MODERN STEEL CONSTRUCTION

February 1993

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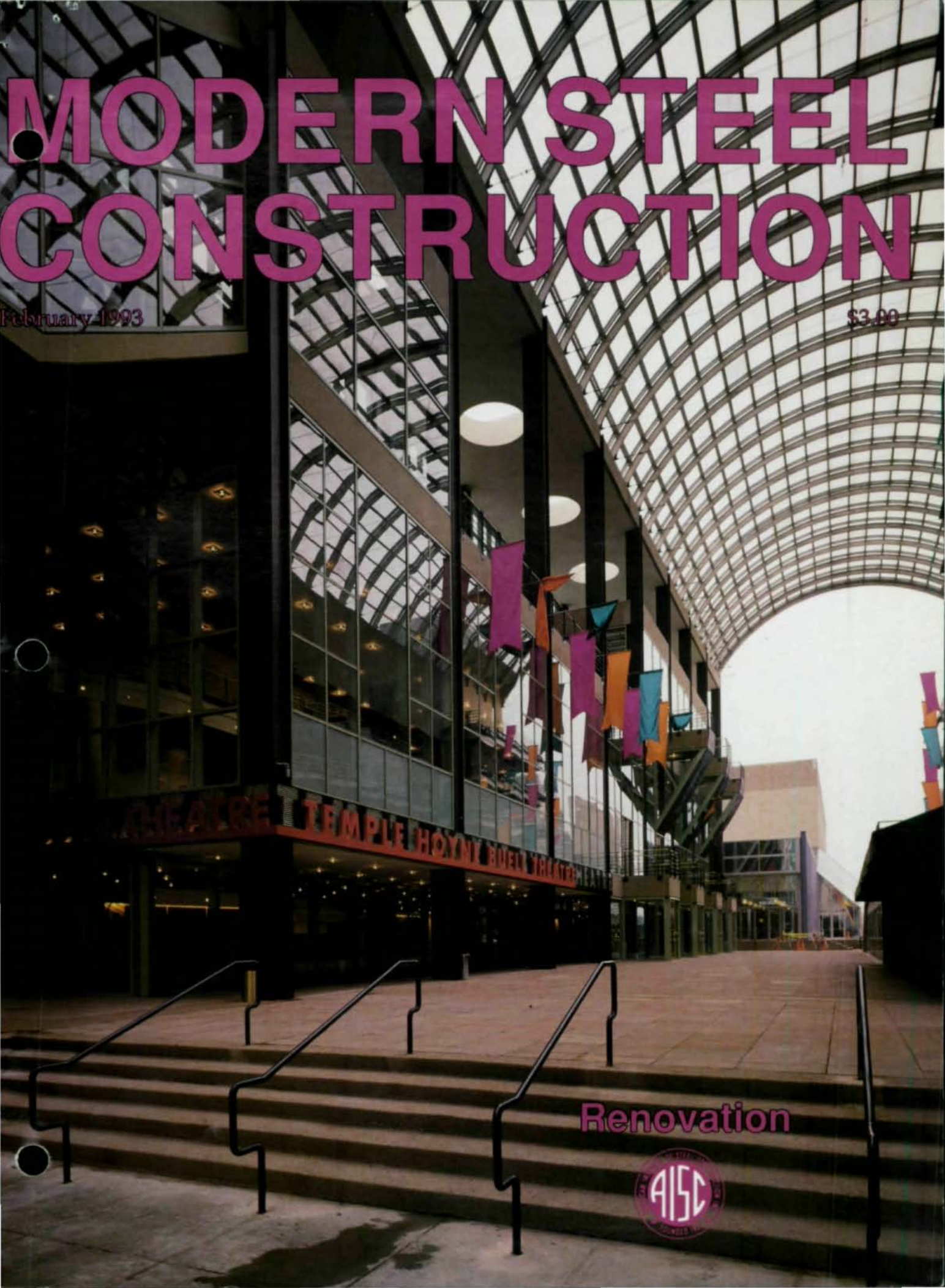


Renovation

AISC

UNITED STEEL DECK, INC.

ROOF DECK DATA BASE

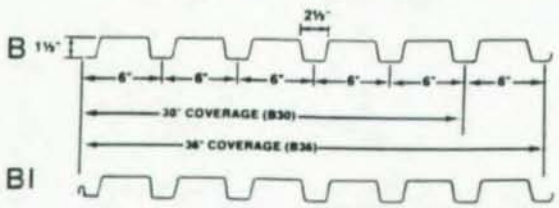
DECK DESIGN DATA SHEET

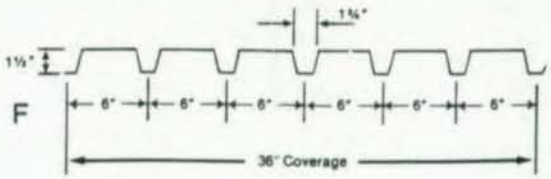
No. 17

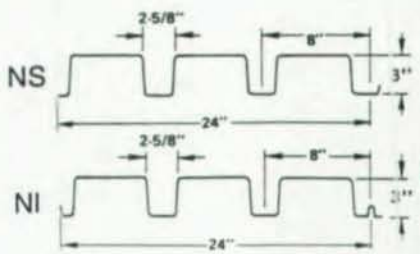
Attribute	Type B Deck (B, BI, BA, BIA)				Type F Deck			Type N Deck (NS, NI, NSA, NIA)			
gage	22	20	18	16	22	20	18	22	20	18	16
thickness	.0295	.0358	.0474	.0598	.0295	.0358	.0474	.0295	.0358	.0474	.0598
weight, psf	1.7	2.1	2.8	3.5	1.6	2.0	2.6	2.1	2.5	3.3	4.1
I_p, in.^{4} (1)	0.17	0.24	0.31	0.40	0.13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

NOTES

(1) I_p, I_n, S_p, and S_n are the section properties per foot of width. These values were calculated using the American Iron and Steel Institute Specifications. The subscripts denote positive or negative bending.
(2) Allowable end reaction per foot of deck width -- 2" bearing.
(3) Allowable end reaction per foot of deck width -- 3" bearing.
(4) Allowable interior reaction per foot of deck width -- 4" bearing.
(5) Allowable interior reaction per foot of deck width -- 5" bearing.
(6) Allowable vertical shear per foot of width -- do not confuse this with horizontal shear strength provided by the diaphragm.
(7) Maximum span recommended for roof construction based on SDI criteria -- single span.
(8) Maximum span recommended for roof construction based on SDI criteria -- 2 or more spans.
(9) Maximum recommended cantilever span based on SDI criteria; these spans are sensitive to the length of the adjacent span as they are controlled by deflection. Call if you need a more precise calculation.
(10) Maximum spans for Factory Mutual Class I construction. Factory Mutual will allow these spans to be extended by 10% (maximum) when the insulation is mechanically fastened to the deck by screws and plates. Whenever this extension is used, sidelap fastening must occur at 18" (maximum) rather than the normal 36". Refer to the Factory Mutual System Approval Guide.
(12) B is generically known as "wide rib" deck; F is "intermediate" rib, and the 3" deep N deck is "deep rib".
(13) The deck type B means flat side lap; BI is the "interlocking" side lap; BA and BIA means the decks are acoustic. F deck is only available with the flat sidelap. NS is flat sidelap; NI is "interlocking" and NSA and NIA are acoustic decks. Better sidelap connections are obtained by screwing or welding through the flat sidelaps and therefore this is the recommended type.
(14) Information not provided on this chart may be obtained by calling our office in Summit, NJ.







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MODERN STEEL CONSTRUCTION

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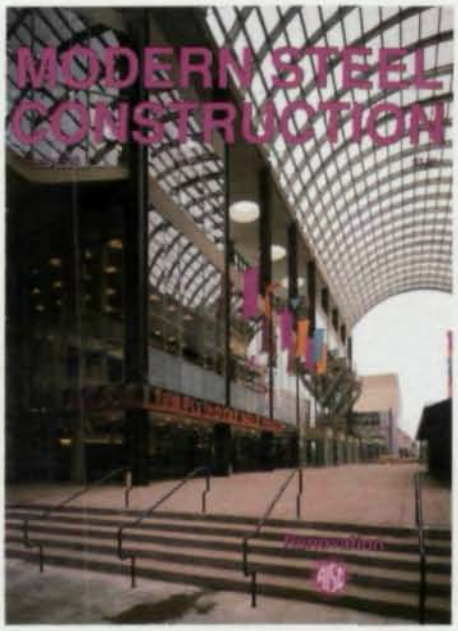

After an old arena was converted into a state-of-the-art theater, it was connected to the Denver Arts Center by a newly constructed, glass-enclosed galleria. The story behind this fascinating project begins on page 16. (Photo by Krebs Photography)

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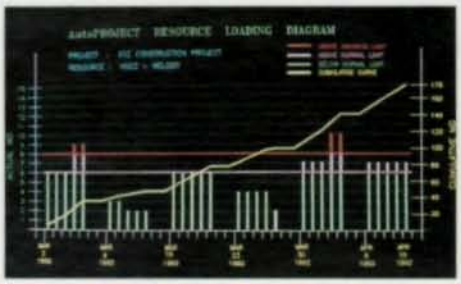

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A Sign Of Things To Come

I was driving home from Springfield recently and had to do a quick double take. The sign on the side of the road read: Chicago 100 kilometers (62 miles). Having often driven back-and-forth to Toronto during the past three years, I was used to seeing distances in metric units. But this was the first time I could remember a such a sign on a prominent U.S. interstate—and it was the only one of its kind on the road between Chicago and Illinois' capital.

But we all should start getting used to it. The U.S. as a whole is switching to metric, and the construction industry is expected to lead the way. During the next few years, a steadily increasing number of federal projects will be bid only in metric (see March 1992, *MSC*), and it is expected that this practice will soon start trickling into the private marketplace.

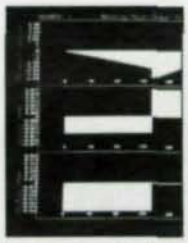
And for the most part, it should be a fairly painless change. I've spent enough time of late north of the border to have come to grips with most simple conversions (an inch is about 2½ centimeters; a kilometer is about a 20 minute walk), and its not that hard to adjust.

Where problems may occur are in an engineers' or fabricators' technical tools—especially computer programs. In this issue is an article discussing how to purchase detailing software. One topic not broached (I apologize in advance for the omission) is whether the program accommodates metric units. Likewise, while we sometimes noted last month that an engineering design program contained metric support, it was not a question on our original survey, and so our data is not complete. I would heartily recommend that you don't wait until the last minute to think about metric. If you're buying a program, ask about metric. If metric values are not currently available, find out when they will be, and what the cost will be to upgrade.

AISC also is moving towards metrification. This past September, AISC published "Metric Properties of Structural Shapes with Dimensions According to ASTM A6M" ($16.00). And plans currently are in the works for the next edition of the LRFD manual to contain metric data. On the computer side, the AISC database and AISC for AutoCAD are both available in metric.

And finally, beginning in March (our special issue covering the National Steel Construction Conference), *MSC* will begin listing metric equivalents along with U.S. dimensions. **SM**

How to get from here



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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 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
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Chicago, IL 60601

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

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

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

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

Can one weld to an existing structure? How does one determine if the steel is weldable?

The answer to the first part of the question is a resounding yes, provided that certain condition are met. These conditions are enumerated in an article which appeared in the AISC *Engineering Journal*, Volume 25, No. 1, 1988. Interested readers are advised to access this publication.

The answer to the second part of the question (also available in the above mentioned literature) is summed up briefly as follows:

If the chemical properties of the steel to be welded are known, either by valid mill certification or laboratory testing of samples, the weldability of the steel can be predicted by use of a carbon equivalent formulae, of which there are many available.

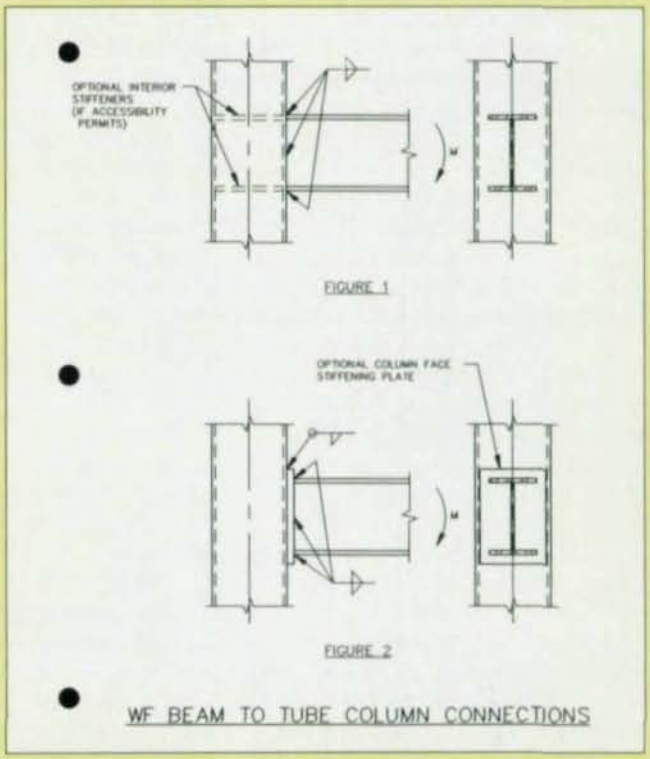
An obvious test of weldability is to examine the existing steelwork for evidence of original welding. If one is still in doubt it is suggested that an on-site test be performed which will address weld ductility and hardening of the base metal. (Refer to AWS Spec. D1.1 Chapter 5).

In addition to determining the weldability of existing steel there are other factors which should be considered: the past history of the structure, nature of the loads, weather conditions, whether the welding involves members carrying stress, etc. The aforementioned article addresses these and other issues and provides useful references.

David T. Ricker, P.E.
Payson AZ

How should I connect wide flange beams to all four faces of a structural tube column in such a way as to transfer wind moments as well as dead and live load reactions?

There are a number of possible solutions for connecting wide flange beams to the face of a structural tube column to transfer moments. The type chosen depends on varying parameters. Economical determination of the proper connection will consider such things as the magnitude of the end moment



(flange forces), thickness and width of the column wall, and width of beam flange in comparison to the width of the connecting face of the tube.

The simplest of connections is to weld the beam directly to the column (see Figure 1). The static moment strength of this beam to column connection can be related to that of a gusset plate welded to the face of a square or rectangular tube. The moment capacity checks for this type connection will vary based on geometry.

Examples:

1. Connections with beam flanges which are the same width as the tube face should be checked for chord wall bearing or buckling failures.

Note: General collapse of the tube can be particularly severe in "cross" connections (connections with members attached on opposing tube faces) and should be fully investigated.

2. All connections should be checked for an effective flange width based on the width to thickness

Steel Interchange

ratio of the column face.

3. Connections with flange widths less than the chord face width minus two times the chord wall thickness need be checked for "punching shear" criteria (severe in connections with low beam flange width to column width ratios).

Of course the beam web to column connection must be adequate to carry any beam end shear. I would recommend to readers that they obtain a copy of the book "Hollow Section Joints" by Jaap Wardenier, published by Delft University Press as a design guide for this type of connection.

If the preceding connection design will not work for members sized by classical analysis and design procedures, possible remedies may include thicker column walls, interior stiffeners if accessibility permits (see Figure 1), stiffening the column walls with face plates (see Figure 2), or changing beam size (depth or flange width). Another possible solution is to weld plates from flange-to-flange of the beam to form a "box" section at the connection, then use a design approach similar to that which is outlined for tube-to-tube connections in Chapter 10 (Tubular Structures) of the 1990 Structural Welding Code (AWS D1.1-90) to check the beam-to-column connection.

Tubes provide very economical structural compression members and we at Continental Bridge utilize them almost exclusively in design and fabrication of our pedestrian bridges; however, their economical use is greatly affected by connection details (tube to tube or wide flange to tube) and connection design must be thoroughly investigated to insure a safe, economical structure.

Steven J. Herth, P.E.
Continental Bridge
Alexandria, MN

Are there any design requirements that an engineer can follow when designing lateral bracing?

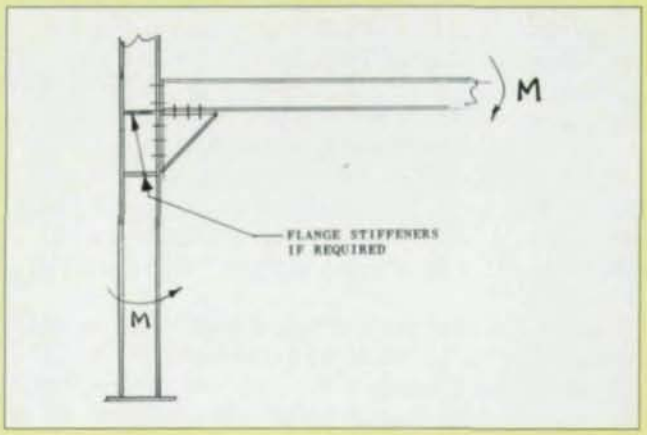
As indicated in the response to this question in the October 1992 issue of *Modern Steel Construction*, there is little information available on how to design bracing. Even in the publications cited, criteria are presented for only a few basic applications. Hopefully, this will soon change. On April 6-7 1993 there will be a 1½ day conference in Milwaukee on the theme "Is your Structure Suitably Braced?" The emphasis of the conference is on the determination of forces and stiffness required for bracing systems of beams, columns, frames and structural systems. The conference is sponsored by AISC, AISI, MBMA and SSRC. A call for papers appeared in the September issue of *Modern Steel Construction* and more information will appear in a future issue. One session of the Conference will be devoted to the discussion of questions raised by the participants.

