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Workers from Bach Steel assemble the Clover Ford Bridge in its new home at Blue River Park in Shelbyville, Indiana, in April, 2019. The Pratt truss bridge was built in 1889 by the King Bridge Company of Cleveland, Ohio, and was previously located over Buck Creek on CR-875 West in Shelby County. *Photo by Nels Raynor.*

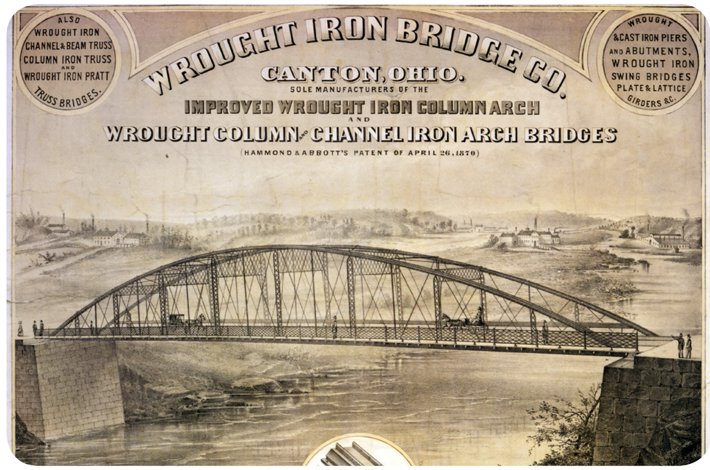
Seeking A New Home:

Kern Bridge, America's Largest Bowstring Span

By Historic Bridge Foundation

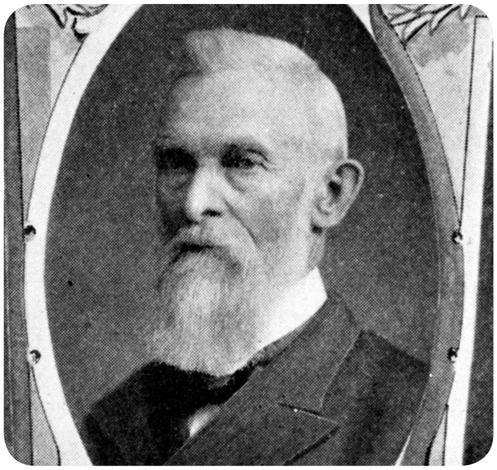
Background of Bowstring Truss Bridges

Bowstring truss bridges are sometimes called bowstring arch bridges because they have similarities to both structure types. Beginning with Squire Whipple's cast iron Whipple arch bridges, which were popular in the 1850s, the bowstring truss bridge is the bridge type that began a transition away from wood and stone and began to make metal a common bridge building material. It also began a period of experimentation until a good bridge form was developed, leading to a gradual standardization of bridge design. During this period, numerous bridge companies all experimented with metal, trying to design the best bridge. Each company had their own distinctive bowstring design, including unique and creative design details. These designs were often patented. Construction of bowstring truss bridges reached a peak in the 1870s. Most bowstring truss bridges surviving today also date to the 1870s. However, unlike Whipple's arch bridges, most bowstring truss bridges built in the 1870s did not use cast iron for the major compression members, with wrought iron having become more popular. During this time, cast iron was still used for some details such as connection assemblies, but wrought iron was generally used for the actual bridge members. Some of the leading bridge companies of the late 19th century rose to prominence by successful marketing of their patented bowstring truss bridges. In particular, the King Bridge Company of Cleveland, Ohio, and the Wrought Iron Bridge Company of Canton, Ohio, enjoyed nationwide success.



An advertisement for the Wrought Iron Bridge Company featuring another long-span bowstring truss bridge (that no longer exists), the Fox River Bridge at Ottawa, Illinois.

A view standing beside the Kern Bridge. *Photo by Nathan Holth.*



A portrait of David Hammond, taken when he was working with the Canton Bridge Company.

By the 1880s, bridge companies (and perhaps their customers as well) decided that the pin-connected Pratt truss was a better structure type, and construction of bowstring bridges sharply dropped after 1880.

Because of the period in which the Midwest was being settled, states in this part of the country constructed a significant number of bowstring truss bridges. As a result, states such as Ohio and Iowa have higher numbers of bowstring truss bridges. However, a number of states do not have even a single historic bowstring truss within their borders. As such, bowstring truss bridges are extremely rare on a national scale, despite a handful of states having more than a few surviving examples.

While ideal candidates for preservation for non-motorized traffic, these lightweight bridges often struggle to meet the needs of modern vehicular traffic. Surviving bowstring truss bridges today are often abandoned as a result. While abandoned bowstring truss bridges themselves do not deteriorate at a high rate due to the rust-resistant properties of cast and wrought iron, these fragile bridges are often at risk for collapse due to flood damage. It is imperative that each surviving bowstring in the county be preserved to protect this key period in bridge building history. Restored and placed onto substructures designed and engineered with modern thought of flooding and hydraulics, historic bowstring truss bridges will be ready to serve non-motorized traffic for another century.

