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Historic Bridge Bulletin

From the Director's Desk

Dear Friends of Historic Bridges,

The Historic Bridge Foundation is pleased to co-sponsor the 25th Historic Bridge Symposium, held in conjunction with the Society for Industrial Archeology's 45th Annual Conference. The conference will be held in Kansas City, Missouri, June 2-5, 2016. The Westin Crown Center, located at Pershing Road and Main Street, is the conference hotel. Registration for the conference will begin in late March. Registration fees are $285 for full registration, $155 for student registration, and $130 for Saturday's paper sessions only. Register online for a $5 discount.

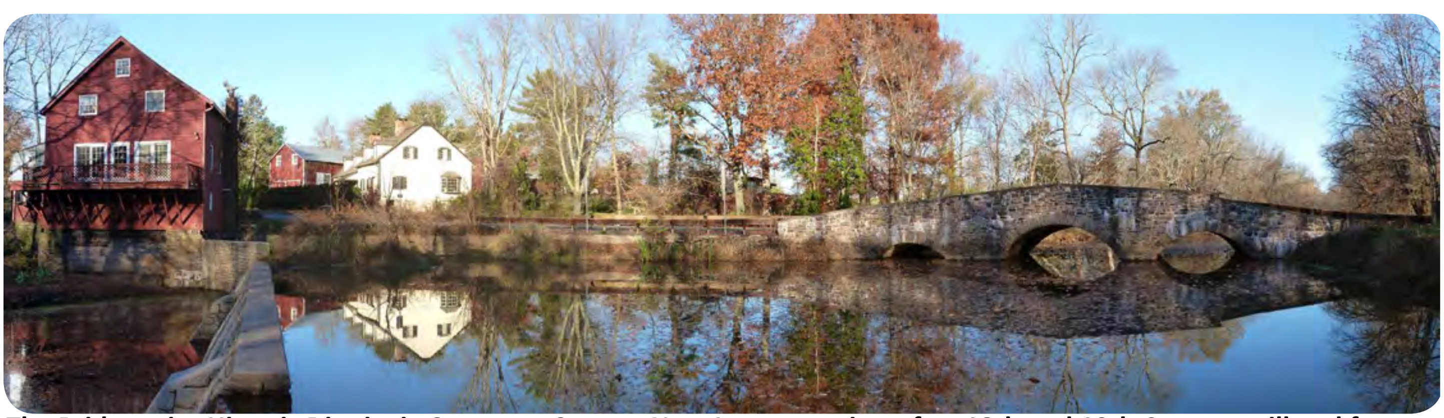
The deadline to submit paper abstracts has been extended to March 4th. For more information and for the online submission form, visit the SIA website at:

sia-web.org/call-for-abstracts-sia-45th-annual-conference/

To learn more about the historic bridge tour that will be held on Friday, June 3, see Justin Spivey's article in this issue. Hope to see you in Kansas City!

Kitty Henderson
Executive Director

In This Issue:



The Bridgepoint Historic District in Somerset County, New Jersey consists of an 18th and 19th Century mill and farm community and includes a contributing 1822 stone arch bridge. *Photo by Nathan Holth.*

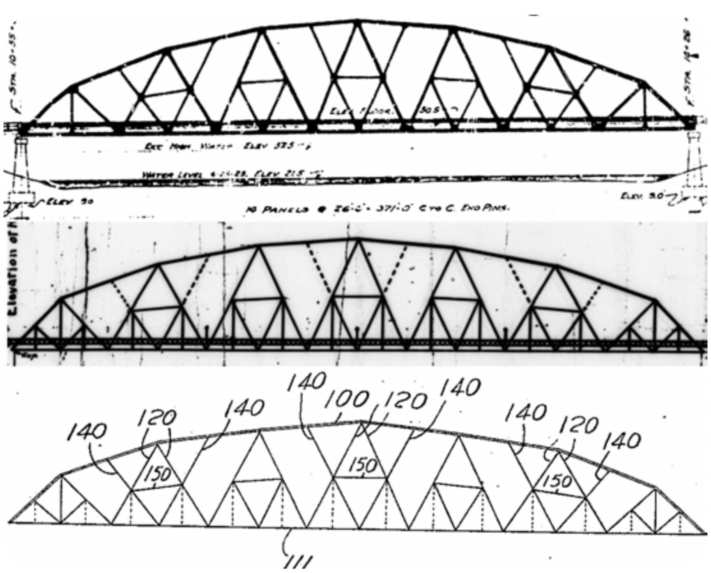
Request For Information:
Meridian Street Bridge and M.M. Caldwell

By Craig Holstine, Washington State Department of Transportation Historian

Maury Morton Caldwell

A HAER report for the Puyallup River (popularly known as the Meridian Street) Bridge over the Puyallup River in the City of Puyallup, Washington is being compiled. The bridge has been removed from its original location, and is awaiting re-installation on a recreation trail. The NRHP-eligible bridge is a steel through truss whose highly unusual modifications to the standard Warren truss appear strikingly similar to the so-called Turner Truss, patented by Claude A.P. Turner in 1923. The only known application of the Turner Truss was in the design of the Liberty Memorial Bridge, that until recently crossed the Missouri River in North Dakota (http://www.loc.gov/pictures/collection/hh/item/nd0032/).

