

## CHAPTER 6G. TYPE OF TEMPORARY TRAFFIC CONTROL ZONE ACTIVITIES

### Section 6G.01 Typical Applications

Support:

- 01 Each TTC zone is different. Many variables, such as location of work, highway type, geometrics, vertical and horizontal alignment, intersections, interchanges, road user volumes, road vehicle mix (buses, trucks, cars and motorcycles), and road user speeds affect the needs of each zone. The goal of TTC in work zones is safety with minimum disruption to road users. The key factor in promoting TTC zone safety is proper judgment.
- 02 Typical figures of TTC zones are organized according to duration, location, type of work, and highway type. Table 6H-1 is an index of these Typical Traffic Control figures. These typical applications include the use of various TTC methods, but do not include a layout for every conceivable work situation. Additional figures can also be found in Chapter 6H of the 2009 MUTCD.
- 03 Well-designed TTC plans for planned special events will likely be developed from a combination of treatments from several of the typical traffic control figures.

*Guidance:*

- 04 *For any planned special event that will have an impact on the traffic on any street or highway, a TTC plan should be developed in conjunction with and be approved by the agency or agencies that have jurisdiction over the affected roadways.*
- 05 *Typical applications should be altered, when necessary, to fit the conditions of a particular TTC zone.*

Option:

- 06 Other devices may be added to supplement the devices shown in the typical traffic control figures, while others may be deleted. The sign spacings and taper lengths may be increased to provide additional time or space for driver response.

Support:

- 07 Decisions regarding the selection of the most appropriate typical traffic control figure to use as a guide for a specific TTC zone require an understanding of each situation. Although there are many ways of categorizing TTC zone applications, the four factors mentioned earlier (work duration, work location, work type, and highway type) are used to characterize the typical traffic control figures illustrated in Chapter 6H.

### Section 6G.02 Work Duration

Support:

- 01 Work duration is a major factor in determining the number and types of devices used in TTC zones. The duration of a TTC zone is defined relative to the length of time a work operation occupies a spot location.

**Standard:**

- 02 **The five categories of work duration and their time at a location shall be:**
- A. Long-term stationary is work that occupies a location more than 3 days.**
  - B. Intermediate-term stationary is work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.**
  - C. Short-term stationary is daytime work that occupies a location for more than 1 hour within a single daylight period.**
  - D. Short duration is work that occupies a location up to 1 hour.**
  - E. Mobile is work that moves intermittently (1 to 15 minutes)<sup>1</sup> or continuously.**

Support:

- 03 At long-term stationary TTC zones, there is ample time to install and realize benefits from the full range of TTC procedures and devices that are available for use. Generally, larger channelizing devices, temporary roadways, and temporary traffic barriers are used.

**Standard:**

- 04 **Since long-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in long-term stationary TTC zones. In addition, Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned cones.**

*Guidance:*

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

## Support:

06 In intermediate-term stationary TTC zones, it might 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 traffic barriers, and temporary roadways. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time.

**Standard:**

07 **Since intermediate-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in intermediate-term stationary TTC zones. In addition, Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned cones.**

## Support:

08 Most maintenance and utility operations are short-term stationary work.

09 As compared to stationary operations, mobile and short-duration operations are activities that might involve different treatments. Devices having greater mobility might be necessary such as signs mounted on trucks. Devices that are larger, more imposing, or more visible can be used effectively and economically. The mobility of the TTC zone is important.

*Guidance:*

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

Option:

11 Appropriately colored or marked vehicles with amber high-intensity rotating, flashing, or<sup>1</sup> oscillating lights may be used in place of signs and channelizing devices for short-duration or mobile operations. These vehicles may be augmented with signs or arrow boards.

## Support:

12 During short-duration work, it often takes longer to set up and remove the TTC zone than to perform the work. Workers face hazards in setting up and taking down the TTC zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed.

Option:

13 Considering these factors, simplified control procedures may be warranted for short-duration work. A reduction in the number of devices may be offset by the use of other more dominant devices such as high-intensity rotating, flashing, or<sup>1</sup> oscillating lights on work vehicles.

## Support:

14 Mobile operations often involve frequent short stops of 15 minutes or less for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations.

**Standard:**

15 **Warning signs and high-intensity amber rotating, flashing, or<sup>1</sup> oscillating, lights shall be used on the vehicles that are participating in the mobile work.**

Option:

16 Flags and/or channelizing devices may additionally be used, but shall be continuously repositioned to keep them near the mobile work area.

17 Flaggers may be used for mobile operations that often involve frequent short stops.

## Support:

18 Mobile operations also include work activities where workers and equipment move along the road without stopping, usually at slow speeds. The advance warning area moves with the work area.

*Guidance:*

- 19 *When mobile operations are being performed, a shadow vehicle equipped with an arrow board or a sign should follow the work vehicle, especially when vehicular traffic speeds or volumes are high. Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.*
- 20 *Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.*

**Standard:**

- 21 **Mobile operations shall have appropriate devices on the equipment (that is, high-intensity amber rotating, flashing, or<sup>1</sup> oscillating lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.**
- 22 **If there are mobile operations on a high-speed travel lane of a multi-lane divided highway, arrow boards shall be used. Additionally, if posted speeds are 45 mph or greater, a Truck-Mounted Attenuator (TMA) shall be used on the shadow vehicle(s).**
- 23 **Mobile operations that move at speeds greater than 20 mph, such as pavement marking operations, shall have appropriate devices on the equipment (that is, high-intensity amber rotating, flashing, or<sup>1</sup> oscillating lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.**

Option:

- 24 For mobile operations that move at speeds of less than 5 mph, mobile signs or stationary signing that is periodically retrieved and repositioned in the advance warning area may be used.
- 25 At higher speeds, vehicles may be used as components of the TTC zones for mobile operations. Appropriately colored and marked vehicles with signs, flags, high-intensity amber rotating, flashing, or<sup>1</sup> oscillating lights, truck-mounted attenuators, and arrow boards or portable changeable message signs may follow a train of moving work vehicles.
- 26 For some continuously moving operations, such as street sweeping and snow removal, a single work vehicle with appropriate warning devices on the vehicle may be used to provide warning to approaching road users.

## Support:

- 27 Figure TTC-11 displays traffic control for a single lane moving/mobile operation on a Limited Access highway, while Figure TTC-13 displays traffic control for a single lane moving/mobile operation on a multi-lane, Non-Limited Access highway. Figure TTC-12 displays traffic control for a moving/mobile operation for multiple lane closure on a Limited Access highway.

Option:

- 28 Figures TTC-11 and TTC-12 may be used for Non-Limited Access highways by adjusting the spacing between shadow vehicles to between 500 to 800 feet between vehicles, while spacing between shadow vehicle prior to the work vehicle stays the same. If TTC-12 is used, the spacing between Shadow Vehicle 1 and 2 may be adjusted to 0.5 mile.

**Standard:**

- 29 **When used in moving/mobile operations, law enforcement vehicles shall be placed as shown in Figures TTC-11 and TTC-12 to minimize their exposure to traffic. Law enforcement vehicles shall not be placed into an open travel lane for planned work operations without the protection of a shadow vehicle.**

## Support:

- 30 Figure TTC 14.0 displays traffic control for a moving/mobile operation on a Two-Lane roadway.

*Guidance:*

- 31 *Where practical and when needed, the work and shadow vehicles should pull over periodically in a moving/mobile operation on a Two-Lane roadway to allow motor vehicle traffic to pass.*
- 32 *Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance from the work vehicle and proceed at the same speed. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
- 33 *A truck-mounted attenuator should be used on the shadow vehicle in Two-Lane moving/mobile operations.*

### **Section 6G.03 Location of Work**

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The choice of TTC needed for a TTC zone depends upon where the work is located. As a general rule, the closer the work is to road users (including bicyclists and pedestrians), the greater the number of TTC devices that are needed. Procedures are described later in this Chapter for establishing TTC zones in the following locations:
- A. Outside the shoulder,
  - B. On the shoulder with no encroachment,
  - C. On the shoulder with minor encroachment,
  - D. Within the median, and
  - E. Within the traveled way.

**Standard:**

- 03 **When the work space is within the traveled way, except for short-duration and mobile operations, advance warning signs shall provide a general warning message (ROAD WORK AHEAD), advise that work is taking place (RIGHT or LEFT LANE CLOSED AHEAD) and direct and supply information about highway conditions (KEEP RIGHT or LEFT, and LANE ENDS MERGE RIGHT or LEFT). TTC devices shall indicate how vehicular traffic can move through the TTC zone.**

### **Section 6G.04 Modifications To Fulfill Special Needs**

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The typical applications in Chapter 6H illustrate commonly encountered situations in which TTC devices are employed. Roadway characteristics to consider in selecting the appropriate temporary traffic control figure also include travel speeds and traffic volumes. The definition of a high speed roadway is prevailing speeds of 45 mph and greater, and low speed roadway of speeds of less than 45 mph. High volume roadways have an average daily traffic (ADT) of 500 or more vehicles per day, while low volume roadways have less than 500 vehicles per day.