Donald R. Sherman
University of Wisconsin-Milwaukee
Milwaukee, WI

New Questions

Listed below is a question that we would like the readers to answer or discuss. If you have an answer or suggestion please send it to the Steel Interchange Editor. Questions and responses will be printed in future editions of Steel Interchange. Also, if you have a question or problem that readers might help solve, send these to the Steel Interchange Editor.

What fatigue catagory is a full penetration weld between a tube column and a base plate?



The AISC and various authors present a multitude of solutions to the connection problem of a horizontal beam transmitting moment to a column. However, one solution I cannot find is the use of a heavily flanged gusset plate used below the beam to connect it to the column. This method would be very handy with industrial type structures for elevated hoppers,m bins, storage silos, as for stone aggregates, coal, cement, flyash and the like, which must make provision for trucks or railcars passing underneath, and where the moment is from wind or seismic forces, for the most part. Is such a concept not a proper or practical solution? If the concept is practical, what is a sensible calculation method, particularly for a bolted connection?

The 1993 National Steel Construction Conference is on March 17-19 and the meeting is quickly approaching. NSCC reservation forms are enclosed in this issue of *Modern Steel Construction.*

February 15 is the deadline for NSCC hotel reservations. ACT FAST to secure your rooms. See you in Orlando.

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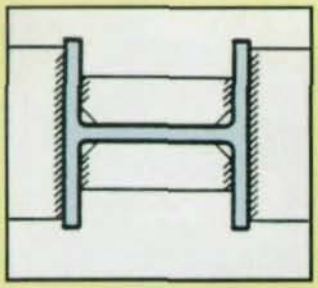

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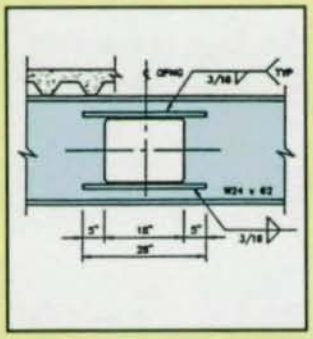

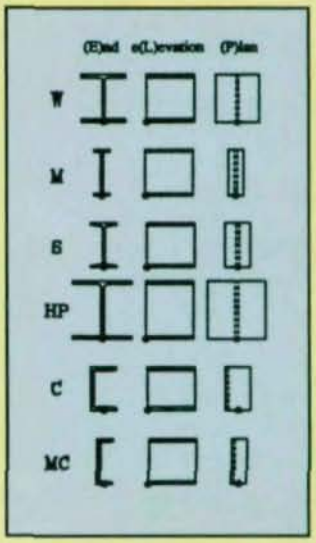

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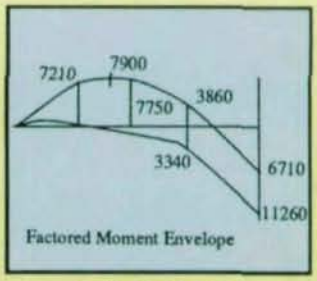

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Judging Criteria

Judging will be based upon aesthetics, economics, design and engineering solutions. Quality of presentations, though not a criterion, is important.

Award Categories

Entries may be judged in one or more categories, but can receive only one award.

Long Span One or more spans more than 400 ft. in length.

Medium Span, High Clearance Vertical clearance of 35 ft. or more with longest span between 125 and 400 ft.

Medium Span, Low Clearance Vertical clearance less than 35 ft. with longest span between 125 and 400 ft.

Short Span No single span greater than 125 ft. in length.

Grade Separation Basic purpose is grade separation.

Elevated Highway or Viaduct Five or more spans, crossing one or more traffic lanes.

Movable Span Having a movable span.

Railroad Principal purpose of carrying a railroad, may be combination, but non-movable.

Special Purpose Bridge not identifiable in one of the above categories, including pedestrian, pipeline and airplane.

Reconstructed Having undergone major rebuilding.

Entry Requirements

All entries must contain an entry form, photographs and a written description of the project. A separate binder must be submitted for each entry. No entry free is required; submission materials will not be returned. The use of any entry's submitted data, detail and/or photographs by AISC shall be unrestricted. **Note:** Projects not receiving an award still may be used in *Modern Steel Construction* magazine or other AISC marketing materials.

1. *Entry form:* The complete and accurate entry form and one copy must be enclosed.

2. *Photographs:* A minimum of four professional quality 8x10 color prints of various views showing the entire bridge, including abutments as well as selected details, are required. 35 mm slides are strongly recommended. Photographs will not be returned.

3. *Description:* Explanation of design concept, problems and solutions, aesthetic studies, project economics and any unique or innovative aspect of the project. Include no larger than 11x17 drawings showing elevation, framing system and typical details.

Method of Presentation

Each entry should be submitted in an 8½" x 11" binder, containing transparent window sleeves for displaying inserts back to back. The entry form included in the brochure must be easily removable, so that the identification of the entry can be concealed during judging.

Awards

The winners will be notified shortly after the mid-August judging. Public announcements of the winners will be made in the November issue of *Modern Steel Construction* magazine. Award presentations will be made to the winning designers at the National Symposium on Steel Bridge Construction, November 11, 1993, in Atlanta, GA.

Deadline for Submission

Entries must be postmarked on or before ***June 18, 1993***, and addressed to: American Institute of Steel Construction Inc., Attn: Awards Committee, One East Wacker Drive, Suite 3100, Chicago, IL 60601-2001. For further information, call 312/670-5432.

AISC 1993 Prize Bridge Competition

Entry Form

Entry Date_____

Name of Bridge_____ Completion Date_____

Location_____ Date opened to traffic_____

Category in which entered_____ Approx. total cost_____

Span lengths_____ Roadway widths_____ Steel wt./sq. ft. of deck_____

Vertical clearance_____ Steel tonnage_____ Painted: Yes_____ No_____

Structural system(s) (describe briefly here)_____

Innovative Concepts_____

Descriptive data: Attach separate sheets (see entry requirements)

No. of photographs enclosed: Color prints_____ 35 mm slides_____

Design Firm:_____
Phone

Address:_____
Street City and State Zip

Person to contact:_____
Title

Consulting Firm (if any):_____
Phone

Address:_____
Street City and State Zip

Person to contact:_____
Title

General Contracting Firm:_____
Phone

Address:_____
Street City and State Zip

Person to contact:_____
Title

Steel Fabricating Firm:_____
Phone

Address:_____
Street City and State Zip

Person to contact:_____
Title

Steel Erecting Firm:_____
Phone

Address:_____
Street City and State Zip

Person to contact:_____
Title

Owner:_____
Phone

Address:_____
Street City and State Zip

Person to contact:_____
Title

This entry submitted by:

Name:_____
Title

Firm:_____
Phone

Address:_____
Street City and State Zip

(ADDITIONAL ENTRIES MAY BE SUBMITTED ON COPIES OF THIS FORM)

NSCC Focuses On Design Responsibility

In addition to seminars on steel design, fabrication, and erection, this year's National Steel Construction Conference will feature a special session on Design Responsibility.

The 1993 NSCC will be held in Orlando from March 17-19, with the first session featuring a panel discussion on design responsibility for connections. The panel includes representatives from the engineering, fabrication, legal, insurance and detailing industries. Among the topics to be discussed are "shared responsibility" and the issue of liability.

In addition to the special session, the conference features four general sessions and a large number of technical sessions.

The general sessions range from the design of a mixed-use complex in Barcelona, Spain, to this year's T.R. Higgins lecture.

Semiar topics include: industrial buildings; managing subcontract detailing; fire restoration and protection; fabrication of architecturally exposed structural tubing; current issues in steel building design; bridge rehabilitation; construction automation in steel framing; project management; composite structures; seismic design in steel; and quality standards vs. fitness for purpose.

The NSCC also features an extensive trade show with nearly 100 exhibitors, many of whom will be holding product workshops.

For more information on the conference, please contact: NSCC, American Institute of Steel Construction, Inc., One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001 (312) 670-2400; fax (312) 670-5403.

Bridge Rehabilitation

The National Science Foundation and Iowa State University are sponsoring a Symposium on Practical Solutions for Bridge Strengthening and Rehabilitation in Des Moines, IA, on April 5-6, 1993.

More than 40 papers will be presented with a emphasis on realistic approaches to bridge repair. Of these papers, nearly three-quarters will be offered by practicing bridge consultants and highway bridge engineers.

For more information and a copy of the final program, contact: Prof. Wallace Sanders, Bridge Engineering Center, 394 Town Engineering Building, Iowa State University, Ames, IA 50011 (515) 294-6048; fax (515) 294-2140.

International Engineering Computing Conference

The International Conference on Computing in Civil and Building Engineering returns to the U.S. in 1993.

This year's conference, sponsored by ASCE, will be held in conjuction with the A/E/C Systems exposition in Anaheim from June 7-10. Of particular interest for structural engineers are three of the five symposia:

- Symposium on Computing in Structures. 24 technical sessions. Symposium leader is J.P. Mohsen, Ph.D., of the department of Civil Engineering, University of Louisville.
- Symposium on Computing in Transportation. Nine technical sessions and one tutorial.
- Symposium on Computing in Construction. 17 technical sessions.

The objective of the conference is to disseminate knowledge of current and projected developments in computer software and hardware, particularly for civil engineers.

An added attraction for engineers is the opportunity to examine the exhibits at A/E/C Systems, including the latest CAD and structural engineering software.

For more information on the conference, contact: Specialty Conference Department, American Society of Civil Engineers, 345 East 47th St., New York, NY 10017 (212) 705-7139; fax (212) 421-1826.

Theatrical Transformation

The interior of an old arena was completely gutted to make way for a glamorous new theater

By Charles D. Keyes, P.E., S.E.

Thanks to a new $24 million conversion of an arena into a 2,830-seat theater, Denver now boasts the country's largest performing arts center outside of New York City. The renovation completes a master plan begun in 1972 to make the Denver Arts Center truly world-class.

What is now the Denver Arts Center began just after the turn of the century with the Auditorium Theatre. In the 1940s, a large arena was constructed adjacent to the theater, and in the 1970s, a concert hall, second theater and a large enclosed parking structure were added to the growing complex. At that time, a galleria also was constructed, which combined the three new structures into one center. Joining all five structures together would only occur in 1991, when a pavilion—featuring a suspended floor and atrium roof structure—was constructed along with the arena conversion.

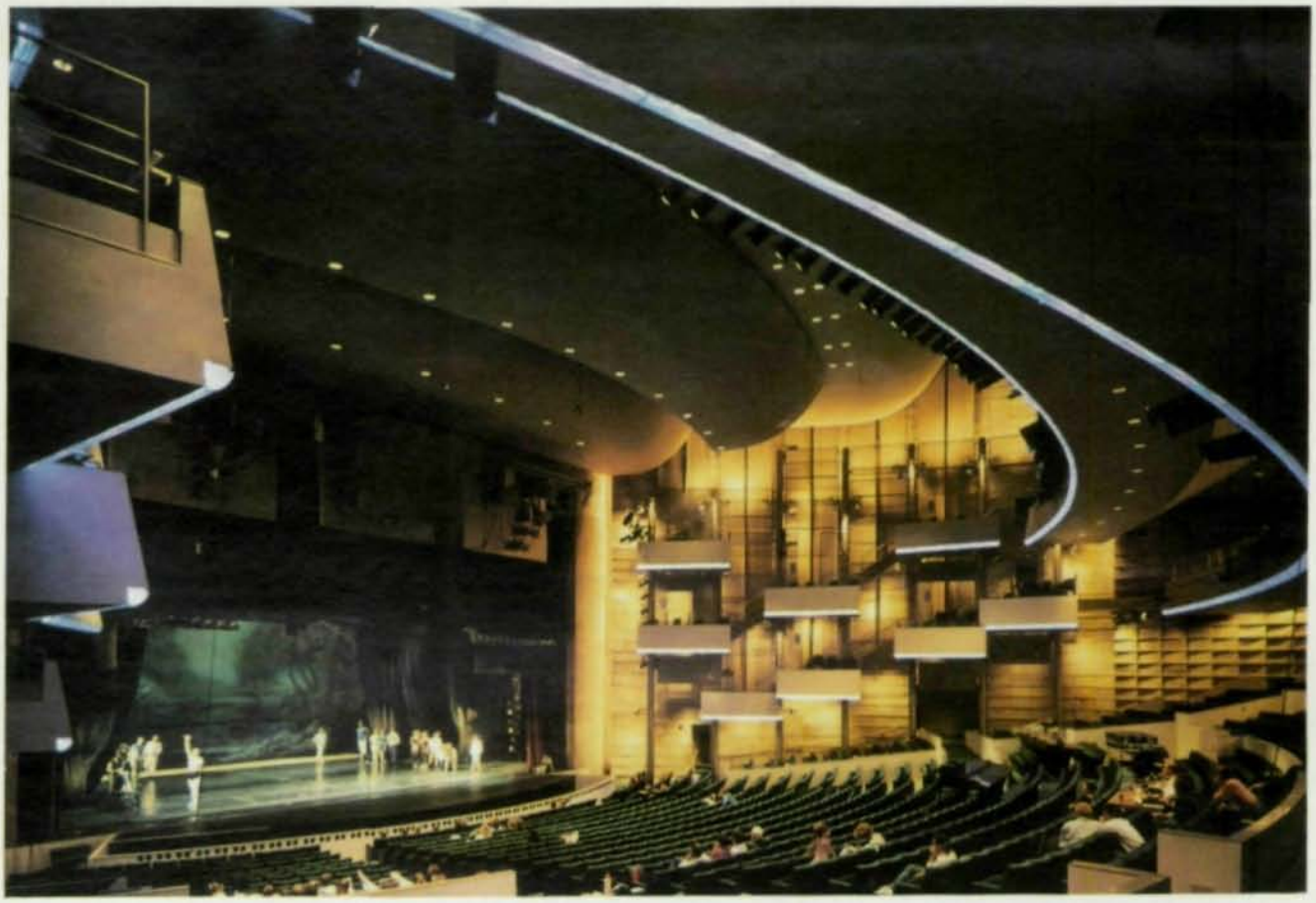
Renovation Vs. New Construction

A large part of the design effort for the new Temple Hoyne Buell Theatre was deciding how much—if any—of the more than 40-year-old structure to save. Several alternatives were considered to provide feasibility and budget information to the owner the City and County of Denver, the project's owner.

After careful analysis, it was determined that the most economical approach—both for cost and time savings—was renovation. The downside, however, was an increase in project complexity and the need for coordination of efforts. Complicating the project was an unusually large design team (three architects all located in different states, mechanical/electrical engineers, acoustical and theater specialists, and structural engineers). In addition, the public nature of the project dragged out the design and discussion phase over six years.

And, of course, the project had the "usual" difficulties associated with renovation, such as the need for asbestos abatement, a limited site, and the need to shoe-horn the building into the existing complex.

A new vaulted galleria connects the newly created Buell Theatre to the existing Denver Arts Center.

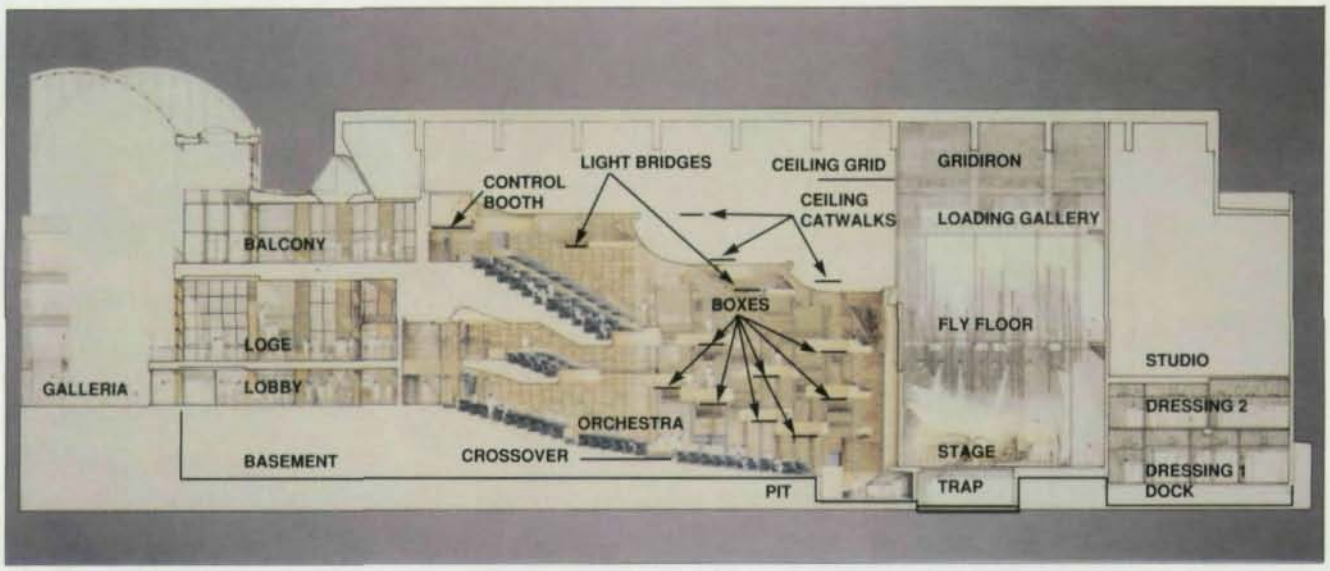


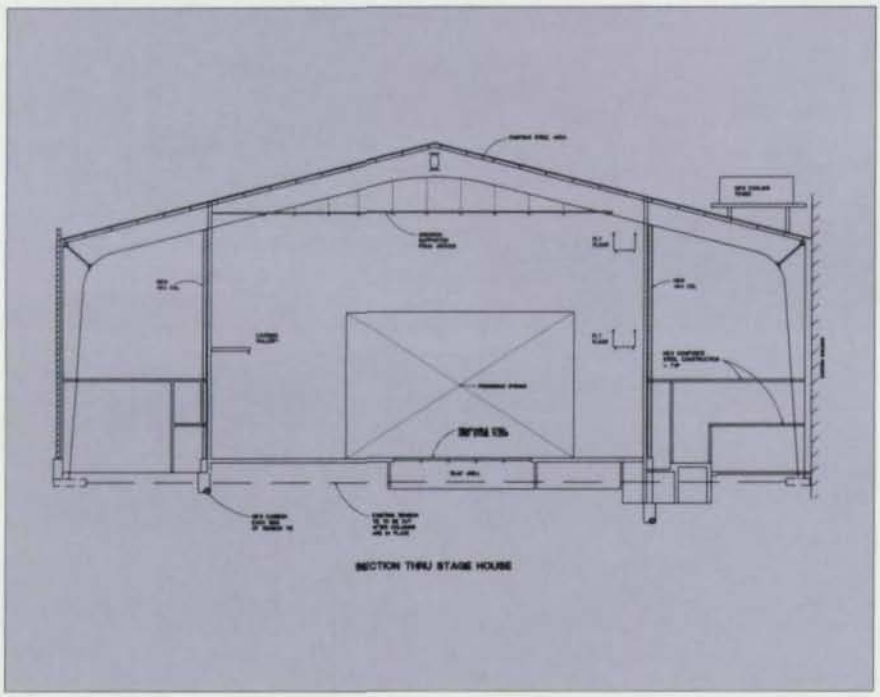
Existing Conditions

Due to an interruption caused by World War II, the arena had been constructed in two phases and featured a variety of building systems. Materials testing and investigation was done on the cast-in-place concrete and steel floor systems, precast concrete roof and floor decks and the four types of existing foundations (concrete footings, concrete drilled piers, wood piles and stone footings). Methods employed included concrete coring and testing, steel coupon testing, pachometer, X-ray and radiographic techniques.

