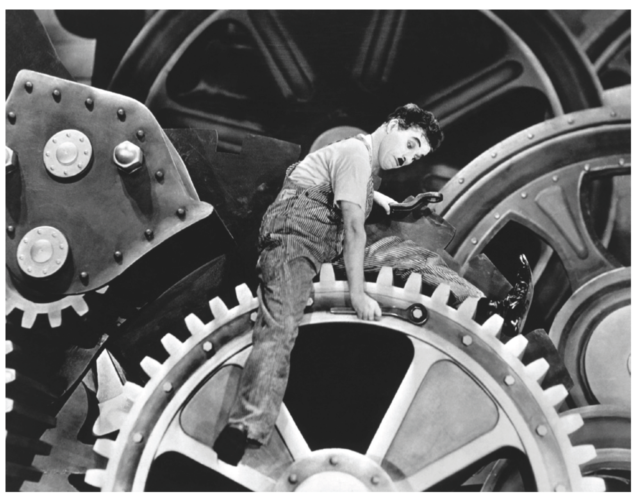
ON THE COVER: Armstrong Oil & Gas in Denver, an IDEAS² Award National Winner. (Photo: Frank Ooms Photography)

MODERN STEEL CONSTRUCTION (Volume 49, Number 5). ISSN (print) 0026-8445: ISSN (online) 1945-0737. Published monthly by the American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 700, Chicago, IL 60601. Subscriptions: Within the U.S.—single issues $6.00; 1 year, $44; 3 years $120. Outside the U.S.—single issues $9.00; 1 year $88; 3 years $216. Periodicals postage paid at Chicago, IL and at additional mailing offices. Postmaster: Please send address changes to MODERN STEEL CONSTRUCTION, One East Wacker Dr., Suite 700, Chicago, IL 60601.

editor's note

EARLIER THIS WEEK, MY WIFE AND I WERE WANDERING THROUGH COSTCO WHEN JUDY STOPPED, MESMERIZED BY THE CONVEYOR BELTS AND WHIRRING DEVICES RAPIDLY MOVING CAKES THROUGH THE MIXING AND BAKING PROCESS. The scene was reminiscent of the events in Charlie Chaplin's classic film *Modern Times*, albeit on a much smaller scale. And the funny thing is, she wasn't alone. There's probably an entire thesis waiting to be written about humankind's fascination with industrial processes (my guess is the academics will focus on the distance between consumer and producer, but frankly, my theory is that big tools and big equipment are just darn fun to watch!).



And it's not just automated baking equipment. Factory tours are a popular tourist destination and range from the Toyota plant in Georgetown, Ky. to the Miller Brewery in Wisconsin to the Louisville Slugger factory in (of course) Louisville. At this year's Steel Conference, more than 200 attendees visited Schuff International's fabrication shop in Phoenix (there was a long waiting list but space constraints prevented unlimited enrollment). A few years earlier, more than 250 attendees toured Triple S Steel's service center in San Antonio. And in the past, AISC has held a series of educational events at service centers and fabrication shops–with each attracting more than 100 engineers, architects, and contractors.

Clearly there's a demand by those involved in the design of structural steel buildings to learn more about the process of fabrication. And that's the genesis of a new program spearheaded by Chris Moor, AISC's industry mobilization director.

SteelDay 2009 is an opportunity for the steel community to interact, learn, and build. On September 18, you'll have the opportunity to tour facilities and jobsites (currently more than 100 events are planned in more than 40 states; visit **www.steelday.org** to sign up for one). Tours include steel mills, HSS producers, machinery suppliers, fabricators, jobsites, service centers, and galvanizers. According to Chris: "This is an opportunity for people to see how the structural steel industry operates, ask questions, and learn about our processes."

Reading about the process of making and fabricating steel is useful, but seeing it firsthand is even better. Chris explained that: "SteelDay is a unique chance for participants to receive hands-on education about the latest advances in the structural steel industry and witness new technologies firsthand. AISC holds tours and seminars throughout the year in specific locations, but we wanted to do something on a grand scale where more people could get these types of learning experiences without having to travel very far." Plus, it'll be a lot of fun.

So mark your calendars for September 18, visit **www.steelday.org**, and get ready to interact, learn, and build with steel!

Scott Melnick

SCOTT MELNICK
EDITOR

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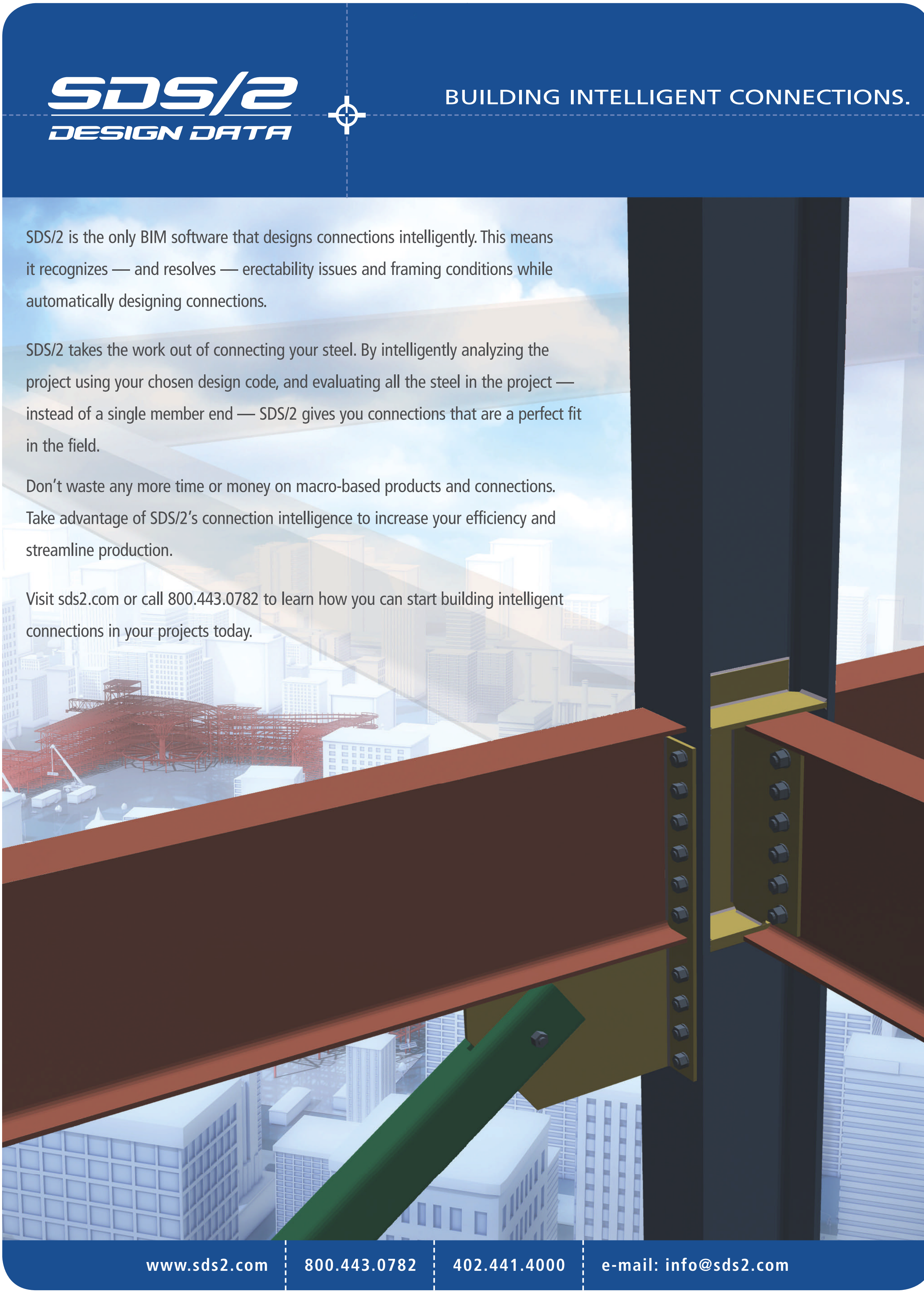
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IF YOU'VE EVER ASKED YOURSELF "WHY?" about something related to structural steel design or construction, *Modern Steel Construction*'s monthly Steel Interchange column is for you! Send your questions or comments to solutions@aisc.org.

Direction of Bend

Where can I find information on bending of plates with respect to the direction of the rolling?

Table 10-12 in the 13th Edition AISC *Steel Construction Manual* and Appendix X4 of ASTM A6, which is similar, provide information on cold bending of plates, including suggested inside radii for cold bending. The suggested radii differ depending on the orientation of the bend with respect to the direction of the rolling. As stated therein, it is preferable that the bend line is perpendicular to the direction of final rolling. Otherwise, a more generous radius is suggested.

Kurt Gustafson, S.E., P.E.

Moment Connections

In AISC Design Guide No. 13, the author chose to neglect story shear in all 13 design examples. Is it *always* conservative to neglect story shear? The author does not address this in the Guide, yet the effects are not included in the examples.

It is always conservative to neglect the effects of story shear. Considering story shear will always reduce the shear on the column panel zone, since the reactions to the moments will always act opposite the moments themselves.

In practice, story shear can be neglected on the first pass—and this doesn't have any impact unless doublers are required. However, if doublers are required, it is worth it to go back and determine what the story shear is in an attempt to eliminate the doublers. Doublers can represent a tremendous increase in fabrication cost, so it is always best to attempt to eliminate them whenever possible.

Larry S. Muir, P.E.

ASTM A449 Threaded Rods

The project specifications call out ASTM A449 threaded rods with nuts on each end for connecting two members. The plans specify to pretension these rods as opposed to just snug-tight. The RCSC *Specification* defines specific tensioning and inspection requirements for ASTM A325 and A490 bolts. Are there any codes or written recommendations on what is considered pretensioned on ASTM A449 rods (i.e., pretension load) and also for inspection requirements?

Yes. When a pretensioned installation is required, Section J3.1 of the 2005 AISC *Specification* discusses the use of ASTM A449 threaded rods, indicating that "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."

Amanuel Gebremeskel, P.E.

CJP Weld for HSS

Is it possible to get a prequalified CJP groove weld on an HSS without a backing bar?

It is possible to make a CJP groove weld from one side without backing; see AWS D1.1:2008 Section 4.26. This is a prequalified joint, but it requires additional welder qualifications that may not be possessed by many welders working on building projects. Welders that do a lot of tube fabrication, such as for offshore structures, may likely posses the required qualifications. There will probably be a premium paid if this type of welding is required on the project.

To avoid the extra expense, one option is to cut a thick steel plate to the profile of the inside of the HSS, and use this as backing. In this scenario, you could attach a threaded rod by tapping a hole in the plate (or otherwise form some attachment) and then provide a slot in one wall of the HSS. The rod attached to the backing plate could be used to adjust the plate so that it fits tightly against the support to complete the weld. Cutting to the inside profile of the HSS can also produce a backing that fits well at the radius corners, something that is otherwise difficult.

Larry S. Muir, P.E.

W/D Ratios

Where are *W/D* values for W-shape beams published? I don't know where to look for these, but was told that AISC could provide them.

AISC Design Guide No. 19, *Fire Resistance of Structural Steel Framing*, includes a listing of *W/D* ratios for hot-rolled shapes. AISC design guides are available as free downloads for AISC members at **www.aisc.org/epubs**, or can be purchased by others.

Kurt Gustafson, S.E., P.E.

Elevated Temperature Service

Where can I find properties of steel at high temperature?

Appendix 4 of the 2005 AISC *Specification* (a free download at **www.aisc.org/2005spec**) includes Table A-4.2.1, Properties of Steel at Elevated Temperatures. Part 2 of the 13th Edition AISC *Steel Construction Manual* also includes a discussion on elevated temperature service.

Kurt Gustafson, S.E., P.E.

Lifting Plate

Can Part 15 of the 13th Edition *Manual*, covering bracket plates, be used as a procedure for the design of lifting plates? Instead of the load applied downward, the load is applied upward.

Bracket plates are typically used to support a reaction from gravity loading, placing the bracket in compression. A lifting lug is typically used to support a force in tension. You may want to look at Chapter D of the AISC *Specification*, which may be more applicable to the lifting plate application. Also, there is a good article in the AISC *Engineering Journal* on this topic by David T. Ricker, "Design and Construction of Lifting Beams," from the 4th quarter 1991 issue. This article is available as a free download for AISC members at **www.aisc.org/epubs**, or can be purchased by others.

Kurt Gustafson, S.E., P.E.

steel interchange

Weak-Axis Flexure of Plates

Section F6 of the 2005 AISC *Specification* does not mention plates bending about the weak axis. Can we use the same F6 equations for weak-axis bending of plates, or do we revert back to the $0.75F_y$? Also, on the Basic Design Values card, the weak axis bending says to use $0.9F_yS_y$ for ASD applications. Where does the 0.9 come from, and do we apply the 1.67 ASD omega factor to that?

Flexure of rectangular bars (plates) is covered in Section F11 of the AISC *Specification*, but this gives the same basic limit state equation for yielding, as covered in Section F6, which is the only flexural check needed for plates bent about the minor axis.

The $0.9F_yS_y$ for the ASD weak-axis bending on the Basic Design Values card reflects using the shape factor (Z_y/S_y) of 1.5, and then dividing by the omega (1.67). Thus the omega is already included. For the LRFD, $1.35F_yS_y$ represents using the same shape factor (1.5) and multiplying it by the phi factor (0.9).

Kurt Gustafson, S.E., P.E.

Camber Measurement

We have a project with cambered beams. The contractor is requiring a survey of the camber after erection as a measure of compliance with the specified camber. The AISC *Code of Standard Practice* indicates that this is not a correct procedure. What is the proper procedure for measuring camber?

The AISC *Code of Standard Practice* (a free download at **www.aisc.org/code**) stipulates that camber must be measured in the shop in the unstressed condition. This means laying the beam on its side in the shop, such that gravity does not affect the measurement, and measuring for compliance within camber tolerances.

Kurt Gustafson, S.E., P.E.

Non-Destructive Testing of CJP Welds

Is there an industry standard defining the amount of NDT that should be done on full-penetration welds of moment connections?

There are requirements for non-destructive testing (NDT) of welds for high-seismic applications defined in Appendix Q of the 2005 AISC *Seismic Provisions*. However, there is no industry standard that defines required NDT of welds in non-high-seismic applications; that is left to the discretion of the responsible design professional for the project. However, the AISC Committee on Specifications is currently considering a proposal for a chapter in the AISC *Specification* similar to Appendix Q, but reduced in scope to that appropriate for non-high-seismic applications.

Kurt Gustafson, S.E., P.E.

Eccentrically Loaded Weld Groups

The table values for the eccentrically loaded weld groups published in the 13th Edition AISC *Steel Construction Manual* result in much greater strength than the comparable table published in the 9th edition ASD *Manual*. What is the reason for this increase?

One factor for the differences between the coefficient values published in the current *Manual* versus those coefficients published in the 9th edition *Manual* is that the tables in the current *Manual* do not include the omega factor for ASD design, or the phi factor for LRFD design. The 9th edition ASD *Manual*, which reflected only the ASD load approach, incorporated the safety factor in the tabularized values.

Additionally, there also is a major difference in strength because the current *Manual* takes advantage of the increase permitted for the component of the force that is at an angle to the axis of the weld. This permitted increase is covered in Section J2.4 of the 2005 AISC *Specification*, but was not included in the 1989 ASD *Manual* table values.

Kurt Gustafson, S.E., P.E.

Thickness Limitation for Single-Plate Shear Connection

Why is there a thickness limitation of $t \le d_b/2 + 1/16$" for single-plate shear connections?

The limitation is intended to ensure that the bolts can "plow" through the material without fracturing. This plowing is used as one mechanism to accommodate the simple beam end rotation that is required at simply supported beam ends. Essentially, it is a connection ductility requirement.

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**.

Kurt Gustafson is the director of technical assistance and Amanuel Gebremeskel is a senior engineer in AISC's Steel Solutions Center. Larry Muir is part-time consultant to AISC.

Steel Interchange is a forum to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

The opinions expressed in Steel Interchange do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.

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:

Steel Solutions Center

One East Wacker Dr., Suite 700
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tel: 866.ASK.AISC • fax: 312.803.4709
solutions@aisc.org

steel quiz

LOOKING FOR A CHALLENGE? *Modern Steel Construction*'s monthly Steel Quiz tests your knowledge of steel design and construction. Most answers can be found in the 2005 *Specification for Structural Steel Buildings*, available as a free download from AISC's web site, **www.aisc.org/2005spec**. Where appropriate, other industry standards are also referenced.

This month's Steel Quiz was developed from information taken from the sessions on galvanizing at the 2009 NASCC. Sharpen your pencils and go!

1 What is the proper order of the following four operations in the galvanizing process? (a) fluxing (b) pickling (c) degreasing (d) zinc bath immersion.

2 Which of the following appearances can occur in newly galvanized material? (a) shiny (b) spangled (c) matte gray (d) dull (e) all of the above.

3 True/False: Cambered members and bent connection materials can relax when heated in the zinc bath during galvanizing.

4 Which of the following is not true about galvanized bolts, nuts and washers?

(a) Galvanized fasteners are recommended for connecting hot-dip galvanized parts.

(b) Hydrogen embrittlement issues apply if the steel tensile strength F_u is less than 150 ksi.

(c) Nuts are galvanized as blanks and the threads are cut afterwards, and the galvanizing on the bolt will protect the inside of the nut.

(d) ASTM A325 bolts are permitted to be galvanized; ASTM A490 bolts are not.

