MALLAHAM BRIDGE
County Route M-6 spanning Riley Creek
Pandora vicinity
Putnam County
Ohio

HAER No. OH-88



Written Historical and Descriptive Data
Photographs

HISTORIC AMERICAN ENGINEERING RECORD
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MALLAHAM BRIDGE

HAER No. OH-88

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| Location: | On County Route M-6 over Riley Creek, vicinity of Pandora, Putnam County, Ohio |
| Date of Construction: | 1876 |
| Fabricator: | David Morrison, Columbia Bridge Works |
| Present Owner: | County of Putnam (Board of Commissioners), County Courthouse, Ottawa, Ohio |
| Present Use: | Vehicular traffic |
| Significance: | The bridge is an example of "Morrison's Patent Wrought Iron Arch Truss Bridge," based on a patent granted David H. Morrison in 1867. Unique among bowstring arches, this design used vertically-oriented I-beam flanges to form the bow. Morrison, founder of the Columbia Bridge Works of Dayton, Ohio, was one of the most important bridge engineers and manufacturers in 19th century Ohio. |
| Project Information: | The Ohio Cast- and Wrought-Iron Bridges Project was cosponsored by HAER, Dr. Robert J. Kapsch Chief; the Instute for the History of Technology and Industrial Archaeology, Dr. Emory L. Kemp, Director; the Ohio Historical Society, Gary Ness, Director and David Simmons, Historic Bridge Specialist; and the Department of Architecture, Ohio State University, Jose Obrerie, Chairman. |
| | Wm. Michael Lawrence, Historian |

The Mallaham Bridge, named after a farmer whose land adjoined its site,[1] is a bowstring arch truss bridge built in 1876. An example of a design patented by David H. Morrison in 1867, it resembles many bridges throughout the Midwest. A prominent Ohio engineer and bridge builder, Morrison founded the Columbia Bridge Works of Dayton, Ohio.

The bridge is 86' long. The arch or bow, the main compression member in each truss, is constructed of a series of I-beams oriented so that the flanges are vertical and the ends butt against each other. The name of the I-beam manufacturer, Union Iron Mill of Pittsburgh, Pennsylvania, appears on the webs. A plate on one of the arches reads, "D. H. Morrison's Patent Issued Oct. 29, 1867 Reissued May 23, 1871 Dayton Ohio."

Each post is a small I-beam. A bar bolted to the upper end fits into a slot in the joint between the beams of the arch; a nut on the end helps secure the beams at their joints. The post's lower end rests on a plate supported by the lower chord. The post does not transfer any forces, but serves as a spacer or brace between the arch and the chord, and supports the handrail. It is similar in this regard to the posts of the Moulton Angle Bridge (1856),[2] an earlier work by David Morrison.

The lower chord of the arch, the primary tension member of the truss, consists of two bars held apart by spacers. At the ends of the truss, a pin holds the bars against the outer faces of the cast-iron "skewback," supporting the arch.[3] At this point the tensile and compressive forces in the arch cancel each other out.

The arch "strutting,"[4] tension members that transfer loads from lower panel points to the arch (except for the horizontal strutting), consists of rods threaded at one end and with eyes at the other. Within each panel diagonal, horizontal, and vertical struts form a visually pleasing star pattern. Horizontal struts are slanted slightly, creating an arc that echoes the curve of the arch above. The form might have some structural rationale, although the designer decorated many of his bridges and might have added this nuance to the truss to enhance its appearance.[5] A clamp consisting of two circular plates holds the struts together. The diagonal struts cross each other between these plates; three bolts in the clamp secure the vertical and horizontal struts. The threaded ends of the diagonals and verticals are secured to the arch with nuts and spacer blocks, while the eyes are held between the bars of the chords by bolts. Nuts hold the threaded ends of the horizontals to the posts.

Hanger bolts with washer plates and nuts pass through the webs of the posts at their lower ends. These support a special kind of

floor beam -- an I-beam reinforced by two "truss rods" that fit into the corners of two triangular "strut castings" in a queen-post truss arrangement. This structural element appears in many of the builder's bridges. According to drawings for this kind of bridge, wood stringers supporting planks would rest on these beams.

Lattice work fastened to the posts serves as a guard rail. At one end of each truss a flat bar for a handrail is supported by a small I-beam post secured to the pin in the skewback by a U-bolt. The railings at the other ends have been damaged. With the exception of such alterations, however, the bridge is virtually identical to a drawing by David H. Morrison's company, sheet no. 65, which survives in a collection preserved by his descendants.[6] Drawings in this collection depict several variations of "Morrison's Patent Wrought Iron Arch Truss Bridge."

Morrison patented the basic design for the truss in 1867. The patent application included several elements found in the Mallaham bridge: the bottom chord of two bars held apart by spacers; posts consisting of I-beams with tabs inserted into the joints of the arch; and, most important of all, an arch composed of I-beams with angled ends butted together. The patent application design features alternative posts or arch segments that are a bit more complicated, with two additional beams bolted at their webs to the flanges of a central one; this was used in other Morrison bridges such as the Howard bridge.[7] Morrison described the advantage of his arch design:

> This construction will afford great strength, and prevent any liability of the arch becoming "kinked" or swayed laterally. The bulk of the metal forming the arch, in either of the modifications represented, being in the flanges, and lateral to the web, and at the same time at the greatest distance from the axis, or central longitudinal line of the arch, the greatest resistance will be exerted against any tendency of the arch to sway laterally...[8]

