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United States Department of the Interior
National Park Service

National Register of Historic Places Multiple Property Documentation Form

This form is for use in documenting multiple property groups relating to one or several historic contexts. See instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. For additional space use continuation sheets (Form 10-900-a). Type all entries.

A. Name of Multiple Property Listing

Historic Bridges of Arkansas

B. Associated Historic Contexts

Early Transportation Era
Arkansas Highway and Transportation Era

C. Geographical Data

State of Arkansas

☐ See continuation sheet

D. Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for the listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in 36 CFR Part 60 and the Secretary of the Interior's Standards for Planning and Evaluation.

Cathy H. Burnett — 2-13-90

Signature of certifying official — Date

Arkansas Historic Preservation Program

State or Federal agency and bureau

I, hereby, certify that this multiple property documentation form has been approved by the National Register as a basis for evaluating related properties for listing in the National Register.

Cindy Federman — 4/6/90

Signature of the Keeper of the National Register — Date

EARLY TRANSPORTATION ERA

In 1831, the Arkansas State Legislature passed a law giving William S. Lockhart a franchise, good for twenty years, to build and operate a toll bridge over the river where the Military Road crossed it, "at or near where the leading road from Little Rock to Washington, Arkansas crosses the said Saline river."[1] Lockhart was permitted "to receive of all persons crossing, and for all species of stock, such rates as the proper court . . . shall from time to time authorize and direct."[2] It was provided, however, that the bridge must be in operation within three years from the passage of the Act, and that the bridge must be kept "in good order and repair".[3] It was also stipulated that the Act should not prohibit any person from fording the river, free of toll, at or near the crossing of the road, when the river was fordable and the traveler preferred that method of passing over it.

This system of granting licence to private individuals or bridge corporations to construct, own and operate toll bridges was the primary means the state used to fund bridge construction during this period. These early bridges were usually constructed from cut timbers in a pony-truss design.

The first major river bridge built in Arkansas was at the point where the Military Road crosses the Ouachita River at Rockport. This bridge has been described as "a lattice type bridge built of wood."[4] It was built in 1846 by the Little Rock Bridge Company, which had been granted the privilege of erecting such a bridge, with the right to charge tolls, by the General Assembly of 1844.[5] An article in the July 1, 1847 issue of the Arkansas Gazette stated:

> The Washita Bridge . . . we understand from its enterprising projector, Capt. D.H. Bingham, is now nearly complete. We are also pleased to learn from all persons who have seen the work, that it is highly creditable to its builder, and will turn out, contrary to the expectations of many, a source of large profit to its stockholders.[6]

The next spring, the river rose unusually high, creating a swift current which resulted in the bridge being washed downstream. The Arkansas Gazette reported:

> The bridge across the Ouachita River at Rockport which had cost the stockholders $20,000 to build was swept away by a flood. The bridge was thought to be 8 feet above the high water mark but on the day of its destruction 'the river was eleven feet higher than it had ever been known to be before.' The bridge was lifted from its foundation and forced from its position by a mass of drift, and 'when last seen' was floating down stream with all its parts holding together.[7]

As the population grew in Arkansas, county politicians under the direction of the County Judge saw an expanding tax base as a means to purchase iron bridges for their local roads and at the same time give its citizens free access without paying a toll. By the 1870's numerous bridge companies, relying heavily on their own patented bridge designs, were sending salesmen across the country to sell their product. Arkansas was no exception. This period in the nation's industrial history was unprecedented in the production of prefabricated iron truss bridges and produced the widest range of bridge designs. Existing Arkansas examples of significant Early Transportation Era bridges purchased from 19th century bridge companies are the Springfield-Des Arc Bridge (HAER No. AR-32), the Old River Bridge (HAER No. AR-46) and the Rockport Bridge (HAER No. AR-47), which have all been previously listed on the National Register of Historic Places.

The oldest bridge to survive in Arkansas is the Springfield-Des Arc Bridge (HAER No. AR-32). It is the premiere example of 19th century patented truss design as well as the only remaining iron bowstring arch

bridge in the state. The bridge was built on the road linking Springfield, the Conway County seat from 1850 to 1873, with Des Arc, an important steamboat landing on the White River.

The bridge is an unaltered example of an iron tubular arch design patented by Zenas King in 1861 and 1866. King was a significant nineteenth-century bridge builder, credited with being the first to develop a practical system for mass-producing bowstring arch bridges. By 1884, his Ohio-based bridge company was the largest highway bridgeworks in the United States. The Springfield-Des Arc Bridge is one of a very few known bridges manufactured by the King Iron Bridge Manufactory and Iron Works of Iola, Kansas, a short-lived branch of the Ohio firm. The Springfield-Des Arc Bridge is one of only two remaining nineteenth-century bridges in Arkansas, and is an excellent example of Zenas King's contribution to bridge construction in the United States.

King Bridge and Iron Works

Zenas King was born in Vermont in 1818. Five years later, he moved with his family to upstate New York, where he grew up on the family farm. He left the farm in 1840 and went to Milan, Ohio, where he held a number of successive positions, as a carpenter, a clothing merchant, and a salesman.[8] King's first experience with bridge building occurred in 1858, when he became an agent for the Moseley Bridge Company in Cincinnati, Ohio. The company's owner, Thomas W.H. Moseley, was the inventor of the first practical tubular arch bridge in America made from wrought iron boiler plate.[9] In a relatively short time, King began to experiment with a tubular bowstring design of his own. Moseley moved to Boston about 1860, and King went to Cleveland, where he established a bridge and boiler works.

Although King hoped to establish his business on the basis of marketing an innovative bowstring arch bridge, it was more likely his introduction of mass-produced wrought iron bridge parts that eventually led his company to become one of the leading bridge companies in the United States during the second half of the nineteenth century.[10]

In 1870, King established a branch of his bridgeworks in Iola, Kansas. About a year later, the branch moved to Topeka, claiming that they needed better transportation facilities.[11] Fragmented documentation, however, indicates that the company branch went bankrupt.[12] The Springfield-Des Arc Bridge was probably one of very few bridges manufactured by the Iola plant. Despite the failure of the Iola branch, the Cleveland firm thrived throughout the next few decades. King's use of standardized parts allowed his company to manufacture large quantities of bridges,[13] and agents and subsidiary companies allowed King to distribute his bridges over a large geographical area. Although King died in 1892, the firm continued into the twentieth century.[14]

The rapid growth of highway and railroad systems in the second half of the nineteenth century "fostered bridges which were efficient in their use of materials and labor."[15] The bowstring was considered a very efficient design because of its high carrying capacity, and use of a relatively small amount of iron.[16]

King's bowstring arch bridge design incorporated a tubular arch, which increased in size toward the crown of the arch, where the strain would be greatest. A uniform section would be wasteful of materials. The first two times King and his assistant, Peter Frees, applied for a patent, they were refused on the grounds that the concepts were not new, because Charles DeBergue, an Englishman, had patented a similar design in 1848.[17] Eventually, in 1861, King and Frees received their patent, after showing that their design incorporated continuous wrought iron plate in the top chord, as opposed to DeBergue's short cast iron sections.[18] King received a second patent in 1866, for an "improvement" to his original design, which in effect reversed the configuration of the first design. This time, the tubular section of the top chord increased at the ends of the arch, and got smaller at the crown. The following year, he revised the patent again, eliminating the varied section of the arch.[19] The

Springfield-Des Arc Bridge follows the design of the 1866 patent reissue, with the tubular chord of the arch getting larger at either end.

The iron bowstring arch enjoyed a popularity in the 1870's that slowly gave way to other truss designs, such as the Pratt truss, which was patented in 1844 by Thomas and Caleb Pratt. Caleb was a Boston architect, and his interest in construction led his son, Thomas, to obtain a degree in engineering from Rensselear Polytechnic Institute. After college, Thomas served with the Army Corps of Engineers and later worked as an engineer for several New England railroads. It was this railroad work that led him to develop an all-iron truss for bridges.[20]

The Pratt truss followed the structural pattern of a popular bridge type, the Howe truss, but reversed the function of the verticals and diagonals. By subjecting the diagonals to tension rather than compression, Pratt reduced the danger of their buckling. The Pratt truss became one of the most popular metal-truss bridge designs in the United States during the nineteenth century.[21]

Many other popular bridge types were spin-offs of the original Pratt truss. These included: the Parker truss, which was a Pratt with a polygonal top chord; the Whipple truss, which was a double-intersection Pratt, where the diagonals extend across two panels instead of one; the Lenticular truss, a Pratt with curved top and bottom chords; the Baltimore truss, which introduced sub-struts and sub-ties into the design; and the Pennsylvania truss, which combined sub-struts and sub-ties with a polygonal top chord.[22]

The earliest Arkansas example of a Pratt through-truss is the 1891 Old River Bridge (HAER No. AR-46). It is the second oldest remaining bridge in Arkansas, and one of two known nineteenth-century bridges in the state. It is an excellent example of a pin-connected Pratt through-truss. A unique feature of the bridge is the connection of the floor beams at each panel point. The floor beams are suspended from U-shaped bolts, which hang from the a pin through each vertical member. Ordinarily, the floor beam would be attached directly to the vertical with a series of rivets, thus making a rigid connection.

The bridge was constructed by the Youngstown Bridge Company of Youngstown, Ohio, a significant bridge-building company between 1878 and 1900.

Youngstown Bridge Company

In 1878 Charles and Henry Morse established the Morse Bridge Company at Haselton, Ohio.[23] The company's construction philosophy emphasized solid work that guaranteed high profit margins rather than innovative designs. A disastrous fire closed the plant in 1888 and the brothers moved to Chicago and Delaware, respectively, to start over. Sometime between 1888 and 1890, the Youngstown Bridge Company formed, bought the Morse plant site, and rebuilt the bridgeworks.[24]

In 1900, the company was acquired by the American Bridge Company, at which time its plant was sold to, and dismantled by, the Youngstown Steel and Tube Company.[25] The American Bridge Company was incorporated by J.P. Morgan and Company in New Jersey on April 14, 1900. The following year, the company became a subsidiary of United States Steel Corporation. The Youngstown Bridge Company was one of twenty-four bridge companies--representing fifty percent of the nation's fabricating capacity--which were consolidated by the American Bridge Company in its first year alone.[26] Personnel from the Youngstown firm figured prominently in the administration of the new company, with a secretary being given the position of company treasurer, and the president becoming the general manager.[27]

Other significant Pratt through-trusses in Arkansas are the Osage Creek Bridge (HAER No. AR-30) in

Benton County and the Cypress Creek Bridge (HAER No. AR-33) in Perry County, an unusual skewed truss built in the early 20th century. A fine example of a Pratt pony-truss can also be seen in the Mountain Creek Bridge (HAER No. AR-34) in Polk County.

