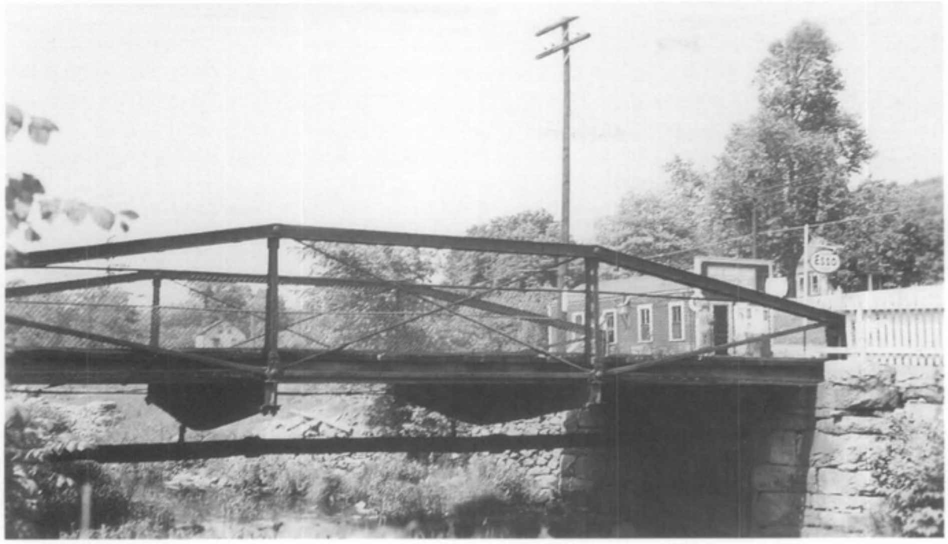


PRESERVATION
Tech Notes
U.S. Department of the Interior
National Park Service
Cultural Resources
Heritage Preservation Services

METALS
NUMBER 4

Rehabilitating a Historic Iron Bridge

Joseph P. Saldibar, III

THE STILLWATER ROAD (SHEA) BRIDGE
Cumberland, Rhode Island

The Stillwater Road Bridge or Shea Bridge, as it is also known, was built in July, 1886 by the Berlin Iron Bridge Company of East Berlin, Connecticut. It features a parabolic, lenticular truss system, a design patented and used exclusively by that company. Of the several thousand bridges with this design that were constructed nationwide between 1870 and 1900, fewer than 5 percent remain standing today.

In Rhode Island, the Stillwater Road Bridge is one of only two remaining lenticular truss bridges, and the only one built as a highway truss. For more than a century the bridge was an integral part of the textile mill village of Georgiaville, in the town of Smithfield, Rhode Island (see figure 1). The bridge was determined to be individually eligible for listing in the National Register of Historic Places in 1984. A year later, the Georgiaville Historic District was listed. Finally, in November, 1989, Stillwater Bridge was documented according to Historic American Engineering Records (HAER) standards after it had been marked for demolition and replacement.

Problem

The almost predictable physical threats to historic bridges–deferred maintenance, harmful de-icing salts, and overloading–have accelerated their rate of deterioration in recent years. In addition, many do not meet current loading and safety requirements. The Surface Transportation and Uniform Relocation Assistance Act of 1987 calls for the preservation, rehabilitation, and re-use of historic bridges and makes such projects eligible for federal funding. The Intermodel Surface Transportation Efficiency Act of 1991 acknowledges the urgent need to upgrade our nation's aging highway infrastructure. Together, the laws create a momentum for positive action.

Preservation projects for historic bridges have the highest success rate–within existing law–when partnerships are forged among transportation planners, preservationists, engineers, state and local governments and the interested public. Creative planning, innovative design solutions, modern technologies, and possible financial savings over new construction, offer the best hope to ensure that historic bridges remain in active use.

In the case of the aging Stillwater Road Bridge, the town of Smithfield began searching for ways to replace it in the 1960s. The relatively light construction of the span, coupled with the deteriorated condition of its structural members, were the primary reasons for its slated removal. In 1984 the town recommended that the Rhode Island Department of Transportation (RIDOT) assume management of the bridge project. Although retaining the bridge on its original site was possible, RIDOT concluded this was not a viable option; an engineering analysis determined that bringing the structure up to current load requirements would have required replacement of most of the supporting truss members.

After a century of use, the bridge showed signs of major deterioration. Three of the four upright posts were bent from automobile collisions. The U-bolt floorbeam hangers had rusted, the result

While moving a historic resource into a new context is generally not a recommended preservation solution, in the case of historic bridges, moving is frequently the only way to assure their physical protection as well as continued use. In addition, making certain structural alterations so that a historic bridge can fit the new site is parallel to altering a building for a new use--if done with sensitivity so that the historic character is not jeopardized in the process, the work meets the Secretary of the Interior's Standards for Rehabilitation.

of moisture and dirt collecting on the flange. The lattice girder stiffeners (zero-force members which serve to prevent "racking" or lateral movement) had lost their latticework and were severely corroded. In addition, the endposts of the bridge showed signs of serious decay *(see figures 2 and 3).*

Figure 1. The Stillwater Road Bridge is shown on its original site in Smithfield, Rhode Island, in 1942. Following the decision to replace the historic iron bridge, it was subsequently dismantled, rehabilitated, moved, and re-assembled in nearby Cumberland. Photo: Rhode Island Department of Public Works.

