Truss Bridge Rehabilitation Using Local Resources

Imaginative use of local resources including materials, expertise and labor can result in cost efficient projects.

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OLD BRIDGES need not die. They can be rehabilitated and put back into service. For many existing bridges where rural conditions still prevail and where traffic has only increased moderately over the years, rehabilitation has particular practical and economic application, especially when the structure has major historic significance.

The Stuyvesant Falls Bridge, in the hamlet of Stuyvesant Falls in Columbia County, New York, is a case in point (see Figure 1). Located on County Road 22, the bridge spans the Kinderhook Creek in the town of Stuyvesant, about 20 miles south of Albany on the east side of the Hudson River. The entire hamlet, including the bridge, is listed in the National Register of Historic Places.

The area now called Stuyvesant Falls was settled before 1667, and in 1800 became the site of the first paper mill in Columbia County. The mill took full advantage of the water power supplied by the Upper Falls that lie approximately 300 feet (100 m) upstream from the bridge. Today, the Niagara Mohawk Power Company operates an hydroelectric station at the Upper Falls. Stuyvesant Falls itself can be best described as a charming hamlet, characterized by large, well-kept wood-frame houses lining County Road 22 from the bridge to the center of Stuyvesant Falls.

The Stuyvesant Falls Bridge

The Stuyvesant Falls Bridge is a single span, steel, two-truss structure erected in 1899 by the Berlin Iron Bridge Company of East Berlin, Connecticut. Columbia County shoulders the maintenance responsibility for the bridge and has performed routine maintenance of sand blasting and painting over the years. The only heavy maintenance on the structure was performed in 1939, when the original wood deck was dismantled and the present open-grid steel deck was installed.

The two steel trusses, measuring 34 feet (10.4 m) top to bottom chord and 19.4 feet (5.9 m) C_L to C_L, carry a 17-foot (5.2 m) wide

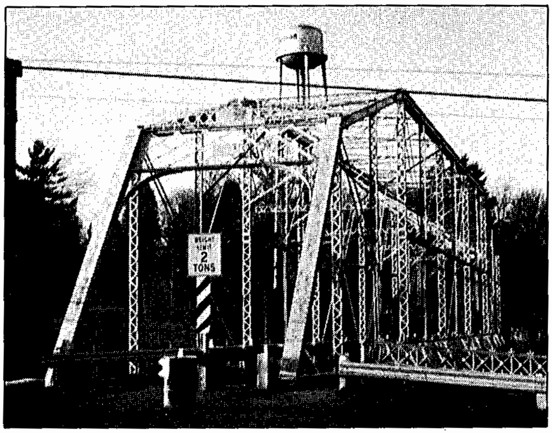

FIGURE 1. The Stuyvesant Falls Bridge viewed from the south.

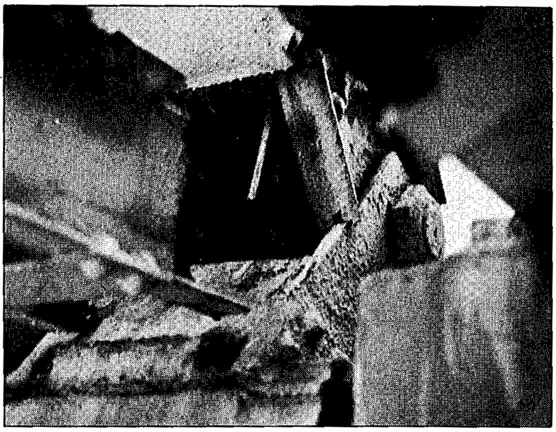

FIGURE 2. A view of the broken lower chord on the east truss (L_0 - L_1).

roadway over the Kinderhook Creek in one simple span 202 feet (61.6 m) long. A 4.7 foot (1.4 m) sidewalk is cantilevered off the upstream truss. The original trusses and floorbeams remained untouched.

An inventory under a state-sponsored bridge inspection program in 1978 revealed that the bridge had structural capacity problems, and recommended that the superstructure be replaced. The estimated construction costs totaled $1.7 million, and did not include engineering or legal costs, or costs for additional right-of-way required for widening the roadway to standard. The state and county were to contribute 20% of this amount based on a specific federal-state funding formula, plus they were to purchase the needed properties for the right-of-way.

After reviewing these costs, the Columbia County Highway Department decided to investigate the feasibility of the county, on its own, making the required repairs and upgrading the bridge. A consulting engineer was engaged to perform this engineering study. An in-depth inspection of the bridge by the consultant then revealed the following structural deficiencies:

1. The bottom chord was entirely severed by corrosion at the south bearing, and the inclined truss member and shoe had moved outward longitudinally 9 inches, and the rocker had twisted. See Figure 2.

