

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Develop and Implement a Freeze Thaw Model Based Seasonal Load Restriction Decision Support Tool

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Freeze-thaw decision tool helps determine seasonal load restriction dates

Setting timely seasonal load restrictions (SLRs) reduces the risk of pavement damage as the underlying soil softens during springtime freeze-thaw cycles. Lifting the restrictions expediently is just as important to minimize the financial cost to local businesses of SLR route detours. To better inform SLR start and end dates, the Michigan Department of Transportation (MDOT) undertook research to develop a web-based tool that draws from a statewide weather sensor network and forecast information to provide easily accessible site-specific SLR guidance. The app assists road engineers with SLR decision-making and provides useful planning information for road users as well.

PROBLEM

Across Michigan and other snowbelt states, local agencies implement SLRs to minimize road damage during spring freeze-thaw periods. Depending on the road's material composition, freezing and thawing of the soil underneath can reduce the road's strength by 50 to 70 percent. SLRs protect the roads, but they also disrupt local economies and trucking routes.

Consequently, it is very important that the load restrictions begin before thawing undermines the pavement strength but are lifted as soon as possible after the freeze-thaw cycles end so that trucking businesses



A data-driven web tool will help Michigan refine its guidance for when to implement seasonal load restrictions and when to lift them when the spring freeze-thaw cycles end.

can resume their usual routes.

Traditional methods of determining SLR dates have varied considerably throughout the state. Often, local agencies have had to calculate dates manually using general data

“Using existing data from a number of sources, the research team was able to develop an easy-to-use web-based tool that supports timely seasonal load restriction decision-making.”

Melissa Longworth, P.E.
Project Manager

rather than site-specific information or have based the dates on previous years' weather patterns. Accuracy of the SLR start and end dates, however, is critical both to pavement service life and to local economies.

RESEARCH

By filtering data from the vast amounts of information gathered through MDOT's Road Weather Information System (RWIS), researchers sought to develop engineering models to better predict pavement and subsoil conditions and changes. These models would provide the basis for a tool to assist in determining the optimal dates for placing and lifting seasonal load restrictions anywhere in Michigan.

First, researchers examined existing freeze-thaw models and practices used by other state DOTs. A Federal Highway Administration model was used with modifications by several northern states and a Canadian province. Some states' models take air temperature into account as well as precipitation from August through November. Freezing and thawing indices are often used, and some methods consider pavement temperature and thickness as well.

Researchers decided to modify and refine those existing SLR procedures to make the new MDOT tool Michigan-specific as well as more precise and responsive in

real time. To that end, they followed the work of a 2015 MDOT research project, [Predictive Modeling of Freezing and Thawing of Frost-Susceptible Soils](#), which examined the feasibility of predicting frost depth and frost heave as a crucial aspect of infrastructure design.

This new project built upon those results and took MDOT's RWIS information in a new direction, making more extensive and innovative use of data MDOT already had. Researchers used real-time freeze-thaw ground data from MDOT's 105 RWIS sites as principal indicators, backed up by data from frost tubes and other indicators. They then combined the RWIS data with geographic information system (GIS) location data, using ZIP codes as locators, and created a connection to a real-time weather forecasting site for weather conditions and forecasts of up to 10 days.

Researchers incorporated these sources into a model for determining accurate and expedient SLR start and end dates for different areas, all packaged in a user-friendly web application.

RESULTS

The web-based tool, [MDOTSLR](#), provides MDOT, local agencies and road users with accurate and timely data on freeze-thaw index values in soil types based on ZIP code locations. By automating the required calculations, the tool saves road engineers time and effort. They can quickly validate data and easily determine and monitor dates for setting and lifting load restrictions.

IMPLEMENTATION

Road engineers are already experiencing the benefits of the MDOTSLR decision tool. To help spread the word and encourage adoption, MDOT conducted a [training and outreach session for local engineers](#). In addition to learning about the tool and its capabilities, attendees discussed ground and pavement temperatures across county roads, SLR status, and decisions concerning

timing of local road restrictions.

Road users, especially those working for trucking and hauling companies affected by SLR policies, can use the tool to estimate when load restrictions are likely to be implemented or removed, allowing them to more easily prepare for route changes.

Research Administration

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