

Work Zone Safety

Highway, road, street, bridge, tunnel, utility and other workers for the highway infrastructure are exposed to hazards from outside and inside the work zone. Falls, electrical, struck-by, and caught-in-between are the common hazards found in this type of work. Guidance for the set-up of work zone signs, barricades, flagging, etc. can be found in the Department of Transportation's "Manual on Uniform Traffic Control Devices (MUTCD)." The MUTCD is referenced in 1926 Subpart G. See Figure 6C-1 at the end of this section for an illustration of a temporary traffic control zone from the MUTCD.

Manual of Uniformed Traffic Control Devices

The following tips can help keep you safe when working in these hazardous areas:

Work Zone Safety Tips

- Hand Signaling Devices - Stop/Slow paddles, not flags, should be the primary signaling device. Paddles must be:
 - Octagonal shape on a rigid handle.
 - And be at least 18 inches wide with letters at least six inches high.
 - Paddles must be reflectorized when used at night.
- Flaggers should wear retroreflective garments that meet the requirements for the speed of the location they are working in per DOT. The garment can be a shirt, vest, jacket or jacket and pants combination and shall be a "strong yellow green" color.
- All workers exposed to vehicular traffic should be in the retroreflective "strong yellow green" color with the appropriate square inches of reflective coloring.
- Vests should be fitted with the 5 point connective Velcro located on the chest, under the arms on the sides and across both shoulders to be worn as a breakaway garment in case of snagging by equipment or vehicles.
- The garments are designed to identify the user more clearly in daytime and low light conditions and will offer 360 degrees of visibility also.
- Workers should be trained on how to work in and around vehicular traffic.
- A traffic control plan established and monitored by a Traffic Control Supervisor is required under many circumstances. Consult with the Manual of Uniform Traffic Control Devices for specific information.

- Ensure that all traffic control devices are set up according to the plan, the manual and other specifications for the road work. All devices must be in good condition and visible to the public.
- Separate workers from traffic using a positive separation such as a barrier, road closure, shadow vehicle and or buffer space.
- Communicate with operators of equipment and the vehicle drivers to ensure that they see you and never assume they will avoid an impact.
- Be alert for overhead utilities and lines for contact.

Remember, proper traffic controls:

- Ensure the smooth safe movement of the traveling public
- Provide safety for the workers & equipment in the work zones

Nighttime Safety Tips:

- Have in place a detailed nighttime work plan before night operations commence.
- Erect roadway lighting as soon as possible.
- Reduce spacing between channelizing devices to compensate for reduced driver visibility.
- Ensure arrow panels are set at nighttime levels.
- Arrange lighting to minimize glare to traveling public (use balloon lights).
- Lane closures on highway construction should be limited to a maximum of 3 miles with at least a 5 mile buffer in between consecutive closures.
- Special signs should be erected - "Double Fines in Effect When Flashing."
- Signs should have flashing lights mounted on top.
- Reduce travel speeds through nighttime work areas - use temporary thermal plastic bumps.
- Have employees trained in a nighttime construction training program.
- Wear additional reflective clothing.
- Remove devices that are dirty, disfigured or are not retroreflective.
- Use good, quality temporary pavement markings. Remove old, confusing markings

Temporary Traffic Control

Whenever the acronym "TTC" is used in Part 6, it refers to "temporary traffic control."

The primary function of TTC is to provide for the reasonably safe and effective movement of road users through or around TTC zones while reasonably protecting road users, workers, responders to traffic incidents, and equipment.

Of equal importance to the public traveling through the TTC zone is the safety of workers performing the many varied tasks within the workspace. TTC zones present constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the workers and incident management responders on or near the roadway (see Section 60.03). At the same time, the TTC zone provides for the efficient completion of whatever activity interrupted the normal use of the roadway.

Consideration for road user safety, worker and responder safety, and the efficiency of road user flow is an integral element of every TTC zone, from planning through completion. A concurrent objective of the TTC is the efficient construction and maintenance of the highway and the efficient resolution of traffic incidents.

The following are the seven fundamental principles of TTC:

- General plans or guidelines should be developed to provide safety for motorists, bicyclists, pedestrians, workers, enforcement/emergency officials, and equipment, with the following factors being considered:
- The basic safety principles governing the design of permanent roadways and roadsides should also govern the design of TTC zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and TTC devices as nearly as possible comparable to those for normal highway situations.
- A TTC plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by an official who is knowledgeable (for example, trained and/or certified) in proper TTC practices.
- Road user movement should be inhibited as little as practical, based on the following considerations:
- TTC at work and incident sites should be designed on the assumption that drivers will only reduce their speeds if they clearly perceive a need to do so (see Section 6C.01).
- Frequent and abrupt changes in geometrics such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers, should be avoided.

