

# MODERN STEEL CONSTRUCTION



August 1995

\$3.00

Steel

063286  
Patrick Newman  
Director  
American Inst. of Const.  
1 East Wacker Dr. #3100  
Chicago, IL 60601-2001



# UNITED STEEL DECK, INC.

## Deck design data sheet #23

The American Society for Testing and Materials (ASTM) recently issued new material specification numbers for galvanized products. The new specification is A653-94\*, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*. There are two important changes:

- (1) The new material designation uses the grade to define the yield point.
- (2) The coating designation (G30, G60, G90) is now part of the A653 specification.

The coating designation was previously part of A525 but A525 has now been replaced with A924-94 which is a general specification covering all metal coatings (aluminum, zinc, lead-tin) applied by the hot-dip process.

Old Grade Name Under A446  
grade A  
grade C  
grade E



New Grade Name Under A653  
Structural Quality (SQ)  
grade 33(230)  
grade 40(275)  
grade 80(550)

The numbers after the grade (33, 40, 80) are the minimum yield strengths in ksi. The bracketed numbers are metric (MegaPascals) and will be used instead of the ksi values in metric specifications.

Example: ASTM A653 SQ grade 33 with coating designation G60 replaces ASTM A446 grade A with coating designation G60.



The ASTM number for uncoated steel products (and for products painted over uncoated steel such as roof deck painted in our factory) is still A611 and the grades C, D, and E are still used.

The SDI thickness tolerance, our load tables, and our section properties have not changed. We will change the ASTM numbers in our catalogs as they are printed. The new ASTM numbers will start to appear in job specifications, but it will probably be a number of years before the old ones are completely gone. We will simply have to endure the confusion during the transition period.

\* The last two digits (94) indicate the adoption year for the specification.

**ASTM**  
specification change



NICHOLAS J. BOURAS, INC.  
P.O. Box 662, 475 Springfield Avenue  
Summit, New Jersey 07902-0662  
(908) 277-1617



Please circle # 33

01154

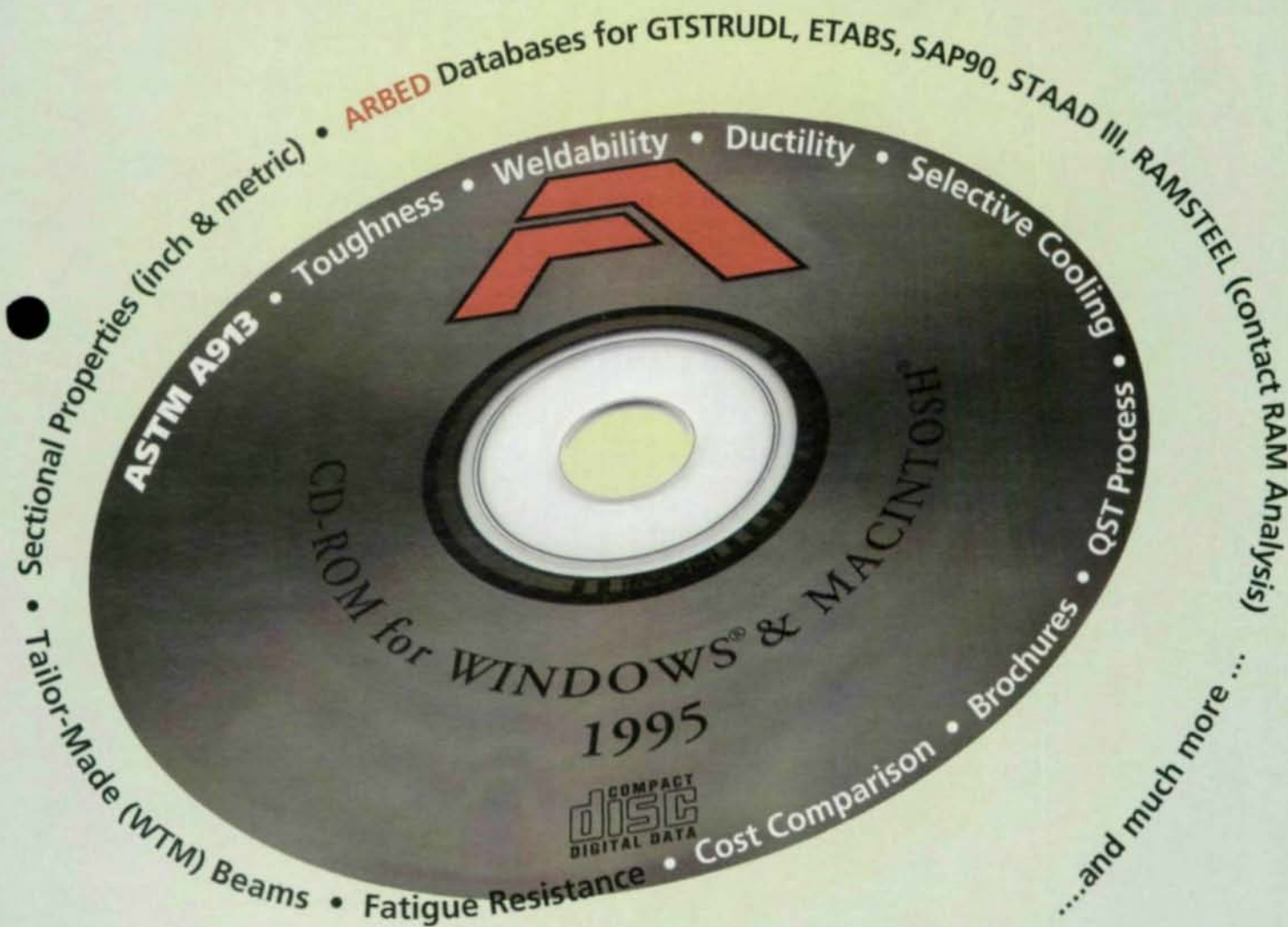
Everything you wanted to know about...

# ARBED & HISTAR

is available on a

## FREE interactive CD-ROM.

Including a 20 minute sound movie: The making of HISTAR steel.



**Hurry! Supplies are limited.**

For a free CD-ROM, send your request by fax or E-mail to:

Trade **ARBED**, Inc. Fax: (212) 355-2159 • E-mail: [tradeared@aol.com](mailto:tradeared@aol.com)

Please circle # 35

# MODERN STEEL CONSTRUCTION

Volume 35, Number 8

August 1995



The brightly colored 152,000-sq.-ft. Florida Aquarium is more than just the latest in a frenzy of aquarium construction across America. The story behind this state-of-the-art, awe-inspiring facility that is one of the nation's largest and most exciting aquatic facilities begins on page 18.

## FEATURES

- 18 Making A Splash**  
*Large steel truss arches span across the new Florida Aquarium to help create a light, airy feel*
- 28 Galvanizing Reduces Maintenance Concerns**  
*The use of galvanized steel tubes for a new conservatory provided strength, aesthetics and a maintenance-free structural system*
- 34 Tight Fit**  
*Despite a narrow, 150-ft.-by-35-ft. site, the designers of a new collegiate fitness center were determined to create an open feeling*
- 38 Essentials Of LRFD**  
*The third in a three-part series presenting an overview of LRFD as found in Part 2 of the Manual of Steel Construction (1994)*

*Modern Steel Construction (Volume 35, Number 8). ISSN 0026-8445. Published monthly by the American Institute of Steel Construction, Inc., (AISC), One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.*

*Advertising office: Facinelli Media Sales, O'Hare Lake Office Plaza, 2400 E. Devon Ave., Des Plaines, IL 60618 (708) 699-6049.*

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

*Please fax any address changes to 312/670-5403 or to the address below.*

*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 additional mailing offices.*

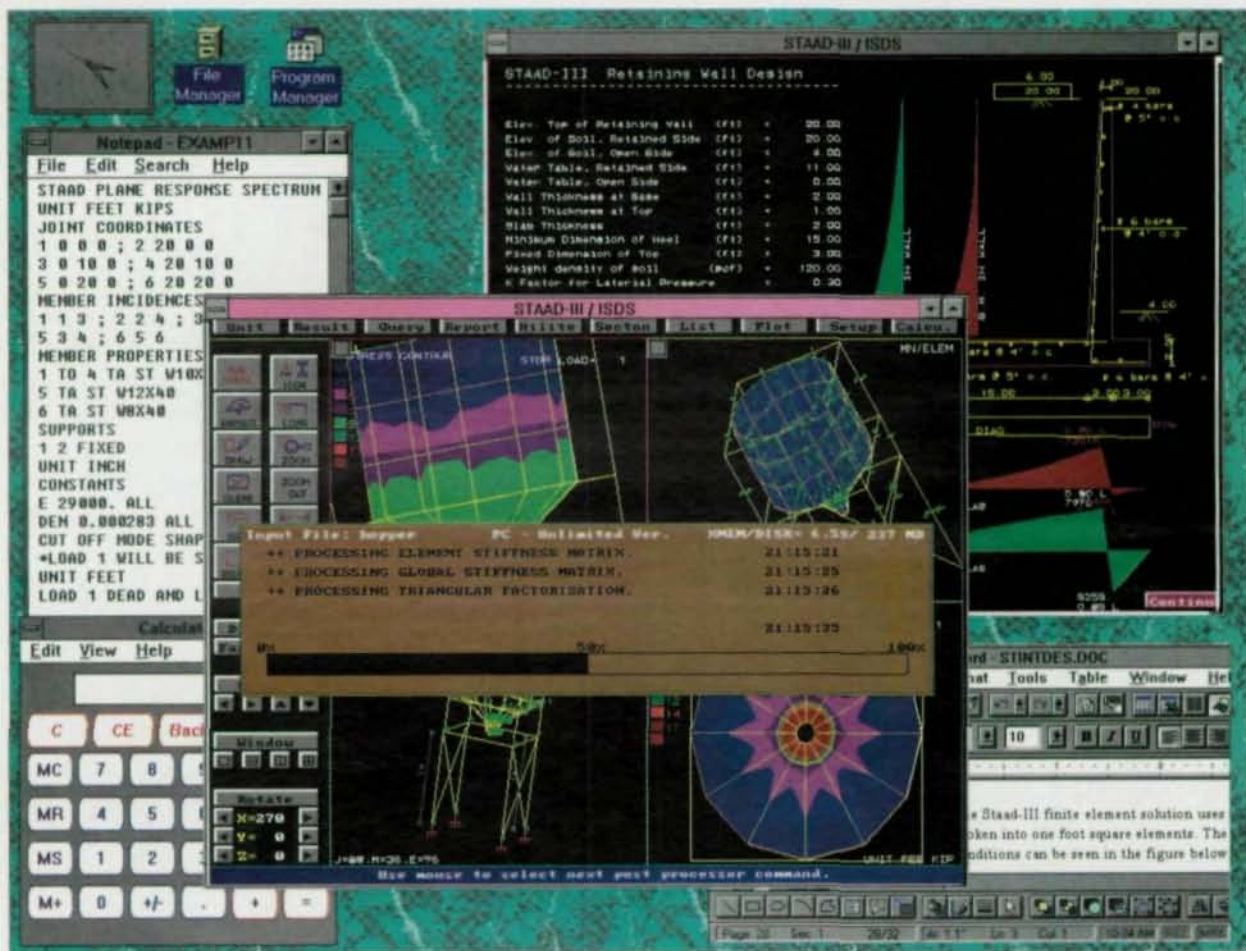
## DEPARTMENTS

- |          |   |           |                          |
|----------|---|-----------|--------------------------|
| <b>6</b> | <b>EDITORIAL</b>  | <b>44</b> | <b>HOT PRODUCTS</b>      |
| <b>9</b> | <b>STEEL INTERCHANGE</b> <ul style="list-style-type: none"><li><i>In a partially covered column, how would you analyze the column for governing <math>l/r</math> ratio to calculate <math>F_c</math>?</i></li><li><i>What is the flatness tolerance for webs of welded plate girders?</i></li></ul> | <b>49</b> | <b>STEEL MARKETPLACE</b> |
|          |   | <b>50</b> | <b>ADVERTISING INDEX</b> |

0155

# It's tomorrow ...

## in Computerized Structural Engineering



### Experience STAAD - III

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

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

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

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

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

*Experience tomorrow today - experience STAAD-III*



**Research Engineers, Inc.**

22700 Savi Ranch Pkwy., Yorba Linda, CA 92687

Tel: (714) 974-2500 Fax: (714) 974-4771 Toll Free: (800) FOR-RESE

• USA • UK • GERMANY • FRANCE • CANADA • JAPAN • KOREA • NORWAY • TAIWAN • INDIA

Please circle # 34

**Editorial Staff**

Scott Melnick,  
Editor and Publisher  
Patrick M. Newman, P.E.  
Senior Technical Advisor  
Charlie Carter,  
Senior Technical Advisor  
Jacques Cattan,  
Technical Advisor

**Editorial Offices**

Modern Steel Construction  
One East Wacker Dr.,  
Suite 3100  
Chicago, IL 60601-2001  
(312) 670-5407  
Fax 312/670-5403

**Advertising Sales**

Facinelli Media Sales  
2400 E. Devon Ave.,  
Suite 267  
Des Plaines, IL 60018  
(708) 699-6049  
Fax 708/699-8681

**AISC Officers**

Frank B. Wylie, III,  
Chairman  
Robert E. Owen,  
First Vice Chairman  
H. Louis Gurthet,  
Second Vice Chairman  
Robert D. Freeland,  
Treasurer  
Neil W. Zundel,  
President  
David Ratterman,  
Secretary &  
General Counsel  
Morris Caminer,  
Vice President,  
Finance/Administration

# Curious Origins

**W**HEN MY WIFE AND I WERE JUST STARTING TO DATE, she lived in Toronto. Back in the early days of our relationship, we visited exclusively by flying back and forth. But one weekend, I decided to surprise Judy with a visit. By the time I had made my decision it was much too late to get a reasonable air fare, so instead I drove the 530 miles to Toronto. Unfortunately, being a little more than somewhat absent-minded, I neglected to bring a map. Fortunately, finding the city itself was pretty simple (just take I94 to Detroit and the 401 to Toronto). It was finding her house that was a bit more challenging.

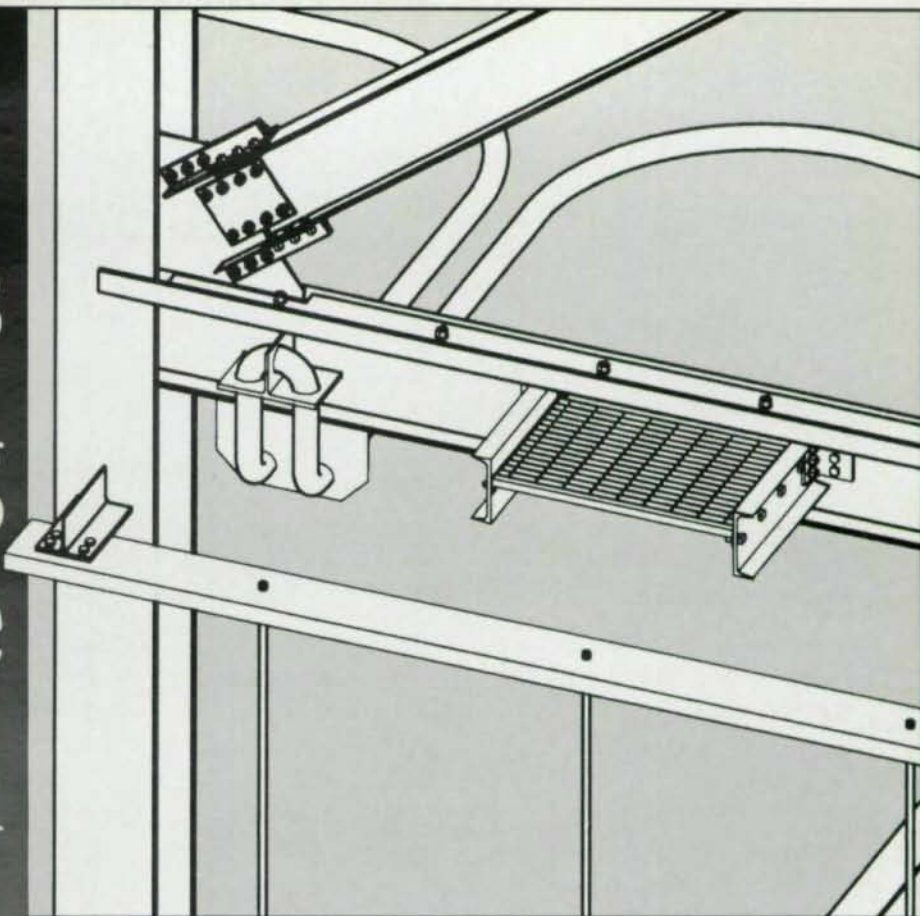
I exited from the highway where I thought it was appropriate, but I wasn't quite sure I was in the right place—until I saw a tower crane looming over a recently begun apartment complex. I made a quick right, a quick left, another left, a right turn and I was there.

During the next year or two, I often made that drive, and I always used that crane as my final landmark. I watched as the building grew and grew, and finally, on one September trip, I noticed a Christmas tree atop the highest girder. I remember thinking that the tower crane—my perfect landmark—would soon be coming down, but at the time, I didn't give the tree much thought. But a recent conversation with Bob Lorenz, AISC's Director of Education and Training, brought the image back. Bob was recently asked how and where the traditional topping-out ritual (either putting a tree or a flag atop the final girder) originated. No one at AISC could answer the question, and we couldn't find any references to it in any of our library books.

So if anyone out there knows the origins of this curious custom, let me know. Either drop a note to me at *Modern Steel Construction*, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001, or fax me a note at 312/670-5403. **SM**

95110

# SDS/2 leaves nothing to the imagination



Imagine...a software system that automatically gives you:

- Shop Drawings
- CNC Data for Shop Equipment
- Connection Design Calculations
- Labor for Estimating
- Ordering & Inventory Data
- Revision Management
- Job, member status and much more

With SDS/2 imagination becomes reality. You get details, estimates and ordering information on every piece of steel in the job—right down to the nuts, bolts and washers. SDS/2 is the only comprehensive software system for every phase in the steel industry. With SDS/2, each phase of a project creates and stores information that is integrated and utilized in the next project phase, eliminating costly data re-entry time. Project schedules, job status, drawing submittal/ approval and erection planning can all be easily done using SDS/2. Whether you are an owner, engineer, fabricator or detailer, you will be able to see the money saving benefits of using SDS/2.

Don't leave anything to the imagination on your next project. Call today for more information or to set up your own personal demonstration of the SDS/2 products that include:

- Estimating
- CNC Interface
- Engineering Design
- Production Control
- Detailing
- DesignLINK

**DESIGN  
DATA** 

"First in...software, solutions, service"  
402-476-8278 or 1-800-443-0782

Please circle # 32

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

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

By acting as a partner or by performing subcontract work, Canam Steel Corporation can assist you at any stage of a project. We have the capability and experience to do everything to guarantee you complete satisfaction and on-time delivery. That's why Canam Steel Corporation is the Fabricators' fabricator.



Boston Garden, Boston (Mass)



Target, Oconomowoc (WI)



Florida, Fort Lauderdale 305-772-0440 - Illinois, Chicago 708-910-1700 - Indiana, Lafayette 317-477-7764

Kansas, Overland Park 913-384-9809 - Maryland, Baltimore 410-472-4327 - Point of Rocks 301-874-5141

Massachusetts, Easton 508-238-4500 - Michigan, Flint 810-653-3506 - Minnesota, Delano 612-972-6135

Missouri, Washington 314-239-6716 - New Jersey, Florham 201-822-3600 - New York, Marcellus 315-673-3456

Pennsylvania, Chambersburg 717-263-7432 - Tennessee, Memphis 901-763-0266 - Virginia, Virginia Beach 804-479-1828 - White Fost 703-869-7515

Please circle # 54



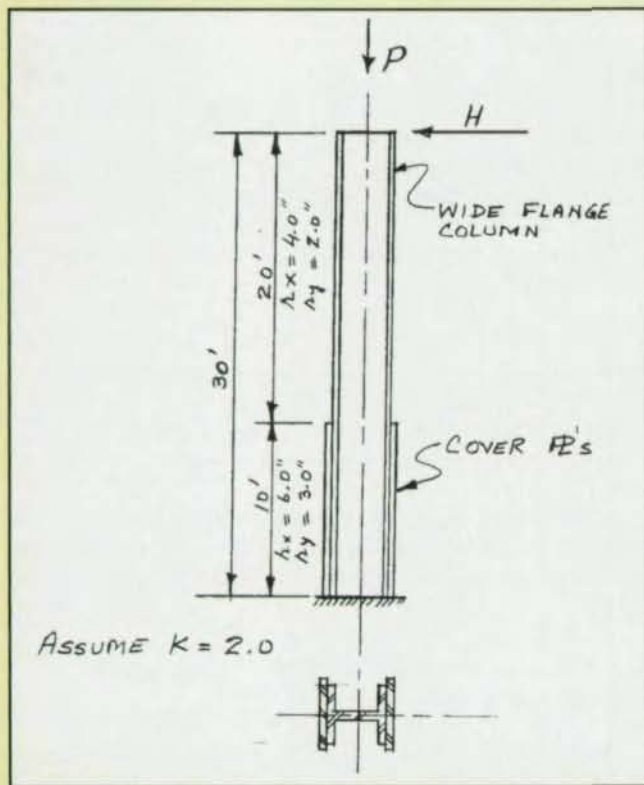
# STEEL INTERCHANGE

*Steel Interchange* is an open forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine. If you have a question or problem that your fellow readers might help you to solve, please forward it to *Modern Steel Construction*. At the same time, feel free to respond to any of the questions that you have read here. Please send them to:

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

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

**In a partially cover-plated column, how would you analyze the column for governing  $l/r$  ratio to calculate  $F_a$ ?**



Since the  $r$ 's (radius of gyration) are known, the key to the calculation of  $F_a$  is to find the  $K$  in the allowable stress equation for axially loaded compression members.

Per AISC Design Guide, "Industrial Buildings, Roofs to Column Anchorage" Appendix B: Calculation of Effective Lengths of Stepped Columns, the values of  $K_1$  and  $K_2$ , representing the effective length factors for upper and lower seg-

ments of column, respectively, can be attained by solving the equations proposed by J.P. Anderson and J.H. Woodward (AISC Engineering Journal, October 1972, pp. 157 - 166) or by entering Table 1 (included in Appendix B) with the values of  $I_1/I_2$ ,  $L_2/L_T$ , and  $P_2/P_T$  under the appropriate end condition category.

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

Information on ordering AISC publications mentioned in this article can be obtained by calling AISC at 800/644-2400.

In this case, by using Table 1,  $L_2 = 10'$ ,  $L_T = 30'$ ,  $P_2 = 0.0$ ,  $P_T = p$ , then  $L_2/L_T = 0.33$ ,  $P_2/P_T = 0.0$  and the end condition is "Fix-Free"; therefore, by entering the value of  $I_1/I_2$  (the ratios of moments of inertia of upper and lower segments, respectively) the values of  $K_1$  and  $K_2$  can be determined by interpolation.

Kunming Gwo, P.E.  
 HCI Steel Building Systems, Inc.  
 Arlington, WA

Another answer:

The  $L/r$  ratios do not work well for this type of column. Instead, calculate the theoretical Euler buckling load, and then check both the elastic and inelastic allowable buckling loads.

There are several procedures to calculate the Euler buckling load. Simple hand calculation methods include Finite Differences, integration, or Newmarks Method. Example calculations for the first two methods are available in "Principles of Structural Stability Theory" by Alexander Chajes, and the last in "Theoretical and Applied Mechanics" edited by N.M. Newmark.

After finding the theoretical Euler buckling load ( $P_{cr}$ ), determine whether elastic or inelastic buckling controls. If the Euler buckling load ( $P_{cr}$ ) is less than  $P_y/2$  (where  $P_y = AF_y$ ) then elastic (Euler) buckling controls. This is the basis for the AISC ASD equation for  $C_c$ , see the AISC ASD Commentary. If elastic buckling controls, simply multiply the theoretical buckling load by  $12/23$  and you have the allowable axial load.

