Chapter Eight
TRAFFIC SERVICES

The purpose of traffic control devices is to aid in insuring highway safety by providing for the orderly and predictable movement of traffic, and providing information, guidance and warnings as needed for safe operation of vehicles. Based on their use, they are generally classified as regulatory, warning, guidance or informational. Regulatory devices are the most important as they must be adhered to in order to maintain the safe movement of the mix of traffic. State laws specifying penalties for drivers, bicyclists and pedestrians who do not abide by these signs reinforce their importance. Warning signs advise of potential hazardous traffic operations. Guidance and information signs aid the driver to more easily find local sites, institutions, etc.

8.1 GENERAL CRITERIA

Because of a recognized need for reasonable nationwide uniformity and consistency in traffic control devices, the *Manual on Uniform Traffic Control Devices* (MUTCD) has been developed through a national advisory committee. This manual has been approved by FHWA for all highways and streets open to public travel. Under authority granted by Congress, the federal Secretary of Transportation has decreed that traffic control devices in each state shall be substantially in conformance with the most current edition of the MUTCD. These standards have been adopted by DelDOT and are applicable to all highways, roads and streets under DelDOT's jurisdiction.

The designer should be aware that DelDOT does develop separate publications that are based on the information found in the MUTCD. These publications cover applications that have been found to perform the best in this state and the designer should contact the Traffic Section for the latest publications.

The MUTCD is a comprehensive publication that provides the warrants, criteria and guidelines for virtually all traffic control installations. The subject matter discussed in the manual includes the following:

- Signs,
- Pavement markings,
- Traffic signals,
- Islands,
- Traffic controls for street and highway construction, maintenance, utility, and emergency operations,
- Traffic controls for school areas,
- Traffic control systems for railroad-highway grade crossings, and
- Traffic controls for bicycle facilities.

The MUTCD and supplemental supporting publications prepared by the Traffic Section are very comprehensive and stand on their own as guidelines for traffic control measures. It would be impractical to reproduce all the information found in them within this Chapter. Emphasis here will be placed on policies, procedures and responsibilities for effective application of the standards.

8.2 DESIGN PRINCIPLES

The first consideration in designing traffic control devices is that there is an optimum number. In many situations, as more devices are installed the goal to provide a safe and efficient transportation system is less likely to be reached.

To maximize the value and obtain the optimum installation of traffic control devices, the designer should ask the following questions when developing the signing and striping plans, and the maintenance of traffic plans (MOT):

- Is there a need for the particular device being considered and what is the correct type for the application under consideration?
- Is the device properly located and sized to command attention?
- Does the device convey a clear, simple and concise meaning?
- Has the device been so over used on the project or misplaced to the point where a driver no longer respects it, but in fact ignores it or even reacts adversely?
- Is the device located and sized with a message that provides the driver with adequate time to react in the manner intended?

To answer these questions the designer, along with traffic, construction, and maintenance personnel, must employ the following considerations.

8.2.1 UNIFORMITY

Conformance with the MUTCD assures that the size, contrast, colors, shape, composition, lighting and reflectorization are combined in a manner that draws attention: the shape, size, colors, and conciseness of the message convey the meaning intended; legibility and size combined with location provide adequate reaction time; and uniformity, size, legibility and the purpose for which the device is used commands a driver's respect.

8.2.2 PLACEMENT

The designer should assure the device is: in the viewer's uncluttered cone of vision so that it will command attention; and placed at the proper point near or at the object, or in the situation to which it applies to aid in conveying the proper meaning.

8.2.3 OPERATION

The designer should assure that the appropriate devices and related equipment are installed to meet the traffic control needs at a given location. The uniform and consistent placement and operation of devices will assure that drivers will respond properly, since they will have been exposed to similar traffic control situations previously. This principle is as important or perhaps more important for the maintenance of traffic during the construction phase of a project. Adapting to the frequent changes in traffic flow and mix is difficult enough for the driver without compounding it with inconsistent signing.

8.2.4 MAINTENANCE

The effort expended in assuring good design, placement and operation of devices will be of little value if the devices are not properly maintained. It is necessary that legibility be retained, that the device is visible and that it is removed when no longer needed. In addition to keeping the devices clean and legible, they should be properly mounted, in good working condition, and when replacing or shifting locations assuring that their functional integrity is maintained.

8.2.5 CONSISTENCY

Treating similar traffic control situations in the same manner simplifies the driver's recognition and understanding of the conditions to be anticipated. Consistency translates into faster reaction time and greater compliance with the functional intent of the device.

8.3 RESPONSIBILITIES

The Divisions of Transportation Solutions and Maintenance and Operations share the responsibilities for assuring adherence to the MUTCD during plan preparation and for the application of these standards to control traffic during the construction and maintenance phases of projects. Maintenance and Operations will advise designers on which products are performing the most effectively.

8.3.1 TRANSPORTATION SOLUTIONS

The assigned design team is responsible for ensuring that the final project plans include the necessary traffic control devices, including projects assigned to consultants for design. The design team is responsible for the design of the roadway sections and geometrics related to the installation of the traffic control devices. The team provides the design and plan preparation for signing and striping plans, construction phasing with necessary traffic control plans (MOT) and standard construction details for traffic control devices as determined appropriate for repetitive use in contract plans.

The Bridge Design Section is responsible for designing the overhead and large ground mount sign supports and foundations for most in-house design projects and the review of designs prepared by consultants.

Considerable coordination between the project design team and the Traffic Section is required throughout the stages of designing a project. Many decisions need to be made early in plan development, and will become an integral part of the design and defining the final right-of-way needs. Items to be coordinated include the following:

- Intersection geometrics — including the need for and the use of channelization and auxiliary lanes;
- The need for and use of traffic signals — including pole location, required coordination, associated underground conduit, and, in particular, the right-of-way required to accommodate the installation;
- Locations of any desired highway lighting or traffic sign illumination, identification of power sources and the need for any underground conduit to be installed during construction;
- The need for overhead signing or large ground-mounted signs that require consideration for support structure locations as well as inclusion in the work schedule of Bridge Design or consultants;
- The identification of a basic plan for any needed detours and traffic control measures to be incorporated in the contract plans; and
- The identification of any unusual pavement marking or other traffic service device concepts.

The findings of these coordination meetings are formally documented and serve as a basis for completing the detailed design and construction plans.

The Traffic Section and Maintenance and Operations provide a continuous review and technical resource during project development and construction of a project's traffic services. The areas of concentration are constructibility, product selection and its proper installation, operation feasibility, safety of the workers and the traveling public, and the practicality of future maintenance of the installed devices.

Maintenance and Operations personnel consult regularly with Transportation Solutions on the effectiveness of the different traffic control measures and plans employed on projects. In addition, any unusual local conditions that may require special consideration or a major change in the proposed treatment is also brought to the attention of Transportation Solutions. Again, engineering judgment and experience are an important element in the field implementation of traffic control plans and devices.

8.3.1.1 TRAFFIC SECTION

In the preparation of contract plans, Transportation Solutions' Traffic Section acts both in a support and review role. In its support role, the section provides the designer with:

- Engineering studies related to the use of particular devices at a requested location(s) within a project;
- Preliminary layout, final design and plan preparation for signals, signal control and coordination plans;
- Preliminary layout for overhead signs and large ground mounts with messages;
- Highway lighting and illumination, including for overhead signs,
- Detailed information for the preparation of off-site detours;
- Changes in the standard details for traffic device installation, and
- Formulation and dissemination of traffic control criteria and procedures related to construction and maintenance operations.

In their review role, the Traffic Section participates in all project reviews. Their review emphasis is placed on signal locations and coordination, overhead and large ground mount sign locations and messages, the maintenance of traffic plans and the final signing and striping plans showing the traffic operation after project completion.

It should be pointed out that the MUTCD is not a substitute for engineering judgment. It is intended that the manual be a standard for providing a basis for the uniform approach in the use and installation of traffic control devices, not a legal requirement for their use and installation. The exercise of engineering judgment and experience is inherent in the selection of traffic control devices.

