MODERN STEEL CONSTRUCTION

NUMBER 6 • 1989

THIS ISSUE

A New Gateway to History
Steel Solves a "Weight" Problem
Sharpest Curve in the Midwest!
It Wasn't There Yesterday!
Commanding Views of the Rockies

SPECIAL SECTION
1990 National Steel Construction Conference
DECK FINISHES

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THE TABLE REPRESENTS NORMAL INVENTORIES; HOWEVER ANY FINISH ON ANY PRODUCT MAY BE AVAILABLE ON SPECIAL ORDER.

NOTES — ROMAN NUMERALS IN THE TABLE CORRESPOND TO NUMERALS IN NOTES.

I. A. CHECK U.L. FIRE RESISTANCE DIRECTORY FOR FINISH REQUIREMENTS. GALVANIZED DECK SHOULD BE USED ON ROOF CONSTRUCTION WITH SPRAYED FIRE RESISTIVE MATERIALS. (SFRM).
B. GALVANIZED DECK IS RECOMMENDED FOR HIGH HUMIDITY AREAS.
C. GALVANIZED ROOF DECK IS RECOMMENDED FOR ROOF CONSTRUCTIONS WITH INSULATION BOARDS THAT ARE FASTENED TO THE DECK WITH PIERCING FASTENERS.
D. USD RECOMMENDS THE USE OF GALVANIZED MATERIALS FOR MOST EXPOSURES.
E. GALVANIZED STEEL IS COVERED BY ASTM A446; GALVANIZING IS COVERED BY ASTM A525; G60 AND G90 ARE COATING WEIGHTS.

II. A. "PHOS/PTD." MEANS THE FLOOR DECK IS ONLY PAINTED ON THE EXPOSED SIDE—THE CONCRETE SIDE SHOULD DEVELOP TIGHT RUST BEFORE THE CONCRETE IS POURED.
B. USE ONLY FOR INTERIOR APPLICATIONS—I.E. OFFICES OR HOTELS.
C. CHECK U.L. FIRE RESISTANCE DIRECTORY—SEE NOTE I.A.
D. "PHOS/PTD." IS APPLIED TO ASTM A611 STEEL.

III. A. "PRIME PAINTED" MEANS A PRIMER COAT OF PAINT IS APPLIED OVER CLEAN BARE STEEL. THE PRIMER PAINT IS FORMULATED TO HAVE "TOOTH" TO HOLD SUBSEQUENT APPLICATIONS OF FINISH PAINT BUT IT IS NOT INTENDED TO PROVIDE EXTENSIVE WEATHER PROTECTION; IT IS FREQUENTLY LEFT EXPOSED IN WAREHOUSES AND MANUFACTURING PLANTS, AND WHEN USED WITH SUSPENDED CEILINGS.

B. USE FOR BALLASTED ROOFS OR ADHERED ROOF SYSTEMS—SEE NOTE I.C.
C. SALT SPRAY (AND OTHER) TEST RESULTS ARE AVAILABLE ON REQUEST.
D. "PRIME PAINTED" DECK IS MADE FROM ASTM A611 STEEL.

IV. A. "GALV. + PAINT" MEANS PRIMER IS FACTORY APPLIED OVER GALVANIZED STEEL. THE PRIMER PAINT IS AS DEScribed IN III.
B. THIS FINISH IS MOST ECONOMICAL WHEN A FINAL COAT OF PAINT IS TO BE FIELD APPLIED.
C. USE IN HIGH HUMIDITY AREAS—THE PAINT PLUS GALVANIZING PROVIDES EXTREMELY GOOD MOISTURE PROTECTION.
D. "GALV. + PAINT" USES ASTM A446 STEEL.

V. A. FINISH COATS OF PAINT CAN BE FACTORY APPLIED. THIS IS DONE ON THE COILS OF STEEL BEFORE FORMING INTO DECK. ALMOST ANY COLOR OR PAINT TYPE CAN BE USED—HOWEVER TO BE ECONOMICAL, THE ORDER SHOULD BE FOR AT LEAST 20,000 SQUARE FEET.
B. WHEN INSTALLING DECK WITH A SPECIAL FINISH, SCREWED SIDE LAPS ARE RECOMMENDED: AND, IN MOST CASES, SCREWS, PNEUMATIC OR POWDER DRIVEN FASTENERS SHOULD BE USED AT SUPPORTS.
C. FINISH PAINT IS NORMALLY APPLIED OVER GALVANIZED STEEL CONFORMING TO ASTM A446.

VI. A. UNCOATED STEEL MEANS THERE IS NO COATING AT ALL. IT IS FREQUENTLY REFERRED TO AS "BLACK" STEEL.
B. UNCOATED STEEL CONFORMS TO ASTM A611.
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That was essential because the building, which was constructed for Evans & Sutherland Computer Corporation, is located within a mile of the Wasatch Fault in Salt Lake City. What’s more, Evans & Sutherland is a leading designer of special-purpose digital computers, software systems and display devices — products extremely vulnerable to damage from seismic tremors.

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So whether you need Vulcraft’s help to protect your building from earthquakes or you want to stay out of the hole when it comes to construction costs, contact any of the plants listed below. Or see Sweet’s 05100/VUL.

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WEST POINT VISITORS CENTER
A New Gateway to History

by Maria Valenti

Conquering challenges and solving problems is a way of life for cadets dedicated to "duty, honor and country" at the U.S. Military Academy in West Point, N.Y. The same spirit of creative resolution helped architects JSA Inc. successfully conclude a difficult mission at the Academy.

The New Hampshire-based architectural and planning firm was charged with designing an expansion to the West Point Visitors Center which would reflect the Academy's dignity and history, but which could be constructed for a predetermined price and within a fast-track time frame. A number of other restrictions and requirements were placed on structure and design by the Army Corps of Engineers.

The project is the centerpiece of both new construction and renovation work on the Academy's "New South Post" campus, acquired from the former Ladycliff College. It included an addition of a gift facility directly adjacent to the existing Visitors Center. A central atrium joins both structures and serves as a common entrance. Furthermore, the facade of the new gift facility replicates the Visitors Center building (a former library) and the new entrance and plaza creates an overall entrance identity to the complex. The project's completion marked the recent official opening of the New South Campus.

The central challenge, according to JSA partner and principal in charge of the project Jim Warner, was, "How do you design a building that can be built in a few months that looks exactly like an adjacent existing..."
Looking down axis of atrium toward entry shows separation of skylight and existing building. Drawing (r.) details juncture.

concrete building, but is made of less expensive and easier to erect materials?"

Specific restrictions in the Request for Proposal (RFP) issued by the Army Corps of Engineers included a prohibition on any structural connection to the existing Visitor's building—and even that the colors used must be Academy black, grey and gold.

Steel Meets the Challenges
Steel was selected as the material which would help the architects meet the design, cost and time demands of the RFP. Structure began to influence form as the JSA team, led by project architect Michael Tague, worked to satisfy the criteria and schedule set forth. For example, the use of structural steel columns to support the atrium skylight, while fulfilling the condition of not tying into the Visitor Center, helped shape the design of the 30-ft high glass atrium/entranceway.

According to Tague and consulting engineer Tim Shelley of Neill and Gunter, Inc. of Maine, steel tube ties were included in

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the atrium design to prevent the thrust of the skylight from kicking out into the existing building. The skylight structure was designed to also support the mechanical unit hidden in the skylight framing. "We just left the glass off of the rear part," said Tague.

Other existing conditions affected design details. "The concrete building we were trying to match had only four concrete columns in the whole building, supporting 60-ft span joists. We had to create a building that looked the same from the outside, but with steel. Obviously, we were not going to do it with only four columns," said Shelley.

The solution was a steel 30-ft by 30-ft bay grid using 18 steel W10 columns which would be, according to Shelley, "perfect for the almost 90-ft by 90-ft space."

As the design progressed, other challenges regarding the steel structure arose. "We had to revise our preliminary structural design since it had been based on moment connections," said Tague. "When the construction budget was revealed after we were awarded the design, we discovered the job had been estimated based on using traditional bracing, not moment connections."

(continued)
Flexibility for Design and Tradition
One of the design dilemmas at this point involved concealing the bracing, since a good part of the facade is glass, according to Shelley. "JSA hid the bracing behind spandrel glass, saving both time and money," he said.

The use of steel provided solutions to other problems, as well as influenced a number of design decisions. It helped satisfy the requirement to match the existing building's five-foot cast-in-place concrete fascia overhang by enabling the architect to design the structure with cantilevered beams to catch precast glass fiber reinforced concrete panels.

Conversely, the bearing capacity of steel vs. concrete influenced the materials used on the entrance facade. To save weight, as well as delivery time, ¼-in. red-and-black granite and black marble face panels, backed by one-in. aluminum honey-comb backing, were used on the entrance canopy instead of dimensional stone. Steel also provided the interior structure for the four, 20-in. polished brass columns that preside over the granite...
plaza and provide a grand entrance for
the tens of thousands of visitors who tour
West Point each year.

"Steel afforded us the flexibility we
needed to conform to certain traditional
design aspects of the existing
building," said Warner, a West Point graduate," as
well as the flexibility to incorporate con-
temporary elements such as the glass sky-
light."

George Liadis, of Trataros Construction,
agreed that steel played an important role
in the successful execution of the project.
"Timing was everything on the job," said
Liadis, who noted that heavy spring and
summer rains created job delays which
had to be made up by working nearly non-
stop from May through to the September
deadline.

