Georgia Tech Facilities Management

Architectural and Engineering Design Standards

Temporary Traffic Control Manual

August 2017

TABLE OF CONTENTS

FIGURES

TABLES

1 INTRODUCTION

Temporary traffic control is essential to providing safe and efficient traffic flow, when interruptions in normal flow are necessary for temporary periods of time. From a temporary traffic control perspective, university campuses present unique characteristics and can be vastly different from non-campus roadways. In addition to daily traffic patterns university campuses accommodate a higher volume of pedestrian, bicycle, and tourist traffic. Care must be taken to accommodate the variety of uses, users, and unique circumstances which may arise on campus. Additionally, with the Georgia Tech campus being in an urban setting, commuter traffic will play a significant role in creating traffic issues.

The Georgia Tech campus is complex in nature with a wide variety of users with varying requirements and skill/ familiarity levels. With enrollment increasing yearly and trends leading towards increased enrollment, traffic conditions across campus are expected to worsen over the coming years. With Georgia Tech developing and implementing infrastructure projects to keep pace with demand temporary traffic control will be required to play a role to maintain a safe and efficient operation of the campus. Depending on the scale of projects temporary traffic control could be required for several hours to many weeks, the scale of projects may even necessitate detours to reroute traffic around the project. Several stakeholders and jurisdictions will be affected by such closures and will need to be involved in the decision-making process.

The objective of this document is to the support in the following:

- Assist designers in creating a well-rounded “Temporary Traffic Control Plan (TTCP)”
- Assist Georgia Tech field inspectors to ensure that the temporary traffic control plans are adhered to in the field
- Assist in providing a guideline that ensures a standardized process in creating an efficient and safe design

2 FUNDAMENTAL PRINCIPLES

A TTCP should be put together anytime a construction project or an event suspends normal function of a roadway. The priority of the TTCP is keep users and workers safe, while maintaining accessibility, and presenting/ disseminating the necessary information to everyone involved. The TTCP should be included and be considered from planning to construction / field inspection. Some of the basic principles that should be applied in a Temporary Traffic Control (TTC) zone are as follows:

- Traffic of all users should be minimally disrupted
- Users should be clearly channelized through all TTC zones
- Reviewing authority should ensure that the TTC plans are accurately represented on-site
- Routine site visits to ensure that all the elements of the TTC are maintained per the plan
- Routine inspection of all TTC elements including devices, signs, and pavement markings along with their condition and location should be performed
- Changes in facility user trends due to any external changes should be noted to ensure changes in the TTC plan
- A person from the contracting agency and the contractor should be assigned for day-today responsibilities of TTC

3 PHASES OF TTCPs

3.1 PLANNING PHASE

The planning phase is critical to the success of the project. During the planning phase, the designers need to meet with Georgia Tech's Facilities Management Office to understand the project details such as project size, type, and timelines, project area, affected stakeholders, governing jurisdictions and their requirements, user mix, special events, potential emergency impacts, etc. Creating a TTCP that takes into consideration concerns of all affected parties will result in a more robust TTCP. A check list is provided in Chapter 11 to assist in information gathering.

3.2 DESIGN PHASE

The results of the checklist provided in Chapter 11 will provide the designer a clear understanding of the project requirements and the stakeholders involved. During this phase, the designer should put together a plan that will have details regarding placement of signs and devices, pavement markings, road/ sidewalk closures, alternative routes for vehicles/ pedestrians, etc. If the construction is phased, a maintenance of traffic plan should be prepared that will address each phase. The plan should ensure that the devices and overall placements are not only in compliance with the MUTCD, but also taken into account local conditions.

3.3 FILED INSPECTION / CONTRUCTION PHASE

Once the TTC plan is prepared and approved, the designer should conduct a site visit along with a Facilities Department staff member and a contractor representative. Any issues the contractor may have should be resolved during this meeting. Once the project is underway, the designer should visit the site along with a Facilities Department staff member to ensure compliance.

4 WORK DURATION

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.

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 three (3) days
B. **Intermediate-term stationary** is work that occupies a location more than one daylight period up to three (3) days, or nighttime work lasting more than one (1) hour
C. **Short-term stationary** is daytime work that occupies a location for more than one (1) hour within a single daylight period
D. **Short duration** is work that occupies a location up to one (1) hour
E. **Mobile** is work that moves intermittently or continuously

5 DEFINITIONS

Shall - indicates a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device.

Should - indicates a statement of recommended practice, but not mandatory, in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate.

May - indicates a statement of practice that is a permissive condition and carries no requirement or recommendation.

Activity Area - the part of a TTC zone activity area where the work actually takes place. It consists of the work space, traffic space and one or more buffer spaces.

Advance Warning Area - that part of a TTC zone used to inform the motorist what to expect ahead. This area may contain anywhere from a single sign or a rotating/strobe light on a vehicle to a series of signs and the use of a portable changeable message sign (PCMS). The location of the beginning of the TTC zone is dependent on its visibility to motorists. Good visibility is achieved where the sight distance is sufficient to meet decision sight distance.

Advance Warning Sign Spacing - the distance between signs or between a sign and some other location or device with the TTC zone. It is determined by the posted speed limit. This will ensure that the motorist has sufficient time to read the signs and react accordingly. Typical Advance Warning Sign Spacings (A) are included in the TTC Distance Charts.

Advisory Speed - the recommended speed for all vehicles operating on a section of highway and based on the highway design, operating characteristics, and conditions.

Approach Sight Distance - the distance which a motorist can visually identify a work space. The work space may be the flagger station, a lane closure, a slow moving or stopped vehicle, or any other situation which requires adjustments by the motorist.

Attended Work Space - a work space is considered to be attended when the TTC devices are reviewed for knock-downs or other needed adjustments on an hourly basis.

Average Daily Traffic (ADT) - the average 24-hour volume, being the total volume during a stated period divided by the number of days in that period. Buffer Space - the space which provides a margin of safety for both the driver and the workers. It is important that the buffer space be free of equipment, workers, material and vehicles.

Crashworthy - is a characteristic of roadside devices that have been successfully crash tested in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features" or the American Association of State Highway and Transportation Officials (AASHTO) "Manual for Assessing Safety Hardware (MASH).

Decision Sight Distance - the total distance traveled during the length of time required for a driver to:

- Detect an unexpected or otherwise difficult-to-perceive information source or hazard in a roadway environment that may be visually cluttered
- Recognize the hazard or its potential threat
- Select an appropriate speed and path, and
- Initiate and complete the required maneuver safely and efficiently

The decision sight distance is used to determine the minimum advance warning distance to the furthest and/or single sign. When determining minimum sight distance to flaggers and mobile operations, these distances also apply. The required Decision Sight Distances(D) are included in the TTC Distance Charts.

Divided Road - a highway or two roadways where opposing traffic is separated by a median (ditch, barrier, curbing, etc.), and the median is generally wide enough to place TTC devices. Temporary traffic control for divided multi-lane roads may be also used for one-way roadways.

Downstream Taper - the taper at the end of the activity area which guides traffic back into its original lane. When used, this taper is a minimum length of approximately 100 feet with a 20-foot spacing between channelizing devices.

Duration - the length of time any work operation occupies a specific location or causes a traffic obstruction without changing the location. This time is measured from the first disruption to traffic until the total clearing of the area. The following durations are defined in overlapping intervals since TTC layouts for longer durations may always be used for shorter durations, especially when roadway attributes such as traffic volume and speed, and the work space location may warrant higher levels of traffic control.

- Mobile - when an operation is continuously moving or stopped in one
- location for periods of 15 minutes or less. The traffic control devices are typically vehicle-mounted. The work area should change by at least the decision sight distance for it to be considered a change in location.
- Short Duration - when an operation stays in one location during daylight conditions from 15 minutes to one hour, such that minimal TTC devices are deployed.
- Short Term - when an operation stays in one location during daylight conditions from 15 minutes to twelve hours, such that advance signing and channelizing devices are required.
- Intermediate Term/Night - when an operation stays in one location during daylight conditions from 15 minutes to no more than 3 days, or stays in one location during hours of darkness. Advance signing and larger channelizing devices (Type B) are required.
- Long Term - when an operation stays in one location for more than 3 days. A project specific Traffic Control Plan is typically required.

Engineering Judgment - the evaluation of available pertinent information, and the application of appropriate principles, standards, guidance, and practices as contained in this Manual and other sources, for deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.

Expressway - any multi-lane, divided highway for through traffic with partial control of access and generally with at-grade intersections.

Following Distance - the distance in a mobile operation between the shadow vehicle and the work vehicle. It is used to provide advance warning to traffic that some type of work is being done within the traffic lane. Traffic will have to change lanes, slow down and wait for a safe time to pass, or adjust their position within the lane to allow for a narrower traffic lane. The shadow vehicle shall be equipped with appropriate advance warning signing.

Typical Following Distances (F) are included in the TIC Distance Charts. This distance is a range with a minimum of the recommended distance between advance warning signs (A), and a maximum of the decision

sight distance. These distances are dependent upon the roadway and traffic conditions. Engineering judgment should be used when selecting distances for specific operations.

Freeway - any divided highway with full control of access (i.e. has ramps and no at-grade intersections).

High Speed Road - a roadway where the posted speed limit is 45 miles per hour or higher.

Lane Closure - a closure of one or more lanes of the roadway to traffic. Work operations that restrict adjacent lane width should consider various lane closure alternatives depending upon volume and speeds on the roadway.

Lane Width - for traffic control purposes, a minimum lane width of 10 feet shall be provided.

Lateral Buffer Space - the space that separates the traffic space from the work space. It is typically the extra space provided between traffic and workers, excavations, pavement edge drop-offs, or an opposing lane of traffic. Traffic lanes may be closed to provide for lateral buffer space. See the Longitudinal Drop-off Guidelines (pages 6K-xxi thru 6K-xxiii) of this manual for more information.

Longitudinal Buffer Space - the distance between the transition area and the work space. If a driver does not see the advance warning or fails to negotiate the transition area, a buffer space provides room to stop before the work space. Typical Longitudinal Buffer Spaces **(B)** are included in the TTC Distance Charts.

Low Speed Road - a roadway where the posted speed limit is 40 miles per hour or lower.

Merging Taper - the taper used on a multi-lane road to close a lane and combine its traffic from that of the adjacent lane. Its length is dependent on the posted speed of the roadway. Higher speeds require a longer distance for traffic to merge lanes. Typical Merging Tapers (L) are included in the TTC Distance Charts.

Mobile Buffer Space - the distance in a mobile operation between the shadow vehicle and the work vehicle. This distance is dependent on whether the shadow vehicle is being used as an advance warning device or as a blocking/protection device for the work vehicle.

Motorist - an operator of a motorized vehicle intended to be used on a roadway.

Multi-Lane Road - a roadway where two or more lanes of traffic travel in the same direction. A multi-lane roadway may be classified as either undivided or divided.

Occupied Work Space - a work space is considered to be occupied when workers are present within the work space. TTC devices should continuously be reviewed by workers and adjustments made as needed.

Off Shoulder - a work space located primarily off of the shoulder, or which causes little or no restrictions on the use of the shoulder. This work space should have little or no interference with traffic such that traffic speeds generally are not reduced.

Portable Changeable Message Sign (PCMS) - a sign either trailer-mounted or vehicle-mounted that is capable of displaying more than one message, changeable by remote or automatic control.

Posted Speed Limit - the speed limit determined by law and shown on Speed Limit signs. It is used in the charts to determine the spacings of TTC devices and the lengths of various tapers on the TTC Layouts. Typical Posted Speed Limits (S) are included in the TTC Distance Charts.

Protection Vehicle - the vehicle that is placed in advance of the work space and equipment to block errant motorists from entering the work space.

Road, Roadway - That portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes, but exclusive of the sidewalk, berm, or shoulder even though such sidewalk, berm, or shoulder is used by persons riding bicycles or other human-powered vehicles.

Roll Ahead Distance - the recommended minimum distance between a protection vehicle and the work space. A protection vehicle may be used in a mobile operation to provide extra safety for the workers. Typical Roll Ahead Distances (R) are included in the TTC Distance Charts.

Roundabout - a circular intersection with yield at entry, which permits a vehicle on the circulatory roadway to proceed, and with deflection of the approaching vehicle counterclockwise around a circular island.

Rural Highway - a highway where traffic is normally characterized by lower volume, higher speed, fewer turning conflicts and fewer conflicts with pedestrians.

Shadow Vehicle - the vehicle placed behind the work space in a mobile operation to provide advance warning to motorists. Because mobile operations generally have all advance warning signing mounted on vehicles, the spacing between vehicles should be the Following Distance (F) as included in the TTC Distance Charts.

Shifting Taper - the taper used to move traffic from the traffic lane onto a bypass or shoulder. This traffic maneuver generally requires half the distance than a merging taper. See the TTC Distance Charts for the length of a shifting taper called L/2.

Shoulder Closure - a closure of the roadway shoulder for work operations. The shoulder then becomes unusable by traffic for vehicle maneuvers or break-downs. TTC layouts for work operations using or on a shoulder are dependent on the type of shoulder usage and duration.

Shoulder Taper - the taper used to close the shoulder off to traffic so that shoulder work can be done or equipment can be placed on the shoulder. Since this taper is used to guide errant traffic back to its normal lane path, it does not require a full merge distance. The taper length is reduced to one third of a merging taper length. See the TTC Distance Charts for the length of a shoulder closure taper called L/3.

Temporary Pedestrian Access Route (TPAR) - a temporary, continuous and unobstructed walkway within a pedestrian circulation path that provides accessibility.

Temporary Traffic Control (TTC) Plan - a plan describing the traffic controls to be used for facilitating vehicle and pedestrian movements through a temporary traffic control zone.

Temporary Traffic Control (TTC) Zone - an area of a highway where road user conditions are changed because of a work zone or incident by the use of temporary traffic control devices, flaggers, uniformed law enforcement officers, or other authorized personnel. See Figures 6K-6 and 6K-7, Component Parts of a Temporary Traffic Control Zone.

Termination Area - that part of a TTC zone located beyond the work space which guides traffic back into its normal traffic path. A longitudinal buffer space may be used between the end of the work space and the beginning of the downstream taper.

Traffic Control Device - a sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, or shared-use path by authority of a public agency having jurisdiction.

Traffic Space - that part of the roadway open to traffic that is next to the activity area. Traffic routing is provided with channelizing devices of various sizes and shapes. For a description of the various types of channelizing devices and their general uses, see the Temporary Traffic Control Devices Section (page 6K-xiii) of this manual

Transition Area - that part of the TTC zone that moves the traffic from its normal path or lane into the traffic space. This movement of traffic is done through the use of channelizing devices and directional signing placed in various types of tapers.

Turn Lane Closure - the closure of a right or left turn lane for work operations. Signing in the TTC zone shall provide adequate warning to the motorists and provide an alternative turning maneuver. Layouts from the various roadway types should be reviewed for the best alternate depending upon roadway intersection design, traffic control (stop, yield, signals, etc.), speed limit and volume.

Two-Lane, Two-Way Road - a roadway consisting of two opposing lanes of undivided traffic.

Two-Way Left Turn Lane - that part of the roadway that has a continuous two-way left turn lane located between the opposing lanes of traffic. This design variation may be found on either two-lane, two-way roads or multi lane roads.

Two Way Taper - the taper used on two-lane, two-way road to change the road into a single lane of two-way traffic. It is primarily used for flagging operations and other traffic control situations. It is typically 50 feet in length and contains five equally spaced channelizing devices.

Undivided Road - a roadway where opposing traffic lanes have no physical separation barriers except pavement markings (where required).

Urban Street - a type of street normally characterized by relatively low speed, wide ranges in traffic volume, narrower roadway lanes, frequent intersections, significant pedestrian traffic, and more roadside obstacles.

Volume - the number of vehicles passing a given point on the roadway or, the Average Daily Traffic (ADT).

Work Space - that part of the TTC zone closed to traffic and set aside for workers, equipment and materials. The space requirements for a specific TTC Zone will determine the type of TTC layout that is appropriate for the project. The layout will specify the appropriate sign locations, flagger stations and tapers depending on the type of work space.

