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MODERN STEEL CONSTRUCTION

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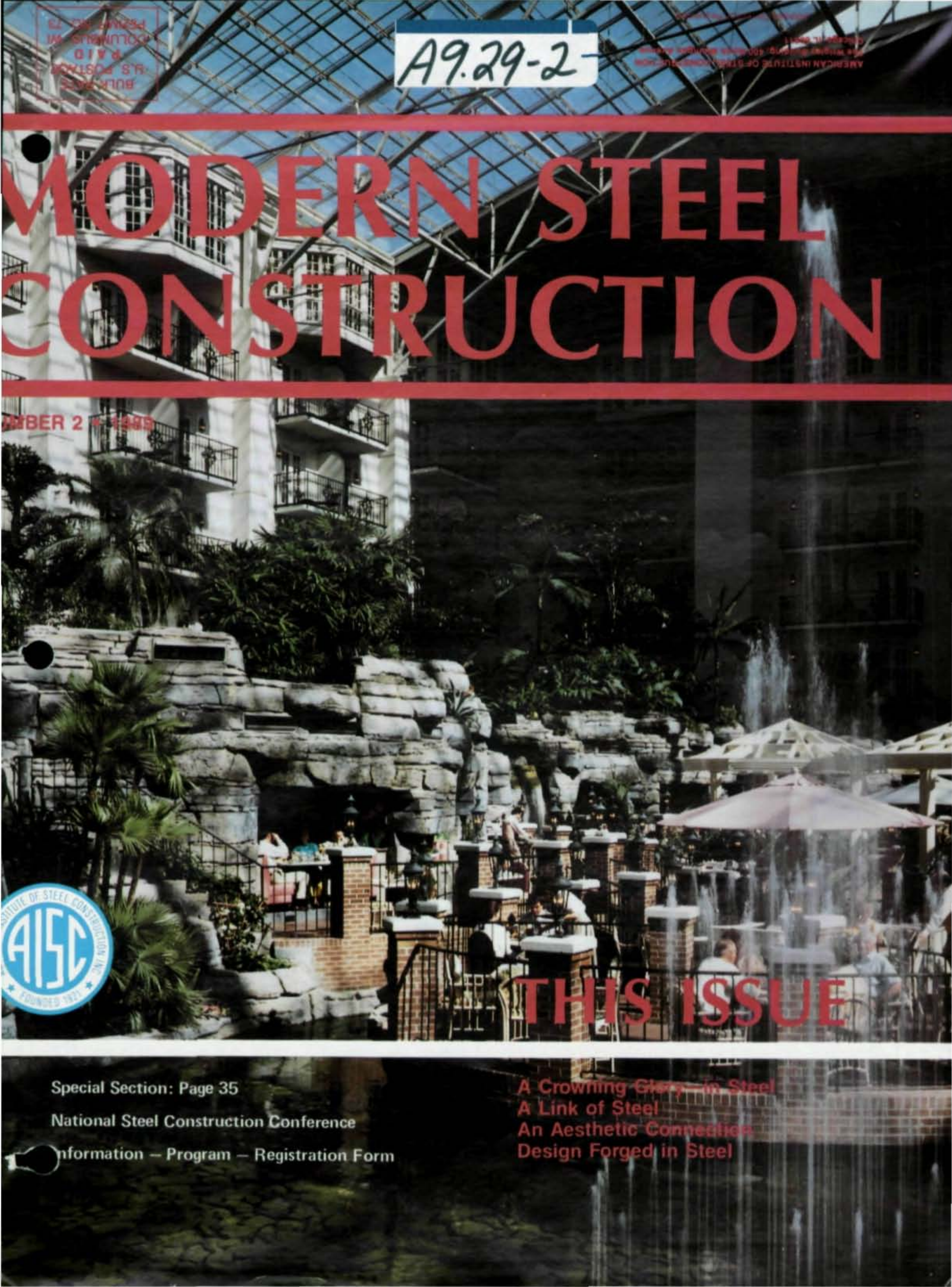


THIS ISSUE

Special Section: Page 35

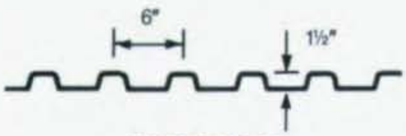
National Steel Construction Conference

Information – Program – Registration Form

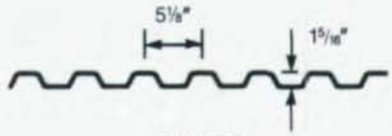
UNITED STEEL DECK, INC.

DECK DESIGN DATA SHEET

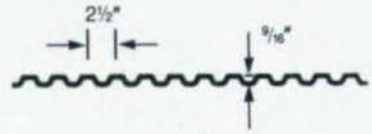
No. 11



INVERTED B



UFX-36



UFS

Questions and Answers About Form Deck

Q. How does *form* deck differ from *floor* deck?
Floor deck is the generic term given to *composite* deck — that is, deck that acts with the concrete, as positive moment reinforcing, to form a structural slab. Form deck simply acts as a stay-in-place form for the reinforced slab. Almost any deck can be a form deck, but the usual profiles are UFS, UFX or inverted B.

Q. How are the slabs designed?
By conventional reinforced concrete design — the reinforcement is usually draped mesh; that is the mesh is held up (into the negative bending region) over the beams (or joists) and draped into the positive bending region at the center of the span. Tables for uniform load, based on allowable stress design, are shown in the USD catalog. The deck profile can influence the design, particularly in the negative bending zone, because it eliminates some of the concrete available for compression. If slabs are cast on unshored galvanized deck, the deck is considered to be permanent and therefore carry the slab weight for the life of the structure; the slab only needs to be reinforced to carry live loads.

Q. What if the slab is under-reinforced?
This frequently happens — particularly on short (2' to 3') deck spans on joists. The common construction is a 2.5" slab with 66 x W2.9 x 2.9 mesh on 9/16" form deck; the mesh does not meet ACI temperature requirements. However, if the deck is galvanized and is therefore permanent, it may be capable of carrying all of the applied loads even if the concrete turns to sand; this would be a worst case model and is a very conservative approach.

Q. How is the deck fastened to the bar joists or the structural steel?
Usually by arc puddle welding; if the deck is less than 0.028" thick (22 gage) welding washers should be used. Air powered fasteners, screws, and powder driven pins can also be used.

Q. Can form deck be used with composite beams and girders?
Yes — but the deck bottom rib dimension must be large enough to accept a 3/4" stud. Our UFX-36 can be used but UFS cannot; B deck, either inverted or "right side up" is, of course, acceptable. Composite beam tables for UFX-36 are available on request.

Q. Is diaphragm design data available?
Yes. The SDI Diaphragm Design Manual, second edition has tables for 9/16" form deck. We can provide data on UFX-36.

Q. Are there fire rated assemblies?
Yes. The UL GXXX series covers many constructions. D753 and D863 cover UFX-36 type profiles on beams.

Q. Is form deck used for other purposes?
Yes. Exposed roofing; utility siding; dry installed roof systems; shelving; temporary covers; and draft curtains are some of the many uses. It is also used with non-structural insulating fills for roofs, but that is a different subject and we are out of room.

Remember, any time you need deck design data or pricing call us — Nicholas J. Bouras, Inc. We have the information available.

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MODERN STEEL CONSTRUCTION

VOLUME XXIX • NUMBER 2
MARCH-APRIL 1989

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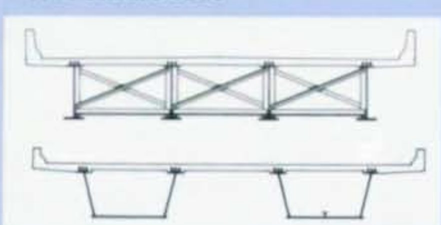

OOPs Dept.:

In the last issue, this non-engineer showed a bridge section upside down. Thank you for all the amusing notes and drawings for futuristic bridge designs. My apology—Ed.

AT LAST!

The Structural Steel Supermarket

At this moment there are about one million tons of brand-new structural steel in the United States.

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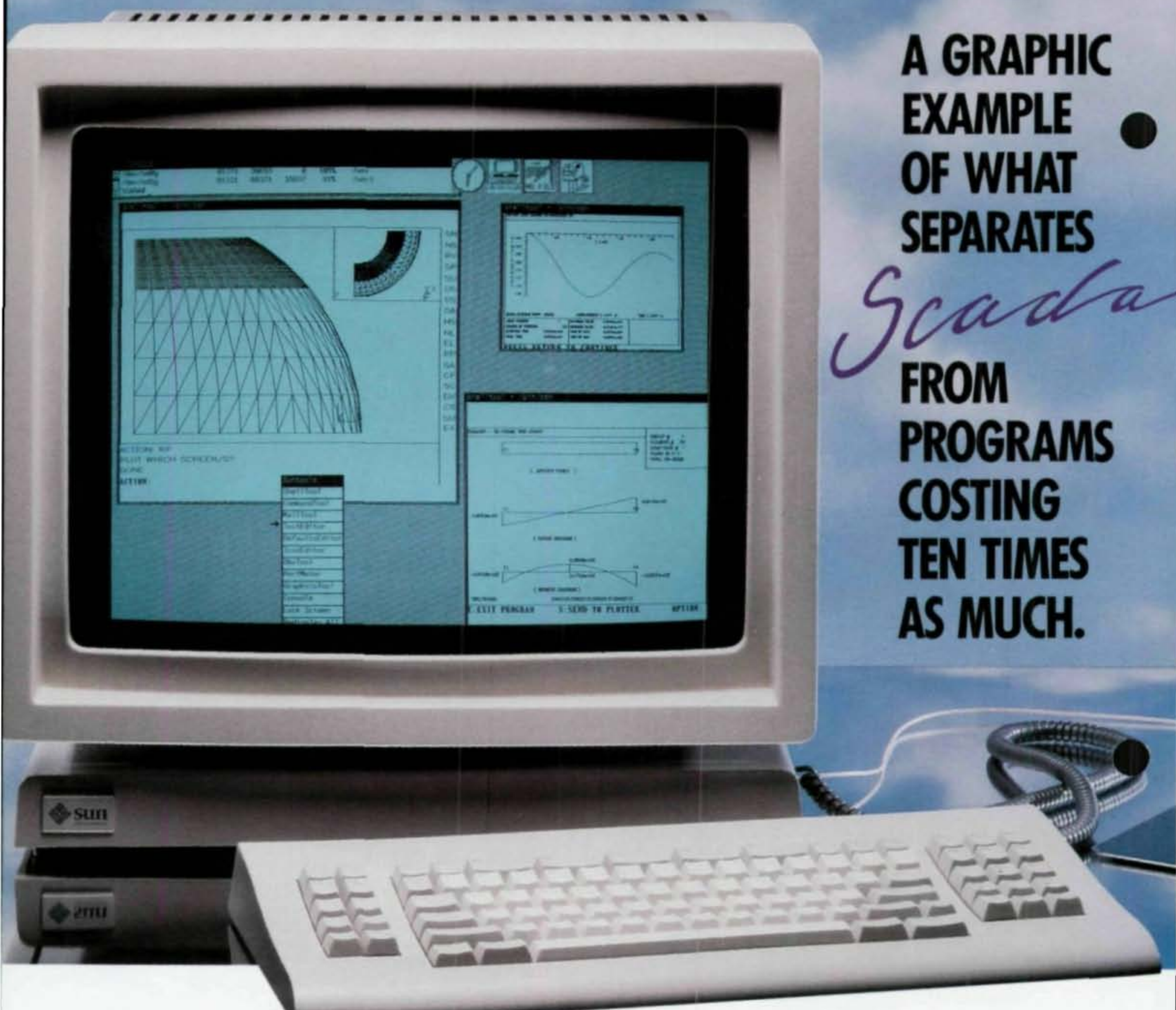

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OPRYLAND'S CASCADES

A Crowning Glory—in Steel

by Kurt Swensson

March, 1988, saw the $55-million Phase III expansion of the Opryland Hotel in Nashville, Tenn. opened to the public. Soon afterward, the hotel was the site of the 1987 ASCE National Convention and this summer will host the AISC National Engineering Conference. The Phase III expansion combines a functional 824-room hotel addition with a two-acre indoor wonderland of waterfalls, fountains, restaurants and a revolving bar. This wonderland, known as the Cascades area, is topped by a graceful 165-ft clear-span skylight, one of the largest in the world!

The 824 rooms of the addition are arranged on double-loaded wings which encircle the Cascades. These six-story wings are framed with a 7-in. post-tensioned slab supported by 8-in. wide concrete columns spaced to fit within the room partition walls. Lateral loads are resisted by shear walls at the elevators and stairs. The entire structure is supported by piles driven to rock. The skylight structure is supported at the fifth floor by a series of 36-in. square architectural concrete columns.

Design Criteria

The heart of the Phase III addition is the Cascades area. Therefore, the aesthetics of the structure was critical to the project. The structure had to be "light and elegant" since it would serve as an architectural focus, as well as a means to support the skylight. The architect and owner envisioned a clear-span structure and a profile which complemented the gabled trusses present in the adjacent Conservatory area of the hotel. Deflections of the structure had to be limited to prevent leakage of the skylight. Gross vertical deflections as well as relative horizontal and vertical deflec-

Central area of magnificent Cascades boasts creative steel-framed roof structure.

tion of the skylight supports were of concern in the design. The preliminary shop drawings provided contained a note calling for a structural support with "no deflection."

