

COOPER'S TUBULAR ARCH BRIDGE

Hill Street Bridge

New York Cast and Wrought Iron Bridges

Spanning Old Erie Canal at Cedar Bay Picnic Area

(Relocated from Canajoharie, Montgomery County, NY)

Old Erie Canal State Park

De Witt

Onondaga County

New York

HAER No. NY-291

HAER
NY
34-DEW,
1-

PHOTOGRAPHS

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

Department of the Interior

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HISTORIC AMERICAN ENGINEERING RECORD

COOPER'S TUBULAR ARCH BRIDGE
(Hill Street Bridge)

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Location:

Spans a restored portion of the old Erie Canal at the Cedar Bay Picnic Area, Old Erie Canal State Park, De Witt, Onondaga County, New York. Relocated from Canajoharie, Montgomery County, New York.

UTM: 18,415376/4765992

USGS Quadrangle: Syracuse East, 7.5 minute

Date of Construction:

1886

Designer/Builder:

William B. Cooper, Division Engineer, Office of New York State Engineer and Surveyor, designer; Melvin A. Nash, Fort Edward, New York, builder.

Present Owner:

New York State Office of Parks, Recreation and Historic Preservation, Central Region, Jamesville, New York.

Present Use:

Pedestrian bridge

Significance:

Cooper's Tubular Arch Bridge was built in 1886 for the Town of Canajoharie, New York by Melvin A. Nash, a Fort Edward, New York bridge builder. It is the only extant example of superstructures fabricated on the 1873 patent of civil engineer William B. Cooper, then employed on the New York State Canals. In 1975, the bridge was acquired by the Central New York State Park and Recreation Commission and moved to the Old Erie Canal State Park in De Witt, where it now carries pedestrians and service vehicles across a restored

portion of the original canal. First built in the early 1870s by canal contractors, Cooper's design was later manufactured commercially by himself in partnership with Nash, and then by Nash alone. His design was one of a variety of trusses of the bowstring and tied arch forms widely used for small highway and street crossings during the mid-to-late nineteenth century. The configuration of its trusses places it in a direct line of descent from the arched trusses of New York engineer and inventor Squire Whipple, whose design was used for many years as a canal standard. The details of Cooper's bridge and the patent upon which it is based, were a reasoned solution to problems believed to have been associated with other tubular arch bridges of the period.

The bridge at De Witt is one of a small number of patented cast and wrought-iron bridges that survive in the United States, and one of the few with a strong Erie Canal association. From its inception, the Erie Canal was a proving ground for engineering innovation, and Cooper's design falls securely within that tradition.

Project Information:

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the Historic American Engineering Record
and the author.

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I. DESCRIPTION OF THE BRIDGE

Cooper's Tubular Arch Bridge consists of a pair of unbraced, cast- and wrought-iron bowstring trusses seated on reinforced concrete abutments faced with coursed ashlar limestone. The bridge's superstructure is 61'-9" in overall length with a clear span of approximately 59', measured between abutment faces at the seats. The deck is approximately 16' above the water and 9-1/2' above the single towpath that parallels the canal's north bank.

Each of the trusses is divided into six panels of approximately equal length by vertical posts consisting of slightly diverging pairs of back-to-back angles laced together and suspended from pins at the upper chord panel points. The upper chords themselves are formed from straight segments of four-element Phoenix columns fitted over cylindrical tenons on either side of cast-iron connecting blocks located at interior panel points. The upper chords are set on cast-iron bearing shoes at the truss ends. The connecting blocks are of particular interest because they are the patented elements of the bridge.¹

The lower chords consist of pairs of 5/8" x 2-3/8" bars spliced in the center four panels and bolted at the shoes. They rest on and are clamped to 9" deep, I-beam floor beams suspended from the interior posts. Diagonals and counters are 1-1/8" rods bolted at the top to clevises supported by the upper chord pins and looped at the bottom around the lower chord-floor beam clamps where they are bolted below the floor beams. The trusses are approximately 9'-3" deep at mid-span, measured from the top of the upper chord to the bottom of the floor beams. A deck of pressure-treated southern yellow pine 2" x 6" beams is supported by eight 4" deep railroad-rail stringers that lie on the upper flanges of the floor beams. Sway bracing is provided in each panel by pairs of 3/4" rods that cross beneath the floor beams' lower flanges and connect to the lower chords' floor beam clamps.

¹William B. Cooper, U.S. Patent No. 135,970, 18 February 1873.