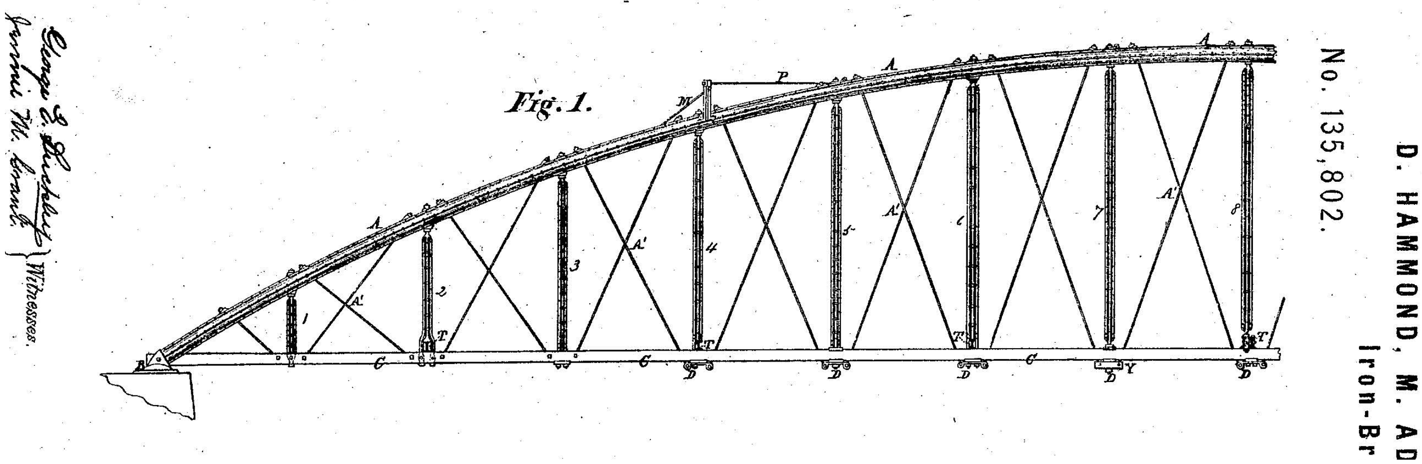
Background of Wrought Iron Bridge Company and David Hammond

The Wrought Iron Bridge Company of Canton, Ohio, was a leading builder of iron bridges in the second half of the 19th century. The success of the company may in part be due to the success of their bowstring truss bridges in the 1870s.

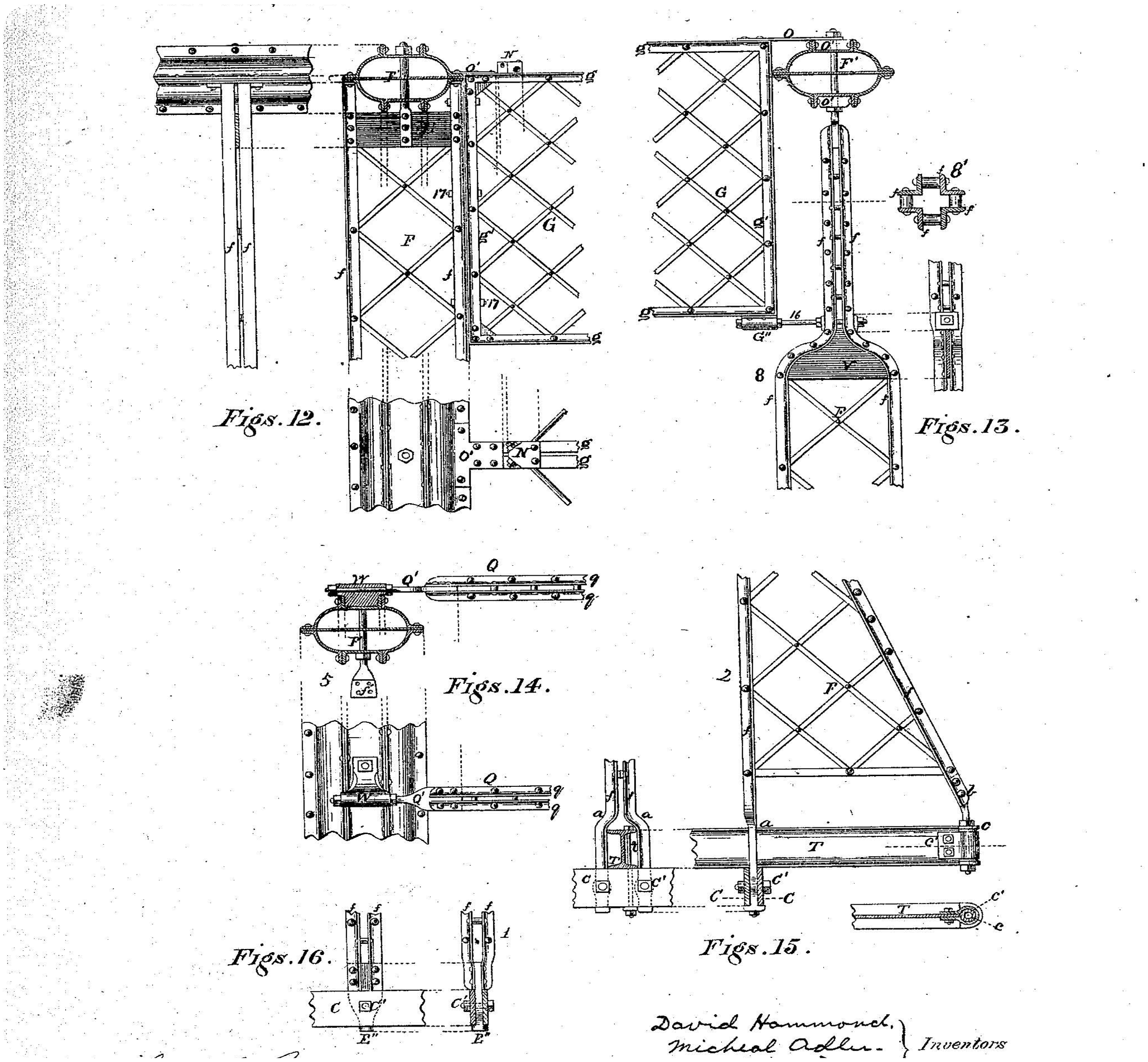
David Hammond, founder of the Wrought Iron Bridge Company of Canton, Ohio, was born on a farm in Plain Township, Ohio, in 1830. At the age of 18, he moved to Canton and began an apprenticeship with a noted carpenter, William P. Prince. By 1860, David Hammond had established his own building construction company and constructed several timber bridges. Unhappy with the quality of all-timber bridges, he developed a combination bridge, which used both timber and iron in bridge members. To assist him with the iron, he worked with Washington Reeves, a local metal worker, and John Laird, owner of the local foundry. Soon, they determined it was possible to design and manufacture all-iron bridges. In 1862, David Hammond obtained a contract to construct a 60-foot all-iron bridge in Canton for $1,200. The success of this bridge encouraged Hammond to continue developing and building iron bridges.

