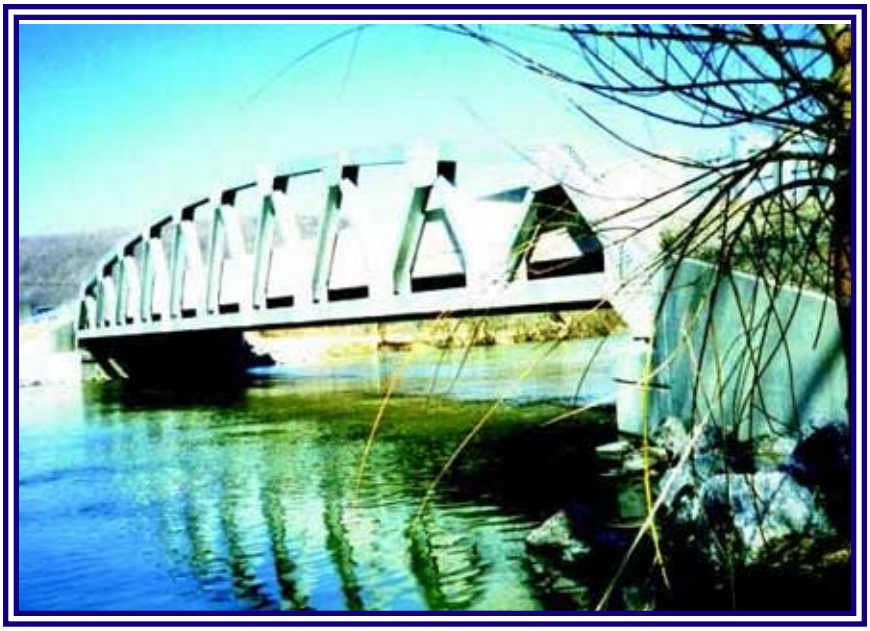
Prize Bridge Award: Short Span

FRANKLINVILLE BRIDGE #31



The replacement of the Franklinville Bridge #31 in Franklinville, NY, involved the use of a new pony truss to economically overcome the hydraulic and foundation challenges of a difficult site. The replacement structure is a 124' single span pony truss, fully galvanized, with all bolted connections. Although this unique superstructure was more expensive than traditional prestressed concrete or steel multi girder alternatives, the low depth to span ratio and relatively low dead weight of the truss allowed the use of spread footings, and decreased the amount of approach fill required. Increased superstructure costs were more than offset by reduced substructure and approach costs, resulting in significant overall savings. In addition, the use of bolted connections and full galvanization resulted in a structure that will be virtually maintenance free over its design life.

The project has demonstrated that the utilization of traditional steel truss design is still a viable, cost-effective solution for many bridge projects. The high strength to weight ratio and design flexibility of steel has resulted in a durable, aesthetically pleasing, cost-effective structure.

Site Conditions and History

The structure being replaced was a through truss with a 117' span constructed in 1941 and closed to traffic in 1993 due to its deteriorated condition. Site conditions required the replacement structure to be light with a low span to depth ratio.

Soil borings indicated that the site consisted of compact soils over relatively deep weaker soils, precluding the use of tradi-

tional pile foundations. Although the upper soils would have been suitable for displacement friction piles, they were not deep enough to develop the pile capacity required for the replacement structure. It was likely that piles would have punched through the upper layers, transferring structure loads into the lower weaker soils. Spread footings, founded on the compact soils just below the creek bed, would be required to distribute loads to competent soils and reduce the anticipated settlement of weaker underlying layers. Substructure costs rose significantly with structure weight due to the required increase in excavation to accommodate larger footings capable of handling higher loads. A lightweight structure was essential to minimizing project costs.

The structure was also located in a low stream valley, with little hydraulic clearance. Hydraulic analysis showed the design flood to be higher than the bottom chord of the existing truss. In addition, the stream alignment was skewed approximately 40° with the roadway. The replacement structure would have to have a low span to depth ratio to reduce the amount of embankment construction required, and would require the flexibility to incorporate a 40° skew.

Permanent steel sheet piling was used both as cofferdams during abutment excavations and as scour protection along with heavy stone fill.

