<table>
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| All     | Chapter renamed from "Maintenance and Protection of Traffic in Highway Work Zones" to "Work Zone Traffic Control"  
All metric values converted to USC |
| 16.1.1  | Added a description of the new contents of Section 16.5 |
| 16.4.4.2.A.3 | Added information to make WZ pedestrian accommodation consistent with the PROWAG |
| 16.4.7.7 | Moved General Considerations for Detours to Subsection 16.5.6. |
| 16.4.7.8 | Corrected MUTCD references in this Diversions Subsection |
| 16.5    | New section entitled Work Zone Impact Management Strategies presented within the framework of the project development process and outlines a process for evaluating work zone traffic control strategies in the larger context of the rule on work zone safety and mobility, transportation management plans, significant projects, transportation management teams, detours, and nighttime construction are discussed. |
| 16.6    | Removed placeholder for a previously anticipated section on TIME RELATED CONTRACT PROVISIONS, because these provisions are not exclusively work zone traffic control-related provisions and may be presented in a different section of the HDM. |
| 16.8    | Removed outdated references to Engineering Instructions; current references now available on HDM Chapter web page. |
| Appendix 16B | New Appendix contains maps that have been developed to assist the designer by highlighting the limits of interstate highways within the approximate geographic boundaries of Transportation Management Areas. |
| Index   | Deleted |
# WORK ZONE TRAFFIC CONTROL

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16.1 INTRODUCTION

16.1.1 Organization of the Chapter

Section 16.1 Introduction describes the purpose of the chapter, states the general policy and objectives for temporary traffic control in and around construction, maintenance and inspection work zones, and provides information on work zone traffic control training conducted by the NHI for Department Designers.

Section 16.2 Traffic Control Devices provides an overview of traffic control devices and includes guidance on their use for both daytime and nighttime operations.

Section 16.3 Safety Devices and Barriers discusses supplementary devices including temporary traffic barriers, vehicle arresting barriers, shadow vehicles, barrier vehicles, crash cushions and attenuating systems, sand barrel arrays, and temporary rumble strips.

Section 16.4 Work Zone Traffic Control Plans deals with the general requirements for traffic control plans, presents the fundamental principles of traffic control, describes the elements of work zones, discusses the considerations for work zone safety, details the requirements for work zone speed limits, and describes various work zone strategies. The section also describes the methods and strategies that may be used to aid workers, vehicle drivers, and pedestrians to navigate highway construction work zones.

Section 16.5 Work Zone Impact Management Strategies is presented within the framework of the project development process and outlines a process for evaluating work zone traffic control strategies in the larger context of the rule on work zone safety and mobility; transportation management plans, significant projects, transportation management teams, detours, and nighttime construction are discussed.

Section 16.6 References is the list of all the references used to develop the chapter. Titles of publications are shown in italics.

16.1.2 Purpose

A temporary work zone or traffic control zone is an area of a highway where road user conditions are changed by the use of temporary traffic control devices, flaggers, police, or other authorized personnel, because of a work zone or incident. Standards and guidelines for work zone traffic control in highway work zones are found in Part 6, Temporary Traffic Control, of the National Manual on Uniform Traffic Devices (MUTCD) and the New York State Supplement, the Standard Specifications Section 619, Standard Sheets, Engineering Instructions (EIs), and various other Department publications, which serve, for the most part, as the basis for this chapter. The designer should be familiar with these other references.

This chapter provides guidance to those who are responsible for determining how to deal with traffic on construction/reconstruction and maintenance projects and for those who are responsible for developing Work Zone Traffic control (WZTC) plans. Primarily, this would include design, traffic, and maintenance engineers, although planners, project developers, and project managers may find information pertinent to their roles in project development. Engineers-in-Charge may also find this chapter useful during...
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project construction if it becomes necessary to modify WZTC plans due to changing field conditions or project schedules.

The requirements and guidelines provided in this chapter apply primarily to construction work zones but may have application to some maintenance projects and work performed under highway work permits.

16.1.3 State and Federal Policies

16.1.3.1 NYSDOT Policy

It is the policy of the New York State Department of Transportation that Department projects shall include provisions and plans when necessary for the temporary control of traffic, workers, motorists, pedestrians, bicyclists, and persons with disabilities, in highway work zones. Such provisions and plans should strive to achieve an appropriate balance of the following objectives:

- Provide a high level of safety for workers and the public.
- Minimize congestion and community impacts by maintaining acceptable levels of service as close as possible to preconstruction levels.
- Provide a feasible design of highway traffic control during highway and bridge operations.
- Provide the contractor with access to the roadway that is adequate to complete the work efficiently while meeting the quality requirements of the contract.
- Keep the cost as low as possible, consistent with safety and an appropriate degree of convenience for the public.

This policy shall apply whenever work is performed within the highway boundaries. This policy applies to all types of bridge/highway construction, reconstruction, maintenance and inspection projects on the State Highway System, projects on local systems that are administered by NYSDOT and urban as well as rural facilities.

In applying this policy, all feasible alternatives for maintaining traffic should be examined and, where possible, the most cost-effective alternative, consistent with safety standards, should be selected.

Projects should also have environmental and community concerns incorporated into the project development process in accordance with Department policy and guidance given in EI 01-020 Context Sensitive Solutions (CSS). CSS maintains safety and mobility as priorities, yet recognizes that these are achieved in varying degrees with alternative solutions. The decision as to how best to balance competing values remains the responsibility of the designer.

When it is not possible to achieve substantial balance among the objectives listed above through work zone traffic control schemes for daytime construction, the feasibility of nighttime construction shall be evaluated along with other traffic systems management strategies. In addition, for Regions 10 and 11, the feasibility of nighttime construction must be evaluated for “every major limited access highway, expressway, and parkway capital construction project ..... with a cost of more than two million dollars in region ten, and with a cost of more than five million dollars in region eleven .....” Refer to Sections 16.2 and 16.4 for further guidance on nighttime construction.

The development of a strategy to control work zone traffic should be an integral part of the project development process from initial planning and project scoping through preliminary and final design.
This will ensure that the project's cost, schedule, scope, and quality goals adequately reflect the needs of the management plan or control plan. The cost to control traffic and mitigate the impacts of highway work zones should be considered an integral part of the project development and design process.

Controlling traffic is an essential project cost, yet it is not intended to provide a lasting benefit after the project is completed. Accordingly, improvements needed to control traffic should not ordinarily be designed to provide long-term benefits after construction is completed, although sometimes this may be the result. If significant road or bridge work and expense is necessary to control traffic, consideration should be given to retaining the work as a permanent improvement, if it would be useful to do so, rather than discarding the investment.

The Department has a goal to increase mobility whenever possible and the techniques of Transportation Systems Management (TSM) should be used when it is appropriate. Consideration should be given to incorporating cost-effective TSM measures, e.g., intelligent transportation system (ITS) elements, as part of the plans for work zone traffic control. In addition, allowing temporary improvements to remain in place should be considered if they provide long-term mobility improvement.

M.A.P. Procedure 7.12-14, titled Quality Assurance of Temporary Traffic Control describes the roles and responsibilities of the involved Main Office groups and responsibilities to be assigned to various Regional groups.

The QA procedures should assign quality assurance/quality control (QA/QC) responsibilities for design and implementation of work zone traffic control to the appropriate Regional group, and should detail areas of coordination between Regional groups. QA/QC procedures should be developed for operational needs, such as lane closures or restrictions, establishing work-area speed limits, obtaining police enforcement, use of variable massage signs, media coordination, and consideration of corridor-wide or system-wide impacts of concurrent projects.

16.1.3.2 FHWA Policy

The designer should refer to 23 CFR 630 subpart J and Subpart K.

“Each State shall implement a policy for the systematic consideration and management of work zone impacts on all Federal-aid highway projects. This policy shall address work zone impacts throughout the various stages of the project development and implementation process. This policy may take the form of processes, procedures, and/or guidance, and may vary, based on the characteristics and expected work zone impacts of individual projects or classes of projects. The States should institute this policy using a multidisciplinary team and in partnership with the FHWA. The States are encouraged to implement this policy for non-Federal-aid projects as well.”
16.1.4 National Highway Institute Training Courses

Each year, the Department offers training courses on work zone traffic control put on by the National Highway Institute (NHI). The courses are available to Designers statewide and provide the latest guidance in work zone strategy planning, design, and operation.

All designers responsible for or involved in some way in work zone traffic control design are urged to attend these training courses. Contact the Regional Training Coordinator for information on when the courses will be offered.
16.2 TRAFFIC CONTROL DEVICES

16.2.1 Standards

The National Manual on Uniform Traffic Control Devices (MUTCD) and the NYS Supplement set forth the basic principles governing the design, use, installation, and operation of traffic control devices in NYS.

The MUTCD is approved by the Federal Highway Administration (FHWA) as the standard for all highways in New York State open to public travel, regardless of type or the governmental agency having jurisdiction.

Only traffic control devices consistent with the MUTCD and the NYS Supplement may be used. Any traffic control device authorized in the MUTCD may be used, where applicable and permitted by the Standard Specifications for highway work zone traffic control. Devices to be used only in work zones are found in Part 6 of the MUTCD. General guidance as well as device application and example illustrations of traffic control at work areas are found in the 619 Standard Sheets and Part 6 of the MUTCD. The MUTCD is available on the internet at http://mutcd.fhwa.dot.gov/. The NYS Supplement is available at www.nysdot.gov

16.2.2 Revisions and Interpretations

The devices in the MUTCD and NYS Supplement will adequately serve the vast majority of situations encountered. However, situations will arise where a singular device or an unusual application of a device is necessary. The Department may consider using such devices or applications, and where a legitimate need is demonstrated, be authorized to use them. The Office of Traffic Safety & Mobility, through the Regional Traffic Engineer, should be consulted for review and approval of such authorizations.

16.2.3 Requirements

Traffic control devices include signs, signals, pavement markings, delineation devices, channelizing devices, hand-held signaling devices, warning flags, and lighting devices, which regulate, warn, and guide traffic. All traffic control devices must meet the following basic requirements to be effective:

- Fulfill a need
- Command attention.
- Convey a clear, simple meaning
- Command respect of road users
- Give adequate time for proper response

Under normal circumstances, other than on highway or bridge projects, actions required by regulatory devices must be specified by state statute, or by local ordinance or resolution. On highway or bridge projects with restricted highway designations, the Engineer-in-Charge has the legal authority to use regulatory devices without such requirements. For more information on the restricted highway designation, refer to §16.4.1 of this chapter and §104-05 of the Standard Specifications.
Five factors that should be considered in the application of each device to ensure that it is effective include:

- Design
- Placement
- Operation
- Maintenance
- Uniformity

Refer to the MUTCD, Parts 4 and 6 for discussion of these factors. The MUTCD Part 6G defines five categories of work duration which is a major factor in determining the number and type of devices used.

- Long-term stationary work is work that occupies a location for more than 3 days.
- Intermediate-term stationary work is work that occupies a location for more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.
- Short-term stationary work is work that occupies a location for more than 1 hour within a single daylight period.
- Short duration work occupies a location up to 1 hour.
- Mobile work moves intermittently or continuously.

Two of the most basic principles of traffic engineering are that a traffic control device should (1) be used only when it meets a specific need, and (2) always be used in a consistent manner. Unnecessary and nonstandard applications are undesirable because they tend to reduce motorists’ respect for the device and can cause confusion. Nonstandard applications require a considered response, rather than an automatic response and, over time, they will detract from the overall effectiveness of traffic control devices.

16.2.4 Construction Signs

Construction signs are included in the Basic Work Zone Traffic Control pay item in the Standard Specifications. The Standard Sheets adopt the MUTCD three sign advance warning series approach. Start with a general warning sign (upstream sign) about the existence of work activity (e.g., ROAD WORK) in advance of the work area. The second sign (intermediate sign) warns of the specific condition ahead (e.g., LEFT LANE CLOSED). The last sign (closest to the work area) advises the highway user what geometric or traffic control features will help them navigate the obstruction, such as a merge, shift, flagger or a traffic signal. The “A” distance shown on the appropriate Standard Sheet drawing is the distance from the obstruction to the nearest sign. The “B” distance is the distance from the nearest sign to the intermediate sign and the “C” distance is from the intermediate sign to the upstream sign. Values for the “A, B, and C” distances are obtained from Table NY6H-3 on Standard sheet 619-11. Sign texts and sizes are shown on the 619 Standard Sheets.

16.2.4.1 General

When choosing signs for work zones, the following should be considered:

- Choose signs that are appropriate and that accurately describe the roadway conditions. Avoid messages having only local meaning since it may not be clear to strangers.
• Choose the message on signs according to what action the driver needs to take.

• Use larger signs when greater visibility is desired, as with high speed or volume or on multilane roadways.

• Consider using smaller/square signs in narrow medians if larger signs will overhang the adjacent travel lane.

• Advance warning signs should not give general, repetitious warnings, e.g., ROAD WORK 1500 FT, ROAD WORK 1000 FT, ROAD WORK 500 FT. Repetition of general signs is a waste of money and causes drivers to pay less attention to them. The signs should describe the specific actions required by drivers.

• The message AHEAD, or an appropriate distance, is used on most warning signs as specified in the 619 Standard Sheets. Generally, AHEAD is used on roadways that have an operating speed less than 45 mph, and on side-street approaches to work zones. Advance posting of signs with an AHEAD distance is generally 200 feet. Numeric distances are used on all other roadways. The magnitude of the numeric distances selected via the Standard Sheets using Table NY6H-3 (1500 FT, 1 MILE, etc.) is based, primarily on the roadway type, with secondary emphasis on the operating speed and other prevailing conditions (geometry, type of work zone, etc.). Numeric distances and AHEAD should never be intermixed.

• Signing sequences for closely spaced highway work zones must not overlap or confuse drivers with conflicting messages. Traffic controls for these situations should be coordinated to present a logical sequence of messages to drivers as they pass from one zone to another. Where it is necessary to have work zones that are closely spaced, it may be advantageous to combine the separate work zones into a single work zone, which may then be shortened as the work is completed.

• The reference point for advance warning distance is typically the point of obstruction or the beginning of the work activity area and should be selected from the following:
  - The beginning of the transition area for a lane closure or lane shift or shoulder closure.
  - The work area for work beyond the shoulder.
  - The shadow vehicle location for short-duration or moving operations on the shoulder or in the lane where channelizing devices are not used.
  - The upstream end of the buffer space for temporary road closures.
  - The beginning of the realignment of the roadway for an on-site diversion.

• The overall effect of the signs should be to make drivers aware of what they are approaching, what action may be required, and the distance to where it is located.

The MUTCD and NYS Supplement describes several design qualities of fixed-message traffic signs that should be considered in the layout of a work zone traffic control plan.

Signs used to alert drivers to daytime or nighttime operations and provide information on road and ramp closures, must be designed to ensure legibility. Messages must be simple and concise so drivers can read them at prevailing operating speeds. Long or involved messages cannot be read.
and may distract drivers from other tasks. If it is necessary to provide messages more than a few words in length, they must be split between two or more signs placed at least 300 feet, preferably 500 feet apart. To ensure that drivers comprehend the total message, no intervening signs should be placed between the two, and the distance between the signs should not be extended such that the connection between the two is lost. Unneeded or inapplicable signs are distracting or misleading and must be completely covered or removed.

Signs should be positioned according to the following guidance:

- Locate signs where they are easily seen.
- Place signs so drivers have time to respond.
- Place signs on the right-hand side of the roadway. Supplemental signs may be placed on the left side.

Occasionally, it may be necessary to locate special first-warning signs farther upstream from the work zone than normal if hazardous conditions such as steep grades make the information useful or necessary at a particular location so a driver can take appropriate action. The presence of warning signs at the top of a mountain would warn truck drivers that they may encounter traffic congestion, and perhaps be required to stop at or before they reach the bottom. Such traffic control could include a truck turnaround or a mandatory stop to check brakes, if space is available.

Regulatory signs with black legends on white background are used in work zones to inform highway users of applicable traffic laws and regulations. The restrictions they impose must be legally established so they can be properly enforced. Refer to §16.4.6 of this chapter regarding work zone speed limit signing. State and local police should be consulted as a courtesy during the development of WZTC plans to address enforcement needs. Refer to the MUTCD Part 6 F and the NYS Supplement for guidance in the use, location, and spacing of work zone regulatory signs.

Project information signs (black legend on orange background) can be used to list work locations and dates, and to suggest alternate routes. To be legible at operating speeds, the messages on these signs should be restricted to no more than three lines of text, with no more than a few words per line.

Work zone guide signs are used to provide drivers with information that will guide them through a work zone, or bypass it altogether by detour, in a simple, direct manner. Guide signs in work zones should include, when necessary:

- Standard route markings where temporary route changes occur.
- Directional signs and street name signs.
- Special guide signs relating to the condition of work being done.

Refer to the MUTCD, Chapter 6F for guidance in the use, location, and spacing of work zone guide signs.
16.2.4.2 Warning Signs for Nighttime Construction and Daytime Operations that Remain in Place Overnight

Extra care is needed to ensure that warning signs are located properly and provide adequate visibility and legibility at night. Designers should apply the following guidance.

Location
Location of advance warning signs should consider exiting and entering traffic. It is generally not desirable to start a warning sign series upstream from a major exit or intersection, except when it is desirable to divert traffic off the route at that point. Advance warning signs should be double-posted (posted on both sides of the roadway) for stationary operations involving lane closures or lane shifts on freeways or expressways. Multilane, high-speed highways with narrow medians need not be double-posted if the posting of signs in the median is impractical.

Placement
Warning signs must be located to provide adequate visibility distance to drivers. They must not be blocked by foliage, roadway features, or other signs and traffic control devices, nor interfere with other signs or the arrow board, if used.

Visibility
The face of the sign shall be placed in a position to obtain the greatest benefit from the retroreflective characteristics of the sign.

In situations where the preferred sign stationing would result in the sign not being adequately visible under headlight illumination, provide artificial illumination to enhance visibility and legibility or relocate the sign to the closest station where it will be adequately visible. Larger sign sizes enhance sign legibility, especially at night.

Type B flashing, high-intensity warning lights should be considered to emphasize the presence and enhance the visibility of isolated warning signs where high-speed, free-flowing traffic raises concerns that drivers will fail to notice the advance warning signs.

16.2.5 Portable Variable-Message Signs

16.2.5.1 General
Portable variable-message signs are a standard specification pay item. PVMS can only be used as supplemental, temporary work zone warning devices and should be used in major active work zones. They have the flexibility to display messages which apply to the particular locations at which they are placed. The MUTCD allows the use of PVMS in highway work zones to supplement, but not replace, regulatory or warning signs. They may also be used in lieu of or to supplement guide signs. A PVMS should only be used where it will be more effective than standard signs used alone. PVMS are highly visible aids to traffic control and can be very effective when used appropriately. However, the effectiveness of these signs can be diminished if they are used too frequently or inappropriately. The “Variable Message Sign Guidelines” should be reviewed for additional information on the use of PVMS.
https://www.dot.ny.gov/divisions/operating/oom/transportation-systems/systems-optimization-section/ny-moves/documents
16.2.5.2 Choosing Whether to Use a PVMS in a Contract

The following factors should be considered before specifying the use of a PVMS in a contract:

**Variability**
- Would the various messages relayed by this sign make it cost-effective and/or improve safety more than an equivalent number of fixed-message, standard construction signs?
- Is “real time” information necessary?
- How often would the message be expected to change?

**Conspicuity**
- Can conspicuity be enhanced using a PVMS?
- Is the message a nonstandard or lengthy message? These can be more effectively read and understood by motorists when displayed via PVMS.

**Safety**
- The PVMS should ideally be shielded or placed outside the clear zone in a location where messages can be clearly read by drivers.
- If a PMVS is necessary on a contract but cannot reasonably be placed outside the clear zone, it should be delineated with retroreflective temporary traffic control devices. The designer should include a note to move the PVMS to a different location when not actively being used to display a message.

**Overriding Considerations**
- Are there any overriding considerations best met by use of a PVMS unit, even if other factors are not met? Such considerations include a need for improved conspicuity or emphasis, presence of workers in the roadway without barrier protection, speed-limit reductions, a new traffic pattern, warning of police enforcement, and other motorist awareness messages.

Designers should consult with the Regional Construction Group, Traffic Safety & Mobility Group, ITS Coordinator, and/or Transportation Management Center regarding PVMS use within their Regions. The Surface Transportation Controller or a representative from the Transportation Management Center and/or the Regional ITS Coordinator should be invited to the scoping and preconstruction meetings, and participate in all of the design process plan reviews to provide input on PVMS use on the contract. PVMS messages shall conform to the Department’s Variable Message Sign Guidelines, issued by the Office of Traffic Safety and Mobility at: https://www.dot.ny.gov/divisions/operating/oom/transportation-systems/systems-optimization-section/ny-moves/documents.
16.2.5.3 Selecting the Correct PVMS Pay Item

When it has been determined that PVMS are appropriate in association with a given project, the designer should select the pay item for PVMS, with consideration of the options desired, whether it is more appropriate to pay for the PVMS by the “each” or by the “week,” and what size and type PVMS is required.

A. PVMS Size and Type:

The Regional Construction Group, ITS Coordinator, and/or Transportation Management Center should be consulted when selecting the appropriate Size and Type of PVMS.

B. Pay Items - Options

1. X Option - Sensors (Refer to PVMS Pay Item Numbers under sections 619 and 729-16 Standard Specification)

   **Radar:** When PVMS is equipped with radar, the system has the ability to determine the speed of an approaching vehicle and interrupt the programmed message with an alternate message displaying the vehicle’s speed and a warning message. Radar equipped PVMS are required in all “major active work zones”.

   **CCTV Camera:** A camera unit mountable on the PVMS enables monitoring of traffic and/or weather conditions by recording live streaming video. It can also take snapshots of the vicinity. This option is required for all “significant projects” as defined in Section 16.5.2 unless otherwise indicated by the Regional Traffic Engineer.

2. Y Option - Communication (Refer to PVMS Pay Item Numbers under section 619 and 729-16 Standard Specification).

   The PVMS standard specification requires that PVMS units that will be remotely operated or monitored by the Department, typically from a Transportation Management Center (TMC), shall be equipped with communications and control systems that are National Transportation Communications for ITS Protocol (NTCIP) compliant. Designers should coordinate with the Regional Traffic Safety and Mobility Group to determine if the Department will need to remotely operate or monitor the PVMS for a given project.

   **No Cellular Communication.** This option shall be specified when the PVMS unit would not need to be remotely controlled through the entire contract or if there is no cellular reception in the area.

   **Communications without NTCIP:** This option shall be specified when it will not be necessary to remotely control or monitor the PVMS at any time during the execution of the contract, either from the field office or the TMC, or if there is no cellular reception in the area.

   **Cellular Communication with NTCIP.** This option shall be specified when PVMS will be remotely operated by the Department, typically from a TMC.

3. Choosing Pay Item Units – Each or Week
The designer may choose either “Each” or “Week”, whichever is most appropriate for the contract, taking into consideration how the PVMS will be needed. For example “Week” would be more appropriate if the PVMS is needed throughout the project life at multiple locations for short durations. There is no additional payment for relocation or reorientation of the PVMS. “Each” would be appropriate if the PVMS will be used continuously during a construction operation with a long duration. Under the “EACH” item the PVMS can be relocated or reoriented up to 4 times per year without any additional cost to the State.

16.2.5.4 Special Note for the Contract Proposal

For NTCIP-Compliant PVMS units that will be remotely operated or monitored by the Department, a Special Note must be included in the proposal that identifies which PVMS on the approved list are acceptable for the contract. This is necessary because not all devices on the Approved List are capable of communicating with every TMC. The Regional Traffic Group should be consulted to determine which PVMS can communicate with the Regional TMC.

If the PVMS is being included for specific use in the project, a Special Note shall be included in the contract proposal entitled “Requirements for PVMS. Additional notes that may need to be added could include the following:

- The approximate locations of the PVMS or the required sight distance along the approaches, if different from the distances noted in Section 729 of the Standard Specifications. (Note: All work on a contract, including the placement of a PVMS, must occur within the contract limits, though limits need not be contiguous or continuous. For distant locations, small areas approximating the PVMS location should be bounded by contract limits.)
- An estimate of the approximate dates and lengths of time the PVMS unit will be in use at each location, in weeks (when specifying by the week).
- Specific messages to be displayed or reference to the contract plans if the message is shown on the Traffic Control Plans.

A sample Special Note is shown in Exhibit 16-1
Exhibit 16-1  Special Note for Portable Variable Message Sign

The NTCIP compliant PVMS Listed below, which appear on the Approved List (https://www.dot.ny.gov/divisions/engineering/technical-services/technical-services-repository/alme/temptraf.html) are the only PVMS acceptable in this contract

<table>
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<tr>
<th>MANUFACTURER</th>
<th>MODEL</th>
<th>COMPLIANCE DATE</th>
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**Phase I**

**PVMS #1 ITEM 619.1105 XY**
**Location:** Eastbound Route 123, ½ mile (0.8 km) west of the start of the left lane closure.
**Duration:** This PVMS will be required for the duration of the project.
**Message:** The message to be displayed shall be as required by contract documents or as directed by the Engineer.

**PVMS #2 ITEM 619.1106 XY**
**Location:** Westbound Route 123, ½ mile (0.8 km) east of the start of the left lane closure.
**Duration:** This PVMS will be required for 2 weeks prior to the start of Phase1 and the first xx weeks of Phase 1.
**Message:** The message to be displayed shall be as required by contract documents or as directed by the Engineer.

**Phase II**

**PVMS #1 ITEM 619.1107 XY**
**Location:** Eastbound Route 123, ½ mile (0.8 km) west of the start of the Route 89 ramp.
**Duration:** This PVMS will be required for the duration of the project.
**Message:** The message to be displayed shall be as required by contract documents or as directed by the Engineer.
16.2.6 Arrow Panels (also referred to as Arrow Boards)

Flashing Arrow panels are included in the Basic Work Zone Traffic Control pay item in the Standard Specifications.

16.2.6.1 General

Arrow panels are trailer-mounted or truck-mounted, self-contained units which are very effective in making drivers aware of lane closures and the resultant need to change lanes.

An arrow panel consists of yellow lamps arranged in a pattern on the face of a nonreflective, rectangular black panel. The lamps are positioned to form displays for Left Arrow, Right Arrow, Left and Right Arrow, and Caution. Guidelines for the application, design, operation, and location of arrow panels are found in Part 6F in the MUTCD. Additional information may be found in the Standard Specifications §619 and 729.

A. Allowable and Prohibited Uses

- Arrow panels shall be used for lane closures on all multilane highways where the preconstruction posted speed limit is 40 mph or higher.
- Arrow panels should be used for lane closures on lower speed multilane highways if the project designer or the Engineer-In-Charge (EIC) determines that high traffic volumes or other considerations warrant their use.
- Only one flashing arrow display is to be used for each stationary lane closure, placed as close to the start of the lane closure taper as possible. A second arrow panel in an already closed lane may operate in the caution mode. Multiple truck mounted flashing arrows may be used in mobile lane closures.
- Arrow panels may be used for shoulder closures and lane shifts only when operating in the caution mode.
- Arrow panels shall be used for lane splits on multilane highways where the preconstruction posted speed limit or the operating speed is 45 mph or higher. For the purpose of this guidance, a lane split is defined as a splitting of travel lanes around a work area without a reduction in the number of available traffic lanes.
- To accomplish a center lane closure, the left or right lane should be closed first, using either a right arrow or a left arrow in the flashing mode, and the remaining lanes may then be split around the work area using a flashing, double-headed arrow.
- Arrow panels should always be used in combination with the appropriate signs, channelizers or other traffic control devices.
- Arrow panels shall not be used for lane shifts except for lane splits. Other devices are readily available for this purpose (e.g., warning signs, chevrons, flags, warning lights). For the purpose of this guidance, a lane shift is defined as a lateral shift in travel path without a reduction in the number of available traffic lanes.
- Arrow panels in the flashing arrow mode are not to be used as a warning device for shoulder work or for roadside work near the shoulder since no lane change is necessary. Vehicle warning lights, signs, and channelizing devices are more effective for these
situations and are the preferred treatment. An arrow panel in the caution mode is permitted as an option.

- **Arrow panels in the flashing arrow mode shall not be used on two-lane, two-way roadways, either in a driving lane or on the shoulder under any circumstances.** Such use may result in a head-on collision. An arrow panel in the caution mode, shown in the MUTCD Figure 6F-6, is permitted as an option.

**B. Location**

- Arrow panels should be positioned as close as practicable to the beginning of the lane closure taper (on the shoulder, if space permits), taking into consideration sight distance restrictions, shoulder widths, and other factors. A lane closure taper should not begin just before or just past the crest of a vertical curve or partially into or just beyond a horizontal curve.

- For mobile and short duration operations, an arrow panel should be mounted on the first upstream vehicle fully occupying a shoulder or travel lane to be encountered by traffic from the rear. If more than one travel lane is taken, an arrow panel should also be mounted on the first upstream vehicle fully occupying each additional travel lane that is closed.

- For mobile or short duration operations, an advance warning vehicle equipped with appropriate static signs, warning lights, and other devices may be positioned fully on the shoulder upstream of the arrow panel, *if traffic and roadway conditions so indicate.*

- For short duration operations located where the shoulder is too narrow for the advance warning vehicle, the appropriate static advance warning signs shall be placed upstream of the arrow panel and a barrier/shadow vehicle with an arrow panel will be positioned in the lane in which the work area is located.

- For short duration operations located where the shoulder is too narrow. A Type B flashing, high intensity warning light or a cone / drum placed at the base of the static sign(s) should be considered to enhance the visibility of advance warning signs where high-speed, free-flowing traffic raises concerns that drivers will fail to notice the sign(s).

**16.2.6.2 Arrow Panels for Nighttime Construction**

- Arrow panels are required for all nighttime lane closures on multilane highways, regardless of the traffic speed.

- The Standard Specifications require that arrow panel displays be adequately dimmed at night to avoid glare to approaching drivers.
16.2.7 Channelizing Devices

All channelizing devices except Type III construction barricades and interim tubular markers are included in the Standard Specifications Basic Work Zone Traffic Control. Type III construction barricades are a separate item. Interim tubular markers are used during two-way two lane operation (TWTLO) to separate opposing traffic and in areas of limited lateral space. Guide rails, curbs, and barriers are highway design features and are not considered to be traffic control channelizing devices (see §16.3 of this chapter).

16.2.7.1 General

The function of channelizing devices is to alert road users to conditions created by work activities in or near the roadway, to guide them through the work zone, and to help protect workers in highway work zones. Channelizing devices are used to provide a physical separation between the travel space and the work and buffer spaces, pedestrians, opposing traffic, and pavement drop-offs. Channelizing devices are also used to provide for safe, smooth, and gradual lane merges, lane shifts, bypasses and detours, and narrowing of lanes. Channelizing devices include cones (standard - 28 inches; tall - 36 inches; extra-tall - 42 inches), tubular markers (temporary; interim), vertical panels (standard - 24 inches min.; oversize - 36 inches min.), drums, and barricades. All work zone channeling devices shall be crashworthy. Refer to Part 6F of the MUTCD.

While channelizing devices cannot physically prevent intrusions, longitudinally placed devices are highly effective in providing positive guidance and in discouraging intrusions. Transverse devices provide re-enforcement to drivers of an area closed to traffic. The appropriate travel path for vehicles, pedestrians, and bicycles through the work zone should be clearly defined using channelizing devices and delineation treatments that are effective under varying light and weather conditions.

The most critical portion of the work zone in terms of the need for positive guidance is the transition area. Special attention should be given to the placement of devices in this part of the work zone. The use of channelizing devices in the transition area and through the work area should be consistent with the MUTCD and the 619 Standard Sheets. For long-term stationary projects, interim pavement markings of solid white and yellow edge lines should be placed along the edges of tapers and parallel to the channelizing devices and/or barriers in tangent sections to further enhance path delineation.
### Exhibit 16-2  Advantages and Disadvantages of Channelizing Devices

<table>
<thead>
<tr>
<th>Channelizing Device</th>
<th>Advantages</th>
<th>Disadvantages</th>
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| Cones               | • Are minor impedances to traffic flow.  
• Do not interfere with traffic flow.  
• Will not damage a vehicle when hit.  
• Are well recognized and understood.  
• Are easy to set up, take down, store, and transport.  | • Are not formidable.  
• Command minimal respect from drivers.  
• Are easily penetrated.  
• Are easily displaced and knocked over.  
• Are not self-restoring.  
• Provide little separation of traffic flow from adjacent areas being used for other purposes.  
• Cannot be attached to the pavement.  
• Have minimal target-value reflective sheeting.  |
| Tubular Markers     | • Are minor impedances to traffic flow.  
• Do not interfere with traffic flow.  
• Will not damage a vehicle when hit.  
• Are well recognized and understood.  
• Are easy to set up, take down, store, and transport.  
• Can be fastened to the pavement.  
• Can be made to be self-restoring when hit.  
• Smaller footprint  
• less target value  | • Are not formidable.  
• Command minimal respect from drivers.  
• Are easily penetrated.  
• Are easily displaced and knocked over.  
• Provide little separation of traffic flow from adjacent areas being used for other purposes.  
• Are not stackable.  
• Have minimal target-value reflective sheeting.  |
| Vertical Panels     | • Are very effective where available lateral spacing is limited.  
• Can be mounted on posts driven into embankment or within roadway edge excavations to delineate drop-offs, downed guide rail, etc.  
• Provide good target value.  
• Provide good portability.  | • Are easily penetrated.  
• Are easily displaced and knocked over.  
• Not visible from all approach angles.  |
| Drums               | • Are highly visible.  
• Give the appearance of being formidable objects.  
• Command the respect of drivers.  
• Have target value from all viewing angles.  | • May reduce roadway capacity if placed near traffic lane.  
• Prone to improper lighting attachment.  
• May cause poor sight distance at intersections, driveways, etc.  |
| Barricades          | • Appear as obstacles and create driver respect.  
• Provide good visibility with a large retroreflective area.  
• Are useful for pedestrian control.  
• Provide good supports for barricade lights.  | • May cause damage to an impacting vehicle.  
• Prone to improper lighting attachment.  
• May cause poor sight distance at intersections, driveways, etc.  |

Adapted from: Design & Operation of Work Zone Traffic Control
The type of channelizing devices used should be consistent throughout the work zone. Different devices should not be alternated or mixed, e.g., alternating drums and cones as this may confuse drivers. Exceptions to this are locations at gores, ramps, bumps/rebates and intersections as described in §16.2.7.2 of this chapter. At locations where lane or shoulder closures are protected by temporary concrete barrier, a taper of channelizing devices is placed upstream of the end of the barrier where the closure begins (see the Standard Sheets and the MUTCD, Figure 6H-5). The benefits of the taper are that it:

- Provides better delineation of the barrier end than treatments placed directly on the barrier itself.
- Moves traffic out of the closed lane upstream of the barrier end.
- Serves as a forgiving first alert to a driver deviating from the intended path.
- Creates a buffer space between the taper and the barrier end.
- Reduces the probability of vehicles striking the barrier end.

The MUTCD Part 6F contains detailed guidance in the application, design, location, and spacing of channelizing devices. Close device spacing, combined with the use of larger devices, discourages intrusions.

Close spacing of channelizing devices applies to all stationary work zones (day or night) where workers are exposed to traffic and the use of channelizing devices is appropriate, as described below.

