The completed Warden Avenue Bridges in Markham, ON, Canada, span Berczy Creek North, Berczy Creek South, and Carlton Creek. This bridge crosses the Berczy Creek South. Courtesy of Armtec LP.

Precast concrete arches meet demands of Canadian bridge project

Designing and constructing three bridges along Warden Avenue in Markham, ON, Canada, involved a lot of work and cooperation among a lot of contractors and other companies. The effort was worth it. In fact, the project was so successful that it won a 2015 PCI Design Award for Best Bridge with a Main Span Up to 75 Feet.

Early on in the project, the decision was made to use high-performance precast concrete arch structures on all three of the bridges. Graham Bros. Construction Limited selected Armtec LP of Concord, ON, Canada, for the precast concrete work, and BEBO arches were chosen as the best solution for the bridges. "We have been working with BEBO arches since 2006," says Frank Mandarin, the senior sales representative on the project for Armtec.

Armtec began working with BEBO, a Swiss company, because its products provided solutions that leveraged Armtec's strengths in engineered bridge solutions for its precast concrete and drainage businesses. "We have several precast facilities between British Columbia and Ontario that can produce these arches, which provide us with a wide reach for this product," Mandarin says.

BEBO arches were uniquely suited for the Warden Avenue project for a number of reasons. First, the long span and low rise accommodated the natural banks and channels of the waterways flowing underneath the bridges. "The low rise also accommodated the low road profiles of the project," Mandarin says.

Workers erect precast concrete arches for bridges on Warden Avenue in Markham. Courtesy of Armtec LP.

In addition, the three bridges are in an environmentally sensitive area, so the small construction footprint afforded by BEBO arches minimized the environmental impact, while the longer distance between footings kept most of the work outside fish boundaries. "The long spans accommodated the hydraulic requirements of major storm events," he said. The arches also facilitated the accelerated construction schedules.

All three arches were 22.7 m (74.5 ft) long. One had an 18.9 m (62.0 ft) span × 2.7 m (9.0 ft) rise, the second had a 22 m (72 ft) span × 3.0 m (9.8 ft) rise, and the third had a 25 m (82 ft) span × 3.4 m (11 ft) rise.

"The construction window for this project was extremely challenging, as there was only an allotted six-month road closure for it to be completed," Mandarin says. "Our solution was to utilize our broad network of precast facilities across Ontario

to cast pieces simultaneously, which allowed us to deliver the project on time."

There have been numerous benefits to the decision to use BEBO arches. They are high-performance concrete structures manufactured in a controlled plant environment, they reduce the environmental impact and risks, they have an accelerated construction window and lower maintenance costs (because bridge decks were eliminated with the use of precast concrete), and they allowed the installation of utilities within the road backfill. "In addition, no piers or columns were required," Mandarin says. "This resulted in no obstructions for wildlife, while creating a more aesthetically pleasing structure."
—William Atkinson

Precast concrete complements historic stone bridge

The masonry arch bridge on State Route 209, East Broad Street, in Tamaqua, Pa., won a 2015 PCI Design Award for Best Special Solution.

The bridge was identified for a major rehabilitation largely as a result of the deteriorating condition of its sidewalks. Although inspectors determined that the original stone masonry core could be rehabilitated, they came to the conclusion that the sidewalk structures were beyond repair.

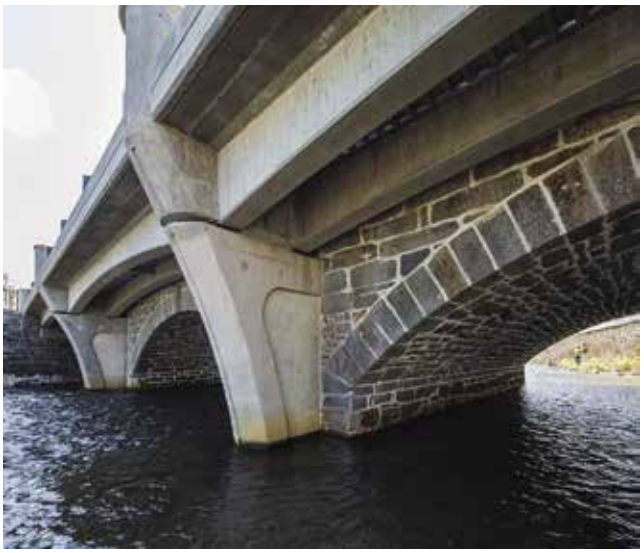
Because the original stone arch core held both national and local historical significance, the project involved not only an engineering firm, a general contractor, and a consulting project manager but also the local historical and architectural review commission, which was included to oversee the design concept and provide input.

The challenge was to find a way to replace the existing sidewalk structures with a new system that could stand next to a thoroughly restored stone masonry arch from the 1890s in a way that would allow the two structures to coordinate visually and that could also solve the inherent structural deficiencies.

The team determined that precast concrete was the solution. The structural system would include prestressed, haunched concrete beams as the focal point of the new sidewalk structure. It was also determined that the arched variable-depth shapes of the precast concrete beams would need to allow for a long-span look that complemented the adjacent stone arches while leaving much of the historic arch exposed.

The team selected Northeast Prestressed Products LLC (NPP) in Cressona, Pa., to fabricate and supply the arched sidewalk beams. "The designer's intent was to maintain the historic nature of the bridge," says Troy Jenkins, chief engineer for NPP. For example, the designer opted for earth tones for the precast concrete pieces so that they would blend in naturally with the original stone masonry of the bridge itself.

"Hamilton Form came up with a nice forming system for us that eliminated what would have been some challenges in fabricating the beams," Jenkins says. Hamilton Form manufactures steel forms and support equipment for the prestressed concrete industry. One of the challenges would have involved the form setup. Another would have been getting all of the reinforcement to work along the arch.



Precast concrete was used to rehabilitate this 1890s stone arch bridge that had deteriorating sidewalks in Tamaqua, Pa. Courtesy of John Baer/Building Images Photography.

The precast concrete portion of the project included 12 solid, haunched prestressed beams and eight precast concrete capstones on concrete pilasters. The beams were designed to provide continuous action for live loads and superimposed dead loads while allowing for shorter beams to facilitate delivery and setup in a compact urban environment.

"The people from the town are very happy with the look of the bridge and the fact that they could keep the original stone arch as a result of being able to widen the bridge," Jenkins says. "The precast beams definitely met the project goals."
—William Atkinson