Modification to the existing structure included temporary support and re-routing of existing structural load paths. Load and settlement interaction of existing foundations also was examined. Relocation of structural expansion joints involved the analysis of interaction with adjacent buildings. Vibration calculations involving the interconnected structural sys-

The configuration of the existing complex and the difficulty in gaining access to the interior space made demolition and construction a special challenge (construction photo by Kent Bolerjack). Pictured at top is the theater's cantilevered balcony, which features a free-floating appearance (photo by Peter Aaron/Esto).





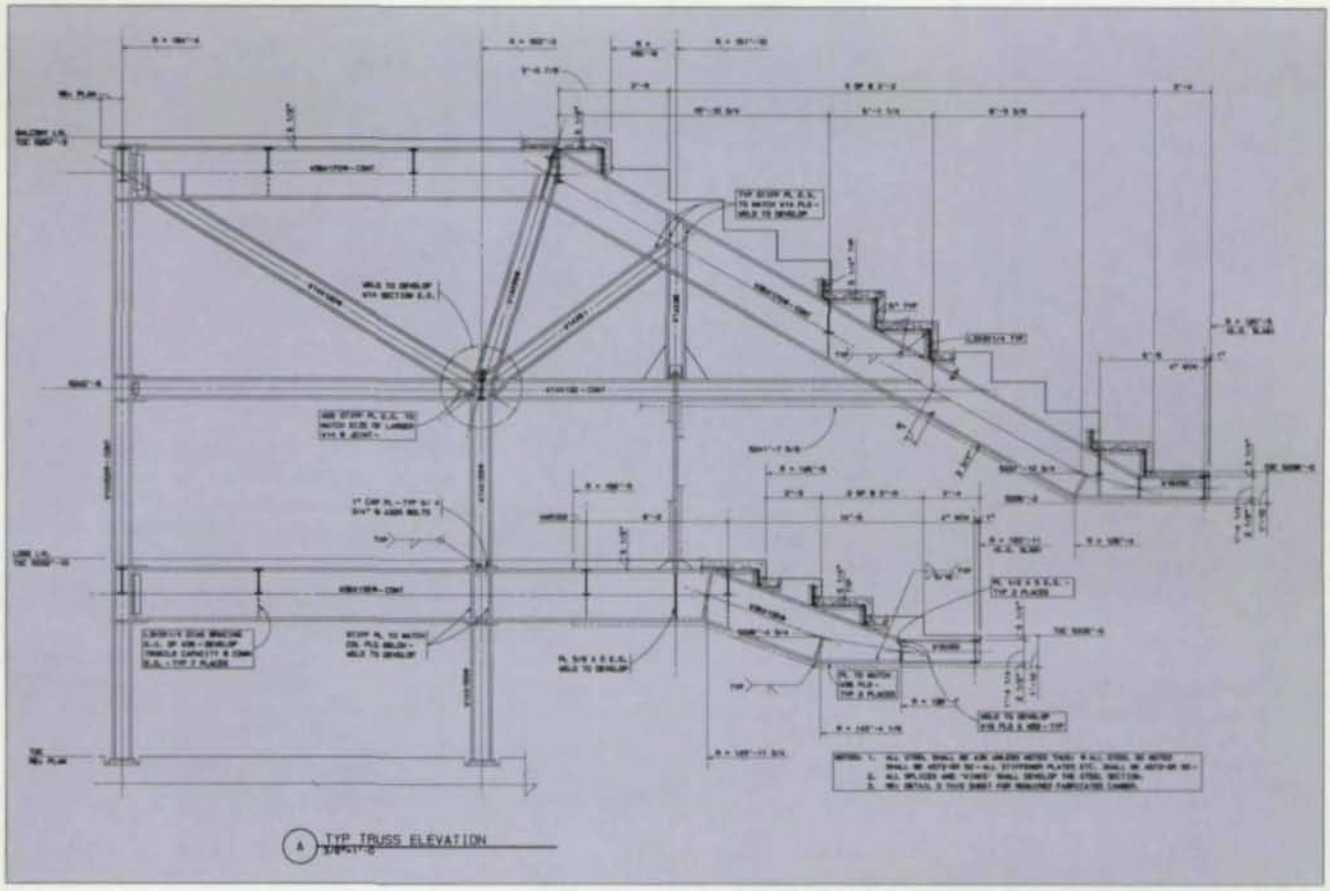
The old structural system was modified from a three-hinged arch structure to a three-bay frame with the addition of a series of W14 columns. In addition, the theater was extended into the basement to provide room for a sloping seating area and additional stage space. And finally, two mezzanines were added. (Top rendering courtesy of van Dijk, Pace, Westlake & Partners.)

tems using three-dimensional models were performed and both audience and mechanical system excitations were investigated.

Finally, a scheme was developed where the existing roof and three of the exterior walls were salvaged. The interior space was entirely gutted, and while the roof plane was kept intact, the orchestra floor and stage levels were lowered into the basement level of the existing building. The fourth exterior wall with its 200'-long brick facade was removed and expanded to open the Buell's lobby space and connect with the Art Center's new vaulted steel galleria structure.

The remaining basic building shell structure included a series of three-hinged steel arches supporting the roof and three exterior walls. By taking steel coupons for materials property testing and reanalyzing the structure, it was determined that the roof arches were capable of supporting roof loads and some new theater ceiling and catwalk loads. However, they needed strengthening for the heavier catwalk and gridiron loads, as well as to support 200 tons of new Colorado sandstone panels that now line the theater walls.

Another problem was the loss of the old floor, which had been removed both to accommodate the excavation for the trap and orchestra below the existing basement level and to allow the installation of a new sloped floor. This caused



a structural problem since the old concrete slab floor housed tension foundation tie steel between the arch bases.

To solve this problem, 12 pairs of interior steel columns were added at the sides of the stage and orchestra, changing the structure from a three-hinged arch to a three-bay frame. The 65'-high columns range from W14x43 to W14x90.

One pair of these new columns was also used to support two levels of cantilevered balconies. The top, larger balcony, is a large truss with a W36x170 top chord and W14x132 bottom chord. The webs range from W14x38 to W14x120. The lower balcony is supported on a W26x135 beam. The lower balcony is both supported on a column and hung from the upper balcony. Both A36 and A572 Grade 50 steel were used on the project, which required 1,250 tons of structural steel. Because of the unique needs of a theater, design of the cantilevering balconies was controlled by vibration considerations

The cantilevered balconies were supported on a pair of new steel columns. Photo by Kent Bolerjack.

The theater's new lobby features a large glass wall overlooking a galleria connecting it to the Denver Arts Center.

rather than strength.

The new columns also support a new glass lobby wall as well as the new stage framing. The 12,000-sq.-ft. lobby includes an 80'-high "thunderbolt" skylight just inside the 70'-high glass and steel-fronted facade, as well as seven small balconies projecting into the galleria plaza area.

Three-dimensional analysis was performed using Research Engineer's STAAD-III program and two-dimensional analysis was performed using RISA 2D from RISA Technologies. Design was done using in-house programs, except for connection design, which was performed on CONXPRT.

Composite metal decks were chosen for the floor framing of both the balcony and main floor areas for three reasons. First, its light weight allowed the reuse of the existing foundations. Second, it offered compatibility with the existing arena and galleria steel shells. And finally, the ease and speed of erection made composite construction the logical choice for construction in a confined space with limited access for heavy equipment.

The design team included MARTIN/MARTIN, Wheat Ridge, CO, as structural engineer; CTC, Denver, for materials testing and inspection; three architects—Beyer Blinder Belle, New York (lobby and facade), van Dijk, Pace, Westlake & Partners, Cleveland (theater interior), and Semple, Brown, Roberts, Denver (exterior renovation); and Roger Morgan Studio, Inc., New York, theater design consultant.

Construction was completed in time for the Buell's grand opening in late 1991—including the addition of a special steel ceiling beam to support the 1,200 lb. chandelier that plays a prominent role in Andrew Lloyd Webber's *Phantom of the Opera*.

Charles D. Keyes, P.E., S.E., is a principal with MARTIN/MARTIN, Inc., in Wheat Ridge, CO, and registered in eight states. He has more than 25 years of experience in the structural design of long span and special structures.

Do Not Disturb

A retrofit of an Indiana school's exterior walls was carried out before and after school hours to minimize disruption

By John F. Vincent, P.E., S.E., Gene Corley, P.E., S.E., and Hans C. Kosel, P.E., S.E.

When displacement and cracking of exterior masonry walls were first discovered in a 20-year-old southern Indiana high school building, the first thought was that they were caused by a subsidence of an old coal mine beneath the school. However, an investigation by Construction Technology Laboratories (CTL), Skokie, IL, determined a variety of structural deficiencies, including inadequate lateral load resisting systems.

The mostly single-story building contains two structural systems: unreinforced bearing walls with steel roof joists and non-bearing masonry cavity walls with a pre-engineered structural steel frame. Exterior masonry cavity walls are constructed of 4" bricks, 4" and 10" lightweight concrete masonry units (CMU), and a 2" insulated cavity. Roof construction consists of corrugated steel deck and a built-up roofing system. The 220,000-sq.-ft. building is founded on drilled piers.

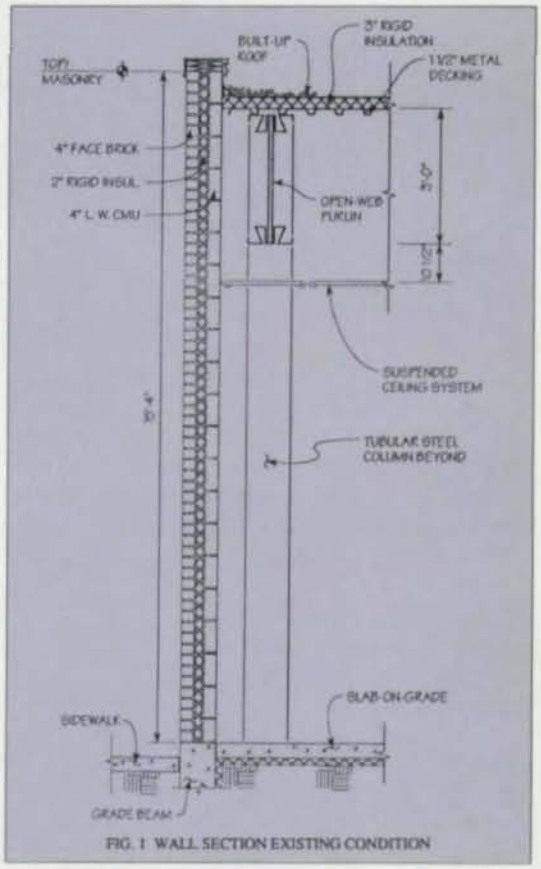


FIG. 1 WALL SECTION EXISTING CONDITION

Structural Investigation

An investigation into the cause of the cracking and displacement began with a survey of the masonry conditions and a review of previous reports. The investigation also included visual and ultrasonic inspections of the foundation, inspections of as-constructed structural steel and masonry details, and appropriate laboratory tests. Calculations were performed to check the original design of the masonry walls.

Major findings included:

- Some of the observed masonry defects were attributable to the effects of subsidence of a subterranean coal mine.
- Lateral-load resisting systems used in the original design of the school were inadequate to carry the design lateral loads. When subjected to code-prescribed wind loads, calculations indicated that all exterior walls were structurally deficient. Masonry overstresses exceeded 100% at several locations. Steel roof deck details did not provide sufficient diaphragm capacity and shear walls were non-existent in most of the structure and inadequate where provided.
- Exterior, non-bearing cavity walls were freestanding; roof cant strips and built-up roof

membrane were the only form of lateral restraint at tops of walls (see Figure 1).

- As-constructed walls contained deficiencies in spacing of ties between brick and the CMU wythes.
- Pre-engineered building frame and roof joists were constructed of proprietary, cold-formed shapes and the supplier of these components was no longer in business.

Based on these findings, CTL recommended immediate installation of remedial repairs to address wind load deficiencies and the temporary closing of some portions of the school.

Retrofit Design

The primary objective of the retrofit was to provide a defined load path capable of transferring applied wind pressures from external surfaces to the building foundation. Several repair schemes were evaluated in an attempt to fulfill this objective.

Among the crucial criteria considered in choosing a retrofit scheme were: speed of construction; obtrusiveness of construction work on students; impact on the building's aesthetics; and maintenance of all useable space after the retrofit was complete.

Before design could begin, it was first necessary to determine the gravity and lateral load capacities of the building frame. The horizontal frame members consisted of open-web purlins and girders with a variety of web and chord configurations and an extensive search was performed to find manufacturer's literature related to the material and section properties of the frame members.

Fortunately, an individual was located who had been involved with the structural design for the defunct manufacturer and who could provide much of the needed information.

Structural analyses, using the SAP90 computer program from Computers and Structures, Inc, were performed utilizing code-prescribed lateral loads and gravity loads. It was assumed that a suffi-

