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NUMBER 5 • 1987

THIS ISSUE

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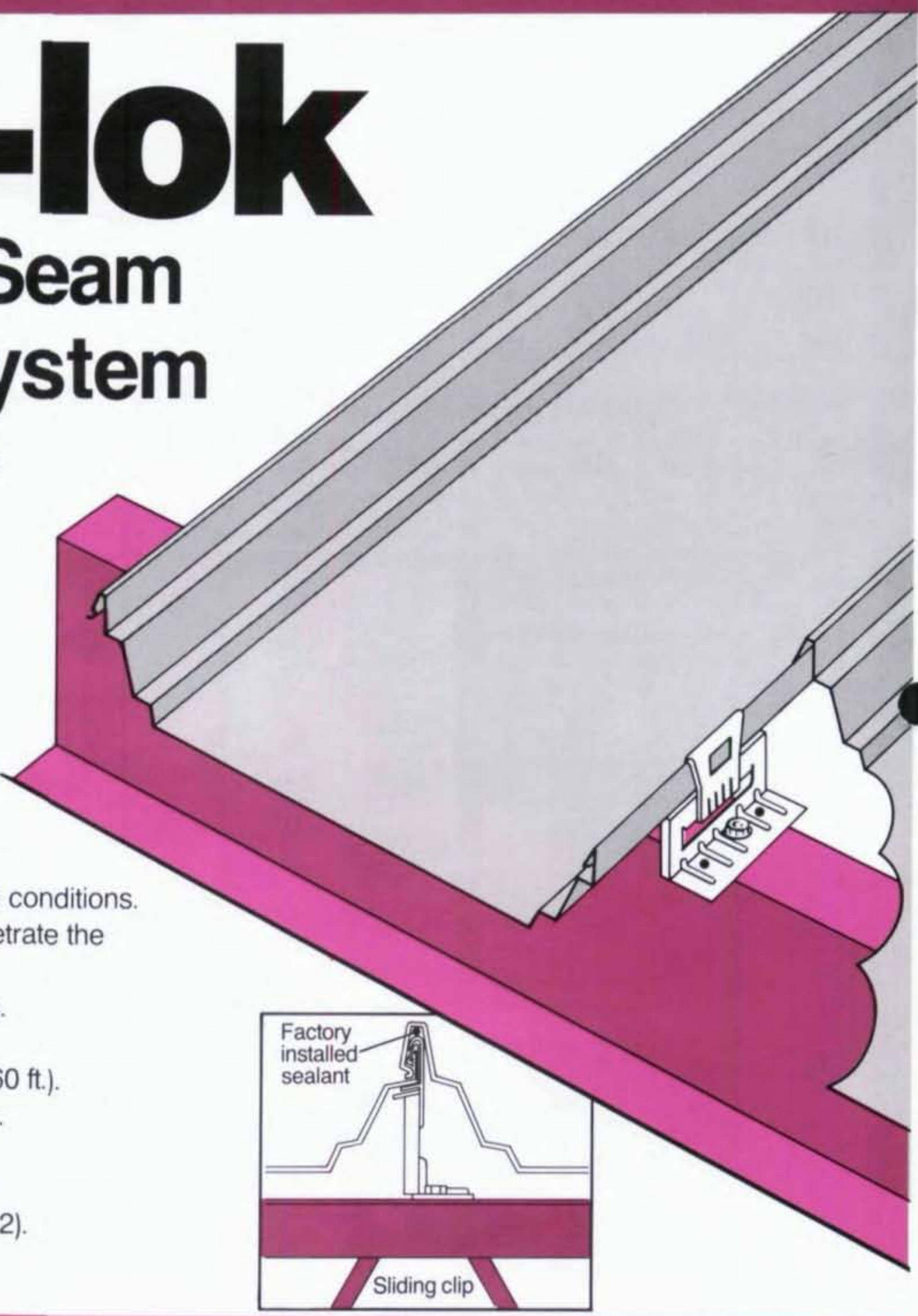

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American Institute of Steel Construction, Inc.

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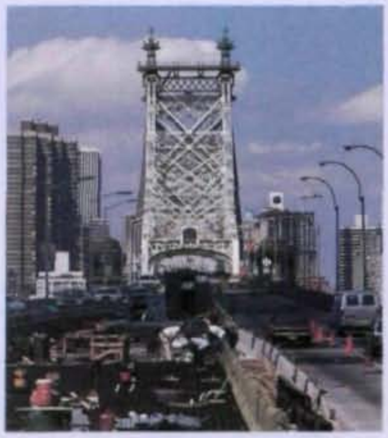
ON OUR COVER:
1987 AAE Award-winning Pier 17 Pavilion, in the shadow of Manhattan



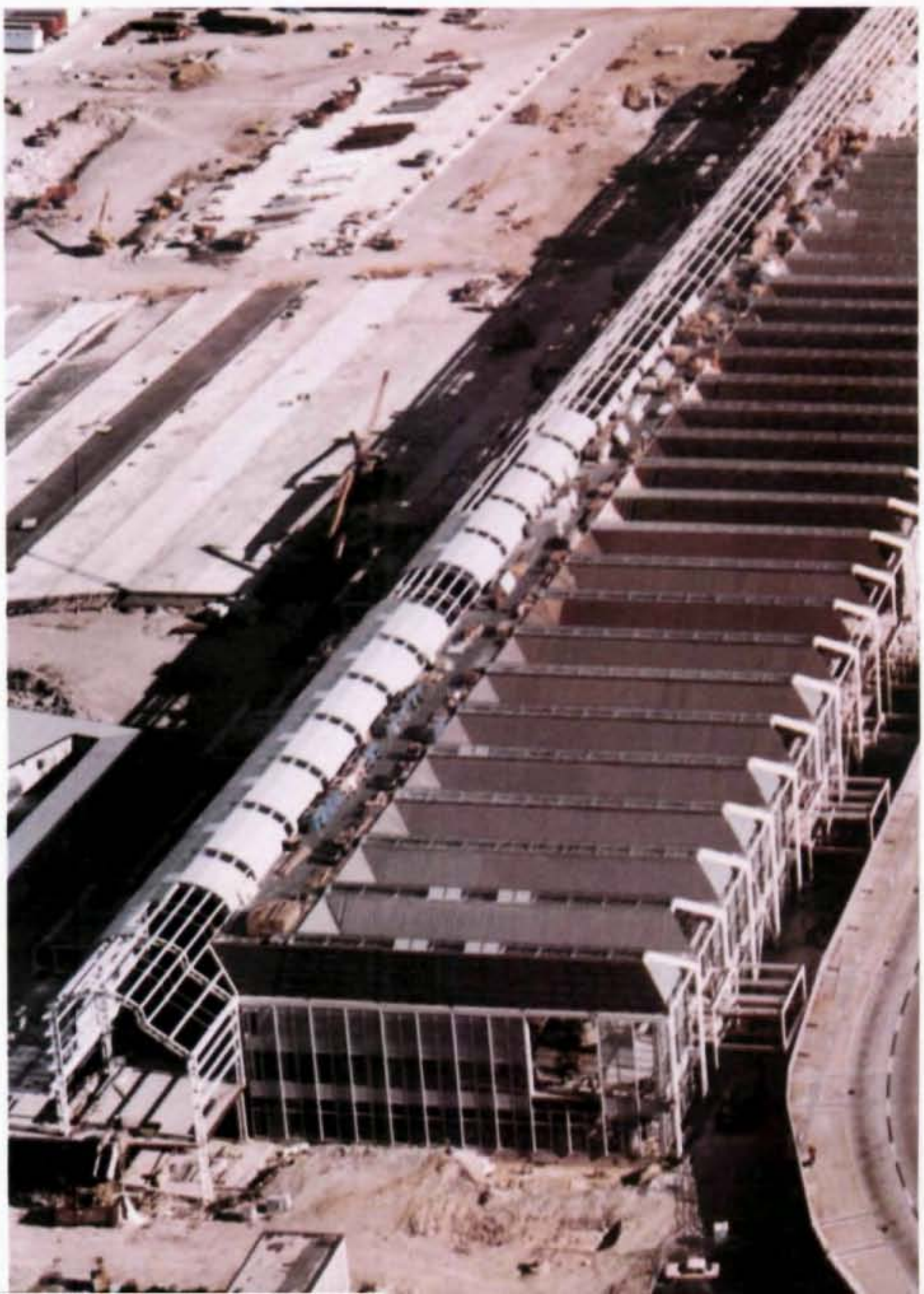
UNITED AIRLINES— O'HARE

Framed for Tomorrow

by Charles H. Thornton, Udom Hungspruke, Robert P. DeScenza and Martin Wolf

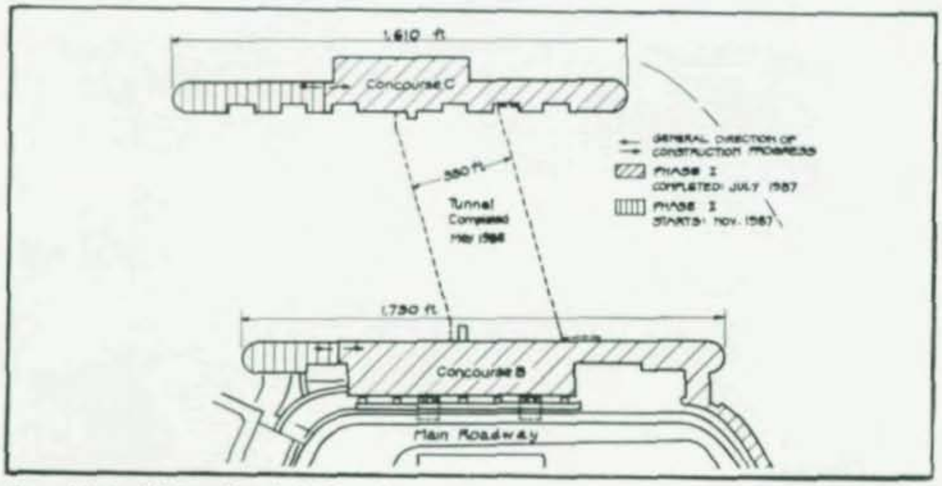
O'Hare Airport in Chicago, already one of the world's busiest airports, is currently undergoing a $1.5-billion redevelopment program scheduled for completion in the 1990s. The architectural centerpiece of this development is the $450-million United Airlines "Terminal for Tomorrow." The two highlighting features of this extraordinary project are the exposed steel structural systems supporting the roof at the 1,730-ft long vaulted gate areas and the exposed steel folded plate roof trusses over the 120-ft x 810-ft column-free ticketing pavilion areas. Phase I construction was completed in July 1987, with Phase II scheduled for completion in mid-1988.

The Terminal I complex is split into two parallel sets of gates—Concourse B and C. The two are separated by 800 ft. Passengers enter the main ticketing pavilion, a column-free area 810 ft wide by 120 ft deep. After passing security, they proceed to their assigned concourse. Passengers for Concourse B, located next to the main access roadway, proceed directly to their gate. Passengers for Concourse C must go through the 800-ft long, 300,000-sq. ft underground passage and baggage handling area connecting the two concourses. The 350-ft x 800-ft roof over the passage and baggage area, of post-tensioned con-



Overall of mammoth United Airlines new Chicago terminal.

Spectacular use of steel in soaring complex in B Concourse



Plan of United Airlines Terminal I Complex

Unclad folded-plate trusses and struts

crete, supports loads from airplane traffic to the two concourses. Each concourse consists of long corridors with 40-ft high glass ceilings with gates and passenger hold rooms off to either side of the main corridor.

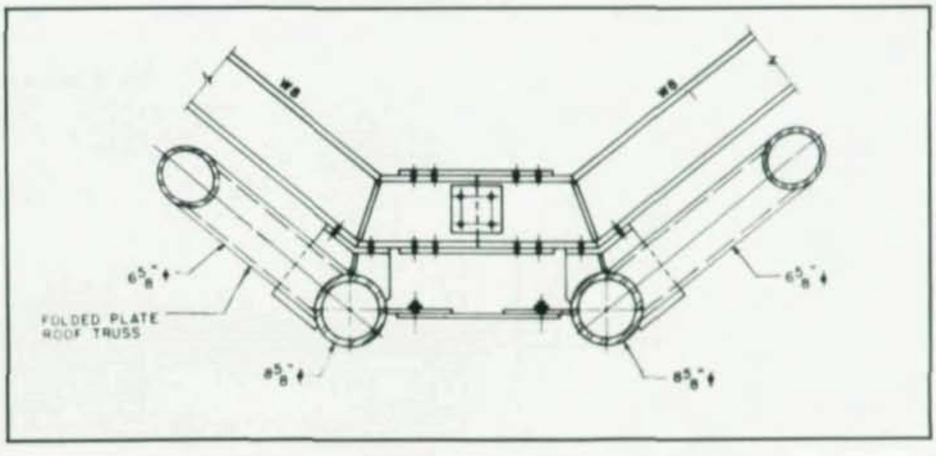
Folded Truss Ticketing Pavilion

The column-free ticketing pavilion area is one of the architectural highlights of the building. Located between Concourse B and the roadway, this area serves as the entrance to the building. Fifty-four exposed steel, folded-plate trusses span 120-ft from the roadway to the Concourse B main corridor. The steel used in the trusses conformed to the following ASTM specifications A500 Gr. C modified for 50-ksi yield strength, A618 Gr. Ia, A53 Gr. B, A252 and A333; in addition, API Gr. XL-52 with a minimum yield strength of 50 ksi was used. Each fold of the trusses is 14 ft-4⅞ in. in depth (the maximum depth that can be shipped) and is set at an angle of 37° from horizontal. The trusses are shop-welded, with 8⅝-in. dia. pipe top and bottom chords and 6⅝-in. dia. pipe diagonals. At the ridges, the top chords of adjacent trusses are spaced 5 ft apart. At the valleys, the bottom chords of adjacent trusses are spaced 2 ft-6 in. apart.

