2015 New Jersey Historic Preservation Award Nomination
N.J. State Historic Preservation Office

Rehabilitation of County Bridge RQ-179 Stanton Station Road over the South Branch of the Raritan River in the Townships of Readington and Raritan County of Hunterdon, New Jersey

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The Rehabilitation of the Historic Hunterdon County Bridge RQ-179 (Stanton Station Road) over the South Branch of the Raritan River in the Townships of Readington and Raritan, County of Hunterdon, New Jersey (see Regional Location Plan), is worthy of a historic preservation award as it involved a mix of historic preservation, conservation, public safety, environmental and engineering requirements.

This historic 8-panel, pin-connected, Pratt thru-truss bridge constructed in 1880 by the Cleveland Bridge and Iron Co. was identified as eligible for listing on the National Register of Historic Structures. The single-span truss was supported on random ashlar abutments. The bridge is notable for its original built up fish-belly floor beams, and for its ornate maker's plaques.

Measuring 103 feet long and 17 feet wide center to center of trusses, the bridge provides a single 15-foot wide lane between beam guide rails over the South Branch of the Raritan River, which serves as the boundary between the Townships of Raritan and Readington. The bridge was posted for 6 tons.

The Hunterdon County Engineering Department retained French & Parrello Associates (FPA) as their design consultant to perform scoping services, engineering design services, prepare contract documents, and provide services during construction in connection with the proposed project. As subconsultants to FPA: Richard Grubb & Associates, Inc. provided cultural resource services; Amy S. Greene Environmental Associates, Inc. provided environmental services; and Paul Carpenter and Associates, Inc. provided air quality and noise evaluation services

The overall goal of this project was to improve Bridge RQ-179's structural deficiencies, via historically sensitive structural repairs that would not alter the historic components and context of the original bridge design, in accordance with the Secretary of the Interior's *Standards for the Treatment of Historic Properties.* The purpose of the rehabilitation was to increase the existing load capacity to a minimum of 20 tons and greater if feasible, through the replacement of and repairs to original wrought iron members.

In addition to the structural problems with Bridge RQ-179, both roadway approaches to the bridge did not meet current design standards for sight distance, and the steep profiles resulted in additional impact loading when vehicles enter the historic structure. Thus, improvements to the approaches were needed to improve safety, as well as to extend the bridge service life.

The scope of work also included survey & right of way; hands-on in-depth inspection and structural analysis; traffic study; geotechnical engineering; re-alignment of the approach roadways and roadway design; structural design report; bridge design; utility engineering; drainage design; hazardous waste screening; permit preparation and submission; community involvement; and preparation of contract documents (contract plans, specifications and engineers construction cost estimate). Services during construction consisted of review of construction submittals (shop and working drawings, materials, etc.); technical advice to the County and Contractor; visits to the steel fabrication shop (Susan R. Bauer, Inc.) to determine additional repairs after dismantling truss and to inspect completed repairs; preparation of change-in-plans; and preparation of as-built drawings.

Existing Conditions (prior to construction)

The bridge had been rated as both structurally deficient and functionally obsolete. Its structural deficiency stemmed from its inadequate load capacity, posted for 6 tons. The bridge was functionally obsolete because of its inadequate width, which accommodated only one lane of traffic (see photo 1). A visual inspection of the bridge revealed corrosion of bridge members, generally below deck level, and deformation of several non-corroded tension members as a result of either over-loading or impact from floating debris during high-water storm events.

Specific problems on Bridge RQ-179 included heavy corrosion of the original wrought iron eye-bar lower chord members at the bearing supports, and buckling of the original wrought iron rods of the end vertical tension member at the west end of the north truss. The top chord was composed of two channels and a welded cover plate. The bottom chord consisted of original eyebars that had section loss varying from 25 to 75% and supplemental flat bars welded in place. The bottom chord bars had also been impacted by floating debris over time and were deflected in the transverse direction. Some original low chord eye-bars on the north truss had horizontal deformations as large as five inches. Intermediate verticals were comprised of two channels connected by lacings bars and end verticals were original round rods reinforced by supplemental flat bars. Supplemental steel bars and other repairs had been made to the structure during its long history. A supplemental horizontal bar at the mid-point of the verticals consisted of 2 channels had been added.

Floorbeams were hung from the trusses by a pair of U-bolt hangers at each vertical. An unusual historic detail was the original open-web fishbelly shaped floorbeams. The top and bottom flanges consist of a pair of back-to-back angles that were strengthened by the addition of welded cover plates to the top and bottom. The easternmost original floorbeam (Floorbeam #7) has been replaced by a rolled beam (see photo 9). The stringers that were supported by the floorbeams appeared to have been replaced in-kind when the cover plates were welded to the top and bottom flanges of the floorbeam.

The stone abutments and wingwalls were in fair condition, with missing mortar at many joints and some erosion below water level (see photos 9 and 11). The existing bridge railing was a standard galvanized guide rail mounted to the verticals (see photo 3). The existing deck and stringers were a replacement of the original materials.

In addition to the structural problems with Bridge RQ-179, the roadway approaches to the existing bridge did not meet current geometric design standards based on the bridge section, roadway classification, ADT and posted speed limit.

