



TECHNICAL SUMMARY

Questions?

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LRRB PROJECT COST:

\$69,599



Road crews must prepare soil mixtures with care to ensure that seasonal weather and temperature change have little to no impact on movement at culverts and subpavement utilities.



Putting Research Into Practice: Limiting Seasonal Soil Movement at Culverts

What Was the Need?

Culverts, utility infrastructure and similar structures that run underneath roadways present a challenge for designers. Because installations typically entail removing existing subgrade material and replacing it with new material or inadvertently aerated old material, the areas beneath roadways prove particularly vulnerable to the impact of seasonal changes in temperature and water content.

These materials may settle when water soaks the area around a culvert, or the materials may expand and contract during freeze-thaw cycles, pushing the culvert and structures. This movement can lead to uneven driving surfaces that rise, fall or shift with seasonal changes within subgrades.

Engineers address environment-based movement with various approaches that may include changing culvert and utility designs, adding sophisticated materials to subgrades during installation or maintenance, and extending approaches with graduated fill depth to disperse the impact of change over a wider area under the pavement.

Effective approaches to mitigating the impacts of soil movement appear to be embedded within detailed design guidelines or other technical resources, and individual local agencies may have developed effective approaches unknown to other agencies. Widely recognized approaches to what works best in unique situations have not been identified, and many local agencies seek guidance for determining the best approach to their installations.

A new field guide offers best practices for mitigating the impact of seasonal movement of soils at culverts and utilities. The user-friendly reference offers links to design drawings, plans, specifications and other resources.

What Was Our Goal?

The goal of this Local Road Research Board (LRRB) project was to gather best practices for mitigating the seasonal movement at culverts and utilities. This information would be used to develop a quick-reference guide for engineers that would provide approaches to specific installations and also point users to more detailed guidance.

What Did We Implement?

An online reference document was developed that describes potential problems and approaches to reduce or eliminate the impact of seasonal frost heave. [Mitigating Seasonal Movement at Culvert and Utilities](#) describes factors that may cause seasonal movement, approaches to evaluating individual sites and potential contributors to seasonal movement, and construction approaches that have successfully mitigated seasonal movement. Designed for easy use, the guide includes links to relevant specifications, guidance and practices, including:

- Federal Highway Administration and U.S. Army Corps of Engineers soil characterizations.
- Minnesota Local Technical Assistance Program guidelines for culvert installation and maintenance.
- MnDOT Pavement Design Manual bedding and backfill detail.
- MnDOT specifications on compaction density.
- MnDOT standard plans drawings.
- MnDOT 2017 Geotechnical Engineering Manual.
- MnROAD User Guide to the Dynamic Cone Penetrometer.

“This guide provides the high points of soil movement mitigation and directs users to other resources for more detail.”

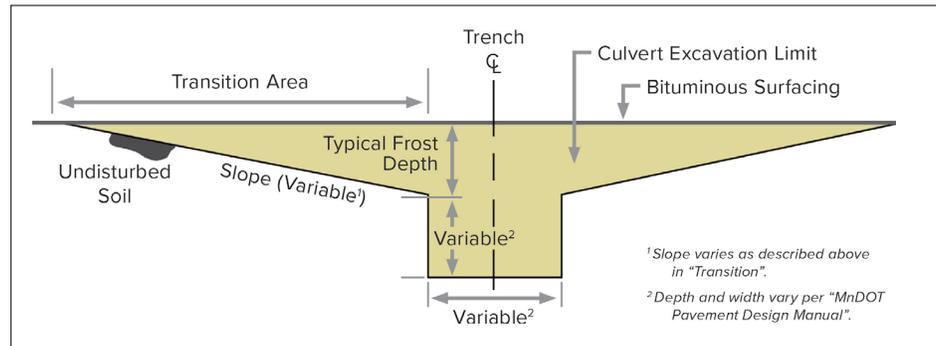
—Guy Kohlnhofer,
County Engineer,
Dodge County

“Mitigating seasonal settlement at culverts is both a science and an art. The science is using the right materials. The art is making sure you blend materials well enough to eliminate movement.”

—Michael Marti,
Principal, SRF Consulting
Group, Inc.

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Sloping a transition area of fill is an effective approach to mitigating seasonal soil movement.

How Did We Do It?

Investigators reviewed a 2016 LRRB Transportation Research Synthesis, [Mitigating Frost Heaves and Dips Near Centerline Culverts](#); conducted a literature search and analysis; and reviewed MnDOT specifications and pavement design manuals. The team then surveyed city and county road agencies in Minnesota, and followed up with promising practitioners and national experts in phone interviews to gather detailed information on effective practices.

What Was the Impact?

The short format and links to detailed information make this a useful tool for engineers. LRRB and Minnesota’s State Aid program will promote the use of the new, searchable guide to city and county engineers. Investigators expect to present study results at local and national conferences, including those for the National Asphalt Pavement Association and National Road Research Alliance.

What’s Next?

The research team may prepare a short video about using the guide and may update the [Frost Damage in Pavement: Causes and Cures](#) video to include a reference to the tool. LRRB may consider further research on this topic with respect to manholes and manhole covers.