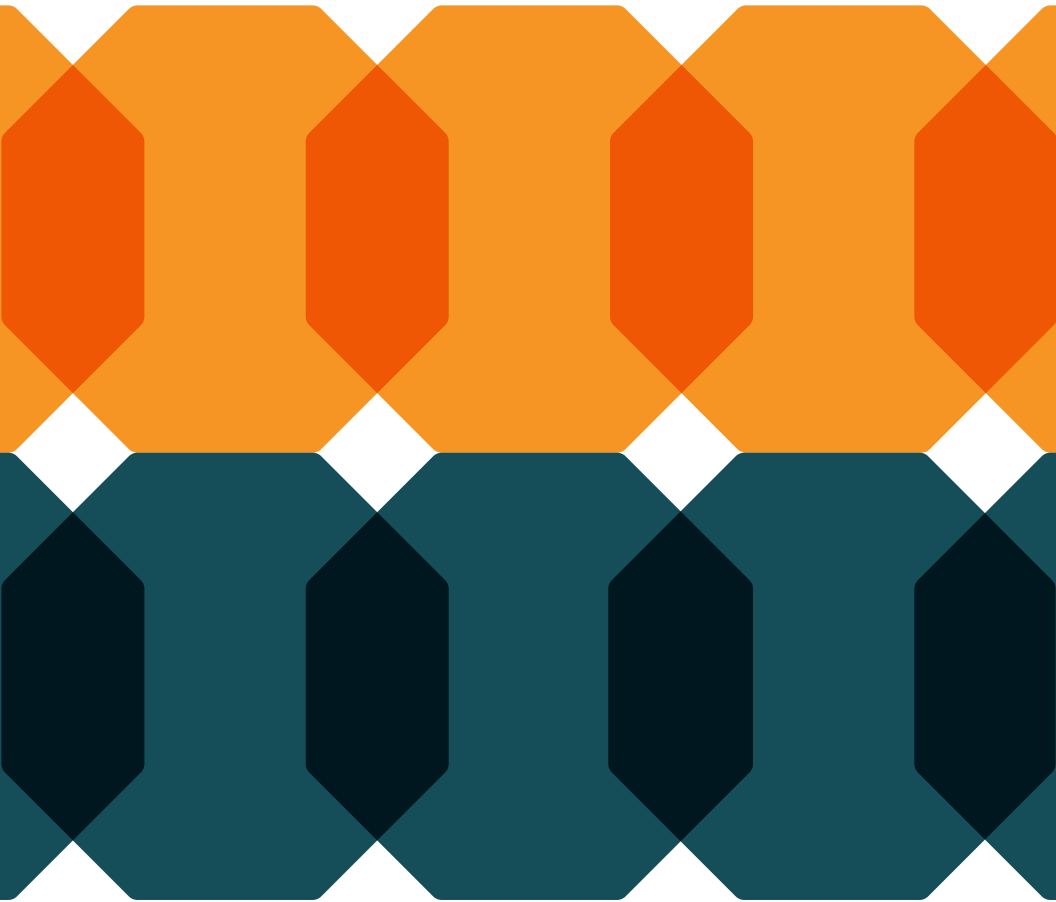


**MUTCD Compliant**  
**Traffic Control**  
**Flagger Certification**



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# MUTCD 11th Edition Compliant Traffic Control Flagger Certification



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# Introduction

## What is a flagger?

Flaggers are the people in a work zone who hold the STOP/SLOW paddles and direct drivers around the work taking place. The most important goal in a work zone is to stay safe while getting work done as efficiently as possible, but work zones are among the most dangerous places to drive due to hazards and other distractions. Flaggers are responsible for the safety of road users, workers, and themselves.

**Many states have instituted double fines in work zones because they are very dangerous for both drivers and workers.**

**Hazards include:**

- Work vehicles suddenly entering or exiting the lane of traffic.
- Workers who may step into the lane of traffic.
- Heavy equipment that may encroach into the lane of traffic.
- Narrow lanes.
- Reduced speeds or unexpected wait times.
- Rough or bumpy road surfaces, or abrupt drops in the road.
- Other drivers who might be confused, distracted, frustrated, or aggressive.
- Flaggers themselves, who are extremely vulnerable to traffic.

It is drivers and passengers—not the workers—who are most likely to be injured in a work zone.



## What you'll learn in this course

This training course covers the basic skills and knowledge required of flaggers. This includes explanations of federal codes that govern work zone processes and procedures, how work zones are set up and operate, equipment to be used, and the flagger's responsibilities within the work zone.

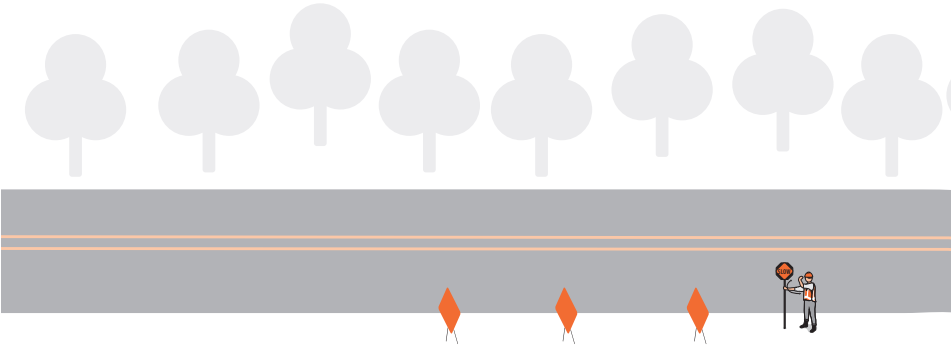
### Topics to be covered include:

- The requirements for becoming a flagger
- The agencies and regulations that govern flagging
- The clothing and equipment that you'll need to have on the job
- What goes into setting up a Temporary Traffic Control (TTC) zone, including warning devices, spacing, and where a flagger fits in
- Flagger placement and how to signal using a STOP/SLOW paddle, flashlight, or red flag
- How to keep yourself and others safe in the work zone
- Special situations such as flagging at intersections, roundabouts, and railroad crossings

After completing this course, you'll need to pass a written exam with a minimum score of 80% in order to earn your certification. Upon successful completion of the exam, you will receive an official wallet-size certification card. The card must be carried on your person when you're performing flagging duties.

The flagger certification is valid for 3 years. You must attend another flagger certification course in order to renew your certification.

This flagger course is based on the MUTCD (Manual on Uniform Traffic Control Devices, 11th Edition) and accepted best practices in the industry. It is your responsibility to know the specific rules in the state(s) and local jurisdictions where you will be working.

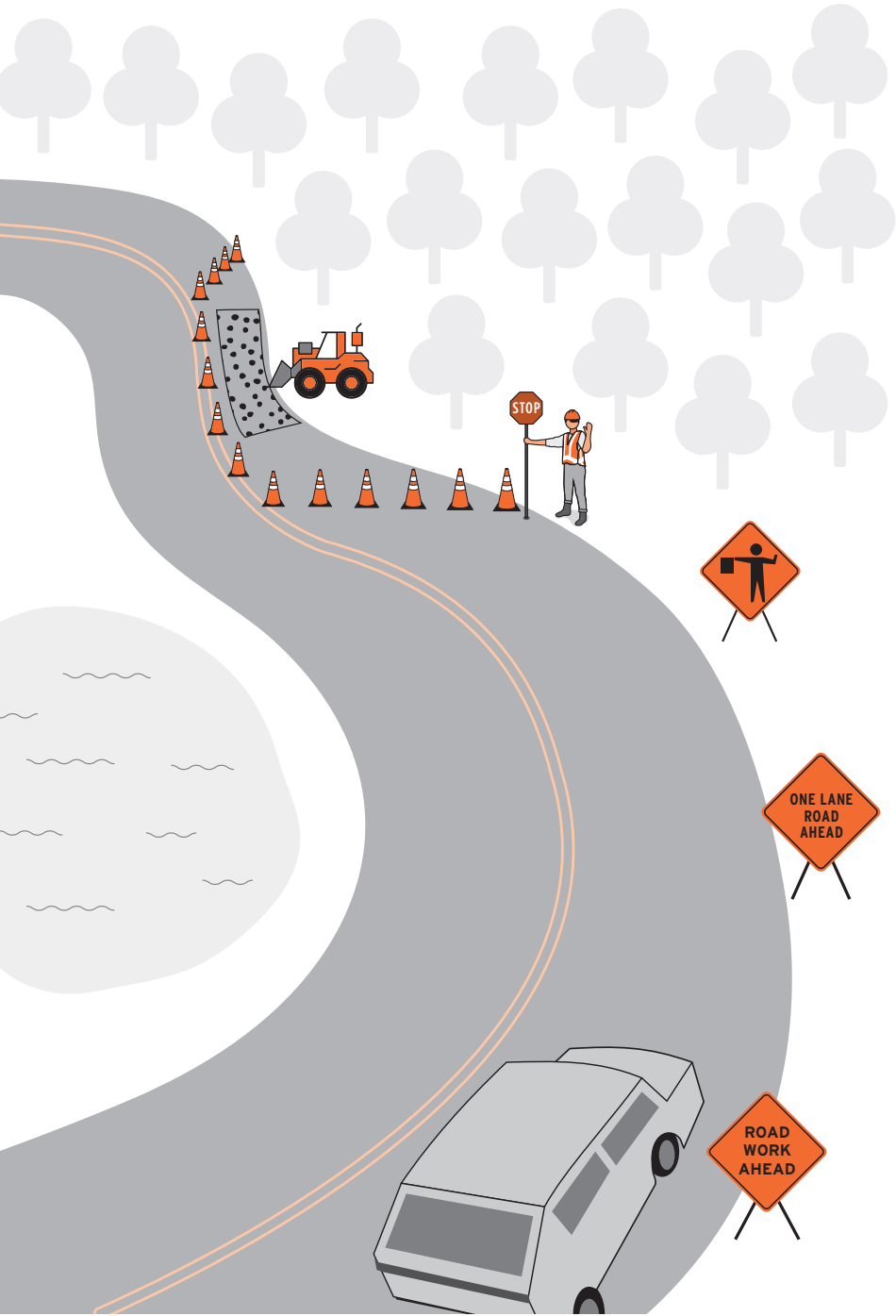


## The importance of a flagger

Flaggers are one of the most important factors in keeping everybody in the work zone safe. From helping to set up the work zone to operating the STOP/SLOW paddle and directing traffic, your job is to protect yourself, road users, and other workers. You may be on your feet for hours at a time, often without relief in extreme weather conditions. You may become bored or fatigued. However, you must be able to perform your job effectively, even under adverse conditions.

The rest of this course will help you understand how to do all of these things properly and safely.





## CHAPTER 1

# **Agencies and regulations that govern flagging**

In this chapter, you'll learn about the guidelines established by federal, state, and other governing bodies that govern flagging operations. It is your responsibility to be familiar with the rules and regulations set forth by the agencies that govern the locations where you work. If you're unsure, check with your employer about what rules apply.

## Federal guidelines

### THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD)

Published by the Federal Highway Administration, the Manual on Uniform Traffic Control Devices (MUTCD) establishes national standards for the installation and maintenance of traffic control devices. It sets national standards for all traffic control devices used on streets, roads, and highways open to public traffic, including private roads and bikeways.

Flagger responsibilities are covered in Part 6D of the MUTCD.

#### Levels of compliance:

STANDARD	"Shall" Conditions	required—mandatory
GUIDE	"Should" Conditions	highly recommended
OPTION	"May" Conditions	optional

## State guidelines

Individual states may establish traffic control guidelines that exceed those established by the MUTCD. They may do this by modifying the MUTCD (as long as the modifications are as or more restrictive than those already included) or by establishing their own state-specific standards.

## Other jurisdictions

Flaggers and others working in the roadway need to be aware that cities and counties may choose to adopt and/or modify these standards. Always check with the road owner on all projects.

## **Guidelines for clothing and equipment**

There are two types of additional standards that government agencies rely on when creating regulations for flaggers.

### **AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

The American National Standards Institute (ANSI) sets the standard for personal protective equipment (PPE) and other items worn and used in the workplace. You will commonly see the ANSI acronym on the labels of safety garments and other gear.

### **MANUAL FOR ASSESSING SAFETY HARDWARE (MASH)**

The Manual for Assessing Safety Hardware, 2016, a publication of the American Association of State Highway and Transportation Officials (AASHTO), is the new standard for crash testing of permanent and temporary highway safety features. It also recommends evaluation criteria to assess test results. Items purchased for work performed in work zones must meet this new standard. MASH 2016 standards replace those previously published by the National Cooperative Highway Research Program in NCHRP Report 350.

## **Physical requirements and skills**

### **AS A FLAGGER, YOU WILL NEED TO:**

- ☐ Be at least 18 years of age.

### **Receive and communicate specific instructions clearly, firmly, and courteously.**

- ☐ Be able to see, hear, and comprehend information and instructions that are presented verbally or in writing.
- ☐ Be able to communicate effectively with others and take positive appropriate action when needed.

### **Understand and apply safe traffic control practices, sometimes in stressful or emergency situations.**

- ☐ Be able to control signaling devices (such as a STOP/SLOW paddle) and physical motions to provide clear and positive guidance to drivers in frequently changing situations.

- ☐ Be able to recognize dangerous traffic situations and warn workers in sufficient time to avoid injury.

**Move and maneuver quickly, stand for long periods, and perform other physical tasks.**

- ☐ Be able to see and hear warnings and hazards.
- ☐ Be able to move quickly in order to avoid danger.
- ☐ Be able to stand for prolonged periods on uneven surfaces (up to 10 hours).
- ☐ Be able to move around on uneven surfaces and terrain; stoop, kneel, crouch, grasp, push, pull; and occasionally lift or move up to 40 pounds.
- ☐ Be able to handle exposure to vibrations; working near moving mechanical parts; extreme cold, wet, or humid outdoor weather conditions; and fumes or airborne particles.
- ☐ Be able to work in an environment with high noise levels.

**Work hours**

- ☐ Be able to work during irregular hours, under on-call status, and/or shift times.

*(Many of these requirements are listed in MUTCD 6D.01.)*

## **Recommended clothing for flaggers**

Proper flagger apparel helps you stand out so motorists and others in the work zone recognize you. Federal guidelines require that you wear certain types of apparel while doing this job.

The American National Standards Institute (ANSI) created the ANSI class system to provide guidelines for high visibility safety apparel worn on the job. As a flagger, your clothing must comply with ANSI Class 2 or 3 specifications, and garments that meet the higher Class 3 specifications are recommended. If you aren't sure if your garment complies with the minimum ANSI Class 2 or 3 specifications, check the tag—it will state both ANSI class and level ratings.

High visibility safety apparel (HVSA) refers to garments worn by workers that provide enhanced visibility in all light conditions. This is achieved through the use of fluorescent and retroreflective materials.

Fluorescent colors absorb invisible ultraviolet light waves and reflect them, making them appear to “glow,” but they are not visible in the dark. Approved fluorescent colors for use in work zones include fluorescent yellow-green, fluorescent orange-red, or fluorescent red. “Retroreflective” refers to a type of material designed to reflect light directly back toward its source, making it more readily visible, even in dark conditions.

*High-visibility garments shall be labeled as, and in a condition compliant with the ANSI/ISEA 107 (2015 or later version) and shall be used in accordance with manufacturer recommendation.*

*(MUTCD 6C.05)*

### **Recommended clothing during daylight hours (with clear visibility):**

- ANSI/ISEA 107 Class 2 or 3 vest or jacket. Approved colors are:
  - fluorescent yellow-green
  - fluorescent orange-red
  - fluorescent red
- High visibility hard hat that is white, yellow, yellow-green, orange, or red.

### **Recommended clothing during hours of darkness (or low-visibility):**

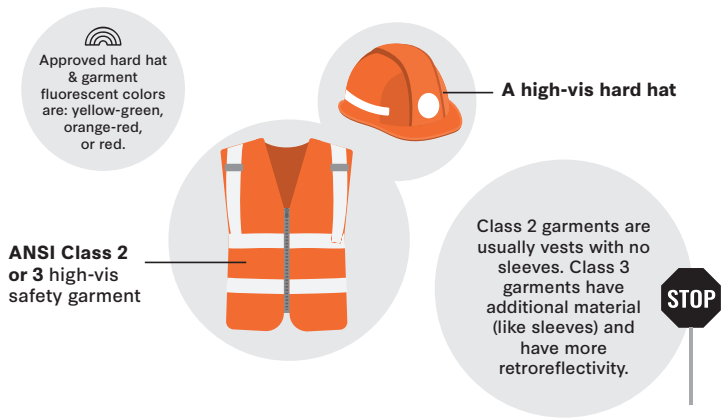
Flaggers must wear a high-visibility ensemble which includes:

- ANSI/ISEA 107 Class 3 vest or jacket in approved color (see above)
- ANSI/ISEA 107 Class E lower garment
- High visibility hard hat (as described above) with 12 square inches of retroreflective material placed to provide 360 degrees of visibility.

Most states define hours of darkness as ½ hour before sunset to ½ hour after sunrise, or during other low-visibility conditions such as snow, fog, or heavy rain.

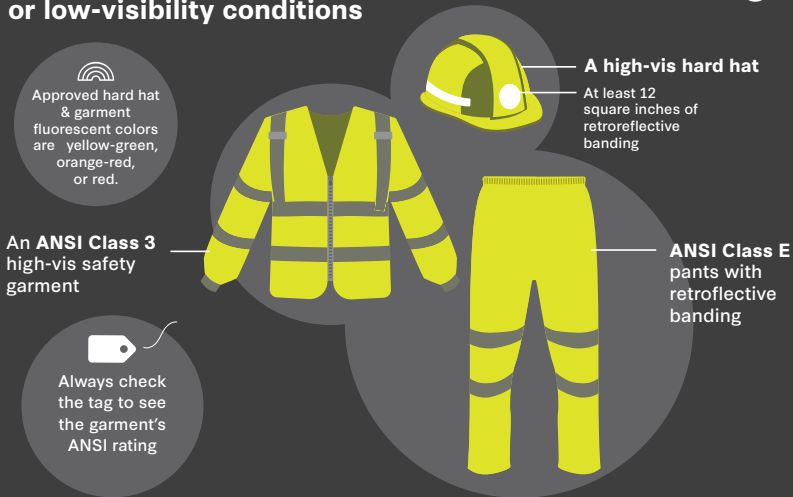


## During daylight hours



Flagger garment requirements

## During hours of darkness or low-visibility conditions



Flagger garment requirements

Some jurisdictions may have different requirements for flagger clothing. Always be sure to check with your supervisor about what rules apply to you.

**CAUTION:**

**During hours of darkness, or when visibility is limited by weather, you aren't as visible to motorists and your fellow workers. This means that in order to be recognized as a flagger, you should wear pants, coveralls, or rain gear in a highly visible color, with additional retroreflective banding on the legs, that meet ANSI Class E specifications.**

It is recommended you own garments in more than one approved color to allow for changes in environment or other conditions. For instance, in the spring, fluorescent orange will stand out more than fluorescent yellow-green.

### **Rain gear**

If you work in wet or snowy conditions that necessitate rain- or cold-weather gear, that gear must meet the requirements for visibility as previously mentioned.

### **Other personal attire you should wear in the work zone**

- Sturdy work boots
- Shirt with sleeves
- Long pants for all weather conditions

Choose sturdy, well-constructed items that will provide adequate protection from sun, wind, rain, flying rock, hot surfaces, and other elements you may be exposed to while working outside. Your shirt may have long or short sleeves, but styles such as tank tops, muscle shirts, or shirts with cut-off sleeves are not acceptable because they provide too little protection.

Find out if there is a dress code for your worksite. Your employer may require you to wear specific colors or styles, or high-vis garments that go above and beyond the minimum ANSI class standards.

**CAUTION:**

**Clothing that restricts your peripheral vision, such as a hood on a sweatshirt, should never be worn under a hard hat.**

**REQUIRED EQUIPMENT**

All of the equipment you use on the job must be MUTCD-compliant.

**STOP/SLOW paddle**

As a flagger, the STOP/SLOW paddle is your most important piece of equipment. Always make sure your paddle is clean and legible.

*Per the MUTCD,*

- The STOP/SLOW paddle is the primary and preferred hand-signaling device because it gives road users more positive guidance than red flags.
- The STOP/SLOW paddle shall have an octagonal shape on a rigid handle.
- STOP/SLOW paddles shall be at least 18 inches wide with letters at least 6 inches high.
- The STOP (R1-1) face shall have white letters and a white border on a red background.
- The SLOW (W20-8) face shall have black letters and a black border on an orange background.

*(MUTCD 6D.02)*

The optimum method of displaying a STOP or SLOW message is to place the STOP/SLOW paddle on a rigid staff that is tall enough that when the end of the staff is resting on the ground, the message is high enough to be seen by approaching or stopped traffic (per MUTCD 6D.02). The recommended staff height is between 6 and 7 feet.

A larger, 24-inch paddle is recommended for use during hours of darkness and/or on high speed roadways.

*All paddles used at night shall be retroreflective or illuminated.*

*(MUTCD 6D.02)*

### **Other required equipment for nighttime flagging**

If you will be flagging during hours of darkness, you should also have:

- A flashlight with an 8-inch wand
- Extra batteries (for both flashlight and two-way radios)
- Gloves (retroreflective)

You should prepare an equipment bag for your safety and comfort. Some basic supplies are:

- ☐ Food and drinking water (1 quart per hour)
- ☐ Whistle or small air horn
- ☐ Rain gear (white, yellow, or orange)
- ☐ Extra jacket
- ☐ Gloves
- ☐ Extra socks (wool)
- ☐ Safety glasses and/or goggles
- ☐ First-aid kit
- ☐ Sunscreen
- ☐ Pencil and notepad for record keeping

### **Equipment that should not be used by an active flagger**

Flaggers should not use devices that may distract their vision, hearing, or attention. Examples of these devices include cell phones and headphones or earbuds.

Devices such as two-way radios used for communications between flaggers to direct traffic or ensure flagger safety are acceptable.

## KEY POINTS TO REMEMBER

- ◆ You must keep your flagger card with you when you are on duty.
- ◆ Hours of darkness are defined as \_\_\_\_\_ hour before sunset to \_\_\_\_\_ hour after sunrise.
- ◆ All of the equipment you use on the job must be MUTCD-compliant.
- ◆ When flagging at night, flaggers should wear a high-visibility ensemble. This includes an ANSI Class 3 vest, hard hat in an approved color and a lower garment that meets ANSI Class \_\_\_\_\_.

