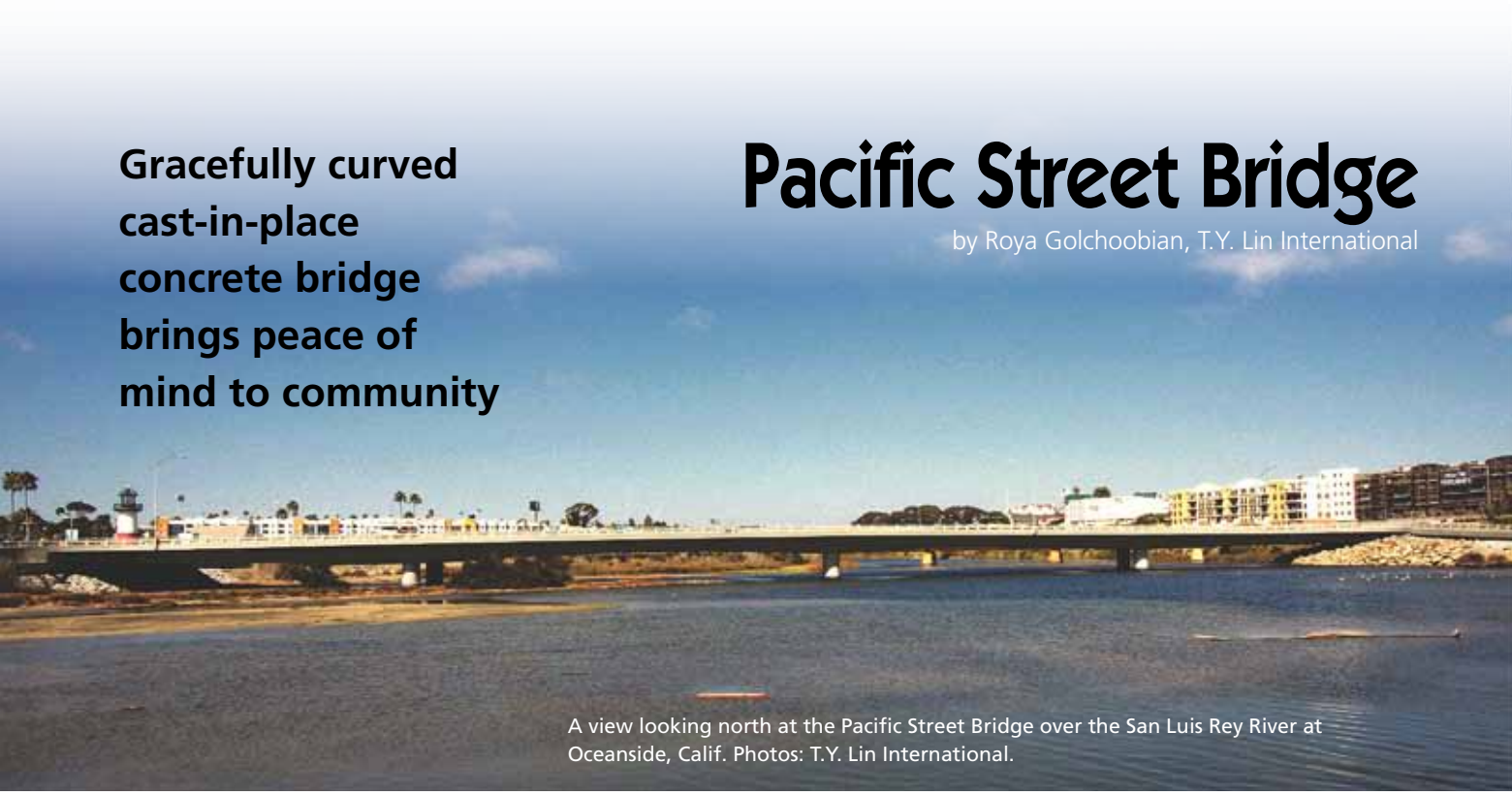
Pacific Street Bridge

Gracefully curved cast-in-place concrete bridge brings peace of mind to community

by Roya Golchoobian, T.Y. Lin International



A view looking north at the Pacific Street Bridge over the San Luis Rey River at Oceanside, Calif. Photos: T.Y. Lin International.

