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notes from the editor

Scott L. Melnick

My middle child, Joshua, is fascinated by nature and is forever stopping to pick up rocks, plants and bugs. When I was growing up, children could buy a "bug bottle," essentially a small bottle about an inch in diameter with a magnifying lens on top. Well, times have progressed, and Josh's grandmother gave him the modern version for his birthday: the bug pail. A jumbo version of the bug bottle, it's about eight inches in diameter and the entire top is a magnifying lens. It even has a shoulder strap for easy conveyance.

Over time, most things change and evolve. Even such hidebound bureaucracies as toll-road authorities adapt to modern technology to reduce costs. Where I live, you can now purchase a transponder for your car, and instead of stopping at tollbooths, you just slow down and 50 cents is deducted from your account. In the near future, a coalition of states from the east coast westward to Illinois will create a joint system. An even better system exists in Ontario, where Highway 407 has no tollbooths at all: cameras detect your license plate and if you don't have an account (qualifying you for reduced rates), a bill is sent to your house.

Surprisingly, a large number of construction industry professionals resist adapting to changing times—even when these advancements can substantially reduce costs. In fact, the adoption of just a few simple steps can more than offset the recent rise in raw material costs.

1 **Involve a fabricator early to ensure an economical structure.** While engineers can often employ rules-of-thumb to reduce the cost of a structural steel building, the most efficient way to ensure that you're receiving the best value is to consult with a specialty steel contractor early in the design process. A study from the Construction Industry Institute, conducted in conjunction with Penn State, investigated 351 construction projects built between 1990 and 1995 and demonstrated that the most successful projects were those where specialty contractors were brought on board before any of the design was completed.

2 **Don't assume that least weight is always least cost.** Many contractors evaluate project costs based solely on the weight of the framing members. While common, in the long run it ends up costing an owner big bucks. Even with the recent price increases in structural steel, the cost of fabrication and erection is still a greater percentage of the cost of the steel package than is the cost of the raw material. Therefore, reducing the weight of the steel while increasing fabrication or erection costs will often end up costing the owner money. For example, you can usually increase column weight by as much 100 lb per linear foot and still save money if it eliminates the need for stiffeners.

3 **Encourage the use of Electronic Data Interchange (EDI).** A growing number of engineers and fabricators are working together to exchange design drawings electronically and work within a total 3D project model. A common objection is that engineers need to spend slightly more time developing their design drawings up front. However, this results in a big time savings during the shop drawing review process, eliminating much of the revising and resubmitting. Studies by AISC show the use of EDI can usually save more than 10% of the steel package and reduce the total project time by between four and 12 weeks. As an example, on the Lansing Community College Health and Human Services Career and Administration Building in Lansing, MI, Douglas Steel Fabricating helped to create an alternate to the original design that lopped $315,000 off the original $2.9 million steel package. This alternative design was generated 2½ weeks prior to the hard bid due date. The client approved the alternative and selected Douglas Steel for fabrication and erection. The design was finalized and Douglas Steel was able to place the mill order four days after being given the nod. Integration of design, detailing and fabrication software helped to quickly generate a more economical design and facilitated incorporation of those changes ahead of schedule.

4 **Make sure you're not paying for unnecessary paint and fire coatings.** In most cases, there is no need to paint or prime steel unless it is being left exposed. On a 100,000 sq. ft. building, unnecessarily painting the steel can easily add $30,000 (though the savings would be slightly less for not painting a bar joist system). Likewise, current building codes allow designers to utilize active fire protection systems (sprinklers) instead of passive systems (spray-on coatings). Too often, designers are unaware of the specific code requirements and end up specifying both. And at a rough cost of $0.40 per square foot for spray-on coatings, the unnecessary costs quickly add up.

The Steel Solutions Center offers a free service to help reduce costs. From typical framing studies to total structural systems (including project costs and schedules), the Steel Solutions Center provides owners, designers, and contractors with up-to-date information with a focus on office buildings, parking structures, multi-story residential, healthcare, and institutional construction. In addition, the Steel Solutions Center answers technical inquiries and offers a number of electronic tools to help reduce project costs. The Steel Solutions Center can be reached by calling toll-free 866.ASK.AISC or e-mailing solutions@aisc.org.

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Modern Steel Construction's monthly *Steel Quiz* allows you to test your knowledge of steel design and construction. All references to LRFD specifications pertain to the 1999 *LRFD Specification for Structural Steel Buildings*, available as a free download from AISC's web site:

www.aisc.org/lrfdspec

ASD references pertain to the 1989 *ASD Specification for Structural Steel Buildings*. Where appropriate, other industry standards are also referenced.

Anyone is welcome to submit questions for *Steel Quiz*—one question or 10! If you or your firm are interested in submitting a *Steel Quiz* question or column, contact ▶

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This month's quiz was developed by AISC's Engineering and Research department with input from Victor Shneur of LeJeune Steel, Minneapolis. Sharpen your pencils and go!

1. **True or False:** When finger shims are used in bolted joints, the requirements for long-slotted holes are applicable.

2. Which of the following statements is true?
   a. All steel must be painted.
   b. Primer is sufficient to prevent corrosion until the building is enclosed.
   c. Steel at the building perimeter requires special coatings, even when isolated by building finishes.

3. Is it acceptable to fill weld access holes with weld metal for cosmetic or corrosion-protection reasons?

4. When must the strength of a bolted joint be reduced for the number of bolts used?

5. Are all shear studs required to be field-installed to eliminate the tripping hazard defined in OSHA's safety regulations for steel erection?

6. ASTM F1852 is the standard that provides the twist-off equivalent of an ASTM A325 bolt. Is there an equivalent standard for ASTM A490 bolts in twist-off configuration?

7. Can gages other than those shown as workable gages in the 3rd Edition AISC *LRFD Manual of Steel Construction* be used?

8. In which of the following situations must the AISC *Seismic Provisions* be met?
   a. Seismic Design Category C with R=3
   b. Seismic Design Category B with R=3
   c. Seismic Design Category D with R=8
   d. Seismic Design Category B with R=8

9. What dimensional tolerances apply to welded structural members?

10. **True or False:** approval of shop and erection drawings means the Structural Engineer of Record is accepting responsibility for the accuracy of the detailed dimensions and fit-up in the field.

Turn page for answers

Answers

1. **False**, per *RCSC Specification* Commentary Section 3.3.4. The *RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts* is a free download at **www.boltcouncil.org**.

2. This is a trick question—all are false as absolute statements!

a. Most steel (including that enclosed by building finishes, in contact with concrete or to receive fire protection materials) need not be painted. Steel exposed to a corrosive environment must be protected.

b. Primer is a bonding layer that improves the adhesion of the paint layers to the steel, not a protective coating. See Section 6.5.1 of the AISC *Code of Standard Practice*.

c. Perimeter steel within the building envelope requires no special treatment. Corrosion can become an issue if the façade fails, but this concern is true for all materials and has its solution in a properly performing façade system.

3. This practice is not recommended as it defeats all the purposes for which the weld access hole was used in the first place (except access for welding). Section 5.17.1 of AWS D1.1/D1.1M:2004 states: "When weld access holes shall be closed for cosmetic or corrosion protection reasons, sealing by use of mastic materials is preferable to welding."

4. End-loaded connections, such as a flange plate in a moment connection, have a non-uniform distribution of shear on the bolts. Side-loaded joints, like shear connections and gusset edges, do not. To account for the case of end-loaded joints and to keep bolted joint design simple, an across-the-board reduction of 20 percent is already included in the design strength of bolts in the AISC *Specification*. This covers all joints up to 50″ in length. For end-loaded joints of length exceeding 50″, an additional 20 percent reduction is necessary per AISC *LRFD Specification* Table J3.2, footnote e.

5. No. There was an article in the May 2001 issue of *Modern Steel Construction* that addresses the OSHA requirements in general, and the tripping hazard requirements specifically (see **www.aisc.org/osha-erection**). If a shear stud does not cross a walking surface, it is not a tripping hazard and can be shop-installed.

6. No, but such a standard is under development. For now, ASTM A490-strength-level twist-off type tension-control bolt assemblies are used under the alternative design fastener provision in *RCSC Specification* Section 2.8.

7. The gages shown are workable, but not absolutely required, as indicated in the *Manual* definition of the term "workable gages." Other gages more convenient or common throughout a given project can be used as long as they satisfy edge distance, entering and tightening, and force transfer requirements.

8. The AISC *Seismic Provisions* must be met in both **c** and **d**. When in Seismic Design category A, B or C, one can use R=3 and the detailing requirements in the AISC *Seismic Provisions* need not be met. If in Seismic Design Category D, E or F, you must use a system in the AISC *Seismic Provisions* and meet the detailing requirements appropriate for the associated level of R. Also, if the design is based upon an R greater than 3, the AISC *Seismic Provisions* requirements for that value of R must be met regardless of which SDC it is in.

9. The dimensional tolerances for welded structural members are given in AWS D1.1/D1/1M:2004 Section 5.23.

10. **False.** Per AISC *Code of Standard Practice* Section 4.4.1, "… approval shall not relieve the Fabricator of the responsibility for either the accuracy of the detailed dimensions in the Shop and Erection Drawings or the general fit-up of parts that are to be assembled in the field." ★

2004 Editors' Choice hotproducts

Machinery, software, tools and materials are the steel industry's most important accessories—and innovation among these products can mean faster, more cost-effective steel design and construction. This year's Editors' Choice Hot Products Award winners are just a sample of some of the creative solutions recently introduced for designers, detailers, fabricators and erectors. Some offer advanced technology; others provide simple and practical applications in response to common problems. But all stand out as novel approaches to on-the-job difficulties.

Products were awarded prizes in the following categories: coatings; safety equipment; engineering software; fabrication, detailing and project management software; and fabrication and erection equipment. The number of "Hot Products" and "Honorable Mentions" awarded was not limited by category. The awards are based on descriptions and claims by the manufacturers; no product testing or evaluation was performed. These awards do not constitute a product endorsement by *Modern Steel Construction* or by AISC. AISC products were not eligible for awards. Only submitted products were considered.

Category: Coatings

HOT PRODUCT

CAFCO SprayFilm – WB 4 Intumescent Fire Protection Coating

Introduced: December 2003

CAFCO SprayFilm – WB 4 Intumescent Fire Protection Coating is the first water-based thin-film intumescent fire-protection coating for structural steel approved by Underwriters Laboratories, Inc. (UL). SprayFilm – WB 4 does not require any reinforcement (i.e. glass fiber mesh and/or adhesive basecoats). It is an environmentally safe and user-friendly product, without the concerns associated with solvent-based products.

The SprayFilm product successfully completed an extensive blast over-pressure program conducted by Advantica Technology at its Spaeadam Test Facility in Cumbria, UK, and witnessed by Lloyd's Register. Steel columns protected with SprayFilm were installed in the vented opening frame of the natural-gas explosion chamber and exposed to an overpressure explosion on 1.9 bar. Upon inspection, the SprayFilm intumescent coating showed no signs of damage and remained intact. Further, the tested columns were exposed to a hydrocarbon fire to insure that the fire-resistive properties remained unaffected.

Contact: Isolatek International, ph: 800.631.9600, www.cafco.com

Category: Coatings

Honorable Mention

Steel Spec™ Epoxy Primer

Introduced: January 1, 2003

Sherwin-Williams Industrial and Marine Coatings Steel Spec™ Epoxy Primer is the first non-zinc containing coating to be Class-B rated for slip coefficient performance for bolted connections per ASTM and AISC specifications. The no-lead coating eliminates zinc-dust mixing issues, including the need for continuous agitation. It accepts a wider variety of topcoats than zinc coatings, and offers better predictability when top coating. Steel Spec Epoxy Primer also eliminates the need to mist coat before primer application and to mask faying areas before intermediate-coat application, saving labor.

Steel Spec Epoxy Primer meets OSHA slip requirements and is approved for use in USDA-inspected facilities. The coating can be applied by brush, roller or airless spray at temperatures as low as 35°F. It dries to touch in 15 minutes and can be recoated with a variety of solvent-borne or water-based topcoats in just two hours. Steel Spec Epoxy Primer is ideal for marine, bridge and heavy-duty industrial applications.

Contact: The Sherwin-Williams Company, ph: 800.524.8979, www.sherwin-williams.com

Category: Safety Equipment

Honorable Mention

DBI/SALA and PROTECTA: Rebel Self-Retracting Lifeline

Introduced: January 2004

Protecta's Rebel is a light and compact self-retracting lifeline (SRL), weighing only 2.8 lb. The 11' of retractable line delivers an excellent working range for economy class SRL's. The Rebel's price point is under $100. It can be used in applications where, in the past, only conventional lanyards were used.

The retractable technology of the SRL stops falls quickly and reduces the impact forces to which workers are exposed. In addition, the 11' length of the Rebel nearly doubles the working area of a lanyard without reconnection. Its aluminum housing can withstand rough use, and thin webbing enables a compact size. The Rebel™ CT is a cable version of this compact SRL technology. Designed for rugged applications, this SRL supplies a full 11' of cable line in a durable unit that weighs only 5.2 lbs.

Contact: DBI/SALA and PROTECTA, ph: 800.328.6146, www.dbisala.com

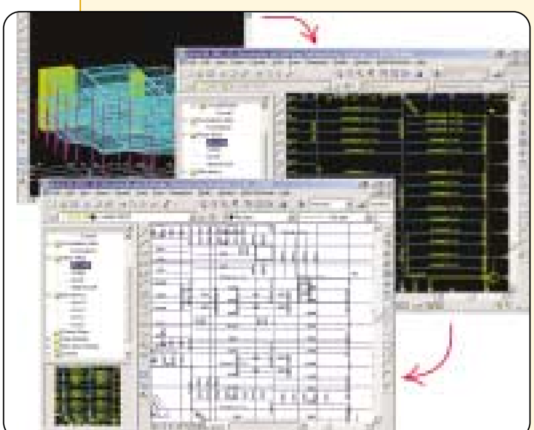
Category: **Engineering Software**

HOT PRODUCT

RAM CADstudio

Introduced: April 2004

RAM CADstudio works inside AutoCAD to streamline the generation, coordination and review of construction drawings. RAM CADstudio provides the "missing link" between engineer and CAD specialist by creating a continuous electronic flow of information between the engineers' analytical/design model and CAD drawings.



The engineer first creates a RAM Structural System model and imports it into RAM CADstudio for preliminary drawing creation. The CAD specialist can update the drawings, adding details, making partial plans, placing text in the desired locations, and more, with CADstudio's advanced file navigator and drag-and-drop capabilities. The drawings can be modified using standard AutoCAD commands and custom LISP routines.

As the project progresses, the link between RAM Structural System and RAM CADstudio automatically updates the drawings based on any structural changes, while maintaining the modifications made by the CAD specialist. All of the changes are updated on the AutoCAD sheets used for printing. Reports track project changes and identify to both engineer and CAD specialist the differences between the analytical model and the CAD model. The result: no redlining, faster drawing review, and minimal errors.

In addition to 2D drawings, RAM CADstudio maintains a 3D structural model, so engineers can more directly communicate with architects using systems like Architectural Desktop. In addition, RAM CADstudio is expected to provide a useful CIS/2 link for EDI with detailing and fabrication software.

