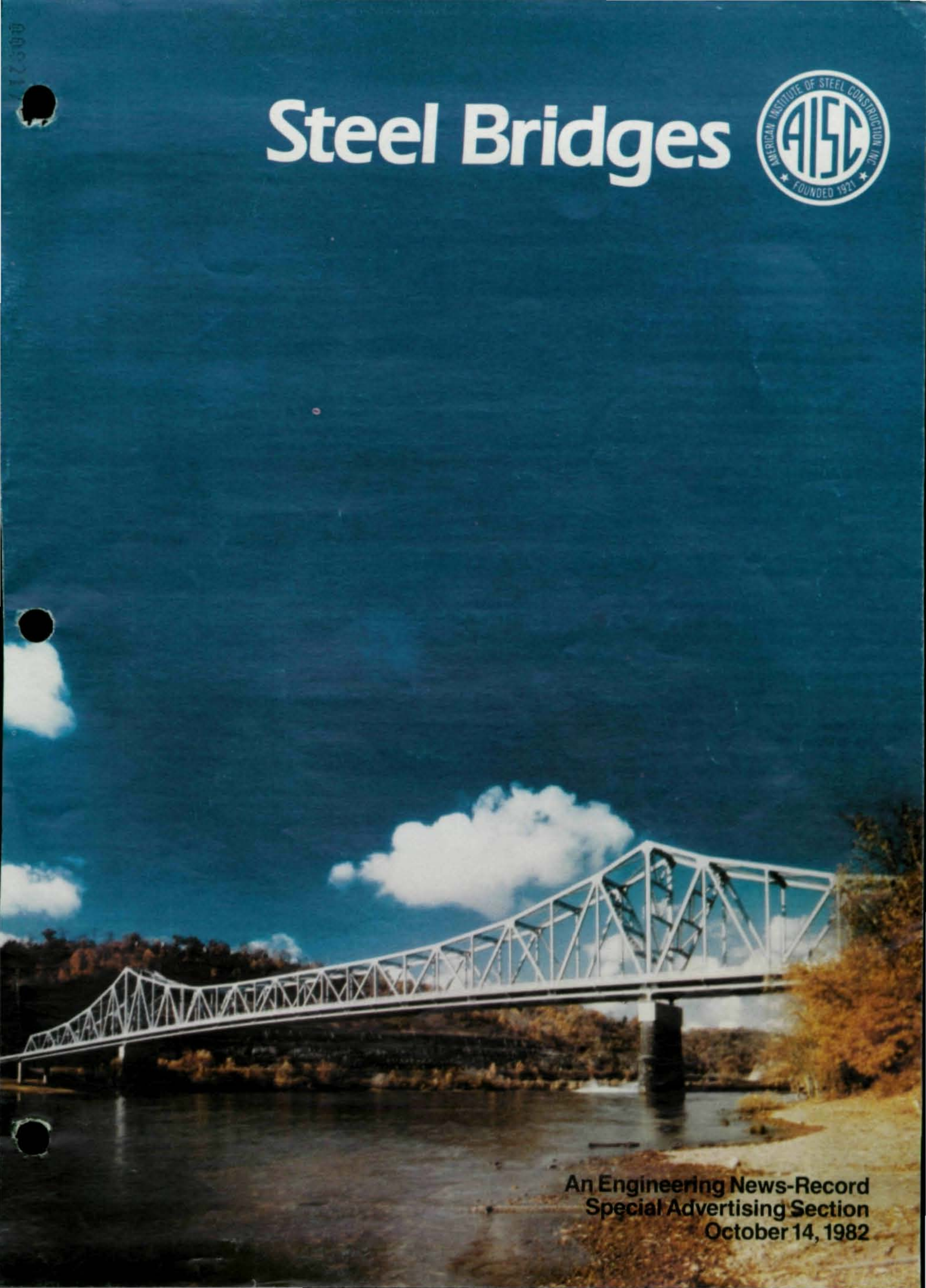
Steel Bridges



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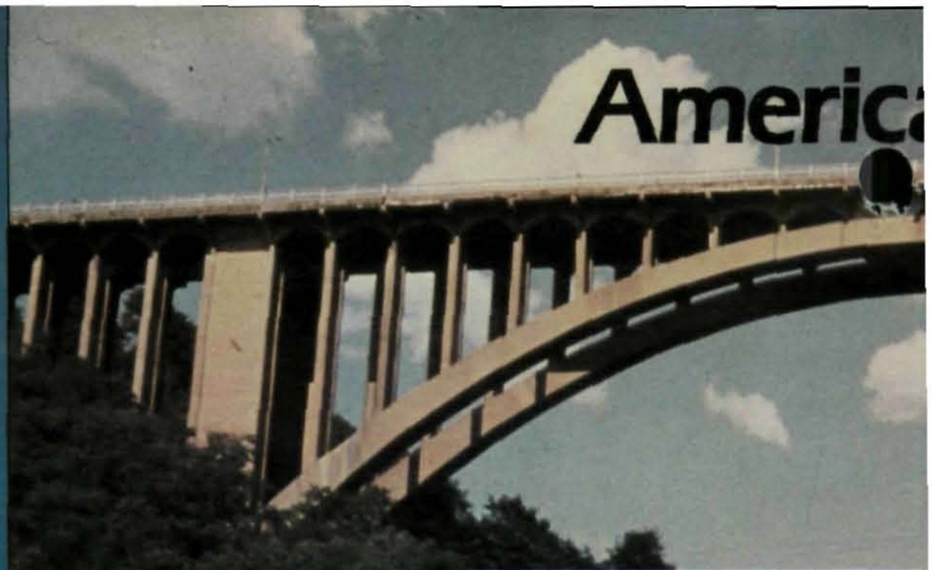


America

The seriousness of America's bridge problems is typified by the arch bridge above. Deterioration of the deck (above right) permits an observer to put a hand through a hole. The pier (above) originally had 6 in. of concrete over the reinforcing bars. This bridge had to be closed. On another bridge, pad supporting a steel column (bottom) has spalled away.

Cover: *Sewickley Bridge Replacement, Sewickley, Pa., winner of the AISC 1982 Long Span prize.*

Forty-five percent of the 557,516 bridges in the United States are classified as structurally deficient or functionally obsolete, according to "The Third Annual Report on the Highway Bridge Replacement and Rehabilitation Program" published by the Department of Transportation.

The report shows that 248,527 bridges are structurally deficient or functionally obsolete. This is an increase of 16% over the number of inadequate bridges cited in the previous year's report.

A functionally obsolete bridge is one whose lane width, load-carrying capacity, clearance or approach alignment can no longer safely serve its traffic load. The bridge report lists 121,872 bridges like this.

A structurally deficient bridge is one that has been restricted to light vehicles, is closed to traffic, or must be rehabilitated immediately to stay open. As of the end of last year, 126,655 bridges fell into this category.

The structurally deficient bridges are the victims of heavy traffic, weather and neglect.

There are about 150 million Americans licensed to drive automobiles, trucks and buses. Last year they drove 1,500,000,000,000 vehicle miles, more than twice the mileage of 1960.

Weather takes a heavy toll of bridges over the years. Expansion and contraction caused by heat and cold strain materials. The freeze-thaw cycle spalls concrete and asphalt decks, allowing rain and deicing salt to penetrate and corrode reinforcing bars and structural members.

Bridges are like houses in that they

Needs New Bridges

must be kept up. Many of our bridges have not had regular inspection and maintenance, because these are items that government officials find easy to postpone or abandon. Just as with a house, the defects of bridges grow geometrically worse with each year of neglect. One out of four of our bridges are more than 45 years old. Too many have been neglected too long.

The results of the effects of neglect, age and weather on bridges is costly. The Department of Transportation estimates it will cost $47.6 billion to replace and repair our deficient or obsolete bridges. No city, state or federal agency presently has money to pay for it.

Federal aid helped to build about 20% of the nation's roads and streets and these include one-fourth of the deficient/obsolete list.

In 1956, Congress created the Interstate and Defense Highway System and the Highway Trust Fund to finance it. Federal taxes on motor fuels, tires and inner tubes, tread rubber, lubricating oil, heavy vehicles, trucks and buses and parts for trucks and buses provided revenue for the trust fund. The fund shares construction of the Interstate highways with the states on 90:10 basis. The fund contributed to the states for primary, secondary and urban roads at a lower ratio.

Construction began immediately. Segments of impressive broad highways and their even more impressive bridges began to appear in every state. Year by year the Interstate Highway System added mileage toward its 42,500-mile goal.

Unfortunately, the program started to [illegible]r because—until recently—Congress [illegible]e no provision to finance maintenance and repair of the Interstate Highway System's bridges and highways. That responsibility was left to the individual states. The cost of maintenance of a bridge increases each year, over and above the factor of inflation. The less maintenance received, the more it costs in each succeeding year to accomplish complete rehabilitation.

Now, at a time when the Interstate System is almost complete, the original elements of the system are 25 years old. Some of it is much older. The system includes 1,145 bridges that are more than 40 years old. These were on existing highways that were incorporated into the system in 1956.

Twenty-five years, even 40 years, shouldn't seem like old age for structures as painstakingly designed and as carefully built as a bridge. But the Interstate bridges take a lot of punishment. Although the Interstate System and other federally aided routes account for only 20% of U.S. bridges, highways and streets, they carry 80% of U.S. traffic.

The needs of our bridge inventory have been well defined and understood and the remedies are well known. The big problem facing Congress, the state legislatures and the man on the street is: How to pay for the solution?

The federal-aid highway network includes 67,696 bridges that are on the list of structurally deficient or functionally obsolete bridges. It is estimated that it will cost $24.6 billion to replace or rehabilitate these bridges.

Right now, there is nothing like $24.6 billion in federal or federal-state money to pay for this work. In 1978, after the Interstate System was 22 years old and beginning to show signs of age, Congress passed the Surface Transportation Assistance Act, which provided a total of $4.2 billion over the subsequent four years for bridge replacement and rehabilitation.

Congress authorized the states to use at least 15% and not more than 35% of their bridge aid funds for bridges not on the federal aid system.

The states, counties and municipalities have even greater financial problems coping with their non-federal obsolete or deficient bridges. The modest aid from Congress provides 80% toward bridge rehabilitation or replacement and many of these government elements are unable to even pay their 20% share. The total amount they need to pay is $23 billion to cope with their 180,831 inadequate bridges.

To compound the bridge financing problem, President Reagan would like the cities, counties and states to take full responsibility for their bridges and highways as part of his New Federalism program.

The President's plan is to commit the federal government to completion of the Interstate System and leave the construction and maintenance of most non-Interstate highway roads to the states. He proposed to pass on to the states one-half the federal 4-cent-a-gallon motor fuel tax to help them finance the work. The National Governors Association calculates that this will be a total income of $2.2 billion per year and not enough. The Association thinks the states should get 3 cents.

A popular proposal for getting more money to the states is to raise the federal fuel tax by 4 cents and grant the states $4.4 billion a year.

Since most states finance their transportation work with user taxes and most have raised their gas taxes, many think a 4-cent rise by the federal government would hamper further rises by the states.

Probably the most talked of scheme for financing bridge and highway upkeep is for states to establish toll booths on their major highways. It is presently against the law to put a toll on Interstate highways, but this law could be changed.

Another possible solution is the creation of turnpike authorities to operate major elements of state highway systems and dedicate earnings to the maintenance of bridges and highways.

Trucks are accused by many highway administrators of causing bridge and highway damage out of proportion to the amount they pay in fuel taxes and other user charges. They may end up paying a larger share.

A revival of the Reconstruction Finance Corporation (1932-1958) has been seriously suggested to issue $25 billion in federally backed loans to cities to help them finance their facilities. Also discussed in Congress is a multi-billion-dollar public works program to provide not only an improved infrastructure, but jobs.

The most likely financing of bridge rehabilitation and replacement will be a user tax based on a percentage of fuel price, rather than a cents-per-gallon tax that does not take into account inflation or the increasing efficiency of automobile engines.