- When used to close travel lanes at work sites where workers are exposed to traffic, the spacing of channelizing devices in tangent sections and tapers shall not exceed 40 feet. (Note: 40 feet is the standard broken lane-line spacing. See Exhibit 16-3.)
- The 40 foot maximum spacing should be maintained in tangent sections for a reasonable distance (minimum 500 feet for speeds <50 mph, 1000 feet for speeds greater than 50 mph) upstream of the work area. The 40 foot maximum spacing may be used throughout the work zone (see Exhibit 16-3).
- Where engineering judgment indicates a special need for closer device spacing, such as to reduce speeds or provide positive guidance to motorists in curved sections of the roadway, channelizing devices should be spaced 20 feet apart.
- When used to close travel lanes at work sites where no workers are present, the spacing of channelizing devices in tangent sections may be increased, not to exceed 80 feet.
- Tables 619-3A and 619-3B of the Standard Specifications detail which channelizing devices are appropriate for specific applications in short term stationary and intermediate/long term stationary work zones, respectively.
- Drums or vertical panels are to be used for intermediate and long term stationary work, daytime or nighttime lane-closure tapers, and at locations where the risk of intrusion is high.
- Vertical panels should be used only in locations where the panel faces will be clearly visible to all approaching traffic.
In long lane or shoulder closures, the Standard Specifications require at least two channelizing devices be placed transversely, at maximum 800 foot intervals, measured from the downstream end of the taper, to discourage traffic from driving through the closed lane (see Exhibit 16-3).

For paving operations on 2-lane, 2-way roadways, longer device spacings may be used where a pilot vehicle is used, or where setting and retrieving the additional devices does not provide any significant safety improvement, such as on roadways with low vehicle volumes, where the work area limits are visible to motorists, etc.

Where driveways or intersecting streets or crossovers are located within the work zone, drums or cones should be placed to adequately define their turning radii. A 6 foot spacing between channelizing devices should be adequate for most circumstances.

Type III construction barricades shall be used at all locations where a highway, bridge, ramp, or other segment of the roadway is closed to traffic.

Type III barricades may interfere with sight distance at ramps and intersections and roadway entrances because of their 5 foot height. Care must be taken to ensure that these devices are not placed where they will interfere with sight distance.

Drums should be provided to designate a change in grade such as a pavement rebate.
16.2.7.2 **Channelizing and Guiding Devices for Nighttime Construction**

Because of reduced visibility and the potential for the increased presence of impaired drivers, work zone intrusions are a higher risk at night. In addition to the guidance provided in §16.2.7.1, enhanced channelization and driver guidance is required to protect workers and the public from the consequences of vehicle intrusions into nighttime work areas. The following requirements modify Tables 619-3B of the Standard Specifications and are to be met for nighttime closures:

- Each series of channelizing devices shall begin with one drum equipped with a Type A, low-intensity flashing light. If the distance from the end of one series to the beginning of the next series exceeds 1/2 mile, the succeeding series must start with a drum and a flashing light.

- Tall cones may be used on nighttime closures except in tapers and only when marked with reflectorized tape in accordance with the MUTCD.

- At gores, ramps, and intersections where reduced spacing is used, channelizing devices are to be either drums or vertical panels.

- Type III barricades used to form roadway or ramp closures are to be equipped with flashing warning lights (either Type A or Type B). One light is to be provided on each barricade.

  Type A, flashing, low-intensity warning lights are excellent devices for directing driver attention to roadway hazards during the hours of darkness. They should not be used in a longitudinal series except as the first unit at the start of the lane-closure taper, shoulder closure, rebate, pavement drop-off, and other locations defining roadway hazards. Type B, flashing, high-intensity warning lights may be substituted where the device is left in place during daytime, and where additional emphasis is desirable.

- Flashing warning lights are not to be used on channelizing devices or traffic barrier in a longitudinal series along the path of traffic.

- Type C, steady-burning, low-intensity warning lights do not significantly enhance the visibility of reflectorized channelizing devices such as drums, vertical panels, or Type III barricades and should not be used on them.

  Type C, steady-burning, low-intensity warning lights provide useful delineation on nonreflectorized safety devices such as temporary concrete barrier, and they may be used as needed to delineate temporary concrete barrier or similar objects that are located close to travel lanes. Select the appropriate pay item(s) from the Standard Specifications 619-5 to provide warning lights on TCB.

16.2.7.3 **Delineators**

Delineators may be used, as provided in 6F of the MUTCD, to guide traffic through a work zone by indicating the horizontal alignment of the proper travel path. Elongated (3 inch x 6 inch minimum) delineators shall be used on freeways and interstate highways. They may be used on other
highways as allowed by Part 6F. They should be spaced sufficiently close to clearly indicate the proper vehicle path during darkness. They are not a substitute for reflectorization of channelizing devices or warning lights.

Temporary concrete barrier must be delineated to make it visible to traffic. Methods available for this are warning lights and delineators in accordance with the requirements of the Standard Specifications and the Standard Sheets.

16.2.7.4 Pavement Edge Drop-off Protection
The pavement edge drop-off protection requirements found in the Standard Specifications Section 619 are appropriate for the majority of Department construction projects. However, extremely high traffic volumes or extremely poor geometrics and/or sight distance may, in the judgment of the designer, require more protection than prescribed in the Standard Specifications. The designer is reminded to include appropriate details, pay items, and notes when modifying the prescribed drop-off protection treatment. Documentation for modifying the prescribed pavement edge drop-off protection treatment should be included when preparing the work zone traffic control plans for approval.

Where projects require guide rail replacement, resetting, or new installations and the work is not being shielded with temporary barrier, the contract documents shall state the maximum amount of time that will be permitted to restore the guide rail.

16.2.8 Pavement Markings
The Department’s policy for work zone pavement markings is consistent with the Department’s Pavement Marking Maintenance Policy, M. A. P. 1.7.1, concerning the requirements for year-round pavement markings

Pavement markings used in work zones must be the same color and style and convey the same message as final markings, except that broken lines installed as temporary pavement markings may be shortened to no less than 2 feet long.

Coding for work zone pavement markings should follow these guidelines:

- In general, on all highways under construction with opposing traffic, the pavement markings separating opposing traffic should be yellow, full-barrier markings indicating a no-passing zone.
- In general, on all highways under construction with two or more lanes of traffic in the same direction of travel, white lane lines should be used between adjacent lanes of same-direction travel.
- For one-lane, two-way, alternating flow operations, solid white edge lines shall be used as channelizing lines on both sides of the lane to direct traffic in either direction around the work area in accordance with the MUTCD.
16.2.8.1 Temporary Pavement Markings

Temporary pavement markings are a separate pay item in the *Standard Specifications*.

**A. Policy Statement**

*It is Department policy that before any interim or final course of pavement on any State highway under construction is opened to traffic, or by the end of the work shift on resurfacing or milling projects, temporary pavement markings complying with the requirements of this policy, the *Standard Specifications*, and the MUTCD must be in place. The MUTCD requires all no passing zones to be striped in accordance with Chapter 3 of the MUTCD, but also allows for 14 days or less signs to be placed in lieu of markings (R4-1, R4-2, W14-3, etc.).*

**B. Policy Summation**

The procedure and guidelines herein for applying pavement markings on new, reconstructed, resurfaced, or milled pavements is in full compliance with Federal guidelines. In consideration of continuity and liability, the procedures and guidelines shall apply to all Department work completed under contract regardless of funding source. While this policy is primarily worded for projects constructed by contract, its provisions should be applied to maintenance work with few, if any, modifications.

With the great diversity of projects that are affected, the highway work zone pavement marking policy allows for the application of various scenarios, depending on whether the final contract markings will be traffic paint or durable material, and whether the final pavement marking pattern can be determined prior to placement of the final course of pavement. See §16.2.8.2.

For projects where reconstruction may affect passing sight distance, thereby changing the location of passing zones, the policy provides for the application of temporary pavement markings before nightfall or the end of the work day, followed by the placement of the final markings after the Department codes the final marking pattern.

**C. Guidelines**

Temporary pavement markings are pavement markings that are placed for short periods not to exceed 14 days. They must be in place prior to opening new or reconstructed pavements or milled surfaces to traffic, or before nightfall on resurfacing projects or before morning or opening to traffic in the case of nighttime paving.

Temporary pavement markings should comply with the standards and guidelines in the MUTCD Section 6F, the Standard Specifications, and with the specific provisions described in this section.. Edge lines, stop lines, cross walks, letters, symbols, and other transverse or special-purpose markings are not required temporary pavement markings, except when: (1) in the designer’s judgment they are necessary, based on functional classification, urban or rural conditions, highway geometry, highway alignment (vertical and horizontal), traffic speeds and volumes, traffic signal locations, roadside hazards, construction phasing, drop-off protection, etc., or (2) the conditions described in §16.4.4.2.B.8 Pavement Markings, are encountered. When selected markings are required, those markings (or appropriate channelizing devices (drums, cones, etc.)) and appropriate signing shall be shown on the contract plans and included
in the contract documents. For information on the use of temporary pavement markings to help avoid motor vehicle encroachment into shoulders used by pedestrians and/or into bicyclist’s paths of travel, refer to sections 16.4.4.2.A.5 and 16.4.4.2.B.8.

The following summary provides guidance in the use of temporary pavement markings.

**Permitted Materials.** Materials permitted to be used for temporary pavement markings include traffic paint, removable tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers, as specified in the *Standard Specifications*. Traffic paint need not be removed before placing a subsequent course. Removable Tape, removable wet-night reflective tape, removable raised pavement markers and temporary overlay markers must be removed at no additional cost to the state before placing a subsequent course.

**C.1 Temporary Pavement Markings, Patterns, and Colors.** Temporary pavement markings, patterns, and colors shall be in accordance with the MUTCD as determined by the designer. The following pavement marking patterns shall be installed as temporary pavement markings:

- Yellow broken lines, partial barrier lines, and full-barrier lines as required by the MUTCD, used to separate opposing traffic flows on two-way roadways.
- White solid or broken lines to define lanes for traffic moving in the same direction on multilane highways.
- Other markings as determined by the designer and specified in the contract documents.
- Individual raised pavement markers spaced every 5 feet may be used as a substitute for solid markings. As a substitute for yellow, full-barrier markings, pairs of removable raised markers shall be placed side-by-side at the same 5 foot spacing to simulate a double line.

When deemed necessary, specify edge lines, gore channelizing markings, or certain transverse or special-purpose markings as temporary pavement markings. This may occur for instance, when paving a multilane, urban/suburban arterial in a major commercial area with double left-turn lanes, traffic signals, turn lanes that are slotted away from through lanes, etc. This can be especially important if motorists need to be in a particular position to actuate traffic detectors. The designer should consult with the Regional Traffic Engineer when conditions require special pavement markings.

All broken-line temporary pavement markings shall be a minimum of 2 feet long in 40 foot cycle lengths. Under special conditions, such as roadways with severe curvature, 2 foot long temporary markings in 20 foot cycle lengths may be used.

Temporary pavement markings should be 4 inches wide minimum. Raised removable markers 4 inches wide may be used to supplement or simulate 4 inch wide, temporary pavement markings.

**C.2 Temporary Pavement Markings Quantity Estimate.** The quantity estimated for temporary pavement markings cannot necessarily be derived from the quantity for the final pavement markings since passing may be prohibited during the construction phase where passing may be permitted afterwards. The estimate must include the quantities for each pavement course for the various stages or phases of construction.
16.2.8.2 Interim Pavement Markings

Interim pavement markings are a separate pay item in the *Standard Specifications*.

Interim pavement markings apply only to markings for temporary traffic patterns associated with construction activities for detours, temporary pavement realignments, median crossovers, lane shifts, and lane closures. It is recommended that interim pavement markings be removable pavement marking tape, and/or removable raised pavement markers. Traffic paint is allowed, but its use is discouraged due to its lower visibility, especially at night, and the need for reapplications. The recommendations below are provided to assist in the selection of the appropriate type of marking to fit various project situations and traffic needs.

Interim pavement markings are those that are in place for more than 14 days. Their widths should be either 4 inches or 6 inches to conform to the widths of the existing markings which they replace. Raised removable markers 4 inches wide may be used to supplement or simulate 4 inch wide, interim pavement markings and supplement 6 inch wide, interim pavement markings. Interim pavement markings may be used for other types of pavement markings such as channelizing lines, chevrons at gores, stop bars, crosswalks, etc. The pavement marking width for these marking types shall match the width of existing markings prior to construction.

A. Preformed Removable Pavement Marking Tape

Preformed, removable pavement marking tape is intended for use on pavement that is to remain in place without being overlaid after the temporary traffic pattern is removed, where scarring of the pavement surface would be objectionable, and where good visibility, both daytime and nighttime, is desired. A typical example of its use is for temporary traffic patterns at an angle to the permanent pattern where pavement marking removal scars crossing permanent lanes at an angle would create an unacceptable appearance on the finished pavement and confusion for traffic. These materials are relatively expensive, and may not adhere well to existing pavement if applied to dirty or dusty surfaces. They should be specified primarily in situations where easy removal with minimal scarring is essential. This material provides excellent durability, excellent daytime visibility, and good night visibility under dry conditions, but may be susceptible to snow plow damage.

B. Raised Removable Pavement Markers

Raised pavement markers are appropriate for use where extremely effective nighttime delineation (especially under rainy conditions) is important. Appropriate situations include lane closure and lane-shift tapers, median crossovers, and narrow roadways.

Interim pavement marking paint stripes, supplemented with raised markers, is an appropriate choice where excellent daytime visibility, as well as wet-night visibility is important. To enhance wet-night delineation on temporary traffic patterns striped with an optional pavement marking item, removable marking tape, or existing markings, supplemental raised pavement markers may be added. This is an especially good choice on curved or narrow alignments with lower design speeds than the adjoining highway sections.

If supplemental delineation is required during the winter, use of raised pavement markers is discouraged because they will be easily removed by snow plows. Alternative supplemental delineation, i.e., post-mounted delineators or other devices should be considered.
A decision of whether to replace raised markers in the spring should be based on the work zone requirements at that time, including duration of work remaining, traffic patterns, other markings and delineation devices present, etc.

Raised removable pavement markers shall not be used to simulate marking letters or symbols or transverse markings such as hatch lines, stop lines, or crosswalks.

16.2.8.3 Final Pavement Markings

Final pavement markings are a separate pay item in the Standard Specifications.

Final pavement markings will be the last pavement markings placed in accordance with the project’s final pavement marking pattern. They are intended to endure until the project receives either durable markings under the Regional durable marking contract, or subsequent restriping under the Region’s annual maintenance marking program. “Durable markings” refers to longitudinal epoxy, polyester, preformed, and thermoplastic pavement markings as described in the Department’s Pavement Marking Materials Guidelines: [https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau-repository/mp01-02.pdf](https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau-repository/mp01-02.pdf) “Durable transverse markings” and “durable special-purpose markings” refer to stop lines, letters, symbols, and other transverse or special purpose markings. These markings are typically placed using preformed tape, although other durable types may be used and included in contracts as needed, regardless of the type of longitudinal markings in the contract.

When traffic paint is used for temporary pavement markings on the top of final pavement course, it shall be installed in the exact location of the final pavement markings. When the final pavement markings are specified to be epoxy or polyester, these materials shall be applied directly over the temporary painted markings provided they consist of only a single layer of paint. If the temporary pavement markings are more than a single layer of paint, the pavement surface must be cleaned and prepared. Interim pavement markings may also be used on detours to provide permanent markings that will remain in place after the route is no longer used as a detour.

On all permanent pavement surfaces or final pavement courses, the final and complete pavement markings should be installed as soon as practicable. However, since the coding of the final pavement markings may not be known or established until after placement of the final pavement course, and because a limited number of projects receive durable pavement markings as a contract item, it may not be possible or necessary to install the final pavement markings prior to opening to traffic. In these situations, temporary pavement markings must be installed on final pavement courses.

Depending on the situation and contract provisions, one of the following cases and subsequent procedures should be followed.

Case 1 - Projects With Durable Longitudinal Markings

Before nightfall or the end of the work shift, temporary pavement markings which meet the requirements previously cited must be installed. As required by the Standard Specifications, Durable longitudinal markings must be installed within 14 days of the top course, or the remaining temporary pavement markings including edge lines, stop bars, and simple crosswalks shall be installed.
Case 2 - Projects With Painted Final Pavement Markings and Pattern is Known

Final pavement markings, excluding edge lines, must be installed by nightfall using traffic paint as indicated or designated for the center lines and lane lines. The final pavement markings including edge lines and all other specified markings must be installed within 14 days.

Case 3 - Projects With Painted Final Pavement Markings and Pattern is Unknown

Temporary pavement markings meeting the requirements previously cited, must be installed before nightfall or the end of the work day, except that only removable tape or removable raised pavement markers will be allowed as substitutes for final pavement markings, including edge lines, either of which must be offset from the final position of the durable markings to be subsequently placed.

It is the EIC’s responsibility to designate the final marking pattern within 7 days. Prior to the 14-day limit, the contractor must install the final pavement markings using traffic paints.

Case 4 - Region-Wide Durable Marking Contract With Removal of Existing Markings

The highway will be considered to be under construction, and the provisions for highway work zone pavement markings will apply. Since the provisions for temporary pavement markings allow a highway to be without edge lines for up to 14 days, any or all edge lines may be removed, with the provision that the new durable edge line markings will be in place within 14 days at any location where such lines were removed.

Any or all center lines and lane lines may be removed, with the provision that the new durable center line and lane line markings will be in place before nightfall or the end of the work day of the day of removal, at any location where such lines were removed. Should the new durable center line and lane line markings not be installed before nightfall or the end of the work day, temporary pavement markings meeting the requirements previously cited must be installed at no cost to the State, except that only removable tape or removable raised pavement markers will be allowed as substitutes for pavement markings, either of which must be offset from the final position of the durable markings.

16.2.9 Hand Signaling Devices and Warning Flags

Hand-signaling devices and warning flags are included in the Basic Work Zone Traffic control item in the Standard Specifications. Refer to the MUTCD 6.E and Standard sheets 619-60 and 61 for guidance on the proper application and location of flaggers and flagger stations.

Flaggers are used to stop traffic intermittently at work sites and to assign right of way, or to slow traffic as it passes the activity area to help protect the work crew. A flagger sign (W20-7) should be used to warn drivers that they are approaching a flagger station. While flagging is an acceptable method of traffic control, it should be used only when other methods of traffic control are not suitable or practical for the situation.

A flagger location that will provide as much advance sight distance as can reasonably be obtained should be selected. This is especially critical at crest vertical curves and horizontal curves where the flagger may have to be moved upstream to assure adequate sight distance for approaching traffic.
Since all traffic in the lane in which the work area is located will be slowed considerably or stopped before entering the transition area, a 100 foot (50 foot minimum) entry taper in a one-lane, two-way, flagger-controlled operation is acceptable, regardless of lane width.

The spacing of the channelizing devices should be 20 feet or less. The distance from the downstream end of the lane taper to the work space is the longitudinal buffer space (refer to Exhibit 16-4 in this chapter, Standard Sheet 619-61 and the MUTCD). It is acceptable to increase the buffer distance for downgrades in accordance with the criteria established for AASHTO stopping distances for various approach speeds.

Enhancement of flagger stations with supplemental traffic control devices (flag trees, cones, etc.) upstream of flagger locations has the potential to increase conspicuity and alert drivers that they are approaching a work site. These additional devices are very low in cost, and are easily deployed. The actual distance to these enhancements will vary to meet approach speeds and roadway conditions, and minor adjustments should be made as necessary to achieve the best results.

The use of one or two centerline cones immediately upstream of the flagger station is also an enhancement which should be considered on a project-by-project basis and selected for use based on good engineering judgment. Centerline cones may be omitted from roadways with narrow cross sections or in situations where drivers may be confused by the cones, causing them to move to their left into the opposing lane.
Exhibit 16-4 One-Lane, Two-Way Traffic Control Flagger Station Enhancement with Flag Tree and Cones

NOTE:
Placement of the flag tree should be at the edge of shoulder behind the channelizing devices.

W8-22
16.2.10 Temporary Traffic Signals

Temporary traffic signals are a separate pay item in the Standard Specifications.

Temporary traffic control signals are installed for a limited period of time to control road user movements through temporary traffic control zones. Typical work zone situations for which temporary traffic signals are used include temporary haul road crossings, temporary one-way operations along a two-lane, two-way highway, temporary one-way operations on bridges, reversible lanes, and intersections. Temporary signals are custom designed and are more able to accommodate project-specific needs such as driveways and pedestrians. Temporary signals can involve considerable design complexity and effort to address traffic needs. Designers should seek the advice of the Regional Traffic Engineer.

Temporary traffic signals must be located so motorists have sufficient time to see the signal and react safely. The design elements that should be considered for temporary traffic signal installations include number, size, mounting alternatives, physical arrangement, placement of the individual signal heads, signal timing, detection, and the accommodation of intersections and driveways.

Advance warning signs in accordance with Part 6F of the MUTCD and Standard Sheet 619-62 are required to ensure that the motorist is alerted to the presence of a work zone and traffic signal. Other traffic control devices, including regulatory, warning, and guide signs, pavement markings, and channelizing devices should be used to supplement temporary traffic control signals.

Temporary traffic control signals should be used only in situations where they are preferable over other means of traffic control, such as using flaggers to control one-way or crossing movements, using STOP (R1-1) or YIELD (R1-2) signs, or using warning devices alone.

Before using temporary traffic signals, the existing roadway and traffic conditions should be assessed. A survey should be made at the time of day when the work will be done. The following is a list of the minimum information that should be gathered:

- Identify locations for temporary traffic signals. Determine the distance between the proposed signal locations (area between the stop lines). The practical maximum length of activity area for one-way traffic signal control should not exceed 1/2 mile. Shorter lengths are desirable, especially if the activity area is on a roadway with limited sight distance and/or higher volumes would encourage red-light violations. Signal timing may also limit the length of the work zone.
- Check the locations for adequate visibility of the signals as motorists approach them. The signal locations will have to be adjusted if minimum sight distance guidelines are not met.
- Note the presence of intersecting streets and driveways. If the work zone limits include high-volume driveways and intersections with major routes, it may be necessary to include temporary traffic signals within the activity area to control the intersecting traffic, and interconnect them with existing traffic signals that may be located within or adjacent to the activity area.
- Record traffic conditions. Count the number of vehicles passing a stationary point during 4-minute intervals, the maximum reasonable wait time. This will be an indicator of how many vehicles would be expected to queue at the signal. Document if the flow is evenly split.
between the two lanes, or if it is uneven, favoring one direction over the other. Check these conditions at different times throughout the day.

- Document the speed at which motorists are approaching the proposed work zone. The speed on approach is an important factor in determining sight distance requirements.

The physical details that affect the driver’s ability to see and respond to the signal display are the minimum visibility requirements, number and location of signal faces, size and arrangement of signal indications, and illumination. Traffic signals should be visible to traffic approaching the signals at the decision sight distances given in the AASHTO “green book”. This requirement is particularly important where temporary traffic signals are used and motorists are not expecting the need to stop or slow down, for instance, due to a queue of several vehicles stopped at the signal. A three sign warning sign series consisting of a W20-1 ROAD WORK AHEAD, a W20-4 ONE LANE ROAD AHEAD, and a W3-3 signal ahead sign shall be installed at the proper distances given in Standard Sheets 619-62 and 619-11.

Methods that may be used to economically mount signal indications at restricted work zones are span-wire-mounted and post-mounted signals. There are several characteristics and advantages and disadvantages of each type of signal mounting that should be considered during the design and installation of temporary traffic signals. One advantage of the span-wire- mounted signals is that the overall conspicuity is greatly improved because the faces are directly in line with the motorist’s approach to the work zone.

Span-wire-mounted signals are more commonly used at restricted work zones, but post-mounted signals are also used. A potential problem associated with post-mounted signals located beside the roadway is that the visibility of the signal may be blocked by large trucks. The presence of signals on both sides of the roadway will ensure that approaching drivers see the red indication and do not attempt to pass. Furthermore, post-mounted signals located beyond vertical curves may not be high enough to be seen over the crest of a hill. In this case, special consideration must be given to the visibility of the signal. Stability is also a concern. Temporary traffic control signals mounted on fixed supports have better resistance to displacement or damage by severe weather, vehicle impact, and vandalism.

Motorists approaching a work zone must have adequate time to see and respond to work zone traffic control devices. The MUTCD requires that all traffic signals have at least two signal heads per approach. If any signal heads are located above a travel lane, the bottom of such a signal head must be at least 15.5 feet in height, but no greater than 17 feet above the road surface as per the Standard Sheets 680-7 and 680-8.

### 16.2.11 Portable Traffic Signals and AFADs

Portable traffic signals and/or Automated Flagger Assistance Devices (AFADs) may be proposed by the Contractor for use as a replacement for flaggers or to avoid delays associated with energizing a pole mounted temporary signal. They must conform to the *Standard Specifications*. The Department maintains an approved list of portable traffic signals and AFADs. Department guidance on AFADs prohibits use of the automatic setting and requires manual control by at least one flagger.

There are 2 types of AFADs, the first is an AFAD that is remotely controlled with a STOP/SLOW sign on either a trailer or a cart. The second type uses a remotely controlled red and yellow lens on a mechanically gated arm. The mechanically gated arm is required for the type 2 AFAD using the red and yellow lens. The gated arm may be added to the first type with the STOP/SLOW sign.
Use of portable signals requires the same design considerations as described above for temporary signals except for the design of the support system. The portable signal must meet the operational requirements of the application (phasing, detection, rest-in-red, etc.) and signal head location requirements in the MUTCD and provide optimal sight distance to approaching drivers. The trailer must be positioned to minimize the possibility of it being struck by an errant vehicle. If the Contractor proposes use of portable signals, adequate time must be provided for Department review of the proposed deployment. Multiple deployments may require multiple reviews which can be unduly burdensome to Department reviewers.

16.2.12 Truck-Mounted Variable Message Signs

Truck-Mounted Variable Message Signs are a separate standard specification pay item that can only be used in addition to static signs. This guidance is for contractor-owned, contractor-provided, Truck-Mounted Variable-Message Signs (TMVMS).

TMVMS are typically used on advance warning vehicles as temporary work zone warning devices and for lane and roadway closures. All work areas on roadways create unexpected conditions for motorists. However, mobile and short duration operations where work is present at a location for only a very short time (e.g., pothole patching, guide rail repair, sweeping, snow/ice removal, incident management) are particularly challenging to highway agencies tasked with ensuring safe and efficient travel approaching and passing these operations. TMVMS may also be appropriate for meeting queue warning requirements in Section 619 of the Standard Specifications.

Traditionally, temporary traffic control for mobile and short duration operations has been limited to arrow panel and static warning messages mounted to the back of the advance warning or protection vehicle for the operation. The use of stationary or ground mounted warning signs in advance of the work operation is usually not practical due to the nature of the work, which is typically continuously moving in a stop-and-go pattern, or of short duration. Additional information provided to drivers improves motorist compliance and reaction in these unexpected circumstances. Unfortunately, many of the established devices to be used for such purposes, specifically portable trailer-mounted variable message signs (PVMS), are not practical for application to mobile or very short duration activities, since the deployment of such equipment in the area of work would take as long as or longer than the operation itself. The use of TMVMS can provide enhanced safety to the motorists and work crews in these situations.

When a TMVMS is used as an arrow board, it should comply with chapter 16.2.6 - Arrow Boards Section and Section 729-15 of the Standard Specifications. A TMVMS should not be specified if its only anticipated use is as an arrow board. In this case, an arrow board should be specified.
16.3 SAFETY DEVICES AND BARRIERS

16.3.1 Temporary Traffic Barriers

Temporary barrier has several separate pay items in the Standard Specifications. The use of these items is explained below.

16.3.1.1 Temporary Positive Barrier Systems

The Department designed and began using Temporary Concrete Barrier in 1978. That generic design was the mainstay for several decades. Since the turn of the century, a variety of proprietary temporary barriers, both concrete and steel, have been developed to compete for use.

A. Traditional NYSDOT Temporary Concrete Barrier

Temporary concrete barrier (TCB) is similar in shape to the Jersey-shape permanent concrete median barrier. The main difference relates to the need to make the installation temporary. To accomplish this, the temporary units are cast with a flared base having holes to allow insertion of pins for anchorage. The ends of each unit include vertical steel tubes with a continuous vertical slot to accommodate a small built-up I-section that may be dropped into facing slots as a connection key. Units are cast with openings through the base to serve as drainage pockets.

The most common means of reducing deflection is to pin the TCB sections to the underlying roadway or bridge deck. To permit this, the units are provided with vertical holes through the outside portion of the barrier so that units can be pinned in place by steel anchor rods on alternate sides of the units.

In 2008, the Department sponsored MASH crash testing of a means of reducing deflection without requiring pinning of the TCB. The method consisted of bolting 12-foot box beam pieces along the back side of the TCB across the joints. This box-stiffened method may be used when there will only be traffic on one side of the barrier. The measure reduced the standard deflection from 39 inches free-standing (unpinned) down to 26 inches (box-beam-stiffened). At present, no other TCB system has been so tested and similar reductions for other systems must not be assumed without confirmation by crash testing.

Table 10-3 in Chapter 10 of this manual shows the standard (MASH TL-3 pickup) deflection for each case, free-standing, box-stiffened, and pinned. Details of the NYSDOT units, connection keys, and anchoring details are shown on the Standard Sheets for 619 series items. Also shown on the Standard Sheets are details of the tapered end sections.

B. Proprietary Temporary Concrete Barriers

Proprietary temporary concrete barrier systems are listed on the Approved Lists, along with “Materials Details” of the configuration that the Department approved.

C. Proprietary Temporary Steel Barriers

Several proprietary temporary steel barrier systems have been developed. Their main appeal is that their light weight permits a much longer length to be transported on a single truck. Additionally, if the barrier is needed on a bridge, the light weight may be an important factor if
the bridge’s load capacity is suspect. Unfortunately, the light weight of steel barriers means they will have large deflections unless pinned in place. This requirement prevents their use where pinning is not allowed.

D. Moveable Concrete Barrier

Moveable Concrete Barrier (MCB) may be appropriate as a special case of Temporary Positive Barrier. It is covered separately in Section 16.3.1.5.

16.3.1.2 Selection of Temporary Positive Barrier Categories

This section describes the process for temporary positive barrier item selection for various locations on a project. The use of temporary barriers on bridges should follow the guidance in the Bridge Manual.

The design process for temporary barrier (not on bridges) involves the following steps.

- Where that temporary positive barriers will be needed, identify zones having similar allowable deflections. Some runs may consist of only a single zone, if the allowable deflection will be similar throughout. In other cases, several zones may be needed as only parts of a run may have tight restrictions on deflection.

- Decide what the allowable deflection will be for each similar zone with similar posted speed limits. This involves consideration of several potential factors and requires engineering judgment. Some of the possible factors to consider are described in section 16.3.1.2.1.

- Decide whether or not pinning is acceptable. It may subsequently be determined that pinning is needed, even if it is undesirable. Pinning issues are described in section 16.3.1.2.2.

- Use the following table to determine the appropriate barrier Category Number to be used for the pay item selection:

<table>
<thead>
<tr>
<th>Design Deflection, inches</th>
<th>≥60</th>
<th>55</th>
<th>50</th>
<th>45</th>
<th>40</th>
<th>35</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>60</td>
<td>2/3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td>2/3</td>
<td>2/3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>40</td>
<td>4/5</td>
<td>2/3</td>
<td>2/3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td>4/5</td>
<td>4/5</td>
<td>4/5</td>
<td>2/3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>6/7</td>
<td>4/5</td>
<td>4/5</td>
<td>4/5</td>
<td>2/3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
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<td>6/7</td>
<td>6/7</td>
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<td>6/7</td>
<td>6/7</td>
<td>6/7</td>
<td>6/7</td>
</tr>
<tr>
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</tr>
<tr>
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<td>6/7</td>
<td>6/7</td>
<td>6/7</td>
<td>6/7</td>
<td>6/7</td>
</tr>
</tbody>
</table>

Categories 1, 3, and 5 should be used when pinning is prohibited.
Categories 2 and 4 should only be used when pinning is permitted.
Categories 6 and 7 require pinning.
As an example, assume the posted speed for the work zone is 50 mph, allowable deflection is 36 inches, and pinning will not be allowed.

a. Go across the table to the column for a posted speed of 50 mph.
b. Go down the Design Deflection column to find the first design deflection that will be less than 36 inches. For this case, select the row for 30 inches of deflection.
c. Where the row column and row intersect, find the Category Number(s) of the required temporary barrier system. Since pinning is not allowed, select Category Number 5.
d. Specify on the project plans and in the estimate that the 619.1715 item should be used for this zone.

During bid preparation and construction, the Contractor may choose and use any of the products which are configured as indicated on the Approved List for that item.

16.3.1.3 Acceptable Deflection

The amount of acceptable deflection involves a subjective risk assessment. The risk is primarily related to the threat posed by the moving barrier, rather than to the motorists in the impacting vehicle. The primary concerns are barriers sliding into or falling onto workers and barriers falling off bridges into traffic below. Guidance for Temporary Barriers on bridges should be in accordance with the Bridge Manual.

Where the concern is over the potential for barrier sliding into workers, the degree of risk will be affected by the frequency at which workers will be in a position to be struck by deflecting TCB, the number at a given time, and their ability to escape the moving barrier. As a worst case, several workers might need to spend an extended amount of time in a narrow space between a barrier and a large piece of equipment, formwork, or a drop-off. In that case, even if they had some warning that the barrier was being struck, they might not be able to safely escape the deflecting barrier.

For a culvert replacement project, risks could be high as several workers may be working in tight quarters below the barrier. In such a situation, if close to the excavation, the sections of barrier adjacent to the excavation should be pinned, while it would typically be acceptable to transition to unpinned barrier away from the excavation.

Much less risk would be involved if the work was a lane addition involving mostly heavy equipment and few situations where the workers would be near the barrier.

The least risk might be where barrier is used primarily for channelization of traffic being diverted across a median.

In all cases, the likelihood of an extreme deflection increases as the potential for impacts increases. Therefore, at higher traffic volumes, designers should consider using more restrictive limits on the acceptable deflections. Locally, the likelihood/frequency of an impact may be increased at abrupt changes in alignment and lane merges.

If the traffic will include an elevated number of heavy vehicles, a more conservative (smaller) value should be selected for the acceptable deflection.

However, the lower the acceptable deflection value is set, the more expensive the barrier system is likely to be and the greater the risk of injury to motorists will be. Therefore, designers should avoid
setting lower deflection limits than are needed. As a cost reference, for the five-year period prior to this writing, pinned TCB cost 50% more than unpinned TCB. The designer should summarize, for each zone of TCB, the factors that were considered most important to the judgment of what the acceptable deflection should be. This documentation should be retained in the design records.

16.3.1.4 Pinning Issues

(Guidance for pinning Temporary Positive Barriers on bridges should be in accordance with the Bridge Manual.)

Some of the temporary positive barriers require pinning to limit their deflection. The designer should determine if pinning into the surface where the barrier will be placed is acceptable. In general, if the pavement will subsequently be removed, pinning should be considered acceptable. If the surface is a new deck or new pavement, it is desirable to avoid pinning. On older pavements that will remain, pinning will be more acceptable if an overlay is planned.

Pinning temporary barriers to the pavement has several undesirable aspects. For new bridge decks, there is the risk that rebar will be severed when the holes for the pins are being drilled. There can be issues with differential wear of the pavement and the plug and issues with poor bond, water infiltration, and freeze-thaw cycling.

