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Historic Bridge Bulletin

From the Director's Desk

The Historic Bridge Foundation would like to dedicate this issue to memory of Eric DeLony, who passed away on October 23rd.

For over four decades Eric worked tirelessly in support the preservation of our nation's cultural heritage of historic bridges. He provided a strong voice in support of policies and initiatives endorsing the preservation and management of historic bridges. His "call for preservation" through his documentation work at HAER and through his publications and seminars encouraged a broader appreciation of the value of bridges as links to transportation and engineering history.

Eric was a good friend of the Historic Bridge Foundation—introducing us to other pontists in our early days and serving on our Advisory Board for several years. Advocacy and education were at the core of Eric's passion for bridges and remains at the core of our mission. He will be missed, but not forgotten.

Kitty Henderson
Executive Director

In This Issue:

Eric DeLony visiting historic bridges. *Photos by Donnie Roberts/The Dispatch (Left) and Patrick Singleton (Right).*

November is Historic Bridge Awareness Month

Take time this month to visit, advocate for, and support historic bridges!

North elevation of the Union Chain Bridge. Scotland is to the right; England is to the left. *Photo by Nathan Holth.*

United Strength is Stronger:
Linking England and Scotland with Captain Samuel Brown's Union Chain Bridge

By Edward Cawthorn

The Tweed is a beautiful river throughout its length and the scene at Union Bridge is nothing less than idyllic.

-------- Edward Grierson, The Companion Guide to Northumbria

Hidden down two country lanes in the Berwickshire parish of Hutton in Scotland and the north Northumberland ward of Norham and Islandshires in England, unsuspecting visitors come suddenly upon a historic bridge of the most graceful design and proportions: the Union Chain Bridge, the oldest suspension bridge in the world still used by vehicles.

The River Tweed at Scotch New Water has seen all manner of activity over the past millennium. In the 13th century, Clarabad de Esseby, Knight of Huntingdon, granted rights to the monks of St. Abbs in Scotland to fish with nets at this spot, and salmon netting continued there for over 700 years. In 1639, Charles I camped there with an army on the English side, in preparation for a confrontation with the Scottish Covenanters. In addition, the ford at New Water Ford, just 200 yards downstream from the site of the bridge—which drew Charles to that spot—was one of the few manageable crossing points between the nearest bridges at Berwick, built in 1611, and Coldstream, built in 1766, although it was a difficult crossing that was treacherous during floods.

The increasing demand in the late 18th century in the Berwickshire Merse for coal and lime from the pits and kilns of north Northumberland necessitated laborious wagon treks via Berwick or Coldstream

View looking east showing the arched tower and the small anchorages in front. *Photo by Nathan Holth.*

The east end of the bridge has no free-standing tower. Instead, a stone structure built into a natural cliffside serves as both tower and anchorage. The road turns to the right here. *Photo by Nathan Holth.*

Detail showing the original loop-forged eyebar chains and the two-pin cast iron connectors that were typical of early eyebar chain suspension bridges. *Photo by Nathan Holth.*

View on the bridge showing the 1902 wire cable on the top, the three rows of original paired eyebar chains below, and at the bottom the railing which is carefully designed to fill in the changing gap between the chains and the roadway. Forged openings in the horizontal railing rods allow the vertical rods to pass through. *Photo by Nathan Holth.*

if the river fording points were not negotiable. This led the Berwick and North Durham Turnpike Trustees to seek parliamentary approval for a new bridge in the vicinity of New Water Ford at the turn of the nineteenth century. In 1818, retired Royal Naval Captain Samuel Brown, who had designed and patented iron chains, was commissioned by the Trustees to design and build a "bridge of suspension" over the river at this point. This was an extraordinarily adventurous decision on the part of the Trustees, as no bridge using iron bar chains instead of cables, or of this size and specification, had previously been attempted in the United Kingdom. Although Thomas Telford's Menai Bridge was started slightly earlier, the Union Bridge, using chains in a new design patented by Brown in 1817, was completed in July 1820, while the Menai Bridge was not completed until 1826. The Union Bridge was therefore the first suspension bridge in Europe built to accommodate vehicular traffic, with a then record-breaking span of 137m/449ft and at a cost of just £7,700 ($9,832), about one-third of the cost of a traditional masonry bridge. The link bars forming the chain are no more than 2in (5cm) in diameter and, as the architectural historian Nikolaus Pevsner remarks, are almost invisible against the darker waters of the Tweed from a distance. For a considerable part of its life, the bridge was painted white, which gave the bridge an extraordinarily ethereal appearance. Since the 1980s,

South elevation of the Union Chain Bridge. Note the assymtrical layout of the main eyebar chain system, since the west (left) end has a tower and anchorage, while the east (right) end has only an anchorage, and at that end the eyebar chains do not rise to the same elevation as the end with the tower. *Photo by Nathan Holth.*

when the original color scheme was re-discovered, the bridge has been painted predominantly green and grey.

