

Preserving pavement

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Michigan State University drives pavement preservation with research and education

Editor's Note: MSU is the first university in the country to have a University Transportation Center (UTC) for Highway Pavement Preservation. Its research is the "UTC Spotlight of the Month" for the U.S. Department of Transportation for August 2015: 1.usa.gov/1gE99eG. The story is reprinted here.

Like a promising student that has learned many lessons along the way -- the science of pavement preservation is growing up.

The National Center for Pavement Preservation (NCPPI) was established in 2003 by Michigan State University (MSU) and the Foundation for Pavement Preservation as the national pavement preservation clearinghouse to practitioners throughout the United States.

It was only a matter of time before a national research and education center on the subject would join the effort.

MSU is the first university in the country to have a University Transportation Center (UTC) for Highway Pavement Preservation. The U.S. Department of Transportation designated Michigan State's Center for Highway Pavement Preservation (CHPP) as a Tier 1 UTC in 2013.

"The main focus of the center is the infusion of science and innovative technology to pavement preservation," said CHPP director Karim Chatti, an MSU professor of civil and environment engineering. "The center sponsors research, education, outreach, and technology transfer activities."

Chatti said training the next generation of tech-savvy workers who can develop integrated solutions for highway pavement preservation is an important aspect of the CHPP's mission.

One of MSU's current students is Shabnam Rajaei, who came from Iran to pursue PhD studies in pavement preservation.

"The complexity of the pavement structure and behavior in different conditions makes pavement engineering an exciting path to follow," Rajaei said. "The cost-effective approach is to maintain and improve the functional capacity of the pavement and control its deterioration. It's the only way you can avoid extensive and expensive reconstruction."

Rajaei is working on a CHPP research project studying how to optimize the trade-off between grip and rolling resistance on pavement preservation treatments. The project focuses on the functionality of pavement treatments, seeking to improve safety, energy savings, and environmental benefits.

While grip and rolling resistance on the country's 3.95 million miles of public roads might not sound like good dinner conversation, the economic impact for the average U.S. consumer is huge.

For owners of passenger vehicles, the financial consequences of rolling resistance shows up at the gas pump. Rolling resistance is a major factor in fuel consumption, Rajaei explained. A 3 percent reduction in fuel consumption would save American consumers an estimated four-to-six billion gallons of fuel from the 200 billion gallons consumed annually by the 255 million vehicles in the United States.

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“So understanding the tire-pavement interaction in the contact patch on different pavements is of great significance,” she said.

Rajaei is part of a research team at the MSU College of Engineering that is designing a surface profile that balances the trade-off between friction, adhesion, and hysteresis (loss of energy). She works under the supervision of Chatti and Roozbeh Dargazany, assistant professor of civil engineering at MSU, who are the project’s principal investigators.

The research team’s proposed roughness spectrum should lead to pavement mixture designs that ultimately improve the sustainability of pavement preservation treatments while maintaining safety.

Imen Zaabar, an assistant professor of civil engineering at MSU, also assists on the project. Zaabar’s expertise is on the effect of pavement condition (roughness, texture, and structure) on rolling resistance.

“We are working to understand what happens between the tire and the pavement in that contact patch,” Zaabar said. “It’s important if we want to understand the mechanism of rolling resistance and grip. To find the answers, we’re going to have to make the pavement ‘talk.’”

Researchers are assembling a multi-scale framework to optimize the pavement texture that would reduce rolling resistance without sacrificing grip. They already know that at high speeds, rolling resistance appears to be dominated more by macro-scale parts of a pavement profile while at low speeds, grip is affected more by small-scale asperities.

Using computer simulations and experimental analysis, the researchers are studying the effect of tire properties and pavement surface characteristics to quantify an optimized rolling resistance on the roughness spectrum. The scales of texture on that spectrum include roughness, mega, macro, meso, micro, and eventually nano.

The research goes a step further than the usual study of macro-texture on rolling resistance and grip. The work summarizes existing models in macro- and mega-scales. It also creates a bridge to the developed concept in micro-scale that can predict the optimized pavement surface for a given traffic condition. Positive results will quantify the best surface properties in the rubber-pavement interface.

Field studies already suggest that reductions in rolling resistance can directly increase fuel efficiency by 2-6 percent.

This two-year research project is currently at its mid-way point.

When completed, the proposed roughness spectrum would assist highway engineers in analyzing the trade-off between pavement grip and rolling resistance, that would result in the ranking and rating of current pavement preservation treatments. Ultimately, this could lead to new pavement preservation treatment mix design specifications that will contribute to a better balance between safety and sustainability.

For more information, visit www.chpp.egr.msu.edu

About this project

The Center for Highway Pavement Preservation is a Tier 1 UTC in the Michigan State University College of Engineering. MSU leads a team of collaborators that includes the University of Illinois, Urbana-Champaign; the University of Texas, Austin; the University of Minnesota; North Carolina A&T State University; and the University of Hawaii. A variety of pavement preservation research highlights are available at <http://bit.ly/1fudC2K>. Created as part of the “State of Good Repair” strategic goal, CHPP has received \$3.8 million to advance research and education activities on pavement preservation. Funding extends through 2018.

Related Website: [MSU Center for Highway Pavement Preservation](#)
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