5 True/False: Double-dipping is a common technique to extend the service life of a galvanized piece.

6 How are piece identifiers maintained in the hot-dip galvanizing process?

7 True or False: Hot-dip galvanizing is of sufficiently high temperature to burn away weld flux, mill lacquer, paint markers, labels and stickers, paint, and cutting oil. Therefore such items need not be removed prior to galvanizing.

8 Which of the following is true about galvanizing?

(a) Holes less than ½ in. diameter may fill with zinc.

(b) Zinc may not penetrate gaps less than 3/32 in.

(c) After galvanizing, visual inspection is carried out to locate surface defects and thickness of zinc coating is gauged by magnetic resistance testing.

(d) All of the above are true.

9 True/False: Seal welding of parts in contact eliminates the concern for explosive entrapment of air in the galvanizing process.

10 True/False: Copes and weld access holes must be ground when steel is to be galvanized.

TURN TO PAGE 14 FOR ANSWERS

steel quiz

ANSWERS

1 The galvanizing process occurs as follows: degreasing to remove dirt, oils, and organic residues; pickling to remove mill scale; fluxing to provide a mild cleaning; and then immersion into a bath of 98%-pure molten zinc. The reaction is complete when the steel reaches the temperature of the zinc bath (5 to 10 minutes, depending on steel thickness).

2 (e) all of the above. However, over time the appearance will even out and become very uniform regardless of the initial appearance.

3 True. Bent plates, cambered beams, and other bent pieces can relax during the galvanizing process.

4 (b) is the incorrect statement. Hydrogen embrittlement issues apply if the steel tensile strength F_u is ***greater*** than 150 ksi. ASTM A325 and F1852 bolts are comfortably below this strength level and can be galvanized. ASTM A490 and F2280 bolts are at or above this strength level—hence the reason they are not permitted to be galvanized.

5 False. Double-dipping is a technique used to permit a longer piece to be galvanized. The typical galvanizing kettle size is 5 to 6 ft wide, 40 to 60 ft long, and 6 to 10 ft deep. The piece to be galvanized must be able to fit in the kettle completely with one dip or two dips from two different angles. This latter option is called double-dipping. The American Galvanizers Association provides a list of kettle sizes available in specific regions (and a lot of other useful information) at www.galvanizeit.org.

6 Metal tags, weld beads, and stamping are all options that can be used for marking pieces that will be hot-dip galvanized.

7 False. These are all problematic materials that should be avoided and/or removed prior to galvanizing.

8 (d) All of the items listed are true.

9 False. Seal welding that encloses less than 16 in.^{2} of area does not require venting. However, if this area is greater than 16 in.^{2}, vent holes per ASTM A385 should be provided.

10 True. This requirement is stated in AISC *Specification* Section M2.2. It is required to help prevent cracking during galvanizing, as explained in Commentary Section M2.11.

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

Steel SolutionsCenter

PUBLICATIONS

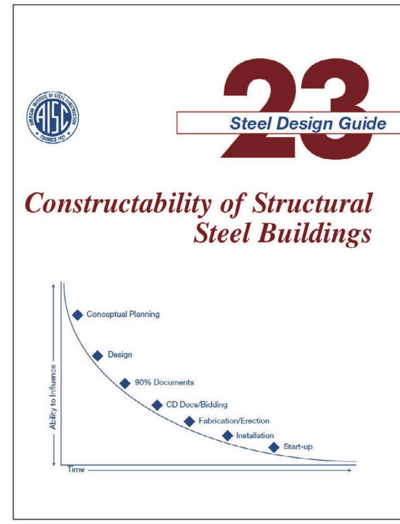
AISC Design Guide, *Constructability of Structural Steel Buildings*, Now Available

Design professionals now have a valuable new resource on constructability: AISC Design Guide No. 23, *Constructability of Structural Steel Buildings*, by David Ruby, P.E., chairman of Ruby + Associates. The publication addresses constructability as a design concept that takes advantage of steel materials, fabrication, and installation expertise early in the design phase.

"I consider this Design Guide to be both the culmination of past lessons learned and the catapult to the future relevance of our profession," said Ruby. "The Design Guide details what we have learned over the past several decades in all aspects of design and construction. It is a guide that brings together voices of the steel industry and identifies the different disciplines, tradespeople, and skill sets required to make a project succeed with this philosophy. I am an ardent believer in the value of constructability: the integration of the design and construction processes aimed at maximizing simplicity, economy, and speed of construction.

"With the design community and construction industry facing intense economic pressure, the focus will be on the bottom line," continued Ruby. "All members of the construction team will be under increased pressure to complete projects faster and more efficiently. We'll be called upon to thoroughly understand holistic project issues and ask the right questions that positively impact overall project objectives. By focusing on constructability, our clients can count on us to make their projects not only possible, but more economical."

The Design Guide highlights constructability as a design philosophy that helps position the structural engineering profession as an evolutionary asset to the client and construction community. It encourages the streamlining of the planning, design, and construction sequence using concept development, design/BIM (building information modeling), and construction processes. The publication covers specific areas such as: early involvement, the design process, issues related to the structural steel framing, detailing and fabrication, steel erection, and special constructability issues (e.g., anchorage to concrete, camber, and tolerances).



"This Design Guide explores an approach that will help all parties to a contract—owners, designers, constructors, everybody," said Charles J. Carter, AISC vice president and chief structural engineer. "It highlights the benefits of early involvement and a team-based approach, where the constructability of the project is the guiding motivation for design and construction decisions. It shows how constructability can result in more creative and relevant solutions that bring enhanced value to clients."

Design Guide No. 23 is available as a free download to AISC members from **www.aisc.org/ePubs** and at a price of $60 for nonmembers. An ePubs subscription is part of AISC's member benefits packages and includes access to more than 10,000 pages of AISC publications in electronic format. AISC also provides freePubs for all of its website visitors. The freePubs section comprises AISC's technical resources, such as specifications and codes, as well as MSC articles.

ENGINEERING JOURNAL

Second Quarter 2009 Article Abstracts

The following papers appear in the second quarter 2009 issue of AISC's *Engineering Journal*. EJ is available online (free to AISC Members) at **www.aisc.org/epubs**.

Design of Unstiffened Extended Single-Plate Shear Connections

Larry S. Muir and Christopher M. Hewitt

Extended single-plate shear connections offer many advantages that simplify the construction process. Because the connection to the supported member is moved clear of the support, coping of the supported member is not required, and the only fabrication process required for the supported member is drilling or punching.

Also, because bolted connections are only used in the connection to the supported member, there is no safety concern over the use of shared bolts through the web of the support. Additionally, in some instances, extended single-plate connections are the only practical solution to a framing problem, such as the case of a member framing into the weak axis of a column with continuity plates.

The rigidity of single-plate connections at the support has always been a gray area. Designers have often been concerned about a considerable, unanticipated moment that could be developed in the connection, which could then result in either a moment delivered to the column that the column has not been designed to resist, or a sudden rupture of either the weld or the bolts. Section B3.6a of the AISC *Specification for Structural Steel Buildings* requires that simple shear connections have sufficient rotational capacity to accommodate the required beam end rotation.

This paper will address each of these concerns, and will present a general design procedure for extended single-plate shear connections.

Topics: Connections–Simple Shear

Experimental Evaluation of the Influence of Connection Typology on the Behavior of Steel Structures Under Fire

Aldina Santiago, Luís Simões da Silva, Paulo Vila Real, Gilberto Vaz, and António Gameiro Lopes

The behavior of steel joints under fire loading is a subject that has only recently received special attention by the research community. In fact, as recently as 1995, the European pre-standard on the fire response of steel structures deemed it unnecessary to assess the behavior of steel joints under fire conditions.

This approach was supported by the argument that there is increased thermal mass at the joint area. However, observations from real fires show that, on several occasions, steel joints fail, particularly their tensile components (such as bolts or end plates), because of the high cooling strains induced by the distortional deformation of the connected members.

The main objective of this paper is to describe an experimental test program carried out by the Department of Civil Engineering at the University of Coimbra on a steel sub-frame in order to evaluate the behavior of various types of steel joints under a natural fire and transient temperature conditions along the length of the beam.

The tests were carried out on a purposely developed experimental installation that could reproduce the transient temperature conditions measured in the seventh Cardington test. The results of these tests provide invaluable evidence on how to design joints that are able to survive a fire.

Topics: Fire And Temperature Effects; Connections–Moment; Connections–Simple Shear

Shear Behavior of A325 and A490 High-Strength Bolts in Fire and Post-Fire

Liang Yu and Karl H. Frank

High-strength ASTM A325 and A490 bolts were tested in shear at temperatures up to 800 °C (1,472 °F). The shear strength showed a gradual reduction in both types of bolts as the temperature was increased above 300 °C (572 °F). Strength reduction factors for both types of bolts at elevated temperatures were obtained to provide a means of estimating the bolt shear strength during fire.

The residual strength of A325 and A490 bolts after exposure to elevated temperatures was also investigated by both direct shear tests and hardness tests. Significant strength loss occurs on both types of bolts after exposure to temperature higher than the tempering temperature employed in the manufacturing process. The hardness value at ½*R* location on the bolt cross section was found to provide a good estimate of the bolts' residual strength. The hardness test provides a simple and practical method to assess the post-fire strength of a bolt.

Topics: Bolts; Fire and Temperature Effects

PUBLICATIONS

Public Review of 2010 AISC Seismic Provisions

The 2010 draft of the AISC *Seismic Provisions for Structural Steel Buildings* is available for public review from May 1 to June 15, 2009. The *Provisions* are available for download from the AISC web site at **www.aisc.org/AISC341PR1**, along with the review form, during this time. A summary of some of the major revisions is included with the review form. Copies of the draft *Provisions* are also available (for a $12 nominal charge) by calling 312.670.5411.

Please submit comments using the form provided online to Cynthia J. Duncan, director of engineering, at **duncan@aisc.org** by June 15, 2009 for consideration.

news & events

EVENTS

Istanbul to Host Steel Cultural and Sustainability Symposium in 2010

The year 2010 will be a big one for Istanbul, Turkey. Not only has it been selected Cultural Capital of Europe for 2010, it will also host the Annual Meetings of the European Convention for Constructional Steelwork (ECCS).

Both events provided the impetus for the creation of the Steel Structures: Culture and Sustainability 2010 International Symposium, sponsored by ECCS and the Turkish Constructional Steelwork Association. The event will be a forum for architects, designers, structural engineers, steel fabricators and builders, urban psychologists, social planners, and environmentalists to discuss new horizons in steel structures in their relation to present culture, as well as a new European vision for a better and sustainable future. The Symposium will take place September 20-22, 2010.

Besides design issues and research related to steel structures, the Symposium will also cover social and cultural aspects in the field within the following themes:

- Historical and Cultural Aspects
- Structural Design Concepts
- Sustainability: Solutions in Relation to Society, Environment, and Economy
- Urban Context
- Steel Structures in Relation to Architectural Functions and Forms (Wide-Span Solutions, High-Rise Solutions, and Innovative Approaches)
- Structural Issues (Stability, Connections, Constructional Issues, Ultimate Load Design, Wind Effect, and Earthquake Resistance)
- Seismic Isolation and Vibration Control
- Fire
- Spatial Structures
- Composite Solutions
- Cold-Formed Steel Structures
- Codes
- Case Studies

Abstracts for the Symposium will be accepted until November 9, 2009. For more information visit **www.sscs2010.com**.

People and Firms

- **Friedman Industries, Inc.** has opened a steel coil processing plant in Decatur, Ala. The facility is designed to convert hot-rolled coils received from the adjacent Nucor Steel Company mill into hot-rolled sheet and plate.
- **Thornton Tomasetti** recently acquired California-based DASSE Design, Inc., a structural engineering firm focused on the health-care, education, government, and corporate sectors.
- Seismic design and consulting firm **Miyamoto International** has opened a new office in Istanbul, Turkey and has joined with **Fuji Architectural and Engineering** to provide a full line of seismic engineering services to the region. In other news, Ed Friedrichs, former **Gensler** president and CEO, has joined Miyamoto's board of directors.
- Thomas Langill, Ph.D., technical director of the **American Galvanizers Association**, has received the ASTM International Award of Merit—the highest organizational recognition for individual contributions to ASTM standards activities—and the accompanying title of Fellow.
- **Wiss, Janney, Elstner Associates, Inc.** has appointed **Tim Allanbrook, John Fraczek**, and **Terry Paret**—currently principals in its New York, Janney Technical Center, and San Francisco units, respectively—all to senior principal.
- **Chris Poland**, chairman and CEO of **Degenkolb Engineers**, has become a member of the National Academy of Engineering (NAE).
- Metal deck distributor **A.C.T. Metal Deck Supply** has opened its 11th distribution center, in San Antonio.
- **GZA GeoEnvironmental Inc.**, an environmental and geotechnical consulting firm, announced that **Lawrence E. Morse** has been named to the position of vice president.
- The **International Association for Bridge and Structural Engineering** put its publications from 1929-1999—a body of work consisting of more than 80,000 pages of documents on structural engineering worldwide—online for free; visit **www.iabse.org**.
- Peddinghaus' daughter company, **Structural Steel Systems Limited**, has released a new tool for fabricators to use in the fight to keep costs down and production running smooth: **www.ssslmachinery.com**.

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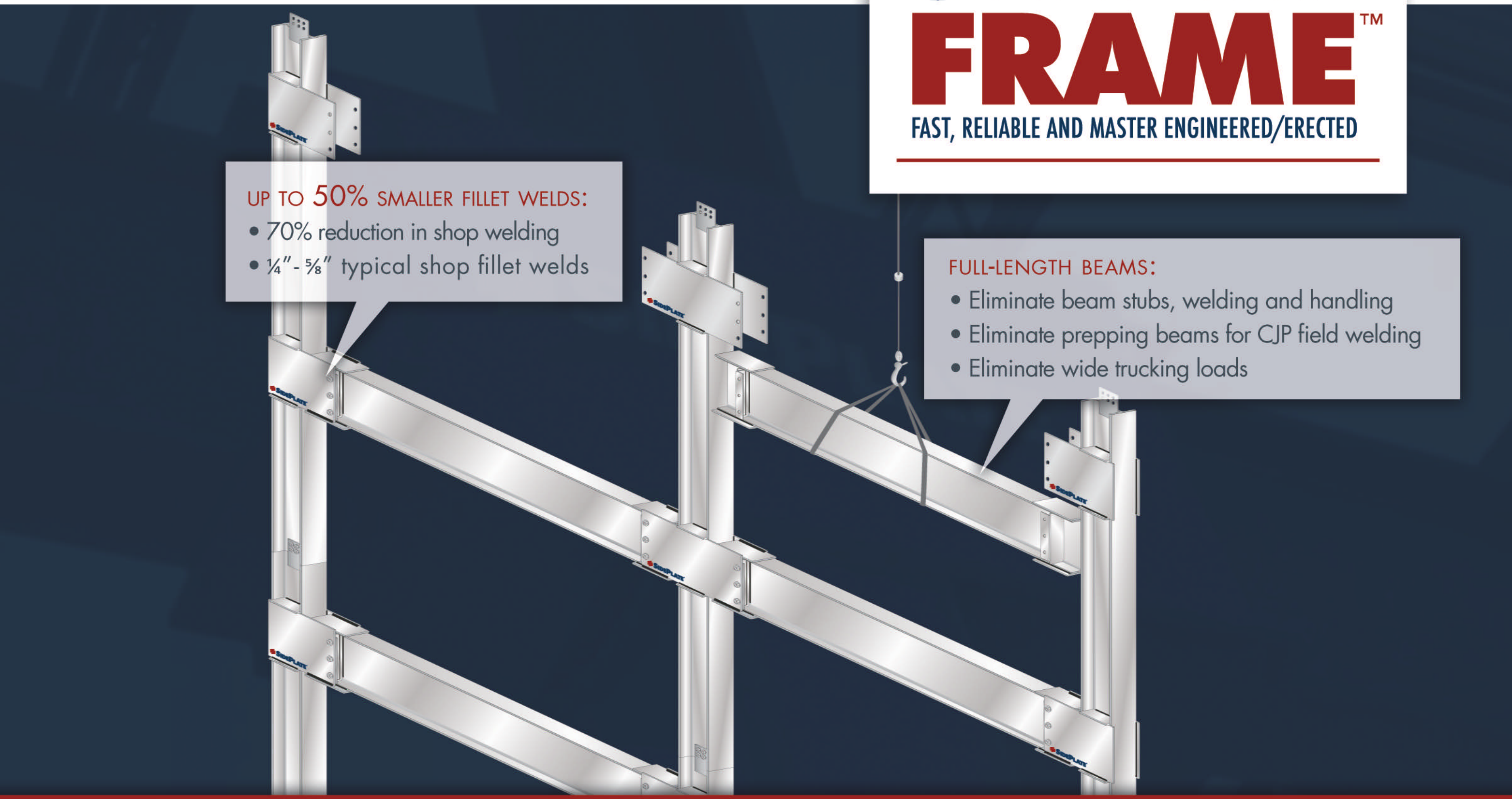

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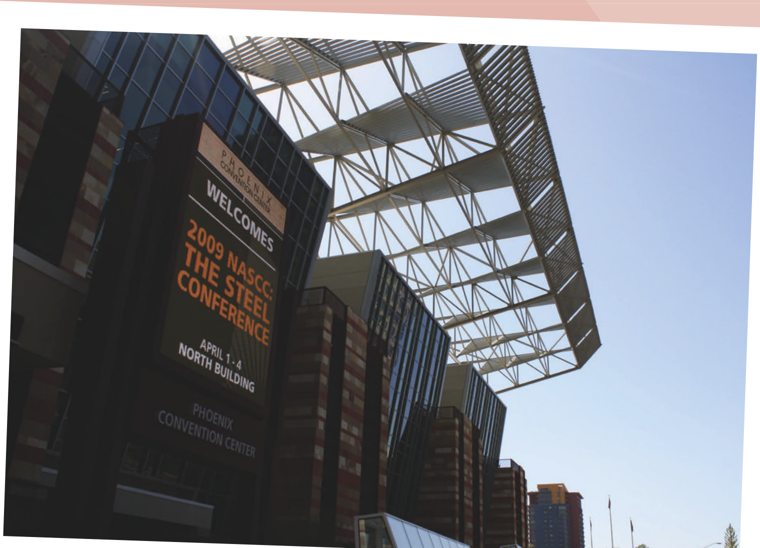

the convention center, Phoenix, Arizona

at Wednesday's keynote speech

BY GEOFF WEISENBERGER

FOR THOSE OF US THAT LIVE UP NORTH, winter seemed to drag on way too long this year (as of this writing, it's *still* here in Chicago). So a trip to the desert was the perfect way to ease into spring, and this year's NASCC—which took place the first week of April in Phoenix—was a much-needed break from the cold (for those who traveled from other southern areas, well, it was a break from the humidity).

