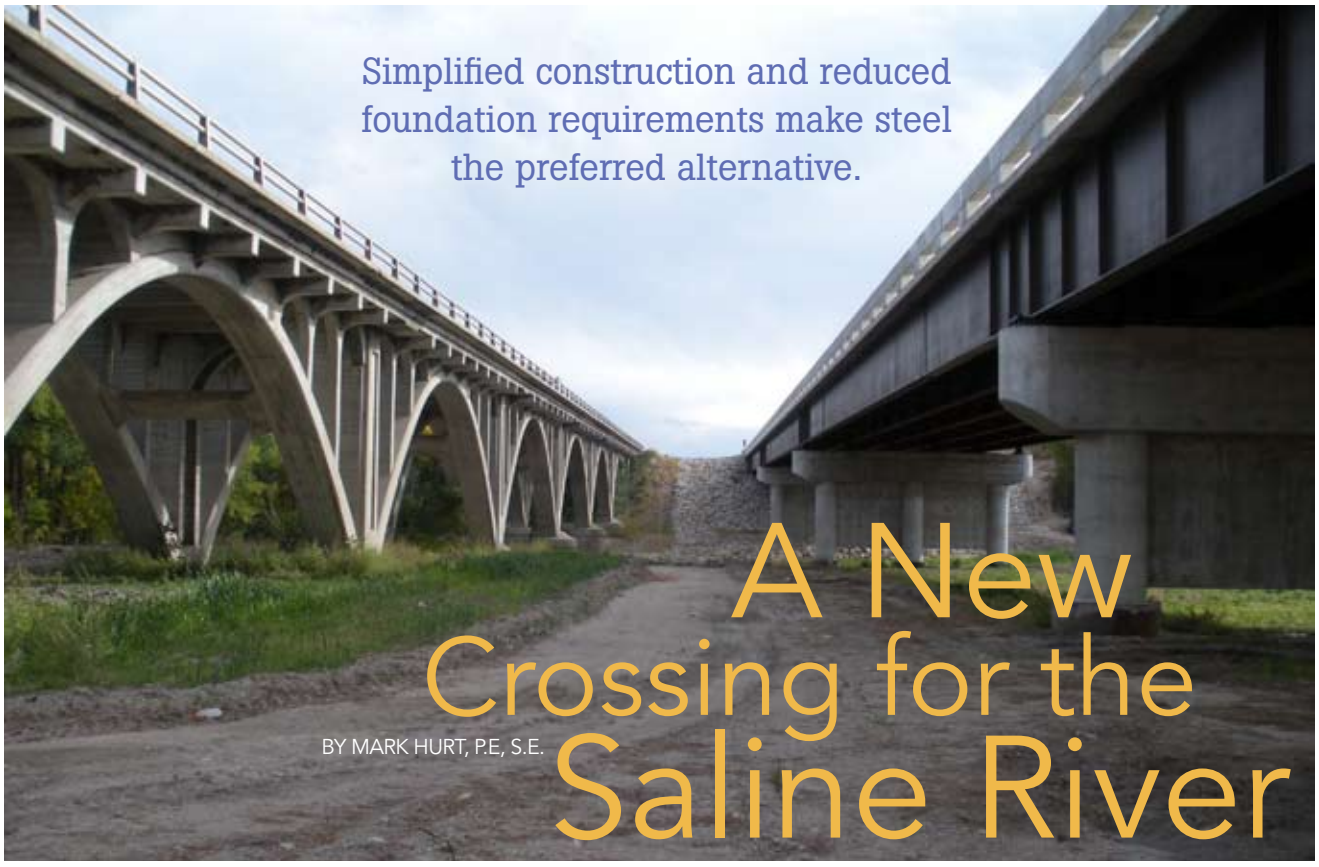

Simplified construction and reduced foundation requirements make steel the preferred alternative.

A New Crossing for the Saline River

BY MARK HURT, P.E, S.E.

Foundations required for the new steel bridge (right) crossing the Saline River in Kansas were somewhat lighter than would have been required if concrete had been used, and far less than those required to support the old reinforced concrete bridge (left).

IN 1933 AN EIGHT-SPAN reinforced concrete spandrel arch was constructed to carry traffic on Kan.sas Highway 1 (now U.S. Highway 183) over the Saline River, north of Hays, Kan. In the intervening years, migration of the upstream section of the Saline changed the river's angle of attack on the piers of the existing bridge, resulting in scouring at its spread footings. Current road design standards require a wider roadway and although the spandrel arch possesses a stately profile, that type of structure is not easily or economically widened. A new bridge with modern, scour resistant, deep foundations was required.

The Kansas Department of Transportation decided this project would provide a good test of the viability of using post-tensioned, prestressed concrete girders compared to traditional steel plate girders. The requirement was for a bridge of moderate length (about 660 ft) and the site had room for construction staging. The location also was readily accessible to contractors in Nebraska and Colorado with post-tension construction experience.

Two designs were prepared for letting: a four-span (140-ft, 187-ft,187-ft, 140-ft) steel plate girder design by the in-house design staff of KDOT's Bridge Office and a four-span post-tensioned prestressed concrete girder design, with spans nearly identical to the steel design, by an experienced consultant. Though both designs carried the same 44-ft roadway, the superstructure and substructure of each design was unique.

The plate girders were designed to act compositely with the concrete and have a uniform web depth of 75 in. Grade 50 weathering steel was used with AASHTO M270 T3 certification called out for the flange material. This was one of the first structures erected using Kansas' Special Provision requiring that specific and detailed erection plans be provided to the engineer on site. This provision was formulated in consultation with the Kansas Contractors Association after multiple steel and prestressed concrete girder erection problems. At a minimum, the provision requires the approval of erection plans by the state and the use of a pre-qualified erection supervisor.

The design for the post-tensioned prestressed concrete girder option used 73-in.-deep modified Kansas K6+1 beams. The girder spacing was slightly wider than that used in the steel girder option (9 ft, 6 in. vs. 8 ft, 2 in.), resulting in one less girder line. The maximum piece length of the concrete girders was limited to 150 ft to facilitate shipping, requiring erection of the girders to be a multi-stage process using strong backs at the girder splice locations on both sides of the center pier and a falsework tower in span three. Post-tensioning was to have been in two phases, one before and one after placement of the concrete deck.

The greater weight of the concrete girders required more substantial foundation elements than the steel alternative. The design of the steel alternative required nine H-piles per abutment, as opposed to 11 of the same size pile for the concrete alternative. The steel bridge uses three 66-in. drilled shafts per pier as opposed to three 72-in. drilled shafts per pier for the concrete alternate.

The engineer's cost estimates for the steel bridge and the post-tensioned prestressed concrete bridges were both around $3 million, but a true comparison of the costs between the structure types is unavailable. When the project was bid in 2008, all four bidders bid only on the steel alternative.

The new bridge was completed in the summer of 2009. The existing spandrel arch bridge, eligible for placement on the National Register of Historic Places, will be preserved on the old alignment adjacent the new bridge. MSC

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