COLORADO
Department of Transportation


# CDOT Guidelines for the Use of Positive Protection in Work Zones

2025 Edition

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Effective on 12/31/2025

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# I. Introduction

Positive protection is defined by Federal Highway Administration (FHWA) as “devices that contain or redirect vehicles and meet applicable industry crashworthiness evaluation criteria.” By this definition, positive protection devices should prevent intrusion into the work area.

These guidelines address the use of positive protection devices in work zones to supplement the Colorado Department of Transportation (CDOT) Work Zone Safety and Mobility Rule Procedures Document (https://www.codot.gov/safety/traffic-safety/design/work-zone-safety) and comply with the Federal Highway Administration Final Rule Subpart K to Title 23 of the Code of Federal Regulations (CFR) Part 630 (https://www.ecfr.gov/compare/current/to/2023-09-28/title-23/chapter-I/subchapter-G/part-630/subpart-K). These guidelines are not intended to be a rigid standard or policy; rather, they are guidance to be used in conjunction with engineering judgment. These guidelines are not a stand-alone document on work zone application of positive protection and should be used in conjunction with other traffic control standards and resources.

# II. Definitions

**Clear Zone:** The unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. This area includes shoulders, bike lanes, and those auxiliary lanes, except those auxiliary lanes that function like through lanes. The desired minimum width is dependent on the traffic volume, speed, and embankment slopes as discussed in the AASHTO *Roadside Design Guide*.

**Crashworthy:** The hardware or work zone devices described meets the crash test and evaluation criteria according to AASHTO’s Manual for Assessing Safety Hardware (MASH).

**Engineering Judgement:** The evaluation of available pertinent information, and the application of appropriate principles, standards, guidance, and practices as contained within this Guidance and other sources, for the purposes of deciding upon the applicability, design, operation, or installation of a traffic control device.

**Engineering Study:** The analysis and evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices for the purpose of determining the choice and application of work zone positive protection devices, exposure control measures, or other traffic control measures to safely manage work zones.

**Escape For Worker:** A clearly identifiable, open escape area where no physical barrier or significant drop-off prevents a highway worker from safely moving out of the path of an intruding vehicle. Physical barriers may include, but not limited to, guardrail, retaining walls, bridge abutment, or long and steep slopes.

**High Speed:** For temporary traffic control and positive protection purposes, high speed is defined as forty-five (45) miles per hour or greater.

**Intermediate-term Stationary Work:** Planned work activities that occupy a location within the traveled way or within CDOT’s right-of-way for more than one daylight period up to three (3) days, or nighttime work lasting more than one (1) hour.

**Long-Term Stationary Work:** Planned work activities that occupy a location within the traveled way or within CDOT’s right of way for more than three (3) days.

**Mobile Work:** Planned work activities in which workers and equipment move along the traveled way or within CDOT’s right-of-way that move intermittently or continuously, usually at slow

speeds. Workers in mobile work zones typically remain inside the vehicle and shall not enter live, unprotected lanes of traffic.

**Non-Recoverable Slope:** Slope which is considered traversable but on which an errant vehicle will continue to the bottom. Embankment slopes between 1V:3H and 1V:4H may be considered traversable but non-recoverable if they are smooth and free of fixed objects.

**Positive Protection:** Physical barriers and devices that contain or redirect errant vehicles, preventing them from entering a work area to protect workers and motorists.

**Recoverable Slope:** Slope on which a motorist may, to a greater or lesser extent, retain or regain control of a vehicle by slowing or stopping. Slopes flatter than 1V:4H are generally considered recoverable.

**Short Duration Planned Work:** Planned work activities that occupy a location within the traveled way or within CDOT's right-of-way for no more than sixty (60) minutes.

**Short-Term Stationary Work:** Planned daytime work activities that occupy a location within the traveled way or within CDOT's right-of-way for more than one hour within a single daylight period.

**Transportation Management Plan (TMP):** Consists of the Traffic Control Plan (TCP) included in the Contract, a Transportation Operations (TO) component, and Public Information (PI) requirements.

**Travel Way:** Portion of the roadway for the through movement of vehicles, exclusive of shoulders, gutters, and auxiliary lanes.

**Traversable Slope:** Slope from which a motorist will be unlikely to steer back to the roadway but may be able to slow and stop safely. Slopes between 1V:3H and 1V:4H generally fall into this category**.**

**Unplanned Work and Emergency Roadway Situations:** Serious, unexpected, and potentially dangerous situation discovered by one or more employees that poses an immediate threat to the employee(s) and/or the traveling public.

## III. Exposure Control Measures

Prior to including positive protection in a Transportation Management Plan (TMP), careful consideration must be given to alternatives which provide a safe environment for workers and the traveling public, and provide a level of transportation management appropriate for the scope of work operations that minimizes delay to the traveling public. Potential exposure control measures include:

- Remove the hazard from the clear zone
- Detouring Traffic
- Minimizing exposure time
- Maximizing the separation between traffic and workers
- Full road closure/ramp closure with traffic detoured
- Road closure with diversion (i.e. onsite detour, median crossover, temporary pavement)
- Performing work during off-peak periods when traffic volumes are lower
- Accelerated construction techniques

- Directional detours or alternate route detours
- Rolling roadblocks
- Use of right side or median shoulder as all or a part of a temporary traffic lane

## IV. Warrants

Positive Protection shall be required in work zones with high anticipated operating speeds that provide no means of escape from motorized traffic to workers unless an engineering study determines otherwise.