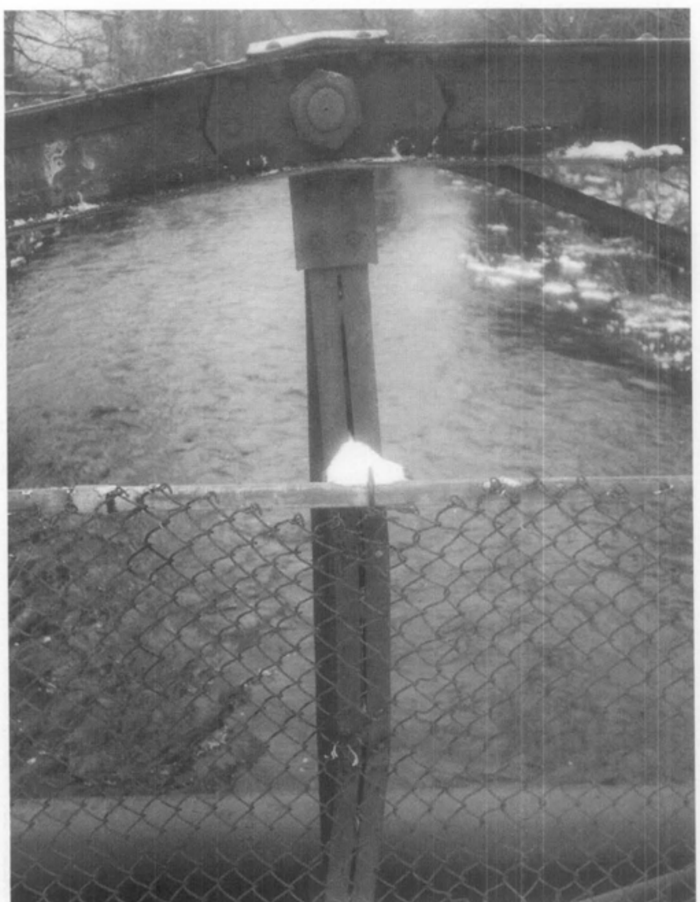
Solution

In the early 1980s, RIDOT concluded that demolition and replacement was the only practical solution. However, after passage of the 1987 and 1991 surface transportation laws–coupled with the eligibility of the Stillwater Bridge for National Register listing–the Rhode Island State Historic Preservation Office requested RIDOT consider alternatives to demolition under Section 106 of the National Historic Preservation Act. RIDOT then began efforts to find a recipient who would agree to relocate and preserve the structure. Failing this, the bridge was to be taken apart and placed in storage, awaiting a future preservation effort.

Fortunately, the nearby town of Cumberland, Rhode Island, was looking for two historic bridges to place in the new Valley Falls Heritage Park *(see figure 4).* The plans called for several bridges to span the old mill runs and canals, which survive at the site of the Valley Falls mill complex. These bridges would primarily serve pedestrian traffic. By coincidence, historic data indicated that one of the mill's bridges had been (or resembled) a lenticular truss.

A plan was agreed upon to dismantle the Stillwater Road Bridge and ship it to Cumberland, where it would be rehabilitated, then installed within the park. The phased work program, developed according to RIDOT specifications, included:

1. Dismantling the bridge on its original site.
2. Transporting the dismantled bridge by flatbed truck to a metal fabrication shop.
3. Inspecting, cleaning, and/or reproducing bridge elements.
4. Re-assembling the parts and installing the bridge on its new site.



Figures 2 and 3. The extent of damage can be seen in the bent vertical post member (below, left) and the heavily corroded end post (right). Similar problems existed throughout the structure. Photo: Beta Engineering.

