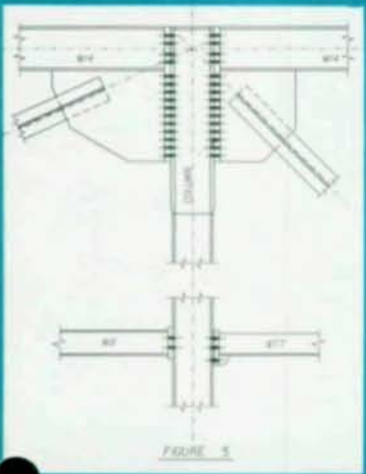
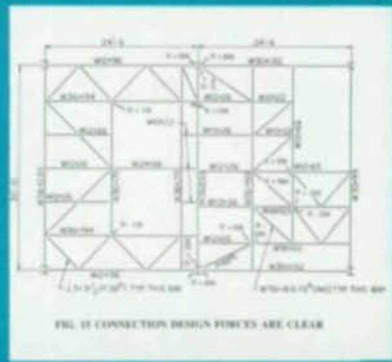
MODERN STEEL CONSTRUCTION

June 1992 $3.00



Design Engineers Can Reduce Fabrication Costs By Indicating Actual Forces On Selected Building Joints—Page 24



Communication Of Design Requirements Between Fabricator And Engineer Is Crucial For A Safe And Economic Structure—Page 27

New International Terminal At O'hare Airport—Page 12

Short Span Bridge Design In The '90s—Page 32

UNITED STEEL DECK, INC.

ROOF DECK DATA BASE

DECK DESIGN DATA SHEET
No. 17

Attribute	Type B Deck (B, BI, BA, BIA)				Type F Deck			Type N Deck (NS, NI, NSA, NIA)			
gage	22	20	18	16	22	20	18	22	20	18	16
thickness	.0295	.0358	.0474	.0598	.0295	.0358	.0474	.0295	.0358	.0474	.0598
weight, psf	1.7	2.1	2.8	3.5	1.6	2.0	2.6	2.1	2.5	3.3	4.1
I_p, in.^{4} (1)	0.17	0.24	0.31	0.40	0.13	0.17	0.24	0.64	0.82	1.19	1.62
I_n, in.^{4}	0.20	0.24	0.32	0.40	0.15	0.19	0.25	0.85	1.04	1.38	1.75
S_p, in.^{3}	0.19	0.25	0.34	0.44	0.13	0.16	0.22	0.37	0.49	0.68	0.88
S_n, in.^{3}	0.20	0.26	0.36	0.45	0.14	0.17	0.23	0.42	0.54	0.74	0.93
Ext.R(2), lbs.	450	620	1010	1860	440	610	1000	320	450	760	1410
Ext.R(3), lbs.	540	730	1160	2100	540	720	1140	390	530	870	1590
Int.R(4), lbs.	1270	1830	3120	4670	1250	1800	3070	940	1370	2370	3800
Int.R(5), lbs.	1320	1880	3200	4750	1320	1880	3190	1090	1580	2700	4020
V(6), lbs.	1920	2300	3000	3780	1970	2360	3120	2350	3390	4960	6180
Max.1 span(7)	5'10"	6'8"	8'0"	9'1"	5'2"	5'11"	7'0"	11'5"	13'0"	15'8"	18'3"
Max.2 span(8)	6'11"	7'10"	9'5"	10'9"	6"1"	7'0"	8'4"	13'5"	15'3"	18'5"	21'6"
Max. Cant.(9)	1'11"	2'4"	2'10"	3'3"	1'2"	1'5"	1'10"	3'6"	4'0"	4'10"	5'5"
FMS span(10)	6'0"	6'6"	7'5"		4"11"	5'5"	6'3"				

NOTES

(1) I_p, I_n, S_p, and S_n are the section properties per foot of width. These values were calculated using the American Iron and Steel Institute Specifications. The subscripts denote positive or negative bending.

(2) Allowable end reaction per foot of deck width -- 2" bearing.

(3) Allowable end reaction per foot of deck width -- 3" bearing.

(4) Allowable interior reaction per foot of deck width -- 4" bearing.

(5) Allowable interior reaction per foot of deck width -- 5" bearing.

(6) Allowable vertical shear per foot of width -- do not confuse this with horizontal shear strength provided by the diaphragm.

(7) Maximum span recommended for roof construction based on SDI criteria -- single span.

(8) Maximum span recommended for roof construction based on SDI criteria -- 2 or more spans.

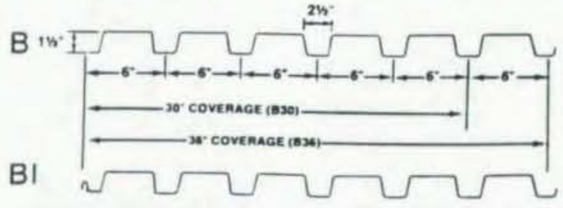
(9) Maximum recommended cantilever span based on SDI criteria: these spans are sensitive to the length of the adjacent span as they are controlled by deflection. Call if you need a more precise calculation.

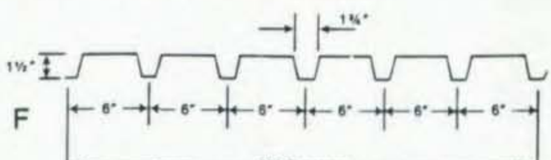
(10) Maximum spans for Factory Mutual Class I construction. Factory Mutual will allow these spans to be extended by 10% (maximum) when the insulation is mechanically fastened to the deck by screws and plates. Whenever this extension is used, sidelap fastening must occur at 18" (maximum) rather than the normal 36". Refer to the Factory Mutual System Approval Guide.

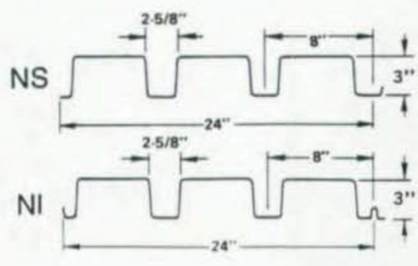
(12) B is generically known as "wide rib" deck; F is "intermediate" rib, and the 3" deep N deck is "deep rib".

(13) The deck type B means flat side lap; BI is the "interlocking" side lap; BA and BIA means the decks are acoustic. F deck is only available with the flat sidelap. NS is flat sidelap; NI is "interlocking" and NSA and NIA are acoustic decks. Better sidelap connections are obtained by screwing or welding through the flat sidelaps and therefore this is the recommended type.

(14) Information not provided on this chart may be obtained by calling our office in Summit, NJ.







MEMBER

ASSOCIATE MEMBER

NICHOLAS J. BOURAS, INC.
P.O. BOX 662, 475 SPRINGFEILD AVE.
SUMMIT, NJ 07902-0662 (908) 277-1617

E$timating

Gives you unrivaled accuracy - and an accurate bid is money in your hand

In these days of declining profits, Structural Software's computerized **Estimating** gives you the accuracy you need to stay competitive. An accurate bid can mean the difference between a healthy profit and an unwelcome surprise. Plus, you're able to bid more jobs using the same personnel. Our **Estimating** program correctly prices all items that go into a job, from the mill to the warehouse. The only thing left for you to calculate is the savings! Almost all of the pricing levels and labor codes can be changed to suit your needs. In fact, our customers agree that Estimating's flexibility makes it the best estimating program on the market. And Estimating's unique modular design for IBM computers lets you easily add on our other programs, like **Multing, Inventory** and **Production Control**, to give you even greater accuracy and control over shop production.

"The computer saves so much compilation time and analysis time, since it groups the pieces automatically. We can bid a lot more work now, and that's really important in today's competitive market. Using the computer saves us hours, or days, on turning estimates around."

Greg Lewis
Elwell Iron Works, Inc.

"The Structural Software system enabled us to bid and run more projects through. Our estimates are more accurate. And because Production Control tracks everything in a job, you can keep full control of a project in the office from the time you bid it to the time it goes out to the site."

Greg Householder
Griffith-Custer Steel

"Estimating saves us the cost of one person per year. We also appreciate the consistency that computerized estimating adds to our operation. Since this program was written by a structural steel fabricator, and for a structural steel fabricator, we don't have to rethink anything to use it."

Jack Holcomb
Berlin Steel Construction Co.

"Our estimates are faster and more accurate now. We are providing more estimates than ever before. We all had a basic understanding of the system soon after it was installed. Within a few weeks, we were totally used to the system and wondering how we'd ever gotten along without it."

Phil Griggs
Topper & Griggs, Inc.

"We're extremely satisfied. Estimating has enabled us to do another 20 to 35 percent more quotes and increased our accuracy tenfold. The computer eliminates the tallying errors that creep in sometimes when you're totaling up the weights. We've had our system for close to five years, and we're very happy with it."

Dave Fritzer
Coastal Steel Corp.

Call **(800) 776-9118** for details on Estimating and other Structural Software programs, including:

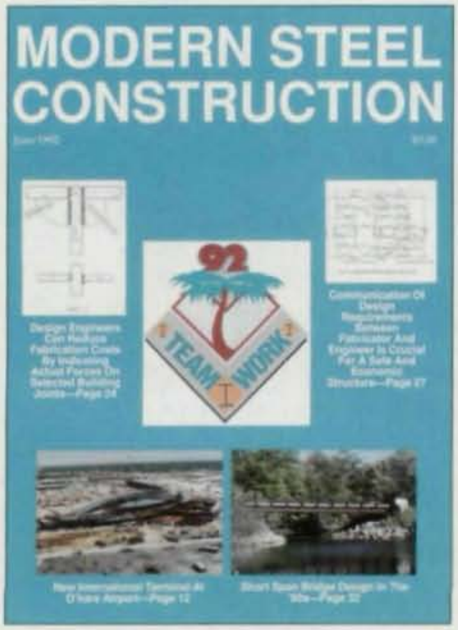
*FabriCAD - A total unit detailing process that includes shop drawings

*Inventory Control, Production Control and Purchase Orders - Material Allocation programs that link purchasing with production to cut waste and boost profits. Structural Software Co., 5012 Plantation Road, Roanoke, VA 24019.

STRUCTURAL SOFTWARE CO.
SOFTWARE FOR THE STEEL INDUSTRY
(800) 776-9118

MODERN STEEL CONSTRUCTION

Volume 32, Number 6 June 1992



The National Steel Construction Conference was held June 3-5 in Las Vegas and featured a wide range of presentations for engineers, fabricators and other professionals directly involved with the fabricated structural steel industry. Condensed versions of selected papers are printed beginning on page12.

FEATURES

NEWS AND DEPARTMENTS

Modern Steel Construction (Volume 32, Number 6). ISSN 0002-8445. Published monthly by the American Institute of Steel Construction, Inc. (AISC), One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

Advertising office: Pattis/3M, 7161 North Cicero, Lincolnwood, IL 60646.

Subscription price:
Within the U.S.—single issues $3; 1 year $30; 3 years $85.
Outside the U.S.—single issues $5; 1 year $36; 3 years $100.

Postmaster: Please send address changes to Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

Second-class postage paid at Chicago, IL and at additonal mailing offices.

Grade School.

Introducing the one steel for North America: Chaparral Steel's A36/A57250 steel. This mill-certified steel satisfies multigrade requirements in the U.S., Canada and Mexico. The A36/A57250 steel meets all the specifications of our A36, A572 Grade 50, 44W and 50W. It's everything you like about these grades rolled into one. Plus, it costs the same as the A36, and has the same carbon equivalent range, an important factor for welding and formability. It's also just as easy to get, thanks to our innovative shipping techniques and central location. Call your Chaparral representative today and order the structural steel that makes the grade a number of ways: Chaparral's A36/A57250.

CHAPARRAL STEEL®

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

Looking Beyond The Lowest Bid

A couple of weekends ago, while shopping with some friends at one of the giant discount malls near the Wisconsin border, I stopped in a shoe store to buy a pair of sneakers. There were *easily more than 25 brands, and it would have been easy to spend the* rest of the day trying on shoes. Or, I suppose, I could simply have found the least expensive brand, and bought it.

Fortunately, I have been buying sneakers for a long time, and based on that previous experience, I had already narrowed my choice to three brands. As a result, I managed to choose a shoe and be out of the store in less than half-an-hour.

Unfortunately, most engineers examining bids for steel projects don't have much experience with a wide range of steel fabricators. In an ideal world, an engineer would have the leisure to examine each fabricator's plant to verify their qualifications. But in the real world, given time and budget constraints, engineers are forced to simply choose the low bid.

But there is an alternative—one that many engineers don't seem to know a lot about. It's called the AISC Quality Certification Program. The purpose of this program is "to confirm to the construction industry that a Certified structural steel fabricating plant has the personnel, organization, experience, procedures, knowledge, equipment, capability, and commitment to produce fabricated steel of the required quality for a given category of structural steelwork."

Fabricators are certified in one of three categories: I—Conventional Steel Structures (small public service and institutional buildings, shopping centers, light manufacturing plants, warehouses, sign structures, low-rise structures and simple rolled beam bridges); II—Complex Steel Building Structures (large public service and institutional buildings, heavy manufacturing, powerhouses, stadiums, auditoriums, high-rise buildings, and processing plants); and III—Major Steel Bridges. Incidentally, membership in AISC is not a prerequisite for certification.

For engineers, the program works as a pre-qualification system. Simply include in your project specification that the fabricator must be AISC certified.

You wouldn't buy a pair of shoes just because it was cheap. *Isn't a multi-million dollar construction project worth the same consideration?* **SM**

Bridge Competition Teaches Practical Lessons

The design team waited anxiously as test loads were applied to their bridge model. In an unusual move, the state DOT had required finalists in a design/build competition for a crucial replacement bridge to build scale models, which could then be tested for material weight, estimated speed of construction, construction cost, and, of course, load bearing capability.

The first model to be tested was a King Post design featuring pretensioned cambered beams.

A 750 pound cart—representing a 75-ton truck—had already been pulled across the bridge and the design had responded with a very minimal recorded deflection.

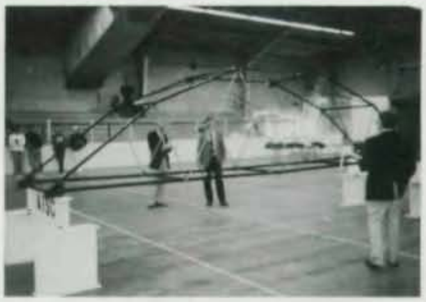
Finally, 2,500 lbs.—representing a 250-ton stationary load—were loaded onto the bridge's center. But as the judges were beginning to take deflection measurements, disaster struck. A beam gave way, and the structure collapsed.

