RANCHO CUCAMONGA'S HAVEN AVENUE GRADE SEPARATION BRIDGE

by Miguel A. Carbuccia and Sam S. Xie, PBS&J, an Atkins company

A world-class design utilizing precast concrete turns an underpass bridge into a city attraction

The award-winning Haven Avenue Grade Separation Bridge has become a stunning new landmark in Rancho Cucamonga, Calif. Built with precast concrete, the colorful and innovative bridge has remedied multiple problems, including massive traffic congestion. By using architecturally enhanced prefabricated concrete elements, in the hands of a highly effective team, the project was completed ahead of schedule and under budget. This project puts to rest the notion that bridge underpasses have to be utilitarian to meet schedule and budgetary constraints.

Rancho Cucamonga lies at the base of the picturesque San Gabriel Mountains and is located roughly 39 miles east of Los Angeles. The city's population has grown by about 35% in the last decade due in large part to two east-west highways—I-10 and State Route 210—that traverse the city. These highways are connected perpendicularly by Haven Avenue, a six-lane divided arterial that leads to Rancho Cucamonga's city center.

Increasing traffic and demand for transportation services have also grown along with the city's population. The Metrolink commuter train and Burlington Northern Santa Fe (BNSF) tracks intersected Haven Avenue at grade near the freeway interchanges. In recent years, rail service has increased to roughly 40 trains per day, which resulted in long traffic delays for the nearly 20,000 daily motorists traveling north and south on Haven Avenue. Before the bridge was built, vehicular traffic idled roughly 64 minutes daily, while emitting about 2.5 tons of carbon dioxide into the atmosphere.

The solution was to separate vehicle and train traffic by lowering the Haven Avenue roadbed by 28 ft and building

The Haven Avenue Grade Separation Bridge stands as a dramatic addition to the City of Rancho Cucamonga, Calif. Photo: City of Rancho Cucamonga.

profile

HAVEN AVENUE GRADE SEPARATION BRIDGE / RANCHO CUCAMONGA, CALIFORNIA

BRIDGE DESIGN ENGINEER: PBS&J, an Atkins company, Orange, Calif.

ROADWAY DESIGN AND GENERAL ENGINEERING SERVICES: URS Corporation, Santa Ana, Calif.

PRIME CONTRACTOR: KEC Engineering, Covina, Calif.

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

PILASTER, BALUSTRADE, AND MEDALLION PRECASTER: QuickCrete, Norco, Calif.

CAST-IN-PLACE CONCRETE SUPPLIER: Chaparral Concrete Company, Glendora, Calif.

POST-TENSIONING CONTRACTOR: DYWIDAG-Systems International USA Inc., Long Beach, Calif.

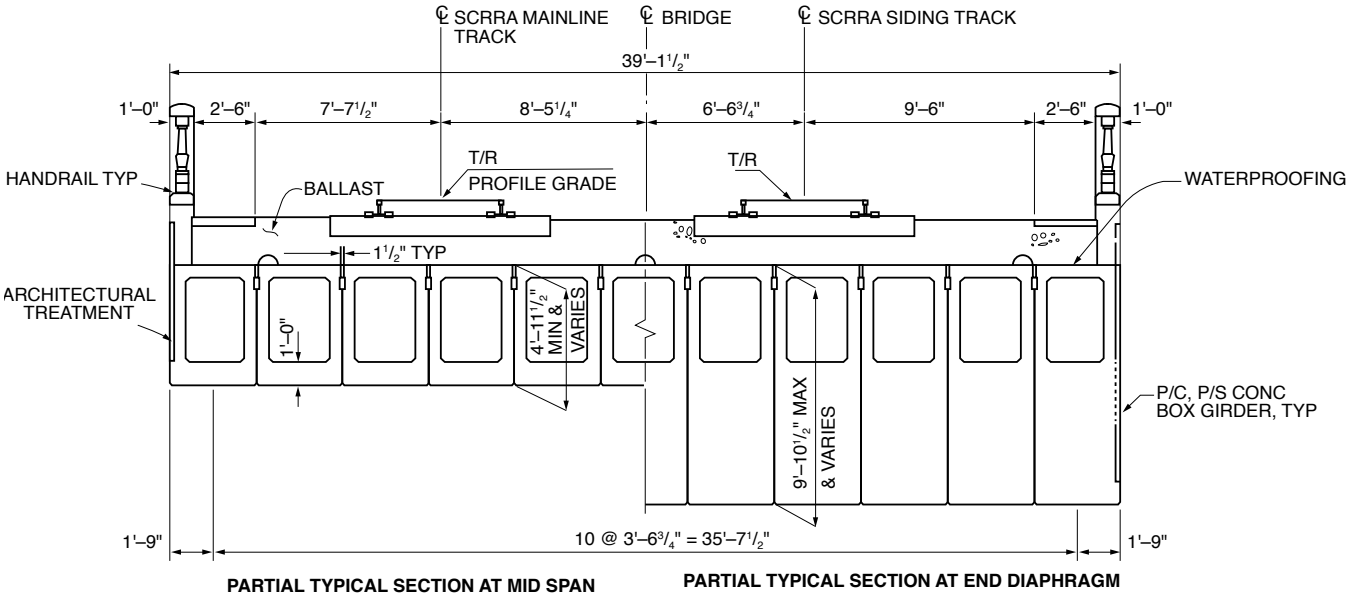
The tops of the piers, which supported the beams, were flared to match the arch shape. Seats on the noses of the piers will receive the precast concrete pilasters. Photo: PBS&J, an Atkins company.

