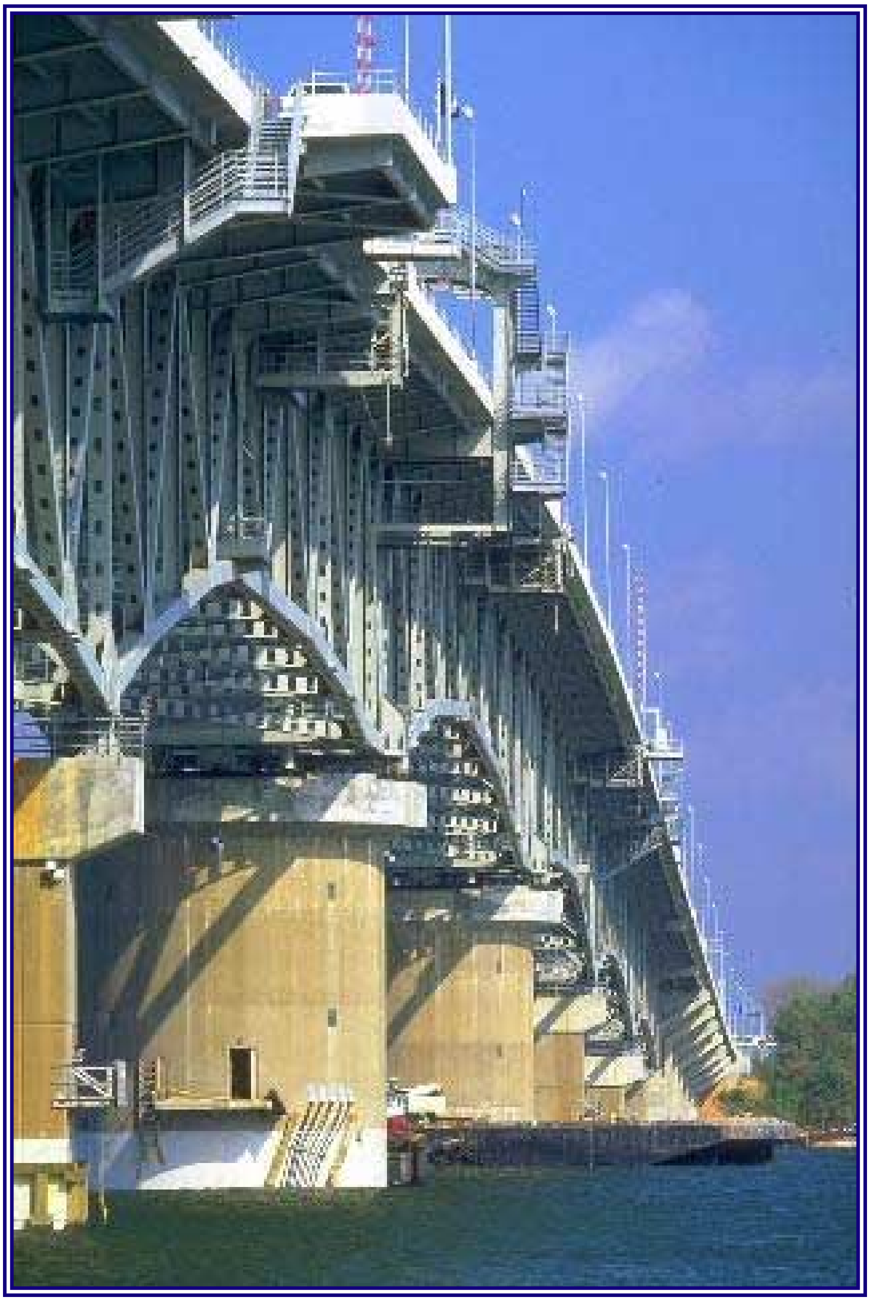
Prize Bridge Award: Movable Span

COLEMAN BRIDGE



The Coleman Bridge in Yorktown, VA had to be redone if it was to meet the current and future needs of travelers in the area. The two-lane, 26'-wide bridge was replaced with a completely new 77' wide, four-lane structure – making it one of the largest double-swing span bridges in the world. The bridge, which has four 12' traffic lanes and two 10' breakdown lanes, is supported by the existing river caissons.

Using numerous innovative technologies and materials, engineers more than doubled the width of the bridge with minimal disruption to the site and to area traffic. The truss spans were constructed off-site and floated in during a dramatic operation that required closing the bridge to traffic for only nine days.