But this year, NASCC was a break from a different climate as well, one that's inescapable for everyone the world over: the current economic climate. The Steel Conference provided a temporary escape from the recession (or at least a chance to meet and grumble about it) and offered a chance to see the latest and greatest on the show floor, meet old friends and make new ones, and attend the more than 80 seminars offered this year.

In the Halls and on the Floor

On the show floor, a visit to AISC's booth provided visitors with a view of the Phoenix Convention Center that was perhaps even better than the real thing; the backdrop for the booth was a photo of the steel skeleton of the new wing, which opened earlier this year—and hosted NASCC. At the booth, attendees were able to step back in time and nurture their inner engineer-child by working on one of the many plastic erector sets available to create scale models of their favorite steel structures. And besides AISC's booth, attendees were able to visit more than 200 exhibitors.

Sessions were once again a mixture of technical, practical, and fun—and all were enlightening. "The Wal-Mart Effect and Your Business" touched upon adding value to engineering services in an effort to keep them from becoming a commodity and to increase profits. As an example, presenter Robert van Arsdall related an everyday occurrence to business, pointing out that people will pay prices several hundred percent higher for vegetables or fruits that are already chopped and packaged than for whole vegetables or fruits. His lesson: people will pay more for this extra "service" and the same can apply to building design.

Another session, "New Developments in Fall Protection," discussed how companies are adapting to ANSI Z359, *Standards for Fall Protection*, as well as new safety equipment. One of the points made is that while there is new safety equipment available, there are not necessarily new problems. "All fall issues have been solved before," noted one of the presenters, who recommended discussing solutions with fall protection vendors "because they have solved the issue for someone else in the past."

"The Art of Steel" was a lighter presentation, well-suited for Friday afternoon after three days of heavy, high-tech information. In it, Duane Ellifritt, creator of AISC's now-famous steel teaching sculpture, presented a gallery of steel in artwork over the last 300 years and also drove home the point that art is truly in the eye of the beholder, displaying slides of steel sculptures (some beautiful and some, well, not as beautiful) from around the globe.


AISC's booth


the sky's the limit!

the exhibit hall was bustling all week

Onstage

This year's Wednesday keynote address was presented by one of AISC's own, chief structural engineer and vice president, Charles Carter. In a presentation that was destined to generate discussion and a bit of controversy, Carter delved into a topic that has been debated for more than four decades: where responsibility for connection design lies. Carter presented three options and explained how the next incarnation of AISC's *Code of Standard Practice* will address them. You can read all about it in Carter's article "Connection Design Responsibility: Is the Debate Over?" on page 28.

Friday's keynote address honored this year's T.R. Higgins Award winner, Donald W. White, Ph.D., a professor at the School of Civil and Environmental Engineering at the Georgia Institute of Technology. White presented his paper on the revisions to the 2005 AISC and 2007 AASHTO provisions for flexural design of steel I-section members; these revisions were made to simplify the provisions' logic, organization, and application in order to improve their accuracy and generality.

Other awards presented at NASSC included the J. Lloyd Kimbrough Award to Larry Griffis of Walter P. Moore and Associates, Inc.; the Geerhard Haaijer Educator Award to Joseph A. Yura of the University of Texas at Austin; the Lifetime Achievement Award to Charles G. Salmon at the University of Wisconsin–Madison, and Irwin Cantor; and Special Achievement Awards to Masayoshi Nakashima of Kyoto University (Japan) and Robert Tremblay of Ecole Polytechnique in Montreal. Former AISC regional engineer John Ruddy, who passed recently, was also honored with a Special Achievement Award.

Off-site

Of the 3,200-plus that made the trip to Phoenix for NASCC, more than 200 embarked on another journey, though this one only minutes from the Phoenix Convention Center: a tour of Schuff Steel's fabrica-


D. Kirk Harman discusses connection design


AISC staff members were on hand to answer questions face-to-face

tion plant on the outskirts of downtown. The tour offered visitors a firsthand look at the steel fabrication process and provided an insider's view of the challenges and details that fabricators have to address on a daily basis. The tour was very informative—even to other fabricators. Shawn A. Alberts of Arrowhead Steel Fabricators was impressed with the size and technological advancements of the shop. "To see such massive members being fabricated was one area that stood out to us," he said. "Where we are from, we rarely, if ever, see projects and/or members the size of the ones that Schuff was fabricating. The equipment that Schuff uses was also very impressive. With the majority of the machines being automated, we could see how it would be a great cost savings and would greatly reduce shop errors."

Another visitor, Liberto Aguiar of the Babcock and Wicox Company, called the tour one of the highlights of the show. "Schuff Steel came across as being a safety-conscious company, very organized, with a unique material-handling system," he said. "They have tours down to science and moved people through their facility as well as Disney World."

In other field trip news, John Cross, AISC's vice president of marketing, and other AISC marketing staff paid a visit to Arizona State University's Polytechnic Campus at Mesa to present a 2009 IDEAS^2 Award for the school's new addition: five new buildings that add 245,000 sq. ft of academic space to the campus in a beautiful collaboration between architecture and structure—and featuring a lot of exposed steel. Representatives from the project's design and construction team and the university accepted the award and gave brief comments in one of the facility's sunny, attractive courtyards (read about the project on page 42).

A New Day for Steel

For those of you that attended NASCC in Phoenix, you may have noticed a booth toward the back of the exhibit hall promoting something called "SteelDay." And you may have spent time busily scurrying from booth to booth in an attempt to complete your SteelDay puzzle. If you didn't make it to the show or the booth, here's the skinny on SteelDay…

Like many other "World" or "National" days/weeks/months, such as Earth Day or Breast Cancer Awareness Month, SteelDay is about promoting awareness. But more than that, it's about interaction—interaction between designers, engineers, developers, architects, owners, fabricators, and others in the structural steel industry. The ultimate goal is to build lasting relationships within and between these groups—and of course, convince more decision-makers to build with steel. And interaction is where it starts.

SteelDay will involve events around the country: facility and jobsite tours, educational seminars, online interactivity, media coverage, etc. AISC's goal is to hold events in every state. Already, more than 100 events in more than 40 states are currently planned, and more will be added in the coming months (see a map of planned events at the web site below).

The date: September 18, 2009. Mark it on your calendar and consider hosting or attending an event. If you're interested in either—or just in learning more about SteelDay—visit **www.steelday.org**.

interact.
learn.
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STEEL
DAY2009
www.SteelDay.org

continued on page 26

NASCC Visited by Robots from the Future (of Fab Shop Automation)

When you visit a show like FabTech International/AWS Welding Show, you're practically bombarded with robotics. As you may guess, that show focuses on welding in several different industries, of course including those that have long invested in robotic welding technology, such as automotive and aviation. For the structural steel audience at NASCC, robotic solutions have been more limited. The primary barrier is the prevailing attitude that there aren't enough repeatable processes to make automated welding a viable option.

But that's beginning to change, as evidenced by a couple of first-time exhibitors at this year's Steel Conference. One of them, SmartTCP, makes a robotic welding system for small batch steel fabrication, building modular and flexible systems in the fab shop for structural steel parts up to 60,000 lb. Efi Lebel, SmartTCP's CEO, noted that his company is currently targeting medium to large fab shops with several welders and multiple small batch operations. The company's goal at its first Steel Conference, he said, was to get people educated on welding robotics in general and demonstrate that welding automation can now be economically implemented for one-off and low volume parts (visit **www.smarttcp.com**). The company found show attendees very interested in its robotic welding solution, which integrates software and hardware components to automate both the robot programming and the welding.

The second company, JITECH, approaches robotics from the software side. While they've been in the robotics software business for 25 years, their structural steel solution, StruCIM, is new. The company, which sells to robot manufacturers but also works with fabricators, produces 3D simulation software that allows fabricators to quickly simulate and evaluate alternative methods for automating the fabrication of structural steel. According to Ivan Jivkov, JITECH's president, "The steel industry needs to get rid of the mentality that it can't automate." Jivkov cited the lack of interest in manual labor amongst younger people entering the workforce and positioned the use of robotics in fabrication shops as one way of addressing this labor shortage. "People are eager for this," he said, adding

A robot-welded assembly from SmartTCP.

that his firm's goal at this year's show, like SmartTCP's, is to educate (visit **www.strucim.com**)—and he did see a lot of interest from booth visitors in automating welding in their shops.

For more on automated/robotic welding, see "Robotic Shop" on page 52.

Kicking Back

As a former Texan, I can tell you that there are fewer things nicer than walking into a place and being greeted with a margarita. And that's just how folks were welcomed to the Corona Hacienda and Rodeo Grounds, a short bus ride away from downtown Phoenix, for this year's conference dinner. Besides the tasty salt-time concoctions, guests were treated to an authentic Southwestern rodeo, complete with trick roping, bull and bronco riding, and death-defying equestrian stunts. One of the highlights was seeing AISC Chairman of the Board Rex Lewis on horseback in full Western regalia. Following the show, attendees enjoyed Southwestern fare—enchiladas, fajitas, quesadillas, and more—and live music, some opting for the festive dancehall and others choosing to dine under the stars.

Next year, NASCC trades its cowboy hat for mouse ears and heads to Orlando. Information for the 2010 Steel Conference, which will collocate with Structures Congress, will be posted soon at **www.aisc.org/nascc**. In addition, photos from this year's show are posted online at **tinyurl.com/nascc2009**.

Getaways—even when they involve industry trade shows—can be invigorating, and in the case of this year's Steel Conference, perhaps even provide invigoration to tackle the current economy, come out of the recession strong, and do both as a united industry (clichéd as it may sound, we *are* all in this together). It appears that many in the industry understood this, as the show's total attendance made it the third-largest Steel Conference of all time—not too shabby for a down economy. MSC

sponsored by...

Thursday's conference dinner

Escaramuza performing at the rodeo

From the 2009 NASCC in Phoenix, Arizona.

Connection Design Responsibility: Is the Debate Over?

BY CHARLES J. CARTER, S.E., P.E.

MY COLLEAGUE SCOTT MELNICK is a journalist, and so he loves controversy. (If you read his editorials in this magazine, you already know this.) I suspect he picked the title of this article—"Connection Design Responsibility: Is the Debate Over?"—in his best attempt to give us a "man-bites-dog" headline.

I'm an engineer, however, and engineers don't tend to seek controversy as much. I might have picked a more innocuous title like "Proposed Changes in Section 3.1.2 of the AISC *Code of Standard Practice*" to downplay the controversy. Of course, it really doesn't matter what title this article carries—the substance remains that we are happy to share with you what the AISC Committee on the Code of Standard Practice believes is a solution to a debate that has been with us for at least four decades.

As Secretary of the AISC Code Committee, it has been my pleasure to be involved in the work that resulted in the 2000 *Code of Standard Practice* as well as the 2005 *Code of Standard Practice*. I am further privileged to be able to write here about the work we have been doing to prepare one piece of the 2010 *Code of Standard Practice*: modifications of Section 3.1.2 to include an option whereby the Structural Engineer of Record (SER) can delegate the work of connection design to a licensed Professional Engineer working for the Fabricator.

A Brief Review of History

There is a long history that has led up to the draft changes proposed in the AISC *Code of Standard Practice*. There have been many debates, some of which took place in formal settings like the AISC Conference, and many others in meetings and gatherings sponsored by other organizations. There may be no other topic that so equally lends itself to the panel discussion and the spontaneous argument.

There have been speeches given and position statements written, rewritten, retracted, and revised. There have been attempts to draft appropriate language for codes, specifications, contracts, and other documents. And the museum of shop drawing approval stamps is replete with many creative ways to say everything but "approved." For the better part of 40 years, this issue has been a question, and it simply is not going to go away if it continues to be ignored, letting whatever will be prevail. Part of the challenge in this process was that the Code Committee is tasked with describing what standard practice is, not prescribing it. And yet this is an area with a multitude of differing practices, which required the Committee to be selective and wise in its process of refinement.

In the late 1990s, AISC reconstituted its Committee on the Code of Standard Practice as a balanced group with representation of all disciplines with an interest in the Code. What a successful action that was! The 2000 and 2005 versions of the AISC *Code of Standard Practice* revitalized the document. Attempts were made in the deliberations for both of these versions to address the common practice of delegating connection design work. However, no proposal succeeded.

Throughout this time, AISC and the Council of American Structural Engineers (CASE) were collaborating through a joint task group, attempting to find a viable path. The task group had representatives of both the AISC Code Committee and the CASE Guidelines Committee. After three distinct proposals and nearly five years of discussion, white smoke finally rose from the deliberation.

As a result, we can discuss the proposal in its current form. This is called a proposal because there are still Committee ballots to complete. Nonetheless, we know at this point that the fundamentals of this proposal are accepted. We are now just down to the punch list of comments and concerns.

Current Draft

The current proposal for Section 3.1.2 in the 2010 AISC *Code of Standard Practice* is available for review at **www.aisc.org/code312**. It covers three options:

(1) The compete connection design shall be shown in the structural design drawings;

(2) The connection shall be designated to be selected or completed by an experienced steel detailer;

(3) The connection shall be designated to be designed by a licensed professional engineer working for the fabricator.

Stated more succinctly, these options can be expressed as follows:

(1) The SER designs the connections.

(2) The SER provides the schematics and the steel detailer completes the details.

(3) The SER provides design criteria and a licensed professional engineer working for the fabricator designs the connections.

Some flexibility is allowed here. One of these methods must be specified for each connection, but it is acceptable to group connection types and utilize a combination of these options for the various connection types involved in a project.

Option (1)

Option (1) was covered in previous versions of the AISC *Code of Standard Practice* and has not changed much, if at all, in this proposal. In this case, the SER shows the complete design of the connections in the structural design drawings. This includes:

(a) All weld types, sizes, and lengths;

(b) All bolt sizes, locations, quantities, and grades;

(c) All plate and angle sizes, thicknesses and dimensions; and,

(d) All work point locations and related information.

The intent of this approach is that complete design information necessary for detailing the connection is shown in the structural design drawings. The steel detailer will then be able to transfer this information to the shop and erection drawings.

Option (2)

Option (2) also was covered in previous versions of the Code, but in a less specific and somewhat more ambiguous form. It has been focused and clarified in this proposal.

In this case, the SER designates connections to be selected or completed by an experienced steel detailer, and provides schematic connection details in the structural design drawings. These schematic details may include tables in the design drawings or reference to tables in the AISC *Steel Construction Manual*, or other reference information, such as journal papers. Perhaps there is recognized software output that is considered acceptible. Whatever the basis the SER establishes, the steel detailer uses that information to select the connection materials and develop the specific connection geometry and dimensional information.

Often in this case, loads must be given in the structural design drawings. It is important to note in this option that these loads are only to facilitate selection of the connections from the referenced tables. It is not the intent that this method be used when the practice of engineering is required.

Option (3)

Option (3) is completely new to the AISC *Code of Standrad Practice* in this proposal. In this option, the SER designates connections to be designed by a licensed professional engineer working for the fabricator. Although this option is new in the Code, it reflects a practice that is common, even if the specifics of how it is being done do tend to vary.

With that variation in mind, it is important to recognize in this option that there are some aspects of what is required that express how this option should be done. Admittedly, this involves qualititative judgement. Nonetheless, the proposal represents the collective wisdom of the AISC Code Committee as well as the CASE Guidelines Committee.