The partnership of Hammond and Reeves was formed in 1864 to engage in bridge building and general contracting. They erected a small fabricating plant and secured bridge repair and small bridge construction projects. Reeves was satisfied and with these small projects, while Hammond was more

A view on the deck of the Kern Bridge. *Photo by Nathan Holth.*



Drawing from the original David Hammond patent showing a general view of the patented bowstring design.



Drawing from the original David Hammond patent showing various connection details. These details are similar, if not identical, to those found on the Kern Bridge. This was often the case with bridge patents. Inventors would frequently vary the exact design from what was filed with the patent office. Patents were legal documents intended to protect company interests, not engineering blueprints.

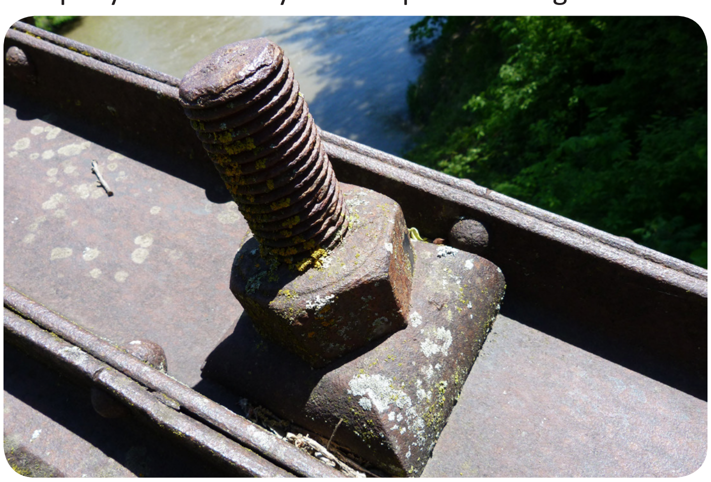

Typical view of a rivet along the top chord column of the Kern Bridge. Note the small notch in the rolled column channel, which was used by the fabricator to locate the holes for the rivets. *Photo by Nathan Holth.*


Detail of the Kern Bridge connections at floorbeam, bottom chord, and vertical member. *Photo by Nathan Holth.*

interested in company growth and larger bridge projects. As a result, David Hammond formed the Wrought Iron Bridge Company in 1865, and for the next four years both companies continued to operate out of the small fabricating plant. In time, the Wrought Iron Bridge Company quickly outgrew the small fabricating plant shared with Reeves. As a result, in 1870, the partnership of Hammond and Reeves was terminated and Washington Reeves returned to the metalworking trade.

In 1871, the Wrought Iron Bridge Company was incorporated, and a new, larger fabricating facility was erected. Skilled workers and graduate engineers were hired and branch offices established to support a widespread sales effort. The results of this effort were quickly realized as the newly incorporated company immediately took its place among the leading bridge builders in the country. The sales grew from 100 bridges in 1871 to 490 in 1880. By 1880, the company had erected 3,300 spans with bridges located in 25 states and Canada. During this period, David Hammond served as president, and during this period iron bowstring truss bridges like the Kern Bridge were the company's main product. In 1881, he was removed as president and for the next nine years served as sales agent and in other capacities. In 1890, David Hammond resigned from the Wrought Iron Bridge Company and withdrew his stock.

Although originally intending to retire, Hammond was convinced by others to organize the Canton Bridge Company in 1891, which became a success in its own right. But Hammond left behind a highly successful Wrought Iron Bridge Company that continued to enjoy success after he left. It had been during Hammond's leadership of the Wrought


Detail of vertical member threaded rod and nut connection, with cast iron washer, along the top chord. *Photo by Nathan Holth.*


Detail of Kern Bridge's vertical member connection to top chord, and sway bracing connection to vertical member. *Photo by Nathan Holth.*

Iron Bridge Company in the 1870s that many iron bowstring bridges were erected across the country, likely paving the way for the company's success with other bridge types such as the Pratt truss in the 1880s and 1890s.