After contract award of a project, a construction group assumes primary responsibility for implementing and maintaining the various temporary and permanent traffic control measures provided in the contract documents. They ensure that the devices are constructed and installed as intended. In particular, they ensure that the prescribed traffic control measures employed during the construction phasing are carried out effectively.

8.3.1.2 SAFETY SECTION

The Safety Section is an integral part of a project's review process during the design phase as well as construction. Their emphasis is on construction sequencing and the associated traffic control during the various stages of construction. They are also responsible for the proper field implementation of the various devices ensuring compliance with the MUTCD and established Department guidelines.

8.4 IMPLEMENTATION GUIDELINES

The following general guidelines are applicable to the design and installation of the various categories of permanent traffic control devices.

8.4.1 SIGNS

Signs should be used only where warranted by facts and field studies. Signs are essential where special regulations apply at specific locations or where hazards are self-evident. Ex-

cessive use of signs may result in confusion, reducing their effectiveness.

Project signing usually includes three types: regulatory, warning and guide signs. How, when and where to use these signs is a function of the class of facility being designed.

Part 2 of the MUTCD provides the designer with detailed guidelines necessary to develop the signing plans for a project. The elements emphasized are consistency, uniformity and geometric design coordination to ensure that they are effective. Due to the importance of maintaining uniformity in signs, the designer does not normally have the freedom to develop unique signing. Size, shape, color, and locations of signs should be in conformance with the criteria set forth in Part 2 of the MUTCD. The Manual provides the sign design details defining the size, color, shape, letter size, mounting height, etc. for all the various types of signs. During plan development, the designer should refer to the sections that describe the general concepts that make a good signing plan. These include ensuring there is consistency of application, there is no over use, there is standardization of location, and the project geometrics allow for the installation of the signs to perform as intended.

However, the designer should remember that even in the best of conditions, visibility is a factor at night and during inclement weather. Therefore, although it may appear as overuse or redundant, additional signing to provide the driver with the information needed at critical locations or situations may be required.

The Traffic Section is to be consulted during the preparation of sign layouts, sign details, sign messages, quantity estimates, and cost estimates.

8.4.2 PAVEMENT MARKINGS

The striping plan is usually developed concurrently with the signing plan. Proper and consistent pavement markings are important to all drivers, especially the elderly, as they place a high priority on what they see on the pavement. This is particularly true during periods of reduced visibility such as at night or during inclement weather. Centerline, lane and edge line markings provide reliable and effective guidance. The advantage of pavement markings under normal conditions is that the driver does not have to divert attention to receive the warning, guidance or information intended.

The effectiveness of pavement markings is reduced quickly by heavy traffic, weather and other environmental conditions. Therefore, in most situations and conditions, pavement markings are used to supplement the traffic control design. Line markings, words and symbols shall be of the shapes, sizes and colors as set forth in Part 2 of the MUTCD.

The designer should coordinate product selection for striping with Operations and Maintenance as heavy traffic use and environmental conditions will affect the longevity of the striping material.

Permanent pavement markings are to be identified and quantified as contract items. The type of material to be used on a project will be specified by Operations and Maintenance and the Traffic Section during project reviews. The type of material that will be recommended depends on the past performance, pavement material, highway classification, anticipated traffic volumes and mix, and other factors that enter into a materials cost/benefit ratio.

8.4.3 TRAFFIC SIGNALS

Traffic signals are valuable devices for the control of vehicle and pedestrian traffic, but unless they are adequately justified and designed, they can adversely affect traffic operations.

Properly located and operated traffic signals can provide the following advantages:

- Provide orderly movement of traffic;
- Increase intersection traffic capacity;

- Reduce the frequency of certain types of accidents, particularly right-angle type; and
- Interrupt heavy traffic flow at intersections to permit vehicles or pedestrians to cross.

Conversely, traffic signals that are poorly located, poorly operated or unwarranted can cause the following adverse effects:

- Excessive delays in traffic;
- Disobedience of the signal indications;
- Use of less adequate routes to avoid the perceived unwarranted imposed delays; and
- Increase accident frequency, usually of the rear end type.

Part 4 of the MUTCD lists eight warrants to be included in an engineering study for justification for installing a traffic signal. The conclusion of this study should not be that one or more of the warrants have been met, but that installation of the traffic signal will improve the overall safety and/or operation of the location under consideration. The warrants to be studied include:

- Eight-hour vehicular volume;
- Four-hour vehicular volume;
- Peak hour volume;
- Pedestrian volume;
- School crossings;
- Coordinated signal system;
- Crash experience; and
- Roadway network.

The MUTCD provides a detailed description and guidelines for studying each of these warrants. The Traffic Section is responsible for performing the detailed engineering analysis related to the warrants for signal installation at a particular location. Traffic is also responsible for the detailed design and preparation of plans and specifications for signal installations. The plans include underground conduit locations with appurtenances, traffic coordination signal systems, quantity estimates and cost estimates.

8.4.4 ISLANDS

Another effective method of traffic control is the installation of islands. Islands can be used to separate traffic lanes and movements or provide refuge for pedestrians. The island can be created by pavement markings or physically constructed.

Islands, depending upon their construction and placement can pose a safety hazard and maintenance problem. Therefore, the designer should not use them in unnecessary locations. Chapter 7, Intersections, provides more detail on the use and design of islands.

8.4.5 MAINTENANCE OF TRAFFIC DURING CONSTRUCTION

Problems of traffic control occur when traffic must be moved through or around street and highway construction and the associated maintenance operations and utility work. No one standard sequence of signs or other control devices can be set up as an arrangement suitable for all situations due to the variety of conditions encountered. The designer is responsible for the Maintenance of Traffic Plan (MOT). In preparing the MOT plan, the designer must consider the construction sequencing, and during which and how many seasons of the year construction will take place. Materials used for temporary use may not be as durable as those used for the final signing and striping and thus may have to be replaced several times during construction phasing.

This plan is closely coordinated with DelDOT's Chief Safety Officer. The scope of the plan is determined during the preliminary design phase of a project. The actual MOT plan sheets are usually prepared concurrently with the construction phasing plans.

The principles for preparing the MOT plan are found in the MUTCD and applicable DelDOT publications.

8.4.6 OTHER TRAFFIC CONTROLS

Parts 7, 8 and 9 of the MUTCD present guidelines and criteria for traffic controls for school areas, railroad-highway grade crossings and bicycle facilities, Bicycle facilities are addressed in greater detail in Chapter Ten of this manual. The provisions in the MUTCD are applicable to related projects in Delaware and should serve as a reference source for designers preparing the MOT plan.

8.5 ROADWAY LIGHTING

8.5.1 OBJECTIVES

Nighttime visibility on roadways has long been recognized as a problem for motorists. Reflective lane lines, edge lines, delineators and signing were developed to help alleviate the problem. However, conditions on some roadway sections are such that additional measures, such as partial or continuous lighting, are needed to improve visibility and safety.

While providing lighting on all roadways might be desirable, it is impractical. Lighting is costly and expensive to install, operate and maintain. Statistically, nighttime fatal accident rates average higher than for the daytime. However, the benefits of lighting roadways must be worth the cost, as lack of nighttime visibility is only one of several factors influencing higher accident rates.

The design goal of highway lighting is to ensure that vehicular and pedestrian traffic can see well enough to react and function quickly, accurately and comfortably for the situation and conditions being encountered.

Good nighttime visibility not only maintains the efficiency and protects the large investment in the transportation system but provides other indirect social and economic benefits such as:

- Reduction in accidents;
- Aids in the prevention of crime;
- Increases roadway capacity and traffic flow;
- Promotes the use of commercial and industrial areas at night;
- Enhances and encourages community activity; and
- Saves in accident costs, lost working time and human injury.

8.5.2 DESIGN RESPONSIBILITY

The design team should submit preliminary plans, early in project development, for evaluation by the Traffic Section for highway lighting consideration and the development of designs, if warranted.