Option:

- 03 Other devices may be added to supplement the devices provided in the typical applications, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

*Guidance:*

- 04 *When conditions are more complex, typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6B of the 2009 MUTCD and by incorporating appropriate devices and practices from the following list:*
- A. *Additional devices:*
    1. *Signs*
    2. *Arrow boards*
    3. *More channelizing devices at closer spacing (see Section 6F.82) for information regarding detectable edging for pedestrians*
    4. *Temporary raised pavement markers*
    5. *High-level warning devices*
    6. *Portable changeable message signs*
    7. *Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals)*
    8. *Temporary traffic barriers*
    9. *Crash cushions*
    10. *Screens*
    11. *Rumble strips*
    12. *More delineation*

*B. Upgrading of devices:*

1. *A full complement of standard pavement markings*
2. *Brighter and/or wider pavement markings*
3. *Larger and/or brighter signs*
4. *Channelizing devices with greater conspicuity*
5. *Temporary traffic barriers in place of channelizing devices*

*C. Improved geometrics at detours or crossovers, giving particular attention to the provisions set forth in Chapter 6B**D. Increased distances:*

1. *Longer advance warning area*
2. *Longer tapers*

*E. Lighting:*

1. *Temporary roadway lighting*
2. *Steady-burn lights used with channelizing devices*
3. *Flashing lights for isolated hazards*
4. *Illuminated signs*
5. *Floodlights*

*F. Pedestrian routes and temporary facilities**G. Bicycle diversions and temporary facilities*

- 05 *Where pedestrian or bicycle usage is high, typical traffic control figures should also be modified by giving particular attention to the provisions set forth in Chapter 6D, Section 6F.82, and other Sections of this Manual and Part 6 of the 2009 MUTCD related to accessibility and detectability provisions in TTC zones.*

**Section 6G.05 Work Affecting Pedestrian and Bicycle Facilities****Support:**

- 01 It is not uncommon, particularly in urban areas, that road work and the associated TTC will affect existing pedestrian or bicycle facilities. It is essential that the needs of all road users, including pedestrians with disabilities, are considered in TTC zones.
- 02 In addition to specific provisions identified in Sections 6G.06 through 6G.15, there are a number of provisions that might be applicable for all of the types of activities identified in this Chapter.

**Guidance:**

- 03 *Where pedestrian or bicycle usage is high, the typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6D, this Chapter, Section 6F.82, and in other Sections of this Manual and the 2009 MUTCD Sections of Part 6 related to accessibility and detectability provisions in TTC zones.*
- 04 *Pedestrians should be separated from the worksite by appropriate devices that maintain the accessibility and detectability for pedestrians with disabilities.*
- 05 *Bicyclists and pedestrians should not be exposed to unprotected excavations, open utility access, overhanging equipment, or other such conditions.*
- 06 *Except for short duration and mobile operations, when a highway shoulder is occupied, a RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) sign should be placed in advance of the activity area. When work is performed on a paved shoulder 8 feet or more in width, channelizing devices should be placed on a taper having a length that conforms to the requirements of a shoulder taper. Signs should be placed such that they do not narrow any existing pedestrian passages to less than 48 inches.*
- 07 *Pedestrian detours should be avoided since pedestrians rarely observe them and the cost of providing accessibility and detectability might outweigh the cost of maintaining a continuous route. Whenever possible, work should be done in a manner that does not create a need to detour pedestrians from existing routes or crossings.*

**Standard:**

- 08 **Where pedestrian routes are closed, alternate pedestrian routes shall be provided (see TTC Figure 36).**
- 09 **When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.**

### **Section 6G.06 Work Outside of the Shoulder**

#### **Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 When work is being performed off the roadway (beyond the shoulders, but within the right-of-way), little or no TTC might be needed. TTC generally is not needed where work is confined to an area 30 feet or more from the edge of the traveled way and out of the clear zone (see Appendix A for clear zone values). However, TTC is appropriate where distracting situations exist, such as vehicles parked on the shoulder, vehicles accessing the worksite via the highway, and equipment traveling on or crossing the roadway to perform the work operations (for example, mowing). For work beyond the shoulder, see Figures TTC-1 and TTC-2.

#### **Guidance:**

- 03 *Where the situations described in Paragraph 1 exist, a single warning sign, such as ROAD WORK AHEAD (W20-1), should be used. If the equipment travels on the roadway, the equipment should be equipped with appropriate flags, high-intensity amber rotating, flashing, or<sup>1</sup> oscillating lights, and/or a SLOW MOVING VEHICLE (W21-4) sign and symbol, see Figures TTC-9 and TTC-10 for slow moving symbol.*

#### **Option:**

- 04 If work vehicles are on the shoulder, a RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) signs may be used. For mowing operations, the sign MOWING NEXT 2 MILES (W21-V3) may be used.
- 05 Where the activity is spread out over a distance of more than 2 miles, the RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD sign may be repeated every 1 mile.
- 06 A supplementary plaque with the message NEXT XX MILES (W16-VP1) may be used.

#### **Guidance:**

- 07 *A general warning sign like ROAD WORK AHEAD should be used if workers and equipment must occasionally move onto the shoulder.*

### **Section 6G.07 Work on the Shoulder with No Encroachment**

#### **Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The provisions of this Section apply to short-term (daytime work that occupies a location for more than 1 hour, but less than 12 hours) through long-term stationary (more than 3 days) operations.

#### **Standard:**

- 03 **When paved shoulders having a width of 8 feet or more are closed, at least one advance warning sign shall be used. In addition, channelizing devices shall be used to close the shoulder in advance to delineate the beginning of the work space and direct motor vehicle traffic to remain within the traveled way.**

#### **Guidance:**

- 04 *When paved shoulders having a width of 8 feet or more are closed on Limited Access highways and expressways, road users should be warned about potential disabled vehicles that cannot get off the traveled way. An initial general warning sign, such as ROAD WORK AHEAD (W20-1), should be used, followed by a RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) sign. Where the downstream end of the shoulder closure extends beyond the distance that can be perceived by road users, a supplementary plaque bearing the message XX FEET (W16-VP3) or NEXT XX MILES (W16-VP1) should be placed below the RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) signs. On multi-lane, divided highways, signs advising of shoulder work or the condition of the shoulder should be placed on both sides of the roadway to give adequate warning to all road users.*
- 05 *When an improved shoulder is closed on a high-speed roadway, it should be treated as a closure of a portion of the road system because road users expect to be able to use it in emergencies. Road users should be given*

ample advance warning that shoulders are closed for use as refuge areas throughout a specified length of the approaching TTC zone. The sign(s) should read *RIGHT (LEFT) SHOULDER CLOSED AHEAD* or *BOTH SHOULDERS CLOSED AHEAD* sign with supplementary distances plaques indicated. The work space on the shoulder should be closed off by a taper or channelizing devices with a length of  $1/3 L$  using the formulas in Table 6C-4.

**Standard:**

06 **When the shoulder is not occupied but work has adversely affected its condition, the LOW SHOULDER (W8-9) or SOFT SHOULDER (W8-4) sign shall be used, as appropriate.**

07 **Where the condition extends over a distance in excess of 1 mile, the sign shall be repeated at 1-mile intervals.**

Option:

08 In addition, a supplementary plaque bearing the message NEXT XX MILES (W16-VP1) may be used. Temporary traffic barriers may be needed to inhibit encroachment of errant vehicles into the work space and to protect workers (see Appendix A for this determination).

**Standard:**

09 **A shadow vehicle shall be used whenever a person is required to operate equipment mounted on or in the work vehicle such as buckets, augers, post drivers, etc. For operations on the shoulder with duration greater than 60 minutes where workers are present, a shadow vehicle shall be used. A truck-mounted attenuator (TMA) shall be used on the shadow vehicle on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.**

10 **When used for shoulder work, arrow boards shall operate only in the caution mode.**

*Guidance:*

11 *A minimum of 4 channelizing devices matching the kind used in the roadway taper on the shoulder should be used to delineate the arrow board (see Section 6F.69 and Figure 6F-6).*

*Support:*

12 A typical application for stationary work operations on shoulders is shown in Figure TTC-4. Short duration or mobile work on shoulders is shown in Figure TTC-3. Long duration shoulder closure with barrier is shown in Figure TTC-6.

