Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Evaluation of Bridge Deck Winter Weather Warning Systems

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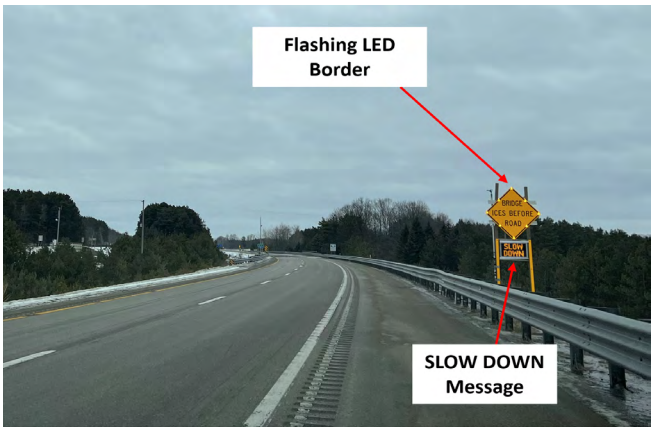
Alerting drivers to unsafe winter conditions on Michigan bridges

In winter, many serious crashes occur in Michigan when drivers are traveling too fast as they move from pavement onto icy bridge decks. To better alert drivers about potentially icy conditions, the Michigan Department of Transportation (MDOT) has installed signs that activate flashing lights and additional messaging based on real-time weather data. To determine their effectiveness, MDOT conducted research to evaluate driver behavior and crash frequency when the weather-activated signs were present. Understanding the effects these signs have on driver behavior will help MDOT decide how to best use them on bridges throughout the state.

PROBLEM

Nearly all drivers have driven from a roadway onto a bridge during winter weather only to encounter a much icier driving surface on the bridge deck. A bridge is exposed to cold weather from all four sides and winds from underneath, making its surface freeze more quickly than the adjacent road pavement.



Enhanced warning signs can help improve driver behavior and safety on cold and icy bridges in Michigan.

While icy bridge warning signs are plentiful, their permanent presence limits their effectiveness. To better ensure the safety of drivers, several enhanced signs have been installed that are only activated when warranted by real-time road weather information system and bridge surface data. MDOT is interested in better understanding how effective these additional weather-activated signs are in reducing speeds and preventing crashes during winter driving conditions.

(continued)

"The results of this research show that the weather-activated signs at bridges work and that drivers will slow down because of them."

David Smith
Project Manager

RESEARCH

Previous research found that use of the standard, always-present warning sign at bridges is only marginally effective because of its static nature. A review of the literature on alternative sign strategies suggests that sign enhancements that operate only during inclement weather may be more effective.

Field evaluations at three locations adjacent to bridges in Michigan assessed the effectiveness of weather-activated signs as a speed reduction countermeasure. Vehicle speeds were collected when weather-activated signs were:

- **Not in operation.** Only the standard "BRIDGE ICES BEFORE ROAD" sign was used.
- **In operation.** The "BRIDGE ICES BEFORE ROAD" sign had either a flashing LED border or a flashing amber light above the sign.
- **In operation along with a radar-activated text panel mounted below the sign.** The panel displayed messages such as "SLOW DOWN" or "ICY ROAD," with letters that were a minimum of 15 inches tall.

Also evaluated were the effects of a full-sized, stand-alone changeable message sign (CMS) (approximately 30 feet wide and 8 feet tall) located on the approach to a bridge that displayed warning messages such as "SLIPPERY ROAD CONDITIONS/ REDUCE SPEEDS."

Lastly, researchers analyzed winter season crash rates at 20 MDOT highway bridge locations using data collected both before and after the installation of weather-activated warning signs.

RESULTS

The results demonstrated that weather-activated signs had a positive impact on reducing vehicle speeds compared to the traditional warning sign. More specifically:

- A weather-activated flashing LED border on the warning sign reduced the speeds of vehicles before encountering the bridge deck.
- A radar-activated text panel beneath the warning sign that displayed messages such as "SLOW DOWN" or "ICY ROAD" provided additional speed reductions.
- A full-sized CMS displaying the message "SLIPPERY ROAD CONDITIONS/REDUCE SPEEDS" was also effective at reducing vehicle speeds before vehicles encountered the bridge deck during winter weather conditions.

The analysis of winter season crashes before and after the weather-activated signs were installed suggested that the crash rates were lower at 16 of the 20 studied sites. While these results are preliminary because of limited post-installation data availability, the results are promising.

Further, researchers identified 100 bridges in the state as candidates for future installations of weather-activated signs. These bridges were selected based on characteristics such as traffic volume, structure length, winter precipitation, horizontal curvature, and geographic region.

IMPLEMENTATION

Based on the findings from this study, a series of guidelines was developed to support future implementation and operation of bridge deck warning systems in Michigan. This included guidance about selection of sign types, warning alerts and messages, and future implementation locations, along with sensors and other related equipment.

The research findings suggest that continued and expanded use of weather-activated signs is recommended. These signs should include either a flashing LED border or dual flashing amber beacons along with a radar-activated text panel beneath the sign to display warning messages related to dangerous road conditions. Winter weather warning messages should also continue to be posted on existing full-sized CMSs located around the state, particularly those positioned near bridges.

Research Administration

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The final report is available online at
MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1728.

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