- Work should be scheduled in a manner that minimizes the need for lane closures or alternate routes, while still getting the work completed quickly and the lanes or roadway open to traffic as soon as possible.
- Attempts should be made to reduce the volume of traffic using the roadway or freeway to match the restricted capacity conditions. Road users should be encouraged to use alternative routes. For high-volume road ways and freeways, the closure of selected entrance ramps or other access points and the use of signed diversion routes should be evaluated.
- Bicyclists and pedestrians, including those with disabilities, should be provided with access and reasonably safe passage through the TTC zone.
- If work operations permit, lane closures on high-volume streets and highways should be scheduled during off-peak hours. Night work should be considered if the work can be accomplished with a series of short-term operations.
- Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur if significant impacts to roadway operations are anticipated.
- Motorists, bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing TTC zones and incident sites. The following principles should be applied:
 - Adequate warning, delineation, and channelization should be provided to assist in guiding road users in advance of and through the TTC zone or incident site by using proper pavement marking, signing, or other devices that are effective under varying conditions. Providing information that is in usable formats by pedestrians with visual disabilities should also be considered.
 - TTC devices inconsistent with intended travel paths through TTC zones should be removed or covered. However, in intermediate-term stationary, short-term, and mobile operations, where visible permanent devices are inconsistent with intended travel paths, devices that highlight or emphasize the appropriate path should be used. Providing traffic control devices that are accessible to and usable by pedestrians with disabilities should be considered.
 - Flagging procedures, when used, should provide positive guidance to road users traversing the TTC zone.
 - To provide acceptable levels of operations, routine day and night inspections of TTC elements should be performed as follows:
 - Individuals who are knowledgeable (for example, trained and/or certified) in the principles of proper TTC should be assigned responsibility for safety in

TTC zones. The most important duty of these individuals should be to check that all TTC devices of the project are consistent with the TTC plan and are effective for motorists, bicyclists, pedestrians, and workers.

- As the work progresses, temporary traffic controls and/or working conditions should be modified, if appropriate, in order to provide mobility and positive guidance to the road user and to provide worker safety. The individual responsible for TTC should have the authority to halt work until applicable or remedial safety measures are taken.
- TTC zones should be carefully monitored under varying conditions of road user volumes light, and weather to check that applicable ' TTC devices are effective, clearly visible, clean, and in compliance with the TTC plan.
- When warranted, an engineering study should be made (in cooperation with law enforcement officials) of reported crashes occurring within the TTC zone. Crash records in TTC zones should be monitored to identify the need for changes in the TTC zone.
- Attention should be given to the maintenance of roadside safety during the life of the TTC zone by applying the following principles:
 - To accommodate run-off-the-road incidents, disabled vehicles, or emergency situations, unencumbered roadside recovery areas or clear zones should be provided where practical.
 - Channelization of road users should be accomplished by the use of pavement markings, signing, and crashworthy, detectable channelizing devices.
 - Work equipment, workers' private vehicles, materials, and debris should be stored in such a manner to reduce the probability of being impacted by run-off-the-road vehicles.
- Each person whose actions affect TTC zone safety, from the upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make. Only those individuals who are trained in proper TTC practices and have a basic understanding of the principles (established by applicable standards and guidelines, including those of this Manual) should supervise the selection, placement, and maintenance of TTC devices used for TTC zones and for incident management.
- Good public relations should be maintained by applying the following principles:
 - The needs of all road users should be assessed such that appropriate advance notice is given and clearly defined alternative paths are provided.

- The cooperation of the various news media should be sought in publicizing the existence of and reasons for TTC zones because news releases can assist in keeping the road users well informed.
- The needs of abutting property owners, residents, and businesses should be assessed and appropriate accommodations made.
- The needs of emergency service providers (law enforcement, fire, and medical) should be assessed and appropriate coordination and accommodations made.
- The needs of railroads and transit should be assessed and appropriate coordination and accommodations made.
- The needs of operators of commercial vehicles such as buses and large trucks should be assessed and appropriate accommodations made.

Table 6C-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 column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. 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.)