Built in 1900, the Rockport Bridge (HAER No. AR-47) is significant as one of six Parker through truss bridges remaining in the state. The bridge is unique in Arkansas, due to its Camelback through truss approach span at either end.

The company that built the bridge, Stupp Brothers Bridge and Iron Company of St. Louis, Missouri, is still in existence and is one of the largest and oldest steel fabricators in the country. The company is known to have built at least thirty bridges in Arkansas between 1900 and 1930.

Located on what was once a major thoroughfare, the Rockport Bridge served much of the vehicular traffic in south central Arkansas until 1970, when the Interstate 30 bridge was built nearby. Turn-of-the-century metal through truss bridges, like the Rockport Bridge facilitated the movement of heavy commercial traffic, particularly wagons carrying lumber and produce, which could not safely utilize wooden bridges or ferries, and thus played an important role in the history of commerce.

Although presently in weakened and deteriorating condition, the Rockport Bridge is an excellent example of a pre-automobile metal bridge that was so well engineered it was able to be adapted for the use of motorized vehicles.

Stupp Brothers Bridge and Iron Company[28]

In 1856, John Stupp established the South St. Louis Iron Works in St. Louis, Missouri. The German-born iron worker had apprenticed throughout Europe, first with ornamental and structural iron, and later with building barges, before coming to America in 1854. For two years he was employed by a St. Louis company that made plows, but soon left the firm to start his own business. The South St. Louis Iron Works manufactured engines, lathes, boilers, and small machine parts. Gradually production expanded to include ornamental iron products--fences, gates and building fronts.

In the 1880's, Stupp's sons, George, Peter, and Julius, entered the business. During this decade, the Stupp Company began to design, fabricate and erect bridges. The company's growth during this period led to its incorporation as Stupp Brothers Bridge and Iron Company in 1890.

Throughout its history, Stupp Brothers Company has been engaged in fabricating bridges; constructing industrial, civic and commercial buildings; and providing steel for national defense projects, including armor plate for Union gunboats in the Civil War, and parts for transport ships, bridges, and landing craft in both World Wars.

Today, Stupp Brothers continues its long tradition of steel manufacture, supplying fabricated steel for national and international projects, such as the space program, power plants, oil rigs, pipelines and bridges. After 130 years of operation, with fifth generation Stupps still in the business, Stupp Brothers Company can boast of being "one of the largest steel fabricators in the country and certainly the oldest under one family control."[29]

Other significant examples of Early Transportation Era bridges in Arkansas are 1) the Parker through-truss 1907 War Eagle Bridge (HAER No. AR-50) and 2) the steel bedstead pony-truss 1909 Spavinaw Creek Bridge (HAER No. AR-29). Both were built in Benton County by the Illinois Steel Bridge Company of

Jacksonville, Illinois.

Illinois Steel Bridge Company

The Illinois Steel Bridge Company of Jacksonville, Illinois won the contract for the War Eagle Bridge, dated May 18, 1907, which committed the company to building the 182-foot steel bridge by January 1, 1908. In return, Benton County would pay $4790.00, ". . .one-half in cash on completion of [the] bridge, and [the] balance in county scrip, redeemable on or before June 20, 1908." The contract is signed by the Benton County bridge commissioners and the Illinois Steel Bridge Company's contracting engineer, Thomas Boles.[30]

The Illinois Steel Bridge Company must have been very competitive, at least in Benton County, because on July 1, 1909, the notice was published announcing that bids would be taken July 31st to build a seventy foot bridge across the Spavinaw Creek according to the existing plans and specification.[31] By the end of the day on July 31, a contract has been drawn up between Benton County, Arkansas and the Illinois Steel Bridge Company of Jacksonville, Illinois with company agent Thomas Boles.[32]

The contract called for the company to erect a seventy foot bridge by December 31, 1909. In return the company would receive $2000 in Benton County "warrants" upon completion.[33] A four panel bedstead truss was the type called for in the specifications. There was to be a county-provided railing, concrete encased piers, an oak flooring and two coats of paint.[34]

The Spavinaw Creek Bridge (HAER No. AR-29) is a bedstead truss as the original specifications demanded. Bedsteads fit into a group of bridges that could be labeled "interesting," but not interesting enough to have survived the standardization that state highway departments imposed when they became the regulating agencies for bridges. James L. Cooper, in his book on Indiana bridges wrote, ". . .[T]he bedstead represents. . . a very different order of creative design, one where short spans could be built cheaply in part by incorporating the substructure directly into the metal fabricator's equation. . . . Neither eye-catching nor otherwise attention getting, bedstead pony trusses provided cheap and quite functional spans. . . ."[35]

The Lee Creek Bridge (HAER No. AR-45) is a late 19th century Pennsylvania through-truss and is one of four surviving in the state. It can be compared with the 1910 Little Missouri River Bridge (HAER No. AR-44) -- a Camelback through truss located in Clark County. Both use a polygonal top chord.

The Pennsylvania truss derived its name from its use on the Pennsylvania Railroad. The design became popular after 1875 and remained in use until the early twentieth century. The combination of the polygonal top chord with the Pratt truss allowed the depth of the truss to be adjusted differentially along the length of the bridge. This reduced the weight of the bridge, in addition to conserving metal.[36]

Early 20th century examples of steel pony-trusses are the 1908 Little Cossatot River Bridge (HAER No. AR-35), a single span Warren pony-truss built by the Morava Construction Company of Chicago, Illinois in Sevier County and a unique double-intersection Warren pony-truss, the Achmun Creek Bridge (HAER No. AR-37), located outside of Ola in Yell County.

The 1912 Winkley Bridge (HAER No. AR-48), spanning the Little Red River at Heber Springs, is an excellent example of a streamlined suspension bridge, and represents the shorter range of spans that may be achieved with this type of design. The bridge is one of three remaining pre-1941 suspension bridges in the state of Arkansas, the others being the Beaver Bridge in Carroll County (HAER No. AR-53) and the Sylamore Creek Bridge in Stone County. It is also the only remaining one of three suspension bridges which were contracted for by Cleburne County and built by Harry Churchill in 1912.

THE ARKANSAS HIGHWAY AND TRANSPORTATION DEPARTMENT ERA

Although the popularity of the metal truss bridge had become well established and entrenched by the beginning of the 20th century, young bridge engineers insistent on breaking away from traditional construction methods and materials were experimenting with new technologies resulting in an altogether unique and exciting concept in bridge design -- the reinforced concrete arch bridge. Motivated by intense competition, entrepreneurs James Barney Marsh and Daniel B. Luten took parallel but separate paths into the 20th century with the establishment of extremely successful bridge construction companies based largely on innovative patented reinforced concrete bridge designs.

By the 1920's, newly funded state departments of transportation were becoming established across the country. These new departments controlled large amounts of federal construction funds that were tied to new federal restrictions and standardizations on bridge designs. Both Marsh and Luten found themselves in an envious position. They had at their disposal companies with successful manufacturing and distribution systems that could supply safe and economical patented concrete bridges to the needs of an unprecedented national expansion in the state and federal highway system.

Reinforced concrete arch bridges were relatively inexpensive to build when compared with other types of bridge construction. They also required less maintenance than traditional iron bridges. Because of the tremendous demand for highway bridges during the 1920's and 30's, reinforced concrete bridges, which could be quickly erected, were often the bridge of choice for highway departments and local governments with tight budgets.[37] This national expansion eventually lead to the establishment of numerous field offices for both companies, including a Luten Bridge Company field office in Little Rock, Arkansas.

Marsh Engineering Company

James Barney Marsh, born in North Lake, Wisconsin in 1856, designed one of the most distinctive bridge types in the history of bridge construction --- the Marsh arch.[38] After graduating from Iowa State College of Agriculture and Mechanical Arts in Ames in 1882 with a Bachelor of Mechanical Engineering degree he accepted a position the following year as a contracting engineer with the Des Moines office of Zenas King's King Bridge and Iron Company of Cleveland, Ohio.[39] From 1883 until 1887 he was involved in the design and marketing of metal bridges and supervised their erection. It was here that Marsh was introduced to some of the most advanced bridge building methods in the industry, and soon made patented improvements in that company's metal bowstring truss.

In 1896 Marsh formed the Marsh Bridge Company, where he began to experiment in concrete bridge construction. His efforts were apparently successful, because the cities of Kankakee and Peoria, Illinois, and Kenosha, Wisconsin commissioned Marsh to design concrete bridges during the years 1902 and 1903.

By 1909 his company had expanded and changed its name to Marsh Engineering Company. Paralleling an earlier 1904 bridge design proposed by the well known French engineer M.A. Considere, Marsh completely superseded the King metal bowstring truss form with an arched bridge design of his own invention. In a design filed with the U. S. Patent Office on November 1, 1911, Marsh remolded the traditional structural and formal concepts of King's metal bowstring truss into a completely contemporary unit. Using the expressive powers of interpenetrating forms and reinforced concrete, he presented an ostensibly modern bridge type to the public.

Granted as Patent Number 1,035,026 on August 6, 1912, the Marsh arch was formally characterized by the passage of the deck through the supporting arches at a point above their springing line. The interaction of these two bridge members gave the Marsh arch its distinctive visual character and this aspect of the bridge patent was applicable to bridge design in any medium.[40] However, the patent medium was "primarily...a bridge of reinforced concrete."[41] The reinforced concrete had "a skeleton framework" of reinforcement, "surrounded by a concrete body molded thereon."[42] The skeleton framework echoed King's bowstring truss in a more substantial form, with "angle irons...and oblique braces or lattice work connecting...at frequent intervals" forming the supporting arches.[43]

> "Broadly speaking the object of the present invention is to construct an arch bridge of reinforced concrete in such a manner as to permit of a limited amount of expansion and contraction both of the arches and of the floor which are, of course, the longest members of the bridge."[44]

The principal of the Marsh arch, in its 1912 patent, was specifically aimed at allowing the expansion and contraction of its members in order to absorb stresses. This involved a complex interaction between floor, arches and abutments in two inter-dependent systems of reinforcement.

The arches were to spring from the inside faces of the abutments or piers, rise above the floor and carry that floor by means of vertical "hangers" suspended from the arches above the deck line. Arches, hangers and floor were to constitute "one unitary reinforced concrete structure."[45]

A second system consisted of two "beams" transversely connecting the arches beneath the floor. While these tied the arch pair together, under the floor, they were not attached to the floor. The floor simply rested "slidably" on the beams.[46] Similarly, while the arches were to spring from inside the abutments, the ends of the floor rested "slidably" on the abutments. This second system of beams, arches and abutments provided support for the outer ends of the floor, yet it allowed the movement of the deck with respect to the beams and abutments, with special metal "wear-plates" absorbing the friction between the moving members.

