

**Standard:**

07 **General Service signs, if used at intersections, shall be accompanied by a directional message.**

## Option:

08 The Advance Turn (M5 series) or Directional Arrow (M6 series) auxiliary signs with white arrows on blue backgrounds as shown in Figure 2I-1 may be used with General Service symbol signs to create a General Service Directional Assembly.

09 The General Service sign legends may be either symbols or word messages.

**Standard:**

10 **Symbols and word message General Service legends shall not be intermixed on the same sign. The Pharmacy (D9-20) sign shall only be used to indicate the availability of a pharmacy that is open, with a State-licensed pharmacist present and on duty, 24 hours per day, 7 days per week, and that is located within 3 miles of an interchange on the Federal-aid system. The D9-20 sign shall have a 24 HR (D9-20aP) plaque mounted below it.**

## Support:

11 Formats for displaying different combinations of these services are described in Section 2I.03.

## Option:

12 If the distance to the next point at which services are available is 10 miles or more, a NEXT SERVICES XX MILES (D9-17P) plaque (see Figure 2I-2) may be installed below the General Service sign.

13 The International Symbol of Accessibility for the Handicapped (D9-6) sign may be used beneath General Service signs where paved ramps and rest room facilities accessible to, and usable by, the physically handicapped are provided.

*Guidance:*

14 *When the D9-6 sign is used in accordance with Paragraph 13, and van-accessible parking is available at the facility, a VAN ACCESSIBLE (D9-6P) plaque (see Figure 2I-1) should be mounted below the D9-6 sign.*

## Option:

15 The Recreational Vehicle Sanitary Station (D9-12) sign may be used as needed to indicate the availability of facilities designed for the use of dumping wastes from recreational vehicle holding tanks.

16 The Litter Container (D9-4) sign may be placed in advance of roadside turnouts or rest areas, unless it distracts the driver's attention from other more important regulatory, warning, or directional signs.

17 The Emergency Medical Services (D9-13) symbol sign may be used to identify medical service facilities that have been included in the Emergency Medical Services system under a signing policy developed by the State and/or local highway agency.

**Standard:**

18 **The Emergency Medical Services symbol sign shall not be used to identify services other than qualified hospitals, ambulance stations, and qualified free-standing emergency medical treatment centers. If used, the Emergency Medical Services symbol sign shall be supplemented by a sign identifying the type of service provided.**

## Option:

19 The Emergency Medical Services symbol sign may be used above the HOSPITAL (D9-13a) sign or Hospital (D9-2) symbol sign or above a sign with the legend AMBULANCE STATION (D9-13b), EMERGENCY MEDICAL CARE (D9-13c), or TRAUMA CENTER (D9-13d). The Emergency Medical Services symbol sign may also be used to supplement Telephone (D9-1), Channel 9 Monitored (D12-3), or POLICE (D9-14) signs.

**Standard:**

20 **The legend EMERGENCY MEDICAL CARE shall not be used for services other than qualified free-standing emergency medical treatment centers.**

*Guidance:*

21 *Each State should develop guidelines for the implementation of the Emergency Medical Services symbol sign.*

**Figure 2I-2. Example of Next Services Plaque**



D9-17P

- 22 *The State should consider the following guidelines in the preparation of its policy:*
- A. **AMBULANCE**
    1. *24-hour service, 7 days per week.*
    2. *Staffed by two State-certified persons trained at least to the basic level.*
    3. *Vehicular communications with a hospital emergency department.*
    4. *Operator should have successfully completed an emergency-vehicle operator training course.*
  - B. **HOSPITAL**
    1. *24-hour service, 7 days per week.*
    2. *Emergency department facilities with a physician (or emergency care nurse on duty within the emergency department with a physician on call) trained in emergency medical procedures on duty.*
    3. *Licensed or approved for definitive medical care by an appropriate State authority.*
    4. *Equipped for radio voice communications with ambulances and other hospitals.*
  - C. **Channel 9 Monitored**
    1. *Provided by either professional or volunteer monitors.*
    2. *Available 24 hours per day, 7 days per week.*
    3. *The service should be endorsed, sponsored, or controlled by an appropriate government authority to guarantee the level of monitoring.*

### **Section 2I.03 General Service Signs for Freeways and Expressways**

Support:

- 01 *General Service (D9-18 series) signs (see Figure 2I-3) are generally not appropriate at major interchanges (see definition in Section 2E.32) and in urban areas.*

**Standard:**

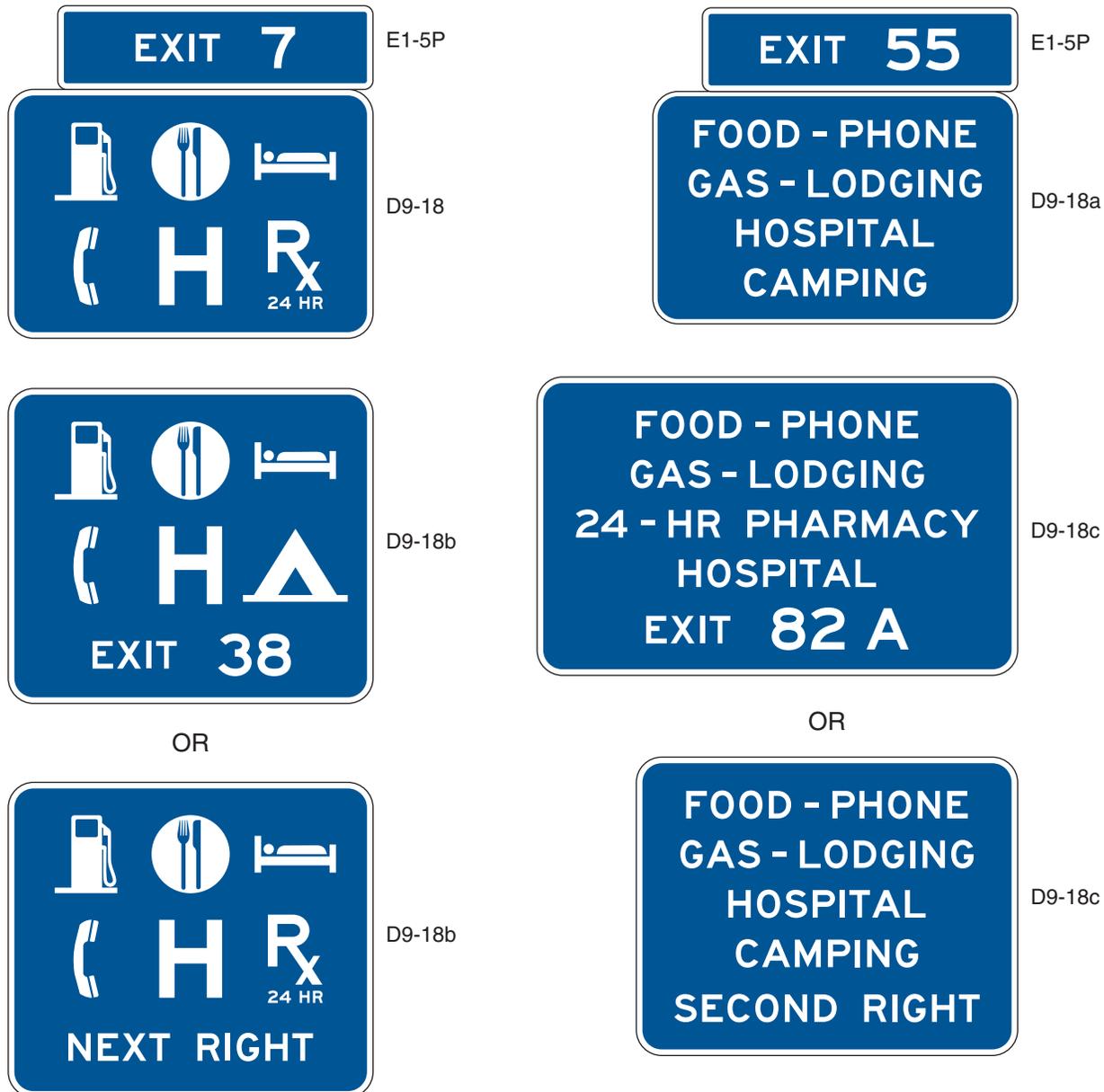
- 02 **General Service signs shall have white letters, symbols, arrows, and borders on a blue background. Letter and numeral sizes shall comply with the minimum requirements of Tables 2E-2 through 2E-5. All approved symbols shall be permitted as alternatives to word messages, but symbols and word service messages shall not be intermixed. If the services are not visible from the ramp of a single-exit interchange, the service signing shall be repeated in smaller size at the intersection of the exit ramp and the crossroad. Such service signs shall use arrows to indicate the direction to the services.**

Option:

- 03 *For numbered interchanges, the exit number may be incorporated within the sign legend (D9-18b) or displayed on an Exit Number (E1-5P) plaque (see Section 2E.31).*

*Guidance:*

- 04 *Distance to services should be displayed on General Service signs where distances are more than 1 mile.*
- 05 *General Service signing should only be provided at locations where the road user can return to the freeway or expressway and continue in the same direction of travel.*
- 06 *Only services that fulfill the needs of the road user should be displayed on General Service signs. If State or local agencies elect to provide General Service signing, there should be a statewide policy for such signing and criteria for the availability of the various types of services. The criteria should consider the following:*
- A. *Gas, Diesel, LP Gas, EV Charging, and/or other alternative fuels if all of the following are available:*
    1. *Vehicle services such as gas, oil, and water;*
    2. *Modern sanitary facilities and drinking water;*
    3. *Continuous operations at least 16 hours per day, 7 days per week; and*
    4. *Public telephone.*
  - B. *Food if all of the following are available:*
    1. *Licensing or approval, where required;*
    2. *Continuous operation to serve at least two meals per day, at least 6 days per week;*
    3. *Public telephone; and*
    4. *Modern sanitary facilities.*
  - C. *Lodging if all of the following are available:*
    1. *Licensing or approval, where required;*
    2. *Adequate sleeping accommodations;*
    3. *Public telephone; and*
    4. *Modern sanitary facilities.*

**Figure 2I-3. Examples of General Service Signs with and without Exit Numbering**

- D. Public Telephone if continuous operation, 7 days per week is available.
- E. Hospital if continuous emergency care capability, with a physician on duty 24 hours per day, 7 days per week is available. A physician on duty would include the following criteria and should be signed in accordance with the priority as follows:
1. Physician on duty within the emergency department;
  2. Registered nurse on duty within the emergency department, with a physician in the hospital on call; or
  3. Registered nurse on duty within the emergency department, with a physician on call from office or home.
- F. 24-Hour Pharmacy if a pharmacy is open, with a State-licensed pharmacist present and on duty, 24 hours per day, 7 days per week and is located within 3 miles of an interchange on the Federal-aid system.
- G. Camping if all of the following are available:
1. Licensing or approval, where required;
  2. Adequate parking accommodations; and
  3. Modern sanitary facilities and drinking water.

**Standard:**

- 07 **For any service that is operated on a seasonal basis only, the General Service signs shall be removed or covered during periods when the service is not available.**
- 08 **The General Service signs shall be mounted in an effective location, between the Advance Guide sign and the Exit Direction sign, in advance of the exit leading to the available services.**

*Guidance:*

- 09 *The General Service sign should contain the interchange number, if any, as shown in Figure 2I-3.*

*Option:*

- 10 If the distance to the next point where services are available is greater than 10 miles, a NEXT SERVICES XX MILES (D9-17P) plaque (see Figure 2I-2) may be installed below the Exit Direction sign.

**Standard:**

- 11 **Signs for services shall comply with the format for General Service signs (see Section 2I.02) and as provided in this Manual. No more than six general road user services shall be displayed on one sign, which includes any appended supplemental signs or plaques. General Service signs shall carry the legends for one or more of the following services: Food, Gas, Lodging, Camping, Phone, Hospital, 24-Hour Pharmacy, or Tourist Information.**
- 12 **The qualified services available shall be displayed at specific locations on the sign.**
- 13 **To provide flexibility for the future when the service might become available, the sign space normally reserved for a given service symbol or word shall be left blank when that service is not present.**

*Guidance:*

- 14 *The standard display of word messages should be FOOD and PHONE in that order on the top line, and GAS and LODGING on the second line. If used, HOSPITAL and CAMPING should be on separate lines (see Figure 2I-3).*

*Option:*

- 15 Signing for DIESEL, LP-Gas, or other alternative fuel services may be substituted for any of the general services or appended to such signs. The International Symbol of Accessibility for the Handicapped (D9-6) sign (see Figure 2I-1) may be used for facilities that qualify.

*Guidance:*

- 16 *When symbols are used for the road user services, they should be displayed as follows:*

*A. Six services:*

1. *Top row—GAS, FOOD, and LODGING*
2. *Bottom row—PHONE, HOSPITAL, and CAMPING*

*B. Four services:*

1. *Top row—GAS and FOOD*
2. *Bottom row—LODGING and PHONE*

*C. Three services:*

1. *Top row—GAS, FOOD, and LODGING*

*Option:*

- 17 Substitutions of other services for any of the services described in Paragraph 16 may be made by placing the substitution in the lower right (four or six services) or extreme right (three services) portion of the sign. An action message or an interchange number may be used for symbol signs in the same manner as they are used for word message signs. The Diesel Fuel (D9-11) symbol or the LP-Gas (D9-15) symbol may be substituted for the symbol representing fuel or appended to such assemblies. The Tourist Information (D9-10) symbol or the 24-Hour Pharmacy (D9-20 and D9-20aP) symbol may be substituted on any of the configurations provided in Paragraph 16.
- 18 At rural interchange areas where limited road user services are available and where it is unlikely that additional services will be provided within the near future, a supplemental plaque displaying one to three services (words or symbols) may be appended below a post-mounted interchange guide sign.

**Standard:**

- 19 **If more than three services become available at rural interchange areas where limited road user services were anticipated, the appended supplemental plaque described in Paragraph 18 shall be removed and replaced with an independently mounted General Service sign as described in this Section.**

*Option:*

- 20 A separate Telephone Service (D9-1) sign (see Figure 2I-1) may be installed if telephone facilities are located adjacent to the route at places where public telephones would not normally be expected.

- 21 The Recreational Vehicle Sanitary Station (D9-12) sign (see Figure 2I-1) may be used as needed to indicate the availability of facilities designed for dumping wastes from recreational vehicle holding tanks.
- 22 In some locations, signs may be used to indicate that services are not available.
- 23 A separate Truck Parking (D9-16) sign (see Figure 2I-1) may be mounted below the other general road user services to direct truck drivers to designated parking areas.

### Section 2I.04 Interstate Oasis Signing

#### Support:

- 01 An Interstate Oasis is a facility near an Interstate highway that provides products and services to the public, 24-hour access to public restrooms, and parking for automobiles and heavy trucks. Interstate Oasis guide signs inform road users on Interstate highways as to the presence of an Interstate Oasis at an interchange and which businesses have been designated by the State within which they are traveling as having met the eligibility criteria of the Federal Highway Administration's Interstate Oasis policy. The FHWA's policy, which is dated October 18, 2006, and which can be viewed on the MUTCD website at <http://mutcd.fhwa.dot.gov/res-policy.htm>, provides a more detailed definition of an Interstate Oasis and specifies the eligibility criteria for an Interstate Oasis designation in compliance with the requirements of laws enacted by Congress.

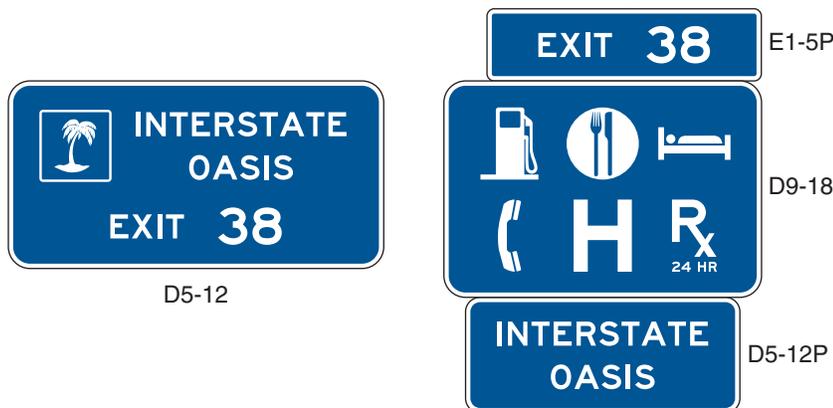
#### Guidance:

- 02 *If a State elects to provide or allow Interstate Oasis signing (see Figure 2I-4), there should be a statewide policy, program, procedures, and criteria for the designation and signing of a facility as an Interstate Oasis that complies with FHWA's policy and with the provisions of this Section.*
- 03 *States electing to provide or allow Interstate Oasis signing should use the following signing practices on the freeway for any given exit to identify the availability of a designated Interstate Oasis:*
- A. *If adequate sign spacing allows, a separate Interstate Oasis (D5-12) sign should be installed in an effective location with spacing of at least 800 feet from other adjacent guide signs, including any Specific Service signs. This Interstate Oasis sign should be located upstream from the Advance Guide sign or between the Advance Guide sign and the Exit Direction sign for the exit leading to the Interstate Oasis. The Interstate Oasis sign should have a white legend with a letter height of at least 10 inches and a white border on a blue background and should contain the words INTERSTATE OASIS and the exit number or, for an unnumbered interchange, an action message such as NEXT RIGHT. The names or logos of the businesses designated as Interstate Oases should not be included on this sign.*
  - B. *If the spacing of the other guide signs precludes the use of a separate sign as described in Item A, an INTERSTATE OASIS (D5-12P) supplemental plaque with a letter height of at least 10 inches and with a white legend and border on a blue background should be appended above or below an existing D9-18 series General Service sign for the interchange.*
- 04 *If a separate Interstate Oasis (D5-12) sign is installed, an Interstate Oasis sign panel should be incorporated into the design of the sign (see Figure 2I-4).*

#### Standard:

- 05 **The Interstate Oasis sign panel shall only be used on the separate Interstate Oasis sign where it is accompanied by the words INTERSTATE OASIS and shall not be used independently without the words.**

**Figure 2I-4. Examples of Interstate Oasis Signs and Plaques**



Option:

- 06 If Specific Service signing is provided at the interchange, a business designated as an Interstate Oasis and having a business logo sign panel on the Food and/or Gas Specific Service signs may use the bottom portion of the business logo sign panel to display the word OASIS.

**Standard:**

- 07 If Specific Services signs containing the OASIS legend as a part of the business logo(s) are not used on the ramp and if the Interstate Oasis is not clearly visible and identifiable from the exit ramp, a sign with a white INTERSTATE OASIS legend with a letter height of at least 6 inches and a white border on a blue background shall be provided on the exit ramp to indicate the direction and distance to the Interstate Oasis.
- 08 If needed, additional trailblazer guide signs shall be used along the crossroad to guide road users to an Interstate Oasis.

### Section 2I.05 Rest Area and Other Roadside Area Signs

**Standard:**

- 01 Rest Area signs (see Figure 2I-5) shall have a retroreflective white legend and border on a blue background.
- 02 Signs that include the legend REST AREA shall be used only where parking and restroom facilities are available.

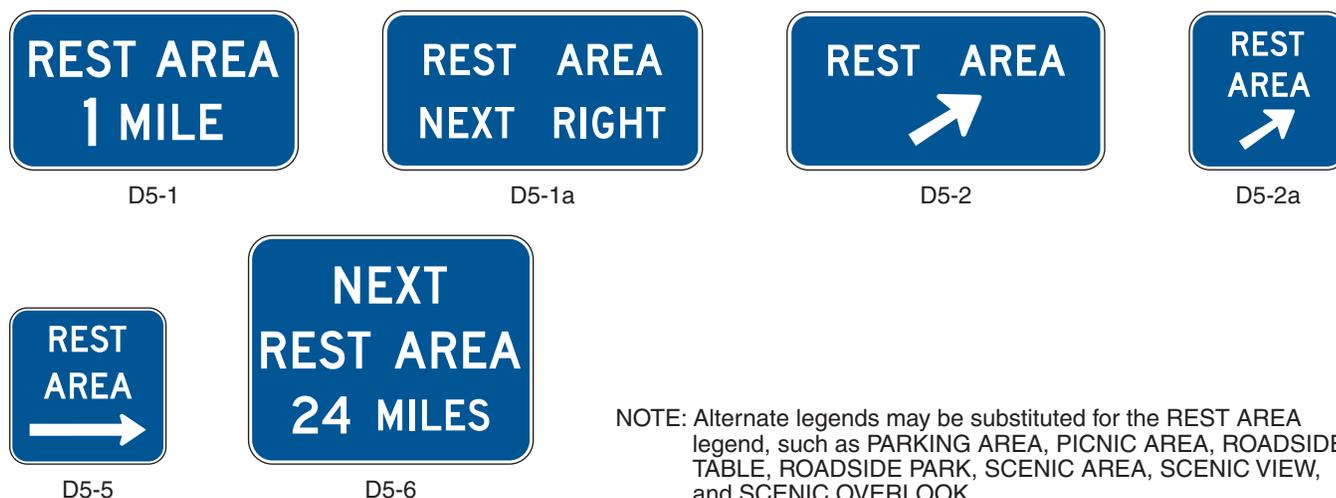
*Guidance:*

- 03 A roadside area that does not contain restroom facilities should be signed to indicate the major road user service that is provided. For example, the sign legends for an area with only parking should use the words PARKING AREA instead of REST AREA. The sign legends for an area with only picnic tables and parking should use words such as PICNIC AREA, ROADSIDE TABLE, or ROADSIDE PARK instead of REST AREA.
- 04 Rest areas that have tourist information and welcome centers should be signed as discussed in Section 2I.08.
- 05 Scenic area signing should be consistent with that provided for rest areas, except that the legends should use words such as SCENIC AREA, SCENIC VIEW, or SCENIC OVERLOOK instead of REST AREA.
- 06 If a rest area or other roadside area is provided on a conventional road, a D5-1 and/or D5-1b sign should be installed in advance of the rest area or other roadside area to permit the driver to reduce speed in preparation for leaving the highway. A D5-5 sign (or a D5-2 sign if an exit ramp is provided) should be installed at the turnoff point where the driver needs to leave the highway to access the rest area or other roadside area.
- 07 If a rest area or other roadside area is provided on a freeway or expressway, a D5-1 sign should be placed 1 mile and/or 2 miles in advance of the rest area.

**Standard:**

- 08 A D5-2 sign shall be placed at the rest area or other roadside area exit gore.

**Figure 2I-5. Rest Area and Other Roadside Area Signs**



NOTE: Alternate legends may be substituted for the REST AREA legend, such as PARKING AREA, PICNIC AREA, ROADSIDE TABLE, ROADSIDE PARK, SCENIC AREA, SCENIC VIEW, and SCENIC OVERLOOK.

## Option:

- 09 A D5-1b sign may be placed between the D5-1 sign and the exit gore on a freeway or expressway. A second D5-1 sign may be used in place of the D5-1b sign with a distance to the nearest 1/2 or 1/4 mile displayed as a fraction rather than a decimal for distances of less than 1 mile.
- 10 To provide the road user with information on the location of succeeding rest areas, a NEXT REST AREA XX MILES (D5-6) sign (see Figure 2I-5) may be installed independently or as a supplemental sign mounted below one of the REST AREA advance guide signs.

**Standard:**

- 11 **All signs on freeways and expressways for rest and other roadside areas shall have letter and numeral sizes that comply with the minimum requirements of Tables 2E-2 through 2E-5. The sizes for General Service signs that have standardized designs shall be as shown in Table 2I-1.**

## Option:

- 12 If the rest area has facilities for the physically impaired (see Section 2I.02), the International Symbol of Accessibility for the Handicapped (D9-6) sign (see Figure 2I-1) may be placed with or beneath the REST AREA advance guide sign.
- 13 If telecommunication devices for the deaf (TDD) are available at the rest area, the TDD (D9-21) symbol sign (see Figure 2I-1) may be used to supplement the advance guide signs for the rest area.
- 14 If wireless Internet services are available at the rest area, the Wi-Fi (D9-22) symbol sign (see Figure 2I-1) may be used to supplement the advance guide signs for the rest area.

**Section 2I.06 Brake Check Area Signs (D5-13 and D5-14)***Guidance:*

- 01 *If an area has been provided for drivers to check the brakes on their vehicle, a BRAKE CHECK AREA XX MILES (D5-13) sign (see Figure 2I-6) should be installed in advance of the brake check area, and a D5-14 sign (see Figure 2I-6) should be placed at the entrance to the brake check area.*

**Section 2I.07 Chain-Up Area Signs (D5-15 and D5-16)***Guidance:*

- 01 *If an area has been provided for drivers to pull off of the roadway to install chains on their tires, a CHAIN-UP AREA XX MILES (D5-15) sign (see Figure 2I-6) should be installed in advance of the chain-up area, and a D5-16 sign (see Figure 2I-6) should be placed at the entrance to the chain-up area.*

**Section 2I.08 Tourist Information and Welcome Center Signs**

## Support:

- 01 Tourist information and welcome centers have been constructed within rest areas on freeways and expressways and are operated by either a State or a private organization. Others have been located within close proximity to these facilities and operated by civic clubs, chambers of commerce, or private enterprise.

*Guidance:*

- 02 *An excessive number of supplemental sign panels should not be installed with Tourist Information or Welcome Center signs so as not to overload the road user.*

**Figure 2I-6. Brake Check Area and Chain-Up Area Signs**

**Standard:**

03 **Tourist Information or Welcome Center signs (see Figure 2I-7) shall have a white legend and border on a blue background. Continuously staffed or unstaffed operation at least 8 hours per day, 7 days per week, shall be required.**

04 **If operated only on a seasonal basis, the Tourist Information or Welcome Center signs shall be removed or covered during the off seasons.**

*Guidance:*

05 *For freeway or expressway rest area locations that also serve as tourist information or welcome centers, the following signing criteria should be used:*

- A. *The locations for tourist information and welcome center Advance Guide, Exit Direction, and Exit Gore signs should meet the General Service signing requirements described in Section 2I.03.*
- B. *If the signing for the tourist information or welcome center is to be accomplished in conjunction with the initial signing for the rest areas, the message on the Advance Guide (D5-7) sign should be REST AREA, TOURIST INFO CENTER, XX MILES or REST AREA, STATE NAME (optional), WELCOME CENTER XX MILES. On the Exit Direction (D5-8 or D5-11) sign the message should be REST AREA, TOURIST INFO CENTER with a diagonally upward-pointing directional arrow (or NEXT RIGHT), or REST AREA, STATE NAME (optional), WELCOME CENTER with a diagonally upward-pointing directional arrow (or NEXT RIGHT).*
- C. *If the initial rest area Advance Guide and Exit Direction signing is in place, these signs should include, on supplemental signs, the legend TOURIST INFO CENTER or STATE NAME (optional), WELCOME CENTER.*
- D. *The Exit Gore sign should contain only the legend REST AREA with the arrow and should not be supplemented with any legend pertaining to the tourist information center or welcome center.*

*Option:*

06 An alternative to the supplemental TOURIST INFO CENTER legend is the Tourist Information (D9-10) sign (see Figure 2I-1), which may be appended beneath the REST AREA advance guide sign.

07 The name of the State or local jurisdiction may appear on the Advance Guide and Exit Direction tourist information/welcome center signs if the jurisdiction controls the operation of the tourist information or welcome center and the center meets the operating criteria set forth in this Manual and is consistent with State policies.

*Guidance:*

08 *For tourist information centers that are located off the freeway or expressway facility, additional signing criteria should be as follows:*

- A. *Each State should adopt a policy establishing the maximum distance that a tourist information center can be located from the interchange in order to be included on official signs.*
- B. *The location of signing should be in accordance with requirements pertaining to General Service signing (see Section 2I.03).*
- C. *Signing along the crossroad should be installed to guide the road user from the interchange to the tourist information center and back to the interchange.*

*Option:*

09 As an alternative, the Tourist Information (D9-10) sign (see Figure 2I-1) may be appended to the guide signs for the exit that provides access to the tourist information center. As a second alternative, the Tourist Information sign may be combined with General Service signing.

**Figure 2I-7. Examples of Tourist Information and Welcome Center Signs**



Note: Alternate legends may be substituted for the TOURIST INFO CENTER legend, such as WELCOME CENTER and (State Name) WELCOME CENTER.

**Section 2I.09 Radio Information Signing**

Option:

01 Radio-Weather Information (D12-1) signs (see Figure 2I-8) may be used in areas where difficult driving conditions commonly result from weather systems. Radio-Traffic Information signs may be used in conjunction with traffic management systems.

**Standard:**

02 **Radio-Weather and Radio-Traffic Information signs shall have a white legend and border on a blue background. Only the numerical indication of the radio frequency shall be used to identify a station broadcasting travel-related weather or traffic information. No more than three frequencies shall be displayed on each sign. Only radio stations whose signal will be of value to the road user and who agree to broadcast either of the following two items shall be identified on Radio-Weather and Radio-Traffic Information signs:**

- A. Periodic weather warnings at a rate of at least once every 15 minutes during periods of adverse weather; or
- B. Driving condition information (affecting the roadway being traveled) at a rate of at least once every 15 minutes, or when required, during periods of adverse traffic conditions, and when supplied by an official agency having jurisdiction.

**Figure 2I-8. Radio, Telephone, and Carpool Information Signs**



D12-1



D12-2



D12-3



D12-4

\* The pictograph of the transportation agency or the travel information service or program may be used in place of the 511 pictograph (see Section 2I.08)



D12-5\*



D12-5a

- 03 **If a station to be considered operates only on a seasonal basis, its signs shall be removed or covered during the off season.**

*Guidance:*

- 04 *The radio station should have a signal strength to adequately broadcast 70 miles along the route. Signs should be spaced as needed for each direction of travel at distances determined by an engineering study. The stations to be included on the signs should be selected in cooperation with the association(s) representing major broadcasting stations in the area to provide: (1) maximum coverage to all road users on both AM and FM frequencies; and (2) consideration of 24 hours per day, 7 days per week broadcast capability.*

Option:

- 05 In roadway rest area locations, a smaller sign using a greater number of radio frequencies, but of the same general design, may be used.

**Standard:**

- 06 **Radio-Weather and Radio-Traffic Information signs installed in rest areas shall be positioned such that they are not visible from the main roadway.**

Option:

- 07 A Channel 9 Monitored (D12-3) sign (see Figure 2I-8) may be installed as needed. Official public agencies or their designees may be displayed as the monitoring agency on the sign.

**Standard:**

- 08 **Only official public agencies or their designee shall be displayed as the monitoring agency on the Channel 9 Monitored sign.**

Option:

- 09 An Emergency CALL XX (D12-4) sign (see Figure 2I-8), along with the appropriate number to call, may be used for cellular phone communications.

#### **Section 2I.10 TRAVEL INFO CALL 511 Signs (D12-5 and D12-5a)**

Option:

- 01 A TRAVEL INFO CALL 511 (D12-5) sign (see Figure 2I-8) may be installed if a 511 travel information services telephone number is available to road users for obtaining traffic, public transportation, weather, construction, or road condition information.
- 02 The pictograph of the transportation agency or the travel information service or program that is providing the travel information may be incorporated within the D12-5 sign either above or below the TRAVEL INFO CALL 511 legend.

**Standard:**

- 03 **The logo of a commercial entity shall not be incorporated within the TRAVEL INFO CALL 511 sign.**
- 04 **The TRAVEL INFO CALL 511 sign shall have a white legend and border on a blue background.**

*Guidance:*

- 05 *If the pictograph of the transportation agency or the travel information service or program is used, the pictograph's maximum height should not exceed two times the letter height used in the legend of the sign.*

#### **Section 2I.11 Carpool and Ridesharing Signing**

Option:

- 01 In areas having carpool matching services, Carpool Information (D12-2) signs (see Figure 2I-8) may be provided adjacent to highways with preferential lanes or along any other highway.
- 02 Carpool Information signs may include an Internet domain name or telephone number of more than four characters within the legend.

*Guidance:*

- 03 *Because this is an information sign related to road user services, the Carpool Information sign should have a white legend and border on a blue background.*

**Standard:**

- 04 **If a local transit pictograph or carpool symbol is incorporated into the Carpool Information sign, the maximum vertical dimension of the logo or symbol shall not exceed 18 inches.**

## CHAPTER 2J. SPECIFIC SERVICE SIGNS

### Section 2J.01 Eligibility

#### Standard:

- 01 **Specific Service signs shall be defined as guide signs that provide road users with business identification and directional information for services and for eligible attractions. Eligible service categories shall be limited to gas, food, lodging, camping, attractions, and 24-hour pharmacies.**

#### Guidance:

- 02 *The use of Specific Service signs should be limited to areas primarily rural in character or to areas where adequate sign spacing can be maintained.*

#### Option:

- 03 Where an engineering study determines a need, Specific Service signs may be used on any class of highways.

#### Guidance:

- 04 *Specific Service signs should not be installed at an interchange where the road user cannot conveniently reenter the freeway or expressway and continue in the same direction of travel.*

#### Standard:

- 05 **Eligible service facilities shall comply with laws concerning the provisions of public accommodations without regard to race, religion, color, age, sex, or national origin, and laws concerning the licensing and approval of service facilities.**

- 06 **The attraction services shall include only facilities which have the primary purpose of providing amusement, historical, cultural, or leisure activities to the public.**

- 07 **Distances to eligible 24-hour pharmacies shall not exceed 3 miles in any direction of an interchange on the Federal-aid system.**

#### Guidance:

- 08 *Except as provided in Paragraph 9, distances to eligible services other than pharmacies should not exceed 3 miles in any direction.*

#### Option:

- 09 If, within the 3-mile limit, facilities for the services being considered other than pharmacies are not available or choose not to participate in the program, the limit of eligibility may be extended in 3-mile increments until one or more facilities for the services being considered chooses to participate, or until 15 miles is reached, whichever comes first.

