Designing Work Space Access Points to Better Accommodate Large Trucks

U.S. Department of Transportation
Federal Highway Administration

American Road & Transportation Builders Association

The Problem

Large trucks have been significantly over-represented in fatal work zone crashes nationally for the past several years. Large trucks are believed to be over-represented in non-fatal work zone crashes as well. Many of these crashes involve rear-end collisions. In fact, between 2012 and 2018, over 58 percent of large truck-involved fatal work zone crashes on interstate and freeway facilities involved rear-end collisions (*1*). Approximately one-half of those collisions involved a passenger vehicle running into the back of a large truck.

Many of those types of crashes happen at the upstream end of traffic queues created by lane closures and other work activities. However, other crashes occur when semi-tractor trailer trucks or dump trucks pull out of a construction work space at very slow speeds directly into high-speed travel lanes and are struck from behind by a vehicle in that lane. Similarly, other rear-end collisions occur when large work vehicles must slow down dramatically in a high-speed travel lane to turn into a construction work space access point and are struck from behind. Additional rear-end collisions may also result between the first approaching vehicle that slows behind a large truck and is itself struck from behind by a second vehicle that fails to slow down in time.

The Solution—Minimize Travel Lane Speed Differentials

One way to reduce rear-end collision potential with these large trucks is to design the work space access points in a way that allows:

- Deceleration out of the high-speed travel lanes into the work space, and
- Acceleration from the work space into the high-speed travel lanes.

Source: Texas A&M Transportation Institute (TTI)

Incorporating deceleration and acceleration lanes into the temporary traffic control (TTC) plan or the contractor's internal traffic control plan of a project can seem burdensome. This is especially true when there is limited right-of-way available to accommodate both travel lanes for traffic and space to complete the necessary work activities. However, the benefits of including these lanes in terms of fewer crashes outweigh the additional effort needed to include them.

Acceleration and Deceleration Lane Lengths

What is the appropriate length of an acceleration or deceleration lane for a work space access point? For acceleration lanes, it depends on a) the operating speed of the roadway, and b) whether material is being brought in or taken out of the work space. Large trucks operate much differently when they are empty compared to when they are fully loaded. The American Association of State Highway Transportation Officials (AASHTO) geometric design criteria for acceleration lane length is acceptable for large trucks when empty, but inadequate when they are fully loaded. As shown in Figure 1, an empty truck takes approximately 1000 ft to accelerate to a speed where it can reasonably merge into a travel lane operating at 55 mph (*2*). However, a fully loaded truck

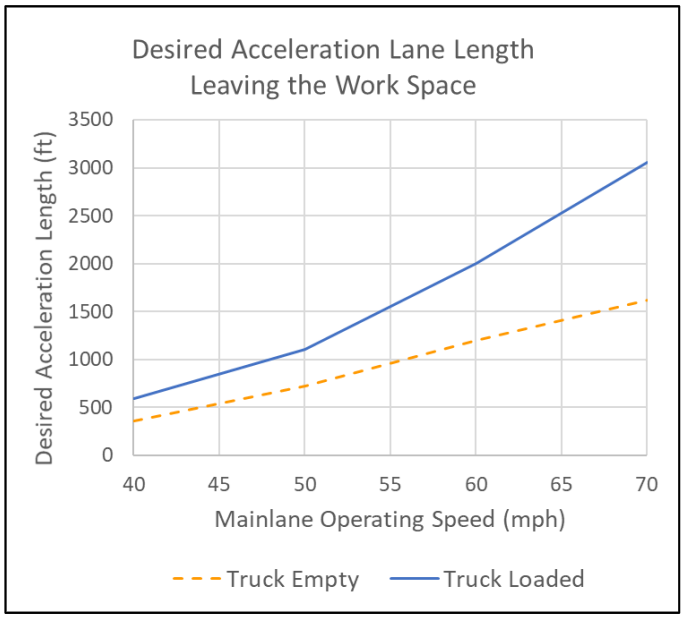
will require 500 feet more (a total of 1500 ft) to reach the same speed before merging into the travel lane (*3*). The difference is even greater when attempting to merge into travel lanes operating at higher speeds.

Meanwhile, the lane length needed to decelerate before entering the work space from a given travel speed is much shorter than the lane length needed to accelerate to that speed. The necessary deceleration lane length also depends on the speed at which the truck can enter the work space itself. An access point design that operates as a slip ramp allowing the truck to enter the work space at 30 mph requires less distance than a design that requires the vehicle to come to a near stop to turn into the space, as shown graphically in Figure 2.