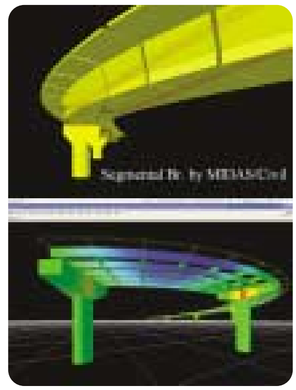
Contact: RAM International, ph: 760.431.3610, www.ramint.com

Category: **Engineering Software**

Honorable Mention

MIDAS/Civil — Bridge Analysis and Design Software

Introduced: January 2003; Major Upgrade March, 2004



MIDAS/Civil analyzes and designs Bridge Structures in 3-D environments plus the time dimension. It covers all bridge types; curved steel girders, composite, segmental post-tensioning (incremental launching, balanced cantilever & movable scaffolding), suspension, cable-stayed, slab, frame and culvert bridges. It generates comprehensive traffic loads to AASHTO Standard and LRFD specifications, CSA-S6-00, BS5400, etc. through influence lines and surfaces. Steel and reinforced concrete design also is provided.

A "Works Tree" lists a summary of the model data systematically, so the user can display, activate, modify and enter any data at any time, in any sequence. Models can be created through "Drag and Drop." All the results can be animated, which visually provides the structural behaviors. This software thus speeds up the analysis and design cycle.

MIDAS/Civil simulates the construction stages of a structure. Each stage is represented by a structure, supports and loadings, reflecting time-dependent effects such as creep, shrinkage, modulus of elasticity, prestress losses, composite action and heat of hydration. MIDAS/Civil eliminates the need to switch software for different bridge types.

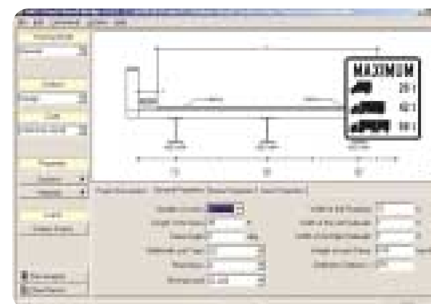
Contact: MIDASoft Inc., ph: 281.920.9958, www.MidasUser.com

Honorable Mention

SAFI Steel-Wood Bridge

Introduced: June 2003

SAFI Steel-Wood Bridge is an automated program for the design, evaluation and rating of steel girder bridges with wood decks. The program can analyze one and two lanes of straight or skew bridges using standard and parametric section shapes subjected to standard or custom moving loads. The program selects optimal section shapes or calculates the resistance of steel beams of known dimensions. The resistance of wood elements also can be calculated for common or user-defined wood grades.



Typical default parameters can be specified to increase the efficiency of design or evaluation procedures. Bridge rating and posting features also are provided. Results are presented on screen or with a Microsoft Word-compatible format. The program complies with Windows 9x/Me/NT/2000/XP.

The Steel-Wood Bridge Software incorporates advanced design and evaluation techniques to design a new bridge or rate and rehabilitate an existing one. It is highly automated and can be used by professionals with different levels of expertise. Metric and imperial units are supported, and the program is multi-lingual.

Contact: SAFI Quality Software Inc., ph: 800.810.9454, www.safi.com

Honorable Mention

Structural Desktop, Version 1.95

Introduced: January 2004

Structural Desktop (SDT) runs inside AutoCAD. Draw lines in AutoCAD; SDT converts them to standard shapes in steel, concrete, or wood. SDT writes geometric data files for: STAAD.Pro, GT STRUDL, RISA 3D, and SAP2000. Analyze the file in these programs and make changes; SDT reads the result and creates 100% AutoCAD DWG drawings and Material Reports for contract documents. SDT has a right-click interface; tapered and light-gage members; automated standard steel libraries by country; concrete double Ts; CIS/2 compatibility through the analytical package; correctly dimensioned outlines for structural details; and 3D models for rendering or animation. Version 1.95 has international tables and metric values.

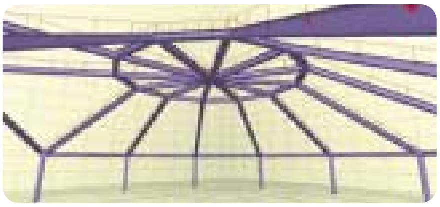
Contact: Structural Desktop, Inc., ph: 479.471.5227, www.structuraldesktop.com

Category Continues Next Page

Category:
Engineering Software

Honorable Mention

Dr. Frame3D v 1.0
Introduced: November, 2003



Dr. Frame3D, available for PC and Macintosh, offers direct-manipulation analysis in 3D. Users can manipulate modeling components (loads, supports, members, etc.) while the structure's behavior is updated continuously on screen. Dr. Frame3D hides the complexity of number-crunching functions, so the designer can focus on model behavior. The software combines model definition, model analysis and results generation. This allows designers to try out "what if" scenarios in minutes. Models can be modified on the fly and behavior is represented accurately via visual and numeric feedback.

Contact: Dr. Software, LLC,
ph: 206.930.5828, www.drframe.com

Honorable Mention

ERITower v3.0
Introduced: January, 2004 (upgrade)

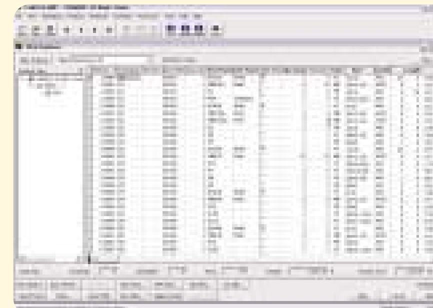
C-Concepts ERITower is an analysis and design tool for telecommunications towers. It automates the analysis and design required to meet the TIA/EIA-222-Standards (222-A through 222-G). ERITower uses True Cable technology, which determines cable forces with a multiple-pass re-tensioning technique. The program can analyze and design three- and four-sided guyed towers, three- and four-sided self-supporting towers, round or tapered monopoles and guyed monopoles. Linear and non-linear analyses determine displacements and forces. Wind pressures and forces are calculated automatically. Graphics plots include material take-off, plot plan, shear-moment, leg compression, displacement, twist, feed line, guy anchor and stress plots. Results are assembled as a Word report. SDNF export allows for transferring data to steel detailing software.

Contact: C-Concepts, Inc.,
ph: 262.252.3173, www.c-conceptsinc.com

Category:
Fabrication, Detailing & Project Management Sofware

HOT PRODUCT

FabTrol MRP
Introduced: May 2004



Version 1.1 is the first major upgrade of FabTrol MRP, a steel-fabrication software. Like its predecessors, it offers fully integrated estimating, drawing management, material management, production management, and shipping. Based in Windows with optional support for SQL Server, FabTrol MRP is designed specifically to meet the needs of steel fabricators.

The latest release delivers several dozen notable enhancements. The purchasing, stock, and shipping modules now offer material traceability improvements, including new functionality for tracking country of origin and heat certs. The system's 300-plus reports now can be outputted as PDF files for easy e-mailing. A new XML-based export function collects material, production, and shipping-status information and makes it available to other software applications or custom-programming efforts. The drawing-management system can attach and view drawing images to each drawing revision and supports all available image formats. The accounting export function has been expanded, as has the system's change-order management functionality, which now supports multiple-document attachments and additional record tracking. Beyond the specific new features, this release also offers widespread usability and interface improvements to reduce learning time and improve productivity.

Contact: FabTrol Systems, ph: 888.FABTROL, www.fabtrol.com

Hot Innovation: Robotics

The Kaltenbach KC1200 robotic coping machine (2003 Hot Product Honorable Mention) is one of a number of robotic fabrication machines that recently have been introduced to the steel-fabrication industry. Jesse Engineering's Robotic Series SHC-BC-R (next page) also uses a robot to precision-cut structural steel members.

The increased use of robotics in U.S. fabrication shops will depend on the greater use of electronic modeling and electronic data interchange (EDI) on the part of designers and fabricators.

"We haven't managed to bring robotics into structural steel fabrication due to structural steel's custom nature and sometimes lack of repetition, but its time is coming soon," said Tom Schlafly, AISC's Director of Research. "We've been talking about using electronic models to trade design information for the last couple of years, and we're extending electronic information into the shop. Robotics hasn't been part of the fabrication shops yet, because engineers, detailers and others do not send a high percentage of design models to the shops electronically. But as the percentage of work like that increases, robotics will make more sense. It is the future."

The KC1200 (pictured above) is an eight-axis robotic structural coping machine, capable of producing 3-D copes (including weld prep). It can download information directly from detailing software with a DStV interface and produce copes without any manual intervention. It incorporates laser-offset calibration and automatically handles short material lengths. Since it's inception, additional software modules have been added, as well as an 8th CNC axis, which allows the KC1200 to create castellated beams and split Ts.

Category: **Fabrication and Erection Equipment**

Honorable Mention

Compact HMD150 Portable Magnetic Drill

Introduced: Spring 2003, upgrade of the Model HMD115 Truck Frame Drill

The HMD150 is designed to permit fabricators to make holes in places where other drills can't fit. This is useful for rehab projects or when installing retrofit equipment, and handy for when just a few holes are needed. Until now, when fabricators were faced with the problem of making holes in confined spaces, they would need to flame cut or punch them if possible. Because of its constant low profile, the HMD150 can fit in any space where its $7^{13}/_{16}$" height will permit.

The drill cuts holes up to $1^{3}/_{8}$" diameters through steel up to 1" thick—three times faster than conventional drills. The magnetic base has a 1,200-lb dead-lift rating on $^{3}/_{8}$" plate and 2,165 lb on 1" plate. It has a removable feed handle for ratcheting the feed in close quarters. It has a rigid quill-feed for maintaining a constant low profile ($7^{13}/_{16}$" high) and ergonomic rear controls. It uses Hougen RotaLoc Plus Annular Cutters with quick-release shanks, requiring no tools for cutter changes. The unit weighs 22.7 lb, and has an electrical rating of 120V, 50/60 Hz and 8-Amps.

Contact: Hougen Manufacturing, Inc., ph: 810.635.7111, www.hougen.com

Honorable Mention

1101 DZ CNC Drilling Line

Introduced: March 2004

Ficep's 1101 DZ CNC drilling line is the first CNC drill line in the market that uses a single spindle to automatically process both flanges and the web without any manual intervention, as the spindle rotates a full 180° in 0.7 seconds. This solution reduces the cost of such an acquisition by eliminating more than half the mechanical and electrical parts that are associated with a typical three-spindle drilling line. The elimination of most parts also adds to the system's simplicity and subsequent reliability.

The single spindle features a ball-screw feeding system in conjunction with a spindle drive to use today's carbide tooling. This combination delivers the ability to drill a 1" flange in as few as 3 seconds. The system is furnished with an automatic tool changer to accommodate differences in the required hole size, tapping, countersinking and milling when slotted holes are required.

Contact: Ficep Corporation, ph: 410.588.5800, www.ficep-corp.com

Honorable Mention

1250AJP Ultra Boom

Introduced: February 2004

The new Model 1250AJP Ultra Boom aerial work platform from JLG Industries, Inc. is an articulating and telescoping model with 63'-2" horizontal reach, 60'-7" up-and-over capability and 125' platform height. The JibPLUS® jib boom rotates both 130° vertically and 125° horizontally. When combined with the 180° platform rotation, it provides workers with maneuverability for reaching hard-to-access areas. Platform capacity in the majority of the work envelope is a restricted 1,000 lb (unrestricted is 500 lb). The machine includes JLG's QuikStik® boom that allows the platform to be lowered to the ground while the tower boom is fully extended. With this feature, workers can go from ground level to full elevation in 115 seconds. A standard feature of the Model 1250AJP is the SkyPower™ package, which includes a 7,500-watt generator that provides power to welders and other platform-mounted accessories.

Contact: JLG, ph: 877.JLG.LIFT, www.jlg.com

Honorable Mention

Robotic Series SHC-BC-R Saddle and Hole Cutting/Beam Channel Profile Line

Introduced: February 2004

The Robotic Series SHC-BC-R was developed with the use of a FANUC Robot for its precision and diversification. Jesse Engineering Company developed a 3D Visual system using an Industrial Color Touch Screen PC for defining the particular part to cut (PIPE). The machine can cut complex contours in pipe, and cut shapes such as structural beams and channel. Beams and channels can be cut to shape, straight cut-off, coped, beveled, and holes cut to most requirements. An integrated conveyor line can process beams, channel, or pipe in one line. Extra savings are in handling and maintenance.

Contact: Jesse Engineering Company, ph: 253.922.7433, www.JesseEngineering.com

2004 **People's Choice**
hotproducts

As a warm-up to *MSC*'s annual Editors' Choice Hot Products Competition, attendees at the 2004 NASCC in Long Beach, CA were invited to vote for People's Choice Awards. The votes were tallied, and the results are in! Products with the highest average scores were given a **Scorching** rating, and products with the next highest scores were given an **Hot** rating. Products appear in no particular order. Don't miss your chance to participate—and cast your vote—at next year's NASCC in Montreal, April 6-9, 2005!

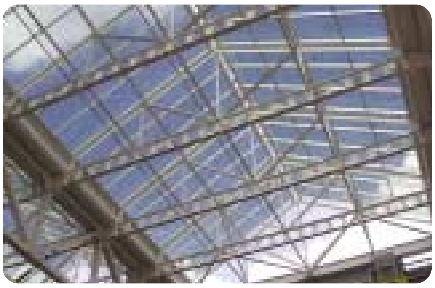
scorching!

Kaltenbach
HDM 1411 Circular Cold Saw
www.kaltenbach.com

The Kaltenbach HDM 1411 Circular Cold Saw benefits structural steel fabricators and service centers with high throughput rates, and provides surface finish and squareness tolerances. With a 56"-diameter saw blade, the saw has the capacity to cut most wide-flange shapes.

SMI Steel Products
SmartBeam®
www.smisteelproducts.com

Manufactured by SMI Steel Products, the SmartBeam® provides a cost-effective option for long-span floor or roof applications. Architecturally pleasing designs allow mechanical services to pass through the structure while reducing building heights. SMI Steel Products is part of the CMC Steel Group of Commercial Metals Company (NYSE:CMC) headquartered in Irving, TX.



Fabtrol
FabTrol MRP
www.fabtrol.com

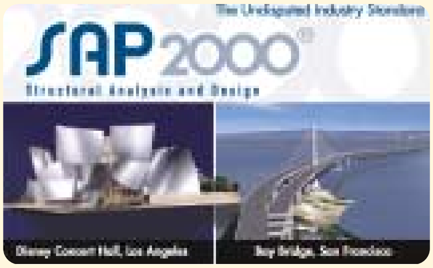
FabTrol MRP is estimating and production-control software for steel fabricators. Version 1.1 offers integrated estimating, drawing management, material nesting, purchasing, inventory control, production management, shipping, and more.

FabTrol MRP

Computers & Structures, Inc.
www.csiberkeley.com

SAP2000

SAP2000 integrates the analysis and design of simple to complex structures in one program. Physical-object modeling, proprietary equation solvers and element types, nonlinear techniques for progressive collapse and buckling are all integrated with current design codes.

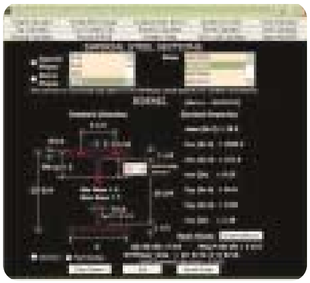


ETABS

ETABS is an integrated, physical-object-based, software package for the modeling, analysis and design of buildings. It provides the tools to produce timely and efficient design solutions for a range of building types, including commercial, retail, medical and residential.