Communication is required in this method! Up front, the SER must provide some information:

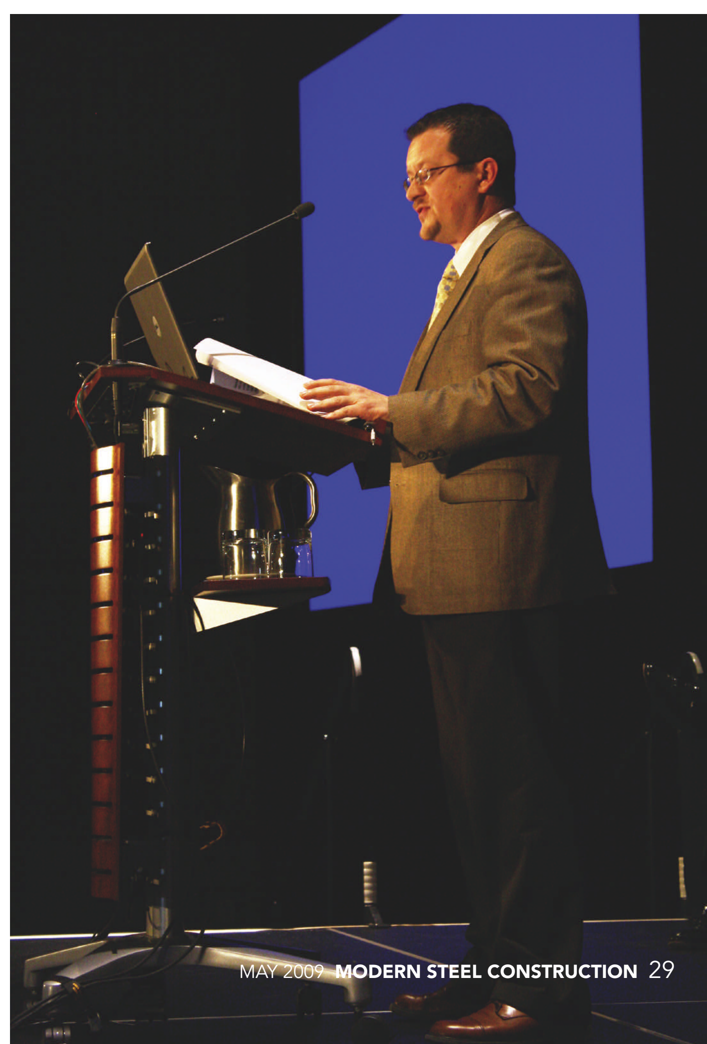
(a) If there are any restrictions as to the types of connections to be used, it is required that these limitations be set forth in the structural design drawings and specifications. There are a variety of connections available in the AISC *Steel Construction Manual* for a given situation. Preference for a particular type will vary between fabricators and erectors. Stating these limitations, if any, will help to avoid repeated changes to the shop and erection drawings due to the selection of a connection that is not acceptable to the SER. This will help avoid additional cost and/or delay for the redrawing of the shop and erection drawings.

(b) The connection design loads and associated criteria must be defined. Forces, moments, whether the loads provided are ASD or LRFD loads, and similar information is key here.

(c) What substantiating connection information, if any, is required.

The term *substantiating connection information* is a new defined term in this proposal for the Code. It is the information submitted by the fabricator, if requested by the SER, when option **(2)** or option **(3)** is designated for connections.

Substantiating connection information, when required, can take many forms. When option **(2)** is designated, shop and erection drawings may suffice with no additional substantiating connection information required. When option **(3)** is designated, the substantiating



Rather, it is in addition to that.

(c) It is required that the fabricator must provide a means by which the substantiating connection information and the connections on the shop and erection drawings are linked. This helps the SER find information during the review and approval process.

connection information may take the form of hand calculations and/or software output. The focus in this article is on substantiating connection information for option **(3)**.

The SER may require that the substantiating connection information be signed and sealed for option **(3)**. The signing and sealing of the cover letter transmitting the shop and erection drawings and substantiating connection information may suffice. This signing and sealing indicates that a licensed professional engineer performed the work but does not replace the traditional review and approval process that is provided in Section 4.4 of the Code.

A requirement to sign and seal each sheet of the shop and erection drawings is discouraged, as it may serve to confuse the design responsibility between the SER and the licensed professional engineer performing the connection design.

Some additional requirements are included to facilitate this option and make it acceptable. It must be recognized that there is information that the fabricator needs to do this work. Moreover, option **(3)** requires cooperation between the SER, fabricator, and licensed professional engineer in responsible charge of the connection design when this option is used. And it is a two-way street.

(a) Early in the process, the fabricator and SER should discuss and agree on representative samples of the required substantiating connection information. A little time spent up front here will save a lot of rework and arguments later on. It will also save cost and delays.

(b) It is required that the licensed professional engineer in responsible charge of the connection design must review and confirm in writing, as part of the substantiating connection information, that the shop and erection drawings properly incorporate the connection designs. This review by the licensed professional engineer in responsible charge of the connection design does not replace the approval process of the shop and erection drawings by the SER.

Simply stated, when the SER selects option **(3)** for connection design, the SER is inviting the fabricator and the licensed professional engineer in responsible charge of the connection design to be a part of the SER's design team. And it is even more simply stated that teams work when there is teamwork. Not working as a team when option **(3)** is selected is one of the abusive practices the Code Committee hopes will become rare, if not nonexistent.

Review and Approval

In all three options covered in the proposal for Section 3.1.2, the approvals process in Section 4.4 of the Code is followed. That is, the SER reviews and approves the shop and erection drawings regardless of what option is specified.

In options **(1)** and **(2)**, there is only the SER involved in an engineering capacity. Thus, the responsibility for the connection designs is clear. In option **(3)**, the SER is permitted to rely upon the work of the licensed professional engineer in responsible charge of the connection design. Nontheless, the SER reviews and approves the shop and erection drawings during the approvals process as specified in Section 4.4 for conformance with the specified criteria and compatibility with the design of the primary structure.

When substantiating connection information is required, the SER must take such action on substantiating Connection information as the SER deems appropriate. Note the difference: where the shop and erection drawings are required to be reviewed and approved, it is left to the discretion of the SER to determine what review of the substantiating connection information is appropriate.

Final Authority

The SER is identified as the final authority in the case of a dispute between the SER and the licensed professional engineer in responsible charge of the connection design when option **(3)** is specified. This is simple and straightforward, and it is how it must be because only the SER has the full knowledge of the structure.

Simple and Straightforward

In summary, the AISC Code Committee believes this proposal provides a simple and straightforward approach to a practice that already exists, is in wide use, and currently is widely varying in how it is used. The AISC Code Committee believes that this proposal bounds all three options within appropriate limits. The proposed language allows all parties to control their own risks, and no party is asked to assume the responsibility for the negligence of another party.

The AISC Code Committee believes this proposal will suceed in practice and make structural steel more competitive. The proposal is still being finalized, and your input is welcome! After you read the draft at **www.aisc.org/code312**, tell us what you think. MSC

Charles Carter is a vice president and chief structural engineer with AISC. This article is based on his presentation at NASCC last month in Phoenix.

The keynote presentation was made by D. Kirk Harman, Glenn Bishop, and Charles Carter (pictured below from left to right).

Innovative Design in Engineering and Architecture with Structural Steel

IDEAS² awards

Bronx County Hall of Justice, Bronx, N.Y. (a Merit Winner in 2008).

THE DESIGN AND CONSTRUCTION INDUSTRY RECOGNIZES THE IMPORTANCE OF TEAMWORK, COORDINATION, AND COLLABORATION IN FOSTERING SUCCESSFUL CONSTRUCTION PROJECTS TODAY MORE THAN EVER BEFORE. In support of this trend, AISC is proud to present the results of its annual IDEAS² Awards competition. This program is designed to recognize all team members responsible for excellence and innovation in a project's use of structural steel.

Awards for each winning project were presented to the project team members involved in the design and construction of the structural framing system, including the architect, structural engineer of record, general contractor, detailer, fabricator, erector, and owner.

New buildings, as well as renovation, retrofit, or expansion projects, were eligible. The projects also had to display, at a minimum, the following characteristics:

- ➜ A significant portion of the framing system must be wide-flange or hollow structural steel sections;
- ➜ Projects must have been completed between January 1, 2006 and December 31, 2008;
- ➜ Projects must be located in North America;
- ➜ Previous AISC IDEAS² or EAE award-winning projects were not eligible.

A panel of design and construction industry professionals judged the entries in three categories, according to their constructed values in U.S. dollars:

- ✓ Less than $15 million
- ✓ $15 million to $75 million
- ✓ Greater than $75 million

The judges considered each project's use of structural steel from both an architectural and structural engineering perspective, with an emphasis on:

- ➜ Creative solutions to the project's program requirements;
- ➜ Applications of innovative design approaches in areas such as connections, gravity systems, lateral load resisting systems, fire protection, and blast;
- ➜ The aesthetic and visual impact of the project, particularly in the coordination of structural steel elements with other materials;
- ➜ Innovative uses of architecturally exposed structural steel;
- ➜ Advances in the use of structural steel, either technically or in the architectural expression;
- ➜ The use of innovative design and construction methods such as 3D building models; interoperability; early integration of specialty contractors such as steel fabricators; alternative methods of project delivery; or other productivity enhancers.

Both national and merit honors were awarded. The jury also selected one project for the Presidential Award of Excellence in recognition of distinguished structural engineering.

2009 IDEAS² Awards Jury

Mark S. Carter, President, American Steel Fabricators Inc., Greenfield, N.H.

Raymond S. Clark, AIA, LEED AP, Principal and Managing Director, Perkins+Will, Chicago

Mario J. Elcid, P.E., Senior Staff II–Structures, Simpson Gumpertz and Heger, New York

Keith Grubb, Senior Engineer–Research, AISC, Chicago

Christina Koch, LEED AP, Editor in Chief, *eco-structure* and *metalmag* magazines, Hanley Wood Business Media, Chicago

Mike Moravek, Senior Vice President, The John Buck Co., Chicago

George Karl Tuhowski III, General Superintendent, Leopardo Construction, Hoffman Estates, Ill.

National Winner—Under $15M

ARMSTRONG OIL & GAS—DENVER

This adaptive reuse of an early 1900s industrial machine shop has helped to launch a new identity for an established local business—Armstrong Oil & Gas—in lower downtown Denver (LoDo). Charged with bringing new life to an underused building, the design team planned the enclosed program around existing elements and created generous, sophisticated spaces filled with daylight, natural ventilation, and views of the Denver skyline.

The existing corrugated steel roof over the main second-floor office had deteriorated over the years due to water infiltration and was replaced with corrugated zinc roofing. The original structure consisted of four gabled steel trusses with riveted connections, with wood framing spanning between.

Two of the trusses were salvaged, while two were replaced with new trusses using double steel angle members to replicate the historic trusses, but with welded connections to differentiate between the old and new. The gable trusses are approximately 24 ft wide and 6 ft tall. The top and bottom chords are double 3×3×¼ steel angles, and the diagonals are 2×2×¼ or 3×3×¼ angles. Sawtooth trusses over the second-floor office area were built with the same-size members. The wood framing was replaced with an 18-gauge steel deck clear-spanning between trusses, and the existing cupola vent was replaced with a steel-framed and glazed monitor to provide additional light and ventilation to the office.

To create the centralized courtyard, which now provides abundant natural light and ventilation to all of the interior spaces, the center section of the original roof was stripped away. Additionally, existing heavy timber roof beams and wood decking were removed to express the steel frame, and the wood was repurposed into many of the custom-fabricated interior furnishings.

Primary vertical circulation is provided by two folded steel plate stairs—using ¼-in. plate—that cantilever off of a central tube structure. A new catwalk made of steel angles and bar grating is suspended on steel rods from the existing roof framing and links the upper lounge and second-floor offices through the double-height space of the "war room."

The mixture of old and new exposed materials impressed juror Raymond S. Clark, who praised the building for its "excellent combination of ornamental steelwork, structural elements, and refurbishment and reuse of historical steel members."

The building was upgraded for earthquake and wind loads by integrating new brace frames and creating moment-resisting rigid frames from the new steel columns and trusses that form the saw-tooth roof. Where new openings were made in the existing brick walls, the lintel was created by sandwiching the head of the opening with a steel channel on each side, secured in place with through bolts. The expressed lintel not only contributes to the historic aesthetic of the space, but also allowed for a safe and economic construction sequence; by installing the lintel first, the brick could be removed and the need for temporary shoring avoided.

The building maintains its existing shell and structure, eliminating tons of waste from local landfills while preserving a venerable landmark in downtown Denver.

photos by Frank Ooms Photography

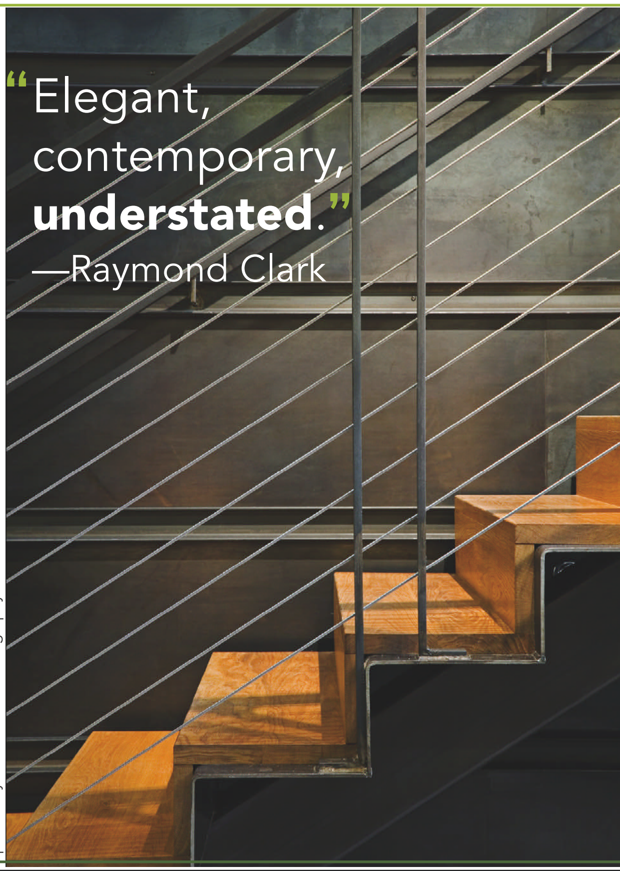
Owner
Armstrong Oil & Gas, Denver

Architect
Lake|Flato Architects, Inc., San Antonio

Associate Architect
Bothwell Davis George Architects, Denver

Structural Engineer
McGlamery Structural Group, Denver

General Contractor
Sprung Construction, Denver



photos by Frank Ooms Photography

Merit Award—Under $15M

HOLOCAUST AND HUMAN RIGHTS CENTER OF MAINE—AUGUSTA, MAINE

The Michael Klahr Center (MKC), the new home of the Holocaust and Human Rights Center of Maine (HHRC), is a 6,300-sq.-ft, one-story building on the campus of the University of Maine at Augusta.

The massing for the MKC creates a bold visual exposition of the HHRC's mission to educate future generations about the Holocaust and other human rights abuses. Four flower-like petals spring forth from the ground around that central focal point, reminding visitors of the rebirth of freedom after the long, hard winter of World War II.

Because the HHRC was charged with building the MKC on a total budget of only $1.8 million, structural steel proved essential to realizing the architect's vision for the building. Although the sculptural forms of the petals could have been well-suited to cast-in-place concrete, the expense of the curved formwork and the construction schedule demanded a different structural system. In response to the sculptural demands of the petal architecture, Simpson Gumpertz and Heger, the structural engineer for the project, developed a structural system consisting of a grid of HSS sections using curved HSS8×8s as the ribs along "meridians" of the spherical petal sections, and straight HSS4×4s along "parallels" of the petals.

These grids, moment connected in-plane and strategically braced in certain bays, enable the petal structures to act as shells. Selecting steel for the petals allowed for portions of the petals to be shop-fabricated, speeding up construction considerably.

The petal structure made quite an impression on the jury. George Tuhowski called the project "striking aesthetically and an excellent example of the design flexibility that steel can provide," while juror Raymond Clark commented on the "excellent detailing and use of flowing curved elements to achieve what one would expect to be executed in concrete."

For more on this project, see "Blooming Knowledge" in the January 2009 issue of MSC, available in the Archives section at **www.modernsteel.com**.

Owner
University of Maine at Augusta

Architect
Shepley Bulfinch Richardson and Abbott, Boston

Structural Engineer
Simpson Gumpertz and Heger, Inc., Waltham, Mass.

General Contractor
Wright–Ryan Construction, Inc., Portland, Maine

"Striking aesthetically and an excellent example of the **design flexibility** that steel can provide."

—George Tuhowski

photos by Esto Photography

Merit Award—Under $15M

RAYMOND AND SUSAN BROCHSTEIN PAVILION—HOUSTON

Carl Mayfield Photography

The Raymond and Susan Brochstein Pavilion is at the center of the Rice University campus in Houston, Texas. Completed last year, the $7 million structure plays host to formal and informal gatherings.

Designers addressed lateral torsional buckling concerns for the stacked steel bar grid and analyzed various required cambers to meet the exacting requirements of a flat and level finished trellis structure with a leading edge of only ¾ in. This delicate steel grid is held 17 ft in the air by slender 4½-in. square billet columns with concealed fixed bases. The architect required submission of a sample of the column to verify that the hot-rolled billet would have acceptably square, unrounded corners.

To ensure the aesthetic integrity of the trellis versus constructability, designers closely coordinated all details during the design phase. Splices in the structural steel members were coordinated with the architectural grid to create manageable lengths and were detailed with mortise joints and decorative head steel bolts. The steel fabricator and erector met the architecturally exposed structural steel tolerances, which were required to align and attach the prefabricated aluminum trellis frames to the top of the steel grid, without any need for field-modifying the shop-fabricated steel. The finished trellis forms an open shaded area for exterior seating surrounding the pavilion.

Four 77-ft by 15-ft clear glass curtain walls form a square and enclose the pavilion. The exterior steel columns supporting the structural steel roof were limited to the smallest structural steel wide-flange shape of W4×13. These exposed columns are spaced at 7 ft all around the perimeter and are integrated as part of the glass wall support system. Each vertical mullion is placed in front of and attached to a W4 column. Each horizontal mullion is in front of and attached to a horizontal ST2×4$^{3}/_{4}$ spanning between the W4 columns. This allows the sizes of the aluminum mullions to be minimized and enables the architect's desire for an unencumbered visual connection between exterior and interior. Likewise, the view from interior spaces to the exterior is unencumbered, since the structure has no interior columns other than those concealed within the 14-ft by 49-ft service core. This required spans of 42 ft to the W4 exterior columns, created with W18 beams that are partially exposed by the perforated metal ceiling. The beams are spaced at 7 ft on center and coordinated with the perimeter curtain wall, shrouded skylights, sprinklers, and the perforated metal panel ceiling, which partially exposes them. The building was detailed with AutoCAD and analyzed with Risa3D.