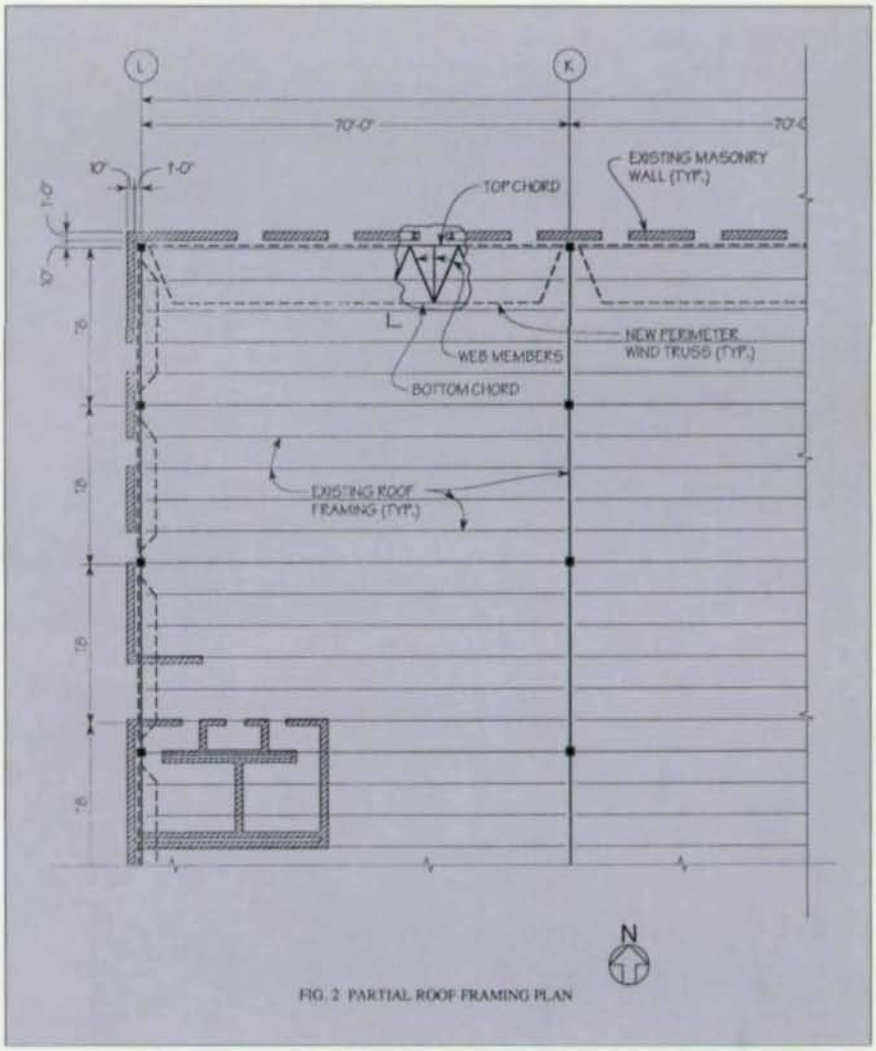


FIG. 2 PARTIAL ROOF FRAMING PLAN

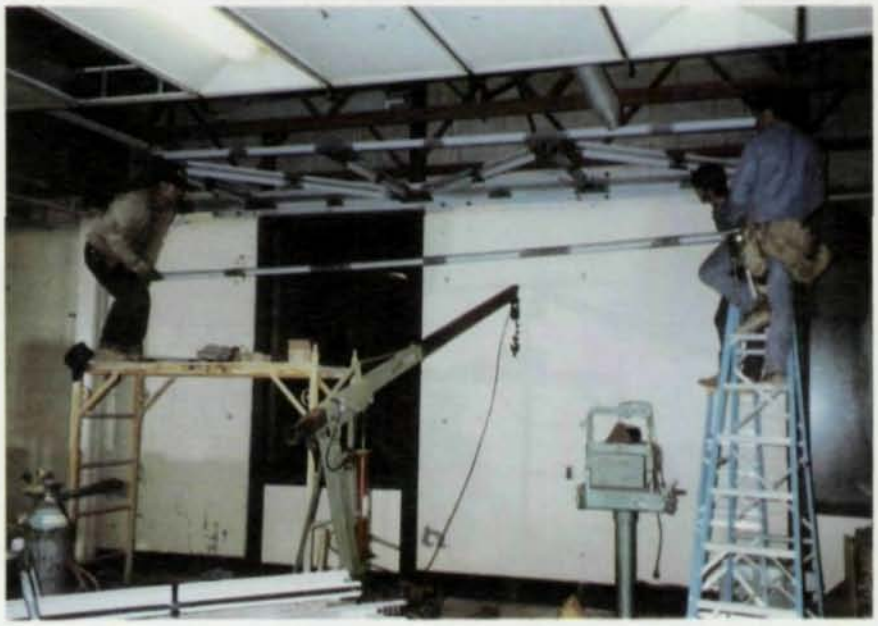


Figure 3: Wind Truss Installation

Figure 4: Completed Wind Truss

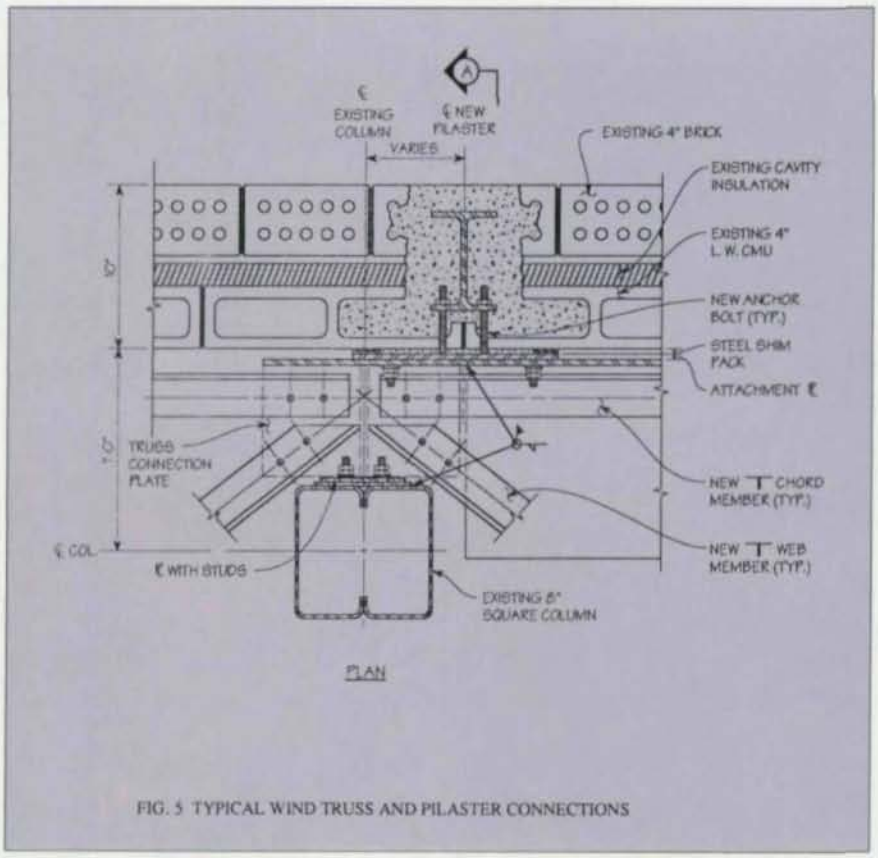


FIG. 5 TYPICAL WIND TRUSS AND PILASTER CONNECTIONS

cient load-transfer existed to provide diaphragm action between exterior walls and building frame. Results of this work indicated the existing building frame contained sufficient capacity to resist stresses induced by applied wind and gravity loads without the need for supplemental bracing or shear walls, as long as the frame and walls are attached.

Wind Trusses

One of the crucial aspects of the project was finding a method for transferring the wind-induced reactions from the tops of walls to building columns. The solution chosen involved installing structural steel trusses—with strong axes oriented horizontally—around the periphery of the building (see Figure 2). The trusses were designed to span between building columns and were sized to fit between the existing suspended ceiling and the girders and purlins of the building frame. Wind truss spans range from 25′ to 75′ and depths range from 3′ to 10′. Web and chord members were typically 2" x 2" and 2½" x 2½" double angles. All truss member connections are bolted. General contractor was ARC Construction Co., Evansville, IN.

Relatively light members, combined with bolted connections, allowed the installation of the trusses to proceed with ladders and light-capacity lifting equipment (see Figure 3). As a result, portions of the trusses could be installed before and after class hours with the temporary removal of ceiling panels being the only evidence of ongoing construction work.

At the completion of construction, the wind trusses were hidden from view by the suspended ceiling (see Figure 4).

Pilasters

After analyzing the structural section properties of the existing walls, it was apparent that either reconstruction of the walls or the installation of bracing was required.

Because the existing walls contained numerous windows and an

NATIONAL STEEL CONSTRUCTION CONFERENCE

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HOTEL REGISTRATION

NOTE: MAIL COMPLETE FORM DIRECTLY TO THE ORLANDO HOUSING CENTER.

HOUSING CENTER:

The Orlando Convention & Visitors Bureau Housing Department will coordinate NSCC 1993 hotel reservations. If reserving by telephone, have all the information below, and phone

1-800-258-ROOM
(1-800-258-7666)

Office Hours:
Monday-Thursday
8:00 a.m. - 7:00 p.m. EST .
Friday, 8:00 a.m. - 5:00 p.m.

RESERVATIONS:

All rooms in Orlando must be guaranteed with a one night's deposit either by credit card or check. If a credit card number is not used, a deposit check in the amount indicated on your acknowledgement form must be sent directly to the hotel within 14 days of date processed. Send one reservation form per room. Names of occupants must be listed in the spot below. Reservations are made on a first-come, first-served basis.

CUT-OFF DATE:

The cutoff date for hotel reservations is February 15, 1993. After that date reservations will be honored on a space available basis.

CHANGES/ CANCELLATIONS:

All changes and cancellations should be made directly with the Orlando Housing Bureau. Your room confirmation will arrive directly from the Bureau.

CONFERENCE HOTEL:

Clarion Plaza Hotel—$93 per night

The Peabody Orlando—$149 per night

Quality Inn Plaza—$57 per night

(The Clarion Plaza Hotel is the official Conference Hotel. Located 1/2 block from the Convention Center, it serves as the primary hotel for sleeping accommodations. All tours and optional events depart and return to the Clarion Plaza Hotel. The Peabody Orlando is across the street from the Convention Center and The Quality Inn is 2 blocks away. The Peabody and the Quality Inn have limited space. Suites are available upon request at the Clarion and Peabody.

NAME OF PERSON	ARRIVAL DATE	DEPARTURE DATE	TYPE OF ROOM SINGLE	TYPE OF ROOM DOUBLE	HOTEL CHOICE FIRST	HOTEL CHOICE SECOND	HOTEL CHOICE THIRD

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CREDIT CARD COMPANY

NUMBER

EXPIRATION DATE

CARD OWNER'S SIGNATURE

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Or Phone: 1-800-258-ROOM or
407/363-5800

HOUSING BUREAU DEADLINE DATE:

FEBRUARY 15, 1993

NSCC 93 "STEEL STANDS FOR THE FUTURE"

AISC brings its 1993 National Steel *Construction Conference to* Orlando, Florida. The NSCC will be held at the Orange County Convention/Civic Center on March 17-19, 1993. Attendees will be housed at the Clarion Plaza Hotel—the official NSCC hotel, the Quality Inn, and The Peabody Orlando. The Conference will focus on the specific interests of structural steel fabricators, engineers, architects, owners, contractors, erectors, detailers, researchers and educators. A comprehensive technical program includes seminars, meetings, product exhibitions, equipment demonstrations, optional family events, and receptions.

Orlando is a top choice of travelers from around the world successful meetings and magical, memorable vacations. Long a North American center for citrus production, the magic blossomed with the opening of Walt Disney World in 1971. Visitors thrilled to the fantasy of The Magic Kingdom and the technological wonder of EPCOT Center. They're captivated by the wonders of Earth's marine life at Sea World and the natural glories of Cypress Gardens. There's the big-screen magic and back-lot excitement of Universal Studios and Disney/MGM, old-fashioned fun at Church Street Station, a continuing out-of-this-world fascination with Spaceport USA, and the wonder of over 50 other theme attractions!

WHY SHOULD YOU ATTEND THE 1993 NSCC?

NSCC is the only "all steel" conference and trade show in the country. At no other meeting will you receive more information ut the design and construc- of fabricated structural steel.

Education—The more than 40 technical seminars will educate and inform you.

Value—Attending the NSCC will save you money and time in the future. Everything you learn at the NSCC is "take-home" knowledge to be shared with your colleagues and used to improve your business.

Networking— Meeting and mingling with your peers can create future business opportunities.

State-of-the-Art— By attending the NSCC, you'll be "up-to-speed" on the new services and products in the steel construction industry.

Fun, Of Course— The family fun in Orlando makes it a top choice of travelers. Along with AISC spouse and optional events and tours, see the famous Walt Disney World, The Magic Kingdom, EPCOT Center, Sea World, and the natural glories of Cypress Gardens.

NSCC COSPONSORS: American Institute for Hollow Structural Sections; American Iron and Steel Institute; American Welding Society; Canadian Institute of Steel Construction; Mexican Institute of Steel Construction; Steel Deck Institute; Steel Joist Institute; Steel Service Center Institute; Steel Structures Painting Council.

SEMINARS AND TECHNICAL PROGRAMS

The Conference continues to be the premier meeting place for engineering professionals and *the best place to obtain the most* information about steel buildings and bridges. Workshop sessions get down to the nuts-and-bolts details of designing, fabricating, and erecting structural steel. Every aspect of the construction process from concept to completion receives attention: computerized design, codes and specifications, research, shop and project management, inspection and safety, and fabrication and erection procedures.

POSTER SESSION

A Poster Session will present technical papers of interest to all NSCC attendees. Anyone interested in having their paper displayed should contact Patrick Newman at 312/670-5417.

THE EXHIBITION

The NSCC offers an ideal marketplace for those who provide products and services to the structural steel industry. In addi*tion to display booths, exhibitors* also will be given an opportunity to conduct a Product/Service Workshop where exhibitors can share, at no charge, the latest technological advances in specialized fields, conduct demonstrations, and introduce new equipments and programs. The workshops will be conducted during time periods that do not conflict with regular Conference sessions.

Who Exhibits? —manufacturers of: fabricating machinery; welding equipment; bolts; fasteners; paints and coatings; erection equipment; other associations; computer software and hardware producers; etc. Information on exhibit space is now available from AISC headquarters; call the AISC Membership Services Department at 312/670-5420.

PRE-CONFERENCE EVENTS

This year's Schedule of Events includes a Design Responsibility Panel Discussion, Educator Meeting on those issues of interest to the teaching of structural steel design, and an AISC Professional Member Forum for structural engineers interested in current and future AISC programs. Pre-conference events are open to all NSCC-attendees. Other organizations or associations wishing to schedule a preconference activity should contact Lewis Brunner at 312/670-5420.

MSC TO PUBLISH SPECIAL SHOW ISSUE

Modern Steel Construction, the monthly AISC magazine, will publish a special show issue in March 1993. This four-color publication has a circulation of 35,000 structural engineers, fabricators, architects and other construction professionals. The issue will include both product information from show exhibitors and reprints of technical papers submitted to AISC.

Advertising information can be obtained from Marci Lynn Costantino or Greg Poland at the Pattis Group, 7161 N. Cicero Ave., Lincolnwood, IL 60646-1622, 708/679-1100.

SPOUSES' PROGRAM & OPTIONAL EVENTS

A special program for spouses and children of registrants is offered. See the schedule of planned evening and pre-and post-conference activities in this publication.

CLIMATE/CLOTHING

Orlando's average March temperature ranges from 55 to 80 degrees. A light jacket or sweater may be needed for evenings. The dress code is cool, comfortable, and casual during the day, and sportswear for the evening. However, some restaurants require men to wear jackets & ties.

LOCAL TRAVEL

It is suggested that you use a metered cab with taxi rates averaging $2.25 for the first mile and $1.30 for each additional mile. A shuttle service offers transportation from Orlando International Airport to International Drive and downtown Orlando. Adult fares range from $10 to $25 with chil*dren's fares at $5 to $15.*

CAR RENTAL

Budget Rent-a-Car will offer discounts on auto rates: $19-39/day, $68-199/week, unlimited mileage. For reservations, call **1-800-772-3773**. Mention that you are an attendee of the National Steel Construction Conference.

NSCC OFFICAL AIRLINES

Delta Air Lines is the official NSCC airline. Their nationwide toll-free reservations number is staffed with meeting specialists to assist you with your travel arrangements. Call Delta at **1-800-241-6760** between 8:00 a.m. - 11:00 p.m. EST. Refer to File Number L0815.

PRELIMINARY SCHEDULE OF EVENTS

MONDAY, MARCH 15

11:00-5:00 p.m. Exhibitor Move-In - continues until 1:00 p.m.

TUESDAY, MARCH 16

Noon-5:00 p.m. Wednesday

4:00-8:30 p.m. **AISC Committee on Research Meeting/Luncheon**

Partners in Education/Committee on

WEDNESDAY, MARCH 17

8:30-Noon **Education Meeting**

Design Responsibility Panel Discussion

A special panel made up of individuals with different industry viewpoints will discuss structural steel design responsibility. All NSCC attendees encouraged to attend.

8:30-10:00 a.m. **AISC Professional Member Forum**

Special session for structural engineers who are AISC Professional Members. AISC programs, plans, and publications will be reviewed.

8:30-1:00 p.m. **ASCE Committee on Steel Building Structures**

8:30-Noon a.m. **Steel Educator Program**

Session on subjects of interest to those teaching structural steel design courses at colleges and universities. Open to all Conference attendees.

9:00-1:00 p.m. **AISC Safety Task Force Committee Meeting/Luncheon**

12:00-3:00 p.m. **Magic of Ming**

1:00-1:15 p.m. **Welcome Remarks: Stephen E. Egger,** AISC Chairman, Egger Steel Company, Sioux Falls, SD

Introductions: Hollis L. (Pat) Hance, Jr., NSCC Co-Chairman
Southern Engineering Co., Charlotte, NC

Robert H. Woolf, NSCC Co-Chairman, Cives Steel Company, Roswell, GA

1:15-3:00 p.m. **General Session: Mill Practices into the 21st Century**

Presiding: Robert H. Woolf

Moderator: Robert Abramson, Interstate Iron Works Corp., Whitehouse, NJ

Panel: Companies represented on the panel include Bethlehem Steel, British Steel, Chaparral Steel, Northwestern Steel & Wire, Nucor-Yamato Steel, and TradeARBED

A panel of experts present the major structural shape producers' views of steel production techniques into the 21st century. There will be particular emphasis on new product development and the impact on the fabricators market for the future.

3:00-5:30 p.m. **Exhibits Open**

5:45-6:30 p.m. **Exhibitor Workshops (A-G)**

These special sessions offer a forum where companies share the latest technological advances in their fields, conduct demonstrations or question-and-answer dialogues, and introduce new or updated equipment and programs.

6:30-8:00 p.m. **AISC Welcome Reception**

All conference attendees and spouses are invited to this party in Exhibit Hall.

THURSDAY, MARCH 18

7:00-8:00 a.m. **All-Speaker Breakfast**

7:00-8:00 a.m. **Southern Association of Steel Fabricators Educator Breakfast**

7:00-8:00 a.m. **Virginia/Carolinas Structural Steel Fabricators Educator Breakfast**

7:30-8:15 a.m. **Exhibitor Workshops (H-N)**

8:30-9:15 a.m. **General Session: "Unique Exposed Steel Frame Creates Architectural Expression for Barcelona Tower"**

Presiding: Hollis L. (Pat) Hance, Jr., NSCC Co-Chairman

Speaker: Robert C. Sinn, Skidmore, Owings & Merrill, Chicago

The Hotel Vila Olimpica Project is a multi-use complex consisting of a luxury hotel/apartment facility, a commercial office building, retail parking, and other amenities. The hotel and apartment portion of the project includes a 43-story tower overlooking the Mediterranean Sea. The primary and most visually prominent structural elements of the hotel tower are the architecturally exposed X-braced structural steel frames located on the building periphery with the curtain wall set back. The exposed, unfireproofed exterior structure was designed using the latest state-of-the-art fire engineering methods developed in Europe and the U.S.

