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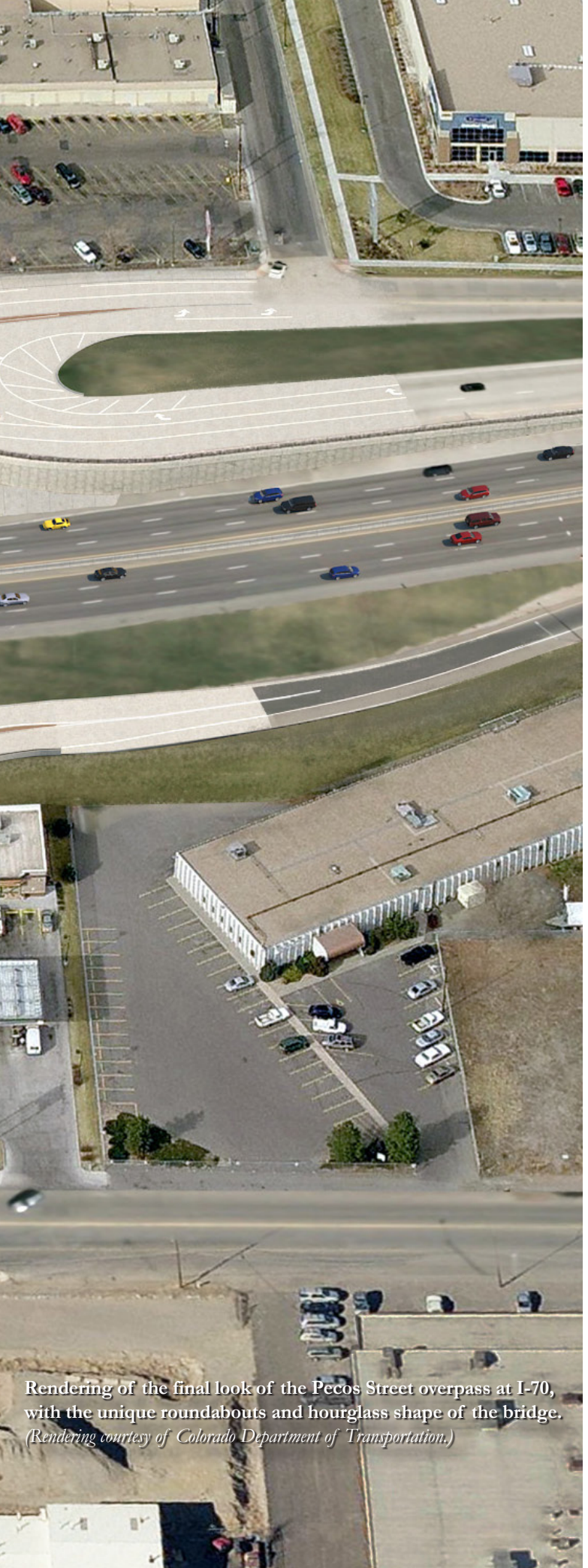
# CDOT USES ITS ABCs in Pecos Street Bridge Replacement



**Rendering of the final look of the Pecos Street overpass at I-70, with the unique roundabouts and hourglass shape of the bridge.** *(Rendering courtesy of Colorado Department of Transportation.)*

Through Accelerated Bridge Construction methodology, the construction schedule was shortened by eight months and the affected section of I-70 was closed for a total of 50 consecutive hours over a single weekend.

By Clinton Waiz

On a mid-summer's afternoon in July 2013, approximately 1,000 spectators gathered in a staged seating area to watch the Colorado Department of Transportation complete the last 800 feet of a milestone moment that was more than seven months in the making.

Having leveraged an innovative construction methodology known as accelerated bridge construction (ABC), CDOT and the crowd watched with delight as the new 2,400-ton Pecos Street bridge rolled slowly down the middle of I-70 astride two self-propelled modular transporters.

A new era in bridge construction has arrived. Though CDOT isn't the first to make use of this highly efficient construction process, the success of the Pecos Street bridge replacement project is very likely to emerge as a model worthy of emulation.