CHAPTER 2

# Traffic control devices

**T**raffic control devices such as signs and channelizing devices help to safely guide road users around the work zone or road closure.

This chapter will help familiarize you with the different types of signs and devices used in Temporary Traffic Control (TTC) zones. Proper setup and spacing for these devices will be discussed in later chapters.

Any traffic control device that is used in the work zone must be in acceptable or marginal condition. The American Traffic Safety Services Association publishes a manual that outlines condition guidelines and provides visual references.

## Signs

Part of your flagging responsibilities may include setting up signs within the work zone. Signs, including those used in road construction and maintenance zones, fall into three categories: regulatory, warning, and guide. Most states follow the sign guidelines set forth in the MUTCD.

- **Regulatory** signs enforce legal requirements.
- **Warning** signs alert drivers to specific hazards.
- **Guide** signs provide information for motorists.

### REGULATORY SIGNS

Regulatory signs inform road users of official traffic laws or regulations, and they are authorized (and usually enforced) by the jurisdiction in charge of that roadway. (The handheld STOP paddles used by flaggers do not require official authorization.)



Regulatory signs are generally rectangular, with a black legend and border on a white background. Exceptions include the STOP sign, the YIELD sign, the DO NOT ENTER sign, and the WRONG WAY sign, which are on a red background with white letters and white border.

## WARNING SIGNS

Warning signs are the most important type for you to understand as a flagger. You may be responsible for knowing which of these signs to place in certain locations in the work zone.

Warning signs are used to alert drivers to specific hazards they may encounter while a road construction or maintenance project is underway. Later in this course, you'll learn what goes into determining the types of signs used and where they should be placed.

### Warning signs should be:

- 36 × 36 inches for city streets and county roads.
- 48 × 48 inches on high speed roads (45 mph or higher).
- Designed to yield on impact (minimum NCHRP 350 or MASH 2016-compliant, which is preferred).
- Supplemented by flags/lights when possible, for added emphasis.
- Placed along all entrances to the roadway, which are located past the initial warning sign.

Note: certain jurisdictions may have different low and high speed recommendations.



Construction and maintenance warning signs are usually diamond-shaped, with black letters and a black border on an orange background.



## Mounting guidelines for temporary warning signs



Temporary warning signs may be mounted on portable supports which are designed to yield on impact.

The bottom of the portable sign must be at least one foot above the traveled roadway.

When ballasting a sign, you should first follow the manufacturer's recommendations, then check with the road owner to see if there are any additional rules for ballasting a warning sign in a TTC zone.

### GUIDE SIGNS

Guide signs give motorists information. Typically these include green street signs, blue informational signs, and brown recreational signs.

However, during road construction and maintenance projects, guide signs are used to inform motorists of upcoming route changes, guide them through detours, and give them specific information regarding the work being performed. Guide signs do not replace advance warning signs; they are used in addition to the warning signs.



When used in construction and maintenance activities, these guide signs are usually rectangular with black letters on an orange background.

## ADDITIONAL SIGNS

### Advisory Speed plaque



When used in conjunction with a warning sign, an Advisory Speed plaque may be used to notify motorists of the recommended speed in the TTC zone.

### Road Work Ahead or Utility Work Ahead



A UTILITY WORK AHEAD sign may replace the ROAD WORK AHEAD sign when utility work takes place on or adjacent to a road or highway. (MUTCD 6H.24)

### Workers symbol



A Workers symbol sign may be used to alert road users of workers in or near the roadway when other warning devices are not present. The WORKERS word message sign may be used as an alternative to the Workers symbol sign. (MUTCD 6H.18)

### Motorized traffic signs



Motorized traffic signs may be used to alert road users that construction or other work zone vehicles may unexpectedly enter, cross, or travel along the roadway. The TRUCK CROSSING word message sign may be used as an alternative to the Truck Crossing symbol sign where there is an established construction vehicle crossing of the roadway. (MUTCD 6H.21)

## Motorcycle signs



In some states, if the work zone includes grooved pavement, abrupt lane edges, steel plates, or gravel or earth surfaces, you may need signs stating the condition, and warning motorcyclists of the potential hazard with a MOTORCYCLES USE EXTREME CAUTION sign.



If a warning is primarily directed toward motorcyclists, a motorcycle plaque may be mounted below a LOOSE GRAVEL, GROOVED PAVEMENT, METAL BRIDGE DECK, OR STEEL PLATE AHEAD sign. (MUTCD 6H.34)

## Channelizing devices

Channelization is the process of diverting road users away from their normal path and safely around the work space. Channelizing devices include (but are not limited to) cones, tubular markers, drums, and barricades.

*According to the MUTCD, channelizing devices facilitate the smooth and gradual flow of traffic from one lane to another. They are also used to divert traffic away from the work space, pavement drop-offs, pedestrian or shared-use paths, or opposing directions of vehicular traffic. Properly executed, channelization provides maximum safety for workers and a smooth, clearly understood transition for road users.*

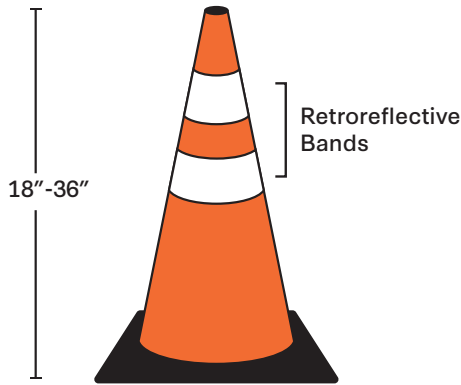
**All channelizing devices shall be crashworthy.**

(MUTCD 6K.01)

It is your employer's responsibility to make sure your worksite is equipped with proper and usable channelizing devices that meet the required specifications.

## CONES

Cones are the most commonly used channelizing device. Remember that all cones must be in acceptable or marginal condition.



*The MUTCD has specific rules regarding the use of cones.*

- For daytime and low-speed roadways, cones shall not be less than 18 inches in height.
- When cones are used on freeways and other high-speed highways, or at night on all highways, or when more conspicuous guidance is needed, cones shall be a minimum 28 inches in height.

*During nighttime use:*

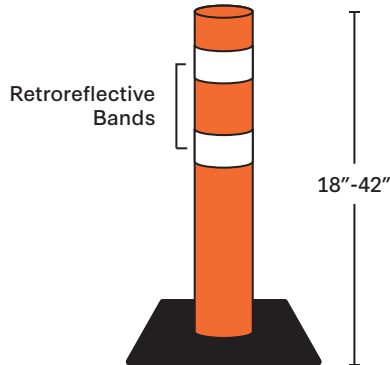
- Cones shall be retroreflectorized or equipped with lighting devices for maximum visibility.

*The MUTCD also states that cones may be doubled up to increase their weight.*

*(MUTCD 6K.03)*

## TUBULAR MARKERS

Tubular markers are cylindrical, flexible channelization devices used for temporary traffic control. They may be removable or affixed to the ground.



*The MUTCD has specific rules regarding the use of tubular markers.*

- When facing road users, tubular markers shall be predominantly orange and shall not be less than 18 inches high and 2 inches wide.
- Tubular markers shall be a minimum of 28 inches in height when they are used on all roadways, including freeways and high speed highways.

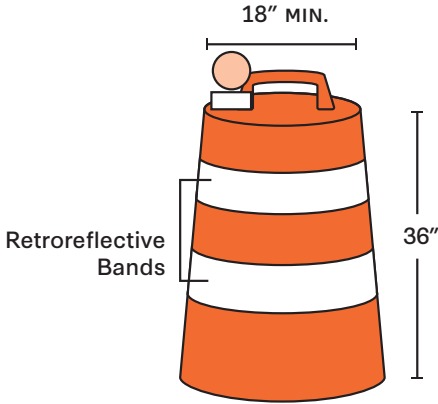
*During nighttime use:*

- Tubular markers shall be retroreflectorized.

*(MUTCD 6K.04)*

## DRUMS

Drums (sometimes called barrels) are larger and more visible than traffic cones, and are often used for long-term construction projects.



*The MUTCD has specific rules regarding the use of drums.*

- They shall be a minimum of 36 inches in height and have at least an 18-inch minimum width, regardless of orientation.
- Metal drums shall not be used.
- Drums shall have closed tops that will not allow collection of debris.

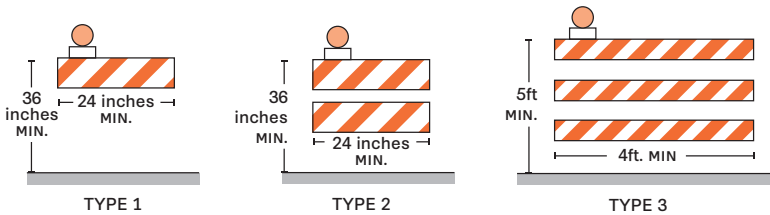
(MUTCD 6K.06)

## BARRICADES

A barricade is a portable or fixed barrier used to close all or a portion of the roadway.

**There are three types of barricades.**

- Type 1 barricades have one rail.
- Type 2 barricades have two rails.
- Type 3 barricades have three rails.



In urban areas, ROAD (STREET) CLOSED TO THRU TRAFFIC or ROAD CLOSED, LOCAL TRAFFIC ONLY, may be used. (MUTCD 6G.05)

### CAUTION

**Road users often do not know how to react to a barricade. It may be necessary to use signs that provide additional guidance.**

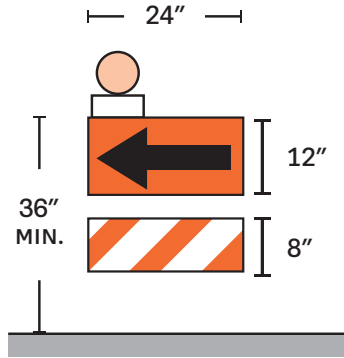
*The MUTCD has specific rules regarding the use of barricades.*

- Stripes on barricade rails shall be alternating orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction road users are to pass.
- The minimum length for Type 1 and Type 2 barricades shall be 24 inches, and the minimum length for Type 3 barricades shall be 48 inches.
- Each barricade rail shall be 8 to 12 inches wide.
- Barricades used on freeways, expressways, and other high-speed roadways shall have a minimum of 270 square inches of retroreflective area facing road users.

(MUTCD 6K.07)

### DIRECTIONAL INDICATOR BARRICADES

A directional indicator barricade depicts symbols, such as directional arrows, that direct traffic into the intended lane.



*The MUTCD has specific rules regarding the use of directional indicator barricades.*

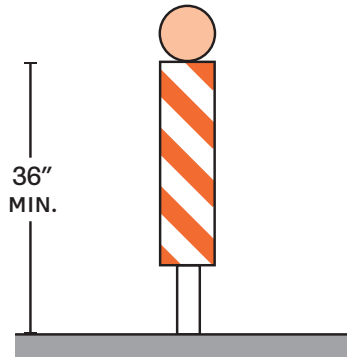
- The directional indicator barricade shall consist of a one-direction large arrow sign mounted above a diagonal striped, horizontally aligned, retroreflective rail.
- The one-direction large arrow sign shall be black on an orange background.
- The stripes on the bottom rail shall be alternating orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction road users are to pass.
- The one-direction large arrow sign shall be 24 × 12 inches.
- The sides of barricades facing traffic shall have retroreflective rail faces.

(MUTCD 6K.08)



**VERTICAL PANELS**

Vertical panels are retroreflective panels used in place of other types of barricades when space is limited.



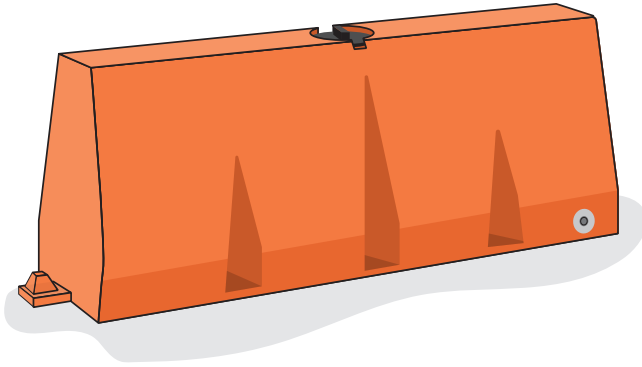
*The MUTCD has specific rules regarding the use of vertical panels.*

- Vertical panels shall have retroreflective striped material.
- They shall have alternating diagonal orange and white retroreflective stripes, sloping downward at an angle of 45 degrees in the direction vehicular traffic is to pass.

*(MUTCD 6K.05)*

## TEMPORARY TRAFFIC BARRIERS

Temporary traffic barriers are used to separate traffic from the work area. Though not considered TTC devices on their own, they do function as channelization devices when they are used in conjunction with channelizing devices and display appropriate channelization features. These barriers are also used to protect the work area.



*The MUTCD has specific rules regarding the use of temporary traffic barriers.*

- Temporary traffic barriers shall not be used solely to channelize road users, but also to protect the work space.
- If used to channelize vehicular traffic, the temporary traffic barrier shall be supplemented with delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility.
- Temporary traffic barriers should not be used for a merging taper except in low-speed urban areas.

*(MUTCD 6K.09)*

# Lights, reader boards, and other devices

## LIGHTING DEVICES

Lighting devices are used to alert and guide road users safely around a work zone, and illuminate hazards or personnel.

**Floodlights**, also sometimes known as “light plants,” must be used to light flagging stations at night. They are also used to light other areas of the work zone, such as those where work is being done.

*Except in emergency situations, flagger stations shall be illuminated at night. The lighting shall not produce a disabling glare condition for approaching road users, flaggers, or workers.*

(MUTCD 6D.06)

Many states have height requirements for floodlights.

**Warning lights**—portable yellow lights that may be steady or flashing—call attention to special hazards.

*When warning lights are used, they shall be mounted on signs or on channelizing devices in such a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield.*

(MUTCD 6L.07)

*Per the MUTCD, there are four types of warning lights.*

**Type A Low-Intensity** flashing warning lights are used to warn road users during nighttime hours that they are approaching or proceeding in a potentially hazardous area. They shall be maintained so as to be capable of being visible from a distance of 3,000 feet on a clear night.

**Type B High-Intensity** flashing warning lights are used to warn road users during both daylight and nighttime hours that they are approaching a potentially hazardous area. They are designed to operate 24 hours a day and may be mounted on advance warning signs or on independent supports. Type B warning lights shall be maintained so as to be capable of being visible on a sunny day when viewed without the sun directly on or behind the device from a distance of 1,000 feet.

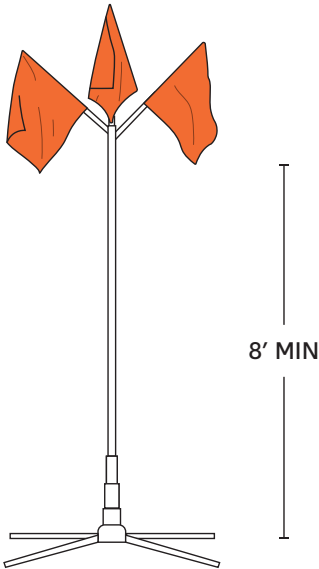
**Type C Steady-Burn** warning lights and **Type D 360-degree Steady-Burn** warning lights may be used during nighttime hours to delineate the edge of the traveled way. They shall be maintained so as to be capable of being visible from a distance of 3,000 feet on a clear night.

When used to delineate a curve, Type C and Type D warning lights should only be used on devices on the outside of the curve, and not on the inside of the curve.

(MUTCD 6L.07)

### HIGH-LEVEL WARNING DEVICES

High-level warning devices, such as flag trees, may be used along with other devices in work zones. Tall enough to be seen over the top of typical passenger cars, these are most commonly used in high-density road user situations to warn road users of short-term operations.



*The MUTCD provides guidelines for these devices:*

- They shall consist of a minimum of two flags, with or without a Type B high-intensity flashing warning light.
- The distance from the roadway to the bottom of the lens of the light and to the lowest point of the flag material shall not be less than 8 feet.
- The flag shall be 16 inches square or larger, and shall be orange or fluorescent orange-red in color.

(MUTCD 6L.08)

ARROW BOARDS

Arrow boards are used for directional warnings or guidance, and are generally vehicle- or trailer-mounted.

*According to the MUTCD, an arrow board shall be a sign with a matrix of elements capable of either flashing or sequential displays. This sign shall provide additional warning and directional information to assist in merging and controlling road users through or around a Temporary Traffic Control zone.*

*An arrow board shall have the following mode selections:*

- A flashing arrow, sequential arrow, or sequential chevron mode;
- A flashing double arrow mode; and
- A flashing “caution” or alternating diamond mode.

(MUTCD 6L.06)

Operating Mode		Display (Type C arrow board)	
MERGE	<b>Flashing arrow</b> Merge Right		
	<b>Sequential Arrow</b> Merge Right		
	<b>Sequential Chevron</b> Merge Right		
	<b>Flashing Double Arrow</b> Merge Right or Left		
CAUTION	<b>Flashing Caution</b>		
	<b>Alternating Diamond Caution</b>		

### **PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)**

Portable Changeable Message Signs (PCMSs) are devices that have the flexibility to display a variety of messages. They are used most frequently on high-density urban freeways, but can be used in many types of places where conditions require advance warning and information. These will be covered in more detail in Chapter 4.

### **PROTECTION VEHICLES AND ATTENUATORS**

Trucks or trailers are often used as shadow vehicles to protect workers or work equipment from vehicles that mistakenly enter the work site. However, protection vehicles may cause injuries to the occupants of these vehicles if they are not equipped with transportable attenuators (TAs), which are sometimes called truck mounted attenuators (TMAs). Attached to the back of the shadow vehicle, the TA is designed to absorb the impact of a crash—protecting the truck, passengers, and workers. There are a variety of TA designs available.

*According to the MUTCD, “TMAs shall be energy-absorbing devices attached to the rear of shadow trailers or trucks. If used, the shadow vehicle with attenuator shall be located in advance of the work space, workers, or equipment to reduce the severity of rear-end crashes from errant vehicles.”*

*(MUTCD 6M.05)*

Along with other barriers and devices that arrest traffic, shadow vehicles with TAs are known as “positive protection” measures.

*According to the Federal Highway Administration,*

*“Positive protection can help reduce the risk to workers and travelers with the use of devices that contain and redirect vehicles, reducing the risk of vehicle intrusion into the workspace. Some of the ways to provide positive protection are by the use of various types of barriers, shadow vehicles with energy-absorbing attenuators, and vehicle arresting systems.”*

*(USDOT FHWA, Work Zone Management Program website)*

**TEMPORARY TRAFFIC CONTROL SIGNALS**

A temporary traffic control signal is a portable stoplight that is temporarily placed in the TTC zone to control traffic when other means are not practical.

*According to the MUTCD, a temporary traffic control signal shall meet the physical display and operational requirements of a conventional traffic control signal.*

*(MUTCD 6L.01)*

**KEY POINTS TO REMEMBER**

- ◆ Traffic control signs are categorized into three groups: regulatory, \_\_\_\_\_, and guide.
- ◆ Signs used on roads with speed limits over 45 mph should be \_\_\_\_\_ inches wide by \_\_\_\_\_ inches tall.
- ◆ The bottom of a portable sign support shall mount the bottom of the sign at least \_\_\_\_\_ above the traveled roadway.
- ◆ Flaggers must be illuminated by flood lights (light plant) during hours of darkness.
- ◆ When flagging at night, a minimum \_\_\_\_\_ inch cone should be used.

CHAPTER 3

# Temporary Traffic Control zones



**W**ork zones and Temporary Traffic Control (TTC) zones are complex places that can be confusing for drivers and workers alike. It's important to understand how they operate, and your role within them, before you begin work as a flagger.

## Understanding work zones and Temporary Traffic Control zones

As a flagger, it's your job to help protect workers and guide traffic around and through areas that have been closed to traffic due to road work or emergencies. These areas are called Temporary Traffic Control (TTC) zones. Part of a flagger's job is to help set up these zones.

A **work zone** is any area where roadwork is being performed.

*The MUTCD defines a work zone as “an area of roadway with construction, maintenance, or utility work activities ... It extends from the first warning sign (or rotating/strobe lights on a vehicle) to the END ROAD WORK sign or the last temporary traffic control device.”*

(MUTCD 6B.02)

A **Temporary Traffic Control (TTC) zone** is an area where the traffic flow is temporarily changed. Not all TTC zones are set up to protect road work—sometimes they are put in place for emergencies or other reasons.

*The MUTCD defines a TTC zone as “an area of a highway/roadway where road user conditions are changed because of a work zone, an incident zone, or a planned special event through the use of TTC devices, uniformed law enforcement officers, or other authorized personnel.”*

(MUTCD 6B.02)

As a flagger, you'll mainly be working in TTC zones that are set up to protect work zones.

## Work duration

Work duration is a major factor in determining how a TTC zone is set up, as well as the number and types of devices used. The duration is defined based on the length of time the work will take, as well as weather and visibility conditions.

*According to the MUTCD, the five categories of work duration and their time at a location shall be:*

- Long-term stationary work: More than 3 days
- Intermediate-term stationary work: 1-3 days or more than one hour during nighttime
- Short-term stationary work: More than 1 hour within one daylight period
- Short-duration work: Up to 1 hour
- Mobile work: Intermittent or continuous movement

*(MUTCD 6N.01)*

### **LONG-TERM STATIONARY WORK**

Long-term stationary work is work that occupies a location for more than 3 days.

*Since long-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in long-term stationary TTC zones.*

*Inappropriate marking in long-term stationary TTC zones should be removed and replaced with temporary markings.*

*(MUTCD 6N.01)*

### **INTERMEDIATE-TERM STATIONARY WORK**

Intermediate-term stationary work is work that occupies a location for more than one daylight period for up to 3 days, or nighttime work lasting more than 1 hour.

*Since intermediate-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used.*

*In intermediate-term stationary TTC zones, it may not be feasible or practical to use procedures or devices that would be desirable for long-term stationary TTC zones, such as altered pavement markings, temporary barriers, and temporary roadways.*

(MUTCD 6N.01)

## **SHORT-TERM STATIONARY WORK**

Short-term stationary work is daytime work that occupies a location for more than 1 hour within a single daylight period.

Most maintenance and utility operations are short-term stationary work. When traffic is interfered with and the traffic control devices alone cannot safely direct traffic, a flagger should be considered.

## **SHORT-DURATION WORK**

Short duration work is work that occupies a location for up to 1 hour. Mobile and short-duration projects may involve different treatments than stationary operations. Devices having greater mobility, such as signs mounted on trucks, may be utilized.