Although very similar in its longitudinal bracing in alternate panels to the design used for Turner's



A truss design comparison: The top drawing shows the truss design of the Meridian Street Bridge, the middle drawing shows the Liberty Memorial Bridge, and the bottom drawing shows the truss design patented by Claude A.P. Turner.

The Meridian Street Bridge. *Photo by Craig Holstine.*

Liberty Memorial Bridge, the Meridian St. Bridge is not a Turner Truss. The primary difference between the two designs is that the only vertical struts in the Meridian St. Bridge are those adjacent to each portal, whereas vertical members connected longitudinal substruts to the bottom chords in every panel on the Liberty Memorial Bridge.

Maury Morton Caldwell designed the Meridian St. Bridge in 1924-1925. It is not known if he used or borrowed from Turner's truss design, patented in 1923. Given that Turner published an article about his design of the Liberty Memorial Bridge in E*ngineering News-Record* in February 1922, Caldwell probably knew of the design.

Caldwell was born May 19, 1875, in Waynesboro, Virginia. He reportedly arrived in Seattle in 1904, and worked as a civil engineer in Tacoma 1910-1916. In 1915 he married Amy F. Webster in Vancouver, B.C. By 1917 Caldwell was working as an engineer in Seattle. His first known bridge projects were with the Union Bridge Company. He reportedly supervised

The Meridian Street Bridge. *Photo by Nathan Holth.*

construction of the Carbon River Bridge in 1921, and in 1922 he designed the Pasco-Kennewick Bridge, a 1,410 ft steel cantilever structure across the Columbia River. In 1924-1925, as a consulting engineer for Pierce County, WA, he designed the Meridian Street Bridge. Caldwell retired from his Seattle practice in 1941, and died in Quesnel, B.C., in 1942, while working for Rumsey and Company developing a gold mine near Cottonwood, B.C. He was survived by his wife, Amy, and a sister, Nettie M. Caldwell, in Virginia. He was never licensed as a Professional Engineer in Washington State.

WSDOT would appreciate knowing of bridges resembling the Meridian Street Bridge, and any information and images of Mr. Caldwell and other bridges he may have designed. Please contact Craig Holstine at holstic@wsdot.wa.gov, phone 360-570-6639.

Craig Holstine is a historian with the Washington State Department of Transportation and the co-author, with Richard Hobbs, of Spanning Washington: Historic Highway Bridges of the Evergreen State*, Washington State University Press, Pullman, 2005.*

Skew in Historic Bridges:
Diverse Designs
By Nathan Holth

The facility that a bridge carries does not always meet the feature that it crosses at a ninety degree angle. This is particularly true if the facility carried places a value on maintaining a straight alignment, as

Marion Center Road Bridge. *Photo by Nathan Holth.*

Lansdowne Bridge. *Photo by Nathan Holth.*

is often desirable for speed and safety on highways and railroads. When a bridge crosses a feature at an angle, engineers could design a bridge that is longer than would be required if the facility crossed at ninety degrees. Alternatively, this additional length can be avoided if the bridge is built with abutments and piers that share the same angle as the feature being crossed. It follows that the superstructure must also be built at an angle to match this angled substructure. Such a bridge with an angled design is said to have skew; it is a skewed bridge.

Historic bridges showcase an impressive and intriguing variety of methods by which engineers produced skewed bridges. While any type of bridge might have a skewed design, much of this article focuses on metal truss bridges because they show skew most visually, and have some of the more unusual skew designs.

19th Century Skewed Bridges

In the 19th Century, the era of the pin-connected truss bridge, skewed truss bridges were uncommon. Efficiency in bridge length was more commonly achieved by curving the approaching road so that it crossed the feature at a ninety degree angle, eliminating the need for a skewed bridge, while also keeping the bridge length to a minimum. That said, skewed bridges from this era do exist, typically with only modest skews. The 1880 Marion Center Bridge in Indiana is a good representative example of a skewed pin-connected through truss. The skew is relatively slight, and is carried through in all panels, at both the sway bracing and the floor beams. In contrast, the Lansdowne Bridge in New Jersey is a pin-connected truss bridge that achieves skew by

PA-51 Bridge. *Photo by Nathan Holth.*

varying the length of the end panels in each truss line. As such, the interior panels maintain a perpendicular design like those in a truss bridge without skew. This arrangement was uncommon among 19th Century pin-connected truss bridges.

Early 20th Century

It was in the first half of the 20th Century, and the era of the fully riveted truss bridge, that skewed bridges became much more common. During this period, skews were not only more common, but the degree of skew became much more diverse, with a fair number of examples featuring profound skews. As motor vehicles (and the higher speeds associated with them) became more common, skewed bridges avoided the increasingly undesirable sharp curves in the approaching roadway, while offering efficient use of materials.

The PA-51 Bridge in Beaver County, Pennsylvania, represents one of the more common and less complex through truss skews of the 20th Century.

