



## County Maintenance Crew Replaces a Bridge Using Prefabricated Components

Prefab components yield significant economic and environmental benefits

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When the Monroe County Road Commission (MCRC) needed to replace the deteriorating Suder Avenue Bridge in September, 2006, they looked at alternatives to the conventional box culvert or three-sided culvert replacement options to minimize cost and construction time. By choosing innovative prefabricated structural elements, the MCRC was able to replace the bridge using their own road crews, thereby saving cost and improving overall structural performance.

### **Remove and Replace**

The existing bridge consisted of a 16-foot span, cast-in-place concrete slab that was supported by full height abutments. Approximately one foot of fill and bituminous pavement covered the cast-in-place slab. The MCRC's goals for the bridge replacement project were to maintain constructability by the county maintenance crews, to minimize construction duration and cost, and to minimize overall environmental impact. The MCRC had \$227,000 budgeted for the project, funded in full by Erie Township.

"We opted against using a culvert because there was an opportunity to do something innovative while using our own drainage crews," explained Coleman Brown, MCRC Director of Maintenance. "Typical culvert installation requires working in the water. However, with this design, we were able to work within the limits of the existing abutment walls due to the fact the existing footings did not require demolition."

Replacing the bridge, which is located over the Hooper Run Drain only a mile from Lake Erie, presented some environmental concerns as well. "The proximity of the bridge to Lake Erie raised some concerns about sedimentation," said Brown. "It was important to avoid disrupting the stream bed as much as possible."

### **Advantages of Prefab Components**

To address the issues of cost and environmental impact, the MCRC took an innovative approach, choosing the Con-Struct Prefabricated Bridge System, designed by Nelson Engineering (now Tricon Engineering, Ltd.) and manufactured at ADL Systems in Portland, MI. According to Tricon Engineering, the Con-Struct bridge system's span depends on application. For vehicular bridges, standard span is up to 60-feet, with special construction up to 100 feet. Pedestrian bridges can be built with a standard span of up to 100 feet. Prefabricated bridge systems provide ease of installation, as well as a controlled construction environment – off-site construction of the superstructure ensures greater quality control during the curing process.

The new design called for cast-in-place abutments just outside the existing abutment foundations, and a concrete deck cast compositely on galvanized steel tub girders. The MCRC crew was able to leave the existing abutment foundations in place, which



The new Suder Ave. Bridge in Monroe County

eliminated expensive and time-consuming work in the water, as well as lessened the impact of sedimentation. To support the new abutments, they drove H-piles just behind the existing abutment foundations. They then lengthened the span of the new bridge to 35 feet to reach the new abutments. The demolition of the existing structure, pile driving, and casting of the abutments took county crews about two weeks to complete.

“We originally planned to use concrete helical piles for the abutments, but we opted for the H-piles so we could drive them into the bedrock, which gave us a stronger foundation,” said Brown. “We saved so much using the precast deck system, we were able to spend more on the piles and still fit within our budget.”

### Additional Benefits

The superstructure was transported from ADL Systems to the construction site in three individual units, arriving at the job site at noon and set in place by 2:00 p.m. that same day. Each unit weighed 24 tons, and required a single 150-ton crane for erection. The precast concrete deck, only nine inches thick, provides the final driving surface. The galvanized steel tub girders were 12 inches thick. In total, the superstructure thickness is only 22 inches. The shallow depth of the new bridge resulted in a bottom beam elevation that was higher than the bottom of the slab on the old bridge.



Monroe County Road Commission maintenance workers place a precast deck slab for the new Suder Ave. Bridge.

MCRC Bridge Engineer, Steve Bouws, said the prefabricated superstructure allowed the road commission to use their county crews throughout the entire project, lowering overall cost of construction.

“A big advantage is that the units came with the wearing surface cast right in with the prefab structure,” said Bouws. “We did all the work internally at the road commission –we just had to do the tie pours to finish, and we had a usable bridge.”

Galvanized metal decking was placed between the precast units to support the 2-foot-wide, 10-inch-deep cast-in-place concrete closure pour. The decking was placed on support angles that had been installed at ADL Systems as part of the precast concrete deck, and allowed the MCRC maintenance crew to create one continuous concrete deck, 30-feet, 9-inches wide. Over the next three weeks, the project was completed as bituminous approaches were paved, final riprap was placed, and the ditches were re-graded. Finally, guardrail was installed on the bridge deck using anchor bolts that had been precast into the deck.

## **Inspection and Maintenance**

The MCRC decided not to put hot-mix asphalt over the top of the structure because they wanted to be able to visually inspect the bridge for wear. In the two years since its completion, they haven't seen any cracking or other structural distress on the prefabricated or cast-in-place sections. In fact, maintenance on the prefabricated bridge is no different from any other bridge. "I anticipate a low-maintenance bridge for many years to come," said Bouws. "Inspection is every two years, per the federal bridge inspection program requirements, just like any other bridge."

## **Impact is Minimal**

The project impacted the stream very little throughout the construction phase, and the resulting structure is completely outside of the waterway. The MCRC's original permit application to the Michigan Department of Environmental Quality (DEQ) called for a 16-foot span, which meant working in the waterway and potentially increasing negative environmental impact such as sedimentation and disrupted stream flow. When MCRC decided to use the Con-Struct system, they submitted a revised application that addressed environmental concerns.

"The MCRC revised their application to a 35-foot span, which allowed them to work outside of the stream bed," said Jerry Fulcher, DEQ. "We prefer this because it minimizes sedimentation and erosion."

Culverts can also pose an environmental concern, requiring more maintenance work as they become plugged with sediment, potentially limiting stream flow and disrupting fish passage through the channel.

The MCRC's design change meant raising the bridge elevation by almost a foot, which increased hydraulic capacity under it.

"The design change is better for fisheries because it's more of a natural channel setting," said Fulcher. "Restricting the channel can limit fish passage, which is something we want to avoid."

## **Encouraging Innovation**

Such innovative bridge projects present financial opportunities to local road agencies as well. According to Dave Juntunen, MDOT Engineer of Bridge Operations, MDOT has \$3 million in funds set aside through the Bridge Preservation Program, specifically for MDOT projects using emerging technologies, like the construction method represented by the Con-Struct and other prefabricated bridge systems. The Federal Highway Administration also has potential funding available through the Innovative Bridge Research and Deployment (IBRD) program, which includes funding for research, deployment and education in support of innovative bridge construction approaches and technologies. While the MDOT Bridge Preservation Program is specifically for MDOT projects, IBRD funds can be used for MDOT or local agency projects.

Prefabricated bridge systems demonstrate much potential, whether prefabrication includes substructure elements, superstructure elements like the decking used at the Suder Avenue Bridge, or a total prefabricated bridge system. MCRC has seen increased quality of the superstructure through the controlled fabrication conditions, as well as minimal environmental impact and improved constructability.

"Prefabricated bridge construction shows a great deal of promise," Juntunen said. "MDOT is very supportive of these types of rapid bridge construction technologies."

Reference: The Bridge, Vol. 21, No. 4, May 2008, Michigan LTAP