8.5.3 GENERAL WARRANTS AND CONSIDERATIONS

The lack of nighttime visibility is one of several factors that affect nighttime driving. Other factors include:

- Confusion and distraction caused by background lighting;
- Loss of environmental clues;
- Headlight glare and misuse;
- Adverse environmental conditions;
- Increase in driver fatigue;
- Increased occurrence of impaired drivers;
- Changes in the mix of traffic; and
- Changes in driver attitudes.

Since lighting is expensive and lack of visibility is not the only factor that affects nighttime driving, warrants have been established to determine when lighting should be considered. The evaluation of projects for lighting, whether partial or continuous follows the guidelines established in AASHTO's manual *An Informational Guide for Roadway Lighting* and the Department's guide *Highway Lighting Policy-Installation Determinates.* As with most AASHTO guidelines, the roadway's classification is a major factor in establishing the need for lighting. For determining lighting needs,

two general classifications are used based on traffic movement and access. The highest types of facilities are controlled access highways such as freeways, interchanges and expressways. The second type of facilities are non-controlled access highways such as major arterials, streets and highways, collector streets, minor highways, and local streets and roads.

The AASHTO guide provides a basis for the installation of highway lighting. This guide also recognizes that an agency has a considerable long term cost associated with lighting. Therefore, the guide provides only minimum conditions, allowing an agency to establish higher warranting values, including local conditions and subjective values, and stresses that meeting the warrants is not the only criteria for justifying whether or not lighting is to be installed. Therefore, the decision to use highway lighting is not reached through applying empirical, easily assigned values to graphs, charts and forms. Instead, it is reached through the use of engineering judgment as applied to the analytical methods adopted by AASHTO, considering the user needs and the resulting user benefits. The warrants used, based on research that has determined that the primary factors affecting the need for roadway lighting, can be classified as:

- Geometric,
- Operational,
- Environmental, and
- Accidents.

The geometric factors used consider that a driver's ability to perform the tasks required to operate a vehicle safely and efficiently is largely influenced by the roadway geometrics. Much of the needed information for the driver to mentally and physically perform effectively is transmitted to the driver through a facility's geometrics. Restricted access to this information, as with reduced visibility, affects a driver's responses.

The operational factors used consider a facility's level of service, operating speed, median width, pedestrian usage, types and frequency of signals, and channelization.

For the driver, the environmental conditions adjacent to a roadway are an important influence on how the driver will perform. The factors considered include the adjacent land use, access points, and any background lighting which may be distracting or objectionable to the driver.

Since a change in accident patterns normally occurs when lighting is installed, a roadway's accident history is a factor in determining lighting needs. Accident experience is developed and the night-to-day accident ratio and its relationship to other similar types of facilities become an important part of the decision-making.

8.5.4 GENERAL LIGHTING DESIGN CONSIDERATIONS

Lighting design includes determining a power source, the type of luminaire, the type of lamp, mounting height, luminaire overhang, luminaire spacing, pavement reflectance and energy consumption. These are all influenced by the roadway geometrics and characteristics, the adjacent environment, expected maintenance, economics, aesthetics, and overall objectives.

The design should provide uniform lighting on the pavement surface, reduce glare from the installation placement itself, reduce headlight glare, and provide adjacent lighting spillover only where desired. In addition, the lighting design should gradually transition the illumination into and out of the site allowing the driver's eyes to adjust. Lighting pole locations should be in conformance with a project's clear zone and have the least number of poles necessary to meet the design criteria.

AASHTO provides two design methodologies—illuminance and luminance. Illuminance is based on determining the average illumination measured in lux on one square meter of roadway area. The luminance method determines the amount of reflected light from the pavement surface visible to the driver's eyes.

The Department has adopted the illluminance method for designing highway lighting.

The design level of illuminance on a facility and other design considerations are established in the Department's publication *Highway Lighting Policy-Installation Determinates.*

8.6 SIGNING AND STRIPING GUIDELINES

The purpose of signing and striping a facility is to improve traffic flow and traffic safety by providing the driver with adequate guidance, warnings and regulatory information. Both have a service life, but striping is particularly subject to rapid wear and pavement adhesion problems. Lack of visibility at night, when wet and during periods of snow cover also reduce the effectiveness of striping.

The value of striping is that it supplements and enhances other devices. It is the only traffic device that can convey certain messages without diverting the driver's attention from the roadway. The performance limitations of striping materials, however, may need to be supplemented with proper signing which requires that the signing and striping plans be designed as a total package.

The MUTCD discusses the general principles that govern the design and use of signs and pavement markings. Again, the level and priorities given for application of these principles to a facility are based on the AASHTO classification system. The interstate system receives the highest attention and local streets the lowest. This heirachy applies to the application of traffic control devices and their maintenance.

The Department has utilized the MUTCD principles and prepared a set of standard details for signing and striping different types of facilities and situations that may occur on a facility. These typical layouts are included as figures at the end of this chapter. The designer should use these to develop the signing and striping plans.

