A Grand Connectivity Improvement in the Grand Valley

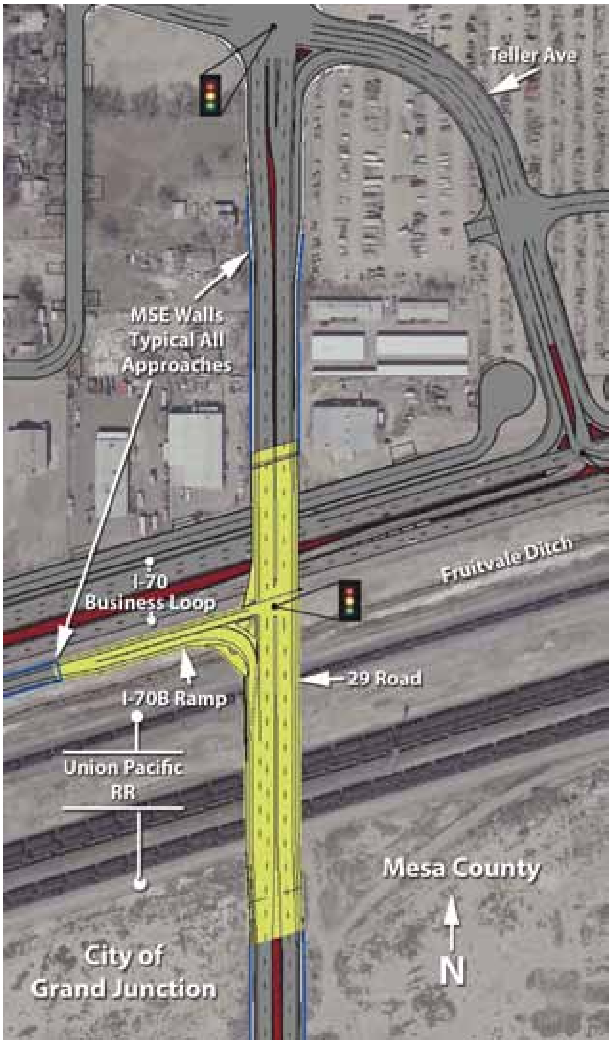
THE 29 ROAD BRIDGE AND I-70B RAMP

by Jeff Mehle, Jacobs Engineering Group Inc.

The 29 Road Bridge and I-70B Ramp project is the most recent infrastructure improvement in Grand Junction, Colo., to enhance transportation connectivity in the Grand Valley. Earlier improvements for mobility and access included the Riverside Parkway along the southern end of Grand Junction in 2008 and the 29 Road crossing of the Colorado River in 2006. The 29 Road and I-70B improvement is a joint effort by the city of Grand Junction and Mesa County to extend and connect 29 Road from these earlier infrastructure improvements north to I-70 Business Loop (I-70B). The project includes nearly 4 miles of roadway and a bridge that crosses over the Union Pacific Railroad (UPRR) switchyard and mainline tracks, Fruitvale Irrigation Ditch, and I-70B. A ramp structure on the west side of the 29 Road Bridge provides access from eastbound I-70B.

Spanning the UPRR

A significant challenge was how to design the bridge to span over UPRR's nine active tracks and accommodate five future tracks while maintaining the required roadway access and vertical and horizontal clearances. The minimum required vertical clearance over the rail tracks is 23 ft 6 in. and over I-70B is 16 ft 6 in. Mechanically stabilized earth (MSE) retaining walls support the roadway approach fill at both ends of the bridge. The designers determined the limits of the bridge structure and roadway approaches by balancing the cost of the bridge with the cost of the tall walls at each end. The design solution used 67,000 ft^2 of MSE retaining walls with a maximum wall height of 30 ft on the south end of the bridge.



Location of the 29 Road Bridge and I-70B Ramp in Grand Junction, Colo. Illustration: Jacobs Engineering Group Inc.

Spliced Girder Design

A life-cycle cost analysis for the bridge examined the initial cost, construction constraints, and long-term maintenance cost before arriving at the splice-girder design as the optimum solution to span the rail yard. To minimize the structure depth while meeting the vertical clearance over the UPRR tracks, three spans over the UPRR right-of-way were designed as precast, pretensioned and post-tensioned spliced girders. Post-tensioning made the girders continuous over the piers prior to the deck placement, thereby optimizing the design. This allowed the structure depth and wall heights to be reduced, and the girder spacing to be increased, which reduced the number of girders needed.

