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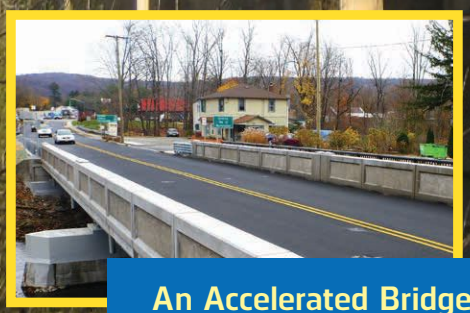
Implications of Connected and Automated Vehicle Technologies

See page 27

Allentown's Historic 8th Street Bridge

See page 30



An Accelerated Bridge Reconstruction

See page 34

Upgrade for a Historic Allentown Landmark and Vital Traffic Artery

by Ralph Eberhardt, PE, MBA, **ASHE East Penn Section**

The 8th Street Bridge, an iconic part of the skyline in Allentown, Pennsylvania, is a vital transportation link. To extend its life, the Pennsylvania Department of Transportation (PennDOT) selected a design team led by Michael Baker International to undertake an $18 million rehabilitation of the 2,700-foot-long, 17-span, concrete spandrel arch viaduct. The design challenges of this project centered on enhancing the long-term durability and functionality of the bridge while respecting its historic significance.

Part of the National Register of Historic Places, the 8th Street Bridge was built in 1913 and spans Little Lehigh Creek, Martin Luther King Jr. Drive, Harrison Street, a former railroad line and a portion of Fountain Park at heights of 80 to 100 feet. This reinforced concrete bridge consists of nine open spandrel arch spans and eight arched "T" beam spans. The original structure was built to carry two trolley lines and one toll lane for motor vehicles. Later, the structure was converted to carry two 10-foot-wide northbound motor vehicle lanes, one 10-foot-wide southbound lane and two sidewalks. Michael Baker coordinated closely with the Pennsylvania Historic and Museum Commission, PennDOT Environmental Unit and the City of Allentown Historic Architecture Review Board throughout the design process to protect the bridge's historical integrity and address the character-defining elements of the bridge. Distinctive elements of this structure include the open-spandrel arches, arched T-beams, arched floor beams, obelisk-style light poles, ornate alcoves, decorative railings and ornamental features on the piers.

The project began with comprehensive inspections of the structure to determine the condition of the numerous bridge elements and to assist with a load rating. Michael Baker employed a three-dimensional LiDAR survey to confirm and supplement the bridge arch geometry found in existing plans and a 1913 *Engineering News* article. Due to the complexity of the open-spandrel arch structure, it was recommended that a three-dimensional finite element model of the structure be created to complete the load rating analysis. In addition, the team obtained several concrete core samples from the existing bridge and conducted testing to determine a realistic compressive strength of the concrete elements. The comprehensive strengths of the structure varied from a low of 4,980 pounds per square inch (psi) to a high of 9,510 psi and significantly affected the structure's ability to carry current-day design loads. Due to the extensive deterioration of the existing T-beams spans and their limited service lives, the team determined it would need to replace all T-beam spans in the superstructure.

To meet current design requirements and provide a functional structure, the team expanded the outside width of the superstructure from 46 feet to 48 feet, 10 inches. The new cross section includes two 11-foot outside lanes, one 12-foot center lane, outside parapet walls and two sidewalks with safety barriers separating the roadway and sidewalk.

To maintain the road's current grade and ensure that the bridge could accommodate future needs, the team installed lightweight geofoam blocks to support the new deck system. Geofoam is an expanded polystyrene material that has been used as a lightweight fill material in transportation projects all over the world for more than 30 years. It has the weight of approximately one percent of

Workers make concrete repairs to arched floor beams and spandrel columns.

typical soil or stone materials, has little or no compression, provides predictable support characteristics and is easy to install. Crews added concrete floor beam extensions to support the new concrete deck and installed geofoam between floor beam extensions to minimize the weight of the structure so it could be used without any load restrictions.

In addition to maintaining the historical structural significance of the bridge, several project-specific specifications were developed to aid in this effort, including period-style acorn lighting fixtures, power washing of the entire structure, tinting of all concrete to match the existing bridge color and metalizing/painting of fabricated steel to blend the new bridge enhancements as seamlessly as was feasible with the existing structure. The team also developed several custom designs to mimic the existing historic features, including pre-cast arch fascia panels, pre-cast decorative alcoves, pier jacketing and pre-cast obelisk light poles. At the request of community stakeholders, the team added a pedestrian safety fence to the top of the decorative railing.

Approach span construction at the north end of the bridge

As part of the environmental clearance, the team determined that a pair of Peregrine Falcons had been nesting on the bridge. There are only 29 known nesting pairs of this protected bird in Pennsylvania. Since the birds are an endangered species, PennDOT coordinates with the Pennsylvania Game Commission to mitigate the potential impact any project might have on the falcons. The commission determined that the falcons had nested for several years on the nearby PPL building prior to nesting on the bridge. The commission directed PennDOT to construct screening on the underside of each of the nine open arches on the bridge to deter the falcons from nesting on the bridge. In addition, the commission directed PennDOT and Michael Baker to build a nest box with an Internet-accessible camera on the PPL building. This provided the falcons with an alternate nesting location during the two-year construction project. The web camera enabled the public and the commission to monitor the birds.

The Michael Baker team determined early on that a full closure of the bridge was not feasible during the projected two-year construction period. To stage the construction, crews kept one motor vehicle lane open into the city and one sidewalk open at all times. With the removal of southbound traffic across the bridge, the team established a detour route. The Michael Baker team also modified four existing traffic signals and created a temporary traffic signal to deal with significant increased traffic volumes from the detoured traffic.

Construction of this vital project is set to be completed in fall 2016. Through collaboration and careful planning, PennDOT and the Michael Baker team engineered a solution that preserves the past, protects the environment and provides for the growing needs of the residents and businesses of Allentown.