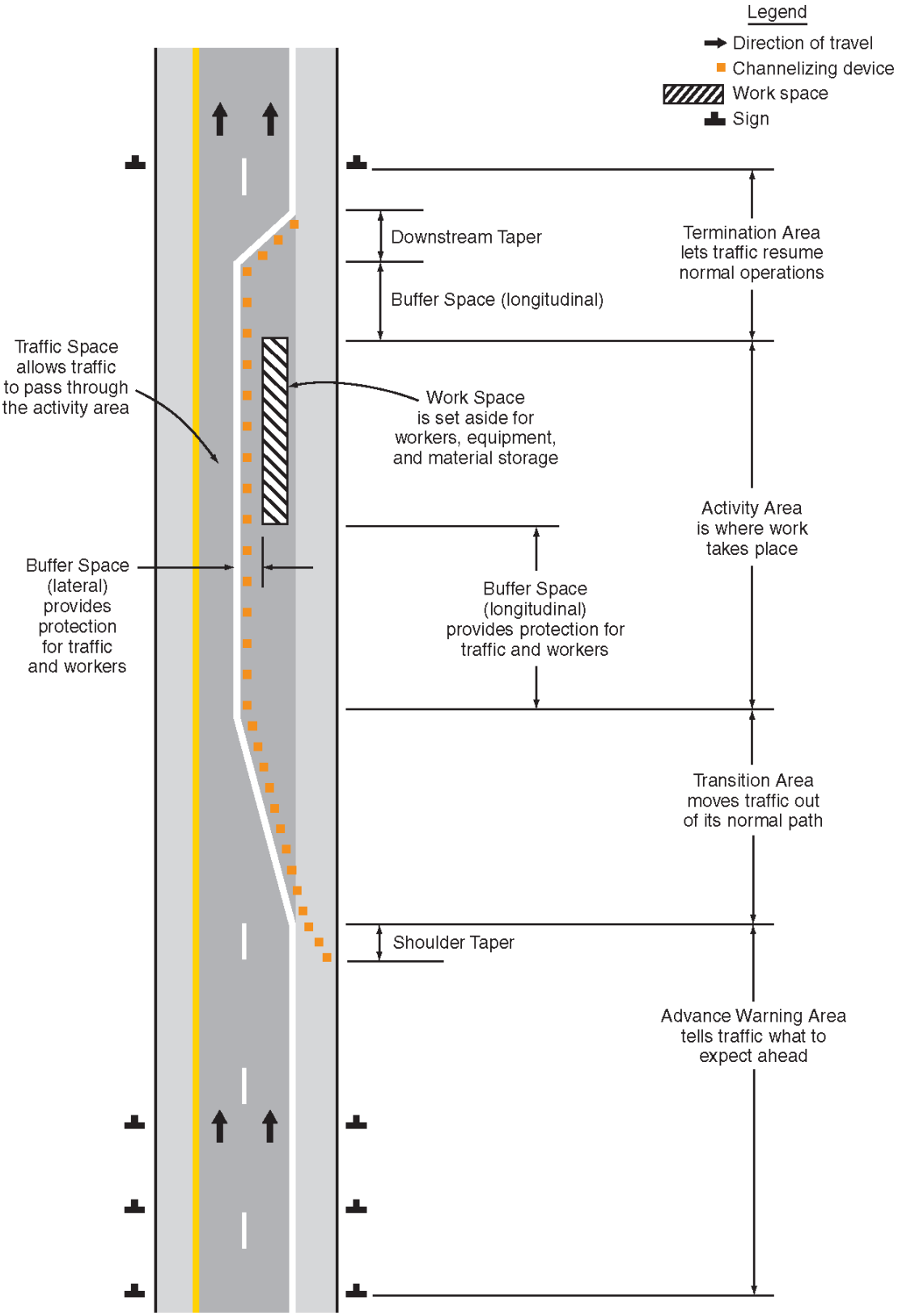
Work Zone Speed Limits - a regulatory speed limit in a temporary traffic control zone. This speed limit requires proper documentation to approve and install.

6 COMPONENTS OF A TEMPROARY TRAFFIC CONTROL ZONE

The work zone is defined as the distance between the first advance warning sign and the point beyond the work area where the traffic is no longer affected. The following are definitions of work zone areas.

- Advanced Warning Area informs roadway users what to expect ahead.
- Transition Area moves or shifts traffic out of its normal traffic path to a temporarily controlled area.
- The Activity Area provides the space for work, traffic and buffer space.
- Termination Area allows traffic to resume back to the normal traffic pattern operation.

Figure 1:Reference Figure 6C-1 MUTCD, 2009 Edition



6.1 ADVANCE WARNING AREA

The advance warning area is the section of roadway where users are informed about the upcoming work zone or incident area. The minimum recommended spacing distances between signs in the advance warning area are shown in Table 1.

Table 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 dimensions. 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.)

6.2 TRANSITION AREA

The transition area is that section of roadway where users are redirected out of their normal path. Transition areas usually involve strategic use of tapers, which because of their importance are illustrated in detail in Section 6.8. When redirection of the road users' normal path is required, they shall be directed from the normal path to a new path.

6.3 ACTIVITY AREA

The activity area is the section of the highway where the work activity takes place. It is comprised of the workspace, the traffic space, and the buffer space.

6.4 TERMINATION AREA

The termination area is the section of the highway where road users are returned to their normal driving path. The termination area extends from the downstream end of the work area to the last TTC device such as END ROAD WORK signs, if posted.

6.5 OTHER WORK ZONE COMPONENTS

- Tapers are created using a series of channelizing devices to move traffic from one path of travel to another. The three primary tapers include the *Merging (or Lance Closure)*, *Shifting*, and *Shoulder Closure* taper.
- The **Buffer Area** separates traffic from workers and provides a recovery area for errant vehicles. No equipment, vehicles or material shall be placed in the designated buffer area.
- The **Merging Taper** is used to merge two traffic lanes into one lane. The length of the Merging Taper is equal to **"L"** and is based on pre-construction posted speeds.
- The **Shifting Taper** is used to shift traffic laterally. A Shifting Taper is equal to **1/2 "L"**.
- The **Shoulder (Closure) Taper** is used to close the shoulder of the roadway. The length of a shoulder closure taper is equal to **1/3 "L"**.

6.6 TAPER LENGTH CRITERIA FOR WORK ZONES

Work zone traffic control roadway tapers, or transitions, are described below:

- **Merging Taper (L):** When a lane is closed and vehicles in that lane must merge with traffic in an adjacent lane.
- **Shifting Taper (L/2):** When there is a lateral shift in the path of the lanes, but there is no reduction in the number of travel lanes.
- **Shoulder Taper (L/3):** When the shoulder is closed to traffic.
- **One-lane, Two-way Taper:** When one lane of a two lane, two-way roadway is closed to traffic and where alternate one-way operation in one lane is in effect.
- **Downstream Taper:** When transitioning traffic back to the normal traveling conditions.

Table 2: Formulas for Determining Tapers

FORMULAS FOR DETERMINING TAPERS	
Speed Limit *S* (mph)	**Taper Length *L* (ft)**
40 mph or less	L = WS(S)/60
45 mph or greater	L = WS

L = Taper length in feet
W = Width of offset in feet
S = Posted speed limit, off peak 85th percentile speed prior to work starting or the anticipated operating speed in mph

6.7 BUFFER SPACES

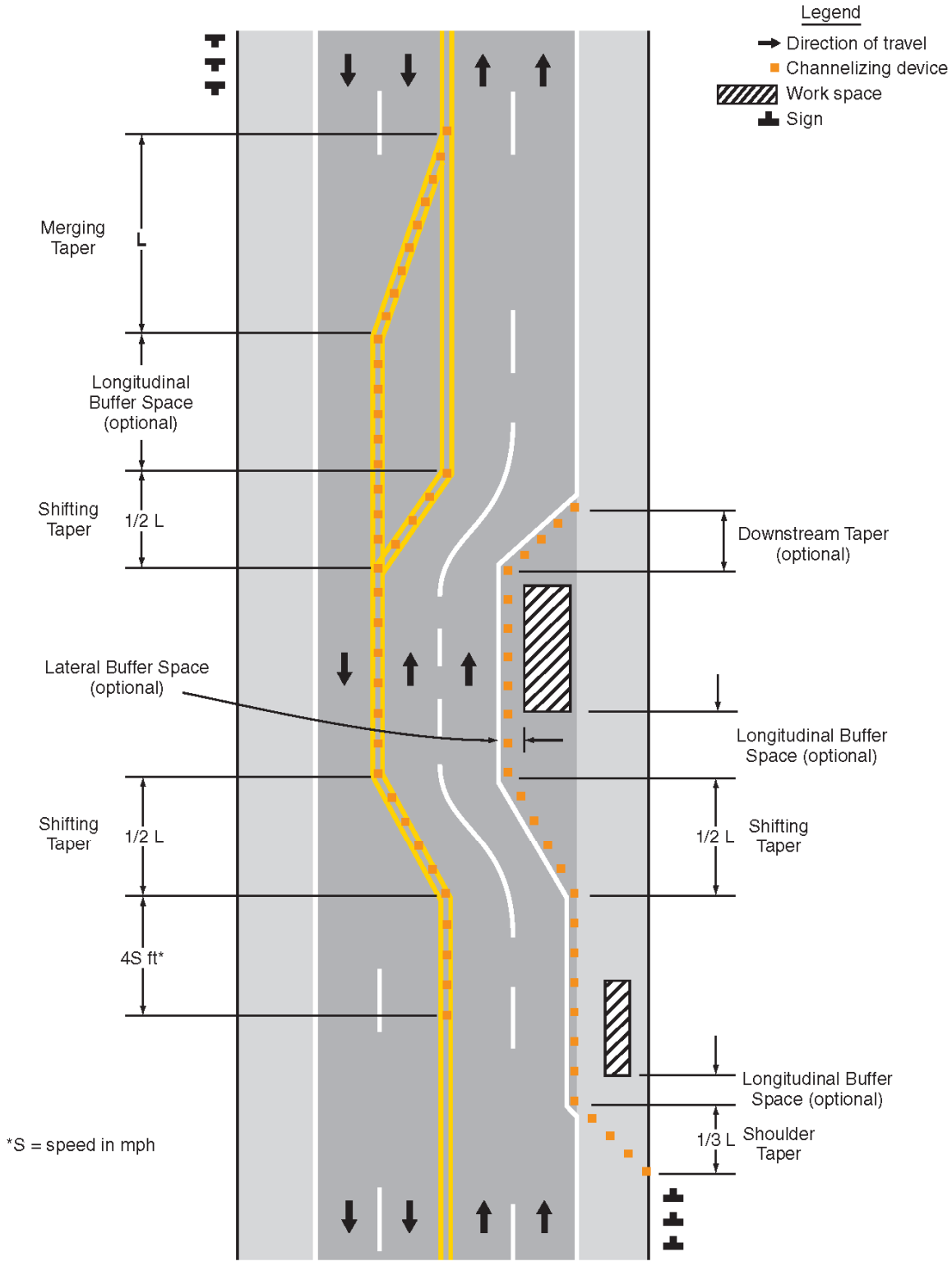
The buffer space is a crucial safety feature of a work zone. The buffer space separates traffic flow from the work area or potentially hazardous area and provides recovery space for an errant vehicle. Neither work activity nor the storage of equipment, vehicles, or material shall occur in the buffer space area. A lateral buffer space may also be used to separate passing traffic from the work area. The use and width of the buffer area is based on conditions at the work site.

Table 3: Length of Longitudinal Buffer Space

LENGTH OF LONGITUDINAL BUFFER SPACE "B"	
SPEED (mph)	**DISTANCE (ft)**
30	200
35	250
40	305
45	360
50	425

6.8 TYPES OF TAPERS AND BUFFER SPACES

Figure 2: Reference Figure 6C-2 MUTCD, 2009 Edition



Note: Use posted speed limit if 85th percentile is unknown.

7 PEDESTRIAN AND WORKER SAFETY

When developing temporary traffic control (TTC) plans, the importance of pedestrian access in and around the work zone is often overlooked or underestimated. A basic requirement of work zone traffic control, as provided in the Manual on Uniform Traffic Control Devices (MUTCD), is that the needs of pedestrians, including those with disabilities, must be addressed in the TTC process. Pedestrians should be provided with reasonably safe, convenient, and accessible paths that replicate as nearly as practical the most desirable characteristics of the existing sidewalks or footpaths. It is essential to recognize that pedestrians are reluctant to retrace their steps to a prior intersection for a crossing, or to add distance or out-of-the-way travel to a destination.

Pedestrians must be kept in a safe environment on a smooth, well-marked travel path. Other pedestrian needs include access to bus stops (consider the need for temporarily moving the bus stop to improve safety and to accommodate work zone operation), sidewalks, crosswalks, and buildings, as well as lighting at night to allow safe walking through the construction area.

Obtaining information regarding the class schedules, walking trends, needs, and special events of the students and visitors on campus is essential to the success of the TTC plan. A sample TTC plan is shown in Figure 3.

The MUTCD provides basic guidance on how to accommodate pedestrians in and around TTC zones. Considerations in planning for pedestrian safety in TTC zones on highways and streets are identified in Part 6D of the MUTCD as follows:

- Pedestrians should not be led into direct conflicts with work site vehicles, equipment, or operations.
- Pedestrians should not be led into direct conflicts with mainline traffic moving through or around the work site.
- Pedestrians should be provided with a convenient and accessible path that replicates as nearly as possible the most desirable characteristics of the existing sidewalk(s) or footpath(s).

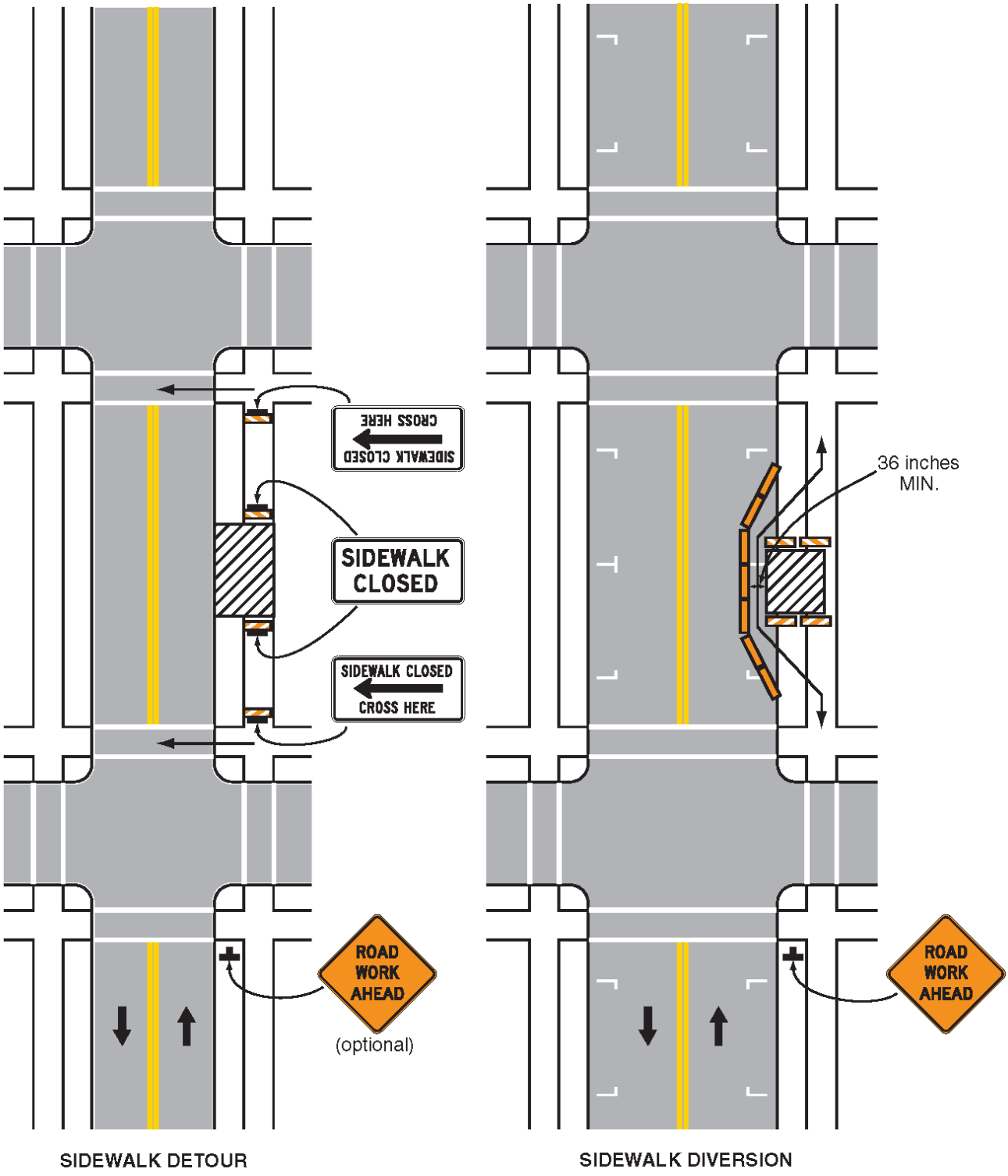
7.1 Sidewalk Detours/Closures During Construction

It is undesirable to close sidewalks or pathways during construction. If unavoidable, consider:

- Using channelizing devices to delineate a temporary route.
- Clearly defining any detoured routes.
- Placing advance signs at intersections rather than midblock locations.
- Maintaining a minimum width and smooth surface for wheelchair access. This includes providing ADA compliant wheelchair ramps if pedestrians are channeled from the sidewalk into the street.
- Protecting pedestrians from vehicle traffic. Protecting pedestrians from hazards, such as holes, cracks, debris, dust, and mud.

