

Kansas City—Kansas—finds a new way to span a vast rail yard and link the north and south sides of town.



Over the Rails in the Other Kansas City

Photos by Brenda Foree

BY BRENDA P. FOREE, P.E.

THE U.S. 169 (7TH STREET) BRIDGE in Kansas City, Kan. accomplishes quite a lot for just one bridge. Located between Kansas Avenue and Interstate 70, it spans over several Union Pacific Railroad and Kansas City Terminal Railway tracks. It serves as a primary route to the University of Kansas Medical Center - Kansas City from north of I-70. And above all, it provides a vital link between the north and south sides of town.

The original 34-span structure was designed in the early 1920s by Harrington, Howard and Ash Consulting Engineers, a predecessor of HNTB Corporation; construction was completed in 1924. To accommodate the Muncie Expressway (I-70) construction in 1959, the north five spans were buried, shortening the structure to 1,450 ft. The bridge was widened from two to four lanes in 1972.

Rehab Time

By the late 1990s the aging bridge was at a proverbial and literal crossroads. The Kansas Department of Transportation (KDOT) contracted with HNTB in 1999 to perform a discovery phase study to evaluate repair, rehabilitation, and replacement options for the bridge. The study was completed in 2003 and established

design criteria, scope of construction improvements, and construction cost estimate; the resulting recommendation was to replace the entire bridge.

Prior to the beginning of the study, KDOT had authorized funds to replace the bridge's reinforced concrete deck girder spans only—approximately 40% of the bridge. The remainder of the bridge would remain and consisted of two spans of continuous welded structural steel plate girders and nine simple spans of riveted structural steel plate girders. The study estimated the bridge replacement cost at \$21.1 million.

HNTB completed final design and bid plans for the replacement bridge in early 2006 and the project was let for construction in September 2006, with a target completion date of December 2008. General contractor Hawkins Construction Company built the bridge's south unit and subcontracted the construction of the north unit to United Contractors, Inc.

Features, Constraints, and Improvements

The replacement structure is a 10-span two-unit steel plate girder bridge and is designed to carry current AASHTO live load, HL-93.



The new 7th Street bridge in Kansas City, Kan. is a 10-span two-unit steel plate girder bridge.

The bridge's typical section consists of northbound and southbound 30-ft-wide roadways, with a 5-ft 6-in.-wide sidewalk located on the west side of the structure. Pedestrians are separated from the southbound roadway by a 42-in.-tall concrete safety barrier. The middle one-third of the bridge tapers out to provide for 650 ft of southbound left turn storage for Kansas Avenue at the south end of the bridge. The total length of the new bridge is 1,464 ft.

The numerous railroad tracks, existing bridge foundations, and an existing sanitary sewer provided limited locations for the new bridge foundations and added complexity to the design and construction of the bridge. The number of piers in the new bridge (nine) was reduced substantially from the existing 28 piers. The continuous movement of rail cars had to be accommodated during existing bridge demolition and new bridge construction.

Span lengths in the south unit are 110 ft, 125 ft, 165 ft, 180 ft, and 126 ft, while spans in the north unit are 160 ft, 160 ft, 151 ft, 136 ft, and 146 ft. The south five piers are not skewed, but the north four piers are skewed from 10° to 26°, resulting in girder lengths that vary by as much as 10 ft in one span.

Structural steel plate girders were chosen as the preferred structure type early in the preliminary design process due to the variable structure width, unbalanced spans, and span lengths up to 180 ft. An additional benefit of structural steel is reduced dead load and corresponding lower substructure and steel pile foundation costs.

The girders are composite, with concrete deck throughout. The partially stiffened webs are 48 in. deep in the south two spans and 66 in. elsewhere. Grade 50 unpainted weathering steel was chosen to minimize future maintenance costs, and the girders are painted only at unit ends, adjacent to expansion joints.

The bridge's vertical profile is constrained by the Kansas Avenue intersection on the south, the railroad tracks, and the I-70 bridge on the north. The existing profile proceeds north from Kansas Avenue at a positive grade of 5.53%. Although this steep grade could not be reduced on the new bridge, the profile was lowered to keep standard slopes within existing right-of-way and to meet the desired design speed criteria of 50 mph. The new profile eliminates the "dip" at the abandoned railroad depot, increasing stopping sight distance and design speed. Steel handrails are provided on each side of the sidewalk to meet ADA requirements.

The new bridge provides the required 23-ft 6-in. minimum vertical clearance over the below railroad tracks, eliminating the existing bridge's substandard vertical clearances at ten of the tracks. Barriers, fences, and pier collision walls meeting current American Railway Engineering and Maintenance-of-Way Association



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(AREMA) criteria are provided.

Besides the typical site constraints, the bridge was also required to stay within spatial boundaries set by agricultural infrastructure: The horizontal alignment is constrained by the Archer Daniels Midland (ADM) grain elevators located within 6 in. of the west fascia of the original bridge. The baseline of the new bridge is shifted slightly east of the existing U.S. 169 centerline to avoid impacts to the ADM elevators and to better align with the I-70 bridge north of the project and with the lanes south of Kansas Avenue. The alignment provides improved right turn radii at the I-70 entrance and exit ramps at the north end of the bridge.

In order to maintain one northbound and one southbound lane during construction, the existing structure was removed and the replacement bridge built in two phases. The east portion of the new bridge was completed in 2007 while traffic used the west half of the existing bridge. During 2008, traffic was shifted to the east portion of the new bridge while the west portion was being constructed. Erecting the phase 2 girders in the south unit between the grain elevators and the phase 1 girders presented a tight window for construction. As such, girder erection began at the south abutment and proceeded northward using the previously erected structure as a platform.

The bridge opened on time last December, providing an up-to-date structure for the vital link between north and south Kansas City, Kan.

MSC

Brenda P. Foree is a project manager with HNTB Corporation.

Owner

Kansas Department of Transportation

Designer

HNTB Corporation, Overland Park, Kan.

Steel Fabricator and Detailer

DeLong's, Inc., Jefferson City, Mo. (AISC/NSBA Member)

General Contractor for South Unit

Hawkins Construction Company, Omaha, Neb.

Subcontractor for North Unit

United Contractors, Inc., Johnston, Iowa