1. NAME OF PROPERTY

Historic Name: Eldean Bridge (preferred historic common name)

Other Name/Site Number: Allen's Mill Bridge (original historic name); Marshall Bridge; *World Guide* #35-55-01; Farver Road Bridge 0.15

Designated a National Historic Landmark by the Secretary of the Interior, December 23, 2016.

2. LOCATION

Street Address: Spanning Great Miami River at bypassed section of Eldean Road/CR33 (bypassed section of Eldean Road is now the west part of Farver Road) Not for Publication: __

City/Town: Troy vicinity, Concord Township-Staunton Township Vicinity: X

State: Ohio County: Miami Code: 055 Zip Code: 45373

3. CLASSIFICATION

Ownership of Property	Category of Property
Private:	Building(s):
Public-Local: X	District:
Public-State:	Site:
Public-Federal:	Structure: X
	Object:

Number of Resources within Property

Contributing		Noncontributing	
buildings	0	buildings	0
sites	0	sites	0
structures	1	structures	0
objects	0	objects	0
Total	1	Total	0

Number of Contributing Resources Previously Listed in the National Register: 1

Name of Related Multiple Property Listing:

4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, 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 forth in 36 CFR Part 60. In my opinion, the property ____ meets ____ does not meet the National Register Criteria.

Signature of Certifying Official Date

State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

Signature of Commenting or Other Official Date

State or Federal Agency and Bureau

5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

___ Entered in the National Register
___ Determined eligible for the National Register
___ Determined not eligible for the National Register
___ Removed from the National Register
___ Other (explain) _____

Signature of Keeper Date of Action

6. FUNCTION OR USE

Historic: Transportation Sub: road-related (vehicular bridge)

Current: Transportation Sub: road-related (vehicular bridge)

7. DESCRIPTION

ARCHITECTURAL CLASSIFICATION:
Other: Long truss covered bridge

MATERIALS:
Foundation: stone
Walls: wood
Roof: metal
Other:

Summary

Built in 1860, Eldean Bridge is a rare, intact example of the Long truss, a highly significant nineteenth-century timber bridge type.[1] Patented by U.S. Army engineer Stephen H. Long in 1830, the Long truss was historically significant as the first American truss type that was based on engineering analysis rather than empirical design methods and it was technologically significant in pioneering the concept of prestressing (i.e. introducing permanent stresses in the structure to resist deflection under loading). The development of the Long truss spurred the trend toward scientific bridge design and influenced further technical innovations in the field of prestressing. The Long truss was used for railroad and highway bridges throughout the eastern United States for several decades, but less than a dozen examples survive. Eldean Bridge exhibits the distinctive features of the Long truss type, as specified in Stephen H. Long's 1830 patent. It was built on-site using traditional nineteenth-century timber-framing methods and has occupied the same site since its construction. With the exception of a ten-year period from 1966 to 1976 when it was closed, the bridge has carried local traffic for nearly 150 years. Eldean Bridge retains a high level of integrity in location, setting, design, materials, workmanship, feeling, and association.

Eldean Bridge is nationally significant under NHL Criterion 4 (a property that embodies the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction), NHL Theme V (Developing the American Economy), Subtheme 3 (Transportation and Communications) and NHL Theme VI (Expanding Science and Technology), Subtheme 2 (Technological Applications). The bridge was listed in the National Register of Historic Places in 1975 and it was recorded by the Historic American Engineering Record (HAER) in 2002. Of the approximately 690 historic (pre-1955) covered bridges surviving in the United States, Eldean Bridge stands out as an excellent example of covered bridge construction and preservation.[2]

Describe Present and Historic Physical Appearance.

Setting

Eldean Bridge is a prominent local landmark and a rare surviving reminder of the nineteenth-century industrial and economic development of Miami County and the Miami River Valley. It was one of two mid-nineteenth century Great Miami River crossings between the cities of Troy and Piqua, a distance of about eight miles. Both crossings (the other being located at Farrington Mills, about two miles north of this site) were originally established to carry secondary wagon roads across the river, enabling farmers to efficiently transport their crops from the field to local processing plants and storage facilities, then on to distant markets via a growing network of turnpikes, canals and railroads.

Eldean Bridge is located on the northern outskirts of the City of Troy, the seat of Miami County, Ohio.[3] The bridge carries a bypassed section of Eldean Road/CR33 over Great Miami River between Concord Township (on the west side of the river) and Staunton Township (on the east side of the river). The crossing is located 0.15 mile east of Dixie Highway/CR25A (originally Troy-Piqua Turnpike) and 0.5 mile west of Piqua-Troy Road/CR15 (originally Staunton-Piqua Road); both transportation corridors were established in the early-nineteenth century. The surrounding area is largely active farmland, with a mix of industrial, commercial and county government properties lining the main transportation corridor (Dixie Highway/CR25A) and some

[1] A truss is a structure built up of relatively small members, combined in a series of interconnected triangles, to form a rigid framework.

[2] Approximately half of the extant historic (pre-1955) covered bridges in the United States have been significantly altered, with much loss of historic fabric and character.

[3] Troy, Ohio, is located approximately 20 miles north of Dayton and 80 miles west of Columbus.

twentieth-century houses interspersed with older farmhouses along adjacent secondary roads (Eldean Road/CR33 and Piqua-Troy Road/CR15). The property immediately west of the bridge features a recreation park with baseball fields, a parking area and a picnic shelter. The property immediately east of the bridge features active farm fields with a few scattered houses nearby.

Great Miami River (also known as Miami River), a tributary of the Ohio River, rises from the outflow of Indian Lake in Logan County, flows 160 miles in a southwesterly direction through Piqua, Troy and Dayton, joins the Whitewater River at Hamilton and empties into the Ohio River just west of Cincinnati. The river was used by early settlers to access the state's interior, where they found the fertile land of the Miami Valley ideally suited for farming and the establishment of water-powered industries. In the 1830s, the Miami & Erie Canal was established through the valley, passing within a few hundred yards of this site; that corridor proved crucial to the area's economic growth and a small industrial hamlet sprang up near the canal locks west of this site in the 1840s and 50s. Present-day Eldean Road/CR33 was laid out in 1847, crossing Great Miami River at this site. Eldean Bridge is the second bridge to occupy the crossing.

The hamlet near the canal locks served as a canal port, originally known as Troy Upper Locks, and subsequently Allen's Mill. In the late nineteenth century and early twentieth century, the hamlet was also the site of a railroad station, known as Eldean Station, and it took on the station name by the 1890s. The name Eldean still appears on current maps, although few remnants of the hamlet's heyday survive. The Great Flood of 1913 destroyed large portions of the Miami & Erie Canal corridor and Dixie Highway/CR25A was widened in 1979-80, covering the remains of the ditch, but a few remnants of the canal survive, including a stone arch culvert located north of Eldean Bridge.[4] The early twentieth-century concrete grain elevators from Allen & Wheeler's Mill still stand about a quarter-mile northwest of the bridge; like Eldean Bridge, they serve as a reminder of the industrial development of this area. Several nineteenth-century farms can still be found in the area, especially along the westerly part of Eldean Road.

Description[5]

Eldean Bridge is a two-span through truss covered wood bridge on a stone masonry pier and abutments.[6] The superstructure is approximately 231' long (along the ridge), 21' wide (eave-to-eave), and 19' deep (bottom of floor beams to top of roof) overall, with clear-spans of 108' each, a roadway width of 17' and overhead clearance of 13'. The trusses are approximately 15' deep and spaced 19' apart.

The mortared stone abutments and pier are built of rough-faced, coursed ashlar and rise approximately 25' above the normal level of Great Miami River. The center pier has a cutwater on its upstream (north) side. The west abutment and pier are capped with concrete; these caps were added in 1936 after the stonework was damaged by flooding. The river embankments differ in elevation, resulting in differences in the length and grade of the bridge approaches. The east approach is approximately 20' long with a grade of 7.5 percent, while the west approach is approximately 100' long with a grade of 9 percent.

The truss design is a very fine example of the Long truss plan, which pioneered the concept of prestressing. Each truss is built up of horizontal top and bottom chords connected by a series of vertical posts and diagonal braces; the braces and counterbraces cross within each panel (i.e. the area between the vertical posts). The top chords comprise three parallel lines of timbers (a 10"x10" timber flanked by 4"x10" timbers) laid on edge with

[4] Miami County Park District's Twin Arch Reserve features a restored 1837 stone arch culvert [NRIS #OH-78002142, 1978] built for the Miami & Erie Canal. The reserve is located less than one mile north of Eldean Bridge on the Great Miami River Recreational Trail.

[5] Dimensions were obtained from the 2002 HAER measured drawings (see appendix).

[6] In a through truss (sometimes called a high truss or overhead truss) the length of the span requires deep trusses with lateral bracing overhead, so that traffic passes *through* the superstructure.

shear blocks between the timbers and fastened together with ¾"-diameter bolts. The bottom chords comprise four parallel lines of 4"x12" timbers laid on edge and fastened together in a similar manner. The top and bottom chords are connected by paired vertical posts (6"x10" typical), forming twelve panels in each truss (each panel is approximately nine feet wide). The chords and posts are notched together and fastened with ¾"-diameter bolts. Paired diagonal braces (6"x9" typical), angling down toward the ends of the span, and single diagonal counterbraces (6"x7" typical), angling up toward the ends of the span cross within each panel. The dimensions of the posts and braces increase toward the ends of the span, where accumulated forces in the members are greatest. There are wood "keys," or wedges, held in place by friction, between the bottom of the counterbraces and the top of the floor beams; these wedges are one of the main features of the Long truss patent. The wedges measure 6" wide by 18" long and taper from 1¼" deep at the butt to ¾" deep at the point. When properly installed, these wedges place the counterbraces in compression and prestress the structure to increase its rigidity under loading.

The ends of the bottom chords are seated on short sections of 15"-deep steel I-beams set longitudinally on the pier and abutments; these pieces were used to raise the bridge in 1912. 8"x12" wood floor beams are placed transversely on top of the bottom chords at each panel point. Seven lines of stringers are laid longitudinally on top of the floor beams. The deck comprises two layers of white oak boards laid diagonally on top of the stringers. The deck is continuous across the center pier.

The lower lateral bracing system comprises 5"x6" cross-bracing between the floor beams. The upper lateral bracing system comprises 5"x7" transverse tie beams seated on the top chord at the panel points and 5"x5" cross-bracing between the tie beams. There are 3"x5" sway braces between the posts and tie beams at the ends of each span.

The 5/12-pitch gable roof comprises 2"x6" rafters supporting a corrugated metal roof laid over skip sheathing. The roof is continuous across the center pier. The east end of the roof is supported on vertical posts and the tympanum is in nearly the same plane as the portal opening. The west end of the roof is supported on diagonal braces attached to the truss end posts, so that the tympanum extends forward over the approach to the bridge.[7] The exterior of the bridge is covered with shiplap siding to about 20" below the eaves; the eave openings allow light and air into the interior of the bridge, which helps keep the structure dry.[8] The siding is fastened to wood nailers on the outside of the trusses. Four 24"x30" window openings are framed into the siding on each side of the bridge; each opening is protected by a small wood awning to keep precipitation from directly entering the bridge. The openings allow additional light and air into the bridge, while offering motorists and pedestrians views of the river below; they were initially created in 1976 as a deterrent to vandalism. The portals are covered with board-and-batten siding, which wraps around the ends of the trusses to form shelter panels inside each entrance; these shelter panels protect the ends of the trusses from accumulated moisture. The tympanums were painted or whitewashed sometime in the 1940s or 50s, while the rest of the siding was left untreated until 1967, when the bridge was painted barn red.[9]

[7] The different portal configurations (both of which are commonly found in nineteenth-century covered bridges) suggest that one of the portals was altered at some point prior to the 1950s, when photographs show the portals close to their present appearance. The author surmises that the west portal *may* have been altered when the abutment was capped with concrete in 1936, as that project likely required removing the last floorbeam and the vertical posts supporting the end of the roof; however, no documentation has been found to confirm this.

[8] Initial rehabilitation plans called for salvaging the existing vertical board siding, but contractors later determined that the siding was too brittle to remove and reinstall, so plans were revised to replace the old siding with new shiplap siding.

[9] Most covered bridges were left unpainted until the mid-twentieth century, when painting them became common practice; approximately one-third of the nation's covered bridges were painted red during that era. Joseph D. Conwill, "The Red Covered Bridge: Fiction Affects Fact," unpublished typescript, July 26, 2004.

A painted wood sign above each portal reads: "ELDEAN BRIDGE/ 1860/ BUILT IN ACCORDANCE WITH/ STEPHEN H. LONG'S PLAN/ BUILT BY: HAMILTON BROS." A pedestal-mounted interpretive plaque discussing the history of the bridge and significance of the Long truss was installed near the northwest corner of the bridge as part of the 2005-06 rehabilitation. A pole-mounted Ohio historical marker was installed near the west approach to the bridge in 2007.[10]

Integrity

Over its many years of service, Eldean Bridge has undergone a number of localized repairs, most of which had to be accomplished in a timely manner with limited funds. Miami County engineers kept the bridge in service with minimal loss of historic fabric, a remarkable achievement, considering how many other covered bridges were lost during the same period.

The earliest written record found concerning a major structural repair dates to 1912, when the pier was damaged by ice and high water. The pier was repaired and the bridge raised by inserting short, 15"-deep steel sections longitudinally under the ends of the lower chords. This likely saved the structure from being washed away in the Great Flood of 1913, when at least six of the county's covered bridges were lost.[11] In 1936, paired metal tie rods were installed next to several posts with broken shoulders at the bottom chord connection and the pier and west abutment were capped with concrete. In 1980, a broken bottom chord was repaired by installing metal brackets and tie rods.[12] In 2005-06, Eldean Bridge underwent a rehabilitation that involved repairing damaged or missing members, reversing most of the 1936 and 1980 repairs, repairing and repointing the stone masonry and installing a new roof and siding.

The bridge's roof, siding and flooring have been replaced periodically as part of routine maintenance; replacement of the housing components and wearing surface of the deck generally does not diminish the integrity of the structure. In 1922 a new wearing surface was laid over the original flooring; the entire deck was replaced in 2014. In 1936, a metal roof was laid over an earlier wood-shingle roof; both layers of roofing were removed and replaced with a metal roof in 2006. The bridge was originally unpainted; it was painted for the first time in 1967 and repainted in 1987 and 2006.[13] Window openings were cut in the siding in 1976; these openings were replicated when the bridge was re-sided in 2006.

Eldean Bridge was bypassed in 1964, but the structure has been preserved in place as a local historic landmark and it still carries light automobile traffic. In the mid-1960s, the property at the west end of the bridge was developed into a park with a parking lot, picnic shelter and baseball fields. In 2015, Eldean Road was widened near its intersection with Dixie Highway/CR25A and a new prestressed concrete beam bridge replaced the 1964 span just north of the old covered bridge. Though its setting has changed somewhat over time, the bridge's overall appearance has changed little from its original construction and the bridge retains the feeling of a nineteenth-century covered bridge.

