DANVILLE BRIDGE
(Mickles Bridge)
Spanning Petit Jean River on unnumbered county road
Mickles
Yell County
Arkansas

HAER AR-92
AR-92

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

DANVILLE BRIDGE
(Mickles Bridge)

HAER No. AR-92

Location:	Spanning Petit Jean River on unnumbered county road, .25 miles north of AR 10, 5 miles east of Danville, Mickles, Yell County, Arkansas
UTM:	15.472904.3880868, Danville Mountain, Arkansas, Quad.
Structural Type:	Bowstring through truss
Construction Date:	1880; relocated 1921
Builder:	King Iron Bridge & Manufacturing Co. (iron superstructure) Tillman J. Gaydon (masonry piers and abutments) William H. Ferguson (wooden approaches)
Owner:	Yell County, Arkansas
Previous Use:	Vehicular bridge
Present Use:	Abandoned
Significance:	The Danville Bridge is a good example of an iron bowstring truss bridge, a type which is becoming increasingly rare. It is one of two extant bowstring trusses in Arkansas, both of which were built by the King Iron Bridge & Manufacturing Company of Ohio, a nationally significant nineteenth century firm.[1] Of the approximately seventy-five surviving bridges built by King Bridge Company, 25 percent are bowstring trusses.[2]

[1] In addition to the Danville Bridge, at least three other King patent bowstring truss bridges were built in Arkansas: Springfield Bridge (1874), Faulkner County; Flat Rock Creek Bridge (1874), Crawford County; and Rocky Crossing Bridge (1880), Yell County.
[2] Allen Sloan King, King Bridge Company website, www.kingbridgeco.com, accessed 28 October 2007.

Project Information:

The Arkansas Historic Bridges Recording Project is part of the Historic American Engineering Record (HAER), a long-range program that documents historically significant engineering sites and structures in the United States. HAER is administered by the Heritage Documentation Programs Division of the National Park Service, United States Department of the Interior, Richard O'Connor, Manager. The Arkansas State Highway and Transportation Department sponsored this project.

Lola Bennett, HAER Historian, 2007

Chronology

1803 Louisiana Purchase doubles size of the United States

1818 Zenas King born in Vermont

1819 Arkansas Territory created from part of Louisiana Purchase

1836 Arkansas becomes 25th state to join the Union

1839 America's first iron bridge erected at Brownsville, Pennsylvania[3]

1840 Yell County formed

1841 Squire Whipple patents America's first iron bowstring truss[4]

1857 Thomas Moseley patents an iron tubular bowstring truss

1858 Thomas Moseley hires Zenas King as company agent

1861 Zenas King and Peter Frees patent an iron tubular bowstring truss

1871 King Iron Bridge & Manufacturing Company incorporated at Cleveland

1873 Arkansas Legislature authorizes counties to build and maintain bridges

1876 Philadelphia Centennial Exhibition features a King patent bowstring truss bridge

1880 Danville Bridge erected

1884 King Bridge Company claims to have built 5,000 bridges

1888 King Iron Bridge Company claims to have built 10,000 bridges

1892 Zenas King dies; James and Harry King take over King Bridge Company

1921 Danville Bridge moved from Danville to Mickles

1922 James King dies; King Bridge Company ceases operations

2006 Local historians discover Danville Bridge

[3] See HAER No. PA-72 Dunlap's Creek Bridge.
[4] See HAER No. NY-4 Whipple Cast & Wrought Iron Bowstring Truss Bridge.

Description

The Danville Bridge is a 100' iron tubular bowstring through truss on concrete piers. The curved upper chords are built-up box-section members comprised of channels and plates. A fabricator's plate, attached to the upper chord, reads: KING IRON BRIDGE & MFG. CO., CLEVELAND, O., Z. KING PAT., JULY 31, 1867. The lower chords are paired, forged I-bars. The upper and lower chords are connected by vertical iron posts, built-up of angles and straps. The posts flanking the center panel consist of single channels with thread-ended rods at each end. Presumably, the chords, posts and diagonals are connected with a nut at each panel point, but these connections could not be examined. The ends of the curved upper chord thrust against cast iron shoes secured to the piers. This thrust is resisted by the lower chord members that pass through the same point. Overhead bracing consists of two transverse lattice struts at the center panel points.

The deck system hangs from the vertical posts below the lower chord. The inboard leg of each post passes between the two channels of the associated floor beam and is secured beneath the floor beam with a plate and nut. The outboard leg of each post is secured to the projecting end of its associated floor beam to provide lateral stiffness. The trussed floor beams (back-to-back channels connected with spacer bars) are supported by trusses comprised of I-section struts and bar tension members. Lower lateral bracing is loop-welded rods crossing diagonally between the trussed floor beams. Typically, bridges of this type had longitudinal timber stringers and a transverse plank deck above the floor beams, but all wooden parts of this bridge, including approaches and deck, have been removed, making the structure inaccessible.

