A "Stitch" Connector is a side lap connector that attaches adjacent sheets at their sides.

- Common names include: interlocking, button punch, and bayonet side lap.
- Can be button punched, welded, or screwed.
- Horizontal return on "female" lip.

- Common names include: overlapping, barge and foot, and nestable.
- Can be welded or screwed.
- Provides adjustment when required.

- Common names include: overlapping, barge and foot, and nestable.
- Can only be button punched.
- No horizontal return on "female" lip.

- Common names include: interlocking, button punch, and bayonet side lap.
- Can be button punched, welded, or screwed.
- Horizontal return on "female" lip.

* Not: In general the nomenclature is "cover width"/ (number of welds).

- 24" Coverage
- 30/6 pattern
- 30/4 pattern
- 30/3 pattern

- 36" Coverage
- 36/9 pattern
- 36/7 pattern
- 36/5 pattern
- 36/4 pattern
- 36/3 pattern

* Welding washers are to be used on deck products lighter than 22 gage (0.028”). Do not use welding washers on side laps.
HISTAR® Grades 50 and 65.

WIDE FLANGE & TAILOR - MADE BEAMS

- High Strength, Low Carbon, Fine Grain, Weldable Without Preheating & Good Ductility.
- Reduces Material, Handling, Transportation, Erection & Welding Costs.
- Sectional properties are available on a free floppy disc (Lotus 1-2-3, Quattro Pro and ASCII versions for IBM, Excel for Macintosh) and the complete ARBED database is ready to use in the design softwares GTSTRUDL, ETABS, SAP90 AND STAAD-III.

TRUSS APPLICATIONS

- Sports Arenas/Stadiums
- Airports (Hangars/Terminals)
- Convention Centers
- Gymnasiums
- Shopping Malls
- Casinos

COLUMN APPLICATIONS

All of the above PLUS:
- High-Rise Buildings
- Hospitals
- Heavy Industrial Plants
- Power Plants

HISTAR® is a registered trade-mark of ARBED.

For complete information, availability, literature and floppy disc, contact one of our TradeARBED offices at the following locations:

- 60 E. Sir Francis Drake Blvd., Larkspur, CA 94939. (415) 925-0100, FAX (415) 461-1624/8257.
- 390 Brant Street, Suite 300, Burlington, Ontario, Canada L7R 4J4. (905) 634-1400, Fax (905) 634-3536.

Please circle # 35
Heat straightening can be a useful and economical alternative for repairing damaged steel. A report on the science of engineered heat straightening begins on page 32.

Features

16 Expressing The Structure
A true design synthesis between architect and engineer resulted in a stunningly successful retail project in Florida

24 Bridges With Unequally Spaced Girders
A proposal to use refined analysis methods for calculating live load distribution factors would reduce costs by as much as 10% to 34%

28 Multimedia Technology And The Steel Industry
A primer on the direction of technology for engineering and fabrication

32 Engineered Heat Straightening Comes Of Age
Established procedures for heat straightening result in safe, reliable and economic repairs

Departments

6 Editorial

9 Steel Interchange
- Is tightening the nut to "snug tight" and tack welding the nut to the bolt thread the only solution in preventing the nut from backing off?
- What are the dimensioning requirement for weld access holes?

11 Steel Counsel

14 Steel News
- Short Course On Bracing And Buckling
- National Steel Construction Conference
- New AISC Publications Phone Number

40 Products & Suppliers For Bending Steel

41 Steel Marketplace

42 Ad Index
It's tomorrow...

in Computerized Structural Engineering

Experience STAAD - III

"Concurrent Engineering" on DOS/Windows/Unix/NT

Welcome to tomorrow in Computerized Structural Engineering. The latest release of STAAD-III, based on the principles of “Concurrent Engineering”, is redefining the way you engineer your structure. Whether you are on DOS, WINDOW, UNIX, or NT, STAAD-III is guaranteed to enhance the performance and productivity to a whole new level.

STAAD-III, from Research Engineers, is an acknowledged world leader in structural software. State-of-the-art Static/Dynamic/Nonlinear analysis, innovative finite element techniques, comprehensive Steel/Concrete/Timber design, powerful graphics and seamless CAD integration have always been our forte. Our deep rooted R & D base, spread over four continents, and our association with the world’s leading institutions, have resulted in a solid technological foundation for STAAD-III.

Today’s STAAD-III, brings you the latest in modern Computer Aided Engineering. Based on the principles of "concurrent engineering", it unifies leading-edge graphics and visualization techniques with proven and time tested analysis/design. A live and unified associative data base provides seamless integration across all mission critical applications, from concept design and analysis to detail design, simulation and visualizations. Today’s STAAD-III - a productivity concept for tomorrow.

With over 10,000 installations, more than 30,000 engineers worldwide rely on STAAD-III for the state-of-the-art in technology.

Experience tomorrow today - experience STAAD-III

Research Engineers, Inc. 22700 Savi Ranch Pkwy., Yorba Linda, CA 92687 Tel: (714) 974-2500 Fax: (714) 974-4771 Toll Free: (800) FOR-RESE

USA  UK  GERMANY  FRANCE  CANADA  JAPAN  KOREA  NORWAY  TAIWAN  INDIA

Please circle # 34
Combining Work With Play

A major brouhaha is brewing at AISC. On one side are the traditionalists—the extremely serious engineers who are constantly trying to expand their capabilities and improve their skills. On the other side is a more laid back group who realize that while the fabricated structural steel community is important, there are other things that are just as important.

No, I'm not talking about LRFD and ASD. Believe it or not, I'm referring to the National Steel Construction Conference. And, in my opinion, both groups should be able to happily co-exist.

The first group is the traditional NSCC attendee. He wants to get up at 6:00 in the morning, meet some colleagues for some shop-talk, and then hit the seminars—non-stop until 6:00 that evening. And then he wants to meet with some more colleagues to talk about the latest engineering or fabrication trends. The second group is the rest of us. Yes, we want to hear interesting and informative seminars. And yes, we want to be able to meet and network with our colleagues. But we also want to bring our families and combine business with pleasure.

Fortunately, this year's NSCC should provide the perfect meeting ground for both groups. Yes, the show will feature the usual menu of wonderful seminars and lectures on such subjects as: how to reduce structural steel costs; new concepts in industrial building design; designing connections for structural tubing; how to protect your firm from lawsuits; improved fabrication equipment & methods; new flame straightening technology; and avoiding field painting failures. And it will provide time and opportunity for engineers, fabricators, detailers, contractors, educators and architects to get together and discuss their industry. But unlike last year's show in Pittsburgh (a nice place to live, but let's face it, not one of the top vacation destinations in the U.S.), this year's NSCC is being held in the major tourist destination of San Antonio. So in addition to the many educational opportunities at the conference, there also is the opportunity for sightseeing and family fun—ranging from the history of the Alamo to the excitement of Splashtown Water Park.

Complete programs were mailed with this issue to all Modern Steel Construction subscribers. But if you didn't get one, just call 312/670-5420 or fax a note to 312/670-5403 and AISC will be happy to send one out to you. Registration is only $320 ($270 for AISC members) and you should make your hotel reservations by April 16.

I hope to see you on the Riverwalk in May. SM
Design Data's SDS/2 Steel Fabrication System.

SDS/2 gives you the flexibility to integrate all aspects of your business with one software system. That concept is called Information Management. Each module by itself will save you time and money and by combining products to implement Information Management you receive more than twice the benefit in savings and productivity. So whether you need one SDS/2 software module or all these tools working together, Design Data can provide the most productive system for you.

For more information about SDS/2, information management in the steel industry or future product demonstrations call 800-443-0782.

Please circle # 32
Creating a masterpiece requires more talent than just welding commodity products!

At Canam Steel Corporation, everything is possible, even carving a masterpiece. This commitment to supply joists, joist girders and specialty products to projects like the Boston Garden or Target requires more talent than just welding commodity products. Our engineering team can propose different solutions to reduce your erection costs.

By acting as a partner or by performing subcontract work, Canam Steel Corporation can assist you at any stage of a project. We have the capability and experience to do everything to guarantee you complete satisfaction and on-time delivery. That’s why Canam Steel Corporation is the Fabricators’ fabricator.
Steel Interchange is an open forum for Modern Steel Construction readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine. If you have a question or problem that your fellow readers might help you to solve, please forward it to Modern Steel Construction. At the same time, feel free to respond to any of the questions that you have read here. Please send them to:

Steel Interchange
Modern Steel Construction
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001

The following responses from previous Steel Interchange columns have been received:

Specifications currently exist which require minimum pretensioning loads for slip critical connections. There is, however, no guidance regarding minimum pre-loading of anchor bolts which occur at column bases. While in most situations this issue is academic since the anchor bolt nut and thread projection are below the plane of the concrete slab on grade and are eventually embedded in concrete at the slab isolation joint, there are instances where the nut and thread projection remain exposed. Is tightening the nut to "snug tight" and tack welding the nut to the bolt thread the only solution in preventing the nut from backing off?

In general, anchor bolts are selected from material meeting ASTM A307 specifications. A307 specifications require material that conforms to the A36 specification. The lower strength of this material compared to high-strength bolts, such as A325, does not lend itself to high pretension loads for a given bolt diameter. When your anchor requirements call for resistance to high tension or conditions where slippage due to shear is not permitted then pretensioning using high strength bolts may be used. Other methods, such as shear keys may be used to prevent slip. High-strength anchor bolts are heat treated and quenched which increases their load carrying capabilities. A307 bolt material is not treated and therefore cannot be expected to produce high, consistent preloads for a given bolt diameter.

In most cases anchor bolts are used in locations where a small clamping force in conjunction with the combined friction from deadweight and or shear keys is all that is required to resist the occasional shear and tensile forces. The design tension loads at column bases are usually a result of large wind forces that the structure seldom experiences with the presence of large dead loads. Therefore, the net tension that the anchor bolts experience does not exceed the clamping force that results from "snug tight" tightening of the nuts. Kulak, Fisher, and Struik in their book Guide to Design Criteria for Bolted and Riveted Joints indicate that this clamping force from "snug tight" nuts in A307 anchor bolts is not very great and should not be considered to have any influence on the connection design. The preloads that result from "snug tight" nuts on A307 bolts are usually in the elastic range (somewhere in the sloping portion of the stress-strain curve) where minor variations in the starting point, amount, and accuracy of the nut rotation have a greater influence on the amount of preload. On the other hand, pretensioning high-strength bolts to the specified values actually stretches the bolt (called set) and produces a large, constant clamping force that is basically unaffected by the conditions at the starting point of nut tightening (snug tight).