Warner went on to note that administrat-
ing the West Point project on a design/
build basis was a departure from the norm
for the Army Corps of Engineers, and was
done so because of a more entrepreneur-
ial approach being attempted by the De-
partment of Defense on many of its con-
struction projects. "The traditional course
is that an architect is engaged to design a
job, and then the job is put out for bid. This
project would never have been completed
in time if that route had been taken."

In fact, due to a certain amount of inevi-
table bureaucracy, the project fell behind
before it even got off the ground. "We told
them we needed 270 days to complete the
job," said Liadis. "Although we received
the contract in October, 1988, we didn't
get the approval to proceed until March
17, 1989. Luckily, the steel erection went
smoothly. Other material delays, like the
skylight and honeycomb panels, had us
working up until the last minute, though."

According to Liadis, the use of steel
helped conclude the job in about half the
estimated time. "The grand opening cere-
mony took place on schedule, Sept.1," he
said.

All involved agreed that a sense of histo-
ry pervaded the project from start to finish.
"West Point has a spectacular campus on
the Hudson River," said Warner. "The Visi-
tors Center is the gateway to the area."

"It was a prestigious job," said Tague.
"The use of steel helped make it a suc-
cess."

Architect
JSA Inc. Architects Planners
Portsmouth, New Hampshire

Consulting Engineer
Neils & Gunter, Inc.
Portland, Maine

General Contractor
Trataros Construction, Inc.
Brooklyn, New York

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For All the Commitments You Make
In 1980, the owners of Philadelphia's Bellevue Hotel constructed a 350-car garage adjacent to a 20-story office building and separated from the hotel by 20-ft wide Chancellor Street. At the time, the owner's program called for a reinforced concrete structure with post-tensioned slabs. During the design, the owners felt assured they would complete negotiations for a tenant to lease a 45,000 sq. ft health club to be constructed above the garage.

Because the foundation design required caissons to rock, and strap grade beams to support exterior columns, the owner chose not to design extra capacity into the structure. When negotiations were terminated, construction stopped at the last parking level. Over the next several years, other clubs were solicited. Some of these deals could not be completed because of the inherent limited capacity of the completed parking structure.

In 1986, the owner negotiated with the Naiman Company of San Diego, Cal. to study the possibility of finally constructing a health club above the garage. From the onset, it became apparent that a program to satisfy them would include far more than the 45,000-sq. ft, two-level health club facility as originally planned. After several studies to determine the amount of new loads to be imposed, it became evident that completion of the building as originally designed was
impossible under existing conditions.

To compound the problem, the owner had begun to refurbish the Bellevue Hotel and to convert it from a luxury historic Center City Hotel to a gallery of shops and offices, with a high-class smaller hotel on the upper floors. For this construction, it was necessary to close Chancellor Street for the temporary exclusive use of the contractor. It became apparent the only possible way to construct the building was to change the building materials—to a structural steel frame to allow a less expensive, lighter construction system.

Because the original parking structure required columns at 62 ft o.c., it became necessary to use either deep beams at every floor or to construct a transfer system. From preliminary pricing by the construction manager, it was determined the building would have 10-ft deep trusses spanning from exterior to interior columns and these would support 30-ft long purlins using a composite steel section with 2-in. metal deck and a 4½-in. lightweight slab.

As the architect and Nainman Company project manager continued to develop their program, more and more square footage became necessary. Because the columns and foundations were designed for specific locations of pools, weight rooms and other public areas of the originally envisioned club, a constant shifting of areas was needed to impose the most balanced new loading to the existing columns and foundations. In the end, the use of structural steel permitted almost 85,000 sq. ft of new construction to be built 85 ft high instead of the original 45,000 sq. ft at 50 ft high. The design was complicated by the need to distribute the vertical loads to the columns where the most reserve capacity existed. Both gravity and lateral loads through the building had to be transferred around the large open areas at the gym with raised running track, the pool, the basketball courts and other high-ceiling areas.

Design Only Part of Problem

Design, however, was only part of the major problems this building faced. There were economic and construction limitations. The fact that Chancellor Street was no longer available, meant that the majority of the structural steel would be erected from Broad Street, Philadelphia's major north/ south thoroughfare. In addition, the Broad Street subway line and pedestrian concourse are directly beneath the street and sidewalk in front of the structure, creating potential hazards in the location of cranes.

The erection of the four-story structural steel frame on top of the existing seven-level parking garage of the Bellevue Hotel took on a complete new degree of difficulty when the owner informed the erector the storage area for cranes and material storage on Chancellor Street was no longer available. Joseph Cooke, the structural engineer for the entire project, designed 18 10-ton trusses, 50 ft long to support the upper four floors and running track. The erector put in place six trusses from Locust Street and twelve trusses from Broad Street on two weekends.

After completing the framing at the truss level, a 5-in. concrete slab was poured on 24,000 sq. ft of 20-ga. metal deck. Two 30-ton cranes were raised to the new slab area with a large crane working off a wood-matted cover over the subway which was approved by Septa Engineers. The cranes were supported on a double 30-in. beam runway on 12 x 12 oak timbers 10 ft long. The runway ran from Broad Street west for
220 ft. Inside the runway beams, a dolly rail­road was built to transport the unloaded material to the existing crane at the west end of the job. About six tons of material could be moved at one time manually with relative ease in about five minutes.

In about five weeks, the steel structure was about 70% erected, and one crane had worked itself out of a job. So the east end crane was lowered to Broad Street, leaving the second crane to both unload and erect the balance of material, which included the miscellaneous steel for the pool and running track.

Despite all of the special considerations given, it is estimated that the project saved $500,000 and six months over a concrete building. More importantly, the use of structural steel made this project feasible. Had it not been converted to steel, we might still be waiting to find the health club promoter who could live with 45,000 sq. ft. of space.

Walter E.B. Jewell is a consultant with the AISC Member steel fabricator firm of Leonard Kunkin & Associates, Line Lexington, Pennsylvania.

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LAMBERT AIRPORT BRIDGE

Sharpest Curve in the Midwest!

by Josephine L. Emerick
Lambert-St. Louis International Airport is a busy place, both in terms of air traffic and airport construction. Part of this new construction includes a multiple ramp bridge project, which features what is believed to be the most highly curved steel bridge in the Midwest.

Lambert is the seventh busiest airport in the nation, with 280,092 flights by commercial air carriers in 1987, and ranks 10th in the world in the number of landings and takeoffs.

Figures for 1987 indicated there are 811 commercial flights and 244 commuter flights each day. That means, in favorable weather conditions, approximately 75 flights take off and land every hour. Eleven major airlines serve the field. Along with the growth of air traffic at Lambert has come a tremendous volume of renovation and new construction. The number of gates at the airport was increased significantly in 1985 when the East Terminal wing was opened. And recent renovation to access roads, the rental car return area, and parking facilities has helped ease traffic congestion around the airport.

Lambert has received $90 million in federal improvement grants since 1981 (more than any other airport in the nation), and plans to invest $130 million in the next five years on improvements to the airfield, the terminal, roadway access and a noise mitigation program.

Booker Associates, Inc., a St. Louis-based multi-disciplinary engineering firm, has provided highway design and consultant services to the Lambert-St. Louis International Airport Authority since the beginning of the major improvements program in 1979. Part of the firm's involvement at Lambert has been the conceptual and engineering design for the reconstruction of the collector distributor roadways. Most recently construction was Phase II, which included the rebuilding of the direct connections to the terminal and the parking garage, south and southeast of the terminal.

Part of this Phase II work involved the design of a multiple ramp bridge to carry vehicles smoothly onto the ticketing/check-in level of the main terminal area and into the rental-car ready area on the lower level of the parking garage. The design required an in-depth analysis of traffic patterns and the construction phasing necessary to facilitate traffic handling. A key issue engineers had to address was how to minimize disruption to traffic flow in and out of the airport during the project.

Fred Weber, Inc. was awarded the contract for the Phase II Roadways Project, including the multiple ramp bridge. The structural part of this project is one ramp that splits into two ramps, with a length of 564 feet and weighing in at 359 tons.

Ramp A, serving traffic from the east, has a 382-ft radius, and Ramp D, serving traffic from the south and west, has a 150-ft radius. If Ramp D were continued on, it would make a complete circle around the ends of a football field. And both ramps are on vertical curves, in addition to their horizontal curves.

One of the big girders, A22, is 75 ft-7 in. long and weighs 29,907 lbs. Top and bottom flanges are plates 22 in. wide by 2 in. thick. The web is 1½ in. thick, with a 4 ft-2 in. horizontal sweep and 1½ ft vertical camber.

F. Joe DeLong III, president of Delong, Inc., believes that Ramp D and its girders have the greatest degree of curvature of any steel bridge in the Midwest. It is the most highly curved of all of the thousands of plans bid upon or built by his firm in its 44-yr. history.

According to DeLong, the horizontal curvature in the girders was obtained by using continuous heat from two torches on each flange. The heat was applied to each flange simultaneously while the girder was in a horizontal position. Heat was applied to the section of the flange in compression and was closely monitored to insure the steel would not exceed 1,150° F.

Multiple passes with the torches were required on most girders. Steel was allowed to cool to normal temperatures before heat was applied again. Horizontal curve offsets were checked on each girder after heating (and cooling), and again on the complete stringer line when it was assembled for drilling the splice holes.