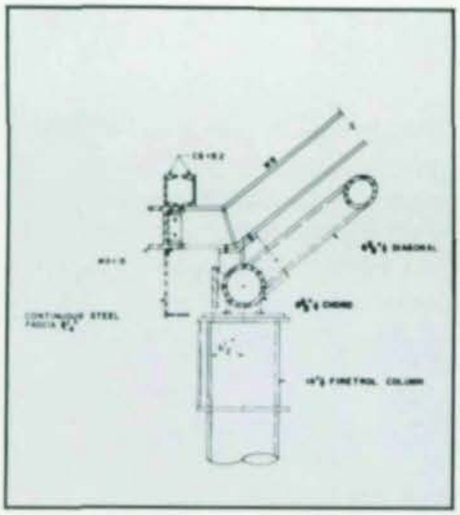
A series of 8-in. wide-flange members spaced at 10-ft intervals undulate up and down directly over the folded trusses in a direction perpendicular to the span of the trusses. These W8 members make the individual planar trusses act as a folded plate system. This combination of the flexural W8 members and the planar trusses allowed for the components to easily be individually shipped to the site and erected as a unit. In addition, the W8 members simplified the connections of the architectural cladding by providing a planar surface. The connections of the W8 members to the pipe trusses are all bolted connections to allow for simplicity of erection. Two adjacent planar trusses and the W8 members were assembled in the shape of an inverted "V" at the opposite end of the site. After the assembly was completed, the 30-ft wide units were pulled on a wheeled vehicle by a tractor ¼-mile and then lifted into place. Each truss took about four hours to move and install. After the trusses were lifted into place, the W8 members were connected to the adjacent inverted truss with simple bolted connections. Horizontal shear plates were field-bolted to insure that wind loads could be transferred to locations with X-bracing.

Along the main elevated roadway, parts of the folded plate trusses and their supports are exposed to the cold weather of Chicago's winters. As a result, these elements require specific toughness to improve their low temperature resistance to brittle fracture. The project specifications required that steel used in these areas be silicon-killed and fully fine-grained. A Charpy V-notch impact value of 25 ft lbs. at +40° F. was required for base metals and a Charpy V-notch impact value of 25 ft lbs. at -20° F. was required for weld metals used in these areas. Special marking and identification procedures were developed to control the traceability of this non-typical steel at critical locations.

Special consideration and analysis was required at both ends of the folded plate structure and at all of the interior expansion joints. At these locations, under vertical loads, the outer bottom chords of the fold-



W8 strut at connection at adjacent bottom chords of folded plate (top, r.). Drawing (r.) details W8 strut and horizontal shear plate connections.

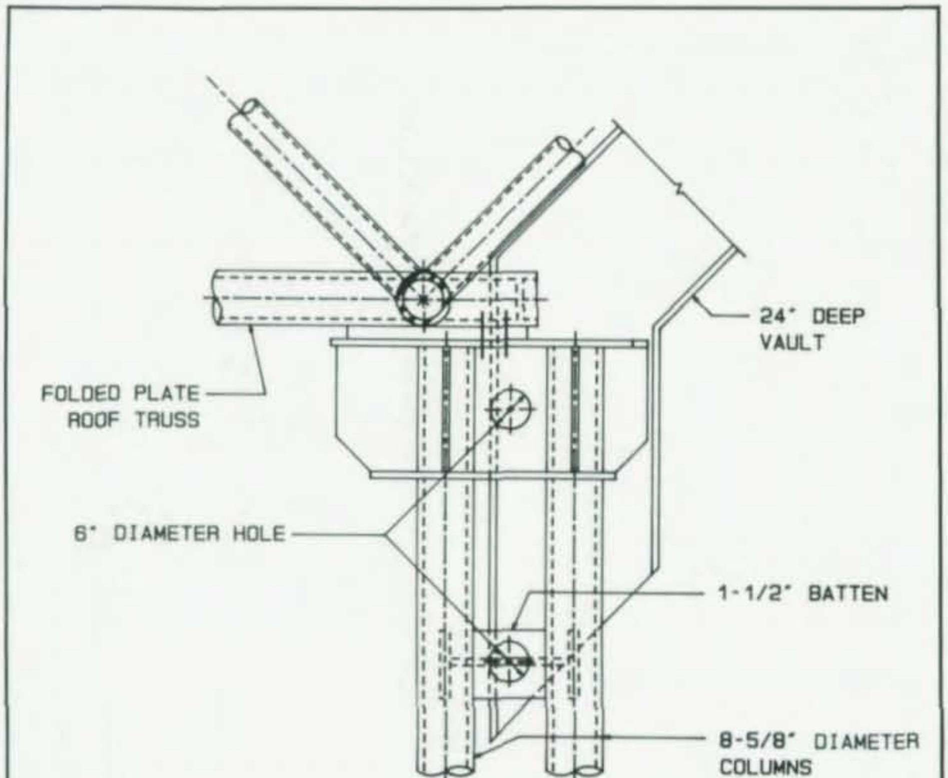


Folded-plate support detail at end fold (above). View of two-column cluster supporting folded-plate trusses at roadway side (r.)

Concourse C vaults

Vault to Vierendeel column connection Concourse B (3-column cluster)

Vault to Vierendeel column connection Concourse C (3-column cluster)



Vault to Vierendeel column connection at folded-plate intersection (4-column cluster)

ed plate system tend to spread apart; hence, the effectiveness of the folded plate system will be impaired and the horizontal displacements too great. Tie rods connecting the bottom chords are typically used to stabilize the exterior flanks' folded plates. However, the tie rod solution at those isolated locations creates an architectural appearance which is aesthetically undesirable. The final stabilization scheme selected at the two ends of the folded plate area consisted of installing columns 20 ft o.c. along the edge and stiffening the W8 beams on the edge segment. At the two expansion joint locations the W8 member size was increased and a W6 tie was added two ft below the ridge.

Battened Columns

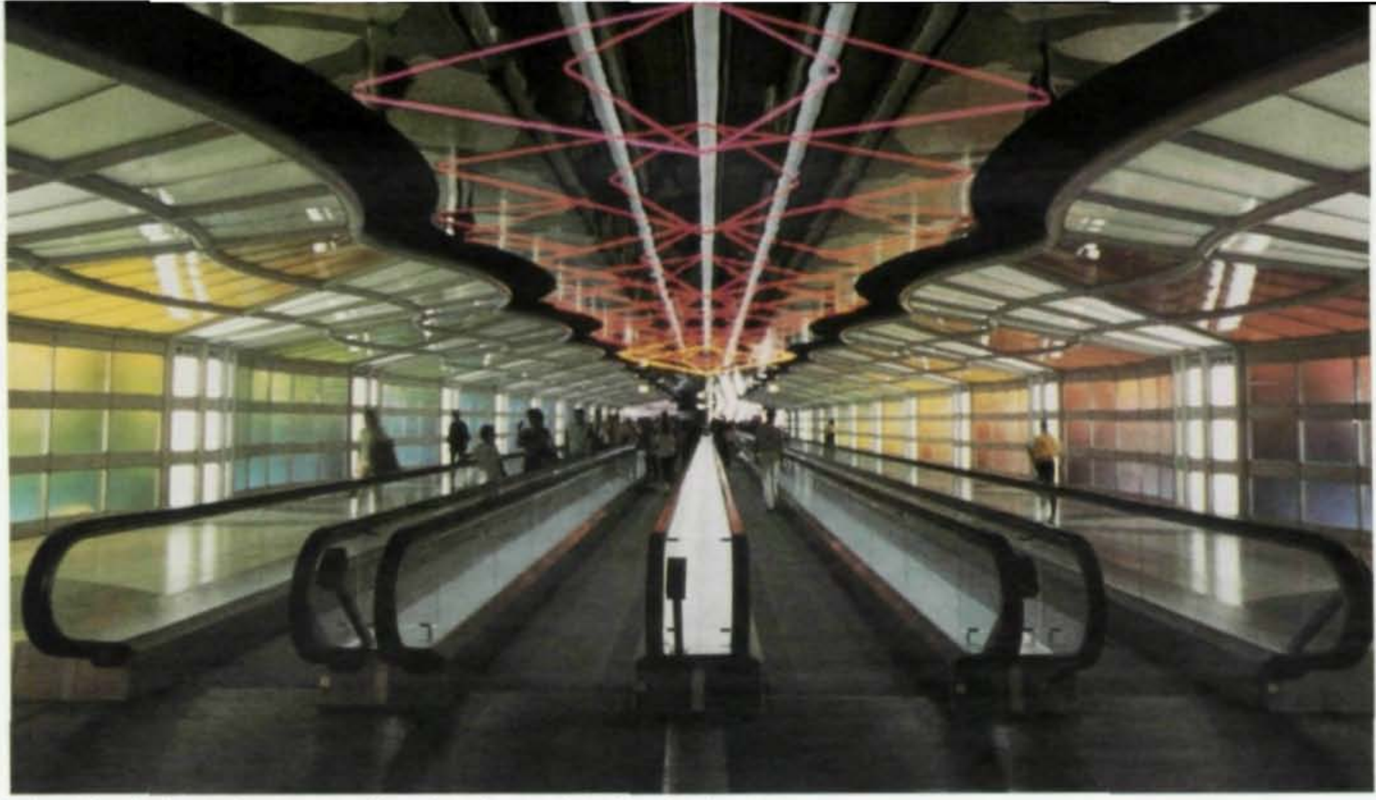
The columns supporting the folded plate area are 8⅝-in. dia. pipes in clusters of from one to five. The pipes were clustered to simplify the support detail for the two

discrete bottom chords. The clustered pipe columns were connected together with 12-in. deep vertical batten plates. A 6-in. dia. hole, located at the center of each of the battens, links the ticketing area architecturally to the vaulted corridor areas. The battens connect the individual pipe columns together to create a single Vierendeel column.

Stability and lateral wind load resistance in the folded plate area is accomplished by using exposed solid rods 4 in. in diameter. These rods are connected to the columns with pins and clevises.

Concourse B and C Vaulted Corridors

The second major architectural feature is the welded steel vaulted arches that form the roofs of Concourses B and C. Since the structure is exposed—and *becomes* the architecture—strict attention to the connection details was required by the entire design team. The roof over both the corridor areas and the hold room areas are skylit. The skylight glass is a ceramic fritted panel with an opaque grid pattern to reduce glare.



Moving sidewalks transport passengers through underground corridor. Overhead kinetic lighting sculpture—744 ft long—is synchronized to background music.

The main support system for the corridor roof is a series of steel-vaulted arches spaced 30 ft o.c. The steel used for the vaulted girders conformed to ASTM A36. In Concourse B, the arches span 40 ft to form a 1,730-ft long corridor. In Concourse C, the arches span 50 ft to form a 1,610-ft long corridor. The vaulted arches are shop-fabricated in an I-shape cross section, with continuous welds between flanges and web. Because of the size of the vaults, two splices are required in each of the girders. These splices are fully welded and ground so as not to detract from the architectural appearance. The 24-in. deep vault girders are perforated with 12-in. holes 24 in. o.c.

To support the glass mullion system, purlins spaced 5 ft o.c. span between the vaulted girders. The purlins are built-up members of a $8\frac{5}{8}$-in. dia. pipe and a WT4. The WT web is oriented perpendicular to the plane of the glass to improve the flexural strength of the purlins. Parallel to the segmental planes of the glass, a series of $1\frac{7}{8}$-in. dia. sag struts stiffens the pipe purlins about their weak axis and transmits unsymmetrical loads through the structure. Cross-bracing members are placed intermittently within the planes of the sag struts to stabilize laterally the vaulted arches. Five expansion joints were required in each concourse to reduce thermal expansion movements. All of the pipe purlins were fitted with stainless steel pins and Lubrite sleeve-type bushings at these locations.