Fortunately, no professional engineer could be blamed for the failure. The bridge design and test were actually part of the AISC Steel Bridge Building Competition for student chapters of ASCE.

The competition is designed to give students the opportunity to design, fabricate and erect a 1:10 scale model of a structural steel bridge. A mock river, complete with riverbanks, safety support abutments, wingwalls, access road and staging yard are created—in this case in the County Forum in Madison, WI. The erection is timed, and students are penalized for entering the river ("a loss of life"), dropping tools into the river ("lost time to repair or replace the item") and for overloading equipment by having individual bridge members too large or too heavy.

The bridges are judged on speed of construction (calculated by actual time multiplied by the number of student erectors), bridge weight, bridge capacity, capacity-to-weight ratio, cost (a combination of material costs and man-hours for erection), and aesthetics.

The competitions are held across the country and typically attract from five to nine competing engineering schools. Now in the sixth year, the competitions are rapidly gaining in popularity and more than 100 schools are scheduled to participate during 1992 (for information on upcoming competitions, contact: Fromy Rosenberg, AISC assistant director of education, at (312) 670-5408.)

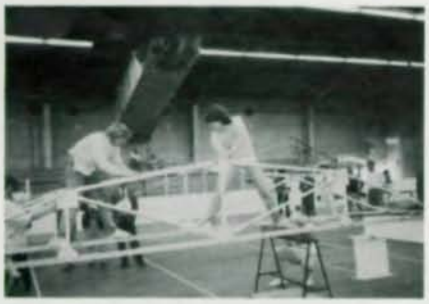


Purdue University's entry, a suspended arch weighing only 190 lbs., won the competition. Photo by Mark Howard

The competition in Madison featured entries from the University of Minnesota, University of Illinois (Champaign-Urbana), Marquette University, Purdue University, and University of Wisconsin (Madison). Supplies for this competition were donated by several fabricators, including AISC-member Zalk Josephs Fabricators.

The King Post bridge from the University of Minnesota had previously won a competition in Platteville, WI, but failed under load in Madison.

"This year's design was a modification of our entry from last year," and reflected a learning curve, according to team leader Andrew Lawver, a fourth year student. While last year the bridge was constructed of 1½" tubes, this year the designers used 1" tubes for the top beam and ¾" tubes for the bottom, which resulted in a bridge weight of only 148 lbs. Also, this



In addition to designing the bridges, the student's were responsible for fabrication and erection. Pictured at top is the University of Illinois bridge and shown above is the entry from the University of Wisconsin. Photos by Mark Howard

year they used a tighter tensioning system to further reduce deflection.

While the design was not ultimately successful, Lawver said the competition is a wonderful learning experience. "The ability to see something go from paper to reality is something we don't normally get to see," he explained.

And of course failure can be a sobering lesson. "It tells you something about designing conservatively," stated Amy Juliot of Purdue, moments after the Minnesota bridge collapsed.

Purdue's bridge, which won the competition, was a suspended arch weighing 190 lbs. "We have a steel design class at Purdue, but we don't learn much about bridge design," Juliot explained. "This competition really taught us a lot. It really tests your knowledge of connections. And the first time we saw it for real was a lot different than seeing it on paper."

Neil Glaser, the University of Wisconsin team leader, agreed about the benefits of the competition. "It's a lot of good experience in that it forces you to design for a whole but to still be aware of the individual pieces. It let's you see what works, and why."

The Wisconsin bridge, a pretensioned inverted deck truss, looked to be a very successful design—until erection difficulties arose. A turnbuckle slipped, and the erection crew had great difficulty reconnecting it. And when the structure was finally loaded, the damaged turnbuckle was too weakened. As it collapsed, Glaser turned to another team member, shook his head, and quietly noted: "Well, we found the weak point."

For Marquette, there were no weak points. The students designed—or rather overdesigned—a 778 lb. overslung truss bridge that easily held the 2,500 lb. test load and looked as though it easily could have supported much, much more. Still, as many practicing engineers will be quick to say, it's better err on the side of caution.

If overdesigning is reflective of real engineering experience, then the complaint of the University of Illinois team may be even more common.

This team also designed a truss bridge, but one that weighed only 427 lbs. Still, Brian Zumbrock, the team leader, was very unhappy with the weight. Echoing the voices of countless engineers, Zumbrock blamed the high weight on a fabrication error. "The fabricators misread the plans and put the channels that supported the deck on the outside, which meant we had to go back and add channels on the inside." Zumbrock did concede, however, that there also were design problems. "We did the crossbracing wrong, which hurt us for lateral deflections."

But despite the problems, Zumbrock was happy to have participated. "It was impressive to see how the pieces go together, rather than just looking at sections. Competing should be a requirement for all civil engineering students so they can learn how their designs will be executed in real life."

"And in addition to being a great learning experience," added Paul Juras from Marquette, "the competition was interesting and a lot of fun."

Multi-certified Steel

Dear Editor:

Your articles in the February issue of Modern Steel Construction emphasizing cost reduction techniques raised much interest in our office. If the letters in the April issue are an indication of the overall reception, I'd say the issue was well received and generated a lot of discussion.

The letter by James L. Wroble from Chaparral Steel [in the April issue] raises two points; one of which I applaud and one that concerns me. First, I am pleased to see the continuation of the trend towards a smaller premium (or none) in the price of A572 Grade 50 steel versus A36 steel. This definitely does help reduce costs for any steel framing design that is strength controlled.

My concern is with the discussion about sections that can be multi-certified for A36 and A572 Grade 50 applications. For general gravity framing this unknown yield strength (but at least 36 ksi for A36) does increase the strength and most likely the safety of the structure. However, for elements that are part of a seismic resisting system, that relies upon predictable behavior of those elements, an uneven increased yield strength may be detrimental to the performance of the system.

For example, an eccentrically braced frame is designed to ensure that the link beam deforms plastically well before the diagonal or column members reach their ultimate capacities. If the link beam was in actuality much stronger than the design assumed, it may alter the behavior of the frame into a nonductile mode such as buckling of the diagonal or column members.

In conclusion, bravo for the tips on cutting project costs. Steel producers, when we specify Fy = 36 ksi steel, please don't send Fy = 50+ ksi and assume you're doing us a service.

Patrick T. Ryan, PE
Principal,
Structural Engineering Manager
TRA
Seattle

J.H. (Ted) Temple, Manager-Structural Products Development, Chaparral Steel Co., responds:

The steel industry has been producing A36 with yields in the 40 to 54 ksi range for several years. The higher figures are an inherent product of electric arc furnace, scrap-based manufacturing (which now accounts for more than 75% of shape and 85% of all section capacity in the U.S.).

Chaparral's multi-certified steel takes advantage of the overlap "window" in the ASTM and CSA specifications for 36, 44 and 50 ksi yield steels through stringent melting and proprietary rolling practices, and complies fully with these standards' chemical and physical requirements. The result is the ready availability of multi-grade steels at A36 prices, which benefits both the manufacturing and construction industries.

The comment on predictable yield behavior for seismic framing is well noted and raises the question of exactly what figure does the engineer use when determining plastic hinge performance criteria—*36 ksi is unrealistic, but the* national average of 47 ksi, while closer to reality, is a product of the highly uneven range mentioned above. Our multi-grade steel, rather than exacerbating the problem, may be the solution as Fy falls consistently between 52 and 56 ksi and Fu between 73 and 78 ksi. This gives the engineer one low-cost steel that provides the closer predictability required for the design of eccentrically braced frame components and the higher strength for the general gravity framing.

In conclusion, our aim is to provide low cost, consistent, high-quality steel—the ultimate service.

June 3-5. **6th Annual National Steel Construction Conference**, Las Vegas. More than 45 seminars and meetings covering every aspect of steel design and construction, including: codes and specifications; computerized design; research; project and shop management; inspection and safety; and fabrication and erection procedures. Trade show features more than 100 exhibitors. Contact: David G. Wiley, AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-5422.

June 8-11. **Seismic Design of Bridges**, Washington, DC. Course includes seismic design, structural dynamics, seismic loading, design concepts, seismic response analysis, bearings and columns, and retrofitting. Contact: Cliff Hopkins at (202) 994-8521.

June 8-11. **A/E/C Systems computer show**, Dallas. Contact: (800) 451-1196.

June 11-12. **Showcase of Innovative Construction Methods and Technologies for Roads and Bridges**, Kansas City. Contact: Dean Testa, Kansas Dept. of Transportation, 915 Harrison, Topeka, KS 66612 (913) 296-3576.

June 15-17. **9th Annual International Bridge Conference**, Pittsburgh. Nine technical sessions, three seminars, a tour of Pittsburgh bridges and an exhibition of bridge products and services. Contact: Melanie Martin, Engineers' Society of Western Penn., Pittsburgh Engineers' Building, 337 Fourth Ave., Pittsburgh, PA 15222 (412) 261-0710.

June 25. **Northeast Steel Bridge Forum**, Albany, NY. Contact: Camille Rubeiz, Steel Bridge Forum, c/o AISI, 1101 17th St., N.W., Suite 1300, Washington, DC 20036 (202) 452-7190.

June 26-28. **CSI Convention and Exhibit**, Atlanta. Contact: CSI, 601 Madison St., Alexandria, VA 22314-1719 (703) 684-0300.

July 7-8. **Welding Structural Design** two-day seminar, Houston. Designed to provide engineers and welding inspectors a greater understanding of weld mechanics and welded engineering structures. Contact: AWS, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, FL 33135 (800) 443-9353.

July 16. **Southeast Steel Bridge Forum**, Columbia, SC. Contact: Camille Rubeiz, Steel Bridge Forum, c/o AISI, 1101 17th St., N.W., Suite 1300, Washington, DC 20036 (202) 452-7190.

August 3-6. **Sea Horse Institute Meeting on Corrosion Technology**, Wrightsville Beach, NC. Contact: LaQue Center for Corrosion Technology, P.O. Box 656, Wrightsville, NC 28480 (919) 256-2271.

August 18-19. **Welding Structural Design** two-day seminar, Miami (See July 7-8).

September 17. **Northeast Bridge Forum**, Trenton, NJ. Contact: Camille Rubeiz, Steel Bridge Forum, c/o AISI, 1101 17th St., N.W., Suite 1300, Washington, DC 20036 (202) 452-7190.

September 22-24. **Fracture & Fatigue Control in Structures** short course, Lawrence, KS. Contact: The University of Kansas, Division of Continuing Education, Attn: Management Programs, Continuing Education Building, Lawrence, KS 66045-2608 (913) 864-3968.

October 5-6. **Central Fabricators Meeting**, Union League Club, Chicago. General topic: fabrication and operations. Contact: LaVerne Duckrow, 7227 W. 127th St., Palos Hills, IL 60463 (708) 361-2338.

October 22. **Southeast Steel Bridge Forum**, Atlanta. Contact: Camille Rubeiz, Steel Bridge Forum, c/o AISI, 1101 17th St., N.W., Suite 1300, Washington, DC 20036 (202) 452-7190.

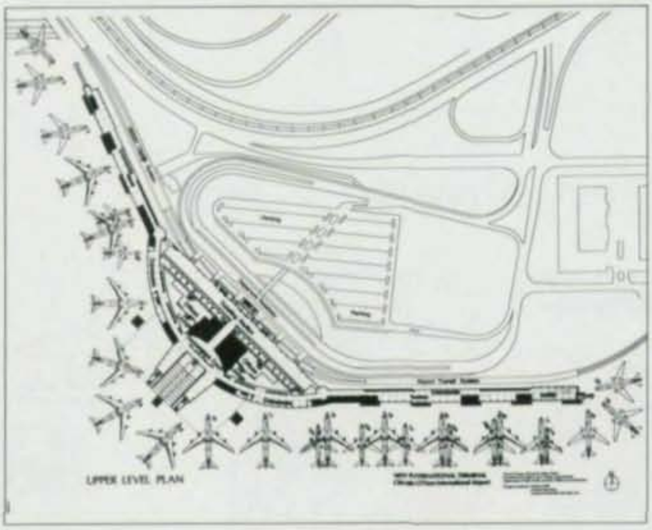
People In The News

Dorothy Owen, chairman of AISC-member Owen Steel Co. in Columbia, SC, has been named one of America's Top 25 Women Business Owners by *Working Woman* magazine. According to the article: "Construction fell 35% last year, putting many inefficient steel mills out of business, but iron-willed Dorothy Owen is holding her own. Owen is modernizing her plants in 5 southern states while a materials oversupply in her industry subsides."

National Steel Construction Conference

O'Hare Airport Landmark

Chicago's new International Terminal continue's the airport's tradition of sensational exposed steel structures



The new International Terminal at O'Hare Airport in Chicago features a gracefully arched roof above large panels of clear glazing.

By David E. Eckmann

Chicago's O'Hare International Airport, in addition to its reputation for handling prodigious amounts of traffic, has gained much repute of late for its beauty. Award-winning recent projects include the United Airlines Terminal and the renovated American Airlines Terminal, as well as a glass-block rapid transit station.

Expected to continue this tradition is the new Permanent International Facility—the last component in a 10-year development program at the airport. The new 21-gate, state-of-the-art facility will replace and triple the capacity of the existing temporary international terminal facility located in the lower level of a parking garage.

The $330 million terminal building has an all-steel superstructure that gracefully encloses expansive public spaces and ably accommodates the complex geometry and functional requirements of the terminal building.

The 15,300-ton steel structure is the first building seen by commuters approaching O'Hare and is intended to establish a landmark at the main entrance to the airport. Located one-half mile from the existing domestic terminals on a 100-acre site, the 1.1 million-sq.-ft. terminal will be connected to the domestic terminals and long-term parking lots by a light rail Airport Transit System (A.T.S.) currently under construction.

Terminal Configuration

The design for the new terminal divides the building into three separate levels: upper; apron; and lower.

The upper level is designed for all enplaning functions. Departing passengers enter the building directly into a 700'-long, 50'-high vaulted ticketing pavilion of exposed steel pipe frames either via an elevated post-tensioned departure roadway, a 160' multi-span pedestrian bridge from the parking area, or from the A.T.S. Passengers proceed from the ticketing pavilion to an elliptical concessions court through the Galleria, which also has a vaulted ceiling framed with exposed pipe. Upon completion of all security checks beyond the concessions court, passengers circulate through concourses to their gate holdrooms.

The apron level serves two functions. The central portion of the apron level encloses all terminal operations, including baggage handling and many of the mechanical and electrical rooms. The outstretched "arms" of the terminal are used as "sterile" corridors at the apron level to transport deplaning passengers to federal inspection facilities (Customs) in the lower level of the central terminal.