Figure 8-1
Signing Guide - Junction of Dual Route/ Signalized Road

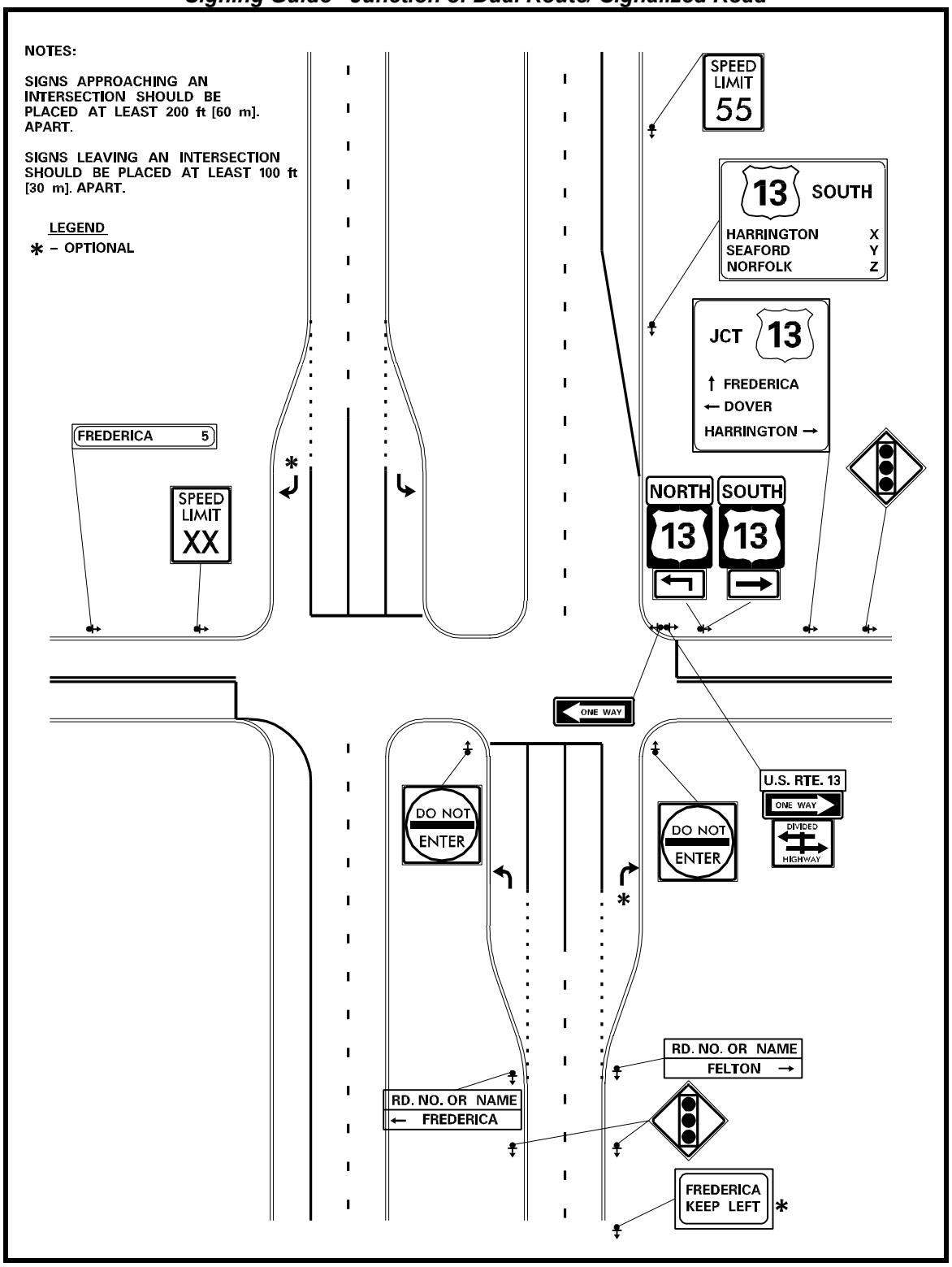

Figure 8-2
Signing Guide - Junction of Dual Route/Major to Minor Stop Road

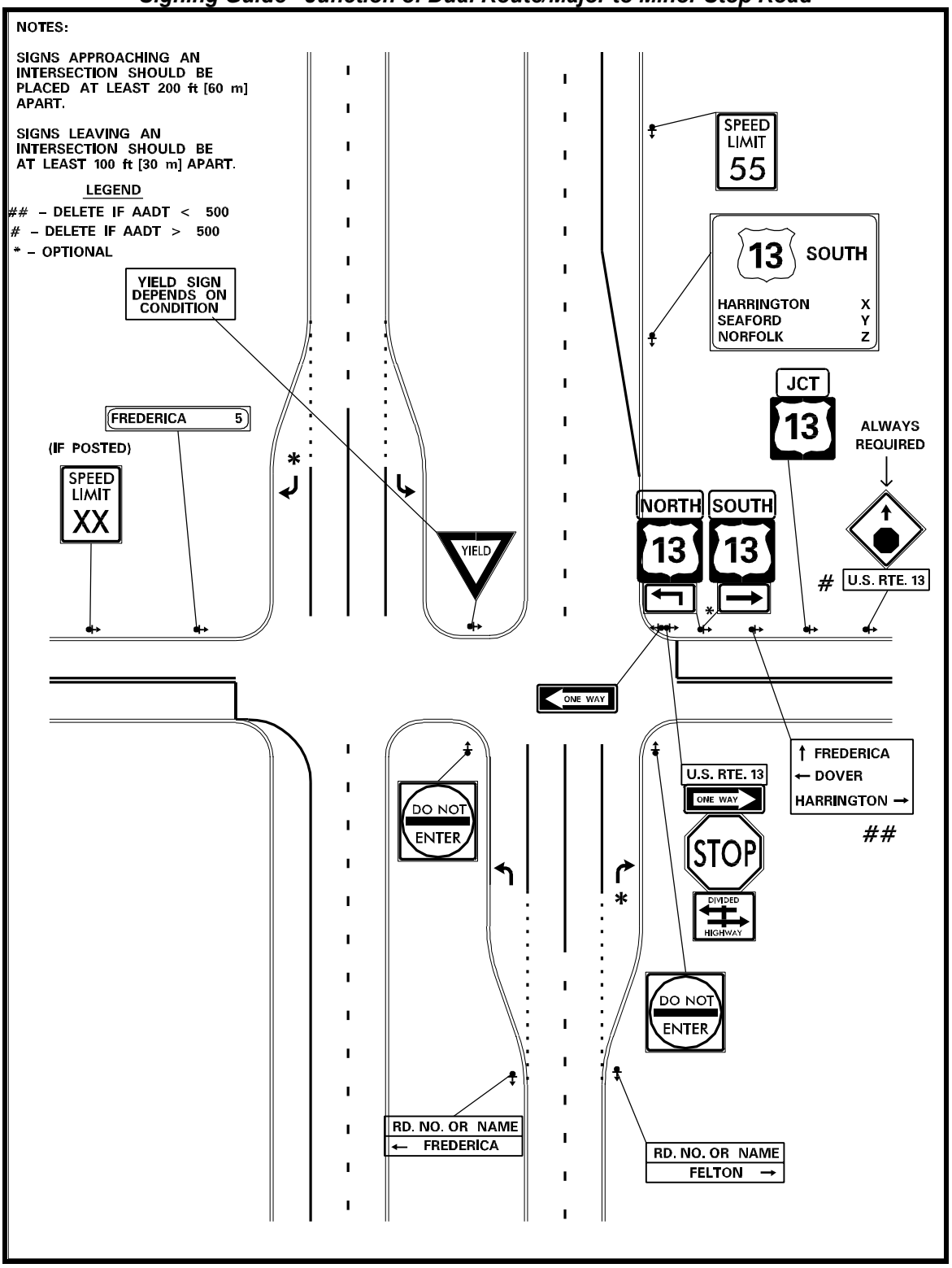