Replacement Structure:

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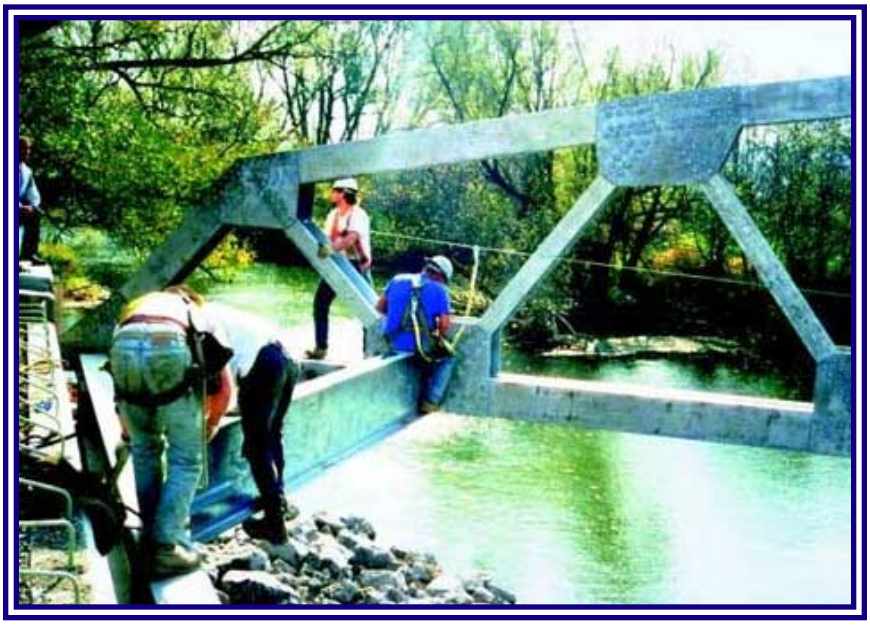
Additional advantages of the steel truss superstructure include: the single span structure eliminated the need for a pier in the creek, resulting in significant reduction of project costs and an increase in hydraulic area; and a single span structure was more tolerant of potential substructure settlement. Low span to depth ratio reduced the amount of approach fill and corresponding right of way acquisition required to obtain minimum hydraulic clearance less fill reduced loads on underlying soils, reducing the potential for settlement. Also, lighter self-weight reduced foundation loads when compared with traditional prestressed concrete or steel multi stringer superstructures; and all bolted connection design eliminated fatigue concerns common with welded truss systems, and allowed full galvanization, including all internal faying surfaces.

The use of bolted connections eliminated the fatigue concerns common with modern welded truss bridge systems and allowed full galvanization of the truss. Galvanizing the individual truss members prior to assembly allowed galvanization in standard tanks resulting in more competitive open bidding. It also is in compliance with the American Galvanizers Association's Class I details, providing the highest degree of corrosion protection attainable. Full-length concrete barrier was also used to protect the truss from vehicular impact and salt laden road spray and run-off.

Design and Detailing to Reduce Complexity

A potential disadvantage of a pony truss superstructure, when compared with traditional prestressed concrete or steel multi stringers, is a considerable increase in complexity both in design and construction. Preliminary design included an evaluation of truss alternatives and establishing an initial working line geometry that would allow truss chords to be fabricated from standard rolled shapes. A warren truss with a chorded parabolic top chord was chosen for its efficiency and aesthetic reasons.

Final design included a three dimensional finite element analysis of the truss and floor



system, an analysis of the capacity of the elastically braced top compression cord, and full design and detailing of all connections. The design was in accordance with AASHTO Strength Design Methods, including provisions for slip critical connections.

To help alleviate construction concerns, the truss, including connections, was fully detailed on the plans, allowing more competitive open bidding.

Although truss fabrication was labor intensive, the truss was designed and detailed to allow the majority of the fabrication and assembly to be completed in the shop simultaneous with substructure construction in the field. Shop assembly provided for greater quality control and helped accelerate the project schedule.

Meeting and Exceeding the Clients Needs

Completion of this project has re-established a safe and reliable stream crossing, eliminating a four-mile detour for local traffic. This crossing is a vital link across the river valley, generating increased access to farms on either side of the stream. The overall value of this structure is illustrated by the county's decision to abandon a recent design that included a two span prestressed concrete bridge replacement in favor of a truss structure at a similar site. The redesigned single span pony truss superstructure with spread footings was constructed for approximately 67% of the estimate cost of the prestressed concrete alternative, with no increase in future maintenance costs.

Franklinville Bridge #31

Owner:
Cattarraugus County
Department of Public Works

Designer:
Erdman Anthony & Associates,
Rochester, NYGeneral

Contractor and Erector:
Silver Line Construction,
Burdett, NY

Fabricator & Detailer:
Seibel Modern Manufacturing
and Welding, Lancaster, NY