Jurors noted the link between form and function. "A great use of innovative design and modeling that shows the importance of the integrative approach to design," said George Tuhowski. Mark Carter was "impressed mightily by the grace of the structure and the practicality of its use" and called the design "absolutely delightful."

Owner
Rice University, Houston

Architect
Thomas Phifer and Partners, New York

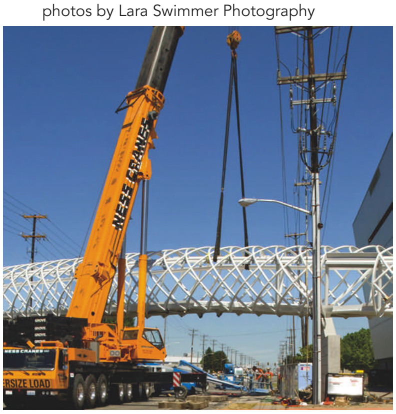
Structural Engineer
Haynes Whaley Associates, Inc., Houston

General Contractor
Linbeck Group, LLC, Houston

Merit Award—Under $15M

MUSEUM OF FLIGHT, T. EVANS WYCKOFF MEMORIAL BRIDGE—SEATTLE

photos by Lara Swimmer Photography



The Museum of Flight in Seattle is one of the largest air and space museums in the world, attracting nearly 500,000 visitors each year. A recent addition to the museum—a symbolic 340-ft pedestrian bridge—helps to better circulate these visitors and also provides an eye-catching icon to the industrial area where the museum is located.

A conventional, utilitarian public works bridge would have been possible but inadequate to convey the spirit of the museum and the area's aviation history. Instead, the design of the bridge is inspired from the metaphor of the contrail, a stream of crystallized vapor created in a plane's wake. The metaphor is carried out in the bridge's unusual tube truss design, made of crossing circular steel pipe sections surrounding an inner glass enclosure and culminating in what juror Mike Moravek deemed "a progressive, innovative connector to the local heritage."

The unique structure of the bridge evolved from the design collaboration between SRG Partnership (architect), MKA (structural engineer), and Jesse Engineering (steel fabricator). The design team conceived a structural design that did not rely on conventional truss webs, but instead distributed the vertical shear in the bridge structure through a matrix of curving steel pipes. This exciting and dynamic form had the potential to be overly complex and unachievable within the project budget. However, using standard steel member sizes, constant radius pipe bends, and predetermined "fish-mouth" end cuts, the complex design was fabricated economically.

The main truss, 200 ft long, is made of a series of crossing 5-in.-diameter pipe hoops tilted at 45°. The elliptical cross section swells slightly in the center, narrowing at its ends to heighten the sense of movement. Lightweight materials and a composition of transparent, translucent, and metallic surfaces soften the reflected light, at times appearing to dissolve against the sky.

Using a steel truss allowed the structural depth to surround the partially enclosed interior space and more successfully reference the language of the existing museum architecture. The bridge uses approximately 10,000 linear ft of steel pipe at a total steel weight of 190 tons. The contrail configuration used approximately 151 pieces of tube rolled to different radii, as the bridge was wider at the middle than the ends (all the pipes were rolled at a constant radius but as the width changes, so does the radius.). Shorter pieces needed to be cut to fit between the full hoops to make the truss that surrounded the main chords, which were made of 10-in.-diameter pipe; the pipes for the chords were purchased in 60-ft lengths, then spliced together.

For more on this project, see "Taking Flight" in the December 2008 issue of MSC, available in the Archives section at **www.modernsteel.com**.

Owner
Museum of Flight, Seattle

Architect
SRG Partnership Inc., Seattle

Structural Engineer
Magnusson Klemencic Associates, Seattle

Steel Fabricator
Jesse Engineering Co., Tacoma, Wash. (AISC/NSBA Member)

Steel Detailer
MKE Detailing, Inc., Seattle (AISC/NISD Member)

General Contractor
Sellen Construction Co., Seattle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National Award—$15M to $75M

POOL/ICE RINK AT FLUSHING MEADOWS CORONA PARK—FLUSHING, NEW YORK

While New York never realized its dreams of becoming the host city for the 2012 Olympic Games, it did get a nice pool as a result of being a candidate city. Although planned as a recreation and community competition facility, the design of the new pool at Corona Park in Flushing, N.Y. was commissioned at the time when New York was in the hunt for the 2012 Games.

At the time, New York had limited indoor swimming facilities, and the new natatorium was programmed as the venue for water polo and synchronized swimming competitions. As such, the building design solution had to be economical both with respect to initial building cost as well as operational costs after the Olympic events. As part of this goal, the building volume was to be kept to a minimum to bring down heating and cooling costs. To achieve this goal and accommodate the possibility of the Olympic seating, a cable-stayed suspended roof structure was chosen for the building, which also contains an ice rink.

Bracing members in the wall stabilize the hinge between the masts above the roof and their support columns, as well as provide part of the lateral support for the building. For the façade cladding, insulated precast panels were specified. Their mass is used to resist any uplift loads that could result from unbalanced roof loads transmitted through the cables to the wall at the ice rink. Lateral bracings composed of hollow structural sections (HSS) are provided in the end and center transverse walls of the building, as well as the exterior side walls of the ice rink.

The roof-supporting masts each anchor twelve 3-in. structural strand cables, of which six support part of the pool roof and six part of the ice rink roof. The roof in elevation is waved with the high elevation over the pool to accommodate the sight lines for the proposed outside seating at an Olympic event. The low elevation over the ice rink was designed to keep the building volume to a minimum for energy use considerations. The roof cables are anchored to W36×300 members, spaced 30 ft apart, and span the length of the roof, equilibrating the compression component resulting from the cable forces. These members are the deepest of the roof structure.

The roof deck is comprised of 2-in.-thick lightweight concrete channel planks. These are exposed to the interior and were employed in lieu of metal deck in light of the corrosive pool environment. They also provide sufficient dead weight to resist wind uplift on the roof. The connections of the roof plank were designed to accommodate the movements of the cable-stayed roof, and no concrete topping was specified for the planks. As a result, the roof planks do not provide a shear diaphragm to distribute lateral loads to the wall bracing. Instead, HSS members address shear in the roof surface, and these tie into the bracing in the walls. The structure above the pool deck consists of steel columns and girts, which support the precast insulated wall panels as well as the glass façades that face south.

Because the roof structure equilibrates the horizontal force components of the roof cables, no expansion joint is used in the 450-ft-long structure. Thus the lateral bracing is concentrated and configured in such a way that it does not constrain the building against thermal movements, but still provides resistance to seismic and wind lateral loads. It could not be in the pool section where the wall framing is to be removed for clear viewing of the swimming events, thus it had to be placed in the ice rink section. The interaction between the precast wall cladding and the thermal movements of the steel required careful design of the precast concrete connections so that the precast would not restrain the steel movements.

Mario Elcid praised the "great, innovative roof structure," noting that

"The flexibility…is very **creative**."
—Mario Elcid

photos by Esto Photography

its "flexibility to accommodate additional seating for an Olympic event is very creative in saving on unnecessary structural steel."

The steel of the roof and the exterior columns are exposed to view. The roof structure is coated with a high-performance two-part epoxy, shop-applied and touched up in the field where required. The columns, girts, and bracings are coated with an intumescent paint for fire protection, matching the color of the roof structure.

HHS varied from HSS6×6 for minor posts to HSS16×16×⅜ for building braces. The HSS in the roof are generally 8×8×⅜, and girts in the walls are generally HSS10×8×⅜. Total steel usage for the project is 1,500 tons.

Owner
New York City Economic Development Corporation

Architect
Hom + Goldman, New York

Associate Architect
Handel Architects, New York

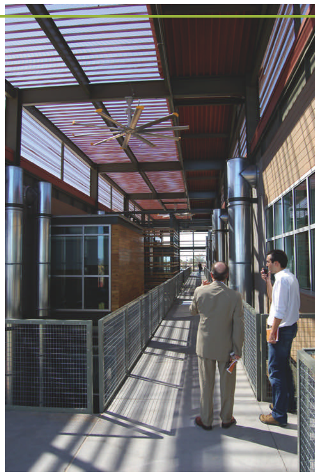
Structural Engineer
Geiger Engineers, Suffern, N.Y.

Steel Detailer
ADF Groupe, Inc., Terrebonne, Quebec (AISC Member)

General Contractor
Bovis Lend Lease LMB, Inc., New York

Merit Award—$15M to $75M

ARIZONA STATE UNIVERSITY POLYTECHNIC CLASSROOM BUILDINGS—MESA, ARIZONA



photos by Bill Timmerman Photography

Five new academic buildings at Arizona State University's Polytechnic Campus in Mesa more than double the campus' instructional lab and classroom space. This 245,000-sq.-ft addition houses four distinct but interrelated academic colleges. Integrated with three existing buildings to create a cohesive complex, the buildings are configured around four courtyards and linked by a series of open-air atriums, building portals, and arcades.

The buildings put their utilities and structural steel on display, reflecting the campus' straightforward philosophy. Through this pragmatic approach to the architecture, practical and repetitive configuration, and concentration on landscape integration, the new pedestrian-friendly campus promotes students and faculty to stay on school grounds to interact and learn.

"These buildings integrate structural steel in a thoughtful way while including many complementary uses of steel for aesthetics and programming reasons," expressed juror Christina Koch. "The open-air aspects of the buildings encourage students to stay within them even after class is over."

The primary materials for the five new academic buildings consist of steel, CMU, and glass. The 2,200 tons of steel used include: painted structural steel, painted flat and corrugated steel siding, and weathered perforated sunscreens. Steel was used at every scale within the project. At the largest extent, the painted structural steel frame is exposed throughout the campus and celebrated within the open-air atriums and on several anchor buildings. Within this steel framework, lightweight corrugated and flat-seam metal siding respond to the aridness of the desert and prevent heat build-up within the wall cavity. Similarly, the weathered perforated corrugated steel sunscreens, which alternate transparencies within the corrugations based on orientation, protect the glazing from the intense east and west low-angled sun.

Documents for the fast-track project, ranging from master planning to construction, were completed in seven months. In order to meet schedule requirements, the structural steel frame had to be designed and steel ordered way ahead of the balance of the building design. To do this, the team agreed on "kit-of-parts" design philosophy that repeated throughout the project. The typical 30-ft. square bays used W16×31 interior beams and W21 exterior beams supported by W24×62 girders. The exterior 21-in. deep floor beams that are exposed throughout the atriums maintain a 6½-in. width despite the variation in weight at the rigid frames, thus simplifying the masonry above and below the beams.

After the structural frame was established and steel ordered, the building design continued with the goal of working around the steel frame already established. Steel joists were used at the roof of the three-story structures except at mechanical equipment, where steel beams were substituted. The two-story structures featured vaulted roofs framed with exposed steel beams. To manage the cost of architecturally exposed structural steel used in the project, all AESS members and connections were identified on the structural plans. All exposed edges, bolts, welds, and copes were discussed with the steel fabricator, Schuff Steel, who was selected early in design to work in a design-assist capacity.

Although typical BIM software was not used on the project, all of the design meetings used a combination of SketchUp, RAM Structural System, and Tekla Structures to work through design issues. When DPR, the contractor, and Schuff determined that the desired suspended walkway system would push erection costs outside the budget, structural engineer Paragon and Schuff traded RAM analysis models back and forth to quickly design and price options. A cantilevered walkway system was selected and brought the project back in line with the budget.

All exposed steel was power-cleaned in the shop. One coat of primer was applied (Tnemec Series 88HS Alkyd) followed by two coats of high-quality, corrosion-resistant paint (Frazee Duratec II 203). The project has a goal of LEED Silver certification, though it is trending toward Gold as the certification process concludes over the next few months. The exposed steel and straightforward finishes were key to the sustainable design approach that limited the waste of materials.

Owner
Arizona State University, Tempe, Ariz.

Architect
Lake|Flato Architects, San Antonio

Associate Architect
RSP Architects, Tempe

Structural Engineer
Paragon Structural Design, Phoenix

Steel Fabricator, Erector, and Detailer
Schuff Steel Company, Phoenix (AISC Member)

General Contractor
DPR Construction, Phoenix

President's Award for Excellence in Engineering—$15M to $75M

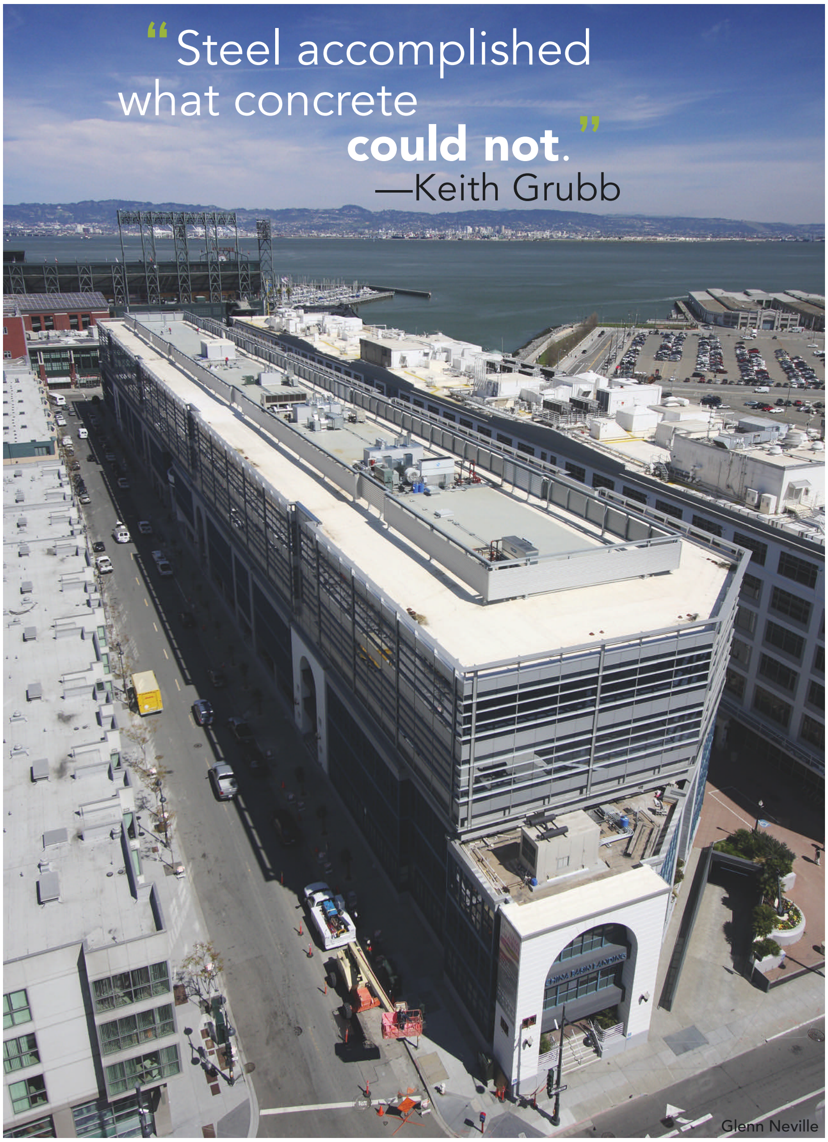
THE ADDITION AT 185 BERRY STREET (CHINA BASIN LANDING)—SAN FRANCISCO

The building at 185 Berry Street in San Francisco might look like any other building upon initial inspection. However, the structure houses a technically innovative application of seismic isolation to create mass damping in vertical building expansion.

The goal was to expand an existing three-story, 216,000-sq.-ft building by 150,000 sq. ft in two new stories, with minimal disruption to the tenants. The existing building was 825 ft long (north to south) and 110 ft wide. To accommodate the long length of the building, two expansion joints were located approximately at the third points, dividing it into three separate structures. The addition is a continuous, approximately 800-ft-long structure, bridging these three independent structures below.

Engineer Simpson Gumpertz and Heger (SGH) constructed a 3D, non-linear model of the three wings in RAM Perform (now CSI Perform). The frame non-linearities were modeled using discrete plastic hinges with properties based on relevant tabulated values in FEMA 356, modified using moment curvature analyses. The frame-beam flexural capacities in the model were obtained using the composite action provided by the floor slab along with the existing prestress.

The non-linear time history analysis confirmed that the base isolated addition was not detrimental to the existing structure. However, the peer review team wanted SGH to demonstrate that the building and the addition possessed the necessary toughness of a code-compliant structure. To do so, SGH performed a reliability analysis using data from incremental dynamic analyses. The results showed that the structure with the base-isolated addition had a higher reliability than the base structure without the addition, clearly illustrating the beneficial effect that isolation/mass damping would have on the overall performance of the building.