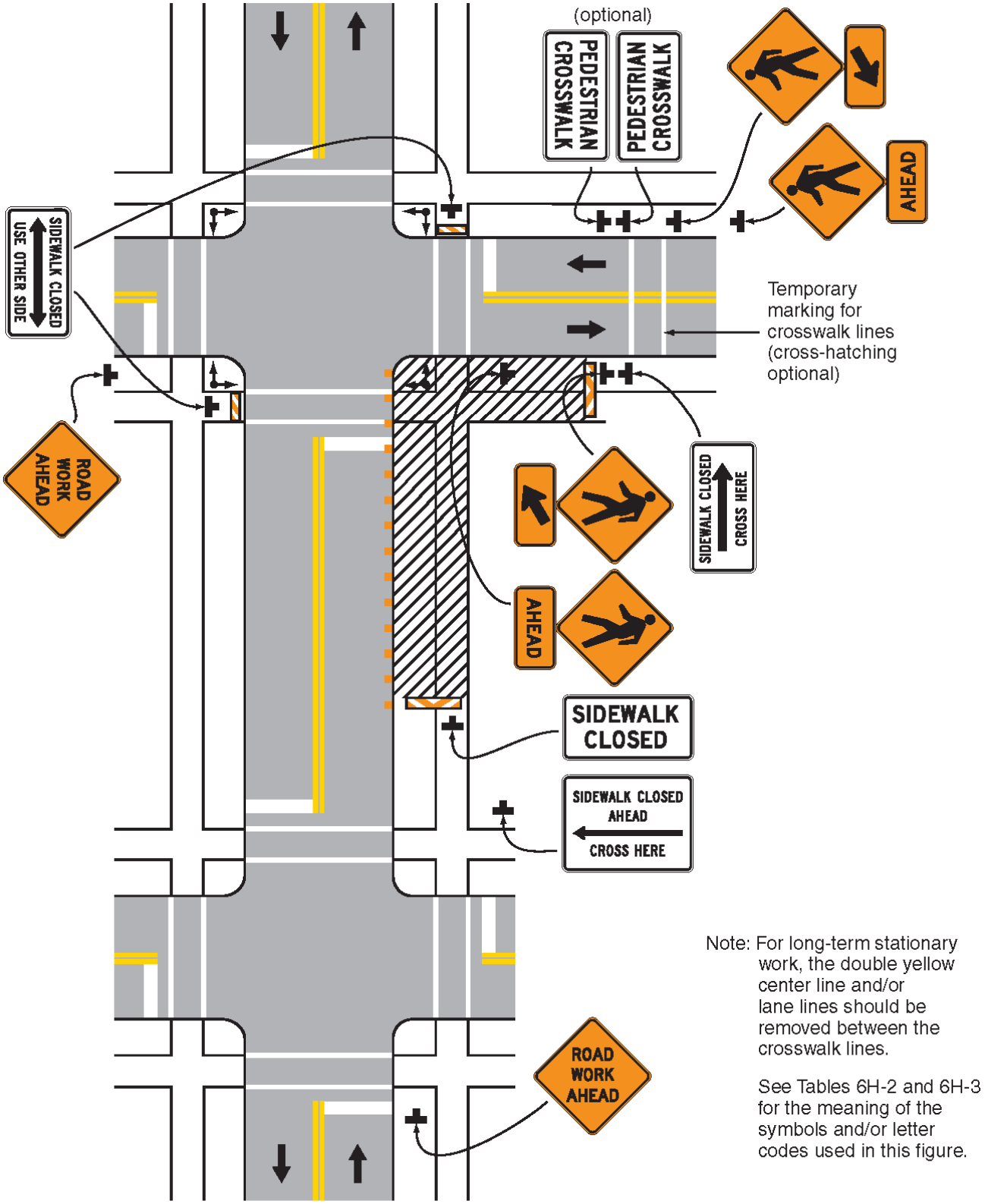
If a temporary route is created in the roadway adjacent to the closed sidewalk, the parking lane or one travel lane may be used for pedestrian travel, with appropriate barricades, cones, and signing. When a parking lane or travel lane is not available for closure, pedestrians must be detoured with advance signs in accordance with the MUTCD. Typical Application 28, below, shows a 36-inch minimum width sidewalk; however, the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADA) requirement has been increased to a 48-inch minimum width. Also, note that when it is not possible to maintain a minimum width of 60 inches throughout the entire length of the pedestrian pathway, a 60-inch by 60-inch passing space should be provided at least every 200 feet to allow individuals in wheelchairs to pass.

Figure 3: Reference Figure 6H-28 MUTCD, 2009 Edition



Typical Application 28

Figure 4: Reference Figure 6H-29 MUTCD, 2009 Edition



Typical Application 29

8 BICYCLE FACILITIES CONSIDERATIONS IN TEMPORARY TRAFFIC CONTROL ZONES

Bicycles are legal non-motorized vehicles in the state of Georgia. Bicycle movements must be maintained during construction and other projects and special events that disrupt vehicular travel. Bicyclists are especially susceptible to roadway disruptions in their normal travel routes because of their slower speeds, exposure to noise, dirt, debris and changes to roadway surfaces. Temporary lane restrictions, detours, and other traffic control measures used during construction should be designed to accommodate non-motorized travelers.

8.1 BICYCLE TRAVEL THROUGH CONSTRUCTION ZONES

- Where construction is occurring on a street that already has a bicycle lane, the area through which the construction is occurring should maintain bicycle lane space.
- Bike lanes should not be used for staging of site construction work.
- Minimize the time that construction work occupies bike lanes.
- Where bicycle lanes are not present, provide a shared vehicle lane as wide as physically feasible.
- If the disruption of a bicycle lanes occurs over a short distance (approximately xxx ft or less), bicyclists may be routed to a shared motor vehicle lane. If bicycle lanes are forced to be routed to a shared vehicle lane W11-1 and W16-1 SHARE THE ROAD bicycle warning signs shall be installed.
- Bicyclists should not be specifically directed onto sidewalks with pedestrians unless there is no reasonable alternative.

8.2 PAVEMENT SURFACES THROUGH CONSTRUCTION ZONES

Bicyclists need to have a pavement surface that is free of defects, debris, loose pavement and aggregates as much as possible to ensure their safety and control of their bicycles. Bicyclists are also susceptible to loss of control on surfaces with deteriorated pavement with loose aggregates, potholes, and debris. Pavement surface considerations through construction zones should include the following:

- Pavement seams parallel to the roadway should not be located on the portion of the road where bicycles are expected to travel.
- Utility covers and drainage grates should be flush with the pavement surface and should be adjusted with pavement overlays.
- When pavement is overlaid, the edge of the overlay should be matched to the height of the adjacent pavement or smooth transitions should be provided.
- Wherever bicyclists are sharing a motor vehicle lane and the space through the restricted area is narrower than the rest of the roadway, temporary “Share the Road” signs should be included.

9 PAVEMENT SURFACE CONSIDERATIONS DURING CONSTRUCTION

Metal plates can create a slippery and dangerous surface for bicycles and may not be easily visible at night.

- Advance warning signs shall be posted.
- Metal plates should be recessed so that the top of the plate surface is level with the adjacent pavement. If plates cannot be recessed, a concrete lip shall be placed around the metal plate surface to provide a smooth transition between the plate and adjacent pavement.
- All metal plate edges should be painted with highly visible reflective paint.
- Metal plates should have a non-slippery textured surface; this is required within pedestrian walkways and crosswalks.

Construction excavations or depressions should never be left without physical barriers in order to help bicyclists avoid potential accidents.

- Temporary excavations or depressions should be filled with packed and tamped aggregates or temporary concrete patches.
- Excavations or depressions located outside motor vehicle and bicycle lanes can be marked and blocked off by traffic barriers such as barricades, cones and barrels.
- If the excavation must be maintained for more than two days, metal plates may be used, following metal plate guidelines listed above.

Narrow cuts in the pavement surface that are parallel with the direction of travel create a hazard for bicyclists, potentially causing their tires to get caught in the cuts. Narrow cuts should never be left in the area where bicycles will be traveling. If cuts are required to be left in the pavement, they should be blocked off and bicyclists shall be routed around the hazard.

Site access and ramps. Temporary ramps are sometimes proposed to access a site from a sidewalk where no driveway or other vehicle access exists. The creation of ramps in the roadway is not permitted unless being created in an area that is otherwise used by on-street parking.

Utility covers: After milling pavement, utility covers (e.g., manhole covers, valve box covers, catch basin grates) may be 1 to 2 inches higher than the surrounding pavement. This presents a hazard for bicyclists and motor vehicles alike. This condition will also occur during roadway construction just before the next layer of pavement is to be placed. Wherever raised utility covers or drainage grates are present, the following should be provided:

- Provide advance warning signs such as Bicycle Surface Warning Conditions, BUMP, DIP, PAVEMENT ENDS, and ROUGH ROAD.
- Spray paint the raised portions of the utility covers and drainage grates with reflective orange paint.

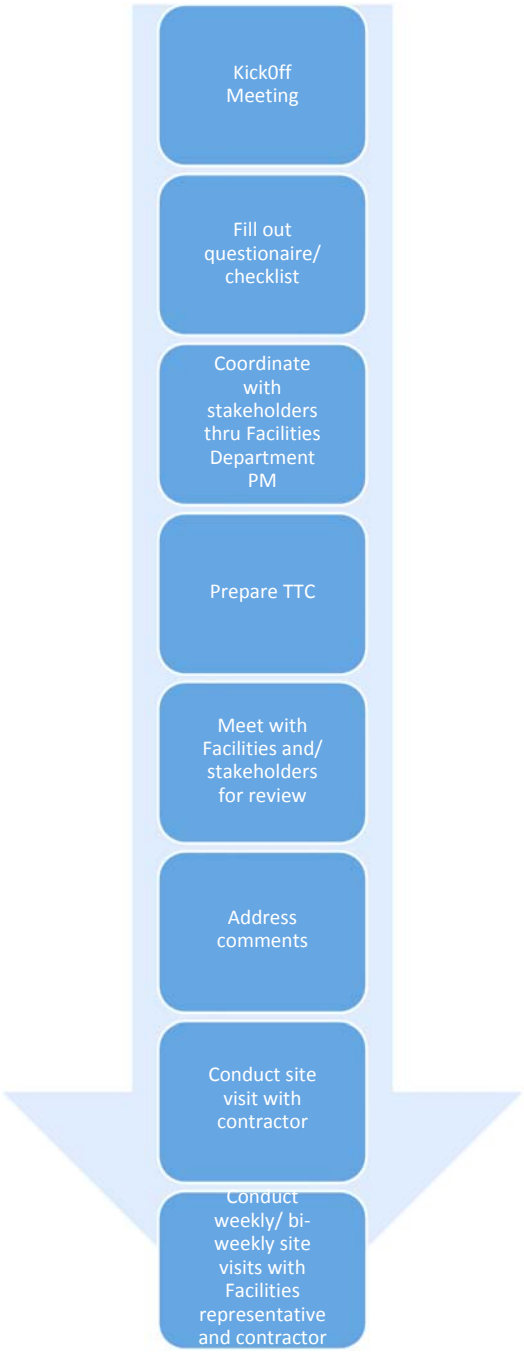
Pavement Sweeping and Debris Removal: Road surfaces in construction zones may experience a greater build-up of debris than other roadway segments. Special attention must be given to keeping roadways surfaces free of debris, including sand, gravel, loose aggregates, stones, trash, and miscellaneous construction debris. Pavement in construction zones should be swept to maintain a reasonably clear riding surface in bicycle lanes and in the outer 6 feet of roadway.

Pot holes: Pot holes are more likely to be found in construction zones due to the impact of construction equipment and due to temporary pavement patching. Special attention must be given to monitoring for the development of pot holes and for promptly filling in and patching pot holes.

Temporary Traffic Sign Placement: The placement of advance construction signs shall not obstruct the pathways of bicyclists. Temporary signs shall not be placed in bicycle lanes.

Restoration of Pavement Markings: Pavement markings should be installed as soon as reasonably possible, particularly bike lanes markings and other markings associated with bike facilities.

10 PROJECT PROCESS



11 CHECKLIST

DETOUR			Yes	No	N/A	SP
1		Will traffic be detoured? If no, go to #7.				
2		Are various detours adequate in terms of:				
	A	Weight - Spring restrictions, height, width?				
	B	Wide loads and oversized?				
	C	Capacity and adequate traffic control devices?				
	D	Railroad crossings and controls?				
	E	Geometrics (turning radii, etc.) ?				
	F	Bridge restrictions and other structures?				
	G	Conflict with other detour in the area?				
	H	Other local motorist routes available?				
3		If the detour is to be established on other than trunk highways, has the preliminary contact been made with:				
	A	County, City, or Townships?				
	B	Who will stripe the detour?				
	C	Does the signing require upgrading?				
	D	Who will be responsible for routine maintenance l(i.e. patching)?				
4		Will all fronting businesses have acceptable ingress and egress and will other municipalities be served?				
	A	Are TOD'S necessary for businesses?				
5		Should the following be contacted?				
	A	School Bus				
	B	Public/ Campus transit				
	C	Police				
	D	Fore				
	E	Ambulance				
	F	Postal Route				
6		Is a public information meeting required?				

TRAFFIC CARRIED THROUGH PROJECT			Yes	No	N/A	SP
7		Will capacity be restricted during the peak hours (Lane Closure)?				
	A	Will alternate routes handle the diverted traffic?				
	B	Have local governments been contacted?				
	C	Number of lanes or reversible lanes needed?				
8		Consider staging (i.e. lengths of permitted construction)				
	A	Include in plans or let the contractor plan?				
	B	Can contractor stage work differently than planned?				
9		Bypasses or temporary widening needed?				
	A	What standards are used?				
	B	What locations?				
	C	Design speed?				
10		Minimum width?				
11		Will oversized load permits be affected?				
		If yes, will it be signed?				
12		Will the project be inplace over the winter months? If yes,				
	A	Are traffic control devices adequate for winter?				
	B	Are there provisions for the TCD's to be maintained over winter suspension? If yes, who will maintain them?				