II. HISTORY

A. The Hill Street Bridge

Cooper's Tubular Arch Bridge was built in 1886 for the Town of Canajoharie, Montgomery County, New York, to replace a deteriorated timber structure that had carried Hill Street in the Village of Canajoharie over Canajoharie Creek. The new cast- and wrought-iron superstructure was fabricated by Melvin A. Nash of Fort Edward, New York, based on a patent granted in 1873 to Nash's partner, William B. Cooper. After passing through several private owners between 1945 and 1975, the bridge was acquired by the Central New York State Park and Recreation Commission, removed from its original site, and re-erected along the old Erie Canal in a linear park then under development between De Witt and Rome, New York.

In 1885, the bridge at Hill Street was the most southerly of three that crossed Canajoharie Creek in the village at that time. Though well within the corporate boundaries, it was at the edge of the center of population and probably the least used of the three. However, it did provide several industries on the east side of the creek with direct access to the main roads that led south from the village.²

On November 12, 1885, citing great damage due to "wear and decay," the Canajoharie Town Board declared the old timber bridge to be "wholly unsafe for public use and travel" and authorized the Commissioner of Highways to either repair or rebuild it.³ Subsequently judged beyond repair, the old bridge was replaced by a new iron superstructure, fabricated and erected at a cost of \$2,450 by Melvin A. Nash of Fort Edward, New York. The new bridge at Hill Street was one of two superstructures provided by Nash to the Town of Canajoharie in 1886; the other was located at

²B. Nichols, Atlas of Fulton and Montgomery Counties, New York (New York: J.J. Stanahan and B. Nichols, 1858).

³Town of Canajoharie, Minutes, 12 November 1885. Office of the Town Clerk, Canajoharie, New York.

the hamlet of Waterville about three miles south of the village.⁴ Interestingly, the Hill Street Bridge was not the first bridge of its type purchased by the Town of Canajoharie. Town records indicate payments in 1878 for an iron bridge at Ames, about ten miles south of the village.⁵

The Hill Street bridge served the community until 1945 when the Town sold it, together with adjoining lands east of the creek, to a local manufacturer of paper bags.⁶ Arkell & Smith had manufactured bags at that location since at least 1868 and owned facilities on both sides of Canajoharie Creek.⁷ When the new owners enlarged their plant east of the creek, they effectively blocked the bridge to all but pedestrian traffic. After the bag factory moved in 1958 to Hudson Falls, New York, both the plant and the bridge were sold to Comptone Company, Ltd. and then to Del Laboratories from whom the bridge was acquired by the Central New York State Park and Recreation Commission in 1975.⁸ The Commission was developing and restoring a thirty-five-mile section of the abandoned Erie Canal between De Witt and Rome, New York as a state park. In addition to providing for a variety of recreational activities, the park was to be a major center for interpreting canal history. One area in particular, the Cedar Bay Picnic Area, was proposed to be developed as a canal-era village of the 1880s with restored period buildings

⁴Town of Canajoharie, Minutes, 12 November 1885, 14 April 1886, 12 and 17 August 1886; Supervisor's Records, Town of Canajoharie, 1869-1907, for the years ending 9 February 1886, 64,70; and 8 February 1887, 78; and The Canajoharie (New York) Radii, 19 November 1885 and 18 February 1886.

⁵Supervisor's Records, Town of Canajoharie, for the year ending 12 February 1878.

⁶Record of Deeds, Liber 261, Montgomery County Clerk's Office, Fonda, New York.

⁷Nichols, Atlas of Fulton and Montgomery Counties.

⁸Neil A. Redding, Landscape Architect, Central New York State Park and Recreation Commission, personal communication, 1975.

acquired and moved to the site for that purpose. The Hill Street Bridge, which was then recognized as a canal-era bridge, was in keeping with the historical theme of this section of the park.⁹

Though structurally sound when acquired by the Commission, the Hill Street bridge had been abandoned for some years and was in poor repair. The timber deck was rotted and the original handrails and handrail posts were missing, though one of the posts was found during the relocation.¹⁰ To facilitate lifting the trusses from their abutments, the floor beams were cut. The original beams had been fabricated with reversing bends just inside one of the trusses to accommodate a slight skew, and the cuts were made just inboard of these bends. Thus, while the bridge at its present location employs the original floor beams, they are now slightly shorter than they were at the Hill Street site and the bridge is correspondingly narrower.