[10] Eldean Bridge was one of fourteen historic sites recognized with a marker during Miami County's bicentennial. Ron Osburn, "Bridge's Place in History Recognized," *Troy Daily News*, September 15, 2007, 1.

[11] "Eldean Bridge Closed," *Miami Union*, February 29, 1912, 7; *Miami County Commissioner's Journal 12* (April 29, 1912), 518; Douglas L. Christian, Telephone conversation with author, June 19, 2015. During the 2005-06 rehabilitation, contractors uncovered a post bearing a spike and the engraving, "H.W. 1913," indicating the high water mark of the Flood of 1913; that mark was just two inches below the bridge deck.

[12] These repairs are shown on Sheet 7 of the 2002 HAER measured drawings (see appendix).

[13] "Old Eldean Bridge to be Painted," *Piqua Daily Call*, August 7, 1967, 1.

8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties:

Nationally: X Statewide: __ Locally: __

Applicable National Register Criteria:	A__B__C X D__
Criteria Considerations (Exceptions):	A__ B__ C__ D__ E__ F__ G__
NHL Criteria:	4
NHL Theme(s):	V. Developing the American Economy 3. Transportation and Communications VI. Expanding Science and Technology 2. Technological Applications
Areas of Significance:	Transportation Engineering
Period(s) of Significance:	1860
Significant Dates:	1860
Significant Person(s):	N/A
Cultural Affiliation:	N/A
Architect/Builder:	James and William Hamilton, Piqua, Ohio
Historic Contexts:	*Covered Bridges NHL Context Study* XVII. Technology (Engineering and Innovation) B. Transportation

State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.

Built in 1860, Eldean Bridge is a rare, intact example of the Long truss, a highly significant nineteenth-century timber bridge type. Patented by U.S. Army engineer Stephen H. Long in 1830, the Long truss was historically significant as the first American truss type that was based on engineering analysis rather than empirical design methods and it was technologically significant in pioneering the concept of prestressing (i.e. introducing permanent stresses in the structure to resist deflection under loading). The development of the Long truss spurred the trend toward scientific bridge design and influenced further technical innovations in the field of prestressing. The Long truss was used for railroad and highway bridges throughout the eastern United States for several decades, but less than a dozen examples survive. Eldean Bridge exhibits the distinctive features of the Long truss type, as specified in Stephen H. Long's 1830 patent. It was built on-site using traditional nineteenth-century timber-framing methods and has occupied the same site since its construction. With the exception of a ten-year period from 1966 to 1976 when it was closed, the bridge has carried local traffic for nearly 150 years. Eldean Bridge retains a high level of integrity in location, setting, design, materials, workmanship, feeling, and association.

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A discussion of the national significance of Eldean Bridge is provided in the associated document, *Covered Bridges NHL Context Study* (2012). The study establishes the history and evolution of the property type and provides a preliminary assessment of the National Historic Landmark (NHL) eligibility of structures that are considered by experts in the field to be the best representative examples of covered timber bridges in the United States. These properties were selected from the National Covered Bridges Recording Project, undertaken in 2002-2005 by the Historic American Engineering Record (HAER), which is administered by the Heritage Documentation Programs (HDP) Division of the National Park Service, United States Department of the Interior. The project was funded by the Federal Highway Administration's (FHWA) National Historic Covered Bridge Preservation (NHCBP) Program, established in 2000 by Section 1224 of the Transportation Equity Act for the 21st Century (TEA21). Over the course of a multi-year project, HAER recorded 86 covered bridges throughout the United States. In 2010, each of these bridges was individually evaluated against National Historic Landmark criteria and a list compiled of twenty covered bridges that have high integrity and are significant as outstanding representative examples of their type, period, and method of construction. Secondary considerations for inclusion in this list were: historical significance of the bridge and/or site, significance of the designer or builder, and aesthetics of the bridge and site.[14]

Covered Bridges in the United States

Covered bridges are pre-eminently—although not exclusively—an American phenomenon. Nowhere else in the world were such impressive timber structures attempted, and nowhere else were they built in such large

[14] Lola Bennett, "Covered Bridges NHL Context Study," (Washington, DC: U.S. Department of the Interior, National Park Service, 2012).

numbers.[15] Over the course of two centuries, covered bridges have played a significant role in American life, by facilitating settlement, transportation and commerce. They also represent a period of remarkable achievement in civil engineering, during which bridge building evolved from an empirical craft to a science.

Timber bridges have been built in forested regions of the world for centuries.[16] Wood is an excellent material for building; it is strong, relatively lightweight, and easy to work with. Since most species of wood suitable for structural applications deteriorate rapidly when exposed to the weather, European bridge builders quickly learned the value of covering wood bridges with roofs and siding to protect the underlying framework.[17]

Bridges were rare in Colonial America. Small streams were spanned with simple wood beams or stone slabs, and occasionally with stone arches, but with few exceptions, larger waterways had to be crossed by ford or ferry. Travel was hazardous and uncertain; delays and accidents were common. A few ambitious crossings were made with pontoons or a series of simple beam spans supported on timber piles, but long-span bridges were generally not built in America until the volume of transportation justified the expenditure of material and labor.[18] Following the American Revolutionary War, the demand for roads and bridges, coupled with access to abundant forests, spurred the development of timber bridge design in the United States.

Internal improvements were a priority of the new nation. Roads, canals and bridges were desperately needed to expand commerce and unite the country. The Louisiana Purchase of 1803 doubled the land area of the United States and over the next half-century, settlement expanded west to the Pacific Ocean. Timber bridges were an ideal solution to America's many transportation hurdles and hundreds of them were built as waves of settlement pushed westward across the continent. They provided for safe, efficient and economical overland transportation that was essential to the new nation's growth.

In 1804–05, Timothy Palmer (1751–1821) built America's first covered bridge across the Schuylkill River at Philadelphia. By 1810, covered bridges were common in southern New England, southeastern New York, Pennsylvania and New Jersey. From this core area, covered bridges spread northward, southward and westward. In the 1820s, town and county governments began to specify covered bridges for construction on local roads. By 1830, covered bridges were commonplace at major river crossings in the eastern United States. The builders of timber bridges utilized readily available materials and traditional hand tools. Making use of patented truss designs, a team of carpenters could erect an average-sized covered bridge in a short time, usually within a few weeks.

Covered bridges were adapted to the needs of every type of transportation corridor, including turnpikes, canals and railroads and they facilitated the settlement of the United States for over a century. The rapid growth of the railroads in the mid-1800s—in particular, the increasing weight of locomotives and rolling stock—encouraged innovations and technical advancements in the design of timber truss bridges and was an important factor in the

[15] According to the 7th edition of the *World Guide to Covered Bridges* (2009), there are approximately 1,500 extant historic (pre-1955) covered bridges in the world; nearly half of these structures are located in the United States. American scholars have recently become aware of large numbers of ancient covered bridges in China, but most were built for pedestrian traffic, and their construction techniques and reason for covering differ from the Western tradition.

[16] In 55 BC, forces under Julius Caesar (100 BC-44 BC) built the earliest known timber bridge across the Rhine River.

[17] Several European covered bridges have survived for more than three centuries, while a few in the United States are nearing the two-century mark.

[18] The Great Bridge (1660) across the Charles River at Boston, Massachusetts, and the York River Bridge (1761) at York, Maine, were notable exceptions. The Great Bridge consisted of "*cribs of logs filled with stone and sunk in the river—hewn timber being laid across it.*" The York River Bridge was a timber pile bridge, which uses tree trunks or piles driven vertically into the river bed to provide a foundation for a series of simple beam spans.

rise of civil engineering as a profession. All the major technological improvements in American truss bridge design occurred when wood was the building material of choice.

By 1850, there were covered bridges in most settled regions of the United States.[19] Thereafter, the number of covered bridges continued to multiply until about 1870, by which time there were well over 10,000 covered bridges in the United States.[20] The golden era of covered bridge building lasted for about a century in most regions of the United States, and even longer in areas where timber was plentiful.[21]

Stephen Harriman Long

Stephen Harriman Long (1784–1864) was a nationally-renowned engineer, explorer and inventor, who served for nearly a half-century with the U.S. Army Topographical Engineers. Over the course of his storied military career, Long made significant contributions to the field of civil engineering, including introducing the concept of prestressing to American bridge design. Born December 30, 1784, in Hopkinton, New Hampshire, Stephen Long was the son of Moses Long (1760–1848) and Lucy Harriman Long (1764–1837) and the second oldest of thirteen children. Moses Long served in the Revolutionary War under Gen. George Washington and became a cooper upon his return to civilian life. Stephen Long received a rudimentary elementary education, but he went on to study a classical curriculum at Dartmouth College, graduating in 1809 with an A.B. degree.

During the War of 1812, Stephen Long was employed as a civilian engineer on a harbor defense project in Brooklyn, New York, and two years later, he entered the U.S. Army as a second lieutenant. After teaching mathematics at the U.S. Military Academy in 1815–16, Long was promoted to the rank of major and transferred to the newly-formed Corps of Topographical Engineers. He was initially tasked with surveying military fortifications along the frontier and subsequently was assigned to lead scientific and surveying expeditions in the West from 1818 to 1824.[22] Long is credited as being one of the leading explorers of the nineteenth century and Long's Peak (14,259'), the highest summit in Rocky Mountain National Park, is named for him.

From 1824 until 1838, the U.S. Army Engineers were charged with assisting in the development of public transportation projects, including the improvement of navigable rivers and the construction of roads, canals and railroads. Following his expeditions, Long was promoted to the rank of lieutenant colonel and assigned to help survey the route of the Baltimore & Ohio (B&O) Railroad, one of the first railroads in the United States. He assisted with laying out the B&O Railroad and subsequently served as engineer-in-chief of the Western & Atlantic Railroad in Georgia. During this period of intensive railroad work, Long experimented with the layout

[19] Fred Kniffen, "The American Covered Bridge," *The Geographical Review* 41, no. 1 (January 1951): 119. Covered bridges once existed in 43 of the 50 states. No records have been found to date concerning covered bridges in Colorado, Idaho, Louisiana, New Mexico, North Dakota, Oklahoma and Utah. The reasons for this presumably vary from region to region, but probably include: absence of readily-available timber, absence of major river crossings, topography more suited to other types of bridges, delayed settlement and low population density.

[20] This is only a rough estimate of known covered bridges that existed ca.1870. Initial data compiled in the "Covered Spans of Yesteryear" project suggests that this figure may be too low.

[21] Covered bridge building ended in New England and the Midwest around 1920. Covered bridges continued to be built in the South into the 1930s and in Oregon into the 1950s. Beginning in the late nineteenth century, timber truss bridges were gradually eclipsed by comparable spans of iron that were increasingly economical to build and maintain. Metal truss bridges also did not require a roof and siding to protect the structure underneath, so covered bridges eventually became relics of a bygone era.

[22] While preparing for his expeditions, Long developed associations with leading scientists, philosophers and scholars in Philadelphia. Traveling in the city's elite social circles, he met Martha Hodgkiss [sometimes spelled Hodkiss or Hodgkins] (1799-1873), who he married in 1819. The Longs had six children: William DeWees Long (1820-1887), of whom little is known; Henry Clay Long (1822-1871), who graduated from Dartmouth College in 1841, sometimes worked with his father and became an accomplished civil engineer in his own right; Richard Harlan Long (1824-1849) graduated from the U.S. Military Academy at West Point and served as an Army officer until his death in 1849; Mary Long (1828) and Edwin James Long (1829-1830) died in infancy; Lucy Leonis Long (1832-1917) married Marcus Breckenridge in 1853 and their son, William Lewis Breckenridge (b.1857), also became a civil engineer.

of grades, the design of steam locomotives and the design of bridges. He published a number of articles and books and obtained patents for several of his inventions, including one for the bridge truss design that bears his name. The Long truss is discussed in greater detail in the next section.

The majority of Long's later career was spent working on navigation improvements of the nation's major rivers. Around 1854, Long moved from St. Louis, Missouri, to Alton, Illinois, where several of his brothers lived.[23] At the outbreak of the Civil War, Long was promoted to the rank of colonel and appointed Bureau Chief of the Corps of Topographical Engineers in Washington, DC. During the war, he transmitted detailed maps and sent engineers to assist troops in the field, developed plans for gunboats and fortifications, and oversaw the Union Balloon Corps, while simultaneously managing the continuation of a number of civilian projects.[24] On June 1, 1863, shortly after the Corps of Topographical Engineers merged with the Army Corps of Engineers, Col. Long retired from active service. Fifteen months later, on September 4, 1864, Stephen Harriman Long died at his home in Alton, Illinois. He is buried in Alton Cemetery.[25]

The Long Truss

The advent of railroads in the late 1820s spurred the application of mathematical and scientific principles to bridge design. Trains were much heavier and faster than horse-drawn wagons, requiring that railroad companies develop bridges with ever greater capacity and rigidity. Academic training in mechanics and strength of materials allowed bridge designers a greater understanding of how various members of a bridge functioned under loading conditions and attempt to design them accordingly. Stephen Harriman Long was one of the first to apply mathematical theory to the practice of bridge building.

Throughout his tenure with the Baltimore & Ohio Railroad, Long advocated for the construction of wood bridges, because they were more economical to build than masonry bridges. He initially recommended building bridges on the Burr truss plan, but later invented a truss design of his own. In 1829, Long designed an innovative timber bridge to carry the Washington Turnpike (now Washington Boulevard) over the railroad right-of-way south of Baltimore, Maryland.[26] That structure, named "Jackson Bridge," was a radical departure from the traditional and more expensive masonry structures the railroad company was in the process of erecting.[27] Using engineering analysis, Long was able to calculate the span's load-carrying capacity, a remarkable advancement in American bridge building.[28] Long also used the structure to introduce the concept of prestressing to bridge design. While Jackson Bridge successfully carried heavy traffic until after the Civil War, the B&O Railroad's board of directors ultimately chose not to build any other bridges according to Long's design, but the type was later widely used by other railroads.[29]

In 1830, Stephen Long received a patent for the truss design used for Jackson Bridge.[30] The feature claimed in Long's patent was not truss geometry (i.e. the arrangement of truss members), but rather, the details of construction, including methods used in joining the members and splicing the chords. The most significant

[23] Enoch Long (1790-1881), George Washington Long (1799-1880) and Benjamin Franklin Long (1805-1888), all settled in Alton, Illinois, (approximately 15 miles north of St. Louis, Missouri), before Stephen Long moved there in 1854.

[24] Richard G. Wood, *Stephen Harriman Long, 1784-1864* (Glendale, California: Arthur H. Clark Company, 1966): 254-256.

[25] "Long, Col. Stephen H.," obituary, *Alton Telegraph*, September 9, 1864, 3.

[26] James D. Dilts, *The Great Road: the Building of the Baltimore Railroad, the Nation's First Railroad, 1828-1855* (Stanford, California: Stanford University Press, 1993), 70.