GENRAL CHECKLIST

			Yes	No	N/A	SP
13		Signing (State or Contractor)	☐	☐	☐	☐
A.		Who maintains or inspects?				
B.		How often				
	C	TCP provided by State or Contractor?	☐	☐	☐	☐
D.		Are any special signs needed If yes, where?	☐	☐	☐	☐
	E	Is cross road signing needed? If yes, by whom (State or Contractor)	☐	☐	☐	☐
14		Are temporary signals needed?	☐	☐	☐	☐
	A	If yes, what type? Manual _____ Fixed time _____ Actuated _____	☐	☐	☐	☐
15		Can in-place signals be shutdown? If yes, during what hours? _____ Does a local municipality need to be contacted?	☐	☐	☐	☐
16		Is temporary street lighting needed? If yes,	☐	☐	☐	☐
	A	Who will install? _____ (State or Contractor) _____ If State, is request letter needed? _____				
	B	Are breakaway or non-breakaway poles needed?	☐	☐	☐	☐
	C	How will power be furnished?	☐	☐	☐	☐
	D	Is an agreement needed with the power company?	☐	☐	☐	☐
	E	Does in-place lighting need to be kept operational?	☐	☐	☐	☐

			Yes	No	N/A	SP
17		Is temporary barrier needed? If yes,				
	A	Who will furnish, install, and maintain?				
	B	Barrier justification High ADT _____ Excessive drop-off _____				
	C	Will it be incorporated into existing permanent barrier?				
	D	How will the barrier be delineated? Warning lights (type) _____ Delineators (type) _____				
E.		How will the barrier ends be protected? Taper buried out to the clear zone GREAT attenuator _____ Barrel attenuator _____				
	F	Is a spare attenuator needed?				
18		Are equipment traffic controls going to be used? _____ If yes, has the proper permission been obtained? _____				
19		Is the Contractor's equipment permitted to use crossovers? If yes, what type?				
	A	Which ones?				
B.		Do the Contractor's vehicles need to be marked?				
20		Can the Contractor store equipment, material, and waste material on the construction site? If yes, must they follow AASHTO guidelines? If no, where?				
21		Can the Contractor's workers park their vehicles on the construction site? If yes, where? If no, where?				
22		Are temporary pavement markings required?				
	A	Who will furnish, install, and maintain? _____				
	B	What type? Paint _____ Tape _____ TRPM _____				

			Yes	No	N/A	SP
23		Do inplace stripes need to be replaced?	☐	☐	☐	☐
	A	If yes, where? _____ Centerline _____ Edgeline _____	☐	☐	☐	☐
	B	How will they be removed?	☐	☐	☐	☐
	C	Who will accomplish this?	☐	☐	☐	☐
24		Is temporary post-mounted delineation needed?	☐	☐	☐	☐
		If yes, who will furnish, install, and maintain?				
25		Will drop-offs and excavations exist? If yes,				
	A	A. Will the drop-off exceed 50 mm (2 inches)?	☐	☐	☐	☐
	B	Will the drop-off exceed 100 mm (4 inches)?	☐	☐	☐	☐
	C	Will the drop-off exceed 150 mm (6 inches)?	☐	☐	☐	☐

ACTION TAKEN			Yes	No	N/A	SP
26		Do inplace signs have to be removed or relocated? If yes, by whom?				
27		Are flagging operations required? If yes,				
	A	A. What type of operation is being considered? Radio communication _____ Pilot car _____ Flag carrying _____				
	B	Will the flagging operation be continued during daylight hours? If yes, is supplemental lighting needed?				
28		Is a construction or work zone speed limit needed? If yes, will they use advisories or regulatories?				
29		Will the project require any special devices				
		Changeable Message Signs, how many?				
30		Will extra protection be required for other road users? pedestrians _____ bicyclists _____ snowmobiles _____ trail users _____ schools _____ parks _____				
31		Do utility operations affect traffic control?				
32		Will the project require dust control?				
33		Are there any restrictions for traffic control which can not be inplace concurrently? (i.e. fire, police, and traffic routing) If yes, by where? _____				
34		Will the source of material on or off the project interfere with traffic or a certain type of traffic?				
35		Does the Contractor have to give advance notice of traffic control changes?				
36		Is the starting or completion date controlled by a school, special events, or holidays? If yes, (event and date)				
37		Is a working day other than as specified, such as an 18 hour day? What is the work week?				
38		Is there as conflict between working hours and local ordinances due to noise, air, or water restrictions?				
39		Is there an incentive clause needed in the contract?				
40		Will working days be charged between November 15 and April 15 or suspended by a work order?				
41		Should there be other than ordinary liquidated damages such as additional penalties?				
42		Is there a possibility that another contract will delay the work of this project?				

12 TYPICAL DEVICES USED

The design and application of TTC devices used in TTC zones should consider the needs of all road users (motorists, bicyclists, and pedestrians), including those with disabilities. The devices typically used for TTC are described below.

12.1 SIGNS

TTC zone signs convey both general and specific messages by means of words, symbols, and/or arrows and have the same three categories as all road user signs: regulatory, warning, and guide.
Please refer to the MUTCD for sign size, type, mounting, and location specifications.

Figure 5: Regulatory Signs and Plaques Used in TTC Plans (MUTCD, 2009 Edition)

Figure 6: Regulatory Signs and Plaques Used in TTC Plans (Contd.) (MUTCD, 2009 Edition)

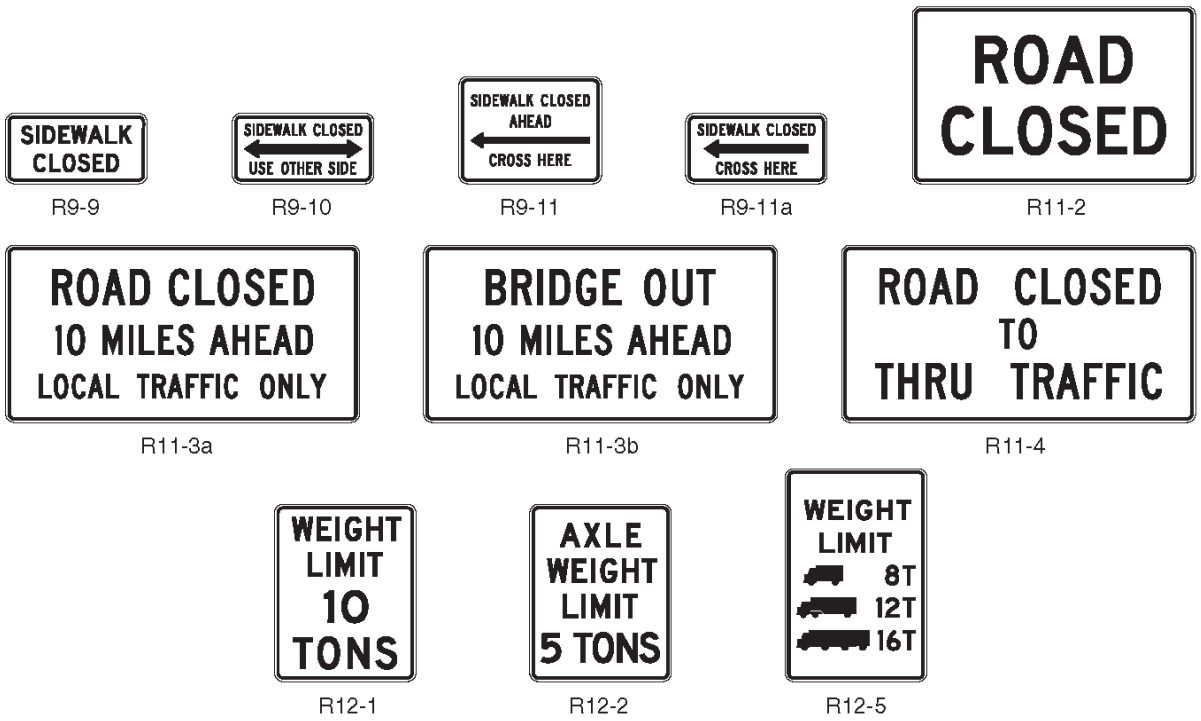


Figure 7: Warning Signs and Plaques Used in TTC Plans (MUTCD, 2009 Edition)

Figure 8: Warning Signs and Plaques Used in TTC Plans (Contd.) (MUTCD, 2009 Edition)

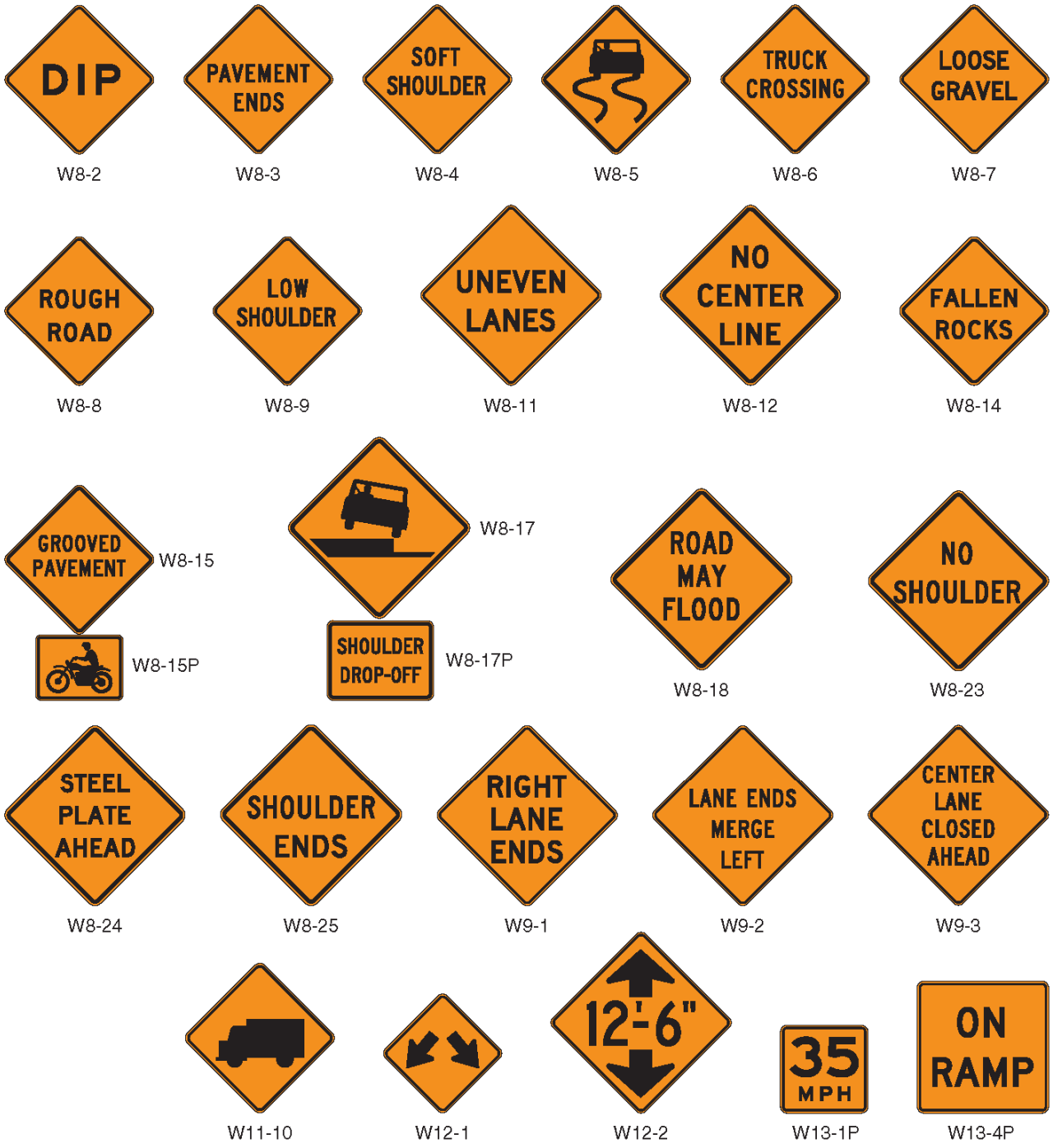


Figure 9: Warning Signs and Plaques Used in TTC Plans (Contd.) (MUTCD, 2009 Edition)

* An optional STREET WORK word message sign is shown in the "Standard Highway Signs and Markings" book.
** An optional STREET CLOSED word message sign is shown in the "Standard Highway Signs and Markings" book.
*** An optional FLAGGER (W20-7a) word message sign is shown in the "Standard Highway Signs and Markings" book.
**** An optional FRESH TAR word message sign is show in the "Standard Highway Signs and Markings" book.

Figure 10: Exit Open and Closed Detour Signs (MUTCD, 2009 Edition)

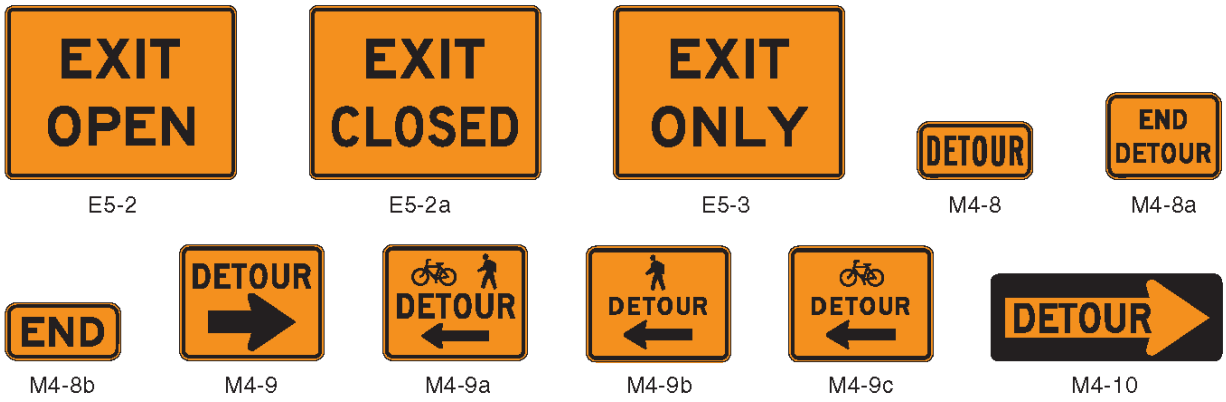


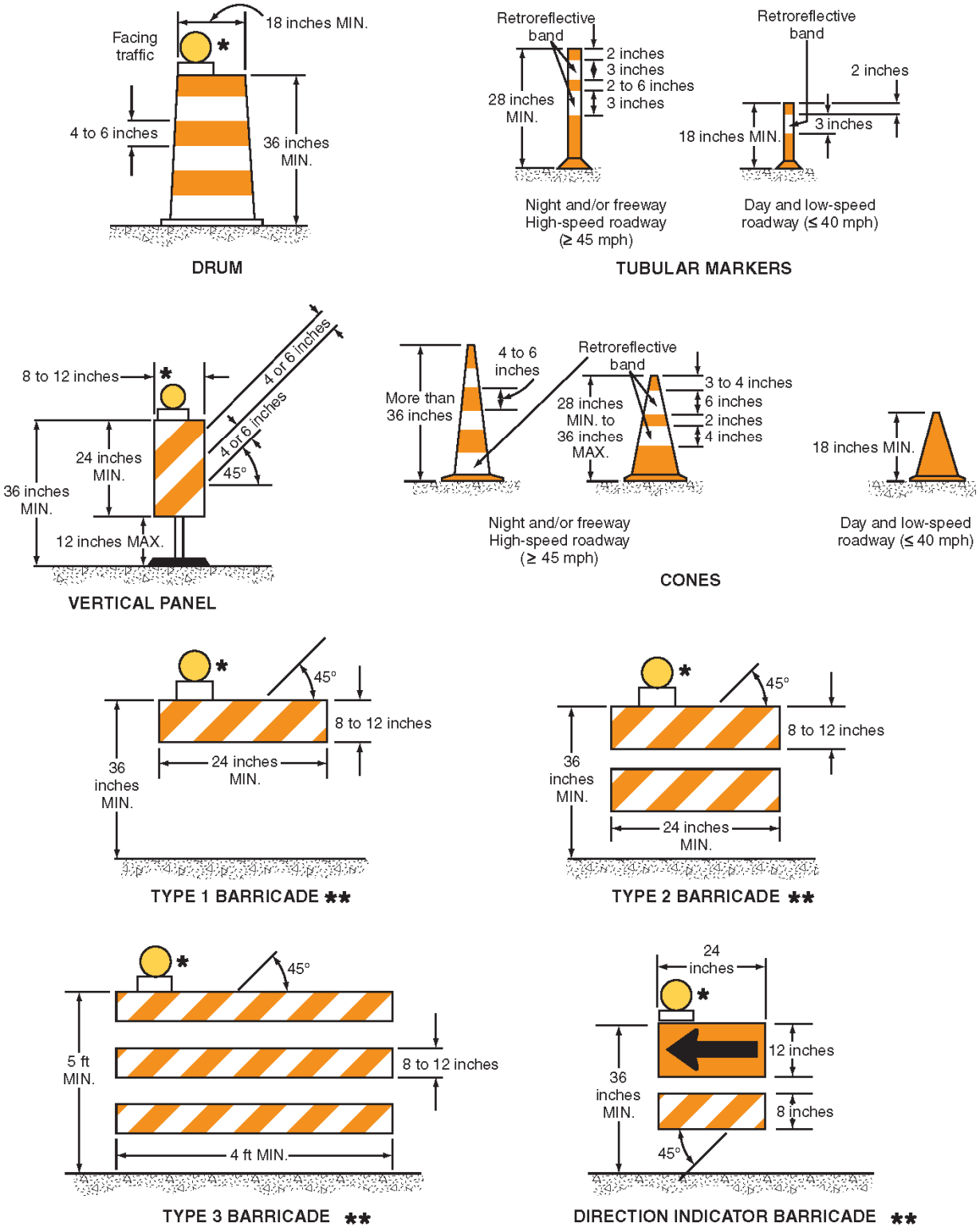
Figure 11:Advance Warning Arrow Board Display Specs. (MUTCD, 2009 Edition)