#### Guidance:

- 10 *If State or local agencies elect to provide Specific Service signing, there should be a statewide policy for such signing and criteria for the availability of the various types of services. The criteria should consider the following:*

A. *To qualify for a GAS logo sign panel, a business should have:*

1. *Vehicle services including gas and/or alternative fuels, oil, and water;*
2. *Continuous operation at least 16 hours per day, 7 days per week for freeways and expressways, and continuous operation at least 12 hours per day, 7 days per week for conventional roads;*
3. *Modern sanitary facilities and drinking water; and*
4. *Public telephone.*

B. *To qualify for a FOOD logo sign panel, a business should have:*

1. *Licensing or approval, where required;*
2. *Continuous operations to serve at least two meals per day, at least 6 days per week;*
3. *Modern sanitary facilities; and*
4. *Public telephone.*

C. *To qualify for a LODGING logo sign panel, a business should have:*

1. *Licensing or approval, where required;*
2. *Adequate sleeping accommodations;*
3. *Modern sanitary facilities; and*
4. *Public telephone.*

D. To qualify for a *CAMPING* logo sign panel, a business should have:

1. Licensing or approval, where required;
2. Adequate parking accommodations; and
3. Modern sanitary facilities and drinking water.

E. To qualify for an *ATTRACTION* logo sign panel, a facility should have:

1. Regional significance, in compliance with the provisions of Paragraph 6; and
2. Adequate parking accommodations.

**Standard:**

11 If State or local agencies elect to provide Specific Service signing for pharmacies, both of the following criteria shall be met for a pharmacy to qualify for signing:

- A. The pharmacy shall be continuously operated 24 hours per day, 7 days per week, and shall have a State-licensed pharmacist present and on duty at all times; and
- B. The pharmacy shall be located within 3 miles of an interchange on the Federal-aid system.

Support:

12 Section 2I.04 contains information regarding the Interstate Oasis program.

### Section 2J.02 Application

**Standard:**

01 The number of Specific Service signs along an approach to an interchange or intersection, regardless of the number of service types displayed, shall be limited to a maximum of four. In the direction of traffic, successive Specific Service signs shall be for 24-hour pharmacy, attraction, camping, lodging, food, and gas services, in that order.

02 A Specific Service sign shall display the word message GAS, FOOD, LODGING, CAMPING, ATTRACTION, or 24-HOUR PHARMACY, an appropriate directional legend such as the word message EXIT XX, NEXT RIGHT, SECOND RIGHT, or directional arrows, and the related logo sign panels.

03 No more than three types of services shall be represented on any sign or sign assembly. If three types of services are displayed on one sign, then the logo sign panels shall be limited to two for each service type (for a total of six logo sign panels). If two types of services are displayed on one sign, then the logo sign panels shall be limited to either three for each service type (for a total of six logo sign panels) or four for one service type and two for the other service type (for a total of six logo sign panels). The legend and logo sign panels applicable to a service type shall be displayed such that the road user will not associate them with another service type on the same sign.

04 No service type shall appear on more than two signs (see Paragraph 6).

05 The signs shall have a blue background, a white border, and white legends of upper-case letters, numbers, and arrows.

*Guidance:*

06 Where a service type is displayed on two signs, the signs for that service should follow one another in succession.

07 The Specific Service signs should be located to take advantage of natural terrain, to have the least impact on the scenic environment, and to avoid visual conflict with other signs within the highway right-of-way.

*Option:*

08 General Service signs (see Sections 2I.02 and 2I.03) may be used in conjunction with Specific Service signs for eligible types of services that are not represented by a Specific Service sign.

Support:

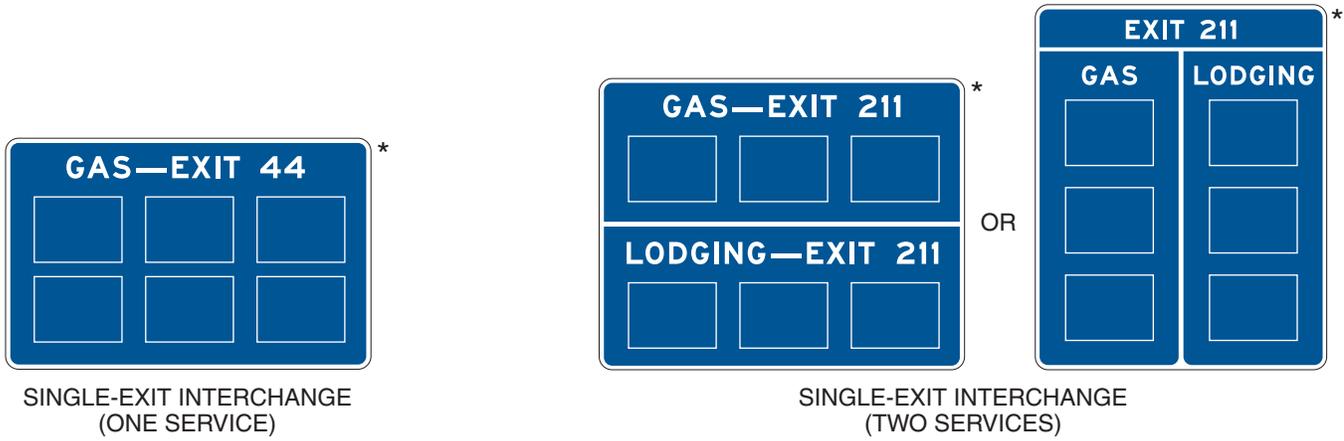
09 Examples of Specific Service signs are shown in Figure 2J-1. Examples of sign locations are shown in Figure 2J-2.

### Section 2J.03 Logos and Logo Sign Panels

**Standard:**

01 A logo shall be either an identification symbol/trademark or a word message. Each logo shall be placed on a separate logo sign panel that shall be attached to the Specific Service sign. Symbols or trademarks used alone for a logo shall be reproduced in the colors and general shape consistent with customary use, and any integral legend shall be in proportionate size. A logo that resembles an official traffic control device shall not be used.

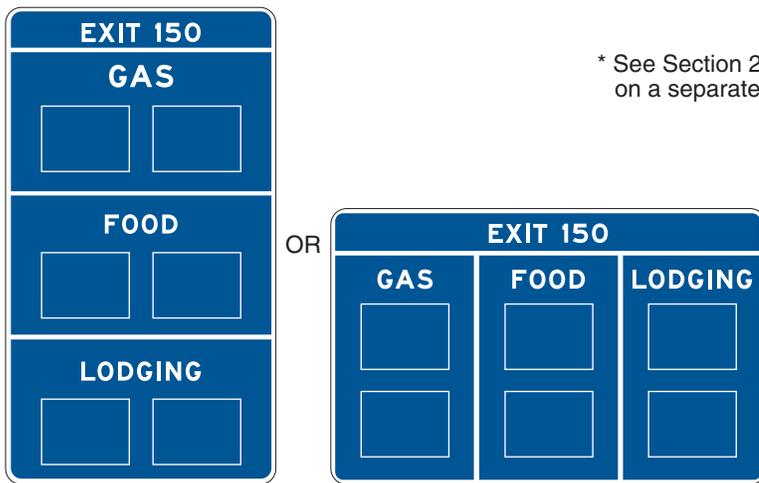
**Figure 2J-1. Examples of Specific Service Signs**



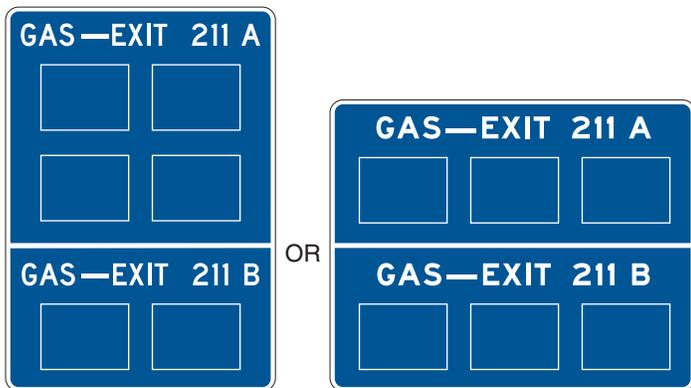
SINGLE-EXIT INTERCHANGE  
(ONE SERVICE)

SINGLE-EXIT INTERCHANGE  
(TWO SERVICES)

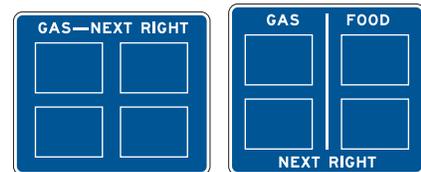
\* See Section 2J.07 for option of displaying exit number on a separate plaque instead of on the sign



SINGLE-EXIT INTERCHANGE (THREE SERVICES)

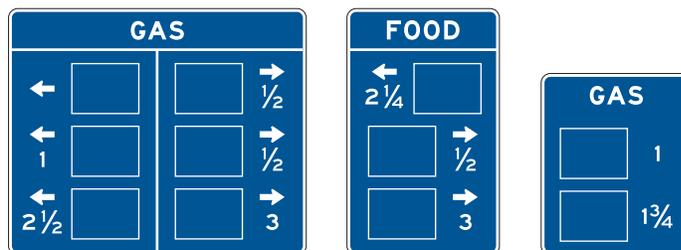


DOUBLE-EXIT INTERCHANGE



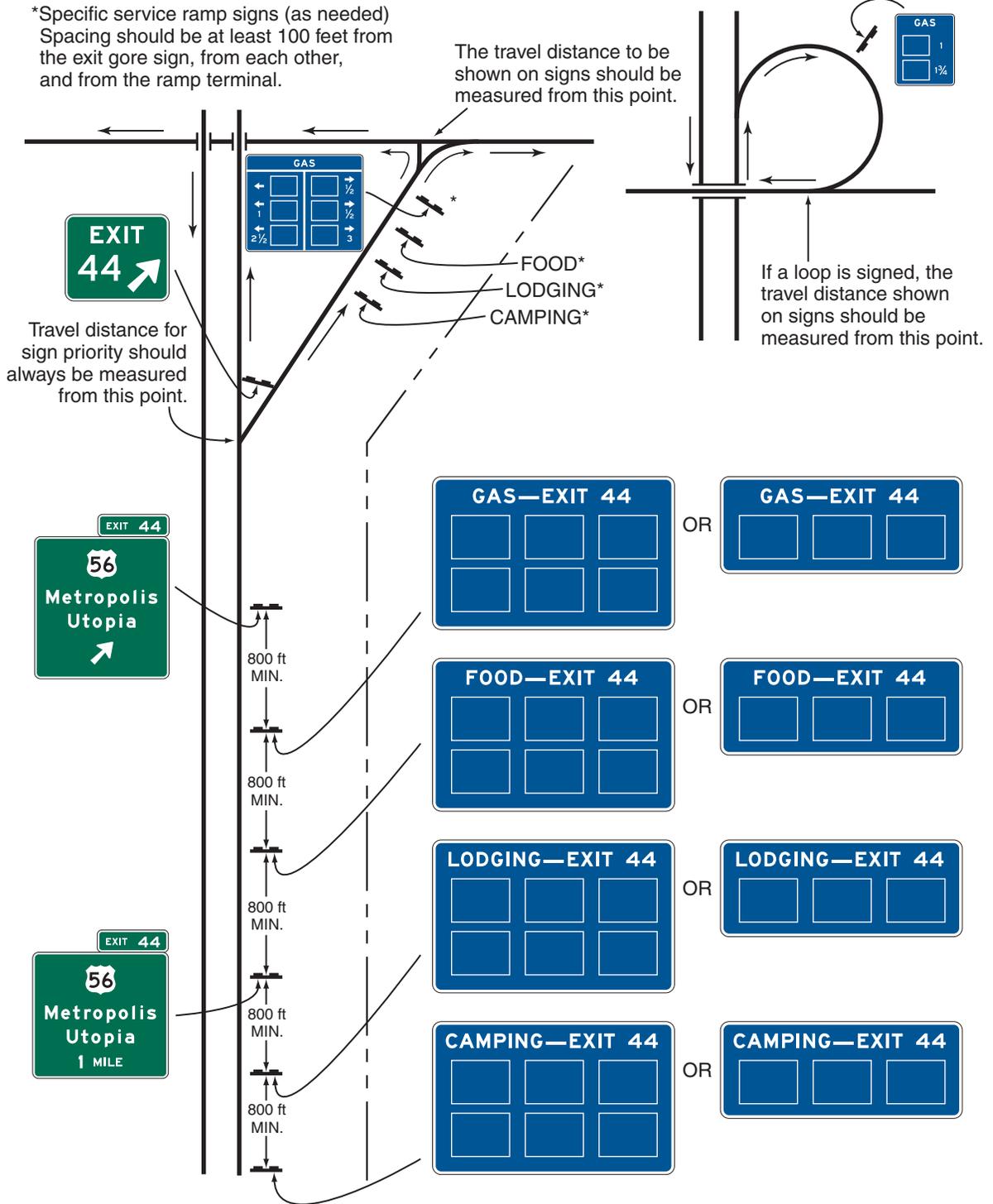
INTERSECTION

Note: Directional arrows or distance may be used when appropriate



RAMP

**Figure 2J-2. Examples of Specific Service Sign Locations**



*Guidance:*

02 A word message logo, not using a symbol or trademark, should have a blue background with white legend and border.

*Support:*

03 Section 2J.05 contains information regarding the minimum letter heights for logo sign panels.

*Option:*

04 Where business identification symbols or trademarks are used alone for a logo, the border may be omitted from the logo sign panel.

05 A portion of a logo sign panel may be used to display a supplemental message horizontally along the bottom of the logo sign panel, provided that the message displays essential motorist information (see Figure 2J-3).

**Standard:**

06 **All supplemental messages shall be displayed within the logo sign panel and shall have letters and numerals that comply with the minimum height requirements shown in Table 2J-1.**

*Guidance:*

07 *A logo sign panel should not display more than one supplemental message.*

08 *The supplemental message should be displayed in a color to contrast effectively with the background of the business sign or separated from the other legend or logo by a divider bar.*

09 *State or local agencies that elect to allow supplemental messages on logo sign panels should develop a statewide policy for such messages.*

**Support:**

10 Typical supplemental messages might include DIESEL, 24 HOURS, CLOSED and the day of the week when the facility is closed, ALTERNATIVE FUELS (see Section 2I.03), and RV ACCESS.

**Option:**

11 The RV ACCESS supplemental message may be circular.

**Standard:**

12 **If the RV ACCESS supplemental message is circular, it shall be the abbreviation RV in black letters inside a yellow circle with a black border and it shall be displayed within the logo sign panel near the lower right-hand corner (see Figure 2J-4).**

*Guidance:*

13 *If the circular RV ACCESS supplemental message is used, the circle should have a diameter of 10 inches and the letters should have a height of 6 inches.*

14 *If a State or local agency elects to display the designation of businesses as providing on-premise accommodations for recreational vehicles with the RV ACCESS supplemental message or the RV Access circular message, there should be a statewide policy for such designation and criteria for qualifying businesses. The criteria should include such site conditions as access between the public roadway and the site, on-premise geometry, and parking.*

**Option:**

15 If a business designated as an Interstate Oasis (see Section 2I.04) has a business logo sign panel on the Food and/or Gas Specific Service signs, the word OASIS may be displayed on the bottom portion of the logo sign panel for that business.

**Standard:**

16 **A logo sign panel shall not display the symbol/trademark or name of more than one business.**

**Figure 2J-3. Examples of Supplemental Messages on Logo Sign Panels**



**Table 2J-1. Minimum Letter and Numeral Sizes for Specific Service Signs According to Sign Type**

Type of Sign	Freeway or Expressway	Conventional Road or Ramp
<b>A. Specific Service Signs</b>		
Service Categories	10	6
Exit Number Words	10	—
Exit Number Numerals and Letters	10	—
Action Message Words	10	6
Distance Numerals	—	6
Distance Fraction Numerals	—	4
<b>B. Logo Sign Panels</b>		
Logo Sign Panels	60 x 36	30 x 18
Words and Numerals (Non-Trademark/Graphic Logo)	8	4
Trademark/Graphic Logo	Proportional	Proportional
Supplemental Message Words and Numerals	5	2.5

Note: Sizes are shown in inches and where applicable are shown as width x height

**Figure 2J-4. Examples of RV Access Supplemental Messages on Logo Sign Panels**



## **Section 2J.04 Number and Size of Signs and Logo Sign Panels**

### *Guidance:*

- 01 *Sign sizes should be determined by the amount and height of legend and the number and size of logo sign panels attached to the sign. All logo sign panels on a sign should be the same size.*

### **Standard:**

- 02 **Each Specific Service sign or sign assembly shall be limited to no more than six logo sign panels.**

### *Option:*

- 03 Where more than six businesses of a specific service type are eligible for logo sign panels at the same interchange, additional logo sign panels of that same specific service type may also be displayed in accordance with the provisions of Paragraph 4. The additional logo sign panels may be displayed either by placing more than one specific service type on the same sign (see Paragraph 3 of Section 2J.02) or by using a second Specific Service sign of that specific service type if the additional sign can be added without exceeding the limit of four Specific Service signs at an interchange or intersection approach (see Paragraph 6 of Section 2J.02).

### **Standard:**

- 04 **Where logo sign panels for more than six businesses of a specific service type are displayed at the same interchange or intersection approach, the following provisions shall apply:**

- A. **No more than 12 logo sign panels of a specific service type shall be displayed on no more than two Specific Service signs or sign assemblies;**
- B. **No more than six logo sign panels shall be displayed on a single Specific Service sign; and**
- C. **No more than four Specific Service signs shall be displayed on the approach.**

### *Support:*

- 05 Section 2J.08 contains information regarding Specific Service signs for double-exit interchanges.

### **Standard:**

- 06 **Each logo sign panel attached to a Specific Service sign shall have a rectangular shape with a width longer than the height. A logo sign panel on signs for freeways and expressways shall not exceed 60 inches in width and 36 inches in height. A logo sign panel on signs for conventional roads and freeway and expressway ramps shall not exceed 30 inches in width and 18 inches in height. The vertical and horizontal spacing between logo sign panels shall not exceed 8 inches and 12 inches, respectively.**

### *Support:*

- 07 Sections 2A.14, 2E.15, and 2E.16 contain information regarding borders, interline spacing, and edge spacing.

## **Section 2J.05 Size of Lettering**

### **Standard:**

- 01 **All Specific Service signs and logo sign panels shall have letter and numeral sizes that comply with the minimum requirements of Table 2J-1.**

### *Guidance:*

- 02 *Any legend on a symbol/trademark should be proportional to the size of the symbol/trademark.*

## **Section 2J.06 Signs at Interchanges**

### **Standard:**

- 01 **The Specific Service signs shall be installed between the preceding interchange and at least 800 feet in advance of the Exit Direction sign at the interchange from which the services are available (see Figure 2J-2).**

### *Guidance:*

- 02 *There should be at least an 800-foot spacing between the Specific Service signs, except for Specific Service ramp signs. However, excessive spacing is not desirable. Specific Service ramp signs should be spaced at least 100 feet from the Exit Gore sign, from each other, and from the ramp terminal.*

## **Section 2J.07 Single-Exit Interchanges**

### **Standard:**

- 01 **At numbered single-exit interchanges, the name of the service type followed by the exit number shall be displayed on one line above the logo sign panels. At unnumbered interchanges, the directional legend NEXT RIGHT (LEFT) shall be used.**
- 02 **At single-exit interchanges, Specific Service ramp signs shall be installed along the ramp or at the ramp terminal for facilities that have logo sign panels displayed along the main roadway if the facilities are not readily visible from the ramp terminal. Directions to the service facilities shall be indicated by arrows on the ramp signs. Logo sign panels on Specific Service ramp signs shall be duplicates of those displayed on the Specific Service signs located in advance of the interchange, but shall be reduced in size (see Paragraph 6 of Section 2J.04).**

*Guidance:*

- 03 *Specific Service ramp signs should include distances to the service facilities.*

*Option:*

- 04 An exit number plaque (see Section 2E.31) may be used instead of the exit number on the signs located in advance of an interchange.

**Section 2J.08 Double-Exit Interchanges***Guidance:*

- 01 *At double-exit interchanges, the Specific Service signs should consist of two sections, one for each exit (see Figure 2J-1).*

**Standard:**

- 02 **At a double-exit interchange, the top section shall display the logo sign panels for the first exit and the bottom section shall display the logo sign panels for the second exit. At numbered interchanges, the name of the service type and the exit number shall be displayed above the logo sign panels in each section. At unnumbered interchanges, the word message NEXT RIGHT (LEFT) and SECOND RIGHT (LEFT) shall be used in place of the exit number. The number of logo sign panels on the sign (total of both sections) or the sign assembly shall be limited to six.**

*Guidance:*

- 03 *At a double-exit interchange, where a service type is displayed on two Specific Service signs in accordance with the provisions of Section 2J.04, one of the signs should display the logo sign panels for that service type for the businesses that are accessible from one of the two exits and the other sign should display the logo sign panels for that service type for the businesses that are accessible from the other exit.*

*Option:*

- 04 At a double-exit interchange where there are four logo sign panels to be displayed for one of the exits and one or two logo sign panels to be displayed for the other exit, the logo sign panels may be arranged in three rows with two logo sign panels per row.
- 05 At a double-exit interchange, where a service is to be signed for only one exit, one section of the Specific Service sign may be omitted, or a single exit interchange sign may be used. Signs on ramps and crossroads as described in Section 2J.07 may be used at a double-exit interchange.

**Section 2J.09 Specific Service Trailblazer Signs***Support:*

- 01 Specific Service trailblazer signs (see Figure 2J-5) are guide signs with one to four logo sign panels that display business identification and directional information for services and for eligible attractions. Specific Service trailblazer signs are installed along crossroads for facilities that have logo sign panels displayed along the main roadway and ramp, and that require additional vehicle maneuvers.

**Standard:**

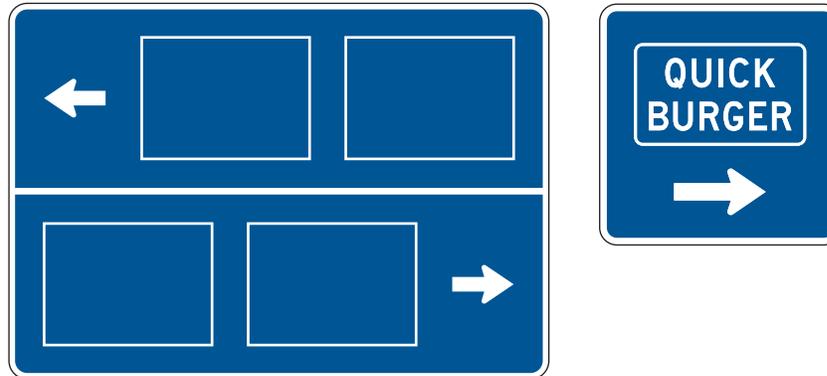
- 02 **Specific Service trailblazer signs shall be installed along crossroads where the route to the business requires a direction change, where it is questionable as to which roadway to follow, or where additional guidance is needed. Where it is not feasible or practical to install Specific Service trailblazer signs to such businesses, those businesses shall not be considered eligible for signing from the ramp and main roadway. A Specific Service trailblazer sign shall not be required at the point where the business is visible from the roadway and its access is readily apparent.**

*Guidance:*

- 03 *If used, a Specific Service trailblazer sign should be located a maximum of 500 feet in advance of any required turn.*

**Standard:**

- 04 **The location of other traffic control devices shall take precedence over the location of a Specific Service trailblazer sign.**
- 05 **When used, each Specific Service trailblazer sign or sign assembly shall be limited to no more than four logo sign panels. The logo sign panels on Specific Service trailblazer signs shall be duplicates of those displayed on the Specific Service ramp signs.**
- 06 **Appropriate legends, such as directional arrows or the word message NEXT RIGHT or SECOND RIGHT, shall be displayed with the logo sign panel to provide proper guidance. The directional legend and border shall be white and shall be displayed on a blue background.**

**Figure 2J-5. Examples of Specific Service Trailblazer Signs**

Option:

- 07 Specific Service trailblazer signs may contain various types of services on a single sign or on a sign assembly.
- 08 Specific Service trailblazer signs may be placed farther from the edge of the road than other traffic control signs.

### **Section 2J.10 Signs at Intersections**

**Standard:**

- 01 **Where both tourist-oriented information (see Chapter 2K) and specific service information would be needed at the same intersection, the design of the tourist-oriented directional signs shall be used, and the needed specific service information shall be incorporated.**

*Guidance:*

- 02 *If Specific Service signs are used on conventional roads or at intersections on expressways, they should be installed between the previous interchange or intersection and at least 300 feet in advance of the intersection from which the services are available.*
- 03 *The spacing between signs should be determined on the basis of an engineering study.*
- 04 *Logo sign panels should not be displayed for a type of service for which a qualified facility is readily visible.*

**Standard:**

- 05 **If Specific Service signs are used on conventional roads or at intersections on expressways, the name of each type of service shall be displayed above its logo sign panel(s), together with an appropriate legend, such as NEXT RIGHT (LEFT) or a directional arrow, either displayed on the same line as the name of the type of service or displayed below the logo sign panel(s).**

Option:

- 06 Signs similar to Specific Service ramp signs as described in Section 2J.07 may be provided on the crossroad.

### **Section 2J.11 Signing Policy**

*Guidance:*

- 01 *Each highway agency that elects to use Specific Service signs should establish a signing policy that includes, as a minimum, the guidelines of Section 2J.01 and at least the following criteria:*
- A. *Selection of eligible businesses;*
  - B. *Distances to eligible services;*
  - C. *The use of logo sign panels, legends, and signs conforming with this Manual and State design requirements;*
  - D. *Removal or covering of logo sign panels during off seasons for businesses that operate on a seasonal basis;*
  - E. *The circumstances, if any, under which Specific Service signs are permitted to be used in non-rural areas; and*
  - F. *Determination of the costs to businesses for initial permits, installations, annual maintenance, and removal of logo sign panels.*

## CHAPTER 2K. TOURIST-ORIENTED DIRECTIONAL SIGNS

### Section 2K.01 Purpose and Application

#### Support:

- 01 Tourist-oriented directional signs are guide signs with one or more sign panels that display the business identification of and directional information for eligible business, service, and activity facilities.

#### Standard:

- 02 **A facility shall be eligible for tourist-oriented directional signs only if it derives its major portion of income or visitors during the normal business season from road users not residing in the area of the facility.**

#### Option:

- 03 Tourist-oriented directional signs may include businesses involved with seasonal agricultural products.

#### Standard:

- 04 **When used, tourist-oriented directional signs shall be used only on rural conventional roads and shall not be used on conventional roads in urban areas or at interchanges on freeways or expressways.**

- 05 **Where both tourist-oriented directional signs and Specific Service signs (see Chapter 2J) would be needed at the same intersection, the tourist-oriented directional signs shall incorporate the needed information from, and be used in place of, the Specific Service signs.**

#### Option:

- 06 Tourist-oriented directional signs may be used in conjunction with General Service signs (see Section 2I.02).

#### Support:

- 07 Section 2K.07 contains information on the adoption of a State policy for States that elect to use tourist-oriented directional signs.

### Section 2K.02 Design

#### Standard:

- 01 **Tourist-oriented directional signs shall have one or more sign panels for the purpose of displaying the business identification of and directional information for eligible facilities. Each sign panel shall be rectangular in shape and shall have a white legend and border on a blue background.**

- 02 **The content of the legend on each sign panel shall be limited to the identification and directional information for no more than one eligible business, service, or activity facility. The legends shall not include promotional advertising.**

#### Guidance:

- 03 *Each sign panel should have a maximum of two lines of legend including no more than one symbol, a separate directional arrow, and the distance to the facility displayed beneath the arrow. Arrows pointing to the left or up should be at the extreme left of the sign panel. Arrows pointing to the right should be at the extreme right of the sign panel. Symbols, when used, should be to the left of the word legend or logo sign panel (see Paragraph 7).*

#### Option:

- 04 The General Service sign symbols (see Section 2I.02) and the symbols for recreational and cultural interest area signs (see Chapter 2M) may be used.

- 05 Logo sign panels (see Section 2J.03) for specific businesses, services, and activities may also be used. Based on engineering judgment, the hours of operation may be displayed on the sign panels.

#### Standard:

- 06 **When used, symbols and logo sign panels shall be an appropriate size (see Section 2K.04). Logos resembling official traffic control devices shall not be permitted.**

#### Option:

- 07 The tourist-oriented directional sign may display the word message TOURIST ACTIVITIES at the top of the sign.

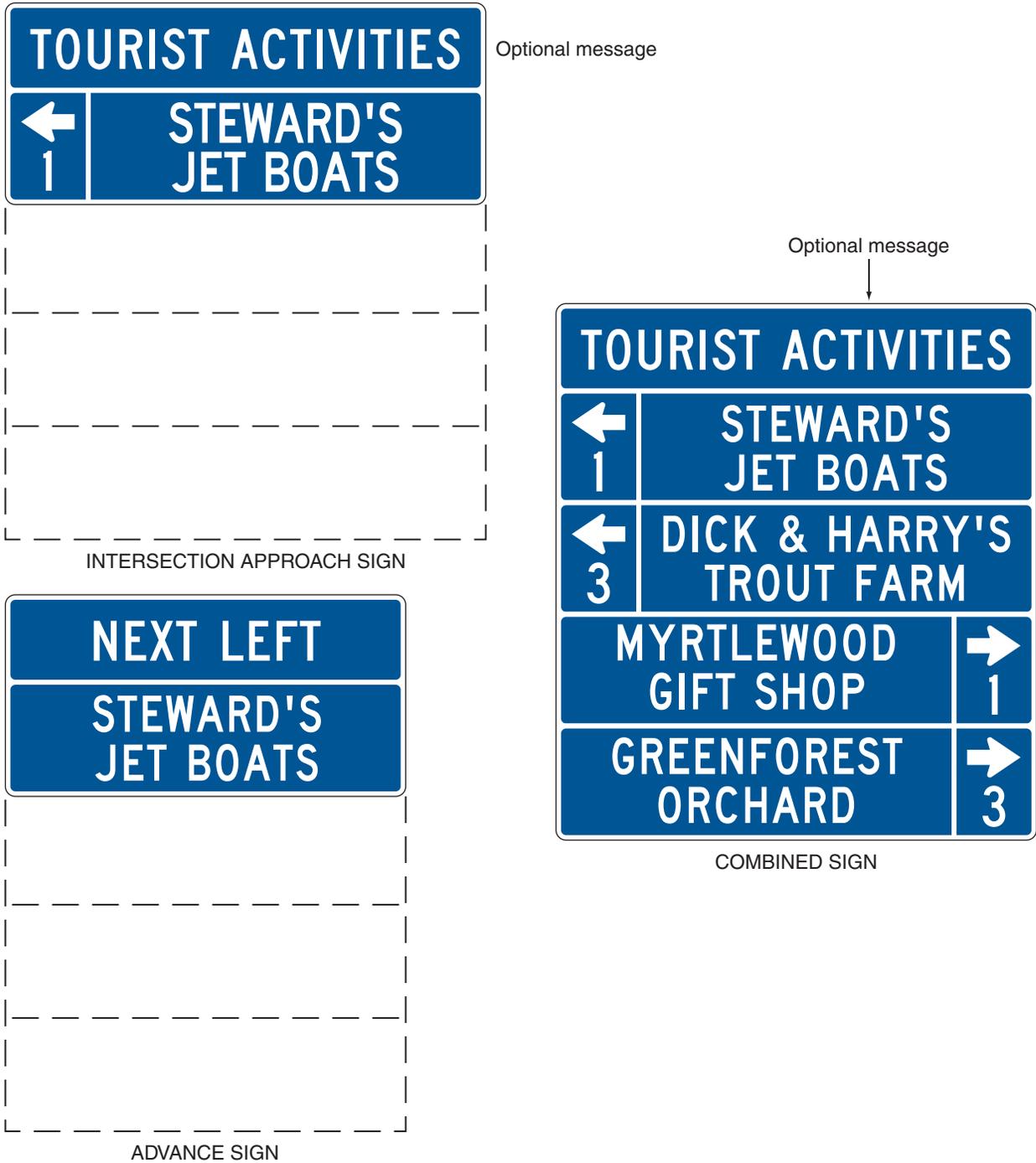
#### Standard:

- 08 **The TOURIST ACTIVITIES word message shall have a white legend in all upper-case letters and a white border on a blue background. If used, it shall be placed above and in addition to the directional sign panels.**

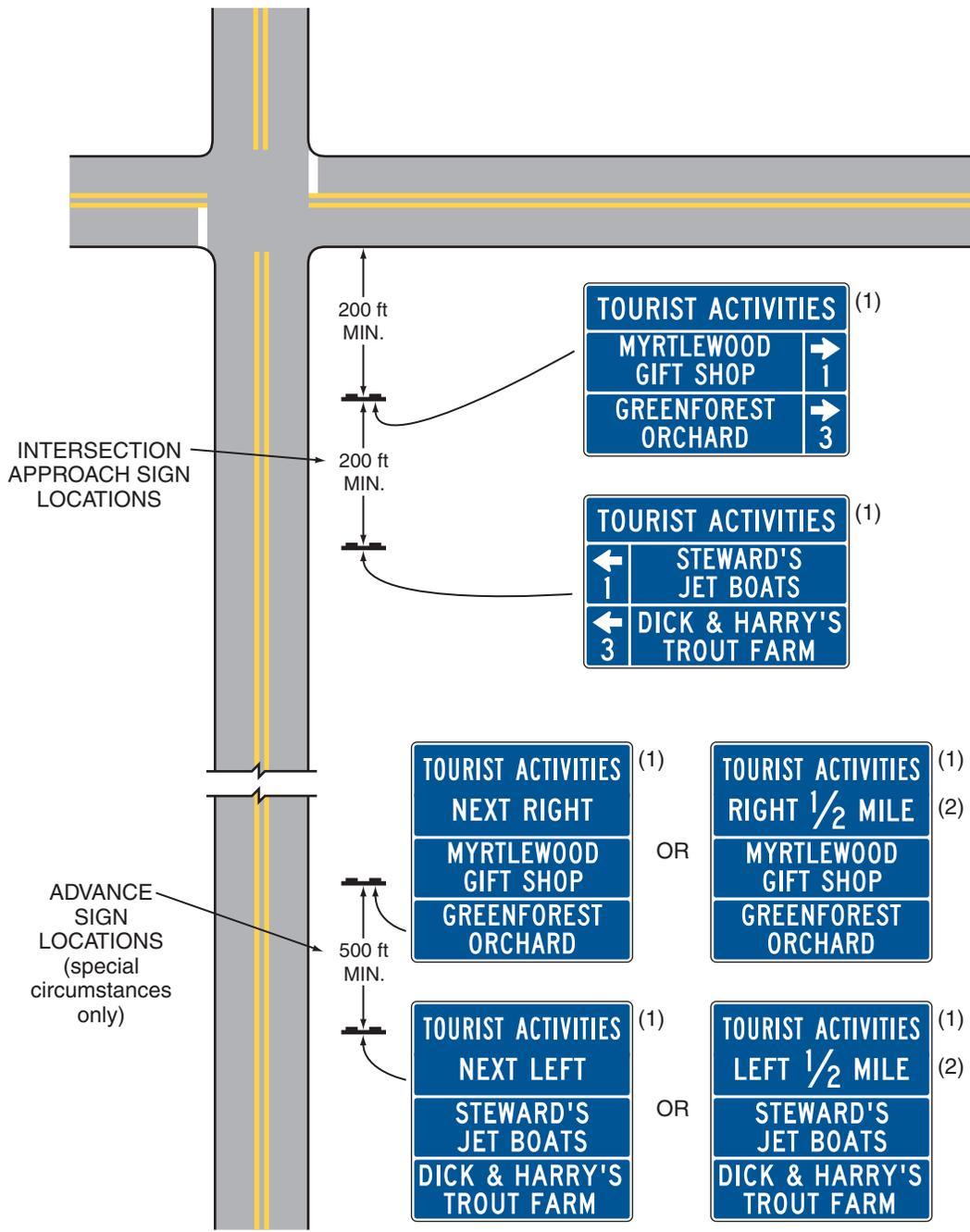
#### Support:

- 09 Examples of tourist-oriented directional signs are shown in Figures 2K-1 and 2K-2.