The design of the large degree of curvature was mandated by existing site conditions, because of the location of an existing parking garage and the layout of access roads and the major interstate that serves the airport. Booker engineers designed the bridges around these physical restrictions, and the firm's landscape architecture department assisted in the selection of a paint scheme and modified hammerhead piers to match existing conditions.

Architect/Structural Engineer
Booker Associates, Inc.

General Contractor
Fred Weber, Inc.

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The Trinity Church Pedestrian Bridge connects the Gothic portico at the rear of the church in lower Manhattan with the second floor of the 25-story building at 74 Trinity Place across the street. It houses the parish headquarters, clergy and staff offices, meeting rooms, classrooms, a cafeteria and dining facility and a preschool nursery. The structure is also a visual symbol linking the church edifice at the head of Wall Street to the site of its operating programs. The Parish of Trinity Church in New York City was chartered in 1697 by King William III of England, with the present building being the third church edifice to occupy the site. Because Trinity Church is a New York City landmark, the bridge's design could not compromise the church's historical integrity. It was also subject to the approval of the Landmarks Preservation Commission as well as 11 other city agencies and community groups, a process that took several years to achieve. In addition, since the bridge is located in a very congested area, its construction could not interrupt the normally heavy vehicular and pedestrian traffic on busy Trinity Place.

Aesthetic Studies
Trinity Church is probably the city's most famous church, and certainly its most dramatically situated. Completed in 1846, it was designed by Richard Upjohn in the delicately detailed, soaring Gothic Revival Style. Even today, the church holds its own in the congested Financial District of the city, and its graceful spire overlooks one of the most lovely churchyards anywhere.

The church is known for its extensive community programs. A dozen years ago, concerned for the safety of the mothers,
Loew Bridge (circa late 1880s) provided design concept for Trinity Bridge.

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**Design Concept a Challenge**

The 86-ft long, 8-ft-wide pedestrian bridge also represents a significant engineering challenge. One problem was that the bridge could not be supported simply by the building and the church. In addition, a 16-ft high, 100-yr. old gravity retaining wall surrounding the church could not withstand the loads of the new structure either. Therefore, to make construction of the bridge possible, it was designed as an overhanging beam to cantilever to the retaining wall from an intermediate support at the curb line. The 19 ft-4-in. N cantilever was not supported on the retaining wall under dead load. This cantilever action under dead load greatly reduced the load on the parish headquarters building so that no reinforcement in the columns or building foundation was required, although a new spandrel girder was added to transfer loads to the building. Otherwise, the reinforcement would have been very costly, if not impossible. The cantilever was supported and anchored at the retaining wall for live load to increase stiffness and reduce the live-load deflection, making the induced transient vibration due to pedestrian traffic acceptable.

The intermediate support consists of two 15-in. dia. circular ASTM A572 steel columns supported by a pile cap which, in turn, rests on two off-center, 12-in. dia. steel pipe, concrete-filled piles. Because of a multitude of subsurface obstacles, including utilities, the exiting sewer and the subway, approval from various New York City agencies was required before the piles could be driven. To satisfy clearance requirements, there was room for only two piles which had to be squeezed within a 7-ft horizontal space between the subway and sewer (each requiring a 3-ft clearance from the piles) and drilled straight through an abandoned elevated subway structure. All piles were augered in with steel casings until beyond the subway foundation. When driving the piles, the subway structure as well as the church retaining wall were monitored for harmful vibrations with velocity meters. The information obtained from the test pits and borings in the foundation area was given to prospective bidders prior to the award of the construction...
contract. This avoided any construction cost extra or time delay.

Another problem was the fact the parish house was not aligned directly with the church portico. Therefore, the bridge was designed with a small skew and a 37-in. drop from the parish house to the church to provide smooth crossings. A maximum grade of 5% allows wheelchair access. To obtain vertical clearance, the bridge profile was broken by a graceful 34-ft vertical curve which maintained the required highway clearance and arch configuration at the intermediate support.

An important consideration in developing the design concept was that, because of the busy traffic on the narrow streets of lower Manhattan, the construction of the bridge could not interrupt the normally heavy vehicular and pedestrian traffic on Trinity Place. To solve this problem, the bridge was conceived, designed and detailed as a steel bridge, shop-welded and fabricated in one piece and erected as a unit.

**Structural Details**
The bridge is a pair of Vierendeel trussed deck arches spaced 7 ft apart and tied together by 6-in. x 13/4-in. rectangular tubes at the bottom and #18-ga. steel deck form at the top. The deck form not only supports the 4-in. concrete deck with its granite paving, but also served as a horizontal shield for street traffic protection during construction.

All the steel in the bridge is A572 Gr. 50. The top and bottom chords of each arch are welded "T" sections. In the Vierendeel sections adjacent to the supports, the vertical members connecting the two chords consist of one web plate lined up and welded to the web of the top and bottom chords and two "T" sections, cut from rolled, wide-flange "I" beams. Elsewhere, top and bottom chords merge to form a single "I" section by using a common web plate with a total depth of only 16 1/2 in. in the mid-portion and 8 1/2 in. at the east end respectively. These shallow depths not only create a graceful appearance but also provide ample vertical clearance. The complete structure was analyzed and optimized as a three-dimensional structure by using a computer for the most economical construction. The effects of a future enclosure for the pedestrian bridge, especially the wind load on the enclosure, were also considered.

All the welds on the bridge are fillet welds, with the exception of the welds at the splice plates, deck form supporting shelf plates and connections to the columns, which are full-penetration butt welds.

**Fabrication**
The greatest concern in the fabrication of the bridge was the distortion and/or warping of the completed structure caused by shrinkage caused by welding, since the overall visual appearance of the complet-
Bridge swings into place overnight to eliminate any traffic jams.

...ed bridge at the site is of prime importance. The distortion was controlled by using symmetrical, built-up sections, with a minimum amount of welding and very strict tolerances as specified in the fabrication contract. Since each of the two arches was to be fabricated in the flat position, i.e., the structure lying on its side, the engineer furnished a camber diagram. The vertical alignment, as well as the deflections of the structure due to present and future dead loads when the structure is in an upright position, were taken into account. By giving the camber diagram and tolerances, the engineer took the responsibility for geometry, which resulted in a lower bid price. The fabricator met the fabrication tolerance by using proper welding techniques and carefully planned welding sequences with the approval of the engineer. He also chose to cut the webs of the chords and the vertical members of each arch near the column supports from one single plate and the flanges of the bottom chords from a single curved plate. In so doing, the welding of many small pieces was eliminated to avoid the consequent shrinkage and distortion associated with welding. For quality control, all butt welds were ultrasonically tested and 50% of the fillet welds were magnetic-particle tested at locations designated by the engineer, including interpasses.

(continued)
Erection
The complete shop-welded structure was shipped from Avonmore, Pa. to the job site in one piece in an upright position by using a specially designed trailer. It was driven across the George Washington Bridge and moved down Broadway in Manhattan late at night on Nov. 7, 1987 under police escort.

On Sunday, Nov. 8, 1987, the Trinity Church Pedestrian Bridge was erected in just 90 minutes. Bolted to the flange plates of the two previously erected steel columns with eighteen bolts each, to the building with eight bolts, and to the church retaining wall with four bolts, the operation was smooth and fast. Careful planning, meticulous engineering, precise fabricating, skilful erection, quality control and coordination enabled the total of forty-eight bolts to the four independent supporting structures to fit with a tolerance of \( \frac{1}{16} \) in.

Railing and Deck
The ornamental railing, installed after the bridge was erected, is shaped like a row of X's and is highlighted by a bronze medallion at the center of each X, just like on the century-old Loew Bridge. With the exception of some other bronze ornamental items, such as the ball finial at the top of each post and the upper and lower horizontal half-round mouldings, the railing is entirely made of A36 steel tubings, bars, channels and plates. All the elements were shop-welded and pre-assembled in the shop before installation—which showed that the beautiful cast-iron work of old can be recreated in today's steel welding shops. Bronze footlamps and granite paving covering the cast-in-place concrete deck provided finishing touches in keeping with the historic setting.

Maintenance Considerations
For minimum maintenance, drain holes are provided at all low points of the bridge to avoid the collection of water. Snow melting conduits were embedded in the concrete deck with an electronic sensor system that will automatically melt ice and snow, and the drainage system discharges all the water into an existing drain to prevent it from running back into the church from the bridge. All the drain pipes are provided with heat tracer cables to prevent the water from freezing. Furthermore, an epoxy based paint with sand-blast cleaning was specified and used to assure long life.

New Vista for Old Landmark
The Trinity Church Pedestrian Bridge provides a safe, convenient link between the church and their parish house across Trinity Place. Because of careful planning and the consideration of fabrication and erection, as well as preventive measures to avoid any extra construction cost in the preparation of the construction contract documents, resulted in a very economical structure. To minimize traffic disruption during its construction, the use of welded steel construction made it possible to fabricate the bridge in one piece and erect it as one unit.

The aesthetic aspect of the bridge design was of prime importance because of its location. Again, the use of welded steel construction made it possible to produce an elegant, Vierendeel-trussed arch with thin members, almost transparent in appearance. From the first moment, the bridge looked so appropriate in its setting, and the disruption to the area had been so minimal, that many New Yorkers hurrying to work the next morning were not quite sure if the bridge had not always been there. Those who noticed, however, agreed that the bridge actually enhances the setting and creates a whole new vista for the beloved landmark.