[27] The nearby Carrollton Viaduct (1829) [NRIS #MD-71001032, 1971], the oldest stone railroad bridge in the United States, was completed three months after Jackson Bridge.

[28] S.H. Long, "Specification of a Patent for Certain Improvements in the Construction of Wooden or Frame Bridges," *Journal of the Franklin Institute* 5, no. 4 (April 1830): 235.

[29] Jackson Bridge survived until about 1870, when it was replaced. The present steel beam bridge is still known as Jackson Bridge. http://www.trainweb.org/oldmainline/bridges/023nview2.jpg, retrieved April 28, 2016.

[30] S.H. Long, U.S. Patent 5862X, March 6, 1830.

claim was a technique now known as prestressing (i.e. introducing permanent stresses in the structure to resist deflection under loading). This was achieved by driving wedges into the counterbrace connections to position the truss as if it were fully loaded. When these wedges were properly installed they effectively reduced flexing of the structure when vehicles passed over it and they could be readjusted periodically as the wood members shrank.[31] Long received several more patents for improvements to his designed and published descriptions of his invention, along with a separate pamphlet for builders, which included tables for sizing truss members. By introducing analytical engineering principles to America, Long's writings and inventions advanced the understanding of the structural behavior of timber bridges and served as a springboard for subsequent developments in bridge design and construction.[32]

Stephen Long built few, if any, bridges himself, but he had numerous agents throughout the eastern United States to promote his design, sell patent rights and oversee bridge construction projects. The Long truss was used for both railroad and highway bridges for a couple of decades, but gradually fell out of favor after the introduction of the Howe truss and the subsequent transition to all-metal truss bridges. Patented by Massachusetts millwright William Howe in 1840, the Howe truss improved on the Long truss by using adjustable wrought iron rods for tension members, thereby overcoming the inherent difficulty of creating tension connections in wood structures and allowing for easier prestressing of the members. Railroads favored the Howe truss design because it had standardized framing connections and could be quickly erected and easily adjusted. The combination wood-iron Howe truss dominated timber bridge construction for the remainder of the nineteenth century and successfully made the transition to metal truss bridge building.

Few examples of the Long truss survive today and none were built by Stephen Long himself. The 2009 edition of the *World Guide to Covered Bridges* identifies 21 extant covered bridges as Long trusses, but two of those bridges are modern replicas and at least eight are vernacular trusses that have been misidentified.[33] The classification of Long trusses is not clear-cut, as some builders may have modified the design or omitted critical features, including the prestressing keys, or wedges; however, bridges lacking the prestressing wedges do not function as described in Long's patent, even if the truss geometry appears to be similar.[34] The following chart shows the eleven surviving historic covered bridges that bear some resemblance to Long's patent.[35]

[31] Although Long specified that the wedges should be installed above the counterbraces, in practice, builders more often installed them below the counterbraces.

[32] Long was the first American to apply engineering principles developed by French engineer Claude-Louis Navier (1785-1835), a pioneer in the field of structural analysis. For more information on Navier, see: Dario A. Gasparini and Francesca da Porto, "Prestressing of 19th Century Wood and Iron Truss Bridges in the U.S.," *Proceedings of the First International Congress on Construction History*, Madrid, Spain, January 20-24, 2003, 977-986.

[33] Low's Bridge (1990) in Piscataquis County, Maine, and Smith Millennium Bridge (2001) in Grafton County, New Hampshire, are modern rebuilds. Misidentified bridges include: Bement Bridge (1854), Dalton Bridge (1853) and Rowell Bridge (1853) in Merrimack County, New Hampshire; Root Bridge (1878), Harra Bridge (1878) and Hune Bridge (1879) in Washington County, Ohio; Indian Creek Bridge (1903) in Monroe County, West Virginia, and Hoke's Mill Bridge (1899) in Greenbrier County, West Virginia. Most of the misidentified bridges are vernacular panel trusses with X-bracing in each panel.

[34] For a detailed discussion of Long truss framing, see: Joseph D. Conwill, "Long Truss Bridge Framing," *Timber Framing* 87 (March 2008), 4-5.

[35] It was previously known that Eldean Bridge and Blair Bridge have wedges at the bottom of the counterbraces. The author has visited most of the bridges categorized as Long trusses in the *World Guide to Covered Bridges* and confirmed that Robyville Bridge has prestressing wedges both above and below the counterbraces, that Sarvis Fork Bridge and Downsville Bridge have wedges below the counterbraces, and that most of the remaining bridges on the list do not have wedges acting on the counterbraces. Hamden Bridge originally had wedges below the counterbraces and wedges were reportedly also added above the counterbraces during the 2001 rehabilitation, although that information has not been confirmed. Staats Mill Bridge has wedges inserted in the upper post-chord joints to force the members into closer contact, a feature that is mentioned in Long's writings but was not often used by bridge builders.

Surviving Long Truss Covered Bridges

WG #	NR	HH#	BRIDGE	STATE	COUNTY	DATE	WEDGES	CONTRACTOR / BUILDER	REHAB	NOTES
14-03-08	---	HAER IN-27	Brownsville	IN	Bartholomew	1840	No	Adam Mason	1991	Moved 1974, 1986
19-10-02	1970	---	Robyville	ME	Penobscot	1876	Yes	Royal A. Sweet	1984	Steel floor beams
29-05-09	Eligible	---	Blair	NH	Grafton	1869	Yes	Hiram W. Merrill	2014	Auxiliary arches
32-13-01	1999	---	Downsville	NY	Delaware	1854	Yes	Robert Murray	1998	Auxiliary trusses
32-13-03	1999	---	Hamden	NY	Delaware	1859	Yes	Robert Murray	2001	Heavily rebuilt
35-09-03	1975	---	Pugh's Mill	OH	Butler	1868	No	Banden, Butin & Bowman	2000	Much modified
35-14-11 35-36-06	1976	---	Lynchburg	OH	Clinton-Highland	1870	No	John C. Gregg		Fair condition
35-55-01	1975	HAER OH-122	Eldean	OH	Miami	1860	Yes	James & William Hamilton	2006	Raised 1912
48-09-01	1983	---	Center Point	WV	Doddridge	1888	No	John Ash & S.H. Smith	1982	Long variation
48-18-01	1981	---	Sarvis Fork	WV	Jackson	1889	Yes	R.B. Cunningham	2000	Moved 1924; Auxiliary arches
48-18-04	1979	HAER WV-31	Staats Mill	WV	Jackson	1888	No	H.T. Hartley	1983	Moved 1983

The majority of the bridges listed in the chart above have been moved, heavily rebuilt, altered, or are otherwise in compromised condition, so they do not meet the requirements for National Historic Landmark consideration. Eldean Bridge is an intact example of the Long truss that embodies the character-defining features of the type, including having prestressing wedges acting on the counterbraces. The design is consistent with Long's patent, except the counterbraces bear directly on the floorbeams and the prestressing wedges are at the bottom of the counterbraces instead of the top.

Ohio Covered Bridges

Most of the early covered bridges in Ohio were toll bridges built by joint stock companies; they were erected on major thoroughfares throughout the state from the 1810s to the 1850s. Covered bridges were also built to carry canals and railroads across the state's many waterways. County governments began building covered bridges in the 1830s and 40s, erecting hundreds of covered bridges on public roads throughout the state. Covered bridge building reached its peak in Ohio in the 1860s and 70s. Historians estimate that between 3,000 and 4,000 covered bridges were built in Ohio during the historic period of covered bridge building, more than any other state in the nation.[36]

Dwindling supplies of virgin timber, coupled with the introduction of prefabricated metal truss bridges, slowed the building of covered bridges in the late nineteenth century, although they continued to be built in scattered locations into the early twentieth century. The historic era of covered bridge building (i.e. the period when timber bridges were built for purely economic reasons) lasted a little over a century in Ohio, coming to a close around 1920.[37]

Over time, many of Ohio's covered bridges were lost to floods, replacement, arson, neglect and other causes. The proliferation of mass-produced automobiles after 1910 took a particularly harsh toll, as many old timber bridges were demolished to make way for modern steel or concrete spans. Nearly 700 of Ohio's covered bridges

[36] Ohio Department of Transportation, *Second Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan* (Columbus: Ohio Department of Transportation, 1990), 95. Initial data compiled by the "Covered Spans of Yesteryear" Project, http://www.lostbridges.org, suggests that this figure may be too low.

[37] More than six decades after Ohio's historic period of covered bridges ended, the revival era of covered bridge building began, with the construction of State Road Bridge (1983) in Ashtabula County. Since then, more than thirty new covered bridges have been built in scattered locations throughout the state. These modern covered bridges differ from their historic counterparts in that they are not part of the continuous tradition that characterized the historic era of covered bridge building and they were all built, at least in part, for sentimental reasons rather than purely economic ones.

survived into the 1930s, but 75 percent of those structures were lost over the next three decades.[38] During the 1950s, most of the state-owned covered bridges were replaced and many others were torn down to make way for flood-control projects. Losses continued through the 1960s, and by 1970 only 162 covered bridges remained standing.[39]

Just as covered bridges seemed threatened with extinction, a concomitant interest in the vintage spans was growing among artists, antiquarians and historians throughout the country. In 1940, engineer John A. Diehl (1917-2015) founded the Ohio Covered Bridge Committee, under the auspices of the Ohio Historical Society (now the Ohio History Connection), to gather information about the state's covered bridges. The committee was active until about 1976 and a collection of their work can be found in the Ohio History Connection Library and Archives in Columbus, Ohio.[40] In 1953, the committee published the first statewide map of 353-½ covered bridges in Ohio, which increased public interest in the structures and, in turn, led to the creation of other organizations by covered bridge enthusiasts. The Northern Ohio Covered Bridge Society was formed in 1958 and the Southern Ohio Covered Bridge Association (now the Ohio Historic Bridge Association) was formed two years later.[41] Through their activities and publications, both groups were instrumental in raising public awareness of the plight of covered bridges; the Ohio Historic Bridge Association, in particular, has successfully lobbied for the preservation of many historic bridges throughout the state.

The wholesale destruction of covered bridges dramatically slowed in the 1960s and 70s. By the time the *Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan* was published in 1983, 63 covered bridges had been listed in the National Register of Historic Places.[42] While covered bridges continue to be lost to arson, accidents and floods, far few are demolished today in the name of progress and most are recognized as attributes to both their local communities and the state.

Today, Ohio has approximately 110 historic covered bridges, the second-highest number of any state in the nation.[43] Of that number, 50 covered bridges are listed in the National Register of Historic Places and eleven have been documented by HABS/HAER. Eldean Bridge stands out as a significant surviving example of covered bridge construction and preservation and it is the only Ohio covered bridge singled out for NHL consideration in the 2012 *Covered Bridges NHL Context Study*.[44]

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[38] John A. Diehl, "Bridge to the Past," *Timeline* 15, no. 3 (May-June 1998): 51; "Covered Spans of Yesteryear," database, http://www.lostbridges.org, retrieved August 8, 2015.

[39] John A. Diehl, "Ohio Timber Covered Bridges, *The Ohio Engineer* 20, no. 4 (April 1962): 6; Richard Sanders Allen, *Covered Bridges of the Middle West*, 131-135; Ohio Department of Transportation, *Second Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan* (Columbus: Ohio Department of Transportation, 1990), 96.

[40] *Ohio Covered Bridge Committee Records*, MSS 878, Ohio History Connection Library and Archives, Columbus, Ohio.

[41] The Southern Ohio Covered Bridge Association's first act was to purchase and repair the dilapidated Salt Creek Bridge (1876) in Muskingum County. For more information, see HAER No. OH-127.

[42] Some of these covered bridges have since been lost. Ohio Department of Transportation, *Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan* (Columbus: Ohio Department of Transportation, 1983), 1; *Second Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan* (Columbus: Ohio Department of Transportation, 1990), 89-139.

[43] David Wright, editor, *World Guide to Covered Bridges*, 7th edition (Concord, New Hampshire: National Society for the Preservation of Covered Bridges, Inc., 2009), 60-87.

[44] Thirty-five Ohio covered bridges have been moved or placed in storage and at least an equal number have been heavily rebuilt, so more than 60 percent are not eligible for National Historic Landmark consideration. [Data compiled from the 2009 edition of the *World Guide to Covered Bridges*.]

Miami County Covered Bridges

Eldean Bridge is the last surviving historic covered bridge in Miami County, Ohio, a county that once had at least 40 of these timber structures. It is representative of the majority of the county's covered bridges, which were public roadway bridges built between 1850 and 1880, and paid for with public funds.

Covered bridge building began in Miami County in 1838, when a group of investors financed the erection of a covered toll bridge across the Great Miami River on the Piqua-Urbana Turnpike.[45] Privately-financed bridges were not common, however, and most river crossings were made by ford or ferry until around 1847, when timber bridge building began in earnest. The county continued erecting covered timber bridges through the 1870s. Historians have found records for approximately 40 covered bridges in Miami County, but there may be others that have not yet been identified.[46] All of the known covered bridges were built between 1838 and 1882, with the majority being built in the 1850s and 60s; this was the period during which Eldean Bridge was built. Miami County had several covered railroad bridges, but the majority of covered bridges were public roadway bridges paid for by the county. The Miami County Commissioners generally specified the Howe truss for bridges built in the 1850s and 60s but used the Long truss for a brief period around 1860 and then switched to the Smith truss in the late 1860s.[47]

In the mid-1870s, the Miami County Commissioners began to favor metal trusses for county bridges and they stopped building timber truss bridges altogether in the early 1880s. This was due, at least in part, to the influence of numerous metal bridge manufacturing firms that were being established in Ohio during the late nineteenth century.[48] Over time, many of Miami County's covered bridges were lost to various causes, either accidental or intentional. The county lost six covered bridges during the Great Flood of 1913 alone. After the loss of several more spans in the early 1930s, Eldean Bridge became the last surviving covered bridge in Miami County.[49]

Site History[50]

The Miami Valley was opened for settlement with the signing of the Greenville Treaty in 1795.[51] The flat, fertile land along the Great Miami River was ideal for agriculture and soon settlers began to arrive. Miami County was formed in 1807 and grew rapidly; over the next fifty years the population increased 660 percent, from 3,941 in 1810 to 29,959 in 1860.[52] Major transportation corridors established through the Miami Valley spurred this growth: in the early 1800s, a road was established along the lines of an old military trail between

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[45] The first *non-housed* timber truss bridge in Miami County was reportedly built in 1820. See: Irene E. Miller, *History of Miami County,* Ohio (Tipp City, Ohio: Miami County Genealogy and Historical Society, 1982), 33.

[46] John A. Diehl, "Ohio Covered Bridge Index," John Diehl Covered Bridges Collection, Ohio History Connection, Columbus, Ohio; Douglas L. Christian, "Covered Bridges of Miami County," pamphlet, 2007. The "Covered Spans of Yesteryear" database, http://www.lostbridges.org, has approximately 70 listings for Miami County, but some of those listings are for non-housed timber pony truss bridges or combination wood-metal bridges, both of which were common in the area.