History

On July 8, 1879, the Yell County Court ordered a bridge to be built across Petit Jean River at Danville, Arkansas. Yell County Bridge Commissioners J.K. Perry, J.B. Albright, George Turner and County Judge John Choate contracted with William H. Ferguson for a wooden bridge, but several months later, they rescinded that contract, stating, "*an iron bridge would be of much more value to the county.*" According to county records, "*The bridge commissioners had apparently been convinced of this in the process of purchasing two iron cells for the county jail.*"[5] One month later, the bridge commissioners let a new contract to the King Iron Bridge & Manufacturing Company of Ohio for a 100' long "*iron tubular arched bridge of Z. King's latest improved patent.*"[6] William Ferguson was awarded a contract for building wooden approaches. The iron trusses were fabricated at the King Bridge Company's plant in Cleveland, Ohio, and shipped by rail to Russellville, Arkansas, where they were loaded onto wagons for the final leg to Danville. The superstructure of the Danville Bridge was completed in the summer of 1880 at a cost of $3,100.

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[5] *Yell County Court Records*, 1880, 81.
[6] *Yell County Court Records*, 1880, 140.

In 1920, the Danville Bridge was replaced by a wider concrete bridge and the old bowstring truss was moved to its present location at Mickles, Arkansas, where it replaced an unsafe wooden bridge. The bridge was abandoned in the mid-twentieth century.

Design

The bowstring truss combines an arched upper chord acting in compression with a horizontal lower chord acting in tension. The thrust exerted by the upper chord is resisted by the lower chord, which ties the ends of the arch together. The efficient design of the bowstring truss had a high carrying capacity while using a comparatively small amount of iron. Light, sturdy and optimized for spans of up to 150', the iron bowstring truss was among the favorite designs of bridge builders in the second half of the nineteenth century. Its heyday lasted from about 1860 until 1890.

The enormous growth of American rail and highway systems after the Civil War made the search for economical and efficient bridges highly competitive. A number of bridge builders obtained patents for variations on the basic "arched truss" patented by Squire Whipple (1804-1888) in 1841. During the 1860s and 1870s, the predominant form for the upper chord was a hollow, wrought-iron tube. Builders experimented with a variety of cross-sectional shapes and configurations, obtaining an impressive number of patents that were manufactured under license to different companies. By the late nineteenth century, the necessity of customizing members to the specific length of each span became a drawback of the bowstring truss and it gave way to the more easily standardized Pratt and Warren trusses.

Builder

In 1858, businessman Zenas King (1818-1892) became an agent for Cincinnati bridge builder Thomas Moseley, inventor of a wrought iron bowstring truss with a triangular-section upper chord. Soon, King began to experiment with improvements to Moseley's design. After Moseley moved his business to Boston, King formed a partnership with Cleveland metalworker Peter M. Frees.

In early 1860, King and Frees filed a patent application for a bowstring truss with an upper chord that increased in cross-section toward the crown of the arch, claiming this resulted in a lighter, more efficient structure. The U.S. Patent Office rejected their application twice, first citing that the concepts employed were well-known, and later on the basis of Charles DeBergue's 1848 British patent.[7] After modifying their claim, King and Frees received their patent in October 1861.

For the next two years, King and Frees built boilers and bridges at Cleveland. After Frees left in 1864, King focused solely on building bridges under the 1861 patent, which was reissued in

[7] David A. Simmons, "Bridge Building on a National Scale: The King Iron Bridge and Manufacturing Company," *IA: Journal of the Society for Industrial Archeology* 15, no. 2 (1989): 24.

1867 with the option of using rolled sections instead of wrought iron boiler plate.[8] It is not known whether King ever used the varied-section upper chord claimed in his patent, as it made fabrication more difficult and expensive. Both of the King bowstring bridges in Arkansas, the Springfield Bridge (1874) and the Danville Bridge (1880) feature a uniform-section upper chord.

Regardless of his tenuous patent claims, King was reportedly a shrewd businessman who made manufacturing bowstring trusses an economic success. In 1871, he established a manufacturing plant at Cleveland, one of the nation's industrial centers. He hired trained engineers and salesmen who aggressively marketed his bridges.[9] By the late 1870s, the company had diversified its work to include Pratt through trusses, reflecting a national trend away from the bowstring truss design in favor of standardized bridge designs.[10] By the early 1880s King had salaried agents in almost every state and his company was one of the largest iron bridge fabricators in the nation, claiming to have built 10,000 bridges before 1900. After Zenas King's death in 1892, the business reorganized as the King Bridge Company and continued under the leadership of King's three sons. The company survived until the death of James A. King in 1922.

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[8] Zenas King and assignee of Peter M. Frees, U.S. Letters Patent No. 2,767, 30 July 1867.

[9] Some of King's agents went on to form other bridge-building companies. Zenas King's nephew, George E. King, one of the company's western agents, formed his own company at Des Moines, Iowa, in the 1880s. George and Frank Austin, who worked as agents for George King, formed the Austin Bridge Company (now, Austin Engineering), one of the major early-twentieth century builders of suspension bridges in Texas. Allen Sloan King, "The King Bridge Company Through the Decades," in *Proceedings of the 7th Historic Bridges Conference in Cleveland, Ohio*, (September 2001), 64.

[10] Simmons, "Bridge Building on a National Scale," 34.

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