Metcalf Street Bridge. *Photo by Nathan Holth.*

Gaines Basin Road Bridge. *Photo by Marc Scotti.*

Here, the trusses are offset by a number of panels (two in this case), and the portal bracing is positioned to match the skew, connecting the two end posts. However, in the interior panels, a non-skewed (perpendicular) configuration is maintained, which is visible in the configuration of the sway bracing. The Metcalf Street Bridge in Ohio is another example of this type of skew. The Gaines Basin Road Bridge over the Erie Canal in New York State shows a common floor beam arrangement, where the end floor beam is skewed, but interior floor beams are perpendicular, sharing the arrangement of the sway bracing. In contrast, the Hunter Station Bridge over Allegheny River in Pennsylvania is an example of a 1930s truss

Hunter Station Bridge. *Photo by Nathan Holth.*

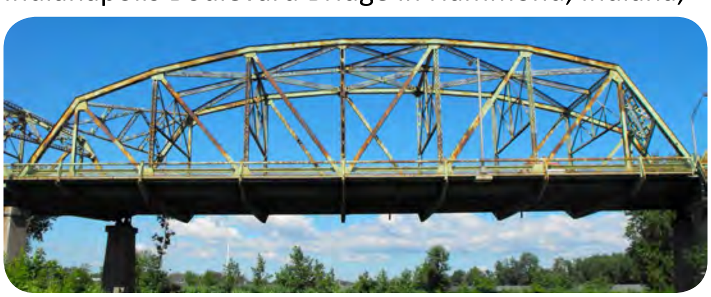
Port Watson Street Bridge. *Top photo by Nathan Holth, bottom photo by Marc Scotti.*

bridge where the skew is found in all parts of the truss, including portal bracing, sway bracing, and floor beams.

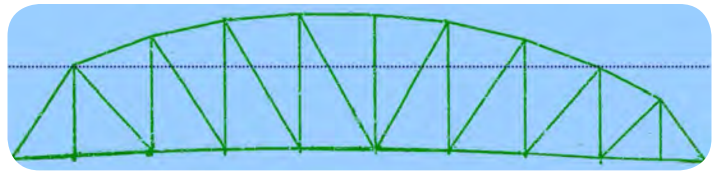
A number of New York State's ca. 1930s state-designed polygonal Warren through truss bridges also display skew throughout the truss. With truss bridges having polygonal top chords, keeping the skew present in the arrangement of the interior sway bracing system is a way of ensuring that the sway braces are kept paired with panel points of equal elevation. However, an unusual detail is that with the exception of the ends of the truss, the floor beams are not skewed, and instead are at a ninety degree angle to the lower chord.

Unusual Skewed Bridges

One of the most unusual skews was found on the Indianapolis Boulevard Bridge in Hammond, Indiana,



Indianapolis Boulevard Bridge. *Photo by Nathan Holth.*



This drawing shows the asymmetrical shape of the Indianapolis Blvd. Bridge.

a bridge with nine Parker through truss spans. The interior truss spans were skewed and featured sway bracing and interior floor beams that were perpendicular. On these spans, skew was achieved by offsetting the trusses by approximately one panel, and trading it with adjacent spans. On the ends of the trusses where there was an extra panel, the upper chord continued its polygonal nature, continuing to slope downward. As a result of this, the end posts at each end of a truss were of different heights. This end post variation also resulted in a truly bizarre portal bracing design, where one end of the portal bracing was much deeper than the other end, as it had to increase its depth to match up with the top of the taller end post. In simple terminology, the asymmetrical trusses and portal bracing resulting from this design presented a very "crooked" looking bridge! The shape and arrangement of these trusses did allow for the interior sway bracing to be perpendicular to the trusses. In this way, it presented a contrast to the aforementioned New York State bridges. This bridge was replaced in March 2013, but one span is placed in storage and is available for reuse by a third party.

In New Castle, Pennsylvania, there are two unusually skewed bridges that sit side by side. Essentially parallel to each other, the two bridges offer a comparison of two uncommon skew methods. The Big Run Branch Railroad Bridge features end posts with varying inclination. The other bridge is the Mahoning Avenue Viaduct, a highway bridge. Its truss

Big Run Branch Railroad Bridge. *Photo by Nathan Holth.*

Mahoning Avenue Viaduct. *Photo by Nathan Holth.*

spans achieve skew by use of a vertical end post on one side, and an inclined end post on the other, which essentially adds a panel to that location.

The North Canal Railroad Bridge in Lawrence, Massachusetts, presents an unusual combination of skew methods. The trusses are offset from each other slightly, resulting in skewed portal braces. This skew is repeated in the interior sway bracing as well. However, this bridge takes the skew a step further, by featuring end posts of two different inclinations.

North Canal Railroad Bridge. *Photo by Nathan Holth.*

For each truss, one end has a very shallowly sloped end post, which adds an additional two panels to the length of the truss at that point.

The Puyallup Avenue Bridge in Tacoma, Washington is a large 2,833 foot bridge that includes three middle (river) truss spans with an unusual skewed design. These spans are Pennsylvania truss spans. Heavily skewed, these spans accommodate a two-panel skew by interrupting the visual arch-like shape of the polygonal top chord, and placing an extra panel at one end of each truss with a top chord that runs nearly horizontally. This, along with the uncommon use of vertical end posts, gives the spans an unusual

Puyallup Avenue Bridge. *Photo by Nathan Holth.*

shape that stands out among skewed truss bridges.