[47] Miriam Wood, 138. For more information on the Smith truss, see: Lola Bennett, "California Powder Works Bridge," National Historic Landmark Nomination (Washington, DC: U.S. Department of the Interior, National Park Service, 2014).

[48] At least two dozen metal bridge manufacturers were established in Ohio in the 1860s and 70s. For more information on bridge manufacturing firms, see: Victor Darnell, *A Directory of American Bridge-Building Companies, 1840-1900* (Washington, DC: Society for Industrial Archeology, 1984), 47-56.

[49] Miami County also has one modern covered bridge, Fletcher Bridge (1998) at Fletcher (*World Guide* #35-55-103).

[50] The 2002 Eldean Bridge HAER report, which was prepared under a tight deadline, contains some errors. The author conducted much additional research in the preparation of this nomination and received invaluable assistance from former Miami County Engineer Douglas L. Christian, who has extensive knowledge of the bridge and site.

[51] The Greenville Treaty, which marked the end of the Northwest Indian Wars, established a new western border for the United States and opened much of present-day Ohio for settlement.

[52] Thomas Bemis Wheeler, *Troy, the Nineteenth Century* (Troy, Ohio: Troy Historical Society, 1970), Appendix 1.

Dayton and Fort Defiance; between 1827 and 1845, the Miami & Erie Canal was built from the Ohio River to Lake Erie; and in 1854, the Dayton & Michigan Railroad was built between Troy and Piqua. All three corridors passed close to this site.

The Miami & Erie Canal was extended from Dayton to Piqua in 1837. That year, William Culbertson erected a saw mill and grist mill near the canal lock north of Troy, about a quarter-mile northwest of this site.[53] In 1846, Culbertson's Mill (also known as Troy Upper Lock Mill), came into the ownership of John B. Fish and David Gibbs and for a short time, it was known as Fish & Gibbs Mill. Two years later, Massachusetts native Henry Ware Allen (1822-1910) of Pembroke, Massachusetts, purchased a half-interest in the mill from David Gibbs.[54] Over the next few years, Mr. Allen expanded the grist mill operation as a small industrial hamlet grew nearby. By 1858, Allen's Mill was the center of a bustling community, which included a blacksmith shop, a cooper shop, a church, a grocery store, and a number of dwellings.[55] In 1867, Thomas B. Wheeler (1837-1918) of Lincoln, Massachusetts, joined Mr. Allen as a partner in the business. By the early twentieth century, Allen & Wheeler's Mill (incorporated in 1911 as the Allen & Wheeler Flour Mill Company) was one of the largest flour mills in Ohio.[56] The mill remained in operation until 1936, when it was sold to Russell Altman of Pittsburgh, Pennsylvania, who operated a feed mill at the site through the 1950s.[57] The flour mill burned in 1944 and was not rebuilt, but the grain elevators are still standing. The property has been used as a grain processing site for 180 years; it is currently owned by Troy Elevator, a division of Mennel Milling Company.[58]

Eldean Bridge and its Predecessors

In 1847, the Miami County Commissioners laid out an east-west county road from the Troy-Piqua Turnpike (now Dixie Highway/CR25A) in Concord Township across Great Miami River near Fish & Gibb's Mill, proceeding along the property line between the lands of William Marshall and Jacob Counts to the Staunton-Piqua Turnpike (now Piqua-Troy Road/CR15) in Staunton Township, a distance of just over one-half mile.[59] Originally known as Fish & Gibbs Mill Road, that corridor is now the eastern section of present-day Eldean Road/CR33.[60]

In 1847-48, shortly after Fish & Gibb's Mill Road was laid out, local carpenter John Pagan (or Pegan) erected the first bridge at the site for $933.33.[61] That structure, known as Fish & Gibbs Mill Bridge, was presumably a non-housed timber span.[62] This was one of two nineteenth-century river crossings between Troy and Piqua, the other being Farrington Bridge, about two miles north of this site.[63] Left uncovered, the Fish & Gibbs Mill

[53] Wheeler, 57.

[54] "David Gibbs and wife to Henry W. Allen," *Miami County Deed Book* 24, 435; Coleman Allen, "The Allen & Wheeler Company," *The History, Development, Industrial and Community Activities of Troy* (Troy, Ohio: Greater Troy Association, 1931), 48.

[55] W. Arrott, "Map of Miami County, Ohio," (Cincinnati: S.H. Matthews, 1858), https://www.loc.gov/item/2012592379.

[56] "Eldean Mills Built During Old Canal Days," *Troy Daily News*, August 9, 1957, 10 and 18.

[57] "Allen and Wheeler Company Will Quit," *Piqua Daily Call*, March 30, 1936, 7.

[58] Douglas L. Christian, Email correspondence with author, October 23, 2015.

[59] See detail of W. Arrott's 1858 "Map of Miami County, Ohio," in appendix.

[60] Miami County, Ohio, *Miami County Road Records*, Book 4, April 6, 1847, 189-191. From its intersection with CR25A (originally Troy-Piqua Turnpike), present-day Eldean Road extends west about three miles to its intersection with SR41 (originally Troy-Covington Turnpike). The westerly section of present-day Eldean Road was laid out sometime prior to 1850, when county records mention the roadway being reduced in width.

[61] Miami County, Ohio, *Miami County Commissioners Journals*, Book 4, December 6, 1847, 369.

[62] "Fish & Gibbs Mill Bridge," Miami County, Ohio, "Covered Spans of Yesteryear," database, http://www.lostbridges.org, retrieved, June 19, 2015.

[63] W. Arrott's 1858 "Map of Miami County, Ohio" curiously shows two crossings at this site. The northerly crossing is believed to have been the Fish & Gibbs Mill Road Bridge (the predecessor of Eldean Bridge), while the disposition of the southerly crossing is not known.. The latter *may* have been a ford, but no written documentation has been found concerning that crossing. Later maps suggest that the present covered bridge was located between the two crossings shown on the 1858 map. Arrott, "Map of Miami County, Ohio," 1858; *Miami County Road Records*, Book 4, April 6, 1847, 191.

Bridge would have lasted approximately 10-12 years, or until about 1858-1860, barring its loss due to other causes. No information has been found concerning the structure's demise; in all likelihood, it simply deteriorated to the point where it was unsafe.

On March 7, 1860, the Miami County Commissioners agreed to build six new bridges, including the bridge that became known as Eldean Bridge, which was recorded at the time as follows: "*one* [bridge] *across the Miami River at H.W. Allen's Mill, to be built on Long's plan with stone abutments and pier*."[64] On April 13, 1860, the commissioners awarded the bridge contract to James and William Hamilton of Piqua, Ohio.[65] The lumber was white pine shipped from Michigan on the Miami & Erie Canal and the stone was presumably cut at the Hamilton brothers' quarry in Piqua.[66] The covered bridge at Allen's Mill was substantially completed in the fall of 1860 (the wingwalls may have been completed in 1861) and final payments were made to the contractors in the fall of 1861. The total cost for the bridge was $4,200.83, including $1,337.68 for the masonry substructure ($2.73 per perch for the abutments and $2.95 per perch for the pier), $2,632.00 for the superstructure (224' at $11.75 per linear foot of truss), $45.00 for fill (230 yards at 19½ cents per yard), $111.15 for wingwalls, and $75.00 for extra work.[67]

Originally known as Allen's Mill Bridge for less than 40 years, the crossing was commonly known as Eldean Bridge by the late nineteenth century.[68] When the Cincinnati, Hamilton & Dayton Railroad was built between Troy and Piqua in the 1880s, Thomas Wheeler, proprietor of Allen & Wheeler's Mill, christened the nearby station stop "Eldean Station," in honor of his youngest daughter, Ellen Dean Wheeler (1882–1980).[69] The name "Eldean Station" appears just west of the bridge site on the 1894 and 1911 Miami County maps; the name was subsequently shortened to "Eldean."[70] Today the historic (c.1894) common name of Eldean Bridge is used to refer to this bridge.

James and William Hamilton

Eldean Bridge is attributed to contractors James and William Hamilton. Born in Uniontown, Pennsylvania, to John Hamilton (1794–1861) and Flora Patterson Hamilton (1797–1874), James Hamilton (1826–1899) and William Hamilton (1828–1890) moved to Miami County, Ohio, with their parents in 1832. The brothers are listed as farmers in the 1850 and 1860 federal censuses. In the 1850s, the brothers began operating a limestone quarry near Piqua.[71] The brothers were also well-known local contractors who were involved with the

[64] *Commissioners Journals*, Book 5, March 7, 1860, 344. "The commissioners specified that both the bridge at Allen's Mill and the bridge 'across Greenville Creek at the Woolen Factory' be built on Long's plan. Why the commissioners specified the Long truss is not documented, but there were a number of Long truss covered bridges in the area at that date. Moreover, in 1857, the county was required to pay licensing fees for the use of the Howe truss for several county bridges, so they may have chosen the Long truss to avoid paying licensing fees. David A. Simmons, "19th Century Prestressing Exemplified in Miami County Bridge," *Ohio County Engineer* 3 (Fall 1994): 12.

[65] *Commissioners Journals*, Book 5, April 13, 1860, 346. Local newspapers were published in both Troy and Piqua in 1860, but the author was unable to locate any extant issues that cover the period of the bridge's construction.

[66] Miriam Wood, 137-138.

[67] *Commissioners Journals*, Book 5, November 8, 1860, 364-365, December 11, 1860, 370, January 22, 1861, 371; Book 6, November 4, 1861, 14-15.

[68] Until at least the 1930s, the bridge was alternatively referred to as Marshall Bridge, after William Marshall (1781-1873) and his heirs, who owned the farm adjacent to the east end of the bridge. "Marshall Bridge is Being Repaired," *Piqua Daily Call*, June 16, 1936, 6.

[69] Wheeler, 210.

[70] *The County of Miami Ohio, an Imperial Atlas and Art Folio* (Richmond, Indiana: Rerick Brothers, 1894), plate 32; *Plat Book of Miami County, Ohio* (Des Moines, Iowa: Northwest Publishing Company, 1911), plate 17; United States Geological Survey, "Troy, Ohio, Quadrangle," 1912, http://www.lib.utexas.edu/maps/topo/ohio/txu-pclmaps-topo-oh-troy-1912.jpg, retrieved December 4, 2016.

[71] The Hamilton Quarry was located on the west side of Great Miami River just south of Piqua. The 1858, 1871 and 1875 Miami County maps show that the property in Section 19 of Washington Township was owned by James Hamilton; later maps show this

construction of a number of county bridges in the mid-nineteenth century, including the nine covered bridges listed in the following chart.[72]

Covered Bridges Associated with James and William Hamilton

WG#	NR	HH#	BRIDGE	STATE	COUNTY	DATE	TYPE	CONTRACTOR / BUILDER	REHAB	NOTES
35-55-23x	---	---	Lower	OH	Miami	1854	Howe	Thatcher, Burt & Co.	---	Lost c1900
35-55-16x	---	---	Upper	OH	Miami	1855	Howe	Scott & Johnson	---	Lost
35-55-12x	---	---	Market Street	OH	Miami	1858	Long?	Banden & Stone	---	Lost
35-55-14x	---	---	Flour Mill	OH	Miami	1858	Long	Morrison & Humphreville	---	Lost 1913
35-55-13x	---	---	Woolen Mill	OH	Miami	1860	Long	James & William Hamilton	---	Lost 1913
35-55-01	1975	HAER OH-122	Eldean	OH	Miami	1860	Long	James & William Hamilton	2006	Extant
35-55-05x	---	---	Clark	OH	Miami	1861		David H. Morrison	---	Lost c1934
35-55-53x	---	---	Middle	OH	Miami	1868	Burr?	Jacob Gray	---	Lost 1895
35-20-03x	---	---	Hopkins Street	OH	Defiance	1875		James & William Hamilton	---	Lost

In the case of Eldean Bridge, James and William Hamilton were awarded the contracts for both the stonework and the superstructure; in the case of Greenville Creek Bridge, erected the same year, the brothers were awarded only the superstructure contract. Since the brothers were stonecutters, it is curious that they are the builders of record for timber bridges; however, it is believed that they may have acted as general contractors and sublet the superstructure contracts.[73] The Hamilton brothers had professional associations with a number of local bridge builders, including civil engineer David H. Morrison (1818-1882) of Dayton and bridge builder Robert W. Smith (1833-1898) of Tippecanoe (now Tipp City).[74] It is likely that the superstructure contract for Allen's Mill (Eldean) Bridge was sublet to a local bridge builder, but no written records have been found to confirm this.[75]

Around 1878, William Hamilton moved with his family to Saginaw, Michigan, where he worked in the lumber industry until his death on August 12, 1890.[76] James Hamilton remained with his family in Piqua, Ohio, where he continued to work as a stone dealer and contractor until the late 1880s.[77] He died at his home on October 13, 1899.[78] James and William Hamilton are buried in Forest Hill Cemetery in Piqua, Ohio.

Subsequent History of Eldean Bridge

Like any other long-lived timber structure, Eldean Bridge has required periodic repairs. The first repair, costing $24.77, was completed shortly after the bridge was erected, although there is no written description of the work

same property owned by G.W. McCabe Quarry (1894) and Statler Stone Co. (1911). By the 1950s, the property was owned by Armco Steel Corporation (now, Armco, Inc.)

[72] This list is likely incomplete, as project time constraints did not allow for extensive research in county records. Data was largely compiled from the following sources: "Covered Spans of Yesteryear," database, http://www.lostbridges.org; John A. Diehl, "Ohio Covered Bridge Index," John Diehl Collection, Ohio History Connection, Columbus, Ohio; David Simmons, "James and William Hamilton," research notes; Miriam Wood, 27, 132 and 137-38.

[73] Simmons, "19th Century Prestressing," 11.

[74] Another brother, John A. Hamilton (1838-1886), worked in the lumber industry in Toledo for a number of years and was one of the early partners in the Smith Bridge Company, which was organized by Robert W. Smith in 1867. In 1859, John Hamilton married Harriet Rowland (1840-1923), with whom he had five children. Around 1879, John Hamilton moved with his family to Saginaw, Michigan, where he worked in the lumber and salt-manufacturing industries with his cousin, William McClure. John Hamilton died in Saginaw on November 10, 1886, at the age of 47. Clark Waggoner, editor, *A History of Toledo and Lucas County, Ohio, Illustrated* (Toledo: Munsell & Co., 1888), 786-787; "Death of John A. Hamilton," *Saginaw Daily Courier*, November 10, 1886, 6.

[75] Simmons, "19th Century Prestressing," 11.

[76] In 1848, William Hamilton married Elizabeth Sellars (1839-1914), with whom he had two children. He is listed as a Piqua stone dealer in the *Illustrated Historical Atlas of Miami County, Ohio* (Philadelphia: L.H. Everts & Co., 1875), 47. He is listed in the 1880 federal census as a lumberman living in Saginaw, Michigan.