Tall, lighter structures where large lateral and tensile forces frequently occur depend on their anchor bolts to carry tension and prevent upward or horizontal movement at the foundation interface. Other examples would be anchor bolts used for large equipment foundations, such as paper machine foundation anchor bolts. In these cases, high-strength anchor can be specified and pretensioned to resist any large dynamic and thermal loads. These loads can produce large, lateral forces that are present at all times. These "slip critical" connections are designed to prevent any slip which can cause misalignment in the precision equipment. These anchors are usually pretensioned to meet the equipment supplier' specifications.

Another method of preventing loosening of a "snug tight" anchor bolt nut (besides tack welding) is to furnish two nuts and torque the second nut against the first nut.

Robert R. McGloh
Rust Engineering Company
Birmingham, AL

Answers and/or questions should be typewritten and double-spaced. Submittals that have been prepared by word-processing are appreciated on computer diskette (either as a Wordperfect file or in ASCII format).

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

Information on ordering AISC publications mentioned in this article can be obtained by calling AISC at 312/670-2400 ext. 433.

Modern Steel Construction / February 1995/ 9
The AISC Manual includes examples and figures in the connection sections, some of these connections include weld access holes in the beam member. What are the dimensioning requirements for these weld access holes? They are not given in the example problems.

All of the examples and details in the manual follow the requirements of the AISC Specification for Structural Steel Buildings. Section J1.6 of the LRFD Specification and Section J1.8 of the ASD Specification include requirements for beam copes and weld access holes. These dimensioning requirements are for all weld access holes and copes. The commentary to each section includes drawings which demonstrate this weld access hole and cope geometry. The figure at right is repeated from the AISC Commentary.

Listed below are questions that we would like the readers to answer or discuss.

If you have an answer or suggestion please send it to the Steel Interchange Editor, Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001. Questions and responses will be printed in future editions of Steel Interchange. Also, if you have a question or problem that readers might help solve, send these to the Steel Interchange Editor.

Is the method of determining the flexural design strength of a single angle with unequal legs as outlined in the Specification for Load and Resistance Factor Design of Single-Angle Members, (December 1, 1993) valid when the angle is not loaded through its shear center?

If the method is valid, what effect does the load eccentricity to the shear center have on the flexural strength?

If the method is valid and \( M_x \) has been determined about the principle axes, should the moment \( (M_x) \) about the x-axis be broken into its components about the minor and major axes by multiplying the moment \( (M_x) \) by the \( \sin \theta \) or by \( \cos \theta \)?

Charles L. Bowman
Morrison and Sullivan Engineers
Raleigh, NC
Our business is based on the same philosophy.

Let's face it. In today's need-it-now world, you don't have to time to deal with companies that make you wait. When you need something, you need it immediately. You simply can't afford to waste any time. Now you no longer have to wait for steel.

In most cases Chaparral already has it in stock.

That's because Chaparral is a different kind of mill, a stocking mill. Our $50-million on-site inventory means we can fill over 80% of your orders from stock. That allows us to process special orders and fast track jobs within 72 hours.

Chaparral has made rolling schedules obsolete. So give us a call. Chances are we've got exactly what you need in whatever quantities you need. And we can have it on its way in an instant. What are you waiting for?

300 Ward Road
Midlothian, Texas 76065-9651
Toll free (800) 527-7979 U.S. and Canada
Local (214) 775-8241
FAX (214) 775-6120

© 1994 Chaparral Steel
How do you get a monster to shape up?

Rich-Con can do it. With our new Boldrini shape roll we can shape up monsters like 24" wide flange beams, 8" x 8" x 1" angles or 3" x 8" flat bars "the hard way."

For precision sawing and plate shearing, computer-aided design assistance or computer-driven multi-torch gas and plasma burning capability, count on Rich-Con for first-class, first-step processing.

A steel service center with a complete inventory of heavy carbon products, Rich-Con is dedicated to outstanding customer service. With a computerized inventory and order-entry system and our own fleet of trucks, Rich-Con can do it.

Kansas City's oldest business. Rich-Con was serving the Midwest before the Civil War. But our commitment's not to the past, it's to the Future. We're working hard to serve you better into the new century...and beyond.

Rich-Con can do it.

Richards & Conover Steel Co.
Kansas City, MO
816-483-9100  1-800-727-0987
FAX 816-483-6983

Faeth Rich-Con
Kansas City, MO
816-221-7680

Springfield Steel Supply
Springfield, MO
417-866-6000  1-800-999-0987
FAX 417-869-6983

Richards & Conover Steel - Joplin Division
Joplin, MO
417-623-2222  1-800-666-0987
FAX 417-623-6983

Member Steel Service Center Institute
This bi-monthly column deals with legal matters of interest to designers, fabricators and contractors. We solicit your comments, concerns, suggestions and questions, both as to individual issues and subjects that you would like to see treated in this column. Some of the issues that we plan on covering in the future include: contract provisions; OSHA standards; employment law; alternative dispute resolution; and dealing with the EPA. Comments should be sent to: Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

Mr. Jones, there are two people in the lobby to see you. Mr. Reich from OSHA and Ms. Blau from the EPA," your receptionist says over the intercom.

You put down the phone, take a deep breath and prepare to go out to the lobby to face the regulatory equivalent of an earthquake, flood and fire. For most people, an OSHA or EPA inspection is the health, safety and environmental regulatory equivalent of an IRS tax audit. The odds of having either are about the same. But while no responsible businessperson would even think of not paying taxes or keeping tax records, there are still some businesses owners that think they can afford to attempt to avoid compliance with OSHA or EPA regulations. If you are prepared, you will survive the unpleasant experience. If not, it can literally put you out of business. Indeed, for some health, safety or environmental violations, it can put you in jail.

In preparation for a possible inspection, you should take several steps.

• First, you have to become familiar with and come into compliance with the substantive health, safety and environmental requirements that apply to your operation. Admittedly, this is no small task since these regulations are constantly expanding and being revised at the Federal level, which sets off a ripple effect at the State and local levels. Keeping up with these requirements can be particularly difficult for small businesses. Fortunately, help is out there. Various publishing houses (such as Thompson, Government Institutes and others) have generalized compliance guides. More focused are the educational bulletins and other materials issued by AISC and other trade associations. In addition, AISC is sponsoring a series of environmental compliance workshops around the country in 1995 (more information will be available on these workshops at a later date—fax 312/670-5403 for info). Also, the EPA has a small business ombudsman (800/368-5888), as well as hotline numbers for specific environmental issues.

• Second, you should ensure that your record keeping system is in place and organized. One of the most fertile areas for OSHA citations is your paperwork. Both OSHA and EPA have countless regulations requiring written plans; every regulation requires records to be kept and many require certifications—of plan adequacy, of training held, and of qualifications of individuals. This mass of paper should not only be organized and tamed, it should be cleansed regularly. For example, some EPA regulations require you to keep records for three years. In certain instances, older records, if maintained, can be the basis for a non-compliance citation. (Care should be taken here, as this class of record can sometimes prove your compliance.) Beyond the records required to be kept are those audits, minutes of health, safety and environmental meetings, notes, memoranda, and similar papers in the file that are generated in the normal course of business. These impulses need to be muted, since they can be used to show you knew of a problem, an unsafe condition, or environmental emission, but failed to take action. Your files should include a paper trail—a written response—that shows why a certain suggestion was not adopted, why some proposal was impractical, infeasible or unnecessary. Finally, you should have a records retention policy and system. Periodically, clean both your hard copy and electronic files.

• Third, you should ensure that your employees have receive mandated train-

Kenneth G. Lee, Esq. as with the Washington, DC, office of Goldberg & Simpson, P.S.C., and concentrates in the area of construction law.
ing. One of the records you will want to have is a log of attendees at training sessions, a description of the subjects covered, who led the training, and the amount of time spend in the session. During the course of an inspection, an employee may be asked about training and give a less than desirable answer. Training logs, particularly with sign-in sheets, can rebut the erroneous impression given by such an employee's comment.

Once these steps are taken, you're ready for an inspection. You go out and greet Reich and Blau. Do you have to let them in? OSHA and EPA have recently announced a policy of "multi-media" inspections. A quarter of all inspections are targeted to be joint, multi-media in the near future. That means you may get both OSHA and EPA, and the EPA may have a specialist for just air, one for just water, and somebody else for SARA 313. Congress, in many of the environmental statutes, has given EPA the right of entry. In certain statutes, for example the Clean Air Act, refusal of entry is itself a violation of the Act, which can trigger fines and other penalties. For the OSHA inspector, on the other hand, you can demand a warrant. This is a company policy matter that you should consider. If the inspection is identified as part of a criminal investigation, immediately consult legal counsel.

After greeting Reich and Browner, they will want to have an opening conference. This will be the time to lay out the scope and nature of the inspection. A couple of important things to remember: More companies get hung on what the employer says during these inspections, than on the records or what the employees say. Keep a bridle on your tongue. Statements like, "Yeah, that's a problem we've been trying to fix," show both knowledge and failure to bring into compliance. Too often employers attempt to justify or explain away situations during the inspection. The inspection is just that, an inspection. The arguing about what it means comes later.

During the inspection, stay with the inspectors. Send prepared individuals with inspectors if you get a multi-media team. Keep a record of what is occurring — use a hand-held recorder, a stenographer or even a video camera. Take the same measurements, photographs, samples and other observations that the inspector takes.

After the walk-through, there will be a concluding conference. Again, be careful what you say. Refer to things observed as a "situation" or a "condition", not as a "problem." Do not agree when the inspector says that something is "unsafe," or "polluting" or a "violation." Remember, the inspection is to observe. The characterization of what is observed comes later, unless you have already agreed with the inspector.

There are a number of practical tips on how to survive an OSHA and EPA inspection. Because of the increased number of inspections planned by OSHA and EPA, the increased fines and penalties associated with these inspections, and because of the increased complexity of health, safety and environmental regulations, AISC has planned a series of 10 regional hands-on, one-day intensive workshops to assist companies in the steel production, fabrication and construction industries. These workshops will not only cover the regulatory requirements, but how to comply, providing hand-outs and workbooks that can form the basis for that compliance. Recognizing that these issues have Federal, State and local parameters, the workshops will be presented by recognized health, safety and environmental experts who can address all levels. AISC will present more information about these workshops in the coming months.

If prepared, at the end of the session you may hear (though it's unlikely): "Excellent facility, keep up the good work." Simply thank Reich and Browner and say: "Goodbye."
Automate repetitive design tasks

1. When you type the column size

2. These values are automatically called up from the AISC Database.

3. To complete the design calculations.

This screen was created in Microsoft Excel™ to calculate base-plate thickness. Since it incorporates the AISC Database, when the column size is entered (Step 1), the column dimensions are automatically called up from the AISC Database (Step 2). These dimensions are used to complete the base-plate thickness calculation (Step 3) without having to look-up the dimensions from a reference and manually type them into the program.