There is also a significant cost associated with drilling the holes in the pavement, placing the pins, capping the ends and then the eventual removal of the pins and repairing the holes made in the pavement. Any holes made for pinning are to be filled after TCB removal in accordance with the provisions of section 619-3.12 of the Standard Specifications.

If pinning is needed, it is desirable for the construction sequence to limit it to pavement that will subsequently be removed or to delay placing the top course until after the pins have been removed and their holes plugged.

If a standard TL-3 deflection of 70" is acceptable, pinning should be unnecessary and is therefore not permitted. If a deflection of only 10" or less is required, pinning will be required, except for very low-speed locations.

Even for unpinned runs of temporary concrete barrier, the end segments on the run will usually need to be pinned with a minimum of four pins. However, rather than relying on pinning for anchorage of the ends of the run, the mass of segments outside of the points of need may provide sufficient inertial anchorage. The minimum length of barrier required to provide inertial anchorage varies with the posted speed as follows:

- 30 mph 20 feet
- 40 mph 40 feet
- 50 mph 70 feet
- 60 mph 100 feet

Wherever a transition is made from unpinned temporary concrete barrier to pinned temporary concrete barrier, one segment of TCB should be pinned with two pins to provide a gradual
transition from an unfixed barrier to a fixed barrier. This requirement includes the pinned ends of otherwise unpinned runs of TCB. The designer should include measurement of these partially pinned segments in the quantity of pinned barrier for the project. Where the ends of a run of unpinned TCB require pinning, the designer should ensure that the estimate and proposal cover that need for pinned TCB.

16.3.1.5 Treatment of Leading Ends of Temporary Barrier

Temporary barriers are intended to have limited deflection. Therefore, if the angle and speed at which they may be struck are large, the passenger decelerations may be severe. To reduce that potential, the angles at which barriers are flared away from the traveled way should be kept relatively low. Impact angles will be smaller if the barrier flare rate is flatter, i.e. 1:20 instead of 1:8. Where exposed to errant vehicles, approach ends of TCBs should be flared away from the road at the rates not exceeding those shown in Table 619-4 on Standard Sheet 619-11 (also Table 619-5 in the Standard Specifications) In some situations, the proximity of driveways or other features may make the use of more abrupt flares necessary.

Barrier flares shall be preceded by a taper of channelizing devices for a distance “L” from the start of the taper, using the taper rate given in Table 6H-4 on Standard Sheet 619-11. Where possible, the channelizing device taper should be followed by a tangent section of channelizing devices for a minimum distance equal to the longitudinal buffer distance in Table 6C-2 on the Standard Sheets.

Where practical, the full height approach ends should be embedded into a back slope or started behind an existing barrier and beyond its deflection distance. (Consideration may be given to temporarily reducing the deflection of the existing rail system by the placement of additional back-up posts up to the spacing limits shown in Table 10-3 in Chapter 10 of this manual.) If approach ends cannot practically be embedded, shielded by sand barrel arrays, or carried beyond the clear zone, the ends must be suitably treated. Impact attenuators should be provided if (1) the anticipated operating speeds are 45 mph or greater, (2) the ends cannot be conveniently embedded or shielded, and (3) the ends are closer than 12 feet to approaching traffic lanes. Where sand barrel arrays are used for shielding and traffic will only be on one side of the array, the barrels on the traffic side of the array should be in a straight line to minimize the potential for errant vehicle to crash directly into one of the heavily loaded barrels in the back of the array without first impacting the lighter barrels in front.

If the first full-height section of temporary positive barrier will be 12 feet or more removed from approaching traffic lanes or if the anticipated operations speeds will be less than 45 mph, a tapered (ramped) end section may be used where embedment or shielding is not practical. Impact attenuators may be warranted for ends over 12 feet from traffic in areas where sharp curves, short sight distances, high-volume weaves, merges, or other traffic conflict situations increase the possibility of vehicles leaving the traveled way.

Rapid changes in horizontal or vertical alignment cannot be accommodated by temporary barrier connections. In most locations, there is a significant drop beyond the shoulder, making it necessary to place fill, which could be a significant amount, to run the end of the temporary barrier outside the construction clear zone. The only practical option is to protect or shield the ends of the barrier. At locations where the likelihood of collisions is low or where a vehicle has adequate opportunity to slow significantly before reaching the tapered end section, engineering judgment
should be used to determine what level of protection is necessary and how best to provide that protection.

In certain circumstances, such as rural bridge re-decking jobs where traffic is maintained parallel to the direction of travel, and driveways or intersections are immediately upstream from the bridge, it may not be possible to use the desired flare rates for the temporary barrier, or even to adequately bury or extend the lead end of the barrier. If it is judged that temporary barrier is needed to protect the workers, then the temporary barrier on the tapered approach should be placed on as gradual a flare as possible to minimize the severity of impact for errant vehicles.

Other alternatives available for consideration include

- Attenuators or sand barrel arrays
- Movable concrete barrier (since it can be flared on a shorter radius than typical temporary barrier)
- Temporary barrier with a flared approach
- An attenuator with a proprietary movable barrier gate to protect the opening
- Vehicle-arresting barriers

Temporary positive barrier alignments at or near right-angle alignments to the roadway should not be used unless none of the other alternatives are appropriate.

On projects where it is necessary to close a bridge to complete the work, worker protection should be provided, even though the approach highway is closed to through traffic. Under the best circumstances where adequate space is available, the approach to the bridge should be closed with Type III barricades and the proper advanced warning and regulatory signs, in accordance with the MUTCD and the Standard Sheets. In situations where the available space is not suitable, a vehicle-arresting barrier should be installed. (Refer to 16.3.2.)

When flaring temporary barrier on approaches, the barrier may come close to an existing run of guide rail. This is very typical on bridge projects, especially in urban areas. The requirements to get the end of the barrier 12 feet removed from traffic may put the tapered-down end section in a location where an errant vehicle that hits the existing guide rail upstream could be led along the rail and right into the end of the TCB. In those cases, the guide rail should instead be fastened to the face of the TCB as a first preference. Details for connecting box beam guide rail to TCB are shown on the 619 Standard Sheets. If that is not possible, temporary impact attenuators should be specified.

16.3.1.6 Moveable Concrete Barrier

Moveable concrete barrier is a PIN-approved item. The designer must obtain approval from the Office of Construction and subsequently from the Design Quality Assurance Bureau to use it on a project. Barrier and the custom-designed vehicle to move it are typically rented from the vendor.

Moveable concrete barrier (MCB) is used on construction projects in congested areas to provide additional traffic lanes to accommodate both AM and PM peak-hour traffic. It is also used to
provide a safe means of expanding the contractor's work area and the opportunity to stage projects in a more effective manner.

Advantages of using MCB on congested construction projects include the following:

- Construction workers in temporary lane closures are protected behind positive physical barriers.
- Errant vehicles are better prevented from intruding into work zones.
- Routine and repetitive lane closures can be accomplished quicker than by using typical channelizing devices or barrier and without exposing workers to traffic.
- Congestion and air quality impacts can be reduced during construction by opening travel lanes during peak traffic times.
- The Contractor’s lane rental costs and/or construction schedule duration may be significantly reduced, in which case, the cost savings should be factored into lane rental charges.

Refer to Chapter 10, §10.2.4.9 of this manual for further information on and additional advantages and disadvantages of MCB.

Generally, during preliminary design, TCPs have not been progressed to the extent that an adequate assessment of the appropriateness of MCB can be made. Nevertheless, enough data should be available at this point to allow for a screening to be done to make an initial determination as to the use of MCB. The answers to the following questions will help the designer determine if the use of MCB should be considered during detail design:

**Preliminary Design Phases I-IV**

**Need 1**: Is there a need during the peak hour(s) to restore to use a lane or shoulder that is closed?

**Need 2**: Is there a need to alter the lane configuration to improve directional traffic flow in the peak direction?

If the answer to both questions is “no”, then MCB is not needed. This should be documented in the design approval document (DAD). If the answer to either (or both) question(s) is “yes”, the next question is:

**Need 3**: Is positive protection of the work zone warranted?

If the answer is “no”, then MCB is not needed. If the answer is “yes”, the designer should document in the DAD that further analysis to determine the appropriateness of MCB will be done during detail design. MCB is a high-cost item that requires special design considerations and should be used only when necessary. If the needs screening indicates it is needed, an analysis should be done as early in the project design as possible to validate its use. Documentation of the need for that analysis in the DAD is considered appropriate.
Detail Design Phases V and VI

As traffic control concepts are further progressed on projects where the DAD indicates that MCB should be considered, additional analysis should be conducted to determine whether MCB should be utilized on the project and the answers to the three questions should be confirmed. Questions to be considered when performing this analysis should include, but are not necessarily limited to the following:

- Can traffic operations be improved, in terms of safety, with the use of MCB compared to other barrier types?
- Is positive protection of the work zone warranted? (This may be critical for projects which include nighttime construction.)
- Can traffic flow be improved without adversely impacting construction scheduling or quality?
- Will there be frequent, short-term stationary or nighttime lane closures where MCB will provide the optimal protection to traffic and workers without permanently closing the lane?
- How many lanes is it permissible to close? (Roadways where only single-lane closures are permitted would likely require positive barrier separation for safety reasons.
- Is the nature of the work conducive to using MCB?
- Is daily contraflow or reversible operation proposed?
- Is there a need to restore closed lane(s) or shoulder to traffic during peak traffic periods?
- Can construction be expedited or quality improved or productivity increased while maintaining a minimum level of acceptable traffic performance?
- Are the benefits in terms of reduced delay worth the extra cost and can the project budget absorb the increase in cost that may result from the use of MCB? (If MCB is determined to be appropriate for safety reasons, the project budget should be adjusted to accommodate it.
- How will delivery and storage of materials and equipment be facilitated?
- Can additional activity area be gained during off-peak hours and substantially reduce construction time?
- Can restaging of work be kept to a minimum?

When developing the WZTC plan, the use of MCB should be limited to projects where a greater benefit can be attained than if standard methods and equipment were used. Listed below are types of projects for which MCB may be a viable option.

- Widening or reconstruction projects on arterials or expressways with high peak-hour traffic volumes, e.g., peak directional traffic operating at or near capacity (level of service E or F) during peak periods and/or is expected to exhibit unacceptable (as determined by the Region) levels of congestion during construction.
- Projects where a reversible traffic lane would be beneficial during peak traffic periods and which would allow for better staging. This has been effective in median reconstruction and has also been used successfully on the reconstruction of parallel structures by increasing the capacity of one structure while closing down the other.
• Projects where the size of the construction work zone is very restricted. Significant construction quality, efficiency, and time savings may be obtained by widening the work area during off-peak periods and night work. MCB may help a contractor reduce lane rental costs.

• Projects on which traffic must be managed on site due to insufficient excess capacity or other operational deficiencies on alternate routes.

The cost-effectiveness of MCB as a traffic management tool should be evaluated by comparing the expected benefits to the cost of obtaining and operating the MCB system. The economic benefit of reduced delay and enhanced construction efficiency (reduced costs) need to be estimated. The QuickZone computer program is an analytical tool to help with this analysis. It was developed by FHWA to evaluate work zone capacity and delay cost.

Safety benefits, construction quality benefits, and public relations benefits are more intangible but should be considered. Assess the potential for severe traffic accidents in lane closures without concrete barrier, which could be prevented or reduced in severity by a barrier, by considering the proximity of traffic to workers and equipment, presence of edge drop-offs, and experience with similar construction projects.

For Consultant-designed projects, the preparation of the technical assessment should be made part of the consultant scope of work for appropriate projects.

If MCB is selected for use on any project operation, the WZTC plans should detail where and when it is to be used and the appropriate pay items should be included in the contract documents.

16.3.1.7 Delineation of Temporary Positive Barriers

Temporary barriers often direct traffic on abnormal paths. Under the best circumstances, they may be merely a fixed object in much closer proximity to motorists than normal. When such zones must be negotiated at night or under rainy conditions, it is important that their presence and path be clearly indicated to motorists. As specified in Section 619-3.12 of the Standard Specifications, Temporary Positive Barriers should be delineated with reflective panels (Section 619-2.12) or Warning Lights. Where Temporary Positive Barriers will be close to traffic, the delineation guidance in Section 16.2.7.2 should be followed. In general, flashing lights may be appropriate at the beginning of a run of TCB, but should not be used along the length of the run. Type C Steady Burn lights may be used along the length. They may be more appropriate on significantly curved sections. Designers should indicate where warning lights are required.

16.3.2 Vehicle-Arresting Barrier (Net-Type)

Vehicle-arresting barriers (VAB) (net-type) are used at highway construction work zones to prevent errant vehicles from entering work areas and causing injury and damage. They have proven effective in restraining vehicles ranging from motorcycles to 40,000 pound trucks. Once a vehicle is caught in the net, it is safely brought from highway speed to a full stop by the release, at a predetermined resistance, of restraining cables on the net. The deceleration rate and final distance traveled before coming to a full stop can be determined from the design formulas below and should be shown on the plans. Vehicles can be stopped with a relatively low “G” force.
These devices protect against vehicles breaching road or ramp closures. Consideration should be given to including VAB in the WZTC plans (or by order-on-contract when work is initiated after the letting) at any locations where there is a concern that drivers will enter the closed roadway. The following points are to be addressed if VABs are used.

- VAB locations are to be shown in the WZTC plans.
- Type III barricades, with flashing warning lights, and appropriate ROAD/RAMP CLOSED (R11-2) signs, must be provided in front of the VAB.
- Where the net is located some distance beyond the closure, a secondary set of Type III barricades should be placed immediately in front of the net to alert construction traffic and any drivers who circumvent the primary closure.
- Adequate stopping distance free of all objects and vehicles must be provided beyond the VAB. See below for information on computing the required stopping distance.
- Consideration should be given to providing access for construction vehicles and other official traffic to enter the closed roadway.
- When there is a concern that drivers will deliberately try to enter the closed roadway by driving around the net, stationing a watchperson or police officer in a vehicle at the entry point should be considered. The vehicle should be equipped with appropriate warning lights and positioned where it is visible to approaching traffic, but in a location where it is not at risk of being struck. The watchperson should be equipped with a radio to alert the work area of any vehicle intrusions.

The vehicle-arresting barrier (VAB) is approved by the FHWA for use on federal-aid projects.

16.3.2.1 Guidelines for the Use of Vehicle-Arresting Barriers (Net-Type)

A VAB (net-type) may be considered for use at locations where one or more of the following situations exist:

- Vehicle encroachment into the work area would result in a probable injury to either workers or vehicle occupants or both. A good example is a bridge removal and replacement project at the bottom of a long downgrade where motorists are more likely to lose control of their vehicles.
- Vehicle encroachment into the work area would be at high speed, usually not requiring any turning movements to enter the work area. A good example is a full closure of a high volume expressway, where contractor operations extend over a long period of time, but the roadway must be reopened daily to traffic.
- Past accident and operational history indicates that conventional equipment, such as Type III Barricades, temporary concrete barrier, and safety fences, are unable to prevent errant vehicles from entering the work area, or are otherwise unsuitable for a particular site.
- For off-peak or night work where the roadway is closed intermittently over a period of days or weeks. A VAB (net-type) can be assembled or disassembled in just 15 minutes once the concrete anchors are installed.
- Errant vehicles must be brought to a full stop so as not to enter the work area.
A VAB (net-type) should not be used for the following situations.

- Where the stopping distance beyond the VAB is inadequate.
- For single-lane closures of multilane roadways.
- Where workers will not be available to periodically check the condition of the various components unless specified in the contract documents.
- Where less costly and less maintenance-intensive conventional equipment could effectively be utilized without sacrificing the safety of the workers or vehicle occupants.

VABs should be used in conjunction with Type III barricades, plastic drums, adequate signing, etc., to alert motorists of a roadway closure. In addition, the anchor posts should be shielded from impact, by an impact attenuator.

Disadvantages of a VAB (net type) are:

- The units are subject to vandalism or theft.
- After each impact, maintenance is required which consists of:
  - Minor impact - replace the tape assembly.
  - Severe impact - replace most components.
- The contractor must be notified quickly to provide maintenance after each impact since the system has no second-hit capability. A battery-powered electronic device to notify the contractor in the event of an impact or vandalism is available from the supplier at extra cost.

16.3.2.2 Design Computations for Vehicle-Arresting Barrier

\[
\begin{align*}
L &= \text{length of net (metal bender to metal bender), ft.} \\
X &= \text{travel distance of vehicle after engaging net, ft.} \\
W &= \text{weight of vehicle, kg (assume 1800 LB and 4500 LB).} \\
V &= \text{initial velocity of vehicle, m/sec. (assume 88 ft/sec.).} \\
T &= \text{metal bender (energy absorber) taped tension force, LB (see available energy absorbers below).} \\
g &= \text{acceleration due to gravity, 32.2 ft/sec}^2. \\
F &= \text{maximum vehicle stopping force, LB.} \\
G_{\text{max}} &= \text{maximum G force on vehicle, LB.} \\
G_{\text{avg}} &= \text{average G force on vehicle, LB.} \\
R &= \text{runout of metal bender (energy absorber) tape, ft.}
\end{align*}
\]
The following manufacturer’s design formulas should be computed in the order shown to obtain the travel distance \( X \) after engaging the net, and the deceleration rate \( G_{avg} \) for the system chosen.

1. \( R = \frac{WV^2}{4Tg} \)

2. \( X = \left( R^2 + RL \right)^{\frac{1}{2}} \)

3. \( F = \frac{2TX}{R + \left( L/2 \right)} \)

4. \( G_{max} = \frac{F}{W} \)

5. \( G_{avg} = \frac{V^2}{2gx} \)

### AVAILABLE ENERGY ABSORBERS

<table>
<thead>
<tr>
<th>Tension (T)</th>
<th>Runout Tape (R)</th>
<th>Usual Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>4500 LB</td>
<td>75 ft</td>
<td>Usual Case, Average Vehicle Mix</td>
</tr>
<tr>
<td>4500 LB</td>
<td>200 ft</td>
<td>High Percentage of Heavy Trucks</td>
</tr>
</tbody>
</table>

Deceleration rates \( G_{avg} \) should be limited to 3 to 6 Gs, when feasible, but in no case should the deceleration rate exceed 10 Gs.

### 16.3.3 Shadow Vehicles and Barrier Vehicles

Shadow and Barrier vehicles are included in the Basic Work Zone Traffic Control item.

A shadow vehicle is an occupied vehicle equipped with a truck-mounted impact attenuator located a short distance upstream from a mobile lane or shoulder closure area where workers are not protected by traffic barriers, barricades, channelizing devices, or flag persons. Mobile work zones typically do not have barrier or channelizing devices.

For maintenance-type mobile operations, an advance warning vehicle may be used as the first vehicle on the shoulder when it is impractical to install ground-mounted signing. A pickup truck with an arrow panel or sign is often used, however, it may not be used in a travel lane as a shadow vehicle.

A barrier vehicle is an unoccupied vehicle equipped with an impact attenuator and parked a short distance upstream from a short duration or stationary lane or shoulder work area (refer to the Standard Sheets). Barrier vehicles protect motorists and workers in stationary work areas that occur on or adjacent to the highway, except when they are protected by temporary concrete barriers or vehicle arresting barriers.
Barrier vehicles may also be used to protect motorists from work area hazards when there are no workers to be exposed to moving traffic adjacent to the work area. If there would be less damage or serious injury resulting from an errant vehicle impact with the barrier vehicle than with a work area hazard, a barrier vehicle may be considered. If, however, it can be shown that the presence of a barrier vehicle would produce greater damage or injury, then it should not be specified.

A shadow/barrier vehicle should be located in each of the lane(s) and/or shoulder in which the work area is located. This information should be shown on the plans. Standard Sheet 619-11 (Table NY1-A) details the requirements for use of a barrier vehicle for stationary lane closures. Table NY1-B details the requirements for shadow vehicles for mobile lane closures. Standard Sheet 619-11 also identifies placement (roll-ahead) distances for barrier vehicles (Table NY2-A) and shadow vehicles (Table NY2-B) which prescribe positioning the vehicle far enough upstream of the work to minimize the potential for the vehicle to be pushed into workers or equipment when it is impacted from behind. They should be at the downstream end of any buffer space (refer to the Standard Sheets, Table 6C-2).

Shadow or barrier vehicles located (moving or parked) in a travel lane or shoulder upstream of the work area shall be equipped with arrow panels, rotating beacons, and impact attenuators. Variable message signs may also be used where specially worded guidance to the motorist is needed.

Shadow vehicles used in moving operations not protected by channelizing devices must be equipped with operational arrow panels in the appropriate flashing arrow mode (see the MUTCD). The arrow panel on the first shadow vehicle should be operated in the flashing arrow mode if it is located at the beginning of the lane closure.

The arrow panels on barrier vehicles used in closed lanes defined by channelizing devices downstream of the taper must not be operated in the flashing arrow mode but may be operated in the flashing caution mode, or be turned off.

Where the posted speed limit is 55 mph or less, barrier vehicles shall be equipped with NCHRP Test Level-2, truck-mounted impact attenuators. Where the posted speed limit is greater than 55 mph, barrier vehicles shall be equipped with Test Level-3, truck-mounted impact attenuators.

While Standard Sheet 619-11 generally governs use of shadow/barrier vehicles, site specific conditions not addressed by the Standard Sheet may warrant a shadow or barrier vehicle. The following items should be considered:

- Type of work operation.
- Special hazards.
- Traffic speed and volumes.
- Traffic patterns (turns, merges/diverges, weaves, etc.).
- Roadway geometry including approach sight distance.
- Type of separation device between traffic and the work area.
- Lateral separation between traffic and the work area.

When determined by the designer to be necessary for the project, shadow and barrier vehicles should be shown or called for in the contract documents.


16.3.4 Temporary Impact Attenuators

Temporary (construction) impact attenuators have been developed specifically to shield TCB end sections and other rigid objects in construction zones. The attenuators currently approved for general use are listed in the Materials Bureau’s Approved List for Materials and Equipment. The selection of the manufacturer and model of a temporary impact attenuator shall be at the Contractor’s option, provided the attenuator supplied is of the type indicated, gating or redirective, shields the hazard; and fits in the location without encroachment into travel lanes or required offsets.

A truck/trailer mounted impact attenuator (TMIA) is a safety device used for short duration or mobile operation work. A TMIA is an energy-absorbing device attached to the rear of a truck (shadow vehicle) used as protective vehicle. It serves as a temporary barrier when placed between live traffic and a work area on highways that must remain open to traffic during repairs or incidents. These devices are designed to protect the motorist, workers, equipment, material, and to protect the vehicle driver upon impact.

Where the posted speed limit is 45 mph or less, the TL-2 attenuators on the Approved List may be used. Where the posted speed limit is 50 mph or greater, the impact attenuator shall be one on the TL-3 Approved List.

16.3.5 Temporary Sand Barrel Arrays

Sand barrels are arranged in arrays designed to gradually transfer the momentum of an impacting vehicle to the sand. Lighter barrels are placed near the front of the arrays to gradually slow small vehicles. Heavier barrels are placed farther back in the array to slow the larger passenger vehicles.

Refer to Chapter 10 of this manual for additional guidance on sand barrel arrays.

16.3.6 Temporary Rumble Strips

Temporary rumble strips are included in the Standard Specifications as a separate pay item. The specification allows the use of raised asphalt strips, recessed saw-cut or milled-in strips, raised preformed strips, and strips formed from layers of pavement marking masking tape.

Temporary rumble strips are placed transversely across a travel lane in accordance with the Standard Specifications to alert motorists to the presence of workers. Because they are intended as a temporary measure, rumble strips should only be used on pavement that will subsequently be overlaid, removed, or replaced, or can be otherwise restored to an acceptable condition.

Rumble strips formed from pavement-marking tape provide optimal performance when multiple layers of tape, preferably four, are placed directly on top of one another. These strips create the right level of noise and can be felt inside a vehicle without causing a jarring effect. By providing audible and tactile warnings, rumble strips can be effective in drawing a driver’s attention to traffic control devices or potential hazards that unfamiliar drivers may not see. This effect is especially helpful in situations where drivers have been mesmerized by traveling long distances on an unrestricted roadway, and then suddenly encounter a construction work zone with roadway width and alignment restrictions, exposed workers, and potential conflicts with slowing traffic and construction activities. Even if the rumble strips do not achieve a speed reduction, alerting drivers to the change in roadway character should reduce accident potential.

EB 20-040 L. 01/01/2021 §16.3 SAFETY DEVICES AND BARRIERS
16.3.6.1 Criteria for Use

Warning signs are provided to inform drivers when they are approaching disruptions to the normal travel pattern. Rumble strips, when used, should be placed upstream from the first advance warning sign in the series on long-duration projects, such that drivers are alerted in time to see and read the signs.

Alternative and supplemental means for alerting inattentive drivers should be considered, including the use of oversize signs or variable-message display units, the use of warning lights and/or flags to draw attention to warning signs, and the posting of signs on both sides of the roadway.

Potential locations for temporary rumble strips should be evaluated on a project-by-project basis. Generally, rumble strips are not effective in urban settings and are not appropriate for residential or commercial settings because of the noise. Rumble strips should be considered on high-speed facilities with uninterrupted flow where motorists are less likely to see and react to work zone traffic control.

Rumble strips should be installed at long-term sites such as paving, bridge repairs, and other sites where temporary traffic controls are in place for more than one week. Rumble strips should not be placed on curves with a radius less than 1500 feet to ensure that they do not adversely affect vehicle traction around the curve. The Standard Specifications require the Contractor to fill in or remove temporary rumble strips before the start of the winter plowing season and before the placement of an overlay. On multiyear projects where it is desired to have rumble strips in place for more than one construction season, the rumble strips must be installed, removed, and paid for separately each year they are used.

On designated bicycle routes or other routes with routine bicycle traffic, where there is no usable shoulder or the shoulder is less than 4 feet wide, rumble strips should be ended sufficiently short of the edge of usable pavement to provide a minimum clear path of 4 feet as per the MUTCD. Rumble strips should not be placed through pedestrian crossings.

Rumble strips are not to be used where they will create operational problems, or where they will provide no additional value, including the following:

- In close proximity to residences where noise may be objectionable.
- On milled surfaces or very rough pavement.
- Interrupted flow conditions or low speeds.

The Regional Traffic Engineer should be consulted for a recommendation as to the desirability of using rumble strips at a particular work zone. This recommendation should consider the integration of rumble strips into the overall WZTC plan, as well as the spacing and locations of the individual strips.

16.3.6.2 Patterns and Location

As a guide, a rumble strip pattern consisting of six separate strips placed on 10 foot centers and traversing the full width of each travel lane is generally acceptable for use on high-speed, multilane roadways. On curbed roadways, rumble strips should end a minimum of 3 feet from the curb in order not to interfere with drainage.

Unless site conditions warrant otherwise, a standard rumble strip installation consisting of a 6-strip
pattern shall be placed in advance of each of the last three advance warning signs for the condition to which drivers are being alerted. On expressways and similar roadways with typically long sign spacings, rumble strip patterns placed 500 feet to 1000 feet upstream from each sign (with the higher values used for larger signs that can be read at a greater distance) should provide adequate driver response time. On highways where warning signs are spaced at 500 feet apart, each of the last two patterns should be placed approximately 50 feet downstream of the preceding sign in the series.

Suggested layout details are shown in Exhibit 16-5 Other patterns and locations may also be appropriate, but should be used only with the approval of the Regional Traffic Engineer.

For long projects such as highway reconstruction or 3R, where there are multiple work zones, sets of rumble strips may be installed at specific work sites, if appropriate. Intermediate rumble strips should be located in advance of warning signs such as ROAD WORK 1 MILE (W20-1), TWO-WAY TRAFFIC (W6-3), or NO SHOULDER (W8-23).

Project plans or drawings by EICs should show the actual spacing and locations of rumble strips at each installation.
Exhibit 16-5  Temporary Rumble Strips (Suggested Layouts)
16.3.7 Portable Temporary Rumble Strips (PTRS)

Use of rumble strips is an effective way, in addition to work zone signing, PVMS, and other visual aids to alert motorists of the approaching work zone and thus provide an added degree of safety to both motorists and workers. Through noise and vibration, rumble strips attract the driver’s attention to features such as, advance warning signs, changes in lane alignment and to conditions which may require the driver to act. Even though other warning devices such as warning signs, portable changeable message signs, arrow panels, temporary pavement markings, etc. may be sufficient to guide drivers through work zones, a stronger and timelier response can be achieved by combining audible and tactile stimuli to improve driver compliance.

Rumble strips are a countermeasure that provides both a physical vibration and an audible warning to alert motorists as the vehicle tires traverse the rumble strips. Because there is no specific message associated with rumble strips they can be used to alert motorists to a variety of conditions. The Manual on Uniform Traffic Control Devices (MUTCD) indicates that transverse rumble strips, which extend across the travel lanes, are intended to notify road users of upcoming hazards or changes in roadway features, such as unexpected changes in alignment, and conditions requiring a reduction in speed and/or a stop (FHWA 2009). This could encompass a variety of situations such as lane closures, speed reductions, changes in alignment, new merge patterns, visual obstructions, nighttime work zones, and more. The circumstances and restrictions of work zones can vary greatly, and transverse rumble strips can alert drivers to the changing conditions and information being provided by temporary traffic control devices. Due to the temporary nature of work zones, a need exists for rumble strips that can be installed and removed quickly and efficiently while providing the same tactile and auditory warnings to drivers as permanent rumble strips.

Portable Temporary Rumble Strips (PTRS) may be included as part of a work zone intended for daily operations type work such as: preventative maintenance paving, small culvert replacement, traffic signal work, bridge maintenance, and other operations that require daily set up and take down of the work zone. Mobile operations, long duration, or overnight work zones shall not use PTRS.

Portable Temporary Rumble Strips should be considered when any of the following conditions are met:

1) Posted speed limit is 40 mph or greater
2) Work zone contains a lane drop (multi-lane road)
3) Work zone contains alternating one-way traffic (with a flagger)

Good judgment should be used before installing rumble strips to ensure that they are necessary, will be effective, and are properly installed.

General Requirements for the use of PTRS:

1) Advanced warning sign NYW4-17 “RUMBLE STRIPS” shall be used in conjunction with PTRS.
2) PTRS shall be inspected for defects prior to deployment. PTRS that display damage or no longer function as designed shall not be put into service.
3) PTRS are not to be used as a substitute for any other safety device or work zone requirement.
4) PTRS are typically deployed from the shoulder and should only be specified when there is sufficient shoulder width and stability to safely deploy and retrieve these devices.
PTRS shall not be deployed on these roads or surfaces:

- Sharp horizontal or vertical curves
- Surface with fresh seal coat
- Bleeding asphalt
- Soft pavement, like fresh asphalt
- Heavily rutted road
- Gravel, stone or debris on surface of road

Design and layout shall be in accordance with the details provided in the specification for Portable Temporary Rumble Strips (PRTS) or on the applicable Standard Sheet.

1) PTRS shall consist of three rumble strips placed perpendicular to the centerline and parallel to one another in accordance with the spacing requirements in note 5, below. The rumble strips shall be installed across the entire travel lane but not intrude into the opposing travel lane. It may be necessary to extend the PTRS onto the shoulder. When used on any roadway open to bicycle travel, a minimum clear path of four feet must be able to be provided at each edge of the roadway or on each paved shoulder for PTRS to be deployed.

2) Where the PTRS are installed, the RUMBLE STRIPS (NYW4-17) sign shall be utilized. PTRS shall be placed at the same time the advance warning signs are installed.

3) The preferred location of the PTRS in two-lane operations is adjacent to the BE PREPARED TO STOP (W3-4) sign but the PTRS can be moved to other locations within the advance warning area based on field conditions and traffic queue.

4) The preferred location of the PTRS in multi-lane operations is in advance of the RIGHT (LEFT) LANE CLOSED AHEAD (W9-3R) sign but the PTRS can be moved to other locations within the advanced warning area based on field conditions and traffic queue.

5) Spacing between each strip shall be as follows:

<table>
<thead>
<tr>
<th>Posted Speed Limit</th>
<th>40 mph</th>
<th>41 – 55 mph</th>
<th>56 + mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRS Spacing (Center to Center)</td>
<td>10 feet</td>
<td>15 feet</td>
<td>20 feet</td>
</tr>
</tbody>
</table>

6) When traffic queues prior to the PTRS, the PTRS and rumble strip signs may need to be relocated in advance of the queue to better serve as a warning device to motorists.

7) Removal of PTRS should be coordinated with the removal of the advance warning signs.

8) The installation of rumble strips shall closely follow the Department’s specifications and the manufacturer’s recommendations.

### 16.3.8 Radar Speed Display Signs

Radar speed display signs can be used to inform vehicles of their speed, and alert them if they are exceeded the posted work zone speed limit. They should be considered when the following criteria are met:

1) Work on a fully controlled access highways with preconstruction posted speed limits of 45mph or greater.

2) Workers on foot in the roadway and not predominately separated from traffic by temporary concrete barrier or other non-yielding system.
3) Work zone is stationary with a duration exceeding 1 hour.

Radar speed display signs may be trailer mounted, truck mounted, or integrated into a PVMS board. The radar speed display sign shall be located midway between the “ROAD WORK AHEAD” and “LANE CLOSED” signs. A future standard sheet will be issued to detail the placement of these signs in a typical lane closure.

16.3.9 Work Zone Cameras

Use of work zone cameras is an effective way, in addition to work zone signing, PVMS, and other tools to reduce speeds and driver aggression - and thus provide an added degree of safety to both motorists and workers. There has been an increasing frequency and severity of work zone intrusions, hostile incidents and threatening behavior by motorists toward flag persons and workers. Work zone cameras provide a deterrent to motorists who would violate temporary reductions in regulatory speed, aggressive actions toward flaggers or other workers, and other undesirable behavior within the work zone. In addition, in extreme cases of driver aggression, the work zone cameras will provide a means of recording hard evidence that can be used to aid in prosecution of violators.

Work Zone Cameras will have the greatest benefit when workers or flaggers are exposed to live traffic without positive protection. Work Zone Cameras should be considered as part of a work zone intended for daily operations type work. This would include preventative maintenance paving, small culvert replacement, traffic signal work, bridge maintenance, bridge inspection, mobile operations and other operations that require a daily set up and take down of the work zone. Work Zone Cameras may be considered for any intermediate or long term operation that involves alternating one way traffic with flaggers or temporary traffic signals. Work Zone Cameras shall be required where Automated Flagger Assistance Devices (AFAD’s) are proposed. Long duration work with workers behind positive barrier should not use Work Zone Cameras, unless there is a special circumstance that would allow for their use (Example: Setting steel using flaggers on a project that otherwise has traffic and workers separated by concrete barrier)

Work Zone intrusions include the following situations:

- Encroachment by any mode of travel into the transition area or activity area
- Vehicular contact with project personnel or equipment (including temporary impact attenuators), or channelizing devices used for delineation of the transition areas and activity area
- Vehicular contact with a flagger, “Stop/Slow” paddle, automatic flagging device (AFAD’s), or temporary signal
- Vehicular encroachment associated with dis-obeying flaggers, including closed lanes or lanes used by opposing traffic
- For mobile operations, any vehicular encroachment from the 1st (most upstream) truck mounted impact attenuator shadow vehicle to the work area
- Vehicular contact with project personnel or equipment associated with setup of advance warning signs

Hostile encounters include the following situations where a person:

- Purposely intrudes a work zone
• Makes threatening gestures or comments
• Drives toward or hits a flagger or person performing flagging operations, vehicle, equipment, or traffic control device in an attempt to intimidate, harm or damage the flagger or object
• Motorist exits his/her vehicle and approaches a flag person or other crew member in an aggressive manner
• Displays a weapon or implies that he/she is armed
• Causes a crew member or flag person to feel threatened for his/her safety

Any project specifying the use of Work Zone Cameras shall include the special note “Use of Work Zone Cameras”. This special note provides additional details to the contractor and inspection staff for the setup, procedures for recording video, and protocol for handling video evidence in the case of an intrusion or hostile encounter. A minimum of number two (2) cameras each shall be provided at each location specifying the use of work zone cameras. Design and layout shall be in accordance with the details provided in the special specification.
16.4  WORK ZONE TRAFFIC CONTROL PLANS

16.4.1 General

Whether driving, walking, or bicycling, a temporary highway work zone or traffic control zone can present obstructions to and diversions from the normal driving environment to which one is accustomed. Highway work zones often change as the work progresses, further disrupting the travelers’ expectations. Therefore, to fulfill the objectives stated in Section 16.1, as well as both State and Federal policies including 23 CFR 630 Subpart J & K, it is necessary to prepare some form, whether basic or complex, of work zone traffic control plans (TCP).

