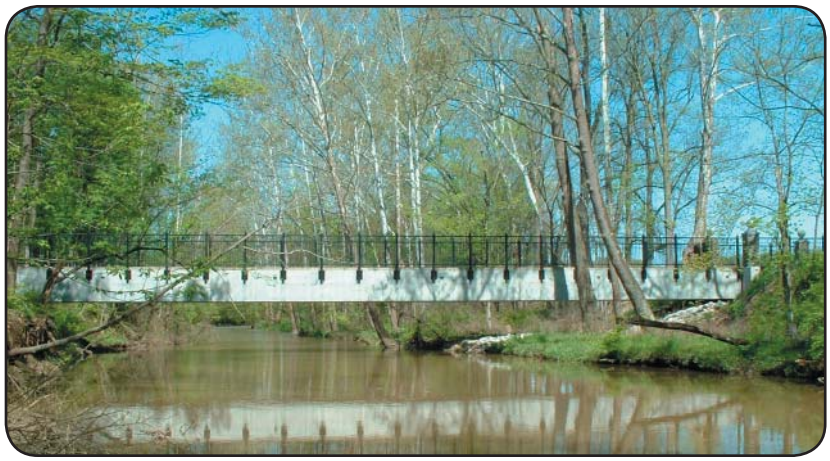
Mill Creek Crossings

The Challenges of a 120 Foot Clear Span Pedestrian Bridge

By Eric G. Peul, P.E.

When the Hamilton County Park District in Cincinnati, Ohio began developing the 360-acre Glenwood Gardens Nature Park, one of their goals was to provide a 2-½ mile nature trail in and around the property, while preserving as much of the natural setting as possible. The trail would have to cross Mill Creek in two locations, and the Park District required that both bridges have identical and economical designs, aesthetically blend in with the wooded landscape, and be as maintenance free as possible. Since Mill Creek is controlled by the Army Corps of Engineers, the bridges would need to clear span the waterway and abutments were required to be constructed outside the 100-year flood level boundaries. Consequently, the north bridge needed a single span of 70 feet while the south bridge span grew to a 120-foot clear span.



Beautiful finished bridge from the south side

Methods of Construction

Three systems were considered for the bridge superstructures: Steel Beams, Prestressed Concrete I-Beams and Prestressed Concrete Box Beams. Each system would support a 6-inch cast-in-place concrete deck. Factors considered in choosing the construction method included:

- Initial construction costs
- Long term maintenance costs
- Site limitations / restrictions
- Lead time for special order pieces
- Aesthetics

The steel beam system had high fabricating costs and a lead time of over four months. However, the prestressed concrete I-beams and box beams could be delivered to the site within six weeks. Neither of the concrete systems would require the lifetime of painting that the steel beam system would. The steel beam and concrete I-beam systems both required structural framework between the beams to construct the concrete deck, while the concrete box beam system did not because it has a continuous top surface. The prestressed concrete box beam system also allowed the custom 5-foot high railings to be erected utilizing standard details provided by the Ohio Department of Transportation (ODOT). After Steven Schaefer Associates, Inc. considered these aspects, performed a preliminary cost analysis and discussed all options with the Park District, it was determined the prestressed precast concrete box beams would be the most economical long term system for their bridges.

Spans being placed

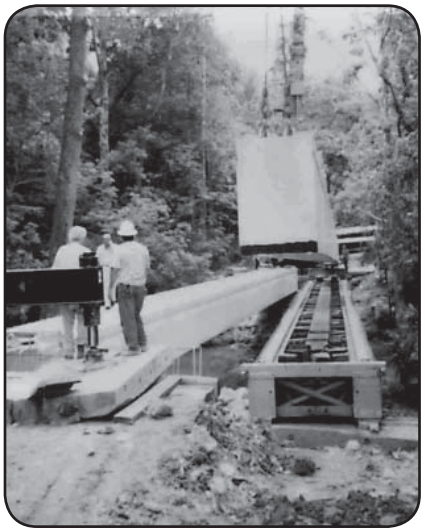
Design Challenges

The 70-foot span north bridge utilized a standard ODOT design and details, which reduced design fees and provided a structure capable of supporting all construction traffic with its AASHTO HS20-44 capacity. However, using a prestressed concrete box beam system for the 120-foot span bridge provided additional challenges. In the greater Cincinnati area, no one has ever fabricated or erected concrete box beams that large. Transporting the large members would also prove to be difficult and would require a "dry run" of the transportation route. The final hurdle was to erect the massive beams within a 25-foot construction easement since the Park District limited the removal of trees and vegetation.