The original site selected by the Trustees and Captain Brown for the new bridge was some 200 yards downstream from the present site and significantly lower at New Water Ford. This would have proved disastrous and the bridge would undoubtedly have been destroyed in the first serious flood. The present higher location accounts in no small measure for the bridge's extraordinary survival, while other similar designed bridges that were built later have long-since been replaced.

The bridge has undergone major repairs on four occasions: in 1871-2 when the Turnpike Trustees carried out extensive repairs; in 1902 when the Tweed Bridges Trustees, who took over responsibility for the Union Chain Bridge (and the other River Tweed bridges Norham and Coldstream that joined the kingdoms of England and Scotland when turnpikes were abolished) and strengthened it by the addition of a wire cable above the chains; in 1974 when the Trustees again carried out major renovation/ repair and replaced the decking with anti-skid plywood panels which are still in place but showing considerable signs of wear; and between 1979 and 1981 when the majority of the links and pins in the chains were replaced.

Some ten years ago, one of the hangers supporting the deck from the chains sheared and the bridge was closed for 18 months. At that time, as a condition of consent for the use of steel rods as temporary hanger replacements (they are still there), English Heritage required the Scottish Borders Council and the English

A view on bridge facing toward England (east). *Photo by Nathan Holth.*

This photo shows the timber decking and floorbeams of the bridge. The floorbeams also include metal tension rods. *Photo by Nathan Holth*

Northumberland County Council (the current joint owners) to prepare a detailed management plan for the repair and restoration of the Union Chain Bridge. Delays in the implementation of the 2010 plan led to the formation of a local action group, Project 2020, to the restore the bridge by July 2020. As a result, the Friends of the Union Chain Bridge, a charitable organization registered in Scotland and England with over 650 members, was formed to demonstrate community support for a bid to the UK Heritage Lottery Fund ("HLF") for assistance towards the substantial cost to the complete the repair and restoration of the major components of the bridge (the chains, hangers, decking, towers and anchors). While controversial, the 1902 wire ropes will be removed as part of the restoration. Against strong competition from other heritage schemes throughout the UK, a grant of £360,000 ($460,000) was awarded in 2017 to enable the project to be developed to the second stage of the bidding process in 2019, when a grant of some £2.5m ($3.2m), towards an overall cost

A view looking west at the bridge, taken from the lower ledge of the east anchorage. *Photo by Nathan Holth.*

of £7.3m ($9.3m), would allow the full restoration program to move forward so that this unique engineering icon can be fully restored to its original splendour for a further 200 years.

On its completion in 1820, our forefathers, the Turnpike Trustees, arranged for cast plaques, bearing the intertwined rose and thistle symbols of England and Scotland above the motto "Vis Unita Fortior", to be placed high on the towers on each side of the river. The message conveyed by those plaques, United Strength is Stronger, remains as valid now as it did two hundred years ago.

View beside the bridge facing southeast toward England. *Photo by Nathan Holth.*

New friends are always welcome to provide support for this remarkable structure at www.unionbridgefriends.com. A new definitive book by Gordon Miller and Stephen K. Jones on the history of the bridge, Captain Sam Brown's other engineering projects, and the chain-making firm of Brown Lenox whose Pontypridd works in Wales supplied the ironwork for the bridge, is also available from the Friends of the Union Chain Bridge.

Edward Cawthorn, a founder, trustee, and honorary secretary of The Friends of the Union Chain Bridge, has lived next to the bridge for the last forty years.

The Making of "Iron Bridge" Road in Pike County, Indiana:

William T. Washer, the Smith Bridge Company, and Bridge #150

By James L. Cooper

As was their practice, the Pike County Board of Commissioners authorized two of its members – Patrick McNabb and Herman Henke – to build a bridge across the Patoka River on the Surphur Springs and Augusta Road in June 1875. Within a month, the board adopted plans and specifications drawn up by A. H. Miller for "the Iron Arch Bridge No. 1, Smith Bridge Company, Toledo, Ohio."[1]