[77] In 1850, James Hamilton married Mary Turk (1832-1920), with whom he had ten children. He is listed in various state and local directories as a quarry owner, stone dealer, or contractor through the 1880s.

[78] "In Memory of James Hamilton," *Miami Helmet*, October 19, 1899, 1.

that was done.[79] Presumably, other repairs took place in the nineteenth century, but details of those repairs were either not recorded in county records or have yet to be discovered. It was not until Miami County established a highway department in the early twentieth century that records of repairs were more consistently documented.

In 1912, the bridge survived a major flood, but the pier required repair. The bridge was subsequently raised on steel I-beams, which likely saved the structure from being washed away in the Great Flood of 1913.[80] In 1922, the trusses were repaired and a new deck was laid on top of the then-existing deck; this work was done by the Bower Bridge Company of Maysville, Kentucky.[81] In 1936, the west abutment and pier were capped with concrete, steel tie rods were installed alongside posts with broken shoulders and a metal roof was laid over the then-existing wood-shingle roof.[82]

Increasing motorized traffic in the first half of the twentieth century took its toll on the aging span. By the 1950s, the bridge was showing signs of structural problems, so the Miami County Engineering Department posted it for a 4-ton load limit and restricted traffic to cars only. In 1963, the Miami County Board of Commissioners voted to bypass the covered bridge and realign Eldean Road, as the east approach to the bridge involved a 90-degree turn and the west approach sometimes had to be closed during periods of high water.[83] In 1964, the Miami County Highway Department realigned Eldean Road and erected a three-span prestressed concrete beam bridge approximately 125' north of the covered bridge.[84] The bypassed section of Eldean Road was officially renamed Farver Drive (colloquially, Farver Road).[85] The Miami County Commissioners agreed to preserve Eldean Bridge in place as a local historic landmark, a decision that was commended by the Ohio Covered Bridge Committee.[86] Around the same time, the property adjacent to the west end of the covered bridge was turned into a recreation park, with baseball fields, a parking area and picnic shelter; originally known as "Eldean Park," the property was renamed "Covered Bridge Park" in 2008.[87]

In 1966, county engineers noticed settlement in the northwest truss and took Eldean Bridge out of service. The county bridge crew jacked up the bottom chord and installed additional bracing to restore the structure's proper camber; this project was completed at a cost of $1,500.[88] The bridge siding was painted for the first time in August 1967; this project cost $1,500 and was paid for by the Troy Foundation, a philanthropic organization that serves the local community.[89] With the bridge closed to traffic, vandalism became an increasing problem. In 1976, the Miami County Engineering Department addressed the issue by framing four window openings on each side of the bridge, installing kickboards along the exterior to secure the siding and installing heavier lower

[79] *Commissioners Journals*, Book 6, November 4, 1861, 14.

[80] The steel I-beams at the abutments are believed to be recycled floor beams cut from a steel truss bridge. "Eldean Bridge Closed," *The Miami Union*, February 21, 1912, 7; Douglas L. Christian, Telephone conversation with author, June 19, 2015; James Barker, P.E., "Report on the Rehabilitation of the Eldean Bridge, Miami County, Ohio" (Bloomington, Indiana: J.A. Barker Engineering, Inc., October 31, 2006), 7.

[81] *Commissioners Journals*, Book 17, August-November 1922, 262-263, 306, 310.

[82] *Miami County Bridge Records*, Miami County Highway Department, Troy, Ohio.

[83] *Commissioners Journals*, Book 37, October 10, 1963 and November 1, 1963, 365, 367; "Covered Bridge at Eldean to be Preserved," *Piqua Daily Call*, October 23, 1963, 1.

[84] The 1964 concrete bridge adjacent to the covered bridge was replaced in 2015.

[85] *Commissioners Journals*, Book 37, July 29, 1964, 598-599. Although the official name is Farver Drive, the road is labeled "Farver Road" on many current maps, including the USGS Troy, Ohio, Quadrangle. The bypassed section of Eldean Road is now the west part of Farver Road; the east part of Farver Road was laid out in the 1980s.

[86] "Miami County Praised for Retaining Covered Bridge," *Piqua Daily Call*, July 27, 1965, 14.

[87] Bill Fox, "Shut Down Kissing Span May Stay Closed to Cars," *Dayton Daily News*, October 14, 1968, 29. The Kiwanis Club of Troy paid for the erection of the picnic shelter. That structure was replaced in the 1980s and again in 2007.

[88] "Plan Eldean Covered Bridge Repair," *Piqua Daily Call*, September 14, 1966, 1; "Eldean Bridge," *Troy Daily News*, September 16, 1966, 1.

[89] "Old Eldean Bridge to be Painted," *Piqua Daily Call*, August 7, 1967, 1. The tympanums were painted or whitewashed in the 1940s or 50s, but the rest of the bridge was not painted until 1967.

lateral bracing so the bridge could once again carry traffic.[90] The bridge was subsequently reopened to automobiles, which helped reduce loitering and attendant vandalism to the structure.

In the spring of 1980, the bridge was closed again for repairs. Engineers repaired the bottom chords with steel braces and tied the bottom chords to the top chords with metal tie rods, providing additional support at the ends of the trusses. The bridge was reopened to traffic in June of that year. In the mid-1990s, a wood sign reading, "ELDEAN BRIDGE/ 1860/ SECOND LONGEST BRIDGE IN OHIO/ BUILT BY: HAMILTON BROS.," was installed over each portal.[91]

In 2002, Eldean Bridge was selected for recording by the Historic American Engineering Record (HAER), as part of HAER's National Covered Bridges Recording Project, funded by the Federal Highway Administration (FHWA). In addition to being recorded with measured drawings, large-format photographs and a written historical report, Eldean Bridge was one of several bridges chosen for an engineering study analyzing the structural behavior of different truss types.[92]

The 2002 HAER recording project renewed local interest in the historic structure. The Miami County Engineering Department subsequently applied for a grant from FHWA's National Historic Covered Bridge Preservation (NHCBP) Program, established by Section 1224 of the Transportation Equity Act for the 21st Century (TEA21).[93] The goal was to repair the trusses so they could function as designed and restore the bridge's appearance, while retaining as much historic fabric as possible.[94] The bridge was restored between June 2005 and September 2006. The total cost of the project was $606,194.33 ($484,955.46 in federal and state funds plus $121,238.87 in local funds).[95] This rehabilitation project involved repairing or replacing damaged members, reversing earlier make-do repairs, installing a new roof and siding, repointing the historic masonry and applying fire retardant. The project was designed by James Barker of J.A. Barker Engineering, Bloomington, Indiana, and the contract was undertaken by the Righter Company, Inc., of Columbus, Ohio, both firms having expertise in rehabilitating historic covered wood bridges. Civil engineering professor Dario Gasparini of Case Western Reserve University, Cleveland, Ohio, reviewed the plans in advance of the project and provided expertise in the installation of new prestressing wedges.[96] Several safeguard features, including interior and exterior lights, heat sensors and closed-circuit cameras were subsequently funded by the Troy Foundation. The bridge deck was replaced in 2014 at a cost of $103,897, utilizing federal and local funds.[97]

Eldean Bridge is currently open to automobiles, pedestrians and bicyclists. It is posted for a 4-ton load limit and a 15-mph speed limit. The Miami County Engineering Department monitors and maintains the bridge and inspects it annually.

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[90] "Kissing Bridge Getting Remodeling Job," *Canton Repository*, March 30, 1977, 49.

[91] The signs above the portals were removed during the 2005-06 rehabilitation; they were reworded and reinstalled in 2007. The signs now read: "ELDEAN BRIDGE/ 1860/ BUILT IN ACCORDANCE WITH/ STEPHEN H. LONG'S PLAN/ BUILT BY: HAMILTON BROS."

[92] For the full engineering analysis of Eldean Bridge, see HAER No. OH-122.

[93] Nancy Bowman, "Miami to Seek Aid on Bridge Plan," *Dayton Daily News*, April 2, 2003, B4.

[94] Small areas of rot were patched with new pieces of wood cut to fit and fastened in place with epoxy and bolts. Members that were deemed beyond repair were replaced with new members of the same species and dimensions.

[95] Douglas L. Christian, "The Historic Eldean Covered Bridge," speaker's notes, Second National Covered Bridges Conference, Dayton, Ohio, June 5-8, 2013. Private collection.

[96] Professor Gasparini supervised the 2002 HAER engineering study of Eldean Bridge, which established that almost 75 percent of the wedges were loose. Since "all of the counterbraces must be prestressed to assure a uniform behavior of the bridge," [HAER No. OH-122, p.49] the wedges require periodic tightening. During the 2005-06 rehabilitation, new prestressing wedges were installed using gauges to quantify their effectiveness.

[97] Miami County, Ohio, *Miami County Engineer's 2014-2015 Annual Report*, 4, https://oh-miamicounty.civicplus.com/DocumentCenter/View/1895, retrieved June 14, 2015.

Chronology

1803 Ohio granted statehood
1805 America's first covered bridge completed at Philadelphia
1807 Miami County formed
1809 Ohio's first covered bridge erected over Little Beaver Creek near Liverpool, Columbiana County
1830 Stephen H. Long patents the Long truss
1837 Miami & Erie Canal extended from Dayton to Piqua
1838 William Culbertson establishes a saw and grist mill near this site
Miami County's first covered bridge erected on the Piqua-Urbana Turnpike
1846 John Fish and David Gibbs purchase William Culbertson's Mill
1847 Fish & Gibbs Mill Road (eastern portion of present-day Eldean Road) laid out
First bridge (presumably a non-housed timber bridge) erected at this site
1848 Henry Ware Allen purchases a half interest in Fish & Gibbs Mill
1860 Covered bridge erected at this site by James and William Hamilton
1867 Thomas B. Wheeler becomes Henry Ware Allen's partner in Allen's Mill
1882 Miami County's historic era of covered bridge building ends
1894 "Eldean Station" labeled on Rerick Brothers' *Atlas of Miami County*
1912 Eldean Bridge damaged in a flood and subsequently raised 15"
1913 Eldean Bridge survives the Great Flood of 1913
1922 Eldean Bridge deck overlaid with new deck
1935 Eldean Bridge is Miami County's last surviving covered bridge by this date
1936 Eldean Bridge abutment and pier capped; trusses repaired; metal roof laid over existing shingle roof
1964 Eldean Bridge bypassed
1967 Eldean Bridge painted red
1968 Eldean Bridge closed to traffic
1975 Eldean Bridge listed in the National Register of Historic Places
1976 Eldean Bridge truss and lower lateral bracing repaired
1977 Eldean Bridge repaired and re-opened to automobile traffic
1980 Eldean Bridge lower chord repaired
2002 Eldean Bridge recorded by the Historic American Engineering Record
2006 Eldean Bridge rehabilitated
2014 Eldean Bridge deck replaced

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Previous Documentation on File (NPS):

__ Preliminary Determination of Individual Listing (36 CFR 67) has been requested.
X Previously Listed in the National Register: Eldean Covered Bridge [NRIS #OH-75001492, 1975]
__ Previously Determined Eligible by the National Register.
__ Designated a National Historic Landmark.
__ Recorded by Historic American Buildings Survey:
X Recorded by Historic American Engineering Record: Eldean Bridge, HAER No. OH-122

Primary Location of Additional Data:

X State Historic Preservation Office: Ohio History Connection, Columbus, Ohio
X Other State Agency: Ohio History Connection Library and Archives, Columbus, Ohio
__ Federal Agency
X Local Government: Miami County Courthouse, Troy, Ohio; Miami County Engineering Dept., Troy, Ohio
__ University
__ Other (Specify Repository):

10. GEOGRAPHICAL DATA

Acreage of Property: Less than one acre

UTM Reference:	Zone	Easting	Northing
1	16	737345	4440124

Verbal Boundary Description:

The property comprises the substructure, superstructure, housing and approaches of Eldean Bridge. Overall, the superstructure is approximately 231' long (along the ridge), 21' wide (eave-to-eave) and 19' deep (bottom of floor beams to top of roof). The tops of the pier and abutments are approximately 25' above normal water level. There is a 100' long inclined approach at the west end of the bridge and a 20' long approach at the east end of the bridge. The bridge, which is aligned on an east-west axis, carries a bypassed section of Eldean Road/CR33 across Great Miami River between Concord and Staunton townships, approximately two miles north of Troy, Miami County, Ohio.

Boundary Justification:

The property boundary includes the essential historic components of the bridge: the substructure (abutments, piers, retaining walls and foundations), the superstructure (trusses, floor system and lateral bracing systems), the housing (siding, roof and architectural embellishments) and the roadway approaches to the structure.

11. FORM PREPARED BY

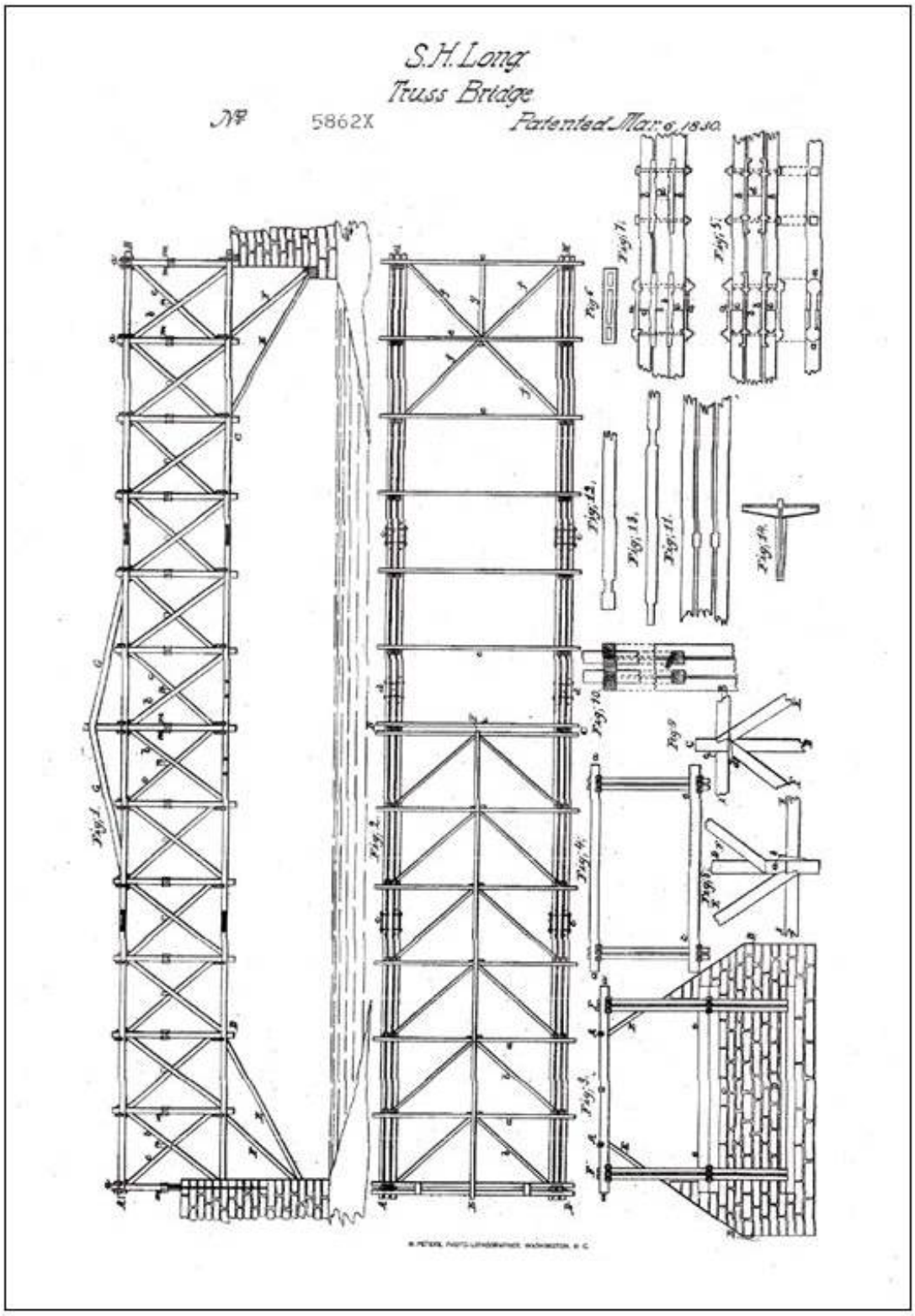
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Date: May 25, 2016

