MSC
MODERN **STEEL** CONSTRUCTION

January 2009

Newsworthy
The New York Times Building

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ON THE COVER: The New York Times Building, New York. (photo: David Sunberg/ESTO)

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editor's note

TO REALLY UNDERSTAND MY MIDDLE CHILD, JOSHUA, YOU NEED TO SPEND SOME TIME WITH HIM OUTSIDE. Like this summer when we were on vacation and were taking a boat ride in Georgian Bay. The guide pointed out a beaver dam, but Joshua piped up that it wasn't a beaver dam. The guide patiently explained that is what it was and even showed us a couple of beavers. But Joshua was adamant—and correct. It wasn't a beaver dam; it was a beaver lodge. (What's the difference? Beavers create small ponds by damming up small rivers and ponds; within these still bodies of water, they build homes—or lodges—from sticks and mud.)

Joshua loves nature and reads, and reads, and reads about it. And this being the 21st century, he's even created Joshua's Nature Site (**http://ideastosavenature.weebly.com**). The great part is he created the site for free; no hosting charges, no software to buy.

Of course, it's also a pretty simple site. When AISC set out to update *its* site, it was a little more complicated. As anyone who's ever visited **www.aisc.org** knows, there's a lot of information on the site (ranging from online seminars to a bookstore to more than 15,000 pages of technical information). The problem has always been arranging the data to make it easy to find.

Our solution was the creation of what we call "channels." When you visit the redesigned site, you'll see five of the channels displayed across the top of the page. You can use the arrow icons to scroll through additional channels, or press "view all channels" to see a list of the channels. The site also makes it easy to look up a member, find a certified company, or check out who produces which steel shape. And, of course, you can view the NASCC: The Steel Conference advance program or register for the conference (visit **www.aisc.org/nascc** for more information). Channels range from certification to competitions and awards to e-learning to engineering FAQs to research to safety to seminars to steel availability to an extensive technical library!

We've tried to anticipate the type of information most visitors will want, and the left side of the home page has a list headed "I want to…" If you think something else should be on the list, let me know. We also give you the latest steel news and a list of upcoming steel-related events.

Currently, the one drawback to the site is there's not enough interactivity between users or between users and AISC. Several upcoming enhancements will provide greater opportunity for networking and communication, and those will be announced both in MSC and (of course) on the website.

Though if you really want networking, there's no substitute for face-to-face communication. And the best place for that? NASCC: The Steel Conference. If you've attended in the past, you know the quality of the presentations, the enormity of the exhibit hall, and the value of the interaction between attendees, presenters, and exhibitors. If you've never been to the conference and want a taste of the types of presentations, visit **www.aisc.org/2008nascconline**.

I hope to see you at the steel conference—and in the meantime, drop me a note with any comments on AISC's updated website (and don't forget to visit **www.modernsteel.com** too)!

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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.

Doubler or Stiffener Plate?

My question pertains to the design of column web reinforcement for directly welded flange moment connections.

When local yielding of the column web occurs, is it acceptable to use web doubler plates in lieu of a pair of transverse stiffeners to provide for the additional material necessary to exceed the design strength requirements? The reason I ask is because all of the AISC design examples, and also the software that we use for connection design, always provide for transverse stiffeners instead of doubler plates when local yielding of the column web is an issue.

If web local yielding is the limit state being checked, the use of a doubler plate is an option. This is covered in Section J10.2 of the 2005 AISC *Specification*.

Design examples often use the transverse stiffener option because it is generally considered easier to fit and fillet weld the stiffener than a doubler plate where the weld to the fillet region becomes somewhat more tedious—and expensive. But if you are providing a doubler plate already for another reason, like web shear strength, it may not be an additional cost.

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

Thermally Cut Holes

On one of my projects, the fabricator is asking to use thermally cut bolt holes. He is citing Section M2.5 of AISC 13th edition *Steel Construction Manual*. That section states that thermally cut holes shall be permitted with a surface roughness not exceeding 1,000 μin.

What are the advantages and disadvantages of thermally cut holes?

How does roughness of surface come into the picture for cutting the holes?

The primary advantage of thermal cutting for the making of holes is that the shaping of the plate and the burning of the holes can often be done on a single piece of equipment. This saves time in handling. Also, thermally cut holes can be cut to different diameters, if necessary, without changing bits. The advantages are primarily economic, though it also could be argued that the thermally cut holes generally will be cleaner as produced. The presence or absence of small burrs is not a significant issue, but the absence of burrs in thermally cut holes often is touted as an advantage in the literature.

Provided that the requirements for surface condition are met, there is no disadvantage to a properly made thermally cut hole. The profile of the hole is also important, and I would not allow thermal cutting of holes by hand, such as for repairs, unless approved by the EOR. Hand-guided thermal cutting usually would produce holes of questionable quality.

Larry S. Muir, P.E.

ASD Flexural Capacity in the 2005 *Specification*

When designing a channel for flexure, I am somewhat confused regarding the allowable/available moments that are published in the 13th edition *Manual*.

I came to the conclusion that all of the channels now have an allowable bending stress of 0.75F_y as opposed to the older 0.66F_y. Am I correct in assuming that this is what the new allowable stress is for channel beams? Can I also get an explanation as to why the sudden increase in allowable stress has been made to be 0.75F_y?

That's not quite correct. The comparison can't be made only on the basis of F_y, because there also is a difference between them on the material property used in the calculation.

In the 2005 AISC *Specification*, the nominal moment capacity based on the limit state of yielding for compact shapes is $M_n = F_y Z_x$. The old ASD *Specification* assumed a lower bound shape factor of 1.1 for rolled shapes and $M_n = F_y (1.1S_x)$, which resulted in allowing a 10% increase in flexural capacity for compact shapes when LTB did not control. Once the factor of safety of 5⁄3 was applied, this resulted in the allowable stress of 0.66F_y in lieu of 0.60F_y.

To make the comparison you're making, then, you also need to account for the ratio of Z_x to S_x. When converting the moment to a stress, the base stress is still 0.60F_y, but the shape-property ratio likely will be greater than 1.1 because it is dependent on the particular shape factor (Z_x / S_x) for the shape.

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

Steel Types

When were A36 and A6 steels in general use for building construction?

ASTM A36 was the common structural steel used in building construction from the early 1960s to the late 1990s. The ASTM A6 Standard is not a specific material type per se, but rather a Standard Specification for General Requirements for Rolling Structural Steel Bars, Plates, Shapes, and Sheet Piling, which defines the cross sections and tolerances for hot-rolled shapes.

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

Knee-Braced Frame

Is a frame with a kick brace considered a special braced frame?

I am assuming that when you refer to a "kick brace" that this is the same as a "knee brace," which is covered in the *Seismic Provisions*. It is treated as an Ordinary Moment Frame, not a braced frame, since the primary response of such a frame is through flexure of the beams and columns between the knee braces and not axial effects in the braces. Please see the Commentary to Section 11 for more detailed information.

Larry S. Muir, P.E.

steel interchange

Dynamic Analysis

What type of structure requires a dynamic analysis?

The subject of what type of analysis is appropriate for a particular structure is not covered by material standards such as the AISC *Specification*, but rather in ASCE 7. It could be argued that all structures behave dynamically to some extent when subjected to loads or displacements. Typically, however, the loads and displacements we address in building design are applied slowly enough that a static analysis is justified. Blast loading is one exception to this. The decision as to what type of analysis is appropriate for a specific application is left to the responsible design professional.

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

Skewed Single-Plate Connection

Per the discussion on page 10-151 of the 13th edition AISC *Steel Construction Manual*, the maximum beam-web thickness is a function of the maximum root opening and the angle of skew in a skewed single-plate connection. Why?

If the beam web becomes too thick relative to the skew angle, the root opening will begin to exceed 3⁄16 in. This limit is the maximum root opening allowed by AWS for a fillet weld. If the opening is 3⁄16 in. or less, the fillet weld size must be increased by the root opening dimension. If the root opening provided by the unbeveled web or plate exceeds 3⁄16 in., the plate or web must be beveled.

Larry S. Muir, P.E.

Prequalified 4ES Connection

Table 6.1 of AISC 358-05, *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications*, lists 10¾ in. as the only width allowed for the end plate of a 4ES connection. Is this correct that the identical max. and min. values are the same?

In the first release of the standard, the width of 10¾ in. was included intentionally, as all of the tests were conducted with that plate width. Subsequent testing since the release of that standard has shown that the limits can be expanded to cover plate widths between 7 in. and 10¾ in., inclusive. This is proposed for inclusion in the Supplement to the standard, currently available at **www.aisc.org/358s2**. Note that this document is still under development, and will not be officially released until next year.

Chris Hewitt, S.E.

Prequalified Connection Standards

I am attempting to design my first SMF using a prequalified connection from AISC 358-05. The only prequalified connections listed are the RBS and the unstiffened and stiffened end plates. Does this document supersede FEMA 350, which lists such connections as the WUF-W as valid for SMF framing systems? Do the FEMA 350 connections not listed in AISC 358-05 lack the proper testing for the AISC 358-05 prequalification?

I have also heard that some proprietary connections have been submitted for prequalification. Is there a location where I can find a list of the connections that have been approved since the publication of AISC 358-05?

AISC continues to develop the AISC 358 standard. Because this is a relatively new standard, there are other connection types in FEMA 350 and other testing reports that have not yet been reviewed for possible inclusion in the standard. The RBS and end-plate connections were included in the first version (2005) of the standard because these had the broadest range of testing and therefore were the easiest to prequalify.

For the other connections in FEMA 350, many code authorities will allow you to use the criteria in FEMA 350 while the connections are being considered by the AISC CPRP for inclusion in the standard. In essence, you are then using qualified connections as permitted in AISC 341, and this is not uncommon. A supplement to the standard, which will address several other connection types—including WUF-W connections—is available from the AISC website at **www.aisc.org/358s2**. As stated in the previous answer, this document is still under development, and will not be officially released until next year.

Chris Hewitt, S.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. Charlie Carter is an AISC vice president and the chief structural engineer. Larry S. Muir, P.E. and Chris Hewitt, S.E. are part-time consultants to AISC.

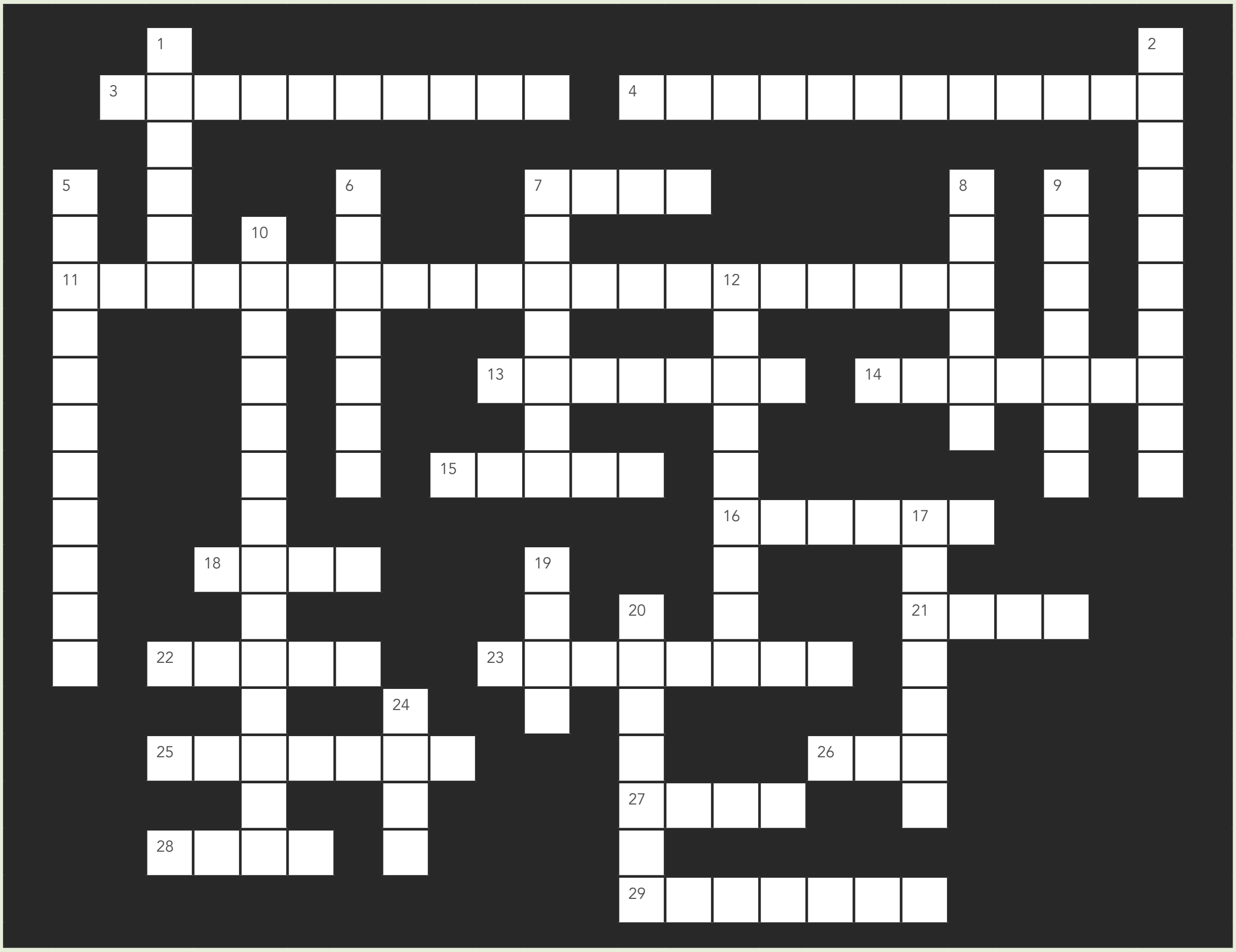
Steel Interchange is a forum to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

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
Chicago, IL 60601
tel: 866.ASK.AISC • fax: 312.803.4709
solutions@aisc.org

steel puzzle

LOOKING FOR A CHALLENGE? *Modern Steel Construction*'s monthly Steel Quiz tests your knowledge of steel design and construction. This month, try your hand at our Steel Puzzle, a feature you can expect to see every few months. Consider it a twist on our traditional Steel Quiz to help you ring in the New Year.



ACROSS

3 The full force of an ____ using an ordinary spud wrench to bring plies in full contact is all that is needed for a snug tightened joint

4 This type of bolted joint requires special faying surface requirements

7 Cutout in a structural member to allow the shape to conform to that of an intersecting member

11 The #1 source for information about structural steel

13 Limit state of crack initiation and growth resulting from the repeated application of live loads

14 A 2008 summer superhero movie that both AISI and AISC could endorse

15 The primary member that extends through a truss connection

16 Weld of generally triangular cross section made between intersecting surfaces of elements

18 Galvanized coatings are formed by a chemical process during which steel and ____ metallurgically bond

21 A structure, in pure compression, capable of spanning a space while supporting significant weight

22 This truss type includes vertical members and diagonals that slope down towards the center

23 The man of Steel

25 The ____ ratio is the transverse strain divided by the axial strain

26 Abbreviation for a compressible-washer-type capable of indicating the achievement of a specified minimum bolt tension in a structural bolt

27 Transverse center-to-center spacing of fasteners

28 The segment of a beam that is located between the ends of two diagonal braces or between the end of a diagonal brace and a column (EBF)

29 City where the AISC headquarters was previously located

DOWN

1 Part of NSBA

2 This type of testing relies on the transmission of high-frequency sound waves through the material

5 The high recycled content and high reclamation rate of steel make it a highly ____ material

6 Pack your bags! The 2009 NASCC will be held in this desert city

7 City where the first steel skyscraper was built

8 Steel is a metallurgical mix between iron and ____

9 This type of cutting can be done with gas, plasma, or a laser

10 Limit state based on an out-of-plane flexural yield line mechanism in the chord at a branch member connection

12 This column type is symmetric in both directions, with one column web cut and welded to the other column web

17 This type of analysis is based on the assumption that the structure returns to its original geometry upon the removal of the load

19 This color, located at the end of an F1554 anchor rod, is used to identify Grade 36 steel

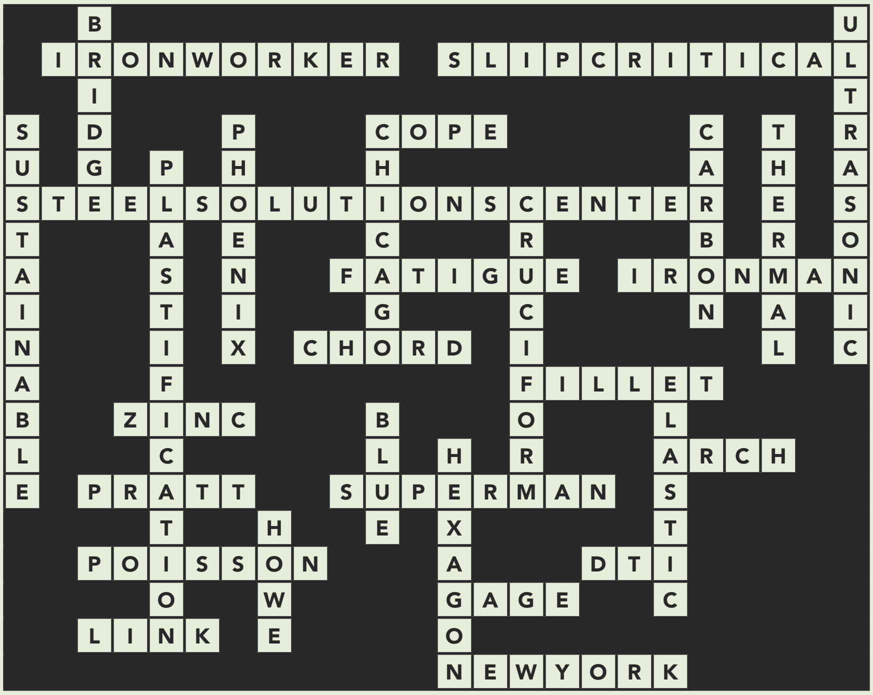
20 The shape of the head of the bolt and nut for high-strength bolts

24 This truss type includes vertical members and diagonals that slope up towards the center

TURN TO PAGE 14 FOR ANSWERS

steel puzzle

ANSWERS



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

What is it? This unusual "sculpture," created from steel scrap, drew plenty of visitors to AISC's booth—as did the free Slinkies.

The exhibition hall itself was a showcase of structural steel.

news & events

EVENTS

Green in Beantown

Several AISC staff members attended the Greenbuild International Conference and Expo this past November, which was held in the steel-framed Boston Convention and Exhibition Center in Boston. The event attracted approximately 28,000 attendees and more than 800 exhibitors. AISC and the American Iron and Steel Institute (AISI) partnered on a booth and were Gold sponsors of the show; AISC's sponsorship included being the sole sponsor of the Greenbuild's opening reception, which kicked off the show. AISC president Roger Ferch was among the dignitaries who made remarks prior to the ribbon-cutting ceremony for the exhibit hall's opening. Archbishop Desmond Tutu gave the opening keynote address for the show.

Traffic was brisk at the booth once again this year, where the two organizations spread the message about steel being the most recycled material on the planet. AISC's famous Slinky giveaway, which bore the tag line "There's always a sustainable solution in steel," was a big hit; booth personnel gave away 1,000 of the classic toys and even ran out of them early. (They also handed out plenty of copies of MSC.) AISC's table featured a sculpture of sorts, made from recycled machine shop scrap metal turnings, and a 4-ft-long wide-flange steel section. Both had architects commenting on the "art" of the material, and passersby couldn't resist touching the shiny, curly, pointy scrap sculpture. A toy erector set display mimicking a steel framing system was also a hit.

Next year's Greenbuild show takes place Nov. 11-13 in Phoenix. For more information, visit **www.greenbuildexpo.org**.

CERTIFICATION

Draft Certification Standard Now Available for Public Review

AISC and the Society for Protective Coatings (SSPC) invite a second public review and comment on a draft *Certification Standard for Shop Application of Complex Protective Coating Systems (Enclosed, Covered, or Open Shop)*. The review period for the draft standard begins January 6 and concludes January 27. This standard has completed balloting by the AISC Certification Committee and the SSPC Shop Certification Committee. A copy of the approved draft standard, dated December 9, 2008, is available from the "News" section of the AISC website at **www.aisc.org** with instructions for submitting comments.

The *Certification Standard for Shop Application of Complex Protective Coating Systems (Enclosed, Covered, or Open Shop)* describes requirements for certification of firms that shop-apply complex painting systems. Certification to this standard will confirm to owners, the design community, and the construction industry that a firm has knowledgeable personnel and the organization, experience, procedures, and equipment to provide surface preparation and application of complex painting systems in a shop facility according to contract specifications.

This second review period provides individuals and organizations that may be affected by implementation of this standard an opportunity to share concerns and offer value-enhancing suggestions and recommendations on changes made since the first public review, which concluded last February. The draft available from AISC's website includes indication of the substantial changes made since the first public review. Comments submitted during this second public review period will be given full consideration by AISC and SSPC.

Until the standard and corresponding certification program is finalized, AISC will continue to offer its Sophisticated Paint Endorsement (SPE), and SSPC will continue to offer its QP 3 program. For additional information about AISC and SSPC certification programs, please call or write:

AISC Certification
One East Wacker Drive, Suite 700
Chicago, Ill., 60601
312.670.7520
certinfo@aisc.org

SSPC Shop Certification Program
40 24th Street, 6th Floor
Pittsburgh, Pa., 15222
412.281.2331
damiano@sspc.org

CONTINUING EDUCATION

February Education Seminars

AISC's continuing education spring 2009 seminar series kicks off in February and will run through June. This season's offerings feature four returning topics and two newly developed seminars, including: Intelligent Design! Low-Rise and Mid-Rise Buildings; Seismic Connections, Listen to the Steel: Duane Miller on Welding; and 2005 AISC Specification Manual. Please visit **www.aisc.org/seminars** to find out more about the topics and to view the full spring schedule. The February seminars are:

Intelligent Design!
Low-Rise and Mid-Rise Buildings
2/10 Jacksonville, Fla.

Seismic Connections
2/12 Chicago
2/26 Cincinnati

Listen to the Steel: Duane Miller on Welding
2/17 Boston
2/19 New York

2005 AISC Specification Manual
2/19 Houston
2/26 Las Vegas

ENGINEERING JOURNAL

EJ Call for Papers

AISC is always looking for *Engineering Journal* articles on interesting topics pertinent to steel design, research, and fabrication methods, or new products of significance to the uses of steel in construction. We are especially seeking technical articles with practical applications in the steel industry. If you have a new idea or an improvement on an old idea, please submit a paper to AISC for publication in EJ. Please send your paper in duplicate to:

Engineering Journal
Editor, Cynthia Duncan
AISC
One East Wacker Drive, Suite 700
Chicago, Ill. 60601
duncan@aisc.org

Detailed information on our review process and requirements for submittals can be found on the inside back cover of each EJ issue.

