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No issues with weight

Historic bridge in New York state revitalized

In the late 19th/early 20th century, there was a boom in truss bridge construction—one of the oldest types of today's modern bridges.

However, as vehicles got bigger, loads got heavier and traffic increased over the years, many of the truss bridges from that era became structurally deficient and obsolete. This was nearly the case for the historic Warren through-truss bridge located in the Forest Home Historic District of Ithaca, N.Y., adjacent to Cornell University, in Tompkins County.

The bridge had reached the end of its useful life. A 15-ton load restriction on the one-lane, 117-ft-long bridge restricted heavy trucks and emergency vehicles from using the bridge, thus forcing detours. Over its 109-year life, the bridge had undergone numerous rehabilitations and repairs. Previous additions of a cantilevered sidewalk and utilities had significantly reduced its live-load capacity. A conventional rehabilitation approach would not have eliminated the load restriction because even on its best day, if all of the truss components were brand new, the truss would not have been able to handle today's load demands due to undersized members. It was an optimal design for the Model T and Model A era of vehicles, not today's fire trucks and tri-axle dump trucks.

Saving the trusses

The bridge is located in the Forest Home Historic District, which is registered in the National Register of Historic Places, and is listed as a contributing structure of the historic district. Thus, finding a solution that would increase the bridge's load capacity while addressing safety along with historical and local concerns was a challenge.

The solution was elegant and simple: Remove and restore the truss structure while replacing the roadway floor system with a

Fact Finder

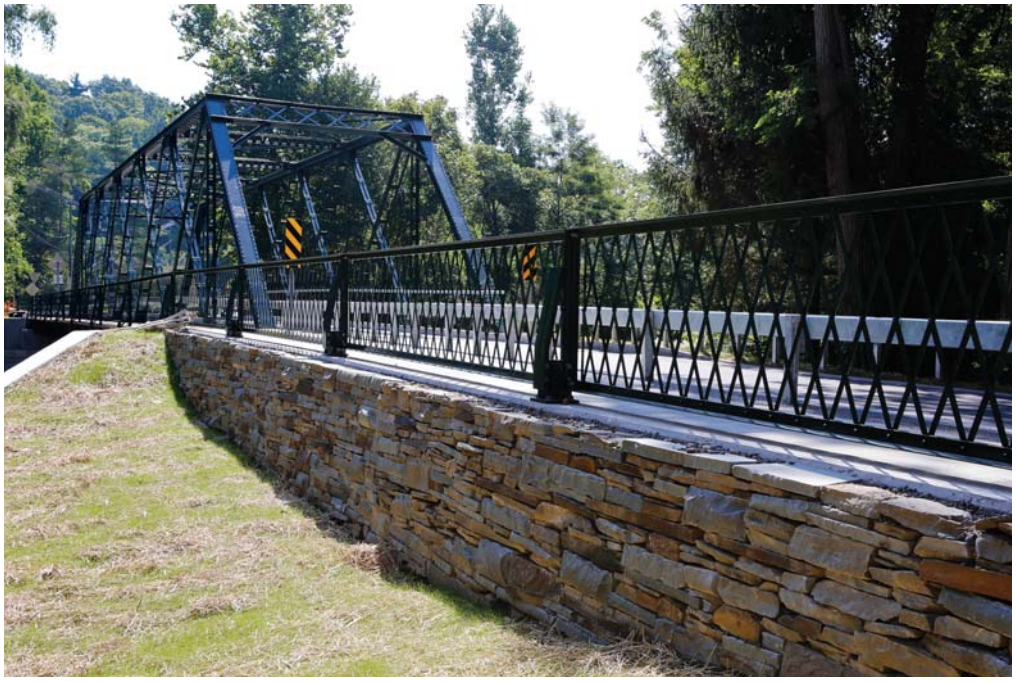
The original bridge is one of only four surviving in Tompkins County to have been manufactured by the Groton Iron Bridge Co., which closed in the 1920s.

steel multigirder superstructure with a composite concrete deck. The new superstructure spans the creek independent of the trusses, which remain in place, preserving the bridge's historic appearance and allowing the removal of weight restrictions.

Designing a modern bridge solution within the historic context of the project area presented quite a challenge. Forest Home Drive is a NYSDOT-designated New York State scenic byway and a New York State Department of Environmental Conservation (NYSDEC)-designated scenic road. The bridge and the historic residential properties adjacent to it contribute to the historic feel of the district.

Replacing a truss structure with a modern superstructure typically means the hydraulic opening of the bridge will decrease significantly or the roadway profile will need to be raised so as not to affect the bridge's waterway opening. The bridge spans Fall Creek, which is part of a FEMA-detailed study area with a delineated floodway. Therefore, the hydraulic opening above the stream became a significant factor in the design. After a detailed evaluation of the FEMA Flood Insurance Study for the site, it was determined there was enough freeboard over the 1% and 0.2% annual chance flood events that the low steel elevations of the proposed bridge could be slightly lower than existing elevations, but not enough to accommodate the full depth of the proposed superstructure. Another possible solution, raising the vertical profile of the roadway, was not feasible because it would significantly impact the historic residential properties adjacent to the bridge.