The vaulted arches are again supported on a series of clustered pipe columns similar to those at the folded-plate trusses. Each of the different support details was planned carefully both structurally and aesthetically. The cluster columns support the vault creating an impression that the vault is floating between columns. To make the wind frame an effective interface between the vault and Vierendeel battened column, the connection was detailed as a moment connection.

Both ends of each of the two cylindrical concourse roofs terminate with domes. The domes are created by gracefully extending and curving the pipe purlins around the dome to form horizontal rings. Sag struts located on vertical great circles emanating from a central hub at the high point of the dome transmit vertical loads to the steel grillage supporting the dome at the lower roof level.

Conclusion

Steel proved to be the material of choice for the United Airlines "Terminal for Tomorrow." The flexibility and aesthetic nature of steel combined to create an innovative and efficient structure that forms the architectural centerpiece for one of the nation's busiest airports. □

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Chicago, Illinois

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Martin Wolf, AIA, is vice president of Murphy/Jahn, Chicago, Illinois.

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Preliminary Design Studies for Structural Steel Bridge and Building Frames

AISC Marketing, Inc. is a new company which has as its objective increasing fabricated structural steel's share of the building and bridge market. The sponsors of AISC Marketing, Inc., are The American Institute of Steel Construction, Bethlehem Steel Corporation and United States Steel Division of USX Corporation.

AISC Marketing maintains a national network of Regional Engineers—ten for buildings, four for bridges—located strategically around the country to assist the influences that design and specify structural products for buildings and bridges. Each of these Regional Engineers is uniquely qualified to assist engineers, contractors, construction managers, architects and anyone else who may be in the decision-making path for the choice of structural material on his project.

While each Regional Engineer has his own capability to assist the decision-maker, there is often the need for a design proposal which can be studied and priced to assist in the determination of the best structural arrangement for a steel solution to the structural problem. The headquarters staff of AISC Marketing, located in Pittsburgh, Pa., is equipped to prepare these design proposals, called Preliminary Design Studies. These studies are prepared under the supervision of experienced, recognized expert engineers who are fully familiar with the codes and standards which govern the design of buildings and bridges. Through their own knowledge and the input of the Regional Engineers, they are also familiar with the local conditions and practices which affect the use of fire protection, forming and other systems used with steel frames.

Studies can be prepared offering a single design which represents a best or optimal design, given the parameters that limit the number of alternates possible; or parametric studies can be prepared which show a range of values allowing the engineer to design his project with an optimization of structure and other functional requirements of the project. In each case, a fully documented presentation, with explanation of the thinking which went into the preparation of the Preliminary Design Study, is presented.

Preliminary Design Studies are done at the request of consulting engineers, contractors, state DOTs and others who make decisions regarding the choice of structural materials. Of particular interest to AISC Marketing, Inc., are projects where structural steel is not being considered, its potential is not understood, or where there is confusion about which structural steel system would be the most economical. In these cases, AISC Marketing, Inc., believes a specific example tailored to the project in question would be helpful and increase the chances for a structural steel frame to be specified.

A word about budget estimates. Budget estimates are not included in the study presentation. The studies are prepared with an understanding of the relative costs of different systems in different parts of the country. This information comes from the Regional Engineers or the person who requests the study. This allows the Preliminary Design Study to be prepared in such a way as to reflect the best and most economical choices of floor systems, fire protection, etc. for a given geographical area. Budget estimates can then be developed in a variety of ways. Local AISC member fabricators can quickly prepare estimates for the structural steel requirements. The Regional Engineers, who have contacts with contractors and suppliers of formwork or precast deck, will develop budget estimates for these materials using these sources. Similarly, fire protection and drywall costs, when needed, can be developed by the Regional Engineers. But very often it turns out that the contractor, construction manager or state DOT already involved in the project has the knowledge and capability or a preferred system to develop a realistic budget for comparison with other structural systems being evaluated.

Timing. From the time a Regional Engineer is asked to help by having AISC Marketing, Inc., prepare a Preliminary Design

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Marietta, Ga. 30068-1170
404/642-9707

Boston, Mass.
78 Airport Road
Warwick, R.I. 02889-1037
401/738-5338

Study, until the study is in the hands of the person requesting the study can be as short as one week. But the complexity of the study requested and the number of other studies being prepared at the same time can stretch this delivery time out two or three weeks. If the requester will indicate the priority of the project, the schedule can usually be accommodated.

If you think that a Preliminary Design Study would help you in the decision-making stage of your project when the choice of structural framing materials is being made, call your local AISC Marketing, Inc., Regional Engineer, or at the Pittsburgh headquarters call Heinz Pak at 412/394-3704 for a building study; or Roy Mion at 412/394-3706 for a bridge study.

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STEEL-GRID BRIDGE FLOORING
Recent Innovations to Proven Modular Decking System

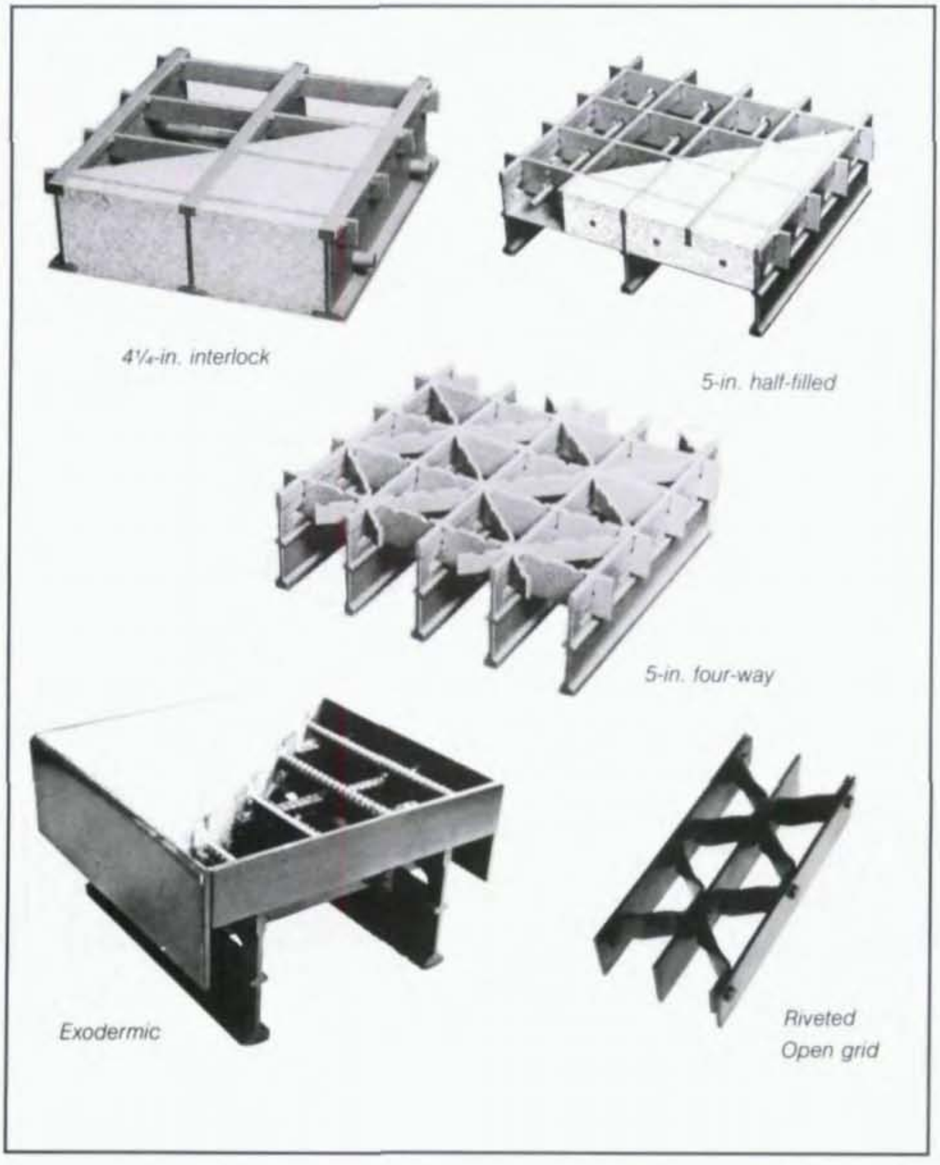
by Gene R. Gilmore

In the 1920s, engineers looking for a lightweight but high strength deck alternative butted flanges of tees together and filled the structure with concrete. These early grid reinforced concrete bridge decks spawned many variations in the years ahead, and were the birth of the most time-tested and most durable of all bridge decks.

Today, four types of steel grid flooring are in everyday use (Fig. 1). They are: (1) Full-depth grid reinforced concrete decks (using 3-in. tees or 4¼-in. I-sections as main reinforcement), (2) Half-depth grid reinforced concrete decks (using 5-3/16-in. I-sections as main reinforcement), (3) Exodermic bridge grid decking (variable depth unfilled grid with a composite slab on top of the grid network) and (4) open steel grid bridge flooring (either welded or riveted construction).

The grid reinforced concrete decks have, and are, playing an ever increasing role in bridge rehabilitation. Product design advantages such as reduced dead load, durability (many bridges have grid reinforced concrete decks with more than 50 years of service), composite action with supporting steel, coupled with construction advantages such as speed of deck replacement and ease of precasting have brought grid flooring to the forefront as the premier deck replacement material. All these advantages blend with attractive in-place costs of $20 to $25 psf, including a wearing course *and* corrosion protection. This paper examines the products' history, the design differences among the various types, the latest precasting and connection

Figure 1



details, case histories of recent projects, corrosion protection and finally, recent and future testing and the "lost report" on composite action with supporting steel.

Product History

As indicated, the first grid reinforced concrete decks were made from structural tees. Figure 2 shows the 10th Street Bridge in Pittsburgh, which opened to traffic in 1932. This photo was taken prior to its 1981 rehabilitation. At that time, the deck was still in excellent condition. Now in service for 55 years, it has endured heavy truck traffic and de-icing chemicals for most of its life.

Figure 3 is certainly the mainstay of grid reinforced concrete bridge decks. The I-beam Interlock floors were introduced in the 1930s. At one time, there was a family of the I-beam sections; 2½ in., 3 in., 3½ in., 4¼ in. and 5 in. Only the 4¼-in. I-beam section has survived the lean years of bridge rehabilitation and the mill closings of the 1970s and 1980s. However, as demand continues to rise, this family will make a comeback.

Figure 4 shows the Half-depth grid reinforced concrete deck developed in the 1950s. To decrease weight even further, an intermediate flange was added to the I-section to allow placement of a form pan halfway down in the grid network. Including a 2-in. cover, the bridge industry now had a deck that weighed less than 70 lbs. psf and with span capabilities up to 13 ft.

(continued on p. 22)

Fig. 2. 10th Street Bridge, Pittsburgh, Pa. Deck type, 3-in. tee, installed 55 yrs. At major rehab in 1981, deck was in excellent structural condition, overlaid with rubberized asphalt.

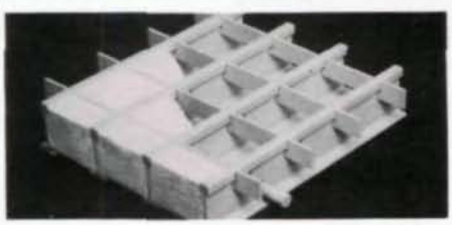


Fig. 3. 4-¼ in. I-beam interlock. Many bridges built in the 30s and 40s with this design are still in use. Most popular of full-depth-filled grids, and most economical.

