



Transportation

Highways & Bridges

Client

Caltrans Office of Structures

Location

Northern California, USA

"... thorough analysis of project schedules and cost estimates has been essential to the successful planning, financing, and delivery of this project.... capable direction has resulted in expedient delivery of a quality project that has met and exceeded Caltrans standards and expectations."

Harry Y. Yahata, District 4 Director
California Department of
Transportation

Benicia-Martinez Bridge Design

Project Highlights

- Construction of a new five-lane bridge across the Carquinez Straits carrying northbound traffic on I-680
- Design of an 8,400-foot, pre-stressed concrete, segmental box girder bridge, classified as a "lifeline" structure during emergencies
- Re-striping of an existing bridge to accommodate four lanes of southbound traffic

Project Description

The new Benicia-Martinez Bridge, designed by a joint venture including CH2M HILL, opened to traffic in August 2007. The new high-level, long-span toll bridge now provides traffic congestion relief to the 100,000 daily vehicles that cross I-680 between Contra Costa and Solano counties in northern California.

CH2M HILL provided complete design services, including:

- Structural and geotechnical engineering
- Agency coordination
- Program cost reporting and schedule control
- Project planning
- Plans, specifications, and estimates preparation and oversight
- Seismic design (includes functional and safety earthquake events)
- Services during construction

The new 1.6-mile-long bridge carries traffic headed north on I-680 while the existing bridge carries southbound vehicles in three lanes. Over the next 2 years, the older bridge will be converted to handle four lanes of traffic with a separated bike and pedestrian lane. A new, 17-booth toll plaza was also constructed south of the existing bridge.

The new bridge is classified as a "lifeline" structure, meaning it will remain open to emergency traffic following a major seismic event. Among the more challenging design tasks were the 11, 1,700-ton pier footings that support the bridge, each of which rests on piles drilled as deep as 254 feet to bedrock.

Specific design features included:

- Lightweight concrete in the superstructure to reduce the structure's mass
- Normal-weight concrete in pile caps, pier shafts, and the pier table to provide greater seismic resistance
- Single-cell box girder with transverse stiffening ribs
- Mid-span hinge with a stiffening steel girder placed inside the concrete box girder at the expansion joint

- Pier consisting of four circular, tied, reinforced columns connected by reinforced concrete walls to form a hybrid cellular element
- Foundations consisting of multiple, 8-foot-diameter steel caissons driven into rock with a 7-foot-diameter socket drilled into rock; caissons were filled with tremmie concrete to form a cast-in-drilled-hole pile to resist axial loads and bending moments

The bridge also features the Bay Area's first open-road tolling, toll-booth-free, lanes for FasTrak users, which will alleviate traffic congestion problems, especially during the area's evening commute times. The high-speed, open-road FasTrak lanes of the bridge allow drivers with FasTrak accounts to pay their tolls without stopping.

Additional features of the bridge's design and construction included:

Reduced noise impact-Noise levels from contractor operations, between the hours of 9:00 p.m. and 7:00 a.m., did not exceed 86 dBA at a distance of 50 feet.

Sedimentation control-All work conformed to the San Francisco Regional Water Quality Control Board permit as well as the Caltrans *Stormwater Quality Handbook* and *Construction Contractor's Guide and Specifications*.

Minimized habitat disturbance-Work was limited in water less than 10 feet deep and dredging restricted to between December 1, 2001 to March 31, 2002 for the initial part of the contract, and from July 1, through October 31, 2002 to minimize impacts to the endangered delta smelt, harvest mouse, and several salmon species.

Met schedule-The project was completed on schedule despite relocating the bridge alignment after the design phase was 25 percent complete. This alignment change was due to the United States Coast Guard rescinding the original Caltrans permit.

Effective communication with stakeholders-The team exceeded client expectations and resolved construction issues up front during the design phase, before field work began.

Design innovations-The team worked closely with the Caltrans Bridge Aesthetics group to develop column design. Design innovations included a long-span, lightweight concrete superstructure requiring close coordination between the design team and contractor.

Because I-680 is classified as a lifeline route, Caltrans designated the new Benicia-Martinez Bridge as a candidate for seismic design considerations. CH2M HILL designed the structure to withstand a functional evaluation earthquake with minimal damage and an immediate service level. For a safety evaluation earthquake, the structure was designed for an immediate service level with repairable damage.

Completion of this complex project is also an important step in the continual development of the San Francisco Area East Bay transportation network.