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Historic Bridge Bulletin

Historic Bridge Foundation

From the Director's Desk

Dear Friends of Historic Bridges,

Did you know that November is Historic Bridge Awareness Month? Although unofficial, bridge enthusiasts promote November as the month to raise awareness and to give special recognition to historic bridges. We urge you to think of ways during the month to support historic bridges and spread the word about their importance to our heritage.

Your donations to HBF can help. Along with our desire to share information with you about historic bridges through our newsletter, we need support of our mission with your donations. Your generous contributions will help us to publish the *Historic Bridge Bulletin*, to continue to maintain historicbridgefoundation.com, and, most importantly, to continue our mission to actively promote the preservation of bridges. Without your help, the loss of these cultural and engineering landmarks threatens to change the face of our nation.

Donations to the Historic Bridge Foundation are tax deductible. You may visit our website to pay through PayPal or send a check to PO Box 66245, Austin, Texas 78766.

Kitty Henderson

Executive Director

In This Issue:

Built in 1909 to carry Middle Road over Etobicoke Creek at what is today the western border of Toronto, Ontario, this concrete bowstring truss bridge was the first in Canada. It is preserved for pedestrians. *Photo by Nathan Holth.*

A Tale of Two Bridges:
The 75th Anniversary of the First Tacoma Narrows and Lake Washington Bridges

By Craig Holstine, Washington State Department of Transportation Historian

Seventy-five years ago this July, Washington State officials dedicated two structures unique to the world of bridge engineering. The first bridges to cross the Tacoma Narrows and Lake Washington could not have been more dissimilar: one, a suspension bridge of unprecedented dimensions, the other consisting primarily of floating concrete pontoons. Although both were destined eventually to fail, both revolutionized bridge engineering in ways their designers could scarcely have imagined. Today we celebrate their legacies.

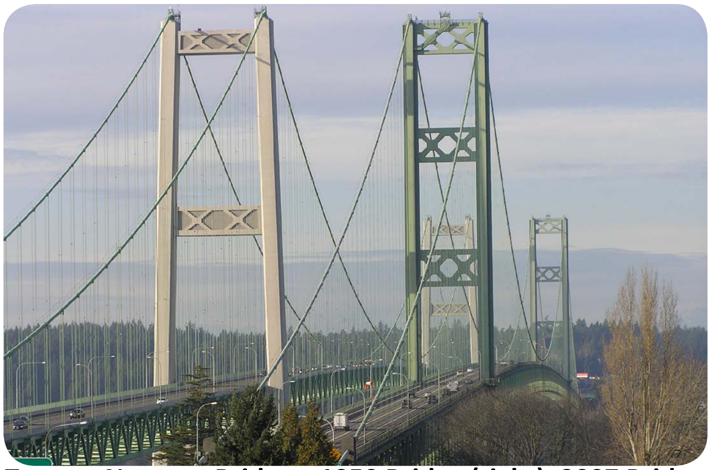
Tacoma Narrows Bridge dedication, July 1, 1940. Lacey V. Murrow (holding hat, left side of ribbon), Washington Governor Clarence D. Martin (holding hat, right side of ribbon). *Courtesy Tacoma Public Library.*

The bridges were products of funding sources not previously available to those dreaming of super-sized bridges: the Washington Toll Bridge Authority (WTBA) and the New Deal. California's toll bridge act, the funding mechanism responsible for the San Francisco-Oakland Bay Bridge, served as a model for the WTBA. Department of Highways Director Lacey V. Murrow crafted legislation enacted by the Washington Legislature in 1937 that provided for the sale of revenue bonds to be retired by tolls to finance bridge construction. Passed in time to allow partnering with the federal government on bridge projects of unprecedented cost, the measure included a provision that named Murrow as the WTBA's Chief Engineer. The biggest bridges in the state at the time became associated with Murrow, whose meteoric career paralleled that of his more famous younger brother, broadcast journalist Edward R. Murrow.

Collapse of Galloping Gertie, November 7, 1940. *Courtesy WSDOT.*

In the early twentieth century, outdated ferries crossed both Lake Washington and the narrowest passage across Puget Sound. Outlying areas languished in bucolic splendor, isolated by the deep-water obstacles created by receding Pleistocene glaciers. As automobile popularity grew, Seattle and Tacoma residents dreamed of driving direct routes east to the Cascades and west to the Olympic Peninsula. Lacey Murrow assembled a Board of Consulting Engineers to take on the daunting tasks of overseeing designs of bridges that would transform western Washington's transportation landscape.