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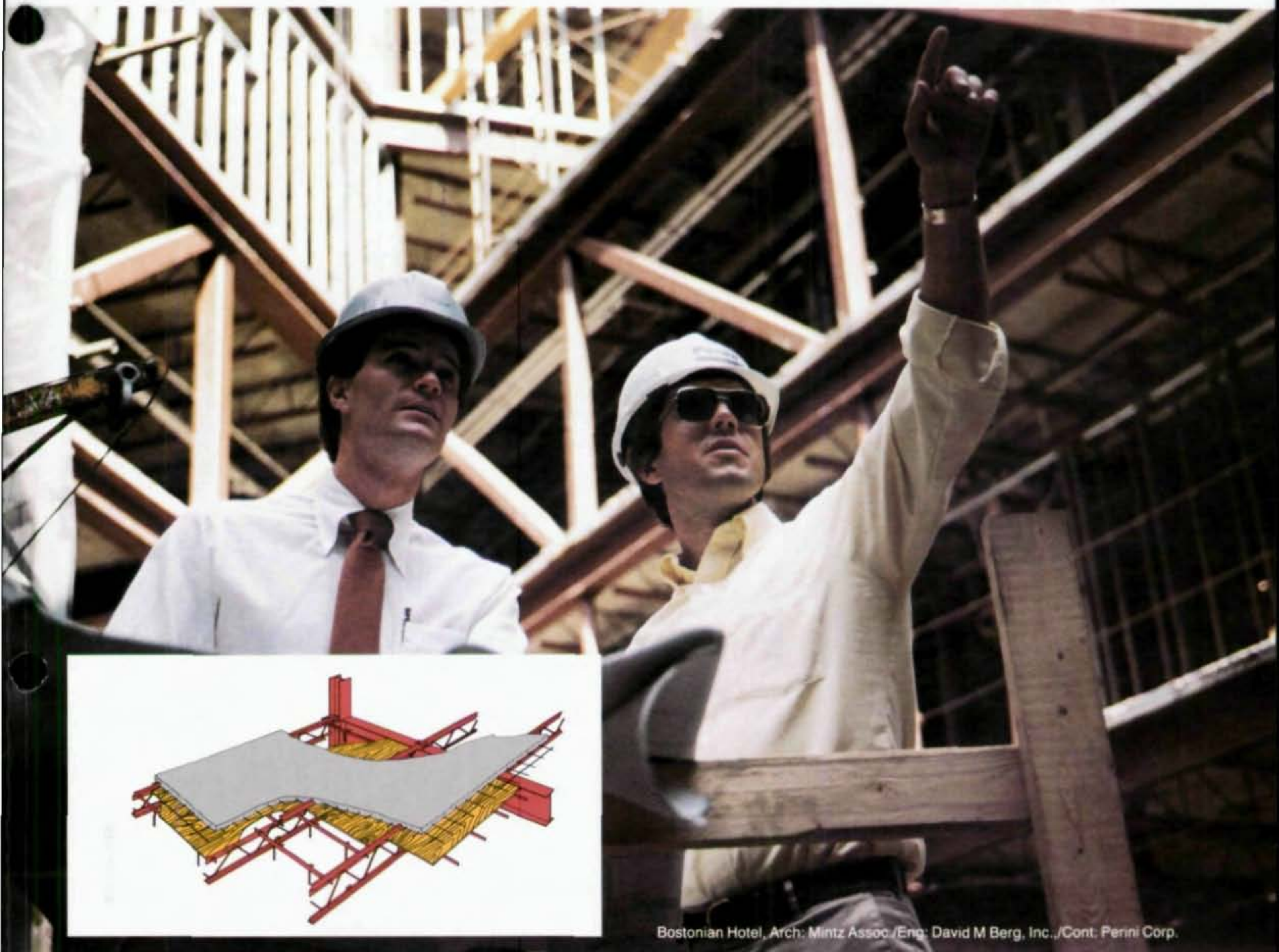

Bostonian Hotel, Arch: Mintz Assoc./Eng: David M Berg, Inc../Cont: Perini Corp.

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Peter Rizzuto, Project Manager, Perini Corp., contractor for Bostonian Hotel

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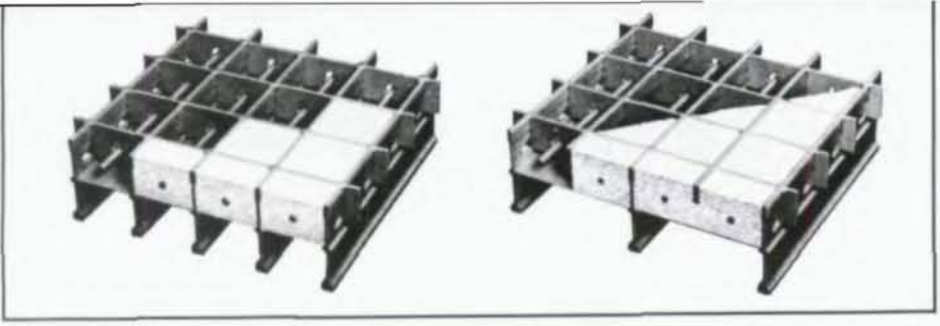


Figure 4

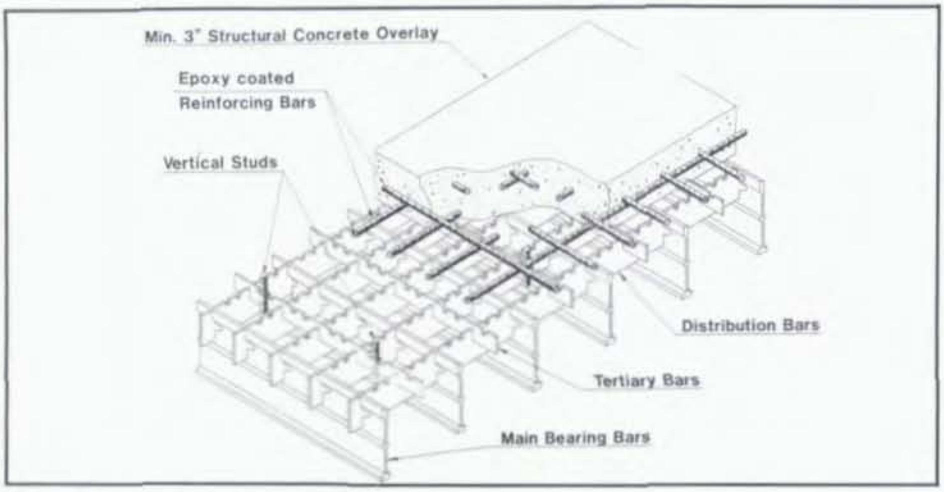


Fig. 5. Exodermic deck system

Note that the 3-in. and 4¼-in. grids also require a wearing course on top of the steel grid network. Riding on the armored surface will eventually cup the concrete and expose the grid bars. This can result in a bumpy ride and it could be slippery. For these reasons, a wearing course is always recommended for Full-depth of Half-depth grid reinforced concrete decks.

However, the exodermic deck in Fig. 5 does not require a wearing course. Its 3-in. or 4-in. composite concrete overlay is a wearing course in itself. As a result, this design yields the lightest concrete deck alternative. This innovation, developed in the 1980s, was tested extensively by the Fritz Laboratories. Its unique structure is a miniature T-beam composite cross section. The neutral axis of this variation is near the top of the steel grid. In positive moment, the concrete is in compression while the steel grid is in tension. Also, welds on the steel grid are near the low stress area of the neutral axis. The slab is connected to the grid by shear studs and an elevated grid bar that penetrates about 1 in. into the slab. Because of all these positive design features, the Lehigh University study stated, ". . . that an infinite in-service fatigue life can be expected . . ."* While Full-depth and Half-depth grids can be either precast or poured-in-place, the exodermic grid type is supplied only as a precast deck slab.

Figure 6 depicts the two types of open grids, welded and riveted construction. Riveted design evolved first in the 1920s. However, because of the riveted floor's greater weight, welded floors eventually dominated this market. Recent testing, however, indicates the riveted floor should not have been shelved so quickly.

Based on recent bids and discussions with the bridge community, Fig. 7 was developed to present reasonable expected in-place costs, including a protective wearing course for the various alternatives.

Design and Performance

To assist in the reader's understanding the design and performance characteristics of these products, Fig. 8 was prepared. Based on design and performance criteria presented, the exodermic grid offers the best performance, although some of its comparison factors are based on laboratory results. The precast grid follows closely, but its performance factors have been field verified. For the best blend of performance and value, the cast-in-place grid fulfills this

**Daniels, J.H. and R.G. Slutter* Behavior of Modular Unfilled Composite Steel Grid Bridge Deck Panels *Lehigh University, January 1985 (p. 21).*

objective. With in-place costs of $20 psf average, it is the prime candidate for value.

Open decks must be considered separately since they are not considered acceptable, and are rarely used, on primary highway structures. The riveted floor has the best performance characteristics, but is also generally heavier and more costly to manufacture and erect. However, it may be money well spent when the superior fatigue life it offers over its welded counterpart is considered.

Connection Methods and Precasting

The method of connection is obviously an important detail to be considered when using any form of grid deck. Furthermore, precasting the grid prior to placement requires additional considerations over and above the traditional cast-in-place connection details. Let us examine these important and various installation details.

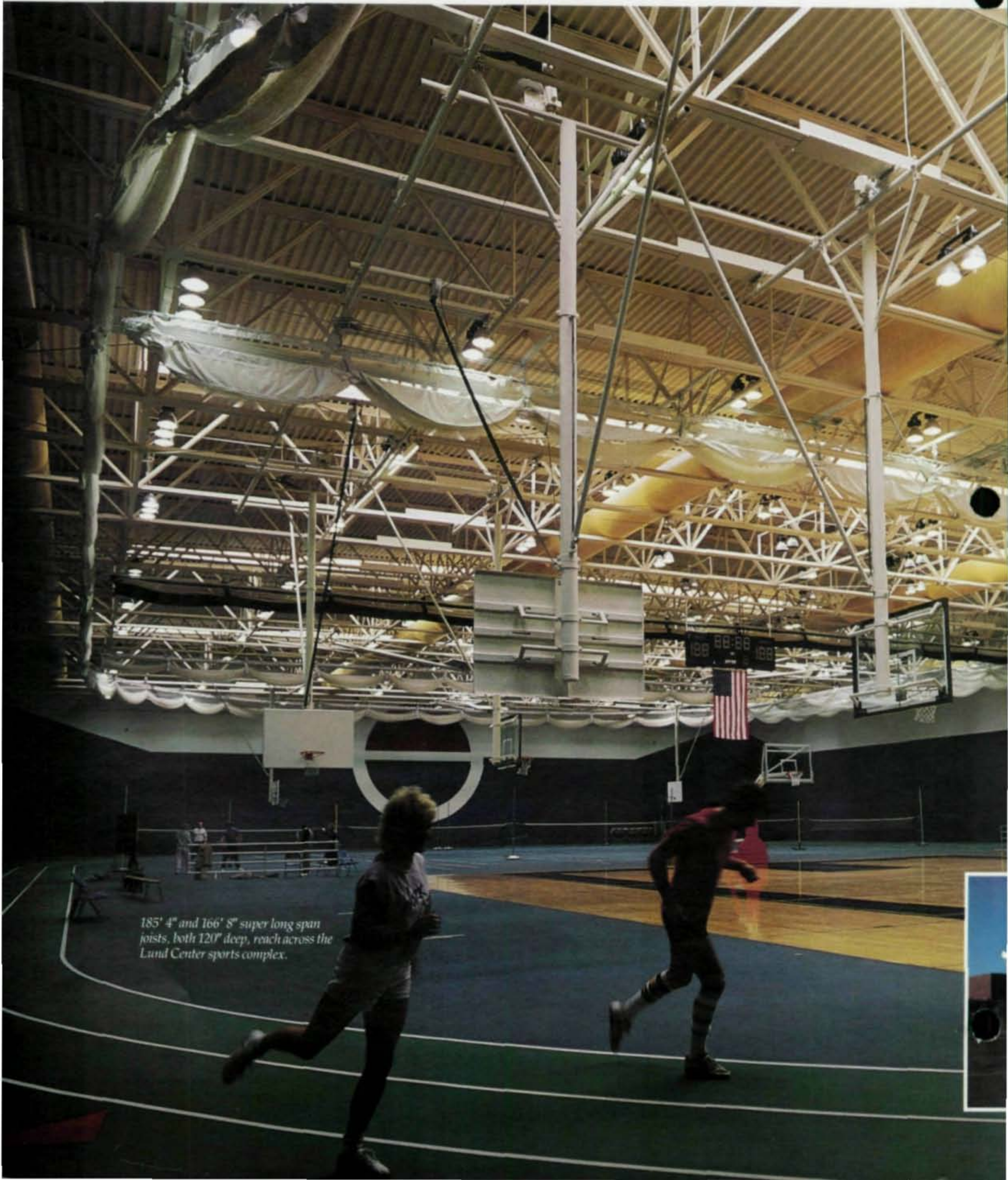
Figure 9 displays the traditional method of deck connection: welding the grid to supporting steel. This method, although still used on many projects, is rapidly being replaced by the use of shear studs. Precasting grids that are either welded or studded to supporting members require pockets in the precast grid reinforced concrete panels. The connection pockets, which permit field welding of the main grid elements to the stringers, were grouted after all the deck panels had been placed. An asphalt overlay was then placed over the armored surface. All deck work was done at night and the bridge was opened fully to traffic during the day. The 133,000 sq. ft of deck was replaced in eight months. The more current and preferred method of deck connection is to use shear studs. Using studs eliminates many of the question marks associated with welding. Figure 10 shows various details of deck connection using studs. When the deck units are precast, a leveling bolt can be used similar to attachment method No. 5. After proper elevation is achieved, the joint is grouted and the leveling bolt removed. Since shear studs are used, the deck develops full composite action with the support system. The isometric drawing in Fig. 11 depicts the exodermic deck attached by shear studs to the structural beams. The concrete overlay is composite with the grid, which in turn is composite with the structural steel. This results in a very efficient combination of lightweight decking and composite design.