Table 6C-2. Stopping Sight Distance as a Function of Speed

Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

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

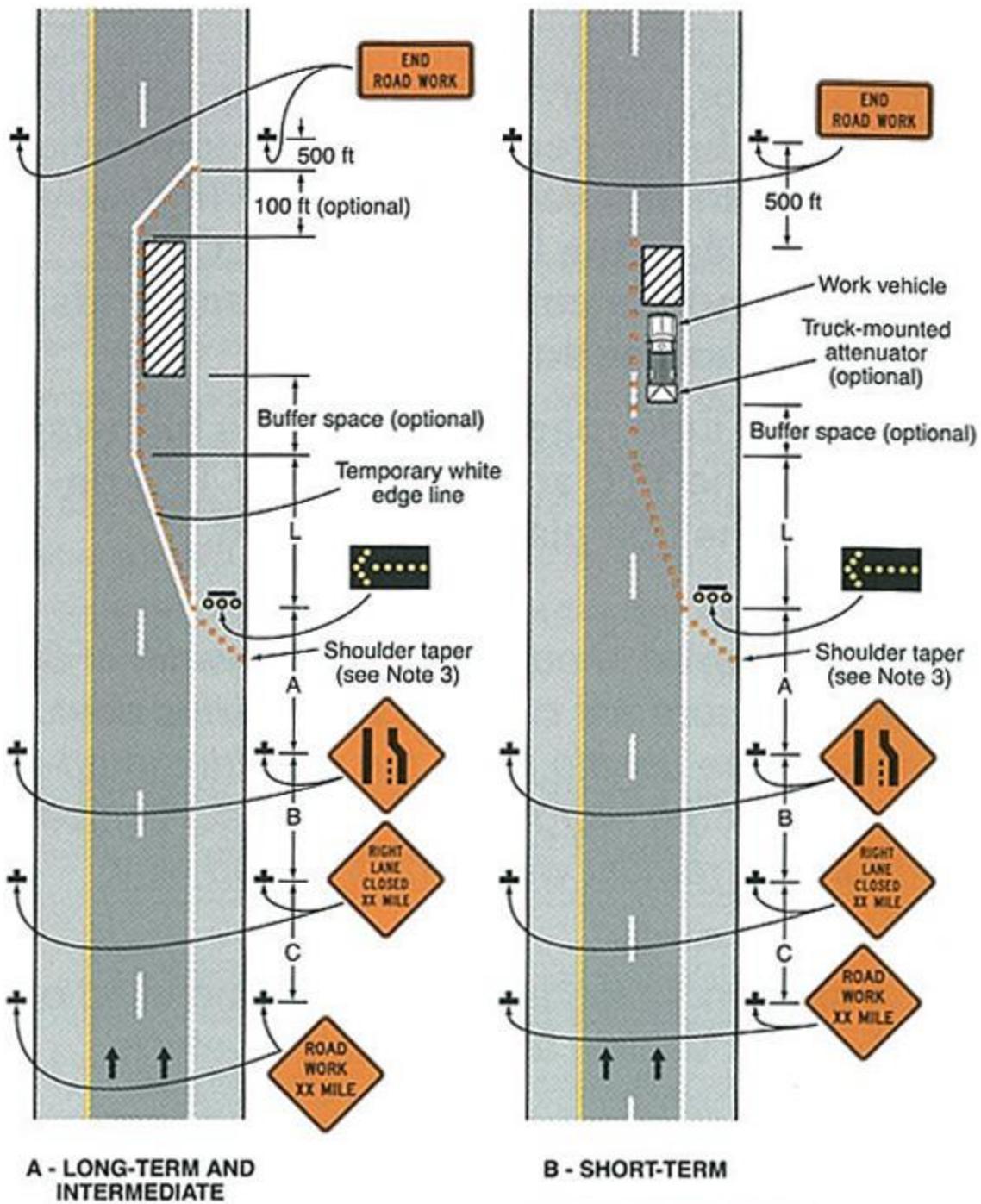
Notes for Figure 6H-33 Typical Application 33
Stationary Lane Closure on a Divided Highway

- **Standard:**
 - This information also shall be used when work is being performed in the lane adjacent to the median on a divided highway. In this case, the LEFT LANE CLOSED signs and the corresponding Lane Ends signs shall be substituted.
 - When a side road intersects the highway within the TTC zone, additional TTC devices shall be placed as needed.
- **Guidance:**
 - When paved shoulders having a width of 8 feet or more are closed, channelizing devices should be used to close the shoulder in advance

of the merging taper to direct vehicular traffic to remain within the traveled way.

- **Option:**
 - A truck-mounted attenuator may be used on the work vehicle and/or shadow vehicle.
- **Support:**
 - Where conditions permit, restricting all vehicles, equipment, workers, and their activities to one side of the roadway might be advantageous.
- **Standard:**
 - An arrow board shall be used when a free way lane is closed. When more than one freeway lane is closed, a separate arrow board shall be used for each closed lane.

Figure 6H-33. Stationary Lane Closure on a Divided Highway (TA-33)



Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.

