Goshen Historic Truss Bridge, Goshen, Virginia

Location and Description of Setting:

The Goshen Historic Truss Bridge, carries Route 746 across the Calfpasture River in Goshen, Rockbridge County, Virginia. The bridge joins the east and west sides of the small town and serves as the only access for emergency vehicles to some homes in Goshen.

Description of Bridge:

The Goshen Historic Truss Bridge was built in 1890 by the Groton Bridge Company. It is a two-span, eight-panel pin-connected Pratt through truss. It has an approximate total length of 261 feet. The trusses are approximately 139 and 121 feet long. Deck width is 19.4 feet, and the vertical clearance above the deck is 19.7 feet. Each of the two trusses supporting a span is non-redundant. The trusses and end posts are two upright channels connected with cover plates and lacing bars; and the posts are two vertical channels connected with latticing. The portal has an ornate cresting sign and end post finials as well as latticed portal struts. Lateral and sway struts are closely spaced with lacing bar sway braces. The bridge has a simple 2-pipe railing. The limestone substructure includes coursed, tooled ashlar masonry piers consisting of large limestone blocks. The abutments are coursed-tooled ashlar masonry.

The Goshen Bridge is one of Virginia's earliest multi-span truss bridges and is typical of late-nineteenth century factory-manufactured bridges. As originally designed, the structure included a lane for vehicular traffic, a lane for streetcars, and a cantilevered sidewalk.

Figure 20. Goshen Bridge

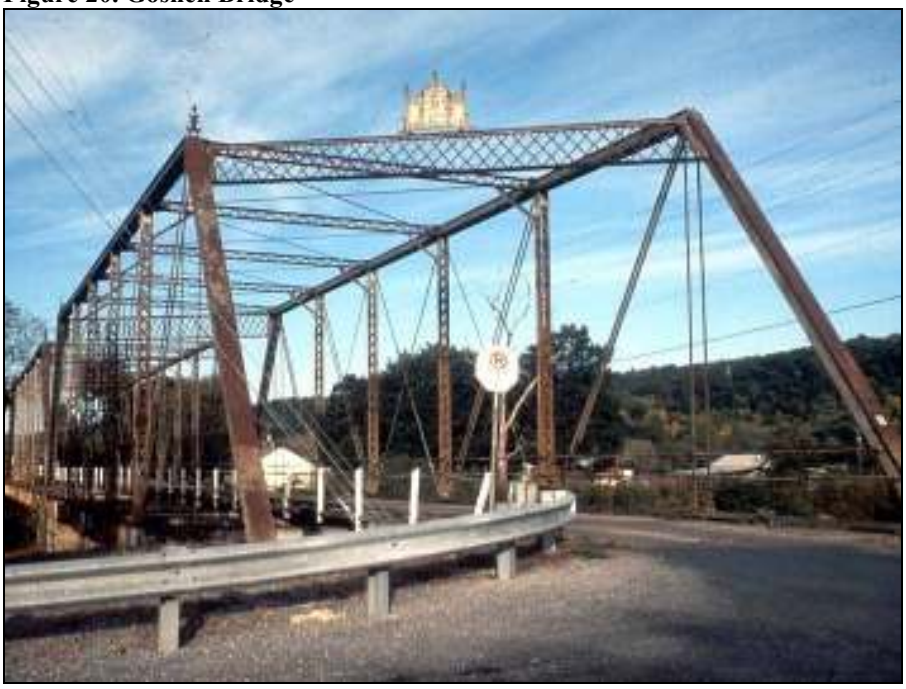

Figure 21. Goshen Bridge

Rehabilitation Project Information

Date/Cost for Rehabilitation:

Documentation of the history and structure of the bridge, and planning for a full rehabilitation of the structure took place over several years. Construction began in March 2001. The removal of the trusses began in June 2001 (the actual removal started with the erection of the false work beams, prior to June 2001). The last truss was removed in October 2001. Reassembly began in February 2002, and construction was completed in July 2002.

The contract was awarded to Allegheny Construction of Roanoke, Virginia, for $2.1 million; the final cost was approximately $2.2 million due to change orders for additional work replacing additional lower chord members.

Project Designer:

Virginia DOT Staunton District Structure & Bridge Office

Bridge Owner/Client:

Virginia Department of Transportation (VDOT)

Source for Additional Information:

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Project Information

1. **Significant issues associated with project (e.g., bridge condition, reasoning behind decision to rehabilitate versus replacement, reasoning behind selected maintenance activity).**

   The Goshen Bridge was in poor condition, with widespread corrosion and section loss in some of the structural members. Prior to 1948, its roadway had been reduced to a single lane, and posted for a load limit of six tons. Because of the load limit, the bridge was unable to accommodate various emergency and service vehicles to some homes in Goshen. Over the years, costly maintenance on the bridge had been deferred with the aim of eventually replacing the bridge with a modern structure. By the late twentieth century, inspection reports detailed the poor condition of the bridge. There were numerous areas of corrosion and section loss to steel members. The piers were missing mortar and substructure stones in various locations. The roller bearing devices were frozen, and some were displaced. In addition, debris was present on the bridge seats, on the connections, and between the stringers. Only one lane was open to vehicular traffic. The other lane, originally planned as a streetcar lane, had not had decking for at least 50 years, and there was attendant corrosion of the exposed members.

   VDOT considered several alternatives for the management of the Goshen Bridge: leave the structure as-is, document and demolish the bridge; preserve or restore the bridge in place or at a more appropriate location, or rehabilitate the bridge to meet current system needs. Several factors resulted in VDOT's decision to rehabilitate the structure. The Goshen Bridge is listed in the Virginia Landmarks Register and the National Register, and VDOT had committed to preserving its historically-significant bridges whenever possible. There also was strong local pressure to preserve the bridge as an important landmark and to keep it in service. These factors contributed to the decision to rehabilitate the Goshen Bridge rather than replace it with a modern structure.