During the winter of 1975-1976, all connections were disassembled, the original paint was removed, and surfaces were wire brushed or sandblasted as required to remove rust. All elements were primed with a rust inhibiting coating and then reassembled. During 1977, the restored bridge was seated at its present location on new reinforced concrete abutments faced with limestone salvaged from an abandoned railroad site. A new timber deck and pipe handrails were added and a finish coat of black paint applied. A 1979 evaluation of the bridge's load capacity resulted in reinforcing the floor beams by welding 1-1/4" rods beneath the upper flanges and 1/2" x 4-1/2" steel plates to the bottom flanges.¹¹

⁹Redding, personal communication.

¹⁰Handrails were likely similar to those seen in a 1961 photograph of another six-panel bowstring truss bridge of the same design built in 1880 by M. A. Nash for the Town of Guilderland, Albany County, New York (John Bennis collection).

¹¹New York State Office of Parks, Recreation and Historic Preservation, Central Region, "Cedar Bay Picnic Area Bridge, Old Erie Canal State Park." Anonymous typescript, n.d., 3 pp. (New York State Office of Parks, Recreation and Historic Preservation, Central Region,

B. The Bridge Manufactory of Melvin Nash and William Cooper

Melvin A. Nash was 46 years old in 1875 when he joined with William B. Cooper in Fort Edward, New York to manufacture and sell iron bridges. Both men were about the same age and had enjoyed successful, though different, careers. Born in Fort Edward in 1829, Nash was a businessman, the son of a successful local merchant. In 1852, at the age of 23, he had entered his father's business, Edwin B. Nash and Son, but by 1859 he was operating under his own name. Though the nature of his business is not known, he was apparently quite successful and enjoyed a good reputation both as a businessman and citizen.¹²

William B. Cooper was an engineer. Born in Tallahassee, Florida on August 4, 1830, he spent his early years in Utica, New York. After graduating in 1851 from Hamilton College in nearby Clinton, he took employment in the Office of the State Engineer and Surveyor in Albany where he served intermittently for the next twenty-four years in a number of responsible capacities, including that of Division Engineer of the Eastern Division from 1872 to 1875. During those years, the chief responsibility of the Engineer's Office was structural maintenance of New York's canals, including the Erie Canal.¹³

Jamesville, New York). Also, Snyder, Burns & Associates, "Cooper's Tubular Bridge." Engineering drawing (Syracuse, New York: 21 August 1979), Sheet No. S-1.

¹²Very little biographical information has been found on Melvin Nash. See obituary, Nashington County (Fort Edward, New York) Advertiser, December 1898; Fort Edward miscellaneous clipping file, Fort Edward Free Library, Fort Edward, New York; and Manuscript Ledgers, New York, v.612, 91, R. G. Dun Collection, Baker Library, Harvard University. Nash's date of birth (12 December 1829) and date of death (20 December 1898) were provided, from an unidentified source, by James R. Cronkite, Hudson Falls, New York; personal communication, 1977.

¹³Hamilton Literary Monthly (November 1886), 115; Noble E. Whitford, History of the Canal System of the State of New York Canals, supplement to the Annual Report of the State Engineer and Surveyor of

In 1873, Cooper was granted a patent for an improvement in iron bridges which consisted of a cast-iron connecting block onto which the straight segments of an arched, upper chord tube could be fitted, and which included a pin from which the post and diagonals could be suspended. The objective of his invention was:

...to enable bridge-builders to construct the tubular arches in iron bridges in sections so that the arches can be transported and put in place without difficulty, and so that the parts can be put together and adjusted without previous boring or fitting.¹⁴

The "adjustments" were provided for by casting the block in two matching parts separated by a vertical joint. By driving a pair of tapered keys (or wedges) into keyways in the joint at the top of the block, and by manipulating the tension on the pin by tightening or loosening the pin nuts, the tenons of the block could be made to fit tightly to the inside surface of the tubes.

Cooper did not identify the specific tubular arches that his patent was intended to improve. In fact, even though the accompanying drawings were based on Phoenix columns, the patent description itself was generic and could theoretically have been applied to any tubular section. The Canal Commission was engaged in a continuing program to replace the wooden superstructures of its bridges with iron ones, and by the late 1860s and early 1870s, a variety of proprietary tubular arch designs had been introduced into New York by manufacturers of prefabricated iron bridges. While canal engineers continued to rely heavily on the earlier cast-and wrought-iron trusses built on Whipple's plans, they also experimented with alternatives, and it may have been their limited experience with the tubular arches of Thomas

the State of New York (Brandow Printing Company, 1906), 1154; obituary, Washington County (Fort Edward, New York) Advertiser, 10 November 1886.

