

HISTORIC AMERICAN ENGINEERING RECORD

NORTH FORK BRIDGE

(Norfork Bridge)

HAER NO. AR-10

LOCATION: State Highway 5, spanning North Fork of the White River, Norfork, Baxter County, Arkansas.

UTM: 15/4007570/564160

Quad: Norfork, Arkansas

DATE OF CONSTRUCTION: 1937

ENGINEER: Arkansas State Highway and Transportation Department.

BUILDER: Vincennes Steel Corporation, Vincennes, Indiana.

PRESENT OWNER: Arkansas State Highway and Transportation Department.

PRESENT USE: Vehicular bridge.

SIGNIFICANCE: Designed by the Arkansas State Highway Department as a result of the unexpected cost involved in the erection of a proposed concrete deck arch bridge, the North Fork bridge was an early example of the modern steel deck truss bridge. Its historical context, where economy prevailed over the more architectural concrete design, and the curiosity of its design, where the deck truss narrows at each end span, contribute to its significance as a representative steel deck truss.

HISTORIAN: Sean O'Reilly

DESCRIPTION: Corinne Smith

Arkansas Historic Bridge Recording Project, 1988.

NORFORK HISTORY

June 17, 1937, was a big day in the history of Norfolk. The \$110,916.00 suspended truss type steel bridge rising seventy feet above the North Fork River was dedicated.(1)

Norfolk, in Baxter County, Arkansas, a settlement that dates back to the 1810s, has been called the oldest continually settled part of the county.(2) However, it was only in 1907 that it was incorporated as the town of Norfolk, having been known first as Liberty and then as Devero. The town was situated near the junction of the White River, one of the most important rivers in the region, and a major tributary, the North Fork. This ensured Norfolk's early success as a trading town. With the development of the railroads in the area at the turn of the century, a new lease of life was given to Norfolk by the routing of the railroad through the town.(3) Norfolk was always very much part of the larger social region of the Ozarks. The Ozarks, the mountainous region passing from the north of Arkansas to the south of Missouri, preserved many of its traditional crafts and ideals. W. Zass, the State Highway Department's chief engineer, noted, in a letter concerning the bridge, that "the community is essentially rural and nothing whatsoever indicates that it will not remain so."(4)

When the Norfolk bridge was opened in 1937, the town celebrated their new symbol of success and modernity with the traditional levity of a fair. However, behind their new bridge lay a dramatic paradigm of modern society, where a labor-intensive bridge design was rejected for a design of the most efficient and economic form.

BRIDGING THE NORTH FORK

Due to the geography of the site, the bridging of the North Fork at Norfork was an extremely difficult task. Situated on the south side of the North Fork, the town sat on a bluff high above the river. On the north side, opposite the town, the ground was some 80 feet lower. To overcome this discrepancy, any bridge-builder had to find some compromise between cutting into the bluff on the south side and setting a massive dump on the north. With an 80 foot gap to be evened, this clearly provided significant engineering and financial problems.

Before the North Fork bridge, the only bridge crossing the river here was that which carried the railroad. This bridge was built by the White River Division of the Missouri Pacific Railroad in the first decade of this century.(5) The rail route through the county, which also passed through the then insignificant town of Cotter, was intended to expand Jay Gould's Missouri Pacific empire through the Ozarks.(6) Surveying for the route began in 1901 and by December 29, 1904, the last rail of the route was spiked. The railroad bridge at Norfork spanned the river below the town, towards the White River. The bridge was supported on the north side on an artificial embankment to make it level. An artificial embankment, however, was a less than perfect solution to the problem of bridging the North Fork in the 1930s. Sheer labor cost obviated the construction of dump to raise the road on the north side the required 80 feet.

All road traffic crossed the river by ferry, situated downstream from the railroad crossing. As the road approached the river upstream from the railroad, two dangerous crossings of the railroad track had to be made by any traffic on the route.

BRIDGE I

As a result of the unsatisfactory crossing of the river at Norfork, a suitable bridge was an early consideration of the State Highway Department. As early as October 3, 1927, the State Highway Commission requested "a report and estimated cost" of a bridge on this site.(7) By November 20, two proposals had been prepared: "a steel cantilever bridge and a suspension bridge, both to have 16 ft clear roadway."(8) Nothing, however, was to develop from these proposals directly, the unnecessarily costly development of the bridge at Cotter absorbing the majority of the finances and interest of the Highway Department in Baxter County in the late 1920s.(9)