Architect
Lee Harris Pomeroy Associates
New York, New York

Structural Engineer
Ammann & Whitney
New York, New York

General Contractor/Steel Erector
Nab Construction Corporation
College Point, New York

Steel Fabricator
Reynolds Manufacturing Co.
Avonmore, Pennsylvania

Owner
Parish of Trinity Church
New York, New York

Edward Cohen is managing partner of the structural engineering firm of Ammann & Whitney, New York, New York.

Trinity Church Pedestrian Bridge was recently selected as the winner in the 1989 AISC Prize Bridge competition—Special Purpose category.
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Bracing Enters Computer Age

Braces are usually stamped with identifying numbers, so erectors spend most of their time finding them and moving them from one spot to another. The various braces that stiffen modern steel construction are not interchangeable. Whether they are called diaphragms, wind braces, X-braces, V-braces, K-braces, knee bracing, symmetrical or nonsymmetrical, each brace is as unique as the horizontal or vertical position where it is bolted or welded. A one-at-a-time, hand-crafted item.

Braces can be made of angles, beams, pipe, tube, flat bars, rods and tees. Tees can be bolted through the web, or through the flange. On a long bridge, otherwise identical diaphragms (X-braces that separate parallel plate girders) come with and without holes. They are bolted into position on the straight stretches of bridge and welded into place on the curves where the clearance is lacking to use a pneumatic wrench.

Detailing braces requires algebra, geometry, trigonometry—and hours—each and every time. Every brace has a unique solution, one that probably will not work for the next brace on the job. One overlooked obstruction or critical dimension and all the previous work can be useless.

The bane of the detailer's life, however, is the change order. Alter an elevation, or widen a bay and a cascade effect ripples through all the other dimensions, rendering every connected brace obsolete.

The American civil engineering profession imposes additional hardships. The metric world works in base 10. In the U.S., work is calculated in base 12 (in. per ft).

(continued on p. 46)
When The Bridge Was Out, We Came Across.

It was the worst flooding upstate New York had seen in thirty years.

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GERALD R. FORD AMPHITHEATER

Commanding Views of the Rockies

by Richard Weingardt

The citizens of Vail envisioned an amphitheater as the centerpiece of their 23-acre Gerald R. Ford Park which adjoins City Center. The community project, 10 years in the making, began with several false starts and a scheme which was too costly. As originally conceived, it was a large, bulky and overwhelming structure with interior roof columns which interfered with a view of the stage. A concrete stage along with some outdoor seating was actually constructed before changing direction and hiring a new architect for a revised concept.

The new design using exposed structural steel frames reduced the cost from $5 million to $1.75 million and gave the citizens of Vail a light, airy structure in harmony with the mountains.

Columns Eliminated Using Steel

After the architects, Morter-Fisher, were hired to redesign with a new concept, they retained Richard Weingardt Consultants, Inc. as their structural engineers, whose structural design eliminated interior columns.

Engineers had to design the theater structure around the stage and seats already constructed from the previous design. The theater, which is 17,000 sq. ft, provides 927 fixed seats and informal outdoor seating for 2,500. The fixed seats wrap around the modified thrust stage to provide the intimate audience/performer relationship appropriate for such a facility. In addition to the theater structure, the facilities include: a ticket sales area; a concessions area; restrooms; a green room and dressing rooms; a storage and receiving building; and a full basement below the stage. The stage is designed to accommodate an orchestra pit in the future. A large plaza near the entry, seating and concession areas accommodate large
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Amphitheater is central element of 23-acre Ford Park. Natural land bench shaped site. Exposed steel structure is the architecture. Free-standing space trusses are structurally sound without need for lateral resistance of roof decks (l. and above).

groups during intermissions and special events.

Built In Stages
Since no public funds were available, the theater was built in stages as money was raised by private citizens. The structure was designed so each phase of construction was structurally adequate by itself. No tax dollars were used. Fund-raising, as well as construction, took three seasons. The community spirit during the fund-raising efforts caused former President Gerald Ford to remark, "I am very happy to see the current effort by so many people to move the Ford Amphitheater to completion. It's a facility which will add to Vail's reputation as a complete year-round resort."

MODERN STEEL CONSTRUCTION
Public Design Sessions
Prior to preparing the drawings, public design discussions were held. During these sessions, individuals from all areas of the community were asked to provide input to the design team so their specific concerns could be addressed. Included were the town council, police and fire officials, private individuals and prospective users of the facility. The proposed facility was modified continuously during design to best accommodate the issues raised.

Traditionally, outdoor concerts in Vail, Colo. had been informal affairs: bring a blanket, a picnic basket and the kids run on the nearby slopes, while the entertainers performed under a makeshift tent. The new amphitheater continues that tradition of informality. More than half of the seats are on grass berms. The backdrop for the stage is a stand of 100-ft high spruce trees along Gore Creek. Beyond, the Rocky Mountains wrap around the facility on the remaining three sides. At these public design sessions, many residents also stressed the importance for good acoustics and the need for a real feeling of quality. The citizens wanted a notable facility with a light and airy feeling—a feeling of spaciousness. They did not want a structure which was “just one big roof.”

Acoustical Roof Panels “Float”
The seven roof panels, arranged for the best acoustics, were designed to “float” above the performance area. Tubular steel space frames support these roof panels, yet do not obstruct views of the stage, even from the outdoor seating areas. The structural steel truss system consists of both long cantilever frames and 100-ft wide arch frames. They were used not only because of economics, but also because they lend the feeling of spaciousness the citizens of Vail desired.

The steel frames withstand heavy wind and snow loads, while offering the visibility and aesthetics desired. The frames are true space frames in that they, by themselves, are capable of resisting lateral as well as vertical forces, without reliance on a roof diaphragm or walls. The roof was designed to support loads of 84 psf; laterally, the frames will resist 90-mph wind forces.

The complicated three-dimensional steel frames were shop-fabricated in large sections and field-assembled. Connections were carefully detailed so as not to detract from the beauty of the steel structure since it is exposed and serves as architecture. Frame segments were designed to allow erection without using heavy equipment. Field connections were kept clean and simple. Their geometry was quite complex because the frames intersect at various planes, which were dictated by acoustical requirements.

Structural Systems Detailed
The structural system for the amphitheater itself consists of steel tube space frames, either cantilevered or gable bents. Main
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Frame peak connection (above). Typical frame detail below.
frame members are $8 \times 8 \times \frac{1}{4}$ while secondary members are $6 \times 6 \times \frac{1}{4}$. Both tube sizes are ASTM A500 steel. The tube pieces were welded either in the shop or field. Spanning between the frames are long-span, open-web roof joists. The joists, which vary from 36 LH 14's to 18 LH 04's and spaced at 8 ft o.c., support the wood roof deck. The deck, made up of 3 x 6 tongue-and-groove wood planks, is bolted to the steel joists.

The roof structures over all other enclosed spaces of the complex are constructed of standard lightweight steel members. Typical roof joists are 24 H6 at three ft o.c. on masonry bearing walls, with one in. deep metal deck. Except for the stage, all floors are slab-on-grade construction. The full basement under the amphitheater stage is framed over with 24 in. deep (ASTM A36) steel girders. The W24 x 68 girders are spaced at 8 ft o.c. and support a 6½-in. concrete topping and 2-in. metal deck stage floor system. A total of 127 tons of structural steel went into the Ford project.

**Unique Rock Anchor Footings**

Because the soils contained large cobbles and rocks, standard drilled pier footings could not be used and regular spread footings would not resist the large overturning forces of the long, cantilevered roof-truss frames. An unconventional soil tension anchor system (similar to rock-anchoring used for tunnels) was engineered to act composite with standard concrete pad footings.

The one and one-quarter inch dia. rock anchors were 140,000 psi high-strength steel tie-rods, drilled 18 ft deep and pressure-grouted. They provided the tension resistance necessary to stabilize the large uplift forces of the cantilevered truss frames. This unique application of proven design techniques, though new for large Colorado structures, was simple, safe and economical.

**Community Spirit Project**

The project brought the whole town together with a common goal and community spirit, while saving $3.25 million. Every penny spent to construct the facility was from citizen donations. Upon the facility's recognition in 1989 by the Consulting Engineers Council of Colorado for "Engineering Excellence," architect James R. Morter remarked, "The Gerald R. Ford Amphitheater is indeed a unique, one-of-a-kind structure. It demanded a unique engineering solution and a unique range of engineering services. Of even greater importance is the satisfaction and acceptance of the performers and audiences who have enjoyed using the facility."
Jim Bolling, President and CEO of the Structural Software Company, is a second-generation steel man. His fifteen years spent managing a 5,000 ton per year family fabricating shop gave him the insider's perspective.

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Nucor-Yamato Steel Company
In a continuing effort to provide steel design aids to structural engineers, the American Institute of Steel Construction has improved and expanded its Computer Data Base for properties and dimensions of structural steel shapes, corresponding to data published in Part 1 of the 1st Edition, AISC LRFD Manual of Steel Construction, as well as properties needed for Allowable Stress Design according to the 8th Edition, AISC Manual of Steel Construction.

PROGRAM PACKAGE

1. Computer Data Base in binary format for the properties and dimensions of the following structural shapes:
   a. W Shapes (many new sections)
   b. S Shapes
   c. M Shapes
   d. HP Shapes
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MODERN STEEL CONSTRUCTION
What Structural Engineers and Fabricators Need to Know About Weld Metal (Part I)

by Duane K. Miller

To supply structural engineers and fabricators with the mechanical properties data needed to ensure good weldment design, manufacturers of consumables use standard filler metal qualification tests developed by the American Welding Society. Tensile properties are thus reported. Too frequently, engineers expect the results of these tightly controlled tests to be applicable directly to the properties of welded connections made in the shop or in the field. They are not. Both the structural engineer and the fabricator need to be aware of the ways in which many variables may affect the properties of the weld deposit.