Work zone traffic control plans describe the methods, strategies, and sequence of construction to be used to facilitate the safe movement of motorists, bicyclists, pedestrians, and workers through and/or around highway or street work zones. They generally contain specific information about: the placement, type, and maintenance of traffic control devices; methods and means for delineation and channelization; construction scheduling; application and removal of pavement markings; roadway lighting requirements; traffic regulations; and surveillance and inspection procedures. This information generally needs to be repeated for each stage or phase of work. The complexity of the work and the extent to which it will impact traffic determines the level of detail necessary in the work zone traffic control plans.

A workable plan should be developed at the earliest possible stage of design, and if major impacts are expected, they should be discussed in the Design Approval Document. Refer to the Project Development Manual for guidance on the information to be included in the Design Report/Environmental Document. The work zone traffic control plan should be prepared by persons trained and knowledgeable in the fundamental principles of temporary traffic control and the work activities to be performed.

The scoping, design, scheduling, and construction of projects should be accomplished in a manner that will provide a high level of safety for workers and the traveling public; minimize congestion and community impacts by maintaining levels of service as close as feasible to preconstruction levels; and provide the contractor with adequate access to the roadway to complete the work safely and efficiently, while meeting the quality requirements of the contract. These often competing priorities may result in a balance based on sound engineering judgment. While the goal is to maintain levels of service, some level of inconvenience should be expected when traveling through an active construction work zone.

In order to achieve these objectives, design and construction of projects should attempt to maintain, to the extent practicable, the existing capacity of the road under construction; and should consider nighttime operations, detours, diversionary roads, crossovers, use of shoulders as travel lanes, temporary roads and bridges, alternating traffic patterns and the use of time-related contract provisions. The incorporation of design features to ease traffic impacts, enhance police enforcement activities, and provide more room for work during future construction should also be considered. These could include wider lanes, wider inside and outside shoulders, full-depth shoulders, shoulders and removable sidewalks on bridges, and other alternatives.

The complexity and duration of the work, and the type of traffic and portion of the highway affected by the work, are all considerations in selecting the most appropriate method of highway work zone traffic control. Large, complex projects located in congested urban areas may require a broad analysis of the corridor, and development of a transportation management plan. For smaller, less complex projects,
especially those located in rural areas, it may be appropriate to simply develop project-specific special
notes. The contract documents should not reference examples or typicals from the MUTCD, or the
Standard Sheets but should directly provide the design needed for the project. Work zone traffic control
plans are essential for project-specific layouts and the 619 series standard sheets should be
substituted for a TCP only when layouts shown on the standard sheets are completely applicable to the
specific conditions of the project.

The work zone traffic control plan should clearly indicate all required phasing, methods of traffic control,
and any time or construction limitations that will be placed on the contractor. Attention should be given
to developing strategies that will limit impact to the traveling public. The designer should attempt to
maintain the existing number of lanes and avoid speed reductions throughout a construction project,
particularly on interstates and other major routes. Where it is determined that lane restrictions are
necessary, consideration should be given to prohibiting work during peak periods of traffic flow on the
route, and nighttime construction should be considered. The work zone traffic control plan should also
take into account other adjacent roadway sections that may be under construction, and avoid conflicts
between competing phases of adjacent projects or work on routes chosen for detours. The needs of
oversize vehicles and those with special dimensions should be considered, especially if the project
affects a route specifically designated for them.

The Department normally allows contractors to develop and use alternate work zone traffic control
plans or make value-engineering changes, but only if they are approved by the Department.

The pay item for Basic Work Zone Traffic Control in the Standard Specifications is used when it is
necessary to maintain traffic 24 hours per day (not removed and restored each day) through work
zones. There are, however, a number of projects, such as sign contracts, guide rail replacement
contracts, signing contracts, lighting contracts, and signal replacement contracts where the roadway
and shoulders can be cleared of work zone traffic control equipment and devices each night. On these
projects, less elaborate and presumably more economical traffic controls are generally appropriate. For
such projects, and when all the following conditions apply, the designer may specify the pay item for
Basic Work Zone Traffic Control (Daily Operations):

- All the traffic lanes and highway shoulders can be restored to normal use at the end of each
  work day.
- It would not be reasonable to require pavement repairs because the work is outside of or not
  likely to affect (other than temporary occupation by construction equipment) the pavement and
  shoulders.
- No Work Zone Traffic Control devices will remain on the highway outside of the staging areas at
  the end of each work day.
- No separate detours are needed.

The basic safety principles for governing the design of permanent roadways and roadsides should
also govern the design of construction, maintenance, and utility work sites. As an exception,
superelevation method 2 may be used for horizontal curve design. See HDM Chapter 5, Section 5.7
for information on superelevation. The goal should be to safely route traffic through these sites with
geometrics and traffic control devices comparable (to the extent practical) to those for normal highway
situations.
The following items should be considered in determining the overall approach to project-specific traffic control:

- Are there major traffic generators located near the project site that will generate commuter, seasonal, or special event traffic? If so, should the permitted hours for lane closures be restricted? Based on traffic count information, determine the number of lanes which can be closed during the day, night, or on weekends. Incorporate seasonal variations on interstate highways and in tourist areas (or routes leading thereto) by obtaining summertime weekend counts. Contact the agency which has jurisdiction (if not NYSDOT) and ask what lane or road closings they will allow and discuss independent findings with them. Obtain concurrence with the proposed lane closings. Also determine if there are any allowable lane closures for holidays. For most projects with moderate to heavy traffic volumes, consider adding notes to the project that restrict work in active lanes on and around major holidays. For recommended examples, see Section 16.4.8.1.

- Do the lane widths for the work zone meet or exceed the minimums and accommodate the design vehicle for the work zone? Where snow plows are expected, at least a 14’ width is needed; and dump trucks, concrete trucks, and tractor trailers need an 11’ width. Therefore, the minimum clear width (i.e., width between barriers, curbs, etc.) for non-freeways and parkways should be 14’ for one-lane, two-way operation and 22’ for two-lane (one-way or two-way) operation, with 10’ for each added lane. The minimum clear width for freeways with truck traffic should be 14’ (16’ desirable) for one-lane operation to accommodate trucks, snowplows, oversized loads and 22’ for two-lane operation, with 11’ for each added lane. If the recommended minimum clear widths cannot be attained, the topic should be discussed further amongst Regional Office Functional Units.

- Are adequate detour routes available?

- Are existing shoulder thicknesses adequate for use, or do they require replacement with full-depth shoulders?

- Is it necessary to remove, relocate, reset, or replace existing guide rail?

- Are temporary signals required?

- Should nighttime construction or time-related contract provisions be used to mitigate delay?

- Are lane closings required and for what duration?

- Is concrete barrier required and should it be the temporary or moveable type?

- Does the proposed work zone traffic control provide safe contractor access to the work site?

- Does the proposed work zone traffic control provide safe contractor access to the work site? Can the design vehicle be accommodated without dropping off the pavement edge along turning roadways or intersections? Where there will be greater than 4” of elevation difference between pavement courses, and temporary pavement is not being used to widen the roadway, turning radii should be checked in the design.

16.4.2 Fundamental Principles

The purpose of temporary traffic control is protecting motorists, pedestrians, bicyclists, and workers from hazards associated with construction, maintenance, and utility operations. To accomplish this, traffic control must:
• Warn road users (motorists, pedestrians, and bicyclists) of hazards.
• Advise road users of the proper travel path through the area.
• Delineate areas where traffic should not operate.
• Separate and protect both road users and the work force.

Fundamental principles, which experience has shown will assist road users and help protect workers in the vicinity of temporary traffic control areas, are found in the MUTCD, Section 6B.01. These principles do not establish specific standards and warrants but do provide the designer with guidance for good temporary traffic control.

16.4.2.1 Construction Supervisor Input

A necessary element for producing quality design and construction is good communication between the design staff and construction staff. A project site visit will give design project engineers greater insight into the quality of the design documents that were prepared, provide a learning experience to improve the quality of documents they prepare or manage in the future, and increase the overall effectiveness and efficiency of the Department’s design-construction process. Regional and Main Office design squad leaders, project engineers managing consultants, and Regional liaison engineers should visit the job site for each project they design to discuss the construction supervisor’s experience with the design documents. Refer to the Contract Administration Manual for complete guidance on obtaining construction supervisor input on design plan quality.

It is also vitally important for Regional Traffic Office to review the plans and provide input to the designer.

16.4.2.2 Purpose of Work Zone Traffic Control Plans (WZTCP)

WZTCPs play a vital roll in providing continuity of safe and efficient road-user flow when a work zone disrupts that flow. They should be developed, or at least closely supervised, by an experienced designer who has complete knowledge of the project and is completely familiar with the project area. WZTCPs are prepared:

1. To provide a workable, safe method or plan for work zone traffic control using criteria set forth in the Manual of Uniform Traffic Control Devices, Standard Specifications, Standard Sheets and other Department issuances and guidance.
2. To provide a plan such that a reasonable estimate of traffic control costs can be developed for the Engineer’s Estimate.
3. To provide a plan such that contractors bidding on the project know what is expected/required and can formulate their bids accordingly
16.4.3 Elements of Highway Work Zones

The MUTCD defines a temporary traffic control zone as “an area of a highway where road user conditions are changed because of a work zone through the use of temporary traffic control devices, uniformed law enforcement officers, or other authorized personnel.” The MUTCD divides work zones into the following areas:

- Advance Warning Area
- Transition Area
- Activity Area
- Termination Area

The advance warning area is the section of highway where road users are informed about the upcoming work zone. The transition area is the section of highway where road users are redirected out of their normal path. The activity area is the section of highway where the work activity takes place. The termination area is the section of highway that is used to return road users to their normal path.

Most work zones, regardless of the type, will consist of these areas. The specific field treatment and selection of traffic control devices will be determined by the character of the operation. These areas and spaces are described in the following sections and illustrated in Exhibit 16-6.

16.4.3.1 Advance Warning Area

An advance warning area is necessary for all work zones because it is where road users are informed about the upcoming work area. The warning may vary from a single sign or flashing lights on a vehicle for mobile and short duration work to several signs in advance of an upcoming work zone or incident area. Drivers must have enough time to read, comprehend, and react safely to the messages contained in advance warning signs. Warning signs are the most common systems of traffic control devices used in the advance warning area. Refer to the the MUTCD Part 6 and the Standard Sheets for guidance in the use and location of warning signs in highway work zones.

At locations where traffic volumes may exceed the capacity of the traffic space, it may be necessary to extend or adjust the location of upstream signing to include that stretch of road where queues may form. Extended advance warning may also be dictated by the geometrics of the approach roadway, such as downhill approach grades, horizontal curves, existing lane reduction, etc. Other special problems include:

- Urban Locations. Adjustments of sign spacing and numbers of signs may be necessary due to the length of city blocks, spacing of intersections, and the locations of alleys, shopping-center access points, and side streets.
- On-Street Parking. The mounting height of signs may have to be increased to be visible over parked vehicles (see 16.4.4.2.A.7).
- Commercial Establishments. Sign locations may have to be adjusted to avoid interference with loading zones or having them be obstructed by delivery vehicles or existing commercial signs.
- Divided Highway and One-Way Streets with Two or More Lanes. Signs should be installed on both sides of the roadway to assure that the messages are visible to all approaching traffic and to minimize the possibility of the view of the signs being blocked by vans and trucks.
- Existing Signs. Existing signs which are not applicable during the road work activity should be covered or removed. The spacing between temporary traffic control signs and the
remaining existing signs may require adjustment so as not to overload the driver’s ability to comprehend and respond to all signs in the system.

16.4.3.2 Transition Area

The transition area is that section of the highway where road users are redirected out of their normal path. In mobile operations, the transition area moves with the work space. Transition areas usually involve strategic use of tapers consisting of channelizing devices and/or pavement markings to gradually guide traffic into the desired path. This is typically done when work is performed in one or more of the travel lanes and a lane closure or lane shift is required. See Exhibit 16-6. (Note: See section 6C. of the MUTCD for detailed guidance on use of tapers in the transition area.

Longer tapers are not necessarily better than shorter tapers (particularly in urban areas characterized by short block length, driveways, etc.). Extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. They also make it more difficult for motorists to perceive visually what is happening (i.e., lane closure) and therefore, cause lane-change maneuvers too late and in conflict with adjacent traffic.

For those tapers whose lengths are based on traffic speed, the speed used should be the 85th percentile speed (from the Design Report) immediately in advance of the transition area. If the 85th percentile speed is not known, use the posted speed + 5 mph. Estimated or calculated speeds may be used. The taper lengths indicated are guides. Different distances may be appropriate in urbanized areas or when a taper occurs near an interchange ramp, an intersection, or a curve. After a taper has been put in place, traffic operation should be observed, and any necessary adjustments should be made. Refer to Exhibit 16-6 for illustrations of, and to Exhibit 16-7 for length criteria for the tapers described below:

1. Merging Taper.

A merging taper is used to close a lane when vehicles in that lane must merge with traffic in an adjacent lane at prevailing speeds. The taper should be long enough to enable drivers in the lane being closed to make any necessary speed adjustments to position themselves opposite traffic gaps in the adjacent lane. Merges should be made before traffic enters work zones. The (L) values in Table 6H-4 and 6C-3 on Standard Sheet 619-11 are based on Section 6C of the MUTCD and should be used as guides in determining the lengths of merging tapers.

2. Shifting Taper.

A shifting taper occurs where a roadway changes direction, but all approach lanes remain open and no merge is required. The taper should be long enough to be negotiated without causing reductions in travel speed. One-half the values (½ L) in Table 6H-4 should be used as minimum lengths. Longer distances are encouraged where space is available. Alignment changes may also be accomplished by using horizontal curves.

3. Lane-Width Taper.

A lane-width taper is used when it is necessary to decrease the lane width in a work zone. The rate of taper required for modifying a lane width is the same as that for a shifting taper, ½ L, except the “W” (the width of offset in feet) is equal to the change in lane width.
4. Shoulder Taper.

A shoulder taper may be appropriate on the approach to a work area or other obstruction which is on the shoulder of a high-speed roadway. One-third the values ($\frac{1}{3} L$) in Table 6H-4 on Standard Sheet 619-11 should be used as guides in determining the lengths of shoulder tapers. Shoulder tapers are not for use where a shoulder is temporarily being used as a travel lane. Shifting tapers should be used to divert traffic onto and off the shoulder in such circumstances.

5. One-Lane, Two-Way Taper.

One-lane, two-way tapers are for use on two-lane, two-way roadways where a portion of the roadway must be closed and alternate one-way operation is in effect in the remaining lane. One-lane-road signal control or flagger control is typically used to establish the alternate one-way operation. Traffic approaching on the side of the roadway which is closed must negotiate two tapers to bypass the work area. The first taper is a one-lane, two-way taper that moves the traffic onto the left-hand half of the roadway where the closure begins. This taper should normally be from 50 feet to 100 feet long. The second taper is a downstream taper about 100 feet long which returns traffic to the right-hand half of the roadway where the closure ends. A taper length of 80 feet is often used for both tapers since it equals two broken centerline segments and is a convenient field measurement. A buffer space should be provided between the end of the downstream taper and the stopped traffic in the opposing direction to ensure that all diverted vehicles completely return to their original lane before reaching the opposing stopped vehicles.


A downstream taper may be used at the end of a closed lane to give drivers a visual cue that work operations end and normal travel conditions resume. Downstream tapers should be about 100 feet long for each lane they cover.
Exhibit 16-6  Component Parts of a Highway Work Zone

Adapted from National MUTCD and Washington State DOT Traffic Manual
Exhibit 16-7  Taper Length Criteria

<table>
<thead>
<tr>
<th>Types of Tapers</th>
<th>Taper Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Merging Taper</td>
<td>L minimum</td>
</tr>
<tr>
<td>2. Shifting Taper</td>
<td>½ L  minimum</td>
</tr>
<tr>
<td>3. Lane-Width Taper</td>
<td>½ L  minimum</td>
</tr>
<tr>
<td>4. Shoulder Taper</td>
<td>⅓ L  minimum</td>
</tr>
<tr>
<td>5. One-Lane, Two-Way Traffic Taper</td>
<td>100 feet maximum</td>
</tr>
<tr>
<td>6. Downstream Ending Taper</td>
<td>100 feet minimum</td>
</tr>
</tbody>
</table>

Occasionally it is necessary to close more than a single lane of pavement in order to perform the necessary work on the highway. This may be accomplished by closing several travel lanes or by shifting lanes or by a combination of both. Any of these conditions will create a need for more than a single transition. Multiple transitions shall be separated by tangent sections. For example, if the number of open lanes in one direction of a multilane highway is to be reduced by two, it will be necessary to provide two merge tapers, separated by a tangent section of desirable minimum length “2L” (where “L” is the minimum permitted taper length of the associated transitions) to give traffic to stabilize before the second merge. If there is a reduction of one lane and a shift of the remaining open lanes, then one merge transition and one shift transition shall be provided. The merge transition and the shift transition should be separated by a tangent section of length “2L.”

16.4.3.3 Activity Area

The activity area is the section of the highway where the work activity takes place. It is further divided into up to five subareas including, as a minimum, the work space and traffic space, and may contain buffer spaces designed to enhance the safety of motorists and workers, as described below:

1. Traffic Space.
   Traffic space defines the portion of the roadway in which traffic is routed through the activity area.

2. Work Space.
   The work space is that portion of the roadway which is closed to traffic and is set aside for the exclusive use of workers, equipment, and construction materials. Work spaces may be fixed or move as work progresses, such as in mobile and moving operations. Work spaces are usually delineated by channelizing devices or shielded by barriers to exclude vehicular traffic and pedestrians.

   Buffer spaces should be provided to further separate traffic from the work activities or potentially hazardous areas and provide recovery spaces for errant vehicles unless precluded by site conditions. In order to effectively serve this purpose, buffer spaces must not
be used for the storage of vehicles, equipment, supplies, or any other obstructions, nor for any work activity. Refer to MUTCD Part 6C and Table 6C-2 and Standard Sheet 619-11.

4. Incident Management Vehicle Storage Space (optional).

The activity area may also be used to provide storage space for vehicles used for incident management on high-volume, highly congested highway facilities in an urban area. Emergency vehicles (e.g., tow trucks), which are needed to respond quickly to traffic incidents, may be stored in the activity area. Such emergency vehicle storage areas should not extend into any portion of the buffer space. The location of an incident management vehicle storage space is determined on a case-by-case basis.

5. Enforcement Areas

Consider providing space, as appropriate, for one or more police cars to enforce work zone speed limits and other traffic regulations in freeway work zones where workers are exposed to traffic or other projects where compliance with speed limits is considered a priority. Police cars need a safe and efficient spot to park and an area to pull over motorists for ticketing. Areas for police enforcement activities should be behind channelization. The State Police should be consulted early in design to identify their enforcement needs.

16.4.3.4 Termination Area

The termination area is used to return traffic to the normal traffic path and extends from the downstream end of the activity area to the END ROAD WORK sign (G20-2), if it is posted, or to the downstream end of the downstream taper when an END ROAD WORK sign is not used. It confirms to the driver that the highway work zone has been terminated. A short downstream taper of 100 feet may be placed in the termination area, or to the downstream end of the downstream buffer space in a flagger-controlled work zone. Refer to the MUTCD Part 6C.07 for guidance in the use of END ROAD WORK signs.

If a reduced work area speed limit is used, an R2-12 END WORK ZONE SPEED LIMIT sign followed by a R2-11 END HIGHER FINES ZONE should be placed to define the downstream end of the reduced speed limit. See 16.4.6 for more detail.

16.4.4 Safety Considerations

Safety is considered to be the most important factor in work zone traffic control design. The Department's goal regarding traffic control on all construction and maintenance projects is to ensure that the plan is designed, implemented, and managed in a uniform, consistent manner to provide a high level of traffic safety for workers and the traveling public. This must be done in a manner which minimizes delays and inconvenience to travelers and which minimizes disruption to the community where the project is located. At the same time, the Work Zone Traffic control plan should permit the contractor to operate in an efficient manner to facilitate completion of the construction in a timely manner and at a reasonable cost.
16.4.4.1 Safe Work Site Access

It is the Department’s policy that in developing Work Zone Traffic Control plans for maintaining traffic during construction, designers shall consider whether special provisions are needed to ensure safe access to work sites by workers, vehicles, and equipment.

The crossing of roadways by workers, vehicles, and equipment shall not be permitted unless specific provisions are in place to do so safely. Safe work-site access is a constructibility issue which should be considered by Department reviewers during the regular plan review process as well as during constructibility reviews.

The contractor is responsible to provide safe access to the work site by workers and inspection staff and safe parking for their vehicles, such that no active traffic lanes are routinely crossed by pedestrian workers or inspection staff reporting to and leaving the work site. Refer to the Standard Specifications §107-05 G.

The designer should consider work site access and include special provisions in the TCP when traffic and site conditions impose high risks to worker and/or public safety. The TCP should be reviewed by Regional Construction staff to ensure specific provisions for work site access are included when appropriate.

The guidelines in this section are intended to help designers identify potentially troublesome locations which may need special consideration in the TCP. It is not intended to suggest or imply that detailed work site access plans and provisions are expected on all projects.

The following items should be considered when evaluating the need for access provisions in the TCP:

- Do speeds and volumes combine such that sufficient gaps to safely cross or enter traffic are not available, especially on controlled-access highways and multilane arterials? Crossing risks are also increased with two-way traffic and where refuge areas are not available in multilane highways.
- Will unique site conditions make access difficult?
- Will sight distance be restricted for motorists by site conditions or by the deployment of temporary barriers, barricades, construction signs, vehicles, or equipment?
- Will workers be exposed to increased risks while walking adjacent to traffic to gain access to the work site? Risks increase when workers cannot face oncoming traffic or where the area available for workers is narrow and close to traffic, and/or where escape paths are blocked by railings, median barrier, excavations, or other site features.
- Will it be necessary for equipment and supply/delivery vehicles to maneuver into or out of work sites?
- Will nighttime construction provide the safest alternative or will it create additional risks with regard to work site access?
When the evaluation indicates that work site access is a safety concern, special provisions may be necessary to ensure that safe access is provided and used. Such provisions may include:

- Barricading or otherwise restricting unsafe access points or routes.
- Imposing contract restrictions that require workers and vehicle operators to access the work site only at designated points.
- Adding temporary walkways, crosswalks, access ramps, stairways, and other features to provide safe access points for workers, vehicles, and equipment.
- Adding temporary crosswalks, traffic signals, or spotters to control movement of workers and vehicles into and out of work sites.
- Requiring remote parking areas for workers, with shuttle vehicles for transport to the work site.
- Setting limitations on when suppliers can drop off material (e.g., limit deliveries to off-peak hours).

When access restrictions are appropriate but it is difficult to include specific provisions in the TCP, special notes should be included on the plan or in the proposal. Generally, the notes should not provide specific direction to the contractor, but rather should outline the operational restrictions which apply, and/or the special requirements that must be met to properly address safe work site access on the project. The notes should also require the contractor to submit an acceptable access plan to the Engineer-In-Charge as part of the Project Safety and Health Plan.

16.4.4.2 Work Zone Pedestrian and Bicycle Traffic Control

The designer should consult with the Regional ADA Specialist and Regional Bike/Pedestrian Coordinator early in the design process to coordinate the bike/pedestrian needs for the project. The Department’s policy (October 1996) extends the requirement to maintenance and other activities. In addition, regulations implementing the Americans with Disabilities Act (28 CFR Part 35) and the current Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) require that both permanent and temporary pedestrian facilities, including those associated with construction and maintenance activities, must provide safe and convenient access for persons with disabilities. It is the responsibility of both the Regional Pedestrian and Bicycle staff and the designer to assess the needs of pedestrians and bicyclists.

Pedestrian and/or bicycle traffic must be safely and continuously maintained through, or around, work zones on highways or streets where pedestrians and/or bicyclists are not prohibited. This does not apply where pedestrians and bicyclists are prohibited. The control of pedestrian and bicycle traffic should be consistent with the type of work zone, the work location, the duration of work activity, anticipated bicycle and pedestrian traffic, motor vehicle traffic characteristics, and the degree of potential hazard to, or conflict between bicycle, pedestrian, and motor vehicle traffic. For example, where there is a low expectation of pedestrian and/or bicycle traffic, low motor vehicle volumes, and no or minimal disturbance is occurring in the work zone, nothing special needs to be done and pedestrians may continue to use the shoulders.

Where pedestrians and bicyclists use the shoulder or sidewalk and the work zone will disrupt it, other arrangements should be made to allow pedestrian and/or bicycle traffic to safely travel through or around the work zone, (e.g., fence, temporary concrete barrier, accessible shuttle service, off-site detour).
Designers and Transportation Maintenance Engineers should use the following requirements and supporting guidelines when developing TCPs for pedestrians and bicyclists. In addition, designers should be guided by the provisions regarding alternate pedestrian access routes in the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG).

A. Pedestrians

A.1 User Needs. The needs and abilities of a diverse pedestrian population must be considered, evaluated, and adequately accommodated through, or around, work zones. That population includes people with disabilities, children, elderly persons, etc. For example, elderly persons and/or persons with disabilities may be more sensitive to abrupt changes in level (e.g., walkway joints that are heaved or displaced greater than ½ inch vertically), surface irregularities, or walkways routed onto a roadway. Children will sometimes dart out into roadways, so where there are significant numbers of children present (such as near a school or playground), positive barrier (e.g., fence, temporary concrete barrier) may be required for walkways routed onto roadways. Vision-impaired people cannot be safely guided by signs, traffic cones, delineators, or tape. In urban areas, commercial areas, residential areas, and other areas where use by vision-impaired pedestrians can be expected, any positive separation between a pedestrian walkway routed onto a roadway and motor vehicle traffic should utilize fencing, temporary curbing (plastic, timber, etc.), or other continuous barrier or material that is detectable by a vision-impaired person using a cane or guide dog.

A.2 Necessities for Pedestrian Traffic. The question of how to provide access for pedestrians through or around work zones must be assessed for each project where pedestrians are not prohibited (not all projects require the same approaches to safely allow passage). While provisions for pedestrian travel should be made, the assessment should take into account the amount of observed pedestrian activity occurring along the roadway, as well as motor vehicle and bicycle traffic volumes. It is important to remember that the apparent absence of pedestrians does not preclude the need to provide access, especially if other indicators are present. One or more of the following are indications that there is pedestrian activity at a site:

- The presence of residences.
- There is an existing sidewalk, trail, or pathway.
- There is observed pedestrian activity.
- Evidence of pedestrian activity exists, such as residences located along rural roads or worn paths along the roadway.
- There are existing or approved plans for generators of pedestrian activity in or within ½ mile of the project that promote or have the potential to promote pedestrian traffic in the project areas during the project, such as schools, parks, playgrounds, places of employment, places of worship, post offices, municipal buildings, restaurants, shopping centers, or other commercial areas or multiuse paths.
Designers may find that the public involvement process is an excellent method by which to determine potential user needs and develop possible solutions that the community will support.

A.3 Accessibility Requirements. If safe access and passage for pedestrians cannot be maintained continuously through the work site, a safe continuous detour must be furnished. Facilities constructed to specifically provide access for pedestrians in or around work zones must be designed to be consistent with Chapter 18 of this manual. A minimum 5-foot wide walkway should be provided to accommodate continuous two-way pedestrian traffic and maintain convenient access. Where a 5-foot width cannot be met, a narrower walkway may be provided, down to 4 feet, the minimum allowed for a Pedestrian Access Route (PAR) by the Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG). However, when the walkway is narrower than 5 feet, PROWAG also requires the provision of passing spaces that are at least 5 feet long and 5 feet wide, spaced no further than 200 feet apart. Use of an accessible shuttle service, accessible on-call taxi, or similar service by special specification may be considered on projects such as bridge replacements, where the construction of temporary, accessible walkways is infeasible or impracticable.

Where there are existing sidewalks on both sides of a road or bridge, work should be staged so that at least one sidewalk remains open and accessible to pedestrians at all times. If one sidewalk is closed, pedestrians should be directed to the other sidewalk by crosswalks, SIDEWALK CLOSED (R9-9) signs, detour signs (M4-8 and M4-9), Type II barricades, and signals, if necessary. Pedestrians should be diverted from the closed sidewalk at the first intersection crossing upstream from the work zone and not at midblock, unless provisions can be made to do so safely. At especially long blocks, it may be necessary to provide midblock crossings. Where they are provided, they should include safety features such as high-visibility striping and warning signs and/or signals. The designer should consult the Regional Pedestrian/Bicycle staff regarding the need for and the selection of the type of accessible signals. Refer to the MUTCD, Part 4E, Pedestrian Control Features.

Where the work encroaches upon a sidewalk and where it is infeasible to route pedestrians across the road, alternatives may be to maintain pedestrian traffic on the sidewalk, separated from the work by fencing or other means, or to construct a temporary sidewalk or path away from the work. Still another alternative may be to designate a walkway in the roadway. Where a designated walkway must be provided in the roadway, positive separation (e.g., channelization devices) or positive barrier (e.g., temporary concrete barrier) should be used between vehicular and pedestrian traffic. In selecting positive separation or positive barrier, the designer should consider the following:

- Pedestrian needs.
- Duration of the work.
- Roadway alignment and lane widths.
- Offset from the traveled way.
- Vehicle operating speeds.
- Truck traffic.
- Volumes of pedestrians and vehicles
- Need for continuous detectable separation.

Alternate pedestrian routes must meet the requirements of PROWAG R205. If technically infeasible, the alteration shall provide accessibility to the maximum extent feasible.
A.4 Walkway Closures and Detours. When planned construction activities will close a sidewalk, shoulder, or existing pedestrian detour for an extended period, or result in major disruption to the pedestrian facility, advance notice to pedestrians is desirable. Information signs, portable variable message signs, or other suitable means should be used to provide reasonable advance notice to pedestrians, including the expected nature and duration of construction activities.

On-site detour routes should be well marked, safe, efficient, continuous, and easy to traverse. They must be maintained free of obstructions and hazards, such as tripping hazards (i.e., lip heights at manholes, etc.), holes, debris, mud, construction equipment, stored materials, etc. Graded ramps meeting accessibility requirements should be used at surface discontinuities where there is a need. Detours should, at a minimum, be a stable, firm, and slip-resistant, all-weather, compacted gravel surface or other material capable of meeting the PROWAG requirements.

Temporary street crossings and crossings of stop-controlled commercial, institutional, and similar entrances to adjacent properties require the use of detectable warnings where walkways intersect the streets or entrances.

Pedestrians will often use the most direct path to their destination regardless of hazards. Signs and fencing should be used to direct pedestrians away from unsafe areas. Avoid designing pedestrian detours that are inconvenient and too circuitous. FHWA's Planning Design and Maintenance of Pedestrian Facilities gives 600 feet as the maximum distance most pedestrians will find reasonable to detour off of their path of travel.

A.5 Rural Work Zones. Rural pedestrian needs should be carefully evaluated. Often these needs are not as obvious as those in more populated areas. While a rural road may not have large numbers of pedestrians, it may be the only route to a particular destination. It should be expected that pedestrians, including permanent and seasonal residents, will use the road or the shoulder or they will walk at the edge of the travel lane if a walkable shoulder is not available. Some obvious rural sources of pedestrian activity include resorts, state parks, camp grounds, recreational areas, amusement parks, homes, etc.

On repaving contracts where the underlying or top course is to be left exposed on roads where pedestrians regularly use the shoulder, include temporary edge lines to delineate the right-hand edges of the motor vehicle lanes closest to the shoulders and create a pedestrian walkway. This should be done when other temporary markings are placed. This will help avoid inappropriate motor vehicle encroachment into shoulders that are regularly used by pedestrians, or vice versa.

Shoulders that are not designed to meet accessibility standards are acceptable when they are not specifically intended as places to walk. However, shoulders are almost always places where people may walk, if they so choose, except on freeways and similar roads where pedestrians are legally prohibited.

It is recognized that it may be excessively costly or impracticable to meet the needs of occasional pedestrian traffic on rural bridges under construction or on paving projects where shoulders are not available to pedestrians. However, there is, nonetheless, a need to provide for pedestrian traffic because many rural bridges provide the only link between destinations for
residents and vacationers who depend on walking or bicycling for transportation. Alternatives to providing for pedestrian traffic on roadway bridges may include temporary pedestrian walkways or structures, accessible shuttle, accessible on-call taxi or van, or similar services, fall-hazard protective fencing, or other innovative solutions. Consideration could also be given to moving the trip destination or providing an alternate service on the pedestrian side of the bridge as is sometimes done with emergency services. When accessible, on-call vehicle service is requested, it must be provided. When the requested service does not require accessibility, an accessible vehicle is not required.

A.6 Economic Impacts. In commercial and residential areas, adequate pedestrian walkways to properties abutting work zones should be provided. Efforts should be made to minimize adverse economic impacts to commercial establishments in the vicinity of the work zone. Refer to §16.3.4.2.A in this chapter and the MUTCD Typical Applications TA-28 and TA-29.

A.7 Signs. Construction signs located over or where they will intrude into a walkway must have a 7 foot minimum clearance height. Signs and other traffic control devices should not be a hazard to pedestrians. Signs directing pedestrians must be illuminated to Level 1 standards (as per the Standard Specifications Section 619-3.19 night time illumination requirements) when used overnight.

A.8 Pedestrian Protection. Walkways under or adjacent to elevated work activities such as bridges or retaining walls may require a protective roof, protective shielding, etc. Fall-hazard protective fencing should be provided, particularly on bridge replacement projects, when the pedestrian travel path through the work zone exposes them to a fall hazard, e.g., after one-half of the existing bridge deck has been removed, before it is replaced.

A.9 Nighttime Lighting. Where there is a likelihood of pedestrians using a walkway at night, sufficient illumination (minimum Level 1 standards) should be provided based on the level of illumination that existed prior to construction, and the level of illumination on adjacent locations. Consideration should also be given to the type and severity of hazards to pedestrians and other site specific factors that may affect the accessibility, safety, security, or convenience of the walkway to determine whether they warrant nighttime illumination. All pedestrian walkways that take pedestrians off their intended path are to be lighted. Temporary lighting should be considered where adjacent street lighting will not illuminate pathways provided around work zones. Lights should be provided to delineate the pathway and to mark hazards. This lighting can be especially beneficial for vision-impaired persons where existing lighting levels are not optimal.