These two systems -- one of upper arches, hangers and deck, the other of lower arches, beams and abutments -- interacted. Through their respective movement they allowed any strain in the structure of the bridge to be absorbed through the relative movement of the members. Marsh described the effect of his new design in the following words:

> "During the expansion or contraction of the members of this improved bridge on account of climatic changes or the stress of weight upon it, the rise and fall of the arches due to their longitudinal expansion and contraction may cause the beams to move slightly beneath the ends of the floor, and this is accommodated by the disconnection of the beam structure and the (floor) slab and the interposition of the wear plates. On the other hand, the expansion and contraction of the floor may cause its ends to move over said beams, and this is accommodated in the same manner."[47]

By 1915, James Marsh was mainly designing bridges, while his son, Frank, had taken over the field supervision of the company's projects.[48] During the 1920's and 1930's, the Marsh Engineering Company was known primarily for their concrete arch bridges. The company designed many bridges in the midwest, particularly Iowa and Kansas. The Marsh company must have done quite well during this period, because they opened a second office in Topeka, Kansas.[49]

Completed relatively late in Marsh's career, the 1930 Cotter Bridge (HAER No. AR-15) in Cotter,

Baxter County, Arkansas survives as the only documented Marsh Arch bridge in Arkansas[50] and is similar in many respects to the Lake City Rainbow Arch Bridge in Lake City, Iowa. The Lake City Bridge was built in 1914 and served as the earliest prototype for the series of "Marsh Arch" multi-span bridges built across the country between the years 1914 and 1935. Other multi-span examples have been documented at the Little Wabash River at Carmi, Illinois (1917), the Cannonball River at Mott, North Dakota (1921), the river at Fort Morgan, Colorado (1922), the Neosho River west of Iola, Kansas (1928), the Neosho River east of Parsons, Kansas, the Elk River north of Independence, Kansas, and one over the Verdigris River east of Neodesha, Kansas (1931).

J.B. Marsh died in June 1936, at the age of 60. An obituary printed in The Des Moines Tribune, June 26, 1936, stated that Frank Marsh was still operating the Topeka branch of the company. The company disappeared from the Topeka business directory soon after that, corresponding with the decline in popularity of the reinforced concrete arch bridge.[51] Apparently, no other company records for the Marsh Engineering Company can be located.[52]

Luten Bridge Company

The Luten Bridge Company had its origins in 1900 under the engineering ingenuity of Daniel B. Luten. Born on December 26, 1869, in Michigan, Luten graduated from the University of Michigan in 1894 with a degree in Civil Engineering.[53] He began his career as an educator and instructor and soon moved to Indianapolis, Indiana, to specialize in the design, patenting and erection of reinforced concrete bridges.

A 1907 brochure from the National Bridge Company, headed by Luten in the 1920's, expounded, ". . .[t]he Luten arch combines numerous improvements in arch reinforcement and construction tending to increase the strength, durability and efficiency of the structure. . . .The Luten type of arch, requiring but a single series of reinforcing members, is the simplest and easiest type of reinforced arch to erect that has yet been devised."[54] In 1925 Luten was credited with fifty patents in the improvement of concrete bridges and over 1400 bridges of his design in use.[55]

The Little Rock branch of the Luten Bridge Company was begun in 1920 when the family of D. H. Dougherty arrived to work on the Broadway Bridge that crossed the Arkansas River in Little Rock.[56] Its successful record of bridge contracts for reinforced concrete bridges in Arkansas continued into the 1930's. The company's decline began thereafter, as the design of bridges using reinforced concrete arches was superseded by more modern designs.

Luten differs with Marsh in that he concentrated his efforts in the design and construction of smaller closed or open spandrel deck arch bridges where Marsh excelled in the Rainbow through arch design.

Significant Arkansas examples of Luten bridges include the 1928 Harp Creek Bridge (HAER No. AR-9) in Newton County and the 1922 Illinois River Bridge (HAER No. AR-28) in Benton County. The original plans for the 130-foot Illinois River Bridge are available at the Benton County Courthouse in Bentonville, Arkansas. The final, revised set of plans is dated January 6, 1922, with the revision being from a July 25, 1921 set. There are drawings of the elevation, and half section views of the crown, pier and roadway. The name on the plans is Daniel B. Luten.[57] The specifications that accompany the plans state that Luten, as designing engineer, was to receive 10% of the total cost for the bridge.[58]

Without question, Marsh and Luten had a revolutionary influence on reinforced-concrete bridge design in the early 20th century. Numerous companies took advantage of their monumental efforts by designing and constructing new variations of their rainbow arch, closed-spandrel arch, and open-spandrel arch bridge designs.

In Arkansas, two interesting interpretations of what is essentially the Marsh Rainbow Arch design can be seen in the Lincoln Avenue Viaduct and the Second Street Bridge. Both bridges are located in Little Rock and were designed by railroad company engineers and constructed by sub-contractors.

The 1928 Lincoln Avenue Viaduct (HAER No. AR-6) is a significant single span variation of the Marsh Rainbow Arch. The bridge was designed by the Missouri Pacific Railroad Company and built--under the supervision of the railroad company's chief engineer in St. Louis, E. A. Hadley--by the Ozark Engineering Company of Joplin, Missouri under the direction of its own foreman, Ray Bishop.

The 1915 Second Street Bridge (HAER No. AR-41) is one of the state's earliest examples of reinforced concrete bridge construction. Built by the Fox Construction Company of El Reno, Oklahoma for the Chicago, Rock Island and Pacific Railroad Company, its rainbow arch pony truss design is unique. The Fox Construction Company was incorporated on December 30, 1911 in El Reno, Oklahoma.[59] The directors of the company, John W. Fox, W. C. Armstrong and A. W. Lippe, all of El Reno, wrote into the articles of incorporation:

> "That the purposes for which this company is formed are the contracting for and the construction of concrete bridges and the approaches thereto, and all other general concrete construction work."[60]

The company was incorporated with a capital stock of $25,000, consisting of 250 shares of $100 each, and with a projected term "for which the company is to exist," of twenty years.[61]

The association of the Fox Construction Company with the Chicago, Rock Island and Pacific Railroad Company is clearly seen soon after its incorporation. The construction of the Second Street Bridge dates from only three years after the incorporation of the Fox Construction Company.

The reinforced concrete deck-arch was a very popular bridge design used extensively by the Arkansas Highway and Transportation Department (AHTD) to span the longer distances across major rivers, such as the Ouachita and Saline Rivers. Significant multi-span examples of this type are represented by the 1) the 1928 Anthony Island Bridge (HAER No. AR-11), designed for the AHTD by the renowned bridge engineer Ira G. Hedrick and constructed the Koss Construction Company and 2) the 1928 Saline River Bridge (HAER No. AR-7), built as a two span deck arch by the Arkansas General Construction Company of Little Rock for the AHTD.

As mentioned previously, the majority of reinforced concrete bridges built in Arkansas in the early 20th century were constructed by sub-contractors working for 1) the Arkansas Highway and Transportation Department and designed by AHTD engineers or consultants or 2) for major transportation industries such as the railroad companies. However, a few Arkansas examples were designed and built at the local level. An outstanding example of this can be seen in the South Fork Bridge (HAER No. AR-28), located near the community of Fountain Lake in Garland County.

At the time of the building of the South Fork bridge there were three distinct systems responsible for the maintenance and development of roads and bridges.[62] These were the county or municipality in whose area the road lay; the improvement district, a local group organized together to improve a specific route or part thereof; and the State Highway Department. The improvement district and the State Highway Department were created successively to supplement route improvement at the county level.

The county was the traditional maintainer of routes, but, as such, it suffered two disadvantages. First, the county had only limited access to finances for the development of roads and bridges. Second, any county road policy lacked the broad perspectives necessary for the development of a coherent statewide system of routes.

These two problems were approached in succession by the state legislature in the early decades of this century.

The problem of limited county funds for the development of roads and bridges was a problem common to many southern states. Not only was the county too small an entity to provide sufficient capital but also:

> "Arkansas, along with many southern states, had constitutional prohibitions against bonded debt by counties and municipalities because of the disastrous abuse in fiscal practices and public borrowings during the Reconstruction Period."[63]

These limitations on borrowing by the county further curtailed the potential for development of routes within the county and, consequently, within the state.

The State General Assembly took the first step towards solving this dilemma in 1907. In Act 144 of that year it authorized the development of local Improvement Districts. Within the system of the Improvement District, "landowners could form road improvement districts, issue bonds, and tax themselves to build roads."[64]

By allowing local groups to gather capital the Assembly could circumvent the constitutional prohibition against borrowing by the county. The Improvement District became "the only political subdivision of the State, free of the constitutional prohibition against borrowing, and the only avenue for funding road improvement...".[65]

While the Improvement District grew rapidly from 1910, until "...by the late 'twenties Arkansas had improvement districts by the dozen", it was an unsatisfactory entity because its perspectives on routes were even more limited than those of the county.[66] It has been noted that:

> "improvement district improvements were with consummate logic designed to serve local traffic needs, that is, to satisfy the wishes of those who were underwriting the costs of the improvements, the landowners, as modified on occasion by the pressures and realities of the local political conditions,"[67]

Thus the second problem of county responsibility, its limited perspective in the development of routes, was compounded by the Improvement Districts. The County Judge, who directed route improvement in the county, was, at least, "interested in an all-weather linkage of all county seats."[68] The Improvement District, however, had an "almost total lack of co-ordination in interdistrict planning."[69]

To provide a stronger state perspective to route planning, the General Assembly created The State Highway Commission by Act 302 of 1913. The Commission "...began with little more than advisory functions in order to assist the road districts in technical matters."[70] However, it later administered the State Highway System established under The Harrelson Road Law passed as Act 5 of The 1923 special session of the General Assembly. By the end of the 1920's the State Highway Commission and its work force, the State Highway Department:

> "...were thought... to be the epitome of highway administration... The end result of thoughtful study and careful planning for contemporary motor vehicular transportation in the Arkansas context"[71]

As the State Highway Department developed, its work increasingly was characterized by the high standards of economy and efficiency in their road and bridge work. Progressive standardization was one of the characteristics of the Department's designs.

Much of the significance of the South Fork Bridge lies in the fact that it was built outside these developments. It was built by a county road crew out of funds provided by the county, at a time when the complex evolution of the State Highway Department was taking an effective form. The bridge, sufficiently important to have $3500 of county funds devoted to it, remained within a financial tradition that reached back into the nineteenth century.