On the 5th of September, the board received construction proposals for the bridge "at or near SW of NE quarter of Section 2, Township 2 South, Range 7 West." The commissioners promptly awarded a construction contract to W. T. Washer of Troy, Perry County, for the stonework at $6.75 per perch[2] "upon which is to be placed Smith Patent Wrought Iron Open Arched Bridge at $22 per [lineal] foot."[3] The County Auditor then transcribed detailed specifications for the substructure and superstructure along with the Articles of Agreement with Washer into the "Commissioners Record."[4]

The specifications for the bridge show quite a bit of collaboration between the parties. "The rock to be used in the building and construction of the work aforesaid [i.e., abutments and wing-walls] shall not be less than twelve inches in thickness, to be well

Bridge #150. *Photo by Nathan Holth.*

jointed, and the face of the abutments and wing-walls are to be dressed the same as rocks are dressed on the Postlelhwait Mill Bridge on Patoka River in Dubois County." Washer is generally credited with constructing the referenced Postlewaite Covered Bridge in 1872.[5] Furthermore, the commissioners acknowledged in the Articles of Agreement that the specifications for the superstructure were "submitted by the said W. T. Washer."[6]

Construction of the iron bridge was to be completed by January 1876. In December 1875, Washer received a partial payment of $1,000 for work on the Patoka River Bridge. In March 1876, he received another partial payment of $120 plus $2,943.50 as the "balance [of] compensation for building an Iron Bridge across Patoka River per contract."[7]

The bowstring soon became a notable Marion township monument. In June 1877, for example, when residents petitioned for a change in the road carrying the bridge, they had already informally renamed the Sulphur Springs and Augusta road as "the Iron Bridge and Augusta road."[8] The commissioners also kept a close watch on the bowstring. In August 1889, they ordered the Marion township trustee to give notice to the parties who built a dam across the Patoka River "at the iron bridge in said township" to remove same or suit would be brought by the county "so that the dam will not damage said bridge or its abutments."[9]

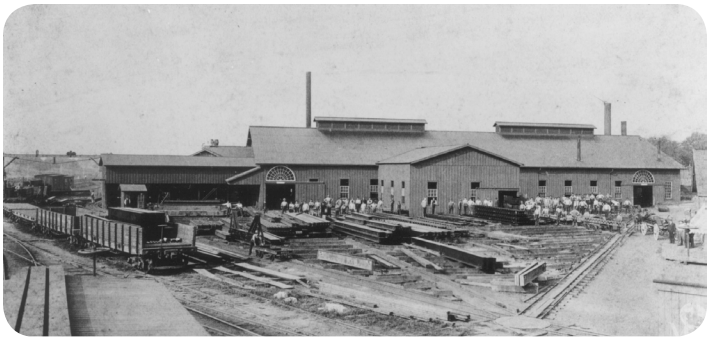
The significance of the Patoka River iron bridge extends well beyond nineteenth-century Pike County, Indiana. The county's consulting engineers were correct to consider this "a unique structure of historical importance."[10] The bridge was also determined "SELECT" in the Indiana statewide historic bridge inventory.[11]

This is the only surviving example of the Smith Bridge Company's "Open-Arch" Bridge design in Indiana and possibly in the United States. It was, furthermore, built by William T. Washer, "a celebrated contractor and bridge-builder" across southwest Indiana and north central to northwest Kentucky in the last half of the nineteenth century.[12] The Patoka River Bridge reveals ways in which both its designer and its builder each shifted efficiently and collaboratively between timber and iron as bridge materials and with production and erection increasingly mechanized and specialized concentrating on bridges.

Robert W. Smith and the Smith Bridge Company

Bridge-building in the Midwest in the second half of the nineteenth century incorporated design, fabrication, and construction-erection in a very competitive process. From the start, Smith relied on efficiency in design and production to generate least-expensive bids.[13] As a young carpenter, he and his brother set up a woodworking machine shop and lumberyard in Tippecanoe City, Ohio, and reportedly invented a system of self-supporting roof trusses for barns. When he focused on bridge work, Smith designed and secured a patent (1867) for a double-intersection Warren truss in timber and two years later (1869) for roofing and lateral bracing systems.[14] Smith's timber truss design was not frozen in his patents. Indeed, he continued to develop his design

Robert W. Smith. *Photo courtesy of Miriam Wood.*



Smith Bridge Company factory . *Photo courtesy of Miriam Wood.*

into what some analysts have categorized as four types of Smith trusses.[15]

First organized as the R. W. Smith & Company partnership, the business moved in 1867 to Toledo, Ohio, where better rail transportation was available both for supplies of timber and iron and for shipment of pre-fabricated superstructures. In Toledo, it was formally incorporated as the Smith Bridge Company.[16] While many bridge designers and fabricators concentrated exclusively on the more traditional timber-truss patterns, others opened for business as exclusively iron designers and fabricators. The Smith Bridge Company of Toledo and the Massillon Bridge Company of Massillon, Ohio, on the other hand, worked in both timber and iron. Smith started in iron fabrication by 1870.[17]