**Section 6G.08 Work on the Shoulder with Minor Encroachment**

*Support:*

01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

*Guidance:*

02 *When work takes up part of a lane, vehicular traffic volumes, vehicle mix (buses, trucks, cars, motorcycles, and bicycles), speed, and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment permits a remaining lane width of 11 feet, the lane should be closed.*

03 *Truck off-tracking should be considered when determining whether the minimum lane width of 11 feet is adequate.*

Option:

04 A lane width of 10 feet may be used for short-term stationary work on low-volume (less than 500 vpd), low-speed (below 45 mph) roadways when vehicular traffic does not include longer and wider heavy commercial vehicles.

05 A lane width of 10 feet may be used for work activities located on entrance and exit ramps of Limited Access highways.

06 A lane width of 10 feet may be used for intermediate-term stationary operations such as milling/paving operations where the restriction is limited to the areas where the work activities are occurring by moving the channelizing devices out as work progresses and then back once the work activity has past.

07 For long-term stationary operations such as construction projects, a travel lane width of no less than 10 feet may be allowed only when a traffic engineering study, as defined in Paragraph 08, is made and documented by the Regional Traffic Engineer or authority with jurisdiction over the roadway.

**Standard:**

- 08 **A traffic engineering study shall consider as a minimum, traffic volumes, vehicle mix, speed, capacity, and type of operation. This assessment must demonstrate that if not allowed, traffic delays and back-ups will create unacceptable safety factors and/or road network failure.**

## Support:

- 09 Figure TTC-5 illustrates a method for handling vehicular traffic where the stationary or short duration work space encroaches slightly into the traveled way.
- 10 Figure TTC-10 illustrates the method of handling vehicular traffic where non-licensed vehicle operations encroach into the Travelway of a Limited Access highway.

**Standard:**

- 11 **Due to occasional travel by over width vehicles, work zones which reduce the one way travel path of roadways or ramps to widths less than 14'-0" wide measured from edgeline to edgeline shall be signed with a ROAD NARROWS (W5-1) or RAMP NARROWS (W5-4) sign and a supplemental plaque mounted below stating the actual width of the roadway or ramp rounded down to the nearest foot or half foot increment, see Figure TTC-38.**

*Guidance:*

- 12 *The ROAD NARROWS or RAMP NARROWS sign assembly should be placed approximately 1000 feet in advance of the restricted location, as well as in advance of the last alternate route prior to the lane width restriction.*

**Section 6G.09 Work Within the Median**

## Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

*Guidance:*

- 02 *If work in the median of a divided highway is within 15 feet from the edge of the traveled way for either direction of travel, or within the clear zone as determined by Appendix A, TTC should be used through the use of advance warning signs and channelizing devices in both travel directions.*
- 03 *Trailer-mounted TTC devices placed in the median should be delineated with four Group 2 channelizing devices placed in a taper in both travel directions when it falls within the clear zone of each travel direction.*

**Section 6G.10 Work Within the Traveled Way of a Two-Lane Highway**

## Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 Techniques for controlling vehicular traffic under one-lane, two-way conditions are described in Sections 6C.11, 6E.07, and 6E.08.

Option:

- 03 Flaggers may be used as shown in Figure TTC-23.
- 04 STOP/YIELD sign control may be used on roads with low traffic volumes (less than 500 VPD) as noted in Figure TTC-25. Conditions are based on an engineering study and approval of the Regional Traffic Engineer. Figure 6H-11 of the 2009 MUTCD may also be referenced.
- 05 A temporary traffic control signal may be used as shown in Figure TTC-25.

## Support:

- 06 When a work zone on a two-lane highway transitions to a multi-lane highway the temporary traffic control continues as a two-lane highway. Lane closure signs and arrow boards typically used for temporary traffic control on multi-lane highways are not needed.<sup>1</sup>



### **Section 6G.11 Work Within the Traveled Way of an Urban Street**

#### **Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 In urban TTC zones, decisions are needed on how to control vehicular traffic, such as how many lanes are required, whether any turns need to be prohibited at intersections, and how to maintain access to business, industrial, and residential areas.
- 03 Pedestrian traffic needs separate attention. Chapter 6D contains information regarding pedestrian movements near TTC zones.
- 04 For urban conditions, it is generally better to attempt to place all advance warning signs within a one block area versus spreading out over several blocks, however, motorists must have time to recognize and react to each warning sign.
- 05 Various conditions, such as limited sight distance or obstructions that might require a driver to reduce speed or stop, might require additional advance warning signs.
- 06 At TTC zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.

#### **Standard:**

- 07 **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.**
- 08 **If the TTC zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided (see Part 9 of the 2009 MUTCD).**
- 09 **Where transit stops are affected or relocated because of work activity, both pedestrian and vehicular access to the affected or relocated transit stops shall be provided.**

#### *Guidance:*

- 10 *If a designated bicycle route is closed because of the work being done, a signed alternate route should be provided. Bicyclists should not be directed onto the path used by pedestrians.*
- 11 *Worksites within the intersection should be protected against inadvertent pedestrian incursion by providing detectable channelizing devices.*

#### **Support:**

- 12 Utility work takes place both within and outside the roadway to construct and maintain services such as power, gas, light, water, or telecommunications. Operations often involve intersections, since that is where many of the network junctions occur. The work force is usually small, only a few vehicles are involved, and the number and types of TTC devices placed in the TTC zone is usually minimal.

#### **Standard:**

- 13 **All TTC devices shall be retroreflective or illuminated if utility work is performed during nighttime hours (from 30 minutes prior to sunset through 30 minutes after sunrise).**

#### *Guidance:*

- 14 *As discussed under short-duration projects, however, the reduced number of devices in utility work zones should be offset by the use of high-visibility devices, such as high-intensity amber rotating, **flashing, or**<sup>1</sup> oscillating, lights on work vehicles or high-level warning devices.*

#### Option:

- 15 It may be advantageous to place advance warning signage equally spaced within one travel block as opposed to the placement of one sign per block over a three to four block area.

## Support:

- 16 Figures TTC-1, TTC-4, TTC-5, TTC-16, TTC-17, TTC-23, TTC-26, TTC-27, TTC-28, and TTC-29 are examples of typical applications for utility operations. Other typical applications might apply as well.

**Section 6G.12 Work Within the Traveled Way of a Multi-Lane, Non-Access Controlled Highway**

## Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 Work on multi-lane (two or more lanes of moving motor vehicle traffic in one direction) highways is divided into right-lane closures, left-lane closures, interior-lane closures, multiple-lane closures, and closures on five-lane roadways.

**Standard:**

- 03 **When a lane is closed on a multi-lane road for other than a mobile operation, a transition area containing a merging taper and an arrow board shall be used.**

*Guidance:*

- 04 *When justified by an engineering study (see Appendix A, Guidelines for the Use of Barrier/Channelizing Devices in Work Zones) temporary traffic barriers (see Section 6F.78) should be used to prevent incursions of errant vehicles into hazardous areas or work space.*

**Standard:**

- 05 **When temporary traffic barriers are placed immediately adjacent to the traveled way, they shall be equipped with appropriate channelizing devices, delineation, and/or other TTC devices. For lane closures, the merging taper shall use channelizing devices and the temporary traffic barrier shall be placed beyond the transition area.**

## Support:

- 06 Figure TTC-20 illustrates a lane closure in which temporary traffic barriers are used.

Option:

- 07 When the right lane is closed, TTC similar to that shown in Figure TTC-16 may be used for undivided or divided four-lane roads.

