ECONOMICAL BRIDGE WIDENING

by Craig A. Shutt

Two types of concrete girders were combined to create an economical design that complements surrounding structures

Designers faced several key challenges in planning the widening of State Route 22 over the Garden Grove Boulevard in Orange County, Calif. A key concern was complementing other bridges along the highway, which were constructed with cast-in-place concrete box girders, while remaining within a tight budget. The solution was found in using two types of precast concrete girders, which also helped overcome other obstacles.

The $500-million project was part of an extensive revamping of State Route 22, which serves as a key regional route through some of the most densely populated areas of the county. The bridges accommodate local vehicular and pedestrian cross-traffic within the communities bisected by the freeway. In all, 34 bridges and more than 100 retaining walls and soundwalls were included in the project, which

profile

GARDEN GROVE BOULEVARD WIDENING / ORANGE COUNTY, CALIF.

ENGINEER: URS Corporation, Roseville, Calif.

PRIME CONTRACTOR: GMR (a joint venture of Granite Construction, C.C. Myers, and Rados), Orange, Calif.

PRECASTER: Pomeroy Corp, Perris, Calif., a PCI-certified producer

AWARDS: *Best Rehabilitated Bridge in the Precast/Prestressed Concrete Institute's 2007 Design Awards competition*

The bridge was widened from three lanes to five in each direction.

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constructed, reconstructed, widened, or modified the infrastructure along 12 miles of highway. The overall project was undertaken on a design-build basis and bid as a lump sum contract.

Widened by One-Third

The existing bridge, built in 1960, was constructed of cast-in-place, reinforced concrete box beams, as were many of the bridges along the route. The construction widened the six-lane bridge by one-third to accommodate a total of 10 lanes of traffic. Each side along the bridge's 340-ft length was widened by 28.75 ft, creating a total width of 170 ft. The deck's total area expanded by 19,500 ft^2 to 57,800 ft^2. The bridge features two 61-ft-long end spans and two 108.75-ft-long main spans. The structure also includes a high skew angle of 59 degrees and a tangent-horizontal alignment, with a 1% grade.

The project involved several key challenges that required innovative thinking, says Syed Mohsin Kazmi, senior project manager for URS Corp. in Roseville, Calif., the bridge designer. These went beyond aesthetics to include both logistical and safety issues that required close teamwork among the design and construction partners. Specifically, the city and Orange County Transportation Authority officials wanted to ensure traffic was not disrupted throughout the project, build the project quickly, blend it with other cast-in-place bridges along the highway, and keep it within tight budgetary restraints.

To resolve these issues, the designers specified two types of precast concrete girders for each of the four spans on each side of the original bridge. The outside girder on each side is a 5-ft-deep rectangular, hollow, precast, prestressed concrete girder. The three interior girders on each side are 5-ft-deep precast, prestressed concrete bulb-tee girders. Approximately 250 precast concrete panels were used for the deck, with four precast domes used for decorative pilasters.

The girders were erected on cast-in-place bent caps, which sit on cast-in-place columns and footings. They, in turn, are supported by 366 precast, prestressed concrete, driven piles that were 14 in. square. "The soil in this area required the addition of piles to provide the necessary support for the additional loads of the columns for the widened bridge," Kazmi explains.

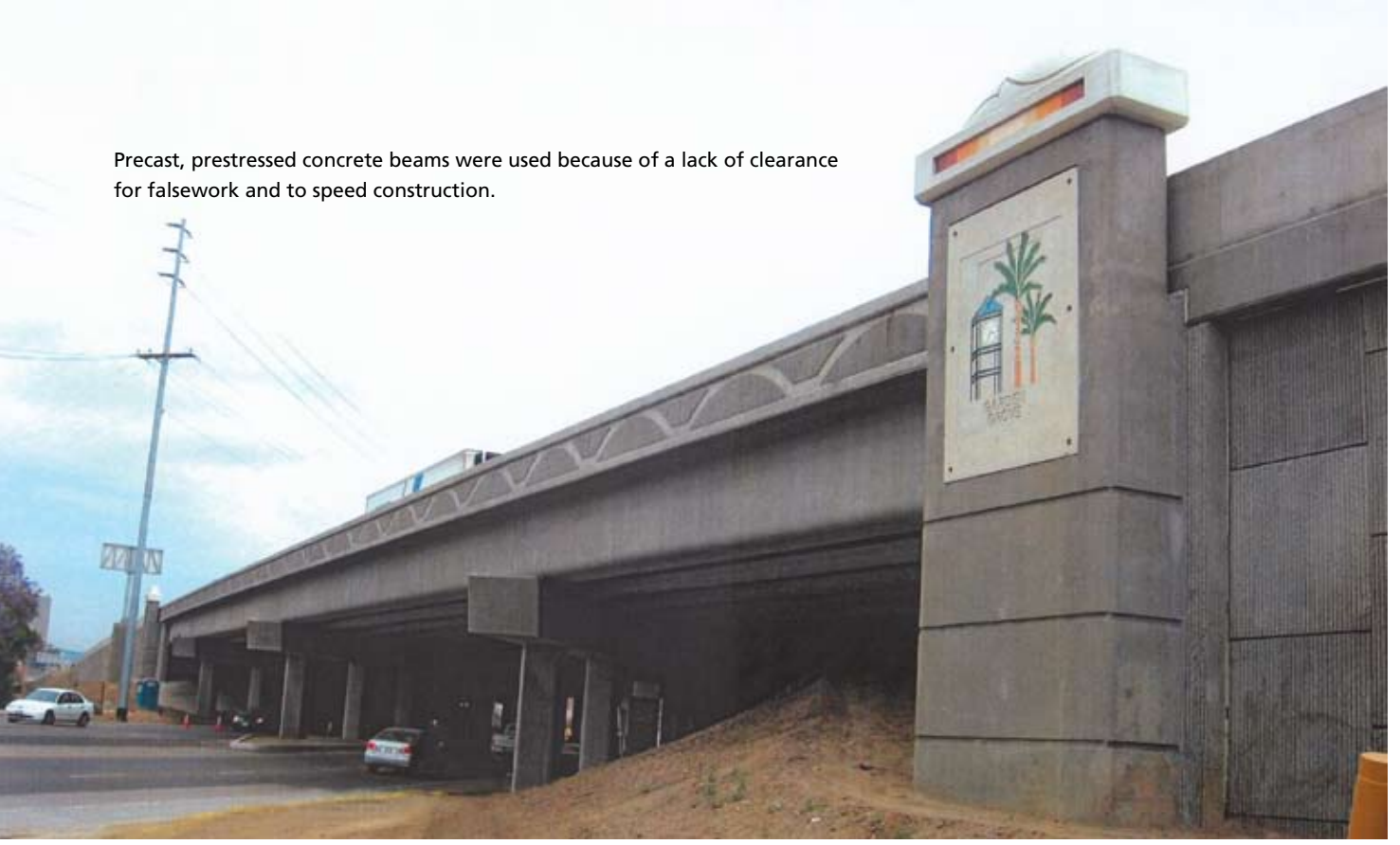
"It was a huge challenge to design and construct this project, because of the variety of concerns involved," he adds. "The selection process for these projects is very rigorous in any event, but we looked at many alternatives before we found the one that provided the best combination of benefits. The challenge was especially to come up with a structure type that could be constructed quickly and without significant impact to the existing traffic."