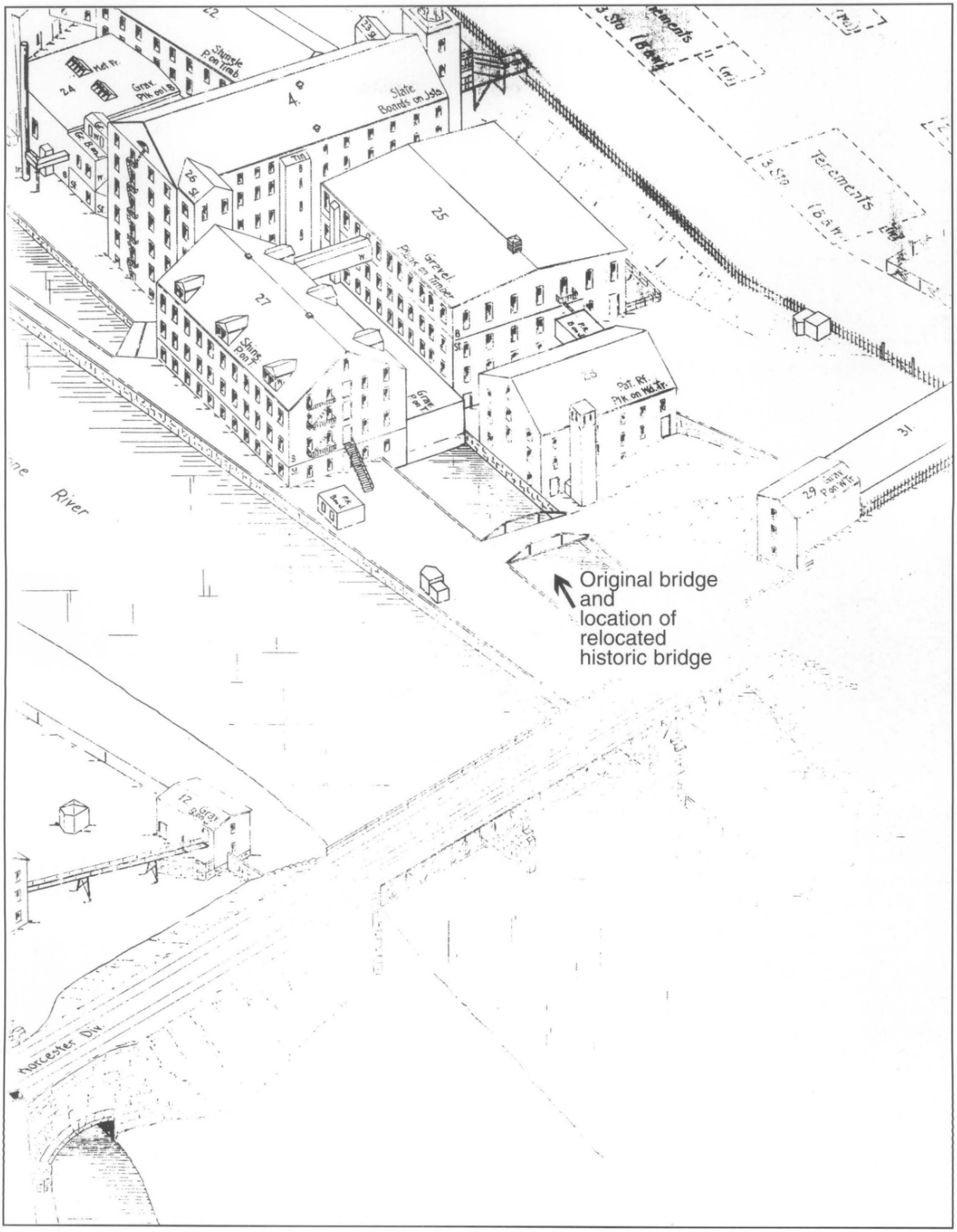


Figure 4. This is a drawing of the early mill complex in Cumberland, Rhode Island. The proposed location for the moved, rehabilitated Stillwater Road Bridge is indicated. None of the early buildings remain. Map: Courtesy, Rhode Island Department of Transportation.