It was not until 1935 that the Highway Department was prepared to reconsider the building of a bridge at Norfolk. In October plans were completed for a reinforced concrete four-span open-spandrel deck arch bridge over the river.(10) The projected bridge was a highly successful, though structurally traditional design adorned with Art Deco motifs. It solved the problem of different levels on each side of the river with a logical compromise. It reduced the bluff on the south side, raised a dump on the north side, and accepted a four degree gradient for the bridge deck. A curiosity of the design was that, due to the varying spaces between the piers, each arch span had a different curvature, the two spans to the north being decidedly asymmetrical. The design as a whole, however, was handled in a distinguished manner. It was described by the local newspaper, the Baxter Bulletin, in the following words: "The plans call for a concrete structure of the open spandrel type, 530 ft. long. There will be three piers and four arches. The roadway will be 22 foot wide."
(11)

The bids for the bridge were advertised on March 1, 1936, with an estimated cost of \$131,000. They were let on the 19th of that month and the competing builders made their bids. However, a problem arose when the "contractors who bid on the bridge job were way above the governments estimate," and as a result no bid was accepted.(12) The State Highway Department immediately decided to redesign the bridge completely and, by April 30, had preliminary designs prepared for the second North Fork bridge proposal.(13)

BRIDGE II

As early as 1935 it was clear that the cost of a reinforced concrete bridge was greater than that of a steel truss system. The extra labor costs involved in a concrete bridge necessarily increased any expenditures. However, the principle given priority in that year was one of greater employment rather than greater economy. In October 1935 the State Highway Department noted with respect to its concrete arch design:

This layout...will provide a maximum of employment and a minimum of purchase materials. It is possible that a steel bridge of the cantilever type would cost somewhat less...but it is our thought that it would be more in keeping with the aims of the administration to use a type that would provide more employment relief.(14)

Such a concern regarding the problem of unemployment was both typical and appropriate for a State Department in the years of the American Depression. As the contract for the first bridge was received, however, the Department realized that it could not subsidize unemployment to the extent

of building an unacceptably expensive bridge. It promptly resolved to design a new bridge based on the "cheaper" steel bridge of the cantilever type.

The new bridge designs proceeded apace after the failure of the bids on the first bridge proposal. The bridge designers selected a bridge of the steel deck truss type for its new proposal. The steel truss consisted of four spans, two cantilevered and two suspended, designed for ease of erection. The use of a steel truss system eliminated much of the expensive labor costs involved in the erection of the formwork needed for a concrete bridge.

The re-designing of the bridge was, effectively, restricted to the method of spanning the distance between the original pier sites. This promoted an efficient search for a new design, as the question of pier siting did not need to be considered.(15)

As early as April 17, less than a month after the rejection of the bids on the first bridge proposal, the Baxter Bulletin could report: "The Norfolk Bridge tangle seems to be getting straightened out again...The bridge is being redesigned now as a steel structure and it is expected that the contract for the structure will be let sometime in May."(16)

On Tuesday, June 1, 1936, the contract was re-let. It was, according to the newspaper, "the largest of the 10 projects let to bidders that day."(17) The contract was let to the Vincennes Steel Corporation of Vincennes, Indiana for \$87,915.62.(18) The estimated cost of the steel bridge was over one-third less than the under-estimated cost of the concrete bridge, emphasizing the cost-efficiency of the revised design.

BRIDGE BUILDING

The Baxter Bulletin, the county newspaper, was the public observer of the progress made during the erection of the North Fork bridge. It documented not only the construction of the bridge, but also the striking impression made by the unashamedly modern bridge on the essentially rural population of the town and surrounding district.

Work on the bridge had begun by August 21, 1936, and a Bulletin reporter was quick for inform his readers of the intentions of the bridge builder:

A fifteen-foot cut will be made through the bluff on the Norfork side which will act as a pier on the bank. Besides this, there will be three other piers. One in the center of the river and one on each side. The fill on this [north] side of the river will be 28 feet. The structure will have a four degree grade from the Norfork side to the dump on the other side.(19)

By December 4, the local reporter was sufficiently excited by the progress made on the bridge to proclaim: "This bridge will be one of the most interesting things in the county to tourists and sightseers."(20) This far-sighted judgment was made with only "...one pier and the abutment on this [North] side of the river" complete and "with the dump to raise the north side river bank" well under way.(21)

By April 9, 1937, the piers were completed and the complex task of placing and securing the four steel spans was under way.(22) By the end of that month the company had begun to pour the floor slabs, the final undertaking before cleaning up and painting the steel, "with aluminum paint, giving it a silvery appearance".(23)

One month later the Bulletin recorded the interest the public was taking in the completion of the bridge. "The final work is being done and it is being given its coat of aluminum paint this week. It is attracting much interest already and large crowds go to see it every Sunday afternoon."(24)

On June 4, the Bulletin presented its final synopsis of the building and aesthetics of the North Fork bridge. With the bridge opening scheduled for June 17, the report displayed full confidence in the success of the bridge design.