Threaded shear connectors were chosen for the replacement decks on the Queensboro Bridge ramps in New York City. As Fig. 12 shows, the threaded studs permitted raising or lowering deck panels

(continued on p. 27)

Figure 6 *5-in., 4-way open grid* *Riveted open grid*

VULCRAFT SUPER LONG



185' 4" and 166' 8" super long span joists, both 120" deep, reach across the Lund Center sports complex.

SPANS GO THE DISTANCE.

The Lund Center of Gustavus Adolphus College

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Since the college is dependent on private funding, the savings afforded by using Vulcraft joists helped make it possible for the college to initiate the project. Also, by using Vulcraft's economical 3" N 20 gage deck, joists could be spaced farther apart. So, fewer joists were needed and construction costs were further reduced.

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P.O. Box 186, Grapeland, TX 75844 409/687-4665
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  - Canadian CAN3 – S16.1 – M84 Limit States Design
- Microsoft® Windows environment
- Mouse or keyboard interaction
- Members selected from AISC or CISC database or from user's custom data base
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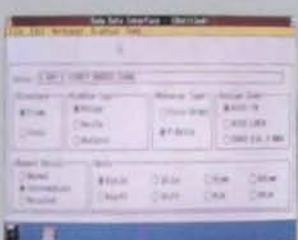

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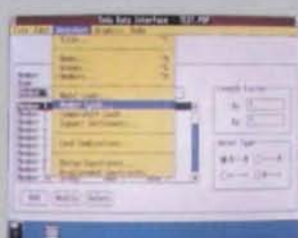

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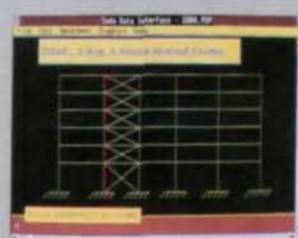

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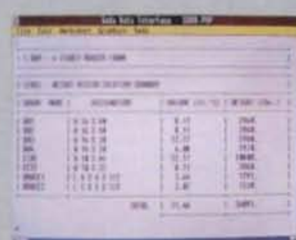

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STRUCTURAL OPTIMIZATION DESIGN AND ANALYSIS

	Type of Deck						
	Precast decks			Cast-in-place decks		Open decks	
	Exodermic grid	Precast grid	Precast concrete	Cast-in-place grid	Cast-in-place concrete	Riveted	Welded
Manufacturing Cost	$14	$9		$9		$14	$12
Concreting Cost	6	4		2		–	–
Erection Cost	6	6		6		12	6
Corrosion Protection* (or)	2	2		2		2	2
Protective** overlay	(Not Req'd)	4		4		–	–
Totals	$28	$21 (or) $23	$20	$19 (or) $21	$15	$28	$20

*Assumed to be galvanizing
**Assumed to be latex-modified concrete

Fig. 7. In-place deck costs in psf

	Type of Deck						
	Precast decks			Cast-in-place decks		Open decks	
Comparison factor	Exodermic grid	Precast grid	Precast concrete	Cast-in-place grid	Poured-in-place concrete	Riveted	Welded
Cost of deck installed	2	3	4	4	5	2	4
Cost of traffic maintenance	5	5	4	4	1	4	4
Weight	4	3	1	3	1	5	5
Future replacement	5	4	4	3	1	4	4
Ease of installation	5	4	4	3	1	4	5
Quality control	5	4	5	3	2	4	3
AASHTO standards	5	5	5	5	5	5	1*
Remaining useful life-rehabilitation project	5	4	1	4	1	5	5
Deck service life	5**	5	2	5	2	4	2
Totals	41	37	30	34	19	37	33

Key: 1 = Poor (or lowest)
2 = Below average
3 = Average
4 = Above average
5 = Best (or highest)

*Meets AASHTO standards, but there is an inadequacy in method of wheel distribution
**According to lab tests

Fig. 8. Relative value comparison of bridge decks

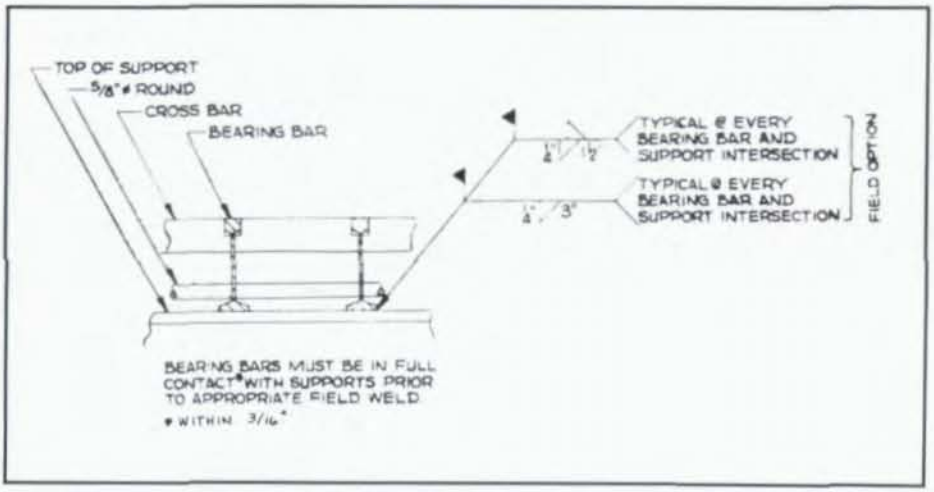


Figure 9

into desired position. They also served as temporary support for the unfilled deck, which was haunched at varying depths. The ramps had horizontal and vertical curves in combination with super elevations and varying roadway widths. The haunches were field-formed and continuously poured with the grid and a 2-in. concrete wearing surface. Finally, the double-duty threaded shear studs provide a positive connection for composite action with supporting steel after the cure. Note that welding of grid reinforced concrete decks to supports provides composite action also.

The use of shear studs with grout on top of the structural steel flange is also worthy of note. Figure 13 shows the final form of this attachment method. As an added benefit, the concrete cover provides pro-

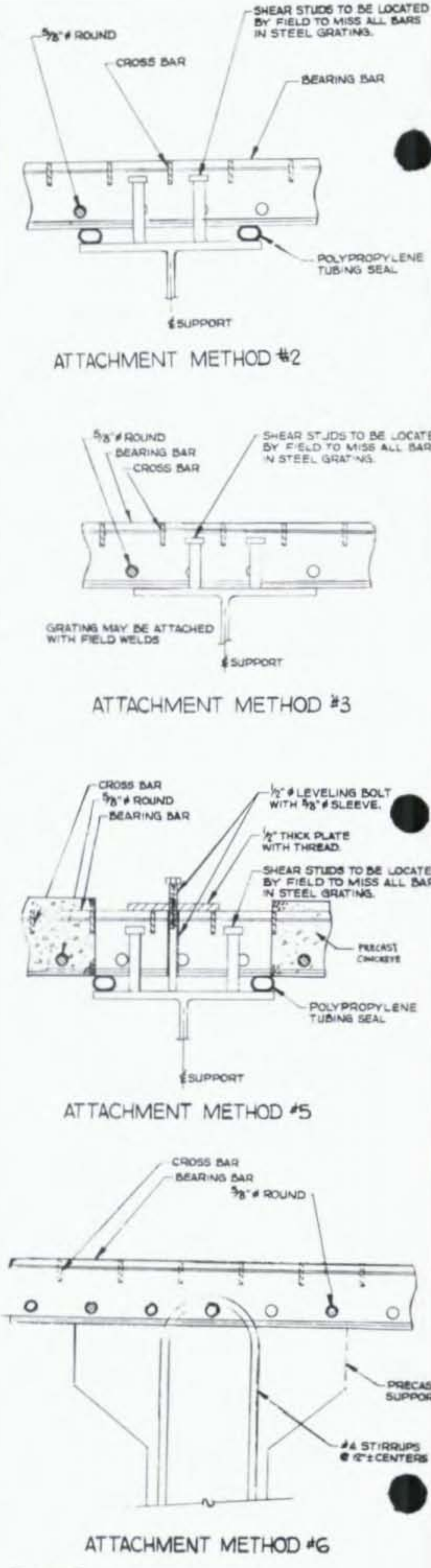


Figure 10

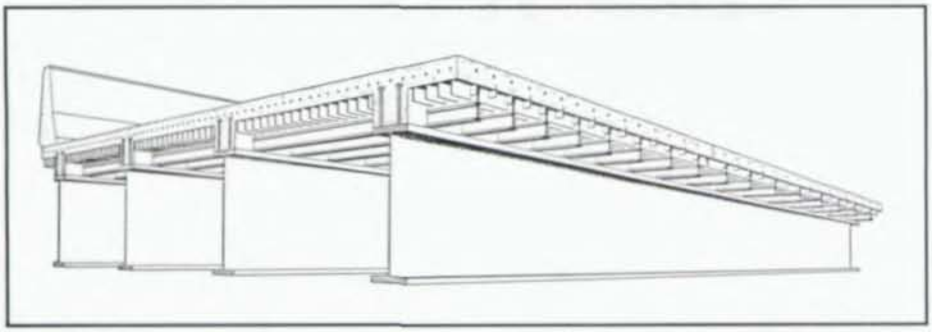


Figure 11

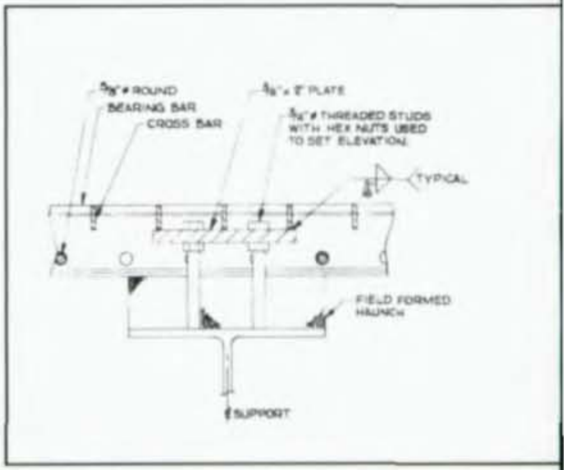


Figure 12

Figure 13

tection for the beam flanges, sometimes an objection when an open grid deck is proposed. Again, any questions involved with field welding are minimized.

Recent Case Histories and In-place Costs

Thousand Islands Bridge Over St. Lawrence Seaway, Upstate New York

Probably no other recent project expresses so completely the positive benefits of grid reinforced concrete decks as does the Thousand Islands Bridge. Built in the 1930s, this bridge (the American crossing) and its twin (the Canadian crossing), span the St. Lawrence Seaway in the picturesque area known as the Thousand Islands. Its long approach ramps were reinforced concrete decks. These had deteriorated badly due to the action of de-icing compounds and extreme freeze/thaw cycles over the years. However, the main span of the structure was a 4¼-in. grid filled flush with concrete and never overlaid. It had performed admirably in this severe environment and required no repairs, although the roadway was widened during rehabilitation.

Construction was limited to night work only, but one lane had to be maintained during the night. And the entire bridge had to be open to traffic during the day. The contractor would precast the grids at the

Thousand Islands Bridge

jobsite during the daytime hours. His precasting hut was under the bridge approaches. The panels, one half the roadway in width (13½ ft) and up to 39 ft long, were delivered to the bridge. Since the deck was precast, form pans in the grid were not required.

The decks were then brought into the precast hut and filled with concrete, including a 2-in. overfill for a wearing course. The finished precast decks were placed in the storage area for nighttime installation. Holes were drilled in the precast decks to permit field attachment. The eroded concrete slab was then removed at night and replaced with the precast grid system. The grid, precasting and installation was bid in 1985 at $22 psf, according to the contractor. This project displays all the grid deck advantages: ease of precasting and traffic maintenance, durability in severe environments and cost-competitive replacement with a lighter weight, superior product.

Allegheny River Bridge,
Pennsylvania Turnpike Commission

This ongoing replacement, again, shows the many advantages of grid reinforced concrete decks. This four-lane bridge was

4-¼ in. Grid installed	$13.45 psf
4-¼ in. Concrete	2.50 psf
1-½ in. Latex overlay	3.50 psf
Total in-place cost.........	$19.45 psf

Fig. 14. Allegheny River bridge bid prices

widened by 12 ft under traffic conditions, with no summer deck work permitted. Also, two and three lanes of traffic had to be maintained during the deck replacement and all four lanes made available in summer and winter. The grid was delivered to the jobsite and placed on the bridge stringers. Another benefit of using grids is evident here. The grid, which serves as a working platform during reconstruction, greatly improves installation time and permits increased traffic flow.