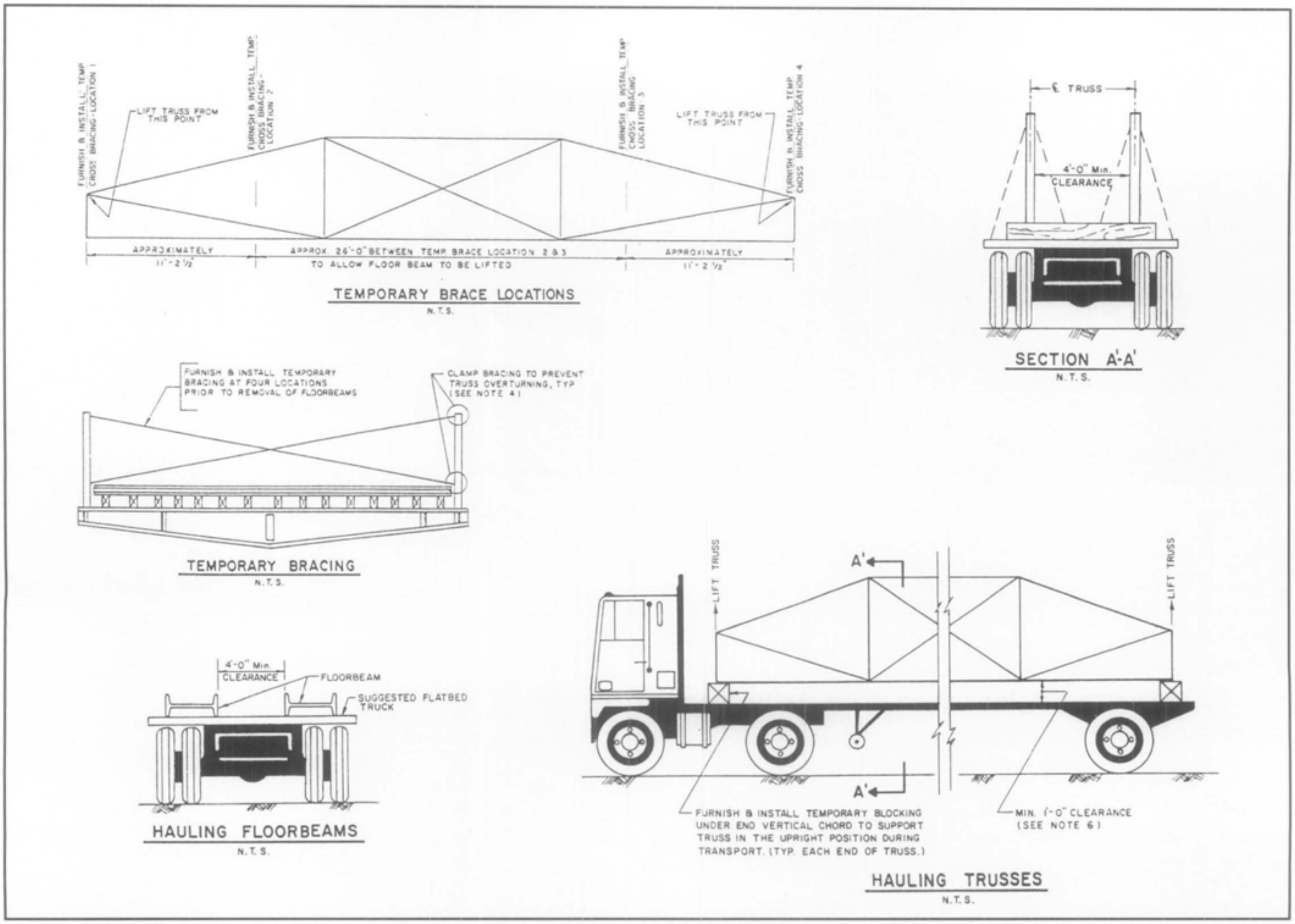


Figure 5. A temporary bracing system assured the protection of the bridge during disassembly.

Work Description

First, a survey of the bridge was conducted to ascertain which existing or non-historic materials would not be saved. These included extensively deteriorated historic materials as well as recent accretions.

Dismantling of the bridge was conducted by experienced private contractors overseen by RIDOT. Materials that could not be saved were removed and discarded, including weight-limit signs, chain link fencing, asphalt paving, and the timber deck. Once this material was removed, the timber deck stringers and iron web braces could be dismantled.

At this point, a temporary bracing system was built to stabilize the trusses before construction work proceeded *(see figure 5)*. This wooden system was extremely important–without it, the trusses might have twisted or overturned during the remaining disassembly work.

With the trusses stabilized, the deteriorated floorbeam hangers were removed. The floorbeams themselves were lifted, one at a time, by crane onto a flatbed truck, and transported to the shop. With the temporary bracing removed, the trusses were then attached to the crane and lifted in one piece, then placed on their sides on the truck *(see figure 6)*. The plans had specified that the trusses be placed on the truck in an upright position, with protective bracing. But when the first truss was mistakenly laid on its side, the deteriorated lattice girder stiffener was severely bent. Fortunately, this lattice girder was slated for disposal before the damage occurred. The other truss was removed without damage.

Fabrication/Rehabilitation

Once at the shop, the bridge was completely taken apart. All pins, beams, bars, nuts, and bolts were labeled and inspected to determine their structural condition *(see figure 7)*. The parts were dismantled using a variety of methods. Threaded parts were unscrewed; some rivets had to be drilled out. Other parts were heated with a torch until they expanded, then cooled; the resulting contraction allowed them to be removed. The bridge's pinned construction made disassembly easier, as fewer pieces were actually riveted together.

Some parts were so deteriorated that they could not be preserved and re-used as planned, including the end posts, lattice girder stiffeners, and all four vertical (lattice girder) stiffeners. This was somewhat disappointing, as the original specifications called only for the removal of the floorbeam hangers, and the intent was to save as many of the original parts and fasteners as possible. The new, matching members would be more cost-effective and actually stronger than repairing the original pieces. The other drawback was that the new elements would need to be fabricated of steel, rather than higher-priced wrought iron. Once completed, however, the

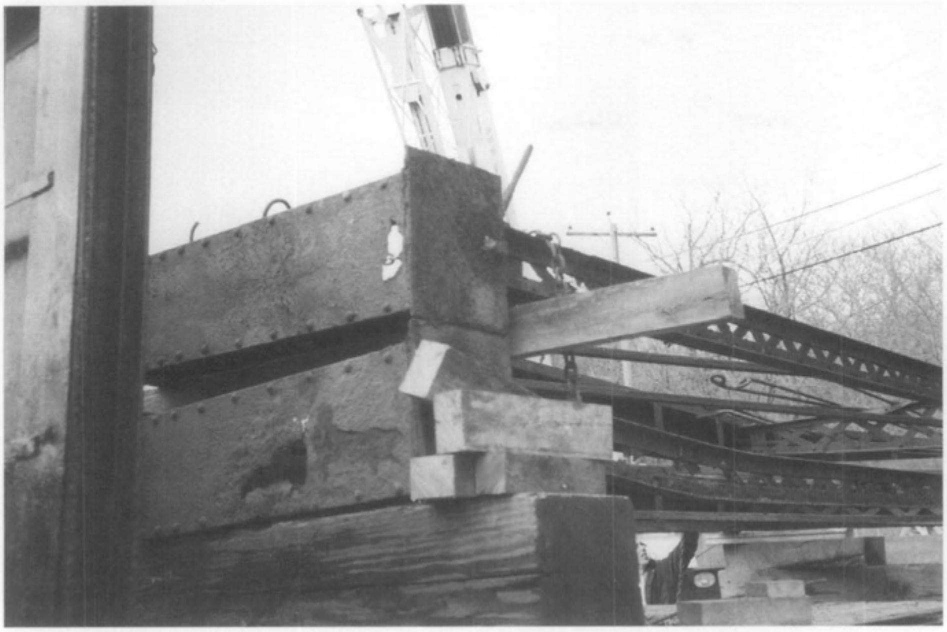


Figure 6. Although plans specified that the trusses be placed in an upright position, they were placed on the truck on their sides (left). The lower truss was damaged during the loading operation. Photo: Beta Engineering.