Figure 8-3
Signing Guide - Junction of Two Routes/Two-Way Signalized Road

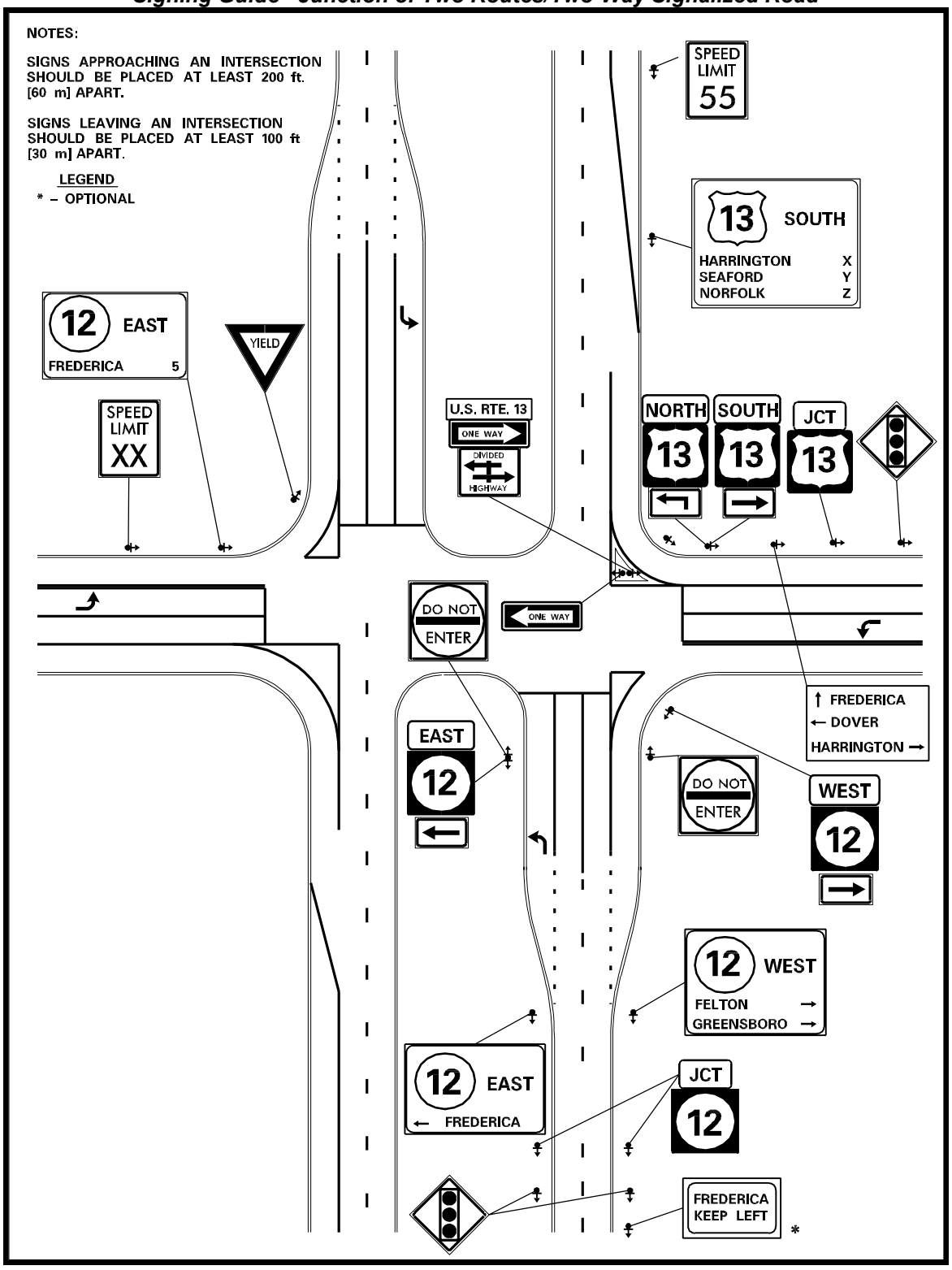

Figure 8-4
Signing Guide - Crossovers

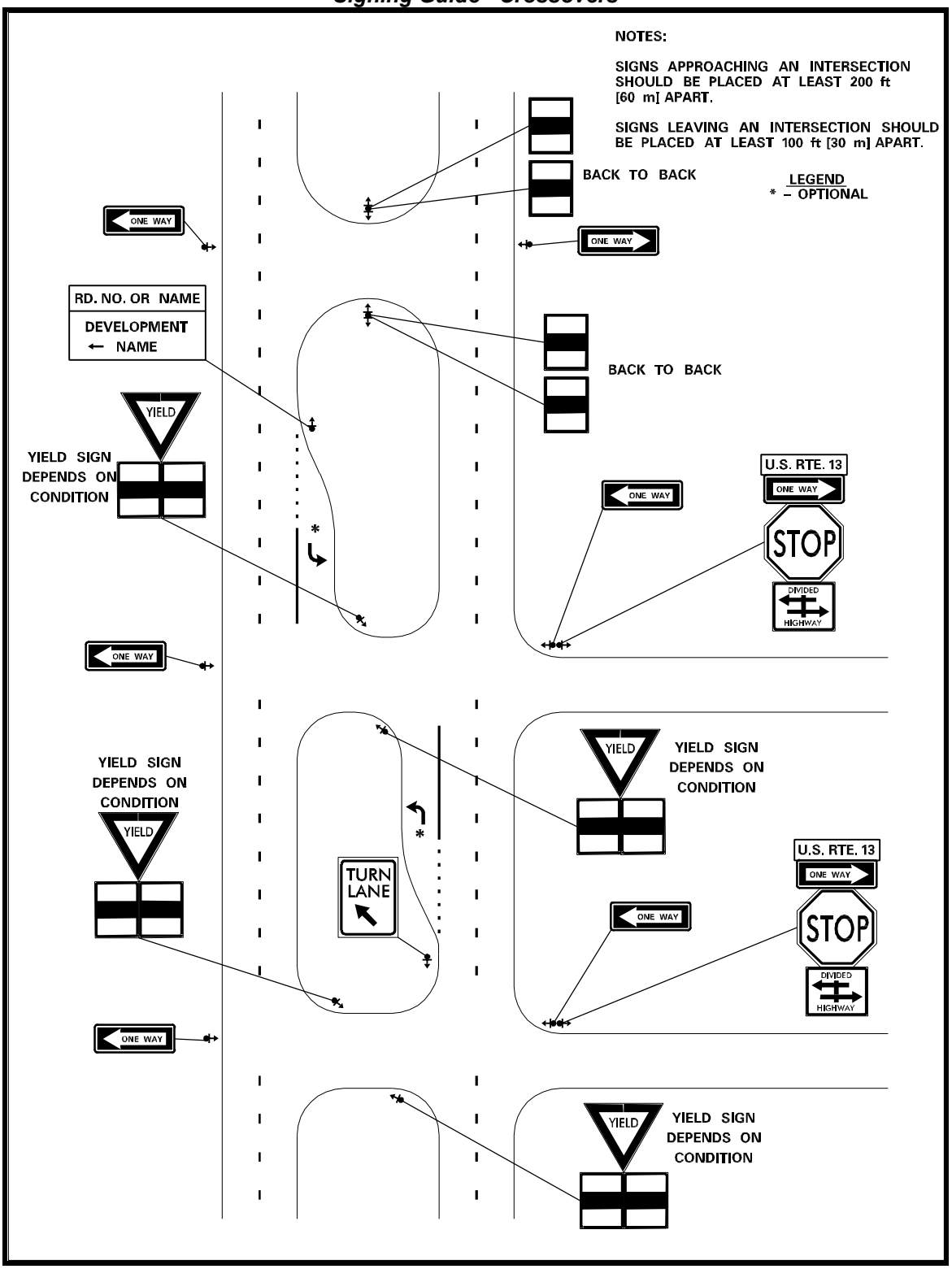

Figure 8-5