DETAILCAD
Detailer's Genie
www.detailcad.com

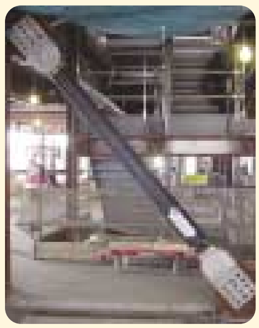
An online library, DetailCAD Detailer's Genie provides all required information to a steel detailer with a click of a button. Genie has the latest database of AISC Steel shapes and sectional properties in imperial and metric units. It displays information to check stiffener size, max and min rows, flange gauge and beam blocks for beams framing at an angle, and also a quick-reference weight and unit-load calculator. Tools like bracing calculator, bracing pull-off calculator, truss camber calculator, stair calculator, hip and valley curve calculator are quick references for checking. The information and diagrams can be saved into CAD formats (dwg or dxf) and can be printed. Genie also provides Interactive tools like feet-inch calculator, triangle calculator, bevel calculator, circle calculator and a numeric converter, which can convert into five different formats (ft, ft-in., mm, etc.).



scorching!

Taylor Devices
www.taylordevices.com

Fluid Viscous Dampers
Since 1955, Taylor Devices has been producing energy-dissipation devices to protect virtually any type of structure against damage caused by earthquakes, wind, blast or live loads. Reusable after multiple earthquakes and active for all levels of earthquakes, these devices can result in enhanced performance while simultaneously reducing the cost of the structure.



Lock-Up Devices
Lock-Up Devices allow free movement for slow velocities such as thermal expansion/contraction, yet act as rigid links for higher-velocity movements. These devices reduce movements and/or allow lateral forces to be shared between fixed piers and expansion piers on bridges.

Tuned Mass Dampers
For applications where the installation of traditional dampers is not feasible, these devices can be used to reduce movement caused by wind, pedestrians or machinery. Contact Taylor Devices to learn more about these custom-engineered devices.

Lohr Structural Fasteners
Thick Washer Face Smarthex™ TC A490
www.lohrfasteners.com

Lohr's Thick Washer Face Smarthex™ TC A490 eliminates the need for a separate $^{5}/_{16}$" hardened washer, which is required when A490 bolts with a diameter of 1" or larger are installed in connections with oversized or short slotted holes in an outer ply. The new bolt features Lohr's basic SMARTHEX™ head design, but with a thickened washer formed as part of the bolt head. In addition to saving the expense of the washer itself, elimination of the $^{5}/_{16}$" washer also provides an additional usable $^{5}/_{16}$" grip on each bolt, which allows for reduced lengths.

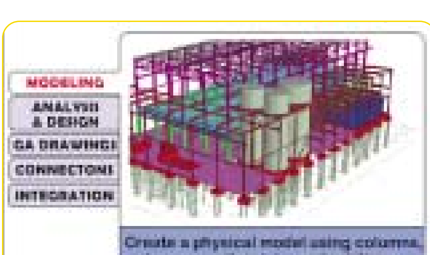
Applied Bolting
www.appliedbolting.com

Squirter DTIs
Squirter™ DTIs have a self indicating feature to aid the installer. Squirter DTIs are made for use with ASTM A325 and A490 bolts, as well as their metric equivalents.

Squirter-Twist Bolt
The Squirter-Twist Bolt combines the features of the TC bolt (light wrench, one-side, one-person installation) and the Squirter DTI.

Research Engineers International and Tekla
Tekla Structures with STAAD.Pro 2004
www.tekla.com and www.reiusa.com

Tekla Structures with STAAD.Pro 2004 enables engineering, detailing and project management to be completed on one platform. All structural information (regardless of material) is managed throughout the project lifecycle from conception to erection. Project team members can share information in real-time regardless of their location, eliminating communication problems and reducing costs. The 3D information-management system is integrated with multi-material physical modeling of beams, slabs, walls, joists, etc.; analysis and design with STAAD inside; automatic creation of general-arrangement drawings, and parametric design of hundreds of connections. When one facet of the structural design chain is updated, the others automatically change, providing a flow of information from the architect to the detailer.



Heckmann Building Products
Weld-On Systems
www.heckmannbuildingprods.com

The Weld-On systems can be welded at the fabrication shop or in the field. The triangle tie slips in the weld-on and allows for vertical adjustment into the masonry joint. The Twist-On Groutless Anchor attaches to a vertical rod installed by the joist manufacturer. All allow for vertical deflection.

hot!

Chicago Metal Rolled

Large Section Bender

www.chicagometalrolled.com

Chicago Metal Rolled's large section bender can roll-curve 14”-20”-diameter steel pipe to tight radii or large sweeps without distortion and without the necessity of heating the material. For the first time, architects, engineers and owners can specify cold-curving of up to 20” pipe for buildings, canopies, and other architectural elements with significant cost savings over heat-induction bending. Fabricators can obtain this service with 3-day, 2-day, 1-day or same-day deliveries. While heat-induction bending works for extremely tight bends, cold-curving works better on large radii. For most structural applications, cold-curving of pipe is preferable to heat-induction bending, because cold-curving does not significantly change the physical and chemical properties of the steel.

Research Engineers International

www.reiusa.com

STAAD.Pro 2004

STAAD.Pro 2004 features a user interface, visualization tools, and analysis and design engines with finite-element and dynamic-analysis capabilities. STAAD.Pro offers model generation, analysis and design, and visualization and result verification for steel, concrete, composite, timber, aluminum and cold-formed steel structures.

STAAD.foundation

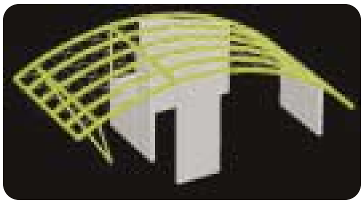
STAAD.foundation enables engineers to analyze and design the underlying foundation for structures, including isolated or combined footings, true mat foundations and pile-cap arrangements and design. By itself or integrated with STAAD.Pro, STAAD.foundation can produce production-quality reports, drawings of rebar arrangements and 3D-renderings of foundation structures.

RAM International

RAM Structural System, RAM Advanse and RAM Connection

www.ramint.com

RAM International offers end-to-end software solutions for structural engineers: analysis and design for structures and materials, construction-drawing management, nonlinear solutions for earthquake engineering and collapse analysis. Thousands of engineering companies have standardized on RAM International's software solutions, including RAM Structural System with RAM Steel, RAM Concrete, RAM Frame and RAM Foundation, RAM CADstudio, RAM Advanse, RAM Concept, RAM Connection, and RAM Perform.



J&B Specialty Tool

www.beamgaugetool.com

The Beam Gauge Tool

The Beam Gauge Tool is two- to three-times faster and more accurate than previous methods of laying out holes in the web. It contacts the outside of the flange at the center line of the web, as shown on structural blueprints for fabricators. Generally, layout people measure from the top of the flange to get to the first hole gauge. If flanges are tipped in or out (not square), the holes will be off. This presents a problem for erectors, because when things don't line up, the job cannot be completed on schedule, and everyone is thrown off track. The beam gauge tool helps prevent this problem.

The Bevel Square Tool

The Bevel Square Tool is a 2' adjustable stand-alone square, for laying-out stairs, handrails, plates and beams. Comes with a time-saving hint for laying-out stair stringers with landings.

Peddinghaus FPDB 2500/3

www.peddinghaus.com

The Peddinghaus FPDB 2500/3 plate-processing center was designed to save overhead (80%) and material costs (up to 40%) for the structural steel fabricator. The one-pass process enables plate from 1/4” to 3” thickness, up to 96” wide, in unlimited lengths, to be processed from raw stock to finished part with one operator. On a typical 500-ton structural job, fabricators report savings of 19,000 man hours when compared to previous manual methods.

hot!

Carboline
Carboxane 2000
www.carboline.com

Carboxane 2000 is a hybrid polysiloxane finish with color/gloss retention. When used over Carbozinc primer, the system offers 25-30 years of weathering and corrosion-resistant performance. It cures at 35°F, eliminates a coat of paint, and is isocyanate-free for worker safety.

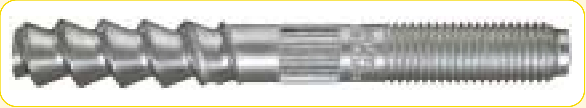
Girder-Slab Technologies, LLC
The Girder-Slab® System
www.girder-slab.com

The Girder-Slab® System is an alternative to cast concrete systems slated for use in mid-to high-rise residential construction. The system offers variable floor-to-floor heights and super fast construction. The system and D-Beam® Girder are available through authorized steel specialty contractors.

Hilti Corporation
www.hilti.com

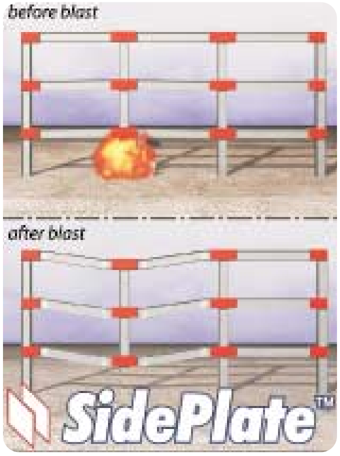
HIT-TZ Threaded Anchor Rod
When used with the Hilti HIT HY 150/HIT-ICE Adhesive Anchor System, the HIT-TZ can save time and money. With 20-percent less embedment than standard embedded threaded rods and no cleaning required, it uses less HIT HY 150 and saves time drilling, cleaning, and inspecting.

ST 1800 110-volt Adjustable Torque Screwdriver & SDT 25 Decking Tool
With the SDT 25, the ST 1800 converts from a hand-held to a stand-up system for fastening deck sidelaps and attaching metal deck to bar joists and purlins. Adjustable handles and a 50-screw capacity promote operator comfort and productivity. Eighteen-position adjustable torque provides precise screw setting, and a rotating nose piece promotes portability.



SidePlate Systems, Inc.
SidePlate™ Steel Moment-Frame Connection Technology
www.sideplate.com

SidePlate™ steel moment-frame connection technology can help respond to today's multi-hazard design challenges with the SureFrame™ system. The structural framing system is for wind and earthquake resistance; blast and impact hardening; and progressive-collapse mitigation. It is fully compliant with all current U.S. Government progressive-collapse design standards.



Adapt & Re-use

By Peter Wilk

Structural steel met the triple challenges of time, space, and budget during the renovation and adaptive re-use of this vintage New York City townhome.

One by one, 70 wide-flange steel members were carried by hand into the new Marymount Middle School in Manhattan, as part of the renovation and expansion of a beaux-arts building. The job's tight site and the building's historic elements prevented the use of heavy cranes and equipment during construction. A strategic design and careful planning made the project a success, meeting the school's functional and aesthetic goals.

In 2000 the Marymount School had acquired the six-story mansion, which was built originally in 1900 as a private residence before being converted into an apartment building in 1939. The structure is considered a "Contributing Building" to the Metropolitan Museum Historic District, and the New York City Landmarks Preservation Commission observed the restoration.

The building's wooden structure was

deteriorated from water damage and age, and its floors sagged. Some decorative elements were damaged or missing, and the exterior required extensive repairs and preservation.

Steel was considered the best choice for the retrofit, said Architect Sam West, of Platt, Byard, Dovell, White Architects. “The floors of the existing building were framed in wood, the bearing walls in masonry. Steel was compatible with both. Our schedule did not allow for the time required for poured-in-place concrete to come up to strength, there was no room to post-tension concrete, and pre-cast was inappropriate because we needed to bring the structural elements into the building in relatively short pieces [and then connect them].”

“Steel was the best solution in terms of overall weight and required strength, versus wood or concrete construction,” said Structural Engineer Chris Anastos. “The weight of the new structure had to be minimized so as not to overstress the existing walls and footings.”

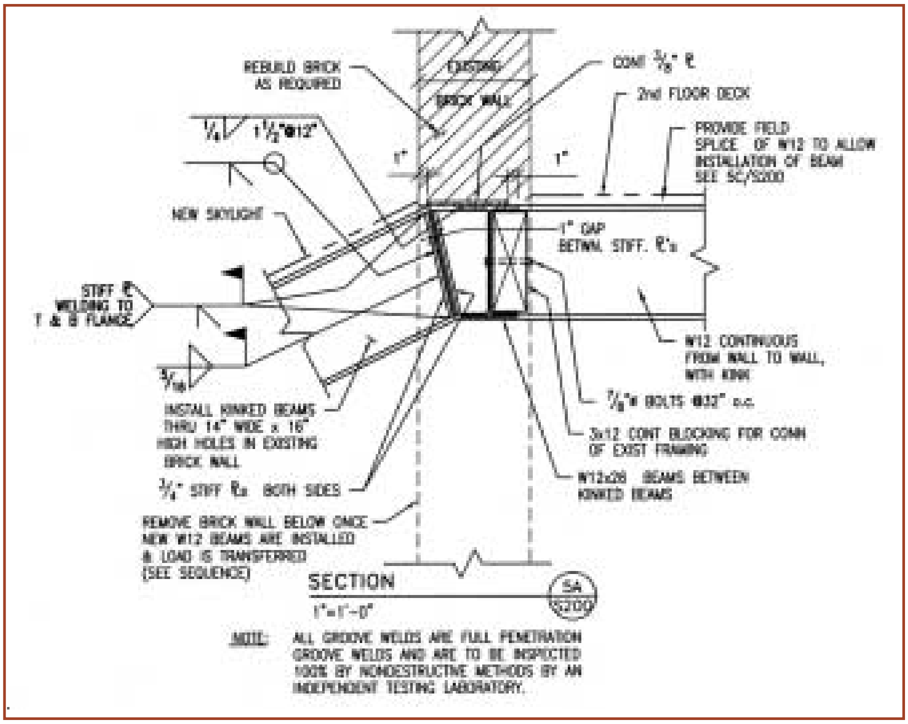
Design Challenges

From a planning perspective, the architect needed to fit the academic program of a freestanding school into a structure originally designed as a single-family residence. The school’s space program had to be accomplished without expanding the building’s exterior envelope above the first floor. The new use had to conform to contemporary codes, including requirements for stairs, elevators, bathrooms and corridors, all within a fixed width established by existing party walls. Within the constraints of a narrow sidewalk, the school had to provide barrier-free access, even though the building’s first floor is 3’ above street level. The New York City Landmarks Preservation Commission would not allow any changes to the entrance.

The greatest design challenge involved the introduction of modern utilitarian elements—fire stairs, elevators, lockers, science and computer classrooms—into a building that the client chose for its Beaux-Arts interiors. The architect developed a two-tiered approach. The team identified the most historically valuable and best-preserved original rooms, and assigned to them “soft” new uses, such as homerooms, the reception room, and the library. These rooms underwent a restoration, received compatible lighting fixtures, and their new infrastructure was concealed.

Above: New steel framing supports five floors above—and a masonry bearing wall—to provide column-free space and skylights for the new ground floor Commons Room (*inset*).

Below: New steel beams with a fabricated “kink” support the existing brick masonry wall where the lower portion has been removed.



Rooms and spaces that did not allow this preservation approach were assigned "hard" uses, such as food-service facilities, the science laboratory, the technology room, and art rooms. These rooms now feature new interiors with contemporary, but historically sympathetic designs.