Figure 14 is a summary of the bid prices for the replacement deck. The complete 4¼-in. grid system was bid in the Fall of 1985 at less than $20 psf, *including* a 1½-in. latex modified concrete overlay. It should be noted that all expansion and relief joints, and all scuppers, were factory-installed, once again highlighting the product's flexibility and factory-controlled, quality benefits.

Missouri DOT Five-year Average Prices

The Missouri DOT, over the past dozen years, has an aggressive bridge rehabilitation program underway. They have used extensively the Half-depth Grid Reinforced Concrete Deck system and kept very detailed deck reconstruction costs. The Half-depth grid reinforced concrete deck met their needs because it reduced dead load by 30 to 50 lb. psf and served as a working platform for the contractor. The working platform facilitates assembly-line deck replacement and makes more deck area available for traffic maintenance. Naturally, the reduced dead load, as is the case for most grids, decreases the need for extensive structure repair and reinforcing or increases live-load capacity. Half-depth grids, in their unfilled state, can usually carry HIS loading without overstress.

Figure 15 shows the most recent (1982-1987) five-year average costs for the in-place grid decks, including waterproofing and wearing course. Once again, the total system cost is less than $20 psf. Recently, where dead load was not critical, Missouri has gone to the 4¼-in. Full-depth grid in anticipation of even lower in-place costs.

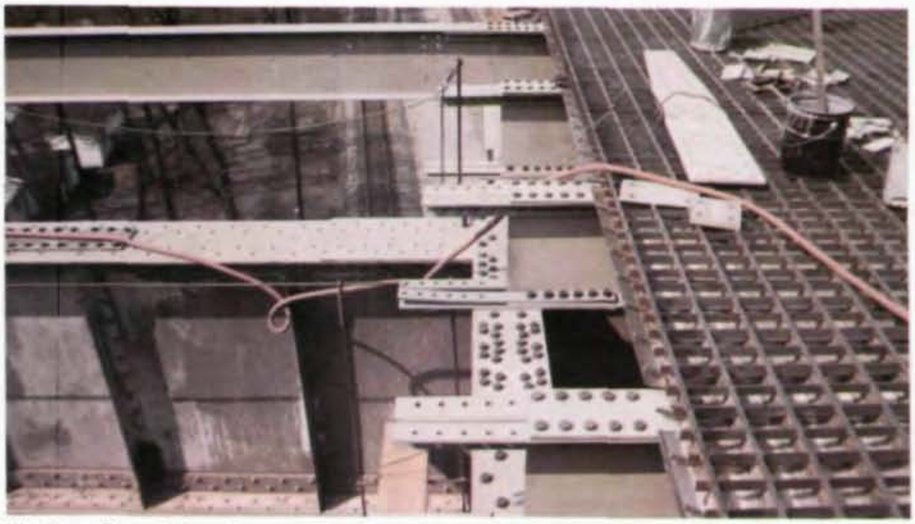
5-$\frac{5}{16}$ in. Half-depth grid, installed with concrete	$15.48 psf
Waterproof membrane & 2-in. asphalt wearing course	4.17
Total in-place cost	$19.65 psf

Fig. 15. Missouri DOT 5-yr. average pricing

Corrosion Protection

Corrosion protection of steel grids, specifically concrete-filled grids, has been a matter for much debate. Many theories, both positive and negative, have come out of this subject. It is difficult to draw conclusions on this matter, but examine the evidence. Figure 16 summarizes a study in 1976 on various western Pennsylvania bridges, some with grid decks and others with reinforced concrete slabs.* The comparison is dramatic. Chloride ion contents in the grids are high, but their average age is considerably greater than the reinforced slabs, yet their surface condition is far better. These decks had no corrosion protection, neither protective overlay or coated steel. Certainly this is a positive statement for deck performance without corrosion protection. This study brought to light that steel grids are grounded systems which limit stray corrosive currents present in reinforced concrete slabs. Copies of this study are available direct from Greulich.

Also, many grid floors are 50 years and



Allegheny River Bridge, Pennsylvania Turnpike

	Date built:	Salt content/ cu. yd. concrete:	Deck area:	Deck area damaged:
Concrete-filled steel grid	1934	10.490 lbs.	468 sq. ft	0.0%
	1940	4.412 lbs.	4,669 sq. ft	0.0%
	1958	0.246 lbs.	2,596 sq. ft	0.0% (asphalt)
	1932	2.902 lbs.	50,000 sq. ft	0.0%
	1932	1.070 lbs.	13,770 sq. ft	0.0%
	1937	1.900 lbs.	31,000 sq. ft	0.0% (asphalt)
	1931	6.575 lbs.	35,430 sq. ft	0.0% (asphalt)
	1940	3.496 lbs.	96,240 sq. ft	0.0% (asphalt)
Reinforced concrete	1958	3.572 lbs.	49,704 sq. ft	0.0% (asphalt)
	1956	5.016 lbs.	1,332 sq. ft	50.0%
	1952	5.510 lbs.	7,327 sq. ft	32.0%
	1950	5.130 lbs.	11,616 sq. ft	18.0%
	1962	2.710 lbs.	17,200 sq. ft	7.0%
	1962	0.207 lbs.	11,000 sq. ft	3.0%
	1965	1.290 lbs.	44,145 sq. ft	0.5%
	1973	0.796 lbs.	8,325 sq. ft	0.0%

Note: "0.0% (asphalt)" in damage column denotes normal wear of wearing surface. Reinforced concrete chart is composed of every fifth bridge listed in original study.*

Fig. 16. General damage comparison: concrete-filled steel grid decks vs. reinforced concrete slab decks

DECK GROWTH PHENOMENA

Theory — After 40 yrs. ± of service, steel in grids expands due to "expansion" in highly compressed concrete cubes.

Limitations — 95% of cases wherein very old decks finished flush with concrete and no overlay, not even asphalt

Other Theories — Concrete used;
poor quality steel;
insufficient expansion allowance

Possible Actions — Prime steel inside and out
Water proof systems
Concrete additives
Always use overlay, at least asphalt—from riding quality standpoint also!

Effects of Salt — Superior performance (Angleoff report)
Grounding aspects of grids
Lack of stray corrosive currents
Grid bridges in study, C1—content/cu. yd. and age of deck

10th Street	2.9 lbs.	54 yrs.
Highland Park	3.5 lbs.	47 yrs.
Boston Bridge	6.6 lbs.	49 yrs.

Figure 17

*Angeloff, Carl. An Evaluation of the Comparative Effect of Chlorides on the Deterioration of Reinforced Concrete Slab and Concrete-filled Grid Bridge Decks. *presented at Transportation Research Board 56th Annual Meeting, Jan. 26, 1977, Washington, D.C.*

older and have performed admirably under de-icing chemicals and severe environments, such as the existing Thousand Islands grid deck. This combination of a grounded deck system and superior performance life indicates corrosion is not a significant problem.

Those are the positives, but what about the negatives? What about the deck growth phenomena? Figure 17 outlines this negative factor. At the bottom of Fig. 17 are the positives for deck performance in corrosive environments. Ultimately, the owner must decide whether corrosive protection is desirable, and at what cost. Waterproofing overlays can cost (in 1987) anywhere from $2 psf up to $10 psf for thin, exotic wearing surfaces. Galvanizing the grid after fabrication adds about $2 psf to the cost of the system and is a relatively low-cost, but proven method. Coatings such as zinc paints and epoxy coatings have also been used. These add $2 to $6 psf to the price of the entire deck system. Therefore, a value judgment must be made concerning the need, and the extent of corrosion protection. The use of a lower cost method for corrosion protection might be the best decision.

It is important to point out another feature of the exodermic grid decking. It cannot exhibit the deck growth phenomena, since the grid cells are not filled with concrete as are conventional grid floors.

Testing

The "Lost" Study on Composite Action

A report by USS in 1960 indicates positively that full, composite action between concrete-filled grid decks and supporting steel is realized via full scale testing outlined in this report. Many times the question of composite action has arisen, and many times composite action has been assumed. That question can now be laid to rest since the "discovery" of this report which had been "lost" in the archives of USS for over 25 years. The report shows conclusively no slip between the deck and supporting system. Furthermore, a summary analysis done recently by the University of Pittsburgh supports the composite action conclusion of this study. Copies of the Test Report and Summary are available from the Bridge Grid Flooring Manufacturers Association.

Present Testing—West Virginia University—Open Grids

Dr. Hota Ganga Rao of West Virginia University completed in May 1987 a two-year, in-depth study of the performance characteristics of various *open* welded grids and riveted bridge decks.

FILLED GRIDS

1. History	First use in 1920s—tee type *I-beam type 1930s* Half-filled type 1950s Exodermic type 1980s
2. Design	Similar to rebar slab-composite Transformed area method for section properties Distribution of load by AASHTO 3.24.3.1 & 3.24.3.2
3. Construction Flexibility	Precast option Shop attachment of structural steel Acts as working platform during construction
4. Product Advantages	Dead-load reduction Speed of deck replacement Simplifies maintenance of traffic Durability Factory controlled quality Price—yes, price

Figure 18

Queensboro Bridge

Early fatigue studies reveal that riveted decks have a significantly longer fatigue life than welded floors. This is because they are generally heavier and their riveted connection provides a method for the riveted design to relieve stresses under live loads. Conversely, welded open grids rely on stiffness. And if transverse stiffness is not adequate, welds will break and fatigue cracks develop. Dr. Rao found high residual stresses in the welded panels. To lower these stresses, he recommends heat treating or galvanizing. Galvanizing, he believes, will perform the same function as heat treating at lower cost and will also provide corrosion protection. He likely will recommend a stiffer transverse bar also. Due to his study, we are likely to see a resurgence of the riveted design along with heavier open decks in general.

Future Testing

The Bridge Grid Flooring Manufacturers Association is considering tests on filled grids using shear-stud connections to supporting steel to verify composite action. Along with this study, wheel distribution will be examined to see if the AASHTO distribution formula for reinforced concrete decks is too conservative when applied to a filled grid. The grid network should provide superior distribution.

Summary

Figure 18 highlights the advantages and features of grid-reinforced concrete decks. These benefits, combined with new connection techniques and design features, make these products the leading candidates for bridge deck construction. □

Gene R. Gilmore is manager of sales and marketing, IKG Industries, Pittsburgh, Pennsylvania.

1987 Architectural Awards of Excellence

Special Section

1987 Architectural Awards of Excellence

This Special Section of *Modern Steel Construction* is a salute to the winners of the 1987 Architectural Awards of Excellence competition. This biennial event, sponsored by the American Institute of Steel Construction, recognizes and honors outstanding architectural achievement in building design.

All registered architects practicing professionally in the United States are eligible for the competition. They are invited to enter buildings of their design constructed anywhere in the United States or its territories. For the 1987 competition, each project must have been designed, fabricated and erected in the U.S. during the calendar years 1985 or 1986.

Buildings of all classifications are eligible, with equal emphasis given to all sizes and types in the judging. The structural frame must be steel, although it is not a requirement that the steel be exposed and a part of the architectural expression. Older structures which have undergone major reconstruction/rehabilitation may also be entered. There is no limitation on the number of entries by any individual or firm.

On Our Cover . . .

A Joe Kinkel sculpture on permanent display at AISC headquarters, "The Long Reach," is the motif for AAE and Prize Bridge Awards presented by AISC. Award winners receive bas relief plaques adapted from the sculpture.

THE AWARDS JURY

(left to right)

DONALD J. HACKL
President
Lobel Schlossman Hackl
Chicago, Illinois
(and 1987 President,
American Institute of Architects)

TED A. NIEDERMAN
Principal
RTKL Associates, Inc.
Baltimore, Maryland

HAL IYENGAR
Partner
Skidmore, Owings & Merrill
Chicago, Illinois

PROFESSOR WILLIAM McGUIRE
School of Civil & Environmental Engineering
Cornell University
Ithaca, New York

BRUNO D'AGOSTINO
Senior Vice President
Benjamin Thompson and Associates, Inc.
Cambridge, Massachusetts

CLARKE COLLEGE

Dubuque, Iowa

Juror comments: ***"Historically, spirituality has often been expressed in structural terms. Clarke College's design and use of materials epitomizes that mode of expression."***

Replacing key buildings lost in a fire, designers created a new "hub" for this 57-acre campus, echoing the character of the original group of closely linked buildings through a single large structure. It accommodates administrative offices, central library, chapel, recital hall, art gallery, post office and bookstore. The roof line has three individual peaks, one of which—the glazed atrium—reinforces the hub concept. Exposed bundled steel tube columns and vaulting are utilized to dramatically shape the space in forms reminiscent of a Gothic cathedral. Similar exposed bundled steel tube columns and vaulting are expressed in the two-story reading room of the library and chapel. The design integrates adjacent campus architecture and the masonry tradition of Dubuque architecture, consisting primarily of brick and limestone resting on the structural steel frame.