¹⁴Cooper, U.S. Patent No. 135,970, 18 February 1873.

Moseley, Zenas King and the Wrought Iron Bridge Company that attracted Cooper's attention to the problem that his patent addressed.¹⁵ The fact that his patent was illustrated with Phoenix columns probably reflected the popularity and availability of these sections. Their manufacture and sale was protected by patent, but they could be and were used by many fabricators for a wide variety of purposes simply by paying the mill price.

While Cooper's patent was granted in 1873, his invention had been conceived at least two years earlier. It was the basis of designs that the Office of the State Engineer and Surveyor referred to as "W. B. Cooper's Wrought Iron Arched Truss Bridge." General plans and specifications had been published in 1871 and at least seven bridges using Cooper's design had been built by the Canal in the early 1870s (see table below), all using Phoenix columns.¹⁶

¹⁵Tubular arches manufactured by the King Iron Bridge and Manufacturing Company (Cleveland, Ohio), the Moseley Iron Building Works (Boston, Massachusetts), the Wrought Iron Bridge Company (Canton, Ohio) and the Ohio Bridge Company (Cleveland Ohio) had all been used in New York by 1873 when Cooper's patent was granted. At least one of each of the first three had been built on the Erie Canal. See New York State Canals, "Iron Arch Bridges," original 1877 Survey Reports, Eastern and Western Divisions, 2 vols. The Canal Museum, Syracuse, New York.

¹⁶New York State Canals, 1871 general specifications for W. B. Cooper's Wrought Iron Arched Truss Bridge, from "Quantities Exhibited at Lettings, 1868-1872," Western Division Monthly Estimates (1871), Item No. 335, Department of Transportation Collection, Canal Museum, Syracuse, New York; and "General Plan of W. B. Cooper's Wrought Iron Arch Truss Bridge," Assembly Document 1871 (1871), No. 6-C.C.

WROUGHT IRON ARCH TRUSS BRIDGES ON THE ERIE CANAL
IDENTIFIED IN VARIOUS INVENTORIES AS COOPER'S DESIGN¹⁷

Bridge Name	Year Built	Class	Panels	Overall Length	Comments
<u>Eastern Division</u>					
Main St. Frankfort		Street	7	80'-8"	2 walks skewed
Central Ave. West Troy		Street	8	89'-10"	1 walk
West Troy Side Cut		Change	9	98'-6"	
East Ilion		Street	7	78'-2"	1 walk
<u>Central Division</u>					
Greens		Highway	-	71'-6"	
<u>Western Division</u>					
Nelson St. Rochester	1873	Highway	8	95'-1-1/2"	2 walks OH Bracing skewed
Hamilton St. Blackrock	1873	Highway & Change	10	112'-7-1/2"	

¹⁷"Table of Bridges," Annual Report of the State Engineer and Surveyor, State of New York: 1891 (Albany, N.Y.: 15 December 1891); Assembly Document No. 75 (13 March 1892), 170-183; New York State Canals, Eastern and Western Division, Bridge Record, Bridge Surveys, Item No. 1222, Canal Museum, Syracuse, New York; Whitford, History of the Canal System: 1071-1088; "Table of Bridges," Annual Report of the State Engineer and Surveyor, State of New York for the Fiscal Year Ending September 30, 1889, (Albany, N.Y.: 8 March 1890), 228-234.

Cooper's designs were required to support a uniform load of 100 lbs. per square foot of deck surface with stresses in individual members limited to 15,000 psi in tension and 10,000 psi in compression. These early Cooper bridges differed from the Hill Street bridge in two primary respects: the vertical web members consisted of rods rather than latticed angles; and the connecting blocks were cast in a single piece rather than matching halves.¹⁸ The first general specification for the arches in 1871 was clearly written with the Phoenix column in mind even though it was not mentioned by name, an omission that was corrected in the 1872 version of the specification.¹⁹

During the winter of 1872-1873, Melvin Nash ceased his commercial activities in Fort Edward and, in collaboration with a John M. Barnett, began to do contract construction on the Champlain Canal enlargement in nearby Whitehall, New York, including the erection of bridges.²⁰ In 1875, he joined with Cooper to form the new bridge building enterprise of Cooper & Nash.²¹ Cooper had moved from Albany to Fort Edward in 1872, possibly to be closer to the work under his jurisdiction on the Champlain Canal. He had been promoting himself as a Civil Engineer and Bridge Builder before coming to Fort Edward and apparently continued to do so, notwithstanding his responsibility as Division Engineer of the New York State Engineer and Surveyor's Eastern Division Office.²² The coincidence in time of

¹⁸New York State Canals, general specifications, 1871.