Figure 2K-1. Examples of Tourist-Oriented Directional Signs



**Figure 2K-2. Examples of Intersection Approach Signs and Advance Signs for Tourist-Oriented Directional Signs**



(1) Optional message  
 (2) Use if there is an intervening intersection

### Section 2K.03 Style and Size of Lettering

#### Guidance:

- 01 *All letters and numbers on tourist-oriented directional signs, except on the logo sign panels, should be upper-case and at least 6 inches in height. Any legend on a logo should be proportional to the size of the logo.*

#### Standard:

- 02 **Design standards for letters, numerals, and spacing shall be as provided in the “Standard Highway Signs and Markings” book (see Section 1A.11).**

### Section 2K.04 Arrangement and Size of Signs

#### Standard:

- 01 **The size of a tourist-oriented directional sign shall be limited to a maximum height of 6 feet. Additional height shall be allowed to accommodate the addition of the optional TOURIST ACTIVITIES message provided in Section 2K.02 and the action messages provided in Section 2K.05.**

#### Guidance:

- 02 *The number of intersection approach signs (one sign for tourist-oriented destinations to the left, one for destinations to the right, and one for destinations straight ahead) installed in advance of an intersection should not exceed three. The number of sign panels installed on each sign should not exceed four. The sign panels for right-turn, left-turn, and straight-through destinations should be on separate signs. The left-turn destination sign should be located farthest from the intersection, then the right-turn destination sign, with the straight-through destination sign located closest to the intersection (see Figure 2K-2). Signs for facilities in the straight-through direction should be considered only when there are signs for destinations in either the left or right direction.*

- 03 *If it has been determined to be appropriate to combine the left-turn and right-turn destination sign panels on a single sign, the left-turn destination sign panels should be above the right-turn destination sign panels (see Figure 2K-1). When there are multiple destinations in the same direction, they should be in order based on their distance from the intersection. Except as provided in Paragraph 5, a straight-through sign panel should not be combined with a sign displaying left- and/or right-turn destinations.*

- 04 *The sign panels should not exceed the size necessary to accommodate two lines of legend without crowding. Symbols and logo sign panels on a directional sign panel should not exceed the height of two lines of a word legend. All directional sign panels and other parts of the sign should be the same width, which should not exceed 6 feet.*

#### Option:

- 05 *At intersection approaches where three or fewer facilities are displayed, the left-turn, right-turn, and straight-through destination sign panels may be combined on the same sign.*

### Section 2K.05 Advance Signs

#### Guidance:

- 01 *Advance signs should be limited to those situations where sight distance, intersection vehicle maneuvers, or other vehicle operating characteristics require advance notification of the destinations and their directions.*

- 02 *The design of the advance sign should be identical to the design of the intersection approach sign. However, the directional arrows and distances to the destinations should be omitted and the action messages NEXT RIGHT, NEXT LEFT, or AHEAD should be placed on the sign above the business identification sign panels. The action messages should have the same letter height as the other word messages on the directional sign panels (see Figures 2K-1 and 2K-2).*

#### Standard:

- 03 **The action message sign panels shall have a white legend in all upper-case letters and a white border on a blue background.**

#### Option:

- 04 *The legend RIGHT 1/2 MILE or LEFT 1/2 MILE may be used on advance signs when there are intervening minor roads.*

- 05 *The height required to add the directional word messages recommended for the advance sign may be added to the maximum sign height of 6 feet.*

#### Guidance:

- 06 *The optional TOURIST ACTIVITIES message, when used on an advance sign, and the action message should be combined on a single sign panel with TOURIST ACTIVITIES as the top line and the action message as the bottom line (see Figure 2K-2).*

**Section 2K.06 Sign Locations***Guidance:*

- 01 *If used, the intersection approach signs should be located at least 200 feet in advance of the intersection. Signs should be spaced at least 200 feet apart and at least 200 feet from other traffic control devices.*
- 02 *If used, advance signs should be located approximately 1/2 mile from the intersection with 500 feet between these signs. In the direction of travel, the order of advance sign placement should be to show the destinations to the left first, then destinations to the right, and last, the destinations straight ahead.*
- 03 *Position, height, and lateral offset of signs should be governed by Chapter 2A except as permitted in this Section.*

*Option:*

- 04 *Tourist-oriented directional signs may be placed farther from the edge of the road than other traffic control signs.*

**Standard:**

- 05 **The location of other traffic control devices shall take precedence over the location of tourist-oriented directional signs.**

**Section 2K.07 State Policy****Standard:**

- 01 **To be eligible for tourist-oriented directional signing, facilities shall comply with applicable State and Federal laws concerning the provisions of public accommodations without regard to race, religion, color, age, sex, or national origin, and with laws concerning the licensing and approval of service facilities. Each State that elects to use tourist-oriented directional signs shall adopt a policy that complies with these provisions.**

*Guidance:*

- 02 *The State policy should include:*
- A. *A definition of tourist-oriented business, service, and activity facilities.*
  - B. *Eligibility criteria for signs for facilities.*
  - C. *Provision for incorporating Specific Service signs into the tourist-oriented directional signs as required by Paragraph 5 of Section 2K.01.*
  - D. *Provision for covering signs during off seasons for facilities operated on a seasonal basis.*
  - E. *Provisions for signs to facilities that are not located on the crossroad when such facilities are eligible for signs.*
  - F. *A definition of the immediate area in compliance with the provisions of Paragraph 2 of Section 2K.01.*
  - G. *Maximum distances to eligible facilities. The maximum distance should be 5 miles.*
  - H. *Provision for information centers (plazas) when the number of eligible sign applicants exceeds the maximum permissible number of sign panel installations.*
  - I. *Provision for limiting the number of signs when there are more applicants than the maximum number of signs permitted.*
  - J. *Criteria for use at intersections on expressways.*
  - K. *Provisions for controlling or excluding those businesses which have illegal signs as defined by the Highway Beautification Act of 1965 (23 U.S.C. 131).*
  - L. *Provisions for States to charge fees to cover the cost of signs through a permit system.*
  - M. *A definition of the conditions under which the time of operation is displayed.*
  - N. *Provisions for determining if advance signs will be permitted, and the circumstances under which they will be installed.*

## CHAPTER 2L. CHANGEABLE MESSAGE SIGNS

### Section 2L.01 Description of Changeable Message Signs

Support:

- 01 A changeable message sign (CMS) is a traffic control device that is capable of displaying one or more alternative messages. Some changeable message signs have a blank mode when no message is displayed, while others display multiple messages with only one of the messages displayed at a time (such as OPEN/CLOSED signs at weigh stations).
- 02 The provisions in this Chapter apply to both permanent and portable changeable message signs with electronic displays. Additional provisions that only apply to portable changeable message signs can be found in Section 6F.60. The provisions in this Chapter do not apply to changeable message signs with non-electronic displays that are changed either manually or electromechanically, such as a hinged-panel, rotating-drum, or back-lit curtain or scroll CMS.

**Standard:**

- 03 **Except as provided in Paragraph 2 of Section 2L.02, changeable message signs shall display only traffic operational, regulatory, warning, and guidance information. Advertising messages shall not be displayed on changeable message signs or its supports or other equipment.**
- 04 **The design of legends for non-electronic display changeable message signs shall comply with the provisions of Chapters 2A through 2K, 2M, and 2N of this Manual. All other changeable message signs shall comply with the design and application principles established in this Chapter and in Chapter 2A.**

*Guidance:*

- 05 *Blank-out signs that display only single-phase, predetermined electronic-display legends that are limited by their composition and arrangement of pixels or other illuminated forms in a fixed arrangement (such as a blank-out sign indicating a part-time turn prohibition, a blank-out or changeable lane-use sign, or a changeable OPEN/CLOSED sign for a weigh station) should comply with the provisions of the applicable Section for the specific type of sign, provided that the letter forms, symbols, and other legend elements are duplicates of the static messages as detailed in the "Standard Highway Signs and Markings" book (see Section 1A.11). Because such a sign is effectively an illuminated version of a static sign, the size of its legend elements, the overall size of the sign, and placement of the sign should comply with the applicable provisions for the static version of the sign.*

### Section 2L.02 Applications of Changeable Message Signs

Support:

- 01 Changeable message signs have a large number of applications including, but not limited to, the following:
- A. Incident management and route diversion
  - B. Warning of adverse weather conditions
  - C. Special event applications associated with traffic control or conditions
  - D. Control at crossing situations
  - E. Lane, ramp, and roadway control
  - F. Priced or other types of managed lanes
  - G. Travel times
  - H. Warning situations
  - I. Traffic regulations
  - J. Speed control
  - K. Destination guidance

Option:

- 02 Changeable message signs may be used by State and local highway agencies to display safety messages, transportation-related messages, emergency homeland security messages, and America's Missing: Broadcast Emergency Response (AMBER) alert messages.

*Guidance:*

- 03 *State and local highway agencies should develop and establish a policy regarding the display of the types of messages provided in Paragraph 2. When changeable message signs are used at multiple locations to address a specific situation, the message displays should be consistent along the roadway corridor and adjacent corridors, which might necessitate coordination among different operating agencies.*

**Support:**

- 04 Examples of safety messages include “SEAT BELT BUCKLED?” and “DON’T DRINK AND DRIVE.” Examples of transportation-related messages include “STADIUM EVENT SUNDAY, EXPECT DELAYS NOON TO 4 PM” and “OZONE ALERT CODE RED—USE TRANSIT.”

**Guidance:**

- 05 *When a CMS is used to display a safety or transportation related message, the message should be simple, brief, legible, and clear. A CMS should not be used to display a safety or transportation-related message if doing so would adversely affect respect for the sign. “CONGESTION AHEAD” or other overly simplistic or vague messages should not be displayed alone. These messages should be supplemented with a message on the location or distance to the congestion or incident, delay and travel time, alternative route, or other similar messages.*

**Standard:**

- 06 **When a CMS is used to display a safety, transportation-related, emergency homeland security, or AMBER alert message, the display format shall not be of a type that could be considered similar to advertising displays.**

**Support:**

- 07 Section 2B.13 contains information regarding the design of changeable message signs that are used to display variable speed limits that change based on ambient or operational conditions, or that display the speed at which approaching drivers are traveling.

**Section 2L.03 Legibility and Visibility of Changeable Message Signs****Support:**

- 01 The maximum distance at which a driver can first correctly identify letters and words on a sign is called the legibility distance of the sign. Legibility distance is affected by the characteristics of the sign design and the visual capabilities of drivers. Visual capabilities, and thus legibility distances, vary among drivers.
- 02 For the more common types of changeable message signs, the longest measured legibility distances on sunny days occur during mid-day when the sun is overhead. Legibility distances are much shorter when the sun is behind the sign face, when the sun is on the horizon and shining on the sign face, or at night.
- 03 Visibility is the characteristic that enables a CMS to be seen. Visibility is associated with the point where the CMS is first detected, whereas legibility is the point where the message on the CMS can be read. Environmental conditions such as rain, fog, and snow impact the visibility of changeable message signs and can reduce the available legibility distances. During these conditions, there might not be enough viewing time for drivers to read the message.

**Guidance:**

- 04 *Changeable message signs used on roadways with speed limits of 55 mph or higher should be visible from 1/2 mile under both day and night conditions. The message should be designed to be legible from a minimum distance of 600 feet for nighttime conditions and 800 feet for normal daylight conditions. When environmental conditions that reduce visibility and legibility are present, or when the legibility distances stated in the previous sentences in this paragraph cannot be practically achieved, messages composed of fewer units of information should be used and consideration should be given to limiting the message to a single phase (see Section 2L.05 for information regarding the lengths of messages displayed on changeable message signs).*

**Section 2L.04 Design Characteristics of Changeable Message Signs****Standard:**

- 01 **Changeable message signs shall not include advertising, animation, rapid flashing, dissolving, exploding, scrolling, or other dynamic elements.**

**Support:**

- 02 Section 6F.61 contains information regarding the use of arrow boards that use flashing or sequential displays for lane closures.

**Guidance:**

- 03 *Except in the case of a limited-legend CMS (such as a blank-out or electronic-display changeable message regulatory sign) that is used in place of a static regulatory sign or an activated blank-out warning sign that supplements a static warning sign at a separate location, changeable message signs should be used as a supplement to and not as a substitute for conventional signs and markings.*
- 04 *CMS should be limited to no more than three lines, with no more than 20 characters per line.*

05 *The spacing between characters in a word should be between 25 to 40 percent of the letter height. The spacing between words in a message should be between 75 and 100 percent of the letter height. Spacing between the message lines should be between 50 and 75 percent of the letter height.*

06 *Except as provided in Paragraph 18, word messages on changeable message signs should be composed of all upper-case letters. The minimum letter height should be 18 inches for changeable message signs on roadways with speed limits of 45 mph or higher. The minimum letter height should be 12 inches for changeable message signs on roadways with speed limits of less than 45 mph.*

Support:

07 Using letter heights of more than 18 inches will not result in proportional increases in legibility distance.

Guidance:

08 *The width-to-height ratio of the sign characters should be between 0.7 and 1.0. The stroke width-to-height ratio should be 0.2.*

Support:

09 The width-to-height ratio is commonly accomplished using a minimum font matrix density of five pixels wide by seven pixels high.

**Standard:**

10 **Changeable message signs shall automatically adjust their brightness under varying light conditions to maintain legibility.**

Guidance:

11 *The luminance of changeable message signs should meet industry criteria for daytime and nighttime conditions. Luminance contrast should be between 8 and 12 for all conditions.*

12 *Contrast orientation of changeable message signs should always be positive, that is, with luminous characters on a dark or less luminous background.*

Support:

13 Legibility distances for negative-contrast changeable message signs are likely to be at least 25 percent shorter than those of positive-contrast messages. In addition, the increased light emitted by negative-contrast changeable message signs has not been shown to improve detection distances.

**Standard:**

14 **The colors used for the legends and backgrounds on changeable message signs shall be as provided in Table 2A-5.**

Guidance:

15 *If a black background is used, the color used for the legend on a changeable message sign should match the background color that would be used on a standard sign for that type of legend, such as white for regulatory, yellow for warning, orange for temporary traffic control, red for stop or yield, fluorescent pink for incident management, and fluorescent yellow-green for bicycle, pedestrian, and school warning.*

**Standard:**

16 **If a green background is used for a guide message on a CMS or if a blue background is used for a motorist services message on a CMS, the background color shall be provided by green or blue lighted pixels such that the entire CMS would be lighted, not just the white legend.**

Support:

17 Some CMS that employ newer technologies have the capability to display an exact duplicate of a standard sign or other sign legend using standard symbols, the Standard Alphabets and letter forms, route shields, and other typical sign legend elements with no apparent loss of resolution or recognition to the road user when compared with a static version of the same sign legend. Such signs are of the full-matrix type and can typically display full-color legends. Use of such technologies for new CMS is encouraged for greater legibility of their displays and enhanced recognition of the message as it pertains to regulatory, warning, or guidance information.

Guidance:

18 *If used, the CMS described in the preceding paragraph should not display symbols or route shields unless they can do so in the appropriate color combinations. For a single-phase message where the Standard Alphabets and other legend elements of standard designs are used, the lettering style, size, and line spacing should comply with the applicable provisions for the type of message displayed as provided elsewhere in this Manual. For two-phase messages, larger legend heights should be used as described previously in this Section because of the need for such messages to be legible at a greater distance. Regardless of the number of phases, the CMS should comply with the legibility and visibility provisions of Section 2L.03.*

**Section 2L.05 Message Length and Units of Information***Guidance:*

- 01 *The maximum length of a message should be dictated by the number of units of information contained in the message, in addition to the size of the CMS. A unit of information, which is a single answer to a single question that a driver can use to make a decision, should not be more than four words.*

*Support:*

- 02 In order to illustrate the concept of units of information, Table 2L-1 shows an example message that is comprised of four units of information.
- 03 The maximum allowable number of units of information in a CMS message is based on the principles described in this Section, the current highway operating speed, the legibility characteristics of the CMS, and the lighting conditions.

**Standard:**

- 04 **Each message shall consist of no more than two phases. A phase shall consist of no more than three lines of text. Each phase shall be understood by itself regardless of the sequence in which it is read. Messages shall be centered within each line of legend. Except for signs located on toll plaza structures or other facilities with a similar booth-lane arrangement, if more than one CMS is visible to road users, then only one sign shall display a sequential message at any given time.**
- 05 **Techniques of message display such as fading, rapid flashing, exploding, dissolving, or moving messages shall not be used. The text of the message shall not scroll or travel horizontally or vertically across the face of the sign.**

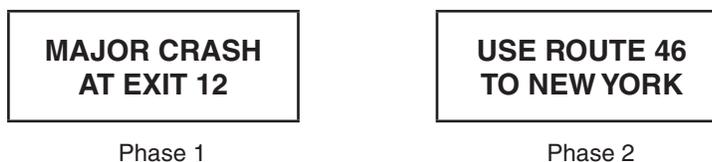
*Guidance:*

- 06 *When designing and displaying messages on changeable message signs, the following principles relative to message design should be used:*
- A. *The minimum time that an individual phase is displayed should be based on 1 second per word or 2 seconds per unit of information, whichever produces a lesser value. The display time for a phase should never be less than 2 seconds.*
  - B. *The maximum cycle time of a two-phase message should be 8 seconds.*
  - C. *The duration between the display of two phases should not exceed 0.3 seconds.*
  - D. *No more than three units of information should be displayed on a phase of a message.*
  - E. *No more than four units of information should be in a message when the traffic operating speeds are 35 mph or more.*
  - F. *No more than five units of information should be in a message when the traffic operating speeds are less than 35 mph.*
  - G. *Only one unit of information should appear on each line of the CMS.*
  - H. *Compatible units of information should be displayed on the same message phase.*

**Table 2L-1. Example of Units of Information**

Question	Answer	Number of Information Units
What happened?	MAJOR CRASH	1
Where?	AT EXIT 12	1
Who is the advisory for?	Drivers Heading TO NEW YORK	1
What is advised?	USE ROUTE 46	1

Note: The following is an example of a two-phase message that could be developed from the four information units shown in this table:



**Option:**

- 07 A unit of information consisting of more than one word may be displayed on more than one line. An additional changeable message sign at a downstream location may be used for the purpose of allowing the entire message to be read twice.

**Guidance:**

- 08 *If more than two phases would be needed to display the necessary information, additional changeable message signs should be used to display this information as a series of two distinct, independent messages with a maximum of two phases at each location, in accordance with the provisions of Paragraph 4.*
- 09 *When the message on a CMS includes an abbreviation, the provisions of Section 1A.15 should be used.*

**Section 2L.06 Installation of Permanent Changeable Message Signs****Guidance:**

- 01 A CMS that is used in place of a static sign (such as a blank-out or variable legend regulatory sign) should be located in accordance with the provisions of Chapter 2A. The following factors should be considered when installing other permanent changeable message signs:
- A. *Changeable message signs should be located sufficiently upstream of known bottlenecks and high crash locations to enable road users to select an alternate route or take other appropriate action in response to a recurring condition.*
  - B. *Changeable message signs should be located sufficiently upstream of major diversion decision points, such as interchanges, to provide adequate distance over which road users can change lanes to reach one destination or the other.*
  - C. *Changeable message signs should not be located within an interchange except for toll plazas or managed lanes.*
  - D. *Changeable message signs should not be positioned at locations where the information load on drivers is already high because of guide signs and other types of information.*
  - E. *Changeable message signs should not be located in areas where drivers frequently perform lane-changing maneuvers in response to static guide sign information, or because of merging or weaving conditions.*

**Support:**

- 02 Information regarding the design and application of portable changeable message signs in temporary traffic control zones is contained in Section 6F.60.

## CHAPTER 2M. RECREATIONAL AND CULTURAL INTEREST AREA SIGNS

### Section 2M.01 Scope

#### Support:

- 01 Recreational or cultural interest areas are attractions or traffic generators that are open to the general public for the purpose of play, amusement, or relaxation. Recreational attractions include such facilities as parks, campgrounds, gaming facilities, and ski areas, while examples of cultural attractions include museums, art galleries, and historical buildings or sites.
- 02 The purpose of recreation and cultural interest area signs is to guide road users to a general area and then to specific facilities or activities within the area.

#### Option:

- 03 Recreational and cultural interest area guide signs directing road users to significant traffic generators may be used on freeways and expressways where there is direct access to these areas as provided in Section 2M.09.
- 04 Recreational and cultural interest area signs may be used off the road network, as appropriate.

### Section 2M.02 Application of Recreational and Cultural Interest Area Signs

#### Support:

- 01 Provisions for signing recreational or cultural interest areas are subdivided into two different types of signs: (1) symbol signs and (2) destination guide signs.

#### Guidance:

- 02 *When highway agencies decide to provide recreational and cultural interest area signing, these agencies should have a policy for such signing. The policy should establish signing criteria for the eligibility of the various types of services, accommodations, and facilities. These signs should not be used where they might be confused with other traffic control signs.*

#### Option:

- 03 Recreational and cultural interest area guide signs may be used on any road to direct persons to facilities, structures, and places, and to identify various services available to the general public. These guide signs may also be used in recreational or cultural interest areas for signing non-vehicular events and amenities such as trails, structures, and facilities.

#### Support:

- 04 Section 2A.12 contains information regarding the use of recreational and cultural interest area symbols on other types of signs.

### Section 2M.03 Regulatory and Warning Signs

#### Standard:

- 01 **All regulatory and warning signs installed on public roads and streets within recreational and cultural interest areas shall comply with the requirements of Chapters 2A, 2B, 2C, 7B, 8B, and 9B.**

### Section 2M.04 General Design Requirements for Recreational and Cultural Interest Area Symbol Guide Signs

#### Standard:

- 01 **Recreational and cultural interest area symbol guide signs shall be square or rectangular in shape and shall have a white symbol or message and white border on a brown background. The symbols shall be grouped into the following usage and series categories:**

- A. General Applications,**
- B. Accommodations,**
- C. Services,**
- D. Land Recreation,**
- E. Water Recreation, and**
- F. Winter Recreation.**

#### Support:

- 02 Table 2M-1 contains a listing of the symbols within each series category. Drawings showing the design details for these symbols are found in the "Standard Highway Signs and Markings" book (see Section 1A.11).

#### Option:

- 03 Mirror images of symbols may be used where the reverse image will better convey the message.

**Table 2M-1. Category Chart for Recreational and Cultural Interest Area Symbols**

General	
Bear Viewing Area	RS-012
Bus Stop	RS-031
Campfires *	RS-042
Cans or Bottles *	RS-101
Cultural Interest Area	RS-142
Dam	RS-009
Deer Viewing Area	RS-011
Falling Rocks *	RS-008
Fire Extinguisher *	RS-090
Lighthouse	RS-007
Lookout Tower	RS-006
Nature Study Area	RS-141
Pets on Leash *	RS-017
Pick-Up Trucks	RS-140
Point of Interest	RS-080
Radios *	RS-103
Rattlesnakes *	RS-099
Recycling *	RS-200
Sea Plane	RS-115
Smoking *	RS-002
Snack Bar *	RS-102
Stay on Trail *	RS-123
Strollers *	RS-111
Tunnel	RS-005
Viewing Area	RS-036
Walk on Boardwalk *	RS-122
Wood Gathering *	RS-120

Accommodations	
Baby Changing Station (Men's Room)	RS-137
Baby Changing Station (Women's Room)	RS-138
Men's Restroom	RS-021
Parking	RS-034
Recreational Vehicle Site	RS-104
Restrooms	RS-022
Sleeping Shelter *	RS-037
Trailer Site	RS-040
Walk-In Camp	RS-148
Women's Restroom	RS-023

Services	
Drinking Water	RS-013
Electrical Hook-Up	RS-150
Firewood Cutting *	RS-112
First Aid	RS-024
Grocery Store	RS-020
Kennel	RS-045
Laundromat	RS-085
Litter Receptacle	RS-086
Lockers/Storage *	RS-030
Mechanic	RS-027
Picnic Shelter	RS-039
Picnic Site	RS-044
Post Office	RS-026
Ranger Station	RS-015
Sanitary Station	RS-041
Showers *	RS-035
Stable	RS-073
Theater	RS-109
Trail Shelter *	RS-043
Tramway	RS-071
Trash Dumpster	RS-091

Land Recreation	
All-Terrain Trail	RS-095
Amphitheater	RS-070
Archery	RS-116
Baseball *	RS-096
Climbing *	RS-082
Corral	RS-149
Driving Tour	RS-113
Exercise/Fitness	RS-097
Golfing *	RS-128
Hang Gliding	RS-126
Hiking Trail	RS-068
Horse Trail	RS-064
In-Line Skating	RS-125
Interpretive Trail	RS-114
Off-Road Vehicle Trail	RS-067
Rock Collecting *	RS-083
Skateboarding *	RS-098
Spelunking/Caves	RS-084
Technical Rock Climbing	RS-081
Tennis	RS-129
Wildlife Viewing	RS-076

Water Recreation	
Beach	RS-145
Boat Motor	RS-147
Boat Ramp	RS-054
Canoeing	RS-079
Diving	RS-062
Fish Cleaning *	RS-093
Fish Hatchery	RS-010
Fish Ladder *	RS-089
Fishing Area	RS-063
Fishing Pier	RS-119
Hand Launch/Small Boat Launch	RS-117
Jet Ski/Personal Watercraft	RS-121
Kayaking	RS-118
Lifejackets *	RS-094
Marina	RS-053
Motorboating	RS-055
Rafting	RS-146
Rowboating	RS-057
Sailing	RS-056
Scuba Diving	RS-060
Seal Viewing	RS-106
Surfing	RS-059
Swimming	RS-061
Tour Boat	RS-087
Wading	RS-088
Waterskiing	RS-058
Whale Viewing	RS-107
Wind Surfing	RS-108

Winter Recreation	
Chair Lift/Ski Lift	RS-105
Cross Country Skiing	RS-046
Dog Sledding	RS-143
Downhill Skiing	RS-047
Ice Fishing	RS-092
Ice Skating	RS-050
Ski Jumping	RS-048
Sledding	RS-049
Snow Tubing	RS-144
Snowboarding	RS-127
Snowmobiling	RS-052
Snowshoeing	RS-078
Winter Recreational Area	RS-077

\* For non-road use only

### **Section 2M.05 Symbol Sign Sizes**

#### *Guidance:*

- 01 *Recreational and cultural interest area symbol signs should be 24 x 24 inches. Where greater visibility or emphasis is needed, larger sizes should be used. Symbol sign enlargements should be in 6-inch increments.*
- 02 *Recreational and cultural interest area symbol signs should be 30 x 30 inches when used on guide signs on freeways or expressways.*

#### *Option:*

- 03 A smaller size of 18 x 18 inches may be used on low-speed, low-volume roadways and on non-road applications.

### **Section 2M.06 Use of Educational Plaques**

#### *Guidance:*

- 01 *Educational plaques should accompany all initial installations of recreational and cultural interest area symbol signs. The educational plaque should remain in place for at least 3 years after the initial installation. If used, the educational plaque should be the same width as the symbol sign.*

#### *Option:*

- 02 Symbol signs that are readily recognizable by the public may be installed without educational plaques.

#### *Support:*

- 03 Figure 2M-1 illustrates some examples of the use of educational plaques.

### **Section 2M.07 Use of Prohibitive Circle and Diagonal Slash for Non-Road Applications**

#### **Standard:**

- 01 **Where it is necessary to indicate a prohibition of an activity or an item within a recreational or cultural interest area for non-road use and a standard regulatory sign for such a prohibition is not provided in Chapter 2B, the appropriate recreational and cultural interest area symbol shall be used in combination with a red prohibitive circle and red diagonal slash. The recreational and cultural interest area symbol and the sign border shall be black and the sign background shall be white. The symbol shall be scaled proportionally to fit completely within the circle and the diagonal slash shall be oriented from the upper left to the lower right portions of the circle as shown in Figure 2M-1.**
- 02 **Requirements for retroreflection of the red circle and red diagonal slash shall be the same as those requirements for backgrounds, legends, symbols, arrows, and borders.**

### **Section 2M.08 Placement of Recreational and Cultural Interest Area Symbol Signs**

#### **Standard:**

- 01 **If used, recreational and cultural interest area symbol signs shall be placed in accordance with the general requirements contained in Chapter 2A. The symbol(s) shall be placed as sign panels in the uppermost part of the sign and the directional information shall be placed below the symbol(s).**
- 02 **Except as provided in Paragraph 3, if the name of the recreational or cultural interest area facility or activity is displayed on a destination guide sign (see Section 2M.09) and a symbol is used, the symbol shall be placed below the name (see Figure 2M-2).**

#### *Option:*

- 03 When the legend Wildlife Viewing Area is displayed with the RS-076 symbol on a destination guide sign, the symbol may be placed to the left or right of the legend and the arrow may be placed below the symbol (see Figure 2M-2).
- 04 The symbols displayed with the facility or activity name may be placed below the destination guide sign as illustrated in Figure 2M-2 instead of as sign panels placed with the destination guide sign.
- 05 Secondary symbols of a smaller size (18 x 18 inches) may be placed beneath the primary symbols (see Drawing A in Figure 2M-1), where needed.

#### **Standard:**

- 06 **Recreational and cultural interest area symbols installed for non-road use shall be placed in accordance with the general sign position requirements of the authority having jurisdiction.**

#### *Support:*

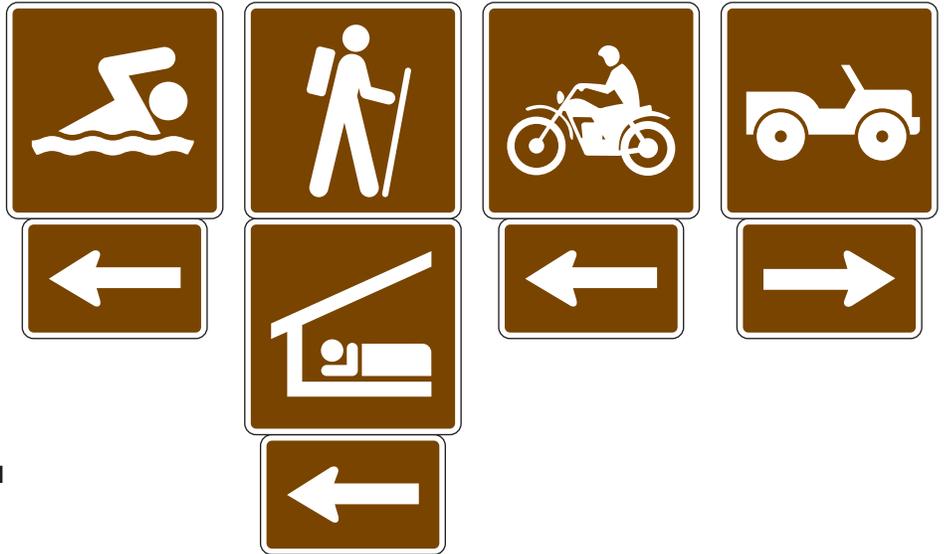
- 07 Figure 2M-3 illustrates typical height and lateral mounting positions. Figure 2M-4 illustrates some examples of the placement of symbol signs within a recreational or cultural interest area. Figures 2M-5 through 2M-10 illustrate some of the symbols that can be used.