Save time. Save money. Efficiency, productivity, and unprecedented programming power are yours when you incorporate the AISC Database V2.0 into your in-house routines. Whether you program in a language like BASIC or C, or create calculations in spreadsheets like Microsoft Excel™, Lotus 1-2-3™, or Borland Quattro Pro™, the AISC Database V2.0 gives you electronic access to the dimensions and properties of the more than 1200 shapes in AISC's Manual of Steel Construction - W, M, S, and HP shapes, channels (C and MC), angles (L and 2L), tees (WT, ST, and MT), structural tubing (TS), and steel pipe (P). This ASCII text file lists over 25,000 dimensions and properties such as the web depth and thickness, flange width and thickness, area, moment of inertia, section modulus, radius of gyration, and torsional constant. The AISC Database V2.0 is available in both U.S. units ($60) and Metric units ($60).

The AISC Database V2.0 reflects the most current shape series. Additionally, new data has been added in the update from Version 1.

As with previous releases, the AISC Database V2.0 comes with a sample search routine programmed in BASIC, a BASIC program to convert the AISC Database V2.0 into spreadsheet format, and a BASIC program to print the database.

TO ORDER - call Carolyn Johnson, AISC Engineering Department Secretary at 312-670-5411.

All trademarks are property of the respective owners.
SHORT COURSE ON BRACING AND BUCKLING

AISC, in conjunction with the Structural Stability Research Council, is offering a short course on The Bracing of Steel Structures. To be held in San Antonio immediately following the National Steel Construction Conference, the course includes five sections: Column & Frame Bracing; Lean-On Systems; Torsional Bracing; Beam Buckling; and Beam Bracing.

Faculty for the course includes Joseph A. Yura of the University of Texas - Austin and Todd Helwig of the University of Houston. The course begins Friday, May 19, at 5:30 p.m. and continues on Saturday at 8:30 a.m. through 11:30 a.m.

Cost for the seminar is $200 ($175 for AISC or SSRC members). For more information, contact Robert Lorenz at 312/670-5406 (fax: 312/670-5403).

The National Steel Construction Conference is scheduled for May 17-19 in San Antonio. In addition to its traditional audience of structural engineers and fabricators, the NSCC is opening its doors to construction managers in 1995. The conference will feature four professional tracks: Construction Management; Steel Fabrication; Structural Engineering; and Engineering Management. In addition, the conference will include a product exhibition with nearly 100 booths.

"We wanted to expand the conference to involve more of the construction industry," explained Franklin B. Davis, chairman of the AISC NSCC Committee and president of Precise Fabricating. "It's an exciting change that will put more life and spirit into the program."

While seminars are assigned to a specific track, show organizers stressed that there is no additional charge for crossing from one track to another. Registration for the show costs $320 ($270 for AISC members) and includes admission to all seminars and general sessions, as well as the trade show. To receive a registration packet, write AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 or call 312/670-2400.

Speakers this year include:
- Duane Miller (Lincoln Electric Co.) on welding inspections;
- Jim Scotti (Brown and Root) and Peter Van Nort (H.B. Zachry) on lean building/pannering;
- David Harwell (Central Texas Iron Works) on bar coding;
- J.J. Suarez (Belcan) on quality management;
- Eric S. Kline (KTA-Tator) and
David Boyd (The Vulcan Group) on paintings and coatings;
• Ken Lee (Goldberg and Simpson) on recent EPA legislation;
• Jim Blackburn (Vernon Tool Co.) on hollow structural section fabrication;
• Tom Webb (Fibre-Metal Products Co.), Joe Derkitch (National Research) and James Morton on new developments in fabrication equipment and methods.
• R. Richard Avent (Louisiana State University) on flame straightening technology;
• Holley Fisk, Phil Fortune and Tag Wilson on how to protect your firm from lawsuits;
• Donald Buettner (Computerized Structural Design) on steel erection awareness;
• Bob Shaw (Steel Structures Technology Center), A.J. Julicher, and John T. Holcomb (Berlin Steel Co.) on the inspection of welded and bolted joints;
• Jim Notch (Notch & Associates); John Nagel (AFCO) and Jim Neil on reducing structural steel costs;
• Jim Rowland (Bethlehem Steel) on industrial buildings;
• Stan Rolfé (University of Kansas), John Bell (Nucor), and Peter Wright (Chaparral Steel Co.) on what structural engineers need to know about fracture mechanics, metallurgy and weldability;
• Michael Engelhardt (University of Texas); Tom Sabol (Englekirk & Sabol); and Jim Malley (Degenkolb Associates) on research applications of from the Northridge Earthquake;
• R.M. Korol (McMaster University) and Donald Sherman (University of Wisconsin) on new developments in using structural tubes.

NEW AISC PUBLICATIONS PHONE NUMBER

Beginning February 1, AISC will offer a new toll-free number for ordering publications. The new phone number is 800/644-2400. AISC’s main office number remains 312/670-2400.
EXPRESSING THE STRUCTURE

A true design synthesis between architect and engineer resulted in a stunningly successful retail project in Florida

By Robert P. Wingard, AIA, and Craig E. McElroy, P.E.

ALL TOO OFTEN, DESIGN BECOMES A TUG-OF-WAR BETWEEN ARCHITECTS AND ENGINEERS, with architects creating images and then expecting structural engineers to dream up some way to make them work. But with the Brandon Town Center, a new regional mall outside Tampa, the architect and structural engineer were clearly on the same side.

The new retail center, which opens this month, is an expansive new single-level retail center anchored by four department stores and a 650-seat food court. Nearly 1,800 ft. in length, the project occupies more than 175,000 sq. ft. in the public areas. Architect for the project was RTKL Associates Inc. of Baltimore and structural engineer was Paul J. Ford and Company of Orlando. Developer is Chicago-based JMB Retail Properties Co.

DESIGN CONCEPT

The city of Brandon is a rapidly expanding bedroom community east of Tampa along the developing I-75 corridor. Though only a half-hour’s drive from the Gulf of Mexico in a part of Florida known as “cattle country”, Brandon has the look of an inland town with its fairly flat landscape organized into expansive fields and forests. With palm trees the exception rather than the rule, white pointed church steeples poking above the trees, and red brick buildings instead of the normal pastel stucco and terra cotta tile expect-

Exposed steel played an important role throughout the project, including the main entrance, corridors and courts.
ed in a Florida community, Brandon seems more like a northeastern village than a sun-drenched semi-tropical town.

It was this New England-like atmosphere that initially inspired the design for Brandon Town Center. The exterior of the project features four 60-ft. tall towers that link four barrel-vaulted roof segments to the large vaulted central court. A fifth tower, 76-ft. high, rises above the food court’s segmented dome roof. Red brick, accented by bands of tan and white, along with standing seam roofing and exposed steel entry, complete the exterior.

The project’s interior theme is loosely based on an industrial, factory-like concept. Dominant materials include red brick piers and column enclosures, combined with heavily stylized curved trusses and exposed structural steel painted off-white with light green accents. Initially envisioned as dark green, the steel was changed to the less industrial off-white color during design development to avoid giving the project too much of a factory appearance and perhaps misrepresenting it as a value-oriented or outlet center.

The original design also called for minimal visible connection detail between the stylized trusses and support members. As part of the design refinement, the architects and structural engineers worked together to achieve a more straightforward approach. Both disciplines agreed that the bold curvature of the trusses and the spaces beneath them would be even more successful if the structural design were simplified and the connections left exposed. To the architects, this became a “celebration” of the structure; to the engineers, it was an opportunity to share authorship for a large potion of the visible project design.

**UNCOMMON APPROACHES**

As with most shopping centers, the majority of the building is a warehouse-like space with few interruptions to the modular bays and basically flat roof. Framing for these areas is typically steel joists at 6-ft. on center supported by joist girders with 30-ft. bays at the tenant areas. The joists and joist girders are rigidly connected to the columns to provide moment frames for wind stability. Additional capacity is provided in bays pre-identified as locations for individual tenant rooftop mechanical units.

In contrast to the simple design of the tenant spaces, the public spaces provided a design
Mound Architectural
Fabricators of Quality Railing and other Decorative Metal Products

Pricing available for standard products. NO CHARGE FOR QUOTATIONS on most custom projects.

Standard picket rail from $17.00 a lineal foot.

940 Holman Ave., Monroe, OH 45050
513-422-0584 513-422-5184 (FAX)

Please circle # 49

challenge to the both the architects and engineers. These extra-high areas were designed to attract attention and feature varying individual section profiles and an emphasis on aesthetics—primarily expressed through an exposed structure.

Brandon Town Center's public spaces have seven different sectional profiles: typical (main mall) courts; end courts; department store side courts; central court; food court; tower courts; and entrance malls. Though similar in some aspects, each of these areas demanded a different approach to design, both of the space itself and the structure surrounding it.

For instance, in the typical (main mall) court, the lease line is straight on one side but curved on the other to create an asymmetrical layout. Mall width and structural span vary from 30 ft. to 48 ft. The section for these areas is asymmetrical as well, with curved trusses creating height at the straight side for clerestory windows and a lower flat ceiling at the curved side. The trusses are 4-ft. deep with cantilevered W36 beams at 30 ft. on center and 7½-in. long span metal deck. Rather than vary the length of each truss to maintain equal distance from the lease lines, the profile of the truss was kept constant and the cantilevered length of the W36 beam became the variable. By allowing the more costly truss element to be repeated, this design was achieved more economically.