In addition, all published papers are eligible for the Best EJ Paper of the Year award. Go to **www.aisc.org/ejsurvey** to cast your vote for the best EJ paper of 2008 and become eligible for a free trip to the 2009 NASCC: The Steel Conference, held April 1-4, 2009 in Phoenix. A drawing will be held next month and the winner will be contacted at that time.

All articles published in EJ in 2008 are included in the survey (excluding discussions of previously published papers). Besides the winning voter, the winning author will also receive free registration to the 2009 NASCC, as well as round-trip airfare and a one-night stay at the conference hotel, where the conference will be held and the award will be presented.

Cast your vote today! Votes will not be accepted after February 8, 2009.

ENGINEERING JOURNAL

First Quarter 2009 Article Abstracts

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

Optimum Flexural Design of Steel Members Utilizing Moment Gradient and C_b

Abbas Aminmansour

Flexural strength of members based on the limit state of lateral-torsional buckling is a function of the moment gradient of the unbraced length under consideration. Bending modification factor, C_b, accounts for the shape of the moment gradient within the unbraced length and allows for adjustment of the member flexural strength, possibly increasing it by a considerable amount. Therefore, neglecting the impact of C_b on member strength may lead to over-design. This paper discusses application of C_b to design of members subjected to bending including beams as well as members subjected to combined loading (compression and bending, tension and bending, or biaxial bending). Numerical examples are presented using both ASD and LRFD methods.

Topics: Beams and Flexural Members, Stability and Bracing, Combined Loading

Design Aids for Built-Up I-Shaped Beams with Slender Webs

Paul P. Nasados, Jr.

Available Strength Tables for I-shaped beams with slender webs for the limit states of flexure and shear are presented. The tables were prepared in a format similar to the design aids available in the 13th edition AISC *Steel Construction Manual*. The generation, applicability and limitations of the tables are discussed. An example is presented to demonstrate the usage of the Available Strength Tables.

Topics: Beams and Flexural Members, Built-Up Members, Stability and Bracing

A Model Specification for Stability Design by Direct Analysis

R. Shankar Nair

This paper presents a model specification for stability design by direct analysis. It is based on the stability provisions of the 2005 AISC *Specification*, rewritten around the Direct Analysis Method alone. The material is presented in the language and format of the AISC *Specification*, including "User Notes" and the italicizing of terms listed in the glossary where they first appear in a section. The focus on a single method has offered the opportunity to expand some of the provisions beyond what is in the current AISC *Specification*, both to improve clarity and to address issues that have arisen from use of the document. Where this involved substantive changes, they are explained in an appendix to this paper (Appendix A). A second appendix (Appendix B) outlines the purpose or physical significance of each of the important steps in the Direct Analysis Method by showing the correlation of these steps to the basic requirements for design of structures for stability. The "traditional" Effective Length Method is included in the correlation to show how that method differs from the Direct Analysis Method. A third appendix (Appendix C) provides guidance to the user on the modeling of structures for the application of the Direct Analysis Method.

Topics: Analysis, Specifications

The Effect of Selected RFI Variables on Steel Fabrication Performance

Thomas M. Burns

The steel fabrication process depends upon documentation that is often in need of clarification due to issues involving completeness and coordination. Clarification is obtained by the steel fabricator through the request for information (RFI) process, which allows the shop drawing production process to continue forward. The volume of requests for information sought, as well as time required to receive clarification, are just two of many variables that may influence shop drawing production as well as subsequent fabrication activities. This research identifies specific RFI variables and their significant relationship with shop drawing production and fabrication duration performance. Data from 48 projects were collected from steel fabricators throughout the United States. Regression techniques identified two variables, the RFI performance indicator and the average RFI response time, as significant predictors for both shop drawing production and fabrication duration performance measures. Within the 48 projects studied, approximately 25% of the performance variability in shop drawing production was explained by these two variables. The generalized model developed from these results may be applied by individual steel fabricators interested in performance improvement through RFI management. Project databases using RFI metrics could benefit fabricators by establishing performance thresholds while also providing engineers with a quality service indicator.

Topics: Fabrication, Quality Assurance and Control, Economy (Cost)

Current Steel Structures Research

Reidar Bjorhovde

This regular feature of the *Engineering Journal* provides information on new and ongoing research around the world. In the 17th installment, research projects are summarized on the following topics: Sustainability of Steel Structures (University of Coimbra, Coimbra, Portugal), Seismic Design and Analysis of Rectangular Concrete-Filled Steel Tube Members and Frames (University of Illinois, Urbana, Ill.), Market Opportunities for Innovative Fastening Solutions for Steel Structures (University of Coimbra, Coimbra, Portugal), Size Effects in the Fatigue Behavior of Tubular Bridge Connections (Federal Institute of Technology, Lausanne, Switzerland), A Methodology for an Integral Life Cycle Analysis of Bridges in View of Sustainability (University of Coimbra, Coimbra, Portugal), and Load Rating of Curved Composite Steel I-Girder Bridges through Load Testing with Heavy Trucks (University of Minnesota).

Topic: Research

People and Firms

- **Macsteel Service Centers USA** (AISC Member) recently expanded its business operations with the opening of a new 100,000-sq.-ft service center in Portland, Ore; a formal plant opening and ribbon-cutting event is planned for the spring of 2009. The Portland plant will service the Pacific Northwest region including Oregon, Washington, and Idaho. The service center will process and stock carbon, stainless, and aluminum flat-rolled and wide-flange beams. Future plans call for the product line to include channels, angles, tubes, and plates.

- **MG Systems & Welding,** a manufacturer of thermal cutting gantry machines, announced the promotion of Milo Nezval to the position of project engineer. In this new position, Nezval will be the engineering liaison between the Menomonee Falls, Wisc. plant and parent company Messer in Gross Umstadt, Germany.

- The **Green Building Certification Institute** (GBCI) announced that Peter Templeton will assume the new role of president of GBCI. In his leadership role at the U.S. Green Building Council (USGBC), Templeton was vital to the early development of the LEED green building certification system, the launch of the LEED Accredited Professional (LEEP AP) program, the expansion of USGBC's educational programming, and the successful spin-off of GBCI earlier this year.

- Structural engineering firm **Ruby + Associates** has transitioned its management to the second generation of the Ruby family. Jay Ruby, son of founder David Ruby, now serves as president and CEO, and his sister, Tricia (Ruby) Huneke, will act as COO and CFO. David is now Chairman.

- **Multivista LLC**, a leading construction documentation company, announced the opening of Multivista Dallas. The company has had more than 20,000 documented commercial and residential projects in the U.S. and internationally in the last five years.

- **Thornton Tomasetti, Inc.** announced the promotion of Yi Zhu to senior vice president/principal in the firm's Shanghai office. Zhu joined Thornton Tomasetti in 1994 and has gained extensive experience in the structural analysis, design, and review of various building types, including high-rise residential buildings, mixed-use complexes, commercial buildings, and long-span structures.

- Kevin J. Hilton has been promoted to the position of senior vice president, representing **The Association of Union Constructors** (TAUC) and the **National Maintenance Agreements Policy Committee** (NMAPC). Hilton has assumed a number of internal operational leadership responsibilities, as well as an increased policy development role.

- **Walter P Moore** has once again received top rankings in the annual ZweigWhite "Best Firms to Work For" competition. The firm's Civil Engineering group received highest honors: #1 "Best Civil Engineering Firm to Work For" (for all civil engineering firms) and #1 for mid-size civil engineering firms. Its Structural Engineering group also received two distinctions: #2 "Best Structural Engineering Firm to Work For" (for all structural engineering firms) and #1 for large structural engineering firms.

news

GALVANIZING

Sustainble Solutions

The American Galvanizers Association has announced the release of *Sustainable Solutions for Corrosion Protection*, an informative brochure detailing new research regarding the strength and sustainability of hot-dip galvanized steel in the alternative energy market.

Sustainable Solutions explores how using hot-dip galvanized steel in biofuel, wind, hydroelectric, and solar structures not only protects them from the effects of corrosion, but also is highly sustainable and earth-friendly. Highlighting the inevitability of corrosion, this brochure stresses the importance of making intelligent environmental and economic decisions, supported by real-life case studies from each sector of the alternative energy market. It also explains how the natural, recyclable zinc coating created in the galvanizing process will provide superior corrosion protection without requiring the costly carbon footprint of maintenance.

Request a free *Sustainable Solutions* brochure and see how galvanized steel can protect your investment in alternative energy. If you have any questions or are interested in obtaining a brochure, please contact AGA marketing coordinator Jenny Clawson at 720.554.0900 x15 or **jclawson@galvanizeit.org**.

CONSTRUCTION MARKET

Nonresidential Construction Continues Decline

The fourth quarter (2008) FMI Nonresidential Construction Index (NRCI) survey was conducted, as the financial crisis moved from Wall Street to Main Street. The results of the construction management consulting provider's quarterly survey of construction industry executives show the effects of the troubled financial markets now spilling over to the nonresidential construction sector. The NRCI dropped 10.6 points to 34.1 since the third quarter. Panelists also indicated they expect significant declines in municipal construction budgets due to financing difficulties and reduced tax receipts for 2009. Uncertainty in the markets and further delays and cancellations will mean lower revenues for contractors working in the nonresidential construction sector for 2009. Highlights of the NRCI included:

- 85% of panelists reported the overall economy as worse than last quarter
- 71% of panelists agreed that the economy in their geographic regions was worse than last quarter, an indication that there are few corners of the country now bucking the national economic trends
- Until the fourth quarter, panelists' business looked better than the national and regional business scenes. As of the fourth quarter, only 4.6% said their business has improved over last quarter
- The "cost of materials" component of the NRCI made a significant improvement to move the component score above the neutral range of 50.0 to 53.4, signaling lower material costs for the near term
- Labor costs slightly improved, as 22% of panelists reported higher labor costs compared with the previous quarter
- 20% of panelists expect revenues to be as much as 16% or more lower for 2009 due to the turmoil in the financial/credit markets
- 32% of panelists expect municipal budget cutbacks for 2009 of 5% to 10%

letters

Aggravated by Acronyms

Upon receiving my November issue of MSC, I noted the cover title "A Healthy Dose of BIM." I work for an engineering firm that provides heavy industrial design to the local industries. I had never heard of BIM, so I immediately turned to the table of contents to look for the article. The first article I noticed was titled "BIM and Beyond." I turned to that article, scanned it to find the meaning of BIM, and could not. I turned back to the TOC, found another article under the heading "BIM" titled "Technical Solutions are Just the Half of It," turned to it, and still could not find the meaning of BIM. (I have a particular aversion to acronyms and was becoming somewhat frustrated.) Once again, I returned to the TOC, found another article that mentioned BIM in the description, and turned to it. Finally, in the second paragraph, I found that BIM stands for "building information modeling."

I would like to suggest that whenever an acronym is going to be used in an article, that it be defined the first time it is used in each article. Not everyone that receives the magazine designs buildings. We design a lot of steel and almost no buildings. We are using 3D modeling for the structures we design, which include piping and equipment. I guess this is similar to BIM but without the building.

I enjoy the magazine and look forward to it coming every month, even if I don't always have time to read it thoroughly.

Rick Goad, P.E.

The Right People for the Job

I've been subscribing to MSC for a few years now and I've always enjoyed Scott Melnick's editorials.

His recent one relaying Howard Putnam's comments [on hiring practices] (10/08) really struck a chord with me, as much of my time over the last three years has been trying to hire the right people. These are all excellent points.

I just wanted to let you know that your work is relevant and appreciated. Great job, and please keep up the good work!

Sam DeFranco
Engineering Authority
BP America, Inc.

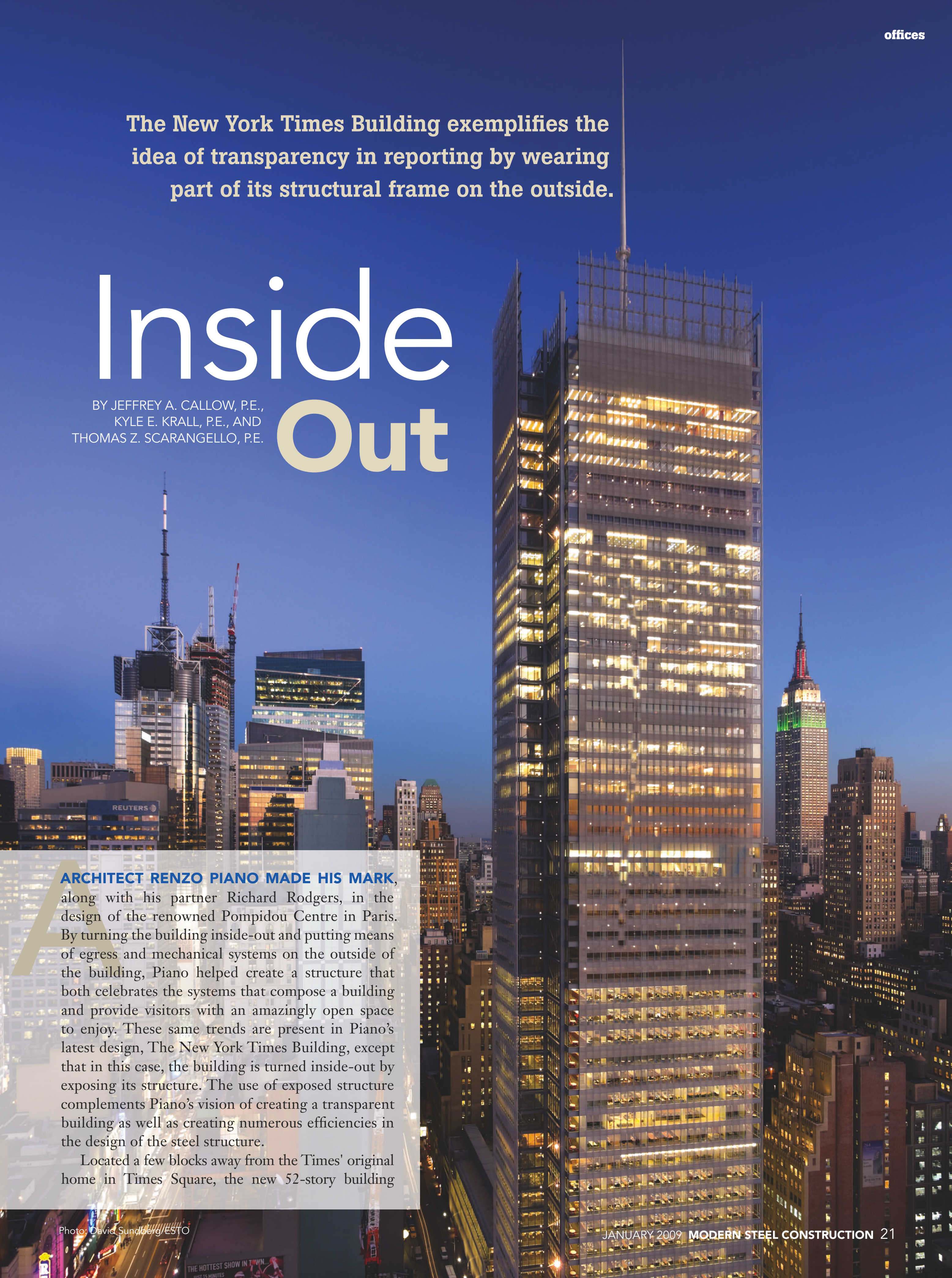


Photo: David Sundberg/ESTO

The New York Times Building exemplifies the idea of transparency in reporting by wearing part of its structural frame on the outside.

Inside Out

BY JEFFREY A. CALLOW, P.E., KYLE E. KRALL, P.E., AND THOMAS Z. SCARANGELLO, P.E.

ARCHITECT RENZO PIANO MADE HIS MARK, along with his partner Richard Rodgers, in the design of the renowned Pompidou Centre in Paris. By turning the building inside-out and putting means of egress and mechanical systems on the outside of the building, Piano helped create a structure that both celebrates the systems that compose a building and provide visitors with an amazingly open space to enjoy. These same trends are present in Piano's latest design, The New York Times Building, except that in this case, the building is turned inside-out by exposing its structure. The use of exposed structure complements Piano's vision of creating a transparent building as well as creating numerous efficiencies in the design of the steel structure.

Located a few blocks away from the Times' original home in Times Square, the new 52-story building stands 744 ft from the sidewalk to the roof. The façade extends above the roof in a marriage between form and function, completing the concept of a transparent building disappearing into the sky, while also hiding rooftop mechanical equipment. A 300-ft-high steel mast extends above the roof, topping the overall structure out at 1,048 ft and making it the third tallest building in New York City at the time of its completion. The New York Times Company occupies the lower 27 floors, while business partner Forest City Ratner Companies developed the upper floors of the building.

The footprint of the building exhibits an elongated cruciform shape in plan. The steel braced-frame core of the building is 65 ft in the east-west direction by 90 ft in the north-south direction. The tight layout of the core allowed for wide 40-ft spans on the west and east sides of the building. At the mid-level and upper-level mechanical floors, double-story outrigger diagonal braces extend from the core to the perimeter columns, allowing all columns to participate in the lateral stiffness of the building.

Four Corners

In each of the four corner notches of the tower, the two columns on the north and south notch faces are brought outside of the building envelope. These columns are 30-in.-wide by 30-in.-deep box columns built from steel Grade 50 or Grade 42 plate. After initial sizing of the columns for stress, structural engineer Thornton Tomasetti worked with Renzo Piano Building Workshop (RPBW) and FXFOWLE Architects to establish a hierarchy of exposed steel sizes. Part of the architect's vision was for the building to get lighter as it approaches with the sky, which worked well with the desire to maintain an efficient structure. Exposed members changed sizes in five levels of hierarchy along the height of the building. For the box columns, the flange thickness was varied, from 4 in. at the base of the building to 2 in. at the top levels. To achieve the required area for strength and stiffness, Thornton Tomasetti varied the thickness of the web plate, allowing for structural efficiency that did not affect the aesthetics of the building. The web plates were also inset 3 in. from the toes of the flange, creating both an aesthetic reveal and a means for welding the plate together with simpler fillet welds rather than penetration welds.

One unique aspect of the project is that it was a break from the traditional fast-track design of many high-rise buildings built by developers. Because of the owner's desire to create a technologically savvy and world-class building, the design team was afforded a flexible design schedule, and the owners pushed them to come up with multiple solutions and understand the positives and negatives of each. This resulted in many instances where the best interests of the architect, engineer, and owner were all satisfied by the final solution. One example of this is the exposed bracing system. In the desire to expose the structure aesthetically, the architect envisioned an elegant vertical bracing system on the outside of the building. Structurally, this was ideal, as additional bracing lines outside of the steel braced-frame core helped spread out the building's lateral stiffness to multiple columns that were already sized for gravity.

Maximum Exposure

Given the amount of exposed steel in the building, one of the principal concerns was the amount of exposed fireproofing that would be required. The columns were fireproofed using intumescent paint for both aesthetics and durability. To avoid the additional fireproofing requirements on the vertical bracing, the exposed bracing lines were only used to limit building drift and accelerations, which governed the building's design. Because the braces themselves were not fireproofed, the core had to be designed to resist lateral loads for strength, assuming the exterior system was not present. In a more typical high-rise, additional steel tonnage would have been required to limit the accelerations of the building to levels deemed acceptable for human comfort. By using the exposed bracing system, less steel was required to be added, as the steel area used to resist gravity loads on the exterior could now also be used as additional axial stiffness to resist building movement. The use of these exterior bracing lines, in addition to the typical outrigger system of the building, allowed all 30 tower columns to participate in the lateral system of the building.

Pretensioned, high-strength (65 ksi) steel rods were used in a two-story-high X-braced system to keep the exposed bracing light and elegant. The rods were pretensioned to overcome any future compression due to differential axial shortening of columns, differential temperatures in exposed steel members, and wind or seismic loads. To maintain a sense of proportion with the columns at each of the five hierarchical levels, the rods decrease in diameter as they go up the building, with 4-in.-diameter rods at the base and 2.5-in. rods at the upper levels.

Thornton Tomasetti, Inc.

above: Outrigger diagonal braces on the 28th floor.

Thornton Tomasetti, Inc.

above: New building, same classic font.

below: Structural elements are brought outside of the building envelope at the four corner notches of the tower.

David Sundberg/ESTO

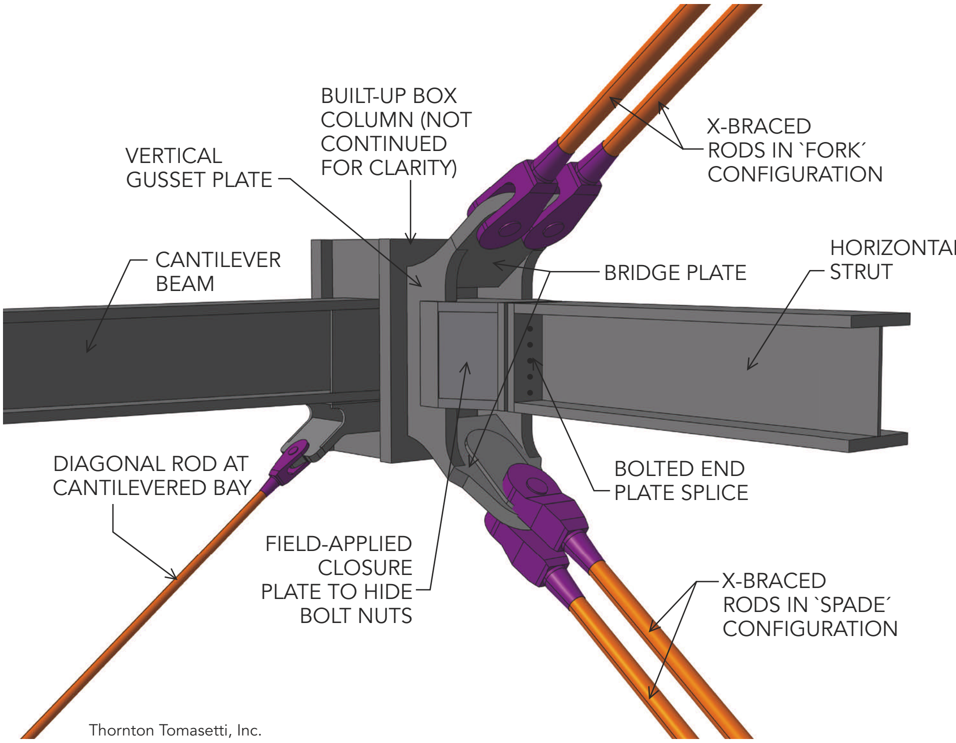
One of the typical pitfalls of X-braces is how to handle the middle of the bay where the braces intersect. Creating a node at this location results in a bulky connection, and many different load paths need to be evaluated. The braces can also be offset so they run by each other, resulting in eccentric connections at the columns. To solve these issues, pairs of rods were used in lieu of single braces. This allowed one set of rods to be aligned horizontally and the other pair to be aligned vertically and pass between the two horizontal rods. In addition, each of the rod pairs would maintain concentric alignment with the center line of the columns. At every other floor level, a horizontal strut connects between the columns to resist the compression component from the rod tension force. This strut is a 22-in.-deep built-up I-shape and its flange thicknesses step in the same five levels of hierarchy (from 2 in. at base to 1 in. at top) as the box columns.

