Putting Research into Practice: Culvert Repair Best Practices

What Was the Need?
By providing a channel for water and wildlife to pass under roadways, culverts are a critical component of roadway infrastructure. However, culverts deteriorate over time due to erosion, corrosion, freeze-thaw cycles, loading and many other causes. This deterioration can cause severe damage to the roadway above the culvert, even to the point of collapse, if not properly addressed. Proper maintenance and repair are necessary for both safety and economic reasons.

The state of knowledge regarding culvert repair practices has evolved significantly in recent years. While this increased knowledge is ultimately beneficial for practitioners, it can be difficult for individual engineers to keep abreast of new developments that come from a wide variety of sources. MnDOT wanted to gather current information related to culvert repair in a single place so state engineers could easily find the information they need.

What Was Our Goal?
The goal of this project was to develop best practices guidelines, special provisions and standard details for several methods of culvert repair based on the current state of knowledge.

What Did We Implement?
This report is part of a project to develop guidance for repairing centerline culverts that are 24 to 72 inches in diameter. The report implements the existing body of knowledge regarding culvert repair, including guidance and research from the Federal Highway Administration; the National Cooperative Highway Research Program; the American Association of State Highway and Transportation Officials; and many states, including Minnesota, California and Maine.

How Did We Do It?
Investigators first conducted a Web survey and interviewed personnel from MnDOT, Minnesota cities and counties, and contractors. These surveys inquired about 11 specific culvert repair methods and about the types of repairs agencies had performed; specifications, standard details and cost information; concerns with the various repair methods; and contact information for contractors and suppliers. A similar survey was then administered to other states through the AASHTO Research Advisory Committee.

The results of these surveys and a review of literature, specifications, drawings and cost information were collected in Transportation Research Synthesis 1209, Culvert Repair Best Practices, Specifications, and Special Provisions: Task C.

Investigators used information from the survey and literature to generate best practices guidelines for replacement, rehabilitation and repair methods for deteriorating culverts. These guidelines present the most commonly used methods in detail, while other methods are described generally. Investigators also wrote special provisions and standard details for several processes.
What Was the Impact?

The report includes detailed discussions of rehabilitation and repair methods for paved inverts, cured-in-place pipe liners, sliplining, centrifugally cast concrete mortar liners, spall repair, joint repair and filling voids outside the culvert. For each of these methods, the report covers best practices, technical and safety issues related to repair, appropriate materials to use and postrepair maintenance.

Investigators also prepared special provisions and standard details for each of these methods. MnDOT uses these documents to provide construction details (that can be adapted to the needs of a specific project) for practices where full specifications are unavailable. MnDOT has not had many special provisions related to culvert repair, so engineers who wanted to use an experimental procedure often had to write their own procedures—an inherently time-consuming process made more difficult by not knowing what practices have been tried in other jurisdictions.

Twelve other methods for culvert rehabilitation, repair or replacement are described more generally. An appendix provides a table that compares most methods, describing the materials needed, relative construction cost, size of culvert appropriate for each method, the specific issues each resolves, and each method’s advantages and limitations.

What’s Next?

This guide should be useful to engineers who need to determine the most effective repair methods for the culverts within their jurisdiction. The special provisions and standard details developed will likely evolve as they are used and may ultimately become boilerplate documents for wider use.

To complete this project, investigators will conduct a brief feasibility study to identify which culvert repair methods can be observed and tested to document the cost, longevity and effectiveness of repairs. Outreach efforts will include a webinar about the guidelines to MnDOT personnel. The hydraulics section of MnDOT’s Bridge Office will also distribute the guide on its website, include it in its training processes and provide ongoing support to district offices.