The end courts are similar to the typical courts with one major exception: The maximum span increases from 48 ft. to 50 ft. to provide room for a water feature. Here, the curved trusses were allowed to complete more of the arc, ending at a lower point than in their mall counterparts. This helped maintain the maximum height of the public space at the same level as the main mall, meaning that previously resolved architectural details and design issues (such as the relationship between hanging
Rolls a 36-Inch Beam

Largest Angle Roll in the Western Hemisphere

CAPACITIES TYPE A-36 STEEL

10" x 10" x 1" Angle Iron: Leg Out and Leg In
9" Solid Round Bar
8" Solid Square Bar
4" x 14" Flat Bar on Flat (the easy way)
2½" x 12" Flat Bar on Edge (the hard way)
16" Pipe and Tubing (square, round and rectangular)
36" Beams and Channels
12" Tees: Stem In and Stem Out

CHICAGO METAL ROLLED PRODUCTS COMPANY
3715 South Rockwell, Chicago, Illinois 60632

FOR INQUIRIES & ORDERS
CALL 312-523-5757
FAX 312-650-1439
<table>
<thead>
<tr>
<th>SECTION</th>
<th>TYPE</th>
<th>We bend ALL sizes up to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANGLE RINGS LEG OUT</td>
<td>1</td>
<td>10'' x 10'' x 1'' Angle</td>
</tr>
<tr>
<td>ANGLE RINGS LEG IN</td>
<td>2</td>
<td>10'' x 10'' x 1'' Angle</td>
</tr>
<tr>
<td>FLAT BAR RINGS THE HARD WAY</td>
<td>3</td>
<td>12'' x 2 3/4'' Flat</td>
</tr>
<tr>
<td>FLAT BAR RINGS THE EASY WAY</td>
<td>4</td>
<td>14'' x 4'' Flat</td>
</tr>
<tr>
<td>SQUARE BAR RINGS</td>
<td>5</td>
<td>8'' x 8'' Square</td>
</tr>
<tr>
<td>BEAM RINGS THE EASY WAY (Y-Y Axis)</td>
<td>6</td>
<td>36'' x 210 lb./ft. Beam</td>
</tr>
<tr>
<td>BEAM RINGS THE HARD WAY (X-X Axis)</td>
<td>7</td>
<td>18'' x 50 lb./ft. Beam</td>
</tr>
<tr>
<td>CHANNEL RINGS FLANGES IN</td>
<td>8</td>
<td>18'' x 58 lb./ft. Channel</td>
</tr>
<tr>
<td>CHANNEL RINGS FLANGES OUT</td>
<td>9</td>
<td>18'' x 58 lb./ft. Channel</td>
</tr>
<tr>
<td>CHANNEL RINGS THE HARD WAY (X-X Axis)</td>
<td>10</td>
<td>13'' x 50 lb./ft. Channel</td>
</tr>
<tr>
<td>TEE RINGS STEM IN</td>
<td>11</td>
<td>12'' x 81 lb./ft. Tee</td>
</tr>
<tr>
<td>TEE RINGS STEM OUT</td>
<td>12</td>
<td>12'' x 81 lb./ft. Tee</td>
</tr>
<tr>
<td>TEE RINGS STEM UP</td>
<td>13</td>
<td>10.5'' x 83 lb./ft. Tee</td>
</tr>
<tr>
<td>ANGLE RINGS HEEL IN</td>
<td>14</td>
<td>8'' x 8'' x 1'' Angle</td>
</tr>
<tr>
<td>ANGLE RINGS HEEL OUT</td>
<td>15</td>
<td>8'' x 8'' x 1'' Angle</td>
</tr>
<tr>
<td>ANGLE RINGS HEEL UP</td>
<td>16</td>
<td>8'' x 8'' x 1'' Angle</td>
</tr>
<tr>
<td>SQUARE &amp; RECTANGULAR TUBE RINGS</td>
<td>17</td>
<td>16'' Square Tube 20'' x 8'' Rectangular Tube</td>
</tr>
<tr>
<td>ROUND TUBE &amp; PIPE RINGS</td>
<td>18</td>
<td>14'' Pipe</td>
</tr>
<tr>
<td>ROUND BAR RINGS</td>
<td>19</td>
<td>9'' Round Bar</td>
</tr>
<tr>
<td>RAIL RINGS BALL IN</td>
<td>20</td>
<td>ASCE 100# Rail  Bethlehem 175# Rail</td>
</tr>
<tr>
<td>RAIL RINGS BALL OUT</td>
<td>21</td>
<td>ASCE 100# Rail  Bethlehem 175# Rail</td>
</tr>
<tr>
<td>RAIL RINGS BALL UP</td>
<td>22</td>
<td>ASCE 100# Rail  Bethlehem 175# Rail</td>
</tr>
</tbody>
</table>

WE ALSO ROLL SPECIAL FORMED SHAPES AND EXTRUSIONS AND HAVE IN STOCK LEG OUT ANGLE RINGS FROM 3' TO 72' INSIDE DIAMETER.
light fixtures, single-side only clerestory windows and tree sizes) did not have to change.

The two department store side courts are completely symmetrical in section and plan but retain the curved truss as part of the design. Here the trusses are carried by cantilevered W36 beams at both ends, which permit the same arc radius as the asymmetrical trusses and again promotes economy through repetitive components.

The 80-ft.-wide by 300-ft.-long central court is the most dramatic of the common areas and features a 60-ft.-high barrel-vaulted roof. The court is designed as the “heart” of the project—the place where special events and a variety of seasonal activities will take place. It also exhibits the most dramatic structural design as it fulfills the design requirements for a light and airy space that maximizes the feeling of height.

A prominent row of columns with 3-ft.-4-in.-diameter banded brick masonry enclosures marches through the space at the midpoints of the 80-ft. long trusses spaced 30-ft. on center. This combination of unique, umbrella-like trusses supporting the roof and the line of columns was conceived as a row of trees under a canopy of foliage. To further the concept, the columns are continued 14-ft. below the bottom of the trusses and branch out with “limbs” in the form of WT8x33.5 diagonal braces extending in two directions to support the trusses. A W16 beam running at the center of the trusses also is supported by WT8 braces to stabilize the entire structure for the 100 mph design wind velocity perpendicular to the span.

**Under the Dome**

The food court is circular in plan with individual tenants arrayed along the circulation...
path surrounding the large seating area. At the center, the tallest of the five towers punctuates the roofscape. The brick-clad food court tower also serves as the central support for 12 trusses that radiate outward to form the segmented dome roof over the vast seating area. Since this tower is square, all the trusses are attached at various angles, requiring careful coordination for a clear and logical fit with the masonry. At their outer ends, the trusses are supported by columns clad as brick piers in a curving masonry.

Another special feature of the food court is the exposed steel and metal deck min-canopy framing the individual food tenants. This miniature version of the central court structural scheme also provides a framework for tenant signage and lighting.
Up Above

Aside from the food court, there are four other towers. Two of these are triangular in plan and serve to introduce the department store side courts. The other two are square and join the typical (main mall) courts to the central court. All feature 60-ft.-diameter central skylight courts. To maintain unimpeded storefront visibility, the towers are wrapped with a 7-ft.-to 9-ft.-high brick masonry wall just above the court trusses and are completely visible through the shed-skylights the trusses support. Above the brick is glass curtain wall; the tower is capped by a pre-manufactured pyramidal skylight.

All of the towers were designed with a combination of X-bracing and moment connections for horizontal stability. With a maximum height of 76-ft., special consideration also was given to controlling drift during high wind velocities.

Connection Concerns

Since all of the connections in the common areas are exposed to view, they were designed not only for strength but for aesthetics. Most of the gusset plates are curved with a carefully designed, slightly oversized, radius. Bolt spacing and edge distances also were specified on the drawings. The connection details were so complete that the steel detailer, Southern Steel Detailers, was able to use the structural engineers’ drawings, with only minimal modifications, as part of the shop drawings submittal.

Through this coordinated detailing of the visible connections, the engineer enabled the architect to control the appearance of the finished product with exceptional precision. In fact, as part of the overall interior color scheme, the gusset plates are painted in bright accent colors for emphasis and contrast.

Another benefit of the close attention to details was the smoothness of the fabrication and erection process, as well as numerous construction economies. General contractor on the project was the Hardin Construction Group of Atlanta and steel fabricator was AISC-member E&H Steel Corporation.

Project architect Robert F. Wingard, AIA, is an associate vice president at RTKL Associates Inc. and is based in the firm’s Baltimore office. RTKL is a full-service architecture/engineering firm with a multidiscipline staff of 500 and additional offices in Dallas, Los Angeles, Washington, London, Tokyo and Hong Kong. Craig E. McElroy, P.E., is project manager for Paul J. Ford and Company, structural engineers, with offices in Orlando, Atlanta and Columbus, OH.

RISA-3D Setting the Standard

Is value important to you when selecting structural software?

If so, you’ll want to know that RISA-3D scored a 10 out of 10 rating for cost vs. benefit in the October ’94 issue of Structural Engineering Forum magazine.

The best software isn’t always the most expensive software!

RISA-3D is setting a new standard for quality vs. cost. Try our demo and see for yourself just how good structural design software can be!

Call or Fax us for a Free Demo

26212 Dimension Dr, Suite 200
Lake Forest, CA 92630
Voice: 800-332-7472
FAX: 714-951-5848

Please circle # 40
EVERYTHING YOU NEED TO KNOW ABOUT SLOPED SEAT JOISTS CAN BE FOUND AT BRANSFORD ELEMENTARY
Take a lesson from the Bransford Elementary School in Grapevine, Texas. Where the structural engineer saved money using Vulcraft sloped seat steel joists instead of wood construction for the pitched roof design.

Vulcraft sloped seat joists work in even the most complex customized framing jobs where wood construction has often been preferred in the past. But now things are changing. The rising cost of wood construction makes steel joists more competitive than ever. And aesthetic considerations are making pitched roof designs more popular. All across the country, contractors, engineers, and architects are turning to America's largest producer of steel joists for engineering experience, economical pricing, and unique design alternatives.

Vulcraft's sloped seat joists can be designed to fit almost any degree of pitch you could want, offer superior strength, and are easy to erect in any kind of weather. And, as we did for Bransford Elementary, we can coordinate the design and delivery of our high quality steel deck to go with our joists, allowing construction schedules to be met and costly delays avoided.

To take full advantage of Vulcraft's engineering expertise with sloped seat joists, contact us early in your design phase. We'll be happy to assist you in finding the most efficient and economical solution for your project.

Maybe it's time you went to the head of the class with Vulcraft. Give us a call or consult Sweet's 05100/VUL and 05300/VUL.

Sloped seat joists can be designed to fit almost any degree of pitch.

Sloped seat joists work in even the most complex customized framing jobs.

Please circle # 37
BRIDGES WITH UNEQUALLY SPACED GIRDERs

A proposal to use refined analysis methods for calculating live load distribution factors would reduce costs by as much as 10% to 34%

By Yohchia Chen, P.E., Ph.D.

While bridge design is typically both simpler and less expensive when equal girder spacing is utilized, there are instances—such as staged construction during bridge replacement, widening of an existing bridge and utility constraints—where unequal girder spacing is required.

The simple formulas for estimating live-load distribution factors contained in the 1992 AASHTO code are intended for use with bridges with uniform girder spacing and generally result in conservative bridge designs, especially for bridges supported by W-shape girders. In contrast, the new bridge design code (1994 AASHTO-LRFD) would take advantage of refined analysis methods for predicting distribution factors.

These factors were recently shown, in a study by this author, to have particular advantages for bridges with unequally spaced girders. In this study, a finite element-based refined method was employed in an attempt to derive more accurate live-load distribution factors. Comparisons of maximum flexural distribution factors for interior I-shaped girders determined from various methods are shown on the opposite page.