9:00 a.m.-2:00 p.m. **Universal Studios of the Stars**

9:15 - 10:00 a.m. **General Session: Design and Construction of the Cooper River Bridge**
Presiding: Hollis L. (Pat) Hance, Jr., NSCC Co-Chairman
Speaker: Raymond J. McCabe, Howard Needles Tammen & Bergendoff
June 20, 1992, marked the opening of the Cooper River Bridge, the longest bridge in South Carolina. Serving as a vital link in the I-526 Mark Clark Expressway, the construction challenges were met with innovative design elements. The main river span of this 5.1-mile bridge is a modern state-of-the-art parallel chord steel truss with spans of 400 feet, 800 feet and 400 feet.

9:30-3:30 p.m. **Park Avenue Shopping/Boat Ride**

10:00-3:00 p.m. **Exhibits Open**
Lunch will be served from Noon-1:30 p.m. in the Exhibit Hall.

10:45-12:15 p.m. **Technical Sessions**
(See Technical Session section for description)
2. Managing Subcontract Detailing
3. Manual of Steel Construction: Volume II-Connections
4. Building and Motivating a Productive Workforce
5. Fire Restoration and Protection
6. Fabrication of Architecturally Exposed Structural Tubing
9. Steel Bridge Rehabilitation

12:30-2:00 p.m. **Poster Session (Exhibit Hall)**
An exhibition of technical papers will be displayed throughout the conference. Authors of papers will be available during this time period for discussion of the papers' contents.

1:30-3:00 p.m. **Technical Sessions**
1. Industrial Buildings
4R. Building and Motivating a Productive Workforce
10. Welding Symbols and What They Really Mean
11. Construction Automation in Steel Framing
12. Project Management: Organizing the Job
13. Composite Structures

3:10-4:40 p.m. **Technical Sessions**
7. Current Issues in Steel Building Design
14. The Fabrication Shop and the Environment
15. Seismic Design in Steel
16. Quality Standards vs. Fitness for Purpose

5:15-6:00 p.m. **Exhibitor Workshops**

7:00-11:30 p.m. **Conference Dinner at Church Street Station**

FRIDAY, MARCH 19

7:30-8:15 a.m. **Exhibitor Workshops**

8:30-9:15 a.m. **General Session:**
Moderator: Robert F. Lorenz, AISC Director of Education
Presiding: Robert H. Woolf
T.R. Higgins Lecture — winner to be announced

9:00-3:00 p.m. **Cypress Gardens Luncheon & Tour**

9:00 a.m. **Exhibits Open**
Lunch will be served from 11:30-1:00 p.m. in the Exhibit Hall

9:30-2:30 p.m. **Walt Disney World Village**

10:00-11:30 a.m. **Technical Sessions**
6R. Fabrication of Architecturally Exposed Structural Tubing
7R. Current Issues in Steel Building Design
8. OSHA's Review of Steel Construction Accidents
9R. Steel Bridge Rehabilitation
11R. Construction Automation in Steel Framing
14R. The Fabrication Shop and the Environment

1:00 p.m. **Exhibits Close**

1:00-2:30 p.m. **Technical Sessions**
1R. Industrial Buildings
3R. Manual of Steel Construction: Volume II-Connections
8R. OSHA's Review of Steel Construction Accidents
12R. Project Management: Organizing the Job
15R. Seismic Design in Steel
16R. Quality Standards vs. Fitness for Purpose

2:40-4:10 p.m. **Technical Sessions**
2R. Managing Subcontract Detailing
5R. Fire Restoration and Protection
10R. Welding Symbols and What They Really Mean
13R. Composite Structures

5:00-9:00 p.m. **Sea World Party**

SATURDAY, MARCH 20

9:00-4:00 p.m. **Kennedy Center Tour**

SPECIAL SESSION

Design Responsibility Panel Discussion

Where does one person's job stop and another's start? A special panel made up of individuals with different industry viewpoints will discuss structural steel design responsibility, and highlight topics such as: insurance, design-build, fabricator input, design assumptions, shop drawing review and submittal, and contract documents. Each panelist will make a brief presentation followed by an open dialogue among panel members, and questions from the audience. All NSCC attendees are encouraged to attend. Wednesday morning: 8:30 a.m. - Noon.

1

Industrial Buildings

Moderator: Robert Lorenz, AISC
Speakers:
James M. Fisher, Computerized Structural Design;
K.V. Bendapudi, Lockwood Grene Engineers
Fisher will speak on the new Design Guide, "Industrial Buildings: Roofs to Column Anchorage." Design and analysis of mill building columns subjected to heavy crane loads require practical experience and utilization of theoretical concepts as innovative design tools. Vast amounts of relevant data available to the practicing engineer is fragmented and static. Bendapudi will integrate and analyze the concepts of structural design of mill building columns. **Thursday 1:30 p.m. and Friday 1:00 p.m.**

2

Managing Subcontract Detailing

Moderator: William G. Ashton, Egger Steel Company
Speakers:
Gunther Baresel, Baresel Corporation;
Jack Duggan, Ted F. Duggan & Sons;
Ed Beittel, Egger Steel Company
This session offers valuable tips on how to achieve a smooth-running relationship between detailer, fabricator, and engineer. The future of fast track projects demands tight coordination. This workshop is for engineers, detailers, and fabricators that must work together to understand each other's needs to furnish a quality product. **Thursday 10:45 a.m. and Friday 2:40 p.m.**

3

Manual of Steel Construction: Volume II-Connections

Moderator: William Thornton, Cives Steel Co.
Speakers:
Lew Burgett, Charles Carter, AISC
In 1992 AISC published a new book, Volume II - Connections-Manual of Steel Construction: ASD/LRFD, that covers bolted and welded shear, moment and bracing connections in applications not specifically treated by the general information in the Manual of Steel Construction, ASD or LRFD. This session will review this Manual and go over the new material that can be used in the office by engineers and in the shop by fabricators. The session and book provide examples in both ASD and LRFD. **Thursday 10:45 a.m. and Friday 1:00 p.m.**

4

Building and Motivating a Productive Work Force

Moderator: R. Philip Stupp, Stupp Bros. Bridge & Iron Co.
Speakers:
John D. Correnti, Nucor-Yamato;
Richard S. Sabo, Lincoln Electric Co.
America is being challenged by a less skilled pool of labor from which to build its future workforce. This session will explore techniques to develop people skills as we approach the 21st century and keep them motivated. **Thursday 10:45 a.m. and 1:30 p.m.**

5

Fire Restoration and Protection

Moderator: Nestor Iwankiw, AISC
Speakers:
R.H.R. Tide, Wiss, Janney, Elstner Associates;
I.R. Thomas, B.H.P. Research Melbourne Lab.
Historically and understandably, the human populace has reacted with alarm in the presence of uncontrolled fire. The specter of buildings collapsing and the implied damage, and loss of life has created a negative image. Much of this negative attitude has been ingrained in the mind of the investigator, regardless of appearance, when evaluating the structural integrity of essentially straight steel members. This session will review and discuss tests and procedures and the associated steel properties to be used in evaluating a structure after a fire. **Thursday 10:45 a.m. and Friday 2:40 p.m.**

6 Fabrication of Architecturally Exposed Structural Tubing

Moderator: David Motyll, Welded Tube Co. of America
Speakers:
Brad Frank, Tulsa Tube Bending;
Larry Kloiber, L.L. LeJuene
This session will deal with the fabrication and bending of structural tubing utilized as architecturally exposed structural members. The problems and solutions faced by the fabricator in meeting the closer tolerances required by architecturally exposed structural members will be discussed. **Thursday 10:45 a.m. and Friday 10:00 a.m.**

7 Current Issues in Steel Building Design

Moderator: Abraham Rokach, AISC
Speakers:
L.F. Geschwindner, Penn State Univ.;
F.A. Charney, J.R. Harris & Co.
Geschwindner will present the leaning column for both ASD and LRFD. He will explain the basic concepts of behavior for the leaning column and will address the main design issues for these members. Designs in both ASD and LRFD will be presented and the importance of considering the leaning column, when it exists, will be emphasized. Charney will present one of the most powerful methods of structural deformation identification. This method, which is based on the principle of virtual work, has been used successfully by design firms nationwide to significantly increase the efficiency and economy of steel building structures. This presentation will include an example design for a 14-story perimeter steel frame building located in California. **Thursday 3:10 p.m. and Friday 10:00 a.m.**

8 OSHA's Review of Steel Construction Accidents

Moderator: Jerry Milligan, Falcon Steel Co.
Speakers:
Mohammad Ayub, OSHA;
Eric S. Waterman, National Erectors Association;
William Treharne, Broad, Vogt & Conant
OSHA Tells All! Report by senior staff member from Washington office will discuss erection accidents as investigated by OSHA, with their conclusions and recommendations for safer job sites. **Friday 10:00 a.m. and 1:00 p.m.**

9 Steel Bridge Rehabilitation

Moderator: Roy Mion, AISC Marketing
Speakers:
Phillip C. Pierce, E.M.J./McFarland-Johnson Engineers;
Peter M. Melewski, New York State Thruway Authority
Pierce will discuss the rehabilitation of several New York bridges requiring new concrete decks and other repairs and upgrades. To minimize roadway joints, an investigation was conducted to examine the consequences of joining the stringers at the piers, similar to the concept of precast concrete beams made continuous. By taking advantage of bearing details, no stringer web connection was required. Melewski will discuss the use of Prestressed Composite Steel Bridge Units (PCSBU), also known as Inverset units. They are composed of two steel beams and a composite concrete deck that is cased upside down and results in a deck of improved durability. **Thursday 10:45 a.m. and Friday 10:00 a.m.**

10 Welding Symbols and What they Really Mean

Moderator: W.H. Reeves,
Carolina Steel Co.
Speakers:
Hans Vanderveldt, American Welding Institute;
Ed Beck, L.E.I.S. Company
A presentation of both the proper interpretation of welding symbols and how they should be specified to achieve the economical required results. Special emphasis on symbols for tube and pipe welding will be discussed. **Thursday 1:30 p.m. and Friday 2:40 p.m.**

11 Construction Automation in Steel Framing

Moderator: B. Vincent Viscomi,
Lafayette College
Speakers: Robert B. Fleischman,
ATLSS Engineering Research Center;
N. Duke Perreira, ATLSS Engineering Research Center;
Toshiaki Fujimore, Shimizu Corp.
One of the primary missions of the Engineering Research Center for Advanced Technology for Large Structural Systems (ATLSS) at Lehigh University is to help increase competitiveness of the U.S. construction industry. To meet this challenge, ATLSS has several ongoing research projects in automated construction and connection systems. This session will review and discuss the work being done on the future advances in automation in the steel industry. **Thursday 1:30 and Friday 10:00 a.m.**

TECHNICAL SESSIONS

12 Project Management: Organizing the Job

Moderator: John Bailey, Havens Steel Co.
Speakers:
Marvin R. Williams, Acme Structural;
H. Louis Gurthet, Zalk Josephs Fabricators;
Raymond Phillips, *Cives Steel Co.*
Fabricator project managers will speak about their company's approach to organizing a job. Session topics include: costumer relations, contract negotiation, keeping the project on schedule, handling changes, backcharges, and collections. **Thursday 1:30 p.m. and Friday 1:00 p.m**

13 Composite Structures

Moderator: Heinz Pak, AISC Marketing
Speakers:
Edwin L. Mead, Mulach Parking Structures Corp.;
Roberto Leon, Univ. of Minnesota
Mead: Traditionally, parking structures have been constructed using structural steel framing and a composite cast-in-place deck, or with a precast concrete structural frame and precast double-tee deck beams. This session will cover a new system, developed by Mulach Parking Structures Corp., which combines structural steel columns, steel girders with a precast concrete flange and precast concrete double-tees. Leon will discuss practical applications of semi-rigid connections with composite steel beams. Partially restrained connections can significantly reduce deflections, increase the frequency of vibration, and provide needed lateral stiffness. **Thursday 1:30 p.m. and Friday 2:40 p.m.**

14 The Fabrication Shop and the Environment

Moderator: Tom Schlafly, AISC
Speaker: Kenneth Lee, Jones, Waldo, Holbrook & McDonough
AISC's Environmental Counsel will outline current regulations affecting the fabrication industry. Specific problems encountered in hazardous waste disposal, air quality, V.O.C. compliance and reporting will be addressed. Regulations being considered by Congress and EPA will be covered. **Friday 10:00 a.m. and Friday 3:10 p.m.**

15 Seismic Design in Steel

Moderator: Jim Marsh, AISC Marketing
Speakers:
Jim Marsh, AISC;
S. Lindsey, Stanley D. Lindsey & Associates
History of earthquakes has demonstrated that steel framed buildings have an excellent performance record when it comes to life safety and limiting economic loss. Its superior performance is due not only to its ductility, but to its inherent ability to absorb and dissipate earthquake energy. Performance and design codes are interdependent and building codes seismic design provisions have burgeoned over the last decade. Recent building code seismic provisions of interest to the design engineer will be discussed. **Thursday 3:10 p.m. and Friday 1:00 p.m.**

16 Quality Standards vs. Fitness for Purpose

Moderator: Philip Levine, Roll Form Products
Speakers:
A.M. *Gresnigt,* *TU-Delft University;*
Jack Skiles, American Welding Society
An evaluation of the international concept of fabricating with two standards: a fitness for purpose standard in addition to a quality criteria standard. The fitness for purpose standard is intended to avoid unnecessary and potentially harmful repairs to fabrication which under a quality criteria standard would be made. **Thursday 3:10 p.m. and Friday 1:00 p.m.**

OPTIONAL EVENTS

All tours will use a modern, fully equipped passenger bus and include licensed tour guides. If your tour requires an admission fee, this is included in the price of the tour. Note: A tour may be canceled if AISC does not receive a sufficient number of registrations by March 2. In this case, you will be notified and a full refund will be issued after the Conference.

1

Thursday, March 18:
7:00 p.m. - 11:30 p.m.

Conference Dinner at Church Street Station

Let the good times roll at this exciting restaurant, night club, and shopping complex in historic downtown Orlando. Enjoy a Conference Reception in the Orchid Garden Ballroom, a delicious plated dinner will be served in the Private South Parlour Room of Lili Marlene's.

After dinner you'll be free to hear exciting Dixieland Jazz at Rosie O'Grady's Goodtime *Emporium; sample exotic drinks at Apple* Annie's; or return to the romance and glamour of the 30's in the Orchid Garden Ballroom and Dessert Cafe; dance to the hottest sounds at Phineas Phogg's Disco; or two-step at the Cheyenne Saloon and shop in style at the Bumby Arcade or Buffalo Trading Company. Sightsee and shop at Church Street Exchange with 130 shops and food marts and the Downtown Marketplace.

Attendees will meet back at the bus at either 9:30, 10:30, or 11:30 p.m. for transportation back to the Clarion. Price includes: round trip transportation; admission to Church Street Station; dinner; and free use of Church Street Station after private party.

Price: $51

2

Friday, March 19:
5:00 p.m. - 9:00 p.m.

Sea World Show & Party

AISC sponsors this private dinner party at Sea World where attendees will behold the sea's mystery and wonder at Sea World of Florida, the world's most popular marine life park. New shows include the spectacular "Shamu: New Visions" killer whale presentation and the "Clyde and Seamore 10,000 B.C." sea lion and otter show. Come face to face with dozens of treacherous sharks, eels and barracuda. Relax and have fun at the beach party and end your night with the "Penguin Encounter." The evening includes a cocktail reception with musical entertainment and a barbecue chicken cookout.

Price includes: round trip transportation; dinner and two drink tickets; admission to Sea World; and reserved seats for two Sea World shows.

Price: $62.50

3

Saturday, March 20:
9:00 a.m. - 4:00 p.m.

Kennedy Space Center

The dream and commitment of space exploration is alive at the Space Center. You'll view the shuttle assembly building, actual launch pads, astronaut training facilities and rocket museums and capture the spirit with ample time for camera stops along the way. A breathtaking space film will be shown on a five-story IMAX screen. Plenty of time for individual exploration among the exhibits and museums. Lunch on your own.

Price: $31 adult, $25 child (3-11)

4

Special Walt Disney World Convention Tickets

AISC has arranged for discounted tickets for NSCC attendees to the Walt Disney World theme parks. These tickets are good for admission to either the Magic Kingdom, EPCOT or the Disney-MGM Studios. They also include admission to Pleasure Island, Disney Water Park and River Country, and can be used anytime from March 5-28, 1993.

These tickets are only available through AISC and any unused portions are non-refundable. Transportation is not provided.

Upon receiving a completed registration form, you will be mailed an order form for Disney tickets with your registration confirmation.

SPOUSES' PROGRAM

Those registering for the COMPLETE Spouses' Program will receive a ticket to ONE tour per day. Anyone wishing to register for any additional tours may do so by selecting the events on the Conference Registration form. There will be no charge for fully registered spouses attending the AISC Welcome Reception Wednesday evening or visiting the Exhibit Hall. All tours will use a modern, fully equipped passenger bus that includes licensed tour guides.

A

Wednesday, March 17:
12:00 - 3:00 p.m.

Magic of Ming

The exclusive Ming Court Chinese cooking class provides a hands-on learning experience about the secrets of gourmet Chinese cuisine. Enter Ming Court through a Pagoda and follow a covered walkway accentuated by floral ponds to the lobby area where you are welcomed with Plum Blossom *Champagne. Prepare appetizers with a Dim* Sum Chef, enter the Wonton or Spring Roll competition, learn the secrets to stir-fry cuisine and prepare your own appetizers, entree, and dessert.

Price: $18

B

Thursday, March 18:
9:00 a.m. - 2:00 p.m.