Positive protection in work zones shall be considered whenever an engineering study clearly indicates any of the following:

- Work zones provide workers with no means of escape from motorized traffic such as tunnels or bridges.
- Long-term stationary work zones result in substantial worker exposure to motorized traffic.
- Projects with anticipated operating speeds of 45 mph or greater, especially when combined with high traffic volumes.
- Work operations that place workers, pedestrians, or bicyclists close to travel lanes open to traffic.
- Roadside hazards, such as drop-offs or unfinished bridge decks.
- Positive protection will reduce the severity of potential crashes.
- Consequences of striking a fixed object or running off the road are likely to be more serious than striking the positive protection.
- Consequences of striking a worker or pedestrian are likely to be more serious than striking the positive protection.

## V. Typical Application

The following provides a list of areas where positive protection has been used in the past. However, this list is intended to provide guidance and should not be used in place of performing an engineering analysis.

- Shield hazards within the clear zone such as:
    - Temporary shoring locations
    - Bridge piers
    - Overhead sign supports including foundations
    - Staged pipe or culvert construction
    - Stored construction material or equipment
    - Pavement edge drop-offs
    - Non-transversable slope or steep/rough embankments within the clear zone
- To Isolate the work zone during staged bridge construction

- When workers or pedestrian safety is at risk due to the proximity of work to travel lanes
- To provide separation of opposing traffic
- To physically prevent vehicle intrusion into the active workspace and temporary pedestrian walkways
- As an exposure control measure to minimize the period or proximity of worker exposure to live traffic
- To supplement other traffic control measures
- To facilitate safe entry and exit of work vehicles and equipment to/from the travel lanes

## VI. Engineering Study and Analysis

An Engineering Study is a process which will integrate data, analysis, judgment, and creativity to determine the best construction strategy for a given scenario. An Engineering Study does not take the place of good engineering judgment, but should be used in conjunction with engineering judgment to guide the decision-making process. It is most important to understand that one individual factor cannot independently determine if positive protection is needed. Considering all the factors will provide the fundamental information for the designer to analyze if an individual operation warrants the need for positive protection.

A report that summarizes the Engineering Study must be stored with the project files. A template has been provided as Appendix B for this purpose.

The Engineering Study performed to determine the need for positive protection shall take into consideration clear zone distances, roadway geometry, anticipated construction year traffic volumes, work zone speeds, roadside geometry, workers safety, pedestrian safety, etc. The following describes in more detail how these areas of concern are considered.

### PRIMARY FACTORS TO CONSIDER

#### A. Clear Zone Distances

The *Roadside Design Guide* (RDG) defines the principles of clear zone. Objects outside the clear zone will generally not require positive protection. A designer must determine if a fixed object or worker will be within this lateral distance from the travel way. The designer shall determine the work zone speed limit of the operation to properly determine clear zone distance requirements in the work zone. Clear zones can be determined using Figure 3.1b *Clear-zone distance curves* or Chart 3.1 *Clear-zone distance in feet from edge of through traveled way* from the *RDG*.

Chapter 9 *Traffic Barriers, Traffic Control Devices, and Other Safety Features for Work Zones* of the *RDG* provides information specifically for work zones. Table 9.1 *Example of clear-zone widths for work zones* of the RDG provides example work zone clear zones. This table can be considered, while using good engineering judgment, when evaluating the need for positive protection.

The lateral distance from the travel way to a drop off or embankment could affect the need for positive protection. The height of a fill section is related to the slope a vehicle would have to travel toward the obstacle. Figure 5.1b *Comparative risk warrants for embankments* of the *RDG* helps to determine if positive protection is needed for a given fill height.

## B. Roadside Geometry

The depth and slope of the drop off or an embankment (roadside geometry) is an important factor to consider and will affect the decision to use positive protection.

### Pavement Edge Drop off

Drop-offs along highways present exposure to risk for highway users, especially vulnerable users such as motorcyclists. Exposure can be minimized by reducing speed, increasing lateral distance to drop offs and utilizing channelizing devices placed at the same level as the traveling lane or shoulder. Temporary barriers may also be utilized to shield a drop off depending on the average daily traffic (ADT), duration/exposure time of the drop off condition, drop off height, drop off slope and distance from drop off to travel lane. Refer to Appendix A for further information.

A simple and cost-effective way to promote pavement edge safety is the use of the safety wedge as outlined in FHWA's brochure "*The Safety Edge*" (https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/pdf/brochure.pdf). The placement of a safety edge during resurfacing operations can mitigate the hazard posed by pavement edge drop offs as soon as the paving machine lays down the asphalt mat, allowing reasonable time to restore the shoulder.

## C. Anticipated Traffic Volumes

For best analysis, the construction year traffic volumes would provide a more realistic "anticipated" traffic volume than the current or the design year volumes. When analyzing the traffic volumes, the traffic mix should be considered. This includes the percentage of truck traffic as well as motorists unfamiliar with the area including seasonal tourists or for special events.

