RESEARCH SUMMARY

MARCH 2024

Finding High-Performing Aggregate Bases for Long-Lasting Pavement

Two county roads provided a testing ground for three combinations of aggregate bases and asphalt binders. Results from more than two decades of research and monitoring of pavement test sections validated previous conclusions. A larger gradation aggregate base showed superior performance over the pavement life cycle when compared with the standard aggregate base. Additionally, sections constructed without transverse joints to allow natural thermal cracking outperformed sections with sawn and sealed joints.

What Was the Need?

Knowing when and where pavement stresses develop is necessary to evaluate the sustainability of different combinations of asphalt materials and construction methods, including resistance to freeze-thaw cycles and other seasonal factors.

Pavement performance was monitored on six test sections constructed in 2000 on two low-volume traffic roads in Olmsted County, Minnesota. Pavement sections were approximately 150 to 300 feet long and included three combinations of aggregate base type, varying by gradation or particle size, and two different asphalt binders. Each combination was constructed both with sawn and sealed transverse joints and without these joints to allow natural thermal cracking to relieve tensile stresses.

LRRB and MnDOT evaluated the performance of the pavement test sections over time in three previous five-year research projects. The agencies were interested in a final phase to continue to monitor pavement performance before reconstruction. Considering the cumulative monitoring and forensic results from the pavement life

"This project concluded more than 20 years of monitoring the long-term performance of different aggregate base types. More in-depth evaluations in this phase validated long-term data, pointing to the highest-performing pavement options."

—KYLE HOEGH, RESEARCH ENGINEER, MnDOT OFFICE OF MATERIALS AND ROAD RESEARCH

cycle would provide a holistic understanding of performance to inform sustainable pavement choices.

What Did We Do?

The pavement test sections consisted of three limestone aggregate base types applied to a conventional Class 5 subbase: standard Class 5 in Section 1, permeable aggregate base (PAB) in Section 2 and Class 5 modified limestone in Section 3. Asphalt binder PG 58-28 was used in Section 1 and binder PG 58-34—more expensive but higher performing against cold weather cracking—was paired with the PAB and Class 5 modified bases.

Investigators used test methods from the previous research phases in addition to new evaluations to determine the seasonal effects on the pavement sections and base layer stiffness. Traffic data collected since 2002 characterized any changes in vehicle loadings, including percentages of heavy commercial vehicles, and provided a comparison for pavement performance among the sections.

Falling weight deflectometer data collected each season since 2008 evaluated pavement layer stiffness through the years. Cone penetrometer testing since 2011 measured the strength of the subsurface materials.

Automated and visual distress surveys evaluated general levels and trends in pavement cracking, rutting and roughness index.

A systematic, photo-based approach in this research phase provided a more objective and detailed monitoring of the progression of any distresses and identified stresses not recorded in the traditional visual survey. Investigators also added ground-penetrating radar to measure the variation in asphalt thickness.

What Did We Learn?

Performance monitoring showed the larger gradation Class 5 modified base material combined with PG 58-34 binder performed better than the other two base types. This research phase included a consolidated analysis of previous results, validated by data from new methods.

Before reconstruction, the severity of the cracking in Section 1 paved with standard Class 5 aggregate was significantly higher than the other sections despite lower traffic volumes on Section 1. The Class 5 modified base in Section 3 showed no severe cracking and exhibited a lower roughness index than the other two sections. Additionally, the pavement sections without sawn and sealed joints produced better ride quality, especially during winter months.

What's Next?

This final research phase followed the performance of the aggregate base test sections from previous phases to reconstruction. Based on the proven performance from past research phases, MnDOT previously updated standard specifications to add a gradation category Class 5Q, which includes the Class 5 modified base material confirmed in this project as the highest performer. Local transportation agencies in Minnesota can be confident in continuing to choose Class 5Q aggregate base material for sustainable road projects.

About This Project

REPORT 2024-01
"Performance Monitoring of Olmsted CR 117 and 104 and Aggregate Base Material Update."
Find it at mdl.mndot.gov.

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$44,000

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