## **MOBILE WORK**

Mobile work is work that moves intermittently or continuously.

These operations often involve frequent short stops for activities such as litter cleanup, pothole patching, or utility operations (e.g. those requiring use of a bucket truck or scissor-lift). Warning signs and high-intensity rotating, flashing, oscillating, or strobe lights should be used on vehicles participating in this type of work. You'll learn more about the specifics of flagging for short-duration and mobile work later in the course.

### **CAUTION**

**Safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location.**

## Temporary Traffic Control Plans

Many projects that take longer than one day require a Temporary Traffic Control Plan (sometimes called a TCP). A TCP, completed before work begins, is a set of guidelines established by the road owner that explains how TTC measures are to be used. These plans are usually designed by an engineer or contractor and submitted to the road authority for approval. A TCP may be simple or detailed, depending on the nature of the project, and may include drawings or diagrams.

The TCP should be prepared by somebody who understands the scope of the work to be performed. It should be developed with and approved by the agency or agencies that have jurisdiction over the affected roadways. If a TCP needs to be modified due to a change in conditions, the new plan should be approved by the responsible highway authority prior to its implementation.

It has become more common for jobs to require Temporary Traffic Control Plans. If the site you're working on requires one, it will be given to you by your Traffic Control Supervisor (TCS) or foreman.

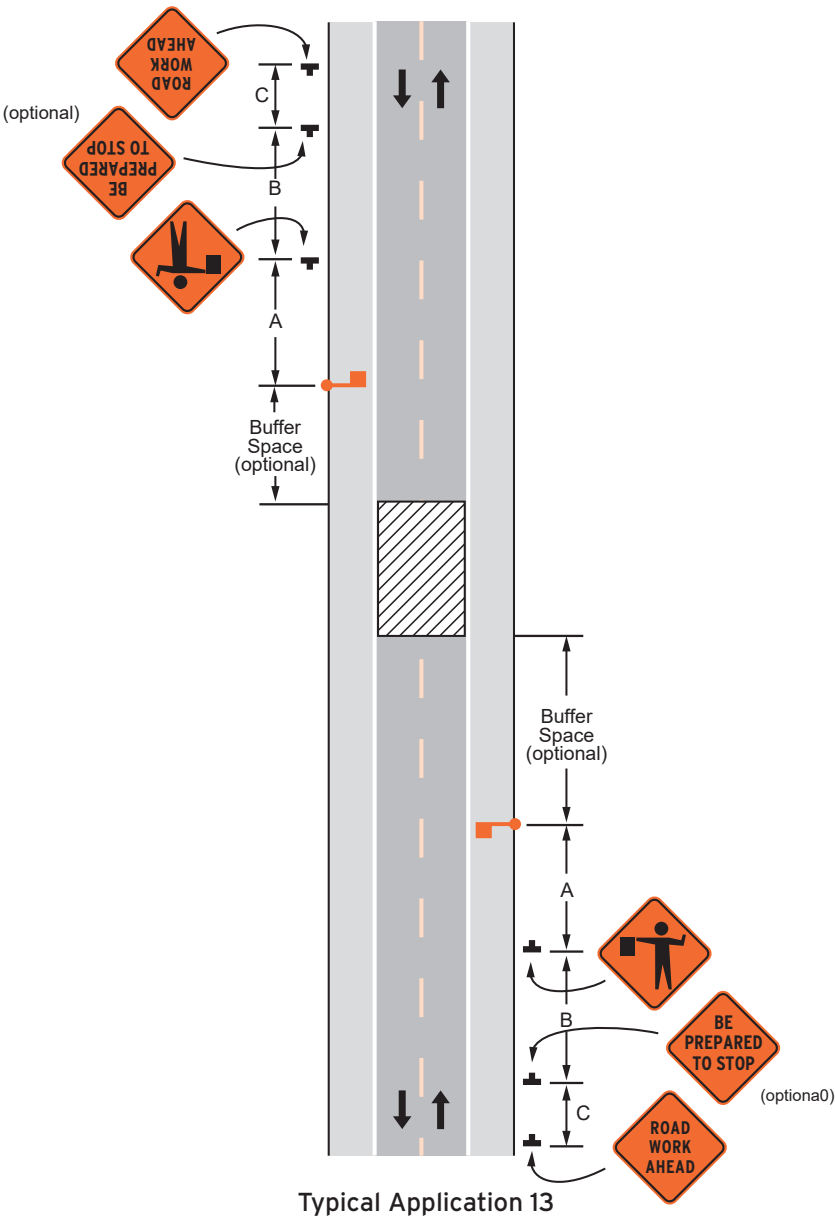
### TYPICAL APPLICATIONS

A typical application (TA) is a "general" TCP that can be modified, depending on the situation, for the actual site conditions. In some cases, it may be necessary to combine features of several typical applications to make a drawing that works for a specific location. Typical applications in the MUTCD include guidance, option, and standard statements to help. The MUTCD includes several, but some states, or local agencies such as cities or counties, may have required modifications to these, or may provide their own.

Typical applications are often used by maintenance workers or others who regularly perform the same type of work on roads owned by the same jurisdiction, such as city or county roads.

The following is an example of a TA from the MUTCD.

Figure 6P-13. Temporary Road Closure (TA-13)



## **Overview of a Temporary Traffic Control zone**

There are four main areas within a TTC zone: advance, transition, activity, and termination. Each area serves a specific function in the channelization of vehicles through or around the work zone.

### **THE FOUR AREAS**

#### **Advance**

This zone warns road users that work is taking place ahead. Here is where advance warning signs should be placed to indicate the presence of a work zone as well as the type of work taking place (for instance, ROAD WORK AHEAD for road work, or UTILITY WORK AHEAD for utility work).

#### **Transition**

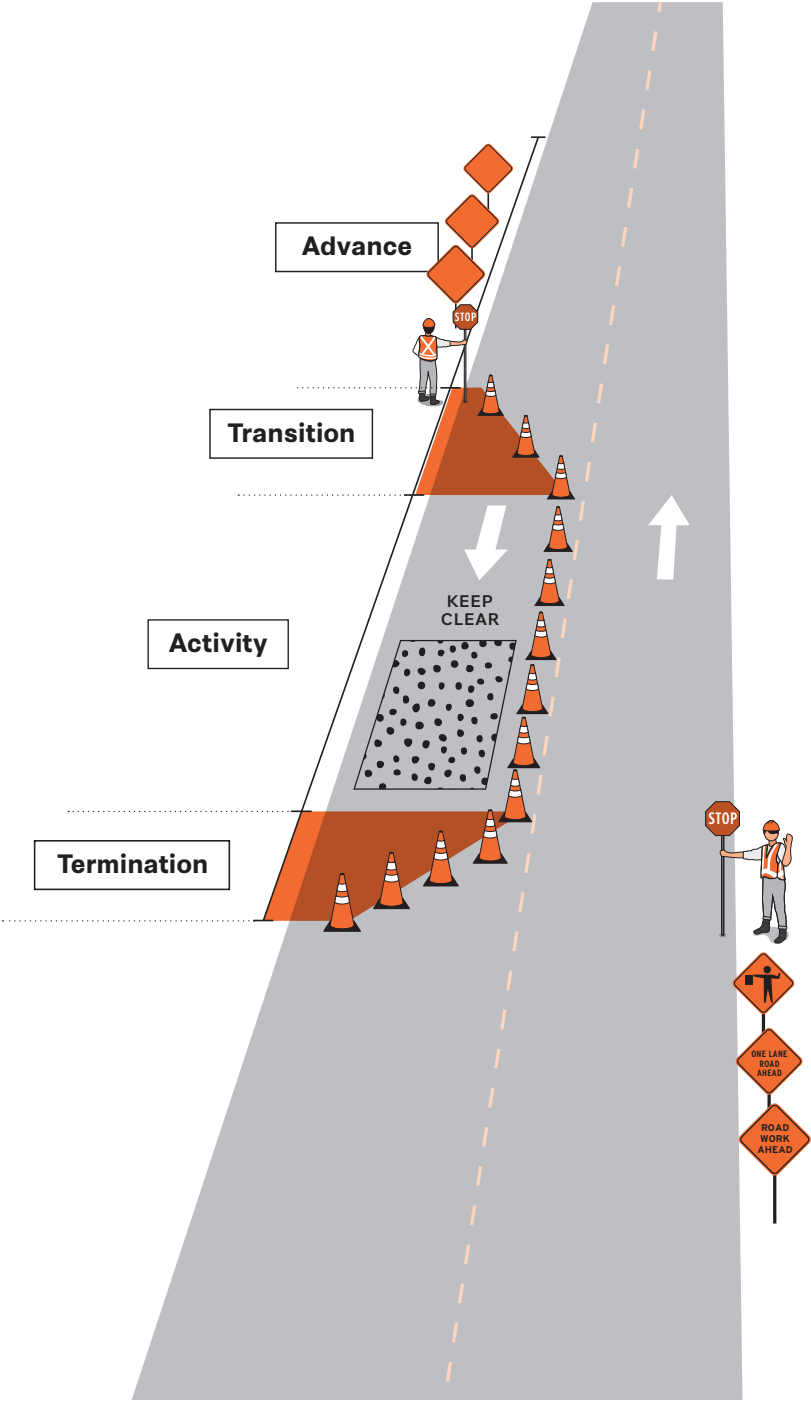
Road users are moved out of their normal path into a new one. This is facilitated by the use of orange cones, barrels, or other channelizing devices. The transition area always involves a taper, which you'll learn more about in this chapter.

#### **Activity**

The area where the work takes place. The activity area includes the buffer space and the work space. This area also includes the tangent (a line of channelizing devices that separates the activity area from traffic).

#### **Termination**

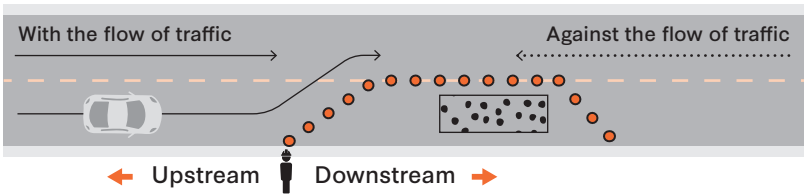
The area in which road users are returned to their normal path.



## Installing and removing traffic control devices

Installing and removing traffic control devices in TTC zones is very hazardous. This must be done in a specific order so that you, your crew, and the public stay safe during the process. (You'll learn more about the specifics of properly configuring and spacing these devices shortly.)

When describing TTC zones, people often use terms like “upstream” or “downstream,” or “with the flow of traffic” or “against the flow of traffic.” These terms help describe where things are located with regard to traffic flow. When describing work zones, it's important to always keep in mind which direction the traffic is flowing.



It's important to note that “upstream” and “downstream” change depending on your reference point within the work zone.

### INSTALLING TRAFFIC CONTROL DEVICES

Devices are installed in the direction that traffic moves—that is, starting “upstream” (the beginning of the TTC zone, from a driver's point of view) and moving “downstream,” or with the flow of traffic, to the end of the TTC zone.

1. The first device placed is the first advance warning sign.
2. The installation then proceeds with the installation of additional advance warning signs.
3. When all advance warning signs have been installed, channelizing devices are set-up in the transition area, the activity area, and, finally, the termination area.



During setup, you must allow for the correct spacing between each area of the TTC zone. This will depend on the road's speed limit and other conditions, such as weather or road conditions. This will be covered in more detail later in Chapter 5.

### **REMOVING TRAFFIC CONTROL DEVICES**

When the TTC zone devices are being removed, the procedure is done in reverse, against the flow of traffic, to make sure the workers are protected as they remove or reopen the closure.

1. Remove the downstream taper channelizing devices
2. Remove the devices around the activity area (the tangent)
3. Remove the devices along the transition taper
4. Remove the advance warning signs.

### **WHEN WORK IS NOT BEING PERFORMED**

Warning signs must reflect the actual condition of the work zone. They should be removed or covered when not in use (for example, at night or on days when work is not being performed).

Do not leave the FLAGGER AHEAD sign up when the flagger is no longer needed or present. Cover, turn, or remove signs that no longer apply.

### **KEY POINTS TO REMEMBER**

- ◆ A Temporary Traffic Control (TTC) zone is an area where the traffic flow is temporarily changed.
- ◆ Long term duration work is work that lasts more than \_\_\_\_ days.
- ◆ The TTC zone consists of four areas: the advance warning area, the transition area, the activity area, and the termination area.
- ◆ TTC zones are typically set up \_\_\_\_\_ the flow of traffic (starting upstream), and removed \_\_\_\_\_ the flow of traffic (starting downstream).
- ◆ A Temporary Traffic Control Plan (TCP) is required for work projects that take longer than one day.

## CHAPTER 4

# Setting up a TTC zone

**T**here are many different components to a TTC zone. This chapter covers each of these in detail, and provides guidelines for their setup. The exact setup and layout of these zones will differ depending on the characteristics of the road, size of the job, and/or work being performed. Because safety is the most important consideration when setting up any TTC zone, many features of the TTC zone are based on state or federal requirements.

## The advance warning area

### PLACEMENT OF ADVANCE WARNING SIGNS

Advance warning signs help road users understand what to expect ahead, and prepare them to safely enter the work zone.

#### Sign selection

The advance warning signs should provide motorists with specific information on the type of work activity ahead, speed controls, and special directions for passing around or through the work zone.

The TCP will tell you which signs to place in the advance warning area. You should check with your supervisor if you don't have a traffic control plan.

#### A typical advance warning sign sequence when in a flagging operation:



Number of signs

The required number of signs in the warning sequence depends on the speed of the road.

Warning signs must reflect the actual condition of the work zone. When not in use, warning signs must either be taken down or covered.

According to the MUTCD, when used, the BE PREPARED TO STOP sign should be located between the Flagger sign and the ONE LANE ROAD sign. (MUTCD TA-10)

Sign placement

TABLE 6B-1 RECOMMENDED ADVANCE WARNING SIGN MINIMUM SPACING			
Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway/Freeway	1,000 feet	1,500 feet	2,640 feet
*Speed category to be determined by the highway agency ** The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC Zone.)			

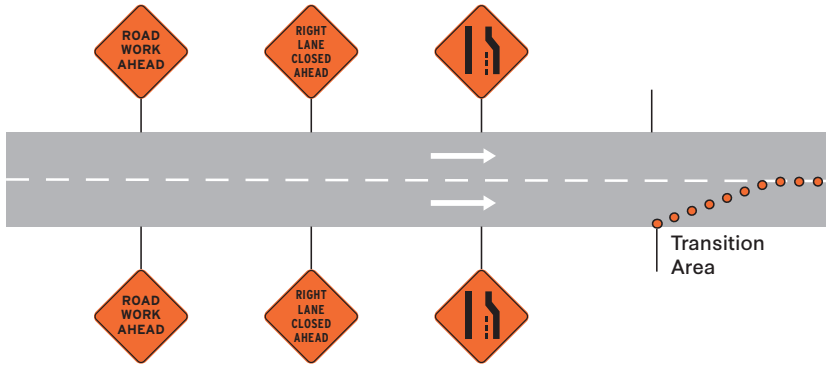
(The information in this table comes from MUTCD 6B.05.)

The spacing of the signs and distance to the work zone depends on the speed and condition of the road. The table here shows approximate recommended distances, but they should be adjusted for field conditions, if necessary.

Advance warning signs are usually placed at a right angle to the road, on the right-hand side. Where special emphasis is needed (such as high-speed or multilane roads), warning signs may be placed opposite each other on the right- and left-hand sides of the road.

## SPECIAL CONSIDERATIONS FOR ADVANCE WARNING SIGNS

### Highways, freeways, and expressways



On multilane roads, a complete series of warning signs, placed on both sides of the road, is usually required in advance of the transition area. The sign layout should provide motorists with specific information on the type of work activity ahead, speed controls, and special directions for passing around or through the activity area.

Distances for placement of advance warning signs on high-speed roads must be longer, typically close to one mile or more. Often, work must be done at night to avoid interference with peak hour traffic.

Remember that larger-sized signs (48 inches × 48 inches) are often required on high-speed roads.

#### CAUTION:

**Flagging is prohibited on freeways and expressways.**

### Cities

City work zones can be restrictive, with narrow streets, parked vehicles, and short distances between intersections. Signs should be placed near enough to the edge of the roadway to be visible, but should not obstruct traffic. Neither portable nor permanent sign supports should be located on sidewalks, in bicycle lanes, or in areas designated for pedestrian or bicycle traffic. When advance warning signs are used on higher speed streets, such as major arterials, the advance warning area should extend a greater distance.

## **Mobile flagging operations**

Mobile operations often involve frequent short stops for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations. Per the MUTCD, warning signs and high-intensity rotating, flashing, oscillating, or strobe lights should be used on the vehicles that are participating in the mobile work.

## **LIGHTING**

Whether or not a flagger will be present, it is recommended that you use additional warning devices, increased sign distances from the work zone, longer tapers, and lighting if work will be performed in the TTC zone at night.

*Except in emergency situations, flagger stations shall be illuminated at night. The lighting shall not produce a disabling glare condition for approaching road users, flaggers or workers.*

*(MUTCD 6D.06)*

Floodlight placement and possible glare should be checked by driving through and observing the floodlighted area from each direction on all approaching roadways.

## **INSTALLING ARROW BOARDS AND PCMS**

### **Arrow boards**

Arrow boards may be used in various roadway situations, but they are required on multilane highways or other major multilane roadways with heavy traffic volumes and high speeds. Whenever possible, the arrow board should be placed on the shoulder at the beginning of the merging taper.

**Placement**

- The arrow board shall be mounted on a vehicle, a trailer, or other suitable support.
- Place the arrow board on the shoulder of the roadway or, if practical, farther from the traveled lane. Where the shoulder is narrow, the arrow board should be located in the closed lane.
- Use an arrow board in combination with signs, channelizing devices, or other TTC devices. The arrow board itself should be delineated with retroreflective TTC devices.

**Lane closures**

- Arrow boards shall only be used to indicate a lane closure.
- An arrow board in the arrow or chevron mode shall only be used on multilane roadways for stationary or moving lane closures.
- If used to close multiple lanes, a separate arrow board shall be used for each closed lane.
- Arrow boards shall not be used to indicate a lane shift.
- Arrow boards shall not be used for a flagging operation.

*For a stationary lane closure, the arrow board should be located on the shoulder at the beginning of the merging taper.*

**Caution mode**

- An arrow board shall be used only in the caution mode for:
  - shoulder work blocking the shoulder
  - roadside work near the shoulder
  - or for temporarily closing one lane on a two-lane, two-way roadway.

(MUTCD 6L.06)

**PCMSs**

Portable changeable message signs are able to display customized, real-time messages about the conditions ahead. Their flexibility makes them ideal in situations where road, weather, or work conditions frequently change. Because drivers are only able to take in a limited amount of information in a short amount of time, MUTCD guidelines regarding message size and phrasing should be considered when programming these signs.

*The following are the MUTCD guidelines regarding PCMSs.*

### **Mounting**

- The mounting of the PCMS on a trailer, large truck, or service patrol truck shall be such that the bottom of the message sign shall be a minimum of 7 feet above the roadway in urban areas and 5 feet above the roadway in rural areas when it is in the operating mode.

### **Application and placement**

- The PCMS should be used as a supplement to and not as a substitute for conventional signs and pavement markings.
- The PCMS should be placed off the shoulder of the roadway or behind a traffic barrier or guardrail if practical, or further from the traveled lane.
- When portable changeable message signs are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.
- If a portable changeable message sign has to be placed on the shoulder of the roadway or within the clear zone, it should be delineated with retroreflective TTC devices. (MUTCD 6F.60)

### **Visibility**

- The PCMS should be limited to three lines of eight characters per line, or should consist of a full matrix display.
- The letter height should be a minimum of 18 inches.
- The message should be visible for at least 1/2 mile in both day and night conditions.
- In order to maintain legibility, the PCMS shall automatically adjust its brightness under varying light conditions.

### **Messages**

- Messages on a PCMS should consist of no more than two phases (a phase consists of no more than three lines of text).
- Each phase should be capable of being understood by itself regardless of the order in which it is read.



- The text of the messages shall not scroll or travel horizontally or vertically across the face of the sign.
- Messages should be centered within each line of legend.
- When PCMSs are used in TTC zones, they should display only TTC messages.

### **Controls and power source**

- The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable.
- The PCMS shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs.

(MUTCD 6L.05)

## **The transition area**

### **TAPERS**

The taper is the area of the work zone in which traffic is moved out of its normal path. Tapers define the transition area, direct traffic, and protect personnel in the work space. Used in both the transition and termination areas, they are marked with channelizing devices such as cones and drums. The length of the taper may be adjusted depending on road features such as ramps, crossroads, curves, or other factors. *(See MUTCD 6B.08 for official definitions of taper types.)*

The solid line marking the outer edges of the roadway is called the “edge line.” You may also hear it referred to as the “fog line” or “shoulder edge.”

### **Merging taper (lane closure, identified by "L")**

A merging taper involves merging one or more lanes of traffic into a common road space due to a lane closure. It should be long enough to provide drivers with advance warning of the merge to come, and give them time to adjust their speeds.

It is the responsibility of drivers in the affected lanes to adjust their speed to accommodate drivers merging in from the closed lane(s). An arrow board, in the flashing or sequential arrow/chevron mode, should be used during this operation. (*MUTCD 6F.61*)

**Shifting taper (no lane closure, identified by "1/2 L" or "L/2")**

A shifting taper is used when a lateral shift is needed, and does not involve a lane closure. Instead of taking a lane away from the driver, it moves the driver over. Arrow boards are not used in this operation.