The bridge is one of the most attractive in Northern Arkansas...In place of the overhead steel work it has decorated steel railing on each side, which gives one a perfect view of the river, either way, in crossing.(25)

The selection of a steel deck truss, where the roadway passes above the structural steelwork, in contrast to the more traditional steel through truss, where the road passes through the steel truss, impressed the people of Baxter County. Not only did the deck truss permit a fine view of the river, but it also gave no hint of the presence of the bridge to the approaching traffic. The Bulletin also noted that when "approaching the bridge...through the main street of Norfolk, one plunges onto the bridge before they are aware of its presence."(26) With the deck truss, bridge and road merge into one and the traditional structural and aesthetic distinction between bridge and roadway was rejected. Clearly, this contributed to the powerful impression made by the bridge on the people of Norfolk.

The completion of the bridge was marked by the official opening and dedication of the bridge on June 17, 1937. The celebrations, with some three thousand people present, were attended by representatives from every county in Northern Arkansas.(27) Among those present were County Judge Ruthven, the prime motivator of bridge building in the area, and James Rhyne, Director of Highways, "who made a short speech on the construction of the bridge...."(28) The dedications

included "placing of a marker at the old Wolf house at Norfork, which is the oldest bridge now standing in the upper White River county"(29) Thus, both old and new were linked in a ritual that absorbed the bridge into the historic tradition of the town of Norfork.

VINCENNES STEEL CORPORATION

The predecessor of the Vincennes Steel Corporation, the Vincennes Bridge Company, was incorporated in 1898 in Vincennes by three former schoolteachers, Frank L. Oliphant, John T. Oliphant and Jacob L. Riddle.(30) Ultimately to become one of Indiana's "most successful bridge-building firms," it began in a small one-room shop in Vincennes with an initial capital investment of \$20,000. The early bridges of this burgeoning company were small I-beam spans and pony trusses. By 1920, annual production had surpassed 1,200 spans a year with annual sales in excess of \$1 million.

With the development of the State Highway Systems in the 1920s, bridge building expanded rapidly and efficiently. The Vincennes Bridge Company, was ideally suited to the vigorous and effective pursuit of the numerous bridge contracts then let.

Its continued concentration on "full service bridge building" after the First World War was untypical.(31) By the 1920s most large bridge-building companies had expanded and diversified to the extent that the companies were only subcontracted to provide material.(32) Not only did the Vincennes Bridge Company compete directly in bridge contracts, but it "retained crews prepared to build concrete substructures and it erected its own spans"(33)

By 1932 the Vincennes Bridge Company was ready to expand into broader markets and a new company, the Vincennes Steel Corporation, was incorporated. "The operations of the business took on new vistas of expansion. In addition to the great program of bridge construction, mass and assembly line production methods stepped up production."(34) The company continued its growth through to World War II and after. In 1956, after some decline, it was taken over by Industrial Enterprises, Inc. for a sum in the region of one million dollars.

By 1956, the company had expanded beyond the proudest dreams of its founders, producing such notable bridges as the 420-foot steel bridge at Paw-Paw, West Virginia, as well as numerous bridges in Arkansas.(35)

These and many other notable bridges are monuments to the...Vincennes Bridge Company and many of them stand out in great contrast to the tiny span bridge over a creek near Arcola, Illinois built in 1898, the first span ever designed and constructed by the company.(36)

ENGINEERING DESCRIPTION

The North Fork Bridge at Norfolk is a steel deck Warren truss with verticals. The 518-foot length is comprised of two cantilevered spans at 139 feet and 185 feet and two suspended spans at 111 feet and 83 feet. The cantilevered spans, the first and third from the south, extend 28 feet past the piers for the suspended spans to hang from.

The road declines 4 percent from south to north, so the level bottom chord of the fourth truss keeps the steel above the highwater mark. The slope of the bottom chord in the first and fourth trusses decreases the truss depth toward the abutments. The first truss may have the identical depth

decrement to keep the bridge symmetrical in appearance. The second and third trusses have parallel top and bottom chords.

The two lines of trusses are roughly 7 feet in from the edge of the sidewalks on either side of the bridge. Web members are either I-sections or two channels with lacing. The top and bottom chords consist of two channels, flanges out, connected by lacing or batten plates. At each panel point, the top chord supports the floor girders. These girders extend the width of the roadway and connect to the posts of the steel handrail. Two I-beam stringers, 3 feet in from the top chords, support the reinforced concrete slab deck. Angle sections laterally brace the upper and lower chords diagonally from every other panel point. Sway bracing made from angles also exists at these point. Despite the similarity of connection plates, rivet patterns vary along the chords, partially due to design and partially to techniques of individual construction workers.