Murrow's assistant, Clark Eldridge, produced the first design of the Tacoma Narrows Bridge, a suspension bridge with a traditional deep deck truss. Public Works Administration (PWA) officials rejected the design as being too costly, insisting that the WTBA adopt Leon Moisseiff's design for a cheaper bridge. Perhaps the nation's most accomplished suspension bridge engineer, he had introduced the "deflection theory" to suspension bridge engineering, eliminating the need for heavy, rigid trusses. His sleeker, lighter design, with its eight-foot-deep plate deck-girder and record length-to-width ratio (1 to 72), would result in a bridge of graceful appearance at a greatly reduced cost. Murrow accepted the PWA offer and Moisseiff's

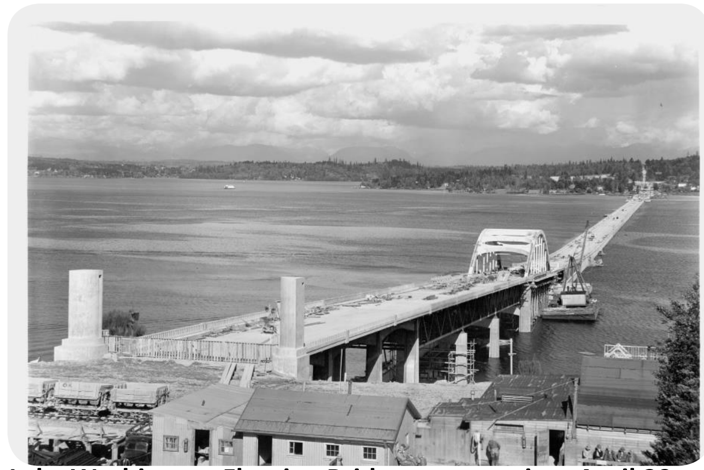


Tacoma Narrows Bridges: 1950 Bridge (right), 2007 Bridge (left). *Photo by Craig Holstine.*

design. Under contract with the WTBA, the Pacific Bridge Company, the General Construction Company, and the Columbia Construction Company began work on November 23rd, 1938, just over a month before construction started on the Lake Washington floating bridge.

Engineers had for years debated the best way to bridge the lake separating Seattle from the rolling Cascade foothills to the east. At over 250 feet deep, with a soft, thick clay bottom, Lake Washington defied crossing with a conventional bridge. Homer M. Hadley, a Seattle engineer with the Portland Cement Association, first proposed a bridge resting on floating concrete pontoons as a solution. During WWI, Hadley had designed concrete ships and barges for the Emergency Fleet Corporation, and knew that concrete could be made to float. In June 1937 he pitched his novel idea to Murrow, who immediately sent it for vetting by his Board of Consulting Engineers. After a brief review, the Board directed Murrow to pursue Hadley's outline. Department of Highways engineers were tasked with designing the bridge. Despite his inspirational role, Hadley could not be included in the design team, due to his Portland Cement Association ties being perceived as a conflict of interest. Murrow supposedly assured Hadley that he would be given credit for his conceptual design, but that was acknowledged only in a professional journal and not prominently in public at the time.

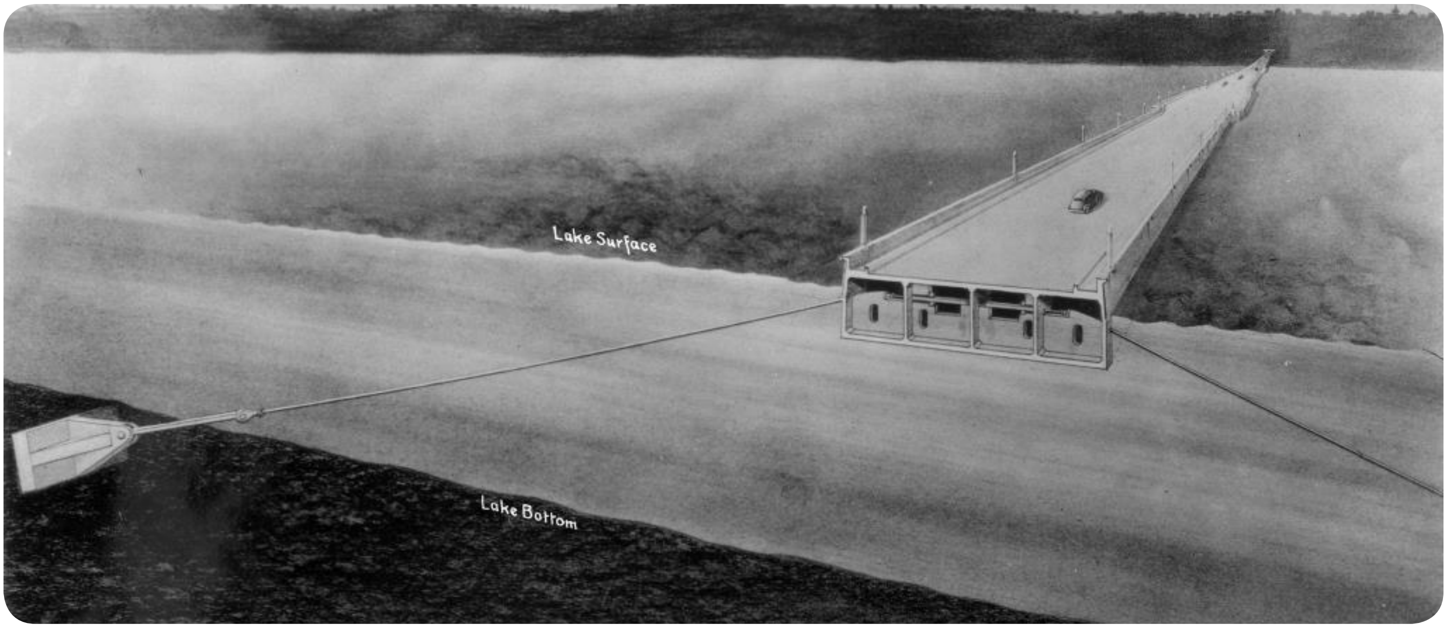
Considerable opposition to the project erupted in Seattle. The *Seattle Daily Times* called the proposal a "scow-crossing." The PWA threatened to cancel grant funding allocated for the project if the City Council rejected the proposal. Lacey Murrow took the lead in convincing a skeptical public and the Council of the wisdom of a floating concrete pontoon bridge. His efforts bore fruit when, on December 21, 1938, the Council voted 5-4 to endorse the bridge. The WTBA accepted PWA's grant and the revenue bonds needed to complete the financing, and construction started