Structural Redevelopment

The renovation process required the removal of most of the original wooden structure, and installation of the new steel structure. Structural elements were installed one floor at a time, beginning with the first floor. Due to a very tight site, limited access to the building, and the need to preserve the façade and interiors, structural steel elements had to be moved-in by hand through window and door openings and then up through the inside of the building. Installation of the entire new steel structure took eight weeks.

The most interesting aspect of the structural steel design involved the creation of the dining commons at the ground floor rear. During the programming and planning phase, the school determined that the building would need to feature a dining room large enough to accommodate half of the students and half of the faculty at one time. For planning reasons, the dining room had to be located in the rear of the first floor, directly above the kitchen.

In order to meet the school's needs, the team decided to expand the width of the building's rear portion from 17′ to the full extent of the 25′-wide lot. The expansion process necessitated construction of a new foundation and introduction of a steel structure to support five floors above, while allowing a column-free span below. The added foundation is 25′ wide by 10′ deep. The new concrete spread-footing foundation is anchored to the bedrock that is 3′ below the surface level. The building's footprint is now approximately 25′ wide by 60′ deep.

The large steel members were fabricated in multiple pieces, each one small enough to carry in through the front door and window openings, as there was no other access, and the team did not want to impact the existing period woodwork of the front lobby.

Standard bolted field connections were used for much of the structure, and shop connections were welded. The majority of steel-to-wall connections were bearing plate connections pocketed into existing masonry walls. The pockets were approximately 8″ deep by 12″ wide by 14″ high. The laborers then installed 12″-by-8″-by-1″ steel plates on the bottoms of pockets in the walls. The beams were placed on top of the plates and welded to them using stick-welding techniques.

The project required fabrication of approximately 70 W12×45s. Construction of the building's rear extension required fabrication of "kinked" beams to support the existing five-story brick bearing wall. The W14×65 beams extend straight from the pre-existing rear wall and then "bend down" at an approximately 45-degree angle to connect with the new concrete wall erected above the new foundation. The beam had to be stiff enough to minimize its deflection and eliminate the possibility for cracking of the existing brick wall. The fabrication of kinked beams involved cutting the ends of two beams at 22.5-degree angles and welding the ends to create the 45-degree angle. The kinked beams also are connected to both pre-existing and new walls through bearing plate connections. The connection to the new wall is approximately 11′ above the ground level.

When the new steel structure was installed, the ICS construction team gradually transferred the weight of the five-story extension onto the new steel bents. Steel was coated with a spray-applied fire-protective coating to give it a two-hour fire rating. The last phase in the structural redevelopment involved the demolition of the old masonry foundation walls below.

Challenges and Solutions

The biggest challenges of the renovation were its location, limited site access, tight schedule, and historical preservation requirements.

"Project location in the dense and historical neighborhood of Manhattan's Upper East Side restricted ICS Builders' site access and work time," said Ted O'Rourke, senior vice president for ICS.

Noisy construction activities were timed to accommodate the surgery schedule of a physician whose office was located near the construction site.

The lack of materials storage space required close coordination with subcontractors and vendors. The steel fabricator could not make deliveries before 7:30 a.m. With virtually no storage space at the site, ICS Builders scheduled deliveries of steel elements at the time each piece was to be installed in the structure. "The majority of materials and equipment were carried into the site and installed immediately upon delivery," O'Rourke said. "The entire process of construction and deliveries was managed through a complex, closely controlled schedule."

There was no space on the street to erect a permanent crane. However, a mobile crane installed the 50-ton rooftop unit on a Saturday morning, when street traffic was lighter than on weekdays. The installation was performed while the street was closed to traffic for three hours.

Construction of scaffolds added to the logistical challenges. A neighbor on the south side prohibited access to his site, forcing the contractor to install the scaffold above the adjacent property. The team devised and installed a hanging scaffold system suspended from the roof on that façade. On the west side, the team erected a conventional scaffold.

Exterior restoration interfaced with interior work. At the roof area, new structural steel was required to support the rooftop HVAC equipment. Agreements with neighbors required that new HVAC units fall within certain heights. Interior ceiling heights also were regulated, which required careful coordination of duct passages and penetrations.

The project received the New York City Landmarks Conservancy 2003 Lucy G. Moses Preservation Award. ★

Peter Wilk is a New York-based public relations and marketing communications consultant to the A/E/C industry, and president of Wilk Marketing Communications. He can be reached at peter@wilkmarketing.com.

Owner
The Marymount School of New York

Owner's Representative
Levien & Company, Inc., New York City

Architect
Platt, Byard, Dovell, White Architects, New York City

Structural Engineer
Anastos Engineering Associates, New York City

General Contractor
ICS Builders, New York City

Exterior Restoration Consultant
Walter B. Melvin Architects, New York City

Music in the Park

By A. Abdelrazaq, P.E., S.E., H. Iyengar, P.E., S.E., C. Rockey, S.E., R. Sinn, P.E., S.E., and J. Zils, P.E., S.E.

The newest addition to Chicago's lakefront is an outdoor performance venue featuring Frank Gehry's signature curving metal panels and a large-scale HSS trellis.

Chicago's skyline is known for its innovative architecture. The new Millennium Park outdoor music pavilion reflects that vitality. Designed by architect Frank O. Gehry, the pavilion features a lawn and fixed seating area for up to 11,000 patrons, and a celebratory orchestral stage area framed by soaring, ribbon-like metallic forms. The great lawn and seating area is spanned by a woven network of exposed arched steel members creating a three-dimensional open-air "trellis" above the level of the spectators. A serpentine pedestrian bridge across Columbus Drive linking Millennium Park and lakefront areas to the east represents Gehry's first realized bridge design.

Band Shell and Metal Elements

The music pavilion is composed of a south-facing band shell housing the stage and related support facilities, which in turn supports the metallic forms. The forms are shaped and located to improve the acoustic characteristics of the performance venue. The central portion of the band shell roof over the stage cantilevers up to 100′ beyond the proscenium door. There are a total of 12 individual metal-clad assemblies arranged around and above the central stage, forming an overall composition about 300′ wide and 120′ tall. Behind the upper metal surfaces, a system of inclined steel pipe struts connected to the band shell structure stabilize the metal elements.

Above the stage, the band shell roof framing consists of a three-dimensional steel platform that includes 12 built-up steel trusses spaced at 9′-8″ on center that vary in depth from 11′-3″ to 5′-0″ at the end of the cantilever. The trusses are composed of wide-flange and tee sections with welded and bolted joints; and are supported on an 11′-3″-deep by 8′-6″-wide built-up box truss girder spanning the 87′ opening over the stage. Overall, the band shell structure is fabricated from 800 tons of structural steel.

Framing the complex geometry of the various metal-clad elements surrounding the stage required careful consideration. The system had to be versatile enough to respond to the significant variety of shapes and sizes of metal forms. Lateral stiffness was particularly important because some of the lower forms cantilever as much as 40′ from their base without lateral supports. Structural rigidity also was required to minimize the potential for wind-induced flutter. Since the structural frame served as the primary support for the architectural stainless-steel-clad surfaces, it also was necessary for the framework to be fabricated and erected within stringent tolerances to install the cladding. Finally, these considerations had to culminate in a structure that could be detailed, fabricated and erected economically within a mandated budget established for the project.

A steel grid/ribbed frame concept was developed for the support of the metal elements, which responded well to the structural system requirements of the project. The structure was configured to closely follow the curvature of the shapes and take advantage of the inherent geometric stiffness of each form. Where required, metal elements were stabilized by steel pipe struts (varying in diameter from 8″ to 14″) framing to the band shell roof. The basic structural system concept was applied and refined through computer-based surface modeling integrating the combined efforts of the architectural and structural engineering teams. First, a structural working surface was generated 2′-0″ behind the clad surface. Vertical slicing planes at 9′-8″ centers and horizontal planes at 10′-0″ centers were electronically passed through the structural working surface, and the intersections created the structural work points. Straight-line segments connecting the work points formed an electronic wireframe representing the centerlines of the structural grid/frame members. Diagonal members were added between work points as required for lateral rigidity.

For this type of structure with relatively few (450) steel tons, considerations other than least weight were more important in terms of overall economy. To promote repetition and control of steel-connection detailing and fabrication, and coordination with cladding systems and attachments, member sizes were standardized as follows throughout the metal elements:

- vertical (inclined) ribs—W12×40 (ASTM A572 – Grade 50)
- horizontal members—HSS 8×8×1/4 (ASTM A500 – Grade B)
- diagonals—WT6×15 (ASTM A572 – Grade 50)

Individual member sizes only were increased as determined by the structural analysis (approximately 10%) and never decreased. Independent, parallel structural analysis and design checks were done using two software programs: S-FRAME (CSC-SOFTEK) and SAP2000 (Computers and Structures, Inc.) for a complete loading regime including wind, temperature, snow, ice and live load.

The drawings together with the computer wireframe were issued to the contractor as part of the project documentation. The steel detailer converted the wireframe electronic data into Tekla Xsteel for use in the preparation of shop drawings for the structural steel. The fabrication/erection concept was to prefabricate vertical sections of each metal element in the shop, trial fit and pre-assemble each section to neighboring sections in the shop, prepare the members for shop painting, and ship them to

Over the Top

The Millennium Park Music Pavilion integrates the space and audio quality of an indoor performance theater with the openness and ambiance of an outdoor musical venue. A three dimensional shell-shaped trellis structure, formed by a grid of arched steel pipes, defines the audience space and connects the stage to the great lawn. The trellis structure supports a system of computer-controlled audio speakers to create the effect of surround sound. This speaker system hovering above and around the audience eliminates the need for speaker towers found in many outdoor concert venues.

The trellis shell encompasses an area approximately 625’ by 325’ in plan. It is truncated at the stage end with a few of the northernmost pipes woven between the metal elements, ending adjacent to the stage walls. The arched trellis frames are supported on 24, 6’-diameter reinforced-concrete pylons, 16’ high, spaced approximately 60’ apart. Twelve arches originating from each side of the lawn span in an inclined direction, creating a distinctive skewed and gridded form.

The trellis structure behaves fundamentally as a discretized shell under gravity loads, with primarily axial compression in the members and secondary flexure near the supporting pylons, node points and midpoint of the segments. Imposed loads considered in the design included the suspended speaker system, wind, ice, temperature, and maintenance live loads.

The number of radii required to define each arch were rationalized such that each piece between splice points had one radius and involved pipe bending in one plane only. The arches intersect at common node points on the shell surface. Each pylon typically supports arches in two diagonal directions; one flatter, the other steeper. This results in a symmetrical diagonal pattern defining the shell surface. Individual arches range in overall length from 230’ to 400’. There are 120 sections of pipe in all, 50’ to 105’ long. The height of the trellis reaches 60’ above the lawn at its highest point. The entire trellis represents approximately 320 tons of structural steel pipe.

At each intersection, one pipe member is continuous through the joint and is outfitted in the shop with stub members to receive the two other pipes at the node. The steel pipes vary in diameter from 12” to 20” with wall thicknesses ranging from 0.375” to 0.750”. All pipes are ASTM A500 with minimum yield strength of 42 ksi. Splices are full-penetration-welded in the field with an internal back-up ring, but without external brackets, to maintain the smooth outer form of the pipes. Where pipe diameter transitions occurred, an external collar ring was shop-welded to the smaller pipe, which was then field-welded to the larger pipe.

At the pylon supports, intersecting internal stiffener plates extend from the pipe intersection down to a base plate, which is then anchored to the top of the concrete. The pipes overhang at least 3’ beyond the face of the pylon, promoting an appearance of a floating trellis structure.

Chicago Metal Rolled Products, a subcontractor to AISC-member fabricator ACME Structural Inc., used a cold-bending technology to bend the large-radii pipes with good control on ovality, which resulted in tight tolerances suitable for the architecturally exposed structural steel (AESS). All pipe chords are bent in a single plane with few tangent arcs, with radii varying between 125’ and 5,100’. The bending process started with very low curvatures and progressively increased to the desired value.

Erection proceeded from both north and south ends of the trellis frame. Shoring towers supported the trellis at each intersection point (48 towers total). The towers were located slightly off of the node point to be able to survey and set it for the correct elevation. The pipes were temporarily suspended by a short adjustable sling from a cathead beam of the tower above the node point. This method allowed for accurate setting without the use of bearing-type supports and jacks. The trellis frame was advanced several lines with cross pipes set, before final field-welding of the splices.

The permanent overhead speakers are suspended from the trellis pipes by a system of 3/8”-diameter stainless steel cables, which allow flexibility in speaker locations. TryPyramid Structures, Inc., Westford, MA supplied the cable system and its related hardware.

Curved stainless steel panels frame the stage opening at the Millennium Park band shell.

the site. The prefabricated steelwork sections then would be assembled on the ground into as large a sub-assembly as could be erected. The pre-assembled geometry was surveyed at key points with any discrepancies adjusted on the ground prior to erecting the steelwork sections. The band shell-roof cantilevered trusses were shored during erection of the metal elements.

AISC-certified fabricators LeJeune Steel and ACME Structural (both have the P1-Sophisticated Paint Endorsement, Enclosed) applied a Carboline four-coat paint system to all exposed steelwork for the metal elements and trellis. The primer and undercoat were applied in the shop over near-white blast-cleaned surfaces. The final color and clear coat were applied in the field after completing the erection of the structure. All site bolting of metal element joints were performed with 1″-diameter A325 galvanized bolts designed with a Class A friction coefficient.

Following survey confirmation of the erected geometry of the structural grid/frame, the aluminum support panels and stainless-steel cladding were applied. The cladding panels, curved to follow the final architectural form, were attached at various locations along the primary horizontal members of the structural frame on steel outrigger arms.

Columbus Drive Pedestrian Bridge

The Lakefront Millennium Park pedestrian bridge provides a pedestrian crossing over Columbus Drive between the park area above the East Monroe Underground Garage (construction circa late-1970s) to the newly built Millennium Park above the Millennium Park Garage to the west. The bridge not only follows a complex curvature, but also includes a superimposed cladding system of stainless steel and secondary cladding support structure similar to an enclosed building. The aesthetic concept is based upon a continuum of the metal-clad form projecting out of the ramping curvilinear abutments that spans across the roadway as a sleek, tapering bridge with minimum depth at the center support.

The approach spans east and west of the Columbus Drive span are curvilinear and framed in reinforced concrete supported directly on the existing underlying garage structures.

The two-span bridge over Columbus Drive is framed in structural steel supporting a cast-in-place reinforced-concrete slab walkway deck. The two-spans over Columbus Drive are on the order of 100′ each and are curved in plan. The structural design for the Columbus Drive crossing had to limit the effects of vibration due to pedestrian walking motions. The high stiffness-to-unit-mass characteristics of a steel design were crucial, particularly because of the limited available architectural envelope within the cladding. Structural calculations provided a minimum fundamental vertical frequency of 3 Hz, per AASHTO *Guide Specification for Design of Pedestrian Bridges*, with sufficient separation between vertical and horizontal modes. Primary longitudinal members include a central structural-steel box girder, transverse outrigger girders, and intermediate longitudinal purlins as required to support the walkway and metal-cladding system. The two-span bridge structure is supported with fixed bearings at the center of Columbus Drive on a new support pylon, and with horizontal expansion bearings at the east and west ends of the span.

