Historic American bridges

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Historic American Bridges

Ponts anciens aux Etats-Unis

Historische amerikanische Brücken

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SUMMARY

Of the approximately 575'000 bridges in the United States, about 1'500 have been classed as historic. Increasingly, the public recognizes the historic and technological value of interesting old bridges, and they want them preserved and rehabilitated. The state of bridge preservation in America will be presented as will techniques that have been successfully applied to keep historic bridges in service. Bridges dating from the 1760s through to the 1950s will be discussed.

RÉSUMÉ

Il y a approximativement 575'000 ponts aux Etats-Unis, dont environ 1'500 sont considérés comme historiques. De plus en plus le public reconnaît la valeur et l'intérêt historique et technologique d'anciens ponts et désire les voir remis en état et conservés. La situation de la conservation des ponts en Amérique est présentée, de même que les techniques qui ont été appliquées avec succès pour maintenir en service des ponts historiques. L'article traite de ponts qui datent de 1760 à 1950.

ZUSAMMENFASSUNG

Von den ungefähr 575'000 Brücken in den Vereinigten Staaten sind 1'500 als historisch wertvoll erklärt worden. In zunehmendem Masse erkennt die Bevölkerung den historischen und technologischen Wert interessanter alter Brücken und verlangt, dass diese geschützt und wiederhergestellt werden. Der Beitrag schildert den Stand der Brückenerhaltung in Amerika und einige erfolgreich eingesetzte Techniken, um sie im Dienst zu halten. Es werden Brücken aus den Jahren 1760 bis 1950 behandelt.

INTRODUCTION

In the development of transportation modes, the United State of America is a relatively young country when compared to Europe, Africa, and Asia. Stone bridges survive on roadways built by the Romans many years before Christ, and Egypt and Israel still have remnants of aqueducts more than 2,000 years old. The oldest bridges in the United States, like the country itself, date only to the late-18th century. Yet America's infrastructure is receiving a great deal of attention and study by the public who have become increasingly interested in having its significance acknowledged and preserved.

The United States has approximately 575,000 highway bridges and 100,000 railroad bridges of which easily a third were built before 1940. Many of the road highway bridges date to the period of great internal improvement of the 1920s and 1930s when states and counties were building the network of roads that still carry most of the vehicular traffic in the country today. Of this inventory of old bridges still in service in America, increasingly many are acknowledged as being historic, and efforts are being exerted by all three levels of government (local, state, and federal) to preserve them.

DEFINITION OF HISTORIC BRIDGE

What is considered a historic bridge in America is a question with many answers. It could be based on age or technological significance, like Roebling's important suspension bridges at Cincinnati and Brooklyn. It can also be viewed as historic even though it is an example of a common type that has done little more than survive in relatively unaltered condition.

Procedures have been established to designate a bridge as historic. The National Register of Historic Places is the official list of those sites, objects, buildings, structures, like bridges, and districts that are considered worthy of preservation. It was established by the National Historic Preservation Act of 1966 and is a joint federal and state program that has evolved as the single most significant means of enhancing the country's attitude and actions toward appreciation and preservation of interesting old bridges.

Listing of historic structures in the National Register is handled on the state level by the State Historic Preservation Officer (SHPO). Each state has one, and their responsibility is to assist local, state, and federal groups and agencies with ensuring that National Register eligible properties are not destroyed. The SHPO and their supporting staff keep an eye on historic bridges and other resources and do what they can to encourage their preservation.

Guidelines for listing in the National Register were established, and they purposely were kept broad to be applicable to all types of resources ranging from Wright airplanes to early 20th century parks and residential neighborhoods. The criteria specify that a structure should be at least 50 years old and have integrity of location, design, setting, materials, workmanship, feeling, and association. If those qualifications are met, then a structure is investigated to see if it has some distinguishing features that makes it notable and worthy of preservation. Some of those features could be special technology, patented details, association with a prominent designer, being the oldest example of a type, or located in a historic setting.

