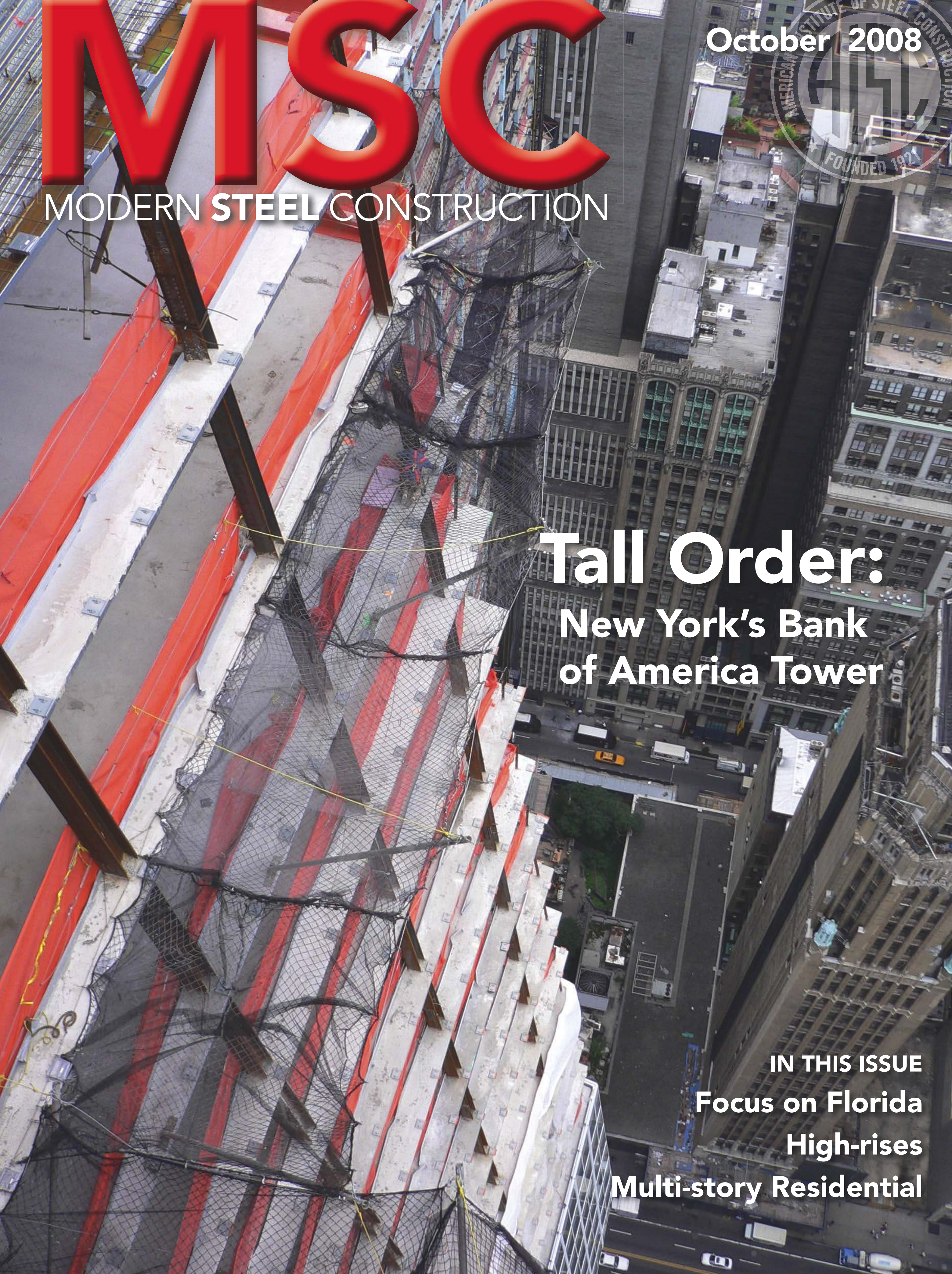
MSC

MODERN **STEEL** CONSTRUCTION

October 2008



Tall Order:

New York's Bank of America Tower

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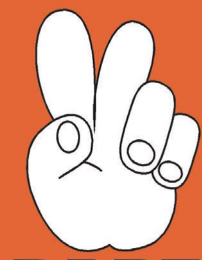
AVOID THE

CRUNCH



PART TWO

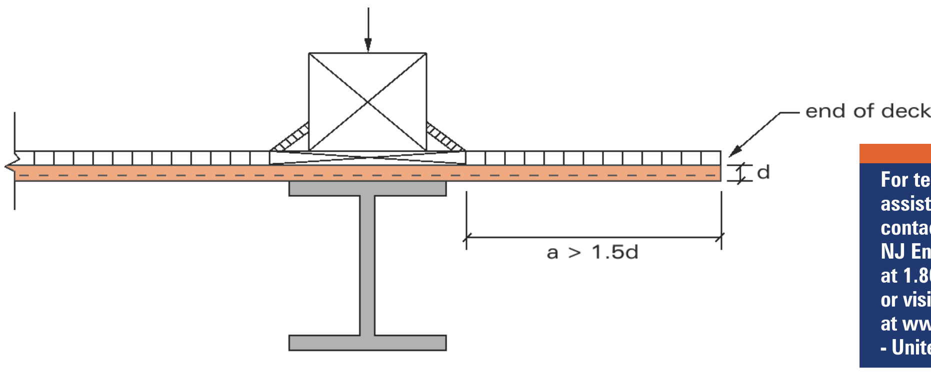
DECK DESIGN DATA SHEET 37R

QUESTION

What is the crushing capacity of roof deck that is sandwiched between a load and a support?

ANSWER

This is defined as the "Two Flange Interior Loading Web Crippling Capacity" when the load is not near the end of a deck sheet.



For technical assistance please contact our Summit, NJ Engineering Office at 1.800.631.1215 or visit us on the web at www.cmcjd.com - United Steel Deck.

Allowable Two Flange Interior Loading for Fastened Deck -- PLF											
Deck Type	B				F			N			
Min. "a"	2.25"				2.25"			4.5"			
Bearing Width	22	20	18	16	22	20	18	22	20	18	16
3	1215	1765	3015	4680	1200	1745	2980	875	1280	2205	3445
3.5	1280	1860	3170	4905	1265	1835	3130	920	1345	2320	3610
4	1295	1880	3195	4930	1290	1870	3175	965	1410	2420	3765
4.5	1295	1880	3195	4930	1290	1870	3175	1005	1470	2515	3910
5	1295	1880	3195	4930	1290	1870	3175	1045	1525	2610	4045
5.5	1295	1880	3195	4930	1290	1870	3175	1085	1575	2695	4175
6	1295	1880	3195	4930	1290	1870	3175	1120	1630	2780	4300
6.5	1295	1880	3195	4930	1290	1870	3175	1135	1675	2860	4420
7	1295	1880	3195	4930	1290	1870	3175	1135	1725	2935	4530

1. Choose the lesser bearing width of the load or support to determine the capacity.
2. "Two Flange Interior Loading" applies when the end of the deck extends more than 1.5 times the deck depth beyond the edge of the beam or load point. An Interior Reaction is such a case.
3. The above table is based on the AISI Standard North American Specification for the Design of Cold-Formed Steel Structural Members, 2007 Edition.

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MEMBER MEMBER MEMBER

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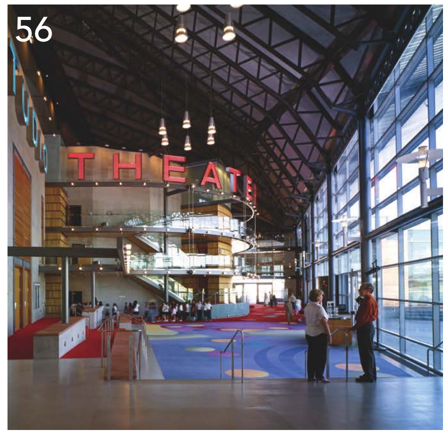

departments

resources

ON THE COVER: Bank of America Tower, New York. Photo: Severud Associates

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editor's note

AT THIS YEAR'S AISC ANNUAL MEETING, ONE OF THE KEYNOTE SPEAKERS WAS HOWARD PUTNAM. I'm sure the name sounds familiar to most of you, but if you're having trouble placing it, he's the former chairman of Southwest Airlines.

His message is particularly relevant today with our rapidly changing market conditions. "Countries, industries, and organizations go through cycles, consolidation, transformation, and turbulence. It's a way of life. Companies that survive turbulence have a flight plan," he explained. So what does he recommend?

First, you need to be proactive, or as Putnam says: "Anticipate turbulence and seek opportunities." And he offers specific traits that can help make your company successful:

- Diversify only where your company's skill sets permit
- Focus on process and productivity
- Take out complexity
- Act and/or react quickly
- Know what business you're in—and what business your customers are in
- Focus on training, education, and customer service
- Review your "people" policies
- Understand technology and decide on what level of utilization is most appropriate for your company; it's just as easy to have "too much" technology as too little
- Minimize bureaucracies and silos within your company
- Focus on your cost structure
- Make sure your distribution network is efficient—and convenient for your customer
- Be quick to adjust to market and price changes

But beyond everything else, Putnam seems to be a strong believer in good hiring. And what does he look for when he hires? Number one on his list is attitude. ("We can teach them skills.") In addition, he looks for cheerfulness, optimism, decision-making ability, a "love of customers," team spirit, communication skills, self-confidence, the ability to be a self-starter, and a sense of humor.

I love that last one. How many CEOs look for a sense of humor when they hire? But when you stop and think about it, you can see how it helps promote teamwork and improves customer relations. (Interestingly, he includes "fun" as one of his top 12 leadership attributes as well.)

What strikes me most listening to Putnam is that it's easy to see why any company he's heading up is not just going to be a dynamic industry leader, but also a place I'd like to work.

As he put it in his book, *The Winds of Turbulence*, "Turbulence is inevitable but misery is optional."

Scott Melnick

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EDITOR

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MODERN **STEEL** CONSTRUCTION

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Wall Thickness .083" to .680"

Specifications:
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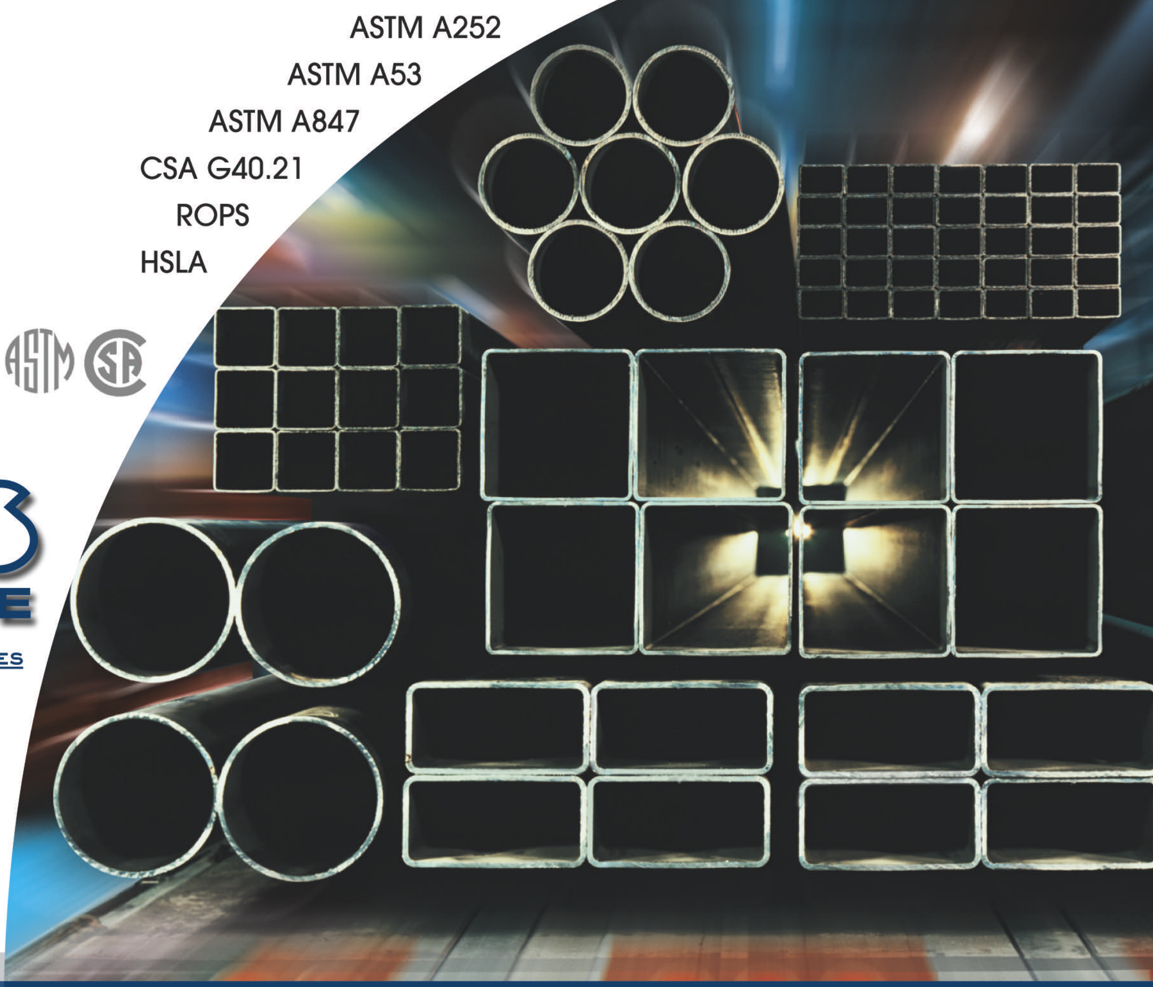
ASTM A252
ASTM A53
ASTM A847
CSA G40.21
ROPS
HSLA



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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.

Slip-Critical Bolts?

TC bolts were used in a bolted splice for W8s. The beams have corrugated deck on top of them that will receive 6 to 12 in. of concrete, and the assembly forms a ramp for foot traffic. The engineer wants us to remove the TC bolts and replace them with slip-critical bolts. I am under the impression that slip-critical is a connection and not a type of bolt. Is this a valid point from the inspector? Do we have to replace the bolts, or is the use of TC bolts acceptable for this condition?

You are correct that slip-critical (SC) refers to a type of connection, while TC refers to a type of bolt. Furthermore, TC bolts often are used in SC connections.

TC bolts are a product that is central to one of the four methods permitted by the RCSC *Specification* to achieve pretension in a bolt, as is required in SC connections. As long as the requirements in the RCSC *Specification* for this method are followed, TC bolts are acceptable in SC connections.

Amanuel Gebremeskel, P.E.

Charpy V-Notch Requirements

AISC 341-05 Section 6.3 specifies a minimum Charpy V-notch value for structural steel in the SLRS with flanges 1½ in. and thicker. Commentary Section C6.3, however, states that steel with flanges exceeding 2 in. is subject to the same requirement. I assume the Standard is correct and the Commentary is incorrect? Please verify.

There does not appear to be an inconsistency between the *Seismic Provisions* Section 6.3 and the Commentary C6.3. The first part of Section C6.3 (where the 2 in. is mentioned) is in reference to the AISC *Specification* (AISC 360-05), while the following statement (where 1½ in. is mentioned) is referring to the requirements of the AISC *Seismic Provisions* (AISC 341-05).

The Commentary is pointing out the difference between AISC 360 and AISC 341 in this regard.

Kurt Gustafson S.E., P.E

Flare-Bevel Groove Welds

I am detailing an HSS-to-HSS weld and have a flare-bevel groove weld, which is shown in the latest edition of the AISC Manual (page 8-61). The effective weld size (E) is shown as ⅝T_1. In Table J2.2 of the *Specification*, the effective weld size of a flare-bevel groove weld is given as ⅝*R* for the GMAW process. Which one is correct?

The Effective weld size shown in Table 8-2 (page 8-61) of the 13th edition *Steel Construction Manual* was based on the 2004 AWS D1.1 requirements. This effective size for flare-bevel groove welds has been revised in the 2006 AWS D1.1 and will vary based on the weld process used. The current draft of the 2010 AISC *Specification* includes a revision to update the provisions for flare-bevel groove welds to be consistent with the current AWS D1.1 requirements for these welds. Look for Manual Table 8-2 and the Specification Table J2.2 to both be based on a function of *R*, rather than the wall thickness in the next editions. For the GMAW process, the proposed draft lists the effective weld size as ⅝*R* for the flare-bevel groove weld.

Kurt Gustafson S.E., P.E

Lessons Learned from the AISC Seminar

In discussions with several engineers, I am hearing it said that the 13th edition is forcing engineers to abandon the ASD method, and to conform to the LRFD method.

Two things that I remember from this year's AISC seminar on the 13th edition are:

1. **The LRFD strength is equal to 1.5 times the ASD strength, and**
2. **Either approach can be used, and the designer just has to remain consistent with the chosen method during the calculation.**

Unfortunately, I am not knowledgeable enough with the 13th edition to convince them that ASD is still permitted. Can you explain this a little more convincingly?

It remains completely viable—and familiar—to use ASD with the 13th edition. You may remember from the seminar you attended that all examples were worked in both ASD and LRFD, and many comparisons showed where provisions were identical or improved in the 13th edition ASD compared to the 9th edition ASD.

The two points that you list form the basis of the "unified" specification. The levels of safety are essentially equivalent regardless of which load combinations in ASCE 7 the designer chooses to use. These were good points to bring away from the seminar.

The 2005 AISC *Specification* was developed in a format that permits the engineer to use either ASD or LRFD for structural steel design. Section B3.3 covers the use of LRFD load combinations and design, while Section B3.4 covers the use of ASD load combinations and design. That is why the AISC lecture series on the 2005 *Specification* and *Manual* bears the title *Design Steel Your Way*.

The R_n used in the Specification is the nominal strength of the member or component, which is the same capacity regardless of whether ASD or LRFD load combinations are used in the analysis. This R_n value is calculated the same way and then the ϕ (LRFD) or Ω (ASD) factor is applied based on which approach you choose. The factor that is applied must be consistent with the load approach used in the analysis. Thus, if the LRFD load approach were used in the analysis, the R_n must be multiplied by the ϕ factor for the applicable limit state to determine the Design Strength (LRFD). Similarly, if the ASD load approach were used in the analysis, the R_n must be divided by the Ω factor for the applicable limit state to determine the Allowable Strength (ASD).

Although the 2005 *Specification* is presented in a strength format, the stress format is usually just lurking right there in the equation; use your thumb to cover the section property (A, Z, S, etc.) if you still can't see it. Also, there have been changes that have occurred in the Specification since the development of the 18-year-old 1989 ASD *Specification*. While some of the capacities may be similar, others have changed. There are limit states to consider that may have not been addressed in past specifications. One would need to look at the controlling limit state for the member or component under consideration in order to make a valid comparison.

In the end, though, ASD has not been abandoned.

Kurt Gustafson S.E., P.E

Welding in the K-Area?

Section 3.9.6 of Design Guide 21 discusses the potential effect of welding in the k-area for column doubler and stiffener (continuity) plates. Does this same concern apply to welding of beam stiffener plates in the k-area?

Yes. AISC recommends that you avoid the k-area when attaching stiffeners to beams. This area is avoided by clipping the stiffener plate. Please see Fig. C-J10.7 of the 2005 AISC *Specification* Commentary (a free download at **www.aisc.org/2005spec**) for how to detail this.

Amanuel Gebremeskel, P.E.

Turning the Bolt Head

A contractor told us that applying the pretensioning by turning the head of an ASTM A325 bolt does not produce as good a result as turning the nut. I never heard of that. Is there any merit in his contention?

It likely is most common to turn the nut, rather than the bolt head, during the installation process; however, the RCSC *Specification* explicitly permits the turning of the head (see Section 8.2). The procedures used in construction must be the same as those demonstrated during the pre-installation verification process, as required by the RCSC *Specification*.

Kurt Gustafson S.E., P.E

Block Shear Strength

I need some help understanding the Block Shear Equation (J4-5) in the 2005 *Specification*. For block shear strength:

$$R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt} \leq 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$$

The left side of the equation must be less than or equal to the right side. For ASTM A36 steel, F_u = 58 ksi and F_y = 36 ksi, which means that $0.6F_u$ will always be greater than $0.6F_y$. The net area in shear, A_{nv}, is smaller than the gross area in shear, A_{gv}, but not enough to overcome the difference between $0.6F_u$ and $0.6F_y$.

As an example, consider a ⅜ in. plate with 1½ in. edge distance and 6 rows of ¾-in. bolts in STD holes at 3-in. spacing.

$$A_{gv} = (\tfrac{3}{8}\text{ in.})(5 \times 3\text{ in.} + 1\tfrac{1}{2}\text{ in.}) = 6.19\text{ in.}^2$$

$$A_{nv} = A_{gv} - \text{hole area deduction} = 6.19\text{ in.}^2 - (\tfrac{3}{8}\text{ in.})[5.5\text{ holes} \times (\tfrac{13}{16}\text{ in.} + \tfrac{1}{16}\text{ in.})] = 4.39\text{ in.}^2$$

From this, $0.6F_uA_{nv}$ = 153 kips, and $0.6F_yA_{gv}$ = 134. That is, this shows $0.6F_uA_{nv} > 0.6F_yA_{gv}$.

So where did I go wrong? When will $0.6F_uA_{nv}$ ever be less than $0.6F_yA_{gv}$?

I believe you went wrong in your preliminary assumption that the net area is smaller than the gross area, but not enough to overcome the difference between $0.6F_u$ and $0.6F_y$.

Remember that the Specification is not written for a specific case, but for a multitude of geometries and material types that may be used in steel construction. Therefore, both parameters of the equation must be checked to find which controls.

Try some other examples and see what happens. One simple extrapolation of your stated problem would be to use ASTM A572 Grade 50 plate instead, substituting F_y = 50 and F_u = 65 into your results as follows:

$$0.6F_uA_{nv} = 153\text{ kips} \times \tfrac{65}{58} = 171\text{ kips}$$
$$0.6F_yA_{gv} = 134\text{ kips} \times \tfrac{50}{36} = 186\text{ kips}$$

In contrast to your example, $0.6F_uA_{nv} < 0.6F_yA_{gv}$.

Kurt Gustafson S.E., P.E

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

Kurt Gustafson is the director of technical assistance and Amanuel Gebremeskel is a senior engineer in AISC's Steel Solutions Center. Charlie Carter is an AISC vice president and the chief structural engineer.

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

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

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

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steel quiz

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

This month's Steel Quiz was developed by AISC's Steel Solutions Center. Sharpen your pencils and go!