More than 80,000-sq.-ft. of the apron level steel framing supports loads from aircraft as they taxi to terminal gates directly above the federal inspection space. Adjacent to the building are an additional 250,000 square yards of new aircraft taxi lanes.

The lower level is primarily used by the Federal Inspection Services (F.I.S.). This space is designed to accommodate up to 4,000 passengers per hour.

The project was designed, financed and constructed by a conglomerate of joint ventures. The design team, called Group One Design, includes Perkins & Will, Heard & Associates, and Consoer Townsend & Associates, all of Chicago. Perkins & Will was the principal architect and engineer on the $489 million project. Terminal Five Venture (T5V), incorporating Gilbane Building Co. as its principal managing consultant, is responsible for the construction management of the project.

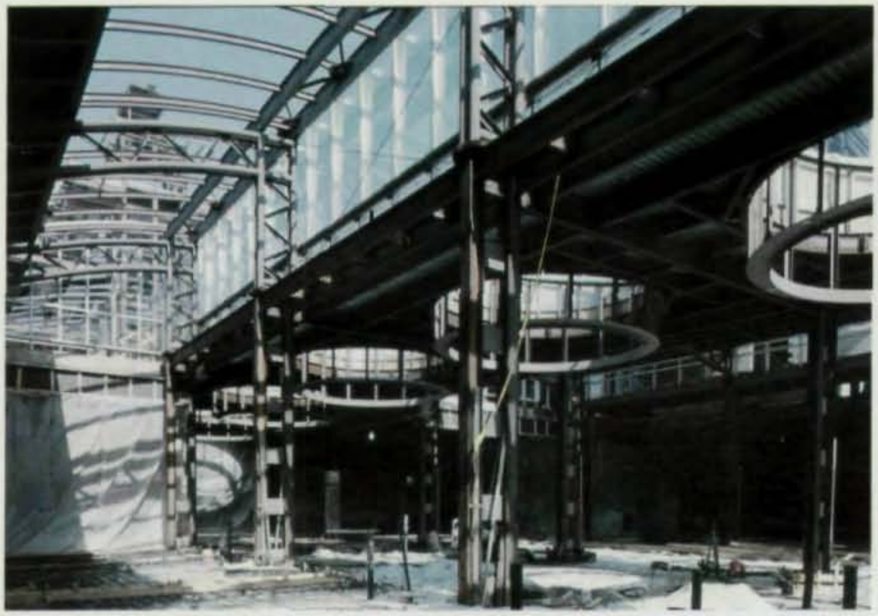
Superstructure

Economics, aesthetics, flexibility and schedule drove the decision to use structural steel framing.

The F.I.S. space required approximately a 30' x 34' rectangular bay size below the apron level, while the curved massing of the central terminal concourses encouraged the use of a radial grid system. This superposition of grids resulted in several hundred column transfers between the roof and foundation.

Several framing schemes, both steel and concrete, were evaluated to determine the most economical system. Composite steel floor framing with metal deck and lightweight concrete slabs was judged to be the most constructable and direct method to accommodate the required column transfers, complex level changes, and variable framing patterns.

Aesthetic requirements for the high-profile public spaces favored the use of framing as "transparent"



At each end of the main ticketing pavilion (above) is a two-story circular rotunda (opposite page) enclosed by a glass curtainwall, allowing a panoramic view. The rotunda roof is supported by five W10 x 112 double-columns at the perimeter of the rotunda. The columns are stiched to each by exposed steel plate spaced vertically at 5' intervals. Photography by Steinkamp/Ballogg Photography.

as possible to achieve the goal of a large, open, light-filled space.

Flexibility of the structure's use was another key criteria for selecting a structural steel system. The design schedule of the project was set up as a "fast track" process with many separate bid packages. The structural framing contracts were bid approximately six months prior to the architectural and M.E.P. contracts. The structural engineers knew that the staggered bid dates would require final coordination of slab openings and would result in additional M.E.P. requirements for beam web penetrations, many of them after initial construction. A structural steel system could reasonably meet these needs. Also, since the airlines were responsible for the tenant build-out within the terminal, a steel structure allowed more flexibility to postpone and later adjust the location of baggage conveyor floor penetrations. Furthermore, the airlines wanted upward expansion capabilities for future use—which again was most practical with a steel system.

Finally, it was vital to accommodate the aggressive construction schedule. The timely erection of the structural steel and metal deck allowed several other trades to begin their work more quickly than if a more time-consuming concrete cast-in-place system had been implemented. The entire structural steel framing for the base building structure was erected in less than seven months.

Supporting Aircraft Loads

The steel framing at the apron level outside of the central terminal covers approximately 80,000 sq. ft. and forms a roof above the below-grade F.I.S. area. Aircraft and tug carts taxi on this framing as they approach the terminal gates.

The restrictive security of the Federal Inspection Agency requires unobstructed spaces to permit a free flow of passengers and baggage. Because diagonal bracing could only be used sparingly, a structural steel rigid framing scheme became the clear choice. A three dimensional rigid frame 170′ x 190′ in plan utilizing more than 2,900 Type 1 moment connections and only eight diagonal braces located in the lower level was designed. The frames, located on each side of the F.I.S. area, support static and dynamic loads of the aircraft, which weigh as much as 875,000 lbs. each. About 80% of the moment connections are field welded

with full penetration flange welds.

The apron framing system consists of 30' x 34' bays framed with A572 Grade 50 W36 x 240 beams spaced at 8'6" on center and supported by W40 x 593 girders. The beams at the perimeter bays of the system were supported in pockets in the foundation wall. The slab system is 23" of normal weight concrete placed on 3" metal form deck. The 5,000 psi concrete slab was topped with an additional 18" of concrete wearing surface.

The rigid steel frame also resists the lateral forces imposed on the concrete wall. The 22 kip per linear ft. reaction at the top of the wall was distributed to the rigid steel frames through the thick concrete slab diaphragm. However, the expansion joint locations further complicate the rigid frame's lateral resistance requirements. Only two adjacent sides of the three dimensional frame system were attached to the perimeter foundation walls and subjected to lateral forces. The other two sides had a continuous expansion joint at the apron level. The unbalanced lateral loading created a torsional moment about the centroid of the three dimensional system. The apron level floor framing was rigidly connected to W14 x 500 Grade 50 columns. Each moment connection of the W36 girders to the columns took approximately six hours of field welding time.

Three dimensional rigid steel frame computer models of the apron framing system were developed using STAAD-III/ISDS analysis software from Research Engineers, Inc. Plate elements were modeled to simulate the apron level diaphragm and loaded with combinations of gravity and lateral earth pressure loads. Column bases were assumed fixed and horizontal displacement was limited to h/500.

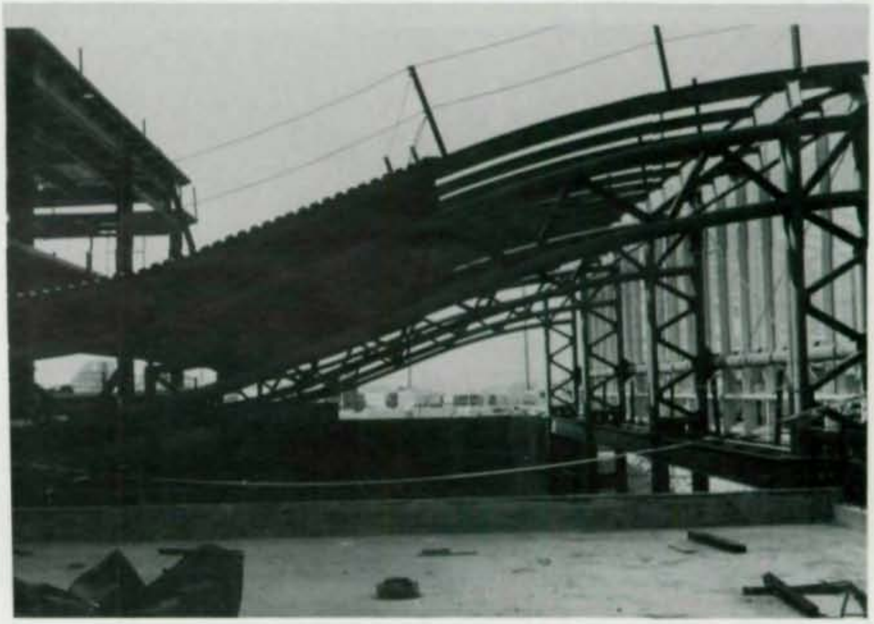
Exposed Steel

Exposed steel was used in several major areas of the new International Terminal, including the ticketing pavilion, main rotundas, end rotundas, A.T.S. platform/skylight, and control tower.

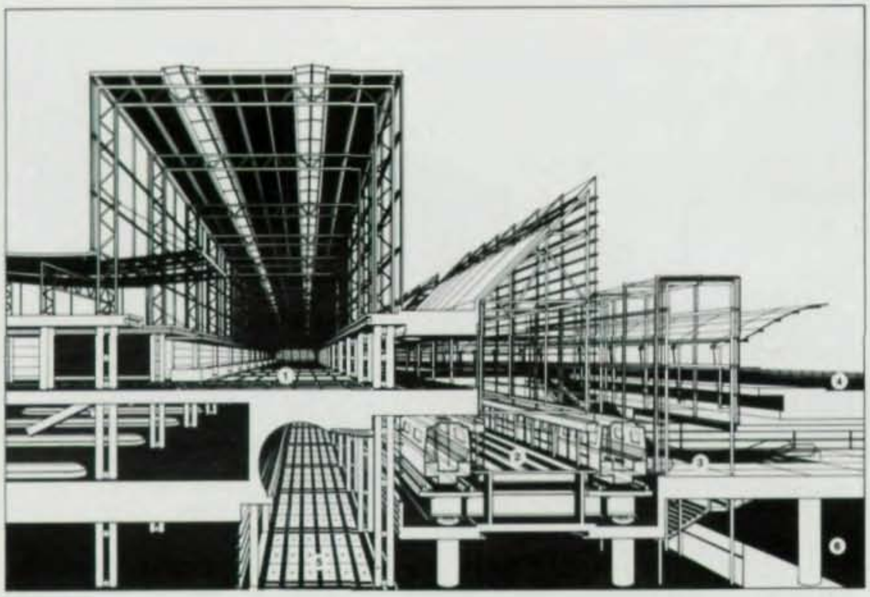
The ticketing pavilion is the most prominent space in the building. Its enclosing structure consists of 28 steel round tubular frames of varying height, which form a vaulted roof line reaching a height of 52′ above the pavilion floor. The slender frames span 50′ across the pavilion and are spaced at 30′ centers.

Each frame has chords consisting of two, 6″-diameter double-extra strong, ASTM Grade B pipes interstiched with 3 x 3 double angle web members. The two pipe top and bottom chords provide strength and rigidity, yet permit the passage of light through the structure, yielding a visual lightness to the frame.

AWS D1.1 (1990) has established a prequalified procedure for welding and inspecting "T" and "K" joint pipe-to-pipe connections which allows the clean welded connection of structural pipes without cumbersome gusset plates or back-up bars. The pipe-to-pipe exposed connections are a theme used on all of the pipe frames throughout the building. The web



AWS D1.1 provides detailed information on welding and inspecting "T" and "K" joint pipe-to-pipe connections that allows the clean welded connection of structural pipes without cumbersome gusset plates or back-up bars. As shown above, the web angles are welded to semi-ciruclar vertical plates that transfer the axial tension and compression forces back to the pipes via three horizontal plates. Shown on the opposite page are curved pipe elements forming a partial arch in the F.I.S. section of the structure.



angles are welded to semi-circular vertical plates that transfer the axial tension and compression forces back to the pipes via three horizontal plates.

The base of each pipe frame terminates on an exposed 1½"-thick, oblong bearing plate. The pipe space frames were analyzed as plane frames (including all diagonals) for gravity and wind loads. Drift due to lateral load was limited to h/500. Diagonal bracing at the pavilion roof was designed to link and distribute some lateral loads between adjacent frames with different heights and varying stiffnesses.

Functional requirements of the building necessitated a change in the steel bay spacing adjacent to the length of the ticketing pavilion. The pavilion frames, therefore, have two different types of supports. One vertical leg of each frame is supported on a set of two W10 x 112 columns, which extend through the building to caissons below. The other vertical leg of each frame is supported on a transfer girder. Since the frame bears on a transfer girder and not a rigid support, the frame stress distribution became more complex than usual. It was necessary to analyze the transferred frame base with a "soft support" approximating the flexural stiffness of the W36 x 135 that supports the frame base.

The same exposed space pipe

frame concept is used throughout other spaces in the building, as well as for the F.I.S. facility roof structure. The F.I.S. frames, however, are curved with linear pipe segments forming a partial arch with 8" diameter pipe girts spaced vertically at 10' spanning horizontally between the pipe frames. The girts distribute the lateral load from the curtainwall back to the pipe frames. The girts were fabricated with end cap plates that matched the curved connection plates on the pipe frames. These identical plates allowed the insertion of shim plates and allow erection tolerance adjustments without compromising the aesthetics of the connection.

Wind Loads

The design wind load on the pavilion structure was 25 psf per Chicago code. Diagonal "kickers" were used to laterally stabilize the highly stressed portions of the frame's panel zones. These kickers connected to the W16 roof purlins that span between the frames. Cross bracing rods were used to resist quartering winds and wind forces parallel to the roof length. The 1½" diameter rods span diagonally between adjacent pipe frames and are connected to the frames by gusset plates and turnbuckles. The rods were pretensioned to minimize sag in the rods due to self weight.

At each end of the main ticketing pavilion is a two-story circular rotunda enclosed by a glass curtainwall allowing a panoramic view. The rotunda roof is supported by five W10 x 112 double-columns at the perimeter of the rotunda. The columns are stitched to each other by exposed steel plates spaced vertically at 5' intervals.

The columns support an exposed radial roof framing system. The perimeter of the roof is a 56'-diameter steel tension ring made up of W18 x35 members curved about their weak axis and moment connected to the perimeter columns. Connected to the perimeter ring, and converging to form a compression ring at the center of the rotunda roof, are 15 wide-flange radial rafters.

Value Engineering At O'Hare Airport

While many structural engineers are reluctant to admit it, consulting with fabricators and erectors can economize the designer's details

One of the largest value engineering decisions made was the deletion of the architectural requirement for prefabricated building columns. Originally, the columns consisted of prefabricated assemblies with loadbearing structural steel members encased in insulating concrete and wrapped with a non-loadbearing steel shell. The steel shell and concrete encasements were intended to protect the exposed columns from damage incurred by baggage carts and motorized vehicles.