Proposed Bridge and General Project Scope

The proposed rehabilitation of the bridge consisted of both repairing and replacing existing structural members, components and bridge deck that had exhibited signs of severe deterioration and collision damage over the bridge's 135 year existence. During design, structural repairs and upgrades were designed utilizing the PennDOT Bar 7 truss analysis software in order to increase the load rating capacity of the bridge to carry AASHTO H20 live load upon completion of the proposed rehabilitation. During construction, the truss was dismantled on-site and transported to a fabrication facility (Susan R. Bauer, Inc.), where repairs were performed. The rehabilitation work included complete replacement/replication of the lower chord eyebars, selected vertical and diagonal members, hanger assemblies, and lacing bars; in-kind replacement of the fishbelly floorbeams and stringers with additional cover plates on the open web fish-belly floor beams to increase their capacity for the AASHTO H20 loading. The easternmost floor beam, a solid steel replacement of an original member (see photo 9), was replaced with a new open web fish-belly floor beam to match the remaining new replacements of the existing original floor beams; replacement of the existing bearings; repairs to the upper chord and vertical members; and blast cleaning and painting of the bridge in the fabrication shop. Riveted connections were used for selected locations. During the bridge rehabilitation in the fabrication shop, the roadway profile and alignment on the approaches were modified at the site to improve sight distance for the design speed (15 MPH), and included rehabilitation of and raising the stone masonry wingwalls using a reinforced concrete L-wall faced with the original stone masonry. The top of the stone masonry abutments were removed and capped with a reinforced concrete seat complete with a backwall. As a scour countermeasure, concrete toe blocks were installed in front of both abutments to provide scour protection for the abutments. Upon completion of steel repairs in the fabrication shop, the truss was transported back to the site and re-erected on the reconstructed bridge seats with new reinforced elastomeric bearing pads for the truss bearings and steel pedestals with PTFE bearing pads for the stringer bearings. Corrugated steel bridge flooring topped with asphalt was installed. New deck joints, bridge railings, approach pavement and guiderail were installed. The project construction was completed in the spring of 2014.

Overall Context Sensitive Design (CSD) strategy - Due to the historic character of the existing bridge, historic research, field investigation, measurement of bridge structural details and surveys were required. The project required coordination with local officials, with NJDEP Historic Preservation Office (SHPO), and with the County in order to develop a Context Sensitive Design that met all of the load and safety design requirements, as well as SHPO historic requirements, so as to ensure that the rehabilitation was conducted in accordance with the Secretary of the Interior's *Standards for Rehabilitation*. Historically accurate treatments for the bridge included the following items toward preserving the integrity and historic appearance of the original bridge, engineering significance and functionality of the 135-year-old structure:

- Replacement of all of the floorbeams by replicating the existing fish-belly floorbeams, hanger assemblies and pins (see photos 8 and 10, and plan sheets 34 and 37);
- Use of riveted connections performed in the fabrication shop (see photos 14 and 23 and note 9A on plan sheet 27);
- Installation of a two-bar steel railings (painted brown) for the vehicular impact, with welded lattice railing to the fascia side of the railing to resemble a historic photo of the bridge (see photos 15 and 16 and plan sheet 45);
- Restoring/replicating the ornamental "Maker's" bridge plaques attached to the portals on either end of the bridge facing (see photos 17 to 19, and plan sheet 46); The maker's plaques on both ends of the bridge were removed during construction. The missing bracket on the plaque at the east end of the bridge was replicated using the west plaque as a guide. Both the in-kind replacement of a missing significant element of the bridge and the cleaning of the plaques were performed using the gentlest means possible met the Secretary of the Interior's *Standards.*
- Repairs to stone masonry abutments and wingwalls including repointing and resetting of any loose stones, raising the height of the stone masonry wingwalls by pouring a concrete L-wall cap and facing the concrete cap with stone masonry closely matching the stone masonry on the existing wingwalls (see photos 12 and 13, and plan sheets 31 to 33); and
- Use of Weathering Steel guide rail on the bridge approaches (see photos 13 and 26, and plan sheets 5 and CD-1 of CD-1), instead of the galvanized steel beam guide rail that had existed.

The Rehabilitation of Bridge RQ-179 project is a excellent example of a project where historic preservation and conservation along with sound structural engineering principles can be integrated to greatly improve the safety, structural capacity and appearance of the historic bridge crossing. The improvements minimized environmental impacts and impacts to the surrounding public to the maximum extent practicable and complied with the requirements of the State Historic Preservation Office and the County of Hunterdon.

County Bridge RQ-179 Rehabilitation Team

James G. Martin, PE, PP, Hunterdon County Engineer, Office of the Hunterdon County Engineer, Department of Roads, Bridges and Engineering, Route 12 County Complex, Building #1, P.O. Box 2900, Flemington, New Jersey 08822 – Project Director (County)

Henry Wieczorek, Senior Engineer, Hunterdon County Engineering Department, Department of Roads, Bridges and Engineering, Route 12 County Complex, Building #1, P.O. Box 2900, Flemington, New Jersey 08822 – County Liaison Engineer

Hernando Escobar, Interstate Contracting & Excavating, LLC, 225 Parkhurst Street, Newark, New Jersey 07114 – Construction Contractor

Richard Bauer Jr., Susan R. Bauer, Inc., 427 Margaret King Avenue, Ringwood, New Jersey 07456 – Fabricator

William C. Pyontek, PE, PP, Chief Engineer, French & Parrello Associates, PA, 1800 Route 34, Suite 101, Wall, New Jersey 07719 – Responsible Structural Engineering Consultant

Total Project Cost:	**$**1,784,958.26
Time to complete project:	Approximately 12 months (The project commenced on May 20, 2013 and was substantially complete on May 12, 2014).