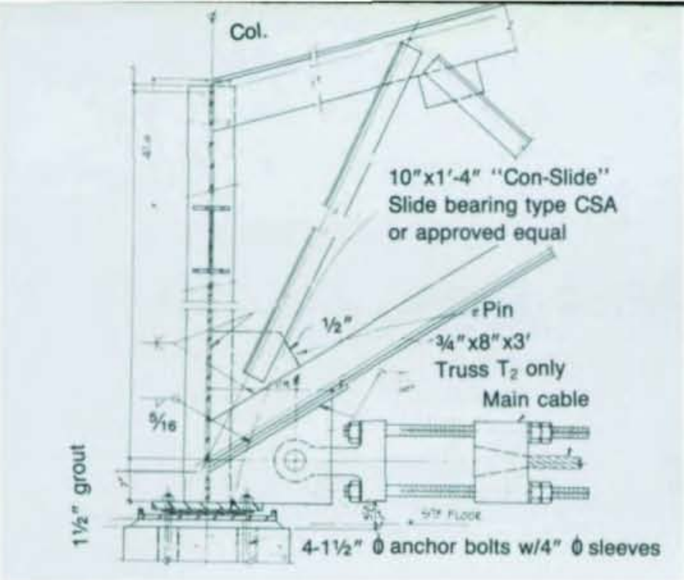
One result of the aesthetic requirements was a flat-arch geometry for the roof structure. This geometry generates significant thrust forces at the supports. Designing the surrounding structure to resist these thrusts was not an option either architecturally or economically. In addition, since the skylight support would be steel and the surrounding structure concrete, the problem of thermal effects was of concern. Therefore, the skylight support had to be independent of the surrounding structure, except for vertical support.

Design Solution

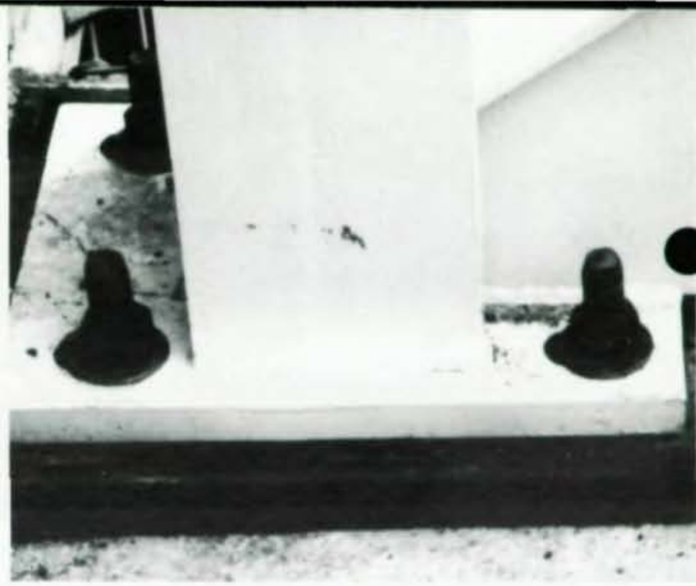
The design solution selected combined a bit of the past with some of today's technology to create an elegant framework of trusses and bracing which a member of the local press referred to as the crowning glory of the project. The design solution employs a series of tied arches isolated from the supports by teflon bearing pads. The tied-arch structure was the only light structural steel solution which would resist the thrust forces developed independent of the supporting concrete structure. In addition, the tied-arch proved to be very economical because the arch is in compression instead of bending, which minimized the material required for the 165-ft arch. The typical arch weighed approximately 95 plf, while a simple span truss of a similar geometry would weigh close to 200 plf. In addition, the tied-arch system eliminated vertical deflection concerns. The total calculated deflection of the arch under dead plus live loads is typically 1½ in., or L/1300. Thus, the tied-arch configuration met all the design criterion: aesthetics, small deflections and independence from the surrounding structure.

In the final design, the arch portion of the structure is composed of steel trusses to meet aesthetic requirements and insure stiffness. The 13 steel trusses span 65 ft typically and are spaced at approximately 27-ft centers. Eighteen-inch bar joists at approximately 7-ft spacings span between the trusses. The trusses stand 35 ft tall with a circular arched bottom chord and a gabled top chord. They vary in depth from a maximum 13 ft at the support to a minimum of 6 ft at the third points of the span. Typical chord members are WT

Rooftop scene shows how trusses are erected.



Detail of baseplate truss support and bridge strand socket



Closeup of truss support

8's with 3- and 4-in. double-angle web members. Total weight of the roof structure is approximately 6 psf.

The ties are 2⅜-in. and 2¾-in. dia. galvanized steel structural strand. Each strand was prestressed to predetermined load levels based on the dead-load thrust and cut to precise lengths before shipment. Each strand was shipped with a closed strand socket on one end and a closed bridge strand socket on the other. The bridge strand sockets include a coupling mechanism which allows for adjustments in strand tension and length in the field. The size of the strand was determined by the maximum allowable spread of the truss bases, which was set at 1½ in. total. The thrust forces varied from 80 to 150 kips under service loads. Many different member types of ties were investigated—rods with couplers, bars with pins, as well as strand. The rods and bars of lower strength material had to be sized for strength and the coupling mechanisms detracted from the aesthetics of the structure, so the strand was accepted as the tie member.

The truss supports are a 36-in. square column with a 2 ft-6 in. by 2-ft leveling plate, a 10-in. by 16-in. Con-Slide slide bearing and a 1½-in. by 1 ft-6 in. by 2-ft baseplate with four 2-in. by 3-in. slotted holes. The holes are slotted parallel to the truss to allow for elongation of the cable under load and for changes in length due to temperature. The baseplate is welded to the bottom of the last truss vertical and the assembly is held to the concrete column with four 1½-in. dia. anchor bolts. Because all thrust is resisted by the cable ties, the anchor bolts are only needed to resist uplift and a small amount of shear normal to the trusses.

Simplified Analysis

The use of a cable as the tie-element with roller supports introduced a degree of indeterminacy into the design. The sag or drape of the cable is a function of the tension in the cable, and the change in cable length is a function of the change in tension as well as the original sag. Because the tied-arch system sits in slide bearings, tension in the cable is created by spread of the arch caused by vertical loads. Therefore, the forces in the system are a function of the initial tension in the cable, the initial sag of the cable, the loading of the arch, and the stiffness of the arch relative to spread.

To simplify the analysis, parameter studies on the effect of cable sag and stiffness of the arch on the elongation of the cable were completed. The results of these studies showed the cable sag could be neglected in the calculation of cable elongations if the sag-to-span ratio was less than 0.0025 and the arched truss had almost no stiffness against spread at the base and thus had no effect on the cable behavior. The requirement on the sag-to-span ratio resulted in approximately five inches of sag in the initial condition for the 165-ft spans. In addition, it was found that the tension required to achieve this sag for the 165-ft span actually controlled the arched truss design and made the system uneconomical.

The only way to reduce the required tension was to reduce the span of the cable. This was achieved by suspending the cable from the bottom chord of the truss using small diameter wire on approximately 27-ft centers. The resulting initial sag was less than an inch, and the required tension in the cable to maintain this sag was below the minimum required to resist dead-load thrust on the structure. With the cable tie supported at 27-ft centers, the cable was no longer indeterminate and could be analyzed as a rigid bar, greatly simplifying the analysis. A further advantage to hanging the cable from the bottom chord of the truss was the elimination of any visible sag in the cable which was a point of concern with the owner and architect.

Load Balancing

Given the design conditions of a maximum 1½-in. change in the length of the cable, a 150-kip thrust under dead and live loads, and a 165-ft span, the required cable area is 8.61 sq. in., or a diameter over 3¾ in. This large a cable would be a special order and proved to be economically unacceptable. Consideration was given to increasing the allowable cable elongations. However, there was concern over binding of the connections if large movements were required, as well as secondary effects on the truss behavior.

Truss erection used three cranes.

The solution was to design the cable with a prestress to balance the dead loads of the structure, similar to the analysis used in prestressed concrete. Thus, the structure was at its initial condition under dead load and only live load, and wind thrusts need be considered in the elongation analysis. This method of design reduced the required area of the cables to approximately 3.25 sq. in. typically, which produced a significant savings.

Bracing

In a tied-arch system, the arch element is in compression and thus is susceptible to a buckling failure. The system as applied in this project resulted in a truss element, which has very little resistance to buckling, with both top and bottom chords in compression. Therefore, both top and bottom chords required bracing. However, the use of a glass roof, which is isolated from the structure, meant the roof diaphragm could not be used as a bracing element. This condition necessitated the design of a system of vertical and horizontal X-bracing to transfer bracing forces to the supporting concrete structure. The bracing system is composed of three elements: vertical X-bracing is used to brace bottom chords and carries bracing forces to the top chord plane; horizontal X-bracing on the top chords in combination with the bar joists create a horizontal truss which transfers the bracing forces to the exterior of the roof where the third element, longitudinal rigid frames, transverse the bracing forces into the concrete structure.

The vertical X-bracing runs the entire longitudinal length of the roof at approximately 14-ft spacings and is composed of ½-in. dia. rod tension ties. There are no compression elements in the bottom chord bracing as is used in conventional bracing. The compression elements were omitted for aesthetic reasons. A series of relatively wide compression struts would detract from the lightness of the structure. The horizontal bracing system behaves as a horizontal truss spanning between the rigid frames at the perimeter of the roof. The web of this horizontal truss is composed of ¾-in. dia. rod tension members and bar joist or compression members. The chord of the horizontal truss is the top chord of each vertical truss. A horizontal truss occurs in every other bay of the roof structure. The perimeter rigid frames are composed of the end verticals of each vertical truss, which is a W14 X 74 turned perpendicular to the truss, and a series of high and low wide-flange beams. The high beams are simply connected to the columns, while the low beams are connected rigidly to the columns. The high and low beams are connected by an X-brace which transfers the shears from the roof level to the low beams. The bases of the columns are assumed to be pinned.

In addition to preventing out-of-place buckling of the vertical trusses, the bracing system, and more specifically, the horizontal trusses tie the vertical trusses together to form a rigid diaphragm. The horizontal trusses transfer the longitudinal wind forces from the roof to the perimeter frames and they restrain relative movements between the trusses. Thus, the entire skylight behaves as a rigid element which floats on the teflon bearings at the supports.

Wind Loads

Because the roof has a very low profile with a slope of 3.5 to 12, lateral loads produced by wind are minimal. However, because of its shape, the roof behaves like an airplane wing in the wind and is subject to significant uplift forces. Two mechanisms are used to resist wind loads, depending on the direction.

Lateral loads from transverse winds (across the ridgeline) are transferred from the skylight to the top chord of the vertical trusses and then through the web members to the bottom chord, and finally from the bottom chord into the anchor bolts at the baseplate and into the concrete structure. These lateral loads are approximately four kips per truss. Since the roof structure is allowed to float in the transverse direction, it is possible that under high wind loads the structure can move until it rests against one set of anchor bolts. Therefore, the bolts are designed to resist wind shear. In reality, it is expected the minimal friction developed in the base connection will prevent significant movement of the roof. The uplift which results from transverse wind is resisted by the anchor bolts at the truss supports. A side effect of the wind uplift is the resulting reduction in the thrust force at the base. A reduction in the thrust force leads to a reduction in the tension in the cable tie and an increase in the sag of the cable. The design of the system included this condition which in many cases controlled the cable size.

Longitudinal winds, parallel to the ridge of the gable, resulted in lateral loads applied at the vertical end faces and hip roofs of the structure. Since the hip roof intersected the trusses at their bottom chord, the end bays included a compression member in the vertical X-bracing to transfer the lateral wind loads to the top chord of the vertical trusses. From this point, the lateral wind loads are taken to the perimeter frames by the horizontal truss system.

Truss-to-truss Connection

As a result of the bent rectangle shape of the Cascades in plan, the centerline truss which spans 170 ft, supports two 109-ft trusses at one of the third points in the span. The tied-arch system is very efficient in resisting uniform loads, so this large concentrated load applied eccentrically to the center truss presented a significant design challenge. In addition, the connection occurred where the center truss was only 6 ft deep.

The concentrated loads produced two undesirable behaviors. First the loads at the thinnest part of the truss required a significant stiffening of the truss at the connection. Second, as a result of geometry, the peaks of the 109-ft trusses and the 170-ft center truss were within 8 ft of each other. The concentrated loads on the center truss resulted in a unsymmetrical deflection of the center truss. Comparison of the vertical deflections at the ridge of the 109-ft and center trusses showed a 1½-in. deferential within a distance of only 8 ft, or L/64. The glass skylight could not resist this amount of differential displacements.

The solution to this design problem was to create a rigid link between the two 109-ft trusses and the center truss at the ridge line. This rigid link served two purposes: it insured uniform displacements among the three trusses, and it transferred a part of the concentrated load from the third point of the center truss to the ridge line where the truss is deeper. The rigid link is composed of vertical X-braced angles with a WT 8 x 18 at the top and bottom chords. One further complication to the connection was the use of the cable ties on the 109-ft trusses. The tension forces of the cable had to be isolated from the center truss. This isolation was achieved with long slotted holes in the connections at the top and bottom chords.

Construction—Many Complications

The flexibility of the tied-arch system both in the out-of-plane direction and in the elongation and shortening of the cable ties produced many complications in the construction process. This flexibility required the design of a special three-point lift of the trusses, vertical field erection and special bracing during construction.

The trusses were fabricated in three pieces in the shop and shipped to the site one truss at a time. Then the fabrication was completed with field-welded splices. Because the trusses are approximately three-stories tall and very flexible in the out-of-plane direction, it was impractical to splice the trusses in a horizontal position and to tilt them up to be placed on their supports. Once the three pieces arrived on site, each piece was held vertically by three separate cranes. At this point, the chords were connected using match-marked splice plates and full-penetration welds were used to connect the flanges of the WT chord members.

Since the trusses are supported at the fifth floor of the surrounding structure, it was impractical to install the cable ties after the truss was set on the supports. So, once the field splices were complete, the cable was installed between the truss base assemblies and a predetermined amount of stress applied by tightening the coupling on the bridge strand socket. The light weight of the trusses required no more than a two-crane lift. However, calculations showed that lifting the trusses near their centerline would relieve the gravity load on the truss which is used to resist the cable tension. This unbalanced condition would result in a shortening of the distance between the bases of the truss, making placement on the preset anchor bolts impossible. For this reason, a special pick-up configuration was designed to model the actual support conditions of the truss in place. The main truss pick-ups were moved to either end of the truss, but this configuration was unstable, so a third crane acted as a stabilizer for the ridge portion of the truss. This configuration at first seemed awkward, but with some practice the erection of the trusses went quickly, with no major problems.

Since the bracing system runs the entire length of the roof and counts on transfer of bracing forces from one truss line to the next, careful attention was given to the erection procedure, construction bracing and the application of the skylights. The roof was constructed in halves based on the line of symmetry in the roof, and each half was stable on its own. Thus, once one half of the roof was in place, skylight installation began while the steel erection continued on the second half. The steel trusses, cables and bracing were assembled and erected in two months. Once the structure was in place, the palates of glass plates used to create the skylight were lifted onto predetermined locations on the trusses by a helicopter.