However, value engineering between the fabricator and designer determined that cast-in-place concrete column enclosures were more economical on this project and still maintained the desired functional and aesthetic objectives of the prefabricated building columns—but with some important benefits.

With prefabricated columns, the desired outer shell dimension restricted the structural column depth, and thus required some full length cover plates to obtain column stiffness. But the cast-in-place enclosures allowed the design team to use a deeper, lighter column section without additional plates and still achieve the necessary stiffness. The prefabricated columns also would have been more costly to fabricate and cumbersome to erect. And finally, the use of cast-in-place enclosures simplified access to the beam connections at the columns since the prefabricated columns would have required cutting and patching of steel shell pieces at all visible framing connections.

Revising details at moment connections was another cost saving measure. Group One had initially detailed all of the beam-to-column moment connections to be welded. However, it was more economical for the fabricator to use field-bolted moment connections on all members lighter than W24 x 68. AISC-member Havens Steel Co. engineered the bolted moment connections and included them in their original shop drawing submittals.

> The rule of thumb is to never exceed a $\frac{5}{16}$" single-pass fillet weld since multi-pass welds are extremely expensive if installed in the field.

Construction Issues

A major construction-related issue on this project was the thermal movement of the structure prior to permanent enclosure.

Continuous expansion joints were located throughout the building at a spacing that generally did not exceed 210'—though the complex form of the terminal and the locations of high-visibility spaces did not allow an ideal rectilinear layout of expansion joints. Unfortunately, as a result of the high temperature differential between a hot Chicago summer and an icy winter, several hundred erection bolts sheared at the slotted openings prior to the completion of building enclosure.

After extensive evaluation, the design team concluded that the seated connections were adequately slotted to accommodate a plus or minus 100 degree F temperature differential but only if the bolts were initially located close to the middle of the slots and the connections were complete, that is, moment connections were completely connected at rigid frames and anchor bolt nuts were tightened at fixed column bases. But since plumbness tolerances allow vertical variations of L/500, columns and supported beams could still be within allowable tolerances but have bolts fastened at either end of a slot.

Fortunately, this construction issue was no more serious than the shearing of some erection bolts. Remaining beam bearing area was sufficient and concrete floor slabs already in place stabilized all floor systems. The remainder of the erection bolts at expansion joints were removed and "keeper plates" were provided at strategic locations to prevent any slippage off the sides of the seated connections. Still, designers and fabricators would be prudent to consider the cumulative effects of erection tolerances, temperature change for a non-enclosed structure and construction sequences when detailing expansion joints.

Field-Installed Web Penetration

Due to the fast-paced schedule, fabrication of the structural steel was completed before the final M.E.P. systems could be fully designed and coordinated.

One key to economy in field penetrations is to install them while the beams are still readily accessible prior to other trades beginning adjacent work. It is also important to identify all of the penetrations in an area so scaffolding does not have to be re-erected.

Another costly aspect of field-installed web penetrations is the reinforcing plates and weld size used for the reinforcing plates. When reinforcing plates are required at rectangular openings, it is always more economical to use flat plates adjacent to the penetrations than to use bent plates which line the perimeter of the penetration. The size of the weld also determines the economy of the penetration. The rule of thumb is to never exceed a 5⁄16" single-pass fillet weld since multi-pass welds are extremely expensive if installed in the field. It is generally less costly to increase the plate size than to use a multi-pass weld.

Out-Of-Plumb Columns

Field surveys during construction showed that a number of heavy W14 series columns at the F.I.S. area were as much as 1¼" out of plumb after full-penetration-welded moment connections to heavy beams were completed at the column tops. Since the survey was done at about 40 degrees F and the connections were welded in midsummer, thermal change was one suspected cause. However, another possible cause was that the erector welded the connection working from one end of the columns to the other, rather than from the middle out as would have been preferred.

Fortunately, only loose erection bolts were present in the beam webs and column bases were free to rotate until after the large beam/column flange welds were made.

The lesson learned here is that planning and control of field welding sequences for major continuous members and continued field monitoring of the effects of welding and thermal change may forestall major construction headaches.

This article was adapted from a paper given at the 1992 National Steel Construction Conference by David E. Eckmann, a project engineer with Perkins & Will, Chicago. ■

Since 1962, we've helped
And a lot

Over 200 bridges in Ohio are constructed of weathering steel. Most of it produced by Bethlehem.

They use it for the same compelling reasons the New Jersey Turnpike Authority, Maine, Maryland, and numerous other states do.

That's because weathering steel cuts costs both initially and over the life of the structure. Plus, it's attractive and offers engineers broad design flexibility.

Ohio is particularly enthusiastic about the use of weathering steel for appropriate locations in conjunction with their jointless bridges.

They began the jointless concept in the 1930's. Since then, they've refined their jointless designs to the point where joints have been eliminated not just over the piers, but at the abutments, as well.

As a result, drainage problems associated with jointed bridges, such as failure of joint seals, or clogged drains overflowing onto structural members, have been eliminated.

Bridge lengths have also increased. Initially, the limit was 200 ft. Today, it's been increased to 300 ft., and even greater lengths are being constructed.

Engineers in the Buckeye state began using weatheri

Ohio save a lot of money. of paint.

steel in the early 1960's.

Low initial cost and minimum maintenance requirements make it highly competitive with other grades of steel. Also, it's attractive and blends in with its natural surroundings.

Strength is another strong factor. Weathering steel is comparable to ASTM A572 Grade 50 high-strength steel. And with a yield strength that's 38% higher than ASTM A36 steel, weathering steel permits the design of lighter, slimmer, more graceful sections.

What's more, since it's self-healing, the need for painting is ...ually eliminated.

For a copy of our Product Booklet No. 3790, and our latest Technical Bulletin TB-307 on "Uncoated Weathering Steel Structures," contact the Bethlehem Steel sales office, Construction Marketing Division, Bethlehem PA 18016-7699. Or call: **(215) 694-5906.**

You'll discover how we can save you a lot of money. Not to mention a lot of paint.

Bethlehem

National Steel Construction Conference

Eliminating The Guesswork In Connection Design:

Design engineers can reduce fabrication costs by indicating the actual forces on selected building joints

By M.E. Hursey, P.E.

For years, the engineering departments in steel fabrication shops have labored over which of the axial forces shown on design drawings are transferred through the connection. Often, the design engineer directs the fabricator to design for the largest forces shown, but that often results in many overdesigned connections. Or, in the case of moments and axial forces not acting simultaneously, some connections could be underdesigned.

A more cost-effective solution is for the designer to recognize the force during design and note it on the drawings. And, if the building design is electronically transferred from the design engineer to the fabricator, these notations must also be transferred.

This article identifies which building joints typically need clarification and suggests a method of indicating the actual forces for which the connections must be designed.

Figure 1: Plan Trusses Intersecting At The Building's Corner

Figure 1A shows a plan truss with south to north forces. The end diagonal is the same for the truss in Figure 1B, with east to west forces. The reaction for the truss in Figure 1B is shown in Section A-A, where it is integrated into the vertical bracing system at Elevation E. Preferably, the truss diagonal and chord forces should be indicated in plan and the truss reaction shown in elevation.

Combining the two trusses and indicating the larger member force as it would be on the design drawing (Figure 1C) results in joints that cannot be balanced without knowing all the forces. Therefore, the actual axial force to be incorporated into the connection design should be indicated as a transfer force

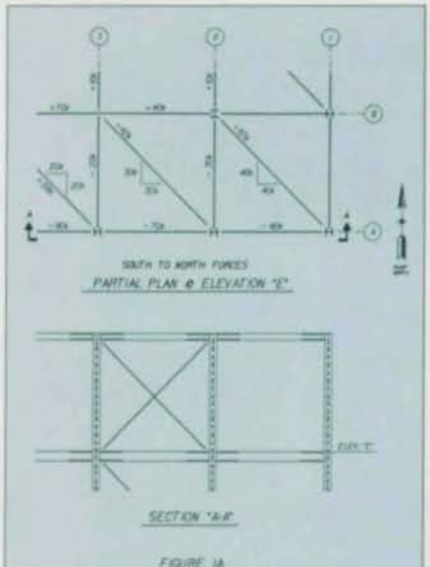


FIGURE 1A

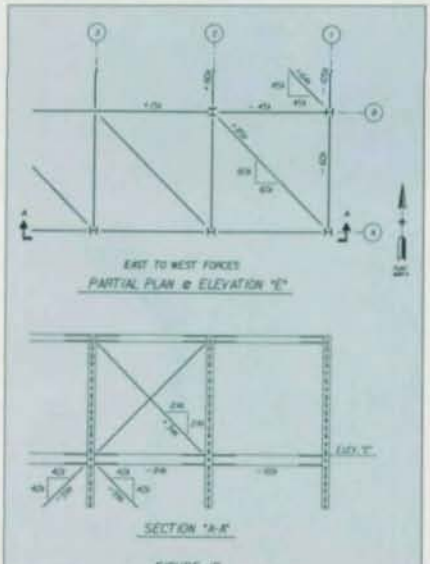


FIGURE 1B

(TF). To avoid clutter, it need only point to the end of one of the two members on opposite sides of the supporting column or beam.

Looking at Figure 1D, it is clear that the connection of beams on line A at column 2 would be designed for the plan transfer force of 40 kips compression if that were the only force to consider. However, the 60 kips compression transfer force shown in Section A-A governs. Conversely, the plan force of 70 kips compression governs at column A-3.

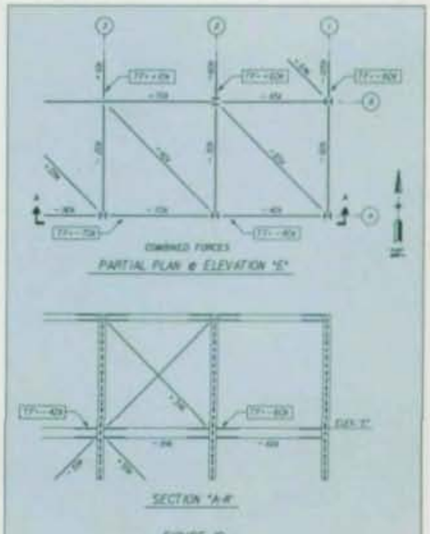


FIGURE 1C

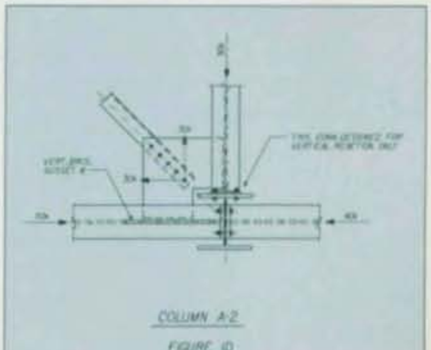


FIGURE 1D

Figure 2: Building With only Three Sides Braced.

Figure 2A shows how confusing the forces can become at a joint when they are introduced from four directions and the structure is braced on only three sides. The combination of forces and of those combined at Column J-6 is shown in Figure 2B.

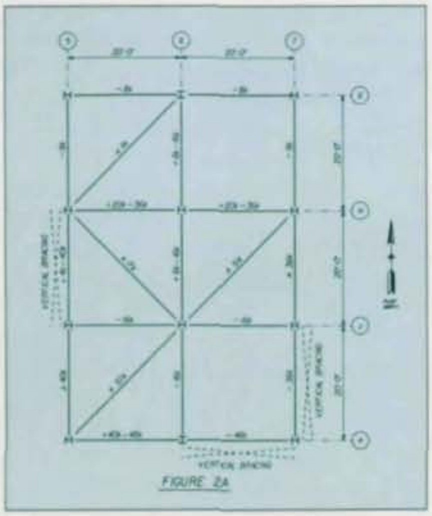


FIGURE 2A

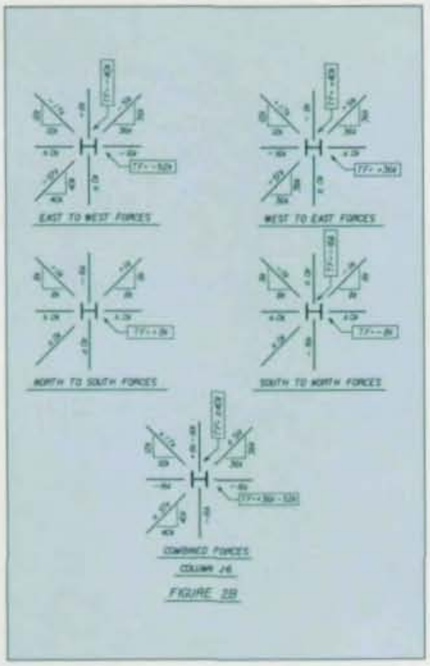

EAST TO WEST FORCES
WEST TO EAST FORCES
NORTH TO SOUTH FORCES
SOUTH TO NORTH FORCES
COMBINED FORCES COLUMN J-6
FIGURE 2B

Figure 3: Transferring Concrete Diaphragm Forces To The Support Steel

When concrete forms are placed under the top beam flange all the beams together are used to transfer the diaphragm forces to the steel. However, when form-deck is used the method of transferring the forces from concrete to steel can be done in many different ways.

Figure 3A uses the concrete bearing on the columns, while Figure 3B uses studs to make the transfer. Whichever avenue the design engineer chooses to transfer diaphragm forces to steel, it should be made clear with member forces and connection transfer forces.

The transfer forces in Figure 3A are different on opposite sides of the column. Most are the same on both sides of a support element (figures 1C, 2B, and 3B). Additionally, *the column web shear, yielding, crippling, and buckling* at line 10 must be checked in Figure 3A if the web is in the plane of the paper. The same column web may have to be stiffened if the web is perpendicular to the paper's plane as shown.