The Kern Bridge

In 2019, among all surviving bowstring truss bridges, the Kern Bridge over the LeSeuer River in Blue Earth County, Minnesota, stands out as one of the most significant in America. The bridge was built in 1873 by the Wrought Iron Bridge Company of Canton, Ohio. With a 190-foot span, this bridge is the longest known surviving cast and wrought iron bowstring truss spans in the United States and is the second longest in North America, with only the 225-foot Blackfriars Street Bridge in Ontario being longer. However, the Blackfriars Street Bridge is today composed of nearly all modern material and has been significantly redesigned, resulting in very poor historic integrity. In sharp contrast, the Kern Bridge enjoys a nearly complete lack of alteration, which is a remarkable achievement for a bridge from the 1870s. Its age, design, lack of alteration, and span length all combine to make this one of the most important historic bridges in the United States.

For comparison, the longest known span bowstring built by the competing King Iron Bridge Company of Cleveland, Ohio, is the 170-foot Cowley Bridge in Lincoln County, Tennessee, which was built in 1878. The next largest bowstring built by the Wrought Iron Bridge Company is the 1878 Freeport Bridge in Winneshiek County, Iowa, which spans 160 feet.

The Kern Bridge has been abandoned for many years and today it is resting on abutments which are critically compromised. Floods have washed out the abutments to a point where the truss is at imminent risk for collapse. Despite all odds, the truss remains standing after the spring 2019 flood season. Recognizing the significance of the truss, and the imminent danger of its destruction, the bridge is to be non-destructively dismantled and placed into storage. However, a new home for the bridge has yet to be located. As such, any community seeking a bridge for a park, trail, or other non-motorized use has a unique opportunity to choose the nationally significant Kern Bridge for their needs.

The superior rust-resistant chemistry of cast and wrought iron (in contrast to steel), combined with the fact that it avoided the winter deicing salts found on modern paved roads, has allowed this bridge's trusses to remain in outstanding condition despite a lack of paint. Indeed, much of the iron on the bridge looks like it did the day it was erected. Tiny notches on the top chord placed by fabricators to mark the position of rivet holes remain clearly visible. Tiny

An elevation view of the Kern Bridge, showing the shallow arch of the bridge. *Photo by Nathan Holth.*

punch marks associated with fabrication can be found in other areas of the bridge as well. The iron on the bridge remains smooth with no pitting and the edges of the metal remain sharp. Pack rust and section loss are practically nonexistent. A few minor parts have damage that would be easy to repair. One portal bracing beam is bent, and some of the castings which connect the truss members have cracked.

To maintain the bridge's excellent historic integrity, it is important that any preservation work done on the bridge follow the latest techniques of restoration, focused on maintaining original bridge material, employing historical construction methods like riveting, and replicating exactly any parts that must be replaced. With an in-kind restoration, the retention of the rust-resistant iron can be a positive for the new owner, and it will ensure that this bridge retains its museum-quality integrity of materials and design.

The aesthetics of the Kern Bridge are truly unique. The intricate design details of the truss convey the bridge's ancient origins, during a period of experimentation and patented, non-standard designs. However, the overall presentation of the bridge is that of a strikingly lightweight bridge, with a very shallowly curved arch, giving the bridge a graceful profile that was not typically seen in bridge design until the second half of the 20th century. Thus, this bridge would be a beautiful addition to any setting, regardless of whether the surrounding architecture of its new setting is predominantly modern or historical. The county plans to let a contract and take the bridge down this fall, and then it will come to MnDOT for storage and marketing. For more information, contact Lisa Bigham, lisa.bigham@state.mn.us, or at 507-304-6105

Orient Bridge: Keeping a Beautiful Bridge Visible

By David Simmons

The Orient Bridge was identified as among the state's most significant bridges when the Ohio Department of Transportation (ODOT) completed their first *Historic Bridge Inventory, Evaluation, and Preservation Plan* in 1983. It is certainly among Ohio's most impressive highway bridges, stretching 228 feet in a single span and with trusses that tower 30 feet above the roadway. Built in 1885 by the Cleveland Bridge and Iron Company, it features highly unusual "onion" finials at each corner. Once a system especially popular in the 1880s for long-span structures, it is now one of only a handful of double intersection Pratt trusses still standing in Ohio. This truss was an important evolutionary step as bridge builders steadily pushed simple span, metal-truss bridges to their practical limits. That limit was ultimately reached in 1906 when the Elizabethtown Bridge was constructed over the Great Miami River in Hamilton County—spanning an astonishing 586 feet long and rising 80 feet high. It replaced a remarkable covered Howe truss, the so-called "Lost Bridge" built in 1866, which was destroyed by fire. The Orient Bridge, crossing the Big Darby Creek near Harrisburg in Pickaway County, was bypassed with a nearby new State Route 762 bridge in the 1980s. Because of its significance, ODOT agreed to preserve the bridge in place and retain ownership. Technically, that also meant maintaining the bridge, at least minimally. The

Ornamentation and plaque on the Orient Bridge's portal bracing. *Photo by Nathan Holth.*