¹⁹New York State Canals, 1872 general specifications for W. B. Cooper's Wrought Iron Arched Truss Bridge, from "Quantities Exhibited at Lettings, 1872-1873," Eastern Division Monthly Estimates (1872), Item No. 348, Department of Transportation Collection, Canal Museum, Syracuse, New York.

²⁰Washington County (New York) Post, 11 April 1873 and 16 August 1872.

²¹Sandy Hill (New York) Commercial Advertiser, 19 November 1875.

²²A December 27, 1872 account in the Sandy Hill Commercial Advertiser places Cooper in Fort Edward at that time. According to the Hamilton Literary Monthly, it was also the home of his wife's

the beginning of Cooper's commercial activities and his application for a patent, coming as much as two years after the canal first prepared its plans and specifications, suggests that the Cooper may have been motivated by thoughts of leaving State service in favor of devoting full time to the commercial exploitation of his invention.

Cooper and Nash conducted their business until about 1878, when Cooper retired, after which Nash continued on his own as Melvin A. Nash, Bridge Builder, until probably the early 1890s. The scant records of the business that have been found, largely newspaper clippings, suggest a successful but modest enterprise based primarily on supplying bridges fabricated from Phoenix columns to towns, counties, and municipalities in northeastern New York State. Cooper died on November 6, 1886, a relatively young man at 56 years of age. It was said that his death was hastened by grief over the loss of his only child, a daughter, the previous year.²³ Nash lived until 1898 when he died after a long, unspecified illness.²⁴

IV. SIGNIFICANCE OF THE BRIDGE

Cooper's Tubular Arch Bridge is the only extant example of superstructures fabricated on the 1873 patent of William B. Cooper, then Division Engineer of the Eastern Division, Office of the New York State Engineer and Surveyor. First built in the early 1870s by canal contractors, Cooper's design was later manufactured commercially by himself in partnership with Nash, and then by Nash alone. Acquired in 1975 by the Central New York State Park and Recreation Commission and moved to the Old Erie

family. An undated letterhead in the author's collection for William B. Cooper, Civil Engineer and Bridge Builder, Albany, New York has "Albany" crossed out and "Fort Edward" written in.

²³Hamilton Literary Monthly, November 1886, 115.

²⁴Washington County Advertiser, December 1898.

Canal State Park in De Witt, New York, it is one of less than a dozen surviving iron bridges with Erie Canal associations, and the only one used for educational and interpretative purposes.

Cooper's bridge was one of a variety of iron trusses of the bowstring and tied arch forms widely used for small highway and street crossings during the mid-to-late nineteenth century. However, unlike many, its simplicity of detail and efficiency of design place it in a direct line of descent from the arched trusses of Squire Whipple, who introduced the bowstring truss form to America and whose 1840 design was a canal standard for highway and street crossings. Cooper replicated the truss configuration of Whipple's design but substituted more modern structural elements for the upper and lower chords, the most significant being the efficient wrought-iron Phoenix column. Cooper's design, and the patent upon which it is based, were a technical response to fabrication, transportation and erection problems, which he believed were associated with other tubular arches that were fabricated in continuous unjointed sections. Such arches either had to be assembled in the shop and shipped as large, awkward single units or fabricated in segments with splices that were pre-drilled and pre-fit so that they could be reassembled and adjusted in the field. By constructing the upper chords of his bridge in short, straight segments that could be cut to appropriate lengths, conveniently transported, and easily fitted over protruding tenons of the connecting blocks, and by providing a means of adjusting the fit between the segments and the blocks, Cooper attempted to correct these problems. The longest upper chord segment of the Hill Street bridge, for instance, is less than 11'. His design was clearly in the tradition of the Erie Canal which, from its inception, had been a proving ground for engineering innovation.

Though the adjustment mechanism of the connecting blocks does not appear to have survived, other features of Cooper's design were attractive enough to support a fifteen-year commercial manufactory in eastern New York and probably western New England which competed with larger, better capitalized companies, some national in scope.

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