



COLORADO
Department of Transportation

COLORADO DEPARTMENT OF TRANSPORTATION



Zipper Merge (Late Merge) Guidelines

2025 Edition

Prepared by



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INTRODUCTION

MISSION

It is the mission of the Colorado Department of Transportation (CDOT) to provide the best multi modal transportation system for Colorado that most effectively moves people, goods, and information. CDOT policy, state statute, and federal surface transportation law, place a strong emphasis on creating a system for use by persons of all ages and abilities for safe and convenient access to jobs, services, schools, and recreation. The Chief Engineer Design Guidance express support for taking a flexible approach when designing and planning our state transportation system, and to identify resources which can be used to provide context sensitive solutions particularly related to bicycle and pedestrian accommodation.

PURPOSE

The purpose of creating a guideline for zipper merge signage and placement in the state of Colorado is to ensure consistent, effective communication to drivers about the proper method of merging in construction zones or areas of lane reduction. Zipper merges, when executed correctly, improve traffic flow, reduce congestion, and minimize the risk of collisions by encouraging drivers to use both lanes fully until the merge point and then alternate merging like a zipper. A standardized guideline will provide clear instructions for optimal sign placement, messaging, and timing, ensuring that all road users understand and adopt this method. This consistency will help enhance safety, reduce frustration among drivers, and promote smoother transitions through high-traffic or construction areas across the state.

BACKGROUND

Not all drivers use the same decision-making strategies when merging; some are passive and merge early, while others are aggressive and merge late. This inconsistency leads to poor lane utilization, causing delays and inefficiencies. When some vehicles merge early and others wait until the last minute, it results in longer queues and slower traffic flow. The zipper merge, or late merge, can improve traffic operations by reducing congestion and enhancing overall efficiency in both permanent lane drop locations and work zones. The following statewide guidelines have been developed to encourage the practice of zipper merging across Colorado.

GENERAL INFORMATION

DEFINITIONS

A **lane drop** refers to a point on a highway where the number of available traffic lanes decreases. Lane drops are often indicated by specific pavement markings and signs.

The **Manual of Uniform Traffic Control Devices (MUTCD)** defines the standards used by Traffic Engineers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to the public.

A **zipper merge** is a traffic management technique where drivers maintain both lanes of traffic until reaching a designated merge point, then alternate into the open lane like a zipper. This method helps improve traffic flow and reduce congestion by maximizing the use of available road space.

PERMANENT LANE DROP LOCATIONS

These signing series and spacing guidelines should be implemented at any location where a lane drop occurs and where congestion is prominent. This may include limit access freeways, and full access highways and arterials.

Zipper merge signage shall not be used at locations with acceleration lanes, deceleration lanes, or lane drops at existing ramps.

SIGNING

A three-sign sequence shall be used to alert drivers about a lane drop ahead. The following sequence effectively informs drivers about lane reduction and guides them to merge safely at the designated merge point. The purpose of each sign in the proposed sequence is as follows:

1. Sign 1: Alerts drivers that a lane will be ending but instructs them to remain in their current lane until the merge point.
2. Sign 2: Indicates that the merge point is approaching.
3. Sign 3: Marks the merge point and directs drivers to merge at this location.

Location 1: Initial Alert

To encourage drivers to use both lanes and not merge early, a USE ALL LANES TO MERGE POINT warning sign shall be used as the first sign in a zipper merge sequence, as shown in Figure 1. This sign is not included in the *Manual on Uniform Traffic Control Devices 11th Edition* (MUTCD), and thus has been created as a CDOT special sign.



Figure 1. *USE ALL LANES TO MERGE POINT (W4-51)*

Location 2: Advance Notice of Merge Point

The MUTCD guidance on signage for lane endings (Lane Ends symbol (W4-2)) has been applied at merge points throughout Colorado. For zipper merge applications, an AHEAD plaque (W16-9P) shall be added below the sign, to help clarify that while the lane is ending, drivers do not need to merge at this sign location.



Figure 2. *Lane Ends & AHEAD (W4-2 and W16-9P)*

Note: When the geometric condition exists where both approach lanes merge, a single lane transition (W4-8) sign shall be used instead of the W4-2. Use of this sign should be limited to locations where two lanes merge into one lane.



Figure 3. Single Lane Transition (W4-8)

Location 3: Merge Point

MERGE HERE TAKE TURNS (W9-2a) shall be the final sign in the series. It notifies drivers to merge at this location and to take turns. This sign has been used in work zone applications in Colorado and is included in a work zone application (black on orange signage) in the MUTCD. However, for permanent lane drop locations, a warning sign version of W9-2a (black on yellow signage) shall be used. This should be double posted where roadway conditions permit to ensure it is visible to vehicles in both merging lanes.



