BRIDGE 23780
Carries U.S. Highway 20 westbound over the North Fork of the Maquoketa River
Dyersville vicinity
Dubuque County
Iowa

HAER IA-98

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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

HISTORIC AMERICAN ENGINEERING RECORD
BRIDGE NO. 23780

HAER No. IA-98

Location: Carries U.S. Highway 20 westbound over the North Fork of the Maquoketa River, Dyersville vicinity, Dubuque County, Iowa.

Bridge No. 23780 is located at latitude 42.470539, longitude -91.124741. The coordinate represents the center of the bridge. It was obtained in 2014 by plotting its location on Google Earth. The location has no restriction on its release to the public.

Present Owner/ Occupant: Iowa Department of Transportation.

Present Use: Vehicular traffic.

Significance: This section of U.S. Highway 20 was constructed as part of a highway relocation project that bypassed the towns of Epworth, Farly, and Dyersville, Iowa. Bridge No. 23780 is a prestressed concrete box girder bridge and is a representative example of this common post-1945 concrete bridge type.

Historian(s): Camilla Deiber, Senior Architectural Historian; The Louis Berger Group; 2014

Project Information: This documentation was prepared as mitigation for the Advisory Council on Historic Preservation (ACHP)'s *Program Comment Issued for Streamlining Section 106 Review for Actions Affecting Post-1945 Concrete and Steel Bridges*, noticed in the Federal Register on November 16, 2012. The Federal Highway Administration (FHWA) and the ACHP are the project sponsors and retained The Louis Berger Group, Inc. and Mead & Hunt, Inc. team to prepare this document. It was prepared by Camilla Deiber, Principal Investigator, The Louis Berger Group, Inc. Rob Tucher completed the photography.

Part I. Historical Information

A. Physical History:

1. Date(s) of construction: 1958.

2. Engineer: Iowa State Highway Commission, Ames, Iowa.

3. Builder/Contractor/Supplier: John P. Abrahamson Construction Company, Des Moines, Iowa; J. C. Costigan Construction Company, Elkader, Iowa.

4. Original plans and construction: Plans for the bridge were prepared by the Iowa State Highway Commission: *Project No. F-305 (7) File No. 18326. Designs for Bridges and Culverts, Primary Road System, F. Project No. 305 (7)*, Dubuque County, June 1957.

5. Alterations and additions: The original steel railing was replaced with a solid concrete railing. No other major alterations have been made to the structure.

B. Historical Context:

U.S. Highway 20

In the 1950s safety concerns on Iowa's highways prompted the straightening of dangerous curves and the installation of truck-climbing lanes on long hills. By the end of the decade, the Iowa State Highway Commission (ISHC) began to relocate major state highways to straighten curved, hilly, and dogleg routes—some work was done to provide better traffic flow with the new interstate highway system. In fiscal year 1958/1959, the ISHC was relocating sections of major U.S. highways, including U.S. Highways 30, 20, 169, 218, and 34. Some highways were relocated to the outskirts of town to eliminate congestion in downtown areas. By 1955 the ISHC adopted "extensive employment of by-pass highways in the vicinity of cities and towns".[1]

Along with controlled access highways came "urban relief routes," which were contemplated as early as 1938 in Waterloo, where several high volume highways converged in the downtown area causing chronic traffic problems.[2] As bypasses became more common, local businesses expressed their worries about the economic impact of by-pass routes. The public at large did not, however, share these fears.

In 1955, while work was underway on the interstate highway system, improvements were being made to the primary road system in Iowa "for the immediate preservation of the public peace, health and safety

[1] Iowa State Highway Commission (ISHC), *Annual Report of the Iowa State Highway Commission* (Ames, Iowa: ISHC, 1956), 4.

[2] Iowa State Planning Board, *Vehicular Traffic, Waterloo, 1938*. (Ames, Iowa: Iowa State Highway Commission, 1938), 4.

and for the promotion of the general welfare."[3] In 1955 the 56th General Assembly of Iowa authorized the designation of a "substantial portion" of the primary road system as controlled access highways. By 1956 the Commission had defined two different types of controlled access highways: complete control and planned control. Completely controlled access highways allowed connections to selected public roads only—completely prohibiting other crossings and direct private driveway connections. Planned control access highways allowed some private driveway connections and other crossings.[4] By June 30, 1957, the ISHC declared 8,554.7 miles of primary roads as controlled access highways.[5] These highways included portions of U.S. Highways 20 and 30, considered to be the main east/west controlled access highways through the state.