Typical Intersection Pavement Marking

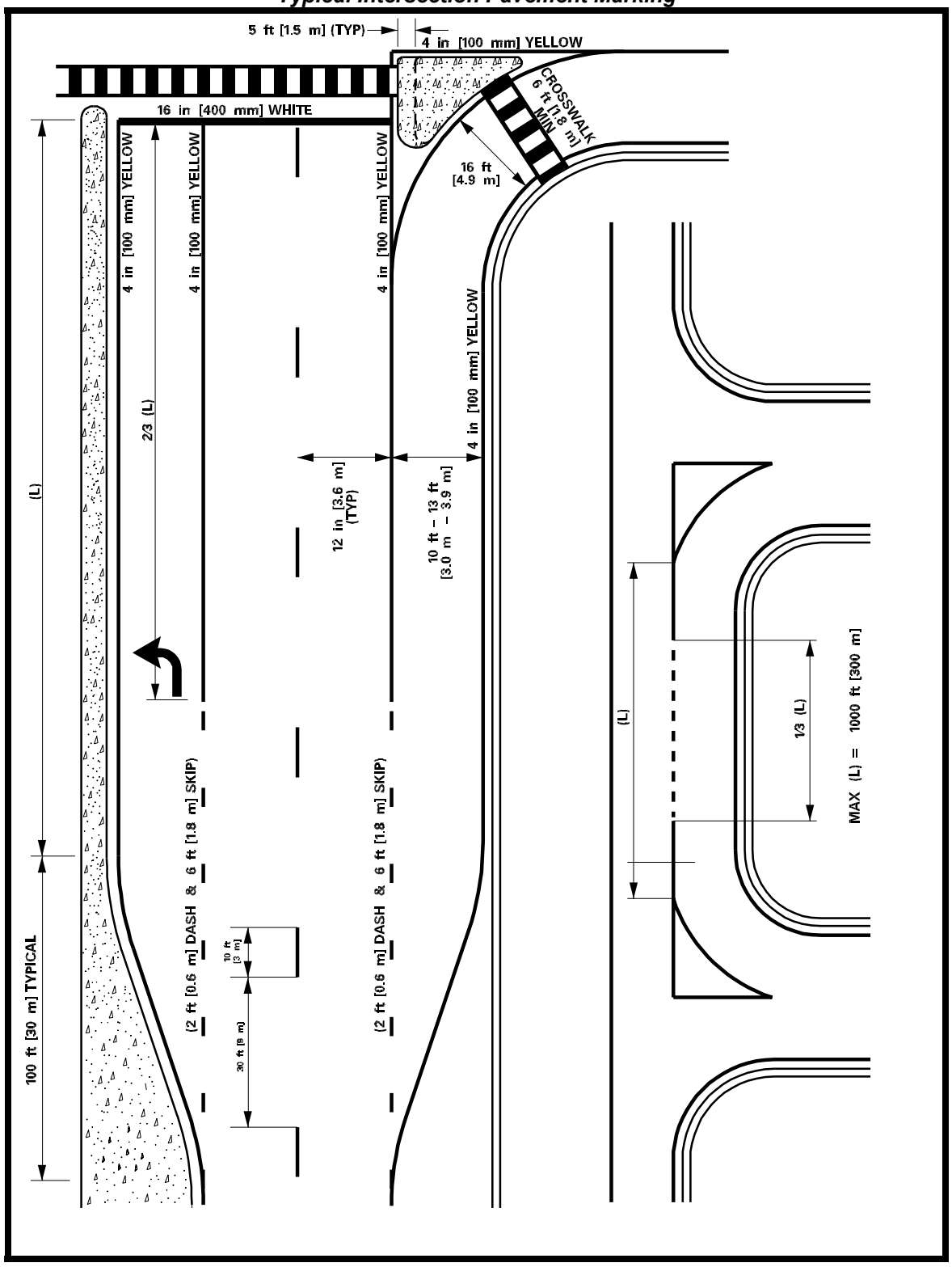

Figure 8-6
Typical Lane Reduction Transition Markings and Signing
Typical Multi-Lane, Two-Way Marking With Single Lane, Two-Way Left Turn Channelization