The graceful horizontal and vertical curves of the bridge gave new meaning to the beauty created by a concrete structure.

The Pacific Street Bridge spans over the San Luis Rey River at the mouth of the lagoon where the river meets the Pacific Ocean at Oceanside, Calif. The river is one of the major river systems in the County of San Diego, but was blocked off from the ocean by a low-flow crossing connecting the residential communities on the south side to the businesses on the north side of the river.

Contribution to the Community

The Oceanside Harbor is home to the businesses catering primarily to recreation, such as restaurants, shops, charter fishing, and beach rentals. The original low-flow crossing was the only direct north-south connection over the river in the heart of Oceanside. It was subject to flooding and recurring washout during every major storm, crippling the residents and businesses in the area. The Pacific Street Bridge replaced the unstable, temporary nature of the crossing and was designed to withstand the 100-year storm, bringing peace of mind to the residents and businesses in the area.

Design Challenges Addressed

The Pacific Street Bridge is a four-span, post-tensioned, cast-in-place concrete structure with a unique S-curve alignment spanning 635 ft over the San Luis Rey River. Consideration had to be given to impacts of the bridge construction method on environmentally sensitive habitats in the area, quality of air, the river's wildlife, and hydrology of the river. All had to be considered and incorporated into the bridge type selection and design.

The span lengths are 136, 181, 181, and 136 ft and the bridge is 53 ft 6 in. wide. The girder has a curved soffit with overall depth varying from 6 ft 3 in. at midspan to 8 ft 6 in. at the piers. The variable depth was selected to reduce the number of supports in the river and to create the illusion of an arched gateway to the ocean. The graceful horizontal and vertical curves of the bridge gave new meaning to the beauty created by a concrete structure.

The post-tensioning comprised three tendons in each web for a total of 12.

profile

PACIFIC STREET BRIDGE OVER SAN LUIS REY RIVER / OCEANSIDE, CALIFORNIA

BRIDGE DESIGN ENGINEER: T.Y. Lin International, San Diego, Calif.

CIVIL ENGINEER: Willdan Engineering, San Diego, Calif.

CONTRUCTION MANAGER: Harris & Associates, San Diego, Calif.

PRIME CONTRACTOR: Flatiron, San Marcos, Calif.

CONCRETE SUPPLIER: Palomar Transit Mix, San Diego, Calif.

AWARDS: *2009 Honor Award, San Diego/Imperial Chapter, American Public Works Association; 2009 Outstanding Project, San Diego Section, American Society of Civil Engineers; The Best of 2008, Award of Merit, California Construction Magazine*

Formwork for the inclined webs and east bulkhead is shown along with the placement of the reinforcement in the soffit and the locations of the post-tensioning tendons.

Each tendon contained thirty-seven, 0.6-in.-diameter strands. Concrete with a compressive strength of 4000 psi was used in the superstructure, columns, and piles. Other concrete used in the project had a compressive strength of 3600 psi.

The soffit of the box girder is 9.8 in. thick. The deck is also 9.8 in. thick and tapers to 7.9 in. at the edges of the cantilevers. Both vertical and inclined webs are typically 11.8 in. thick but vary up to 18 in. thick.

To reduce the impacts to the riverbed, bridge columns were supported on 7-ft-diameter, cast-in-drilled-hole single piles that penetrated 150 ft into the river bed. The use of drilled shafts instead of the conventional driven piles substantially reduced the level of construction generated noise, benefitting both residents and endangered species in the area.