Universal Studios of the Stars With Lunch

Find out the scoop on your favorite Hollywood stars on this guided tour down the streets of New York, Hollywood, and San Francisco. Roam glamorous streets like Hollywood Blvd., Fifth Avenue and Rodeo Drive. Watch real filmaking, action-packed stunts, and see big name stars in production on next year's hits. You'll receive a lunch coupon which can be used at Studio of the Stars, Cafe La Bamba or Finnegan's Pub restaurants. After lunch, you'll enjoy three hours of sightseeing and leisure shopping in the more than 40 shops of Universal Studios Florida.

Price: $58

C

Thursday, March 18:
9:30 a.m. - 3:30 p.m.

Park Avenue Shopping/Boat Ride with Gourmet Lunch

Located in beautiful Winter Park, Park Avenue is a haven for boutique shoppers and gourmet palates. Take a scenic boat ride and view the beautiful estates along the Chain of Lakes followed by a private luncheon at one of Park Avenue's gourmet *restaurants.*

Price: $38

D

Friday, March 19:
9:00 a.m. - 3:00 p.m.

Cypress Gardens Luncheon

Cypress Gardens is the home of the world's most photographed water ski show combining daredevil excitement with artistry and laughter. Ski-jumping champions and hang gliders will provide the thrills, water clowns provide the laughter, and ballet aquamaids perform with beauty and grace. Following these performances, there will be time to meander through lush gardens, bearing more than 12 million blooming flowers, and experience the vibrant panorama of exotic birds and animals including the proverbial Florida "gator".

Price: $32

SPOUSES' PROGRAM

E

Friday, March 19:
9:30 a.m. - 2:30 p.m.

Walt Disney World Village

Walt Disney World Village invites you into a world of enchantment. Wooden and weathered brick shops present treasures from around the world. Stroll through more than two dozen waterfront shops and catch the aroma of freshly baked pastries or delicate perfumed bath soaps. One of a kind gifts, the latest in Mickey fashions, and a year-round Christmas shop are a few of the captivating treasures you'll encounter. You may enjoy lunch on your own or board the Express Lily, an authentic 19th century stern wheeler. Or if you prefer, lunch at one of the many other restaurants located at the Village or next door at Pleasure Island.

Price: $15

F

Wednesday, March 17:
6:30 p.m. - 8:00 p.m.

AISC Welcome Reception

Hors d'oeuvres and cocktails in the Exhibit Hall.

Price: $20 (included in spouse & full registration fee)

G

Wednesday - Friday:
Open Exhibit Hours
Exhibit Floor pass

Price: $5 a day (included in spouse & full registration fee)

NSCC COSPONSORS:

American Institute for Hollow Structural Sections

American Iron and Steel Institute

American Welding Society

Canadian Institute of Steel Construction

Mexican Institute of Steel Construction

Steel Deck Institute

Steel Joist Institute

Steel Service Center Institute

Steel Structures Painting Council.

NATIONAL STEEL CONSTRUCTION CONFERENCE

THE ONLY "ALL-STEEL" CONFERENCE AND TRADE SHOW IN THE U.S.

MARCH 17-19, 1993

ORANGE COUNTY CONVENTION/CIVIC CENTER
ORLANDO, FLORIDA

1993 NATIONAL STEEL CONSTRUCTION CONFERENCE
ORLANDO CONVENTION/CIVIC CENTER
ORLANDO, FL • MARCH 17-19

REGISTRATION FORM

REGISTRATION FEE:
(please circle appropriate fees)

AISC Member Fee: **$290.00**
(Includes AISC Active, Associate & Professional Members)
Non-Member Fee: **$340.00**
Educator Fee: **$100.00**
(Employed full-time at accredited architectural or engineering college or university.)
Student Fee: **$ 75.00**
(Letter from faculty advisor or equivalent required.)
Exhibitor, in booth: **No charge**
Added Exhibitor: **$100.00**
Spouses' Fee: **$100.00***
*Includes: Wed. evening reception; exhibit floor pass; 1 spouse tour each day—Wed., Thurs., Fri.

PARTIAL REGISTRATION FEES
(You also may pre-register for one day or half-day.)
Circle your choice below:
Design Responsibility Panel $50.00
Half Day Sessions: (Lunch **not** included)
Wednesday afternoon: $ 55.00
Thursday morning: $ 70.00
Thursday afternoon: $ 70.00
Friday morning: $ 70.00

One Day Sessions:
Thursday (includes lunch) $160.00
Friday (includes lunch) $160.00
Exhibitor Floor Pass: $ 5.00
(included in full, partial, and spouse registrations)

TOTAL OF PARTIAL REGISTRATION FEES: _____

REGISTRATION FEES INCLUDE: General Sessions; workshops; seminars; exhibition; coffee breaks; luncheons Thursday and Friday; Cocktail Reception Wednesday evening; and a printed, bound copy of the NSCC Proceedings. Exhibitors are entitled to one registration for each 10 ft. x 10 ft. exhibit space reserved. "Added Exhibitor" fee is payable ONLY if in excess of one person per 10 ft. x 10 ft. exhibit space.

REGISTRATION CANCELLATION POLICY: For cancellations received on or before March 2, 1993, 100% of pre-paid registration fees will be refunded; after March 2, 50% will be refunded. Those canceling after March 2 will receive a copy of the Conference Proceedings. Refunds will be sent after the NSCC.

REGISTRATION FOR OPTIONAL AND SPOUSE EVENTS

Event No.	Tickets	Total Price
OPTIONAL EVENTS		
#1—Conference Dinner at Church St. Station (Thurs., 7:00 p.m.)	_____ @ $51.00	$_____
#2—Sea World Party (Fri., 5:00 p.m.)	_____ @ $62.50	$_____
#3—Kennedy Space Center (Sat., 9:00 a.m.)	_____ @$31.00 Adult _____ @$25.00 Child	$_____
SPOUSE EVENTS *(Note: $100 Spouse Package: Choose one tour each day)*		
#A—Magic of Ming (Wed., 12:00 a.m.)	_____ @ $18.00	$_____
#B—Universal Studio Tour (Thurs., 9:00 a.m.)	_____ @ $58.00	$_____
#C—Winter Park/Boat Ride (Thurs., 9:30 a.m.)	_____ @ $38.00	$_____
#D—Cypress Gardens (Fri., 9:00 a.m.)	_____ @ $32.00	$_____
#E—Walt Disney World Village (Fri., 9:30 a.m.)	_____ @ $15.00	$_____
#F—AISC Cocktail Reception (Wed., 6:30 p.m.—included with spouse or regular registration)	_____ @ $20.00	$_____
#G—Exhibit Floor Pass (Wed., Thurs., Fri.—included with spouse or regular registration)	_____ @ $ 5.00	$_____

TOTAL OPTIONAL/SPOUSE EVENT FEE **$**_____

PLEASE REGISTER (Type or Print)

Name _____ Nickname (for badge) _____

Company _____ Title _____

If AISC Member: _____ (___) Active _____ (___) Associate _____ (___) Professional _____ Member #

Mailing Address _____ City/State/Zip _____

(____) Bus. Phone _____ (____) Fax Phone _____ (____) Home Phone _____

If spouse or other guest is registering for Complete Spouses' Program, or individual Spouse or Optional Events, please complete the next line for a name badge:

Name of individual registering for other events _____ Nickname (for badge) _____

CONFERENCE FEES PAYABLE:

Registration Fee: $_____
Spouses' Fee: $_____
Partial Registration Fee: $_____
Optional Events: $_____

TOTAL REGISTRATION FEES: **$**_____

MAIL COMPLETED FORM AND CONFERENCE FEES TO:
American Institute of Steel Construction, Inc.
1993 NSCC • P.O. Box 806286
Chicago, IL 60680-4124

Phone inquiries and information: 312/670-2400 X203 Fax 312/670-5403

_____ I enclose check (U.S. Funds) payable to AISC in amount of total fees

_____ Please charge my credit card - Visa or MasterCard ONLY

_____
Circle One: VISA MasterCard

_____
Signature (if credit card charges)

_____
Expiration Date (month and year)

_____
Name on card:

extensive network of mechanical and electrical embedments, wall reconstruction was ruled as being too time-consuming and too expensive. Instead, a design was developed that allowed the walls to be braced with pilasters.

Alternative Considerations

Timber members, oriented vertically and mounted at interior wall surfaces, initially were considered due to ease of fabrication and installation. However, fire resistance requirements and difficulties in designing and installing pilaster/foundation connections were significant drawbacks. Additionally, surface mounted members would encroach on useable space and detract from the aesthetics of the building's interior.

An alternative to mounting the pilasters was to embed them within the confines of the existing walls. It was determined that the pilasters could be installed from the building exterior by sawcutting brick and the exterior face shells of the CMU. An advantage of this plan was that the existing building envelope would not be breached and there would be no evidence of the pilaster installation from the building interior. To mitigate visual effects on the building's exterior, the design called for the installation of thin-brick facing over the completed pilasters.

The owner agreed to this plan, and masonry demolition work was performed after normal school hours to avoid classroom disruption.

Both reinforced concrete and concrete-encased structural steel shapes were considered for the pilasters. However, due to the anticipated tight working space after sawcutting the masonry, it was concluded that fabrication and placement tolerances of conventional reinforcing bars could not be maintained and therefore reinforced concrete was not practical. Instead, W6 shapes encased in concrete were chosen.

After the pilasters were installed, the owner decided that the appearance of the building's exterior was acceptable and decided not to install the brick facing over the pilasters.

Project duration was approximately five months and construction cost was $5.67/sq. ft.

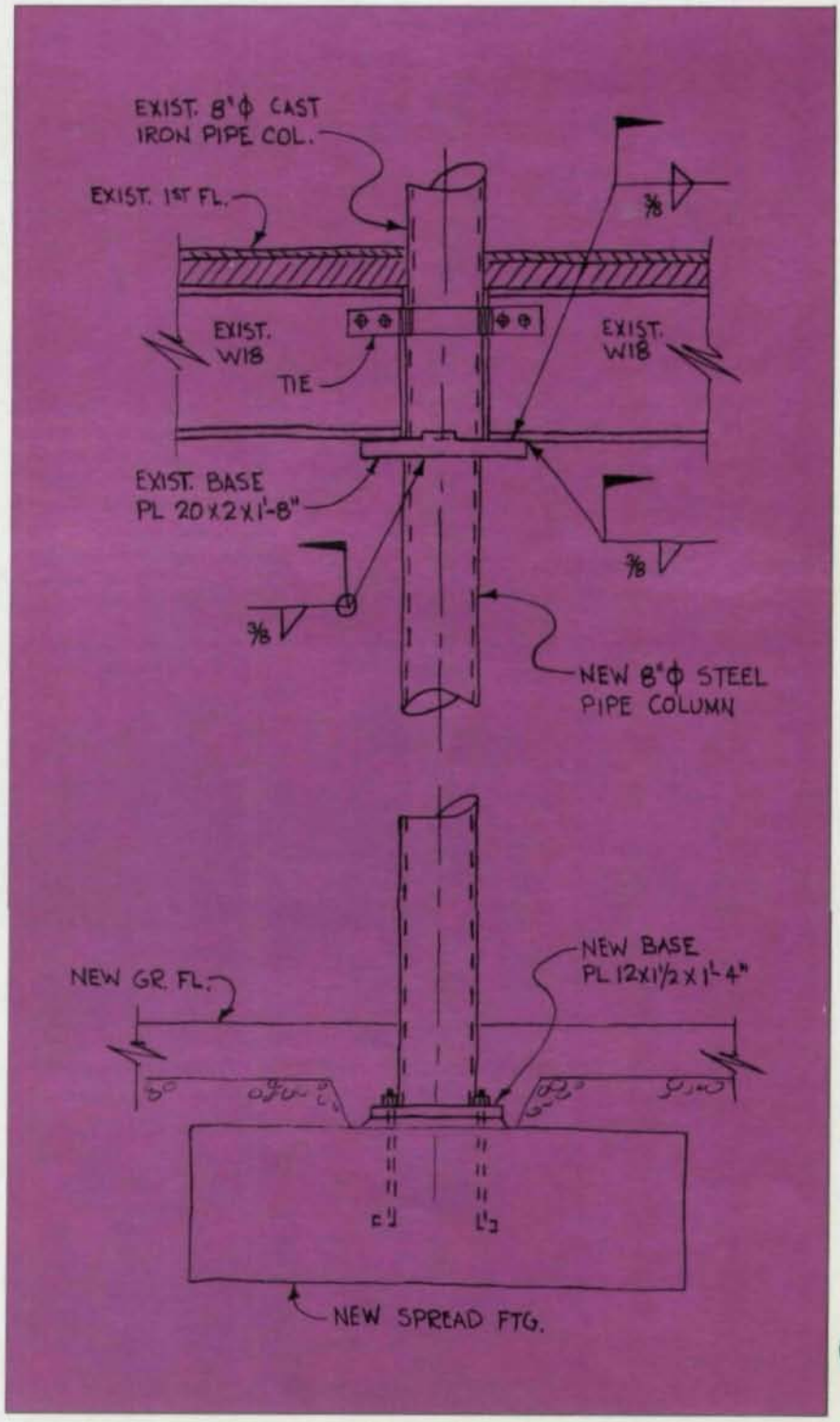
Figures 6, 7, & 8: Sawcutting of Masonry; Installation Of W6 Sections; and Finished Project

John F. Vincent, P.E., S.E., is a senior structural engineer, W. Gene Corley, P.E., S.E., is a vice president, and Hans C. Kosel, P.E., S.E., is a principal engineer and group manager with Construction Technology Laboratories, Inc., Skokie.

Building Downward

A below grade addition proved quicker and less expensive than adding another floor

By Frederick M. Law, Ph.D., P.E.



Usually, the word "addition" conjures forth images of vertical or horizontal construction. But in the case of the recent Brittany Dyeing and Printing Company Plant Addition, steel was used to build downward beneath the existing four-story manufacturing plant.

During the past 20 years, this prominent New Bedford, MA, firm has expanded its plant to a point where it completely fills the available site. However, with its business continuing to grow, the company clearly needed additional space. The normal alternative would be to add an additional floor; however, a preliminary structural analysis of the existing cast iron structure showed that while the piers could support the additional weight, the columns would require additional reinforcing.

As an alternative, a review was conducted of the soil around the concrete foundation piers and it was discovered that if the large foundation piers were removed and replaced by steel columns on spread footings, the ground could be excavated and a new floor (or story) could be added below the existing building.

Although conceptually simple, the details of load transfer during construction presented some problems—primarily in how to provide temporary support for the existing cast iron columns during the removal of the concrete piers and the installation of the new steel columns and spread footings.

The first floor girders could be, and were, easily supported by temporary timber posts of timber grillage footings. However, the columns supporting the four floors and the roof were not supported by the first floor girders. Rather, both the first floor girders and the columns rested on large, 2"-thick base plates on top of each of the piers.

The solution for temporarily supporting the cast iron columns was to use the 2"-thick base plates as short, simple span beams, spanning between the ends of the first floor girders. The bottom flanges of the first floor girders on each side of each column were welded to the large base plates to provide the required temporary support for the existing columns until the new steel columns and spread footings could be installed.

Shown at left is the crawl space below the existing first floor after excavation around the large concrete foundation piers. Shown below is the newly framed additon.

While it might appear that it would have been easier to weld the ends of the first floor girders to the sides of the cast iron columns, this was not the case. Several attempts by the contractor to make even a temporary weld between the steel girders and the cast iron columns did not produce satisfactory results.

Because of the obviously delicate nature of the replacement operation, the general contractor, D.W. White Construction, Acushnet, MA, replaced one pier at a time until the total of 52 piers were replaced. As you can imagine, the sight of a large steel base plate—with nothing beneath it—supporting a column with four stories above it, was quite unnerving!

The project was a success, however, and 18,000 sq. ft. of manufacturing space was added. While the same operation could have been conducted with reinforced concrete, steel proved to be quicker and more economical.

Frederick M. Law, Ph.D., P.E., is a principal in the structural engineering firm bearing his name in South Dartmouth, MA.

Over The Hill Bridges

A sophisticated analysis showed that a 52-year-old steel bridge could easily *and* inexpensively be adapted to meet today's needs

By Larry Sessions, P.E., Brian Blanchard, P.E., and John Locke, P.E.

Almost all states have old steel bridge structures that were designed for H or HS15 truck traffic. Many of these structures have been well maintained and are functioning quite well. Some of these structures are magnificent in stature and are quite beautiful, and as a result have become historically significant.

Unfortunately, most of these bridges do not conform to present geometric design standards.

A typical example of this type of bridge is the 52-year-old bridge over the Apalachicola River between Bristol and Blountstown, Florida. It has been well maintained and has functioned without any signs of distress. This structure is a combination deck and through truss with long approach spans over a major flood plain. The overall length of the structure is 8,400'. It has a vertical clearance of 14'-3" between roadway surface and overhead truss portals and a roadway width of 24'.

The relatively low overhead clearance has increasingly caused problems, however, and several times accidents due to overheight vehicles have closed the bridge for repairs. Further exacerbating the problem, the detour distance at this site is 60 miles.

At first glance, a $20 million replacement project seemed the logical—if expensive—solution. However, traffic growth patterns indicate that four lanes of traffic will be needed in just a few years, and this opened up the door to an alternative solution: Renovation.

Accident data for the site was reviewed and it was determined that 25% of all accidents were due to head-on collisions and another 25% were due to overheight vehicles striking the low clearance overhead truss portals. Thus, by eliminating two-way traffic and structurally modifying the structure to increase the overhead clearance to 16'-6", half of the accidents could be eliminated. With these improvements, the safety index of the bridge would be within the acceptable normal limits. As a result

of this analysis, the project concept changed from replacing the bridge to instead utilizing it as one-half of a new four-lane structure.

Sophisticated Analysis

Initially, the bridge was analyzed using working stress methods with two dimensional analysis. The initial results indicated the structure would not measure up to HS20 design standards. This conclusion did not jive with practical experience, however, since the structure had routinely carried full highway traffic including routine overloads up to 112,000 lbs. without any serviceability problems.