By bringing the columns outside of the building envelope, one issue that arose was how to handle the interior girders that frame to these columns. In the lower 28 floors of the building, a raised floor system was incorporated, meaning that the structural slab was 1 ft, 4 in. lower than the top of finished floor. This put the steel supporting this slab low with respect to the center-line of the spandrel panel, which the architect required all horizontal steel framing into the columns to be centered upon. To maintain this requirement, the girders framing into exterior columns dog-leg at the end to allow their elevation to change before penetrating through the building façade. This was achieved by transitioning the beam's depth and elevation over a 3-ft zone. The beam was wrapped with insulation where it penetrates through the façade, and stiffener plates were welded between the beam flanges to provide a seal point to disrupt outside air from getting into the building.

One of the other principal structural challenges of the building was the north and south cantilevered bays. These 65-ft-wide by 20-ft-deep bays form the north and south stems of the cruciform in plan. The architects envisioned that the building would float above the elegant glass storefront beneath these bays without any building columns running through. Thornton Tomasetti investigated several options including transfer trusses and girders, hanging systems, and cantilevering out from each floor. The final system was a hybrid of these options. At the east and west faces of the bay, the structure is supported by large exposed, built-up cantilevered

Transparency

Piano's principal objective in the design of the New York Times Building was to reflect the ideals of journalists in being open and transparent to the world on which they report. Piano envisioned a light, transparent building in which the outside world could watch the newsroom at work and the building's inhabitants could connect—and share natural light—with the city. The building's curtain wall system is a primary component in achieving this vision. The system consists of an inner clear glass wall that allows abundant natural light to imbue the workspace. An outer screen wall of closely spaced ceramic rods helps diffuse the light efficiently by eliminating excess heat and glare. In concert with the transparent curtain wall system, the steel superstructure is exposed in four corners of the building, giving the impression that the building is so transparent that its skeleton is visible.



A diagram of the "knuckle" connection, the primary exposed connection used throughout the New York Times Building project.

beams. These beams taper from 22 in. deep at the column to 18 in. at the tip, and the end moment is transferred directly into the box columns. These cantilevered beams match the flange thickness of the horizontal struts from the X-braced system. A single 2.25-in.-diameter diagonal rod is used to control the deflection of the cantilevered beam, allowing the beam to be sized only for strength. Similar to the X-braced system, the rod did not have to be fireproofed because it only serves a role of serviceability. Back-to-back vertical channels connect between the tips of the cantilevered beams between each level to smooth out any differential deflections between floors to limit the strain on the exterior wall system.

The inner column line of the cantilevered bay was more complicated to support, as it was not desired to have a diagonal brace interrupting the floor plan. Instead, the girders were moment connected between the inner column and an outer column, which only extended to the second floor, creating a ladder vierendeel truss. A temporary diagonal was installed between the second and third floors to resist gravity load during construction until enough floors of the moment connections were completed, in order for frame action of the vierendeel truss to provide sufficient support.

Knuckles

Piano's focus on the proportioning of the exposed steel did not limit itself to the design of the built-up members themselves. The connection details of the exposed members were also critical to maintain the sense of lightness of the building's exoskeleton. The primary exposed connection was the "knuckle" connection, where the exposed rods from above and below and the horizontal strut frame into the built-up box column. Early discussions of casting the knuckle were quickly shelved due to cost. Instead, the team developed an extremely compact built-up knuckle that had a similar appearance to a steel casting, but with much less cost.

The knuckle extends off of the "flange" of the box column. Two 3-ft-high vertical gusset plates extend off the column, with the outer face of these gussets aligning with the recessed web plate of the column. The gusset plates gently curve above and below the horizontal strut to create a profile that thins as it meets the plane of the rods. A "bridge plate" in the plane of the diagonal rods is nestled between the two vertical gussets. This bridge plate receives the pin-ended connections of the rods and spans between the two gusset plates. Because the rods are configured in two separate planes to allow them to pass by each other, two different configurations of the bridge plate were required. In the "fork" configuration, the two rods are aligned horizontally and each rod comes fitted with a fork at each end. In this configuration, the bridge plate has two holes side by side to which the forks connect. In the "spade" configuration, the rods are oriented vertically and each rod has a spade at its end. The spades frame in above and below a single hole in the bridge plate, and a single pin connects both spades to the plate. Similar to the gusset plate, the bridge plates were also curved to enhance the aesthetic appearance of the connection and maintain the connection's proper proportion to the structural members.

Between the two bridge plates that meet the rods from above and below, a built-up stub of the horizontal strut was connected between the vertical gusset plates. The horizontal strut was connected to the built-up stub portion of the knuckle by means of a bolted end-plate connection. After the bolted connection was complete, a thin closure plate was field welded between the flange toes of the built-up stub to conceal the bolts and give the knuckle the appearance of a single casting.

The same extreme care that was taken in the design of these connections was also desired in the fabrication and erection of the steel. The design team provided specific guidelines on the structural drawings outlining all the tolerance and finish requirements for the exposed steel. While this steel is not technically classified as architecturally exposed structural steel, many of the requirements of AESS steel were incorporated into the exterior steel notes on the drawings. Notably, all tolerances for exposed steel had to be one-half of typical AISC tolerances. The design team provided a corrective fix detail on the contract documents for column splices that were out of tolerance, that involved field welding thin tapered plates to visually smooth out the step in the two column shafts. The fabricator and erector both agreed that this was a very expensive detail and initially took special care to get the alignment of columns within tolerance. An on-site representative from Renzo Piano Building Workshop's office visually inspected every exposed splice before welding and, after a few slight adjustments, all columns met the required tolerance without the need to perform the corrective detail. In addition to tolerance requirements, the drawings noted that all penetration welds were to be ground smooth and seal welds were required at all joints between exposed plates. Special Charpy V-Notch requirements were applied for exposed steel to ensure ductile behavior of the steel undergoing continual temperature changes.

The owner and design team also commissioned a full-size mockup of the knuckle to be completed before the steel structure was sent out for bid. This mockup helped take the fear factor out of the bidders by showing that the connection was constructible within the tolerances indicated on the drawings. It became part of the contract documents as an example of the quality of work expected in the final product. MSC

Jeffrey A. Callow, P.E., is a senior project engineer, Kyle E. Krall, P.E., is a principal, and Thomas Z. Scarangello, P.E., is the chairman, all with Thornton Tomasetti, Inc.

Architect
Renzo Piano Building Workshop, Genoa Italy
FXFOWLE Architects, New York

Structural Engineer
Thornton Tomasetti, New York

Steel Fabricators
W&W/AFCO Steel, Oklahoma City, Okla. and Little Rock, Ark. (AISC Member)
Owen Steel Company, Columbia, S.C. (AISC Member)
MRP, LLC, South Plainfield, N.J. (AISC Member)

Steel Detailer
SP International, Inc., N. Kansas City, Mo. (NISD Member)

Temperature Differentials

One of the principal design challenges of designing with exterior steel is handling the thermal differentials between steel on the outside and the inside of the building. All interior steel is constantly conditioned at room temperature, whereas the exposed steel undergoes continual temperature changes. Using recommendations from the National Building Code of Canada and a report produced by specialty consulting engineering firm Rowan Williams Davies and Irwin, Inc. (RWDI) summarizing recorded temperature history for New York City, the team developed a temperature range of -80 °F to 70 °F to evaluate stresses and movements caused by the differential temperature. Thirty different thermal load combinations were applied to evaluate the effects of one side of the building having more differential temperatures than the other sides. These combinations also reflected a potential difference in temperatures between large, heavy steel members like the box columns and the light steel members such as the rods.

In the initial thermal studies, the analysis showed that the outrigger braces at the top of the building were successfully limiting the differential deflections between the exposed perimeter columns and the adjacent interior columns. At the east and west faces of the building, however, no outriggers were present, and thus the anticipated differential vertical deflection at the top of the building at these faces was approximately L/120 in the initial analysis. This movement was deemed to be too significant for serviceability issues such as floor levelness and compatibility with the façade system. To reduce the deflection on these faces, thermal belt trusses were provided on each face, which limited the differential movement to a more reasonable L/300.

In Plain View

BY ROBERT E. STOLLER, P.E., S.E.

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A new steel hotel-casino now graces the windswept plains of northeastern Oklahoma.

WHILE MULTITUDES OF PROJECTS are referred to as "fast-track" these days, casino projects add a whole new meaning to the term. Once approved, the desire to quickly open and begin generating revenue is intense, which can be challenging given the enormous scale of most casino projects. The new Downstream Casino Resort project in northeastern Oklahoma is a testament to what can be done using structural steel to fulfill this desire.

Located on a 71-acre green field site near the intersection of Oklahoma, Kansas, and Missouri, the project is owned by the Quapaw Tribe of Oklahoma. The first phase consists of a 183,000-sq.-ft, one-story casino and a 165,000-sq.-ft, 12-story luxury hotel at a combined cost of about $140 million. Based on a preliminary program, the design team worked with the owner and construction manager to establish a budget estimate for the project. The one-story casino required large open bays with up to 60-ft clear spans, and various floor plans and structural systems were examined, with steel becoming the obvious choice for framing this building. The hotel, however, offered several possibilities.

General contractor Manhattan Construction and its concrete subcontractor were of course very familiar with concrete flat slab construction. Their initial thought was to frame the tower with either conventionally reinforced or post-tensioned flat slabs. But the structural engineers at Wendel Duchscherer felt that a steel framing system might be more economical and better suited to meet the tight schedule presented by the Downstream Casino Authority. All options were considered and several alternate floor plans were developed to evaluate composite steel framing with either lightweight or normal weight concrete on composite steel deck. Alternate bracing systems included a steel braced core versus a reinforced concrete shear wall core.

Manhattan Construction evaluated all the options and decided that a steel-framed structure with a steel-braced core and lightweight concrete floors provided the best solution to meet both the client's budget and schedule. The company established a guaranteed maximum price (GMP) based on the preliminary designs, and our structural engineers were authorized to start work on the modified design in early June 2007.

Scheduling the "Impossible"

After reviewing the mill schedules of several steel producers, Schuff Steel—the project's steel fabricator—informed the team that in order to meet the project opening dates (August 2008, with a preferred early-July opening for the casino and mid-November 2008 for the hotel), a mill order reservation was needed by June 22, 2007

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left: Approximately 2,040 tons of steel were used to complete the 212-ft-tall hotel tower portion of the project.

below: Steel supports this continually changing lighting feature.

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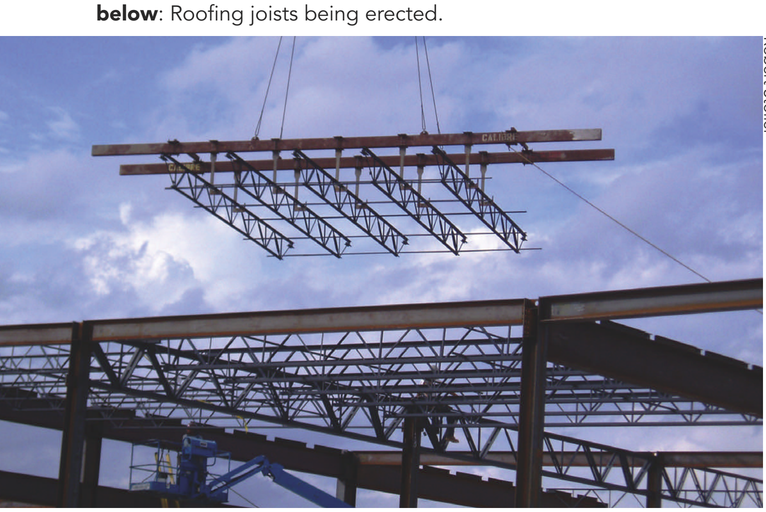
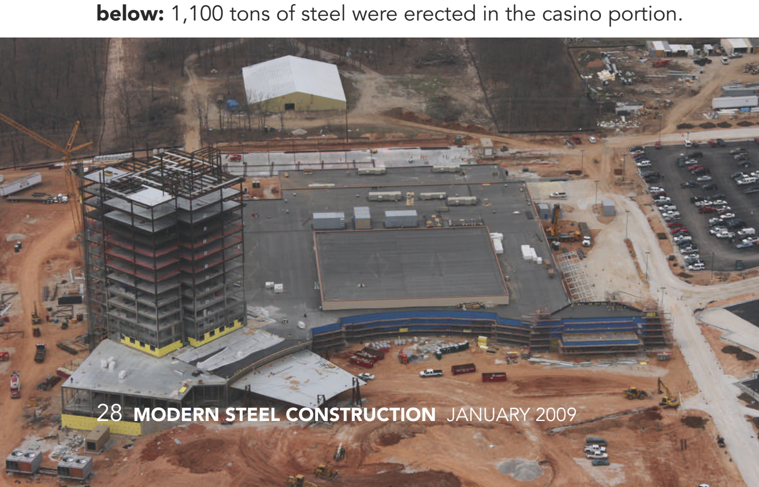
below: Roofing joists being erected.



Robert Stoller

below: 1,100 tons of steel were erected in the casino portion.



Helicopteradvantage.com

that would reserve the tonnage of each shape. A complete mill order including actual final designs was needed two weeks later, by July 6.

At first, this seemed like an impossible task. Many of the project's design elements had not been finalized by the architect, JCJ Architecture, nor agreed to by the owner. But the design and construction team was determined to make the "impossible" possible. We studied the state of the design and came back with an idea based on our previous work on other casino projects; it has been our experience that 90% of the framing can be locked in fairly quickly. This requires that geometry and loadings are "frozen" by the design team. The last 10% requires more time in working through design and detailing with the owner and other design team members. JCJ agreed to freeze the design concepts as much as possible at this early stage, and Manhattan agreed with the idea of a 90% complete steel mill order within the desired time frame. Subsequent steel packages would be either mill ordered or bought from service centers as the schedule dictated.

After placing the mill order, Schuff immediately began shop drawings. Their internal team worked with a connection engineer in Michigan and a steel detailer in New Zealand. Given the distances and time zone variations between the parties, all submittals were made electronically. Our structural team turned around most submittals within one or two days rather than the more standard 10-day cycle, and RFIs were usually answered within a matter of hours.

Framing

The casino structure is approximately 450 ft long by 360 ft wide. While only one story, it has roofs at three different levels ranging from 18 ft to 32 ft above ground. The eastern end has several curved surfaces in plan and includes the main casino entrances. The casino also intersects the hotel at the southeast corner, and the hotel geometry is skewed at about a 45° angle from the casino.

The roof framing is a combination of rolled sections and bar joists. Lateral bracing is predominantly provided by braced frames, with some moment frames where braces were not acceptable architecturally; JCJ worked with us to locate braces where they could be integrated within the architectural design. In fact, four chevron braces flank the sides of the central casino floor, where large 60-ft spans and a 32-ft story height made moment frames impractical. These braces were made into part of the architectural expression of the space.

All of the casino framing was designed in time for the mill order deadlines except for the last eastern bay and the interface to the hotel. These more complicated areas required additional time to resolve geometric issues and design options, and the remaining portions were issued in subsequent fast-track bid packages.

The 12-story hotel was framed by composite steel beams clear spanning between the perimeter and the braced steel core. The floor plan is fairly standard, with a pinwheel-type geometry. This symmetry allowed for many beams of the same size and length, greatly improving the ability to quickly design and detail them. The four corner columns of the braced core had large axial forces and required steel wide-flange sections larger than those domestically produced. In order to avoid the time delay of ordering imported jumbo shapes, these columns were designed as composite columns using the largest domestic shape available, and encased in 6,000-psi concrete.

Steel erection of the casino started on October 12, 2007 and was complete by mid-November. In all, 1,100 tons of structural steel were erected in the casino portion. Everything possible was done to expedite construction, including setting whole bays of joist framing at once.

The drilled pier foundations for the hotel were started in late October and completed in early December. Steel erection began immediately thereafter and was completed by March 28, 2008. Approximately 2,040 tons of steel were used to complete the 212-ft-tall hotel tower. With great fanfare, the casino opened to the public one month ahead of schedule, in early July. Finish work on the hotel was completed in time for a partial opening on October 31 and a grand opening on November 22.

Evidently Steel

The use of structural steel is evident throughout the casino. Many areas have no ceilings, exposing the framework to view. A center bar feature uses a structural steel column with two circular steel rings supporting a visually exciting double-spiral cable structure. Continually changing lighting makes this a distinguishing feature of the casino.

With imaginative packaging of the structural steel elements, this 348,000-sq. ft project went from beginning of design to topping out in just over nine months. Initial occupancy of the casino was achieved just four months later, with the hotel opening its doors four months after that. The design team has since caught its breath and will soon begin a second phase expansion of the property, which will include a spa and meeting room addition, followed by a second hotel. MSC

Robert Stoller is an associate principal with Wendel Duchscherer.

Owner
Downstream Casino Authority (Quapaw Nation), Quapaw, Okla.

Architect
JCJ Architecture, New Haven, Conn.

Structural and Civil Engineer
Wendel Duchscherer, Amherst, N.Y.

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

Steel Detailer
BDS Steel Detailers, Auckland, New Zealand

Connection Design
Ruby and Associates, Farmington Hills, Mich.

Steel Erector
Peterson Beckner Industries, Richardson, Texas (AISC Member)

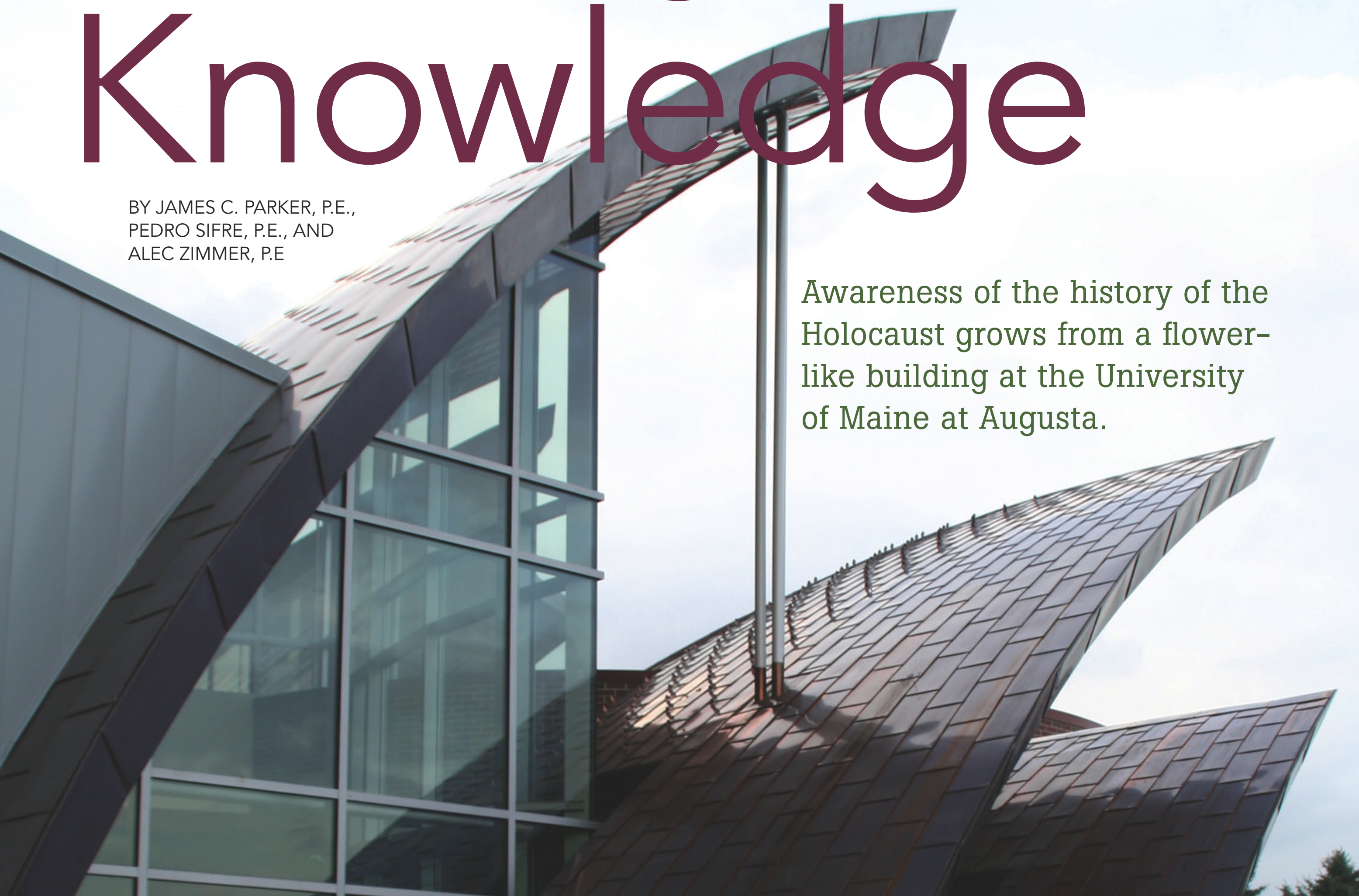
General Contractor
Manhattan Construction, Tulsa, Okla.

Software
RAM Structural System, Staad Pro, Tekla Structures

Blossoming Knowledge

BY JAMES C. PARKER, P.E.,
PEDRO SIFRE, P.E., AND
ALEC ZIMMER, P.E

Awareness of the history of the Holocaust grows from a flower-like building at the University of Maine at Augusta.