Operating Mode	Display (Type C arrow board illustrated)
1. At least one of the three following modes shall be provided:	(right arrow shown; left is similar)
Flashing Arrow	 Merge Right
Sequential Arrow	 Merge Right
Sequential Chevron	 Merge Right
2. The following mode shall be provided: Flashing Double Arrow	 Merge Right or Left
3. At least one of the following modes shall be provided: Flashing Caution or Alternating Diamond Caution	 Flashing Caution or Flashing Caution or Alternating Diamond Caution

Arrow Board Type	Minimum Size	Minimum Legibility Distance	Minimum Number of Elements
A	48 x 24 inches	1/2 mile	12
B	60 x 30 inches	3/4 mile	13
C	96 x 48 inches	1 mile	15
D	None*	1/2 mile	12

*Length of arrow equals 48 inches, width of arrowhead equals 24 inches

Figure 12:Channelizing Devices (MUTCD, 2009 Edition)



* Warning lights (optional)
** Rail stripe widths shall be 6 inches, except that 4-inch wide stripes may be used if rail lengths are less than 36 inches. The sides of barricades facing traffic shall have retroreflective rail faces.

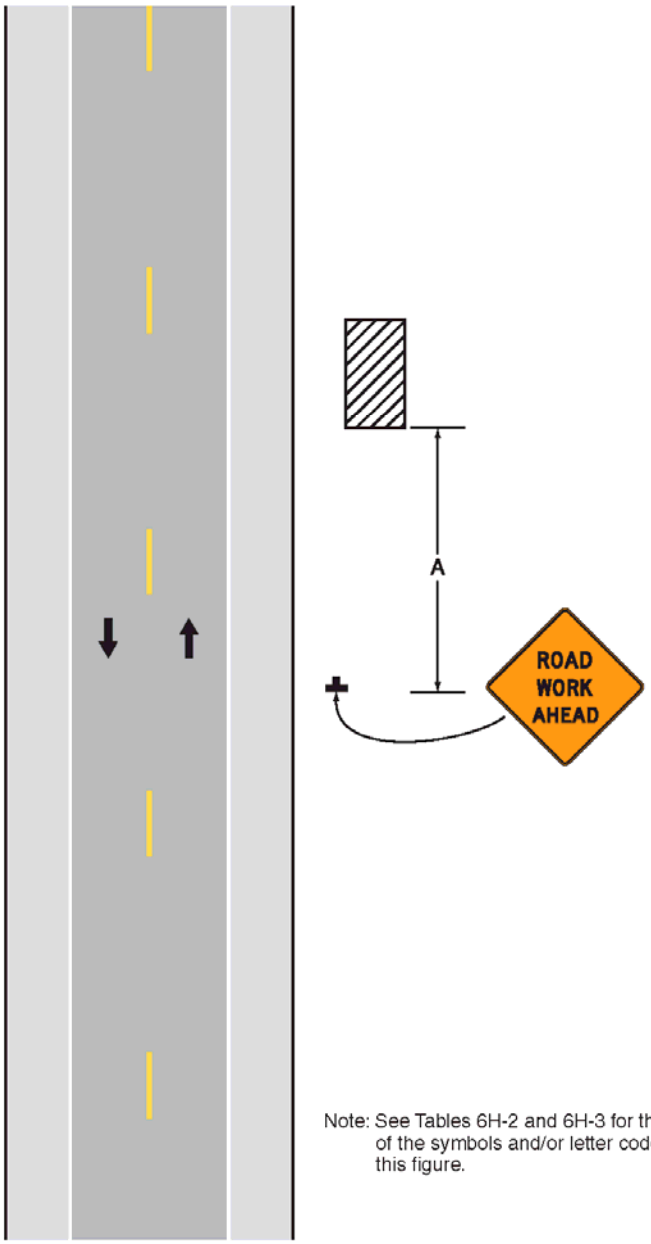
13 SYMBOLOGY

Electronic CAD files for all signs are available via Georgia Institute of Technology's Office of Facilities Management. The contact information for the Office of Facilities Management is available at - https://facilities.gatech.edu/contact-us.

14 TYPICAL LAYOUTS

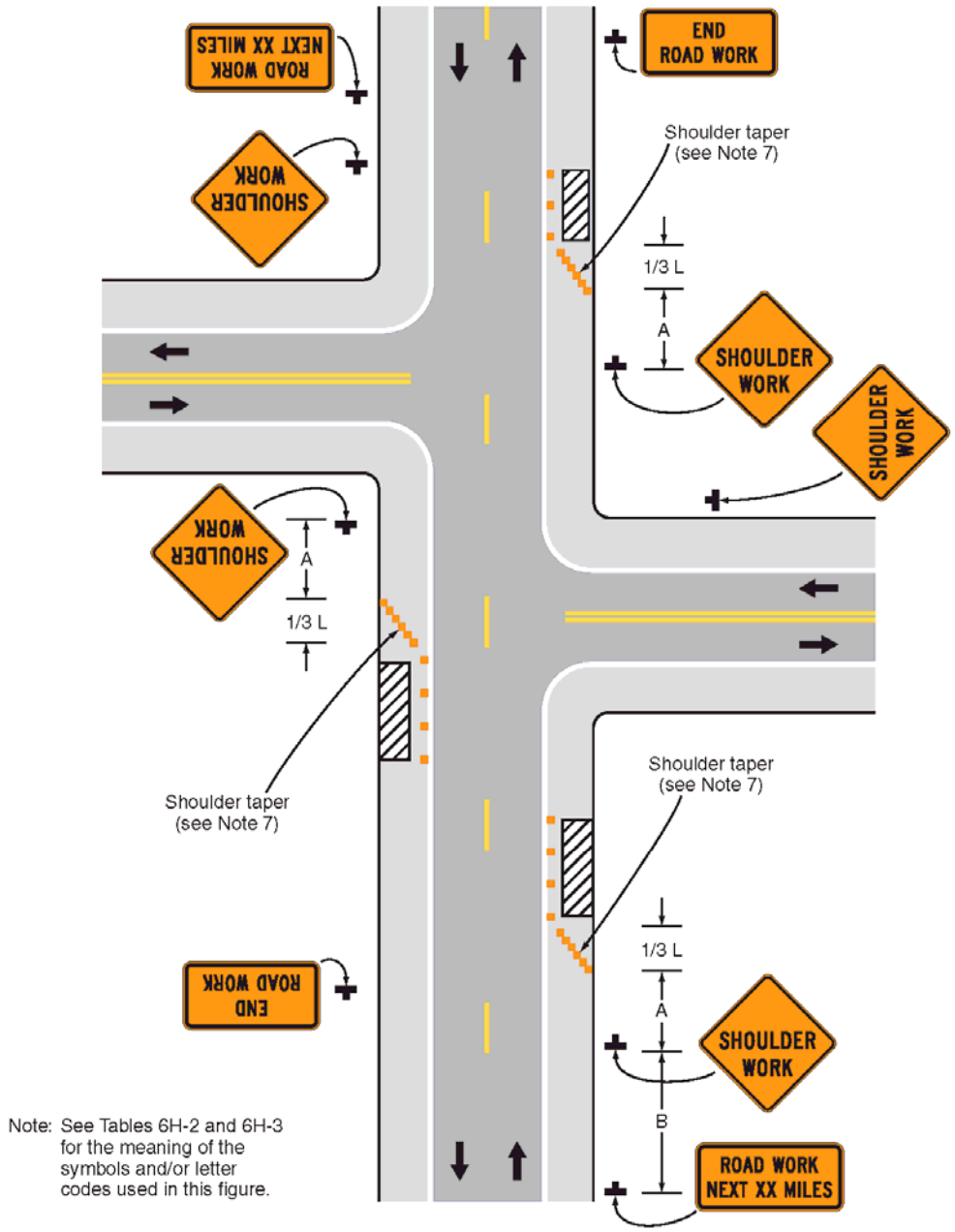
The MUTCD provides typical layouts for commonly occurring scenarios. This section only shows typical layouts that are expected on campus. There will be situations where engineering judgement will be required in making decisions for which typical layouts are not provided. Figures 13 through 27 show layouts that will typically be required during campus projects.