2. **Project description, including purpose and need.**

   The VDOT Staunton District Structure & Bridge Office planned a full rehabilitation of the Goshen Bridge over several years, and in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Weeks and Grimmer 1995). The plan was to repair and repaint the stone piers as needed, using compatible mortar. The truss was to be disassembled, and the members repaired as needed and galvanized. The truss was then to be reassembled and restored for two lanes of vehicular traffic.

   The project involved disassembling, reassembling, and rehabilitating the structure not only to continue to serve vehicular traffic but also to handle increased loads. VDOT personnel measured and photographed the bridge prior to its disassembly. Because the original drawings for the bridge no longer existed, new blueprints were created.

   Rehabilitation included the disassembly of the bridge, replacement of elements weakened by section loss or not fabricated to meet modern design specifications, galvanizing of the members to provide lasting protection, and reassembly of the restored substructure. Based on the findings of the field inspection, the design team determined that more than 100 structural components needed to be replaced. These components included all endposts, hip verticals, upper chord members, counters, and pins, as well as the floor beams, stringers, and deck. Radiographic and ultrasonic testing was conducted to ensure the suitability of all fracture-critical tension members designated for reuse in the reconstructed trusses. Tension control (round head) bolts, placed with the round head on the visible face of the structure, were to be used in the reconstruction of the structure. All of the structural steel,

including the bolts and bearings, was galvanized. Modern construction equipment allowed modification of the dismantling and erection processes at the bridge site, including the use of the internal falsework beam system rather than falsework bents at every panel point.

Preserving the historical integrity of the Goshen Bridge was an important consideration. Rehabilitating the bridge required substantial replacement of members, but the original configuration of the bridge was maintained. The rehabilitation was controversial in part because it was more expensive than replacing the bridge with a modern structure.

The technology and materials used to build truss bridges are no longer in use, however, and few people have practical experience building or repairing these bridges. Further, little information is readily available on safely and effectively identifying and performing necessary operations. To address this issue, VDOT's Knowledge Management Division and the Virginia Transportation Research Council (now the Virginia Center for Transportation Innovation & Research) interviewed active and retired engineers, consultants, field personnel, environmental specialists, and architectural historians, and collected best practices related to pin-connected and riveted truss bridges.

3. **Traffic levels, loading needs, and other related issues.**

   The structure was completely rehabilitated with two lanes of vehicular traffic and designed for the AASHTO H20-44 standard truck loading.

4. **Section 106 effects finding (no adverse, adverse). Major issues discussed with State Historic Preservation Officer, and how issues were resolved.**

   VDOT, in consultation with the Virginia SHPO, determined that the proposed rehabilitation would have No Adverse Effect on the historic bridge.

5. **Lessons Learned.**

   The lessons learned from the Goshen Bridge project were:

   - The disposition of a historic truss depends on its suitability for continued service in the transportation system, and its evaluation as a historic property. Local support is critical to the success of these projects.
   - Successful restoration or rehabilitation of a historic truss is best accomplished through a partnership that includes historic resource personnel, bridge engineers, and the project contractor.
   - Rehabilitation of the Goshen Bridge to carry modern loads cost much more than a conventional replacement structure, requiring funds beyond those available for normal maintenance replacement. Funding for a rehabilitation or restoration project must be in place to ensure its success.
   - The first step in dismantling the Goshen Bridge was a detailed field inspection of the condition of the truss members, identifying the presence of lead paint, and measuring the general dimensions of the bridge and its site. Because the rehabilitation included the reassembly of the truss with the replacement of members, the inspection included detailed measurements of the dimensions of every member in the bridge. This level of documentation was essential in order to analyze the loads and determine stresses in the truss members.
   - The detailed inspection and structural analysis of the bridge was critical. The project team also recognized that, to ensure worker safety, it needed to exercise sufficient care in properly supporting the truss.

- Project plans included those items needed to facilitate bidding and ensure proper completion of the project. It is also useful to include a suggested sequence of construction, details of the falsework system, any limitations on the size and weight of worker access systems, and any needed information on the layout of the existing bridge, in addition to details of the rehabilitated structure.
- The Goshen Bridge was constructed prior to the development of standard specifications for structural steel. For the rehabilitation project, samples from the truss members were tested to provide data on the strength and the weldability of the steel.
- The *Secretary of the Interior's Standards for Treatment of Historic Properties* (Weeks and Grimmer 1995) were used to guide the rehabilitation. Members in the rehabilitated bridge complied with AASHTO specifications applicable to their planned use. This included pedestrian loading for the bridge. In addition, the rehabilitation's field operations complied with environmental regulations of several local, state, and federal agencies.
- While the bridge trusses were dismantled, a falsework supported the structure. Generally, the falsework could be an internal beam system, a system of individual supports, or another approach suitable for the site. Each must be designed to carry safely the loads transferred from the trusses, and each must be in place to support the trusses completely prior to beginning dismantling operations.
- The location of members in the truss were marked in place before dismantling began. They were permanently die-marked prior to any treatment, including lead paint removal, after the truss was dismantled.
- Depending on the size of the structure and the extent of the movement required, modern construction equipment may allow for the removal and transport of a structure from its site with little or no dismantling,
- By applying the principles of preventive maintenance to bridges determined to be truly significant, their deterioration – and thus the costs of their restoration or rehabilitation – can be minimized, facilitating the preservation of important historic properties for future generations.