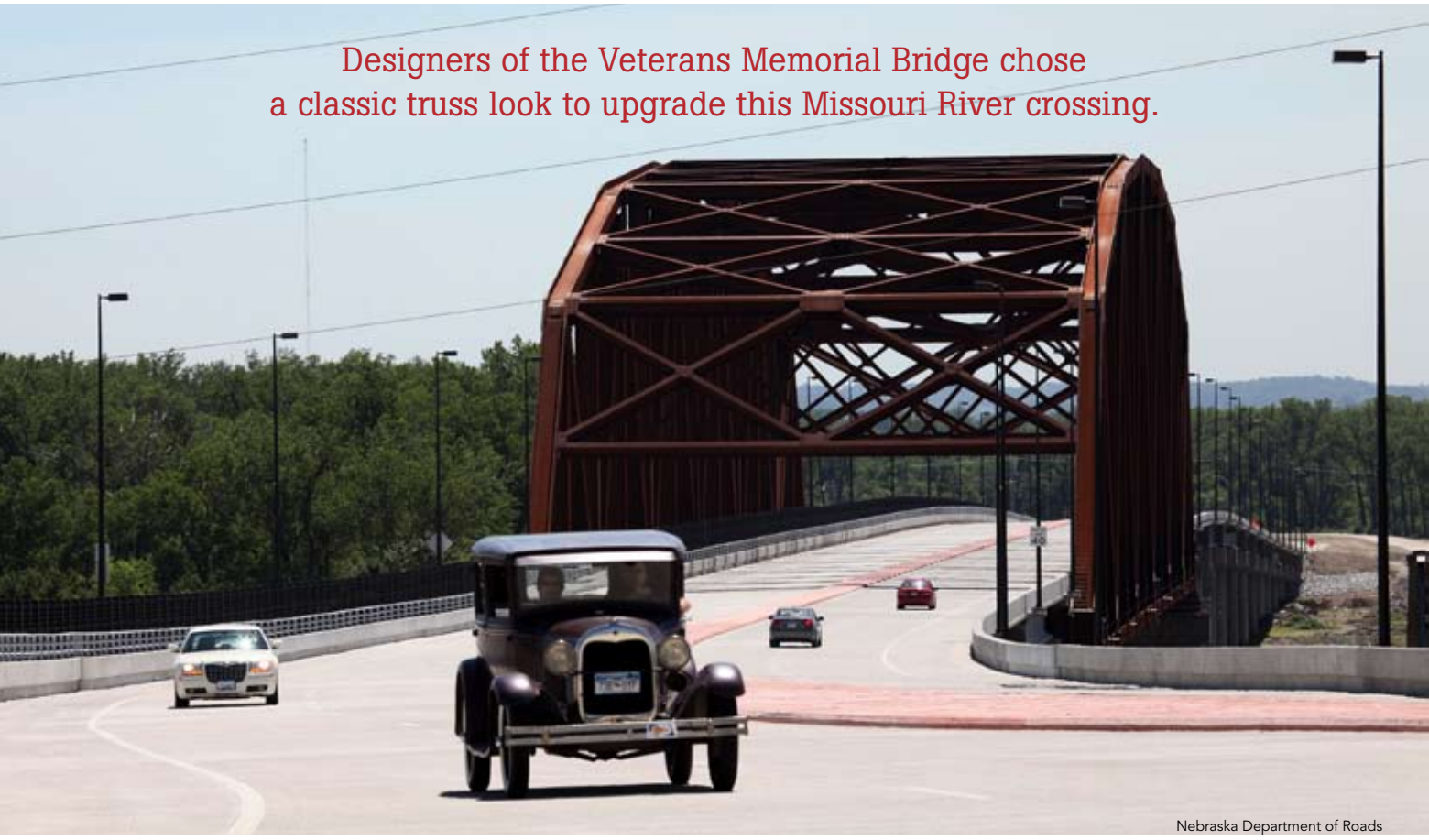
Designers of the Veterans Memorial Bridge chose a classic truss look to upgrade this Missouri River crossing.



Nebraska Department of Roads

Modern Design of a *Historical* Bridge Type

BY DOUG WALTEMATH, P.E., AND STEVE PELLEGRINO, P.E.

IT TOOK A WHILE, but when the opening day ribbon cutting for the new Veterans Memorial Bridge across the Missouri River finally arrived, dignitaries and citizens of Iowa and Nebraska turned out to celebrate the new link between Omaha, Neb., and Council Bluffs, Iowa. Fittingly, the ceremony took place on the Friday that ushered in the 2010 Memorial Day holiday weekend. Many veterans occupied front row seats as the governors of both states honored their past service to our country and spoke of the potential benefits of increased commerce between the two cities and how this bridge will contribute to that effort. To further celebrate the past, a parade of motorcycles and vintage cars took the first drive across the bridge.

The project had been in the works since 1996 when, due to the deteriorating condition of the existing bridge, preliminary studies for a replacement structure began. The existing bridge, a two-span continuous Warren Truss, was considered a landmark by many long-time residents of Omaha and in 1992 was listed on the National Register of Historic Places. However, its narrow 22.5-ft width disqualified it for restoration.

Harrington & Cortelyou (H&C) provided the design for the truss span piers, the truss span and the substructure for 17 of the 24 approach spans as a subconsultant to the project's prime consultant, TranSystems, Kansas City, Mo. H&C engineering services included coordination with the U.S. Coast Guard, the Nebraska Department of Environmental Quality and the Iowa Department of Natural Resources, all of which had to issue the permits and certifications needed for construction.