IN 1984, A SEMINAR AT BOWDOIN COLLEGE in Brunswick, Maine called "Teaching about the Nazi Holocaust in Maine Schools" inspired a number of participants to found the Holocaust and Human Rights Center (HHRC) of Maine the following year. Since its founding, this organization has developed a lending library of materials on the Holocaust and human rights issues, and it regularly sponsors multi-day seminars for students and educators on these themes.

In 2004, the HHRC, looking for a permanent home, sponsored an international competition to design a new building on the campus of the University of Maine at Augusta (UMA); the competition drew more than 200 entries. Boston-based architecture firm Shepley Bulfinch Richardson and Abbott (Shepley Bulfinch), with the assistance of structural engineering firm Simpson Gumpertz and Heger's (SGH) Waltham, Mass. office, prepared the winning entry for the design competition.

The result is the Michael Klahr Center (MKC). Named in honor of a Maine resident who survived the Holocaust, the Center is a 6,300-sq.-ft, one-story building that houses classroom space, administrative offices for the HHRC, and a soaring atrium that can be used for temporary exhibits and functions. The centerpiece is a permanent exhibit space that tells the stories of Holocaust survivors from Maine through their own words in an audio-visual presentation. The MKC is situated on a low hill at the southeastern edge of the UMA campus along Jewett Road and is linked to the Bennett D. Katz Library, helping to enclose an existing academic quadrangle.

A Symbol of Preservation

Shepley Bulfinch's massing for the MKC is a visual metaphor for the HHRC's mission to educate visitors about the Holocaust and other human rights abuses. Like a seed that preserves and perpetuates a flower, the cylindrical permanent exhibit space at the center of the structure is dedicated to preserving the stories of Holocaust survivors for future generations. Four light-filled, flower-like petals spring from the ground around that central focal point, reminding visitors of the rebirth of human rights, freedom, and democracy after the long, hard winter of World War II. Bundled pipe columns that support the petals extend the floral metaphor by evoking stamens. As visitors leave the permanent exhibit space, they pass beneath and through the light-filled petals into the classrooms and meeting rooms on the north side of the building. The ground to the south of the structure slopes down, following natural grades into a space that will, some day, become a landscaped amphitheater.

The petals are clad in copper panel shingles.

photo by SGH/Alec Zimmer

While the building's gross floor area is relatively small, the design was not without its challenges. The steeply graded amphitheater to the south of the structure necessitated that the footings for the cylindrical permanent exhibit space be well below the footings of the petals and the classroom spaces. Dropping these footings to stay below the 5-ft frost protection depth at the lowest point of the amphitheater brought the footings close to an existing 30-in.-diameter storm drain that bisected the site. In several areas, the foundation walls had to be designed to bridge the storm drain.

The classroom areas on the north side of the building are conventionally framed with structural steel wide-flange non-composite beams and columns with 3-in. roof deck. The lateral load resisting system consists of structural steel concentrically braced frames not specifically detailed for seismic resistance (R = 3) with hollow structural section (HSS) brace members. The gravity framing was designed using RAM Steel. In addition to the lateral loads imposed by wind and seismic forces, the lateral load resisting system also resists forces from the two largest petal structures. Although these petals extend to the ground and are supported by columns, the flat roof above the classrooms provides additional out-of-plane restraint for the petals, and these restraining forces were combined with the wind and seismic forces for the brace design. The petal structures, in turn, provide nominal in-plane frame action to the building.

The roof of the cylindrical permanent exhibit space consists of 3-in. roof deck and non-composite structural steel wide-flange beams framing to load-bearing concrete masonry unit (CMU) walls. This structural steel framing also supports two of the bundled pipe columns and part of one of the petals. The smallest of the petals attaches to steel wide-flange columns embedded within the CMU wall of the exhibit space.

Steel Petals

Because the HHRC built the MKC on a total budget of only $2.8 million, structural steel proved essential to realizing the architect's vision for the building. Although the sculptural forms of the petals were well-suited to cast-in-place concrete, the expense of the curved formwork and the construction schedule demanded a different structural system. The design team also considered using glue-laminated wood beams to create the petals, but the architect's requirement that the petals not exceed 12 in. in thickness (including cladding) precluded this system. In response to the sculptural demands of the petal architecture, SGH developed a structural system consisting of a grid of HSS sections using curved HSS8x8s as the ribs along "meridians" of the spherical petal sections and straight HSS4x4s along "parallels of latitude" of the petals. The HSS grids, moment connected in-plane and strategically braced in certain bays, provide the petal structures with shell membrane action. Selecting steel for the petals allowed for portions of the petals to be shop fabricated, speeding construction considerably. The petals bear partially on painted architecturally exposed structural steel (AESS) bundled columns consisting of three 3-in.-diameter pipe sections that diverge as they rise to meet the petals. SGH modeled the petal structures with RISA 3D based on 3D geometry provided by the architect. To check the demands and capacities of the petal rib and parallel elements, SGH developed a post-processor in Excel to compare the member capacities and demands.

The fact that the architect agreed to base the petal shapes on spherical shell geometry proved beneficial in design, fabrication, and construction. Shepley Bulfinch used Bentley Architecture building information modeling (BIM) software to produce a 3D model of the building. The BIM model helped the design team determine the


SGH/Alec Zimmer

View of the south façade of the Michael Klahr Center, showing all four petals.


SBRA/Harold Hon

The structural steel frame above the classrooms on the north side of the building is erected and temporarily braces Petal 2 as it cantilevers over the permanent exhibit space.


SBRA/Harold Hon

View from the lobby of the architecturally exposed structural steel that supports the curtain wall; outside the glass, the two smaller petals frame to steel columns embedded in the masonry wall at left.

complex geometry of how the petals relate to the other portions of the building. It was particularly useful in assessing how the openings in the petals relate to the structure. For each petal, the geometry was clearly defined using spherical coordinates originating from a geometric center defined in relation to the building grids. The structure and all of the finishes were defined by varying radii. For each petal, the HSS meridians are bent following a radius with a constant curvature. The reduced dimensions of the straight segment latitude sections allowed them to remain within the spherical structural envelope. This decision reduced the cost of bending the shell steel by half.

SGH also developed a system of wood-framed box beams consisting of 2x4s and plywood that span between the ribs of the petals. These box beams, spaced at 2 ft on center along the ribs, provided a convenient way for the contractor to sheath the petals in plywood and install the standing seam copper roofing panels.

Independent Entrance

The connector to the adjacent Katz Library is the new main entrance to both buildings. The connector's structure is laterally independent of both the library and the MKC. The roof of the structure is framed with 3-in. roof deck supported on tapered structural steel wide-flange sections and HSS columns. Lateral load resistance is provided by moment-frame action between the columns and the roof beams. All the steel in the connector is AESS.

Constructed in 1974, the Katz Library is a load-bearing CMU wall building with an open-web joist roof. The portion of the building immediately adjacent to the connector structure formerly housed a lobby, restrooms, audio-visual equipment storage, periodical storage, and the circulation desk. The renovation plans called for this space to be entirely reprogrammed to make way for a new lobby, circulation desk, and access to the MKC. The plans included removing a major interior load-bearing CMU partition and creating a new door opening in the exterior load-bearing CMU wall at the connector. SGH reviewed the original contract documents for the building and investigated the condition of the existing structure, then determined that the seats of the existing roof joists were not adequately braced to prevent sliding. To remove one of the bearing walls, installation of a new structural steel beam was required. The new beam is supported at one end by a steel new HSS column and at the other end by an existing steel column that needed to be reinforced to support the additional load. MSC

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Structural Engineer
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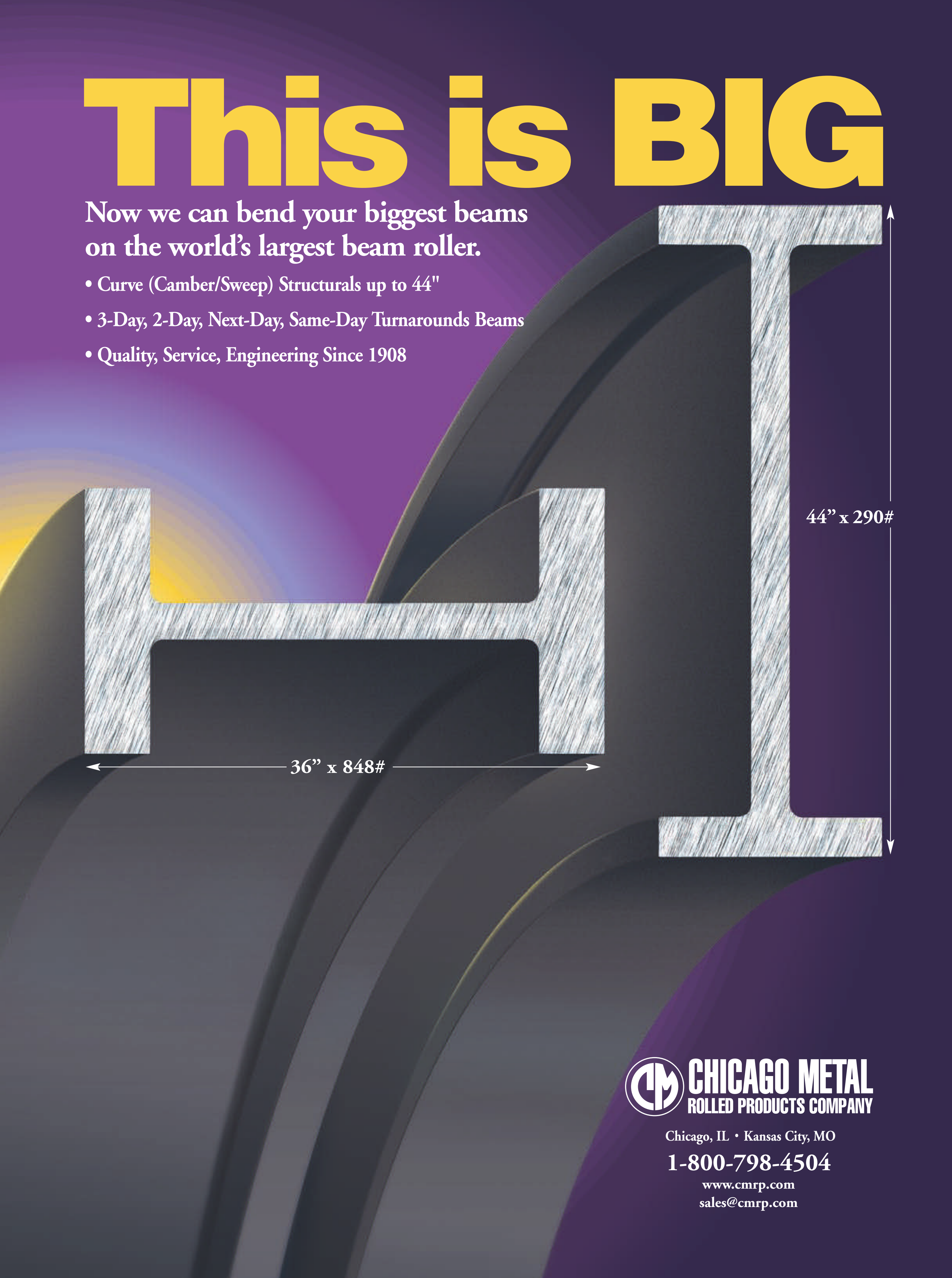
General Contractor
Wright-Ryan Construction, Inc., Portland, Maine

Software
RAM Structural System, RISA 3D


TEREX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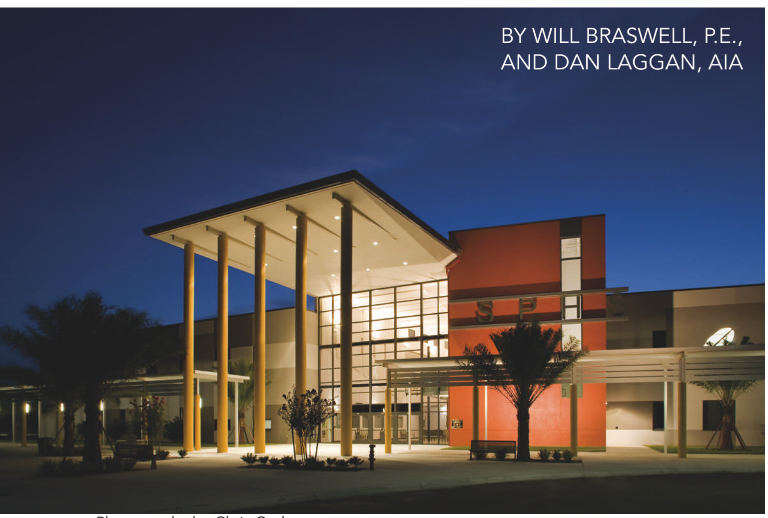
School Days

BY WILL BRASWELL, P.E., AND DAN LAGGAN, AIA



Photography by Chris Casler

An attractive new Florida high school provides not only education, but also a memorable structure.

WHEN YOU THINK BACK TO YOUR HIGH SCHOOL YEARS, what do you remember? For most of us, we first recall our friends, our teachers, and the experience of becoming an adult with new-found challenges and privileges. Sure, we remember the building(s) we entered and exited every school day, but did it have any affect on our education? For some of us, yes, but for most of us, probably not. For those of us that went on to become architects and engineers, we can assist teachers and administrative personnel in the schools we design to develop a sense of pride in their buildings—and perhaps even give students buildings that they'll remember as adults.

Perhaps Suncoast Polytechnical High School (SPHS) in Sarasota, Fla. will become such a school. The school, which opened last August, is very different from the traditional high school, and nothing like the vocational/tech schools of the past. It is organized using the small learning community concept and allows for a seamless integration of core curriculum subjects and career technical education. The flexible and easily adaptable spaces accommodate both group and individual learning styles, which increases collaborative learning. The 600-student station high school contains 16 classrooms and four science laboratories, fine arts and technology education laboratories, raised access flooring, wireless internet access, a grand "Forum" area, and a 10,000-sq.ft outdoor gymnasium.

The school is the first phase of the 72-acre Sarasota Technical Center campus, a complex that will update the existing 40-year old campus over a five-year span to provide training and educational opportunities for the Sarasota community.

Exterior

The first thing that we typically look for when approaching a building for the first time is the signage as an indication that we are at the right place. In the case of SPHS, this sign is actually part of the structural system. The AESS hollow structural section (HSS) members that house SPHS's main signage became the creative result of a lateral bracing issue for the main front wall, which was caused by a continuous window the full height of the tower. This

above left: The signage for Suncoast Polytechnical High School is actually part of the structural system.

above right: Expressive pillars transition to the building's entrance overhang via architectural HSS.

Schenkel Shultz Architecture

left: The site plan for the 72-acre Sarasota Technical Center campus. SPHS is the yellow building.

below: The "Forum" of the building is a showcase for AESS and SmartBeams, which have round holes in the web to allow building services to pass through the beams instead of below them.

"structural signage," spelling out "SPHS," allowed the window to exist and fill the otherwise utilitarian stairwell with natural light.

Further creating a memorable entrance is an expansive roof overhang that creates a unique architectural identity using rectangular HSS members, a thin fascia, and a tapered soffit. The overhang tops five eye-catching yellow cast-in-place concrete pillars that are inspired by the school's "five pillars of education": Quality, People, Service, Resources, and Safety. The span between the curtain wall and the five pillars forced the architect to use deep yet efficient HSS members than what could be squeezed within a rather slender tapered soffit. Instead of increasing the depth of the soffit, the architect chose to highlight the structural members by expressing them as the "five fingers of education" that emerge from the bottom finished surface to visually grasp the front portion of the overhang.

The expansive curtain wall, braced by horizontal HSS wind beams, of the main entry into the school provokes an uplifting invitation to the building and allows students to interact with one another from both levels through the opening of the floor plate at the curtain wall. The space also becomes a "lantern" for those driving by after dusk.

Forum Area

Inside the building, the AESS members frame the "Forum" ceiling neatly and cleanly due to the notable absence of bridging, ductwork, fire sprinklers, and conduit. The spans of the Forum roof beams vary due to the splayed wall lay-out, but instead of varying the member sizes, one member size was chosen and the wall thickness was varied to achieve the necessary strength and stiffness while maintaining economy. Dapping the ends of the beams so that an "underslung" arrangement was achieved allowed for similar detailing as when a bar joist has an extended end. It allowed the edge of the overhang to be thin and unobtrusive. The metal roof deck of the Forum space is an acoustical/cellular type deck with a perforated flat bottom to further accentuate the clean lines and absorb sounds thereby reducing echoes. Plans for an upcoming phase include suspending an elevated interior walkway from the roof with exposed stainless steel cords. The roof beams are SmartBeams, which have round holes in the web to allow fire sprinkler lines and electrical conduit to pass through the beams instead of below them. The SmartBeams are fabricated from standard structural steel wide-flange shapes that are cut longitudinally in a quasi-sine wave pattern at the beam mid-depth to form two pieces. The two pieces are then spread apart, shifted longitudinally with respect to each other and welded back together, thereby increasing the beam depth approximately 50% and the strength and stiffness by approximately 40% while maintaining the same weight. While traditionally used in composite floor systems, we feel that SmartBeams offer an alternative to standard wide-flange shapes for long-span roof systems as well.

The second floor framing is composed of a 3-in. galvanized composite metal deck with 3½ in. of normal weight concrete above the flutes (6½ in. total thickness), which provides a one-hour "unprotected" deck fire rating and excellent vibration characteristics. The concrete slab was reinforced with a blend of steel and polypropylene fibers, with additional mild reinforcing added over the girders to control cracking. The deck bears on composite structural steel beams spaced approximately

10 ft. on center. The beams were cambered an amount equal to 80% of the calculated pre-composite dead load deflection. The filler beams and girders that frame to columns have an inherent greater connection rotational stiffness when compared to the filler-beam-to-girder connection, so a reduced camber is sometimes specified. After careful review of the anticipated pre-composite deflections, we came to the conclusion that we could ignore the differences in the connections, so we chose not to deduct any camber from members connecting to columns. Feedback from the field confirmed our decision, as the floor beams and girders deflected as anticipated so that the specified camber was forced out of the members by the weight of the wet concrete.

The floors, both slab-on-grade and elevated, were recessed in areas to receive access flooring to facilitate easy wiring of the data systems. Consequently, some areas of the elevated floor had to be thicker than the standard 6½ in. because the recessed areas have little relationship to the beam locations. If a step in the slab occurred midway between beams, the recessed slab would be 6½ in. thick but the main slab would be 10½ in. thick if the recess is 4 in. deep. The additional dead load due to the thicker than normal slab was easily accounted for in the RAM Structural System model.

The roof framing consists of a 1½-in. galvanized G90 metal roof deck spanning between open-web bar joists spaced approximately 5 ft on center. This deck was not exposed to view, so a standard wide-rib deck was used and cellular lightweight insulating concrete was placed on it.

In all, 350 tons of steel was used in the building.

Visual Memories

We need to remind ourselves of the importance of how structural elements can creatively enhance architecture and create a greater experience for its intended use, an experience that provokes a clear identity, a sense of spirit, and visual memories—all of which create a strong foundation for students' bright futures. We like to think that SPHS is such a building. MSC

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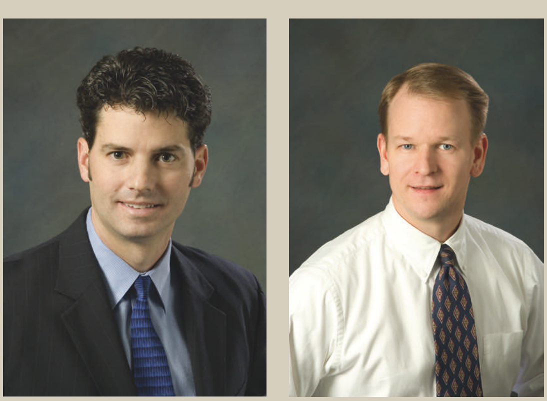
Structural Steel Economy: Revisiting the Assumptions

BY JAY RUBY, P.E. AND JOHN MATUSKA, P.E.

Clarifying what is myth and what is reality when it comes to material and labor costs.

WHILE STEEL PRICES CONTINUE TO RISE AND FALL, responding to market factors, the basic cost equation of structural steel design remains the same: fabrication and erection labor exceeds material costs. Labor remains the largest piece of the puzzle, as illustrated in the chart on the following page. Furthermore, as the percentage increase in steel price is tracked over time, the data indicates that the percentage increase in labor costs has grown in proportion to other costs.

Structural engineers face a myriad of choices as they proceed through the design decision matrix for a project. As decisions are made, careful consideration must be given to use of materials, labor requirements, and schedule implications to deliver the most economical design—a goal that will be even more important in today's economic climate. There are several myths of structural design that have a tremendous impact on economy of design, and addressing them can help you make better design choices:



Jay Ruby is president and CEO Ruby+Associates in Farmington Hills, Mich.; John Matuska is a senior project manager with the firm.

Myth #1: Using less material reduces overall costs.

Design must consider material costs, but minimizing labor (in the shop and in the field) can improve efficiencies in the construction schedule and reduce total cost far more than weight reduction.

In general, designers can minimize labor in the shop by:

- ➜ Discussing fabrication/connection preferences with the fabricator (welding vs. bolting)
- ➜ Avoiding excess welding
- ➜ Allowing use of one-sided simple shear connections
- ➜ Reviewing member sizes as they relate to connection design. For instance, using the lightest member may require a web doubler plate or stiffener to carry the connection forces. Heavier columns and beams minimize reinforcing.

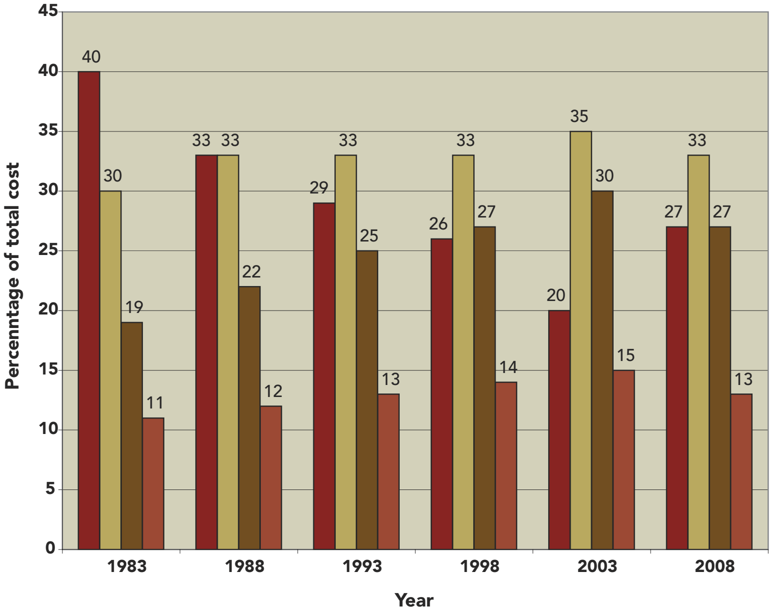
Designers can minimize labor in the field by providing:

- ➜ Simple load paths
- ➜ Systems that have inherent stability during construction
- ➜ Connectability
- ➜ Trade autonomy
- ➜ Trade interface
- ➜ Coordination between design and construction

Erection costs can be increased by using less material. For instance, lighter members (trusses and/or girders) may require additional shoring or erection bracing. This adds labor costs, equipment costs, and field time to the erector's schedule.