Testing and Inspection

Because this is a one-of-a-kind structure, a complete series of inspections and measurements were done on the in-place structure both before and after the placement of the skylights. To verify the assumptions made in the analysis, measurements including spread of the arched-truss bases and vertical deflection at the centerline of the truss were recorded to determine the movement of the structure under load. The measurements agreed very well with calculated values. The actual spread of the bases, or elongation of the cable, was within $\frac{1}{4}$ in. of the calculated value, while the vertical deflection of the truss centerline was within $\frac{1}{8}$ in. of the calculated value.

Inspections included tightness and welding of tension bracing, vertical and horizontal alignment of arched trusses. Since compression members were eliminated from the bottom chord bracing, it is imperative that the tension bracing be tight to prevent excess movement and the welding be of good quality to prevent fatigue failure over the life of the structure. Each brace was visually inspected and approved for alignment, tightness and adequate welding before the structure was opened.

Since the bottom chord is flexible in the out-of-plane direction, over-tightening of the tension braces could pull the bottom chord out of line. This alignment was checked and adjusted to insure proper behavior of the bottom chord in compression. Finally, the position of each truss on the baseplate and the location of the bolt in the slotted holes was inspected and documented after the skylight was placed. This inspection was done to insure that the available movement in the truss was greater than, or equal to, that assumed in the design.

The design and construction of this structure illustrates how simplifying assumptions based on statistics can be used to design and construct a seemingly complex structure. In addition, the project illustrates how close cooperation between the trades and a free exchange of ideas can produce a very successful project. □

Architect
Earl Swensson and Associates
Nashville, Tennessee

Structural Engineer
Stanley D. Lindsey and Associates, Ltd.
Nashville, Tennessee

General Contractor
Hardaway Construction Company
Nashville, Tennessee

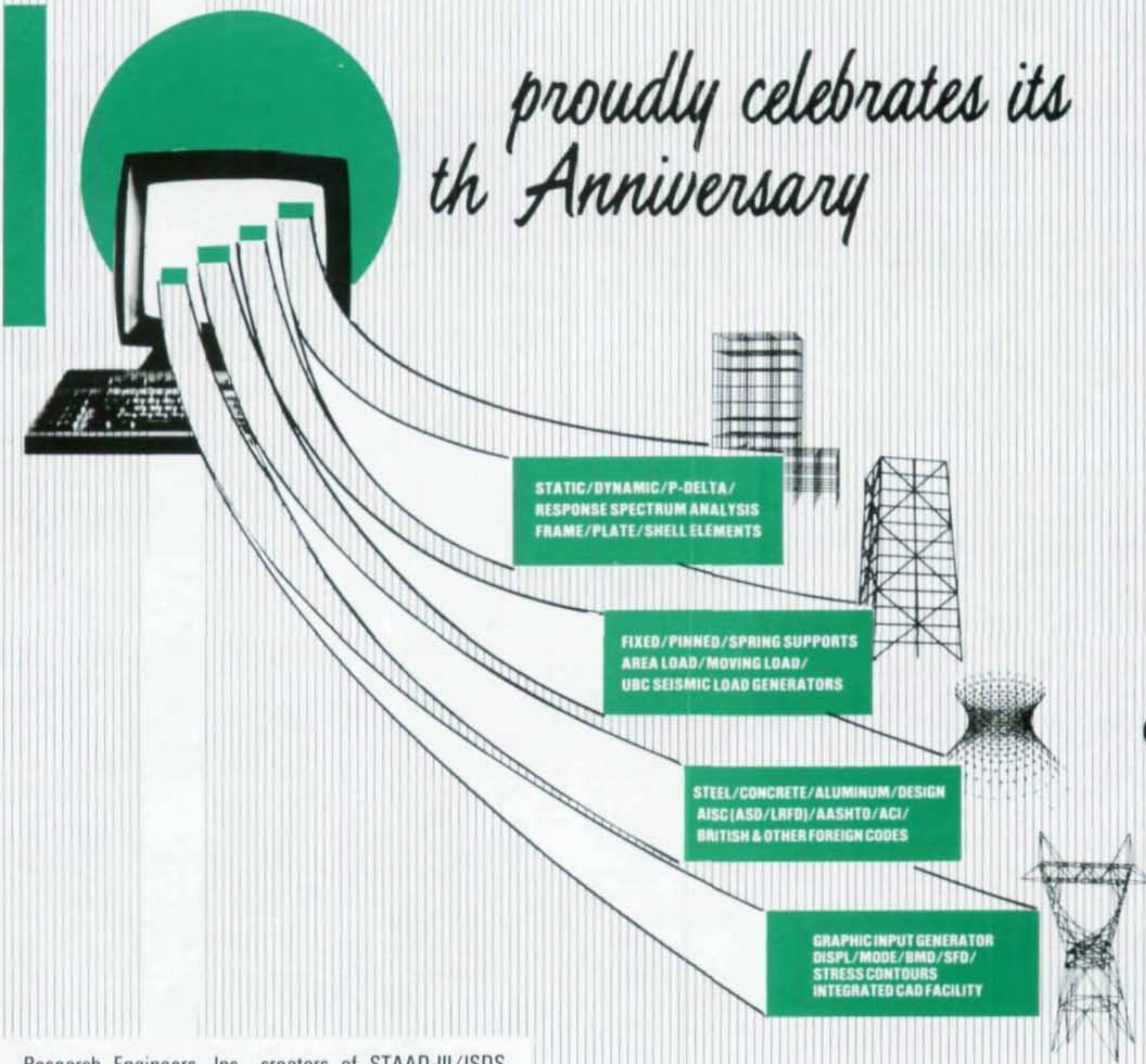
Cable Supplier and Consultant
Leschen Wire Rope
St. Joseph, Missouri

Owner
Opryland Hotel Corp.

Kurt Swensson, Ph.D., is a design engineer for Stanley D. Lindsey and Associates, Nashville, Tennessee.

Closeup of huge cables

STAAD-III/ISDS STRUCTURAL ANALYSIS AND DESIGN



Research Engineers, Inc., creators of STAAD-III/ISDS, won't be commemorating the program's tenth anniversary with the usual fanfare. Instead, this energy will be directed towards extensive R & D and continued outstanding customer support. Striving to meet their users' needs, REI has established STAAD-III/ISDS as the leading software system of its kind. Computer-aided structural analysis and design ground is constantly being broken with STAAD. REI's mission throughout the next decade will be setting higher software standards and maintaining the leadership in the industry.

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"THE LINK" WALKWAY

A Link of Steel

by Michael R. Walkiewicz and Daniel W. Stocker

Hyatt Walkway looking toward Crown Center, prior to glass installation

The opening of "The Link" on Nov. 10, 1988, fulfilled a need by Crown Center Redevelopment Corporation, a subsidiary of Hallmark Cards, Inc., to join the buildings of Crown Center Complex near downtown Kansas City, Mo. Spanning three major thoroughfares, this elevated pedestrian walkway connects the Hyatt Regency Crown Center Hotel, the Westin Crown Center Hotel and the adjacent retail complex with the Crown Center office community. The Link provides easy pedestrian access to all facilities, creating maximum flexibility in building use.

Design Solution

When architects Zimmer Gunsul Frasca Partnership of Portland saw the site for the first time, they immediately suggested a triangular shape with sweeping curves. The glass-enclosed 18-ft x 18-ft triangular cross section features exposed tubular steel and 3-in. composite cellular deck with a 2½-in. concrete topping slab. The structure has three distinct walkway sections which span a total of 830 ft.

Limited potential support locations and an established bay size of 18 ft placed severe geometric restraints on the walkway layout. The radii and locations of each curved section of the walkway were determined by available support locations as well as the connection point at each build-

Interior of steel-framed walkway (above). Rendering (r.) shows magnitude of project.

ing. Working within these constraints, KPFF Consulting Engineers of Portland began structural design work for each walkway section.

Unique Design Characteristics of Each Walkway Section

The first section of walkway, which connects the Hyatt Regency and the 2400 Pershing Office Building of Crown Center, is the longest, spanning 325 ft over two major roadways. Because of its geometry and triangular shape, computer analysis determined the ends had to be tied to the existing structures to maintain mid-span deflections within acceptable limits. This resulted in significant thermal forces being transferred into the buildings. The connection at the Hyatt Regency used the existing reinforced concrete basement wall with through bolts and drilled anchors to resist lateral loads. At the 2400 Office Building of Crown Center, two 16-ft long drag plates with bolts through the roof slab transferred these loads.

The triangular shape and alternating diagonal members of the walkway make it inherently stable and enable it to resist the

Half-span section of Westin walkway moves into position with two cranes and flatbed trucks.

torsional forces resulting from its curvature and lateral loading. It was more economical to span the floor deck perpendicular to the floor diagonals, thus reducing its span and resulting in the deck alternating direction every bay. Since the deck was to be exposed and spans were still significant, cellular composite deck was selected to strengthen and stiffen the floor.

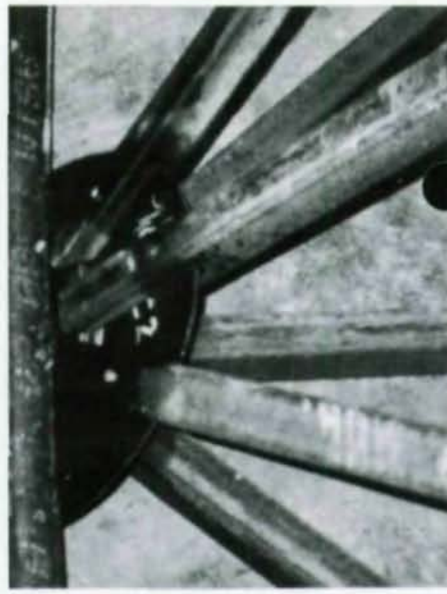
The second section, which spans 200 ft over a major street between the 2400 Office Building and the 2405 Grand Office Building of Crown Center and the Westin hotel complex, is similar to the Hyatt Regency part of the walkway—with one major important difference. The connecting point for the walkway coincides with an existing expansion joint between the Westin hotel and its retail complex, which prohibits tying the walkway to the hotel. It was determined this span should be tied to Crown Center and free to move laterally at the Westin complex. The resultant expansion joint had to facilitate a total movement of up to six inches under thermal and lateral loads.

The third section of the walkway, 300 ft long, runs over the top and between the 2405 Grand Building and the 2400 Office Building of Crown Center, thus creating an atrium between the adjacent buildings. The sloping roof structure and walkway are tied rigidly into the high-rise 2405 Grand Building, and supported on the roof of the adjacent low-rise 2400 Office Building, with freedom to move laterally.

Rock, located close to the ground surface, permitted spread footings in several support locations. Excavations during the construction of the existing buildings, however, resulted in substantial fills of up to 30 ft in those areas. Four-ft diameter drilled piers, capable of resisting both vertical and horizontal forces, were required as foundations at these locations.

Fabrication and Erection

Because of concerns for both shop and field fit-up sequencing, the steel fabricator/erector constructed a ¼-scale mockup of two bays of the walkway, complete with scaled connection plates. This enabled the contractors, design team and owner to determine potential problems during fabrication and erection and to plan accordingly. The walkway was shipped to the site in two-bay segments, in some cases with the deck already in place. Half-spans were then assembled in the median strip of Pershing Road and lifted onto scaffolding with two cranes.



Typical 45° sloping face connection mockup (¼ scale)

This process reduced significantly the amount of welding required in the air and also minimized disruption of traffic. Because of heavy traffic on the adjacent streets, these lifts could only occur during weekends. Because virtually all fit-up was done in the shop or on the ground, no field problems were encountered with tolerances when the sections were lifted. So fabrication and erection were completed in a five-month schedule.

This unique walkway remained true to the architect's initial vision. Through the cooperation of the design and construction team, the steel structure was placed to tight tolerances on a short schedule without problems. With its sweeping curves and striking profile, The Link is not only a functional structure, but also one which adds its own touch of class to the heart of this great city. □

Architect
Zimmer Gunsul Frasca Partnership

Structural Engineer
KPFF Consulting Engineers

General Contractor
J.E. Dunn Construction Company

Steel Fabricator/Erector
The Bratton Corporation

Owner
Crown Center Redevelopment Corporation

Michael R. Walkiewicz and Daniel W. Stocker are project design engineers with KPFF Consulting Engineers' Portland, Oregon office.

Steel Notes

Council for Advancement of Steel Bridge Technology Formed

The Council for the Advancement of Steel Bridge Technology, a new national not-for-profit organization dedicated to the enhancement of economical and innovative solutions to steel bridge needs, was formed Feb. 2, 1989 in Chicago at a meeting of independent industry organizations comprising the originating group.

Robert P. Stupp, who was elected chairman, states the main purpose of the council is "to assure that steel bridges reflect the latest developments in steel design concepts, construction technology, economical solutions and reliable service performance." Stupp is also the chairman of AISC's Committee on Bridges, the national organization representing the fabricated structural steel industry, and executive vice president of Stupp Bros. Bridge & Iron Company, St. Louis, Mo., an active member company of AISC.

Thomas Heimerl was elected vice chairman of the council. Heimerl is manager, Marketing-Plate and Structural Products, USS Division of USX (a member company of the American Iron and Steel Institute).

Council membership, Stupp noted, will include active members from organizations having a direct interest in the design and construction of steel bridges. Those comprising the organizing group are:

- American Iron and Steel Institute (AISI)
- American Institute of Steel Construction (AISC)
- AISC Marketing, Inc.
- National Erectors Association (NEA)
- Steel Structures Painting Council (SSPC)
- National Electrical Manufacturers Association (NEMA)
- Industrial Fasteners Institute (IFI)

"This coalition of industry interests closes the bridge industry 'loop'," Stupp said, "forming a continuum which includes AISI's expertise on the base material, the technical and educational resources of AISC, NEA's knowledge of construction technique, the marketing capabilities of AISC Marketing, Inc., and the product and service support of SSPC, NEMA and IFI.