With higher traffic volumes, night work is often used as an exposure control measure. Night work may present unique challenges that must be taken into account such as, increased speeds, glare from portable lighting, driver's impaired visibility, and inattentive drivers. Nightly installation and removal of positive protection devices will increase time and traffic exposure and may offset any advantage associated with the use of positive protection, except in cases where it can be installed and left in place for extended periods. These items need to be considered prior to requiring night work.

Higher volumes increase the risk to road users and roadway workers. Therefore, positive protection will more likely be used in cases with higher volumes.

## D. Work Zone Speeds

The determination shall be based on a traffic investigation or survey or upon the basis of appropriate design standards and projected traffic volumes. For unplanned work or emergency work, the determination to reduce speed limits shall be based on the interest of the safety of workers and the traveling public, in which case Table 1 shall guide the reduction of speed limits.

In order to determine the appropriate speed limit, refer Procedural Directive 1502.2.

**Table 1: Recommended Minimum Work Zone Speed Limits**

| Existing Posted Speed Limit (mph) | Minimum Width Available to Traffic 1 (ft)[1] | Non-Active Work Zone Speed Limit 2 (mph)[2] | Active Work Zone Speed Limit 3 (mph)[3] | Approaching a Potential Full Stop Condition (mph) |
|---|---|---|---|---|
| 75 | 14 | 65 | 60-40 | 40 |
| 70 | 14 | 60 | 60-40 | 40 |
| 65 | 14 | 55 | 55-40 | 40 |
| 60 | 14 | 50 | 50-40 | 40 |
| 55 | 14 | 45 | 45-40 | 40 |
| 50 | 12 | 40 | 40 | 40 |
| 45 | 12 | 40 | 40 | 40 |

1. Travel lane width adjacent to the shoulder plus the shoulder width. Reduced speeds are not recommended where the width available to traffic exceeds these measurements.
2. See notes 1 and 7 in Section (IV)(B) in PD 1502.2. Must include an additional rationale for speed limit reduction for a nonactive work zone.
3. See notes 1 and 7 in Section (IV)(B) in PD 1502.2. The speed limit should be set at the maximum value practical within this range and must be justified by the extent of exposure/risk.

Also, the Chief Engineer has delegated authority to the Region Traffic Engineer and the Labor Trades & Crafts Operations (LTC Ops) I or higher to determine the appropriate reductions in speed limits. Refer to Procedural Directive 1502.2 “Temporary Reduction in Speed Limits” for more information.

## E. Roadway Geometry

The geometry of the roadway may affect the site distance for motorists, especially at entrance ramps. If the construction operation is on the outside curve of a road, the clear zone distance may be affected. Table 3.2 of the *RDG* provides adjustment factors for the clear zone. This data considers ADT, speed, and the roadway geometry. Restricted site distance issue and adjustments to the clear zone could both affect the decision to use positive protection.

## F. Duration

Duration is the length of time the hazard potentially requiring positive protection will be present. A designer must consider the exposure time associated with completing the operation versus the risk of installing the positive protection. In addition, the percent increase in duration must be considered when the installation of the barrier is included in the operation. If the duration to install the positive protection is longer than the construction operation itself, then positive protection may not be justified.

## SPECIAL FACTORS TO CONSIDER

### A. Worker's Safety

Where worker's exposure to traffic cannot be adequately managed through the application of an exposure control measure, positive protection should be considered. Consider positive protection in situations that place workers at increased risk from motorized traffic. Consideration must be given to an increase in worker's exposure during the installation and anchorage of positive protection.

### B. Pedestrian Safety

Positive protection should be considered if there is a high potential for vehicle intrusion into pedestrian paths. If the project increases the risk to pedestrians over existing conditions, positive protection should be considered.

### C. Separating Opposing Traffic

Positive separation should be considered in situations where multilane divided facilities are temporarily shifted to a 2-lane-2-way traffic pattern for periods lasting longer than three days. Conditions that may influence the decision to use positive protection would be high speed facilities, narrowed lanes, and high traffic volumes.

### D. Law Enforcement

Enforcement plays a unique and critical role in relation to work zones. The presence of law enforcement appropriately deployed in the vicinity of a construction project has proven effective in gaining compliance with posted speed limits to enhance work zone safety.

Beginning in 2006, to increase awareness and improve work zone safety, every summer from June through September, CDOT teamed up with the Colorado State Patrol (CSP) and other local agencies to conduct the "Slow for the Cone Zone" campaign (https://www.codot.gov/programs/cone-zone). The campaign entails providing overtime enforcement on highly-visible construction projects across Colorado.

The primary reasons to utilize law enforcement services in work zones are:

**Presence**

The presence of a marked police vehicle in a work area is an effective measure to capture the attention of passing motorists causing greater motorists alertness. The use of uniformed officers for presence should only be used when there is an added risk to the workers and road users due to speeding, other aggressive driver behaviors, and/or high traffic crash rates attributed to other features such as poor highway geometries.

Uniformed officers should be used for presence on high-speed facilities when workers are unprotected and in close proximity to high volume traffic for extended periods of time or where unique work zone conditions require a higher level of driver awareness to ensure safety. Facilities where the application may be appropriate include, but are not necessarily limited to:

- Interstate Facilities
- Roads with a posted speed of 45 mph or higher and an ADT volume of 15,000 vehicles per day (vpd) or greater.
- Mountain Passes

If all work is behind barrier officers are typically not necessarily. The use of police vehicles should be considered for nighttime operations in most instances as the use of flashing blue lights, visible 360 degrees, has been proven to deter aggressive driving behavior. However, the manner of their use during nighttime operations should be carefully considered as police vehicle lights provide no positive direction to motorists traveling through the work zone and are often overpowering and distractive. Excessive use of police vehicles with lights at night, or inappropriate positioning of these vehicles, may actually detract from the positive guidance the work zone traffic control devices (TDCs) provide. When used for night timework, flashing blue shall be dimmed if capable.