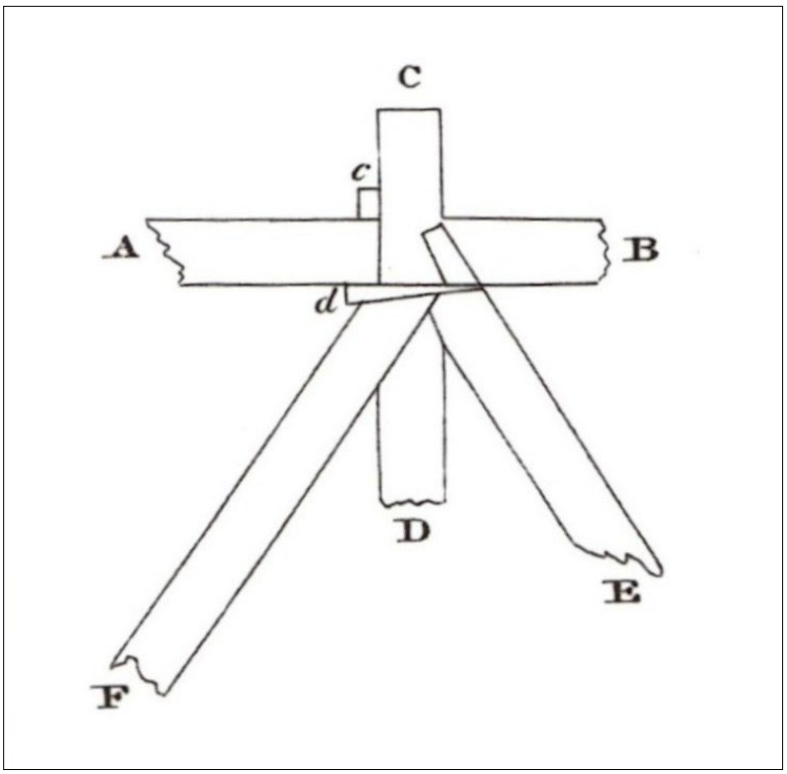
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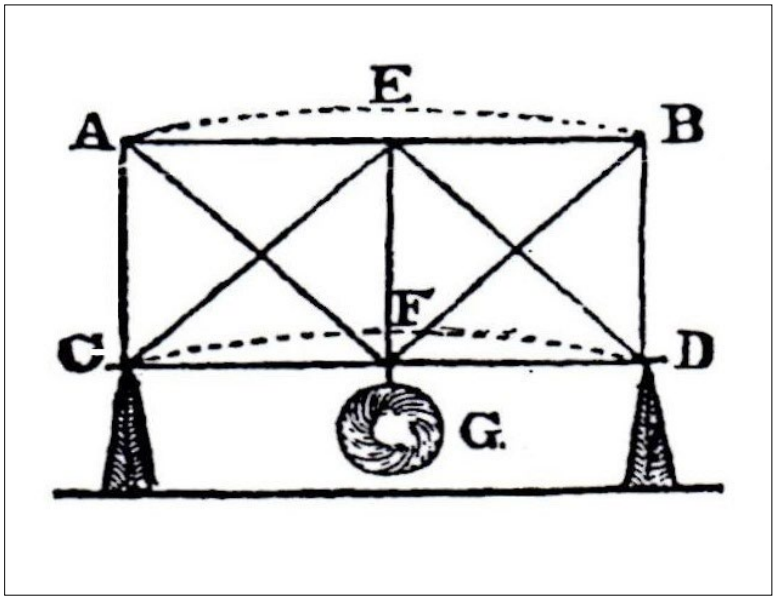
NATIONAL HISTORIC LANDMARKS PROGRAM



S.H. Long, U.S. Patent 5862X, March 6, 1830.
Source: United States Patent and Trademark Office.



Long truss detail, showing arrangement of brace *E,* counterbrace *F*, and prestressing wedge *d*.
Source: S.H. Long, *Description of Col. Long's Bridges*, 1836, page 4.



Prestressing diagram, showing position of chords before and after counterbraces and wedges are installed.
Source: S.H. Long, *Description of Col. Long's Bridges*, 1836, page 42.

ELDEAN BRIDGE
(Allen's Mill Bridge)
Spanning Great Miami River
Troy Vicinity, Ohio

Patented in 1830 by Col. Stephen H. Long (1784-1864) of New Hampshire, the Long truss was a framework of horizontal chords connected by paired vertical posts and paired diagonal braces and single counterbraces crossing within each panel. By putting wedges in the joints to position the bridge as if it were fully loaded, Long was able to "prestress" the truss. This made possible more precise structural analysis of the members and made the bridge much more rigid. Some of the first truss railroad bridges in the United States used the Long truss because of its ability to carry heavy loads without excessive deflection. Although rare today, the Long truss is historically important because it advanced understanding of structural behavior and laid the foundation for development of the Howe truss (1840) that dominated wooden bridge construction for the remainder of the nineteenth century.

The field work, measured drawings, historical report, and photography were completed under the direction of Eric DeLony, Chief of HAER, Christopher Marston, Project Leader, and Richard O'Connor, HAER Senior Historian. The field team consisted of Field Supervisor Naomi Hernandez (Pratt Institute), Architects Kimberly Clauer (U. of Wisconsin-Milwaukee), Vuong Dang (U. of Arkansas), William Dickinson (U. of Pennsylvania), Dave Groff (U. of Maryland), and Charu Chaudhry (ICOMOS-Italy) and Dylan Lamar (U. of Arkansas); Historians Joseph Conwill (Rangeley, ME), Lola Bennett (Stow, MA), and Sarah Dangelas (U. of Maryland). Dr. Dario Gasparini, P.E. (Case Western Reserve U.), and Dr. Ben Schafer (Johns Hopkins U.), served as engineering consultants. Large-format photography was produced by Jet Lowe.

Long Truss, 1860

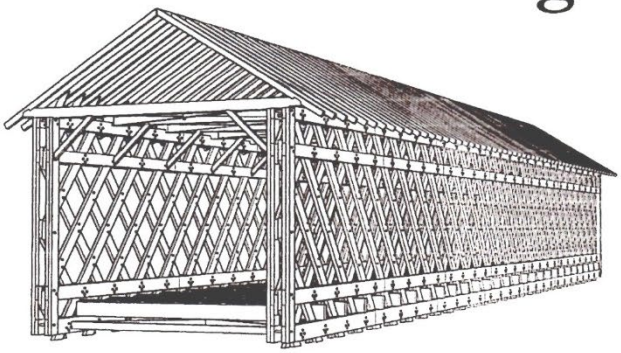
There was a bridge at this site by 1842, when Miami County road records show the "road to Dayton" (present-day Eldean Road) crossing Great Miami River just north of an old ford. In 1848, Henry Ware Allen emigrated from Massachusetts to Miami County, Ohio, where he established a flour mill at this location on Great Miami River. Allen's Mill (later, Allen & Wheeler) grew to become one of the largest flour mills in western Ohio and continued operations into the twentieth century. At least twenty nine covered bridges were built in Miami County in the mid-nineteenth century; of these, only the Eldean Bridge is still standing. A 218' - 10" span, the Eldean Bridge is the second longest bridge in Ohio.

In 1860, the Miami County Commissioners contracted with James and William Hamilton of Piqua, Ohio, for construction of a bridge across the Miami River at H.W. Allen's Mill, to be built on Long's plan with stone abutments and pier. The Eldean Bridge was completed in the fall of that year, at a cost of $4,080.83. After carrying traffic for more than a century, the bridge was bypassed in 1964 and is maintained by the county as an historic landmark and tourist attraction. Eldean Bridge is the second-longest covered bridge in Ohio and one of the best preserved examples of a Long truss in the United States.

DELINEATED BY: William Dickinson, Dave Groff, 2002

ELDEAN BRIDGE - 1860
DRAWING THE EAST/WEST ROAD AT PRESENT SECTION OF ELDEAN ROAD
MIAMI COUNTY
TROY VICINITY
OHIO
1 OF 7
OH-125

Covered Bridge Trusses



Brown Bridge

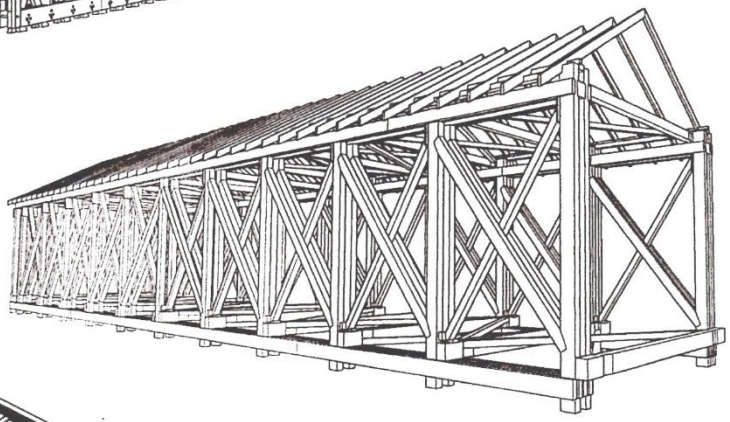
Town Lattice, 1880
Built by Nicholas M. Powers
Spanning Cold River
Upper Cold River Road
Rutland County, Vermont

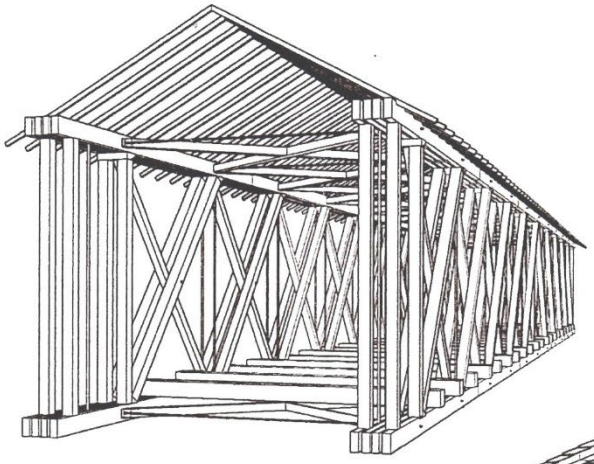
HAER No. VT - 28

Eldean Bridge

(Allen's Mill Bridge)
Long Truss, 1860
Built by John & William Hamilton
Spanning Great Miami River
Eldean Road
Miami County, Ohio

HAER No. OH - 122

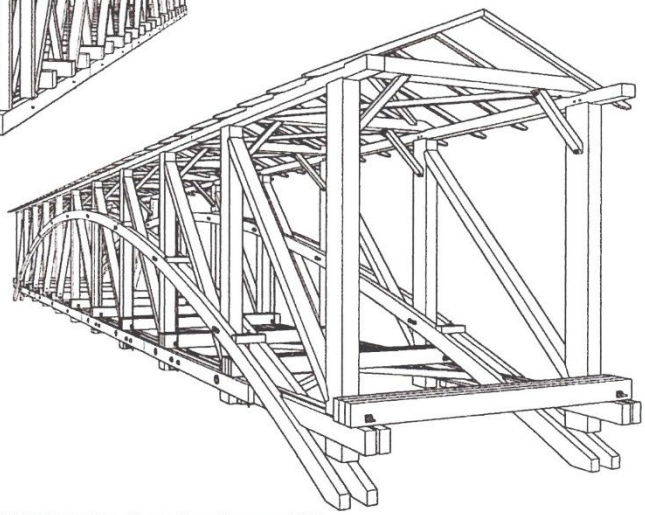




Pine Bluff Bridge

Howe Truss, 1886
Built by Joseph A. Britton
Spanning Big Walnut Creek
County Road 950N
Putnam County, Indiana