The NY-7 Bridge northeast of Sidney, New York, is a particularly unusual skewed bridge. Its two skewed spans, one a pony truss and the other a through plate girder, have floor beams which are perpendicular to the girders and trusses. At the pier, the floor beams actually run between the two spans. In these locations, one end of a floor beam is attached to the truss, while the other end of the floor beam is attached to a girder in the other span. A similar concept at the abutments can sometimes be observed in bridges with a heavy skew, where a

NY-7 Bridge. *Photo by Marc Scotti.*

This plate girder bridge has a very heavy skew that resulted in some of the floorbeams resting on the abutment at one end. *Photo by Nathan Holth.*

number of floor beams at the end of the span do not span between two trusses or girders, but instead rest on the abutment at one end.

A Brief Note On Skewed Stone Arch Bridges

The skews of stone arch bridges also deserve mention, although a detailed article could be dedicated to these alone. When a stone arch bridge is skewed, the barrel of the arch is angled to match the feature crossed. With stone arch bridges, this was most easily done by offsetting each row of stones in the barrel by incremental amounts. Technically each row of stones is not skewed, but when combined, the offset rows produce a skewed barrel for the bridge.

The 7th Street Improvement Arches, St. Paul, Minnesota features a helicoidal design. *Photo by Nathan Holth.*

The Willow Road Overpass in Bloomsbury, New Jersey, is a stone and brick arch bridge using offset rows to produce a skew. *Photo by Nathan Holth.*

Looking under such bridges, a visitor will note the stepped appearance of the arch barrel.

Far more rare and complex are stone arch bridges which produce their skew by truly shaping the barrel in a skewed design. Helicoidal arch bridges use a series of stones, each carefully cut in a curved, angled design, which fit together in a spiral-like pattern to produce a skewed arch barrel, with a smooth interior where all the rows of stones are in line with each

Helicoidal arch railroad overpasses. Top: Rockford, Illinois *Photo by John Marvig.* **Bottom: Silver Creek Village, New York State.** *Photo by Marc Scotti.*

Blaine Hill "S" Bridge on the National Road, Ohio. *Photo by Nathan Holth.*

other. Only a few such bridges are known to survive in the United States.

Some builders, particularly those on the National Road, avoided the need for a skewed stone arch bridge by instead aligning the main spans to the river at a ninety degree angle, while curving the approach of the bridge itself. These bridges are known as "S Bridges" due to the curves.

Skew in Modern Bridges

The historic bridges discussed here were built in an era when labor was inexpensive, but materials were costly, making it sensible to use skewed bridges if it saved materials, despite perhaps taking more labor to construct. Today, the opposite is true: labor is expensive and materials are less expensive. This may be one reason that skewed truss bridges are increasingly uncommon in bridge construction, and in fact are even discouraged. For example, in New York State, the bridge design manual states that "Skewed trusses should be avoided if possible. The skew makes fabrication difficult and costly and introduces out of plane bending problems to the structure. Small skew angles can often be eliminated by a small increase in the span length." This does not mean that skewed bridges are no longer built. For example, in some cases, new bridges may be built to a skew to match the alignment of a previous bridge. But the fact remains that they are not as common as they once were in new bridge construction.

When evaluating the significance of historic bridges, a skew should be considered an important feature in light of its rarity in modern bridges.

Nathan Holth is the author of the website HistoricBridges.org and the editor for the Historic Bridge Bulletin. In researching and advocating for the preservation of historic bridges over the past decade, he has photographed thousands of historic bridges across North America.

Special thanks are due to Dr. Frank Hatfield, P.E. for reviewing this article.

SIA and Historic Bridge Symposia

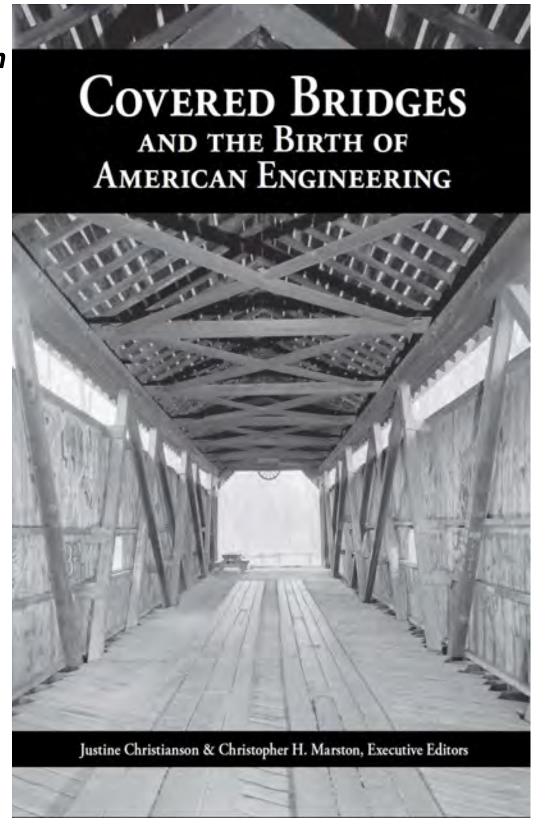
By Justin M. Spivey

The Society for Industrial Archeology's 2016 Annual Conference in Kansas City will mark two major milestones, the 45th such event since SIA's founding, and the 25th Historic Bridge Symposium, now co-sponsored by the Historic Bridge Foundation (HBF). Although the numbers might indicate otherwise, this does not mean that the conference is 20 years older than the symposium! On the contrary, the two events have a much longer history together.