**Shoulder taper (identified by "1/3 L" or "L/3")**

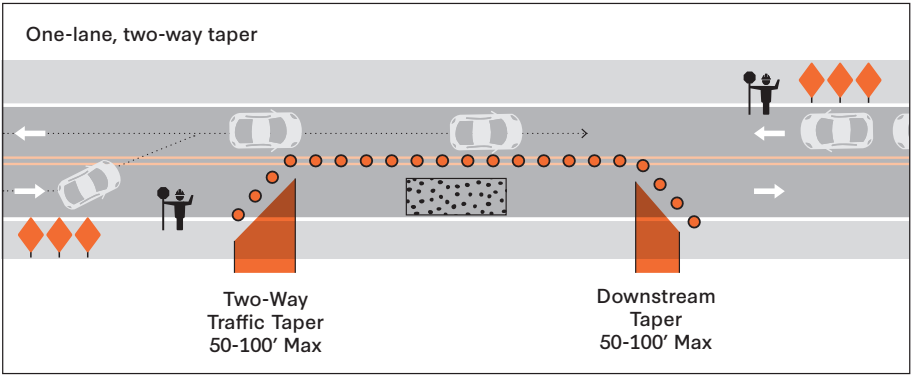
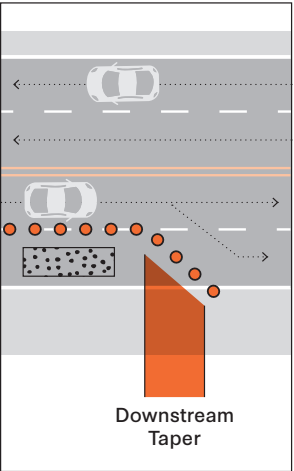
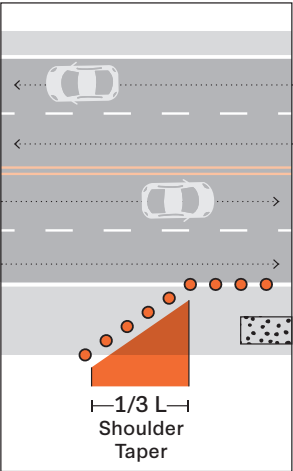
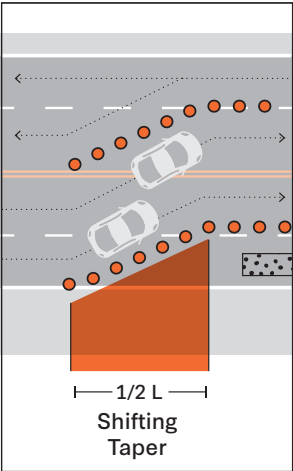
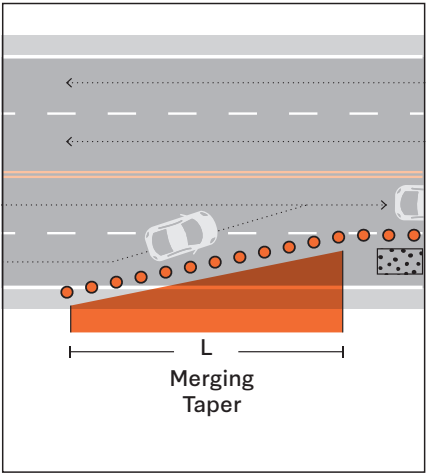
A shoulder taper may be used on a high-speed roadway where shoulders are part of the activity area and are closed, or when improved shoulders might be mistaken as a driving lane. It can also be used to alert drivers that it is unsafe to use the shoulder and/or prevent access to the shoulder. An arrow board in the “caution” mode is used in this operation; do not use it in the arrow mode.

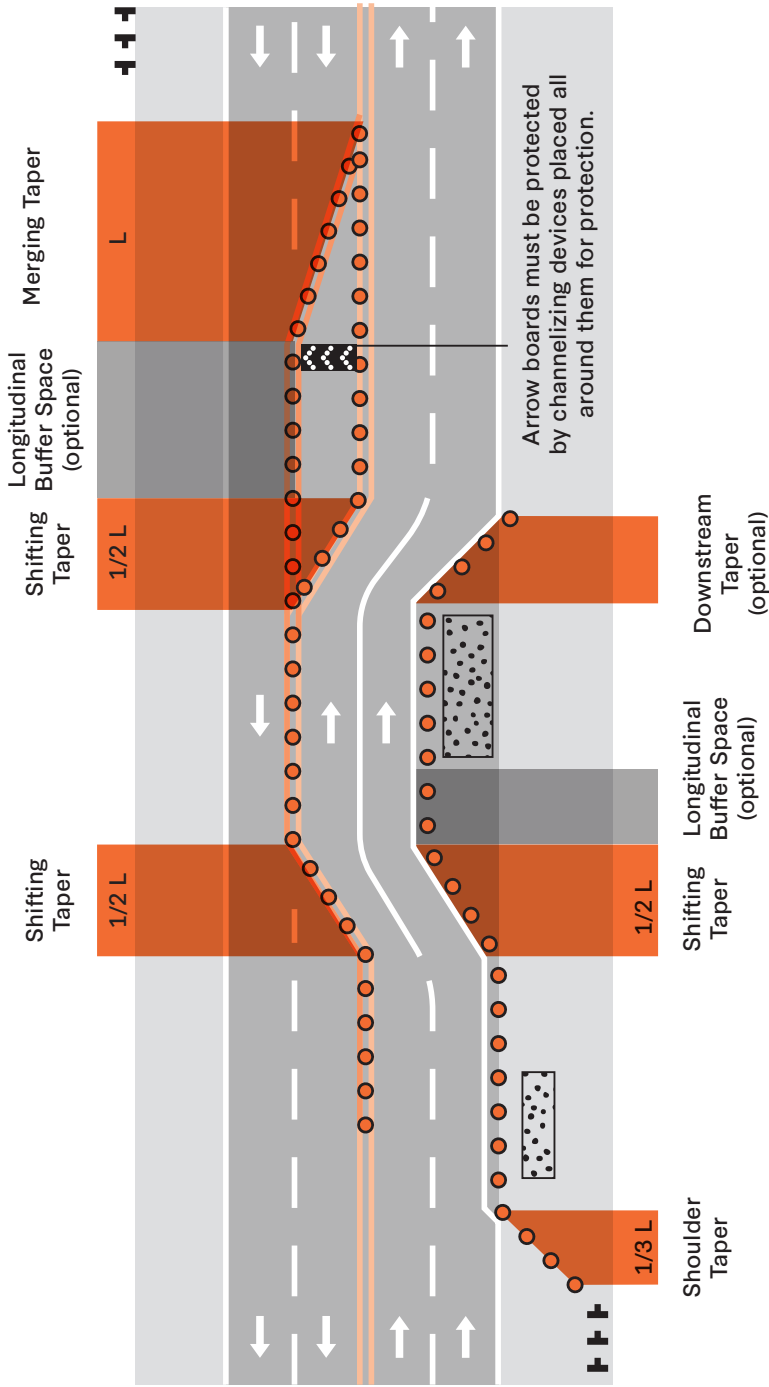
**Downstream taper (50'–100')**

A downstream taper is useful in the termination area to provide a visual cue to the driver that access has been returned to the original lane or path that was closed.

**One-lane, two-way taper (flagger taper, 50'–100')**

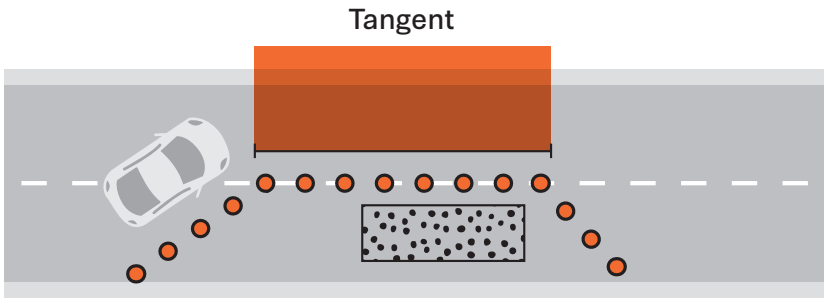
The one-lane, two-way taper is used in situations where the activity taking place requires traffic to take turns using the same portion of the road. Flaggers are generally used. However, the MUTCD gives alternative methods using a STOP or YIELD sign, temporary traffic signals, or the Automated Flagging Assistance Device (AFAD).





THE TANGENT

The tangent is a line of channelizing devices, placed parallel to the lanes of traffic, that runs from taper to taper.



LENGTH AND SPACING OF TAPERS AND TANGENTS

Spacing of channelizing devices

This chart lists the maximum spacing allowed between channelizing devices on tapers and tangents, regardless of lane width.

MUTCD MAXIMUM CHANNELIZING DEVICE SPACING	
Tapers	Spacing
Merging/Shifting/Shoulder	Not to exceed 1 × speed limit in feet
One-Lane, Two Way	20 foot spacing regardless of speed
Downstream	20 foot spacing regardless of speed
Tangent	Not to exceed 2 × speed limit in feet

(This information in this table comes from MUTCD 6B.08 and 6K.01.)

Taper length

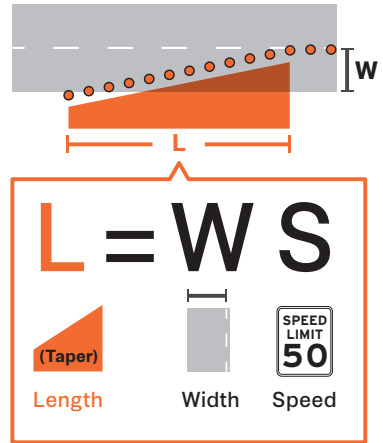
Taper length is determined by calculating a number designated by the letter “L.” L represents the minimum distance required for vehicles to safely merge. It is different in every TTC zone setup, depending on the road and the work zone configuration.

## Finding L

There are set formulas for how to calculate L. They are based on:

- the posted speed limit in miles per hour (mph), designated by the variable “S”
- the width of the closed lane or offset in feet, designated by the variable “W”

For roads with speeds of 45 mph or greater, use the formula  **$L=WS$**



Note: certain jurisdictions may have different low and high speed recommendations.

For example, the width of the lane being closed is **12 feet** and the speed limit is **55 mph**:

$$L = 12 \times 55$$

Answer: L is 660 feet.

For roads with speeds of 40 mph or less, use the formula  **$L = W \times S^2/60$**

Note: certain jurisdictions may have different low and high speed recommendations.

For example, if the width of the lane being closed is **10 feet** and the speed limit is **40 mph**:

$$L = 10 \times 40^2 \div 60$$

Answer: L is 266 feet.

Round calculations up to the nearest 5 feet.

So, if L is 266, round up to 270 feet.

Using L to calculate taper length

Different types of tapers have different length requirements based on L. Once you know what L is for the specific roadway situation, you can use L to determine the length of the taper, depending on the type.

Note that one-lane, two-way (flagger) and downstream tapers have set lengths that do not depend on L. A one-lane, two-way taper is always 50'-100' long and the downstream taper is always 50'-100' long per lane.

WORK ZONE TAPER LENGTH FORMULAS	
L = taper length in feet W = width of the lane to be closed or offset S = posted speed limit	
POSTED SPEED	FORMULA
45 MPH (or faster)	$L = WS$
40 MPH (or slower)	$L = W \times S^2 / 60$
TYPE OF TAPER	TAPER LENGTH
Merging Taper	L minimum
Shifting Taper	$\frac{1}{2} L$ or L/2 minimum
Shoulder Taper	$\frac{1}{3} L$ or L/3 minimum
Two-Way Taper (flagger)	50' min, 100' max
Downstream Taper	50' min, 100' max

MERGING, SHIFTING, AND SHOULDER TAPER LENGTHS AND NUMBER OF CHANNELIZATION DEVICES (CONES) USED																			
Lane Width	10 feet					11 feet					12 feet					Shoulder Tapers			
	"L"		"1/2 L"			"L"		"1/2 L"			"L"		"1/2 L"						
	Merg	Cone	Shift	Cone	Merg	Cone	Shift	Cone	Merg	Cone	Shift	Cone	Merg	Cone	Shift	Cone	MPH	Length	Cone
MPH																			(Assumes 10' Shoulder)
20	70	5	35	3	75	5	40	3	80	5	40	3	20	25	3				
25	105	6	55	3	115	6	60	4	125	6	65	4	25	35	3				
30	150	6	75	4	165	7	85	4	180	7	90	4	30	50	3				
35	205	7	105	4	225	8	115	5	245	8	125	5	35	70	4				
40	270	8	135	5	295	9	150	5	320	9	160	5	40	90	4				
45	450	11	225	6	495	12	250	7	540	13	270	7	45	150	6				
50	500	11	250	6	550	12	275	7	600	13	300	7	50	170	6				
55	550	11	275	6	605	12	305	7	660	13	330	7	55	185	6				
60	600	11	300	6	660	12	330	7	720	13	360	7	60	200	6				
65	650	11	325	6	715	12	370	7	780	13	390	7	65	220	7				
70	700	11	350	6	770	12	385	7	840	13	420	7	70	235	7				
All lengths are in feet. This chart is MUTCD compliant. All numbers are minimums.																Shoulder Taper equals Shoulder Width × Speed / 3			



Taper length and channelizing device table

This table shows minimum lengths for merging, shifting, and shoulder tapers. Flaggers are not used to control traffic when these tapers are used.

The activity area

All work takes place in the activity area, which includes the tangent, buffer space, and work space. It is important to understand how the activity area is set up, and the importance of each of these spaces.

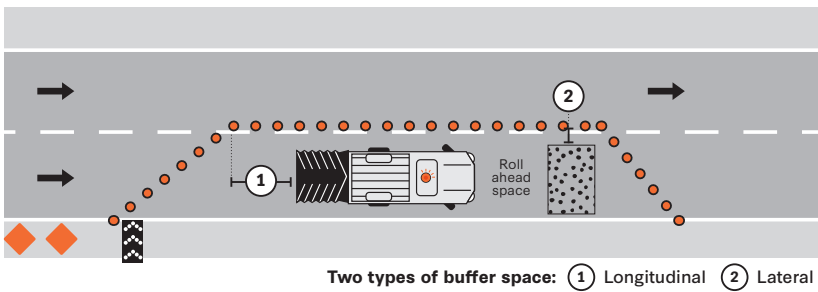
The tangent runs along the length of the activity area, from the end of the first taper to the beginning of the downstream taper (if used).

BUFFER SPACE

Buffer space separates traffic from the work zone, and provides extra space (and time) for the work crew to escape harm, in case a vehicle fails to obey instructions and runs into the activity area. There are two types of buffer space: longitudinal (lengthwise in the direction of traffic flow) and lateral.

CAUTION

There should be no work activity, storage of equipment, vehicles, or material in the buffer space. (MUTCD 6B.06)



Longitudinal buffer space

Longitudinal buffer spaces are placed “upstream” of the work space (that is, before the work space, from the perspective of someone driving through the work zone), in the initial portion of the Activity

Area. Additional buffer space can be added after the work space to accommodate advance warning signs and flaggers when there are curves or hills in the road.

This table shows the distances required for longitudinal buffer space length, based on speed.

TABLE 6B-2 (MUTCD) BUFFER SPACE	
Speed (mph)	Distance (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

(This table comes from MUTCD 6B.06)

**Placement of shadow vehicles or TAs**

Shadow vehicles, which may be equipped with transportable attenuators (TAs), protect workers from traffic that may mistakenly enter the work zone. (MUTCD 6C.04) Shadow vehicles may be moving or stationary, depending on the type of work being performed.

When a protection vehicle is placed in advance of the work space, only the space upstream of (before) the vehicle constitutes the buffer space. (MUTCD 6B.06) The longitudinal buffer space shown in the table should end at the back bumper of the shadow vehicle. There should be at least 2 feet of clearance between the truck and the channelizing devices (lateral buffer space).

The shadow vehicle must be positioned far enough in front of the work area to allow for appropriate vehicle roll-ahead (but not so far that another vehicle could travel around it and strike the workers or equipment). For stationary operations, the truck's parking brake should be set, and the transmission should be in park (automatic transmission) or reverse (manual transmission). Turn the wheels toward the curb so that the impact trajectory is away from traffic.

If used, the TA must be used in accordance with the manufacturer's specifications, and should be in the full down and locked position. The following illustration shows the component parts of a TTC zone using a transportable attenuator.

### **Lateral buffer space**

A lateral buffer space may be placed between traffic and the work space or a potentially hazardous area, such as an excavation site or pavement drop-off. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows. The width of the lateral buffer space is recommended to be a minimum of 2 feet. It is usually determined by an engineer and designated in the traffic control plan.

### **THE WORK AREA**

The ultimate purpose of the entire TTC zone is to safely divert traffic around the work that is being performed. But the work area occupies only a small part of the TTC zone, and is the only area in which actual work takes place. You should be briefed on what will be happening in the work area and how to keep yourself and others safe within the TTC zone.

## **The termination area**

The termination area is the final section of the TTC zone. Here, the downstream taper and/or signs are used to notify road users that access to their original path or lane has been restored.

## Pedestrian considerations

Temporary Traffic Control zones need to accommodate pedestrians who regularly access the area. This may require establishing temporary pedestrian pathways and/or alternate access points to divert pedestrians around the work zone. These pathways should, as best as possible, replicate the characteristics of the existing sidewalk(s) or footpath(s).

Temporary pedestrian pathways should not obstruct access to transit stops.

All pedestrians, including those with disabilities, should be considered when temporary pedestrian pathways in TTC zones are designed or modified. If Americans with Disabilities Act (ADA) compliance is required, a TCP should be provided.

If the sidewalk is closed, the appropriate closure controls, such as those illustrated in MUTCD Typical Application (TA) 28 and 29 should be used.

*When this is not the case and the sidewalk facility will remain open, MUTCD guidelines state:*

- If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided.
- If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.

*When channelization is used to delineate a pedestrian pathway, a continuous detectable edging should be provided throughout the length of the facility such that pedestrians using a long cane can follow it. These detectable edgings should comply with the provisions of Section 6M.04.*

*(MUTCD 6C.02, 6K.02, and 6M.04)*

Temporary pedestrian pathways should be smooth, hard surfaces free of barriers or curbs that may cause tripping or impede wheelchair use. When possible, they should maintain the same width of

the original pedestrian facility. Audible information devices, accessible pedestrian signals, and detectable edgings should be used to accommodate visually impaired users.

Temporary pedestrian pathways should be kept free of debris, work equipment, and other obstructions.

Pedestrians, like motorists, may find it confusing or annoying to be rerouted around a work zone. They may overlook or deliberately ignore rerouting instructions, putting their own safety at risk. Pedestrians who choose to ignore flaggers using proper signs, devices, and flagger protocol are responsible for their own actions.

Pedestrians should not be led into conflicts with workers, vehicles, equipment, or operations taking place on the worksite.

**CAUTION**

**Do not touch or yell at a pedestrian who deliberately disobeys your instructions. If they choose to disregard your guidance, alert your crew, but do not attempt to restrain or intimidate the person.**

**Considerations for cyclists**

When flagging, you may not stand in or block access to a bike lane unless it has been closed using appropriate signage and a taper.

**CAUTION**

**Just like road users, cyclists are required to follow the direction of the flagger's STOP/SLOW paddle; however, you must be aware that cyclists may ignore the rules of the road, or behave differently from both drivers and pedestrians. You may need to give them special attention to make sure they know how to safely navigate the work zone.**

## Short-duration and mobile work

Though they may not be as complex as longer-term road work or large construction projects, short-duration and mobile work may sometimes require flaggers. Some examples of this type of work include minor road repairs, trash pickup, lane striping, and tree trimming.

Regardless of the duration or complexity of the work, a TTC zone, with a complete sequence of advance warning signs, should be established when flaggers are used.

**Short-duration work** is defined as work that occupies a location for up to 1 hour.

Often, it will take longer to set up and remove the TTC zone than it will to complete the work. However, safety should not be compromised by using fewer devices or taking other shortcuts. Workers should also be aware that they also face hazards while setting up and taking down the TTC zone.

**Mobile work** is work that moves intermittently or continuously.

When mobile work requires a flagger, you will often be walking along with a machine and crew. The advance warning area moves with the work space. Warning signs, vehicle lights, flags, and/or channelizing devices should be used and moved periodically to keep them near the mobile work space. Exemptions may be made for certain types of mobile work, when cones are not set up and only signs are used.

A shadow vehicle equipped with an arrow panel or a sign should follow the work vehicle, especially when traffic speeds or volumes are high. Per the MUTCD, a vehicle displaying an arrow board shall be equipped with high-intensity rotating, flashing, oscillating, or strobe lights. For mobile operations where a lane is closed, the arrow board should be located far enough ahead of the work operation to allow for appropriate reaction by approaching drivers. (MUTCD 6M.05, Figures 6P-17 and 6P-35).

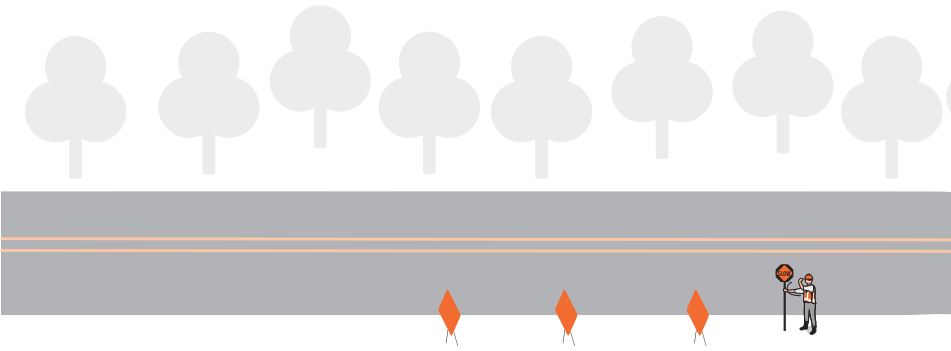
To help ensure the safety of both workers and road users, mobile and short-duration operations might use different equipment from what is used in a stationary TTC zone.

This may include:

- Marked or colored vehicles
- Signs mounted on trucks
- High-intensity rotating, flashing, oscillating, or strobe lights
- Arrow panels
- Signs and other devices that are larger or more visible
- A reduction in the number of devices may be offset by the use of other more dominant devices such as those listed above.

### KEY POINTS TO REMEMBER

- ◆ The taper is the area of the work zone in which traffic is moved out of its normal path, and is marked by channelizing devices.
- ◆ The taper that is identified as "L/2 or 1/2 L" is called a \_\_\_\_\_ taper.
- ◆ A One-Lane, Two-Way taper and a \_\_\_\_\_ taper have lengths that are 50-100 feet long.
- ◆ When closing a lane on a multilane roadway the arrow board should be placed on the \_\_\_\_\_, at the beginning of the merging taper.
- ◆ Don't flag in or block access to a bike lane unless it has been closed using the proper signage and taper.