Designing Welds

When a structural engineer is designing a welded connection, that weld typically will be a fillet weld, a full-penetration butt weld, or a partial-penetration weld. It is being designed for a particular strength requirement. The fillet weld strength will be proportional to the leg size, the length and the strength of the filler metal. A butt weld will be proportional to the cross-sectional area and the strength of the filler metal. A partial-penetration weld will have a strength proportional to the depth of penetration, the length and the strength of the filler metal used. So, in any of these three situations, the strength of the filler metal used is critical to the performance of the particular joint.

Properties Required

The word “strength” is used here specifically, because in some cases yield strength is more important, and sometimes tensile strength is more important. Most welded connections are designed around the tensile strength, but the yield strength is very often the controlling factor since permanent deformation is not desirable. The modulus of elasticity, used for designing structure stiffness, is not a structure-sensitive property and therefore is not within the scope of this discussion. Another strength factor that does not figure into the strength equations mentioned above is toughness, a very difficult property to use in design. Fracture mechanics is required to utilize the property of toughness. However, impact resistance measured by the Charpy specimen is frequently used. To that extent, this paper discusses the effects of variables on toughness. Toughness properties are not required by AWS D1.1 structural code, however, unless specified in contract documents.

The structural engineer requiring the properties of yield strength and tensile strength may go immediately to the electrode classification to try to discern these. Using an example of a typical low-hydrogen electrode, an E7018, he may look at the 70 designation, knowing that 70 stands for a minimum tensile strength of 70,000 psi, and use that for design purposes. The same strength level may not be seen in the actual weld joint selected by the engineer. To understand why, it is necessary first to review filler metal specifications and qualification tests.

Filler Metal Specifications

Mechanical properties requirements spelled out in the AWS classification include specific yield, tensile strength and elongation properties. Charpy values for toughness may or may not be specified. Certain chemical properties are specified, indicating key alloy levels. Finally, there may be welding performance criteria such as the percentage of moisture in the coatings of low-hydrogen electrodes. A look at a typical certification demonstrates that electrodes exceed the minimums specified. However, note that the Appendix to the filler metal specification includes restrictions on the use of this information, as follows:

“Weld metal properties may vary widely, according to size of the electrode and amperage used, size of the beads in the weld, plate thickness, joint geometry, preheat and interpass temperatures, surface condition, base metal composition, dilution, etc.”

The test plate was never designed to duplicate the actual welding properties. It would be impossible to duplicate all of the properties that may be encountered. The purpose is for classification or qualification of a particular product to a specific filler metal type. It does permit comparisons within the specification. That is, one E7018 electrode can be compared to another. But technically, an E7018 electrode cannot be compared to a deposit of submerged arc, for example, because there are differences between the tests.

Test Controls

In relying on test results, the engineer again will do well to heed the Appendix to the filler metal specification:

“Properties of production welds may vary accordingly, depending on the particular welding conditions. Weld metal properties may not duplicate, or even closely approach, the values listed and prescribed for test welds.”

These tests were actually designed to minimize variations in results due to testing from one manufacturer to another, from
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Figure 3

One year to another and from one product to another.

An in-depth look at one test, for a low-hydrogen stick electrode, will help to clarify the nature of tests. That product, a shielded metal arc-welding electrode, is covered in AWS A5.1. The mechanical properties are those with which structural engineers are most concerned. The first step is to find out what tests are required by the specification. Table #8 in that specification indicates that a 0.040 in. electrode does not require mechanical testing. For the 0.050 in. electrode, however, an on-weld test is required, with the plate to be welded in the flat position. Out of the same plate, impact specimens are to be taken and also a fillet weld test is to be performed in the vertical and overhead position to ensure weld soundness.

The 0.050 in. electrode has the same requirements for mechanical testing as does the 0.040 in. electrode. However, the fillet weld is to be made in the horizontal position, as opposed to the vertical and overhead position of the 0.050 in. A 0.050 in. electrode does not require any mechanical tests.

The 0.050 in. electrode can be subjected to a closer look, since it does require mechanical testing. The next step is that the particular test plate to be used must be made of one of the three grades of steel listed: A285 Gr C; A36; or A283 Gr D. Typically, A36 is used. The plate is to be pre-heated to 225°F. plus or minus 25°F. Interpass temperature is to be maintained at 225° to 350°F. The amperage is suggested to be run between 150 and 220 amps. The welding sequence is specified. The first layer is to be made with a full weave, with one layer for the entire half-inch of the root opening. The second and all subsequent layers are to be welded...
with two passes per layer. A total of seven to nine layers could be used to make this weld specimen. Dictating the amperage and welding sequence restricts the travel speed. Note that the test plate will always be multiple pass, with a minimum of 13 relatively small beads.

The specimen is to be tested per ASTM specifications. The test specimens are to be removed from the plate configuration, as shown in Figs. 1, 2 and 3. The machining of the test plate, the accuracy of the test instruments, etc., are all covered in the ASTM specifications. For the E7018 electrode, the all-weld-metal tensile strength must be a minimum of 72,000 psi. Yield must be 60,000 psi minimum. Elongation must be 22% minimum. The impact energy must be a minimum of 20 ft-lbs at minus 20°F. In addition, there are chemical and performance tests that are not discussed here, but if all these other criteria are met, it may be classified as an E7018 SMAW stick electrode.

Other consumables may be tested in a different form. For instance, consider the E6010 electrode, which is still within the A5.1 specification. In this case, the specimen can be aged at 200° to 220°F for 48 hours, plus or minus two hours. This permits any hydrogen to escape from the weld metal; this test is not designed to hide the fact that hydrogen may be present in the weld metal; its purpose is rather to present a very consistent way of comparing products that may have hydrogen in the weld metal. If, for example, the weld specimens are not tested for two to four weeks after welding, most of the hydrogen has escaped from the sample. This is an accelerated way of letting the hydrogen escape to ensure the consistency of test results.

A different filler metal specification, A5.20, for flux-cored arc welding, shows that the ambient or starting temperature for the test plate is room temperature, vs. the low hydrogen test under 5.1, which called for an initial temperature of 225°F. Here, the initial temperature is specified as 70°F. In addition, flux-cored arc welding may utilize externally supplied shielding gas. When required, the controlling gas is to be carbon dioxide.

A consideration of specification 5.17 for submerged arc welding demonstrates the procedure is tightly controlled for testing. The % in.-dia. electrode should be used at 550 amps and 28 volts. There can also be post-weld heat treatment, or stress relieving, of submerged arc welds and other products as well. The stress relief temperature is 1,150°F, plus or minus 25°F, and the weld should be stress-relieved for one hour.

**Effects of Deviations**

These test configurations and controls may or may not represent the actual welding conditions. Indeed, in the majority of situations, there will be deviations. Such deviations as amperage, weld bead placement, plate thickness and so forth, have already been noted. These can be classified, however, into two broad categories: chemical and thermal changes.

**Chemical Effects**

Chemical changes are due to two key influences: first, the plate chemistry and secondly, the amount of admixture. Three

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terms may need definition here: admixture, dilution and pickup.

Figure 4 helps to illustrate admixture. As the illustration shows, this weld is joining plate A to plate B. A backing strip labeled C is included. The joint is to be filled with a filler metal labeled D. The arc force and energy of the electrode will melt some of plate A, some of plate B and some of plate C. The final composition of the weld metal will be A, B, C and D. This conglomeration of material is called "admixture."

Figure 5 illustrates dilution. Dilution occurs when a high alloy electrode is used to weld on lower alloy plate. Thus, as the high alloy is mixed with the lower alloy, creating an admixture, the high alloy is diluted. For example, using a stainless steel electrode with high chrome and high nickel to weld on mild steel, will result in lower chrome and nickel content in the weld than in the electrode. This result is called "dilution."

Figure 6 shows alloy pickup, which is just the opposite of dilution. Here, a mild steel electrode is used to weld on high alloy plate. The weld deposit will contain nickel that was never present in the mild steel filler. When the deposit contains a greater amount of alloy than the electrode, the situation is referred to as alloy "pickup."

As base plate is introduced into the admixture, the weld chemistry changes. If the plate chemistry is different than that used for filler metal qualification, the weld chemistry may be different. The significance of this will be considered later.

The extent of admixture is a function of joint geometry, the process used and procedures. Since few people weld AWS filler metal qualification plates in production, the test plate is not typical of most production joints.

Figure 7 shows two different butt joints. The plate thickness is the same in both cases. One involves a penetration weld, welding from two sides. In this example, the bottom side was welded first, then the top side was turned and welders achieved the weld. The artwork shows there would be a tremendous influence of base material in this particular weld, as shown by the dotted lines. A high percentage of the base metal would be contained in the weld metal. This admixture would be composed primarily of base material.

The second butt joint in Fig. 7 shows a beveled joint with a backup that comes close to approaching that of a filler metal specification. Here, minimum amounts of base material are melted. The admixture is composed primarily of the filler metal. So the joint geometry plays an important role in determining the composition of the admixture.