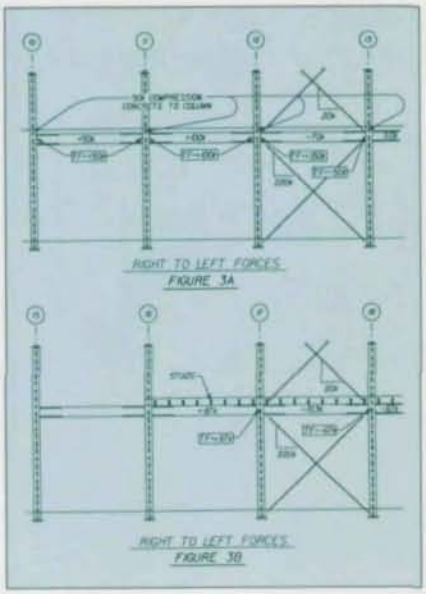
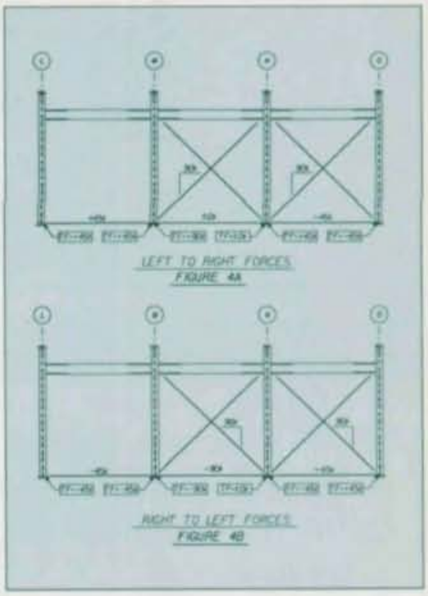

RIGHT TO LEFT FORCES FIGURE 3A
RIGHT TO LEFT FORCES FIGURE 3B

Figure 4: Transferring Bracing Forces To Base Plates

As shown in Figure 4A, 4B, and 4C, the fabricator would not have difficulty in determining that 180 kips divided by four column bases will result in each having 45 kips of shear.

However, in more complicated bracing schemes it is reassuring to know that the math is confirmed by the transfer forces. Figure 4D indicates one method of utilizing the transfer force to determine the weld needed from gusset to base plate.


LEFT TO RIGHT FORCES FIGURE 4A
RIGHT TO LEFT FORCES FIGURE 4B

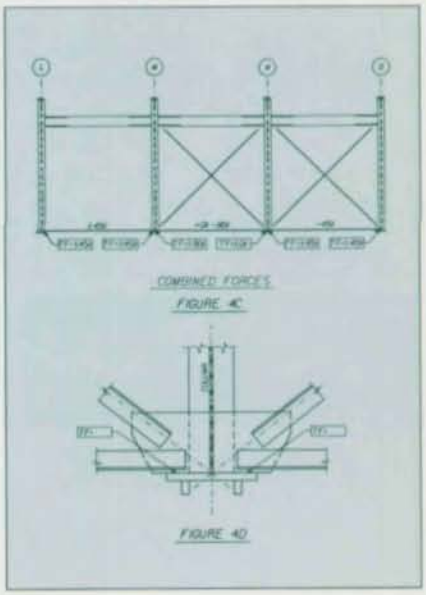

COMBINED FORCES FIGURE 4C
FIGURE 4D

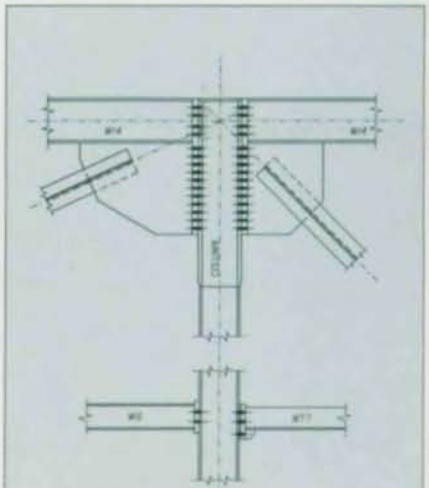
Figure 5: Truss Connections With End Moments And Transfer Forces

The connections shown in Figure 5 could be under-designed if the fabricator is directed to connect for the maximum member forces shown because the moments and axial forces don't always act simultaneously.

These fixed end trusses may experience higher bolt tension due to wind or earthquake without the live load present. Using transfer forces in this case is not the answer. These type of connections are best designed by the engineer of record who has access to all of the loading combinations. If the fabricator is to design these connections, the complete joint analysis must be made available in order for fabricators to determine which combinations must be used.

Also note that a heavier column section can be spliced-in at the top replacing the original column section, if it is found to be less expensive than adding needed reinforcing.

This article was adapted from a paper given at the 1992 National Steel Construction Conference by Martin E. Hursey, P.E., a staff engineer with CRSS Sirrine Engineers, Inc., Greeville, SC. ■



Eliminating The Guesswork In Connection Design:

Communication of design requirements between fabricator and engineer is crucial for a safe and economic structure

By W.A. Thornton, Ph.D., P.E.

National Steel Construction Conference

For the proper design of connections, a large amount of information is needed, ranging from bracing forces to column splice loads. But because of constraints on time and money, "released for construction" drawings are seldom complete regarding connections. Unfortunately, this can lead to errors affecting both safety and economy.

Shear Connections

The most common connection on all jobs is the shear connection. Ideally, the engineer should give the shear for every beam end. While this may appear to be a lot of extra work, it is not as difficult as it first seems since the loads are known from sizing the beams. Why not put them on the drawing? (In addition to helping the fabricator, having the loads used in the original design right on the drawing is very handy for future renovations.) If the loads are shown for every beam end, there is very little room for error, and the connections will be as economical as possible.

However, instead of actual loads, most jobs these days have one or more of the statements regarding shear connections:

- Item 1. All shear connections shall contain the maximum possible number of rows of bolts;
- Item 2. Design all shear connections for ½ UDL;
- Item 3. Design all shear connections for the shear capacity of the beam;
- Item 4. Minimum design loads for standard rolled shapes, unless noted otherwise:

W8 C8	10 kips	W21	65 kips
W10 C10	15 kips	W24	75 kips
W12 C12	25 kips	W27	90 kips
W14 C15	35 kips	W30	125 kips
W16	45 kips	W33	140 kips
W18	55 kips	W36	175 kips

Let's consider each of these.

Item 1 requires "full depth" connections.

The fabricator assumes the engineer has reviewed his design and the capacity of these connections will exceed the actual loads in all cases. But in many cases, these will be uneconomical, as with long span beams. In other cases, it may be unsafe.

Suppose a beam has a large cope, as when connecting a small beam to a large one (see Figure 1). This may greatly reduce the capacity of the full depth connection because of the reduced beam section. Has the engineer considered this, or has he reviewed his drawings by checking the actual load against the capacity of a full depth connection on an uncoped beam? It is very likely that he has done the latter. As a second example, consider steel at different elevations.

Figure 2 shows a "full depth" connection for the upset W18x35. The capacity of this "full depth" connection is 20k, whereas a true depth connection for the W18x35 (Figure 3) is 49k. Will the engineer realize this if he specifies "use the maximum possible number of rows"?

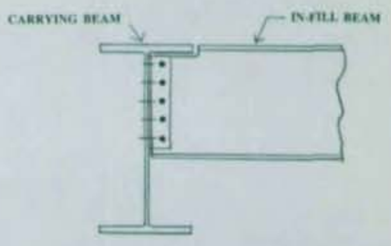


FIG. 1 USUAL BEAM TO BEAM CONNECTION
TOP OF STEEL AT COMMON ELEVATION

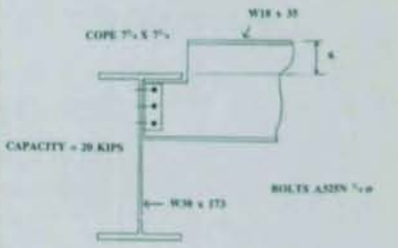


FIG. 2 "FULL DEPTH" CONNECTION FOR UPSET BEAM

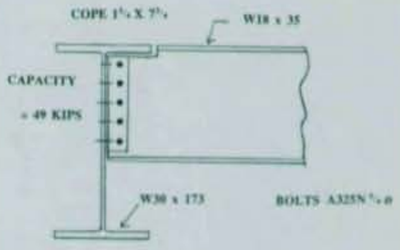


FIG. 3 NORMAL FULL DEPTH CONNECTION

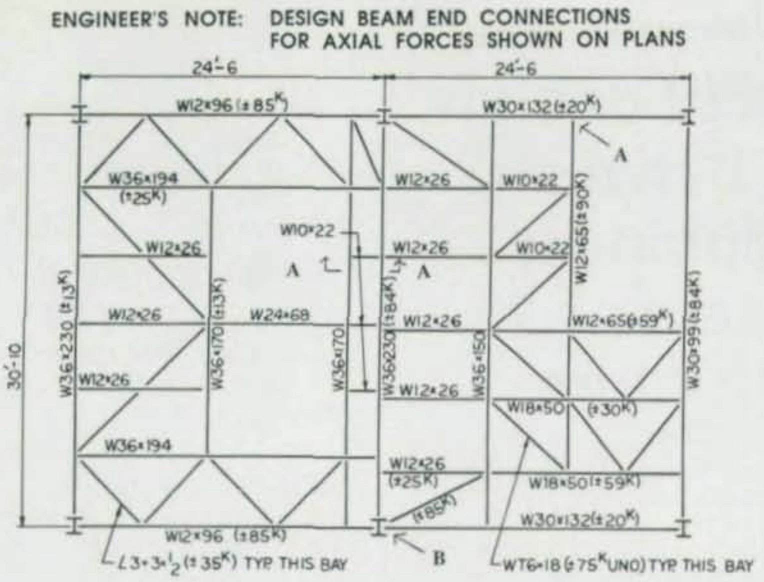


FIG. 4 AMBIGUOUS FORCES FOR CONNECTION DESIGN

Item 2, "design for ½ UDL" is the most commonly used method for shear connection design (the factor ½ may be ¾ or more for composite design). It is usually safe, but not always.

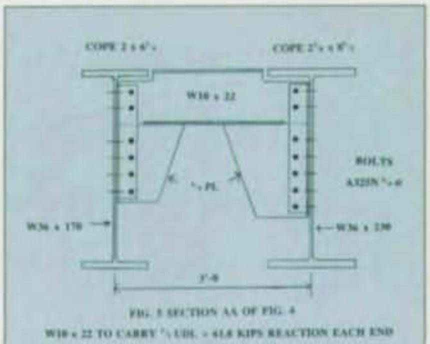


FIG. 5 SECTION AA OF FIG. 4

If in-fill beams frame near the ends of a main beam, the UDL method can be unsafe. If beams are short, it will be uneconomic. Figure 4 shows a partial floor framing plan. All beam shear connections are contractually required to be designed for ½ UDL. The three W10x22s framing between the W36x170 and the W36x230 are 3' long. The ½ UDL reaction is 61.8k! Of course, this is ridiculous—but the fabricator is contractually obliged to supply it if the engineer insists, and we have done jobs where the engineer did just that. Figure 5 shows the resulting connection. Note that the shear capacity of a W10x22 is only 35.4 kips, so designing for 61.8 kips is doubly ridiculous and leads to a discussion of Item 3.

Item 3 requires the coonection to develop the shear capacity of the beam, but this is impossible with the usual shear connections (single clips, double clips, shear end plate, shear tab) unless the beam is haunched or web doublers are used.

Also, since most beams are coped, just what is the "shear capacity" of the beam? Is it the uncoped capacity (35.4 kips for the W10x22 shown previously) or should the capacity of what is left be used?

It's clear that Item 3 is ambiguous, which can lead to errors affecting safety as well as result in ridiculous designs. In Figure 6, the W10x22 of Figure 4 has end connections good for 35.4 kips, which means the W10x22 is capable of supporting *35.4 tons*! Obviously, these W10x22s are just intended to reduce the unbraced length or provide decking support. If a real load of 35.4 tons must be carried, a short W18x35 with five rows of bolts would be cheaper and safer.

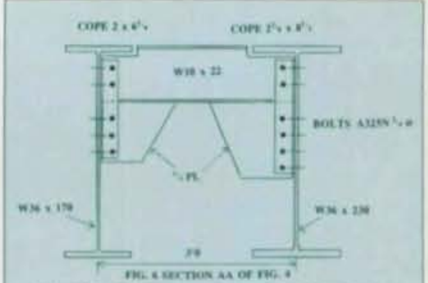


FIG. 6 SECTION AA OF FIG. 4

W10 x 22 TO CARRY MAXIMUM UNCOPED SHEAR CAPACITY OF 35.4 KIPS AS REACTIONS AT EACH END

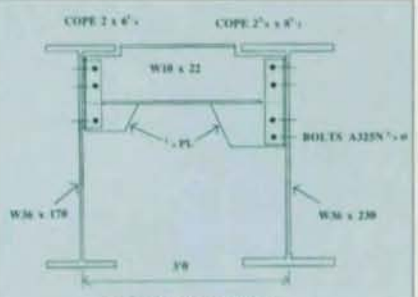


FIG. 7 SECTION AA OF FIG. 4

W10 x 22 TO CARRY 15 KIP REACTION EACH END

While at first glance Item 4 appears to be innocuous, try to develop 15k in the W10x22 shown previously. Figure 7 results.

Bracing Connections

There are many ways to design bracing connections, some more economical than others. For a discussion on economic connections, see the February 1992 issue of *MSC*. The topic here is "connection interface forces," also generally referred to as "transfer forces."

Figure 8 shows a typical ambiguous situation. How much of the bracing forces to the left of the column are transferred to the right of the column at Point A? This force is the "transfer force."

Faced with this situation, the fabricator can perform analyses as shown in Figures 9 and 10 for assumed simultaneous and non-simultaneous loads. This results in possible transfer forces varying from 223k to 23k. Without further information from the engineer, the fabricator has no choice but to design for 223k, which will be safe but very expensive. The connection design strategy, based on ignorance, is shown in Figure 11!

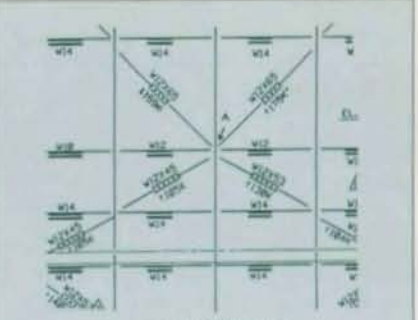
This problem occurred on an actual job, and when the engineer realized our problem, told us the transfer force at Point A was 30k (Figure 12) and proceeded to provide the TF force at all ambiguous points on his drawings. Obviously, designing for 30 kips rather than 223 kips is much more economical as well as being safe. It is a design based on knowledge rather than ignorance.

For another example of an ambiguous situation, again consider Figure 4. This shows axial forces of the beams along with the engineer's note:

"Design beam end connections for axial loads shown on plans."

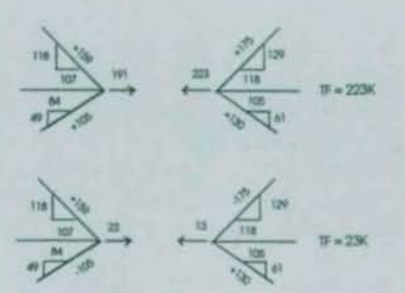
The framing plan shown is from an actual job and is not a partial plan, that is, no other beams frame to it other than those shown. So there are certain points, such as point A, where designing for the axial force makes no sense because there is no place for the 90k load to go.