Figure 4. MERGE HERE TAKE TURNS (W9-2a)

SIGN SPACING

Sign 1 shall be placed at least 500 feet upstream of the sign 2 Location and no greater than 1000 feet upstream of the sign 2 Location. At lane drop locations where backups greater than 1000 feet regularly occur, an additional Sign 1 may be installed at the discretion of the Region traffic engineer.

For arterial lane drop locations downstream of a traffic signal, Sign 1 should be located upstream of the signalized intersection to encourage drivers to use all lanes through the intersection.

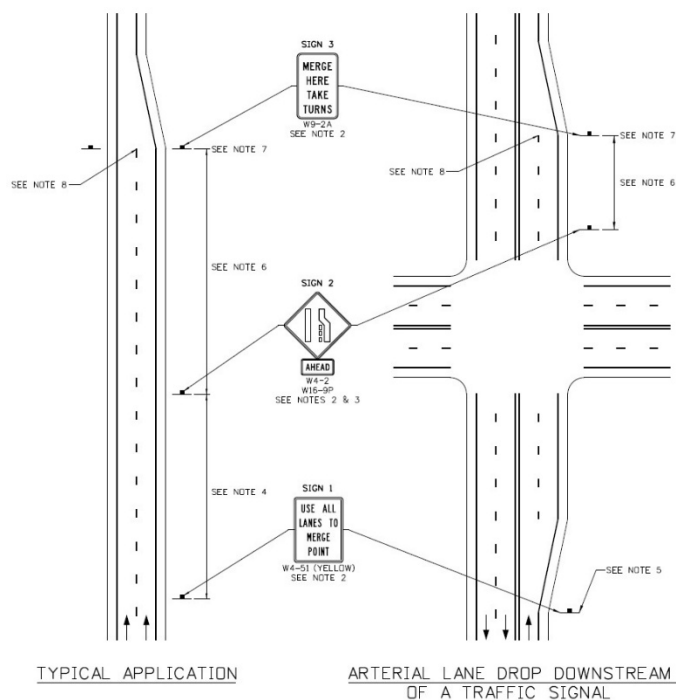
Sign 2 shall be placed using Guidelines for the Advanced Placement of Warning Signs from the current MUTCD (Table 2C-3 in the MUTCD 11TH Edition, Condition A), shown in Table 1.

Posted or 85th-Percentile Speed	Advance Placement Distance ¹									
	Condition A: Speed reduction and lane changing in heavy traffic ²	Condition B: Deceleration to the listed advisory speed (mph) for the condition								
		0 ³	10 ⁴	20 ⁴	30 ⁴	40 ⁴	50 ⁴	60 ⁴	70 ⁴	80 ⁴
20 mph	225 ft	115 ft	N/A ⁵	—	—	—	—	—	—	—
25 mph	325 ft	155 ft	N/A ⁵	N/A ⁵	—	—	—	—	—	—
30 mph	460 ft	200 ft	N/A ⁵	N/A ⁵	—	—	—	—	—	—
35 mph	565 ft	250 ft	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—	—
40 mph	670 ft	305 ft	100 ft ⁶	100 ft ⁶	N/A ⁵	—	—	—	—	—
45 mph	775 ft	360 ft	125 ft	100 ft ⁶	100 ft ⁶	N/A ⁵	—	—	—	—
50 mph	885 ft	425 ft	200 ft	175 ft	125 ft	100 ft ⁶	—	—	—	—
55 mph	990 ft	495 ft	275 ft	225 ft	200 ft	125 ft	N/A ⁵	—	—	—
60 mph	1,100 ft	570 ft	350 ft	325 ft	275 ft	200 ft	100 ft ⁶	—	—	—
65 mph	1,200 ft	645 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft ⁶	—	—
70 mph	1,250 ft	730 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—	—
75 mph	1,350 ft	820 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft ⁶	—
80 mph	1,475 ft	910 ft	725 ft	700 ft	625 ft	550 ft	450 ft	350 ft	200 ft	—
85 mph	1,600 ft	1,010 ft	825 ft	800 ft	750 ft	675 ft	575 ft	450 ft	300 ft	150 ft

Table 1. Guidelines for The Advanced Placement of Warning Signs (MUTCD 11th Edition Table 2C-3)

Sign 3 shall be placed at the beginning of the lane taper (merge point).

Figure 5 shows the sign placements for zipper merges.



