



REPLACEMENT

New Bridge Slated for Columbus

To pave the way for a new downtown landmark, demolition began the week of September 25 on the 68-year-old Main Street Bridge in Columbus, Ohio.

The new span will link parkway developments on both sides of the Scioto River, contributing to the revitalization of the Columbus Civic Center. Total cost of the project is projected to be \$44.1 million, with completion in 2009.

The new bridge will feature an innovative single-rib tied arch with a 400-ft span that will carry separate vehicle and pedestrian lanes. The arch will be inclined at a 10° angle from vertical, adding to the uniqueness of this signature structure. A pedestrian deck will sweep horizontally and vertically away from the roadway to provide an unobstructed view of the city's downtown.

The project team is led by DLZ Ohio, Inc., with HNTB Corporation as the lead structural design firm. The prime contractor is Kokosing, and Jansen & Spaans is

the construction engineer. S.N. Pollalis of the Harvard University Graduate School of Design developed the initial design concept.



A MESSAGE FROM THE

Executive Director



As 2006 comes to a close, the steel bridge industry continues its efforts to increase market share, advance technology in bridge design and construction, and promote improvements for accelerated steel

bridge deployment. We also continue to make excellent strides in providing protection and influence on the Buy American Provision for our industry.

Phase I of the *Steel Bridge Design Handbook* has been completed, and the chapters are available as PDF downloads from our new web site. Phase II is scheduled for a completion date of mid-2007 and the third and final phase will begin later this year. The chapters are based on the *AASHTO LRFD Bridge Design Specifications*, Third Edition, and will be upgraded online for each new specification edition. The chapters cover a wide range of topics about steel bridge de-

sign, fabrication and erection and include several design examples. The completed *Steel Bridge Design Handbook* will provide the steel bridge community with a valuable tool for answering many of their technical and design questions.

Our increased trade and public awareness efforts have continued to provide information on several signature bridges as well as everyday steel bridges. Included in this effort are interesting articles and information to educate and influence the decision maker in making the right choice in steel design and construction. A new web site (www.steelbridges.org) was developed, compiling information about NSBA as well as steel bridge information from all sectors of the industry. The web site can be viewed for all updated news, AASHTO documents, opinion statements, and meeting dates for the industry.

The political scene remains active. Privatization of roads and bridges is receiving more and more consideration, and our influence will be directed to assist these new

decision-makers in using steel components. Many state and local authorities are choosing to look offshore, avoiding the Buy America Provision. Not only are these challenges presenting themselves on our coasts, but they have also migrated to several inland states. NSBA is dedicated to preserving the Buy American Provision and will continue to represent member mills and fabricators in their effort to keep our domestic steel bridge industry strong. The midterm elections should provide interesting times. Our efforts will evolve and we will continue nurturing existing relationships and making new friends where offices change.

On behalf of the entire staff of the National Steel Bridge Alliance, I would like to take this opportunity to wish you and your family a wonderful and happy holiday season and a prosperous new year.

Best regards,
Conn Abnee
NSBA Executive Director

EVENTS

Steel Bridge Symposium

The 2007 World Steel Bridge Symposium will take place December 4–7, 2007 at the Sheraton New Orleans Hotel, New Orleans, La. For exhibit and sponsorship information, contact Jody Lovsness at 402.758.9099 or lovsness@nsbaweb.org. For general information, contact Elizabeth Purdy at 312.670.5421 or purdy@aisc.org. Visit www.steelbridges.org for the latest information.

