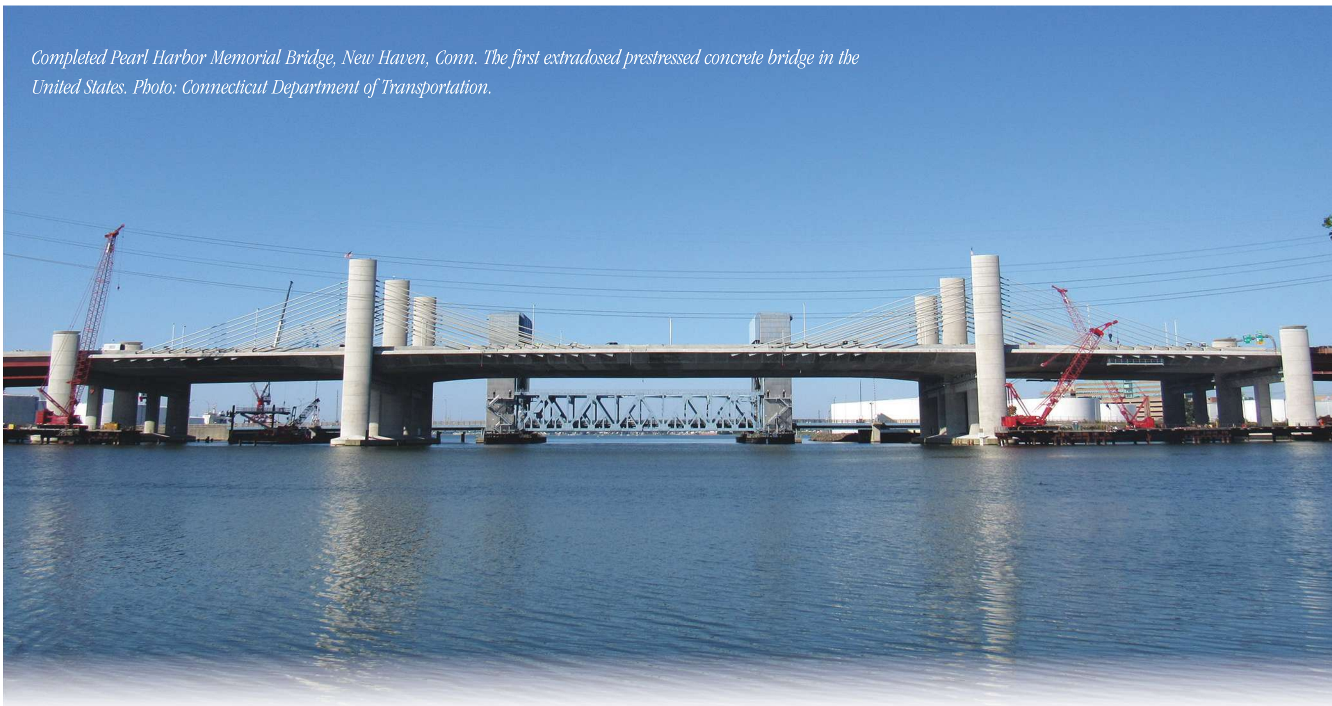
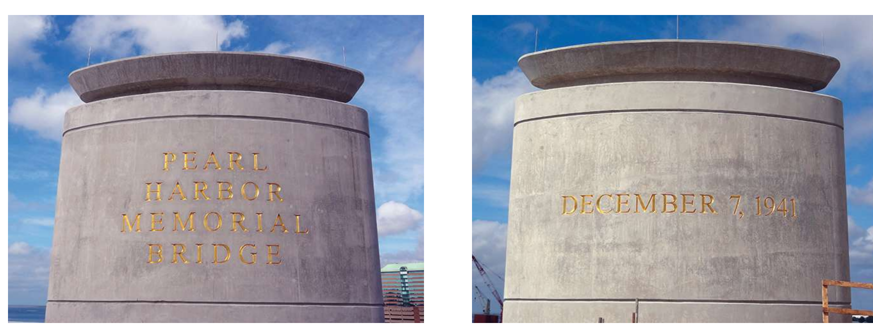
Pearl Harbor Memorial Bridge

by Dr. Steven L. Stroh, AECOM



Completed Pearl Harbor Memorial Bridge, New Haven, Conn. The first extradosed prestressed concrete bridge in the United States. Photo: Connecticut Department of Transportation.