When the project was designed, CDOT looked at many innovative options for expediting construction of the bridge and reconstructing the Pecos Street intersections, said Tamara Hunter-Maurer, CDOT project manager.

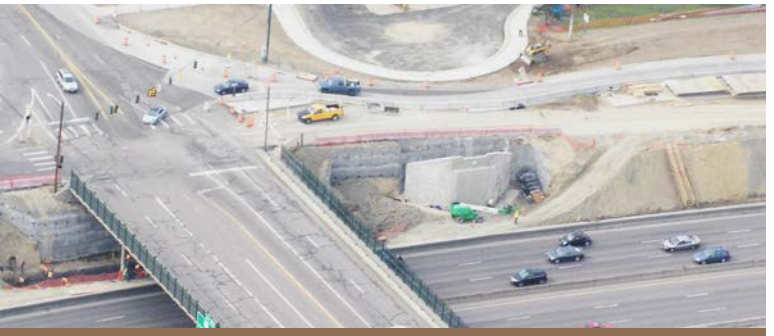
"In large-scale infrastructure construction, a primary objective is reducing the negative public impacts. In road and bridge reconstruction that means keeping traffic moving at the pace people are accustomed to," says Hunter-Maurer. "Accelerated bridge construction techniques allow us to do that and a lot more."

With Pecos Street located less than a mile from Colorado's busiest interchange, the swirling tangle of entrance and exit ramps at I-70 and I-25, known as the Mousetrap, the need to minimize traffic impacts simply could not have been greater any place in the state.

Initially, CDOT estimated that erecting the replacement bridge over I-70 as they had typically done would have taken 15 months. It also would have meant 20 to 30 lane closures on the state's primary east-west interstate, periodically snarling traffic in every direction.

Instead, through the ABC methodology, the construction schedule was shortened by eight months and the affected section of I-70 was only closed for a total of 50 consecutive hours over a single weekend.

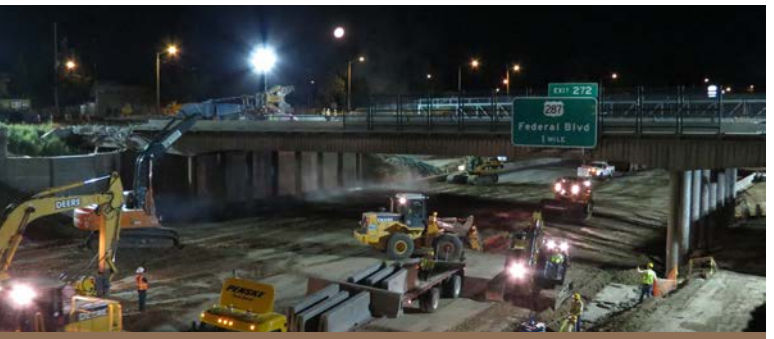
It's not without considerable expertise and tremendous collaboration that a project of this magnitude could have been undertaken. CDOT commissioned Wilson & Co. to lead design and Kiewit to lead construction though an integrated construction manager/general contractor delivery method, which paired the designer and builder under separate contracts.



**Aerial view of the old Pecos bridge prior to demolishing.**
*(Photo courtesy of Kiewit Infrastructure.)*

In total, the Pecos Street bridge project drew upon the expertise of hundreds of engineers, builders, heavy transport professionals and material suppliers.

Once the team was configured, the next step was to determine which of several primary ABC processes would work best.




**Night-time demolition of the Pecos bridge over I-70.**
*(Photo courtesy of Wilson & Co.)*

One method would have involved constructing the replacement bridge directly adjacent to the existing structure on temporary abutments. Then the old bridge would have been demolished and the new structure slid into place. This process would have reduced the schedule but still would have required numerous lane closures on I-70.

The second method, which was ultimately chosen, required that the replacement structure be constructed nearby and then transported to the site of insertion just after the old bridge was removed.

"Everyone agreed that to provide the greatest benefit to the traveling public, the superstructure had to be built offsite and then brought in when everything was ready," said Dave Paris, Kiewit project manager. "In addition to reducing traffic impacts, there were also considerable safety advantages."