Figure 13: Work Beyond the Shoulder



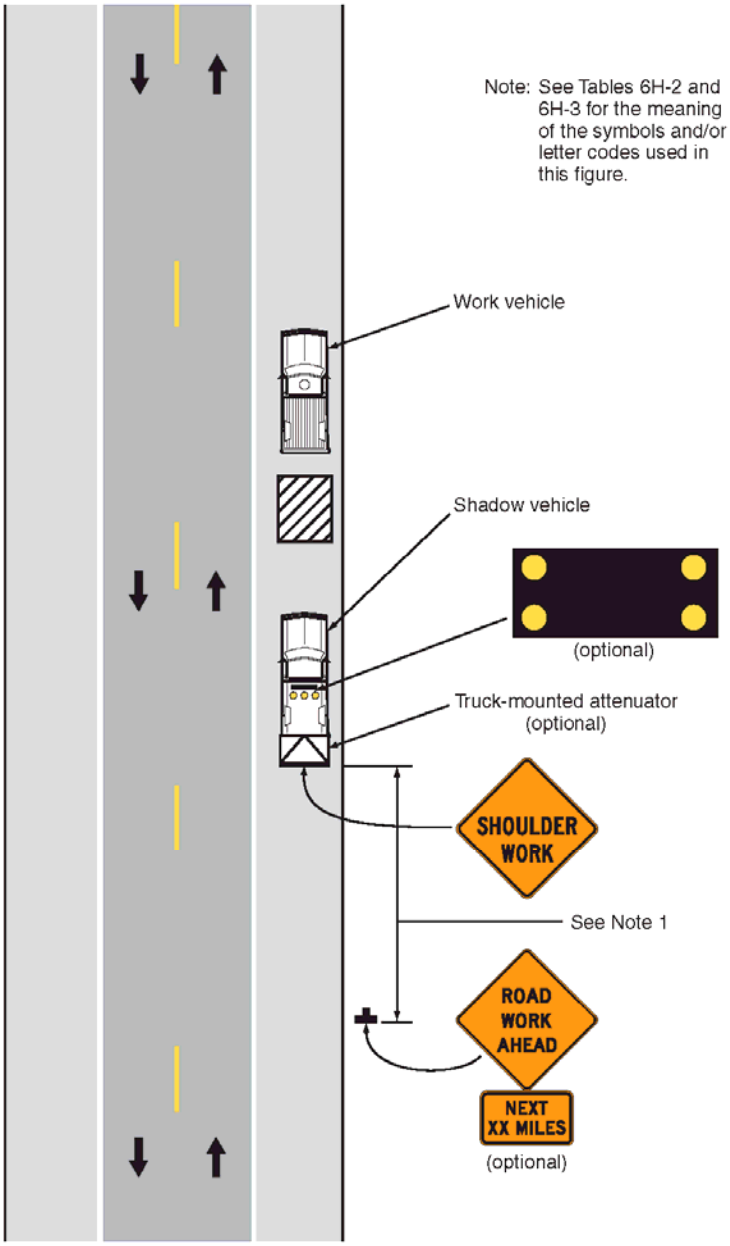
Typical Application 1

Figure 14: Work on the Shoulder



Typical Application 3

Figure 15: Short-Duration or Mobile Operation on a Shoulder



Typical Application 4

Figure 16: Shoulder Work with Minor Encroachment

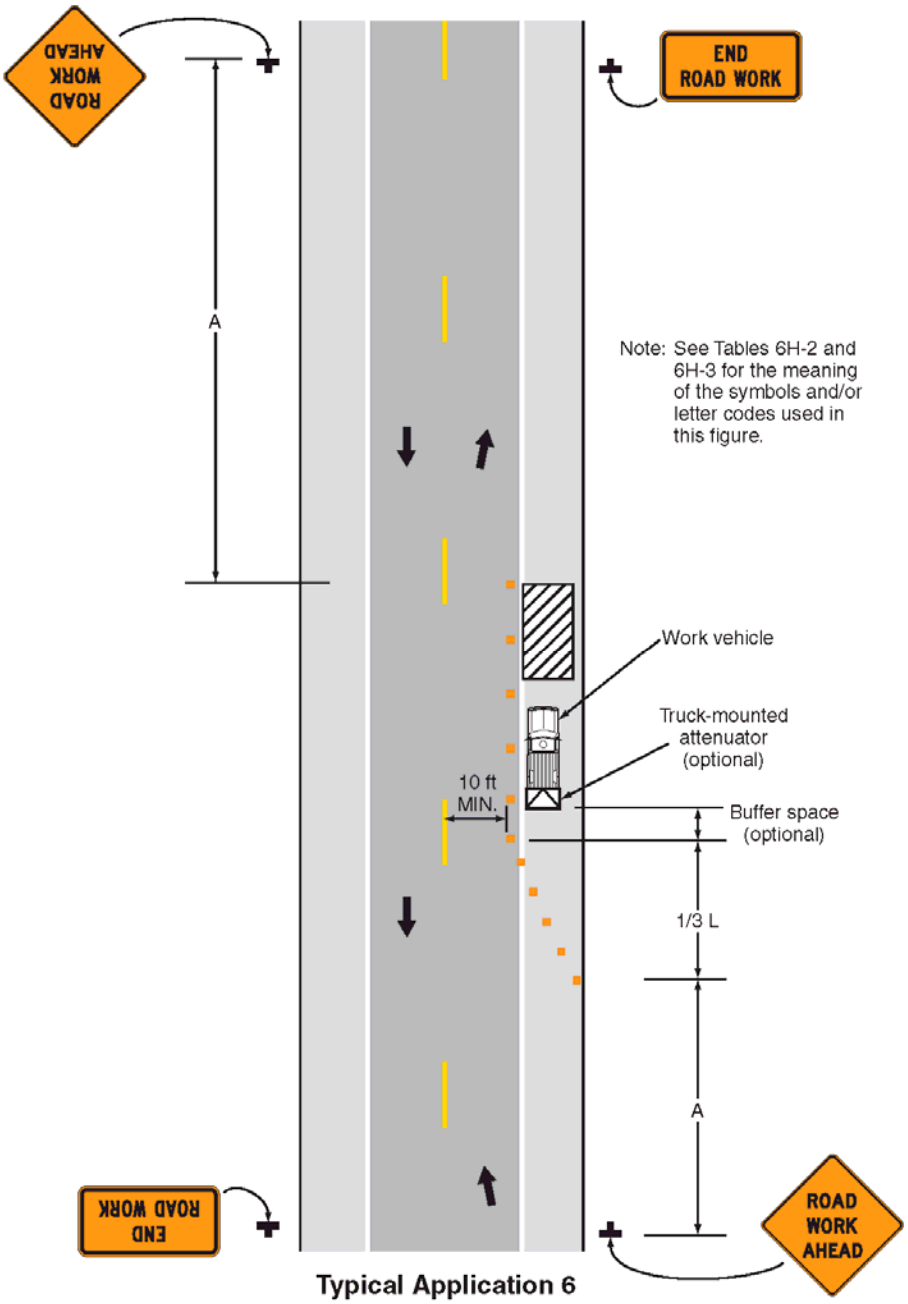
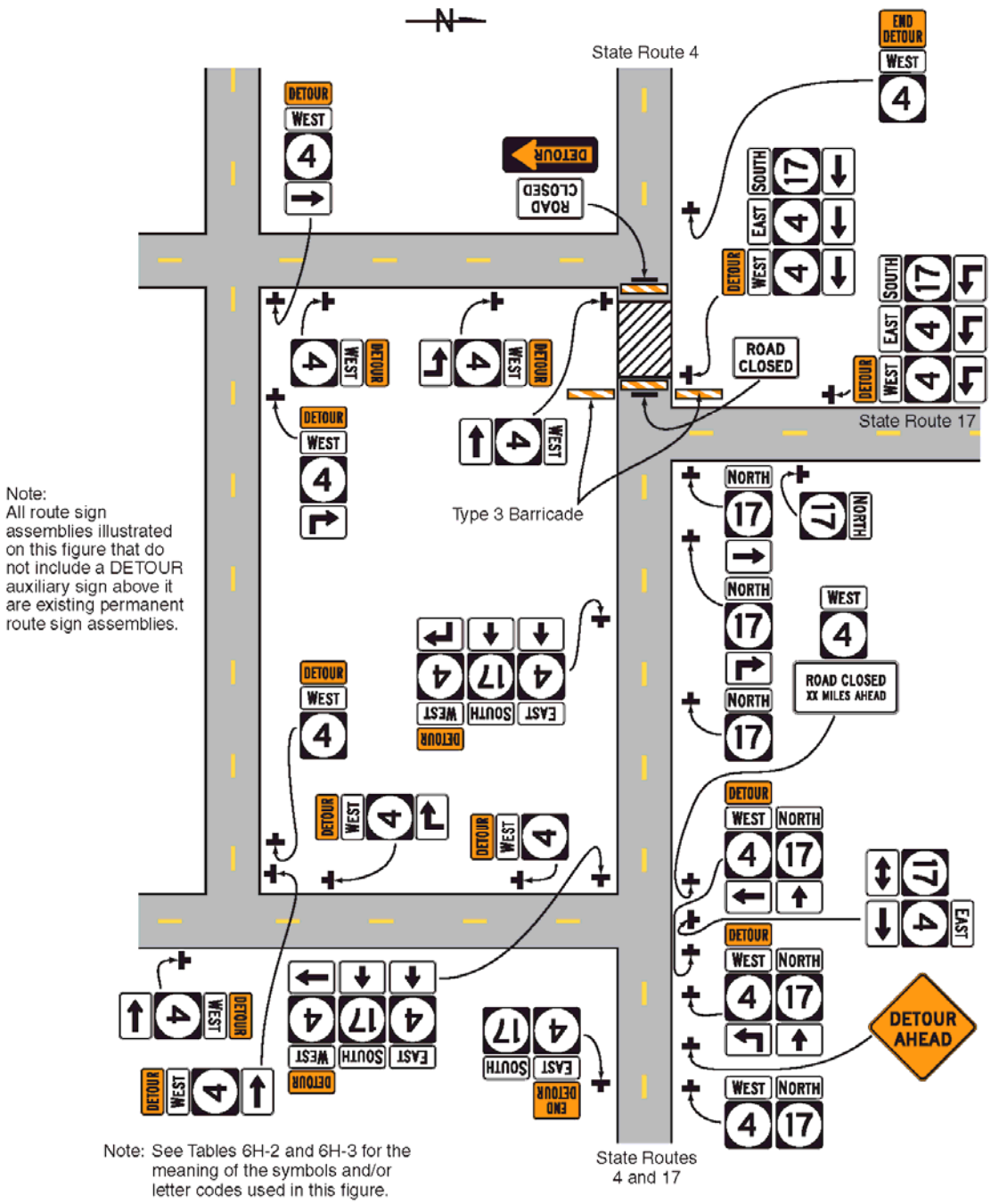
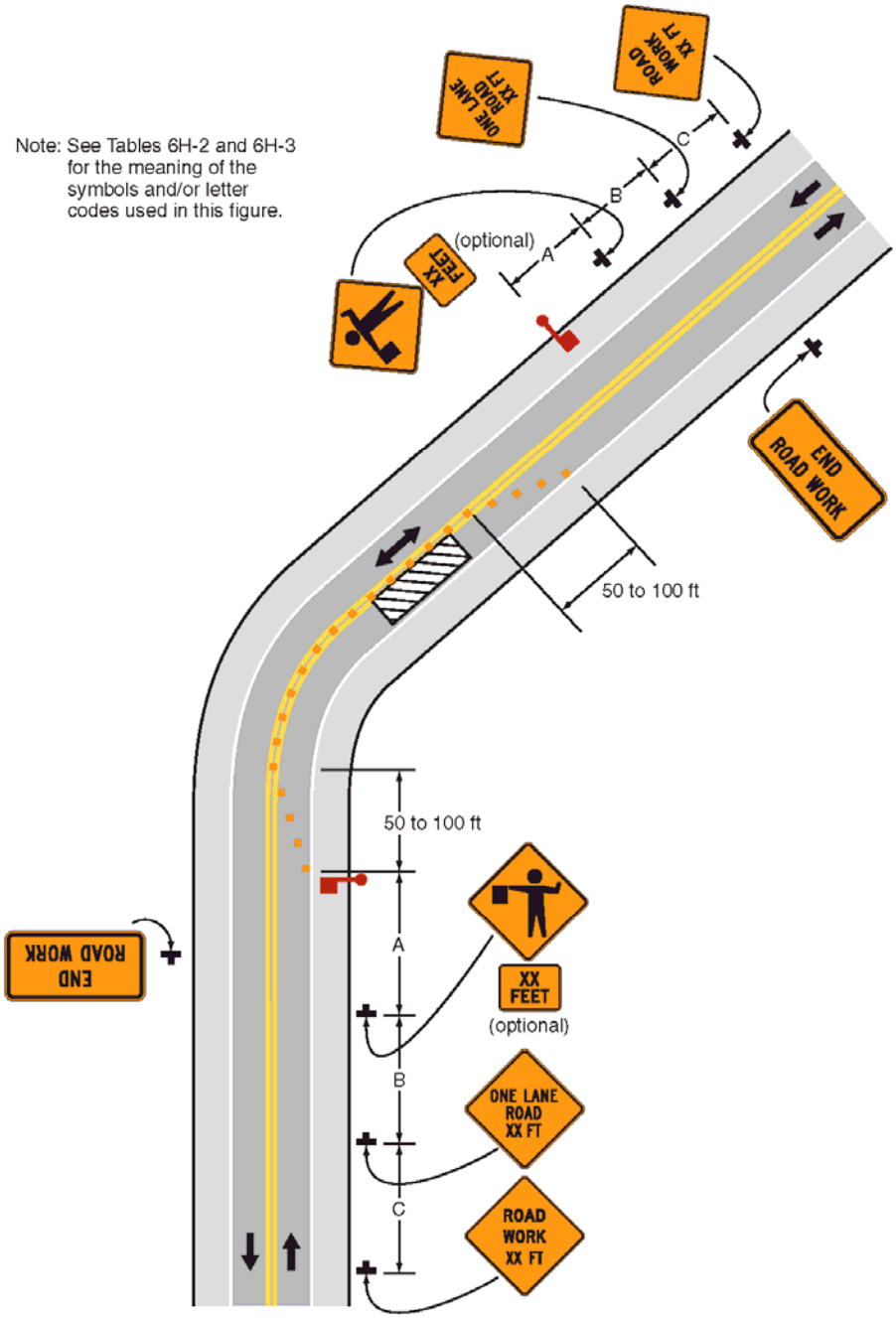


Figure 17: Overlapping Routes with a Detour



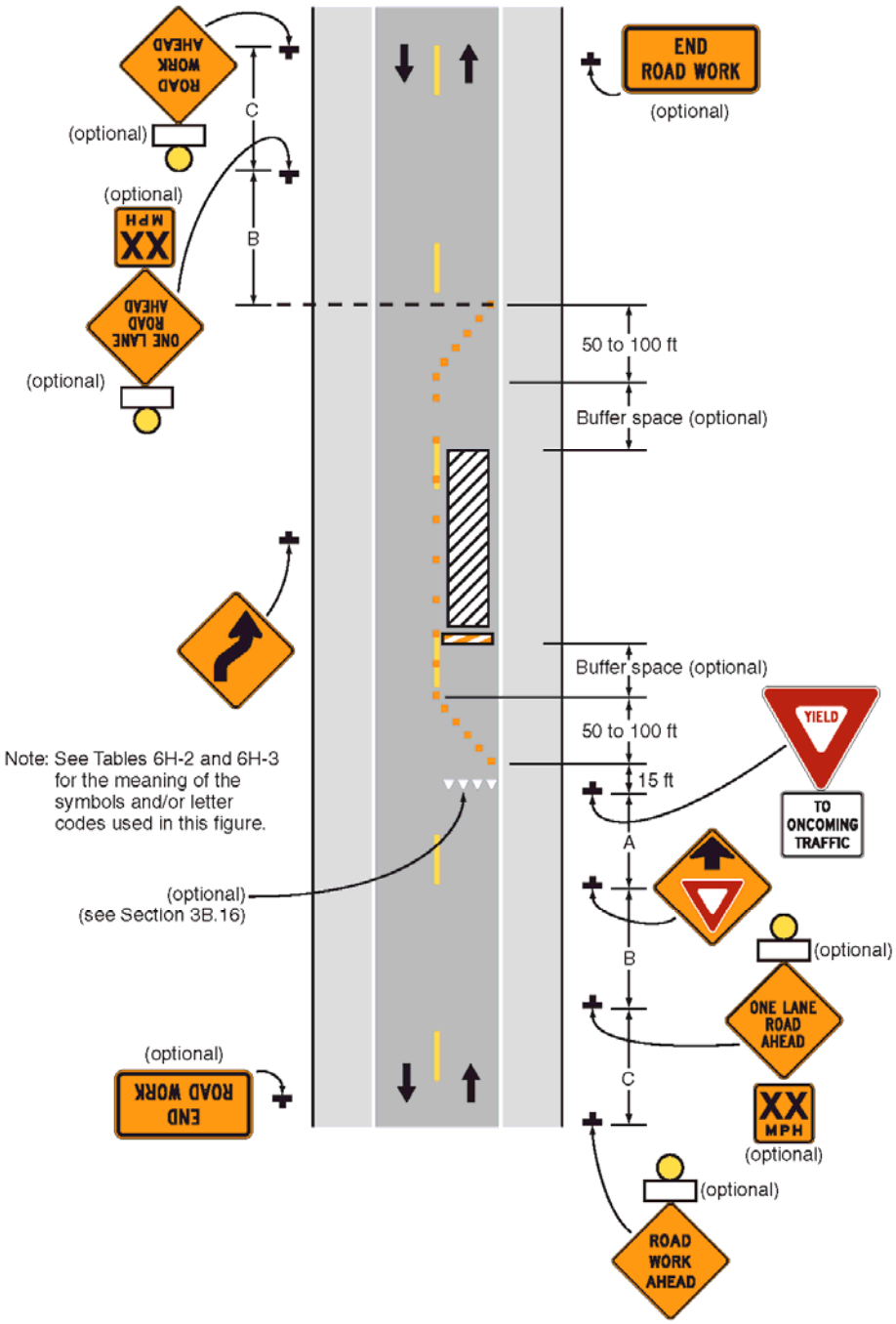
Typical Application 9

Figure 18: Lane Closure on a Two-Lane Road Using Flaggers



Typical Application 10

Figure 19: Lane Closure on a Two-Lane Road with Low Traffic Volumes



Typical Application 11

Figure 20: Temporary Road Closure

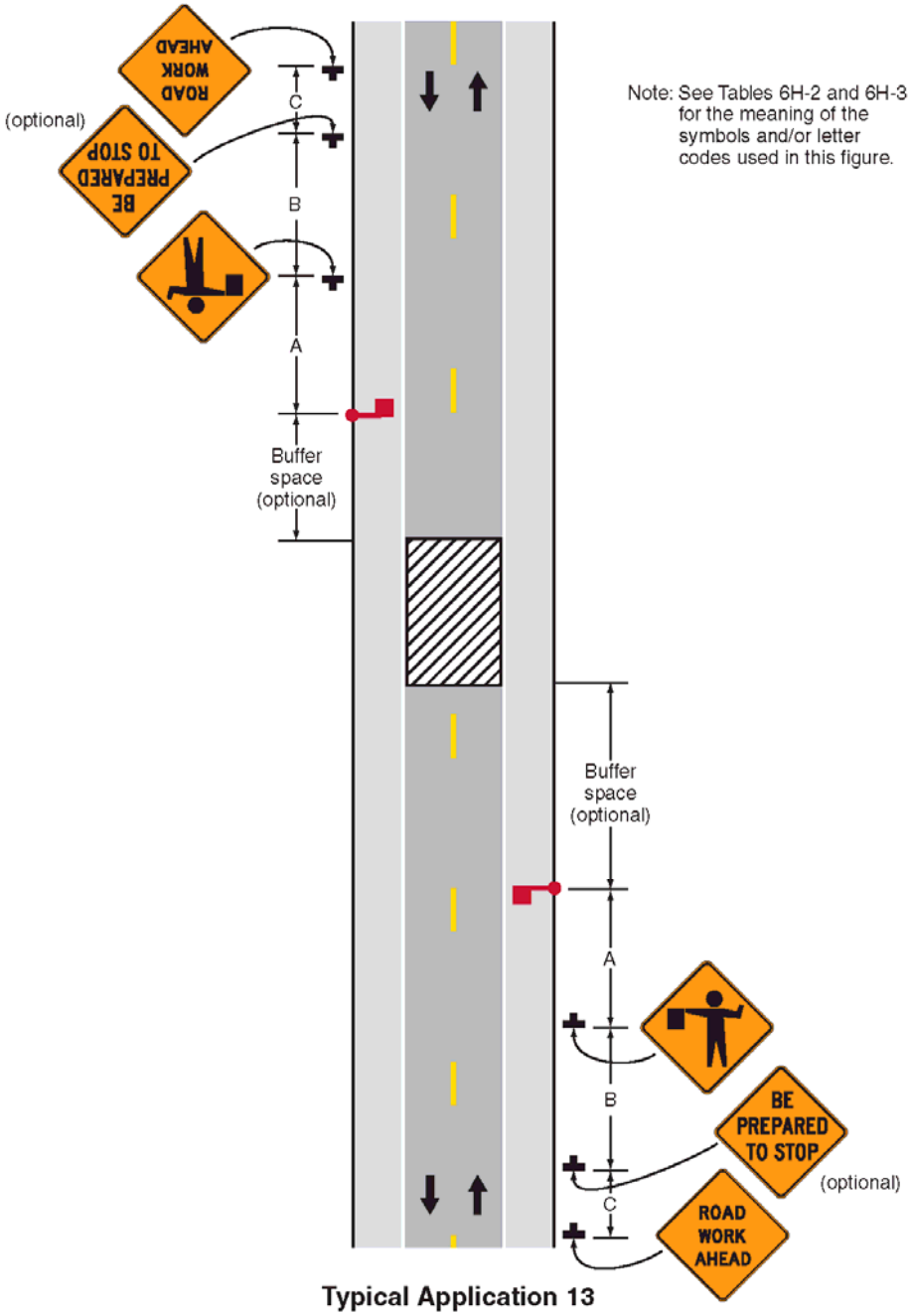
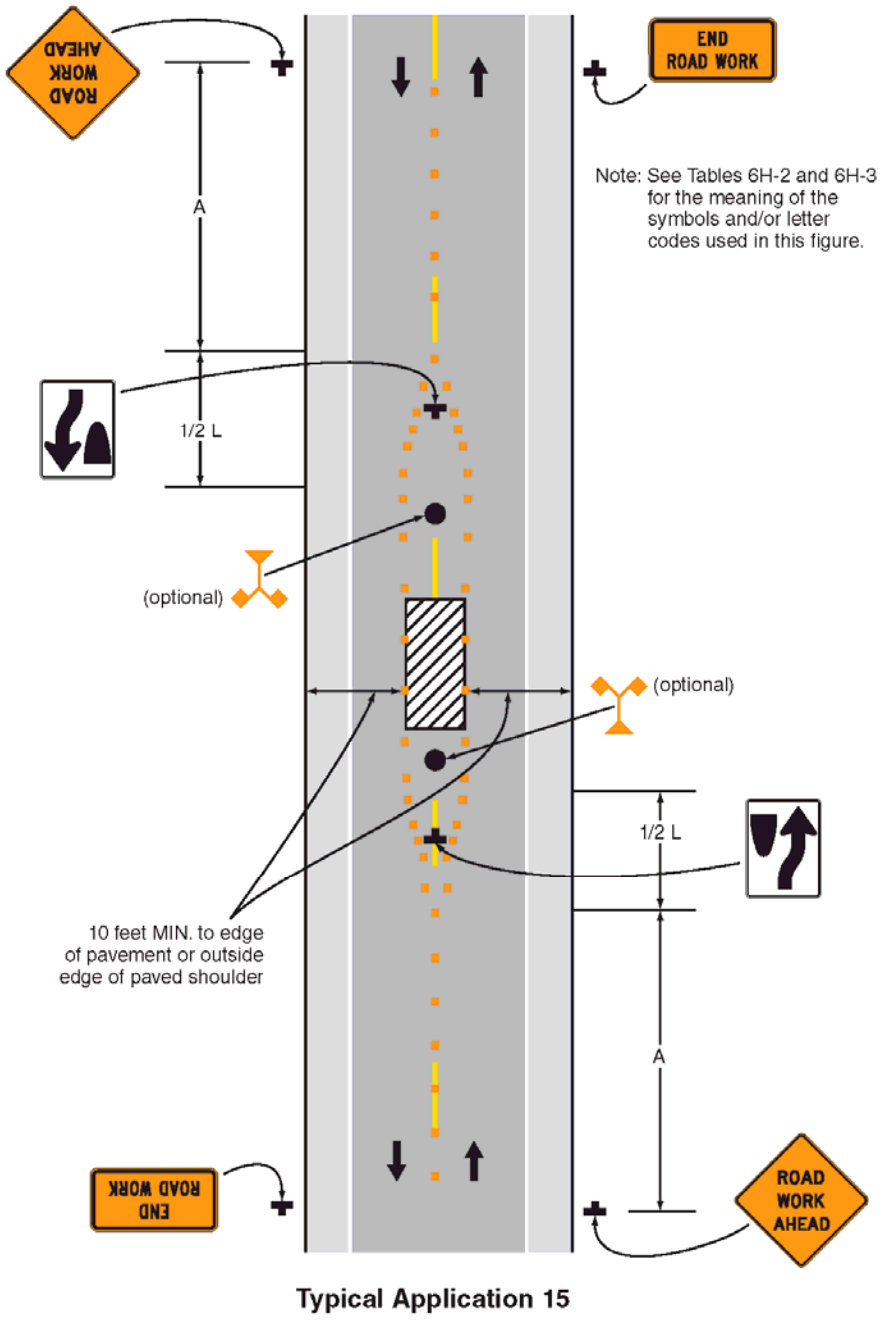