Architect
VOA Associates Incorporated
Chicago, Illinois

Structural Engineer
Shive-Hattery Engineers, Inc.
Moline, Illinois

Construction Manager
Conlon C.M.
Dubuque, Iowa

Steel Fabricators
Bradley Iron Works, Inc.
Dubuque, Iowa
and
Venetian Iron Works, Inc.
Des Moines, Iowa

Steel Erector
Northwest Erection Services, Inc.
Des Moines, Iowa

Owner
Clarke College
Dubuque, Iowa

345 CALIFORNIA CENTER

San Francisco, California

An elegant and unique form on the cityscape, this is one of the first major projects using a multiple tube and eccentric brace concept: a welded ductile, moment-resisting space framed tube at the exterior of the building, two transverse interior frames with an eccentrically braced core. Both frame and concept were selected because of ductility considerations and the fact that steel, light and flexible, reduced the inertia forces due to earthquake load. Steel framing also provided flexibility for inter-floor stairs for two-floor tenants; and erection of the tower's concrete-backed granite wall system. Rising 47 stories above grade, the project includes several parts: at the top, in two separate towers emerging from the office building and linked together with glazed skybridges, are 11 floors of hotel rooms; at the base is a full floor of mechanical equipment; then 31 floors of office space, two large podium office floors and—at street level and one above—two floors of office building and hotel lobbies, retail and restaurant space.

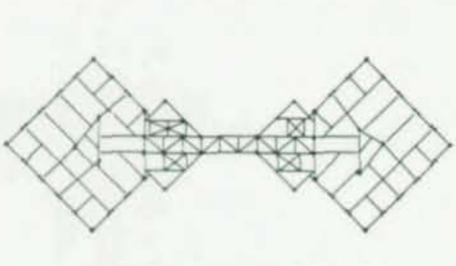
Jury comments: ***"A very aggressive, robust and powerful building statement."***

Architect/Structural Engineer
Skidmore, Owings & Merrill
San Francisco, California

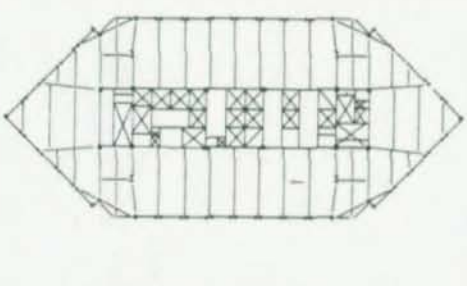
General Contractor
Dinwiddie Construction Company
San Francisco, California

Steel Fabricator/Erector
The Herrick Corporation
Hayward, California

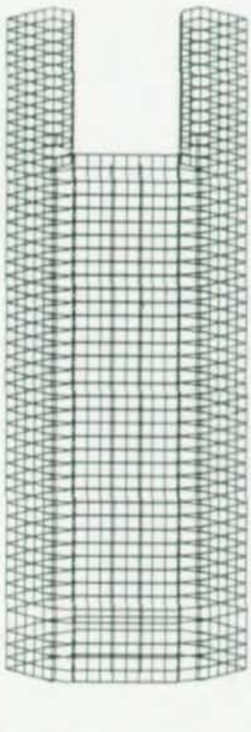
Owner
California Center Partners,
Norland Properties
San Francisco, California



TYPICAL HOTEL FLOOR FRAMING PLAN



TYPICAL OFFICE FLOOR FRAMING PLAN



ELEVATION-
DUCTILE MOMENT FRAME

TRW WORLD HEADQUARTERS

Lyndhurst, Ohio

Expressive use of steel and aluminum emphasizes the technological sophistication of this company headquarters. Steel columns and beams are clad in bronze anodized aluminum with window frames and other components set in from the steel building frame. The 450,000-sq. ft building steps down in terraces; four narrow, pavilion-like office wings with full-height glass walls radiate from the central atrium.

Jury comments: ***"An almost timeless piece of corporate architecture, as fresh and wonderful 20 years from now as it is today."***

Architect
Lohan Associates
Chicago, Illinois

Structural Engineer
KKBNA Unlimited, Inc.
Chicago, Illinois

General Contractor
Gilbane Building Company
Cleveland, Ohio

Steel Fabricator/Erector
Kilroy Structural Steel Company
Cleveland, Ohio

Owner
TRW, Inc.
Lyndhurst, Ohio

PIER 17 PAVILION

New York, New York

This final element of the South Street Seaport in lower Manhattan is a three-story steel frame structure with painted metal siding and a standing-seam metal roof. Interior circulation is oriented around two three-story atria, one running north/south parallel to the shoreline, the other running east/west to the river. Retail stores and specialty shops focus inward; restaurants, cafes and public spaces focus outward, overlooking the waterfront.

Architect
Benjamin Thompson & Associates, Inc.
Cambridge, Massachusetts

Structural Engineer
Severud-Szegezdy Consulting Engineers P.C.
New York, New York

General Contractor
Tishman Construction Corp. of New York
New York, New York

Steel Fabricator
Mosher Steel Company
Birmingham, Alabama

Steel Erector
American Steel Erectors
South Plainfield, New Jersey

Owner
Seaport Marketplace Limited Partnership,
Affiliate of The Rouse Company
Columbia, Maryland

Jury comments: ***"This type of building brings life into the city, captivates and holds shoppers in a pleasant, stimulating environment."***

VACATION HOUSE

New England Coast

This family complex of autonomous units includes parents', children's and guest houses, and studio, with the parents' dwelling composed of two pavilions under a glass "tent:" master bedroom and living-dining-kitchen, each defined by piers at the corners supporting tubular steel space trusses spanning the entire space to carry the roof deck.

Architect
Peter Forbes and Associates, Inc.
Boston, Massachusetts

Structural Engineer
Zaldastani Associates, Inc.
Boston, Massachusetts

General Contractor
Prin A. Allen & Sons
Brooklin, Maine

Steel Fabricator
Maine-Cascade Iron Works
Clinton, Maine

Steel Erector
Nancy's Welding
Freedom, Maine

Jury comments: ***"A modern house that fits beautifully into the rugged landscape."***

VIRGINIA POWER'S INNSBROOK TECHNICAL CENTER

Glen Allen, Virginia

The open structural steel frame used throughout this utility's new center achieves the visual impact needed for the building's central architectural element, a 189-ft microwave tower. And it enabled the erector to lift pre-assembled platforms like building blocks. Building modules of open office are organized along an open 3-story circulation spine. The frame and exterior envelope were being constructed while the design team completed the interior package. Steel framing also permitted minor adjustments on the interior without major cost.

Architect/Structural Engineer/General Contractor
Virginia Power, E & C Division
Glen Allen, Virginia

Steel Fabricator
Owen Steel Company, N.C., Inc.
Gastonia, North Carolina

Steel Erector
W. O. Grub Steel Erection, Inc.
Richmond, Virginia

Owner
Virginia Power
Glen Allen, Virginia

Juror comments: ***"Integration of a new technology with forms that go back historically."***

MORROW HYDROELECTRIC DAM

Kalamazoo County, Michigan

Generating facility is crisp and prismatic. Primary triangular bents of built-up architecturally exposed structural steel elements form the design icon, linked by tubular steel sections. Secondary and tertiary structural steel elements frame the entire exterior glass wall system, and form graceful catwalks, stair and craneway elements.

Architect/Structural Engineer
Skidmore, Owings & Merrill
Chicago, Illinois

General Contractor
Erhardt Construction Company
Ada, Michigan

Steel Fabricator
Grand Rapids Steel & Supply
Grand Rapids, Michigan

Steel Erector
Steelcon
Kalamazoo, Michigan

Owner
STS Consultants, Ltd.
Northbrook, Illinois

Jury comments: ***"This simple, elegant enclosure becomes architecture. It's direct, powerful and has a real poetry."***

LLOYD CENTER CINEMAS

Portland, Oregon

The design for this multi-screen cinema complex is intended to "rekindle the spirit and excitement of the 20s, when a night out at the movies was a grand event." Red-painted exposed structural steel lends a lightness throughout, starting with an entrance galleria, moving through a transitional rotunda and ending in the "street of theatres." Each movie house has its own identity and sparkling neon marque. All detailing is exposed where appropriate; fasteners and cable structures are used to suspend light fixtures and neon artwork.

Jury comments: ***"Totally unique . . . they put some real show business into this."***

Architect
Broome, Oringdulph, O'Toole, Rudolf, Boles & Associates, PC
Portland, Oregon

Structural Engineer
KPFF Consulting Engineers
Portland, Oregon

Steel Fabricator
Fought & Company, Inc.
Portland, Oregon

General Contractor
Hoffman Construction Co.
Portland, Oregon

Steel Erector
REFA Erection, Inc.
Tigard, Oregon

Owner
Tom Moyer Theaters
Portland, Oregon

RADIO STATION K92FM/WDBO

Orlando, Florida

Two major components of this broadcast facility and corporate office have been integrated into the overall design: the 200-ft tower and the satellite dish. A 10-ft × 150-ft skylight-covered corridor permits viewing of both elements from within the building. Because the building is severed literally into two pieces by the barrel arch skylight, an exceptionally strong column system was required to resist hurricane force winds. Steel truss columns resist wind shear by triangulation in a manner similar to the 200-ft broadcast tower.

Jury comments: ***"Refreshing and very laid back; a building that says the public is welcome."***

Architect
Helman Hurley Charvat Peacock/Architects,
Maitland, Florida

Structural Engineer
Allan and Conrad, Inc.
Winter Park, Florida

General Contractor
R.C. Stevens Construction Co.
Orlando, Florida

Steel Fabricator/Erector
Southern Central Steel
Sanford, Florida

Owner
NewCity Communications, Inc.
Orlando, Florida

INDUSTRIAL TECHNOLOGY INSTITUTE

Ann Arbor, Michigan

A steel frame provides the "high-tech" image for this project, and curved stainless steel panels for the facade enforce the dynamic projection of a progressive corporation whose work is in "factories of the future." The interior integrates three functions: corporate headquarters, industrial research laboratories and training facilities. The corporate offices, a series of pods which include the training center, are sheathed in stainless steel and two shades of gray spandrel glass. The two-story industrial-bay laboratories are identified with black masonic tile.

Jury comments: ***"A high-tech solution, using both symmetry and materials very nicely."***

Architect
William Kessler and Associates, Inc.
Detroit, Michigan

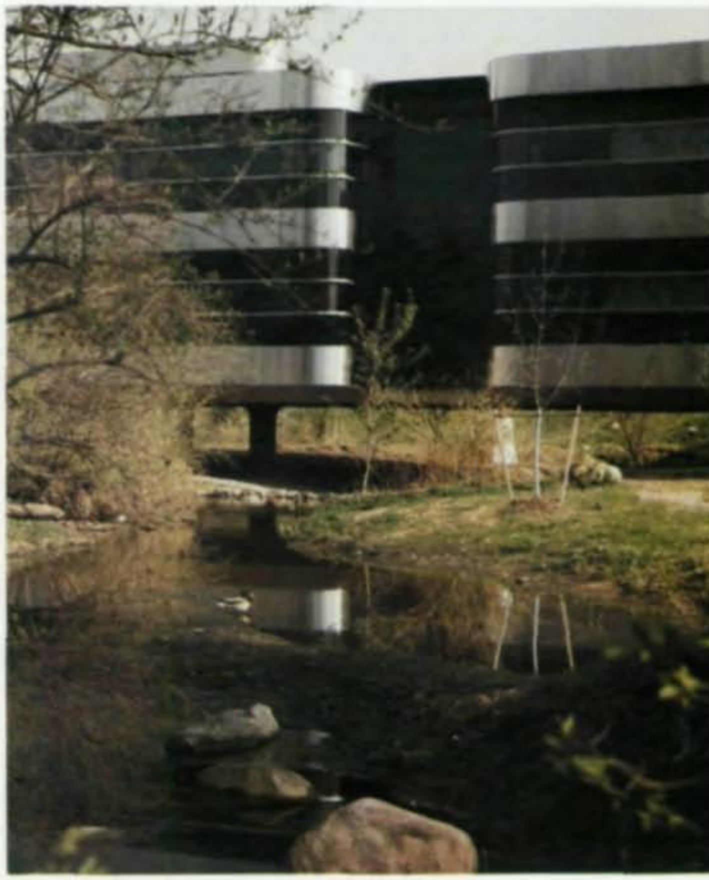
Structural Engineer
Robert Darvas Associates, P.C.
Ann Arbor, Michigan

General Contractor
O'Neal Construction
Ann Arbor, Michigan

Steel Fabricator
Service Iron Works, Inc.
Livonia, Michigan

Steel Erector
McGuire Steel Erection, Inc.
Northville, Michigan

Owner
Industrial Technology Institute
Ann Arbor, Michigan



Jury comments: ***"A very simple, natural expression of exposed structural steel . . . clarity and order are apparent."***

GEORGIA STATE BOTANICAL GARDEN CONSERVATORY VISITOR'S CENTER

Athens, Georgia

The steel frame, painted white, ensures lightness and elegance for this great glass box. The aluminum skylight and curtain wall system is broken thermally and glazed with insulating glass. The main purpose of this teaching/visitor complex was the development of a tropical rain forest as part of the University's research efforts in biotechnology. However, it is also the setting for many special events, including lectures, parties and weddings. For general use, large exhaust fans in connection with motorized greenhouse window sash allow air circulation; for special events, the conservatory is air-conditioned.

