

## PROJECT

# Cottonwood Creek Bridge

Accelerated bridge construction speeds bridge replacement

by Jason Langhammer, Garver

Accelerated bridge construction (ABC) methods were used for the first time in Oklahoma in the replacement of the Cottonwood Creek Bridge, which transports State Highway (SH) 51 over Cottonwood Creek in Creek County, Okla. When comparing the ABC technique to conventional construction methods, it was estimated that the time needed to close and detour SH 51 could be conservatively reduced by 5 months. Because the detour is roughly 30 miles, this was expected to save motorists thousands of miles and many hours of drive time around the construction project.

ABC methodology seeks to reduce construction duration and impacts on traffic. Additional benefits include improving work zone safety, eliminating temporary roadway construction, decreasing post-construction repairs to detour routes, and reducing user costs. As bridge repair and replacement becomes increasingly more important throughout the nation, transportation officials are looking to implement ABC methods.

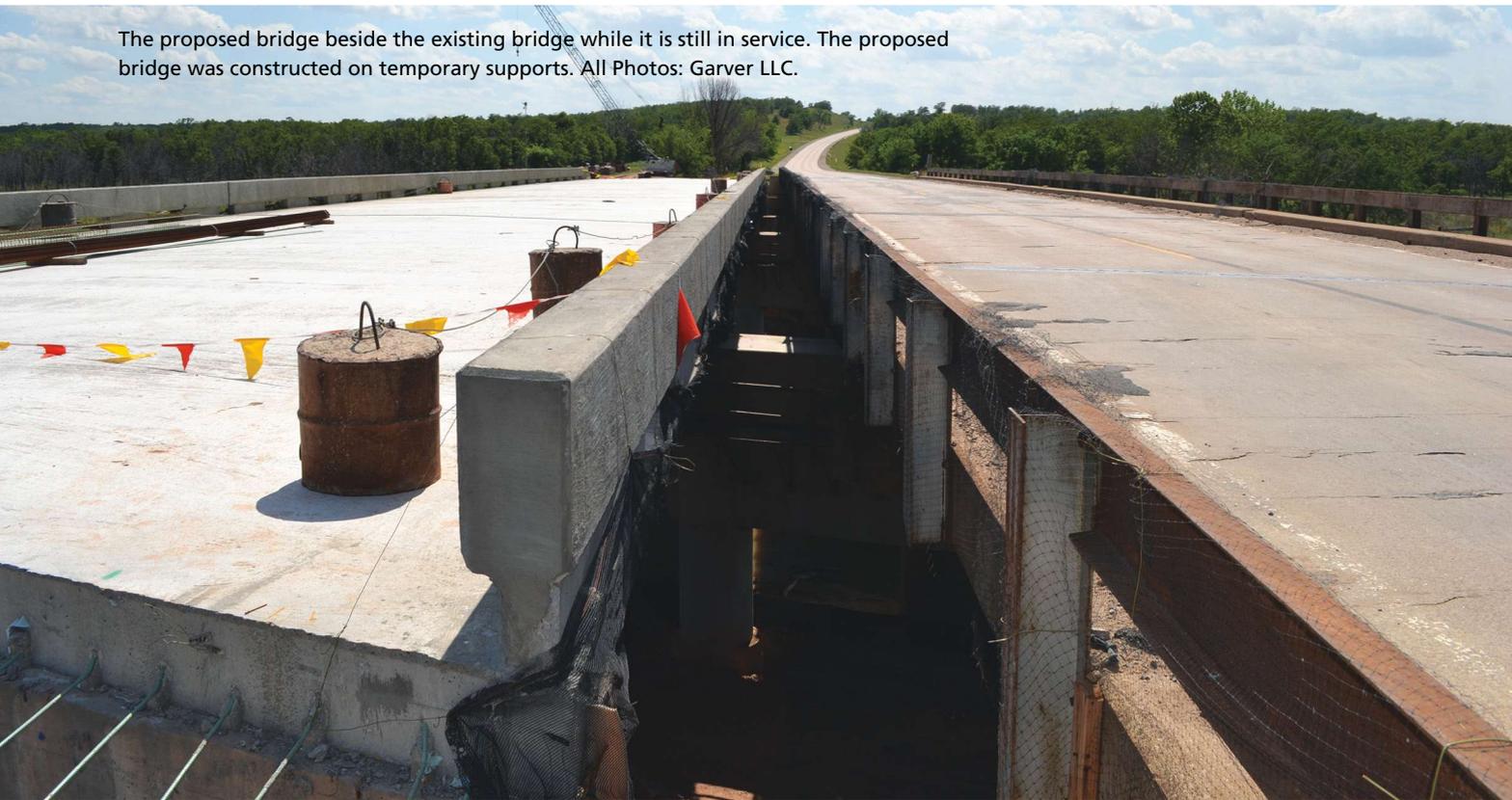
The original Cottonwood Creek Bridge was built in 1961 and when it was deemed functionally

obsolete, Oklahoma Department of Transportation (ODOT) selected this site to consider ABC because of the site accessibility of the deteriorating bridge. To construct the new bridge on the existing alignment, the contractor had to first construct the substructure elements under the existing bridge—while it remained in service.