Lake Washington Floating Bridge construction, April 29, 1940. *Photo by Alfred Simmer, courtesy WSDOT.*

on December 29, two days before federal funding was to expire at year's end. Digging the "twin-bore" tunnels through Mt. Baker Ridge to connect the bridge with downtown Seattle preceded construction of 25 pontoons at a "graving dock" on Seattle's south shore. The pontoons, some as long as football fields, were designed to pass through the Ballard Locks between Lake Union and Puget Sound. Among the innovative features of the bridge was a 378-foot drawspan near its center that opened a 200-foot clear

Pontoon in Ballard Locks in transit to Lake Washington, January 27, 1940. *Photo by Alfred Simmer, courtesy WSDOT.*



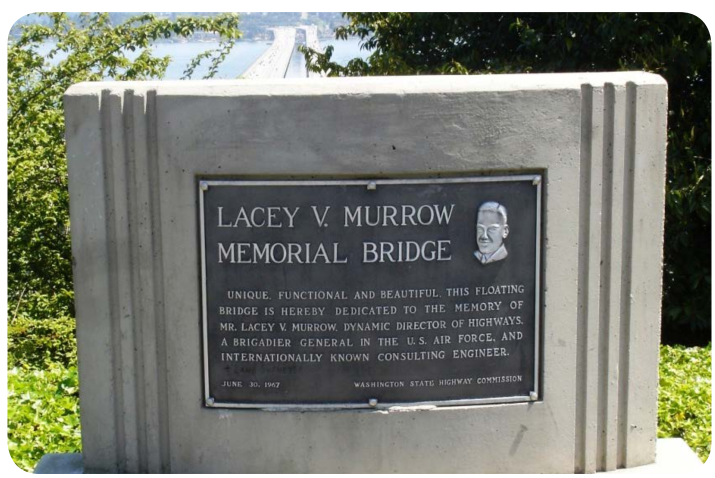
Pontoon cross-section. *Drawing by Lloyd Lovegren, ca. 1940, Courtesy WSDOT.*

channel for ship passage, another first of its kind in bridge engineering.

After only 18 months of construction, both the Tacoma Narrows Bridge and Lake Washington Floating Bridge were complete. Thousands attended dedication ceremonies held on successive days, July 1 and 2, 1940. In Tacoma, the new bridge was nothing short of majestic: then the third longest suspension bridge in the world, its 425-foot high towers rose above its 5,939- foot length (including the 2,800-foot suspended center span). "Galloping Gertie" had already earned her nickname by the wild movements of her light, slender deck in the frequent Narrows winds. In Seattle, the elegant 6,620-foot ribbon of floating concrete across Lake Washington charmed even her critics; the Seattle Daily Times editor admitted "Its effect upon me was both stunning and exciting."

The euphoria of the moment was to be short-lived. Galloping Gertie's oscillating deck prompted Murrow and Eldridge to install tie-down cables in a vain attempt to calm the bridge's movements. But the problems outpaced potential remedies, and on the morning of November 7, 1940, Galloping Gertie's center span ripped itself apart in winds clocked at just over 42 mph. Its plate girder deck created a vortex of swirling wind, contributing to its "torsional flutter," the self-generating twisting motion that ended the bridge's brief life. Gertie was to be the last suspension bridge designed without wind-tunnel testing to determine aerodynamic effects. Since Gertie's demise, two new suspension bridges have risen above her ruins: a steel deck truss with steel towers, completed in 1950, and a wider steel deck truss with concrete towers, opened in July 2007.