**Figure 2M-1. Examples of Use of Arrows, Educational Plaques, and Prohibitive Slashes**

**A - DIRECTIONAL SIGNS**



**B - DIRECTIONAL ASSEMBLIES**



**C - DIRECTIONAL ASSEMBLY WITH EDUCATIONAL PLAQUE**



**D - PROHIBITED ACTIVITIES AND EDUCATIONAL PLAQUE FOR NON-ROAD USE\***



\* Standard regulatory signs shall be used where provided elsewhere in this Manual

*Guidance:*

08 The number of symbols used in a single sign assembly should not exceed four.

*Option:*

09 The Advance Turn (M5 series) or Directional Arrow (M6 series) auxiliary signs with white arrows on brown backgrounds shown in Figure 2D-5 may be used with Recreational and Cultural Area Interest symbol guide signs to create a Recreational and Cultural Interest Area Directional Assembly. The symbols may be used singularly, or in groups of two, three, or four on a single sign assembly (see Figures 2M-1, 2M-3, and 2M-4).

**Section 2M.09 Destination Guide Signs**

*Guidance:*

01 When recreational or cultural interest area destinations are displayed on supplemental guide signs, the sign should be rectangular or trapezoidal in shape. The order of preference for use of shapes and colors should be as follows: (1) rectangular with a white legend and border on a green background; (2) rectangular with a white legend and border on a brown background; or (3) trapezoidal with a white legend and border on a brown background.

**Standard:**

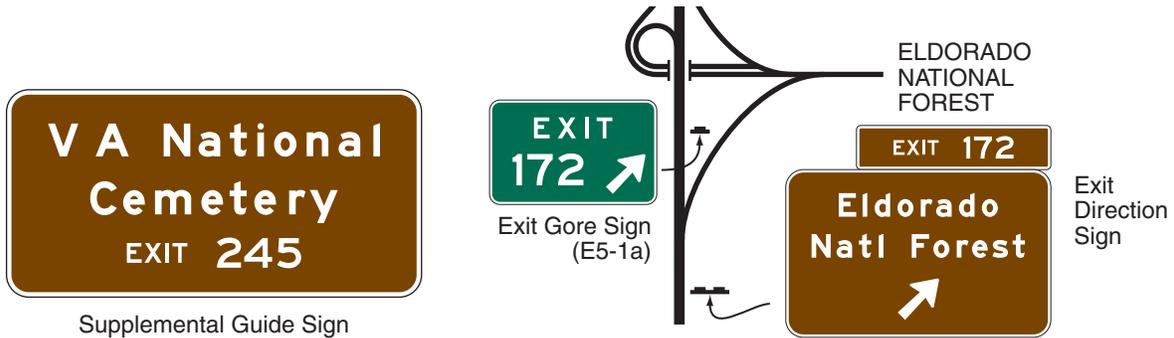
02 Whenever the trapezoidal shape is used, the color combination shall be a white legend and border on a brown background.

**Figure 2M-2. Examples of Recreational and Cultural Interest Area Guide Signs**



\* Optional shape

**B - EXPRESSWAYS AND FREEWAYS**



Option:

03 Destination guide signs with a white legend and border on a brown background may be posted at the first point where an access or crossroad intersects a highway where recreational or cultural interest areas are a significant destination along conventional roads, expressways, or freeways. Supplemental guide signs with a white legend and border on a brown background may be used along conventional roads, expressways, or freeways to direct road users to recreational or cultural interest areas. Where access or crossroads lead exclusively to the recreational or cultural interest area, the advance guide sign and the exit direction sign may have a white legend and border on a brown background.

**Standard:**

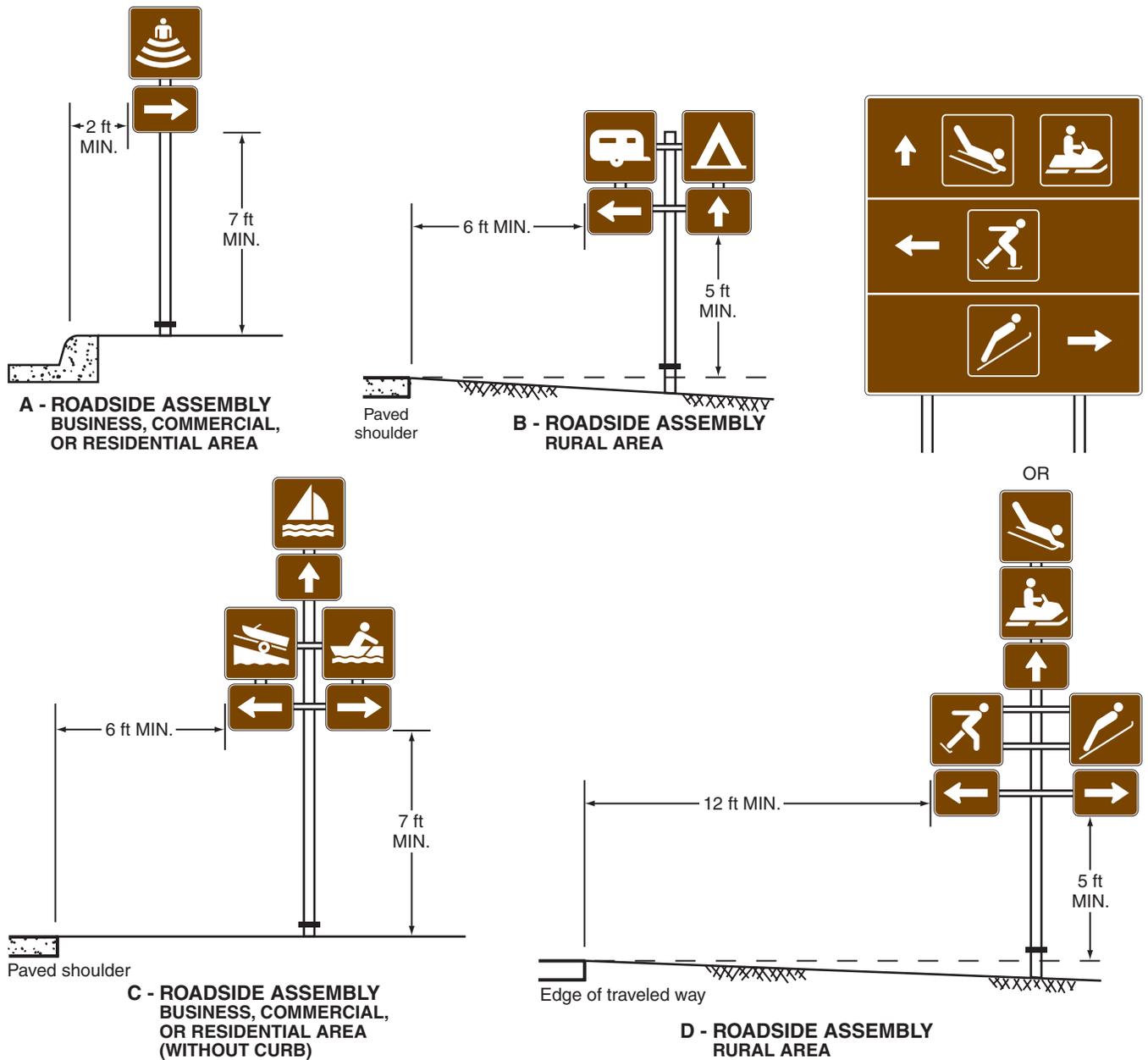
04 All Exit Gore (E5-1 and E5-1a) signs (see Section 2E.37) shall have a white legend and border on a green background. The background color of the interchange Exit Number (E1-5P and E1-5bP) plaque (see Section 2E.31) shall match the background color of the guide sign. Design characteristics of conventional road, expressway, or freeway guide signs shall comply with Chapter 2D or 2E except as provided in this Section for color combination.

05 The advance guide sign and the Exit Direction sign shall retain the white-on-green color combination where the crossroad leads to a destination other than a recreational or cultural interest area.

Support:

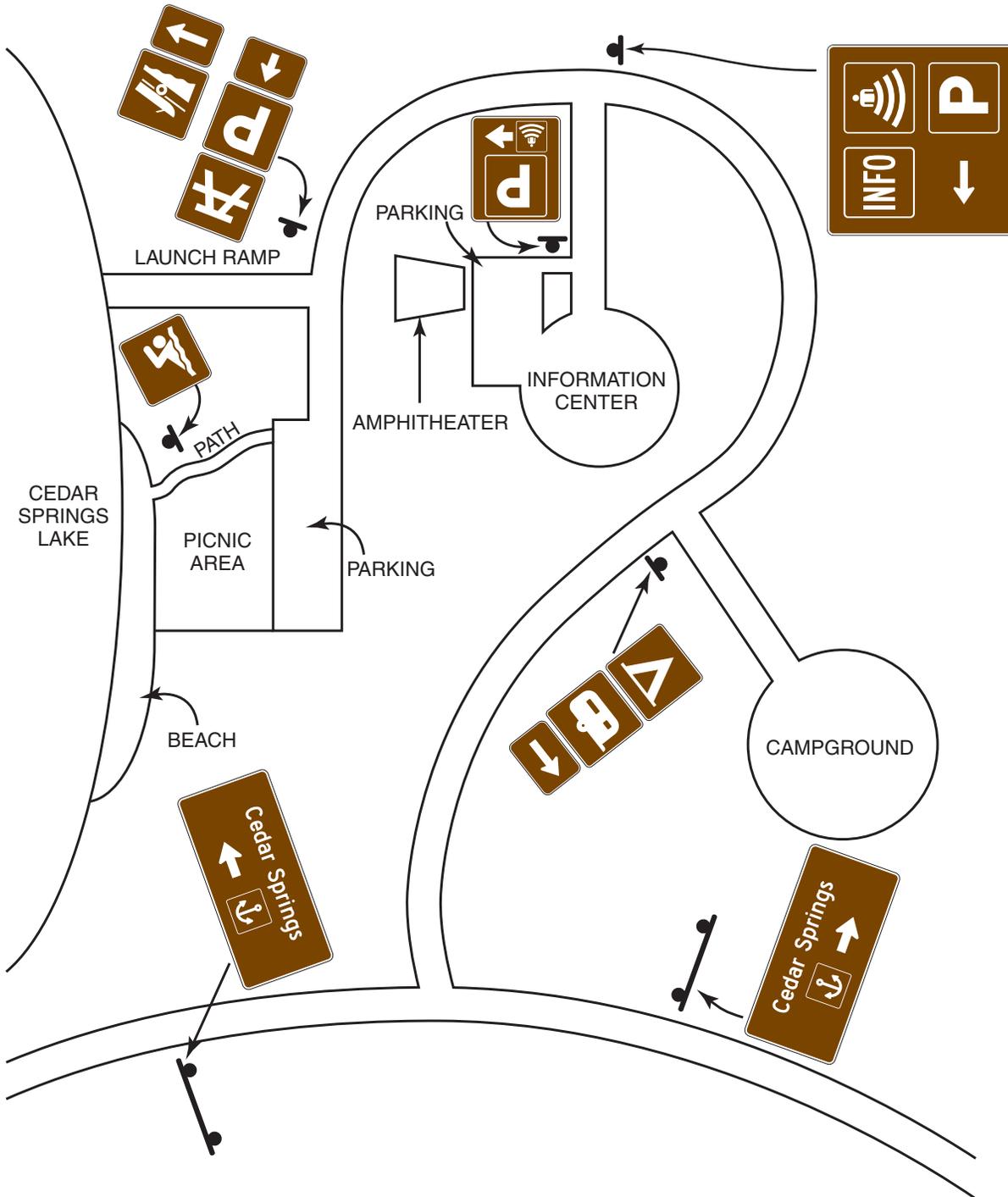
06 Figure 2M-2 illustrates destination guide signs commonly used for identifying recreational or cultural interest areas or facilities.

**Figure 2M-3. Arrangement, Height, and Lateral Position of Signs Located Within Recreational and Cultural Interest Areas**



Note: See Section 2A.19 for reduced lateral offset distances that may be used in areas where lateral offsets are limited, and in urban areas where sidewalk width is limited or where existing poles are close to the curb.

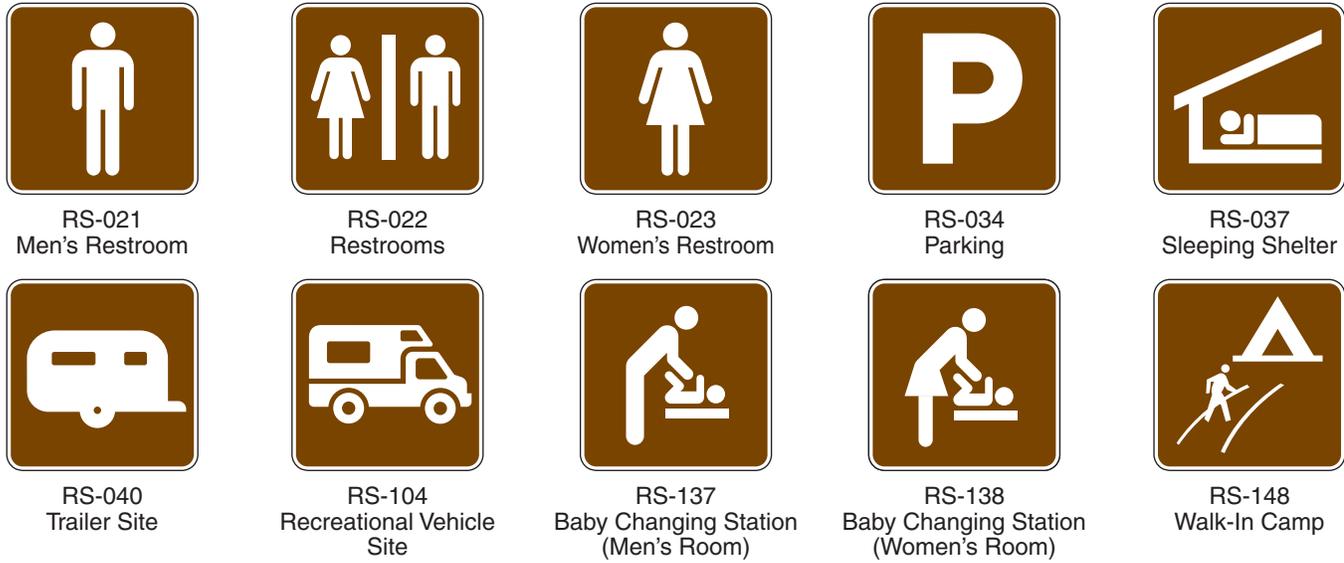
Figure 2M-4. Examples of Symbol and Destination Guide Signing Layout



**Figure 2M-5. Recreational and Cultural Interest Area Symbol Signs for General Applications**



**Figure 2M-6. Recreational and Cultural Interest Area Symbol Signs for Accommodations**



**Figure 2M-7. Recreational and Cultural Interest Area Symbol Signs for Services**



**Figure 2M-8. Recreational and Cultural Interest Area Symbol Signs for Land Recreation****Section 2M.10 Memorial or Dedication Signing**

Support:

- 01 Legislative bodies will occasionally adopt an act or resolution memorializing or dedicating a highway, bridge, or other component of the highway.

*Guidance:*

- 02 *Such memorial or dedication names should not appear on or along a highway, or be placed on bridges or other highway components. If a route, bridge, or highway component is officially designated as a memorial or dedication, and if notification of the memorial or dedication is to be made on the highway right-of-way, such notification should consist of installing a memorial or dedication marker in a rest area, scenic overlook, recreational area, or other appropriate location where parking is provided with the signing inconspicuously located relative to vehicle operations along the highway.*

Option:

- 03 If the installation of a memorial or dedication marker off the main roadway is not practical, memorial or dedication signs may be installed on the mainline.

*Guidance:*

- 04 *Memorial or dedication signs should have a white legend and border on a brown background.*

**Figure 2M-9. Recreational and Cultural Interest Area Symbol Signs for Water Recreation**



**Figure 2M-10. Recreational and Cultural Interest Area Symbol Signs for Winter Recreation****Standard:**

- 05 Where such memorial or dedication signs are installed on the mainline, (1) memorial or dedication names shall not appear on directional guide signs, (2) memorial or dedication signs shall not interfere with the placement of any other necessary signing, and (3) memorial or dedication signs shall not compromise the safety or efficiency of traffic flow. The memorial or dedication signing shall be limited to one sign at an appropriate location in each route direction, each as an independent sign installation.
- 06 Memorial or dedication signs shall be rectangular in shape. The legend displayed on memorial or dedication signs shall be limited to the name of the person or entity being recognized and a simple message preceding or following the name, such as “Dedicated to” or “Memorial Parkway.” Additional legend, such as biographical information, shall not be displayed on memorial or dedication signs. Decorative or graphical elements, pictographs, logos, or symbols shall not be displayed on memorial or dedication signs. All letters and numerals displayed on memorial or dedication signs shall be as provided in the “Standard Highway Signs and Markings” book (see Section 1A.11). The route number or officially mapped name of the highway shall not be displayed on the memorial or dedication sign.
- 07 Memorial or dedication names shall not appear on supplemental signs or on any other information sign on or along the highway or its intersecting routes.

**Option:**

- 08 The lettering for the name of the person or entity being recognized may be composed of a combination of lower-case letters with initial upper-case letters.

**Guidance:**

- 09 *Freeways and expressways should not be signed as memorial or dedicated highways.*

**Support:**

- 10 Named highways are officially designated and shown on official maps and serve the purpose of providing route guidance, primarily on unnumbered highways. A highway designated as a memorial or dedication is not considered to be a named highway. Section 2D.53 contains provisions for the signing of named highways.

## CHAPTER 2N. EMERGENCY MANAGEMENT SIGNING

### Section 2N.01 Emergency Management

#### Guidance:

- 01 *Contingency planning for an emergency evacuation should be considered by all State and local jurisdictions and should consider the use of all applicable roadways.*
- 02 *In the event of a disaster where highways that cannot be used will be closed, a successful contingency plan should account for the following elements: a controlled operation of certain designated highways, the establishment of traffic operations for the expediting of essential traffic, and the provision of emergency centers for civilian aid.*

### Section 2N.02 Design of Emergency Management Signs

#### Standard:

- 01 **Emergency Management signs shall be used to guide and control highway traffic during an emergency.**
- 02 **Emergency Management signs shall not permanently displace any of the standard signs that are normally applicable.**
- 03 **Advance planning for transportation operations' emergencies shall be the responsibility of State and local authorities. The Federal Government shall provide guidance to the States as necessitated by changing circumstances.**
- 04 **Except as provided in Section 2A.11, the sizes for Emergency Management signs shall be as shown in Table 2N-1.**

#### Support:

- 05 Section 2A.11 contains information regarding the applicability of the various columns in Table 2N-1.

#### Option:

- 06 Signs larger than those shown in Table 2N-1 may be used (see Section 2A.11).

#### Guidance:

- 07 *As conditions permit, the Emergency Management signs should be replaced or augmented by standard signs.*
- 08 *The background of Emergency Management signs should be retroreflective.*
- 09 *Because Emergency Management signs might be needed in large numbers for temporary use during an emergency, consideration should be given to their fabrication from any light and economical material that can serve through the emergency period.*

#### Option:

- 10 Any Emergency Management sign that is used to mark an area that is contaminated by biological or chemical warfare agents or radioactive fallout may be accompanied by the standard symbol that is illustrated in the upper left corner of the EM-7c and EM-7d signs in Figure 2N-1.

### Section 2N.03 Evacuation Route Signs (EM-1 and EM-1a)

#### Standard:

- 01 **The Evacuation Route (EM-1 and EM-1a) signs shall display a blue circular symbol on a white square sign without a border as shown in Figure 2N-1. The EM-1 sign shall include a white directional arrow (except as provided in Paragraph 3) and a white legend EVACUATION ROUTE within the blue circular symbol. The EM-1a sign shall include a white EVACUATION ROUTE legend and the tsunami symbol within the blue circular symbol. The EM-1 and EM-1a signs shall be retroreflective.**
- 02 **An Advance Turn Arrow (M5 series) or Directional Arrow (M6 series) auxiliary sign as shown in Figure 2D-5, but with a white arrow on a blue background instead of a black arrow on a white background, shall be installed below the EM-1a sign.**

#### Option:

- 03 Instead of including a directional arrow within the blue circular symbol on the EM-1 sign, an Advance Turn Arrow (M5 series) or Directional Arrow (M6 series) auxiliary sign as shown in Figure 2D-5, but with a white arrow on a blue background instead of a black arrow on a white background, may be installed below the EM-1 sign.
- 04 If desired, the word HURRICANE, or a word that describes some other type of evacuation route, may be added as a third line of text above the white EVACUATION ROUTE legend within the blue circular symbol on the EM-1 sign.

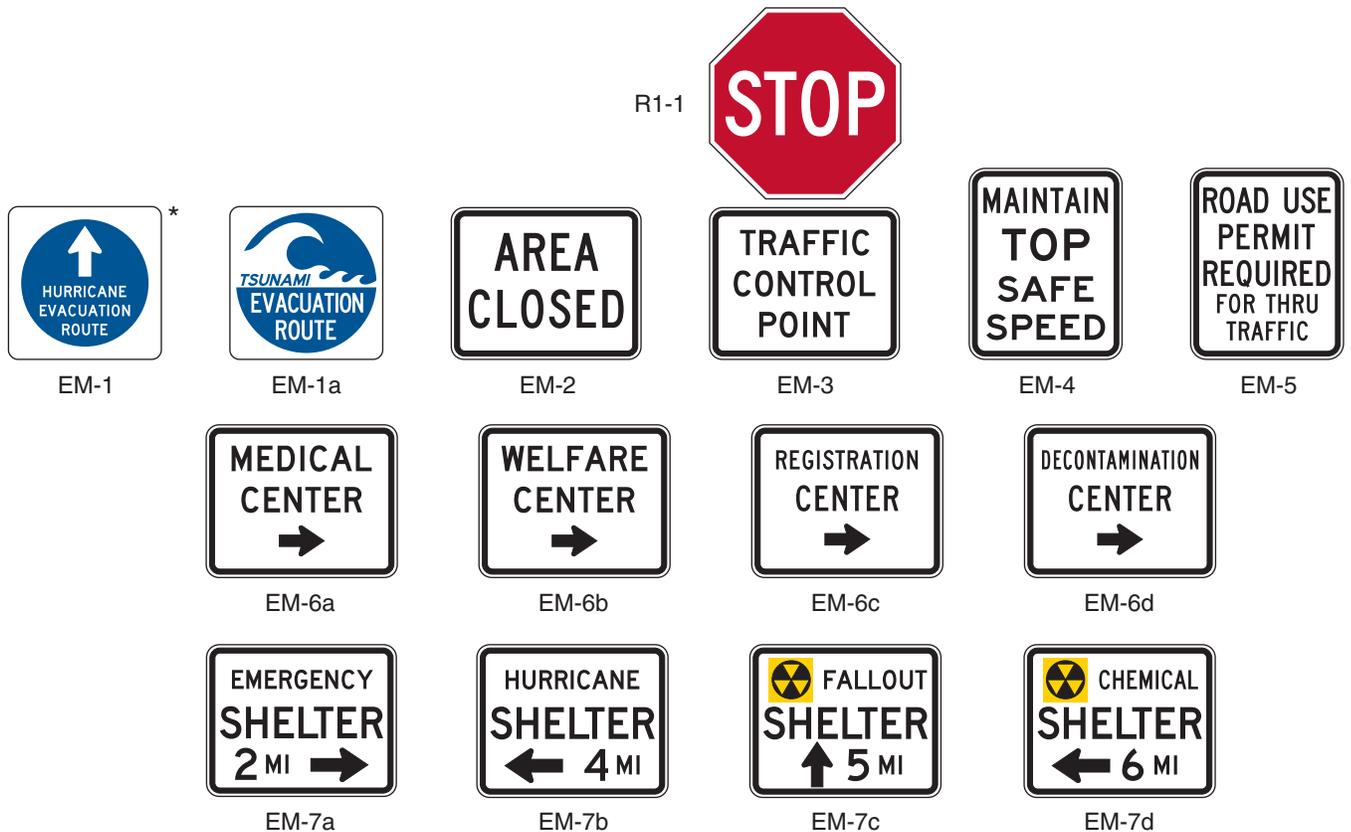
**Table 2N-1. Emergency Management Sign Sizes**

Sign or Plaque	Sign Designation	Section	Minimum Size
Evacuation Route	EM-1,EM-1a	2N.03	24 x 24*
Area Closed	EM-2	2N.04	30 x 24
Traffic Control Point	EM-3	2N.05	30 x 24
Maintain Top Safe Speed	EM-4	2N.06	24 x 30
Permit Required	EM-5	2N.07	24 x 30
Emergency Aid Center	EM-6a to EM-6d	2N.08	30 x 24
Shelter Directional	EM-7a to EM-7d	2N.09	30 x 24

\* A minimum size of 18 x 18 may be used on low-volume roadways or roadways with speeds of 25 mph or less

Notes: 1. Larger signs may be used when appropriate  
 2. Dimensions in inches are shown as width x height

**Figure 2N-1. Emergency Management Signs**



\* HURRICANE is an example of one type of evacuation route. Legends for other types may also be used, or this line of text may be omitted.

05 An approved Emergency Management symbol with a diameter of 3.5 inches may appear near the bottom of an Evacuation Route sign.

**Standard:**

06 **The arrow designs, if used, on the EM-1 sign shall include a straight, vertical arrow pointing upward, a straight horizontal arrow pointing to the left or right, or a bent arrow pointing to the left or right for advance warning of a turn.**

07 **If used, the Evacuation Route sign, with the appropriate arrow, shall be installed 150 to 300 feet in advance of, and at, any turn in an approved evacuation route. The sign shall also be installed elsewhere for straight-ahead confirmation where needed.**

08 **If used in urban areas, the Evacuation Route sign shall be mounted at the right-hand side of the roadway, not less than 7 feet above the top of the curb, and at least 1 foot back from the face of the curb. If used in rural areas, the Evacuation Route sign shall be mounted at the right-hand side of the roadway, not less than 7 feet above the pavement and not less than 6 feet or more than 10 feet to the right of the right-hand roadway edge.**

09 **Evacuation Route signs shall not be placed where they will conflict with other signs. Where conflict in placement would occur between the Evacuation Route sign and a standard regulatory sign, the regulatory sign shall take precedence.**

**Option:**

10 In case of conflict with guide or warning signs, the Evacuation Route sign may take precedence.

*Guidance:*

11 *Placement of Evacuation Route signs should be made under the supervision of the officials having jurisdiction over the placement of other traffic signs. Coordination with Emergency Management authorities and agreement between contiguous political entities should occur to assure continuity of routes.*

**Section 2N.04 AREA CLOSED Sign (EM-2)**

**Standard:**

01 **The AREA CLOSED (EM-2) sign (see Figure 2N-1) shall be used to close a roadway in order to prohibit traffic from entering the area. It shall be installed on the shoulder as near as practical to the right-hand edge of the roadway, or preferably, on a portable mounting or barricade partly or entirely in the roadway.**

*Guidance:*

02 *For best visibility, particularly at night, the sign height should not exceed 4 feet measured vertically from the pavement to the bottom of the sign. Unless adequate advance warning signs are used, it should not be placed to create a complete and unavoidable blocked route. Where feasible, the sign should be located at an intersection that provides a detour route.*

**Section 2N.05 TRAFFIC CONTROL POINT Sign (EM-3)**

**Standard:**

01 **The TRAFFIC CONTROL POINT (EM-3) sign (see Figure 2N-1) shall be used to designate a location where an official traffic control point has been set up to impose such controls as are necessary to limit congestion, expedite emergency traffic, exclude unauthorized vehicles, or protect the public.**

02 **The sign shall be installed in the same manner as the AREA CLOSED sign (see Section 2N.04), and at the point where traffic must stop to be checked.**

03 **The standard STOP (R1-1) sign shall be used in conjunction with the TRAFFIC CONTROL POINT sign. The TRAFFIC CONTROL POINT sign shall consist of a black legend and border on a retroreflectorized white background.**

*Guidance:*

04 *The TRAFFIC CONTROL POINT sign should be mounted directly below the STOP sign.*

**Section 2N.06 MAINTAIN TOP SAFE SPEED Sign (EM-4)**

**Option:**

01 The MAINTAIN TOP SAFE SPEED (EM-4) sign (see Figure 2N-1) may be used on highways where conditions are such that it is prudent to evacuate or traverse an area as quickly as possible.

02 Where an existing Speed Limit (R2-1) sign is in a suitable location, the MAINTAIN TOP SAFE SPEED sign may conveniently be mounted directly over the face of the speed limit sign that it supersedes.

## Support:

- 03 Since any speed zoning would be impractical under such emergency conditions, no minimum speed limit can be prescribed by the MAINTAIN TOP SAFE SPEED sign in numerical terms. Where traffic is supervised by a traffic control point, official instructions will usually be given verbally, and the sign will serve as an occasional reminder of the urgent need for maintaining the proper speed.

*Guidance:*

- 04 *The sign should be installed as needed, in the same manner as other standard speed signs.*

**Standard:**

- 05 **If used in rural areas, the MAINTAIN TOP SAFE SPEED sign shall be mounted on the right-hand side of the road at a horizontal distance of not less than 6 feet or more than 10 feet from the roadway edge, and at a minimum height, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of 5 feet. If used in urban areas, the minimum height, measured vertically from the bottom of the sign to the top of the curb, or in the absence of curb, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, shall be 7 feet, and the nearest edge of the sign shall be not less than 1 foot back from the face of the curb.**

**Section 2N.07 ROAD (AREA) USE PERMIT REQUIRED FOR THRU TRAFFIC Sign (EM-5)**

## Support:

- 01 The intent of the ROAD (AREA) USE PERMIT REQUIRED FOR THRU TRAFFIC (EM-5) sign (see Figure 2N-1) is to notify road users of the presence of the traffic control point so that those who do not have priority permits issued by designated authorities can take another route, or turn back, without making a needless trip and without adding to the screening load at the post. Local traffic, without permits, can proceed as far as the traffic control post.

**Standard:**

- 02 **If used, the ROAD (AREA) USE PERMIT REQUIRED FOR THRU TRAFFIC (EM-5) sign shall be used at an intersection that is an entrance to a route on which a traffic control point is located.**
- 03 **If used, the sign shall be installed in a manner similar to that of the MAINTAIN TOP SAFE SPEED sign (see Section 2N.06).**

**Section 2N.08 Emergency Aid Center Signs (EM-6 Series)****Standard:**

- 01 **In the event of emergency, State and local authorities shall establish various centers for civilian relief, communication, medical service, and similar purposes. To guide the public to such centers a series of directional signs shall be used.**
- 02 **Emergency Aid Center (EM-6 series) signs (see Figure 2N-1) shall carry the designation of the center and an arrow indicating the direction to the center. They shall be installed as needed, at intersections and elsewhere, on the right-hand side of the roadway, in urban areas at a minimum height, measured vertically from the bottom of the sign to the top of the curb, or in the absence of curb, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of 7 feet, and not less than 1 foot back from the face of the curb, and in rural areas at a minimum height, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of 5 feet, and at a horizontal distance of not less than 6 feet or more than 10 feet from the roadway edge.**
- 03 **Emergency Aid Center signs shall carry one of the following legends, as appropriate, or others designating similar emergency facilities:**
- A. **MEDICAL CENTER (EM-6a),**
  - B. **WELFARE CENTER (EM-6b),**
  - C. **REGISTRATION CENTER (EM-6c), or**
  - D. **DECONTAMINATION CENTER (EM-6d).**
- 04 **The Emergency Aid Center sign shall be a horizontal rectangle. Except as provided in Paragraph 5, the identifying word and the word CENTER, the directional arrow, and the border shall be black on a white background.**

## Option:

- 05 When Emergency Aid Center signs are used in an incident situation, such as during the aftermath of a nuclear or biological attack, the background color may be fluorescent pink (see Chapter 6I).