The cottonwood had actually grown around the lower chord of the Orient Bridge and when in full leaf totally obscured the end of the bridge. *Photo by David Simmons.*

bridge was part of the spring tour in 2014. Since being closed, trees had grown up around the bridge. In fact, a cottonwood tree had germinated at the base of the western abutment, grown around the lower chord, and was towering over the portal of the bridge. It was a pretty ludicrous sight, and several local residents told me that they regularly complained to both ODOT and county officials. In fact, ODOT had explored removing the tree in 2012, but it obviously remained a low priority. In early April this year when traveling to and from Washington Court House, I decided to stop and inspect the bridge a little closer. The tree had continued to grow, convincing me that OHBA needed to get involved. I sent some photographs to the Cultural Resources Section in ODOT's Columbus office. My query was forwarded to the District 6

While removing trees from the east end of the bridge, the trimmer discovered a honeybee hive and comb attached to an onion finial. *Photo by David Simmons.*

Office in Delaware, and that office forwarded a right-of-way work permit application. My plan was to use proceeds from the Pauline Miller Fund at the Columbus Foundation to finance the tree's removal. I met with Rich Germann of McCullough Tree Service at the bridge. While discussing the project, it became apparent that the cottonwood at the west end was only the most obvious problem, and that far more trees were growing against the bridge at the opposite end. Together we devised a plan of action, and he gave me a bid of $3,500 to cut the cottonwood and trim or remove all the other trees. Because Big Darby Creek is included in Ohio's Scenic River program, I knew McCullough's crew would be required to haul away all the trimmings. With this estimate in hand, I filed the application, and by May 4, I had the permit in

Grapevines had crawled up the Orient Bridge end post and grown into the top chord of the bridge. The trimmer had to suspend himself between the top of the cottonwood and the lacing of the top chord to remove them. *Photo by David Simmons.*

While cutting the tree from around the Orient Bridge's lower chord, the trimmer got his chain saw caught. It was only released when a colleague sawed through the trunk closer to the abutment. . *Photo by David Simmons.*

hand. Getting equipment in on the west side required coordination with Trapper Joe's Canoe Livery whose drive and locked gate controlled access. Land on the east end was formerly the grounds of the Orient State Hospital, now operated as the Pickaway Correctional Institution. Both private and public entities proved happy and willing to help once the proper contacts were made. The work was done over two days in mid-May. Watching the primary trimmer at work was like studying an acrobat high in the air. He was highly skilled in climbing and supporting himself with rope rigging while handling any number of tools, including a chain saw, and his expertise in the proper sequence for safely trimming a tree was immediately apparent. Possessed of a deep historical appreciation, he considered it a privilege to work on a historic bridge. The bridge is at the busy intersection of the Big Darby Creek Road and SR 762, and the removal of the cottonwood was a dramatic and highly visible improvement. Even while the crew was still at work,

An OHBA sign now marks the end of the Orient Bridge. *Photo by David Simmons.*

those passing by indicated their enthusiastic support of the project. One woman who lived just a few miles south of the bridge—she turned out to be a former OHBA member!— stopped to gush how thankful she was for the effort. I hired a sign maker to prepare a sign indicating the project had been funded by OHBA and which also listed our website address. Since then, I have received additional calls at the Ohio History Center expressing appreciation for the project. It was also featured in The Columbus Dispatch and Dayton Daily News under the headline "Bridge gets tree-ectomy." With the bridge free of trees, it will hopefully revive efforts to develop a project to replace the deck and make the bridge safe for more widespread use.

David A. Simmons is president of the Ohio Historic Bridge Association, which promotes the study and protection of historic bridges in Ohio, and is the Senior Editor for the Ohio Connection's (formerly the Ohio Historical Society) popular history magazine Timeline.

The Preservation of Historic Bridges

By Patrick Sparks, P.E.

(This article is an updated reprint from Bridge News, Spring 2007)

Introduction

Historic bridges constitute an important cultural, technological, and functional link to our past. Sadly, in spite of growing awareness of historic bridges and cultural resources in general, we continue to lose historic bridges at an alarming rate. In 2003, the report *Historic Bridges: A Heritage at Risk* estimated that 50% or more of the nation's historic bridges had been lost in the past 20 years. Almost all historic bridges are considered structurally deficient or functionally obsolete, and pressure to replace them is mounting.

The physical risks to historic bridges include deterioration, impact damage from vehicles or barges,

The c. 1889 Lampasas River Bridge in Bell County collapsed on February 4, 2006, when a vehicle struck the northwest end-post during a police chase. It was one of a handful of wrought-iron Whipple through-trusses remaining in Texas. Photo by Trent Jacobs. *Photo by Trent Jacobs.*

A 1930s WPA stone arch bridge, Austin, Texas. *Photo by Patrick Sparks.*

flood, and overload. Sometimes these conditions lead to collapse, as in the example of the Lampasas River Bridge in Bell County, Texas. Fortunately, the risk of collapse can usually be minimized with a modest investment in proper maintenance and repairs.

While a loss to neglect and physical forces is tragic, an even greater risk to historic bridges is planned replacement, resulting from a lack of awareness of alternatives, and scarcity of funding for preservation.

This article addresses several areas that are fundamental to the preservation of historic bridges: significance, risk factors, alternative uses, funding, and advocacy.

Significance

The nation's preservation community does not have a clear idea of how many historic bridges there are, and which ones are the most significant. Although each state is required to have an inventory of their historic bridges, many of the inventories are incomplete or inaccurate. Also, most local preservationists are not familiar with, and have no access to, the inventory databases.