Those advantages extended beyond the obvious merits of not assembling 2,400 tons of steel and concrete above an active highway but also considered the positives of segregating construction personnel from adjacent roadway traffic.

"We had some initial thoughts about parcels of land that might be suitable for the 'Bridge Farm,' said Hunter-Maurer. "However, during the selection process Kiewit shed light on a nearby abandoned roadway that fell under the authority of the City and County of Denver."

Beyond eliminating traffic created by frequent lane closures and increased safety, the bridge farm concept also resulted in higher quality construction and enhanced collaboration.

By constructing the superstructure in a more controlled environment, product quality was improved by allowing longer concrete cure times, better material staging areas and smoother assembly, and giving quality control inspectors more observation time.

The superstructure also was constructed in a single phase, which eliminated longitudinal joints in the deck, reducing the long-term potential for corrosion of concrete and reinforcing steel.

Another substantive benefit of assembling the superstructure off-site was that the replacement abutments could be constructed concurrently beneath the existing bridge expediting overall production.

CDOT's original focus for the Pecos Street project was replacing the 45-year-old bridge, which had been classified as structurally deficient. However, during early site visits with Wilson & Co. it became clear that addressing the adjoining intersections on Pecos was another major consideration.

The team immediately noted the volume of vehicles entering and exiting I-70. Significant truck traffic due to the area's industrial nature, coupled with frequent pedestrian movements, and the need to improve both the north and south intersections took on new urgency.

"When we were hired, a traffic engineering study was conducted and both intersections were determined to be geometrically deficient," said Tom Melton, PE, transportation structural director for Wilson & Co.

An example of such geometric deficiency was readily apparent while watching trucks exiting westbound I-70 then attempting to make a south bound turn onto Pecos. It was a turning movement that large vehicles simply couldn't accomplish within the established lane widths – which was not only unsafe, but frequently led to congestion.

To correct this problem, Wilson & Co. had to balance many different considerations, Melton said.

"Preserving the existing on and off ramp layouts to and from I-70 on both sides of the bridge became a driving factor from a construction cost perspective," he said. "That's what led us to see the roundabouts as the best option."

Incorporating large-scale roundabouts was an unusual approach, especially within a heavily trafficked urban environment. CDOT and the CM/GC team had to work closely with the City and County of Denver to gain acceptance of the idea before proceeding with design.

Innovative though they were, the use of roundabouts was not without complications. In order to make the required turning radiuses work within the highly constrained right-of-way, the bridge itself had to be widened on either end, resulting in something of an hourglass shape.

Another concern was the high level of pedestrian traffic the existing bridge was accommodating.

"Pedestrian movement within the roundabouts would have required that the bridge be even wider," said Hunter-Maurer.

"According to our calculations the expense required to support the added weight of pedestrian use on the bridge was equal to what it would cost to add a dedicated pedestrian bridge beside it."

**The old Pecos bridge during demolition.**
*Photo courtesy of Wilson & Co.)*

Integrating the foot bridge was also safer, with pedestrians no longer traveling immediately adjacent to passing drivers.

With all the pieces in place and construction going on under the bridge, as well as at the bridge farm location just down the road, the final hurdle was to prepare the travel path required to get the bridge in place. Moving and attaching the bridge to the abutments during a single weekend would only be a success if the existing highway surface didn't incur any damage in the process.

**Slow movement of the pre-built Pecos bridge begins.**
*(Photo courtesy of Colorado Department of Transportation.)*

The team determined that steel street cover plates placed end-to-end along the travel path would protect the roadway under the massive weight of the bridge and the self-propelled modular transporters.

**The new bridge, painstakingly transported into place, is jacked up flush with the Pecos Street surface.** *(Photo courtesy of Rocksol Consulting Group.)*

"Kiewit must have acquired every steel street cover plate in the state of Colorado, and perhaps a few more beyond that," said Melton.

They were laid end-to-end, and as the self-propelled modular transporters rolled along, fork lifts came in and moved the last set of plates up to the front of the travel path. Plate by plate, the bridge crept up the highway while a crew of technicians stood on top of the rolling superstructure making sure the two SPMTs remained in nearly perfect synchronicity.