HAER No. IN - 103



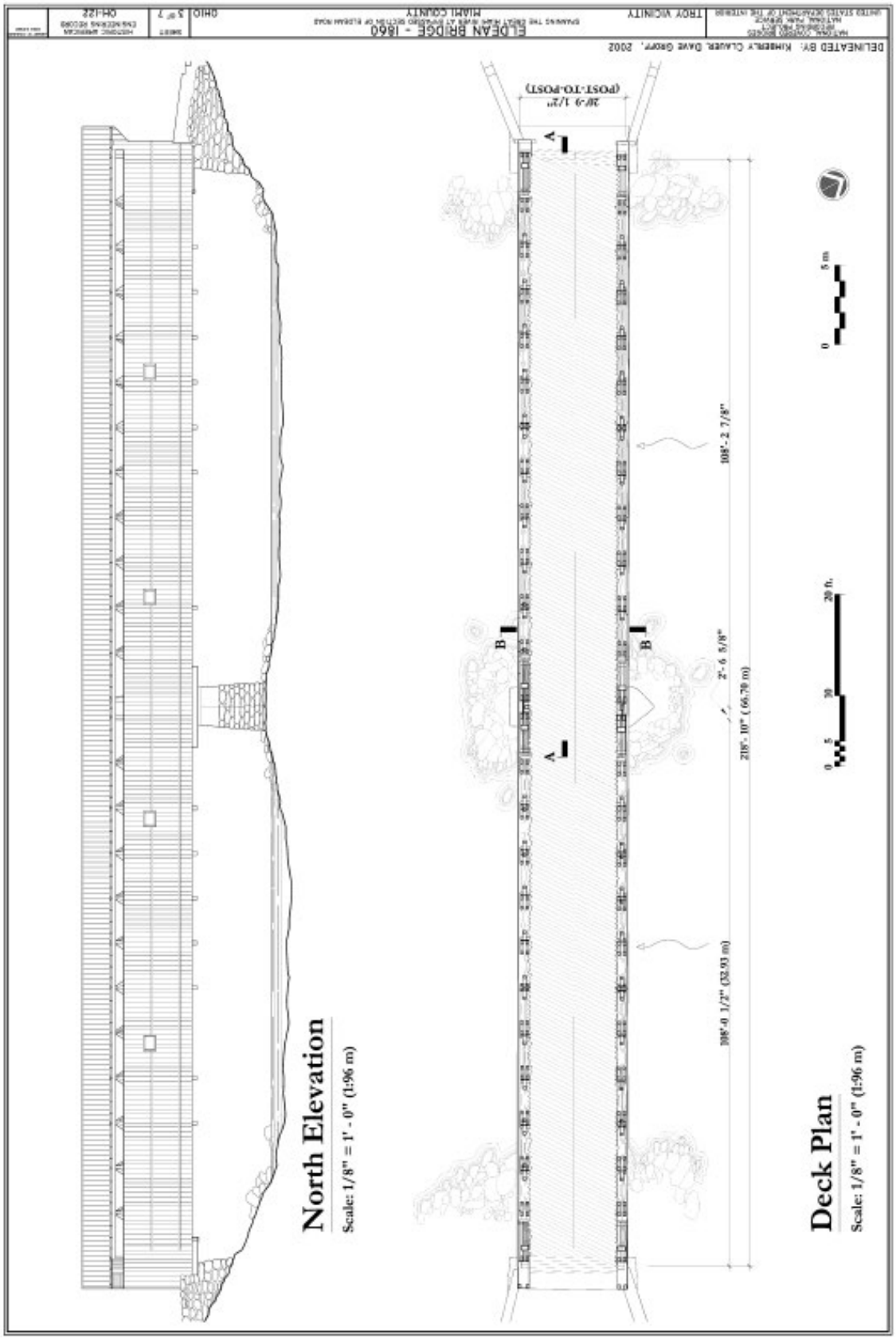
Pine Grove Bridge

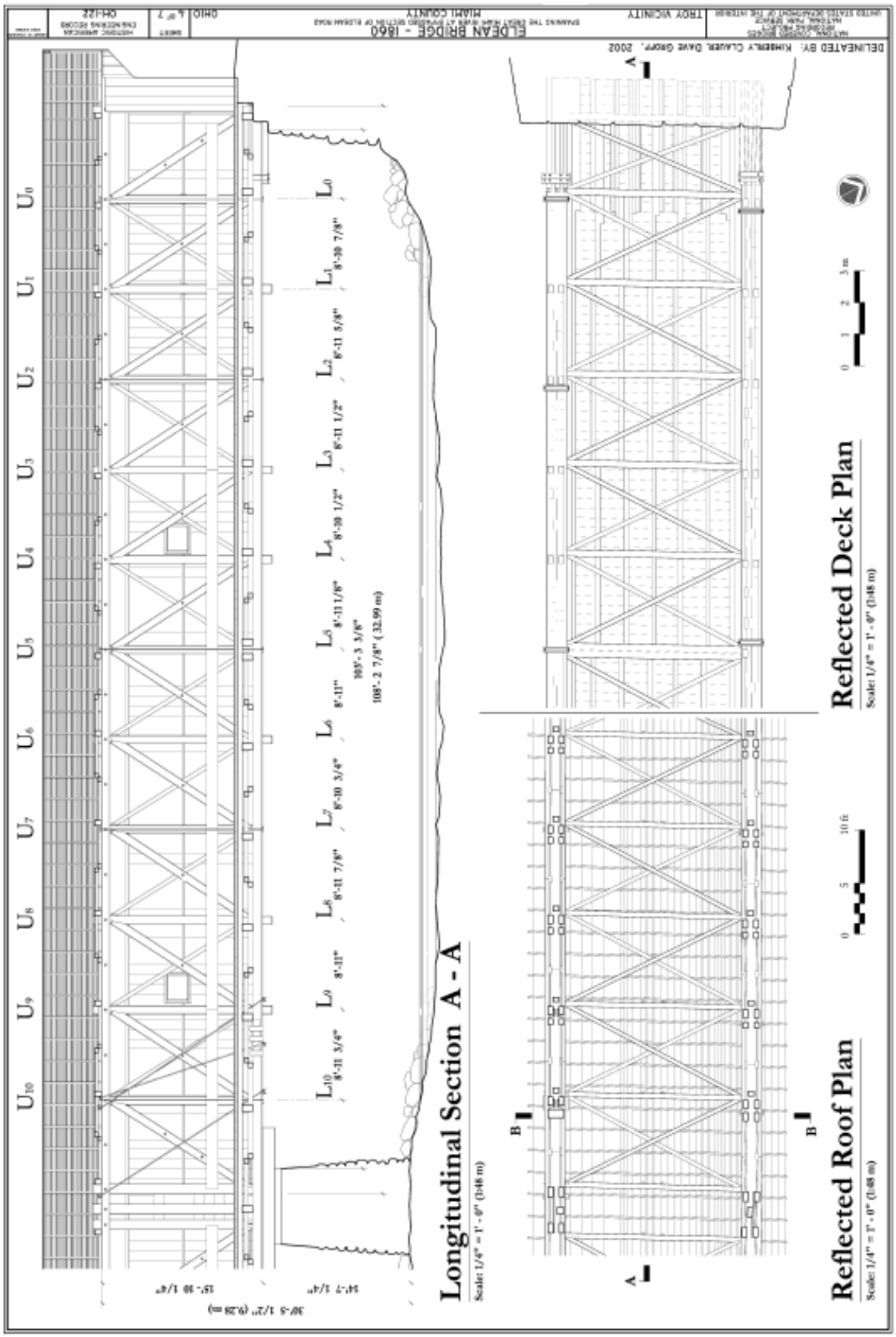
Burr Arch, 1884
Built by Elias McMellen
Spanning Octoraro Creek
Ashville & Forge Roads
Lancaster & Chester County, PA

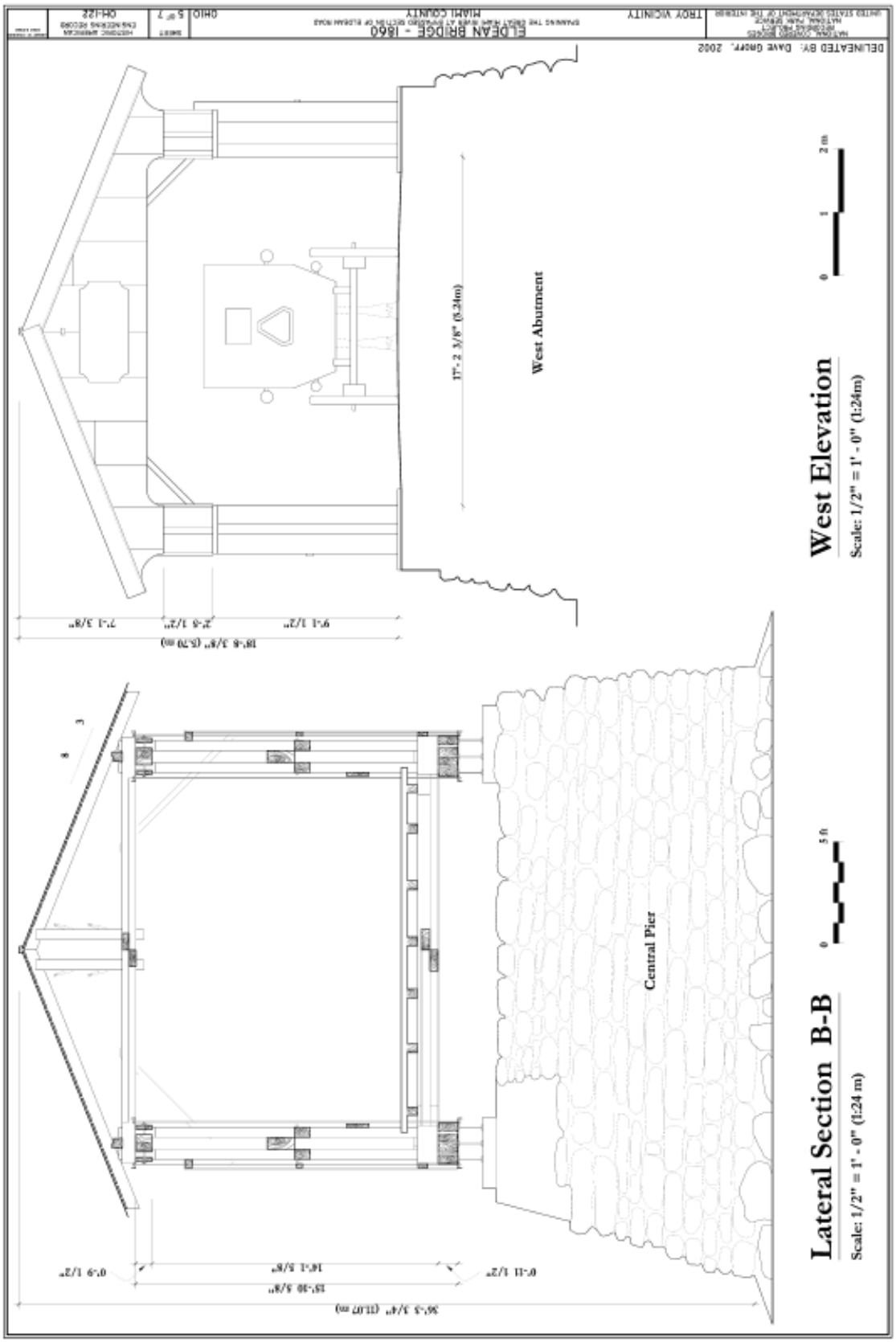
HAER No. PA - 586

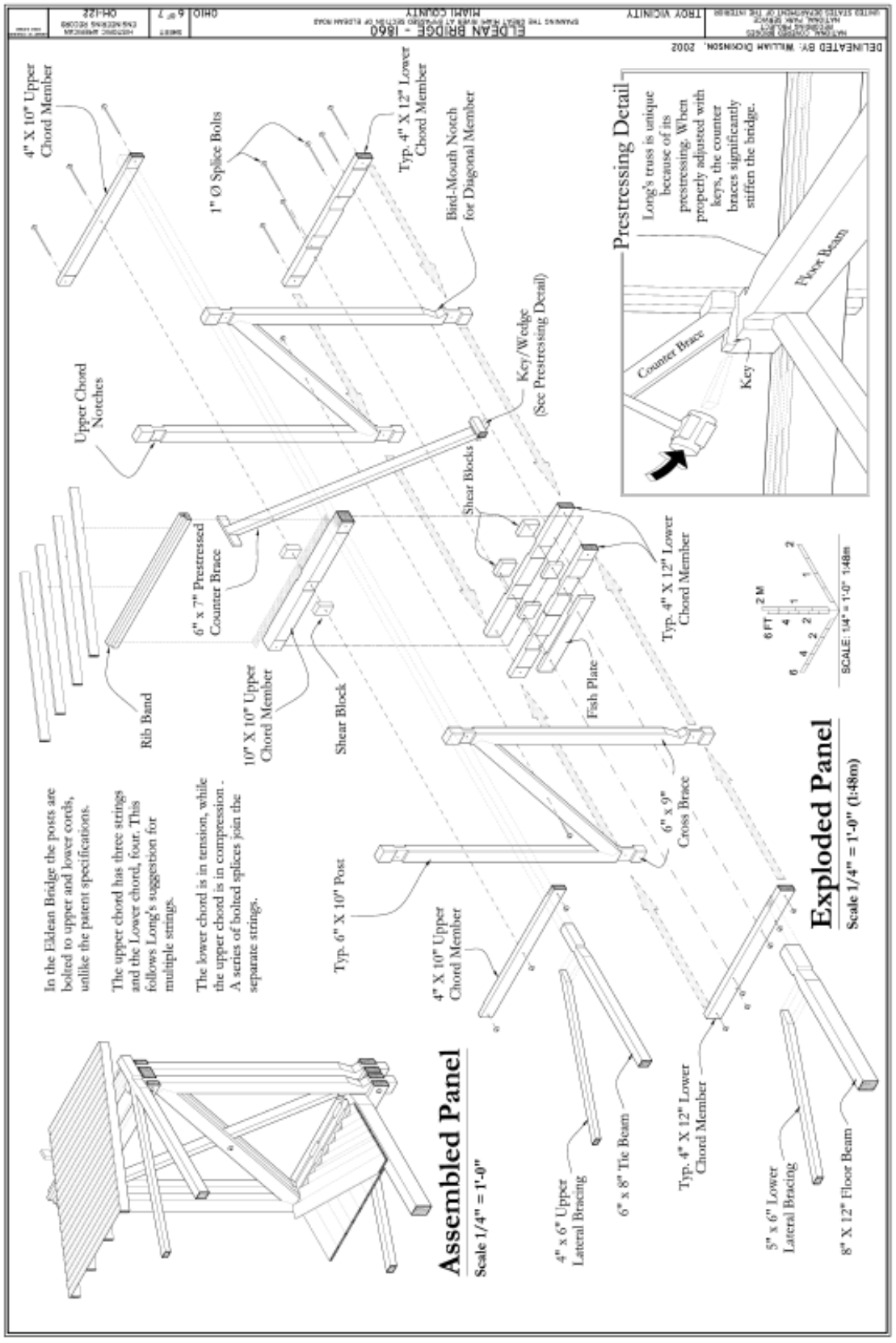
DELINEATED BY: CHARU CHAUDHRY, KIMBERLY CLAUER, VUONG DANG, WILLIAM DICKINSON, DAVE GROFF, NAOMI HERNANDEZ, 2002