Whatever the means, time is running out and a solution can not wait. Steel stands ready to do its part. ■

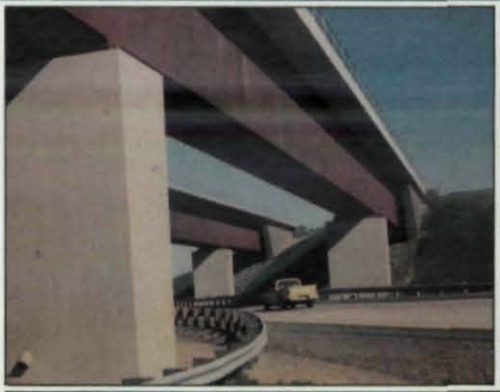
Steel Is the Answer

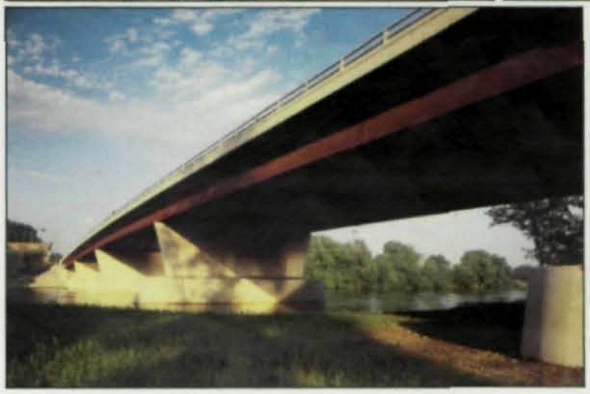
The rebuilding of our nation's bridge system demands a material that is reliable, economical, long-lasting and beautiful.

Steel is the answer.

Some of the many advantages that steel offers over other bridge construction materials are:

- Steel's light weight—its high strength per pound — permits less costly foundations.
- It is easy to erect and build on land or over water.
- Steel bridges are erected quickly.
- A steel bridge can be erected in winter.
- The freeze-thaw cycles of winter and early spring have little effect on steel.
- Because of prefabrication of its elements, a steel bridge can be constructed rapidly.
- Because the materials of a steel bridge exist in their ultimate form *before* construction, a higher degree of quality control is possible.
- A wide variety of visually pleasing designs are available for steel bridges.
- A steel bridge can be quickly and easily repaired if it is damaged.
- Steel bridges are comparatively easily designed. Computer programs provided by the steel industry assist designers in determining the most economical structures.
- Sub-assembly of bridge sections prior to construction ensures a proper fit-up in the field.





New designs in truss bridges (top and above) and box girder bridges (left) demonstrate steel's ability to combine beauty and construction economy. Weathering steel bridges of either design blend into the environment and offer reduced maintenance.

Steel for Beauty

Steel is not only the most versatile of bridge construction materials, it is, in its wide variety of production and application, the most beautiful. A steady flow of improvement in the basic metal and in the design of bridges is enriching the American landscape. Some examples are:

Weathering Steel—A development in steel technology that has produced bridges that are more economical and beautiful is weathering steel.

Its beauty derives from its very nature. This special higher-strength, low-alloy steel is designed to go unpainted. Exposed to the elements, it forms a tight oxide coating on its surface that retards further corrosion and needs no painting when properly applied as recommended by the producers. The resulting surface has a rich dark russet brown texture that blends in with the natural surroundings.

The reduction of maintenance painting means a cost saving for the life of the bridge. Another advantage is that traffic need never be interfered with for painting.

Weathering steel (ASTM A588) is stronger than conventional carbon structural steel and permits use of less steel, which can result in lighter foundations.

Box Girders—Steel box-girder bridges offer both beauty and economy. Their design permits a lesser weight of steel. Box-girder bridges have clean lines and shallow profiles that have no exposed projecting surfaces in which dirt may accumulate, providing for easier maintenance.

There are many examples of steel box girders: curved, straight, single or in multiple sections with straight or sloping sides to meet the design and esthetic needs. Brought to the site in long prefabricated segments, they allow speedy erection.

Box girder bridges easily satisfy the esthetic demands that are being required by specifiers, users and neighbors of most bridge projects.

Truss Bridges—Advances in steel making and bridge design have improved the appearance of the truss bridge, which has been so much a part of the American scene for more than 90 years.

With contemporary design and materials the truss bridge has a less cluttered look. Sections can now be made of three-plate weldments or of closed box design; this eliminates the riveted lacing bar details that make some of the old truss bridges unattractive. This also makes painting simpler. And, if weathering steel is used, painting can be eliminated from bridge maintenance.

The only "must" in a truss bridge is the triangular panel. Designers of truss bridges now give variations in size, slant and distance from the top and bottom chords. Some designers experiment with shaping of some of the triangular panels to add distinctive, curved appearance.

The truss may be the most economical bridge for spans of 500 to 1,500 ft. and economy is a strong consideration in these days of cutbacks in federal funding.

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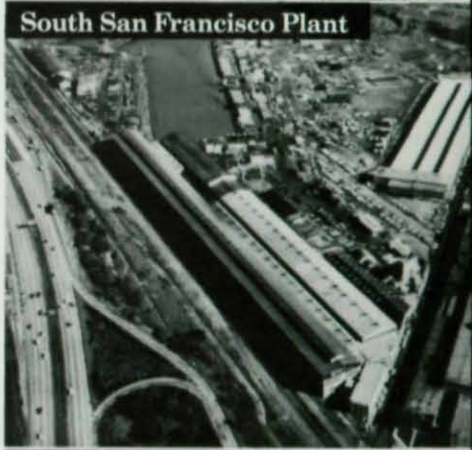

South San Francisco Plant


Shiffler Plant


Fresno Plant


Orange Plant


Ambridge Plant


Marine Facility, Ambridge

Steel for Economy and Efficiency

Advances in the art of steel bridge design have been made with greater frequency in recent years, thanks in large part to the contributions of the American Iron and Steel Institute (AISI). Over the past 20 years the Institute has worked with universities, private engineering firms and its member companies on bridge research projects aimed at improved simplicity, efficiency and economy with steel. Some examples of AISI research:

Load Factor Design—A new method of designing steel bridges, Load Factor Design can effect savings in superstructure steel of from 6 to 14% due to AISI research. The design makes further savings through the use of smaller welds and fewer stiffeners, and other expensive detail items.

In the traditional bridge design method, Working Stress Design, a uniform factor of safety is applied to both dead and live loads. In Load Factor Design, a smaller safety factor is applied to the known dead load (the weight of the bridge itself) and a larger factor to the live load (vehicles using the bridge). This provides a more consistent live load capacity for steel bridges, regardless of span length, as compared with the Working Stress Design. As span lengths increase, the dead load influence becomes greater and allows for larger savings in steel.

Autostress Design—A refinement of Load Factor Design, Autostress Design uses a more realistic picture of the behavior of the bridge under live loads. Autostress Design leads to simpler bridge design, to simpler fabrication and, as a result, to greater economy of bridge building. Presently in the prototype stage, Autostress Design is one of the many bridge research projects carried out by universities and private engineering firms under the sponsorship of the American Iron and Steel Institute.

Curved Bridge Girder Design—As presently designed, horizontally curved steel bridge girders are considered by many engineering authorities to use more steel than necessary. By existing standards, their design is based on elastic analyses, as opposed to ultimate strength concepts.

A study sponsored by the American Iron and Steel Institute is aimed at developing a simplified analytical model to predict ultimate strength. Success will produce steel bridges that are simpler and more economical to design and build.

Bracing and I-Girder Bridges—An examination of the effects of bracing on I-girder bridges also aim at economies of fabrication and materials. Studies at the University of Maryland funded by the American Iron and Steel Institute seek to improve the understanding of I-girder bridge behavior by analyzing the contribution of lateral bracing to wind load resistance and vehicle live load distribution between girders. ■

Prize Bridges/1982

Steel bridges selected in the national competition conducted by the American Institute of Steel Construction as the most beautiful bridges opened to traffic in 1980/1981.

AWARD CATEGORIES

LONG SPAN
Bridges having one or more spans over 400 ft. in length.

MEDIUM SPAN, HIGH CLEARANCE
Bridges with vertical clearances of 35 ft. or more, having the longest span (as measured by the bridge supports) not more than 400 ft. nor less than 125 ft. in length.

MEDIUM SPAN, LOW CLEARANCE
Bridges having vertical clearances of less than 35 ft., having the longest span (as measured by the bridge supports) not more than 400 ft. nor less than 125 ft. in length.

SHORT SPAN
Bridges having no single span 125 ft. or more in length.

GRADE SEPARATION
Bridges whose basic purpose is grade separation as contrasted to the above categories.

ELEVATED HIGHWAYS OR VIADUCTS
Bridges having more than five spans, which cross over one or more established traffic lanes, and which may afford access for pedestrian travel and for parking.

MOVABLE SPAN
Bridges having a movable span.

SPECIAL PURPOSE
Includes pedestrian bridges, pipeline bridges, airplane bridges, and other special purpose bridges not identifiable to one of the above categories.

RAILROAD
Bridges (non-movable) which are primarily for the purpose of carrying a railroad, but which may also be a combination railroad-highway bridge.

RECONSTRUCTED
Bridges which have undergone major rebuilding and/or reconstruction using steel framing to upgrade them to present day traffic requirements.

Over the years the American Institute of Steel Construction has developed several awards programs to recognize and applaud individuals and firms that have made outstanding contributions to the advancement of structural steel.

Among the leading programs, for its effectiveness and lasting impact, is the AISC Bridge Awards Program. By honoring the creative, functional and esthetic excellence of modern bridge design, AISC promotes a broader appreciation of steel bridges and takes a leading role in creating a more beautiful America.

AISC makes known that the esthetic appeal of steel bridges is eloquent tribute to the vision and skill of the persons who plan, design and build them. The bridge designers of today are both artist and engineer. They understand the potential for strength and beauty in steel structures and know that a pleasing appearance can be achieved at no sacrifice of efficiency or economy. The simple grace of a highway overpass, just as the majestic sweep of a river crossing, reflects a creative integration of structure, function and form skillfully executed in steel.

Since 1929, AISC's Bridge Awards Program has honored the steel bridges judged by noted professionals to be the most handsome and functional of those opened to traffic within the previous two years. The awards and the resulting national acclaim for the designers and builders of those bridges inspire the design profession toward greater creativity in producing steel bridges of beauty, economy and safety. This trend has grown throughout the years and is evident in the comparison of contemporary bridges with those built many years ago.

The Jury of Awards for the 1982 competition are (from left to right):

Dr. Frederick M. Law, F.ASCE, Consulting Structural Engineer and Professor of Civil Engineering, Southeastern Massachusetts University, North Dartmouth, Massachusetts

Sherwood Richardson, Richardson, Gordon and Associates Consulting Engineering, Pittsburgh, Pennsylvania

Stan Gordon, Chief, Bridge Division, FHWA, Washington, D.C.

Dr. James R. Sims, President of ASCE, (Endowed Chair) Herman and George R. Brown, Professor of Civil Engineering, Rice University, Houston, Texas

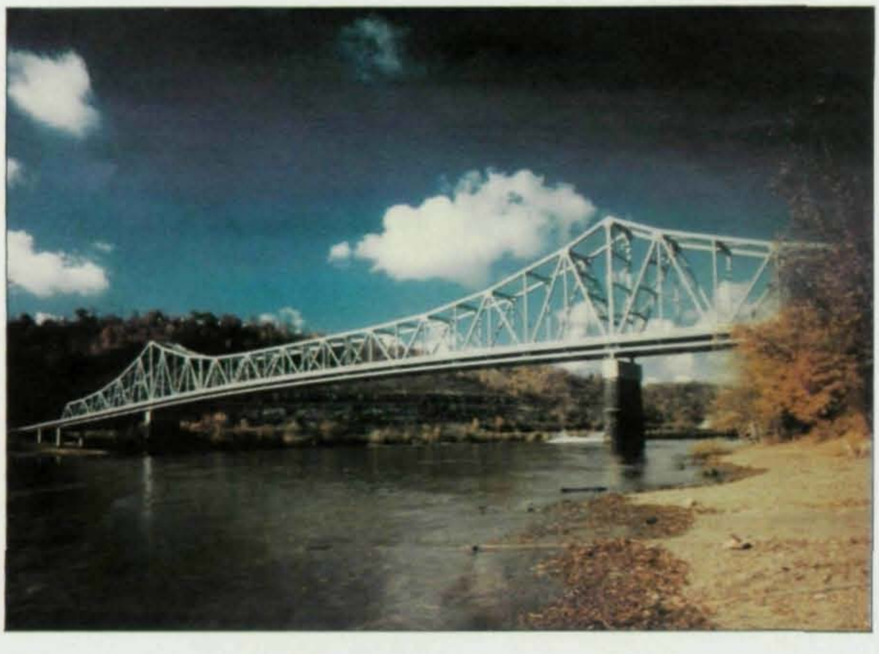
Joseph R. Passonneau, Joseph Passonneau & Partners Architecture, and Engineering, Washington, D.C.