Historic bridges comprise a wide range of types and materials. Most people are familiar with the metal truss bridges that were common in the late nineteenth and early 20th century, but there are also many types of masonry and concrete bridges.

In evaluating the significance of a historic bridge, the usual National Register criteria apply, but additional factors should be considered as well. Most historic bridges were designed by engineers or builders, not architects. Often the engineers worked for manufacturers, contractors, or governing

The Broad Street Bridge in Mason, Texas, is an example of a rare concrete truss bridge. *Photo by Nathan Holth.*

authorities (e.g., the railroad). Structure type, materials, methods of design, and technological advances are key elements in establishing significance, as opposed to aesthetics. The graceful beauty of a bridge derives primarily from its mathematical and geometric expression of structure. Decorative features do not affect significance to the extent they do in architectural heritage. For these reasons, it is important for historians or others evaluating the significance of a bridge to understand the history of engineering technology.

For example, in early concrete bridges, much of the engineering significance may be in the steel reinforcement system, which is not visible, and for which documentation is rare. In metal truss bridges, the kind of metal becomes a consideration due to rapid technological change. Whether a bridge is made of wrought iron, of which few remain, may determine if it is more or less significant than a similar bridge of steel. Another example is the combining of multiple types of metal in one structure, such as the Hays Street Bridge in San Antonio, an 1881 Whipple through-truss that has cast iron joint blocks, wrought-iron chord members, and steel pins.

Although the National Historic Preservation Act (NHPA) specifically identifies some categories that are usually not eligible, such as reconstructed or relocated structures, this rule does not necessarily apply to truss bridges, which were routinely moved, re-erected, or even combined with parts of other bridges. Engineers generally see these activities in themselves as contributing to significance.

Note that characteristics of condition, traffic volume, and maintenance difficulty should not be considered in determining historic significance.

Preservation Alternatives

Another key aspect of preservation is the identification of alternative ways of preserving historic bridges. Selection of a preservation alternative depends on many factors, including the condition of the bridge, site considerations, traffic conditions, cost, government regulations, legal liability considerations, commercial conditions, and local interest in preservation.

The following is a generally preferred hierarchy of choices:

1. Continued vehicular use in its present location. If widening, repair or strengthening is needed, it should be done discreetly.
2. Continued vehicular use as part of a one-way pair in its present location, with a new adjacent span.
3. Continued vehicular use at another site.
4. Reuse as a pedestrian or bicycle bridge.
5. Architectural adaptive use.
6. Salvage and store for reuse. It should be match-marked, carefully dissembled, and stored, with the intent that at some future time and place it could be rebuilt.

A top-chord pin connection from the 1881 Phoenix Whipple truss on the Hays Street Bridge in San Antonio. The bridge contains three distinct materials: wrought-iron, cast-iron, and early steel. *Photo by Patrick Sparks.*

From left to right, three similar Parker through trusses with different outcomes: The Llano River Bridge was once slated for removal but was rehabilitated and kept in vehicular service. *Photo by Nathan Holth.* **The US 90 Bridge over the Nueces River was successfully kept in service as part of a one-way pair.** *Photo by Patrick Sparks.* **The Colorado River bridge on SH 29 was bypassed and converted to pedestrian use, albeit with an inappropriate chain link fence.** *Photo by Patrick Sparks.*

7. Set off as a historic ruin, making provisions to minimize the rate of decay.

8. Salvage selected components of the bridge that would be otherwise destroyed. These components could be made into exhibits, or used for engineering research.

9. Demolish after documentation with drawings and photographs to HAER standards.

As an example of alternatives, consider the case of similar Parker trusses. Bridges of this type from the 1920s and 1930s tend to be well-constructed robust structures. They often have less width and vertical clearance than is now required in new construction, but rarely do they have major structural deficiencies. The Llano River Bridge in Texas remained in service because citizens rallied to save it and engineering studies validated its structural capacity. The U.S. 90 Bridge over the Nueces River in west Texas was continued in service as part of a one-way pair. Similar bridges on U.S. 377 and on SH 29, both over the Colorado River, were bypassed with new bridges. The U.S. 377 Bridge was cut-off entirely from vehicular and pedestrian access. The SH 29 Bridge is accessible to pedestrians, but is enclosed in a historically inappropriate chain-link fence.

Strategies for Preservation

Along with the realization that the nation's bridges are in disrepair has come a growing awareness among preservationists that bridges need attention as legitimate objects of preservation. At the same time, almost all historic bridges are seen as liabilities by transportation authorities and are considered de facto candidates for replacement.

Local Support

As with any preservation effort, success is determined largely by the momentum of local citizens and organizations. The key is to identify an area's most important bridges as soon as possible, and begin to create public awareness– not only of the significance, but also of the feasibility of restoration. It is particularly important to bring civic leaders into agreement with the idea of saving the bridge. While most historic buildings are privately owned, essentially all historic bridges are owned by a city, county, or state government.

Actual implementation must occur at the state and local levels. In fact, most bridges of historic significance are on county or municipal road systems, rather than part of the federally-funded highway system.

It is also common for local citizens and other interested parties to learn about replacement plans only after those plans are fully developed and have gained momentum, making it harder to rally support or to change the governing authority's intent. Engaging the city or county engineers, and the DOT district staff early on will help.

