PROJECT

Bridge Replacement: Pecos Street over I-70

Accelerated bridge construction techniques significantly reduce impacts to the traveling public

by Tamara Hunter-Maurer, Colorado Department of Transportation, and Tom Melton, Wilson & Company

The Colorado Department of Transportation (CDOT) bridge department made the determination to replace the Pecos Street Bridge over I-70 because it was structurally deficient and rated poor. The structure spans six lanes on I-70, carries 130,000 vehicles per day, and is located less than a mile away from the heavily traveled I-70/I-25 interchange. For these reasons, it became readily apparent that minimizing disruption to traffic during construction would be a critical element in planning, designing, and constructing the replacement bridge.

CDOT management and the Colorado Bridge Enterprise (CBE) made the decision that this replacement project was an excellent candidate for applying accelerated bridge construction (ABC) techniques in an effort to significantly reduce impacts to the traveling public. During preliminary design, an ABC evaluation was conducted that confirmed this decision. CBE provided most of the project funding.

This project was slated initially to be only a bridge replacement project, but after site visits, it was determined that there were traffic operation and geometric deficiencies that warranted improvements. The traffic study evaluated 15 alternatives and showed that the best solution was to replace the two traffic signals at each ramp intersection with two modern roundabouts.

Design Considerations

Aligned in a north-south direction, Pecos Street marks a dividing line between an industrial area to the east, and the Sunnyside and Chaffee Park neighborhoods to the west. Small communities of local retailers on the fringe of the interchange provide services and goods contributing to the vitality of the area. It was determined during the design process this was an area of environmental justice, which meant any taking of land or right of way purchases for roadway

Rendering of new Pecos Street Bridge over I-70 facing east. Figure: Prepared by Digital Adrenalin for Colorado Department of Transportation.

profile

PECOS STREET OVER I-70 / DENVER, COLORADO

BRIDGE DESIGN ENGINEER: Wilson & Company, Denver, Colo.

GENERAL CONTRACTOR: Kiewit Infrastructure Group, Littleton, Colo.

POST-TENSIONING CONTRACTOR: VSL, Denver, Colo.

improvements would create overall consequences to the community and should be minimized as much as possible.

Replacing the signalized intersections with two-lane roundabouts required only four lanes across the structure. This resulted in a 63-ft-wide deck at the narrowest section in the middle of the bridge. However, the deck flares at the ends of the bridge to accommodate the roundabouts increasing the deck width to 130 ft at the south abutment and 80 ft at the north abutment.

Because there are a number of pedestrians, including those with disabilities, and bicyclists regularly crossing I-70 on the old bridge, it was decided early in the design process to remove the sidewalks from the Pecos Street bridge and provide a separate pedestrian bridge. Further analysis showed construction of a wider street bridge structure to accommodate the pedestrian movement was comparable to the cost of a separate pedestrian structure.

To meet an aggressive 20-month schedule for design and construction set by the CBE funding requirements, CDOT used an innovative project delivery method called Construction Manager General Contracting (CMGC). The contractor was selected and started working on the design with CDOT and the bridge engineer in January 2012. The design was completed in November. The contractor brought ABC experts to the team from recently completed projects utilizing self-propelled modular transporters (SPMTs) in Utah.

To minimize right-of-way impacts, both roundabout footprints encroached on the new roadway bridge, which created an opportunity for the project team to satisfy several project constraints. With the contractor's participation, the structure type, ABC technique, and bridge footprint were finalized. Seven different structure types were initially considered including steel girders, and precast and cast-in-place concrete. The cast-in-place, post-tensioned concrete box girder bridge was selected because it best satisfied the evaluation factors of construction costs, bridge move costs, procurement schedule, structure depth, and aesthetics.

Overview of the bridge staging area (BSA) for the new Pecos Street over I-70 bridge. Photo: 360Media.

Superstructure

The superstructure has a span length of 156 ft and consists of three cells with four webs. The two internal webs are straight with a thickness of 12 in. whereas the two external webs are curved in plan with a thickness of 15 in. Web spacing varies from 16 to 23.5 ft. The superstructure is longitudinally post-tensioned internally in the webs and externally in the boxes. The overall depth of the superstructure varies from 76 to 84 in. The transversely post-tensioned deck has a thickness of 9 to 15 in. The bottom slab has a thickness of 6 to 8.5 in. The nonprestressed reinforcement is epoxy coated.