SEWICKLEY BRIDGE REPLACEMENT

Sewickley, Pennsylvania

1982 Prize Bridge
Category: Long Span

Designer: Richardson, Gordon & Associates, Inc., Pittsburgh, PA
General Contractor & Steel Erector: American Bridge Division, U.S. Steel Corp., Pittsburgh, PA
Steel Fabricator: USS Fabrication, Ambridge, PA
Owner: Pennsylvania Department of Transportation, Harrisburg, PA



The original 70-year-old Sewickley Bridge needed replacing and the primary requirement was to minimize closure time. By using the two original river piers, portions of the original abutments, and a steel structure, the new bridge was in use only 17 months after closing. Steel was used to minimize structure weight and depth, yet the new bridge is 4 ft. wider than the old.

Main spans consist of a three-span continuous Warren truss with spans of 375 ft -750 ft -375 ft. Design features to increase life of the new bridge and decrease maintenance were epoxy-coated deck reinforcing bars, a complete deck drainage system, sealed deck expansion joints, and a high performance paint system. Sealed box truss members and simple details were used to provide *an attractive, low maintenance* structure. The new structure carries the overall appearance of the original bridge to satisfy the wishes of local residents.

RELOCATED CHAPEL ROAD BRIDGE

Bethlehem, West Virginia (OVER I-470)

1982 Prize Bridge
Category: Medium Span, High Clearance

Designer: Richardson, Gordon & Associates, Inc., Pittsburgh, PA
General Contractor: Marble Cliff Quarries, Inc., Columbus, OH
Steel Fabricator: Fort Pitt Bridge Div. of Spang Industries, Inc., Canonsburg, PA
Steel Erector: The Vogt & Conant Company, Cleveland, OH
Owner: West Virginia Department of Highways, Charleston, WV

Aesthetics played an important role in the design of Chapel Road Bridge because of its high visibility spanning I-470. Yet the dramatic visual effect of the slant leg rigid frame structure was economically competitive.

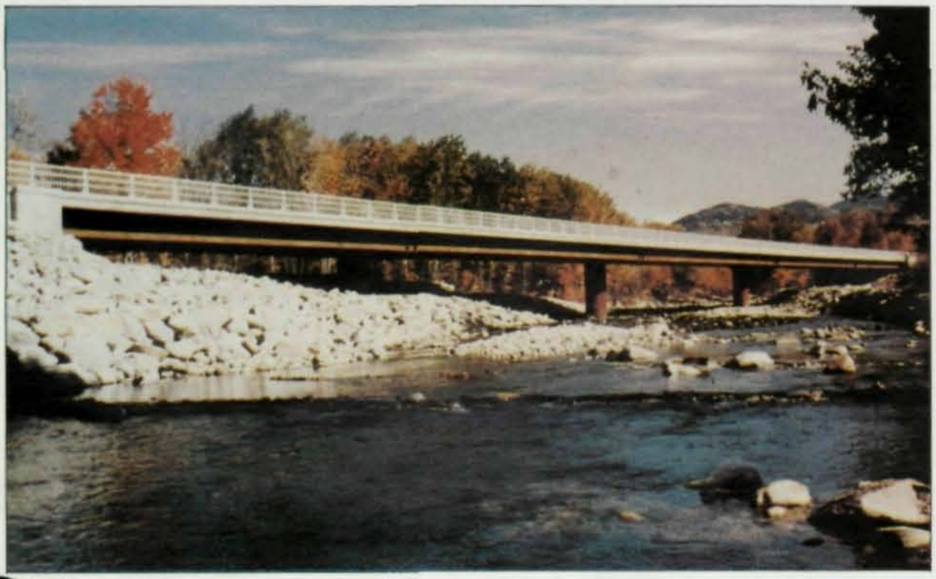
Two frames placed 28 ft 4 in. center to center with floor beams supporting three stringers have span lengths of 134 ft -226 ft -134 ft and support a 28-ft wide roadway with a 5-ft sidewalk on one side. This clean looking bridge is fabricated of weathering steel to reduce maintenance as well as for aesthetics.

GOOSE HOLLOW BRIDGE

Thornton, New Hampshire (OVER MAD RIVER)

1982 Prize Bridge
Category: Medium Span, Low Clearance

Designer: Pavlo Engineering Company, New York, NY
General Contractor & Steel Erector: Shoals Corporation, Eliot, ME
Steel Fabricator: Bancroft & Martin, Inc., South Portland, ME
Owner: New Hampshire Department of Public Works and Highways, Concord, NH



Located in the White Mountain National Forest, a rustic setting of river and woods dictated a structure compatible with its surroundings. The designers achieved their goal with unpainted weathering steel, white concrete, and aluminum railing that all blended with the topography and natural colors of this very scenic area.

Built as a five-span continuous curved girder bridge 534 ft long and 39 ft 6 in. wide, it carries two lanes of traffic and one sidewalk. The superstructure consists of five longitudinal curved girders framed into transverse box girders, supported on bearings on single round pier columns of 1-in.-thick steel plate 7 ft in diameter, and filled with concrete. The resulting structure has a low profile and shallow depth.

DISMAL RIVER BRIDGE

Thedford-South, Nebraska

1982 Prize Bridge
Category: Short Span

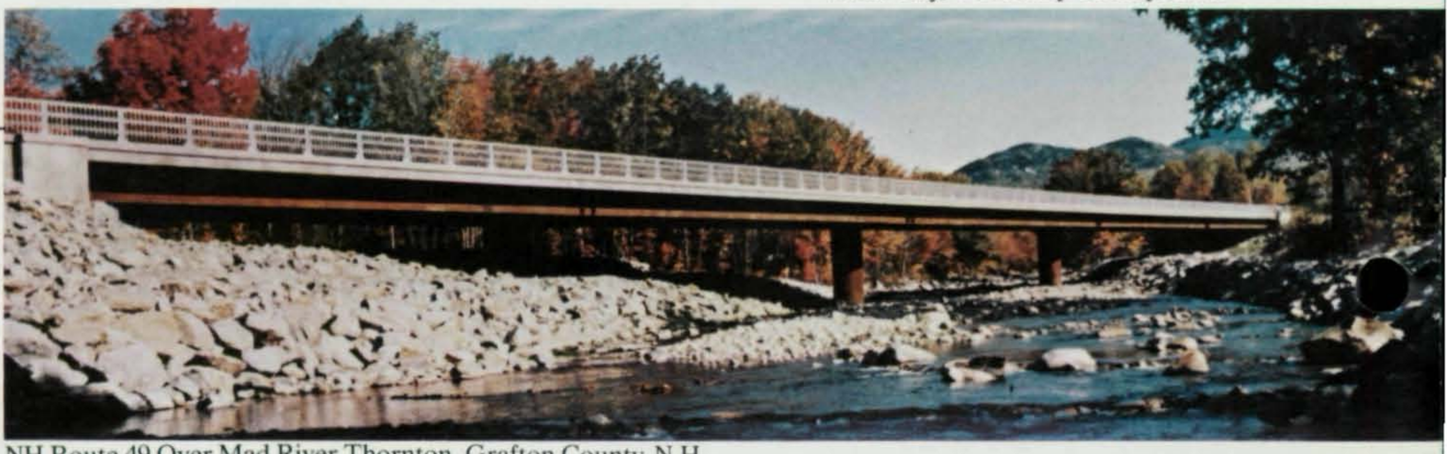
Designer & Owner: Nebraska Department of Roads, Bridge Division, Lincoln, NB
General Contractor & Steel Erector: Dobson Brothers Cosntruction Company, Lincoln, NB
Steel Fabricator: Lincoln Steel Division of Lincoln Northland Inc., Lincoln, NB

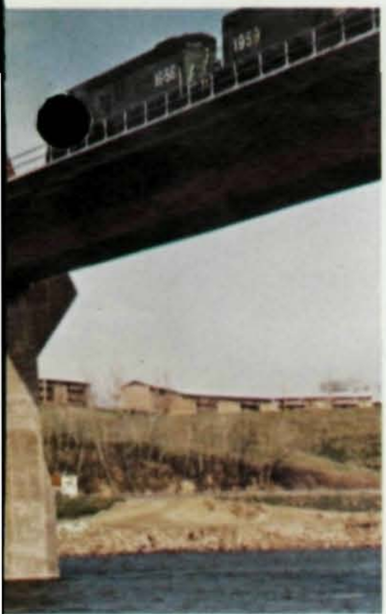
The design and materials selected for this bridge in the Sand Hills region of Nebraska were for maximum aesthetics, simplicity, lightness of appearance and minimum maintenance. It carries U.S. 83, a major link between Canada and Mexico, through the surrounding rolling terrain and beautiful river valley. Weathering steel was chosen to meet design criteria including economy and material availability. The 285 ft structure with spans of 87 ft, 111 ft, 87 ft are fabricated of continuous welded plate girders with bent plate separators at the piers and cross frames at intermediate points. Abutments are the integral type with steel piling placed on the Y-Y axis in the direction of superstructure movement. Freedom from excessive columns was provided by hammerhead piers in the substructure.


Relocated Chapel Road Over I-470, Bethlehem, W. Va., Ohio County


Augustine Bridge Over Brandywine Creek, Wilmington, Del.


BN Bridge No. 106.6 Over the Missouri River, Sioux City, Woodbury County, Iowa


NH Route 49 Over Mad River, Thornton, Grafton County, N.H.



Congratulations 1982 Award Winners AISC Prize Bridge Competition.

The four bridges shown are among the nineteen award-winning structures selected by the AISC as the most aesthetically pleasing steel bridges opened to traffic in 1982. These examples demonstrate that structural steel is virtually unlimited in its ability to conform to a wide variety of design configurations—without penalizing construction economy or efficiency. Bethlehem furnished structural steel for all of the bridges shown.

Prize Bridge Awards:
Project: Relocated Chapel Road Over I-470, Bethlehem, W. Va., Ohio County
Category: Medium Span, High Clearance
Designer: Richardson, Gordon & Associates, Inc., Pittsburgh, Pa.
General Contractor: National Engineering and Contracting Company, Strongsville, Ohio
Fabricator: Fort Pitt Bridge Division of Spang Industries, Cannonsburg, Pa.
Erector: Vogt and Conant Company, Cleveland, Ohio
Owner: West Virginia Department of Highways, East Charleston, W. Va.

Project: BN Bridge No. 106.6 Over the Missouri River; Sioux City, Woodbury County, Iowa
Category: Railroad and Long Span
Designer: Howard Needles Tammen & Bergendoff, Kansas City, Mo.
General Contractor: Johnson Bros. Corporation, Litchfield, Minn.
Fabricator: Truss—Atlas Machine & Iron Works, Inc., Gainesville, Va. Approaches—Mississippi Valley Structural Steel Co., St. Louis, Mo.
Erector: Nebraska Steel Erectors, South Sioux City, Neb.
Owner: Burlington Northern Railroad Company, St. Paul, Minn.

Project: NH Route 49 Over Mad River, Thornton, Grafton County, N.H.
Category: Medium Span, Low Clearance
Designer: Pavlo Engineering Company, P.C., New York, N.Y.
General Contractor/ Erector: Shoals Corporation, Eliot, Me.
Fabricator: Bancroft and Martin, Inc., South Portland, Me.
Owner: N.H. Department of Public Works and Highways, Concord, N.H.

Project: Augustine Bridge Over Brandywine Creek, Wilmington, Del.
Category: Reconstructed Bridge, Medium Span
Designer: Pavlo Engineering Company, P.C., New York, N.Y.
General Contractor: The Whiting-Turner Contracting Company, Inc., Towson, Baltimore, Md.
Fabricator: Harris Structural Steel Company, Inc., South Plainfield, N.Y.
Erector: S.A. Lindstrom Company, Woodbury, N.J.
Owner: Delaware Department of Transportation, Dover, Del.

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SPECIAL ADVERTISING SECTION

L & N RR BRIDGE NO. 19

Biloxi, Mississippi (OVER BILOXI BAY)

1982 Prize Bridge
Category: Movable Span

Designer: Hazelet & Erdal, Consulting Engineers, Louisville, KY
Consultant: Hazelet & Erdal, Consulting Engineers, Chicago, IL
General Contractor: Scott Bridge Co., Inc., Opelika, AL
Steel Fabricator: Stupp Bros. Bridge & Iron Co., St. Louis, MO
Steel Erector: John F. Beasley Construction Company, Dallas, TX
Owner: Harrison County Development Commission, Gulfport, MS

Recent commercial development in Back Bay of Biloxi required widening and straightening the shipping channel from the Mississippi Sound to accommodate river traffic. The new movable span with two 190-ft spans provides a 132-ft clear channel. The continuous through welded steel trusses, which span the main channel, are constructed of box and H sections completely shop welded. Field connections were made of high-strength bolts. The single-track floor system in the truss swing spans is made up of treated timber ties supported by steel rolled stringers. The stringers are supported by welded steel floorbeams framed into the trusses at the bottom chord. Motive power for swinging the span is provided by two 30-hp electric motors that power two 40-gal-per-minute hydraulic pumps. Four oil motors drive the pinion drive gears. Hydraulic oil powers the end and center wedges, rail joints and bridge locks. The bridge is designed to resist hurricane wind and wave forces.