Glenn Neville

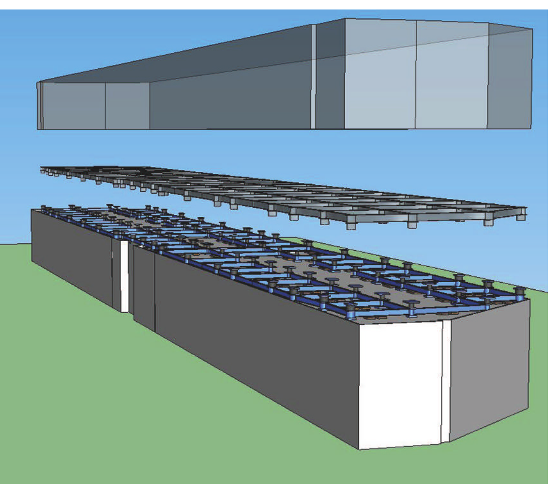
The project employs 87 seismic isolation bearings, all supplied by Dynamic Isolation Systems (DIS). The design of the isolation system presented a significant challenge: isolating a relatively light superstructure while keeping the isolators stable at a displacement of +/– 45.5 in. (1.5 times the code-required maximum displacement of +/– 30 in.). This required an isolation system consisting of 45-in.-diameter lead-rubber bearings and a new combined system of sliders in series with elastomeric bearings, where the sliders provided +/– 30 in. of displacement and the additional +/– 15 in. of displacement was accommodated in the 24-in.-diameter elastomeric bearing. Prototype testing demonstrated the bearings' stability.

SGH provided a grid of large structural steel members above and below the isolators to resist the moments from the displaced isolators. To protect the relatively thin prestressed concrete roof slab, an interlocking shear transfer system, consisting of concrete pads connected to the roof and steel shear lugs connected to the lower steel grid, were used. The connection of the concrete pads to the existing roof employed 6-in.-diameter pipes cored into the slab, as well as threaded rods epoxy-grouted into the slab. Contractor Hathaway Dinwiddie Construction (HDC) used ground-penetrating radar to locate the post-tensioning cables and reinforcing steel, both in plan and elevation, and carefully laid out all of the existing elements before coring. This attention to detail paid off. Although HDC used 780 cores and approximately 2,800 dowels, they only damaged one cable.

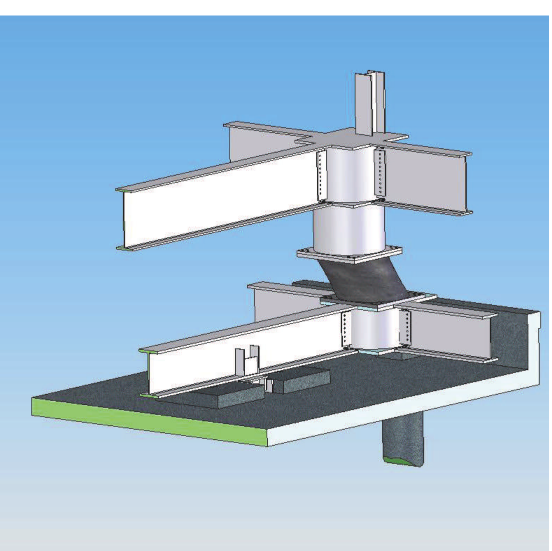
The use of seismic isolation as a means of mass damping a building with a new addition impressed the jury. "Steel accomplished what concrete could not," said Keith Grubb. "This is an innovative structural solution that will have applicability to future renovation projects in seismic zones."

Added Mike Moravek, "This may be the future direction of engineering additions in high-seismic areas."

For more on this project, see "On the Grid" in the June 2008 issue of MSC, available in the Archives section at **www.modernsteel.com**.



renderings courtesy of SGH



Owner
McCarthy Cook, San Francisco

Architect
Helmuth Obata and Kassabaum, San Francisco

Structural Engineer
Simpson Gumpertz and Heger, Inc., San Francisco

Steel Fabricator
Herrick Corporation, Stockton, Calif. (AISC Member)

General Contractor
Hathaway Dinwiddie Construction Company, San Francisco

National Award—$75M and greater

CALIFORNIA ACADEMY OF SCIENCES—SAN FRANCISCO

Green roofs are becoming more and more popular. One of the newest and largest tops the California Academy of Sciences new $488 million home in San Francisco's Golden Gate Park.

The visually striking building features an undulating 2.5-acre living roof with a perimeter steel canopy supporting photovoltaic cells, a large glass skylight supported by a tensile net structure, a freestanding 90-ft-diameter planetarium dome, five separate iconic aquarium tanks, and a 90-ft-diameter glazed dome housing a rainforest exhibit.

The steel canopy covers an area of 52,200 sq. ft and is supported by light steel framing totaling 75 tons, while the structural steel package—which included the internal structural framing of African Hall, the planetarium, and the roof—totaled 1,500 tons.

With seven "hills" mimicking the seven hills of San Francisco, the roof structure, detailed with StruCAD and blanketed with 1.7 million native California plants, consists of a grillage of curved steel beam sections—some spanning up to 96 ft—that support a contoured concrete slab. The curved steel beams form a structural skeleton whose concrete skin was applied from above with the aid of temporary timber formwork to achieve a carefully contoured finished surface. This temporary formwork was taken into account in the design of the long-span steel beams as "shored composite construction," thereby achieving significant savings in steel tonnage.

Temporary shoring of the roof framing, which spans 98 ft above the main exhibit hall, was required in order to support the temporary construction dead and live loads required to place concrete on the framing. The curved final geometry made any calculation of the required camber nearly impossible otherwise, and the shoring towers were removed only after the concrete roof diaphragm had fully cured.

In addition to providing the necessary structural supports to achieve the aesthetic goal, the living roof plays a critical role in the building's seismic performance. The site of the Academy lies within 10 miles of the San Andreas Fault, and in its lifetime the building is likely to be subject to very strong ground shaking. A standard building code approach required the use of ground anchors on the building to prevent the Academy from overturning during a seismic event.

Pushing the boundaries of conventional design, structural engineer Arup agreed that instead of the building aggressively resisting an earthquake by tying it down, the structure should work with the seismic forces, dissipating the energy in an elegantly simple manner: through rocking at the foundations. As such, the roof steel framing collects and redistributes seismic forces to the concrete shear walls located in four buildings at each quadrant of the building site. Principal steel elements are extended and "casted into" the shear wall, with shear studs welded to the overlapping steel section, creating a robust "locking" mechanism between the steel to concrete seismic force transfer mechanism. Steel framing above the north and south entries was locally strengthened to create "chord and strut" elements. These elements were detailed to tolerate 1 in. of relative horizontal displacement when buildings move relative to each other during a seismic event.

Owner
D.R. Young Associates, San Rafael, Calif.

Architect
Renzo Piano Building Workshop, Genova, Italy

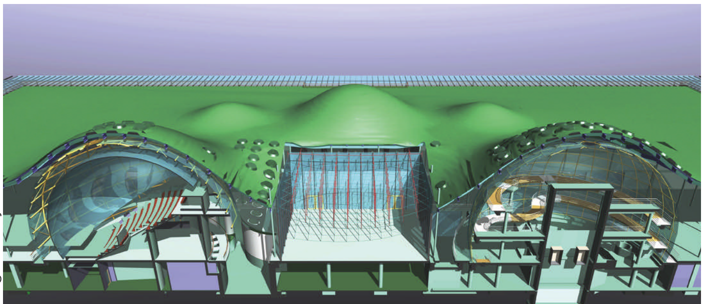
Associate Architect
Stantec, San Francisco

Structural Engineer
Arup, San Francisco

Steel Fabricator, Erector, and Detailer
SME Steel Contractors, West Jordan, Utah (AISC/NISD Member)

General Contractor
Webcor Builders, San Francisco

photos and rendering courtesy of Webcor



"It's a testament to the **innovative shapes** steel can create." —Christina Koch

National Award—$75M and greater

BANK OF OKLAHOMA CENTER (BOK CENTER)—TULSA

photos by Architectural Imageworks, LLS – Gayle Babcock

"Only **steel** could have provided the building's curves."
—Christina Koch

Practically in the center of the country, the city of Tulsa, Okla. seems as good as any as a focal point for athletic and concert events. Add the new $178 million, 18,500-seat Bank of Oklahoma (BOK) Center, and there's even more incentive for teams and musicians to drop in. Beyond providing a new venue for Tulsa, the City also envisioned the BOK Center as a new architectural icon as well as the anchor of its downtown revitalization effort.

Revitalizing an area takes years, but the architectural goal was immediately met. "Aesthetically, this is the most remarkable stadium project I have seen in a long time," said juror Christina Koch. "Only steel could have provided the building's curves, and the metal façade is a nice complement."

"Best in class of any arena to date," agreed juror George Tuhowski.

The irregular shape and geometry of the 600,000-sq.-ft arena required several innovative engineering solutions. Six different exterior wall geometries use wide-flange columns that slope at 10° from vertical to define the building envelope. This gave the appearance of truncated cones wrapping into each other that interconnect with varying sloping "sliver" roofs. These six distinct, sloping perimeter walls support very spacious and scalloped floor plates, allowing patrons to see daylight at almost every vantage point from the concourses. With constantly changing roof diaphragm elevations, transferring lateral loads provided additional challenges that were overcome by inventive bracing configurations using HSS, wide-flange members, and built-up steel sections.

Supporting the architectural focal point, the glass Icon Wall, was no small feat. This portion of the structure is bolstered by a sloping, radiused 8-ft-deep steel box girder cantilevering 80 ft over the main entrance. The cantilevered structure supports both the main entry roof and a 75-ft-high sloping glass curtain wall system. The Icon Wall is laterally supported by 4-ft, 8-in.-deep architecturally exposed vertical pipe trusses set at 17 ft, 6 in. on center, spanning up to 75 ft in height in combination with sloped pipe trusses that support the Icon Roof.

Inside, high above the spectators, the long-span roof consists of two box trusses clear-spanning 330 ft. The box trusses have a flat bottom chord and taper from a 30-ft mid-span depth to an 18½-ft end depth. Infill trusses spaced at 37½ ft frame between the box trusses and from these trusses to the perimeter steel ring beam. The selection of this framing system allowed for easy erection, early erection stability, and a flexible rigging capacity of 150,000 lb for center-stage shows and 120,000 lb for end-stage shows. The

Owner
City of Tulsa, Oklahoma

Architect
Matrix*Odell (Joint Venture), Tulsa

Structural Engineer
Thorton Tomasetti, Inc., Kansas City

Steel Fabricator
Schuff Steel Company - Midwest Division, Overland Park, Kan. (AISC Member)

Steel Detailer
Dowco Consultants, Ltd., Burnaby, British Columbia (AISC/NISD Member)

Steel Erector
National Steel Constructors, Plymouth, Mich. (AISC Member)

General Contractor
Tulsa Vision Builders, Tulsa

project uses approximately 4,500 tons of structural steel in all.

Due to the complex geometry of the project, structural engineer Thornton Tomasetti used Tekla Structures software to lay out the columns in the curved, sloping walls to "best fit" the steel structure into the architect's building envelope, which was prepared via Rhino NURBS (non-uniform rational B-splines) software. Throughout the design process, the team used the 3D model to visualize and coordinate the structural steel transitions and framing with the architect's vision. By using a 3D model, the design team was able to anticipate and resolve coordination issues before setbacks surfaced in the field. The approach worked so well throughout the design process that it became a project requirement for the construction team to share the 3D model amongst the different trades for coordination purposes.

Marjorie Lund

Benjamin Benschneider Photography

"Deserves **recognition** for utilization of advanced design techniques."

—Raymond Clark

Soundview Aerial Photography

Merit Award—$75M and greater

SWEDISH ORTHOPEDIC INSTITUTE—SEATTLE

Sitting atop First Hill overlooking downtown Seattle, the new Swedish Orthopedic Institute comprises seven occupied floors, four stories of underground parking, and a two-story penthouse. It covers an entire city block and connects via a sky bridge and tunnel across a city street to the main Swedish Medical Center.

The 372,000-sq.-ft building is the first in Seattle to employ the design of special steel moment frames using AISC 358-05, *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications*. The City of Seattle Department of Planning and Development approved the use of this design methodology for this particular project prior to the official code adoption of AISC 358. Structural engineering firm Lund & Everton LLC worked with the City to develop the proper use of the new standard and establish the special inspection program to assure its proper installation.

"This project deserves recognition for utilization of advanced design techniques while proposed code modifications were still under review," noted juror Raymond Clark. "It demonstrates that the design community and code-enforcement agencies can work harmoniously to achieve efficient designs in structural steel."

AISC 358-05 allowed the designers to use large beam sections (W27 and W30) as the columns in the moment frames, saving over $5.00 per sq. ft in construction cost. The moment frames are a reduced-beam section (RBS) system located primarily on the perimeter of the tower. Other prequalified moment frame systems were compared with this frame, and the RBS produced the least material cost and fastest installation. Plus, it allowed the team to decrease steel tonnage on the project by 500 tons; total tonnage for the job ended up at 2,500 tons.

According to the project's architect, NBBJ, the driver for the structural layout was the need for large column-free spans on the surgery floor and a grid that would also be efficient for both the inpatient nursing unit and physician office configurations stacked above. The architects and engineers looked at many options for floor layout and systems, and developed a tower floor plan with only 12 (steel) interior columns in the 22,000-sq.-ft footprint.

The RBS system has beam/column connections with bolted webs and welded flanges. The welding of the beam flanges proceeded faster than expected, saving erection time. The column-free bays for the surgery layout in the tower are 37 ft, 2 in. by 30 ft. Trusses over the post-surgery recovery room create a 60-ft by 105-ft column-free area.

A building information modeling (BIM) approach was used to speed the design and ensure the coordination between disciplines. RamSteel 3D software was used for gravity framing, Etabs for the lateral analysis, and Bentley Structural for the BIM model (Soft Steel was used for the detailing). The use of BIM technology was one of the key drivers in compressing the original construction schedule from 22 months down to 19 months.

Owner
Swedish Medical Center, Seattle

Architect
NBBJ, Seattle

Structural Engineer
Lund and Everton, LLC, Vashon, Wash.

Steel Fabricator
Fought and Company, Inc., Tigard, Ore. (AISC Member)

Steel Detailer
Steel Systems Engineering, Inc., Sherman Oaks, Calif. (AISC/NISD Member)

General Contractor
Sellen Construction Company, Seattle

Merit Award—$75M and greater

UNIVERSITY OF ILLINOIS MEMORIAL STADIUM—CHAMPAIGN, IL

Built in 1923 in a classical revival architectural style, the University of Illinois Memorial Stadium plays home to the Fighting Illini football team. After more than 80 years of use, though, the stadium was in need of upgrades. An expansion plan, completed in time for the 2008 season, brought the historic landmark into the 21st century, involving the addition of 49 luxury suites, premium club space, a north end-zone seating bowl, and a training facility; enlarging concourses; and replacing restrooms and concessions.

In many stadium expansions, the suites and additional levels are added adjacent to and outside an existing seating bowl. However, this addition was constructed inside and above the existing facility.

The primary challenges were related to construction phasing, sequencing, logistics, and tight working quarters. The project plan called for the main existing transfer trusses in the interior of the west stadium to be partially demolished to receive the new structure. To prevent damage to the historic façade and colonnades, the existing structure had to be shored, jacked, reinforced, selectively demolished, re-jacked, and supported prior to the completion of the new structure, all while minimizing any movement. The historical masonry façade and other brittle elements were continuously monitored during the process to verify they were not damaged.

"In an era when so many stadiums are torn down to build new, it's nice to see a stadium utilizing steel for a renovation, that respects its historical significance," said juror Christina Koch.

Slabs on composite metal deck, supported by composite steel beams, and steel transfer trusses were designed to support the new facility. Using steel allowed the new system to integrate with the old, transfer between two different structural grids, and meet the fast schedule demands. It also provided the flexibility to adjust connections and configurations in the field when reacting to uncovered surprises and tolerances in the existing structure.

The material properties of the structure's 1920s-era steel are far different from that of today's steel. As such, material testing was conducted on the existing steel to establish the new welding and bolting provisions necessary. Testing revealed welding was possible, but drilling and bolting to the existing riveted structure was used for all connections with high loads.

Column loads from the radial structural grid between the upper-story suites were transferred to the smaller, orthogonal existing grid supporting the lower bleachers and historic façade. As a result, no single column continued directly from the roof to the foundation. Transfer girders and trusses, both new and existing, were designed to provide a load path for the columns.

The new design required the existing trusses to be cut in half while they were still supporting the upper half of the building. Where existing trusses were cut, an 8-ft-deep perpendicular transfer truss constructed of 12-in. wide-flange sections was erected to support the existing trusses. In addition, a second transition from the 45-ft column spacing of the existing stadium to a 30-ft radial column spacing of the upper levels occurred two levels further above, using transfer girders. Total steel used was approximately 3,300 tons.

For more on this project, see "Big Draw" the February 2009 issue of MSC, available in the Archives section at **www.modernsteel.com**.

photos by Brad Feinknopf

Owner
University of Illinois, Champaign

Architect and Structural Engineer
HNTB Architecture, Kansas City

Associate Architect
Isaksen Glerum Wachter, LLC, Urbana, Ill.

Steel Fabricator and Detailer
Blattner Steel, Cape Girardeau, Mo. (AISC Member)

General Contractor
Hunt Construction, Indianapolis

Robotic Shop

For structural steel welding, automation offers a viable path towards efficiency.

