

2017 ACPA Project Achievement Award

Aging MDOT Cast-in-Place Culvert Replaced with Precast

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There is one clear choice of product for resilient culvert replacement and that is precast concrete.

An aging three-sided cast-in-place (7-foot x 7-foot) box culvert constructed in 1946 under M-43, west of Grand Ledge, MI was compromised by degradational scour, which undermined its foundation and footings. M-43 is a critical roadway owned by the Michigan Department of Transportation (MDOT) that links industry, commerce, agriculture, and residents. The failing structure was identified through MDOT's ongoing condition surveys of existing culverts and bridges. MDOT closed the road and specified a 12-foot x 6-foot precast concrete box culvert to expedite the replacement of the failing structure.

Although it was clear that the 70-year culvert structure was failing, the concrete in the top slab bridged the waterway averting a potentially catastrophic and life threatening failure. The aging culvert could still withstand the live loads, as well as accommodate forces of

nature, thereby demonstrating the value of life cycle cost analysis performed by the former Michigan State Highway Department.

Upon close inspection, the 70-year culvert exemplified the effect of autogenous healing on concrete structures. Autogenous healing is a natural process of crack repair that occurs in concrete when moisture is present along with the deposition of calcium carbonate from the cementitious materials. It is observed as a white precipitate. Of all the available culvert material options, only concrete has this unique natural process for sealing cracks throughout the service life of structures while maintaining structural integrity.

After closing the road, MDOT's University Region engineering team, led by Will Thompson, P.E., Lansing TSC's

Quick Notes

Who	Michigan Department of Transportation (MDOT) Northern Concrete Pipe, Inc.
What	Replacement of an aging three-sided cast-in-place box culvert constructed in 1946 under M-43, west of Grand Ledge, MI.
Why	The failing structure was identified through MDOT's ongoing condition surveys of existing culverts and bridges.
When	2016
Where	West of Grand Ledge, MI
How	Specification of a 12-foot x 6-foot precast concrete box culvert to expedite the replacement of the failing structure within 13 working days.

Manager, coordinated re-routing of traffic. Coreen Strzalke, P.E. organized various MDOT, County Road, and County Drain personnel, and John Perry, Engineer for the Eaton County Drain Commission favored the precast concrete replacement option, noting; "We have one clear choice for culvert materials, and that is concrete". Three culverts were directly impacted by the upsizing of the Oneida Road crossing, but only two would be addressed by MDOT during the M-43 emergency replacement. The Eaton County Drain Commission handled the third culvert.

The design team of Northern Concrete Pipe presented a precast design that would enable MDOT to solicit emergency bids from local, prequalified contractors. Shortly thereafter, Northern submitted the required loading calculations, and required steel end area for department review for both the box sections, and the precast headwalls and wingwalls. Will Thompson, P.E. noted, "I cannot tell you how thankful I am for your help on this emergency repair." Adding, "Without your help we would not be close to sending out a bid document so we can get this work rolling".

MDOT quickly overcame several potential delays to initiating the project including financing; tendering the project at a time when they were already struggling to meet construction deadlines on other MDOT contracts; recent heavy rains that affected minimizing the road closure period; the approaching Labor Day holiday; and the fact that precast box sections needed for the project were not a stocked product.

Davis Construction, of Lansing, MI, was awarded the contract for this fast-tracked culvert replacement. Northern Concrete Pipe, Inc initiated a production schedule that would produce three wet cast box sections per day until completion. All precast sections for

the 96-foot crossing were completed before the demolition of the failing culvert and beginning of the sub-base work. The duration of the culvert replacement, from the day the failure was identified to the day the last box section for the first crossing was set, was only 13 working days. Completion of the second culvert was accomplished within 28 days of the discovery.

Expedited design and review of the proposed culvert replacement, along with Northern Concrete's allocation of multiple forms contributed significantly to shortening the construction schedule from bid date to installation. The shortened schedule reduced inconveniences to nearby residents, especially inconveniences from detoured traffic and noise.

MDOT continues to seek a long-term funding mechanism to address replacement of culverts and bridges that are functioning well beyond their design life. MDOT department heads are looking for new ways to accommodate emergency repair funding that is essential to the management of Michigan's aging infrastructure.

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Photos: Therese Kline, P.E., of MDOT



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Precast concrete culvert sections produced and installed within 13 working days.

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