National Steel Bridge Alliance

One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
www.nsbaweb.org
www.steelbridges.org

Conn Abnee

Executive Director

Phone: 606.724.2347
Cell: 312.804.1524
abnee@nsbaweb.org

Mike Moffitt

Director of Engineering Services

1228 S. 4th Street
St. Charles, IL 60174-4019
Phone: 630.443.8090
moffitt@nsbaweb.org

Jody Lovsness

Marketing and Membership Coordinator

11708 Jackson Road
Omaha, NE 68154
Phone: 402.758.9099
Fax: 402.778.9499
lovsness@nsbaweb.org

Calvin R. Schrage

Regional Director (west)

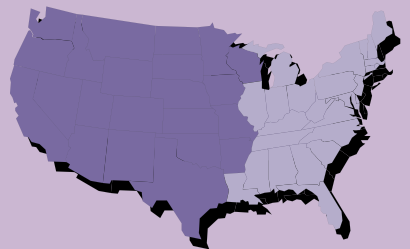
5620 Harding Drive
Lincoln, NE 68521
Phone: 402.466.1007
Fax: 402.466.1027
schrage@nsbaweb.org

William F. McEleney

Regional Director (east)

45 Pasture View Lane
Cranston, RI 02921-2732
Phone: 401.943.5660
Fax: same as phone
mceleney@nsbaweb.org

Regional Directors' Territories



MATERIALS

Prefabricating Standard Orthotropic Steel Decks

BY ROMAN WOLCHUK

The American steel industry must offer new and better products to more effectively compete in the bridge market.

Wider use of cost-effective orthotropic steel decks provides one possible way to increase the role of structural steel for bridges. Currently, bridge engineers tend to consider these decks expensive and useful only for large bridges. They also associate them with complex design and analysis.

Specifications permitting the use of standardized orthotropic decks not requiring elaborate analytical investigations would encourage their increased use. The Eurocode provisions for orthotropic decks, for example, expressly exempt some common bridge types from numerical fatigue investigations, provided that the decks satisfy certain geometric requirements and fabrication rules. The Japanese bridge code contains similar provisions.

The 1994 edition of the AASHTO LRFD specifications for orthotropic decks also dispenses with numerical investigations of fatigue strength of certain details not easily amenable to analytical treatment. The junctions of the ribs with the deck plate can be considered to have adequate fatigue resistance if the stipulated requirements for geometric proportions and welding details are satisfied.

It should be noted that provisions permitting the use of certain standard pre-tested bridge components, such as steel gratings, precast concrete deck panels or T-beams, without numerical strength and fatigue analysis by the designer have been already included in the earlier AASHTO specifications.

Designing the Standard Panel

Figure 1 shows a proposed design for a standard orthotropic steel deck panel. It is suggested that hot-rolled ribs replace the conventional cold-pressed ribs. Cold pressing of ribs in the fabricator's shop is an expensive process, requiring specialized heavy equipment. Generally, the length handled by fabrication presses cannot exceed about 12 m (40 ft). Other disadvantages of cold pressing are the high residual stresses and strain hardening at the corners of the ribs, reducing their fatigue resistance. Cold pressing also increases the difficulty of attaining the prescribed straightness tolerances, essential for correct welding of the ribs to the deck plate. Initially, however, the cold-