For example, during the design phase of the Mercy Hospital of Willard (Ohio) project for which Ruby+Associates was the structural EOR, our team considered using lighter members in several girders, which would have saved thousands of dollars in steel costs. However, when we looked at the big picture, these lighter members would have required shoring prior to placing the concrete, and the construction manager and erector determined it was not worth it due to additional scheduling complexity. In this case, the field costs outweighed the material savings.

Piece count also impacts fabrication and erection costs. Sometimes, in an effort to minimize materials, designers can increase the number pieces required in a structure. Each additional piece requires labor to fabricate, ship, and install, as well as connections at each end to attach it. Reducing piece count, even if material weight increases, can reduce overall costs by reducing labor and simplifying design.



Source: AISC

For example, a structural design with beams spaced at 7 ft, 6 in. on center equates to three beams per 30-ft bay. That's three pieces and six end connections for each bay. By redesigning the beam spacing to 10 ft on center, the count is reduced to two pieces and four end connections. This is a relatively small savings for a single bay, but buildings typically include multiple bays and multiple floors, causing this small savings to grow proportionally.

Design economy also can be achieved by grouping member size. This reduces fabrication costs, simplifies erection, improves quality, and shortens the schedule. This was the case in another medical project with which we were involved. Our original design for St. Vincent Mercy Medical Center Heart Pavilion optimized structural steel weight by using a mix of W18x35s with W21x44s. Our fabricator said it would be cheaper to use all W21x44 members, standardizing all connections and eliminating field confusion.

Myth #2: Designing connections for a percentage of UDL is a simple and effective approach.

Design should follow analysis, not necessarily an arbitrary percentage of the member capacity. As a designer, don't rely solely on the use of "50% of uniform distributed load (UDL)" for connections. Put reactions on design drawings and give fabricators a choice of how to design the connection.

As connection designers, we have seen some very short beams (which, with 50% UDL rule, equate to a very large connection force) require full-depth bolting and web doubler plates at the connections. We suggested designing for the actual member end reaction and were able to eliminate all of the doubler plates, reducing costs significantly.

With today's analysis and design tools, it is easier than ever to provide beam end reactions and member forces on the design documents. This information is invaluable to the steel construction team during the bidding and delivering of projects.

Myth #3: Increase design complexity to reduce material costs.

Increasing design complexity to reduce material costs may actually end up increasing total project costs. Schedule is part of cost; simpler buildings go up faster, reduc-

Ten things to remember when designing steel projects:

- ➜ Least weight isn't always least cost; least labor is least cost.
- ➜ Keep it simple!
- ➜ Heavier columns minimize reinforcing.
- ➜ Heavier beams minimize reinforcing.
- ➜ Design connections for actual reactions.
- ➜ Allow one-sided connections.
- ➜ Don't over-weld!
- ➜ Specify the correct bolt for the job.
- ➜ Integrate your design.
- ➜ Understand how your building will be built.

ing labor costs. Design complexities can be reduced by incorporating:

- ➜ Simple load paths
- ➜ Simple connections
- ➜ Simple fabrication
- ➜ Simple erection

Apply the "KISS" principle: Keep it simple, stupid. Increasing design complexities in labor-intensive areas (such as steel erection and fabrication) in an attempt to reduce material costs addresses the wrong side of the equation. Design should not reduce materials at the expense of labor. Design time should be invested in identifying ways to reduce the labor side of the equation to save project time and money.

Myth #4: Construction methods are not a design concern.

With labor costs accounting for more of the structural construction costs, it is very important for a designer to understand how their building will be built. This understanding and knowledge is a valuable tool to help in making good design decisions. Construction methods directly impact labor costs and schedule.

As a designer, eliminate and minimize:

- ➜ Beam copes
- ➜ Doubler plates
- ➜ Stiffener plates
- ➜ Skewed connections
- ➜ Full moment connections
- ➜ Full-capacity column splices
- ➜ Large beams framing into small beams

During design, consider:

- ➜ Site constraints, access, and lay-down areas
- ➜ Temporary bracing shoring requirements
- ➜ Approaches to minimize field welds

If possible, talk to the fabricator, connection designer, and erector to get feedback on your design approach. Factoring coordination of the other structural parties into the design matrix can significantly shorten a construction schedule—sometimes by bringing significant changes to the design. Working with a fabricator/erector during design and construction of a multi-story facility, we recently suggested a design modification to use a steel core instead of a concrete core. A concrete core would have taken significantly more time to construct in the field, extending the schedule. A steel core was mostly shop fabricated and required less field time.

In addition, when steel members are framed into, or supported by, masonry or concrete, then (depending on how they interface) one trade may be waiting on another trade in the field, or—even worse—interfering with their progress. So coordination with non-structural trades is a good practice to follow as well.

Balancing Costs

When designing a structure, the design matrix must balance material costs, labor costs, and schedule to deliver the most economical design. As the construction industry continues to be challenged with tough economic conditions, this holistic approach to design will become a mandatory element in moving projects forward. MSC

Searching for Value

BY TABITHA S. STINE, P.E., LEED AP

In today's economic climate, pricing and availability are more important than ever when purchasing steel.

AS WE CONTINUE TO WORK in some of the most trying economic times in recent construction history, every piece of a project is being scrutinized in an attempt to save both time and money. In the last 12 months, steel prices have risen at record rates, flattened out, and have now started to fall. This requires specifiers to be more in-tune than ever in the "science" of shape selection so that the chosen shape not only works structurally but is also the most economical section.

On any given project, there are a number of options for how best to acquire the steel. The steel fabricator makes the decision on how the material will be purchased. Fabricators can purchase steel directly from a producer or from a steel service center (warehouse). The factors that contribute to how and where the steel will be acquired vary based on project schedule, material costs, and the fabricator's relationships with both the producers and service centers.

Contact Information for Rolled Shape Producers

ArcelorMittal
www.arcelormittal.com

Bayou Steel
www.bayousteel.com

CMC Steel - Alabama
www.cmcsteel-al.com

Corus
www.corusgroup.com

Gerdau AmeriSteel
www.gerdauameristeel.com

Nucor Bar Mills
www.nucor.com

Nucor-Berkeley
www.nucorsteel.com

Nucor Steel Kankakee
www.nucorbar.com

Nucor-Yamato Steel Co.
www.nucoryamato.com

Steel Dynamics
www.steeldynamics.com

Steel Dynamics Roanoke Bar Division
www.roanokesteel.com

Tabitha S. Stine is AISC's director of technical marketing. She can be reached at ***stine@aisc.org****.*

Today, about 70% of all project steel is being purchased from steel service centers. It is always best to talk with a fabricator early on about prospective material that will be used on a given project. Before you specify a particular size, it is best to work both with the fabricator and their prospective service center and/or mill contacts to discuss various size range availabilities. Also, steel service centers are currently storing approximately three months of inventory that is produced from the mills. Similarly, not all producers manufacture a full range of shapes and sizes.

In the end, material *can* be acquired… but in what time frame, from where, and at what price? In today's unusual economic climate, everyone involved in a project, including the engineer, needs to be aware of these contributing factors so that one can best anticipate any costs or schedule impacts that may arise, particularly from shape selection.

The AISC website is a great resource for checking on shape production by various mills. If you go to **www.aisc.org/steelavailability**, you can view current sizes that are produced by mills in addition to contact information for that mill for specific questions about their production and rolling schedules. For example, if you type in "W18x35" and select "A992" as the grade and then press "search," you can immediately see a list of steel mills that produce that particular size.

The most important thing to understand in general about specifying and selecting sizes is to always remember that least weight is not always least cost. The early involvement of a steel fabricator is critical in evaluating the economic tradeoffs between weight, quantity purchase opportunities, and the number of shop hours required to fabricate the section. For example, sometimes ordering bundles of a particular size at a consistent length can bring cost savings to a job because the least-weight solution may result in low quantities of too many shapes. Selecting members with thicker webs or flanges to handle particular connections (eliminating web stiffeners and doubler plates) should also be considered. In the end, the fabricator can answer many questions early that will help you specify the best shapes for—and bring value to—your next project. **MSC**

Contact Information for AISC Member Steel Service Centers

Alro Steel Corporation	www.alro.com	517.787.5500
Azco Steel Company	www.azcosteel.com	908.754.8700
CCC Steel, Inc. (subsidiary of Reliance)	–	310.637.0111
Chatham Steel Corp. (subsidiary of Reliance)	www.chathamsteel.com	912.233.5751
Delta Steel, LP	www.deltasteel.com	713.623.8080
DuBose Steel Inc. of NC	www.dubosesteel.com	910.525.4161
IMS Steel Company (subsidiary of Reliance)	–	310.637.0111
INFRA-Metals Co.	www.preussag.com	770.641.6460
Intsel Steel Distributors (subsidiary of Triple-S)	www.intselsteel.com	713.937.9500
Lampros Steel	www.lamprossteel.com	503.285.6667
Macsteel Service Centers USA	www.macsteelusa.com	219.933.1000
Metals Supply Company, Ltd.	www.metalssupply.com	713.330.8080
Metals USA - Plates and Shapes Group	www.metalsusa.com	800.523.3340
O'Neal Steel	www.onealsteel.com	205.599.8000
PDM Steel Service Centers, Inc. (subsidiary of Reliance)	www.pdmsteel.com	209.943.0513
R & S Steel (subsidiary of Triple-S)	www.rssteel.com	303.321.9660
Reliance Steel & Aluminum Co.	www.rsac.com	323.582.2272
Saginaw Pipe Co.	www.saginawpipe.com	205.664.3670
Smith Pipe & Steel, Inc. (subsidiary of Delta Steel)	www.deltasteel.com	602.257.9494
Triad Metals International	www.triadmetals.org	215.784.0240
Triple-S Steel Supply & Subsidiaries	www.sss-steel.com	713.697.7105

Simple and Direct

BY R. SHANKAR NAIR, PH.D, P.E., S.E.

The Direct Analysis Method will become the primary method of design for stability in the next AISC *Specification*.

THE DIRECT ANALYSIS METHOD (DAM) OF DESIGN for stability was introduced in the 2005 AISC *Specification for Structural Steel Buildings* (AISC, 2005) to cheers from stability professionals, who recognized it as the most rational and transparent stability design method yet proposed in the U.S.—and to the consternation of many practitioners, who imagined that the arcane art of stability design was about to get even more complicated. But as this brief article will show, the consternation was unwarranted. The DAM is really simple; it consists of just these steps:

- A second-order analysis
- Use of reduced stiffness in the analysis
- Application of a "notional load" in the analysis under certain circumstances
- Strength check of members using $K = 1$ for compressive strength

Second-Order Analysis

Second-order analysis was already required in the 1999 AISC *Specification* (AISC, 1999); this is not a new requirement unique to the DAM. Both P-Δ effects (the effects of loads acting on the displaced locations of joints or nodes in the structure) and P-δ effects (the effects of loads acting on the deformed shapes of individual members) must be considered.

Almost all computer programs that claim to do second-order analysis handle P-Δ effects adequately, but some do not consider P-δ effects. For many (if not most) real-world buildings, it is acceptable to use a program that neglects the effect of P-δ on the overall response of the structure: If the ratio of second-order drift to first-order drift is less than 1.5, and no more than one-third of the total gravity load on the building is on columns that are moment-connected in the direction of translation being considered, the error in a P-Δ-only analysis will be negligible. (It is necessary in all cases to consider the effect of P-δ on individual compression members.)

Instead of doing a rigorous second-order analysis, the designer still has the option of using the familiar "B_1 and B_2" procedure, in which the results of a first-order analysis are amplified by factors B_1 and B_2 to account for second-order effects. Factor B_1, calculated for each beam-column and each direction of bending of the beam-column, accounts for P-δ effects; B_2, calculated for each story of the building and each direction of lateral translation of the story, accounts for P-Δ effects. First-order analysis amplified by B_1 and B_2 is second-order analysis.

The second-order analysis must be conducted for LRFD load combinations. (Note that the principle of superposition does not apply; results for different loads cannot be superimposed.) If ASD is being used, the analysis must be conducted under 1.6 times the ASD load combination and the results divided by 1.6 to obtain the forces and moments for ASD strength checks of components.

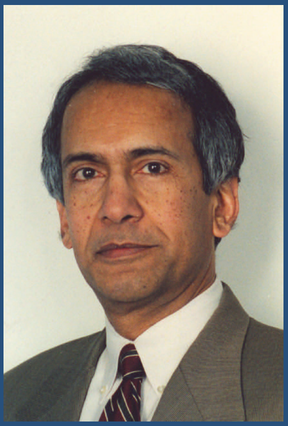
Reduced Stiffness in the Analysis

A factor of 0.8 has to be applied across the board to all stiffnesses in the analysis. An additional factor, τ_b, has to be applied to the flexural rigidity of framed columns in which the axial force (under LRFD load combination or 1.6 times ASD combination) is greater than half the yield force.

In lieu of applying the additional reduction factor τ_b (if there are indeed columns to which the additional factor is applicable), the designer may apply at each floor an additional lateral load of 0.001 times the vertical load applied on that floor.

Application of Notional Loads

A "notional load" (which is an additional lateral load intended to simulate the effects of initial out-of-plumbness of



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COMPARISON OF STABILITY DESIGN METHODS			
	Direct Analysis Method	Effective Length Method	First-Order Analysis Method
Type of analysis	Second-Order	Second-Order	First-Order
Member stiffness in analysis	Reduced EI & EA	Nominal EI & EA	Nominal EI & EA
Notional lateral load?	In some cases	In some cases	Yes; always
Column effective length in strength check	$K = 1$	Sidesway buckling analysis	$K = 1$

the building) must be applied under certain conditions. When required, the magnitude of the notional load on each floor is 0.002 times the vertical load applied on that floor.

If the ratio of second-order drift to first-order drift (a ratio reasonably approxi-mated by the B_2 multiplier) is greater than 1.5, notional loads must be included in all load combinations. If the ratio is less than 1.5, notional loads need to be applied only in gravity-only load combinations; they need not be applied in combination with other lateral loads.

Member Strength Checks

When the forces and moments in members have been determined from the analysis outlined above (second-order reduced stiffness notional loads when applicable), member capacities can be checked using an effective length factor, K, of unity for members subject to compression.

Comparison with Other Methods

The 2005 AISC *Specification* offers three alternatives for the design of structures for stability. The Direct Analysis Method is in Appendix 7. The main body of the *Specification*, in Chapter C, prescribes two methods: the Effective Length Method (ELM) in Section C2.2a and the First-Order Analysis Method (FAM) in Section C2.2b. (Unfortunately, neither method is identified by these names in the *Specification*.) The DAM is applicable to all structures; the ELM and FAM are applicable only to structures for which the ratio of second-order drift to first-order drift is less than 1.5.

The only significant difference between the Direct Analysis Method and the Effective Length Method is that where the DAM uses reduced stiffness in the analysis and $K = 1$ in the member strength check, the ELM uses nominal stiffness in the analysis and K is determined from a sidesway buckling analysis in the strength check of columns in moment frames. In this author's experience, K is rarely calculated properly for real buildings (as opposed to the isolated plane frames typically used in academic exercises).

The First-Order Analysis Method uses mathematical manipulation to achieve approximately (and conservatively) the same results as the Direct Analysis Method. In the FAM, an additional lateral load is applied in a first-order analysis to simulate the effects of a B_2 multiplier, a stiffness reduction, and a notional load; B_1 multipliers are then applied explicitly to all beam columns.

Design for stability under the 1999 AISC *Specification* was generally similar to today's Effective Length Method except that the limit on applicability of the ELM (ratio of second-order drift to first-order drift less than 1.5) and the requirement for a notional load in gravity-only load combinations were not present.

Looking Ahead

In the 2010 AISC *Specification*, now in the later stages of balloting by the AISC Committee on Specifications, the Direct Analysis Method will be the primary method of design for stability; it will be presented in Chapter C while the Effective Length Method and the First-Order Analysis Method will be in an appendix.

The "B_1 and B_2" procedure for approximate second-order analysis will be in a separate appendix, to emphasize that unlike the DAM, ELM and FAM, which are methods of design (defined as the combination of analysis and component strength checking), the B_1–B_2 procedure is simply an analysis technique, applicable wherever a second-order analysis is required.

The focus on the DAM as the primary method of stability design in the 2010 *Specification* offered the opportunity to expand some of the provisions beyond what is in the current *Specification*, both to improve clarity and to address issues that have arisen from use of the document. A preview of the stability design section of the 2010 *Specification* can be found in a paper by this author (Nair, 2009); the paper also outlines the rational basis of the specification provisions and offers suggestions for the modeling of structures for the application of the Direct Analysis Method. MSC

REFERENCES

AISC (1999), *Load and Resistance Factor Design Specification for Structural Steel Buildings*, American Institute of Steel Construction, Inc., Chicago.

AISC (2005), *Specification for Structural Steel Buildings*, American Institute of Steel Construction, Inc., Chicago.

Nair (2009), "A Model Specification for Stability Design by Direct Analysis," *Engineering Journal*, AISC, Vol. 46, No. 1, Chicago.

Are You Properly Specifying Materials?

BY MARTIN ANDERSON AND CHARLES J. CARTER, S.E., P.E.

Keeping tabs on available ASTM Specifications for each structural shape will help you make the right choices when designing your projects.

THE MATERIALS AND PRODUCTS USED IN BUILDING DESIGN and construction are almost universally designated by reference to an appropriate ASTM specification. This simplifies the design and construction process because you can define all the characteristics of a specified product. However, with dozens of ASTM specifications applicable in steel building construction alone, it can be a challenge to keep the standard designations used in contract documents current.

This article provides a summary of the common ASTM specifications used in steel building design and construction, including structural shapes, plate products, fastening products, and other products. This information is based upon similar and more extensive information in the 13th Edition AISC *Steel Construction Manual*. The reader may also find it convenient to use the recently revised AISC publication *Selected ASTM Standards for Structural Steel Fabrication 2008*, which is a compilation of more than 60 steel-related ASTM standards. Both of these publications are available for purchase online at **www.aisc.org/bookstore**.

STRUCTURAL SHAPES

See the summary in Table 2-1.

W-Shapes

The preferred material specification for W-shapes is ASTM A992 (F_y = 50 ksi, F_u = 65 ksi). The availability of W-shapes in grades other than ASTM A992 should be confirmed prior to their specification. W-shapes with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 60 or 65, or ASTM A913 Grades 60, 65, or 70. W-shapes with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 or ASTM A242 Grade 42, 46, or 50. Other material specifications applicable to W-shapes include ASTM A36, ASTM A529 Grade 50 and 55, ASTM A572 Grade 42 and 50, and ASTM A913 Grade 50.

M-Shapes and S-Shapes

The preferred material specification for M- and S-shapes is in transition. ASTM A36 (F_y = 36 ksi, F_u = 58 ksi) has been traditional, but at least one steel producer now sells these shapes in ASTM A572 Grade 50 (F_y = 50 ksi, F_u = 65 ksi) for a lower price than ASTM A36. During this transition, we suggest you ask a fabricator what grade is most common when you use these shapes. The availability of M-shapes in other grades should be confirmed prior to their specification. M-shapes with atmospheric corrosion resistance (weathering) can be obtained by specifying ASTM A588 or ASTM A242 Grade 50. Other material specifications applicable to M- and S-shapes include ASTM A572 Grades 42, 55, 60, and 65, ASTM A529 Grades 50 and 55, ASTM A913 Grades 50, 60, 65, or 70, and ASTM A992.

Channels

The preceding comments for M- and S-shapes apply equally to channels.

HP-Shapes

The preferred material specification for HP shapes is ASTM A572 Grade 50 (F_y = 50 ksi, F_u = 65 ksi); the availability of other grades should be confirmed prior to specification. HP-shapes with atmospheric corrosion resistance (weathering) can be obtained by specifying ASTM A588 or ASTM A242 Grades 46 or 50. Other material specifications applicable to HP-shapes include ASTM A36, ASTM A529 Grades 50 or 55, ASTM A572 Grades 42, 55, 60, and 65, ASTM A913 Grades 50, 60, 65, and 70, and ASTM A992.

Angles

The preferred material specification for angles is ASTM A36 (F_y = 36 ksi, F_u = 58 ksi). The availability of angles in grades other than ASTM A36 should be confirmed prior to their specification. Angles with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 42, 50, 55, 60, or 65, ASTM A529 Grades 50 or 55, ASTM A913 Grades 50, 60, 65, or 70, and ASTM A992. Angles with atmospheric corrosion resistance (weathering)

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Table 2-1

Applicable ASTM Specifications for Various Structural Shapes

Steel Type	ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Min. Yield Stress[a] (ksi)	Applicable Shape Series									
					W	M	S	HP	C	MC	L	HSS Rect.	HSS Round	Pipe
Carbon	A36		36	58-80[b]	▒	■	■	▒	■	■	■			
	A53 Gr. B		35	60										■
	A500	Gr. B	42	58									■	
			46	58								■		
		Gr. C	46	62									▒	
			50	62								▒		
	A501		36	58								▒	▒	
	A529[c]	Gr. 50	50	65-100	▒	▒	▒	▒	▒	▒	▒			
		Gr. 55	55	70-100	▒	▒	▒	▒	▒	▒	▒			
High-Strength Low-Alloy	A572	Gr. 42	42	60	▒	▒	▒	▒	▒	▒	▒			
		Gr. 50	50	65[d]	▒	▒	▒	■	▒	▒	▒			
		Gr. 55	55	70	▒	▒	▒	▒	▒	▒	▒			
		Gr. 60[e]	60	75	▒	▒	▒	▒	▒	▒	▒			
		Gr. 65[e]	65	80	▒	▒	▒	▒	▒	▒	▒			
	A618[f]	Gr. I & II	50[g]	70[g]								▒	▒	
		Gr. III	50	65								▒	▒	
	A913	50	50[h]	60[h]	▒	▒	▒	▒	▒	▒	▒			
		60	60	75	▒	▒	▒	▒	▒	▒	▒			
		65	65	80	▒	▒	▒	▒	▒	▒	▒			
		70	70	90	▒	▒	▒	▒	▒	▒	▒			
	A992		50-65[i]	65[i]	■	▒	▒	▒	▒	▒	▒			
Corrosion Resistant High-Strength Low-Alloy	A242		42[j]	63[j]	▒									
			46[k]	67[k]	▒			▒			▒			
			50[l]	70[l]	▒	▒	▒	▒	▒	▒	▒			
	A588		50	70	▒	▒	▒	▒	▒	▒	▒			
	A847		50	70								▒	▒	

■ Preferred material specification.