BY GEOFF LIPNEVICIUS

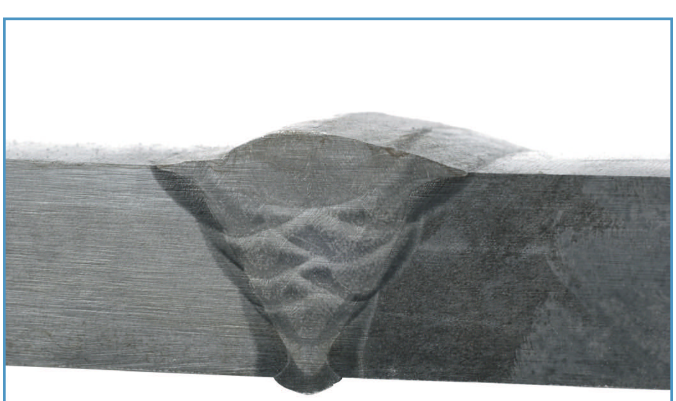
WHILE U.S. DEMAND FOR STRUCTURAL STEEL has increased significantly over the last five years, construction spending prospects have declined rapidly for the beginning of 2009, as the credit freeze recession spreads rapidly through most economies around the world. Now that the economic stimulus plan has passed, questions remain as to how soon we might begin to see the infrastructure projects moving, and whether they will be sufficient in sparking a turnaround for the economy.

The infrastructure section of the package includes funding for building and repairing highway bridges, expanding transit systems, upgrading airports and rail systems, and building and repairing federal buildings. Lawmakers indicate that some of the projects could be up and running within three to six months, spurring steel fabricators to keep a vigilant eye out for technology and processes that give them a competitive advantage in taking advantage of this stimulus. This includes the pursuit of welding productivity improvements and leveraging opportunities that combine equipment, consumables, advanced welding processes, and automation.

Improved Predictability

Construction material prices have varied significantly since late 2003, creating significant challenges for project cost estimators. The downturn in construction demand may result in a stabilization of construction material prices in 2009. Yet only 30% to 35% of the fabricated and erected cost of structural steel is the actual cost of the material. Therefore, it remains very important to be able to accurately predict the cost of shop activities. The use of robotic automation can increase predictability of the variable shop costs. Robots provide the means to secure precision and repeatability via tightly controlled procedures in combination with heavy-duty positioning equipment. They also provide improved weld joint accessibility and numerous other benefits to the structural steel industry, including improved quality, productivity, and manufacturing flexibility. While over-welding is common in manual processes, a robot can be programmed and qualified to produce cost-effective, repeatable procedures that match the correct weld size to the load that is to be applied, reducing waste.

Designers have typically provided for a single-sided bevel rather than a double-bevel to avoid labor-wasting positioning time, which can be a significant hindrance for large fabrication. However, this actually doubles the amount of weld metal for the same effective weld throat. Robotic automation allows for larger fabrications to be automatically positioned for easier accessibility and reduced welding time, resulting in the improved ability to



A synchronized tandem MIG multi-pass weld sample on thick weldment, performed via automation.

A multi-pass weld sample (some weldments require as many as 70 passes), performed via automation.

reduce and control shrinkage stresses and reduce overall cycle times.

Robot Intelligence Trends

Vision is becoming an increasingly important component of many automation opportunities in the structural steel industry. The integration of vision to robotics has been made easier and more cost-effective in recent years.

Robots can use a vision sensor to "see" the location and orientation of parts, examine and verify part fit-up, find features pre-weld, measure the joint position, detect what is going on ahead of the arc, provide for real-time seam tracking, and signal changes to user-defined process parameters using adaptive parameter control. Laser vision systems are also commonly used for multi-pass welding sequence management and can also be used for error-proofing.

Error-proofing in automation relates to the ability of a system to either prevent an error in a process or detect it before further operations can be performed. It can be performed on every weld in a process or to monitor critical welds of a process.

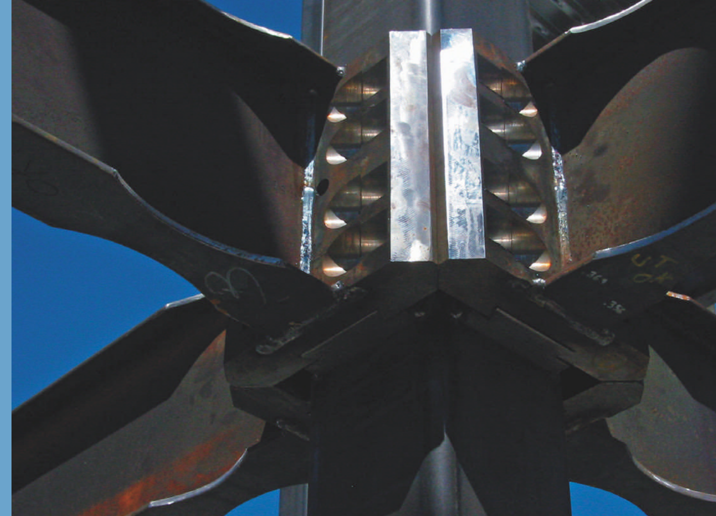
Automated Monitoring

Robots are increasingly integrating digital technology to network welding equipment and bring data from the factory floor to the business arena. Production monitoring enables any networked power source to be set up so that weld data can be monitored, files can be stored and shared, production tasks can be monitored, weld limits and tolerances can be set, consumable inventory can be tracked, serial number traceability can be performed, and diagnostic troubleshooting can be performed remotely.

Excellent Fusion

Historically, gas metal arc welding (GMAW) has been associated with incomplete fusion defects in the structural steel industry. Pulsed spray metal transfer (GMAW-P), however, takes advantage of the high energy of axial spray metal transfer and alternates this high-energy (peak) current with a lower energy (background) current. Many aspects of the GMAW-P waveform can be controlled, and the benefits of the pulsed energy are that it produces excellent weld fusion characteristics and considerably reduces the heat input. The dynamics of the pulse also permit the use of GMAW-P for out-of-position welding. Out-of-position welding, coupled with lower heat input, assists in achieving lower dilution rates, excellent weld metal mechanical properties, and improved Charpy Impact test values.

In semiautomatic pulse applications, an operator can manually adjust the torch height to adjust for variation. In automated applications, to control the length of the arc despite changes in the contact tip-to-work distance (CTWD), welding equipment with adaptive control is required. Adaptive control adds energy to the arc as the CTWD decreases, and it takes energy out of the waveform as the CTWD is increased. The adaptive loop provides stability to the arc length and increases the overall usability of the pulse waveform in automated structural



The bolted collars in this assembly were shop-welded via robotics—24 in. of full-penetration welds and 64 in. of fillet welds.

Robots in Action

In the fall of 2000, Robert J. Simmons, a 30-year veteran of the structural steel industry, developed a concept for constructing mid-rise residential structures using a steel moment space frame system. From this concept, Simmons founded ConXtech, a company that completes all of its fabrication work in-house and then simply assembles the column and beam components together on the construction site, bolting them in place.

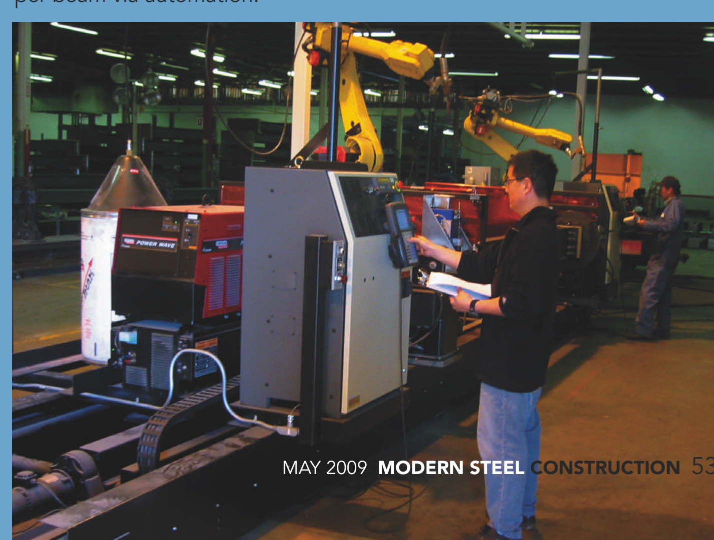
Unlike typical structural steel construction, which usually takes seven to eight months using traditional methods, the steel moment space frame system allows ConXtech to cut structural steel erection time to less than two weeks.

Robotic welding systems used in ConXtech's Hayward, Calif., shop are a critical factor to the company's success. Compared to ConXtech's earlier semi-automatic welding operations, the robotic system offers faster travel speeds, high deposition rates, and superior quality finished welds.

In one ConXtech fabrication example, when welded semiautomatically, it takes 40 minutes to weld one collar piece to a beam. Since there are two ends to each beam, this equates to one hour and twenty minutes of welding per beam. With the robotic system, the cell is able to weld collar pieces to both ends in only five minutes and thirty seconds.

In another example, beams, composed of A992 structural steel, are joined to the A572 Grade 50 collar pieces. The plate requires the use of full-penetration welds on the top and bottom flanges and fillet welds on the beam's web and the back side of the flanges. The 24 in. of full-penetration welds on each beam are made in four passes, while the 64 in. of fillet welds can be completed in a single pass.

ConXtech was able to cut production time from 80 minutes to 5½ minutes per beam via automation.



applications, especially when fixturing is prohibitive.

Where hydrogen-induced weld cracking is an issue, the lower hydrogen weld deposit of GMAW-P (<5 mL H(2) / 100 grams) is also an excellent choice. GMAW-P typically provides higher efficiency metal transfer (98%) for solid or metal-cored electrodes. Comparably, the lower heat input of the GMAW-P process can result in lower weld fume generation, helping to meet EPA and OSHA standards.

Synchronized Tandem MIG

The dual-wire synchronized tandem MIG process continues to gain popularity as a means to increase production in automated arc welding applications. The process follows early industry trends of reducing welding costs by developing dual-wire processes for greater productivity in high-speed welding applications or in higher deposition/heavy-fabrication applications. Early developments in multiple-wire welding focused on the submerged arc process. The availability of high-powered inverter power sources has enabled dual-wire welding using the GMAW and GMAW-P processes.

Since the introduction of tandem MIG in the early 1990s, the estimated installed base of dual-wire systems has grown to more than 1,500 units worldwide. The majority of the systems have replaced single-wire processes that had been pushed to the extreme high end of the useable operating range in an attempt to improve productivity and lower costs by depositing as much metal in the shortest time frame possible. Synchronized tandem MIG extends the welding productivity range beyond what is possible with conventional single-wire processes.

The synchronized tandem MIG process employs two electrically isolated wire electrodes positioned in line, one behind the other, in the direction of welding. The first electrode is referred to as the lead electrode, and the second electrode is referred to as the trail electrode. The spacing between the two wires is usually less than ¾ in. so that both welding arcs are delivering to a common weld puddle. The function of the lead wire is to generate the majority of the base plate penetration, while the trail wire performs the functions of controlling the weld puddle for bead contour, edge wetting, and adding to the overall weld metal deposit rate.

The synchronized tandem MIG process can, on average, represent a 30-80% increase in deposition potential when compared to conventional single-wire processes.

Synchronized tandem GMAW enjoys expanded use in girder fabrication for several cost-effective reasons, including higher deposition rates, faster travel speeds, lower heat input, and reduced distortion. The lower hydrogen deposit makes it a primary choice for use on high-strength low-alloy or thermo-mechanical controlled processing (TMCP)-type steels.

Ready for Robots

Setting up a shop line for automated welding requires careful thought and preparation, and often includes plant layout considerations and a proper balance and optimized flow between robotic and manual operations. On the front end, designing and/or redesigning parts for optimum robotic access makes a dramatic difference that leads to improved weld quality and shorter cycle times.

When tight tolerances are difficult to maintain, robots can be programmed with special software to locate a seam or remain in the weld joint once it starts. When conditions such as significant gaps in plates or gussets are common, or when fixturing is prohibitive to a robot accessing a joint, manual welding can provide a better solution to increase quality and decrease rework.

In addition, the increased flow of material that is expected to work its way through an automated manufacturing cell also needs to be considered and properly planned for to optimize system uptime. Perhaps as important, expectations should be managed for a sensible timeline of success.

It takes time, often multiple weeks, to program the robot, optimize the welding procedure, and select operators that have a background in understanding the manual process and then can extend their knowledge to robotics, to prove out best practices and maximize the return on investment of the system. But once it's set up, an automated line can provide long-term benefits to a fabrication shop.

And, its use on complete-penetration-type welds and joining the web to the flange eliminates the need for back-gouging operations.

The system components specified depend upon the level of automation. Automated side beam delivery, tractors, sidecars, and welding bugs are all involved. In some cases, the use of robotic welding automation, which both tracks and welds web to flange connections for girder fabrication, is quite viable.

Combined Advantages

Submerged arc welding (SAW) combines the advantages of AC and DC SAW welding, which was not possible until a few years ago. This technology is increasingly applied to structural steel automation applications due to its superior welding performance and process control.

The latest technology provides for control over the ratio of positive to negative amplitude, as well as the amount of time spent at each polarity. The limiting factor for SAW AC welding is that it takes too long to cross from electrode positive (EP) to electrode negative (EN), and this lag can cause arc instability and penetration or deposition problems in certain structural applications. AC/DC SAW solves this problem by controlling amplitude and frequency, allowing the automated process to take full advantage of the reduction in arc blow experienced with AC, while maintaining the penetration advantages of DC positive and the advantageous deposition rate of DC negative. Using these controls, the shape of the output waveform is changed, and in turn the welding characteristics are controlled. With AC/DC submerged arc welding, you get the best of both worlds: the speed, deposition rate, and penetration that DC SAW offers, and the resistance to arc blow that AC SAW offers.

There are many new opportunities to capitalize on technology to identify cost-saving approaches to project design and construction. If you are welding structural steel manually today, consider looking for opportunities and project types where automation might be able to improve your process. MSC

Geoff Lipnevicius is engineering manager of the Automation Division for The Lincoln Electric Company.

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It's a Bird, It's a Plane, It's... AISC Certification!

BY BRIAN RAFF

AISC Certification is earned, not given.
If you're a Certified company, display the logo proudly.

CONSIDER THIS: AISC CERTIFIED COMPANIES are the Superman of the steel construction industry.

Allow me to explain: AISC Certification represents a company's heroic passion for continual improvement, its valiant determination to complete an extremely rigorous audit process, and its gallant dedication to the overall quality of the steel construction industry.

The first quarter of 2009 has been particularly noteworthy. AISC has received more applications than any other quarter in history, a staggering statistic considering the state of our current economy. While competition is fierce, fabricators, erectors, and specifiers all see the value that an AISC Certified company can add to their projects. For example, AISC Certified fabricators may be able to "leap over" code-required special inspection requirements in a single bound—or at least simplify those requirements, saving project owners a substantial amount of money.

Super Goals

Like Superman, AISC Certified companies must fight for "truth, justice, and the American way." Within the past several months, I have experienced a handful of situations where non-certified companies have falsely purported to being Certified in order to bid on jobs that require AISC Certification. It is up to all of us as law-abiding citizens of our steel construction Metropolis to ensure that everyone plays by the rules.

AISC takes a hard stance on false Certification claims that undermine our brand and damage the reputation that AISC has worked so hard on preserving since 1921. The value and credibility of AISC Certification and its companies could be diluted as fast as a speeding bullet if unqualified, non-certified imposters are allowed to run rampant. So, what can we collectively do about it?

I ask all specifying engineers, architects, contractors, code officials, Certified fabricators and/or erectors to inform us about any company falsely claiming to be AISC Certified. We will act on any and all leads we receive that provide actionable evidence, such as business cards, title blocks, bid documents, websites, etc., that erroneously display the AISC Certification logo or the words "AISC Certified."

Based on the feedback we've received from industry stakeholders, we have taken our stance one step further. AISC is currently in the process of registering trademarks related to what it means to be AISC Certified. Activities certified by the phrase "AISC Certified" will represent steel fabrication, erection, and bridge and highway metal component manufacturing services. This phrase and the related logo will certify that a fabrication facility or erector's operation has implemented a nationally recognized quality management system specific to the steel construction industry, and has undergone an independent third-party audit. Companies will no longer be able to make false Certification claims without being held accountable to U.S. trademark law. This decision to register our trademarks will give our program the additional teeth our industry has asked for.

We've covered truth and justice, but what about the American way? AISC relies on several other domestic information sources to support our program. These institutions include the American Welding Society (AWS), the American Society for Testing and Materials (ASTM), and the American National Standards Institute (ANSI), among others.

You might be asking what AISC Certified companies can do to promote or market themselves. Below is a brief description of how the AISC Certification logo can be used to effectively promote your organization:

Any appearance of the name and/or mark of AISC creates an impression of our organization and yours. Over time

Brian Raff is AISC's manager of certification business development.

Quality Corner is a monthly feature that covers topics ranging from how to specify a certified company to how long it takes to become a certified company. If you are interested in browsing our electronic archive, please visit **www.aisc.org/QualityCorner**.

the collective impressions of those whose opinions help shape our success also shape our identity. Thus it is critical that all who are entrusted with the privilege of sharing AISC's identity do so with the utmost discipline. To aid that process, I would like to share the following guidelines for the application of the AISC Certification mark (logo).

AISC Certification has developed one logo that may be used by our Certified customers. This logo may appear in one-color: black. When used in close proximity to the classic AISC Membership logo, or your company logo, those logos should complement the Certification logo, not overwhelm it. In most cases, the logos should match visually in scale and color (see sidebar).

X-Ray Vision

In order for everyone to uphold the truth, it is important to have the right tools. Superman has the ability to fly. We all have an equally important ability: to search for currently Certified companies. The new AISC Certification search engine is online at **www.aisc.org/certsearch** and allows the user to search for Certified companies in a multitude of new ways, including a proximity search. Users now have the ability to search for AISC Certified companies within a specific distance from any location and then export that data to a downloadable spreadsheet. Please visit the Certification search engine to find out who is certified in your area.