NUMERICAL STUDIES

Table 1 and Figure 1 summarize the bridge studies; bridge girders are summarized in Table

<table>
<thead>
<tr>
<th>Bridge Case</th>
<th>S1 (ft)</th>
<th>S2 (ft)</th>
<th>S3 (ft)</th>
<th>S4 (ft)</th>
<th>A (ft)</th>
<th>B (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>-</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>-</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>8a</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>8b</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>12</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>9a</td>
<td>10</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9b</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>10a</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>10b</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>12</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>11a</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>11b</td>
<td>4</td>
<td>12</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>12a</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>12</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>12b</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>10</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bridge Case</th>
<th>G1</th>
<th>G2</th>
<th>G3</th>
<th>G4</th>
<th>G5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>W36x393</td>
<td>W36x393</td>
<td>W36x393</td>
<td>W36x393</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>W36x150</td>
<td>W36x150</td>
<td>W36x150</td>
<td>W36x150</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>W36x170</td>
<td>W36x170</td>
<td>W36x170</td>
<td>W36x170</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>W36x150</td>
<td>W36x150</td>
<td>W36x150</td>
<td>W36x150</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
<td>W36x300</td>
</tr>
<tr>
<td>8a &amp; 8b</td>
<td>W36x439</td>
<td>W36x439</td>
<td>W36x439</td>
<td>W36x439</td>
<td>W36x439</td>
</tr>
<tr>
<td>9a &amp; 9b</td>
<td>W36x328</td>
<td>W36x328</td>
<td>W36x328</td>
<td>W36x328</td>
<td>W36x328</td>
</tr>
<tr>
<td>10a &amp; 10b</td>
<td>W36x328</td>
<td>W36x328</td>
<td>W36x328</td>
<td>W36x328</td>
<td>W36x328</td>
</tr>
<tr>
<td>11a &amp; 11b</td>
<td>W36x439</td>
<td>W36x439</td>
<td>W36x439</td>
<td>W36x439</td>
<td>W36x439</td>
</tr>
<tr>
<td>12a &amp; 12b</td>
<td>W36x232</td>
<td>W36x232</td>
<td>W36x232</td>
<td>W36x232</td>
<td>W36x232</td>
</tr>
</tbody>
</table>

24 / Modern Steel Construction / February 1995
REFINED METHOD:
Equation One:
\[ DF = \frac{N_L \cdot M_{\text{comp}}}{\Sigma M_{\text{comp}}} \]
where \( N_L \) is the number of loaded traffic lanes, \( M_{\text{comp}} \) the composite girder moment, and \( \Sigma M_{\text{comp}} \) is the total composite girder moment.

Equation Two:
\[ M_{\text{comp}} = \sigma_{\text{comb}} S_{b,nc} \]
where \( S_{b,nc} \) is the composite section modulus at the bottom of the girder and \( \sigma_{\text{comb}} \) is the combined stress at the bottom of the girder computed by:

Equation Three:
\[ \sigma_{\text{comb}} = \frac{P}{A} + \frac{M}{S_{b,nc}} \]
where \( P \) is the axial load computed at the center of gravity (c.g.) of girder, \( M \) the bending moment at the c.g. of girder, \( A \) the cross-sectional area of girder, and \( S_{b,nc} \) is the non-composite section modulus at the bottom of girder.

1992 AASHTO CODE:
Equation Four:
For interior I-shaped girders with \( N_L \) greater than or equal to 2:
\[ DF_{\text{int}} = \frac{S}{5.5} \]
when \( S \leq 14 \) feet

where \( S \) is interpreted as the “average” center-to-center girder spacing across the bridge.

1994 AASHTO CODE:
(For interior girders)
Equation Five:
\[ DF = 0.5[0.15 + (S / 3)^{0.6} (S / L)^{0.2}] \]

Table 3: Maximum Flexural Distribution Factors for Interior Girders

<table>
<thead>
<tr>
<th>Case</th>
<th>1992 AASHTO (1)</th>
<th>1994 AASHTO (2)</th>
<th>Refined Method (3)</th>
<th>RF x (3)</th>
<th>(4) / (1)</th>
<th>(4) / (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.73</td>
<td>0.62</td>
<td>0.58</td>
<td>0.58</td>
<td>0.79</td>
<td>0.94</td>
</tr>
<tr>
<td>2</td>
<td>0.79</td>
<td>0.72</td>
<td>0.62</td>
<td>0.62</td>
<td>0.78</td>
<td>0.86</td>
</tr>
<tr>
<td>3</td>
<td>0.79</td>
<td>0.62</td>
<td>0.57</td>
<td>0.57</td>
<td>0.72</td>
<td>0.92</td>
</tr>
<tr>
<td>4</td>
<td>0.73</td>
<td>0.70</td>
<td>0.61</td>
<td>0.61</td>
<td>0.84</td>
<td>0.87</td>
</tr>
<tr>
<td>5</td>
<td>0.79</td>
<td>0.82</td>
<td>0.71</td>
<td>0.71</td>
<td>0.90</td>
<td>0.87</td>
</tr>
<tr>
<td>6</td>
<td>0.79</td>
<td>0.70</td>
<td>0.62</td>
<td>0.62</td>
<td>0.78</td>
<td>0.89</td>
</tr>
<tr>
<td>7</td>
<td>0.73</td>
<td>0.62</td>
<td>0.56</td>
<td>0.56</td>
<td>0.77</td>
<td>0.90</td>
</tr>
<tr>
<td>8a</td>
<td>0.73</td>
<td>0.62</td>
<td>0.48</td>
<td>0.48</td>
<td>0.66</td>
<td>0.77</td>
</tr>
<tr>
<td>8b</td>
<td>0.73</td>
<td>0.62</td>
<td>0.61</td>
<td>0.55</td>
<td>0.75</td>
<td>0.89</td>
</tr>
<tr>
<td>9a</td>
<td>0.73</td>
<td>0.62</td>
<td>0.54</td>
<td>0.54</td>
<td>0.74</td>
<td>0.87</td>
</tr>
<tr>
<td>9b</td>
<td>0.73</td>
<td>0.62</td>
<td>0.50</td>
<td>0.50</td>
<td>0.68</td>
<td>0.81</td>
</tr>
<tr>
<td>10a</td>
<td>0.73</td>
<td>0.62</td>
<td>0.56</td>
<td>0.56</td>
<td>0.77</td>
<td>0.90</td>
</tr>
<tr>
<td>10b</td>
<td>0.73</td>
<td>0.62</td>
<td>0.53</td>
<td>0.53</td>
<td>0.73</td>
<td>0.85</td>
</tr>
<tr>
<td>11a</td>
<td>0.73</td>
<td>0.62</td>
<td>0.60</td>
<td>0.60</td>
<td>0.82</td>
<td>0.97</td>
</tr>
<tr>
<td>11b</td>
<td>0.73</td>
<td>0.62</td>
<td>0.62</td>
<td>0.62</td>
<td>0.85</td>
<td>1.00</td>
</tr>
<tr>
<td>12a</td>
<td>0.73</td>
<td>0.62</td>
<td>0.56</td>
<td>0.56</td>
<td>0.77</td>
<td>0.90</td>
</tr>
<tr>
<td>12b</td>
<td>0.73</td>
<td>0.62</td>
<td>0.49</td>
<td>0.49</td>
<td>0.67</td>
<td>0.79</td>
</tr>
</tbody>
</table>

2. The bridges were assumed to be single span, simply supported and non-skewed.

In modeling a bridge system using the finite element technique, consideration must be given to the number of elements per span, aspect ratio (element length/element width) for quadrilateral element, relative vertical distances between the centers of various elements, and torsional stiffness.

In this study, the generalized shell elements that couple bending with membrane action were used to model the bridge deck/slab. The shell elements are proportioned so that the maximum aspect ratio always remains at two-to-one or less. However, for bridge girders and diaphragms (C15x33.9 applied at the end supports and quarter points), standard beam elements were employed. The bridge barriers were not modeled, though, since they have negligible effects on live-load distribution. Modeling efforts also were made to see how many elements are needed transversely and longitudinally. As a result, it is recommended that two transverse slab
three different methods are summarized in Table 3. As can be seen, the simplified methods of lateral load distribution are generally more conservative, especially the method currently used (i.e. Equation 4), than is the refined method. Use of the refined method yields cost savings of 10% to 34% depending on the girder situation. The empirical formula adopted in the 1994 A A S H T O -LRFD Code gives a good approximation for only about one-third of the bridge cases studied.

In conclusion, for bridges with non-uniform girder spacing, a refined analysis method is recommended for predicting lateral distribution of live loads. Significant cost savings also can be expected for the exterior girders. This proposed refined method is applicable to any bridge system.

Yohchia Chen, P.E., Ph.D., is with the Department of Civil Engineering at PennState-Harrisburg. Financial support for this study was provided by the University and bridge information was given by Dr. S. Tabsh.

CONCLUSIONS

The maximum flexural distribution factors obtained from the elastic properties were used:

\[ E_{\text{steel}} \text{ (Young's modulus)} = 29,000 \text{ ksi; } \nu_{\text{steel}} \text{ (Poisson's ratio)} = 0.3; \ E_{\text{concrete}} = 3,122 \text{ ksi; and } \nu_{\text{concrete}} = 0.17. \]
Curved & Straight Steel Bridge Design

Integrated Girder and Bracing Design
Complex grid and roadway geometries, I girders, box girders, rolled shapes
Influence surface (grid) or influence line approach (grid or line girder)
Powerful nonprismatic girder optimization processing (curved and straight)
1992 AASHTO SPEC, 1993 interims, 1993 CURVED GIRDER GUIDE SPEC

Demos and 30-day trials available

MDX software

Phone (314) 446-3221
Fax (314) 446-3278
Please circle # 47

Making the Difference When Performance, Reputation and Quality Count.

Registered head markings on all structural and machine bolts.

A-449  A-449  Type 1  Type 1
A-325  A-325  Type 3  Type 3

All products made from steel melted and manufactured in the U.S.A.

St. Louis Screw & Bolt Company
6900 N. Broadway  St. Louis, MO 63147  U.S.A.
1-800-237-7059/(314)389-7500/FAX (314)389-7510
Please circle # 36
MULTIMEDIA TECHNOLOGY AND THE STEEL INDUSTRY

By Abbas Aminmansour

Most fabricators and engineers have already made the initial leap into the computer world. Now, the steel industry must prepare itself for the next generation of tools: Multimedia. Many people are already familiar with some multimedia applications, such as the latest versions of the Sega and Nintendo Entertainment Systems, where full-motion video and audio is combined with more traditional text and graphics of a personal computer.

But the benefits of multimedia go far beyond mere game playing. Multimedia programs may have the most capability as educational tools. For example, a multimedia program could be used for the initial training of an operator of new fabrication equipment or to help an engineer better understand connection design.

Typically, multimedia programs or applications are interactive, requiring user's involvement in the learning process. This interactivity along with potentials offered by the media to operator of new fabrication equipment or to help an engineer better understand connection design.

Typically, multimedia programs or applications are interactive, requiring user's involvement in the learning process. This interactivity along with potentials offered by the media applications, such as the latest versions of the Sega and Nintendo Entertainment Systems, where full-motion video and audio is combined with more traditional text and graphics of a personal computer.