GALENA RIVER PEDESTRIAN BRIDGE

Galena, Illinois

1982 Prize Bridge
Category: Special Purpose

Designer: Homer L. Chastain & Associates, Decatur, IL
Design Consultant: Michael B. Jackson, Architect, New York, NY
General Contractor & Steel Erector: Savanna Construction Co., Savanna, IL
Steel Fabricator: Theo. Kupfer Iron Works, Inc., Madison, WI
Owner: City of Galena, Galena, IL

This footbridge spans the Galena River to connect parking facilities with the historic town of Galena, Illinois, and accommodate the thousands of visitors who come each year.

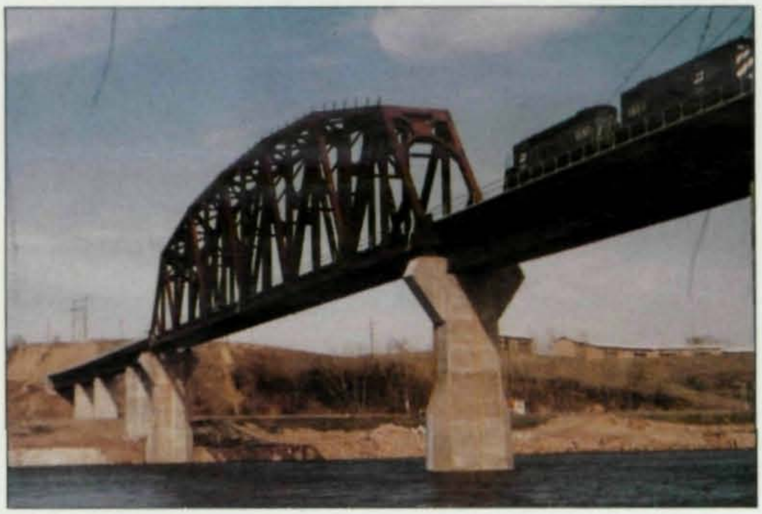
To satisfy the design criteria, including those of the National Historic Preservation Act, the designers chose a three-span continuous steel deck arch with parabolic arch spans of 85 ft 10 in. x 125 ft x 85 ft. All structural members are of unpainted weathering steel for appearance and economy of maintenance. The structure stands above the estimated 100-year flood height and has a substructure of reinforced concrete faced with native limestone. The 8-ft-wide walkway has period ornamental handrails and lighting fixtures that fit the Galena historic preservation and restoration theme.

BURLINGTON NORTHERN BRIDGE NO. 106.6

Sioux City, Iowa (OVER THE MISSOURI RIVER)

1982 Prize Bridge
Category: Railroad

Designer: Howard Needles Tammen & Bergendoff, Kansas City, MO
General Contractor: Johnson Bros. Corporation, Litchfield, MN
Steel Fabricators: Atlas Machine & Iron Works, Inc., Gainesville, VA
Bristol Steel & Iron Works, Inc., St. Louis, MO
Steel Erector: Nebraska Steel Erectors, Inc., South Sioux City, NB
Owner: Burlington Northern Railroad Company, St. Paul, MN



This crossing over the Missouri River at Sioux City, Iowa, is a vital link in the Burlington Northern railroad system. It replaces a bridge built by the Chicago Burlington and Quincy R.R. in the 1800's that was not designed for, nor could it handle, today's loads at normal operating speeds.

Built of weathering steel, a single through truss spans 425 ft across the navigation channel. The stringers are supported by floorbeams and are designed for composite action with the concrete ballast pan. Approach spans are of simple span welded deck girders also designed for composite action with the concrete ballast pan. The complete steel structure, supported on scrulptured piers, gives an authoritative message of strength.

AUGUSTINE BRIDGE

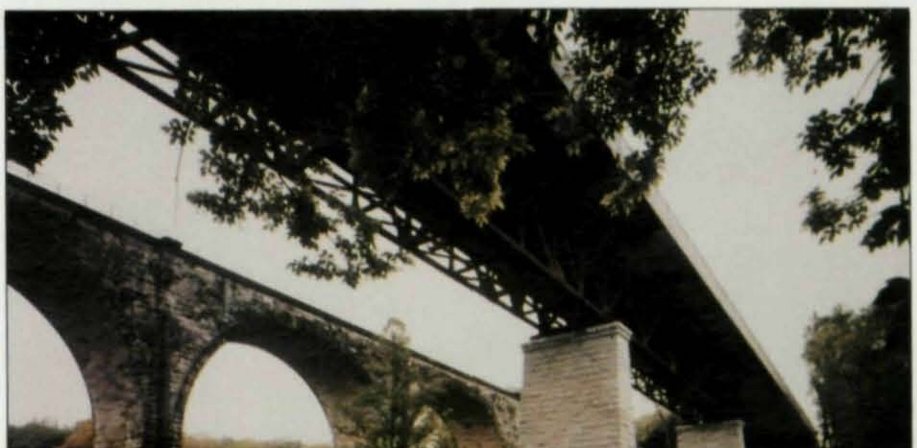
Wilmington, Delaware (OVER BRANDYWINE CREEK)

1982 Prize Bridge
Category: Reconstructed

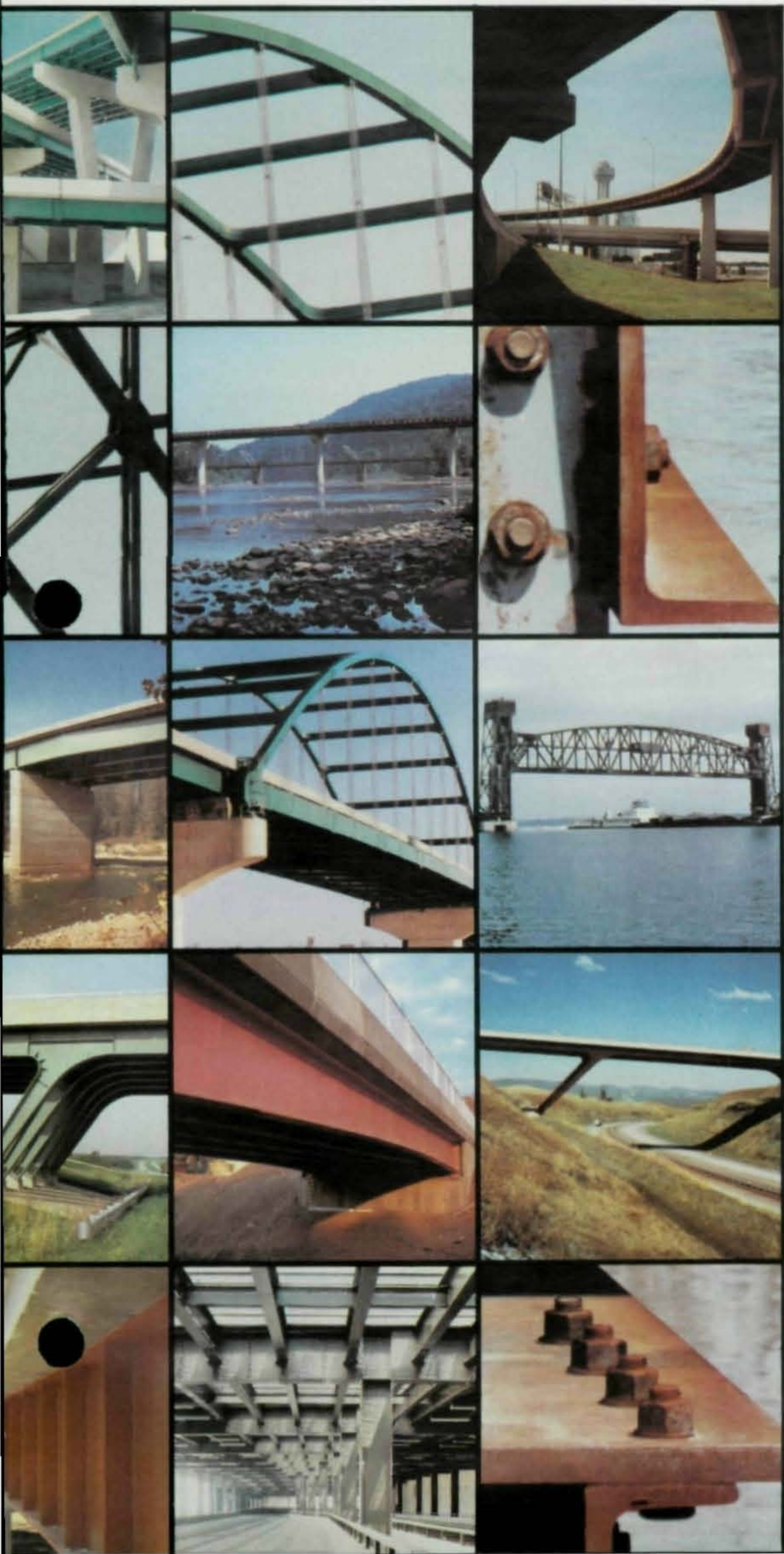
Designer: Pavlo Engineering Company, New York, NY
General Contractor: The Whiting-Turner Contracting Company, Inc., Baltimore, MD
Steel Fabricator: Harris Structural Steel Company, Inc., South Plainfield, NJ
Steel Erector: S. A. Lindstrom Company, Woodbury, NJ
Owner: Delaware Department of Transportation, Dover, DE

Cost efficiency and acceptance by historic, civic and political groups were determining factors in the design configuration and appearance of this six-span, 816-ft-long structure, an integral part of two historic sites.

The new structure replaces a railroad bridge built in 1885, subsequently converted to road traffic in 1920, and closed by the state in 1978. Built of weathering steel, the new superstructure retains a strong likeness to the original truss structure and blends harmoniously with the original stone piers, a nearby stone arch railroad bridge and the surrounding wooded area. The new bridge deck carries a 40-ft-wide roadway and two 7-ft sidewalks.



When you do it,



SPECIAL ADVERTISING SECTION

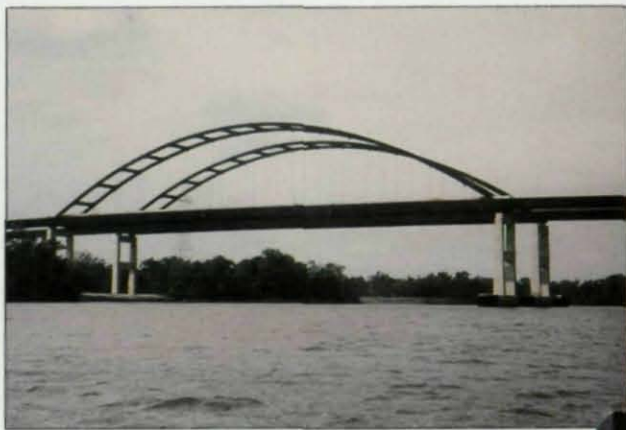
1982 Awards of Merit

I-65 Bridge

1982 Award of Merit
Category: Long Span

Mobile, Alabama
(OVER THE MOBILE RIVER DELTA)

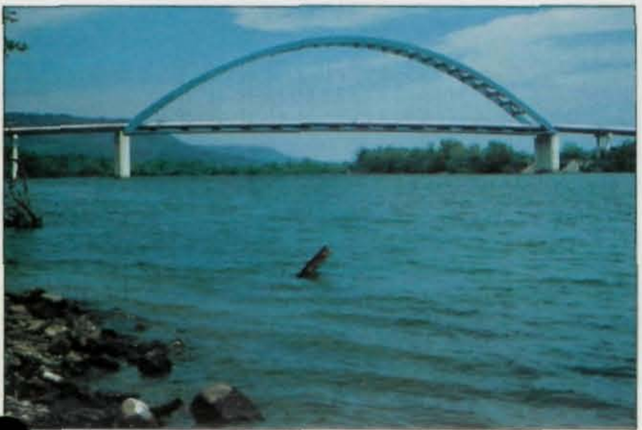
Designer: Howard Needles Tammen & Bergendoff, Kansas City, MO
General Contractor: Expressway Constructors, Saraland, AL
Steel Fabricators: Harris Structural Steel Company, Inc., South Plainfield, NJ
High Steel Structures, Inc., Lancaster, PA
Gamble's, Inc., Montgomery, AL
Steel Erectors: Vogt & Conant Southwest Corporation, Little Rock, AR
Expressway Constructors, Saraland, AL
Owner: State of Alabama Highway Department, Montgomery, AL
Span Lengths: Two arch spans of 800 ft