The project team (a collaborative effort between Steven Schaefer Associates, Inc., Prestressed Services of Melbourne, Inc and JMA Consultants, Inc.) realized that the Park District would need to limit the load carrying capacity of the 120-foot span bridge to only light emergency vehicles traffic and pedestrians (AASHTO H15-44). This would reduce the design loads and result in a shallower box girder depth which was more aesthetic and ultimately easier to erect.

South Bridge Construction

For the 120-foot span south bridge, the precast members were so large that two cranes were needed to lift them, in tandem, onto the abutments. But how could this be accomplished? The Park District's site constraints (25-foot wide construction easement) would not allow the cranes to swing the beams into place. Also, the long clear span prohibited a crane to reach across the Mill Creek and safely pick up one end of the massive concrete box beams.



Prestressed beams being set

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The team decided that a modular launch frame would be needed to successfully install the concrete box beams. This modular launch frame is a light-weight, four-sided, steel truss frame configuration which can be incrementally assembled in 5-foot sections quickly, to the desired length, on or off site. The launch frame for this project had a base section of 70 feet, with additional sections of 5 feet each that could be added on site. The relatively light weight of the launch frame, compared to the concrete box beams, allowed the crane at the west abutment to safely reach across and pick up one end of the frame. Once the crane at the east abutment hoisted the other end of the frame, the two cranes "walked" the frame across the creek and set it on the north wingwalls parallel to the bridge beam alignment. The top of the launch frame was equipped with channels (toes up) to act like "crane rails" allowing a four-wheeled dolly to roll along the top carrying whatever required loads. In this case, it would carry one end of a concrete box beam across the launch frame until the west crane could safely pick it off the dolly.

As a precast box beam arrived at the site, the east crane would pick up the end of the beam off the rear of the truck trailer and place it on the dolly. The truck would then back up towards the bridge, which pushed the dolly and the end of the beam across the launch frame. When the dolly was between halfway and three-quarters of the way across the launch frame, the west crane would hoist the box beam off the dolly and the east crane would lift the other end of the beam off the truck. The cranes in tandem then set the beam in place on the abutments. This process was slow and meticulous, but achieved the desired environmental friendly installation required by the Park District. Once the beams were in place, the bridge was ready for its concrete deck, railings and finishing touches.

Deck ready to be poured

Side view looking southwest

Conclusion

Every aspect of this project was a challenge that required innovative design, communication and patience. Actual construction time and expense was greatly diminished by working out every detail prior to the start of construction and contracting an experienced contractor (Ford Development). From the unique design of the 120-foot box beams, the innovative ideas of the precast manufacture, to utilizing standard ODOT bridge details, the Hamilton County Park District was able to obtain an aesthetic, environmentally friendly structure with low maintenance costs while staying within a lean budget.▪

Eric Peul, P.E. joined Steven Schaefer Associates, Inc. of Cincinnati, Ohio in 1997 and has seventeen years of engineering experience. His expertise includes design of bridges, low-rise office buildings, schools and retail structures.

South Bridge Construction Details

Bridge Dimensions:
12' wide x 120' long

Bridge Superstructure:
Single Span Precast, Prestressed Box Beams

Bridge Substructure:
Reinforced Cast-In-Place Concrete on 42" diameter Drilled Piers

Number of Precast/Prestressed Beams: 4

Unit Dimensions:
3' wide x 54" deep x 119' 10" long

Weight of a single box beam:
108,600 lbs

Cost to construct bridge:
$177,000

General information and typical details for precast box beam bridge construction can be found at the web sites of the National Precast Concrete Association (**http://www.precast.org/**), the National Concrete Bridge Council (**http://www.nationalconcretebridge.org/**), or your local Department of Transportation.