Frederick Avenue Bridge over Gwynns Falls and CSX Railroad

by Mike Izzo, Whitney, Bailey, Cox & Magnani

The concrete arch façades for the Frederick Avenue Bridge were manufactured to closely resemble the design of the existing two-span, closed-spandrel filled arch structure that was built around 1930. Photo: Joseph B. Fay Company.

The city of Baltimore faced several unique challenges when it began the process of replacing the bridge carrying Frederick Avenue over Gwynns Falls and the CSX Railroad. First and foremost, the community and the Maryland Historic Trust wanted the replacement bridge to closely resemble the design of the existing two-span, closed-spandrel filled arch structure that was built around 1930. To satisfy this request, the superstructure was designed as a two-span prestressed concrete-beam bridge with concrete arch façades in each span that mimicked the appearance of the existing arch. The city also had to protect an environmentally sensitive stream, maintain rail traffic for CSX and pedestrian traffic for the Gwynns Falls Trail, and convey numerous existing underground utilities.

Close up of structural steel splice plate connection ready to be cast into one of the precast concrete box beams. After all segments of the arch were erected, concrete was placed around the connection to complete the arch. Photo: Northeast Prestressed Products.

The arch façade is comprised of a precast concrete arch rib spanning from abutment to pier in each span that supports a cast-in-place concrete arch wall. The precast concrete arch ribs were detailed as three separate box sections with concrete closure placements between each of the sections and the substructure units. Couplers consisting of structural steel splice plates were cast into the hollow portions of each precast concrete box to allow them to be bolted together in order to erect the arch prior to completing the closure placement.

Precast concrete was chosen primarily to avoid having to shore the formwork needed to construct the arch and wall because the bridge crosses both the environmentally sensitive Gwynns Falls and the CSX Railroad tracks. The completed precast concrete arches supported the formwork for the cast-in-place concrete arch walls. Each precast concrete arch rib was designed to resist its own self-weight, the vertical dead load from the arch wall, and the horizontal wind load on the arch wall, which was transferred to the arch through dowels cast in the top of the arches.

Construction of the arch by the general contractor also presented several challenges. The installation of a temporary causeway over Gwynns Falls was needed to access the site and temporary shoring towers and a crane were set up in two stationary positions to erect the arches. Additionally, the contractor had to construct each arch rib to within a 1/16 in. tolerance to ensure that the ribs fit into place without a noticeable misalignment.

With sound engineering and creative construction techniques, the precast concrete arch ribs allowed for an efficient, low-cost solution to provide the requested appearance of the original arch.

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