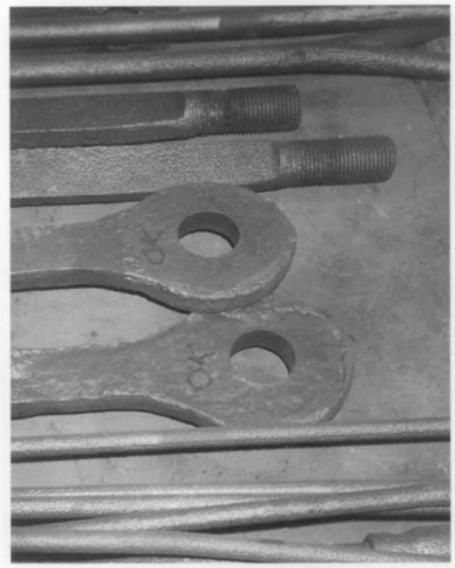


Figure 7. The pieces were disassembled in the shop, then cleaned of rust and paint. The worn condition of the eye bars can be seen in the center of the photograph. Photo: Beta Engineering.

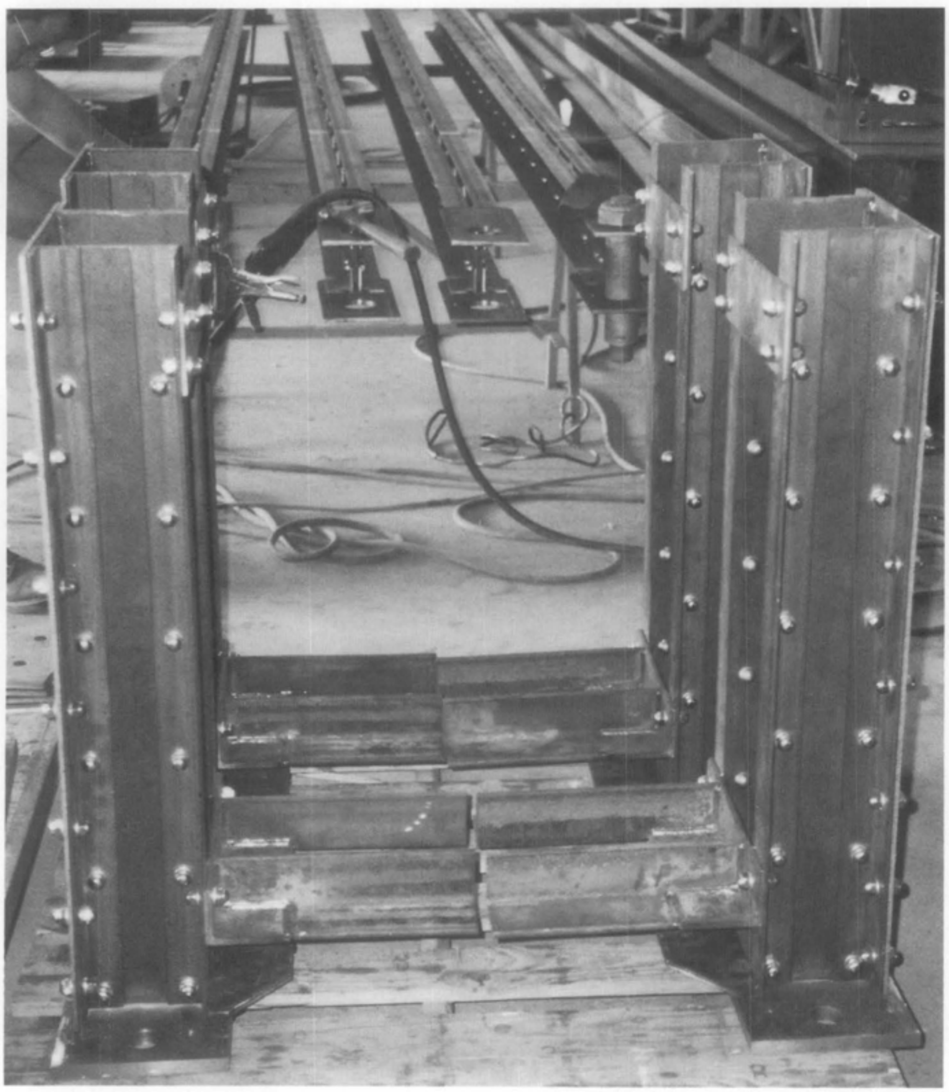


Figure 8. New endposts (foreground) and lattice vertical posts (background, center) were fabricated from steel. The rivets are actually threaded; hidden bolts help keep the pieces together. Welding provides additional strength. Photo: Beta Engineering.

steel members would be visually indistinguishable.