1 When a project is subject to a metric design requirement, what shapes are available?

2 Is it permissible to use controlled heat to straighten, curve, or camber structural steel shapes?

3 When forces are to be transferred by contact bearing, is a gap allowed between the contact surfaces?

4 When should notch toughness properties be specified by the engineer?

5 Is it acceptable to substitute SAE J429 grades 5 and 8 bolts for ASTM A325 and A490 bolts, respectively?

6 When are plug and slot welds used?

7 Does AISC provide information on rated assemblies for fire protection?

8 How do intumescent painting systems work?

9 In blast design, what is a shock wave?

10 What is progressive collapse?

TURN TO PAGE 14 FOR ANSWERS

steel quiz

ANSWERS

1 ASTM A6/A6M covers the metric series of structural shapes that is in use in the United States. Because it is a soft metric conversion, the metric series is physically identical to the inch-pound-unit shape series. The dimensions are given in millimeters, with the mass expressed in kilograms; note that the mass must be multiplied by acceleration of gravity 9.81 m/s^2 to obtain kilonewtons (KN). Please see FAQ 1.3.3 for more on this topic at **www.aisc.org/faq**.

2 Yes. The 2005 AISC *Specification* Section M2.1 and a discussion in the 13th edition AISC Manual (part 2), provide a sound basis for the use of controlled heat to straighten, curve, camber, and form structural steel. Moreover, Section 5.26.2 of the 2006 AWS D1.1 permits heat-straightening of members that are distorted by welding and stipulates rules for this procedure.

3 Yes, although the gap size is limited. As per the 2005 AISC *Specification* section M4.4, "Lack of contact bearing not exceeding a gap of 1/16 in. regardless of the type of splice used, is permitted." If the gap exceeds 1/16 in., but is less than ¼ in., and an engineering investigation shows that the actual area in contact (within 1/16 in.) is adequate to transfer the load, the gap is acceptable.

4 Some examples of when notch toughness may be specified by the engineer include applications with dynamic or impact loading, fatigue loading, low service temperature, and some welded joints in heavy shapes/plates and CJP groove welds in high-seismic applications. See FAQ 4.4.1 for an explanation of why toughness is required in general.

5 No. However identical these materials are in terms of mechanical properties, they differ in that ASTM A325 and A490 specify thread length and head size, whereas SAE J429 does not. Moreover, quality assurance and inspection requirements for ASTM A325 and A490 bolts are more stringent.

6 Plug and slot welds are permitted for the transfer of shear force only. As such, they are sometimes used to transmit shear in lap joints, to join components of built-up members, or to prevent buckling of lapped parts. Their design and usage is covered in Section J2.3 of the 2005 AISC *Specification*.

7 Yes. AISC Design Guide 19 provides detailed information on rated assemblies and many other aspects of the fire protection for steel buildings.

8 An intumescent coating is one that chars, foams, and expands when heated. This way it is able to provide insulation for the steel from high temperature in a fire. Please see FAQ 11.1.6 and AISC Design Guide 19 for more details on this.

9 The rapid expansion of hot gases resulting from the detonation of an explosive charge gives rise to a compression wave called a shock wave, which propagates through the air. The time required for compression of the undisturbed air just ahead of the wave to full pressure just behind the wave is essentially zero. See FAQ 12.1.2 for more on peak pressures and its phases.

10 Progressive collapse is the propagation, by chain-reaction, of a local structural failure into the failure of a substantial portion of the building, disproportionate in magnitude to the original failure.

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 Solutions Center


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news & events

AISC NEWS

AISC Joins American Scrap Coalition

AISC and the Concrete Reinforcing Steel Institute (CRSI) have joined the American Scrap Coalition (ASC), and both institutes urged strong, immediate government action to eliminate the taxes and other market barriers that numerous offshore governments maintain on their exports of steel scrap. The American Scrap Coalition (**www.scrapcoalition.com**) now includes industry associations representing more than 3,200 companies.

"Rising scrap costs are beginning to have a chilling effect on the construction industry and the U.S. economy in general," stated Roger E. Ferch, president of AISC. "The growing use of steel scrap export taxes by foreign governments is artificially increasing the cost of steel scrap in the U.S. and driving up domestic costs unfairly and in an anti-competitive way."

"Our fabricator members are being squeezed by scrap and other raw material costs," said Bob Risser, president and CEO of CRSI. "They have long-term projects with established pricing, but their costs have increased tremendously. They are not only losing money, but in some cases their companies are threatened."

The American Scrap Coalition is calling on Congress, the U.S. Trade Representative, and the Commerce Department to immediately address scrap trade barriers. The Coalition has identified several priority issues:

➜ Identification and removal of barriers to trade in steel scrap, which hinder U.S. companies and global competition.

➜ The U.S. carbon steel industry recycled approximately 75 million tons of ferrous scrap last year, with approximately 80% of that scrap consumed in Electric Arc Furnaces. Recycling scrap metal is the most efficient way to make steel, and therefore results in the lowest level of greenhouse gas emissions. The American Scrap Coalition will support and promote policies to encourage the recycling, recovery, and use of recycled scrap material in production of new steel products.

➜ Consider actions by Congress, the Commerce Department, and the Office of the U.S. Trade Representative to remove trade barriers.

Companies and industries wishing to join the American Scrap Coalition can register at **www.scrapcoalition.com.** The web site contains additional information on scrap trade barriers, import and export levels, and prices.

In July, ASC released its newly compiled list of foreign trade barriers to steel scrap and called for the removal of these barriers. The Coalition identified more than 25 countries that have imposed barriers on the trade of steel scrap and other raw materials, harming U.S. companies and their workers.

According to Tom Danjczek, president of the Steel Manufacturers Association, the U.S. government has long rejected imposing export restrictions on U.S. scrap and has instead focused on removing foreign trade barriers. "If that is still the case, it is now time for the U.S. Government to get serious," Danjczek stated in an ASC release.

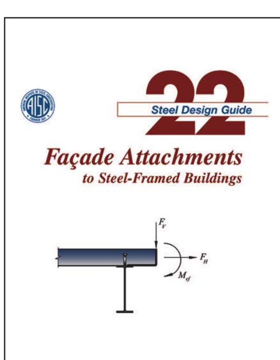
In particular, the Coalition singled out Russia's recent announcement that it plans to raise export tariffs on steel scrap from the current 15% level to 120-130 euros ($191-$207) per metric tonne.

Other countries imposing scrap export bans or particularly heavy export taxes include: Indonesia, Saudi Arabia, Vietnam, Pakistan, Argentina, India, and Ukraine. The Coalition's complete list of barriers is available at **www.scrapcoalition.com** under "Latest News."

PUBLICATIONS

Façade Attachment Guide Now Available

Design Guide 22: *Façade Attachments to Steel-Framed Buildings*, by James C. Parker, P.E., is now available. This new AISC design guide addresses the design of façade attachments to steel-framed buildings.



"Structural engineers will find this to be a practical resource when designing the interface between the façade system and a steel structure," says Cynthia Duncan, AISC's director of engineering. The objective of the design guide, according to the Introduction, is to "assist the practicing engineer in achieving economical slab edge details for steel frames that are structurally sound, durable, and accommodating of the performance requirements of the particular façade system."

Façade system fundamentals are discussed, along with building performance issues that influence attachment design. The details of various façade systems are exemplified, including masonry cavity wall systems with concrete-block or steel-stud back-up, precast concrete wall panels, aluminum curtain walls with glass and/or metal panels, glass-fiber-reinforced concrete panels and other lightweight panels, and exterior insulation-and-finish-system panels. Design examples for the various systems are also provided.

For more inforamtion or to order the guide, visit **www.aisc.org/epubs** or **www.aisc.org/bookstore**.

PUBLICATIONS

Brochure Touts Green Aspects of Galvanizing

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

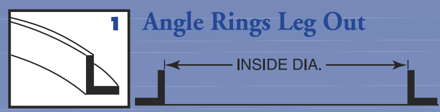
Sustainable Solutions explores how using hot-dip galvanized steel in biofuel, wind, hydroelectric, and solar structures not only protects them from the effects of corrosion, but also is highly sustainable and earth-friendly. Highlighting the inevitability of corrosion, this brochure stresses the importance 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.

Learn how to further the earth-friendly efforts of alternative energy sources by incorporating hot-dip galvanizing. Request a free *Sustainable Solutions* brochure by visiting **www.galvanizeit.org**.

Standard Mill Shapes - Curved To Your Specifications

We bend ALL sizes up to:

1 Angle Rings Leg Out



10"x10"x1" Angle

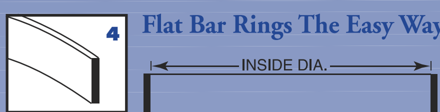
2 Angle Rings Leg In

10"x10"x1" Angle

3 Flat Bar Rings The Hard Way

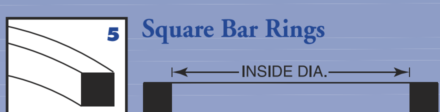
24"x10" Flat

4 Flat Bar Rings The Easy Way



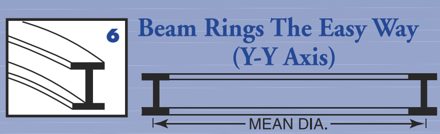
36"x12" Flat

5 Square Bar Rings



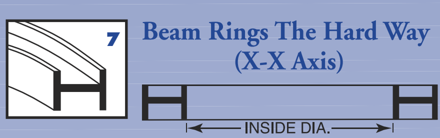
18" Square

6 Beam Rings The Easy Way (Y-Y Axis)



44"x 285#, 36"x 848#

7 Beam Rings The Hard Way (X-X Axis)



44"x 285#

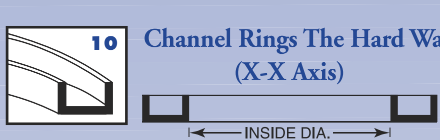
8 Channel Rings Flanges In

Any Size

9 Channel Rings Flanges Out

Any Size

10 Channel Rings The Hard Way (X-X Axis)



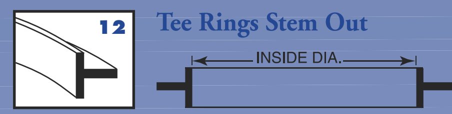
Any Size

11 Tee Rings Stem In

22"x142 1/2# Tee

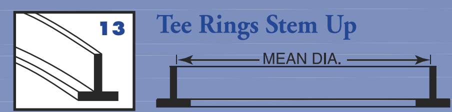
We bend ALL sizes up to:

12 Tee Rings Stem Out



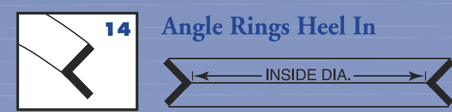
22"x142 1/2# Tee

13 Tee Rings Stem Up



22"x142 1/2# Tee

14 Angle Rings Heel In

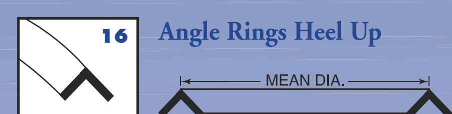


8"x8"x1" Angle

15 Angle Rings Heel Out

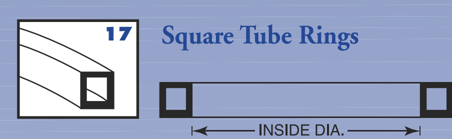
8"x8"x1" Angle

16 Angle Rings Heel Up



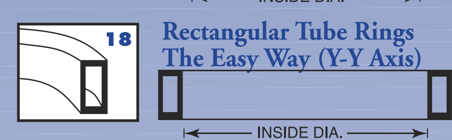
8"x8"x1" Angle

17 Square Tube Rings



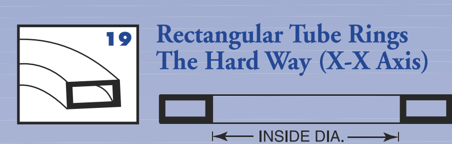
16" Square Tube
20"x12"x1/2" Tube

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



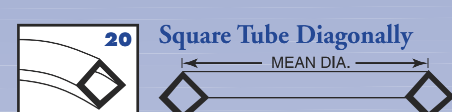
20"x12"x1/2" Tube

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



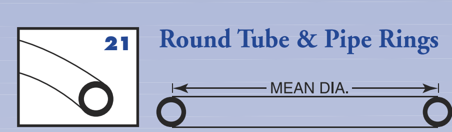
20"x12"x1/2" Tube

20 Square Tube Diagonally



12"x5/8" Square Tube

21 Round Tube & Pipe Rings



20" Sched. 80 Pipe

22 Round Bar Rings

Any Size

We also curve stair stringers, helical hand rails, off-axis bends, formed shapes and extrusions.

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AISC SPECIFICATION

Tracking the Progression of the AISC Spec

BY JAMES FALLS AND JIE ZUO

Every few years, AISC releases a new specification for steel buildings. New research often breeds significant improvements to the specification, and it is important to understand what changes were made and how they affect the design of future steel buildings.

Several major changes have been made between the 1989 *Specification for Structural Steel Buildings—Allowable Stress Design and Plastic Design* and the ASD side of the newer 2005 *Specification for Structural Steel Buildings*, which also contains LRFD. (An extensive look at the detailed changes between the two specifications can be viewed online at **www.aisc.org/crossrefASD**.)

First, it is important to understand what sparked the industry to switch from *allowable stress design* to *allowable strength design*, a change reflected in the 2005 *Specification*. Allowable strength provisions are based on forces and moments that are absolute capacities; units are usually in kips or kip-ft. On the other hand, allowable stress works with proportional stress capacities, which usually indicates units in kips per unit area. By eliminating allowable stresses and introducing the safety factor, Ω, the provisions in the 2005 *Specification* can be applied to both ASD and LRFD, unifying the two design philosophies with each producing similar results.

Another important update is the introduction of the term *limit state* to the 2005 *Specification*. Since previous LRFD specifications have always used the term *limit state* to define the boundaries of which a building is adequate for its intended use, it was only fitting that it should be incorporated into the 2005 *Specification*. Interestingly, traditional allowable stress design was also formulated based on limit state principals, but the term was never used.

Globalizing Measurement

One problem with the 1989 *Specification* was that it dealt exclusively with U.S. customary units. Since most countries use metric units, this hindered the use of the specification outside of the U.S. Now that many design firms are working on international projects, the inclusion of metric units into the 2005 *Specification* facilitates design outside the U.S. by avoiding pesky conversions. For example, in Table J2.4, Minimum Size of Fillet Welds, millimeters are provided in parentheses next to inches. This is typical throughout the 2005 *Specification*.

Taking it one step further, all ratios in the 2005 *Specification* were non-dimensionalized by factoring out the modulus of elasticity of steel, *E*. Once again, this change allows flexibility for designers to use either U.S. customary or metric units in their calculations. High-temperature design, which allows for a smaller *E* value, has also benefitted from this change.

On that Note…

Although not considered part of the 2005 *Specification*, User Notes were inserted throughout, with useful information to assist users. The content of these User Notes consists of helpful design tips, general rules-of-thumb, approximations, recommendations, and references to relevant documents. To avoid confusion, they appear in shaded boxes to help segregate them from the actual specification.

In addition, several important topics were added to the 2005 *Specification*, most notably Chapter K, Design of HSS and Box Member Connections. Originally, the provisions that governed HSS design were included in a separate specification titled AISC *Specification for the Design of Steel Hollow Structural Sections*, which was last published in 2000. The provisions were abridged and combined with the 2005 *Specification*. The appendices were completely revamped, and the most obvious change is the addition of six entirely new appendices, some of which reflect new research and newly developed methods, such as the appendices on structural design for fire conditions and the direct analysis method.

While new content accounts for the majority of the differences between the 2005 and 1989 *Specifications*, some parts of the 1989 version were entirely removed, most notably Chapter N, Plastic Design and Appendix F, Beams and Other Flexural Members, which covered the design of web-tapered members.

Besides the removal and addition of content, the actual organization of the specification was overhauled. Some sections moved from one chapter to another, while others were combined into a single section. For example, former Sections B4 and C1 were combined into C1.1, General Requirements.

James Falls is an undergraduate student at the University of Florida in Gainesville, and Jie Zuo is an undergraduate student at the University of Illinois at Urbana-Champaign. Both were 2008 summer interns with AISC.

AISC NEWS

Prequalified Moment Connection Standard Supplement Now Available for Public Reveiw

Supplement No. 1 to the 2005 AISC *Standard Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications* (ANSI/AISC 358-05) is now available for a second public review. This supplement includes limited revisions to existing provisions for End-Plate and Reduced Beam Section (RBS) Connections, and provides design provisions for additional moment connection technologies, including the Bolted Flange Plate (BFP) Moment Connection, the Welded Unreinforced Flange–welded Web (WUF-W) Moment Connection, and the Kaiser Bolted Bracket (KBB) Proprietary Cast Moment Connection. The Supplement also includes an appendix for cast steel material and quality.

The only item to be reviewed in this ballot is Section A.2.4(2)b. The proposed revision increases the sampling to 50% of the production castings from 25% in the previous ballot. This change was made as a result of negative comments received on the first ballot and the committee's determination that this rate would be more consistent with that necessary to assure a quality product.

The complete supplement is available for your review by downloading the document at the links provided below. A hard copy of the supplement can also be requested for a fee of $15 by e-mail to cummins@aisc.org.

Please submit your comments electronically to cummins@aisc.org using the comment form available at the links below, or mail to:

Janet Cummins
AISC
One East Wacker Drive, Suite 700
Chicago, IL 60601

All comments are due by October 20, 2008.

To download the public review document, visit **www.aisc.org/358s2**. To download the comment form, visit **www.aisc.org/358s2PRcomments**. To download the existing 2005 ANSI/AISC 358 Standard visit **www.aisc.org/AISC358**.

AISC Certification Releases Draft Standard for Public Review

The AISC *Certification Standard for Bridge and Highway Metal Component Manufacturers* will be available for a second period of public review beginning October 7, 2008 and concluding after 21 days on October 28, 2008. This standard has completed balloting by the AISC Certification Committee. A copy of the approved draft standard dated August 19, 2008 will be available from the AISC web site **www.aisc.org** with instructions for submitting comments.

This second review period provides individuals and organizations that may be affected by implementation of the standard, an opportunity to share concerns and offer value-enhancing suggestions and recommendations on changes made since the first public review, which concluded on July 27, 2007. The draft available from the AISC web site will include 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 the AISC Certification Committee.

The standard will support the new Component Manufacturer Certification, a new AISC Certification program. The Component Manufacturer Certification will confirm to owners, design professionals, and the construction industry that a firm has the personnel, organization, experience, procedures, knowledge, equipment, and commitment to produce components of the quality required for normal bridge and highway construction. It is anticipated that the Component Manufacturer Certification program will provide a valuable means for qualifying firms, and serve as an effective way for steel bridge fabricators and manufacturers participating in the program, to communicate their commitment and capability with respect to quality.

The Component Manufacturer Certification program is expected to become available to the industry by the beginning of 2009.

TAUC Leaders Tackle Tough Questions

Some of the country's top union leaders recently took part in a town hall-style forum that is now available for viewing on The Association of Union Constructors' (TAUC) web site, **www.tauc.org**.

Never before have such prominent labor leaders gathered for such a unique discussion that included an audience of several hundred contractors from around the nation. The five general presidents responded to hard-hitting questions at TAUC's 2008 Leadership Conference, an annual event that attracts leading union contractors, labor representatives, employer associations, and construction users from around the country to discuss the future of the union construction industry. The forum was moderated by construction industry strategist and speaker, Mark Breslin.

"This was a critical step in the ongoing path to improving the dialogue between the building trades and contractors. Ensuring a viable working relationship between both groups means high-quality and affordable industrial construction," said TAUC CEO, Stephen Lindauer.

Disaster Site Safety Considerations

With hurricane season in full throttle, the National Association of Tower Erectors (NATE) has issued a safety bulletin outlining considerations when performing disaster relief work on broadcast and wireless communication towers. The bulletin includes bid considerations as well as advice on safe working conditions. "Do not be pushed to complete tasks faster than you can safely [do]," the bulletin advises. "Safety needs to remain the number one priority on all job sites, even more so regarding disaster relief work. Please ensure that, when pricing the work to be performed, you can do the job safely and for a reasonable price. And if you accept the bid, please work safely." To view a copy of the bulletin, visit **www.natehome.com**.

news & events

INDUSTRY EVENTS, EDUCATIONAL OPPORTUNITIES, AND NEWS

Engineering Home Runs in Houston

The Structural Association of Texas (SEAoT) will hold its 2008 State Conference in Houston, November 6-8 at Houston's Minute Maid Park, home of the Houston Astros. It's a big event in a state known for doing things big; according to SEAoT, it's the largest gathering of structural engineers in the state. The theme of this year's conference is "Engineering Home Runs" and speakers will cover topics ranging from business management to structural engineering technical issues. Professional attendees can expect to attain up to eight PDHs by attending the conference sessions. For more information, visit **www.seaot.org**.

Steel Structures Technology Center's Fall Lineup

The Steel Structures Technology Center has announced three one-day, seven-hour seminars on the inspection of steel construction and structural welding, and a two-hour evening seminar on structural steel plan reading. All four seminars are conducted in cooperation with the International Code Council (ICC).

The "Structural Steel and Bolting Inspection" seminar includes International Building Code (IBC) special inspection requirements, steel materials, steel fabrication and erection, and high-strength bolting.

The "Structural Welding Inspection" seminar includes IBC special inspection requirements and welding inspection under American Welding Society (AWS) Structural Welding Codes D1.1–Steel, D1.3–Sheet Steel, and D1.4–Reinforcing Steel.

The "Inspection of Seismic Steel Frames" includes AISC, IBC, and AWS requirements for connection details, welding, bolting, inspection, and nondestructive testing for steel buildings designed to the AISC *Seismic Provisions*.

"Plan Reading for Steel Construction" includes structural steel design and shop drawings.

Seminars are scheduled in the following cities:

South San Francisco	Nov. 5, 6, & 7
Los Angeles/Buena Park	Nov. 11, 12, & 13
Las Vegas	Dec. 1, 2, & 3
Phoenix/Scottsdale	Dec. 4 & 5

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

Green in D.C.

The Ecobuild Fall conference will bring its green message to the nation's capital this December. The goals of the show, running Dec. 8-11 in Washington, D.C., are:

1. Educating the entire building industry about designing and building sustainable projects
2. Promoting the use of energy-efficient products
3. Providing updates on the newest and best green and sustainable products to the end users and specifiers
4. Promoting all rating systems that improve sustainability compliance
5. Providing information on the latest information technology that advances the sustainable movement in building and construction.
6. Protecting the environment's natural resources

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

Ample Online Learning Opportunities

For the time being, the International Association for Bridge and Structural Engineering's (IABSE) E-Learning Platform is accessible for free for Members and Non-Members at **www.iabse.org/publications/elearning**.

Fifteen lecture series—including webcasting of lectures, short courses, videos, and animations on the construction of structures—are currently available online.

And if that's not enough online educational information for you, you can also check out AISC's online offerings at **www.aisc.org/elearning** or **www.aisc.org/seminars**.