"All elements of bridge construction will be considered," Stupp continued, "including, but not limited to, substructure, deck, structural support systems, corrosion protection systems, materials, shop practices, erection procedures and overall construction practices. It is anticipated that other oganizations representing suppliers of items such as bearings, decks, joints, etc., will be added to the council."

The council will serve as a clearinghouse for information on the most recent developments in steel bridge construction and will sponsor programs and activities to develop and support specific research and design programs as well as national legislation on infrastructure issues. In addition to supporting existing local organizations with the capacity to distribute pertinent information and implement new developments, the council urges the establishment of regional forums or roundtables to serve as communication links for identification and resolution of specifically regional problems.

The council will also act as a co-sponsor for the biennial National Symposium on Steel Bridge Construction. The 1989 Symposium is scheduled for Oct. 19-20 at The Shoreham Hotel, Washington, D.C.

AISC Develops New Rules for Heavy Shapes

AISC has announced new provisions covering material properties, splicing details, thermal cutting and welding of heavy W-shapes. The new provisions were developed by AISC's Committee on Specifications in response to problems encountered with the use of heavy W-shapes in non-column applications. The committee includes about equal numbers of engineers in private practice, in research and education and those employed by steel fabricating companies. In addition, a special task group included engineers with metallurgical expertise.

AISC's board of directors has approved the new rules, effective Jan. 1, 1989, being published as:

Supplement No. 2 to the *Specification for the Design, Fabrication and Erection of Structural Steel for Buildings* (Nov. 1, 1978), AISC Publication No. S332; and

Supplement No. 1 to the *Load and Resistance Factor Design Specification for Structural Steel Buildings* (Sept. 1, 1986), AISC Publication No. S333.

Supplement No. 1 to the LRFD Specification is identical to Supplement No. 2 of the 1978 Specification, except for section numbers.

The new rules are applicable to ASTM A6 Group 4 and 5 rolled shapes and to welded shapes built up from plates with thicknesses exceeding 2 in., if such rolled and welded shapes are subject to primary tensile stresses due to tension or flexure and if they are spliced using full-penetration welds. The supplements require that material toughness shall be specified when these conditions are met. Design requirements for beam copes and weld access holes are also specified to facilitate welding operations and to minimize restraint. Fabrication requirements include preheat for thermal cutting and for making groove-weld splices.

To order, send $1 for each copy requested (specify AISC publication number) to AISC, P. O. Box 806276, Chicago 60680-4124.

(continued on p. 22)

(continued from p. 21)

National Symposium on Steel Bridge Construction Scheduled

The 1989 National Symposium on Steel Bridge Construction will be held Oct. 19-20 at The Shoreham in Washington, D.C. The Symposium is a continuing dialogue between owners, designers and builders on state-of-the-art techniques in design, detailing, fabrication and erection of steel bridges.

First conducted in 1987, The Symposium is co-sponsored by the Federal Highway Administration, American Association of State Highway and Transportation Officials, American Institute of Steel Construction and the American Iron and Steel Institute. The 1½-day meeting for owners, designers and builders targets topics to assist the industry in improving steel bridge economy, quality and reliability.

The 1989 Symposium program will deal with matters of great concern to all involved in steel bridge design, construction and maintenance. Lectures and presentations will feature leading experts on paint systems, weathering steel, bolts and bolting, design of longitudinal welds and jointless bridges. Case studies of several recent unique bridges (Staley Viaduct, Minnesota's High Bridge, Cooper River Bridge) will be headlined, as well as the State of Maine's approach to design and determination of structure type.

The New *Bridge Fatigue Guide* and the *AASHTO/AWS Welding Code* will be reviewed, and status reports presented on the Bridge & Structures Information Center and the Council for Advancement of Bridge Technology. Another segment will consider methods for integrating efforts of the various members of the bridge team during both planning and construction.

A highlight of the 1989 meeting will be presentation of awards to the winning designers in AISC's 1989 Prize Bridge Competition. The presentations will be made at the Symposium dinner Thursday evening, Oct. 19. Entries will be accepted until June 19 for the Competition (write AISC Awards Committee, 400 N. Michigan, Chicago, IL 60611-4185 for entry forms).

For Symposium registration information contact AISC Membership Services Dept., 400 N. Michigan, Chicago, IL 60611 (call 312/670-2400).

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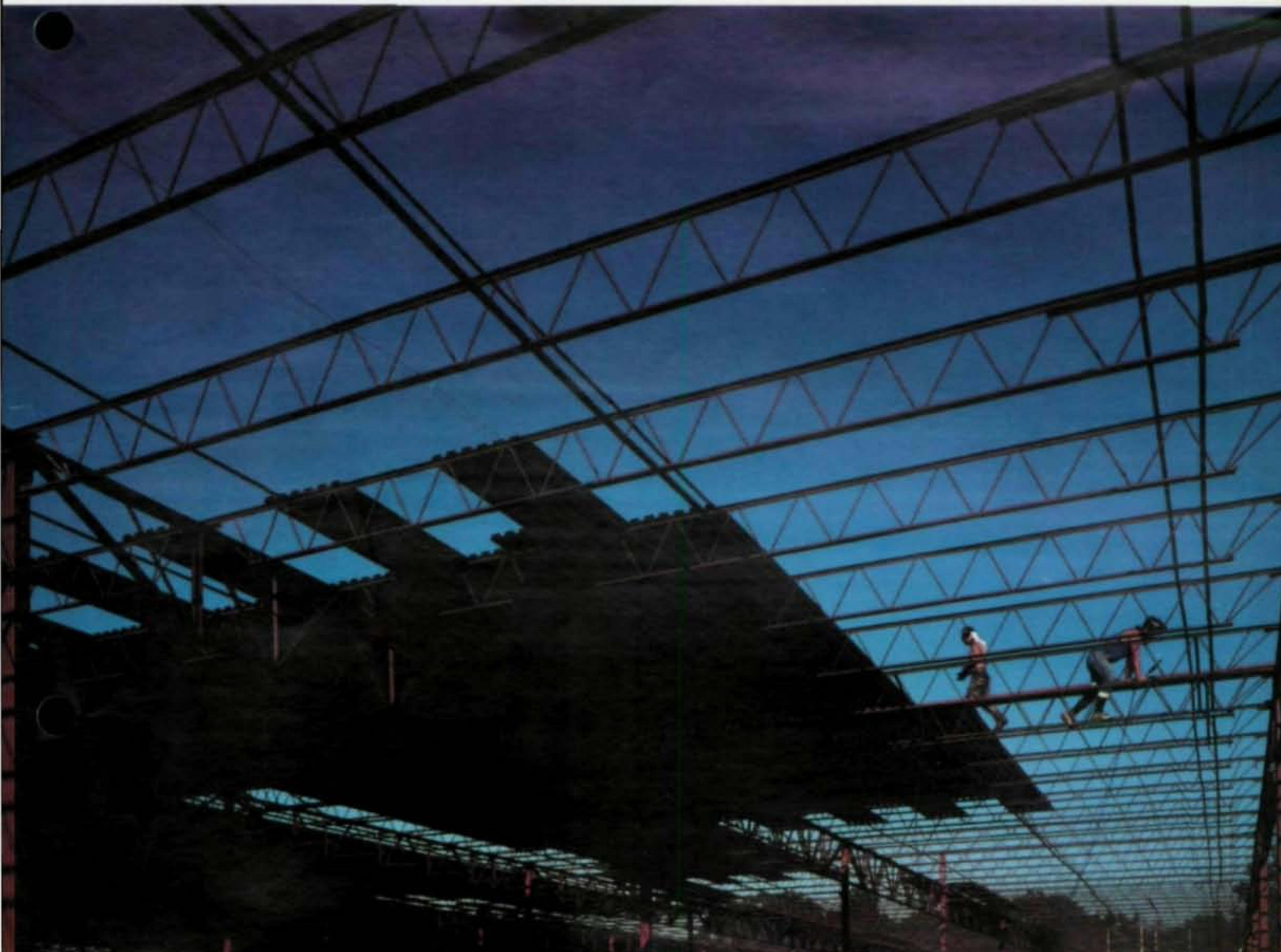
RT AS FAR AS THEY WANT TO GO.



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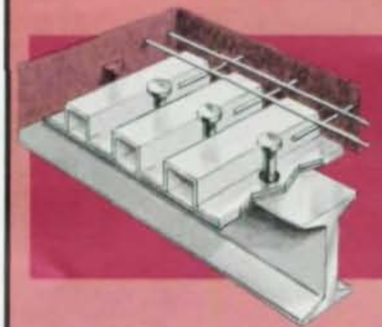
Applications



Composite Bridges – Shear connectors provide equal shear in all directions, eliminate distortion that might result from hand welding and permit more satisfactory compaction of concrete around the connectors.

Composite Buildings – Shear connector studs welded to the beam or through a permanent form steel deck result in increased live load capacity. As much as 20% less steel may be used and shallower floor sections reduce building height.

Retrofitting – Bridge retrofitting usually involves removing the old concrete and replacing it with new concrete tied to the beam with stud welded shear connectors.
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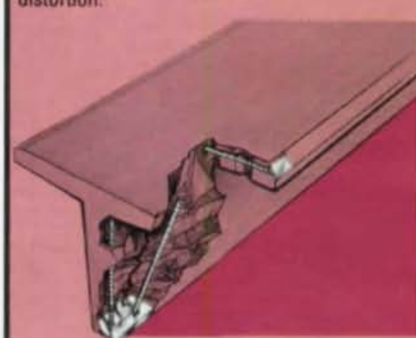
Concrete Anchoring – Stud welded headed concrete anchors deliver specified axial tension and shear strength values and can be applied up to three times faster than hand welded anchoring devices. Other advantages include much higher yield points, elimination of costly set-up time for shearing and bending, stronger welds, reduced material handling and no distortion.

Insulation/Lagging – Stud welded fasteners secure all types of insulation material in all density ranges faster, easier, more economically and better than any other methods.



Precast/Prestressed – Because of their known values, anchor studs can be used in standardized designs for such connections as bearing plates for beams and tees, shear keys for tees, column baseplates, and various other embedded steel elements. In these applications, stud welding reduces cost per plate, ensures consistently high weld quality, frees certified welders for other jobs, eliminates long lead time and storage problems.

Electrical/Mechanical – Threaded studs and a variety of stud configurations are used to fasten conduit clamps, lighting fixtures, outlet boxes, sprinkler systems, cable runs and piping. Fast positive attachment is achieved without holes or costly clamping devices.

Other cost saving construction applications are securing concrete forming and timber shoring, wood nailers, crane and guide rails, grating, refactory and wear resistant materials.

Imaginative Aesthetics

NATIONWIDE PLAZA

An Aesthetic Connection

by Robert Corby and Jack Pettit

A multi-use redevelopment of eight downtown city blocks in Columbus, O., initiated by The Nationwide Insurance Company in 1972, nears completion with the addition of two more high-rise office buildings, below-grade parking and a 40,000-sq. ft, six-story, glass-enclosed Atrium connecting all three office structures. One Nationwide Plaza, opened in 1975, is a 37-story, 1,300,000-sq. ft building, a totally occupied national headquarters of The Nationwide Insurance Company. Scheduled to open in early 1989 is the 27-story, 680,000-sq. ft Three Nationwide Plaza, which houses a computer center, cafeteria and general offices. The third building on the property will be a 33-story, 995,000-sq. ft State of Ohio Bureau of Worker's Compensation/Industrial Relations office complex, to open in late 1989.

The Atrium, interconnecting all three office towers at their base, is designed as a tropical garden amenity for the employees of both Nationwide and the state. The Atrium also connects the City Convention Center and two hotels via second level walkways extending across major streets. Also, along the second level walkway loop are a federal office building and Two Nationwide Plaza, a 17-story, multi-tenant office building.

The voluminous, six-story Atrium provides 40,000 sq. ft of open and relaxing environment adjacent to the work space. To create the desired atmosphere, the Atrium is filled with lush tropical vegetation and abundant water features. The space is opened to the outside by large roof skylights and window walls. The Atrium, containing 779 tons of structural steel, is six stories tall at the face of the Three Nationwide Plaza Tower and steps down one level at each bay towards the east.

Prominent X-brace Features

The long roof skylights made transfer of lateral loads by using a roof diaphragm impossible. Instead, a series of large X-braces extend in the plane of the roof through the skylights to become a prominent architectural feature. The X-braces are 20-in. x 12-in. structural tubes which also function as roof beams. The tubes span diagonally to the major roof trusses.

The interior trusses—exposed to view—consist of 20-in. x 12-in. tube top chords and 12-in. x 12-in. tube bottom chords and web members in a Pratt configuration. They span 64 ft to 20-in dia. pipe columns. The tallest of the pipe columns rises 70 ft from the plaza level to the bottom chord of the trusses.

At the exterior step-downs, Pratt trusses composed of W8's are hidden by wall finishes. The wide-flange trusses in combination with W27 exterior columns make up the lateral load-resisting frames for north-south direction loads. East-west direction loads transfer through the X-braces back into the tower structure.

An Aesthetic Connection

Just as the Atrium provides a physical connection between the existing One Nationwide Plaza and the state's BWC/IC building, the Three Nationwide Tower provides an aesthetic connection between the modern One Nationwide and the post-modern BWC/IC by incorporating forms and colors common to both buildings.

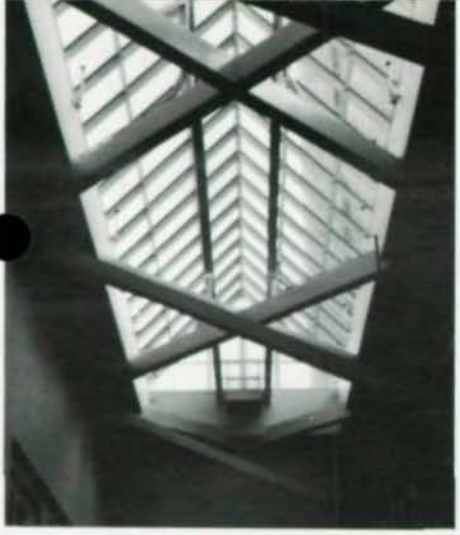
The tower structure contains 7,582 tons of structural steel supported on 458 W14x73 steel H-piles extending 80 ft to bedrock. A typical floor is about 22,500 sq. ft in approximately 30-ft x 30-ft bays. The floor system is 2½-in. concrete over a blend of standard 3-in. composite deck and 3-in. electrified deck. The electrified, three-celled units are spaced at 6 ft o.c., making power, telephone and computer services accessible anywhere in the offices. The corners of each floor are saw-toothed to provide additional corner office space.