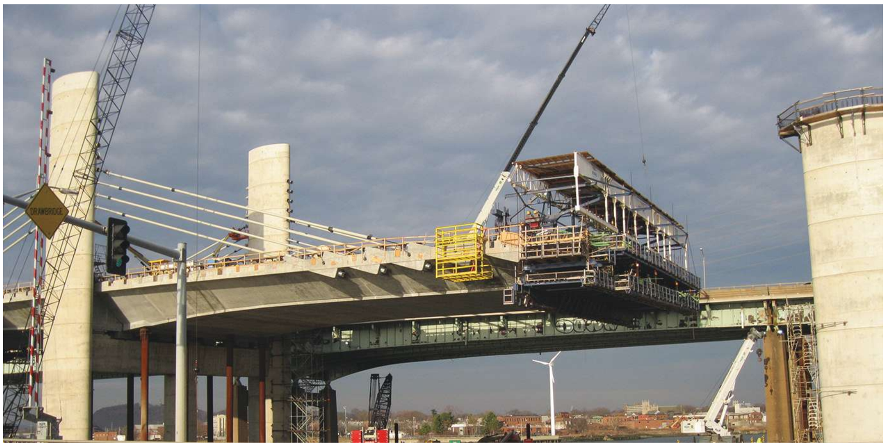
On October 19, 2015, the Connecticut Department of Transportation (ConnDOT) held a bridge party and ribbon cutting for the southbound Pearl Harbor Memorial Bridge (PHMB), the second half of the new I-95 crossing of the Quinnipiac River in New Haven, Conn. The bridge was named by the Connecticut legislature as a memorial structure to honor the more than 2500 Americans, including 17 Connecticut residents, who died in the Japanese attack on Pearl Harbor on Dec. 7, 1941. The event was attended by more than 6000 people, including Connecticut Governor Dannel P. Malloy, U.S. Senator Richard Blumenthal, U.S. Representative Rosa DeLauro, Commissioner of Veteran Affairs Sean M. Connolly, and in the front row of the viewing area, two survivors of the attack on Pearl Harbor.



Bridge entry portal columns. Photos: Connecticut Department of Transportation.

The choice of an extradosed prestressed bridge type for the PHMB was a creative concrete solution to challenging site conditions, and represented the first application of this new bridge type in the United States. The 515-ft-long main span was desirable for navigation clearance, but structural depth was limited by profile constraints required to meet the grades tying into the adjacent interchange, and precluded a conventional girder type bridge. A nearby airport constrained tower height that would have been necessary for a conventional cable-stayed bridge solution. The extradosed prestressed design allowed the desirable span, while staying within structural depth constraints and keeping the towers below the aviation clearance surface. The all-concrete design also provided a highly durable bridge solution to meet the 100-year service life design requirement.

The extradosed bridge type also met the fundamental project goal to provide a signature span worthy of the memorial character of the crossing. The towers are strong, simple, oval cylinder shapes, similar to what one might see on a ship. The outer webs of the girders are sloped to visually minimize the depth of the structure and provide a good balance between the visual mass of the girders and towers, and the superstructure is variable depth, which makes clear the girder's strong role in supporting the span. Representative DeLauro called the bridge "a work of art" and said she hoped all those who helped build



Cantilever construction on the northbound bridge. Photo: AECOM.

Grand opening party. Photo: AECOM.

it had carved their names in the concrete somewhere to be remembered.

An interesting design consequence of the phased construction of the twin structures and the stiff extradosed superstructure was the design of the connection between the superstructure and the towers. Initially, an integral connection was investigated. But considering the combined effects of creep and shrinkage, foundation stiffness (including a bracketing of stiffness), and the "leaking" of secondary post-tensioning effects between the second superstructure and the first superstructure, an efficient design could not be found. When the effect of the range of design values was evaluated, there were instances for which tension limits were exceeded on one side of the member with the low end of bracketed parameters, and then, assuming the high side of the bracketed values, tensile limits were exceeded on the other side of the member. Compression was also at the limits. Increasing member size made restraint forces worse. The solution was to build more flexibility into the system by adding bearings. For a single bridge, a solution would have been possible with an integral connection, but with the twin decks sharing a central tower, this design issue was critical and forced a solution using bearings.

The bridge was completed 8 months ahead of schedule and on budget, providing a practical solution to a real-world transportation need. The project also highlights concrete as a creative solution in providing a landmark bridge to be enjoyed by the public.

Dr. Steven L. Stroh is a vice president and complex bridges practice leader for AECOM in Tampa, Fla.

EDITOR'S NOTE

For more information on this bridge see the Fall 2012 issue of ASPIRE.™ *For more information on extradosed prestressed bridges see Summer 2015 issue of* ASPIRE. *For a discussion of the installation of the cable stays for this bridge, see the Winter 2016 issue of* ASPIRE.