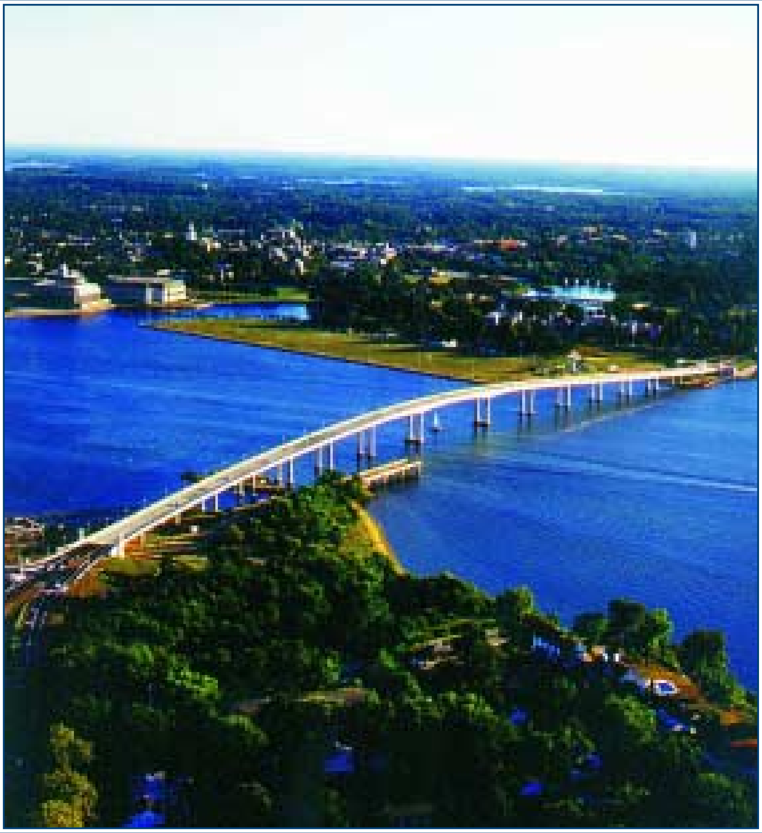
1996 Prize Bridge Award: Medium Span
U.S. Naval Academy Bridge



Judges Comments:

"The right bridge for this site"

"An excellent example of form following function"

"A modern design with unique features that complement an historic area"

BUILT AS THE GATEWAY TO MARYLAND'S HISTORIC CAPITAL, the design of the new U.S. Naval Academy Bridge was the wonderful result of an international design competition. The $34 million project replaces a low-level structurally deficient movable bridge with a visually significant high-level fixed bridge to carry Maryland 450 over the Severn River in Annapolis.

The bridge is aligned on large radius curves with spiral transitions. From the west abutment on the Annapolis side, the roadway first curves right and then reverses to a long central curve that connects with the eastern approach. Its superstructure consists of two trapezoidal steel composite box girders supporting a concrete slab carrying the roadway and sidewalks. The girder profile haunches over the main piers and smooths out into parallel flange boxes. The two girders are each directly supported on column lines with a transverse steel box cross member recessed between the main girders. Individually, slightly tapered columns with octagonal cross sections support the girders. The columns rest on granite-covered bases just above water level.

Details of the bridge include unique railings and parapets with brick facing, distinctive roadway lighting and dramatic flared entrances on either side of the bridge. The underside of the structure is clean and uncluttered.

The design of the structure achieves both visual and technical elegance, using proven techniques that are extended beyond their usual range of application. The wide spacing of the girders and long concrete deck spans represent a dramatic departure from ordinary practice. The concrete deck freely spans 20' between girders and cantilevers 9.5' beyond the 8'-wide trapezoidal boxes. Steel composite boxes are usually arranged with clear slab spans approximately equal to the width of the boxes and with much more modest deck overhangs. The adopted two girder layout achieves improved appearance and economy of steel girder material, fabrication and erection. The layout also provides ease of future deck replacement while maintaining two lanes of traffic and allowed portions of the new bridge deck that conflicted with the old structure to be built in stages so vehicular and pedestrian traffic could be continuously maintained.

Another example of the structure's technical originality is the absence of intermediate expansion joints in a curved bridge that is more than one-half mile in length. Bridge expansion and shortening as temperature rises and falls is accommodated by large-movement modular joints at each abutment. The new bridge is among the longest continuous girder structures in the U.S. and is especially significant since it also is curved in plan. The superstructure is fixed at both main channel piers and glides over laterally restrained bearings for the balance of its supports.

Besides giving a smooth and quiet ride, the continuous arrangement offers several advantages. The approach spans and piers are all functionally identical and are continuous with the main span, so the structural and visual continuity remains unbroken. The deck provides a protective canopy for the full bridge length and covers all steelwork and piers. Expected maintenance is minimized since the number of expansion joints has been reduced to the absolute minimum.

The long curved length of this bridge contributes to increased movement demands for the bridge's bearings. The design includes a special arrangement of internal stiffening for the box girders, permitting vertical reactions to remain aligned with the supporting column as the superstructure shifts over a movement of up to 18".

The profile of the new bridge allows 75' of vertical clearance over the 140' navigation channel and provides for generous clearance over the rest of the river. This increased vertical clearance and the open spacing of all columns effectively unlocks the upper regions of the Severn River to recreational boating. The bridge's wide shoulders and generous sidewalks offer a safe invitation to bicyclists and pedestrians to enjoy the views of the river, city and the Naval Academy—all from a unique perspective. And the elimination of the draw span provides an economic (and quality of life) improvement by eliminating the periodic and potentially costly traffic delays once caused by bridge openings.

The bridge's curved alignment was necessary to maintain traffic during construction and to avoid conflicting with an electrical substation located on the western bank. Allowing pedestrians and drivers to view the structure from the approaches, the continuous, large radius curves enhance the visual flow and interesting geometry of the bridge. Spiral transitions, necessary for future construction of a light rail transit line, further smooth the graceful sweep of the structure.

The approach span lengths vary with the structure's height so that the span-to-height ratio is kept reasonably uniform. Construction of the unusually long continuous girder had to be carefully considered during design. The 60' to 90'-long box girder field sections were designed to be erected by beginning with the three spans in the center of the bridge. A special procedure using temporary loads, cranes and jacking was employed to close the last connections in

Project Team

Designer:
Greiner, Inc.
Timonium, MD

Consultant:
Leonhardt, Andra and Ptnrs.
Stuttgart, Germany

G.C. & Erector:
Cianbro Corporation*

Fabricator:
Trinity Industries Inc.
Montgomery, AL

Owner:
Maryland State Highway Department

Please note that red text denotes an AISC member

Project Data

Steel wt./sq. ft. of deck:
45 lbs.

Cost:
$34 million

Steel Tonnage:
3,500

the long center span after its girders were cantilevered from the previously erected flanking spans. The bridge has 17 spans, with a maximum length of 315'.

Once the main span was closed, the girders of the remaining approaches were erected, progressing from the center of the structure toward the abutments. Deck construction also was specified to commence in the center of the bridge and progress towards both abutments.

At the west end of the bridge, the two land piers and three spans they support, were constructed in stages to maintain traffic. Temporary towers at the piers and abutment provided torsional support for one box as its share of the deck was built and opened to two lanes of traffic. After removing conflicting portions of the old bridge, the pier foundations were widened, the missing columns constructed, and the second half of the superstructure completed. This staged construction also demonstrated the techniques proposed for future reconstruction of the concrete deck, if necessary.