SR-156
Marion, Tennessee
(OVER THE TENNESSEE RIVER)

1982 Award of Merit
Category: Long Span

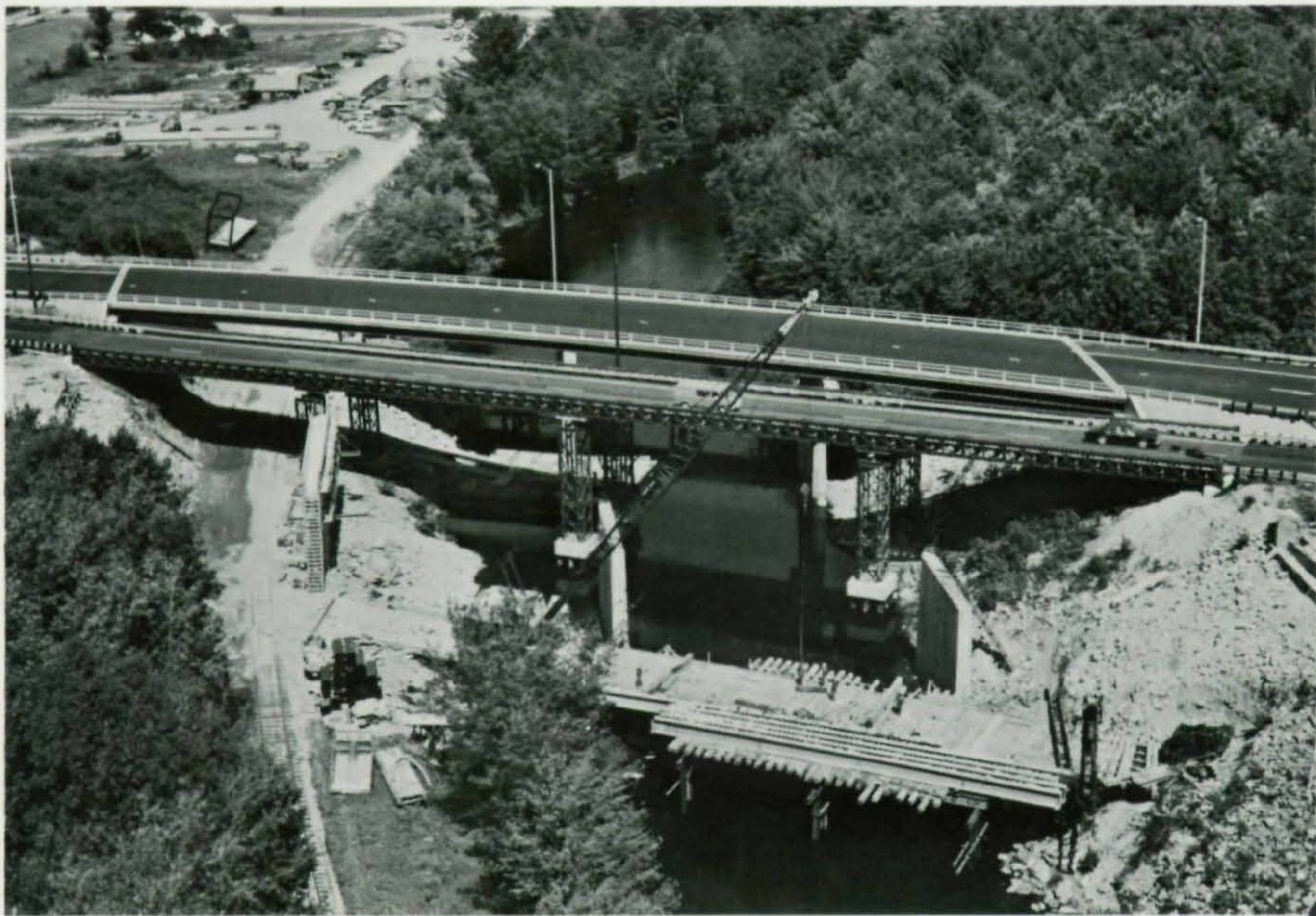
Designer & Owner: Tennessee Department of Transportation Division of Structures, Nashville, TN
General Contractor: W. L. Hailey, Inc., Nashville, TN
Steel Fabricator: USS Fabrication, Ambridge, PA
Steel Erector: American Bridge Division, U.S. Steel Corp., Pittsburgh, PA
Span lengths: 158 ft-213 ft-159 ft-750 ft-117 ft-117 ft



INTAKE CHANNEL BRIDGE-HAVASU PUMPING PLANT
Yuma County, Arizona

1982 Award of Merit
Category: Medium Span, High Clearance

Designer: United States Department of the Interior Bureau of Reclamation, Division of Design, Denver, CO
General Contractor: S. J. Groves & Sons Company, Minneapolis, MN
Steel Fabricator & Erector: Marathon Steel Company, Phoenix, AZ
Owner: Arizona Department of Transportation, Phoenix, AZ
Span lengths: 105 ft-133 ft-97 ft



330-ft Acrow Panel Bridge with Acrow Panel Piers does double duty

Acrow Panel Bridges are:

- **quick and easy to erect with minimum labor**
- **flexible and versatile**
- **capable of carrying very heavy loads**
- **modular—components are 100% reusable**
- **easily transportable**
- **lifted into place or launched from one side of the river**
- **economical to use**
- **available for rent, lease or purchase**

To widen and refurbish the two bridges across this river under I-93 in Northfield, New Hampshire, the two-lane Acrow Panel Bridge was erected between the two permanent bridges. While the northbound bridge was being rebuilt, the Acrow Panel Bridge carried the northbound traffic.

The photograph shows the northbound bridge completed with the Acrow Panel Bridge carrying the southbound traffic and the piers for the southbound section under construction. The length of the bridge is 330 feet continuous over three piers. The piers consisted of Acrow Panels erected vertically in a square pattern. The State of New Hampshire owns the Acrow Panel Bridge and it was erected by Shoals Corporation of Eliot, Maine.

When the permanent bridge is completed, all the components of the Acrow Panel Bridge will be reusable for other bridge projects. In fact, the use of these components has already been planned for another bridge having a total length of 320 feet.

For more information call or write

ACROW CORPORATION OF AMERICA

396 Washington Avenue, Carlstadt, New Jersey 07072

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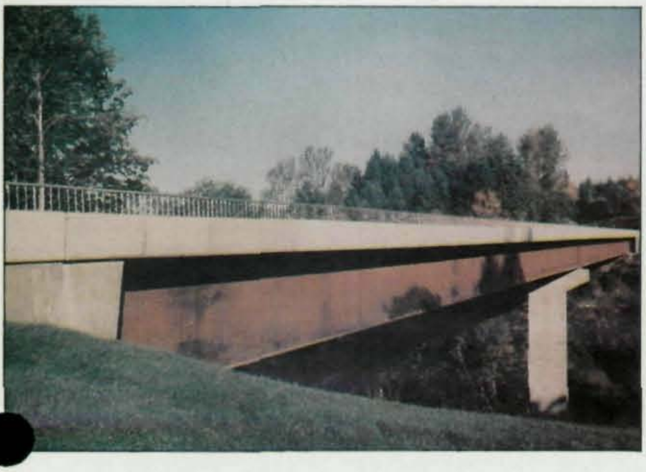
SOUTH PRAIRIE CREEK BRIDGE

Pierce County, Washington **1982 Award of Merit**
Category: Medium Span, High Clearance

Designer: Arnold, Arnold & Associates, Seattle, WA
General Contractor: Donald B. Murphy Contractors Inc., Federal Way, WA
Steel Fabricator: Fought & Company, Inc., Tigard, OR
Steel Erector: Cooney-McHugh Company, Tacoma, WA
Owner: Washington State Department of Transportation, Olympia, WA

Span lengths: 286.5 ft-282.5 ft



MOUNTAIN SPRINGS ROAD

Tolland, Connecticut (OVER I-86) **1982 Award of Merit**
Category: Medium Span, Low Clearance

Designer: Frankland & Lienhard, Consulting Engineers, New York, NY
General Contractor: Savin Brothers, Inc., Newington, CT
Steel Fabricator & Erector: The Standard Structural Steel Co., Newington, CT
Owner: State of Connecticut, Department of Transportation, Wethersfield, CT

Span lengths: 200 ft-240 ft

SOUTH DIVISION STREET

Salisbury, Maryland **1982 Award of Merit**
Category: Short Span

Designer: Dewberry & Davis, Fairfax, VA
General Contractor: George & Lynch, Inc., New Castle, DE
Steel Fabricator & Erector: High Steel Structures, Inc., Lancaster, PA
Owner: The City of Salisbury, Salisbury, MD

Span lengths: 105 ft 4 in.

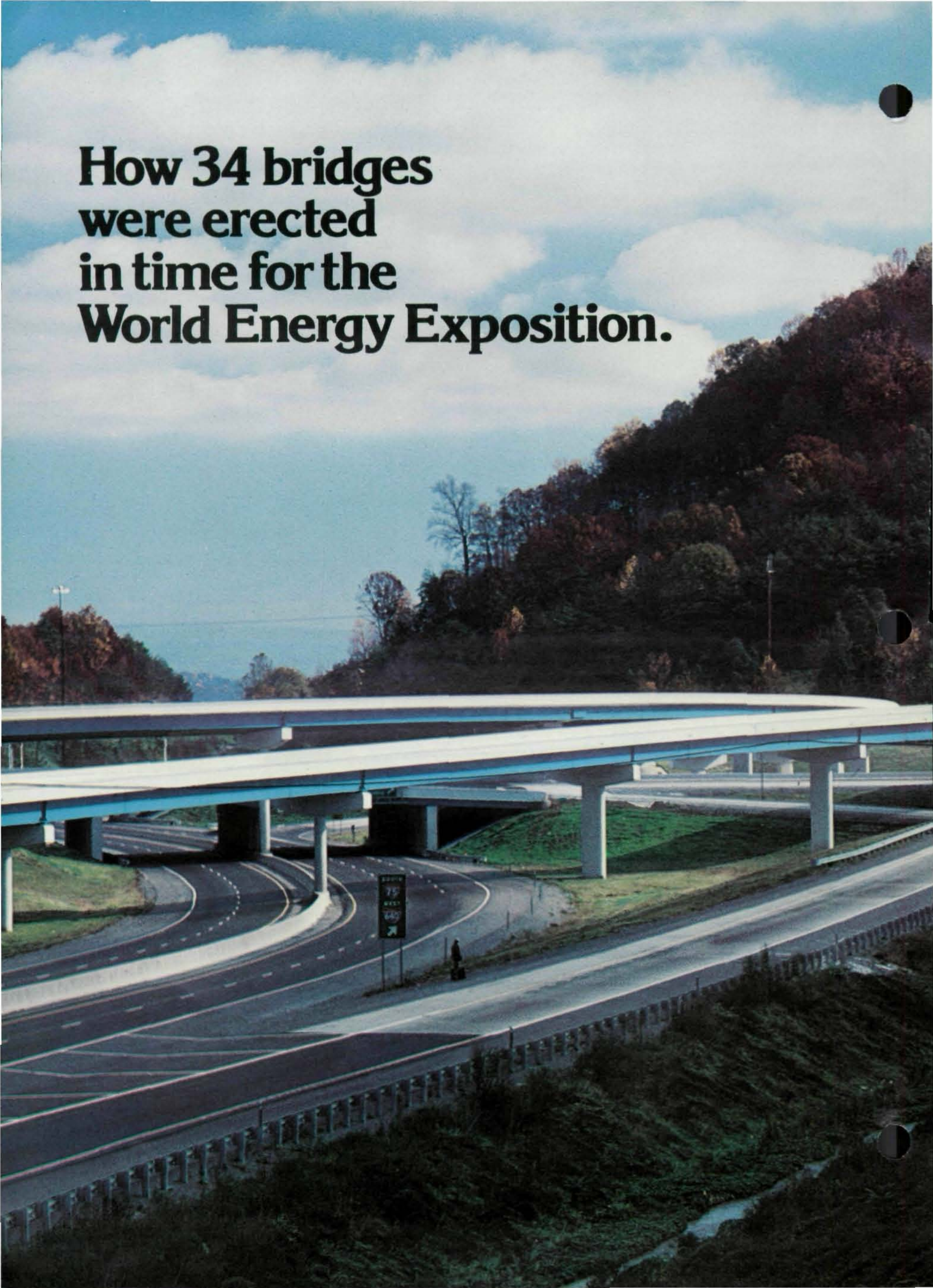
STATE ROUTE 45 "CONNECTOR"

Sarasota, Florida (RAMP B OVER I-75) **1982 Award of Merit**
Category: Grade Separation

Designer: Beiswenger, Hoch and Associates, Inc., North Miami Beach, FL
General Contractor: Wiley N. Jackson Company, Roanoke, VA
Steel Fabricator & Erector: Florida Steel Corporation, Tampa, FL
Owner: Florida Department of Transportation, Tallahassee, FL

Span lengths: Seven spans from 83 ft 9 in. to 132 ft 3 in.