But the benefits of multimedia go far beyond mere game playing. Multimedia programs may have the most capability as educational tools. For example, a multimedia program could be used for the initial training of an used allow for better, easier, and longer lasting understanding and comprehension of the subject matter than traditional methods of education and training. The more senses of the user involved in the learning process, the better the understanding of the material. For example, seeing and hearing is a more effective way to learn than just hearing alone. In addition, being actively involved in the learning process increases this effectiveness even further. According to IBM, researchers believe that an average learner has short term retention of about 20% of what (s)he hears, 40% of what (s)he sees and hears, and 75% of what (s)he sees, hears, and does. Multimedia technology allows developers to take advantage of this fact as well as the flexibility, effectiveness, and innovations in a number of technologies to produce tools that enhance the teaching/learning process in a variety of fields.

Multimedia applications allow active, individualized, hands-on learning, self-paced instruction and very close to real world experience. They allow random access, immediate feedback and automatic or manual review. Video segments, animations, and other forms of information may be reviewed as many times as necessary for the user to fully understand and comprehend the material.

A major advantage of the multimedia technology is that while it allows for development of more effective tools, the user need not know anything about the technology itself. A well designed and developed multimedia program is very easy to install and run. That is one reason why we see more and more of these tools appearing in such places as shopping malls, tourist information centers, museums, and automobile repair shops where the users are likely to be not familiar with computer and other technologies involved in multimedia. In fact, the casual user is often not even conscious of the fact that they are using a very sophisticated computer program when they touch a screen to view additional information on tourist sites.

While developing multimedia

Aminmansour is in the process of developing a multimedia program to teach structural steel design. Shown above is a screen capture from the program's working model.
programs is time consuming and expensive, the benefits are tangible and immediate. For instance, a learner utilizing a multimedia program will typically spend less time in training and becomes more productive earlier due to a better and quicker understanding of the subject matter. Also, there will be less use of equipment and material. Further, there is less chance of the worker potentially endangering anyone's life as a result of working with equipment that he may be totally unfamiliar with. Also, the multimedia teaching tool is ready for use by others continuously and without any change in its effectiveness or losing any of its benefits. As soon as one person is finished going through the material, the system is ready for the next person. Simply put, a right combination of this technology, instructional design, expertise in a subject matter, and creative minds could result in tools which not only improve learning and retention of a subject, but they do so in a more effective and entertaining way.

Multimedia has many potential applications in steel construction and related fields. It may be used to develop tools for education, from teaching the basics of engineering design to engineering students to refresh courses for practicing engineers and others. Students can now learn practical and real world issues during their education. For example, most college graduates may not even have had a chance to study a steel connection in detail. Some cannot recognize a partially restrained connection from a fully restrained one even if they saw one. All they might have seen in school are line drawings that represent these types of connections. Utilizing multimedia technology, tools can be developed that not only allow the students to see the details of a connection, but see for instance how the size and orientation of the joining members and elements affect the design, fabrication and assembly of the connection.

Another area in which multimedia technology offers great potential benefits is in training. Imagine workers learning how to carry out certain processes and procedures in a steel mill or learn how to operate new equipment or simulate different conditions including potentially dangerous ones, before even touching the equipment for the first time or using any material. Or how about training workers for safety issues in the job environment and updating their knowledge periodically with minimal expense and effort.

Multimedia can also be combined with other useful technologies for easier and more effective ways to access or present information. For example, you may have online access to many resources such as codes, references, and design aids including tables, charts, plots, etc. right at your fingertips while working on your computer. Data bases, case studies, and other useful information may be accessed in different formats for quicker solutions to problems. An example of use of multimedia technology in research is showing actual

---

**Electronic Publications**

Some fledgling multimedia efforts are already available for structural engineers and fabricators:

- **Last year, AISC introduced LRFD on CD to accompany the new 2nd Edition LRFD Manual of Steel Construction. LRFD on CD includes, page-by-page, the entire manual. It's advantage is that key words are hypertext linked, which allows a user to double-click on one word and immediately find other references elsewhere in the manual. In addition, powerful search functions are available to quickly locate any word or equation in the Manual. And finally, the CD-ROM includes complete copies of each issue of Engineering Journal published in 1992 & 1993 as well as more than 50 drawings (.dxf files) taken right from the manual. For information on ordering the CD, call 312/670-2400 (after February 1, call 800/644-2400) or for more information circle number 10 on the reader service card in the back of this magazine.**

- **The monthly Journal of Protective Coatings & Linings has issued JPCL Archives, a CD-ROM featuring the first 10 years (120 issues) of the magazine. Users can search by any combination of key words, authors, article titles and issues. For more information, contact: JPCL, 2100 Wharton St., Suite 310, Pittsburgh, PA 15203-1951 (phone 800/837-8303) or circle number 97.**

- **The National Institute of Building Sciences offers a series of disks containing standards and technical information from more than 125 government agencies, professional societies, and associations, including AISC, AWS, ASTM, and FHWA. The information is available for an annual subscription fee of $970; contact NIBS at 1201 L Street N.W., Suite 400, Washington, DC 20005 (phone 202/289-7800) or circle number 98.**
THE NEW COMPUTER VIBRATION ANALYSIS PROGRAM FOR STEEL JOIST CONCRETE SLAB FLOORS.

Let's you do in minutes what used to take hours!

Now you can get results at the touch of a button. The new computer vibration analysis for floor systems employing steel joist/concrete slab floor construction lets you...

- calculate frequency and amplitude resulting from transient vibration caused by human activity on joist-concrete floors
- perform various "what-if" scenarios—variation in slab thickness, concrete strength, joist size, joist spacing, floor decking, live and dead loads and span lengths
- verify your own calculations
- handles up to 100 foot spans

The program is available on 5½ and 3½ inch disks, is IBM PC compatible and comes with a comprehensive 58-page user's manual. And at just $125.00, this program pays for itself after just one project. So fill out the coupon to order this time-saving program today.

Please send me program(s) at $125.00 each (includes Postage and Handling).

ALL ORDERS MUST BE PREPAID

Disk Size: 3½", __ 5¼", __

Total Remittance

U.S. Currency Only

Name __________________________

Company _______________________

Street Address __________________

City ______ State ______ Zip ______

Mail to: Managing Director

Div. A-1

Steel Joist Institute

1205 48th Avenue North

Myrtle Beach, SC 29577

behavior of a member or system in the form of video while displaying the theoretical or predicted behavior of the parts along with the pertinent formulas, plots, and other information at hand. The possibilities are simply many. Just think about what you do in your profession every day, and very likely you can think of some of those tasks that can be performed more effectively using multimedia technology.

While running a multimedia program, the computer serves as a control center and the software provides the capability to manage the direction, type, and speed at which the information is being presented. In response to the user selecting menu items, pushing buttons, or responding to questions, the program may displays certain information or make intelligent decisions as to what should happen next.

In terms of hardware, it takes very little to run a multimedia application. Typically, the recommended minimum system configuration for running multimedia software is a 386-33MHz (or equivalent) computer with four megabytes of Random Access Memory (RAM)—though a 486 or faster system with at least eight megabytes of RAM is much preferred. Playing audio files requires a sound card and speakers, but in most cases, video files may be played without any additional hardware requirements. Needless to say, running large video segments in large windows and with high frame per second (fps) counts and high resolutions and more colors will require a heftier machine.

Due to their relatively large size, most multimedia applications are distributed on CD-ROM's. Consequently, a CD-ROM drive may also be necessary to run such programs. However, today, CD-ROM drives are very common on new computers and fairly inexpensive to add to existing ones (usually less than $300 for a double speed C-
A Quick Quiz
For Structural Engineers

The more a computer program costs, the better it is.  TRUE FALSE
A program that solves complex, difficult problems must be complex and difficult to use.  TRUE FALSE
Structural engineering software can never be fun to use.  TRUE FALSE
If you answered TRUE to any of the above, or you would like to know more about a truly innovative software program, call us!

RISA-2D
Your complete solution for frames, trusses, beams, shear walls and much more!

26212 Dimension Drive, Suite 200
Lake Forest, CA 92630
1-800-332-7472

CALL TODAY FOR YOUR FREE DEMO KIT!

E.J.E. INDUSTRIES, INC.
287 Davery Avenue, Washington, PA 15301
1-800-321-3955 or 412-228-8841

Hands-Off Experience

CadVantage Structural cuts through structural detailing like a knife. The program doesn't require tedious job set-up and lets you re-use previous work. With the time saved, the pressure of meeting critical deadlines and budgets will become less horrifying.

CadVantage®
619 South Cedar Street • Studio A
Charlotte, North Carolina 28202
704-344-9644
Please circle # 45

Modern Steel Construction / February 1995 / 31
ENGINEERED HEAT STRAIGHTENING COMES OF AGE

Established procedures for heat straightening result in safe, reliable and economic repairs

By R. Richard Avent, P.E.

HEAT STRAIGHTENING OF DAMAGED STEEL HAS PROBABLY been a part of the fabricator's tool kit since the invention of the oxy-fuel welding and cutting apparatus. Reported repairs extend at least 40 years into the past. The process, however, has remained primarily an art, learned by trial and error in the fabricating shop, and passed from one craftsman to the next. In addition, a small number of contractors have specialized in the art of heat straightening and travel the world to perform emergency repairs on damaged structures.

While engineers have appreciated the work of the more competent craftsmen, the lack of a clear scientific basis for the method has limited its use.

Until recently, scientific information on heat straightening has been limited. The engineering criteria that did exist was often found in obscure sources and sometimes provided contradictory information. As a result, engineers faced with the dilemma of selecting the most viable repair scheme for damaged steel structures tended to avoid heat straightening. Two key questions have been consistently voiced: Do heat-straightening procedures exist that do not compromise the structural integrity of the steel? And, if so, how can such repairs be engineered to insure adequate safety of the

Figure 1: Vee heat in progress at the Mississippi River bridge near Greenville, MS.
structure both during and after repair?

I have been conducting analytical and experimental research on heat straightening since 1985. As a result of more than 1,000 bench scale tests on small rolled shapes, 20 full-scale girder tests and several field repairs, a protocol for heat straightening repair has been established.

**BASIC CONCEPTS**

Structural damage typically consists of a combination of strong and weak axis bends of the plate elements forming the rolled or built-up shape. Vee, strip, and line heats are the fundamental heating patterns with vee heats playing the dominant role. The plate element in Figure 2 illustrates the process. The heating begins at the apex of the vee with the torch gradually moved across and down the vee in a serpentine motion so that the entire vee area is eventually heated. Heats in progress are shown in Figure 1.