B. Bicyclists

B.1 Level of Accommodation. Bicyclists of various skill levels use most roadways to various extents where bicycling is not prohibited. Therefore, the question of what is necessary to provide access for bicyclists through or around work zones must be carefully assessed for each project where bicyclists are not prohibited. This assessment should take into account the amount and types of bicycle activity occurring along the roadway, as well as motor vehicle and
pedestrian traffic characteristics. A project may require one or more different methods to provide proper appropriate access based on these assessments. One or more of the following are indications that there is bicycle activity at a site:

- The road is a designated bicycle route.
- Bicyclists have been observed on site visits.
- Bicycle traffic generators, such as residential, commercial, recreational, and/or institutional land uses, are located adjacent to or near the work zone.
- The roadway is in a recreational area such as the Adirondacks, the Catskills, the Finger Lakes, etc.

Bicyclists can often travel in the same vehicle lane as motorists when one or more of the following conditions occur:

- The work zone lane width will be at least 12 feet. (Lanes should be at least 14 feet wide adjacent to concrete barriers, guide rail, vertical retaining walls, or abutments.)
- Motor vehicle speeds and volumes are low. This decision will require engineering judgement as there are no nationally adopted guidelines for these situations. However, examples include locations where operating speeds are 30 mph or less and volumes do not exceed 500 to 1000 AADT and where truck, bus, and RV volumes do not exceed approximately 30 per hour.
- The roadway will be paved.
- The grades in the work zone are not steep(<5.0%). Where grades are steep (>5.0%), consideration may be given to providing a shoulder in the uphill direction of travel. Bicyclists traveling downhill can frequently be accommodated in vehicle travel lanes.
- There is no parking on the side of the roadway.

Where it is not desirable to combine bicycle and motor vehicle traffic due to higher motor vehicle speeds and volumes, bicyclists can be accommodated on shoulder space. In this situation, a shoulder of reasonable width (min. 4 feet) should be provided. In some cases, bicyclists may be advised, through the use of signing, to use pedestrian facilities. See B.3 below.

B.2 Bicycle Traffic Closures and Detours. An alternative to providing for bicycles where there is insufficient roadway width may be to provide a separate bicycle detour around the construction site. The detour should be convenient and have appropriate warning signs and traffic control devices, especially when routing an off-road bicycle detour back into the main roadway.

Off-road bicycle detours should be paved continuously and free of surface irregularities such as potholes, cracks, ponded water, etc. On-road provisions should be paved whenever feasible (especially on bike routes). Where this cannot be accomplished, and there is considerable risk of injury, bicyclists may be advised, through the use of signing, to dismount and use pedestrian facilities. This should not be used where bicyclists would be required to spend considerable time on foot because it may be viewed as unreasonable and ignored.
B.3 **Use of Pedestrian Routes.** Bicyclists may be advised, through the use of signing, to dismount and use pedestrian routes only where sufficient roadway widths cannot be provided or where roadway construction conditions may make bicycling hazardous and an off-road alternative for bicyclists cannot be provided. As previously stated, this alternative should only be used in extreme circumstances and should not be used for long distances, as it may be viewed as unreasonable and ignored.

B.4 **Rural Work Zones.** Providing for bicyclists in or around rural work zones should be considered, even when there is not an obvious need. While there may not be large numbers of bicyclists, the road may be the only route to a particular destination in the area.

B.5 **Precautions.** The skill level of the bicyclists using the roadway should be considered. If the work zone is near a school, playground, or other area where the predominance of riders is likely to be children, extra precaution should be taken to provide for them safely. For example, off-road provisions are usually preferable, use of shared lanes (as discussed in 16.4.4.2.B.1) should be avoided, and shoulders should be wider than 4 feet where motor vehicle operating speeds exceed 40 mph.

B.6 **Fall-Hazard Protection.** Fall-hazard protective fencing should be provided, particularly on bridge replacement projects, when the bicycle travel path through the work zone exposes them to a fall hazard, e.g., after one-half of the existing bridge deck has been removed, before it is replaced. Keep in mind that bicyclists tend to have a higher center of gravity than do pedestrians.

B.7 **Signs.** Appropriate signs should be used to warn bicyclists and motorists. The bicycle warning sign (W11-1) with IN LANE (NYW5-32P) panel may be used either where bicycle and motor vehicle traffic are intended to share a reduced roadway width (due to shoulder closure and/or lane width reduction (less than 12 feet in width)) or where bicyclists are diverted into the roadway from a pathway off the road. The sign assembly can be used when changes in routing bicycle or motor vehicle traffic through or around the work zone affects the proximity of bicyclists to motor vehicle traffic. These signs should not be used routinely where the above conditions do not exist since unnecessary use can reduce their effectiveness.

B.8 **Pavement Markings.** On repaving contracts where the binder course is to be left exposed on roads designated as a Shared Roadway, Signed Shared Roadway, Bike Lane or Bicycle Lane, and on other roadways where bicycle volumes are greater than 50 AADT and motor vehicle volumes are greater than 500 AADT, temporary pavement markings should include edge lines to delineate the right (outside) edge of the motor vehicle travel lane as well as the center line or lane line. This should be done when other temporary markings are placed. This will help prevent motor vehicle encroachment into bicyclists' paths of travel, or vice versa. A special note should be placed in the contract documents that states that the edge line markings must be placed the same day the new pavement is opened for traffic, i.e., the same as for other temporary pavement markings. Where bicycle traffic must be routed onto a dedicated pedestrian walkway, bicycle riders must dismount and walk their bicycles through the walkway.
16.4.4.3 Oversize Vehicles

Oversize vehicles exceed the dimensional and weight limitations as set forth in Section 385 of the NYS Vehicle and Traffic Law. Oversize vehicles can become trapped or stuck in a constrained work zone and must be considered during design. While some traffic control devices or equipment can be moved to allow passage of an oversize vehicle in an emergency, when oversize loads enter a work zone without warning, serious problems can result. Designers should consult the Regional Permit Engineer (RPE) to determine if the project is on a highway designated for 16-ft wide loads. Short-term disruptions in the flow of 16-ft wide loads can be tolerated but longer-term disruptions will severely impact the hauling industry and must be avoided.

A. Permitted Vehicles

Operators of oversize vehicles must obtain Special Hauling Permits, which allow their vehicles to travel on State highways only during regular business days from one-half hour before sunrise to one-half hour after sunset. Specific routing, special restrictions may be prescribed by the RPE. When they are written, typed, or stamped on the permit, they become enforceable by any police.

Any loads/vehicles wider than 8.5 ft require a Special Hauling Permit. Permits are approved by either the RPE or the Main Office Permit Unit. A high level of coordination is maintained between the RPE and the Main Office Permit Unit to ensure that all construction restrictions are accurately posted and maintained on the State internet site. Annual Radius and Blanket Permits are issued to some carriers that regularly haul loads between 8.5 ft and 12 ft wide. These permits allow the carrier to haul anywhere on the State system for an entire year. Trip Permits are required for anyone hauling a load between 8.5 ft and 12 ft who does not otherwise have an Annual Permit and for all loads wider than 12 ft. A typical modular home is 14 ft to 16 ft wide.

Haulers operating under a Trip Permit have to obtain a permit approved and issued by an RPE or the Main Office Permit Unit every time they want to haul their load. At that time, the permit issuer can (if properly notified of work zone restrictions) ensure that the load is routed around a work zone which cannot accommodate the oversize load. Under an annual Trip Permit, haulers do not need to consult with the permit staff for each trip, and they may be unaware of temporary restrictions placed after the annual permit is issued. There are tens of thousands of annually permitted loads and it is not uncommon for an annually permitted load, or a load that is running illegally without a permit, to enter a work zone resulting in possible worker injury or death, property damage, and extensive delays to traffic and construction work.

On roadways with two or more lanes open to traffic, either one-way or two-way, occasional wide loads can generally be accommodated, regardless of temporary lane widths in place. (Other vehicles will stagger or get out of the way.) Single-lane sections are the primary concern, especially when barrier or other immovable constraints are present. However, on high-volume highways or where oversize loads are more frequent, wide loads may cause a great deal of disruption and designers may want to prohibit them, even if they could make it through physically. Consult with the RPE and the Regional Traffic Group to determine the anticipated frequency of wide loads and whether they should be prohibited.

All roadway or bridge widths less than 14 ft should have signing to direct all the annual permit
haulers exceeding the available width of the highway. While annual permit haulers are
responsible for verifying the adequacy of the route before each trip, the consequences of an
oversize vehicle becoming stuck in the work zone or trapped on an approach, warrants signing
to remind the haulers of their responsibility. The available roadway width shall not be less than
the vehicle width plus one foot of clearance on each side. A 12-ft wide load with 1-ft clearance
on each side typically requires at least 14 ft of available roadway width. Consider increasing
the clearance if there will be an alignment shift or other conditions which complicate the task of
negotiating the work zone. Since Trip Permit haulers are provided with routing information by
the permit issuer, no signing is needed to accommodate them. Typical special warning signs for
a roadway width of 13 ft might read “NARROW BRIDGE/XX MILES,” followed by “VEHICLES
OVER/11 FT WIDE/USE EXIT XX,” followed by “VEHICLES OVER/11 FT WIDE/EXIT HERE.”

Consider installing signing (traditional or portable variable message signs) one month prior to
the beginning of the restriction, to give annual permit operators advance notice of the
upcoming restriction and remind them to find another adequate route. Signing a detour for
oversize vehicles is generally not recommended because designating a formal detour would
place the liability for an accident involving an oversize vehicle on the Department. If a detour is
to be used, it must be thoroughly checked for adequacy for all types of oversize vehicles before
being signed. If a detour is being considered, consult with the RPE and the Regional Traffic
Group.

The EIC (or the Regional Construction Group) is responsible for notifying the RPE of any
construction-related restrictions and their durations. The RPE then notifies the other RPEs and
the Main Office Permit Unit so that they do not issue permits for loads exceeding the restriction
through the work zone.

B. Farm Equipment

In rural areas, designers should consider the needs to accommodate access by farm
vehicles/equipment. Farm vehicles must be accommodated if the farmer needs a portion of the
highway to access parts of his or her property. Farmers are not required to obtain a permit
unless the vehicle/load exceeds 17 ft in width. Designers should reach out to local farmers to
identify their equipment width needs and to ensure that the project allows access to all portions
of their property.

16.4.4.4 Snow Removal

Any roadway with restricted width that might be in place during winter months needs to be wide
enough to accommodate snow plows or other snow removal equipment. Consider the possibility
that jobs not expected to go through the winter might end up doing so due to delayed letting
dates, field problems, etc. For projects which might have wintertime width restrictions, consult the
Regional Transportation Maintenance Group for guidance on the minimum width needed for snow
and ice control.
16.4.4.5 Other Considerations

A. Motorcycles

Any change in condition of the pavement surface should be communicated to motorcyclists by signs, far enough in advance of the change to give the operator time to make the necessary adjustments. Extra precaution should be taken to ensure that no construction materials, steel plates, or debris reaches the traffic lanes, especially at night, because the reactions of motorcyclists to objects on the road tend to produce a more severe corrective maneuver, irrespective of the nature of the object.

To warn motorcyclists of the presence of milled pavement, the contract documents should show GROOVED PAVEMENT (W8-15) signs on each approach (including side streets) to locations of milled pavement. It may be supplemented with the W8-15P motorcycle plaque. As required by the Standard Specifications, place a variable-message sign (VMS) on high-speed (45 mph or higher), mainline approaches to the milled pavement. An appropriate two-part message would be GROOVED PAVEMENT AHEAD/MCYCLES USE CAUTION. VMSs and messages deemed appropriate must be shown in the contract documents and paid for under their own item.

Milled, longitudinal or transverse vertical faces exceeding 1 inch in height that will be exposed to traffic during nonwork hours shall be sloped or tapered by temporary patches or shims to avoid creating a traffic hazard. For bumps and where vertical transverse faces cannot be adequately sloped or tapered, BUMP (W8-1) signs shall be installed in accordance with the MUTCD, NYS Supplement Section 2C.05, Table NY2C-4, and the Standard Specifications. An object marker (OM1-1; OM1-2; OM1-3) shall be installed on the right side of the roadway at the rebate. On divided highways, an object marker shall be installed on both sides of the roadway. A drum with a Type B, flashing warning light may be used instead of an object marker.

When both the BUMP and GROOVED PAVEMENT signs are used, strict conformance to the advance posting distances in the NYS Supplement results in the signs being placed too close together. The Standard Specifications directs contractors to install the GROOVED PAVEMENT sign in nonurban areas 500 feet (300 feet in urban areas) upstream of the BUMP sign so that the signs are adequately spaced. Designers should consider the possibility that a BUMP sign will be needed when specifying advance posting of the GROOVED PAVEMENT sign. Since BUMP signs are usually 200 feet in advance of the rebate, GROOVED PAVEMENT signs in nonurban areas should be located 700 feet (500 feet in urban areas) in advance of the rebate to maintain adequate spacing.

On multilane highways where only one lane in a direction is milled and both lanes are open to traffic, supplement the GROOVED PAVEMENT sign with the appropriate LEFT LANE or RIGHT LANE panel below the sign. While the MUTCD allows repeated use of GROOVED PAVEMENT signs with W7-3aP auxiliary mileage panels, the presence of other work zone traffic control devices reminds motorcyclists of the continuing milled pavement, and repetition is not recommended unless warranted by project-specific conditions.

Where only a ramp is milled, sign the mainline with a GROOVED PAVEMENT sign and a supplemental RAMP panel.
Speeds prescribed in work zones should be low enough so that the motorcyclist is not exposed to increased risks due to sudden braking.

B. Incidents

Incidents that occur within highway work zones can effectively reduce the flow of traffic and potentially stop the work activities for an extended period of time. Failure to plan for emergency situations will cause unnecessary inconvenience and frustration to motorists, increase the cost of incidents, and result in poor perception of the contractor and Department. Refer to Chapter 24 in this manual for more information on incident management.

C. Class A Containment Systems

Class A Containment Systems contain spent abrasive and paint waste debris from bridge painting projects. The design of a Class A containment system may significantly impact the traffic control requirements. It is important to provide as many details as possible should the contractor chose to develop an alternative traffic control scheme. These details should include typical lane closure and signing layouts, limitations on when the roadway may be occupied, clearances, special features such as shadow/barrier vehicles, hours of work, and other considerations.

16.4.5 Sequence of Construction

Staged construction denotes the construction of a facility by phases in a sequential manner. Staging plans establish what, where, and when construction activities will be performed and where traffic will go during these activities. Staged construction is widely used, generally when a detour route is not available or feasible. Several stages may be necessary to complete the project.

WZTC staging plans should be utilized when the work must be done in accordance with a certain sequence of construction. Notes related to the various construction stages should be included on these plans. Each phase of construction should be thoroughly described in the sequence in which they are to be performed.

A TCP is necessary to ensure that the flow of traffic can be maintained while building the project without undue difficulty and with a minimum number of orders-on-contract. Developing a sequence of construction and traffic control plan is an essential part of the overall project design and may affect the design of the facility itself. Design of the proposed improvements should be coordinated with the traffic control plan. There may be acceptable design alternatives which will improve tie-ins to existing pavement and facilitate significantly smoother traffic flow.

Except for the most simple projects, a recommended sequence of construction should be provided. Delays and redesign during construction are often extremely costly, may cause an unsafe situation, and can unnecessarily disrupt traffic patterns. To the extent possible, the plan should have flexibility. Each project presents unique challenges and developing a sequence of construction offers opportunities to address these concerns at an early stage.

In the case of multistage construction projects involving several traffic pattern shifts, significant detail is involved. Detailed control plans defining the staging needs as well as the specific traffic control devices required for each stage will be required.
A phasing overview plan may be appropriate to highlight the work to be done and the traffic flow patterns in each construction phase.

Throughout the design process, it is important to keep the “big picture” in mind and solicit input from the appropriate Regional functional units and experienced individuals. Before beginning to prepare a sequence-of-construction plan, the designer should walk or drive the project to become familiar with the site and critical construction areas, take notes, make sketches, and video tape and take photographs to assist in communicating issues to be considered.

Another means by which to familiarize oneself with the site is to view the Department’s photolog files. The photolog is a series of sequential photographs, taken from a moving vehicle at driver’s eye level. While not as informative as a site visit, the photolog shows such items as the number of lanes, surface type, pavement markings, structures, signing, and hazards in true perspective and in their relative positions. The Department’s photolog viewer (iVision) is accessible via an internal network application. The application and instructions may be accessed at the following link: NYSDOT Photolog

A draft sequence-of-construction plan should be prepared by thinking through each step as it relates to the other steps. Well-prepared sequence-of-construction plans from other projects should be reviewed to learn about the various issues involved. Brain storming alternative construction sequences may lead to the most practical method. It may be helpful to color-code each phase of construction and prepare a written narrative of each phase.

The work to be performed during each stage of construction and work completed while construction is being performed during subsequent stages should be identified by symbols on the TCP. When temporary pavement is required, a typical section should be provided.

The designer is responsible for determining the need for lane closures, shoulder closures, sidewalk closures, full road or bridge closures, and detours during construction. The designer should also determine if it will be necessary to shift traffic lanes away from the normal position during construction and determine required easements. If closing or shifting lanes is necessary, a sequence of construction should be prepared.

If detours, right of way, or easements are required for traffic control, the sequence of construction should be completed in sufficient detail for the right of way requirements to be incorporated into the plans used for the public meeting.
Items to address in preparing the sequence of construction should include, where appropriate:

- The sequences of construction of adjoining projects should be coordinated. There may be occasions where a portion of one project would be more efficiently constructed at a designated stage of construction sequence of another project.

- Bridge construction should be addressed in sequence of construction. The coordination of the bridge construction with the roadway portion should be evaluated. Detours may be necessary during periods of bridge construction.

- Sequences of construction should be designed to prevent worker activity left and right of traffic at the same time. This situation makes the driver feel restricted, slows traffic, and endangers workers.

- Similarly, sequences of construction should be designed to avoid having work in the middle with traffic on both sides. This makes access difficult and there is no safe escape route for workers.

- Replacement of existing drainage may require a temporary diversion ditch or pipe. Jacking versus open cut for pipe causes less interruption to traffic but is normally a considerably more expensive method of pipe installation. Proposed pipes under roadways with high traffic volumes or difficult detours options are candidates for jacking.

- New construction and extensions of box culverts require considerable construction time. Urban projects should use precast concrete items as much as is practical, since urban improvements are generally adjacent to and performed under traffic.

- Environmental concerns include avoiding wetlands and stabilizing disturbed slopes at the earliest appropriate stage of construction.

- Excavation and earthwork must match maintenance of traffic and sequence of construction plans. Consider borrow material versus surplus material at each stage of the sequence. Address locations where surplus material may be placed. Areas of graded slopes may be appropriate locations to waste surplus material. Consider areas of major cut or fill to anticipate slope tie-in difficulties. It is essential that the project sequence of construction be taken into consideration to avoid specifying use of material which is not available in the appropriate phase of construction. On complex projects, it may be necessary for the designer to develop rough grading diagrams and summaries for each phase of work to accurately determine the grading effort required.

- Where practical, the top layer of a hot mix asphalt concrete pavement should be paved as a single stage of construction for the full width of the traveled way, shoulder, and auxiliary lanes to improve the riding quality of the finished pavement. Therefore, the development of the WZTC staging plans for projects involving paving operations should specify a construction sequence in which work progresses up to the bottom of the final pavement course. The final pavement course should be shown as the final paving stage.

- Staging should provide for a minimum exposure to drop-offs and uneven pavement adjacent to and between travel lanes during all phases of paving.

- Staging should minimize the time between removal of guide rail or barrier and placement of guide rail or barrier.

- The delivery and unloading of materials and equipment should be planned so as to minimize the impact on traffic movement, as much as practical.
• Nighttime construction may greatly reduce the disruption of traffic flow resulting from stoppages. Certain construction activities, such as the placement of bridge girders or overhead sign structure might be better accomplished at night. However, additional safety precautions may be necessary when accomplishing these activities.

• Pavement or structure demolition sequence should be considered.

• The effects of railroad crossings or construction adjacent to rail lines should be considered. Avoid situations where traffic could queue across railroad tracks.

• Time of day, holidays, or other day and time restrictions may be necessary stating when construction or traffic flow restraints are not allowed. Several Regional offices have lists of highways where daytime single or multiple lane closures are not permitted. Notes may be necessary stating specific dates/times. Local ordinances such as noise may restrict when work can be performed.

• Existing utilities should be addressed in the sequence of construction as to when and by whom they will be relocated. Completion of a portion of the road construction may be necessary prior to installing or relocating utilities. If temporary widening is necessary for stage construction, the temporary pavement section must fit within the right of way and/or existing utilities. Consider and develop, in consultation with the Regional Construction Group, contingency plans for scenarios where delayed utility pole relocation could adversely impact roadside safety or sidewalk construction.

• Notes in the traffic control plans should clearly spell out the limitations and requirements of the project so that if the contractor chooses to develop a different traffic control scheme, the essentials are specified.

The above list is not all-inclusive and there may be other items not listed therein that would be appropriate for consideration on certain projects.

16.4.6 Work Zone Speed Limits

Vehicle speeds through work zones are an important factor affecting the safety and mobility of road users and highway workers. The intent of speed limit reductions in work zones is to promote safe and efficient traffic flow through work zones, as well as enhance the ability of traffic to safely react to highway work and disruptions in traffic flow. Speed limit reductions in work zones should only be used when necessary and should be relevant to the conditions or restrictive features that are present. This guidance reflects when to include speed limit reductions in work zone traffic control plans, and describes the methods for establishing and implementing them.

Work Zone Component Definitions:

Major Active Work Zone is a stationary work zone having a duration exceeding 4 hours with workers on foot in the work zone and not predominately separated from traffic by positive barrier on a fully controlled access highway with a preconstruction posted speed limit of 55 mph or greater.

A Work Zone is the area of a highway with construction, maintenance, or utility work activities. It is typically marked with signs, channelizing devices, barriers, pavement markings, and/or work vehicles and extends from the first warning sign to the END ROAD WORK sign.
An **Activity Area** includes the work space (where workers, equipment and materials are present) and buffer space.

A **Work Space** is the portion of the highway closed to road users and set aside for workers, equipment, and material, and a barrier vehicle if one is used. Work spaces are usually delineated by channelizing devices or temporary barriers to exclude vehicles, bicycles, and pedestrians.

A **Delineated Work Space** is a work space delineated by channelizing devices that does not provide positive protection from traffic.

A **Protected Work Space** is a work space delineated by concrete barrier or other devices providing workers with positive protection from traffic.

**Work Duration Definitions:**

- **Long-term Stationary Work Zone** is a work zone that occupies a location more than 3 consecutive days.

- **Intermediate-term Stationary Work Zone** is a work zone that occupies a location more than 1 daylight period up to 3 consecutive days, or a nighttime work zone lasting more than 1 hour.

- **Short-term Stationary Work Zone** is a daytime work zone that occupies a location for more than 1 hour within a single daylight period.

- **Short Duration Work Zone** is work that occupies a location up to 1 hour.

- **Mobile Work Zone** is a work zone that moves intermittently or continuously.

**Speed Definitions:**

- **Preconstruction Posted Speed limit** is the speed limit, prior to commencing construction, established by official order and shown on Speed Limit signs.

- **Advisory Speed** is a recommended speed for vehicles operating on a section of highway within a work zone, based on the design, operating characteristics, and conditions of the work zone.

- **Regulatory Work Zone Speed Limit** is the reduced speed limit applicable to a section of highway within a work zone as established by official order or under a designation of restricted highway.

16.4.6.1 **Determination of the Need for Speed Reduction**

The Manual on Uniform Traffic Control Devices (MUTCD) states: “Reduced speed limits should be used only in the specific portion of the work zone traffic control where conditions or restrictive features are present.” Advisory speeds that warn motorists of potential hazardous conditions are a preferred alternative to regulatory speed reductions. Studies show that drivers will reduce their speed only when they feel the need to do so regardless of posted limits and that the greater the speed differential or variance, the greater the potential for crashes. The MUTCD further states: “Reduced regulatory speed limits should be avoided as much as practicable because drivers will
To the extent practical, a work zone traffic control plan should be designed to provide work zone geometric transition(s), sight distance, lane width, and superelevation that result in a recommended speed for the work zone that meets or exceeds the design speed or the preconstruction posted speed limit plus 5 mph. Where a reduction in the regulatory speed limit is warranted within a work zone, the speed limit should not be reduced more than 10 mph below the preconstruction posted speed limit, unless an engineering study shows that the geometric conditions warrant a greater speed limit reduction. The Regional Traffic Engineer or their designee will be responsible for approving all work zone advisory speeds and reduced regulatory speed limits.

Reductions in advisory speeds or regulatory speed limits in work zones are to be established consistent with changes in the physical character of the work area. Reduced advisory speeds or regulatory speed limits in work zones shall be in effect only where conditions warrant the speed reduction within the work zone. However, in some circumstances, a speed limit reduction may be required because a speed limit reduction was in existence prior to construction, such as on the approach to a residential area.

In long work zones with several intermittent activity areas, where it has been determined that a regulatory speed limit reduction is necessary at each activity area, the preconstruction posted speed limit shall be restored between activity areas where they are separated by 2 miles (3 km) or greater. In those cases, it is essential to ensure that the speed zones reflect consistently different conditions, and that no zone is less than ¼ mile in length.

The decision to include a reduced speed limit should normally be made during design and included in the traffic control plan. However, at times it may not become apparent that a speed limit reduction is needed until after construction is underway. In such cases, Regional Construction personnel are responsible for initiating the establishment of a speed limit and, if deemed important, for ensuring that there are adequate areas for police enforcement operations. The Regional Traffic Engineer or their designee will be responsible for approving all work zone advisory speeds and reduced regulatory speed limits.

The original speed limit should be restored when the condition(s) that warranted it will no longer be present. Leaving the reduced speed limit in effect when not needed will encourage motorists to ignore it when it is needed. Notes should be included in the WZTC plans specifying when the reduced speed limit is active and when the original speed limit is to be restored.

### 16.4.6.2 Selecting and Approving Speed Limit Reductions in Work Zones

Speed reductions in work zones may be selected by the designer during the development of the Work Zone Traffic Control Plan or by Construction Inspection Staff during construction. Speed limit reductions warranted by construction conditions should generally be by 10 mph. Larger reductions should only be used for especially restrictive conditions. Speed reductions in work zones should be recommended by the Regional Design Engineer and/or Regional Construction Engineer, but require the approval of the Regional Traffic Engineer.

The flowchart shown in Figure 16-8 should be used to assist in determining the need for work zone advisory speeds.
The flowchart shown in Figure 16-9 should be used to assist in determining the need for work zone regulatory speed limit reductions.

16.4.6.3 Signage for Regulatory Speed Limit Reductions in Work Zones

Speed limits in work zones are enforceable in court, when they are placed pursuant to traffic control powers granted, by law, to state and local authorities and in accordance with sign design and placement requirements of the MUTCD. Speed limit signs shall be posted as illustrated in Exhibits 16-10 through 16-12 (labeled in the images as Exhibits 3A, 3B, and 3C). Exhibit 3A provides signing for cases where a regulatory work zone speed reduction is implemented at a merging taper. Exhibit 3B provides signing for cases where a regulatory work zone speed reduction is implemented, but where the work space is located more than ½ mile beyond the merging taper. Exhibit 3C provides signing for cases where a regulatory work zone speed reduction is implemented in association with transition geometry.

A. Speed Limit Signs

All reduced speed limits in work zones shall be posted with black/white regulatory speed limit signs (R2-1) with black/orange WORK ZONE panels (G20-5aP) mounted above speed limit signs, to call attention to the reduced speed limits in work zones. A WORK ZONE panel shall not be mounted above preconstruction speed limit signs within a work zone. Existing regulatory speed limit signs or advisory speed plaques that conflict with a reduced speed limit in a work area must be completely covered or removed when a reduced work zone speed limit is in effect. Conversely, reduced work zone speed limit signs must be completely covered/removed and preconstruction posted speed limit signs are to be uncovered/replaced, after a work zone activity area is removed or the reduced speed limit is no longer needed.

All reduced work zone speed limit signs in work zones shall be installed on both sides of a multi-lane divided highway. When traffic is reduced to a single lane, work zone speed limit signs are to be installed only on the right side of the highway. Supplemental work zone speed limit signs shall be interspersed within the work zone activity area with a maximum spacing of ½ mile (0.8 km). A preconstruction posted speed limit sign or END WORK ZONE SPEED LIMIT (R2-12) sign is to be posted 100 ft (30 m) beyond the end of the work zone activity area having a reduced speed limit. An END HIGHER FINES ZONE (R2-11) sign shall then be placed 200 ft beyond the END WORK ZONE SPEED LIMIT or preconstruction speed limit sign to define the ending limit of the higher fine zone (see section below).
EXHIBIT 1:
WORK ZONE ADVISORY SPEED FLOW CHART

Advisory speeds are not warranted and shall not be used
where the work zone consists solely of a shoulder closure.

NOTE 1:
EXHIBIT 1 SHOULD BE USED IN CONJUNCTION WITH EXHIBIT 2 (REGULATORY SPEED REDUCTION FLOW CHART). FOR EXAMPLE, ADVISORY SPEEDS MAY BE USED FOR HAZARDOUS CONDITIONS WITHIN A REDUCED REGULATORY SPEED ZONE.

NOTE 2:
ROUND ALL ADVISORY SPEEDS TO 5 MPH.
EXHIBIT 2:
WORK ZONE REGULATORY SPEED LIMIT REDUCTION FLOW CHART
*Regulatory speed reductions are not warranted and shall not be used where the work zone consists solely of a shoulder closure.

NOTES:
1. **EXHIBIT 2 SHOULD BE USED IN CONJUNCTION WITH EXHIBIT 5 (WORK ZONE ADVISORY SPEED LIMIT CHART).**
For example, advisory speeds may be needed for hazardous conditions regardless of whether or not regulatory speed limit reductions are implemented.

2. **SHORT TERMS** DEFINED AS MORE THAN 4 HOURS AND A MAXIMUM OF 1 DAY TIME SHIFT. **INTERMEDIATE TERMS** DEFINED AS MORE THAN 4 HOURS, SHIFTS UP TO 5 CONSECUTIVE DAYS OR MORE THAN 4 DAYS AT A TIME.

3. A **MAJOR ACTIVITY WORK ZONE** IS DEFINED AS A WORK ZONE HAVING THE FOLLOWING CONDITIONS:
- Work on a fully-controlled access roadway with preconstruction posted speed limit of 55 MPH or greater;
- Workers on foot on the roadway and not permanently separated from traffic by positive protection such as temporary concrete barriers;
- Work zone is stationary with no duration exceeding 4 hours.

4. A GEOMETRIC TRANSITION IS DEFINED AS A CHANGE IN THE EXISTING HORIZONTAL OR VERTICAL ALIGNMENT OF THE TRAVEL LANE. A LANE SHUT OR LANE CLOSURE IS NOT CONSIDERED A GEOMETRIC TRANSITION WHEN APPROPRIATE TAPER LENGTHS ARE PROVIDED.

5. **GEOMETRIC TRANSITIONS SHOULD BE RECORDED IN THE WORK ZONE GEOMETRIC TRANSITION DISTANCE, LANE WIDTH, AND SUPER ELEVATION THAT MEETS OR EXCEEDS THE CRITERIA FOR THE DESIGN SPEED OR PRECONSTRUCTION POSTED SPEED PLUS 5 MPH.**

6. **REGULATORY SPEED LIMIT REDUCTIONS SHOULD BE MORE THAN 10 MPH.** REGULATORY SPEED LIMIT REDUCTIONS OF MORE THAN 10 MPH SHOULD BE USED ONLY WHEN REQUIRED TO NSTRICTIVE CONDITIONS IN THE WORK ZONE. ALL REGULATORY SPEED LIMIT REDUCTIONS MUST BE APPROVED BY THE REGIONAL TRAFFIC ENGINEER OR DESIGNER.
B. Higher Fines Signs and Plaques for Work Zones

NYS Vehicle and Traffic Law Section 1180(h) establishes higher fines for convictions of reduced speed limit violations within a work zone and 1809-d mandates a surcharge for violating the maximum speed limit in a work zone when a reduced regulatory work zone speed limit is instituted. These laws constitute the establishment of a higher fines zone within the work zone. Where increased fines are imposed for traffic violations, Section 6F.12 of the 2009 MUTCD requires a BEGIN HIGHER FINES ZONE (R2-10) sign be installed at the upstream end of a work zone, and an END HIGHER FINES ZONE (R2-11) sign be installed at the downstream end of the work zone. In lieu of using the BEGIN HIGHER FINES ZONE sign, NYSDOT instead requires that the “State Law” FINES DOUBLED FOR SPEEDING IN WORK ZONES (NYR9-12) sign shall be used at the upstream end of the work zone in accordance with Section 619 of the Standard Specifications and 6F.12 (01A) of the NYS Supplement to the MUTCD.

Speed limit signs shall be posted as illustrated in Exhibits 3A, 3B, and 3C. Exhibit 3A provides signing for cases where a regulatory work zone speed reduction is implemented at a merging taper. Exhibit 3B provides signing for cases where a regulatory work zone speed reduction is implemented, but where the work space is located more than ½ mile beyond the merging taper. Exhibit 3C provides signing for cases where a regulatory work zone speed reduction is implemented in association with transition geometry.

16.4.6.4 Advisory Speed Signs in Work Zones

All advisory speeds shall be posted with black/orange Advisory Speed Plaque (W13-1) below the appropriate warning sign, on the same post. Advisory Speed Plaques shall not be used in conjunction with any sign other than a warning sign, nor shall they be used alone.
EXHIBIT 3A: SIGNING PATTERN RELATIVE TO MERGING TAPER

(Continued from EXHIBIT 2)

NOT TO SCALE

WORK ZONE TRAFFIC CONTROL PLANS

Exhibit 16-10  Signing Pattern Relative to Merging Taper

NOTES:

1. WHEN THE ROADWAY IS OPEN TO ONLY A SINGLE LANE OF TRAFFIC, THE SPEED LIMIT SIGN SETUP SHALL BE PLACED ON THE RIGHT HAND SIDE OF THE ROADWAY ONLY. WHEN MULTIPLE LANES ARE OPEN TO TRAFFIC THE SPEED LIMIT SIGN SETUP SHALL BE PLACED ON BOTH SIDES OF THE ROADWAY.

2. FOR MULTIPLE LANE CLOSURES, THIS IS THE MERGING (LANE) TAPER LOCATED CLOSEST TO THE WORK SPACE.
Exhibit 16-12 Signing Pattern Relative to Transition Geometry

Exhibit 3C: Signing Pattern Relative to Transition Geometry

NOTE: WHEN TRAFFIC IS OPEN TO ONLY A SINGLE LANE OF TRAFFIC THE SPEED LIMIT SIGN SETUP SHALL BE POSTED ON THE RIGHT HAND SIDE OF THE ROADWAY ONLY. FOR MULTIPLE LANES OF TRAFFIC OPEN TO TRAFFIC THE SPEED LIMIT SIGN SETUP SHALL BE POSTED ON BOTH SIDES OF THE ROADWAY.