On March 20, 1967, the State Highway Commission voted to name the first Lake Washington floating bridge in honor of Lacey V. Murrow. The bridge was to sink in 1990 during an intense rain storm, shortly after a second floating concrete bridge, the Homer M. Hadley Memorial Bridge, was built immediately adjacent. Both bridges now carry lanes of Interstate 90. The floating concrete pontoon technology



Lacey V. Murrow Memorial Bridge plaque, Lacey V. Murrow Memorial Bridge (right rear), Homer M. Hadley Memorial Bridge (left rear), Seattle. *Photo by Craig Holstine.*

pioneered by the first Lake Washington Bridge has spawned other like structures around the world, including a third bridge on Lake Washington (the Albert D. Rosellini or SR 520 Bridge) and the William Bugge Memorial Bridge on Hood Canal also in western Washington, the first floating concrete bridge built on tidal-affected salt water. In addition, the off-shore oil industry has benefited from the floating concrete bridge that made its world premiere on Lake Washington in July of 1940, seventy-five years ago. The American Society of Civil Engineers has dedicated the rebuilt Lacey V. Murrow Memorial Bridge and the Tacoma Narrows Bridges as National Historic Civil Engineering Landmarks, a distinction shared by a select few engineering marvels.

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.*

What is a Fracture Critical Bridge, and Why Does It Matter?

By the Historic Bridge Foundation

The FHWA Bridge Inspector's Reference Manual (BIRM) provides a good start to understanding what a fracture critical bridge is. It states that "A fracture critical member (FCM) is a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse. Bridges that contain fracture critical members are fracture critical bridges." The manual notes that there are two main criteria for a member to be Fracture Critical. #1: "Members that are in tension or members that have fibers or elements that are in tension meet the first criterion." #2: "The second criterion for a bridge member to be classified as fracture critical is that its failure must cause a total or partial collapse of the structure."

Redundancy is what prevents a bridge from being fracture critical. Redundancy comes in three forms: Load path, structural, and internal. As stated in the BIRM, "Bridge designs that have three or more

This 1938 continuous bridge's design consisting of eight parallel riveted built-up beams potentially offers all three types of redundancy. *Photo by Nathan Holth.*

main load-carrying members or load paths between supports are considered load path redundant." In other words, when one main member on a load-path redundant bridge fails, loads transfer elsewhere onto other main members. Multi-beam (stringer) bridges are a basic example. Structural redundancy refers to continuous bridges with three or more spans, such that adjacent spans can lend support to each other if a member fails. The BIRM notes that "Some continuous truss bridges have structural redundancy, but this can only be determined through structural analysis." Internal redundancy refers to a built-up member consisting of three or more elements, where one element can take up the slack if a different element fails. Built-up riveted beams such as those found in historic truss bridges may be internally redundant. Load path redundancy is the most important of the three types, as noted in the BIRM where it is stated that "Bridge inspectors are concerned primarily with load path redundancy. The inspector should neglect structural and internal redundancy and classify all bridges with less than three load paths as non-redundant."

The public often hears generalized descriptions of fracture critical bridges, which state that failure of ANY member WILL cause collapse of the ENTIRE bridge. However, the more accurate definition of a fracture critical bridge is that failure of a TENSION member MAY cause collapse of the entire bridge, or a PORTION of the bridge.

The reality is that fracture critical bridges are not necessarily dangerous death traps, particularly if

A collision severely damaged one vertical member of this pin-connected truss bridge. Another vertical was broken and fell into the river. Although this severely compromised the bridge, these members were compression members, and do not meet the definition of fracture critical members. The bridge was closed but did not collapse during this event.
Photo by Nathan Holth.

they are properly maintained and inspected. In this regard, its worth noting that fracture critical members require a special arm's length inspection which is more rigorous than the standard bridge inspection procedure.

Implications for Pin-Connected Truss Bridges

As historic bridge preservationists, we typically find ourselves dealing with fracture critical bridges when working with metal truss bridges of all types, but in particular with pin-connected truss bridges.

Historic pin-connected truss bridges are generally considered by engineers to be fracture critical, as noted in the Bridge Inspector's Reference Manual's list of fracture critical bridge types: "Simple span truss with two eyebars or single member between panel points." With the exception of railroad bridges or very large highway bridges which may have more, pin-connected truss bridges typically have two eyebars composing tension members (such as bottom chord and diagonal members in a Pratt truss). The presence of two eyebars instead of one might suggest to the layperson that this is a form of redundancy. However, the concern is that in a pair of eyebars, a single eyebar may not capable of handling the bridge's tension forces for a particular member, and therefore if one eyebar fails in a pair, this will overload the other remaining eyebar with double forces and cause it to fail as well. Then, with the entire tension member failed (both eyebars), the bridge would (in theory) collapse.