The basic mechanism of heat straightening is to create plastic flow, causing expansion through the thickness (upsetting) during the heating phase, followed by elastic longitudinal contraction during the cooling phase. This upsetting can be accomplished in two ways. First, as the heat progresses toward the base of the vee, the cool material ahead of the torch prevents unrestrained longitudinal expansion of the heated material leading to upsetting through the thickness. However, as illustrated in Figures 2a-b, some longitudinal expansion does occur, which results in a temporary change in displacement (decreasing at beginning of heat, and increasing near the end of heating). After cooling, the net degree of damage is reduced, as shown in Figure 2c, so that the net effect is a reduction in the damage curvature in the immediate vicinity of the vee as the vee closes slightly. Repetitive cycles of heating and cooling are required.
A second method of producing the desired upsetting (usually in conjunction with the vee heat) is to provide a restraining force. The role of the restraining force is to reduce or prevent beam movements, which tend to favor longitudinal expansion during the heating phase. For example, if a restraining force is applied that generates a bending moment tending to close the vee as shown in Figure 2b, the upsetting effect will be increased through the flexural constriction of free longitudinal expansion at the open end of the vee. A restraining force is usually applied externally, but sometimes the structure itself provides restraint through internal redundancy.

**HEAT STRAIGHTENING ROLLED SHAPES**

For structural shapes, the typical damage falls into one of four categories that requires certain combinations of vee, strip and line heats (Figure 3a). For example, a wide flange shape subjected to various types of damage can be straightened using the heating patterns indicated:

1. Damage as a result of bending about the strong axis (Category S) requires the vee and strip heat pattern shown in Figure 3b;
2. Weak axis damage (Category W) requires the pattern in Figure 3c;
3. Twisting damage (Category T) requires the pattern in Figure 3d;
4. Local bulging (Category B) is heated as shown in Figure 3e.

For all cases, the general order of heating is line, vee and strip.

**ENGINEERED REPAIRS**

The key to safe, reliable heat-straightening repairs is to control certain specific parameters. The vee depth is usually taken as the full depth of the plate element except for Category B, which may require half-depth vees. The vee angle should gen-
Use these cards to request information from manufacturers and other companies mentioned in this issue. Simply circle the numbers referenced in the advertisement or article, fill out the rest of the information requested on the card, and either mail it to: Modern Steel Construction, Creative Data Center, 650 South Clark St., Chicago, IL 60605-9960 or fax it to: 312/922-3165.
Use these cards to request information from manufacturers and other companies mentioned in this issue. Simply circle the numbers referenced in the advertisement or article, fill out the rest of the information requested on the card, and either mail it to: Modern Steel Construction, Creative Data Center, 650 South Clark St., Chicago, IL 60605-9960 or fax it to: 312/922-3165.
Figure 3: Heating Patterns For Wide Flange Shapes

(a) Torch patterns for vee, strip and line heats

(b) Heating pattern for strong axis damage

(d) Heating pattern for twisting damage

(c) Heating pattern for weak axis damage

(e) Heating pattern for local bulges
eraly not exceed 20 degrees. Control of the heating temperature is critical and should be limited to 1200 degrees F for carbon and low alloy steels and 1100 degrees F for constructional-alloy steels. Temperature crayons and contact pyrometers can be used to monitor temperature. However, at 1200 degrees F steel takes a satiny silver color that a trained observer can quickly learn to recognize.

One of the most critical factors is the applied restraining force. Research has shown that the use of jacks to apply restraints can greatly shorten the number of heating cycles required. However, over-jacking can result in a brittle fracture during or shortly after heat straightening. To prevent such a sudden failure as illustrated in Figure 4, jacking forces should always be limited. The recommended procedure is to calculate the bending moment capacity of the damaged member and limit the moment resulting from applied jacking forces to one-third of this value. Very few practitioners take this precaution and, thus, brittle fractures are not uncommon. It is strongly recommended that jacks be gauged and calibrated with the maximum force limitation computed. Of course, the jacking forces should always be applied in the direction tending to straighten the beam.

In general, all yield zones and only yield zones should be heated with either line, strip or vee heats. Since yield zones may extend 3 ft. or more, successive heating cycles require the vee to be shifted sequentially over the entire zone. With proper control of jacking forces and heating temperature, temporary shoring is not required. There also is no recognized limit as the degree of damage that can be repaired. Research has shown that strains up to 100 times the initial yield strain can be safely heat straightened. Even repetitive damage that has not been previously heat straightened may be re-shored, although this process should not be repeated more than once.

**EXAMPLES OF REPAIR**

A common type of damage is the result of over-height vehicle impact to the steel girders of an overpass. I have worked with the Iowa Department of Transportation to develop a heat-straightening training program for their maintenance personnel. The final phase was to conduct a repair of a damaged bridge of I-80 near Davenport. The facia girder, in which the lower flange more than 7 in. of permanent deflection, was successfully repaired, as shown in the before and after photos (Figure 5).
A second example is the Mississippi River Bridge in Greenville, MS, in which the through truss cross bracing had excessive localized damage from a crane boom that broke its mooring while being transported over the bridge. (Before and after views are shown in Figure 6).

**SAFETY & ECONOMIC IMPACT**

If heating temperatures and jacking forces are controlled, heat straightening does not significantly change the strength characteristics of the material. For example, data is available for hundreds of tests in which the percent change of key parameters before and after heating have been measured. For yield stress, there tends to be a small increase averaging 13% after heating. Similar increases have been found for maximum tensile strength. The modulus of elastic-
Figure 6a (above): Damaged cross brace on Mississippi River bridge near Greenville, MS.
Figure 6b (opposite page): Cross brace after completion of heat straightening.

Ductility has the greatest change, decreasing by an average of 20%. Fracture sensitivity, as measured by the Charpy V-notch test, shows little change before and after heating.

The cost of heat straightening tends to be quite low when compared to alternatives such as replacement of all or part of a girder. A typical bridge project with one to three damaged girders typically requires less than a week to complete. While traffic is usually diverted from the lanes directly over the girders, the rest of the bridge can remain open. Costs typically range between $20,000 to $30,000. IDOT's in-house repair of the single girder in Figure 5 was less than $10,000. A heat straightening specialty contractor's estimate was $20,000. Replacement would have exceeded $100,000.

Research has reached the
point that a prototype engineer's guide to heat straightening was presented and published at AISC's National Steel Construction Conference in 1992 and more information will be presented at the 1995 NSCC in San Antonio in May (For more information on the upcoming NSCC, please call the American Institute of Steel Construction at 312/670-5420). The emphasis on future research is to conduct field repairs in which the response to heat straightening is closely monitored. The LSU research team is seeking candidate bridges and other structures that can be repaired by heat straightening as part of this continuing research.

R. Richard Avent, P.E., Ph.D., is a professor in the Department of Civil and Environmental Engineering at Louisiana State University.

Automatic preheating or manual—how do you decide?

Once you compare, the choice is obvious.
Automatic electrical resistance preheating helps control project costs by:

**Increasing welder productivity**
Labor costs are reduced because components are always ready for welding. Your personnel are freed from time-consuming manual preheating chores. The electrical equipment creates a safe working environment.

**Avoiding expensive rework**
Uniform maintenance of minimum temperature controls two common causes of rework—cracking and hydrogen formation.

Request our FREE literature and information on our successful Northridge earthquake projects.

CORPORATE HEADQUARTERS
1021 Centennial Avenue, Piscataway, NJ 08854
Toll Free: 800-526-4233
Tel: 908-981-0800 • Fax: 908-981-0850

Please circle # 56
Company: **Advanced Fabricating**  
**Machinery**  
Product: Pipe & Tube Bending Machines  
Address: #65 Route 125  
Kingston, NH 03848  
Telephone: 603/382-1476  
Fax: 603/642-4813  
Information: INECO pipe and tube bending machines have a bending capacity up to 3-in O.D. (2 in. Sch. 40 or 2 1/8-in. Sch. 10) and up to 15 3/4-in. CLR. The machines are microprocessor controlled and available with motorized counterbending die.

Circle: **68**

Company: **Chicago Metal Rolled**  
**Products Company**  
Product: Angle Rolling  
Address: 3715 South Rockwell  
Chicago, IL 60632  
Telephone: 312/523-5757  
Fax: 312/650-1439  
Information: Chicago Metal rolls wide flange up to a 36-in. beam. Capacities for A36 steel includes: 10-in. x 10-in. x 1-in. angle iron leg out and leg in; 9-in. solid round bar; 8-in. solid square bar; 4-in. x 14-in. flat bar on flat (the easy way); 2 1/4-in. x 12-in. flat bar on edge (the hard way); 16-in. pipe and tubing (square, round and rectangular); 36-in. beams and channels; and 12-in. tees stem in and stem out.

Circle: **76**

Company: **COMEQ, Inc.**  
Product: Section Bending Rolls  
Address: P.O. Box 2193  
Baltimore, MD 21203  
Telephone: 410/325-7900  
Fax: 410/325-1025  
Information: COMEQ, Inc. offers a full line of ROUND0 Section Bending Rolls manufactured in Sweden. ROUND0 Angle Rolls come in 15 models, with up to 85-cubic-in. modulus section capacity and capabilities to 14-in. wide flange beams on X-X axis. ROUND0 Beambenders are available to roll beams on edge to W44 and section modulus capacities ranging up to 1000 cubic in. Computer controls are available for all models. Free literature is available on all models.

Circle: **66**

Company: **Richards & Conover Steel Co.**  
Product: Shape Rolling  
Address: 6333 St. John Ave.  
Kansas, MO 64123  
Telephone: 800/727-0987  
Fax: 816/483-6983  
Information: Boldrini shape roll can shape wide flange beams up to 24 in., angles to 8-in. x 8-in. x 8-in., and flat bars 3-in. x 8-in. In addition, tees, channels, tubing, and plate can be shaped, all the "hard way". Other services include precision sawing and plate shearing, computer-aided design assistance and computer-driven multi-torch gas and plasma capability. Rich-Con also offers a service center with a complete line of heavy carbon products.

Circle: **93**

Company: **Max Weiss Co., Inc.**  
Product: Steel Shaping  
Address: 8625 W. Bradley Road  
Milwaukee, WI 53224  
Telephone: 414/355-8220  
Fax: 414/355-4698  
Information: The company offers a full-range of bending and shaping services for both architectural projects and unique applications. Services offered includes: rolling & forming; blacksmithing; welding & machining; irregular curves; vertical offsets; elliptical shapes; circles; and segments with or without tangents. Max Weiss bends steel both the easy way and the hard way.

Circle: **56**

For information on the National Steel Construction Conference (May 17-19 in San Antonio) call 312/670-2400
STAAD3-2D
State-of-the-art 2D Structural Analysis and Design Software for $595

Research Engineers, Inc. is proud to announce the arrival of STAAD3-2D, the most comprehensive 2D Structural Analysis and Design software in today's industry. STAAD3-2D is the 2D version of RE's world famous structural software STAAD-III. Equipped with powerful Analysis/Design, brilliant GUI, easy Visualization/Verification, and flexible Report/Query facilities, STAAD-3D represents the true state-of-the-art in modern structural engineering.