"We were allowed only a quarter inch of deflection in the internal lifting diaphragms over the self-propelled modular transporters," said Hunter-Maurer. "That

**The pre-built Pecos Street bridge in place. The pedestrian walkway can be seen behind the bridge.**
*(Photo courtesy of Colorado Department of Transportation.)*

meant that if the middle of the lifting diaphragm exceeded this deflection, the potential for additional cracking in the bridge would increase."

In terms of lessons learned, though all involved agreed that the overall level of collaboration on the project was outstanding, there is always room for improvement.

Both Kiewit and Wilson & Co., who had already completed several ABC projects in Utah, stressed the importance of working closely with the heavy lifters responsible for moving the bridge as early as possible in design to ensure that the structural requirements of the move operation are carefully integrated into the overall design.

The team worked with heavy lifting subcontractor Mammoet-USA to develop a lifting diaphragm to support the weight of the bridge during transport as part of the overall superstructure.

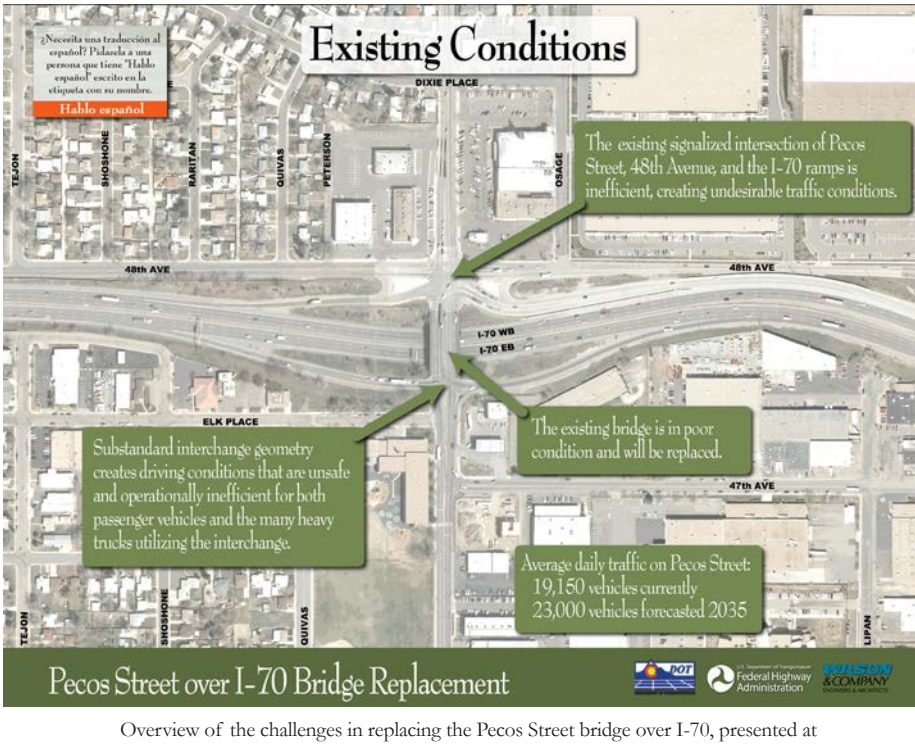
**Inspecting the new bridge after raising it level with Pecos Street.**
*(Photo courtesy of Rocksol Consulting Group.)*

"These supports are about 15 feet in from either end of the superstructure, so that the actual ends of the bridge cantilevered over the edges of the SPMTs during the move," Melton said.

The great success of the project is not simply that something new or innovative was tried, said Hunter-Maurer.

The project team almost completely eliminated any impact on the travelling public. They worked closely with the businesses on either end of the bridge to make sure people had access to their services throughout construction. And a safer travel path for pedestrians was created.

"We also generated a great deal of public participation in a first-of-its-kind project for CDOT and the state of Colorado," she said.




Overview of the challenges in replacing the Pecos Street bridge over I-70, presented at a meeting of neighbors and businesses. *(Rendering courtesy of Wilson & Co.)*