If inelastic buckling controls (i.e.  $P_{cr} > P_y/2$ ) it becomes a little more complicated. Lets dissect AISC ASD Equation E2-1. The denominator is sim-

# STEEL INTERCHANGE

ply a sliding factor of safety that results in  $\frac{23}{12}$  where  $Kl/r = C_c$ , and results in  $\frac{5}{3}$  when  $Kl/r = 0$ . For the moment, call the denominator the safety factor, SF. Now we can rewrite equation E2-1 as:

$$F_b = [1 - ((Kl/r)^2 / (2C_c^2))] F_y / SF$$

This equation can be rewritten in terms of force as follows:

$$P_b = [(1 - AF_y) / 4P_{cr}] AF_y / SF$$

$$\text{since } P_{cr} = \pi^2 E / (Kl/r)^2$$

$$\text{and } C_c = \sqrt{2\pi^2 E / F_y}$$

Now, having calculated  $P_{cr}$  from one of the methods noted above, and knowing all the other terms, you have only to determine the appropriate safety factor, SF. The term  $(Kl/r)/C_c$  can be rewritten in terms of force if one remembers that:

$$C_c = \sqrt{2\pi^2 E / F_y}$$

Substitute this into the equation for  $(Kl/r)/C_c$  and you will finally get:

$$(Kl/r)C_c = \sqrt{(F_y A) / 2P_{cr}}$$

Substitute this into the denominator in place of  $(Kl/r)/C_c$  and you have an equation rewritten in terms of force. Use the smaller section to determine steel area, A, since inelastic buckling will occur there first.

Remember that K is already included in  $P_{cr}$ , since you determined the buckling load  $P_{cr}$  directly with its actual boundary conditions.

**Duane L. Siegfried, P.E., S.E.**

**Ralph Hahn and Associates, Inc.**

**Springfield, IL**

Another response:

The most common approach is to use the formula  $P_{cr} = K_1 \pi^2 E I_1 / L_1^2$ , where  $E/I_1$  is the stiffness of the smaller section,  $L_1$  the total length of the column, and  $K_1$  depends not only on end constraints, but also on the ratio of stiffness and lengths for the two sections.

Values of  $K_1$  are tabulated for different end constraints and ratios of stiffness and lengths in "Formulas for Stress and Strain", by Raymond J. Roark and Warren C. Young, McGraw-Hill, New York (various editions).

For the case in question (cantilever column),  $K_1$  varies between and 0.5, with the larger section up to twice as stiff as the smaller one.

**Behrouz Jazayeri, P.E.**

**Mueser Rutledge Consulting Engineers**

**New York, NY**

## What is the flatness tolerance for webs of welded plate girders?

Since for statically loaded (buildings) structures, web flatness does not affect the structural integrity of a girder, neither the LRFD Specification nor the AISC Code of Standard Practice provides a limitation on the maximum out-of-flatness of girder webs. AWS D1.1 Section 8.13.2 does, however, provide such requirements for welded plate girders. Problems arise, however, when these tolerances are applied to girders with thin webs. Specifically, in girder webs less than  $\frac{5}{16}$ -in. thick, they do not account for operational difficulties caused by shrinkage resulting from web-to-flange welds and/or welds that attach stiffeners to the web. Because of this, in some cases, flatness within AWS tolerances cannot be practically provided.

AISC recommends that, for statically loaded (building) structures, the dimensional tolerance for deviation from flatness of a girder web less than  $\frac{5}{16}$ -in. thick, without stiffeners or with stiffeners on one or both sides, be determined by the larger of  $\frac{1}{2}$ -in or AWS Section 8.13.2. If architectural considerations require special flatness tolerances, such special requirements must be identified on the engineering drawings and stipulated in the bid documents.

**American Institute of Steel Construction  
Chicago, IL**

## New Questions

**Are there special requirements for the design of High-strength A325 or A490 bolts that are going to be in a high temperature area?**

**Alice Leich**

**S.E.S Environmental, Inc.**

**Knoxville, TN**

**If a W-shaped column is made up of three welded plates, how does one design the welds connecting the plates together?**

**Correction:** The answer by James McCarthy in the June issue referred to the wrong question. The correct question is: In a partially cover-plated column, how would you analyze the column for governing  $l/r$  ratio? We regret the error.

# New Plans and Software for Short-Span Steel Bridges



This two-volume Short-Span Steel Bridge Package contains more than 1,100 predesigned steel superstructures with details, plus user friendly, PC compatible software, that will bring you quick, efficient solutions to many simple-span non-skewed bridges.

The plans tabulate the design of bridges that are 20 feet to 120 feet long in five foot increments for 24, 28, 34, 40 and 44 foot roadway widths. The software provides back-up calculations to the pre-designs and allows the engineer to custom design, code check or rate the bridge.

The package was developed by Dr. S. Taavoni, PE, of Kennedy Porter & Associates for the American Iron and Steel Institute in collaboration with AISC Marketing, Inc. Sponsors of the package include Bethlehem Steel Corporation, Inland Steel Industries, Lukens Steel Co., and U. S. Steel.

With AISI's new comprehensive short-span steel bridge package designers can minimize design time and project cost. Quickly explore design and detail options for:

- Welded plate girders with unstiffened and partially stiffened webs
- Rolled beams with and without cover plates for composite and non-composite construction
- Normal and lightweight concrete deck
- Elastomeric bearings
- Jointless and conventional abutment information
- Crash tested Jersey barrier
- Tables of reactions, moments and deflections
- Table of quantities for each design (structural steel, rebar and concrete)
- AASHTO's Load Factor Design
- HS25 Live Load
- Over 150 11" x 17" design and detail sheets
- Much more!!!

Please send me:

- Information about the AISI Short-Span Steel Bridge Package.  
 A copy of the AISI Short-Span Steel Bridge Package (payment enclosed).

**Ship Short-Span Bridge Package to:**

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_  
Phone \_\_\_\_\_ Fax \_\_\_\_\_

**FAX:** 202-463-6573 or  
**MAIL:** American Iron and Steel Institute  
1101 17th St., NW  
Washington, D. C. 20036  
**TEL:** 202-452-7140



**Order Form**

**Short-Span Bridge Package** \_\_\_ @ \$150 = \$ \_\_\_

*Additional shipping and handling will be added for orders outside the U. S.*

Check  Visa  Mastercard  
(payable to AISI)

Cardholder Name \_\_\_\_\_

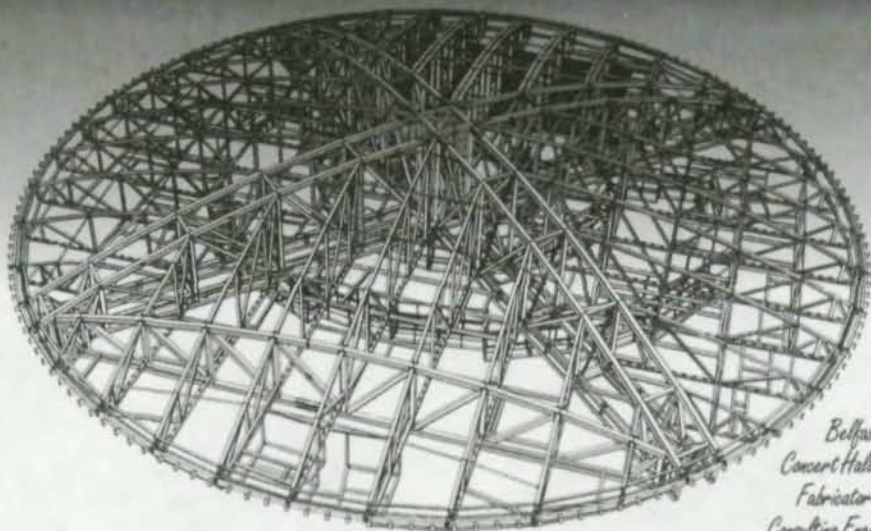
Card Number \_\_\_\_\_

Expiration Date \_\_\_\_\_

Signature \_\_\_\_\_

Please circle # 15

# STRUCAD<sup>®</sup> 2000



*Belfast, Northern Ireland  
Concert Hall dome detailed using Strucad  
Fabricator—Fisher Engineering Ltd.  
Consulting Engineer—Kirk, McClure Martin*

## Finally, a 3-D detailing solution that will produce 100% of your work.

The future of steel fabrication is here. Steel Solutions introduces STRUCAD 2000—3-D detailing software that dispenses with manual drafting operations and results in productivity gains up to 5-to-1.

Developed specifically for steelwork, STRUCAD 2000 allows the user to interactively construct a 3-D wireframe model of a steel structure using a PC workstation. Connection types can be designated from an extensive library of standard connections or the user can easily create any non-standard detail at any location in the structure and save it to a library for reuse. Automatic clash detection eliminates error.

From the solid model, it is possible to produce all drawings and material lists completely automatically. STRUCAD 2000 automatically creates field erection drawings, shop detail drawings, fitting details, full-size templates, 3-D erection drawings, and CNC manufacturing data for a wide range of workshop machinery. Data downloads from STRUCAD 2000 directly to CNC machinery to ensure accurate and consistent results.

Integration between STRUCAD 2000's design and detailing data and the production control and management data of STEEL 2000 is seamless. Structures designed in STRUCAD 2000 will flow through all aspects of estimating,

detailing, mulling, purchasing, receiving, production, shipping and erection with complete traceability. The estimated labor to produce any structure that is designed or detailed in STRUCAD 2000 can be printed from STEEL 2000 Estimate with a few keystrokes.

STRUCAD 2000 is interfaced to a large variety of other software packages including AutoCAD applications, STAAD-III from Research Engineers, Intergraph's Mica Plus Analysis and PDS, PDMS from Cadcentre, and PASCE from CE Automation, to name only a few.

Proven in production for six years, there are more than 400 STRUCAD systems installed throughout 22 countries. Now available in imperial units, Steel Solutions is pleased to market and support STRUCAD 2000 in the United States.

To facilitate use of this powerful tool in your plant, Steel Solutions offers a low-cost, five-day training course for your employees at our Training Center in Jackson, Mississippi. In addition, regular user group meetings at the Training Center will ensure that on-going requirements are constantly being integrated into STRUCAD 2000.

Call today to find out more about how STRUCAD 2000 can reduce your detailing costs and eliminate expensive manufacturing and site errors.

Please circle # 98



2260 Flowood Drive • P.O. Box 1128 • Jackson, MS 39215 • 601-932-2760 • Fax 601-939-9359  
Support/Development • Rt. 3, Box 312A • Buckhannon, WV 26201 • 304-472-2668 • Fax 304-472-3214  
STRUCAD is a registered trademark of ACECAD Software Ltd., England, U.K.

# We designed our mill with the same convenience in mind.

When you're in the market for steel, and you need it fast, you know there's nothing convenient about waiting for a rolling schedule. Maybe it's time you switched from a rolling mill to a stocking mill: Chaparral.

Our \$50-million on-site steel inventory is one of the largest in the world. It's so large, in fact, that we can fill over 80% of our steel orders from stock — in two weeks or less. Special orders? Fast track jobs? We'll process those within


72 hours. Even if your order changes, we'll work with you to fill it as quickly as possible.

So what are you waiting for? Next time you're shopping for steel, call Chaparral. You'll always get the right steel...right away.

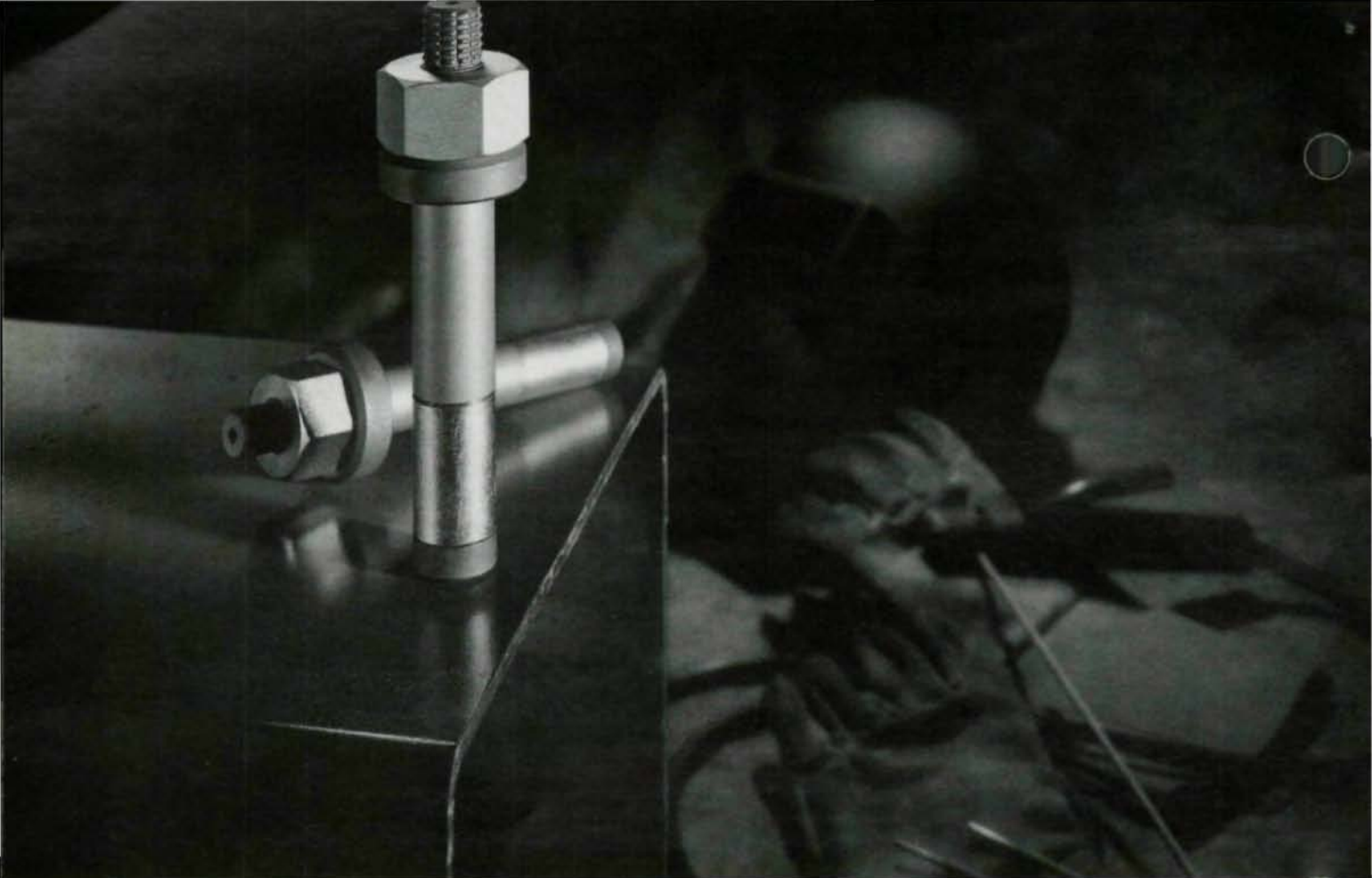


**CHAPARRAL  
STEEL.**

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



Please circle # 43



# LEAVE THE HIGH COSTS OF WELDING BEHIND.

STILL USING COSTLY WELDING TO JOIN SECTIONS OF TUBULAR STEEL? YOU COULD BE FALLING BEHIND THE TIMES.

HUCK INTERNATIONAL'S **ULTRA-TWIST™**



Detail of actual box column-to-beam connection using Huck ULTRA-TWIST fasteners.

BLIND FASTENING SYSTEM IS THE WORLD'S FIRST AND ONLY BLIND BOLT STRONG ENOUGH TO MEET ASTM-A325 REQUIREMENTS. AND

THE ONLY ONE WITH JAPANESE MINISTRY OF CONSTRUCTION ARTICLE 38 APPROVAL.

WHICH MEANS IT'S THE IDEAL ALTERNATIVE METHOD FOR FAST JOINING OF BOX COLUMN-TO-COLUMN AND BOX COLUMN-TO-BEAM CONNECTIONS. AND THE BEST WAY TO LEAVE THE EXPENSE, HAZARDS AND TROUBLES OF WELDING BEHIND. **CALL 1-800-285-4825** TODAY FOR A FREE DEMO OR MORE INFORMATION.



Please circle # 111

## Special Report:

# WIDE FLANGE SHIPPING TIMES EXPECTED TO IMPROVE

**A**S OF MID-JULY, LEAD TIMES FOR SHIPPING WIDE FLANGE SECTIONS BY MILLS TO STRUCTURAL STEEL FABRICATORS were approximately twice as long as historical levels, but all of the major mills state that by the end of the year lead times will return to normal. And already, there have been some indications that shipping times are beginning to improve.

Longer lead times this summer were the result of a confluence of factors. Foremost was a surge in demand that hit in late March. But adding to this problem was the scheduling by some mills of summer downtime for annual maintenance and for capital improvements. For example, Chaparral Steel Company shut its mill for two weeks beginning June 19 for maintenance and upgrading. "We're a stocking mill, but our inventories were severely depleted during our shutdown. However, we don't have another scheduled shutdown for 52 weeks," explained Jeff Werner, senior vice president of sales at Chaparral. Another factor has been increased purchases by speculators who are concerned about potential shortages, especially as Bethlehem Steel Corporation begins phasing out production of larger wide flange shapes, including W40, W36,

W33, W30, and W27 shapes plus selected W24, W21, W18, W16, W14, and W12 shapes.

All of the mills are taking independent steps to reduce shipping times. At Chaparral, they are closing their rolling orders at 70% of capacity in order to use the remaining 30% to build inventory. However, Werner pointed out, as of mid-

products between its mills to additionally increase productivity. For example, all of the W12 and W14 shapes, which previously were rolled on the medium mill, are being shifted to the larger mill. "This will free up rolling tonnage for beams in the 10-in. and down range and will increase availability of light-weight beams."

Nucor-Yamato Steel Company is taking similar steps, including shifting production. For example, HP12s, the most popular piling size, is being shifted from Nucor-Yamato's large size mill to a smaller-sized mill. "In essence, what we have done is add enough

**WE ANTICIPATE INCREASING PRODUCTIVITY BY 8% DURING THE NEXT 12 MONTHS—JEFF WERNER, CHAPARRAL STEEL**

July most of the August and September rollings were not yet at 70% of capacity. In addition, both the large and medium size mills at Chaparral have added additional shifts—and as a result of the recent capital improvements productivity on these mills has increased. This capacity increase is substantial enough that Chaparral has begun purchasing billets and blooms rather than depending solely on the hot metal produced by its own furnaces. "We anticipate increasing productivity 8% during the next 12 months for structural products," Werner stated. Chaparral also is shifting

extra capacity to replace the loss of Bethlehem's capacity in the sections we make in common," explained Bob Johns, sales manager at Nucor-Yamato. "We've opened a tremendous quantity of mill time to replace the void left by Bethlehem in closing their large-section mill." Nucor-Yamato also is taking steps to reduce speculation. "We're trying to take the speculative tonnage out of the backlog. If we find companies are blocking tons based on bids rather than sold projects, we won't accept additional orders from that company without proof of a contract."

As of mid-July, Nucor-Yamato

was booked through September. Additionally, the mill will shut down for semi-annual maintenance for one week at the end of September. "After that, though, we expect the cycle to tighten and we expect to return to historic lead times by the end of the fourth quarter," Johns said. Part of the reduction in lead times will be accomplished through increases in capacity. "We've added a second crew to our big mill and a second strand to the caster. As a result, we're rolling more raw tons."

Crew additions also are in the works at Northwestern Steel and Wire Company. "We are currently hiring and training a fourth crew for our Houston mill," said Ray Bauer, Manager/ General Sales, Steel Division at Northwestern. "Also, this fall we will install our second ladle metallurgy furnace and late this year we will begin the conversion to ultra-high-power transformers at our melting facility in Sterling. These improvements will further enhance our hot-metal and semi-finished steel capabilities to feed our rolling mills."

As of mid-October, Bethlehem will permanently close its largest mill. In addition, it will be closing its combination mill, which produces structural shapes up to 24 in., sometime during the fourth quarter for maintenance and modernization. However, Bethlehem reports that the combination mill will be back in operation in December and that availability will improve at that time.

Jumbo shape availability was

adversely affected earlier this year by the temporary closing for modernization of TradeARBED's heavy beam mill. "ARBED has now completed the modernization of their Differdange heavy beam mill that adds a continuous caster and electric arc furnace," said Greg DePhillis, product manager with TradeARBED. "Production of medium sections will be via continuous casting while heavy Tailor-Made Beams (WTMS) and Jumbos will be ingot cast. In view of the closing of Bethlehem's heavy beam mill, ARBED has geared up to give

shapes during the fourth quarter," DePhillis stressed.

Foreign purchases of steel from U.S. mills, however, has not affected lead times, according to Johns. "Exports, as a percentage, haven't changed one iota at Nucor-Yamato. But we have seen some U.S. fabricators increasing their amount of international work." Werner concurred that foreign purchases are not a big factor in U.S. shipments, though exports are up very slightly at Chaparral.

Despite the increase in mill orders, Werner stressed that

**IN ESSENCE, WHAT WE HAVE DONE IS ADD ENOUGH EXTRA CAPACITY TO REPLACE THE LOSS OF BETHLEHEM'S CAPACITY IN THE SECTIONS WE MAKE IN COMMON—BOB JOHNS, NUCOR-YAMATO**

industry-wide demand is actually less than it was during 1989. "The U.S. steel industry shipped 3.6 million tons of wide flange in 1989 and 1990, but the demand today is 20% less, about 3 million tons at our current shipping levels." And even if demand continues to increase, Werner estimates that current existing capacity is 3.4 to 3.5

million tons per year.

Producers indicated that increased demand has not fueled a sharp run-up in steel prices. The increases that did occur earlier this year merely brought steel prices back to approximately 1989 levels, or even lower, depending on member size. These relatively low prices occurred despite substantial material costs increases, such as an increase in scrap metal prices of \$40 per ton since 1989. Any additional increases this year, according to Werner, will likely only be the result of material cost increases.

Jumbo columns (W14x426 through 730) a top priority in terms of rolling and delivery." August and September rollings remain open for orders as of mid-July. For medium shapes (14-in. through 36-in. to about 400 lbs.), ARBED currently has limited availability due to the heavy orderbook at the mill, caused partly by downtime from the modernization and also from heavy worldwide steel demand. "However, a special priority will continue to be given to HISTAR Grade 65 (ASTM A913/65) in all sizes. We hope to return to more normal offerings of medium



## STEEL SEMINARS CONTINUE

**F**ROM DISCUSSIONS OF BOLT INSTALLATION TO THE DEVELOPMENT OF A NEW HIGH-STRENGTH STEEL, AISC's 1995 Seminar Series is designed to provide practical information for structural engineers, fabricators, and others involved in the steel construction industry. As an added bonus, the seminar will offer a session on "Answers to the Most Commonly Asked Questions" of AISC staff engineers.

Each seminar begins at 2:00 p.m. and ends at 8:15 p.m. Cost for the seminar, which has a CEU value of 0.45, is \$120 (\$90 for AISC members). The fee includes the lectures, numerous handouts, LRFD educational software, and dinner.

For more information, call AISC at 312/670-5422.

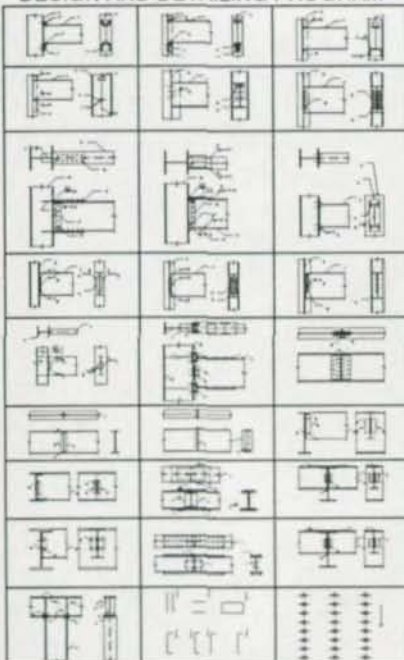
## 1995 STEEL SEMINAR SCHEDULE

August 8.....Rochester, NY	October 3.....Birmingham, AL
August 9.....Albany	October 5.....Atlanta
August 10.....Portland, ME	October 10.....Detroit
August 15.....Washington, DC	October 12.....Indianapolis
August 17.....Philadelphia	October 17.....Cleveland
August 22.....Chicago	October 18.....Columbus
August 24.....Milwaukee	October 19.....Cincinnati
September 7.....New York City	October 24.....Memphis
September 12.....Meriden	October 26.....Nashville
September 14.....Boston	October 31.....Pittsburgh
September 19.....Dallas	November 2.....Edison
September 21.....Houston	November 7.....New Orleans
September 26.....Denver	November 9.....Albuquerque
September 28.....Kansas City	November 28.....Miami
	November 30.....Orlando

**For more information, call 312/670-5422  
or FAX 312/670-5403**

## DESCON

STEEL CONNECTIONS  
DESIGN AND DETAILING PROGRAM



For a Free Demo Disk Call or Write  
**OMNITECH ASSOCIATES**

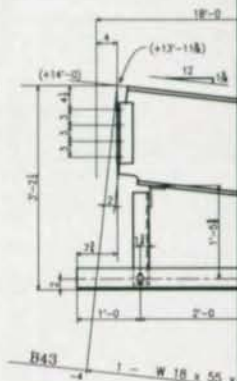
P. O. Box 7581  
Berkeley, CA 94707-0581  
(510) 658-8328

## STEEL DETAILING

with AutoCAD®

If your present CAD system  
doesn't detail everything you  
fabricate, then you should  
look at one that does.