The three span lengths over the UPRR are 135, 157, and 138 ft with the pier columns placed between the existing and future tracks and access roads. The 72-in.-deep Colorado Department of Transportation (CDOT) bulb-tee girder was modified with end blocks for the coupling of post-tensioning ducts and to accommodate the tendon

profile

29 ROAD BRIDGE AND I-70B RAMP / GRAND JUNCTION, COLORADO

BRIDGE DESIGN ENGINEER: Jacobs Engineering Group Inc., Denver, Colo.

PRIME CONTRACTOR: Lawrence Construction, Littleton, Colo.

PRECASTER: Plum Creek Structures, Littleton, Colo., a PCI-certified producer

CONCRETE SUPPLIER: United Companies, Grand Junction, Colo.

POST-TENSIONING CONTRACTOR: VSL, Wheat Ridge, Colo.

REINFORCEMENT SUPPLIER: CMC Banner Rebar Inc., Denver, Colo.

The bridge spans over nine active and five future railroad tracks.

The completed 29 Road Bridge and the intersection of the I-70B Ramp on the left. Photo: Paul Jagim, City of Grand Junction, Colo.

anchorages. With a maximum girder spacing of 10 ft 3 in., the spliced girders allowed the design team to eliminate at least two girder lines and reduce the structure depth by over 1 ft compared to a conventional girder design. This shallower structure depth also allowed the roadway profile to be lowered an equal amount, resulting in reduced costs for approach fill and MSE walls.

The remainder of the 29 Road Bridge and the ramp structure were constructed using conventional 72-in. and 63-in.-deep precast, prestressed concrete bulb-tee girders with a design concrete compressive strength of 8500 psi. The width of the 29 Road Bridge varies from 95 ft 3 in. at the connection to the I-70B Ramp to 79 ft 0 in. on the north approach end, accommodating two travel lanes, a bicycle lane and a sidewalk in each direction, and a right turn acceleration lane from the ramp access. The four spans north of the UPRR tracks over Fruitvale Ditch and I-70B measure 118, 69, 104, and 58 ft. The total length of the 29 Road crossing is 779 ft.

The ramp structure from I-70B tees into 29 Road and is 320 ft long with a span configuration of 70, 80, 75, 47, and 48 ft. The ramp has a minimum width of 30 ft 10 in. to carry two lanes of traffic with shoulders. The ramp flares to a maximum width of 110 ft 6 in. at the connection with the 29 Road structure to provide left and right turn movements. The geometry at the end of the ramp was challenging because the last span is flared wider on each side. It spans between skewed supports and the final deck cross-slope had to match the profile of the center span on the 29 Road Bridge. To solve the span geometry, additional flared girders were added to the cross section, and the ramp span deck was not cast until the center span was constructed to help match the elevations.

Delivery of a precast, prestressed concrete spliced girder section at the site.

Fabrication and Shipment of Girders

The girders were fabricated in Littleton, Colo., southwest of Denver and shipped 250 miles to Grand Junction on I-70. At the Continental Divide, I-70 passes through the Eisenhower Tunnel, which has a limited vertical clearance. Depending on the transport equipment used, deeper girders, such as an 84-in.-deep bulb-tee section, would have difficulty with the limitations of the tunnel. The alternate route to bypass the tunnel over Loveland Pass, adds time and cost, not to mention uncertainty with inclement weather. Working within other design requirements, the design team chose a spliced girder solution with 72-in.-deep girders. On a trailer, the girders are tall, but a 72-in.-deep bulb-tee girder with its projected reinforcement, just passes beneath the top of the tunnel. In the end, all girders were easily transported by truck through the Eisenhower Tunnel.

No Falsework Required

Once on site, the girders were erected by crane. The spliced girders were designed to span from pier to pier with no temporary falsework supports. The girders were pretensioned to control stresses during handling and shipping, which allowed the girders to be transported and erected as simple spans. The elimination of falsework was important to minimize impacts in the UPRR right-of-way. Once erected, the post-tensioning ducts were coupled, reinforcement placed, and the integral pier diaphragm concrete placed. Two tendons containing nine 0.6-in.-diameter strands in 3-in.-diameter ducts were installed in each girder and stressed to 395 kips each. Stressing from each end achieved the proper force along the parabolic tendon path.