Project Challenges

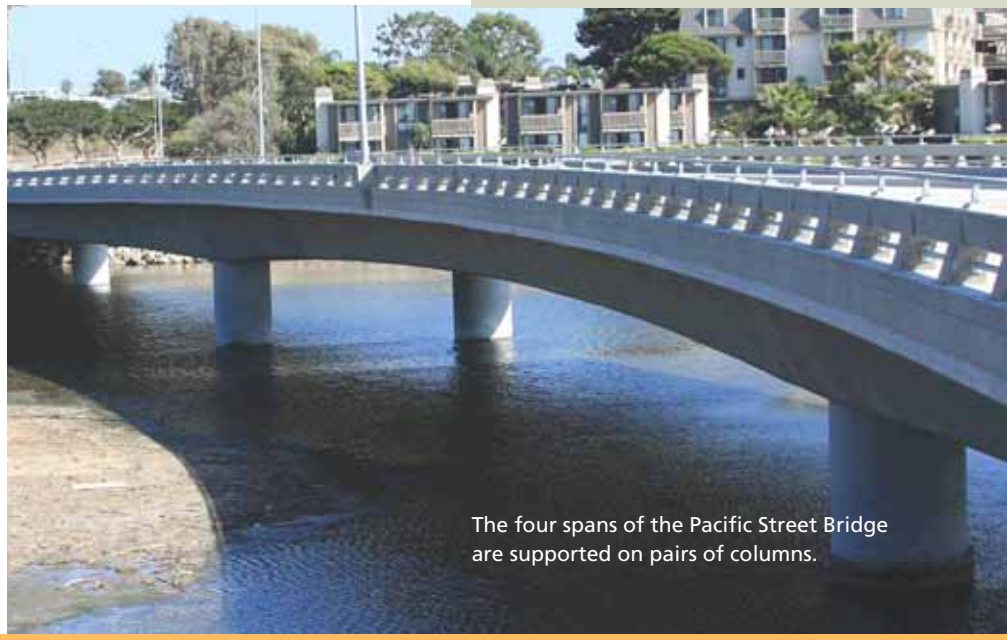
The bridge is located in the seismically active area of Southern California and near faults capable of generating earthquakes of 7.5 magnitude. The loose sandy soil in the river bed introduced additional challenges in design of the structure for withstanding seismically induced down drag forces of high intensity. Soil liquefaction and caving were other challenges of the design and construction at this site.

To withstand the 100-year storm, the bridge was constructed above the elevation of roadways on the south and north sides of the river. The profile of the roadways at both ends of the bridge was raised to meet the bridge elevations at the connection points. To meet the federal funding limitation placed on the approach roadway work for a bridge project, the profile modifications to the adjoining roadways had to be optimized to minimize the modification lengths and to touch down at the existing ground elevations before entering nearby intersections.

Environmental Impact

The river corridor is home to several state and federally listed threatened and endangered species of fish and wildlife. The blockage of the stream and tidal flow caused by the low-flow crossing had impacted the estuarine system. It resulted in deterioration of the typical function of a brackish water ecosystem and the reduction in diversity of species.

Removal of the crossing after construction of the Pacific Street Bridge and opening of the river to the ocean has increased the potential for migration, spawning, and establishment of important species of fish and wildlife in the river, including the once abundant and now absent steelhead trout and tidewater goby. Removal of the low-flow crossing also eliminated the recurring washout and depositing of roadway debris and asphalt into the ocean and lagoon.



The four spans of the Pacific Street Bridge are supported on pairs of columns.

CAST-IN-PLACE POST-TENSIONED CONCRETE BOX GIRDER / CITY OF OCEANSIDE, OWNER

POST-TENSIONING CONTRACTOR: Dywidag Systems International, Lakewood, Calif.

REINFORCEMENT FABRICATOR: CMC Fontana Steel, Lakeside, Calif.

BEARING SUPPLIER: D.S. Brown, North Baltimore, Ohio

EXPANSION JOINT SUPPLIER: Stinger Welding Inc., Coolidge, Ariz.