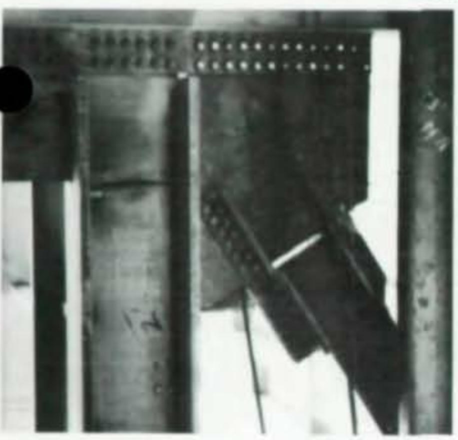
The exterior facade is granite with strip windows supported on an aluminum curtainwall system. The curtainwall connects to a bent-edge plate which also functions as the slab pour stop.

Hybrid Lateral-force System

To allow for the strip windows, the saw-tooth corners and the offset columns created by the transition from a 30-ft x 30-ft

Aerial of steel-framed Three Nationwide Plaza. Fred Schaaf/Aerographics photo. Below, North atrium exterior under construction.





North Atrium interior (top). Wind-frame column base plate (c.). Braced frame connection (bott.).

South atrium perspective

bay at the tower to a 32-ft x 32-ft bay in the adjoining atrium, a hybrid lateral-force carrying system was developed.

The tower contains seven lateral-force carrying frames of five different designs. There are three moment-resistive frames, two braced frames and two combination braced and moment frames. The frames are located to avoid biaxial stress and complicated two-directional connections. In an effort to balance the stiffness of the moment-resistive frames with the inherently stiffer braced frames, reduce the steel weight and reduce the risk of lamellar tearing in jumbo steel sections, deep column sections where used. Columns in the moment resistive wind frames are built-up, 36-in. deep wide-flange shapes, 32-in. deep wide-flange shapes and 32-in. deep box shapes which reduce to W36 and W30 sections in the upper levels of the building. Selecting these sections in lieu of the standard W14 columns resulted in dramatic weight reduction. As an example, a W36x230 column was used at the 17th floor which has a stiffness equal to a W14x730—for a net savings of 500 lbs. per linear foot of column and a reduction in flange thickness of 3⅝-in. Because of the high axial loads present W14 sections were used for the interior core-braced frame columns. Where full-penetration welds to the W14s were required, killed steel was specified and ultra-sonically tested to minimize the nonmetallic inclusions at the point of the welded connections. The bracing connections to the columns in the north-south direction braced frames were staggered a floor from the east-west bracing connections for ease of detailing.

At the north side of the tower, an existing driveway, which provides access into One Nationwide Plaza, had to remain open throughout the construction. The path of the driveway eliminated two corner tower columns at the first-floor level. To support the columns above, two 2-story high transfer trusses were used. Both trusses, at the third-floor mechanical level, are composed of W14 chords and web members. The trusses, which span 42 ft and 31 ft, were designed for a maximum live-load deflection of ⅜-in. dictated by the exterior curtainwall support system. □

Architect
Bohm-NBBJ, Inc.
Columbus, Ohio

Structural Engineer
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Columbus, Ohio

Construction Manager
Turner Construction Company
Columbus, Ohio

Steel Fabricator
Owens Steel Company, Inc.
Columbia, South Carolina

Steel Erector
John F. Beasley Construction Company
Columbus, Ohio

Owner
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Columbus, Ohio

Robert Corby is a project structural engineer and project manager for Korda/Nemeth Engineering, Inc.

Jack Pettit is a principal and project manager for Bohm-NBBJ, Inc.

SAAB-SCANIA CAMPUS

A Design Forged in Steel

by Stuart D. Solfi and Alan M. Rosa

Saab-Scania of America developed this image-setting Parts & Accessories Distribution Center as the cornerstone of a new corporate campus near Meriden, Conn.

Despite the industrial mission of the structure, the multi-national automaker and aircraft manufacturer wanted a facility to make a strong statement about the American operating unit of the Swedish-based company. The 144,000-sq. ft center easily satisfies both the functional and aesthetic criteria that guided the program.

The effort began with a study of methods to improve the productivity and reduce overcrowding at a previous parts distribution hub. Any major expansion was ruled out there because the investment would have produced an essentially unmarketable building with a disproportionate ratio of office-to-warehouse space. This conclusion and the company's long-term need for more offices and a research facility led to the totally new P & A facility as the first priority in developing the 150-acre site just off an interstate in nearby Meriden/Wallingford. Other buildings to come will include a Corporate Office complex, Technical Center and other Scania-based operations. They are likely to share much of the architectural character evident in this first building.

Clear Definition of Operations

Like so many programs geared to industrial buildings, this one pivoted off a clear definition of the operational environment. An exhaustive analysis of present and projected needs identified the equipment, layout and other technologies necessary to support a more productive order flow. Once those criteria were identified, a design team led by the Wallingford office of Greiner, Inc., developed an appropriate envelope.

That design was forged in steel. Five hundred tons of A50 and A36 steel combined with 90,000 cu. yds. of reinforced concrete to deliver the needed answer.

Factors influencing the architectural engineering included the center's parts-storage media, 1,100-ft conveyor line and height limitations imposed by local authorities. Anticipated growth in the company's dealer network also dictated a building engineered to accept a probable expansion. The criteria translated into a gleaming showcase with three pronounced roof elevations. The 136,000 sq. ft of warehouse/order processing space has high- and low-bay areas with an 8,000-sq. ft office at the front. Environmental, lighting and life-safety systems are high-efficiency, task-balanced systems selected to deliver lowest operating cost and highest productivity.

The building gains much of its high-tech character from a glistening metal skin of factory-insulated metal wall panels finished in silver with Saab Blue accent striping. These, manufactured in a special run by H.H. Robertson, clad the building in a horizontal orientation, with a 7-ft high corporate signature just beneath the roof.

The rigid-steel frame is the product of a special analysis of load and other design criteria. The goal was to deliver a flexible, unrestricted space with the highest possible net cube. The expansion would occur along the north width of the building, which precluded cross bracing to preserve an unobstructed passage between the original and any future space.

Eye to Expansion

The decision was made to keep the steel framing for the possible expansion structurally independent of the original construction system. This also presented a better solution for controlling thermally induced expansion and contraction. Keeping the structural systems, walls and roofing independent should also minimize operational disruptions during any later construction program.

The decision, however, did impact the original building engineering by ruling out any wall bracing along the north side. Drift of the building frame caused by wind loading was minimized with moment-resisting connections and relatively deeper girders than if the building had incorporated wall bracing. The column footings and anchor bolts necessary for the expansion were built during the original construction and protected by a temporary masonry [illegible]ework.

The design also addressed the potential snow-load conditions along the base of the stepped roof elevations. The base of these walls could incur drift loads reaching 120 to 160 psf, compared to the 40 psf anticipated across unobstructed roofs in this snow belt. Consequently, 18-ga. metal decking extends about 20-ft out from the stepped walls before merging with 22-ga. material supporting the balance of the single-ply, ballasted roof.

The structural frame provides 37 ft of ceiling clearance in the high-bay space and 23 ft throughout the low-bay area. The high-bay portion has a total of 32 50-ft x 60-ft bays, aligned eight across and four deep, compared to 16 50-ft x 50-ft bays in two rows across the low-bay portion.

Primary members are 49-in. deep trusses with 36-in. and 32-in. deep long-span joists. Fabricated from A50 steel, they are on 6 ft-3 in. and 5-ft centers, respectively. Welded moment-resisting connections apply to the top and bottom chords with the frame's balance comprised of 10-in. deep, wide-flange spandrel beams and girts.

The 14-in. deep, wide-flange columns are fabricated from A36 steel. These stand at alternating, major-minor axes to equalize the frame's stiffness in all directions. The columns in the high-bay area have 34-ft unsupported lengths compared to columns with 21-ft unsupported lengths in the low-bay space. Column web stiffener plates help resist top and bottom axial

Structural steel framing provides 37 ft of ceiling clearance for parts storage.

chord reactions of up to 180 kips. The columns have varying thickness base plates anchored by four-bolt moment connections to reinforced concrete piers and footings. The anchor bolts vary from ¾-in. to 1½-in. in diameter.

The high-bay space houses steel racks for the palletized storage of slower-moving parts. Aligned in 210-ft long aisles, they subdivide into 8 to 14 levels, depending on the required cube for pallets. The loaded shelving, which concentrates floor loads up to 13,000 lbs., are distributed by ½-in. thick, 12-in. x 12-in. base plates attached to rack support columns. This section of the building received an 8-in. floor slab, reinforced top and bottom with wire mesh. Because of the height of the racks, the narrow aisle layout and the use of wire-guided, high-lift order pickers which track a floor-embedded signal grid, it was necessary to construct these slabs with a surface finish tolerance of ⅛-in. in 10 ft. A 6-in. single-reinforced floor went into low-bay space housing modular carousels used for other parts, conveyor lines and general order staging. The office area steps down to a 14-ft ceiling height with 50-ft joists on 5-ft centers. Simple bolted and welded connections were used here with wide-flange columns.

High-rise steel shelving and parts conveyor system

Both the site and building plan reflect a conscious effort to make the parts and accessories distribution center compatible with others planned in the ultimate build-out of the campus. For example, the 15 dock stations are situated across the south side of the building. This shields shipping/receiving activity from winter winds and from any direct view from the proposed office building. Other measures that will visually understate the industrial missions performed at the site include the property road scheme, earthen berms and extensive landscaping. Collectively, these measures should maintain the eye appeal sought by the owner.

Saab-Scania has demonstrated comparably high standards in previous building programs. This one produced a pace-setting status symbol almost as enviable as the company's turbo-charged sedans. □

Architect/Structural Engineer
Greiner, Inc.

General Contractor
C.H. Nickerson Company

Steel Fabricator
Topper & Griggs, Inc.

Owner
Saab-Scania of America, Inc.

Stuart D. Solfi, P.E., is senior vice president, and Alan M. Rosa is a structural engineer with Greiner, Inc. Wallingford, Connecticut.

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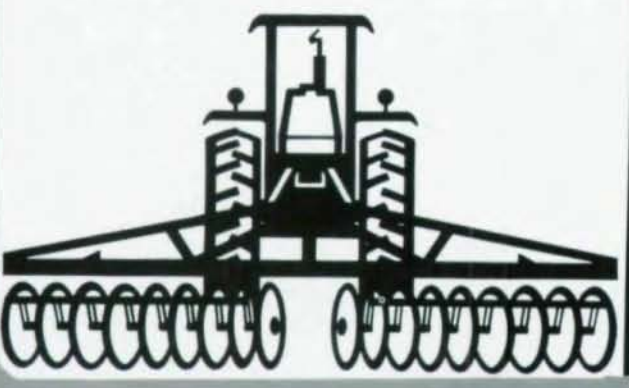

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Fabricators & Engineers, Working Together

1989 NATIONAL STEEL CONSTRUCTION CONFERENCE

OPRYLAND HOTEL

NASHVILLE, TENNESSEE

PROGRAM & REGISTRATION FORM

JUNE 21-24, 1989

SPONSORED BY THE

AMERICAN INSTITUTE OF STEEL CONSTRUCTION

Opryland Hotel Is Site for 1989 National Steel Construction Conference

The Opryland Hotel in Nashville, Tennessee is the site of the 1989 National Steel Construction Conference. One of the largest convention centers in the nation, Opryland is part of a complex that includes the Grand Ole Opry House and Opryland U.S.A. A recent expansion has nearly doubled the meeting space at Opryland. All sessions will be held in the hotel, and over 100 exhibit booths have been reserved in the Ryman Exhibit Hall.

The Conservatory's 10,000 tropical plants cover a two-acre area between two wings of guest rooms.

The new expansion, an interiorscape even larger than the Conservatory, called the Cascades, emphasizes water: streams, brooks, waterfalls and a lake of almost a half-acre. All under glass and surrounded by 824 new guest rooms.

Opryland Hotel has seven restaurants and lounges as well as several retail shops for the convenience of guests.

The Only "All-Steel" Show

The 1989 National Steel Construction Conference combines, for the third consecutive year, the AISC National Engineering Conference and AISC Conference of Operating Personnel. It is the only annual "all-steel" conference in the world, a "meeting of the minds," with special sessions focusing on the specific interests of structural steel fabricators, consulting engineers, architects, owners, public officials, erectors, detailers, researchers and educators.

The Conference continues to be the premier meeting place for engineering professionals, the best place to obtain the most information about buildings and bridges designed and built in steel.

The focus is on practical solutions to common problems, but it has also been the first forum for introducing the latest research on structural steel design, recent code changes and technological advances.

This year's highlights will include the introduction of the **9th Edition, Manual of Steel Construction**—the first revision of the Allowable Stress Design Manual in nine years; the premier presentation of the 1989 T. R. Higgins Lecture; continuing dialogue in the debate over responsibility for connection design; guidelines for avoiding "bad bolts" and complying with EPA toxic waste disposal regulations; a new Fracture Control Plan for heavy weldments.

Special presentations will focus on the Minneapolis Convention Center, the Bishopsgate Office Complex (London) and an overview of Scandinavian advances in steel bridges and tunnels, as well as recent U.S. "jointless," truss and cable-stayed bridges.

SCHEDULE OF EVENTS

(Note: "R" Sessions are Repeats.)