Section 106 and Section 4(f) Processes

Because many transportation projects use federal money, it is usually possible for preservation advocates to make use of the available review processes required by federal laws. When federal funds are involved, then the National Historic

Preservation Act (NHPA) Section 106 review process is required. This is the same review process as required when federal actions affect historic buildings and sites.

Another federal law concerning historic preservation of bridges is the U.S. Department of Transportation Act of 1966, Section 4(f), which bars federal transportation programs from using land from a publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless a determination is made that there is no feasible and prudent alternative to the use of land from the property; and the action includes all possible planning to minimize harm to the property resulting from such use.

It often seems that the Section 106 and 4(f) reviews are just a formality, with replacement being a foregone conclusion. Nevertheless, the time bought by the process, and the opportunity for public involvement, have been crucial in saving historic bridges. While some efforts have been made by DOTs at "streamlining" the process to avoid delays, for those who wish to save a bridge, it is better to buy time, which means using the process to its full intent.

There are a number of things that can be done locally to strengthen the preservationist's position in the review process. Seek nomination to the National Register for Historic Places for the bridge and nearby structures. In an urban area, try to include the bridge as a contributing element to a historic district. Identify existing parklands, recreation areas, refuges, and historic sites in your area and their relation to significant bridges. Ideally, try to proactively establish such areas in proximity to the most important bridges, before replacement plans have been developed, so the Section 4(f) review will be triggered and the chances for preservation will be greater.

Engineering

Typically, the DOT will assert that a historic bridge is structurally deficient and/or functionally obsolete. While it is true that many older bridges are deficient or obsolete, these two things do not necessarily mandate replacement. Obviously, all bridges that are not "up to code" shouldn't be replaced, nor do they need to be. Therefore, it is important to query the authority about the specifics of their assessment.

It is possible to rehabilitate a historic bridge in a manner that maintains the historical integrity of the bridge. However, most DOTs insist on rigid adherence to design standards for new bridges and roadways, which may not be appropriate for historic bridges. Although there are provisions under which the standards may be relaxed, they are rarely invoked.

1887 Faust Street Bridge, New Braunfels, Texas, rehabilitated to pedestrian and bicycle use in 1998, using Transportation Enhancement funds. *Photo by Nathan Holth.*

An independent engineering evaluation is often needed to determine whether the bridge is structurally deficient or if its functional characteristics can be improved short of replacement.

All bridges in the U.S. must be inspected biannually, with the results of that inspection being recorded in the condition ratings for the superstructure, substructure, etc. The condition rating numbers are then used in a complicated formula to arrive at the sufficiency rating, a single number that is used by the state DOTs and the FHWA to decide which bridges are to be replaced or rehabilitated. When attempting to save a historic bridge, it is crucial to review the inspection reports and the condition ratings to see what factors are affecting the sufficiency rating. In most cases, the sufficiency rating of the bridge declines over time, as expected, because the condition of the structure deteriorates. Generally, however, structural deterioration is a slow process, so a rapid lowering of the scores indicates a need for closer examination.

Closer examination of the design and planning assumptions, structural condition, and cost estimates may help to understand which measures are necessary, and which might possibly be relaxed. Here are a few examples:

1. Rather than widening or replacing the bridge it may be possible to dramatically improve safety simply by reducing the posted traffic speed, improving the lighting and signage, adding guide rails, and providing traffic-calming features to the roadway.

2. Often repairs and maintenance are a much lower cost than replacement: repair damage to members, seal deck joints, upgrade the railing, install lighting, and perform maintenance painting.

3. Consider alternative routes for heavy traffic. A truck spur around the heart of a historic city can remove heavy vehicles from downtown, increase the traffic volume of the roadway, and improve safety of the downtown area.

Advocacy Groups

A number of organizations focus on saving historic bridges. The Historic Bridge Foundation (HBF) provides a clearinghouse of information and helps local entities develop strategies for saving bridges. The National Trust for Historic Preservation (NTHP) has supported local advocacy actions, legal advice, and emergency engineering studies of endangered bridges. HBF and the NTHP often work together. Examples of this partnership include the U.S. 83 Bridge in Collingsworth County, Texas, and the Amelia Earhart Bridge in Atchison, Kansas.

The American Society of Civil Engineers (ASCE) supports the maintenance, repair and rehabilitation of historic bridges, preferably in continued vehicular use, and when that is not possible, in an alternative transportation means such as a pedestrian or bicycle bridge. ASCE's support includes nominations for Civil Engineering Landmarks, and local/regional chapter involvement in direct efforts to save bridges, as occurred with the Hays Street Bridge in San Antonio.

Funding

Bridge rehabilitation, like building preservation, is sometimes a costly endeavor. Costs are generally in proportion to bridge size, running approximately $1,000 per linear foot to over $12,000 per linear foot, depending on type, condition, complexity, and location. Unfortunately, there are few sources of funding specifically for historic bridges.

Since most historic bridges are on local road systems, funding is scarce unless provided or matched by federal-aid, but these funds are focused almost entirely on new construction and replacement projects, and rarely on saving historic bridges. State maintenance funds go mostly to routine pavement overlays, sealing, and minor repairs to bridge railings.

The establishment of the Transportation Enhancement Program in 1991 offered broad opportunities and federal dollars to undertake unique and creative actions to integrate transportation into our communities and environment, including historic preservation.