Much of Robert Smith's success in both timber and iron was due to his inventiveness in industrial machinery, including "a gaining-machine, which does the work of 15 men," "a process for making a steel eye-bar," a "rotary saw, for making the joints of bridge-chords," "and a multiple punch, by which six pieces of iron can be punched at one operation."[18]

The Pike County Patoka River Bridge provides a relatively rare opportunity to detail some of the ways in which Robert W. Smith and his associates explored their way from efficient timber to efficient iron design and fabrication.

View illustrating the arched top chord of the bridge. *Photo by Nathan Holth.*

Smith's Wrought-Iron, Open-Arch Bridge, No. 1

The Patoka River bowstring was to have a clear span of 90-feet and be 93-feet "full" with a 14-foot roadway built "in accordance with accompanying plans and following specifications":

Arched Top Chord

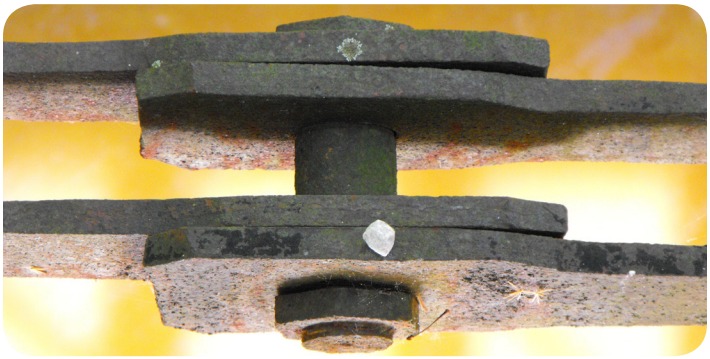
The chords were to be constructed "in straight sections of panel length, and when joined together, the ends of the sections will form a true segment of a circle." Each section was to consist of two pieces of 7-inch channel bar "placed edgewise" and 10-inches apart with flanges outward. By creating an arch from short, straight sections of rolled iron rather than heating and bending sections, Smith followed the straight-section principle he applied to his timber design. In both cases, it simplified construction without sacrificing strength.

The arched-chord channels were to be held apart and in line "by continuous trussing, consisting of a flat bar of iron ½ by 2.5 inches, placed edgewise between the channel bars, bent into zigzag shape and riveted firmly at its angles to the respective channel bar alternately." The ends of the sections were to be planed "to a perfect surface at angles corresponding to the radii of the arch, and when placed in position form tight perfect joints which are secured by plates firmly riveted."[19]

The "continuous trussing" did require a fair amount of metal heating and bending, but was probably simpler to fabricate than a multitude of separate lacing bars and would require fewer rivets per foot of chord. It was also likely quicker and cheaper to install, although it may be a bit less strong.

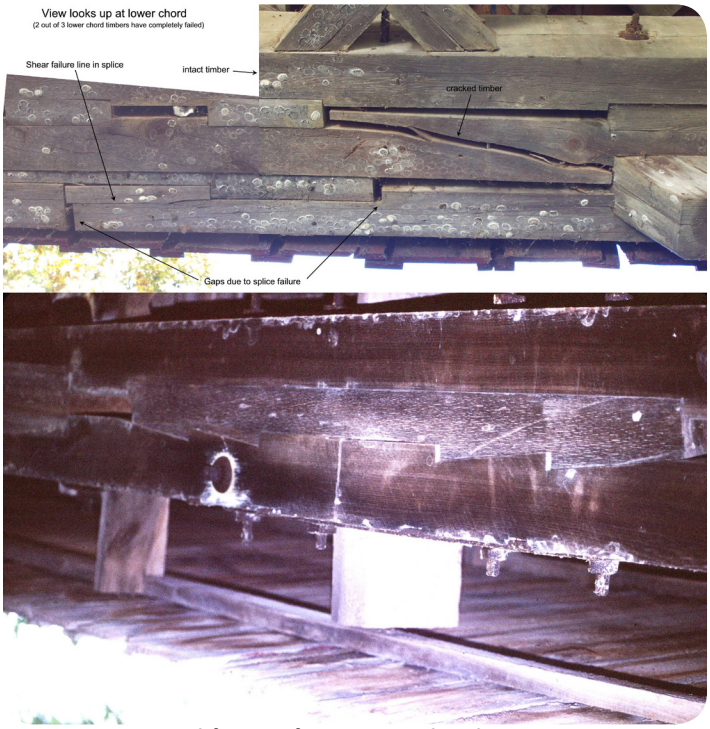
Detail showing the "continuous trussing" in the chord. *Photo by Nathan Holth.*