In reality, it is certainly possible (especially with historic truss bridges from the 1800s for example) that the bridge may have been over-engineered to an extent, such that in reality a single eyebar in a pair might be able to survive and function on its own to some unknown extent , or that if both eyebars in a pair fail, perhaps the bridge might still stand and even function to some unknown extent. This can explain why in the real world, historic pin-connected truss bridges that experience member failure do not collapse. However, in the interest of safety, engineers and inspectors are not going to make such an assumption when evaluating a bridge of this type.

Fracture critical pin-connected truss bridges were the bridge of choice for the United States during 19th Century industrialization. Hundreds of these bridges have survived into the 21st Century, and have thus served traffic faithfully without incident for over a century. Even the Bridge Inspector's Reference Manual, while acknowledging the concerns and need for careful inspection of fracture critical bridges also notes that "Since the 1960's, many steel bridges have developed fatigue-induced cracks. Although these localized failures have been extensive, only a few U.S.

bridges have actually collapsed as a result of steel fatigue fractures."

About the I-35W Bridge Collapse?

The collapse of the I-35W Bridge in Minneapolis is often presented to the public as a reason for demolishing a historic metal truss bridge, with the historic bridge being compared to the I-35W Bridge. However, the reality is that although the I-35W Bridge, like many truss bridges, was fracture critical, the collapse was initiated by a problem that was specific to the initial design of this single bridge. As such, making comparisons to this tragic event is extremely misleading, and offers little value when discussing the fate of a historic truss bridge.

Per the official NTSB Accident Report, the I-35W Bridge collapse was initiated when a single connection failed because this connection's gusset plate was one of several gusset plates on the bridge that were incorrectly designed when the bridge was first built. These gusset plates were not thick enough to provide the needed strength. Because this bridge was a fracture critical bridge, lacking load-path redundancy, failure of the single connection caused the collapse of the bridge as a whole.

The report specifically noted other aspects of deterioration on the I-35W Bridge that specifically did not cause or contribute to the collapse of the bridge. These included corrosion damage, fracture of a floor truss, preexisting cracking in the bridge deck truss or approach spans, temperature effects, or shifting of the piers.

The U10 node on the I-35W Bridge. The gusset plate shown here was improperly designed, and after decades of use failed and caused the collapse of the bridge when it was subjected to a heavy load. *Photo from NTSB I-35W Accident Report.*

Its also worth noting that even though the bridge was designed improperly from day one, it still managed to carry traffic for decades. The NTSB noted that there had been "substantial increases in the dead load from bridge modifications and, on the day of the accident, the traffic load and the concentrated loads from the construction materials and equipment."

It is also worth noting that the I-35W Bridge's trusses did not have any eyebars composing any of its members. Truss bridges with eyebars feature pin connections to hold members together, instead of the gusset plates that the I-35W Bridge used. As such, comparisons of the I-35W Bridge to pin-connected truss bridges make little sense. Moreover, even historic truss bridges with riveted connections that do make use of gusset plates cannot be expected to fail for the reason that the I-35W Bridge did, unless they were also built with undersized gusset plates. This possibility has already been addressed nationwide. Following the collapse of the I-35W Bridge, bridge inspectors were required to analyze the design of all gusset plates on truss bridges to ensure that no other bridges had a similar design error.

The NTSB's Probable Cause statement included the following:

"The National Transportation Safety Board determines that the probable cause of the collapse of the I-35W bridge in Minneapolis, Minnesota, was the inadequate load capacity, due to a design error by Sverdrup & Parcel and Associates, Inc., of the gusset plates at the U10 nodes, which failed under a combination of (1) substantial increases in the weight of the bridge, which resulted from previous bridge modifications, and (2) the traffic and concentrated construction loads on the bridge on the day of the collapse."

What does this mean in terms of fracture critical bridges? Certainly, if this bridge had not been fracture critical by having load path redundancy, it should not have collapsed. However, had the bridge been designed properly, like countless historic truss bridges are, it would not have collapsed either. A properly designed fracture critical bridge that is maintained in good condition does not present a collapse risk.