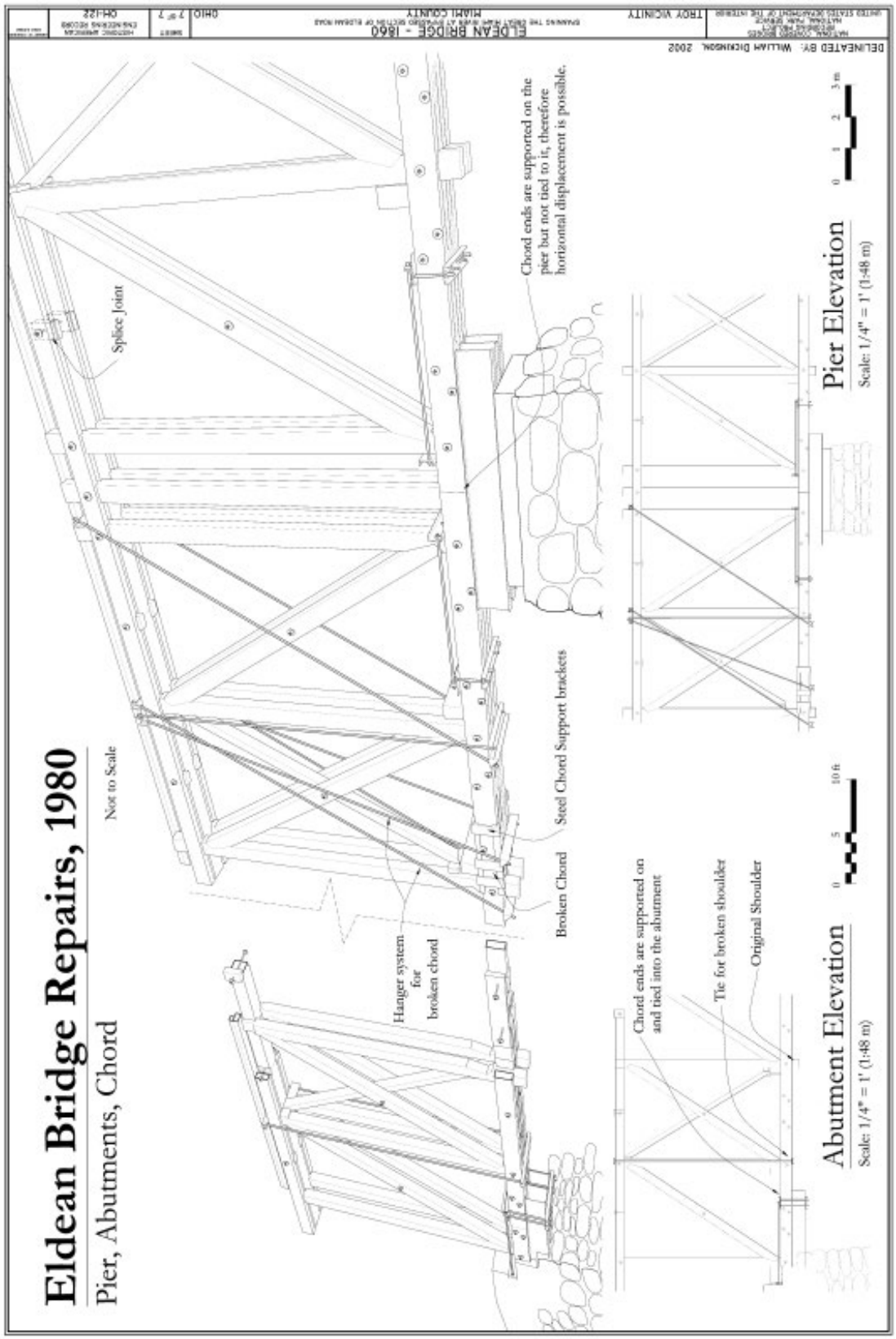
NATIONAL COVERED BRIDGES RECORDING PROJECT NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR	TROY VICINITY	ELDEAN BRIDGE - 1860 SPANNING THE GREAT MIAMI RIVER AT BYPASSED SECTION OF ELDEAN ROAD MIAMI COUNTY OHIO	SHEET 2 OF 7	HISTORIC AMERICAN ENGINEERING RECORD OH-122


North Elevation
Scale: 1/8" = 1' - 0" (1:96 m)
Deck Plan
Scale: 1/8" = 1' - 0" (1:96 m)
108'-0 1/2" (32.93 m)
218'- 10" (66.70 m)
108'- 2 7/8"
2'- 6 5/8"
20'-9 1/2"
(POST-TO-POST)
A
B
0 5 m
0 5 10 20 ft.


ELDEAN BRIDGE - 1860
MIAMI COUNTY
TROY VICINITY
DELINEATED BY: KIMBERLY CLAUSER, DAVE GROVE, 2002
Longitudinal Section A - A
Scale: 1/4" = 1' - 0" (1:48 m)
Reflected Roof Plan
Scale: 1/4" = 1' - 0" (1:48 m)
Reflected Deck Plan
Scale: 1/4" = 1' - 0" (1:48 m)
108' - 2 7/8" (32.99 m)
98'- 3 3/8"
14'-7 1/4"
15'- 10 1/4"
39'-3 1/2" (9.28 m)


ELDEAN BRIDGE - 1860
MIAMI COUNTY
TROY VICINITY
OHIO
OH-122
DELINEATED BY: DAVE GROVE, 2002
West Abutment
17'- 2 3/8" (5.24m)
West Elevation
Scale: 1/2" = 1' - 0" (1:24m)
Central Pier
Lateral Section B-B
Scale: 1/2" = 1' - 0" (1:24 m)


ELDEAN BRIDGE - 1860
MIAMI COUNTY
TROY VICINITY
OHIO
DELINEATED BY: WILLIAM DICKINSON, 2002
Prestressing Detail
Long's truss is unique because of its prestressing. When properly adjusted with keys, the counter braces significantly stiffen the bridge.
Floor Beam
Counter Brace
Key
Exploded Panel
Scale 1/4" = 1'-0" (1:48m)
Assembled Panel
Scale 1/4" = 1'-0"
In the Eldean Bridge the posts are bolted to upper and lower cords, unlike the patent specifications.
The upper chord has three strings and the Lower chord, four. This follows Long's suggestion for multiple strings.
The lower chord is in tension, while the upper chord is in compression. A series of bolted splices join the separate strings.
4" X 10" Upper Chord Member
1" Ø Splice Bolts
Typ. 4" X 12" Lower Chord Member
Bird-Mouth Notch for Diagonal Member
Key/Wedge (See Prestressing Detail)
Upper Chord Notches
Shear Blocks
6" x 7" Prestressed Counter Brace
Typ. 4" X 12" Lower Chord Member
Rib Band
10" X 10" Upper Chord Member
Shear Block
Fish Plate
Typ. 6" X 10" Post
6" x 9" Cross Brace
4" X 10" Upper Chord Member
4" x 6" Upper Lateral Bracing
6" x 8" Tie Beam
Typ. 4" X 12" Lower Chord Member
5" x 6" Lower Lateral Bracing
8" X 12" Floor Beam
6 FT 4 2 2 4 6
2 M 1 1 2
SCALE: 1/4" = 1'-0" 1:48m



NOTE: The repairs shown on HAER drawing sheet 7 were reversed during the 2005-06 rehabilitation.



ELDEAN BRIDGE. Perspective view to southwest.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-1].



ELDEAN BRIDGE. East portal elevation.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-2].



ELDEAN BRIDGE. Perspective of west portal.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-9].



ELDEAN BRIDGE. North elevation.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-8].



ELDEAN BRIDGE. Perspective view from east riverbank.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-3].



ELDEAN BRIDGE. Detail of west abutment.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-6].



ELDEAN BRIDGE. Interior view from east portal.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-10].



ELDEAN BRIDGE. Long truss detail.
Photograph by Jet Lowe, 2002 [HAER No. OH-122-13].



ELDEAN BRIDGE. Perspective view to southeast.
Photograph by Lola Bennett, 2012.



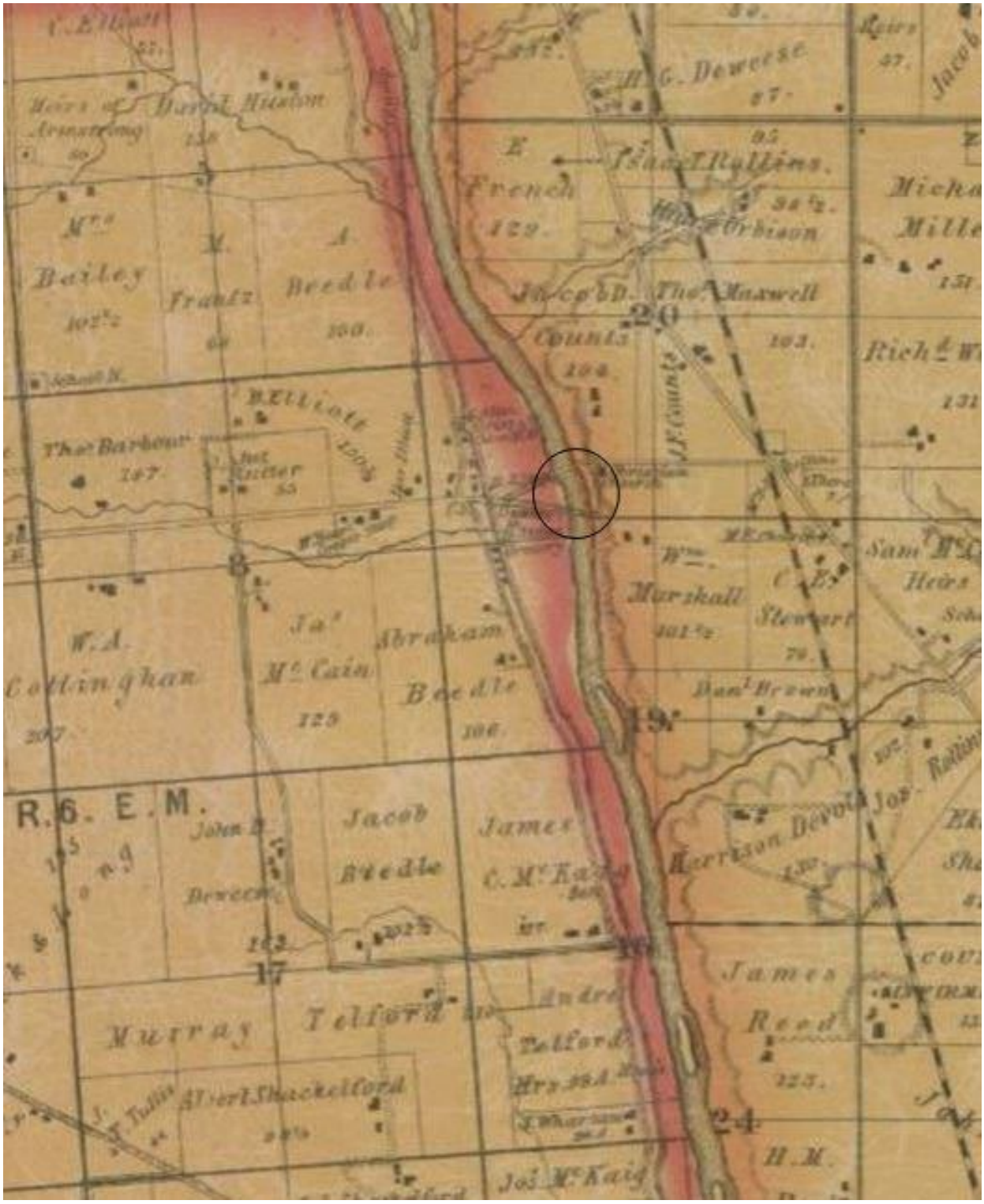
ELDEAN BRIDGE. Perspective view to southwest.
Photograph by Lola Bennett, 2012.



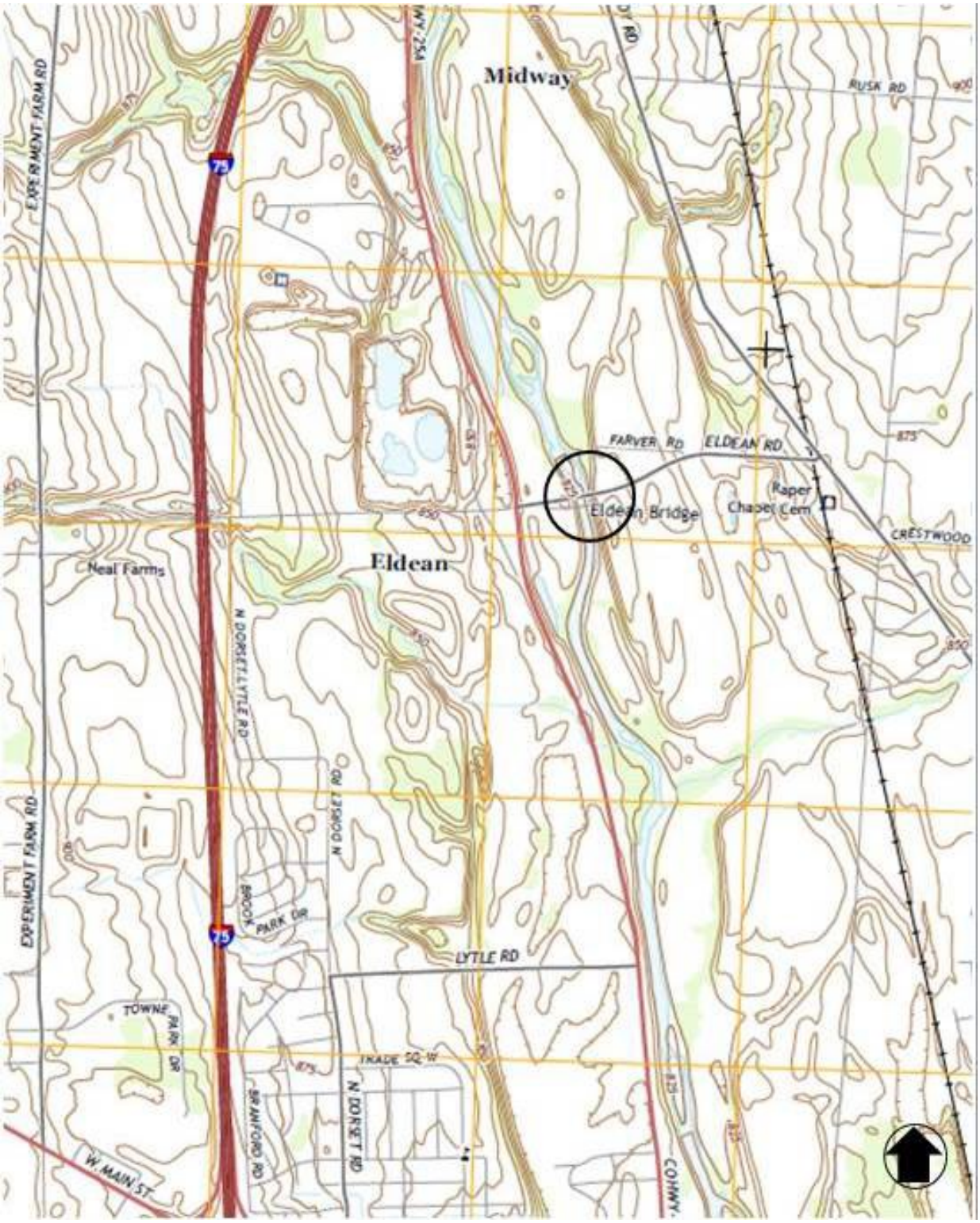
ELDEAN BRIDGE. Interior view of south truss.
Photograph by Lola Bennett, 2012.



ELDEAN BRIDGE. Truss detail, showing wedge under one of the counterbraces.
Photograph by Lola Bennett, 2012.



Detail of W. Arrott's 1858 "Map of Miami County, Ohio," showing bridge site near Allen's Mill.
Source: Geography and Map Division, Library of Congress.



Topographic map detail, showing Eldean Bridge location.
UTM Reference: 16.737345E.4440124N, WGS84 geodetic datum.
Troy, Ohio, USGS Quad., 7.5-minute series/1:24,000 scale, 2013.
Source: United States Geological Survey, U.S. Department of the Interior.