See Table NTCIP-4 for minimum distances.
16.4.6.5 **Speed Compliance Strategies**

Speed limit reductions in work zones are most effective when drivers perceive the need to slow down, whether through noticeable geometric or work-related constraints on traffic flow, or through active police enforcement of the work zone speed limit. Arbitrary speed limit reductions erode motorist's confidence in the need for reducing speed within a work zone. Traffic speed in work zones is generally lower, regardless of posted speed limit, when work zone conditions such as flagging, variable message signs, lane shifts, lane-width reduction, and enforcement exist. Engineering, education/awareness, and enforcement measures are to be used to influence motorists, promote work zone awareness, and achieve safe work zone traffic speeds. As a guide to speed control selection, Exhibit 16-13 summarizes the advantages and disadvantages of speed control methods.

A. **Engineering Measures**

Incorporating engineering measures into work zone designs will encourage drivers to safely negotiate work zones. Warning signs, advisory speeds, positive guidance, width restrictions, channelized chicanes, and use of intelligent transportation system technologies are examples of engineering measures that can be used to slow traffic traveling through a work zone. Other engineering measures, such as shifting traffic, median cross-over diversions and road closures with off site detours can help to maintain mobility of the traveling public, as well as remove potential conflicts between the traveling public and road work.

B. **Education/Awareness Measures**

The news media and internet are resources available to inform the public of impending and/or existing work zones. Newspapers, radio announcements, and television reports, as well as the Department's [http://511ny.org/](http://511ny.org/) web page, social media, or mobile device application, provide the public with useful travel information. The required signing indicating the presence of zones with higher fines enhances public awareness of the need to comply with reduced speed limits.

C. **Portable Variable Message Signs**

Portable Variable Message Signs (PVMS) with built-in radar detectors can be used in active work zones to alert drivers that they are exceeding the speed limit with the following 2 phase message:

<table>
<thead>
<tr>
<th>WORKZONE SPEED IS XX MPH</th>
<th>YOUR SPEED IS XX MPH</th>
<th>YOU ARE SPEEDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st phase of message</td>
<td>2nd phase of message</td>
<td>Triggered phase</td>
</tr>
</tbody>
</table>

PVMS deployed specifically to display these messages shall not be considered a replacement for any PVMS required by the work zone traffic control plans. PVMS equipped with trigger panels should be programmed using a "Trigger Speed" of 15 mph above a posted speed limit of 45 mph or higher and a "Trigger Speed" of 10 mph above a posted speed limit of 30 mph to 40 mph.
PVMS should be utilized only in work zones where it can be safely located without interfering with the work zone traffic control and where it can accurately track the speed of vehicles and prove to be effective. PVMS should be de-activated during periods of traffic congestion, and regularly moved to enhance effectiveness. PVMS shall not display the above message for a period of longer than 2 consecutive weeks per project. Overuse may desensitize the motoring public to their use and reduce their effectiveness.

D. Speed Display Trailers

Speed Display Trailers with built-in radar detectors can be used to alert drivers that they are exceeding the speed limit by displaying approaching vehicle speeds. Speed Display Trailers are to be supplied, positioned, maintained, and removed by the Department. Speed Display Trailers should be de-activated during periods of traffic congestion, and regularly moved to enhance effectiveness.

E. Enforcement Measures

Engineering and education/awareness measures can help reduce speeds. However, active police enforcement is the most effective measure to encourage motorist compliance with posted regulatory speed limits and other traffic regulations within work zones. Under the 2005 Work Zone Safety Act Regulation, 17 NYCRR 164, state police services will be provided to the extent practicable within major active work zones. The need for police presence and/or enforcement should be determined as early as possible during the project design phase and prioritized at the time of construction.

Police enforcement needed for maintenance type work zones should be coordinated as early as possible with the police agency and the Regional Traffic and Maintenance Groups.

All affected parties should meet prior to any active enforcement within a work zone. Adjustments to reduced regulatory work zone speed limit sign locations and/or the work zone set-up may be needed in order to safely accommodate active enforcement within the work zone. Any changes made to the typical work zone set-up shall be at the discretion and approval of the Regional Traffic Engineer.
## Exhibit 16-13  Advantages and Disadvantages of Speed Control Methods

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Law Enforcement (Stationary patrol car treatments only)</strong></td>
<td>1. Large speed reduction possible.</td>
<td>1. Constrained by availability of police officers and patrol cars.</td>
</tr>
<tr>
<td></td>
<td>2. Relatively inexpensive for short duration applications.</td>
<td>2. Agency/Contractor does not have direct control over performance.</td>
</tr>
<tr>
<td></td>
<td>3. Quick and easy to implement and remove.</td>
<td>3. High cost for long-duration applications.</td>
</tr>
<tr>
<td></td>
<td>4. Can be effective at night, especially with lights flashing.</td>
<td>4. Competes with other police functions.</td>
</tr>
<tr>
<td></td>
<td>5. Sporadic use may encourage reduced speeds during &quot;nonuse&quot; periods.</td>
<td>5. Long work zones may require additional patrol car units.</td>
</tr>
<tr>
<td></td>
<td>6. Suitable for all types of highways and work zones.</td>
<td>6. Success depends on good cooperation from enforcement agencies.</td>
</tr>
<tr>
<td><strong>Variable Message Signs</strong></td>
<td>1. Relatively inexpensive for both short- and long-duration applications.</td>
<td>1. Only modest speed reductions possible.</td>
</tr>
<tr>
<td></td>
<td>2. Agency/Contractor has direct control over performance.</td>
<td>2. Constrained by availability of signs.</td>
</tr>
<tr>
<td></td>
<td>3. Little or no disruption to traffic flow.</td>
<td>3. Effectiveness may decrease with continuous use.</td>
</tr>
<tr>
<td></td>
<td>5. Suitable for all types of highways and work zones.</td>
<td>4. Sign maintenance and repair may require technical expertise.</td>
</tr>
<tr>
<td></td>
<td>6. Effective at night and in inclement weather.</td>
<td>5. May be used only as substitutes for other signs, cannot be used alone.</td>
</tr>
<tr>
<td></td>
<td>7. May be used in combination with other techniques in this table.</td>
<td></td>
</tr>
<tr>
<td><strong>Flagging</strong></td>
<td>1. Large speed reductions possible.</td>
<td>1. Requires specially trained and conscientious personnel.</td>
</tr>
<tr>
<td></td>
<td>2. Agency/Contractor has direct control over performance.</td>
<td>2. Fatigue and boredom necessitate frequent relief.</td>
</tr>
<tr>
<td></td>
<td>3. Relatively inexpensive for short-duration applications.</td>
<td>3. High labor costs for long-duration applications.</td>
</tr>
<tr>
<td></td>
<td>4. Little or no disruption to traffic flow.</td>
<td>4. Effectiveness may decrease with continuous use.</td>
</tr>
<tr>
<td></td>
<td>5. Quick and easy to implement and remove.</td>
<td>5. Two flaggers (one each side) may be needed on multilane roadways.</td>
</tr>
<tr>
<td></td>
<td>6. Suitable for all types of highways and work zones.</td>
<td>6. Additional flaggers may be needed for long sections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Drivers may have a problem seeing flaggers or police traffic controllers at night.</td>
</tr>
<tr>
<td><strong>Effective Lane-Width Reduction</strong></td>
<td>1. Moderate speed reductions possible.</td>
<td>1. May be more expensive to implement and maintain for short-term applications than for long-term applications, depending on the devices used.</td>
</tr>
<tr>
<td></td>
<td>2. Agency/Contractor has direct control over performance.</td>
<td>2. May disrupt traffic flow (i.e., reduce capacity).</td>
</tr>
<tr>
<td></td>
<td>3. Relatively inexpensive for long-duration applications, depending on devices used.</td>
<td>3. May increase certain types of accidents.</td>
</tr>
<tr>
<td></td>
<td>4. Retains effectiveness with continuous use and long-duration use.</td>
<td>4. Device maintenance may be expensive.</td>
</tr>
<tr>
<td></td>
<td>5. Speed reduction achieved throughout narrow lane section.</td>
<td>5. May not be as effective on multilane highways.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Not easy to implement or remove.</td>
</tr>
</tbody>
</table>

*Source: Adapted from Improvements and New Concepts for Traffic Control in Work Zones*
16.4.6.6 Approving and Documenting Reduced Speed Limits

Documentation should provide a specific description of the locations, dates, and types of operations where the reduced speed limits will be imposed, as well as the justification for the reduction. However, for recurring situations, the descriptions need not be completely explicit in terms of dates and locations. The recommendation and approval will be recorded in the project records and actual implementation of the speed limits will be documented in the project records along with other records on work zone traffic control.

For long-duration projects, a copy of the same documentation should be sent to the State Police, to the local sheriff, and to the town clerk of the municipality that will have judicial jurisdiction. These officials must also be notified when the reduced speed limit is terminated.

16.4.7 Work Zone Traffic Control Layouts

The MUTCD and the Standard Sheets contain examples of generally minimum requirements for a large variety of traffic control situations which are normally found in the field, but they cannot include a layout for every possible highway work zone situation, nor do they provide adequate bases on which to bid the work. Many variables, such as location of work, road type, traffic speeds, travel volumes, roadway geometrics, vertical and horizontal alignment, pedestrians and bicyclists, and intersections affect the needs of each work zone. Since the purpose of traffic control is to make the work zone safe and disrupt the flow of traffic as little as possible, good engineering judgment must be used to choose the appropriate layout for the project and modify it to meet the requirements of a particular work zone. Modifications should comply with the principles and requirements of the MUTCD. For projects that affect traffic (e.g., bridge overpasses) on the NYS Thruway, the plans should include time restrictions and details as supplied by the NYS Thruway Authority.

In the interest of cost-effective design, the least expensive strategy should be investigated first. Exhibit 16-12 shows a suggested order in selecting the method to be used. The choice of strategy should be based on its economic feasibility, as related to traffic impacts, community impacts, business impacts, etc., as well as its physical possibility.

The designer should consider duration of the work, location of the work, and highway type when selecting a course of action. These three factors are discussed in more detail in the MUTCD Chapter 6 and are incorporated in the Standard Sheets.. Generally, the duration of the work determines the type of control devices (mobile, short duration, or stationary, short-term, intermediate, or long-term) to be used; the location of the work (off the shoulder, on the shoulder, in the median, or in a lane) often times determines the number of control devices to be used; and, the type of highway (rural, urban, expressway, arterial, one-way, two-way) usually affects the length of the advance warning and transition areas.. Select the appropriate layout from the examples in the Standard Sheets or Chapter 6 of the MUTCD if there is no applicable Standard sheet and develop detailed TCPs, as necessary, and in conformance with the requirements of the MUTCD.

When modifications to MUTCD requirements are necessary, it is usually because higher type treatments than those shown are required. The following are examples of modifications that may be desirable and necessary to satisfy the needs found in the field.
• **Additional Devices**
  - Increased number of signs (take care not to "oversign").
  - Special signs (portable variable message signs or temporary guide/destination signs).
  - Flashing arrow boards.
  - Channelizing devices reduced spacing.
  - Temporary raised pavement markers or wet reflective tape.
  - Temporary traffic signals or modification of existing signals
  - Temporary barriers.
  - Barrier vehicles.
  - Vehicle arresting barriers.
  - Impact attenuators.
  - Gawk/glare screens.
  - Rumble strips.
  - Intrusion alarms.
  - Reduced speed limits or advisory speed signs
  - Automated Assistance Devices (AFADs)

• **Upgrading of Devices**
  - Larger signs with lights/flags.
  - Brighter and/or wider pavement markings.
  - Higher-type channelizing devices.
  - Barriers in place of channelizing devices.
  - A full complement of standard pavement markings in areas of high hazard.
  - Variable message signs.

• **Improved Geometrics**
  - At detours.
  - At crossovers.
  - Widened shoulders to enable staged construction.

• **Increased Distances**
  - Longer advance warning areas.
  - Longer buffer spaces.

• **Lighting**
  - Steady-burn lights for channelization.
  - Flashing lights at isolated hazards.
  - Illuminated signs.
  - Floodlights.
  - Temporary roadway lighting.

• **Mobility/Efficiency Strategies**
  - Island work zones
  - Reversible lanes
  - TWTLO
  - Permanent Variable message signs and other Traffic Management Center assets
  - Moveable barriers
The following points should be considered when designing a TCP for a specific field condition:

- Drivers may not perceive or understand one or more of the devices placed in the traffic control zone. Therefore, some extra signs or devices may be required to protect motorists and workers, however, guard against oversigning.
- Consideration should be given to what might happen if the motorist does not get the required information. The level of protection used and the delivery of the message should be related to the level of hazard. More emphatic messages and a higher level of protection are needed for high-hazard situations.
- Where possible, a recovery space (buffer zone) should be provided.
- Devices should be evaluated on a system basis. Consider how the entire set of devices will perform in the work zone to guide drivers and protect workers.
- Whenever possible, remove the traffic from the facility or make the work area as large as possible. Large work areas provide a safer working environment and foster smoother, longer lasting and less costly pavements by allowing the use of high-quality, high-volume paving equipment resulting in fewer interruptions, and minimizing short and/or irregular placements.
Exhibit 16-14  Suggested Steps for Selecting Traffic Control Strategy

WORK OPERATIONS

Work operations are such that traffic control plans cannot consist of notes and references to the NYS SUPPLEMENT.

Consider road closure  Feasible  Refer to NYS SUPPLEMENT for signing

Road cannot be closed.

Consider traffic control/transportation management strategies that allow accommodation of traffic without detours.

Feasible  Develop schemes

Not feasible

Consider maintaining two-way traffic on one-lane roadway at project site.

Feasible  Develop scheme

Not feasible, detour necessary

Select on-site diversion or off-site detour.

On-site diversion  Develop schemes

Off-site detour:
- Design signing per NYS SUPPLEMENT
- If necessary, design detour route improvements
16.4.7.1 Design of Road Closures

Road closures should be considered where alternate routes exist close to, and generally parallel to, the roadway to be closed, and where the alternate routes have sufficient capacity to carry the diverted traffic including special dimensioned and permitted vehicles. Where feasible detour facilities are available or where traffic conditions are otherwise suitable (low volumes of strictly local traffic), closing the roadway to public traffic should be considered.

When roads are closed, a certificate must be filed with the town clerk as required by Section 104 of the New York State Highway Law. To fulfill these certification requirements, the Regional Director must file a notice of state highway closure with the town clerk of the town in which the state highway to be closed is located.

When the decision is made to completely close a road for nighttime construction, the following traffic control elements are to be provided:

- Type III construction barricades shall be used to close a roadway or ramp in a highway construction work zone in accordance with the MUTCD and the Standard Sheets.
- Appropriate ROAD CLOSED or related signs are required, mounted above the barricades.
- Flashing warning lights are to be provided on Type III barricades at the point of closure. They are not to be installed in a longitudinal display, such as at a lane closure that diverts traffic onto a ramp.
- Appropriate work zone and ROAD CLOSED warning signs as shown on Standard Sheet 619-66 and work zone guide signs as described in Chapter 6F of the MUTCD are required in advance of all closures. Type B flashing, high-intensity warning lights should be considered to provide target value and to emphasize the presence of signs on freeways and in other locations where there is concern that drivers may fail to notice these signs.
- Vehicle-arresting barriers (VABs) should be considered for use on mainlines or entrance ramps where there is a risk of traffic circumventing the closure. Design information is presented in §16.3.2. Redundancy is essential for all closures when space permits. It may be provided with an additional set of Type III barricades located some distance beyond the primary closure and in front of VABs to alert drivers who circumvent or breech the primary closure.
- DETOUR signs and detour route markers, as appropriate, to provide advance warning and guidance to traffic, in accordance with Standard sheet 619-66 and the MUTCD Section 6F.53. TCB
16.4.7.2 Design of Lane Closures

When traffic must be maintained through the project during work hours, temporary lane or shoulder closures may be necessary to provide separation between traffic and the contractor's operations. The use of traffic barriers (temporary concrete barrier, movable concrete barrier, etc.) is desirable to provide positive separation, but may not be feasible. Most lane closures that are set up and removed on a daily basis must rely on channelizing devices to mark the closed lanes. All lane and shoulder closures, whether barriers or channelizing devices are used, must adhere to the following requirements:

- Closures must be started at locations providing optimum visibility, i.e., before curves and crests. Closure locations should take advantage of available escape paths such as wide medians and shoulders, and avoid bridges, underpasses, and other locations without available escape paths.
- Closures should be located away from other conflict points such as on-ramps and intersections whenever possible.
- On freeways and interstates, where spot work areas are located less than 1 mile apart, it is recommended that they be treated as a single work zone with a long lane closure.
- Lane closure taper lengths must adhere to the requirements of Standard Sheet 619-11. The standard taper length, L, must be provided as a minimum for lane closures, except where intersections or other site situations necessitate shorter tapers. For multiple lane closures, a tangent section 2L in length is preferred between adjacent lane closure tapers.
- Longitudinal buffer space should be provided between the downstream end of the lane closure taper and the start of the work area, to provide a margin of safety for workers and motorists. Standard Sheet 619-11 provides guidance for the design of longitudinal buffer space length. Any available buffer space is helpful, and should be used even if the recommended distance is not available. The longitudinal buffer space given in Table 6C-2 of Standard Sheet 619-11 may have to be increased to optimize visibility of the approach taper. Refer to Exhibit 16-10 for an illustration of the components of a temporary traffic control zone.
- For roadways with relatively high speeds and free-flowing traffic, longer tapers may help to facilitate merging. However, for slower speed roadways where traffic volumes approach congestion, increasing the taper length may prolong the merge conflict and should be avoided.
- Where temporary concrete barrier is used to close lanes or shoulders, the closure must first be formed using channelizing devices on the appropriate taper length. Immediately downstream of the merging taper, where the channelizing devices become parallel to the lane, an appropriate longitudinal buffer space is to be provided in advance of where the temporary barrier crosses the edge of pavement. The barrier is then introduced beyond the buffer space using the flare rate listed in §16.3.1 and Table 619-4 of the Standard Sheets.
- Channelizing devices must be carefully aligned at intersecting ramps, gores, and other critical locations to clearly define the intended travel path for drivers.
- Where construction operations are restricted to a shoulder or only one lane of a three-lane roadway, consideration should be given to providing additional lateral buffer space by closing an additional travel lane adjacent to the work operation. This decision must be based
on the tradeoff between traffic flow and worker safety. In addition to potentially reducing traffic speeds, the added lane closure reduces the risk of equipment or workers straying into the open lane. However, this option cannot be used where it results in unacceptable congestion and delays.

- Where space is available on the open-lane shoulder, traffic can be shifted further away from construction operations by locating channelizing devices on the open-lane side of the lane line. The designer should be aware of whether shoulder rumble strips (MIARDS) are located on the shoulders since traffic tends to shy away from rumble strips. For longer term closures or shifts, consider paving over existing shoulder rumble strips

- Where neither of the immediately preceding options can be used to provide an adequate lateral buffer space to protect the workers, a protection vehicle (barrier vehicle for stationary work and shadow vehicle for mobile work) with a truck or trailer-mounted impact attenuator to provide protection to workers in accordance with the Standard Sheets is required and may be supplemented by stationing a spotter to provide warnings. More information on protection vehicles is in Section 16.4.4.

- Arrow boards are required for lane closures on multilane highways where the preconstruction posted speed limit or the operating speed is 45 mph or higher as shown on the Standard Sheets. During nighttime construction, however, arrow boards are required for all lane closures on multilane highways regardless of traffic speed. This must be shown on the TCP. See §16.2.6 for additional guidance on arrow boards use.

- Black-on-orange single arrow signs (W1-6) or chevron signs (W1-8) may be used at strategic locations (i.e., intersections, lane shifts and closures, crossovers, etc.) to emphasize lane closures. Placement above and behind Type III barricades spaced periodically throughout the lane closure is especially effective.

- During paving operations and other construction operations, it may be necessary to change the lane closure from left to right, or vice versa. It is often simpler to leave the original closure in place and shift traffic into the reopened lanes using channelizing devices. The shift should occur at a minimum distance of 2L downstream from the merging taper. The shift taper length must be at least 0.5L, although the use of “L” is encouraged. Single arrow signs (W1-6) or chevron signs (W1-8) should be used to mark the shift. Arrow boards are not to be used. Channelizing devices must be spaced to confine traffic to a single lane throughout the shift without allowing an opportunity to form additional lanes (i.e., channelize both sides of the lane leading up to and within the shift).

- When one lane closure is maintained with a lane shift used to adjust lane use, the decision as to which lane is to be closed should be based on site conditions and available sight distance. Generally, the left lane is closed because there is less traffic in the left lane and less conflict with entrance and exit ramps. It also avoids having to create temporary gores and acceleration and deceleration lanes with channelizing devices.
16.4.7.3 Ramp Control

Normally on-ramp traffic has sufficient acceleration length available to merge into gaps in mainline traffic. Ramp control in a work zone should duplicate the existing configuration. However, in some cases, downstream lane width restrictions may limit the available acceleration distance and compromise the safety and efficiency of the merge. Where adequate acceleration length to support a merge is not available, traffic control of the on-ramp traffic may, depending on mainline and ramp traffic volumes, consist of STOP (R1-1) or YIELD (R1-2) signs, and for very brief work or moving work zones crossing an on-ramp, flagger control to control traffic on the ramp, not the mainline.

Designers should make every practicable attempt to provide adequate acceleration length. A significant difference in speeds between mainline and entering traffic creates a safety concern. The use of STOP (R1-1) or YIELD (R1-2) signs to control on-ramp traffic contributes to a speed differential and should only be used where adequate acceleration length is not available or closing the ramp and detouring traffic is not practical for safety reasons. This is a project-specific decision and should only be done in consultation with the Regional Traffic Engineer and, as appropriate, the Regional Construction Engineer. Considerations include the cost of geometric improvements such as widening, which may facilitate adequate acceleration length, traffic volumes on both the mainline and the ramp, grades, sight distance, length of detours used if the ramp is closed, length of time the acceleration length will be restricted, the volume of truck traffic that uses the ramp, and any relevant accident history.

If only the acceleration lane is to be closed, close the right lane in advance of the on-ramp and create a dedicated ramp entry lane using the closed right lane unless precluded by site-specific conditions. Also, restrict work hours to times when mainline traffic can be accommodated in the remaining open lanes upstream. Where there are three or more through lanes and work occupies the right lane, close the right two lanes in advance of the on-ramp, only if it does not cause unacceptable congestion, and create a dedicated ramp entry lane using the closed center lane unless precluded by site specific conditions.

When use of a STOP (R1-1) or YIELD (R1-2) sign to control on-ramp traffic is determined to be the best alternative due to inadequate acceleration distance, consider the choice between stop and yield control. There are no commonly accepted criteria for selecting between the two, but the following are some considerations and best practices.

- Where the available acceleration distance is very short (less than half of the AASHTO minimum), a STOP (R1-1) sign should be considered since on-ramp traffic is unlikely to be able to accelerate to mainline speed, even if there are adequate gaps in mainline traffic. Consider eliminating the entire remaining acceleration lane to reinforce the stop condition and minimize driver confusion. A short acceleration lane may encourage drivers to attempt a merge, only to stop suddenly at the end of the lane when there is no gap in traffic and expose themselves to a rear-end collision by a following accelerating vehicle. On-ramp traffic should be brought into the mainline at as near a right angle as practicable so the drivers can best see approaching mainline traffic and accelerate into the mainline traffic flow. Avoid specifying channelizing devices on the left side of the ramp which can block the view of approaching mainline traffic.
Where poor compliance with YIELD (R1-2) signs is expected, consider using STOP (R1-1) signs.

Avoid forcing trucks to stop if they will be climbing an upgrade immediately downstream of the on-ramp. Where car-truck conflicts will present a significant potential for serious accidents, close the ramp or develop an alternative method of traffic control.

If the acceleration distance is more than half of the AASHTO minimum, consider using a YIELD (R1-2) sign to encourage more efficient use of available gaps in the mainline flow while advising drivers not to expect normal merge conditions.

Some other states use yield signs when there will be two open lanes on the mainline and stop signs when there will only be one open lane. However, this policy is most likely based on the assumption that there will be more gaps in mainline traffic when there are two open through lanes. Before basing the type of traffic control on the number of open lanes, make sure that the assumption is valid.

In all cases, provide advance warning of the stop or yield condition by using STOP AHEAD (W3-1) or YIELD AHEAD (W3-2) signs with flags or warning lights and VMS units if appropriate. If there is space available, install the STOP (R1-1) or YIELD (R1-2) signs on both sides of the ramp and enhance their visibility with flags or warning lights.

When using either stop or yield control, consider speed limit reductions and warning signs on the mainline in advance of the on-ramp. A 65 mph speed limit shall be reduced upstream of a stop or yield condition. A W4-1 Merge sign with a NO MERGE AREA supplemental plaque (W4-5P) beneath it may be used to advise mainline drivers of an abrupt merge conflict at a right-side on-ramp. A W4-5 Entering Roadway Merge sign with a NO MERGE AREA plaque (W4-5P) may be used on the ramp to warn ramp traffic but in most cases, the Stop or Yield Ahead warning signs should be adequate. Deployment of VMS units is also recommended. Consult the Regional Traffic Engineer for appropriate message text.

When a roadway is closed, provide warning of the closure at all on-ramps upstream of the closure following the guidance in §16.4.8.1. When the mainline is open to traffic, special considerations must be given to controlling traffic at ramps, and in some cases, it will be necessary to selectively close on-ramps or off-ramps while the mainline remains open.

For facilities with existing ramp metering equipment, it may be necessary to adjust the ramp metering cycle or turn the system off when the construction operation is underway.

For facilities without ramp metering, it may be beneficial to provide temporary metering during the construction operation.

When paving or other operations require providing to the contractor full use of the lanes adjacent to off-ramps, it is necessary to temporarily close individual off-ramps. In such cases, it is essential to provide advance warning that the ramp is closed, and to provide information on alternate ramps or detours. This information must be provided well upstream of the decision point using large information signs or variable-message signs. In addition to advance information signs, regulatory ROAD CLOSED (R11-2) signs are required in the area of the ramp. To emphasize the closure through the ramp area, the channelizing device spacing should be 20 feet.
• In addition to full-road closures, on-ramp closures may be necessitated by closure of the right lane for the contractor’s operations, or because restriction of all mainline traffic to the right lane does not provide adequate gaps for entering traffic to merge safely. In either case, closure of an on-ramp must be addressed in a manner similar to that for a full-road closure.

• When entering or exiting traffic must cross closed lanes, the travel path must be clearly defined using channelizing devices spaced at 20 feet.

• Temporary advance signs telling motorists how far it is to the temporary off-ramp opening, e.g., “EXIT/500 FT” or “EXIT XX/1000 FT.”

• Temporary EXIT (E5-1) panels on portable supports are to be provided in relocated gores to direct traffic to open off-ramps.

• In addition to mainline VMSs, consider VMSs for on-ramps carrying high-speed, high-volume traffic to alert drivers to nighttime construction activities.

16.4.7.4 Two-Lane, Two-Way Operations

Two-lane, two-way operations (TLTWOs) occur on one roadway of a normally divided highway when traffic must be moved through or around a temporary traffic control zone. This section discusses the policy and guidance for this optional method of temporary traffic control for projects on 4-lane divided highways, e.g., rural or urban interstates or arterials. The unique operational problems inherent in a TLTWO makes it a method that may not be applicable to every situation.

It is the policy of the NYSDOT to consider a two-lane, two-way operation (TLTWO) on one roadway of a normally divided highway as an alternative method of work zone traffic control.

A. Considerations:

A TLTWO 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, an increase in the risk of head-on crashes) can arise with a TLTWO. Some of the considerations designers should make when assessing the use of TLTWO include:

• Will a TLTWO provide a safety benefit to workers by removing the conflicts that occur when traffic is maintained immediately adjacent to the work? Will a TLTWO make nighttime construction safer for workers?

• Will operational and safety problems be caused by low-speed (<40 mph) vehicles, creating excessive delays and encouraging illegal passing due to motorist frustration and impatience?

• Will emergency vehicles experience difficulties resulting from the restricted section when passing through or responding to accidents in, or downstream of, a TLTWO segment? Compare to the difficulties to be experienced if the traffic is maintained adjacent to the work.

• Can the work be accomplished without TLTWO? If another option is considered, will it result in an additional safety risk to temporary traffic control zone personnel?

• Can temporary lanes be constructed in the median?
• Will a TLTWO enhance the quality of construction? A TLTWO removes all traffic from the work area and allows the contractor better control of the work operation. All other things being equal, better quality work may result in extended pavement and bridge deck service lives and a reduction in the frequency and extent of future maintenance and reconstruction operations.

• If a TLTWO is selected, will this result in a shorter contract time?

• If a TLTWO is selected, will this result in restricting traffic in a reduced lane configuration longer than would a conventional staged operation?

• Will a TLTWO allow a contractor to perform the work more efficiently? In many cases, contractors will choose to stage their work, even if given total access (by closing a road or bridge), in order to maintain convenient access across a bridge.

• Will a TLTWO provide more capacity? Generally, TLTWOs will provide somewhat wider travel lanes than conventional staged construction as there is no need to be concerned about contractor work room behind the temporary concrete barrier. In some cases, the extra travel width may provide a second lane in one direction.

• Are there any width or height restrictions that would preclude the use of a TLTWO or the use of a shoulder or the median as a temporary lane? Wider temporary lane widths (see above) that may result with TLTWO may better accommodate wide loads and could mean the difference between allowing them on-site as opposed to detouring them off-site.

• What is the condition of the pavement and shoulders in the proposed TLTWO section?

• If traffic will be forced to drive on the shoulders due to width restrictions, is the shoulder design adequate?

• Is a suitable detour available that will preclude the need for on-site temporary traffic control or carry traffic in the event of emergency incidents?

• Will use of TLTWO cause a significant increase in the project cost?

• What are the characteristics of the traffic (e.g., traffic volume, demand volume, vehicle-type distribution, etc.)? Traffic volumes may be too heavy, causing significant congestion and delays.

• Is the project located on a roadway where bicyclists and pedestrians are permitted to travel? Refer to §16.4.4.2 for guidance on providing traffic control for bicyclists and pedestrians.

• Can traffic be controlled to minimize or eliminate the safety risk to workers when resetting channelizing devices?

• Is there an impact on existing drainage?

B. Design Standards (Required, mandatory, or specifically prohibitive practices.)

1. Separation of Traffic Between Crossovers.

Temporary concrete barrier (TCB) or channelizing devices shall be used to separate opposing traffic throughout the length of the TLTWO between crossovers, except when the work zone is located on an urban-type street or arterial where operating speeds are low (< 40 mph) and traffic control devices, including signs and pavement markings, are provided in accordance with the MUTCD, separation devices may be omitted.
2. Separation of Traffic at Crossovers.

TCB shall be used to separate opposing traffic at crossovers for all TLTWOs. TCB shall be installed at the crossover exit roadway to protect exiting traffic where fixed objects located in the median or the slope of the crossover embankment are a hazard to the exiting traffic. If there are no hazards, the TCB is not required. TCB and the excessive use of traffic control devices are not allowed as compensation for poor geometric and roadway cross section design of the crossover.

3. Design Speed.

Where it is not possible to achieve a design speed equivalent to that of the existing facility, the design speed of the crossover and TLTWO shall not be lower than 10 mph below the highest of the anticipated operating speed or the preconstruction off-peak 85th percentile speed or the posted speed limit prior to work starting. Use of any design speed below the preconstruction off-peak 85th percentile speed shall be approved by the Regional Traffic Engineer. If circumstances force a further lowering of the design speed, consideration should be given to additional measures for reducing speed to a safe operating level approaching the crossover, such as temporary rumble strips. (See Guideline C.3.)

4. Lane Width and Shoulder Width and Depth.

Lane width and shoulder width for the TLTWO and crossovers shall be provided in accordance with the requirements of Chapter 2 of this manual. The depth of paved shoulders shall provide for heavy-duty use in accordance with the Comprehensive Pavement Design Manual.

5. Channelization at Interchanges and Rest Areas.

The directions of travel (exit, enter, through) at interchanges and rest areas located within the TLTWO shall be properly channelized to prevent wrong-way travel and confusion on the part of the motorist.

6. Temporary Concrete Barrier Protection.

Protection against direct impact with the approach ends of TCB shall be provided in accordance with §16.3.1 and the Standard Sheets.

7. Warning Signs With Channelizing Devices.

Two-way traffic signs (W6-3) supplemented with auxiliary mileage signs (W7-3aP) shall be located every 1 mile maximum, in both directions of the TLTWO when channelizing devices are used to separate opposing traffic. (See Guideline C.10 below.)
8. **Regulatory Signs With Channelizing Devices.**

DO NOT PASS (R4-1) signs shall be located in both directions of the TLTWO when channelizing devices are used to separate opposing traffic.

9. **Roadside Protection, Signing, and Pavement Markings.**

Appropriate roadside protection, signing, and pavement markings in accordance with the MUTCD, the HDM, and this section shall be provided for the opposite direction of traffic at obstacles and locations which do not require protection, signing, and pavement markings under normal unidirectional conditions (e.g., trailing ends of guide rail or barrier shall be converted to approach ends).

10. **Winter Operations.**

A TLTWO shall not be left in place during the winter snow removal months except as approved by the Regional Traffic Engineer, Regional Construction Engineer, and Regional Maintenance Engineer.

11. **Lane Separation.**

If channelizing devices are used to separate traffic, the lanes shall be a minimum of 3 feet apart and full-barrier lines shall also be used.

12. **Crossovers.**

All pavement and hazardous features and conditions must be removed and the area returned to a safe and pleasing appearance. There must be no features that mislead drivers to follow unsafe direction. Drainage must not be impeded.

C. **Design Guidelines** (Recommended, not mandatory practices, with deviations allowed if engineering judgment or analysis indicates the deviation to be appropriate.)

1. **Length of TLTWO.**

A TLTWO should not exceed 5 miles in length, except when, in the designer’s judgment, an existing interchange is located a reasonable distance downstream from the terminal of the TLTWO in the crossover direction, the TLTWO may be extended to terminate at that interchange. Special consideration shall be given to the effects of horizontal and vertical alignment and truck volumes on the operation and safety of the TLTWO for lengths in excess of 5 miles regarding the potential for aggressive driving.
2. Emergency Pull-Offs.

Emergency pull-offs should be provided on the median side of the crossover lane (see Exhibit 16-16). They should be delineated by delineators or paved. In situations where the median-side shoulder configuration is too narrow to accommodate emergency pull-offs, they should be provided on the other shoulder. The spacing should not exceed 1 mile on a TLTWO longer than 2 miles.

3. Design Speed.

The design speed for crossovers and TLTWO should be equivalent to the design speed of the existing facility. (See Standard B.3 above.)

4. Separation of Traffic by TCB.

TCB (positive barrier) should be used instead of channelizing devices when, in the judgment of the designer, the volume of traffic, the anticipated operating speed, the volume of heavy trucks, or other traffic or roadway conditions result in a potential for unacceptable conflicts between opposing flows. Guidelines for when to consider the use of TCB are when one or more of the following conditions occur.

- The DDHV exceeds 1300.
- The anticipated operating speed is 50 mph or greater.
- The volume of trucks exceeds 10%.
- Long, steep grade or sharp curve at the base of a long, steep grade.

5. Separation of Traffic in Short TLTWOs.

For short (approximately 2000 feet or less) TLTWOs, it may be more beneficial in terms of economics, uniformity, and consistency to use continuous TCB throughout the work zone and crossovers rather than to use channelizing devices through the TLTWO and TCB with impact attenuators (at the approach ends of the TCB) at the crossovers.