BRIDGE DESCRIPTION: Four span, 635-ft-long, variable depth cast-in-place, post-tensioned concrete box girder bridge

STRUCTURAL COMPONENTS: Four spans up to 181 ft long varying from 6 ft 3 in. to 8 ft 6 in. deep supported on pairs of columns with a single cast-in-drilled-hole, 7-ft-diameter concrete pile under each column

BRIDGE CONSTRUCTION COST: $18,000,000

of a landscape architect for creating the images and architectural treatments that were used on the retaining walls.

Open barrier railings were used at the edges of the bridge deck to maximize the driver's view while travelling on the bridge.

Roya Golchoobian is senior bridge engineer and project manager with T.Y. Lin International, San Diego, Calif.

AESTHETICS COMMENTARY

by Frederick Gottemoeller

At first glance a project like the Pacific Street Bridge looks deceptively easy. After all, the spans are short, the bridge is low to the water, and it's not that big a body of water in the first place. Who is really going to care what the bridge looks like? Luckily, this designer cared, and realized that all of the residents in the condos around the bridge would care, too.

Using cast-in-place post-tensioned concrete allowed the superstructure to be relatively thin, and also allowed the wide overhangs that make it appear even thinner. The pier caps are invisible, hidden within the superstructure. Only two columns are required at each pier line. Most of the space between the water and the roadway is left open, and the natural reflectivity of the superstructure allows light to carry through the structure. Rather than creating a dark slit just above the water, visually cutting the lake in two, the bridge reveals the water surface beyond the bridge, keeping the lagoon visually intact. Finally, the superstructure seamlessly follows the geometry of the roadway, with no special brackets or offsets. The bridge seems to float effortlessly from shore to shore.

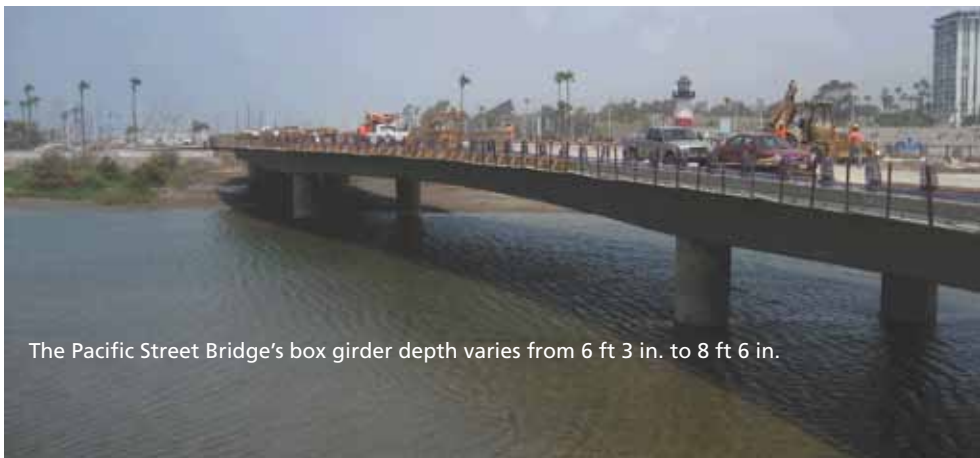
If the "bones" of a structure are as successful as this one, very little additional detail or ornamentation is needed. Knowing this, the designer has left the piers as simple cylinders, and made the railing transparent without adding complication. All in all, it's a very nice bridge to come home to.

For more information on this or other projects, visit www.aspirebridge.org.

The Pacific Street Bridge in Oceanside, Calif., incorporates a unique S-curve and open barrier rail.

The bridge is located in the seismically active area of Southern California.

Construction of the open barrier that permits views of the San Luis Rey River.



The Pacific Street Bridge's box girder depth varies from 6 ft 3 in. to 8 ft 6 in.