STAAD-2D supports STEEL/CONCRETE/TIMBER design per AISC (ASD & LRFD), ACI and AITC codes. With a price tag of $595, it offers you the best value for all your 2D structural needs.

Research Engineers, Inc.
22700 Savi Ranch
Yorba Linda, CA 92887
Toll Free: 1-800-FOR-RESE
Fax: (714) 974-4771

Computerized Steel Detailing

Our staff has over 25 years experience in the design and detailing of structural and miscellaneous steel. Our in-house developed software can be customized to provide shop drawings to meet your specific needs. Our licensed P.E. can provide certified connections when required.

Engineering Design & Software, Inc.
400-A 14th St. S.E., Decatur, AL 35601
Tel: (205) 306-0909 Fax: (205) 306-0909

Southeastern Steel Detailing, Inc.
9729 Parkway East — Suite 200
Birmingham, AL 35219-7856

Highly experienced staff specializing in every aspect of steel detailing, including: Large Commercial Projects; Industrial Projects; Hip and Valley Roofs; Conveyor Systems; Complicated Plate Work.

References available
Phone (205) 833-4912 or (205) 836-5987
Fax: (205) 833-4798

WE PROVIDE
CADD STRUCTURAL STEEL DESIGN/DETAILING for Engineers, Fabricators and Contractors
JOHNSON TECHNICAL SERVICES
2509 Saint Paul St., Suite 4B
Baltimore, MD 21218
(410) 243-3269/ FAX (410) 243-1963

Help Wanted — Chief Draftsman

Aggressive, expanding structural steel fabricator in the midwest is seeking an experienced Chief Draftsman. Department has (12) to (14) detailers. Must be a take charge individual with total control over department and outside detailers. Great assistant on board. CAD experience a plus. Send resume with salary history and requirements to:

President
Doing Steel, Inc.
2125 North Golden
Springfield, MO 65803

Executive Wanted:

Progressive, medium size structural and miscellaneous steel fabricator with modern Category II shop, needs licensed P.E. to be vice-president and chief engineer. Must be experienced in steel industry with emphasis on management of both in-house and contract detailers. Design capability and computer literacy is required. We offer an opportunity to work in a wonderful four-season part of the country where it is possible to live hassle-free while progressing professionally and economically. Please send resume to:

Midland Steel Company, P.O. Box 527, Wathena, KS 66090
Attn: Don Jones, President

Project Management/Estimating/Detailing

Progressive and rapidly expanding Structural Steel Fabricator in the Midwest is seeking motivated, aggressive individuals for Project Management/Estimating/Quality Control/Detailing. Minimum 10 years industry experience required. Proficient oral and written communication skills essential. Commensurate compensation and excellent benefits. Send resume with salary requirements to: Sales Manager, P.O. Box 1066, Salina, KS 67402-1066.

Estimating/Sales

Growing fabricator of specialty bridge products is seeking an experienced professional to estimate and sell products in our central states region (NE, KS, MO, IA). Our products include bearing assemblies, expansion devices, drainage systems, catwalks and other specialty items for bridges. Must have significant estimating experience in the steel fabricating industry. Strong oral and written communication skills and computer literacy a must. Send resume with salary requirements to:

Lewis Engineering Company, 4201 Norex Dr., Chaska, MN 55318
Fax: 612/448-7000

Help Wanted

Structural steel and Miscellaneous Metal Fabricator of bridges and buildings is seeking individuals with experience in Detailing, Estimating or Project Management specific to steel projects. Send resume to:

PRECISE FABRICATING CORPORATION
3 Farm Lane
Georgetown, MA 01833
Attn: Mr. Frank Davis

AISC Professional Membership

Receive a FREE Manual of Steel Construction and 25% discounts on AISC publications, seminars and the National Steel Construction Conference. In addition, be eligible to serve on AISC Committees.

For more information, contact:
LeAnn Schmidt at 312/670-5432.

Engineering Journal

The only technical magazine in the U.S. devoted exclusively to the design of steel structures, the AISC Engineering Journal provides structural engineers, fabricators, and educators with the latest information on steel design, research and construction.

For a one-year subscription, send $18 to:
American Institute of Steel Construction, P.O. Box 806276, Chicago, IL 60680-4124 or phone 312/670-2400

Modern Steel Construction / February 1995 / 41
Announcing: SD5C Steel Roof Designer
ECOM is pleased to announce the latest addition to our SES Library. SD5C will analyze, design, and perform a quality take-off/price estimate of a complete flat steel roof or floor system. This includes options for standard joints, joist-girders, and standard steel sections. SD5C also designs interior columns, wind columns, base-plates, girts and bracing. The program considers the entire roof system including a diaphragm analysis and deck selection.
ECOM Associates, Inc. • 8324 N. Steven Road, Milwaukee, WI • 53223 • Phone 414-365-2100 ext. 494 • FAX 414-365-2110

AISC Certification
Categories I, II, III
Do you want to become certified but are just buried with work?
I offer assistance with the necessary paperwork plus training for your people.
McGowan Technical Services, Inc.

StruCAD*3D
The Flagship Product for 3D Structural Analysis & Design
• Pop-Up & Pull-Down Menus
• Full 3D Graphics-Oriented
• Pre- and Postprocessing
• 3 D AutoCAD Interface
• AISC-ASD, AISC-LRFD, ACI-318
• Reinforced Concrete Design
• Finite Element Analysis
• Wind & Gravity Load Generation
• Material Takedoff
• P-Delta and Thermal Analysis
• Pile-Soil Interaction
• Seismic & Machine Vibration
• Detailed Fatigue Analysis
• Prices Begin at $249
Zentech, Inc.
8552 Katy Freeway, #205, Houston, TX 77024
Tel (713) 984-9171 Fax (713) 984-9175

GT STRUDL
Static, Dynamic, Linear, Nonlinear & Pushover Analysis
Straight & Curved Steel Bridge Model & Load Generator
SC Solutions, Inc.
Tel (415) 903-5050 Fax (415) 691-9452

SC-Bridge SC-Push3D
Hewlett-Packard
Computers/Peripherals
A complete line of used and refurbished HP Equipment to fill all your computer needs. Laser printers, scanners, disk drives, plotters (Draftpro, Drafmaster & Designjet), PC's and 9000 series workstations are available for immediate delivery. Call our toll free number for additional information and pricing.
Ted Dasher & Associates
4117 2nd Avenue South
Birmingham, AL 35222
800-638-4833 fax (205) 591-1108

Structural & Miscellaneous Steel Detailing CAD Programs
AutoCAD parametric LISP programs for preparing structural and miscellaneous steel shop drawings. All programs have been updated for 1995 and new programs have been added. Anchor bolts to roof opening frames and "everything between," Imperial and metric versions with USA, Canadian and European steel sections. 45-DAY MONEY BACK GUARANTEE. Discounts up to 30%. Buy only what you need. Used in the field for 8 years. Programs written by a detailer with 39 years experience. Extremely "flexible" programs. FREE telephone support. No maintenance fee. Reasonable yearly update fee. EXCELLENT PROGRAMS at a REASONABLE PRICE. Call for a FREE demo disk, list of programs, and prices.
SSDCP
110 Shady Oak Circle, Florence, MS 39073
Tel: 601/845-2146 (fax same)

Rolling
Beam-Angle-Tube-Pipe-Channel Plate
Easy/Hardway Heavy Capacities
Up to 36" W.F. Beam
209-466-9707
N.J. McCutchen, Inc.
123 W. Sonora St., Stockton, CA 95203

Images—3D
2D-3D Structural/Finite Element Analysis
Easy to learn and use
Shear & Moment Diagrams
AISC Code Check
Large Problems to 3,000 Joints
Complete Static Package—Only $795
Celestial Software, 2150 Shattuck Ave., Suite 1200
Berkeley, CA 94704
Tel: 510-843-0977 / Fax: 510-848-9849
Fifty-node fully functional evaluation package for only $49.95

NORTHRIDGE JAN. 17, 1994
EARTHQUAKE SLIDES/VIDEO
The one and only available technical slides showing close-up views of damage to Office Buildings, Hotels, Parking Structures, Bridges & Apartments. Each slide is explained individually. Great material for discussions.
70 Photo Slides - $89.00 Video cassette - $49.00
Please send request & check/money order to: MA & Associates, 5106 E. Los Angeles Ave., Suite E157, Simi Valley, CA 93063
Phone/Fax (805) 579-8291

Advertisers' Index
Advertiser Page Number Circle No.
AISC Database 13 1
Advanced Fabricating 18 93
Nicholas J. Bouras 19 33
CIA V31 35
CIV 31
Comeq Inc. 34 68
Computer Detailing Corp. 38
Das Consulting, Inc. 14 82
Data Images 15 89
Design Data 7 32
EJE Industries 31 46
Graphic Magic 14 92
Grinder Software 38 83
Integrated Engineering Software 15 87
Metrosoft Ch 51
Mound Architectural Products 18 49
Onnittech 27 52
Optimatte 36 53
Ram Analysis 36 81
Research Engineers 5 34
Richards & Conover 76
RISA Technologies 21 40
St. Louis Screw & Bolt 27 36
TradeARBED 3 35
Vulcraft 22-23 37
Max Weiss 37 56
very easy to learn and use, become a productive user in just one day
- extremely fast, shortens the concept through design cycle
- most powerful on PC platform - 3D FEM, buckling, nonlinear, P-delta, dynamic,
  3D moving loads, parametric structures, phase constructions, US and foreign codes
- buy the power you need, starts from $495 version - 150 node/3D plus plate elements
- no risk, 30 day money back guarantee

See for yourself. Have fun. Any questions? Call us. 1-800-60-ROBOT

Please circle # 51

LIMITED WORKING VERSION OF PROGRAM WITH PRE-RECORDED EXAMPLES AVAILABLE. OVER 2000 USERS WORLDWIDE. FOR MORE INFORMATION CALL 201-438-4915 OR FAX TO 201-438-7058

Name:
Company:
Address: __________________________ State ___________ Zip ___________
Tel.: ______________________________ Fax: __________________________
I am: structural engineer, architect, educator, dealer, other:
☐ Please have a product specialist call me ☐ Please send more information
☐ Please send working demo version (limited to 25 elements and 25 nodes), with recorded macros of real design examples. Enclosed is a check for $25 (plus applicable Tax in NJ and NY). I have a system equal to or better than 386SX with math coprocessor, 4 MB 8 MB RAM, 25 MB of free disk space, VGA monitor.

Metrosoft Structures, Inc. 332 Paterson Ave., E. Rutherford, NJ 07073. Tel 201 438-4915, Fax 201 438-7058.

©1994 Metrosoft Structures, Inc. All brand and product names are trademarks or registered trademarks of their respective holders. Developer Tested Only. Novell makes no warranties with respect to this product.