Although being evaluated eligible for the National Register does not automatically mean that a structure will be preserved or that it cannot be destroyed, it does highlight its significance and certainly makes it more difficult to demolish without a very compelling reason. National Register status is particularly effective if federal funds or permits are involved with a project. Legislation from the Department of the Interior, Environmental Protection Agency, and Federal Highway Administration, and others, afford various interests the opportunity to get involved with planning bridge projects so that

ingenious contributor who will help produce the solution that can be supported by good engineering judgement and preservation practice.

As illustrated by the examples listed below, there are many historic bridges that have been rehabilitated and returned to service. Solutions vary from one type of bridge to another, but all illustrate that sensitive rehabilitations are an economical alternative to new construction.

The once common wood truss covered bridge is a particularly popular American icon. Vulnerable to fire, rot, and high water, the timber bridges that remain in America are prized for their scenic and historic qualities. Many, like the 1887 Partridge "scissor" truss bridge in Ohio (Figure 1), have been stabilized and preserved in situ as part of a park. Now dedicated to pedestrian use, the truss was strengthened by the addition of steel stringers below the timber floor beams, and the truss members were conserved. These are commonly used procedures for rehabilitation wood truss bridges.

Another means of preserving covered bridges is to relocate them. An 1870 Col. Long-type timber truss span threatened with demolition as the result the building of a reservoir was moved to a golf course. It was rehabilitated and now carries golf carts and maintenance equipment.

Pony, or low, metal truss bridges often require specialized solutions to strengthen them to be able to carry light traffic without adversely effecting its historic fabric. In Bergen County, New Jersey, a patented Phoenix-section wrought iron pony truss span of insufficient load capacity was reinforced by the unobtrusive addition of beams adjacent to and below the truss lines. The new members work in concert with the trusses to carry live loads. A riveted Warren pony truss bridge fabricated in Scotland in 1890 and shipped to Hawaii illustrates that good maintenance can keep a historic bridge in service. The bridge was moved to its present location in 1919 where it has carried local traffic ever since the move.

Not many 18th- and early 19th-century stone arch bridges have survived because of floods and deterioration. Their useful life can be prolonged indefinitely with good maintenance. The two-span Choate Bridge in Ipswich, Massachusetts built in 1765 and widened in kind in 1820 has been in continuous service carrying heavy traffic on the town's main street. The recent sensitive repointing and resetting of loose or missing stones will ensure its continued service for years to come. A similar but later stone arch bridge in New York state was rehabilitated in a manner that preserves its original appearance, but live loads are supported on prestressed concrete beams hidden within the spandrel walls (Figure 2).

Reinforced concrete deck and through arch bridges are particularly susceptible to damage from salt and moisture penetration. In many instances replacing the deteriorated material in kind can restore the bridge to sufficient capacity. An important ca. 1930 patented Marsh through (rainbow) arch at Wichita, Kansas, is being rehabilitated primarily by reconnecting the encased hangers to the arch and floor beams (Figure 3).

Wrought iron and steel through truss bridges built from the late 1870s through the 1930s were abundant in America, but they are becoming increasingly scarce. Consequently, through truss bridges should be preserved whenever possible. The 1891 pin-connected multi-span Parker through truss at Chattanooga, Tennessee is being rehabilitated to provide a crossing for light trains and pedestrians. Closed to traffic for many years, the bridge was thoroughly inspected and evaluated. It could be returned to service by installing cables to provide a redundant stress path. The cables are concealed within the historic trusses.

A 1912 Pratt through truss bridge over the Hanalai River on Kauai Island in Hawaii was strengthened with the addition of Warren pony trusses set outside the original truss lines in the 1960s. The state wanted to replace the altered but historic span with a highrise multi span bridge. In the face of considerable opposition and years of negotiations, the historic trusses were preserved by transferring live-load stresses to the existing pony trusses that were strengthened.

Figure 1.
Rehabilitated 1887 wood truss bridge at Canal Winchester, Ohio.

all perspectives are considered. If a bridge cannot be saved, it should be photographed and its plans and history documented and made part of the national archives in Washington, D.C.

Since the inception of National Register in 1966, the number of acknowledged historic bridges has increased dramatically and an estimated 1,500 bridges have been listed or determined eligible for the Register. Most states have done a survey to identify and evaluate their historic bridges, and the survey findings are being used when proposing new projects. Conflicts and delays are being avoided because the historicity of a bridge has been addressed at the beginning of the planning process.