▒ Other applicable material specification, the availability of which should be confirmed prior to specification.

☐ Material specification does not apply.

[a] Minimum unless a range is shown.
[b] For W-shapes with flange thickness over 3 in., only the minimum of 58 ksi applies.
[c] For shapes with a flange thickness less than or equal to 1.5 in. only. To improve weldability a maximum carbon equivalent can be specified (per ASTM Supplementary Requirement S78). If desired, maximum tensile stress of 90 ksi can be specified (per ASTM Supplementary Requirement S79).
[d] If desired, maximum tensile stress of 70 ksi can be specified (per ASTM Supplementary Requirement S81).
[e] For shapes with a flange thickness less than or equal to 2 in. only.
[f] ASTM A618 can also be specified as corrosion-resistant; see ASTM A618.
[g] Minimum applies for walls nominally 3/4-in. thick and under. For wall thicknesses over 3/4 in., F_y = 46 ksi and F_u = 67 ksi.
[h] If desired, maximum yield stress of 65 ksi and maximum yield-to-tensile strength ratio of 0.85 can be specified (per ASTM Supplementary Requirement S75).
[i] A maximum yield-to-tensile strength ratio of 0.85 and carbon equivalent formula are included as mandatory in ASTM A992.
[j] For shapes with a flange thickness greater than 2 in. only.
[k] For shapes with a flange thickness greater than 1.5 in. and less than or equal to 2 in. only.
[l] For shapes with a flange thickness less than or equal to 1.5 in. only.

characteristics can be obtained by specifying ASTM A588 or ASTM A242 Grades 46 or 50.

Structural Tees

The Structural tees are split from W-, M-, and S-shapes to make WT-, MT- and ST-shapes respectively. For the preferred material specifications, as well as other suitable material specifications for structural tees, refer to the preceding sections on W-, M- or S-shapes as appropriate.

Rectangular (and Square) HSS

The preferred material specification for rectangular HSS is ASTM A500 Grade B (F_y = 46 ksi, F_u = 58 ksi), although ASTM A500 Grade C (F_y = 50 ksi, F_u = 62 ksi) continues to be common. The availability of rectangular HSS in grades other than ASTM A500 Grade B should be confirmed prior to their specification. Rectangular HSS with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A847. Other material specifications applicable to rectangular HSS include ASTM A501 and ASTM A618.

Round HSS

The preferred material specification for round HSS is ASTM A500 Grade B (F_y = 42 ksi, F_u = 58 ksi), although ASTM A500 Grade C (F_y = 46 ksi, F_u = 62 ksi) continues to be common. The availability of round HSS in grades other than ASTM A500 Grade B should be confirmed prior to specification. Round HSS with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A847. Other material specifications applicable to round HSS include ASTM A501 and ASTM A618. See also items 4 and 5 in the sidebar "10 Important Tidbits."

Steel Pipe

The preferred (and only) material specification for steel pipe used in structural applications is ASTM A53 Grade B (F_y = 35 ksi, F_u = 60 ksi). See also items 4 and 5 in the sidebar "10 Important Tidbits."

PLATE PRODUCTS

See the summary in Table 2-2.

Structural Plates

The preferred material specification for structural plates is ASTM A36 (F_y = 36 ksi for plate thickness equal to or less than 8 in., F_y = 32 ksi otherwise; F_u = 58 ksi). The availability and cost-effectiveness of structural plates in grades other than ASTM A36 should be confirmed prior to their specification. Note also that the availability of grades other than ASTM A36 varies through the range of thicknesses as shown in Table 2-2. Structural plates with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 42, 50, 55, 60, or 65, ASTM A529 Grade 50 or 55, ASTM A514 Grade 90 or 100, or ASTM A852. Structural plates with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 or ASTM A242 Grade 42, 46, or 50.

Structural Bars

The preceding comments for structural plates apply equally to structural bars, except that neither ASTM A514 nor A852 are applicable.

Table 2-2

Applicable ASTM Specifications for Plates and Bars

Steel Type	ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Min. Yield Stress[a] (ksi)	Thickness: to 0.75 incl.	0.75 to 1.25 incl.	1.25 to 1.5 incl.	over 1.5 to 2 incl.	over 2 to 2.5 incl.	over 2.5 to 4 incl.	over 4 to 5 incl.	over 5 to 6 incl.	over 6 to 8 incl.	over 8
Carbon	A36		32	58-80										■
			36	58-80	■	■	■	■	■	■	■	■	■	
	A529	Gr. 50	50	70-100	▨	▨ b	▨ b	▨ b	▨ b					
		Gr. 55	55	70-100	▨	▨ b	▨ b							
High-Strength Low-Alloy	A572	Gr. 42	42	60	▨	▨	▨	▨	▨	▨	▨	▨		
		Gr. 50	50	65	▨	▨	▨	▨	▨	▨				
		Gr. 55	55	70	▨	▨	▨	▨						
		Gr. 60	60	75	▨	▨								
		Gr. 65	65	80	▨	▨								
Corrosion Resistant High-Strength Low-Alloy	A242		42	63				▨	▨	▨				
			46	67		▨	▨							
			50	70	▨									
	A588		42	63								▨	▨	
			46	67							▨			
			50	70	▨	▨	▨	▨	▨	▨				
Quenched and Tempered Alloy	A514[c]		90	100-130						▨	▨	▨		
			100	110-130	▨	▨	▨	▨	▨					
Quenched and Tempered Low-Alloy	A852[c]		70	90-110	▨	▨	▨	▨	▨	▨				

■ Preferred material specification.

▨ Other applicable material specification, the availability of which should be confirmed prior to specification.

☐ Material specification does not apply.

[a]Minimum unless a range is shown.
[b]Applicable to bars only above 1-in. thickness.
[c]Available as plates only.

Changes to A490: Introducing F1136 Grade 3

Hydrogen embrittlement concerns have always meant that ASTM A490 bolts are not permitted to be galvanized. This has always left the question of what to do when the A490 strength level is desired and the structure is galvanized.

Research was undertaken to qualify a metallic coating suitable for use on A490 bolts, following the procedures provided by IFI-144 ("Test Evaluation Procedures for Coating Qualification Intended for Use on High-Strength Structural Bolts") and using a coating system meeting the requirements of ASTM F1136 Grade 3 ("Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners"). Accordingly, the ASTM A490-08a revision allows ASTM F1136 Grade 3 coatings to be applied to A490 bolts (see Section 4.3.1 & 4.3.2).

The application of an F1136 Grade 3 coating is a multi-step process of cleaning via alkaline bath and mechanical blast, followed by two coating layers that are applied and cured each in turn before a final seal coat is applied and cured. Acid is not involved at any stage in the process. The resulting silvery finish has a thickness of around 0.4 mils (9.25 microns), whereas equivalent hot-dip galvanizing would be on the order of 4 mils (90 microns), or 3 mils (65 microns) for mechanical galvanizing. If desired, paint may be applied on top of the F1136 Grade 3 coating.

The Research Council on Structural Connections provides the research report on their website at **http://boltcouncil.org/files/IBECAResearchReport6-02.pdf**. However, note that at present neither the RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" nor the AISC Specification recognize the use of F1136 Grade 3 coatings, as they were written prior to completion of the relevant research and subsequent acceptance in A490-08a.

Table 2-3

Applicable ASTM Specifications for Various Types of Structural Fasteners

ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Min. Yield Stress[a] (ksi)	Diameter Range (in.)	Applicable Product: High-Strength Bolts: Conventional	High-Strength Bolts: Twist-Off-Type Tension Control[d]	Common Bolts	Nuts	Washers	Direct-Tension-Indicator Washers	Threaded Rods	Shear Stud Connectors	Anchor Rods: Hooked	Anchor Rods: Headed	Anchor Rods: Threaded & Nutted
A108		–	65	0.375 to 0.75, incl.								■			
A325[d]		–	105	over 1 to 1.5 incl.	■										
		–	120	0.5 to 1, incl.	■										
A490		–	150	0.5 to 1.5	■										
F1852		–	105	1.125		■									
		–	120	0.5 to 1, incl.		■									
F2280		–	150	0.5 to 1.125		■									
A194 Gr. 2H		–	–	0.25 to 4				▒							
A563		–	–	0.25 to 4				■							
F436[b]		–	–	0.25 to 4					■						
F959		–	–	0.5 to 1.5						■					
A36		36	58-80	to 10							■		▒		▒
A193 Gr. B7[e]		–	100	over 4 to 7							▒		▒		▒
		–	115	over 2.5 to 4							▒		▒		▒
		–	125	2.5 and under							▒		▒		▒
A307 Gr. A		–	60	0.25 to 4			■							▒	
A354	Gr. BC	–	115	2.5 to 4 incl.	c						▒		▒	▒	▒
		–	125	0.25 to 2.5, incl.	c						▒		▒	▒	▒
	Gr. BD	–	140	2.5 to 4 incl.	c						▒		▒	▒	▒
		–	150	0.25 to 2.5, incl.	c						▒		▒	▒	▒
A449		–	90	1.75 to 3 incl.	c						▒		▒	▒	▒
		–	105	1.125 to 1.5, incl.	c						▒		▒	▒	▒
		–	120	0.25 to 1, incl.	c						▒		▒	▒	▒
A572	Gr. 42	42	60	to 6							▒		▒		▒
	Gr. 50	50	65	to 4							▒		▒		▒
	Gr. 55	55	70	to 2							▒		▒		▒
	Gr. 60	60	75	to 1.25							▒		▒		▒
	Gr. 65	65	80	to 1.25							▒		▒		▒
A588		42	63	over 5 to 8, incl.							▒		▒		▒
		46	67	over 4 to 5, incl.							▒		▒		▒
		50	70	4 and under							▒		▒		▒
A687		105	150 max.	0.625 to 3							▒		▒		▒
F1554	Gr. 36	36	58-80	0.25 to 4									■	■	■
	Gr. 55	55	75-95	0.25 to 4									▒	▒	▒
	Gr. 105	105	125-150	0.25 to 3									▒	▒	▒

■ Preferred material specification.

▒ Other applicable material specification, the availability of which should be confirmed prior to specification.

□ Material specification does not apply.

–Indicates that a value is not specified in the material specification.
[a]Minimum unless a range is shown or maximum (max.) is indicated.
[b]Special washer requirements may apply per RCSC Specification Table 6.1 for some steel-to-steel bolting applications and per Part 14 for anchor-rod applications.
[c]See AISC Specification Section J3.1 for limitations on use of these products as bolts.
[d]When atmospheric corrosion resistance is desired, Type 3 can be specified.
[e]For anchor rods with temperature and corrosion resistance characteristics.

Raised-Pattern Floor Plates

ASTM A786 is the standard specification for rolled steel floor plates. As floor-plate design is seldom controlled by strength considerations, ASTM A786 "commercial grade" is commonly specified. If so, per ASTM A786 Section 5.1.3, "the product will be supplied with 0.33 percent maximum carbon, by heat analysis, and without specified mechanical properties." Alternatively, if a defined strength level is desired, ASTM A786 raised-pattern floor plate can be ordered to a defined plate specification such as ASTM A36, A572, or A588; see ASTM A786 Sections 5.1.3 and 8.

Sheet and Strip

Sheet and strip products, which generally are thinner than structural plate and bar products, are produced to such ASTM specifications as A606, A1008, or A1011. Previously A570 and A607 were listed. These standards have been withdrawn and the materials covered by them are now in A1008, A1011, and (for thicker materials) A1018. These are "umbrella" standards with many types and grades; the structural steel type is designated "SS" and the standards provide for grades from 25 or 30 to 80. Availability should be checked before specifying the grade.

FASTENING PRODUCTS

See the summary in Table 2-3.

Conventional Bolts

The preferred material specification for conventional (heavy hex) high-strength bolts in steel-to-steel connections is ASTM A325, although ASTM A490 can be specified when higher strength is desired. In either case, Type 1 is the most commonly specified (medium-carbon steel). When atmospheric corrosion resistance is desired, Type 3 can be specified. While still formally permitted in the AISC Specification, the use of other bolt material specifications like ASTM A307 in steel-to-steel bolting applications has become quite uncommon.

In the rare cases when diameters larger than 1½ in. are required, the upper limit of ASTM A325 and A490 is exceeded. To cover these cases, ASTM A354 Grade BC and A449 are permitted to be used as bolts for A325 strength level, and ASTM A354 Grade BD is permitted for A490 strength level. Note that these standards are material standards, not bolt standards, so the desired head and threading dimensions must be specified as per ANSI ASME B18.2.6 heavy hex class 2A.

Twist-Off Type Tension-Control Bolt Assemblies

The preferred material specification for twist-off type tension-control bolt assemblies is ASTM F1852 (which offers the strength level of ASTM A325 bolts), although ASTM F2280 (which offers the strength level of ASTM A490 bolts) can be specified when higher strength is desired. In either case, Type 1 is the most commonly specified (medium-carbon steel). When atmospheric corrosion resistance is desired, Type 3 can be specified. The use of these devices must conform to the requirements in the RCSC Specification, which provides detailed requirements for pre-installation verification (Section 7), installation (Section 8) and inspection (Section 9).

Nuts

The preferred material specification for heavy-hex nuts is ASTM A563. The appropriate grade and finish is specified per ASTM A563 Table X1.1 according to the bolt or threaded part with which the nut will be used. For steel-to-steel structural bolting applications, the appropriate grade and finish is summarized in the RCSC Specification Section 2.4. If its availability can be confirmed prior to specification, ASTM A194 Grade 2H nuts are permitted as an alternative, as indicated in the RCSC Specification Table 2.1.

Washers

The preferred material specification for hardened steel washers is ASTM F436. This specification provides for both flat and beveled washers. While standard ASTM F436 washers are sufficient in most applications, there are several specific applications when special washers are required. The special washer requirements in RCSC Specification Section 6 apply when oversized or slotted holes are used in the outer ply of a steel-to-steel structural joint.

In anchor rod and other embedment applications, hole sizes generally are larger than those for steel-to-steel structural bolting applications. Accordingly, washers used in such applications generally are larger and might require design consideration for proper force transfer, particularly when the anchorage is subject to tension. Table 14-2 in the 13th Edition AISC *Steel Construction Manual* discussed the use of ASTM F844 washers in some of these applications.

Compressible-Washer-Type Direct-Tension Indicators

When bolted joints are specified as pretensioned or slip-critical and the direct-tension-indicator pretensioning method is used, ASTM F959 compressible-washer-type direct-tension indicators are specified. Type 325 is used with ASTM A325 high-strength bolts and type 490 is used with ASTM A490 high-strength bolts. The use of these devices must conform to the requirements in the RCSC Specification, which provides detailed requirements for pre-installation verification (Section 7), instal-

lation (Section 8), and inspection (Section 9). The RCSC Specification also permits alternative washer-type indicating devices subject to the provision in Section 2.6.2.

Anchor Rods

The preferred material specification for anchor rods is ASTM F1554, which covers hooked, headed, and threaded and nutted anchor rods in three strength grades: 36, 55, and 105. ASTM F1554 Grade 36 is most commonly specified, although grades 55 and 105 also are normally available. ASTM F1554 Grade 36 may be welded, while Grade 55 may be welded if it is ordered with Supplement S1 and the carbon equivalent formula in Section S1.5.2.1. Grade 105 is not suitable for welding, as the heat may detrimentally affect the product. Other material specifications applicable to headed anchor rods include ASTM A307, A354, and A449. For applications involving rods that are not headed, ASTM A36, A193, A307, A354, A449, A572, A588, and A687 can be specified. For applications involving headed rods, note that Grade C has been deleted from ASTM A307 and replaced by ASTM F1554 Grade 36.

Threaded Rods

The preferred material specification for threaded rods, whether provided with plain or upset ends, is ASTM A36. Other material specifications applicable to threaded rods include ASTM A193, A307, A354, A449, A572, A588, and A687.

Shear Stud Connectors

The preferred material specification for shear stud connectors used for the interconnection of steel and concrete elements in composite construction is ASTM A29 provided as defined in ASTM A108. The mechanical requirements are stated in AWS D1.1 Table 7.1 for Type B shear stud connectors (F_y = 50 ksi, F_u = 65 ksi).

Forged Steel Structural Hardware

Forged steel structural hardware products, such as clevises, turnbuckles, eye nuts, and sleeve nuts occasionally are used in building design and construction. These products are generally provided to AISI material specifications. AISI C-1035 is commonly used in the manufacture of clevises and turnbuckles. AISI C-1030 is commonly used in the manufacture of steel eye nuts and steel eye bolts. AISI C-1018 Grade 2 is commonly used in the manufacture of sleeve nuts. Other products, such as steel rod ends, steel yoke ends and pins, cotter pins, and coupling nuts are provided generically as "carbon steel." The dimensional and strength characteristics of these devices are described in the literature provided by their manufacturer. Note that such information often is provided as a safe working load and based upon a factor of safety as high as 5, assuming that the product will be used in rigging or similar applications subject to dynamic loading. If so, the tabular value might be overly conservative for permanent installations and similar applications subject to static loading only. In these applications, a factor of safety of 3 is more common.

Filler Metal

The appropriate filler metal for structural steel is summarized in ANSI/AWS D1.1 Table 3.1 for the various combinations of base metal specification and grade, and electrode specification. A tensile strength level of 70 ksi is indicated for the majority of the commonly used steels in building construction.

OTHER PRODUCTS

Steel Castings and Forgings

Steel castings are specified as ASTM A216/A216M Grade WCB with Supplementary requirement S11. Steel forgings are specified as ASTM A668.

Crane Rails

Crane rails are furnished to ASTM A759, ASTM A1 and/or manufacturer's specifications and tolerances. Rail is designated by unit weight in units of pounds per yard. Dimensions of common rail are shown in Table 1-21 in the 13th Edition AISC *Steel Construction Manual*. Most manufacturers chamfer the top and sides of the crane rail head at the ends (unless specified otherwise) to reduce chipping of the running surfaces. Often crane rails are ordered as end-hardened, which improves the resistance of the crane rail ends to impact from contact with the moving wheel during crane operation. Alternatively, the entire rail can be ordered as heat-treated. When maximum wheel loading or controlled cooling is needed, refer to manufacturer catalogs. Purchase orders for crane rails should be noted "for crane service." Light 40-lb rails are available in 30-ft lengths, standard rails in 33-ft or 39-ft lengths, and crane rails up to 80 ft. Consult manufacturer for availability of other lengths. Rails should be arranged so that joints on opposite sides of the crane runway will be staggered with respect to each other and with due consideration to the wheelbase of the crane. Rail joints should not occur at crane girder splices. Odd lengths that must be included to complete a run or obtain the necessary stagger should be not less than 10 ft long. Rails are furnished with standard drilling in both standard and odd lengths unless stipulated otherwise on the order. MSC

10 Important Tidbits

1. When in doubt, check it out. Have questions about availability? Call a fabricator or the AISC Steel Solutions Center (**solutions@aisc.org**). Either one can keep you swimming in available steel.

2. Remember that quantity means economy! Repetitive use of similar shape sizes brings the total cost of steel construction down. Best advice: Strive to use enough of any individual shape specified so that the quantity on the job is a mill order quantity–generally about 20 tons. The small cost of additional weight will be offset easily by the economies of mill ordering cost savings and detailing, fabrication, and erection similarity.

3. Times change. ASTM A992 originally was introduced covering only W-shapes. A recent revision to this ASTM standard expanded its scope to include other hot-rolled structural cross-sections (channels, angles, M-shapes, etc.), allowing them to be made to ASTM A992. Nevertheless, A992 is still not very common in shapes other than W-shapes.

4. Round HSS ≠ Steel Pipe. Know the difference between ASTM A500 and ASTM A53. ASTM A500 is for HSS (F_y = 42 ksi for grade B; 46 ksi for grade C). ASTM A53 is for steel pipe (F_y = 35 ksi).

5. But round HSS are similar to steel pipe. Know the similarity between available round HSS (ASTM A500) and steel pipe (ASTM A53). Generally speaking, only round HSS with the same cross-sectional dimensions as steel pipe are stocked and available. So avoid specifying a round HSS with a cross section that does not match up to one of the steel pipe cross-sections. This is a lot easier than it sounds; just use round HSS with non-zero numbers after the decimal point in the diameter. For example, HSS 5.563x0.258 has the same cross section as a Pipe 5 Std. And it generally will be available, while HSS 5.000x0.250 is an HSS-only product and will require a mill order quantity to obtain.

6. Properly designate your HSS. A round HSS is designated by nominal diameter and wall thickness, each expressed to three decimal places—for example, HSS 5.563x0.258. A square or rectangular HSS is designated by nominal outside dimensions and wall thickness, each in rational numbers—for example, HSS 5x3x⅜.

7. Properly designate your steel pipes. Use nominal pipe size (NPS) designation through NPS 12—for example, Pipe 5 Std., Pipe 5 x-strong or Pipe 5 xx-strong. Note that this notation has commonly been abbreviated as follows for the examples given: P5, PX5 and PXX5, respectively. Above NPS 12, use the format "Pipe" followed by diameter x nominal wall thickness, each expressed to three decimal places—for example, NPS 14 Standard is designated Pipe 14.000x0.375. The latter format also applies to any steel pipe size smaller than NPS 12 that does not have an NPS size.

8. Don't confuse anchor rods with bolts. Do not specify your anchor rods as ASTM A325 or A490. ASTM A325 and A490 are for headed bolts, with limited thread length, generally available only up to 8 in. in length, and governed by provisions for steel-to-steel structural joints only. You say you've always specified your anchorage devices this way and it's never been a problem? Well, the reality is that your fabricator has been awfully nice to not embarrass you by pointing out that you've specified a product that does not come in the length you likely specified—or as a hooked or longer-threaded rod. Use ASTM F1554, which covers hooked, headed, and threaded/nutted rods in three strength grades.

9. Have all the information at your fingertips. More extensive information can be found in the 13th Edition *Steel Construction Manual* and the AISC publication *Selected ASTM Standards for Steel Construction*, both of which are available at **www.aisc.org/bookstore**.