The design team opted to investigate further and conduct a sophisticated analyses that would model the bridge as a three dimensional global unit instead of a two dimensional unit. Also, it was decided to utilize load factor design with verification of connection capacity. The three-dimensional truss analysis was performed using GTStrudl and the deck girder analysis used BRUFEM (Bridge Rating Using Finite Element Methods), which was developed by the University of Florida.

The analysis included:

- *Space frame analysis for truss spans.* Space frame analysis was required to analyze the truss spans for wind loading and other secondary effects.
- *Finite element analysis for non-composite deck girder superstructure spans.* Deck edge stiffening by the traffic barrier and curb could be used; however, it was found to be unnecessary.
- *Traffic railing analysis performed by finite element methods.* This was needed to verify existing curb and deck capacity to sustain the 10,000 lb. design force.

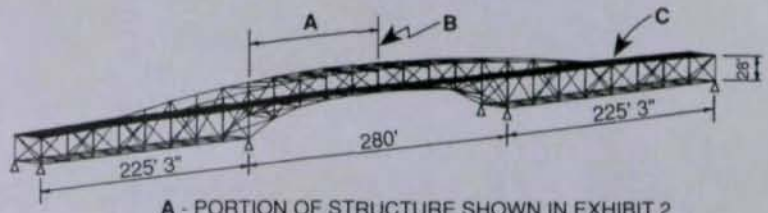
All of the connections checked by hand or spreadsheet methods, and the fatigue was checked using "AASHTO Guide Specifications for Fatigue Evaluation of Existing Steel Bridges." Load factor design was used, and plastic section modulus was used for bending members.

The results of the analysis were very positive.

Structures designed with working stress methods in which unfactored deadload stress is equal to or greater than 40% of the total stress have an advantage when analyzed using load factor. For this bridge, the main channel truss spans deadload stress in the primary members accounted for 77% of the total stress. Therefore, using load factor analysis methods improved the truss rating from HS15 to HS22. Connections were checked and were found not to control the design.

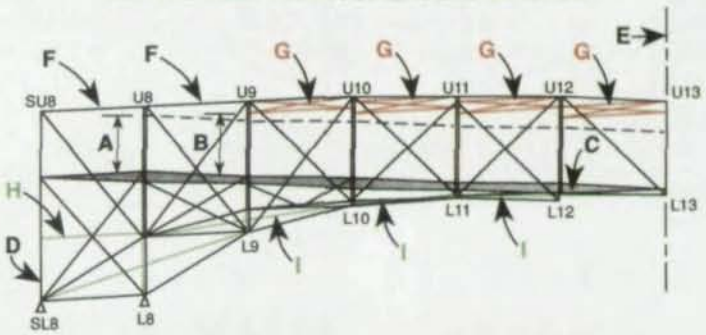
Global three dimensional finite element analysis using a ribbed plate model was used to analyze the non-composite deck girder su-

EXHIBIT 1
S.R. 20 OVER APALACHICOLA RIVER
SPACE FRAME MODEL



A - PORTION OF STRUCTURE SHOWN IN EXHIBIT 2
B - ℄ OF CHANNEL SPAN
C - ROADWAY SURFACE

EXHIBIT 2
IMPROVED VERTICAL CLEARANCE



A - PRESENT V.C. = 14' 3"
B - PROPOSED V.C. = 16' 6"
C - ROADWAY SURFACE
D - END POST
E - ℄ SPAN
F - PORTAL OR BRACE REMOVED
G - SWAY BRACING REPLACED
H - END POST BRACED
I - SECONDARY BRACING STRENGTHENED

Pictured above is an end view of the bridge channel span of the Apalachicola River Bridge. Under the proposed retrofit scheme, some of the sway bracing would be replaced in order to increase the overhead clearance.

perstructure. This analysis yielded an improved load distribution with an advantage of approximately 15% over the current AASHTO code. In addition, the utilization of the plastic section modulus for bending yielded an advantage of about 15% above the elastic section modulus. The lowest rated superstructure span was increased from HS15 to HS21.

Finite element analysis using solid and beam elements was used to analyze the traffic barrier retrofit. This retrofit is crash tested and is known as the Iowa Block. The barrier consists of doweled reinforcing steel and a cast-in-place block 2' by 10" wide cast on top of the existing 10" high curb. The analysis proved that the existing deck and curb could sustain the 10,000 lb. design load. Again, connections were checked and were found not to govern the structure capacity.

Fatigue analysis was performed on the superstructure deck girders

and the truss spans. Since the liveload stress was lower than the threshold value, approach and truss spans have infinite fatigue life.

Strengthened Secondary Bracing

Wind load analysis with the revised portal and sway bracing resulted in the need to beef-up some of the secondary bracing between the trusses. The portal and the next interior sway brace were removed. This resulted in the need to add an additional secondary brace to the end post (U8/L8) to reduce the buckling effect. The new sway bracing was less effective than the original design; therefore, wind resistance migrated to the bottom cord where secondary bracing located between panel points L9-L10, L10-L11, L11-12, L14-L15, L15-L16, and L16-L17 required strengthening.

Through utilization of three dimensional analysis, modeling the structure in its completed form, and utilization of modern analysis codes, it was found that this 52-year-old HS15 bridge does indeed meet and in fact exceed the current HS20 liveload requirements.

Compared to tearing down the old bridge and building a new four-lane structure, rehabbing the existing structure and building a new two-lane structure shows a cost benefit ratio of 8.3. These cost comparisons include a 75-year life expectancy for a new structure with a 40-year life for the rehabbed bridge.

The rehabilitation cost of $1.5 million—which is equal to the cost of demolition—includes: new traffic barriers, complete spot and top coating of all structural steel; and replacement of existing portals and sway bracing above the bridge deck.

Bids on the renovation project are expected to go out late in 1993.

Larry M. Session, P.E., is Engineer of Structures Design, Brian Blanchard, P.E., Structures Design Engineer, and John Locke, P.E., Structures and Facilities Engineer with the Florida Department of Transportation.

Small Bridge Projects Offer Big Savings

Renovating short span steel bridges can substantially reduce a project's budget

While nobody cuts the ribbon when a small bridge is rehabbed, the hundreds of thousands of dollars saved can quickly add up.

Finney & Turnipseed is a consulting engineering firm headquartered in Topeka, KS, specializing in bridge design and rehabilitation. The majority of the bridges in the state are three-span, continuous beam or girder bridges ranging from 130′ to 400′ in total length—and many are deficient by today's standards.

An example is a steel beam bridge constructed over the Nemaha River in Nemaha County west of Bern, KS, in 1952. The bridge was designed and constructed as a 24′-wide roadway bridge with spans of 64′-80′-80′-80′-64′ and a design load of H15-44. Initially, KDOT contracted with Finney & Turnipseed to design a new $515,000 replacement bridge.

"In reviewing the design, it was determined that the bridge could be made composite by welding headed stud anchors to the beams, increasing the roadway to 28′ and increasing the load carrying capacity so the bridge could carry the legal truck loads of Kansas without posting," explained Robert B. Thorn, owner of Finney & Turnipseed.

The total cost to remove the concrete deck and rails, weld the headstuds to the beams, replace the concrete deck and rails and also to remove the original red lead paint system and paint using a new inorganic paint system was $216,000. Of that total, paint removal and the new coating was $24,650. The bridge was reopened to traffic in the Fall of 1992.

A similar project occurred with the Shawnee County Bridge. This 28′ roadway with spans of 87′-107′-87′ was built in the late 1950s and

The bridge shown at left and below was constructed in the late 1950s in Shawnee County, KS. It featured H15 loading and a 28' roadway with spans of 83'-100'-83'. The size of the roadway was increased to 32' and the loading to HS20, all for $379,660.

designed for an H15 loading. The superstructure was non-composite and had four 36" steel beams with sliding plate expansion devices at each abutment.

"The bridge was rehabilitated to meet the requirements of HS20 loading, 28' roadway with a 6' sidewalk on one side," said Thorn. This project was complicated by the existence of a 12" city water line that had been added to the bridge after its construction. It was supported by the two interior beams down the center of the roadway and those two beams and the water line could not be disturbed during rehabilitation, except that permission was given to lift the two beams and the water line 3/8" during the removal and reconstruction of the pier cap. The pier columns and pier cap were removed to the bottom of the web wall—a distance of 12'—and a new wider pier cap was formed and concrete placed. The beams were lowered to the new pier cap, two new steel beams were added and studs were added to all of the beams.

The expansion devices were removed at each abutment and the deck, sidewalk and abutments were all cast in one continuous placement of concrete. The existing red lead paint was sandblasted from the bridge and a new inorganic zinc paint system was applied to the bridge.

The total cost for the bridge work including all removal items and painting was $343,450. The bridge was reopened to traffic in Fall 1991.

Both of these renovation projects were only possible because the original bridges were steel. "The State of Kansas has learned a bitter lesson on concrete box girders and concrete voided slabs as they are being removed when maintenance dictates a major rehabilitation as they are usually not feasible to rehabilitate," Thorn explained. While the initial costs of new steel and concrete bridges are often similar, the question of future adaptability often tips the decision to steel.

Another advantage of steel construction for bridges is the added embankment and surfacing quantities needed for concrete construction. "The economy of steel becomes obvious because of the increased depth of prestressed beam over the depth of steel beam," Thorn said.

Environmentally Sound

Environmental concerns also must be considered, especially in areas where the creek banks should not be disturbed by access roads. "By ordering a length of steel to go from abutment across the pier or by bolting the first field splice and erecting the two pieces so that they will span from abutment across the pier and then placing the center portion of steel, a crane or falsework bent is not needed near water level," according to Thorn. "Prestressed concrete erection may dictate two large cranes to handle the length and weight of longer spans and needs an access road to obtain a good base from which to work."

An additional economy and maintenance blessing is the welding of the steel abutment pile to the steel beam and placing concrete for a jointless bridge. "This detail has not shown any distress in the 35 years we have been doing this," Thorn said. "Another cost saving feature is designing a bolster at each pier with only a base plate and a simple curved plate for deflections. The piers will deflect with expansion and contraction on moderate-to-tall piers and there is economy in the simple device."

As an increasing percentage of the infrastructure budget is spent on rehabilitation, designers and owners are becoming aware of the need to consider future adaptability in choosing a design for a new bridge. "Nobody cuts the ribbon on rehabilitated structures, but they do show the versatility of steel," Thorn concluded.

Thermal Spraying For Steel Bridges

By Robert A. Sulit

The well-documented decay of our infrastructure is placing added emphasis on surface protection of new and existing bridges. As a result, thermal spraying of steel bridges, either as the singular surface protection system or as the prime coat for organic systems, will likely be on the increase.

In numerous applications, primarily in Europe, thermal sprayed zinc or aluminum coatings have been found to provide protection for more than 20 years to first maintenance. A British Standard (BS 5493: 1977, Amd. No. 4443, Jan. 84) recognizes this effectiveness, as do tests reported by the American Welding Society in their 19-year report (1974).

And anecdotal information abounds. In the United Kingdom, the suspension chains and other components of the Menai Straits Bridge were zinc-sprayed just before World War II. During the war, the bridge received no maintenance. But at the end of the war, the sprayed areas were in excellent condition. The steel deck structure, on the other hand, which had been painted rather than thermal sprayed, was rusting. In fact, 20 years after the original metal spraying, the protective coating of the sprayed areas was still intact, and only renewal of the paint top coats was necessary.

Britain's Forth Road Bridge, erected in 1961, was zinc-sprayed during fabrication and construction prior to erection and then painted. When the bridge was inspected after 12 years, some breakdown was found in the paint, but the zinc coating was found to be almost completely intact. This experience was in remarkable contrast to the neighboring Forth Railway Bridge, which was not metal sprayed and instead required a continuous program of maintenance painting.

The British also have used zinc spraying in the renovation of some older bridges, including parts of the Tower Bridge of London.

While Europeans routinely use thermal spraying, U.S. designers have been more resistant. This lack of use in the U.S. is due primarily to: high first costs; the lack of thermal-spraying knowledge and experience among bridge designers, builders and maintainers; lack of production-efficient thermal-spray equipment; lack of trained labor; and the bureaucracy inherent in establishing new codes and standards for thermal-spray coatings.

Specifying engineers in several states have indicated that the available engineering data supports the merits of thermal-spray systems, but the bureaucracy is too hard to change. Off the record, some report they have full-time paint crews going all the time on some bridges, crews that could be reduced by the longer life span of thermal-spray coatings.

Progress, however, is being made. For eight years, the Federal Highway Administration and some states have sponsored thermal-sprayed steel bridge demonstration projects to demonstrate production feasibility. Ohio, Virginia, California, and New Jersey, as well as British Columbia in Canada, have all used thermal-sprayed zinc to protect steel bridges.

Cost comparisons between thermal spraying and epoxy coatings will vary between manufacturers and geographic areas, but on a recent bridge project in central Ohio, the cost difference was $4 to $6 per sq. ft. According to Tom Fox, Bridge Section, Ohio DOT, an organic zinc primer plus epoxy intermediate plus polyurethane topcoat runs about $8 to $10 per sq. ft. By comparison, thermal spraying on a recent project cost $14 per sq. ft.

Part of the cost differential is due to the faster rate of application with painting. Joe Butler of ASB in Barberton, OH, reports a spray-rate difference of 100 sq. ft. per hour per sprayer vs. 300 sq. ft. per hour per sprayer for thermal spraying and painting respectively. The advent of new application technology may therefore reduce the marginal cost difference between painting and thermal spray coating.

The American Welding Society C2 Committee on Thermal Spraying is developing a guide for protecting steel with thermal-spray coatings. It is anticipated that this consensus document will be issued early in 1993 and will provide a document for specifiers to cite.

The Steel Structures Painting Council (SSPC) published its guide for thermal-spray metallic coating systems in June 1991. This coating system guide provides SSPC/industry consensus for protecting steel with aluminum, zinc and 85% zinc/15% aluminum. The guide covers: reference standards; surface preparation; thermal-spray application procedures; primer, seal and topcoat application; inspection requirements; and safety. (Copies of the *Steel Structures Painting Manual Volume 2: Systems & Specifications*, can be purchased by sending $100 to: SSPC, Attn: Publications, 4400 5th Ave., Pittsburgh, PA 15213-2683.)

A critical element in all thermal-spray-coating applications is surface preparation. The SSPC guide calls for *white metal finish*—no oil, dirt, rust, oxides, corrosion products or any foreign matter—with a 2 to 4 mil profile. If not attainable

(as on rehabilitation projects) and with the approval of the purchaser, *near-white finish*—same as white finish but up to 5% staining per sq. in.—is allowable.

Thermal Spraying

Thermal spraying is done by heating and propelling molten material onto a suitably prepared substrate. As flying molten globules hit the surface and solidify, they interlock with each other. For aluminum and zinc anti-corrosion coatings, thickness is built by spraying 3 to 4 mils per crossing path.

Two systems are available.

The flame wire metallizing system melts the thermal spray material in a flame and propels it against the substrate. The melted spheres pancake out to form a laminar structure—building a coating. The flame gun burns a fuel such as propane or acetylene and oxygen to produce about 5,000 degrees F in the flame with an effective temperature to melt the wire of about 3,500 degrees F. A wire gun automatically feeds the wire into the flame to be melted. Propulsion air, at about 60 to 70 psi, blows the vaporized metal on to the steel substrate. The gun is kept 5" to 7" from the substrate. In some cases, a flame powder gun is used, where the spray material is in powder form.

The second system is an arc wire system, where two wires come together in the gun and the heat source is an arc between them. The arc is sustained by direct current from 100 to 1,300 amps at 28 to 30 volts. This arc heats the metallizing wire to 10,000 degrees F. As in the flame gun system, an air stream blows the molten droplets on to the substrate, about 4" to 7" away. The spray cone for a flame wire gun is about ¾", and for the arc wire gun it is about 1½".

Application skills can be taught in approximately three to four weeks, with skilled labor only being needed for supervisory roles and maintenance.

Organic Alternatives

When a bridge is first built, and later during the maintenance cycle, owners and designers are faced with choosing a finishing surface. Typically, this decision is governed primarily by cost, with aesthetics also occasionally playing an important role.

Costs are determined by many factors: surface preparation of the steel; location and environment, type of bridge, scaffolding and containment, the materials cost of the coating system; and application cost. SSPC has developed a computer-based cost methodology for ranking and determining coating system initial costs, maintenance costs, and life cycle costs. More than 100 different systems can be selected, factoring in such variables as environment, surface preparation technique, in-shop and field labor costs in four geographical areas, and other such parameters. However, since many applicators will not give actual labor costs and material mark-ups and instead provide relative numbers, the program only provides relative costs of one system vs. another for a specific application. It makes the SSPC model a very useful tool for making comparisons, if not for actual pricing.

Choosing among the various organic and thermal-spray coating systems generally depends on the technical coating requirements, including maintenance and affordability. Routine maintenance cycle with thermal-spray systems are 15 to 20 years instead of seven to eight years with high-performance epoxy and polyurethane organic coating systems.

Where wear and abrasion prevail, as on or near bridge road beds where sand or salt is used in the wintertime, coating systems are required that will withstand abrasion. Bridge areas where vehicles can crash also are a problem. Thermal-spray coating system provide anodic protection until they can be temporarily repaired with paint patches or permanently repaired with new thermal-spray coatings, which requires degreasing, abrasive blasting, thermal spraying and sealing/top coating.

Combinations of systems often are indicated. If abrasion or cuts are expected that will cut through to the substrate steel, a purely organic coating will not work. A metallic protection coat is needed as the primer on the metal. This may mean a duplex system consisting of a thermal-spray coating system topped with an organic coating.