*Guidance:*

- 08 *If morning and evening peak hour vehicular traffic volumes in the two directions are uneven and the greater volume is on the side where the work is being done in the right-hand lane, consideration should be given to closing the inside lane for opposing vehicular traffic and making the lane available to the side with heavier vehicular traffic, as shown in Figure 6H-31 in the 2009 MUTCD.*
- 09 *Conflicting pavement markings should be removed for long-term projects. For short-term and intermediate-term projects where this is not practical, the channelizing devices in the area where the pavement markings conflict should be placed at a maximum spacing of 1/2 the normal spacing based on the posted speed limit. Temporary markings should be installed where needed.*
- 10 *If the larger vehicular traffic volume changes to the opposite direction at a different time of the day, the TTC should be changed to allow two lanes for opposing vehicular traffic by moving the devices from the opposing lane to the center line. When it is necessary to create a temporary center line that is not consistent with the pavement markings, channelizing devices should be used and closely spaced.*
- 11 *When closing a left lane on a multi-lane undivided road, as vehicular traffic flow permits, the two interior lanes should be closed, as shown in Figure TTC-42, to provide drivers and workers additional lateral clearance and to provide access to the work space.*

**Standard:**

- 12 **When only the left lane is closed on undivided roads, channelizing devices shall be placed along the center line as well as along the adjacent lane.**

*Guidance:*

- 13 *When an interior lane is closed, an adjacent lane should also be considered for closure to provide additional space for vehicles and materials and to facilitate the movement of equipment within the work space.*
- 14 *When multiple lanes in one direction are closed, a capacity analysis should be made to determine the number of lanes needed to accommodate motor vehicle traffic needs. Vehicular traffic should be moved over one lane at a time. As shown in Figure TTC-18, the tapers should be separated by a distance of  $2L$ , with  $L$  being determined by the formulas in Tables 6C-3 and 6C-4.*

Option:

- 15 If operating speeds are 40 mph or less and the space approaching the work area does not permit moving traffic over one lane at a time, a single continuous taper may be used.

**Standard:**

- 16 **When a directional roadway is closed, inapplicable WRONG WAY signs and markings, and other existing traffic control devices at intersections within the temporary two-lane, two-way operations section shall be covered, removed, or obliterated.**

Option:

- 17 When half the road is closed on an undivided highway, both directions of vehicular traffic may be accommodated as shown in Figure TTC-41. When both interior lanes are closed, temporary traffic controls may be used as provided in Figure TTC-42. When a roadway must be closed on a divided highway, a median crossover may be used (see Section 6G.20 and Figure TTC-44).

## Support:

- 18 TTC for lane closures on five-lane roads is similar to other multi-lane undivided roads. Figure TTC-41 can be adapted for use on five-lane roads. Figure TTC-12 can be used on a five-lane road for short duration and mobile operations.

**Standard:**

- 19 **When work is being performed over a roadway open to traffic (on bridges, overhead signs, traffic signals, etc.) the traveled lanes(s) or shoulder that the work operation is over shall be closed, unless it is physically impossible materials, equipment or personnel could fall into the open lane or shoulder.**

## Support:

- 20 There are hazards involved when working over open travel lanes, especially in a bucket truck: The chance of dropping something onto traffic, the chance of a tractor-trailer or over height load striking the bottom of the bucket and ejecting the workers, and the chance the operation is a distraction to passing motorist. Therefore, this practice is not allowed.

Option:

- 21 A mobile closure may be an acceptable method of TTC depending on traffic volumes and location of the overhead work.

**Standard:**

- 22 **When the center lane of a multi-lane roadway must be closed for work activities, an additional adjoining lane on one side shall be closed such that through traffic is not split around the work area (see Figure TTC-18).**
- 23 **If the center lane closure must encroach on the remaining lanes, a minimum 11 foot travel lane(s) shall be maintained.**
- 24 **A center lane shall not be closed when work is only being performed in an adjacent lane unless the lane closure encroaches into the center lane resulting in a travel lane width of less than 11 feet.**

**Section 6G.13 Detours and Diversions**

## Support:

- 01 Detour signs are used to direct road users onto another roadway. At diversions, road users are directed onto a temporary roadway or alignment placed within or adjacent to the right-of-way. Typical applications for detouring road users are shown in Figures TTC-46, TTC-47 and TTC-48. Figure TTC-43 illustrates the controls around an area where a section of roadway has been closed and a diversion has been constructed. Channelizing devices and pavement markings are used to indicate the transition to the temporary roadway.

**Option:**

- 02 Detours may be established either daily or nightly for performing work activities such as surface rehabilitation work and then removed during peak travel periods, or may be established for long periods of time such as bridge removal and repair projects.

**Support:**

- 03 A Short Term Detour occupies a location for more than 2 hours within a single work period but not longer than three consecutive days and uses M4-9, M4-9 (V) and M4-V sign series to direct traffic along an alternate route.
- 04 **A Long Term Detour occupies a location longer than three consecutive days, or on a periodic basis (less than 24 consecutive hours) longer than three days and uses a DETOUR (M4-8) sign above a route shield assembly (route marker, cardinal direction auxiliary sign and advance turn/direction arrow auxiliary signs) or the cardinal direction, route marker over the M4-9, M4-9 (V) and M4-V sign series to direct traffic along an alternate route (see Section 6F.66 Detour Signs and Figures TTC-46 and TTC-47).**

**Standard:**

- 05 **Detours and diversions shall be reviewed and approved by the Regional Traffic Engineer or authority with jurisdiction over the roadway prior to implementation.**

*Guidance:*

- 06 *When a detour is long, Detour signs (see Section 6F.66) should be installed to remind and reassure road users periodically that they are still successfully following the detour.*
- 07 *When an entire roadway is closed, as illustrated in Figure TTC-48, a detour should be provided and road users should be warned in advance of the closure, which in this example is a closure 10 miles from the intersection. If local road users are allowed to use the roadway up to the closure, the ROAD CLOSED - LOCAL TRAFFIC ONLY (R11-3a) sign should be used. The portion of the road open to local road users should have adequate signing, marking, and delineation.*
- 08 *Detours should be signed so that road users will be able to traverse the entire detour route and back to the original roadway as shown in Figures TTC-46 and TTC-47.*

**Section 6G.14 Work Within the Traveled Way at an Intersection****Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The typical applications for intersections are classified according to the location of the work space with respect to the intersection area (as defined by the extension of the curb or edge lines). The three classifications are near side, far side, and in-the-intersection. Work spaces often extend into more than one portion of the intersection. For example, work in one quadrant often creates a near-side work space on one street and a far-side work space on the cross street. In such instances, an appropriate TTC plan is obtained by combining features shown in two or more of the intersection and pedestrian typical applications.
- 03 TTC zones in the vicinity of intersections might block movements and interfere with normal road user flows. Such conflicts frequently occur at more complex signalized intersections having such features as traffic signal heads over particular lanes, lanes allocated to specific movements, multiple signal phases, signal detectors for actuated control, and accessible pedestrian signals and detectors.

*Guidance:*

- 04 *The effect of the work upon signal operation should be considered, and temporary corrective actions should be taken, if necessary, such as revising signal phasing and/or timing to provide adequate capacity, maintaining or adjusting signal detectors, and relocating signal heads to provide adequate visibility as described in Part 4 of the 2009 MUTCD.*
- 05 *The design and construction of any new signal or modification to an existing signal should include keeping the existing signal in operation while the construction or modification work is being performed.*

**Standard:**

- 06 **When work will occur near an intersection where operational, capacity, or pedestrian accessibility problems are anticipated, the appropriate VDOT Regional Operations Manager or the agency having jurisdiction shall be contacted.**

*Guidance:*

- 07 *For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical applications depict urban intersections on arterial streets.*
- 08 *Pedestrian crossings near TTC sites should be separated from the worksite by appropriate barriers that maintain the accessibility and detectability for pedestrians with disabilities.*

## Support:

- 09 Near-side work spaces, as depicted in Figure TTC-26, are simply handled as a midblock lane closure. A problem that might occur with near-side lane closure is a reduction in capacity, which during certain hours of operation could result in congestion and backups.

Option:

- 10 When near-side work spaces are used, an exclusive turn lane may be used for through vehicular traffic.
- 11 Where space is restricted in advance of near-side work spaces, as with short block spacings, two warning signs may be used in the advance warning area, and a third action-type warning or a regulatory sign (such as Keep Left) may be placed within the transition area.

## Support:

- 12 Far-side work spaces, as depicted in Figure TTC-27, involve additional treatment because road users typically enter the activity area by straight-through and left- or right-turning movements.

*Guidance:*

- 13 *When a lane through an intersection must be closed on the far side, it should also be closed on the near-side approach to preclude merging movements within the intersection. In addition, if multiple turn lanes feed into the far side closure, one lane of the dual turn lane should be closed.*

Option:

- 14 If there are a significant number of vehicles turning from a near-side lane that is closed on the far side, the near-side lane may be converted to an exclusive turn lane.

## Support:

- 15 Figure TTC-28 provides guidance on applicable procedures for work performed within the intersection.

Option:

- 16 If the work is within the intersection, any of the following strategies may be used:
- A. A small work space so that road users can move around it, as shown in Figure TTC-28;
  - B. Uniformed law enforcement officers to direct road users;
  - C. Certified flaggers to direct road users, as shown in Figure TTC-30;
  - D. Work in stages so the work space is kept to a minimum; and
  - E. Road closures or upstream diversions to reduce road user volumes.