FMI Releases 2009 Schedule of Events

Building and construction management consulting firm FMI has unveiled its schedule of programs and workshops for late 2008 and 2009. This year's lineup includes 15 programs in seven disciplines:

Business Development
- Contractor Selling Skills
- Marketing and Selling Strategies for 2009

Compensation
- Contractor Compensation and Rewards

Investment Banking
- 31st Annual Conference on Acquisitions in the Building and Construction Industry
- Mergers and Acquisitions Forum
- Ownership Transfer and Management Succession

Leadership
- Leadership Institute

Project Execution
- Improving Construction Productivity
- Project Manager Academy

Strategy
- Contractor Strategies for 2009
- Executive Program for Senior Managers
- 2009 Seminar Digest

Talent
- Emerging Managers Institute
- Financial Management for Non-Financial Managers
- Pricing and Bidding Strategy

The programs and workshops range in length from two to four days. Each program is designed for individuals to sharpen their knowledge and skills, stay informed of industry trends, and leave with applicable and valuable tools and techniques all while interacting with, and learning from, industry peers.

For a copy of the calendar, go to **www.fmiresources.com/pdfs/SCOCALENDAR0809V2.pdf**.

Dowco Unites with FabTrol

FabTrol Systems, a provider of steel fabrication management software recently announced that it has been purchased by the Dowco Group, a Canadian-based provider of 3D modeling and steel detailing services. According to FabTrol, the merger will allow both of these AISC Associate Member companies to expand their international presence, especially in the growing economies of India, China, and the Middle East. Terms of the sale were not disclosed.

Douglas and Gerry Diane Cochrane, founders of Eugene, Ore.-based FabTrol, say the decision to sell was difficult, but necessary "in order for the company to live beyond a single generation."

"When we began seeking a buyer we knew they had to share our corporate values," said Gerry Diane Cochrane, CEO of FabTrol. "Our success has been built upon providing superior service to our clients before and after the sale. Our software is considered 'mission-critical' to the success of our clients' operations, and providing a high level of training and technical support has to be part of our deliverables. We feel that Dowco has been built upon the same principles and will continue to care for our clients and staff as we have."

Dowco president Ewen Dobbie agreed with Cochrane, saying, "Both FabTrol and Dowco are proven brand names in the steel fabrication industry and have earned their excellent reputations through hard work and good service. Adding FabTrol Systems to the Dowco Group provides good synergy and enhances our long-range goal of being a global provider of comprehensive services from engineering to detailing to fabrication management."

Dobbie also said that FabTrol's headquarters would remain in Eugene, where Cochrane founded the company with her husband, Douglas Cochrane, more than two decades ago.

MEMBER NEWS

Tubular Expansion

Hollow structural section (HSS) producer Independence Tube Corporation (an AISC Active Member) has announced the expansion of its manufacturing facility in Marseilles, Ill.; the company currently has operations in Decatur, Ala., Chicago (headquarters), and Marseilles.

This green-field, 170,000-sq.-ft expansion will include a new manufacturing mill capable of producing HSS tubing 1.66 in. OD through 5.00 in. OD. This expansion will give Independence Tube the full-size range on pipe tubing from 1.66 in. OD though 12¾ in. OD and complement its 2-in. SQ through 12-in. SQ tube sizes.

Steel for Peddinghaus' New Building Fabricated on Trusted Equipment: Its Own

Peddinghaus Corporation (an AISC Associate Member) has added a new 45,000-sq.-ft facility to its manufacturing operation in Bradley, Ill. The new facility (at right) will employ approximately 400. Erected in only five months, all of the building's structural steel was fabricated with, of course, Peddinghaus equipment by Peddinghaus customers.

news & events

ENGINEERING JOURNAL

Fourth Quarter 2008 Article Abstracts

The following papers appear in the fourth quarter 2008 issue of AISC's *Engineering Journal*. EJ is available online (free to AISC members) at **www. aisc.org/epubs**.

Cyclic Behavior and Seismic Design of Bolted Flange Plate Steel Moment Connections

ATSUSHI SATO, JAMES D. NEWELL, AND CHIA-MING UANG

The AISC Connection Prequalification Review Panel (CPRP) is currently reviewing the bolted flange plate moment connection for inclusion in the next edition of the AISC *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications*. To expand the experimental database for prequalifying the bolted flange plate (BFP) moment connection for special moment frames, cyclic testing of three full-scale BFP steel moment connection specimens has been conducted. Beam sizes for these specimens (W30×108, W30×148, and W36×50) were larger than previously tested to extend the range of available experimental results. All three specimens performed well and met the Acceptance Criteria of the AISC *Seismic Provisions*. The specimens achieved an interstory drift angle of 0.06 radians before failure.

Topics: Connections-Moment, Seismic Design, Lateral Systems

Simplified LRFD Design of Steel Members for Fire

TAI-KUANG LEE, AUSTIN D.E. PAN, AND KEN HWA

This paper proposes a simplified design methodology for steel members under fire in accordance with LRFD provisions. The fire design criterion compares the required design strength ratio with the design strength reduction ratio. Design strength ratios are derived from the required strength factor and the overstrength factor. Simplified formulas for member strength at elevated temperatures, as well as their corresponding critical temperatures, are derived for steel members under tension, compression and flexure, for unrestrained boundary conditions. An illustrative example is presented and comparisons are made with experimental data.

Topics: Fire and Temperature Effects, Tension Members, Columns and Compression Members, Beams and Flexural Members

Quantifying and Enhancing the Robustness in Steel Structures: Part 1 – Moment-Resisting Frames

CHRISTOPHER M. FOLEY, CARL SCHNEEMAN, AND KRISTINE BARNES

and

Quantifying and Enhancing the Robustness in Steel Structures: Part 2 – Floor Framing Systems

CHRISTOPHER M. FOLEY, KRISTINE BARNES, AND CARL SCHNEEMAN

The objective of this two-part manuscript is to provide information that can lead to: (a) better understanding of disproportionate collapse in structural steel framing systems; (b) improved understanding of secondary load paths that form within structural steel framing systems in the event of a localized failure; (c) development of minimum general structural integrity provisions for structural steel framing systems analogous to those present in ACI 318; (d) recommendations for minimum tie forces that can be used as the basis of indirect design methodologies for structural steel framing systems; (e) an understanding of the distribution of tensile forces within typical steel floor framing systems to facilitate compartmentalization damage or collapse; and (f) identification of simple and economical means with which to enhance the robustness in the typical structural steel framing system.

Topics: Blast, Physical Security and Progressive Collapse, Lateral Systems

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 16th installment, research projects are summarized on the following topics: Behavior and Strength of Link-to-Column Connections in Eccentrically Braced Frames (University of Texas-Austin), Use of Cast Steel Connectors for Bracing Connections in Special Concentrically Braced Frames (University of Toronto), Minimizing the Strength of Bracing Connections (Canam Corp.), Block Shear Evaluation for Members with Uncommon Failure Paths (University of Alberta), Testing of Shear Lugs for Column Bases (Technical University Federico Santa Maria, Valparaíso, Chile), Punching Shear Resistance of Tension Bolts (University of Thessaloniki in Greece and University of Pécs in Hungary), Three-Dimensional Web-Based Semi-Rigid Steel Frame Analysis with Graphical Interface (University of Texas at Arlington), Monitoring of Crane Girders in Actual Structures (University of the Witwatersrand in Johannesburg, South Africa), and Cold-Formed Stainless Steel HSS (University of Hong Kong).

Topics: Research

letters

The Wrong Path

Regarding Steven Lang's "Growing a Detailer" (August, p. 78), I agree with his assessment 100%. I've been in the profession for 50 years. I started in the drawing room of a fabricator, and I guess I will always lean toward on-the-job training by the fabricator. Each fabricator has their own set of shop standards to live by and their own type of work that they go after.

I have worked for a heavy structural fabricator and a light miscellaneous fabricator, and now work for a machine shop that also does movable bridges and very heavy fabrication for the Army Corps of Engineers. Different types of fabrication demand their own special sets of required information that must be shown on the shop drawings. I wish anyone luck in training new detailers. Please tell them that it takes ten years to be a detailer and that every day, for the rest of their life, they will learn something new.

I believe our schools have lowered the standards too much. They allow calculators in class and think that the student will learn it next year. I wish that high schools would require four years of math, English, history, and science for a diploma. When my son graduated high school in the late 1980s, he was told that "you don't need to know that now, you can get that in collage if needed." I could not convince him otherwise.

If we continue on the path we are on now, all of our engineering will be done offshore.

Eugene Krutsch, Senior Detailer
Steward Machine Co., Inc.

Steven Lang, did you ever hit the nail on the head! I've been detailing for 21 years now (joists and deck), and it seems the design drawings get worse and worse every year. It would be nice if the industry could hold the architects and engineers to a higher standard. Our job is difficult enough without having to help finish the design of the building.

I also totally agree with your comments on the training and development of a detailer. Back when I first got into this profession, it was still being done with pencil and paper, calculators, and good math skills. To this day, I still have a Smoley's book sitting on my shelf to remind me where I started. Nowadays, with AutoCAD and office information systems, there is so much more to learn than just the detailing part of it, which is enough in itself.

Kurt A. Shatto
Detailer
Nucor-Vulcraft-SC

My hat goes off to Steven Lang. His article explains one of the problems why the industry is in short supply of detailers. From the wording of the article, I can only say that Mr. Lang speaks the detailers' language. Good job!

Patrick J. DePaul
Project Coordinator
BDS Steel Detailers

Steel Inspiration

We really appreciated Steve Kurtz's article "Learning By Doing" (April, p. 66) and we of course got even more inspired about our Canadian Institute of Steel Construction structural steel teaching aid project. So thanks to you, CISC, AISC, Steve Kurtz, and Dr. Duane S. Ellifritt, we are planning more sub-fabrications for our students. This is a great idea and we invision taking it out to our high schools partners as a smaller version of the CSIC donation we erected here at Kwantlen and even a little smaller than the one in your article. This next phase will start this fall and we are hoping to have some smaller units done by spring 2009. We will be incorporating it as part of our metal fabrication, welding, and CAD drafting students' projects. Thank you for the inspiration!

See the following story about our own structural steel teaching aid: www.kwantlen.bc.ca/news/2008/072908.html.

Robert A. Finlayson
Metal Fabrication and Welding Instructor
College of Trades and Technology
Kwantlen Polytechnic University

Depends on the Source...

Mr. Gebremeskel's answer regarding the ⅓ stress increase for wind and seismic loads (May 2008 Steel Interchange) was only partially correct.

Section 1605.3.2 of the Ohio Building Code, which is based on IBC 2006, permits the use of ⅓ stress increase for the dead and live load portions of the equation when combined with wind.

The equation becomes:

$\frac{3}{4}(D + L + 1.3W)$ for wind, and
$\frac{3}{4}(D + L + E/1.4)$ for seismic

This is only permitted for ASD design. Unless this is a combination only permitted in the Ohio version of the code, the ⅓ stress increase is allowed in a somewhat reduced amount.

Raymond Blinn
Eeman and Blinn, Inc.

Response from Amanuel Gebremeskel:
Various sections of Chapter 16 in IBC 2006 reference AISC 360 for steel design. I am afraid it is not permitted to use the ⅓ stress increase under any condition, according to AISC 360. This practice was stopped with Supplement #1 of the 1989 specification.

It is quite possible that the Ohio Building Code takes exception to this IBC/AISC requirement. However, we at the Steel Solutions Center try to limit our answers to only addressing AISC publications and rarely the specific governing building codes.

IN MEMORY

Former Indiana Fabricators Association President Dies

Former Indiana Fabricators Association president Sterling C. Phillips passed away on August 3, 2008. He was 76. Phillips was the president and owner of AISC Active Member General Steel Fabricating in Indianapolis. He is is survived by his wife of 58 years, Audrey Phillips; his children, Elaine (Donald) Lee and Douglas C. (Janet) Phillips; his grandchildren, Brian Lee, Adam Lee, Bradley Phillips; his great grandchildren, Makenzie and Makayla Lee; and his brothers, William, Ray, Chuck, and Don Phillips.

Florida Confidential

BY GENE MARTIN, WALT PRIMER, AND GEOFF WEISENBERGER

AISC's "Team Florida" provides some insight on just what's happening steel-wise in the land of alligators, oranges, and theme parks.

FROM A CONSTRUCTION STANDPOINT— well, from several other standpoints as well—Florida is unique compared to most northern states.

Changes in the business environment—affected by the financial world, current political tone, increasing price of gasoline, slumping housing market, value of the U.S. dollar, material prices, and availability of material and trained labor—seem to be magnified and responded to quickly in the Florida market. Rapid changes in material preferences for projects are driven by the dynamic balance between the cost and availability of materials.

The impact of these changes is also significant on a national level, considering the sheer size of the Florida construction market, which is about 10% of the total U.S. market. Florida is currently the second largest state for construction, representing 8.5% of all non-residential (single-family) construction; the largest state is Texas with 11.7%.

The widely reported downturn in the housing market has certainly impacted apartment and condo construction in Florida. For example, in 2005 apartment and condo construction accounted for 32% of the state's overall construction volume. Today that figure looms at 7%. Miami alone saw a 50% decline in multi-family housing construction in 2007. This trend is affecting the downstream commercial, retail, and office markets as well.

The good news, at least in Florida, is the market share for structural steel. As an industry, we have made great strides in increasing the visibility and market share for steel. In 2005 Florida's market share for steel was at 22% and had increased to 36% by the end of 2007. This number slipped to 29% for the first half of 2008 but remains well ahead of the 2005 numbers.

The growth in the steel market share over the past few years is increasingly important, as we have seen a drop in overall construction square footage in Florida by 24% between the first half of 2007 and the first half of this year. This drop is square footage in Florida is greater than the total construction volume of at least 22 of the other states. The percentage rate of drop in Florida is exceeding the national downturn of 15%. Indications are that housing, commercial, and manufacturing projects will see a decline, while institutional, public works, and electrical utilities will experience an increase. The projected $2 billion shortfall in Florida's state budget will likely affect state projects as well.

A Healthy Opportunity

Compared to the rest of the nation, Florida's construction market has a higher percentage of warehouse, parking, and hotel construction but a lower percentage of manufacturing, school, and, surprisingly, hospital and health-care projects. Nationally, health-care is about 6% of non-residential construction; in Florida it averages about 4%. But this could indicate a strong health-care push in the near future, as baby boomers continue to retire to the Sunshine State. In fact, the fastest growing industries in Florida right now are health services and education, with most of the growth attributable to the former. However, this is expected to shift to the business sector over the next few years.

The bottom line is that when it comes to any type of facility, the construction community in Florida is using structural steel more

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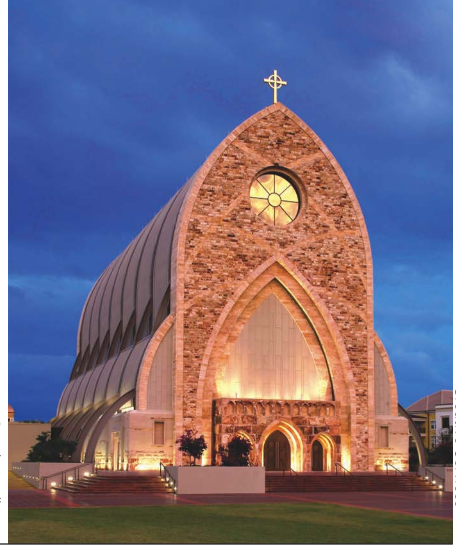


Creative Services

Far right: Latitude One is the largest structural steel office building in Miami.

Right: Ave Maria Oratory is the centerpiece of the town and university of the same name, in southwestern Florida.

often than in the past. But, fabricators still have some concerns about Florida's future market. The media's constant stream of bad news about the housing and construction markets seems to be a self-fulfilling prophecy that is hindering even viable projects from moving forward.

In general, our opinion is that the market has slowed a bit but is by no means dying. As Kurt Langsenkamp, with AISC Member Steel Fabricators in Ft. Lauderdale, puts it, "There still is plenty of work to bid, and architects and engineers are still busy, although not working the frenzied pace they were in 2005–2007."

(Sun)shining Examples

In a shift from the "numbers" approach, perhaps the best way to illustrate the steadily growing success of steel in the Sunshine State is by highlighting some of the significant projects taking place there. On the office side of things, Miami recently added a high-rise with the opening of the 24-story Latitude One project. At 455,000 sq. ft and using 4,300 tons of structural steel, it's the largest structural steel office building in the city. For this project, steel framing followed a migration pattern from north to south thanks to construction manager Suffolk Construction Company's experience and concurrent success with this project type in the northeast. (For more on the Latitude One project, see "Changing Attitudes," July 2007 or at **www.modernsteel.com**.) And on the steel skyscraper horizon in Miami are the 600 Brickell high-rise and retail development and the Metropolitan Miami complex's Met II, consisting of a 46-story office and 31-story hotel tower.

On the other side of the state, just east of Naples in the town of Ave Maria, steel recently made another statement, this one in the form of an elegant curved-steel system for a new iconic church. The Ave Maria Oratory, which won a 2008 AISC IDEAS[2] Award, stands 120 ft tall and consists of 1,270 tons of fabricated structural steel, more than 70% of which had to be rolled to various radiuses prior to the start of fabrication. The framing system in this project is a beautiful illustration of the harmony of function and artistic expression, as

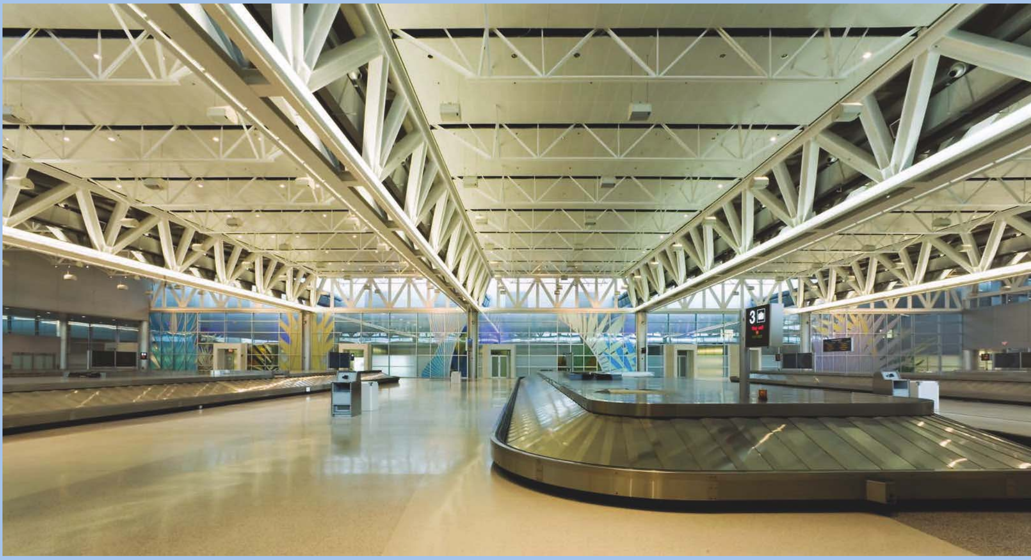
Continued on page 31

Flying Over

BY WILLIAM R. O'DONNELL, P.E.

One recent major steel project in Florida puts exposed steel on prominent display to more than 8 million people per year. This figure reflects the number of people that travel through the South Terminal Expansion of the Miami International Airport, a five-story, 800,000-sq.-ft structure linking Concourse H to the new Concourse J. The expansion provides an additional 14 gates and houses the airport's international terminal.

Photos by Steven Brooke Studios



The upper passenger level of the terminal accommodates immigration and customs processing as well as international baggage pick-up, and features an 850-ft by 165-ft long-span open area with ceiling heights of 35 ft. In the customs and immigration area, tri-chord, 8-ft-deep, arched trusses span 120 ft. These arches emanate from each side of a 60-ft-wide central spine; the spine itself spans 165 ft from end to end.

The terminal's structural system uses a steel frame, concrete shear walls, and composite steel moment frames that act as the wind-resisting system. A composite slab of lightweight concrete, reinforced with welded wire fabric cast on steel deck, is supported by steel beams and girders, which in turn are supported by steel columns. Headed studs are welded to the beams and girders to allow the concrete slab to function as a compression flange for the beams. The slab thickness was set to 6¼ in., so the required fire rating was achieved without spraying the underside of the deck. However, the beams and columns are coated with sprayed-on cementitious fireproofing.

Two expansion joints divide the terminal. The three sections move independently, mitigating excessive stress buildup due to thermal movement. Utilizing double rows of columns at these expansion joints would have disrupted the design pattern of slender columns, so girders were located to one side of each joint. These girders sit atop a sliding connection, which consists of Teflon bearing pads mounted to a bracket off the column to the other side of the joint.

Lateral stability of the upper-level long-span roofs under wind loading is provided by moment frames in each direction. The use of moment frames mitigates the need to run diagonal bracing between floors and provides flexibility for architectural layouts.

Modern airports require clear, open spaces and natural light. Generous areas of upper-level glazing flood the South Terminal's public areas below with natural light via an abundance of perimeter glazing, and the upper roof appears to float above the building's main roof. Moment frames stiffen the tall roof and minimize unnecessary view obstructions. Light is brought further into the building through strategically placed floor openings. A 65-ft-tall wall of glass runs the entire length of the terminal and exposes the third-level circulation corridor, complete with people movers, to the public. As with all the glazed surfaces, missile impact-resistant glass was used to protect from increasingly frequent tropical storms. MSC

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French Framing

BY PETER WILK

Besides the South Miami-Dade Cultural Arts Center, another new cultural facility in Miami that employs steel framing, albeit on a smaller scale, is the new home for the Alliance Française de Miami, a not-for-profit organization whose mission it is to promote French language and culture.

The project, constructed by McGowan Builders and designed by HOK, encompassed the renovation and conversion of two preexisting buildings—a 5,000-sq.-ft one-story warehouse and a 6,000-sq.-ft two-story industrial building—and ground-up construction of a 5,000-sq.-ft addition. The new facility houses 14 classrooms, a reception area/lobby atrium, a library, a bookstore, a large multi-purpose space, offices, two meeting rooms, a catering kitchen, and a retail component with six tenants, including a French café and a travel agency.

The structural work involved installation of new steel trusses for the pitched roof and reinforcement of preexisting concrete tie beams, tie columns, and column bases in the one-story building; and erection of structural elements for the new extension, including shallow-footing strip concrete foundations, new reinforced concrete and masonry walls, two new 40-ft high towers (one of which houses an elevator shaft), and structural steel support for the sloped roof above the addition.