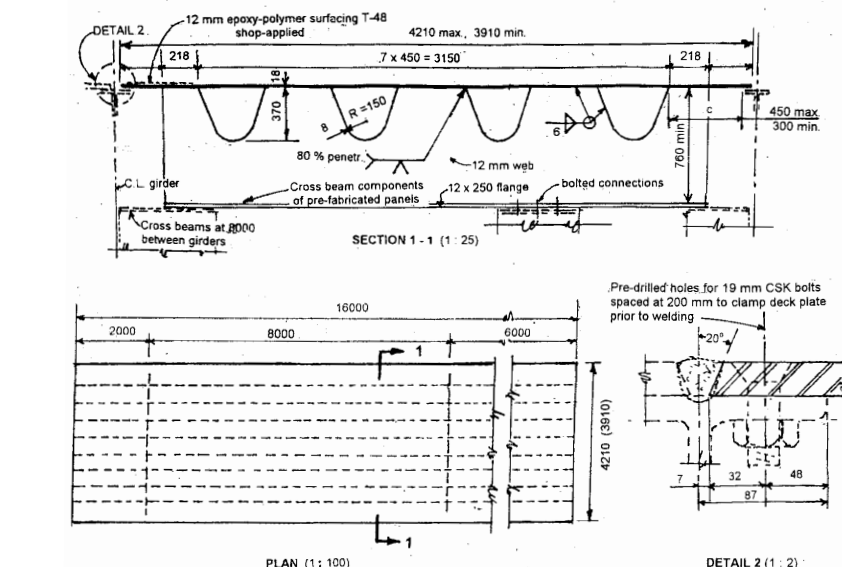


Figure 1. Proposed prefabricated orthotropic deck panels.

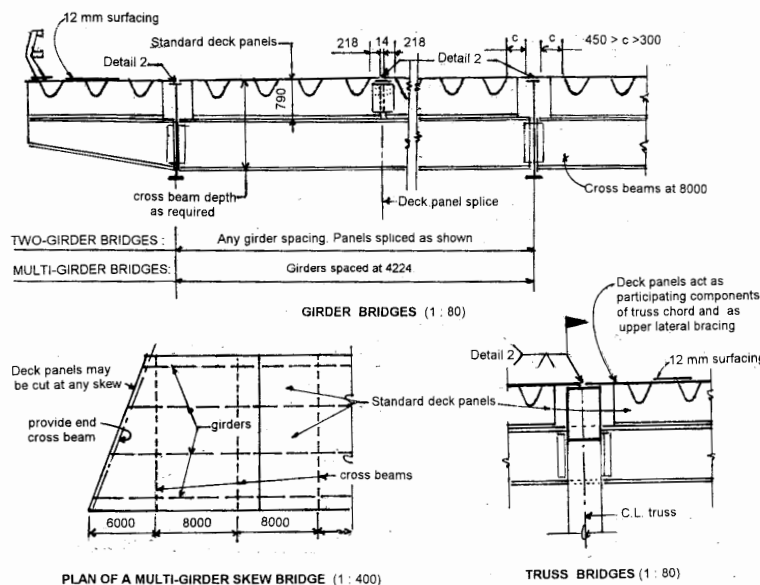


Figure 2. Applications to new bridges.

pressed ribs would have to be used because the steel mills could produce hot-rolled profiles only if assured of sufficient tonnage.

The cost of fabrication and erection of orthotropic decks depends primarily on specialized labor, not the cost of the steel plate. The rib intersections with the cross beams are labor-intensive. Proposed deck panel design minimizes the number of such intersections by spacing the cross beams at 8 m (26 ft) and spreading the ribs farther apart. This modification requires a thicker (18 mm) deck plate, which is also desirable for reducing local deck flexibility. A stiffer deck plate improves the performance of the

wearing surface.

Substantially longer rib spans of 9.8 m (32 ft) have already been used on one of our projects. They perform well under heavy traffic. To further reduce the labor cost, the detail at the rib intersections with the cross beams may be simplified by omitting the free cut-outs at the rib bottoms, which require laborious "wrapping around" of the welds and costly grinding smooth the weld ends and around the cut-out. Instead, the ribs with rounded bottoms are fitted tightly in the web cut-outs and welded continuously all around the rib periphery. This alternative is possible where the depth of the cross beam is at least