In July 1950 the ISHC was completing plans to relocate a 14-mile-long stretch of U.S. Highway 20 in Woodbury County to eliminate "sharp and treacherous curves."[6] On May 21, 1952, Christenson Brothers of Cherokee, Iowa, received the bids for bridge and culvert work.[7] Within six years the new segment of highway was slated to become a four-lane highway. On December 17, 1958, Christenson Brothers was awarded the $185,396 contract for construction of three bridges along the new four-lane route.[8] By May 1961 the bridges and grading were complete; however, because of cuts in spending, federal matching funds for the remainder of the project were diverted to other projects. All that remained was paving the additional two lanes of highway. The additional lanes were finally paved by January 1964.[9] The project cost an estimated $1.25 million.[10]

As early as 1955, the ISHC proposed to relocate U.S. Highway 20 between Dyersville and Center Grove, located just west of Dubuque. The 22-mile-long highway was located south of the existing U.S. Highway 20, bypassing the towns of Centralia, Epworth, and Farley.[11] The bypass was designed to be a safer route than the narrow U.S. Highway 20, which had numerous dangerous curves. The eastern 3.6 miles of the route had four lanes of traffic, and the remaining route had two lanes. John P. Abrahamson Construction Company of Des Moines and J.C. Costigan Construction Company of Elkader constructed

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[3] Iowa State Highway Commission (ISHC), *Progress on Iowa Highways, 1955-1956: An Interim Report to Iowa Highway Users* (Ames, Iowa: Iowa State Highway Commission, 1956), 4.

[4] Iowa State Highway Commission (ISHC), *Annual Report of the Iowa State Highway Commission* (Ames, Iowa: Iowa State Highway Commission,1957), 50-51.

[5] ISHC, *Annual Report*, 1957, 51.

[6] "New Highway Planned," *Cedar Rapids Gazette*, July 16, 1950, 4.

[7] "Let Contract On Highway 20," *Sioux City Journal*, May 22, 1952, 1.

[8] "Let Contract For Paving Portion of Interstate 29," *Sioux City Journal,* December 18, 1958,1.

[9] "Four-Lane Finally Paved," *Cedar Rapids Gazette,* January 13, 1964, 2c.

[10] Iowa Department of Transportation (Iowa DOT), *Biennial Report of the Iowa State Highway Commission. Iowa State Highway Commission (*Ames, Iowa: Iowa DOT, 1963/64), 21-22.

[11] "A Gently Curved Highway 20 Is Replacing a Narrow, Twisted Route," *Dubuque Telegraph-Herald*, August 16, 1959, 1.

the bridges along the bypass route.[12] By July 20, 1958, all of the bridges along the bypass were complete.[13] The highway was opened to traffic on August 31, 1959. At the time of completion, extension of the four-lane route into Dubuque was already being planned.[14]

In 1960 the ISHC proposed to relocate U.S. Highway 20 between Dyersville and IA Highway 38 near Delaware. The 9-mile-long highway was located south of the existing U.S. Highway 20, bypassing the towns of Earlville and Delaware.[15] The bypass was designed to be a safer route than the narrow U.S. Highway 20. The relocated highway was opened to traffic on November 13, 1964.[16] At the same time other sections of old U.S. Highway 20 were being widened to accommodate "long" trucks, which were trucks longer than 50'. In 1963 the Iowa Legislature banned long trucks on roads that were less than 22' wide. By the end of the year, only two segments of narrow roads remained, one of which was east of Manchester.[17]

