Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Evaluation of MDOT's Long-Life Pilot Projects

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Evaluating pavements designed for longer life

A 2015 state law directed the Michigan Department of Transportation (MDOT) to explore innovations that can help pavements last longer and require less maintenance. To accomplish the task, the agency designed and constructed four projects using top-of-the-line materials and building methods. The completed roads are predicted to have service lives that are significantly longer than pavements built by traditional means. This research project analyzed the various enhancements and identified cost-effective strategies that MDOT engineers can incorporate into everyday plans to build longer-lasting roads across the state.

PROBLEM

MDOT typically designs and builds its asphalt and concrete pavements to last 20 years. A variety of additional maintenance treatments can continue to extend the road's service life by a decade or more; however, these practices are costly and the road will typically still need to be replaced after about 37 years.

Using two pavers in close formation was found to be an important strategy for increasing the durability of asphalt roads.

In contrast, long-life pavements use higher-quality materials and more expensive construction methods at the time they're built. These roads can last 50 years and require less maintenance, but despite being a more durable and cost-effective option over the course of their life, their higher upfront costs make them unaffordable for most state projects.

In 2015, the Michigan Legislature passed a law requiring MDOT to investigate the long-term benefits and savings of long-life pavements. Between 2017 and 2019, MDOT designed and built four pilot pavements – two concrete and two asphalt – using both standard and long-life materials and practices. This research assessed the differences to provide support and guidance for future road-building decisions in the state.

(continued)

"By identifying which materials and construction practices provide the greatest benefit, MDOT will be able to stretch taxpayer dollars more efficiently."

Michael Eacker
Project Manager

RESEARCH

The researchers began by documenting each of the design methods, materials and practices that were used in building the four long-life pavements and comparing them with MDOT's standard processes. Next, samples collected from each of the finished pavements were subjected to a variety of laboratory tests to better understand their physical and structural properties. Lastly, data collected from field tests during construction were reviewed and analyzed. Then, each stage of the building process was considered and evaluated, including details of how the pavements' foundations were formed and the amount of compaction each received. The individual materials that were used in the different layers of each pavement were also evaluated, including the binders and aggregates in the asphalt and the ratio of water and additives in the concrete.

Finally, the structural and performance data collected from the tests were entered into mechanistic-empirical design software to produce an estimate of the design life for each pavement, and the costs of constructing the long-life and standard pavements were calculated and compared.

RESULTS

Since the four long-life pavements have only been in service a few years, they have yet to need maintenance or repairs and data on how they are performing is limited. However, the design software predicted better performance from the long-life pavements than standard 20-year designs. Some of the contributing differences and the anticipated effects are listed below.

Design – The long-life pavements were designed to be thicker than standard pavements, making common types of cracks and other distresses less likely to ever form.

Materials – In the asphalt long-life pavements, the use of better-quality aggregates and fewer recycled materials produced better performance projections. In concrete long-life pavements, adding slag cement to the mixture in place of fly ash may result in a more durable pavement, though more research is needed.

Construction – Standard asphalt pavements are often weakest at the centerline joint, where the separately compacted lanes meet. The long-life asphalt pavements were compacted by two pavers working simultaneously in an echelon formation, which eliminates that joint for a stronger finished pavement.

As expected, the long-life pavements were more expensive to build. The research found the costs of the long-life cross-sections were between 27.2 percent and 59.4 percent higher than the standard cross-sections. However, when considering the overall project total costs, the long-life designs were between 6.6 percent and 16 percent higher but the completed roads should last 21 percent to 177 percent longer than standard. The long-life pavements may be more cost-effective but more time is needed for a more definitive conclusion.

IMPLEMENTATION

The higher price tag of long-life pavements can be problematic for road budgets that are very tight. However, long-life pavements may be a cost-effective option for some high-traffic or deterioration-prone locations across the state. For all road construction projects, greater insight into the costs and benefits of each improvement strategy will help MDOT more effectively choose the right design, material and construction options for a project's specific needs and budget.

As with all its pavements, MDOT will continue to monitor and assess the performance of the four sample long-life pavements and determine which routine treatments – if any – are needed.

Research Administration

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Final report and related materials are available online at
https://mdotjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1722.

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