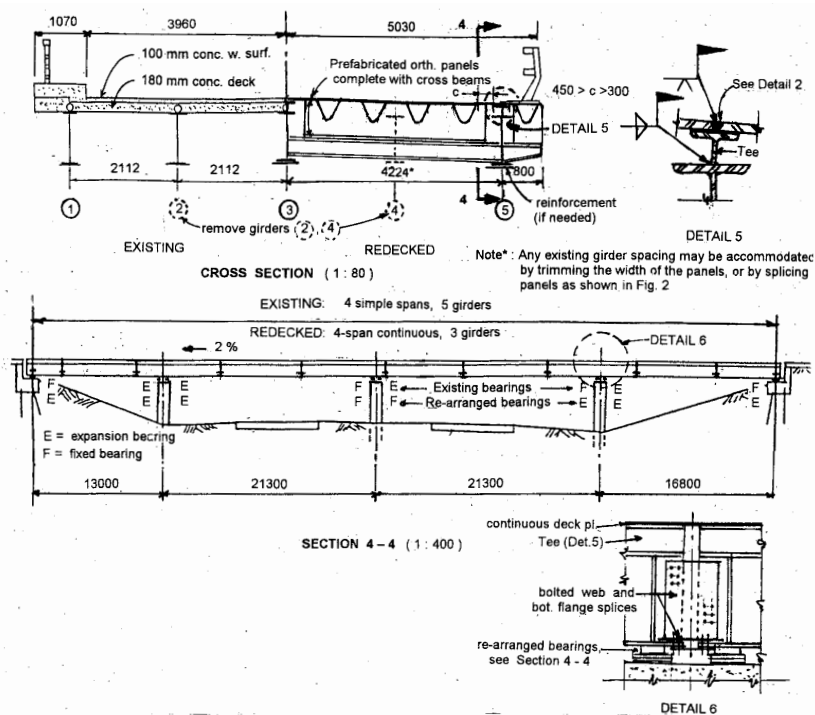


Figure 3. Re-decking of short-span stringer bridges.

twice the rib depth.

For good fatigue resistance, fabricators must strictly adhere to required tight dimensional tolerances. They should also choose welding methods and sequences to minimize residual stresses. The size of the proposed prefabricated panels is governed by their ability to be transported to the project site by truck.

The panels will act as top flanges of longitudinal girders, as shown in Figure 2. Erectors will weld the edges of the panels to the tops of the girders in the field. These welds will resist the interaction shears between the steel roadway deck and the girder.

Wearing Surfaces

We've proposed a thin (12-mm or 1/2-in.) epoxy-polymer surfacing of the type proven on such projects as the Poplar Street Bridge in St. Louis and the Macdonald Bridge in Halifax, Nova Scotia, Canada. This material has relatively low susceptibility to temperature effects. Bituminous surfacings exhibit undesirable stiffening at low temperatures that may result in pavement embrittlement and cracking.

Note the critical location on the deck in the vicinity of the rigid main girders where the deck plate is subject to sharp local curvature, causing maximum tensile strain in the surfacing, as shown in Figure 4. To minimize this effect the distance c between the web of the rib and the deck plate support at the girder (see Sect. 1-1, Figure 1) must be sufficiently large. Our investigation indicates that, with distance c within the indicated limits,

the resulting strains may be safely withstood by the thin surfacing of our choice. But much larger strains and stresses will develop in a thick bituminous pavement at low temperatures, possibly causing its failure.

Applying the Prefabricated Panels

Figure 2 shows that prefabricated panels of this type could be used for all kinds of steel bridges with two or more rolled-beam stringers or plate girders. The needed roadway width can be obtained by longitudinally splicing the deck plates of two or more panels. For skewed bridges the end panels may be cut at any angle. In the end bays the rib spans should not exceed 6 m (20 ft). In truss bridges the panels will function as participating components of the truss chords and as the lateral bracing.

Figure 3 shows possible application of prefabricated panels to re-decking of short span stringer bridges. Overpass structures over the interstate highways built in the 1950s to 1980s typically consist of four simple spans, as shown in Section 4-4. Rolled-beam stringers are generally spaced at about 2.1 m (7 ft) with composite or non-composite concrete decks that have open joints at the piers and the abutments. On most of these structures the concrete decks are deteriorated. The use of prefabricated orthotropic panels would offer the following advantages:

- elimination of the open deck joints at the piers by using a continuous deck plate between the end abutments.
- conversion of simple span stringers to con-