Above: Red circles show where the pins on the lower chord occur. Below: Lower chord pin connection detail. *Photos by Nathan Holth.*



Lower Chord

Each lower chord consisted of two runs of "flat bars of iron 5/8 by 4-inch." "At all splices the ends of all the links are enlarged to receive pin holes and have [the] same sectional area of iron as elsewhere." Round iron pins of 2-inch diameter join the four "links" of lower-chord eye-bar runs.[20]



Top: Cataract Bridge under restoration in 2004. Bottom: West Union Bridge, Parke County. *Photo courtesy Barker Engineering.*

That pinning does not occur at panel points nor include truss web members is unique among Indiana's metal-truss superstructures. Smith may have carried over the practice of "splicing" lower-chord members between rather than in panel points from timber-truss design where sections of a run were typically connected with blocks or fish-plates.

In the lower right hand images are two examples of intra-panel splices in timber trusses. In the top photo can be seen Smith's use of spice blocks to connect a lower-chord run on the Cataract Bridge in Owen County. The bottom photo illustrates J. J. Daniels' use of fish-plates for the same function in the West Union Bridge in Parke County. Both employ intra-panel joints. Also note Smith's search for efficiency in the simplicity of his splice blocks compared with Daniels' more elaborate fish-plates.

The specifications for the Patoka River Bridge do not describe the point of bearing where the top and lower chords meet. At span-end, the lower chord plates have been shaped as round and threaded rods which pass through a cast-iron plate placed at the end of the top-chord channels. The rods are then bolted for adjustment to keep the top chord's designed circumference true.

Detail of bridge shoe where top and lower chords meet. *Photo by Nathan Holth.*

Posts

The specifications called for 2.5-inch "Star iron with thread cut on each end."

The lower end passes between the pairs of lower-chord eye-bars and through a cast-iron shoe where secured by adjustable "jam nuts above and below."

Top: Upper end of vertical posts. Bottom: Lower end of vertical posts. *Photos by Nathan Holth.*

Top: Upper end of diagonals. Bottom: Lower end of diagonals. *Photos by Nathan Holth.*

The upper end passes though a "cast block placed between the channel bars of the arch with jam nuts above and below."

Diagonal or Tie Rods

Round iron rods supplied the truss diagonals. Their dimensions varied by location. The specifications called for "the upper ends" to be "looped round upper end of posts." The "lower ends" were to pass between the pairs of lower-chord eye-bars, "through cast shoe beneath and adjusted and secured by threat and nut." [lower left] In practice, the upper ends of the diagonal rods were also threaded, passed through cast blocks, and were secured with nuts.

Perpendicular brace beams that extend beyond the trusses and anchor the sway braces. *Photo by Nathan Holth.*

Details of the sway bracing connections on the bridge. *Photos by Nathan Holth.*

"Brace Beams" and Lateral Bracing

A pair of "overhead girders" form "brace beam[s]" running perpendicular to the roadway and riding on the lower chord adjacent to lower panel points 4 and 6. The "brace beams" extend beyond the trusses to anchor sway braces. According to the specifications, the girders consist "of two parallel flat bars of iron [½ by 3 inches], held apart and in line by continuous zigzag trussing [3/8 by 2 inches] riveted at its angles to each side alternately."

A sway or "diagonal brace" of "Star iron" extends from each outer end of a "brace beam," through which the Star's threaded lower end is bolted [above, top] "up to the arch" where the Star iron end has been forge-welded into an eye and bent to enter a post and, through the post, the upper panel point's cast-iron block [above, bottom].

Round 3/4-inch iron rods with threaded ends originally supplied lateral bracing. The rods extended diagonally between the lower panel points of the trusses, passed through the cast-iron blocks there, and were secured with nuts.

Floor Joists

"To be of oak 3 by 10 inches laid on [the lower] chords 2-feet apart."

Flooring

"To be of oak lumber 2 1/4-inches thick and laid diagonally."