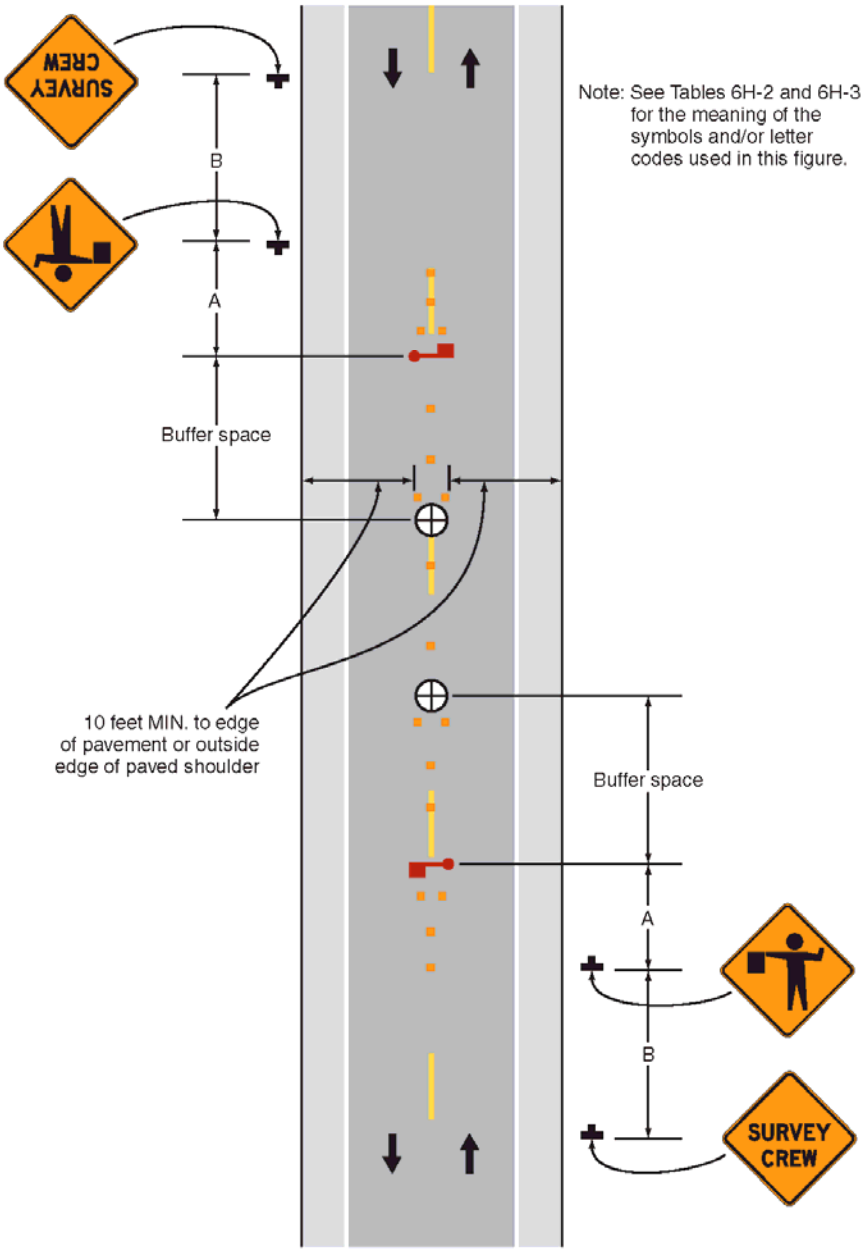
Figure 21: Work in the Center of a Road with Low Traffic Volumes



Typical Application 15

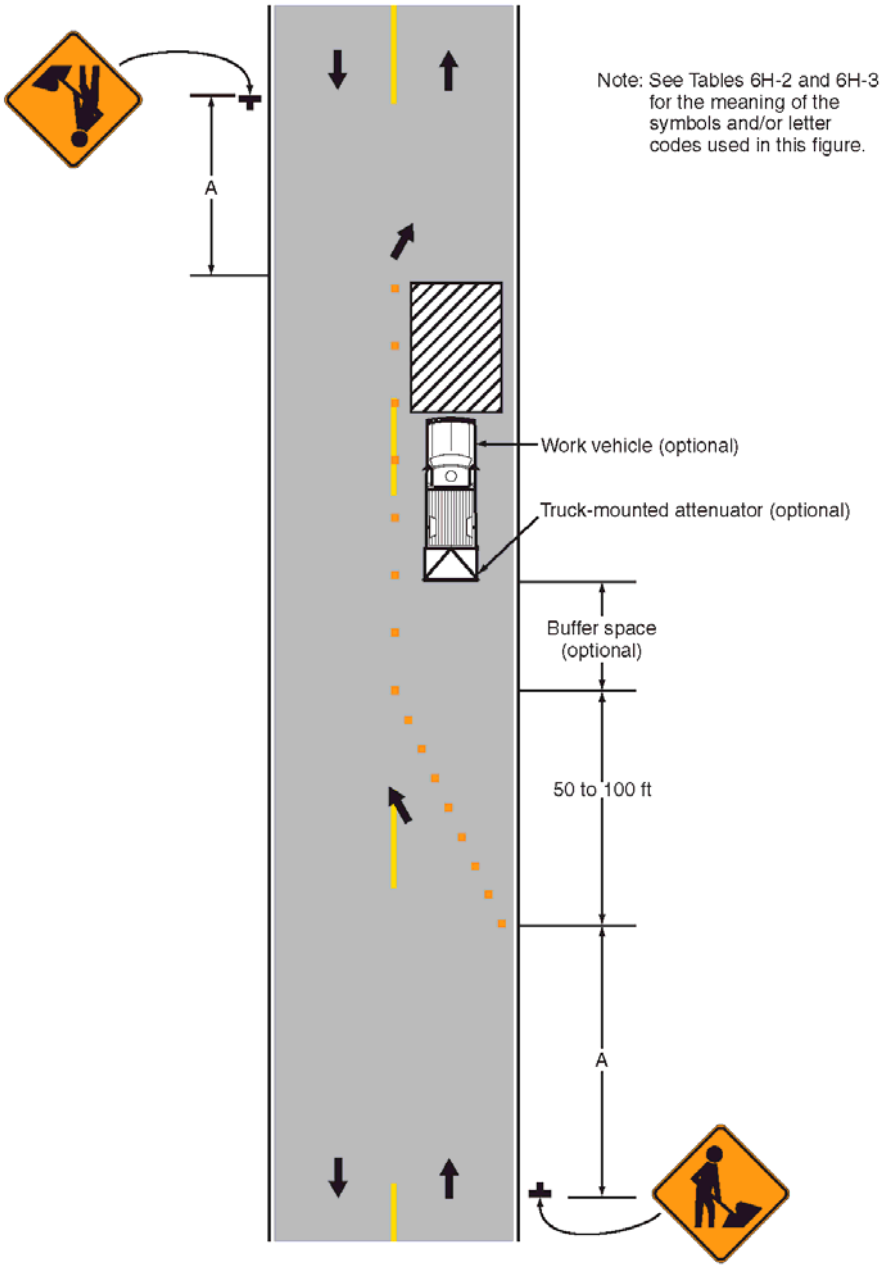
Figure 22: Surveying Along the Center Line of a Road with Low Traffic Volumes

Figure 6H-16. Surveying Along the Center Line of a Road with Low Traffic Volumes (TA-16)