When the engineer was queried about this, he was annoyed and sent us a Fax stating: "Design beam end connections for axial loads shown on plans." He repeated the note on his drawing and was basically saying, "Do what you are told, dumb fabricator!" We said OK, that means at Point B we design the beam to column connection for 20 kips, right? He repeated his earlier Fax. Now, at Point B there happens to be a brace with 85



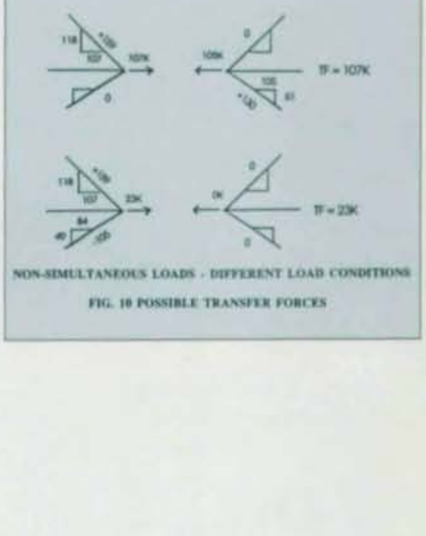
PARTIAL ELEVATION

FIG. 8 WHAT IS THE TRANSFER FORCE AT POINT A?



SIMULTANEOUS LOADS - SAME LOAD CONDITION

FIG. 9 POSSIBLE TRANSFER FORCES



NON-SIMULTANEOUS LOADS - DIFFERENT LOAD CONDITIONS

FIG. 10 POSSIBLE TRANSFER FORCES

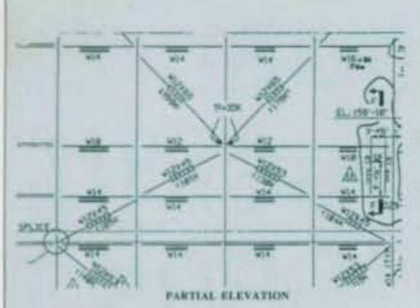


FIG. 12 TRANSFER FORCE IS 30 KIPS PER ENGINEER

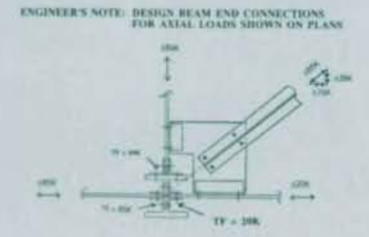


FIG. 13 CONNECTION DESIGN FORCES BASED ON ENGINEER'S NOTE

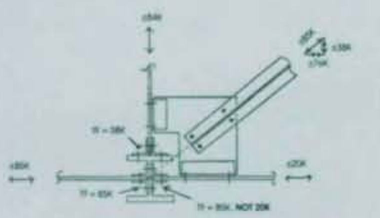


FIG. 14 CONNECTION DESIGN FORCES ARE CLEAR BECAUSE TRANSFER FORCES ARE GIVEN

FIG. 15 CONNECTION DESIGN FORCES ARE CLEAR

Figure 11
Connection Desgin Strategies Based On Ignorance

Assume The Worst, Hope For The Best!

When In Doubt, Make It Stout!

Use "Belt And Suspenders"

kips in it and the engineer provided the usual detail of a wraparound gusset as shown in Figure 13. So we sent a copy of Figure 13, showing how his NOTE would be interpreted in this case. When he saw this, he finally paid attention and said, no, he wanted 85k between the beam and column as shown in Figure 14. We agreed that was right, but that 90 kips at Point A was wrong. He agreed and changed his drawing to Figure 15, where the transfer forces are clear.

In summary, unclear transfer forces are sometimes uneconomical, as in the first example, but also can be unsafe, as in the second example.

Guesswork can lead to a lack of economy and should be tolerated by no one in the construction process. One way to eliminate guesswork is to provide loads and a clear description of how they travel throughout the structure. For shear connections, loads only are required; for bracing connections, transfer forces are required in addition to the brace force itself.

This article was adapted from a paper given at the 1992 National Steel Construction Conference by William A. Thornton, Ph.D., P.E., Chief Engineer, Cives Steel Co. ■

National Steel Construction Conference

Shortspan Bridge Design In The 1990s

Field inspections show that about 40% of the nearly 600,000 bridges in the U.S. are in need of repair and replacement, and 90% of these are shortspan bridges

By J.M. Montgomery, Jr., P.E., C.D. Gorman, P.E., and R.P. Alpago, P.E.

While many designers think of steel primarily for its advantages in bridge superstructures, it also can be beneficially used for the entire structure, from the foundations up through the deck.

Substructures

Steel Pipe Piers. In recent years, steel pipes have begun to gain acceptance for pier construction. For example, in 1989, the Pennsylvania Turnpike Commission selected 18"-diameter steel pipes for the pier **shafts** on the overpass at Mile Post 134.2 in Bedford County. Turnpike engineers, citing the harsh Pennsylvania winters and damaging effects of salt spray on concrete, elected to use steel substructures because of their durability and easy maintenance. The steel piers also speeded the project schedule, since construction could proceed immediately, without the typical delay for curing of cast-in-place concrete piers and the "stripping" of forms. To date, the Turnpike Commission has built four of these bridges with four more planned.

H-Piling. Steel "H"-piling is commonplace in the support of

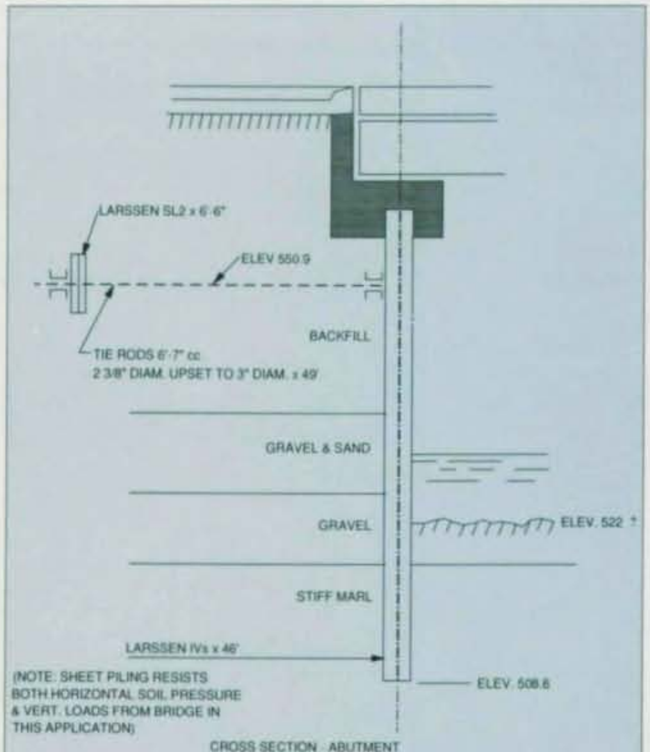


FIGURE 1 - EUROPEAN SHEET PILING ABUTMENT APPLICATION (ADAPTED FROM SACILOR REFERENCE 1)

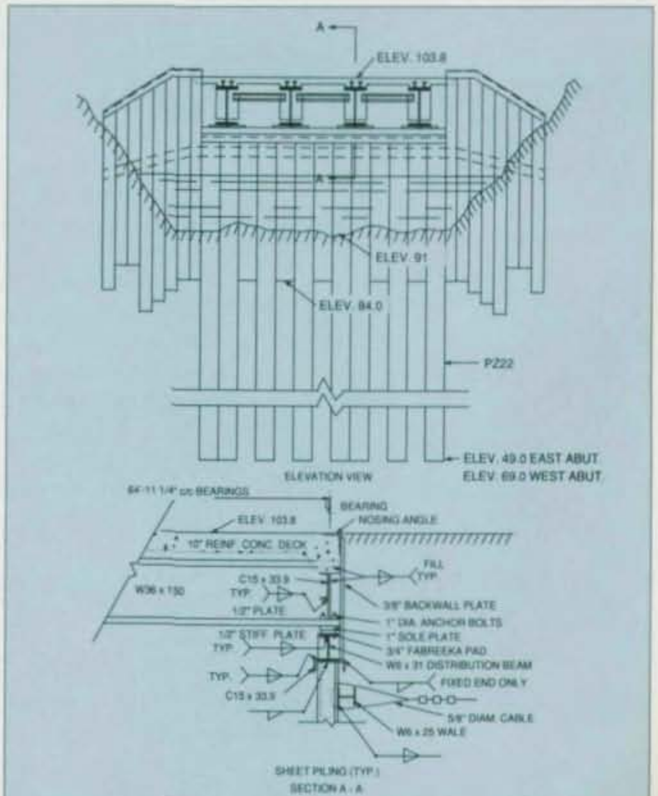


FIGURE 2 - BANKS ROAD BRIDGE, TOMPKINS COUNTY, NEW YORK

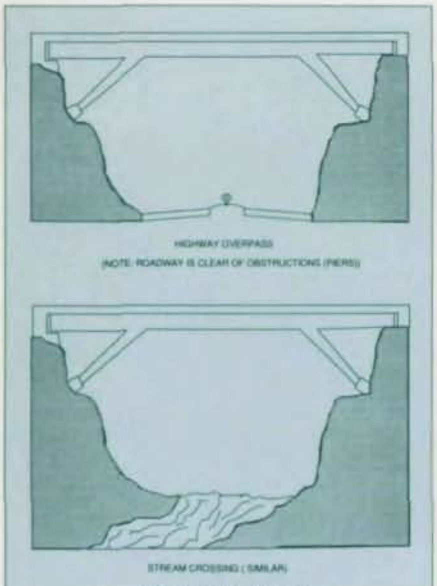


FIGURE 3 - SLANT LEG STEEL PIERS

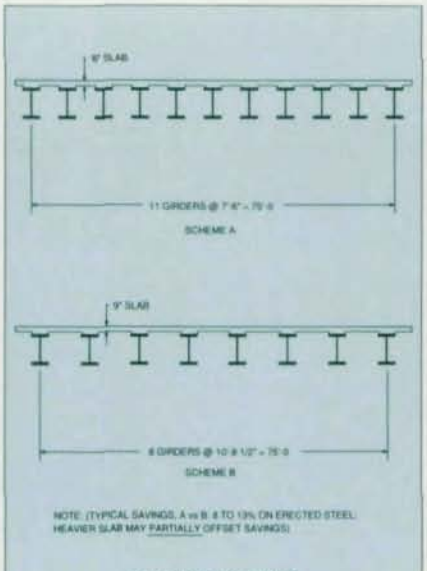


FIGURE 4 - WIDER GIRDER SPACING

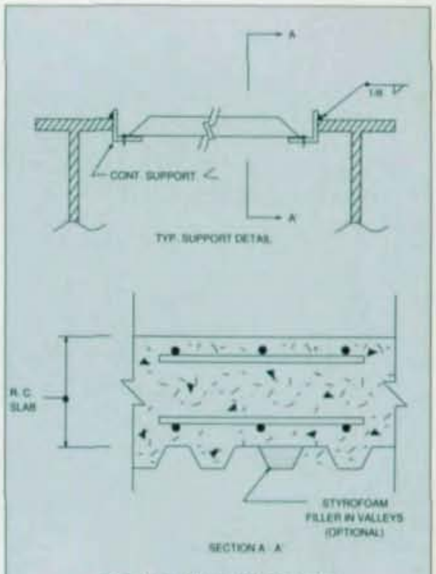


FIGURE 5 - PERMANENT METAL DECK FORMS

pier and abutment footings. This product is available in 8" to 14" depths from domestic mills. The flexibility of H-piling has been used to gain advantage in Integral Abutment (jointless) bridges, which will be covered later.

Sheet Piling Abutments. Sheet piling (Figures 1 & 2) has been used extensively for years in Europe for bridge abutments and wing walls in both rural and urban settings. However, while European engineers utilize sheet piling for permanent applications, many U.S. engineers tend to view sheet piling as a temporary construction material.

The advantages of sheet piling for bridge owners include:

- The sheeting can be readily installed by "in-house" forces.
- Very quick erection.
- Low maintenance costs.
- Excellent scour protection—a feature of increasing importance for consultants and owners.

For ease of driving the sheets, structural performance and long-term durability, a minimum sheet piling thickness of ⅜" is recommended. While it is common practice to leave the sheet piling uncoated for fresh water applications in rural sites, the material can be readily painted.

Slant-Leg Piers. Many turnpike operators and state DOTs have chosen "slant-leg" piers (Figure 3) for overpasses and river crossings. This treatment yields not only a slim, "streamlined" appearance, but also clears the piers from highways or waterways—eliminating a potentially hazardous obstacle.

Superstructures

In *Steel Bridges: The Best Of Current Practice* (AISC-1985), a number of cost efficient design practices are described.

Load Factor Design (LFD) can net a 5% to 10% savings for shortspan bridge superstructures compared with working stress design (WSD).

Continuous Spans are more efficient than a series of simple spans and eliminate many potential deck joint problems.

Wider Girder Spacings lead to fewer pieces to fabricate, ship and erect (Figure 4). Note, however, that the wider spacing may result in the need for a heavier, more expensive concrete slab, which could partially offset some of the savings.

Galvanized Permanent Metal Deck Forms can reduce deck costs. They help speed the construction schedule and also provide a safe working platform for bar placers and other craftsmen (Figure 5). These forms further enhance jobsite safety by reducing the amount of form removal required from the underside of the bridge—a potentially hazardous operation.

Engineers have long been aware that this forming system may also provide a significant amount of lateral support to the top compression flanges of steel girders and rolled beams during construction. A testing program is currently underway at the University of Texas to help quantify this lateral support.

Unpainted A588 Weathering Steel can yield a first cost savings of 10% or more over a comparable painted A572 Grade 50 scheme, plus a substantial long-term savings through reduced maintenance painting. In addition, there are environmental benefits since emissions from paint systems is virtually eliminated. More information on weathering steel is available in the Federal Highway Administration publication: "Uncoated Weathering Steel in Structures," Technical Advisory T5140.22.