F. M. Kelley, Builder

Born in March 1891, Francis Marion Kelley was the fourth and youngest son in a family of six.[72] His father, James M. Kelley, came from Alabama and settled in Garland County after the Civil War. A carpenter by trade, James Kelley was also a successful farmer and music teacher. He passed on many of these talents to his youngest son, Francis Marion.

Francis Marion Kelley served in the First World War as a diesel mechanic. He returned to his home county to open a garage, but soon joined the county road crew. His technical expertise was welcomed by the county and he served as supervisor in the construction of a number of county bridges in the 1920's.[73]

Under Kelley's direction, the South Fork Bridge was erected by the county bridge crew, resulting in a bridge unusual for this scale and date. Typically, such bridges would have been erected either by the State Highway Department, if the route lay within the State Highway System, or the bridge construction would have been contracted to a bridge-building company. However, Garland County, under the direction of Judge Davis, consistently entrusted its bridge building to Kelley and his crew. This was a significant gesture of confidence in the abilities of F. M. Kelley.

H. S. Moreland, Engineer

The plaque commemorating the completion of the South Fork bridge attributes its design to H. S. Moreland. However, Moreland remains an essentially anonymous figure. His practice is not known beyond its association with a number of contemporary bridges in the county.[74] Bridge plans with Moreland's name are in the possession of the Kelley Family, but no address is given; nor can Moreland be associated with the erection of any of the bridges.[75] While Kelley certainly directed the entire construction of the South Fork bridge, and undoubtedly played a significant role in the details of its erection, the precise roles played by Moreland and Kelley cannot be determined from the information available on the bridge.

Vincennes Bridge Company

The Vincennes Bridge Company was incorporated in 1898 in Vincennes, Indiana, by three former schoolteachers, Frank L. Oliphant, John T. Oliphant and Jacob L. Riddle.[76] 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. For the first two decades they built county and township bridges mostly in Indiana and Illinois.

An early Arkansas example of a Vincennes bridge is the 1908 Wyman Bridge (HAER No. AR-38) in Washington County. This single span Parker through-truss can be compared with a similar bridge to show, in fact, that the Vincennes Bridge Company clearly offered an inexpensive alternative to the existing older bridge building firms. In 1907, a 180-foot Parker truss (the War Eagle Bridge, HAER No. AR-50) was put up by the Illinois Steel Bridge Company over the War Eagle Creek twenty-five miles north of the Wyman Bridge, which

was a 150-foot Parker. The War Eagle job cost $4790,[77] while the Wyman's cost was about $3400 for the superstructure and substructure. That much of a dollar difference would certainly give the Vincennes an advantage at the bidding table. By 1920, annual production had surpassed 1200 spans a year with annual sales in excess of $1,000,000.

With the development of the State Highway Systems in the 1920's, 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 and was able to expand its operation to North Carolina, West Virginia, Alabama, Kentucky and Arkansas.

Its continued concentration on "full service bridge building" after the First World War was atypical.[78] The company continued to specialize in simplified structures that "emphasized function and economy more than elegance and novelty." By the 1920's most large bridge-building companies had expanded and diversified to the extent that the companies were only subcontracted to provide material.[79] 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"[80] The Vincennes Bridge Company became the largest metal fabricator in Indiana when the capital stock was increased from $50,000 to $75,000 in 1927.

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."[81] The company continued its growth through World War II and after.

This unprecedented expansion can be seen in Arkansas with notable examples clearly showing the wide range of bridge design and construction technology that allowed Vincennes to become one of the most successful contractors in the state. Flexibility in design and construction can be seen in the 1) 1934 St. Francis River Bridge at Lake City (HAER No. AR-18), a fine example of a unique steel truss lift-span, 2) the 1934 Cache River Bridge (HAER No. AR-25), a Parker pony-truss built with a skew and 3) the 1937 North Fork Bridge (HAER No. AR-10), which exhibits a significant deck truss design. All three of these bridges were designed by Arkansas Highway and Transportation Department engineers with the fabrication and construction contract awarded to Vincennes.

In 1956, after some decline, the company was taken over by Industrial Enterprises, Inc. for a sum in the region of $1,000,000. This New York Company, later known as Novo Industrial Corporation, was a diversified manufacturing, transportation, and service enterprise. By this time, the company had expanded beyond the proudest dreams of its founders, producing such notable bridges as the 420 ft. steel bridge at Paw-Paw, West Virginia, as well as numerous bridges in Arkansas.[82]

> "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."[83]

The Vincennes Bridge Company's legacy in Arkansas spans two historic contexts. The Wyman Bridge (HAER No. AR-38) was constructed during the Early Transportation Era and is a significant Arkansas example of the Vincennes Bridge Company's earlier work in the state. The St. Francis River Bridge at Lake City (HAER No. AR-18), the Cache River Bridge (HAER No. AR-25) and the North Fork Bridge (HAER No. AR-10) are significant examples of Vincennes' later work during the Arkansas Highway and Transportation Department Era.

During the Depression of the 1930's, the Arkansas Highway and Transportation Department (AHTD)

relied on numerous sources of funding for the construction of major bridge projects. The collection of tolls was resurrected in the late 1920's as a method of financing. The construction debt incurred was financed by state bond issues and paid off by collecting a user fee after a bridge was completed. The bridge was to become a free bridge after the bonds were paid off.

The collection of tolls is a time honored tradition in Arkansas beginning in the early Territorial Period of the 1820's. The majority of bridges built during this period were licensed by the territorial government (and later the state legislature) to private individuals who owned and initially financed the construction of a bridge, usually on a major road. The government received a needed bridge at no cost and the licenced owner could hopefully make a profit from the collection of tolls by the users of the bridge.

By the 1870's, corporate enterprises used stock holders equity to finance major bridge construction. This method of financing was used by the White River Bridge Company to construct and later collect tolls at the 1924 White River Bridge at DeValls Bluff (HAER No. AR-21). This bridge was built by the Missouri Valley Bridge and Iron Company of Leavenworth, Kansas, using the design of Harrington, Howard and Ash, who were engineering consultants from Kansas City, Missouri. The White River Bridge at DeValls Bluff is in service today on U.S. Highway 70 and is a significant Arkansas example of a Pratt through-truss lift span built outside the jurisdiction of the newly formed Arkansas Highway and Transportation Department.

Arkansas state government took advantage of the toll system relatively late in the state's transportation history. Nine major toll bridges were constructed in the early 1930's through a major state bond issue. Significant examples of these AHTD toll bridges that still survive are 1) the Cotter Bridge (HAER No. AR-15), 2) the Newport Bridge (HAER No. AR-12), 3) the Augusta Bridge (HAER No. AR-13), 4) the Red River Bridge (HAER No. AR-14), 5) the Ouachita River Bridge at Calion (HAER No. AR-19), 6) and the White River Bridge at Clarendon HAER No. AR-49).

Ira G. Hedrick, Bridge Engineer

The AHTD often used the services of private consulting engineers for the engineering design of these more ambitious toll bridge projects. As previously mentioned, the Marsh Engineering Company was awarded the contract to design the Cotter Bridge (HAER No. AR-15). However, the most successful consulting engineer in Arkansas was Ira G. Hedrick. In 1927, the AHTD had hired this successful bridge engineer to design several of the state's new, larger bridges.[84] He designed three very similar double cantilever through-trusses spans over the White River at Newport (HAER No.12), Augusta (HAER No. AR-13) and Clarendon (HAER No. AR-49). His efforts in the design of a Pennsylvania through-truss is shown in the Red River Bridge at Garland City (HAER No. AR-14) and a significant example of a multi-span, reinforced concrete deck arch, the Anthony Island Bridge (HAER No. AR-11), is his finest work in this medium. Hedrick was considered to be "one of the outstanding engineers of the South."[85]

Hedrick's capabilities as a bridge designer were due in part to his extensive education in the general sciences and structural engineering and to his involvement in engineering associations. He graduated from the University of Arkansas at Fayetteville in 1892 with a bachelors in civil engineering. In 1899 he received his Bachelor's of Applied Science at the University, followed one year later by another civil engineering degree and by a Masters of Science in 1901. He went to McGill University in Montreal to study for a Doctorate, which he earned in 1905. He was a member of the American Society of Civil Engineers, the Engineering Institute of Canada, and Tau Beta Pi engineering honor society.

After receiving his bachelor's in engineering, Hedrick spent six years as an assistant engineer for J.A.L. Waddell, a widely respected bridge engineer of his time. He then worked for one year with the Kansas City,

Pittsburgh, and Gulf Railroad Company as an assistant chief engineer, but returned to his first employer to be a junior partner in the firm of Waddell and Hedrick from 1899-1907. After leaving Waddell for a second time, Hedrick was a partner in two consulting firms. Hedrick and Cochrane worked together from 1907-1915 and then Hedrick started a consulting firm with another Hedrick in 1915. He was also a senior member of Hedrick, Smith, and Frost. His last consulting firm worked from offices in Hot Springs, Arkansas, Shreveport, Louisiana, and Kansas City, Missouri. Over the course of his life, he was a member of several engineering firms and the American Society of Civil Engineers.[86]

Hedricks' work on the Augusta Bridge (HAER No. AR-13) was delayed until numerous legal problems could be resolved. On March 3, 1925, the R.L. Gaster Construction Company of Little Rock was granted authorization by the U.S. Congress to build a bridge at Augusta across the navigable White River. The act allowed Gaster to collect tolls to cover his costs with a twenty year amortization. The time limit on this saleable act expired, but was renewed June 15, 1926.[87] On March 17, 1927, the Gaster company had sent out an engineer to take preliminary measurements on the White River.[88]

In the meantime, support for a state supported bridge at Augusta had been growing. In February of 1927, state legislation to fund just such a bridge was introduced.[89] By March 10, the governor had signed the bill and said that the bridge construction was now "in the hands of the State Highway Department."[90]

As if two interests competing to build a bridge were not enough, a third party surfaced with plans to build the Augusta bridge. Back in January of 1926, the Woodruff County Judge E.M. Carl-Lee gave a franchise to Alvin Bell of Little Rock to construct the bridge. In late March 1927, after there was the legislative funding for a state bridge, "local citizens" went to court to get Bell's franchise revoked. Bell's franchise had been awarded without public notice, and Bell happened to have been the judge's son-in-law. Besides, the suit argued, Bell's franchise was awarded when another, Gaster's, had already been given.[91]

The dilemma was simplified to some extent by the death of R.L. Gaster September 5, 1927.[92] Gaster's estate sold the franchise for $3000 to W.N. Gregory of Augusta, who had collected money from private citizens in the area interested in seeing Highway 64 completed.[93] After further complications, the construction contract was finally awarded to the Missouri Valley Iron & Bridge Company of Leavenworth, Kansas, using Hedrick's design.