Typical Application 16

Figure 23: Lane Closure on a Minor Street



Typical Application 18

Figure 24: Right-Hand Lane Closure on the Far Side of an Intersection

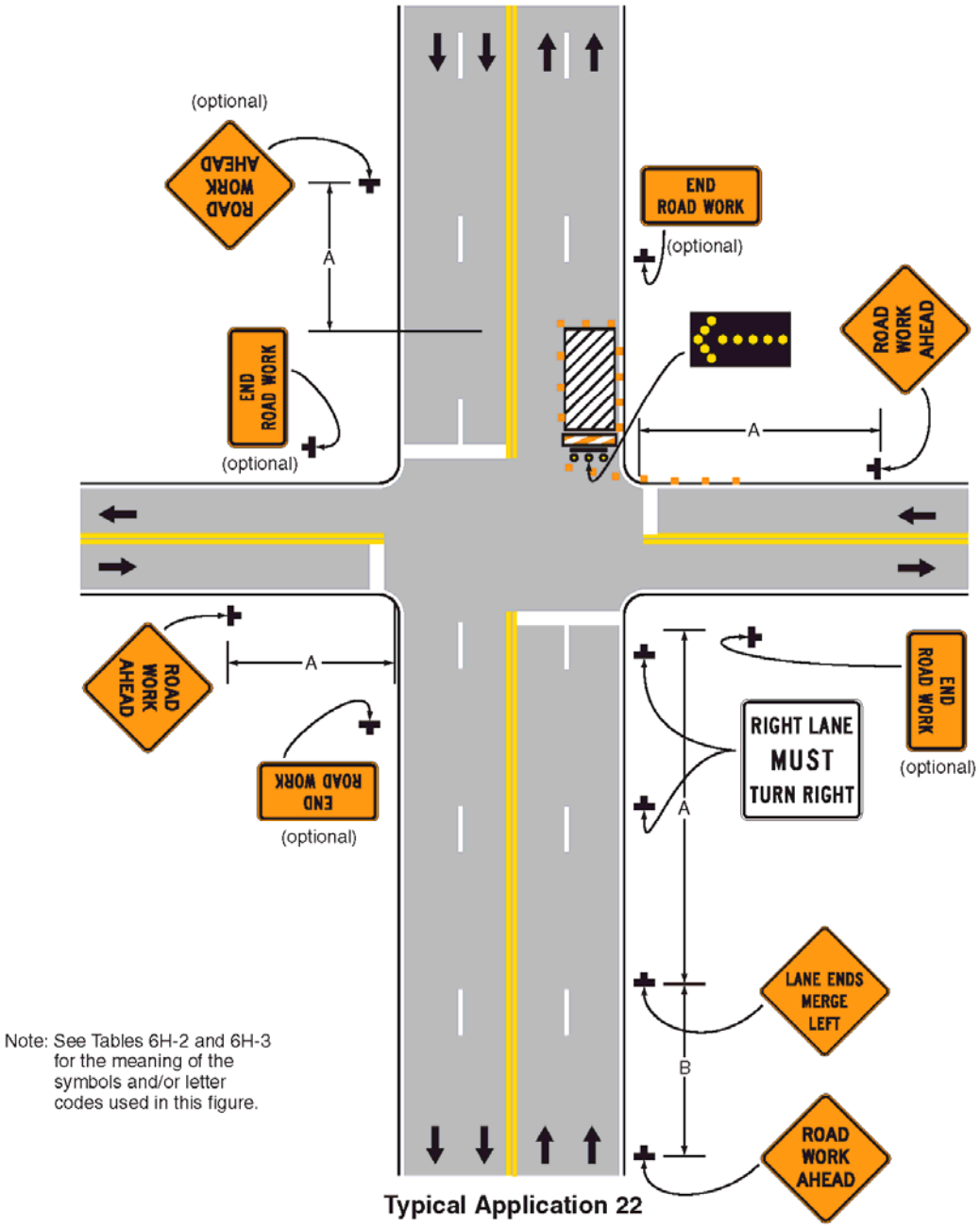
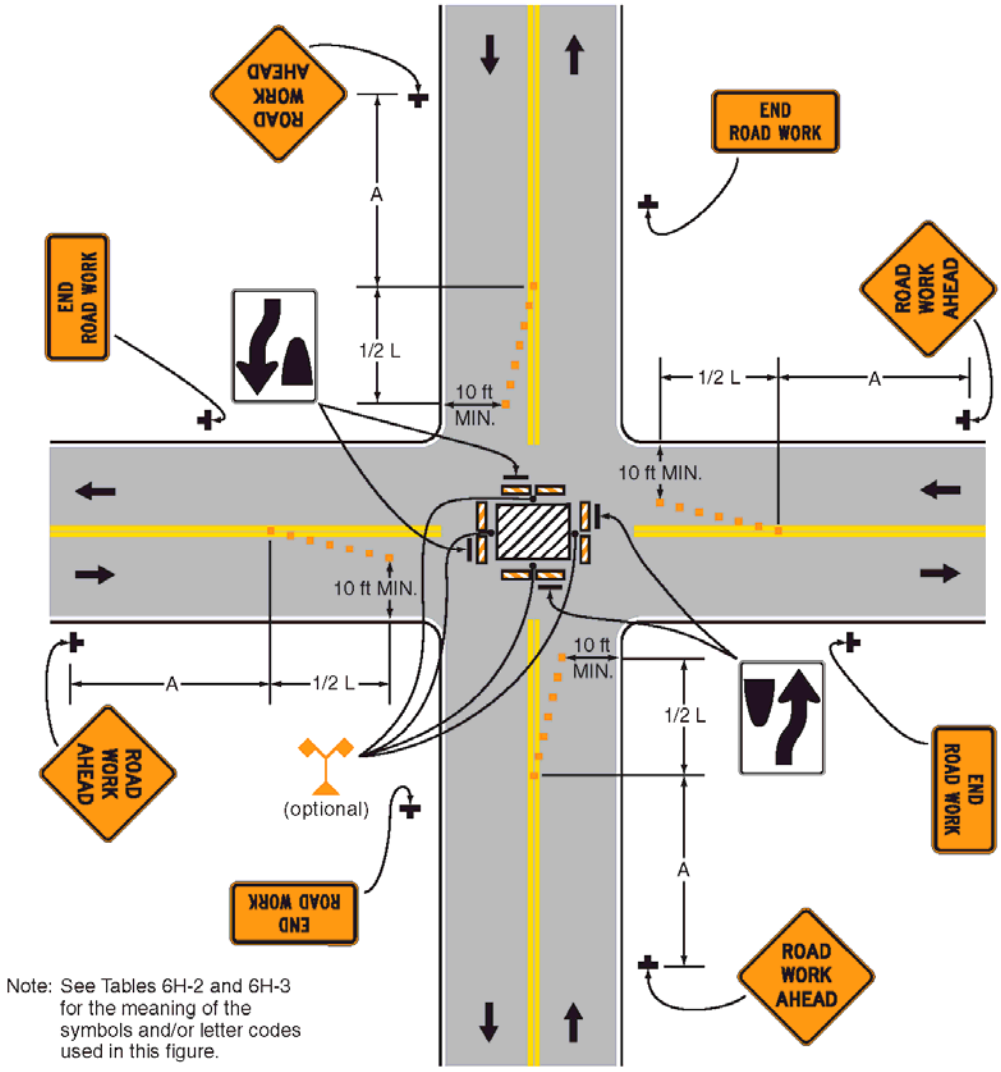
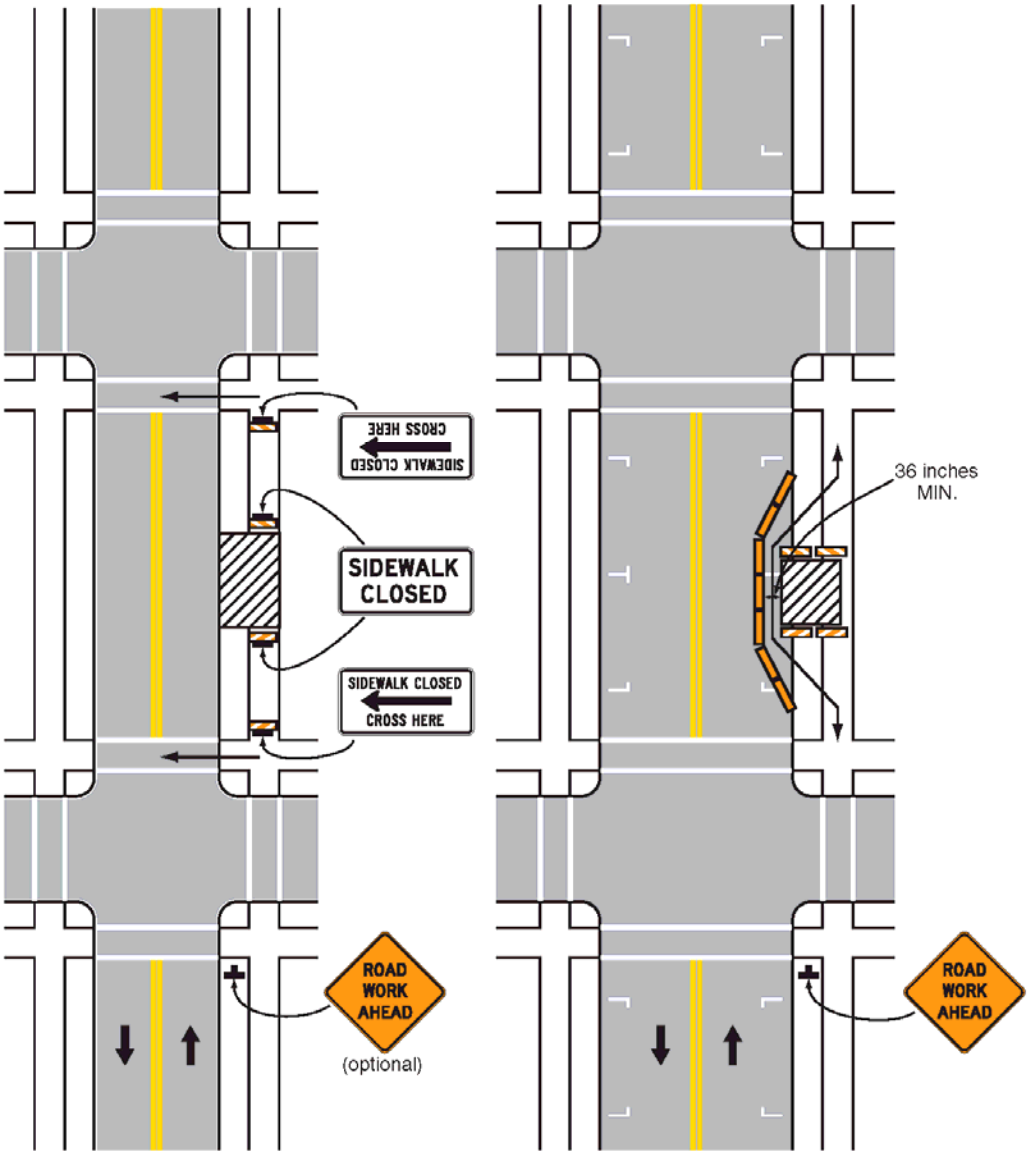


Figure 25: Closure in the Center of an Intersection



Typical Application 26

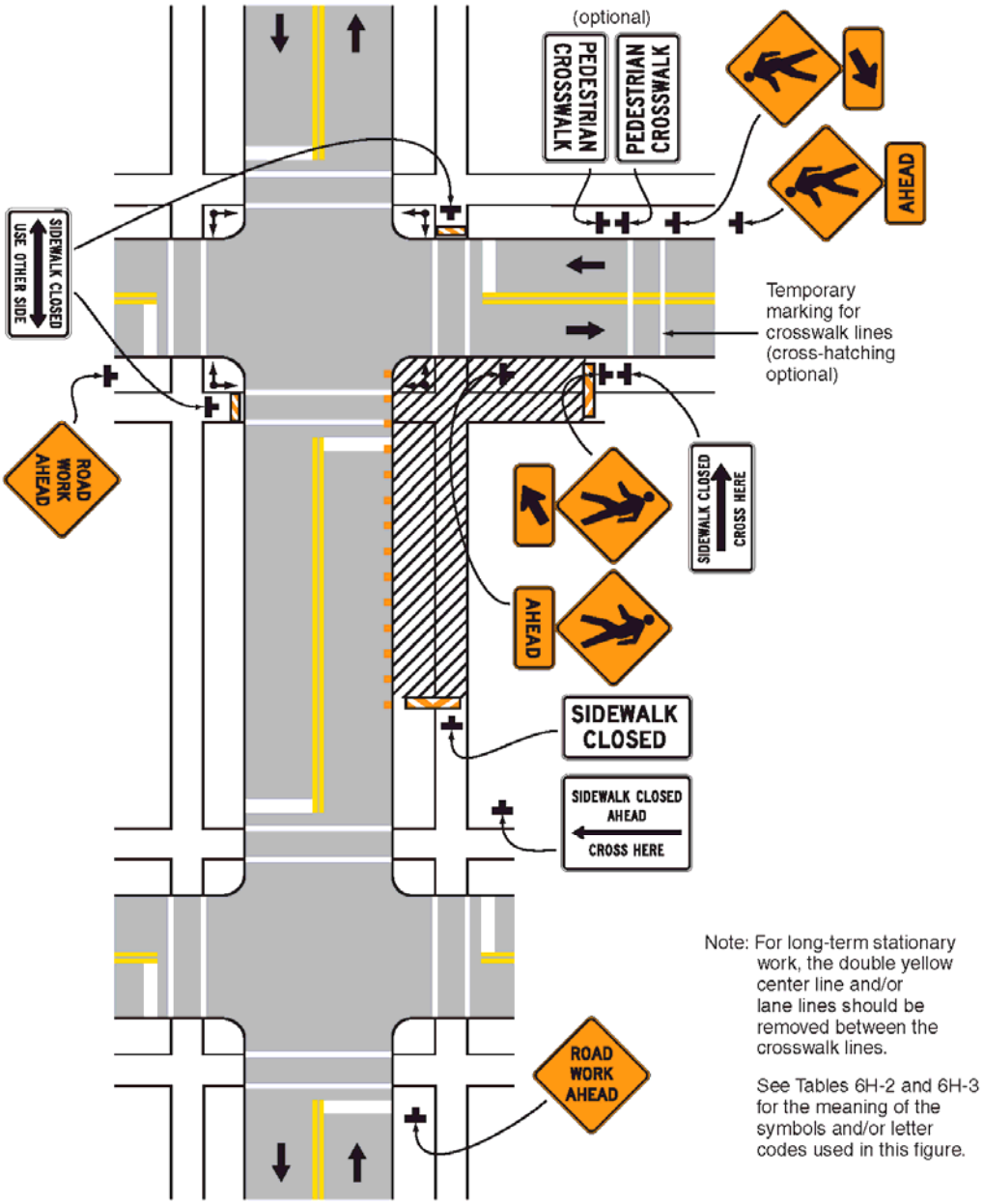
Figure 26: Sidewalk Detour or Diversion



Typical Application 28

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

Figure 27: Crosswalk Closures and Pedestrian Detours



Typical Application 29

15 QUALITY STANDARDS FOR APPAREL

Working near traffic can be potentially dangerous and hence wearing a high-visibility safety apparel is of utmost importance. According to Worker Visibility rile, high-visibility safety apparel is defined as 'personal protective safety clothing that is intended to provide conspicuity during both daytime and nighttime usage, and that meets the Performance Class 2 or 3 requirements of the ANSI/ ISEA 107-2004 publication entitled 'American National Standard for High-Visibility Safety Apparel and Headwear". Please note that these standards are periodically updated and that the latest version should be used.

Apparel Selection

High-visibility apparel should be selected based on the following:

- National, State, and local standards and regulations. The State and local standards take precedence over Federal standards
- Optimum visibility in daytime, low-light, and nighttime conditions
- Contrasting colors
- Weather conditions
- Sight or stopping distances
- Proximity to traffic
- Traffic speed and volume
- Worker needs and comfort

Performance Classes

Performance Class I

Performance Class I apparel is not acceptable to wear within the ROW under the FHWA Worker Visibility Final Rule because it provides a minimal amount of required material to differentiate the wearer from the work environment, which makes them less visible. This type of apparel tends to blend in with the work environment instead of drawing attention to workers. The minimum specifications for this type of apparel are:

- Background material equals 217 in.
- Retroreflective or combined performance material with background material equals 155 in.
- Combined-performance material used without background material equals 310 in.

Unacceptable Apparel Examples

Performance Class 2

Performance Class 2 provides superior visibility for wearers through additional coverage of the torso and is more visible than Performance Class 1. This type of apparel is required as a minimum for all workers within the ROW of a Federal-aid highway who are exposed either to traffic or to construction equipment within the work area. The minimum specifications for this type of apparel are:

- Background material equals 755 in.
- Retroreflective or combined performance material with background material equals 201 in.

Typical Factors or Characteristics for Workers Wearing Performance Class 2

- Daytime activities.
- Working off the roadway.
- Physical barrier between worker and traffic.
- Lower speed roadways.

Examples of Work Activities Requiring a Minimum of Performance Class 2 Apparel

- Mowing.
- Inspection.
- Maintenance.
- Road signage installation.
- Surveying.
- Utility operations.
- Toll collection.
- Incident response.
- Volunteer work (Adopt-a-Highway).
- News media coverage (covering incident management)

Examples of Performance Class 2 Apparel

Washington DOT Performance Class 2 Apparel

Michigan DOT Performance Class 2 Apparel

Performance Class 3

Performance Class 3 apparel offers the greatest worker visibility in both complex backgrounds and through a full range of body movements. This type of apparel should be worn when conditions include highly congested areas, complex lane shifts, or complex work zones. Visibility for Class 3 apparel is enhanced beyond Performance Class

2 by the addition of background and reflective materials to the arms and/or legs. Performance Class 3 apparel has to have either sleeves or trousers. The minimum specifications for this type of apparel are:

- Background material equals 1,240 in.
- Retroreflective or combined performance material with background material equals 310 in.

Typical Factors or Characteristics for Workers Wearing Performance Class 3

- Nighttime.
- No physical barrier.
- Work on roadway.
- High speed roadways.
- Urban areas.
- High-crash areas.

Example of Performance Class 3 Apparel

Examples of Work Activities Requiring a Minimum of Performance Class 3 Apparel

- Flagging operations.
- Temporary traffic control setup and removal.
- Positive protection setup and removal.
- Construction.
- Incident response in emergency response particularly at night.
- Emergency utility crews dispatched at night.

What is a Performance Class 3 Ensemble?

A combination of Performance Class 2 with Performance Class E apparel is considered a Performance Class 3 ensemble. An ensemble is a combination of apparel; for example, wearing a Performance Class 2 vest combined with Performance Class E trousers. Therefore, a Performance Class 3 ensemble can consist of one of the following:

1. A combination of a Performance Class 2 vest and Performance Class E trousers.
2. A combination of a Performance Class 2 vest and Performance Class E shorts.

Example of Performance Class 3 Ensemble
(Performance Class 2 Vest and Performance Class E Trousers)

The design of Performance Class 3 apparel allows workers to be easily seen through a full range of body motions at a minimum of ¼ mile (1,280 feet). Performance Class 3 apparel is worn typically when workers must focus all their attention on their work and not traffic.

Performance Class E Apparel

Performance Class E apparel, which take the form of either waistband trousers or shorts, is not intended to be worn without Performance Class 2 or 3 apparel.4 When worn with Performance Class 2 or 3 apparel, the overall classification for the ensemble will be classified as a Performance Class 3 ensemble. The specifications for this type of apparel are:

- Background material equals 465 in.
- Retroreflective or combined performance material with background material equals 108 in.

Resources

Manual on Uniform Traffic Control Devices (MUTCD):

http://mutcd.fhwa.dot.gov/kno_2009.htm

United States Access Board's Proposed Right-of-Way Accessibility Guidelines:

https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/proposed-rights-of-way-guidelines

United States Access Board's Public Right of Way Access Advisory Committee's Special Report on Accessible Public Rights-of-Way Planning and Designing for Alterations:

https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/guidance-and-research/accessible-public-rights-of-way-planning-and-design-for-alterations

Pedestrian Safety and Accessibility in Work Zones:

http://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/atssa_pedestrian_work_ zones.pdf

Guidance Sheet-Temporary Traffic Control Zone Pedestrian Access Considerations: https://www.workzonesafety.org/node/10588

New York State DOT Work Zone Traffic Control Manual 2015

https://www.dot.ny.gov/divisions/operating/oom/transportation-systems/safety-program-technical-operations/work-zone-control/repository/Work%20Zone%20Traffic%20Control%20Manual.pdf

Temporary Traffic Control Zone Layouts Field Manual 2014 Minnesota DOT:

http://www.dot.state.mn.us/trafficeng/publ/fieldmanual/

2016 Virginia DOT Work Zone Pedestrian and Bicycle Guidance:

http://www.virginiadot.org/business/resources/wztc/2016_WZ_Ped_BikeGuide.pdf