PROJECT

MOUNT HOPE BRIDGE

by Abdul Hamada, WSP

The Mount Hope Bridge project is located about 2 miles north of the small rural town of Mount Hope in Sedgwick County, Kans. The bridge spans the Arkansas River and carries 279th Street West, a major collector, and is essential for the local farming community and the traveling public. Every harvest season farmers drive heavy machinery across this bridge, and, after 60 years of use, the previous eight-span, 654-ft-long, and 26-ft-wide structurally deficient bridge had to be replaced to accommodate the traffic demand.

Timeline

Construction of the project started in November 2014 and had an anticipated end date of November 9, 2015. The schedule was accelerated to minimize the closure period of the vital route and the impact of that closure on the farming community. The project timeline was also influenced by the Kansas Department of Wildlife and Parks requirement for construction to stay out of the wetted channel from April 1 to August 31 to protect multiple endangered fish species.

In fact, the project was completed on September 30, 2015, weeks ahead of schedule. The timeline was shortened because Sedgwick County Public Works provided a temporary construction staging area for the contractor and because all environmental and hydraulic permits were acquired before the start of construction. The simplicity of the

Finished bridge over the Arkansas River. The 5-ft-deep web walls below the pier beams between columns were designed to eliminate the accumulation of debris that could get tangled between columns. To keep road salts away from the piers, 6-in.-high curbs were added between railing posts above the piers. All Photos and Figures: Abdul Hamada.

profile

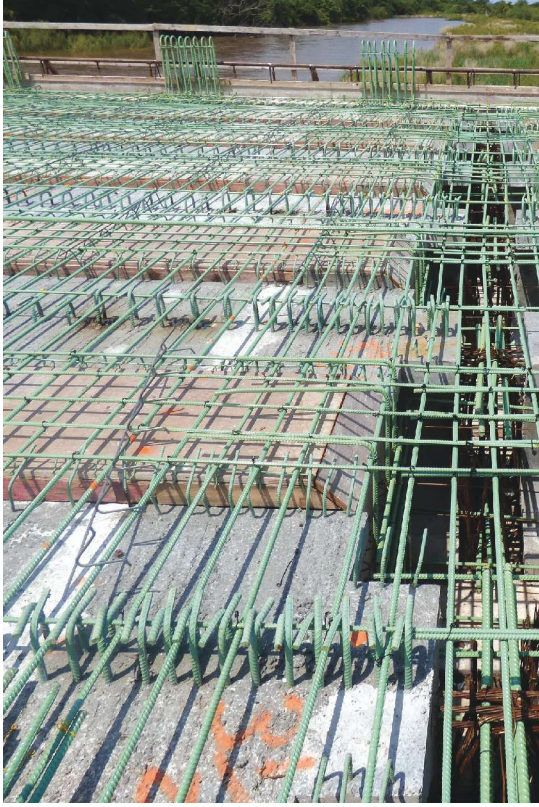
MOUNT HOPE BRIDGE / MOUNT HOPE, KANSAS

BRIDGE DESIGN ENGINEER: WSP, Wichita, Kans.

PRIME CONTRACTOR: Dondlinger Construction, Wichita, Kans.

PRECASTER: Coreslab Structures, Kansas City, Kans.—a PCI-certified producer

NU 1100+25 prestressed concrete girders are in place, and reinforcement is being placed for the abutment. Bent strands extending from girders are used for the connection to the abutment as well as in diaphragms between spans.



All reinforcement in the superstructure was epoxy-coated.

plans and the use of the shallow precast concrete beams were also major factors in completing the project ahead of the tight schedule.

Detour Planning

The project site was too narrow for staged construction, so the project used a signed detour. The official designated signed detour was approximately 22 miles long and used a route that included a bridge at 117th Street North, which was part of another replacement project. That construction had to be completed before work could begin on the Mount Hope Bridge. Coordinating with emergency response teams to ensure coverage for areas north of the bridge, as suggested by the Sedgwick County project manager, was another important step in the detour planning.