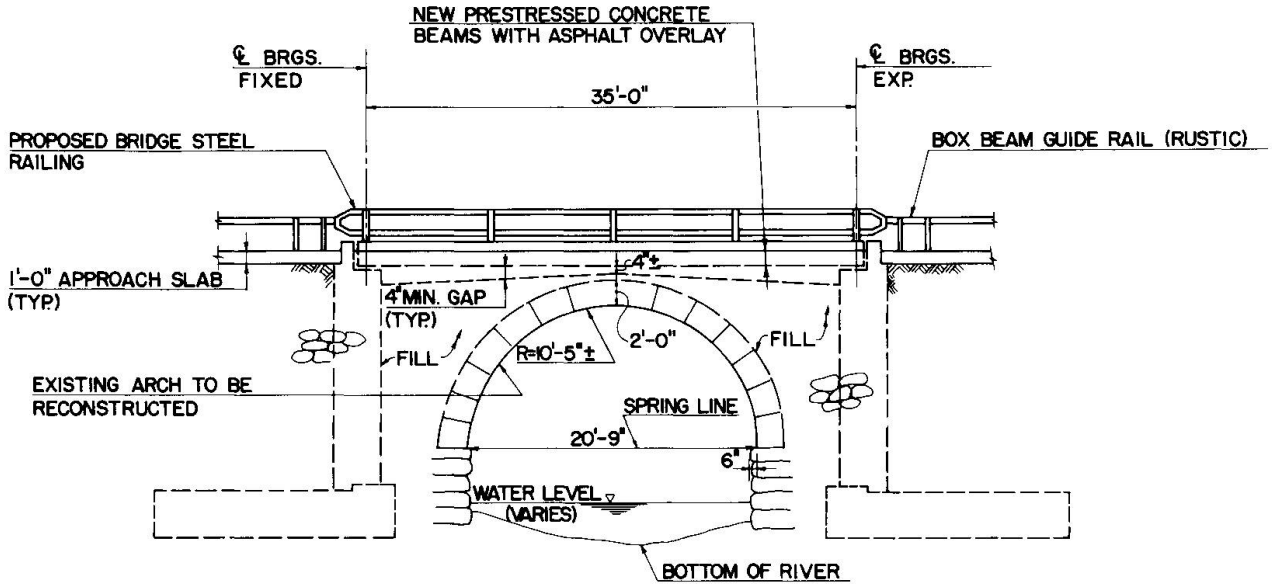
PROBLEMS AND SOLUTIONS

The problems associated with preservation of historic bridges are numerous. Historic bridges are often functionally obsolete or structurally inadequate because they were designed for lighter and smaller loads. The roadways may not be wide enough to accommodate modern traffic requirements, and the portals of many of the through trusses are not high enough for passage by trucks. Additionally old bridges have frequently suffered from lack of maintenance. Modern transportation and traffic needs versus the desire to retain and rehabilitate historic bridges is a continual conflict that keeps bridge owners, historians, and engineers occupied finding solutions on a site-specific basis.

