NATIONAL STEEL BRIDGE ALLIANCE

2001 Prize Bridge Award

merit award: SHORT SPAN

James P. Kirkwood Bridge

West Argonne and Clay Avenue, Kirkwood, MO

In 1996, the City of Kirkwood, MO, was faced with the challenge of replacing the deteriorating James P. Kirkwood bridge, (formerly Clay Avenue bridge), which spans the Union Pacific Railroad and is located in a historic (pre-Civil War) downtown business district.

The engineering firm, in coordination with the City Steering committee, selected a steel pony truss bridge as the replacement structure. A pony truss bridge presents a unique structural design challenge since the top chord is not directly braced as it would be in a through truss bridge.

Although the pony truss bridge was popular before World War II, they are rarely used today and there is little guidance in AASHTO or other current references about their design. The design team's innovative solution included treating the top chord as a beam-column supported by an elastic foundation (the truss verticals). The truss verticals are connected to the floor beams with a fixed moment connection to develop their "spring stiffness" resulting in an unbraced length design that is a function of the floorbeam and truss vertical stiffness, the top chord section properties and length.

Economic Benefit and Cost-Effective Aspects of the Design

The James P. Kirkwood bridge is vital to the economic viability of Kirkwood's downtown business area, carrying over 8,000 vehicles a day and providing a bypass for the frequently blocked Kirkwood Road (State Highway 61) railroad crossing.

Cost-effective aspects of the design included providing the minimum structural depth solution, resulting in a minimal impact to the current grade. Most economic bridge types currently in use would have required raising the grade substantially to provide adequate vertical clearance.

The pony truss bridge provides greater horizontal and vertical clearances for the railroad tracks below without causing costly reconstruction of the intersections on each end.

Design Problems and Solutions

Vertical clearance requirements of the Union Pacific Railroad and State Department of Transportation, Bridge Safety Division and the grade of the approach roadway presented design challenges.

The James P. Kirkwood bridge provides a grade separation at the Union Pacific Railroad crossing. The span was lengthened from the original 64′ to 90′ due to the horizontal clearance required by the railroad. To meet the vertical clearance requirement a steep vertical curve is used which caused considerable increase in complexity both in design and fabrication of the steel structure.

The limited right-of-way of the approach roads with structures along the right-of-way lines further increased the complexity of the design. The roadway approaching the bridge has a +10% grade on the north and a -5.75% grade on the south. The bridge trusses were cambered to approximate the roadway camber.

The pedestrian sidewalk also contributed complexity to the connections on the bottom chords. The sidewalk was cantilivered from the bottom chord in line with the floor beams, which meant that continuity had to be maintained in three directions: the truss bottom chord, the floor beam and sidewalk beam and the truss vertical.

Owner
City of Kirkwood, Kirkwood, MO

Structural Engineer
Horner & Shifrin, Inc., St. Louis, MO

Steel Fabricator
Havens Steel Company, Kansas City, MO (AISC member)

Steel Detailer
Havens S.P.I., Kansas City, MO (NISD member)

Steel Erector
Havens Erectors Inc., Kansas City, MO (AISC & NEA members)

General Contractor
The Harlan Company,
St Louis, MO

Software
SAP2000