Though typically not necessary, uniformed officers may also be used for presence on roads with posted speeds of less than 45 mph or ADT volumes less than 15,000 vpd if CDOT determines that a police presence is needed to address a specific safety issue. Examples of traffic control safety issues where a uniformed officer may be needed include:

- A work zone with a high rate of crashes
- A work zone with vehicles traveling at excessive speeds
- A work zone with poor highway geometries
- A work zone with excessive east-west sun glare

Using the flashing blue lights from a police vehicle to slow traffic approaching a work zone with poor visibility (i.e. East-West sun glare) or poor sight distance due to geometric features should be considered only after other measures have been determined to be ineffective.

**Speed Enforcement**

Speed enforcement in designated work zones per Colorado Revised Statute (CRS) 42-4-614. Designation of highway maintenance, repair, or construction zones, is allowed by Colorado Revised Statutes. There are two options available for speed enforcement in CDOT work zones.

The following guidelines are recommended to reduce the likelihood of injuries and fatalities to workers and road users by enforcing traffic laws within work zones.

- Local agency or Colorado State Patrol
    - Police Enforcement may be used on an as needed basis within a work zone where another officer is being used for presence to improve that officer's effectiveness. Uniformed officers being used for presence should typically not be used for enforcement except for flagrant violations of traffic law.
    - In situations where uniformed law enforcement assistance may be needed to enforce specific traffic laws, affect driver behavior, help maintain appropriate speeds, improve driver alertness and help address other safety and mobility issues, funding and plans to support their participation should be identified and developed early in the planning process. Factors to be considered when determining the need for active law enforcement include:
        - Nighttime operations that create traffic safety risks for workers and road users.
        - Operations requiring a slow down or brief stoppage of traffic in one or both directions.

        - High-speed roadways where sudden traffic queuing is anticipated.
        - Traffic control setups or removals that present significant potential risks to workers and road users.
        - Other work site conditions where traffic presents a high risk for workers and road users (including but not limited to work in signalized intersections, ramp closures and auxiliary lane closures), such that the risk may be reduced by improving road user behavior and awareness.
    - If an arrest is necessary, the work-zone uniformed officer shall call in, and turn the arrest over to an on-duty officer.
- Automated Speed Enforcement
    - Per CRS 42-4-110.5 and speed enforcement program administrative rules, automated speed enforcement may be used in work zones (construction, repair, or maintenance zones) through one or more vendors and is coordinated by the Traffic Safety and Engineering Services Branch.

Both Speed Safety Cameras and police enforcement increase motorists' compliance with work zone regulations and discourages aggressive or careless driving.

Current Colorado statutes support increased fines for violating regulations in work zones and as of 2024 Automated Vehicle Identification Systems are also allowed by Colorado law (CRS 42-4-110.5).

Enforcement may be used during work zone operations where excessive speed and/or other aggressive driving behaviors are likely to jeopardize the safety of the workers and other road users.

**Traffic Crash Management**

Work zone officers can immediately respond to any incident, quickly restoring traffic flow and enhancing the safe operation of the work zone.

Emergency assistance while on site; work-zone uniformed officers may offer immediate assistance in emergency situations, such as a motor vehicle crash within the limits of the work-zone. The officer may investigate minor property damage crashes that occur within the work-zone if the time required to complete the investigation is minimal and the officer is not actively engaged in directing traffic. The officer should limit investigation of minor property damage crashes to assurance that no injuries are involved. Crashes involving injury should be investigated by the appropriate personnel once other emergency personnel arrive at the scene, not the officer.

During development of the project within the Residency, these guidelines should be used as a first step in identifying initial needs and an Operations Evaluation should be conducted. This will ensure consistency and conformity over all projects. These guidelines should also be used in the development of the contract documents. The Contract Administrator with the Resident Engineer should be involved in the development of the contract plans, Scope of Work (SOW), and Traffic Control Plan (TCP) narrative as much as possible, such that an appropriate cost for flaggers and uniformed officers is provided in the contract.

**Traffic Control/Operations**

A police officer commands respect and authority. Thus, his presence facilitates the safe and efficient movement of traffic through the work zone (e.g., detour/diversion situations).

Flaggers shall be used to the greatest extent possible for "dynamic" traffic control operations. However, the use of uniformed officers may be necessary in some instances. Examples of dynamic traffic control operations where flaggers should be used include:

- Alternating one-way traffic (stop/slow paddles must be used).
- Directing traffic through low volume and/or non-signalized intersections.
- Assisting trucks and equipment in and out of work areas.
- Providing coverage at side roads and driveways during mobile operations (i.e. paving, striping, etc.).
- Directing pedestrians and bicyclists through the work zone.
- Providing detour guidance beyond work zone limits.