- Beams • Columns • Plans • Elevations
- Stairs • Trusses • Hand Rail • Spandrel Angles
- Caged Ladders • Ship ladders • Piperacks
- Sloping Beams • Curved Beams • Frames
- Gusset Plates • Bracing • Templates
- and any other drawings that you might need to fabricate Structural Steel or Miscellaneous metal.



Sheet Format, Bill of Material format, detailing and text styles can be modified by the user.

Programs for cutting lists, inventory control, Linear nesting (Multing) and non-symmetrical bracing.

### Call Today!

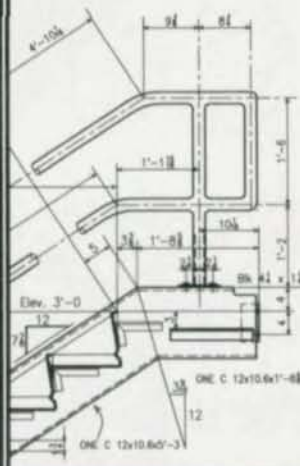
For free information about the detailing software that is the most cost effective and easiest to use.

## COMPUTER DETAILING CORPORATION

A Service Company for Steel Fabricators and Detailers

80 Second Street Pike - Suite 10  
Southampton, PA 18966  
215-355-6003  
Fax 215-355-6210

eMail: 70655.1300@compuserve.com



Please circle # 52

## T.R. HIGGINS LECTURE SCHEDULE

**C**ONNECTION DESIGN IS A COMPLEX SUBJECT FOR BOTH ENGINEERS AND FABRICATORS. This year's T.R. Higgins Lectureship Award was presented to William A. Thornton, Ph.D., P.E., for his work on safe and economical connection design.

In his lecture, Thornton, chief engineer of Cives Steel Company and President of Cives Engineering Corporation, both of Roswell, GA, discusses bracing connections, shear connections and moment connections. The presentation features descriptions of both "good" and "bad" connections, as well as presents "rules of thumb" for designing connections.

The lecture has a C.E.U. value of 0.1.

Six have so far been scheduled for 1995:

- **Chicago—Sept. 27**  
(call 708/527-0770)
- **Milwaukee—Sept. 28**  
(call 414/251-5110)
- **Denver—Oct. 17**  
(call Arla Zimmerman at 303/294-0180)
- **Kansas City—Oct. 18**  
(call Gordon Finch at 816/373-1203)
- **St. Louis—Oct. 19**  
(call 314/638-5000)
- **Albany—Oct. 27**  
(call Anne Sylvester at 518/785-3221)
- **Atlanta—Nov. 21**  
(call 404/642-9707)

Additional lectures will be held in New England.

## INTERNATIONAL BRIDGE CONFERENCE SCHEDULED FOR AUGUST

**D**ESPITE INDICATIONS OF INCREASED INFRASTRUCTURE INVESTMENT, the number of proposed projects still exceeds the available funds. The Fourth International Bridge Engineering Conference, to be held in San Francisco August 27-30, will include sessions on both project management and engineering.

Conference sessions include: bridge management systems (condition rating, PONTIS, BRIDGIT, and safety assurance); bridge aesthetics; bridge performance; bridge construction; long-span bridges; bridge loads and

# Making the Difference When Performance, Reputation and Quality Count.

- FULL TRACEABILITY
- LOT CONTROL
- CERTIFICATIONS

Registered head markings on all structural and machine bolts.



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



## St. Louis Screw & Bolt Company

6900 N. Broadway St. Louis, MO 63147 U.S.A.

1-800-237-7059 / (314)389-7500 / FAX (314)389-7510



Associate

dynamics; FRP composites and other materials for bridges; bridge rehabilitation; seismic response of bridges; bridge bearings, joints and details; prestressed concrete bridges; bridge structural systems; bridge substructures (scours and ship impact); and wood bridges. In addition, a special session will be devoted to bridge performance during the Kobe earthquake in Japan.

Scheduled speakers include engineers in private practice, academics from the U.S. and several foreign countries, domestic and international government officials, and state bridge engineers.

Registration is \$350. For more information, contact: Reggie Gillum, Transportation Research Board, Box 289, Washington, DC, 20055; 202/334-2382; fax: 202/334-2003.

## New Manual Aids Renovation of Steel Joists

**T**HE 318-PAGE STEEL JOIST INSTITUTE 60-YEAR JOIST MANUAL CONTAINS A CHRONOLOGICAL COMPILATION OF ALL SPECIFICATIONS AND LOAD TABLES of SJI steel joists manufactured between 1928 and 1988. This new Manual is designed to answer questions about the load-carrying capabilities of steel joists in existing buildings requiring renovation.

In addition to pertinent data on joists, the \$59 Manual includes information on various building documents required for renovation, investigative procedures and a complete listing of commonly used live and dead loads for the past 60 years.

For more information, contact:

Steel Joist Institute, Suite A, 1205 48th Ave. N., Myrtle Beach, South Carolina, 29577; 803/449-0487.

## New Publications Catalog Available

**T**he American Institute of Steel Construction has published its 1995/1996 Publications list. This document contains a short synopsis of books, design guides, specifications, software and periodicals available from AISC, along with ordering information.

The catalog also lists a new ordering address for AISC publications: AISC, Dept. 77-5245, Chicago, IL 60678-5245. AISC's main address remains unchanged.

To receive a free copy of the publications list, call 800/644-2400.

## WHEN THERE'S NO ROOM FOR DOUBT...



**Tonight, a handful of players, coaches, and 18,000 fans will be jumping, stomping, and cheering...**

**Take a moment to think about those design calculations.**

Now is not the time to question the accuracy of your analyses or the soundness of the design results.

**GT STRUDL**, the world's premier structure analysis and design software, gives the accuracy you need, great versatility, and the highest user support rating in the industry.

**All the power for the most complex designs. It's all included with GT STRUDL.**

**SO SIT BACK. ENJOY THE GAME. YOU USED THE RIGHT TOOL.**

## GT STRUDL®

*Quality engineering demands the highest quality software*

For more information, please contact:

TEL: **404.894.2260** FAX: **404.894.8014**

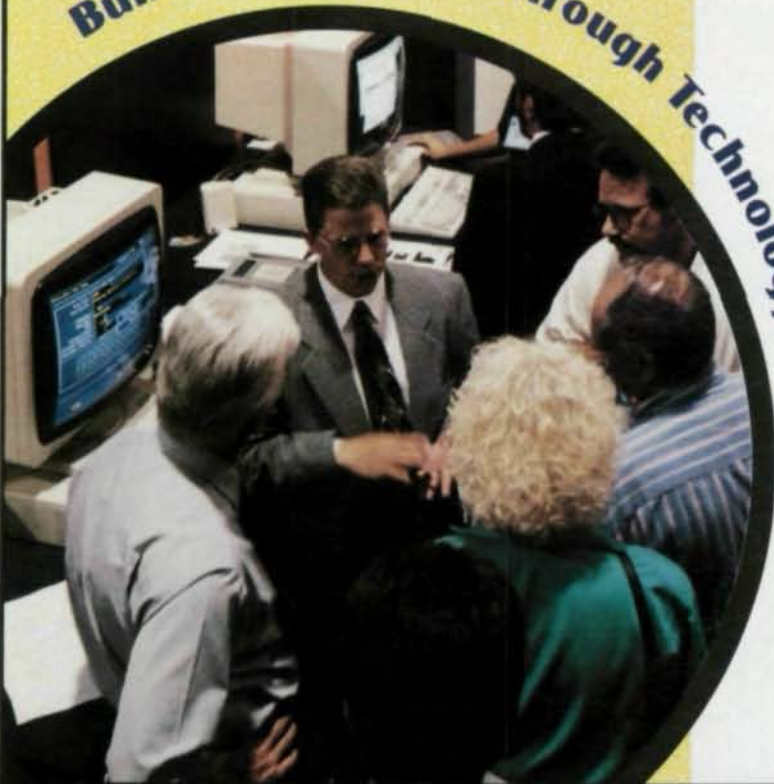
Computer Aided Structural Engineering Center  
Georgia Institute of Technology

University of Arkansas "Bud Walton" Arena, Home of the 1994 National Collegiate Basketball Champions Engineering design using GT STRUDL  
Rosser International, Inc. Architecture, Engineering, Program Management © Tod Sierackowski



For Every Construction Professional

Build Profitability through Technology



## The Computer Applications and Management Show for Contractors

Conference: October 3-5, 1995

Exhibit: October 4-5, 1995

Navy Pier • Chicago, IL

Sponsored by

**Engineering News-Record**

The McGraw-Hill Construction Weekly

Computers for Contractors '95 is a 100-vendor, 300-booth exhibit plus a complete package of specialized seminars, tutorials and other conference sessions all dealing with high-tech solutions for the construction industry. Don't miss it!



For more information, call 1-800-451-1196 or fax 1-203-666-4782.

# TO MAKE SURE OUR TENSION CONTROL SYSTEMS OUTPERFORM THE COMPETITION, WE PUT A HEX ON THEM.



Our Tru-Tension® bolt was designed with one very important advantage over other twist-off bolts: a hex head. So removing this bolt or checking the installation with a torque wrench is just as easy as installing it.

Using a quiet, hand-held power tool, our Tru-Tension system always provides the correct tension. It also eliminates operator error during assembly, the bolts come pre-assembled and you can even save money thanks to the quick, easy installation and lower costs for visual inspection.

But, install any button head fastener compared to our hex head fastener, and there's no turning back. Because it's almost impossible to remove a button head fastener, you may even need a welder to burn it off. That costs you time and money. If you'd installed our hex head bolt in the first place you could remove it with a simple, four dollar wrench.

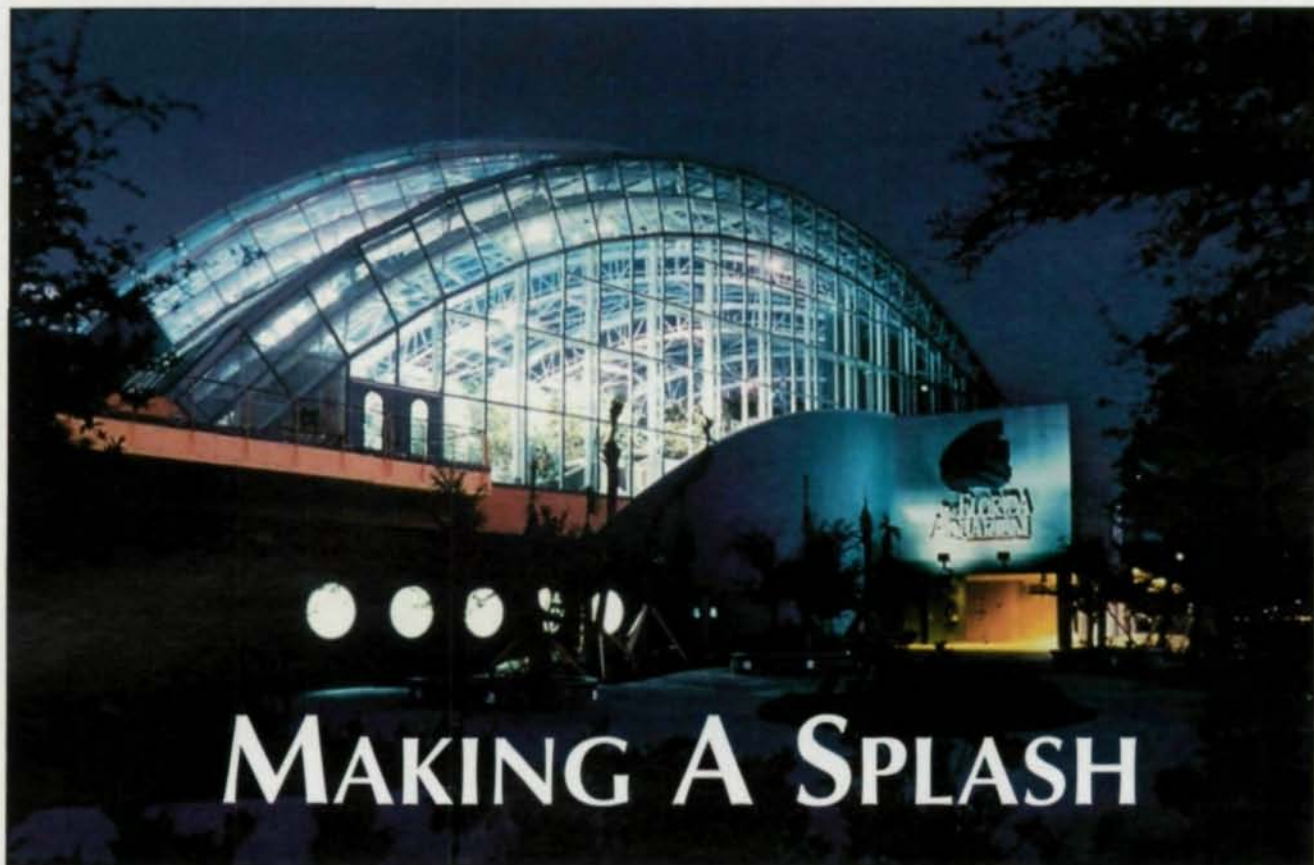
What if you have to verify the proper installation of a button head bolt? Again, it's almost impossible since you can't even get a wrench on the head to test or remove it. But you can verify installation of our hex head bolt with the turn of a wrist and a calibrated torque wrench.

Clearly, this is one bolt that won't let you screw up. Our Tru-Tension system is also fully traceable to our domestic sources, like all Nucor fasteners. They're fully tested and certified, including compliance with FHWA, DOT and AASHTO specifications for bridge construction.

So, forget about cutting bolts off with a torch if something goes wrong. Call us at 800/955-6826, FAX 219/337-5394 or write PO Box 6100, St. Joe, IN 46785 to find out more about our Tru-Tension system. And get a fastener that has a good head for business.



**NUCOR FASTENER**  
A Division of Nucor Corporation



# MAKING A SPLASH

Large steel truss arches span across the new Florida Aquarium to help create a light, airy feel

By David W. Landis, P.E., and Blair K. Hanuschak, E.I.

**W**HEN THE \$84 MILLION FLORIDA AQUARIUM OPENED ITS DOORS IN TAMPA on March 31, 1995, it made quite a splash. The brightly colored 152,000 square foot aquarium is more than just the latest in a frenzy of aquarium construction across America. The Florida Aquarium is a state of the art, awe-inspiring facility that is one of the nation's largest and most exciting aquatic facilities.

The aquarium's signature glass-covered, shell-shaped dome roof spans 140 feet over 20,000 square feet of lush exhibit space representing various types of Florida wetlands habitat. Striking architecture, engineering prowess, and cutting edge aquatic technology came together in spectacular fashion to create southwest Florida's newest landmark and tourist destination.

The aquarium commands a prominent site along the waterfronts of Ybor and Garrison Channels, just southeast of

downtown Tampa. As part of the Garrison Seaport Center, which also includes a new cruise ship terminal, the Florida Aquarium is within walking distance of the Tampa Convention Center, the Harbour Island master planned residential, retail, and hotel community, and the new NHL arena currently being built. Planned development for this growing area includes a high-rise hotel, an outdoor music venue, restaurants, and other entertainment and retail amenities. Construction of the aquarium has been a key factor in the revitalization of this area of town.

The Florida Aquarium's mission is to tell the Florida water story, from the inland stream and swamp to the coast and open sea, in an educational and entertaining way. Exhibits are arranged to follow the journey of a drop of water from Florida's inland freshwater springs and aquifers, through marshes, swamps, and wetlands, out to bays and beaches, through coral

reefs, and finally, out to the open ocean. The exhibits are organized into four main areas: Florida Wetlands, Florida Bays and Beaches, Florida Coral Reefs, and Florida Offshore. The Florida Aquarium is unique in that it focuses specifically on the rich diversity of plant, animal, fish, and marine habitats found in Florida.

#### 4,300 SPECIMENS

The aquarium is home to more than 4,300 specimens of 550 fish, animal, and plant species native to Florida. The Florida Wetlands takes the visitor through springs, streams, saw grass marshes, rivers, hammocks, cypress swamps, and mangrove forests. The Florida Bays and Beaches exhibits allow the visitor to examine the marine habitats of Florida bays, sea grass beds, bay bottoms, bridges, and beaches. The Florida Coral Reefs simulates a 60-foot dive off the Florida Keys, beginning at the shallows of a near-shore reef, passing through an underwater tunnel, and ending at an enormous viewing window into the huge 500,000 gallon coral reef tank, alive with a myriad of brightly colored coral, fish, sharks, and rays.

The building's unique architecture, and the engineering systems that support it, are an integral part of the visitor's experience. The most notable architectural element is the aquarium's signature roof, which was inspired by and mimics the form of a scallop shell. The glass-covered, shell-shaped dome roof encloses the 20,000 square foot, 65-foot high column-free Florida Wetlands exhibit space. Eight arched trusses spring radially from a central buttress at the shell's apex to form the dome's thematic shape. The use of arched trusses, wind tunnel tests, a refined three-dimensional analysis, tube shapes, and intricate detailing made possible the light, airy structure that complements the exhibits below.

Architect on the project was



Photo courtesy of Aerial Innovations



Photo courtesy of Aerial Innovations



# Curved & Straight Steel Bridge Design

## English & Metric

### Integrated Girder and Bracing Design

Complex grid and roadway geometries, 1 girders, box girders, rolled shapes  
Influence surface (grid) or influence line approach (grid or line girder)  
Powerful nonprismatic girder optimization processing (curved and straight)  
1992 AASHTO SPEC, 1994 Interims, 1993 CURVED GIRDER GUIDE SPEC

Demos and 30-day trials available

# MDX software

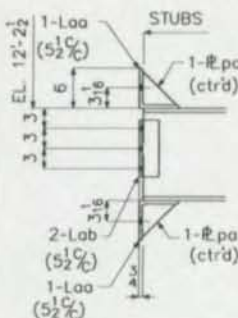
Phone (314) 446-3221

Fax (314) 446-3278

Please circle # 47

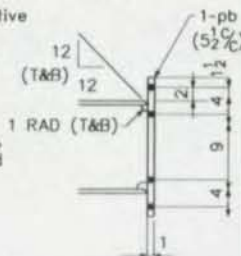
### TIRED OF BEING RESTRICTED TO ONLY THOSE CONNECTION TYPES FURNISHED WITH YOUR DETAILING SOFTWARE?

DetailCAD is proud to announce the addition of user connections to our software package. User connections allow you to design your own connections and integrate them into our detailing program. DetailCAD incorporates your connection into the member you are detailing, then it assigns the next sequential piece mark, calculates all dimensions, stubs, and cut lengths for the connection, and bills out a complete material list for the member in the shop bill.



DetailCAD—The easiest, most productive detailing software for the money...

Each beam, column, brace, or stair is drawn fully and immediately after answering a few simple questions. All dimensioning is done by the program, including set-backs, blocks, and stubs. Shop standards, clip angles, base and cap plates are entered only once at the beginning of each job. The information is stored in data files, and may be used again for future jobs.



DetailCAD was written by detailers. We use this product daily and we understand your needs. Give us the opportunity to show you that you don't have to spend \$30,000 for a good detailing program. We offer a free 30 day test period for a deposit of \$150, which is fully refundable. The purchase price of this program, including stairs, is \$5000. For information, contact:

Marvin Alexander  
2314 First Ave. N.  
Birmingham, AL 35203  
(205)324-5741

David Crow  
437 Patrick Mill Road SW  
Winder, GA 30680  
(404)867-6756

# DetailCAD

STEEL DETAILING SOFTWARE FOR AUTOCAD

Please circle # 24

HOK / EHDD, a joint venture of Hellmuth, Obata & Kassabaum, Inc., Tampa and St. Louis, and Esherick Homsey Dodge & Davis, San Francisco, and wind consultant was Cermak Peterka Peterson, Inc., Fort Collins, CO.

Because the many live plants and trees require large amounts of natural light to thrive, the roof structure was required to be as open and unobstructive as possible. At the same time, the glass-covered dome has to stand up to the 100 mph hurricane winds expected along the Florida Gulf coast. In response, the structural engineer worked closely with the architect to develop an ethereal but strong structural system that is free from large gusseted connections and other obstructions. Various truss schemes were investigated, including trusses of wide flange shapes, tubes, and pipes. Tube trusses were selected because of their strength, architectural appeal, ease of connection, and relatively low cost.

### ARCHED TRUSSES

The arched trusses, which span as much as 140 feet, vary in depth along their length from four feet at the apex to eight feet at the base. Truss top and bottom chords are segmented at panel points to follow the curved roof geometry. The chords are 8-in. x 4-in. tubes with wall thicknesses varying from 1/4-in. to 1/2-in. as required for strength. The segmented chords are full-penetration welded at each panel point. The truss web diagonals are tubes as well, varying from TS2.5x2.5x<sup>3</sup>/<sub>16</sub> to TS3.5x3.5x<sup>1</sup>/<sub>4</sub>. Connections of web diagonals to truss chords are fillet welded or partial penetration welded, depending upon diagonal size. This eliminated the need for gusset plates, resulting in aesthetic, unobtrusive connections.

Structural engineer on the project was Walter P. Moore and Associates, Inc., Tampa, and mechanical/electrical engineer was Syska and Hennessy, New York City.





The arched trusses are supported at the shell's apex by one towering concrete buttress column. The trusses come to a point at the apex and are field-bolted to heavy W12s that are embedded in the concrete buttress. Each truss is supported at its far end (the shell's base) by a curved concrete buttress. A simple anchor bolt connection is used at these supports. Each of the arched trusses was delivered to the site in two pieces, spliced together on the ground with full-penetration welds, and then lifted into place. Two cranes were used to erect the trusses.

To create the scallop shell shape, the radial roof trusses are sequentially stepped. As a result, the roof purlins span from the top chord of each lower truss to the bottom chord of the adjacent higher truss. Faceted "horizontal" trusses between the chords of adjacent arched trusses provide lateral resistance and overall roof stability. These trusses follow the curved profile of the roof and share a common chord with the arched vertical trusses.

Tube purlins spanning between the roof trusses vary in size from TS 6x4 near the shell's apex to TS 20x12 at the shell's base. For aesthetic reasons, the purlin's depth is always oriented perpendicular to the curved roof surface, resulting in biaxial

bending and torsional loads. Additionally, because the purlins help to form the lateral-load resisting trusses, they are also subjected to axial loading. Purlin connection design was complicated because it was necessary to accommodate the biaxial shears, axial loads and torsion, and yet maintain small, aesthetic, and easily constructable connections. Connection plates that are only slightly larger than the tube dimensions are shop-welded to the purlins and trusses; the field connections are bolted with slip-critical bolts.

Steel fabricator and erector on the project was AISC-member Tampa Steel Erecting; detailing was performed by Structural Technics in Irondale, AL. General contractor was Turner/Kajima, a joint venture of Turner Construction Company, Orlando and Kajima Construction Services, Atlanta.

#### COMPUTER-AIDED DESIGN

Close coordination among the designers and builders helped to accurately analyze, detail, and construct the complex geometry of the roof system. The architect developed the roof geometry using a three-dimensional CAD model developed on STAAD-III. Top and bottom truss chords are segmented to form non-concentric circles. The architect's CAD

# AISC

## Publications

## and Software

**Now Available:**  
**1995-1996 listing**  
**and prices of**  
**AISC publications**  
**and software**

#### Including:

- Manuals
- Specifications & Codes
- Design Guides
- Conference Proceedings
- Journals & Magazines
- Books from other publishers
- Electronic Publications
- Video Products
- Software

#### New this year:

- Guide For Metric Steel Fabrication
- Nuclear Specification
- Welding of Steel Bridges
- Innovative Practices In Structural Steel Video

For a **FREE**  
 copy, call:  
**800/644-2400**



geometry model was then used as a basis for a three-dimensional computer model for the structural analysis and design. The structural computer model consisted of more than 900 members and 1,900 degrees of freedom. The steel detailer used the

structural computer model and CAD files as an aid in generating the shop drawings. In addition, some two dimensional drawings were developed using RISA 2D.

To assure high reflectivity, durability, and ease of maintenance, the roof steel is painted

with an off-white high-build epoxy-based paint system. Each roof component was primed with a zinc primer and then painted in the shop with two coats of paint. To protect the paint, nylon lifting straps were used to erect the steel. Touch-up work and bolted connections were painted in the field prior to the application of a final 2 mil semi-gloss finish coat to the entire in-place dome structure. The overall paint system thickness is 18 mils.

