ACCELERATED CONSTRUCTION

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Accelerated bridge construction, combined with bold moves by the Utah Department of Transportation (UDOT), have forever changed the face of bridge replacement in Utah. Bridge replacements that used to inconvenience motorists for months now take mere days.

Incorporating newly accepted techniques by UDOT, four total bridge replacements were performed on I-80 at Mountain Dell Interchange and Lambs Canyon Interchange near Salt Lake City in Parley’s Canyon. The design-build team of Wadsworth Bros. Construction and Stanley Consultants removed and replaced four bridges in just 37 hours. The two eastbound bridge replacements were completed in 16 hours.

A regional construction magazine reported it to be the fastest-known bridge replacement for two structures in North America.

The $9.4 million project was completed so quickly that local residents and businesses might not have known of the brief I-80 detours if not for the extensive public announcements.

An unusual proposal

The project scope originally conceived by UDOT was to replace the decks and approach slabs for four bridges, two at Lambs Canyon Interchange and two at Mountain Dell Interchange. The request for proposal (RFP) called for removing and reconstructing four existing bridge decks, with construction of temporary bypass structures and roadways.

Utah continues to blaze through bridge construction; erects four in 37 hours
in order to keep three lanes of I-80 open in each direction throughout the bridge-deck replacements. The RFP allowed four 16-hour weekend closures to facilitate switching the traffic between the temporary and permanent facilities.

However, in the final stages of preparing the proposal, the Wadsworth Bros./Stanley Consultants team concluded that because of the limitations imposed for traffic closure, the project was better suited for a different approach: building the new bridges near the existing bridges and later swapping the new and old bridges during the prescribed weekend closures. The goals of replacing the entire superstructure, rather than removing only the existing deck and attempting to replace it with precast elements. The bridges would be moved by self-propelled modular transporters (SPMT).

Though this unusual proposal was outside of that requested by UDOT, it still provided the overall scope. UDOT was agreeable. As a result of using the SPMT method of bridge superstructure replacement, taxpayers saved 17% over the next-lowest bidder.

Shortly after the project was awarded, in response to the public outreach campaign, UDOT approached the team about reducing the I-80 closures from four weekends (16 hours each) to two weekends (24 hours each). This was no small request. UDOT’s ongoing coordination with the traveling public, art events and other events scheduled in the resort community surrounding Park City required close coordination of the schedule and a consistent, well-executed public information program. The feat of removing two old bridge superstructures and moving in superstructure for two complete new bridges in less than 24 hours had never before been accomplished. Neither had a bridge-and-approach slab replacement been completed in less than two weeks. But the team accepted the challenge.

**A need for speed**

The single-span superstructures for both the existing and replacement structures consisted of 120-ft span-welded steel plate girders at the Mountain Dell Interchange and 85-ft span AASHTO Type IV prestressed girders at the Lambs Canyon Interchange.
isting superstructures and approach slabs on the four bridges on two successive weekends during a closure not to exceed 24 hours. The Lambs Canyon and Mountain Dell westbound structures were scheduled for the weekend of Aug. 10, and the eastbound bridges at the same locations were replaced the next weekend. A mere 48 hours was allotted for the project, but only 37 hours was needed. The two westbound bridges were replaced in just 21 hours, and the two eastbound bridges were replaced in just 16 hours.

“This project called for a really high level of coordination between the contractor and the designer that really made the difference in being able to open I-80 in less than 24 hours in each case,” said Brett Hadley, a project principal with Stanley Consultants. The project was completed three hours early the first weekend and eight hours early the second weekend.

With only two short-term closures, the project had minimal disruption to local businesses and interstate commerce. Because of the essential nature of I-80 for transportation through Utah and for commuters and tourists, an aggressive public information program was developed and implemented. Associated with these closures, a maintenance-of-traffic plan was developed to inform and reroute the traveling public around the project locations during the closure times.

Improvements and innovations to the typical accelerated bridge construction process resulted in significant quality innovations in three areas of the project:

- Method of approach-slab precasting;
- Replacement of bridge girders; and
- Coincident lift and staging support points.

At 25 ft by 57 ft and weighing in at 54,000 lb each, the approach slabs were too large to be transported and lifted into place in one piece. Their size necessitated pouring the entire slab near the site, cutting it into smaller pieces and then post-tensioning them together once they were placed. Instead of pouring several pieces and risking a bad fit between slabs, especially at the post-tensioning duct interfaces, the entire slab was poured adjacent to the existing approaches in the median and gore areas of I-80. Each slab was then cut into four pieces. This procedure ensured a near-perfect fit once the slabs were finally placed. The parapet barriers were cast on the approach slabs before they were lifted into place.

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Though the contract required replacement of only the bridge decks, the girders also were replaced for an added value to taxpayers of over $1.3 million.