As soon as the Augusta Bridge (HAER No. AR-13) was completed, John James Ferguson was appointed the toll collector and his original assistants were W.R. Cain and C.R. Ramey. They would cover the day's 24 hours in three shifts.[94] The toll was 50 cents for an automobile (although coupon books could be purchased to reduce the fee to 25 cents), one and one-half ton trucks were 75 cents, busses were one dollar, and it cost 25 cents for a wagon or buggy.[95] A newspaper article a week after its opening suggested business on the bridge was fine. There had been an average collection of $97.63 in tolls per day, which was expected to increase when more people knew of the new route. Local businesses, especially gas stations and restaurants, saw increased activity. The same article reported:

> Several attempts have been made to run the bridge without paying toll, but none of them have been successful. It is not good judgment to even try it while Mr. Looney is on the job. One car sped past the gate and the driver looked back to laugh at the collector till he heard a pistol shot and a bullet ripping a tiny hole through the top. With shaking knees he returned to pay his fifty cents. Others have been stopped with a shot fired into the air.[96]

As it turned out, tolls remained a concern for several years. Federal legislation in 1937 allowed the state to get reimbursement of one-half the cost of certain bridges from the Federal Bureau of Public Roads,

provided the state would free the toll bridges. In 1938, federal legislation made $4,300,000 in federal money available to the State of Arkansas, provided Arkansas took the toll off all of its bridges. On April 1, 1938, Governor Bailey called a special session of the state legislature and all state owned toll bridges became free.[97] While the local Augusta paper mourned for the loss of three jobs, there was not any complaint for the loss of tolls.

On May 3, the Newport toll taker's residence was towed to the Highway Department's oil station in the east part of Newport.[98] The announcement of the freeing of the bridge gave the town short notice, but another celebration was organized and executed on May 26, 1938. "Several thousands", including Augusta residents twenty miles downstream, turned out for this celebration that included political speakers, Miss Jackson County, seven bands, a banquet, a baseball game, and a street dance. There was a special effort to make the freeing of the bridge widely known in order to attract business that may have shied away from a toll bridge.[99]

As previously mentioned, railroad companies operating in Arkansas since the 1870's have always had the ability to finance the construction of their own bridges. The AHTD would solicit the comments of the railroad company when a new AHTD bridge would cross railroad lines. Although the reinforced-concrete Rainbow Arch bridge design was a common bridge type used by the railroads, like the Lincoln Avenue Viaduct (HAER No. AR-6) and the Second Street Bridge (HAER No. AR-41), other bridge types were often employed. Good examples are the 1937 St. Louis-San Francisco Overpass (HAER No. AR-26) at Imboden and the 14th Street Bridge (HAER No. AR-42), a timber King-post truss in North Little Rock.

The St. Louis-San Francisco Overpass was built to carry traffic over both the St. Louis-San Francisco Railroad lines and the Spring River. This impressive structure uses steel deck trusses to approach a center span consisting of three Parker pony-trusses. It was constructed using AHTD plans by the C.F. Lytle Construction Company of Iowa.

C. F. Lytle Construction Company

Working from his own company, Charles F. Lytle was one of the most dynamic construction entrepreneurs in Iowa.[100] From the turn of the century he was "involved with construction work of all kinds" and, in the early days of his company he "...built practically all of the paved county roads of Woodburg (Iowa)".[101] Founded through his individual efforts, the Lytle Investment Corporation, incorporated in Iowa in 1915 and developed in association with Lytle's extensive construction work, had an authorized capital of $1,000,000 by 1923.[102]

The C. F. Lytle Company was described in 1944 as "one of the oldest construction firms in the midwest." By then it had worked on a variety of river contracts, including dams.[103] Its later work ranged from oil exploration to bomber base construction to a dam on the Rio Grande.[104]

The St. Louis-San Francisco Railway Company, known as the Frisco Lines, was described as having "made a very great contribution to the development of northwestern and eastern Arkansas, and both these territories yielded excellent returns to that property".[105] Operated in 1936 under the direction of its President, J. M. Kurn, the company had evolved from a consolidation of smaller railroads that began their development in the 1880's. The tracks, of the Frisco Lines at the time of the construction of the overpass at Imboden, extended from St. Louis through Missouri, Arkansas, and Oklahoma to Texas.

The company was continually eager to improve its route. Any intersection of its tracks with a road was a potential source of danger to the public. The intersection of its lines with Route 62 at Imboden was a particular problem to the company due to the traffic density on the route.

One solution available to the Frisco Lines was to build a viaduct out of its own funds, as was the case with the Lincoln Avenue Viaduct built by the Missouri-Pacific Railroad Company some eight years earlier.[106] However, the geography of the route across the tracks meant that a company viaduct serving the tracks would have been too expensive. In this instance, they relied on federal funding administered through the AHTD.

The crossing of the Spring River at Imboden was a minor problem that arose after the preliminary designs were submitted to the Bureau of Public Roads for approval. In reply to the query regarding the eligibility of the overpass for federal funds, "it was noted that the project involves the construction of a bridge over the Spring River and it is not known whether this stream is a navigable water of the United States at the proposed point of construction."[107] The Bureau further suggested that the approval of the project be upon the condition that before the project agreement is submitted for execution the record will be supplemented by satisfactory evidence showing that the plans and locations of the bridge...have been approved by the Secretary of War and the Chief of Engineers."[108]

The erection of a bridge across the Spring River was dependent upon whether it was considered a "navigable water" or not. If it was so considered, a decision which had to be made by the War Department, it required the prior approval of that Department and the Chief of Engineers before it could be constructed legally.[109] However, the War Department, on January 21, 1936, informed the Bureau that "..this stream is not a navigable water of the United States at the proposed point of construction."[110] Further approval was not, therefore, required.

The question of whether a river was considered navigable or not was also raised during the designing of the Black River Bridge (HAER No. AR-8) at Pocahontas, the St. Francis River Bridge (HAER No. AR-20) at Madison, the St. Francis River Bridge (HAER No. AR-18) at Lake City and the county owned and constructed 1924 Judsonia Bridge (HAER No. AR-51).

Both the Black River and Madison Bridges have a center swing truss that could be moved to allow river traffic to pass. It is doubtful that either one of these bridges were ever turned. River traffic in northeast Arkansas had long been supplanted by the railroads, and the requirement of a swing truss design was only the result of federal regulation.

However, this is not the case with the 1924 Judsonia Bridge (HAER No. AR-51). This White County constructed cantilever Warren through-truss was turned by hand for several years to allow river barges from a local quarry to pass.

The Black River Bridge (HAER No. AR-8) at Pocahontas was constructed by the Pittsburgh-Des Moines Steel Company and uses two Parker through-trusses and one Warren swing through-truss to span the Black River. The swing truss was designed to be turned by hand.

Pittsburgh-Des Moines Steel Company

The Pittsburgh-Des Moines Steel Company began on March 5, 1900, when two engineers, William H. Jackson and Berkeley M. Moss, joined with Edward W. Crellin, owner of a steel fabricating shop in Tuttle Street, Des Moines, Iowa.[111] Together they formed the Des Moines Bridge and Iron Works and the Des Moines Bridge and Iron Company.

The founders of the new company were already experienced in their own fields. Jackson, a civil engineering graduate of Iowa State College, had joined with his former classmate Berkeley Moss to form Jackson

and Moss, Engineers and Contractors. They quickly proved their engineering capabilities, specializing in the erection of water towers. Through their association with Edward Crellin they could expand their interests and, by 1901, the company was producing bridges, water systems, electric lighting plants, and general street improvements.

With profits consistently re-invested in the company, it grew rapidly. By 1907 the company was able to expand its offices to Pittsburgh, Pennsylvania. This city was the major source of steel in the United States, and controlled the price of steel throughout the nation. In 1910 the headquarters of the Des Moines Bridge and Iron Company were moved to Pittsburgh, securing its intimate association with the center of the steel industry. By 1915 the company was able to boast that, "being located at the principal source of (steel) supply enables us to make prompt shipments and to quote the very best prices on foreign and domestic business"[112]

Beginning in 1916, the company underwent a dramatic re-organization which resulted in its transformation, in 1918, into the Pittsburgh-Des Moines Steel Company. An almost continuous expansion was effected thereafter until the Depression of the 1930's.

In the early days the company specialized in bridge construction, with an impressive range of bridge types: suspension, truss, arch, girder and I-beams. From the time of its incorporation as the Pittsburgh-Des Moines Steel Company it broadened its services to industry, frequently being employed as a sub-contractor. Bridge building, however, remained an important though subordinate part of the company's larger business.

The Black River Bridge's sister bridge at Madison (HAER No. AR-20) uses three Parker through trusses and one center-bearing Parker swing span, also turned by hand.

J. Waddell, discussing the building of bridges over navigable waters stated:

> "The United States Government through the War Department has jurisdiction over all the navigable waters of the country, and has the right to dictate as to the character and location of all proposed bridges for crossing them..."[113]

The bridging of navigable waters was a matter of great importance when waterways formed the major transportation routes in the country. The free passage of river traffic needed to be preserved at all times to ensure the protection of an essential trade route. By the 1930's the significance of navigable waters was much reduced, first by the railroads and then by the newly constructed roads. Congress, however, still retained its authority to approve or reject any proposal for the erection of a bridge over navigable waters.[114]

To ensure the non-obstructive erection, citing and structure of a bridge over navigable waters, the authority of Congress was supplemented and qualified by that of the War Department and the Chief of Engineers. In an act passed by Congress on March 23, 1906, entitled "An Act to regulate the construction of bridges over navigable waters", it was deemed that:

> "...when, hereafter, authority is granted by Congress to any persons to construct and maintain a bridge across or over any of the navigable waters of the United States such bridge shall not be built or commenced until the plans and specifications for its construction, together with such drawings of the proposed construction and such maps of the proposed location as may be required for a full understanding of the subject have been submitted to the Secretary of War and the Chief of Engineers for their approval, nor until they shall have approved such plans and specifications and the location of such bridge and accessory works."[115]

Thus, while Congress may approve a bridge over navigable waters, that approval was subject to the further approval of the War Department and the Chief of Engineers. The latter, however, could not give any approval without the prior legislation on the bridge having been passed through Congress.

To ensure that the river remained navigable during construction it was further enacted that "...no bridge...shall at any time unreasonably obstruct the free navigation of the waters over which it is constructed"[116]

Time limits were also placed on the construction and completion of the bridge construction, Section 6 of the 1906 Act Provided that:

> "Whenever Congress shall...authorize the construction of any bridge . . . across . . . navigable waters . . . and no time for the commencement and completion of such bridge is named in said Act, the authority thereby granted shall...be null and void unless the actual construction of the bridge...be commenced within one year and completed within three years from the date of the passage of such act."[117]

Consequently any bridge whose commencement or completion was delayed beyond the stipulated one and three years had to receive new congressional legislation to legalize its construction.