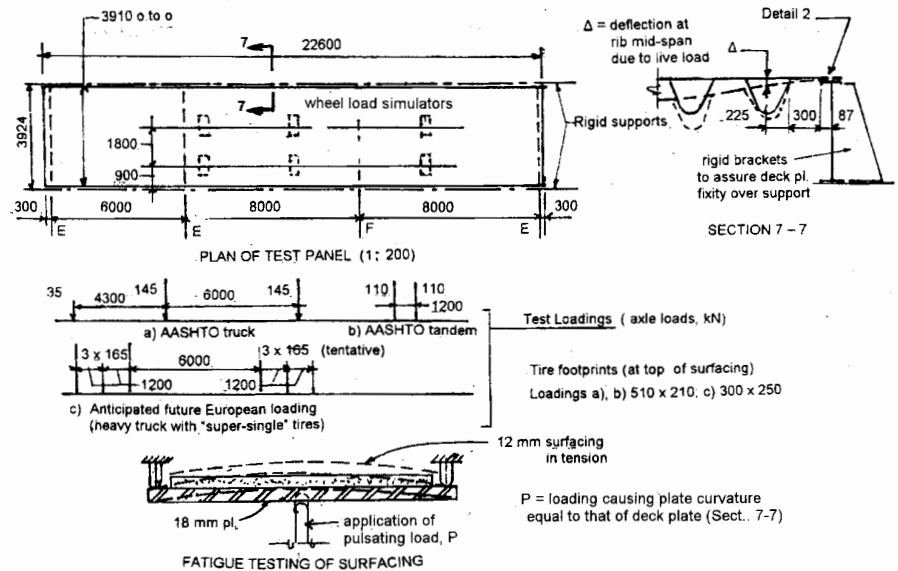


Figure 4. Proposed testing of panel prototypes.

tinuity, considerably decreasing the positive moments due to live loads.

- the possibility of eliminating two out of the existing five stringers, as shown in the cross section.

Installation of the new deck can be done expeditiously, one lane at a time, minimizing traffic restrictions. Eliminating two stringers provides the further advantage of reducing future painting and maintenance cost.

Testing Prefabricated Panels

The use of prefabricated panels without detailed numerical investigation by the designer will require certification of their strength and fatigue resistance by testing of prototypes. Such certified standard prefabricated panels could then be confidently specified by engineers and owners without the need for analytical drudgery and uncertainty.

Figure 4 shows the proposed testing panel. Its framing plan will make it possible to study the structural behavior of the 8-m (26-ft) interior spans and the 6-m (20-ft) spans of the ribs at the ends of a bridge. The tests should subject the panels to live loads representing current AASHTO specifications and possible future European heavy truck loading.

Several panels must be fabricated to complete the loading test series and to compare the effects of various fabrication factors, tolerances, welding procedures and panel treatment methods. This will be a large and costly testing program. We are fortunate to have in the U.S. the excellent Lehigh University/ATLLS testing facilities, well

experienced in full-scale testing of large orthotropic deck prototypes. This work could possibly be shared with laboratories in Europe or in Japan where the steel industry and transportation authorities may be interested in prefabrication of standard decks.

The testing program will also include testing of wearing surfacing for fatigue resistance in flexural tension. Such tests are made on small specimens of the deck plate with applied surfacing as shown schematically in Section 7-7 of Figure 4. Practical methods for such testing at various temperatures have been worked out by the University of Missouri, where tests of this kind were successfully carried out for the Poplar Street Bridge and other projects. Manufacturers of the thin surfacing proposed for the panels may be willing to co-sponsor such testing.

We expect that such pre-fabricated standard panels, produced in large quantities by industrial methods, will be substantially less costly than the decks designed and fabricated for a specific project. Current practice requires:

- considerable engineering design effort
- excessive time needed for preparation, review and approval of the shop drawings
- engineering inspection.

Avoiding these time-consuming procedures will not only reduce the cost, but will also considerably shorten the construction period.

Roman Wolchuk is a principal with Roman Wolchuk consulting Engineers, Jersey City, N.J.