**Section 2N.09 Shelter Directional Signs (EM-7 Series)****Standard:**

- 01 **Shelter Directional (EM-7 series) signs (see Figure 2N-1) shall be used to direct the public to selected shelters that have been licensed and marked for emergency use.**
- 02 **The installation of Shelter Directional signs shall comply with established signing standards. Where used, the signs shall not be installed in competition with other necessary highway guide, warning, and regulatory signs.**
- 03 **The Shelter Directional sign shall be a horizontal rectangle. Except as provided in Paragraph 4, the identifying word and the word SHELTER, the directional arrow, the distance to the shelter, and the border shall be black on a white background.**

**Option:**

- 04 When Shelter Directional signs are used in an incident situation, such as during the aftermath of a nuclear or biological attack, the background color may be fluorescent pink (see Chapter 6I).
- 05 The distance to the shelter may be omitted from the sign when appropriate.
- 06 Shelter Directional signs may carry one of the following legends, or others designating similar emergency facilities:
- A. EMERGENCY (EM-7a),
  - B. HURRICANE (EM-7b),
  - C. FALLOUT (EM-7c), or
  - D. CHEMICAL (EM-7d).
- 07 If appropriate, the name of the facility may be used.
- 08 The Shelter Directional signs may be installed on the Interstate Highway System or any other major highway system when it has been determined that a need exists for such signs as part of a State or local shelter plan.
- 09 The Shelter Directional signs may be used to identify different routes to a shelter to provide for rapid movement of large numbers of persons.

**Guidance:**

- 10 *The Shelter Directional sign should be used sparingly and only in conjunction with approved plans of State and local authorities.*
- 11 *The Shelter Directional sign should not be posted more than 5 miles from a shelter.*

# PART 3

## MARKINGS

### CHAPTER 3A. GENERAL

#### Section 3A.01 Functions and Limitations

Support:

- 01 Markings on highways and on private roads open to public travel have important functions in providing guidance and information for the road user. Major marking types include pavement and curb markings, delineators, colored pavements, channelizing devices, and islands. In some cases, markings are used to supplement other traffic control devices such as signs, signals, and other markings. In other instances, markings are used alone to effectively convey regulations, guidance, or warnings in ways not obtainable by the use of other devices.
- 02 Markings have limitations. Visibility of the markings can be limited by snow, debris, and water on or adjacent to the markings. Marking durability is affected by material characteristics, traffic volumes, weather, and location. However, under most highway conditions, markings provide important information while allowing minimal diversion of attention from the roadway.

#### Section 3A.02 Standardization of Application

**Standard:**

- 01 **Each standard marking shall be used only to convey the meaning prescribed for that marking in this Manual. When used for applications not described in this Manual, markings shall conform in all respects to the principles and standards set forth in this Manual.**

*Guidance:*

- 02 *Before any new highway, private road open to public travel (see definition in Section 1A.13), paved detour, or temporary route is opened to public travel, all necessary markings should be in place.*

**Standard:**

- 03 **Markings that must be visible at night shall be retroreflective unless ambient illumination assures that the markings are adequately visible. All markings on Interstate highways shall be retroreflective.**
- 04 **Markings that are no longer applicable for roadway conditions or restrictions and that might cause confusion for the road user shall be removed or obliterated to be unidentifiable as a marking as soon as practical.**

Option:

- 05 Until they can be removed or obliterated, markings may be temporarily masked with tape that is approximately the same color as the pavement.

#### Section 3A.03 Maintaining Minimum Pavement Marking Retroreflectivity

(This Section is reserved for future text based on FHWA rulemaking.)

#### Section 3A.04 Materials

Support:

- 01 Pavement and curb markings are commonly placed by using paints or thermoplastics; however, other suitable marking materials, including raised pavement markers and colored pavements, are also used. Delineators and channelizing devices are visibly placed in a vertical position similar to signs above the roadway.
- 02 Some marking systems consist of clumps or droplets of material with visible open spaces of bare pavement between the material droplets. These marking systems can function in a manner that is similar to the marking systems that completely cover the pavement surface and are suitable for use as pavement markings if they meet the other pavement marking requirements of the highway agency.

*Guidance:*

- 03 *The materials used for markings should provide the specified color throughout their useful life.*
- 04 *Consideration should be given to selecting pavement marking materials that will minimize tripping or loss of traction for road users, including pedestrians, bicyclists, and motorcycleists.*
- 05 *Delineators should not present a vertical or horizontal clearance obstacle for pedestrians.*

**Section 3A.05 Colors****Standard:**

01 **Markings shall be yellow, white, red, blue, or purple. The colors for markings shall conform to the standard highway colors. Black in conjunction with one of the colors mentioned in the first sentence of this paragraph shall be a usable color.**

02 **When used, white markings for longitudinal lines shall delineate:**

- A. **The separation of traffic flows in the same direction, or**
- B. **The right-hand edge of the roadway.**

03 **When used, yellow markings for longitudinal lines shall delineate:**

- A. **The separation of traffic traveling in opposite directions,**
- B. **The left-hand edge of the roadways of divided highways and one-way streets or ramps, or**
- C. **The separation of two-way left-turn lanes and reversible lanes from other lanes.**

04 **When used, red raised pavement markers or delineators shall delineate:**

- A. **Truck escape ramps, or**
- B. **One-way roadways, ramps, or travel lanes that shall not be entered or used in the direction from which the markers are visible.**

05 **When used, blue markings shall supplement white markings for parking spaces for persons with disabilities.**

06 **When used, purple markings shall supplement lane line or edge line markings for toll plaza approach lanes that are restricted to use only by vehicles with registered electronic toll collection accounts.**

**Option:**

07 Colors used for official route shield signs (see Section 2D.11) may be used as colors of symbol markings to simulate route shields on the pavement (see Section 3B.20.)

08 Black may be used in combination with the colors mentioned in the first sentence of Paragraph 1 where a light-colored pavement does not provide sufficient contrast with the markings.

**Support:**

09 When used in combination with other colors, black is not considered a marking color, but only a contrast-enhancing system for the markings.

**Section 3A.06 Functions, Widths, and Patterns of Longitudinal Pavement Markings****Standard:**

01 **The general functions of longitudinal lines shall be:**

- A. **A double line indicates maximum or special restrictions,**
- B. **A solid line discourages or prohibits crossing (depending on the specific application),**
- C. **A broken line indicates a permissive condition, and**
- D. **A dotted line provides guidance or warning of a downstream change in lane function.**

02 **The widths and patterns of longitudinal lines shall be as follows:**

- A. **Normal line—4 to 6 inches wide.**
- B. **Wide line—at least twice the width of a normal line.**
- C. **Double line—two parallel lines separated by a discernible space.**
- D. **Broken line—normal line segments separated by gaps.**
- E. **Dotted line—noticeably shorter line segments separated by shorter gaps than used for a broken line. The width of a dotted line extension shall be at least the same as the width of the line it extends.**

**Support:**

03 The width of the line indicates the degree of emphasis.

**Guidance:**

04 *Broken lines should consist of 10-foot line segments and 30-foot gaps, or dimensions in a similar ratio of line segments to gaps as appropriate for traffic speeds and need for delineation.*

**Support:**

05 Patterns for dotted lines depend on the application (see Sections 3B.04 and 3B.08.)

**Guidance:**

06 *A dotted line for line extensions within an intersection or taper area should consist of 2-foot line segments and 2- to 6-foot gaps. A dotted line used as a lane line should consist of 3-foot line segments and 9-foot gaps.*

## CHAPTER 3B. PAVEMENT AND CURB MARKINGS

### Section 3B.01 Yellow Center Line Pavement Markings and Warrants

#### Standard:

- 01 **Center line pavement markings, when used, shall be the pavement markings used to delineate the separation of traffic lanes that have opposite directions of travel on a roadway and shall be yellow.**

#### Option:

- 02 Center line pavement markings may be placed at a location that is not the geometric center of the roadway.
- 03 On roadways without continuous center line pavement markings, short sections may be marked with center line pavement markings to control the position of traffic at specific locations, such as around curves, over hills, on approaches to grade crossings, at grade crossings, and at bridges.

#### Standard:

- 04 **The center line markings on two-lane, two-way roadways shall be one of the following as shown in Figure 3B-1:**
- A. **Two-direction passing zone markings consisting of a normal broken yellow line where crossing the center line markings for passing with care is permitted for traffic traveling in either direction;**
  - B. **One-direction no-passing zone markings consisting of a double yellow line, one of which is a normal broken yellow line and the other is a normal solid yellow line, where crossing the center line markings for passing with care is permitted for the traffic traveling adjacent to the broken line, but is prohibited for traffic traveling adjacent to the solid line; or**
  - C. **Two-direction no-passing zone markings consisting of two normal solid yellow lines where crossing the center line markings for passing is prohibited for traffic traveling in either direction.**
- 05 **A single solid yellow line shall not be used as a center line marking on a two-way roadway.**
- 06 **The center line markings on undivided two-way roadways with four or more lanes for moving motor vehicle traffic always available shall be the two-direction no-passing zone markings consisting of a solid double yellow line as shown in Figure 3B-2.**

#### Guidance:

- 07 *On two-way roadways with three through lanes for moving motor vehicle traffic, two lanes should be designated for traffic in one direction by using one- or two-direction no-passing zone markings as shown in Figure 3B-3.*

#### Support:

- 08 Sections 11-301(c) and 11-311(c) of the “Uniform Vehicle Code (UVC)” contain information regarding left turns across center line no-passing zone markings and paved medians, respectively. The UVC can be obtained from the National Committee on Uniform Traffic Laws and Ordinances at the address shown on Page i.

#### Standard:

- 09 **Center line markings shall be placed on all paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater. Center line markings shall also be placed on all paved two-way streets or highways that have three or more lanes for moving motor vehicle traffic.**

#### Guidance:

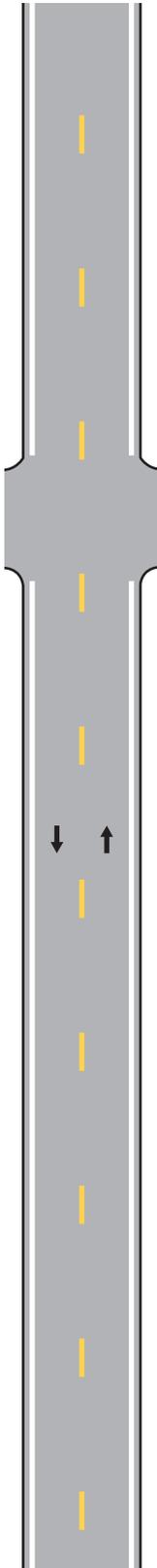
- 10 *Center line markings should be placed on paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 4,000 vehicles per day or greater. Center line markings should also be placed on all rural arterials and collectors that have a traveled way of 18 feet or more in width and an ADT of 3,000 vehicles per day or greater. Center line markings should also be placed on other traveled ways where an engineering study indicates such a need.*
- 11 *Engineering judgment should be used in determining whether to place center line markings on traveled ways that are less than 16 feet wide because of the potential for traffic encroaching on the pavement edges, traffic being affected by parked vehicles, and traffic encroaching into the opposing traffic lane.*

#### Option:

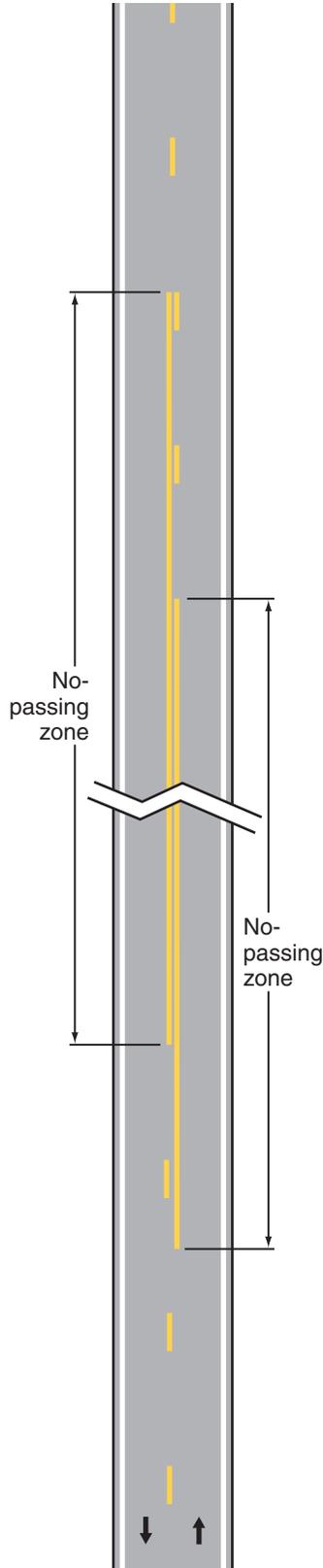
- 12 Center line markings may be placed on other paved two-way traveled ways that are 16 feet or more in width.
- 13 If a traffic count is not available, the ADTs described in this Section may be estimates that are based on engineering judgment.

**Figure 3B-1. Examples of Two-Lane, Two-Way Marking Applications**

**A - Typical two-lane, two-way marking with passing permitted in both directions**



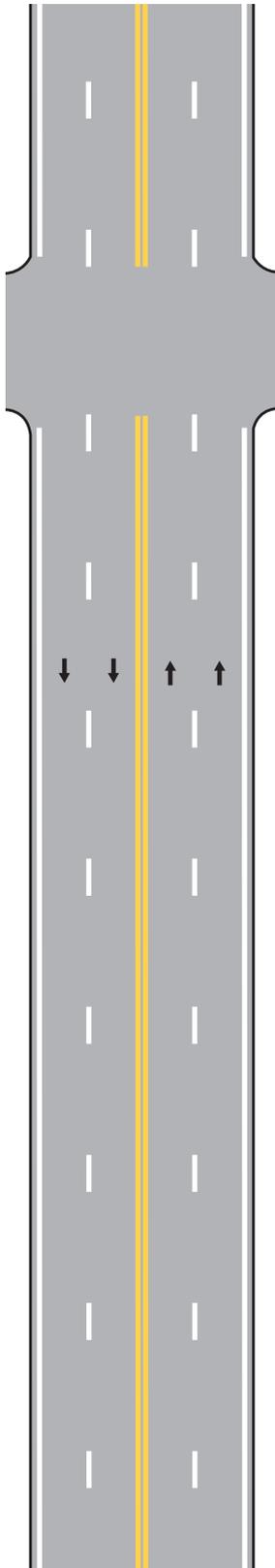
**B - Typical two-lane, two-way marking with no-passing zones**



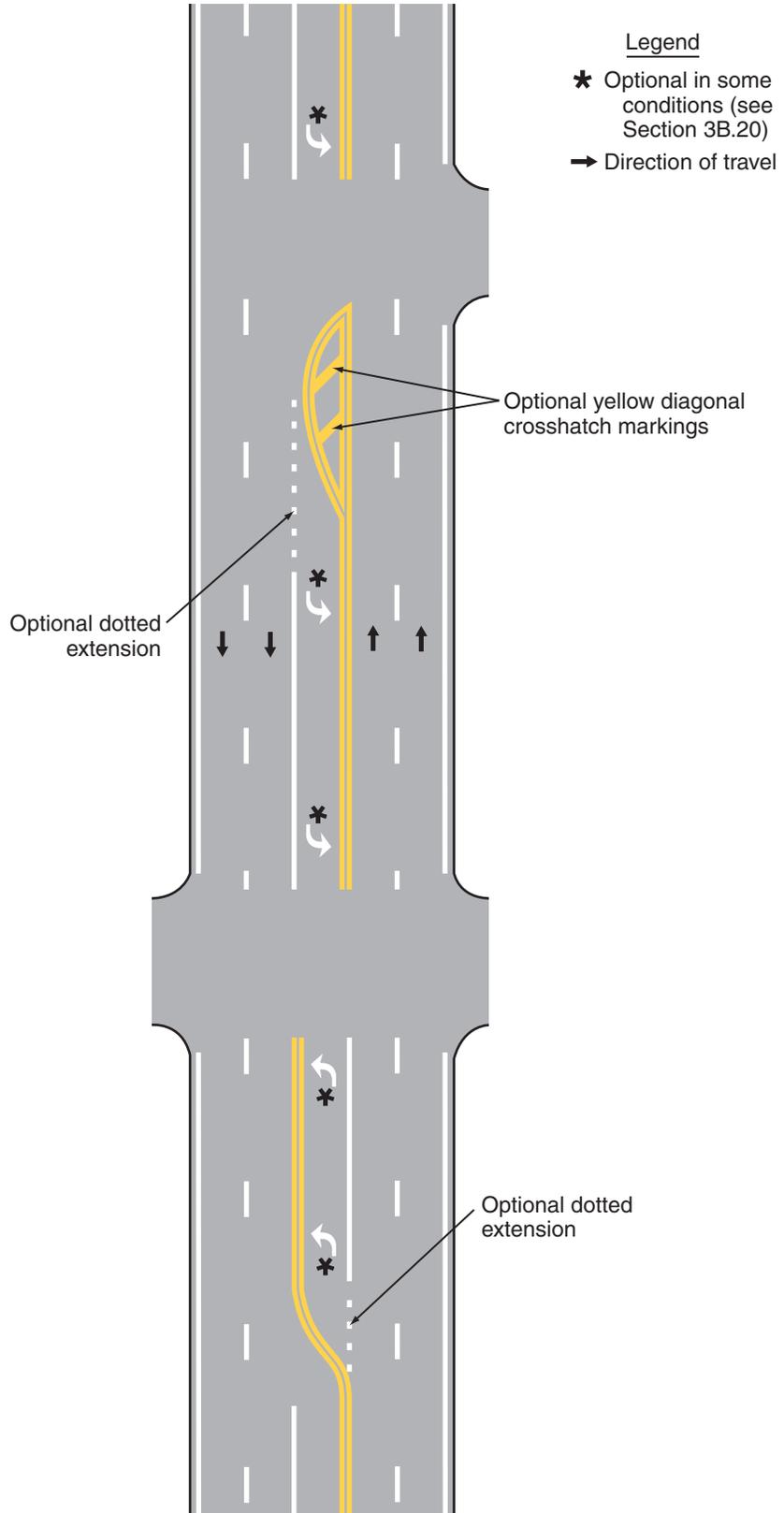
Legend  
→ Direction of travel

**Figure 3B-2. Examples of Four-or-More Lane, Two-Way Marking Applications**

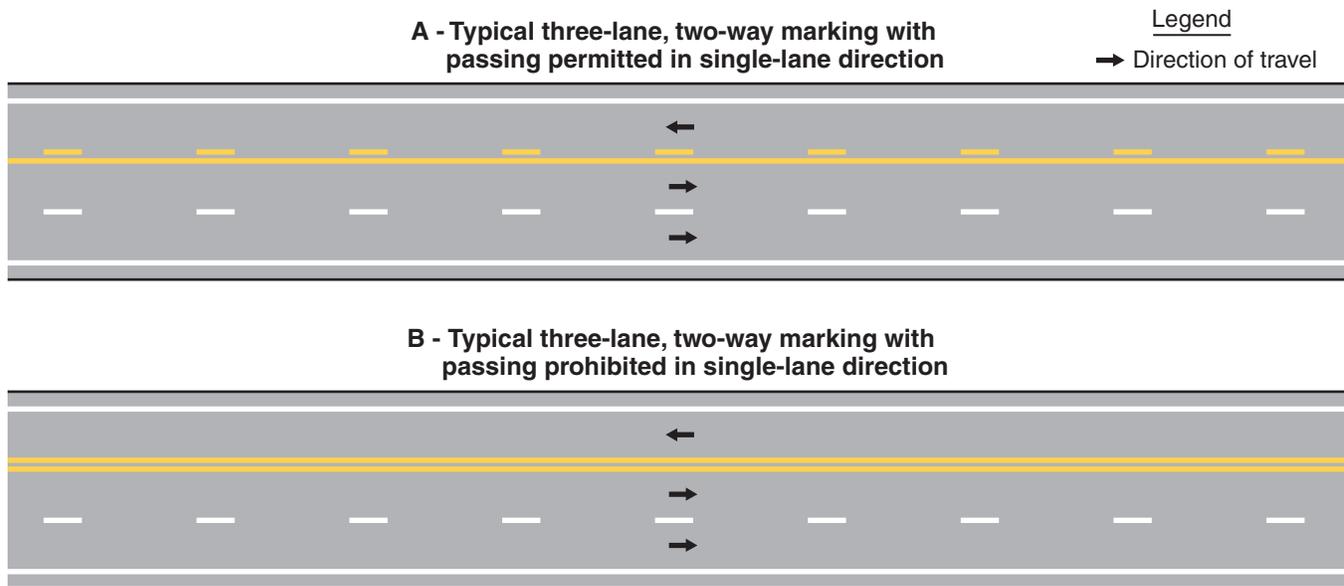
**A - Typical multi-lane, two-way marking**



**B - Typical multi-lane, two-way marking with single lane left turn channelization**



**Figure 3B-3. Examples of Three-Lane, Two-Way Marking Applications**



**Section 3B.02 No-Passing Zone Pavement Markings and Warrants**

**Standard:**

- 01 No-passing zones shall be marked by either the one direction no-passing zone pavement markings or the two-direction no-passing zone pavement markings described in Section 3B.01 and shown in Figures 3B-1 and 3B-3.
- 02 When center line markings are used, no-passing zone markings shall be used on two-way roadways at lane-reduction transitions (see Section 3B.09) and on approaches to obstructions that must be passed on the right (see Section 3B.10).
- 03 On two-way, two- or three-lane roadways where center line markings are installed, no-passing zones shall be established at vertical and horizontal curves and other locations where an engineering study indicates that passing must be prohibited because of inadequate sight distances or other special conditions.
- 04 On roadways with center line markings, no-passing zone markings shall be used at horizontal or vertical curves where the passing sight distance is less than the minimum shown in Table 3B-1 for the 85<sup>th</sup>-percentile speed or the posted or statutory speed limit. The passing sight distance on a vertical curve is the distance at which an object 3.5 feet above the pavement surface can be seen from a point 3.5 feet above the pavement (see Figure 3B-4). Similarly, the passing sight distance on a horizontal curve is the distance measured along the center line (or right-hand lane line of a three-lane roadway) between two points 3.5 feet above the pavement on a line tangent to the embankment or other obstruction that cuts off the view on the inside of the curve (see Figure 3B-4).

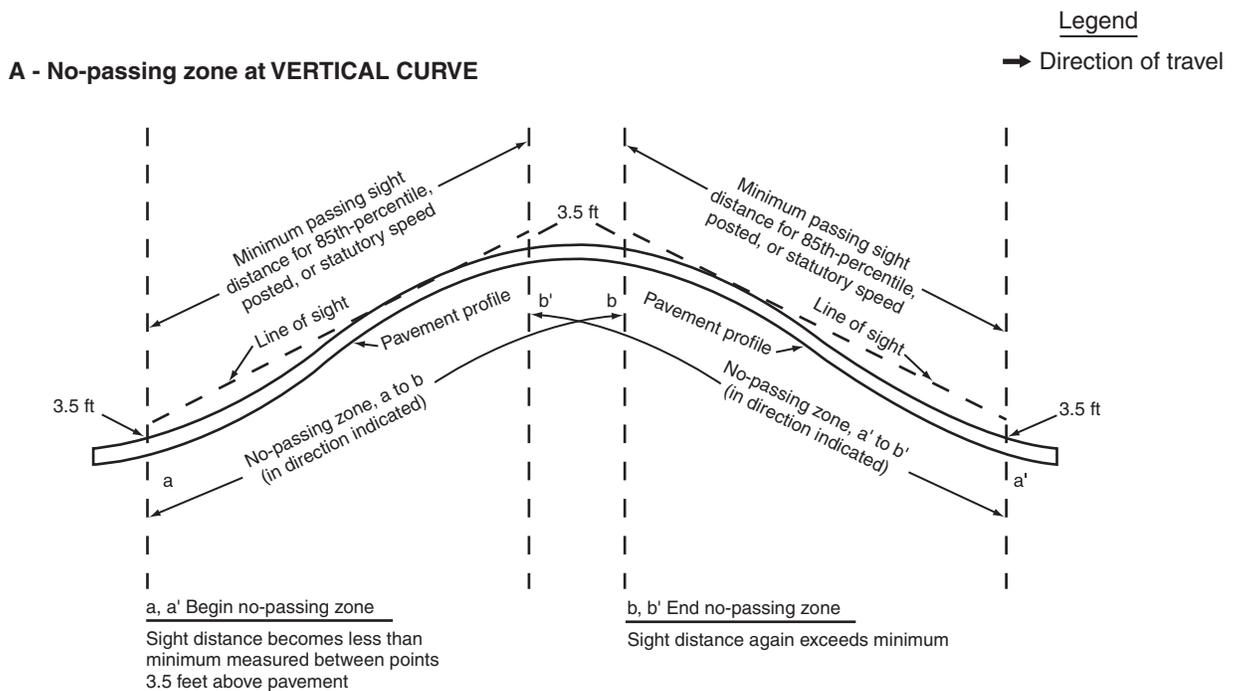
**Support:**

- 05 The upstream end of a no-passing zone at point “a” in Figure 3B-4 is that point where the sight distance first becomes less than that specified in Table 3B-1. The downstream end of the no-passing zone at point “b” in Figure 3B-4 is that point at which the sight distance again becomes greater than the minimum specified.
- 06 The values of the minimum passing sight distances that are shown in Table 3B-1 are for operational use in marking no-passing zones and are less than the values that are suggested for geometric design by the AASHTO Policy on Geometric Design of Streets and Highways (see Section 1A.11).

**Table 3B-1. Minimum Passing Sight Distances for No-Passing Zone Markings**

85th-Percentile or Posted or Statutory Speed Limit	Minimum Passing Sight Distance
25 mph	450 feet
30 mph	500 feet
35 mph	550 feet
40 mph	600 feet
45 mph	700 feet
50 mph	800 feet
55 mph	900 feet
60 mph	1,000 feet
65 mph	1,100 feet
70 mph	1,200 feet

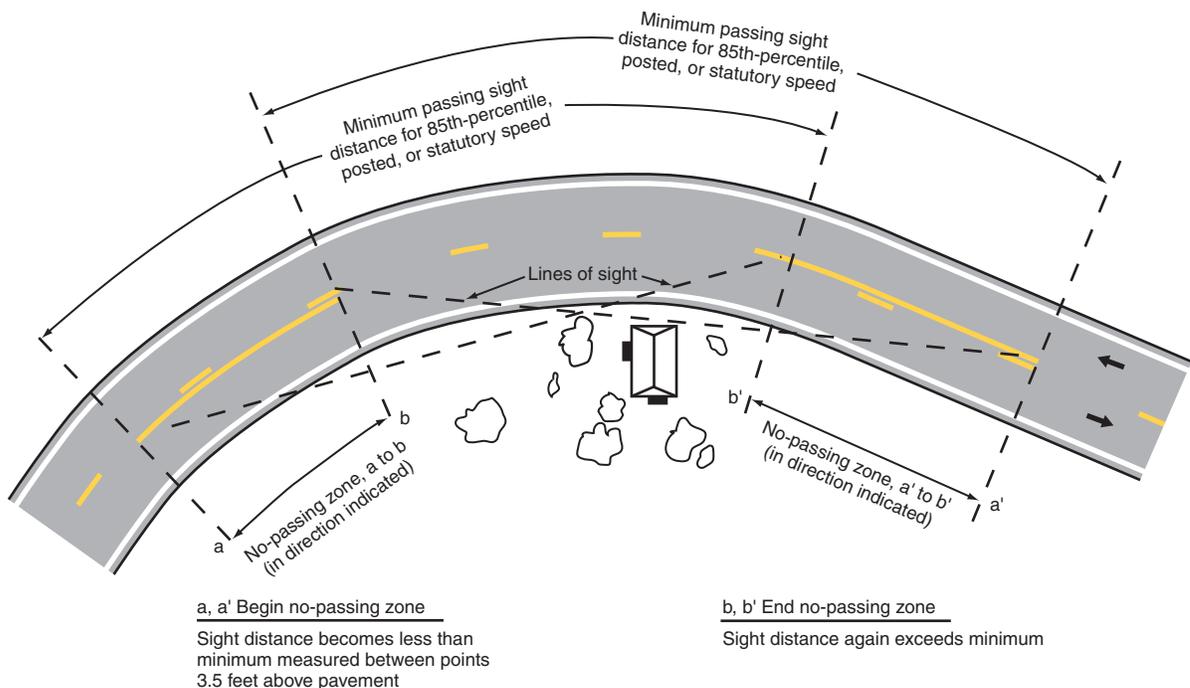
**Figure 3B-4. Method of Locating and Determining the Limits of No-Passing Zones at Curves**



**Profile View**

Note: No-passing zones in opposite directions may or may not overlap, depending on alignment

**B - No-passing zone at HORIZONTAL CURVE**



**Plan View**

Note: No-passing zones in opposite directions may or may not overlap, depending on alignment

*Guidance:*

- 07 *Where the distance between successive no-passing zones is less than 400 feet, no-passing markings should connect the zones.*

**Standard:**

- 08 **Where center line markings are used, no-passing zone markings shall be used on approaches to grade crossings in compliance with Section 8B.27.**

*Option:*

- 09 In addition to pavement markings, no-passing zone signs (see Sections 2B.28, 2B.29, and 2C.45) may be used to emphasize the existence and extent of a no-passing zone.

*Support:*

- 10 Section 11-307 of the “Uniform Vehicle Code (UVC)” contains further information regarding required road user behavior in no-passing zones. The UVC can be obtained from the National Committee on Uniform Traffic Laws and Ordinances at the address shown on Page i.

**Standard:**

- 11 **On three-lane roadways where the direction of travel in the center lane transitions from one direction to the other, a no-passing buffer zone shall be provided in the center lane as shown in Figure 3B-5. A lane-reduction transition (see Section 3B.09) shall be provided at each end of the buffer zone.**

- 12 **The buffer zone shall be a flush median island formed by two sets of double yellow center line markings that is at least 50 feet in length.**

*Option:*

- 13 Yellow diagonal crosshatch markings (see Section 3B.24) may be placed in the flush median area between the two sets of no-passing zone markings as shown in Figure 3B-5.

*Guidance:*

- 14 *For three-lane roadways having a posted or statutory speed limit of 45 mph or greater, the lane transition taper length should be computed by the formula  $L = WS$ . For roadways where the posted or statutory speed limit is less than 45 mph, the formula  $L = WS^2/60$  should be used to compute the taper length.*

*Support:*

- 15 Under both formulas, L equals the taper length in feet, W equals the width of the center lane or offset distance in feet, and S equals the 85<sup>th</sup>-percentile speed or the posted or statutory speed limit, whichever is higher.

