Hillery Street Bridge Spans Three Centuries

Replacement bridge recaptures historic past.

By Bruce J. Karalius

When the original Hillery Street Bridge was constructed in 1898, it was a four-span, simply supported, riveted Pratt Pony Truss carrying one lane of traffic in each direction across the Passaic River in northern New Jersey. The only bridge of its type in Passaic County, it had many of the distinctive design features of the late 19th century.

Based on the design developed by Parsons Brinckerhoff (PB, www.pbworld.com), the Hillery Street Bridge was replaced with a modern structure with a load-carrying capacity of 40 tons. As a result of the team's efforts to retain or replicate key features of the original bridge, the new bridge not only meets today's engineering standards, it also reflects its past.

The Hillery Street Bridge links West Paterson and Totowa, alleviating congestion on adjacent roadways, and provides commuters with access to state and interstate routes. Due to its age and configuration, the original structure no longer met current geometric and safety requirements. However, because of its importance to local residents, business owners, and the traveling public, retaining the bridge was a priority for its owner, Passaic County.

During the conceptual design phase, a study was undertaken to determine the best alternative for correcting substandard conditions on and at the bridge. It became evident that the structure needed significant rehabilitation if it were to continue to safely serve motorists and pedestrians. In particular, the existing bridge no longer met current requirements for safety due to its substandard geometrics and load-carrying capacity. The bridge was unable to accommodate current and projected volumes of traffic. Moreover, there had been an increase in the number of accidents at the intersection immediately west of the bridge. There also were concerns regarding continued maintenance costs related to the service life of the bridge. Considering these issues, PB recommended replacement.

The New Jersey Department of Transportation, in concert with the

Bridging Old and New

The original Hillery Street bridge was constructed in 1898 as a four-span, simply supported riveted Pratt Pony Truss carrying one lane of traffic in each direction. The span of each truss measured approximately 88 ft, and the total length of the bridge was about 350 ft.

By the late 1900s, the original bridge was deemed structurally deficient and functionally obsolete. It consisted of the Pratt through-trusses with a floor-beam/stringer floor system and a steel grid deck. The width of the bridge from curb to curb was just 17 ft 6 in. Sidewalk brackets cantilevered from the panel points of the trusses, about 11 ft on center, with the trusses supported by piers and abutments constructed of masonry stone blocks. Each sidewalk was five ft six in. wide.

The New Jersey State Historic Preservation Office determined that the Hillery Street Bridge was individually eligible for listing on the National Register of Historic Places as a structure "... that embodies the distinctive characteristics of a type, period, or method of construction."

The only multi-span, riveted construction example of its type remaining in Passaic County, the original bridge had many unique features: its riveted connections were fairly uncommon on Pratt-type trusses because of their lower compatibility with rigid connections; knee braces were connected to vertical truss members to provide stability; and the ornamental pedestrian railing was a one-of-a-kind design, like those of other county bridges spanning the Passaic River.

The design engineer, Parsons Brinckerhoff, and contractor, Rosangela Contracting Company, Inc, made significant efforts to comply with a memorandum of agreement between the New Jersey State Historic Preservation Office and the Federal Highway Administration to preserve and replicate historic elements into the new structure. For example, original trusses are a part of the structural framework. Ornamental rosette-patterned pedestrian railings were restored and reused. Capstones from the original bridge piers, abutments, and wingwalls were reused. Cantilevered sidewalk brackets were replicated because deterioration and substandard thickness prevented their reuse. The stone color and pattern of the piers, abutments, and wingwalls were replicated because the original stone was unsalvageable. Additionally, although not required, period reproduction lighting fixtures were installed on the bridge. Finally, a historic marker identifying the bridge's significance was erected at the site.

The new Hillery Street Bridge replaces the original, built in 1898. The original was a four-span, simply supported, riveted Pratt Pony Truss carrying one lane of traffic in each direction across the Passaic River in northern New Jersey.

North Jersey Transportation Planning Authority and the FHWA, agreed to help fund the replacement of the bridge. However, for Passaic County to receive the funding, several features of the original bridge would have to be preserved or replicated as per a memorandum of agreement between the New Jersey State Historic Preservation Office and the FHWA.