The process selected is very important with respect to penetration. Figure 8 delineates six major arc welding processes; the degree of penetration will vary according to the process. The deepest penetrating process, the one in which the base materi-
al has the most significant effect, is submerged-arc welding. At the other extreme, gas tungsten arc welding or TIG welding has relatively shallow penetration, still giving adequate fusion, but the base material has a lesser effect. Between these two extremes are: the flux-cored gas process, which gives relatively deep penetration; the self shielded, flux-cored process, which can have a tremendous range in penetration; the gas metal-arc process, which features deep penetration in the spray mode and relatively shallow penetration in the short arc mode (note: the latter is restricted on structural applications); and the stick electrode process or shielded metal-arc welding, which has a tighter range. For a given process, the extent of penetration is a function of amperage and electrode size. Travel speed, polarity and welding position affect the penetration to a lesser extent (Fig. 8).

References
2. Ibid.

Duane K. Miller is a welding engineer with The Lincoln Electric Company, Cleveland, Ohio.

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Located in both the geographic and population center of the nation (more than one-third of the U.S. population resides within 600 miles, and more than 55 million people within a day’s drive), Kansas City describes itself as the “Heartland of America.” Electric and eclectic, casual yet energetic, the city’s character features some of the best characteristics of east and west, north and south—a virtual microcosm of America. A sophisticated metropolis, it still retains a small-town friendliness.

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The arts thrive in Kansas City. Lyric Opera is in its 29th season, the Kansas City Symphony performs regularly from late fall to spring, and the city’s jazz legacy is evident in the city’s night life. Both the State Ballet of Missouri and the Westport Ballet delight audiences each season. Touring Broadway musicals and locally produced theatre, including children’s and dinner theatre, offer another dimension to live entertainment.

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Two religious denominations are headquartered in Kansas City. Nearby, Independence is home to the Harry S Truman Library and Museum; Weston has over 100 pre-Civil War (and lived-in) homes listed on the National Register of Historic Places.

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MSC to Publish Special Show Issue

Modern Steel Construction will publish its January/February issue as The 1990 National Steel Construction Conference Official Program issue. It will also expand circulation for the November/December issue to offer information (including Official Program and Registration Form) to the widest possible audience.

The Pattis Group-3M, Lincolnwood, Ill. is MSC’s advertising representative. Eric Neiman (708 / 679-1100) will be happy to give you full details on advertising in this special issue.
## PRELIMINARY SCHEDULE OF EVENTS

### MONDAY and TUESDAY — MARCH 12-13

- **Exhibitor Move-in** and Pre-conference Events

### WEDNESDAY — MARCH 14

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>8:00-12:00 AM</td>
<td><strong>Partners in Education Meeting</strong></td>
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<tr>
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<td>A meeting of AISC's 30-member Educator Advisory Council, which provides data and suggestions for development of programs which will assist those who provide college and university instruction in structural steel design.</td>
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<tr>
<td>8:00-5:00 PM</td>
<td><strong>Committee Meetings</strong></td>
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<td>Organizations or associations who would like to schedule committee meetings or other pre-conference activities to take advantage of this expected high concentration of industry representatives may contact Lona Babbington, Conference Coordinator, at 312/670-5432.</td>
</tr>
<tr>
<td>9:30-12:00 AM</td>
<td><strong>Optional Event #1: Tour of Kansas City</strong></td>
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<td>A bus tour of the “Heartland of America” will include Hallmark’s Crown Center and the elegant Country Club Plaza, Liberty Memorial, Penn Valley Park, the affluent Mission Hills estate area, and Old Westport (once the largest outfitting post for wagon trains headed west).</td>
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<tr>
<td>Noon-1:00 PM</td>
<td><strong>Partners in Education Luncheon</strong></td>
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<tr>
<td>1:30-5:00 PM</td>
<td><strong>Educator Session</strong></td>
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<td>Session concentrating on subjects of interest to those who teach structural steel design courses at colleges and universities.</td>
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<tr>
<td>1:30-5:00 PM</td>
<td><strong>Professional Member Forum</strong></td>
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<td>Session for structural engineers interested in current programs and publications available from AISC.</td>
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<tr>
<td>1:30-3:00 PM</td>
<td><strong>General Session: “Construction Claims”</strong></td>
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<td><strong>Moderator:</strong> Robert B. Nelson, AFCO Steel, Little Rock, AR</td>
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<td></td>
<td><strong>Speaker:</strong> David B. Ratterman, Goldberg &amp; Simpson P.S.C., Louisville, KY (and AISC general counsel)</td>
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<td>A comprehensive lesson in the fundamentals of avoiding claims, as well as negotiation, arbitration and litigation processes that may be necessary to resolve disputes.</td>
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<tr>
<td>3:00-5:00 PM</td>
<td><strong>Exhibits Open</strong></td>
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<tr>
<td></td>
<td>No technical seminars are scheduled for this time period, giving attendees an opportunity to visit the 100-plus exhibit booths in Bartle Hall.</td>
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<tr>
<td>5:15-6:00 PM</td>
<td><strong>Exhibitor Workshops</strong></td>
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<td>These special sessions offer a forum where companies share the latest technological advances in their specialized fields, conduct demonstrations or question-and-answer dialogues, and introduce new or updated equipment and programs.</td>
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<tr>
<td></td>
<td><strong>Session A - TradeARBED</strong> introduces HISTAR, a new generation of rolled beams and column shapes for economical steel construction.</td>
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<tr>
<td></td>
<td><strong>Session B - Welded Tube Company of America</strong></td>
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<td></td>
<td>&quot;Structural Tubing for Fabrication&quot;</td>
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<tr>
<td></td>
<td><strong>Sessions C - G</strong> also scheduled for this time period; names of additional companies presenting workshops to be announced.</td>
</tr>
</tbody>
</table>

### THURSDAY — MARCH 15 (Morning)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>7:00-8:00 AM</td>
<td><strong>SASF Educator Breakfast</strong></td>
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<tr>
<td></td>
<td>Members of the Southern Association of Steel Fabricators will host a breakfast for educators from the states represented in SASF membership.</td>
</tr>
<tr>
<td>7:00-8:00 AM</td>
<td><strong>VCSSF Educator Breakfast</strong></td>
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<tr>
<td></td>
<td>Members of the Virginia-Carolinas Structural Steel Fabricators Association will host a breakfast for educators from the states represented in VCSSF membership.</td>
</tr>
<tr>
<td>7:00-8:15 AM</td>
<td><strong>Exhibitor Workshops</strong></td>
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<tr>
<td></td>
<td>Already scheduled:</td>
</tr>
<tr>
<td></td>
<td>H. Structural Software</td>
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<td></td>
<td>I - N to be announced.</td>
</tr>
<tr>
<td>8:30-9:00 AM</td>
<td><strong>Award Presentations</strong></td>
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<tr>
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<td>Individuals who have rendered outstanding service to the structural steel industry will be honored.</td>
</tr>
<tr>
<td>9:00-9:15 AM</td>
<td><strong>General Session: “Bridge &amp; Structures Information Center”</strong></td>
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<tr>
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<td><strong>Speaker:</strong> Reidar Bjorhovde, University of Pittsburgh, Pittsburgh, PA</td>
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<tr>
<td>9:15-10:00 AM</td>
<td><strong>General Session: “Case History – 27-story LRFD Office Building”</strong></td>
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<td><strong>Speaker:</strong> Lawrence G. Griffin, Walter P. Moore, and Associates, Inc., Houston, TX</td>
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<td>A major office building is framed in steel as a result of savings from an LRFD design. The particulars of the framing and floor systems will be described.</td>
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<tr>
<td>10:00-3:00 PM</td>
<td><strong>Exhibits Open</strong></td>
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<tr>
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<td>Lunch will be served beginning at 11:45 AM in the Exhibit Hall.</td>
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<tr>
<td>10:00-10:45 AM</td>
<td><strong>Coffee Break (Exhibit Hall)</strong></td>
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<tr>
<td>10:45-12:15 PM</td>
<td><strong>Technical Seminars</strong> (See details on pp. 52-53)</td>
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<tr>
<td></td>
<td>1. Construction Claims</td>
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<td>2. Products Liability Insurance</td>
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<td>3. Frame Analysis, LRFD</td>
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<td>4. Connection Design and Detailing</td>
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<td>5. Recruitment and Training of Steel Details</td>
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<td></td>
<td>6. Plant Automation and Layout</td>
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<td></td>
<td>7. Economical Bridge Design</td>
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<tr>
<td>11:45-1:30 PM</td>
<td><strong>Lunch Service Open</strong></td>
</tr>
</tbody>
</table>

### THURSDAY — MARCH 15 (Afternoon)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00-2:00 PM</td>
<td><strong>Poster Session</strong></td>
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<td></td>
<td>An exhibition of technical papers will be displayed near the entrance to the exhibit hall throughout the conference. Authors of papers will be available during this time period for discussion of the papers' contents.</td>
</tr>
<tr>
<td>2:30-4:00 PM</td>
<td><strong>Technical Seminars</strong></td>
</tr>
<tr>
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<td>3. What the First-line Supervisor Should Know</td>
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<tr>
<td></td>
<td>6. PR Connections</td>
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<tr>
<td></td>
<td>7R. Recruitment and Training of Steel Details</td>
</tr>
<tr>
<td></td>
<td>8. Plant Automation and Layout</td>
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<tr>
<td></td>
<td>10. Floor Serviceability and Constructability</td>
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<td></td>
<td>11. Beam Camber</td>
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</tbody>
</table>
4:10-5:25 PM Technical Seminars
1R. Construction Claims
12. Building Design
13. Tubular Connections
16. Economical Framing System
18. Fire Protection of Steel Frames