From the bracing through the joists and the flooring, the specifications made no reference to floor-beams – members typically found on metal-truss superstructures. In metal-truss structures floor-beams provided some lateral stability and supported runs of stringers which in turn helped to carry the roadway above. Smith's "overhead girders" or "brace beams" did add some lateral stability but had nothing directly to do with supporting the roadway. Instead, the oak floor joists which ran perpendicular to the roadway at 2-foot spacing picked up the floor-beam function in deck support – much as found in Smith's and in many other timber-truss bridges. Thus the Smith Bridge Company's "Wrought-Iron, Open-Arch Bridge" design was transitional in that it incorporated a number of elements it regularly employed in timber-truss design as well.[21]

Capacity of Bridge

"Per W. T. Washer," the Smith Bridge Company "warranted" this Wrought-Iron, Open Arch Bridge "to sustain a test of 1,800 lbs. per lineal foot, exclusive of its own weight, without subjecting the iron to a greater strain than 1/5 of its ultimate strength."[22]

The cast and wrought iron in the structure was "to be thoroughly painted with two coats of mineral paint and linseed oil."

William T. Washer

Although Washer was a well-known bridge-builder in southwestern Indiana and in north-central and northwest Kentucky in the last quarter of the nineteenth century, his reputation rather quickly

faded from view after his death in 1901. He has been best remembered in covered bridge circles. But even the dean of Hoosier covered bridge history, George Gould, reported that "little is known about William T. Washer, except for the covered bridges he built in southwestern Indiana." "He built at least 20 covered bridges which, I believe, included the eight in Evansville over Pigeon creek."[23] Gould was, however, sure of Washer's paternity for only nine of the 20 bridges he noted.[24]

Like Robert W. Smith, Washer began his career as a carpenter and soon moved into bridge-building. Both understood the benefits of efficiency for successful contracting in the second half of the nineteenth century. Smith focused on design and fabrication. Washer, on the other hand, concentrated on contracting – i.e., on the building of bridge substructures and the erection of superstructures– and depended on others for their design and fabrication. In this increased specialization of function, Washer moved ahead of most nineteenth-century builders of timber bridges and towards twentieth-century practice.

Born in June 1829, William T. Washer by age twenty worked as a carpenter in Troy township of Perry County, Indiana, and quickly became a community leader. When Troy was reincorporated in 1859, Washer was named trustee. In the same year, he became an officer at the founding of the local masonic lodge.[25]

As the bridge under consideration illustrates, Washer did not always work in timber. That the Smith wrought-iron bowstring was erected within a year or two of the three Smith timber-truss superstructures Washer is credited with erecting in Gibson County is more than coincidence. Washer's relationship with the Smith Bridge Company during the second half of the 1870s was, indeed, close. He allied himself with Smith's design and productive efficiencies in fabrication.

Washer's versatility, extended marketplace, and relationship with the Smith Bridge Company were also noted in passing in two court cases that reached the U. S. Supreme Court.[26] Washer received a contract from Bullitt County, Kentucky, to build a stone arch bridge over Pond Creek on the Jefferson County line in July 1878, and he went to court to secure pay for the construction.[27] According to the court decisions, the

A view on the roadway of the bridge. *Photo by Nathan Holth.*

Smith Bridge Company reportedly supplied materials valued at $340.75 for the Pond Creek Bridge.

Washer did a fair amount of bridge masonry along with the erection of superstructures. His name can be found along with date (1874) on a nameplate on the stone abutments of the Dry Run Bridge on Wyandotte Avenue in Crawford County. He is also known to have received contracts for stone work in Vanderburgh County.[28] Son Edward, who rose to virtual partnership in the family business, was designated in the 1880 federal census as a "stone mason."[29]

Washer was by no means tied exclusively to the Smith Bridge Company. In the 1890's after Smith sold his company, and it was transformed into the Toledo Bridge Company, "W. T. Washer & Son of Troy, Indiana" switched his informal partnership to the Indiana Bridge Company. He signed 21 contracts for metal bridge superstructures and parts with Muncie metal designers and fabricators. These included from 1892 through 1898 a couple of through-truss structures, a number of ponies, a "cantilever leg," some "beam girders," and a few sets of metal caissons.[30]

Not surprisingly, Washer had expanded the definition of his work from "carpenter" to "bridge-builder" by the time the1900 census-taker arrived on the family doorstep.[31] Still, we know only a piece of what this builder constructed. His work in Kentucky remains largely unknown, and his erection of timber, stone, and metal bridges in Indiana only partly documented. Fortunately, Pike County Bridge #150 remains as a testament to the invention and fabrication of the Smith Bridge Company,

the craftsmanship of William T. Washer, and the efficiencies of each in and through their specialization.

