



RESEARCH SERVICES SECTION

TECHNICAL SUMMARY

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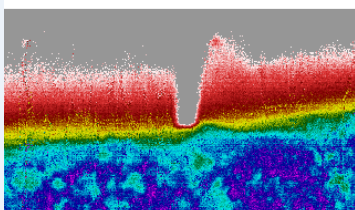
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PROJECT COST:

\$25,126



String lines (top) and thermal imagery (bottom) were used to measure pavement tenting.



Investigation of Winter Pavement Tenting

What Was the Need?

Pavements sometimes respond to freezing temperatures by heaving at existing joints and cracks. Pavement tenting occurs when this heaving lifts up the pavement on both sides of a joint or crack, creating a ridge or peak along the joint. Found in transverse cracks in asphalt, pavement tenting, if severe, can have a significant effect on the quality of driving experience.

Previous research suggests that road deicing chemicals may contribute to tenting. More research was needed to verify these findings and to establish what Minnesota municipal, county and state engineers believed to be:

- The prevalence and severity of tenting in their road networks
- The most important factors contributing to tenting
- Pavement structures that are tent-resistant or tent-susceptible

What Was Our Goal?

This research sought to identify the causes of winter pavement tenting to test the theory that deicing chemicals, sands and crack sealing influence tenting. Researchers also sought to recommend pavement design and maintenance strategies for preventing tenting from recurring in roadways previously affected by it.

What Did We Do?

Researchers first conducted a literature search into current theories for winter tenting and methods used for measuring and analyzing it. They then surveyed municipal, county and state engineers regarding the frequency of winter tenting in their areas, factors the engineers believed influenced tenting, and remedies typically used to treat it.

Finally, investigators performed inspections and cold weather monitoring at 11 sites for two years to test factors that survey comments identified as most important to winter tenting: surface types, maintenance treatments and base materials. Investigators periodically collected data at these sites, making manual straight-edge measurements, gathering and performing laboratory conductivity tests on samples taken from road surfaces and transverse cracks, using thermal imaging and string lines, and recording temperatures. They also conducted forensic studies at two of these sites by using excavation pits to sample base materials for conductivity and gradation analysis, as well as by performing longitudinal profile analyses on these pits. The resulting data was used to examine relationships between winter tenting severity, temperature conditions, the presence of deicing chemicals, and the effect of maintenance activities and road treatments.

What Did We Learn?

Almost 40 percent of survey respondents reported tenting in their local road systems, typically covering about 25 percent of a system, with about 25 percent of this coverage characterized as severe. Tenting affects ride quality, particularly before the spring thaw, and has been linked to the intrusion of winter maintenance materials into the base. Sealing cracks consequently reduces tenting; field measurements showed that the concentration of deicing salts decreased with depth and distance from cracks. The literature suggested that high amounts of recycled asphalt pavement in base layers may also contribute to tenting. The study results show that tenting occurs in both virgin aggregates and recycled base materials, including base containing recycled concrete.

“Places with open, transverse cracks that experience regular deicing are susceptible to pavement tenting. Additionally, roads that experience winter heaving and the typical subsequent associated pavement distresses may eventually experience cracking and tenting.”

–Tom Struve,
Superintendent of
Streets, Equipment and
Central Services, City of
Eagan

“Our field measurements show that crack sealing was an effective treatment for tented roads. I believe sealing should be done as early as possible to reduce accumulation of distress.”

–Eddie Johnson,
Research Project
Engineer, Mn/DOT Materials and Road Research

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To measure the vertical heaving effect of tenting on transverse cracks, investigators used a steel level near the crack. This process involved either measuring the tenting projected to a location 1 foot from the crack or measuring the cupping at the crack.

Investigator recommendations for combating pavement tenting include:

- Seal cracks as early as possible. This was shown to reduce the height of tenting, cutting surface roughness by 20 percent to 35 percent during the following year.
- Use the most elastic and durable sealant available on roads with wide cracks that are prone to tenting. Longitudinal profile measurements showed that heaving may occur several feet from crack openings.
- Inspect sealants in cold weather to identify adhesion failures, which may not show in warm weather.
- For pavements prone to tenting, evaluate moisture sensitivity and salt contamination of the base and consider the results when selecting future pavement rehabilitation or maintenance strategies.
- In cases of contaminated bases or moisture-sensitive structures, consider full-depth reclamation and base replacement.

Investigators did not recommend any changes in pavement design, in part because all evaluated base types showed tenting.

What's Next?

This study is one of the first addressing winter pavement tenting; treatment of tenting remains a work in progress. Mn/DOT will continue to monitor selected pavement sections and will communicate with counties as they continue to develop and refine plans to address pavement tenting. More testing may be useful in identifying ways to treat the factors that contribute to pavement tenting.

Treatment of severely tented pavements requires further investigation, particularly for pavements otherwise in good condition. The impact of weather on areas with contaminated bases should also be investigated, as it is not clear what role falling temperatures play in tenting, particularly in areas with bases contaminated by salt and water incursion.

This Technical Summary pertains to the LRRB-produced Report 2008-03, “Investigation of Winter Pavement Tenting,” published January 2008. The full report can be accessed at <http://www.lrrb.org/PDF/200803.pdf>.