The project team worked closely when selecting the ABC roll-in technique and the internal support system necessary to lift the bridge. Two transverse lifting diaphragms were placed 15 ft from the abutments, and were permanently designed into the bridge for lifting during transportation. Three-dimensional finite element software was used to design the bridge for all load conditions including loads induced into the bridge during the move.

Construction

The bridge abutments were designed to be constructed underneath the existing bridge in front of the existing abutments, prior to bridge removal. Thus, the new abutments and superstructure were constructed concurrently, cutting the construction time from 15 months down to seven months—a critical component that allowed the substantial completion date to be achieved.

The superstructure was constructed about 800 ft away from the final bridge location on an abandoned street in the bridge staging area (BSA) in the southeast quadrant of the interchange. In a similar fashion to other ABC roll-in projects, building the bridge in a BSA

Building the bridge away from traffic provided improved worker safety, construction access, and construction quality.

COLORADO DEPARTMENT OF TRANSPORTATION, OWNER

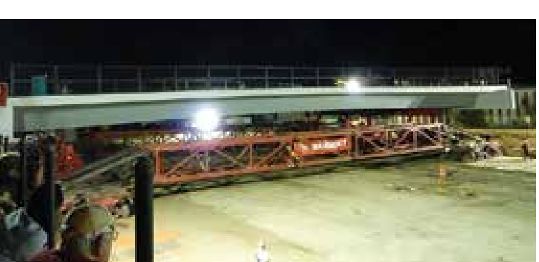
BRIDGE DESCRIPTION: A 156-ft-long, single span, cast-in-place, post-tensioned concrete box girder bridge with a variable depth and a transverse post-tensioned deck. The deck overhang span varied from 8.5 to 15.5 ft. Bridge webs were post-tensioned internally and externally, exterior webs were curved, and web spacing varied from 16 to 23.5 ft

The edge of the deck and exterior webs are curved to accommodate the roundabouts at each end. Photo: Colorado Department of Transportation.

Steel street plates were used to protect travel path surfaces and prevent tires from digging into fill material. Photo: Wilson & Company.

Climbing jacks at final height above ground. Photo: Wilson & Company.

Self-propelled modular transporter equipment installed and ready to move the bridge. Photo: Wilson & Company.



Spectators view from the public viewing area during the bridge move weekend. Photo: Wilson & Company.

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Moving the Bridge

The project team collaborated on designing the temporary and permanent construction elements required to move the bridge. Major features of the bridge move included:

- jacking the bridge 17 ft above the ground using climbing jacks,
- placing SPMT supports under the lifting diaphragms,
- transporting the bridge along a travel path, and
- setting the bridge on adjustable bearing devices.

The project team conducted 13 meetings and spent hundreds of hours refining the design of the moving equipment and the lifting diaphragms resulting in a design compatible for both. The travel path design required significant coordination time to ensure that:

- the 3% maximum grade for the equipment stability was not exceeded,
- twisting of the bridge was not induced, and
- the vertical stroke on the SPMT equipment worked both to lift the bridge off the climbing jacks, as well as to set the bridge in the final resting place on the new abutments.

On Friday evening, July 19, 2013, at 10:30 p.m., I-70 was closed and then re-opened 50 hours later on Monday morning at 12:30 a.m. During this weekend closure, the existing bridge was demolished and removed, the bridge travel path was constructed using metal plates and fill material, the bridge moved, and the travel path removed. The bridge did not develop any new cracks as a result of the move.

Public Participation

CDOT set up a public viewing area near the travel path to allow spectators to witness this unprecedented construction method for Colorado. Throughout the weekend, there were over a 1000 spectators that observed and cheered on the construction team as the bridge slowly moved into final position.

One of the great successes for this project is not simply that CDOT tried a fairly new innovative construction method, but that it almost completely eliminated impact on the I-70 traveling public. In addition, CDOT worked closely with the local businesses on either end of the bridge to make sure people had access to their services throughout construction.

With the Pecos Street over I-70 Bridge in place, the roundabout construction was finalized and Pecos Street reopened Labor Day weekend, September 1, 2013.

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