HAER
IOWA
82-DAVPO,
8-

CENTENNIAL BRIDGE
Iowa Bridges Recording Project
Spanning Mississippi River
at U.S. Highway 61
Davenport
Scott County
Iowa

HAER No. IA-73

BLACK & WHITE PHOTOGRAPHS

WRITTEN HISTORICAL & DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

HAER
IOWA
82-DAVPO,
8-

HISTORIC AMERICAN ENGINEERING RECORD

CENTENNIAL BRIDGE

HAER No. IA-73

Location:	Spanning the Mississippi River and connecting U.S. Highway 61 (Iowa) with U.S. Highway 67 (Illinois); Davenport, Scott County, Iowa/ Rock Island County, Illinois UTM: 15.703150.4598820 USGS: Davenport East, Iowa quadrangle (7.5 minute series, 1991)
Date of Construction:	1940
Designer:	Ned L. Ashton of Ash, Howard, Needles, and Tammen, Kansas City, Missouri
Builders:	Crouse and Saunders, Detroit Michigan (concrete deck); American Bridge Company, New York (superstructure); McCarthy Improvement Company, Davenport, Iowa (substructure)
Fabricator:	American Bridge Company, New York
Present Owner:	Iowa Department of Transportation
Present Use:	Highway bridge
Significance:	This bridge is a major river span and was the first tied-arch span across the Mississippi River. The bridge was fabricated, and the superstructure built, by American Bridge Company, New York, one of the largest bridge companies in American history. The bridge's designer, Ned L. Ashton, was one of Iowa's most influential engineers.
Historian:	Robert W. Jackson, August 1995
Project Information:	This document was prepared as part of the Iowa Historic Bridges Recording Project performed during the summer of 1995 by the Historic American Engineering Record (HAER). The project was sponsored by the Iowa Department of Transportation (IDOT). Preliminary

research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, CO.

The construction of the Centennial Bridge between Davenport, Iowa and Rock Island, Illinois in 1940 marked a new chapter in an old story concerning the relation between private enterprise and governmental action in the construction of Mississippi River bridges at this location.

The very first bridge over the Mississippi River was built by the privately owned Railroad Bridge Company in 1856 between Davenport, Iowa and Rock Island, Illinois. The company was created to unite the lines of the Chicago & Rock Island Railroad and the Mississippi & Missouri Railroad, with bonds to finance the project guaranteed by both railroads. The only governmental authority to build the bridge was granted by the legislature of Illinois, even though the middle segment of the bride consisted of the tracks which ran across Rock Island itself. This island was located between the two states and was owned by the federal government. The United States district attorney applied for an injunction to prevent the building of the bridge over federal property but it was denied by the United States Supreme Court.[1]

Shortly after the bridge was completed, it was rammed by the steamboat "Effie Afton". This collision not only ignited both the bridge and the boat, it also ignited a controversy over the rights of profit-minded private companies to erect bridges across the nation's most important navigable waterway. The federal government struggled for years over the question of whether it should help or hinder the construction of such bridges. Finally, in 1866, Congress passed legislation that allowed private bridges to be built on major navigable waterways with federal approval. The race to build new spans across the Mississippi was then on.

The remnants of the first Davenport-Rock Island bridge, which had suffered extensive damage in 1868, were removed in 1872 and a new bridge was built about one-half mile downstream by the Federal government. The main purpose of this bridge was to provide access to Arsenal Island (as Rock Island was called by the government) from Davenport, but it was constructed partly at the

---

[1]F.B. Maltby, "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River," Journal of the Western Society of Engineers 8 (August 1903), 464; Marlys A. Svendsen and Martha H. Bowers, "Davenport: Where the Mississippi Runs West: A Survey of Davenport History and Architecture," (Davenport, IA: City of Davenport, 1982), 3-3, 3-4.

expense of the Railroad Company. This bridge featured both a railroad track and a wagon roadway, with the first being located above the latter. A new superstructure was authorized by Congress in 1894 and was completed in 1896 with sixty percent of the funds coming from the Chicago, Rock Island & Pacific Railway Company. The new spans rested upon the old piers, and the bridge once again carried a railroad track above a roadway. This time, however, the bridge was designed for a double-track rail line and two lanes of roadway. This bridge has come to be known as the Government Bridge.[2]