Prestressed Spans

Prestressed concrete is concrete with stresses intentionally induced in it to counteract stresses created by loads. Concrete is weak in tension, therefore prestressing concrete for structural uses such as beams an girders for bridges is accomplished by inducing compressive stresses. The most common method for prestressing concrete beams is to precisely stretch high-strength steel bars or wires that are imbedded in high-strength concrete and in some way bonded to it. The elastic properties of steel causes the bars or wires, called tendons, to try to retract to their original length, thereby inducing the desired compressive forces in the beam. There are two general methods of prestressing concrete beams, pretensioning, in which the tendons are tensioned before the concrete hardens, and posttensioning in which the tendons are tensioned after the concrete hardens to a specific strength. A variety of techniques for prestressing concrete beams, some proprietary, have been developed and used for bridge construction. Both pretensioning and posttensioning methods can be used with either cast-in-place concrete bridge construction, or with precasting the prestressed members onsite or offsite in forms. The manufacturer of standardized precast-pretensioned beams and girders for short span bridges of sizes that could be reasonably transported over the road from factory to bridge site, evolved rapidly after WWII. Design criteria for prestressed bridges were published by the Bureau of Public Roads in the early 1950s.

The first prestressed concrete bridge was built in the U.S. in 1949 and the type was quickly adopted during the 1950s. Like most state highway departments, Iowa was utilizing precast/prestressed concrete beams and girders for a large percentage of their short span bridges by the mid-1950s. Over 250 prestressed concrete stringer, beam or girder bridges [Type 503] were built during 1958 and 1959,

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[12] "Route 20 Work Stops For Winter," *Dubuque Telegraph-Herald,* December 22, 1957, 1.

[13] "Superhighway Taking Shape," *Dubuque Telegraph-Herald,* July 20, 1958, 28.

[14] "A Gently Curved Highway 20 Is Replacing a Narrow, Twisted Route," *Dubuque Telegraph-Herald*, August 16, 1959, 1.

[15] "Bids on No. 20 Grading To Be Taken," *Cedar Rapids Gazette*, July 21, 1963, 4B.

[16] "Hwy. 20 Segment Opened," *Waterloo Daily Courier,* November 13, 1964, 9.

[17] "2 Long-Truck Roads in Iowa," *Des Moines Register*, January 29, 1964, 5.

compared with 176 of the next most popular type, the simple span steel girder bridge [Type 302]. A total of 991 Type 503 bridges were built during the study period, making the type the fourth most numerous in the state. The prestressed concrete t-beam [Type 504] bridges were built in small but steady numbers, averaging about 10 per year between 1953 and 1970 for a total of 178 of the type. Iowa was not establishing "firsts" or other records in the application of prestressed concrete bridges but could be considered progressive for its application of the technology prior to about 1955. By 1957 Iowa was confronting the national steel shortage by establishing standard designs for prestressed concrete beams in lengths between 30' and 67' for pretensioned beams, and between 50' and 80' for post-tensioned beams.[18]

Box Girder Bridges

The Prestressed Box Girder bridge [Type 506], may be precast or cast-in-place and is well suited for curved girder construction. Prestressed box girder or beam bridges became commonly used in the 1960s. Box beams became popular where minimum section depth was critical. As box girder bridges were easily assembled, the type was used where speed of construction was necessary. Box girder bridges have a rectangular cross section with the sides acting as webs and the top and bottom slabs as flanges.[19] Eighteen prestressed concrete box beam bridges [Type 505] were built in Iowa from 1958 to 2001.

Part II. Structural/Design Information

A. General Statement:

1. **Character:** Bridge No. 23780 is a prestressed concrete box girder bridge and is a representative example of this common post-1945 concrete bridge type.

2. **Condition of fabric:** Good.

B. Description: Bridge No. 23780 is a five-span prestressed concrete box girder bridge. A box girder is simply a girder bridge with a bottom slab providing a smooth underside.[20] Prestressed concrete is concrete with stresses intentionally induced in it to counteract stresses created by loads. Concrete is weak in tension, and therefore prestressing concrete for structural uses, such as beams and girders for bridges, is accomplished by inducing compressive stresses. The most common method for prestressing concrete beams is to precisely stretch high-strength steel bars or wires that are imbedded in high-strength concrete and in some way bonded to it. The elastic properties of steel cause the bars or wires, called tendons, to try to retract to their original length, thereby inducing the desired compressive forces in the beam. There are two general methods of prestressing concrete beams: pretensioning, in which the

[18] The Louis Berger Group, Inc., *Highway Bridges in Iowa: 1942-1970* (Marion, Iowa: The Louis Berger Group, Inc., 2004), 48.