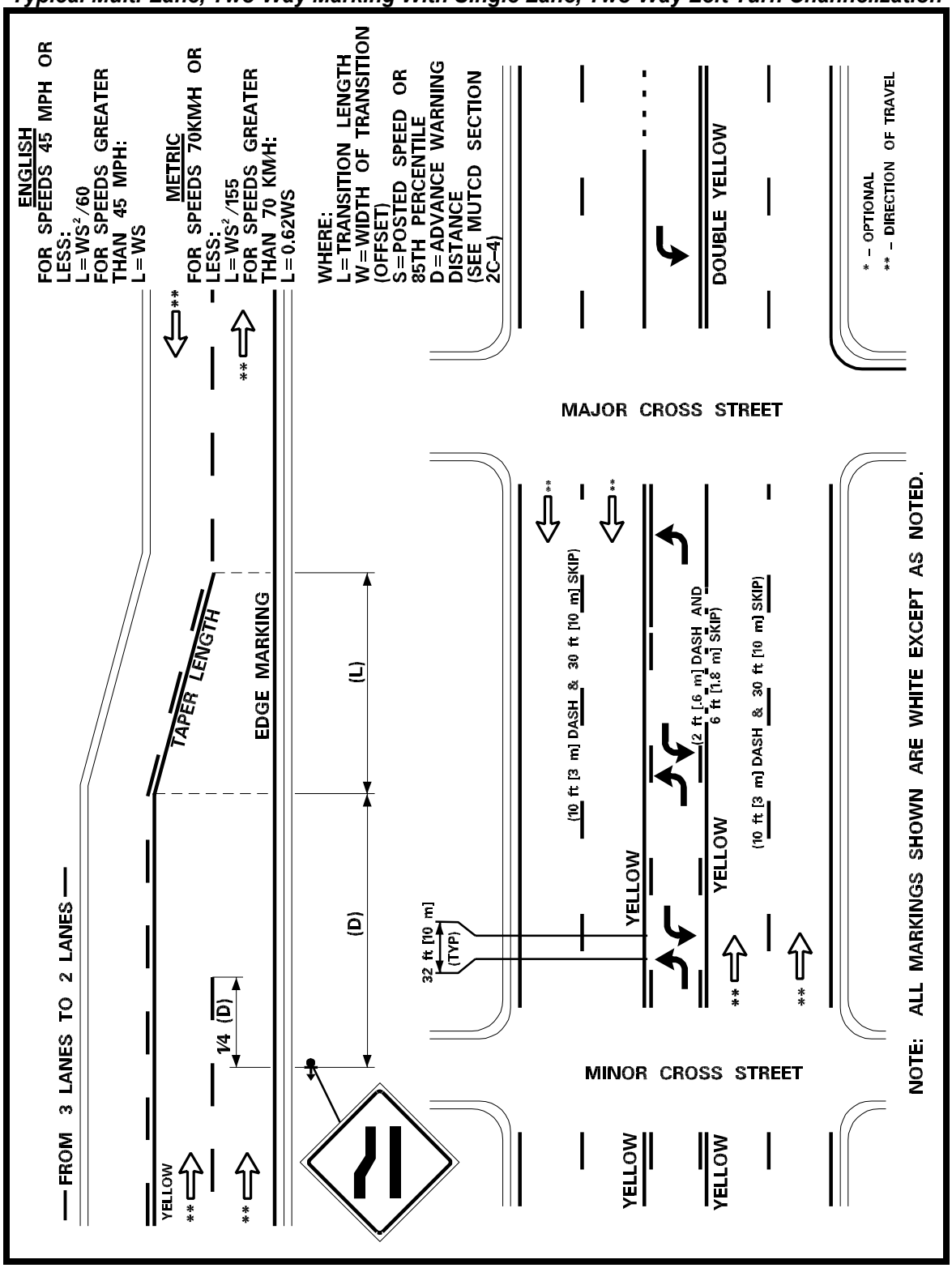

Figure 8-7
Typical Pavement Markings at Railroad-Highway Grade Crossing

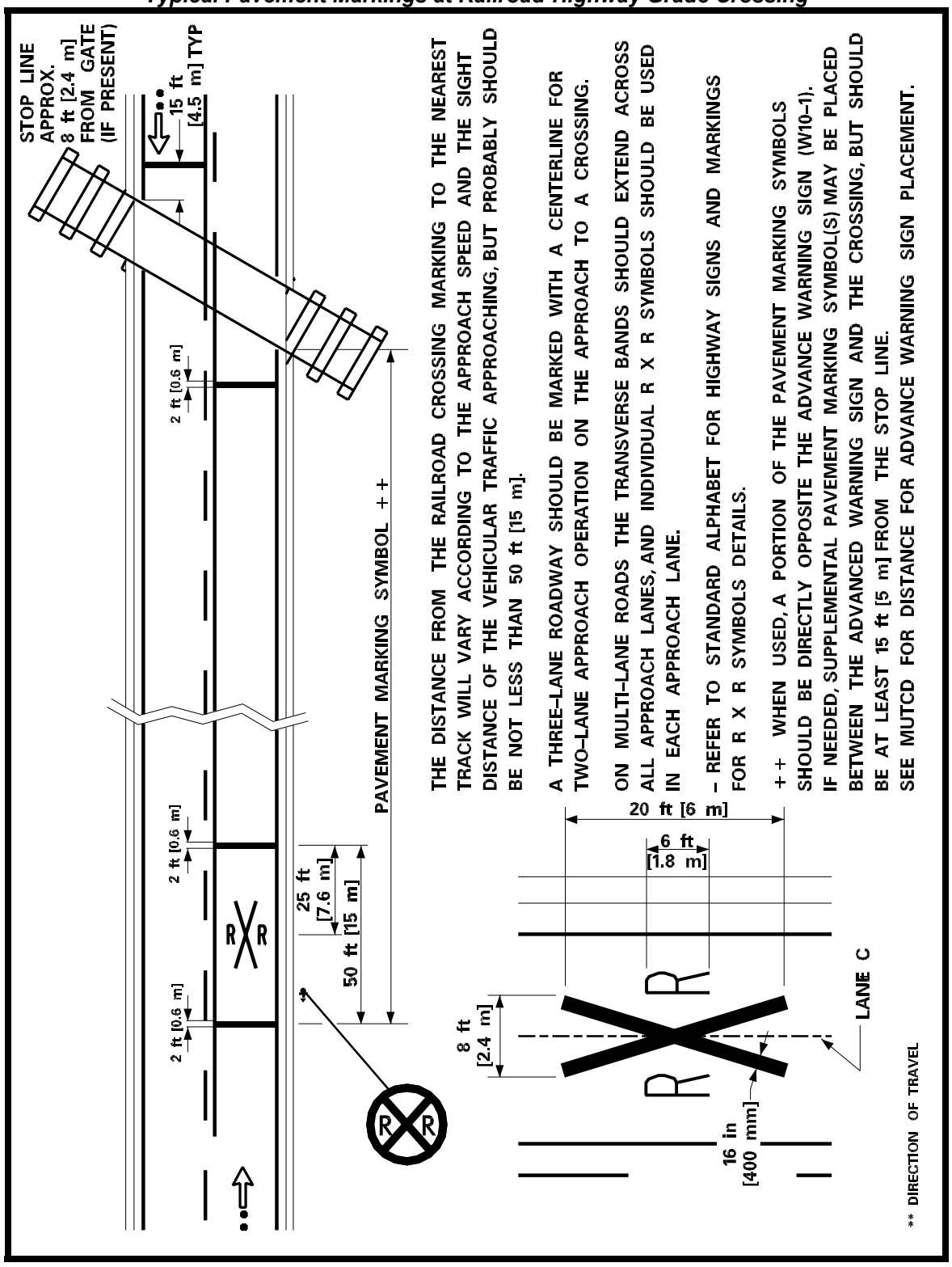

Figure 8-8
Typical One Way and Divided Highway Marking Applications

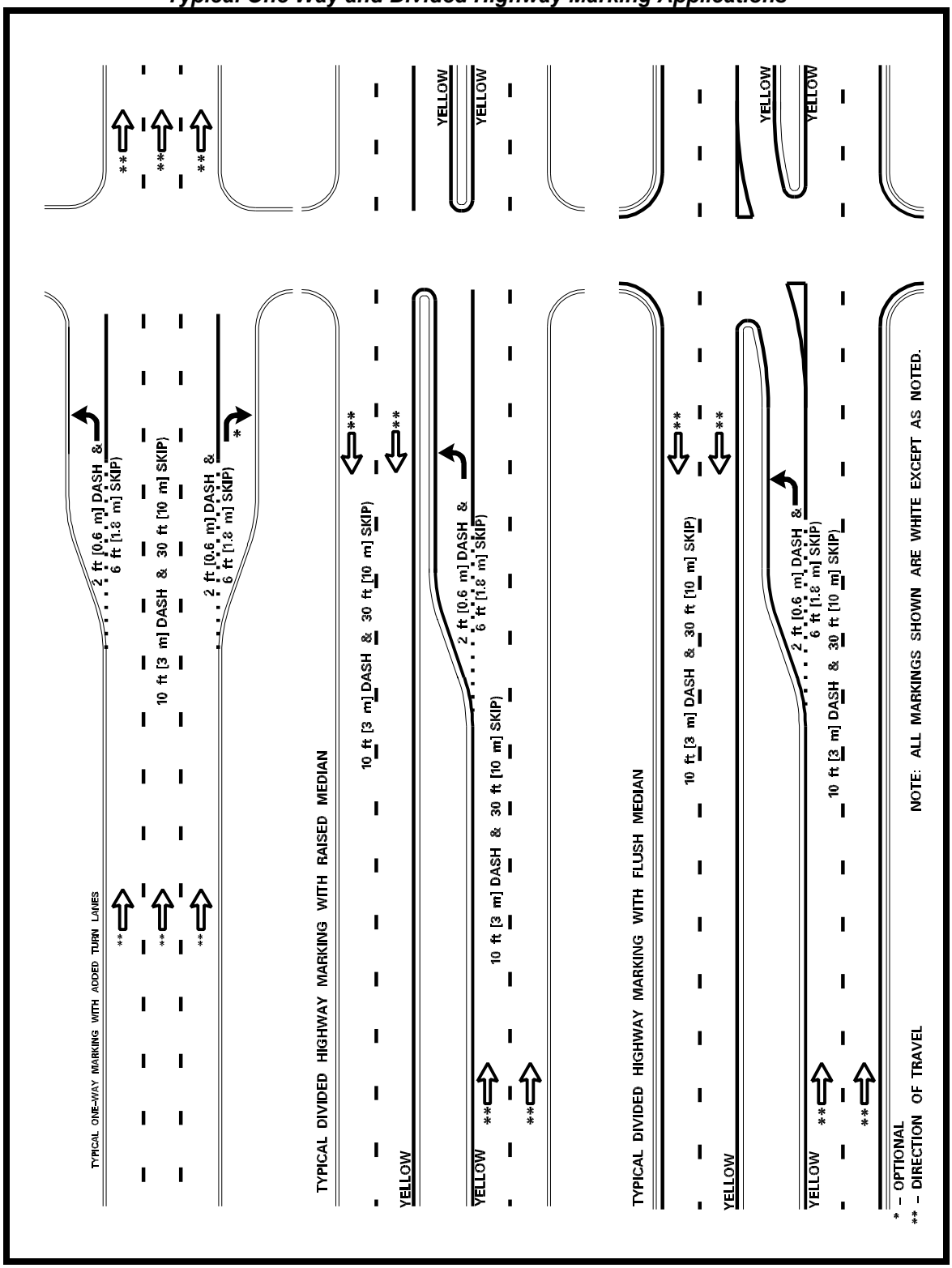

Figure 8-9
Typical Expressway/Freeway Acceleration and Deceleration Lane Pavement Markings

