

# Evaluation of Work Zone Split Traffic Symbol Sign

tech transfer summary

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## MTC RESEARCH PROJECT TITLE

Evaluation of Work Zone Split Traffic Symbol Sign

## SPONSORS

Missouri Department of Transportation  
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## MTC

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The Midwest Transportation Center (MTC) is a regional University Transportation Center (UTC). Iowa State University, through its Institute for Transportation (InTrans), is the MTC lead institution.

MTC's research focus area is State of Good Repair, a key program under the 2012 federal transportation bill, the Moving Ahead for Progress in the 21st Century Act (MAP-21). MTC research focuses on data-driven performance measures of transportation infrastructure, traffic safety, and project construction.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the project sponsors.

Alternative signage for closure of a middle lane in a freeway work zone was found to be effective at communicating a lane change without adverse effects on work zone safety or operations.

## Objective

The primary objective of this project was to evaluate the use of alternative signage for a middle lane closure in a freeway work zone based on the implementation of the signage on a bridge rehabilitation project in Missouri.

## Background

The Federal Highway Administration's (FHWA's) Manual on Uniform Traffic Control Devices (MUTCD) provides guidance on signage for temporary traffic control in work zones. While this guidance works for many conditions, alternative signage may be more effective at enhancing safety in some instances.

Section 6F.16 of the MUTCD suggests using signs W1-4 and W1-4b in combination to notify drivers that three contiguous lanes are being split into a single lane (W1-4b) and dual lanes (W1-4).



MUTCD W1-4



MUTCD W1-4B



Alternative

*Horizontal alignment warning signs from MUTCD Section 6F (left and center) and alternative warning sign evaluated in this project (right)*

A potential issue with these two signs is that drivers must notice and interpret the two signs in conjunction with each other to understand that three lanes are open. If drivers miss one of the two signs, they may incorrectly interpret that only one or only two lanes are open.

## Project Methodology

The alternative signage evaluated in this study is designed to eliminate the potential confusion with signs W1-4 and W1-4b by displaying the lane arrangement on a single sign. The alternative sign is posted on both sides of the highway.

The use of alternative signage to indicate closure of a middle lane in a freeway work zone was evaluated based on its implementation in a work zone for a bridge rehabilitation project on I-170 between I-70 and Natural Bridge Road near St. Louis, Missouri. The work zone required the shifting of drivers into three lanes, two lanes around one side and one lane around the other side of the work area.

The researchers relied on both qualitative and quantitative measures to evaluate the effectiveness of the alternative sign in the freeway work zone:

- Collection and analysis of drive-through videos to understand drivers' perspectives and evaluate sign visibility
- Collection and processing of stationary videos to assess driver behavior
- Stakeholder interviews with contractor and Missouri Department of Transportation (MoDOT) personnel to learn their views on the effectiveness of the sign
- Review of survey responses from MoDOT's "Rate our Work Zones" website to determine if drivers provided any feedback regarding the use of the alternative sign
- Analysis of crash data for the work zone period and the period prior to the work zone
- Travel time analysis for the work zone period and the period prior to the work zone

## Key Findings

The results of the video analysis showed the following:

- The number of lane changes decreased from the early construction period to the late construction period.
- The most frequent lane changing occurred between the outside and middle lanes. The reduction in lane changing behavior could be due to driver acclimation to the work zone, including the work zone split sign.
- While the rate of lane changing decreased, the locations of the lane changes relative to the alternative sign and the gore point remained the same.
- Several types of unusual driver behavior, such as aggressive lane changes before and at the gore point, drivers crossing into the lane closure area, and vehicles being stranded in the gore area, were observed in the videos. However, the unusual driver behavior generally appeared to be related to aggressive driving and not to the presence of the alternative sign.

The results from the personnel interviews can be summarized as follows:

- Respondents generally thought that the alternative sign was a good idea but were divided on whether the use of the alternative sign improved work zone safety for drivers and construction workers when compared to the MUTCD sign. Some respondents thought the alternative sign improved safety because they perceived that it communicated information more clearly and was easier to understand. Other respondents indicated that the level of safety was the same because they do not think that drivers pay attention to the signs.

- According to the responses, the use of the alternative sign had no effect on work zone delay.
- Interviewees believed that the use of the alternative sign had almost no effect on the driving behavior of people because the rates of aggressive lane changes, erratic maneuvers, and horn honking were much the same with the alternative sign and the MUTCD sign.
- Respondents did not observe changes in driver behavior during the time that the alternative sign was in place.
- Feedback from MoDOT and contractor staff regarding the use of the alternative sign was generally positive.

The crash data analysis yielded the following results:

- It does not appear that the use of this alternative split sign affected the crash patterns on this section of I-170. The number of crashes in 2016 was generally lower than the number of crashes in 2015.
- The predominant types of crashes that occurred on this stretch of I-170 during the non-work zone period were rear-end, passing, and out of control. This crash pattern mirrors the types of crashes that occurred during the work zone period. During the work zone period, 46 percent of the crashes were rear-end and 38 percent were passing.
- A total of 13 crashes occurred during the work zone time period, although three of these crashes took place on northbound I-170 when the work zone was only in place on southbound I-170.
- While some crashes were due to lane changing or passing when the alternative sign was in place, the use of the alternative sign did not appear to be a contributing factor to these crashes based on the information contained in the crash reports.

The travel time analysis yielded the following results:

- There was a minor travel time increase of a few seconds during the time that the alternative sign was present in the work zone. The small increase had minimal impact on travel times through the work zone.
- I-170 had higher travel time differences than I-70, and I-170 southbound had higher travel time differences than I-170 northbound.
- The travel time differences on Natural Bridge Road were also higher than the travel time differences on I-70.
- Use of the alternative sign in the work zone did not significantly affect operations on I-170 or its adjacent corridors.

## Conclusions

- Drivers seemed to generally accept the alternative signage since no concerns regarding the use of the sign were submitted through the MoDOT work zone customer survey website.
- The use of the alternative sign did not create any adverse safety impacts. Crash patterns during the work zone period were similar to the crash patterns before the work zone was in place, and the use of the alternative sign did not appear to be a contributing factor in any work zone crashes.
- Instances of aggressive driver behavior were observed in the videos, but these instances do not appear to be related to the use of the alternative sign.
- The use of the alternative sign did not cause any adverse operational impacts in the work zone or surrounding area.
- MoDOT personnel and contractors familiar with the project believed that the sign helped to communicate information clearly to drivers but had mixed perceptions on whether the use of the sign improved safety. Some respondents believed that drivers simply do not pay attention to signs.



*Screenshot from a drive-through video*

## Implementation Benefits and Readiness

The alternative sign evaluated in this research has great potential for use on freeway work zones with lane closures in the middle lane. The stakeholders believed that it communicated information more effectively to drivers, and the use of the sign did not appear to create any adverse impacts on operations or safety.