[19] Parsons Brinckerhoff and Engineering and Industrial Heritage, A Context For Common Historic Bridge Types (Parsons Brinckerhoff and Engineering and Industrial Heritage, 2005), 3-104).

[20] George Kramer, *Slab, Beam & Girder Bridges in Oregon: Historic Context Statement* (Eugene, Oregon: Heritage Research Associates, Inc., 2004), 29.

tendons are tensioned before the concrete hardens; and posttensioning, in which the tendons are tensioned after the concrete hardens to a specific strength. Both pretensioning and posttensioning methods can be used with either cast-in-place concrete bridge construction, or with precasting the prestressed members onsite or offsite in forms. Bridge No. 23780 was pretensioned and the concrete was cast in place. Design criteria for prestressed bridges were published by the Bureau of Public Roads in the early 1950s.

Bridge No. 23780 is 498’ long with a 30’-4” out-to-out deck that carries a 28’ wide roadway over the North Fork of the Maquoketa River. The three center spans are 109’ long. The two approach spans are 85’ 6” long. Three concrete box girders form each span. The top slab of the girders is 7” thick and the bottom slab is 6” thick. Both slabs are longitudinally reinforced. Four pretensioned, prestressed stringers form the sides of each box girder. Diaphragms are placed every 28’-6” on the approach spans and 27’-3” on the center spans. Pier diaphragms are 1’-6” thick, and intermediate diaphragms are 1’ thick.

The girders were poured in place with the bottom slab poured first. The stringers, which are essentially inversed T-beams, were poured next. The top slab, which forms the bridge deck, was poured last. Each section of slab and T-beams was poured separately with keyways (formed by beveled 2”x4”s) used to tie into the next section. Interior forms were removed after each section had cured. The curb extends 1’-8” out from the edges of the top slab. Originally a steel railing was bolted to the concrete curb. The railing is currently concrete.

Cantilever piers are steel reinforced concrete with untreated wood piles. The concrete sill abutments have 18’ wing walls set at a 120 degree angle. Curved wing posts are set atop the wing walls.

C. Site Information: Bridge No. 23780 spans the North Fork of the Maquoketa River in Dubuque County, Iowa. It is located in a rural area on the outskirts of Dyersville. A large bend in the North Fork of the Maquoketa River was straightened and channelized for the new bridge crossing.

Part III. Sources of Information

A. Primary Sources:

"2 Long-Truck Roads in Iowa." *Des Moines Register*, January 29, 1964.

"A Gently Curved Highway 20 Is Replacing a Narrow, Twisted Route." *Dubuque Telegraph-Herald*, August 16, 1959.

"Bids on No. 20 Grading To Be Taken." *Cedar Rapids Gazette*, July 21, 1963.

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"Hwy. 20 Segment Opened." *Waterloo Daily Courier,* November 13, 1964.

Iowa Department of Transportation (Iowa DOT). *Biennial Report of the Iowa State Highway Commission.* Ames, Iowa: Iowa State Highway Commission, 1963/64.

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———. *Annual Report of the Iowa State Highway Commission*. Ames, Iowa: Iowa State Highway Commission,1957.

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"Let Contract On Highway 20." *Sioux City Journal*, May 22, 1952.

"Let Contract For Paving Portion of Interstate 29." *Sioux City Journal,* December 18, 1958.

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"Route 20 Work Stops For Winter." *Dubuque Telegraph-Herald,* December 22, 1957.

"Superhighway Taking Shape." *Dubuque Telegraph-Herald,* July 20, 1958.

B. Secondary Sources:

Kramer, George. *Slab, Beam & Girder Bridges in Oregon: Historic Context Statement*. Eugene, Oregon: Heritage Research Associates, Inc., 2004, 29.

The Louis Berger Group, Inc. *Highway Bridges in Iowa: 1942-1970.* Marion, Iowa: The Louis Berger Group, Inc., 2004.

Parsons Brinckerhoff and Engineering and Industrial Heritage. *A Context For Common Historic Bridge Types*. Parsons Brinckerhoff and Engineering and Industrial Heritage, 2005.