For specifiers requiring the use of an AISC Certified company, it is imperative that you ask your bidders to provide a copy of their *current* AISC certificate. In the past, dishonest companies have used expired certificates to manipulate designers and contractors into accepting their bid. Understand that an AISC Certification audit is conducted on an annual basis, and the certificate explicitly states the expiration date of a company's Certification. It would be a good idea to ask for a copy of this certificate as a prerequisite to bidding.

If you've ever read comics or watched comic-inspired television shows or movies, you'll notice that most superheroes, or villains for that matter, wear a symbol on their chest (in addition to tights and a cape). Superman proudly wore the iconic "S" set within a shield of red and yellow. This is no different than the AISC classic logo that has been an icon within the steel industry for more than 70 years. In 1945, National Periodical Publications (later simply known as DC Comics) trademarked Superman's symbol. I have asked myself where NPP got the idea to trademark the Superman logo, and the only conclusion I can come to is that they got the idea from AISC! Why else would they still refer to Superman as the Man of Steel? MSC

Logo Logic

In the past, there has been some confusion about how the standard AISC logo and the AISC Certification logo can be used. The AISC logo and its variations can only be used by members of AISC, while the AISC Certification logo can only be used by those who are currently AISC Certified. It is extremely important to remember that only AISC Certified companies have undergone a third-party independent audit to certify that their quality management system meets a minimum level of acceptable quality. Additionally, AISC members do not have to be Certified, and Certified companies are not required to become members of AISC. For more information on the benefits of AISC membership, please visit **www.aisc.org**.

The AISC Certification logo should be reproduced in black. Do not crowd the logo with type or illustration. The logo should always have a clear and sufficient margin of space around it.

If you are an AISC Certified company, please feel free to place the AISC Certification mark on you business cards, web sites, company letterhead, title blocks, etc. For more information, or to obtain high-resolution image files of the logo, please e-mail **certinfo@aisc.org**.

AISC logo

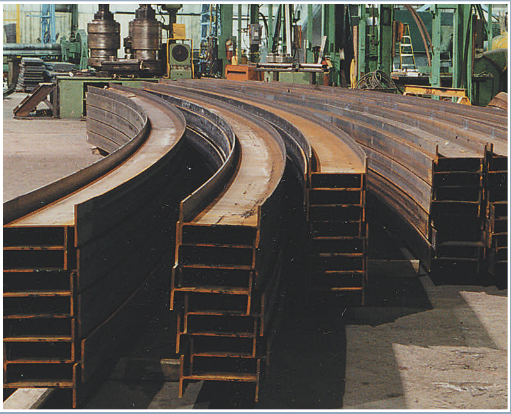
AISC Certification logo

1.125" preferred

Min 0.687"

Hodgson Custom Rolling Inc.

services a wide variety of industries in the ENERGY SECTORS of hydro, petro chemical, atomic, gas, oil, wind, etc. in addition to those in heavy manufacturing, steel, pulp & paper, mining, marine, forestry, etc. Hodgson's commitment to providing customers superior products and personalized professional service has earned itself a reputation for excellence, making the name HODGSON synonymous with "paramount quality and workmanship".



Hodgson Custom Rolling Inc. is one of North America's largest plate rolling, forming, section rolling and fabricating companies.

STRUCTURAL SECTION ROLLING

Hodgson Custom Rolling has the expertise to roll curved structural sections into a wide range of shapes and sizes (angle, wide flange beam, I-beam, channel, bar, tee section, pipe, tubing, rail, etc.). We specialize in **Spiral Staircase Stringers**, flanges, support beams, gear blanks, etc.

PRESS BRAKE FORMING & HOT FORMING

Hodgson Custom Rolling's brake department processes all types of steel sections and plate up to 14" thick. Developed shapes such as cones, trapezoids, parabolas, reducers (round to round, square to round) etc.

PLATE ROLLING & FLATTENING

Hodgson Custom Rolling specializes in the rolling and flattening of heavy plate up to 7" thick and up to 12 feet wide. Cylinders and segments can be rolled to diameters ranging from 10" to over 20 feet. Products made include ASME pressure vessel sections. **Crane Hoist Drums**, thick walled pipe, etc.

FABRICATING

Hodgson Custom Rolling combines expertise in rolling, forming, assembly and welding to produce various fabrications including kiln sections, rock drums, heavy weldments, ladles, pressure vessel parts, multiple **Components for Heavy Equipment** applications etc.

Hodgson
Custom Rolling Inc.

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HODGSON CAN HELP SOLVE YOUR PROBLEMS

Each month MSC's product section features items from all areas of the steel construction industry.

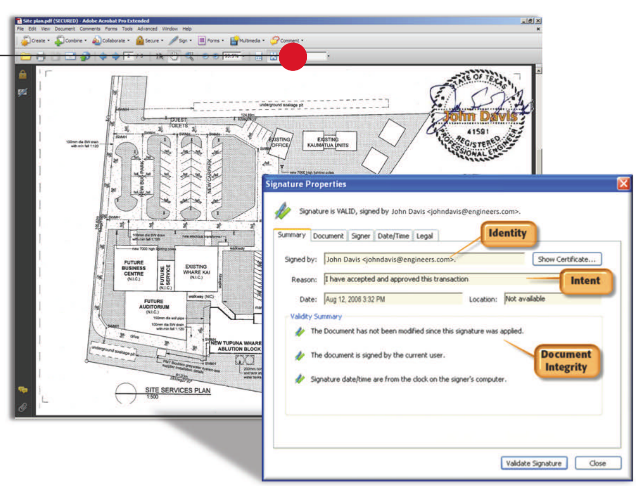
In general, these products have been introduced within the past six months. If you're looking for a specific product, visit MSC's online product directory at **www.modernsteel.com/products**. You can browse by product category or search on any term to help find the products you need, fast.

Fine Finish

The WE9-125 Quick 5" angle grinder is built with vario-constamatic (VC) electronic speed stabilization, making it ideal for heavy operating conditions such as grinding and finishing metals and other materials. Metabo's VC electronics constantly monitor the current in the motor, adding voltage as load increases and keeping the tool running at optimum speed. A soft start feature extends longevity of both the motor windings and gears. The WE9-125 Quick grinder also incorporates Metabo's "CoolFlow" technology, with repositioned carbon brushes for unrestricted airflow and a fan that pulls 35% more air through the tool to keep it running cooler during operation, significantly extending tool life. In addition, the grinder features an aluminum die-cast housing to help with heat dissipation and provide increased durability. Weighing only 5.4 lb, this lightweight grinder features a secure "racket" grip and dual grip zones for comfortable, ergonomic handling. The tool's anti-vibration side handle absorbs up to 60% of the vibration and, coupled with its excellent balance, allows the operator to hold the tool longer, resulting in fatigue-free operation.

For more information visit www.metabousa.com or call 800.638.2264.

Speedy Signatures



CoSign electronic signature software from Algorithmic Research produces a signature record for every signature it captures. This Portable Signature Format (CoSign PSF) allows anyone to seamlessly verify and retain proof of identity, intent, and document integrity without costly, complicated, or proprietary software. Product features include the following:

Graphical signatures – Before the document is sealed, CoSign will add the user's graphical signature (wet-signature). This enables a smooth transition from "rational" signatures to an electronic system.

Multiple signatures – Allows for multiple digital signatures on the same document.

Batch (bulk) signing – With high throughput, CoSign can digitally sign millions of documents, making it an ideal solution for bulk signing needs such as eInvoicing and eArchiving.

Extensive third-party application support – Works with many standard applications including Microsoft Word, Excel, Adobe Acrobat, and many more.

Sign any document type – You can add digital signatures to any document type, even a proprietary format, and documents are converted into signed PDF files.

Synchronizes with standard user management systems – The CoSign digital signature solution will work within your existing infrastructure, and is easy to use and manage.

Scalability – Scalable from a few signers to several million users, and will work in your existing authentication environment.

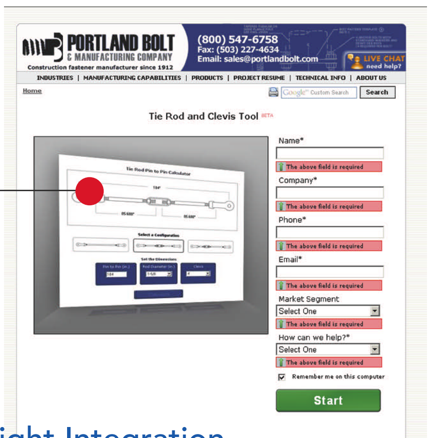
For more information visit www.arx.com or call 415.839.8161.

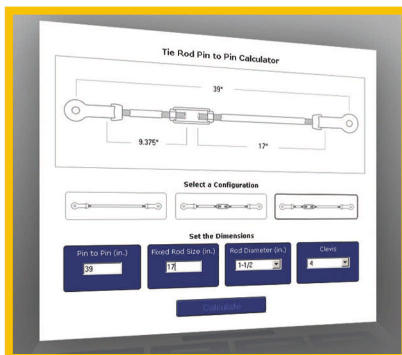
All products submitted are considered for publication, and we encourage submittals related to all segments of the steel industry: engineering, detailing, fabrication, and erection. Submit product information via e-mail to Geoff Weisenberger (weisenberger@modernsteel.com). To be included in MSC's online products directory, contact Louis Gurthet (gurthet@modernsteel.com).

Rod and Clevis Calculations Made Easy

Portland Bolt and Manufacturing Company has released a Tie Rod Length and Clevis Calculator (www.portlandbolt.com/tools/tie-rod-calculator) for use in construction and structural steel applications. The tool allows users to simply enter the overall tie rod assembly length and diameter to determine individual rod dimensions and the appropriate clevis size. Tie rod shop drawings often specify an overall length from the center of each clevis pin, without detailing the required individual rod length. This tool quickly estimates rod lengths for three different tie rod configurations. Whether the assembly is a standard two-clevis rod or clevises with a turnbuckle and different rod lengths, this tool will calculate the dimensions quickly and accurately.

For more information visit www.portlandbolt.com or call 800.547.6758.

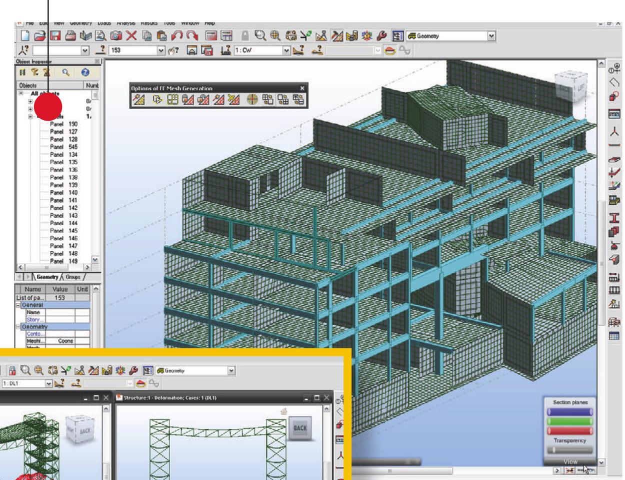


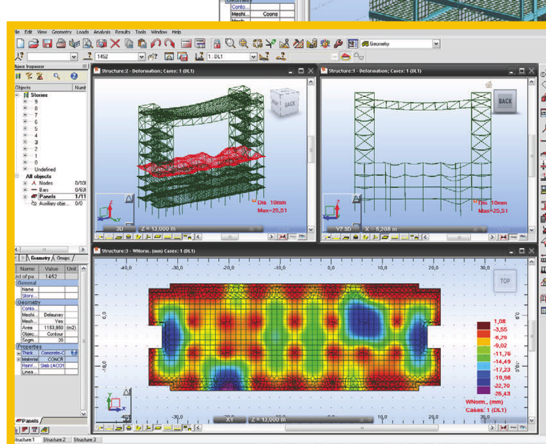


Tight Integration

Aimed at structural engineers and based on technology acquired by Autodesk from Robobat, Autodesk Robot Structural Analysis Professional 2010 software is tightly integrated with Revit Structure software for building information modeling (BIM), allowing engineers to more seamlessly analyze complex structures. The software is multi-regional, incorporating more than 15 languages and addressing more than 60 design codes for the structural engineer to analyze multiple structure types, including buildings and bridges, as well as civil and specialty structures. Structural analysis features include advanced auto-meshing and modeling capabilities, faster dynamic solvers, and integrated reinforced concrete design and structural steel design modules. Embracing BIM, the software incorporates a powerful and flexible user interface with rich 3D collaboration and bidirectional links between Revit Structure, AutoCAD Structural Detailing, and Revit Extensions to help simplify communication and collaboration across project phases. It can produce faster results in minutes versus hours, with nonlinear and dynamic algorithms for the most demanding and complex structures. As a result, engineers can more easily analyze different design analysis alternatives and make early improvements to the way their projects look and perform in the real world.

For more information visit www.autodesk.com or call 415.507.5000.





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vironmental footprint" as well as improve on their profitability. In an industry where outside sources challenge the financial success of every steel fabricator, doing everything that is in the control of a company is of paramount importance.

With cutting and welding technologies becoming increasingly automated, powder coating becoming increasingly in demand from fabricators, and specialty brazing, chipping, and heat treatments all seeing increased use, the challenges for steel fabricators are many. However, they can improve their business by focusing on increased efficiency, reducing energy consumption, and managing all of the waste streams from the fabrication process. Examples of these can be natural lighting systems, dust collection, and electronic air-cleaning systems.

Although LEED does not currently address processes like steel fabrication, fabricators can reduce their environmental footprint by adopting corporate goals for sustainability that address their individual incoming materials, material handling, by-products, and waste streams. And again, they should make these efforts known. As an initiative that addresses the life cycle of a building, there's no reason LEED shouldn't recognize all of the companies that work to make buildings come together, and that includes fabricators. MSC

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Fabricators and LEED

BY GEORGE D. HALKIAS, AIA, LEED AP

Whether they realize it or not, steel fabricators can play a role in the sustainability of their projects.

BY NOW, THOUSANDS OF ARTICLES exist that address sustainable design and LEED. The body of written material covers subjects from brownfield development to urban heat island effect to embodied energy reduction. I'd like to take a different path and address these two questions:

- ➜ Does LEED Certification affect steel fabricators?
- ➜ Do steel fabricators affect LEED Certification?

In short, the answer to both of these questions is "yes." The obvious follow-up question, then, becomes "How?" In order to answer this question, we need to start with the same basic understanding of LEED and how materials and processes affect it or are affected by it.

LEED (Leadership in Energy and Environmental Design) is the only third-party green building certification program with national acceptance. LEED is produced and managed by the United States Green Building Council (USGBC). (For a crash course in LEED or detailed descriptions of topics and credits, please visit USGBC's website at **www.usgbc.org**.) The areas that LEED addresses fall into the following categories:

- ➜ Sustainable Sites (SS)
- ➜ Water Efficiency (WE)
- ➜ Energy and Atmosphere (EA)
- ➜ Materials and Resources (MR)
- ➜ Environment Quality (EQ)
- ➜ Innovation in Design (ID)

George D. Halkias is the principal-in-charge of commercial and federal architecture with Kimball, a full-service AE firm in the Mid-Atlantic Region.

The most common areas where fabricators are involved in the LEED Certification process on a project are usually out of the control of the fabricator and fall under the Materials and Resources category:

- ➜ Recycled Content
  (LEED Credit MR 4.1 and 4.2)
- ➜ Regional Materials
  (LEED Credit MR 5.1 and 5.2)

Fabricators do not generally specify the materials or control the project location, so usually the involvement of fabricators in this part of the process will be limited to documentation of decisions made by someone else on the project team. Because of the high recycled content in steel building materials (93.3%, according to AISC), this involvement should be assumed on each LEED project. Fabricators who are looking for advantages over their competitors have begun to make the paperwork process and data collection for these credits easier. But they should go a step further and advertise their willingness and ability to provide the required information.

In the case of steel-framed buildings, the steel comprises a large enough percentage of the total material value to allow project teams to pursue LEED Innovation Credits for "Exemplary Performance." The Exemplary Performance compliance path for Innovation Credits is essentially exceeding the credit requirement by the next incremental percentage. For example, if the credit requirement for one point is 10% and two points for 20%, you can achieve a third point for exceeding 30% in that category. On the majority of LEED projects that I have participated in, we have achieved four points for the Materials and Resources credits—as well as achieved two Innovation Credits. For these projects, six points were achieved by the project team primarily by selecting steel as the structural material.

As LEED evolves, opportunities for steel fabricators to affect certification will increase. The best example of this will be the inclusion of Life Cycle Analysis (LCA) in the near future. A good working definition for LCA is:

> *"Life Cycle Assessment (or Analysis) is an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying energy and materials used and wastes released to the environment, and to evaluate and implement opportunities to affect environmental improvements."* (SETAC, 1990)

Steel as a building material will have a good LCA, in most cases due, again, to the high percentage of recycled content in its makeup. The lower embodied energy required to reuse materials versus extracting new materials from the earth accounts for the large portion of the credit given to steel in its LCA.

Although recycled content and LCA advantages will be the primary focus of how steel and steel fabricators will participate in LEED projects, there are some other sustainable impacts that steel fabricators can have if they are focused on improving both environmental impact and their bottom line:

- ➜ Operational Efficiency
- ➜ Waste Stream Management
- ➜ Energy Reduction Strategies

Each of these categories represents significant opportunities for fabricators and manufacturers to reduce their "en-

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Have an opinion you'd like to share in "Topping Out"? Send your feedback to Geoff Weisenberger, senior editor, at weisenberger@modernsteel.com.