Because the majority of the structural steel is over 20 feet above the floor, fireproofing was not required. The small amount of steel below the 20-foot fire-protection threshold was protected by increasing the density and capacity of the sprinklers and using sprinklers that are activated at a temperature lower than conventionally required.

Comprehensive wind tunnel tests were conducted on the

## A Quick Quiz For Structural Engineers

The more a computer program costs, the better it is.

TRUE FALSE

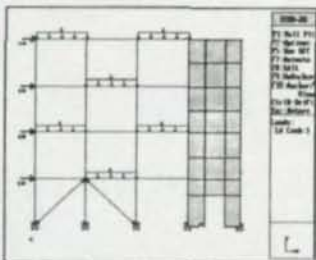
A program that solves complex, difficult problems must be complex and difficult to use.

TRUE FALSE

Structural engineering software can never be fun to use.

TRUE FALSE

If you answered *TRUE* to any of the above, or you would like to know more about a truly innovative software program, call us!



## RISA-2D

Your complete solution for  
frames, trusses, beams,  
shear walls and much more!

**RISA**  
TECHNOLOGIES

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

Please circle # 40

## GRINDER SOFTWARE COMPANY

### MATERIAL ESTIMATING FOR STEEL FABRICATORS

- ✓ Accomplish in 3 hours time what used to take 8 hours with pencil and paper.
- ✓ Keep material waste to the absolute minimum using our unique length optimizing process.
- ✓ Produces 12 precise, easy to read reports for use by the shop and office.
- ✓ Handles ferrous and non-ferrous metals, fasteners, hardware, misc. items and assembled units. Also tracks shop and field labor.
- ✓ Interfaces with the SteelCad™ International detailing software.
- ✓ A "Competitive Upgrade" is available.
- ✓ "Test Drive" our fully functional demo for 30 days and start saving today.

1774 Rose Valley Road  
P.O. Box 431  
Kelso, WA 98626

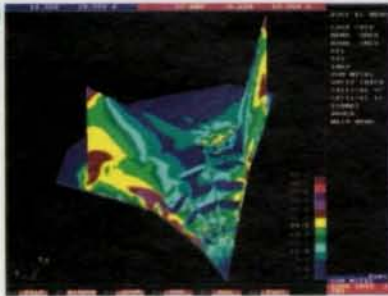
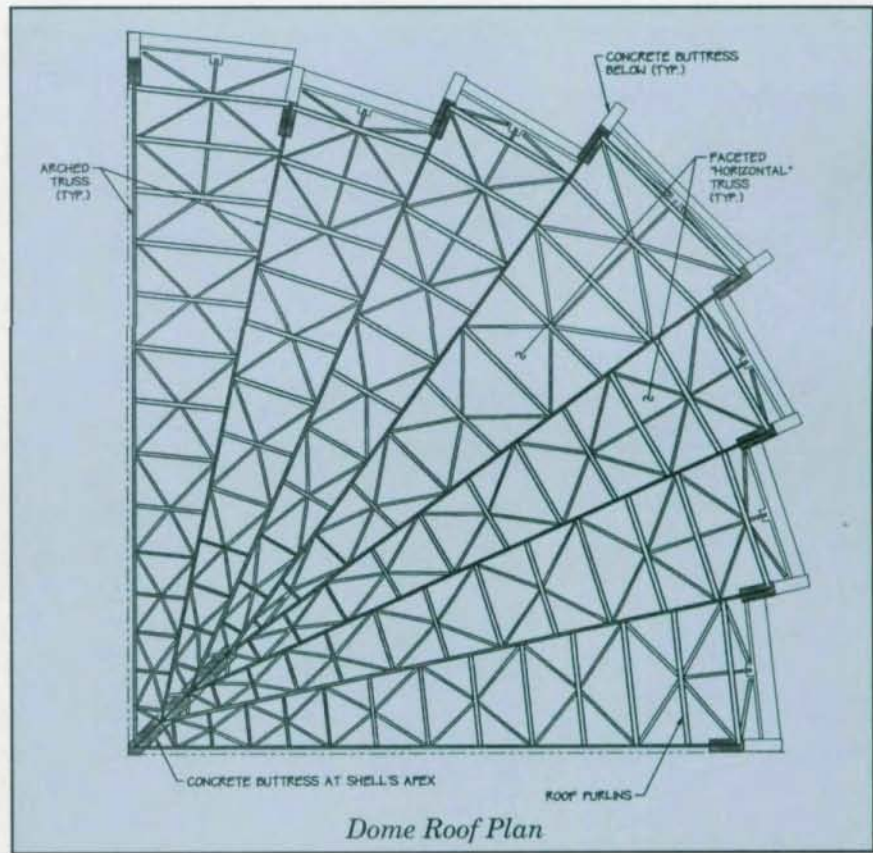
Tel 800 677-4474  
Fax 206 577-4474

COMPUTER SOFTWARE FOR SUCCESSFUL STEEL FABRICATORS

Please circle # 83

uniquely shaped roof. The tests were based on historical wind speed data for the Tampa Bay area and a 100-year recurrence interval. While the wind tunnel tests did reveal some localized areas of high pressure, the pressures for the most part were less than code-prescribed values. This allowed the use of reduced design wind loads, resulting in a cost savings for both the structure and the glass and glazing system. The lower wind pressures, in conjunction with an optimized three-dimensional structural analysis, reduced the structural steel weight by 25 percent compared to preliminary designs based on the higher code-prescribed values.

The shell-shaped dome contains over 110 tons of steel tubes and connection material, equating to a relatively modest structural steel weight of 11 psf. Another 9 tons of steel tubes support the glass-covered sides



## StruCAD\*3D

The Flagship Product for 3D Structural Analysis and Design

- True 3D Interactive Design and Interactive Modeling
- User Friendly Pop-Up & Pull-Down Menu Systems
- Full 3D Geometry and Load Generation
- Complete 3D FEM Analysis and Design
- Interactive Graphics Preprocessing & Postprocessing
- AISC-ASD & LRFD, API-WSD & LRFD, ACI-318 Codes
- Reinforced Concrete Design and Code Checks
- Torsion Design Checks with Warping Stresses
- Deflections, Shear, and Bending Moment Diagrams
- Automatic Wave, Wind, Gravity, Buoyancy, and Inertia Load Generation
- Static, Dynamic, Seismic, and Pile-Soil Analysis
- Steady State Machine Vibration Analysis
- P-Delta and Thermal Analysis
- 2D and 3D AutoCAD DXF Interface
- Detailed Deterministic and Spectral Fatigue Analysis
- Capacities up to 6,000 Nodes (36,000 DOF), 12,000 Elements, 200 Basic and 200 Combined Load Cases
- Many Industry-Specific Modular Packages Available

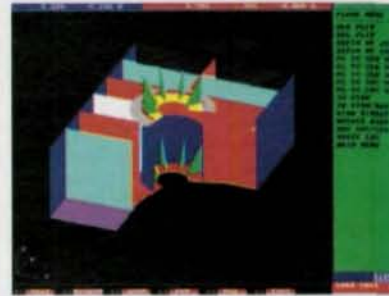
Prices Begin At Only **\$249** Educational Version

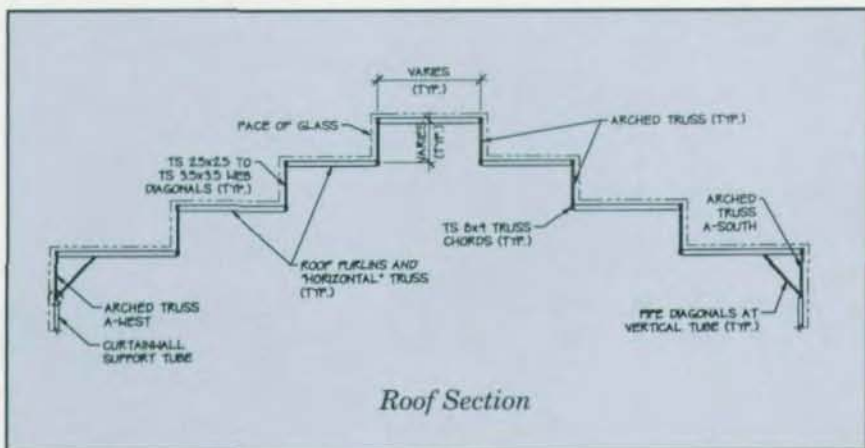
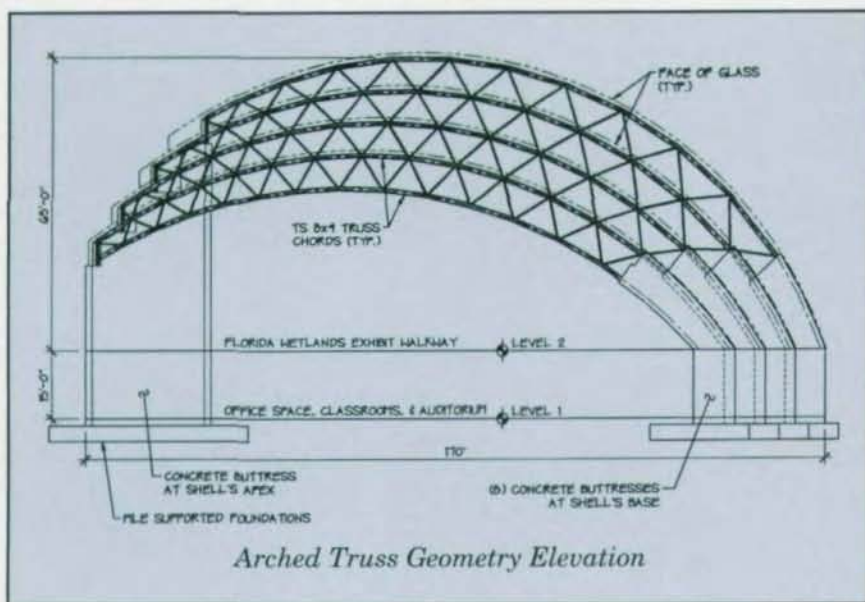
Includes Technical Support & Complete Documentation

Capability Versatility Reliability

Zentech, Inc.  
8582 Katy Freeway, #205  
Houston, Texas 77024  
Tel (713) 984-9171  
Fax (713) 984-9175  
74012.56@compuserve.com

Zentech London  
103 Mychett Road  
Mychett, Camberly  
Surrey, UK GU16 6ES  
Tel 44-1252-376388  
Fax 44-1252-376389





of the dome. The dome is enclosed with 1,100 laminated glass panels, most of which have different geometries. Despite the complicated roof geometry, construction of the shell-shaped dome went smoothly and was completed ahead of schedule. Erection of the structural steel was completed in only four weeks. Glass and glazing installation took five months to complete.

In addition to the dome roof, 43 tons of structural steel create a skeleton for fabric-covered parasail-shaped canopies that protect open-air saltwater exhibit tanks from the sun and elements. Curved TS 8x3 purlins shape the canopies and are supported by tubular beams spanning over the tanks. Translucent vinyl fabric is

stretched over the curved tube frames. The steel tubes are protected from the corrosive saltwater environment with the same durable coating system used for the dome roof.

#### SUPPORTING THE EXHIBITS

The aquarium's large exhibit tanks also required careful design. The tanks are constructed of high-performance reinforced concrete for durability and water-tightness. Various reinforcing steel corrosion protection schemes were investigated, including silica fume concrete, corrosion inhibitors, epoxy coated reinforcing steel, and cathodic protection. The selected scheme incorporates high-performance concrete and uncoated reinforcing steel. The concrete mix design includes the use of a high

cement content, fly ash, and silica fume for all tanks, resulting in a very dense concrete matrix. Additionally, a corrosion inhibitor was incorporated into the concrete for all brackish and saltwater tanks. Extra concrete cover, special concrete placing and curing procedures, and a crystalline forming water-proofing system further enhance tank durability.

The Coral Reef tank, the largest in the aquarium, is up to 26 feet deep and holds 500,000 gallons of saltwater. The concrete tanks are highly irregular in shape, with numerous viewing windows penetrating the tank walls. Accommodating the acrylic windows required special detailing and close coordination with the architects, exhibit designers, and acrylic window manufacturer. The largest acrylic panel, 14 feet tall by 43 feet wide, is 12" thick, weighs 24 tons, and provides a panoramic view of the colorful coral reef habitat. Over 100 acrylic panels are incorporated in tanks throughout the aquarium.

The project was financed by the sale of an \$84 million bond issue backed by the City of Tampa. The aquarium is projected to draw over 1.8 million visitors annually, creating 1,700 jobs and a \$210 million impact to the local economy. The success of the aquarium is aided by the fact that there are over 5 million people within a 100 mile radius and the Tampa Bay area is a popular tourist destination.

The Florida Aquarium's grand opening on March 31, 1995, was a memorable event full of fanfare, complete with marching bands and fireworks. In line with its educational theme, 350 school children participated in the opening ceremony. The aquarium made its debut on national television's Good Morning America as a crowd of over 1,000 looked on, and 10,000 visitors toured the aquarium on opening day. The facility has been well received, accommodating over 150,000 guests in the

01467

first month. The Florida Aquarium provides visitors with an exciting and entertaining educational experience, made possible by extraordinary design and construction teamwork, creative architectural design, and structural ingenuity.

*David W. Landis, P.E., is a Senior Associate and Blair K. Hanuschak, E.I., is an Associate with Walter P. Moore and Associates, Inc. Landis and Hanuschak served, respectively, as structural project manager and project engineer.*

*Walter P. Moore and Associates provided all structural engineering services for The Florida Aquarium project. Walter P.*



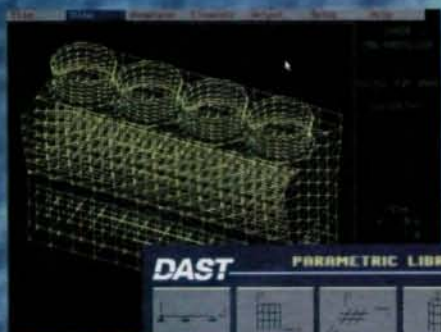
*Moore and Associates maintains offices in Houston, Dallas, Tampa and Atlanta, and provides diverse building-related*

*structural, civil and traffic engineering services throughout the US and internationally.*

# DAST™

## Comprehensive Structural Analysis and Design Software Series

Productivity you need. Value you demand.



DAST offers powerful structural design and analysis solutions in several easy-to-use packages designed for both infrequent and power users. Some DAST features include:

- 2D/3D Static, Dynamic, and P-Delta Finite Element Analysis
- Steel and Concrete Design per American and various international codes
- Advanced graphics with animation and contours
- Icon-based user friendly Input Generator and Parametric Library
- Powerful AutoCAD interface
- Comprehensive printed and on-line documentation
- Unparalleled technical support.

With all the other products available, why should you choose DAST? Simple. DAST Version 11 is the only package that combines powerful features, ease of use, value, a large user base, and over a decade's worth of structural software experience.

Call Toll FREE  
1-800-322-1487  
For More Information  
and a Free Demo

**Das Consulting, Inc.**

865 Turnpike Street  
North Andover, MA 01845 USA  
(508) 794-1487 • FAX: (508) 685-7230  
email: dascon1@world.std.com

# WE CATER OVE GET-TOGETHERS



*Herman Miles Trucking Inc., El Paso, Texas, 8,500 sq. ft.;*  
*Architect: Joe M. James, AIA; Structural Engineer: Pedro Herrera; General*  
*Contractor: Balboa Enterprises, Inc.; Steel Fabricator: Area Iron & Steel*

89110

# R 1,000 SMALL EVERY MONTH.

As the country's largest supplier of steel joists, joist girders and steel deck, we've pulled off some pretty big productions in our time. But that's actually a small part of what we do.

Day in and day out, the average Vulcraft project is relatively small, about 15,000 square feet. And we take on more than 30 such projects a day; that's more than 1,000 each month, more than 12,000 a year. In short, small projects are a very big part of our business.

As such, we treat each and every one of them to the same quality products, service and expertise that we'd offer on a million square foot project. That's something smaller



*Independence Point Office Park, Charlotte, North Carolina, 17,000 sq. ft.; Architect/Engineer: Overcash/Demmitt; General Contractor: D. A. Davis Construction Co.; Steel Fabricator: Steelfab, Inc.; Steel Erector: Dixon Industries*

joist suppliers just can't do.

Extremely efficient manufacturing means that Vulcraft is uniquely able to respond to the tightest delivery schedules.



*Station KMSP-TV, Eden Prairie, Minnesota, 36,000 sq. ft.; Architect: Korsunsky Krank Erickson; Consulting Engineer: Nelson-Rudie & Associates; General Contractor: Kraus-Anderson Construction Co.; Steel Fabricator: Central Minnesota Fabricating; Steel Erector: Amerect, Inc.*

We have the experience and the personnel to solve design problems that might otherwise stand in your way.

And with six joist plants across the country, Vulcraft is incredibly convenient.

All of which means shorter lead times and cheaper freight for you.

So the next time you've got a little something in the works, give us a call, or consult Sweet's 05100/VUL and 05300/VUL. Because no one else brings such vast experience and superior resources to the party.



*Tony Ingolia Salami & Cheese Co., Sacramento, California, 25,000 sq. ft.; Architect/Engineer: Edward A. Bonelli & Associates; General Contractor: Holdener Construction Co.*

## VULCRAFT

*A Division of Nucor Corporation*

PO Box 637, Brigham City, UT 84302, 801/734-9433; PO Box 100520, Florence, SC 29501, 803/662-0381; PO Box 169, Fort Payne, AL 35967, 205/845-2460; PO Box 186, Grapeland, TX 75844, 409/687-4665; PO Box 59, Norfolk, NE 68702, 402/644-8500; PO Box 1000, St. Joe, IN 46785, 219/337-5411.

Please circle # 37



# GALVANIZING REDUCES MAINTENANCE CONCERNS

The use of galvanized steel tubes for a new conservatory provided strength, aesthetics and a maintenance-free structural system

By Timothy W. Porritt, P.E.

**W**HEN THE WEST MICHIGAN HORTICULTURAL SOCIETY FIRST BEGAN PLANNING A MAJOR BOTANICAL AND SCULPTURAL GARDEN, they envisioned a facility that would not just attract visitors from around the world, but would also serve as a valuable educational resource for the community. That vision is now a reality on 70 acres of land purchased with private funding on the east side of Grand Rapids, MI.

The focal point of the facility is the glass conservatory, which rises the equivalent of five stories above the site and has a floor area of 15,000 sq. ft. Within the glass walls are beautiful landscapes of plants and trees, meandering walking paths, and a waterfall cascading over a cave and into a stream that flows below footbridges and rock formations. The structure consists of insulated panels supported by an aluminum frame, with a conventional modular greenhouse roof including powered vents, sun screens, misting systems and other mechanical systems to control the tropical environment.

Next to the conservatory is a 17,400-sq.-ft building housing the facility's entrance, administration space, tour information/reception area, gift shop, a cafe with outdoor terrace, classrooms/banquet facilities, rest-



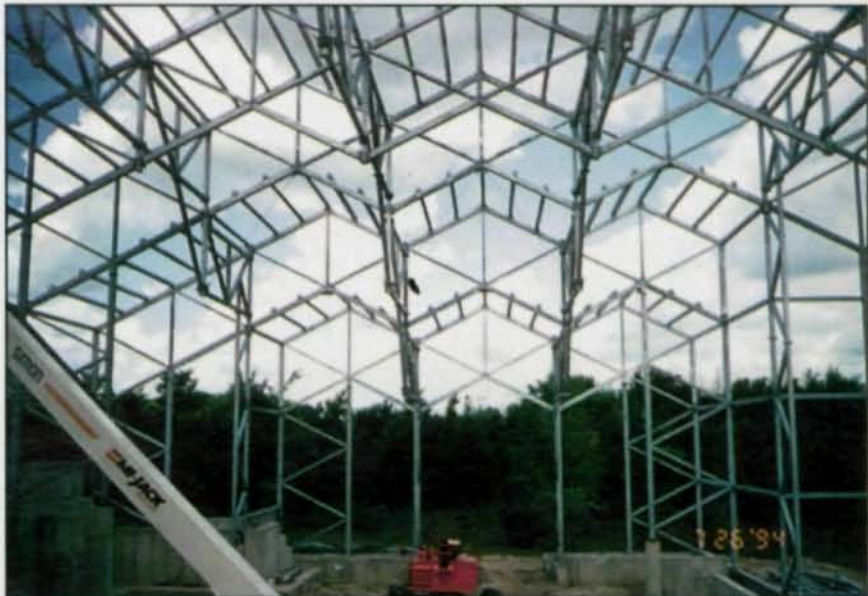
rooms, multimedia center and library. The building is a conventional steel-framed structure with a masonry and limestone exterior.

Connecting the two main structures is a gallery/corridor for displays and art shows. It also provides access to the specialty greenhouses. The long, curved gallery is constructed of masonry and conventional steel framing, and highlights the very unique reinforced concrete trees that serve as support columns. The specialty greenhouses, which house other climates and activities, are modular systems. The gallery floor area is 4,700 sq. ft. and the specialty greenhouses total 8,000 sq. ft.

#### THE CONSERVATORY

The entire conservatory was designed around a modular, standard greenhouse system, with a modular vented-glass roof system supplied by a greenhouse manufacturer. However, the sheer size of the space, coupled with a desire for the highest level of natural light possible, mandated the design of a unique structural system. In addition, the northern location of the conservatory made wind and snow loadings critical, while strict deflection criteria had to be met because of the glass systems. The deflections were determined by applying lateral and gravity loadings to a computer model generated and analyzed using SAP 90.

The interior environment influenced the selection of materials and the manner in which they integrated with each other. The atmosphere within the conservatory is tropical and a high level of moisture is present year-round. Structural steel tube trusses were selected for the structural members not just for their performance characteristics, but also because it minimized exposed surface area and created an attractive appearance. However, because of the desire to create a maintenance-free structure—and because of



# IN STOCK!

## YOUR SOURCE FOR HIGH STRENGTH WEATHERING & ABRASION RESISTANT STEEL

### HIGH STRENGTH WEATHERING

**A588**

BARS • SHAPES • PLATES  
FLATS • ROUNDS • SQUARES  
ANGLES • CHANNELS • BEAMS

**A242-1**

PLATES

**A606-4**

HOT ROLLED COILS & SHEETS

### HIGH STRENGTH

**A572-50**

BARS • SHAPES  
FLATS • ROUNDS • SQUARES  
ANGLES • CHANNELS • BEAMS

### ABRASION RESISTANT

**AR 360**

PLATES

**Hardox 400 & 500**

PLATES

### QUENCHED & TEMPERED

**A514 Gr. A**

PLATES

**A517 Gr. E**

PLATES



Central Steel  
Service, Inc.

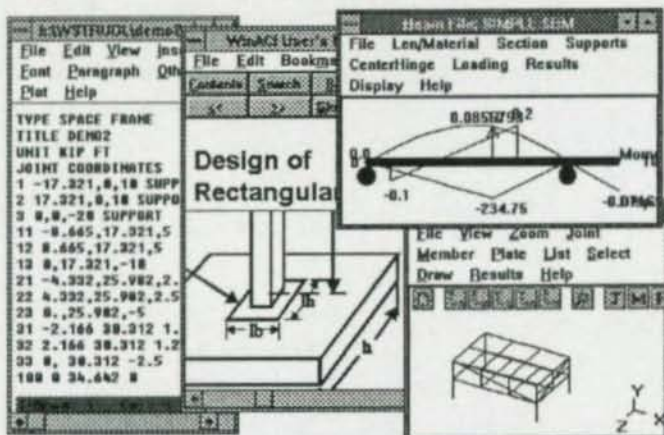
**1-800-868-6798**

P.O. Box 326 • Pelham, AL 35124  
205/664-2950 • Fax 205/663-3391

Please circle # 65

# WinSTRU DL

The Only 32 bit Structural Engineering  
Program written in C/C++ and 100% Windows



Includes 12 Windows Programs

WMaster, WSTRU DL, WinASD, WinACI, WinLRFD, WEdit,  
WinPost, WinPlot, WinBeam, WinTool, WFrame, and WSciSab!

