Hays Street Bridge Restoration

Patrick Sparks
Sparks Engineering, Inc.
www.sparksengineering.com

In the early 1900s the Galveston, Harrisburg, and San Antonio Railway was in the midst of an expansion from the City of San Antonio, Texas, westward, and as its tracks intersected the city's existing roadways, the railway was required to construct above-grade crossings for horse-drawn carriages and, later, motor vehicles. In 1910 a viaduct was required to carry Hays Street over two active railroad tracks and two city streets, and to economize, the railroad decided to move two narrow-gauge iron trusses that formed a bridge over the Nueces River in southwest Texas to the San Antonio location. One truss was a 130 ft long 1910 Pratt truss and the other a more historically significant 225 ft long Whipple truss, both produced in 1881 by the Phoenix Bridge Company of Phoenixville, Pennsylvania. In the process of connecting the trusses to form the new bridge in San Antonio, the railway widened both spans from 16 ft to 25 ft, and constructed 1,000 linear ft of concrete approach spans. The Whipple truss, one of only six such trusses remaining in Texas, and one of the few remaining trusses with Phoenix columns in the country, featured segmental wrought iron columns, cast-iron joint blocks, and early laminated steel pins.

The bridge served its purpose dutifully as the region grew, but by the early 1980s it was determined to be structurally deficient and was closed to vehicular traffic. A movement began to replace the bridge, but in the 1990s, Douglas Steadman, P.E., formerly the president of W. E. Simpson Company in San Antonio, identified the trusses as historically significant and successfully lobbied for their inclusion on the list of Historic Civil Engineering Landmarks of Texas in 2001. Steadman then led an effort to obtain grant funding and private contributions to save the trusses and convert the bridge for use as a pedestrian and bicycle crossing.

Thanks in part to those efforts, the bridge was recently rehabilitated and transformed by the City of San Antonio under a grant from the Texas Department of Transportation. Sparks Engineering, Inc., of Round Rock, Texas, served as the design consultant for the project. The work involved rebuilding the bridge's two elevated concrete approaches, structurally rehabilitating the truss spans, and adding lighting, landscaping, and interpretive signage. The design team identified the following key goals for the project: safety, utility, beauty, permanence, and economy.

The design assures compatibility with the bridge's historic character, in accordance with The Secretary of the Interior's Standards for Rehabilitation (36 CFR §67.7). The iron trusses are the principal historic features of the bridge and had to be preserved.

Because of extensive deterioration, entirely new approaches were designed. The characteristics of the approach spans that the team chose to maintain in the new design are the basic 1910 alignment and profile, although slight modifications were made in slope to improve the crossing's accessibility and its vertical clearance above the two street crossings. The new approaches are 15 ft wide, much narrower than the 30 ft width of the 1910 approaches, which opens up the space beneath the bridge visually and creates greater opportunities for plantings, seating, and interpretation installations at ground level. This design is compatible with the size, scale, and character of the neighborhood and surrounding environment, as recommended by the Secretary of the Interior's Standards. The new approaches are of cast-in-place concrete, with a slender profile and tapered brackets that recall the character of the 1910 work. Using mostly single-column supports at 40-ft on-center lends elegance to this dominant part of the project. This scenario also represented the least cost, longest life-cycle, greatest utility, and best potential for aesthetic excellence.

The two historic trusses were in essentially good condition but with some areas of serious corrosion. The original materials were wrought iron and cast iron (used in the joint blocks in the Whipple span), which have very good durability The elements having the highest amounts of corrosion were those steel elements that were added in 1910, including lateral struts on the Whipple span and miscellaneous stiffening angles and cover plates on the floor beams. The unusual laminated steel pins of the Whipple truss had detectable corrosion pits in some locations.