Wednesday, June 21

12:30-1:15	Product/Service Workshops A1 A2 A3 A4
1:30-5:00	Educator Session
1:30-5:00	AISC Professional Member Forum
1:30-3:00	Plenary Session—Dealing with the Shop Work Force: New Hires, Shop Rules, Productivity & Employee Relations
3:30-5:00	Workshop Sessions/Seminars 1 2 3
5:15-6:00	Product/Service Workshops B1 B2 B3 B4
6:30-7:30	AISC Cocktail Party

Thursday, June 22

7:30-8:15	Product/Service Workshops C1 C2 C3 C4
8:30-8:45	Plenary Session—Welcome/Announcements
8:45-9:15	Plenary Session—AISC Position, ASCE Manual on Quality of the Constructed Project
9:15-10:00	Plenary Session—Panel: Responsibility for Connection Design
10:30-11:15	General Session: Bishopsgate Office Complex (London)
11:15-Noon	General Session: Major Scandinavian Bridges and Tunnels Workshop Sessions/Seminars 1R 2R 4
Noon-1:15	Lunch—Exhibit Hall (Exhibits Open)
1:15-2:30	EXHIBIT SESSION and Product/Service Workshops POSTER SESSION
1:30-2:15	Product/Service Workshops D1 D2 D3 D4
2:30-3:55	Workshop Sessions/Seminars 3R 4R 5 6 7 8 9
4:00-5:30	Workshop Sessions/Seminars 4R 5R 6R 10 11 12 13
5:45-6:30	Product/Service Workshops E1 E2 E3 E4
7:00-10:30	OPTIONAL EVENT: General Jackson Showboat Dinner & Cruise

Friday, June 23

7:30-8:15	Product/Service Workshops F1 F2 F3 F4
8:30-9:15	Plenary Session: AISC Marketing's Design Analysis Service
9:15-10:00	Plenary Session: 9th Edition, AISC Manual of Steel Construction
10:30-Noon	Workshop Sessions/Seminars 7R 10R 14 15 16 17 18
Noon-1:30	Lunch
1:30-3:00	Workshop Sessions/Seminars 8R 9R 11R 12R 14R 19 20
3:30-5:00	Workshop Sessions/Seminars 13R 15R 16R 17R 18R 19R 20R
5:15-6:00	Product/Service Workshops G1 G2 G3 G4
7:00-9:15	OPTIONAL EVENT: Country Barbecue
9:30-11:00	OPTIONAL EVENT: Grand Ole Opry

Saturday, June 24

8:30-9:30	Plenary Session: T. R. Higgins Award and Lecture "Flexibly Connected Steel Frames"
10:00-11:30	Plenary Session: Material and Fabrication Considerations for Heavy Weldments: Minneapolis Convention Center
11:30	Drawing for Attendance Prizes
12 Noon	Adjourn
2:30-5:00	OPTIONAL EVENT: "Music, Music, Music"
9:30-11:00	OPTIONAL EVENT: Grand Ole Opry

SPOUSES PROGRAM

Wednesday, June 21

6:30-7:30 AISC Cocktail Party

Thursday, June 22

11:00-12:45 Welcome Brunch/Speaker: Opryland's Conservatory
1:00-5:00 Tour of Travellers' Rest and the Upper Room

Friday, June 23

9:30-5:00 Tour of Cheekwood (and Lunch)/Green Hills and Bandywood

Workshop Sessions

(See following pages for program details.)

1. Dealing with Shop Work Force
2. Welding Procedures
3. Tubular Structures
4. Connection Design Responsibility
5. Toxic Waste Disposal
6. Economical Steel Connections & Details
7. New Seismic Design Developments
8. Eccentric Bracing for Lateral Loads
9. Long-span Steel Bridge Construction
10. Surface Preparation & Painting
11. New Welding Technology, Specifications and Concepts
12. New Steel Connection Concepts
13. Design Guides & Software
14. Water Base Paint Procedures
15. High Strength Bolts
16. Steel Bridge Advances
17. ATLSS
18. Serviceability Considerations
19. 9th Edition, Manual
20. Shop & Erection Problems

EXHIBIT HOURS:
Wed., June 21, 11:00 AM-8:00 PM
Thurs., June 22, 10:00 AM-8:00 PM
Fri., June 23, 8:00 AM-3:00 PM
Special Exhibit Session:
Thursday, June 22: 1:15-2:30 PM
(No workshops or seminars scheduled.)

Product & Service Workshops

This year the National Steel Construction Conference introduces a new education/information feature: special sessions, sponsored and produced by exhibitors, which offer a forum where companies who supply the structural steel industry can share the latest technological advances in products and services.

These Product/Service Workshops will be conducted during specific time periods, not in conflict with regular Conference Sessions, and the schedule will be included as part of the Official Conference Program.

OFFICIAL PROGRAM OF EVENTS

MONDAY — JUNE 19

8:00 AM 5:00 PM	**Exhibitor Move-in**—Ryman Exhibit Hall

TUESDAY — JUNE 20

8:00 AM 11:00 AM 5:00 PM	**Exhibitor Move-in Continues**—Ryman B **Registration Desk Open**—Ryman B

WEDNESDAY — JUNE 21

12:30-1:15 Product/Service Workshops

1:30-5:00 *Educator Session*

1:30-5:00 AISC Professional Member Forum

1:30-3:00 Plenary Session—Dealing with the Shop Work Force: New Hires, Shop Rules, Productivity & Employee Relations
Moderator: S. W. Blaauw, Vice President/Operations, Paxton & Vierling Steel Company—Omaha, NE
Speakers:
James E. Self, Corporate Personnel Manager, Cives Steel Company—Roswell, GA
Max Downing, President, Selway Corporation—Stevensville, MT
Representatives of fabricating firms and industry consultants discuss shop rules, evaluating and processing new employees (physical examination, hearing test, drug testing, etc.) on-the-job employee relations and effect of company personnel procedures on productivity.
(See Also Workshop #1)

3:30-5:00 Workshop Sessions/Seminars
1. Dealing with the Shop Work Force
2. Welding Procedures
3. *Tubular Structures*

5:15-6:00 Product/Service Workshops

On stage at "Music, Music, Music"—optional event #4

THURSDAY — JUNE 22 (Morning)

7:30-8:15 Product/Service Workshops

8:30-8:45 WELCOME—**Samuel Y. Golding,** President, Standard Structural Steel Co., Newington, CT **and** Chairman, AISC

8:45-9:15 Plenary Session—AISC Position, ASCE Manual on Quality of the Constructed Project
AISC has issued a statement on a proposed Chapter 21 of the American Society of Civil Engineers' Manual on Quality of the Constructed Project, objecting to assignment of responsibility for connection design as outlined in the proposed Chapter. An AISC spokesman will explain the Institute's position in greater detail.

9:15-10:00 Plenary Session—Panel: Responsibility for Connection Design
Moderator: Robert B. Nelson, Vice President/Engineering, AFCO Steel—Little Rock, AR
Speakers: Mark Holland, Chief Engineer, Paxton & Vierling Steel Company—Omaha, NE
Leonard Ross, President, L.N. Ross Engineering Co.—Atlanta, GA
Company Representative (to be named)
Black & Veatch Architects & Engineers—Kansas City, MO
Panel includes fabricator, engineer, architect and owner in discussion of one of the most-debated engineering issues of the 1980's: responsibility for connection design. (See also Workshop #4)

10:00-10:30 Coffee Break—Exhibits Open

10:30-11:15 General Session: Bishopsgate Office Complex (London)
"Exposed Steel Frame—A Unique Solution for Bishopsgate, London"
Hal Iyengar, Partner and Director of Structural Engineering, Skidmore, Owings & Merrill—Chicago, IL
Exposed steel framework requiring no fireproofing (curtainwall is of fire-rated construction) utilized large clear spans and column transfers for constricted site in London as new and unique solutions respond to century-old tradition of iron, steel and glass in Britain.

11:15-Noon *General Session: Major Scandinavian Bridges and Tunnels*
Henning Agerskov, Associate Professor/Structural Engineering, Technical University of Denmark—Lyngby, Denmark
Emphasis in design on fabrication and erection considerations result in very economical Scandinavian steel bridges with many alternative solutions; Denmark's Great Belt bridge and tunnel project is given special emphasis.

10:30-Noon Workshop Sessions/Seminars
1R. Dealing with Shop Work Force (Repeat)
2R. Welding Procedures (Repeat)
4. Connection Design Responsibility

OFFICIAL PROGRAM OF EVENTS

THURSDAY — JUNE 22 (continued)

Noon-1:15	Lunch—Exhibit Area (Exhibits Open)
1:15-2:30	EXHIBIT SESSION POSTER SESSION
1:30-2:15	Product/Service Workshops
2:30-3:55	Workshop Sessions/Seminars 3R. Tubular Structures (Repeat) 4R. Connection Design Responsibility (Repeat) 5. Toxic Waste Disposal 6. Economical Steel Connections & Details 7. New Seismic Design Developments 8. Eccentric Bracing for Lateral Loads 9. Long-span Steel Bridge Construction
4:00-5:30	Workshop Sessions/Seminars 4R. Connection Design Responsibility (Repeat) 5R. Toxic Waste Disposal (Repeat) 6R. Economical Steel Connections & Details (Repeat) 10. Surface Preparation & Painting 11. New Welding Technology, Specifications & Concepts 12. New Steel Connection Concepts 13. Design Guides & Software
5:45-6:30	Product/Service Workshops

FRIDAY — JUNE 23

7:30-8:15	Product/Service Workshops
8:30-9:15	Plenary Session: AISC Marketing's Design Analysis Service **Ronald L. Flucker,** General Manager, AISC Marketing, Inc.—Pittsburgh, PA Project design analysis services available from AISC Marketing to those in the process of evaluating framing materials for buildings and bridges are described.
9:15-10:00	Plenary Session: 9th Edition, AISC Manual of Steel Construction **Speaker: Robert O. Disque,** Director/Building Design Technology, AISC—Chicago, IL The 9th Edition of AISC's Manual of Steel Construction is scheduled for publication in mid-1989, the first revision of the Allowable Stress Design Manual in nine years. AISC staff will premier the new edition in this special presentation. (See also Workshop #19)
10:00-10:30	Coffee Break—Exhibit Hall (Exhibits Open)
10:30-Noon	Workshop Sessions/Seminars 7R. New Seismic Design Developments (Repeat) 10R. Surface Preparation & Painting 14. Water Base Paint Procedures 15. High Strength Bolts 16. Steel Bridge Advances 17. ATLSS 18. Serviceability Considerations

FRIDAY — JUNE 23 (continued)

Noon-1:30	Lunch—Exhibit Hall (Exhibits Open)
1:30-3:00	Workshop Sessions/Seminars 8R. Eccentric Bracing for Lateral Loads (Repeat) 9R. Long-span Steel Bridge Construction 11R. New Welding Technology, Specifications & Concepts (Repeat) 12R. New Steel Connection Concepts (Repeat) 14R. Water Base Paint Procedures (Repeat) 19. 9th Edition, Manual 20. Shop & Erection Problems
3:00-3:30	Coffee Break—Exhibit Hall (Exhibitor Moveout Begins at 3:30)
3:30-5:00	Workshop Sessions/Seminars 13R. Design Guides & Software (Repeat) 15R. High Strength Bolts (Repeat) 16R. Steel Bridge Advances (Repeat) 17R. ATLSS (Repeat) 18R. Serviceability Considerations (Repeat) 19R. 9th Edition, Manual (Repeat) 20R. Shop & Erection Problems (Repeat)
5:15-6:00	Product/Service Workshops

SATURDAY — JUNE 24

8:30-9:30	Plenary Session: T. R. Higgins Award and Lecture "Flexibly Connected Steel Frames" **Joint Winners:** **Kurt Gerstle,** Professor University of Colorado—Boulder, CO **and** **Michael Ackroyd,** Consultant Acton, MA
9:30-10:00	Coffee Break
10:00-11:30	Plenary Session: Material and Fabrication Considerations for Heavy Weldments: Minneapolis Convention Center **Larry A. Kloiber,** President, L. L. LeJeune Company—Minneapolis, MN The fabricator for this complex project describes the problems encountered in fabrication to meet the design constraints, especially regarding heavy weldments. Coordination and cooperation of the entire construction team (steel producer, fabricator, erector and designer) were required for satisfactory resolutions.
11:30	Drawing for Attendance Prizes
12 Noon	Adjourn

PROGRAM TOPICS

WORKSHOPS AND SEMINARS

1 Dealing with the Shop Work Force (Workshop)

Moderator: S. W. Blaauw, Vice President/Operations
Paxton & Vierling Steel Company—Omaha, NE

Assistant Moderator: Frank A. Becher,
Vice President/Manufacturing
Vincennes Steel Corporation—Vincennes, IN

Speakers:
James E. Self, Corporate Personnel Manager
Cives Steel Company—Roswell, GA
Max Downing, President
Selway Corporation—Stevensville, MT

Discussion continues from plenary session: shop rules, conditions for new hires, physical exam, hearing test, drug testing, employee relations and increased productivity.
Wednesday, June 21: 3:30—5:00 PM
Thursday, June 22: 10:30 AM—Noon (Repeat)

2 Welding: Procedures, Techniques, Inspection & Control (Workshop)

Moderator: W. H. Reeves, Jr., Operations Manager
Carolina Steel Corporation—Greensboro, NC

Panel:
Duane K. Miller, Welding Engineer
The Lincoln Electric Company Welding Technology Center—Cleveland, OH
L. E. Collins, Manager/Quality Control
Trinity Industries, Inc.—Montgomery, AL

A discussion of correct welding procedures, techniques and inspection; control of distortion.
Wednesday, June 21: 3:30—5:00 PM
Thursday, June 22: 10:30 AM—Noon (Repeat)

3 Tubular Structures-Fabrications and Connections (Workshop)

Moderator: D. T. Motyll, Manager Sales/Administration
Welded Tube Company of America—Chicago, IL
"Tubular Structures, Design, Fabrication & Connections"
Donald R. Sherman, Professor
University of Wisconsin—Milwaukee, WI
"Gaining Confidence with Fabrication, Welding and Inspection of Box Tube Connections"
Jeffrey W. Post, Consulting Welding Engineer
J. W. Post & Associates, Inc.—Humble, TX

Discussion of typical connections and fabrication techniques for tubular sections.
Wednesday, June 21: 3:30—5:00 PM
Thursday, June 22: 2:30—3:55 PM (Repeat)

4 Responsibility for Connection Design (Workshop)

Moderator: Robert B. Nelson, Vice President/Engineering
AFCO Steel—Little Rock, AR