How 34 bridges were erected in time for the World Energy Exposition.



Innovative design idea: integral, steel-girder, prestressed concrete cap, was used where vertical and horizontal clearance problems prevented the use of conventional dropped caps.

Faced with a difficult traffic situation and the opening of the 1982 World Energy Exposition, the state of Tennessee had to make some major improvements in the Interstate Highway System that traverses Knoxville.

To meet the deadline, 34 highway bridges for four Interstate Highway Interchanges, I-75/I-640, I-40/I-640 West, I-40/I-640 East and I-40/I-275 had to be designed and detailed in just 12 months!

The Structures Division–Tennessee DOT and Wilbur Smith and Associates, the designers, selected by the T.D.O.T. for two of the Interchanges, chose steel as the construction material for 31 of the structures because steel bridges could be designed and built rapidly, in the face of some formidable problems.

For example: only seven of the 34 bridges would be straight. All the others were either variable width or on curved alignment. All but three had to be erected over traffic. And highway geometric conditions dictated severe depth limitations.

Solutions to problems like these were accelerated through the use of U.S. Steel's computer program SIMON for both preliminary and final design–in conjunction with the USS V-Load method and other computer models for curved girders. In addition, all bridges were structurally designed by the Load Factor Design method–a "must" with the Tennessee DOT–which they have found provides substantial savings in material and construction costs.

Multi-girder, welded-plate girder systems were used throughout–with no lateral bracing required in accordance with the new provisions of AASHTO Standard Specifications. The designers incorporated many innovative structural features such as integral-steel-girder concrete abutments; continuous joint free spans for units up to 1331 feet in length, and integral, steel-girder, prestressed concrete caps.

At U.S. Steel, we think steel could be the best answer to <u>your</u> bridge design or construction problems. For a structural report on these bridges, or for information on steel bridge design, contact a USS Construction Services Representative through your nearest U.S. Steel Sales Office. Or write: United States Steel, P.O. Box (C1720), Pittsburgh, PA 15230.

USS United States Steel

TRADEMARK

Owner: Tennessee Department of Transportation, Nashville, TN

Designers: Division of Structures, Tennessee Department of Transportation • Wilbur Smith and Associates, Inc., Columbia, SC • Subconsultant: Hazelet and Erdal, Louisville, KY

Fabricators: Pidgeon-Thomas Iron Company, Memphis, TN • Texas-Tennessee International, Knoxville, TN • Allied Structural Steel Company, Chicago Heights, IL • Carolina Steel Corp., Greensboro, NC • Bibb Steel Company, Macon, GA

Contractors: Oman Construction Company, Inc., Nashville, TN • Lockwood Construction Company, Franklin, TN • Dement Construction Company, Jackson, TN • McKinnon Bridge Company, Inc., Franklin, TN • Southeastern Bridge Company, Brentwood, TN

27TH STREET VIADUCT

Milwaukee, Wisconsin **1982 Award of Merit**

Category: Elevated Highway/Viaduct

Designer: Howard Needles Tammen & Bergendoff, Milwaukee, WI
General Contractors: Allied Structural Steel Company, Chicago Heights, IL
Highway Pavers, Inc., Milwaukee, WI
Lunda Construction Company, Black River Falls, WI
Steel Fabricator: Allied Structural Steel Company, Chicago Heights, IL
Steel Erector: Edward Kraemer & Sons, Inc., Plain, WI
Owner: City of Milwaukee, Milwaukee, WI

Span lengths: 22 spans varying from 10 ft to 190 ft

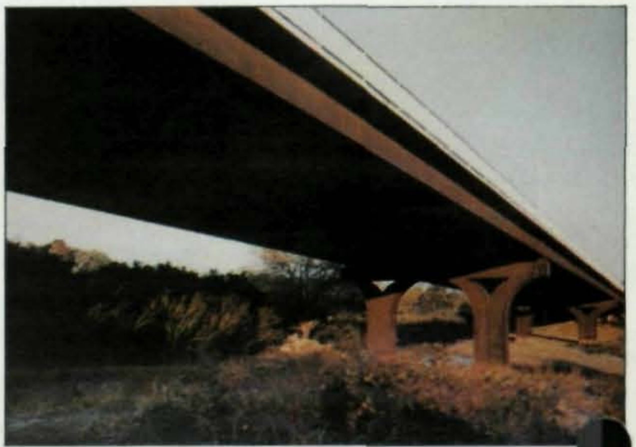
WYOMING AVENUE **1982 Award of Merit**

Philadelphia, Pennsylvania (OVER TACONY CREEK)

Category: Elevated Highway/Viaduct

Designer & Owner: City of Philadelphia, Streets Department, Philadelphia, PA
Consultant: H2L2 Architects, Philadelphia, PA
General Contractor: Tel-Stock, Inc., Washington Crossing, PA
Steel Fabricator: Williamsport Fabricators, Inc., Williamsport, PA
Steel Erector: Cornell & Company, Inc., Woodbury, NJ

Span lengths: One of 67.5 ft, two of 138 ft, 2 of 172.5 ft

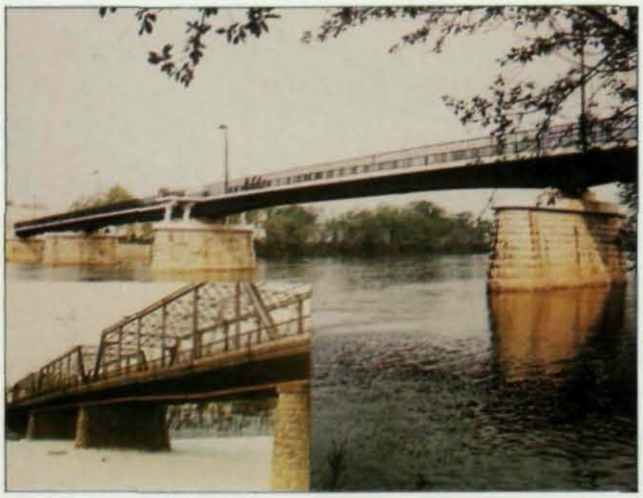


GRAND AVENUE PEDESTRIAN BRIDGE **1982 Award of Merit**

Eau Claire, Wisconsin **Category: Special Purpose**

Designer: Owen Ayres & Associates Inc., Eau Claire, WI
General Contractor & Steel Erector: H. F. Radandt Inc., Eau Claire, WI
Steel Fabricator: Phoenix Steel Corp., Eau Claire, WI
Owner: City of Eau Claire, Eau Claire, WI

Span lengths: 145 ft-145 ft-145 ft-145 ft

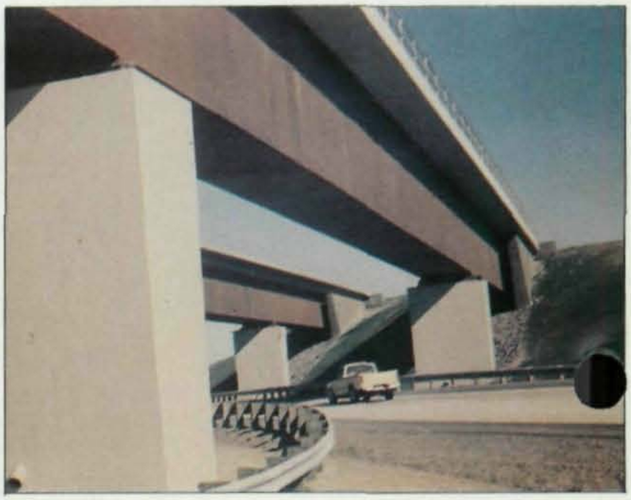


BNI RAILROAD BRIDGE AT ZILLAH **1982 Award of Merit**

Yakima County, Washington **Category: Railroad**

Designer & Owner: Washington State Department of Transportation, Bridge & Structures Branch, Olympia, WA
General Contractor: Northwest Construction Inc., Kirkland, WA
Steel Fabricator: Isaacson Steel Company, Seattle, WA
Steel Erector: Max J. Kuney Co., Spokane, WA

Span lengths: 105 ft-147 ft-152 ft-107 ft



Steel research speeds advances

AISI seeks bridge simplicity, economy on many fronts

Advances in the art and science of steel bridge design, once gradual and intuitive, have become faster and surer with the advent of formal research programs. One of the largest and most successful of these is that of American Iron and Steel Institute, working with universities, private engineering firms, and its own member companies. In the 20 years since AISI began sponsoring bridge research on a regular basis, it has seen some 30 projects completed. Today, in the age of computer analysis and advanced materials engineering, these examples from the current crop of AISI bridge research projects promise giant steps toward improved simplicity, efficiency, and economy with steel.

Load factor design. AISI research developed Load Factor Design (LFD) for steel bridges as an alternative to Working Stress Design (WSD). LFD provides for a more consistent live load capacity for any span length than does WSD and therefore, a more efficient use of material and more uniform structural safety. This is accomplished by reducing the factors of safety for the known dead loads so that more emphasis can be placed where needed on the factors of safety for the variable live loads. LFD emphasizes serviceability and durability by controlling permanent deformations under overloads, limiting live load deflections and the influence of fatigue under the loading spectrum. Material savings range from 6 percent to over 14 percent, and smaller welds and fewer stiffeners reduce fabrication costs. At least 30 state highway departments now use LFD.

Over the years, the LFD studies have revealed more and more about the actual behavior of bridges, uncovered new areas requiring research, and thus spawned new projects. For example, Autostress Design is really an extension of LFD, applying plastic design concepts to evaluate the rotational characteristics and the capacity of bridge beams in negative bending.

Autostress design. The newest AISI-sponsored bridge design method, Autostress Design (ASD) extends Load Factor Design by employing an even more realistic picture of how a bridge behaves under moving loads. The method reverses a trend toward engineering complexity: ASD leads to simple designs that result in simpler fabrication and overall economy. In many cases, ASD eliminates the need for cover plates for rolled beams, or for changes in section of plate girders. Applied to existing bridge designs, ASD substantially increases rated load-carrying capacity. A prototype ASD bridge is under construction by the Forest Service on a heavily travelled logging road in the Mount Baker National Forest near Seattle. The bridge will be fully instrumented and special loading will be applied to verify the predicted stresses and deflections. Funding for this phase will be provided by the FHWA and AISI. Meanwhile, a revision to the AASHTO bridge specification has been drafted to permit Autostress Design.

Ultimate strength of curved bridge girders. Because existing standards for horizontally curved steel bridge girders are based on elastic analyses as opposed to ultimate strength concepts, they are much too conservative; industry sources estimate that these girders can carry as much as 25 percent more load than now assumed. Among several AISI-sponsored studies of steel girder ultimate strength is one at Lehigh University, where researchers are analyzing both curved plate girders and curved steel box girders. Two full sized curved steel plate girder assemblies have been tested to ultimate strength, and one full sized box girder will be tested this year, to validate the theoretical analysis. The next steps are to develop a simplified analytical model to predict ultimate strength, and to propose a new design specification. The hoped-for result: steel bridges that are simpler and more economical to design and build.

Effects of bracing on I-girder bridges. Studies at the University of Maryland, funded by AISI, seek to improve the understanding of I-girder bridge behavior by analyzing the contribution of lateral bracing to wind load resistance and vehicle live load distribution between the girders. Research considers both tangent and curved composite I-girder spans, and compares continuous bracing with bracing in every other bay and with no bracing. Based on the first phase of this research, a revised AASHTO specification now permits removal of bracing in the plane of the bottom flange for most straight plate girder bridges. This eliminates troublesome details at the connection of the bracing to the girder, and leads to economies in materials and fabrication.

Meanwhile, work scheduled for completion next year relates to curved girder bridges. Here the objective is not to remove bracing, but to use the increased torsional stiffness which the bracing provides to improve lateral distribution of live loads. Studies of typical plate girder bridges are confirming this improvement; expected results are an improved AASHTO specification, and improved material and construction economy.