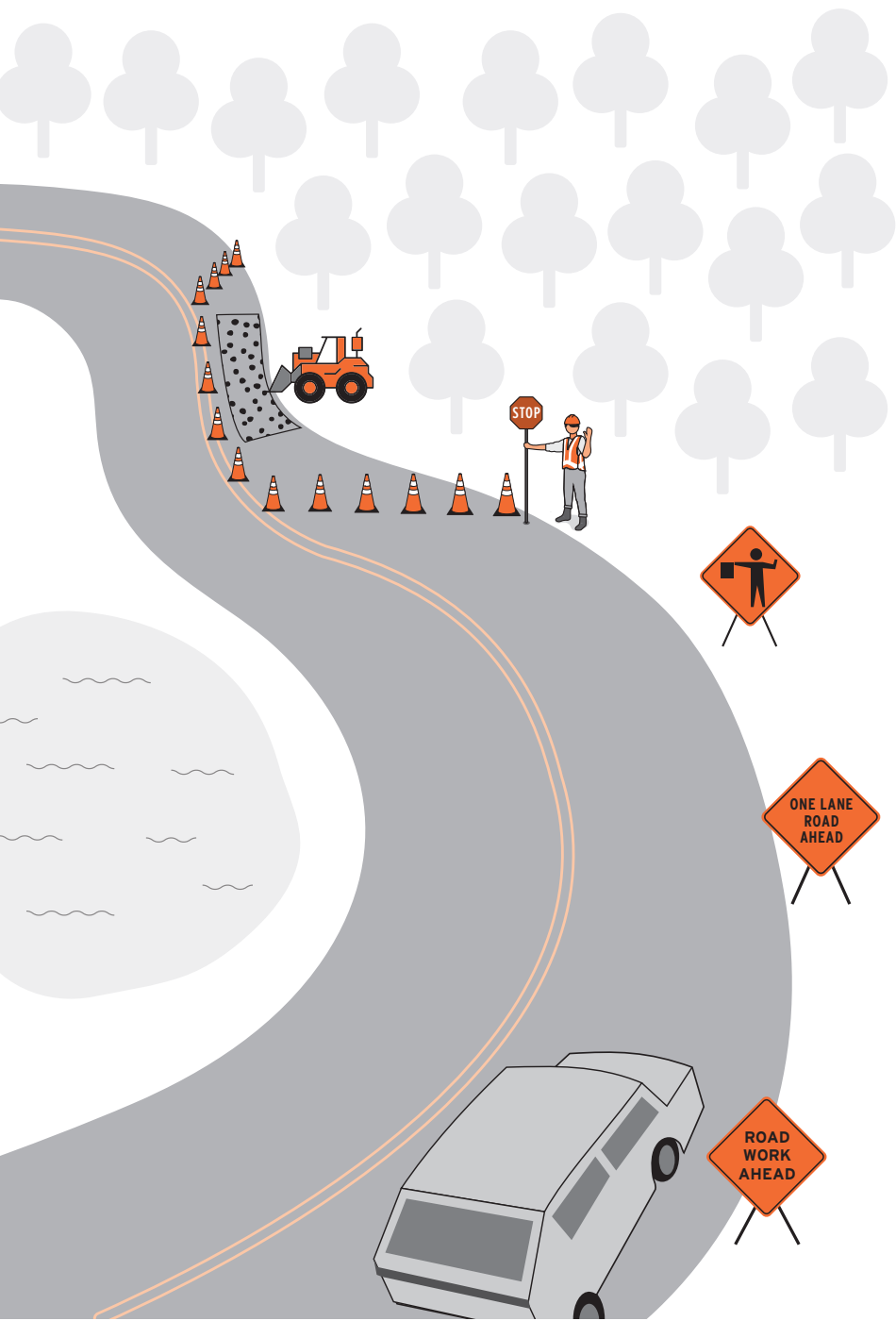
# Review exercises

## PROBLEM 1

- A. On the illustration shown here, identify:
- The four areas of the TTC zone
  - The tangent
  - The taper types used
- B. If you were setting this TTC zone up where would you begin?
- C. What potential problems could arise in this particular roadway situation?

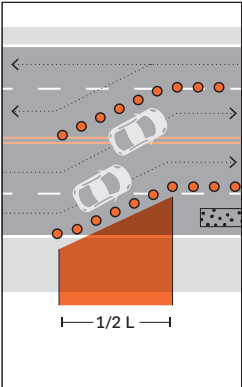




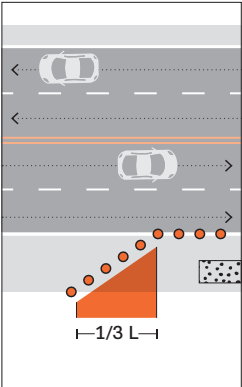


**PROBLEM 2**

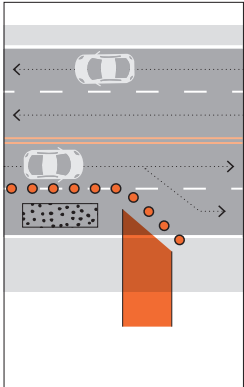
On the illustrations below, correctly identify the type of taper.



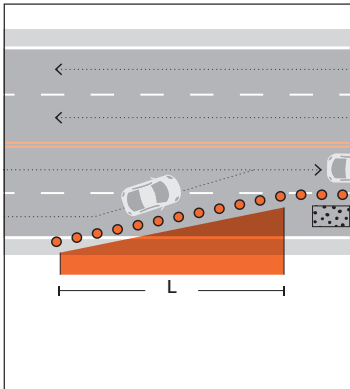
A. \_\_\_\_\_



B. \_\_\_\_\_



C. \_\_\_\_\_



D. \_\_\_\_\_

**PROBLEM 3**

- A. How long is a downstream taper? \_\_\_\_\_
- B. What are the identifiers for a shoulder taper, shifting taper, and merging taper?
- Shoulder \_\_\_\_\_
  - Shifting \_\_\_\_\_
  - Merging \_\_\_\_\_

## PROBLEM 4

Using the tables in this book, correctly identify the following for a right lane closure on a multi-lane roadway. There is also shoulder repair being accomplished as part of the same project. The lanes are 11 feet wide, the shoulder is 10 feet, and the speed limit is 45 mph.

- A. What type of taper do you use for the lane closure?  
\_\_\_\_\_
- B. What should the first traffic control device be? (Be specific.)  
\_\_\_\_\_
- C. Should an arrow board be used for the lane closure?  
**Yes / No** In which mode? \_\_\_\_\_
- D. Where should the arrow board be located?  
\_\_\_\_\_
- E. How long should the shoulder taper be? \_\_\_\_\_  
How many channelizing devices should be used for the shoulder taper? \_\_\_\_\_
- F. How long should the merging taper be? \_\_\_\_\_  
How many channelizing devices should be used for the merging taper? \_\_\_\_\_
- G. How long should the buffer space be? \_\_\_\_\_

## PROBLEM 5

- A. On a rural two-lane road with two-way traffic, if one lane is closed and flaggers are controlling traffic, which taper is used in the transition area? \_\_\_\_\_
- B. Which taper is used in the termination area? \_\_\_\_\_
- C. On this same two-way road, with two flaggers, and a speed limit of 45 mph, which signs should be used?  
\_\_\_\_\_
- D. What should be the spacing in between the signs?  
\_\_\_\_\_

**For problems 6-10, assume a 10-foot shoulder.**

**PROBLEM 6**

An urban low-speed road has an 11-foot-wide lane with a speed limit of 30 mph.

- A. How long is a shoulder taper? \_\_\_\_\_
- B. How many cones in the shoulder taper? \_\_\_\_\_
- C. How long is a merging taper? \_\_\_\_\_
- D. How many cones in the merging taper? \_\_\_\_\_
- E. How long should the buffer space be? (Table 6B-2)  
\_\_\_\_\_
- F. What is the distance between advance warning signs?  
\_\_\_\_\_

**PROBLEM 7**

An urban high-speed road has a 10-foot-wide lane with a speed limit of 45 mph.

- A. How long is a shoulder taper? \_\_\_\_\_
- B. How many cones in the shoulder taper? \_\_\_\_\_
- C. How long is a merging taper? \_\_\_\_\_
- D. How many cones in the merging taper? \_\_\_\_\_
- E. How long should the buffer space be? (Table 6B-2)  
\_\_\_\_\_
- F. What is the distance between advance warning signs?  
\_\_\_\_\_

**PROBLEM 8**

A rural road has a 12-foot-wide lane with a speed limit of 50 mph.

- A. How long is a shoulder taper? \_\_\_\_\_
- B. How many cones in the shoulder taper? \_\_\_\_\_

- C. How long is a merging taper? \_\_\_\_\_
- D. How many cones in the merging taper? \_\_\_\_\_
- E. How long should the buffer space be? (Table 6B-2)  
\_\_\_\_\_
- F. What is the distance between advance warning signs?  
\_\_\_\_\_

## PROBLEM 9

A freeway has a 12-foot-wide lane with a speed limit of 60 mph.

- A. How long is a shoulder taper? \_\_\_\_\_
- B. How many cones in the shoulder taper? \_\_\_\_\_
- C. How long is a merging taper? \_\_\_\_\_
- D. How many cones in the merging taper? \_\_\_\_\_
- E. What is the spacing of traffic control devices in the taper?  
\_\_\_\_\_
- F. What is the distance between advance warning signs on a freeway? \_\_\_\_\_

## PROBLEM 10

On a flagging operation, the urban low-speed road has an 11-foot-wide lane and a speed limit of 40 mph.

- A. Which type of taper is used? \_\_\_\_\_
- B. What is the maximum cone spacing in the taper?  
\_\_\_\_\_
- C. What is the maximum cone spacing in the tangent?  
\_\_\_\_\_
- D. If the taper is 100' long, how many cones should be used?  
\_\_\_\_\_

## CHAPTER 5

# Flagger placement and signals

Sometimes a TTC zone with signs, signals, and/or barricades is not enough to safely control traffic around a work zone. In these cases, one or more flaggers may be necessary. The following are typical examples of the positioning of flaggers in various roadway situations.

## Flagger placement on two-way roads

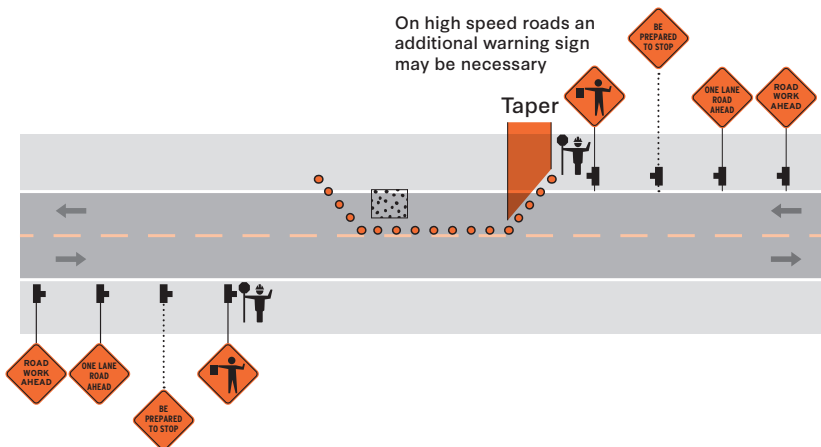
### LANE CLOSURE ON A LOW SPEED TWO-LANE, TWO-WAY ROAD (TYPICALLY 40 MPH OR LESS)

Traffic should be controlled by a flagger at each end of a constricted section of the roadway. Flaggers should stand either in the shoulder or in the closed lane.

To provide coordination of the control of traffic, flaggers should be able to communicate with each other, either electronically or with manual signals using your paddle. Flagger communication will be discussed in more detail later in this chapter. If flagging on a curve, hill, or other place with limited sight distance, flaggers must be stationed in advance of this area, and visible to approaching traffic.

### LANE CLOSURE ON A HIGH-SPEED, TWO-LANE, TWO-WAY ROAD (TYPICALLY 45 MPH OR GREATER)

For high speed roadways, an additional advance warning sign may need to be used. The example shown here would be used when four advance warning signs are used during a flagging operation.



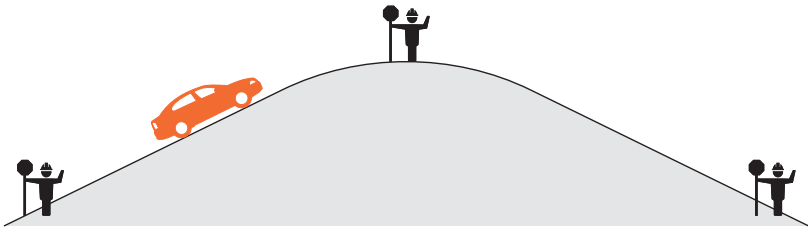
## **ROADS WITH RESTRICTED VISIBILITY**

### **Radio communications**

Two-way radios are used when flaggers on opposite ends of the TTC zone cannot see each other, or when radio messaging can enhance visual communication. If radio contact fails, flaggers should stop all traffic until it is reestablished. Communication should be brief, clear, and to the point — do not use radios for personal communication. Extra batteries should be kept on hand and easily accessible.

### **Hills and curves**

When flagging near a hill, you should take a position before the top (apex/crest), or in advance, of the hill, making sure you are visible to approaching traffic. Never take a position over the crest of a hill.



When flagging near curves, always make sure that you are visible to approaching traffic. The flagging station should be placed well in advance of the curve. Never take a position around a sharp curve. In some cases, additional signs or channelizing devices may be necessary to alert drivers to the presence of the work zone.



## **Driveways or crossroads**

Advance warning signs are required when traffic enters a roadway from a driveway within the TTC zone. This might occur when the work is taking place in a residential area, business, or shopping center. A flagger is necessary to control and release traffic entering and exiting these areas. This flagger will need to coordinate with the lead flagger so they know when it's safe to release traffic. When the TTC zone blocks a single driveway, such as in a residential area, the work crew may assist in escorting vehicles in and out.

Members of the work crew may not always be available to alert flaggers to the presence of trucks and other work vehicles as they travel in and out of the work area. If vehicles frequently travel in and out of the work area, an additional flagger or other personnel may be stationed there to coordinate the flow of traffic and communicate their presence to other flaggers. Because every work zone is different, it is important to coordinate these details with your supervisor and fellow flaggers and workers before work begins.

## **Advance flaggers**

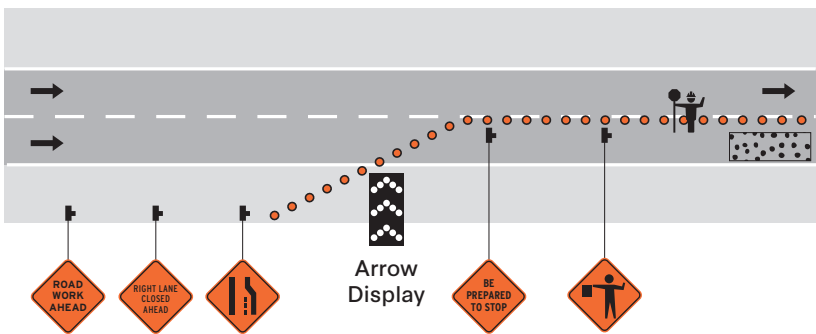
Advance flaggers are used when approaching motorists cannot see a work space due to hills, curves, or other hazards, or when special instructions need to be given to road users well in advance of the work space. The advance flagger station must be preceded by the appropriate warning signs.

## **One-lane, two-way traffic control using three flaggers**

Occasionally, three flaggers might be required in complex situations where visibility is restricted due to equipment, the work taking place, or road features such as curves or hills. When three flaggers are used, the lead/most experienced flagger should be placed in the middle to control the flagger operation. Communication between flaggers is critical under these conditions. The best way to maintain communications is with two-way radios.

# Flagger placement on one-way roads

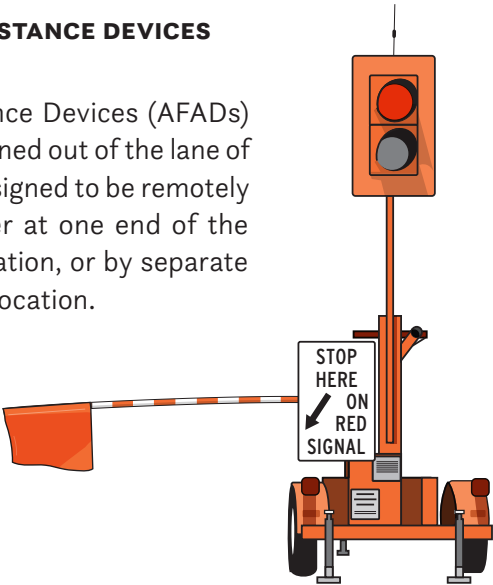
Even if traffic does not need to be constantly controlled by a flagger, one may be necessary to facilitate the movement of equipment onto or off of the work zone. In this situation, the BE PREPARED TO STOP and Flagger symbol signs are added to the advance warning sequence and the flagger stands in the closed lane, ahead of the work area. The signs must be removed, covered, or turned around when the flagger’s activity at this post is complete.



# Other methods used to control traffic

## AUTOMATED FLAGGER ASSISTANCE DEVICES (AFADS)

Automated Flagger Assistance Devices (AFADs) enable a flagger to be positioned out of the lane of traffic. These devices are designed to be remotely operated by a single flagger at one end of the TTC zone or at a central location, or by separate flaggers near each device’s location.



*According to the MUTCD, AFADs shall only be used in situations where there is only one lane of approaching traffic in the direction to be controlled. When used at night, the AFAD location shall be illuminated. Because AFADs are not traffic signals, they shall not be used as a substitute or replacement for a continuously operating TTC signal. AFADs shall meet the crashworthy performance criteria contained in section 6L.02 of the MUTCD.*

### **ONE-LANE, TWO-WAY TRAFFIC CONTROL WITH A TEMPORARY TRAFFIC CONTROL SIGNAL**

Temporary portable traffic signals may be used to control vehicular traffic movements in one-lane, two-way TTC zones.

Temporary traffic control signals should only be used in situations where they're preferable to other means of traffic control (such as changing the TTC zone to eliminate one-way traffic, using flaggers, using STOP or YIELD signs, or using warning devices alone). (MUTCD 6L.01)

### **ONE-LANE, TWO-WAY TRAFFIC CONTROL WITH STOP OR YIELD SIGNS**

STOP or YIELD signs may be used to control traffic on low-volume roads for a one-lane, two-way TTC zone, if drivers are able to see the other end of the one-lane, two-way operation, and approaching vehicles are sufficiently visible.

If the STOP or YIELD sign is installed for only one direction, the STOP or YIELD sign should face road users who are driving on the side of the roadway that is closed for the work activity area.

### **PILOT CARS**

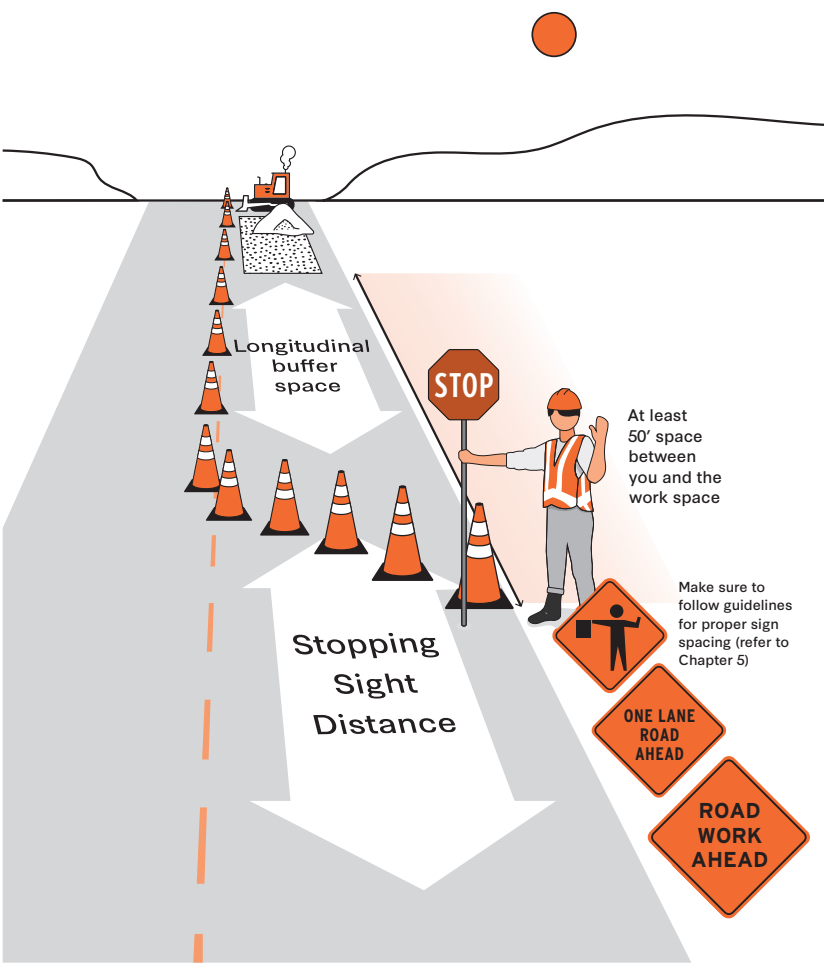
A pilot car is used to guide one-way traffic through or around a particularly hazardous or long road construction or maintenance project. During this type of operation, flaggers stationed at either end of the TTC zone coordinate operations and hold traffic.

The pilot vehicle must be lightweight and easy to maneuver, with a PILOT CAR FOLLOW ME sign mounted on its rear. The name of the contracting authority should also be clearly visible on the vehicle.

This type of operation requires ample turn-around room for the pilot vehicle at the end of each section. In the case of a difficult or hazardous detour, two or more pilot vehicles may be used.

**The flagger station**

Choosing a proper flagger station is key to your safety, and that of everyone in the work zone. You must be visible to road users, allow them enough distance to react to your signals, and have a route of escape in case of emergency.



**GUIDELINES FOR POSITIONING AND VISIBILITY**

Before positioning yourself, make sure that you are wearing the proper safety apparel and have the right equipment for the situation and time of day.

Your position should be far enough in advance of the work space that vehicles have time to stop, and you will have adequate time to warn other workers if an out-of-control vehicle enters the work zone. The next section provides specifics on calculating your position as a function of vehicle stopping distance, but the flagger should always be a minimum of 50 feet ahead of the work space.

Your correct flagging position is at the edge (shoulder) of the road or in the closed lane behind the channelizing devices, where you can be easily seen by the line of approaching vehicles.

Stand so that you can see both the approaching traffic and the work space. Usually, this means positioning your body so your feet and hips face the opposite side of the road and your toes are pointed at the edge line.

When there are two or more flaggers, they should be able to see each other clearly. If that is not possible, two-way radios should be used for communication. (Procedures for how to direct traffic if radios don't work should be discussed in your job site briefing.)