Notes for Figure 6H-10-Typical Application
10 Lane Closure on a Two-Lane Road Using Flaggers

- **Option:**
 - For low-volume situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions, a single flagger, positioned to be visible to road users approaching from both directions, may be used (see Chapter 6E).
 - The ROAD WORK AHEAD and the END ROAD WORK signs may be omitted for short-duration operations.
 - 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 sign series.
- **Guidance:**
 - The buffer space should be extended so that the two-way traffic taper is placed before a horizontal (or crest vertical) curve to provide adequate sight distance for the flagger and a queue of stopped vehicles.
- **Standard:**
 - At night, flagger stations shall be illuminated, except in emergencies.
- **Guidance:**
 - When used, the BE PREPARED TO STOP sign should be located between the Flagger sign and the ONE LANE ROAD sign
 - When a grade crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the grade crossing, the TTC zone should be extended so that the transition area precedes the grade crossing.
 - When a grade crossing equipped with active warning devices exists within the activity area, provisions should be made for keeping flaggers informed as to the activation status of these warning devices.
 - Early coordination with the railroad company or light rail transit agency should occur before work.
- **Option:**

- A flagger or a uniformed law enforcement officer may be used at the grade crossing to minimize the probability that vehicles are stopped within 15 feet of the grade crossing, measured from both sides of the outside rails.

Figure 6H-10. Lane Closure on a Two-Lane Road Using Flaggers (TA-10)

Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.

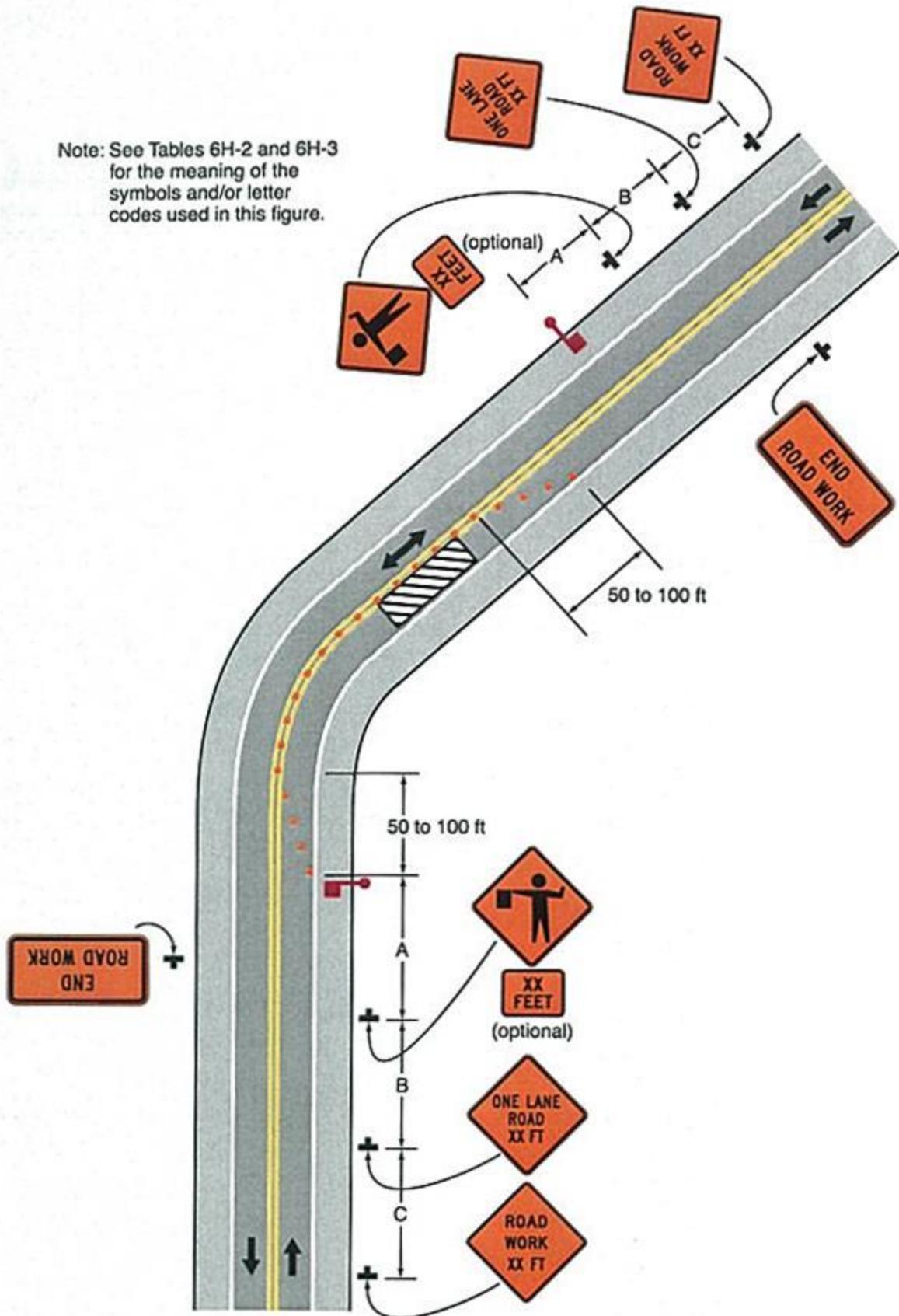


Figure 6C-1. Component Parts of a Temporary Traffic Control Zone