Weathering steel bridge study. Under the auspices of AISI, an ongoing study, evaluating the performance of weathering steel on 49 bridges in seven states, has been carried out by a task group of state and federal highway officials and steel company corrosion/ metallurgical specialists. A State of Michigan moratorium on the use of weathering steel, in response to reported local corrosion problems, prompted the survey. The task group set out to determine if the reported Michigan problem is a general one or specific to that state, and to report all findings as a guide to states and specifying agencies. According to the group's interim report, the bridges inspected show 30 percent good performance in all areas; 58 percent good performance with moderate corrosion in some areas; and 12 percent good performance with some heavy corrosion. Deicing salt use was found to be the single largest factor related to corrosion, and the Michigan structures were, by far, exposed to most deicing salts. Leaking joints permitting salt brine to infiltrate to the steel beams also were found to be a major factor contributing to corrosion. The report, just published by AISI, outlines selection criteria for use of the material, and confirms that most weathering steel is performing well.

Member companies of the Committees of Structural Steel and Steel Plate Producers are: The Algoma Steel Corporation, Ltd.; Armco Inc.; Bethlehem Steel Corporation; Inland Steel Company; Kaiser Steel Corporation; Lukens, Inc.; Northwestern Steel & Wire Company; Republic Steel Corporation; United States Steel Corporation.

A list of publications is available from:
Committees of Structural Steel and Steel Plate Producers
American Iron and Steel Institute
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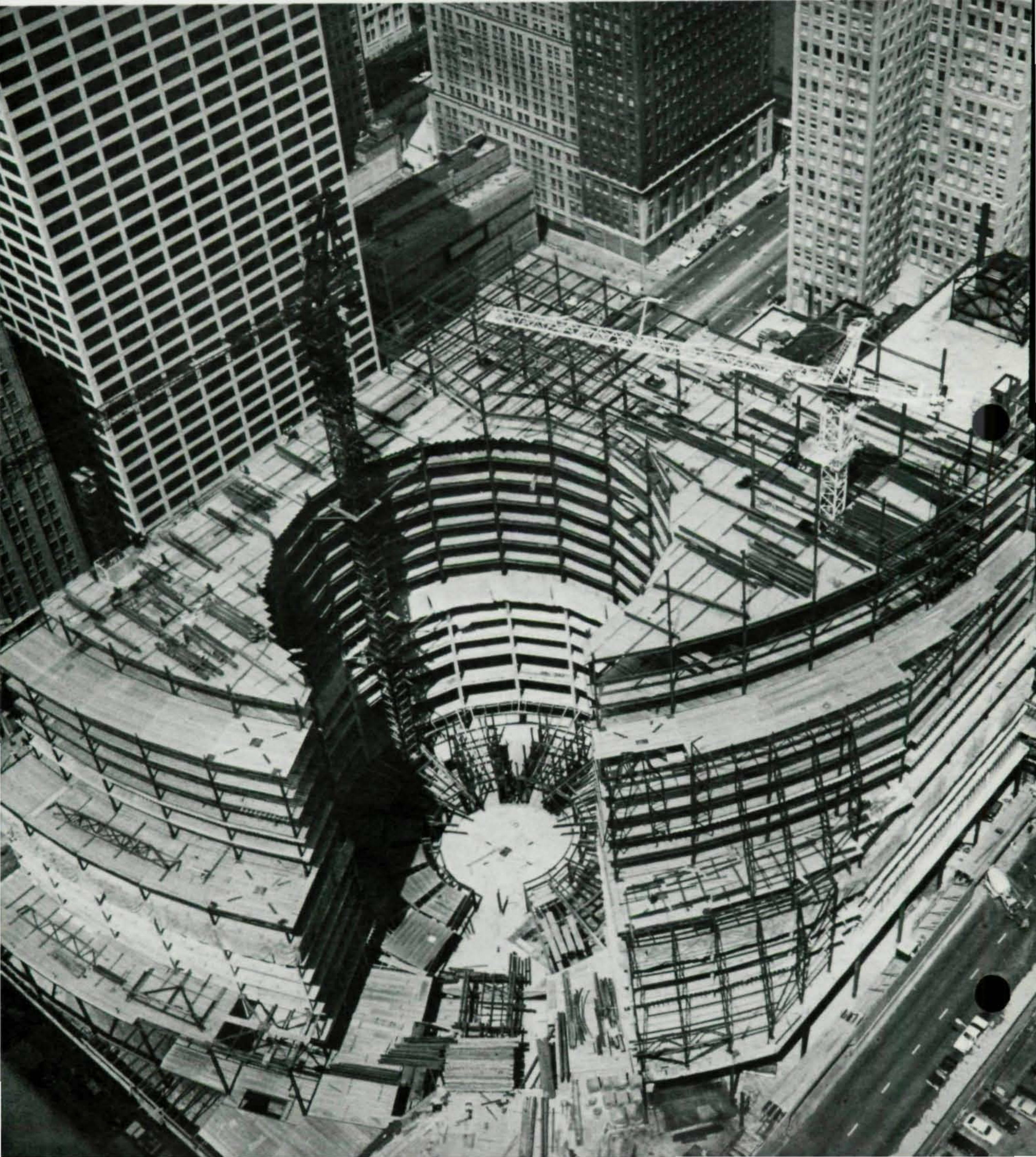
Steel S.M.

TEAMWORK IS THE KEY
FOR THE BIG JOBS—ON



More Economical Bridges Through Alternate Design

In December, 1979, the Federal Highway Administration issued a technical advisory notice that endorsed the policy of offering alternate bridge designs when inviting construction bids.

The advisory said: "To receive the most economical construction between basic structural materials...there should be maximum opportunity for competition between structural steel and concrete."

The alternate bridge design system operates in three different ways:

- Two complete designs, one in steel and one in concrete, are prepared and bid against each other.
- One complete design, in either steel or concrete, is prepared and bidders are allowed to present their own alternate designs for the other material or for both concrete and steel, depending on contract specifications.
- Two complete designs, one for steel and one for concrete, are prepared for bidding and bidders are also allowed to present their own alternate designs in either steel or concrete for bidding.

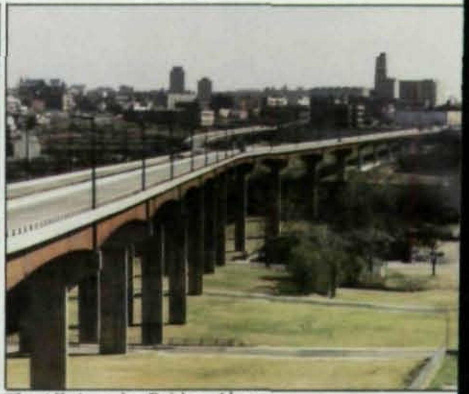
Where previously state highway departments or departments of transportation would decide what material a bridge should be designed in, the alternate process leaves the choice of material to the marketplace. The Federal Highway Administration supports competitive designs, working on the premise that the money saved through competition will be greater than the cost of an additional bridge design.

The concept of alternate bridge design began in the mid-1970s, when some state highway departments adopted the practice. While it is now federal policy, it is not mandatory.

The competition that alternate design fosters is saving the taxpayers money and giving them more efficient bridges. Of 20 bridge projects bid this way recently, 16 came in under the engineer's estimate. The total of the engineers' estimates for the 20 bridges was $435.7 million. The sum of low bids was $399.7 million, a saving of $36 million for U.S. taxpayers.

Some examples of how alternate bridge design works:


South Knoxville Boulevard Bridge


The All-America Bridge, Akron


Erie County, Pa., Bridge


Vail Pass Bridge, Colorado


Bonners Ferry Bridge, Idaho

The All-America Bridge, Akron

One of the first bridge projects in the United States to offer bidding on alternate designs, steel plate girders or concrete box segmented girders, or to invite contractor design in concrete or steel was the North Main St. Viaduct, in Akron, Ohio. The bridge is now called The All-America Bridge.

The Ohio Department of Transportation decided in 1976 on a 3,400-ft, Y-shaped bridge to carry North Main St. over the Little Cuyahoga River, as a replacement for a deteriorated concrete viaduct. The following year, the department sought lower construction costs by inviting competition between steel and concrete. The department engaged the same engineer to design a bridge in each material.

At the bid opening, the contractor bidding the steel specified design came in low at $25.8 million. This was $900,000 less than the second low, which was for an optional design in concrete. As evidence of the money-saving ability of the alternate design program, the low bidder was $3.4 million under the engineer's estimate for the job.

South Knoxville Boulevard Bridge

The Tennessee Department of Transportation offered two designs for its South Knoxville Boulevard Bridge over the Tennessee River. This is a 1,900-ft-long structure with a 390-ft main span.

The state's steel design used haunched I-girders for the main span and precast concrete girders for the approach span and called for 13 piers. Only 40% of the design called for steel.

The official concrete design called for precast, post-tensioned segmental construction and only 10 piers.

The Tennessee Department of Transportation also offered the opportunit contractors to produce their own de in either concrete or steel.

Technical support by mill producers helped alternative design team of fabricator, contractor and engineer develop preliminary plate girder design details for a revised main span that was 100 ft longer than the original design and eliminated two piers.

When 10 bids were opened on February 13, 1981, the contractor's alternative design in steel was the low bidder, at \$14.7 million. This winning bid was \$3.3 million lower than the engineer's estimate. The second low was in concrete and less than 5% separated the two bids.

Erie County Bridge

The Pennsylvania Department of Transportation (PennDOT) provided only a steel design for this 1,575-ft bridge in Erie County. A team using the Bethlehem Steel Preliminary Girder Bridge Optimization Program reviewed the consultant's steel design offered by PennDOT and concluded that a more economical design was possible.

In a redesign that was accomplished in six calendar days, the program eliminated 3,500 out of 3,900 transverse stiffeners from the official design, reduced the steel requirements by 9%, and achieved a savings of \$33,000 in materials cost. A significant reduction in man hours for flange splices saved 3,000 hours of shop labor.

The resulting design in steel qualified as low bidder. Out of 10 bids received, the concrete alternative placed eighth overall, about 14% more costly than the winning steel design.

The Vail Pass Bridges

When the Colorado Division of Highways began design to take Interstate 70 over the Rocky Mountains by way of Vail Pass, the beauty of this mountainous area was a major consideration. The highway passes through some of the most spectacular scenery in the United States. Architectural consultants recommended bridge designs that presented thin profiles and blended in with the scenery. The architects also suggested long-span bridges over the many canyons and streams to avoid large cuts and fills that would damage the landscape.

The Division of Highways chose box girder bridges, because of their resistance to twisting and their uncluttered appearance. The division commissioned its consulting engineers to produce two designs, one employing single precast segmental concrete box girders and one using pairs of steel box girders with composite concrete decks.

The designer (International Engineering Co.) and the Colorado Department of Transportation were supported by preliminary studies developed by U.S. Steel, enabling them to develop the most efficient steel box girder system.

Bonners Ferry Bridge, Idaho

The Idaho Department of Transportation (IDOT) commissioned alternate designs for the Bonners Ferry Bridge over the Kootenai River on U.S. 95 near the Canadian border.

The Seattle office of Howard Needles Tammen & Bergendoff designed a cast-in-place, post-tensioned concrete bridge. T.Y. Lin International, of San Francisco, produced a design for a cable-stressed bridge weighing one-fifth less than a conventional steel plate girder structure.

IDOT's engineer's estimate for the Bonners Ferry Bridge was \$11.5 million.

All eight bidders for the 1,378-ft-long, four-lane bridge chose the cable-stressed steel alternative. The apparent low bid of \$9.14 million was submitted by Peter Kiewit Sons' Co., Omaha. The second low bid was \$9.15 million. The highest bid was \$11.5 million. The steel design saved the taxpayers \$2.36 million.

Cable-stressing of the top flanges of steel plate girders over the bridge piers cuts steel weight from the usual 30 lb per square foot to 24 lb. According to the designer, while the concrete design would have needed two seasons for construction, the cable-stressed bridge can be built in one season. ■

HIGH STEEL BRIDGES THE QUALITY GAP WITH ITS "GOOD MEASURE" COMMITMENT.

Over a half-century ago the founder of High Steel Structures, Inc. instructed his welding crews, "Put down a good weld. . .and give good measure." Today, that same commitment to quality guides the efforts of over 600 employees.

One of the few companies in the industry that fabricates and erects structural steel, and carries an AISC Category 3 Certification, High Steel Structures ranks among the largest of bridge builders east of the Mississippi. Maintaining its own fleet of delivery vehicles, with over 200 pieces of rolling stock, including 11 truck cranes with capacities up to 140 tons, the High "good measure" people can measure up to your toughest, most demanding contracts.