Panel:
Mark Holland, Chief Engineer
Paxton & Vierling Steel Company—Omaha, NE
Leonard Ross, President
L. N. Ross Engineering Co.—Atlanta, GA
Company Representatives (to be named)
Black & Veatch Architects & Engineers—Kansas City, MO

Workshops continue discussion from Thursday morning's Plenary Session, offering opportunity for expanded presentations by panel leaders and a more informal forum for industry dialogue.
Thursday, June 22: 10:30 AM—Noon
Thursday, June 22: 2:30—3:55 PM (Repeat)
Thursday, June 22: 4:00—5:30 PM (Repeat)

5 Disposing of Toxic Waste (Workshop)

Moderator: Charles Peshek, Jr.
Director/Fabricating Operations and Standards
AISC—Chicago, IL

Speaker:
Robert Waldhauser, Production Manager
Fought & Company, Inc.—Tigard, OR

There are EPA regulations for proper and legal disposal of toxic waste (i.e., paint residue, etc.). You can't just dump it in the back yard; if, however, you have already done so, you'll have to clean it up. Proper procedures are described, with ample time for answers to your questions and an opportunity for you to share your company's efforts to solve its own problem.
Thursday, June 22: 2:30—3:55 PM
Thursday, June 22: 4:00—5:30 PM (Repeat)

6 Economical Steel Connections and Details (Seminar)

Moderator: Lewis B. Burgett, *Associate Director of Education*
AISC—Atlanta, GA

Speakers:
John W. Nagel, Chief Engineer
AFCO Steel—Little Rock, AR
David T. Ricker, Vice President/Engineering
The Berlin Steel Construction Company—Berlin, CT

A discussion among fabricators on what constitutes economical connections and details. Real examples will be presented for comments by the audience.
Thursday, June 22: 2:30—3:55 PM
Thursday, June 22: 4:00—5:30 PM (Repeat)

7 New Developments in Seismic Design of Steel Structures (Seminar)

"The Building Seismic Safety Council Program on Improved Seismic Safety Provisions"
Gerald H. Jones, Vice Chairman/Building Seismic Safety Council and Director/ Codes Administration—Kansas City Kansas City, MO
"Supplemental Damping for Improved Seismic Resistance of Buildings"
Robert D. Hanson, Professor of Civil Engineering
University of Michigan—Ann Arbor, MI

Review of the new 1988 edition of the NEHRP Recommended Provisions for Development of Seismic Regulations for New Buildings: state-of-the-art guidelines for buildings in U.S. earthquake-risk areas. Second presentation summarizes effects of supplemental damping in both retrofit and new building design for improved seismic resistance and analyzes several commercially available damping devices.
Thursday, June 22: 2:30—3:55 PM
Friday, June 23: 10:30 AM—Noon (Repeat)

8 Eccentric Bracing for Lateral Loads (Seminar)

"Eccentric Braced Steel Frames for Wind and Low-to-Moderate Seismic Loads"
Stanley D. Lindsey, President
Stanley D. Lindsey & Associates, Ltd.—Nashville, TN
"Tests on Long Links in Seismic-Resistant Eccentrically Braced Frames"
Michael D. Engelhardt, Asst. Professor of Civil Engineering
University of Texas—Austin, TX

Continuing research indicates use of eccentrically braced frames (EBFs) can be much greater than originally intended (i.e. in high seismic areas). Design concepts for EBF in low to moderate seismic regions and in non-seismic areas will include actual examples of use and economics (LRFD approach emphasized). Second paper describes recent experimental results on behavior of long, flexural yielding links in EBFs.
Thursday, June 22: 2:30—3:55 PM
Friday, June 23: 1:30—3:00 PM (Repeat)

9 Innovations in Long-span Steel Bridge Construction (Seminar)

"Erecting Procedure for the Cooper River Bridge"
George P. Wright, Jr., President
Tylk, Wright & Gustafson, Inc.—Frankfort, IL

"A State-of-the-Art Review of Cable-Stayed Bridges"
Anthony F. Gee, Consultant/Tony Gee & Quandel Division
Alfred Benesch and Company—Atlanta, GA

Features both truss and cable-stayed advances: design and erection of three-span continuous truss (Warren-type) Cooper River Bridge described; overview of progressive design developments leading to bigger, more economical cable-stayed bridges in U.S.
Thursday, June 22: 2:30—3:55 PM
Friday, June 23: 1:30—3:00 PM (Repeat)

10 Surface Preparation & Painting (Workshop)

Moderator: Frank A. Becher, Vice President/Manufacturing
Vincennes Steel Corporation—Vincennes, IN

Speakers:
Donald A. Ziegler, Vice President/Engineering
Vincennes Steel Corporation—Vincennes, IN
Jon R. Cavallo, Representative
S. G. Pinney & Associates, Inc.—Eliot, ME

Problems and solutions are offered for the proper surface preparation of structural steel members to attain required surface and profile. Procedures for using zinc-rich paints are also described.
Thursday, June 22: 4:00—5:30 PM
Friday, June 23: 10:30—Noon (Repeat)

11 Welding Technology—New Specifications and Concepts (Seminar)

"A Fracture Control Plan for Welded Static Structures"
Gerard A. Gix, Senior Welding Engineer
Neyer, Tiseo & Hindo, Ltd.—Farmington Hills, MI

"AISC Specification Rules for Tension Splices of Jumbo Shapes"
William A. Milek, Consultant (& Director of Research, Emeritus), AISC—Chicago

A Fracture Control Plan for heavy weldments which encompasses design considerations, material requirements, quality control for both fabricator and erector (including verification of performance by independent testing agency) is described. The new AISC Specification provisions for welding tension splices in heavy shapes and plates are also presented.
Thursday, June 22: 4:00—5:30 PM
Friday, June 23: 1:30—3:00 PM (Repeat)

12 New Concepts in Steel Connections (Seminar)

"Behavior and Design of Single Plate Shear Connections"
Abolhassan Astaneh, Assistant Professor
University of California—Berkeley, CA

"Experimental Study of Gusseted Connections for Laterally Braced Steel Buildings"
John L. Gross, Research Civil Engineer
National Institute of Standards & Technology—Gaithersburg, MD

New and comprehensive (yet simple) design procedures for single plate shear tab connections, forming the basis of new 9th Edition AISC-ASD Manual tables, are described; National Institute of Standards and Technology researcher describes recent tests to determine behavior of gusseted connections for laterally braced steel buildings.
Thursday, June 22: 4:00—5:30 PM
Friday, June 23:1-30-3:00 PM (Repeat)

13 AISC Design Guides & Software (Seminar)

Nestor Iwankiw, Director/Research and Codes
AISC—Chicago, IL
Cynthia J. Zahn, Staff Engineer/Structures
AISC—Chicago, IL

AISC staff will describe and explain the various design guides and software available through the Institute's Publication Department.
Thursday, June 22: 4:00—5:30 PM
Friday, June 23, 3:30—5:00 PM (Repeat)

14 Use and Application of Water Base Paint (Workshop)

Moderator: Charles Peshek, Jr. Director/Fabricating Operations and Standards
AISC—Chicago, IL

Speakers:
William G. Morrow, Manager/Corrosion Control Group
and
Douglas M. Jones, Manager/Engineering, Research Services
Southern Coatings, Inc.—Sumter, SC

A discussion of water base paint. Can it solve the disposal problem and still be satisfactory from both application and maintenance standpoints? Procedures for proper application are included in the presentation.
Friday, June 23: 10:30—Noon
Friday, June 23: 1:30—3:00 PM (Repeat)

15 H.T. Bolts—Purchase Order, Testing, Selection of Type and Installation (Workshop)

Moderator: W. H. Reeves, Jr., Operations Manager
Carolina Steel Corporation—Greensboro, NC

Speaker:
Thomas S. Tarpy, Jr., Vice President/Structural Engineer
Stanley D. Lindsey & Associates—Nashville, TN

Quality, and source, of high strength bolts continues to be a subject of controversy and potential hazard in the structural steel industry. This workshop offers guidelines on selection of bolt type, testing requirements and proper preparation of purchase orders. The how-to of determining manufacturing source by head and nut marking is described.
Friday, June 23: 10:30 AM—Noon
Friday, June 23: 3:30—5:00 PM (Repeat)

PROGRAM TOPICS

16 Advances in Steel Bridge Design (Seminar)

"Jointless Decks Advance Steel Bridges"
Morad G. Ghali, Project Engineer/Design
Howard Needles Tammen & Bergendoff—Atlanta, GA

"Behavior of Two-Span Plate Girder Bridge Designed by Alternate Load Factor Method"
Mark Moore, Senior Structural Engineer
Wiss, Janney, Elstner Associates, Inc.—Irving, TX

Raleigh-Durham Airport's Taxiway "E" illustrates benefits of jointless deck with welded steel plate girders, special focus on treatment of effect of aircraft's acceleration and braking; results of experimental test program evaluating behavior of autostress-designed continuous plate girder bridge with precast prestressed deck panels are also presented.
Friday, June 23: 10:30—Noon
Friday, June 23: 3:30—5:00 PM (Repeat)

17 Research on Behavior, Design and Erection of Steel Connections at the ATLSS Center (Seminar)

"Overview of Constructional Steel Research at the ATLSS Multidirectional Laboratory"
John W. Fisher, Professor of Civil Engineering and Director/ATLSS, Lehigh University—Bethlehem, PA

"Behavior and Strength under Monotonic and Cyclic Loading: Top and Seat Angle Connections and End Plate Connections"
George C. Driscoll, Professor of Civil Engineering and Principal Investigator, ATLSS Center
Lehigh University (Fritz Laboratory)—Bethlehem, PA

"Pre-Load vs. Snug-tight in Bolt Installation"
Cameron Chasten, Research Scholar
Lehigh University—Bethlehem, PA
and
Robert B. Fleischman, Research Scholar
Lehigh University—Bethlehem, PA

An overview of the work at the ATLSS Center as well as presentations of test re. ults on behavior and strength under monatonic and cyclic loading and pre-load vs. snug-tight in bolt installations.
Friday, June 23: 10:30—Noon
Friday, June 23: 3:30—5:00 PM (Repeat)

18 Serviceability Considerations in Steel Structures (Seminar)

"Optimization of Tall Steel Structures for Wind Loadings"
Charles H. Thornton, President
Thornton-Tomasetti—New York, NY

"Serviceability Design Considerations for Low-rise Buildings"
Michael A. West, Vice President
CSD—Milwaukee, WI

Presentation on optimization techniques which offer designer the ability to quantify efficiency of resistance to lateral loads in high rise buildings early in design. The goal of the second paper is to document in a single source the various existing serviceability criteria for low-rise buildings on deflections, vibrations and draft.
Friday, June 23: 10:30—Noon
Friday, June 23: 3:30—5:00 PM (Repeat)

19 AISC's New Allowable Stress Design Specification and the 9th Edition of AISC's Manual of Steel Construction (Workshop)

Moderator: Robert O. Disque, Director/Building Design Technology, AISC—Chicago, IL

Speakers:
Ted Winneberger, Senior Vice President/Engineering
W & W Steel Company—Oklahoma City, OK
Hollis L. "Pat" Hance, Jr., Executive Vice President/Sales
Southern Engineering Company—Charlotte, NC

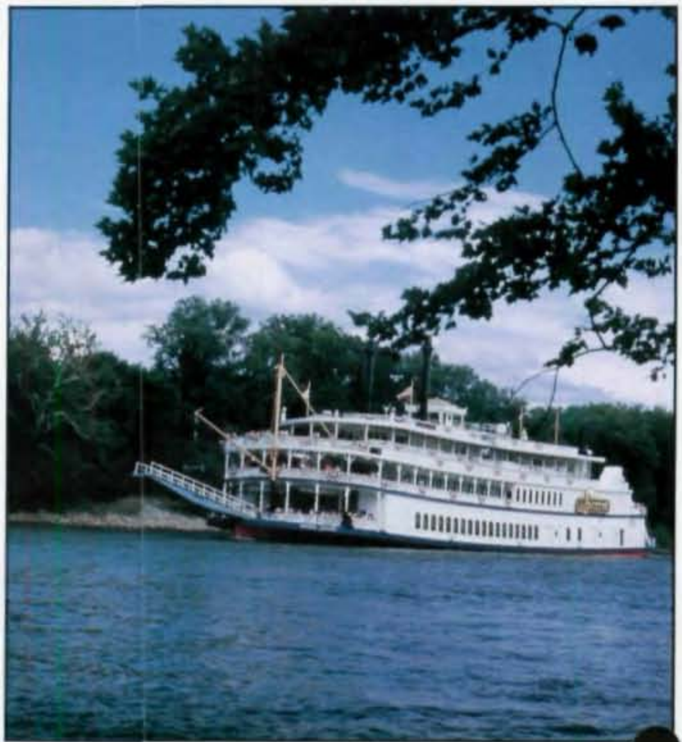
AISC's Manual Committee will continue the morning's Plenary Session with a broader, more detailed discussion of "what's new" in the 9th Edition and some suggestions on utilizing the revised version.
Friday, June 23: 1:30—3:00 PM
Friday, June 23: 3:30—5:00 PM (Repeat)

20 Shop and Erection Problems (Workshop)

Moderator: Frank A. Becher, Vice President/Manufacturing
Vincennes Steel Corporation—Vincennes, IN

Speakers:
James W. Neal, President
John F. Beasley Engineering Co., Div of
John F. Beasley Construction Company—Dallas, TX
Mark Douglas, Project Manager
Broad, Vogt & Conant, Inc.—River Rouge, MI

Three experienced, knowledgeable (and successful) steel erectors bring to the forefront some very common erection problems—and offer very cogent advice on how to avoid both the problems and the disastrous consequences that often follow in their wake.
Friday, June 23: 1:30—3:00 PM
Friday, June 23: 3:30—5:00 PM (Repeat)



General Jackson dinner cruise—optional event #1

SPOUSES' PROGRAM

Those registering for the COMPLETE Spouses' Program will receive tickets for **all** events listed below. Anyone wishing to register for any one or more of these events INDIVIDUALLY, may do so by selecting Events A, B, C and/or D on the Conference Registration Form (see opposite page).

Event A—*Wednesday, June 21: 6:30—7:30 p.m.*
Get-acquainted Cocktail Party, *in the Exhibit Hall.* Includes drinks, hors 'douevres and entertainment. (Note: this event is also included in the Conference Registration Fee.)