## Ask for a Free Demo Today!

Computer Aided Structural Technology  
POBox 14676, Fremont, CA 94539-4676 Tel (510) 226 8857 Fax 226 7328

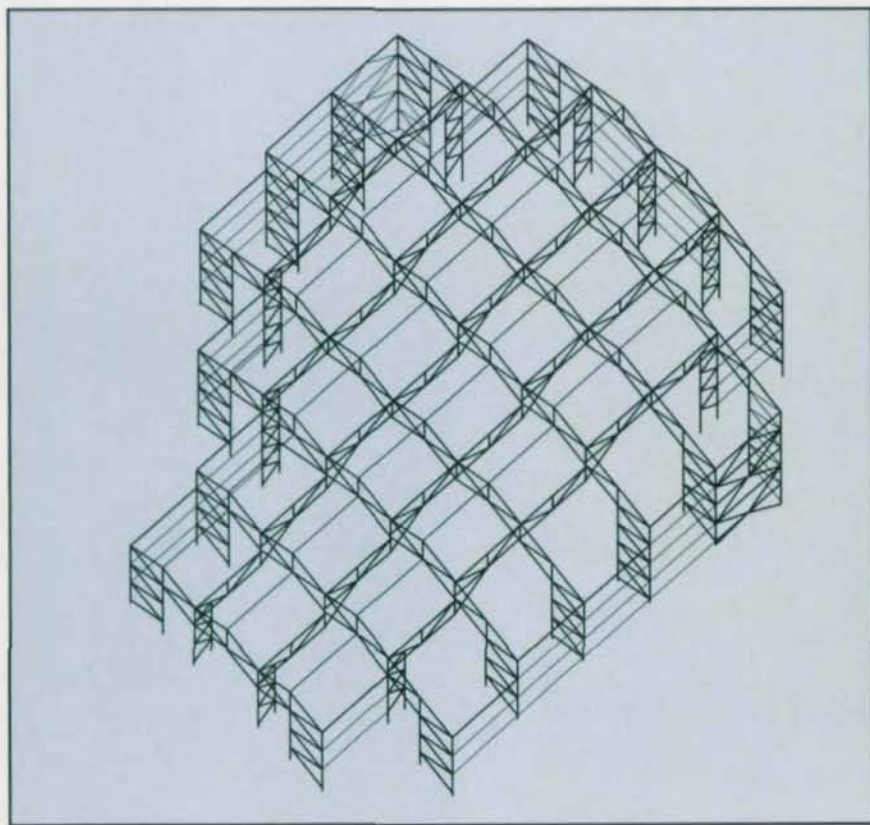
Please circle # 27

the potential for damage to foliage in any re-painting operation—the structural tubes were hot-dipped galvanized. Galvanizer on the project was Columbus Galvanizing-Voigt & Schweitzer, Inc. and Voigt & Schweitzer Galvanizers, Inc.

From the exterior, the glass-enclosed conservatory presents a steeped appearance. The glass is supported by a series of truss/frames of varying sizes with spans ranging from 63 ft. to 126 ft. These truss/frames are constructed of TS8x8 and TS8x4 structural tubes. The components for the Frederik Meijer Gardens are the largest possible, taken into account limitations for shipping, galvanizing and erection. The depth between compression and tension chords is typically 10-ft.-6-in., which also is the dimension of the greenhouse manufacturer's modular roof components. The top of these truss/frames forms a saw-tooth configuration. Optimizing the design required close coordination between the steel fabricator, galvanizer and erector.

Web members of the truss/frames were continuously welded to the main chord members. Prior to welding, small-diameter ports were drilled between members so the steel could be coated galvanically on the inside of all tube surfaces. This also prevents components of the trusses from floating in the dip tanks. Connections between truss components are field-bolted butt plates with galvanized bolts; all other connections are through-bolted tubes attached to welded clip angles. No field cutting or welding was allowed, eliminating possible damage to the galvanized coating, which could lead to discoloring and staining of the structural steel over time. The glass systems are supported by structural tube purlins at the roof and along the walls between truss/frames. These tubes are designed to transfer both wind and gravity loads to the truss/frames.

The main truss/frames are lat-



erally supported by a combination of wind truss/frames and cross bracing where frames were not physically possible. The truss/frames are located in the interior of the building spaced 21-ft. o.c. The overall depth between compression and tension chords is 8-ft.-3-in. Cross braces are used along exterior

walls and perpendicular to the main truss/frames.

There is a concrete mechanical tunnel 8-ft. wide by 12-ft. deep below grade following the perimeter of the conservatory that also functions as the foundation for the truss/frames. This tunnel carries water, air and heat to the conservatory and acts

# MAX WEISS

STEEL  
SHAPING  
SPECIALISTS



UNUSUAL  
SHAPES AREN'T  
UNUSUAL  
AT MAX WEISS.

ROLLING &  
FORMING  
BLACKSMITHING  
WELDING &  
MACHINING  
INDUSTRIAL AND  
CONTRACTORS  
SUPPLIES



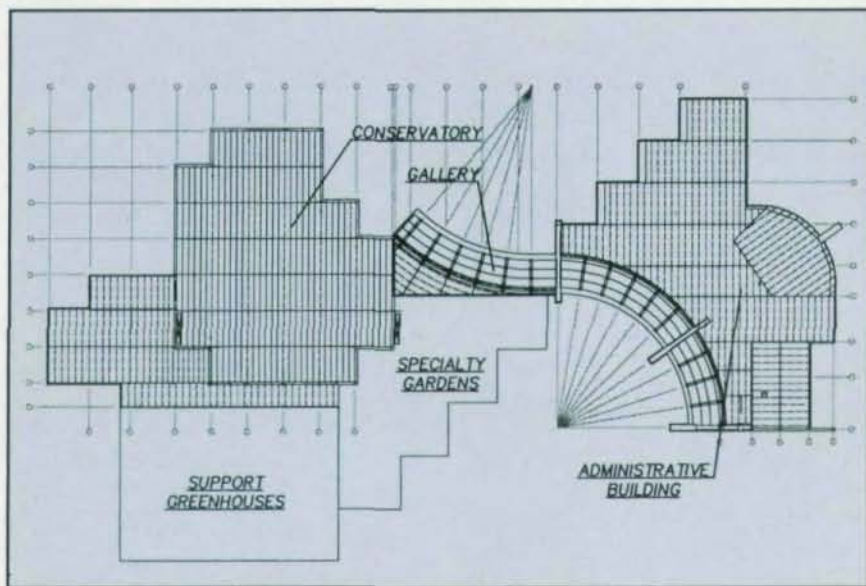
IRREGULAR CURVES,  
VERTICAL OFFSETS,  
ELLIPTICAL SHAPES,  
CIRCLES, OR  
SEGMENTS  
WITH OR WITHOUT  
TANGENTS

If it's structural steel that needs to be bent, for major architectural projects or for unique applications, chances are, Max Weiss bends it. If you have a question or problem in bending, call, FAX or write Dept. M93 for a solution. **TAKE IT TO THE MAX.**

**Max Weiss**

MAX WEISS CO., INC.  
8625 W. Bradley Road  
Milwaukee, WI 53224 USA  
Telephone: 414-355-8220  
MAX FAX 414-355-4698

Please circle # 56



tages of modular spacing of structural members. The structural steel members include W16 wide flange beams and 16K steel joists supporting 1½-in.-wide rib metal deck. The corridor that links the gallery has exposed structural framing supported by on-site precast concrete trees. These unique trees are 22-ft. high and spaced 15-ft. o.c. Support for the concrete trees is provided by combined footings used grade beams and spread footings.

#### GALLERY/CORRIDOR

The gallery linking the conservatory to the administration building is constructed with more conventional steel beam and joist framing. The support for this framing also is provided by the reinforced concrete trees. The trees are a popular, repetitive theme that begins at the main entrance and ends at the doorway to the conservatory.

as a retaining wall to support as much as 23 ft. of soil.

#### ADMINISTRATION BUILDING

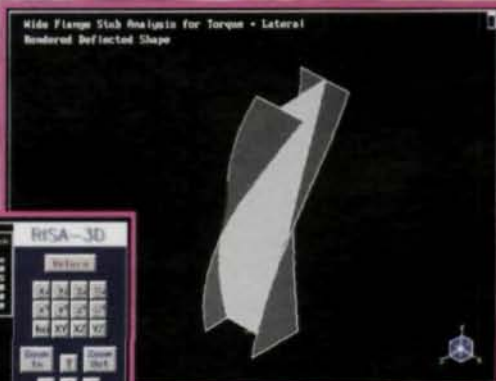
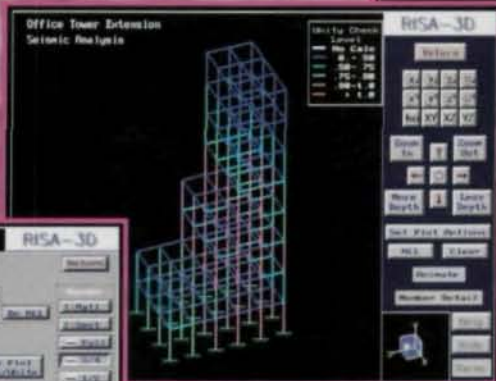
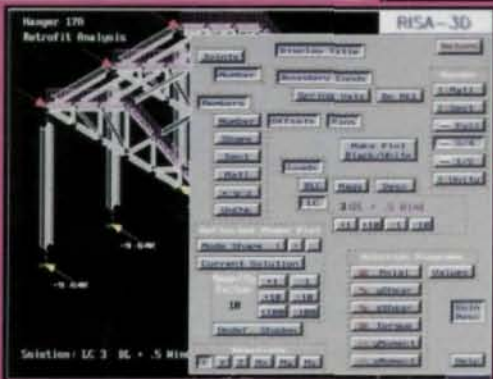
The administration building is a single-story structure of steel framing, steel joists and metal

deck enclosed by brick, limestone and glass. LRFD was used to design the framing for this structure. It was a challenge to come up with a framing system that would conceal the steel and still offer some economical advan-

# RISA-3D *Setting the Standard*

Is *value* important to you when selecting structural software?

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



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

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

*Call or Fax us for a Free Demo*



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

Please circle # 40

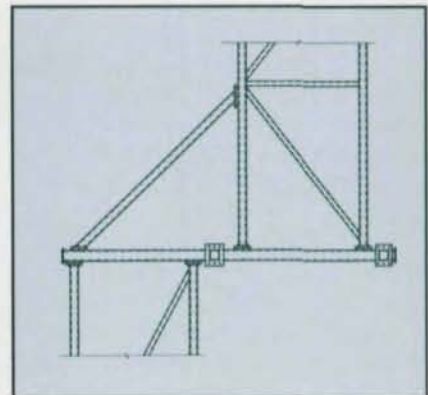
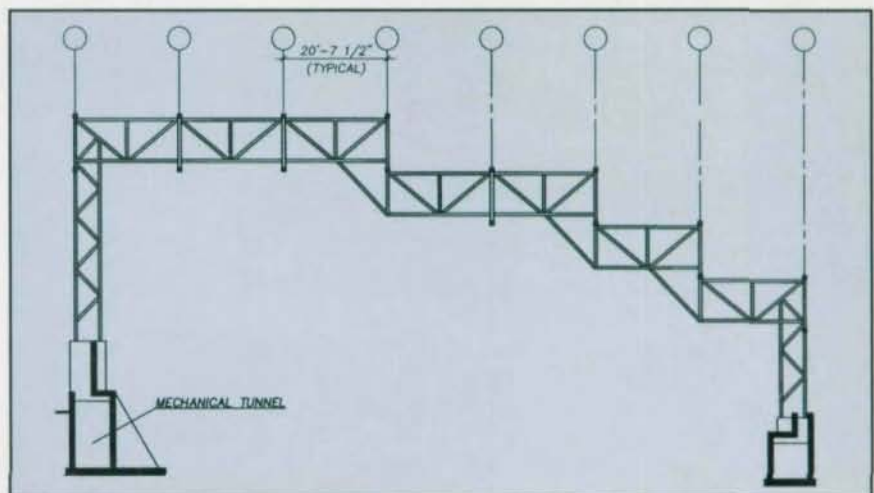
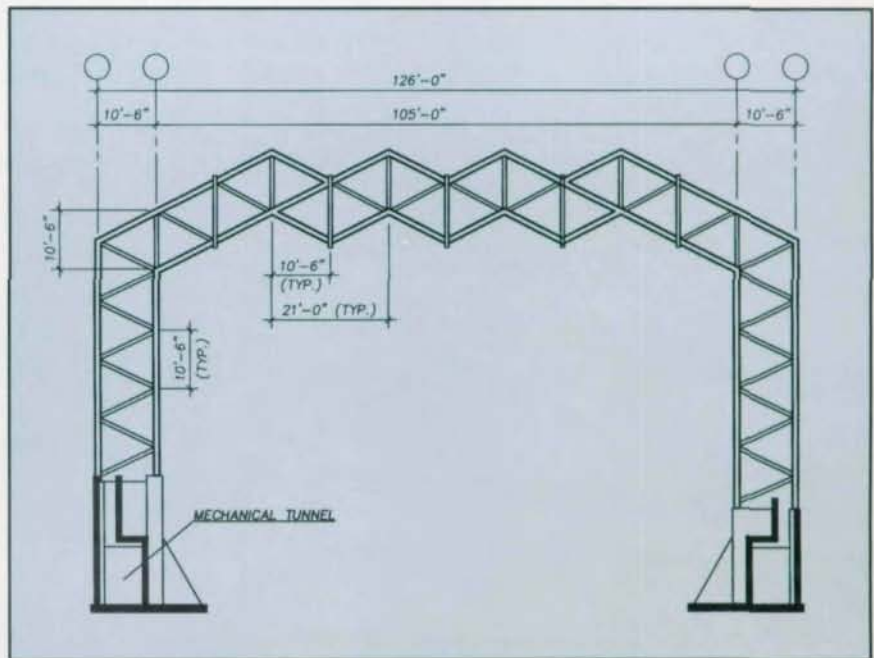
## ERECTION

The erection went smoothly and began at the tallest end of the conservatory with the first main truss/frame. Each truss/frame was erected from the base on both ends, placing components sequentially, working up the frame then toward the middle, until the last segment was placed to form the full truss/frame. After the first truss/frame was installed, segments of the wind truss/frames were constructed to provide stability during erection. This sequence continued along the length of the structure until it was complete, with only minor shoring or bracing required.

Approximately 186 tons of galvanized structural tubing were used in the conservatory and 104 tons to construct the remaining support facilities and administration building. The sloping corridor roof is protected by 7,300 sq. ft. of standing seam copper roofing. The remaining flat roof area is covered by 23,700 sq. ft. of 1½-in. Type B metal deck. The project required 18 tons of steel roof joists, 280 tons of 4-in. split-face Wisconsin limestone, and 3,200 cu. yds. of concrete.

The overall project cost, including all the planting and sculptures, reached nearly \$20 million. The constructed buildings had a price tag of approximately \$8.5 million, with the structural steel, steel joists, and metal deck—including material and erection—costing approximately \$665,000 or \$13.75/sq. ft.

*Timothy W. Porritt, P.E., is an associate with Fishbeck, Thompson, Carr and Huber, Inc.—Engineers, Scientists, Architects, headquartered in Grand Rapids, MI. The Frederick Meijer Gardens recently was honored by the American Galvanizers Association with both their 1995 Architectural/Building Construction Award and their 1995 Most Distinguished Project Award.*





# TIGHT FIT

Despite a narrow, 150-ft.-by-35-ft. site, the designers of a new collegiate fitness center were determined to create an open feeling

By Eliot W. Goldstein, AIA  
and Glenn A. Wrigley

**O**VER THE PAST SEVERAL DECADES, UNION COUNTY COLLEGE in Cranford, NJ, has grown considerably, both in student population and physical plant. However, what has not—and could not—change was the size of its campus, which is limited to a narrow 48-acres. As a result, each new building on campus was constructed in close proximity to existing ones.

The latest addition is a new Fitness Center. The program called for a 16,000-sq.-ft. facility with the school's shipping & receiving center, central storage, maintenance workshops and print shop on the first floor, and a 5,000-sq.-ft. fitness center on the second floor, along with physical plant offices and several new classrooms. As a result of the campus' space limitations, the new building had to be constructed on a narrow, L-shaped site squeezed between existing

campus buildings and inviolate parking lots. The highly constrained site included a long leg on a sliver of land 150-ft. long and just 35-ft. wide.

Several difficulties arose due to the unusual site constraints. The new building would wrap around portions of two existing buildings. However, for one of these buildings, the unsprinklered gymnasium, the loss of this "street frontage" meant that its actual floor area would be in excess of the area allowed by the existing building code for an unsprinklered building. To satisfy the building code, the existing gym had to be sprinklered and the new construction had to be separated from the existing one by rated walls.

Another unusual code problem emerged from the desire to add enough windows to bring substantial natural light into the building. The code constraint

was related to the proximity of the addition's clerestory windows to the outside face of the existing building. The clerestory windows, at a distance of 4-ft. from that surface, were limited to 15% of the area of the wall in which they were located. Since the fire wall was offset from the plane of the clerestory, the overall area of the clerestory wall was relatively small, resulting in a minuscule allowable window area. However, if the clerestory were sprinklered both in and out, and the roof between the clerestory and the fire wall were of protected construction, the authorities were willing to consider the overall assembly as an offset fire wall, in which the area of the fire wall could be considered in the calculation of the allowable area of the clerestory windows.

Non-code related challenges included satisfying ADA guidelines for the toilets, locker rooms

and shower rooms, and adding an elevator accessible from the existing buildings.

#### DESIGN CONCEPTS

The existing campus was constructed in several distinct phases, each with its own architectural vocabulary. The earliest buildings were characterized by large expanses of brick and simple, punched windows—some with decorative sunscreens. The second phase was Brutalist: glazing occupied the spaces between three-dimensional brick and concrete forms. The third phase, which began with the construction of the nearby Student Commons, was characterized by an exposed steel structure, large curtain walls, and facades divided into bases, middles and tops.

For the exterior of the new building, the designers opted to exploit its prominent location at the western end of the network of interconnected campus buildings by creating a distinctive curving roof on the long wing, which rises above the existing gym. The fitness center, occupying the entire area directly under this roof, is glazed on all four sides. On the high side, the glazing is in the form of a clerestory, filling the space between the existing roof of the gym and the higher roof of the new building. To the west, the view is toward an existing pond. The vocabulary of the new building's facades is similar to that of the nearby student commons: brick on the first floor, decorative concrete block above.

Given the forms and materials of contemporary exercise machines, and the static and dynamic loads imparted by their users, the designers decided that an exposed steel superstructure was appropriate for the center. The simplest way of spanning the space would have been to use inclined members running in the short direction. However, we were concerned that the result would be of little visual interest, a major issue in an environment where the users often spend long



periods working out in place.

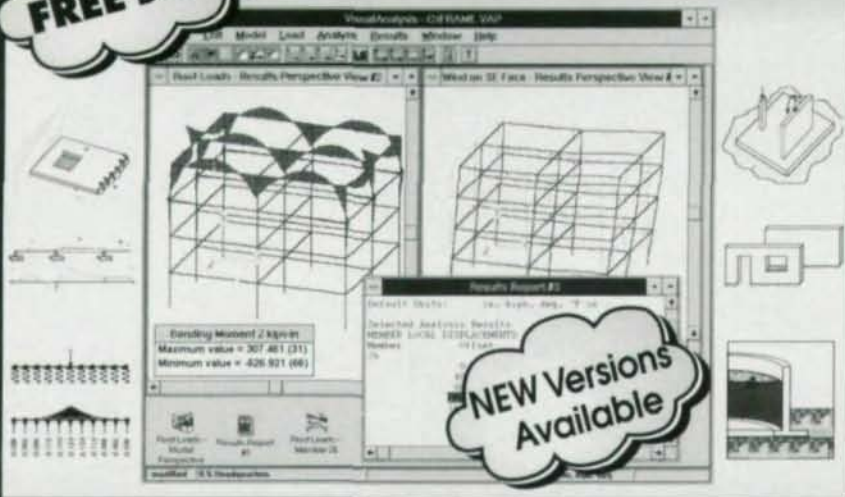
Instead, we explored a variety of roof forms, trying to find a balance between spatial richness and construction economy. The form we eventually settled on consists, in building section, of a tilted flattened "S", where both its arcs are identical but oriented in opposite directions.

The fitness center is essentially one large 35-ft.-by-150-ft. room. A single longitudinal row of interior columns separates the workout area from the corridor. An interior curtain wall separates the apparatus areas from

*Building adjacent to an existing building was difficult not just because of the site constraints, but also because the new construction altered the fire rating of the existing building.*

# "Solve Your Next Problem in Minutes!"

Call for  
**FREE Demo**



**NEW Versions Available**

**f Integrated Engineering Software**

Affordable, high quality software for structural engineers. Real Windows® applications save you time, even for small jobs. **VisualAnalysis™** for graphical, unlimited 3D FEA. **AnalysisGroup™** for tools not found elsewhere: shear walls, circular tanks & more! Please call or fax for information.

8840 Chapman Road, Bozeman, MT 59715 **1-800-707-0816**  
(406) 586-8988 Fax: (406) 586-9151

Please circle # 87

## CALL TODAY FOR YOUR FREE DEMO KIT!

### STRUCTURAL MATERIAL MANAGER 5.0

SMM 5.0 gives fabricators and detailers the fastest, most accurate material list manager available. No more time-consuming manual calculations!



ASSOCIATE MEMBER

The software's speed and efficiency delivers an easy-to-use system that's second to none. Call today for a FREE, no-obligation demo disk with all modules and the complete system's user's guide.

Let SMM 5.0 turn your next material list into hands-off experience!

- Main Module computes weights, surface areas, bolt counts & lineal totals
- Length-Nesting module produces optimal cut lists from in-house stock, vendor stock or the best combination of both
- Plate-Nesting Module draws the best layout for cutting plates from stock sheets
- Estimating Module tallies material costs, shop hours & field hours
- Production-Control Module prints shipping lists, loading tickets & job status reports

**E.J.E. INDUSTRIES, INC.**

287 Dewey Avenue, Washington, PA 15301

**1-800-321-3955 or 412-228-8841**

# HANDS-OFF EXPERIENCE.

Please circle # 46

the aerobics area. The curve of the roof is extruded the entire length of the fitness center, and the underside of its structure is exposed to view. Acoustic metal roof deck spans between identical curved steel tubes spaced at 10-ft. o.c. and supported by longitudinal edge beams. Uplights illuminate the structure. Only the corridor has a suspended ceiling; all of the ductwork and much of the sprinkler piping is concealed above it.

The long narrow leg contains the large unpartitioned areas (fitness center on the second level, central storage area on the first level). The shorter leg contains a variety of partitioned functions. To maximize the efficiency of the plan, circulation was placed along the inside of the L, where it would be shortest. The elevator was located at the juncture of existing and new corridors, and two new fire stairs were located at opposite ends of the long wing.

### BUILDING MATERIALS

To avoid concentrated loads near existing exterior walls, new columns were kept 5-ft. away from them, and the structure was cantilevered toward them. The new moment-resisting steel structure is supported on concrete footings, piers and foundation walls. Roofing consists of single-ply membranes over high-performance insulation board. Interior finishes included painted drywall, decorative block, and in the fitness center, rubber flooring. High-performance glazing is used throughout.

To satisfy code constraints, it was necessary that sprinklering of the gym be completed prior to erection of the superstructure. Also, it was crucial that erection of the superstructure was completed prior to the fall 1994 semester. As a result, the project was fast tracked and constructed under two bids—one for site utilities, foundations and superstructure; the second for enclosure, operating systems and finishing.



01173

Phase 1 general contractor was Tormee Construction, Tinton Falls, NJ, and Phase 2 general contractor was The Conklin Corporation, Franklin Lakes, NJ. Architect on the project was The Goldstein Partnership, West Orange, NJ, structural engineer was Klein Associates, Mountainside, NJ, and mechanical/electrical contractor was Syska & Hennessy Engineers.

#### STRUCTURAL DESIGN

"The compound curve roof form (sine wave) evolved from the architect's desire both for natural interior lighting at the interface of the existing building and for a fitting form for the fitness center," according to Allan Klein, P.E., principal and project engineer with Klein Associates. "To maximize volume, reduce acoustic echoes and reduce costs, an exposed acoustic metal deck was chosen as the roof diaphragm. The continuous run of clerestory windows provided light and transition from the curved ceiling to the existing roof."

The basic semi-rigid bent was composed of W8x67 (50 ksi) columns, W24x94 floor beams spanning 30-ft., and an 8x12x $\frac{1}{2}$  curved tube roof beam. The tubular rectangular roof beam was chosen as the most efficient shape, while the 8x12x $\frac{1}{2}$  tube provided the least weight, strongest section. In addition, the tube greatly reduced the distortion usually associated with a curved wide flange beam bent about its strong axis. Five-ft. cantilevered brackets were welded to the columns and span the gap between the new column line adjacent to the existing building and the code-mandated three-hour fire-rated masonry wall between and independent of both the existing construction and the addition, Klein explained.

"The excellent torsional rigidity provided by the tubes, he added, greatly reduced secondary stresses. Lateral bracing was provided by upturned



ST6x17.5s welded to the tops of the tubes. Because this orientation concealed their vertical legs within the thickness of the roof deck, a clean unbroken reflected ceiling plan resulted. The tubular 8x12x $\frac{1}{2}$ s were bent in one piece by Reco Nelson of Newark, NJ. The 8x12x $\frac{1}{2}$  tubular spandrel girders and intermediate curved roof beams completed the roof framing and simplified connections, while providing an efficient moment-resisting frame capable of accommodating wind and earthquake forces.