The salvageable parts were placed in a Wheelbrator, a machine which removes rust through repeated vibration. The iron members were then sandblasted to remove paint and any remaining rust, then subjected to magnetic particle testing to determine which pieces had unseen damage or decay. The test was useful in determining wear in some of the parts, particularly the eyebars of the lower chord and the middle panel tension rods. In addition, some of the pins had worn by more than 1/4" over time.

In order to reuse as much of the historic material as possible while ensuring sufficient structural integrity, it was decided to "build up" through welding those pieces that were worn down. In order to match the metallurgical composition of each part,achemical test was undertaken. This testing allowed for an exact metallurgical match between the new built-up welds and the original metal of each part. Such a match reduced the possibility that a harmful physical or chemical reaction would take place between the weld and the wrought iron.

Meanwhile, the endposts, lattice girder stiffeners, and vertical posts were being fabricated from steel *(see figure 8)*. The original end posts had been constructed as a box section; one plate and two angle iron pieces were riveted together to form a column with one lattice side.

While some old rivets were eventually located, they were hardly ready for use.

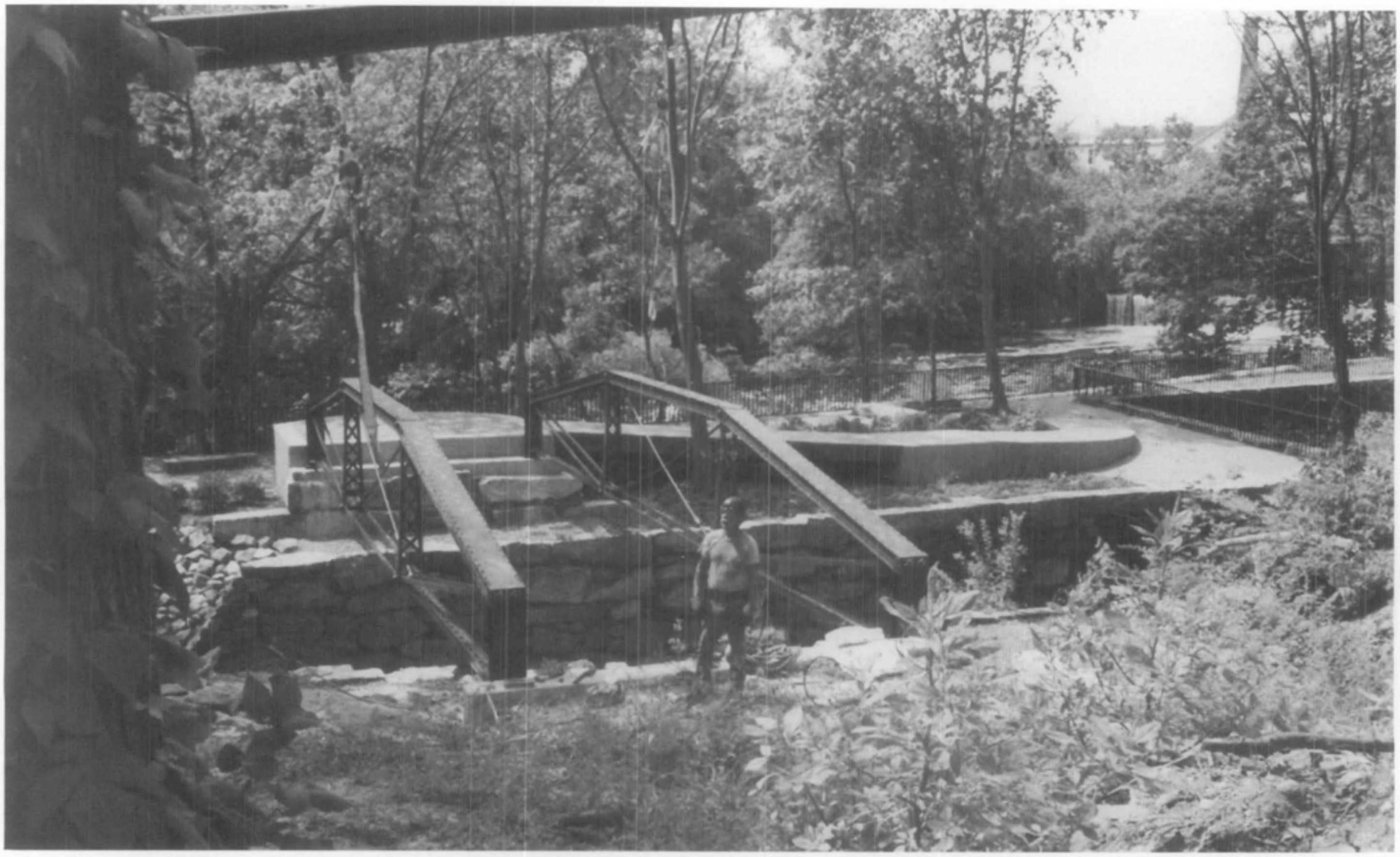


Figure 9. The trusses were lifted by crane and set into position on the new site. Photo: Beta Engineering.