Further downstream the Crescent Bridge, which was originally built to serve the Davenport, Rock Island & Eastern Railway, was opened to traffic in 1899. The bridge was authorized by an act of Congress in 1885, but no actual work was begun until 1895. This bridge was built exclusively for rail traffic with private funds.[3]

With the explosive growth in automobile traffic during the 1920s, it was becoming apparent that the Government Bridge alone would not be sufficient to meet the motoring needs of the Quad-City area, which included Davenport and Bettendorf, Iowa, and Moline and Rock Island, Illinois. More than 500,000 vehicles a year used the Government Bridge in 1899 and that figure had climbed to 5 million by 1923. In response, a group of businessmen began in 1927 exploring the idea of building a highway bridge across the Mississippi with private capital. Although the promoters acquired a congressional franchise in 1928, the stock market crash of 1929 eliminated potential sources of private financing. An appeal was made to the cities of Moline and Bettendorf, but when they declined to provide funds the City of Davenport took on the venture. A special act of Congress and new state legislation allowed the City to own and operate a bridge which was not in its city limits.

Construction of the Iowa-Illinois Bridge, which was upstream from the Government Bridge, was financed by the Public Works Administration, and labor for its construction was employed

---

[2]Ibid, 464-468; Marlys Svendsen, Davenport: A Pictorial History (Davenport, IA: G. Bradley Publishing, 1985), 31, 58, 132; Howard, Needles, Tammen & Bergendoff and Wilbur Smith & Associates, "Mississippi River Toll Bridge: Bridge Location, Revenue and Traffic Studies at Davenport, Iowa," (Kansas City, MO: Howard, Needles, Tammen & Bergendoff, 1968), iv, a report located in the files of the Iowa Department of Transportation, Ames, Iowa; Svendsen and Bowers, 3-5.

[3]Svendsen, 58; Svendsen and Bowers, 3-6.

through the National Re-Employment Service at Davenport and Rock Island. The bridge was completed as a toll facility in 1935, with the first two-lane suspension span often referred to locally as the Bettendorf bridge. The bridge, which cost $1.4 million to construct, was paid for and maintained by tolls for passenger cars of $0.15 with ticket books available that reduced the toll to $0.10. Larger vehicles paid up to $0.30. The Davenport Bridge Commission opened an additional two-lane suspension span in 1960.[4]

By 1940 the Government Bridge was carrying approximately 9 million vehicles annually on its two-lane roadway and also carried two street car tracks. Despite the relief provided by the Iowa-Illinois Memorial Bridge, traffic on the Government Bridge during rush hour was becoming congested. On the initiative of the City of Rock Island, traffic studies were done that established the feasibility of constructing a new toll bridge between the Government Bridge and the Crescent Bridge, connecting the business sections of Rock Island and Davenport. But despite the favorable prospects of such a bridge, the Public Works Administration turned down a loan-and-grant request submitted by the city. All of the revenue bonds were therefore sold to a private banking syndicate, making the Centennial Bridge the first highway bridge in the Quad-Cities area to be financed entirely with private funds. Named in honor of Rock Island's 100th Anniversary, the bridge cost $2.5 million to build. The construction and operating costs were paid for by a passenger vehicle toll of $0.10, with six axle vehicles paying up to $0.45.

The Centennial Bridge was designed and its construction was supervised by Ash, Howard, Needles & Tammen consulting engineers from Kansas City, Missouri under the direction of R.N. Bergendoff of that firm. The chief designer was Ned L. Ashton, with assistance from chief draftsman Carl S. Harper. William Schmidt was resident engineer for the consultants, with Stephen Collins as assistant. Foundation contractor was the McCarthy Improvement Company of Davenport, and the superstructure contractor was the American Bridge Company of New York. Crouse & Saunders of

[4]Modjeski, Masters & Case, "Report to the Davenport Bridge Commission of Davenport, Iowa on Survey of Cross-River Traffic in August, 1935 and Schedule of Toll Rates With Estimate of Annual Income for the Iowa-Illinois Memorial Bridge," (Harrisburg, PA: Modjeski, Masters & Case, 1935), 1, a document located in the files of the Iowa Department of Transportation, Ames, Iowa; Howard, Needles, Tammen & Bergendoff and Wilbur Smith & Associates, vii; Svendsen, 151, 162; Svendsen and Bower, 3-9.