Because the geometry and sections of the main members are relatively simple to model, material characterization became the key issue in the structural analysis of the bridge. A rigorous evaluation was necessary because the materials were of unknown quality, the critical fabrications were never quality-checked by modern standards, design loads have increased over time, and the effects of decay and fatigue may have reduced the members' capacity. On the other hand, the importance of bridges such as this one as significant icons of history requires that our evaluation methods be as least invasive as possible. So it was not feasible or appropriate to remove sufficient material to test the material properties in a laboratory. Instead, we used in-place nondestructive methods. In addition to a visual assessment and structural analysis, we relied on a combination of materials characterizations and nondestructive testing. In this approach, data regarding the elements' microstructure, hardness, and chemical composition, together with other historical data, are used to characterize the behavior of the material without the need for physical sampling.

On the basis of the findings above, the team determined that the two truss spans could indeed be rehabilitated for use in the pedestrian crossing. The trusses themselves did not have to be strengthened, but corrosion was repaired and those diagonal members that had bent over the years were straightened. The center and top lateral struts of the Whipple span had been lengthened in 1910 with steel, not wrought iron, and these were severely corroded. The team therefore replaced them with weathering steel, a substitute material that is resistant to corrosion. All of the floor beams of the Whipple truss had to be rehabilitated and their corroded cover plates replaced. Two of the floor beams were removed from the truss for repair, but the remainder were rehabilitated in place.

In keeping with the practices used in constructing the truss, the team used traditional hot riveting methods rather than, as is more conventional, replacing the rivets with bolts. A special crew was trained in hot riveting in order to accomplish this, and the process was videotaped and posted on Youtube.com. Hot riveting was also used to replace corroded rivets throughout the trusses. Pack rust was removed from many of the floor beams and vertical members; in some cases the team removed the rivets in order to do this, but in some cases a technique developed by the riveting consultant was used whereby the rust was loosened from the crevices with the aid of a rivet hammer.

The deck was replaced with lightweight, foot-friendly 2 × 6 pressure-treated lumber. Only the floor beams were painted and the upper truss members were given an appearance coat of linseed oil.

The project was funded by a TxDOT Enhancement Grant, private donations, and the City of San Antonio. Plans and specifications were completed in September 2006, and the project was bid in early 2009. Construction began shortly thereafter and was completed in the spring of 2010.

The design required flexibility to meet current code requirements, ensure compatibility with the bridge's historic character, and stay within budget.

In addition to the truss rehabilitation and the reconstruction of the concrete approaches, the project included architectural and pedestrian lighting, interpretive signs, and a landscaped entry plaza. The $3.2-million project also included badly needed drainage improvements and repairs to broken and clogged storm sewer pipes in the neglected neighborhood nearby.

As a pedestrian bridge that will serve as a link between the east side of San Antonio and its downtown, the newly renovated Hays Street Bridge is inviting to all, providing not only a sense of community as an area of recreation but also as an attraction for visitors.

S. Patrick Sparks is the principal of Sparks Engineering, Inc., Round Rock, Texas.

Bridge Facts:

Map:
http://maps.google.com/maps/ms?hl=en&ie=UTF8&msa=0&msid=102047806124284212679.00046683f083297074f8b&ll=29.430814,-98.476875&spn=0.012783,0.01929&z=16&iwloc=00048bfc8679f549fa3e7

Bridgehunter: http://bridgehunter.com/tx/bexar/hays-street/

Total length of viaduct: 1,400-lf
Historic spans: 225-lf Whipple + 130-lf Pratt
Cost of project: $3.2 Million

Owner:	City of San Antonio
Prime Consultant:	Sparks Engineering, Inc., Round Rock, Texas
Site/civil engineer:	Garcia & Wright, San Antonio, Texas
Contractor:	Jay-Reese Contractor, Inc., Austin, Texas
Landscape architect:	Bender Wells Clark, San Antonio, Texas
Electrical Engineer:	Joshua Engineering Group, San Antonio, Texas
Riveting Consultant:	Vern Mesler, Lansing, Michigan

Resources:

Facebook Fan Page: http://www.facebook.com/profile.php?id=597281599#!/pages/San-Antonio-TX/Hays-Street-Bridge/151580447463?ref=ts&__a=21&ajaxpipe=1

Hot riveting videos: http://www.youtube.com/watch?v=qD9eWgcAtLg
http://www.youtube.com/watch?v=Xi_LRrsv8QA