an underpass bridge to support the two train tracks. Instead of a typical bridge underpass, the city and its residents wanted a monumental gateway to the town center.

The Haven Avenue underpass bridge was planned to be built less than a mile away from Rancho Cucamonga's new city hall along a corridor that is emerging as a retail and commercial hub. The aesthetic treatment of the bridge was extremely important, though the city had a relatively low budget of $28 million for the entire bridge and roadway separation project. Furthermore, in order to minimize traffic disruption, the bridge needed to be built quickly.

A Landmark Design with Precast Concrete

The innovative design for the Haven Avenue Bridge preserved the vertical railroad alignment, and won approval from the city, the Southern California Regional Rail Authority, and the California Public Utilities Commission. To speed bridge construction and reduce costs, the design called for use of precast colored concrete arched girders to span arched piers. Precast bridge pilasters were used because of the limited space between the bridge structure and shoring that was necessary to support the adjacent bypass railroad tracks (called shoofly tracks). The precast method also cut construction time by allowing the completion of concurrent construction of the bridge and road project.



Typical section of the Haven Avenue Grade Separation Bridge in one of the main spans. Drawing: PBS&J, an Atkins company.

FOUR-SPAN, 172-FT-LONG URBAN RAILROAD BRIDGE WITH ARCHED PRECAST, PRESTRESSED CONCRETE BOX BEAMS / CITY OF RANCHO CUCAMONGA, CALIFORNIA, OWNER

BRIDGE DESCRIPTION: A 172-ft-long bridge with four spans of 33.25, 53, 53, and 33.25 ft, 39 ft 1½ in. wide comprising 44 arched precast, post-tensioned concrete abutted box girders, which are simply supported on cast-in-place concrete bents and abutments. The bridge also used precast concrete pilasters at the piers and abutments and a precast concrete balustrade railing.

BRIDGE CONSTRUCTION COST: $4.7 million ($650/ft^2)

AWARDS: *2009-2010 ASCE Riverside/San Bernardino Chapter, Project of the Year; 2010 ASCE Los Angeles Chapter, "Outstanding Government Civil Engineering Project, Honorable Mention; 2010 PCI Bridge Design Award, Best Non-Highway Bridge; 2010 ACI, Outstanding Achievement in Excellence in Concrete Construction; 2011 ASCE, California Engineering Excellence Merit Award*

Fascia beams with vertical face projections are 2.45 ft deeper providing confinement for the roadbed ballast and a base for the balustrade railings. Photo: PBS&J, an Atkins company.

Placement of balustrade railings on beam face projections and architectural precast concrete pilasters on the edges of bents 2, 3, and 4. Photo: City of Rancho Cucamonga.

Prefabrication Supports Schedule

Girders, pilasters, and balustrade railings were prefabricated off site utilizing reusable forms to avoid the need for handling intricate forming details in the field. Prefabricating these units also accelerated construction, which further reduced costs.