NOTES

1. LATE/ZIPPER MERGE LOCATIONS SHALL BE DETERMINED PER THE DIRECTION OF THE REGION TRAFFIC ENGINEER.
2. ALL ZIPPER MERGE SIGNING SHALL HAVE A BLACK LEGEND ON A YELLOW BACKGROUND.
3. WHEN THE GEOMETRIC CONDITION EXISTS WHERE BOTH APPROACH LANES MERGE, A W4-B SIGN SHALL BE USED INSTEAD OF THE W4-2.
4. SIGN 1 SHALL BE PLACED AT LEAST 500 FEET UPSTREAM OF THE SIGN 2 LOCATION AND NO GREATER THAN 1000 FEET UPSTREAM OF THE SIGN 2 LOCATION AT LANE DROP LOCATIONS WHERE BACKUPS GREATER THAN 1000 FEET REGULARLY OCCUR, AN ADDITIONAL SIGN 1 MAY BE INSTALLED AT THE DISCRETION OF THE REGION TRAFFIC ENGINEER.
5. SIGN 1 SHALL BE PLACED A MINIMUM OF 500 FEET AND IN ADVANCE OF THE UPSTREAM LANE TAPER, AND THE SIGN LOCATION MAY BE ADJUSTED BASED ON GEOMETRIC CONDITIONS AND ENGINEERING JUDGMENT.
6. SIGN 2 SHALL BE PLACED USING GUIDELINES FOR THE ADVANCED PLACEMENT OF WARNING SIGNS FROM THE CURRENT MUTCD, TABLE 2C-3 FROM THE MUTCD 11TH EDITION IS PRESENTED BELOW FOR REFERENCE.
7. SIGN 3 SHALL BE PLACED AT THE BEGINNING OF THE LANE TAPER (MERGE POINT). SIGN 3 SHOULD BE DOUBLE POSTED WHERE ROADWAY CONDITIONS PERMIT.
8. WHITE BROKEN LANE LINE SHALL BE PLACED TO THE BEGINNING OF THE LANE TAPER (MERGE POINT). DO NOT INSTALL ANY LANE REDUCTION ARROW PAVEMENT MARKINGS.
9. A TAKE TURNS ROAD STENCIL MAY BE PLACED IN EACH OF THE MERGING LANES AT THE MERGE POINT, AT THE DISCRETION OF THE ENGINEER. SEE 5-627-1 FOR STENCIL.

Table 2C-3. Guidelines for Advance Placement of Warning Signs

Posted or 85th-Percentile Speed	Advance Placement Distance ¹									
	Condition A: Speed reduction and lane changing in heavy traffic ²	Condition B: Deceleration to the listed advisory speed (mph) for the condition								
		0 ³	10 ⁴	20 ⁴	30 ⁴	40 ⁴	50 ⁴	60 ⁴	70 ⁴	80 ⁴
20 mph	225 ft	115 ft	N/A ⁵	—	—	—	—	—	—	—
25 mph	325 ft	155 ft	N/A ⁵	N/A ⁵	—	—	—	—	—	—
30 mph	460 ft	200 ft	N/A ⁵	N/A ⁵	—	—	—	—	—	—
35 mph	565 ft	250 ft	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—	—
40 mph	670 ft	305 ft	100 ft ⁶	100 ft ⁶	N/A ⁵	—	—	—	—	—
45 mph	775 ft	360 ft	125 ft	100 ft ⁶	100 ft ⁶	N/A ⁵	—	—	—	—
50 mph	885 ft	425 ft	200 ft	175 ft	125 ft	100 ft ⁶	—	—	—	—
55 mph	990 ft	495 ft	275 ft	225 ft	200 ft	125 ft	N/A ⁵	—	—	—
60 mph	1,100 ft	570 ft	350 ft	325 ft	275 ft	200 ft	100 ft ⁶	—	—	—
65 mph	1,200 ft	645 ft	450 ft	400 ft	350 ft	275 ft	200 ft	100 ft ⁶	—	—
70 mph	1,250 ft	730 ft	525 ft	500 ft	450 ft	375 ft	275 ft	150 ft	—	—
75 mph	1,350 ft	820 ft	625 ft	600 ft	550 ft	475 ft	375 ft	250 ft	100 ft ⁶	—
80 mph	1,475 ft	910 ft	725 ft	700 ft	625 ft	550 ft	450 ft	350 ft	200 ft	—
85 mph	1,600 ft	1,010 ft	825 ft	800 ft	750 ft	675 ft	575 ft	450 ft	300 ft	150 ft

Figure 5. Zipper Merge Signing and Striping Layout

STRIPING

Zipper merges shall be striped as shown in Figure 5. The broken white lane line striping shall extend to the beginning of the lane taper (merge point). Any existing merge arrow pavement markings shall be removed.