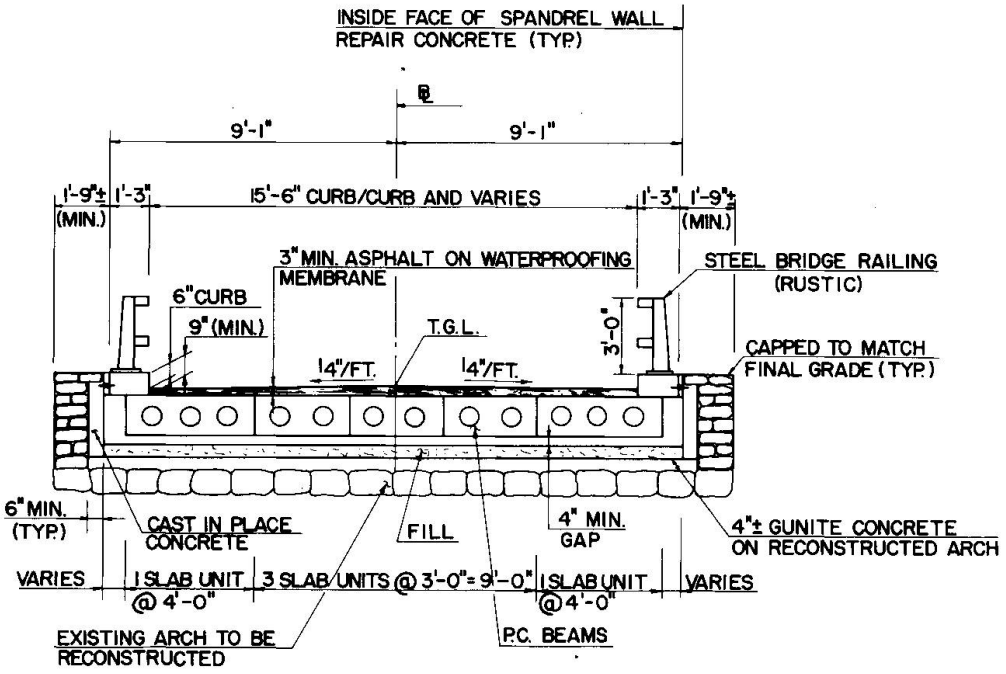
The easy way out is to remove the historic bridge and build a new structure. But the easy way is often not the best route. Many construction methods and techniques are available to retrofit and rehabilitate the historic bridge and keep it in some transportation mode without damaging the historic fabric or intent of the span. As a result of the available technology and know-how, the attitude of the bridge owner should be as follows

> First, let me try to study ways to upgrade the existing bridge to make it safe for the traveling public. if I cannot achieve this within reasonable economic limits, then, and only then, will I consider replacement.

Too often the planning process is reversed and the preservation community has to "fight" the bridge owner, who has already decided beforehand that the old bridge must go. The role of the engineer in this dilemma is to become an impartial and



ELEVATION



BRIDGE SECTION

KEELER LANE
BRIDGE RESTORATION
NORTH SALEM, N.Y.

Figure 2. Rehabilitation plans for ca. 1840 Keeler Lane stone arch bridge at North Salem, NY.

Figure 3. Circa 1930 patented Marsh encased steel through arch span at Wichita, Kansas.

Some historic suspension bridges were reconstructed to improve their load carrying capacity without the need to replace the main suspension cables. A most interesting 600'-long canal aqueduct in Lackawaxen, Pennsylvania was converted to a highway bridge after the canal was abandoned early in this century. The historic 1849 span was designed by John Augustus Roebling, and it is the oldest extant Roebling suspension bridge in service. While the superstructure underwent many modifications, the cables, composed of special wrought iron wire dipped in hot linseed oil, have survived in excellent condition and will continue to do so as long as maintained properly.

Not every historic bridge can be saved. An eye bar suspension bridge at Lordville could not be saved (Figure 4). The main concern with the span was the settlement of one tower leg that caused one chain to be lower than the other thus distorting the eye bar and hanger connections beyond economical repair. Because the bridge had been determined historic, it was photographed and documented in accordance with federal requirements before it was demolished.

The ca. 1860 patented King bowstring pony truss bridge in New Jersey was the only example of the historic truss type in the state, but it was too narrow and too deteriorated to warrant rehabilitation (Figure 5). Instead of being demolished, the rare old bridge was dismantled and stored until a suitable, protected site can be identified. While its original setting will be lost, the technologically important artifact will be recaptured.

An important bridge that was lost was the ca. 1950 steel through arch bridge at Bellows Falls, Vermont. Designed by J.R. Worcester, it was closed to traffic because it was determined to be structurally unsafe. Two days and five dynamite blasts later, it finally succumbed. With some encouragement from the bridge owner, the arch could have been retained and upgraded as part of a larger project.