Paul Zilio, senior vice president and partner with the project's structural engineer, Bliss & Nyitray, Inc., described the condition of the original wood trusses supporting the roof of the preexisting one-story structure, erected in 1946, as decayed and outdated in terms of current building codes, thus making replacement necessary. So, the engineering team devised a procedure that reinforced the tie beams and columns and designed a new roof support system featuring open-web trusses and bottom chord-bracing, which are connected with $3/16$-in. × 2½-in. fillet welds. The trusses are welded to steel plates, which feature headed stud anchors embedded into the tops of new concrete columns below, and the chord bracing prevents buckling of the trusses due to wind uplift. This design was necessary to accommodate the Florida Building Code's (2004 edition) specific requirements for the Miami-Dade and Broward counties, which are located in a high-velocity hurricane zone; all buildings in Miami-Dade are required to withstand a three-second gust of 146-mph wind.

Despite these increased local structural requirements, Bliss & Nyitray, which has extensive experience in hurricane-resistant design, was able to develop the truss and bracing system, using standard, pre-designed, and prefabricated elements. Doing so allowed the team to significantly lower the construction cost by avoiding manufacture of a custom structural system for this part of the project. In total, 50 tons of steel, including 40 tons in the one-story building and 10 tons in the addition, were used for the project. The total area of the new galvanized metal deck roofing for the complex is 10,000 sq. ft, including 4,000 sq. ft above the addition and 6,000 sq. ft above the one-story structure.

The roofing system also features an interesting custom-designed element: a structural steel gutter drain located at the seam between the sloped roof of the addition and the pitched roof of the one-story building. The U-shaped internal drain—35 ft long, 2 ft wide, and 1 ft deep—was manufactured from Grade 50 steel plates, prime-painted at the fab shop, and finish-coated upon installation at the site. The sturdy design of the drain prevents leaks into the building below. **MSC**

Photos: Wilk Marketing Communications

The erection team developed procedures to lift the beams of one of the roof sections into position at the exact 30° angle at which they were to be installed, allowing for immediate installation upon material delivery to the site.

Peter Wilk is the president and founder of Wilk Marketing Communications, a New York-based publicity and advertising firm specializing in the construction industry. He can be reached at peter@wilkmarketing.com.

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General Contractor
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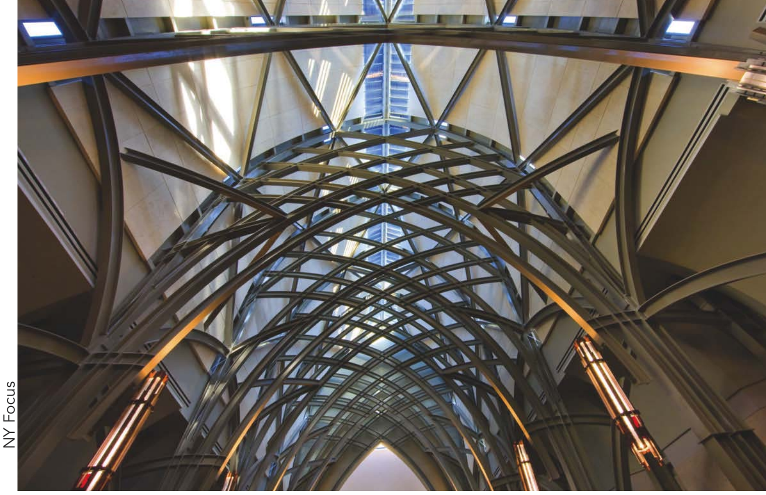
Continued from page 28

Right: More than 70% of Ave Maria Oratory's steel had to be rolled prior to fabrication.

Below, right: The South Miami-Dade Cultural Arts Center's unique structural geometry continues the long history of innovative, modern design in the Miami area.



NY Focus

© Arquitectonica

the lattice pattern of the steel is fully exposed in the nave. (For more on Ave Maria Oratory, see "Center of Attention," July 2008 or at **www.modernsteel.com**.)

Up the coast in Tampa, work has begun on a medical office building for the University of South Florida, which includes 467 tons of structural steel. Major steelwork was erected in just six weeks, and the building is expected to open within the next few months.

Back to Miami, steel forms the unusual geometry of an under-construction arts facility. Designed by Miami firm Arquitectonica, the South Miami-Dade Cultural Arts Center will feature a 1,000-seat theater and related performing-arts-related spaces, plus an adjacent activities building. The main Theater Building structure is a combination of structural steel framing in the public areas and load-bearing masonry walls and composite concrete-encased steel columns in the stage and back-of-house areas.

In addition, the eastern coast of the state can boast another notch in the steel parking belt with a seven-story parking garage at the Seminole Hard Rock Hotel and Casino in Hollywood, held up by 4,000 tons of steel framing. The framing decision was based on the project being designed and completed in 11 months using steel versus the estimated typical 26-month time frame that would have come with a concrete package.

Continued on page 32

A 1,000-seat theater is the main attraction in the South Miami-Dade Cultural Arts Center.

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Continued from page 31

Like predicting the weather, predicting the construction market is by no means an exact science. But all of these projects, and others, paint a favorable picture of the structural steel market in Florida. This varied and increasingly widespread use of structural steel framing across the state is at least one indicator that the steel market in Florida—even in the face of the "hurricane" of the current housing and economic slumps—should remain sunny. MSC

Gene Martin is AISC's southeast regional engineer and Walt Primer is AISC's Florida Initiative area marketing representative. Contact either of them to find out more about AISC's efforts to promote structural steel in the state of Florida: martin@aisc.org and primer@aisc.org.

Bevelling

Web Coping

Flange Coping

Haunching

Plate Processing


NUCOR-YAMATO
STEEL

This page: Bank of America Tower, under construction here, consists of 2.1 million sq. ft of office space in 55 floors.

Opposite page: The building, just across Bryant Park from the New York Public Library, adds a new structural icon to Midtown Manhattan.

Photo by: Severud Associates

Growing UP in Manhattan

BY ANDREW MUELLER-LUST, P.E.

Well-studied use of structural steel allows Bank of America Tower to rise in New York City.


Cook+Fox Architects

TRADERS ARE ALREADY AT WORK IN BANK OF AMERICA TOWER AT One Bryant Park, the new headquarters for Bank of America's New York City operations, which will be completed in 2009. When the steel for the architectural spire topped out at 1,200 ft this past December, it completed the structural work for 2.1 million sq. ft of office space spread vertically over 55 stories. At the lower end of things, the new skyscraper also includes three cellar levels, an underground pedestrian passage, and a restored Broadway theater. To make all of this come together, an equally sizeable effort by the project team was needed, especially for the structural steel design.

Studies in Steel

Many studies were performed early in the design phase to ensure that the structural systems used were economical and would help maintain the project's aggressive construction schedule. Once the basic floor plan at the base of the building—a rectangle with 15-ft-wide extensions at the northeast and southwest corners—was established, various concrete and steel framing systems were compared. Based on the schedule requirements of the construction manager, structural steel was chosen.

With the framing system set, additional studies were performed to determine how best to support the northeast and southwest extensions. The typical span from the core to the exterior is 40 ft. At the extensions, the span would increase to 55 ft and consequently, the typical filler beam would increase from 18 in. to 24 in. in depth. This would have presented problems to the mechanical engineers who needed as much space above the ceiling as possible. A second line of columns would have resulted in the lowest tonnage but also more pieces to erect. In addition, the closely spaced column grids were not as attractive to space planners.

Cantilevering, therefore, became the only method of supporting the floor extensions. At 15 ft long with a depth restriction of 18 in., the cantilever beams were controlled by deflection. To keep the tonnage as low as possible, still more studies were carried out. Neither cantilevering every beam (too many moment connections) nor cantilevering at the columns only (very heavy sections) was an acceptable solution. Instead, small vertical members were installed to tie the tips of the cantilevers (located on the columns only) from floor to floor. This allowed live load to be shared by several floors, which significantly reduced the tonnage.

Although Bank of America Tower is rectangular at its lower floors, the skewed and sloping walls that give the building its distinctive, faceted shape make the floor plates very irregular for the upper two-thirds of its height. Because every floor above the 18th is different, keeping the steel framing reasonably uniform at each successive level required further study, this time in conjunction with the architect. Their investigation of the curtain wall compared the effect of mullions that remained vertical in true elevation to mullions that appeared vertical only when projected onto major axis planes; the exterior columns would align with the mullions in either scheme.

The second mullion scheme was preferred by the architect and owner, which was also beneficial structurally, as it allowed the exterior columns to maintain their relative alignment to the core and produced framing plans where only the length of the beams (and not their locations in plan) varied at each level of the building.

To close out the structural steel framing studies, different approaches were investi-


Tishman Construction Corp.

Sloped exterior walls—as shown here, transitioning to a vertical wall—give the building its distrinct faceted shape.

gated to accommodate the sloping surfaces of the façade. Keeping the columns vertical and transferring them every few floors produced transfer girders much too deep to fit above the ceilings. Even stepping the columns—i.e., offsetting vertical columns at every floor—proved infeasible, especially at the lower floors; although each individual offset is small, the shear that would have to be transferred is very high.

Sloped columns, alternatively, allowed for a smooth transfer of vertical load while having the least architectural impact as well. Still, the induced horizontal loads had to be taken into account, especially at the transition from vertical to sloped. At most locations, this was handled with an upsized tie beam and connection. At the 3rd, 4th, 11th, and 12th floors, however, where all of the columns at the southeast corner of the building slope inward simultaneously, horizontal trusses were necessary to deliver the large lateral loads to the core shear walls.

Coordinated Core Construction

Once structural steel was chosen for the floor framing, braced frames at the building core were investigated for the lateral system. For center-core buildings, where elevator banks are typically arranged back-to-back, this is the logical choice since the bracing does not interfere with occupant circulation or mechanical systems. However, for other reasons, the owner wanted to harden the stair and elevator shafts by enclosing them within concrete walls. Consequently, reinforced concrete shear walls were also studied.

Whenever concrete and steel are used together, development of efficient details to combine the two materials, as well as coordination of the two trades, can become issues. In other cities, steel buildings with concrete cores often use a "jump-formed" system where the concrete walls are constructed first using self-climbing formwork. The steel framing follows below and connects to plates that are embedded in the core walls. Traditionally, however, this system has not been used in New York City, where steel erection almost always precedes concrete work on buildings where both materials are used. Consequently, such buildings are usually designed as steel frames with concrete encasement. The resulting details are inefficient and slow to construct, mainly due to problems associated with the formwork.

To maintain the pace of construction but simplify the connection details and concrete formwork, modifications to the steel framing were studied that would allow a self-climbing formwork system to be used, similar to traditional jump-formed buildings. The formwork system consists of a multi-level hoisting platform that is supported on the inside face of the concrete shear walls. The platform provides work areas for installation of the reinforcement; the inner and outer forms also hang from the platform. Using vertical rails, the platform raises itself (like an inchworm) along with the forms after each lift of wall is placed. Upward movement of the inner forms is not usually a problem (since the platforms are located within elevator banks) but raising the outer forms is impeded by the floor framing.

The building's core is framed with columns and beams as it would be for a conventional steel building but this framing is much lighter, because it only needed to support at most 12 stories before it was encased in concrete. To accommodate the outer forms, slots were framed in every floor surrounding the core. Each slot was about 3 ft wide and 30 to 40 ft long (depending on which side of the core the slot was located). The outer member of each slot supports the floor framing, and at each end a girder transfers the gravity load to the core columns. As erection of the steel frame progressed, placement of concrete on the floors followed behind, leaving the slots open. The slots allowed the outer wall forms to come up from below as wall construction progressed. Finally, the slots were closed up with framed concrete slabs, along with the elevator lobbies and stairs within the core walls.

Another complication of the combined steel and concrete system is the transition from steel to concrete at the top of each elevator bank. For the high-rise and high mid-rise elevators, the steel column above simply bears on the concrete wall below it. For the low mid-rise and low-rise elevators, however, the load accumulated in the columns is much too great for simple bearing. To spread the load at each of these locations over a greater width of concrete wall, two supporting trusses at right angles to each other were encased within the concrete. During steel erection, the trusses transferred the temporary load to the core columns below. Now encased in concrete, the truss bottom chords deliver the load from each column above in bearing to a 30-ft length of shear wall below.

New Life for an Old Theater

Although primarily an office building, One Bryant Park also houses the new Henry Miller's Theatre, a first-class Broadway venue. The original theater, on the northwest quadrant of the site, was built in 1918 and at more than 90 years old, had almost reached the end of its useful life; the theater was in use up until it went dark for demolition. The theater's façade has Landmark status—as does its box office lobby, known as the Oval Room—and had to be maintained in the reconstruction. Unlike the Oval Room, which was disassembled and stored for reinstallation later, the façade could not be removed, even temporarily. Instead, a steel framework cantilevering from the sidewalk was installed that braced the façade from the outside. This allowed the existing theater to be demolished and the new theater to be built in its place. After the façade was reattached to the building framing, the temporary bracing was used as scaffolding to facilitate restoration of the brick and terra cotta before being removed.

The theater's new 1,055-seat auditorium is acoustically isolated from the building that surrounds it. (Contrary to expectation, the isolation is not intended to protect the theater audience from unwanted noise from the building but to protect the traders, who work 24/7, from the distractions that could be produced by a Broadway performance). To accomplish the isolation, double lines of framing and columns located on the sides and back of the auditorium create a 4-in.-wide joint. Independent bracing on the east and west sides of the auditorium resist lateral loads longitudinally. Transversely, bearing pads bridge the joint—with no significant loss of acoustic isolation—to transfer lateral loads to the building's diaphragms and shear walls.

The auditorium's location within the building required the transfer of several of the podium columns. Originally, 20-ft-deep trusses located at the front and back of the fly tower and lounge area carried the load to columns on either side of the auditorium. The trusses would have been the most efficient system but during erection would have required temporary supports along their span. To eliminate the need for shoring and reduce overall erection time, plate girders were investigated as an alternative. Single-plate girders would have been too heavy and too deep to lift over the existing façade, so instead, each plate girder was built up from three 7-ft-deep full-length sections. Making this substitution allowed steel erection over the theater to proceed without interruption. At the exterior of the building, a vierendeel truss was employed to minimize obstruction of the view from the windows.

Complex Made Simple

During the building's design, it seemed that nothing was easy. Even something that is usually straightforward—typical floor framing, for instance—required a significant amount of study and investigation; incidentally, the tower has no "typical" floor. As a result of these careful analyses and with the valuable input of all team members, simple, economical—and in many cases elegant—solutions emerged. MSC

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Steel Erector
Cornell and Company, Inc., Woodbury, N.J. (AISC Member)

Architectural Topping

Although only 945 ft high at the peak of its curtain walls, it is the Bank of America Tower at One Bryant Park's 300-ft-high architectural spire the that makes the building so tall. A latticed tower of 12.75-in.-diameter pipes with a central cylindrical mast, the spire was originally intended to be entirely welded to produce the clean appearance desired by the architect. Early in the construction phase of the building, however, concerns were raised about performing field welding 1,200 ft above street level as well as the erectability of some of the larger components. To allay the concerns of the owner and construction manager, bolted connections were developed. To address the architect's aesthetics concerns, the connections were designed to be as simple and minimal as possible.

Because the spire is composed primarily of steel pipes, bolted flange connections were the first to be considered. An early proposal by the steel contractor located this type of splice connection a few feet above each of the horizontal levels of the spire, spaced vertically at 25 ft. Although relatively straightforward from a fabrication point of view, the effect was not visually appealing. The architect preferred a more symmetrical approach, with the splices located at the centerline of the horizontal members. Of course, this meant splitting the horizontal members in two. Clearly, a pipe section would not be practical in this case, so a pair of built-up tee sections, with their flanges back-to-back, were substituted. At each joint, one tee is connected to the lower section of the spire and the other to the upper section; the tee flanges were bolted to each other in the field. This detailing had the added advantage of allowing completely braced and stable sections of the spire to be assembled in a staging area before being lifted into their final position.

Total Safety Consulting, Inc.

Room to Grow

BY PETER CHEEDER, P.E., AND ADAM BLANCHARD

MIT takes advantage of an adjacent, unused industrial area to increase its living space.

EVERY YEAR, PRESTIGIOUS UNIVERSITIES have to turn away several times more students than they can accept. Many of these schools are located in or near large cities, which limits their capacity to expand their campus to accommodate more students.

In the case of the Massachusetts Institute of Technology, however, former industrial portions of Cambridge, Mass. adjacent to campus allowed the university to transform abandoned spaces to modern, useful buildings of architectural significance. And part of MIT's expansion and reclamation plan was to provide more on-campus housing options for students pursuing graduate degrees.

MIT wanted a large-scale housing complex that allowed for the intermingling of students away from the classroom, and to provide the northwest portion of the campus with a beacon indicating the school's commitment to improving the community by complementing its housing needs with a unique structure. The 265,000-sq.-ft project, called NW35, includes five interconnected buildings with low floor-to-floor heights in order to provide the maximum number of housing units in a relatively low-rise complex.

The design team had to consider ways to ensure MIT could boast a completed building with a signature look and at the same time be able to maintain an aggressive 18-month schedule. William Rawn Associates, the architect, incorporated a curved building massing, rooftop monitors, and a large-span window into the design. These design features, coupled with the relatively short schedule, drove the design team to choose a steel framing system. Plus, steel allowed for repeatable framing, minimizing the need for special detailing at unique shear connections. In fact, the entire project was designed with the use of only a single transfer girder.

LeMessurier Consultants, the structural engineer, undertook the painstaking process of "smoothing" the framing of each of the buildings to achieve repeatable beams despite there being bay-spacing and beam spans that were non-regular. The intent was to streamline the shop drawing review and erection processes so that there were not 6,000 unique pieces of steel—the approximate number used on the project—to be reviewed, delivered, and erected. This effort produced hundreds of W14×22 beams with ½-in. camber. However, the process was simplified by LeMessurier's in-house composite beam framing program, Chiquita, which allows engineers to specify steel beam depths and/or sections and receive instantaneous feedback regarding the strength and stiffness design characteristics of the composite beams. The resulting integration of lightweight concrete slab-on-deck forcing composite action with the steel beams was instrumental in reducing the floor-to-floor heights throughout the project. These low heights correspondingly drove the demand for hundreds of beam penetrations throughout the project. The beam penetrations were mainly coor-

William Rawn Associates

Curved metal panels (above) alternate with red brick to provide visual transition points between the interconnected buildings.

LeMessurier Consultants

A pedestrian bridge with a curtain wall links two buildings within the complex.

dinated early in the design phase to ensure shop installation, which kept costs down. In addition, implementing the penetrations in a repeated beam size made the analysis of the beam penetrations, prior to detailing and erection, significantly more efficient.

Springtime in New England is always an adventurous time of year to plan outdoor work, as the rain, and sometimes even snow, can potentially be extensive. The MIT Graduate Housing Facility project was fortunate to have an extended period of dry weather, which allowed the steel to be erected near continuously for as long as the weather would allow. With the steel framing for the five buildings proceeding at such a frenetic pace, with steel topping out a mere two-and-a-half months after erection had begun.

With such a vast project, steel erection was completed in some portions of the five-building complex while it was still underway in other areas of the project. With the complexities in the progression of erection, the concrete work had to be fit in to accommodate the steel schedule. During preconstruction meetings, the project team discussed a scheme that would have the structural steel in place prior to the placement of the ground-level structural slabs at each of the five buildings. At the upper levels of the complex, all of the buildings are interconnected to allow for the flow of students throughout, but at the ground level, there are several distinct breaks between the buildings to allow access to the two courtyards. The breaks in the slabs at the ground level created the need for expansion joints in similar locations in the composite steel framing above. Many of the expansion joints between buildings would pass through arterial hallways and would be visible to the buildings' inhabitants. William Rawn felt that minimizing the width of the expansion joints would be the aesthetically preferable option thanks to this high level of traffic. However, this would be a challenge due to the site's poor soil conditions, as such conditions tend to increase the seismic base shear required for lateral force analysis. In response, LeMessurier instituted a complex series of ordinary concentrically braced frames (OCBFs) that provided a stiff lateral system, keeping the elastic deflection of each isolated structure to less than 1 in.

With the expansion joints minimized, efficient delivery of the lateral forces into the foundations was the next step. LeMessurier detailed the lateral-force resisting system to allow the lateral forces to be transferred from the OCBFs to the structural slab. The lateral forces were distributed to the structural slab, and in turn to the pile caps and grade beams via steel elements that were to be poured monolithically into the structural slab. Early in the steel erection process, the construction manager recognized the potential to advance the overall schedule by placing the structural slab for one of the five buildings that had not yet seen its first steel erected. In addition to adding a cold joint in a structural slab, a major hurdle in this proposed change was that the shop drawings for steel columns to be changed had already been reviewed. LeMessurier was able to adeptly change the lateral-force distribution detail from a series of embedded bars to a plated member with shear studs embedded in the slab. This solution did not interfere with the architecture of the space along the braced frames, as they had been placed only in solid wall sections.

Countless factors, including the low floor-to-floor elevations, expedient erection time, and ease of detail alteration, made the design team very happy with its choice of framing system. With its successful opening in time for the fall 2008 semester, NW35 not only expanded MIT's housing stock, it also replaced a parking lot with contaminated soils and a decrepit warehouse with an environmentally conscious gathering spot for some of the world's most ambitious students. Given the university's prominence in the field of engineering, everyone involved with the project foresees the facility as another feather in MIT's collective cap. MSC

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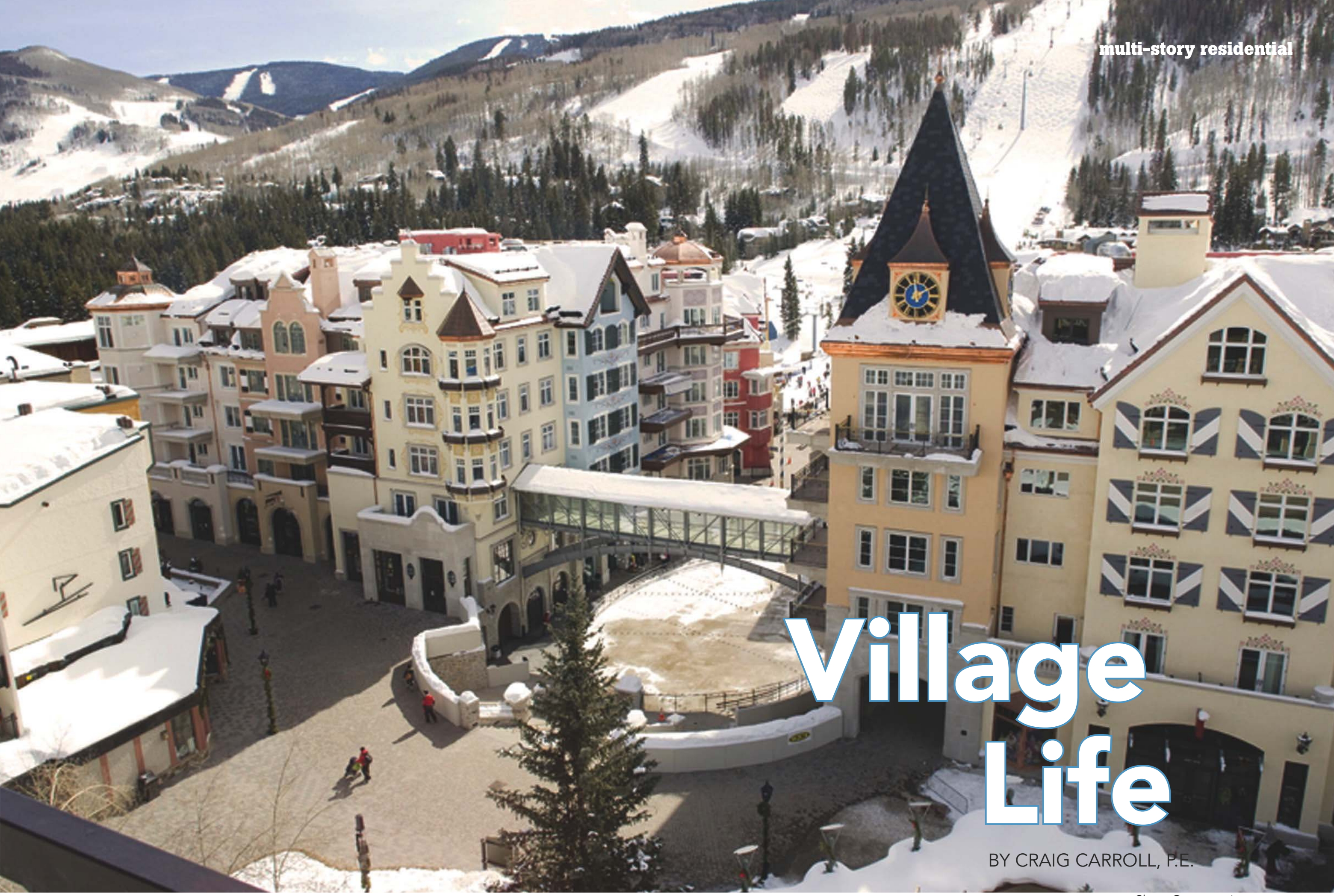
Software
Chiquita, STAAD, SDS/2

LeMessurier Consultants

Consistent beam depths and non-regular column bays were key structural goals for NW35.