Field inspections by an AISI Task Group revealed that the vast majority of problems with unpainted weathering steel resulted from the interruption of the intended weathering process due to the passage of brine through open deck joints and down onto the steel. Bridge owners can avoid this problem by setting up two lines of defense: placing troughs beneath the joints to divert the salt-laden water off the structure; and painting the steel a color closely matching the unpainted A588 for a short distance—5' to 10'—out from the joint. This partially painted section is provided in case the troughs clog or

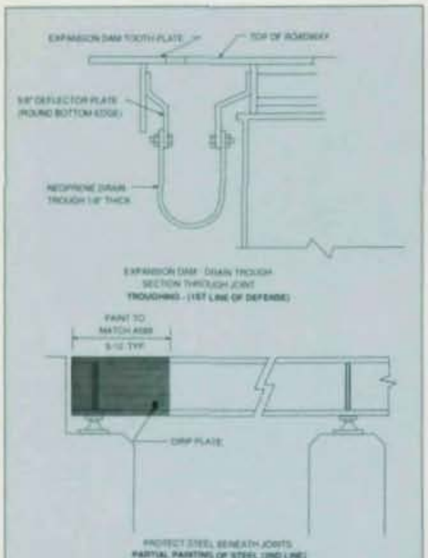


FIGURE 6 - BRIDGE PROTECTION AT JOINT (A588 WEATHERING STEEL)


Unpainted A588 weathering steel was used for this stream crossing in Green, ME. Photo by Peter Wing.

malfunction (Figure 6).

Jointless Bridges, also known as "Integral Abutment" structures, have been built in many states to avoid the problems associated with deck joints (Figure 7). Combining unpainted A588 weathering steel with the Integral Abutment concept can yield bridges with both low first costs and low maintenance costs. Ohio is currently building jointless bridges up to 300′ in overall length and Tennessee has gone as long as 400′.

Autostress Load Factor Design (ALFD), also known as the "Autostress" method, offers potential weight savings as well as reduced fabrication costs and is based upon the ability of continuous steel bridge members to automatically adjust for effects of controlled local yielding.

Previous analytical and empirical studies of this ability were confirmed in the late 1980s via testing of a model 40% of the size of a typical two-span plate girder bridge. The two-year test showed that the Autostress criteria are sufficient for service load, overload and maximum load levels. Also, modular prestressed concrete deck panels performed satisfactorily over the entire range of loadings. These panels offer potential savings in bridge rehabilitation as well as new construction.

The ALFD method has been used successfully by the New York, Tennessee and Maine DOTs.

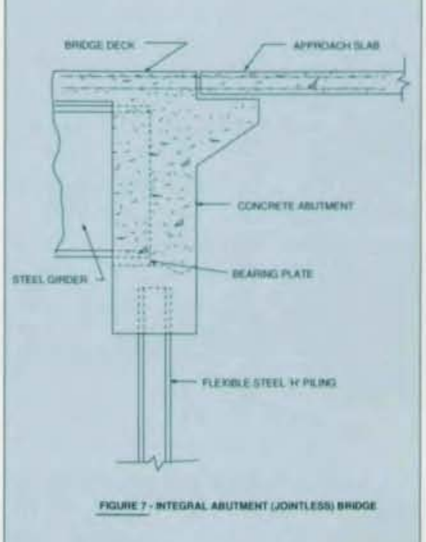


FIGURE 7 - INTEGRAL ABUTMENT (JOINTLESS) BRIDGE

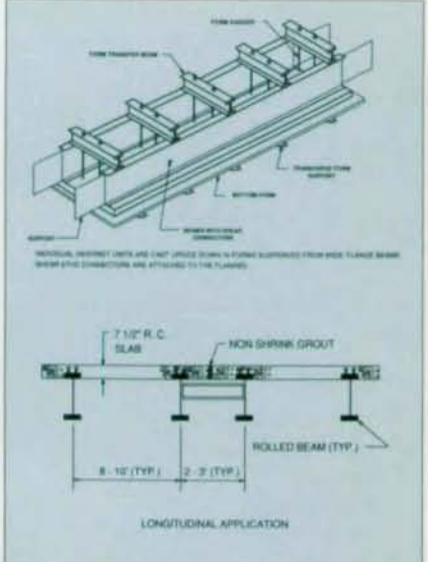


FIGURE 8 - "INVERSET" MODULES FOR BRIDGES

Superstructure Types

Rolled Beams have long been a viable option for shortspan bridges and are now available domestically in 36" depths up to 393 plf., and in 40" depths up to 264 plf. ASTM A36, A572-50, and A588 all are available.

Inverset Prestressed Modules, a concept developed in Oklahoma, involves modular units cast with rolled beams in the upside down position (Figure 8). This production method, with forms suspended from the beams, prestresses them, and thus requires significantly less steel than that needed for a traditional design. This system offers the engineer a low-cost option with minimum construction time and a concrete deck of higher quality, as the modules can be produced in the shop. More than 60 of these structures are now in service. The modules can be applied parallel with the traffic flow or transversely, as was done in the rehabilitation of the Rockwell Falls Bridge in Saratoga County, NY. In the latter case, small concrete diaphragms were place between adjacent modules to insure load transfer and an asphaltic wearing surface was installed for added protection. (For more information, see "Upside-Down Casting Combines Advantages Of Steel And Concrete," March 1991 *MSC*.)

Welded Plate Girders enable the designer to tailor the members for each bridge, resulting in less weight than that required for a rolled beam option. Pricing for both schemes is recommended.

Steel Trusses offer the owner a bridge with an aesthetic profile, light weight and maximum waterway opening. Often, existing abutments can be modified to accept the trusses. There are hundreds of these structures in service.

(For more information on the use of steel for short span bridges, see "Steel Proves Economical For Short Span Bridges", July 1991 *MSC*.

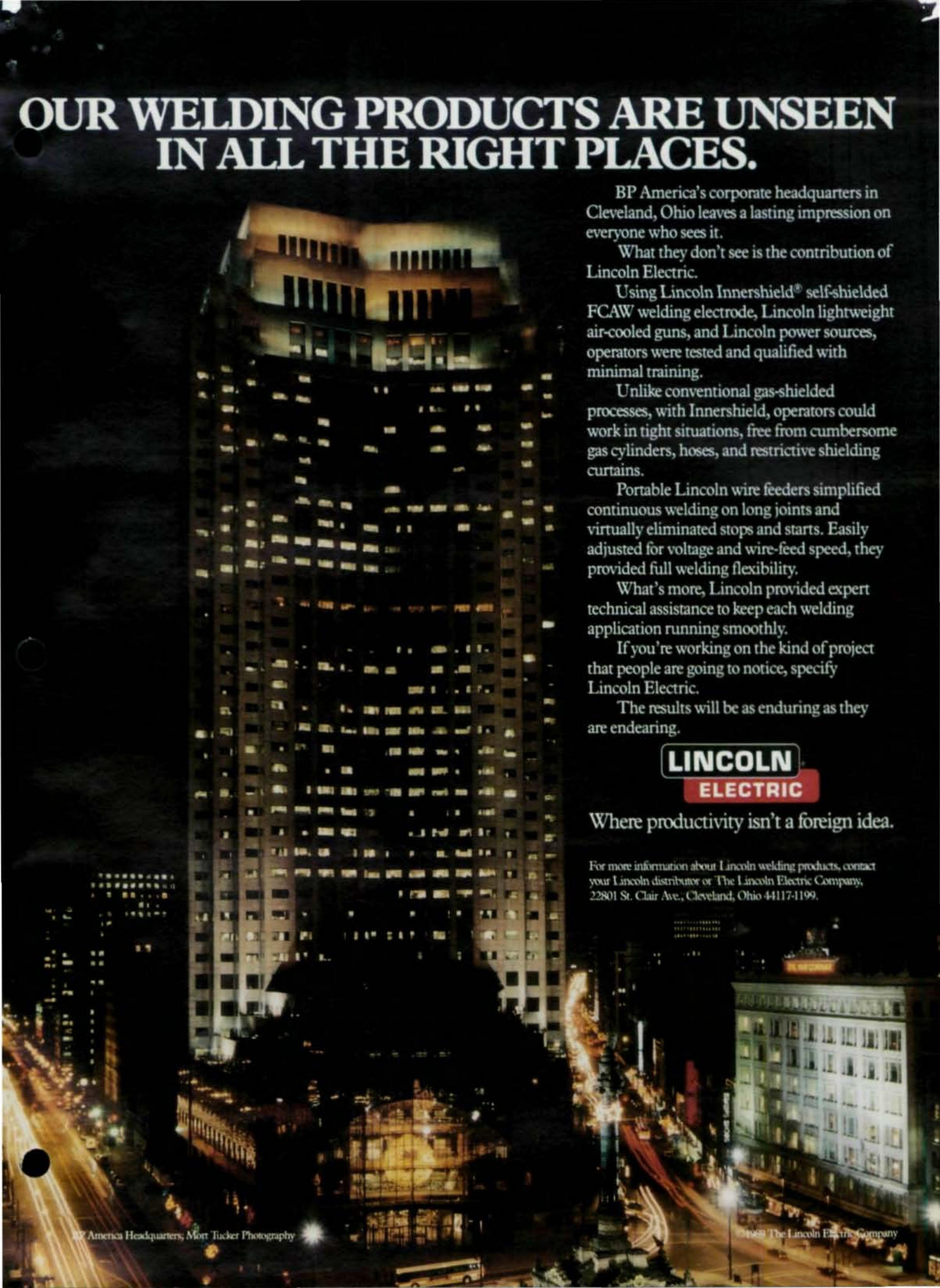
Deck Types

The type of deck selected for a shortspan bridge can have a significant effect on it overall economy and performance. Fortunately, steel members can accommodate most deck systems the engineer wished to consider.

To enable owners to objectively compare deck systems, a task group from the Steel Bridge Forum has suggested the use of a Bridge Deck Rating Matrix. The maxtrix can systematically rate and compare bridge decks (cast-in-place concrete, precast concrete panels, open steel grid, concrete-filled grid, concrete-filled steel grid, exodermic, and steel orthotropic) for given projects. Importance factors, on a scale of 1 to 10, are assigned to a comprehensive list of 15 review criteria, such as weight of deck, cost of traffic maintenance, first cost, and annualized life cycle cost. A Final Weighted Rating is then computed for each deck, with higher numbers indicating a more favorable rating.

To enable engineers to use the matrix, low density floppy disks are available from AISI for $10, including shipping and handling. Contact: Claudette Pinkney, AISI, 1101 Seventeenth St., 13th Floor, Washington, DC 20036. The disk serves as a Lotus 1-2-3 template for IBM-compatible PCs.

This article was adapted from a paper given at the 1992 National Steel Construction Conference by: James Montgomery, P.E., Bethlehem Steel Corp.; Stanley J. Grossman, P.E., Grossman & Keith Engineering Co., Norman, OK; and Ted Temple, P.E., Chaparral Steel. ■


OUR WELDING PRODUCTS ARE UNSEEN IN ALL THE RIGHT PLACES.
BP America's corporate headquarters in Cleveland, Ohio leaves a lasting impression on everyone who sees it.
What they don't see is the contribution of Lincoln Electric.
Using Lincoln Innershield® self-shielded FCAW welding electrode, Lincoln lightweight air-cooled guns, and Lincoln power sources, operators were tested and qualified with minimal training.
Unlike conventional gas-shielded processes, with Innershield, operators could work in tight situations, free from cumbersome gas cylinders, hoses, and restrictive shielding curtains.
Portable Lincoln wire feeders simplified continuous welding on long joints and virtually eliminated stops and starts. Easily adjusted for voltage and wire-feed speed, they provided full welding flexibility.
What's more, Lincoln provided expert technical assistance to keep each welding application running smoothly.
If you're working on the kind of project that people are going to notice, specify Lincoln Electric.
The results will be as enduring as they are endearing.
LINCOLN ELECTRIC
Where productivity isn't a foreign idea.
For more information about Lincoln welding products, contact your Lincoln distributor or The Lincoln Electric Company, 22801 St. Clair Ave., Cleveland, Ohio 44117-1199.
BP America Headquarters; Mort Tucker Photography
© The Lincoln Electric Company

National Steel Construction Conference
EXHIBITOR PRODUCTS

Assigned booths as as May 1, 1992:

Exhibitor	Booth
American Galvanizers Association	214
American Institute for Hollow Struct. Sections	105
American Punch Co.	314
American Welding Institute	TBA
American Welding Society	215
Arkansas Steel Processing	216
ASC Pacific, Inc.	407
Brisard Machine Inc.	316
CANAM Steel Corporation	404
CNA Insurance	TBA
Controlled Automation	903
Daito Seiki Co., Ltd.	901C
Design Data	309/310/409
Dogwood Technologies	602/701
Egypt Structural Steel Processing Corp.	609
ELCO Industries, Inc.	419
Elite Equipment, Inc.	608/610/707/709
Franklin Manufacturing, Inc.	102/104
Hub Machine & Tool, Inc.	902
Inorganic Coatings, Inc.	502/504/601/603
ITW Buildex	308
Kaltenbach Corporation	415
The Lincoln Electric Co.	421
Lohr Structural Fasteners	301B
MetalMizer	507C
Mid-South Bolt & Screw	203
Mi-Jack Products, Inc.	802
NAPtech, Inc.	313
National Institute of Steel Detailing	210
Nets That Work	307
NSS Industries	201
Nucor Fastener Division	109/111/113/115/117
Nucor Building Systems	109/111/113/115/117
Nucor-Yamato Steel Company	109/111/113/115/117
Pangborn Corporation	403/304
Peddinghaus	514+
Ram Analysis	510
RASteel-Havens International, Inc.	803
Research Engineers	402/501
St. Louis Screw & Bolt Co.	320
Service Supply	413
Softdesk	208
Southern Coatings, Inc.	408
Steel Solutions, Inc.	401C
Steelcad International	519B
Structural Software Company	220/319
Tnemec Company, Inc.	213
TradeARBED, Inc.	315
TSP America, Inc.	322
Voss Engineering, Inc.	503
Welded Tube Company of America	103
Welding Design & Fabrication	702
Wheelabrator Corporation	410

ITW Buildex Booth 308

The Autotraxx ICH Deck Fastening System is used to attach steel deck in a stitch or structural steel application. The system has two components: a stand-up tool that includes a screwgun, special fastener guidance system, depth sensitive feature and unique drive socket; a Traxx fasteners with ICH (Internal Conical Head) design.

The fasteners have either a Traxx/1 point for stitch applications or a Traxx/4 or Traxx/5 point for structural attachments. The design allows the tool drive pin to engage securely with the fastener for consistent drilling.

The BX 900 powder actuated tool is used for the attachment of steel deck to structural steel. Special features also allow for a safe and economical method of attachment in this application.

For more information, contact: ITW Buildex, 1349 West Bryn Mawr Ave., Itasca, IL 60143 (708) 595-3500.

Egypt Structural Steel Processing Booth 609

Egypt will display and market their support services to fabricators at this year's National Steel Construction Conference. Included will be first stage processing (cutting/drilling/coping beams and other structural shapes); complete fabrication of all structural shapes in an AISC Category III shop; and some of the products sold by Egypt's sister companies, KARD Welding, Inc., and KARD Bridge.