Examples of dynamic traffic control operations where uniformed officers may be used include:

- Directing traffic through complex intersections, especially where signals are being overridden.
- Assisting construction vehicles and equipment in and out of work areas on high-speed, high-volume facilities. Note: If an access area is anticipated to be in place for an extended period of time and it is determined that assistance is required for the safe exit and entry of construction vehicles, then a cost analysis should be completed to determine if stationary measures (i.e. signals) would be more cost effective than officers or flaggers.
- Rolling roadblock operations on interstate and other multi-lane State Highways.
- If a uniformed officer is already on site for other needs (enforcement or presence), then the officer may be asked to supplement these duties by providing limited duration traffic control that would otherwise be covered by a flagger. However, the officer must be adequately trained for the flagger operation to be performed and must use appropriate equipment and techniques (which may include the use of stop/slow paddles).

Police presence/enforcement is a very effective measure of speed control in work zones. Studies have shown that average speeds in the work zone are reduced by 6 to 22 percent, and the percentage of vehicles traveling at excessive speeds through the work zone is reduced by 14 to 32 percent. The percentage of traffic merging in advance of a lane closure location is also increased. The effectiveness of police presence/enforcement is sustained over time, and this speed control measure is relatively easy to implement and remove. Police presence/enforcement with a stationary police cruiser with lights and active radar can be especially effective at night. Driver attention is higher and behavior more cautious when police are present. Increased police presence/enforcement in work zones also appears to significantly reduce the frequency of work zone crashes.

Deployment policies and procedures should always be reviewed and discussed with law enforcement prior to the deployment of law enforcement resources to ensure effective deployment and good communication to prevent or mitigate an incident. CDOT Work Zone Safety and Mobility Rule Procedure Document outlines the training requirements for law enforcement personnel who provide uniformed traffic control in CDOT work zones.

In situations where uniformed law enforcement assistance may be needed to enforce specific traffic laws, affect driver behavior, help maintain appropriate speeds, improve driver alertness and help address other safety and mobility issues, funding and plans to support their participation should be identified and developed early in the planning process. Factors to be considered when determining the need for active law enforcement include:

- Nighttime operations that create traffic safety risks for workers and road users.
- Operations requiring a slow down or brief stoppage of traffic in one or both directions.
- High-speed roadways where sudden traffic queuing is anticipated.
- Traffic control setups or removals that present significant potential risks to workers and road users.
- Frequent worker presence adjacent to high-speed traffic without positive protection devices.
- Other work site conditions where traffic presents a high risk for workers and road users (including but not limited to work in signalized intersections, ramp closures and auxiliary lane closures), such that the risk may be reduced by improving road user behavior and awareness.

Costs associated with non-routine work of uniformed law enforcement personnel to help protect workers and road users and to maintain safe and efficient travel through highway work zones are eligible for Federal-aid participation. CDOT's Contracts and Market Analysis unit maintains an interagency agreement with the Department of Public Safety, Colorado State Patrol, to provide uniform traffic control services at various construction zones throughout the state. Payment for law enforcement services will be included in a construction contract or via direct interagency payment.

The following methods are used to incorporate law enforcement on CDOT projects:

- *Residency Office Task Order:* Set up a standalone Task Order with the CSP for a residency office. Each Resident Engineer will need to calculate the projected number of hours needed for all projects.
- *Highway Corridor Task Order:* Set up a Task Order with CSP for a corridor. The residency will set up a task order with CSP for a corridor, such as for I-70 from Denver to Vail.
- *Engineering Program Task Order:* Set up a Task Order with CSP for an engineering program, such as North, South, East or West.
- *UTC Specification:* This involves including the Uniformed Traffic Control (UTC) specification in the plans. The Contractor will coordinate with local law enforcement to provide UTC on the project.

## SECONDARY FACTORS TO CONSIDER

While the primary factors listed above are generally the driving force in the decision to use positive protection, secondary factors should not be dismissed especially in situations where a clear decision is not evident. These secondary factors could change the decisions to place positive protection devices, but this decision should be discussed with the Region or a Headquarters traffic unit before a final determination is made.

The following are a list of secondary factors that may influence the decision to use positive protection:

- **Crash History**: Crash history of the area prior to construction and lessons learned from the crash history of previous work zone projects may be helpful in determining the need for positive protection. The Headquarters Traffic Safety and Engineering Branch is a good resource to help identify any potential areas of concern.
- **Impacts on Project Cost and Duration:** Positive protection will have an impact on the overall project duration and cost.
- **Impacts on Available Lane Widths**: Restricted lane widths due to the use of positive protection may affect mobility for road users and the contractor. Consideration must be given to wide loads and equipment requirements to complete the work.
- **Roadway Classification**: Roadway classification is indicative of the characteristics of the road. Characteristics that may have an effect on the decision to use positive protection may include, speed, access, rural vs. urban, etc.
- **Work Area Restrictions**: Access to and from the work area for the delivery of materials and the constructability issues due to equipment operations should be considered.
- **Bridge Construction**: Positive protection could affect the weight posting of the bridge for overweight vehicles. In addition, the ability to anchor positive protection to an existing bridge may be limited.

## VII. Positive Protection Devices

### Mobile Barrier Trailers

Mobile barrier trailers may be considered for short-term stationary work where high speeds are a concern.