Work Space Access Point Design Options

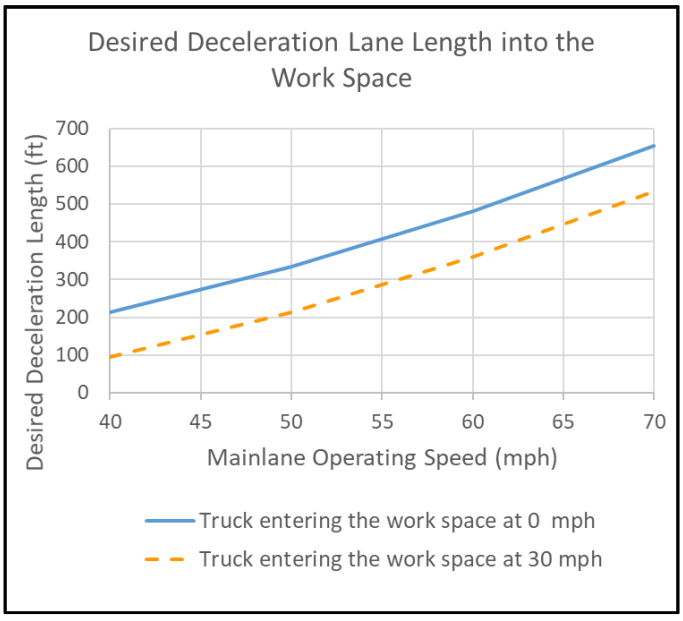
A few agencies have incorporated access point requirements into their work zone manuals and standards. For example, the Virginia Department of Transportation (VDOT) requires that the design of access into and out of the work space be included in the required TTC plan (*4*). The manual requires the location of access points meet stopping sight distance requirements, and that the ends of the access point opening be designed to be crashworthy. VDOT recommends a minimum of 1320 ft be provided for ingress and egress maneuvers at access points, and that the width of the access point should be a minimum of 15 ft (although 12 ft is sometimes allowable where right-of-way is severely constrained).

As another example, the Ohio Department of Transportation (ODOT) has developed standard TTC drawings for access point designs on multi-lane roadways with work in the median or to the outside of the travel lanes (*5*). A simplified rendition of the drawing is shown in Figure 3. In this configuration, construction vehicles leave the work space using the opening on the left end of the figure. Meanwhile, entrance into the work space is accomplished by moving from the right travel lane into the deceleration lane, slowing down, and making a right turn into the



Source: Adapted from the AASHTO Policy on Geometric Design for Streets and Highways, and NCHRP Report 505, Review of Truck Characteristics as Factors in Roadway Design.

Figure 1. Desired Acceleration Lane Lengths.



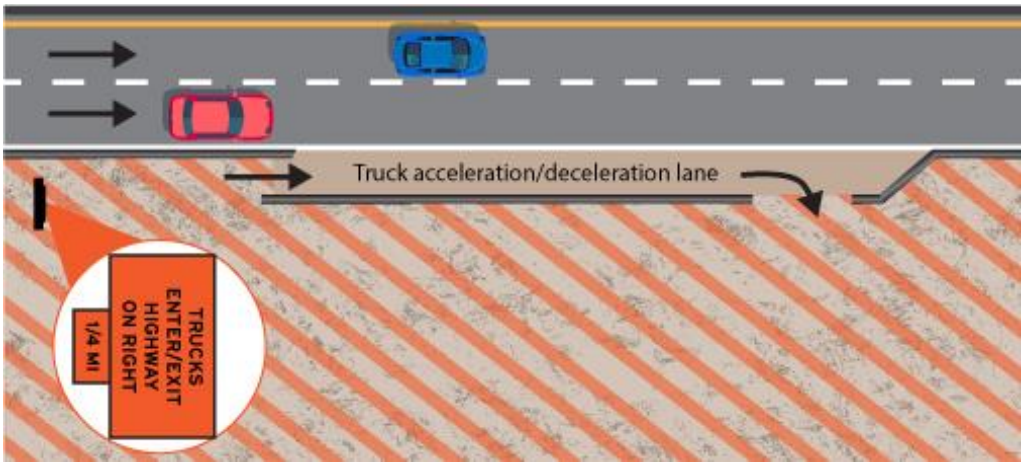
Source: Adapted from the AASHTO Policy on Geometric Design for Streets and Highways, and NCHRP Report 505, Review of Truck Characteristics as Factors in Roadway Design.