In general, thermal-spray systems are effective only with rather smooth surfaces having few bends because the thermal spray must impact the surfaces within 45 degrees of the perpendicular and at a 5" to 7" standoff. In high-pollution environments, bridge towers with few surface interruptions also call for a duplex system. However, cables can only be painted because thermal-spray coatings cannot reach in between the strands of the cable.

One of the biggest problem areas in bridge maintenance is where beams attach to foundations or to other beams. Because of the movement due to expansion and contraction, paint doesn't hold up well. Where steel structures join, duplex systems are a good solution.

Forecast

Aluminum and zinc thermal-spray coating systems for protecting bridge components and structures provide improved barrier and anodic protection over that of organic coating systems. As costs come down with the increased availability of new thermal-spray equipment specifically designed for field work, use will increase.

While no volatile organic compounds (VOC) are produced in thermal spraying, water-based sealer/topcoat paint components still must be developed for minimum-maintenance thermal-spray coating systems.

Robert A. Sulit is chairman of the American Welding Society C2 Committee for Thermal Spraying and a surface engineering consultant with Duralcan USA, a leading supplier of reinforced aluminum composite products.

Beyond Increased Productivity

When selecting a computerized detailing program, it's important to look at more than just increased productivity

Traditionally, the story starts: *There's good news and bad news.* But for steel fabricators and detailers looking to computerize their operations, the story is different: *There's good news, and there's great news.*

Back in the mid-1980s, when firms started taking the first, tentative steps towards computerized detailing, the message was simple. Computerize the drawing process and productivity will increase.

Well, the good news is software suppliers weren't kidding. Detailers routinely report a minimum of 10% greater productivity with computerized detailing. The great news is that increased productivity is only the beginning of the benefits detailers have realized.

"When we initially purchased our software [in 1988], we were primarily concerned about productivity," reports Mark Holland, chief engineer with AISC-member Paxton & Vierling Steel. "But it later became clear that other issues were more important. As we gained experience, we grew up in the way we thought about computers and detailing."

"Of course productivity increased," stated Ken Peare, CAD Systems Manager at Paxton & Vierling. "We also discovered that the quality of our presentation improved and the availability of information increased."

Roy Burchfield, president of Burchfield Detailing and its sister company Cadvisions (a consulting firm for steel fabricators), got into computerized detailing to gain a competitive edge. "We couldn't compete with independent detailers on price alone," he commented. "Our only edge was to be able to produce drawings faster and more accurately." Burchfield bought a computer detailing system two-and-a-half years ago and found he gained a 15-30% increase in productivity.

However, knowing the advantages of computerized detailing is only the first step. Much harder is selecting a program to purchase, despite the great deal of unanimity on what features are desired in a detailing program.

Choosing Software

Of foremost importance is who developed the program. "It's extremely important that the program was developed by an experienced steel detailer," stated Cliff Cole, a draftsperson with a small fabricator in Joplin, MO, which bought a new software package in 1992. For most end-users and software developers, that's an obvious statement. And most, if not all, of the detailing programs currently on the market have been developed either by experienced detailers or with substantial input from one or more detailers. "Good programs have the flare of a detailer's perspective; they're not written by programmers who learned how to do detailing," stated Holland.

So given the large number of programs on the market, how does a firm choose one?

The first step is the same that would be followed with the purchase of any computer software program. Start by examining your current computer system. If you choose to keep it, then obviously it is important that the software you buy is compatible with your existing hardware—including processor (IBM or compatible, Macintosh, Sun, etc.?), monitor (monochrome, ega or vga?), and size and speed of system (how big is your hard drive; how fast done it run?). One consideration is that the price of computer hardware has dropped considerably in the last 12 months. Today even a good quality 80486-based system can be bought for less than $2,500—which in many cases will be less than the cost of the new software that you are considering.

Next, take a few days to examine the way your company currently does detailing. This will be important when you look at the various packages on the market. "You need to consider your needs and the way you work," commented John Briese, president of a small fabricator based in Rochester, MN, which has been using computerized detailing since 1986. "For example, does the software handle stairways and railings? It's important that the package works the same way your detailers do."

Ultimately, the final test of a software package can only come with hands-on experience. Detailing software is not inexpensive. At the least, you should sit down with a rep and try out the program. Burchfield takes it one step further. "If a software vendor is confident in his product, he'll offer a 30-day moneyback guarantee," he stated. Good programs should be easy to learn—the best programs are almost intuitive. "Programs should be user friendly," added Holland. "It should mimic the way a detailer works." And, of course, during the test period its important to look at

the quality and speed of output.

At one time, Burchfield spent considerable time and money attempting to development an in-house program. "We eventually looked at outside vendors and decided there were good programs on the market selling for less than we would spend developing one ourselves."

One item that all of the good programs share is flexibility.

"We wanted to be able to ad lib a bit to get exactly what we wanted," Cole explained. With the package he purchased, "if you're on the fifth beam on a page and you see something you want to change, you can change it without affecting anything else."

John Briese uses a different program, but agrees with the need for flexibility. "We still want control of each individual piece, but we want the expertise to be inside the machine."

Not all programs, however, do the same tasks.

Most of Burchfield's work is on two-story buildings, primarily offices and warehouses. "It was important that the program we chose do erection drawings, anchor bolts, beams, columns and bracing," he said. "And even though we don't do very many, we still wanted the program to handle stairs."

In addition, since he works with a wide range of small fabricators, he finds it crucial that the software includes a bill of material program.

At Paxton & Vierling, they expect their detailing software to do even more. "We now use it on a limited basis for structural analysis, though the program still has some growing to do in that area," Holland said. More importantly, Holland said, the software includes CNC downloading.

For Briese, he values his recently received data base of shapes and a column-girder end connection reference. "We're getting to the point where you don't even have to look at the T-distance," he said.

In addition to performing different tasks, each program works differently. Perhaps the biggest variance relates to how the program deals with AutoCAD. On one end, there are programs that run within AutoCAD; while at the other extreme there are programs completely non-compatible with AutoCAD.

The program Cole uses is compatible with AutoCAD. "It's a valuable feature since you can then use AutoCAD to make changes," he explained. Peare takes the opposite viewpoint; the program he uses doesn't require AutoCAD. "The program features fully automated picture drawing," he explained. "I like it because I don't want to have to draw with files like I would with AutoCAD."

Robert Abramson, CEO of AISC-member Interstate Iron Works Corp., adds that its important to consider how data is input into a system. Typically, the input can either be graphically (through

a CAD system such as AutoCAD) or in batch files. Abramson favors the batch file approach where a detailer develops input sheets that are then keyed into a system and processed as an entire building. "The graphic input system is an easier concept since the building frame is constructed point by point by point," he explained. "But we find a batch system to be more productive per employee. Also, since most of the work is done prior to entering the data into the system, fewer expensive workstations are needed."

Cost And Service

The final two factors to consider are cost and service.

The price of automated detailing systems varies widely, with the more expensive programs typically providing more features. However, not all fabricators require all of these features and can therefore make do with a less expensive program. Also, when looking at the price of a program, inquire about the cost of upgrades. As every software user has by now learned, there is no final version and upgrades can be very expensive.

Service is an even trickier issue.

Burchfield is a strong believer in looking at a company's reputation. He also prefers to deal with a larger company. "If the original software developer dies, will someone step in and continue to develop the package or will the users will left out in the cold?" he wonders.

But for Cole, he values the strong relationship that can be developed with a smaller software designer. "After we bought our package, we needed a slight modification to meet our special needs," he explained. "We called the owner of the company and he was very helpful. I'm not sure we would have gotten the same results from a bigger company."

The following pages contain information about some of the major software programs for fabricators and detailers. In addition to detailing programs, there are programs for billing, production control and inventory.

NES

AutoSD is a four module, automated steel detailing software application that performs all calculations and drawings when detailing beams, columns, bracing, gusset plates, stairs, stair rails, and sections. Pull-down icon menus and slide drawings make the program extremely user-friendly. Integrated with the open architecture of AutoCAD, AutoSD allows the user to: automatically set paper size and drawing to scale; plot-to-scale using automatic plot setup and script files; customize dimensions for straight lines, arcs and circles using custom fractions if needed; automatically calculate bevel and place it on either side of a selected line; edit text inside AutoCAD; create weld symbols from AutoSD's pre-defined blocks; draw all AISC shapes to scale; and create a shop bill. Modules, which can be purchased individually or as a set, include: Beams & Columns; Bracing & Gusset Plates; and Stairs.

For more information or a demonstration diskette, contact: Northridge Engineering Software, Inc., P.O. Box 2014, El Segundo, CA 90245 (800) 637-1677; fax (310) 546-7158.

SSDCP

SSDCP has released the latest version of its program for Structural and Miscellaneous Steel Shop Drawings. Currently, SSDCP offers more than 130 different parametric LISP programs that run inside of AutoCAD release 10, 11 or 12. These programs have been used in the field for up to five years, and are available in English and Metric equivalents. Steel sizes for AISC or CISC sections are included. Because the programs run "inside" AutoCAD, drawings are easy to modify.

For more information and a price list, contact: SSDCP, 110 Shady Oak Circle, Florence, MS 39073 (801) 845-2146.

Softdesk

The Steel Detailer from Softdesk couples structural information with parametric programs to quickly produce accurate and high-quality drawings. Operating interactively within AutoCAD, the detailing system provides the user total control over drawing production. Sophisticated reporting features automate the preparation of project material summaries. Features of the program include: enabling the user to draw steel shapes and plates at either true or exaggerated scales for plotting; commands for creating bills of material and project reports; specific detailing programs for beams, columns, bracing, stairs, and anchor bolts; parametrically created weld-

ing symbols that conform to typical welding specifications; creation and management of details and sections at any scale within current drawing; and beams drawn horizontally or sloped with any of five types of end connections.

For more information, contact: Softdesk, 7 Liberty Hill Road, Henniker, NH 03242 (603) 428-3199; fax (603) 428-7901.

Steel Solutions

Steel Solutions has released Version 2.1 of its Steel 2000 management program for steel fabricators and service centers. Available for the first time is an automated production control program that works with the shop labor simulation module to accurately and consistently predict the shop hours needed by workstation for every piece in a bill of materials. This information can then be used by management to schedule the shop and balance resources. Capturing of the shop hours and process completion status can be done in real time using PCs on the shop floor. The program also has been enhanced to include support for additional CNC machine tool programming. Also, this version includes full support for metric, international sizes and language translators.

For more information, contact: Richard F. Inserra, Steel Solutions Inc., 2260 Flowood Dr., P.O. Box 1128, Jackson, MS 39215-1128 (601) 932-2760; fax (601) 939-9359.

ASG

ASG/Vertex Detailer is an AutoCAD application designed specifically for architectural detailing. The program allows the user to assemble building details from pre-drawn "parts", rather than having to draw them line-by-line. The "building block" approach allows the user to develop details faster, more accurately, and more consistently. Revisions also are done by component. The program includes: automated detail annotation; automated re-scaling; automated plot sheet layout; a drawing database manager for previewing details; easy customization of title blocks; report function listing detail materials by CSI division; and file compression to save disk space.

For more information, contact: ASG, 4000 Bridgeway, Suite 309, Sausalito, CA 94965-1451 (415) 332-2123; fax (415) 332-2146.

Structural Analysis, Inc.

SAI has introduced a powerful package of programs designed for the structural steel fabricators. The package, called, appropriately, The Steel Fabricator, consists of 41 programs from the company's library of steel design, structural analysis and graphics software. Programs are included for the design, detailing and analysis of beams, columns, trusses, baseplates and footings. The programs are production oriented and feature extensive menus with spreadsheet formats and on-screen help features. A built-in text editor and error checking help reduce input time. Standard steel shapes are stored within the program or on disk files for fast, easy access.

The entire package costs $395, or a smaller sample package can be obtained for a shipping and material charge of $19. Contact: Structural Analysis, Inc., 555 South Federal Highway, Suite 210, Boca Raton, FL 33432 (407) 394-4257.

Autodesk

Autodesk has begun shipping AutoSketch for Windows, an affordable, easy-to-learn, high-precision illustration tool for technical users. The program is mouse-driven and combines the features of a simple drawing program with more powerful CAD capabilities, such as associative dimensioning and a full set of measurement tools. Users can display drawings in decimal units accurate to six places, or in feet and inches. The program is priced at $299. Autodesk also has released Generic CADD 6.0, a 2D design and drafting tool with strong tie-ins to AutoCAD. The program is priced at $495.

For more information on either product, contact: Autodesk Retail Products, 11911 North Creek Parkway South, Bothell, WA 98011 (800) 228-3601; fax (206) 483-6969.

Computer Detailing Corp.

Beams and Columns, a program written by steel detailers, is designed to speed the creation of fabrication drawings for structural steel and miscellaneous metal. The program uses AutoCAD to create a detailing environment and therefore is extremely flexible. Anything that can be fabricated in a structural shop can be detailed with this system. The program can be configured to produce details with a variety of different shop standards, including bills of material and consolidated cutting lists. The system, which picks items from a tablet menu, follows the same procedures that a detailer uses when producing drawings manually, which simplifies the learning process. Details of spandrels, moment connections, trusses and fittings for other trades all are easily handled. Sister programs for detailing stairs, creating plans and elevations, and sorting and weighing lists of material also are available.

For more information, contact: *Computer Detailing Corp., 1310 Industrial Blvd., Southampton, PA* 18966 (215) 355-6003.

Structural Software Co.

Structural Software's integrated system of independent computer program modules provides the user with complete tracking capability of all material. The programs, which are designed specifically for the steel industry, include: Estimating; Purchase Orders; Inventory Control; Production Control; and Combining. The latter program interfaces with In-

ventory Control to let the user control the order in which products are used. Other modules also work together. For example, Production Control interfaces with Purchase Orders to generate cutting lists that give the added capability of tracking material from the time it's ordered to the time it's cut.

For a free demo disk, contact Structural Software Co., P.O. box 19220, 5012 Plantation Road N.E., Roanoke, VA 24019 (703) 362-9118.

E.J.E. Industries

The company's Structural Material Sorter software system, first released in 1985, is designed to aid steel fabricators in managing material lists. It reduces the manhours required to process the lists by requiring the operator only to enter the material items and then automatically providing weights, surface areas, paint/primer requirements, bolt counts, shipping lists, estimating reports and optimal cut lists. During the estimating phase, the program's Estimating Module helps generate a fast, accurate bid. Once the job is in production, the system produces both master shipping lists and shipping tickets. It also automatically tracks which items have been shipped and which have yet to ship. The Nesting Module is useful for both estimating and production. Its primary purpose is to find the most efficient method to cut a job's lineal items from available stocks to yield a truly optimal cut. The system uses either English or Metric dimensions and runs on an IBM-PC or compatible computer.

For a free demo kit or more information, contact: E.J.E. Industries, Inc., 287 Dewey Ave., Washington, PA 15301 (800) 321-2955 or (412) 228-8841.

CadVantage

CadVantage has recently announced version 5.0 of its automated Structural Steel Detailing software. The program now includes bent plate end connections (bolted, welded, single- or double-sided), skewed wing plates, sloping wing plates, and one-sided angles in beam webs. Text input has been retained for ease of data entry and revisions. The system's processing programs have been revised and streamlined, allowing group builds of multiple sheets to be performed unattended. Graphics zoom features have been added to allow complete viewing of all pieces without a third-party graphics package. Further enhancements include automated material application in the Advance Bill of Material system, along with the ability to have material lists downloaded for shop floor control purposes. System prices begin at $11,000; updates from prior releases are free to maintenance program subscribers and cost $1,050 for other users.

For more information, contact: Steve Passaly, CadVantage, Inc., 619 South Cedar St., Studio A, Charlotte, NC 28202 (800) 231-0317.

MDX

MDX licenses PC-based programs for designing or analyzing steel highway and building girders. These programs feature optimization, flexible input, and comprehensive output. The highway girder program can be used for analyzing existing designs and producing alternative designs for non-prismatic I girders, box girders and rolled shapes up to 12 continuous spans. Prior to the design process, the user may fix or specify ranges for any of the design variables, including live load deflections. Flange, web, and stiffener plates are optimally designed for minimum weight, or for minimum cost using relative unit costs. Welds are sized. Outputs of specific interest to fabricators include camber diagrams and slab pour sequencing stresses and deflections. The programs require a 386-based computer or better with a math coprocessor and are available to qualified firms for a free, no obligation, trial period.

For more information, call MDX at (314) 446-3221 or fax (314) 446-3278.

Good Software

Steel Lookup from Good Software is a steel section properties program for Macintosh computers. The program displays an extensive set of properties, including torsional properties, for all standard steel sections and for double angles for back-to-back spacing. The program documentation gives explanations and derivations of the properties. The section properties also can be exported to spreadsheet format files. With System 7.0, the program can function as a steel data server, providing section properties to requesting programs running on the same computer and on networked computers. Documentation for the AppleEvent-based interface is included. The $100 program includes a 29-page manual and runs on Macintosh Plus and later models and requires System 6.0 or later.

For more information, contact: Good Software, P.O. Box 8435, Ann Arbor, MI 48107 (313) 996-8608.

Design Data

Design Data's SDS/2 Steel Engineering & Fabrication System eliminates repetitive data entry by integrating Engineering Analysis and Design with Connection Design, Detailing, Estimating and Production Control. Companies do not need to re-input data such as the geometry of a steel structure, bill of material, CNC files and other data to produce the information needed in separate phases of the same project. The user builds a 3D model of the structure once, and all of the information needed throughout the project is available. The program keeps tack of information about every piece of steel in the project. The 3D model can be used for connection design, detailing, labor calculations for fabrication, CNC files for automated shop equipment, design drawings, fabrication cost estimates, interference checking of connection material and material ordering and tracking.

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