*Guidance:*

- 17 *Depending on road user conditions, a uniformed law enforcement officer(s) and/or a certified flagger(s) should be used to control road users.*

**Standard:**

- 18 **Certified flaggers shall not direct vehicles through a red signal or stop vehicles at a green signal at an intersection since they are not authorized to do so (see Section 46.2-834 of Highway Laws of Virginia).**

**Section 6G.15 Steel Plate Conspicuity and Warning**

## Support:

- 01 Steel plates are occasionally used in areas where an excavation is made in the roadway for repairs or utility work, providing temporary protection to motorists and pedestrians and continued movement of traffic. This situation provides a challenge to motorcyclists when they traverse a steel plate unexpectedly in the roadway.

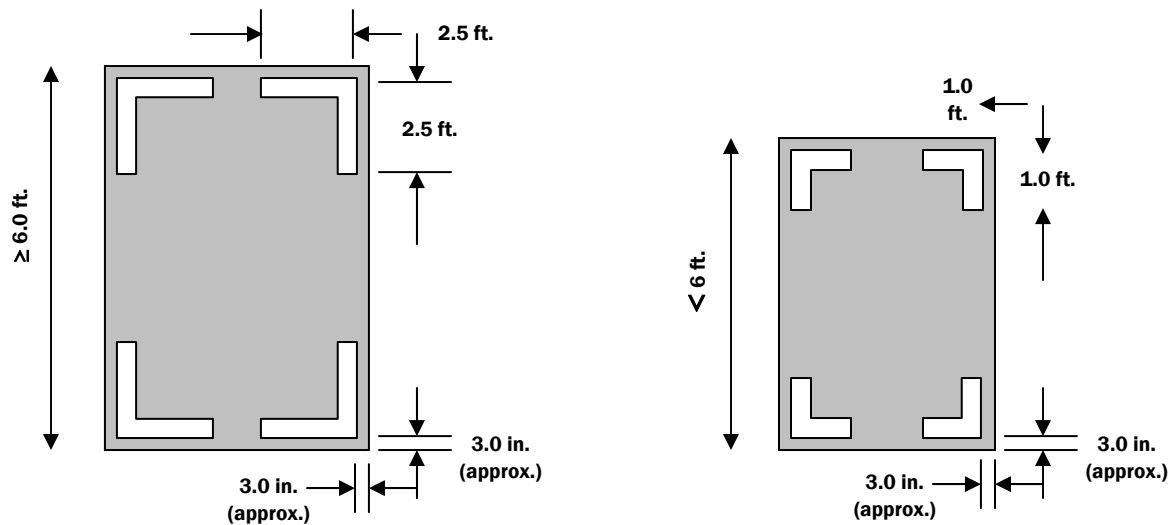
**Standard:**

- 02 Steel plates installed in connection with temporary repairs on roadways open to traffic shall be marked with durable, highly reflective white Type B, Class VI pavement marking tape, no less than 4 inches in width, and shall be recommended for turning movements by the manufacturer. Pavement marking shall be in compliance with Sections 246 and 704 of the Road and Bridge Specifications.
- 03 Placement of the reflective white pavement marking shall be as shown in Figure 6G-1. The markings shall be maintained throughout the use of the plate in a condition that provides sufficient retroreflectivity to distinguish the corners of the steel plate. Replacement of the markings shall be based on a visual assessment performed periodically at night by a moving inspection vehicle. Any leg of the marking that has lost fifty percent or more of its conspicuity shall be replaced.
- 04 A STEEL PLATE AHEAD (W8-24) sign shall be placed in advance of the temporary steel plate to warn approaching motorists of the changed roadway condition (see Section 6F.52).

Option:

- 05 Additional warning signs may be needed due to the complexity of the work location and other field conditions.

**Figure 6G-1, Steel Plate Conspicuity Markings**



LEFT: Steel plates with any side greater than or equal to 6 feet in length  
 RIGHT: Steel plates with all sides less than 6 feet in length

**Section 6G.16 Work Within the Traveled Way at a Roundabout**

**Support:**

- 01 Each roundabout is unique and the traffic control must be developed to meet the specific conditions of the location and the work operation. A detour could possibly better serve traffic movement and must be considered as an alternative to flagger controlled operations. The typical traffic control shown in Figures TTC-31 through TTC-33 can also be applied to traffic circles.

**Standard:**

- 02 **Flaggers shall control only one travel lane. For multi-lane roundabouts, one of the two approaching lanes shall be closed in advance of the roundabout as shown in Figures TTC-32 and TTC-33.**

*Guidance:*

- 03 *Consideration should be given in the use of law enforcement instead of certified flaggers.*
- 04 *When designing the traffic control and installing the TTC devices for work activities at roundabouts, accommodations for the turning radius of tractor trailer vehicles or other large vehicles should be considered and the work zone designed accordingly.*

Option

- 05 Periodic adjustments to the channelizing devices may be allowed in an active work zone to accommodate the turning movements of tractor trailer vehicles or other large vehicles through the temporary traffic control zone.

**Section 6G.17 Work Within the Traveled Way of a Limited Access Highway**

## Support:

- 01 Problems of TTC might occur under the special conditions encountered where vehicular traffic must be moved through or around TTC zones on high-speed, high-volume roadways. Although the general principles outlined in the previous Sections of this Manual are applicable to all types of highways, high-speed, access-controlled highways need special attention in order to accommodate vehicular traffic while also protecting road users and workers. The road user volumes, road vehicle mix (buses, trucks, cars, and motorcycles), and speed of vehicles on these facilities require that careful TTC procedures be implemented, for example, to induce critical merging maneuvers well in advance of work spaces and in a manner that creates minimum turbulence and delay in the vehicular traffic stream. These situations often require more conspicuous devices than specified for normal rural highway or urban street use. However, the same important basic considerations of uniformity and standardization of general principles apply for all roadways.
- 02 Work under high-speed, high-volume vehicular traffic on a controlled access highway is complicated by the roadway design and operational features. The presence of a median that establishes separate roadways for directional vehicular traffic flow might prohibit the closing of one of the roadways or the diverting of vehicular traffic to the other roadway. Lack of access to and from adjacent roadways prohibits rerouting of vehicular traffic away from the work space in many cases. Other conditions exist where work must be limited to night hours, thereby necessitating increased use of warning lights, illumination of work spaces, and advance warning systems.
- 03 TTC for a typical lane closure on a divided highway is shown in Figure TTC-16 for short-term and intermediate-term stationary operations and Figure TTC-20 for long-term stationary operations. Temporary traffic control for mobile operations on Limited Access highways is shown in Figures TTC-11 and TTC-12. A typical application for shifting vehicular traffic lanes around a work space is shown in Figure TTC-40. TTC for multiple lane closure on a roadway is shown in Figure TTC-18 and for an interior lane closure on a roadway is shown in Figure 6H-38 in Chapter 6H of the 2009 MUTCD.

*Guidance:*

- 04 *The method for closing an interior lane when the open lanes have the capacity to carry vehicular traffic should be as shown in Figure TTC-17. When the capacity of the other lanes is needed, the method shown in Figure 6H-38 in Chapter 6H of the 2009 MUTCD should be used.*

**Standard:**

- 05 **When work is being performed over a roadway open to traffic (on bridges, overhead signs, traffic signals, etc.) the traveled lanes(s) or shoulder that the work operation is over shall be closed, unless it is physically improbable materials, equipment or personnel could fall into the open lane or shoulder.**

## Support:

- 06 There are hazards involved when working over open travel lanes, especially in a bucket truck: The chance of dropping something onto traffic, the chance of a tractor-trailer or over height load striking the bottom of the bucket and ejecting the workers, and the chance the operation is a distraction to passing motorist. Therefore, this practice is not allowed.

Option:

- 07 A mobile closure may be an acceptable method of TTC depending on traffic volumes and location of the overhead work.

**Section 6G.18 Pull-Off Areas in Limited Access Highway and Expressway Work Zones***Guidance:*

- 01 *Work zone pull-off areas should be considered in work zones along Limited Access highways where one or both shoulders are closed due to construction.*

Option:

02 Pull-off areas may serve one or more of the three primary functions:

- Vehicle Refuge – Motorist who experience mechanical problems, flat tires, medical emergencies, distractions from children or passengers, etc. may not be able to travel completely through the work zone before their situation becomes a safety hazard. Appropriately designed pull-off areas can increase the likelihood of a driver reaching a safe area without potential involvement in an incident.
- Law Enforcement – Law enforcement near the upstream end of a work zone can have a significant effect toward promoting safer driver behavior. However, the effect may be diminished if aggressive drivers perceive that the law enforcement officer will not engage in pursuit. By providing pull-off areas, law enforcement officers can pursue aggressive drivers and have a safe area within the work zone in which to issue citations.
- Crash clearing and/or investigation – When crashes occur within the work zone, vehicles need to be cleared to the shoulder quickly in order to minimize the amount of upstream traffic congestion. Pull-off areas can provide locations where a greater proportion of motorists may feel comfortable moving their vehicles after a minor incident. Additionally, a pull-off area may provide emergency response vehicles with adequate space to aid victims after a crash without taking up an additional traffic lane.