The east and west ends of the two-span bridge over Columbus Drive are supported on structural steel, three-dimensional, four-chord cantilevered trusses supported directly on the existing underlying garage structures. These trusses are variable in depth and width, and curved in plan to match the architectural envelope. The supporting truss cantilevers approximately 10′ on the west of Columbus Drive and approximately 25′ on the east. The cantilevered trusses are composed of circular pipe sections for all chords, 20″ in diameter, 1.25″ to 2.0″ wall thickness.

Relatively short lengths (5′ to 10′) of pipe were robotically spliced-welded. The American Pipe Bending Company in Tulsa, OK then electric-induction bent them to the correct radii before shipping the pipes for fabrication. All pipe chords are bent in a single plane with a few tangent arcs, with radii varying between 50′ and 130′.

All steelwork connections for the bridge were designed by SOM and were included in the bid documents. As part of the project documentation, SOM submitted a colored electronic wireframe (AutoCad .dwg format) defining all member geometries and sizes. This file was directly loaded in Xsteel software to create the assembly and individual piece drawings for review. Since the engineer of record designed the connections, and the geometry was submitted electronically to the steel fabricator, 90% of the steelwork shop drawings were approved quickly without any additional review comments or resubmission.

The steel-framed portion of the bridge comprises 260 tons of structural steel. The steel fabricator completely pre-assembled the entire cantilever trusses and central box-girder span in the shop prior to shipment to the site. The Columbus Drive crossing was erected in a single weekend, with two welded air splices performed in the field. All steelwork for the bridge received an inorganic zinc-rich primer supplied by Carboline, over near-white blast-cleaning of the bare steel. All

Getting a Lift

Eighteen JLG® boom lifts were used to build the complex band shell at Chicago's Millennium Park. Ironworkers relied on the JLG boom lifts to build the structure, which extends to 145' above ground and is 320' across. Rented from Illini Hi-Reach of Lemont, IL, as many as 30 machines with platform heights ranging from 60' to 150' were used on the job at one time. Three of the JLG Model 150HAX articulating, telescoping boom lifts were used for the high-reach work. They are the tallest self-propelled booms available in the United States, with 150' platform height and the capability of reaching 79'-3" horizontally. For the majority of their work envelope, they have a platform capacity of 1,000 lb.

Most of the boom lifts were JLG's new Ultra-boom lifts, including the Model 1350SJP (The JLG Ultra-boom lift was awarded an Honorable Mention in this month's *Modern Steel Construction* Hot Products award competition. See p. 59 for more). It has a 141' working height and could lift workers to most of the overhead areas of the band shell. The Model 1350SJP boom lifts' features were well-suited for the crowded site. Extendible axles could be deployed by driving the machine forward or backward in as few as 8', an important feature for setting-up a machine in minimal space. It also meant that no outriggers occupied extra area. The Model 1350SJP has three steering modes: two-wheel front-wheel steer, four-wheel coordinated steering, and crab steering when maneuvering around the site.

"We needed boom lifts that give workers the flexibility to reach into the structure to set the steel and that could do it with speed because of our tight timetable," said Larry Ferris, Danny's Construction Company superintendent for the band shell. "All of the steel needed rustproof coating and that had to be done at temperatures above 40°. With winter approaching, we needed the work done!"

JLG lifts also helped install the aluminum panels and skin for the surface of the structure. With their compound curves, the panels look like a segment of an airplane wing and are built within a ±$^1/_{16}$" tolerance. Once the steel structure was completed, the panels were bolted to the arm plates using boom cranes and the JLG boom lifts.

bolts are A325 galvanized bolts designed as slip-critical with the primer faying surface supplying a Class A slip resistance. ★

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Owner
City of Chicago

Structural Engineer
Skidmore, Owings & Merrill LLP, Chicago

Architects
Gehry Partners LLP, Los Angeles

General Contractor
Walsh Construction, Chicago

Steel Detailers
Dowco Consultants, Ltd., British Columbia, Canada (Band shell and Metal Elements) (NISD members)
Industrial Detailing, Inc. St. Louis (Trellis) (AISC member)
Mountain Enterprises, Inc., Sharpsburg, MD (Pedestrian Bridge) (AISC member)

Steel Fabricators
LeJeune Steel Company, Minneapolis (Band shell and Metal Elements) (AISC members)
ACME Structural, Inc., Springfield, MO (Trellis) (AISC member)

Steel Erectors
Danny's Construction Company, Inc., Shakopee, MN (Metal Elements and Trellis) (AISC, NEA member)
Imperial Construction Associates, Joliet, IL (Pedestrian Bridge)

Metal Cladding
A. Zahner Company, Kansas City (Metal Elements)
Permasteelisa Cladding Technologies, Ltd., Mendolta Height, MN (Pedestrian Bridge)

Structural Engineering Software
S-FRAME (CSC-SOFTEK)
SAP2000

Detailing Software
Tekla Xsteel
Design Data's SDS/2

Play Ball!

By Jeffrey D. Wells, P.E., S.E.

Playful structural steel elements and urbanist design make Hammons Field in Springfield, MO a popular new venue for America's favorite pastime.

Hammons Field in Springfield, MO is the cornerstone of the city's downtown redevelopment. A structural steel frame helped designers achieve the desired aesthetic for the new AA minor-league and Southwest Missouri State University ballpark, built by developer John Q. Hammons.

A stadium's architecture is critical for a good game-day experience, and the project team researched venues nationwide to guide the new ballpark's design. A common theme of successful venues was their old-time atmosphere and urbanist design principles. The design team chose a brick street presence with an articulated steel structure on the interior, similar to Coors Field in Denver.

The Overall Design

Pellham-Phillips-Hagerman Architects & Engineers (PPH) led the design effort, and the owner's in-house architectural staff was also an integral part of the team. Wells & Scaletty, the structural engineer, developed the concept for the exposed steel structure. CDFM2 of Kansas City, with expertise in sports architecture, assisted in the programming and schematic design.

The stadium plan included 8,000 seats and 28 box suites. Most seating was accommodated in the bowl, with the upper deck reserved for the suites and the party deck. A third level behind home plate section contains press boxes and three luxury suites. An important design goal was for fans to be able to see the field directly upon entering the main gate.

The bowl seating risers are concrete slab-on-grade. The sections along the first and third base lines are connected via bridges to the center section. Breaking up the structure in this manner helped define entrances and created more visual interest. The visitors' clubhouse, kitchen, and mechanical spaces are located below the concourse level.

The home team clubhouses, maintenance building, and an indoor practice facility are in the outfield. The project was sufficiently under budget that the practice facility could be added without increasing the project cost.

The Outfield berm accommodates 1,000 people. A sidewalk extends from concessions, restrooms, and stairs around the top of the berm. Handicapped-accessible platforms are provided along the berm. Large patio decks are located at the end of the first and third base lines.

In a traditional building, columns are often fire-protected with coatings or concealed by gypsum board, but baseball grandstands permit the exposure of steel framework. Exposed, painted steel was the only logical choice for Hammons Field, and a great deal of attention was focused on the steel detailing.

The $32-million-dollar facility included 874 tons of structural steel, 34 tons of bar joists, and 93,300 sq. ft of metal deck.

The Structural Concept

The design team wanted to create a structure that encouraged fans' eyes to roam. Engineers are used to drawing idealized structures with pins and rollers—items that have mathematical meaning but are not literal. Such idealizations rarely express themselves in the final structure, since connections are selected for strength and economy.

The design team wanted to create a stadium structure something that was visually playful and that would draw the attention of baseball fans. The goal was a structure that would encourage kids in the crowd to make the connection from the steel frame to their own toy building sets; and that would cause fans to imagine giant wrenches and tools required to construct the stadium.

Pipes were the preferred structural members. Their closed and curved section would stand up to rain and snow. The nooks and crannies created for bird nests would be minimized. Pipes are also relatively inexpensive. Standard weight and extra-strong 3″ pipes proved adequate.

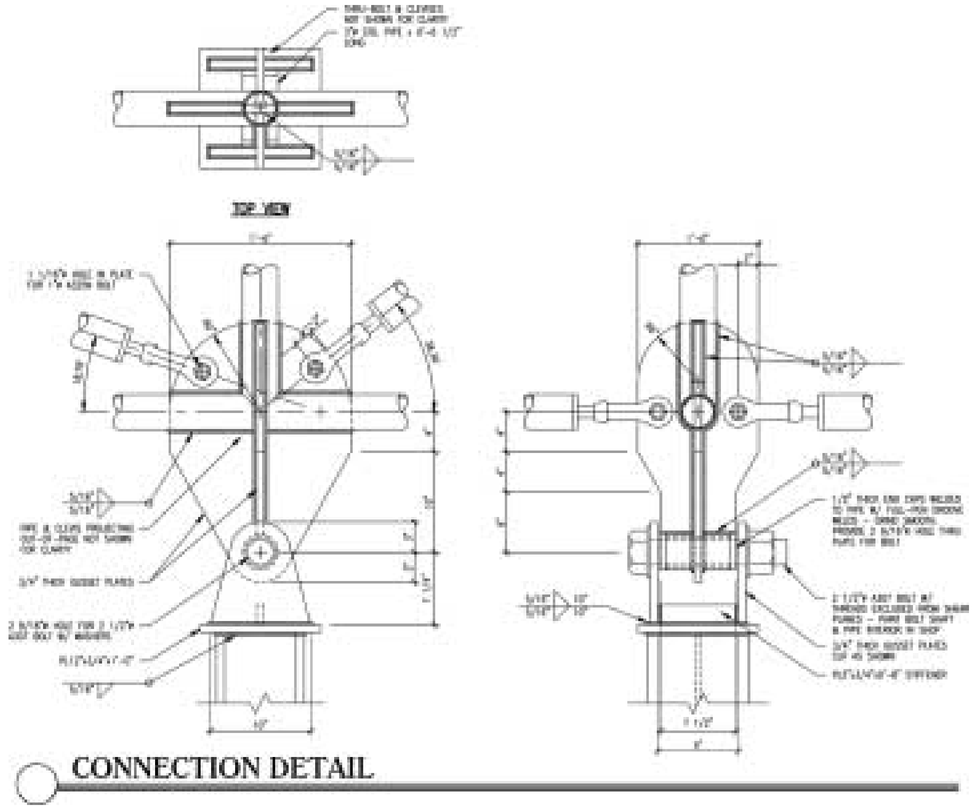
The question emerged as to the best way to connect the pipes into trusses. Clevises supplied by Cleveland City Forge were used to make member-member connections, and they fit the desired "overgrown erector set" aesthetic. No. 3 clevises were used at the roof and no. 5 clevises were used for the floor framing. A325N bolts were used in the clevises instead of pins. Some of the pipes and rods were left-hand threaded on one end and right-hand threaded on the opposite end so their lengths could be adjusted in place.

Steel rods, 2″-diameter, were used for truss tension members. Pipes were then used for the compression struts. Truss top flanges were kept as double-angles to support the deck. The knee braces supporting the cantilevered suite risers took on the appearance of shock absorbers or hydraulic pistons.

The connection from the roof canopy trusses to the columns was oversized intentionally. The metaphor was a piece of machinery frozen in place—it looks as if it was designed to move. The single 2½″-diameter through-bolt reinforced the hinge concept. The roof trusses were propped up on this big knuckle with a massive bolt passing through it. The height of this connection was kept low deliberately, so that it wouldn't get lost from view.

Pipes were considered for the columns but wide-flanges proved to be the more economical. Keeping the truss bottom-chord connections low served more than an aesthetic goal. The short unbraced lengths meant that W8x48 and W8x58 columns sufficed.

Precast-concrete slabs were originally planned for the Suites Level. The General Contractor, Killian Construction Company, proposed using a cast-in-place slab over metal deck. The 6″ overall-depth slab with 3″, 16 ga. composite metal deck proved to be less expensive. The seating risers at the front of the Suites Level remained a precast-concrete section. The precast concrete risers spanned 28′ between column lines.



Above and below, right: Structural details using clevises, threaded rods, pipe sections, and plates serve as functional architectural elements.

Special Analysis

RISA-3D was used to analyze and design the steel superstructure. To reduce lateral displacements, the Suites Level was tied to masonry shear walls surrounding some of the stairwells and the street-frontage structures. Calculated wind forces were slightly magnified because the bowl seating acted like an escarpment. Wind load acts on all the exposed truss members. The overall magnitude of the force on the open structure was surprisingly large, and depending upon wind direction, can exceed the force on the structure if it were considered completely enclosed.

Steel framing supports precast concrete risers.

Continuous connections from bay-to-bay meant that compression forces were introduced to the bent-bottom truss chords. This presented a potential buckling instability exacerbated by fabrication tolerances at the knee joint.

Bucking stability was assessed in two ways. First the linear elastic buckling load (minimum eigenvalue) was calculated. This is the critical load assuming the structure is geometrically perfect. Then, small imperfections were modeled and a Newton-Raphson incremental-iterative analysis was performed to account for non-linear geometry. By including the geometric-stiffness matrix, the restraining effect of the truss webs and the torsional resistance of the center, vertical pipe web could be taken into account.

Most of the concourse level is a slab-on-grade. However, the portions used for certain areas like the kitchens and the visitors' clubhouse required a structural slab. RAM Structural System was used to design non-composite steel beams and girders supporting a composite metal deck and slab. A drainage fabric and rigid insulation were placed over this slab, and a second concrete slab placed over it. From the concourse level it is impossible to tell when you are on grade or over an occupied space.

Alternate Framing Considerations

Traditional wide-flange beams and girders were considered for the superstructure. In fact, the owner requested an alternate design be prepared for cost comparison. Overall tonnage increased in this alternate design. Although connections were more traditional, the alternate price was only $35,000 less than the clevis-connected trusses. "The cost difference was trivial, and considering how much the steel design added to the overall project, we opted to go with the custom trusses," said Jim Thomas, project director for John Q. Hammons Industries.

Fabrication and Erection

AISC-member fabricator Doing Steel built the trusses in the shop as complete units. The overall goal was to minimize field welding that interrupted the shop-applied primer. Where adjustments were required, the clevises could be spun around, lengthening or shortening the member. Some specific column gusset plates had to be shipped loose and field-welded. Gusset plates were plasma-cut on a Versagraph burn table with a Burny No. 5 CNC control. Other cuts were made by a Kaltenbach CNC robotic coping machine. This German device is the first fully robotic coping machine in the United States (see the "Robotics" sidebar on p. 58). For assembly, Doing Steel made their own tools and wrenches to handle the large clevises and bolts.

The Double-A franchise for the park has not yet been named, but the team is planned for the 2005 season. Hammons Field opened April 2, 2004 with a 9,000-plus crowd for the NCAA Division I SMSU Bears. "I don't know of any finer place to play," said SMSU Athletic Director Bill Rowe after completing their first season. "At the collegiate level, this is absolutely the tops. Nothing was overlooked." ★

Jeffrey D. Wells, P.E., S.E. is a partner for Wells & Scaletty, LLC, in Springfield, MO.

Owner/Developer
John Q. Hammons

Architects/Engineers
Pellham-Phillips-Hagerman Architects & Engineers (PPH), Springfield, MO

Structural Engineer
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Design Consultant
CDFM2, Kansas City, MO

Steel Fabricator/Detailer
Doing Steel, Springfield, MO (AISC member)

Detailer
Havana Steel Detailers, Havana, FL (AISC member)

Engineering Software
RISA-3D
RAM Structural System

General Contractor
Killian Construction Company, Springfield, MO

Show Stopper

© Ben Tanner Photography

By Jaime E. Vasquez, P.E.