### Temporary Concrete Barrier

Temporary concrete barrier should be considered for the following conditions:

- Long-term stationary work on state highways with high speeds and that provides no escape for workers.
- To shield a drop off depending on the ADT and duration/exposure time of the drop off condition.
- Distance between opposing traffic has been reduced.
- Work zones located between travel lanes and the drop-off.
- Work zones with no buffer zone between the workers and the traffic.
- Unfinished decks that remain overnight.

A temporary concrete barrier should be installed with a four (4) foot minimum distance from the centerline of the precast type 7 concrete barrier to any obstruction or drop off. Temporary concrete barriers should typically be installed two (2) feet from the traveled lane. For temporary installations with less than a four (4) foot minimum distance, stabilization pins shall be used on each precast type 7 concrete barrier unit adjacent to and within ten (10) feet of both sides of the obstruction. Details on M-Standard M-606-14 include the pinning requirements for temporary conditions.

If, due to field conditions, pinning is not fully compliant then the reasons and locations where pinning is not fully achieved shall be documented by the Engineer.

The final determination to use a temporary concrete barrier shall be made by the Engineer.

### Temporary Steel Barriers

Steel barriers may be considered for short-term stationary work where high speeds are a concern. Where drop offs are present or the temporary steel barrier is close to active work the Engineer shall ensure that the deflection of the steel barrier per manufacturer's recommendation is taken into account for placement.

### Temporary Water Filled Barrier

Temporary water filled barriers may be used for emergency, intermediate or short-term stationary work. Temporary water filled barriers are easy to transport and move around while empty. Once filled they become stable and secure for use. These barriers absorb impact instead of staying rigid which may reduce the damage to vehicles and lower the risk of serious injuries.

### Truck Mounted Attenuator (TMA)

TMAs are best suited for mobile work, intermediate-term stationary work and short-term stationary work as it is easily moved and positioned. TMAs provide protection from intrusion over a relatively short work area and therefore are generally not suitable for lengthy work areas. Buffer space between TMA and a work vehicle can be found in CDOT Standard Plan S-630-1 "Traffic Controls for Highway Construction.

## VIII. Conclusion

There are great benefits to using positive protection in appropriate situations. Positive protection techniques, when properly implemented, can help improve safety for workers and the motoring public. However, careful evaluation needs to be exercised before installing positive protection devices. The decision to use positive protection should be based on the best overall management of safety, mobility, constructability, cost, and overall project duration. These guidelines are meant to be coupled with engineering judgment in determining the use of positive protection.

## ADDITIONAL REFERENCES

Processes/procedures for considering road user and worker safety that specifically address the following:

**A. Policy and Procedures for Work Zone Safety**

1. Policy Directive 1502.1
2. Procedural Directive 1502.2
3. CDOT Work Zone Safety and Mobility Rule Procedures Document (https://www.codot.gov/safety/traffic-safety/assets/work-zones/safety-mobility-program/work-zone-safety-and-mobility-rule-procedures-document-2014.pdf)

**B. Positive Protection Devices**

1. CDOT Standard Plans S-630-1 “Traffic Controls for Highway Construction” and S-630-2 “Barricades, Drums, Concrete Barriers (Temp) and Vertical Panels” (https://www.codot.gov/safety/traffic-safety/design/s-standards)

**C. Exposure Control Measures**

1. Lane Closure Strategies (https://www.codot.gov/safety/traffic-safety/design/work-zone-safety)
2. Construction Traffic Control Documentation Pre-Con Meeting (https://www.codot.gov/safety/traffic-safety/assets/work-zones/safety-mobility-program/tcm-tcp-mht-1-pager_final-accessible.pdf)
3. ATSSA Work Zone Positive Protection Toolbox (https://www.codot.gov/safety/traffic-safety/assets/documents/Work_Zone_Positive_Protection_Toolbox.pdf)
4. ATSSA Temporary Traffic Control Guide
5. ATSSA Field Guide on Installation and Removal of Temporary Traffic Control for Safe Maintenance and Work Zone Operations (https://workzonesafety-media.s3.amazonaws.com/workzonesafety/files/documents/training/fhwa_wz_grant/atssa_pocket_guide_traffic_control.pdf)
6. ATSSA Field Guide for the use and Placement of Shadow Vehicles of Shadow Vehicles in Work Zones (https://workzonesafety-media.s3.amazonaws.com/workzonesafety/files/documents/training/fhwa_wz_grant/shad_veh_final.pdf)

**D. Other Traffic Control Measures**

1. CDOT Roadway Design Guide (https://www.codot.gov/business/designsupport/bulletins_manuals/2023-cdot-roadway-design-guide)
2. CDOT Standard Plan M-614-1 “Rumble Strips” (https://www.codot.gov/business/designsupport/mstandards)
3. Automated Speed Enforcement (https://www.codot.gov/programs/speedenforcement)

**E. Uniformed Law Enforcement;**

1. CDOT Methods to Incorporate Law Enforcement on Construction/Maintenance Projects
    a. Task Order (at Residency Office, Highway Corridor, or Engineering Program level)
2. Project Special Provision Worksheet: Revision of Section 630 - Uniformed Traffic Control (Local Agency) (https://www.codot.gov/business/designsupport/cdot-construction-specifications/2025-construction-specifications/project-special-provision-work-sheets?b_start:int=60)
3. Project Special Provision Worksheet: Revision of Section 630 - Uniformed Traffic Control Coordination (Colorado State Patrol) (https://www.codot.gov/business/designsupport/cdot-construction-specifications/2025-construction-specifications/project-special-provision-work-sheets?b_start:int=60)
4. ATSSA Safe and Effective Use of Law Enforcement Personnel in Highway Work Zones – Pocket Guide (https://workzonesafety-media.s3.amazonaws.com/workzonesafety/files/documents/training/fhwa_wz_grant/atssa_lec_pocket_guide.pdf)