For those not familiar with the Society for Industrial Archeology (SIA), the organization was founded in Washington, D.C., in October 1971, to promote the study and preservation of historic industrial sites, structures, and equipment. Many of SIA's early leaders had also been involved in the creation of the Historic American Engineering Record (HAER) in 1969, as a sister program of the New Deal-era Historic American Buildings Survey (HABS). In addition to the Annual Conference with its presentations of scholarly

The 2015 Historic Bridge Tour. *Photo by Michael Holt.*

Covered Bridges and the Birth of American Engineering: Now Available From Historic American Engineering Record



The Historic American Engineering Record (HAER) is pleased to announce the publication of *Covered Bridges and the Birth of American Engineering* (2015), edited by HAER Historian Justine Christianson and HAER Architect Christopher H. Marston.

The book represents the culmination of research under the Federal Highway Administration (FHWA)-sponsored National Historic Covered Bridge Preservation (NHCBP) Program. HAER and the FHWA's Office of Infrastructure Research and Development have maintained a joint research and technology program for historic covered bridges since 2002. This partnership has also included a variety of initiatives including documentation, engineering studies, National Historic Landmark designations, conferences, and a traveling exhibition.

This book examines the development of wood trusses and covered bridge construction, profiles the pioneering craftsmen and engineers involved, explores the function of trusses in covered bridges, and looks at the preservation and future of these distinctly American bridges. The editors have collaborated with some of the leading historians and engineers of historic covered bridges in the country to produce this volume. Contributors include Jim Barker, Lola Bennett, Joseph Conwill, Dario Gasparini, Matthew Reckard, and Rachel Sangree. Richard O'Connor and Sheila Rimal Duwadi supplied overviews of the HAER and NHCBP programs, and Michael Harrison and David Simmons provided invaluable editorial assistance.

HAER is distributing this publication to members of the covered bridge community nationwide. Paper copies may be requested while supplies last, by contacting Christopher Marston at christopher_marston@nps.gov. It's also available for download at: nps.gov/hdp/coveredbridges.htm

research and tours of historic and active industrial sites, SIA also hosts an annual Fall Tour and occasional international study tours.

The history of SIA and the Historic Bridge Symposia are also intertwined with the career of Eric DeLony, an architect involved with HAER from its inception. Eric was first hired as a student intern and his 1969 drawing of the Troy Gasholder building was later used as the SIA logo. He became HAER's first permanent employee in 1971 and led the organization from 1987 until his retirement in 2003.

Although not trained as an engineer, Eric learned to speak their language and built enduring relationships with numerous preservation-minded engineers involved in the maintenance and rehabilitation of historic bridges, as well as historians and cultural resources professionals. Eric also spearheaded statewide historic bridge recording projects in collaboration with state DOTs and SHPOs. His innovative inclusion of structural engineering analyses in HAER projects added depth to the documentation and took it beyond mere recording of historic fabric.

Eric Delony in 2009. *Photo courtesy BridgeMapper.com.*

Eric maintained his network of experts and encouraged them to help solve each other's research and preservation quandaries through in-person networking, phone calls, and letters. By the late 1990s, he was facilitating many of these conversations through an email distribution list called the Pontists or, in a more playful mood, the "historic bridge mafia." This list continues today, as a LinkedIn discussion group called Pontists: Historic Bridge Forum, with many of the same members. In both incarnations, the Pontists group has been a vehicle for exchanging knowledge and promoting the Historic Bridge Symposium.

The first several Historic Bridge Symposia were not numbered. As with some events that grow into long-running series, initial modesty or uncertainty dictates that numbers not be assigned until there are more than a few to count. In fact, it is not clear which of the historic bridge-themed presentation sessions at SIA's early conferences counted as the first Historic Bridge Symposium.

It is apparent from a review of available programs that presentations about historic bridge topics made a regular appearance at SIA conferences starting in the early 1980s, such as a session entitled "Recording, Evaluating and Restoring Historic Bridges" at the 11th Annual Conference in Harrisburg, Pennsylvania (1982). The 14th Annual Conference in Newark, New Jersey (1985) had a "Symposium on Bridges," followed by sessions entitled "Historic Bridge Symposium" at the 15th and 17th conferences in Cleveland and Wheeling, West Virginia, respectively (1986 and 1988), and simply "Bridges" in Troy, New York (1987).

Although the name of the event and its annual appearance at SIA conferences had become established at this point, it was still not numbered. Counting backward from the 20th Annual Historic Bridge Symposium at SIA's 32nd Annual Conference in Montréal (2003), Eric must have considered the Wheeling event to be the 5th. From that point, he tirelessly recruited presenters for a continuous run of fifteen numbered Annual Historic Bridge Symposia until he retired. As the symposium became a regular feature, so did his opening remarks, known as the "State of the Bridge" address.