Innovative engineering and structural steel combined to provide nearly 1 million sq. ft of exhibit space with 180' clear spans for the Orange County Convention Center in Orlando, FL.

The Orange County (Florida) Convention Center recently completed its Phase V expansion, adding 3 million sq. ft to nearly double the capacity an existing facility. Constructed on 230 acres of land, the $748-million expansion includes approximately 1 million sq. ft of unobstructed exhibit hall space designed and built on an aggressive schedule.

The project was planned on a fast-track schedule, with only 42 months for design and construction. Through early coordination, the design team and construction manager devised a plan that reduced the risk associated with early packages. The strategy was to compress the schedule by prioritizing early construction documents based on the intensity of architectural coordination needed and the likelihood of revisions required after the packages were issued.

Early packages of structural components, influenced more by function than aesthetics, were completed and issued first. Aesthetic elements that required intensive design and coordination were issued last. Three months into the construction document phase, foundation permit drawings were issued. Construction started just six months after the start of schematic design. One month later, bid documents for the primary steel structure were issued, seven months prior to the completion of the construction documents phase.

Simplification, repetition and symmetry also helped meet the tight schedule. Complex geometry was reduced to simple symmetric elements that met the design intent. Detailing was simplified by including bending coordinates in the construction drawings as part of the geometry for the roof arches.

Construction-sequence studies indicated that the structure, approximately the size of 25 city blocks, should be divided into three distinct segments: The exhibit hall in the center, and North and South concourses. The 1,200'-long North and South concourses house lobbies, pre-function space, public circulation, meeting rooms and back-of-house support facilities.

Steel was an obvious choice for the long-span exhibit-hall roof trusses. 180'-long spans are only attainable with steel structures. The trusses provide support for the roof and mechanical penthouses, and they provide a rigging grid (bottom chord) for exhibit loads. In addition, structural steel was the only material that could efficiently frame the complex geometry of the entry lobby shells.

Trusses Go the Distance

The 18'-deep trusses spanning 180' in two directions are the backbone of the convention center exhibit hall. Secondary trusses, 180' long and spaced 30' on center, are supported by primary truss girders of the same length. They form 30 typical roof panels that cover the exhibit hall area. Continuity at the supports increases efficiency and makes this truss assembly

Above: The steel structure of the roof over North and South concourse takes a leading role in the finished architecture (inset, right).

Right, middle: The complex geometry of the sloping roof did not preclude the use of clean and relatively simple connections.

Right, bottom: Steel trusses, braced by movable erection towers, are assembled in the field.

behave as a space frame. Performance and efficiency were increased further by tapering the secondary truss top chords. Truss depth vary from 17′ at the center to 18′ at the supports. Tapered truss top chords also ease roof drainage. The truss system, in combination with the roof filler beams, weighs only 21 psf.

At the supports, truss girders connect to a box-column and base-plate assembly. The typical interior pre-fabricated assembly consists of steel-plate box columns flanked by 2″-thick gusset plates along the orthogonal axis, welded to round base plates, 8′-8″ in diameter. Using this plate assembly simplifies the problem of connecting the massive trusses with relatively large reactions to concrete columns. It also helps develop the rigidity needed by the steel/concrete hybrid moment frame. At expansion joints and expansion-joint intersections, 1′-wide voids along the column centerlines divide the concrete columns in halves and quarters respectively. At these locations, the expansion joints reduce the column cross section to the point that the base-plate assemblies cover the column cross sections almost in their entirety without leaving space for anchor rods. To transfer shear and uplift forces, steel box columns are welded to the underside of the base plates and embedded in the concrete columns.

The use of repetitive structural elements simplified detailing, fabrication and erection. Pre-assembled truss segments were delivered to the site and then assembled to complete the 180′-long roof trusses. The truss bottom chords support a network of steel catwalks totaling 2.8 miles in length that service the entire exhibit hall. They also support a steel rigging grid of 30′-by-30′ panels designed to support exhibit loads totaling 30,000 lb per secondary truss, or 60,000 lb per primary truss girder.

Mechanical and electrical equipment required to power and ventilate the 3-million sq.-ft facility are housed in three 60′-wide by 900′-long mechanical penthouses located on top of the exhibit-hall roof structure. One is located over the center and the other two along the north and south extremes.

The steel fabricator secured 19,072 tons of structural steel and more than 200 tons of bolts, and detailed the structural components in more than 10,000 shop-drawing sheets. The roof structure alone required approximately 8 miles of 18′-

Completed segments of the pedestrian bridges were assembled nearby and then trucked into place and erected during the convention center's limited down-time.

deep steel trusses and 36.7 miles of steel beams.

Let in the Sunshine

The exposed roof structure shelters the 80′-wide by 1,200′-long column-free lobby. The criss-crossing pattern of wide-flange sections extends to the main lobby entrances and meets with elliptical main roof shells. The roof structure also merges with the glass-walled front for daylight entry. The design concept braces the glass-front structure and provides lateral support to the concourse.

Intricacy of design was minimized through the use of three-dimensional computer models and renderings, which offered visual identification of opportunities and potential problems during design. The steel fabricator assembled a full-scale mock-up section of the roof structure to provide visual control of the finished structure and to identify and correct potential field fit-up problems.

Not a Shell Game

Each roof shell structures frames a 44′-tall glass portal, which cascades down to cylindrical, three-dimensional minor structures. These minor cylindrical structures straddle a steep-sloping roof surface that merges into exposed-steel bus canopies. These multipurpose shells are visual icons that direct the public to the main entrances.

The elliptical geometry of the roof shells is derived from angled cylinders with a truncated vertical face. The opposite end of the cylinder intersects a sloping roof plane. The geometry at both ends of the structure results in elliptical shapes. The roof shells are framed with 12″-deep wide-flange elliptical arches, equally spaced, that rise along the axis of the cylinder. The array of elliptical arches is laced with round HSS bracing members that complete the surface of the shell. Geometric coordinates of all the curved structural elements were included in the construction documents to simplify detailing and fabrication. The highest point on these structures rises more than 150′ above the ground floor.

For erection, the large elliptical voids through the two levels of framing below made scaffolding nearly impossible and costly. However, the design methodology simplified construction. The structure was assembled on top of a 36″-deep girder and curved along a sloped elliptical roof opening at the base of the shells. Its major axis is approximately 154′ long. Layers of steel arches and bracing members were erected slices at a time, and each erected segment became the erection platform for subsequent arch layers.

Pedestrian Pathways

Pedestrian bridges with minimal structural depth were provided to connect the new expansion to the existing convention center, more than 1,400′ away across International Drive. Profiles of the 200′-span sky bridges were required to match floor heights and provide vehicular access below. Walter P. Moore optimized the design and vibratory performance of these shallow structural depth bridges using time-history dynamic analyses with forcing functions appropriate for their intended use. Field vibration testing confirmed the calculated structural natural frequencies and acceleration values.

One of the bridge segments spans from the existing convention center across a pond, where it meets the second segment that spans over International Drive. On-going events in the existing convention center did not allow access to the construction crew, and daily traffic presented additional construction constrains. There were only a few hours when the intersection could be closed for any continuous length of time, typically from 8:00 p.m. to 6:00 a.m.

The project team executed a solution that made erection possible. The 200′-long segments were assembled in a staging area adjacent to the bridge's final location. Metal deck for the composite concrete deck and handrails also were installed. After assembly, the high-performance paint finish was applied. On the nights of erection, mounted on two mammoth crawlers, the pedestrian bridge segments slowly began their journey from the staging area, across International Drive and over the pond where construction crews waited. A few hours later, the bridge segments only needed to be cleaned before the paint finish was touched-up.

Steel Shelters

Y-shaped steel canopies flank the lobby. Sets of slim arms, spaced 15′ apart, cantilever from 15′-tall central round HSS steel supports. The slender look of each of these tapered arms was achieved with steel plate assemblies, radiused at the ends, with varying depth from 10″ to 20″. The 2″ width of the arm's cross-section consists of 1″-thick steel plates between two ½″-thick steel plates. These arms connect to rounded gusset plates mounted through the steel columns, to provide a total span width of 34′. A series of round pipes links the steel arms at the ends and also at mid length to provide torsional stability. Masts extend from every other column above the roof, from which stainless steel cables straddle to the tip of the arms.

Steel Made the Difference

Steel's versatility, efficiency, and aesthetic, combined with structural ingenuity and team collaboration made this proj-

Y-shaped exposed steel bus canopies are framed with tapered members.

ect a success. From the exhibit hall trusses and criss-cross framing in the concourses to attractive pedestrian bridges, steel stole the show. ★

Jaime E. Vasquez, P.E., is a principal of Walter P. Moore.

Architects
A joint venture:
Helman Hurley Charvat Peacock, Orlando
Hunton Brady Architects, Orlando
Thompson, Ventulett, Stainback and Associates, Atlanta

General Contractors
A joint venture:
Huber Hunt & Nichols, Orlando
Clark Construction, Orlando
Construct II, Orlando

Structural Engineer
Walter P. Moore, Orlando

Structural Sub-Consultants:
Brindley-Pieters & Associates, Orlando
Martinez Kreh & Associates, Miami
TLC Engineering, Orlando

Steel Fabricators
Havens Steel, Kansas City, MO (AISC member)
Addison Steel, Orlando (AISC, SEAA member)

Steel Erector
National Riggers and Erectors, Plymouth, MI (AISC, NEA member)

Steel Detailer
Havens-SPI, N. Kansas City, MO (NISD member)
Lee Croteau, St. Petersburg, FL (NISD member)
Addison Steel, Orlando (AISC, SEAA member)

Engineering Software
SAP 2000

Detailing Software
SDS/2, AutoCAD

Steel Bending Services
Marks Metals Technologies, Clackamas, OR

Welding Wisdom

By Mike Flagg and Doug Krebs

Learn how to purchase consumables for welding under current FEMA 353 guidelines for steel moment-frame construction in seismic applications.

Created in response to the 1994 Northridge earthquake, FEMA 353 details quality assurance guidelines for construction of steel moment-frame buildings in seismic applications. Because it's a guideline and not a code, the Engineer of Record, building owner or municipality specifies which parts, if any, of the FEMA recommendations should be used on a particular construction job.

Since specifications can change from project to project, it is important for contractors and welding engineers to have a good understanding of what FEMA 353 entails. For example, electrodes meeting FEMA 353 recommendations could be more expensive than standard electrodes. In addition, special qualification of welders might be recommended. If the contractor does not take this into account, project costs could be underestimated. Also, these consumables might not be as readily available, resulting in possible project delays if not accounted for during the planning phases.

FEMA guidelines commonly are used in regions subject to seismic activity, including the U.S. West Coast, Boston, Memphis, St. Louis, Charlotte, Salt Lake City and Phoenix.

This article will examine FEMA 353 welding recommendations related to flux-cored self-shielded (FCAW-S) electrodes, typically the consumable of choice for building erection in seismic areas. For example, for on-site construction, flux-cored self-shielded electrodes can be used in winds of up to 30 mph without affecting the weld quality or degrading the mechanical properties. In comparison, gas-shielded electrodes, typically used in the fabrication shop, can have problems in winds as low as 3 mph.

The article also discusses:

- how the FEMA guidelines for electrodes differ from AWS A5 requirements;
- what to look for when purchasing electrodes; and
- what actions the erector or fabricator must take to comply with these guidelines before welding.

Please note that FEMA 353 includes design, inspection, quality control, quality assurance, joint details, and other fabrication/erection issues that are beyond the scope of this article. Readers are encouraged to review the entire FEMA 353 document for these and other guidelines. (This document, *Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications*, FEMA 353, July 2000, can be ordered by calling FEMA, 800.480.2520, or visit **www.fema.gov**.)

Comparing FEMA 353 to AWS A5 Test Requirements

AWS A5 filler-metal classification-test requirements for electrodes are not always the best indicators of how the consumable will perform in actual field conditions. FEMA 353, with significant focus on performance in the field, is more stringent and calls out testing parameters that more closely simulate actual welding conditions seen on a job site. FEMA 353 guidelines strive to ensure a high level of quality for these applications.

So where do FEMA 353 and the AWS A5 requirements differ? Here are the four primary areas:

- ***Welding Procedure Specification Toughness Verification Test***

The AWS test plate is completed at one heat input, which is specified as any heat input within the range in which the electrode will be used. In contrast, FEMA dictates two test plates at different heat inputs—a high heat input at high interpass temperature and a low heat input at low interpass temperature. During production fabrication, FEMA 353 recommends that the welder use a procedure in between those two, which provides better control of the resulting weld-metal properties.

- ***Filler Metal Trade Name and Electrode Diameter***

FEMA 353 requires that the consumable be qualified per trade name and manufacturer as well as electrode diameter. Why? Even though electrodes may be in the same AWS classification, their arc behavior can be significantly different. FEMA 353 also requires manufacturing lot control and testing, which provides a higher level of confidence.

- ***Diffusible Hydrogen Requirement***

AWS specifications allow weld-metal diffusible hydrogen tests to be run on a broad range of procedures, while FEMA 353 requires the test to be run in the top 75 percent of the procedure range. This additional stipulation typically increases the measured diffusible hydrogen level.

- ***Extended Exposure Test***

Under AWS specifications, diffusible hydrogen testing can be conducted immediately after the electrode is manufactured. However, in actual service, welding consumables are not used right after manufacturing. Again, FEMA 353 recommendations take a different approach. Here, for spooled or coiled electrode types exposed on the job longer than one day, electrodes of that type must be exposed in a humidity chamber to test diffusible hydrogen levels. In this way, FEMA electrode-exposure limits provide a more accurate picture of the actual hydrogen levels that will be achieved in the field.

In the future AWS is expected to issue D1.8, a seismic welding code that probably will incorporate the recommendations of FEMA 353.

What to Look for When Purchasing Electrodes

Below are some of the recommendations in FEMA 353 that can be used to aid contractor buying decisions regarding welding filler metal. The manufacturer will perform most of the testing recommended under these guidelines. The contractor or erector should make sure these tests have been completed and that the electrodes meet the guidelines set forth by FEMA.

- ***Filler Metal Trade Name and Electrode Diameter***

As was mentioned previously, when procedures are qualified, they must be qualified according to the electrode manufacturer's trade name and specific wire diameter. When purchasing material, the contractor must purchase the same tradename, manufacturer and diameter electrode that was qualified.

- ***Weld Strength Recommendations***

It is recommended that all welds be made with E70 type filler metals (nominal 70 ksi tensile strength). However, if A913 Grade 65 is used, an E80 type filler metal shall be used for matching strength.

- ***Charpy V-Notch Toughness Recommendations***

FEMA 353 recommends that filler metals be tested at two temperatures. Charpy V-Notch (CVN) toughness levels should meet the following minimum recommendations:

1. 20 ft. lbf avg. at 0º F (using the AWS A5 filler metal classification test)
2. 40 ft. lbf avg. at 70º F (using the FEMA 353 Appendix A test)

- ***Welding Procedure Specification Toughness Verification Test*** (FEMA 353 Appendix A Test)

The contractor, or a third party like the electrode manufacturer, are to run a Welding Procedure Specification (WPS) Toughness Verification Test to determine the heat input range qualified for the electrode. The contractor must use a WPS that falls within the range of heat inputs and interpass temperatures tested. The toughness verification test results must meet the following minimum mechanical properties: 70 ksi tensile, 58 ksi yield, 22 percent elongation and average CVN toughness of 40 ft. lbf at 70º F.