*Guidance:*

- 16 *The minimum lane transition taper length should be 100 feet in urban areas and 200 feet in rural areas.*

**Section 3B.03 Other Yellow Longitudinal Pavement Markings****Standard:**

- 01 **If reversible lanes are used, the lane line pavement markings on each side of reversible lanes shall consist of a normal broken double yellow line to delineate the edge of a lane in which the direction of travel is reversed from time to time, such that each of these markings serve as the center line markings of the roadway during some period (see Figure 3B-6).**

- 02 **Signs (see Section 2B.26), lane-use control signals (see Chapter 4M), or both shall be used to supplement reversible lane pavement markings.**

- 03 **If a two-way left-turn lane that is never operated as a reversible lane is used, the lane line pavement markings on each side of the two-way left-turn lane shall consist of a normal broken yellow line and a normal solid yellow line to delineate the edges of a lane that can be used by traffic in either direction as part of a left-turn maneuver. These markings shall be placed with the broken line toward the two-way left-turn lane and the solid line toward the adjacent traffic lane as shown in Figure 3B-7.**

*Guidance:*

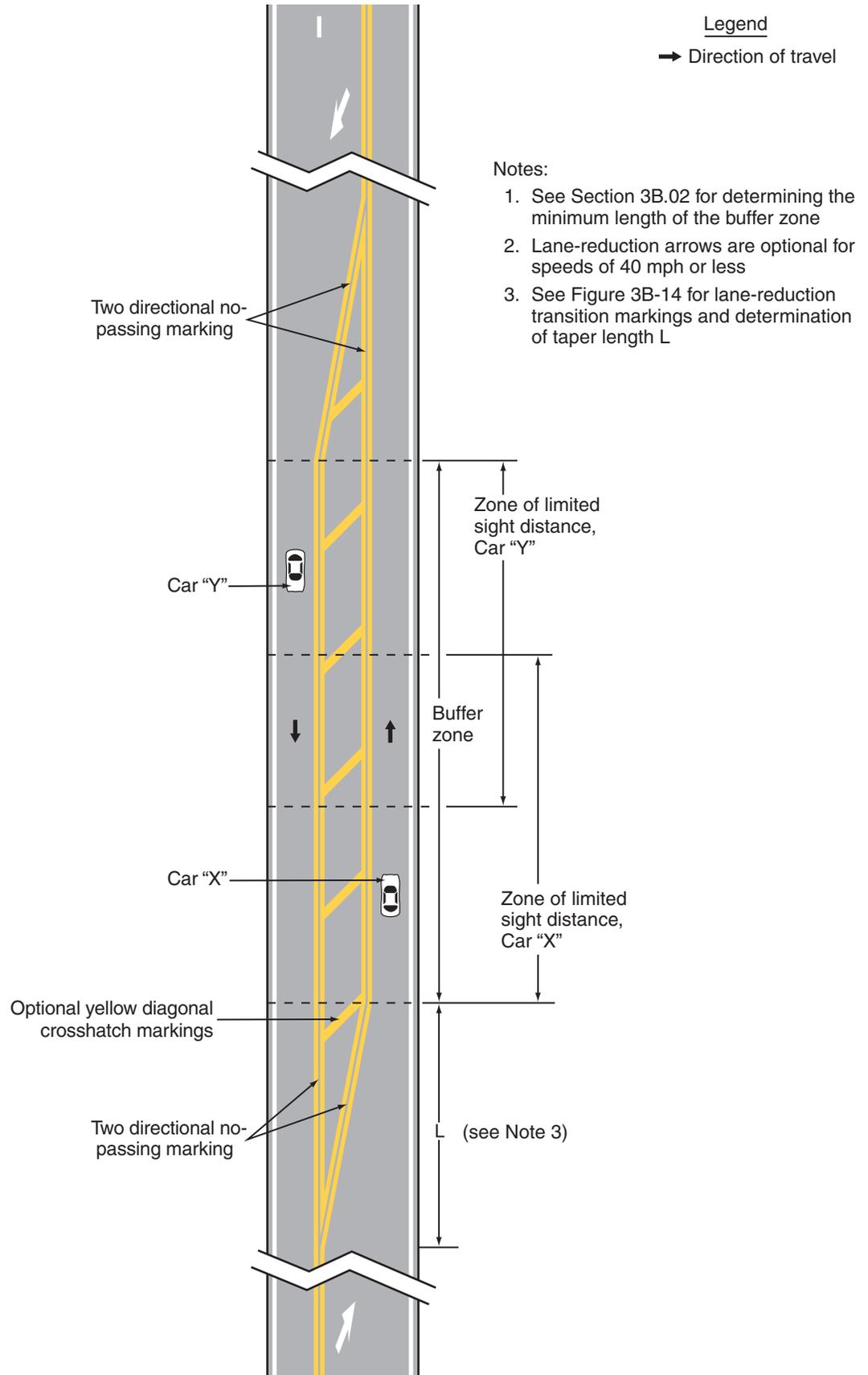
- 04 *White two-way left-turn lane-use arrows (see Figure 3B-7), should be used in conjunction with the longitudinal two-way left-turn markings at the locations described in Section 3B.20.*

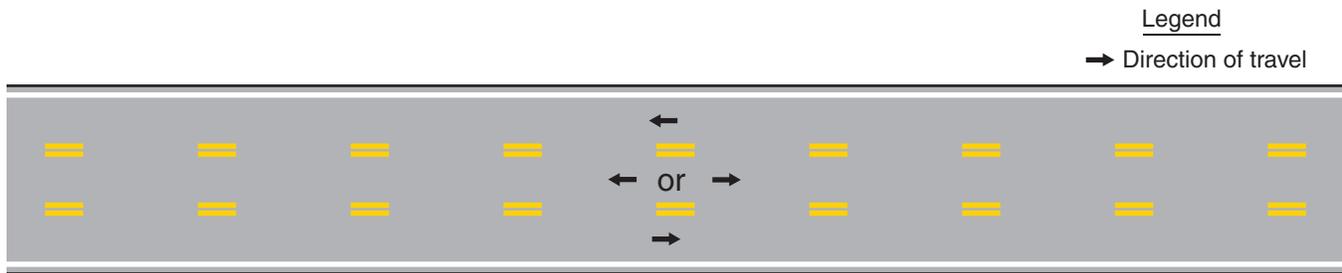
- 05 *Signs should be used in conjunction with the two-way left turn markings (see Section 2B.24).*

**Standard:**

- 06 **If a continuous flush median island formed by pavement markings separating travel in opposite directions is used, two sets of solid double yellow lines shall be used to form the island as shown in Figures 3B-2 and 3B-5. Other markings in the median island area shall also be yellow, except crosswalk markings which shall be white (see Section 3B.18).**

**Figure 3B-5. Example of Application of Three-Lane, Two-Way Marking for Changing Direction of the Center Lane**



**Figure 3B-6. Example of Reversible Lane Marking Application****Section 3B.04 White Lane Line Pavement Markings and Warrants****Standard:**

01 **When used, lane line pavement markings delineating the separation of traffic lanes that have the same direction of travel shall be white.**

02 **Lane line markings shall be used on all freeways and Interstate highways.**

*Guidance:*

03 *Lane line markings should be used on all roadways that are intended to operate with two or more adjacent traffic lanes in the same direction of travel, except as otherwise required for reversible lanes. Lane line markings should also be used at congested locations where the roadway will accommodate more traffic lanes with lane line markings than without the markings.*

*Support:*

04 Examples of lane line markings are shown in Figures 3B-2, 3B-3, and 3B-7 through 3B-13.

**Standard:**

05 **Except as provided in Paragraph 6, where crossing the lane line markings with care is permitted, the lane line markings shall consist of a normal broken white line.**

06 **A dotted white line marking shall be used as the lane line to separate a through lane that continues beyond the interchange or intersection from an adjacent lane for any of the following conditions:**

- A. A deceleration or acceleration lane,
- B. A through lane that becomes a mandatory exit or turn lane,
- C. An auxiliary lane 2 miles or less in length between an entrance ramp and an exit ramp, or
- D. An auxiliary lane 1 mile or less in length between two adjacent intersections.

07 **For exit ramps with a parallel deceleration lane, a normal width dotted white lane line shall be installed from the upstream end of the full-width deceleration lane to the theoretical gore or to the upstream end of a solid white lane line, if used, that extends upstream from the theoretical gore as shown in Drawings A and C of Figure 3B-8.**

*Option:*

08 For exit ramps with a parallel deceleration lane, a normal width dotted white line extension may be installed in the taper area upstream from the full-width deceleration lane as shown in Drawings A and C of Figure 3B-8.

09 For an exit ramp with a tapered deceleration lane, a normal width dotted white line extension may be installed from the theoretical gore through the taper area such that it meets the edge line at the upstream end of the taper as shown in Drawing B of Figure 3B-8.

**Standard:**

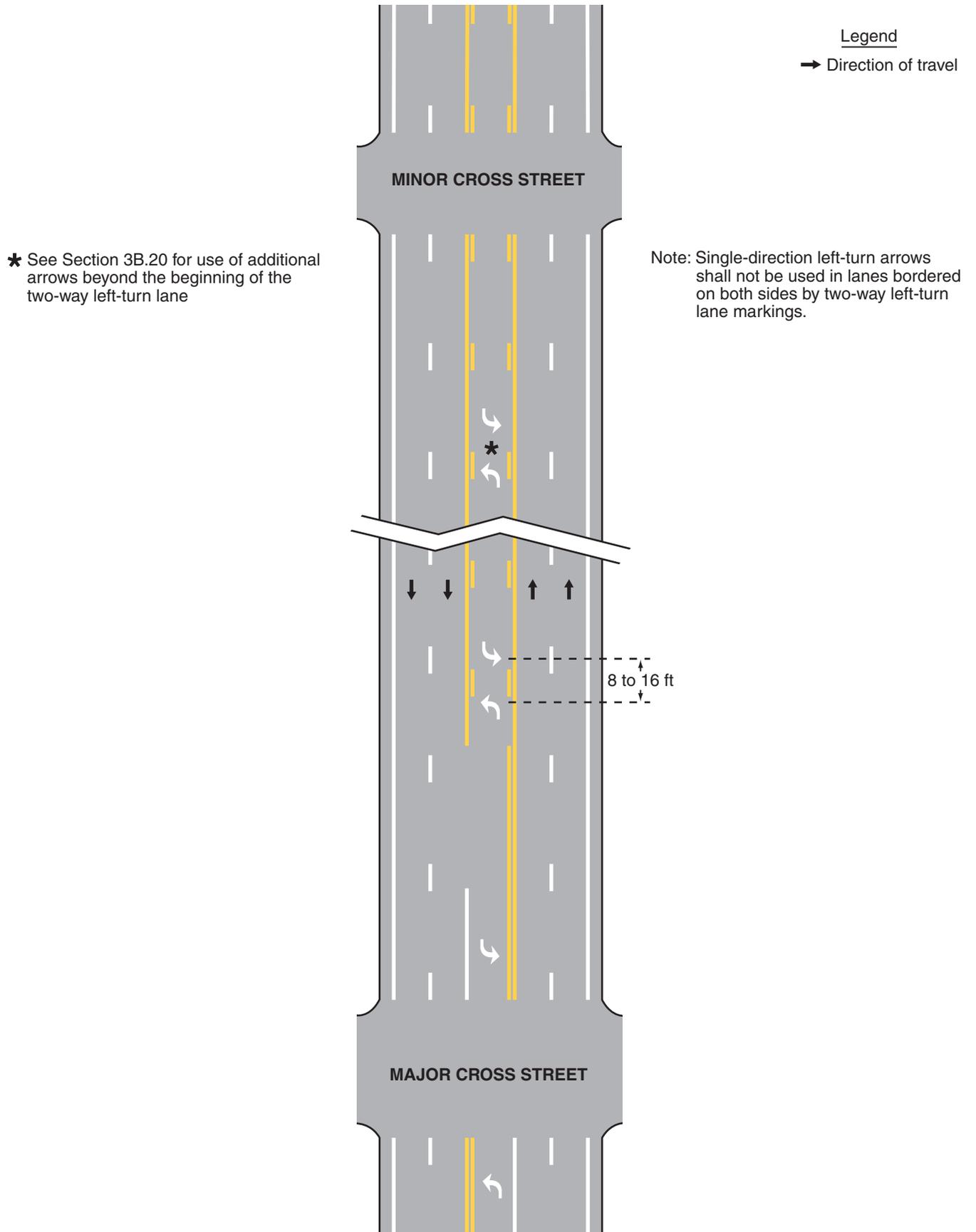
10 **For entrance ramps with a parallel acceleration lane, a normal width dotted white lane line shall be installed from the theoretical gore or from the downstream end of a solid white lane line, if used, that extends downstream from the theoretical gore, to a point at least one-half the distance from the theoretical gore to the downstream end of the acceleration taper, as shown in Drawing A of Figure 3B-9.**

*Option:*

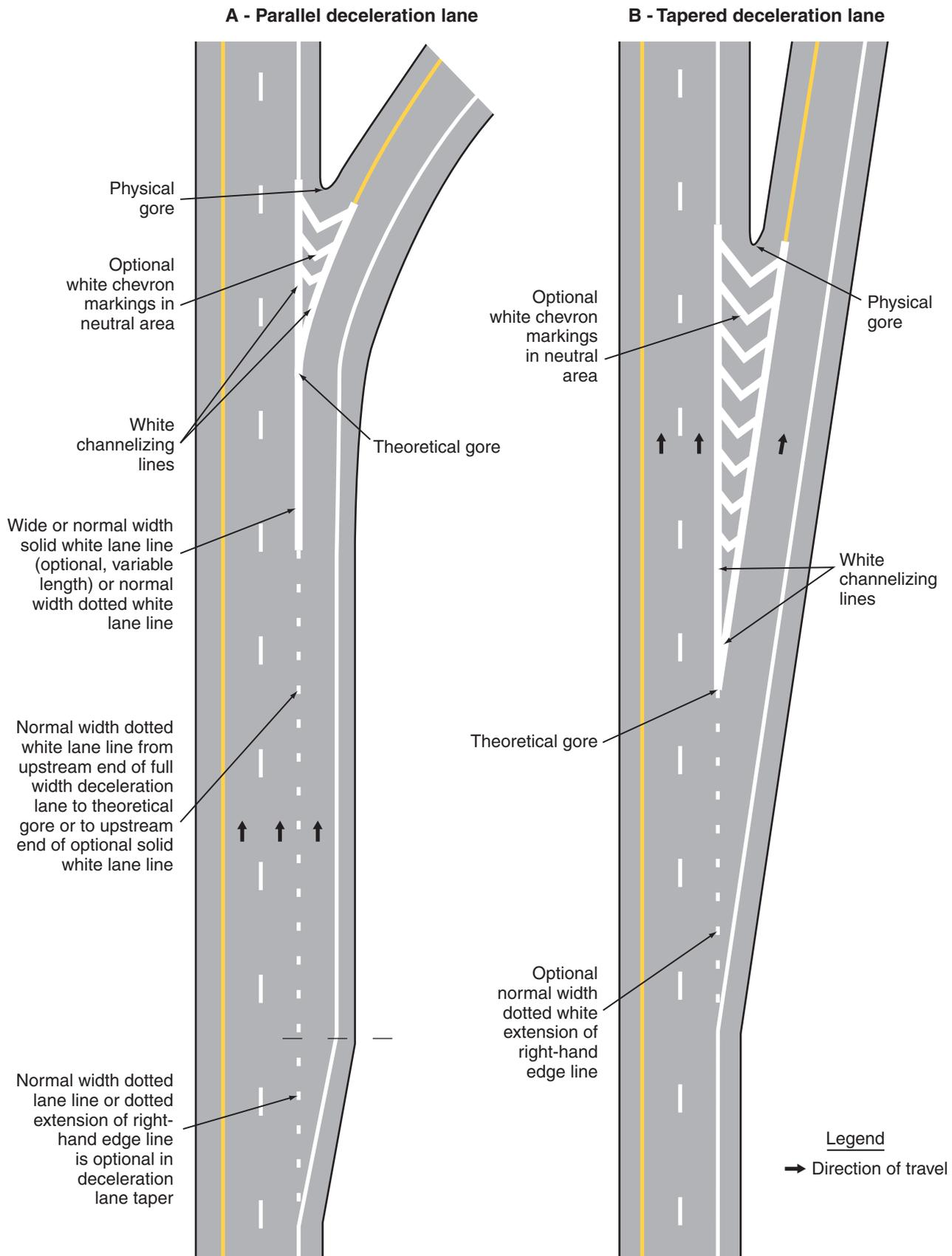
11 For entrance ramps with a parallel acceleration lane, a normal width dotted white line extension may be installed from the downstream end of the dotted white lane line to the downstream end of the acceleration taper, as shown in Drawing A of Figure 3B-9.

12 For entrance ramps with a tapered acceleration lane, a normal width dotted white line extension may be installed from the downstream end of the channelizing line adjacent to the through lane to the downstream end of the acceleration taper, as shown in Drawings B and C of Figure 3B-9.

**Figure 3B-7. Example of Two-Way Left-Turn Lane Marking Applications**

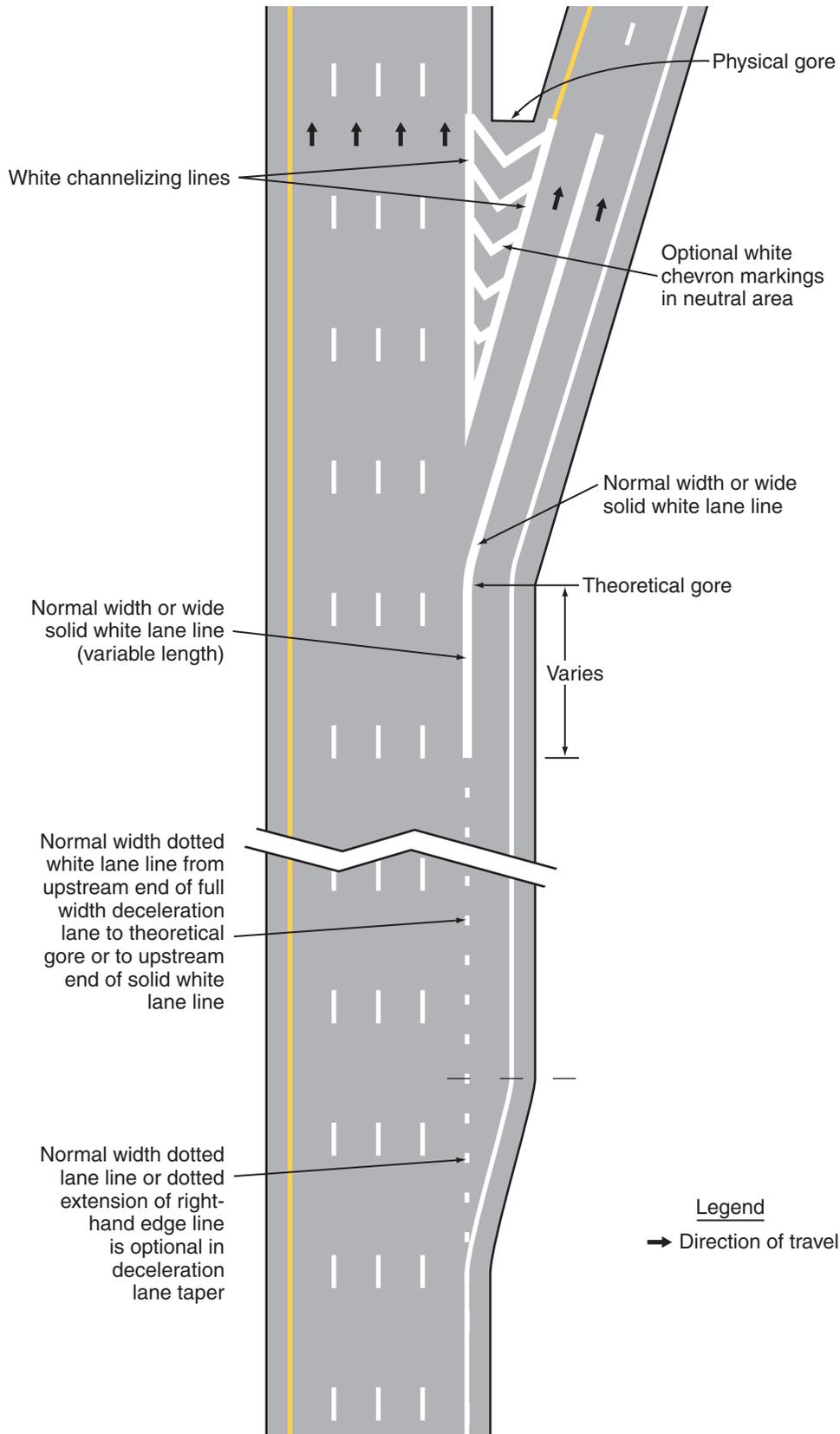


**Figure 3B-8. Examples of Dotted Line and Channelizing Line Applications for Exit Ramp Markings (Sheet 1 of 2)**

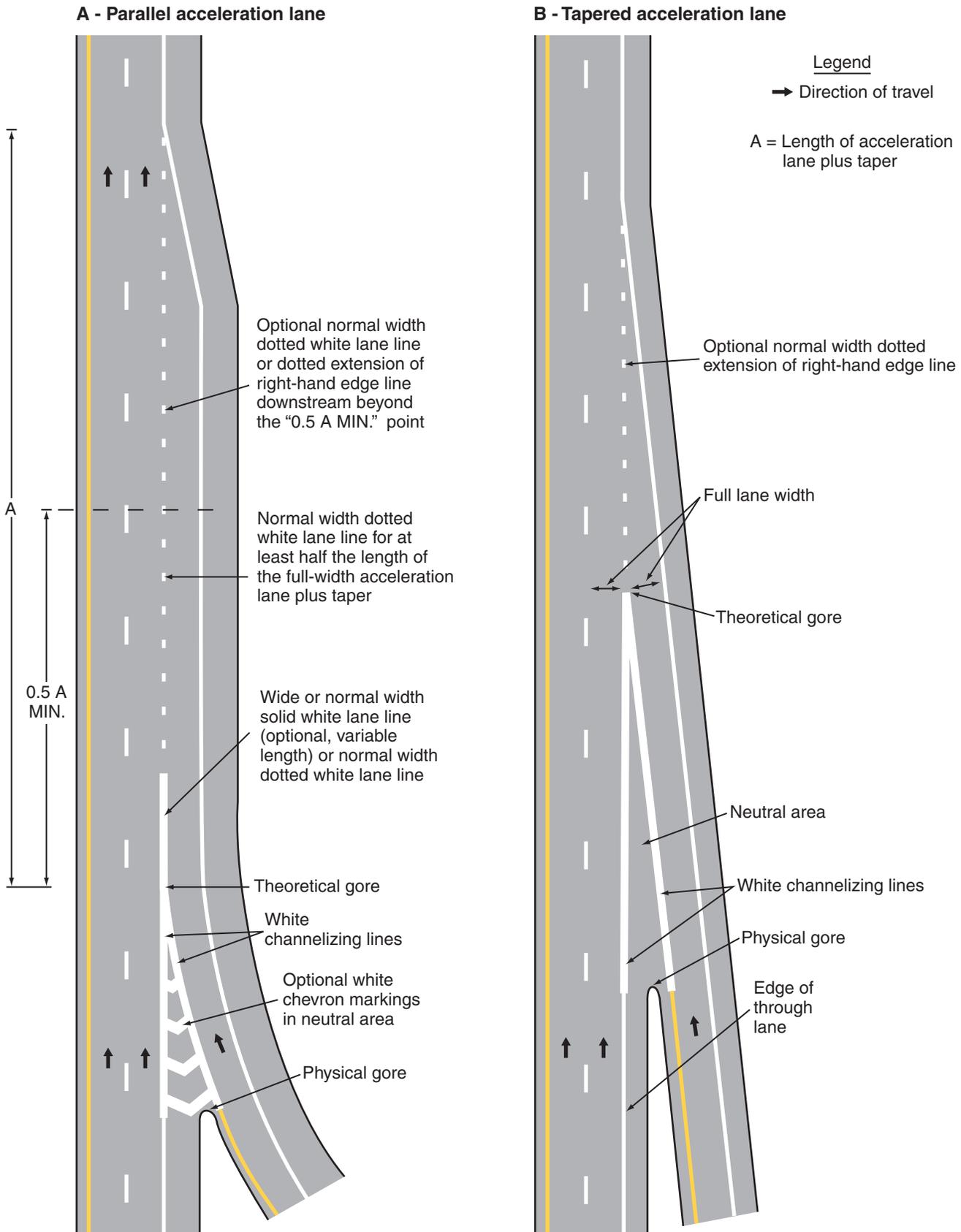


**Figure 3B-8. Examples of Dotted Line and Channelizing Line Applications for Exit Ramp Markings (Sheet 2 of 2)**

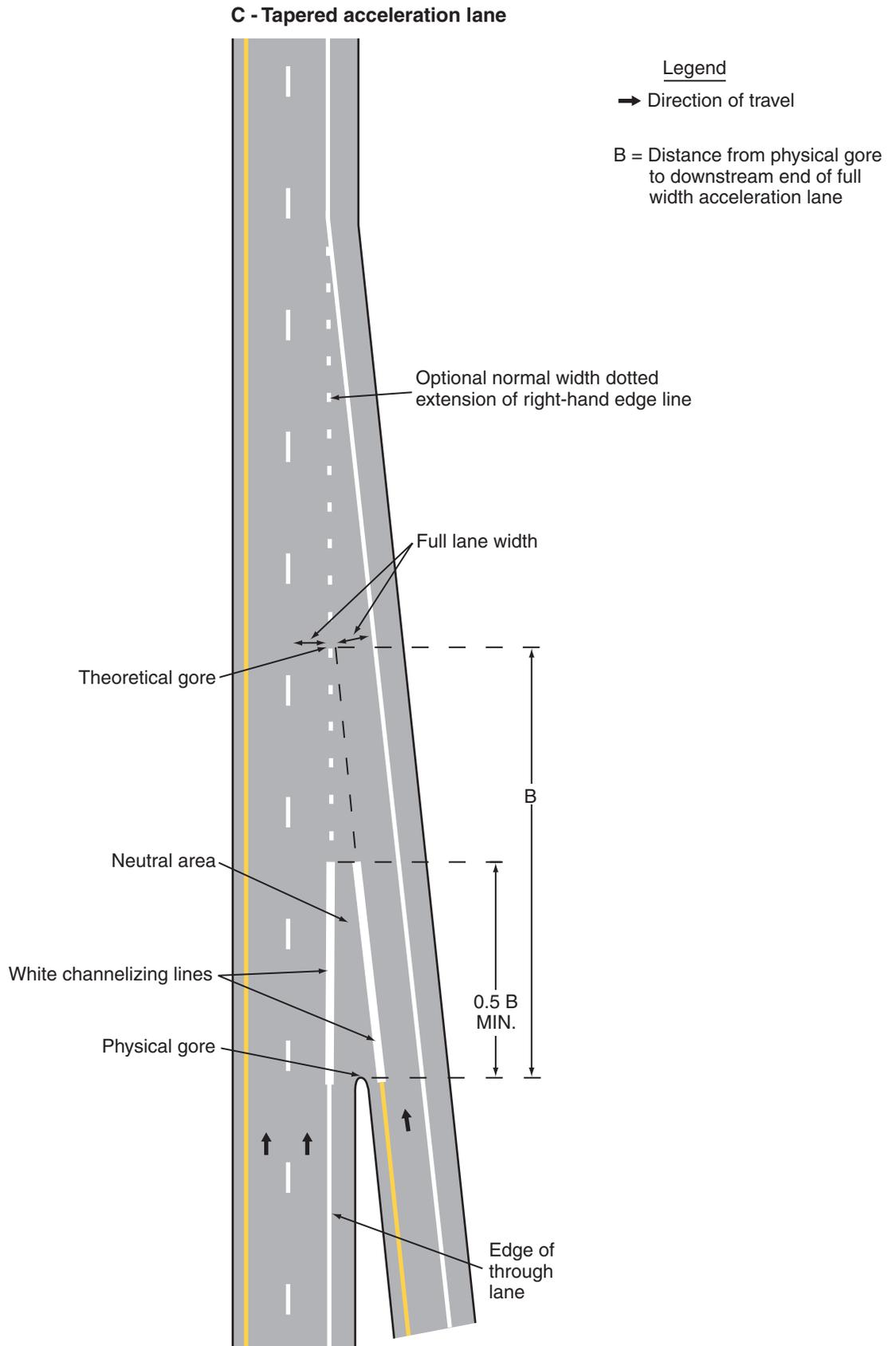
**C – Parallel deceleration lane at a multi-lane exit ramp having an optional exit lane that also carries the through route**



**Figure 3B-9. Examples of Dotted Line and Channelizing Line Applications for Entrance Ramp Markings (Sheet 1 of 2)**



**Figure 3B-9. Examples of Dotted Line and Channelizing Line Applications for Entrance Ramp Markings (Sheet 2 of 2)**



**Standard:**

- 13 **A wide dotted white lane line shall be used:**
- A. As a lane drop marking in advance of lane drops at exit ramps to distinguish a lane drop from a normal exit ramp (see Drawings A, B, and C of Figure 3B-10),
  - B. In advance of freeway route splits with dedicated lanes (see Drawing D of Figure 3B-10),
  - C. To separate a through lane that continues beyond an interchange from an adjacent auxiliary lane between an entrance ramp and an exit ramp (see Drawing E of Figure 3B-10),
  - D. As a lane drop marking in advance of lane drops at intersections to distinguish a lane drop from an intersection through lane (see Drawing A of Figure 3B-11), and
  - E. To separate a through lane that continues beyond an intersection from an adjacent auxiliary lane between two intersections (see Drawing B of Figure 3B-11).

*Guidance:*

- 14 *Lane drop markings used in advance of lane drops at freeway and expressway exit ramps should begin at least 1/2 mile in advance of the theoretical gore.*
- 15 *On the approach to a multi-lane exit ramp having an optional exit lane that also carries through traffic, lane line markings should be used as illustrated in Drawing B of Figure 3B-10. In this case, if the right-most exit lane is an added lane such as a parallel deceleration lane, the lane drop marking should begin at the upstream end of the full-width deceleration lane, as shown in Drawing C of Figure 3B-8.*
- 16 *Lane drop markings used in advance of lane drops at intersections should begin a distance in advance of the intersection that is determined by engineering judgment as suitable to enable drivers who do not desire to make the mandatory turn to move out of the lane being dropped prior to reaching the queue of vehicles that are waiting to make the turn. The lane drop marking should begin no closer to the intersection than the most upstream regulatory or warning sign associated with the lane drop.*
- 17 *The dotted white lane lines that are used for lane drop markings and that are used as a lane line separating through lanes from auxiliary lanes should consist of line segments that are 3 feet in length separated by 9-foot gaps.*

**Support:**

- 18 Section 3B.20 contains information regarding other markings that are associated with lane drops, such as lane-use arrow markings and ONLY word markings.
- 19 Section 3B.09 contains information about the lane line markings that are to be used for transition areas where the number of through lanes is reduced.

**Standard:**

- 20 **Where crossing the lane line markings is discouraged, the lane line markings shall consist of a normal or wide solid white line.**

**Option:**

- 21 Where it is intended to discourage lane changing on the approach to an exit ramp, a wide solid white lane line may extend upstream from the theoretical gore or, for multi-lane exits, as shown in Drawing B of Figure 3B-10, for a distance that is determined by engineering judgment.
- 22 Where lane changes might cause conflicts, a wide or normal solid white lane line may extend upstream from an intersection.
- 23 In the case of a lane drop at an exit ramp or intersection, such a solid white line may replace a portion, but not all of the length of the wide dotted white lane line.

**Support:**

- 24 Section 3B.09 contains information about the lane line markings that are to be used for transition areas where the number of through lanes is reduced.

*Guidance:*

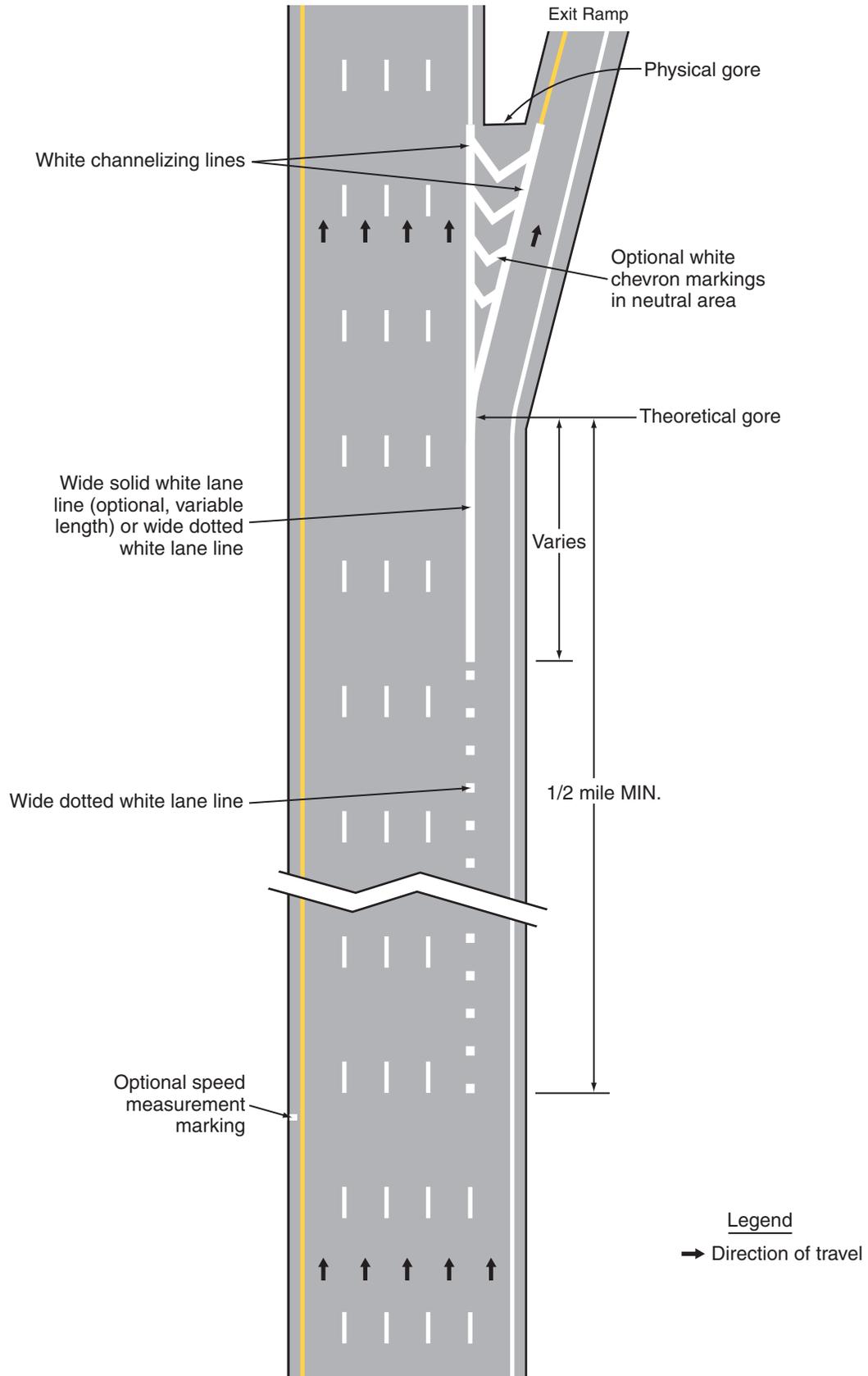
- 25 *On approaches to intersections, a solid white lane line marking should be used to separate a through lane from an added mandatory turn lane.*

**Option:**

- 26 On approaches to intersections, solid white lane line markings may be used to separate adjacent through lanes or adjacent mandatory turn lanes from each other.
- 27 Where the median width allows the left-turn lanes to be separated from the through lanes to give drivers on opposing approaches a less obstructed view of opposing through traffic, white pavement markings may be used to form channelizing islands as shown in Figure 2B-17.

