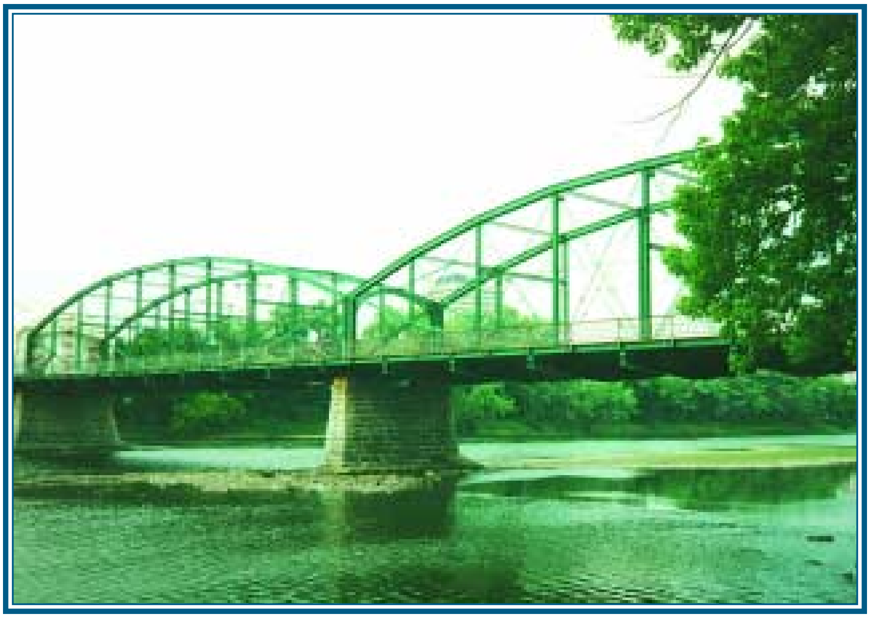


Bridge Rehabilitation Saves a Lost Art

Once a popular bridge design, lenticular truss bridges are now few and far between

When the South Washington Street Bridge was erected by the Berlin Iron Bridge Company in Binghamton, NY, in 1886, parabolic lenticular truss bridges were peaking in popularity. More than 1,000 bridges of this type were built nationwide between 1880 and 1890. They were forged from meticulously crafted wrought iron and carried the load of horse-drawn carriages.

The Berlin Iron Bridge Company constructed several hundred patented lenticular trusses in New York, Pennsylvania and the New England States during this time. The South Washington Street Bridge is one of these remaining landmarks. The bridge, listed on the National Historical Register, consists of three identical spans of 160'.

Owned and maintained by the City of Binghamton, the bridge serves as a pedestrian and bicycle crossing of the Susquehanna River between the downtown business district and South Side business and residential districts. The bridge was closed for vehicular traffic in 1969, due to extensive corrosion of the floor system. Since that time, several individual areas of the bridge were rehabilitated and repaired.

The most recent and total rehabilitation of the structure began in March 1996, as part of the city's South Washington Street Revitalization project. General contractor Fahs Rolston Paving Corp., Binghamton, selected High Steel Structures, Inc., Lancaster, Pa., to fabricate and replace the bridge's deteriorated wrought iron members and floor system with high-strength steel. Detailer on the project is Upscale Detailing, Burnt Hills, NY. The 50 ksi steel used on the bridge is three times stronger than the original material.

McFarland-Johnson, Inc., the design firm, also based in Binghamton, had the challenge of designing new connections

Built in 1886 by the Berlin Iron Bridge Company, the South Washington Street Bridge in Binghamton, NY, is one of the last lenticular truss bridges in the U.S. The bridges existing timber and open steel grid deck was replaced panel-by-panel with new floor beams and stringers.

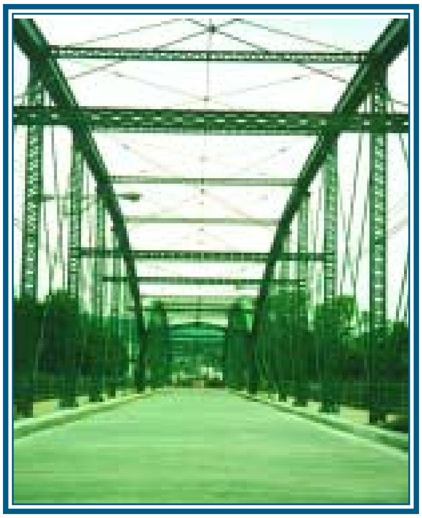
with material conforming to current bridge design criteria. For example, replacing the diagonal eye-bars with fracture critical members.