5:30-6:15 PM Exhibitor Workshops
Already scheduled:
O. Mountain Enterprises
P - U to be announced

7:00-7:45 PM Reception (Cash Bar) - Mezzanine, Allis Plaza Hotel

7:45-10:00 PM Optional Event #2: Conference Dinner and Entertainment, "All That Jazz," Count Basie Ballroom, Allis Plaza Hotel

FRIDAY — MARCH 16

7:30-8:15 AM Exhibitor Workshops - to be announced.
8:30-10:00 AM Technical Seminars
2R. Products Liability Insurance
4R. Frame Analysis, LRFD
5R. Connection Design and Detailing
9R. Protecting Your Workers Against Welding Fumes
15. Scope of Business
17R. Economical Bridge Design

10:00-10:45 AM Coffee Break
10:00-2:30 PM Exhibits Open
10:45-12:15 PM Technical Seminars
3R. What the First Line Supervisor Should Know
6R. PR Connections
8R. Plant Automation and Layout
10R. Floor Servicesability and Constructability
11R. Beam Camber
15R. Scope of Business

11:45 AM Lunch Service Begins

12:15-3:00 PM Lunch/Exhibits Open
3:15 PM EXHIBITS CLOSE - Exhibit Moveout begins
3:00-3:45 PM General Session:
T. R. Higgins Lecture - winner to be announced

4:00-5:30 PM Technical Seminars
9R. Protecting Your Workers Against Welding Fumes
12R. Building Design
13R. Tubular Connections
14R. Connection Design Responsibility
16R. Economical Framing System
18R. Fire Protection of Steel Frames

6:30-10:45 PM Optional Event #3 - Dinner Theatre
Dinner and show at the Waldo Astoria, combining good food, music and fun—pre-show entertainment, lively Broadway comedy.

SATURDAY — MARCH 17

8:30-9:30 AM General Session
"Unusual Steel Framing - 34-story Office Building in Kansas City. Block 111"
Speaker/Fabrication and Erection: William L. Richey, Havens Steel Company, Kansas City, MO

9:30-12:00 Noon Choice of:
Optional Event #4 - Hard-hat Tour of Block 111
(No charge, but advance reservation required)
Optional Event #5 - Tour of Fabricating Plant
(No charge, but advance reservation required)
Optional Event #6 - Hard-hat Bridge Tour
(No charge, but advance reservation required)

1:00-4:00 Optional Event #7 - Trip to Independence
Repeat of Spouse’s Event C, does not include lunch.

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.

There will be no charge for spouses attending the Welcome Cocktail Party Wednesday evening in the Exhibit Hall.

EVENT A - Thursday morning, March 15: 11:30 - 1:00 PM
Secrets of the Stones - Following luncheon in the Count Basie Ballroom of the Allis Plaza Hotel, one of Kansas City’s leading jewelers will reveal “secrets of the stones,” a display and discussion of gems, their value, how to buy and clean them—showing breathtakingly beautiful jewelry pieces not normally seen outside stores.
Price (including lunch) $20.00

EVENT B - Thursday afternoon, March 15: 1:00 - 5:30 PM
Historical Weston Tour - Travel to the 1837 Missouri River town of Weston, Mo., for a visit to one of the town’s more than 100 pre-Civil War (and lived-in) homes listed in the National Register of Historic Places, the Weston Historical Museum and a business section featuring many craft and antique shops.
Price (including bus and admissions) $16.00

EVENT C - Friday morning, March 16: 9:15 - Noon
 Nelson Gallery/Kansas City Museum - tour of one of the most comprehensive art museums in the U.S., with art collections of all civilizations, from Sumeria 3,000 B.C. to modern painting and sculpture. Silver, furniture and period rooms, the Oriental collection from China, painting and pottery from Persia, screens and ceramics from Japan—plus the new outdoor sculpture garden. The Museum of History and Science, a 70-room mansion built by the lumber millionaire R. A. Long, now houses regional history exhibits, North American Indian artifacts, a showcase for costumes and textiles, and a planetarium.
Price (including bus and admission) $16.00

EVENT D - Friday afternoon, March 16: 12:30 - 4:30 p.m.
Trip to Independence - Buses will leave at 12:30 p.m., stopping for lunch at Stephenson’s Apple Orchard, a charming and cozy, award-winning restaurant where country cooking is featured and President Harry S. Truman entertained heads of state—then to Independence, Mo. for a tour of the fiery and colorful Truman’s hometown, highlighted by a visit to the Truman Library and Museum and, on the return trip, a drive by the massive Kansas City Royals/Chiefs Baseball/Football Stadium.
Price (including lunch, tips and admissions) $25.00

Complete spouses’ program (includes A, B, C & D) $75.00
TECHNICAL SEMINARS

1 Construction Claims (Panel)
Moderator: Robert B. Nelson, AFCO Steel, Little Rock, AR
Speakers:
David B. Ratterman, Goldberg & Simpson, Louisville, KY
James R. Jones, Havens Steel Co., Kansas City, MO
Frank Goldenberg, Montague-Bettis Company, Inc., Lynchburg, VA

2 Products Liability Insurance (Panel)
Moderator: Morris H. Caminer, AISC
Representative, CNA Insurance Company
Representative, Hiatt Agency, Inc.
Representative, AISC
Representatives of a major insurance company, national brokerage firm and fabricator share thoughts on common-sense approaches to purchasing insurance. Regardless of firm size, attendees will leave this session with cost-saving tips easily implemented in their business. Question-and-answer period follows presentation.

3 What the First-line Supervisor Should Know (Panel)
Moderator: Robert H. Woolf, Cives Steel Company, Roswell, GA
Dorman S. Conklin, Employee Development Services, Jackson, MS
James E. Self, Cives Steel Company, Roswell, GA
A workshop to give managers the information and skills they need to successfully implement participatory management in the production environment, nurturing the environment necessary to encourage, foster and maintain employee commitment and quality production. Self will discuss employee motivation and expectations, as well as legal restrictions impacting supervision of the workforce.

4 Frame Analysis, LRFD
Moderator: William McGuire, Cornell University, Ithaca, NY
“Second Order Elastic Analysis in LRFD - Research to Practice” - Donald W. White, Purdue University, West Lafayette, IN
“Studies in Inelastic Analysis and Design” - Ronald D. Ziemian, Cornell University, Ithaca, NY
Case studies from research directed towards advancement of inelastic building systems design includes a series of plane-frame studies; three-dimensional frame of compact sections, member vs. system behavior and illustrations of force redistribution as calculated by inelastic analysis programs.

5 Standard Details and Connections
“— in Buildings” - Cynthia Zahn, AISC, Chicago, IL
“— in Bridges” - Charles L. Chambers, FHA Region 3, Baltimore, MD
AISC has developed new design aids for pre-engineered web bolted connections. Zahn will describe those aids in detail. FHWA Region 3 has developed standard specifications and design details for steel bridges. The acceptance and use of the adopted standards have been encouraging.

6 PR Connections
Moderator: Robert F. Lorenz, AISC, Chicago, IL
USA - Gregory G. Deierlein, Cornell University, Ithaca, NY
Europe - Riccardo Zandonini, University of Trento, Italy
Speakers will describe international developments in the theory and practice of Partially Restained Connections in LRFD.

7 Recruitment and Training of Steel Detailers (Panel)
Moderator: Terry Peshia, Garbe Iron Works, Aurora, IL
Speakers:
Al Frechette, Executive Director, Great Lakes Fabricators Association
Ken Voite, Paxton-Vierling Steel Company, Omaha, NE
Leonard Ross, L. N. Ross Engineering Co., Atlanta, GA
One of the key limiting factors of a fabricator’s ability to expand and be successful is the capacity to quickly produce accurate shop drawings. The solution to this potential problem is recruiting and training of qualified detailers. Ideas and solutions from the perspective of a fabricator, a detailing service company and a structural steel trade organization will be presented to stimulate thought on the variety of things which must be done to resolve this major concern.

8 Plant Automation and Layout
Moderator: Sidney W. Blaauw, Paxton & Vierling Steel Company, Omaha, NE
Charles B. Jensen, Jensen Engineering & Machinery Company
Fred Kohler, Paxton & Vierling Steel Co., Omaha, NE

9 Protecting Your Workers Against Welding Fumes (Panel)
Moderator: W. H. Reeves, Carolina Steel Company, Greensboro, NC

10 Floor Serviceability and Constructability
“Composite Construction” - Robert Leon, University of Minnesota, Minneapolis, MN
“Innovative Floor Systems” - Thomas H. Murray, Virginia Tech, Blacksburg, VA

11 Beam Camber
“Producer’s Viewpoint” - Jay W. Larson and Robert K. Hussard, Bethlehem Steel Corporation, Bethlehem, PA
“Fabricator’s Viewpoint” - Lawrence A. Kloiber, L. L. LeJeune Company, Minneapolis, MN
Use of lighter, high-strength steel beams spanning greater distances produces more economical steel frames, but also results in larger deflections to be accommodated: several recent projects and field-measured data support suggested guidelines for understanding, specifying and implementing cambering, evaluating cost effectiveness and specifying cambering.