William Rawn Associates

A design model of the NW35 graduate student housing facility, which features five separate buildings and two inner courtyards.



Village Life

BY CRAIG CARROLL, P.E.

Shaw Construction

Colorado's Vail Village gets a new addition that blends in with its old-world style.

ANYONE THAT HAS BEEN TO VAIL, COLO. has likely noticed the charming, Bavarian look of the main Vail Village. However, until recently one particular section of the village clashed with the rest. The Lionshead portion of the village, built more than three decades ago, had no clear architectural vision. Its buildings generally emulated the "mod" look of the early 1970s, which most people would put in the same category as satin shirts and disco music.

To bring Lionshead into step with the the rest of Vail Village, Denver-based 4240 Architecture developed a new look for the dated development, relying on trips to Prague, Czech Republic and Salzburg, Austria to come up with a European-style structure that looks like it has evolved over a period of centuries. This design feature created a unique challenge of customization in that no two building elevations are the same; there are roughly 33 exterior façade elements using cast and cut stone, stucco, ornamental railings, and wood trim.

The new structure, called Arrabelle at Vail Square, replaces the demolished Lionshead core and incorporates two levels of below-grade parking, a five-star hotel with an entry porte cochere, a world-class spa and rooftop swimming pool, a ballroom, restaurants, retail shopping, a plaza with an ice rink, and an 85-ft pedestrian bridge connecting the east and west areas.

Multiple Elevations

The site is surrounded by existing structures on three sides and the Vail Ski Resort on the fourth side. The sloping site and integration with existing streets and ski facilities created more than 25 different floor elevations in a nine-story structure; the plaza level alone has nine different floor elevations.

Structural steel was chosen as the framing system for the superstructure, due in part to its flexibility in dealing with multiple architectural requirements such as structure weight, minimal column sizes, and several column transfers. The typical floor-to-floor distance of 11 ft 4 in. was very tight for typical composite construction, but it allowed the required number of floors to be achieved while keeping within the strict building height requirements for Vail. Structural steel was also the only viable option for roof framing with complicated geometric shapes and angles and fully vaulted ceilings that would allow an optimal view of the surrounding mountains; it was also used to support the exterior stone in the many arched locations throughout the plaza.

Making it Work

It didn't take long for structural engineering firm Monroe and Newell Engineers to realize that the lower level steel transfer beams were going to exceed the maximum sizes rolled in the United States at the time. However, staying committed to domestic steel was achieved by using U.S.-supplied steel beams and reinforcing them as necessary with steel plating. At many locations the largest size of W40×431 was used with top and bottom cover plating added to achieve the desired structural strength—e.g., the

4240 Architecture

An 85-ft pedestrian bridge connects the east and west areas of the Arrabelle development. The entire project had more than 500 steel beam penetrations.

Shaw Construction

The completed pedestrian bridge, ready for skiers.

large-clear span ballroom required a double steel transfer beam with plating to keep the depths acceptable.

Where the largest rolled plated sections were insufficient Monroe and Newell used 60-in. built -up steel plate girders. These were used above the loading dock where column spacing is quite large to accommodate semi-truck maneuvering. The low floor-to-floor depth of the level above the loading dock required the plate girders be located at the plaza level, and the floor located between the loading dock and plaza level was then hung from the plate girders. This unusual construction technique required shoring of one level while the level above was completed. The towers are connected by an 85-ft clear span pedestrian bridge using trusses created from large steel rods and clevises with the bearing end conditions detailed to allow horizontal movement. The plaza level incorporates the loading of an ice rink and two elevators serving the plaza through the seventh level.

Keeping the Customer Satisfied

High ceilings were critical to the marketability of the residential units, each valued at over $2,000 per sq. ft. Steel beam depths were carefully selected and coordinated with the mechanical and lighting requirements of each unit. Additionally, the location of each exterior wall penetration was carefully located for aesthetic purposes. As a result of these factors and the tight floor-to-floor layout, the project had more than 500 steel beam penetrations, many of which required extensive reinforcing. Each of the residential units was unique in floor layout, requiring column locations to vary from floor to floor.

The plaza level required a unique column layout to allow for fully functional retail space, restaurants, a top-level spa, and a hotel lobby. However, the plaza level column layout conflicted with the parking layout on the garage levels and a 2,500-sq.-ft column-free ballroom below. This proved not to be an issue, as the steel framing for the structure consists of more than 3,000 column transfer beams, resulting in no columns running from the roof directly to the foundation.

Monroe and Newell used RAM Steel to model the entire steel building frame. The model was divided to reduce the size of each part and to allow multiple users access to the steel model at the same time. While the steel detailing for the project was performed by Acuña Y Asociados S.A.—in Santiago Chile—the long-distance communication was handled by e-mail and a quick RFI turn-around process, along with the drawings being digitally transferred and locally plotted (several visits to Chile by Monroe and Newell also helped the process). The steel for the project consisted of more than 3,500 tons and 12,000 pieces. The hotel opened in time for Christmas 2007. MSC

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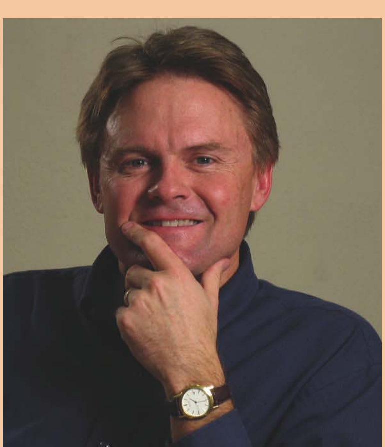
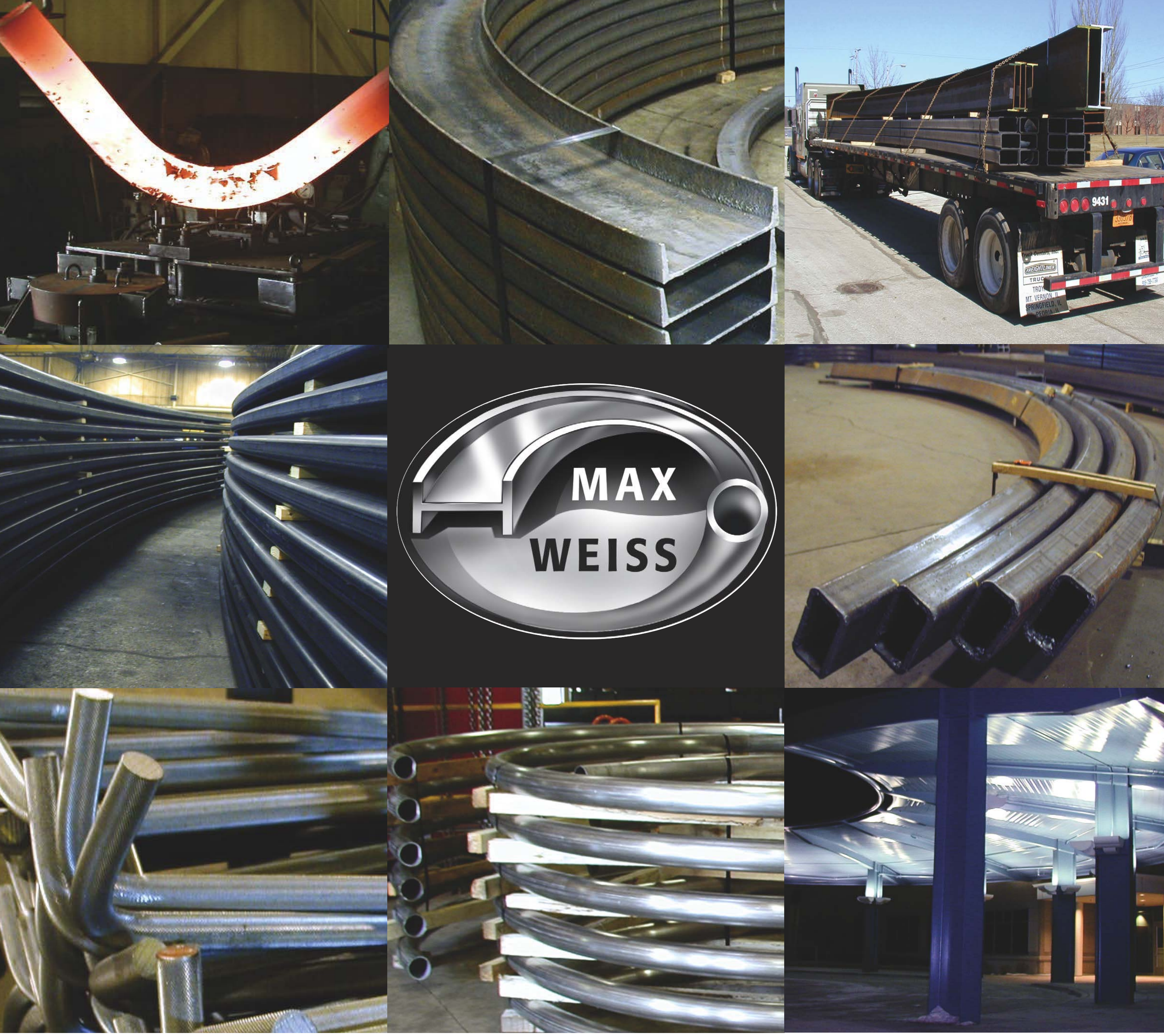


Craig Carroll is a principal with Monroe and Newell Engineers, Inc.


MAX
WEISS

Alise O'Brien

At the Center of Things

BY MARC ALPER, P.E., S.E., AND ANDREW TRIVERS, AIA

A new luxury condo building holds its own in a thriving commercial and cultural hot spot in suburban St. Louis.

CLAYTON, MO. MIGHT BE A SMALL TOWN IN TERMS OF POPULATION, but it packs a punch. This suburb of St. Louis, with less than 15,000 residents, serves as a secondary business district for the metro area and a major financial center for the Midwest, and features a thriving cultural scene.

The Crescent, a new $73 million, nine-story luxury condominium/retail development, fits well into this environment. Located in Clayton's downtown area, it is designed to reinforce the urban context established by a dramatic fountain and sculpture located on a circular plaza at the intersection of a high-rise Ritz-Carlton hotel and 30-story condominium development.

The building includes 72 condominiums, 27,000 sq. ft of retail space, and a 300-car parking garage located on a rectilinear, tight, sloping site. Since the structure occupies the entire site, a landscaped terrace was created on the upper level of the garage with easy access for residents to the green space.

A Slight Change in Plans

A nine-story luxury condominium with a curving footprint would typically be thought best framed with cast-in-place concrete. In fact, that's how the Crescent almost ended up. After schematic design discussions with the initial general contractor, after Alper Audi began modeling the structure as a cast-in-place, post-tensioned concrete system with concrete shear walls, and after structural drawings were already underway, a second contractor offered to provide a steel-framed structure more quickly and at considerably less expense. A redesign using steel beam and purlin composite framing was rapidly completed and priced; the steel design showed potential savings of more than $3 million from the overall $45 million shell cost of construction.

The contractor was able to offer this pricing reduction because the steel system was considerably less expensive and could be erected more quickly, and a concrete structure would have required two expensive tower cranes in order to cover the elongated work area; these cranes would have had to be rented for almost the entire duration of the project. Conversely, the steel frame could be erected using only a single mobile crane moving from one end of the site to the other, and could then leave the site after erection was complete. Also, since the steel structure could be completed earlier, the overall cost of the contractor's general conditions and the owner's construction interest

Alise O'Brien

One of the condo units in the steel-framed Crescent.

carriage would be reduced. The project's schedule would no longer be driven by the time for concrete to cure, stress, and cycle floor placements. With steel, much of the work would be fabricated off-site, so there would be less weather concerns and less waste on-site.

Immediate benefits of using steel framed construction included:

- ➜ Producing a lighter structure with noticeable savings in the foundations and seismic/ lateral-force resisting systems.
- ➜ Allowing the structural steel to be designed and fabricated and the foundation design to be complete and under construction before the architect finished his design. The team used the steel structure's ability to easily accommodate inevitable owner and architectural detailing changes as the design was finalized.
- ➜ Eliminating the need for formwork shoring and re-shoring, which impedes any subsequent work on the floors below until the concrete achieves minimum strengths.
- ➜ Producing smaller columns than with a concrete scheme, therefore having less physical impact on tenant space.

However, initial concerns about changing to steel included:

- ➜ Corrosion aspects of the two-level steel-framed parking structure and outdoor terraces.
- ➜ Increased story heights with steel framing and its effect on the building skin.
- ➜ Vibration perceptibility, sound transmission, and fire ratings.
- ➜ Relative difficulty to frame the curved floor plan and terrace depressions.
- ➜ Minimized extraneous steel framing needed to hang the brick and masonry façade.

To address these concerns, galvanized steel framing and formdeck were used for the supported level of the garage and landscaped terrace to provide corrosion resistance and to be compatible with spray fireproofing. We carefully developed the terrace and railing details to allow proper waterproofing and sloped drainage to protect the support structure and to keep water out of the occupied space below. A thicker-than-minimum concrete slab thickness was used to achieve excellent vibration and noise performance characteristics—closely comparable to the previous all-concrete scheme.

The steel building's story height gained more than 12 in. per floor from the previous 8-in. concrete flat-plate scheme, thus increasing the height of building by almost 12 ft. This required architectural revisions to window sizing and fenestration to properly rebalance the building proportions for the new height. However, the steel framing and its time savings more than made up for any increased cost of the skin. Furthermore, the taller building makes for a more impressive appearance from the street, views are much improved from the upper floors, and the larger windows are a welcome upgrade in the living units, thus enhancing their value.

The composite girder and purlin framing system was organized to require the minimum number of pieces to be erected while simultaneously providing generous space between beams to accommodate mechanical units and piping. Spray-on fireproofing was required on all beams and columns, but the slab and composite deck system satisfied the needed 2-hour rating without additional fireproofing of the decking. The third-level roof over the garage was designed for much heavier loading to accommodate 12 in. to 36 in. of planting material, which creates a beautifully landscaped half-acre park for building residents.

Despite stacking the different uses for apartments, retail, and parking—each with their own preferred column arrangement—the designers were able to achieve an efficient layout for each without column transfers. However, it was necessary to laterally offset and transfer some of the vertical braced frames to free up drive aisles in the parking levels.

The property-line-to-property-line construction site was tight, so the rear, lower-story portion of the footprint that was not located

The Crescent includes 72 condominiums, 27,000 sq. ft of retail space, and a 300-car parking garage.

Alise O'Brien

under the condominium tower was erected last to leave work room for material deliveries, laydown, and crane maneuvering. This sequencing required several temporary braced frames to be installed through the lower stories in order to stabilize the initial erection of the nine-story L portion. This bracing was later removed after the lower "infill" stories were completed.

Cut in Half

Due to plan irregularities and size, the 450-ft-long building is separated nearly in half by an expansion joint. Calculations determined that the building required more than a 4-in. joint width at the roof level to accommodate wind and seismic effects; yet when magnified by the required C_d factor, the joint width became approximately 18 in. This large expansion joint width was functionally difficult to plan and detail for, so an innovative approach using a sacrificial slab zone was developed to satisfy the code requirement and then detailed for a more acceptable 4-in. joint width.

The project was executed under a CM-at-risk contract with guaranteed pricing based on the early steel and foundation packages. These packages were issued for construction use more than six months before completion of architectural building and shell documents. Furthermore, foundation construction and steel fabrication and erection were well underway before these final drawings were issued. Modeling the structure in 3D, files were converted to SDS-2's structural steel detailing format and made available to the fabricator early in the process to expedite preliminary pricing, scheduling, and shop drawing preparation. A wide variety of skewed connections were required to accommodate the building's irregular and curved footprint, so it was a great benefit to the fabricator to have these shared BIM files. MSC

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1st on the Block

A San Diego condominium project sets a structural precedent in a high-profile part of town.

BY ROBERT PYLE, P.E.

Above, left: Nexus is the first steel multi-story residential building to be constructed in downtown San Diego since the 1980s.

Below, left: The eight-story project, which includes three floors of underground parking, used 2,000 tons of structural steel.

Right: The project was the first in San Diego to use a buckling-restrained braced frame system.

Photos: KMA Architecture and Engineering

SEEMINGLY OVERNIGHT, DOWNTOWN SAN DIEGO'S once-quiet, industrial East Village has transformed into a bustling urban mixed-use neighborhood, thanks largely to the opening of Petco Park, home of the San Diego Padres, in 2004. Since then, competition has been fierce among residential developers in the area who are anxious to complete projects as quickly as possible.

And speed of construction is what paved the way for the 76-unit Nexus condominium building to become the first steel multi-story residential project constructed in downtown San Diego since the 1980s. This speed was due in part to the "one-stop-shop" nature of the project's eSteel design-build team, an Albuquerque-based collaborative partnership of structural engineering firm Chavez-Grieves Consulting Engineers, Inc., steel fabricator AmFab, Inc., and steel detailer dtl's, Inc. In all, 2,000 tons of structural steel was used on the project, which includes eight floors of steel-framed above-grade residential and mixed-use space, and three floors of below-grade steel-framed parking.

A New Approach

eSteel consulted the rest of the project team on a number of framing solutions before selecting a buckling-restrained braced frame

Painted galvanized steel was used for Nexus' balconies.

(BRBF) system. A buckling-restraint brace (BRB) acts like a large shock absorber, with a central plate or cruciform cross-section stretching in tension and shortening in compression. In contrast, a typical special concentrically braced frame (SCBF) has diagonal braces that stretch in tension but buckle in compression, which is not as ideal due to the buckled behavior. The BRB works without global buckling because the central plate is grouted solid—but free to elongate and shorten—inside a larger restraining tube.

Because this was the first time the BRBF system had been used in San Diego, the city's planning department was concerned that it was not recognized in the locally enforced UBC code. The department informed the design team that there would be a 90-day review period with no guarantee that they would approve the BRBF system, since it would set a precedent in town.

A workshop was set up between city officials and the eSteel team with support from AISC and Dr. Chia Ming Uang from University of California at San Diego. Dr. Uang has tested the largest buckling BRBs in the U.S. to date, and the samples for this project were loaded up to 1,200 kips. The workshop involved discussion of the specific design of the structure, review of the requirements included for the BRBF system in the 2005 AISC *Seismic Provisions*, and review of Dr. Uang's test results. It paid off for the design team, as the building department approved the plans two weeks after it took place.

Tight Site

On a job site with no lay-down area, everything had to be organized so that steel could be erected directly off of the trucks. The project involved significant early coordination between the structural and mechanical teams to ensure proper fit-up. Several openings were left in the framework so that building systems could be easily transported through the beams and properly placed. Approximately three or four beams per floor, used for shoring, were removed once the concrete floors cured, to raise the ceilings in certain areas.

Steel was also used for Nexus' balconies; all exterior steel was galvanized. The balconies were dropped down in thickness from 2 in. to 3 in. so that the floor slab could be cut into and sloped to allow for drainage. MSC

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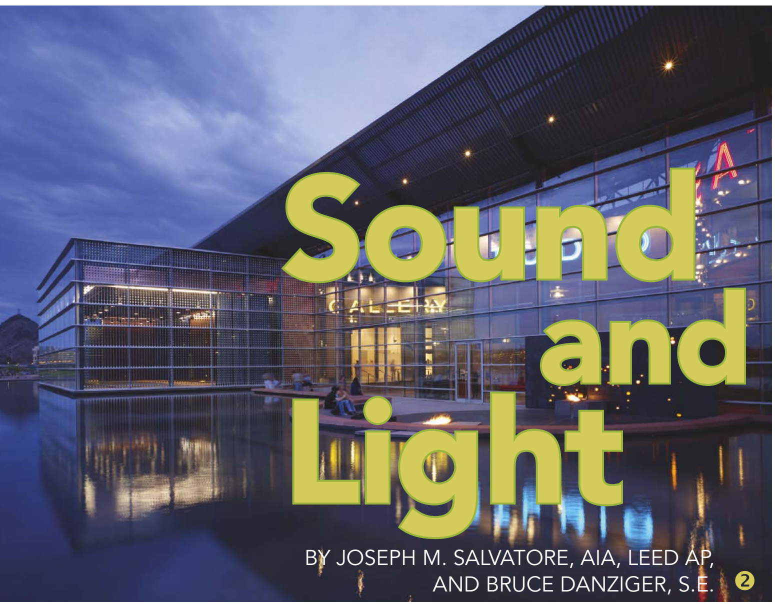
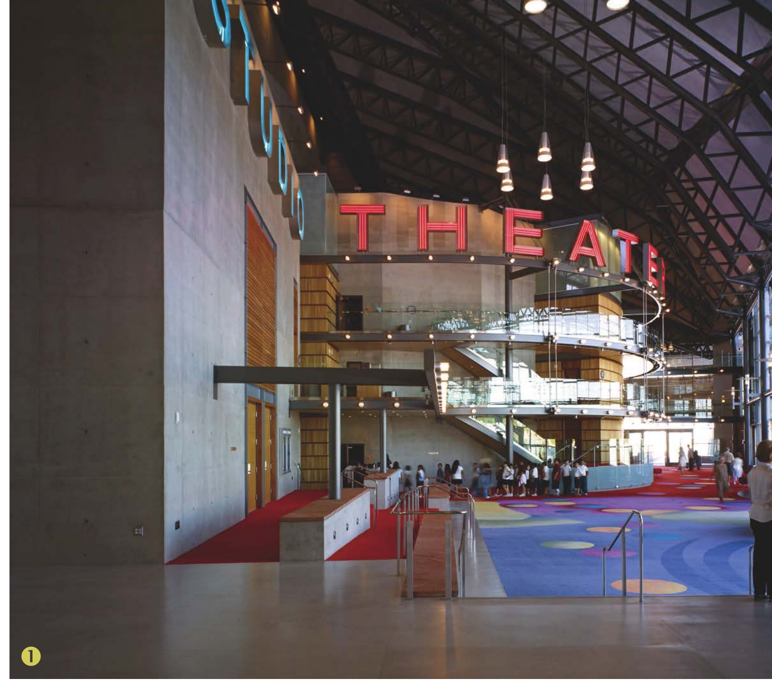


Sound and Light

BY JOSEPH M. SALVATORE, AIA, LEED AP, AND BRUCE DANZIGER, S.E.