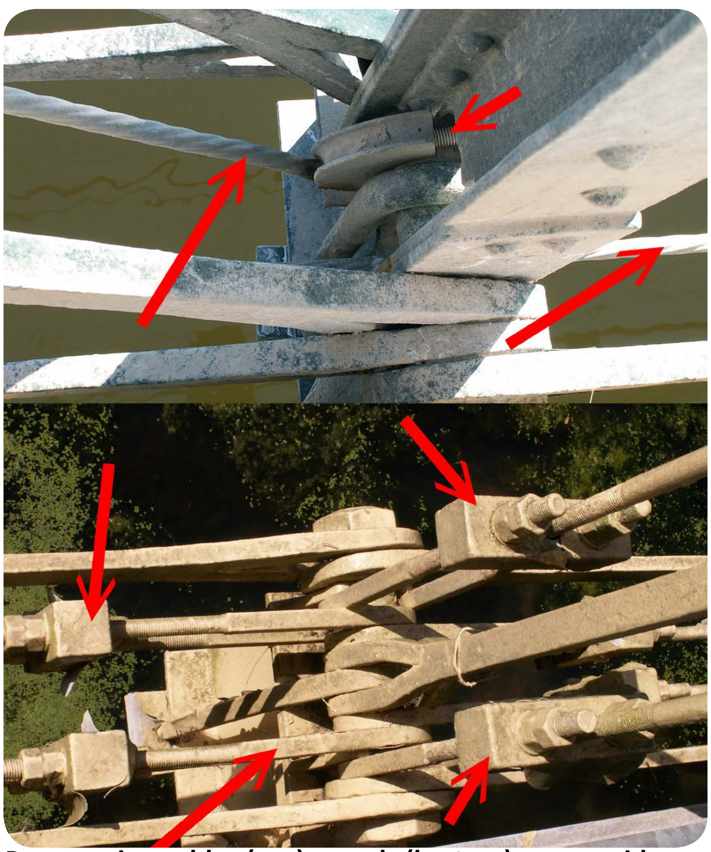
Missouri: Seeking Champ Clark Bridge Materials

The Missouri Department of Transportation (MoDOT) is seeking historic photographs and postcards of the Route 54 Bridge at Louisiana, Missouri, commonly called the Champ Clark Bridge. We are also interested in family stories of the construction of the bridge and early toll collectors. This information will be used in mitigation and interpretive materials about the history of the bridge. If you have information, please contact Karen Daniels, Senior Historic Preservation Specialist at Karen.Daniels@modot.mo.gov or 573-526-7346.

Photo at right By Jessie Sanders, CC BY 2.0, flickr.com/photos/eagle102/2581732658

My Historic Bridge Is Fracture Critical – Now What?

A fracture critical bridge can still be a safe bridge. Numerous examples of restored fracture critical historic bridges exist across the country. Countless fracture critical pin-connected truss bridges have provided over a century of safe and reliable service. Restoration can ensure they continue to do so. If possible, seek out the assistance of engineering firms with prior experience in the rehabilitation of fracture critical historic bridges, such as pin-connected truss bridges, since not only will they be familiar with the best practices for rehabilitation of these bridges, they also will be confident in putting their stamp on a rehabilitated fracture critical bridge. Following rehabilitation, a fracture critical bridge will still most likely at a minimum of every two years require a special arm's-length bridge inspection called the "fracture critical inspection" to check for defects in fracture critical bridge elements.



Post-tension cables (top) or rods (bottom) can provide redundancy for the original tension members on a pin-connected truss. *Photos by Nathan Holth.*

If the owner of the bridge requires redundancy for a pin-connected truss bridge, there are a few ways of doing this. Post-tensioning cables can be added between the historic eyebars. Rods can be added in between eyebars. In general, cables will be less noticeable. In either case, it is typically possible to retain the original eyebars, and simply supplement them with these additional members.

With loop-forged eyebars (which have teardrop shaped eyes), the seam where the bar splits is sometimes misinterpreted as a crack. Dye penetrant testing is a way to better see whether a crack has propagated from this location.

With pin-connected truss bridges, the pins are (structurally) the most important part of the bridge. As part of a rehabilitation, many engineers will recommend their replacement because it can be difficult to detect any cracks or defects in the pins.

Ongoing Research

As described earlier, it is possible for some tension members on fracture critical bridges to be composed of built-up beams that may have internal redundancy, meaning that if one of the components composing the built-up beam fails, the other components can take up the slack, and continue to provide a beam that functions as a whole. However, the challenge has been to understand which built-up beams have a design that offers this internal redundancy. As such, the typical approach has been conservative, where built-up beams in fracture critical members are automatically considered to be non-redundant, and are required to have the fracture critical inspection at an arm's length.

Purdue University is conducting research on real, full-size riveted built-up beams to determine the level of internal redundancy of these types of beams. The home for this research is the Robert L. and Terry L. Bowen Laboratory for Large-Scale Civil Engineering Research and the Steel Bridge Research, Inspection, Training, and Engineering Center (S-BRITE). The typical testing procedure is to simulate a load on the girders great enough to cause a fracture in an element. This is done at very low temperatures to simulate service in very cold conditions when steel is more brittle. After the fracture has occurred, researchers then simulate the type of cyclical loading caused by traffic driving over a bridge, and see how long the fractured beam functions until fatigue causes the beam to fail. Preliminary results of this research suggest that the typical types of riveted built-up beams found on truss and girder bridges can continue to perform for a substantial period even after one component has fractured.

The goal of this research is to show that certain types of built-up riveted beams offer significant internal redundancy, enough to allow them to be considered non-fracture critical members. Not only would this demonstrate that many bridge parts have more layers of safety than previously thought, it also can save money by reducing the time and labor needed to conduct fracture critical inspections since fewer members would actually require an arm's length inspection.