Integrating Existing Members and Modern Materials

The new bridge is a four-span, multi-steel beam superstructure with a reinforced concrete deck slab. The width of the bridge deck was increased from 17 ft six in. to 30 ft from curb to curb, and the load carrying capacity increased from three to 40 tons. The original five-ft six-in. sidewalk width along each side of the bridge was retained. Roadway improvements were made to reduce the incidence of traffic accidents. These included correction of the poor site distance and substandard turning radii at the intersection immediately west of the bridge by flaring the west span of the bridge and adding traffic signalization to the intersection. The new bridge was designed in accordance with the requirements of load and resistance factor design.

The superstructure is composed of painted W36 steel beams (AASHTO M270 Gr. 50) continuous over the four spans. The beams are spaced at seven ft eight in. on center and have a nine-in. thick reinforced high-performance concrete deck slab. The flare of the west span was accommodated by providing diagonal beams, which frame into the "fascia" beams. The continuous structure eliminated the need for deck joints, thereby reducing the problems associated with leaking joints. Reinforced elastomeric bearings were installed at the abutments and piers.

Six original bridge trusses that were in the best condition were reused on three of the four spans. Each truss consisted of various members (i.e., the top and bottom chords, verticals, and diagonals), which were, themselves, composed of individual components (i.e., angles and plates). Even though most of the individual components were only 1/4 or 5/16 of an inch thick, whereby only a minor amount of corrosion could significantly reduce the cross sectional area, about half of the members were in good enough condition to be retained. The other half had to be replaced with new members that replicated the old ones.

To preserve the remaining trusses as part of the new bridge, they were integrated into the structural framework of the superstructure. The cantilevered sidewalk brackets were connected to gusset plates attached to the trusses in the same manner they were connected in the original bridge. The gusset plates were then attached to the fascia beam. In this manner, members of the truss still assist in providing some load-carrying capability.

To resist moment created by the sidewalk loads on the cantilevered sidewalk brackets, W24 steel beams were used as diaphragms, which transform the moment from the cantilevered sidewalk into reactions, which were then resisted by the beams. To provide rigidity, the W24 diaphragms were used throughout the entire framing plan and not only in the fascia bays.

The cantilevered sidewalk brackets, which are mostly composed of double angle components, were replaced in-kind, except the thickness of the angles was increased from 1/4 in. to 3/8 in. to meet current state requirements. The

At left is a view of the sidewalk brackets and lower portion of the truss on the original Hillery Street Bridge. At right, a view of the new cantilevered sidewalk brackets from the underside of the replacement bridge.

Once both abutments were relaced with new reinforced concrete abutments founded on spread footings, stone facing was attached that replicated the general color and appearance of the original stone .

sidewalk brackets were placed at the panel points of the trusses.

The original pedestrian railings along each sidewalk were cleaned, repainted, and used in the same fashion on the new bridge.

Drilled Shafts Replace Original Piers

The criteria to reuse the existing trusses required the span lengths of the new bridge to be the same as the original bridge; hence new substructure units needed to be placed at the same locations as the original units. This requirement necessitated complete removal of the existing piers and installation of four-ft diameter drilled shafts in their place. Accordingly, four drilled shafts were installed at each pier. Atop each of the drilled shafts a cast-in-place reinforced concrete pier cap was constructed. The pier cap extends from just below the mudline to the bottom of the beams. Stone facing was then attached to the pier caps. Additionally, both abutments were also removed and new, reinforced concrete abutments were founded on spread footings.

As with the piers, stone facing was attached to the abutments and wingwalls. The stone facing was originally intended to be fabricated with stone blocks from the original piers and abutment. Unfortunately, since the stone was too severely deteriorated and cracked, it could not be reused. Therefore, other stone that replicated the general color and appearance of the original stone was used. The original capstones, which were composed of a harder stone than that found in the original piers and abutments and wingwalls, were in a condition suitable to be reused as capstones on the new bridge piers.

The new Hillery Street Bridge opened to traffic in February 2009. As a result of careful planning, design, and construction, the successful replacement project enabled the new bridge to meet today's transportation standards while preserving many elements of the historic structure.

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Mr. Karalius, P.E., is a supervising engineer and professional associate in the Princeton, NJ office of Parsons Brinckerhoff.

The steel ornamental pedestrian railing, decorated with a pattern of rosettes, was in fairly good condition so it was reused on the new bridge. The railing did require a modification because it did not meet current geometry and safety requirements; the railing openings were too large. To correct this condition, a steel, circular-patterned component was installed on the top portion of the railing to reduce the size of the opening. The thickness of the material for this element was minimized so as not to detract from the overall appearance of the railing, yet function structurally and meet current code requirements.