Detroit, Michigan were awarded the contract for the concrete deck.[5]

The involvement of Ned Ashton in this project is one of the most significant aspects of the structure. Ashton held a Master of Science degree in both hydraulics and structural engineering from State University of Iowa, Iowa City, and was well qualified to design a bridge of this type. He is also responsible for the design of the Julien Dubuque Bridge (1941) in Dubuque County and for the Clive Street Overpass (1958) in Des Moines, the first aluminum welded girder highway bridge built in the United States. Ashton became an advocate of welding, helping to promote it within the engineering establishment.[6] It was Ashton who first recommended to the City of Burlington, Iowa in 1953 that they weld certain joints of the Cascade Bridge, a process that has been continued and may be repeated in the future.

The American Bridge Company of New York, an amalgamation of about twenty-five competing firms representing approximately fifty percent of the nation's fabricating capacity, was organized by J.P. Morgan and Company in April 1900. Less than a year later, most of its stock was acquired by United States Steel Corporation, a creation of Andrew Carnegie. Other companies were subsequently added to the corporation, and the firm was one of the most important bridge construction firms in America when contracted to build the superstructure of the Centennial Bridge.[7]

Work on the bridge began in April 1939 at the Davenport (north) end where the material yard was located. The bridge was built over thirty one railroad tracks in both cities without serious interruption of rail traffic, and officially opened in June 1940.

---

[5]Unless otherwise noted, information contained in this report concerning the Centennial Bridge is from "Tied Arches to Span the Mississippi," Engineering News-Record 124 (March 1940), 366-370; and from Howard, Needles, Tammen & Bergendoff, "Rock Island Centennial Bridge and Ancillary Bridges Bridge Inspection Report," (Kansas City, MO: Howard, Needles, Tammen & Bergendoff, 1991), 3-6, a report located in the files of the Iowa Department of Transportation, Ames, Iowa.

[6]Clayton B. Fraser, "Iowa Historic Bridge Inventory," (Loveland, CO: Fraserdesign, January 1994), 31, a report prepared by Fraserdesign for the Iowa Department of Transportation, located in the files of the Iowa Department of Transportation, Ames, Iowa.

[7]Victor Darnell, A Directory of American Bridge-Building Companies: 1840-1900 (Washington: Society for Industrial Archeology, 1984), 85-86.

This four-lane bridge carrying U.S. Route 67 over the Mississippi River between Iowa and Illinois was the first four-lane highway to cross the river. It consists of five steel tied-arch spans totaling 2,262′ in length. All five spans are on a tangential horizontal alignment. The two main channel arches each span about 538′. They are flanked on the Iowa side by two shorter arch spans and on the Illinois side by a single arch span, each about 395′ long. Continuous beam and girder viaduct approach spans, totaling 511′ and 1,075′ in Rock Island and Davenport, respectively, complete the bridge. The bridge provides clearances of 515′ horizontally and 66′ vertically at the navigation channel. Roadways of 22′-0" are separated by a 2′-6" raised steel median and flanked by 5′-0" sidewalks. The skew angle is zero degrees for all of the arch spans.

The arches are spaced 51′-6" at centers. The two roadways are carried between the arches while the two sidewalks are carried outside each arch on cantilever brackets. The tied arches consist of plated steel box girder arch ribs, horizontal ties connecting the ends of the arches, and vertical hangers suspended from the arch ribs which support the roadway. The heavy steel ties eliminate the need for massive pier construction to resist the thrust of the arch ribs. There is no structural continuity between successive arches; each span is an independent structural unit.