2. The connections of three vertical truss members to the floorbeams at the panel points were corroded to the point of uselessness. See Figure 3.

3. Many roadway stringers were rusted and cracked in the end panels at the abutments where salt and dirt had accumulated around them.

4. All floorbeams were in good condition, but could only carry a 7 ton live-load safely.

5. The trusses rated well, except for 16 subpanel verticals whose rating was 9 tons.

6. Other deficiencies requiring rehabilitation included the twisted rocker, deteriorated sidewalk and railing areas, and general deterioration of the paint protection over the entire bridge.

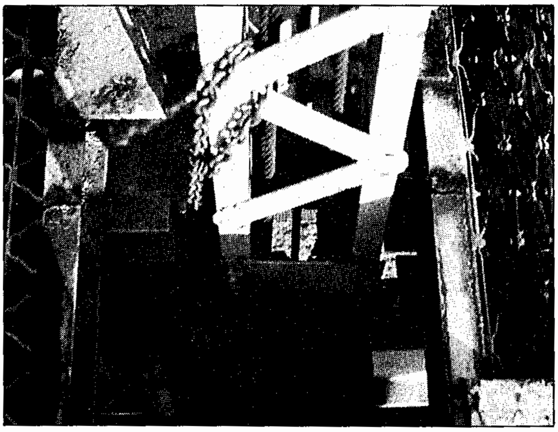

FIGURE 3. Broken vertical on the east truss (L_{11} - O_{11}).

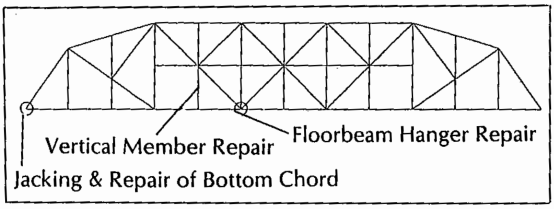

FIGURE 4. Elevated view of the east truss noting repair locations.

Following the consultant's inspection, the county decided to effect immediate temporary repairs for deficiencies in the broken bottom chord and in the corroded connections of three vertical truss members. The County Maintenance Department, under direct instruction of the consultant, first placed wire ropes tensioned by turnbuckles between panel points and load posted the bridge for 2 tons. With this expedient approach the bridge could then be used to some extent while the county and the consultant studied alternative methods for upgrading the bridge.

Repairing the Bridge

Further study by the consultant revealed that economically correcting the bridge's deficiencies enumerated above was feasible. While the necessary repairs, *per se,* were eligible for federal funding assistance, the substandard 17-foot width of the roadway posed a grave obstacle to gaining initial approval for the project and made the chances for ultimate project approval virtually nil.

Since upgrading the roadway to standard would have negated the county's intention to undertake the project itself, and do it economically, the county was left with two options. The first alternative was to solicit bids from contractors to effect the repairs. The second alternative was to have the relatively inexperienced but enthusiastic county maintenance personnel perform the work, while renting necessary equipment and buying structural steel as required.

The county, following consultation between the highway superintendent, his foreman and the consultant, opted for the second alternative. The consultant subsequently discovered that the county possessed a stockpile of structural steel that had been stored over the years at its yard. An inventory of the steel was performed and the needed temporary or permanent steel sections were used whenever possible from this inventory, with members chosen that met or exceeded minimum calculated requirements.

In order to begin repairs, the first order of business was to jack up the south end of the trusses approximately one foot (0.3 m) and remove the load from the twisted shoe (see Figure 5). Once the jacking was completed, the repair could be effected. The truss member and rocker were pushed horizontally by another jack to a calculated point and a chord mending device was installed to keep them there permanently. The jacks and auxiliary beams were then removed. The verticals and floorbeams were reconnected with permanent-type details, and the subverticals of the two trusses were reinforced with special "horseshoe"-shaped collars (see Figure 6).