Morrison's solution to the problem inherent in the bowstring arch truss was so straightforward that he had difficulty persuading the patent office that it was novel, but it was so successful he managed to market the bridge throughout the Midwest during the 1860s and 1870s and he renewed the patent in 1871.[9]

The design is a rather elegant one, with its repetitive use of the I-beam. The use of simple rolled shapes, especially the I-beam, represents an important change in the bridge construction industry. As recently as one decade before the construction of

the Mallaham bridge, such structures were largely built of cast-iron shapes. Morrison's own Blackhoof Street bridge (1867) is an example. The development of mechanical means to roll shapes such as I-beams out of wrought iron was developed around 1850; only then could wrought iron replace cast.[10]

Such developments resulted in dramatic economic changes in rapidly industrialized states such as Ohio during the late 19th century. Local carpenters building wood bridges and small shops were gradually replaced by large companies that relied more and more on distant factories such as the Union Iron Mill for materials. Little by little, builders of country bridges were no longer local individuals but companies in distant cities represented by agents. Many other industries changed in similar fashion.[11]

The Journal of the Putnam County Commissioners indicates that the Mallaham bridge was an example of the success of Morrison's Patented Wrought Iron Arch Truss Bridge. The Commissioners decided not to put the bridge out for bids because they believed Morrison's price of $1,000 could not be bettered.[12]

The Patent Wrought Iron Arch Truss Bridge was but one of the achievements of David H. Morrison. During his career, he was one of Ohio's preeminent civil engineers and bridge builders, founding the Columbia Bridge Company of Dayton, Ohio. He and his company exemplified the many changes in the bridge construction industry during the 19th century.[13]

ENDNOTES

1.David A. Simmons, "Putnam County Bridge Built on 1867 Patent," Ohio County Engineer, August 1984, 12.

2.HAER No. OH-86

3.This is Morrison's term. Wherever possible, his terminology, as it appears in his drawings, is used in this report.

4.Morrison used the word strutting for the diagonal tension members, most engineers used the word strut for vertical compression members and ties for tension members.

5.See HAER No. OH-92.

6.Columbia Bridge Works, "Morrison's Patent Wrought Iron Arch Truss Bridge." A safety negative of the drawing is accessible to scholars at the Ohio Historical Society Library in Columbus, Ohio. Drawing sheet No. 65 in the Morrison Family Collection, Beaver, Pennsylvania.

7.HAER No. OH-92.

8.Patent No. 70,245, 29 October 1867. Copy in the bridge file, Ohio Historical Society (compiled by David A. Simmons, OHS). Cited by David H. Simmons in "Risk and Innovation: Bridge Patents in the 19th Century," in The Proceedings of the First Historic Bridge Conference in Columbus, Ohio (Columbus, Ohio: Ohio State University and Ohio Historical Society, 1 November 1985): 119.

9.Simmons, "The Risk of Innovation."

10.Condit, Carl W., American Building Art in the Nineteenth Century (New York: Oxford University Press, 1960), 280-1.

11.David A. Simmons, "Ohio Bridges from 1850 to 1950: Reflections of a Society," The Old Northwest, 12 (Spring 1986): 97.

12.Putnam County, Ohio. Journal of the County Commissioners of Putnam County, Book 4, p. 203. According to notes in the Bridge File at the Ohio Historical Society (compiled by David A. Simmons, OHS).

13.The definitive biography for David H. Morrison is by David A. Simmons, "David H. Morrison, Dayton's Premier Bridge Builder," Miami Valley History: A Journal of the Montgomery County

Historical Society, 3 (1991): 18-30. Revision of "David H. Morrison: Bridge Builder and Civil Engineer," paper presented at the 9th Annual Conference of the Society for Industrial Archaeology, Detroit, 31 May 1980. For a summary, see HAER No. OH-87.

BIBLIOGRAPHY

Columbia Bridge Works, "Morrison's Patent Wrought Iron Truss Bridge." Drawing sheet No. 65. A safety negative of the drawing is available to scholars at the Ohio Historical Society Library in Columbus, Ohio. Original in the Morrison Family Collection, Beaver, Pennsylvania.

Condit, Carl W. American Building Art in the Nineteenth Century. New York: Oxford University Press, 1960.

HAER No. OH-86, Blackhoof Street Bridge, New Bremen, Auglaize County, Ohio.

HAER No. OH-87, Germantown Covered Bridge, Germantown, Montgomery County, Ohio.

Patent No. 70245, 29 October 1867.**

Putnam County, Ohio. Journal of the County Commissioners of Putnam County, Book 4, p. 203.**

Simmons, David A. "The Risk of Innovation: Bridge Patents in the 19th Century," in The Proceedings of the First Historic Bridge Conference at Columbus, Ohio. Columbus, Ohio: Ohio State University and the Ohio Historical Society, 1 November 1985: 108-137.

Simmons, David A. "David H. Morrison, Dayton's Premier Bridge Builder," Miami Valley History: A Journal of the Montgomery County Historical Society, 3 (1991): 18-30. Revision of "David A. Morrison: Bridge Builder and Civil Engineer," paper presented at the 9th Annual Conference of the Society for Industrial Archaeology, Detroit, 31 May 1980. For a summary, see HAER No. OH-87.

Simmons, David A. "Ohio Bridges from 1850 to 1950: Reflections of a Society." The Old Northwest, 12 (Spring 1886): 95-115.

Bridge Files, Ohio Historical Society (Compiled by David A. Simmons, OHS).

** Denotes materials taken from the Bridge Files.

ADDENDUM TO
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