Recommendations

Pike County Bridge #150 has survived due to the repairs and rehabilitations undertaken over the years by the county authorities. In December 1908, for example, the commissioners decided to refloor "The Iron Bridge" over the Patoka River near Survant. John Survant received a contract to lay new oak joists (12-inches wide by 2-inches thick by 16-feet long) on centers 12-inches apart.[32]

The major rehabilitation occurred in 1978 when the original stone abutments were encased in concrete, some rolled steel stringers added, and more external sway braces welded on. The county also built a timber structure above steel beams seated on raised abutment ledges. Placed inside and somewhat above the old iron superstructure, the new one reduced the roadway to a width of 10 feet and 2 inches.

Not surprisingly, Pike County finds Bridge #150 an issue for contemporary traffic and wishes to replace it for vehicular use. The best preservation alternative would be to remove the whole assemblage from the Patoka River, recycle the 1978 additions, repair the original cast and wrought iron, relocate the superstructure to an appropriate pedestrian trail location, and rebuild the timber deck and roadway to the original specifications. As James Barker has suggested, the old superstructure restored to original strength should meet AASHTO standards for pedestrian loading. And, without modern add-ons, the superstructure will fully display the special and rare Smith Bridge Company design, originally erected by the once highly respected builder, William T. Washer.

Notes

[1] In September, Miller was paid $15 for his specifications for the "Patoka River Bridge." Pike County, "Commissioners Record," J: 252, 255, 277.

[2] A "perch" is 1.5 feet wide by one foot high by 16.5 feet long, equaling 24.75 cubic feet.

[3] Robert Smith only had one iron bridge patent to his name: #339,492 was granted in 1886, more than a decade after Pike #150 was built, and dealt with improved ways of forming the "eyes" at the ends of eye-bars. Smith did not receive a patent, at least in his own name, dealing with any sort of arch or bowstring truss bridge. There was, furthermore, no reference to a patent in the Smith Bridge Company specifications for the Patoka River bowstring.

[4] Pike County, "Commissioners Record," J: 279, 281-286.

[5] George Gould, *Indiana Covered Bridges Thru the Years* (Indianapolis, 1977), 31-32, 50; Wayne M. Weber, *Covered Bridges in Indiana* (Midland, Michigan, 1977), 63.

[6] Pike County, "Commissioners Record," J: 285.

[7] Pike County, "Commissioners Record," J: 347, 377, 385.

[8] The petitioners were quite specific about the location of the road: beginning in S2/T2S/R7W and heading south into S11 and then west to Patoka township. Pike County, "Commissioners Record," K: 48, 56-57.

[9] Pike County, "Commissioners Record," O: 418.

[10] United Consulting Engineers, Inc., *Bridge Reinspection Report for Pike County, Indiana* (Indianapolis, 1980).

[11] Mead & Hunt, *Indiana Historic Bridge Inventory: List of Select and Non-Select Bridges* (December 2010), 4: 3-34.

[12] Interstate Publishing Co., *History of Daviess County, Kentucky* (Chicago, 1883), 435-436.

[13] Mark Brown & Matthew Reckard, "Cataract Bridge: Historical Background" (J. A. Barker Engineering, Inc., 2001, rev 2002); Matthew Reckard, P.E., "Smith Trusses: Bringing Covered Bridges into the Industrial Age" (J. A. Barker Engineering, Inc.).

[14] Robert W. Smith, "Improvement in Bridges," U.S. Patent No. 66,900 (July 16, 1867);

"Improved Bridge," U.S. Patent No. 97,714 (December 7, 1869).

[15] Ray E. Wilson, "The Smith Patented Truss," *Indiana Covered Bridge Society Newsletter*, April 1966: 1, 3, 4; Ray E. Wilson, "The Story of the Smith Truss," *Covered Bridge Topics* (National Society for the Preservation of Covered Bridges), April 1967: 2, 3, 5; Ray E. Wilson, "More on Smith Truss Bridges," *Indiana Covered Bridge Society Newsletter*, January 1972: 2.

[16] Robert W. Smith sold out to a group of investors in 1890 who reorganized the operation into the Toledo Bridge Company. Toledo Bridge sold out in 1901 to J. P. Morgan and were incorporated into the American Bridge Company.

[17] The author's extensive but nonetheless incomplete research notes shows the Smith Bridge Company engaged in 26 bridge contracts in Indiana, of which 15 were for timber-trusses and 11 for iron.

[18] Clark Waggoner, ed., *History of Toledo and Lucas County, Ohio* (Munsell & Co., New York, 1888), 786-787.

[19] Pike County, "Commissioners Record," J: 283.

[20] In 1886 – more than a decade after the Patoka River Bridge was constructed – Robert W. Smith did receive a

U.S. patent (#339,492) for manufacturing eyes for steel eye-bars by working wrought iron into the eyes. Here again Smith was concerned with efficiency and with the newer material, steel.