DESIGN INNOVATIONS

The bridge designers used lightweight concrete deck, grade 70 high strength steel, and load factor design to minimize the weight of the bridge trusses to an economical 76 pounds per square foot. The float-in construction of very large bridge truss sections - complete with their concrete deck and lighting - was a spectacular example of innovative design and construction techniques. An in-situ investigation of subsurface conditions, 150' below the water surface (believed to be the deepest testing of that kind ever performed) established the viability of reusing the existing caissons. In addition, the engineers developed a method to install and monitor the deep pile approach foundations without disturbing the existing timber pile supported footings or bridge traffic.

To evaluate possible ship-bridge collisions, engineers used a sophisticated non-linear, three-dimensional soil structure interaction analysis. This innovative analysis saved millions of dollars in pier protection costs. Computer-based controls linked by fiber optics and state-of-the-art hydraulic operating machinery keep the 500'-long swing spans operating smoothly. A state-of-the-art electronic toll collection system, housed in a facility that reflects the region's historic architecture, significantly reduced toll collection costs and has been well received by area commuters. The new toll collection system is believed to have the highest participation level of any toll facility in the country.

Economic Considerations

The combination of lightweight concrete deck, grade 70 high strength steel, and load factor design produced a superstructure that was both economical and lightweight, contributing to the re-use of the existing cais-

sons. The reuse of the caissons significantly reduced construction costs and impacts on the environment, saving the owner an estimated $134 million for an entirely new bridge. Moreover, it is doubtful that an entirely new structure could have been built while satisfying the site's numerous environmental constraints. Demonstrating the adequacy of the existing caissons to resist ship impact loads saved the client money that might have been spent in efforts to strengthen the existing piers or to provide an energy-absorbing fender system. The large element float-in construction resulted in a minimal shut down period that eliminated the need for a temporary bridge, saving an estimated $15 million in construction costs.

Aesthetic Considerations

Designed by the same firm that designed the original bridge in 1952, the double-swing span bridge permits the passage of ships while maintaining a low profile in deference to neighboring Colonial National Historical Park - the site of the last major battle of the Revolutionary War. The new bridge was designed to have almost the same visual impact as the original structure although it is almost twice as wide. Construction of the replacement bridge also preserved Revolutionary War shipwrecks on the river bottom. Architectural detailing for the new toll facility building incorporates brick that simulate handmade bricks consistent with the area's colonial architecture.

Design Problems and Solutions

In order to accomplish the removal of the old bridge and installation of the new bridge - and make it all work in the stipulated traffic closure time - the new bridge had to be fully outfitted with deck, roadway lighting, operating machinery, and bridge control systems. The construction contract stipulated that traffic could not be interrupted for more than 12 consecutive calendar days on two separate occasions (a maximum of 24 days).

In May of 1996, the bridge closed for only nine days to accommodate the replacement of the swing spans. Six new bridge sections that had been erected on temporary piers at a remote location were floated 40 miles from Norfolk on barges. The sections arrived ready to carry traffic - a float-in first - with everything from the roadway to the lightpoles in place.

"Floating in bridges is nothing new, but usually it's just the steel superstructure," says Jim Cleveland, VDOT's district administrator. "Sometimes it takes several months until the bridge can carry traffic. The Coleman Bridge re-opened to traffic in just nine days." From the development of a float-in scheme that allowed the bridge to be replaced with minimal impact on the public and considerable savings in consruction cost to the use of state-of-the-art materials and machinery the replacement of the Coleman Bridge has advanced the state-of-the-art of bridge design and construction.

Coleman Bridge

Owner:
Virginia Department of Transportation

Designer:
Parsons Brinkerhoff Quade & Douglas, New York City (NSBA Affiliate Member)

General Contractor:
Tidewater Construction Corporation,
Virginia Beach, VA

Detailer:
Stupp Bros. Bridge & Iron Co., St. Louis, MO (NSBA Member)

Tensor Engineering Co., Indian Harbour Beach, FL (NSBA Affiliate Member)

Fabricator:
Stupp Bros. Bridge & Iron Co., St. Louis, MO (NSBA Member)

Vincennes Steel Corporation, Vincennes, IN (NSBA Member)

Erector:
Peterson Beckner Industries, Houston (AISC Associate Member)