Within the wing of the building containing the fitness center, the second floor platform required a total of 14.2 psf of structural steel, while its roof required a total of 13.7 psf of structural steel.

*Eliot W. Goldstein, AIA, is a partner and Glenn A. Wrigley is a project manager with The Goldstein Partnership, West Orange, NJ.*



# ESSENTIALS OF LRFD

An overview of LRFD as found in Part 2 of the *Manual of Steel Construction* (1994)

**N**EARLY A DECADE AGO, THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC. (AISC) BEGAN AN INDUSTRY-WIDE TRANSITION from Allowable Stress Design (ASD) to Load and Resistance Factor Design (LRFD). While acceptance has been slow, momentum is gathering: A recent Gallup poll showed that industry acceptance of LRFD is growing and a majority of structural engineers now believe that LRFD is the steel design method of the future. Some people, however, have interpreted the existence of two specifications as an indication of an unclear direction. Therefore, the AISC Board of Directors has adopted the following resolution:

"Based upon expert input from its Committee on Specifications, the Board of Directors of AISC affirms that the 1993 *Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings* is the preferred Specification for the fabricated structural steel industry. LRFD is a modern and technologically superior steel design specification. Its direct representation of ultimate structural behavior is especially relevant for seismic design, design of frames with partially restrained connections, and composite systems design. It offers engineers the opportunity to innovate in the analysis and design of highly reliable and competitive steel structures by encouraging the consideration of strength and serviceability criteria under appropriate combinations of gravity and lateral loads. In this way, LRFD is consistent with the prevailing trend toward limit-states design in all materials, both domestically and internationally."

This article is the third of a three-part summary of LRFD (part one appeared in June and part two appeared in July).

## H. MEMBERS UNDER COMBINED FORCES AND TORSION

### SYMMETRIC MEMBERS SUBJECT TO BENDING AND AXIAL TENSION

The interaction of flexure and tension in singly and doubly symmetric shapes is governed by Equations H1-1a and H1-1b, as follows:

$$\text{For } \frac{P_u}{\phi P_n} \geq 0.2, \quad \frac{P_u}{\phi P_n} + 8 \left( \frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) \leq 1.0 \quad (\text{H1-1a})$$

$$\text{For } \frac{P_u}{\phi P_n} < 0.2, \quad \frac{P_u}{2\phi P_n} + \left( \frac{M_{ux}}{\phi_b M_{nx}} + \frac{M_{uy}}{\phi_b M_{ny}} \right) \leq 1.0 \quad (\text{H1-1b})$$

where:

$P_u$  = required tensile strength; i.e. total factored tensile force, kips

- $\phi P_n$  = design tensile strength,  $\phi P_n$ , kips
- $\phi$  = resistance factor for tension,  $\phi_t = 0.90$
- $P_n$  = nominal tensile strength as defined in Chapter D of the LRFD Specification, kips
- $M_u$  = required flexural strength; i.e., the moment due to the total factored load, kip-in. or kip-ft. (Subscript x or y denotes the axis about which bending occurs.)
- $\phi_b M_n$  = design flexural strength, kip-in. or kip-ft.
- $\phi_b$  = resistance factor for flexure,  $\phi_f = 0.90$
- $M_n$  = nominal flexural strength determined in accordance with the appropriate equations in Chapter F of the LRFD Specification, kip-in. or kip-ft.

Interaction Equations H1-1a and H1-1b cover the general case of biaxial bending combined with axial force. They also are valid for uniaxial bending (i.e., when  $M_{ux} = 0$  or  $M_{uy} = 0$ ). In this case they reduce to the form plotted in Figure H-1. Pure biaxial bending (with  $P_u = 0$ ) is covered by Equation H1-1b.

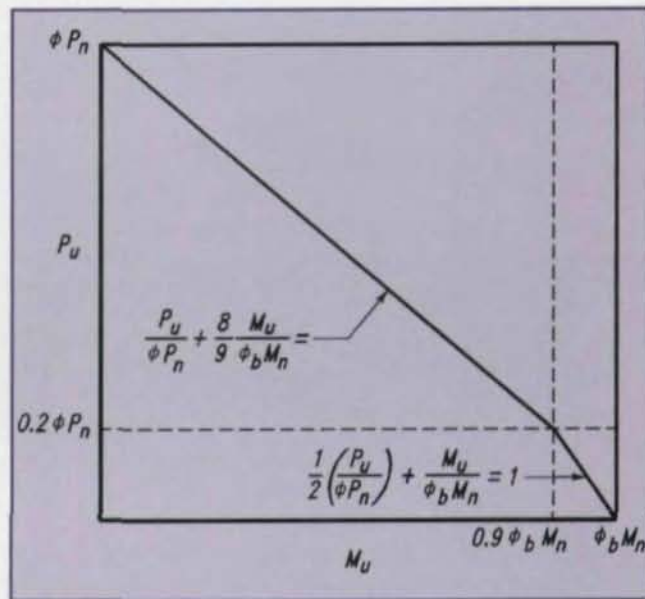


Figure H-1: Interaction Equations H1-1a and H1-1b modified for axial load combined with bending about one axis only.

### SYMMETRIC MEMBERS SUBJECT TO BENDING AND AXIAL COMPRESSION

The interaction of compression and flexure in beam-columns with singly and doubly symmetric cross sections is governed by Equations H1-1a and H1-1b.

- $\phi P_n$  = design compressive strength,  $\phi P_n$ , kips
- $\phi$  = resistance factor for compression,  $\phi_c = 0.85$
- $P_u$  = required compressive strength; i.e., the total

- factored compressive force, kips
- $P_n$  = nominal compressive strength as defined in Chapter E of the LRFD Specification, kips
- $M_u$  = required flexural strength including second-order effects, kip-in. or kip-ft.
- $\phi_b M_n$  = required flexural strength, kip-in. or kip-ft.
- $\phi_b$  = resistance factor for flexure = 0.90
- $M_n$  = nominal flexural strength from Chapter F of the LRFD Specification, kip-in. or kip-ft.

The second-order analysis required for  $M_u$  involves the determination of the additional moment due to the action of the axial compressive forces on a deformed structure. In lieu of a second-order analysis, the simplified method given in Chapter C of the LRFD Specification (and in Section C of the June issue) may be used. However, in applying the simplified method, the additional moments obtained for beam-columns must also be distributed to connected members and connections (to satisfy equilibrium).

### Example H-1

Given: Check the adequacy of a W10x22 tension member of 50 ksi steel to carry loads resulting in the following factored load combination:

$$\begin{aligned} P_u &= 55 \text{ kips} \\ M_{uy} &= 20 \text{ kip-ft.} \\ M_{ux} &= 0 \end{aligned}$$

Solution: From Section D for 50 ksi steel,

$$\phi P_n = \phi_t P_n = 45.0 \text{ ksi} \times 6.49 \text{ in}^2 = 292 \text{ kips}$$

$$\frac{P_u}{\phi P_n} = \frac{55 \text{ kips}}{292 \text{ kips}} = 0.188 < 0.20;$$

therefore Equation H1-1b governs.

For bending about the y axis only, Equation H1-1b becomes:

$$\frac{P_u}{2\phi P_n} + \frac{M_{uy}}{\phi_b M_{ny}} \leq 1.0$$

From Section F for 50 ksi steel,  $M_n = M_p = Z_y F_y = 50 \text{ ksi} \times Z_y$  for minor-axis bending (regardless of unbraced length).

$$\begin{aligned} \phi_b M_{ny} &= 0.90 \times 50 \text{ ksi} \times Z_y = 45.0 \text{ ksi} \times Z_y \\ &= 45.0 \text{ ksi} \times \frac{6.10 \text{ in}^3}{12 \text{ in./ft.}} \\ &= 22.9 \text{ kip-ft. for a W10x22 member} \end{aligned}$$

$$\begin{aligned} \frac{P_u}{2\phi P_n} + \frac{M_{uy}}{\phi_b M_{ny}} &= \frac{0.188}{2} + \frac{20 \text{ kip-ft.}}{22.9 \text{ kip-ft.}} = 0.094 + 0.873 \\ &= 0.967 < 1.0 \quad \text{o.k.} \end{aligned}$$

### Example H-2

Given: Check the same tension member, a W10x22 in 50 ksi steel, 4.0-ft. long, subjected to the following combination of factored loads:

$$\begin{aligned} P_u &= 140 \text{ kips} \\ M_{ux} &= 55 \text{ kip-ft.} \\ M_{uy} &= 0 \\ C_b &= 1.0 \end{aligned}$$

Solution: Again,  $\phi P_n = 292 \text{ kips}$

$$\frac{P_u}{\phi P_n} = \frac{140 \text{ kips}}{292 \text{ kips}} = 0.479 > 0.20;$$

therefore Equation H1-1a governs.

For bending about the x axis only, Equation H1-1a becomes:

$$\frac{P_u}{\phi P_n} + \frac{8}{9} \frac{M_{ux}}{\phi_b M_{nx}} \leq 1.0$$

From Section F for 50 ksi steel,  $M_n = M_p = Z_x F_y = 50 \text{ ksi} \times Z_x$  for major-axis bending if  $L_b \leq L_p$  for ( $C_b = 1.0$ ). Assume unbraced length,  $L_b = 4.0 \text{ ft.}$  By equation F1-4a in Section F,  $L_p = 42.4 r_y$  for 50 ksi steel.

For a W10x22,  $r_y = 1.33 \text{ in.}$ ,  $Z_x = 26.0 \text{ in}^3$ .

$$L_p = \frac{42.4 \times 1.33 \text{ in.}}{12 \text{ in./ft.}} = 4.7 \text{ ft.}$$

$$L_b = 4.0 \text{ ft.} < L_p = 4.7 \text{ ft.}$$

Then  $M_n = 50 \text{ ksi} \times Z_x$

$$\begin{aligned} \phi_b M_{nx} &= \frac{0.90 \times 50 \text{ ksi} \times 26.0 \text{ in}^3}{12 \text{ in./ft.}} \\ &= 97.5 \text{ kip-ft. for a W10x22 member} \end{aligned}$$

$$\begin{aligned} \frac{P_u}{\phi P_n} + \frac{8}{9} \frac{M_{ux}}{\phi_b M_{nx}} &= 0.479 + \frac{8}{9} \times \frac{55 \text{ kip-ft.}}{97.5 \text{ kip-ft.}} \\ &= 0.479 + 0.501 = 0.980 < 1.0 \quad \text{o.k.} \end{aligned}$$

## BENDING AND AXIAL COMPRESSION—PRELIMINARY DESIGN

The design of a beam-column is a trial and error process which can become tedious, particularly with the repeated solution of Interaction Equation H1-1a or H1-1b. A rapid method for the selection of a trial section is given in the LRFD Manual, Part 3, under the heading Combined Axial and Bending Loading (Interaction). As in earlier editions of the AISC Manual, the Interaction Equations are approximated by an equation which converts bending moments to equivalent axial loads:

$$P_{u \text{ eq}} = P_u + M_{ux} m + M_{uy} mu$$

where:

$P_{u \text{ eq}}$  = equivalent axial load to be checked against the column load table, kips

$P_u, M_{ux}, M_{uy}$  are defined in the Interaction Equations for compression and bending

$m, u$  are factors tabulated in the LRFD Manual, Part 3

As soon as a satisfactory trial section has been found (i.e., one for which  $P_{u \text{ eq}} \leq$  tabulated  $\phi P_n$ ), a final verification should be made with the appropriate Interaction Equation, H1-1a or H1-1b.

## TORSION AND COMBINED TORSION, FLEXURE, AND/OR AXIAL FORCE

Criteria for members subjected to torsion and torsion combined with other forces are given in Section H2 of the LRFD Specification. They require the calculation of normal and shear stresses by elastic analysis of the member

under the factored loads. AISC's *Torsional Analysis of Steel Members* (American Institute of Steel Construction, 1983) provides design aids and examples for the determination of torsional stresses. Extensive coverage is given there to wide-flange shapes (W, S, and HP), channels (C and MC) and Z shapes. For these members, the charts and formulas simplify considerably the calculation of torsional rotations, torsional normal and shear stresses, and the combination of torsional with flexural stresses.

In the LRFD Specification,

$f_{un}$  = the total normal stress under factored load (ksi) from torsion and all other causes

$f_{uv}$  = the total shear stress under factored load (ksi) from torsion and all other causes

The criteria are as follows:

a. For the limit state of yielding under normal stress,

$$f_{un} \leq \phi F_y, \text{ where } \phi = 0.90 \quad (\text{H2-1})$$

For 50 ksi steel,

$$f_{un} \leq 0.90 \times 50 \text{ ksi} = 45.0 \text{ ksi} \quad (\text{2-24})$$

b. For the limit state of yielding under shear stress,

$$f_{uv} \leq 0.60\phi F_y, \text{ where } \phi = 0.90 \quad (\text{H-2})$$

For 50 ksi steel,

$$f_{uv} \leq 0.60 \times 0.90 \times 50 \text{ ksi} = 27.0 \text{ ksi} \quad (\text{2-25})$$

c. For the limit state of buckling,

$$f_{un} \leq \phi_c F_{cr} \text{ or } f_{uv} \leq \phi_c F_{cr}, \text{ as applicable,} \\ \text{where } \phi_c = 0.85 \quad (\text{H2-1})$$

For 50 ksi steel, values of  $\phi_c F_{cr}$  are given in Table E-1, in Section E.

Torsion will accompany flexure when the line of action of a lateral load does not pass through the shear center. For wide flange and other doubly symmetric shapes, the shear center is located at the centroid. Singly symmetric shapes have their shear centers on the axis of symmetry, but not at the centroid. (The location of the shear center of channel sections is given in the Properties tables in Part 1 of the *LRFD Manual*.)

Open sections, such as wide-flange and channel, are very inefficient in resisting torsion; i.e., torsional rotations can be large and torsional stresses relatively high. It is best to avoid torsion by detailing the loads and reactions to act through the shear center of the member. In the case of spandrel members supporting building facade elements, this may not be possible. Heavy exterior masonry walls and stone panels can impose severe torsional loads on spandrel beams. The following are suggestions for eliminating or reducing this kind of torsion:

1. Wall elements may span between floors. The moment due to the eccentricity of the wall with respect to the edge beams can be resisted by lateral forces acting through the floor diaphragms. Torsion would not be imposed on the spandrel beams.

2. If facade panels extend only a partial story height below the floor line, the use of diagonal steel "kickers" may be possible. These light members would provide lateral support to the wall panels. Torsion from the panels would be resisted by forces originating from structural elements other than the spandrel beams.

3. Even if torsion must be resisted by the edge members, providing intermediate torsional supports can be helpful. Reducing the span over which the torsion acts will reduce torsional stresses. If there are secondary beams framing into a spandrel girder, the beams can act as intermediate torsional supports for the girder. By adding top and bottom moment plates to the connections of the beams with the girder, the bending resistances of

### Example H-3

**Given:** Check the adequacy of a W14x176 beam-column, 14.0 ft. in height floor-to-floor, in a braced symmetrical frame in 50 ksi steel. The member is subjected to the following factored forces due to symmetrical gravity loads:  $P_u = 1,400$  kips;  $M_x = 200$  kip-ft.,  $M_y = 70$  kip-ft. (reverse curvature bending with equal end moments about both axes); and no loads along the member.

**Solution:** For a braced frame,  $K = 1.0$ ;  $K_x L_x = K_y L_y = 14.0$  ft.

For a W14x176:

$$A = 51.8 \text{ in.}^2$$

$$Z_x = 320 \text{ in.}^3$$

$$Z_y = 163 \text{ in.}^3$$

$$r_x = 6.43 \text{ in.}$$

$$r_y = 4.02 \text{ in.}$$

$$K/r_x = (14.0 \text{ ft.} \times 12 \text{ in./ft.})/6.43 \text{ in.} = 26.1$$

$$K/r_y = (14.0 \text{ ft.} \times 12 \text{ in./ft.})/4.02 \text{ in.} = 41.8$$

From Table E-1,  $\phi_c F_{cr} = 37.4$  ksi for  $K/r = 41.8$  in 50 ksi steel.

$$\phi_c P_n = (\phi_c F_{cr})A = 37.4 \text{ ksi} \times 51.8 \text{ in.}^2 = 1,940 \text{ kips}$$

$$\text{Since } \frac{P_u}{\phi_c P_n} = \frac{1,400 \text{ kips}}{1,940 \text{ kips}} = 0.72 > 0.2;$$

Interaction Equation H1-1a governs.

For a braced frame,  $M_n = 0$ . From Equation C1-1:

$$M_{ux} = B_{1x} M_{mx}, \text{ where } M_{mx} = 200 \text{ kip-ft.; and}$$

$$M_{uy} = B_{1y} M_{my}, \text{ where } M_{my} = 70 \text{ kip-ft.}$$

From equations C1-2 and C1-3:

$$B_{1x} = \frac{C_{mx}}{(1 - P_u/P_{ex})} > 1.0$$

where in this case (a braced frame with no transverse loading),

$$C_{mx} = 0.6 - 0.4(M_y/M_x)$$

For reverse curvature bending and equal end moments:

$$M_y/M_x = +1.0$$

$$C_{mx} = 0.6 - 0.4(1.0) = 0.2$$

From Table C-1:

$$P_{ex} = 420 \text{ ksi} \times A_g = 420 \text{ ksi} \times 51.8 \text{ in.}^2 \\ = 21,756 \text{ kips}$$

From Table C-1:

$$P_{ey} = 164 \text{ ksi} \times A_g = 164 \text{ ksi} \times 51.8 \text{ in.}^2 \\ = 8,495 \text{ kips}$$

$$B_{1x} = \frac{C_{mx}}{1 - P_u/P_{ex}} = \frac{0.2}{1 - 1,400 \text{ kips} / 21,756 \text{ kips}} = 0.2$$

Use  $B_{1x} = 1.0$ , per Equation C1-2.

$$B_{1y} = \frac{C_{my}}{1 - P_u/P_{ey}} = \frac{0.2}{1 - 1,400 \text{ kips} / 8,495 \text{ kips}} = 0.2$$

Use  $B_{1y} = 1.0$ , per Equation C1-2.

$$M_{ux} = 1.0 \times 200 \text{ kip-ft.}$$

$$M_{uy} = 1.0 \times 70 \text{ kip-ft.}$$

From Equation 2-15 for 50 ksi steel,

$$L_p = 42.4 r_y = \frac{42.4 \times 4.02 \text{ in.}}{12 \text{ in./ft.}} = 14.2 \text{ ft.}$$

Since  $L_b = 14.0 \text{ ft.} < L_p = 14.2 \text{ ft.}$ ,  $M_{nx} = M_{mx} = Z_x F_y$

$$M_{ny} = M_{my} = Z_y F_y$$

$$\phi_u F_y = 0.90 \times 50 \text{ ksi} = 45.0 \text{ ksi}$$

### Example H-3, cont.

$$\phi_b M_{nx} = \phi_b F_y Z_x = \frac{45.0 \text{ ksi} \times 320 \text{ in.}^3}{12 \text{ in.} / \text{ft.}} = 1,200 \text{ kip-ft.}$$

$$\phi_b M_{ny} = \phi_b F_y Z_y = \frac{45.0 \text{ ksi} \times 163 \text{ in.}^3}{12 \text{ in.} / \text{ft.}} = 611 \text{ kip-ft.}$$

By Interaction Equation H1-1a

$$\frac{1,400 \text{ kips}}{1,940 \text{ kips}} + \frac{8}{9} \left( \frac{200 \text{ kip-ft.}}{1,200 \text{ kip-ft.}} + \frac{70 \text{ kip-ft.}}{611 \text{ kip-ft.}} \right) = 0.72 + \frac{8}{9} (0.17 + 0.11) = 0.72 + 0.25 = 0.97 < 1.0$$

W14x176 is **o.k.**

### Example H-4

Given: Check the adequacy of a W14x176 beam-column ( $F_y = 50$  ksi) in an unbraced symmetrical frame subjected to the following factored forces:  $P_u = 1,400$  kips (due to gravity plus wind);  $M_{ux} = 300$  kip-ft. (due to wind only),  $M_{uy} = 0$  kip-ft.; and  $K_x L_x = K_y L_y = 14.0$  ft. Drift index,  $\Delta_{oh}/L \leq 0.0025$  (or  $1/400$ ).

$$\Sigma P_u = 24,000 \text{ kips}$$

$$\Sigma H = 800 \text{ kips}$$

Solution: As in Example H-3, for a W14x176 with  $KL = 14.0$  ft.,  $\phi_c P_n = 1,940$  kips.

$$\text{Since } \frac{P_u}{\phi_c P_n} = \frac{1,400 \text{ kips}}{1,940 \text{ kips}} = 0.72 > 0.2;$$

Interaction Equation H1-1a **governs.**

Because  $M_{ux} = M_{uy} = M_{ny} = 0$  and  $M_{nx} \neq 0$ ,  $M_{ux} = B_x M_{nx}$  and  $M_{uy} = 0$ .

$$M_{nx} = 300 \text{ kip-ft.}$$

According to Equation C1-4,

$$B_2 = \frac{1}{1 - \frac{\Sigma P_u (\Delta_{oh})}{\Sigma H L}} = \frac{1}{1 - \frac{24,000 \text{ kips}}{800 \text{ kips} (0.0025)}} = 1.08$$

$$M_{ux} = 1.08 \times 300 \text{ kip-ft.} = 324 \text{ kip-ft.}$$

Because  $L_b < L_p = 14.2$  ft.,  $M_{ux} = M_{px} = Z_x F_y$ ;  $\phi_b M_{ux} = 1,200$  as in Example H-3.

By Interaction Equation H1-1a:

$$\frac{1,400 \text{ kips}}{1,940 \text{ kips}} + \frac{8}{9} \frac{324 \text{ kip-ft.}}{1,200 \text{ kip-ft.}} = 0.72 + \frac{8}{9} 0.27 = 0.96 < 1.0$$

W14x176 is **o.k.**

the beams can be mobilized to provide the required torsional reactions along the girder.

4. Closed sections provide considerably better resistance to torsion than open sections; torsional rotations and stresses are much lower for box beams than for wide-flange members. For members subjected to torsion, it may be advisable to use box sections or to simulate a box shape by welding one or two side plates to a W shape.

## I. COMPOSITE MEMBERS

Chapter I of the LRFD Specification covers composite members. Included are concrete-encased and concrete-

filled steel columns and beam columns, as well as steel beams interactive with the concrete slabs they support and steel beams encased in concrete. Unlike traditional structural steel design, which considers only the strength of the steel, composite design assumes that the steel and concrete work together in resisting loads. This results in more economical designs, as the quantity of steel can be reduced.

### COMPRESSION MEMBERS

Composite columns (concrete-encased and concrete-filled) must satisfy the limitations in Section I2 of the LRFD Specification. The design strength of axially loaded composite columns is  $\phi_c P_n$ , where  $\phi_c = 0.85$  and the nominal axial compressive strength is determined from Equations E2-1 through E2-4 with the following modifications:

$A_s$  replaces  $A_g$ ,  $r_m$  replaces  $r$ ,  $F_{my}$  replaces  $F_y$ , and  $E_m$  replaces  $E$ .

$$F_{my} = F_y + c_1 F_{yr} \frac{A_r}{A_s} + c_2 f'_c \frac{A_c}{A_s} \quad (I2-1)$$

$$E_m = E + c_3 E_c \frac{A_c}{A_s} \quad (I2-2)$$

$r_m$  = radius of gyration of the steel shape, pipe or tubing, in. (For steel shapes it shall not be less than 0.3 times the overall thickness of the composite cross section in the plane of buckling.)

where

$$E_c = w^{1.5} \sqrt{f'_c}$$

and

$F_{my}$  = modified yield stress for the design of composite columns, ksi

$F_y$  = specified min. yield stress of the structural shape, ksi

$F_{yr}$  = specified min. yield stress of the longitudinal reinforcing bars, ksi

$f'_c$  = specified compressive strength of the concrete, ksi

$E_m$  = modified modulus of elasticity for the design of composite columns, ksi

$E$  = modulus of elasticity of steel = 29,000 ksi

$E_c$  = modulus of elasticity of concrete, ksi

$w$  = unit weight of concrete, lb/ft<sup>3</sup>

$A_c$  = cross-sectional area of concrete, in.<sup>2</sup>

$A_r$  = cross-sectional area of reinforcing bars, in.<sup>2</sup>

$A_s$  = cross-sectional area of structural steel, in.<sup>2</sup>

$c_1, c_2, c_3$  = numerical coefficients.