10. When in doubt, check it out. Oh wait, this is number 1. Well, it is important and therefore bears repeating.

A Website Reborn

BY BRIAN RAFF

Quality Management Company's revamped online presence makes it easier than ever to learn about AISC Certification.

ANOTHER YEAR HAS PASSED, and what a success it has been for the AISC Certification program! Since November 2007, the program has seen a 9% increase of Certified fabricators (from 694 to 763) and a 26% increase in Certified erectors (from 116 to 155). In addition to increasing the number of program participants, AISC has also launched a new Certification program to support bridge and highway metal component manufacturers. With continual improvement taking place within the AISC Certification program, Quality Management Company (QMC) has kept the momentum going by revamping its website to reflect and better support these program changes.

If you are familiar with the old QMC website, you know that it contained a wealth of resources to help prospective fabricators and erectors through the rigorous Certification process. These resources have not disappeared, but they have been reorganized to make the process of becoming Certified easier.

Intuitively, it makes sense to organize the resources in a way that links to the actual certification process. Instead of having people search through a global list of resources, QMC has compartmentalized the appropriate requirements as they relate to the actual process of Certification. This means that if you are interested in becoming certified, you no longer have to guess which resources are required or appropriate at a particular stage in the process. You simply visit the section that corresponds to your *current* status within the Certification process to find all applicable documents.

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

For example, if you are a building fabricator and have turned in your application and paid the required fees but have not completed writing your quality manual, you would visit the Documentation Audit section under the Building Fabricator heading (Figure 1) to view everything that needs to be addressed in your manual and corresponding paperwork. For a quick review of the Certification process, you can find and download the process flowchart by clicking on the Become Certified link at the top of the page.

Another example would be an erector that has passed their documentation audit and scheduled their on-site audit. What can this erector do to ensure that their on-site audit is successful? They can visit the On-Site Audit section under the Erectors heading (Figure 2) to view the appropriate program requirements and audit policies that will be checked by the auditor.

Resources

Although this new organizational scheme makes it easier for prospective companies to become Certified, there is something to be said for having many different program resources all in one place. Why not have your cake and eat it too? Through a comprehensive analysis of how our old website was used, it was clear that the resources section was the most used section of the site. By grouping most of the resources in one section, it gives specifiers, owners, and contractors the opportunity to browse different program requirements without having to look too deeply into the site. Fabricators can also find sample procedures and a sample quality manual in the resources section.

About Us

By now, you are probably eager to check out the new QMC website for yourself. When you do, the first thing you'll notice on the home page is the friendly face of one lucky QMC staffer, which will change periodically. The purpose of this portrait is to introduce the industry to the people who dedicate their professional lives to the overall quality of the steel construction industry. If you would like to familiarize yourself with the rest of the staff, click on the About Us link across the top of the home page.

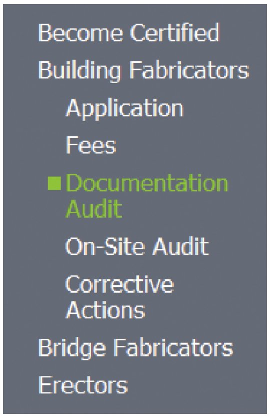


Figure 1

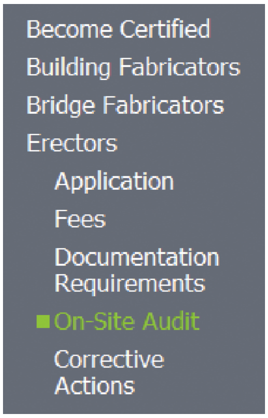
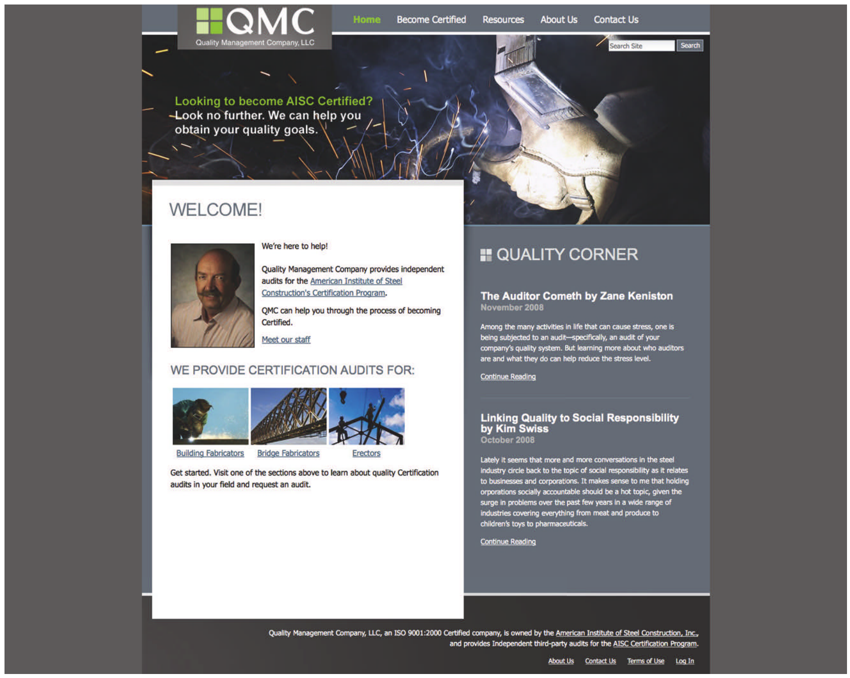


Figure 2

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**.

Quality Corner

If you are reading this article, then it is fair to assume that you are familiar with the objectives of Quality Corner, AISC Certification's monthly feature in MSC. But did you know that you can access every Quality Corner ever written, online? To get you started, the two most recent Quality Corners are featured news items located on the right side of the QMC home page. For all other archived Quality Corner articles, visit **www.modernsteel.com**.



Contact Us

One of the main purposes of this new website is to provide as much helpful information as we can to make the process of AISC Certification easier. Looking to speak with someone in particular? You can find each team member's name, title, and individual e-mail address in the Contact Us portion of the site.

We are extremely excited about the new QMC website and have received some enthusiastic feedback about it so far. However, we understand that these kinds of projects always represent a moving target. If you have any suggestions for additional resources, program information, or general improvements to the site, I would love to hear about them. You can email me directly at **raff@aisc.org** or call 312.670.2400. Last year was a very positive one for AISC Certification and QMC, and we look forward to an even better year serving the steel construction industry in 2009. **MSC**

Flynn ON HEALTHCARE

ARCHITECTS "I particularly enjoy working with architects at the beginning of a project because, well, that is when the most creative structural solutions are born. We have to really understand the architect's vision, their goals, to provide world-class structural design for our healthcare projects. For hospitals, that means understanding the relationships between the different departments, the desired design aesthetic, the project goals and challenges, and how best to deliver all of this within an established budget. It's never a cookie-cutter design! We deliver the most value to the project when we participate in the process early."

Lanny J. Flynn, P.E., S.E. Principal. Heads up the Healthcare Specialist Group at Magnusson Klemencic Associates. Harmonizes creativity with structural engineering. Appreciates the flexibility of steel shapes to enhance the vision of today's architects and healthcare facilities.

PATIENT CARE "The primary focus of hospitals is patient care, which demands intense medical, mechanical and electrical systems with very rigid architectural requirements…efficient staff circulation and patient flow, acuity adaptable rooms, patient- and family-friendly spaces, and integration of infrastructure. There are also required levels of transparency, as well as stringent vibration criteria for sensitive equipment and procedures. The structure must support all these demands and be flexible enough to change rapidly. Steel structural systems are great for this type of design. As hospitals bring in new technologies and adjust patient care strategies, steel structures are able to easily morph to make these modifications possible."

SEISMIC "Hospitals need to function after an earthquake, so Codes impose more stringent requirements on their design. Steel is a wise choice, because it is a very ductile and predictable material. One of our recent hospital designs involved a 700,000-square-foot expansion and utilized a unique steel bracing system with a well-defined ductile steel core designed to dissipate the energy imparted by an earthquake. That system actually bettered code requirements and, because of the steel bracing system, actually reduced the structural costs of the foundation system and columns. The hospital not only saved money, but also received a better-performing building."

PERFORMANCE-BASED "MKA has taken a leadership role in the development of performance-based seismic design for new buildings, with over 3 dozen successful projects. A performance-based approach is becoming the trend in seismic design, rather than prescriptive Code-based structural design. Performance-based design involves a very detailed analytical process that identifies anticipated demands on structural elements and sets parameters of acceptable performance for each element. Armed with that knowledge, we proportion and create the structure to support those criteria. In light of the benefits to be gained by the industry, MKA has even sponsored physical testing to verify performance and further advance the technology."

FAST TRACK "Hospitals are about patient care, but the financial part of the operation is equally important. If you are not successful financially, you can't deliver the best patient care. Steel pays the dividends on fast track construction, and for hospitals, fast track is always an issue. The shorter the construction, the faster they can treat patients!"

DESIGN "Twenty years ago, hospitals were more institutional. They had repetitive grids, boring public areas, and drab décor. Today's hospitals incorporate amenities you see in five-star hotels, and the framing is moving away from institutional to the longer spans of steel. In one of our recent hospital designs, a portion of the patient-care wing was cantilevered 120 feet. Steel made it possible."

BIM "Our firm has been doing this for quite some time, even though the transition to BIM (Building Information Modeling) is occurring as we speak. We actually use a BIM delivery system for all of our hospital designs, because of the benefits it provides in coordinating structure with the intense MEP systems and Architectural requirements embedded in modern healthcare design. In one hospital where we used a BIM delivery, all the structural steel framing was developed in 3D object-based design. The mechanical routing of the intense duct work and HVAC systems through the interstitial truss work was shown, and a lot of conflict checking and coordination occurred early on in the design phases avoiding downstream coordination issues. BIM is a real time saver, and steel is leading the way."

TRANSPARENCY "Today's healthcare designs call for openness and controlled transparency. Small, sleek structural members and long spans aid in supporting this concept. Steel systems are an excellent choice to create open and transparent spaces which help to improve the experience of the patient and the patient's family and friends."

STEEL "Owners saving money, saving time, increasing building performance, and lengthening the hospital's service life is what steel is all about. You have more ability to dial-in performance with steel."

The Many Faces of AISC

BY TODD ALWOOD

AISC regional engineers: Who we are and what we do.

DID YOU KNOW THAT AISC has eight regional engineers who cover the entire country? Do you know what a regional engineer is or does, for that matter?

Eight regional engineers (REs) means eight different definitions of the job title (nine, if you include AISC's director of technical marketing, Tabitha Stine, who manages the REs), but all of them boil down to one common theme: increasing the use and market of structural steel by making it the material of choice. How we go about doing this differs by person and region, and that is what the eight of us will be sharing with you in this new column.

Each month, we'll take turns offering you a view into our day-to-day work—from our travels throughout our regions to issues affecting our local membership. Not only will this column give you a glimpse of our efforts in promoting structural steel, it will also give readers in our respective regions a chance to get to know us a little better.

Since I'm up first, here's a little background information on myself and how I came to be at AISC. I grew up on a small farm in central Illinois. Even my high school was named after farming—Farmington High School—and our mascot was a farmer! I attended the University of Illinois at Urbana-Champaign (more cornfields) for both my undergrad and graduate degrees—undergrad in architecture and graduate in structural engineering. I spent my senior year studying abroad in Versailles, France (10 miles outside Paris and near very little corn).

After college, I worked at PSA in Peoria, Ill. for six months before realizing that big-city life was a better fit for this small-town boy. I worked at Teng Associates in Chicago for three years on projects across the country and had the opportunity to work with Shankar Nair. I joined AISC more than six years ago by way of meeting a former AISC vice president, Bobbi Marstellar, at a friend's party. I was involved with the Steel Solutions Center for four years and have been an RE for the past two years. My region includes Wisconsin, Illinois, Michigan, Indiana, and Ohio.

One of the ways I try to accomplish our goal of promoting steel is to be as active as possible in several regional associations, which range from fabricators to contractors to architectural groups. One fabricator group I'm involved with is the Ohio Steel Association, which hosts quarterly meetings to educate their membership on current issues and also acts as a forum for updates from AISC and industry suppliers. They also host periodic breakfast meetings to reach out to design professionals, and offer several scholarships to students in Ohio. I act as a director in this association, which allows me to work with the board in developing education topics for both members and the design professionals they are trying to reach. I also have the opportunity to continually remind the group of the resources AISC has at its disposal, such as the Steel Solutions Center and Steel Talks (**www.aisc.org/seminars**). Other fabricator groups that I am actively involved with are the Bi-State Fabricators Association, Central Fabricators Association, and Indiana Fabricators Association. (You can find a complete list of associations in your area by visiting **www.aisc.org** and clicking "Find a Company or Person.")

In the coming months, if not by the time you're reading this copy of MSC, each RE will have his or her own personalized web site (linked from **www.aisc.org**). Mine will feature links for the above associations (along with other engineering, architectural, and contracting associations), plus upcoming trips, presentations, conferences, and a blog—and maybe even my Facebook link!

I look forward to giving MSC readers a better understanding of our multi-faceted position here at AISC, as well as the variety of groups, individuals, firms, projects, etc. we are reaching out to on a daily basis. As always, please feel free to reach out to your RE! MSC

*Todd Alwood is the Upper Midwest Regional Engineer for AISC. He can be reached at **alwood@aisc.org**.*

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Technical Seminars ✤ Networking ✤ Product Showcase
for Structural Engineers, Detailers, Erectors, and Fabricators

Who attends?

More than 3,700 structural engineers, steel fabricators, erectors, detailers, educators, and others involved in the design and construction of fabricated steel attend the conference each year. In addition to conference seminars, attendees have many networking opportunities, including the annual Fabricator Workshops, where fabricators can exchange ideas in a non-competitive environment.

What about the exhibit hall?

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What will I learn?

Learn about topics ranging from gusset plates for seismic construction to structural integrity in buildings to HSS design. Some sessions focus on technical issues while other focus on fabrication, erection, or detailing. But all attendees are welcome to attend any of the sessions, regardless of track. In addition to our regular technical sessions, we've also invited some of the industry's top professors and some of the leading experts to give their "best lecture." Speakers include Shankar Nair, Bill Thornton, Jim Malley, Tom Ferrell, Abbas Aminmansour, Peter Birkemoe, Chia-Ming Uang, and Duane Ellifrit. And new this year, we're offering a two-day "how to design" program from one of the nation's top structural engineering firms (this is a more formal version of the program Computerized Structural Design uses to train its new employees).

For more information, visit
www.aisc.org/nascc

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THE **STEEL** CONFERENCE is a premier education event aimed at providing structural engineers, steel fabricators, erectors, and detailers with practical information and the latest design and construction techniques. More than 60 technical sessions offer a variety of educational opportunities:

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- Delegating Connection Responsibility to the Fabricator—What Is the EOR's Legal Responsibility?
- Rules of Thumb for Steel Design
- Design of Frames Using Web-Tapered Members
- Staggered Truss Systems: Lessons Learned
- HSS Design
- Specifying Camber—Rules of Thumb for Designers
- The Process of Renovation—Concept to Completion!
- Safety by Design
- Better Base Plate Designs
- Connection Design: Dealing with Load Paths, Transfer Forces, and the Apparent Lack of Joint Equilibrium
- Cold-Formed and Hot-Rolled: The Best of Both Worlds
- What Fabricator Certification Means to the EOR
- Wind Design Considerations for Steel Joists and Joist Girders
- Trends in Offshoring/Outsourcing and How Advances in Software Address the Migration
- An Introduction to Earthquake Engineering and Seismic Codes—Part I: Ductility
- An Introduction to Earthquake Engineering and Seismic Codes—Part II: Seismic Provisions
- An Introduction to Earthquake Engineering and Seismic Codes—Part III: Design Examples
- BIM: "Cradle to Grave"—From the Structural Engineer's Perspective
- How Does Parking Play with Mixed-Use?
- Ethics and Accountability
- Improving Shop Safety
- Estimating Rules of Thumb
- QMC's Top 10 CARs: Part I
- QMC's Top 10 CARs: Part II
- Current Sales Forecasts and Outlook
- Contract Language and Risk Management—Understanding Basic Contract Language
- Employee Retention (What's New? What Can We Do?)
- Trucking: Lease vs. Buy vs. Contract
- Fabricator Roundtable
- Connections: The Good, the Bad, and the Ugly
- RFIs: Use and Abuse (Do you Know the Difference?)
- Document Control Management
- How to Get Rich in Detailing
- Value-Added Selling: Competing Against Overseas Detailers
- OSHA Revisited
- Fire Protection, Painting and Galvanizing (What the Detailer Should Know)
- Communicating and Coordinating Between Detailers
- Stair and Miscellaneous Steel Detailing in 3D
- High Seismic—An Erector's Guide
- Safety First
- Moving Steel to Make Iron
- Preparing a Site-Specific Erection Plan

and much more!

Seeing the Big Picture—on the Big Screen

BY BRENDA ASCHLIMAN

"Think of it as an IMAX theater for the entire design team."

TO JIM JACOBI, P.E., senior principal and chief information officer at structural engineering firm Walter P Moore, being able to visualize engineering plans is the key to understanding the final product. But it is often difficult for stakeholders to get a sense of the design from two-dimensional drawings. His vision of the ideal design review environment is one that uses technology to give all players—not just the design team—the big picture.

"One of the biggest issues in our industry for end users or facility owners is developing clear mental images of what their architects and engineers are talking about when showing the drawings," Jacobi says. "Drawings are hard to read and conceptualize."

Sometimes it isn't until construction has begun that end users/owners realize what's being built isn't what they had envisioned. Jacobi wanted to leverage technology to enroll those stakeholders in a meaningful way early in the design process. Among the other advantages is the ability to avoid the complications and expense of having to redo designs.

"The capability for visualization has proven to be the key," he says. "People 'get it' when they can see the digital imagery, when they can 'walk' through the facility, when they can experience it from different angles and interrogate it."

As Walter P Moore began to design its new Houston office space, which opened early this year, Jacobi's idea took shape. The completed result, the Visionarium, gives participants a sense of total, visual 3D immersion. Think of it as an IMAX theater for the entire design team. Shown onto the 25-ft screen are images from a three-tier projection system. Special imaging hardware renders a single surround-image without distortion. Three projectors can independently display images from up to three separate computer systems in any combination and from digital video and cable TV transmissions and DVDs. A digital conferencing system allows voice and data sharing with participants in remote locations. In the ceiling is an echo-canceling audio system. The 600-sq.-ft conference space seats up to 25. According to Jacobi, the cost of the project system components for the custom-built system, including the screen, came in at under $10,000.

"We now have a cost-effective, immersive design review environment where we can not only bring in project team members to do this multi-disciplinary review using a virtual, digital model, but where we can also bring together stakeholders in an informative, participatory environment," Jacobi says.

Stakeholders who have experienced the virtual environment include other design team professionals, owners, end users, and public officials.

For the design team, building information modeling (BIM) is extremely valuable for bringing models together from all the disciplines to detect physical clashes and determining how to best remove them. Jacobi has found that the virtual environment also allows the team to find functional clashes that they didn't recognize before, such as layout or positioning of different architectural components, or a better way to zone air conditioning and other building systems.

"It allows us to build these digital mock-ups of our projects, just like General Motors is building digital mock-ups of automobiles and Boeing is building digital mock-ups of aircraft," explains Jacobi. By building things virtually, we can discover any potential problems and optimize the design."

Mark Scheyer

"When a structure designed using BIM gets constructed, it is a much smoother and time- and cost-effective process."

Walter P Moore staff also use the Visionarium as a multipurpose conference room, taking advantage of the 25-ft-wide desktop for work sessions.

"The Visionarium functions not just as a big design review environment," Jacobi explains. "[In addition] you can have an infrastructure simulation model on the screen at the same time you're looking at sections and profiles in Civil 3D Design. The large field of view is beneficial."

"Because of our experience using BIM with the design team, we saw that clients could also benefit from seeing projects virtually. It's equally important that stakeholders—including the owner or end user, who is often our client's client—get the big picture, too. The Visionarium has exceeded our expectations." MSC

Brenda Aschliman is a senior associate and the director of corporate communications with Walter P Moore.

Arnold ON STEEL

Barry Arnold. Principal. Vice President. ARW Engineers, Ogden, Utah. Started his career with ARW in 1985 as a drafter. Received master's degree in engineering in 1991. Received the 2007 Engineer of the Year award from Utah Engineers Council. Loves nature for its structures. Uses steel to create what he sees.

STARTING OUT "I wanted to be an architect. I started working in an engineer's office and enjoyed the speed at which projects went through my office. There were 10 projects on and off my desk in a week, or sometimes in a day. Engineering is very exciting. Architects make a building beautiful and interesting, but engineers are the people who make them stand up."

FLEXIBILITY "ARW works on a large variety of projects, but my greatest interest and affection is in steel design. Every designer finds that, despite their best efforts, no project can be perfect; problems happen. Steel provides the simplest and easiest solutions to fix any problem. With steel there's always an easy solution to any problem. If a beam's a little short, you can weld something on. If you need to move a column 10 feet, with steel, it's easy. If your concrete beam is short or a column needs to be moved – you've got a big problem with no easy solution. Steel keeps the projects flowing and going, no matter what type of building it is. I'm happiest when I'm designing in steel… Steel is not nearly as frustrating as other materials – there's always an economical solution in steel."

GREEN "My love of steel wasn't a huge epiphany, it was a growing appreciation of its characteristics and qualities, you know, the nature thing. It only takes working on one or two projects in other materials to make you wish you were designing in steel. You know the design would have been so much easier with steel; it's just so much more predictable. Steel allows for expression in combination with simplicity of design. If an owner is thinking long-term about the environment and building flexibility, steel's the only answer. With everything going green, steel is a natural choice because it's revered as a recyclable material. LEED® is making an impact now, and in years to come, it will be a significant driving factor. With steel, it's easy to make LEED points and points with your clients."

LEARNING "The inspiration I get personally comes from when I attend AISC seminars or go to AISC conferences. There's a plethora of new ideas and innovation available through AISC. Information is presented in a neat, orderly format. You can come back to your office and use the ideas and information immediately. It's always applicable to the projects you're working on today. AISC gives you all the backup and support you need. If you ask a question, AISC responds very quickly."

TEAMWORK "Teamwork is very important… Engineers can be very opinionated. If you ask 20 engineers how to solve a problem, you'll get 20 different answers and that's a good thing. They're all slightly different answers, but they're all correct. You have to keep options open. We tend to gravitate toward what we've done before and many times, that turns out to be a solution that includes steel.