Contact was made with the Coast Guard very early in initial studies. The horizontal clearance requirement would determine structure types that were feasible for consideration. The preference of the owners was to use the normal minimum clearance required by the Coast Guard of 400 ft for the Missouri river when site conditions permit. With a navigation span of 425 ft to 450 ft, using economical parallel flange welded plate girders was a feasible option. Unfortunately site conditions did not permit use of the shorter span. The existing bridge has a horizontal clearance of 514 ft and is located at the immediate downstream end of a

The new Veterans Memorial Bridge combines a dramatic visual presence with a historical feel.

Nebraska Department of Roads

The walkway/bikeway on the new Veterans Memorial Bridge connects trail systems in Omaha, Neb., and Council Bluffs, Iowa.

U.S. 275 crosses the Missouri River on the Veterans Memorial Bridge's 624-ft. center span, which provides the Coast Guard-required 600 ft minimum horizontal clearance for navigation.

Nebraska Department of Roads

crossover in the navigation channel. The channel shifts from hugging the Iowa bank to hugging the Nebraska bank upstream of the bridge. The Coast Guard surveyed the barge operators and they indicated that often the barge tows are still skewed with respect to the bridge when they pass under it and the new bridge's navigation span should be as long as possible.

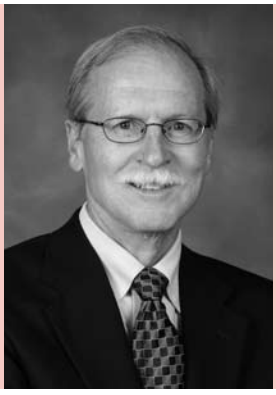
The preferred alignment of the new bridge was 110 ft upstream of the existing bridge. The Coast Guard required a 600 ft minimum horizontal clearance for the navigation span of the replacement structure. After setting back the Nebraska pier from the bank to minimize the chances of a barge collision, the truss span length needed was 624 ft.

The navigation span requirement eliminated consideration of a plate girder river unit. A brief cost comparison of cable-stayed, tied-arch and truss structure types showed that single-span tied-arch and truss were the most economical options with both having comparable costs. Early in the project a concern was expressed that highway truss bridges over the Missouri River were disappearing. In most cases new welded plate girder spans replaced old, often historical, truss bridges. With the mandate of a 624-ft span and the truss alternative being cost competitive with the other structure types considered, the decision was made to go with the truss span.

The truss was designed using the 2005 AASHTO *LRFD Bridge Specifications*. The truss is a 12-panel, Warren-type truss with variable height verticals and measures 624 ft between bearings. Significant features include an 87-ft, 8-in. bridge deck width consisting of two 34-ft roadways, a 6-ft center median and a 10-ft sidewalk. The center-to-center of the truss chords measures 93 ft. The maximum vertical height is 90 ft. Nine stringers are spaced at 10 ft, 3 in. and designed to be continuous over the floor beams, which eliminated costly bolted stringer-to-floorbeam connections. The truss itself consists of welded plate H-sections for the chords and all secondary members for ease of fabrication and erection and reduced costs. Structural steel is primarily Grade 50 weathering steel. HPS Grade 70 steel was used for the lower chords.

The total steel weight for the truss was 4,508 tons and required 50,600 high-

Doug Waltemath, P.E., was project manager for the Veterans Memorial Bridge project, and Steve Pellegrino, P.E., was the lead designer and supervised the plan production. Both are senior bridge engineers with Harrington & Cortelyou, Inc., a Burns & McDonnell Company.



▲ Erection of the Veterans Memorial Bridge utilized temporary bents at L2' and L6.

strength bolts for construction. ASTM A490 bolts, 1⅛ in. in diameter, were used in the primary truss joints.

The construction contract for the truss span and supporting piers was awarded to Jensen Construction Company. Construction began on the piers in late 2007. The massive truss piers are each founded on 10 drilled shafts each 7 ft in diameter and 70 ft deep. Typically, the design of Missouri River bridge piers in the river is controlled by barge impact loading. For this project, however, the wind loads on the truss controlled the foundation design.

The contractor opted to erect the truss in place. The design and truss erection sequence were developed by the contractor. Temporary bents were erected at L6 and L2'. Due to navigation requirements, falsework could not be placed between the Nebraska bank and L6. The columns of the bent were 8-ft-diameter steel shells founded on a concrete footing supported by four drilled shafts similar in size to the permanent construction. With the temporary reduction in navigation span width, the bent at L6 had exposure to being struck by a barge, but the cofferdam acted somewhat like fenders/collision protection.

Steel erection began between the Iowa pier and L2' and from there to L6 it was cantilever construction. To resist uplift at the Iowa pier, the end floor beam was locked down using anchorages consisting of bundles of post-tension strands cast in the columns of the pier. The Iowa end of the truss is the expansion end. The contractor developed and installed an elaborate restrainer device to lock the expansion bearings and prevent longitudinal movement during erection. After landing on the bent at L6, cantilevered construction continued until reaching the Nebraska bank pier.

The new Veterans Memorial Bridge features two 12-ft lanes of traffic with a 10-ft shoulder in each direction. A 10-ft clear bikeway/walkway runs along the north side of the bridge providing connectivity between the trail systems in Omaha and Council Bluffs. The finished bridge has a dramatic visual presence and provides a link to the past, when the truss was the only structure type spanning the Missouri River. The project also provides a safe, comfortable and welcome travelled way. MSC

Owners
Nebraska Department of Roads and the Iowa Department of Transportation

Structural Engineer (truss span)
Harrington & Cortelyou, Inc., a Burns & McDonnell Company, Kansas City, Mo.

Contractor
Jensen Construction Company, Des Moines, Iowa

Contractor's Engineer
Genesis Engineers, Kansas City, Mo.