Public Engagement

Sedgwick County Public Works conducted several public meetings and published articles in the local newspaper to educate the public about the construction schedule, environmental concerns, detour route, and the construction progress. From the public meeting and discussions, the owner and the transportation-design consultant gained ideas about the scope and importance of the project. The needs of local farmers and the safety of the traveling public became important aspects of the project design. Because the previous bridge could not carry wide farming equipment, the local farmers had to take a long detour. Also, the previous bridge did not have a shoulder, which made it unsafe for travelers who became stranded on the bridge or needed to stop for assistance. In response to these issues, the new design included two 12-ft-wide lanes and two 6-ft-wide shoulders with barriers that comply with current Kansas Department of Transportation design specifications.

Environmental Issues and Construction Challenges

Because the project involved working both over and in the Arkansas River, special permits were required. These were obtained by the owner and the consultant in advance of the start of construction, which allowed the construction schedule to be shortened.

The contractor was obligated to comply with all regulations during construction. A site-specific Stormwater Pollution Prevention Plan was developed to protect and control both potential erosion and the endangered fish species that inhabit

SEDGWICK COUNTY PUBLIC WORKS, OWNER

BRIDGE DESCRIPTION: Replacement of an existing 654-ft-long, 26-ft-wide, 8-span, deteriorated steel beam bridge with a 683-ft-long, 38-ft-wide, 6-span (115-110-110-110-110-115 ft) prestressed concrete beam bridge over the Arkansas River.

STRUCTURAL COMPONENTS: Thirty-six 3 ft 8 5/16-in.-deep prestressed concrete bulb-tee girders spanning 110 or 115 ft; 8½-in.-thick cast-in-place concrete deck; cast-in-place pier caps, and cast-in-place columns and abutments with pile foundations. Epoxy-coated reinforcement was used in the abutments, girders, deck, and railings.

BRIDGE CONSTRUCTION COST: $3,164,200 ($128.40/ft^2)

AWARDS: Kansas American Public Works Association award

the river. As part of this plan, the erosion control measures were inspected every two weeks and after any weather event with more than 0.5 in. of rainfall, and the control measures were repaired or replaced as required.

A temporary river crossing that allowed for the free passage of the various aquatic species in the river was required for the project. The contractor paid special attention to the construction of this crossing to minimize turbulence both during its construction and removal.

Construction of the substructure was completed before April 1, 2015, the start of the critical period in which construction in the active channel was prohibited. To meet the overall construction schedule, the start of construction above the active channel coincided with the period in which construction was prohibited in the active channel.

For greater longevity, the three-column, cast-in-place concrete piers were constructed atop a concrete foundation supported by friction steel piles. Wooden piles had been used in the original 1954 bridge. The number of pier bents in the channel was decreased, and the piers were aligned with the flow of the channel to minimize impact of any potential scour. A 5-ft-deep web wall was added below the pier beam and between columns to eliminate the accumulation of any debris or brush that could get tangled between piers, again to mitigate possible causes for scour.

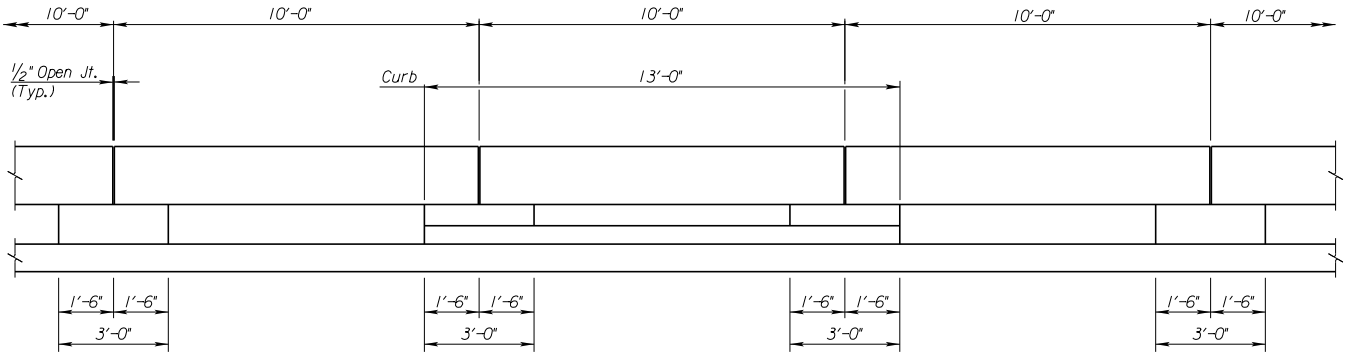
The bridge is in a high-risk Federal Emergency Management Agency (FEMA) flood zone AE, which has a 1% annual chance of flooding— more commonly known as the "100-year floodplain." Bridges in a FEMA zone AE must be designed to prevent any rise to the backwater surface profile. Therefore, the new waterway opening needs to match the existing waterway opening to keep the characteristics of the flow and conveyance of the river unchanged. A design that alters the river's flow and conveyance may lead to flooding downstream or upstream. This hydraulic issue was a challenge in the design, but it was resolved by the careful placement of abutments, piers, and superstructure. The project successfully achieved minimal impact on