*Guidance:*

03 *Pull-off areas should be considered where any of the following conditions exist:*

1. *Both the left and right shoulders will be closed simultaneously for a distance greater than 0.5 mile for long duration operations.*
2. *Speeding is expected to be or has been shown to be a problem and law enforcement is scheduled for the project.*
3. *The duration of construction will be significant (at least 30 days) where the shoulder would be unavailable for motorist.*
4. *High crash locations have been identified within or near the work zone limits.*
5. *Projects have been identified as Category C or “significant projects,” by the Department’s TMP policy.*
6. *Traffic volumes are such that, during peak hours, a blockage of a through lane by a disabled vehicle due to the lack of a pull-off area would create an unacceptable level of congestion.*
7. *Alternate places of refuge do not exist nearby.*

04 *The spacing of pull-off areas should be as follows:*

- *For projects with activity areas greater than 1.0 mile but less than 2.0 miles in length, one every 0.5 to 0.75 mile.*
- *For projects with activity areas greater than 2.0 miles in length, one every mile.*

05 *As illustrated in Typical Traffic Control Figure TTC-8, pull-off areas should be a minimum of 1320 feet long. The width of pull-off areas should be at least 12-15 feet.*

06 *To minimize conflicts with adjacent construction work, pull-off areas should be avoided on grades steeper than 2% if possible. Where level areas are not available in locations that meet all other criteria, the length of the pull-off should be increase by 200 feet.*

07 *Pull-off areas should not be located where adequate sight distance for acceleration and deceleration maneuvers would not exist, such as in proximity to horizontal or vertical crest curves. The location of temporary traffic barrier and construction activities occurring on the inside of horizontal curves just behind that barrier should be considered when determining whether motorists will have adequate sight distance through a horizontal curve.*

08 *Where pull-off areas are intended to enhance the role of law enforcement, coordination with law enforcement personnel should begin early in the project implementation schedule.*

09 *For shoulder closures greater than 0.5 mile in length, advance warning signs should be placed as follows after the ROAD WORK AHEAD sign:*



1. A *NEXT XX MILES (W16-VP1) supplemental plaque should be provided with the first RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) sign in the sequence.*
2. *The third sign in the sequence should be either:*
  - *A NO PULL-OFF AREA (W21-V15) warning sign with NEXT XX MILES (W16-VP1) supplemental plate, if there are no pull-off areas throughout the work area, or*
  - *A LEFT (RIGHT) PULL-OFF AREA (W21-V14) warning sign with EVERY X MILE (W16-VP2) supplemental plaque, if pull-off areas are provided. Additional options for the supplemental sign plaque that could be considered for these locations include a XX FEET (W16-VP3), NEXT EXIT (LEFT/RIGHT) (W16-VP4) or EXIT NUMBER (W16-V5) plaque. The plaque message should be appropriate for the geometric conditions and design speed of the roadway (for example “500 FT” or “1000 FT”), “NEXT EXIT,” “NEXT LEFT” or “NEXT RIGHT,” “EXIT 148 or EXIT 118 C.”*
3. *A LEFT (RIGHT) PULL-OFF AREA (W21-V14) warning sign with a 1000 feet (W16-VP3) supplemental plaque should be placed in advance of each pull-off area.*
4. *A Pull-Off Area Entrance (E5-V2) sign should be placed immediately prior to the pull-off area to give information to help a driver navigate to it safely.*
5. *Consideration should be given to whether there is adequate guide signing already in place for nearby interchanges to facilities that would provide adequate places for refuge. For instance, a pull-off area may not be needed within 0.5 mile of a freeway interchange exit if the exit is clearly signed and PULL-OFF AREA (W21-V13) sign with a NEXT EXIT plaque is provided.*

### **Section 6G.19 Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway**

Support:

- 01 Two-lane, two-way operation on one roadway of a normally divided highway is a typical procedure that requires special consideration in the planning, design, and work phases, because unique operational problems (for example, increasing the risk of head-on crashes) can arise with the two-lane, two-way operation.

**Standard:**

- 02 **When two-lane, two-way traffic control must be maintained on one roadway of a normally divided highway, opposing vehicular traffic shall be separated with either temporary traffic barriers (concrete safety-shape or approved alternate), channelizing devices, or a temporary raised island throughout the length of the two-way operation. The use of markings and complementary signing, by themselves, shall not be used.**

Support:

- 03 Figure TTC-23 shows the procedure for two-lane, two-way operation. Treatments for entrance and exit ramps within the two-way roadway segment of this type of work are shown in Figures 6H-40 and 6H-41 of the 2009 MUTCD.

Guidance:

- 04 *Modifications to any of these layouts must first be reviewed, documented and approved by the Regional Traffic Engineer prior to their use.*

### **Section 6G.20 Crossovers**

Guidance:

- 01 *The following are considered good guiding principles for the design of crossovers:*
- A. *Tapers for lane drops should be separated from the crossovers, as shown in Figure TTC-44.*
  - B. *Crossovers should be designed for speeds no lower than 10 mph below the posted speed, the off-peak 85<sup>th</sup>-percentile speed prior to the work starting, or the anticipated operating speed of the roadway, unless unusual site conditions require that a lower design speed be used.*
  - C. *A good array of channelizing devices, delineators, and full-length, properly placed pavement markings and pavement markers should be used to provide drivers with a clearly defined travel path.*
  - D. *The design of the crossover should accommodate all vehicular traffic, including motorcycles, trucks, and buses.*

- E. The use of screens mounted on the top of temporary traffic barriers should be considered in crossover applications whenever multi-lane traffic is reduced to two-way motor vehicle traffic to reduce headlight glare from oncoming traffic and improve mobility through the crossover (see Section 6F.97).*

Support:

- 02 Temporary traffic barriers and the excessive use of TTC devices cannot compensate for poor geometric and roadway cross-section design of crossovers.

### **Section 6G.21 Interchanges**

*Guidance:*

- 01 *Access to interchange ramps on limited-access highways should be maintained even if the work space is in the lane adjacent to the ramps. Access to exit ramps should be clearly marked and delineated with channelizing devices. For long-term projects, conflicting pavement markings should be removed and new ones placed. Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur before ramp closings.*

Option:

- 02 If access is not possible, ramps may be closed by using signs and Type 3 Barricades. As the work space changes, the access area may be changed, as shown in Figure TTC-37. A TTC zone in the exit ramp may be handled as shown in Figure TTC-38.

- 03 When a work space interferes with an entrance ramp, a lane may need to be closed on the highway (see Figure TTC-39). A TTC zone in the entrance ramp may require shifting ramp vehicular traffic (see Figure TTC-39).

### **Section 6G.22 Movable Barriers**

Support:

- 01 Figure 6H-45 of the 2009 MUTCD shows a temporary reversible lane using movable barriers.

Option:

- 02 If the work activity in Figure TTC-20 permits, a movable barrier may be used and relocated to the shoulder during nonwork periods or peak-period vehicular traffic conditions.

**Standard:**

- 03 **Modifications to Figure 6H-45 of the 2009 MUTCD shall be reviewed and approved by the Regional Traffic Engineer prior to its use and documented.**

### **Section 6G.23 Work in the Vicinity of a Railroad Grade Crossing**

**Standard:**

- 01 **When railroad grade crossings exist either within or in the vicinity of a TTC zone, lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or a certified flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.**

Support:

- 02 Figure TTC-56 shows work in the vicinity of a grade crossing.

- 03 Section 8A.08 of the 2009 MUTCD contains additional information regarding temporary traffic control zones in the vicinity of grade crossings.

*Guidance:*

- 04 *Early coordination with the railroad company or light rail transit agency should occur before work starts.*

### **Section 6G.24 Slow Roll Temporary Traffic Control Operations**

Support:

- 01 The following guidelines have been developed to ensure consistency for Slow Roll Temporary Traffic Control (Slow Roll TTC) on Limited Access highways. Activities which may warrant the use of Slow Roll TTC on Limited Access highways include, but are not limited to: setting of bridge beams, pulling wires or cables across the roadway, placing overhead or cantilever signs, and performing traffic switches from one half of the roadway to the other half.