You should always stand alone. Never permit a group of workers to congregate around the flagger station.

Stand where there is a sharp color contrast between you, the background, and the equipment. Avoid standing in the shade, if possible. Never lean, sit, lie on, or flag from inside of a vehicle.

Park your own vehicle away from the flagging station, so it won't trap you during escape. Place your lunch or other personal items well out of the way so they will not distract drivers or block your escape route. Do not leave any litter or trash at your flagger station.

## **GUIDELINES FOR MOVING INTO THE LANE OF TRAFFIC, WHEN NECESSARY**

You should avoid stepping into the traffic lane if at all possible. However, it may be difficult for vehicles following large vehicles, such as trucks or buses, to see you. To stop additional vehicles, you may have to move towards the centerline.

- Maintain eye contact with the driver of the first vehicle to be sure of a complete stop before moving into the lane of traffic.
- Remain on your side of the centerline.
- Do not turn your eyes away from approaching vehicles.
- Do not release the line of stopped vehicles to go until you have returned to your proper road shoulder flagger position.

### **CAUTION**

**Moving into the traffic lane should be a last resort. A flagger should only stand in the lane being used by moving road users after they have come to a complete stop.**

## **FLAGGER STATIONS AS A FUNCTION OF STOPPING DISTANCE**

*Flagger stations shall be located such that approaching road users will have sufficient distance to stop at an intended stopping point.*

*(MUTCD 6D.06)*

There must also be enough additional space to allow an out-of-control vehicle to stop without entering the work space, and/or for workers to be warned and clear the area.

### **CAUTION**

**Under no circumstances should the flagger station ever be less than 50 feet from the work space.**

STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED (TABLE 6B-2 MUTCD)	
Speed (mph)	Distance (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

*\*Posted speed, off-peak 85th percentile speed prior to work  
starting or the anticipated operating speed.*

The distances shown here should be increased for downgrades and other conditions that affect stopping distance.

**CONTROL ONLY ONE LANE AT A TIME**

When working on a multilane roadway, you may stop only one lane of traffic. Trying to stop more than one lane of traffic would be hazardous and confusing for both you and the drivers. This is especially important to remember if you’re flagging near an intersection with turn pockets.

**ROAD WIDTHS AND VEHICLE DIMENSIONS**

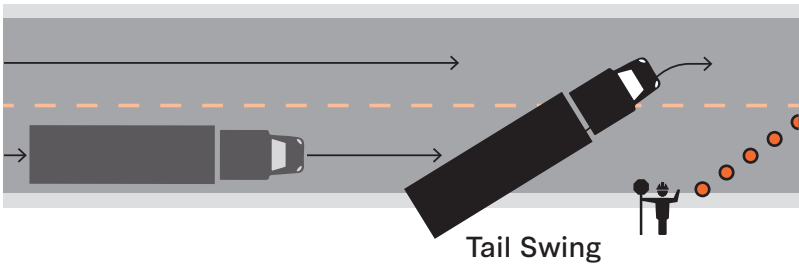
Not all roadways are the same width. Rural and city streets may be as little as 8 feet wide, while freeways and many highways may have lanes that are a generous 12 feet in width.

Vehicles on the road also vary from a 5-foot-wide compact car to an 8½-foot-wide semi-truck.

To accommodate traffic that includes many larger vehicles, the flagger should be positioned slightly further away from the work area and create a visual stopping line ahead of them (for example, by using cones) to indicate where drivers should stop.

**CAUTION**

**Large vehicles may encroach on the shoulder of the road and endanger the flagger, especially if they must negotiate a turn.**



Pay special attention to long vehicles like buses, RVs, semi trucks, and those towing trailers or other attachments. They need more room to maneuver, and may have tail swing, which is when the rear of the vehicle swings in the opposite direction from the front of the vehicle as it turns. The speed of the tail swing can be up to four times as fast as the speed the vehicle is traveling. For your own protection, position yourself outside of the tail swing area.

**NIGHTTIME FLAGGING**

Illumination and retroreflective equipment are the keys to safe night flagging.

*In most states, nighttime is defined as ½ hour before sunset until ½ hour after sunrise.*

*Remember, if you are flagging in a work zone at night, your flagging station shall be illuminated. (MUTCD 6D.06)*





*During emergency nighttime flagging operations in a non-illuminated station, it's recommended that you use a flashlight with a red glow cone to supplement the STOP/SLOW paddle or flag. (MUTCD 6D.04)*

Whether you're flagging in an illuminated work zone or performing emergency flagging operations (emergency means an unforeseen occurrence endangering life, limb or property), you should always use proper retroreflective apparel and equipment. Staying visible to road users can be a matter of life and death.

### **EMERGENCY ESCAPE ROUTE**

Your flagging station should have a clear route of escape in case a vehicle threatens your safety. The route of escape should be at 90 degrees to the direction of traffic.

You should never have any type of barrier, guardrail, parked vehicle, equipment, trip hazards, or other obstruction between you and your escape route.

In the event that you must make an emergency escape, do not attempt to carry the paddle — drop it away from your direction of exit. When leaving the station, exit at 90 degrees to the path of the oncoming vehicle.

If your flagging station does not allow an escape route, notify your supervisor and relocate your position to a safer one. If this is not possible, barriers should be used to redirect vehicles away from the work zone and provide workers with additional protection against vehicle intrusions. An Automated Flagger Assistance Device (AFAD) may also be considered for this type of operation.

### **ELEVATED ROADWAYS**

Although flagging from bridges or elevated roadways is allowed, it is not recommended. Directing traffic on an elevated roadway or a roadway under an overpass does not allow the flagger an avenue of escape. It is also hard to see a flagger in the shadows cast by an overpass.

### **ALARM SIGNAL**

If a vehicle fails to respond to your directions and enters the work zone, you must alert other workers by sounding a prearranged alarm. This should be an audible signal, such as a whistle or air horn, that can be heard above the noise of the work machinery. This alarm must be understood by all workers. Flaggers should notify or brief workers to plan for an emergency response when the flagger's whistle is blown or air horn is sounded.

### **DO NOT LEAVE YOUR STATION**

If you are holding the STOP/SLOW paddle, you are an “active flagger,” and flagging is the only duty you're allowed to perform until you are properly relieved. Leaving your station endangers the lives of both road users and workers.

Never leave your flagging station for any reason until you are relieved by your supervisor or a qualified flagger.

## Flagging signals

Flaggers must be able to clearly, firmly, and courteously direct road users using well understood hand signals. Hand signals are often used in conjunction with a STOP/SLOW paddle, but at nighttime or in other emergency situations other equipment may be necessary.

### **HAND-SIGNALING WITH THE STOP/SLOW PADDLE**

These specific flagger signals are required by the MUTCD. These signals may not be modified or abbreviated.

### **WORKING WITH ANOTHER FLAGGER**

Two-way radios should be used for communication when working with another flagger. If radios are not available, you need to use recognizable paddle signals. When paddle signals are used, you must take extra steps to ensure the other flagger has received and understands your message.

#### **Here is one example of this type of communication:**

- Before you release a line of stopped traffic, you must request permission from the other flagger. Do this by pumping your paddle up and down, as if asking, “Mother may I?”
- Once the traffic on the other end of the work zone has been safely stopped, the other flagger will respond, “Yes, you can” by waving their paddle back and forth.
- Once you’ve been given permission, you will want to do a scan to make sure the roadway is clear and safe for traffic to pass before releasing your line of traffic.

There may be other hand gestures that are used to convey different things; you should discuss these with your team/supervisor.

### **WHEN YOU ARE AN “ACTIVE FLAGGER”**

Remember, if you are holding the STOP/SLOW paddle, you are an “active flagger,” and flagging is the only duty you’re allowed to perform until you are properly relieved. Leaving your station endangers the lives of both road users and workers.



## STOP

To stop road users, the flagger shall face road users and aim the STOP paddle face toward road users in a stationary position with the arm extended horizontally away from the body. The free arm shall be held with the palm of the hand above shoulder-level toward approaching traffic. (MUTCD 6D.05)

## PROCEED

To direct stopped road users to proceed, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body. The flagger shall motion with the free hand for road users to proceed by moving the free hand horizontally left to right. (MUTCD 6D.05)



## To ALERT or SLOW traffic

To alert or slow traffic, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position, with the arm extended horizontally away from the body.



To further alert or slow traffic, the flagger holding the SLOW paddle face toward road users may motion up and down with the free hand, palm down. (MUTCD 6D.05)

## EMERGENCY FLAGGING SITUATIONS

### Nighttime

During emergency nighttime flagging operations in a non-illuminated station, a flagger may use a flashlight with a red glow cone to supplement the STOP/SLOW paddle or flag.

#### STOP signal with a flashlight

To inform road users to stop, the flagger shall hold the flashlight with the left arm extended and pointed down toward the ground, and then shall slowly wave the flashlight in front of the body in a slow arc from left to right such that the arc reaches no farther than 45 degrees from vertical.



#### PROCEED signal with a flashlight

To inform road users to proceed, the flagger shall point the flashlight at the vehicle's bumper, slowly aim the flashlight toward the open lane, then hold the flashlight in that position. The flagger shall not wave the flashlight.



#### To ALERT or SLOW traffic with a flashlight

To alert or slow traffic, the flagger shall point the flashlight toward the oncoming traffic and quickly wave the flashlight in a figure eight motion.

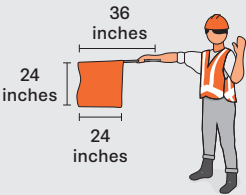


*All of these can be found in (MUTCD 6D.04)*

### Signaling with a red flag

**CAUTION**

The use of red flags should be limited to emergency situations. If possible, you should always use a STOP/SLOW paddle.



Flags shall be red or fluorescent orange/red in color, retroreflectorized at night, shall be a minimum of 24 inches square, and shall be securely fastened to a staff that is approximately 36 inches in length. The flag should be weighted so the flag will hang vertically, even in heavy winds.

### STOP with a red flag



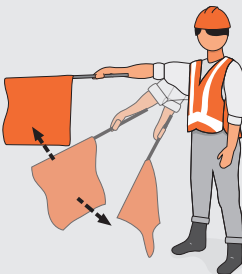
To stop road users, the flagger shall face road users and extend the flag staff horizontally across the road users' lane in a stationary position, so that the full area of the flag is visible hanging below the staff. The free arm should be held with the palm of the hand above the shoulder-level toward approaching traffic.



### PROCEED with a red flag

To direct stopped road users to proceed, the flagger shall stand facing road users with the flag and arm lowered from the view of the road users, and shall motion with the free hand for road users to proceed. Flags shall not be used to signal road users to proceed.

### To ALERT or SLOW traffic with a red flag



To alert or slow traffic, the flagger shall face road users and slowly wave the flag in a sweeping motion of the extended arm from shoulder-level to straight down, without raising the arm above a horizontal position. The flagger shall keep the free hand down.

All of these can be found in MUTCD 6D.03

## KEY POINTS TO REMEMBER

- ◆ When choosing the location of a flagger station, you should choose a location that provides you with an \_\_\_\_\_.
- ◆ When stopping traffic using a STOP/SLOW paddle, stand on the shoulder and aim the STOP paddle face toward the road user. Your free arm should be held with the \_\_\_\_\_ above the shoulder, toward approaching traffic.
- ◆ While actively flagging from a designated flagging station, you may not leave to set up signs or assist with the establishment of additional traffic control features.
- ◆ Flagging on bridges or elevated roadways is not recommended.
- ◆ When flagging on a multilane roadway, you may stop only \_\_\_\_\_ lane of traffic at a time.
- ◆ Make sure to agree on signals and methods of communication when coordinating traffic control measures on opposite ends of a closed lane.
- ◆ Stand where there is a sharp color contrast between you, the background, and the equipment.

## CHAPTER 6

# **Ensuring safety in the work zone**



**F**laggers are responsible for the safety of all road users, flaggers, and other workers in the work zone, which is a dangerous and often complex situation. Road users are looking for direction, and other workers in the work zone will be focused on their own work. You must be able to clearly communicate information to these different groups and coordinate with other flaggers to ensure everyone's safety.

## **Briefings for personnel**

You should always familiarize yourself with the work space before starting a flagging job. Depending on the road or project owner, job sites may have specific rules or requirements that go above and beyond state and federal regulations. Some companies or project owners may require you to participate in extra safety briefings or training sessions before beginning work. Your employer will let you know if this is the case.

Flagging crews don't always work directly for the contractor. Check with your supervisor to ensure that you are properly briefed on the safety protocols required by the site and/or contractor.

### **The project manager (contractor or supervisor) should brief the flagger and work zone personnel on the following:**

- The activities to be performed in the work zone on their shift
- The flaggers' responsibilities
- Emergency signals from the flagger (air horn or whistle)
- Specific work zone hazards
- Protective equipment to be worn while on site
- Planned equipment and vehicle movements

The work area is a busy place, and may receive frequent deliveries of supplies or other equipment. Before your shift begins, find out when these deliveries are scheduled and which company they're coming from so you can prepare for their arrival and recognize them. You may need to get this information from the foreman or another work crew member.

When not actively flagging, you may be asked to assist with the establishment of TTC zone elements or participate in other duties, such as spotting. But remember—if you are actively flagging, you may not leave your station or perform any other duties until you are relieved.

## Staying alert

Your most important task as a flagger is to anticipate every reasonable hazard that could happen in the work zone. You must keep your mind on your flagging job at all times. **Always expect the unexpected.** Never assume a vehicle will stop where you intended. Daydreaming can endanger your life and the lives of road users and workers.

Standing in one spot for a long period of time can cause boredom and fatigue. It is more difficult to remain alert on a “sleepy” road that receives little traffic than it is to stay alert while flagging on a busy road. Make arrangements with the site supervisor to get appropriate breaks for relief. Eat food that gives you long-lasting energy and bring snacks to have on breaks.

Regardless of how busy the road is, you can remain active and engaged by doing your best to keep the flow of traffic smooth and consistent. It may help to think of your job as a “game,” with the goal being to perform the best that you can.

## Ensuring safety for road users

### REDUCING CONFUSION

One of the flagger’s primary responsibilities is to reduce road user confusion. A flagger operating safely in a well-planned traffic control zone will help road users stay safe and calm by:

- Communicating clear messages to drivers
- Allowing adequate time and distance for drivers to respond
- Keeping traffic congestion to a minimum
- Providing access for emergency vehicles
- Keeping traffic moving safely and as near as possible to its normal speed

## CONTROLLING THE TRAFFIC FLOW

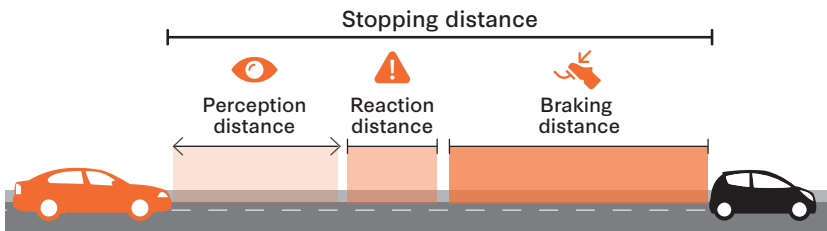
**Aspects of traffic flow that a flagger must constantly consider include:**

- Traffic volume
- Traffic speed
- Cross-traffic movement
- Pedestrian and bicycle traffic
- Visibility
- Type of road — city, county, highway, or freeway
- Road conditions — dry or wet pavement, gravel, snow, ice
- Weather

All of these can change at any time. It's a flagger's job to be alert and monitor all of these aspects of traffic flow so that they can respond properly.

## STOPPING DISTANCE

A flagger needs to be able to estimate the speed of the traffic and the distance it will take for vehicles to stop. There are four factors that affect the time it takes a vehicle to stop.



**Perception distance:** Distance traveled in the time it takes the driver to realize they need to stop.



**Reaction distance:** Distance traveled in the time it takes the driver to move their foot onto the brake pedal. This is usually  $\frac{3}{4}$  of a second or more.



**Braking distance:** The distance traveled after the brakes are engaged.



**Vehicle and road conditions:** Braking distance is affected by the speed of the vehicle, the condition of the tires and brakes, the road surface and incline, weather, the weight of the vehicle, and the weight of any load being hauled.

At 60 miles per hour on dry pavement, an average vehicle requires 366 feet to come to a complete stop.

Stopping distances vary according to road and weather conditions. Rain, fog, ice, snow, and visibility conditions can all affect a vehicle's stopping distance. On an icy road, for example, a vehicle may travel four times the distance it would require to stop on dry pavement. Larger vehicles, especially, require extra time to stop when these conditions are present.

### **CAUTION**

**For vehicles with air brakes (like large trucks), there can be a delay of a half-second or more from the time the pedal is applied until the brakes engage. These vehicles do not have the ability to stop as quickly as others do.**

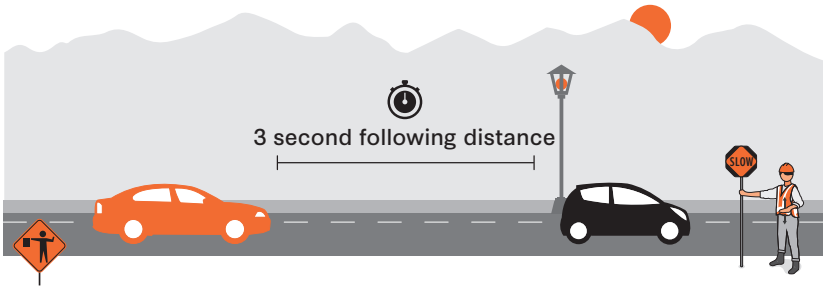
Knowing the stopping distance of vehicles on the road where you are working will help you know where to station yourself, as well as where to properly place channelizing devices and signs to safely manage traffic flow. The charts and formulas discussed earlier in this handbook are meant to help you determine these distances.

### **The 3 second rule**

No matter the stopping distance (how far a vehicle will travel before it stops), a good rule of thumb is that it will take about 3 seconds for a car to stop under normal road conditions. In adverse conditions, you need to add 1 second or more to the following distance for each condition.

You can use the 3 second rule to identify whether vehicles are following each other too closely, and to help pace traffic through the work zone.

To measure the following distance in seconds, watch a vehicle pass a specific stationary object. Count the seconds until the front bumper of the next vehicle reaches the object. If it is less than 3 seconds, you should give the SLOW DOWN signal so that they are properly spaced as they drive through the work zone.



Add +1 second for EACH adverse condition



Weather



Reduced  
traction on  
road surface



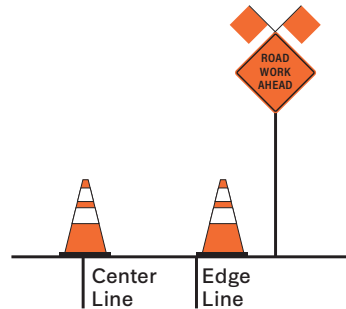
Low visibility



Large vehicles

### IF YOU NOTICE RECURRING PROBLEMS

If you notice that drivers are repeatedly going too fast and/or following too closely, and your SLOW DOWN signals do not resolve the problem, you should talk to your supervisor about modifying TTC zone elements to improve traffic flow. Examples might include:



- Increasing the size of advance warning signs.
- Placing two warning flags on top of each advance warning sign.
- Placing either a type A or B flashing warning light on each advance warning sign.
- Placing cones next to each advance warning sign on the edge line and on the centerline if needed.

## Traffic hazards

Although it is the flagger's responsibility to protect all road users, it is equally important that you remain mindful of your own safety and that of other workers. You should be aware of common traffic hazards you're likely to encounter. Occasionally, when a driver's behavior is putting others at risk, you may be required to intervene.

## **DRIVER INATTENTION**

Work zones are confusing, and drivers are often distracted. Drivers who frequently travel a section of road or are fatigued may be traveling on “auto-pilot,” not noticing the changes of driving patterns in the TTC zone. Confused drivers may also become “fixed” on the flagger—who can then become the driver’s unintentional target. An inattentive or confused driver is very likely to invade the work zone despite the signs and the flagger’s efforts.

When stopping traffic, make sure you maintain eye contact with the driver of the first vehicle until they come to a complete stop. Drivers are looking for guidance in these unfamiliar situations, and will look for signs if they don’t receive a clear signal from you. If you look away, or fail to successfully communicate, the driver may see another flagger’s SLOW sign in another area of the TTC zone and decide to proceed rather than stop.

### **CAUTION**

**Never assume the driver can see you, even if they seem to make eye contact.**

## **DRIVERS UNDER THE INFLUENCE**

Drivers who have used drugs (prescription or otherwise) and/or alcohol are a particular hazard to flaggers. They may be drowsy or slow to react to a flagger’s signal. Drivers affected by alcohol are more common in the late afternoon and evening when people are heading home after an evening out.

## **IF A VEHICLE OVERSHOOTS THE FLAGGING STATION**

Always have an escape route in mind and be ready to alert the crew with your audible warning signal. If a motorist disobeys your STOP signal and keeps going, use your escape route if necessary and alert your crew. You may need to use your escape route to protect yourself. Never attempt to slow or stop the car by jumping in front of it. When everyone is safe, note the license number and a description of the vehicle and driver. Report the information to your supervisor.

**CAUTION**

**If the car overshoots the flagging station but comes to a stop, never walk behind the car. The driver may unexpectedly move the vehicle.**

**ANGRY MOTORISTS**

Flaggers are charged with the road users' safety, but road users may not see it that way. Traffic delays can cause hostility and frustration that sometimes result in verbal abuse. The motorist is generally not angry with the workers, but with the interruption and inconvenience.

As a representative of the crew and company, you must exercise restraint and work to calmly diffuse the situation.

A good rule of thumb is stay calm, agree with the driver, and de-escalate the situation.

**You can help reduce the road users' anxiety and win their support by:**

- Staying aware of all expected delays, when they will occur, and how long they will last. You can pass this information on to the driver and possibly prevent them from becoming angrier.
- Being as pleasant as possible toward the angry road user. It is harder for the motorist to be upset with a worker who is polite.
- Not challenging the road user regardless of how irrational or irate their statements may be.
- Apologizing to the road user for the inconvenience, and expressing your understanding for their frustration. It may have a calming effect on the angry road user if they know somebody cares about the reason they are upset.
- Avoiding extended eye contact with a hostile road user, while keeping them under surveillance and watching for any sudden hostile movement.

