

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Quantifying the Impact of Wide Base Tires on Pavement Performance in Michigan

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Understanding the impacts of wide base tires on Michigan's pavements

The trucking industry has recently started using wide base single tires (WBTs) in place of conventional dual tires on commercial trucks to achieve better fuel economy and improved truck stability. While WBTs offer benefits for freight hauling, their larger size can cause more pavement damage than conventional dual tires. To design and maintain pavements that can withstand these potentially increased stressors, the Michigan Department of Transportation (MDOT) initiated a research project that collected data on wide base tire use within the state and developed methods to predict pavement performance under the corresponding tire loads.

PROBLEM

Dual tires have been the standard on commercial trucks for decades – it's why the vehicles are often known as "18-wheelers." Some fleets, however, have begun to use WBTs because they can reduce fuel consumption, resulting in cost savings and fewer gas emissions. Compared with dual tires, WBTs have a smaller area of contact with the road.

MDOT designs its concrete and asphalt pavements using design software that estimates pavement damage based on anticipated truck traffic and other traffic



The smaller surface area of wide base tires (left) can cause more pavement distress than typical dual tires (right). This research will help MDOT design pavements that can better withstand these challenges.

inputs and assumptions, including tire load distribution and tire contact area or pressure.

For decades, MDOT has built the state's pavements and measured their performance based on the presumption that trucks will ride on dual tires. To accommodate a new tire configuration, the agency needed to

“This work validated our suspicion that we have a measurable quantity of wide base tires on Michigan roads. Having an idea of the tires’ impacts will help us predict pavement performance as they are likely to become more common.”

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identify the impact of WBTs on both asphalt and concrete pavements of different thicknesses and potentially modify its pavement designs for the future.

RESEARCH

To estimate the number of WBTs on Michigan roads, the investigators observed truck tires at various weigh stations and truck parking lots around the state. Additionally, the investigators gathered video recordings and used a computational learning tool to distinguish axle and tire types. As a result, they estimated the percentage of truck tires on Michigan’s roads that are WBTs.

Next, investigators explored how WBTs affect pavement performance by reviewing the differences between dual- and wide-tire stresses on road surfaces. Multiple pavement analysis tools helped to predict pavement stresses from WBTs. The analyses measured the potential for fatigue cracking and rutting in hot mix asphalt pavements of varying thicknesses, as well as cracking and faulting distresses in rigid concrete pavements. The results allowed investigators to develop predictive models to show how WBTs are likely to damage pavements.

The study also explored how weigh-in-motion (WIM) devices, which detect and

record axle and gross vehicle weight as a truck passes over sensors on a roadway, can be used to distinguish the types of tires on a truck. Reviews of the WIM devices used in Michigan and other related technologies revealed newer and more advanced tools that promise to differentiate between tire types and detect other vehicle characteristics, such as wheel spacing and even tire pressure.

RESULTS

The research showed that of all the commercial trucks driving on Michigan’s roads today, approximately 10 percent of the tires currently are WBTs. This information will help MDOT engineers design pavements that are appropriate for the type and volume of traffic they will need to support, to design more effective pavements. Investigators calculated the increased distress due to WBTs and accordingly made recommendations for potential pavement design revisions.

As expected, the impacts of WBTs on asphalt and concrete pavements are greater compared to a dual tire configuration:

- **Asphalt:** Added pavement distress is relatively minor, though fatigue cracking is a possible concern. Increasing the thickness of pavement layers will help to reduce cracking but will not alleviate rutting.
- **Concrete:** Rigid pavements are susceptible to faulting from wide tire loads, and constructing thicker slabs can reduce this effect.

For both pavement types, pavement smoothness is not significantly affected by WBT loads.

Finally, this study summarized the capabilities of WIM technologies in detecting wide tires. Newer systems may accurately distinguish between tire types, which the current versions used in Michigan do not.

IMPLEMENTATION

MDOT will use the estimates of wide base tires on state roads, as well as the prediction

functions for pavement impacts, as it continually works to improve the accuracy of its pavement design models. With a better understanding of how the wider tires will likely affect Michigan’s roads, the agency will be better able to anticipate pavement performance over time and evaluate alternative pavement designs. The agency will also consider updating its statewide design standards to account for WBTs on the state’s roads.

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**This final report is available
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