**F. Maintenance of Temporary Traffic Control Devices;**

1. CDOT Employs ATSSA's Quality Standards for Work Zone Traffic Control Devices
2. Other Agencies' Quality Standards for Work Zone Traffic Control
    a. Illinois Tollway Quality Standard for Work Zone Traffic Control Devices (https://agency.illinoistollway.com/documents/20184/111199/Tollway_Quality+Standard+for+Work+Zone+Traffic+Control+Devices_06232014.pdf/e88dbcec-504d-4635-8bbc-ed616d55d577?version=1.0)
    b. MODOT Quality Standards for Temporary Traffic Control Devices (https://epg.modot.org/index.php?title=616.19_Quality_Standards_for_Temporary_Traffic_Control_Devices)
    c. ODOT Quality Standards for Temporary Traffic Control Devices (https://www.transportation.ohio.gov/working/engineering/roadway/manuals-standards/quality-standards-ttcds)

## REFERENCES/RESOURCES

American Association of State Highway and Transportation Officials Roadside Design Guide.

Ivey, Don L., King K. Mak, Harold D. Cooner, and Mark A. Marek. “Safety in Construction Zones Where Pavement Edges and Drop-Offs Exist.” Transportation Research Record 1163, 1988, pp. 43-62.

Center for Transportation Research and Education, Department of Civil and Construction Engineering, Iowa State University, “Traffic Control Strategies in Work Zones with Edge Drop-Offs”, August 2002 p. 76.

Federal Highway Administration (2023). Manual on Uniform Traffic Control Devices (MUTCD). U.S. Department of Transportation, Washington, D.C.

Bryden, James and Mace, Douglas (2002). Guidelines for Design and Operation of Nighttime Traffic *Control for Highway Maintenance and Construction,* National Cooperative Highway Research Program Report NCHRP-476, Transportation Research Board of the National Academies, Washington, D.C.

# Appendix A

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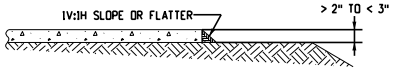
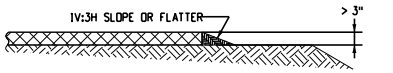
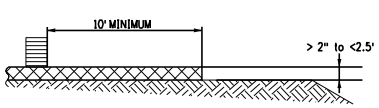
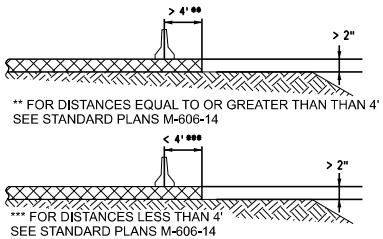
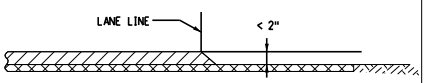
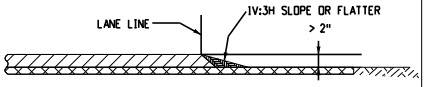
## Typical Criteria for Consideration of Temporary Traffic Barriers (from other State DOTs)

| State | Criteria |
|---|---|
| Iowa | Drop-off depth > 10 inches, located within 10 feet of travel way (informal) |
| California | Drop-off depth > 6 inches, located within 8 feet of travel way; special engineering consideration for all drop-offs > 2.5 feet |
| Florida | Drop-off depth > 3 inches, located within 12 feet, project duration > 1 day |
| Minnesota | Optional for drop-off depth > 4 inches, if no wedge, located adjacent to travel way, speed > 30 mph, project duration > 3 days, length < 50 feet; if 12 inches, recommended |
| Missouri | Alternative for use with lane closures when drop-off depth > 2 inches |
| Montana | Drop-off located within 30 feet of travel way, if no wedge provided, exposures exceeding 48 hours, spacing factor < 20 feet by formula) |
| North Dakota | Drop-off depth > 5 inches located between travel lanes, drop-offs depth > 12 inches, located adjacent to travel way, speed limit> 30 mph, project duration > 7 days, project length > 50 feet. |
| Ohio | Drop-off depth > 5 inches located between travel lanes, drop-off depth > 2 feet located within 30 feet of travel way, overnight exposure |
| West Virginia | Drop-off depth > 3 inches, project duration > 48 hours, speed limit > 45 mph, located within 30 feet of travel way on multilane highways, located within 20 feet of travel way on undivided highways |