Figure 2. Desired Deceleration Lane Lengths.

work space. The ODOT design provides 780 ft of acceleration once the truck leaves the work space, which would allow a fully loaded truck to reach between 50 and 55 mph before merging into traffic. Their design offers 650 ft of deceleration before making the turn into the work space, which would allow trucks operating between 65 and 70 mph to move out of the travel lane and come to a near stop before turning into the work space. Ideally, the contractor should coordinate the location and operation of these access points with their own internal traffic control plan (ITCP). An ITCP is a method or protocol to coordinate worker, work vehicle, and equipment movements in the activity area of a work zone (*6*).

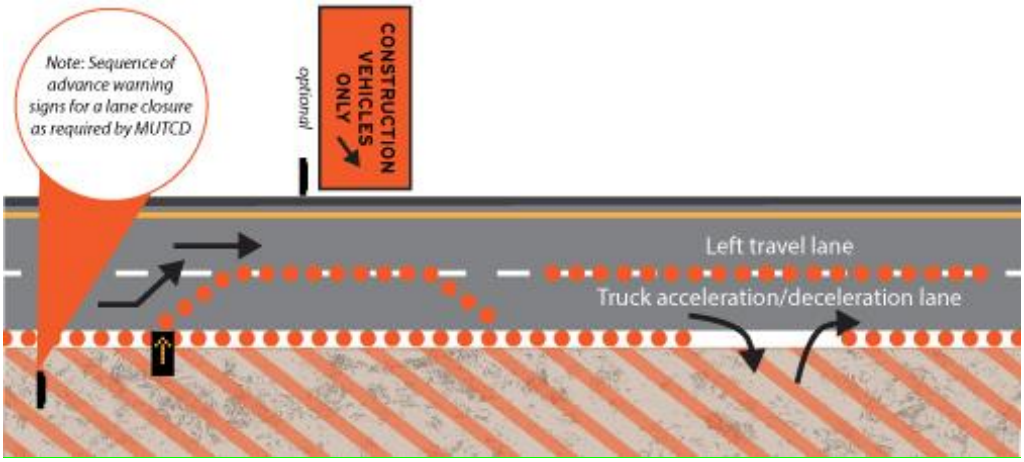
If traffic volumes are low enough, it is sometimes possible to create temporary acceleration and deceleration lanes from an existing travel lane. To accomplish this, short-term lane closures are used to create a temporary deceleration or acceleration lane for trucks to access active work spaces. An example of such an application when the work space is adjacent to the direction of travel that the trucks are coming from is shown in Figure 4. A standard lane closure is set up in advance of the access point to create a temporary deceleration lane, and then an opening in the channelizing devices is placed the desired deceleration length upstream of the access point. A warning sign that indicates that the opening is for construction vehicles only can also be placed upstream. The TTC plan for this situation should be designed so that sufficient deceleration distance for a construction vehicle can be accommodated in the closed lane.

The situation is more challenging if the construction vehicles are using lanes in the opposite direction of travel from where the work space is located. In these situations, the trucks must use the left lane to turn across opposing lane traffic to access the work space.



Source: TTI

Figure 3. Work space access point design concept on a multi-lane divided roadway using barrier.