In summary, a person intending to erect a bridge over a navigable water must first receive congressional approval, succeeded by and subject to the approval of the War Department and the Chief of Engineers, the task of the latter being to preserve the navigation of the river. Unless otherwise stipulated, the bridge must be commenced within one year of the passing of the relevant act, and completed within three years of that date. If these temporal restrictions were not complied with, a new application had to be made to Congress.

By the early part of this century, permission to build a bridge over navigable water was largely routine, provided navigation remained unobstructed. Waddell noted that "...under ordinary conditions there is no difficulty experienced in obtaining the approval of the War Department to the plan and location of a proposed bridge..." and that "the army engineers endeavor to make it as easy as possible to get (the applicant's) plans approved."[118] The act essentially preserved the right of the Federal authorities to veto any bridge that might obstruct the waterways, a right largely made redundant by the development of roads. However, especially during the Depression of the 1930's when bridge financing was slow and irregular, the Act of Congress of 1906 caused many complications for those involved in the erection of bridges over navigable waters.

There exists today several significant Arkansas bridges that were designed by the Arkansas Highway and Transportation Department. The 1931 Buffalo River Bridge at Pruitt (HAER No. AR-23) was fabricated by the Virginia Bridge and Iron Company of Roanoke, Virginia, using plans drawn by AHTD engineers as a unique Pennsylvania through-truss design. It was constructed by Fred Luttjohann of Topeka, Kansas.

A more typical AHTD designed Pennsylvania through-truss is the 1934 Lee Creek Bridge at Natural Dam (HAER No. AR-24). It was designed by the AHTD bridge engineering division under the general supervision of N.B. Garver, Chief Bridge Engineer. The construction contract was awarded to M.E. Gillioz Company, Monett, Missouri.

Gillioz Construction Company

Mr. M.E. Gillioz was born in Rolla, Missouri, in 1877. He learned the construction business as a

young man working for the Sante Fe Railroad Company and by 1907 had started his own contracting company that moved to Monett, Missouri by 1914. His company was concerned with not only the construction of both concrete and steel truss bridges, but also with the construction of churches, commercial buildings, roads, and dams. His business brought him huge success and he quickly expanded into the local Monett economy with business operations that included the Gillioz Clothing Store, the Gillioz Motor Company, the Gillioz Implement Company, the Gillioz Paint and Body Shop, and the Gillioz Bank and Trust Company. Some of Gillioz's construction projects in the state include the Lake Fort Smith Dam near Mountainburg, Arkansas, and the Current River Bridge at Van Buren, Arkansas.

The Lee Creek Bridge at Natural Dam is one of four historic Pennsylvania through steel truss bridges remaining in Arkansas. This bridge was built as part of a two bridge improvement project over Lee's Creek approximately one mile north of the small community of Natural Dam. It is an excellent example of its type and clearly demonstrates the advancements made by the AHTD in steel truss bridge design and technology by the 1930's.

The 1931 Big Piney Creek Bridge (HAER No. AR-22) provides an interesting example of an Arkansas Highway and Transportation Department bridge design of the early 1930's executed with limited funds. Here the result of limited funds are seen in a narrowing of the roadway and a limited loading capacity in a variation of the Warren through-truss design. Its status as a Forest Highway bridge caused its limited funding, and further enhances the significance of this bridge.

The speed with which the preparations were made was evident in the design of the bridge. The drawings were commenced on January 28, 1931, just 16 days after agreement on the bridge was reached, and completed on February 11.[119] On that same day the bridge bid was let.[120] The notice to bridge contractors of the letting described the bridge as consisting of "...one bridge with one 140 foot through steel truss span and reinforced concrete deck girder approaches."[121] The bridge construction contract was let to the lowest bidder, Fred Luttjohann, of Topeka, Kansas, at a contract price of $24,336.04.1[122] As in the case of the Big Buffalo River Bridge (HAER No. AR-23), Newton County, Luttjohann sub-contracted the Virginia Bridge and Iron Company of Roanoke, Virginia, to provide the steel.[123]

Luttjohann

Fred Luttjohann was, like many of the bridge contractors of the 1920's and 1930's, a largely unknown figure. He was involved with a number of Arkansan bridges of the period. His position as a contractor involved him primarily with subcontracting work, consequently leaving his contract work largely supervisory and anonymous. However, he did regularly advertise in the State Highway Department magazine of the period. Advertisements there declare that his bridges are "built for the ages" and that his "best reference" was his record in the building of the mile-long Ramsey Bottom approach to the Batesville Free Bridge..."[124]

The position of bridge contractors in the 1920's and 1930's who extensively subcontracted requires further study. It has been noted that, after the First World War, bridge companies tended to be sub-contracted to provide materials, rather than "focusing on full-service bridge building."[125]. By this period the bridge-building companies, for example the Pittsburgh-Des Moines steel company, had become more diverse in their operations, and small contractors were often able to bid more efficiently than the more unwieldy large companies.[126]

The 1929 Eight Mile Creek Bridge (HAER No. AR-17) is a single span, pony Pratt steel truss bridge designed under the general supervision of Mr. C.S. Christian, Chief Bridge Engineer of the Arkansas Highway and Transportation Department (AHTD). Miller's Garage & Construction Company, St. Louis, Missouri, was awarded the construction contract.

There are several significant masonry deck arch bridges identified in the state. They were constructed outside the jurisdiction of the AHTD and are usually associated with either the federal work relief programs of the 1930's and 1940s, such as the Civilian Conservation Corps (CCC), Works Progress Administration (WPA) and the United States Resettlement Administration (USRA), or with private residential developers, such as Mr. Justin Matthews.

In 1921, Dr. T.W. Hardison and a few other influential Arkansans launched a campaign to designate an area on Petit Jean as a National Park. After careful study, the National Park Service determined that the area was too small, and, although interesting and picturesque, not of national significance. They suggested that the sponsors of the Petit Jean project try to have the area set aside as a state park instead.[127]

In March 1923, the Arkansas legislature passed Act 276, which authorized the commissioner of state lands "to accept lands donated to the state for parks and state reservations" and designated a section of land already donated as Petit Jean State Park.[128]

In March 1927, the State Parks Commission was created by Act 172:

> to select and acquire such areas of the State of Arkansas which, by reason of their natural features, scenic beauty and historical interest, have educational, recreational, health, camping and out-door life advantages; to protect and preserve in its original habitat and native beauty the flora, fauna and wild life therein and preserve the same for all future generations, thereby promoting health and pleasure through recreational places, resorts and scenic playgrounds for the people of the State and to attract visitors, homeseekers and tourists to the State and to provide places of recreation and pleasure for them, and to increase the wealth and revenue of our State by means of such parks.[129]

The Act also charged the State Parks Commission with the responsibility of overseeing the lands entrusted to its care.

When the stock market collapsed in 1929 and the nation fell into an economic depression, acquisition of land for park areas was simply not possible due to lack of funds. Ironically, however, the economic effect of the Depression was one of the catalysts which brought about the development of many of the nation's parks and recreational areas. Act 39 of 1881 had allowed that the lands where taxes were delinquent would, after a reasonable time, revert to the State. Since many people were unable to pay their property taxes during the Depression, the land holdings of the state increased, and lands for State Parks became available. The other force that helped shape the course of the Arkansas State Parks program during the its formation was the Civilian Conservation Corps, a federally funded work program which operated during the Depression years. Much of their work in Arkansas formed the core of park facilities in Petit Jean, Mt. Nebo, Crowley's Ridge, Devil's Den and Lake Catherine State Parks and the Buffalo National River.

By 1935 the state government was informed that most of the planned development of the parks was completed and that the CCC would disband by 1938: therefore, it should put together a working staff to take over the supervision of the parks. The State Parks Commission appointed Sam Davies, the supervising engineer at Petit Jean, to be the first Director of State Parks.[130]

On April 5, 1933, President Franklin D. Roosevelt established the Emergency Conservation Work Program, also known as the Civilian Conservation Corps, by Executive Order 6101. The country at this time was facing two national crises--the economic depression, and the loss of precious natural and historic resources through exploitation and apathy. In asking Congress for appropriations to establish work programs, Roosevelt

saw a way to bring both problems together, each one helping to solve the other. The goal of the CCC was primarily to provide work for unemployed youths, war veterans, and Indians, with the allotments from their salaries providing income for their families. The program was run in cooperation with the Department of Agriculture and Interior, the Department of War and the Department of Labor. The work consisted of conservation projects on public lands--forestry; erosion and flood control; road, structural and landscape improvements; and development of recreational areas. Enrollees were given $30 a month, in addition to clothing food, housing and medical care. Each man was assigned to a camp with approximately 200 other men. At the peak of the program in 1936, there were 650,000 enrollees on duty, located in 2700 camps throughout the nation. The program lasted until 1942, when the United States entered World War II.

It was under direction of the CCC program administered through the state parks that the 1934 Cedar Creek Bridge (HAER No. AR-31) and others like it were constructed. Its single span masonry deck arch design is simplistically compatible with the general "Rustic" theme of the Petit Jean State Park architecture.

A significant CCC constructed masonry arch bridge built outside the jurisdiction of the State Parks system is the Mulladay Hollow Bridge (HAER No. AR-43), a simple double span deck arch located on the road leading into the Lake Leatherwood recreation area in Carroll County.

The 1936 Spring Lake Bridge (HAER No. AR-36) is a two span, masonry arch bridge built under the authority of the United States Resettlement Administration (USRA). This bridge is one of eight known masonry arch bridges identified in Arkansas and is currently the only known bridge constructed under the authority of the USRA in Arkansas. The Spring Lake Bridge exhibits high quality craftsmanship and significant design details not seen in other Arkansas stone arch bridges. These details include roughly squared, coursed masonry, dressed springers and keystones, stone paving, and an inscribed date stone.

There are two significant masonry deck arch bridges that are believed to have been constructed under the authority of the WPA. These bridges are the Jenny Lind Bridge (HAER No. AR-54) and the Milltown Bridge (HAER AR-55).

Three other masonry deck arch bridges have been attributed to the efforts of developer Justin Matthews. The Lake No. 1 Bridge (HAER No. AR-39), the Edgemere Street Bridge (HAER No. AR-40) and its sister bridge, the Lakeshore Drive Bridge (HAER No. AR-52), are prime examples of Matthews skill in blending "organic" landscape features with transportation structures to create what was then an innovative concept in residential landscape design.