Only the rivet heads could be found, and there seemed little use for them. But after some thought, a creative solution was formulated. The shanks of the rivet heads were threaded, and the plates screwed together. For structural strength, the pieces were also welded, but this weld is invisible from the outside. The result is a welded box girder that looks, from the outside, like an authentic riveted member. Had no rivets been found, a similar procedure could have been followed using hack bolts. (These are bolts with heads that look like rivets but have nut fasteners.)

The final challenge lay in the floorbeams. The new site was nine to ten feet narrower than the original site. To fit the new foundation, the bridge had to be reduced in width. This was done by cutting the ends of the floorbeams by four to five feet on each side. Fortunately, the cut was made near a vertical brace in the floorbeam, matching the original ends, which also terminated near a vertical brace. The lateral bracing attachment points were removed from the excess lengths and re-installed on the shorter floorbeams. New U-bolts of round stock (as opposed to the original square stock) were also fashioned.

Once the built-up welds and fabrications were completed, the entire bridge was sprayed with an epoxy primer, followed by two coats of red iron oxide paint. Because none of the early paint remained, a compatible color was chosen in keeping with the bridge's historic character.

The final problem was that the old bridge foundation at the new site was intended to support a shorter span. Since reducing the length of the span was not possible, a new foundation would need to be built for the relocated bridge. The old foundation of the bridge that once occupied the site was to be retained and preserved. First, cut granite blocks from the Providence River Relocation Project were obtained and transported to the new site. The new foundation was laid so that the bridge, as installed, would clear the old foundation by approximately one foot.

When the new foundation was completed, the trusses were lifted by crane to the site, installed in place, and secured with temporary wooden bracing *(see figure 9).* The rest of the bridge (floor beams, hangers, stringers, etc.) was then assembled, in the reverse of the dismantling process *(see figure 10)*, and a new hardwood deck was installed.

For safety, a contemporary steel pedestrian railing was installed on each side. Whether the historic bridge had a railing or not is unknown, but any such early railing would probably have consisted of only one or two horizontal members. The pipe railing on the Stillwater Bridge was chosen because it matched a railing design used throughout the park and met applicable code requirements. To lessen the visual impact and distinguish it as a new feature, the railing was painted black. As noted, the historic bridge members were painted red.

Project Costs

Costs to the town of Cumberland to rehabilitate and erect the bridge on the new site was $130,000. The granite foundation blocks were provided at no cost by RIDOT, while the expense of their transportation to Cumberland was $3,350. The most expensive item in the budget was the $49,500 to install the foundation. Repairs to the bridge superstructure, excluding paint and sandblast-

Figure 10. The new lattice girders are shown as installed on the bridge. Photo: Joseph P. Saldibar, III.

ing, were $8,525, while the cost of installation was $17,110.

The cost of relocating the historic bridge from Smithfield to Cumberland was $72,000 and was covered by RIDOT and the Federal Highway Administration as part of the bridge replacement project at Smithfield. It was an allowable form of mitigation to the adverse effect of the bridge replacement project. The new Stillwater Road Bridge in Smithfield has not yet been constructed, but is projected to cost $150,000. Nearby crossings currently handle road traffic.

Project Evaluation

The Stillwater Road Bridge was destined for certain loss, despite its long history and contributing presence in the Georgiaville Historic District. Although the new Cumberland site required some modifications to the old bridge, no other solution was more suitable. The only viable options were to move the bridge to the Valley Falls Industrial Heritage Park in Cumberland, or to dismantle and warehouse it for an indefinite period of time. RIDOT actively seeks new recipients for structures that have been moved from their original sites, and this project is an excellent example of the success of the program.

Severe damage from neglect and use resulted in fewer members being salvaged than initially expected. The damage incurred over the years from vehicular collisions, deterioration from exposure to the elements, and the improper removal of one of the trusses led to the fabrication of new members. Although the new members are steel, rather than wrought iron, they are visually indistinguishable from the historic members. Also, great care was undertaken to match the metallurgical composition and visual appearance of the members as closely as possible; to replace lost or unusable pieces in kind; and to find a creative solution in using the threaded rivets. Finally, while the pedestrian railing is a prominent new feature, it is perceived as "clearly new," and was added only to meet applicable code requirements.