The construction process started with the erection of the anchor arm of the first cantilever span, the north cantilever arm of the second, and the northern most suspended span. Next the remaining cantilever arms were constructed. The second suspended span could then be hung between the extended arms of both cantilever spans with a hinge at one end and a rocker at the other. (See Highway Drawing No. 4518).

ENDNOTES

1. Messick, M.A. History of Baxter County, 1973, p. 62.
2. *ibid.*
3. *ibid.*
4. W.H. Zass, Chief Engineer, State Highway Department to C. E. Swain, District Engineer, Bureau of Public Roads, November 19, 1935. AHTD Microfilm Files.
5. Messick, M.A. A History of Baxter County, 1973, p. 99.
6. *ibid.*
7. C.S. Christian, State Highway Engineer, to N. B. Garver, State Highway Department Engineer, October 3, 1927. AHTD Microfilm Files.
8. Memorandum dated November 20, 1927. AHTD Microfilm Files.
9. Historic American Engineering Record. HAER Report AR-15: "The Cotter Bridge," 1988.
10. "North Fork Bridge", Drawing No. 4167. AHTD.
11. "Norfork Bridge Approved", Baxter Bulletin, November 15, 1935, p. 1.
12. "Paving and Bridge Jobs Bids too High", Baxter Bulletin, March 27, 1936, p. 1.
13. W.H. Zass to C.E. Swain, April 30, 1936. AHTD Microfilm Files.
14. W.H. Zass to J. Page, Senior Highway Engineer, Bureau of Public Roads, October 4, 1935. AHTD Microfilm Files.
15. The argument is based upon a comparison of the relevant drawings, Drawings Nos. 4167 and 4516. AHTD.
16. "May Let Bridge Contract Soon," Baxter Bulletin, April 17, 1936, p. 1.
17. "Norfork Bridge Contract Let Tuesday," Baxter Bulletin, July 3, 1936, p. 1.

18. Bridge 587. Card Index, AHTD.
19. "Norfolk Bridge will be Complete in 8 Months," Baxter Bulletin, August 28, 1936, p. 1.
20. "Work is Progressing Rapidly on Norfolk Bridge," Baxter Bulletin, December 4, 1936, p. 1.
21. *ibid.*
22. "Piers Completed at Norfolk Bridge," Baxter Bulletin, April 9, 1937, p. 1.
23. "Queen for Bridge Dedication to be Selected Monday," Baxter Bulletin, April 30, 1937, p. 1.
24. "Norfolk Bridge Celebration June 17," Baxter Bulletin, May 28, 1937, p. 1.
25. "Program for Bridge Opening June 17 is Being Completed," Baxter Bulletin, June 4, 1937, p. 1.
26. *ibid.*
27. "Three Thousand People Attended Bridge Celebration," Baxter Bulletin, Opportunity Edition, June 25, 1937, p. 10.
28. *ibid.*
29. "Norfolk Bridge Opening Being Celebrated Today," Baxter Bulletin, June 18, 1937, p. 1.
30. Cooper, Jas. L., Monuments to Distant Posterity. Indiana's Metal Bridges 1870-1930, Indiana 1987, p. 28 and "Bridge Works City Stalwart for 58 Years" Vincennes Sun Commercial, Vincennes, Indiana, November, 1956, p. 1.
31. Cooper, *op.cit.*, p. 28.
32. *ibid.*
33. *ibid.*
34. "Bridge Works City Stalwart for 58 Years," Vincennes Sun Commercial, Vincennes, Indiana, November, 1956, p. 1.

35. *ibid.* c.f. also Historic American Engineering Record, HAER Report No. AR-25: "The Cache River Bridge" and HAER Report No. AR-38: "The Wyman Bridge", 1988.
36. Cooper, Jas. L., *loc.cit.*

BIBLIOGRAPHY

Arkansas State Highway and Transportation Department, Bridge Section; Card Index, Microfilm File and Drawings. Ref. Bridge No. 587, Job. No. 5194.

Baxter Bulletin, Mountain Home, Baxter County, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, and 1937.

Builder's Plate: "North Fork Bridge".

Cooper, Jas. L. Iron Monuments to Distant Posterity. Indiana's Metal Bridges 1870-1930, Greencastle, Inc., Depauw University, 1987.

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Vincennes Sun Commercial, Vincennes, Indiana, November, 1956.