For concrete filled pipe and tubing:  $c_1 = 1.0$ ,  $c_2 = 0.85$ ,

$$c_3 = 0.4$$

For concrete-encased shapes:  $c_1 = 0.7$ ,  $c_2 = 0.6$ ,  $c_3 = 0.2$

Composite columns can be designed by using the Composite Columns Tables in Part 5 of this LRFD Manual (or the numerous tables in AISC Steel Design Guide No. 6: *Load and Resistance Factor Design of W-Shapes Encased in Concrete*) for the cross sections tabulated therein, or the above equations for all cross sections.

## FLEXURAL MEMBERS

The most common case of a composite flexural member is a steel beam interacting with a concrete slab by means of stud or channel shear connectors. The slab can be a solid reinforced concrete slab, but is usually concrete on a corrugated metal deck.

The effective width of concrete slab acting compositely with a steel beam is determined by three criteria. On either side of the beam centerline, the effective width of concrete slab cannot exceed:

- one-eighth of the beam span,
- one-half the distance to the centerline of the adjacent beam, or
- the distance to the edge of the slab.

The following pertains to rolled W shapes in regions of positive moment, the predominant use of composite beam design. Other cases (e.g., plate girders and negative moments) are covered in Chapter I of the LRFD Specification.

The horizontal shear force between the steel beam and concrete slab, to be transferred by the shear connectors between the points of zero and maximum positive moments, is the minimum of:

- $0.85f'_cA_c$   
(the maximum possible compressive force in concrete)
- $A_sF_y$   
(the maximum possible tensile force in the steel)
- $\Sigma Q_n$   
(the strength of the shear connectors)

For W shapes, the design flexural strength  $\phi_b M_n$ , with  $\phi_b = 0.85$ , is based on:

- a uniform compressive stress of  $0.85f'_c$  and zero tensile strength in the concrete
- a uniform steel stress of  $F_y$  in the tension area and compression area (if any) of the steel section, and
- equilibrium; i.e., the sum of the tensile forces equals the sum of the compressive forces.

The above is valid for shored and unshored construction. However, in the latter case, it is also necessary to check the bare steel beam for adequacy to support the wet concrete and other construction loads (properly factored).

The number of shear connectors required between a point of maximum moment and the nearest location of zero moment is

$$n = \frac{V_h}{Q_n} \quad (2-26)$$

where

$V_h$  = the total horizontal shear force to be transferred, kips

= the minimum of  $0.85f'_cA_c$ ,  $A_sF_y$ , and  $\Sigma Q_n$

$Q_n$  = the shear strength of one connector

The nominal strength of a single stud shear connector in a solid concrete slab is

$$Q_n = 0.5A_{sc}\sqrt{f'_cE_c} \leq A_{sc}F_u \quad (15-1)$$

where

$A_{sc}$  = cross-sectional area of a stud shear connector, in.<sup>2</sup>

$f'_c$  = specified compressive strength of concrete, ksi

$F_u$  = minimum specified tensile strength of a stud shear connector, ksi

$E_c$  = modulus of elasticity of concrete, ksi

Special provisions for shear connectors embedded in concrete on formed steel deck are given in Section I3.5 of the LRFD Specification. Among them are reduction factors (given by Equation I3-1 and I3-2) to be applied to the middle term of Equation I5-1 above.

The design of composite beams and the selection of shear connectors can be accomplished with the tables in Part 5 of this LRFD Manual.

The design shear strength for composite beams is determined by the shear strength of the steel web, as for noncomposite beams; see Section F above.

## COMBINED COMPRESSION AND FLEXURE

Composite beam-columns are covered in Section I4 of the LRFD Specification.

## LRFD On CD for only \$375!

AISC members can now purchase the entire 2nd Edition LRFD Manual of Steel Construction on one convenient CD-ROM for only \$375 (non-members pay \$500).



LRFD on CD uses the latest Hypertext technology to seamlessly link related sections of the Manual together—click on “connections” in one part of the Manual and quickly and easily find other sections dealing with the same subject.

As an added bonus, the CD also contains nearly 100 drawings (.dxf files) taken right from the Manual that can be quickly copied directly into your AutoCAD or other CAD program.

To order your copy of LRFD on CD, call:

**800/644-2400**  
or fax 312/733-3107

### Not a Member of AISC?

Join today and receive: any one AISC publication (up to a \$72 value); a \$125 discount on purchasing LRFD on CD; \$50 discount on NSCC registration; 25% discount on AISC publications and seminars; and a free subscription to Engineering Journal (an \$18 value). First year membership is only \$150; annual renewal is \$100.

For more information, fax name & address to:  
**312/670-5403**

# Looking For ANSWERS?

- What is the compatibility of spray-applied fireproofing with shop primers? .....see page 1-11
- When must expansion joints be provided in steel structures? .....see page 1-13
- Where can I find a good primer on LRFD? .....see section 2
- How are single-angle struts designed? .....see page 3-104
- How can I design to eliminate floor deflection and vibration problems? .....see page 4-207
- What is the difference between snug-tightened and fully tensioned bolts? .....see page 8-12
- How can the engineer-of-record determine if bolts are suitable for re-use? .....see page 8-19
- When can bolts and welds in the same connection be considered to share load? .....see page 8-211
- What is the difference between a shim and a filler? .....see page 8-327
- How can I avoid problems with double connections? .....see page 9-9
- How is eccentricity considered in the design of shear splices? .....see page 9-179
- Why are extended end-plate connections limited to static loading only? .....see page 10-21
- When are stiffeners required at beam-to-column flange moment connections? .....see page 10-35
- How are forces transferred in diagonal bracing connections? .....see page 11-19
- What is the most efficient reinforcement detail for beams with web penetrations? .....see page 12-11

They're in here →

Call 800/644-2400

Two-volume set only \$132  
(\$99 for AISC members)



2nd Edition LRFD  
Manual of Steel Construction



Setting Standards For Over 70 Years

Please circle # 2

One of the newest and most exciting products to hit the market is the **Castelite** line of steel shapes from **Chaparral Steel Company**. Castelite is a line of castellated beams that are scheduled to begin shipping this September. The beams behave in a manner similar to Vierendeel trusses, with stresses and deflections that exceed those calculated using simple bending theory. The primary benefit is the increased section modulus and moment of inertia, which are realized with no increase in the weight of the beam. The loss of web area has little effect on bending strength, as the beam flanges carry most of the bending load. The design of the Castelite beams does, however take into account the secondary bending stresses generated by the shear force transfer across the tee at a castellation.

For a brochure fully describing the new product line, including load designations and details, contact: Castelite Steel Products, 300 Ward Road, Midlothian, TX 76065-9651; 800/779-1211; fax: 214/779-1236 or **CIRCLE #43**.

Seismic design has been a hot topic since the steel problems were discovered after the Northridge Earthquake, and

two companies have introduced systems to help designers. **MNH-SMRF Systems** is marketing a proprietary column-to-beam connection system for new and retrofit construction. The system is accomplished without direct attachment between beam flanges and the column flange and it utilizes fillet welds to complete the connection. As part of the system, MNH-SMRF provides: details of the connection assemblies; design guides and system computer software; technical and engineering information, drawings, data, and construction and operating information; general review of structural drawings, specifications, data, calculations and shop detail drawings; and coordination of testing as may be required to obtain agency acceptance and/or approval of elements or details.

An alternate approach is provided by **Tekton** with its **Seismic Brake**. The product is a maintenance-free, passive, dry friction damper. It can be custom fabricated for loads of a few hundred pounds to loads in excess of 890 kips. It converts energy into heat when a structure is set in motion by earthquake or wind-induced horizontal loads force a metal rod in the device back and forth between spring loaded gripping blocks.

The devices can be used in both new and retrofit projects. When the Seismic Brake is incorporated into an SMRF, the bay will become an energy dissipating braced frame and the structure will be able to survive an earthquake without any permanent deformation.

For more information on the MNH-SMRF Systems, contact MNH-SMRF at 3151 Airway Ave., Suite N-1, Costa Mesa, CA 92626; 800/475-2077; fax: 714/540-0319; or **CIRCLE #114**. For more information on the Seismic Brake, contact: Tekton, 2985 W. Whitton Ave., Phoenix, AZ 85017; 602/254-8661; fax: 602/254-6621; or **CIRCLE #25**.

While OSHA's new fall protection standard does not directly apply to the erection of steel buildings, they have drawn renewed attention to the subject. One of the leader's in the field, **Miller Equipment**, has recently introduced the **Veralite #650 Series Harnesses**. The harnesses meet all applicable OSHA and ANSI standards while allowing unrestricted movement while climbing and working. The harness comes in four models, allowing workers to customize the harness to their specific needs. Accessories include cooling backpacks and shoulder pads as well

as a saddle-seat with D rings.

The photo on the cover of the May 1995 issue of *Modern Steel Construction* resulted in more than 30 phone calls from people wanting information on the safety device so prominently shown. For those who don't already know, the picture showed the **Sinco Beam Safe system**, which provides an easy-to-install tie-off point for ironworkers and other construction personnel who must work at heights before flooring or other protection is available. The system includes two stanchions, a steel safety cable, and an energy absorber on the cable. The stanchions weigh less than 35 lbs. each and are available for use on 6-in.-wide or greater beams. Also, they mount at a 19 degree angle from the base so they are out of the way of workers.

Another fall safety product is the **Gemtor energy absorber lanyard**. The lanyard is designed to be used in conjunction with a body belt or full body harness and reduces the maximum arresting force to approximately 650 lbs. The energy absorbers meet OSHA and ANSI standards and come in a choice of models, with locking snap hooks on both ends, D ring and locking snap hook, or a locking snap hook and loop configuration for



# MODERN STEEL CONSTRUCTION Reader Service Card

Please type or print only

name \_\_\_\_\_  
 company name \_\_\_\_\_  
 address \_\_\_\_\_  
 city \_\_\_\_\_ state \_\_\_\_\_ zip code \_\_\_\_\_  
 ( ) ( )  
 business telephone \_\_\_\_\_ fax number \_\_\_\_\_

Check this box to renew or start a **FREE\*** subscription to *Modern Steel Construction* \*This offer good only for practicing professionals within the U.S.

signature \_\_\_\_\_

<p><b>1. Type of work</b> Please circle <b>all</b> that apply</p> <p>a. Bridges          b. Office Buildings          c. Hospitals          d. Retail          e. Industrial          f. Schools          g. Multifamily          h. Institutional          i. Low-Rise          j. High-Rise</p> <p><b>2. Your position</b> Please circle <b>ONLY</b> one</p> <p>a. Owner/President          b. Chief Engineer/          Chief Architect/          Department Head          c. Staff Engineer/          Staff Architect/          Construction          Manager          d. Other</p>	<p><b>3. Type of business</b> Please circle <b>ONLY</b> one</p> <p>a. Structural engineer          b. Civil engineer          c. Structural steel          fabricator          d. Other fabricator          e. Educator/library          f. Architect          g. Building          owner/developer          h. Steel mill          i. Erector          j. Steel product          manufacturer          k. GC/CM          l. Student          m. Other</p> <p><b>4. Reason for Inquiry</b> Please circle <b>ONLY</b> one</p> <p>a. Information file          b. Immediate or          Future Purchase</p>
--	---

For free information on advertisers and other companies mentioned in this issue, circle the appropriate number below:

- |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  |
| 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  |
| 25  | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  | 36  |
| 37  | 38  | 39  | 40  | 41  | 42  | 43  | 44  | 45  | 46  | 47  | 48  |
| 49  | 50  | 51  | 52  | 53  | 54  | 55  | 56  | 57  | 58  | 59  | 60  |
| 61  | 62  | 63  | 64  | 65  | 66  | 67  | 68  | 69  | 70  | 71  | 72  |
| 73  | 74  | 75  | 76  | 77  | 78  | 79  | 80  | 81  | 82  | 83  | 84  |
| 85  | 86  | 87  | 88  | 89  | 90  | 91  | 92  | 93  | 94  | 95  | 96  |
| 97  | 98  | 99  | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 |
| 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 |

Please type or print only

name \_\_\_\_\_  
 company name \_\_\_\_\_  
 address \_\_\_\_\_  
 city \_\_\_\_\_ state \_\_\_\_\_ zip code \_\_\_\_\_  
 ( ) ( )  
 business telephone \_\_\_\_\_ fax number \_\_\_\_\_

Check this box to renew or start a **FREE\*** subscription to *Modern Steel Construction* \*This offer good only for practicing professionals within the U.S.

signature \_\_\_\_\_

<p><b>1. Type of work</b> Please circle <b>all</b> that apply</p> <p>a. Bridges          b. Office Buildings          c. Hospitals          d. Retail          e. Industrial          f. Schools          g. Multifamily          h. Institutional          i. Low-Rise          j. High-Rise</p> <p><b>2. Your position</b> Please circle <b>ONLY</b> one</p> <p>a. Owner/President          b. Chief Engineer/          Chief Architect/          Department Head          c. Staff Engineer/          Staff Architect/          Construction          Manager          d. Other</p>	<p><b>3. Type of business</b> Please circle <b>ONLY</b> one</p> <p>a. Structural engineer          b. Civil engineer          c. Structural steel          fabricator          d. Other fabricator          e. Educator/library          f. Architect          g. Building          owner/developer          h. Steel mill          i. Erector          j. Steel product          manufacturer          k. GC/CM          l. Student          m. Other</p> <p><b>4. Reason for Inquiry</b> Please circle <b>ONLY</b> one</p> <p>a. Information file          b. Immediate or          Future Purchase</p>
--	---

For free information on advertisers and other companies mentioned in this issue, circle the appropriate number below:

- |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  |
| 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  |
| 25  | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  | 36  |
| 37  | 38  | 39  | 40  | 41  | 42  | 43  | 44  | 45  | 46  | 47  | 48  |
| 49  | 50  | 51  | 52  | 53  | 54  | 55  | 56  | 57  | 58  | 59  | 60  |
| 61  | 62  | 63  | 64  | 65  | 66  | 67  | 68  | 69  | 70  | 71  | 72  |
| 73  | 74  | 75  | 76  | 77  | 78  | 79  | 80  | 81  | 82  | 83  | 84  |
| 85  | 86  | 87  | 88  | 89  | 90  | 91  | 92  | 93  | 94  | 95  | 96  |
| 97  | 98  | 99  | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 |
| 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 |

AUGUST

AUGUST



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

**BUSINESS REPLY MAIL**

FIRST CLASS MAIL PERMIT NO. 12522 CHICAGO, IL

POSTAGE WILL BE PAID BY ADDRESSEE

**MODERN STEEL  
CONSTRUCTION**

c/o CREATIVE DATA SERVICES  
650 S CLARK ST  
CHICAGO, IL 60605-9960



Use these cards to request information from manufacturers and other companies mentioned in this issue. Simply circle the numbers referenced in the advertisement or article, fill out the rest of the information requested on the card, and either mail it to: Modern Steel Construction, Creative Data Center, 650 South Clark St., Chicago, IL 60605-9960 or fax it to: **312/922-3165.**



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

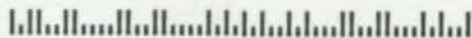
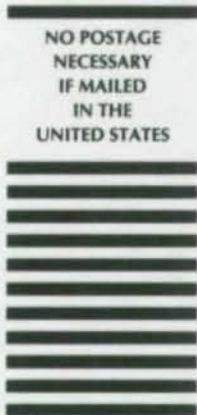
**BUSINESS REPLY MAIL**

FIRST CLASS MAIL PERMIT NO. 12522 CHICAGO, IL

POSTAGE WILL BE PAID BY ADDRESSEE

**MODERN STEEL  
CONSTRUCTION**

c/o CREATIVE DATA SERVICES  
650 S CLARK ST  
CHICAGO, IL 60605-9960



**MODERN STEEL  
CONSTRUCTION**  
Reader Service Card

Franklin, PA 16323-0271; 814/432-2118; fax: 814/432-2415 or **CIRCLE #29**. For more information on SINCO safety systems, contact: The Sinco Group, One SINCO Place, P.O. Box 361, East Hampton, CT 06424; 800/243-6753; fax: 203/267-5515 or **CIRCLE #62**. For more information on the Gemtor lanyard, contact: Gemtor, Inc., 1 Johnson Ave., Matawan, NJ 07747; 800/405-9048 or **CIRCLE #80**.

The fastest changing segment of the design and construction industry is undoubtedly the com-

puter field. One extremely useful recently introduced product is **PowerPLOT Lite** from **20/20 Software**. The program, designed to work specifically with AutoCAD, offers: plot file generation and spooling; batch plotting; accurate plots; and printer/plotter support.

Speaking of printing, several new output devices are on the market. **Mutoh America** has introduced the **Accujet Series** of large format inkjet plotters. The plotters offer 300 dpi resolution in both monochrome and color models. Prices range from \$2,995 to \$4,495.

In addition, the company has introduced a new series of pencil/pen plotters.

The **SummaJet 2 Series** Large-Format Ink Jet Plotters from **Summagraphics** have been reduced in price and now range from \$2,299 for a D-size monochrome plotter to \$3,199 for an E-size color plotter.

On the input side, **ANatech** has introduced a new large-scale scanner, the **Eagle SLI 3840**, with a maximum document width of 38-in. and a maximum base resolution of 400 dpi.

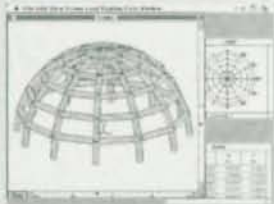
For information on PowerPlot, contact:

20/20 Software, 322 East Broad St., Falls Church, VA 22046; 703/534-3400; fax: 703/534-0100 or **CIRCLE #104**. For information on the Accujet Series, contact: Mutoh America, 500 West Algonquin Road, Mt. Prospect, IL 60056; 708/952-8880; fax: 708/952-8808 or **CIRCLE #105**. For information on the SummaJet 2 Series, contact: Summagraphics Corp., 8500 Cameron Road, Austin, TX 78754-3999; 512/835-0900; fax: 512/835-1916 or **CIRCLE #106**. For information on the Eagle SLI 3840, contact:

## 3D Structural Analysis & Design for Macintosh

Now for PowerPC

The graphical interface you've always wanted, with the advanced analysis power you really need.



- ✓ Dynamic Analysis
- ✓ Interactive 3D Modeling
- ✓ Rendering & Animation
- ✓ Code Checking
- ✓ True Mac Interface

Graphic Magic Inc. 180 Seventh Ave #201 Santa Cruz CA 95062  
Tel (408) 464 1949 Fax (408) 464 0731

# Multiframe

Please circle # 92

STEELCAD'S detailing productivity ratio is so high, we can't say what it is in this ad.

**TOP SECRET**

Frankly, we're afraid you wouldn't believe us. And there's not enough room here to back our claim. But call us and we'll give you all the documentation you need. Better yet, we'll give you the numbers of people who are using the STEELCAD system. Then you can believe!



**CALL US TODAY!**  
**800-456-7875**

Please circle # 85

## HOT PRODUCTS

ANAtch, 10499 Bradford Road, Littleton, CO 80127; 800/533-0165; fax: 303/973-7092 or **CIRCLE #107**.

New releases are available for a number of structural engineering software products. **RAM-STEEL** from **Ram Analysis** has introduced V4.1, which now includes a DXF Import command. This powerful feature allows the designer to import .dxf format CAD drawings into the Floor Framing Program. Drawings originating with the project architect, client or created in-house can

now be directly imported for analysis, design and drafting.

**STAAD-III**, perhaps the most used general purpose structural software for analysis, design and drafting, is now available in a Windows version. It offers: pulldown menus; multiple viewports; multiple sessions; non-preemptive multitasking; intra- and inter-software interrupts, custom icons and controls, copy and paste, object linking and embedding and dynamic data exchange compliance.

Another new Windows introduction is from **Numerica**, which

recently shipped v1.2 of **VisualCADD** for Windows. The new release offers completely open architecture, improved performance, and customization enhancements.

Still another new Windows introduction is v1.0 of **Analysis-Group** from **Integrated Engineering Software**. The software performs structural analysis for six common problems: rectangular plates; continuous beams; beams on elastic foundations; rectangular mat footings; circular tanks; and shear wall systems.

**Metrosoft** has recently introduced v3.0

of **Robot V6**, a fully integrated graphical structural analysis and design program. Emphasis in v3.0 was on including more productivity features, including: intelligent proactive prompting system that suggests the next action by displaying text at the current mouse position; and implementation of DLL technology, which allows for instantaneous switching between cursor location and message field. Other enhancements include the addition of Kan's meshing method for finite elements and support for SSDNF (Structural

### For the BEST in Bridge Software . . .

**WIN-DASH**  
MERLIN DASH FOR WINDOWS

**MERLIN DASH**  
DESIGN OF STRAIGHT HIGHWAY BRIDGES

**NEW!**  
Get WIN-DASH  
and receive a  
**FREE BONUS MODULE**  
(a \$1000 Value)  
**CALL!**

- ◆ AASHTO - WSD, LFD (LRFD Analysis)
- ◆ Analysis, Rating, Code Check
- ◆ Optimization by Cost or Weight
- ◆ Auto Live Load - AASHTO and Multiple User Defined Concurrent Live Load
- ◆ Auto RATING FACTORS - Inventory, Operating, Posting, Special Vehicles
- ◆ METRIC/English Conversion
- ◆ Deck Pouring Sequence Analysis
- ◆ Haunched Web, Hybrid, Composite
- ◆ Continuous Spans, Support Restraints
- ◆ Graphics - Moment, Shear, Camber Allow/Actual Stress & Ranges
- ◆ Menu Input - Very Friendly

**DESCUS** DESIGN & ANALYSIS  
CURVED BRIDGES

**SABRE** SIGN BRIDGE  
ANALYSIS/DESIGN

**TRAP** TRUSS RATING  
AND ANALYSIS

- ◆ Curved & Straight Bridge Systems
- ◆ Influence Surface Approach
- ◆ "T" and BOX Girder Sections
- ◆ Latest AASHTO - LFD & WSD
- ◆ METRIC and English Units
- ◆ Girder Optimization
- ◆ Auto MESH Generation
- ◆ Auto RATING FACTORS - Inventory Operating, Posting, Special Vehicle
- ◆ Complex Geom. - Skewed, Bifurcated
- ◆ Pouring Sequence Analysis Available
- ◆ PC License or Lease, Timesharing
- ◆ Menu-Driven/CAD-Like Features
- ◆ Fast Running (Minutes)

- ◆ Most Types - Tri-Chord, Box Chord Single/Double Cantilever, Other
- ◆ Analysis - Moment, Shear, Torque Displacement, Reaction, Stress
- ◆ Design - Splices, Base Plates
- ◆ Auto Load Cases - Wind (shielding), Ice, DL, User Defined Loads
- ◆ Pull Down Menu/CAD-Like Features
- ◆ Latest AASHTO Code Checking

- ◆ NEW - AASHTO LRFD and LFD Spec.
- ◆ Cable Member Prestressing
- ◆ Most Truss Types Considered
- ◆ Analysis, Design, Rating, Rehabilitation
- ◆ Auto RATING FACTORS - Inventory, Operating, Posting, Special Vehicles
- ◆ Automatic Group Load Combinations
- ◆ Simple or Continuous to 6 Spans
- ◆ Pull-Down Menu/CAD-Like Features

Available Exclusively Thru:

**OPTI-MATE, INC.**

P.O. Box 9097 • Dept. A  
Bethlehem, PA 18018

Tel 610-867-4077  
Fax 610-865-1030

Free Trial...  
FULL PROGRAM  
(No Deposit)

Please circle # 53

### ▶ RAMSBEAM ◀

Guaranteed to be the BEST beam program ever or your money back!  
RAMSBEAM, a single steel/steel composite beam program utilizing a Windows graphical interface. Features: ASD or LRFD; vibration analysis; checks existing framing or optimizes new. Allows for depth restrictions, cantilever beams; partial or full composite and unbraced flange conditions; includes SI/Metric units.

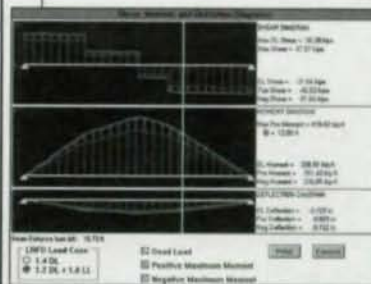
Special Limited Time Offer \$150

**Ram Analysis**

5315 Avenida Encinas, Suite 220  
Carlsbad, CA 92008

Tel. 800-726-7789 • Fax. 619-431-5214

**RAMSBEAM**



FREE  
DEMO!

Please circle # 81

01379

Steel Detailing Neutral File) for direct interface with steel detailing programs.