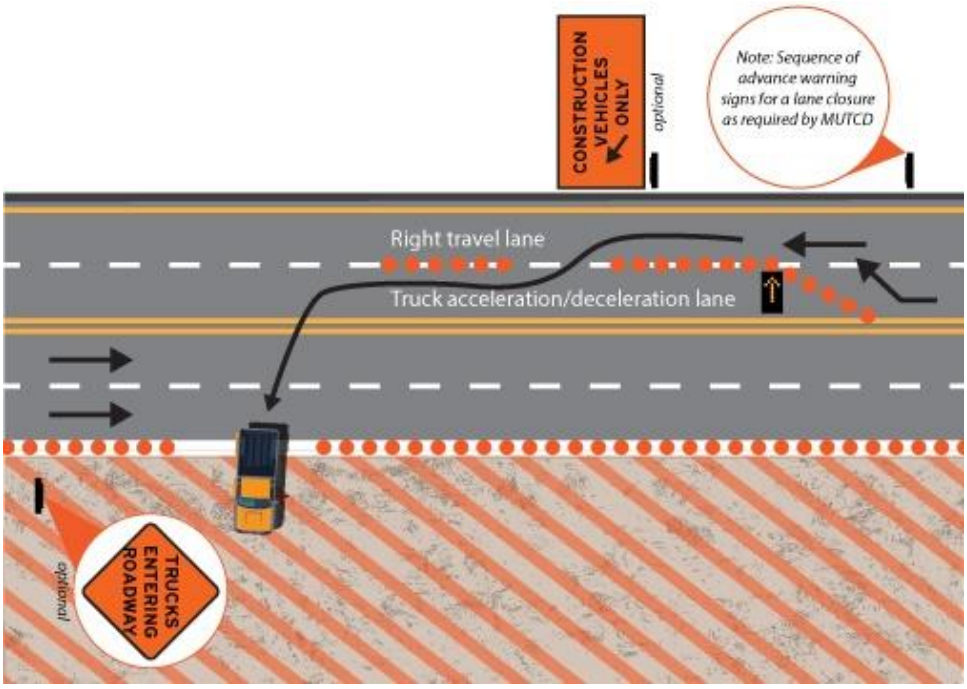
Source: TTI

Figure 4. Rendition of a temporary lane closure to create an acceleration/deceleration lane on a multi-lane roadway for work trucks to access the work space from adjacent travel lanes.

Having large trucks sitting in the left lane waiting to make the turn creates a significant rear-end collision risk. Use of a temporary lane closure to create a turn lane can reduce that risk. Figure 5 and Figure 6 show two potential applications. In Figure 5, the work trucks that want to access the work space are coming from the right. The left-lane closure creates a left-turn pocket for large trucks to move into to wait to find a gap in opposing traffic. In Figure 6, the large truck in the work space must turn left. Rather than force the driver to find an acceptable gap in both directions of traffic, the left-lane closure creates an acceleration lane so that the driver only needs to worry about finding a gap in traffic approaching from the left.

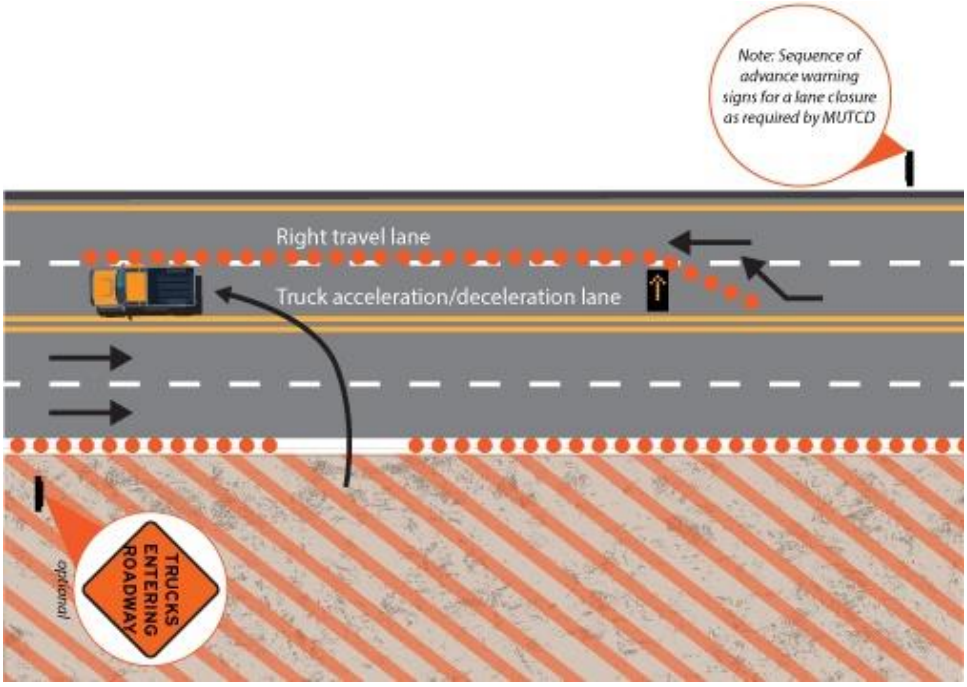
Engineering judgment must be used when deciding whether this strategy is a reasonable option, as it does reduce the roadway capacity past the work space and cause queuing upstream of the lane closure. Mitigation strategies such as queue warning systems or portable rumble strips may need to be implemented to reduce the effects of such queues upon traffic flow.

Ideas on other ways to improve large truck, including construction vehicle, safety in work zones can be found elsewhere (*7, 8*).



Source: TTI

Figure 5. Rendition of a temporary lane closure to create a left turn lane for work trucks entering the work space.



Source: TTI

Figure 6. Rendition of a temporary lane closure to create an acceleration lane for work trucks making left turns from the work space.

This material is based upon work supported by the Federal Highway Administration under Cooperative Agreement No. 693JJ31750001. The material was prepared by the Texas A&M Transportation Institute. Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Transportation. This publication does not constitute a national standard, specification, or regulation.

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