After a brief hiatus, the Historic Bridge Symposium was reinvigorated in 2010 with co-sponsorship from HBF. Executive Director Kitty Henderson joined Eric at the lectern for the 21st and 22nd Annual Historic Bridge Symposia at SIA's 39th and 40th annual conferences in Colorado Springs (2010) and Seattle (2011). The "Annual" was dropped as the symposium became biennial, with the 23rd and 24th being held in St. Paul, Minnesota (2013), and Albany, New York (2015). Recent SIA conferences have also included tours of historic bridges in and around the host city, such as the Mississippi River boat tour co-sponsored by HBF in St. Paul. Given the exciting historic bridge selections in Kansas City, however, HBF agreed to co-sponsor the 25th Historic Bridge Symposium and a historic bridge tour again at the 2016 conference.

The Kansas City historic bridge tour will introduce attendees to a diverse collection of significant historic bridges in the area. Highlights of the tour include

The 2013 Historic Bridge Boat Tour, on the Mississippi River. *Photo by Emily Ganzel.*

Armour-Swift-Burlington (ASB) Bridge. *Photo by Nikky, flickr.com/photos/allynfolksjr/9173910278/ , CC BY 2.0.*

stops at some of the impressive bridges on the Kansas River (also known as the Kaw River), as well as notable works by famous engineer J. A. L. Waddell, who established his firm of Waddell and Harrington in Kansas City. Bridges that will be part of the tour include the following:

1. ASB Bridge

Crossing the Missouri River, the unique Armour-Swift-Burlington (ASB) Bridge was built to carry highway traffic on an upper deck, and railroad traffic on lower deck. Its unusual 425 foot movable vertical lift span features a riveted through truss, with vertical hangers that telescope out of the vertical truss members to support the lower railroad deck below the truss. These hangers, connected to motors and counterweights, can be retracted up into the through truss, raising the lower deck of the span to provide needed clearance for boat traffic. Today, the upper deck is no longer in use, and the upper deck approach spans have been removed. However, the lower deck remains in use and the lift span still operates as originally designed by famous engineers J.A.L. Waddell and John Lyle Harrington, who were leaders in the development of vertical lift bridges.

2. Hannibal Bridge

This bridge is at the site of the first permanent railroad crossing of the Missouri River, and an early iron truss bridge, completed in 1869 under the direction of Chief Engineer Octave Chanute, who had as his Assistant Engineer George S. Morison. Morison would later go on to design many of America's longest truss spans of the 19th Century. The bridge seen here today is the 2nd Hannibal Bridge, completed in 1917. The steel truss bridge features an impressive movable through truss swing span. The bridge was built as a double-deck bridge with the lower deck for railroad traffic and the upper deck for highway traffic. The highway deck was abandoned in 1956 when the nearby Broadway Bridge was completed to serve as a fixed high-level bridge for highway traffic.

3. Broadway Bridge

Constructed in 1955, the Broadway Bridge carries US-169 over the Missouri River. Its three riveted steel through tied arch main spans with wire rope hangers are both iconic and uncommon. The longest arch span is 540 feet and the overall length of the bridge including approaches is over 2500 feet. The bridge was operated as a toll bridge until 1991. The demolition and replacement of this bridge is under consideration, making its future uncertain.

Broadway Bridge (Left) and Hannibal Bridge (Right). *Photo by Chris Murphy, flickr.com/photos/chrism70/3272586620/ CC BY-NC-ND 2.0.*

Twelfth Street Trafficway Viaduct. *Photo by Chris Murphy, flickr.com/photos/chrism70/420575780/ , CC BY-NC-ND 2.0.*

4. Twelfth Street Viaduct

Located just west of downtown Kansas City, the Twelfth Street Trafficway Viaduct was built in 1914, having been designed by Waddell and Harrington and constructed by the Graff Construction Company. Roughly 2,053 feet long, the viaduct is noted for its architectural details, size, double-deck design, and main concrete arch span over railroad tracks. The approach spans are concrete girders.

5. Highline Bridge

Built in 1917, the Highline Bridge is a double-deck bridge with 300 foot pin-connected Baltimore through truss spans over the Missouri River. The bridge carries two sets of railroad tracks on each deck, and features extensive approaches for the upper deck that provide an overall bridge length of around a mile. In 1961, in response to a major flood in 1951, special flood jacks were added to the bridge to enable the river spans to be raised up like a vertical lift bridge, to prevent flood waters from reaching the truss spans.

6. Truman Lift Bridge

Completed in 1945, this vertical lift railroad bridge features a riveted Warren through truss lift span of 427 feet. The overall bridge contains 23-spans totaling 2,577 feet. The bridge was named for Harry S. Truman, a Kansas City native who had just become President of the United States when construction began.

7. Waddell A-Frame Bridge

With a span of 100 feet, the Waddell "A" Truss Bridge, spanning Lin Branch Creek is one of only two surviving examples of a bridge truss type patented by noted engineer John Alexander Low Waddell in 1894. Originally serving railroad traffic, it was converted for highway use in 1953, and in 1987 was relocated and preserved here to serve non-motorized traffic. Waddell described his "A" truss design as the most rigid short-span pin-connected truss ever built, but by 1916 admitted that the increasingly popular "modern" riveted Pratt truss bridge was a better solution for short, rigid truss spans.