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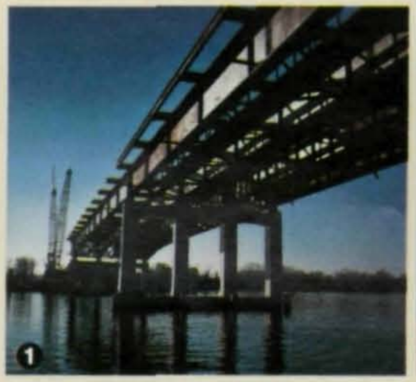
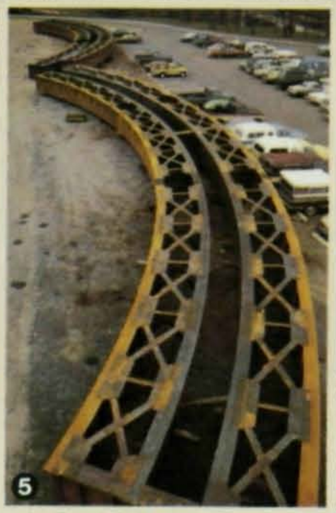
1. Shipping Expertise
Chautauqua Lake
Jamestown, N.Y.
11,000 tons fabrication. HSSI's fleet met the difficult demands of shipping girders over 145′ long, and haunched girders 16′6″ deep, 98,000 lbs.

2. Special Fabrications
Rt. 77 Overpass
Wythe County, Va.
5,053 tons with 16′7″ haunched girders up to 166′ long, 135,000 lbs.



3. On-Time Delivery
Joe Louis Arena Exit Ramp, Detroit, Mich.
850-ton, 12-span bridge fabricated and delivered within 11 weeks from signed contract.

4. Accelerated Schedule
I-83 bridge over Susquehanna River, Harrisburg, Pa.
5,500 tons fabricated and erected within one season. Total project, including river spans, 11,000 tons.



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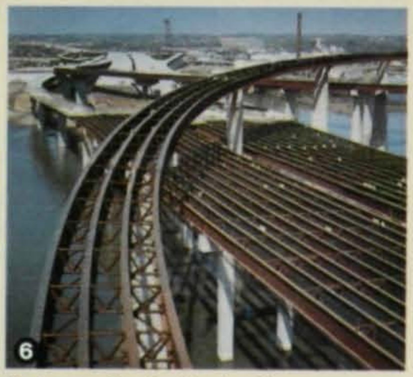

5. Large-Scale Production
HSSI's facilities accommodate the most complex projects, like these curved trough girders, assembled in yard for reaming to insure a proper fit in the field.

6. Marine Erections
I-95 Interchange, Baltimore, Md.
16,000 tons fabricated and erected primarily over middle branch of Patapsco River.

Student Programs Encourage Design in Steel

AISC works with engineering and architectural students to encourage expertise in the creative use of structural steel. The AISC Education Foundation grants up to eight $4,750 fellowships to senior or graduate civil or architectural engineering students who plan a course of graduate study related to fabricated steel structures. This program consistently draws outstanding applicants.

For more than 10 years the American Iron and Steel Institute has funded grants to accredited architectural schools for the "Hands on Steel" program. The aim of this program is to acquaint students of architecture with steel. It helps them learn to cut, bolt and weld steel with their own hands so that they become familiar with steel and learn its properties and advantages and encourages them to think steel when they design professionally. AISC administers the program through its regional engineers and active member companies.

AISI makes grants to architectural schools to finance administration, purchase of plain steel materials and welding and cutting equipment. Architectural students in participating schools design and build a project made primarily of steel. AISC fabricator-sponsors are encouraged to take part in the "Hands on Steel" projects by helping students to get steel, by providing skilled employees to instruct in cutting and welding, by offering fabrication plant tours and by taking students on steel construction projects where they may discuss work in progress with on-site management.

In addition to these regular structured programs, AISC regional engineers and headquarters staff and AISC members make known the advantages of steel design and construction by serving as guest lecturers in structural steel design classes and by conducting tours of steel fabricating plants and of job sites of steel construction projects.

These and other university-related programs are supported by a plan approved by AISC active members that grants a portion of the member dues to the AISC Education Foundation.

This year, the Advisory Committee on Education, working to implement the objectives of the Education Foundation, begins a new program called "Partners in Education." The committee has divided the 230 colleges and universities in the United States that teach structural steel design into 21 geographical groups. An outstanding professor from each group has been named group leader. After attending two-day planning meetings in Chicago in February, the 21 group leader professors have returned to their areas to set up seminars for all the professors in each area who teach structural steel design. Representatives from practicing engineering and design firms and fabricators take part in the seminars. Participants discuss requirements placed on graduate engineers, the ways in which structural steel design is taught, teaching aids available and field trips.

The aim of the "Partners in Education" program is to create a direct relationship between AISC and every teaching professor and to offer the help of AISC members to colleges and universities. In addition the committee provides support for college professors teaching structural steel design and encourages local member groups to sponsor those professors to the National Engineering Conference. ■

SPECIAL ADVERTISING SECTION

Report of the AISI Task Group on Weathering Steel Bridges

The American Iron and Steel Institute Task Group on Weathering Steel Bridges was organized during the period when the Michigan Department of Transportation was observing a moratorium on the use of weathering steel in its highway program.

The Task Group is comprised of corrosion and metallurgical representatives from several steel producers, representatives from the Federal Highway Administration, American Institute of Steel Construction, bridge engineers from six highway departments and the New Jersey Turnpike Authority. The objective of the Task Group is twofold: to determine whether the bridge situation in Michigan is indicative of a general problem, and provide guidance for the evaluation and application of unpainted weathering steel in other bridge programs.

The Task Group outlined several tasks to be undertaken:

- Conduct a uniform bridge **inspection program.**
- Study the use of **deicing salts** and their effects on weathering steel.
- Consider the effects of **mill scale** on weathering steel performance.
- Consider the effects of **corrosive deposits** on weathering steel bridge surfaces.
- Review studies on **fatigue life** of weathering steel.
- Encourage development of recommendations on **remedial painting** practices for previously weathered steel.

As part of the **inspection program** 49 bridges from a group of approximately 900 were selected for inspection. Inspections were conducted by industry corrosion engineers and state highway representatives on samples which included various geometric conditions, traffic conditions, and salting conditions.

The inspections revealed that:

- 30% of the bridges showed good performance in all areas.
- 58% of the bridges showed good overall performance with moderate corrosion in some areas.
- 12% of the bridges showed good overall performance with heavy corrosion in some areas.

One or more of the following factors were determined to be responsible for the formation of non-adherent flaky rust:

- Water runoff contaminated with deicing salts during winter months draining through leaky seals and open joints or expansion dams.
- Tunnel-like conditions that concentrate salt-laden road sprays from traffic passing under the bridge, resulting in the accumulation of water, dirt and salt on the superstructure.
- Water and deicing salts leaking through cracks in the concrete deck.
- Salt-laden water runoff draining directly over the edge of the bridge onto the steel superstructure.

By far, the most prevalent and important factor leading to the formation of non-adherent flaky rust was the passage of salt-laden water through leaking joints or open expansion dams.

Deicing salt application rates developed by the various agencies and through The Salt Institute indicated that Wayne County, Michigan, and Metropolitan Detroit are the heaviest users.

After considering the question of the effects of **mill scale** raised by Michigan, the Task Group did not find any detrimental effect caused by mill scale remaining on weathering steel. Therefore, it recommends that mill scale be removed only for aesthetic considerations.

Analysis of **corrosive deposits** such as flaky non-adherent rust showed significant amounts of chlorides. Accumulation of these deposits on the steel surfaces aggravates the corrosion problem by providing a poultice environment.

At the present time the Task Group does not have conclusive information to assess the effects of surface roughness due to corrosion on the **fatigue life** of a weathering steel member. No evidence of fatigue problems was observed on any of the bridges inspected by the Task Group.

The Task Group has engaged the Steel Structures Painting Council to conduct a study on the **remedial painting** of weathered steel. When completed the study results will be made available to transportation officials.

The selection of weathering steels for bridge structures is a matter of engineering judgment. Some of the factors to be taken into account are environment, economics, safety, and esthetics. Due to the potential for leakage of bridge joints, designing and detailing play an important role in avoiding possible problems at critical points.

The bridge inspections revealed that a majority of the weathering steel actually installed is performing satisfactorily. However, there are notable exceptions in Michigan, where local conditions of environment have indicated a need to reevaluate the use of weathering steel in bridges.

A National Cooperative Highway Research Program (NCHRP) sponsored study on weathering steel has been developed and is awaiting funding. The AISI Task Group will make its meeting reports and bridge inspection reports available to the NCHRP research agency.

The Task Group hopes the information presented in this report will be of assistance to engineers in evaluating the application of weathering steel to their particular structures. ■

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Steel Strives for Better Bridges

The present state of the art in steel bridge design and construction owes much of its development to the contributions made by the steel industry and the wide variety of companies that make up the industry acting independently.

Improved research and the investigation and development of materials and techniques by producing mills, fabricators, erectors and equipment manufacturers have produced products and skills that have brought the steel bridge to its present high degrees of refinement. These materials and practices are evident in bridges large and small for highways, railroads and pedestrians. A major change came about with the introduction of high strength, low alloy steel. The subsequent improvement of fabrication and erection techniques has resulted in spans that are lighter in weight, more attractive in appearance and less expensive to maintain.

The steel industry and its various components have also been in the forefront in investigation and development of improved design techniques. Load and resistance factor design, now the accepted method of bridge analysis, caught the imagination of the steel industry. Through the efforts of the industry, it was refined and promoted with regulatory officials and designers. These many developments have helped to lower the cost of bridges and to benefit taxpayers.

In recent years, the market for long-span steel bridges has come under intense competitive presssure from the concrete industry. Improvements in concrete materials and construction methods developed in Europe are now evident in the American bridge market.

To meet this challenge, the steel industry has concentrated on improving the design of medium and long-span bridges. The objective is to develop more economical solutions in steel and educate designers and public officials to the attractions of these solutions. The first target for this effort is the highly visible, attention-getting, long-span, cable-stayed major river crossing market.

A number of these cable-stayed crossings now being planned have been identified by the steel industry. The agencies responsible for final design are receiving information that should make the cost of these structures substantially less than those of similar long-span structures built in the recent past. While all aspects of each are being studied, the main emphasis is on design of the deck structural system.

For example, a floor framing system never before used in the United States is part of a recently completed design for a 1,200-ft-main-span, cable-stayed, four-lane highway bridge that is 92 ft wide. The primary forming system consists of two 6-ft-deep, continuous-fascia, C-shaped girders supported every 50 ft by cable attachments in combination with 5-ft-deep, 92-ft-long transverse girders on 12-ft 6-in. centers. Splices in the fascia girders and the transverse girder connections are field-bolted. This unusually light (24 lb) floor system is designed to act compositely with pre-cast concrete elements. The deck is made up of 12 x 50-ft panels with openings to allow for grouting of the shear studs after placement on the transverse girders.

Another recent development is the computer analysis of the distribution of horizontal loads in medium-size plate girder bridges. This analysis demonstrates that the actual distribution factor for interior girders with full-depth cross bracing was about 25% less than the S/5.5 rule. This permitted wider girder spacing and a reduction in overall steel weight and cost. This system was first used on the high-level approach spans to the Sunshine Skyway replacement project over Tampa Bay and was the first acceptance by the Federal Highway Administration on a major project.

An example of the steel industry's enterprise and ingenuity in serving the public is the speedy replacement this summer of a middle span of the Norfolk & Western Railroad Bridge at Hannibal, Mo. At the beginning of May, barges out of control knocked the span into the Mississippi River. This forced a diversion of rail traffic between Kansas City and Chicago/Detroit that was costly in time and money.

Norfolk & Western, while selecting an engineering company, asked fabricators to offer quotes on costs and completion schedule without the benefit of bid drawings.

The railroad awarded the construction contract for fabrication and erection of the 246-ft 3-in. truss span to Bristol Steel and Iron Works, Inc., on the basis of price and time, only three days after the accident.

Thanks to fast tracking of the production process, fabricated material began to arrive on site 10 days after the contract award. The erector began assembly of the span on three barges. Three months and one day after the accident, a derrick barge lifted the 465-ton replacement span into place.

AISC/AISI Joint Industry Task Force, a group of industry representatives from the design profession, fabrication and erection segments of the industry, continues to monitor and investigate new ideas that will improve the design and performance of steel bridges and help to reduce the overall costs of bridge structures. This effort by all elements — mills, fabricators and erectors, in cooperation with the two major trade associations, strives to distribute information about these technical developments to a broad range of persons involved in the design and construction of bridges. ■

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