PRECAST, PRESTRESSED CONCRETE SPLICED-GIRDER BRIDGE AND RAMP CONNECTOR USING PRECAST, PRESTRESSED CONCRETE, PARTIAL-DEPTH DECK PANELS AND CAST-IN-PLACE CONCRETE SUBSTRUCTURE / CITY OF GRAND JUNCTION AND MESA COUNTY, COLORADO, OWNERS

BRIDGE DESCRIPTION: Seven-span, 779-ft-long precast, prestressed, spliced girder bridge (span lengths are 118, 69, 104, 58, 135, 157, and 138 ft) and a five-span, 320-ft-long precast, prestressed concrete girder ramp (span lengths are 70, 80, 75, 47, and 48 ft). Both have a cast-in-place concrete composite deck cast on precast, prestressed concrete deck panels. The structures are supported on cast-in-place concrete column bents and abutments.

STRUCTURAL COMPONENTS: Bridge: 30 CDOT 72-in.-deep, precast, prestressed concrete, modified bulb-tees, 10 CDOT 72-in.-deep, standard bulb-tees, 27 CDOT 63-in.-deep bulb tees, and 3½-in.-thick precast, prestressed concrete deck panels; Ramp: 53 CDOT 63-in.-deep bulb-tees, and 3½-in.-thick precast, prestressed concrete deck panels

BRIDGE CONSTRUCTION COST: Total project $34 million; Bridge cost $7.5 million ($107/ft^2)

Construction of the spliced-girder unit over the UPRR showing the MSE approach retaining walls. Photo: Kristin Winn, City of Grand Junction, Colo.

A 3½-in.-thick, precast, prestressed concrete, stay-in-place deck panel form being lowered to the bridge during installation. Photo: Kristin Winn, City of Grand Junction, Colo.

The pier design is conventional with multi-column piers, cast-in-place with 3-ft 2-in.-square columns supporting 4 by 4 ft caps. To address the soft soils in the Grand Valley, 377 individual steel piles with an average length of 50 ft, were driven to support the substructure. The piers in the UPRR right-of-way had crash protection walls designed to absorb collision loading from adjacent tracks. The piers were offset the minimum horizontal clearance of 18 ft from existing and proposed future tracks in compliance with UPRR requirements.

Precast Deck Panels Assist Schedule

The 8-in.-thick bridge deck utilized partial depth precast, prestressed concrete deck panels. The 3.5-in.-thick panels span between girder flanges and form the bottom of the composite deck. The top 4.5 in. of the deck is cast-in-place concrete with the epoxy-coated deck reinforcement placed directly on the roughened surface of the precast deck panels. Upon curing, the cast-in-place portion of the deck, the precast deck panels, and the precast girders act compositely. The precast deck panels helped minimize the project schedule and demonstrate a method of accelerating bridge construction.

The project was built in four phases. The first three phases in 2009 addressed irrigation, utilities, roadway, and infrastructure improvements on the north and south ends of the project. These smaller phases yielded a construction opportunity for local contractors on the Western Slope of Colorado. They advanced the total project while creating the necessary time to obtain final approval from the UPRR and Public Utilities Commission for the bridge crossing. The final phase—the bridge construction—was awarded in 2010.

The project was completed on schedule and opened with great public anticipation with a ribbon-cutting ceremony on November 19, 2011. The next planned transportation improvement for the Grand Valley is to extend 29 Road further north to I-70, including an interchange that will complete the beltway around Grand Junction for both local and regional mobility needs.

Jeff Mehle is the structures manager for Jacobs Engineering Group Inc. in Denver, Colo.

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

Environmental Sensitivity

The new 29 Road and I-70B crossing provides a more direct south-north connection in the Grand Valley of Grand Junction, Colo. It eliminates over 2 miles of transit route and travel time for 30,000 commuters. The reduced vehicle miles provide environmental benefits through reduced vehicle emissions. The crossing also improves emergency response time for police, fire, and ambulance providers to less than 5 minutes to residents and two schools on the south side of the UPRR tracks, which is a reduction of over 2 minutes. The corridor provides a more efficient bus route for Grand Valley Transit and multi-modal access for bicyclists and pedestrians on both sides of 29 Road that lead to Riverside Parkway and the 29 Road Colorado River crossing.

The project received a $3.2 million energy grant award from the Colorado Department of Local Affairs. Aesthetically, the bridge and walls were colored with a concrete coating. Sand beige was used for the walls, abutments, monuments, pier cap, curb, and portions of the piers. Dark brown was used for the exterior girders and portions of the pier columns. The colors match those used on the Riverside Parkway, which includes eight bridges. The project provided a context-sensitive solution, which met the transportation need with an environmentally sensitive design that is an asset to the community.

The cast-in-place pier columns are shown with crash protection wall and striated surface that will be stained. Photo: Kristin Winn, City of Grand Junction, Colo.