Thanks to Frank J. Hatfield, Ph.D., P.E. for reviewing this article.

Case Study: Opie Road Bridge, New Jersey

By Historic Bridge Foundation

The bridge trusses and roadway after the project. *Photo by Nathan Holth.*

Erected in 1921, the Opie Road Bridge crosses the South Branch Raritan River in Somerset County, New Jersey. The bridge is a rare example of a historic

The Opie Road trusses and deck before the project (left) and after (right). *Before photo courtesy Mary Delaney Krugman Associates and after photo by Nathan Holth.*

The Opie Road Bridge floor beams before the project (left) and after (right). *Before photo courtesy Mary Delaney Krugman Associates and after photo by Nathan Holth.*

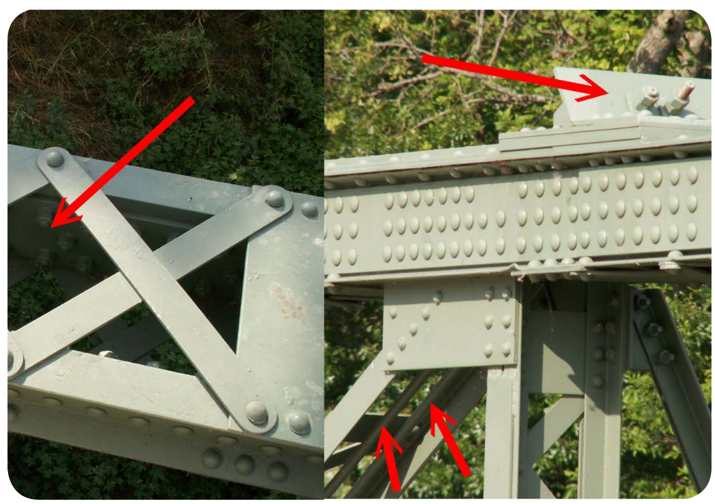
pony truss that was widened without eliminating the functional role that the trusses play in carrying live (traffic) loads. The project was undertaken in 2005.

The bridge consists of two 89 foot spans and an overall length of 180 feet. It is a 6 panel Pratt pony truss with riveted connections, and was built by the Dover Boiler Works of Dover, New Jersey. It was evaluated by the state's Historic Bridge Inventory as eligible for listing in the National Register of Historic Places as an uncommon and unaltered example of a riveted Pratt pony truss bridge.

The scope of the project was to widen the bridge's roadway from the original width of approximately 18 feet to 28 feet, while also addressing deterioration and eliminating a posted weight limit of 10 tons. As one might expect, increasing the roadway by 10 feet, while also increasing the weight limit, meant that a lot of alteration and strengthening had to take place. Indeed, an interpretive sign installed at the bridge describes the project as construction of a replacement bridge, with the new bridge utilizing refurbished trusses from the original bridge. During the project, the abutments and pier were replaced. The wider bridge required new floor beams and a new deck. The trusses from the historic bridge were strengthened by adding post-tension rods to tension members. Additionally, a number of members had plates bolted to the inside of members. Some members also had plate welded to them. The careful placement of added plate and use of button-headed bolts show an attempt to minimize the visual impact of these additions.

This project was the outcome of a Section 106 Review, and the reuse of the historic trusses was mitigation for adverse effect as stipulated in a Memorandum of Agreement.

The consulting engineer for this project was Keller and Kirkpatrick of Parsippany, NJ, while Mary Delaney Krugman Associates of Montclair, NJ, served as historic preservation consultants for the project. Ferreira Construction Company of Branchburg, NJ, was awarded the construction contract with their bid of $4,587,828.90.



Alterations to the trusses included bolted plates added (left) and post-tension rods (right). *Photos by Nathan Holth.*