Event B—*Thursday, June 22: 11:00 a.m.—12:45 p.m.*
"Food and Foliage" aptly describes this Nashville-style Welcome Brunch. The lavish display includes popular selections from the famous Opryland Sunday Brunch menu. And we've invited one of Opryland's "green thumb" experts who care for the 10,000 thriving plants in the hotel's three-acre Conservatory & Cascade to give us some informative tips on the selection, care and maintenance of house and landscaping plants.

Event C—*Thursday, June 22: 1:00—5:00 p.m.*
Amid the Tennessee magnolias is the oldest home in Nashville, Judge John Overton's Travellers' Rest, dating to 1799. A functioning weaving house, smokehouse, formal garden and a display of prehistoric Indian relics enhance the site. On the way we'll stop for a visit at a most unique chapel/museum: the Upper Room with its many depictions of the "Last Supper" and an unusual collection of cultural and religious artifacts commemorating man's quest for eternal truths.

Event D—*Friday, June 23: 9:30—5:00 p.m.*
Cheekwood is one of the South's most beautiful private estates, housing modern galleries of fine art and architectural treasures from numerous private and public collections. We'll lunch in Cheekwood's Pineapple Room, with its wonderful garden view and then visit Green Hills/Bandywood Fashion Square. Green Hills is Nashville's most exclusive mall: three department stores, 40 shops, and Bandywood is sometimes described as the "most exciting l/4-mile in Tennessee."

Spouses' Program Registration Fee: $90.00
(Includes Events #A, B, C & D)

Grand Ole Opry—events #3 & 4

OPTIONAL EVENTS

Event #1—*Thursday, June 22, 7:00—10:30 p.m.*
General Jackson Showboat dinner cruise & revue offers a total entertainment experience, featuring a sumptuous prime rib dinner and spectacular musical production—with additional musical excitement on all four decks. (Includes transportation to boat, dinner, show & gratuities; cash bar.)
Price per person: $42.00

Event #2— *Friday, June 23, 7:00—9:15 p.m.*
We'll provide private tram cars for a **"Down-Home" Country Barbecue** in our own little corner of Opryland—right next door to the Grand Ole Opry. There'll be continuous entertainment by some of Nashville's brightest talent, who'll stop "pickin' and singin'" just in time for you to walk across the street to the Grand Ole Opry's evening show. (Complimentary beer and wine, cash bar for mixed drinks.)
Price per person: $30.00
(See Event # 3 for Grand Ole Opry Tickets, priced as separate event.)

Event #3—*Friday, June 23, 9:30—11:00 p.m.*
A visit to Music City is not complete until you've attended a performance of the longest-running live radio show in the world, the Grand Ole Opry.
Ticket Price (including tax): $13.00

Event #4—*Saturday, June 24, 2:30—5:00 p.m.*
The extravagant musical production **Music, Music, Music** is presented in the Acuff Theatre, featuring a cast of 22 singers and dancers and a 16-piece orchestra. Music star Brenda Lee is featured.
Ticket Price (including tax): $10.00

Event #5—*Saturday, June 24, 9:30—11:00 p.m.*
Grand Ole Opry Saturday night performance.
Ticket Price (including tax): $13.00

Event #6—Opryland USA Theme Park 3-day Pass
The world's only musical showpark, Opryland USA, offers up to 12 daily shows in simultaneous performance devoted to gospel, rock 'n' roll, bluegrass, contemporary country and songs of the Old West, more than 21 thrilling rides, a variety of restaurants, specialty shops, sidewalk artists, craftsmen, and games. Through AISC, you may purchase theme park tickets valid for three consecutive days' admission at the price usually charged for a one-day park admission.
Price per pass (including tax): $18.00

Airline Discounts

American Airlines has been designated as Official Carrier for the Conference. American will offer 5% off the lowest published fare at time of booking (subject to $30 service fee when applying for a full or partial refund once tickets are issued). This special fare must be purchased at least 7 days in advance, based on class availability and is valid to Nashville from the 48 states, Hawaii, Puerto Rico and the Virgin Islands.

American has set up a special number for the Conference. You or your travel agent should call:

1-800-433-1790 and refer to
AISC Star Number: S68274

HISTORICAL AND CULTURAL ATTRACTIONS

The Hermitage: Home of President Andrew Jackson
4580 Rachel's Lane, Hermitage

Tennessee's premier historic attraction, the Hermitage was the home of Andrew Jackson, 7th President of the U.S. and hero of the Battle of New Orleans. The beautiful Greek revival mansion is furnished with original family pieces of furniture, silver, paintings, etc. Tulip Grove, home of Andrew Jackson Donelson, is located across the road. Admission charged.

Belle Meade Mansion
110 Leake Avenue

The queen of Tennessee plantations, this 19th century mansion was the crowning jewel of a 5,300-acre working plantation and the site of one of the first thoroughbred breeding farms in the U.S. Admission charged.

Belmont Mansion
Box A-39, Belmont College

Ornate Italian villa built in the 1850's and, at the time of its construction, recognized as one of the most elaborate and unusual homes in the South. Admission charged.

Cumberland Science Museum
800 Ridley Boulevard
(615) 259-6099

The Museum offers unique opportunities for fun and learning with its many programs and hands-on exhibits, live animal shows, health and science programs, and the Sudekum Planetarium. Admission charged.

Fort Nashborough
170 First Avenue North
(Downtown Nashville)
(615) 255-8192

This rugged log building, a replica of Fort Nashborough, stands atop a bluff overlooking the Cumberland River. It was at this location that James Robertson and a hardy band of pioneers established what was later to become Nashville. Donations accepted.

Governor's Residence
882 South Curtiswood Lane
(615) 383-5401

Tennessee's home for its chief executive. Tours by reservation only.

Historic Rock Castle
139 Rock Castle Lane, Hendersonville
(615) 824-0502

Historic home of General Daniel Smith, one of the earliest examples of Federal Architecture in Middle Tennessee (built around 1790 while Sumner County was part of North Carolina). The 2-story, 7-room stone house (furnished in late 18th century and very early 19th century antiques), smokehouse and family cemetery are all that remain of a 3,140-acre plantation. Admission charged.

The Parthenon
West End and 25th Avenue, Centennial Park
(615) 259-6358

An exact-size replica of the ancient Parthenon in Greece, the building also houses art exhibits and artifacts. Greek theater is performed on the steps of the building in summer. Admission: Minimal charge.

One of 31 thrilling rides at Opryland USA—event #6 for 3-day pass

SHOPPING IN THE NASHVILLE AREA

Anyone who lives to shop could spend a lifetime in Nashville. An abundance of malls, specialty shops, souvenirs, antiques and more makes Nashville shopping diverse and delightful. Whether you venture downtown or visit some secluded emporium, you won't be disappointed.

Downtown are more than 300 stores, an array of specialty and souvenir outlets: antiques, plants, designer labels, custom hats, musical instruments and more. Shopping in the historical district along Market Street features boutiques, an ice cream parlor and a bakery—musical performers entertain workers and shoppers at noon.

Bandywood Shopping Area includes antiques, crafts, clothing and sporting goods.

Farmer's Market has fresh fruits, vegetables and plants for sale, between 7th and 8th Avenues, N. and Jefferson Street, downtown Nashville.

The Nashville Flea Market, held at the Tennessee State Fairgrounds, is held the fourth weekend of every month except September and December (and will be held June 24-25, 1989). Usually more than 450 traders, craftsmen and antique dealers. Hours: Saturday, 9 AM—6 PM; Sunday, Noon-6 PM.

Franklin Shopping Area in Historic Franklin features more than 50 shops, including antique and art galleries, specialty shops and restaurants. **Carter's Court** is located across from the Carter house in Franklin with two restaurants and 12 specialty shops, including antique, craft and jewelry shops.

REGISTRATION AND ROOM RESERVATION FORM

Registration Fees: (Please circle appropriate fees)

AISC Member Fee: $275.00 (before May 1)
$325.00 (after May 1)
(Includes AISC Active, Associate & Professional Members)

Non-Member Fee: $325.00 (before May 1)
$375.00 (after May 1)

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: $ 75.00

Spouse's Fee: $ 90.00

Registration Fees Include all General and Plenary Sessions, workshops, seminars, coffee breaks, luncheons Thursday and Friday, the Get-acquainted Cocktail Reception Wednesday evening and a printed, bound copy of the Proceedings. Exhibitors are entitled to one registration for each booth reserved. "Added Exhibitor" fee is payable **ONLY** if in excess of one person per booth.

Registration Cancellation Policy: Cancellations received before June 16, 1989, 100% of pre-paid registration fees will be refunded; after June 16, 50% will be refunded. (Those cancelling after June 16 will receive their copy of the Conference Proceedings.)

Partial Registration Fees
(You may pre-register for only one day or half day. Circle your choice below.)

Half Day Sessions: (Lunch not included)	
Wednesday Afternoon	$ 50.00
Thursday Morning	$ 65.00
Thursday Afternoon	$ 65.00
Friday Morning	$ 65.00
Friday Afternoon	$ 65.00
Saturday Morning	$ 25.00
One Day Sessions:	
Thursday (includes Lunch)	$150.00
Friday (includes Lunch)	$150.00
Exhibit Visitor:	$ 5.00
Total Partial Registration Fees	**$**______

Registration for Optional Events

Event	No. Tickets	Total Price
#1—General Jackson (Thurs., 7 p.m.)	____@ $42.00	$ ______
#2—Down-Home Barbecue (Fri.,7 p.m.)	____@ $30.00	$ ______
#3—Grand Ole Opry (Fri., 9:30 p.m.)	____@ $13.00	$ ______
#4—Music, Music, Music Matinee (Sat., 2:30 p.m.)	____@ $10.00	$ ______
#5—Grand Ole Opry (Sat., 9:30 p.m.)	____@ $13.00	$ ______
#6—Opryland Theme Park 3-Day Pass	____@ $18.00	$ ______
#A—Cocktail Party (Wed., 6:30 p.m.)	____@ $20.00	$ ______
#B—Food & Foliage (Thurs., 11 a.m.)	____@ $25.00	$ ______
#C—Travellers' Rest (Thurs., 1 p.m.)	____@ $20.00	$ ______
#D—Cheekwood, Lunch & Shopping (Fri., 9:30 a.m.)	____@ $40.00	$ ______
Total Optional Event Fees		**$**______

PLEASE REGISTER: (Type or Print)

Name __________ Nickname (for badge) __________

Company __________ Title __________

Mailing Address __________

City and State/Zip __________ ( ) Bus. Phone ______ ( ) Home Phone ______

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

Name of Individual Registering for Other Events __________ Nickname (for badge) __________

Hotel Registration—Opryland Hotel

☐Single ($110) ☐Double ($122)

Do you wish to reserve an inside garden-terrace room (at an additional $25)?
☐Yes ☐No

Arrival Date__________ Time__________

Departure Date __________ Time__________

NOTE: Rooms are subject to 7 3/4% sales tax and 4% room tax. Rooms must be guaranteed by a separate check, payable to the Opryland Hotel, in the amount of one night's stay or by credit card (see space below). You must notify Opryland of any cancellation 72 hours in advance in order to receive a refund of your deposit. Opryland will honor and guarantee reservations received by May 16, so mail this form promptly.

☐ I enclose check for $__________ payable to the Opryland Hotel.

☐ Please charge my Credit Card # __________

Circle card Used: American Express VISA MasterCard Diners Carte Blanche Discover

Expiration Date: __________

Signature (if any credit card charges): __________

Conference Fees Payable:

Registration Fee:	$______
Spouse's Fee:	$______
Partial Registration Fees:	$______
Optional Events:	$______
TOTAL CONFERENCE FEES DUE:	**$**______

☐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

Expiration date__________

MAIL COMPLETED FORMS, CONFERENCE FEES AND HOTEL GUARANTEES TO:

American Institute of Steel Construction, Inc.
1989 National Steel Construction Conference
P.O. Box 806286
Chicago, Illinois 60680-4124
Phone inquiries and information: (312) 670-5422 or 5432

MSC#2

MSC ADVERTISERS

STEMFIRE

AISC Steel Member Fire Protection Computer Program

This new AISC computer program developed by Hughes Assoc. determines safe and economic fire protection for steel beams, columns and trusses. It is intended for use by architects, engineers, building code and fire officials, and others interested in steel building fire protection. STEMFIRE is based on rational procedures developed by the American Iron and Steel Institute that extend the published Underwriters Laboratories, Inc., fire resistive designs to other possible rolled structural shapes and common protection material requirements. For a required fire rating, STEMFIRE determines minimum spray-on thickness for various rolled steel shapes as well as the ceiling membrane or envelope protection for trusses. This methodology is recognized by Underwriters Laboratories, Inc. and has been adopted by the three national model building codes in the USA.

The software data base contains all the pertinent steel shape properties and many listed Underwriters Laboratories, Inc. *Fire Resistance Directory* construction details and their fire ratings. In this manner, user search time is minimized and the design or checking of steel fire protection is optimized. Hence, STEMFIRE is easy to use with little input effort to quickly produce specific design recommendations.

Minimum Equipment Requirements

- IBM PC, XT, AT or compatibles
- MS.DOS operating system
- One 5¼" floppy disk drive and hard drive
- 256K bytes of memory
- IBM compatible dot matrix printers or Hewlett Packard Laserjet

STEMFIRE Program Package

- Two 5¼" floppy disks containing executable software bearing AISC copyright
- Users Manual, with instructions and sample problems

Order Form

MAIL TO: AISC, STEMFIRE Order, P.O. Box 806276, Chicago, IL 60680-4124

I enclose payment of $_____ for qty. of _____ STEMFIRE at $96.00 each. (Member price: $72.00. Please give AISC Membership Number________)

Name & Title ________________

Company ________________

Address ________________

City __________ State_____ Zip_____

Phone number (_____) __________
Area

Please enclose remittance. No C.O.D. orders. In New York, California and Illinois, add sales tax. Shipping charges prepaid in the U.S. On shipments outside the U.S., add 10% of total purchase for postage and handling. Visa and MasterCard accepted.

Check one: ☐ Visa ☐ MasterCard

Charge to my card # ________________

Expiration date ________ Signature ____________