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OUTLINE OF PROPERTY TYPES

1. Pony Truss Bridges
2. Through-Truss Bridges
3. Swing Through-Truss Bridges
4. Deck Arch Bridges
5. Other Bridge Designs

PONY TRUSS BRIDGES

Description:

There are very few remaining pony truss bridges in Arkansas. Constructed of steel channels, angles, continuous plates, and batten plates riveted together, the pony truss bridges are characterized by top and bottom chords, diagonals and verticals. Two of the state's surviving pony truss bridges were built in the early 1900's using the patented Warren truss design (see Section E, Early Transportation Era Historic Context). Both bridges are now maintained by the county; one is still in use and is in fair condition, while the other has been taken out of service due to its poor condition.

Two other surviving pony truss bridges, both still in use and in good condition, utilized the popular Pratt design, which was one of the most common bridge types in the state in the late 19th and early 20th centuries. One of these Pratt pony truss bridges is a two span design that was built in the early 1900's; the other is a single span built during the early years of the Arkansas Highway and Transportation Department (see Section E, Arkansas Highway and Transportation Era Historic Context).

The latest surviving pony truss bridge in the state is a skewed Parker design dating from 1934 that is still in excellent condition and is maintained by the Arkansas Highway and Transportation Department.

Significance:

While each of the remaining pony truss bridges are significant because of their contributions to the state's advancements in transportation and engineering, they all contain design elements that make them unique to the state and therefore further enhance their significance.

One of the early Warren pony truss bridges is the state's only known example of a double intersection Warren pony truss. The other Warren bridge, which is the state's only documented bridge built by the Morava Construction Company of Illinois, is bolt-connected rather than rivet-connected, and includes a solid I-beam top chord and angle outriggers among its unique features.

The two Pratt pony truss bridges were built during the two different eras in the state's bridge history. The two-span bridge, built in 1908, is an excellent example of the type of bridge built prior to the standardization methods incorporated by the Arkansas Highway and Transportation Department, while the single span bridge, built in 1929, represents the advancements made in these standardization methods during the AHTD era.

The Parker pony truss bridge, built along with five others as part of a two-county development project, is significant not only for its simple skew, which allowed the river to be spanned economically, but also for its builder, the Vincennes Bridge Company, which was one of the most important in the nation during the early part of the 20th century.

Therefore, these pony truss bridges are significant on a statewide level under National Register Criterion A for their contributions to the state's developments in transportation, as well as under Criterion C for their engineering designs.

Registration Requirements:

Arkansas' remaining pony truss bridges, dating from the Early Transportation Era and the Arkansas Highway and Transportation Department Era, are significant because of their unique engineering features, construction materials and workmanship; they are also significant because of their representation of the advancements made in the state's transportation system during the early part of the 20th century. In general, to meet registration requirements, these bridges should have been built in the period between 1900-1939; they should retain sufficient physical features to identify them as having been built during this period; they should be good examples of the patented designs they represent; they should be intact and unaltered; and they should retain their integrity of setting.

THROUGH-TRUSS BRIDGES

Description:

The state's surviving through-truss bridges are constructed of steel and include the popular Pratt design as well as Pennsylvania, Warren, and Parker designs. One of these Pratt through-truss bridges, built in 1910 and still in excellent condition, incorporates the Camelback design in its primary span. Another Pratt bridge is a single-span, skewed through-truss located in an unusual topographical setting.

The Parker through-truss bridges, which are spin-offs of the original Pratt design (see Section E, Early Transportation Era Historic Context), are characterized by a polygonal top chord. Surviving Parker through-truss bridges include one built by the Vincennes Company in 1908 that is still in good condition, and another massive bridge that is in fair condition and is scheduled for replacement.

There are only four known Pennsylvania through-truss bridges left in the state, three of which were built during the Arkansas Highway and Transportation Era (see Section E). The other Pennsylvania through-truss has stone abutments and is connected by pins rather than rivets, which suggests that it was built in the later years of the 19th century. This bridge, along with two others, is still in use and in good condition. The bridge located at Garland City, with the longest span of the four, is in poor condition and its fate is in question.

The remaining Warren through-truss bridges includes one that displays an unusual use of verticals, diagonals, and vertical sub-struts. Two others, both spanning the White River, have cantilever arms. Each of these bridges was built in the early 1930's during the Arkansas Highway and Transportation Department era (see Section E, Historic Context), and each is still in good condition.

Significance:

The steel through-truss bridges are significant not only because of their design features, but also because they are intact and unaltered and their numbers are very few. There are only six Parker through-trusses left in the state, four Pennsylvania trusses, and three Warren cantilever trusses. Of the remaining Pratt trusses, one is the only documented primary span Camelback Pratt through-truss in the state, and another is a rare example of a skewed single span design. One of the remaining Pennsylvania through-trusses is significant because of its age, which dates from the late 19th century (see Section E, Early Transportation Era Historic Context).

The other nominated Parker, Pennsylvania and Warren through-truss bridges are significant either for exhibiting unique engineering features, for their associations with a prominent bridge builder, or for representing the advancements made in bridge design during the Arkansas Highway and Transportation Department era (See Section E, Arkansas Highway and Transportation Department Era Historic Context). Therefore, these bridges are eligible for listing on the National Register on a statewide level under both Criteria A and C.

Registration Requirements:

There are several registration requirements for Arkansas' remaining through-truss bridges, which are significant because of their engineering features, construction materials, workmanship and associations either with prominent bridge builders or with the state's transportation development. They must have been built either during the Early Transportation Era or the Arkansas Highway and Transportation Department Era; they should retain sufficient physical features to identify them as having been built during one of these eras; they should be good examples of the patented designs they represent; they should be intact and unaltered; and they should retain their integrity of setting.

SWING THROUGH-TRUSS BRIDGES

Description:

Swing through-truss bridges were designed to allow the passage of river traffic. In Arkansas, there are only three remaining swing through-truss bridges. Two of these, both located in northeast Arkansas, have a center swing truss that could be turned by hand. Similar in design, these bridges differ mainly in the details of their trusses. One is a steel four-span bridge, with the Parker truss swing span as the third span; the other is a steel three-span consisting of two Parker trusses and a Warren truss center swing span. Both were built in the mid-1930's during the Arkansas Highway and Transportation Department era (See Section E, Historic Context).

The third swing through-truss bridge, built in 1924, is a steel three-span design that uses a Warren cantilevered swing truss that was also turned by hand.

Although these bridges no longer make use of the turning mechanism (in fact, it is doubtful that the two northeast Arkansas bridges were ever turned), they are each still in use and in good condition.

Significance:

The state's three swing through-truss bridges represent the federal government's jurisdiction over the country's navigable waters. When the two northeast Arkansas bridges were built in the mid-1930's, the importance of navigable waters was no longer as great, due to the advent of the railroad and the automobile, yet Congressional approval was still required before building could take place. For the state's Highway and Transportation Department, obtaining this approval was often slow and arduous, and reflected the disorganization amidst good intentions that characterized the department's early years (See Section E, Historic Context, as well as individual nominations). Because these bridges played a primary role in the development of the AHTD, they are significant on a statewide level under National Register Criterion A. They are also significant under Criterion C as the only bridges in the state to use the swing through-truss mechanism in their design.

Registration Requirements:

To meet requirements for listing on the National Register of Historic Places, the state's swing through-truss bridges should have been built during the Arkansas Highway and Transportation Department Era (1923-39); they should retain sufficient physical features to identify them as having been designed and built during this period; they should retain their turning mechanisms; they should be good examples of the patented designs they represent; they should be relatively intact and unaltered; and they should retain their integrity of setting.

DECK ARCH BRIDGES

Description:

The state's surviving deck arch bridges fall into two design categories: open spandrel and closed spandrel. The open spandrel deck arch bridges were constructed in the late 1920's of reinforced concrete. One surviving example is a single-span design located in north-central Arkansas built by the Luten Bridge Company, which specialized in reinforced concrete arch bridges. It is in good condition and is being maintained by the Arkansas Highway and Transportation Department. Another open spandrel design consists of two spans and is currently in poor condition.

Of the surviving closed spandrel deck arch bridges, one is constructed of concrete and eight are constructed of masonry (either brick or fieldstone). The eight masonry bridges were built during the 1930's, outside the influence of the Arkansas Highway and Transportation Department. Five were designed and built by federal government relief programs (either the CCC or the WPA), and three were built by Justin Matthews, a private entrepreneur.

Each of the closed spandrel bridges exhibits unique design characteristics and/or fine craftsmanship. For example, the brick deck arch bridge, a two-span design, has an unusual semi-circular "ice breaker" on its center pier; two of the privately-funded fieldstone bridges have vertical columns incorporated into their spandrel walls; and one CCC-constructed bridge uses finished rather than rusticated fieldstone. Although one of the bridges has been covered over, with only its road deck and parapet still visible, they are all still in use and in good or excellent condition.

Significance:

Each of the nominated deck arch bridges are significant not only because of the unique design characteristics, fine craftsmanship, and/or construction methods that they possess, but also because of their associations with the state's transportation development.

For instance, the three closed spandrel deck arch bridges that were built by Justin Matthews represent rare examples of privately designed and constructed bridges. They also played an important part in the trend-setting residential development project orchestrated by Matthews in the late 1930's (See Section E, Arkansas Highway and Transportation Era Historic Context).

The eight federal government-constructed closed spandrel deck arch bridges are significant because of their association with federal relief programs like the CCC and the WPA, and with the general 'rustic architecture' theme of the state parks that these programs are credited with creating (See Section E, Historic Context).

The concrete open spandrel and closed spandrel deck arch bridges are the best examples of their design type and their construction is associated either with the AHTD, a prominent builder, or, as in the case of one bridge, with a county project.

Therefore, the deck arch bridges are significant on a statewide level under National Register Criterion A for their contributions to the state's transportation development, and under Criterion C for their engineering designs.

Registration Requirements:

The remaining deck arch bridges in Arkansas (which are significant for their engineering features, fine craftsmanship, construction materials, and associations) should meet these requirements before being considered eligible for National Register status: they should have been built during the Arkansas Highway and Transportation Department Era (1923-39); they should have been designed and built either by the AHTD, the county government, federal relief programs, or a private individual; they should retain sufficient physical features to identify them as having been built during this period and by those parties; they should be intact and unaltered; and they should retain their integrity of setting.

OTHER BRIDGE DESIGNS

Description:

Several of the state's surviving bridges from the Early Transportation Era (1870-1923) and the Arkansas Highway and Transportation Department Era (1923-39) are too unique to fall into any of the four Associated Property Type categories, either because they are the only remaining examples of a particular design or because they were the only ones ever constructed in the state. Each of these bridges is in good condition and still in use.