Precast, Post-tensioned Concrete Arched Girders

The four-span, 172-ft-long bridge is 39 ft 1½ in. wide with 44 arched precast concrete box girders; 11 in each span. These are simply supported at the pier supports and the abutments and are placed edge to edge, allowing a ¾-in.-wide joint. The span lengths were 53 ft in the center spans over the roadway and 33 ft in the approach spans over the sidewalks. The design utilized large girder units with depths of 9.88 ft and 12.33 ft and weighing up to 70 tons. The girders were designed to be cast on their sides and post-tensioned after removal from the forms and being set upright. In order to achieve a uniform appearance, the girders were cast so the exposed face was down-in-form to achieve a more uniform distribution of aggregate along that face. The design compressive strength of the girder concrete was 6000 psi. Since the width of the units was approximately 3.5 ft, casting sideways had the further benefit of reducing formwork costs. The use of precast elements accelerated the construction schedule. All girders were erected in just 4 days.

Piers and Pilasters

Flared cast-in-place concrete piers consisting of arched concrete units supporting pilasters provide contrast and enhance the concrete arched girders. In section, each pier and abutment flares to match the arch of the supported girder. The piers are rounded at each end supporting a total of 10 decorative pilasters. The pilasters were precast and installed on supports on the piers. By doing so, the contractor was able to eliminate intricate forming at each pier and accelerate the construction schedule. The pilasters surrounding the main spans were 19 ft tall, 9 ft wide, and 4.5 ft deep.

Balustrade Railings and Medallions

More than 1100 individual precast concrete pieces were required for the railings. Four custom logo medallions were produced and attached at the crowns of the arches.

Utilities and Traffic Issues

Utilities were a problem and caused more than minor delays. Haven Avenue is a utility corridor that includes buried wet and dry utilities, in addition to overhead power and communication lines. During project construction, utility line relocation caused a 5-month delay in the construction schedule. Aggressive rescheduling was required to keep the bridge and roadway project on track.

Throughout construction of the bridge, rail traffic continued on schedule without disruption. Two lanes of vehicle traffic in each direction remained open on Haven Avenue during peak travel times, using a temporary bypass parallel and adjacent to the west side of Haven Avenue. The avenue was closed to traffic on only two limited occasions when an alternate traffic detour was constructed and later removed.

Low Price, Inestimable Value

The Haven Avenue underpass bridge was completed in only 13 months—ahead of schedule—between November 2008 and December 2009. According to the Southern California Regional Rail Authority, this was the fastest grade separation construction of this scale to be completed in the region. Even better, the architecturally significant project cost $2 million less than the engineer's estimate of $16 million (excluding right-of-way and engineering costs).

The innovative bridge has remedied multiple problems. The traffic bottleneck at grade has been removed, resulting in smoother flowing traffic and improved motorist safety. Fuel emissions from idling vehicles has been greatly reduced, which contributes to better air quality and a healthier environment. New

The City of Rancho Cucamonga has a bold new landmark—a precast concrete bridge that compliments the San Gabriel Mountain range while welcoming visitors to the town center. Photo: City of Rancho Cucamonga.

sidewalks have increased mobility for pedestrians and bicyclists.

The bridge's ornamental railing, bold color, massive columns, and curvilinear form has given Rancho Cucamonga an impressive city landmark that compliments the dramatic backdrop provided by the mountain range. Having an architecturally significant entry monument to Rancho Cucamonga is helping to improve the livability of the community, attract new businesses, and enhance property values—all of which contribute to improving the lives of local residents.

Miguel A. Carbuccia and Sam S. Xie are transportation project managers with PBS&J, an Atkins company, in Orange, Calif.

For additional photographs or information on this or other projects, visit www.aspirebridge.org and open Current Issue.

The Metrolink train passes over the newly constructed Haven Avenue Grade Separation Bridge during the ribbon cutting ceremony on December 16, 2009. From his position under the bridge, city engineer Mark Steuer said at the podium, "And it works!" Photo: City of Rancho Cucamonga.

Beautiful Cucamonga Peak rises majestically beyond the completed Haven Avenue Grade Separation Bridge. Photo: PBS&J, an Atkins company.

A pedestrian way alongside Haven Avenue passes beneath the new grade separation. Photo: City of Rancho Cucamonga.

PROJECT / HAVEN AVENUE SEPARATION BRIDGE