12 Building Design
“Steel Plate Shear Walls” - Mohamed Elgaaly, University of Maine, Orono, ME
Steel savings of as much as 50% have been achieved employing steel plate shear walls rather than moment-resistance frames. Results of new research on seismic behavior of thin steel plate shear walls at the University of Maine is presented.

“Interaction of Cladding and Steel Frame” - Stan Korista, Skidmore, Owings & Merril, Chicago, IL

13 Tubular Connections (Panel)
Moderator: David T. Motyll, Welded Tube Company of America, Chicago, IL
Speakers:
Fred Palmer, American Institute for Hollow Structural Sections, Pittsburgh, PA
14 Connection Design Responsibility - Present Status
Moderator: Phillip Levine, Roll Form Products, Inc., Boston
Speakers:
Representative, AISC Staff
Representative, ASCE Staff

15 Panel: Scope of Business, including the following:
Erection - Subcontract vs. Erect Yourself
Freight - Contract-hauler vs. Your Trucks
Drafting - Subcontract Detailing vs. In-house Drafting
Moderator: Terry Pesha, Garbe Iron Works, Inc., Aurora, IL
Speakers:
Ray Jasica - PDM, Melrose Park, IL
Jack D. Wickliffe - Almet Corporation, New Haven, IN
Robert D. Long, Bratton Corporation, Kansas City, MO

At its core, the steel fabrication business is a manufacturing operation in a factory environment. There is, however, a difference in the in-house services offered by fabricators. Drafting, trucking and erection may be done directly by the fabricator or may be furnished by subcontractors. The questions are: Why does the fabricator choose to provide one service and not another? How did that function evolve?

16 Composite Members
"Trusses" - D. J. Laure Kennedy, University of Alberta, Edmonton, Alberta, Can.
"Long-span Composite Joists" - Kurt D. Swensson, Stanley D. Lindsey Associates, Nashville, TN
Outlines design and construction of Sovran Bank Building, Knoxville, a 6-story parking structure topped by 8 stories of offices. Composite joist system made the project viable and brought the job in under budget.

17 Economical Bridge Design
"Route 150 Bridge over James River" - Steven J. Chapin, Hayes, Seay, Matern & Matern, Roanoke, VA
Steel Box Girder - I-95/I-595 Interchange in Florida" - Bogdan O. Kuzmanovic, Beiswenger, Hoch & Associates, North Miami, FL.
Chapin will describe the design and construction of dual 4,233-ft bridges that carry Virginia Rt. 150 over the James River, the historic Kanawha Canal and railroad tracks of CSX Transportation. Kuzmanovic will discuss design and erection of the curved, continuous composite hybrid box girders (spans ranging from 100 to 205 ft) for the I-95/I-595 Interchange in Florida.

18 Fire Protection of Steel Frames
"Effect of End Restraint" - Boris Bresler - Wiss, Janney, Elstner Associates, Emeryville, CA
Guidelines are proposed to aid designers of fireproofing for steel-framed buildings in identifying restrained and unrestrained construction.
"Fire Endurance, Case Studies" - Kathleen H. Almand - American Iron & Steel Institute, Washington, DC
"Load Combinations for Buildings Exposed to Fire" - Bruce Ellingwood - Johns Hopkins University, Baltimore, MD
An improved methodology for determining loads and load combinations for use in fire-resistant structural design is presented (consistent with European limit-states design approaches and compatible with LRFD philosophy).

 OPTIONAL EVENTS

EVENT #1 - Wednesday morning, March 14: 9:30 - Noon
Tour of Kansas City - A bus tour through the "Heartland of America" to view the beauty and grace of hundreds of lovely fountains (more than any other city in the world except Rome) and statues, the first settlement of the Missouri and Kansas River, Crown Center, the Liberty Memorial, historic Westport—last outpost of the Santa Fe and Oregon trails, the affluent Mission Hills estate area and the Country Club Plaza, first U.S. suburban shopping community.
Price (including guide) $10.00

EVENT #2 - Thursday evening, March 15: 7:45 - 9:30 PM
All that Jazz (Conference Dinner and Show) - The Count Basie Ballroom of the Allis Plaza hotel makes an ideal setting for dinner (Kansas City sirloin steak, of course) followed by a show that includes all the varieties of American jazz for which Kansas City is known: blues, ragtime, Dixieland, swing. (Open reception with cash bar immediately preceding dinner in the Ballroom Foyer, Mezzanine Level.)
Price (dinner, tip and entertainment) $37.00

EVENT #3 - Friday evening, March 16: 6:30 - 10:45 PM
Dinner Theatre - Dinner and show at the Waldo Astoria, a delightful and nostalgic theatre featuring oil paintings and posters of the "grets" of yesteryear, opera boxes and tiered floor seating. Evening includes marvelous pre-show entertainment, a lively Broadway comedy and gourmet buffet (drinks "on your own").
Price (transportation, buffet, show, tax & tips) $30.00

EVENT #4 - Saturday morning, March 17: 9:30 - Noon
Hard Hat Tour of Block 111 - An on-site visit to the construction side of the Kansas City steel-framed highrise featured in the morning general session. (No charge, but advance reservation is required)

EVENT #5 - Saturday morning, March 17: 9:30 - Noon
Tour of Fabricating Plant - Two Kansas City area structural steel fabricators will open their plants for guided tours—buses will load on first-come, first-served basis; number of buses to be accommodated may be limited due to plant safety requirements. (No charge, but advance reservation is required)

EVENT #6 - Saturday morning, March 17: 9:30 - Noon
Hard-hat Bridge Tour - Arrangements are now underway to visit one of the steel-framed bridges in the Kansas City area; site to be announced. (No charge, but advance reservation is required)

EVENT #7 - Saturday afternoon, March 17: 1:00 - 4:00 PM
Trip to Independence - Buses will leave at 1:00 for Independence, Mo. and a tour of the fiery and colorful Harry S. Truman's hometown, highlighted by a visit to the Truman Library and Museum and, on the return trip, a drive by the massive Kansas City Royals/Chiefs Baseball/Football Stadium.
Price (including admissions) $12.00

CATCH THE K.C. TROLLEY FOR ON-YOUR-OWN FUN
The Kansas City Trolley ($3 fare good for three rides in one day) stops at the Barney Allis Plaza (less than one block from any of the Conference Hotels), travelling to:
Crown Center - a complete urban community offering specialty shopping, fun-to-fancy restaurants, movies, live Broadway-style theatre and the Hallmark Visitors Center;
Westport Marketplace - a thriving area reminiscent of the 19th century, with shops, restaurants and boutiques.
**REGISTRATION FORM**

Registration Fees: (Please circle appropriate fees)

- **AISC Member Fee:** $275.00 (before February 1)
  - $325.00 (after February 1)
  (Includes AISC Active, Associate & Professional Members)
- **Non-Member Fee:** $325.00 (before February 1)
  - $375.00 (after February 1)
  - $500.00 (after February 1)

**Educator Fee:** $100.00
(Based on full-time employment at accredited architectural or engineering college or university.)

**Student Fee:** $75.00
(A letter from faculty advisor or equivalent is required)

**Exhibitor in Booth (no charge)**

**Added Exhibitor:** $75.00

**Spouse's Fee:** $75.00

### Partial Registration Fees

(You may also pre-register for 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

**Exhibitor Visitor:** $5.00

**Total Partial Registration 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 Spouse's Program, or individual Spouses' or Optional Events, please complete next line for badge:**

**Name of Individual Registering for Other Events**

**Nickname (for badge)**

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**Conference Fees Payable:**

- **Registration Fee:** $______
- **Spouse's Fee:** $______
- **Partial Registration Fees:** $______
- **Optional Events:** $______
- **Total Registration Fees:** $______

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**Registration for Optional Events**

<table>
<thead>
<tr>
<th>Event</th>
<th>No Tickets</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Kansas City Tour (Wed., 9:30 a.m.)</td>
<td>10.00</td>
<td>$______</td>
</tr>
<tr>
<td>#2 Jazz Show/Dinner (Thurs., 7:45 p.m.)</td>
<td>37.00</td>
<td>$______</td>
</tr>
<tr>
<td>#3 Dinner Theatre (Fri., 6:30 p.m.)</td>
<td>30.00</td>
<td>$______</td>
</tr>
<tr>
<td>#4 Tour, Block 111 (Sat., 9:30 a.m.)</td>
<td>No fee</td>
<td>$______</td>
</tr>
<tr>
<td>#5 Tour Fab. Plant (Sat., 9:30 a.m.)</td>
<td>No fee</td>
<td>$______</td>
</tr>
<tr>
<td>#6 Tour Steel Bridge (Sat., 9:30 a.m.)</td>
<td>No fee</td>
<td>$______</td>
</tr>
<tr>
<td>#7 Independence (Sat., 1:00 p.m.)</td>
<td>12.00</td>
<td>$______</td>
</tr>
<tr>
<td>#A Secrets of the Stones (w/lunch) (Thurs., 11:30 a.m.)</td>
<td>$20.00</td>
<td>$______</td>
</tr>
<tr>
<td>#B Weston Tour (Thurs., 1:30 p.m.)</td>
<td>16.00</td>
<td>$______</td>
</tr>
<tr>
<td>#C Nelson Gallery/K.C. Museum (Fri., 9:15 a.m.)</td>
<td>16.00</td>
<td>$______</td>
</tr>
<tr>
<td>#D Independence (w/lunch) 12:30 p.m.</td>
<td>25.00</td>
<td>$______</td>
</tr>
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**Total Optional Event Fees**

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