The next repair in line was the strengthening of the floorbeams. Without removing the grating (which was in fair condition) and stringers, a platform was erected under each floorbeam (see Figure 7). Four angles were bolted onto the webs of the beam as close to the flanges as possible. The corroded stringers

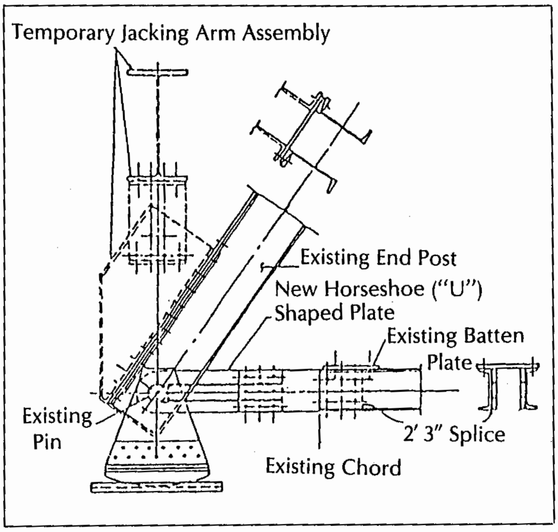

FIGURE 5. Jacking details and repair of the bottom chord.

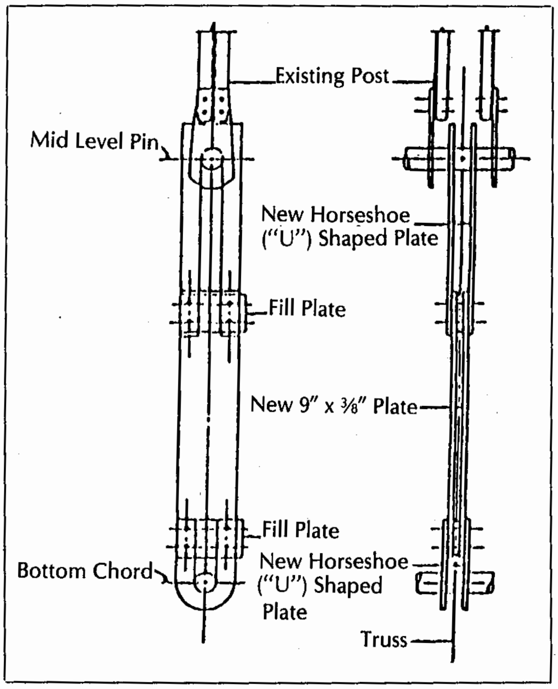

FIGURE 6. Vertical member repair.

were then left in place, but beams of similar depth were set alongside the bad ones and shimmed into place. The railing and sidewalks were repaired in spots where needed. Since cleaning and painting were not priority tasks, they were deferred to the following season. The bridge was reopened to traffic with a capacity of 15 tons — adequate to handle all traffic including buses, fire engines, ambulances and other community vehicles. For the occasional runaway heavy truck, the bridge's operating rating is 20 tons.

With an inexperienced work crew, the time necessary to complete the project was four months. No time was lost for permit application or outside agency approvals. The cost of the project to the county was $59,000 in addition to the salaries of the maintenance workers and the structural steel salvaged from the yard. In all, the county minimized its costs, preserved an historic structure, and gained a maintenance workforce that had acquired additional skills.

The county solved the Stuyvesant Falls Bridge problem by doing most of the work itself, and derived a great deal of satisfaction on account of this reduced expenditure. The

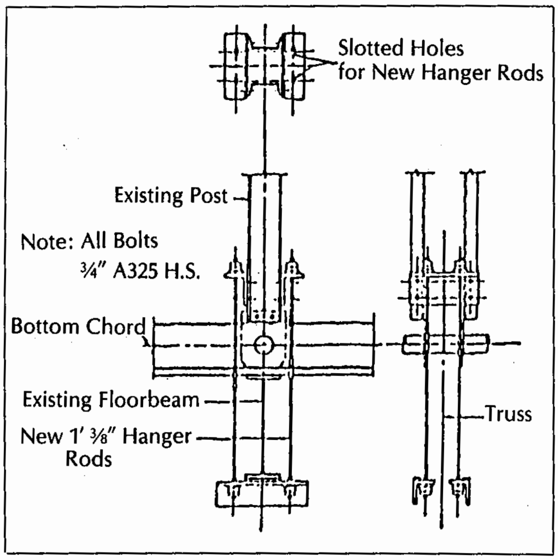

FIGURE 7. Floorbeam hangers.

then Governor of New York, Hugh Carey, recognized the Columbia County Superintendent of Highways, Richard Brady, with a special award for his imagination and good sense in restoring that historic bridge. Another plaque in similar recognition was given to Richard Brady and Columbia County by the National Association of Counties.

The restoration of the Stuyvesant Falls Bridge provides a surprising and encouraging example of how resourceful engineering can contribute, cost effectively, not only to the preservation of an historic landmark, but also to the necessary upgrading of a modern roadway system.

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