Ten percent of each state's Surface Transportation Program (STP) funds were set aside for enhancements. By federal law, these funds were to be used for transportation enhancements and for

1881/1910 Hays Street Bridge in San Antonio, rehabilitation as a pedestrian and bicycle bridge using Transportation Enhancement funds, completed by 2010. *Photo by Patrick Sparks.*

no other purpose. Over the history of the program, the Texas Department of Transportation (TxDOT) awarded an estimated $466 million to a total of 505 enhancement projects.

The Transportation Enhancement program was, perhaps, the largest funding source for historic bridge preservation in the United States. Two notable examples in Texas to receive enhancement grants were the 1887 Faust Street Bridge (1998) and the 1881/1910 Hays Street Bridge. Now called Transportation Alternatives funding, the majority of the funds spent in Texas are for bike and pedestrian improvements. Other states may use the funds for historic bridges and those interested should contact their state department of transportation.

Conclusion

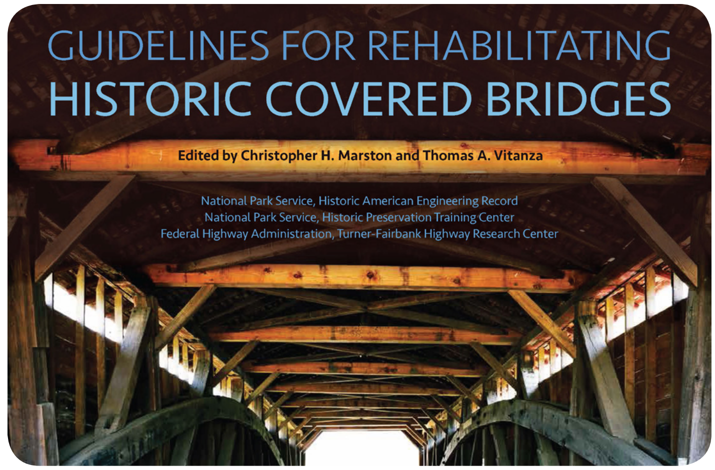
Although many historic bridges can remain in service given appropriate repairs and maintenance, they remain at risk due to overly rigid transportation standards and lack of funding.

Vehicular use is the best preservation alternative because it keeps the bridge in highway maintenance, inspection and funding programs. When not possible to continue in vehicular use on primary roads, consideration should be given to relocating historic bridges to roads receiving lighter volumes of traffic, or converting to pedestrian use.

Saving historic bridges means rallying local support, engaging the responsible authorities, and using established regulatory processes to advantage. It also means finding money, at task made much more difficult in Texas by the retraction of the Transportation Enhancement program.

As the preservation community grows in its awareness of the importance of historic bridges, so do the opportunities for saving these engineering icons.

Patrick Sparks, P.E. is a former board president of the Historic Bridge Foundation and is also president of Sparks Engineering, Inc., an engineering firm specializing in evaluation and rehabilitation of existing structures. He is a Professional Fellow of the Center for Heritage Conservation at Texas A&M University, and is a member of ISCARSAH, an international scientific committee on structural conservation .



Guidelines for Rehabilitating Historic Covered Bridges

By Christopher Marston

The Historic American Engineering Record (HAER) is pleased to announce the publication of *Guidelines for Rehabilitating Historic Covered Bridges*, edited by Christopher H. Marston, HAER Architect, and Thomas A. Vitanza, Senior Historical Architect, NPS Historic Preservation Training Center (HPTC).

The book represents a final milestone from 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

Cataract Falls Covered Bridge, located in Owen County, Indiana. This Smith truss, built by the Smith Bridge Company of Toledo, Ohio, in 1876, is shown here being moved off the river for restoration. *Photo by J. A. Barker Engineering, January 2003.*

Cornish-Windsor Covered Bridge, located on the state line between Sullivan County, New Hampshire and Windsor County, Vermont. This two-span modified continuous Town lattice truss was built in 1866. *Photo by Scott Wagner, 2013.*

including documentation, engineering studies, National Historic Landmark designations, conferences, a traveling exhibition, and the 2015 book, Covered Bridges and the Birth of American Engineering.

At the First National Covered Bridge Conference in Burlington, VT, in 2003, attendees adopted the "Burlington Charter for the Preservation of Historic Covered Bridges." The charter resolved to develop guidelines that adapt the *Secretary of the Interior's Standards for the Treatment of Historic Properties* with *Guidelines for Preservation, Rehabilitation, Restoration, and Reconstruction* to historic covered bridges. Focusing on rehabilitation of covered bridges, these *Guidelines* are organized by function of the structure. Following general principles, chapters examine superstructure, substructure, exterior envelope, site features, and safety/protection systems. The illustrated *Guidelines* are presented in a two-column format describing recommended and non-recommended treatments.

King's Covered Bridge, located in Somerset County, Pennsylvania. This multiple-kingpost truss, retrofitted with nail-laminated arches, was built in 1857 and rebuilt in 1906. *Photo by SCLA, 2008.*

The book concludes with eleven covered bridge rehabilitation case studies (written by the engineers, bridgewrights, and public officials who worked on them), comprised of various truss types, locations, rehabilitation issues, and budgets. The *Guidelines* will be a useful resource for educating engineers, State Historic Preservation Officers (SHPOs), Departments of Transportation (DOTs), bridge owners, preservationists, and residents in maintaining these historic symbols of American engineering for future generations.

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: https://www.nps.gov/hdp/project/coveredbridges/publications.htm

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