For more information, contact: Egypt Structural Steel Processing Corp., 480 Osterloh Road, P.O. Box 124, Minster, OH 45865 (419) 628-3893.

Voss Engineering Booth 503

Voss Engineering will display their structural bearing pad product line featuring "NEOSORB" AASHTO Grade Neoprene, "VOSSCO" ROF pads, "FIBERLAST" engineered random oriented fiber pads and "SORBTEX" preform fabric pads at the National Steel Construction Conference. The company also will debut new research data on PTFE expansion bearings featuring the "SORBTEX" and "FIBERLAST" materials. This information will be detailed in a technical seminar at the conference.

For more information, contact: Voss Engineering, Inc., 6965 North Hamlin Ave., Lincolnwood, IL 60645-2598 (708) 673-8900.

Tnemec Co. Booth 213

Tnemec Co., Inc., is a manufacturer of high-performance coatings for steel, including fast-curing zinc rich primers, low-temperature curing epoxies and VOC-compliant polyurethanes that have excellent color and gloss retention. Tnemec coatings are used for specialized architectural and industrial applications.

For more information, contact: Tnemec Co., Inc., 6800 Corporate Dr., Kansas City, MO 64120-1372 (816) 483-3400.

Design Data
Booths 309/310/409

Design Data is a leading supplier of software solutions to steel fabricators, detailers and engineers. Its software family, SDS/2, is a single-source solution and gives fabricators the foundation to a truly integrated system. The SDS/2 software modules on display at the National Steel Construction Conference in Las Vegas include: Engineering; Analysis & Design; Detailing; Estimating; Production Control; CNC Interface; and DesignLINK. SDS/2 gives the fabricator the opportunity to take advantage of proven innovative technology to become more competitive.

For more information, contact: Design Data, 1033 O St., Suite 324, Lincoln, NE 68508 (800) 443-0782.

The Lincoln Electric Company
Booth 421

Products exhibited by The Lincoln Electric Co. at the National Steel Construction Conference include: LN-25 Portable Wire Feeder; Pro-Cut 40 Plasma Cutting System; and Invertec V300 Pro, a CV/CC Power Source.

For more information, contact: The Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, OH 44117-1199 (216) 481-8100.

Mi-Jack Products
Booth 802

Mi-Jack Products will feature a pictorial representation of their Travelift for structural steel handling at the National Steel Construction Conference. The Travelift is a rubber-tired gantry able to pick-up and carry capacities ranging from 15 to 325 tons. Besides being manufactured to match specific dimensional and load requirements, the Travelift is backed by Mi-Jack's 24-hours-a-day, 7-days-a-week service department and a $24 million parts inventory.

For more information, contact: Mi-Jack Products, 3111 W. 167th St., Hazel Crest, IL 60429 (708) 596-5200.

TSP America
Booth 322

TSP America, a leading designer and manufacturer of TS Profiles (Corrugated Web Beams) and TS profile technology (Corrugate Web Beam equipment) will be displaying and offering its complete line of TS beams and TS equipment at the National Steel Construction Conference in Las Vegas. In addition to sales, the company seeks qualified partners interested in introducing the TS profile in the U.S.

For more information, contact: TSP America, Inc., 4919 80th Ave. Circle East, Sarasota, FL 34243 (813) 351—6096.

Ram Analysis
Booth 510

Ram Analysis is introducing RAMSTEEL Version 2.1, which includes support for both English and SI units and provides designs based on American or foreign steel shapes or user-defined built-up shapes. RAMSTEEL is a special purpose software package for the design of steel buildings, automating the design of the entire floor framing system. With the graphical modeling capabilities of the program, the user creates a model of the entire structure, including member locations, slab properties, floor loads and story data. From this database, the interaction of members, the distribution of loads, and the Live Load reduction factors are automatically determined based on the appropriate building code (BOCA, SBC or UBC) and moments, stresses, deflections are calculated and the members optimally sized according to AISC code requirements (ASD 8th or 8th Edition or LRFD).

The user may specify design parameters such as composite or noncomposite beam design, member depth restrictions, and deflection limitations. A floor vibration analysis also may be performed. After the analysis and design are complete, RAMSTEEL can create a CAD file (DXF format) of each framing layout complete with grids, slabs, columns and beams with member sizes, shear stud information, beam cambers and reactions.

For more information, contact: Gus Bergsma, 55 Independence Circle #201, Chico, CA 95926 (800) 726-7789.

Welded Tube Co.
Booths 103

Welded Tube Co. of America is the largest domestic manufacturer of quality welded structural and mechanical tube and pipe. Produced in sizes 1" square through 16" square up to 5⁄8" gauge. The company also produces Kleen-Kote, a cleaned and coated tube or pipe. KleenKote is produced from an in-line process where Welded Tube Co. mechanically cleans, degreases, and pre-primer coats the tubing or pipe during manufacturing. Some benefits of KleenKote Tubing are reduced cleaning and preparation, enhanced welding, and prolonged storage life.

For more information, contact: Welded Tube Co. of America, 1855 East 122nd St., Chicago, IL 80633 (800) 733-5683.

Southern Coatings
Booth 408

Southern Coatings, a subsidiary of Pratt & Lambert, Inc., is a leader in providing environmentally conscious primers and topcoats for the steel fabricator and joist manufacturing industries. Featured at the NSCC show will be lead and chromate free primers and coatings that offer superior protection against rust and corrosion on steel. Complete information on the Enviro-Guard VOC compliant primers as well as Chemtec 606 Water Base Epoxy Zinc Rich Primer, Chemtec 608 Inorganic Zinc Rich Primer and our Dura-Pox

646 Epoxy Mastic High Build system will be available.

For more information, contact: Skip Pendry, Southern Coatings, Inc., P.O. Box 160, Sumter, SC 29151 (800) 766-7070.

Structural Software Booths 220/319

FabriCAD Six, Structural Software's newest version of its computerized detailing program, offers a new graphical input that simplifies the interaction between user and computer. Everything that goes into a job is centralized under one menu option called Input. All attachments, base and cap plates, moment plates, splice plates, skewed beams, etc., are entered directly through the graphical E-plan. The program is now mouse-driven, which makes menu selections a simple matter of pointing and clicking—an extremely fast and easy input method.

No detailed setup work is required because grid lines are unlimited and can be added, inserted, adjusted or deleted at any time throughout the job. The copy function speeds up the input of main beams and filler beam patterns by reducing the steps to just a few keystrokes. Zoom and pan features let the user zoom in close to selected areas or pan across the gird to view the whole job.

All information entered is based on the erection plan. All standard connections can be assigned in one operation and they can be overridden as desired on a member-by-member basis. The program accurately completes details and design connections according to the latest edition of the AISC Specifications.

The company also sells an estimating and material allocation program.

For more information, contact: Structural Software at (800) 776-9118.

Canam Steel Corp. Booth 404

Canam Steel provides quality *open web joists, girders and* trusses to fabricators from coast-to-coast from its five North American plants. Development of its own *state-of-the-art design and estimator* software programs enables Canam to assist engineers and customers in providing the most efficient and economical roof and floor system.

For a free 76-page catalog, contact: Sales Manager, Canam Steel Corp., 2000 West Main St., Washington, MO 63090 (314) 239-6716.

Steel Solutions Booth 401C

Steel Solutions will be demonstrating its latest release of STEEL 2000, a fully automated fabrication management system developed in cooperation with Steel Service Corporation, a multi-plant steel fabricator and service center. Developed by fabricators for fabricators, the program comes to the market with a competitive edge: By being written in FoxPro—a leading database system—every piece of information is available for your own individualized use through the on-line data dictionary and custom report writer.

Automatic production recording from the shop floor including integrated CNC tool programming and an International version for the world market that includes all foreign sizes and language translation capabilities are just two of the new features that will be highlighted at the National Steel Construction Conference.

For more information, contact: Steel Solutions, P.O. Box 1128, Jackson, MS 39215-1128 (601) 932-2760.

Mid South Bolt and Screw Co. Booth 203

With three locations (TN, VA and LA) specializing in fastener products for steel fabrication and construction, Mid-South Bolt & Screw offers two day delivery to most of the U.S. Even custom made Anchor Bolts can often be shipped the same day as ordered.

Mid-South manufacturers: Anchor Bolts; Anchor Bolt Assemblies; U-Bolts; Eye Bolts with capacity to 4" diameter; and 40'-length continuous rods. Shearing, threading, bending and welding are done in-house to your specifications. A full line of fasteners are stocked, including: A325, A490 and A325 structural bolts; Hex and Tension Control Bolts; and Nuts and Washers.

For more information, contact: Mid South Bolt and Screw Co., Inc., 499 Cave Road, Nashville, TN 37210 (800) 251-3520.

TradeARBED Booth 315

TradeARBED introduced its HISTAR HSLA (High Strength Low Alloy) steel shapes last year. The high yield strength (maximum Fy = 70,000 psi), outstanding toughness and excellent weldability have provoked widespread interest from the steel construction industry. A new report by the American Welding Institute on the weldability of HISTAR will be distributed at the National Steel Construction Conference.

The company is best known in the U.S. for its Tailor-Made shapes—wide flange shapes with depths up to 44" and weights up to 920 lbs./ft. The availability of those shapes in highly weldable Grades 50, 65 and 70 have expanded the options that structural engineers have in designing heavy structures.

For more information, contact: TradeARBED, Inc., 825 Third Ave., New York, NY 10022 (212) 486-9890.

Pangborn Corp. Booths 304/403

Pangborn Corp., a world leader in surface finishing and blast cleaning for the basic and fabricated steel industries, will feature equipment designed for economy, low operating cost and maximum operating efficiency. Models showing structural and plate descaling machines, as well as a video showing actual operating equipment cleaning a variety of products, will be on display at the National Steel Construction Conference. Also available will be a variety of brochures and data sheets describing the variety of steel descaling systems offered by the company.

For more information, contact: Pangborn Corp., P.O. Box 380, Hagerstown, MD 21741-0380 (301) 739-3500.

Lohr Structural Fasteners Booth 301B

Lohr's line of domestic high-strength Tension Control Fasteners and Hex Head Fasteners are part of a total assembly concept, which is designed to solve the problem with current specifications not requiring fasteners to be lubricated and tested as matched assemblies to assure they will work together properly when shipped. Lohr's fasteners are domestically manufactured, lubricated and tested as pre-assembled sets, to assure that when they arrive at the project they can be properly tensioned. The fasteners also meet the new FHWA guidelines for bridge projects.

For more information, contact: Lohr Structural Fasteners, P.O. Box 1387, Humble, TX 77347 (800) 782-4544.

AIHSS Booth 105

The American Institute for Hollow Structural Sections is a non-profit technical trade organization committed to advance and improve the use of hollow structural sections/structural steel tubing in building, bridge and special structure applications. The Institute serves as an information resource center for the design profession and construction industry. It encourages knowledgeable decisions concerning the selection and utilization of hollow structural sections in construction applications through the preparation and publication of engineering data, technical seminars, research & development, and specifications & standards activities.

For more information, contact: AIHSS, 929 McLaughlin Run Road, Suite 8, Pittsburgh, PA 15017 (412) 221-8880.

Arkansas Steel Processing Booth 216

Arkansas Steel Processing is a full-service structural steel processing facility located near Blytheville, AR. Representative from the company will be at the National Steel Construction Conference to discuss available services.

For more information, contact: Arkansas Steel Processing, Inc., 17W697 Butterfield Road, Oakbrook Terrace, IL 60181 (800) 255-8601.

Research Engineers Booths 402/501

Research Engineers, Inc., will be demonstrating its World Class suite of structural analysis and design software tools for the structural engineer. STAAD-III/ISDS performs 2D/3D frame and finite element analysis and design for steel, concrete and timber structures incorporating U.S. and many foreign design codes. In addition, the company's staff will be demonstrating AutoSTAAD, a state-of-the-art structural drafting, detailing and model generation software running inside of AutoCAD.

For more information, contact: Research Engineers, 1570 N. Batavia St., Orange, CA 92667 (800) 367-7373.

Peddinghaus Booths 514+

Peddinghaus Corp. will exhibit the latest technologies for the automated processing of structural steel at the National Steel Construction Conference in Las Vegas. Application problem solving for the structural fabricator will be featured, with special emphasis on control/software enhancements for existing equipment. Innovative methods of fabricating beams, columns, angle channel and plate will be shown. The principles of automated punching, drilling, sawing, burning and plasma cutting will be explained.

For more information, contact: Lyle Menke, Peddinghaus Corp., 300 N. Washington Ave., Bradley, IL 60915 (815) 937-3800.

Softdesk Booth 208

Softdesk is the world's leading supplier of application software for Autodesk. Featured at the NSCC will be products from Softdesk's Structural Engineering Family, including: Plans & Elevations, which creates accurate construction details with steel, wood, concrete and masonry; and the Steel Detailer, which provides the tools to create shop fabrication erection and bolt setting drawings. In addition, The Modeler provides an environment for creating frame analysis models inside AutoCAD and supports a direct link to industry-standard frame analysis programs.

For more information, contact: Softdesk, 7 Liberty Hill Road, Henniker, NH 03242 (603) 428-3199.

Dogwood Technologies Booth 602/701

PDS is an automated detailing system that operates under UNIX rather than DOS. UNIX offers a vast speed increase over DOS because of its ability to utilize a 32-bit mode of operation on the 386/486 Intel chip. UNIX also provides true multi-user and multi-tasking operation.

PDS provides automated detailing of: beams and columns including standard parts; vertical bracing of X, V and A type for single and double angle and WT members; horizontal bracing with variable drops; pan and grated stairs with breakovers and landings; automated engineering calculations for connection design; material management including material billing, sequencing, sorted cut lists, automated weigth and surface area calculations and shipping tickets; fabrication control for downloading to CNC equipment; and an integrated CAD graphics module set-up specifically for steel detailing applications.

For more information, contact: Dogwood Technologies, Inc., 1900 Winston Road, Suite 407, Knoxville, TN 37919 (800) 346-0706.

CONXPRT Software Booth TBA

Staff engineers from AISC will be available to demonstrate CONXPRT, a knowledge-based PC software system for steel connections. Expert advice from long-time fabricator engineers is used to augment the design rules. CONXPRT incoropartes provisions to set dimensional and material defaults for a particular project or general shop needs. Additionally, CONXPRT is menu driven and incorporates help screens designed for easy use.

Two modules are available, one for shear connections and one for moment connections.

For more information, contact: AISC Software, (312) 670-2400.