**Das Consulting** has released **DAST-EZ-Analysis**, a simple-to-use 2D/3D Finite Element Static, P-Delta and Dynamic Analysis software program. It comes with a parametric library, which offers simple icon-based model generation; a graphical pre-processor; built-in input editor with context sensitive help; output browser; and a graphical post-processor. Users may view and print structures, deformations and contours. The \$439 program can handle up to

200 joints per 2D/3D model.

While not software per se, **Algor's** new 24-minute video, "**Finite Element Analysis In Action**," is clearly a related product. The video is designed to help engineers improve their skills in performing computer-aided finite element analysis (FEA) and includes: a lesson in brittle materials engineering; laboratory testing of a part under high load stress; finite element analysis of a part under high load stress; finite element analysis of the part under simulated laboratory loading; a comparison of the two

results; and an additional, more complex, example comparing the two results to demonstrate techniques in finite element modeling including load applications, boundary conditions, the "staged model" concept and engineering judgement.

For information on **RAMSTEEL**, contact: Ram Analysis, 5315 Avenida Encinas, Suite 220, Carlsbad, CA 92008; 619/431-3610; fax: 619/431-5214 or **CIRCLE #41**. For information on **STAAD-III**, contact: Research Engineers, 22700 Savi Ranch, Yorba Linda, CA 92687; 714/974-2500; fax: 714/974-4471

or **CIRCLE #34**. For information on **VisualCADD**, contact: Numera, 1501 Fourth Ave., Suite 2880, Seattle, WA 98101; 206/622-2233; fax: 206/622-5382 or **CIRCLE #112**. For information on **AnalysisGroup**, contact: Integrated Engineering Software, 8840 Chapman Road, Bozeman, MT 59715; 406/586-8988; fax: 406/586-9151 or **CIRCLE #87**. For information on **Robot V6**, contact: Metrosoft, 332 Paterson Ave., East Rutherford, NJ 07073; 201/438-4915; fax: 201/438-7058 or **CIRCLE #51**. For informa-

## A Guide for Metric Steel Fabrication

New AISC publication provides basic training in metric units and offers cautionary advice until standard metric practice has been established. Includes information on materials, detailing and preliminary revisions to the *AISC Code of Standard Practice*.

**\$20.00**

(\$15.00 for AISC Members)

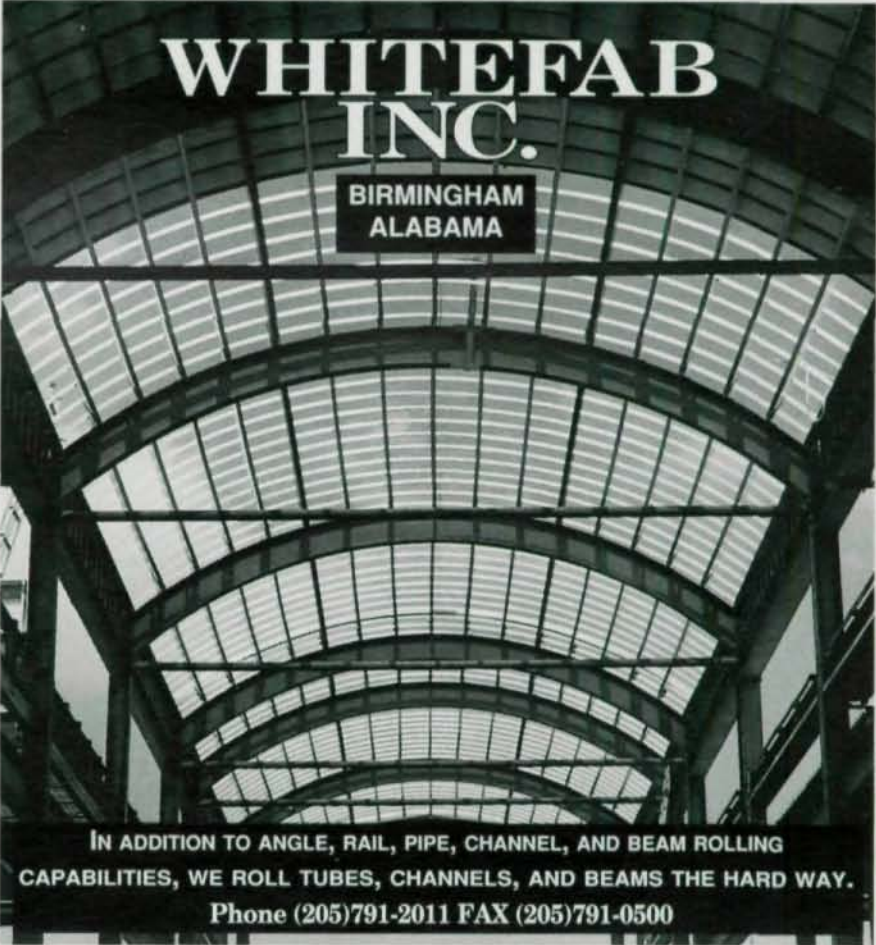
To order call:

**800/644-2400**

Please circle # 1

## WHITEFAB INC.

BIRMINGHAM  
ALABAMA



IN ADDITION TO ANGLE, RAIL, PIPE, CHANNEL, AND BEAM ROLLING CAPABILITIES, WE ROLL TUBES, CHANNELS, AND BEAMS THE HARD WAY.  
Phone (205)791-2011 FAX (205)791-0500

Please circle # 55

## HOT PRODUCTS

tion on DAST-EZ, contact: DAS Consulting, 865 Turnpike St., Norht Andover, MA 01845; 800/322-1487; fax: 508/685-7230 or **CIRCLE #82**. For information on the FEA video, contact: Algor, 150 Beta Dr., Pittsburgh, PA 15238-2932; 412/967-2700; fax: 412/967-2781 or **CIRCLE #113**.

**D**etailers and fabricators also have a number of new software products available. A program recently introduced to the U.S. market is **SteelModeler** from **dcCAD**. The program produces a 3D model of the structure, including standard steel sections, plates, bolts, and welds, as well as any tailor-made or special shapes. Outputs include drawings, lists and NC files.

The **Precision Steel Database** from **Timberline** provides fabricators with all the needed details—from drilling holes to the total weight of steel on a project—to start estimating right away. Material and labor estimates take into account: types of plates; clips; angles; and even drilling sets of holes.

A free demonstration diskette is now available from **Steel Solutions**. The disk demonstrates the **STEEL 2000** system. Modules include estimating, mill order, inventory/purchasing, fabrication, drawing control, service center, plate burning/shearing, CNC programming &

multing, and accounting.

**CompuSTEEL** from the **Baresel Corp.**, a powerful steel detailing program, now employs **ARRIS** graphics, a full-featured, 32-bit professional application software system that runs in Windows.

**E.J.E. Industries** has introduced v5.0 of its **Structural Material Manager**. The series of programs produces: job estimates; bills of material; length-cutting lists; and shipping lists. New is a plate-nesting report. Single-user systems start at \$995.

A new inventory control system from **P2 Programs** utilizes a bar coding system to identify each piece of steel with a unique serial number. The **Steel Tracking System** also offers custom interfaces for AutoCAD, SteelCAD, Dbase, Design Data, E.J.E. Industries, and other major applications.

For information on SteelModeler, contact: dcCAD, 605 Royal York Road, Suite 201, Etobicoke, Ontario, M8Y 4G5 CANADA; 800/776-4840; fax: 416/253-4315 or **CIRCLE #107**. For information on the Precision Steel Database, contact: Timberline Software, 9600 SW Nimbus Ave., Beaverton, OR 97008-7163; 800/628-6583; fax: 503/526-8049 or **CIRCLE 123**. For information on STEEL 2000, contact: Steel Solutions, P.O. Box 1128, Jackson, MS

39215-1128; 601/932-2760; fax: 601/939-9359 or **CIRCLE #98**. For information on CompuSTEEL, contact: Barasel Corp., Bank of America Tower, 300 South Harbor Blvd., Suite 500, Anaheim, CA 92805; 714/776-3200; fax: 714/776-1255 or **CIRCLE #131**. For information on Structural Material Manager, contact: E.J.E. Industries, 287 Dewey Ave., Washington, PA 15301; 800/321-3955; fax: 412/228-7668 or **CIRCLE #46**. For information on the Steel Tracking System, contact: P2 Programs, P.O. Box 1000, Dripping Springs, TX 78620-1000; 800/563-6737 or **CIRCLE #126**.

**T**wo very useful new tools are now available for both engineers and fabricators. **Jobber 4** from **Jobber Instruments** is a dimensional calculator. In addition to working in feet, inches, sixteenths, decimals and metric lengths, the calculator offers scientific functions and works directly with degrees-minutes-seconds. And finally, the program now solves both triangles and circles. The calculator is currently priced at \$99.95 plus \$5.50 s&h.

Another calculator is the **Inchmate+** from **Digitool**. The foot/inch/fraction calculator automatically solves for rise, run, diagonal or slope of any right triangle. The cal-

culator is currently priced at \$49.95.

For more information on Jobber 4, contact: Jobber Instruments, P.O. Box 4112, Sevierville, TN 37864; 800/635-1339 or **CIRCLE #23**. For information on Inchmate+, contact: Digitool, 414 North Mill St., Aspen, CO 81611; 800/543-8930 or **CIRCLE #129**.

**A**nother useful "tool" for fabricators and engineers is the pocket-sized **"Structural Bolting Handbook"** from the **Steel Structures Technology Center**.

The guide includes step-by-step instructions for: bolt installation using the turn-of-the-nut, calibrated wrench, twist-off bolt and direct tension indicator methods; pre-installation tests and inspection procedures for each method; dispute arbitration procedures; AASTHO/FHWA rotational capacity test procedures; bolt, nut and washer product and manufacturer identification markings; bolt, nut and washer dimensions; compatibility tables; and discussion of many critical bolting issues. Single copies are \$9; 11-50 copies are \$8 each; and 51+ copies cost \$7 each.

For more information, contact: Steel Structures Technology Center, 40612 Village Oaks Dr., Novi MI 48375-4462; 810/344-2910; fax: 810/344-2911 or **CIRCLE #21**.

# Automate repetitive design tasks

1. When you type the column size

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

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

	A	B	C	D	E	F	G	H
1	<b>BASE-PLATE THICKNESS CALCULATOR (AISC LRFD Manual, 2nd Ed.)</b>							
2	Axial load		1100	kips	<b>Column dimensions</b>			
3	Column		W12x170			depth, d	14.03	in.
4	Base-plate steel grade		A36			web thickness, tw	0.96	in.
5	Concrete strength, f'c		3	ksi		flange width, bf	12.57	in.
6	Available concrete area					flange thickness, tf	1.56	in.
7	Max. strong-axis dimension		30	in.	<b>Max. concrete area, A2</b>			
8	Max. weak-axis dimension		30	in.	<b>Base plate</b>			
9	<b>Base-plate dimensions</b>					Steel yield strength, Fy	36	ksi
10	Actual strong-axis dim., N		28	in.		Steel tensile strength, Fu	58	ksi
11	Actual weak-axis dim., B		26	in.		Minimum area	574	in. <sup>2</sup>
12	<b>Cantilevered distances</b>					Optimum strong-axis dim.	25.6	in.
13	On strong-axis, m		7.34	in.		Optimum weak-axis dim.	22.4	in.
14	On weak-axis, n		7.97	in.		Actual area, A1	728	in. <sup>2</sup>
15	Between flanges, lambda*n'		3.32	in.	<b>Intermediate quantities</b>			
16						Concrete capacity, phi Pp	1238	kips
17	Minimum plate thickness, t		2.43	in.		X	0.886	
18						lambda	1.00	

3. To complete the design calculations.

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

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

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

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



All trademarks are property of the respective owners.



Setting Standards for Over 70 Years

Please circle # 1

# The Amazing Grace of Steel

Steel is not all brawn, it's much more. With today's steel framing, *grace, art* and *function* can come together in almost limitless ways thanks to:

- High strength-to-weight ratio of steel
- The ability to curve and shape steel members
- Clean and precise fabrication to close tolerances
- High-performance coatings for long-term protection against the elements

When you want to achieve an amazing and graceful form in your building, think of steel as the framing material of choice. For a free brochure, **Innovations in Steel**, fax your request to AISC Marketing 312-670-5403.

**Setting Standards For Over 70 Years**  
Please circle # 8





**STAAD3-2D**

**State-of-the-art 2D Structural Analysis and Design Software for \$595**

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

STAAD3-2D supports STEEL/CONCRETE/TIMBER design per AISC (ASD & LRFD), ACI and AITC codes. With a price tag of \$595, it offers you the best value for all your 2D structural needs.

**Research Engineers, Inc.**  
**22700 Savi Ranch**  
**Yorba Linda, CA 92687**  
**Toll Free: 1-800-FOR-RESE**  
**Fax: (714) 974-4771**

**Help Wanted**

**CHIEF DRAFTSMAN**

Well established AISC Certified Category II medium size structural and miscellaneous fabricator needs well qualified department head. Reply in confidence via fax or mail to:

**Stein Steel & Supply Company**  
 P.O. Box 17907  
 Atlanta, GA 30316  
 Attn: Bert Stein, President  
 Fax: (404) 523-8415

**Help Wanted—CHIEF DRAFTSMAN**

Needed to start up and run computer detailing room for Florida medium size fabricator. AISC II.

Salary negotiable. Good Benefits. Reply to:

**Allstate Steel Company, Inc.**

Attn: K.W. Suggs  
 P.O. Box 61148  
 Jacksonville, Florida 32220

**StruCAD\*3D**

**The Flagship Product for 3D Structural Analysis & Design**

- Pop-Up & Pull-Down Menus
- Truly Interactive 3D Graphics
- Pre- and Postprocessing
- 3D AutoCAD Interface (in & out)
- AISC-ASD, AISC-LRFD, ACI-318
- Reinforced Concrete Design
- Wind & Gravity Load Generation
- Material Takeoff
- P-Delta and Thermal Analysis
- Pile-Soil Interaction
- Seismic & Machine Vibration
- Detailed Fatigue Analysis

**Prices start at only \$249**

**Zentech, Inc.** 8582 Katy Freeway, #205, Houston, TX 77024  
 Tel (713) 984-9171 Fax (713) 984-9175

**Help Wanted—Detailing Manager**

Progressive and rapidly expanding AISC Certified Category II Structural Steel Fabricator in Midwest is seeking motivated, aggressive individual for Detailing Manager. Minimum of 10 years structural steel industry experience required. Duties include supervision and training of detailing and print room staff, coordination with in-house departments and outside vendors, and hands-on detailing and checking. Steelcad and AutoCAD experience a plus. Commensurate compensation and excellent benefits. Send resume with salary history to: Human Resources, P.O. Box 1066, Salina, KS 67402-1066.

**Structural & Miscellaneous Steel Detailing CAD Programs**

AutoCAD parametric LISP programs for preparing structural AND misc. steel shop drawings. All programs have been updated for 1995 and new programs have been added. Anchor bolts to roof opening frames and "everything between". Imperial and metric versions with USA, Canadian and European steel sections. 45-DAY MONEY BACK GUARANTEE. Discounts up to 30%. Buy only what you need. Used in the field for 8 years. Programs written by a detailer with 39 years experience. Extremely "flexible" programs. FREE telephone support. No maintenance fee. Reasonable yearly update fee. EXCELLENT PROGRAMS at a REASONABLE PRICE. Call for a FREE demo disk, list of programs, and prices.

**SSDCP**

110 Shady Oak Circle, Florence, MS 39073  
 Tel: 601/845-2146 (fax same)

**Employment**

ProCounsel searches for the right job for you, in the right geography, at the right money. Engineers, architects, draftspersons, detailers, checkers, estimators, plant managers/engineers/supers, erection professionals. Confidential. Fee paid. Buzz Taylor 214-741-3014. Fax: 214-741-3019 or leave a msg: 800-545-5900.

**GT STRUDL**

**ADINA**

Static, Dynamic, Linear, Nonlinear & Pushover Analysis  
 Straight & Curved Steel Bridge Model & Load Generator

**SC Solutions, Inc.**

Tel (415) 903-5050 Fax (415) 691-9452

**SC-Bridge**

**SC-Push3D**

**Help Wanted—Structural Steel Detailer**

Young, aggressive detailing firm seeks experienced detailers to join our growing company. Qualified applicants will be able to perform quality work, with attention to detail, according to schedule requirements and customer standards.

Fax or mail resume with salary history and requirements to:

**Steel Connections, Inc.**  
 4006 Barrett Dr., Suite 202  
 Raleigh, NC 27609

Ph: (919) 781-8386 Fax: (919) 781-7886

**Comprehensive Review Manuals  
 SE and PE (Civil) License**

PE (Civil) six vol. (4200 pp). Calif Structural Engr (SE) five vol. (4170 pp). C.V. Chelapati, Ph.D., Editor. Covers solution techniques with several hundred solved problems. Invaluable reference for PE/SE exams. Highly acclaimed as excellent references for practicing engineers.

Call/write for detailed brochures. PEDP, Inc., 5912 Bolsa Ave., Suite 108-MS-C, Huntington Beach, CA 92649;

**(714) 898-3658; Fax (714) 898-4635**

**Help Wanted**

**Structural Steel Detailer/Checker**

Steel fabrication company w/stable 50 year history seeks a talented structural steel detailer w/3-5 years experience. Responsibilities include preparation/checking of shop drawings for fabrication and erection. Good benefits & compensation package. Send resume & references to:

**Boulder Steel**  
 2696 30th st.  
 Boulder, CO 80301-1287  
 Fax: 303/442-8906

## HEWLETT-PACKARD Computers/Peripherals

A complete line of used and refurbished HP Equipment to fill all your computer needs. Laser printers, scanners, disk drives, plotters (Draftpro, Draftmaster & Designjet), PC's and 9000 series workstations are available for immediate delivery. Call our toll free number for additional information and pricing.

**Ted Dasher & Associates**  
4117 2nd Avenue South  
Birmingham, AL 35222  
800-638-4833 fax (205) 591-1108

## STEEL SHAPING SPECIALISTS

WE CAN BEND STRUCTURAL STEEL: THE EASY WAY, THE HARD WAY, IRREGULAR CURVES, OFFSETS, ELLIPTICAL SHAPES, CIRCLES, SEGMENTS WITH TANGENTS AND WE CAN BEND IT TO TIGHT RADII WITH MINIMAL DISTORTION.

We also offer forging, the hot shaping of metals and the rolling and forming of tubing, rail and bars. Call or fax Frank Hutterer for more information.

Tel: 414-355-8220 Fax: 414-355-4698  
Max Weiss Co., Inc.  
8625 W. Bradley Rd., Milwaukee, WI 53224

## Structural Expert Series (SES)

A complete library of analysis and design software. This library is based on over 20 years of commercial software experience and is installed in over 2,000 companies throughout the world.

Library includes:

- 3D and 2D analysis
- Steel Design, ASD & LRFD
- Concrete design
- Timber design
- Masonry walls & retaining walls

For more information, or to receive a FREE demo kit, please call.  
ECOM Associates, Inc. • 8324 N. Steven • Milwaukee, WI 53223  
Ph: 414/365-2100 ext. 494 • Fax: 414/365-2110

## Computerized Structural Steel Detailing

Experienced Staff including licensed Professional Engineers with many years of detailing experience. 31 years of service to steel fabricators and contractors.

**R.A. Gress & Associates**  
176 Planebrook Road, Frazier, PA 19355  
Ph: (610) 644-3250 Fax (610) 889-4836

## WE PROVIDE CADD STRUCTURAL STEEL DESIGN/DETAILING

for Engineers, Fabricators and Contractors  
**JOHNSON TECHNICAL SERVICES**

231 E. 25th St.  
Baltimore, MD 21133  
Ph: 410/243-3269 Fax: 410/243-1963

## Engineering Journal

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

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

## Barcode Tracking Systems, Sales & Service

- Asset Tracking/Inventory Control
- Work-in Process Tracking
- Label Printing Systems
- Tool Room (Issues/Receipts)
- Turn-key Shipping/Receiving
- Time and Attendance
- Photo ID Badges
- Preprint Labels

**Janes/Reiland, Inc.**  
17314 SH249, Suite 355, Houston, TX 77064  
Tel: 713/807-9091 Fax: 713/807-9094

## AISC Professional Membership

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

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

### Advertisers' Index

Advertiser	Page Number	Circle No.
A/E/C Systems.....	16	12
Nicholas J. Bouras.....	CII	33
Canam Steel.....	8	64
CAST.....	30	27
Central Steel Detailing.....	30	65
Chaparral Steel.....	11	43
Computers & Structures.....	CIV	31
Computer Detailing.....	13	
Das Consulting.....	25	82
Design Data.....	7	32
DetailCAD.....	20	24
E.J.E. Industries.....	36	46
Graphic Magic.....	45	92
Grinder Software.....	22	83
GTStrudl.....	15	71
Huck International.....	12	111
Integrated Eng. Software.....	36	87
LRFD of CD.....	42	2
LRFD Manual.....	43	2
MDX Software.....	20	47
Metrosoft.....	CIII	51
Nucor Fastener.....	17	38
Omnitech.....	13	52
Optimate.....	46	53
Ram Analysis.....	46	81
Research Engineers, Inc.....	5	34
RISA Technologies.....	22 & 32	40
St. Louis Screw & Bolt.....	14	36
SteelCAD.....	45	84
TradeARBED.....	3	35
Vulcraft.....	26-27	37
Max Weiss.....	31	56
Whitefab.....	47	55
Zentech.....	23	22

*Announcing version 3.0,  
incorporating intrinsic ergonomics which will  
catapult you to the next level of productivity.*

# ROBOT V6

**THE FINEST IN STRUCTURAL ANALYSIS AND DESIGN SOFTWARE**

*intelligent proactive prompting*

We have even thought about details like our **intelligent proactive prompting system** that suggests next user action and displays prompts at the current mouse position to **reduce eye fatigue**, and full implementation of DLL technology allowing for **instantaneous switching** between modules, and choice of **beginner, advanced, and expert** menu levels or **customizable toolbars**, and ....

Of course **ROBOT V6** is **not** a set of separate programs just glued together and adopted to work on PC - it is **written in C++ specifically for the PC platform**, providing a **rich set of features** for structural analysis and design, in one **easy to use coherent and ergonomically designed** user interface. **Versatility** of the single program and **fast solvers** combined with the addition of **new algorithms** (Kang's - emitter and wave propagation FEM meshing method) make **ROBOT V6** a **powerful, truly interactive** tool, that meets the most **demanding engineer** requirements.



IMAX DOME. DESIGN PRAT

**TO LEARN HOW ROBOT V6 CAN HELP YOU MEET THE CHALLENGES OF 21ST CENTURY, PLEASE CALL 800-60-ROBOT, OR USE FAX BACK SERVICE AT 201-438-2733.**

**Please circle # 51**

**yes**  
It runs with  
NetWare

**metrosoft**  
STRUCTURES, INC.

332 Paterson Ave,  
E. Rutherford, NJ 07073

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

**ROBOT V6**

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

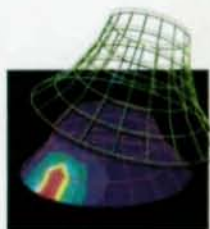
Tel.: \_\_\_\_\_ Fax: \_\_\_\_\_

I am:  structural engineer,  architect,  educator,  dealer,  other: \_\_\_\_\_

Please have a product specialist call me  Please send more information

Please send working demo version (limited to 25 elements and 25 nodes), with recorded macros of real design examples. Enclosed is a check for \$25 (plus applicable Tax in NJ). I have a system equal to or better than 386SX with math coprocessor, 8 MB RAM, 25 MB of free disk space, VGA monitor.

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



MSC

©1995 Metrosoft Structures, Inc. All brand and product names are trademarks or registered trademarks of their respective holders. Developer Tested Only. Novell makes no warranties with respect to this product.

**UK • Germany • Italy • Belgium • Spain • Portugal • France • Brazil • Luxembourg • Poland • Jordan • Morocco**

STATE OF THE ART

# Structural Engineering Software

INTEGRATED ANALYSIS AND DESIGN SOFTWARE FOR STRUCTURAL AND EARTHQUAKE ENGINEERING.

Developed by Ashraf Habibullah & Edward L. Wilson



For further information:

Computers & Structures, Inc.  
1995 University Avenue  
Berkeley, California 94704

TEL: 510/845-2177  
FAX: 510/845-4096

Please circle # 31

**SAP90<sup>®</sup>**  
General Analysis & Design

**ETABS<sup>®</sup>**  
Building Analysis & Design

**SAFE<sup>™</sup>**  
Slab Analysis & Design

SAP90 is a registered trademark of Computers & Structures, Inc.  
ETABS is a registered trademark of Computers & Structures, Inc.  
SAFE is a trademark of Computers & Structures, Inc.  
CSI is a registered trademark of Computers & Structures, Inc.  
© 1993 Computers & Structures, Inc.