"When we visually inspected the bridge, we listed six fracture critical members in the bid," says Richard Soovajian, engineer in charge for the New York State Department of Transportation. "After we sandblasted it, we found additional places where corrosion occurred around the diagonal eye-bars, bringing our count to 28."

FRACTURE CRITICAL REQUIREMENTS

The material needed to meet fracture critical design requirements and preserve the bridge's historic value posed procurement challenges for the fabricator. According to Fahs Rolston Project Manager Terry Kellogg, High Steel Structures worked through the winter and accelerated its construction schedule to keep the job on-time, especially after additional fracture critical members were identified.

"We were in the process of replacing deck members, floor beams, stringers and the steel grid decking when 22 additional fracture critical members were identified," says Kellogg. "High Steel Structures had to start the



procurement process again to obtain the additional materials. It was a significant increase in work, but their fast response helped us remain on schedule."

In addition to replacing the bridge's deck members, floor beams and stringers, the first phase of the rehabilitation also involved erecting jacking falsework at both abutments and piers to replace 6' to 7' of deteriorated wrought iron on the bridge's end posts. High Steel Structures fabricated the temporary structural lifting system, which raised the structure 2' on the north end and 1'-2" on the south end in an effort to raise it out of the flood plain.

Each span was jacked and supported by falsework while the deteriorated portion of the end posts and diagonal struts were removed. Joining the new end posts and diagonal struts to the existing members required a difficult "mill-to-bear" connection, which the fabricator successfully achieved with the mating surface 100% in contact.

Substructure Repair

The granite stone masonry substructure also required repair. Approximately 2' of the substructure was removed to reach sound material, which Fahs Rolston replaced with concrete. Each span was then lowered until the end posts rested on the new elastomeric bearings, which are approximately 1' higher in elevation than the original.

Replacing eye-bar connections forged around wrought iron pins on the bridge's bottom chords, posed another challenge. "Substituting a U-bolt mechanism was considered acceptable for a historical bridge," says Phil Pierce, manager of McFarland-Johnson's Structural Department.

Since fracture critical material for this configuration was not available in square bar, the fracture critical material was ordered in a plate and stripped into 1⅝" squares. Because fracture critical material has more stringent physical and testing requirements, tests were performed at the mill to ensure the material met NYSDOT specifications.

The bar was bent to form an uncommonly tight radius U-bolt to fit around a 4" pin. "The U-bolt assemblies were then configured to duplicate the geometry of the bridge by substituting modern steel," says Pierce. The new floor beams and stringers connected to traverse the structure would now hang from the U-bolts.

Floor System Replacement

Replacing the bridge's floor system was another significant challenge, according to Pierce. "The existing floor beams were deeper at the center of the bridge and tapered at the outside ends. This shape was very common in the 1800's for this type of bridge," he explains. "For a historic reconstruction, the floor must be carefully rehabilitated to duplicate the floor of the original and still be a product of the 90's."

Due to the deteriorated condition of the bridge, construction equipment was not permitted on the floor system during construction. To meet this challenge, tension cables were used to temporarily support the diagonals and sequentially removed and replaced the deck, two bays at a time, with new floor beams, stringers and steel grid decking. "This method made it possible to then place a crane on the rehabilitated deck bays and not exceed acceptable load limits," according to Soovajian.

High Steel Structures fabricated and erected 24 floor beams meeting fracture critical specifications to support the steel grid deck. Each floor beam was tapered to be a more efficient member and to minimize the weight of the structure. The fabricator also installed new stringers, utilities, bridge railing, deck grating and deck joints.

A concrete deck originally proposed for the bridge's walking and riding surface was challenged by historians. However, a steel grid deck, partially filled with concrete, was ultimately accepted by New York's Historic Preservation Office.

IKG Greulich, Cheswick, Pa., fabricated the new deck for the South Washington Street project.

Repainting

The final stage of the rehabilitation required cleaning and field painting the sandblasted metalwork on each truss with a dark green epoxy paint.

"There was cooperation from everyone working on this project," comments Steve Weinhold, High Steel Structures engineer. "We encountered several challenges and the NYSDOT and Fahs Rolston collaborated with us on alternative methods and provided quick answers to some of the unknowns we faced in the field."

With the bridge's reopening to pedestrians and bicyclists in August, it stands as a symbol of the past, present and future.

"Though we've rehabilitated the bridge by modern methods, it still retains the nostalgia of our past," says Pierce. "The opportunity to restore the structure with new technology is indicative of our present capabilities and the longevity it provides will preserve the bridge for many years into the next century."