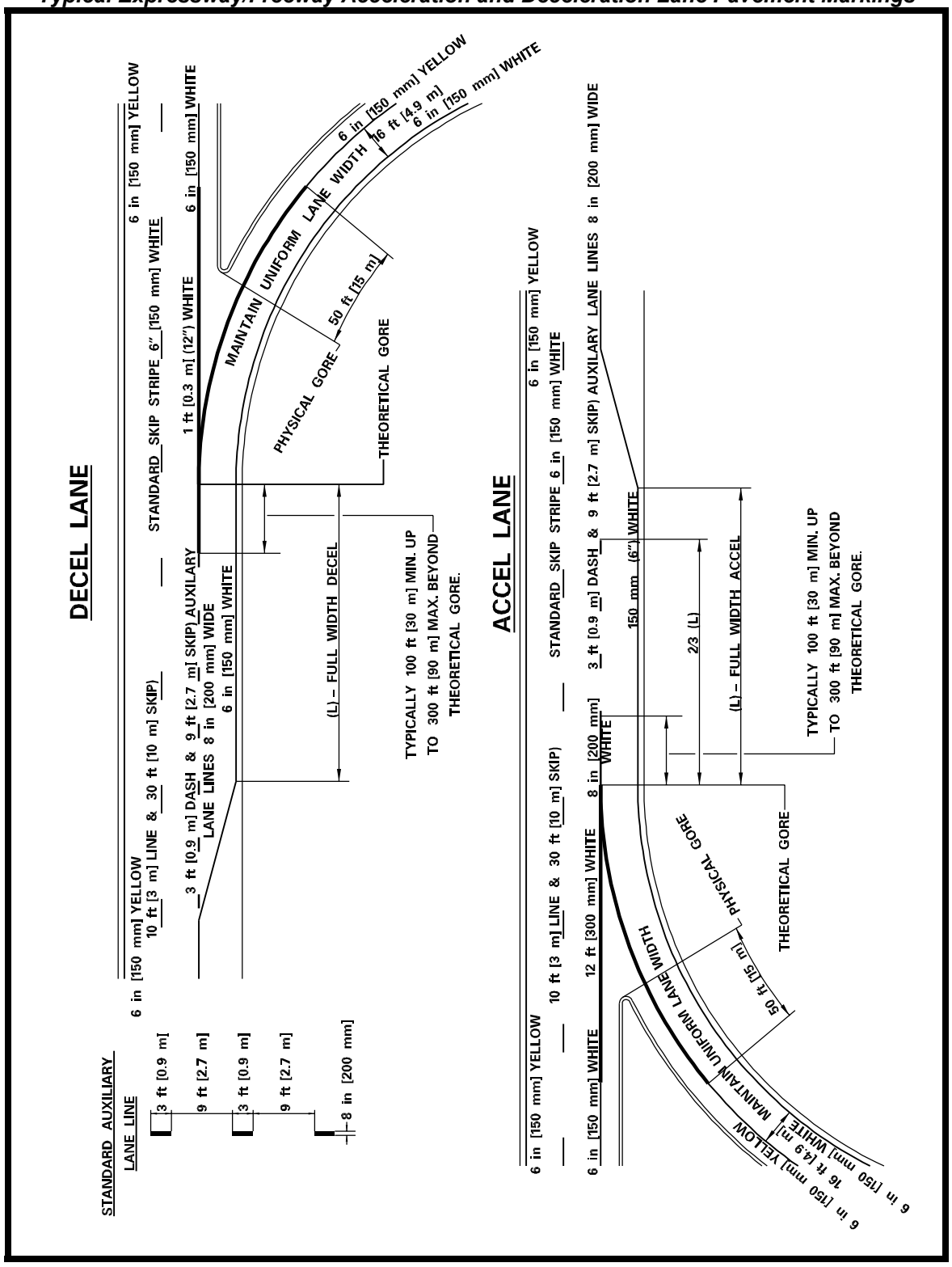

Figure 8-10
Typical Entrance and Exit Ramp Pavement Markings

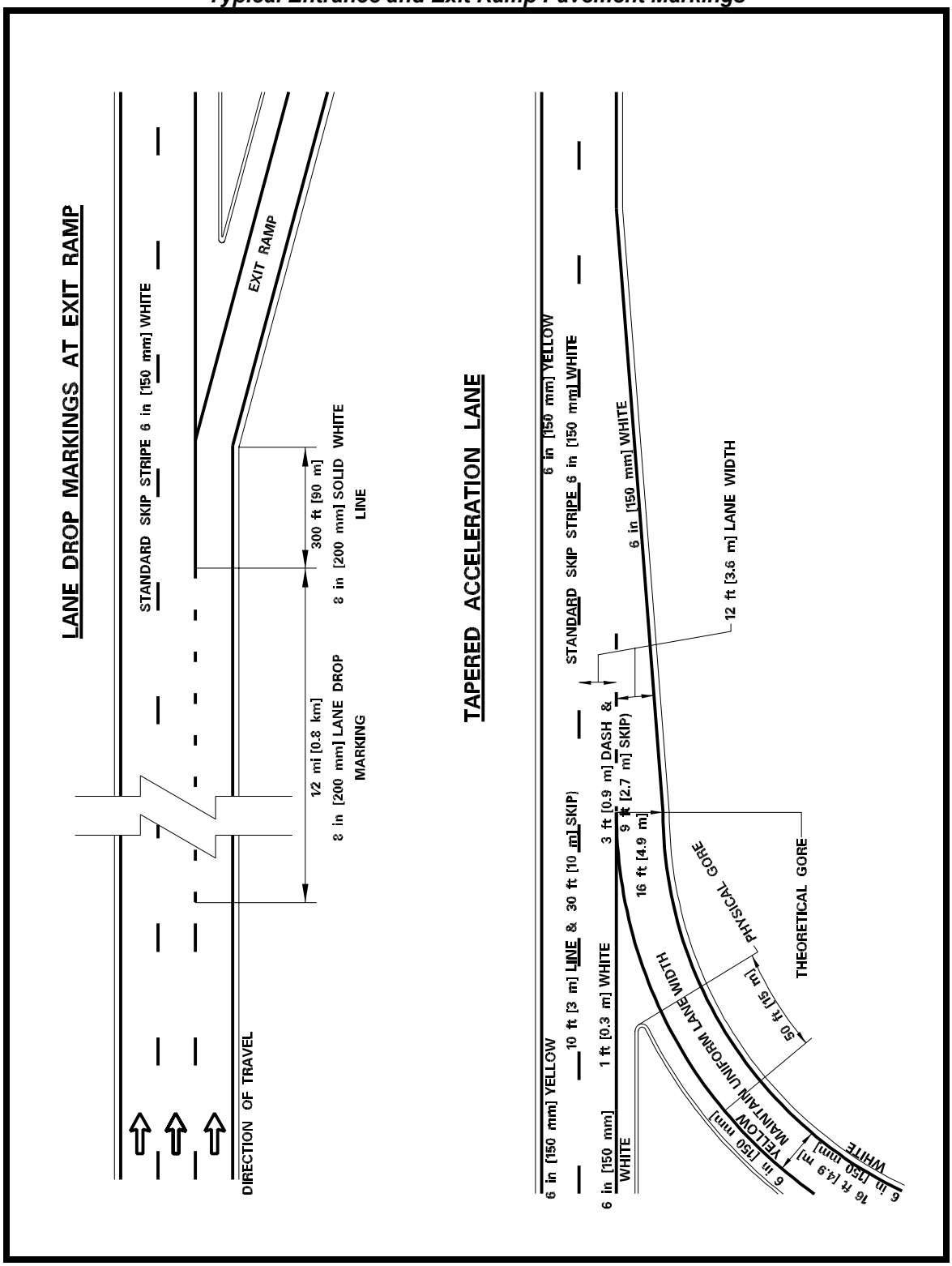

Figure 8-11
Guidelines for Advance Placement of Warning Sign-US Customary

Posted or 85th per-centile Speed (mph)	***Advance Placement Distance[1] (ft)***						
	Condition A: High Judgment required[2]	***Condition B: Stop condition[3]***	**Condition C: Deceleration to the listed advisory speed (mph) for the condition[4]**				
			10	20	30	40	50
20	*175*	*N/A[5]*	*N/A[5]*				
25	*250*	*N/A[5]*	*100*	*N/A[5]*			
30	*325*	*100*	*150*	*100*			
35	*400*	*150*	*200*	*175*	*N/A[5]*		
40	*475*	*225*	*275*	*250*	*175*		
45	*550*	*300*	*350*	*300*	*250*	*N/A[5]*	
50	*625*	*375*	*425*	*400*	*325*	*225*	
55	*700*	*450*	*500*	*475*	*400*	*300*	*N/A[5]*
60	*775*	*550*	*575*	*550*	*500*	*400*	*300*
65	*850*	*650*	*650*	*625*	*575*	*500*	*375*

Figure 8-12
Guidelines for Advance Placement of Warning Signs-[Metric]

Posted or 85th per-centile Speed [km/h]	***Advance Placement Distance[1][m]***								
	Condition A: high judgment required[2]	***Condition B: stop condition[3]***	**Condition C: Deceleration to the listed advisory speed [km/h] for the condition[4]**							
			10	20	30	40	50	60	70	80
30	50	N/A[5]	N/A[5]	N/A[5]						
40	70	N/A[5]	25	N/A[5]	N/A[5]					
50	100	30	50	40	35	N/A[5]				
60	130	60	80	70	60	50	40			
70	160	80	100	100	90	80	70	35		
80	180	110	130	120	120	110	100	70	50	
90	210	140	160	150	150	140	130	100	80	60
100	240	180	190	180	180	170	160	130	110	90
110	270	220	220	210	210	200	190	160	150	130
120	300	260	240	240	230	230	220	190	180	160
130	320	300	270	270	270	260	250	220	210	190

Notes for Figures 8-11 and 8-12:

[1] The distances are adjusted for a sign legibility distance of 175 ft [50 m] which is the appropriate legibility distance for a 5 in [125 mm] series D word legend. The distances may be adjusted by deducting another 100-ft [30 m] if symbol signs are used. Adjustment may be made for grades if appropriate.

[2] Typical conditions are locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge, Right Lane Ends etc. The distances are determined by providing the driver a PIEV time of 6.7 to 10.0 seconds plus 4.5 seconds for vehicle maneuvers minus the legibility distance of 175 ft [50 m] for the appropriate sign.

[3] Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead of Signal Ahead. The distances are based on the 1990 AASHTO Policy for stopping sight distance (page 119) providing a PIEV time of 2.5 seconds, friction factor of 0.30 to 0.40, minus the sign legibility distance of 175 ft [50 m].

[4] Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, or Cross Road. The distance is determined by providing a 1.6 second PIEV time (1990 AASHTO, page 119}, a vehicle deceleration rate of 10 ft/sec^2 [3 m/sec^2], minus the sign legibility distance of 175 ft [50 m].

[5] No suggested minimum distances are provided for these speeds, as placement location depends on site conditions and other signing to provide an adequate advance warning for the driver.