**Standard:**

- 02 Any Slow Roll TTC operation shall be approved by the Regional Traffic Engineer or their designee<sup>1</sup> prior to use and shall be performed as follows:
- 03 Slow Roll TTC shall only be performed during non-peak travel periods and must be planned to not exceed periods of 15 minutes in duration.
- 04 The performance of Slow Roll TTC shall include the use of the Virginia State Police (VSP) or other law enforcement personnel unless an exception is granted by the Regional Traffic Engineer.
- 05 Prior to utilizing Slow Roll TTC, a coordination meeting shall be held with all entities involved in the operation to discuss each person's role.
- 06 At a minimum, a portable changeable message sign (PCMS) or, if available, an overhead changeable message sign (CMS) shall be used a minimum of 1 mile in advance of the beginning of the Slow Roll TTC operation with the following messages: ROAD WORK AHEAD; BE PREPARED TO STOP.
- 07 A control vehicle (contractor, public agency<sup>1</sup>, or VSP) shall occupy each travel lane of the route affected by the Slow Roll TTC. All entrance ramps within the Slow Roll TTC operation shall be temporarily closed. A drive through of the route shall be performed prior to beginning the Slow Roll TTC operation to ensure there are no parked vehicles along the roadway which could enter the travel lane during the Slow Roll TTC operation (Once the Slow Roll TTC operation has passed a closed entrance ramp, the ramp may be reopened).
- 08 Determining where to begin a Slow Roll TTC shall include an evaluation of all factors unique to the road system in question. As a minimum the following items shall be considered in the evaluation:
- A. The time lapse expected for the last uncontrolled vehicle to pass by the site of the planned work.
  - B. The assumed maximum time needed for the work operation to be completed.
  - C. The projected travel time of the Slow Roll. For example, a travel speed of 10 mph will cover 1 mile in six minutes.
  - D. The number of entrance ramps requiring closing at interchanges.
  - E. The starting point for the Slow Roll TTC shall be in a tangent section (both horizontal and vertical) of the approach roadway with adequate sight distance.
- 09 Upon a sufficient gap in traffic, each slow roll vehicle will pull out and occupy a travel lane with their warning lights and hazard lights operating and will travel at a minimum of 10 miles per hour. A shadow vehicle shall follow the last motorist vehicle traveling in advance of the slow roll operation vehicles to notify the work crew when the roadway is closed and free of approaching motorist.
- 10 The lead vehicle in the slow roll operation shall have radio/telephone communication with the work crew. Once the need for the road closure is complete, the work crew shall notify the lead vehicle in the slow roll operation, who in turn will notify the other work vehicles. The slow roll vehicles shall gain speed and pull over to the right side of the roadway; starting from the vehicle occupying the left lanes first (the VSP should continue with the flow of traffic to ensure controlled acceleration by the released vehicles).
- 11 If the slow roll operation vehicles reach the work site before receiving notification that the operation has been completed, they shall slow down and/or stop until signaled that the roadway is safe to release traffic.
- 12 Once the slow roll operation is complete and free flow travel conditions have been re-established, the PCMS or overhead CMS messages shall be modified to remove the BE PREPARED TO STOP message.

**Section 6G.25 Installing/Removing Temporary Traffic Control***Guidance:*

- 01 Care must be exercised when installing and removing temporary traffic control devices.
- 02 The acts of installing and removing TTC on a two-lane roadway should begin as a non-stationary flagging operation using a Temporary Traffic Control (TTC) Spotter, a shadow vehicle, and a work operations vehicle.<sup>1</sup>

**Option:**<sup>1</sup>

- 03 On a two-lane roadway, when a shadow vehicle is not available the work operations vehicle may act as a shadow vehicle to protect workers installing and removing TTC devices.<sup>1</sup>

*Guidance:*

04 On a two-lane roadway, where pull off areas are limited, a **Temporary Traffic Control Spotter<sup>1</sup>** using a **red or red-orange<sup>1</sup>** flag and proper flagger procedures should temporarily stop traffic while TTC devices are being installed. The **TTC Spotter<sup>1</sup>** moves with the operation or can be stationary. At nighttime, road flares, a red glow-cone flashlight, or a red traffic wand can be used to increase the visibility of the flagger.

**Option:<sup>1</sup>**

05 **The STOP/SLOW paddle may be used as a supplement to enhance the flag used by a TTC Spotter.<sup>1</sup>**

**Standard:<sup>1</sup>**

06 **The TTC Spotter shall be positioned after the Road Work Ahead sign and must remain highly visible to oncoming traffic at all times.<sup>1</sup>**

*Guidance:<sup>1</sup>*

07 When a work operations vehicle acts as shadow vehicle, two TTC Spotters should be used. One TTC Spotter to control traffic and the other to alert co-workers who are installing and removing TTC of approaching traffic and control traffic when necessary.<sup>1</sup>

08 On a multilane roadway installing and removing TTC begins and ends as a modified mobile operation (for an example, see TTC-62)<sup>1</sup>. A shadow vehicle with an<sup>1</sup> arrow board and amber warning lights<sup>1</sup> should be placed on the shoulder to direct traffic out of the closed lane. Another<sup>1</sup> shadow vehicle with an arrow board and<sup>1</sup> amber warning<sup>1</sup> lights closes the lane while TTC devices are being installed or removed by the work operation vehicle<sup>1</sup>. The shadow vehicle should be 80' to 120' in advance of the work operation vehicle.

**Option:<sup>1</sup>**

09 On a multi-lane roadway the work operations vehicle may be equipped with a TMA; however it must also be protected by a shadow vehicle.<sup>1</sup>

**Standard:**

10 On a multilane roadway TTC devices shall not be stored, installed or removed from a shadow vehicle or a shadow vehicle with a TMA. Temporary traffic control devices shall be stored, installed or removed from a work operation vehicle.<sup>1</sup>

11 When a shadow vehicle on a multilane roadway is unable to be positioned on the shoulder and is partially or fully in the travel lane it shall be equipped with a TMA when the posted speed limit is 45 mph or greater.<sup>1</sup>

*Guidance:*

12 Stationary lane closures on a multi-lane roadway should be installed with the flow of traffic in the following sequence:

- A. Install all advance warning signs, beginning with the ROAD WORK AHEAD (W20-1) sign and ending with the END ROAD WORK (G20-2 (V)) sign. Install all signs beginning with the opposite side which will be closed (for a right lane closure; first, install all signs on the left side (shoulder) and then install all signs on the right side (shoulder).
- B. Install shoulder taper if required.
- C. Install arrow board on the shoulder prior to the merging taper or as close to the beginning of the merging taper as possible.
- D. Install channelizing devices to form a merging taper. Use of a shadow vehicle (with or without a TMA, depending on the type of roadway) is recommended during installation.
- E. Install traffic control devices along the buffer space.
- F. Continue placing devices along the work space at the appropriate spacing.
- G. Install devices for the termination area. Install an END ROAD WORK sign, if necessary.
- H. Review the lane closure by performing a drive through inspection, correcting any deficiencies and documenting necessary adjustments.

13 All TTC devices for a stationary lane closure on a multi-lane roadway, except advance warning signs, should be removed against the flow of traffic in the following sequence:

- A. *Remove the channelizing devices starting from the end of the activity area working back to the widest part of the merging taper.*
  - B. *Place the removal vehicle on the shoulder, and remove the channelizing devices from the merging taper by hand onto the work vehicle.*
  - C. *Remove the arrow board.*
- 14 *Advance warning signs should be removed with the flow of traffic beginning with the ROAD WORK AHEAD sign and ending with the END ROAD WORK sign. Remove signs beginning with the lane closure side (for a right lane closure; first, remove all signs from the right side (shoulder) and then remove all signs left side (shoulder)).*
- 15 *Workers' running across an open travel lanes of traffic to install TTC devices is a dangerous practice that should not be performed unless slow roll temporary traffic control operations as described in Section 6G.24 are being performed.*

Option:

- 16 When traffic delays have exceeded expectations, a worker on each shoulder may disassemble the advance warning signs and their portable sign support in reverse order to allow delayed traffic to clear. The disassembled signs and their supports may be stored beyond the shoulder until such time traffic delays have dispersed and signs can be removed safely.

