Guidance on Use of Channelization for Two-Lane Two-Way Work Zone Configurations – Phase II

tech transfer summary

This project provides guidance regarding the use of traffic control devices to separate opposing traffic in two-lane, two-way, work zone configurations.

May 2026

RESEARCH PROJECT TITLE
Guidelines on Use of Temporary Barriers in Work Zone – Phase II

SPONSORS
Iowa Department of Transportation (InTrans Project 22-804)

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Objectives

The overarching objectives of this research were to assess the advantages and disadvantages in terms of cost, safety, mobility, and ease of application/removal of various types of traffic control devices (TCDs) used to separate opposing lanes of traffic in two-lane two-way (TLTW) work zones and summarize information on their use. In particular, the technical advisory committee (TAC) was interested in guidance on the use of portable concrete barriers.

The first phase of this research (InTrans Project 19-720, 2019–2022) aimed to identify the advantages and disadvantages of various types of TCDs, evaluate the effect of different TCDs on truck lane position in Iowa TLTW work zones, and analyze crashes in Iowa TLTW work zones.

The second phase of this research (InTrans Project 22-804, 2022–2025) aimed to evaluate crash patterns on two-lane roadways to determine whether an inflection point could be identified at which a concrete barrier would have more utility than other types of separation. Work zone crash patterns were also assessed to determine whether any insight could be gained from such data.

The methods and results of both phases are summarized in this document.

Problem Statement

Agencies have little guidance regarding the use of TCDs to separate opposing traffic in TLTW configurations.



Willie Sorenson, Iowa DOT

Channelizers (left) and concrete barriers (right) used in Iowa work zones to separate traffic in TLTW operations

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Background

Addressing work zone crashes is critical for both the traveling public and highway workers. TLTW work zone configurations pose a special crash risk because the separation between opposing lanes of high-volume, high-speed, multilane traffic narrows to a head-to-head configuration, increasing the potential for conflicts with oncoming traffic.

TCDs used to separate opposing traffic in TLTW configurations include channelizers and temporary barriers, each of which has its own advantages and disadvantages in terms of cost, safety, mobility, and ease of application/removal.

Channelizers such as tubular markers and cones are cost-effective and easy to apply/remove but provide minimal protection from opposing vehicles. Temporary barriers of concrete or other materials provide positive protection from oncoming vehicles but are significantly more expensive and not easily moved. Barriers also tend to have a wider footprint and may restrict traffic flow.

Research Description

Phase I

The researchers gathered information about the advantages and disadvantages of eight types of TCDs used to separate opposing traffic in TLTW work zone configurations. The devices included four channelizers (longitudinal channelizing devices, cones and tubular markers, vertical panels, and drums) and four types of temporary barriers (portable concrete barriers [PCBs], moveable concrete barriers, ballast-filled barriers, and steel barriers).

Additionally, the researchers identified available guidance from 24 states on the use of channelizers or barriers in TLTW work zone configurations; most guidance addressed positive protection devices.

The team evaluated the safety impacts of channelizers and temporary barriers in TLTW work zones through a brief literature review and two analyses focusing on TLTW work zones in Iowa.

The first analysis evaluated the lateral lane position of large trucks in TLTW work zones during the 2019 and 2020 construction seasons. Lateral lane position was used to measure the "friction" vehicles experience in the presence of certain TCDs. Six TLTW work zones were identified that used curbing with tubular markers to separate opposing lanes of traffic; three used tubular markers only, and only one used a positive protection device, PCBs.

The second analysis reviewed the crash type and sequence of events for crashes that occurred within five TLTW work zones during the 2019 construction season. Three of these work zones used curbing with tubular markers, one used tubular markers only, and one used PCBs. Crashes were combined by separator type. The first events for each crash (e.g., crossed centerline, ran off road) and the type of crash (e.g., rear-end, head-on) were reviewed.

Phase II

In evaluating the impact of barrier type on large truck lane position in Phase I, few sites were available, particularly for concrete barriers. Additional sites suitable for further analysis could not be found.

Instead, head-on crashes on rural two-lane roadways were assessed to determine whether an inflection point is evident where increased traffic volume disproportionately impacts crashes, suggesting that a concrete barrier would be most appropriate for head-to-head TLTW traffic. Linear regression models were used to fit a slope showing the relationship between crash rate and annual average daily traffic (AADT). Two analyses were conducted: single-vehicle run-off-road crashes and multivehicle head-on and sideswipe crashes.

Work zone crashes in general were also evaluated to determine whether a pattern could be noted that might suggest whether a particular barrier type would be more effective than others for separating TLTW traffic. Work zone crashes were summarized by several factors, including crash type, location within the work zone, type of work zone closure, and fixed object struck.

Key Findings

Phase I

- In the analysis of lateral lane position, 20% of large trucks positioned themselves over the right lane line when a PCB was present, compared to 4% when only tubular markers were present or 3% when curbing with tubular markers was present.
- Large trucks were most likely to be positioned within their lane when separated from opposing traffic by only tubular markers (73%), compared to 51% when curbing with tubular markers was used or 43% when PCBs were used (43%).
- The analysis of crashes in TLTW work zones that used tubular markers only or PCBs did not yield useful insights due to the small sample size.
- For work zones that used curbing with tubular markers, the majority of crashes were rear-end crashes, likely due to congestion and traffic volume. About 21% of crashes involved vehicles crossing into opposing lanes of traffic.



Large truck positioned well over the right lane line in the presence of PCBs

Phase II

- Single-vehicle run-off-road crashes increase sharply after an inflection point around an AADT of 4,447, suggesting that consideration be given to whether concrete barriers might move drivers to the right away from the barrier. However, little evidence suggests that vehicles would move far enough to the right to create an issue.
- Multivehicle head-on and sideswipe crashes increase disproportionately after an inflection point at an AADT of 2,981. Since concrete barriers may prevent crashes that involve crossing the centerline, this may be a beginning point to decide when they should be used.
- Speeding-related crashes are overrepresented in work zones. Because speeding can result in loss of control and higher kinetic energy in a crash, speeding-related crashes that result in a head-on collision may be more problematic than crashes that involve striking a barrier at an angle. However, striking a fixed object at higher speeds also increases risk.
- Head-on and opposite-direction sideswipe crashes make up only 3% of total crashes and 9% of fatal/serious injury crashes in work zones, while 26% of total crashes and 37% of fatal/serious injury crashes involve striking a fixed object. The latter is more likely if a vehicle shies away from a concrete median and runs off the roadway. Given the difference in magnitudes, a barrier that results in more run-off-road crashes seems problematic.
- Concrete barriers account for 7% of total crashes and 9% of fatal/serious injury crashes in work zones compared to 3% and 7% for other barrier types, suggesting that concrete barriers create a greater risk than other barriers. However, concrete barriers are involved in a small portion of work zone crashes, and it is unknown whether increased use of this barrier type would increase the risk of striking the barrier.

Implementation Readiness and Benefits

Understanding the advantages, disadvantages, and safety performance of the different TCDs used to separate opposing lanes of traffic in TLTW work zones can help agencies mitigate the potentially severe crashes that can occur when high-volume, high-speed, multilane traffic is channeled into a head-to-head configuration.

Due to the small sample size of the crash analysis, no definitive patterns or insights emerged. However, the initial findings indicate that evaluating additional data would be useful.

A review of crashes on two-lane rural roads and in work zones offers some insight into the appropriate use of concrete barriers in TLTW work zones. However, no compelling case can be made either for or against the use of concrete barriers using this information.