PHOTOS BY JOHN LINDEN



Acoustic and visual requirements drive the design of an Arizona arts center.

THE GOOD NEWS ABOUT THE NEW TEMPE CENTER FOR THE ARTS is its scenic and central location. The 90,000-sq.-ft performing and visual arts center sits on the south bank of Town Lake in downtown Tempe, Ariz.

The bad news is, well, also the location. It's exactly two miles east of the center runway of Phoenix's Sky Harbor International Airport, one of the busiest in the nation. It is also one-quarter mile west of a heavily used railroad bridge spanning the lake and a stone's throw from a ten-lane freeway directly across the lake. In other words, this theater is bombarded with noise from all directions *and* above—not an ideal situation for a performance venue. As such, elimination of noise infiltration was a top priority for the design team.

The solution was a "boxes within a box" approach, effectively creating buildings within a larger building, using the interstitial space as a sound buffer. The various functions of the complex are separated into individual buildings enclosed by an overarching high roof. The enclosed buildings include the main theater with fly tower, a studio theater, a gallery, a multi-purpose room, and a donor bar. The high roof mitigates the airborne noise and vibration caused by the close proximity of air traffic and along with the rest of the outer building, also gives the Center its iconic shape. The multi-faceted roof resembles a stealth fighter designed to deflect radar waves while the overall shape of the building is reminiscent of the nearby buttes.

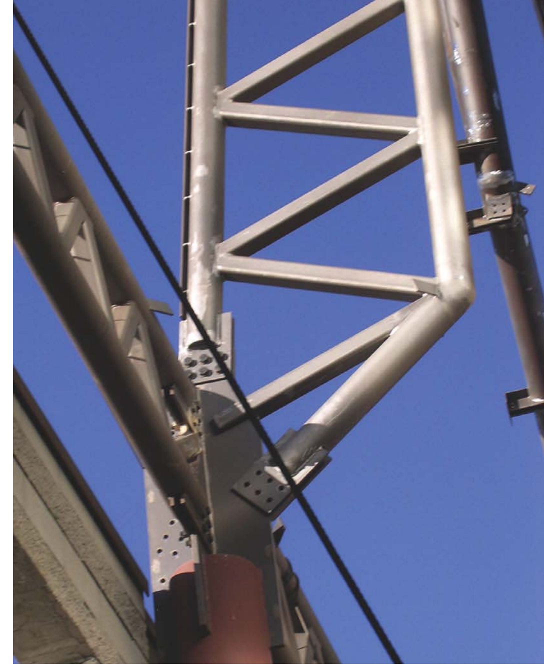
The structure for the Center uses a combination of concrete and steel systems. All of the walls and a portion of the floor and roof slabs are reinforced concrete, while the remaining floors and roof slabs are formed from composite systems of metal deck and concrete. Reinforced concrete walls and slabs envelope the main theater and fly tower. The studio theater, gallery, multi-purpose room and donor bar have concrete walls with steel composite framing for the floors and roof. The high roof uses long-span steel trusses supporting canted planes of composite deck. A circular lobby balcony area cantilevers from the back of the main theater with steel-framed composite floors hung from stainless steel tension rods. Steel-framed bridges with composite decks connect the lobby balcony to the donor bar, and a long circular reinforced concrete wall envelopes the perimeter of the project. This combination of steel framing and reinforced concrete required many steel plates embedded within the concrete to support the steel members.

❶ The building uses a "boxes within a box" approach, apparent from the lobby.

❷ A reflecting pool provides a tranquil meeting place that offers views into the building.

❸ Angular roofing at the west entrance.

❹ The lobby is a patchwork of steel trusses and HSS-supported bridges.



Complex truss connections are featured throughout the building.

The High Roof

The roof planes are built in several layers with 6 in. of normal-weight concrete acting as the sound collection mass. Rigid insulation and a standing seam metal roof give the building its thermal and moisture protection as well as its identifying "strata" appearance. Supporting the roof planes nearly 100 ft above the lobby floor is a hollow structural section (HSS) truss system with the visual impact of the flying ribs of the great gothic cathedrals in Europe. These trusses were placed 24 ft on center with a stiffened steel deck spanning them and supporting the roof's concrete.

Additional support at the top of the high roof over the fly tower is provided by small columns (W10s) that have laminated bearing pads (rubber with internal steel plates) at their base on the fly tower roof below. These pads provide a somewhat soft support so that vertical loads are resisted by the fly tower and at the same time mitigate the airborne vibration from aircraft.

Three "fissure" trusses were designed into the system to allow daylight to illuminate the steel truss geometries. The entire roof assembly is supported on thirty 16-in.-diameter columns, and 16-in.-diameter steel cross-bracing and HSS sheer structures support these columns, eliminating almost all solid shear walls. This allows the roof to "float" on 4-ft-high clerestory windows, bringing more natural lighting into the building.

Reasons for Looking Up

With the overall theme of artistic achievement in mind, the designers decided to celebrate the large roof structure with uplifted HSS outriggers at each support column and span those outriggers with perforated decking, providing transitory lighting for patrons upon entering the building from the intense Arizona sun.

On the other side of the weather specturm, another feature of the steel structure is the building's celebration of rainfall. It does not rain a great deal in Arizona, so when it does, the designers decided that the building should take full advantage and included a special waterspout off the large roof. At the east end of the roof structure the HSS outriggers fold downward to create a waterspout sheathed in copper. Water collected from the large roof finds its way to the spout and drops onto a conical shaped "island" of Mexican beach pebbles in the middle of the Center's expansive reflecting pool.

A Pleasing A/V Experience

Due to the desire to maintain the steel as an eye-catching element, intumescent paint was used for fireproofing. All steel in the building that is not stainless or galvanized is coated in silver or gray Hammerite paint to give it a glazed and intricate texture, keeping it in line with the high aesthetic standards that the design team hoped to achieve. These tight visual parameters, along with the strict acoustic requirements, make for an audiovisual experience that extends beyond the art and performances within the building, into the building itself. MSC

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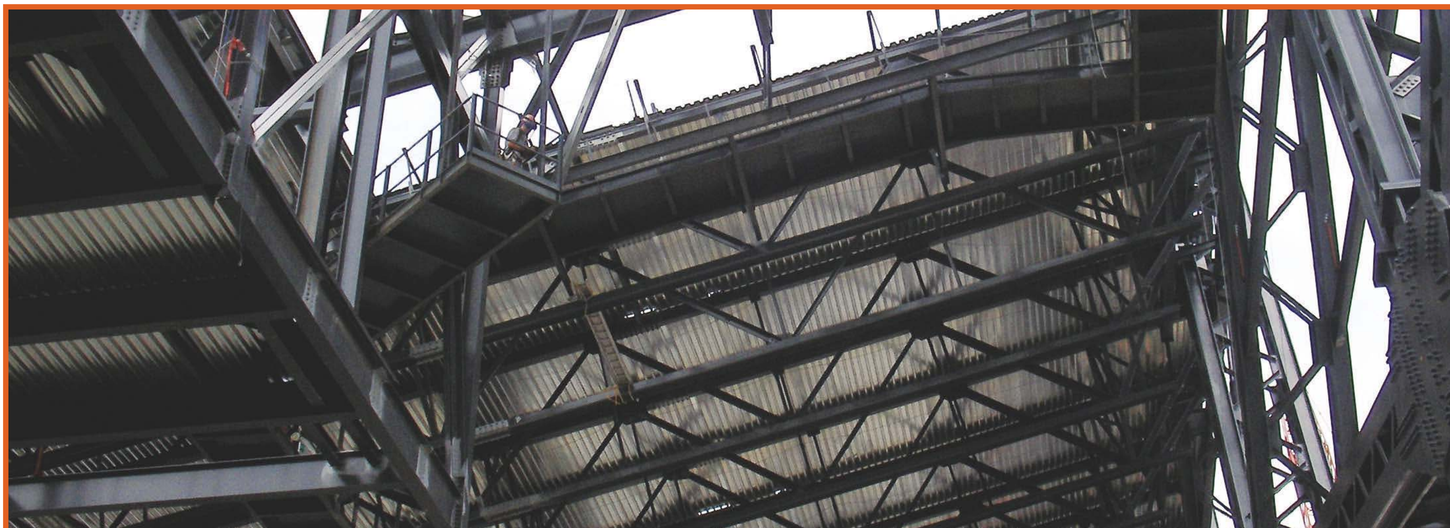

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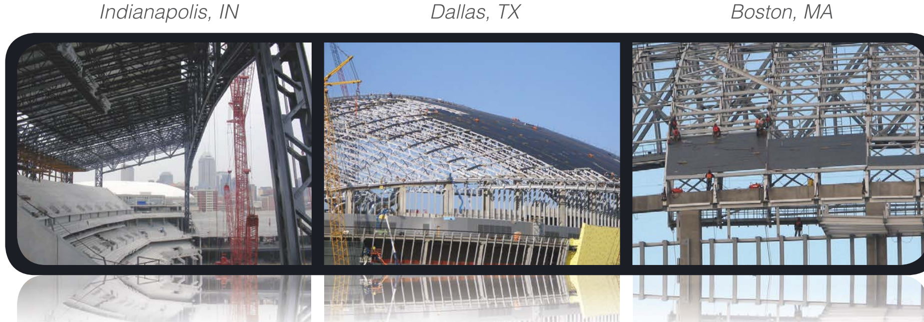

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The outside is old, the inside is new, and both revolve around the ancient world in this academic renovation project.

E.W. Howell Co., Inc.

Nikolas Koenig

Stepping Back in Time

BY VICTORIA ARBITRIO, P.E., SECB, RANDALL GOYA, AND JULIE HAUSCH-FEN

THE NEW HOME FOR NEW YORK UNIVERSITY'S Institute for the Study of the Ancient World has come a long way since it was built more than a century ago.

Practically an antiquity itself, the 27,000-sq.-ft townhouse on Manhattan's Upper East Side, originally built as a residence in 1899, underwent extensive alterations to both the exterior and interior in the late 1920s—the majority of which remain today. The building served as a private residence until 1950, when it was sold to the American Jewish Congress for use as the organization's headquarters. In 2004 the site was acquired by the Leon Levy Foundation to house the Institute, which the foundation endows.

A complete renovation of the existing six-story building was necessary in order to meet the needs of an academic facility. The first and second floors were retrofitted and adapted to house various exhibition and study rooms. The remaining floors, which had suffered both poorly conceived and poorly executed alterations, required significant work and creative redesign for adaptive reuse as a library and offices.

On the Shelf

Of critical importance to the facility was the design of a new library to accommodate the Institute's extensive book collection. Removing parts of the fourth and fifth floor slabs at the back of the building allowed for a three-story atrium to house a freestanding stack structure. The structure is composed of three new steel-framed levels that can support high-density shelving and study carrels. These levels are equivalent in weight to the two floor sections that were removed.

To maximize the ceiling height in the second floor exhibit space below the library, a new third floor was built, rather than reinforcing the old one. The new floor is composed of 2½-in. stone-weight concrete over 3-in. composite metal deck, composite W14×30 infill beams, and composite W24×68 or W24×76 girders, which transfer the new library columns above to the original building columns below.

The masonry exterior walls needed additional lateral support after the removal of the fourth and fifth floors and were reinforced with 14×6HSS tubes to transfer the loads to the perpendicular walls. One existing steel column remains in the space; it runs the full height of the atrium, supporting the sixth floor and roof above. In order to extend unbraced for three stories, the column was reinforced with steel plates for its entire height.

The library stack structure is a moment frame with infill beams. The beams and girders are W10×33s and W10×45s and the columns are W8×35s. The rails for the sliding book storage units rest directly on steel girders. The columns are pinned to the underside of the sixth floor in order to brace them against lateral loads, with vertical slotted connections allowing for the floor deflection. The landings of the stair that connects the library floors and the existing floors were cantilevered on W8×40s and W8×58 members.

Seel framing is exposed prominently in this structural renovation project.

Thin, perforated steel plates, bent into channels and finished with a gunmetal powder coat, make up the floors, landings, and stair risers. The perforations allow light to pass through the space and in turn lend a feeling of overall lightness to the structure.

The design called for the steel members to remain exposed, so the size of the steel wide-flange shapes was kept consistent, as was the size of the bolts (¾-in.-diameter A325s). Similarly, there were set parameters for routing the building systems, all of which needed to be coordinated with the design of the stack itself prior to the fabrication of the steel. Penetrations through the steel beams to accommodate these systems were predetermined and drilled in the shop. All of the library's steel is ASTM A992 Grade 50. Because the finish of the structure is exposed metal, the beams and columns were coated with intumescent paint.

Erecting the library structure within the existing envelope presented considerable challenges. The space was small and largely inaccessible by cranes. The solution involved inserting steel members horizontally through the windows from the street, then distributing and moving them across the flooring, and finally using a chain-fall to pivot and lift each piece into place.

Selldorf Architects

A new egress stair tower at the rear of the building supports two wooden water tanks.

Adding to the Stories

In addition to the library, another key component in the renovation was refurbishing and extending the grand elliptical staircase an additional flight, to reach the sixth floor. Steel was chosen for the structure of the stairwell extension, as the complex curves of the winding stair stringer could be perfectly formed in steel. The curved tube stringers were supported at a new landing platform at the sixth floor, infilling a former skylight opening. The tubes were sized to limit deflections as well as possible vibration effects. The stringer was then clad in wood and plaster to match the stairs at the existing floors below. The original skylight was salvaged, restored, and reinstalled above the new stair extension.

Steel was also used to reinforce much of the original structure in order to accommodate new loads introduced by the Institute—e.g., a new elevator, a new cornice, upgraded mechanical systems, and a new egress stair tower added at the rear of the building to support two wooden water tanks. (Two tanks were required, as having only one tank would have violated the zoning height restrictions.) The stair tower is open to the elements on one side. This braced frame is constructed with 8×8HSS columns, 10×8HSS beams, and 2L6×4 or 2L6×3½ braces. W14×68s with W6×20 grillage beams at 2 ft on center provide a dunnage platform for the water tanks over the stair roof. In the case of the cornice, the original limestone cornice was found to be severely deteriorated. However, as it did not align with an actual floor, new steel support anchors were installed inside the wall and the new GFRC cornice was through-bolted to these anchors.

The design team's plan for the Institute exemplifies both creative solutions to the project's program requirements as well as innovative structural approaches. The design seamlessly incorporates requisite state-of-the-art technologies and a new academic program while preserving the architectural integrity of a historic New York City townhouse. MSC

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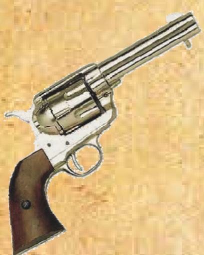




Detailers: Where to Find Them and How To Keep Them

BY HUGH DOBBIE, RSD, ASCT, MBA

Recruitment and training efforts are more important than ever when it comes to molding new steel detailers.

A HALF-CENTURY AGO, IT WAS considered normal for North American fabricators to train their own detailers. Alternatively, they would import them from Britain and Europe. Wages were not high compared to shop personnel, and it was difficult to move between one fabricator and another—particularly with the larger companies. There seemed to be an unwritten law that they would not poach from one another.

My own recollection of those days is that when the recession of the 1960s hit, the fabricators had a difficult time holding on to their detailers. They didn't have enough when they had a big job and had too many when they were in between large projects. Long-time detailers would at times be laid off until demand picked up, when they might again be rehired. Some of the more entrepreneurial detailers looked at how they could weather the highs and the lows of the fabricator's office.

It was about this time that detailing companies started to emerge. They filled a need by servicing the fabricators when they needed more detailing staff. The detailing companies had the flexibility of working for a variety of fabricators and could employ their own staff where the work was needed. Unfortunately, with the emergence of this new detailing industry, very few companies engaged in training detailers as the fabricators had done in the past. As a result, over the last five decades there has been a general attrition in detailing forces in North America, and few institutions now cater to training steel detailers.

An Obscure Career

Steel detailing is not generally considered a high-profile job and very few high school students set their sights on detailing as a career. Most people, in fact, don't know what a detailer is or does. People get into the industry through relatives or friends or by default when they are looking for a job, as I did.

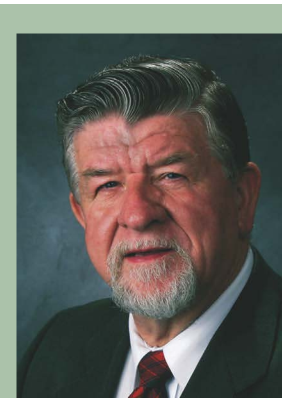
So where do we find bright young candidates who might become detailers? One option is to recruit them in high school. This can be accomplished on career days by visiting schools and extolling the virtues of the steel detailing industry. Offering scholarships can also serve to encourage students to consider a career in detailing. Colleges that provide structural engineering technology programs can be yet another source of recruits.

Lately, we have found another excellent vehicle for hiring: new immigrants from abroad. Often, immigrants with engineering and architectural degrees are frustrated because they can't find employment in their discipline. In many cases they are required to take additional courses and need experience in North America before they can be accepted into their chosen profession. I have found that many of these individuals, through frustration, end up taking jobs far below their qualifications. I have also found that with training in steel detailing, these individuals make excellent candidates for our industry.

Technological Attraction

Attracting new blood into the industry is essential to our goal of meeting the fabricator's and the owner's requirements. We can encourage potential detailers into the profession by successfully using new technology. Drafting is no longer identified as merely producing drawings for a specific task. With the arrival of computers, drafting has become a much more exciting vocation, particularly with the 3D programs now available. The level of automation has now reached the point where even a junior detailer can produce shop detail drawings after only a few weeks of training. A junior detailer can be taught how to build a 3D model on the computer and add pre-selected connections in the appropriate locations. He or she can quickly, with adequate supervision, become a valuable member of the team. Unfortunately, the detailer's depth of experience at this stage is limited and further training is required. In the long run, the detailer must constantly expand his or her knowledge of the craft.

AISC's *Detailing for Steel Construction* is a good reference. The information is useful and important for anyone in the steel detailing industry. The AISC Committee on Steel Detailing began considering how this material could effectively be communicated to would-be and/or junior detailers. As the committee prepared sample questions and answers and developed methodologies for conveying this information to detailers, the decision was made to develop a web-based course for detailers that could be taken anywhere in the country with the benefit of a computer and a high-speed Internet connection.



Hugh Dobie is chairman and CEO of steel detailing firm Dowco Consultants Ltd., which developed and offers the AISC Steel Detailer Course.

Detailer "Start-up" Costs (total over 3 years and per year):		
Computer	$2,500	$833
Desk, chair, bookshelf, etc.	800	267
3D software	25,000	8,333
Annual maintenance	11,250	3,750
Basic training on software	2,000	667
Total Cost	$41,550	$13,850

As stated above, most of today's steel detailing is done with the aid of sophisticated 3D modeling software. Unfortunately, while students very quickly pick up *how* to detail using a computer, they do not have the detailing experience to understand *what* they are doing. With this new AISC web-based steel detailing program, we expect to close this gap. Many companies are investing heavily in steel detailers. Approximate basic costs to outfit a detailer today are listed in the table on the left.

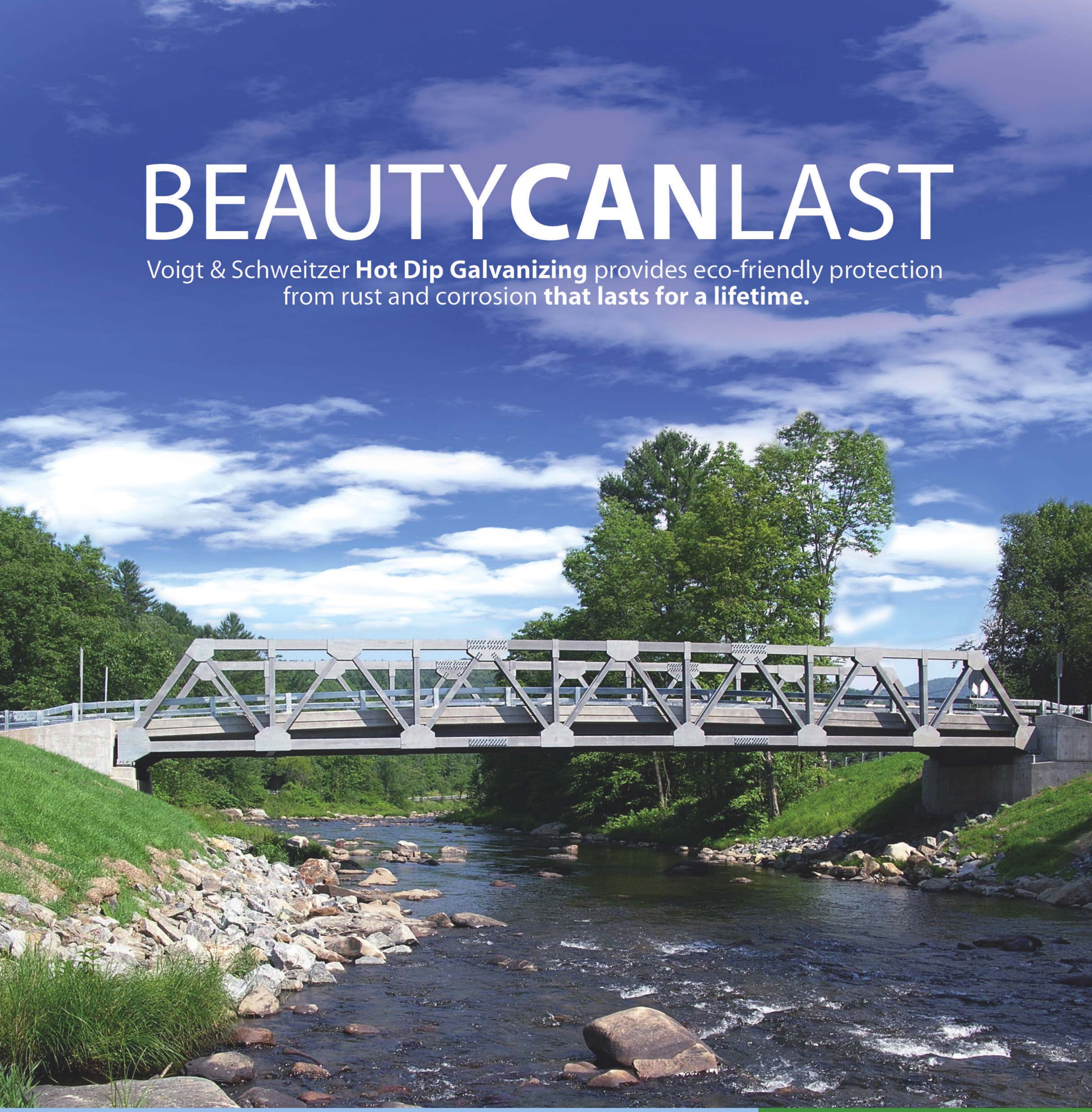
So, now you have to spend $41,550 over three years to equip your detailer, and you have not even given him or her any actual detailer training yet, save for software training. This is where the AISC Detailing for Steel Construction Web-Based Course comes in.