Everyone has that 'manual' in their head of how to do things and that's okay. The young engineers like to test the old engineers as much as the old engineers like to test them, but one thing we all seem to end up having in common is a deep appreciation for what steel can do that other materials can't. We review lessons learned on projects weekly in our office. Everybody has a say. We talk freely and openly without egos getting in the way. We're one unified company, with 20 different people thinking about the options. You get to pick one answer. And most of the time the answer you pick will center around steel and its seemingly unlimited capabilities."

PRIDE "I have no dreams about a special project that I'd like to do one day. I've devoted myself to being proud of every single job I worked on – regardless of whether it's big or small, or designing the whole building or a few connections. I do what needs to be done every day. I don't put my professional ego on display and say, 'look at all these buildings we've done.'"

INSPIRATION "I have a huge appreciation for the environment. In fact, I can see the Wasatch Mountain Range from my office. Being outdoors helps me appreciate my responsibility and obligation to future generations. Engineers have an ethical obligation to protect our natural resources; it's your way of contributing to all of mankind. My work directly affects the environment – I'm humbled by that fact. I find inspiration when I'm in our National Parks and take in the grandeur and majesty of it all, and understand that we all have an obligation to preserve these spaces and our resources for future generations. You get a much bigger perspective out there."

STEEL "If you look at modern steel construction, you will see some exciting innovation going on. I've seen a lot in my career but I know the best is yet to come. Steel is like a good friend – reliable, strong, tested and trustworthy – that has supported me, as I interpreted the architects' concepts to make their dream a reality. That's what young engineers really need to know. That's the power of steel."

BIM in the Real World

EDITED BY GEOFF WEISENBERGER

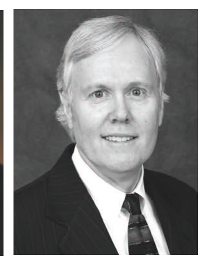
Revit Structure appears to be leading the pack in terms of building information modeling software, and some of its users share their thoughts.

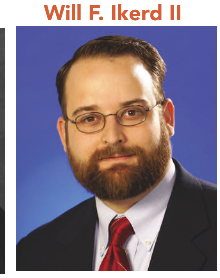

Tom Bartolomucci


Alexander Baumel


Justin Den Herder


James A. Corsiglia


Randy Karl Hagens


Will F. Ikerd II


Atul Khanzode

ALLOW ME TO REPEAT A STATEMENT THAT HAS BEEN MADE AD NAUSEAM: BIM IS HERE TO STAY.

Does this mean that all structural engineering firms are using building information modeling on all projects? Certainly not. But a survey conducted in 2008 by the Structural Engineering Institute's BIM Committee, in collaboration with the Structural Engineers Association of Texas' IT Committee, indicates that more than half of structural engineering firms at least have BIM software at their offices. Further, approximately 65% of the respondents said that they think they will have to use BIM to meet client needs within the next two years; almost 80% said within the next five years. (The survey was sent to more than 15,000 SEI members and received more than 700 responses.)

Tekla Structures and Bentley Structural were two of the top programs; 9% and 13.5%, respectively, of firms that said they own BIM software have these programs. But the most-owned program by a significant margin was Autodesk's Revit Structure at 60%.

Below, representatives from a handful of firms using the latter program weigh in on its pros and cons, its interoperability with other packages, and BIM use in general.

Is Revit Structure/BIM in regular use at your firm?

Bartolomucci: We have already implemented and used Revit Structure for about two years on many projects. Revit has been used on a majority of structural projects and several architectural projects. We are attempting to use Revit on all projects as scope and budgets allow.

Khanzode: Revit/BIM is in regular use at DPR, and we are using it on about 70 total projects across the company. As a national builder of projects for the advanced technology, health-care and life sciences markets, a majority of our work is highly technical, including data centers, pharmaceutical manufacturing facilities, and hospitals. For these types of technical projects with complex systems, Revit/BIM has proven to add a lot of value, especially resolving issues early and enhancing productivity out in the field.

Participants

Hanson Professional Services Inc.	**Tom Bartolomucci, P.E., S.E.** Vice President
Robert Silman Associates	**Alexander Baumel,** Engineer **Justin Den Herder,** Engineer
Harley Ellis Devereaux	**James A. Corsiglia, P.E., S.E.** Principal
HDR Architecture, Inc.	**Randy Karl Hagens, AIA, P.E.** Vice President, Structural Team Leader
Raymond L. Goodson Jr., Inc. (RLG) Consulting Engineers	**Will F. Ikerd II, P.E.** Director, Integrated Project Delivery Department
DPR Construction, Inc.	**Atul Khanzode, P.E.** Director of Virtual Building

Corsiglia: We have been working in a 3D/BIM environment for more than a decade and use Revit Structure exclusively for our BIM platform. Structurally speaking, we do 95% of our work in the Revit/BIM environment, and we balance our projects with minimal CAD documentation.

Baumel and Den Herder: Robert Silman Associates (RSA) has been using Revit Structure for about two years in both our New York and Washington D.C. offices. Currently, both offices only use Revit when requested to do so by a client.

Ikerd: Raymond L. Goodson, Jr., Inc. (RLG) uses Revit Structure regularly, with some legacy projects still in AutoCAD. My role as Director of RLG's Department of Integrated Project Delivery (IPD) is to guide the implementation of BIM tools like Revit to facilitate downstream use of our models with a multitude of different applications.

Hagens: We began with Revit Structure version 4 when it first became available. Initially, only a few smaller projects were completed with the software. We produced plans and a very limited quantity of details with the Revit Structure software; the bulk of the detail work was done with AutoCAD. When Revit Structure 2008 became available, we started working with much larger projects and did more detailing inside of Revit. In 2008, we completed a couple of smaller projects with all design details completed wholly within Revit Structure, without the help of AutoCAD. All whole building projects are now being started in Revit Structure. Renovation projects involving small structural modifications remain in AutoCAD or Microstation, depending on prior work with the client. To date, we are attempting all types of institutional buildings in Revit in order to test the state of the technology.

What are the challenges with using Revit Structure/BIM?

Bartolomucci: The main challenge in implementing BIM is accepting a change in the design and delivery processes—not just the new software. One of our challenges is providing education and training on BIM to our employees.

Khanzode: One particular challenge is that the purpose you want to use the model for determines how you build it and what you get out of it. If we are able to get involved with the design team earlier on in the process, we can collaboratively determine what purpose the model gets used for and then build the model to meet that purpose. This is especially true for model-based estimating. The other challenge we are facing is use of models on large projects and how to share information in a networked environment.

Baumel and Den Herder: The biggest challenge with using Revit is training engineers and drafters on the program and ensuring that they are familiar enough with the program to use it efficiently on projects. While few of our employees have used Revit extensively before, it has a relatively fast learning curve, especially for those who know AutoCAD or who have experience with other 3D modeling software. Once the design team begins using Revit on a project, coordination between the consultants is easy and efficient. Revit helps locate coordination discrepancies—for instance, between a structural element and a mechanical duct—and brings it to the user's attention.

Ikerd: Challenges related to linking Revit with structural analysis applications and also with detailing applications include: slab definitions, top of steel definitions, member axial rotation definitions, material specifications and naming conventions, original location of objects, and material tolerances. The models typically account for the world as it should be and not the way it might be, with all the different conditions with various tolerances.

Hagens: We have learned that approaching a product like Revit Structure with a CAD mentality will greatly limit success. Revit Structure is not a drafting program; it is a documentation modeling program from which drawings and other information can be extracted. This can be a difficult concept for both technicians and engineers to grasp largely because our typical deliverable has been either a printed set of drawings or PDF files of drawings. We have historically thought about an output in terms of two-dimensional lines.

However, to build a correct Revit Structure model, we must think in terms of assembling objects that are, in effect, multi-dimensional—not just 2D or 3D, but objects that have a rich set of characteristics that can be used for more than just graphical purposes.

A significant challenge within the workflow is deciding how much detail to put into the documentation model. Within a multi-dimensional model, it is easy to overdo it. Just because we have the capability to model nearly every component in the structural system, do we actually need to do so? Or, more importantly, is it required by our contract? Beyond defining the actual workflow and training, the detail in our deliverables will need to be further defined as BIM becomes more mainstreamed. Whether the model will be used for material take-off or just collision detection will impact the required amount of detail in the documentation model, the cost to produce that model and, ultimately, the contract documentation for construction.

What other structural or detailing software packages do you generally use as part of your workflow, and how do they interact with Revit Structure or your other BIM package?

Bartolomucci: We use RISA Building System linked with Revit Structure for integrated design and analysis with minimal compatibility issues.

Khanzode: We use Revit Architecture, Revit Structure, Tekla Structures, NavisWorks, and VICO.

Corsiglia: We regularly export, via CIS/2, to RISA and RAM Structural Systems. Additionally, we import fabricators SDS/2 files into our system as well as NAVIS works for coordination.

Over the last two years we have been relatively successful in bi-directional linking between the BIM and analytical platforms. Modeling and showing the information only once and having the information be replicated in multiple platforms is extremely efficient for engineers.

Baumel and Den Herder: Other than AutoCAD, we use a variety of different analysis programs, including RISA-3D, RAM Structural System, SAP2000, and SAFE. We use proprietary third party software that allows users to export models from Revit into RISA-3D and RAM. This can save up to 50% of the time it would otherwise take to build both a Revit model and a separate analysis model. While the model exports are not flawless and usually require touch-ups to ensure accuracy, they definitely save a large amount of time when modeling and analyzing buildings with complicated geometries.

Ikerd: Tekla and SDS/2. While we do not have them in-house, we do look for others that use them to share models with.

Hagens: We use RAM Structural System, RAM Advanse, ETABS, and SAFE as our primary analysis and design programs. However, we currently are only able to link RAM Structural System and ETABS to Revit Structure.

Regardless of where the workflow starts, we have found that the models must be extremely accurate in their connectivity in order to prevent analysis errors. We have also found the need to limit the workflow to one full cycle of transferring information between models. Beyond one full cycle, unnecessary errors creep into the analytical model due to changes in the documentation model that are a part of normal design development. With current technology, we find it more efficient to maintain two separate models after the initial analysis and design is reported to the Revit Structure model. In time, we hope the links and analytical program databases will be smarter about communicating with the documentation model, thus enabling an ongoing link between the models.

What challenges do you experience with using CIS/2—and what are the workarounds?

Bartolomucci: In the past, Hanson has used SDS2 Global Review when interacting with fabricators. However, we are currently testing the ability of Revit Structure to import CIS/2 files from a fabricator to our system.

Khanzode: We are aware of the CIM Steel Exchange standards (CIS/2) and sponsored a workshop to bring steel detailers and designers together in the western U.S. to speed the process of data transfer using this format between design and construction team, and we anticipate using this method of exchange on one of our upcoming projects. We see a lot of promise in this and know of success stories of others using it and hope to do our first few pilots in 2009.

Corsiglia: We have not experienced any difficulties in exporting to CIS/2. The last project we exported was an atrium infill, sandwiched between three buildings, with irregular expansion joint locations.

Ikerd: From my perspective, for simple buildings, the model is approximately 80% good on the other side on transfer (non-scientific number, here). However, if you are working with a good team, the 20% that needs to be "fixed" in the model after transfer should be easily identified. There is value in transferring the models even though it is not perfect. The most important aspect of integrated project delivery from my perspective is understanding people/communication first, then process/understanding, followed by technology and tools. Communication with the team of designers, fabricators, detailers, erectors, and general contractors is the most important "workaround" with any use of technology, and especially BIM when leveraging CIS/2.

Hagens: We do not actively use CIS/2. However, our Omaha and Chicago offices recently tested the waters on conducting "paperless" shop drawing reviews with a similar detailing/fabrication software solution. The idea was to conduct on-screen reviews of the fabricator's detailing model. Though the process has merit, we found the software package to lack significant communication and tracking tools to convey the designer's comments and concerns to the fabricator. The idea has great merit, but the current software tools do not mesh well with engineering professional practices. In time, we think the evolution of these transfer options will develop features to better fit with the structural engineer's changing workflow.

BIM has been a frequent topic in MSC in recent years. "Practical BIM" in particular provides some more insight on BIM adoption and use. This article appeared in the 11/07 issue of MSC, and you can find it at ***www.modernsteel.com****.* **MSC**

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Bentley Systems, Inc.
http://www.bentley.com
Tekla, Inc.
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For a complete list of structural engineering/BIM software providers, visit MSC's online Product Directory. Go to www.modernsteel.com and click Product Directory on the right.

Working with CIS/2

Revit Structure 2009 has the ability to import and export CIS/2 files via the Revit Extensions tool. This free tool is an add-on from Autodesk, and must be installed separately from Revit Structure. In our experience, there are a couple of situations where one would want to integrate CIS/2 with Revit Structure. The first situation would be importing a CIS/2 file from an analysis program. In many structural engineering firms, a 3D model is first created in an analysis program. Rather than recreating this model in Revit Structure, the CIS/2 Import function can be used to bring in the all-ready created model. Though this will save modeling time, it may be necessary to modify the imported grids and levels. In addition, complicated geometry may not come in properly, so a thorough check of the imported model should be done.

A second situation would be exporting a CIS/2 file from Revit Structure for use in a steel detailing model. This would save the time and cost of recreating the structural steel framing from scratch. As with importing a CIS/2 model into Revit Structure, the steel detailer must carefully review the imported model to confirm that it accurately represents the structure. Particular attention needs to be paid to geometry, member orientation, and proper import of member shapes. It may be necessary to use a conversion file, which translates the names of structural shapes from one program to another. CIS/2 is an easy and convenient means of getting structural steel information into and out of Revit Structure. The transfer of data, however, is not perfect and the engineer should closely verify the information that is exchanged.

– Joseph M. Ales Jr., Ph.D., P.E., Principal, Walter P Moore

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.

No Premature Darkness

Miller Electric Mfg. Co. has introduced its new Digital Elite Series auto-darkening welding helmets with X-mode technology, which automatically differentiates between sunlight and the welding arc in outdoor construction applications. Ideal for steel erection, pipeline construction, and heavy equipment repair, the Digital Elite Series enables workers to see through the lens while not welding and offers the flexibility of using one helmet for welding, cutting, and grinding while outdoors. Unlike other auto-darkening welding helmets that often confuse sunlight for the welding arc and darken when there is no arc, Digital Elite helmets feature a unique technology called X-Mode, which detects the arc electromagnetically, eliminating the possibility of the lens darkening before an arc is struck. This new technology will significantly enhance the functionality of auto-darkening helmets for anyone who welds outdoors on a regular basis. The helmets are available in five graphic designs and are covered by a two-year warranty.

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For more information, visit www.comeq.com or call 410.933.8500.

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).

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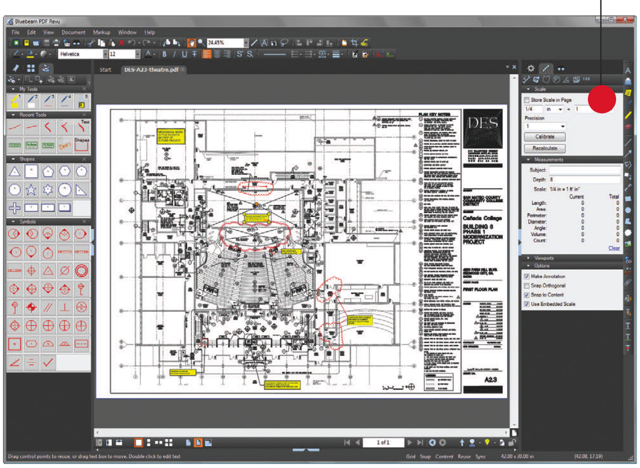

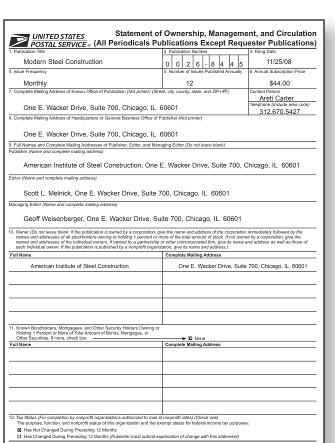

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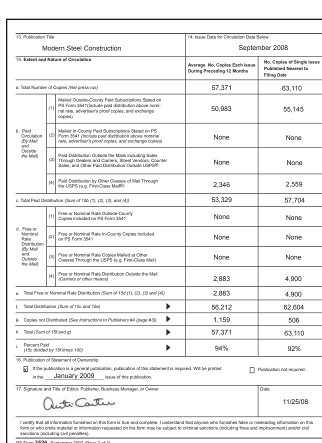

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continued from p. 66

Those terms, of course, do not really designate the plural, though they do share an inclusive form. Perhaps you have all heard this before, but I heard it from a respected engineer from Texas (or was that Pennsylvania?) that the plural of y'all is "all y'all." I do not think I will vote for that one. But I do think you should let us know what utterance you (or yins, youse, or y'all) think we should use for the plural of "you." If you have an opinion, email it to chief editor Scott Melnick at **melnick@aisc.org**. (I don't want these e-mails; I'm too busy helping my colleagues out with SteelWise articles to answer them.)

I have tried throughout my career to get useful terminology into the codes. In horror at the notion that there might be a need for people running around job sites with anemometers after they read about wind-speed limits on gas-shielded welding processes, I suggested at an AWS committee meeting once that we use the Beaufort scale, which was invented by Admiral Francis Beaufort in 1805, and used to gauge wind speed in the Royal Navy starting in 1830. It relates wind speed to observable conditions.

At Beaufort 1, wind motion is visible in smoke; at Beaufort 2, wind is felt on exposed skin. By the time you are at Beaufort 12 (a hurricane), you'll see some broken windows and structural damage. By the way, I recommend that you not weld in a Beaufort 12 wind—with any process!

The committee did not vote the idea out of consideration for inclusion in the code, but I could tell from their tone that I would be eating alone that night. So, the Beaufort scale disappeared like the sails of a clipper ship going over the horizon on its way to the far reaches of the Empire.

In closing, I have to let you know that the epitome of lingo occurred for me one day in Indiana, where I heard someone say, "We need to pea whistle that column into place and stash that yo-yo fast, or we'll be whistle bit." I'd explain it in full, if I thought I could, but that crew took right to it.

Rest assured we will continue to work to clarify the codes and specifications in an attempt to improve them for your benefit. You let us know where we miss. And yes, I will say "complete-joint-penetration groove weld," complete with the properly placed hyphens, one hundred times as punishment for these thoughts.

Later, all y'all! **MSC**

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SteelWize

BY THOMAS J. SCHLAFLY

You may walk the walk, but can you talk the talk?

IT HAS COME TIME to speak of language in the steel industry. The topic has been building for many years, and since no one else has tended to this task, I will do my best.

I went to my first AWS committee meeting many years ago and found the participants—all very well-established and respected individuals—arguing for 15 minutes about whether a sentence in question should use "and" or "or" as the conjunction. At the time, I could not believe that they were debating over something so seemingly trivial.

Nowadays, I can definitely say I believe it! Lest you think it is peculiar to AWS committees, I can say that AISC committees can do similar things. I'm sure we are not alone.

Many words are chosen with great care. Others just seem to slip in. As frustrating as it is to argue the "ands" and the "ors," on one level or another, we do recognize that it can make a difference. Yet it is not long after a new code or specification is published that you (I will return to this word in a moment) make it very clear that we have not made it very clear. With that understanding and with the intent to do our very best to help you, we continue to argue and sometimes clarify. In the interest of clarity, we often have ruined the language (or at least the fun).

I am old, though this is the first time in my career I've been willing to admit it. Perhaps that is why I like to say "tubes" not "HSS." With apologies to Mr. Omer Blodgett, who has waged a relentless campaign to improve language in welding circles, I like to say "rat holes" too, not "weld access holes." While we're at it, I am not that fond of "full-pen welds," but the term works well for me. "Complete-joint-penetration groove welds" takes a lot longer to say, but they are not any stronger.

I think we who prefer the slang terms have to admit that a knowledge and usage of colloquial phrasing doesn't really make anyone smarter. Rather, it just helps to make one feel like an insider. Inside of what is a good question…

Tom Schlafly is AISC's director of research.

Long ago, in my younger days, I heard one wasn't "in" until he or she called that vertical piece in a building frame a "f---ing colyoom." (I have two daughters now and am working harder than ever to keep them "out.") I am hoping they recognize my plight and learn to avoid what I have taught them all too well through some of my more colorful explanations. Like the time I tried to teach daughter number one how to use a clutch. You'll know how much they learned when I tell you that we were on clutch number three for the same lesson with daughter number two.

I think there are a few terms we need to work on. While helping a colleague who was writing an article for MSC magazine the other day, I used the word "fabricator" and it was quickly pointed out to me that I meant to say "erector." That was true, but I was trying to cover both the fabricator and the erector with one word. In fact, I now think we need to invent such a word.

We know the "contractor" is another person, so that won't suffice. We could use "steel contractor" but that sounds so "legal" that I think we need something better. We need a "fabector" or an "erecticator." Could we use "steel puncher?" Back when I was a fabricator, I had a cousin who sold radio advertising and said he sold air; I responded that I punched steel. Why not use "feson" (which means a Ferric person, carries with it a little Latin for atmosphere, and is politically correct, to boot)?

While we are working on that, we know we need a better word for assembling a steel frame. I understand there is "machismo" involved here but there are times the current terminology does not seem appropriate, and a less "male-oriented" term would certainly help reduce some of the spam we get. It would keep us from straying into dark territory in Google searches, too.

There also are terms the general population uses that we might improve upon while we are pondering this topic. I do enjoy at times the freedom of the word "you." Does it mean one, or two, or everybody but me? I had a friend who was in a relationship in which I had trouble telling whether he would invite his companion (or "expanion") or not. But if I said, "You are invited," I could dump these momentous decisions on him with nary an extra word. It was glorious for me, and all I had to do was make sure there was room for an extra seat at the table if it was needed.

One has to admit, though, that there are occasions in which distinguishing the singular "you" from the plural might have advantages—i.e., when you are not a coward like me and you want control. (Like I said, I'm old and I don't care about control any more. I want to be left alone and not told to do things, like write SteelWise articles!) There are words we might use for those occasions but Mom always asked me to speak for polite company, and we need to make a decision here anyway.

I understand in Pittsburgh there is a word "yins." (I originally spelled this differently but was corrected. One certainly would not want to misspell yins!) In Cleveland, which is my hometown, I have heard "youse." (I don't think we invented it, I just heard it there first.) You know we have to include a word that will make any viable male fall in love with any female from the Carolinas. (Was that sexist? Well like I said, I'm old. And please rest assured that the Carolinas are in my list of my favorite places.) Hence the appeal of the word "y'all."

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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.