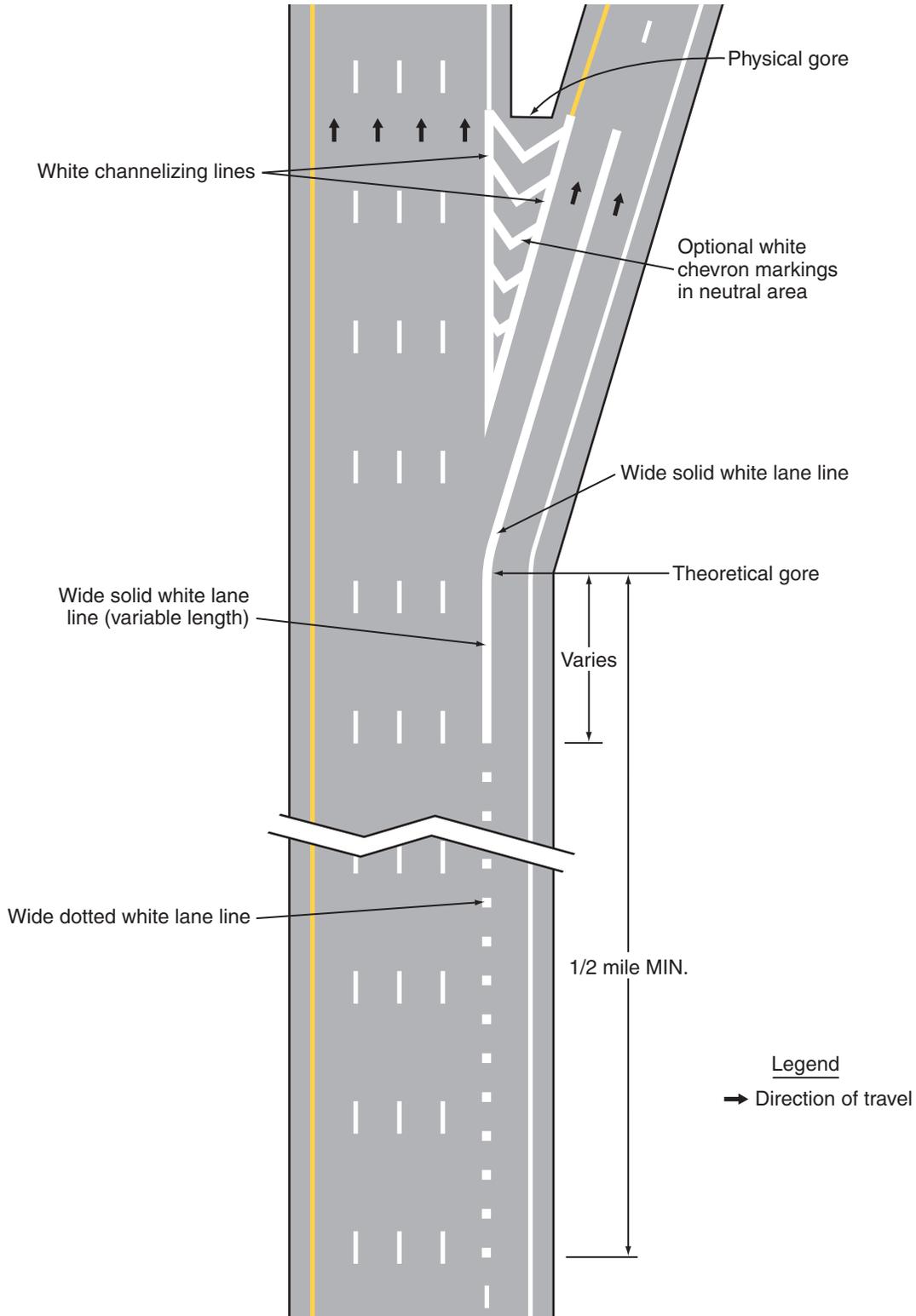
**Figure 3B-10. Examples of Applications of Freeway and Expressway Lane-Drop Markings (Sheet 1 of 5)**

**A – Lane drop at a single lane exit ramp**

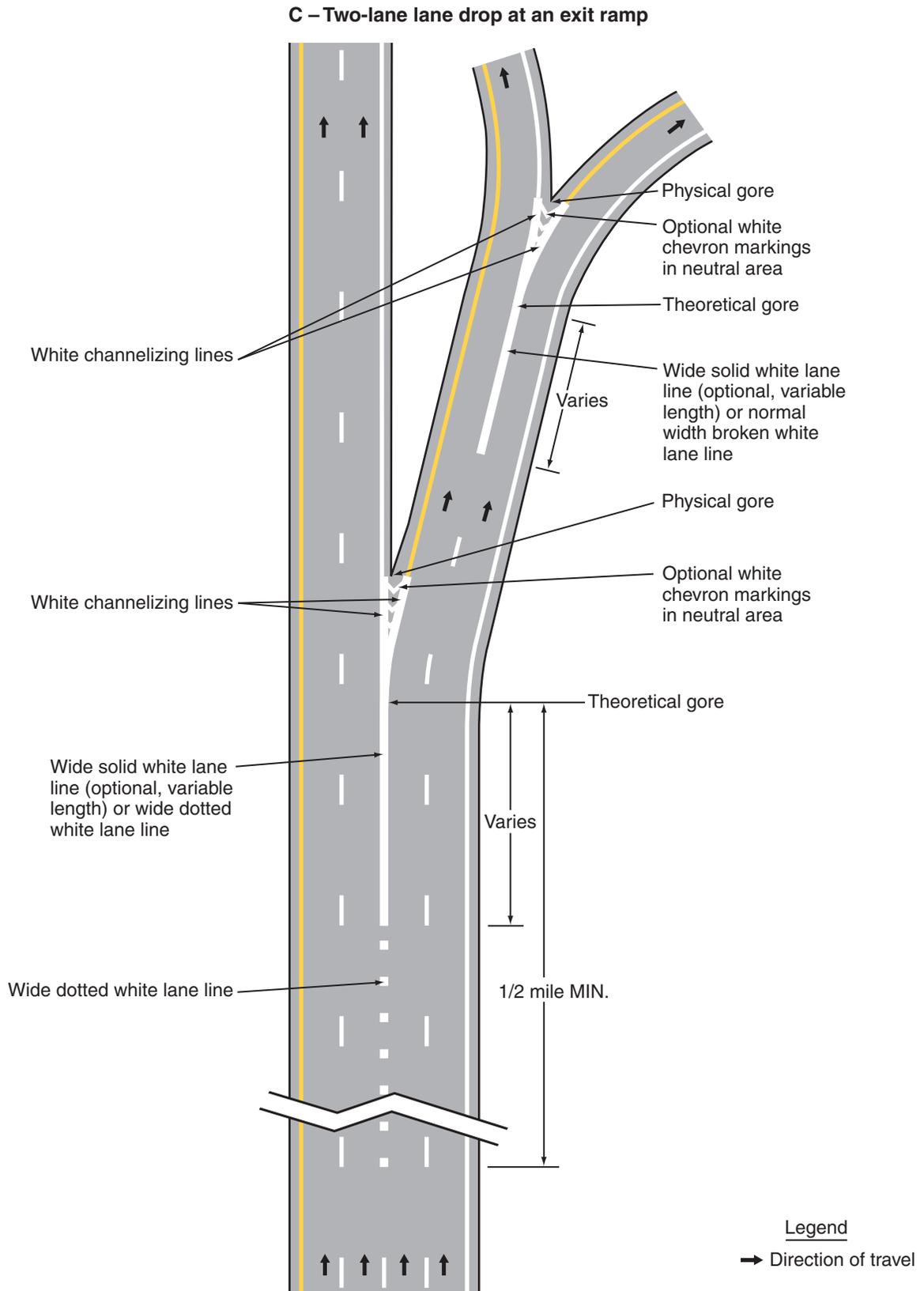


### Figure 3B-10. Examples of Applications of Freeway and Expressway Lane-Drop Markings (Sheet 2 of 5)

**B – Lane drop at a multi-lane exit ramp having an optional exit lane that also carries the through route**

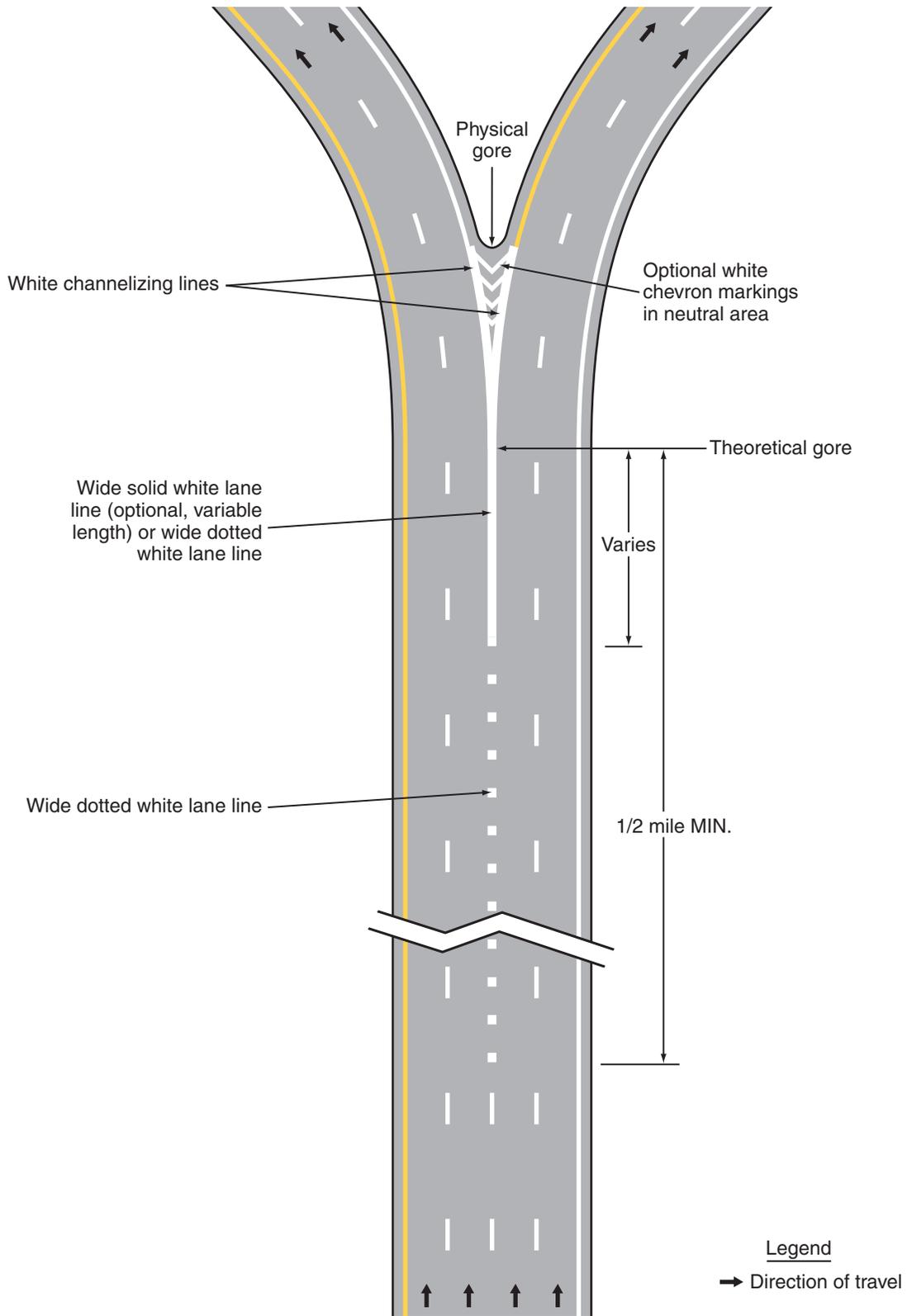


**Figure 3B-10. Examples of Applications of Freeway and Expressway Lane-Drop Markings (Sheet 3 of 5)**

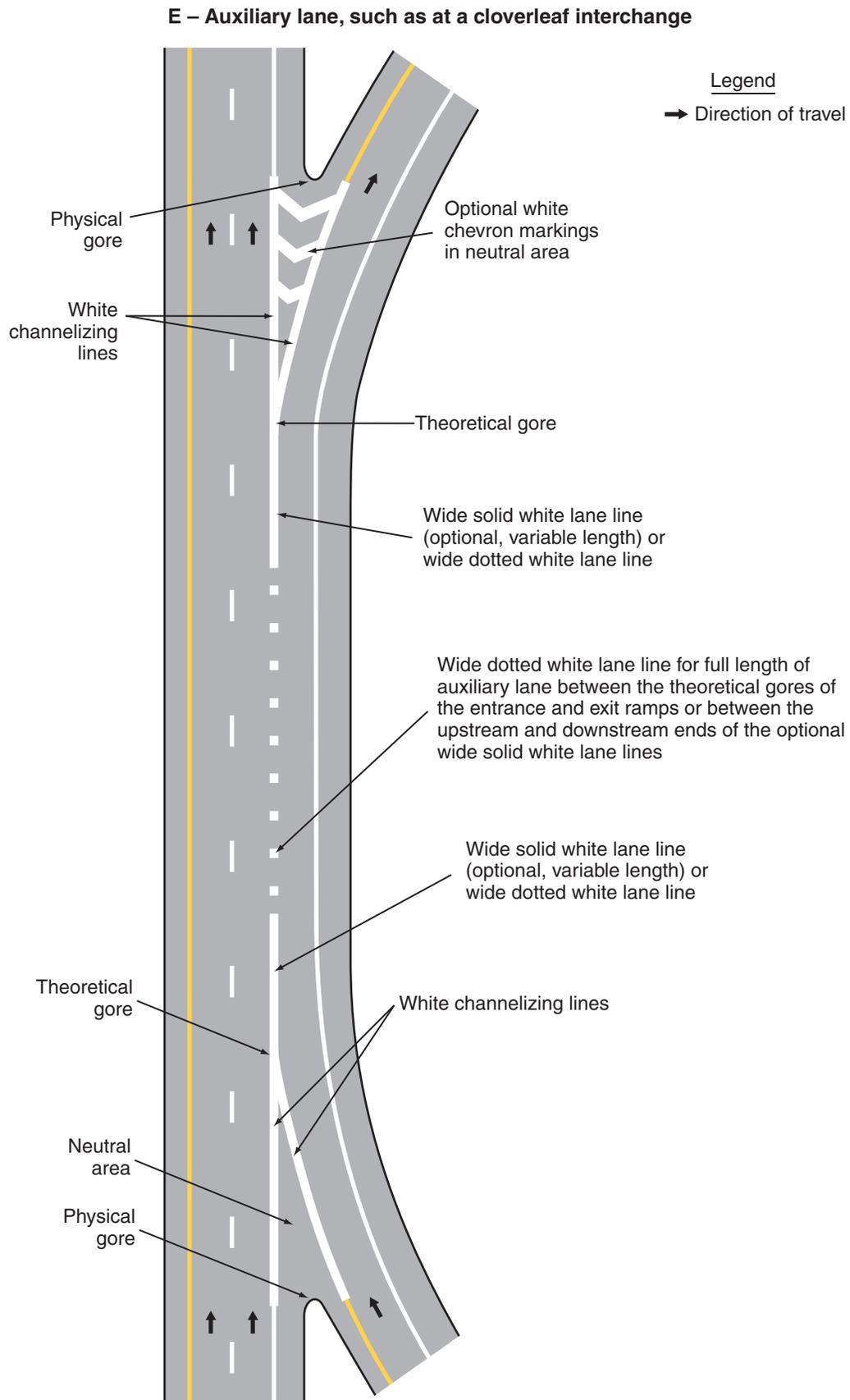


**Figure 3B-10. Examples of Applications of Freeway and Expressway Lane-Drop Markings (Sheet 4 of 5)**

**D – Route split with dedicated lanes**

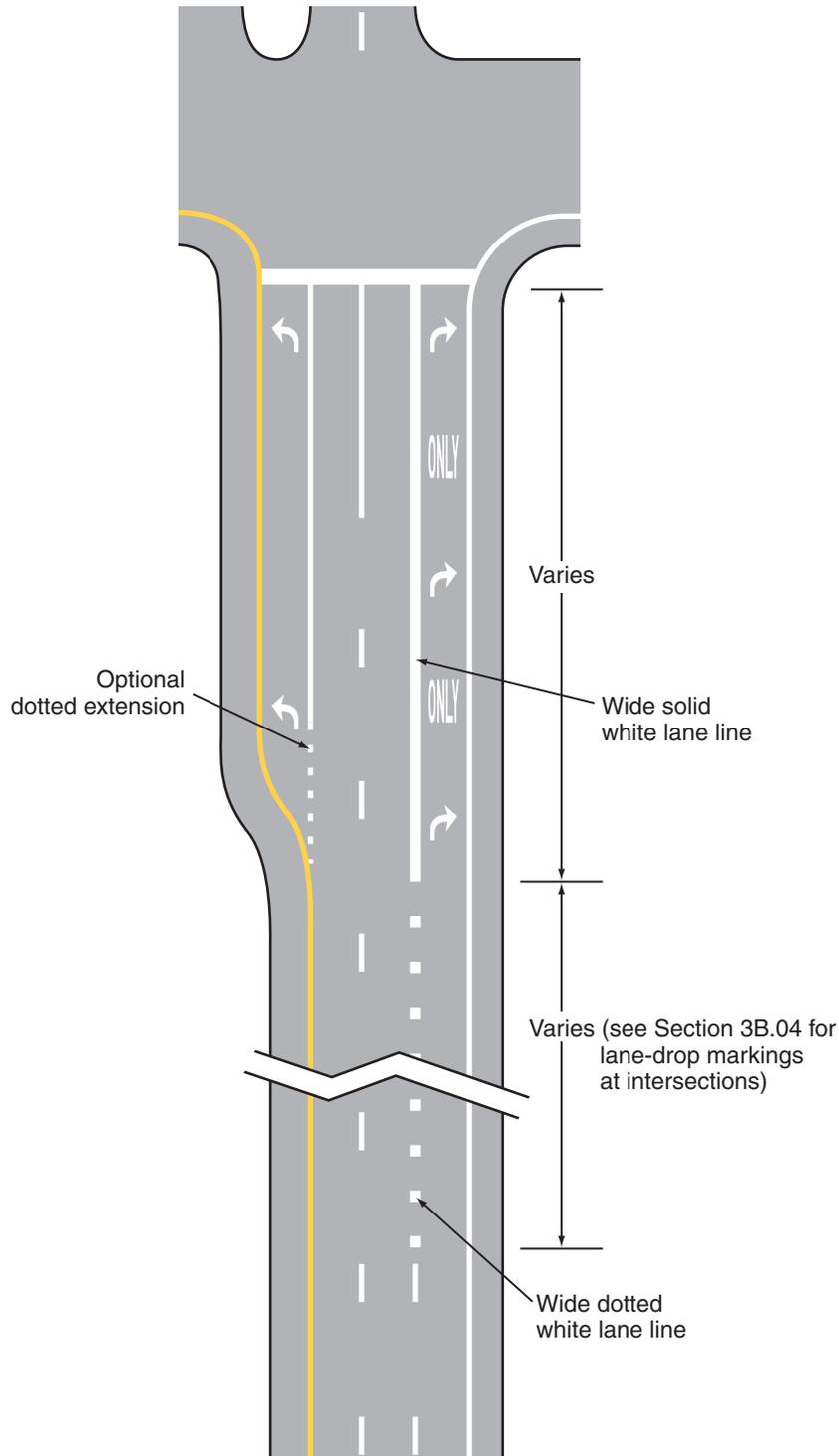


**Figure 3B-10. Examples of Applications of Freeway and Expressway Lane-Drop Markings (Sheet 5 of 5)**



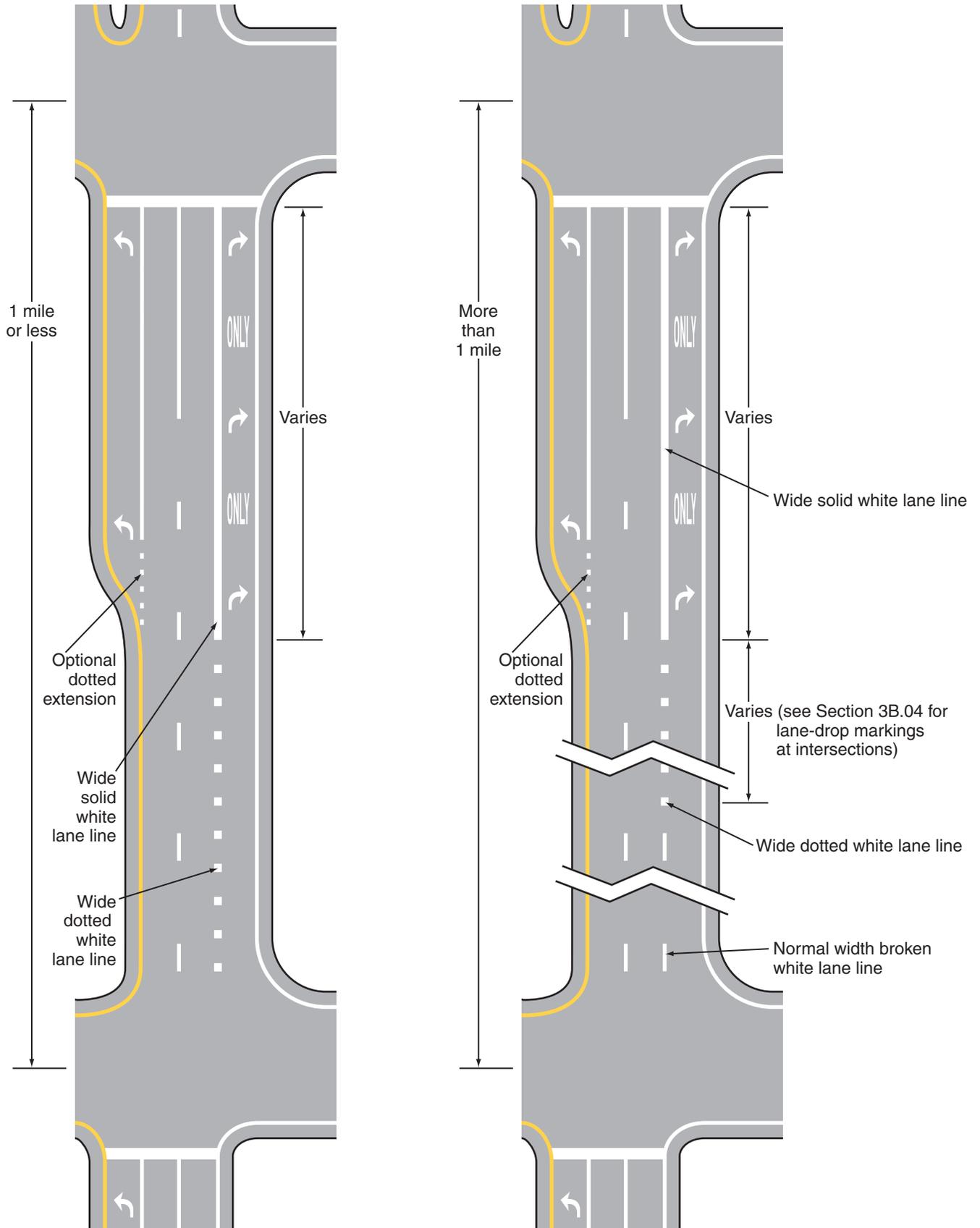
**Figure 3B-11. Examples of Applications of Conventional Road Lane-Drop Markings**  
(Sheet 1 of 2)

**A – Lane drop at an intersection**



**Figure 3B-11. Examples of Applications of Conventional Road Lane-Drop Markings**  
(Sheet 2 of 2)

**B – Auxiliary lane between intersections**



28 Solid white lane line markings may be used to separate through traffic lanes from auxiliary lanes, such as an added uphill truck lane or a preferential lane (see Section 3D.02).

29 Wide solid lane line markings may be used for greater emphasis.

**Standard:**

30 **Where crossing the lane line markings is prohibited, the lane line markings shall consist of a solid double white line (see Figure 3B-12).**

**Section 3B.05 Other White Longitudinal Pavement Markings**

**Standard:**

01 **A channelizing line shall be a wide or double solid white line.**

Option:

02 Channelizing lines may be used to form channelizing islands where traffic traveling in the same direction is permitted on both sides of the island.

**Standard:**

03 **Other pavement markings in the channelizing island area shall be white.**

Support:

04 Examples of channelizing line applications are shown in Figures 3B-8, 3B-9, and 3B-10, and in Drawing C of Figure 3B-15.

05 Channelizing lines at exit ramps as shown in Figures 3B-8 and 3B-10 define the neutral area, direct exiting traffic at the proper angle for smooth divergence from the main lanes into the ramp, and reduce the probability of colliding with objects adjacent to the roadway.

06 Channelizing lines at entrance ramps as shown in Figures 3B-9 and 3B-10 promote orderly and efficient merging with the through traffic.

**Standard:**

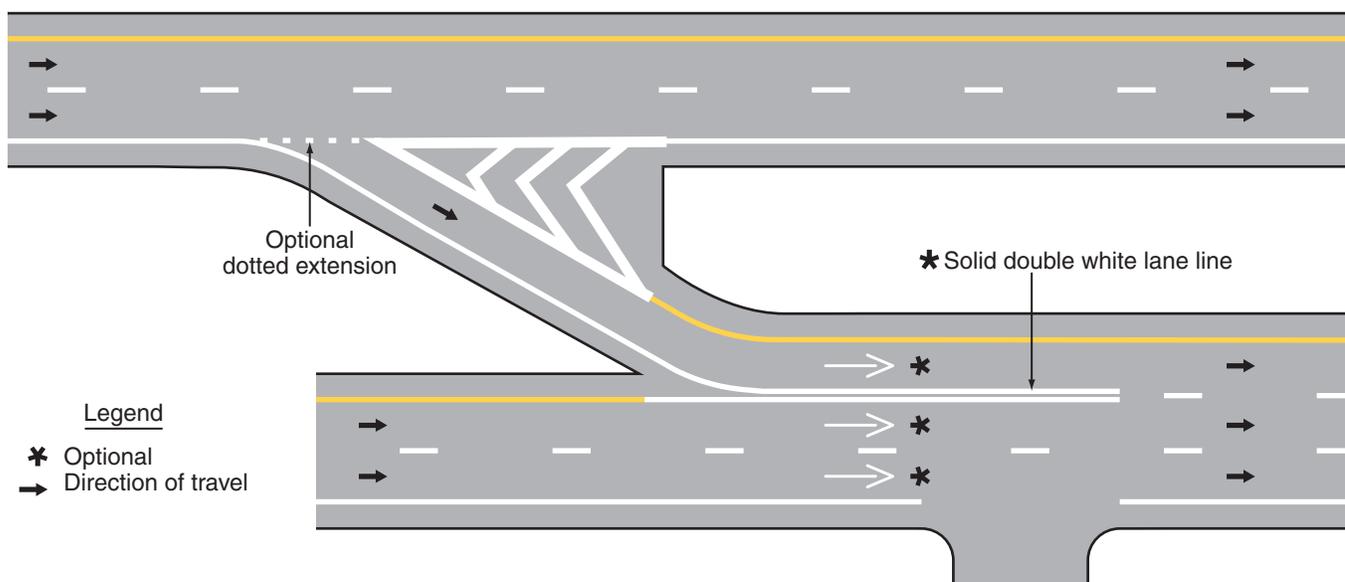
07 **For all exit ramps and for entrance ramps with parallel acceleration lanes, channelizing lines shall be placed on both sides of the neutral area (see Figures 3B-8 and 3B-10 and Drawing A of Figure 3B-9).**

08 **For entrance ramps with tapered acceleration lanes, channelizing lines shall be placed along both sides of the neutral area to a point at least one-half of the distance to the theoretical gore (see Drawing C of Figure 3B-9).**

Option:

09 For entrance ramps with tapered acceleration lanes, the channelizing lines may extend to the theoretical gore as shown in Drawing B of Figure 3B-9.

**Figure 3B-12. Example of Solid Double White Lines Used to Prohibit Lane Changing**



- 10 White chevron crosshatch markings (see Section 3B.24) may be placed in the neutral area of exit ramp and entrance ramp gores for special emphasis as shown in Figures 3B-8 and 3B-10 and Drawing A of Figure 3B-9. The channelizing lines and the optional chevron crosshatch markings at exit ramp and entrance ramp gores may be supplemented with white retroreflective or internally illuminated raised pavement markers (see Sections 3B.11 and 3B.13) for enhanced nighttime visibility.

### **Section 3B.06 Edge Line Pavement Markings**

#### **Standard:**

- 01 **If used, edge line pavement markings shall delineate the right or left edges of a roadway.**  
 02 **Except for dotted edge line extensions (see Section 3B.08), edge line markings shall not be continued through intersections or major driveways.**  
 03 **If used on the roadways of divided highways or one-way streets, or on any ramp in the direction of travel, left edge line pavement markings shall consist of a normal solid yellow line to delineate the left-hand edge of a roadway or to indicate driving or passing restrictions left of these markings.**  
 04 **If used, right edge line pavement markings shall consist of a normal solid white line to delineate the right-hand edge of the roadway.**

#### *Guidance:*

- 05 *Edge line markings should not be broken for minor driveways.*

#### Support:

- 06 Edge line markings have unique value as visual references to guide road users during adverse weather and visibility conditions.

#### Option:

- 07 Wide solid edge line markings may be used for greater emphasis.

### **Section 3B.07 Warrants for Use of Edge Lines**

#### **Standard:**

- 01 **Edge line markings shall be placed on paved streets or highways with the following characteristics:**  
 A. **Freeways,**  
 B. **Expressways, and**  
 C. **Rural arterials with a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater.**

#### *Guidance:*

- 02 *Edge line markings should be placed on paved streets or highways with the following characteristics:*  
 A. *Rural arterials and collectors with a traveled way of 20 feet or more in width and an ADT of 3,000 vehicles per day or greater.*  
 B. *At other paved streets and highways where an engineering study indicates a need for edge line markings.*  
 03 *Edge line markings should not be placed where an engineering study or engineering judgment indicates that providing them is likely to decrease safety.*

#### Option:

- 04 Edge line markings may be placed on streets and highways with or without center line markings.  
 05 Edge line markings may be excluded, based on engineering judgment, for reasons such as if the traveled way edges are delineated by curbs, parking, or other markings.  
 06 If a bicycle lane is marked on the outside portion of the traveled way, the edge line that would mark the outside edge of the bicycle lane may be omitted.  
 07 Edge line markings may be used where edge delineation is desirable to minimize unnecessary driving on paved shoulders or on refuge areas that have lesser structural pavement strength than the adjacent roadway.

### **Section 3B.08 Extensions Through Intersections or Interchanges**

#### **Standard:**

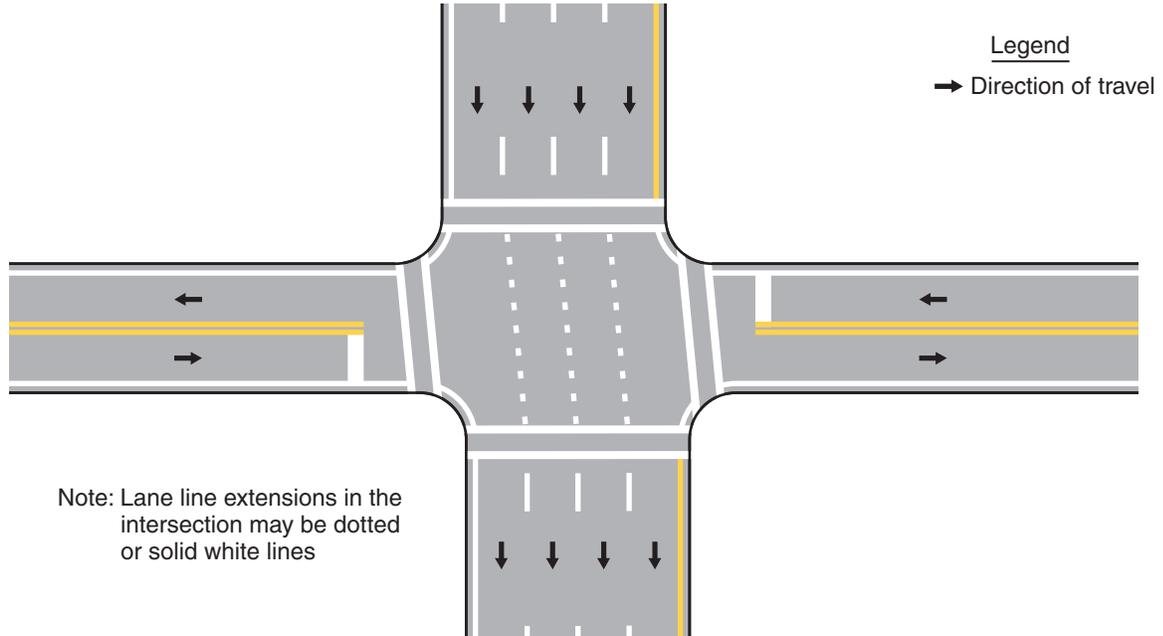
- 01 **Except as provided in Paragraph 2, pavement markings extended into or continued through an intersection or interchange area shall be the same color and at least the same width as the line markings they extend (see Figure 3B-13).**

#### Option:

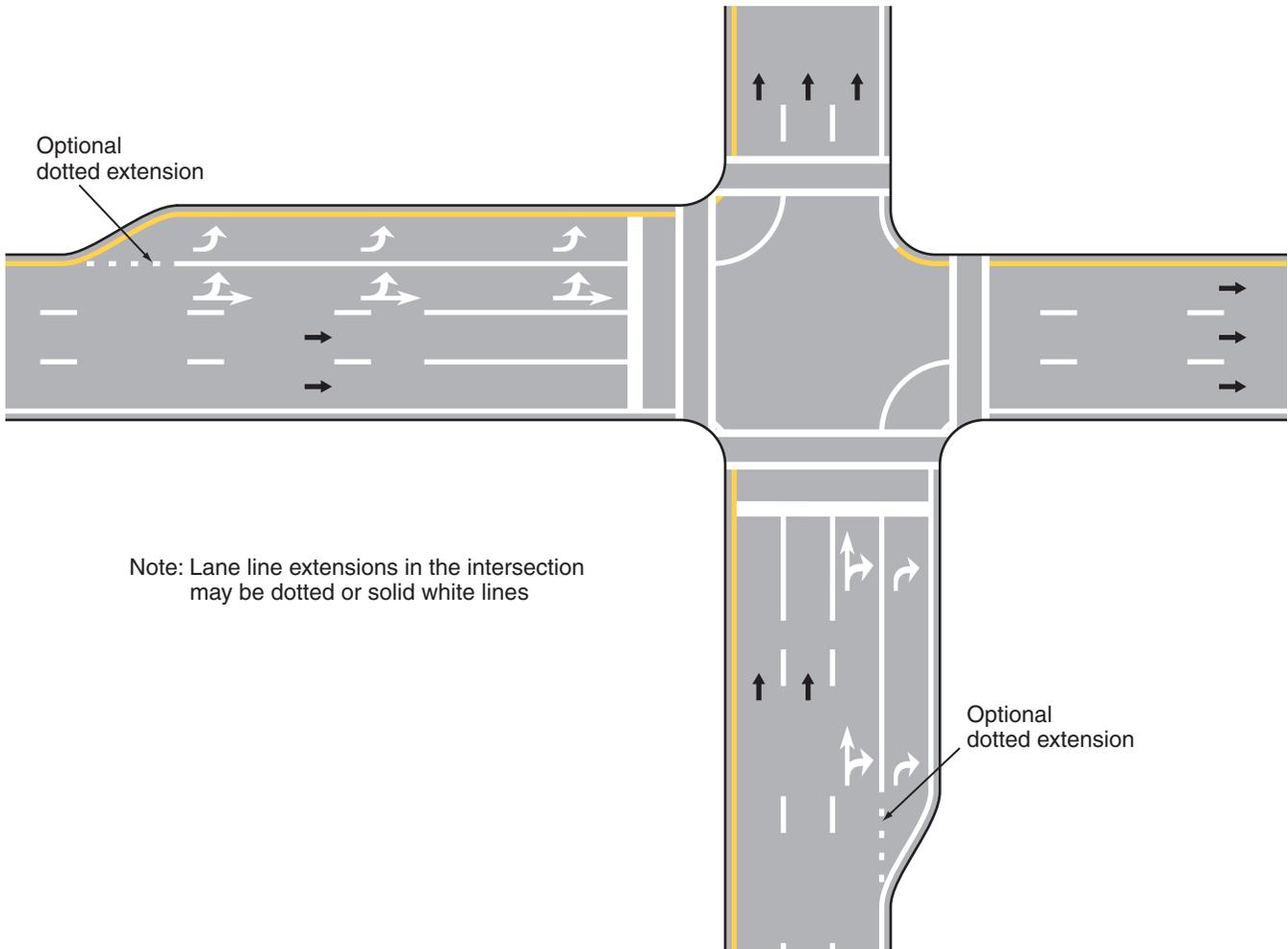
- 02 A normal line may be used to extend a wide line through an intersection.