Architect
Hall, Norris & Marsh, Inc.
Atlanta, Georgia

Structural Engineer
Sedki & Russ Engineers
Atlanta, Georgia

General Contractor/Steel Erector
Terry Development Corporation
Athens, Georgia

Steel Fabricator
Thackston Steel Co., Inc.
Statesboro, Georgia

Owner
University of Georgia
Athens, Georgia

McCORMICK PLACE EXPANSION FACILITY

Chicago, Illinois

A steel-framed low-rise building utilizing a cable-suspended structural steel roof system, the McCormick Expansion resolves site constraints, yet remains harmonious with adjacent lakefront environs. It augments the existing McCormick Place Exhibit Hall to form the world's largest contiguous exhibition facility, and has a 480 ft × 780 ft long-span roof, suspended from cables supported by 12 concrete pylons projecting 60 ft above roof level. The 3-¾ in. diameter galvanized steel cables, six at each pylon, are jacketed by an extruded white PVC protective sheath with polished stainless steel anchorage fittings.

Jury comments: ***"An extremely delicate way of handling a gigantic structure."***

Architect/Structural Engineer
Skidmore, Owings & Merrill
Chicago, Illinois

Construction Manager
Schal/McHugh
Chicago, Illinois

Steel Fabricator/Erector
Bristol Steel Corporation
Bristol, Virginia

Owner
Metropolitan Fair & Exposition Authority
Chicago, Illinois

OWINGS MILLS TOWN CENTER

Owings Mills, Maryland

Structural steel creates a light, airy, upscale and sophisticated statement within a low-maintenance, highly durable framework. The food court's conservatory appearance was achieved using bent structural steel T-sections to support curved glass skylights. Exposed Vierendeel steel roof trusses serve both as stabilizers and decorative elements throughout the mall, forming the feature design element. Exposed steel columns are built up from one WF-shape and two T's welded together to make cruciform columns.

Jury comments: ***"A very sophisticated, state-of-the-art type structure."***

Architect/Structural Engineer
RTKL Associates, Inc.
Baltimore, Maryland

General Contractor
HCB Contractors
Baltimore, Maryland

Steel Fabricator
Strait Manufacturing
Greencastle, Pennsylvania

Steel Erector
L. R. Willson & Sons, Inc.
Gambrills, Maryland

Owner
The Rouse Company
Columbia, Maryland

THE HARTFORD LIFE INSURANCE HEADQUARTERS

Simsbury, Connecticut

Stub girders proved cost-effective while minimizing floor-to-floor height in this 4-story building. Ducts serving three separate wings run parallel to the beams, through the girders. The composite steel beams afforded great design flexibility, allowing openings to be cut in the field. The exterior is clad in 2-in. pink Connecticut granite. The 650,000 sq. ft campus-style building includes a computer center, corporate office space for 2,000 employees, cafeteria, private dining rooms and conference center, and a 100-seat multi-purpose auditorium.

Architect
Thompson, Ventulett, Stainback & Associates, Inc.
Atlanta, Georgia

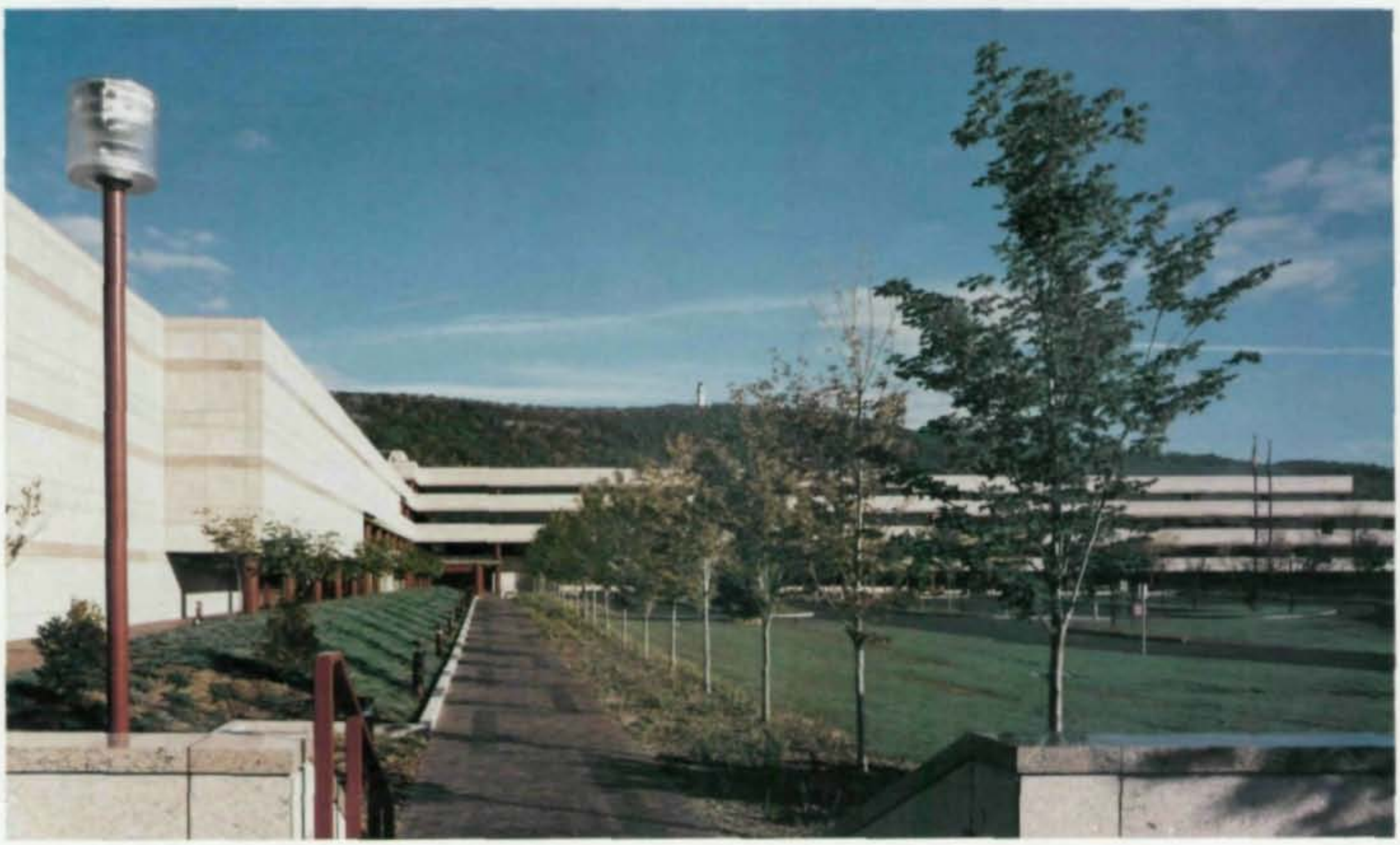
Structural Engineer
Ross Bryan Associates, Inc.
Nashville, Tennessee

General Contractor
Bartlett, Brainard, Eacott/Dugan & Meyers, a Joint Venture
Bloomfield, Connecticut

Steel Fabricator/Erector
The Berlin Steel Construction Co.
Berlin, Connecticut

Owner
The Hartford Insurance Group
Hartford, Connecticut

Jury comments: ***"Traditional mainstream architecture, eminently well-executed."***



Steel Notes

LRFD TEACHING GUIDE OFFERED

A new publication, *Elements of Teaching LRFD* (S332), is now available in manuscript form from AISC for educators who plan to incorporate Load and Resistance Factor Design (LRFD) in their structural curriculum. The new teaching tool is based on a syllabus prepared by Prof. Joseph A. Yura, Dept. of Civil Engineering, University of Texas at Austin. Yura is a contributor to the 1st Edition of AISC's *Load and Resistance Factor Design Manual of Steel Construction*, and has been teaching LRFD as a part of the university's structural design program.

LRFD is a design procedure based on the actual strength of a member or component, rather than on an arbitrary calculated stress. It is an ultimate strength concept wherein both working loads and resistance are multiplied by factors, and the design performed by assuming that the strength exceeds the load.

Teachers of structural design may obtain one complimentary copy of the new *Elements of Teaching LRFD* by requesting it in writing. Send requests to Robert F. Lorenz, director of education and training, AISC, 400 N. Michigan Ave., Chicago, Ill. 60611-4185. For further information, call him at 312/670-5406.

BOOKLET SHOWS STUDENTS' BEST

Winners of the 1986 AISC/American Institute of Architecture Students (AIAS) student design competition are featured in a 30-pg. booklet available from AISC.

The competition, titled "Bridges of Steel," involved the hypothetical reconstruction of the historic Smithfield Street Bridge in Pittsburgh. The student was asked to design a new bridge using the latest advances in theory and technology. But the student also had to preserve the memory of the original bridge within the urban fabric of Pittsburgh. Emphasis was placed on aesthetic design with steel and the relationship between the new bridge and the urban context of renaissance Pittsburgh.

The booklet includes an explanation of the competition, profiles on the jurors, jurors' comments, photos of the winning entries and the students' design statements. For a free copy of the booklet (quantities are also available), contact William Noble, AISC headquarters, 312/670-5422.

COMBINED CONFERENCE FOR THE COMING YEAR

For the second consecutive year, the Conference of Operating Personnel and the National Engineering Conference (COP/NEC) will be combined. The conference will be held at the Hilton Fontainebleau Hotel, Miami Beach, Fla., June 8-11, 1988. A call for papers has already been issued. And the committees for the two meetings, chaired by Victor H. Thompson, Jr., Mosher Steel Company and Larry A. Kloiber, L.L. LeJeune Company, are now conducting planning meetings to prepare for technical sessions. The Hilton Fontainebleau Hotel offers excellent facilities for the numerous workshop sessions planned and for the more than 100 exhibitors expected to display their products and services. With more than 1,000 attendees at last year's combined conference in New Orleans, AISC anticipates an even larger representation from engineers, fabricators and consultants in 1988.

LIGHTWEIGHT MANUAL AVAILABLE AGAIN

A limited number of the *Manual of Steel Construction*, 8th Ed.—Lightweight (M012) has been reprinted and is now available. At 1 lb.-5¼ oz. and 7/8-in. thick, this lightweight Manual is ideal for both jobsite and traveling. Printed on opaque "bible" paper, it is unabridged and complete in every detail. The 832-pg. Manual still contains the provisions of the November 1978 AISC *Specification for the Design, Fabrication and Erection of Structural Steel for Buildings*. Data is divided into six basic sections: (1) Dimensions and Properties, (2) Beam and Girder Design, (3) Column Design, (4) Connections, (5) Specifications and Codes and (6) Miscellaneous Data and Mathematical Tables. To order, send check, money order or Visa/MasterCard information (state type of card, number and expiration date) to AISC Publications Dept., P.O. Box 4588, Chicago, Ill. 60680-4588.

FELLOWSHIP APPLICATIONS NOW ACCEPTED

AISC's Education Foundation is now accepting applications from engineering students for $8,000 scholarships. A maximum of five fellowships will be awarded to those senior or graduate civil or architectural engineering students majoring in structural engineering who propose a one-year project dealing with some aspect of steel construction. Entries must be received no later than April 1, 1988. For an application, contact Robert Lorenz, AISC Education Foundation, 400 N. Michigan Ave., Chicago, Ill. 60611-4185; 312/670-5406.

NOMINATIONS INVITED FOR 1988 T.R. HIGGINS LECTURESHIP AWARD

Applications are now being accepted for the 1988 Theodore R. Higgins Lectureship Award, which recognizes the author of the most significant engineering paper related to steel in the five-year period from Jan. 1, 1982 to Jan. 1, 1987.

The winner, who receives a $5,000 cash award, presents his paper on six occasions during 1988. A jury of six distinguished engineers from the fields of design, education and the fabricated structural steel industry selects the winning author. Nominations, which should be directed to the Committee on Education, AISC, 400 N. Michigan Ave., Chicago, Ill. 60611-4185, must be received by Nov. 13, 1987. □

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