The exterior beam is a rectangular section to match other bridges, whereas, more economical bulb-tees are used for the interior beams.

PRECAST, PRESTRESSED CONCRETE GIRDERS AND DECK PANELS / CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS), OWNER

BRIDGE DESCRIPTION: Widening of a four-span cast-in-place concrete bridge with precast, prestressed concrete rectangular box beams, bulb-tee girders, and deck panels

STRUCTURAL COMPONENTS: Twenty-four, 5-ft-deep precast, prestressed concrete bulb-tee girders; eight, 5-ft-deep rectangular hollow precast, prestressed concrete girders; 250 precast, prestressed concrete deck panels, 366 14-in.-square precast, prestressed concrete driven piles; and four precast domes for decorative pilasters



Precast, prestressed concrete beams were used because of a lack of clearance for falsework and to speed construction.

Limited Vertical Clearance

One of the significant logistical concerns was the inadequate vertical clearance available for using falsework. Using cast-in-place box girders to replicate the look of the existing bridge and surrounding structures would have required falsework spanning three traffic lanes in each direction, he explains. "The available vertical clearance was not adequate to accommodate falsework deep enough to span three lanes of traffic. This was the key factor in choosing precast concrete."

The girders and deck panels also offered a shortened construction time, as they could be fabricated off-site and erected quickly upon arrival. "The precast girders significantly reduced the timeframe for impacting on-going traffic," he says. The project was designed in six months, with construction taking about 1 year. But the actual road closure to erect the precast girders amounted to only 2 days during this period.

Although cast-in-place girders could not be used due to falsework requirements, the concern was that the use of precast, prestressed concrete bulb-tee girders would not blend with the appearance of the rest of the bridge, or with other bridges in the area. "We usually see cast-in-place box girders being used in California, and the agencies involved in this project wanted to match their design," Kazmi explains.

To replicate that look, precast, prestressed concrete rectangular box girders were used as the exterior girder on each side of the bridge. The girders were deeper than they were wide and featured a rounded outside fascia corner to replicate the look of cast-in-place box girders. The design provided the box shape that all the bridges offered to drivers nearing the structures, he says. Inside girders, which are viewed only when cars are directly beneath them, are bulb-tee sections. "Motorists see the look of a concrete box-girder bridge as they approach, and the structure blends well with the adjacent structures." This combination of girders kept the cost of the project in line by using less expensive bulb-tee girders in the less visible area, he notes.

Aesthetics

The existing structure and several structures along the corridor are cast-in-place box girder bridges with vertical webs for the exterior girders. The use of more typical precast, prestressed concrete girders at this location would not have matched the aesthetic character of the bridges. The problem was addressed by the use of precast, prestressed concrete rectangular box girders with a rounded outside corner for the exterior girders. This gives the motorist the look of a concrete box girder bridge and the structure blends well with the adjacent structures.

Speed of Construction and Public Safety

Another challenge on this project was the need for a structure type that could be built quickly and would significantly reduce the duration of the inconvenience to the on-going traffic. This was largely achieved by the efficient use of precast, prestressed concrete girders as well as permanent precast concrete deck panels.

While preparation work was underway at the site, the girders were cast at the precaster's Perris, Calif., plant. Once they arrived at the site, all 32 girders were erected in 2 days, while the road under the bridge was closed and traffic rerouted. Traffic could flow under the bridge while the precast concrete deck panels were being installed. "Being able to keep traffic open while the deck panels were installed provided a considerable advantage."

The project achieved all the goals set for it, by combining several types of girders and maximizing the benefits offered by the precast concrete design. "There were a number of factors that created key challenges on this project," says Kazmi. "But solutions for all of them were made possible because of the use of precast concrete members."

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