Images of America: Pittsburgh's Bridges

A New Book from Arcadia Publishing

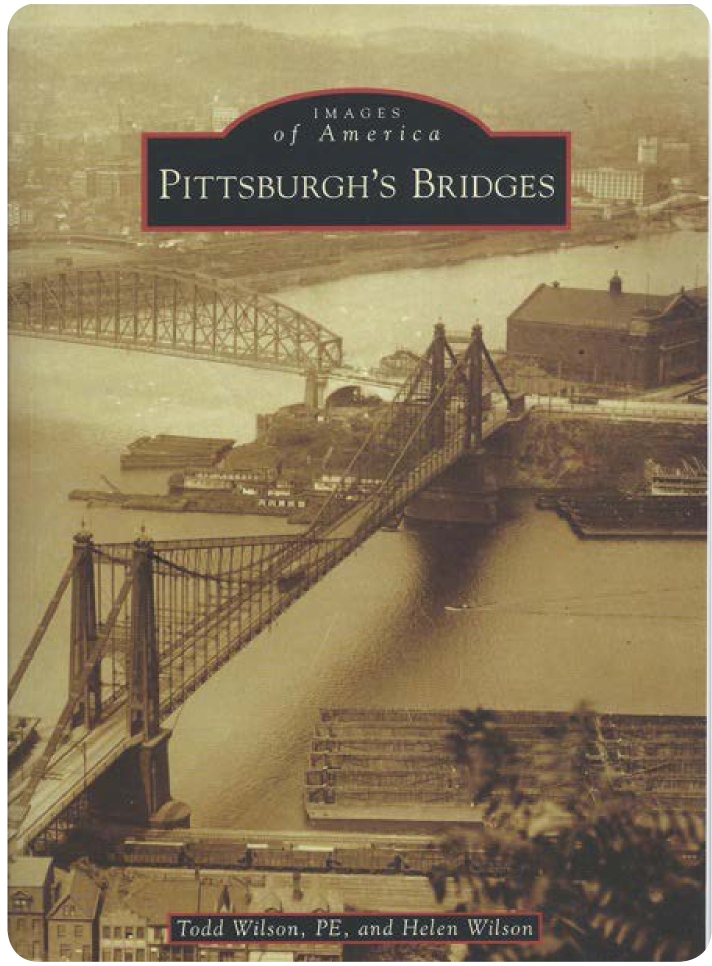
Civil Engineer Todd Wilson, PE, and Helen Wilson, a historical writer, have collaborated on a book about the history of bridges and bridge building in Pittsburgh, Pennsylvania. The book is part of Arcadia Publishing's Images of America series and is entitled, fittingly enough, Images of America: Pittsburgh's Bridges.

Although other books have been written about the bridges of the "City of Bridges," as Pittsburgh is known, the Wilsons' book is different in that it takes a look at all of the major bridges within the boundaries of the city and many smaller bridges as well. Arcadia's format of being heavy on photographs and other images from the past, accompanied by lengthy captions, allows readers to view each bridge as it is discussed, a format that lends itself particularly well to bridges because of their varying histories and details of their construction. A four-page main introduction and shorter chapter introductions put the images in historical context.

The arrangement of the chapters makes the book an easy way to grasp the history of bridge building in Pittsburgh, explaining why various types of bridges were built and the conditions that caused many of them to be replaced. Chapter One deals with the sequence of bridges at the Point, the location of much of the city's development. The next three chapters deal with the bridges—past and present—spanning Pittsburgh's three great rivers, the Allegheny, Monongahela and Ohio, proceeding from the Point outward and also back in time.

Pittsburgh is a city of hills and valleys, and bridges were needed to connect its numerous neighborhoods. Chapter Five looks at the bridges over valleys and ravines, many of which have historical and architectural significance.

Chapter Six deals with a period in Pittsburgh's history that created the most aesthetically pleasing of all the bridges in the city—the graceful concrete arch structures of the City Beautiful Movement of the early 1900s, now being demolished one by one. Few



remain. Pittsburgh's Bridges ensures they will not be forgotten.

Railroads played a major part in Pittsburgh's development, and vehicular overpasses were built to separate railroad tracks from roads. These overpasses are discussed in Chapter Seven.

The final chapter deals with a type of bridge most often found only in hilly terrain such as Pittsburgh's—pedestrian bridges spanning ravines and creeks that allowed people to get to trolley and train stops as they went to work.

The book was a labor of love for Todd Wilson, who has been passionate about bridges since childhood. He has traveled not only around the Pittsburgh area but also to all 50 states and various countries worldwide to photograph bridges. These beautiful structures, he feels, are a perfect combination of art and technology. They soar into the sky and lift the spirits of those who see and cross them.

Todd's training as a civil engineer gives him the knowledge to write expertly about the technical details of the bridges and provide details of their construction. Helen's experience as a historical writer puts the bridges in the context of the times in which they were built. Their collaboration has resulted in a handbook of more than 144 of Pittsburgh's significant bridges.

Images of America, Pittsburgh's Bridges is available on amazon.com. Click here to visit the Amazon listing.

Upcoming Conferences

Iron & Steel Preservation Conference & Workshop

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

National Trust, PastForward Conference

Location: Washington, DC
Date: November 3-6, 2015
Website: http://pastforwardconference.org/

GIS: Practical Applications for Cultural Resource Projects

Location: Austin, TX
Date: November 17-18, 2015 or November 19-20, 2015
Website: http://www.npi.org/sem-GIS.html

Section 106 Training and Seminars

Location: Various
Date: Various
Website: http://www.achp.gov/106essentials.html

Bypassed by a new bridge and abandoned, the suspension bridge over the Muskingum River in Dresden, Ohio is a rare eyebar chain suspension bridge. It was built in 1914 by the Bellefontaine Bridge and Steel Company of Bellefontaine, Ohio. *Photo by Nathan Holth.*