**CAUTION**

**Do not provoke or elevate a hostile situation. Never strike out at, or be abusive to, motorists or a vehicle. This may result in official (criminal/civil) action being taken against you.**

## **Work zone hazards**

In addition to traffic, hazards present within the work zone should be taken into consideration when performing flagging operations.

### **MOVEMENT OF EQUIPMENT**

Flaggers and workers-on-foot have been severely injured or killed due to the sudden and uncoordinated movement of heavy equipment on a construction site. You must be aware of not only the moving traffic on the roadway, but also any movement of equipment in the work zone that may endanger you.

### **HEARING DAMAGE**

Hearing protection, such as ear plugs, should be worn whenever noise levels reach 85 decibels (dB). Short duration exposure to high noise can be acceptable depending on frequency and intensity. High volume freeways frequently exceed the 85 dB level. As a general rule, hearing protection will be made available by the site manager if high noise levels are recognized.

### **OVERHEAD HAZARDS**

When overhead utility lines are being worked on, position yourself away from the path of potential hazards caused by falling utility lines. Downed utility lines should be treated as if they are “live,” and you should direct traffic from a safe distance of the downed lines.

## **Hazards from weather exposure**

Depending on the time of year, you may experience hot, dehydrating temperatures reflected by the roadway, or icy winds that may cause your hands and feet to become stiff with cold. It is vital that you take precautions to protect yourself from heat and cold.

### **HOT WEATHER**

Health problems resulting from high temperatures include heat exhaustion and heat stroke. You can help prevent heat-related injuries by drinking plenty of water and wearing well-ventilated clothing.



**Sunburns** are not only painful, but can lead to deadly illness such as malignant melanoma (skin cancer). Sunscreen application is recommended on cloudy days as well as sunny days. Clouds do not stop the light that causes sunburn.

For maximum protection and effectiveness, apply the sunscreen to all exposed parts of your body 15 minutes before your skin is exposed to the sun. You may need to reapply at various times throughout the day.

**Heat exhaustion** is dehydration due to overheating. This can occur even in mild temperatures if you are overdressed and sweat too much without hydrating properly.

Signs of heat exhaustion include heavy sweating, clammy skin, nausea, and weakness.

In its early stages, heat exhaustion is treated by having the person rest, retreat from the heat, and drink water. Electrolyte replacement drinks are beneficial if available, but do not use salt tablets. If the person is unconscious or unable to drink water, call 9-1-1.

**Heat stroke** is severe overheating of the body's core. It can develop from heat exhaustion, extreme high temperatures, the body's inability to sweat, or clothing that does not "breathe."

Signs of heat stroke include high body temperature (103 degrees or higher), headache, nausea, altered mental status, and loss of consciousness. A person with heat stroke will die if not cooled immediately. Pour water over the victim's head, neck, and torso. Once the victim's mental status has improved, cool slowly. Someone with heat stroke should always be seen at the emergency room.

### **Heat and humidity**

Humidity compounds the body's experience of heat. In a humid environment, a temperature that seems to only require caution can actually be dangerous. For example, if the true temperature is 88° F and the relative humidity is 80%, it will feel like 106° F. It is recommended that you check the weather forecast to see what the temperature and humidity levels are each day.

## COLD WEATHER

Extremely cold temperatures can result in hypothermia or frostbite. You can prevent cold-related injuries by eating well, staying active, staying dry, and dressing in layers. Wear wool or synthetic clothing instead of cotton. Do not wear tight clothing.

Early signs of mild **hypothermia** include uncontrollable shivering, pale skin, and slightly altered mental status. Signs of severe hypothermia include an inability to shiver and severely altered mental status (even unconsciousness). Treat hypothermia by removing the individual from the cold and following first aid training guidelines. Do not attempt to re-warm the severely hypothermic person in the field; call for an ambulance or immediately transport them to a hospital.

**Frostbite** is caused by frozen water in the skin tissues. In early frostbite, the skin may appear white, waxy, and numb. It can be warmed by placing a hand over it, placing the frostbitten part against warm skin, or placing it in warm (105° F) water. Late frostbite will be stiff to the touch. It should be re-warmed at the hospital and not in the field. Do not rub any frostbitten part with snow or hold it over hot air from a fire or heater.

### Wind chill

The human body radiates heat, and wind carries this surrounding heat away from the body. As wind velocity increases, more heat is carried away, making it seem colder than the actual temperature. Wind chill is the relationship between wind speed and true temperature expressed as an estimated temperature. For example, if the true temperature is 20° F and the wind is blowing at 15 mph, the wind chill will be 6° F.

## DEHYDRATION

### CAUTION

**Many flaggers report suffering from dehydration, or loss of body fluids, while on the job. Dehydration can occur in all types of weather.**

Symptoms of dehydration include thirst, dry mouth, headache, dizziness, and lethargy. Severe dehydration can result in delirium or loss of consciousness, but even mild dehydration can result in impaired judgement. Your body may be affected by lack of fluids before you feel thirsty. Therefore, it's important to hydrate throughout the day.



Bring an equal amount of water and electrolyte replacement drinks with you to the worksite (electrolyte drinks can actually make you ill if you drink too much).



Have enough water on hand to cover your entire shift.



Caffeine has a dehydrating effect. Avoid drinking coffee, sodas, or energy drinks with caffeine unless you are balancing them with adequate amounts of water.

## Equipment movement and spotting

Equipment movement within the work zone represents a hazard to all workers on foot, including flaggers with their backs to the work zone. Flaggers should be aware of all vehicle and equipment movement in the work zone. To prevent crashes and injuries in the work zone, vehicles should be equipped with a back-up alarm and flashing lights, and should sound their horn before equipment is moved.

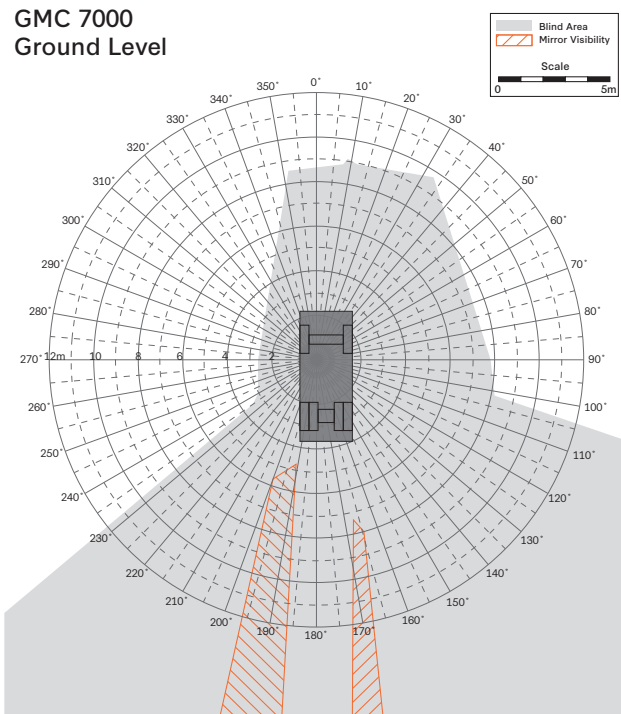
It is also advisable to use a spotter/observer. This can be any individual at the construction site, except a person performing the duties of a flagger, and must:

- Be in direct line-of-sight, or able to communicate with the driver.
- Be able to see the entire backing zone.
- Agree with the driver on hand signals before the vehicle backs up.
- Alert other personnel to the movement of equipment and clear the path for the equipment's movement.
- Continue to provide direction to the driver until the driver reaches the destination. The driver should stop immediately if they lose sight of the spotter.

- Not perform any additional duties while they are acting as a spotter.
- Not use a personal mobile phone, personal headphones, or other items which could pose a distraction during spotting activities.

*(Part of this information comes from U.S. Occupational Health and Safety Administration, “Preventing Backovers”)*

Almost all vehicles have blind spots, or space around the vehicle that is not visible in the operator’s line of sight or via the vehicle’s mirrors or cameras. This is especially true of the large vehicles and equipment that operate within the work zone—the larger the equipment, the larger the blind spots. For your own safety, you must avoid standing in places where the operators of these vehicles might not see you. In general, if you can’t see the operator, they can’t see you.



*(This chart comes from “Highway Work Zone Safety: Construction Equipment Visibility” from the National Institute for Occupational Safety and Health)*

The chart shown here provides one example of how to determine the size of a GMC 7000 truck’s blind spot. All of the greyed-out area falls within the blind spot. If you stand within this area, the vehicle’s operator will not be able to see you. Each vehicle or piece of equipment has its own unique blind spots. The National Institute for Occupational Safety and Health (NIOSH) has blind spot diagrams for common construction vehicles available online.

**Suggested spotting signals**

Back up



Back, turn left



Back, turn right



Move forward



Distance remaining to back



Slow down



## KEY POINTS TO REMEMBER

- ◆ When dealing with an angry motorist, you should remain calm, \_\_\_\_\_ with the driver, and de-escalate the situation.
- ◆ If a driver disobeys your STOP signal and keeps going, warn your coworkers and protect yourself by using an escape route.
- ◆ Be aware of vehicles moving in and out of, and within, the work zone. Remember that all vehicles have blind spots, and the drivers of these vehicles may not be able to see you.
- ◆ Extreme hot temperatures can result in heat exhaustion or heat stroke. Extreme cold temperatures can result in frostbite or hypothermia. Dehydration can occur in all types of weather.



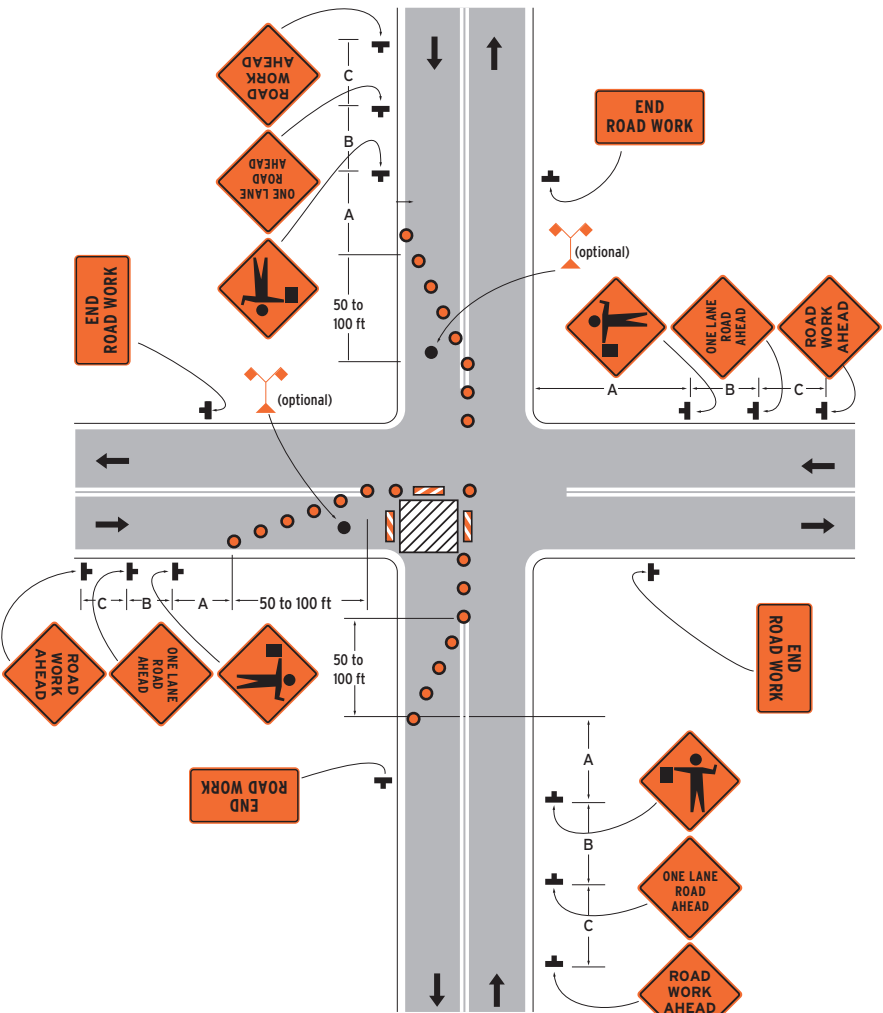
## CHAPTER 7

# **Intersections, railroad crossings, and roundabouts**



Work or road closures that take place at intersections, railroad crossings, and roundabouts require special attention due to their complex nature. In some cases, coordination with other agencies may be required.

Intersections



Typical Application 27

### **CLOSURE AT THE SIDE OF AN INTERSECTION**

If work is being done in an intersection, flaggers may be necessary to help traffic navigate the TTC zone.

Because of the complexity of this type of situation, you should be briefed at a team pre-meeting where you agree on proper communication protocol. A supervisor should lead the operation.

### **CLOSURE AT THE SIDE OF AN INTERSECTION**

- The situation depicted can be simplified by closing one or more of the intersection approaches. If this cannot be done, and/or when capacity is a problem, through vehicular traffic should be directed to other roads or streets.
- Even for short-duration work operations, all channelizing devices and signs must be used when flaggers are present.
- A BE PREPARED TO STOP sign may be added to the series.
- When used, the BE PREPARED TO STOP sign should be located before the Flagger symbol sign.
- Turns can be prohibited as required by vehicular traffic conditions. Unless the streets are wide, it might be physically impossible to make certain turns, especially for large vehicles.
- Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity rotating, flashing, oscillating, or strobe lights, but may be used to supplement them.
- Nighttime safety procedures need to be implemented if the operation is taking place at night.

## **Roundabouts**

When work is being performed within a roundabout, warning signs are required for each approach leg. If the work operation and all work vehicles are out of the travel lanes and the central island apron, a Road Work Ahead sign per approach is all that is required.

If any of the road approaches to the roundabout cannot access the intersection due to work operations, either flagging or a detour is required. If the central island apron will be impacted by the work or equipment, treat it as a shoulder closure for the

length of the work and consider diverting truck traffic due to large vehicle wheel tracking.

For multilane roundabouts, flaggers may not be necessary if work can be done without closing both travel lanes. Appropriate signs for lane closure at each entry are required. Since all roundabouts are unique, a TCP must be developed for each roundabout specific to its location.

Most cities and counties will require a TCP if work is to be done in or near a roundabout.

**Figure 6P-53. Flagging Operation on a Single-Lane Circular Intersection (Typical Application 53)**

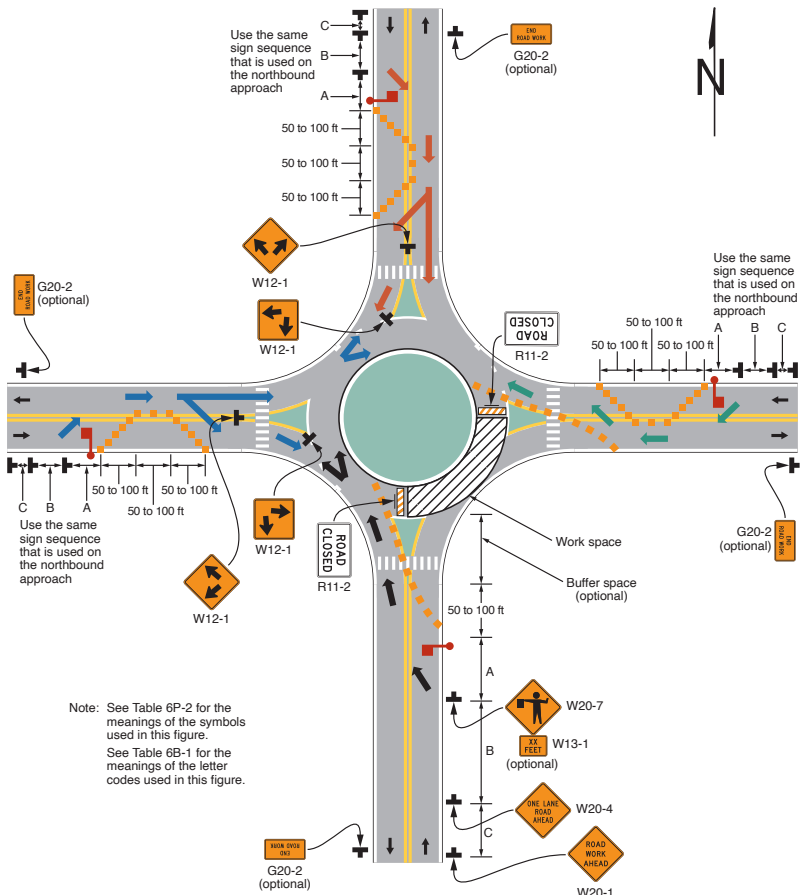
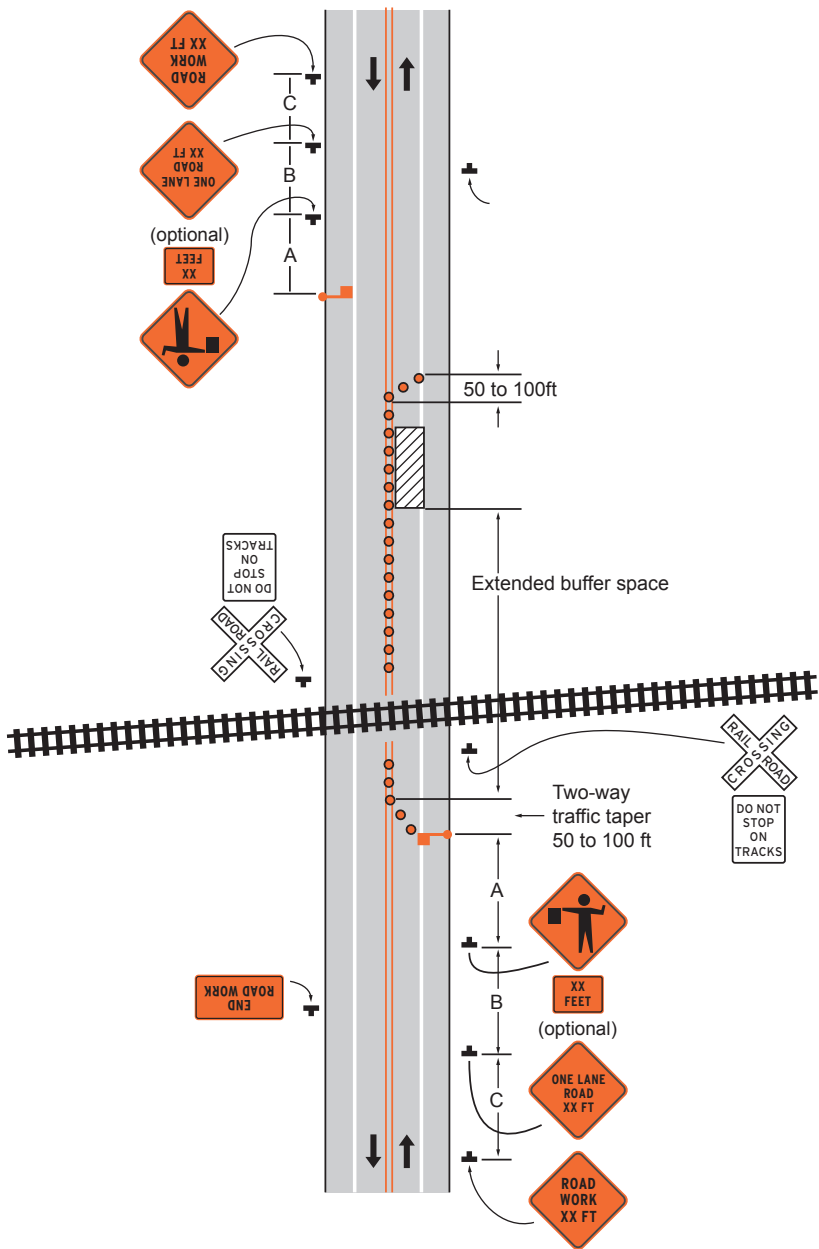


Figure 6P-46. Work in the Vicinity of a Grade Crossing  
(Typical Application 46)



## Work in the vicinity of a railroad or light rail grade crossing

*When a railroad or light rail transit (LRT) grade crossing exists either within or in the vicinity of a TTC zone, lane restrictions, flagging, or other operations shall not be performed in a manner that would cause highway vehicles to stop on the railroad or LRT agency tracks.*

*Exceptions may be made if a flagger or uniformed law enforcement officer is stationed at the grade crossing to minimize the possibility of highway vehicles stopping on the tracks. The grade crossing is considered to be 15 feet on either side of the closest rail and farthest rail.*

(MUTCD 6N.17 and 8A.13)

### CAUTION

**Never stop traffic on the tracks when flagging in the vicinity of a railroad or grade crossing.**

### WORK IN THE VICINITY OF A GRADE CROSSING

You may be required to go through additional training and carry an additional card in order to perform flagging duties in the vicinity of a railroad crossing. This photo ID badge is usually obtained by completing an online Contractor Orientation Course, which is an annual training. You may be required to take more than one course. Your employer will let you know where you need to go to take this training.

Note that you will be required to have special personal protection clothing and equipment in order to flag at a grade crossing. You will learn about this in your training.

Often, you will also be working with a flagger provided by the railway. Railway flaggers maintain constant communication with the rail line.

In the example depicted, the buffer space of the activity area should extend upstream of the grade crossing (as shown) so that a queue created by the flagging operation will not extend across the grade crossing.

- The DO NOT STOP ON TRACKS sign should be used on all approaches to a grade crossing within the limits of a TTC zone.
- Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
- A BE PREPARED TO STOP sign may be added to the signs.
- When used, the BE PREPARED TO STOP sign should be located before the flagger symbol sign.
- At night, flagger stations shall be illuminated, except in emergencies.

### KEY POINTS TO REMEMBER

- ◆ In many states, only uniformed law enforcement officers are authorized to control traffic in the middle of an intersection.
- ◆ **Never** stop traffic on the tracks when flagging in the vicinity of a railroad or grade crossing.



-----

# Conclusion



**A**lthough this training may not cover every possible scenario you'll encounter while on the job, it has prepared you to confidently and competently work as a flagger. Keep this handbook in an easily accessible place (such as your vehicle's glove box) in case you need to refer to it. Some additional points to remember include:

- Your flagger certification is good for 3 years. Keep your flagger card with you at all times, and make plans to attend a flagger certification class every 3 years to keep your certification up to date.
- Check the weather before heading to the work site, and make sure your ANSI-approved gear is suitable for the expected conditions. You may want to keep a change of clothes on hand for emergencies.
- Make sure your required equipment is in good condition, and meets the state and local requirements for use in the areas where you will be flagging.
- Prepare an “essentials” bag or kit to bring with you to the job site. Refer to the checklist in Chapter 1 for a list of recommended items to include.
- Get clarification from your supervisor or the site foreman if you have questions about policies, procedures, equipment, or other concerns.

