Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Safety Enhancements at Short-Storage-Space Railroad Crossings

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Enhancing safety at short-storage railroad crossings

Rail lines that cross traffic near street intersections, which offer little space to "store" stopped vehicles, often present challenges to drivers. New research investigated historical crash data, driver behavior at these types of crossings and the effectiveness of various signs and pavement markings for reducing crashes. Suggested revisions to Michigan Department of Transportation (MDOT) guidance documents and facilitated collaborations among staff will support the agency's efforts to enhance safety at short-storage railroad crossings.

PROBLEM

MDOT strives to ensure Michigan's rail system meets the state's economic needs in ways that are safe for all road users, railroad employees and train passengers. Certain highway-rail grade crossings, however, can present a safety challenge when there are high traffic volumes, frequent trains or adjacent intersections.

Train crossings with short storage can be challenging for drivers. Additional road markings and signage can reduce crashes.

Short-storage crossings are roadway segments that have insufficient space for vehicles to queue while waiting for a train to pass. Without enough distance, vehicles at these intersections may stop too close to the tracks or even enter into the railroad crossing. MDOT uses a variety of treatments to increase safety at railroad crossings. Active measures like gates and traffic signals are typically more effective than passive signs, flashing lights or pavement markings, but they are also more costly.

With little information available on the efficacy of passive safety treatments at rail crossings and the challenges associated with

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"What we learned from the project, including in the workshop discussions, will be extremely helpful in guiding future efforts to enhance safety at short-storage crossings. Our toolbox for making site-specific modifications has grown."

Nikkie Johnson
Project Manager

short-storage train crossings, MDOT initiated this research project to better understand which passive safety improvements are most effective and what other variables may impact safety at short-storage railroad crossings.

RESEARCH

To better understand the current state of knowledge and practice at highway-rail grade crossings, researchers reviewed past studies on crossing characteristics and operational factors, the effectiveness of passive and active safety treatments and driver behaviors at train crossings. Crash data at train crossings from 2015 to 2019 informed an analysis of crossing types, safety treatments, crash specifics – including the cause and severity of any injuries – and the spatial distribution of crashes across Michigan.

The crash data analysis provided the basis for a safety evaluation of long- and short-storage crossings. Two safety indexes developed with existing methods enabled an assessment of the relative risks and collision predictions for each crossing type.

Leveraging a study of driver behavior and driving simulations, researchers examined how drivers tend to approach and traverse crossings and selected 10 sites for field testing. These short-storage crossing locations featured five types of passive safety methods: crossbuck signs by themselves; crossbuck signs with either stop signs or yield signs; near-side stop lines; and dynamic envelope markings, which are a series of "X"s on the pavement designed to make the crossing more pronounced.

Analyzing speed and acceleration, drivers' head rotation and whether drivers followed signs or pavement markings illustrated how motorists' actions varied with different safety treatments.

RESULTS

The research found there is little uniformity in the selection of safety treatments for highway-rail grade crossings. Additionally, crossings with passive treatments can be difficult for drivers, who must simultaneously navigate various signs and make decisions regarding an approaching intersection.

The results of the crash data analysis and safety evaluation of train crossings revealed most highway-rail grade crashes happened on local undivided roadways, and more crashes occurred at short-storage crossings than others. Failure to yield or stop, and disregarding traffic controls, were the most common driver violations.

The driver behavior study and simulator data yielded measures of effectiveness for passive safety treatments. Dynamic envelope markings and crossbucks with stop signs were found to be more effective than the other passive safety treatments reviewed. The data confirmed, however, that following signs and pavement markings near short-storage crossings is generally challenging for drivers.

Finally, researchers facilitated discussion among staff from MDOT's Office of Rail and Traffic Safety Office about crossing improvements, which led to potential modifications to several of MDOT's guidance documents. The variety of manuals, plans and guidance affected by this research illustrate the broad reach of the short-storage crossing issue into other MDOT areas.

IMPLEMENTATION

Improved understanding of driver-related distraction and driver ability to follow signs provides a new perspective on short-storage train crossing safety. Knowing how to use the modifications and countermeasures studied in this research project will be an important part of revising key MDOT guidance documents on this topic. Continuing the collaborative discussions between MDOT's offices will set the stage to implement effective crossing safety tools.

Research Administration

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