RESEARCH SUMMARY

DEPARTMENT OF TRANSPORTATION

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Strategies for Addressing Deteriorated Concrete Roads

Treating early deterioration in concrete pavement can extend a road's service life and defer costly replacement. An assessment of different strategies years later demonstrated that over time, asphalt overlays made the roadways smoother for travelers.

What Was the Need?

Some roads built in Minnesota in the late 1980s and early 1990s have deteriorated at an accelerated rate as a result of an alkali-silica reaction (ASR), a chemical reaction in the concrete mixture used during that period. This deterioration could potentially shorten the service lives and affect riders' experience.

In ASRs, moisture causes the alkalis in the cement and the silica from the aggregate to produce a gel-like substance that absorbs water and expands, creating stress on the concrete and leading to "map cracking," spalling and increased water infiltration.

In newer pavements, ASR damage has decreased because different materials and techniques have been used for concrete construction. But roads built in the 1980s and 1990s had visible cracks and deformation five to 15 years after construction. This damage cannot be reversed.

When its roads showed signs of deterioration, MnDOT tried different strategies to keep them in safe and usable condition and to avoid the cost of replacement. These strategies included diamond grinding, chip seals, asphalt overlays and concrete overlays. More severe damage warranted partial- or full-depth repair, requiring partial or full replacement of a pavement section down to the base layer.

“Knowing that MnDOT’s past efforts to address ASR damage had a measurable positive effect helps our decisions for future action. Even though this damage cannot be reversed, we can still prolong the road’s service life and improve the driving experience for roadway users.”

—GREG OUS, DISTRICT ENGINEER, MnDOT DISTRICT 7

In the years since they implemented these corrective measures, MnDOT had not systematically studied the condition of the treated pavements. This study assessed the different repair methods to identify the most effective approach for repairing and limiting ASR-related deterioration.

What Did We Do?

Six pavement sections that had been rehabilitated because of ASR-related damage were chosen for this assessment:

- U.S. Highway 169 (U.S. 169) from Blue Earth to Winnebago (4-inch asphalt overlay).
- U.S. 169 from Winnebago to Vernon Center (3-inch asphalt overlay).
- Minnesota State Highway 15 (MN 15) from New Ulm to Winthrop (2- to 3-inch asphalt overlay).
- Interstate 94 (I-94) near St. Paul (full- and partial-depth repair).
- MN 55 near Mendota Heights (full- and partial-depth repair, diamond grinding).
- MN 210 near Aitkin (full- and partial-depth repair, diamond grinding).

Two measurements provided the quantitative data for evaluating the pavement condition in the six test cases: ride quality index (RQI), which is used to measure pavement roughness, and surface rating (SR), which is used to assess visible pavement distresses.

In addition to correlating the two measures with maintenance efforts, the investigators visually inspected five of six test segments. Tomographic readings of ASR-affected pavements with no intervention were also taken to assess whether ASR-related cracking could be detected before it was visible on the pavement surface.

What Did We Learn?

RQI and SR data from pavement sections that received asphalt overlays indicated an improvement in ride quality and surface condition in the years after the maintenance intervention. The site visit revealed that the asphalt overlays were generally in good condition, but showed reflective cracking mirroring the damage in the concrete layer.

The measured and observed conditions of pavement sections that received full- or partial-depth repairs with diamond grinding were good. However, because the repairs were made recently, more time and data are needed to draw conclusions on long-term effectiveness.

The results of the tomographic images were inconclusive. Potential differences in density detected below the concrete’s surface might indicate ASR cracking, but more data are needed to confirm the results.

What’s Next?

Continued monitoring of ASR effects through RQI, SR and observation will guide maintenance decisions that extend the longevity of Minnesota’s roads. Additional tools for early detection may become available with further study.

About This Project

REPORT 2025-29
“Effective Strategies to Extend Remaining Life of ASR-Affected Pavements.”
Find it at mdl.mndot.gov.

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