- ***Diffusible Hydrogen Requirement***

FEMA 353 recommends that filler metals meet the H16 diffusible hydrogen levels, as defined by the applicable AWS filler-metal specification. Diffusible hydrogen levels should be tested in accordance with AWS A4.3 and can be reported on the manufacturer's typical certificate of conformance. Ask manufacturers for evidence of this disclosure on their typical certificates of conformance.

- ***Packaging***

FEMA 353 recommends that flux-cored arc-welding electrodes (FCAW) be received and stored in a sealed moisture-resistant package until ready for use. New foil bags and other package types are used to meet these guidelines.

- ***Extended Exposure Test***

The exposure time for an electrode can be extended if it passes an extended exposure test. Look for manufacturers that have performed this test when purchasing electrodes.

What Actions Should the Erector or Fabricator Take to Comply?

- ***Seismic Weld Categories***

Contractors must be aware of the seismic weld categories into which each weld falls as well as the ramifications for welding and quality assurance on those joints in accordance with FEMA 353. The guidelines recommend each weld be classified and listed on the shop and erection drawings. For example, each weld should list a Seismic Weld Demand Category and a Seismic Weld Consequence category—this will dictate the weld property recommendations, the level of inspection and other fabrication issues. (See FEMA 353, July 2000, Part II Tables 5-1, 5-2, 5-3 and 5-4.)

- ***Supplemental Welder Qualification Testing***

FEMA 353 recommends that welders pass a "Supplemental Welder Qualification Test" within the 12 months prior to starting on the project. Basically, for each process that the welder is going to use on the job, the ability to make a sound weld must be proved.

- ***Intermixing FCAW-S Test***

When flux-cored self-shielded (FCAW-S) arc welding is used with another welding process, a test is recommended to confirm the CVN toughness of the intermixed zone to meet 40 ft. lbf. at 70º F. For contractors, intermixing situations could include tack welds or welds made in the shop with gas-shielded flux-cored, and then erected on site using self-shielded over those welds.

- ***Electrode Exposure – Time Limits***

Electrode exposure time is restricted to minimize the risk of hydrogen cracking. If welding stops for more than eight hours, unless extended exposure testing has been performed, the electrode cannot be used unless it has been removed from the welding machine and stored in an oven. Contractors also have to dispose of an electrode 24 hours after the package is opened or up to the manufacturers' recommendations on exposure limits.

- ***Wind Velocity Limit***

For all gas-shielded processes, contractors and welders are limited to 3-mph winds in the vicinity of the arc. This guideline is intended to minimize the loss of shielding gas that has a detrimental effect on the weld-metal mechanical properties.

- ***Maximum Preheat and Interpass Temperature***

The maximum recommended preheat and interpass temperature is 550º F, to avoid excessively slow cooling rates which could affect mechanical properties.

- ***Welded Joint Details***

Tack welds attaching steel backing should be placed in the weld joint. After welding has been completed, backing is removed, where indicated, and back-welded with a 5/16″ leg fillet, to minimize stress concentrations. (Refer to FEMA 353 for complete details.)

Conclusion

When purchasing electrodes for jobs specifying FEMA 353 guidelines, make sure the manufacturer offers a product that has:

- Undergone extended exposure testing.
- Been subject to testing at both low and high heat inputs.
- Been sealed in robust, moisture-resistant containers such as a foil bag or a hermetically sealed pail.

In conclusion, it should be noted that not all manufacturers carry tested and lot-controlled material in stock. If your application is one in which you will need immediate access to such consumables, find a manufacturer that can accommodate your request. ★

Mike Flagg is a manager, application engineering and Doug Krebs is a flux-cored consumables product manager with the Lincoln Electric Company, Cleveland, OH.

What's COOL in Steel

Always on the lookout for the latest and greatest happenings in the world of structural steel, *MSC*'s editorial staff has pulled together a list of our favorite folks, trends, structures, and more.

cool architect: Rem Koolhaas

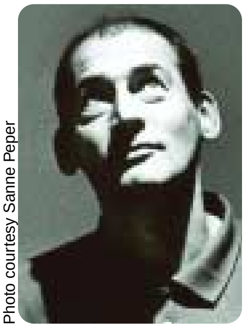


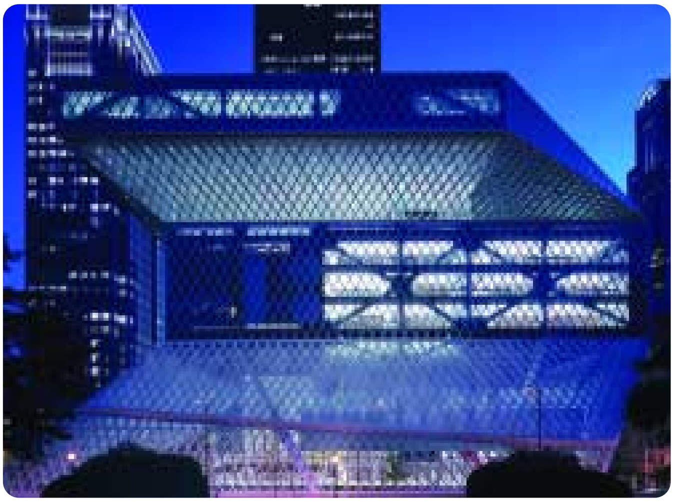
Photo courtesy Sanne Peper

Does architecture shape society, or does society shape architecture? This is one of the key questions that architect Rem Koolhaas has considered throughout his career, whether designing innovative spaces or examining the urban landscape. While the answer might not be clear, it is certain that Koolhaas is creating new spaces in cities around the globe that both affect and reflect the way people interact with the buildings around them.

Structural steel has helped Koolhaas make this happen. For his first two U.S. projects—Illinois Institute of Technology's McCormick Tribune Campus Center and Seattle's new Central Library—he chose steel to frame dramatic and innovative structures.

Koolhaas' design for the Seattle Central Library destroys the idea of a traditional dark, library, that is a cramped, silent maze of inaccessible and dusty books. Instead, the new library exemplifies visual lightness and user-friendliness. Its 11 floors span five main platforms and "in-between areas" that, from the outside, appear to float. The building's gathering spaces and easy-to-navigate collection redefine a library as a place not only for reading and research, but also for conversation and collaboration.

Koolhaas' IIT Student Center is also a building that responds to its occupants while redirecting their activities. Prior to the Student Center's construction, student spaces had been spread around the IIT campus in various buildings. Now, Koolhaas' new structure incorporates them into a unified whole. The 85,000-sq.-ft. single-story facility was built beneath Chicago's elevated train tracks, and includes student areas for dining, campus organizations and informal gatherings. A 530' x 60' tube built around the elevated train tracks lowers the noise volume of passing trains to less than 70 decibels inside of the building.



Seattle's new Central Library combines Koolhaas's architecture and Magnusson's structural engineering into a visually dynamic steel-framed structure. Photo courtesy LMN Architects.

cool engineer: Jon D. Magnusson, P.E.

For Jon Magnusson, chairman and CEO of Magnusson Klemencic Associates (formerly Skilling Ward Magnusson Barkshire), creativity in design is key—especially when it comes to steel. A licensed professional engineer in 23 states, Jon is responsible for the structure of many new steel-framed landmarks, including the Experience Music Project, Key Arena, Benaroya Hall, Safeco Field, Seahawks Stadium, and the new Seattle Central Library. His work also can be seen at the Hawaii Convention Center in Honolulu, where innovative exposed structure "tree columns" mirror local palm trees; the Guggenheim Hermitage Museum in Las Vegas, featuring Cor-Ten steel and a movable roof; and the Panama Museum of Biodiversity in Panama City, where steel design and modeling was performed entirely in CATIA 3-D. In the last five years alone, four of MKA's projects have received AISC Engineering Awards of Excellence.

Following Sept. 11, 2001, Jon granted more than 100 media interviews to discuss the future of tall buildings, eloquently defending the viability of structural steel and tall buildings. He served on the American Society of Civil Engineers/FEMA national team to assess the WTC attacks and develop ways to make buildings most resistant to extreme overload conditions. He also has authored papers on building safety, blast protection, and the World Trade Center (check out the March 2003 issue of *Modern Steel Construction*).

Jon hopes the next generation is inspired by his model: In 2001, he established a high school mentoring program to expose students to architecture, construction, and engineering career opportunities. Known as ACE Mentoring—Seattle, the program this year had more than 60 participants and awarded a total of $21,000 in scholarship money.

cool guru:
Omer Blodgett

“Innovation comes from people who roll their sleeves up and get busy.”

Omer Blodgett, Sc.D., P.E. is a legend in the structural steel and welding communities. A self-described life-long student, the 86-year-old design consultant, welder and educator has inspired engineers and students around the world with his knowledge of welded design and insightful lessons.

At the 2004 NASCC in Long Beach, CA in March, Blodgett received a standing ovation for his “Lessons I’ve Learned in my Lifetime” presentation. Born into a family of welders, Blodgett began welding by the time he was 10 years old. He worked as a welder, ironworker, and ship builder before becoming a salesman for the Lincoln Electric Company. His 18 lessons about “what they did not teach me in school” summarized some of the practical principles that have guided his career. He reminds engineers, welders and others that they must always strive to educate and challenge themselves—by actively participating in industry discussions, practically applying their knowledge in the field, mastering old technology and keeping an open mind towards what’s new.

Blodgett is the author of *Design of Weldments* and *Design of Welded Structures*, which have been in print for more than 30 years and are considered the bibles of welding design. He will be leading an upcoming “Welding Design Seminar,” Oct. 12-14, 2004, an intensive three-day program covering essential elements of steel-weldment design for manufactured products. The program is part of Lincoln Electric’s Professional Seminar Series, Oct. 26-28, 2004. For more information and to register, call 216.383.2240 or e-mail dorothy_steinbach@lincolnelectric.com.

cool job:
Ropelink, Ltd.

Ever picture yourself as Spider-Man, scaling the sides of skyscrapers? That’s what Ropelink employees do as part of inspection, maintenance and repair projects around the world. An alternative to traditional inspection techniques, industrial rope access combines mountaineering and caving skills and equipment for industrial use. Workers safely access structures by climbing on suspended or tensioned double-static ropes. They can move up, down and sideways, quickly, with minimal equipment, and with no damage to structures.

For steel-framed structures, Ropelink professionals can handle weld-inspection and emergency repairs of difficult-to-access areas, like roller coasters and the undersides of bridges. Skylights, telecommunications towers, and the cables of cable-stayed bridges also are areas that they can tackle. In addition, rope access can be used to install fall-protection systems for high-rise projects; to install platforms for long-term bridge repairs; and to install advanced curtain-wall systems.

Rope-access systems can be assembled and dismantled quickly to accommodate project constraints, can operate independently of site conditions, and do not disrupt adjacent work areas. Because they permit hands-on, close-up inspections, rope access often is used for façade inspections. Towers, bridges, antennas, masts, chimneys and offshore structures are all appropriate for rope access.

Ropelink offers training for engineers, architects, technicians, and contractors. Candidates should have a positive attitude, be physically fit, and free from any disability that could prevent them from working safely at heights.

Most importantly: is it scary? “What we do is no different to what workers building a high-rise structure do,” said Hamid Vossoughi, P.E., Director of U.S. Operations for Ropelink. “Our personnel has knowledge, experience, and training. What we do, we do in a calculated way, so there is nothing to be scared about.”

For more information, visit www.ropelink.com.

cool bridge:
Millennium Park Pedestrian Crossing

The new pedestrian bridge linking Chicago’s Millennium Park to the City’s lakefront is a steel-framed visual treat. The bridge snakes across Columbus Drive in a complex curvature with a superimposed cladding system similar to an enclosed building. The approximately 100’ two-span bridge is framed in structural steel supporting a reinforced-concrete slab walkway deck. Due to the structure’s slender profile, a vibration analysis was performed to minimize the effects of vibration from pedestrian walking motions. The steel fabricator completely pre-assembled the entire cantilever trusses and central box-girder span in the shop. The Columbus Drive crossing was erected in a single weekend, with two welded air splices performed in the field.

cool press release:

Spider Power

Modern Steel Construction receives hundreds of news releases each month, but this one really caught our eye. To promote the movie “Spider-Man 2,” a 60’-by-30’ inflatable Spider-Man was suspended from the façade of the arcade of New York City’s Sony Building. LZA Technology, a division of The Thornton-Tomasetti Group, provided structural engineering services for the installation, designing special attachments for the web of cables that secured Spider-Man to existing vertical trusses. LZA’s structural super-powers also helped affix a second Spider-Man to the front of an apartment building in Union Square.

cool structural system:

Steel Plate/Composite Column/Shear Walls

Seattle’s new Federal courthouse has a feature most people will never see: a steel plate/composite column/shear wall (SPCCSW). The courthouse’s SPCCSW system was under development for decades, and in its culminated form is the first of its kind. Magnusson Klemencic Associates collaborated with NBBJ Architects, the Canadian Institute of Steel Construction, University of California-Berkeley and the General Services Administration in its application on the new U. S. Federal Courthouse. The SPCCSW initially was designed to provide resistance to gravity, wind, and earthquake forces, although other performance benefits are inherent. The system includes thin structural steel plates and rolled shapes, large-diameter steel pipes, and high-strength concrete arranged within the building’s core. Inelastic drift for the SPCCSW system was measured at 3.3 percent, significantly better than other structural systems. The SPCCSW is economical and fast to build. It is a tool to create buildings with thinner core walls that consume less building space. The concentration of the lateral-force resistance in the core frees the exterior for more windows, horizontal articulation, and building setbacks.

cool building retrospective:

Soviet Pavilion, Montreal Expo ‘67

Photo courtesy Library and Archives Canada

Thirty-seven years ago, the Soviet Pavilion debuted at the Montreal World’s Exposition. Today, it is at home in Moscow—after it was disassembled, transported, and reassembled there. The 140,000-sq.-ft hall’s four-point supported roof structure is the largest of its kind ever constructed. The light, airy and modern building was built partially in honor of the 50th anniversary of the Russian Revolution of 1917. Inside, exhibits focused on the country’s history, way of life, agriculture and industry.

The roof, shaped like a ski-jump, rises to nearly 190’ high. It consists of two longitudinal edge girders supporting crossbeams. Two enormous V-shaped structural steel frames act as columns, supporting the crossbeams. The roof structure suspends the outside bays of floor slabs with structural hangars, which also functioned as framing members within the curtain-wall system. Steel post-and-beam systems support the floors.

The two-story building has multiple terraces on its North end. At the Expo, it contained an exhibit hall, a 6,000-seat movie theater, and the 1,100-seat *Moskva*, the fair’s largest restaurant. The building featured dozens of Sputnik and other air and spacecraft. One popular attraction was a copy of the space capsule that, in 1961, carried the first man into space. Also heavily trafficked was the spherical 60-seat Cosmic Hall, which simulated a space flight.

Curious to learn more about the Soviet superpower, about 13-million people visited the U.S.S.R. pavilion, more than any other at the Expo. Unfortunately the crowds brought to light an unsolved design aspect of the structure: continuous vibrations could be felt in the pavilion due to improper isolation.

cool web site:

Emporis.com

So you’re looking for a high-rise in Sri Lanka, and you need an architect in Peru. You want to check the progress of a condo construction in Houston, and you’re curious about Russian real estate. Where do you go?

Formerly known as www.skyscrapers.com, www.emporis.com, allows you to explore the buildings of the world—without leaving your office. The site profiles more than 87,000 structures, and includes information on international design and construction, and relevant businesses and consultants.