Construction Timeline

The actual bridge construction activity start dates were as follows:

August 26, 2014	Bridge letting
October 6, 2014	Begin construction
November 2014	Demolish existing bridge
December 2014	Drive piles; form and place concrete for abutments and piers
March 2015	Place precast concrete girders
April 1 to August 31, 2015	Construction not permitted in wetted channel; superstructure construction continues over channel
April 2015	Cast concrete for intermediate diaphragms; place deck forms and install reinforcement
July 2015	Place cast-in-place concrete deck and install bridge rail
September 30, 2015	Construction complete

Open corral rail with 6-in.-high curb above piers to keep runoff from reaching piers and help prevent corrosion.



PARTIAL CORRAL RAIL ELEVATION
(Along Traffic Face, West Corral Rail shown, East Corral Rail similar)
Showing curb above Pier #2 and Pier #4

the channel below ordinary high water.

The selection of superstructure type was a key decision for this bridge project because it related to the environmental concerns, construction costs, and maintenance costs. Low-profile precast, prestressed concrete bulb-tee girders were selected to maximize the span lengths needed for fewer number of bents in the Arkansas River. These NU1100+25 girders—NU is named after University of Nebraska and is a cross-section type often used in the midwestern states—were designed to span 110 and 115 ft and were 3 ft $8^{5}/_{16}$ in. (1125 mm) deep (30:1 span-to-depth ratio). The NU1100+25 girders had a top flange approximately 4 ft wide and a bottom flange approximately 3 ft 3 in. wide and that contained 0.6-in.-diameter prestressing strands. The span arrangement of the bridge was 110, 115, 115, 115, 115, 110 ft with a total bridge width of 38 ft. Precast, prestressed concrete girders with wide flanges were chosen in part because they would take the least time for construction over the wetted channel, which helped the project deal with the scheduling limitations related to protection of endangered fish species.

Another reason that shallow bulb-tee girders were chosen was to minimize the raising of the vertical profile grade of the road. Keeping the profile low and keeping construction away from a nearby intersection minimized both right-of-way acquisition and approach work. This strategy, in turn, limited the impact of the project on adjacent property owners and reduced the cost of the project significantly.

The precast, prestressed concrete girders were also chosen because of their low maintenance costs. At the time of replacement, the previous bridge's steel beams were severely deteriorated and showed a significant amount of rust. The use of concrete decreased life-cycle costs because concrete requires no paint, does not rust, and exhibits less fatigue than steel. The precast, prestressed concrete girders were cast in an environmentally controlled manufacturing site, which virtually eliminated poor-weather construction situations. By using a system of prestressed concrete girders, cracks are minimized and the durability and longevity of the bridge are increased.

Kansas has harsh winters with snow and ice. To increase the life of the bridge, epoxy-coated reinforcement was used in the superstructure to minimize corrosion in the abutments, girders, deck, and railings that are exposed to road salts during the winter months. The piers can also be exposed to road salts if measures are not taken to protect them. In addition to strip-seal assemblies at the expansion joints, 6-in.-high curbs were added between the posts of the open corral railing above the pier bents, to keep salted water and water runoff from reaching the piers and help prevent corrosion in those vital areas.

Conclusion

Through partnership and close coordination among all the parties involved in the bridge project, all challenges were resolved. The contractor was able to start the project on the Notice to Proceed date; the project was completed ahead of schedule, despite several rainy periods; all the environmental concerns were addressed before or during construction; and the project was open to traffic more than a month ahead of schedule. In addition, the early completion of the project allowed the local community to harvest in the fall of 2015 with minimal interference from bridge construction, and no major complaints about the project were raised during construction.

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