Waddell A-Frame Bridge. *Photo by Vincent Parsons, flickr.com/photos/mrtickles/22655758016/ , CC BY-NC 2.0.*

Justin M. Spivey, P.E., is a Senior Associate at Wiss, Janney, Elstner Associates, Inc., in Princeton, New Jersey, and a Lecturer at Johns Hopkins University. His professional interests include forensic engineering, adaptive reuse of existing structures, historic bridges, and the history of structural engineering. He has compiled or edited Historic American Engineering Record documentation for hundreds of historic bridges and is a licensed professional engineer in eight states.

Martin Marvels:

Adam Oscar Martin of Bucks County

By Kathryn Ann Auerbach

Some hold the opinion that a stonemason cannot lay bricks, nor a bricklayer fashion a stone wall. But can an architect be an engineer? Or an engineer an architect? Adam Oscar Martin (1873- 1942), a native of Dublin in Bucks County, Pennsylvania, demonstrated a keen ability to succeed both as architect and engineer. Deeply rooted in his family's tradition of construction, Martin pursued formal education at Drexel Institute, followed by work for architectural firms in Buffalo, Philadelphia, and the celebrated architect Milton Bean in Lansdale, Pennsylvania, before opening his own practice in Doylestown, Pennsylvania, ca. 1899.

Martin combined Victorian sensibility and aesthetics with emerging designs of fashion, embracing Arts and Crafts, Prairie, Spanish Mission and Colonial Revival styles with a sense of scale and materials to appeal to his Bucks County clientele. The expansive Spanish Geil Mansion south of Doylestown, the elegant Italianate tower of the Doylestown Fire House, and the gracious Colonial Revival and Prairie style homes that incorporate into the streetscapes of Quakertown, Wycombe, and Doylestown remain

A. Oscar Martin in 1926. *Photo Source: Summer-Fall 2013, Newsletter of the Bucks County Historical Society.*

today as noticeable examples of his work. The appeal of wood handcraft and textures of tile, brick and stone masterfully blend with modern amenities to celebrate both building heritage and comfort.

As the county's first bridge engineer, serving from 1900 – ca. 1923, Martin directed the repair and new construction of over 100 bridges throughout the entire county. It is possible that Martin served as county commissioner when he offered his first bridge designs. While biographical references on Martin do not call out a political career, an "Adam" Martin is listed as commissioner on bridge plaques from 1900-1902, including a stone arch bridge on Quarry Road in Nockamixon Township.

A collection of Martin's bridge drawings (as well as many of his other architectural designs) is held at the Bucks County Historical Society's Spruance Library. This collection provides unique insight into the emerging technologies of the early 20th century, as well as Martin's practical and sensitive approach to design, and a record of bridges and bridge types that no longer exist. Nearly one half of the bridges documented in the collection were "repairs," incorporating elements of existing bridges, maintaining road alignments and widths, using existing stone abutments and piers, and repairing or replacing the superstructure.

Martin rehabilitated open wooden beam and truss bridges, covered wooden truss bridges, metal truss and stone arch bridges. Martin's new designs for either deck replacement or entire new construction included metal plate girder bridges, reinforced concrete deck, concrete encased I-beam and concrete deck, reinforced concrete beam and deck, concrete arch and stone arch constructions. Many of his repairs were simply the replacing of wooden beam and deck components in I-beam and concrete, while maintaining the footprint and profile elevations of the existing bridge. Concrete decks were macadamized

Campbell's Bridge. *Photo by Joseph Elliott, Historic American Engineering Record.*

(paved by laying and compacting successive layers of broken stone, often with asphalt or hot tar) to blend with the approach roads and open wooden railings were replaced with open pipe rail.

Martin designed well over fifty concrete bridges of various types from 1906 - ca.1923. Martin's concrete arch bridges represent an early county-level adoption of concrete for common use in bridge construction. While concrete had been in limited use for bridge construction in prior years, it was still considered a developing bridge technology that was frequently discussed in engineering periodicals of the time. Martin's work with concrete and steel appears first in 1906 with designs for a single arched span at Auchey's Mill in Milford Township. He had designed a stone arch approach to the mill, but changed to concrete and steel with success. That same year he designed two longer spans, the first with two arches on Dark Hollow Road at Stover's Mill over the Tohickon Creek from Bedminster into Tinicum Township and the second with a single 72-foot span on Allentown Road at Campbell's Mill over the Unami Creek in Milford Township. Martin's 1906 open spandrel arch design for Campbell's Bridge has been cited in numerous bridge journals and historical bridge assessment studies as significant, including the contemporary article "What Makes a Bridge Great?" (*Better Roads*, Feb. 2005) where Campbell's Bridge shares the limelight with cast iron masterpieces in New York's Central Park and others. Unfortunately, both bridges were demolished in 2004 and 2005, respectively. Another notable bridge of the period is the Walnut Street Bridge over the Branch Creek (also called the Branch Bridge) in Perkasie. Locally famous as the "Bridge That Carried a Bridge," the Branch Bridge is a closed spandrel three-arch achievement built 1907 that supported the ca. 1832 Perkasie Covered Bridge during its move from active service over the creek into the adjacent Lenape Park in 1958. Now the oldest of Martin's larger, multi-span concrete bridges, the Walnut Street Bridge is under study for replacement.