The most prominent of these unique bridges is a five-span, concrete-covered steel bridge, built in 1930, that utilized the patented Marsh Rainbow Arch design. Two other bridges, both built by railroad companies, also incorporated the reinforced concrete Rainbow Arch into their design. One is an unaltered single-span built in 1928 and the other, built in 1915, is a small, functional structure that uses a pony-truss arch.

Two steel vertical-lift bridges, designed to allow the passage of river traffic, survive in the state. One was constructed by the Vincennes Company in 1934 and uses I-beam trestles; the other is a Pratt through-truss design that was built in 1923. Its lift mechanism is powered by a diesel engine.

The Vincennes Company also constructed a steel Warren deck truss bridge consisting of two cantilevered spans and two suspended spans, with the deck truss narrowing at each end span. A second

steel deck truss bridge uses the Pratt design for the deck truss along with three Parker pony trusses.

The state's surviving suspension bridges, built in the early 1900's, use steel cables draped over two steel towers on concrete piers.

Significance:

Because they are the only examples of particular designs, the bridges described above are unique to Arkansas and thus are significant contributors to the historic landscape of the state.

Besides their rarity, some of these bridges are significant for other reasons as well. The Marsh Rainbow Arch bridge is an outstanding example of a rare design, and therefore is eligible for national recognition under Criterion A and C; the pony truss rainbow arch bridge is one of the most important small bridges in the state because its design precedes the popular period for this type of bridge; and the Pratt through-truss vertical lift bridge was one of the last major privately financed bridge construction projects in the state.

Therefore, with the exception of the Marsh Rainbow Arch bridge, which is significant on a national level, these unique bridges are significant on a statewide level under National Register Criterion A for their contributions to the state's developments in transportation, and Criterion C for being outstanding examples of engineering techniques.

Registration Requirements:

Arkansas' unique bridges are significant because of their rarity, their engineering features, their craftsmanship and their associations with the advancements made in the state's transportation system during the early part of the 20th century. In general, to meet registration requirements, these bridges should have been built in the period between 1900-39; they should retain sufficient features to identify them as having been built during this period; they should be good or outstanding examples of the designs they represent; they should be intact and unaltered; they should retain their integrity of setting; and they should be few in number.

The historic bridges presented in this nomination were identified during a three year evaluation project (1985-1987) conducted by the Arkansas State Highway and Transportation Department (AHTD), with the Arkansas Historic Preservation Program (AHTD) acting as project advisors.

The AHTD presently maintains records for 6,649 bridges on the State Highway System and 6,302 bridges located on county roads and urban streets. The records for these 12,951 bridges are maintained by the AHTD using a computer program, OASIS (On-line Arkansas Structure Inventory System), which is continually updated and is the matrix from which this historic inventory was taken.

For the purposes of the evaluation, it was decided to consider all existing bridges built prior to 1941 to establish an initial inventory which is valid until the year 1990. This produced a group of 2,596 bridges, comprising 31 separate bridge types, and became the data base from which these potentially eligible bridges were identified.

All bridges were assigned to a specific bridge type and further categorized by construction material. Each bridge was then evaluated solely within its own type by using as system based on engineering attributes, such as number of spans and span length, and on historical information, such as date of construction, builder, and the number of surviving examples. All attributes were weighted accordingly within each type. The highest scoring examples were then further considered and a consensus was reached between the AHTD and the AHPP to determine potentially eligible structures (For a more detailed explanation of this evaluation procedure, see McClurkan, 1987).

As a result of this evaluation, a total of 51 historic bridges were identified as being potentially eligible to the National Register. 9 of these bridges were already listed or have been individually listed on the National Register prior to the preparation of this nomination. 4 additional bridges have been or are currently being replaced and are not included in this nomination, leaving the total number of bridges in this Multiple Property nomination at 38. All bridges were considered eligible on at least the state level of significance.

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Amendment to the Multiple Property Listing:
Historic Bridges of Arkansas
Name of Property

Arkansas
State

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

Section number **Amendment** Page **1**

We are requesting that the Multiple Property Listing "Historic Bridges of Arkansas," be amended to include a new Historic Context, "Post World War II Era," which allows for the inclusion of bridges built between 1946 and 1950 to the National Register of Historic Places. These bridges must possess the best overall construction quality and the greatest integrity in their geographical location and be significant for their strong association with the state's transportation development.

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I hereby certify that this ☒ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set for in 36 CFR Part 60.

Signature of certifying official/Title — Date: 4-28-00

State or Federal agency and bureau

AMENDMENT TO THE HISTORIC BRIDGES OF ARKANSAS MULTIPLE PROPERTY NOMINATION

Historic Context: Post World War II Era

SUMMARY:
This amendment to the above-referenced multiple property nomination, at this time, seeks to recognize the historic significance of a total of five historic vehicular bridges constructed between 1947 and 1950 that are located throughout the state. This amendment will provide the historic context for the nomination of Deck truss, Pony truss, Through truss, and Deck Arch bridges constructed Post World War II between 1946 and 1950.

When the 1985-87 and 1992 surveys were conducted each of these structures had yet to reach the fifty-year-old mark. In 1992 a follow-up survey was conducted which specifically targeted three categories of historic bridges that were not considered during the initial (1985-1987) survey: first, all bridge types constructed between 1940-45; second, timber bridges; and third, open masonry substructure bridges. During the 1992 survey all qualifying vehicular bridges were identified. The examples possessing best overall construction quality and greatest integrity were determined eligible, most often under Criterion C, though those with verifiable public works agency associations will also be eligible under Criterion A. As a result of the 1992 survey, twenty-nine bridges were nominated to the National Register of Historic Places in 1995 as an Amendment to the *Historic Bridges of Arkansas Multiple Property Nomination* under the historic context "World War II Era: Timber and Open Masonry Substructure Bridges."

This amendment, "Post World War II Era," seeks to amend the multiple property nomination to include bridges constructed between 1946 and 1950 that are the best examples of Deck truss, Through truss, Pony truss, and Deck Arch bridges in their geographical location and that possess the best overall construction quality and greatest integrity. It is under these conditions that the following bridges are being nominated under this historic context: *Big Slough Ditch County Road 35 Bridge*, Greene County; *U.S. 63 Bridge over the Black River*, Lawrence County; *Ben Laney Bridge*, Ouachita County; *Self Creek Bridge*, Pike County; and *U.S. 62 Bridge over Crooked Creek*, Marion County. This context also recognizes the strong association that these bridges have with the state's transportation development.

United States Department of the Interior
National Park Service

National Register of Historic Places Continuation Sheet

ELABORATION:

During World War II, Arkansas experienced an extreme shortage of men, materials, and equipment. In many locations throughout the state construction was suspended on highway related projects except for those projects considered critical to national defense. During World War II the Arkansas Highway Commission implemented tight money management practices which resulted in a small surplus of funds that could be used for postwar construction. However, despite the availability of minimal funding few construction contracts were awarded in 1945-46. However, the need for better highways encouraged Arkansas' government to continue to find ways to improve transportation routes. Along with the need for better highways came the need to build new and wider bridges to handle the increase in vehicular traffic. Many of the bridges built after World War II were constructed with funding from the Federal Aid Project. As engineering techniques improved, the highway department began building fewer truss bridges and more bridges made of reinforced concrete.

Truss Bridges

During the late nineteenth and early twentieth centuries iron and steel bridges were erected throughout the country in rural and urban settings. There are two basic structural types of truss bridges found in the United States – the Warren truss and the Pratt truss. The Warren truss is designed to allow the diagonals to carry both the compressive and tensile forces. Some Warren truss bridges have vertical members which serve as additional bracing for the triangular web system; whereas, the Pratt truss is designed to allow the vertical members to act in compression and the diagonals to act in tension. Pratt truss bridges have several variations such as the: Howe, Pratt, Pratt Half-hip, Parker, Camelback, Lenticular, Baltimore, and Pennsylvania. In Arkansas, the Warren, Parker, Pratt, Pennsylvania and Camelback truss variations were historically most common. Both Warren and Pratt truss types occur in three basic forms: the deck truss, the through truss, and the pony truss bridge.

Deck Truss Bridges

Constructed of steel channels, angles, continuous plate, and batten plates riveted together, the deck truss bridge is distinguished by its engineering design. A deck truss is designed to carry its traffic load level with the top chords. The deck truss was one of the more commonly constructed bridges. The *Big Slough Ditch County Road 35 Bridge*, Greene County; *U.S. 63 Bridge over the Black River*, Lawrence County; and *U.S. 62 Bridge over Crooked Creek*, Marion County are being submitted under this context. Each bridge was constructed between 1946 and 1950 and is the best example of a deck truss bridge in its surrounding area. These bridges display a high degree of integrity as evidenced by their fine craftsmanship and construction method.

Through Truss Bridges

Through truss bridges are constructed of steel and include the popular Pratt design as well as Pennsylvania, Warren, and Parker designs. The defining characteristic of a through truss bridge is that it carries its traffic load level with the bottom chords.

Pony Truss Bridges

Pony truss bridges are constructed of steel members that make a long truss that provides the necessary length and strength for the bridge. A pony truss is a through truss with no lateral bracing, it carries its traffic load level with the bottom chords. Constructed in 1947, the *Ben Laney Bridge* in Ouachita County, is being submitted under this context as the best example of a Pony truss bridge in its surrounding area which displays fine craftsmanship and a great degree of integrity.

Concrete Bridges

During World War II and after, there was a shortage of steel around the United States and even Arkansas felt the ramifications of this plight. Therefore, the highway department began exploring other options for building materials. By this time in history construction techniques had improved greatly from the turn of the century. Although truss bridges had become popular at the turn of the century because of their durability they were costly to construct and time consuming, because they were often prefabricated by specialized bridge companies and shipped to the building site. Due to the popularization and availability of reinforced concrete, construction companies were able to build bridges on-site, which was not only faster but also more economical. During the Post World War II era, concrete bridges generally fell under two categories, an open spandrel deck arch bridge or a closed spandrel deck arch bridge. Deck arch bridges constructed between 1946 and 1950, which possesses a strong degree of integrity and are significant for their engineering feats and craftsmanship, will also be submitted under this context.

Deck Arch Bridges

The state's surviving deck arch bridges fall into two design categories: open spandrel and closed spandrel. An open spandrel arch is designed so that it has spandrel walls with its spandrel unfilled opposed to the closed spandrel arch which has spandrel walls with the spandrel being filled. Oftentimes, deck arch bridges were constructed out of concrete or some form of masonry. The *Self Creek Bridge* in Pike County is being submitted under this context as the best example of a concrete deck arch bridge in its geographical location that possess the best overall construction quality and greatest amount of integrity.

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