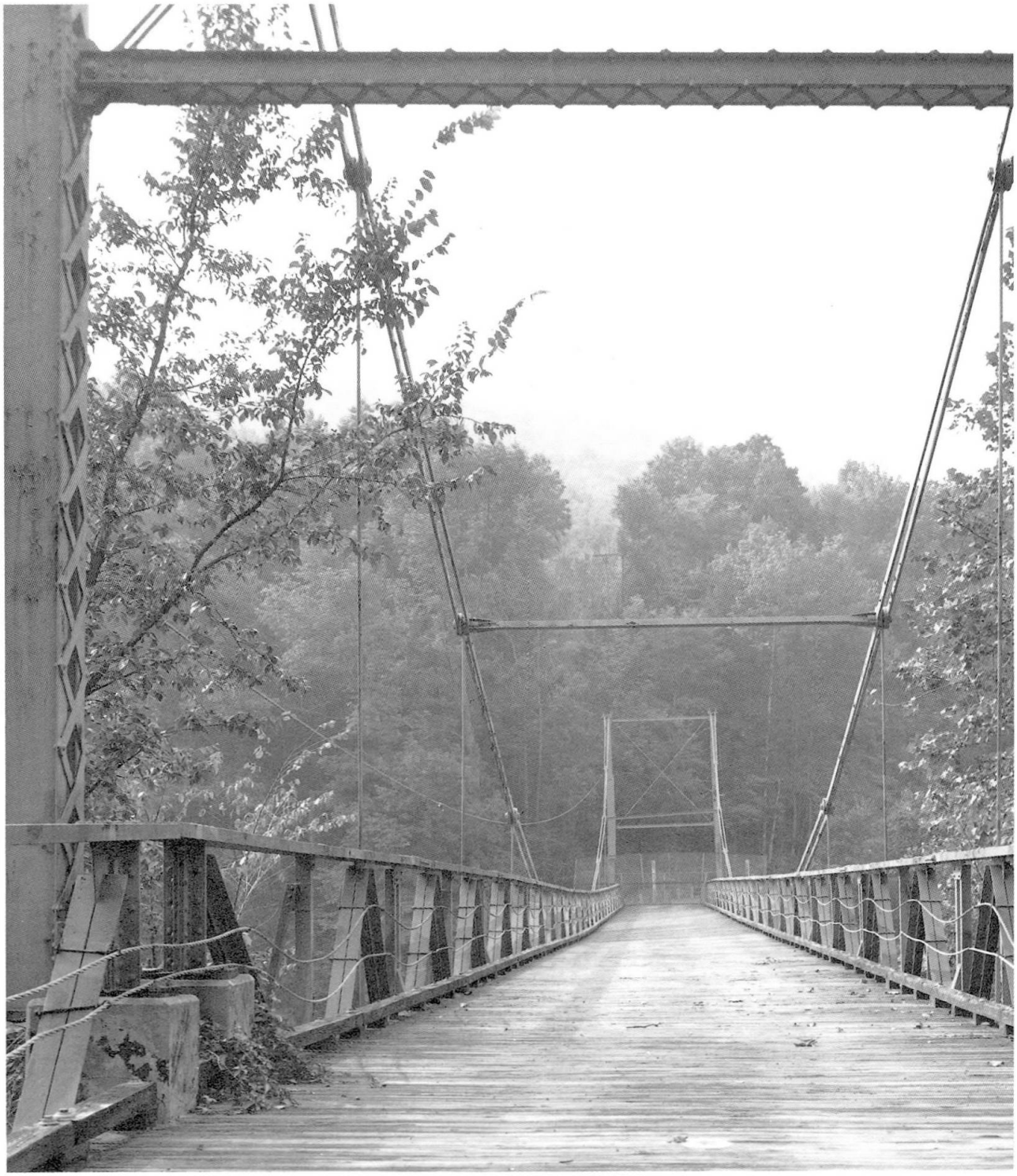


Figure 4. Ca. 1902 eyebar suspension bridge at Lordville, NY that failed and was recorded and demolished in 1986-1987.

Figure 5. Ca. 1860 King bowstring truss bridge at Allenwood, NJ.

CONCLUSION

The preservation of historic bridges in America will continue to be an uncertain proposition which will only be solved on a project by project basis. The publicity surrounding the disposition of historic bridges is improving, and both the public and bridge owners are becoming increasingly aware that historic bridges are worth preserving. The technology and engineering expertise are available to upgrade and reuse historic bridges, and bridge engineers are being encouraged to avail themselves of this know-how. It is hoped that no deserving historic bridge will be demolished without a public hearing and discussion. It may be tedious and time consuming, but it guarantees that historic bridges will not disappear, at least not quietly. This would be intolerable.