During the period from 1908-1915, Martin perfected his designs for rural single-span arch bridges that recalls heritage design features of the venerable stone arch, while embracing the lightness of a concrete arch that could span longer distances with less materials. A good example of this is the Rickert Road Bridge over Morris Run, just on the edge of Martin's hometown of Dublin and within a heritage landscape that evokes the image of substantial German farmsteads and classic villages. Rickert Road Bridge is a reinforced concrete deck girder bridge with arched girders and is noted as a regionally prototypical example of reinforced concrete. The bridge is now under study for replacement.

A lower-profile twin to Rickert Road, the Clay Ridge Road Bridge, lies within the Ridge Valley Rural Historic District in Tinicum Township, where it is both individually eligible for the National Register of Historic Places and was built within the Historic

The Rickert Road Bridge. *Photo by Jet Lowe, Historic American Engineering Record.*

District's 1790-ca. 1940 period of significance. Built in 1909, Martin's Clay Ridge Road Bridge is a reinforced concrete girder bridge with arch-shaped girders. The bridge contributes to the historic character of the district.

Other noteworthy Martin bridges include the open-spandrel concrete arch bridge over Aquetong Creek on Stockton Avenue in New Hope Borough. Built in 1910, it was rehabilitated by the County of Bucks, and continues to actively serve as well as artistically inspire. It contributes to the New Hope Village Historic District. Additionally, along Easton Road in Durham Township, the Easton Road Bridge over Cooks Creek, built in 1913, is another open-spandrel arch bridge and was bypassed by road improvements in the 1950s.

The Delaware River along much of Bucks County enjoys the Federal designation of a Wild and Scenic River for its beauty, natural attributes, historical sites, villages, and engineering achievements that include bridges and the Delaware Canal. Along the scenic river road is the village of Point Pleasant. Found on PA-32 is Oscar Martin's two-span deck arch bridge that rises over the Tohickon, and echoes the Burr-arch aqueduct of the nearby canal. Perhaps one of the largest of his bridges, the design maintains the surface scale of the town and also retains stone wing walls of a previous bridge, with the large 1921 concrete arch span over the Tohickon Creek in Point Pleasant being one of his last. This bridge, including the stone wingwalls, is being demolished and replaced this year.

While quickly disappearing, a number of Martin's marvels still exist in rural areas of upper Bucks County and have been recognized in national engineering journals for their exceptional ingenuity. While Martin designed well over 100 bridges throughout the county and beyond its borders, fewer than twenty remain today and many of them are slated for replacement. Despite interest in preservation by local residents, historians, and preservationists across the county, Martin's bridges face uncertain futures as the need for wider bridges that carry heavier loads trumps the desire to retain structures that record the early development of concrete bridge construction and the beauty of a Martin-designed bridge.

Information from this article was taken from Burnt Mill Bridge aka Headquarters Bridge over Tinicum Creek, Historic Assessment Summary, prepared for the Delaware River Keeper Network by Kathryn Ann Auerbach, 2013.

Kathryn Auerbach is a historic preservation consultant and has been involved in historical research and documentation in Bucks County for 40 years.

Upcoming Conferences

Iron & Steel Preservation Conference & Workshop

Location: Purdue University, West Lafayette, IN
Date: May 18-20, 2016
Website: www.historicbridgerestoration.com/articles/ispc2016b.pdf

Historic Bridges: Management, Regulations, and Rehabilitation

Location: St. Paul, MN
Date: April 27-28, 2016
Website: www.npi.org/sem-bridge.html

7th National Forum on Historic Preservation Practice

Location: Baltimore MD
Date: March 18-19, 2016
Website: www.goucher.edu/graduate-programs/ma-in-historic-preservation/7th-national-forum

Built in 1938, the Trammell bridge near Blountstown, Florida is a historic cantilever through truss bridge that was preserved by constructing a new parallel bridge and turning it into a one-way couplet of bridges. *Photo by Nathan Holth.*

Section 106 Seminars
Location: Various
Date: Various
Website: www.achp.gov/106essentials.html and www.achp.gov/106advanced.html

Architectural Iron & Steel in the 21st Century: Design & Preservation of Contemporary & Historic Architecture
Location: Cambridge, MA
Date: April 2-4, 2016
Website: www.preservationdirectory.com/preservationnewsevents/NewsEventsDetail.aspx?id=5093

Society of Architectural Historians 2016 Annual International Conference
Location: Pasadena / Los Angeles CA
Date: April 6-10, 2016
Website: www.sah.org/2016

South Carolina's Annual Historic Preservation Conference
Location: Columbia SC
Date: April 22, 2016
Website: shpo.sc.gov/events/Pages/presconf.aspx

Florida Trust for Historic Preservation Annual Conference
Location: Tallahassee FL
Date: May 12-14, 2016
Website: www.preservationdirectory.com/preservationnewsevents/NewsEventsDetail.aspx?id=5035

2016 Arizona Historic Preservation Conference
Location: Phoenix AZ
Date: June 8-10, 2016
Website: www.preservationdirectory.com/preservationnewsevents/NewsEventsDetail.aspx?id=5004

Originally built in 1912 to carry pedestrians over a rail yard, this foot bridge in Palmerston, Ontario has been preserved in place as part of the Palmerston Railway Heritage Museum. *Photo by Nathan Holth.*