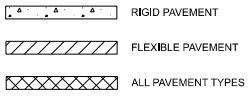
## Additional Edge Treatment Guidance

| | CROSS SECTION | CONDITION | | TREATMENT | SIGN | |
|---|---|---|---|---|---|---|
| | | DIFFERENTIAL | TIME | | MAINLINE | SIDE STREET |
| EDGE DROP-OFF |  | PAVEMENT EDGE DIFFERENTIAL > 2" TO < 3" | NON-WORKING HOURS | WEDGE SLOPE TO 1V:1H OR FLATTER |  | NO SIGNS REQUIRED |
| | | | WORKING HOURS | NO EDGE TREATMENT REQUIRED | | |
| |  | PAVEMENT EDGE DIFFERENTIAL > 2" TO < 3" | NON-WORKING HOURS | WEDGE SLOPE TO 1V:1H OR FLATTER |  | NO SIGNS REQUIRED |
| | | | WORKING HOURS | NO EDGE TREATMENT REQUIRED | | |
| |  | PAVEMENT EDGE DIFFERENTIAL > 3" | NON-WORKING HOURS | WEDGE SLOPE TO 1V:3H OR FLATTER |  |  <br>W8-1 |
| | | | WORKING HOURS | DELINEATE DIFFERENTIAL WITH CHANNELIZERS | | |
| |  | ANY PAVEMENT EDGE OR LANE LINE DIFFERENTIAL | NON-WORKING AND WORKING HOURS WHERE PLANS REQUIRE ADJACENT LANE CLOSURE WITH CHANNELIZATION OR PARTIAL LANE CLOSURE WITH BARRIER | NO EDGE TREATMENT REQUIRED |  | NO SIGNS REQUIRED |
| |  | ANY PAVEMENT EDGE OR LANE LINE DIFFERENTIAL | NON-WORKING AND WORKING HOURS WHERE PLANS REQUIRE ADJACENT LANE CLOSURE WITH CHANNELIZATION OR PARTIAL LANE CLOSURE WITH BARRIER | NO EDGE TREATMENT REQUIRED | NO SIGNS REQUIRED | NO SIGNS REQUIRED |
| LANE DIFFERENTIAL |  | LANE LINE DIFFERENTIAL < 2" | NON-WORKING AND WORKING HOURS | NO EDGE TREATMENT REQUIRED |  <br>W8-11 | NO SIGNS REQUIRED |
| |  | LANE LINE DIFFERENTIAL > 2" | NON-WORKING AND WORKING HOURS WHERE LANES OPEN TO TRAFFIC | WEDGE SLOPE TO 1V:3H OR FLATTER |  <br>W8-11 |  <br>W8-1 |
| | | | NON-WORKING AND WORKING HOURS WHERE LANE CLOSED TO TRAFFIC | DELINEATE DIFFERENTIAL WITH CHANNELIZERS | | |

### GENERAL NOTES

1. SIGNS SHALL BE VISIBLE TO TRAFFIC ONLY WHEN AND WHERE THE CONDITIONS EXIST.
2. SIGNS SHALL BE SPACED AT APPROXIMATELY ONE MILE INTERVALS AND LOCATED WITHIN 150 FEET BEYOND ANY INTERSECTION WITH A STATE HIGHWAY. WHEN A SIGN PLACED AT THE ONE MILE INTERVAL FALLS WITHIN 1/2 MILE OF A SIGN PLACED AFTER AN INTERSECTION, THE SIGN PLACED AT THE 1/2 INTERVAL MAY BE OMITTED. WHEN SHOULDER DROP-OFF SIGNS WITH UNEVEN LANES ARE BOTH SPECIFIED, ALTERNATING SIGN MESSAGES SHALL BE USED AT 1 MILE SPACINGS.
3. ON SIDE ROADS WITH POSTED SPEED OF 45 MPH OR GREATER, SIGNS SHALL BE PLACED 150 FEET IN ADVANCE OF INTERSECTION WITH MAINLINE.
4. SIGNS SHALL BE LOCATED ON THE SIDE OF THE ROADWAY WHERE THE PAVEMETN EDGE DIFFERENTIAL EXISTS.
5. SIGNS SHALL REMAIN VISIBLE UNTIL SHOULDER SHAPING IS COMPLETE.
6. SIGNS SHALL BE LOCATED ON RIGHT SIDE OF NON-DIVIDED HIGHWWAYS AND ON BOTH SIDES OF DIVIDED HIGHWAYS WHERE A LANE LINE DIFFERENTIAL EXISTS.
7. WHEN THE SHOULD DROP-OFF SIGNS ARE IN PLACE FOR GREATER THAN THREE DAYS, THE SHOULD DROP-OFF PLAQUE SHOULD BE USED IN ADDITION WITH THE SHOULDER DROP-OFF SIGN.
8. FOR ADDITIONAL SIGN SPACING AND DETAILS SEE STANDARD PLAN S-630-1.

### LEGEND



# Appendix B

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Colorado Department of Transportation

# Positive Protection Engineering Study Summary

## Project Information

Project Name: _____ Project Number: _____

Highway Name: _____ Begin Mile Point: _____ End Mile Point: _____

Project Engineer: _____

Report prepared by: _____

## Work Zone Information[1]

Project Duration: _____

Work Zone Speed Limit: _____

Traffic Volume (AADT): _____

Work Hours: _____

Buffer between work zone and live lane: _____

Maximum drop off: _____

Escape route for workers present: ◯ Yes ◯ No

Lis of present hazards in the clear zone:

## Positive Protection Summary

Will positive protection be used?

◯ Yes ◯ No

If so, please list all the positive protection measures that will be in place:

If no positive protection will be used briefly summarize reasoning:

1 Select a typical representative work zone from the project and answer the questions based on that.

Note: The engineering study should be attached to the Positive Protection Engineering Study Summary as Exhibit 1.


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