The course costs $9,500 for non-members. AISC members receive a 25% discount, and National Institute of Steel Detailers (NISD) members a 10% discount. These discounts can be combined, so someone who is both an AISC and NISD member receives a 35% discount and pays $6,175. That translates to $2,088 per annum for three years or 55% of the annual cost of maintaining the software. It also equates to 13% of the cost for training and equipment for three years.

From the beginning, it's been apparent that we must be prepared to invest in outfitting and training detailers; it has been proven that investment in technology and training pays dividends in the long run. That said, it may be prudent nowadays to have detailers sign employment contracts—with special provisions regarding repayment of training fees, for example—if an employee leaves before three years.

In an effort to cut costs, some companies have resorted to outsourcing their detailing to India, China, the Philippines and other countries. Time differences can make this arrangement challenging and a strong North American detailing force is still essential to providing the necessary liaison with the fabricator, engineer, etc.

In the end, detailers are a hot commodity in North America right now. Train them well. Pay them well. Treat them well, and I am sure this will bring rewards for all involved. MSC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Digging Through the Rubble

BY MONICA STOCKMANN AND THOMAS J. SCHLAFLY

The Northridge earthquake changed the way we weld, and a little guidance is helpful in navigating the current applicable welding requirements for seismic projects.

DISASTERS, NATURAL OR OTHERWISE, are well known for being catalysts for change in thinking and practice.

The 1994 Northridge (California) earthquake, for example, sparked more than 10 years of research and development in the field of high-seismic structural engineering and steel fabrication. In 1995 the SAC Joint Venture received funding through the Federal Emergency Management Agency (FEMA) to address both immediate and long-term needs to improve the seismic performance of welded, steel moment frame connections. The project culminated in several publications, including FEMA 350 and FEMA 353. As a result of this research, structural engineers are now equipped with better seismic design procedures.

In order to put this FEMA material into consensus codes and keep it up to date, AISC incorporated design provisions into the AISC *Seismic Provisions for Structural Steel Buildings* (AISC 341-05), and the American Welding Society (AWS) generated AWS D1.8 *Structural Welding Code—Seismic Supplement* (AWS D1.8). These documents supplement the standard specification for buildings and include much of the information presented in the FEMA documents as well as corresponding updated seismic requirements.

At the time that AISC released AISC 341-05, AWS had not yet released AWS D1.8. Thus, AISC 341-05 does not formally recognize AWS D1.8. Instead, Appendices W and X were included in AISC 341-05 to cover the seismic welding requirements, with the stipulation that these appendices were included on "an interim basis pending adoption of such criteria by AWS or other accredited organization." The 2010 AISC *Seismic Provisions* will not include Appendices X and W. Instead, it will simply reference AWS D1.8.

Testing requirements for qualification of connections and provisions for the prequalification of seismic connections are provided in Appendices S and P of AISC 341-05. AISC also assembled the Connection Prequalification Review Panel (CPRP), the committee responsible for prequalifying special moment frame (SMF) and intermediate moment frame (IMF) connections. The CPRP publishes and maintains AISC *Prequalified Connections for Special and Intermediate Moment Frames for Seismic Applications* (AISC 358-05), which specifies the design, detailing, fabrication, and quality criteria for prequalified connections for use with SMFs and IMFs.

Navigating the Resources

With the near nationwide adoption of the International Building Code (IBC), seismic design requirements now apply in almost all jurisdictions. Even today, some engineers and fabricators may be required to navigate through the seismic provisions for the first time in their careers. So, we've provided some guidelines on where to turn for more detailed information on the topic.

Because AISC and AWS have incorporated and built upon the FEMA documents in their current specifications, today there is no need to reference or specify the FEMA documents for requirements for steel construction projects. Specifying the current AISC and AWS documents in the contract documents is all that need be done.

For high-seismic applications (anytime the seismic framing is designed with an *R* other than 3), not only does the engineer need to design in accordance with AISC *Specification for Structural Steel Buildings* (AISC 360-05) and AWS D1.1 *Structural Welding Code—Steel* (AWS D1.1), but he/she also needs to meet the requirements of their seismic counterparts AISC 341-05 and AWS D1.8. When prequalified moment connections are to be used, the engineer can make use of AISC 358-05.

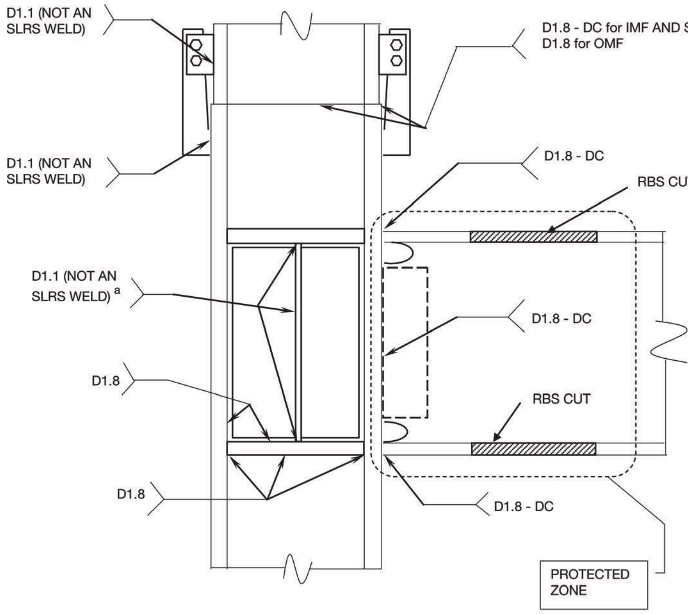
Another helpful resource for welding design is AISC Design Guide 21 *Welded Connections—A Primer for Engineers*; for seismic weld information, Chapter 10 "Seismic Welding Issues" is particularly helpful.

Three Welds

1. Non-seismic welds include all welds in a building where the lateral force resisting system is not specifically detailed for seismic resistance (referred to as non-seismic applications for the purposes of this article)—i.e., buildings designed with *R* = 3 in accordance with ASCE 7-05. In addition, welds that are not part of the seismic framing in buildings designed with *R* other than 3 are considered non-seismic welds. The design of non-seismic welds is subject to the requirements of AISC 360-05 and AWS D1.1.

2. Seismic welds include all welds that are part of the seismic framing in buildings specifically detailed for seismic resistance—i.e., buildings designed with *R* other than 3. AISC 341-05 and AWS D1.8 provide supplemental provisions for the design of seismic welds.

3. Demand-critical welds are seismic welds in the seismic framing that have been determined and specified by the engineer as demand-critical in the contract documents. Demand-critical welds generally are those that are subject to yield-level strains. The failure of a demand-critical joint would result in significant degradation in the strength and stiffness of the seismic framing. Demand-critical welds have additional require-



a As shown, the member connecting to the weak axis is not an SLRS member.

Notes:

- D1.8 - DC indicates welds commonly designated demand critical joints.
- D1.8 indicates joints subject to the requirements of D1.8, but not commonly designated demand critical welds.
- D1.1 indicates joints subject to the requirements of D1.1 only.

Figure 1 – Example RBS/Column Strong Axis Connection (AWS D1.8 Figure C-1.1, p. 58)

ments, such as the use of filler metals with heat input envelope tests and others as specified in AISC 341-05 and AWS D1.8.

The locations of demand-critical welds are described in general terms (i.e., conditions applicable in all cases) in Section 7.3b of AISC 341-05, and AISC 358-05 provides specific additional demand-critical joint locations for the prequalified connections. For example, in SMFs, typical examples of demand critical welds include the following cases when complete joint penetration (CJP) groove welds are used: beam flanges and beam webs to columns, single-plate shear connections where the beam web is not welded to the column, and column splices and bases. In addition to those that are established in the provisions as demand-critical welds, other similar welds included in the seismic framing should be considered and evaluated for demand-critical status, based upon the inelastic strain demand on the weld and the consequence of failure of the weld (AISC 341-05 Section 7.3b).

Following are some of the additional design and fabrication issues for the latter two groups of welds—seismic welds and demand-critical welds. Figure 1, above, taken from AWS D1.8, illustrates the three types of welds in a typical Reduced Beam Section (RBS) connection.

Protected Zone

The protected zone is the portion of a member of the seismic framing, designated by the engineer of record in the contract documents, in which inelastic straining is anticipated to occur. In the protected zone, restrictions on attachments and fabrication practices apply. Welded shear studs and decking attachments cannot be placed on beam flanges within the protected zones; however, decking arc spot welds to secure decking are permitted. Attachments for perimeter edge angles, exterior facades, partitions, duct work, and other construction should not be placed within the protected zone. Tack welds are prohibited outside the weld joint in the protected zone, unless specifically required or permitted by the engineer. Gouges and notches in the protected zone should be repaired by grinding or repair welding, as required by the engineer.

Similar to demand-critical weld locations, the locations and extents of the protected zones are dependent upon the seismic framing and the connection type used, as determined using AISC 341-05 and AISC 358-05. (Refer to the January 2007 Steelwise article "Prequalified Seismic Moment Connections," available at **www.modernsteel.com**, for a visual summary of two prequalified moment connections.

Filler Metal

All welds in the seismic framing must be made with a filler metal classified with a minimum Charpy V-notch (CVN) toughness of 20 ft-lb at 0 °F. Filler metals meeting this requirement are readily available and relatively operator friendly. For demand-critical welds, filler metals must be classified with a CVN toughness of 20 ft-lb at -20 °F (AISC 341-05) or 0 °F (AWS D1.8)—this discrepancy in temperature is in the process of being resolved between AISC and AWS—and heat input envelope tests must confirm a CVN toughness of 40 ft-lb at 70 °F. These requirements further limit the selection of filler metals for demand-critical welds, but they are still readily available. The filler metal specification for flux-cored carbon steel electrodes now includes the "-D" designator to denote wire tested with the heat input envelope CVN tests. The CVN toughness provisions apply to buildings in which the seismic framing is enclosed and maintained at a temperature of 50 °F or higher. If the seismic framing service temperature is lower than 50 °F, CVN testing of welds at lower temperatures is required.

All seismic welding electrodes and electrode-flux combinations must meet the requirements for H16 (16 mL maximum diffusible hydrogen per 100 grams deposited weld metal) as required in Section 6.3.2 of AWS D1.8. Specifying a maximum hydrogen content helps to prevent hydrogen-induced cracking.

When self-shielded flux-cored arc welding filler metals are used in combination with filler metals for other welding processes, supplemental notch toughness testing is required, in accordance with Section 6.3.4 and Annex B of AWS D1.8.

To be Continued…

Part Two of this article will appear in next month's MSC. There, we will discuss and highlight several more seismic welding requirements, including the removal of steel backing, weld access hole and weld tab requirements, welder qualification testing, and nondestructive examination requirements. MSC

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Linking Quality to Social Responsibility

BY KIMBERLY A. SWISS

There are lots of ways to define social responsibility—and even more ways to implement it.

LATELY IT SEEMS THAT MORE AND MORE CONVERSATIONS IN THE STEEL INDUSTRY circle back to the topic of social responsibility as it relates to businesses and corporations. It makes sense to me that holding corporations socially accountable should be a hot topic, given the surge in problems over the past few years in a wide range of industries covering everything from meat and produce to children's toys to pharmaceuticals.

But what about the steel industry? One can easily make the connection between quality and social responsibility if you are shipping out beef, but does the same hold true for steel? Because of steel's high recyclability and the popularity of Leadership in Energy and Environmental Design (LEED) efforts, you could make the case that it is a socially responsible product. But couldn't social responsibility extend further than this? As it turns out, many companies in our industry have been working hard at being socially responsible for some time, thereby making an even better name for steel.

How to Define It?

What exactly does social responsibility mean? When I read how the American Society for Quality (ASQ) describes social responsibility on their web site, I felt that they really embody how it applies to our industry. ASQ "believes that being 'socially responsible' means that people and organizations must behave ethically and with sensitivity toward social, cultural, economic and environmental issues. Striving for social responsibility helps individuals, organizations and governments have a positive impact on development, business and society with a positive contribution to bottom-line results." I think this definition captures how being a socially conscientious organization can mean multiple things. Be it in-house or out in the community, social responsibility gives room for even the smallest of efforts to become meaningful to a business.

Likewise, the International Organization for Standardization (ISO), who is currently developing ISO 26000, a guidance standard on social responsibility, states: "In the wake of increasing globalization, we have become increasingly conscious not only of what we buy, but also how the goods and services we buy have been produced. Environmentally harmful production, child labor, dangerous working environments, and other inhumane conditions are examples of issues being brought into the open. All companies and organizations aiming at long-term profitability and credibility are starting to realize that they must act in accordance with norms of right and wrong." I think that this certification will give assurance and ease to individuals or companies when looking for socially responsible companies to partner with. It supports tangible socially responsible goals for companies to adhere to.

In the past it seemed many companies essentially made decisions based on one thing: net profit. "Value" primarily meant "dollars." But today, many astute decision-makers that I speak with anticipate how their choices not only impact their bank account but also their organization, employees, community, and reputation. By incorporating socially responsible behavior into their business practice, companies are thereby positioning themselves to potentially gain the respect of their customers, attract employees, help the marketplace, and improve society and/or the environment.

Beyond the Shop

For many AISC Certified fabricators and erectors, having a Certified quality management system in place is appealing because of the benefits it brings to the workplace environment. When observing audits, I always find that there is a sense of pride and forward thinking that coincides with the ability to identify, measure, control, and improve core business processes, ultimately leading to improved business performance. And many of these same companies apply this attitude to how they forecast the future of their organization, and how social responsibility can be linked to quality. In my experience, many who believe in the value of a quality system also make the connection that incorporating socially conscientious policies is equally valuable, not only to their company, but to the industry overall.

For instance, Able Steel Fabricators, Inc., a Steel Building Certified Fabrica-

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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**.

tor in Mesa, Ariz., partners with Mesa United Way on an annual basis to fundraise for United Way's mission in helping the community. Able Steel is also helping Arizona State University structure its steel detailing curriculum in the architectural program. Mark Fultz, vice president of Able Steel, explains that "courses are primarily geared toward architectural fields, so we are trying to get more technical awareness. This will help as we are looking to grow the market and the industry." The company also advocates for promoting from within the company, giving more incentive to the employees it already has in place.

Kenny Waugh, Director Industry Liaison for Ironworker Management Progressive Action Cooperative Trust (I.M.P.A.C.T.), explains how ironworker unions approach social responsibility: "The Ironworkers Union has always considered giving back vital to their existence in [any given] region. Some local unions even require their apprentices perform a certain number of hours community service as part of their training. It is important to raise the bar of your work force just like certification."

David Leavitt, General Manager of Fabrication and Coating for Cianbro Fabrication and Coating Corp., an AISC Certified Steel Fabricator in Pittsfield, Maine and Baltimore, Md., speaks to social awareness as well, noting that the U.S. needs more leaders. "Those that are in a position to lead—and have the courage, convictions, resources, and abilities to make positive change—have the responsibility to do it, to do the right thing," he says. "We need to take control, seize the initiative—not wait for others—and become the catalysts for positive change."

The Cianbro Companies have many programs in place that support Leavitt's statement, including a "Healthy Life-Style Plan" (HLP) that focuses on healthy living, nutrition, and exercise. Its participants receive subsidized healthcare costs, a people-focused concept that allows Cianbro's employees to partake in a program that has the potential to reduce illness and increase productivity and quality of life without experiencing a reduction in health benefits or an increase in healthcare costs—a revolutionary approach in today's healthcare situation. Overall participation is at 75% and of those who participate, 70% also qualify for the new healthy living reward by meeting three of the four health criteria: for cholesterol level, blood pressure, body mass index, and tobacco use.

In addition to a scholarship program for employees and their children, the company has created the Cianbro Institute, a program that pays high school and trade school graduates to receive training to work within Cianbro Companies and other organizations and education centers that Cianbro has partnered with. Cianbro has also initiated several innovative building projects such as the "Destiny USA Project" in Syracuse, N.Y., in which a remediated brown field site is being rebuilt into a mall with high environmental standards.

One of the industry's most recognized names, Lincoln Electric, also embraces social responsibility in numerous ways. Recognizing that the health and well-being of its employees can directly affect their job satisfaction and performance—like Cianbro—the company has initiated its own employee wellness program. The program includes an emphasis on diet, exercise, and health; the company now offers healthier food choices in its cafeteria, and a physician from a local hospital is regularly available on-site.

Along these same lines, employee safety, too, is a top priority at Lincoln. In 2000, the company finalized its safety program under the acronym WELD: Workplace, Education, Lifestyle, and Discipline. John Petkovsek, Lincoln's director of environmental health and safety, describes it as a behavior-based safety initiative that looks at ways to empower employees to be responsible both for themselves and others when it comes to safety.

"Since implementing the program, we've seen accident/injury rates drop by 25% of what they were before we started WELD," says Petkovsek. "For this program, as with our employee wellness program, we recognize that an employee's family is involved. The safety measures and focus they learn on the job translates into many situations they encounter at home. One example that highlights this is that we sent home an outlet tester with many of our employees, which allowed them to test the integrity of their home electric outlets."

AISC too has made its own efforts toward social responsibility. Recently, it won the "People's Choice Award" in the second annual 2008 Chicago Canstruction Competition held throughout the month of June. The contest was part of a national charity event that combines the competitive spirit of a design-build competition with a unique way to help make a difference in the fight against hunger. Teams of architects and engineers competed to design and build large structures made entirely from cans of food, which were then donated to local food banks. Since its inception, more than 10 million pounds of food have been donated to aid in the fight against hunger. AISC's team captain Monica Stockmann comments, "Our team was so enthused to collaborate for an event where we could use our skills and creativity for such a great cause. I'm proud to work at an organization where I can suggest an idea for a community involvement project, and the whole staff rallies behind the effort to make that idea into a reality."

These examples represent just a few of the efforts those in the steel industry are doing to better their environment, the marketplace, and our world. While it is true that the wave of the future is certainly for organizations to operate in a more socially conscientious manner, it is up to each company to decide what fits best with their overall mission and goals. Social responsibility is one component of a general sustainability focus that not only enhances the quality of your workforce with higher moral and lower turnover, but can also lower operating costs and make your company more competitive. An organization that is a good community partner is likely going to find expansion and operating approvals easier and will be viewed by potential employees as a great place to work. Owners with a focus on sustainability are likely to assign additional value to products and services from fabricating firms that can demonstrate that they are like-minded.

We want to continue to highlight this subject in future articles and would love to learn more about the efforts of companies in the steel industry. Some companies want to do more, but are not sure exactly how. If you wish to share what your company is doing, please e-mail me at swiss@qmconline.com. MSC

Overcoming Challenges in Public Projects

BY RACHEL LEBEAUX

Learn how your A/E firm can surmount the difficulties that arise in public-sector projects.

EXPERIENCED A/E FIRM LEADERS KNOW that unique challenges present themselves in public-sector projects. Funding sources can seemingly vanish overnight, voters can turn down a proposed site plan, and public agencies can try to turn liability over to the contractor; the list goes on and on.

To offset such challenges, A/E firm leaders must exercise patience, convince public clients to see them as partners rather than just contractors, and spell out the terms of agreements carefully so that disputes do not become publicly embarrassing or costly to the firm.

Stephen Lucy, principal at Jaster-Quintanilla (Austin, Texas)—a 110-person firm offering structural and civil engineering and land surveying services to public and private clients in the higher education, K-12, municipal/governmental, health-care, water/wastewater infrastructure, and power markets—says that the firm gets approximately 70% of its work for public-sector clients.

Lucy says that the biggest issue facing public clients today is the rapid escalation in construction costs, which is hard to predict when project budgets are established as part of a capital improvement planning process.

When such escalation occurs, "because the funding sources are typically bond funds that were approved by voters or state legislators, our public clients have limited ability to increase construction budgets and thus must reduce project scope to fit within the budgets or reallocate funds," Lucy says.

There are some cases in which project budgets can be augmented, but doing so typically requires the reduction or elimination of other projects to cover more critical or urgent work, he says.

For example, the new downtown campus for the Tarrant County College District in Fort Worth, Texas originally had a construction budget of $165 million that has since increased to $195 million. Accordingly, construction of two buildings in the facility has been deferred until additional funding can be obtained [at time of original publication], necessitating consolidation of functions within other portions of the project, Lucy says.

Other public entities, such as water utilities, rely on revenues generated from water and sewage fees. However, "the funds may go into general revenue accounts for the municipality and may not be available for use on water or wastewater capital improvement projects," Lucy says. "Thus, as funding becomes critical for other municipal projects, the water utilities may have to cut back on their capital projects."

In addition, since revenue depends on water usage, funding may be affected if rainfall varies significantly year-to-year, Lucy explains. Since Texas has experienced a wet year and water usage and revenues are down, anticipated funding is not available and capital projects are being pushed back to the next fiscal year.

Lucy says that the best way for firms to counter such public-sector volatility is to diversify their work within that sector. "In areas of the country experiencing population growth, such as Texas and the southwestern United States, there will be continued need for public investment in infrastructure and other public services."

In addition, understanding the needs and missions of public clients and adapting to meet those needs and acting as an extension of their staff can make the A/E firm an asset to the client.