While there are cases where it is technically and economically feasible to save

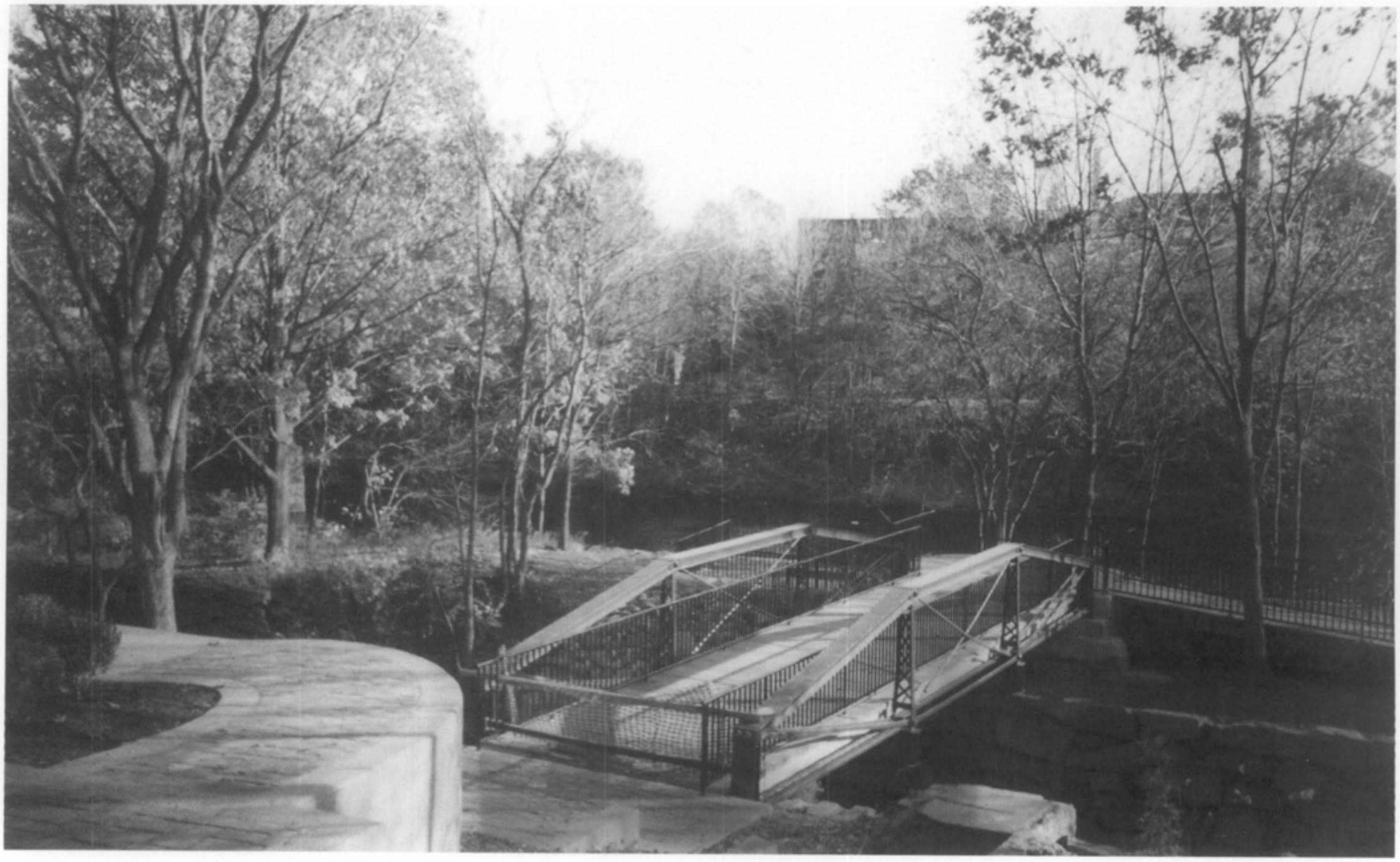


Figure 11. Valley Falls Heritage Park (left) as it is viewed today. The park is part of the Blackstone River Valley National Heritage Corridor, and is a welcome addition to downtown Cumberland, Rhode Island. Photo: Joseph P. Saldibar, III.

significant historic bridges in place, upgrading them for regular vehicular traffic, still others can be saved only through their relocation and use for pedestrian or bicycle traffic, or limited vehicular access *(see figure 11)*.

The Stillwater Road Bridge rehabilitation project saved a significant historic bridge from certain demolition. The reduced wear and tear on the bridge (pedestrian traffic as opposed to automobiles) and regularly scheduled maintenance supervised by the municipal employees of the town of Cumberland, will allow it to be carefully monitored to prevent further deterioration. Finally, the public is made aware of the bridge's engineering and historical significance through signage and ongoing interpretation of the area.

PROJECT DATA

Structure:
Stillwater Road (Shea) Bridge
Valley Falls Heritage Park
Corner of Mill and Broad Streets
Cumberland, Rhode Island.

Owner:
Town of Cumberland.

Project Dates:
1993-1995
Dedication Ceremony October 28, 1994.

Landscape Architect:
Gates/Leighton & Associates, Inc.
East Providence, Rhode Island.

Engineer:
Beta Engineering, Inc.
Lincoln, Rhode Island.
RIDOT
(Design and funding for bridge removal)
Rhode Island Department of Transportation
Providence, Rhode Island

Project Costs:

$72,000	Removal from Smithfield (covered by RIDOT/FHWA)
$ 8,525	Rehabilitate existing structure.
$ 3,650	Sandblasting and painting.
$17,110	Erect bridge on new site.
$52,850	Granite block foundation: $3,350 Transport; $49,500 Construction block
$ 9,320	Scaffolding and temporary bracing.
$ 4,500	Install new railing.
$ 5,000	Mobilization and demolition costs.
$26,753	Overhead, profit, etc.

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Cover Photo: Rhode Island Department of Public Works.

PRESERVATION TECH NOTES are designed to provide practical information on traditional and innovative techniques for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act, as amended, which directs the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

Comments on the usefulness of this information are welcomed and should be addressed to Tech Notes, Heritage Preservation Services, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127.
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