Support:<sup>1</sup>

- 17 For activities where a TMA will not be required in the operation, such as work beyond the shoulder (TTC-1.0), litter removal or mowing (non-Limited Access) off of the travelway and shoulder, surveying operations (TTC-49.0), or logging operations (TTC-63.) as examples, a shadow vehicle with a TMA will not be required since the placement of warning signs for these operations can be performed quickly with no further use of the TMA vehicle needed.<sup>1</sup>

### **Section 6G.26 Temporary Traffic Control During Nighttime Hours**

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

**Standard:**

- 02 **Nighttime hours shall be defined as the time from 30 minutes prior to sunset to 30 minutes after sunrise on the next calendar day.**

Support:

- 03 Conducting highway construction and maintenance activities during night hours could provide an advantage when traditional daytime traffic control strategies cannot achieve an acceptable balance between worker and public safety, traffic and community impact, and constructability. The two basic advantages of working at night are reduced traffic congestion and less involvement with business activities. However, the two basic conditions that must normally be met for night work to offer any advantage are reduced traffic volumes and easy set up and removal of the traffic control patterns on a nightly basis.
- 04 Shifting work activities to night hours, when traffic volumes are lower and normal business is less active, might offer an advantage in some cases, as long as the necessary work can be completed and the worksite restored to essentially normal operating conditions to carry the higher traffic volume during non-construction hours.
- 05 Although working at night might offer advantages, it also includes safety issues. Reduced visibility inherent in night work impacts the performance of both drivers and workers. Because traffic volumes are lower and congestion is minimized, speeds are often higher at night necessitating greater visibility at a time when visibility is reduced. Finally, the incidence of impaired (alcohol or drugs), fatigued, or drowsy drivers might be higher at night.
- 06 Working at night also involves other factors, including construction productivity and quality, social impacts, economics, and environmental issues. A decision to perform construction or maintenance activities at night normally involves some consideration of the advantages to be gained compared to the safety and other issues that might be impacted.

*Guidance:*

- 07 *Considering the safety issues inherent to night work, consideration should be given to enhancing traffic controls (see Section 6G.04) to provide added visibility and driver guidance, and increased protection for workers.*
- 08 *In addition to the enhancements listed in Section 6G.04, consideration should be given to providing additional lights and retroreflective markings to workers, work vehicles, and equipment.*

Option:

- 09 Where reduced traffic volumes at night make it feasible, the entire roadway may be closed by detouring traffic to alternate facilities, thus removing the traffic risk from the activity area, see Figures TTC-46 through TTC-48.
- 10 A PCMS may be placed up to 1 mile in advance of the advance warning signs, with the message NIGHT WORK AHEAD, to supplement the advance warning signs.<sup>1</sup>

*Guidance:*

- 11 *Because typical street and highway lighting is rarely adequate to provide sufficient levels of illumination for work tasks, temporary lighting should be provided where workers are active to supply sufficient illumination to reasonably and safely perform the work tasks.*
- 12 *Temporary lighting for night work should be designed such that glare does not interfere with driver visibility, or create visibility problems for truck drivers, equipment operators, flaggers, or other workers.*
- 13 *Consideration should be given to stationing uniformed law enforcement officers and lighted patrol cars at night work locations where there is a concern that high speeds or impaired drivers might result in undue risks for workers or other drivers (see Appendix C, Guidelines for Use of Virginia State Police in Construction/Maintenance Work Zones).*

## Support:

- 14 Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of 5 foot candles can be adequate for general activities. An average horizontal luminance of 10 foot candles can be adequate for activities around equipment. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 20 foot candles.

**Standard:**

- 15 **Except in emergencies, temporary lighting providing a minimum horizontal luminance of 5 foot candles (50 lux) shall be provided at all flagger stations during nighttime operations.**
- 16 **Floodlighting shall not produce a disabling glare condition for approaching road users, flaggers, or workers.**
- 17 **The adequacy of the floodlight placement and elimination of potential glare shall be determined by driving through and observing the floodlighted area from each direction on all approaching roadways after the initial floodlight setup, at night, and periodically during each shift.**

*Guidance:*

- 18 *Consideration should be given to the use of non-glare type lighting such as non-glare balloon lights for nighttime activities.*
- 19 *Advance warning signs used during night hours should be reviewed on a periodic basis during the shift to ensure moisture/condensation has not obscured the retroreflectivity or visibility of the sign text.*

**Standard:**

- 20 **Group 2 channelizing devices shall be used in all unmanned work zone locations, and drums shall be used in all merging and shifting tapers on Limited Access highways for nighttime operations.**

**Section 6G.27 Work Area Ingress/Egress Considerations***Guidance:*

- 01 *The Temporary Traffic Control Plan (TTCP) should address the need for access to and from the work area. This is a constructability issue in which the designer should address the question of how the contractor will safely move materials and equipment into the work area with a minimum of disruption to traffic. This is a particularly critical issue on high speed roadways such as Limited Access highways, especially if temporary traffic barrier is used to protect work areas.*

**Option:**

02 Consideration may be given to the design and construction of temporary acceleration and deceleration lanes for use by construction equipment.

*Guidance:*

- 03 *The following should be considered in the planning, design, and operation of work zones:*
- *Designers and contractors should anticipate types of work zones that typically create ingress/egress problems. Examples are work spaces requiring work vehicles to merge in/out of high-speed traffic and work activities that will generate frequent delivery of materials such as paving projects, bridge projects, and the delivery/movement of fill materials.*
  - *Access into/out of the work space should be included in the Temporary Traffic Control Plan.*
  - *Adequate acceleration/deceleration space for work vehicles should be provided.*
  - *The location of access openings should meet the sight distance requirements listed in Table 6G-1 (Intersection Sight Distance for Construction Entrances). In extreme conditions such as downgrades, lane closures may need to be considered.*
  - *Construction access openings in traffic barrier service should be planned per Appendix A to ensure that blunt ends of barrier walls are properly protected. The barrier channelization devices should be planned in a manner as to not create a sight distance problem for equipment operators or motorists.*
  - *Warning signs (CONSTRUCTION ENTRANCE (W11-V2) or TRUCKS ENTERING HIGHWAY (W11-V4)) are available for ingress/egress conditions at work area accesses and should be used when appropriate. All warning sign(s) noting work zone access activities should be covered or removed when the daily work activity ceases.*
  - *For nighttime operations, illuminating the construction access should be considered.*

**Option:**

04 Ingress/egress conditions may justify lowering the speed limit during this activity. Any reduction in the posted speed limit must be authorized by the Regional Traffic Engineer and based on an engineering study per TE-350.

**Table 6G-1, Intersection Sight Distance (ISD) for Construction Entrances**

Posted Speed (mph)	20	25	30	35	40	45	50	55	60	65	70
Minimum ISD (Feet)	195	240	290	335	385	430	480	530	575	625	670
Height of eye – 3.5 ft. Height of object – 3.5 ft.											

**Guidance:**<sup>1</sup>

- 05 *The spacing of work area ingress/egress should be as follows:*
- *For projects with activity areas up to 2.0 miles in length, one every 0.5 to 0.75 mile.*
  - *For projects with activity areas greater than 2.0 miles in length, one every mile.*
- 06 *Work area ingress/egress should be a minimum of 1320 feet long. The width of ingress/egress areas should be a desirable distance of 15 feet.*
- 07 *During day and<sup>1</sup> night operations, work vehicles entering and exiting the work area should be equipped with and have operating at least one high intensity amber rotating, flashing or<sup>1</sup> oscillating light visible from 360 degrees*

**Option:**<sup>1</sup>

08 The width of the work area ingress/egress may be reduced to a minimum of 12 feet on roadways with Right-of-Way constraints.

**Standard:**

- 09 **Type 3 barricades shall be used to close or partially close a work access opening or construction entrance.<sup>1</sup>**
- 10 **A WORK VEHICLE FREQUENT TURNS (G20-V1a) or WORK VEHICLE DO NOT FOLLOW (G20-V1) vehicle-mounted sign shall be placed on the rear of trucks hauling/delivering material to the work space (see Section 6F.64).<sup>1</sup>**

**Section 6G.28 Work During Inclement Weather**

## Support:

- 01 Inclement weather (rain, snow, fog, etc.) creates the following conditions for road users:
- Lack of visibility to the road and temporary traffic control devices;
  - Greater distance required for slowing and stopping a motor vehicle;
  - An increase in the difficulty of controlling a motor vehicle, and;
  - An increase in the distraction and anxiety for road users while traveling on the roadway.

*Guidance:*

- 02 *Therefore, planned work activities should be avoided, if possible, during inclement weather conditions.*

Option:

- 03 Emergency operations (snow removal, debris cleanup, etc.), however, may be performed where inaction would be worse for motorists than allowing the condition to remain unattended.

## Support:

- 04 See Chapter 6I, Control of Traffic Through Traffic Incident Management Areas, for TTC.