### Oklahoma's Decision

ODOT recognizes the benefits of ABC and selected the Cottonwood Creek Bridge to serve as a pilot project to evaluate the benefits of ABC techniques for its state. Additionally, ODOT could

The proposed bridge beside the existing bridge while it is still in service. The proposed bridge was constructed on temporary supports. All Photos: Garver LLC.



profile

**COTTONWOOD CREEK BRIDGE** / CREEK COUNTY, OKLAHOMA

**BRIDGE DESIGN ENGINEER:** Garver, Tulsa, Okla.

**PRIME CONTRACTOR:** Manhattan Road & Bridge Co., Tulsa, Okla.

**PRECASTER:** Coreslab Structures, Tulsa, Okla.—a PCI-certified producer



The hydraulic jack used to horizontally pull the spans into place. The spans were guided by a track and supported on polytetrafluoroethylene (PTFE) pads to reduce friction.

apply the knowledge gained through this pilot project to other projects where ABC techniques are feasible and prudent.

There are several options to consider when constructing a bridge in an expedited manner. During the Cottonwood Creek Bridge project's preliminary engineering phase, several ABC methods were investigated, including the use of prefabricated bridge elements and various structural placement methods. Site topography, hydraulic adequacy, vertical and horizontal clearances, site accessibility, existing facility geometry, user costs, and total construction costs were also considered.

After evaluating all factors, a transverse sliding/skidding bridge move was selected to replace the existing bridge on the existing alignment. Using this method, the existing new superstructure was constructed on temporary supports adjacent to the existing structure. A track system and sliding shoes were then used to move the bridge into position on top of new piers and abutments. This allowed the existing bridge to stay in service while the new bridge was constructed, lessening the impacts to motorists.

The new bridge's clear roadway width is 40 ft, which is 12 ft wider than the existing 28-ft-wide bridge. The spans also change from six, 45-ft-long steel



The new pier fully constructed under the existing bridge with new girders on the temporary pier adjacent to it. The existing bridge is still in service.

spans to three spans of prestressed concrete bulb-tee girders (two 70-ft end spans and one 120-ft center span). This span configuration eliminated potential geometric conflicts between the existing and proposed structures and allowed work outside of the Cottonwood Creek channel.

The prestressed concrete bulb-tee beams have a larger structural depth, which created a lower bearing elevation than the existing superstructure. This lower bearing elevation allowed the proposed substructure to be constructed below the existing in-service bridge.

**Equipment used for drilled-shaft construction could not fit under the existing bridge. For this reason, the drilled shafts were located outside of the existing bridge's footprint.**

Placing new piers underneath the existing bridge also proved a challenge. Drilled shaft foundations are typically used in Oklahoma, but the equipment used for drilled-shaft construction could not fit under the existing bridge. For this reason, the drilled shafts were located outside of the existing bridge's footprint, and long-span pier caps were utilized. Using long-span pier caps in the traditional rectangular configuration are not the most structurally efficient; therefore a T beam configuration was utilized to increase capacity and structural efficiency.

At each end of the bridge, driven piling would typically be used to resist dead, live, earth-pressure, braking, and wind loads. Again, equipment used in piling installation would not fit under the existing bridge. This resulted in positioning the new abutments in front of the existing ones, allowing for their construction while the existing bridge was in service.

This configuration required specific design strategies related to lateral earth pressure. Similar to the piers, drilled shaft foundations were constructed outside of the existing bridge's footprint. For this configuration, the design had to account for lateral earth pressures and the potential for excessive lateral deflections.

## OKLAHOMA DEPARTMENT OF TRANSPORTATION, OWNER

**BRIDGE DESCRIPTION:** A 260-ft-long, prestressed concrete beam bridge with spans of 70, 120, and 70 ft

**STRUCTURAL COMPONENTS:** 72-in-deep bulb-tee girders; cast-in-place concrete deck; and cast-in-place pier caps, columns, and drilled shafts

**BRIDGE CONSTRUCTION COST:** \$3,809,500



A constructed soil nail wall in front of the existing abutment. The wall allowed for the construction of the proposed abutment under the existing bridge to facilitate the shortest detour duration.

To reduce the earth pressures and assist in constructability, a soil nail wall was put in place at abutment locations.

Due to tall embankments around the creek crossing, as well as limited space for transport equipment, the transverse sliding method was best suited for the site. Transverse sliding/skidding systems are often employed for structures over rivers where adjacent construction will not impact traffic and where it's not viable to transport in prefabricated pieces.

## Construction

Construction of the bridge occurred in two phases. The first phase involved constructing the substructure elements under the existing bridge and the superstructure on temporary supports adjacent to the existing bridge. Once complete, the second phase required closing and detouring traffic on SH 51, removing the old bridge, sliding the new bridge spans onto the support structures, and performing the final bridge and pavement connections.

Once the substructure was constructed under the existing bridge and temporary structures were built outside the existing bridge, the contractor constructed the new bridge on the temporary supports. Once the new bridge was ready to be moved, the existing bridge was demolished, and the new bridge was jacked vertically to place the guide track and sliding shoes. Then, hydraulic jacks were used to pull the new spans into place horizontally. The pulling method was chosen over pushing method due to the forces imparted at the permanent and temporary support connection.



The new first and third span in place, and the center span being moved. The highway was detoured and the existing bridge demolished prior to moving operations.



Removing the guide track after the spans were slid into place.



This photo shows placement of concrete for the approach slabs and pavement.

After the new end spans were in place, the roadway approach pavements were constructed. In less than 11 days of closure time, normal traffic operations resumed. ⚠️

*Jason Langhammer is a bridge team leader and project manager for Garver in Tulsa, Okla.*

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