As a solution, variable-depth girders were designed to minimize impacts to both the roadway profile and the hydraulic opening. The roadway's vertical profile is built into the girders, which are 31 in. deep at the abutments and 42 in. deep at mid-span. The top flanges of the girders follow the vertical curvature of the roadway, and the bottom flanges are straight, an innovative design for a multigirder bridge. While the use of non-prismatic girders is not unprecedented, it is unusual to have the



Above: The Ithica, N.Y., bridge is registered in the National Register of Historic Places; its original truss steel dates from the Model T era and had a 15-ton load restriction.

Below: The steel multigirder superstructure allowed the removal of weight restrictions while preserving the historic flavor of the original truss structure. Moreover, three bays carry water, sewer and gas lines between Cornell University and the Forest Home community.

The Cayuga Heights Fire Department celebrated the completion of the new bridge by sending its heaviest fire truck across Fall Creek when the bridge opened to traffic.

driving surface along the curved edge of the girder. Using the girders in this orientation allows for enough structural depth to handle load demands at mid-span while minimizing the depth of the girders at the approaches and avoiding an additional 11-in. impact to the vertical clearance over Fall Creek.

Moreover, the new superstructure carries utilities over Fall Creek to ensure that the truss is not burdened with loads beyond its own weight. All three bays are used to carry water, sanitary sewer and gas lines between the Forest Home community and Cornell University. A new sidewalk was designed to cantilever off the upstream fascia girder beneath the existing truss, accommodating the high level of pedestrian/bicycle traffic along the road. New sidewalks at the bridge approaches create a safer separation of pedestrians from vehicular traffic. The new bridge handles all of these loads and demands within its compact, single-lane width of 14 ft 10 in., which was dictated by the available distance between the trusses.

Four surviving members

Fall Creek winds through the gorges and waterfalls of the Cornell campus. Working over the creek and preventing construction debris from entering it was a major concern during construction, and care was taken to clean and remove debris from the bridge deck and work areas. Since Fall Creek is listed as a Class B stream by the NYSDEC, the contractor followed all in-stream work restrictions.

The construction element that posed the greatest risk to the creek was the rehabilitation of the trusses, which included the replacement of the bottom chords of both trusses in their entirety due to significant deterioration, partial replacement of the end posts at the

four corners of the truss, and cleaning and repainting the entire truss structure. The threat to the creek was avoided altogether, however, as the contractor used a GMK 6300L 350-ton crane to remove the truss, through a series of two lifts, to an area adjacent to the bridge site for its rehabilitation. This not only protected the creek from rehabilitation debris but also increased worker safety by eliminating the fall hazard associated with working over the creek.

The bridge is one of four surviving in the county manufactured by the Groton Iron Bridge Co., which was located in nearby Groton until its closure in the 1920s. The bridge also is the only Warren through-truss in Tompkins County. Its double-intersection method of diagonal bracing, where the diagonals are doubled and overlapped to provide a more rigid truss, eliminated the need for vertical ties, thus making it even more unique to the area. The new bridge design preserves the truss and its historic significance alike.

Move right on in

Outreach and partnering were critical due to potential impacts on adjacent residential properties and Cornell University, which borders the east side of the bridge. Tompkins County and the town of Ithaca were major stakeholders; private project development team partners included Cornell, local historical groups and the Forest Home Improvement Association (FHIA).

> **We are thrilled that the new bridge** has no weight or height restrictions.
>
> — *George Tamborelle*

The FHIA historian, who participated in all biweekly construction progress meetings, served as a liaison between residents and the construction crew throughout the process. Residents felt more comfortable approaching the liaison, a member of their community, than they did approaching the construction crew directly with concerns about the project.

The bridge opened to traffic ahead of schedule and in time for move-in weekend at Cornell in late August 2014. The community's great affection for the bridge and the project team's focus on finding a solution that preserved an increasingly rare bridge type came together in a simple yet elegant way. While the bridge had always been loved by the community, the old steel deck made a tremendous racket with each passing vehicle. Now the only sound heard by nearby residents is the hum of crossing vehicles' tires.

George Tamborelle, chief of the Cayuga Heights Fire Department, expressed a great deal of enthusiasm for the new bridge, saying, "We are thrilled that the new bridge has no weight or height restrictions. We hadn't driven over the bridge since 2003. No more circuitous detour routes." In fact, the chief sent his heaviest fire truck to be one of the first to cross the bridge when it opened to traffic. **R&B**

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