“Originally the project was just going to be a deck replacement. As we looked at different possibilities, we discovered it was cheaper to replace the entire superstructure,” said Stanley Consultants’ Structural Engineer Paul Blackham. Providing an entirely new superstructure rather than just a new deck will drastically improve the life expectancy of the bridges.

The removal of the existing structures at the Lambs Canyon Interchange was completed by conventional demolition methods. At the Mountain Dell Interchange, temporary abutments were designed and constructed to accommodate staging of the existing bridges removed by the SPMT and then demolished by lightweight demolition equipment. The temporary abutments doubled as the staging area for new construction and the demolition staging area.

**Giving a lift**

The superstructure replacements were staged on temporary abutments, which were designed and constructed on haul roads to match the grades required to drive the SPMT trailers underneath the temporary abutments, then lift and transport them to rest on the existing abutments. The temporary abutments became the SPMT blocking between the trailers and the superstructures. This staging had to be done so that multiple bridges could be completed in one closure. There was no time to waste building up temporary supports during the closure. While this method required a significant amount of additional planning and engineering, it also reduced the required time for the SPMT trailers to move multiple bridges and limited the moving distance from the temporary abutments to the bridge’s final resting location.

In all previous accelerated bridge construction projects in Utah, the bridges moved by the SPMT have been built on temporary abutments at the end of the girder, which mimicked the permanent abutments. The SPMT would then have to be placed to the interior of the temporary abutments and lift the bridge at pick points located away from the bearings. Lifting the bridge in this manner introduces tensile stresses in the deck and parapets and causes cracking in these elements during the move. The cracks close when the bridge is placed on the permanent abutments.

In contrast, on this project the preconstructed bridges were cast and supported atop the framework at the temporary pick points where the bridges were supported during the move. With the temporary abutments positioned at the eventual lifting points, the superstructure was designed to accommodate the temporary loading conditions from the point of the staged construction to when the bridge was placed in service with the applicable highway loads at the permanent abutments. Hence there was no additional tensile stress introduced in the bridge decks and parapets during the lifting and moving operation. In fact, the bridge deck became a pre-compressed element when it was placed into its final position because the deck and parapets are put into compression. This innovative design will greatly increase the life of the bridge deck and parapet elements.

“We believe this technique will result in far superior quality and durability of bridges versus approaches used by other contractors and other designers that cause the bridges to crack during the move,” said Hadley.

This was the first known application of this technique, but it may become an industry standard. Supporting the preconstructed bridges atop the framework at the pick points could become standard UDOT practice. UDOT officials have shown interest in the concept and are currently gathering more data.

“This method of supporting the bridge during the initial bridge construction stage at the pick points has merit,” according to Fred Doehring, UDOT deputy bridge engineer. “We are investigating the implementation of this method on other projects.”

**Breaking new ground**

The project involved many other firsts, raising the bar on Utah’s rapid bridge replacement program:

- It was the first project in Utah where the contractor chose to use SPMTs to remove/replace a bridge. UDOT mandated the use of SPMTs
in all previous instances;
• It was the first time two complete bridge superstructures were de-
molished, moved and replaced in
less than 16 hours;
• It was the first total closure of a
major interstate trucking route
for bridge replacement. DOT and
FHWA officials from around the
nation called UDOT, incredulous at
its courage in proceeding with this
project; and
• It was the first time bridge ap-
proaches have been replaced with
the bridges during the brief inter-
state closure. Previously, approac-
hes have always been replaced later
in separate closures.

While the time constraint was by
far the greatest challenge to over-
come, there were other significant
obstacles to deal with. One replace-
ment bridge was constructed in the
median between live I-80 traffic
during the most severe winter and
spring experienced in the canyon in
several years. During this time, traf-
ffic was kept open on Mountain Dell
Road (S.R. 65) and Lambs Canyon
Road almost without interruption
even though the contract allowed
both roads to be closed for 70 days.
Demolition of the existing bridges
took place 20 ft in the air on tem-
porary abutments between live in-
terstate lanes. As such, work-zone
safety and minimal traffic delays
were significant factors behind us-
ing accelerated bridge construction
because it reduced the amount of ex-
posure time to moving traffic. There
were no lost-time accidents during
the project.

This project validated UDOT’s in-
sightful promotion of accelerated
bridge construction techniques. On
two successive weekends, motorists
traveling I-80 east of Salt Lake City
drove on old bridges on Friday and
Saturday. The next time they drove
that same direction, they were trav-
eling over two new bridge decks and
approaches. The economic benefit of
being able to replace bridges while
minimizing traffic disruption to this
degree is substantial. I-80 through
Salt Lake City is an essential national
east-west route used heavily for com-
merce. UDOT estimated the rapid
nature of the project saved 180,000
hours of delays, or $2.5 million in
delay costs based on current traffi-
c volumes.

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