A description of the 538′ tied arch spans will illustrate the type of construction of the 395′ spans as well, since they are all similar. The arch ribs of the 538′ spans rise about 89′ above the roadway at midspan. The arch tie is five feet below the level of the roadway. The arch ribs are box girders constructed of silicon steel and consist of two vertical web plates 96" deep spaced 27" apart, top and bottom flanges made up of four angles each, and 37" wide cover plates top and bottom. The web and cover plates are stiffened by angle frames that are spaced at five foot intervals and which are braced at mid-depth by a steel channel. On the 395′ long arch ribs the webs are 72" deep and are stiffened at mid-depth by a single angle. There is room for a man to walk on the inside of the arch ribs. Manholes for access to the interior of the ribs are provided near each end just above the deck level. The hangers are 14" deep carbon steel H-shaped sections weighing 87 lbs. per square foot. The hangers are spaced at 35′-7" panel points along the arch span. At the hanger to rib connection, a 27" deep beam section is used as a diaphragm in the rib and the hanger is connected to that beam by car channels. The arch tie is a heavy silicon steel H-section which weighs 398 lbs. per foot. The arch tie is 18 1/4" deep and 16 5/8" wide with flanges which are nearly 3" thick.

Roller type expansion bearings are provided under each arch at one end of each span to provide for the lengthening and shortening of the arch spans caused by changes in temperature and loading conditions. The opposite end of each span is supported on fixed bearings which prevent displacement of the superstructure. The expansion bearings are composed of an upper and a lower casting which "ride" on a nest of rollers which in turn are supported on a steel plate. The fixed bearing consists of an upper and lower casting. Provision is made in both the fixed and expansion bearings for the upper casting to rotate on the lower casting, thus accommodating deflection of the bridge span.

The tied arch is an unusual design choice for a river as wide as the Mississippi because of the large number of deep piers required for a long crossing. However, tests of the river bottom at the proposed location of the bridge revealed that a firm foundation of hard shale or clay occurs at a relatively shallow depth. Sand or gravel at a depth of fifteen to twenty feet overlies a hard clay or shale which is seldom over forty feet below pool level. This indicated that steel H-piles could be driven economically. Pile driving for the first, northernmost pier actually revealed the clay to be dense enough to permit placement of the foundations directly on the bottom, without the need of piles. Therefore only the first pier, which is actually on land, is founded on steel H-piles. All of the other piers supporting the tied arches are on spread footings. Single-wall sheetpile cofferdams were used in placing the piers after the use of a double-wall design on the first pier indicated that a single wall would be adequate. Excavated to approximately 20′ below river bottom, the cofferdams were sealed by tremie concrete and pumped out, permitting the piers to be built in the dry.

The Rock Island approach of the bridge is about 511′ and consists of the southernmost eight spans. The Davenport approach consists of the northernmost sixteen spans and is about 1,075′. The concrete approach bents are all on steel piles, with the footings only slightly below ground level to reduce excavation. Considerable effort was devoted to the design of the piers and concrete bents to make them aesthetically pleasing without added adornment.

The favorable conditions of the river bottom also satisfied another requirement of tied arch construction by enabling the contractor to use falsework economically. An adjustable falsework was built from pier to pier with bents at every panel point, upon which the floor members were assembled. The hangers were then used as posts to support the arch rib as it was erected piece by piece. The panels were erected panel by panel and closure was made in the arch rib, tie splices being riveted up as erection progressed. The falsework was placed by a derrick boat which also erected all floor steel and the arch tie.

Erection of the superstructure began with the first approach girder span next to the river by means of a crawler crane. On this a 65-ton deck traveler with a 105-foot boom was assembled in position to start work on the first arch. The traveler moved out on the deck and, always backing away, erected the hangers and the arch ribs in two-panel lengths which were brought out to it on push cars. The heaviest pieces lifted were the crown sections of the ribs, weighing 47 tons in the long arches and 43 tons in the shorter ones. The spans were swung with the aid of jacking posts temporarily substituted in place of every second or third hanger. By means of these posts the arch rib could be raised or lowered to effect connections between the various erection pieces and in the end to adjust the rib as needed for closure and swing the arches free of the falsework.

The deck consists of a 7 1/4" reinforced concrete slab and a 1 1/2" bituminous or Portland cement concrete overlay which carries four 11'-0" traffic lanes, two in each direction. The transverse expansion joints are of the cast steel finger joint type, and are provided in the deck at every third panel point to reduce stresses in the floor. The original castings have been built up with plates to match the thickness of the overlays. This was done by welding 1-1/2" plate, cut to match the finger configuration, to the tops of the castings. Drainage is provided by open gutters which allow water to run off the pavement edges.