For instance, "many public clients are embracing LEED® (Leadership in Energy and Environmental Design) due to the desire of the public to be more sustainable and good stewards of the environment," Lucy says. While this may increase initial costs, the long-term benefits outweigh the short-term adverse impact on project budgets. "Assisting the client in obtaining these goals in creative ways and being an advocate for the client in representing the benefits to the public can allow the client to obtain funds to complete needed projects."

Above all, Lucy stresses the importance of patience. Firms that are successful in the public sector must understand that those clients cannot react as quickly to changing market conditions as private clients. "As sources of funds can change, project schedules also change. Those firms that are patient and diversified can adjust to these changes and excel in the public market."

Closely Examine Liability Lingo

Jose Villalobos, president of V&A Consulting Engineers (Oakland, Calif.)—a 29-person firm specializing in corrosion control, coating management, and condition

Tactical Toolbox

Tackle the pitfalls of public projects with the following tips in mind:

Patience is paramount. Funding may not be available when you anticipate it. Voters may not like your proposed building. Take these setbacks in stride and simply accept that they are part of the frustrations of having thousands of tax-paying "clients" to answer to.

Partner up with your public client. Help your client sell the positives of your work to the public. You're more likely to complete the project at hand and be first in line the next time the agency has more work in your field.

Monitor contracts closely. This is a given in all of your projects, but remember that these contracts with public-sector clients are public documents that anybody can view and potentially find fault or liability in. Don't give them that opportunity!

assessment, with a special focus on the preservation of public-works infrastructure and facilities in the water, wastewater, and transportation industries—says that 80% of the firm's work is public.

According to Villalobos, "the primary challenge facing consultants in dealing with the public is the shifting of responsibility from the agency to the consultant." The firm sees more and more contracts that are not covered by errors and omissions insurance, he says, increasing the possibility that the firm could be left shouldering unanticipated costs.

Design professionals scored a victory in this area at the beginning of 2007 when the state of California passed AB 573, which limits the amount of liability an agency can pass on to its consultants for defects that are not the result of the designer's negligence or willful misconduct.

In order to avoid such conflicts, V&A Consulting Engineers has worked with public agencies to modify the language in contracts to reflect what the firm can and cannot insure. "Basically, consultants can be insured for errors of omission that are the result of negligent acts. Consultants cannot insure 'all acts,' which is what we find in many public-works contracts," Villalobos says. "We would recommend that all design professionals review their contracts before they sign them to make sure they are not assuming uninsurable risks."

Villalobos advises firm leaders to discuss this matter with the agency's project manager to come up with a solution acceptable to both parties. MSC

Rachel Lebeaux is a former writer/editor with ZweigWhite.

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From Flat to Fluted

EDITED BY GEOFF WEISENBERGER

Flutes—the ridges in metal deck—are what give deck its strength. MSC recently got the skinny from various metal deck industry representatives on what keeps their industry going strong.

What are some recent developments with metal deck design/erection practices, materials, and equipment?

Rutherford: We have seen a rise in fabricator use of BIM software, and we see a benefit in deck layout accuracy and speed with this type of technology. In addition, we've seen an increase in demand for pneumatic sideseam attachment tools, both for seismic diaphragm design enhancement and for labor savings.

Heilbrun: More and more attention is being paid to the working conditions associated with deck installation. Leading-edge power tool and fastening system companies like Hilti have responded with technologies that reduce the time spent on the job, and improve ergonomics. High fastening-rate stand-up, ergonomically designed powder-actuated fastening systems, new powder-actuated fasteners, and high-speed screw fastening systems for metal deck attachment are now available. Not only are contractors finding that the ability to work standing up helps keep their productivity high all day, but these fastening systems require less expertise to install and provide extremely reliable performance, which can minimize rework and speed installation.

Many fasteners have been tested and evaluated to the latest IBC code requirements under ICC-ES AC43 Acceptance Criteria for Steel Deck Roof and Floor Systems. ICC-ES issues evaluation service reports for steel deck applications including specific combinations of proprietary fasteners.

Hilti also offers a steel deck diaphragm design software program called Profis DF available on our web site for free download (www.hilti.com).

Day: In order to maximize the allowable clear span of composite deck, higher strength steel is being specified on more projects. Designers must recognize the deflection limitations that come with higher yield steel. But with the proper steel frame and deck design, there are potential cost savings. We are also furnishing more roof deck, with open-web steel joists and joist-girders, for projects that are erected "panelized"—where steel roof deck is attached to several joists, with the necessary bridging, on the ground and the completed "panels" are erected in sections. This saves installation time and limits the number of structural steel and deck installers that must be on the steel frame.

Holman: As costs for construction materials and shipping all continue to rise at unprecedented rates, the construction industry is taking a hard look at new cost-reduction strategies. For projects using large-span roof decks, one way to reduce costs is the use of crimp-curved profiled panels.

Crimp-curving is a process in which metal panels are fed through a computerized press that shapes the panel into the specified angles and curves while greatly increasing the load factor. When crimp-curving is used for roof decks, panels can be installed "against the grain" or across the top of the structure, as opposed to curved decks formed from straight panels that are laid parallel to the length of the building. The resulting deck is so strong that it is possible to reduce panel gauge and/or the required amount or type of support. For structural decks, we recommend 20- or 22-GA panels in place of 18-GA. Today more than ever, material savings can exceed the relatively modest fees for panel-curving.

Roehrig: The most significant recent accomplishment by the Steel Deck Institute has been obtaining ANSI approval for Standards for Composite Steel Floor Deck, Non-Composite Steel Floor Deck, and Steel Roof Deck. These three standards provide a comprehensive guide for the design of these products and continue the efforts of the industry to provide up-to-date information for use by the design community. Another major effort is the ongoing presentation of joint seminars around the country with the Steel Joist Institute regarding the correct design and use of steel decks for roofs and floors as well as detailed information pertaining to diaphragm shear design.

Darsey: Vulcraft continues to respond to code-driven changes such as more demanding uplift requirements, which typically require higher strength steels and effective fastening methods. Various fastener manufacturers have been active with the introduction of new fasteners or improvements in existing options.

The introduction of mechanical clinching tools such as the PunchLok tool by Nucor's Verco Decking, Inc. for side laps of interlocking deck has largely eliminated the need for welded side laps in areas requiring high diaphragm capacities, such as the west coast.

Given the recent increases in raw material costs, have you put into place any mechanisms to provide price stability for your customers?

Day: We continue to hold contract prices firm with our customers, primarily structural steel fabricators, for extended periods of time—depending on project duration—without raw material surcharges. Raw material inventory sourcing, timing, and backlog management have never been more important to our deck business. We must maintain higher inventory levels to protect against sudden, and dramatic, mill increases. Through this period of price volatility, CMC Joist and Deck has maintained the necessary inventory levels for continued on-time deliveries of deck to all of our customers.

Rutherford: We are still working through these issues and are *considering* mechanisms such as pre-payment and storage, escalations based on indexes, and possibly other ways developed by owners or our customers.

Darsey: Raw material increases have definitely been a challenge to our industry, as we have been dramatically affected by higher energy and steel costs. Increases in those two items alone have tended to drive increases in most other components and consumables used in our manufacturing processes.

Despite these challenges, Vulcraft/Verco continues to honor our quotes and delivery commitments.

Kevin Walsh Photography

Exposed metal roof deck in a Department of Motor Vehicles facility in southern California (see "Getting the Green Light," January 2008).

Coils of flat steel at a deck producer, waiting to be turned into deck.

What, if any, are some recent innovations/changes with acoustic/perforated metal deck?

Rutherford: Deeper roof deck profiles with acoustical perforations and properties are becoming more common, although their use is still limited due to higher product costs.

Day: CMC Joist and Deck continues to suggest that all of our acoustic roof and cellular-acoustic floor and roof deck are furnished with a galvanized finish—even if the specifier has chosen painted acoustic deck. This ensures that there is no staining through the perforations, considering that acoustic deck is always exposed from the bottom side. A hot-dip galvanized coating seals the exposed edges of perforated deck. The cost of a galvanized coating versus cold-rolled (non-galvanized) steel is a good investment for the owner.

Darsey: Relative to the rest of the deck market, acoustical deck volumes continue to be a small, although important, component.

One related change has been new Steel Deck Institute Noise Reduction Coefficients (NRC) in the *Design Manual for Composite Decks, Form Decks and Roof Decks* (Publication No. 31).

How has your facility changed in recent years? Have you added more roll-forming lines or expanded your services?

Rutherford: Over the past six years we have added two production facilities (Bradenton, Fla. and Fallon, Nev.).

Day: We continue to refine our material-handling processes to safely and more efficiently produce all of the deck profiles we offer. Our customers require very fast delivery lead-times, one week and less in some cases, on a regular basis. We operate multiple roll-forming lines in all of our plants to ensure we are rolling the required deck profiles every day and every week.

Voigt: In 2007, our Salem, Va. operation added a 50,000-sq.-ft metal deck manufacturing facility. Like our Lake City, Fla. facility, Salem is able to produce 3-in. composite metal decking, along with standard roof and form decking.

Participants

CMC Joist and Deck	**www.cmcjoist.com**	**Tim Day**, Vice President – Operations
Curveline, Inc.	**www.curveline.com**	**Terry Holman**, President
Hilti, Inc.	**www.hilti.com**	**Aaron Heilbrun**, Product Manager, Screw Fastening Systems
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Steel Deck Institute	**www.sdi.org**	**Steve Roehrig**, Managing Director
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How has the metal deck market changed in recent years?

Rutherford: We can confirm the increase in stadium projects using composite deck and the trend toward vertical construction using composite deck. As of this printing, we are working on four high-rises in Chicago and the Freedom Tower in New York. All five employ composite deck.

Day: Designers have increased the use of composite steel deck in multi-story residential and hotel projects. The expanded use of staggered structural steel trusses and the all-weather construction capabilities of steel deck have been driving the increased use of our product. Designers are also specifying composite deck in multi-level parking garages. Multi-story office, manufacturing, health-care, and school projects continue to be built primarily with composite steel deck.

Holman: When Curveline launched its panel-curving service in the 1980s, most orders were for curved walls and fascias. Over the past five or six years, curved metal decking has become our most frequently requested item. As the industry recognizes the cost and aesthetic benefits of curved decking, demand is increasing. The projects most frequently employing curved decks are schools, gymnasiums, maintenance buildings, transportation facilities, and commercial building applications.

Roehrig: In my opinion, the market is focused on using the most cost-effective approach to design. For example, the most common 1½-in.-deep roof profile used today is the wide rib deck (Type WR) because of its efficiency in developing a high strength-to-weight ratio. In addition, the use of long-span products (3 in. and deeper) is growing, since it permits significantly increased spacing between structural supports. The deck industry is also investigating use of its products in other markets such as residential construction, since steel offers inherent advantages with regard to wind, fire, durability, etc.

Heilbrun: Significant changes in the metal deck industry involve development of ANSI standards, AISI test standards, ICC-ES Acceptance Criteria, and ongoing university research. University research into the inelastic seismic load performance of steel deck diaphragms is being conducted at Ecole Polytechnique Montreal by Dr. Robert Tremblay and Dr. Colin Rogers. University research into steel deck diaphragm performance involving deep deck and cellular deck has also been conducted at Virginia Tech University by Dr. Sam Easterling. Dr. Easterling has also recently completed research into the performance of arc spot "puddle" welds in steel deck applications. This research has investigated the actual performance of arc spot puddle welds in thick steel deck layer conditions as well as lap joint shear strength vs. arc time.

A challenge is to remain on time and on budget since design-build and value engineering are becoming more common. Even with the most skilled and hardened ironworkers, there are simply finite limitations to how much metal deck can be fastened in a single day. Several years ago, Hilti initiated an extensive research project to address this limitation. In early 2009, Hilti will launch improved diaphragm load data, which was achieved through a proprietary sidelap connector. In certain instances it is now possible to reduce the deck gauge and save on the steel package—a smart option for whoever buys this material. It is also possible to optimize the fastening pattern—a solid option for installers. Using fewer fasteners reduces labor by needing fewer pins and screws to achieve the lateral and uplift load demands on the structure.

Darsey: Markets have remained fairly stable over the years, obviously varying in volume as economic climates have varied over the years. There has been a noticeable shift from prime coat-finished over black metal to a higher usage of galvanized materials.

Growing emphasis in the markets to "go green" dovetails with our products. With our steel decks being fabricated from largely recycled materials, and our primer coatings being water-based, LEED points are available when our products are provided. MSC

Steel deck being formed, with flutes being created from the center out.

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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.

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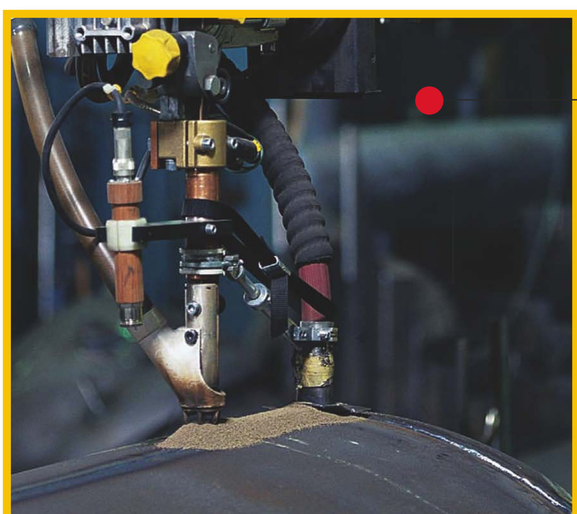

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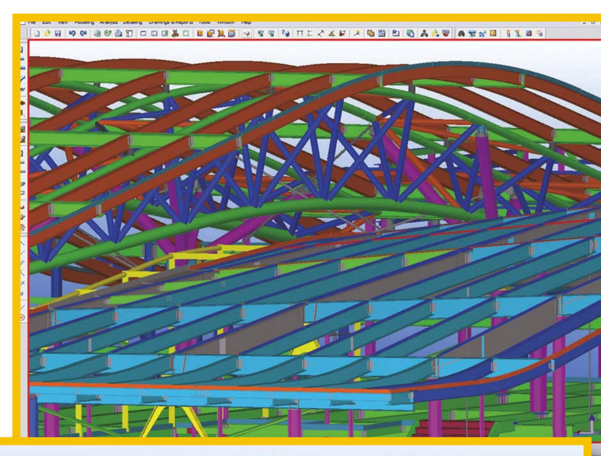

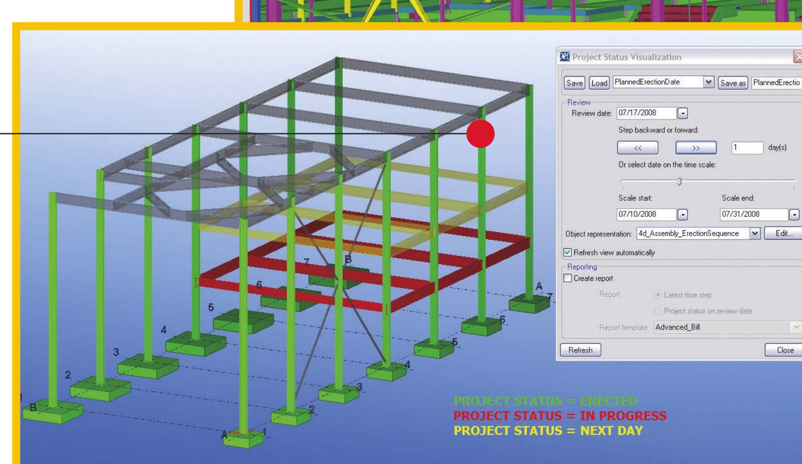

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ABOUT SE SOLUTIONS: We are a specialty recruiting company run by structural engineers. In our 27 years of experience working with structural engineers, we have built relationships with companies all over the U.S. which allows us to match up your talents with the right company.

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AISC Steel Solutions Center Advisor
"There's always a solution in steel."

One of the most interesting parts of any structural engineer's job is the conceptual design phase, agreed?

Now imagine a job where you can spend most of your time working with decision makers in developing conceptual solutions for their steel construction projects while also spending time assisting in answering a wide variety of technical questions on structural steel. Imagine working at AISC.

As an Advisor in our Steel Solutions Center, you'll be able to share your structural design experience and creativity to help other professionals like yourself in the design and construction industry develop innovative conceptual solutions for their steel construction projects. You'll also use your current talents and experience to answer technical questions that come in from the construction and design decision makers. All the while, you'll be trained on a wide variety of topics in the industry to help you become a future leader in the structural steel community.

Work among our staff of experienced engineers and marketing professionals, and connect with a fascinating group of industry leaders to develop the knowledge, resources, and expertise you'll need to provide the best answers and technical assistance to the design and structural steel community we serve.

We offer an excellent salary and benefits package, along with an awesome working environment, flexible working hours, and professional development opportunities.

To be considered for this position, you must have a BS degree in Engineering, along with a minimum of 3 years experience as a consulting structural engineer or construction project engineer and proficiency with structural design software.

AISC is committed to employing only U.S. citizens or those authorized to work in the U.S. To apply for this position, please send your resume and cover letter with your desired salary requirements to: **HR@AISC.org**

Join AISC and become part of the solution.

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A Wide Range of Wide-Flange

BY MAX POWELL

Readily available inventories make service centers an important link in the steel supply chain.

WE'VE PROBABLY ALL had the experience of visiting a large home improvement center, walking up and down the aisles, looking for those items we need for a particular home project.

As a homeowner, whenever I have a project around the house, I make a list of the materials I need and then pay a visit to one of these establishments.

I'm often amazed at the variety and quantity they stock. Nevertheless, I only buy what I need and in the sizes that come closest to my final dimensions. The less I waste, the less it costs me.

It's the same for steel fabricators. When they get a project to fabricate, they also make a list of the materials they need, then place the order. As an alternative to ordering directly from the mill, fabricators can make a call to their version of Home Depot: the steel service center. The salesperson at the service center prices the material on that list and, if asked, notes the availability of each item. The completed list is returned to the fabricator who can then order the items needed. The fabricator purchases only the items required for each project, in the exact quantities required and to the closest dimensions possible. Again, less waste is less cost.

There are several advantages of ordering steel from a service center, but it's their inventory that creates the most value for fabricators and manufacturers. Service centers generally have three to four months of inventory on hand at any given time so that larger-than-normal orders can be met from current inventory. A heavy carbon service center like ours, for example, stocks a wide range of steel products, from wide-flange beams to hollow structural sections to plate and sheet to HR bar, flats, channel, and rebar. It's important to note that this material isn't available in just one size or length; it is generally available in many sizes and many different lengths to help end users find the best size and hold down waste.

In order to maintain the three-month level of inventory at any given time, a service center orders from a variety of steel mills many months in advance to take advantage of the best pricing opportunities available and to ensure that temporary problems at a producing mill do not prevent the service center from meeting its customers' needs.

Trucking Too

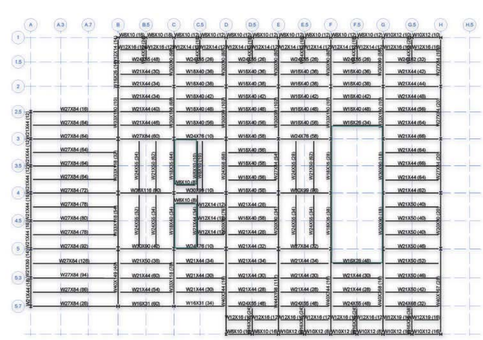
Most steel users aren't equipped to handle material wider than 8 ft or longer than 40 ft; picking up material that exceeds these dimensions requires trucking, which often puts the customer at the mercy of a third party's schedule—the trucker's—and increases his costs. However, some service centers, such as ours, have their own fleet of trucks and trailers that are equipped to handle large steel loads, and because the service center controls the delivery, they can usually schedule a customer's delivery within a day at little or no additional cost. Unlike a common carrier, the service center will generally deliver truck-load quantities and smaller quantities on the same basis. Adding to the value, service centers with in-house delivery capacity can do a very good job of sequentially shipping items or performing just-in-time delivery—especially when the project requires a large amount of steel.

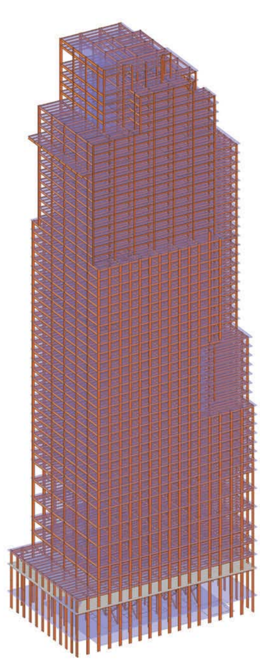
Custom Cutting

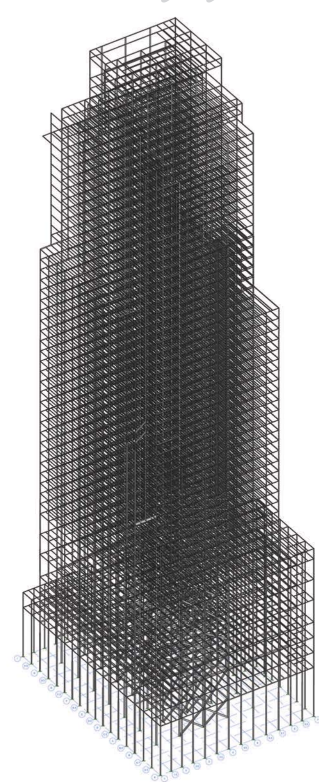
Different service centers do different types of material processing based on their customers' needs. Fabricator customers are most interested in saw cutting to length and shearing or burning plate into gussets and base plates. In addition to these basic services, our service centers use software that can match up the exact cut lengths that a customer needs to the standard lengths that are actually in inventory. This "nesting" process produces a list of cut lengths that should come from each standard length so that the minimum amount of waste is produced. We can either deliver the nesting information along with the standard lengths needed to cut the finished lengths or we can cut the standard lengths and deliver the finished lengths needed. Just one more advantage of ordering steel from your friendly, neighborhood service center. MSC

Max Powell is the Structural Products Marketing Manager of PDM Steel Service Centers, Inc. in Lehi, Utah, and can be reached at mpowell@pdmsteel.com.

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







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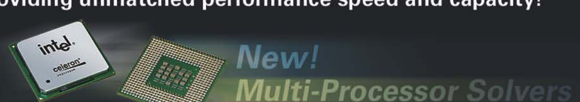

Model-Alive™ – Evaluate your model in real-time!

- Instantaneous re-analysis
- Instantaneous display updating

BrIM – Bridge Information Modeler

- Sophisticated wizard for rapid modeling of complex bridges
- Integrated design of concrete box girder bridges
- Comprehensive list of vehicles for influence lines and dynamic vehicle loading
- Single or dual sets of bearings at bents
- Continuous or discontinuous superstructure at bents

Nonlinear Staged Construction

- Construction scheduling Gantt charts
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