# Review exercises

## PROBLEM 11

**Location:** Two lane-two way rural road

**Work operations:** Utility Excavation—broken water main repair.

The water utility must expose a broken water main which will require closing 5 feet adjacent to the shoulder of the northbound lane. The job is estimated to take 8 to 10 hours and will start at 5:00 PM. The lanes are 11 feet wide and the shoulders are 7 feet wide. The speed limit is 45 mph. Traffic volumes are heavy between 4:00 PM and 6:00 PM.

- A. Indicate the four areas in the Traffic Control Zone.
- B. Show the warning sign types, placement, and distance.
- C. Show taper and tangent placement.
- D. What type(s) of channelizing devices will you use?  

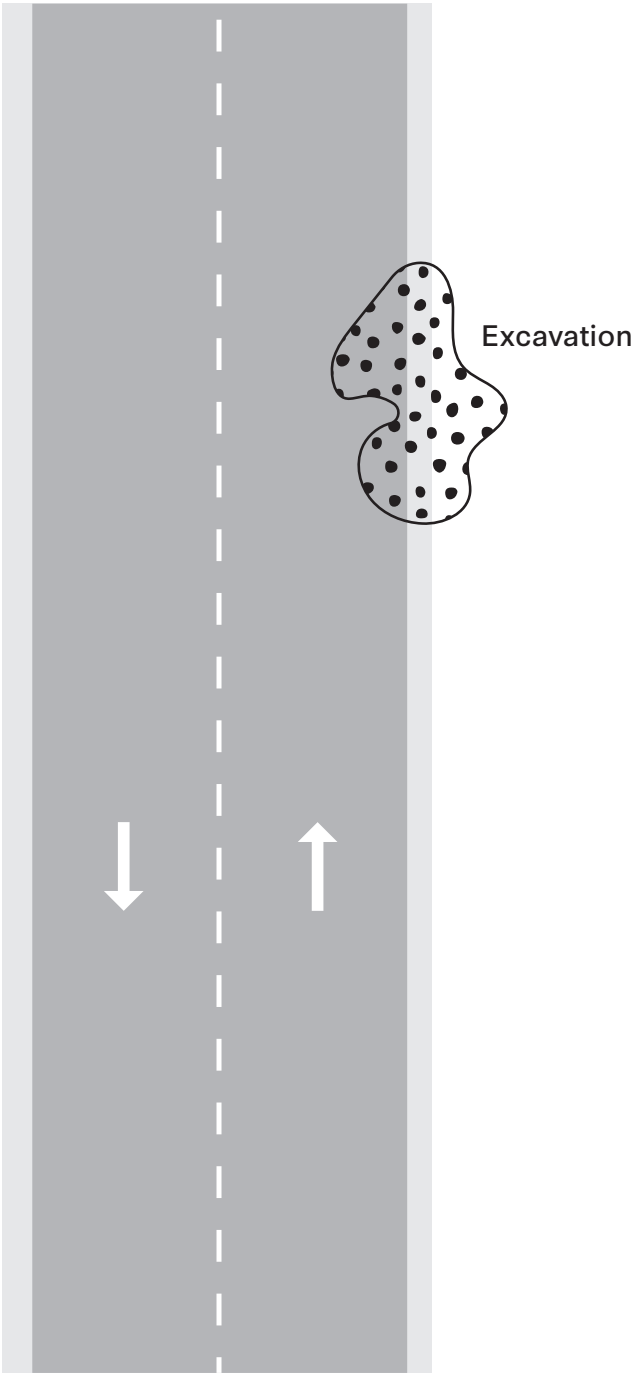
---
- E. What are the distances between the channelizing devices?  
In taper: 

---

 In tangent: 

---
- F. If a flagger or flaggers are to be used, show their station location(s).
- G. What other traffic control equipment will be required for this job?  

---



## PROBLEM 12

**Location:** Two lane-two way mountain highway

**Work operations:** Clearing rock slide debris from northbound lane of State Highway.

A rock slide has blocked the northbound lane of State Highway 3 at mile post marker 127. Approximately 24 dump truck loads of debris must be removed from the roadway and taken to a nearby campground to be dumped at the river's edge. One lane of traffic is restricted for 1 mile. The lane width is 12 feet and the speed limit is 60 mph.

- A. Indicate the four areas in the Traffic Control Zone.
- B. Show the warning sign type, placement and distances.
- C. Show taper and tangent placement.
- D. What type(s) of channelizing devices will you use?  

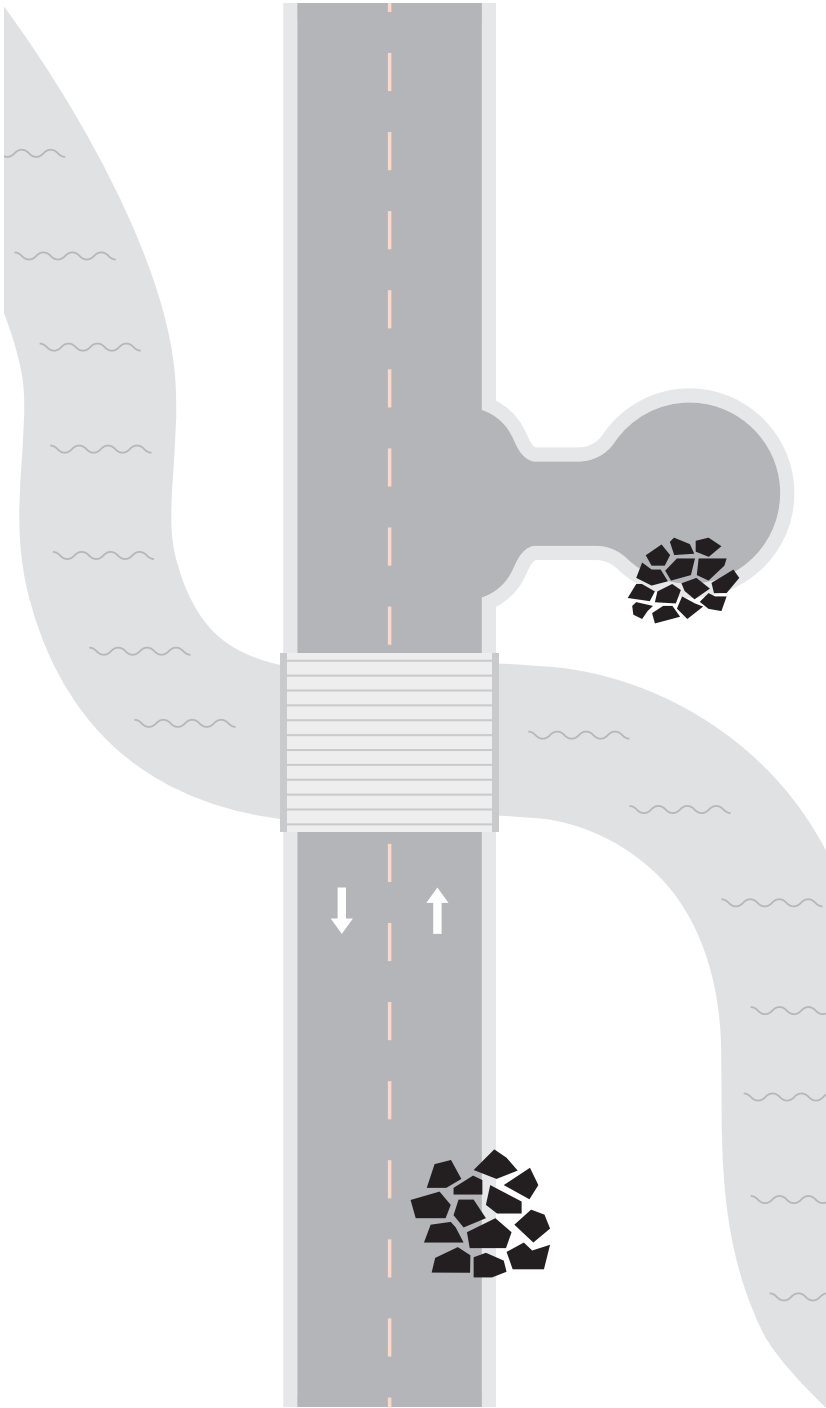
---
- E. What are the distances between the channelizing devices?  
In tapers: 

---

 In tangent: 

---
- F. If a flagger or flaggers are to be used, show their station location(s).
- G. What other traffic control equipment will be required for this job?  

---



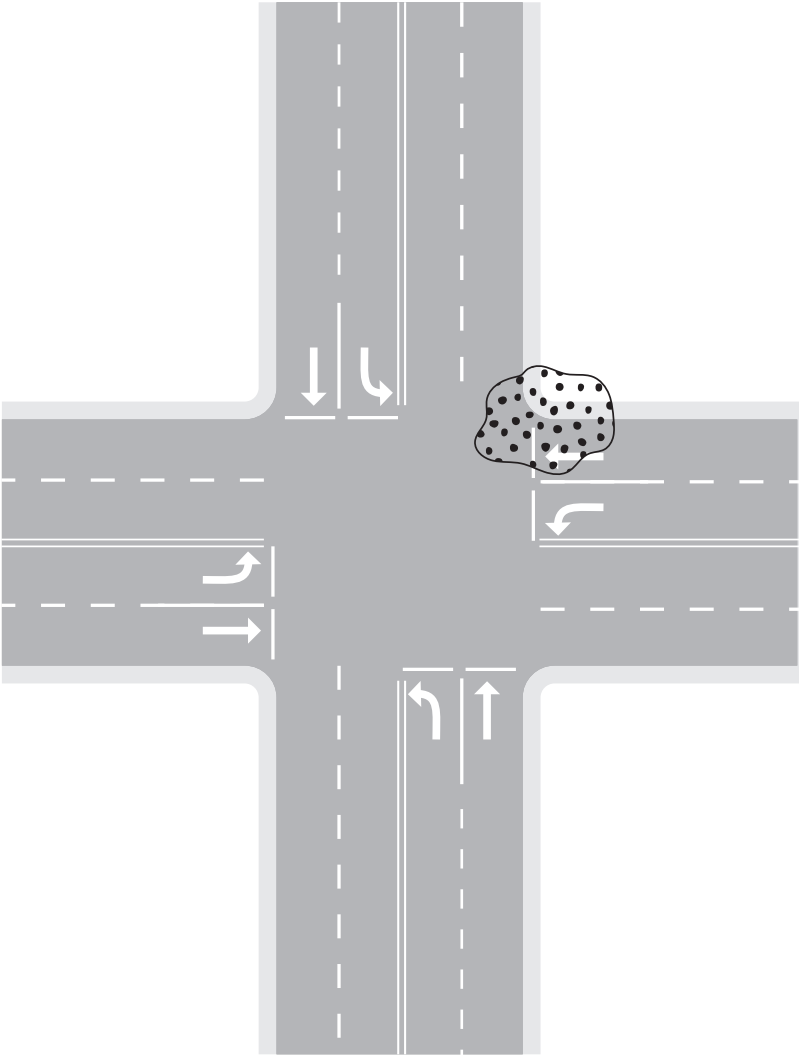
**PROBLEM 13**

**Location:** Urban intersection, four lanes in all directions

**Work operations:** Curb/sidewalk replacement—adding wheelchair access at pedestrian crosswalk.

The curb and sidewalk on the northeast corner of the intersection are being removed and replaced. The work will require closing the northbound and westbound lanes immediately adjacent to the corner. The project is expected to take 3 weeks. The lanes are 11 feet wide and the speed is 35 mph. There are no available shoulders or parking spaces adjacent to the work. The job will be completed during daylight hours. Traffic volumes are light to moderate in all directions.

- A. Indicate the four areas in the Traffic Control Zone.
- B. Show warning sign type, placement, and distances.
- C. Show taper and tangent placements.
- D. What type(s) of channelizing devices will you use?  
\_\_\_\_\_
- E. What are the distances between the channelizing devices in the taper? \_\_\_\_\_  
in the tangent? \_\_\_\_\_
- F. If a flagger or flaggers are to be used, show their station location(s).
- G. What might we have to do to accommodate pedestrians?  
\_\_\_\_\_  
\_\_\_\_\_



# Glossary

**Activity Area:** The area in the traffic control zone that extends from the transition area to the termination area.

**Advance Warning Area:** A sequence of three or four advance warning signs are positioned in this area to warn road users of hazards in the upcoming roadway work and traffic revisions.

**Automated Flagger Assistance Device (AFAD):** These devices are designed to be remotely operated either by a single flagger at one end of the TTC zone or at a central location, or by separate flaggers near each device's location.

**Barricade:** A portable or fixed barrier used to close all or a portion of a roadway. A Type I barricade has one rail, Type II has two rails, and Type III has three rails.

**Buffer Space:** The area in a traffic control zone immediately preceding the work space. The buffer space allows motorists to regain control of their vehicles if they miss the advance warning signs and overshoot the flagging station.

**Channelization:** The diverting of traffic from its normal path in order to: 1) safely guide motorists around a work zone, and 2) provide maximum safety to workers. When properly executed, channelization provides a smooth and gradual transition, moving traffic from one lane to another.

**Cone:** A commonly used channelizing device. Cones used at night must be 28 inches high and have two retroreflectorized bands.

**Conspicuity:** The process of being highly visible through the use of bright contrasting colors or retroreflective materials.

**Delineate/delineator:** To mark, or make apparent. Delineators are guidance devices that alert drivers to changes in road conditions, boundaries, or other risks present in the TTC zone.



**Driver Reaction Time:** The length of time needed for a driver to respond to a sign or flagger's signal (i.e., the length of time it takes for a motorist to step on the brake pedal after seeing a stop sign).

**Drum:** A channelizing device commonly used for long-term construction projects. Drums are a minimum of 36 inches tall, 18 inches in diameter, and have two retroreflectorized white bands and two retroreflectorized orange bands.

**Expressway:** A divided highway with partial control of access.

**Flagger:** A person trained and certified in "traffic control" methods for safely moving vehicles and other road users through or around a traffic control zone, while also protecting on-site workers and equipment.

**Flagger Station:** Flagger stations are located ahead of the work space within a traffic control zone so that approaching traffic has sufficient time and distance to safely stop when directed by the flagger.

**Freeway:** A divided highway with full control of access.

**Federal Highway Administration (FHWA):** The U.S. Department of Transportation agency responsible for supporting the country's highway transportation system.

**Guide Signs:** Signs which show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information.

**High-Level Warning Device:** A device designed to be seen over the top of typical passenger cars. They are most commonly used in high-density road user situations to warn road users of short-term operations.

**Manual on Uniform Traffic Control Devices (MUTCD):** Published by the U.S. Department of Transportation and the Federal Highway Administration, it establishes nationally recognized standards for the design and application of traffic control devices.

**Pilot Car:** A lightweight vehicle used to guide motorists through a work space that is especially long, hazardous, or subject to frequent alterations.

**Regulatory Signs:** Signs which give notice of traffic laws or regulations.

**Retroreflectivity:** A property of a surface that allows a large portion of the light coming from a point source to be returned directly back to a point near its origin, making the retroreflective object appear brighter.

**Short-duration:** Work that occupies a location for up to 1 hour.

**STOP/SLOW Paddle:** A device used by a flagger to stop and slow traffic. A STOP/SLOW Paddle has a shaft (usually seven feet long) topped by an 18- (minimum) or 24-inch octagon. One side is red with the word STOP in 6-inch (or larger) white letters. The other side has an orange diamond over a black background with the word SLOW in 6-inch (or larger) black letters.

**Tangent:** The straight area(s) that are parallel with road users and run from taper to taper.

**Tapers:** A common important element of a TTC zone, used in both the transition and termination areas. Tapers are created using a series of channelizing devices or pavement markings placed to move traffic out of or into its normal path. There are five specific tapers: 1) merging taper, 2) lane-shift taper, 3) shoulder tapers, 4) two-way traffic taper, and 5) downstream taper.

**Taper Length Formulas:** The mathematical formulas used to calculate taper length. For roads with a posted speed of 45 mph or faster, the taper length formula is  $L = WS$ . For roads with a posted speed limit of 40 mph or slower, the taper length formula is  $L = WS^2 / 60$ . ( $L$  = taper length,  $W$  = the width of the lane being closed, and  $S$  = the posted speed limit). (*Note: certain jurisdictions may have different low and high speed recommendations.*)

**Taper Rate:** The distance between channelizing devices in a taper. The maximum distance between channelizing devices should be

equal in feet to the speed limit. If, for example, the speed limit is 25 mph, the maximum distance between two channelizing devices would be 25 feet.

**Termination Area:** The final area in a traffic control zone. The termination area includes the downstream taper, which channelizes traffic back into its normal path.

**Temporary Barriers:** Temporary traffic barriers are not TTC devices in themselves; however, when placed in a position identical to a line of channelizing devices and marked and/or equipped with appropriate channelization features to provide guidance and warning both day and night, they serve as TTC devices.

**Temporary Traffic Control (TTC) Zone:** The area along a roadway immediately preceding, following, and including the actual work zone.

**Transition Area:** The area in a traffic control zone immediately following the advance warning area. Channelizing devices are used in this area to move traffic out of its normal path.

**Transportable Attenuator (TA):** The TA is designed to be attached to a truck parked between oncoming traffic and the work zone. It is intended to prevent vehicles from injuring workers or damaging equipment during highway repair.

**Vertical Panel:** A channelizing device consisting of a rectangular panel, 8 to 12 inches wide by a minimum of 24 inches long, mounted vertically on a pole. The panel is marked with orange and white retroreflectorized stripes. Vertical panels are used for traffic separation or shoulder barricading where horizontal space is at a minimum.

**Warning Signs:** Signs that call attention to potentially hazardous conditions on, or adjacent to, a highway or street.

**Work Space:** The area in a traffic control zone where construction or maintenance activities are performed. Motorists are directed around this area and only workers are permitted in this area.

-----

# Quick reference

<b>TABLE 6B-1 RECOMMENDED ADVANCE WARNING SIGN MINIMUM SPACING</b>			
<b>Road Type</b>	<b>Distance Between Signs**</b>		
	<b>A</b>	<b>B</b>	<b>C</b>
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway/Freeway	1,000 feet	1,500 feet	2,640 feet
<p>*Speed category to be determined by the highway agency</p> <p>** The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC Zone.)</p>			

(The information in this table comes from MUTCD 6B.05.)

(This table can also be found on page 46.)

<b>MUTCD MAXIMUM CHANNELIZING DEVICE SPACING</b>	
<b>Tapers</b>	<b>Spacing</b>
<i>Merging/Shifting/Shoulder</i>	Not to exceed $1 \times$ speed limit in feet
<i>One-Lane, Two Way</i>	<i>20 foot spacing regardless of speed</i>
<i>Downstream</i>	<i>20 foot spacing regardless of speed</i>
<b>Tangent</b>	Not to exceed $2 \times$ speed limit in feet

(The information in this table comes from MUTCD Sections 6B.08 and 6K.01.)

(This table can also be found on page 55.)

WORK ZONE TAPER LENGTH FORMULAS	
L = taper length in feet W = width of the lane to be closed or offset S = posted speed limit	
POSTED SPEED	FORMULA
45 MPH (or faster)	$L = WS$
40 MPH (or slower)	$L = W \times S^2 / 60$
TYPE OF TAPER	TAPER LENGTH
Merging Taper	L minimum
Shifting Taper	$\frac{1}{2} L$ or $L/2$ minimum
Shoulder Taper	$\frac{1}{3} L$ or $L/3$ minimum
Two-Way Taper (flagger)	50' min, 100' max
Downstream Taper	50' min, 100' max

*(This table can also be found on page 57.)*

**MERGING, SHIFTING, AND SHOULDER TAPER LENGTHS AND  
NUMBER OF CHANNELIZATION DEVICES (CONES) USED**

Lane Width	10 feet					11 feet					12 feet					Shoulder Tapers				
	"L"		"½ L"			"L"		"½ L"			"L"		"½ L"							
	Merg	Cone	Shift	Cone	Merg	Cone	Shift	Cone	Merg	Cone	Shift	Cone	Merg	Cone	Shift			Cone		
MPH																		MPH	Length	Cone
20	70	5	35	3	75	5	40	3	80	5	40	3	80	5	40	3	20	25	3	
25	105	6	55	3	115	6	60	4	125	6	60	4	125	6	65	4	25	35	3	
30	150	6	75	4	165	7	85	4	180	7	85	4	180	7	90	4	30	50	3	
35	205	7	105	4	225	8	115	5	245	8	115	5	245	8	125	5	35	70	4	
40	270	8	135	5	295	9	150	5	320	9	150	5	320	9	160	5	40	90	4	
45	450	11	225	6	495	12	250	7	540	13	250	7	540	13	270	7	45	150	6	
50	500	11	250	6	550	12	275	7	600	13	275	7	600	13	300	7	50	170	6	
55	550	11	275	6	605	12	305	7	660	13	305	7	660	13	330	7	55	185	6	
60	600	11	300	6	660	12	330	7	720	13	330	7	720	13	360	7	60	200	6	
65	650	11	325	6	715	12	370	7	780	13	370	7	780	13	390	7	65	220	7	
70	700	11	350	6	770	12	385	7	840	13	385	7	840	13	420	7	70	235	7	
All lengths are in feet. This chart is MUTCD compliant. All numbers are minimums.																	Shoulder Taper equals Shoulder Width × Speed / 3			

All lengths are in feet. This chart is MUTCD compliant. All numbers are minimums.

*(This table can also be found on page 58.)*

TABLE 6B-2 (MUTCD) BUFFER SPACE	
Speed (mph)	Distance (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

*(This table comes from MUTCD 6B.06)*

*(This table can also be found on page 60.)*



<b>STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED (TABLE 6B-2 MUTCD)</b>	
<b>Speed (mph)</b>	<b>Distance (ft)</b>
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

*\*Posted speed, off-peak 85th percentile speed prior to work starting or the anticipated operating speed.  
(This table can also be found on page 81.)*



the 1990s, the number of people in the UK who are employed in the public sector has increased by 1.5 million, from 2.5 million in 1980 to 4 million in 1998. The public sector has become a major employer in the UK, and its growth has been a major factor in the overall growth of the economy.

The public sector has also become a major provider of social services, and its growth has been a major factor in the overall growth of the economy. The public sector has become a major provider of social services, and its growth has been a major factor in the overall growth of the economy.

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