Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Efficacy of Speed Warning Technologies

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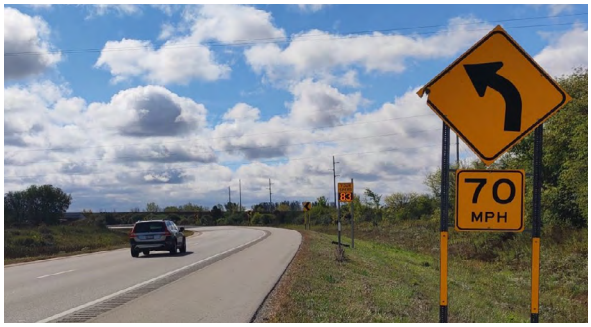
Speed warning technologies slow drivers in critical speed-change areas

New speed warning technologies offer promise for enhancing safety in critical speed-change areas on freeways and highways. Several advanced signing technologies tested on freeway curves and ramps, highway transition areas, roundabouts, and other areas showed meaningful speed reductions. Recommendations for placing warning sign technologies, choosing technologies and sign characteristics, and installing and operating technologies support updates to the Michigan Department of Transportation's (MDOT) *Freeway Digital Speed Feedback Sign Guidelines* to enhance safety across Michigan's transportation network.

PROBLEM

MDOT continually strives to enhance road safety and reduce crashes. Nearly 20 percent of traffic fatalities in Michigan are due to excessive speed, often in areas where drivers must quickly adjust speeds to accommodate highway transitions, curved highway segments and other roadway changes.



Digital warning signs that detect and display a driver's speed encourage drivers to reduce their speed, potentially reducing crashes in critical speed-change areas.

MDOT has used traditional warning signs, pavement delineation and beacons in these areas to warn drivers of approaching speed-change areas. The agency has also begun using advanced warning technologies such as dynamic speed feedback signs (DSFS), flashing beacons, sign borders or chevrons, and other warning strategies in these areas and wanted to evaluate their effectiveness.

The relatively recent implementation of the new speed warning tools prevented meaningful crash analyses over time. Previous MDOT research found that driver speeds were reduced when DSFS were deployed on freeway exit ramps. But the conditions under which drivers were observed in that project were limited. MDOT wanted to continue earlier research

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"This project was invaluable for understanding where and how to employ enhanced warning sign treatments for maximum effectiveness. Results are immediately useful for ensuring our Freeway Digital Speed Feedback Sign Guidelines *will reduce traffic crashes and fatalities across the state."*

Alonso Uzcategui, P.E.
Project Manager

to understand how several new warning sign technologies impact drivers in various roadway contexts and conditions.

RESEARCH

After reviewing nationwide practices and research gaps on the use of warning measures in speed-change and high-crash risk areas, the research team assessed the effectiveness of speed warning technologies through a series of field evaluations. MDOT's Research Advisory Panel assisted with identifying which warning technologies to assess in a variety of roadway contexts involving speed transitions:

- **Horizontal curves.** DSFS were placed at five freeway ramps and two mainline freeway sections; flashing LED chevrons were placed at three rural highways.
- **Speed limit transition areas.** DSFS were installed on one freeway transitioning to a nonfreeway highway, four roundabouts approaching a community and one rural highway entering a village.
- **Winter weather hazard areas.** A slippery curve warning system with two Slippery When Wet signs and a curve warning sign (both with LED borders) was activated by road weather information systems and tested on two rural highway curves. Weather warning messages on changeable message signs were installed and assessed on three freeway bridge overpasses.

MDOT had installed permanent DSFS or chevrons at some sites, and the research team installed temporary sign treatments at the remaining sites. Before and after each warning device was installed, vehicle speeds were tracked at multiple locations within each speed-change area with lidar guns from unmarked parked cars alongside the road. On freeway exit ramps, a trailer-mounted radar speed sensor replaced human-operated lidar guns.

RESULTS

Overall, advanced speed warning signing technologies can result in meaningful speed reductions up to 3.5 mph in areas where the speed limit quickly changes. Site-specific factors, such as roadway context, and installation and operation of warning equipment, however, impacted the magnitude of the speed reduction benefits.

Drivers were 50 percent to 75 percent less likely to exceed the curve advisory speed or posted speed limit after speed warning treatments were installed. Importantly, the signing technologies had the greatest impact on reducing the speeds of the fastest drivers.

Researchers provided detailed guidance for implementation and operation of speed warning technologies in each road context, including covered site and sign treatment selection, installation location and operation, and suggestions for messaging or warning alerts.

To assist MDOT regions in prioritizing locations for installing and maintaining advanced speed warning technologies, the research team ranked freeway and highway curved segments by traffic volume, crash frequency and crash rate, identifying the top 25 freeway curves and top 50 two-lane highway curves.

IMPLEMENTATION

MDOT is already collaborating internally to update its *Freeway Digital Speed Feedback Sign Guidelines*, adopting almost all of the researchers' recommendations. The agency will also continue to evaluate crash data at sites where warning technologies have been installed and further update guidance as needed. With updated guidance and highway segment rankings, MDOT regions seeking to install and maintain advanced speed reduction treatments will be well-equipped to enhance road user safety in speed transition areas.

Research Administration

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The final report is available online at
MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1748.

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