Potentially hazardous features with a high accident potential should be shielded, such as with sand barrels for point objects or with temporary guide rail or temporary concrete barrier for linear objects. The designer should determine the point-of-need for guide rail for traffic traveling in the opposite direction from which it was originally designed and provide shielding wherever necessary. The trailing end of any bridge rail, guide rail, concrete barrier, etc., should be given special consideration. Designers should show on the plans where and what length of roadside protection is required throughout the length of the TLTWO.
7. Separation of Lane Closure Tapers and Crossovers

Tapers for lane closures should not be contiguous with crossovers. Drivers need time to acclimate to the change and adequate space is needed for the advance warning signs. The distance from the downstream end of the lane closure taper to the beginning of the crossover should be at least twice the length of the lane closure taper “2L” but no less than the length of the lane closure taper “L”.

8. Spacing of Channelizing Devices Used in a Longitudinal Series.

Spacing of channelizing devices used in a longitudinal series to separate opposing traffic flows should not exceed a distance of 40 feet, when used for taper channelization, and a distance of 80 feet, when used for tangent channelization. Full barrier lines must also be used.

9. Spacing of Channelizing Devices at Interchanges and Rest Areas.

The spacing of channelizing devices used at interchanges and rest areas located within the TLTWO should be 1/4 the spacing (typically 20 feet) of the channelizing devices used in tangent locations.

10. Warning Signs With TCB.

Two-way traffic (W6-3) signs supplemented with auxiliary mileage (W7-3aP) signs may be used but are not required when TCB is used to separate opposing traffic. (See Standard B.7 above.)

11. Intermittent Use of Alternate Channelizing Devices.

Intermittent use of alternate channelizing devices, such as opposing-traffic lane dividers (separation devices manufactured of lightweight materials with 2-way arrows (W6-4) on both faces, (Part 6F. of the MUTCD). These devices may be used to break the monotony of a continuous line of primary channelizing devices, such as tubular markers. One alternate channelizing device may be installed in place of every 5th, or more, primary channelizing device.

12. Speed Limit Signs.

Maximum speed limit signs should be provided in both directions of the TLTWO and located in accordance with the requirements of Section 2B.13 of the NYS Supplement to the MUTCD. Where the original speed limit is 65 mph, reduce it to 55 mph due to the proximity of either temporary concrete barrier or opposing traffic.


It may be necessary to widen existing shoulders to provide the necessary lane width, especially the median-side shoulder.
14. Signs at Intersections
Include provisions for KEEP RIGHT (R4-7) signs at intersections along the TLTWO.

An example of a TLTWO, including crossovers and a tangent section, with separation of opposing traffic by channelizing devices, is provided as Exhibits 16-15, 16-16, and 16-17. In situations where there is a median barrier, the downstream taper in the “southbound lane” needs to extend only to the point beyond which the median barrier provides protection to the “northbound traffic.”

D. Variance From Standards

When a designer determines that unique, project-specific circumstances are just cause to vary from the standards for the use of a TLTWO, the decision shall be documented in the project files. The documentation should describe and provide explanations and support for features that do not comply with the TLTWO standards. Documentation is not required for variance from guidelines.

Implementation of a TLTWO shall be by concurrence of the Regional Traffic Engineer, the Regional Construction Engineer and the Regional Design Engineer for capital construction projects or in accordance with the procedure established by the Regional Director.
NOTES:
1. REFERENCES TO SECTIONS, SIGNS, AND TABLES ARE FOUND IN THE NYS STANDARD SHEETS, UNLESS OTHERWISE NOTED.
2. THE MAXIMUM LENGTH OF TCB TO THE SAFETY TERMINAL IMPACT ATTENUATOR IS DETERMINED ON A PROJECT-BY-PROJECT BASIS.
3. * NEEDED ONLY IF THERE ARE NO PREVIOUS "ROAD WORK AHEAD" SIGNS WITHIN 1000 FT, OR IF IT IS OUTSIDE OF THE REGULAR CONSTRUCTION AREA.
4. LOCATE THE ARROW PANEL AT THE BEGINNING OF THE MERGING TAPER EXCEPT WhEre THE Motorists’ VIEW OF IT IS BLOCKED BY ADVANCE SIGNING, IN THAT CASE, LOCATE THE ARROW PANEL AT THE MIDPOINT OF THE TAPER.
Exhibit 16-16  Example of Two-Lane, Two-Way Operation

LEGEND
SIGN
TYPE III BARRICADE
CHANNELIZING DEVICES
DELINERATORS
TEMPORARY CONCRETE BARRIER
SAFETY TERMINAL IMPACT ATTENUATOR
DIRECTION OF TRAFFIC

NOTE:
1. REFERENCES TO SECTIONS, SIGNS, AND TABLES ARE FOUND IN THE NYS SUPPLEMENT, UNLESS OTHERWISE NOTED.
2. REFER TO SECTION 16.4.7.4 OF THIS MANUAL FOR DESIGN GUIDANCE ON TWO LANE TWO WAY OPERATIONS.

PLAN VIEW
EMERGENCY PULLOFF
SEE GUIDELINE 2
Exhibit 16-17  Example of Crossover Exit in Two-Lane, Two-Way Operation

NOTES:
1. REFERENCES TO SECTIONS, SIGNS AND TABLES, ARE FOUND IN THE NYS STANDARD SHEETS, UNLESS OTHERWISE NOTED.
2. THE MAXIMUM LENGTH OF TCB FROM THE PG TO THE SAFETY TERMINAL IMPACT ATTENUATOR IS DETERMINED ON A PROJECT-BY-PROJECT BASIS.
3. *NEEDED ONLY IF THERE ARE NO PREVIOUS "ROAD WORK AHEAD" SIGNS WITHIN 1.0 mi, OR IF IT IS OUTSIDE OF THE REGULAR CONSTRUCTION AREA.
4. LOCATE THE ARROW PANEL AT THE BEGINNING OF THE MERGING TAPER EXCEPT WHEN THE MOTORIST'S VIEW OF IT IS BLOCKED BY ADVANCE SIGNING. IN THAT CASE, LOCATE THE ARROW PANEL AT THE MIDPOINT OF THE TAPER.
16.4.7.5 Urban Arterial Work Zones

Unique characteristics of urban arterial work zones that distinguish them from rural highway or freeway work zones are primarily related to traffic conditions, traffic signals, geometrics, and limitations on work zone traffic control. Among the most important of the characteristics are higher speed variations, highly variable volumes, limited maneuvering space, frequent turning, crossing and lane-changing maneuvers, multiple access points, higher pedestrian volumes, frequent traffic obstructions, greater competition for driver attention, and more traffic signals. These characteristics require special consideration when preparing an WZTC plan for construction activities.

Designers must consult with the Regional Traffic Group and obtain their approval of the design.

The traffic control guidelines include those related directly to the movement of traffic through the work zone and the traffic control devices used to control the traffic. They address intersections, lane closures, speed control, channelization, and pavement markings.

A. Signalized Intersections

The overall capacity of an arterial is typically limited to the capacity of the intersections on that arterial. During construction, the capacity of signalized intersections is often reduced. Therefore, it is important that steps be taken to ensure that the traffic signals within the work zone are operating in the most effective manner possible, given the restrictions of the work zone.

   Signal phasing and timing should be adjusted, when necessary, with each change in construction phasing, and signal operation should be checked in the field after each adjustment. The assistance of the Regional Traffic Group should be requested. Construction activities cause a significant disruption of normal traffic patterns, and construction phasing may alter the lane arrangements at approaches to signalized intersections.

2. Shorten Cycle Lengths.
   If queues due to construction activities or traffic generators are common, a shorter cycle length may be effective at minimizing queue lengths and preventing backups into the intersection, especially near railroad grade crossings. A level-of-service analysis should be performed to determine the optimum timing.

   The positions of traffic signal heads should be shifted to line up with approach lanes in accordance with the MUTCD any time lanes are shifted laterally. The typical construction phasing plan for an urban arterial work zone uses narrow lanes and shifts the positions of the lanes within the intersection. If the signal head positions are not changed accordingly, indications for left- or right-turn movements may not be visible from realigned turn lanes.

4. Signal Control.
   The operation of actuated signal detectors should be checked on a regular basis. At critical intersections, temporary detection may be needed or desired (consult the Regional Traffic Group). Temporary microwave detectors are very useful for this purpose because they are pole-mounted and not damaged by milling or excavation activities. They can also be easily readjusted as traffic lanes are shifted. The Regional Traffic Group should be contacted when there is a traffic signal in the plans. Any number of construction activities may disrupt the operation of traffic signal detectors. Without detection capability, an
actuated signal becomes a pretimed signal by default, and the signal phasing and timings should be developed accordingly. If an existing lane is closed, especially an exclusive turning lane, either the detection or the phasing should be modified accordingly. Contact the Regional Traffic Group for guidance. Also, if lanes are shifted, vehicles may “trip” detectors that should not be activated or fail to trip detectors which should be activated.

5. Accommodation of Pedestrians.
The congestion and delays associated with signals in a work zone are compounded by the need to accommodate pedestrians at signals. Pedestrian push buttons should be used with actuated controllers to maximize the efficiency of signals in a work zone. Even if pedestrians are infrequent, sufficient crossing time must be provided for them. If the length of vehicular green will not adequately accommodate pedestrians, pedestrian actuation will be needed to extend the green for them, when present. Even if vehicle detection capability is lost and the signals are operated in a pretimed manner, the pedestrian phase can still operate in an actuated mode.

New or temporary signals in arterial work zones should use 12 inch diameter signal lenses. The large number of construction activities, traffic control devices, other vehicles, vehicle maneuvering, and development present in urban arterial work zones creates many demands for the driver’s attention.

7. Provide Left-Turn Lanes.
Left-turn lanes should be provided at major signalized intersections. If they are provided for use during construction, they should be part of the completed project. The lack of a left-turn bay can significantly increase delay because of left-turning vehicles blocking a through lane while waiting for an acceptable gap. Although the addition of left-turn lanes may create some difficulties for construction scheduling and activities, the benefits associated with these lanes make it desirable to provide them at major signalized intersections where left-turning vehicles are present. If it is not possible to construct a left-turn lane, it may be necessary to restrict or prohibit the left-turn movement in the interest of reducing congestion. The Regional Traffic Group should be consulted if left-turn capacity is expected to be a recurring problem.

B. Maintain Traffic Signal Equipment

Maintain traffic signal equipment requirements A, B, and C are standard pay items in the Standard Specifications.

Variations in Regional Maintenance capabilities and local contractor capabilities, the maintenance needs of different intersections, and the decision by the Department to furnish microcomputers which operate with State-supplied software led to the development of several traffic signal equipment maintenance items to allow the designer flexibility in selecting a maintenance item appropriate for the specific needs of each location within the contract. Outlined below are recommendations concerning the use of the various Maintain Traffic Signal Equipment items. If different item numbers are to be used for different intersections within the project, a table should be included in the plans defining which item will be used at each intersection.


Use this item on projects that are on either restricted highways or highways that are not restricted. It must be used at locations where the signal controller is not a State-supplied microcomputer. Under this item, the contractor must maintain the indicated existing, relocated,
modified, and newly installed traffic signals as per the contract specifications, for the duration of the contract.


Use this item for the maintenance of existing or relocated traffic signals where a new State-supplied microcomputer is to be installed. Under this item, the State will assume operation and maintenance responsibility for the entire signal following the successful completion of electrical testing of the contractor’s installation as prescribed in the Standard Specifications. This item minimizes the contractor’s maintenance responsibility and should only be used where the Department’s signal crews have the resources and interest in assuming maintenance responsibility.


Use this item to provide maintenance for existing or relocated signals where a State-supplied computer is in place before the contract begins. This item could also be used for new computer installations. Under this item, the Contractor must maintain the existing signal, with the exception of the four items listed in the Standard Specifications (all are related to the microcomputer itself), for the duration of the contract. The State is responsible for the four items excluded from contractor maintenance. At relocated, modified, or newly installed signals, the State is responsible for the four items after the Contractor’s installation has performed successfully in the required electrical tests. This item was designed to allow the Department signal crews to maintain the microcomputer-related items with which contractors were formerly inexperienced. Since this item was developed, contractors have gained familiarity with the microcomputer items.

The designer should consult with the Regional Traffic Group before selecting one or more of the above items for use on a given project.

C. Intersections

The large number of intersections associated with urban arterial work zones introduce many difficulties related to work zone traffic control. Most of these difficulties are related to vehicle maneuvering and the intersection geometrics.

1. Street Name Signs.
   Large street name signs (construction signs with minimum Series D lettering) with block numbers should be provided at major signalized intersections, if possible. These street signs should be mounted overhead (on existing signal mast arms or span wire) to increase their visibility. (A structural analysis or span-wire analysis will be necessary.) When construction begins, many of the navigational aids, such as street signs, business signs, and addresses, that drivers use are removed or become less visible. Locating street signs overhead at signalized intersections will improve the visibility of street name signs. In some cases, it may be useful to provide advance or midblock guidance, e.g., MAIN ST./300 FT.

2. Driveway and Intersection Radii.
   As large a turning radius as possible should be maintained at driveways and intersections. Making it easier for vehicles to turn in and out of intersections and driveways by increasing the turn radius to reduce the potential for encroaching on
adjacent lanes may help reduce accidents. This should be based on the type and size of vehicles to be accommodated and their turning radius. If turns cannot be accommodated, consider prohibiting turns by those vehicles. Driveway access should be maintained to the maximum extent practicable to avoid adverse impacts on residences and commercial properties.

D. Lane Closures

Although lane closures have a significant impact on traffic flow, they are a necessary part of many projects. The detrimental effects of lane closures include the creation of queues that block intersections and driveways, the compounding of peak-period traffic congestion, and an increase in erratic lane changing.

1. Arrow Panels.
   Major arterials typically have high speeds and heavy volumes - conditions well suited to the use of an arrow panel for lane closures. Arrow panels shall be used on high-speed and/or high-volume arterials in the same manner as for freeway lane closures.

2. Location of Lane Closures.
   Lane closures should be set up so that the queue will not block signalized intersections upstream of the lane closure. If the lane closure is located too close to a signalized intersection, the queue may back up into the intersection and prevent cross-street traffic from entering the intersection. Sufficient distance should be provided between the lane closure and the intersection so that the queue will not block cross-street traffic. If this cannot be done, the lane closure should be extended upstream of the intersection. This will allow for platooning rather than jockeying for position just beyond intersection work area.
   Lane closures should be located on a tangent section of roadway, if possible, making them more visible to approaching drivers, allowing them to change lanes farther in advance of the merge point.

   Where possible, the lane closure should be located so that there are no intersections, driveways, or temporary median crossovers in the taper area or within 200 feet to 300 feet of the beginning of the taper.
   Other alternatives include posting signs, e.g., DO NOT BLOCK SIDE ROAD (NYR9-4) or providing flaggers or police officers to keep traffic from blocking the intersection. Section 2B.53 of The NYS Supplement to the MUTCD prohibits use of the R10-7 DO NOT BLOCK INTERSECTION sign.

3. Signing for Lane Closures.
   Sign placement should be in accordance with the Standard Sheets. Table NY6H-3 on Standard Sheet 619-11 lists advance posting and spacing requirements for warning signs based on the type of roadway (urban, rural or freeway/expressway). Table NY6H-3 differs slightly from MUTCD Table 6C-1 by defining low speed and high speed and adding an intermediate speed. Signing for a lane closure should be located upstream and downstream of a signalized intersection if the proximity of the lane closure to a signalized intersection precludes the spacing of the three signs shown on the Standard Sheet between the closure and the intersection. Additional signing should also be considered where arterial traffic volumes are high or where drivers may not be able to see the lane closure or signing when it is located close to a signalized intersection. The higher traffic density associated with departure flow from a signalized intersection eliminates many lane-changing opportunities downstream of the intersection. Placing the lane closure signing in advance of the signalized intersection gives drivers the opportunity to change
lanes before reaching the queue at the intersection. Signing should also be provided on the cross street approaching the intersection to advise drivers that they are going to encounter construction. ROAD WORK AHEAD signs (W20-1) should be used for approaching lanes and END ROAD WORK signs (G20-2) should be used for retreating lanes.

E. Speed Control

Speed restrictions should be avoided, if possible. If they are necessary, they should be carefully selected, recognizing that it may be necessary to supplement them with other more positive means of controlling driver behavior.

1. Speed Limits.
   Speed limits should be selected to be consistent with site conditions. The normal arterial speed should be maintained in the urban arterial work zone, if possible. If speed restrictions are necessary, they should be carefully selected with the recognition that additional measures may be needed to slow traffic. Refer to §16.4.7.

2. Enforcement Areas.
   An enforcement area should be provided for police activities. The space restrictions associated with arterial construction may reduce the ability of police to enforce traffic laws. Police are hesitant to issue citations if a safe area to do so is not available.

F. Channelization

The spacing of channelizing devices has some unique implications in urban arterial work zones. At speeds found on many arterials, vehicles can travel between the devices at standard spacing and drive on the wrong side. Drivers may cross the line of channelizing devices to make an illegal turn, to pass an area of congestion, or because they are confused. Reduce the spacing to one-half the standard spacing to discourage drivers from crossing into the work space. In addition, place channelizing devices transversely across the closed lane between driveways and side streets.

G. Pavement Markings

The relocation of traffic lanes requires existing markings to be removed or covered and temporary markings to be placed. However, it is difficult to completely remove pavement markings. Short of placing an overlay over old pavement markings, there is no method that will obliterate permanent pavement markings without leaving a scar. Black-mask covering tape placed over the pavement markings will conceal them or hydro-blasting may be effective in removing them. Blackout markings can have higher conspicuity on east west facing highways and where the pavement is lighter from oxidation.

Raised pavement markers, in conjunction with pavement markings, may be used to enhance lane delineation in potentially hazardous areas. Raised pavement markers can be easily placed and removed, and after removal, the remains of the markings do not provide as visible an indication of the former lane lines as other types of markings. Raised pavement markers have greater visibility in periods of wet weather at night, but they are not suitable alone, especially during daylight hours. They provide a tactile indication to the driver when the vehicle begins to change lanes but may be a problem for motorcyclists and bicyclists. Alone, they do not provide adequate guidance through curves, and are more easily destroyed by vehicles, especially on curves. Refer to §16.2.8 in this chapter for further guidance on raised pavement markers.
16.4.7.6 One-Lane-Road Traffic Signals at Work Zones

Refer to Standard Sheet 619-62 for placement guidance for temporary one-lane-road traffic signals. Use of a "rest in red" feature designed for the detector placement can reduce operating speeds approaching the signal.

16.4.7.7 Detours

General considerations for detours are discussed in subsection 16.5.6 of this chapter. When on-site traffic control methods are not appropriate, detours may be required.

A. Signing and Maintenance

Clear detour signing is critical to avoid confusing highway users. A survey of existing signs along the detour, the approaches to the detour, and within the closed section of the roadway (especially if it is open to local traffic) is necessary. The information gathered should be incorporated into the detour signing plan.

This is most important for destination and information signs and route marker assemblies. If, for instance, the distance to a destination is based on the closed route, the sign must be modified to reflect the distance along the detour. Existing route marker assemblies along the detour must also be modified with the addition of DETOUR (M4) route markers.

Traffic generators located within the closed section should also be considered. Informational and directional signing should be provided for travelers whose destinations are located within the closed section. Examples of such destinations might include colleges, state/local parks, stadiums, race tracks, etc.

The designer should investigate each of these issues and others specific to the particular project during the initial evaluation of off-site detours. Contact the Regional Traffic Group or local authorities for accident locations and numbers for on-system detours or off-system detours, respectively.

Detours require considerable traffic control, especially with high-speed freeway traffic. Drivers should be provided with enough information in advance of and throughout the detour to allow them time to make decisions and to help them determine how to return to the original roadway.

Reasonable advance notice should be provided to highway users when a highway or bridge is to be closed and traffic detoured. It is recommended that 1-2 weeks be allowed. The message can be passed on by traffic reports, television and radio spots, etc. Portable (and stationary, if available) variable message signs should be used in most cases.

The Highway Law requires that designated detour routes be signed. Refer to the MUTCD and Standard Sheet 619-66 for examples of detour signing on designated detours.

Similarly, local businesses within a closed section of highway may be affected by loss of traffic when detour routes are employed. If possible, this problem should be minimized by taking care in scheduling and/or by providing temporary generic business signing, however, a roadside business has no legal claim to a given volume of passing traffic.

When considering a detour over a locally owned road, the detour construction cost will be limited to the basic work items normally considered under Section 619 of the Standard
Specifications or pavement repairs that are needed for the detour to function for the life of the construction contract. This would include the installation, maintenance, and removal of items such as signs, pavement striping, etc. Special features such as pedestrian access and emergency services, if necessary, may also be included as legitimate project charges. Any substantial capital improvements requested by the municipality that are not absolutely necessary to make the detour work for the duration of the contract must be paid for by the municipality under a Betterment Agreement. However, if the municipality is not satisfied with the proposed detour improvements, some compromise might be appropriate.

An example of a form that may be used when establishing a detour is provided in Appendix 16A, Exhibit 16A1.

B. Establishing a Detour

When it is determined that a state highway must be closed and local road detours are needed to reroute traffic during project construction/reconstruction, the “owner” of the local road is contacted and the following procedure is followed.

For proposed detours which require improvements.repairs to handle increased traffic, Example 14-5, Detour Resolution, revised May 1982. The resolution or letter should clearly state that the Department will maintain the detour road during the period of use per Section 619, excluding snow and ice control.

An Official Order for temporary takeover of the local road by the State must then be issued. To fulfill the requirements of Section 42 of the Highway Law, the designer must prepare a draft official order for the closure of a highway as prescribed in the Manual of Administrative Procedures (MAP) 1. 1-2, Official Orders, and include any necessary supporting documentation such as detailed descriptions of the property, maps, the section to be closed, and the temporary detour route. It must be cleared by all affected Regional Units and submitted to the Regional Director for concurrence, after which it is to be sent to the Operating Division for final approval and issuance to the Town Clerk. The construction contract documents must specify the necessary improvements/repairs to be made to the detour during the period it is a temporary State highway, in accordance with Standard Specifications Section 619. The official order can be conveniently filed concurrently with the “Notice of Restricted Highway” filing for the contract to the same recipients.

Where no detour improvements are needed to handle traffic, the construction contract documents must specify the erection and maintenance of necessary detour signs, to meet the requirements of Section 104 and Section 10, Subdivision 19 of the Highway Law. While no Official Order is required, the designer should obtain a detour resolution. It should state the Department’s intent to use the local road detour as written concurrence from the local jurisdiction, and make it clear to the local jurisdiction that the Department’s maintenance responsibility on the detour road will be limited to the detour signs only.

When detour routes are used, signing should be sufficient to direct motorists back to the route from which they were detoured, i.e., detours must maintain the continuity of the closed route. Detour directional signing and confirmatory signing should conform to the MUTCD Section 6F.59.

When State highways are utilized for project detours, maintenance of the detour will be performed by State forces, except that the contract documents must specify the Contractor is responsible for the necessary erection, maintenance, and removal of detour signs.
It is sometimes desirable and sometimes necessary to close single-lane ramps for paving or other work operations since it can generally be done in just a few hours. Designated (signed) detours should always be provided when the closed ramp serves to interchange traffic between numbered touring routes, i.e., when some of the traffic may be using the route numbering system to navigate.

Sufficient advance notice must be given since the designated detour exit may precede the closed exit. Variable message signs are ideal for these short-term closures.

16.4.7.8 Diversions

A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work area. Figure 6H-7 in the MUTCD illustrates a work-site diversion for bridge and culvert replacements on a conventional highway. Diversions may be designed to accommodate all existing lanes of traffic, or as alternating one way roadways controlled by a temporary traffic signal.

HDM Chapter 2 should be used as guidance for diversion radii. Ideally, the speed used to determine the radii should be the same as the existing speeds at the site (usually the regulatory speed limit can be used). Where right of way constraints or excessive costs preclude the use of the existing speed, a lower speed may be acceptable. To determine an acceptable speed, consult the Traffic Group. For high-speed roadways, a 10-mph or 15-mph reduction may be acceptable. For low-speed roadways, a 5-mph or 10-mph reduction may be acceptable. Appropriate advisory speed panels shall be posted for the diversion geometry, including for alternating one way roadways controlled by a traffic signal.

Because the superelevation of the curves at each end of the diversion will be dependent on the cross slope of the existing highway, those curves may need to be flatter than the center curve where the desired superelevation can be designed.

The tangent lengths along the diversion will vary depending on site or right of way constraints. Generally, a minimum length of 100 feet should be provided. In extreme cases, it may not be possible to achieve any tangent.

Lane widths along the diversion should be determined using the appropriate lane width table in Chapter 2 of this manual. One way diversions should have a minimum clear width of 14 feet.

Diversion shoulder widths should be at least 4 feet to accommodate pedestrian and bicycle traffic. Lesser widths may be acceptable if separate facilities for pedestrian and bicycle traffic are provided. The Regional Landscape Group should be consulted.

If a temporary bridge is required (as opposed to a temporary culvert), a tangent section will be required in the center curve where the temporary bridge is constructed. The length of the tangent should generally be twice the length of the existing bridge or 100 feet minimum. The Regional Structures Group should be consulted. When a temporary structure or temporary culvert is required, details should be in accordance with Section 3.2.7.5 of the Bridge Manual.

Diversion geometry should be approved by the Regional Traffic Group and the Regional Structures Group before right of way take lines are established. The designer should seek to minimize property, environmental, and utility impacts when designing a diversion. If the proposed diversion cannot be built within existing state ROW, this must be considered during preliminary design and a TE included with the property acquisitions.

Pavement sections for on-site diversions will be dependent on the length of time the diversion is planned to remain in service and the expected traffic loading. The following minimum thicknesses are recommended:
One season project | Two season project
---|---
Subbase | HMA | Subbase | HMA
8" | 5" (2 – 2.5" lifts 25 temporary binder HMA) | 12" | 7" (2 – 2.5" lifts 25 binder HMA, 2” 12.5 top HMA)

The diversion section minimums should be increased for heavy truck traffic, high AADT’s, or other special conditions. Any diversions planned to be in service for over 2 years shall be designed as a permanent roadway.

Temporary asphalt HMA items should be specified for one season jobs. Any diversions that are proposed to last two or more construction seasons should use 80 series permanent asphalt as it will be intended to winter over. Two season and longer projects should specify a standard top course asphalt to ensure adequate friction over the service life of the diversion.

16.4.8 Work Zone Traffic Control Documents

16.4.8.1 Notes

Work zone traffic control notes should be project-specific and should not duplicate the standard specifications. Designers should be aware that these notes are as much for the EIC as they are for the contractor. A properly conveyed WZTC concept should not leave ambiguity during the bidding process or in construction. As applicable to the project, the work zone traffic control notes should include, but not be limited to:

- A general description of the WZTC plan. For example, “To replace the bridge using staged construction while maintaining two lanes of traffic.”
- An overview of the sequence of work, with a brief description of each stage and phase. See Section 16.4.5 of this Chapter for additional information on Sequence of Construction.
- An overview of the work, such as temporary pavement, saw cuts, temporary fills, etc, that will be paid for under the pay item for Basic Work Zone Traffic Control.
- The Design Quality Assurance Bureau will insert the “Temporary Lane Closure Restrictions for Major Holidays” Special Note into all Design-Bid-Build contract bid documents and the Design-Build Group will add it to Design-Build contracts Requests for Proposals. The “Temporary Lane Closure Restrictions for Major Holidays” Special Note supersedes all existing contract provisions relating to temporary lane closures on the days preceding and following major holidays. This includes more restrictive contract specific work zone traffic control provisions unless Drivers First requirements or project specific work zone conditions warrant the more restrictive provisions. Exceptions for more restrictive provisions require approval by the Office of Traffic Safety and Mobility.
- There shall be no temporary lane closures on roadway facilities owned and/or maintained by NYSDOT on the following major holidays:
  - New Years Day - January 1st
  - Memorial Day - Last Monday in May
  - Independence Day - July 4th
WORK ZONE TRAFFIC CONTROL

- Labor Day - 1st Monday in September
- Thanksgiving - 4th Thursday in November
- Christmas Day - December 25th

- Exceptions can only be made under the following conditions:
  - Emergency work
  - Work within long-term stationary lane closures
  - Safety work that does not adversely impact traffic mobility and has been authorized by the Office of Traffic Safety & Mobility

- Construction activities using temporary lane closures shall be suspended to minimize travel delays associated with road work for major holidays as follows:
  - Friday, Saturday, Sunday, and Monday Holidays - Beginning 6:00 AM the business day before the holiday and ending 6:00 AM the business day following the holiday.
  - Tuesday Holidays - Beginning 6:00 AM the Friday before the holiday and ending 6:00 AM the next business day.
  - Wednesday Holidays - Beginning 6:00 AM the Tuesday before the holiday and ending 6:00 AM the next business day.
  - Thursday Holidays - Beginning 6:00 AM the business day before the holiday and ending 6:00 AM the following Monday.

- Traffic regulations including times when regulations such as reduced speed limits, ramp merge control, and parking restrictions are to be in effect, and details of staging areas, turnarounds, etc., for police enforcement of traffic regulations.

- Anticipated traffic demand adjusted to “passenger cars per hour per lane” (pc/h/l) during lane closures or flagging operations. This information should result in more accurate bids for Basic Work Zone Traffic Control, and may also be used in the event the contractor elects to offer a Value Engineering Change Proposal to the traffic control plan. Designers are expected to exercise judgment on the amount of traffic that may be diverted due to the lane closure or flagging operation.

- Required coordination with emergency services such as, but not limited to, local police, fire departments, and transportation management centers (TMCs).

- Congestion mitigation measures that may be taken by the EIC and contractor in the event that queues exceed specific limits, as determined by the Region. While the suggested congestion mitigation measures should be mentioned in the bid documents, the possible implementation of them should not be accounted for with items/quantities and/or ambiguous notes, since there are many variables involved and the suggestions are only based on what might occur. Rather, implementation will be handled by the Regional Construction Group in accordance with the Contract Administration Manual, if appropriate and depending on if the particular situation calls for using the suspension of work and/or extra work provisions of the contract. Examples of queues exceeding specific limits are: if traffic backs up on to the freeway, if traffic backs up across an active rail line, if queues exceed some pre-determined length such as one mile, or if traffic backs up into a major intersection. Examples of suggested congestion mitigation measures include but are not limited to: specific changes to Portable Variable Message Sign (PVMS) location and/or message, additional flagging
operations, shutting down the work zone and reopening lanes, or revising the allowable lane closure hours.

- Notes to describe any time-related contract provisions in the contract.
- Nighttime Operations.
- Signal modifications.
- Pedestrian Traffic.
- Driveways.
- Drainage Construction.
- Snow and Ice Removal.
- General and specific notes associated with the construction operations and traffic control operations.
- Descriptions of traffic control procedures necessary to accomplish the work before, during, and after construction.
- Description of special manpower-personnel/worker-type needs such as flaggers.

### 16.4.8.2 Typical Sections, Profiles, and Other Details

Typical sections and profiles may be included on the corresponding work zone traffic control plan view sheet for clarity. As applicable to the project, the work zone traffic control typical sections, profiles, and other details should include, but not be limited to:

- Typical sections, profiles and banking diagrams for detours and diversions.
- Typical sections and profiles for staged construction.
- Typical sections with lane width dimensions that meet or exceed the minimums and accommodate the design vehicle for the work zone.
- Culvert alignment, profile, minimum span/opening, and minimum acceptable low chord elevation along with the minimum waterway area (sq. ft.) that is to be provided under the low chord elevation.
- Culvert scour slope protection (in accordance with Bridge Manual Section 3.2.3.1).

### 16.4.8.3 Plans

Work zone traffic control plans are essential for project specific layouts. The 619 series standard sheets should be used as supplemental data for WZTC plan development when layouts shown on the standard sheets are applicable to the specific conditions of the project. Note that work zone typical sections and profiles are sometimes included on the corresponding work zone plan sheets for clarity. As applicable to the project, the work zone traffic control plans should include, but not be limited to:

- Plan view showing overall project in all stages, including traffic control devices for on-site work and any roads to be used for alternate routes or detours during construction.
- Applicable WZTC pay items. For construction installation of materials outlined in other standard specification sections, indicate that the construction item is to be installed in accordance with the requirements of that section but paid for under the WZTC item. For example, installing subbase in a temporary on-site detour is identified as "Furnish and install..."
subbase material in accordance with Section 304 Subbase Course, paid for under Item 619.06nn Temporary Structures and Approaches”.

- Pedestrian and vehicular detour map showing on-site diversions, off-site detours, construction phasing, and traffic patterns through the work zone.

- Plans with on-site diversions shall include alignment information, curve tables, banking diagram, horizontal control tables, minimum waterway area under low chord elevation, scour countermeasures, and appropriate transition railing/barrier at each end of the temporary culvert.

- Location of potential change in grade or drop-off problems between existing and proposed.

- Temporary sidewalks and driveways

- Temporary barrier, delineators, barricades, shadow/barrier vehicles and impact attenuators.

- Temporary drainage work

- PVMS sign locations.

- Work site access

- Temporary signals and signal modifications
16.5 WORK ZONE IMPACT MANAGEMENT STRATEGIES

16.5.1 General

Every project should be assessed relative to its potential to impact the traveling public, the people who live adjacent to the work zones, and those along adjacent routes used by diverted or detoured traffic. Consideration should be given to the cumulative impacts that may occur because of other projects (by NYSDOT or others), either planned or underway, on adjacent routes and on a regional basis.

In 2012, the Department adopted a Drivers First approach to addressing traffic impacts of construction projects. It prioritizes the convenience of motorists and ensures that disruptions are as minimal as possible to drivers at highway and bridge projects across NY State. When disruptions cannot be limited to an acceptable level, provide adequate travel information to the highway users to allow them to make informed travel mode and routing decisions. Basic principles of the Drivers First approach include:

- Construction schedules should cause as few disruptions for motorists as possible
- Efficiently balance user and construction costs without compromising safety
- Expand role of Traffic Management Centers (TMCs) as surface transportation controller (STC) for all planned and unplanned construction and maintenance events
- Enhance work zone signage and VMS content with alternate route and condition information focused on non-local travelers where appropriate
- Utilize all department travel information outlets (511NY, social media, project websites, Highway Advisory Radio, traditional media)

In order to thoroughly understand the potential impact of the construction operations and planned mitigation of those impacts, impact assessment should begin during project scoping and become progressively more rigorous as the design process continues through preliminary design toward the completion of construction contract documents. This is particularly important for large projects to reduce the risk of unanticipated and disruptive changes occurring late in design or during construction. Management of cost, scope, schedule and quality (CSSQ) impacts both the overall project and the management of traffic through and/or around the work zone. The project assessment should consider traffic and contract management strategies aimed at reducing the magnitude and duration of work zone impacts including construction time constraints.

Development of work zone impact management strategies is one element in the overall project development process described in the Project Development Manual (PDM). For example, it is within the context of the procedures described in the PDM that the project's work zone traffic control (WZTC) plans are developed. Traffic control strategies are defined by the identified needs of, and problems faced by, the traveling public as they travel through or around the work zone and those of the contractor as it works to construct the project and maintain traffic flow. Projects can usually be built in a number of alternative ways. The objective of the designer is to identify the strategy that will optimize the competing goals of minimizing construction costs and inconvenience to the traveling public and adjacent property owners, while maximizing traffic and worker safety, product quality, and operational efficiency. The Department's policy on work zone traffic control adopts the premise that motorists using a facility that is being improved must accept a certain amount of inconvenience as part of the cost of the improvement. The objective of WZTC plans in all cases should be to balance the needs for high quality project construction, life cycle costs, user costs, and schedule while providing adequate safety for both the workers and the public.
Designers are expected to work closely with their colleagues in the Regional Traffic Group and Regional Construction Group throughout the development of work zone impact management strategies. The Regional Traffic Group is responsible for overseeing the Regional Surface Transportation Control (STC) activities. The objective of the STC function is to ensure the coordination of traffic control for all roadwork, incident, and maintenance activity on the state highway system within each Region, and to serve as a hub for the information flow necessary for facilitating that traffic control, during both the planning and execution stages. Within this context, it is critical that Designers are aware of the concept of STC and how it is managed within the Region. Transportation Management Plans (TMPs) should be consistent with the objectives of the STC.