[21] The Massillon Bridge Company, the other Ohio designer-fabricator who also build in timber and iron, also carried over some elements of its timber design into its iron bowstring. Joseph Davenport's patented "Wrought Iron, Howe Truss Arch" has some of the same elements as Smith's "Open-Arch."

[22] Emailed letter of James A. Barker to James L. Cooper, 26 August 2013.

[23] George E. Gould, *Indiana Covered Bridges Thru the Years* (Indianapolis, 1977), 18.

[24] Gould's list of structures attributed to Washer:
Perry-Spencer Co. line: Huffman Mills & Shoals
Posey Co.: Grafton, Solitude, New Harmony
Pike Co.: Pikeville & Winslow (?)*
Dubois Co.: Kessner's (?) & Postlewaite (?)**
Gibson Co.: Old Red, Moore & Wheeling
Vanderburgh Co.: eight in Evansville (?)
*Indeed, H. J. Dare, not Washer, secured the construction contract for the Winslow Bridge in September 1877. Pike County, "Commissioners Record," K: 119-126.
**References in the Specifications cited above rather confirm Washer's construction in this case.

[25] Troy Township, Perry County, Indiana, 1850 federal census, 367b; Thomas J. De La Hunt, *History of Perry County, Indiana* (W. K. Stewart Co., Indianapolis, 1916), 113, 120.

[26] Washer v. Bullitt County, 110 U.S. 558 (1884); Bullitt County v. Washer, 130 U.S. 142 (1889). Both cases concerned the same bridge.

[27] Bullitt County is located south of Louisville towards the center of the state.

[28] Vanderburgh County, "Commissioners Record," D-1: 307, 312-314,

[29] Troy Township, Perry County, Indiana, 1880 federal census, 67a.

[30] Contracts 730, 1838, 2004, 2012, 2178, 2310, 2310 1/3, 2310 ½, 2311, 2331, 2359, 2519, 2520, 2526, 2983, 3028, 2028 1/4, 3028 ½, 3109, 3110, 3110 ½, "Client Index," Indiana Bridge Company (Drawings Archives, School of Architecture, Ball State University).

[31] Troy Township, Perry County, Indiana, 1900 federal census, 5b.

[32] Pike County, "Commissioners Record," T: 159-161.

James L. Cooper, professor emeritus of history at DePauw University, is a bridge historian who specializes in the history of Indiana's bridges. He is the author of several books about historic bridges, and has been a consultant for the Indiana Division of Historic Preservation and Archaeology, Historic Landmarks Foundation of Indiana, and past board president for the Historic Bridge Foundation.

Call For Papers: SIA 48th Annual Conference, Chicago, 2019

The Society for Industrial Archeology invites proposals for presentations and poster displays at the **48th Annual Conference in Chicago, Illinois, June 6-9, 2019.** The presentation sessions will be held at the conference hotel, the Hyatt Regency McCormick Place, on Saturday, June 8, 2019.

Topics: industrial archeology, history of technology, social change related to industry, historic industrial structures and bridges, and projects related to and perspectives on the Historic American Engineering Record (celebrating 50 years in 2019). Papers about regional industries and transportation in Chicagoland and the Midwest are particularly encouraged. **Proposals on historic bridge-related topics will be considered for inclusion in the 26th Historic Bridge Symposium.** Poster displays are also encouraged, and can be on works in progress or finished projects. All presentations and poster displays should offer both interpretation and synthesis of data.

Presentation Formats: Proposals may be for individual presentations, a session of papers, a roundtable on a theme, or posters. Individual presentations 20 minutes in length, a group of three or four presentations on a common theme filling a 90-minute session, or a 90-minute panel discussion with 2-5 discussants (a formal moderator is optional, but encouraged). SIA will provide computers, data projectors, screens, microphones, and speakers as needed in each presentation room. Posters will be on display all day Saturday with a dedicated time for poster presenters to be present at their posters for discussion.

The deadline for proposals is January 31, 2019.

An online proposal form as well as the detailed requirements for the format of proposals are available at the following website: http://www.sia-web.org/cfp-chicago-2019/

The official conference webpage is: http://www.sia-web.org/sia-48th-annual-conference.

Note that all speakers are expected to have paid their annual SIA membership fee and also must pay the registration fee (for either the full conference or one-day rate).

For questions contact: Saul Tannenbaum, SIA Presentations Committee Chair: saul@tannenbaum.org

Above from left to right: Chicago and Illinois Western Railway Rall Bascule Bridge, Lake Street Bridge bridgetender house, and Lake Shore Drive Bridge. *Photos by Nathan Holth.*