The 7-1/2" bar-truss-reinforced concrete roadway slab is supported on 10" deep steel I-beam cross beams placed at 4'- 5-3/8" centers. The cross beams are supported on three lines of 35'-6" long steel stringers in each dual lane roadway. The stringers are rolled beam sections from 27" to 33" in depth. The stringers frame into 60" deep built-up steel plate girder floorbeams. The floorbeams are connected to the hangers at panel points which are spaced at 35'-7". Stringers at the contraction joints are attached to the floorbeams by pinned link hangers. The bottom flange of the end floorbeams is stiffened by a horizontal flanged plate to prevent buckling of the bottom flange of the end floorbeams due to lateral stresses.

An excellent example of Ned Ashton's work, the Centennial Bridge is a technologically significant structure as the first tied-arch span across the Mississippi River, and is also regarded as one of the most striking bridges ever built across the "Father of Waters".

APPENDIX
IMPLICATIONS FOR FURTHER RESEARCH

Several questions concerning the Centennial Bridge arose during the research and writing of this report. Some of these questions, due to limitations in the scope of the Iowa Historic Bridges Recording Project, have remained unanswered. It is suggested that scholars interested in this bridge consider pursuing the following:

1. How might the overall cost of the bridge be divided between substructure cost and superstructure cost?
2. How cost efficient is the tied-arch design?
3. What role did this bridge play in the evolution of Ned Ashton's design philosophy?
4. Under what circumstances did Ash, Howard, Needles, and Tammen become Howard, Needles, Tammen & Bergendoff?

SOURCES CONSULTED

Darnell, Victor. A Directory of American Bridge-Building Companies: 1840-1900. Washington: Society for Industrial Archeology, 1984.

Fraser, Clayton B. "Iowa Historic Bridge Inventory." Loveland, CO: Fraserdesign, January 1994. A report prepared by Fraserdesign for the Iowa Department of Transportation, located in the files of the Iowa Department of Transportation, Ames, Iowa.

Howard, Needles, Tammen & Bergendoff. "Rock Island Centennial Bridge and Ancillary Bridges Bridge Inspection Report." Kansas City, MO: Howard, Needles, Tammen & Bergendoff, 1991. A report located in the files of the Iowa Department of Transportation, Ames, Iowa.

Howard, Needles, Tammen & Bergendoff and Wilbur Smith & Associates. "Mississippi River Toll Bridge: Bridge Location, Revenue and Traffic Studies at Davenport, Iowa. Kansas City, MO:Howard, Needles, Tammen & Bergendoff, 1968. A report located in the files of the Iowa Department of Transportation, Ames, Iowa.

Maltby, F.B. "The Mississippi River Bridges: Historical and Descriptive Sketch of the Bridges over the Mississippi River." Journal of the Western Society of Engineers 8 (August 1903): 464.

Modjeski, Masters & Case. "Report to the Davenport Bridge Commission of Davenport, Iowa on Survey of Cross-River Traffic in August, 1935 and Schedule of Toll Rates With Estimate of Annual Income for the Iowa-Illinois Memorial Bridge." Harrisburg, PA: Modjeski, Masters & Case, 1935. A document located in the files of the Iowa Department of Transportation, Ames, Iowa.

Svendsen, Marlys A. Davenport: A Pictorial History. Davenport, IA: G. Bradley Publishing, 1985.

Svendsen, Marlys A. and Martha H. Bowers. "Davenport: Where the Mississippi Runs West: A Survey of Davenport History and Architecture." Davenport, IA: City of Davenport, 1982.

"Tied Arches to Span the Mississippi." Engineering News-Record Vol. 124 (March 1940), 366-370.

ADDENDUM TO
CENTENNIAL BRIDGE
Iowa Historic Bridges Recording Project
Spanning Mississippi River at U.S. Highway 61
Davenport
Scott County
Iowa

HAER No. IA-73

HAER
IOWA
82-DAVPO,
8-

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
1849 C Street, NW
Washington, DC 20240

HISTORIC AMERICAN ENGINEERING RECORD

CENTENNIAL BRIDGE

This appendix is an addendum to a 10-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."