16.5.2 Transportation Management Plans and Significant Projects

Title 23, Section 630, Subpart J of the Code of Federal Regulations (Rule on Work Zone Safety and Mobility), requires a TMP for all Federal-aid highway projects, including local projects that are Federally funded. One hundred percent state-funded projects should also follow the Rule.

A TMP is a program of activities for alleviating or minimizing work-related traffic delays by the effective application of traditional traffic handling practices and an innovative combination of various strategies. These strategies encompass public awareness campaigns, motorist information, demand management, incident management, system management, construction methods and staging, and alternate route planning. TMPs may consist of three components: 1) The Temporary Traffic Control (TTC) component; 2) The Transportation Operations (TO) component; and 3) The Public Information (PI) component. TMPs deal with project-related impacts within a project corridor and sometimes beyond.

The type of TMP needed for a project is based on whether the project is determined to be a "significant" project. A "significant" project is generally a project that a State or Local transportation agency expects will cause a relatively high level of disruption, as detailed below. Significant projects and corridors serve multiple users, including commuters, freight, and tourist traffic. This designation and judgment of "significance" is made by the DOT Region where the project resides.

16.5.2.1 "Significant" Projects

A. The Rule states that interstate system projects within the boundaries of a designated Transportation Management Area (TMA) that occupy a location for more than three days with either intermittent or continuous lane closures shall be designated as "significant" projects. A judgment of "significance", therefore, is not needed for projects meeting these criteria, as they are always "significant". A TMA is an area designated by the US Secretary of Transportation, having an urbanized area population of over 200,000. The following TMAs have been designated in New York State:

New York--Newark, NY--NJ--CT.
Buffalo, NY
Rochester, NY
Albany, NY
Syracuse, NY
Poughkeepsie--Newburgh, NY

The maps in Appendix 16B have been developed to assist the designer by highlighting the limits of interstate highways within the approximate geographic boundaries of TMAs. The exact geographical boundaries of TMAs change periodically so these maps are conservative in the
identification of these limits by establishing the limit at the nearest interchange outside of the current TMA boundary.

B. For projects that do require a decision of “significance” by the Regions (i.e. not meeting the criteria in A. above), note that projects that should be designated as “significant” under the Rule are usually large projects, on major highways or critical urban facilities with large traffic volumes, design-build projects, projects which coincide with large special events, projects delivered to letting with accelerated design schedules, projects that have received multiple inquiries by elected officials or significant media attention regarding the inconvenience to motorists, and projects with long detours or with long delays expected. Projects may also be deemed “significant” because of their cumulative impact in combination with other projects. See 23 CFR 630.1010 for additional guidance on “significance”.

When a project is deemed by the Region to be “significant”, this decision of “significance” is recorded in the Work Zone Safety and Mobility Section of the IPP/FDR, PSR/FDR, or combined DDR documents as part of the project development process; see the PDM Shells. In these cases, TTC plans alone are not able to achieve substantial balance among the TMP objectives (see factors to consider in subsection 16.5.5.7), so there is a need for PI and TO strategies and activities. In Exhibit 16-18, TTC and TO work zone impact management strategy components are broken down into subcategories, and examples of the activities in each subcategory are provided. Fillable check boxes have been incorporated into Exhibit 16-18. If desired, by checking the appropriate boxes, this Exhibit may be used to document the TTC and TO strategies used on a “significant” project. Note that there is no expectation that all of the sample strategies provided in Exhibit 16-18 will be used on any single “significant” project. Since the TMP encompasses both the design and construction phases of the project(s) it covers, some of the strategies within the TMP will be initiated and implemented during construction. For PI strategies used on a significant project, Appendix 2 of the PDM is the Public Involvement Manual. The Public Involvement Manual Appendix C is a Public Involvement Plan Checklist. This will serve to document PI.

16.5.2.2 Projects not designated as “Significant”

If the project is not deemed to be “significant” (in accordance with the criteria and guidance in subsection 16.5.2.1), the TMP must contain, at a minimum, the TTC plan component.

16.5.3 Definitions and Terminology

The categories and subcategories of work zone impact management strategies referred to in Exhibit 16-18 defines the terminology used in this Section of HDM Chapter 16. Note that Temporary Traffic Control (TTC) plans are also referred to in the federal regulations and guidance as Work Zone Traffic Control (WZTC) plans.

A comprehensive TMP Strategy Matrix, developed by the FHWA, is available at: TMP Strategy Matrix. This matrix provides considerations that assist in identifying the specific strategies which may be employed for the wide variety of projects and project conditions that may be encountered.
### Exhibit 16-18  Work Zone Impact Management Strategies

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<th>Traffic Control Devices</th>
<th>Project Coordination, Contracting and Innovative Construction Strategies</th>
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<td><strong>Control Strategies</strong></td>
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<td><strong>Project Coordination, Contracting and Innovative Construction Strategies</strong></td>
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<td>- Regulatory</td>
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<td>- Reduced lane widths to maintain number of lanes (constriction)</td>
<td>- Guide/Information</td>
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<td>- Lane closures to provide worker safety</td>
<td>□ Variable Message Signs (VMS)</td>
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<td>□ One-lane, two-way operation</td>
<td>□ Channelizing devices</td>
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<td>□ Business access Improvements</td>
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<tr>
<td>□ Off-site detours/use of alternate routes</td>
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**Temporary signs**
- Warning
- Regulatory
- Guide/Information

**Variable Message Signs (VMS)**
- Arrow panels
- Channelizing devices
- Temporary pavement Markings
- Flagger and uniformed traffic control officers
- Temporary traffic Signals
- Lighting devices
- Automated Flagger Assistance Devices
- Project coordination
- Coordination with other projects
- Utilities coordination
- Right-of-way coordination
- Coordination with other transportation infrastructure
- Contracting strategies
- Design-build
- A+B bidding
- Incentive/disincentive clauses
- Lane rental
- Innovative construction techniques (precast members, rapid cure materials)
### Transportation Operations (TO)

<table>
<thead>
<tr>
<th>Demand Management Strategies</th>
<th>Corridor/Network Management Strategies</th>
<th>Work Zone Safety Management Strategies</th>
<th>Traffic/Incident Management and Enforcement Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit service improvements</td>
<td>Signal timing/coordination improvements</td>
<td>Speed limit reduction/variable speed limits</td>
<td>ITS for traffic monitoring/management</td>
</tr>
<tr>
<td>Transit incentives</td>
<td>Temporary traffic signals</td>
<td>Temporary traffic signals</td>
<td>Transportation Management Center</td>
</tr>
<tr>
<td>Shuttles services</td>
<td>Street/intersection improvements</td>
<td>Temporary traffic barrier</td>
<td>Traffic screens</td>
</tr>
<tr>
<td>Ridesharing/ carpooling incentives</td>
<td>Bus turnouts</td>
<td>Movable traffic barrier systems</td>
<td>Call boxes</td>
</tr>
<tr>
<td>Park-and-ride promotion</td>
<td>Turn restrictions</td>
<td>Crash-cushions</td>
<td>Mile-post markers</td>
</tr>
<tr>
<td>High occupancy vehicle (HOV) lanes</td>
<td>Parking restrictions</td>
<td>Temporary rumble strips</td>
<td>Tow/freeway service patrol</td>
</tr>
<tr>
<td>Toll/congestion pricing</td>
<td>Truck/vehicle restrictions</td>
<td>Intrusion alarms</td>
<td>Photogrammetry</td>
</tr>
<tr>
<td>Ramp metering</td>
<td>Separate truck lanes</td>
<td>Warning lights</td>
<td>Coordination with media</td>
</tr>
<tr>
<td>Parking supply management</td>
<td>Reversible lanes</td>
<td>Automated Flagger Assistance Devices (AFADs)</td>
<td>Local detour routes</td>
</tr>
<tr>
<td>Variable work hours</td>
<td>Dynamic lane closure system</td>
<td>Construction safety supervisors and inspectors</td>
<td>Contract support for incident management</td>
</tr>
<tr>
<td>Telecommuting</td>
<td>Ramp metering</td>
<td>Road safety audits</td>
<td>Incident/emergency response plan</td>
</tr>
<tr>
<td></td>
<td>Temporary suspension of ramp metering</td>
<td>TMP monitor/inspection team</td>
<td>Dedicated (paid) police enforcement</td>
</tr>
<tr>
<td></td>
<td>Ramp closures</td>
<td>Team meetings</td>
<td>Cooperative police enforcement</td>
</tr>
<tr>
<td></td>
<td>Railroad crossings controls</td>
<td>Project on-site safety training</td>
<td>Increased penalties for work zone violations</td>
</tr>
<tr>
<td></td>
<td>Coordination with adjacent construction site(s)</td>
<td>Safety awards/Incentives</td>
<td>Work Zone Cameras</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Windshield surveys</td>
<td></td>
</tr>
</tbody>
</table>
16.5.4 Establishing a Transportation Management Team

When a project has been identified as a “significant” project, a Transportation Management Team should be formed with designated Department representatives of all involved functional areas and a leader of the Team. The Transportation Management Team should be closely coordinated with the Project Team formed as part of the Project Scoping Procedure described in Chapter 3 of the PDM. The Team should be an interdisciplinary Team composed of stakeholders that can provide valuable input on what strategies to include in the TMP to help manage the work zone impacts of a project through design and construction. Team stakeholders should represent different perspectives and will vary depending on the nature of the project. Team members may include staff from Planning, Design, Traffic, Construction, Maintenance, External Relations, Integrated Modal Services, and Structures; and external stakeholders such as the FHWA, local government, public transportation providers, enforcement agencies, emergency services, and schools. If the project is being designed by consultants, they should also be represented. The Regional Transportation Management Center and Surface Transportation Control function should always be represented on the Team. The designer should also review 23 CFR 630 Subpart J and K for additional guidance.

In developing and managing the TMP, the Transportation Management Team is responsible for keeping an overview of project TTC, TO, and PI-related issues such as:

- Contracting strategy (e.g. schedule, time constraints, Best Value)
- Scheduling of other highway projects and utility projects in the corridor.
- Emergency response and incident management during construction.
- Transit, ride sharing, park-and-ride lots, etc.
- Traffic impact management strategies on alternate routes, including coordination with local governments for impacts on local streets.
- Involvement of affected businesses and the public.
- Public information needs and media involvement.
- Detours.
- Nighttime construction and other construction time restrictions.
- Time-related contract provisions such as incentives, disincentives, liquidated damages, and lane rentals.
- The needs of commuter, through, tourist and event traffic.
- Truck traffic including permitted oversize and overweight vehicle traffic.
- The cost effectiveness of potential work zone impact management strategies.
- Regional approval and public support of the TMP.
- Prediction of the effects of mitigation measures on road users choice of travel routes and mode of transportation.
- Cumulative effect of constraints on feasibility of construction.

16.5.5 Evaluation of Work Zone Impact Management Strategies

For projects that are not classified as significant projects, the TMP may consist only of a TTC plan. However, agencies are encouraged to consider TO and PI for these projects as well. Analysis of the impact of a project will ultimately determine which work zone management strategies are to be used. Exhibit 16-19 provides an overview of the evaluation process.
Exhibit 16-19  Process for Evaluation of Work Zone Impact Management Strategies

1. ASSEMBLE DATA
   Describe the work to be done and provide the required data

2. DETERMINE EXTENT OF ROADWAY OCCUPANCY
   Assess the first level of roadway capacity

3. IDENTIFY FEASIBLE ALTERNATIVES
   Determine which strategies may be appropriate for the type of work activity to be performed

4. ANALYZE VOLUME/CAPACITY RELATIONSHIPS
   This involves a more detailed analysis of capacity constraints, queue lengths, and delays

5. ANALYZE CAPACITY IMPROVEMENT TECHNIQUES
   If problems exist or have been identified in the earlier steps, additional techniques should be considered to reduce delays and congestion

6. DEFINE ALTERNATIVES
   Review the alternatives for practicality and achievability

7. QUANTIFY IMPACTS
   Relative impacts of different strategies need to be measured not only from a traffic flow perspective, but also with regard to constructability and construction cost, as well as environmental and economic impact

8. MODIFY PROCEDURES
   Modify the project design, phasing, and/or schedule as required in response to problems

9. SELECT PREFERRED ALTERNATIVE
   For the selected strategy, develop the necessary traffic control plans for implementation

ARE THERE CAPACITY DEFICIENCIES?
YES

ARE THERE SEVERE IMPACTS?
YES

NO
The steps in the process shown in Exhibit 16-19 are detailed below:

1. **Assemble Data** - To analyze the impact, data must be gathered about the highway including existing road conditions, operational features, horizontal and vertical restrictions, and peak and off-peak speed and traffic volume data. Project information must be gathered including the type of work to be done, project and work limits, tentative schedule, and potential detour routes. Community information must be gathered including jurisdictions involved, business access, emergency facilities locations, schools, other user groups (bicyclists, pedestrians, etc.), activities or events, and designated access routes. The extent and type of data to be assembled depends on the complexity and size of the project.

2. **Determine the Extent of Roadway Occupancy** - During construction, most projects require occupancy of some portion of the traveled way or shoulder by the construction activity. The extent to which the roadway is occupied by construction activities and buffer space and is unavailable for use by traffic is known as roadway occupancy. Roadway occupancy results in a reduction in capacity of the roadway, and defines a number of constraints within which the traffic control strategy must be developed. Both spatial requirements and time durations of the roadway occupancy must be determined.

3. **Identify Feasible Alternatives** - Identify Strategies in accordance with Exhibit 16-18 and the FHWA’s [Work Zone Impact Management Strategies](https://www.fhwa.dot.gov/). The guide for the types of work zones and feasible work zones are in Exhibits 16-21 and 16-22.
### Exhibit 16-20 Descriptions of the Basic Types of Work Zones

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Lane Constriction** | - Lane widths are reduced to retain the number of lanes normally available to traffic.  
  - Applicable only if the work area is mostly outside the normal traffic lanes.  
  - May depend on the availability of shoulders.  
  - Least disruptive of all work zone types. |
| **Lane Closure** | - Close off one or more normal traffic lanes.  
  - May require capacity analysis to determine whether serious congestion will result.  
  - Use of shoulder or median as a temporary lane may mitigate the capacity problems. |
| **Alternating One Way Flow** | - Uses one lane for both directions of traffic.  
  - Traffic must be controlled and coordinated with the use of flaggers or traffic signals. |
| **Temporary Bypass (Diversion)** | - Requires the total closure of the roadway in one or both directions.  
  - Traffic is diverted to a temporary roadway constructed within the highway right of way.  
  - Requires extensive preparation of the temporary roadway to withstand the traffic loads. |
| **Intermittent Closure** | - All traffic in both directions must be stopped for a short period of time to allow the work to proceed, after which, traffic is allowed to proceed.  
  - Normally applicable only on very low-volume roadways. |
| **Crossover, including Two-lane Two-way Operation** | - The traffic in one direction is rerouted across the median to the opposite traffic lanes.  
  - May also require the use of the shoulder and/or lane constrictions to maintain the same number of lanes.  
  - Consideration must be given to separation devices, crossover design, and length before selecting this strategy. Long work zones can be a delay concern for drivers.  
  - Refer to Section 16.4.7.4 for further guidance. |
| **Use of Shoulder or Median** | - The shoulder or median serves as a temporary lane.  
  - Must determine if there are underpasses or other vertical clearance issues.  
  - Must determine if shoulder or median will adequately support the expected traffic loads.  
  - Must determine if the traffic can be transitioned safely to the temporary lane.  
  - May be used in combination with other work zone types or as a separate technique.  
  - Potential drainage and rollover concerns. |
| **Detour** | - Requires total road closure and rerouting of traffic to existing off-site facilities.  
  - Particularly desirable when there is unused capacity on roads running parallel to the closed roadway.  
  - May require improvements to existing roadway(s) to make it suitable to carry detoured traffic. |
Exhibit 16-21  Guidelines for Identifying Feasible Work Zone Types

Source: Planning and Scheduling Work Zone Traffic Control
4. **Analyze Volume/Capacity Relationships - An analysis of capacity constraints, queue lengths, and delays.**

This step in the process is a detailed investigation of the volume/capacity relationships of the different strategies identified from the previous step, and the consequent general levels of congestion that may develop. The Regional Traffic Group will generally be the program area responsible for this analysis.

The Highway Capacity Manual is a fundamental and extensive resource for examining capacity for a wide variety of conditions and facilities. NCHRP Report 475 provides the principles for analyzing capacity of work zones and comparing alternative work zone impact management strategies, including the estimation of user costs and evaluation of the costs of accidents related to work zone activity. The following excerpt from that report explains why it is important that determinations about project impacts on capacity be made by those familiar with not only the project but also the region and communities that are impacted:

*There is no widely accepted definition of “unacceptable” congestion. It is often not the same among urban and rural areas, and even among different areas within the same state. “Unacceptable” congestion must therefore be determined by local norms. Typically, the determination of whether congestion is unacceptable on a given project involves consideration of changes in level of service during construction, queue length/duration and resulting delay, and disruption of access to businesses and to travel patterns throughout the community. Another critical consideration is whether a queue grows so large that it blocks other intersections or interchanges. This is called ‘spillback’ and often has large negative delay and safety consequences that the profession cannot calculate at this time. The agency responsible for the work must determine what level of congestion and delay is unacceptable for each project on the basis of the impact of the project on the community.*

Lane closure time restrictions will be supplied by the Regional Traffic Group to the Regional Design Engineer (RDE). The “Department Approved List of Traffic Analysis Software” is available under “Resource Links” on the HDM Chapter 5 Web Page.

**A. Work Zone Capacity**

The roadway capacities of the various work zone strategies should be determined to compare them to the traffic volumes that will use the facility. Due to constrained space for traffic on the project and a shortfall of available capacity on alternative routes, the project traffic demands may be less than the normal traffic demands, but may still exceed those for which the work zone is designed. When project traffic demand exceeds capacity, a queue will develop and an estimate of queue length can be calculated. Depending upon the length and duration of the queue, certain strategies may have to be abandoned, unless measures can be taken to increase capacity or reduce demand. Examples of such measures include restricting construction work to certain hours of the day or night, or certain days of the week, removing parking along the streets or roads involved, and diverting traffic to other facilities with available capacity.
B. Queue Delay, Size, and Duration

When demand volume exceeds capacity, congestion will occur and a queue will form. The duration of the congestion, the amount of delay, and the size of (number of vehicles in) the queue may be calculated using the procedure and equations given in Chapter 2 of the FHWA's Publication *Work Zone Road User Costs - Concepts and Applications*. Due to the many project type and location variables, engineering judgment should be exercised to determine the need for an analysis and the depth of the analysis when one is needed.

5. Analyze Capacity Improvement Techniques - If, after the initial analysis, unacceptable capacity deficiencies are still anticipated on all feasible alternatives, additional work zone impact management strategies (see Exhibit 16-18) should be considered to mitigate delays and congestion.


When the capacity improvement techniques analysis is completed, some of the strategies may be unacceptable.

Components that must be included in defining the Work Zone Impact Management Strategies are below:

- Basic construction sequence, e.g., on multilane highways, reconstruction by halves, parallel/adjacent reconstruction, serial/segmental reconstruction (two-lane, two-way operations), complete closure, or a combination of sequences.
- Overall construction time period or construction seasons and how they will affect user costs.
- Traffic management strategy through the construction area with segment-by-segment delineation for each phase of construction and definition of the time period for each segment and phase.
- Traffic diversions including identifying all routes to be used and necessary associated improvements for diversions and detours.
- Proposed temporary detours.
- Specific traffic control plans showing the traffic control devices for each strategy.

7. Compare Impacts - Relative impacts of different work zone impact management strategies need to be considered from a traffic flow, safety, constructability, construction cost, environmental, and economic perspective.
Factors to consider are:

- Traffic delay and safety
  - Vehicle volume.
  - Delay/Travel time.
  - Travel speed.
  - User cost.
  - Accidents.
  - Vehicle occupancy.
  - Pedestrian use and accessibility.
  - Bicycle use and accessibility.

- Constructability
  - Effect on quality of construction.

- Project costs
  - Traffic control and enforcement.
  - Maintenance of traffic control devices.
  - Construction and demolition.
  - Efficiency of the work area.

- Environmental impacts
  - Air pollution.
  - Energy consumption.
  - Noise levels.
  - Light pollution
  - Community Services

- Business loss.

- User Costs.
  
  A. User costs associated with construction work zones are:
  - User time cost.
  - Vehicle crash cost.
  - Vehicle operating cost.
  - Vehicle emission cost.

Work zone road user costs can be determined using the guidance available at: Work Zone Road User Costs - Concepts and Applications and Valuation of Time in Economic Analysis. Also, a support document entitled “New York Value of Time and Vehicle Cost” is available on the HDM Ch16 Web Page.

If a project returns more to the public than is spent, the project is considered a cost-effective project. For temporary traffic maintenance estimates, when the average delay per vehicle is 15 minutes or less, the user costs as determined by that method, should be reduced as shown in Exhibit 16-22.
Exhibit 16-22  Allowable Delay and User Cost Reductions

<table>
<thead>
<tr>
<th>Average Delay/Vehicle (minutes)</th>
<th>% of User Cost Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5</td>
<td>0</td>
</tr>
<tr>
<td>5 to 10</td>
<td>50</td>
</tr>
<tr>
<td>10 to 15</td>
<td>75</td>
</tr>
<tr>
<td>greater than 15</td>
<td>100</td>
</tr>
</tbody>
</table>

A spreadsheet for cost comparison of on-site staging versus a detour option is available. See “Work Sheet For Comparing Off-Site Detour with On-Site Staging” is available under “Resource Links” on the HDM Ch16 Web Page.

B. Project Cost Impacts

All costs of construction, mitigation, and traffic control, including an allowance for enforcement, should be used in the analysis. If, for example, there are mitigation costs involved in the detour scheme ultimately selected, include those costs in the overall project cost.

Alternative Work Zone Impact Management Strategies may have substantial project cost impacts. For example, a given strategy may involve time restrictions on construction activities, i.e., construction during off-peak hours only, the effective work day may be reduced by 25% or more. This will increase the overall duration of the project and may substantially affect the project cost.

Other strategies may have an impact on the amount of available work area during certain construction phases, such as work space limitations resulting from an adjacent project, causing increased project costs.

It is essential that the constructability of the Work Zone Impact Management Strategies be reviewed to ensure that unrealistic constraints are not placed on the project. This is accomplished by maintaining close contact with, and receiving input from the Regional Construction Group during the design phase.

16.5.6  Detours

16.5.6.1  General Considerations for Detours

A detour is a temporary rerouting of road users onto an existing highway in order to avoid a WZTC zone. Depending on the impact to traffic caused by project work being performed, detours may be considered if a detour might be the most cost-effective solution. In the case of total roadway closure where traffic is detoured to adjacent roadways, the detour route(s) must have the capacity to handle both existing and detoured traffic.

When evaluating a longer detour on a State highway against a shorter detour on a local road the designer should keep in mind that the posted detour is for travelers following the route who are not familiar with the area. Most local and frequent users of the route will likely select an alternate route.
Detours for rural work zones have special considerations and are covered in Section 16.5.6.B.

For a large project, a detour is often the best solution for only certain phases of the work. During project scoping, the Regional Maintenance Group and Regional Traffic Group should send potential detour routes to the designer for analysis. Collaboration with the Regional Traffic Group should continue throughout design. Traffic Engineers can advise on the route's ability to handle truck traffic, increased traffic volume, and the need for signals and signs and other improvements to establish an acceptable level of safety throughout the life of the detour. The Regional Materials Group should be consulted regarding any pavement condition issues on the detour route. Considerations for detours are provided below and in Bridge Manual Section 3.7:

Construction operations which sometimes require detours are:

- Bridge replacements.
- A significant raising of the existing highway profiles while utilizing the same, or nearly the same horizontal alignment.
- Construction of grade separations at highway crossings.
- Reconstruction work on bridge approach slabs.
- Combination of fill widening and profile.
- Culvert replacements for culvert spans of 8 ft. or greater.
- Miscellaneous work that requires trenching across the highway for long periods of time.
- Other work requiring profile changes at frequent intervals along the segment of roadway being improved.
- Bridge rehabilitation where there is not enough width to adequately maintain traffic under staged construction.

Considerations for detour routes are:

- State highway or local road.
- Cross section shape (normal or rounded crown).
- Lane and shoulder widths.
- Mainline and intersection horizontal and vertical geometry and sight distances.
- Pavement/shoulder structure and condition; need for repairs.
- Minimum design criteria.
- Duration of the detour (short-term or long-term).
- Length of the detour vs. length of road to be closed from the beginning to the end of the detour.
- Determine if existing traffic control (traffic signals, pavement markings and signing) needs upgrading to conform to NYSDOT standards.
- Existing level of traffic control (signing, signals, pavement markings, etc.).
- Speed limit on the detour route.
- Travel time on the detour route.
- Peak-hour traffic volumes (local + detoured); heavy-truck volumes.
- Level of service.
- Accident rates and potential problem areas.
- Capacity restrictions/analysis.
- Ability to handle trucks (geometric restrictions) and over-dimensional permitted vehicles. Weight and height restrictions.
- Commuter transfer facilities (e.g., bus stops, park-and-ride lots).
- Local traffic generators (events, employment centers, etc.).
- Adjacent or nearby projects.
• Structural condition of bridges and pavement on the detour route.
• Pedestrian and bicyclist access and accommodation.
• Roadside hazards and safety issues (steep slopes, drop-offs, fixed objects, clear zone, condition and location of guide rail).
• Roads prone to flooding.
• Evacuation Routes.
• Emergency services access.
• Railroad crossings.
• Neighborhood characteristics.
• Economic impacts on businesses.
• Effects on schools and school bus routes.
• Use by farm machinery.
• Environmental effect of any necessary construction.

Advantages of road closures and detours are:
• Conflicts between traffic and the work activity are eliminated.
• Driver avoids congestion in the work zone.
• Safer for the workers.
• Shortens the construction schedule and can improve quality.
• May provide permanent improvements to the detour route.

Disadvantages of road closures and detours are:
• Longer driving time.
• Higher user costs.
• Lower level of service on the detour route.
• Higher traffic volumes and accident rates on the detour route.
• Driver confusion.
• Disruption to local business traffic and emergency vehicles.
• Costly upgrading may be necessary to prepare the detour for increased traffic.
• Sometimes not feasible on high volume roads.

Once the cost data and impacts for each strategy have been determined and documented, the Regional Director (or his/her designated representative) should select the most cost-effective detour consistent with public safety. As used herein, cost-effective means a decision based upon careful consideration of the construction cost, user cost, (including time, operation, and accident costs) and demolition cost with consideration for quality of construction, duration of construction, and other intangible impacts. The Regional Director may choose to allow their designated representative to decide on the detour option for “routine” projects. However, if a preferred strategy is not readily apparent, or when the cost of the detour recommended exceeds the lowest cost option, the Regional Director will decide the appropriate detour scheme. All decisions should be documented in the project records and any involvement by local jurisdictions should be acknowledged by them in writing.

A. Considerations for Detours for Rural Work Zones

For rural non-freeway highway reconstruction work, and rural bridge and culvert replacement work, it is the Department’s policy that offsite detours should be the preferred alternative when selecting a method of temporary traffic control due to its lower cost, increased speed of construction, potential for better quality construction, and potential for a safer work environment for workers and motorists. This policy applies whenever the normal travel paths must be shut down or significantly restricted for a substantial period of time (longer than can be handled under
While the detour route may still be preferred, other traffic control schemes may be considered when:

- An improved alignment will allow an on-site diversion (e.g., the preferred alternative improves a nonstandard horizontal bridge approach curve to reduce crash frequency and severity).
- The detour will be in place for more than one construction season;
- The detour route has vertical clearance or weight restrictions below that of the current route. A separate detour for oversize and overweight permit vehicles is not feasible (e.g., increases trip for through traffic by more than 25 miles);
- The detour route would result in traffic queuing-up across at-grade mainline railroad crossings;
- The detour route would result in a decrease in level of service to E or worse during construction;
- The detour route substantially increases traffic through low-speed (posted 35 mph or less) residential neighborhoods or elementary school zones;
- There are a substantial number of bicyclists or pedestrians who would be severely impacted;
- The length of the detour would be excessive;
- Staged construction on site is a practical alternative

OR,

The combined cost of the following outweigh the detour alternative by more than 25% (note that when evaluating user costs, no more than 25% of the user cost should be compared directly with the Department’s capital costs):

- The cost to upgrade the detour route to a minimum of 10 ft lanes and 2 ft shoulders (14 ft minimum for one-way traffic), accommodate a large school bus design vehicle, and address safety items from a road safety audit (using 1R requirements from HDM Chapter 7), and
- The cost of staging emergency response vehicles on the opposing side of the closed bridge or culvert where response times (using the most direct route) will be worse than the response time that currently exists to the furthest part of the district.

When an offsite detour route will not be used for a rural work zone, the design approval document should include documentation of the above factors.

If the decision is made to implement a detour, reference HDM 16.4.7.7.B, “Establishing a Detour”.
16.5.7 Nighttime Construction

16.5.7.1 General

Nighttime construction (operations) is defined in the Standard Specifications as work occurring after sunset and before sunrise. Activities that require lane closures on high-volume roadways are often considered for night work. The same types of work zones used for daytime construction may be considered for nighttime construction (see Exhibit 16-23).

Whenever it is not possible to achieve substantial balance among the Department’s objectives through work zone impact management strategies for daytime construction, the feasibility of nighttime construction shall be evaluated. Consideration of night construction activities requires an understanding of the tradeoffs that are involved. Exhibit 16-23 lists the factors affecting the nighttime construction decision and summarizes the advantages and disadvantages of nighttime construction.
### Nighttime Operations: Considerations

#### Traffic-Related

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Congestion</strong></td>
<td>Significantly reduces or avoids traffic congestion and motorist delays.</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Lower traffic demand at night lead to reduced overall crashes. Some workers may be more aware of the dangers and more conscious of safety practices.</td>
</tr>
<tr>
<td><strong>Traffic Control</strong></td>
<td>Increased flexibility in work zone due to less traffic interference and improved level of service.</td>
</tr>
</tbody>
</table>

#### Construction-Related

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality</strong></td>
<td>Quality can be enhanced when sufficient level of lighting is provided. Cooler temperatures can enhance the quality of the concrete set at night.</td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
<td>Less traffic interference and longer work shifts can enhance productivity and efficiency. Allows more lanes to be temporarily closed to accommodate work activities.</td>
</tr>
<tr>
<td><strong>Equipment Repair</strong></td>
<td>Breakdown of equipment can be mitigated through the use of contingency plans.</td>
</tr>
<tr>
<td><strong>Work Operations</strong></td>
<td>Possibility of decreased completion time through double shift work.</td>
</tr>
</tbody>
</table>
### Social

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Condition</td>
<td>Driver anger and frustration as a result of traffic delays may be reduced.</td>
</tr>
<tr>
<td>Worker Health</td>
<td>Health of workers can be affected positively by less exposure to automotive emissions caused by decreased congestion.</td>
</tr>
</tbody>
</table>

### Economic

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Cost</td>
<td>Losses incurred by surrounding business as a result of operations may go down as a result of eliminating work during daytime.</td>
</tr>
<tr>
<td>Driver Cost</td>
<td>Driver costs will decrease because of lower vehicle operating cost and time savings.</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>Reduced traffic interference and enhanced flexibility can drive down the cost of nighttime operations compared to daytime operations.</td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th>Positive Aspect</th>
<th>Negative Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Pollution</td>
<td>Excessive lighting can be controlled by using new technologies.</td>
</tr>
<tr>
<td>Noise</td>
<td>Disturbances can be mitigated by using the latest technologies, and proper planning and administration of work zone.</td>
</tr>
<tr>
<td>Fuel Consumption/Energy Use</td>
<td>Less fuel is burned through idling cars in congested work zones. New lighting technologies consume less energy.</td>
</tr>
<tr>
<td>Air quality</td>
<td>Pollution from automotive exhaust emissions decreases from reduced congestion levels.</td>
</tr>
</tbody>
</table>

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**Exhibit 16-23  Nighttime Operations: Considerations (continued)**
16.5.7.2  Nighttime Construction Plans

Whenever traffic is maintained through the work zone it is preferable to provide as much positive protection (buffer space, barrier, or delineation) as practical between construction activities and the traffic. Lane closures using channelizing devices provide the least protection, but some projects will be forced to utilize this option because reasonable detour routes are not available and all travel lanes must be available to carry traffic during daylight hours. Where the work area will remain at a fixed location for more than a few days, consideration should be given to using movable concrete barriers. However, for typical night construction operations such as paving and pavement/joint repairs, the work area is generally not fixed and it becomes necessary to rely on channelizing devices and barrier vehicles to form temporary lane closures on a nightly basis. Retroreflective signs, paddles, and flags are of increased importance during nighttime construction.

16.5.7.3  Lighting Requirements

Illumination requirements related to work zone traffic control are contained in Section 619 of the Standard Specifications.
16.6 REFERENCES


- *Official Compilation of Codes, Rules, and Regulations of the State of New York*, Title 17 Transportation Volume B, (a.k.a. the New York State Supplement to the Manual of Uniform
References

Traffic Control Devices), 2009. Secretary of State, State of New York, Department of State, 41 State Street, Albany, NY 12231.

- Policy on Moveable Concrete Barrier, June 25, 2001, by NYSDOT Region 11, Long Island City, NY 11101.


- Roadside Design Manual, Appendix A. Virginia Department of Transportation, Location and Design Division, 1221 East Broad Street, Richmond, VA 23219.

- Roadway Design Manual, New Jersey Department of Transportation, 1035 Parkway Avenue, PO Box 600, Trenton, NJ 08625.

- Standard Drawing TM525, Oregon Department of Transportation, Traffic Management Section, 355 Capitol Street NE, Salem, OR 97301-3871.


APPENDIX 16A  Local Road Detour Information Form
Detour on Local Road – Example

DETOUR ROUTE ON LOCAL ROAD FOR S.H. NO. __________ Region
No._________

1. Local route no. __________ Municipality & County

2. Reason for detour

3. Total length of detour (including portions of other S.H.s if used)


5. Designation and mileage of each road, and mileage of each surface type of road used as
detour.

6. General and minimum width of each surface type.

7. Will adverse weather affect the detour?

If so, an additional sheet for an alternate road should be prepared.

8. List all structures on detour indicating those limited to less than 20 tons. Also list limited
clearances.

9. Will an additional detour be needed for this project?

10. Who will maintain the detour?

11. Approximate date the detour will become effective.

Adapted from MnDOT Traffic Engineering Manual
APPENDIX 16B  Transportation Management Areas
Exhibit 16B-1
New York-Newark, NY-NJ-CT.
Exhibit 16B-2
Buffalo, NY
Exhibit 16B-4
Albany, NY
Exhibit 16B-5
Syracuse, NY
Exhibit 16B-6
Poughkeepsie-Newburg, NY