Building profiles include location and dimension information; construction dates; owner, contractor and supplier names; and facts about architecture, history, and more. Photos accompany most profiles, and the web site boasts more than 100,000 new photos annually. Emporis.com also features a database of more than 21,000 building-industry professionals, which you can search by type (“steel supplier,” “asset managers”) or by location.

A “Building News” section describes current building activity and industry trends. Browse interviews with “decision makers”—politicians, engineers, architects, and developers—on topics like security, real estate strategies, and up-and-coming ideas.

Click on the names of cities and countries for regional information, including architectural histories and new developments. Zero-in on particular urban zones, with building statistics and photos of works-in-progress.

You can also research tallest buildings by type, country or continent, and find out which cities have the most per-capita skyscrapers. How does your town measure up to the top skylines in the world?

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Deconstructing Deconstruction

I consider *Modern Steel Construction* to be one of the best I receive. It presents extremely useful information to me as a practicing structural engineer and I read it thoroughly.

I have been in the business for almost 40 years. During that time I have seen many changes; the introduction of calculators, computers, several new codes (which appear to be sold by the pound) and now as the June issue of *MSC* touts, “Sustainable Construction.”

However, I must have missed something because my Webster defines sustainable as "keeping in existence, keeping up, maintain or prolong." For the past 40 years, I have been designing structures which sustain themselves. If they didn't, I would have lost my license a long time ago. I also missed something about the benefit of growing grass and trees on roofs which few can see. If people object to the usual black or silver color of roofs, why not paint them green or even put little yellow spots on them to remind those coming into O'Hare of dandelions which do a wonderful job of sustaining themselves throughout the metropolitan area.

Seriously, in an age where everyone is cutting budgets, and more and more I see the results of less and less building maintenance, how do we justify the added costs of construction and maintenance to support these roof gardens?

But the real temperature riser in the June issue was the article titled “Design for Deconstruction.” I think the premise of this article is so irrational in terms of the duty of the structural engineer that it is inappropriate for *MSC* magazine, where there are other subjects that would be of greater value to practitioners.

Structural engineers (good ones) expend an inordinate amount of time figuring out today's codes, etc., and then design a practical and economical structure, as easy to construct as possible within the requirements of the architect's design. In today's economic reality, building ownership changes regularly and building uses change from that for which it was originally designed.

The suggestion that consideration be given during the initial design of a structure to the inclusion of shafts which might make deconstruction easier but with a corresponding loss of floor area (and possible income), and the detailing and arrangement of structural members for possible de-construction of the building at a future date, is just ludicrous. Your article on the Lillis Business Complex (also in June 2004) makes my point. How could the "tree" column assembly which is a strong visual feature of this building be considered for use in a future building? And if this still cannot be reused, then it must be taken down and separated from that steel which possibly can be reused. The problems and costs are endless.

Since almost all steel removed from a demolition site will be recycled, and some of it will require (gasp) a torch to get it out, why not just let it go at that? Instead of an article on how a building structure should be considered as made up of “Tinkertoys,” why not give us a tribute to the inventor of the acetylene torch? Keep up the good work.

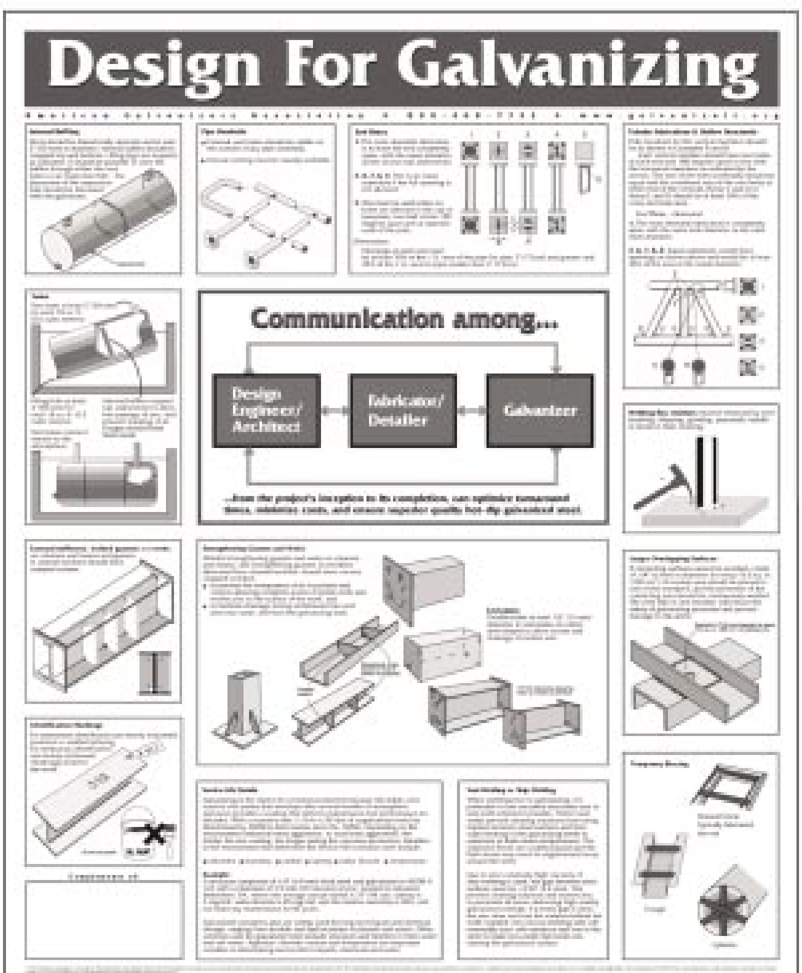
Barry A. Goldberg, S.E.
Skokie, IL

New AISC Specification for Nuclear Facilities Available

A new AISC specification, *Load and Resistance Factor Design of Safety-Related Steel Structures for Nuclear Facilities* (ANSI/AISC N690L-03), is now available for free downloading on the AISC web site. This is the first version of the document based on the load and resistance factor design (LRFD) method. It has been approved by the AISC Committee on Specifications and it is ANSI-accredited. The allowable stress design (ASD) version (ANSI/AISC N690-94) already had been available, along with a Supplement dated April 15, 2002. There are plans to produce a "unified" version, similar in format to the 2005 AISC *Specification for Structural Steel Buildings*, by 2006. The unified version will allow the designer to use either ASD or LRFD methods of design. ★

AGA Offers Free Galvanizing Poster

The American Galvanizers Association (AGA) is offering a free "Design for Galvanizing" poster. This wall poster gives any fabricator, architect, engineer, or specifier a quick reference when designing steel fabrications to be hot-dip galvanized. Developed to help optimize turnaround times, minimize costs, and result in a superior-quality end product, the poster addresses topics such as the location of vent and drain holes, welding, identification marking products, service-life prediction, and more. For your free copy of this design poster, please contact Sue Bieber at 800.468.7732 x11, or e-mail publications@galvanizeit.org. ★



2004 Winners of AISC Scholarships & Fellowships

AISC announces the 2004 winners of Scholarships and Fellowships. A total of $49,500 was distributed by AISC and industry associations. Contact Fromy Rosenberg, P.E., AISC Director of University Relations, for further information at rosenberg@aisc.org.

2004 AISC/Carolina Steel Scholarship: Raymond Richard Foltz, The Citadel, Charleston, SC

2004 AISC/Southern Association of Steel Fabricators Scholarship: Jeremy Grant Godwin, Tennessee Technological University, Cookeville, TN

2004 AISC/Associated Steel Erectors of Chicago Scholarships: John G. Doles, Illinois Institute of Technology, Chicago; Megan Marie Folkman, Illinois Institute of Technology, Chicago; William Lucius Griffiths, Northwestern University, Evanston, IL; Donald R. Kinzler, University of Illinois - Chicago, Chicago; Collwyn Chen Tan, Northwestern University, Evanston, IL; and James Robert Wonneberg, University of Illinois - Chicago, Chicago.

2004 AISC/Fred R. Havens Fellowship: Jake James Perkins, Kansas State University, Manhattan, KS

2004 AISC/Structural Steel Fabricators of New England Fellowship: Michael C. Gryniuk, Tufts University, Medford, MA

2004 AISC/US Steel Fellowship: Dylan Matthew Lamar, University of Illinois at Urbana-Champaign, Champaign, IL

2004 AISC/Klingelhofer Fellowship: Jason M. Reither, Villanova University, Villanova, PA

2004 AISC/Great Lakes Fabricators and Erectors Association Fellowship: Jason A. Harris, Wayne State University, Detroit

2004 AISC/Southern Association of Steel Fabricators Fellowship: Jarrod Clinton Burns, University of Arkansas, Fayetteville, AR

2004 AISC/Rocky Mountain Steel Construction Association Fellowship: Reneé Michelle Anderson, Colorado School of Mines, Golden, CO.

2004 AISC/Structural Steel Education Council Fellowship: Stephen Robert Spence, Santa Clara University, Santa Clara, CA. ★

ASCE Seminar: Progressive Collapse Mitigation

ASCE's new two-day seminar, "Progressive Collapse Mitigation: Practical Analysis Methods and Proven Solutions," will be presented in Baltimore, Jan. 20-21, 2005 and Scottsdale, AZ, Feb. 24-25, 2005. The seminar is a practical course on the development and intent of national anti-terrorism building-design guidelines and standards and their supporting research. The seminar will show how to implement these design guidelines using actual projects as teaching models. The course also discusses proven cost-effective solutions, with emphasis on steel-framed applications.

Special guest speakers will be Bruce Hall, P.E., of GSA's Office of the Chief Architect (OCA) who will speak on the development of the GSA's June 2003 "Progressive Collapse Analysis and Design Guidelines" for satisfying Interagency Security Committee (ISC) Security Criteria. Bernie Deneke, P.E., of Naval Facilities Engineering Command (NAVFAC EICO) will speak on the development of the new DoD Unified Facilities Criteria (UFC) "Design of Buildings to Resist Progressive Collapse." Jesse Karns, P.E., S.E., of Myers, Houghton & Partners–Structural Engineers, and Henry Gallart, P.E., S.E., of SidePlate Systems will be the seminar instructors. For more information or to register, visit **www.asce.org**. ★

Call for Papers: 2005 NASCC

Designers, contractors, detailers, erectors, and educators are invited to submit proposals for the poster session at the 2005 North American Steel Construction Conference. All poster presenters will receive free registration to the NASCC. The 2005 Conference will be held April 6-9 in Montreal, Canada. Abstracts are due Oct. 1, 2004; accepted presenters will be notified by November 15.

Presentations should provide practical information on state-of-the-art design or construction methods, or present information on the relevant research activities. Possible topics include innovative projects, design, fabrication or erection solutions, EDI, fire engineering, blast and progressive collapse, software or product innovations, new steel systems, seismic design, wind engineering, connection design, and research updates/results, etc.

Final presentations should be mounted on 24"x36" boards (maximum size), which will be displayed in the main exhibit hall at the conference. Presenters should be available to discuss their presentations on April 6 (5-6 p.m.), April 7 (noon-1 p.m.), and April 8 (noon-1 p.m.). Please submit your abstract by Oct. 1, 2004 to:

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New Edition of AISC Design Guide 4 Available

The second edition of *Design Guide 4: Extended End Plate Moment Connections* is now available. The recently updated design guide presents a new design philosophy for the design of extended end-plate moment connections in wind and seismic applications. The guide incorporates the state of the art in end-plate connection design by making use of yield line theory.

The authors of the new design guide are Thomas Murray, Ph.D., P.E., Montague-Betts Professor of Structural Steel Design at Virginia Tech and Emmett Sumner, Ph.D., P.E., Assistant Professor at North Carolina State University

Because of the change in design theory, this revised design guide "extends end-plate moment connection design to seismic applications" and "presents design procedures for 50 ksi steel" according to Thomas Murray.

The *Design Guide* is available to AISC members and *e*Pubs subscribers as a free download from AISC's *e*Pubs web site, **www.aisc.org/epubs.** Hard copies can be purchased at **www.aisc.org/bookstore** ($30 for AISC members, $60 for non-members), or call 800.644.2400. ★

AISC and IAI Begin Work on International Model for EDI

AISC and the International Alliance for Interoperability (IAI) have formed an alliance to work cooperatively to advance the use of new technology in the AEC industry.

"The first effort is to develop a joint technical advisory committee," explained Gabe Coleman, AISC's Director of Information Technology. "This committee's charter will be to develop the business cases for 'harmonization' of the CIS/2 and IFC (IAI) data exchange standards. The goal is to seamlessly integrate structural steel into the overall building information model (BIM)—the electronic 3D representation of a building, seen to be the future method of AEC industry production."

According to a memorandum of understanding signed by the two groups, the goals of the alliance are to:

- Foster a strong, continuing alliance to better serve the construction industry, AISC members, and IAI members.
- Provide an effective communication and coordination mechanism to enable AISC and IAI to work effectively on specific projects.
- Leverage the strengths of our organizations to develop unique products and services that will expand each other's markets, better serve our members and customers, and better serve the industry.
- Collaborate on select national issues in order for the construction and structural steel community to have the greatest impact on these issues.

As part of the alliance, AISC has been invited to present at IAI meetings in Bath, United Kingdom, and Munich, Germany in 2004. ★

Correction

Modern Steel Construction mistakenly omitted AISC-member fabricator Canron Construction Company from the project team lists for "Seattle Seahawks Stadium" (April 2004) and "Classic Revival" (June 2004). We regret any confusion caused by the omission. ★

AIA Offers Online Program on Coping with Material Price Volatility

A new on-line continuing education program from the American Institute of Architects (AIA) focuses on developing an understanding of the dynamics of the current volatility of various construction materials, including structural steel, Portland cement, plywood, and other staple construction materials.

The program, which featured two economists (one from the AIA and the other from the Associated General Contractors) and AISC's Vice President of Marketing offers specific suggestions for designers to help their clients cope with the current market volatility. In addition, data is provided on the wide availability of structural steel compared with other construction materials.

According to John Cross, P.E., AISC's Vice President of Marketing and one of the presenters at the AIA program, five factors must be considered to understand the impact of recent material price changes:

- **Volume.** The capacity of domestic steel mills (6 million tons) exceeds domestic demand for wide-flange steel members (4 million tons).
- **Velocity.** Currently, the steel industry has maintained the standard six-to-eight-week mill cycle for wide flange; in addition, there is an estimated 1 million tons of service center inventory.
- **Value.** The net impact of structural steel increases is 1.5% of project cost; overall project impact for all types of steel is between 7% and 8%; and when all materials are considered there is no appreciable cost difference between structural framing systems (steel or concrete).
- **Variety.** The variety of structural steel shapes has minimized stockpiling by contractors, which has prevented shortages of wide-flange material.
- **Volatility.** All construction materials are in a period of long-term volatility; short stability could occur, but cannot be relied upon.

"Designers need to consider changing their processes rather than waiting for stability to return to the marketplace," Cross stated. Among his suggestions are:

- Involving specialty contractors early in projects
- Exploring process innovations like EDI and 3-D modeling
- Improving project communications
- Evaluating costs on a consistent, current basis
- Examining bidding and material-acquisition practices
- Utilizing industry tools like the AISC Steel Solutions Center to bring value to the project.

The program offers 1.5 learning units and costs $99.95 ($49.95 for AIA members). For more information, visit **http://eclassroom.aia.org**. ★