A TAKE TURNS road stencil (S-627-1) as shown in Figure 6 may be placed in each of the merging lanes at the merge point, at the discretion of the traffic engineer. Stencils should be considered at locations where double posting a MERGE HERE TAKE TURNS sign is not feasible.



Figure 6. TAKE TURNS Road Stencil

WORK ZONE LANE DROP LOCATIONS

Section 6N.19, "Late Merge," in the MUTCD 11th Edition, includes signing for a late merge point. The layout incorporates signage such as "STAY IN LANE TO MERGE POINT" (R9-8a) and "MERGE HERE TAKE TURNS" (W9-2a), along with other standard work zone signage. This guidance was incorporated into CDOT's S-630-1 Case 29 work zone application (Figure 7).

For construction projects with lane closures in urban or high volume work zones, the project manager should consider an electronic detection system that detects slow or congested traffic and activates a portable variable message sign with messages such as "Use Both Lanes" and "Take Turns At Merge Point."

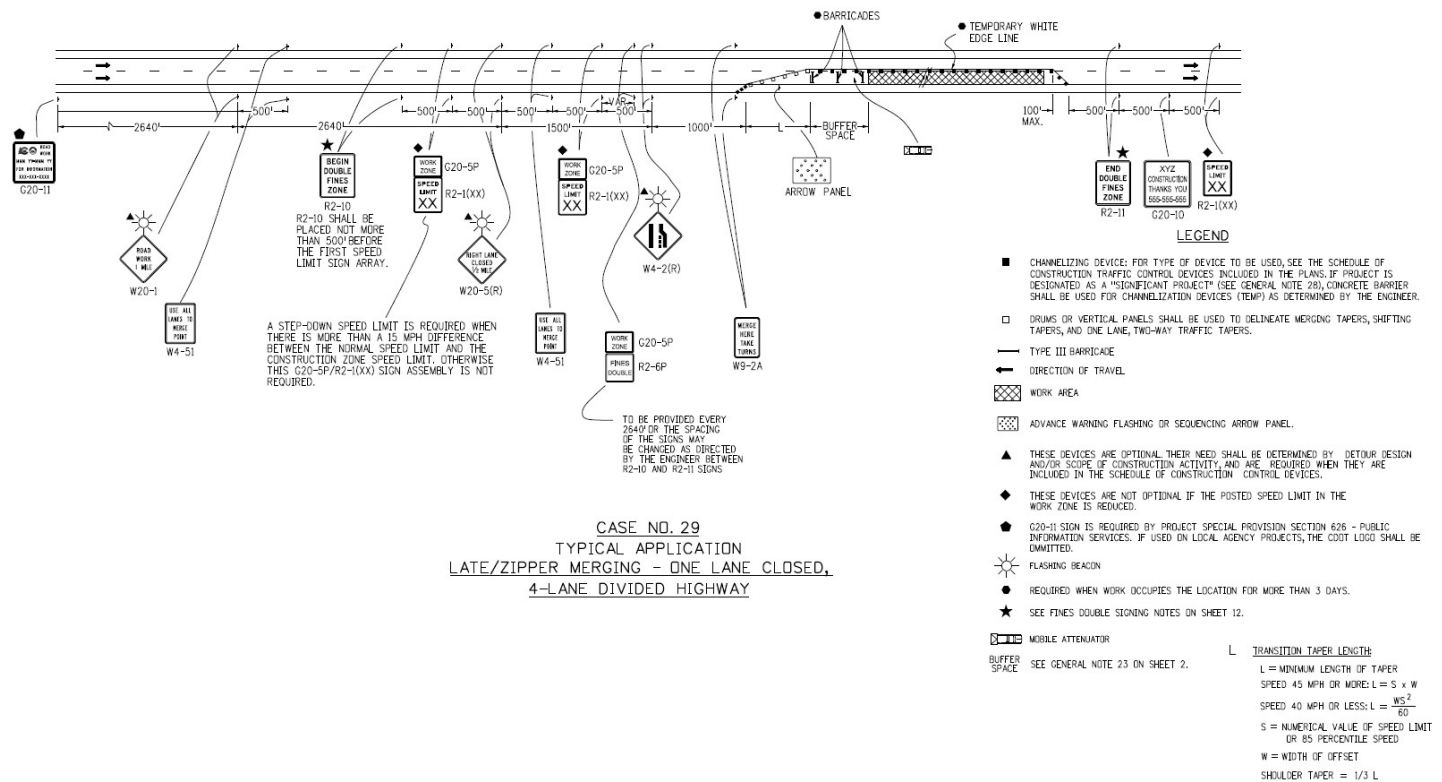


Figure 7. Work Zone Late Merging (Zipper Merge) Signage Sequence.