### Figure 3B-13. Examples of Line Extensions through Intersections (Sheet 1 of 2)

**A - Typical pavement markings with offset lane lines continued through the intersection and optional crosswalk lines and stop lines**

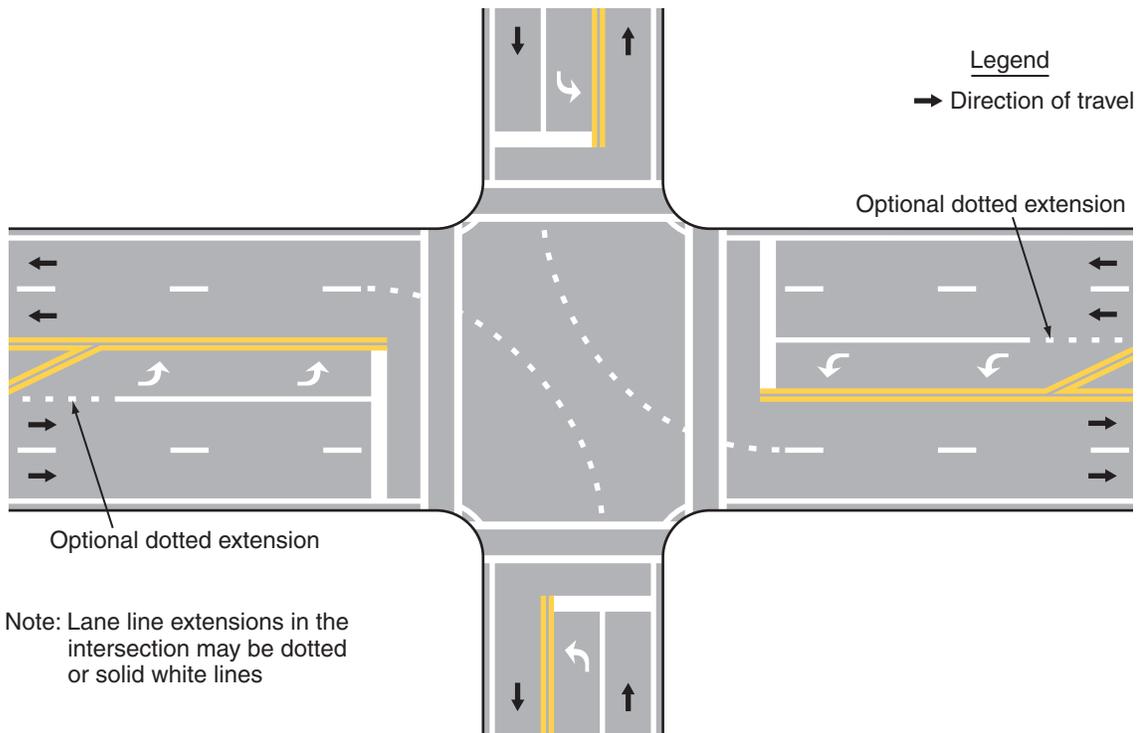


**B - Typical pavement markings with double-turn lanes, lane-use turn arrows, and optional crosswalk lines, stop lines, and line extensions into intersection for double turns**

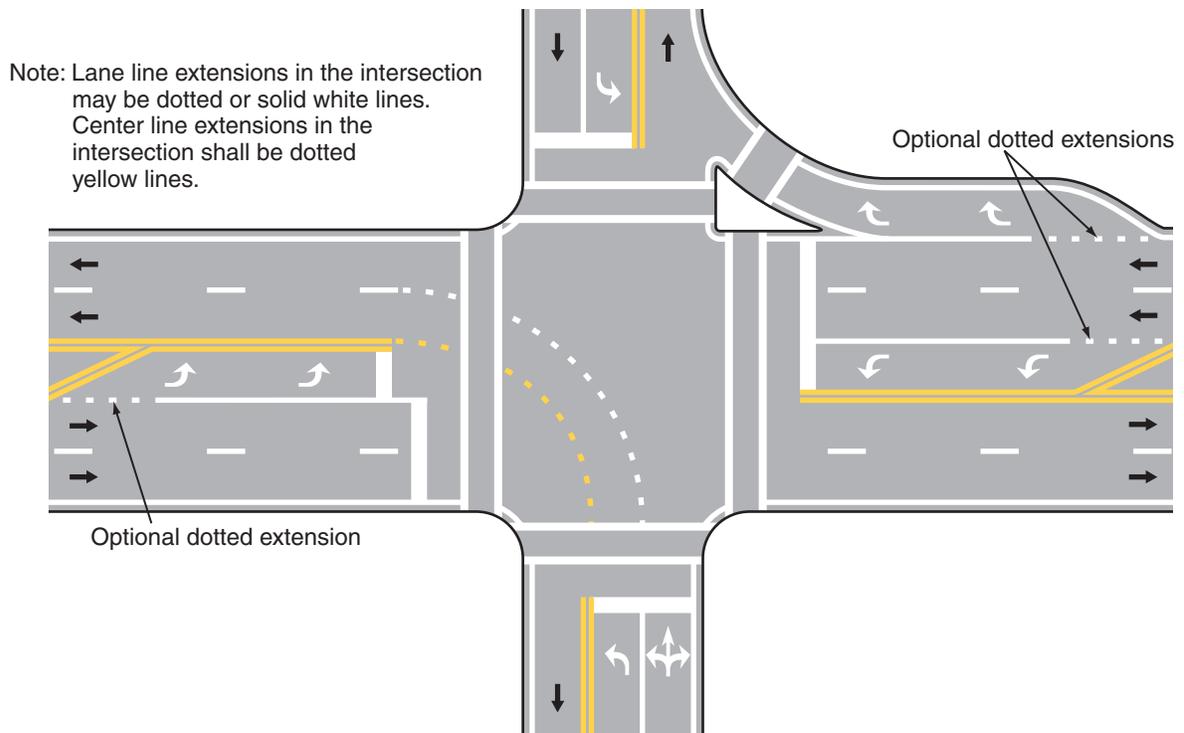


**Figure 3B-13. Examples of Line Extensions through Intersections (Sheet 2 of 2)**

**C - Typical dotted line markings to extend lane line markings into the intersection**



**D - Typical dotted line markings to extend center line and lane line markings into the intersection**



*Guidance:*

- 03 *Where highway design or reduced visibility conditions make it desirable to provide control or to guide vehicles through an intersection or interchange, such as at offset, skewed, complex, or multi-legged intersections, on curved roadways, where multiple turn lanes are used, or where offset left turn lanes might cause driver confusion, dotted line extension markings consisting of 2-foot line segments and 2- to 6-foot gaps should be used to extend longitudinal line markings through an intersection or interchange area.*

*Option:*

- 04 Dotted edge line extensions may be placed through intersections or major driveways.

*Guidance:*

- 05 *Where greater restriction is required, solid lane lines or channelizing lines should be extended into or continued through intersections or major driveways.*

**Standard:**

- 06 **Solid lines shall not be used to extend edge lines into or through intersections or major driveways.**

*Guidance:*

- 07 *Where a double line is extended through an intersection, a single line of equal width to one of the lines of the double line should be used.*
- 08 *To the extent possible, pavement marking extensions through intersections should be designed in a manner that minimizes potential confusion for drivers in adjacent or opposing lanes.*

**Section 3B.09 Lane-Reduction Transition Markings***Support:*

- 01 Lane-reduction transition markings are used where the number of through lanes is reduced because of narrowing of the roadway or because of a section of on-street parking in what would otherwise be a through lane. Lane-reduction transition markings are not used for lane drops.

**Standard:**

- 02 **Except as provided in Paragraph 3, where pavement markings are used, lane-reduction transition markings shall be used to guide traffic through transition areas where the number of through lanes is reduced, as shown in Figure 3B-14. On two-way roadways, no-passing zone markings shall be used to prohibit passing in the direction of the convergence, and shall continue through the transition area.**

*Option:*

- 03 On low-speed urban roadways where curbs clearly define the roadway edge in the lane-reduction transition, or where a through lane becomes a parking lane, the edge line and/or delineators shown in Figure 3B-14 may be omitted as determined by engineering judgment.

*Guidance:*

- 04 *For roadways having a posted or statutory speed limit of 45 mph or greater, the transition taper length for a lane-reduction transition should be computed by the formula  $L = WS$ . For roadways where the posted or statutory speed limit is less than 45 mph, the formula  $L = WS^2/60$  should be used to compute the taper length.*

*Support:*

- 05 Under both formulas, L equals the taper length in feet, W equals the width of the offset distance in feet, and S equals the 85<sup>th</sup>-percentile speed or the posted or statutory speed limit, whichever is higher.

*Guidance:*

- 06 *Where observed speeds exceed posted or statutory speed limits, longer tapers should be used.*

*Option:*

- 07 On new construction, where no posted or statutory speed limit has been established, the design speed may be used in the transition taper length formula.

*Guidance:*

- 08 *Lane line markings should be discontinued one-quarter of the distance between the Lane Ends sign (see Section 2C.42) and the point where the transition taper begins.*

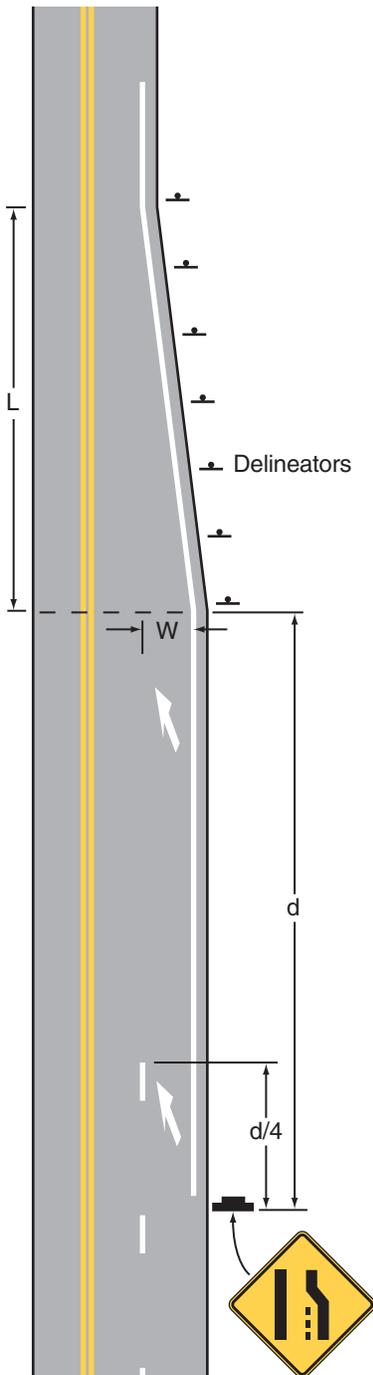
- 09 *Except as provided in Paragraph 3 for low-speed urban roadways, the edge line markings shown in Figure 3B-14 should be installed from the location of the Lane Ends warning sign to beyond the beginning of the narrower roadway.*

*Support:*

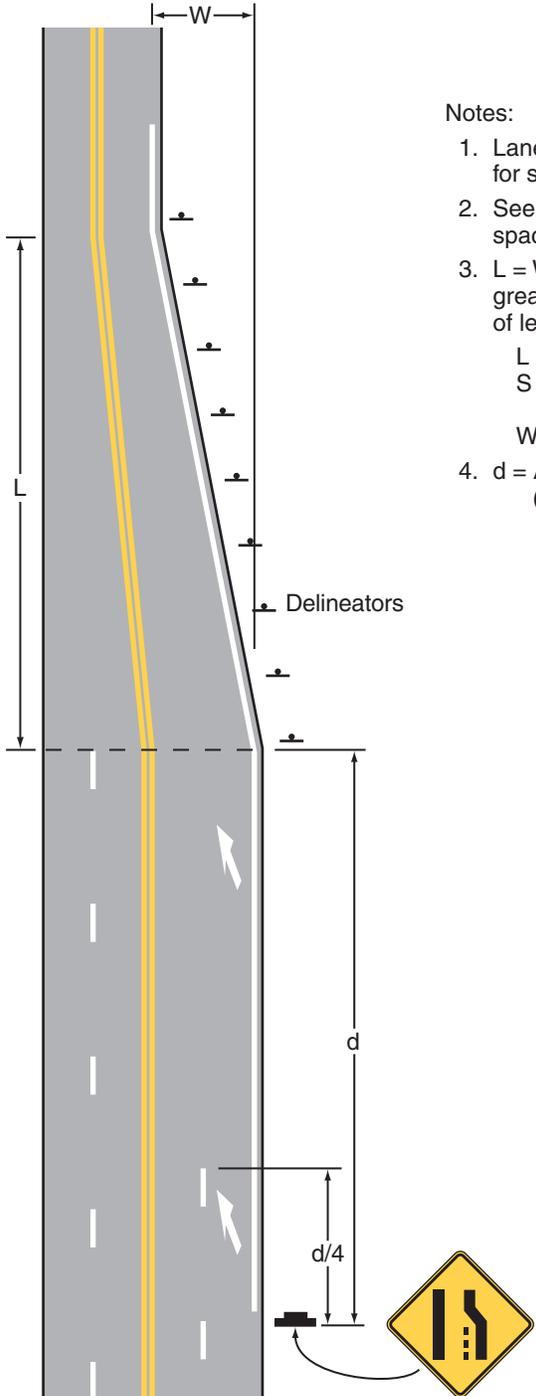
- 10 Pavement markings at lane-reduction transitions supplement the standard signs. See Section 3B.20 for provisions regarding use of lane-reduction arrows.

**Figure 3B-14. Examples of Applications of Lane-Reduction Transition Markings**

**A – Lane reduction**



**B – Lane reduction with lateral shift to the left**



**Notes:**

1. Lane-reduction arrows are optional for speeds of less than 45 mph
2. See Section 3F.04 for delineator spacing
3.  $L = WS$  for speeds of 45 mph or greater and  $L = WS^2/60$  for speeds of less than 45 mph, where:  
 $L$  = Length of taper in feet  
 $S$  = Posted, 85th-percentile, or statutory speed in mph  
 $W$  = Offset in feet
4.  $d$  = Advance warning distance (see Section 2C.05)

### Section 3B.10 Approach Markings for Obstructions

#### Standard:

- 01 **Pavement markings shall be used to guide traffic away from fixed obstructions within a paved roadway. Approach markings for bridge supports, refuge islands, median islands, toll plaza islands, and raised channelization islands shall consist of a tapered line or lines extending from the center line or the lane line to a point 1 to 2 feet to the right-hand side, or to both sides, of the approach end of the obstruction (see Figure 3B-15).**

#### Support:

- 02 See Chapter 3E for additional information on approach markings for toll plaza islands.

#### Guidance:

- 03 *For roadways having a posted or statutory speed limit of 45 mph or greater, the taper length of the tapered line markings should be computed by the formula  $L = WS$ . For roadways where the posted or statutory speed limit is less than 45 mph, the formula  $L = WS^2/60$  should be used to compute the taper length.*

#### Support:

- 04 Under both formulas, L equals the taper length in feet, W equals the width of the offset distance in feet, and S equals the 85<sup>th</sup>-percentile speed or the posted or statutory speed limit, whichever is higher.

#### Guidance:

- 05 *The minimum taper length should be 100 feet in urban areas and 200 feet in rural areas.*

#### Support:

- 06 Examples of approach markings for obstructions in the roadway are shown in Figure 3B-15.

#### Standard:

- 07 **If traffic is required to pass only to the right of the obstruction, the markings shall consist of a two-direction no-passing zone marking at least twice the length of the diagonal portion as determined by the appropriate taper formula (see Drawing A of Figure 3B-15).**

#### Option:

- 08 If traffic is required to pass only to the right of the obstruction, yellow diagonal crosshatch markings (see Section 3B.24) may be placed in the flush median area between the no-passing zone markings as shown in Drawings A and B of Figure 3B-15. Other markings, such as yellow delineators, yellow channelizing devices, yellow raised pavement markers, and white crosswalk pavement markings, may also be placed in the flush median area.

#### Standard:

- 09 **If traffic can pass either to the right or left of the obstruction, the markings shall consist of two channelizing lines diverging from the lane line, one to each side of the obstruction. In advance of the point of divergence, a wide solid white line or normal solid double white line shall be extended in place of the broken lane line for a distance equal to the length of the diverging lines (see Drawing C of Figure 3B-15).**

#### Option:

- 10 If traffic can pass either to the right or left of the obstruction, additional white chevron crosshatch markings (see Section 3B.24) may be placed in the flush median area between the channelizing lines as shown in Drawing C of Figure 3B-15. Other markings, such as white delineators, white channelizing devices, white raised pavement markers, and white crosswalk markings may also be placed in the flush median area.

### Section 3B.11 Raised Pavement Markers – General

#### Standard:

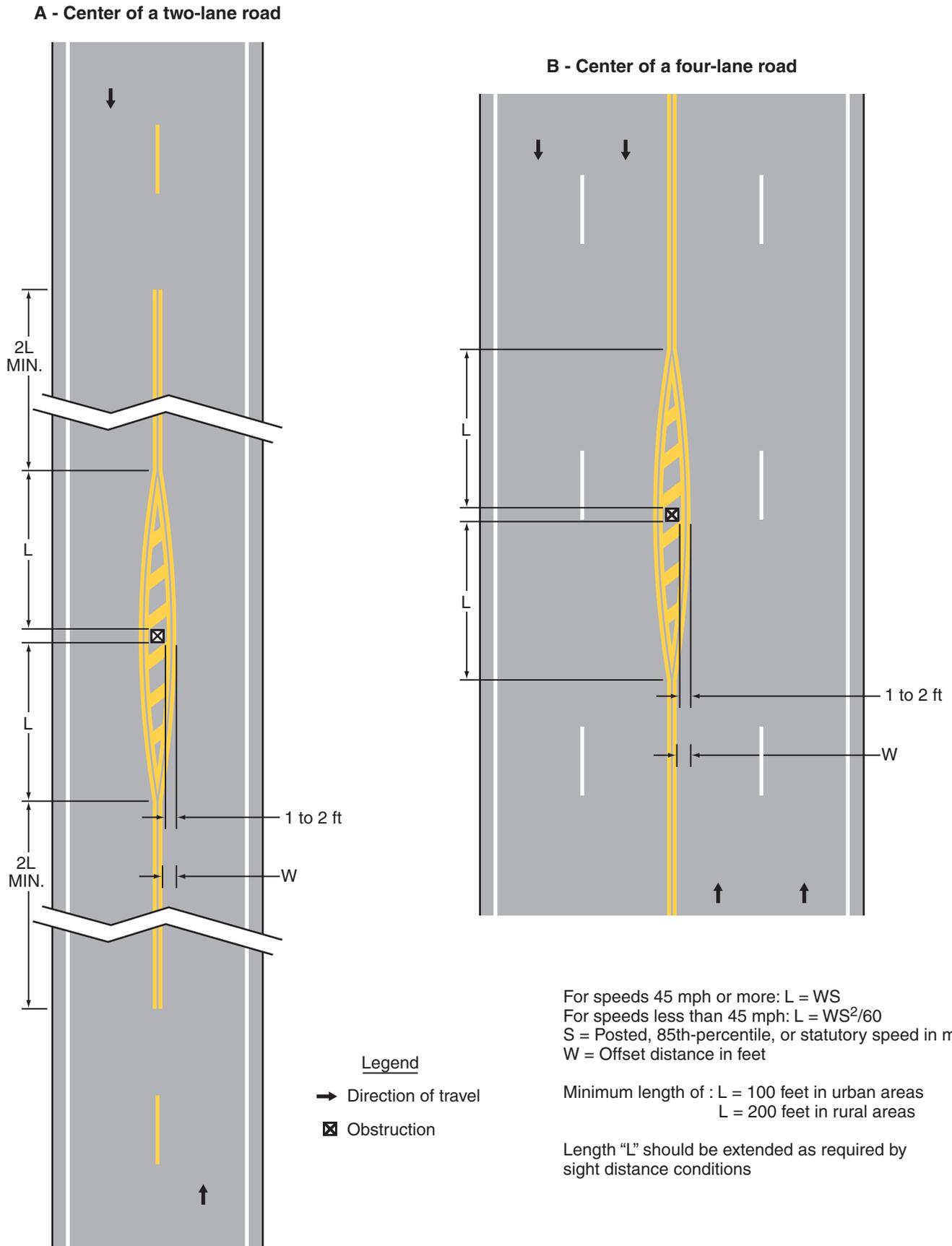
- 01 **The color of raised pavement markers under both daylight and nighttime conditions shall conform to the color of the marking for which they serve as a positioning guide, or for which they supplement or substitute.**

#### Option:

- 02 The side of a raised pavement marker that is visible to traffic proceeding in the wrong direction may be red (see Section 3A.05).

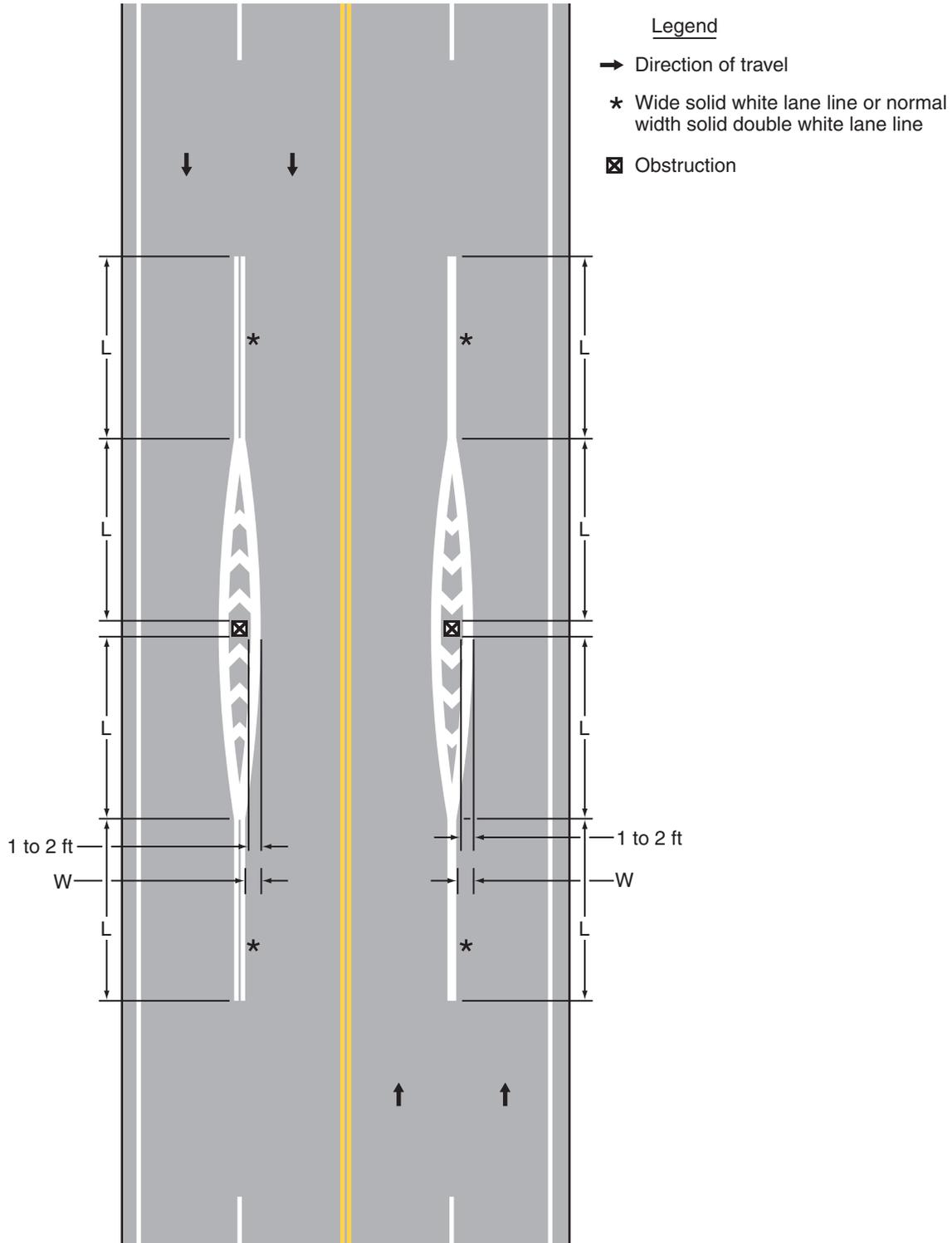
- 03 Retroreflective or internally illuminated raised pavement markers may be used in the roadway immediately adjacent to curbed approach ends of raised medians and curbs of islands, or on top of such curbs (see Section 3B.23).

**Figure 3B-15. Examples of Applications of Markings for Obstructions in the Roadway**  
(Sheet 1 of 2)



**Figure 3B-15. Examples of Applications of Markings for Obstructions in the Roadway**  
(Sheet 2 of 2)

**C - Traffic passing in the same direction on both sides of an obstruction**



For speeds of 45 mph or more:  $L = WS$   
 For speeds of less than 45 mph:  $L = WS^2/60$   
 S = Posted, 85th-percentile, or statutory speed in mph  
 W = Offset distance in feet

Minimum length of: L = 100 feet in urban areas  
 L = 200 feet in rural areas

Length "L" should be extended as required by sight distance conditions

Support:

04 Retroreflective and internally illuminated raised pavement markers are available in mono-directional and bidirectional configurations. The bidirectional marker is capable of displaying the applicable color for each direction of travel.

05 Blue raised pavement markers are sometimes used in the roadway to help emergency personnel locate fire hydrants.

**Standard:**

06 **When used, internally illuminated raised pavement markers shall be steadily illuminated and shall not be flashed.**

Support:

07 Flashing raised pavement markers are considered to be In-Roadway Lights (see Chapter 4N).

*Guidance:*

08 *Non-retroreflective raised pavement markers should not be used alone, without supplemental retroreflective or internally illuminated markers, as a substitute for other types of pavement markings.*

09 *Directional configurations should be used to maximize correct information and to minimize confusing information provided to the road user. Directional configurations also should be used to avoid confusion resulting from visibility of markers that do not apply to the road user.*

10 *The spacing of raised pavement markers used to supplement or substitute for other types of longitudinal markings should correspond with the pattern of broken lines for which the markers supplement or substitute.*

**Standard:**

11 **The value of N cited in Sections 3B.12 through 3B.14 for the spacing of raised pavement markers shall equal the length of one line segment plus one gap of the broken lines used on the highway.**

Option:

12 For additional emphasis, retroreflective raised pavement markers may be spaced closer than described in Sections 3B.12 through 3B.14, as determined by engineering judgment or engineering study.

Support:

13 Figures 9-20 through 9-22 in the “Traffic Control Devices Handbook” (see Section 1A.11) contain additional information regarding the spacing of raised pavement markers on longitudinal markings.

### **Section 3B.12 Raised Pavement Markers as Vehicle Positioning Guides with Other Longitudinal Markings**

Option:

01 Retroreflective or internally illuminated raised pavement markers may be used as positioning guides with longitudinal line markings without necessarily conveying information to the road user about passing or lane-use restrictions. In such applications, markers may be positioned in line with or immediately adjacent to a single line marking, or positioned between the two lines of a double center line or double lane line marking.

*Guidance:*

02 *The spacing for such applications should be  $2N$ , where  $N$  equals the length of one line segment plus one gap (see Section 3B.11).*

Option:

03 Where it is desired to alert the road user to changes in the travel path, such as on sharp curves or on transitions that reduce the number of lanes or that shift traffic laterally, the spacing may be reduced to  $N$  or less.

04 On freeways and expressways, the spacing may be increased to  $3N$  for relatively straight and level roadway segments where engineering judgment indicates that such spacing will provide adequate delineation under wet night conditions.

### **Section 3B.13 Raised Pavement Markers Supplementing Other Markings**

*Guidance:*

01 *The use of retroreflective or internally illuminated raised pavement markers for supplementing longitudinal line markings should comply with the following:*

#### *A. Lateral Positioning*

1. *When supplementing double line markings, pairs of raised pavement markers placed laterally in line with or immediately outside of the two lines should be used.*
2. *When supplementing wide line markings, pairs of raised pavement markers placed laterally adjacent to each other should be used.*

### B. Longitudinal Spacing

1. When supplementing solid line markings, raised pavement markers at a spacing no greater than  $N$  (see Section 3B.11) should be used, except that when supplementing channelizing lines or edge line markings, a spacing of no greater than  $N/2$  should be used.
2. When supplementing broken line markings, a spacing no greater than  $3N$  should be used. However, when supplementing broken line markings identifying reversible lanes, a spacing of no greater than  $N$  should be used.
3. When supplementing dotted lane line markings, a spacing appropriate for the application should be used.
4. When supplementing longitudinal line extension markings through at-grade intersections, one raised pavement marker for each short line segment should be used.
5. When supplementing line extensions through freeway interchanges, a spacing of no greater than  $N$  should be used.

02 *Raised pavement markers should not supplement right-hand edge lines unless an engineering study or engineering judgment indicates the benefits of enhanced delineation of a curve or other location would outweigh possible impacts on bicycles using the shoulder, and the spacing of raised pavement markers on the right-hand edge is close enough to avoid misinterpretation as a broken line during wet night conditions.*

#### Option:

03 Raised pavement markers also may be used to supplement other markings such as channelizing islands, gore areas, approaches to obstructions, or wrong-way arrows.

04 To improve the visibility of horizontal curves, center lines may be supplemented with retroreflective or internally illuminated raised pavement markers for the entire curved section as well as for a distance in advance of the curve that approximates 5 seconds of travel time.

### Section 3B.14 Raised Pavement Markers Substituting for Pavement Markings

#### Option:

01 Retroreflective or internally illuminated raised pavement markers, or non-retroreflective raised pavement markers supplemented by retroreflective or internally illuminated markers, may be substituted for markings of other types.

#### Guidance:

02 *If used, the pattern of the raised pavement markers should simulate the pattern of the markings for which they substitute.*

#### Standard:

03 **If raised pavement markers are used to substitute for broken line markings, a group of three to five markers equally spaced at a distance no greater than  $N/8$  (see Section 3B.11) shall be used. If  $N$  is other than 40 feet, the markers shall be equally spaced over the line segment length (at  $1/2$  points for three markers, at  $1/3$  points for four markers, and at  $1/4$  points for five markers). At least one retroreflective or internally illuminated marker per group shall be used or a retroreflective or internally illuminated marker shall be installed midway in each gap between successive groups of non-retroreflective markers.**

04 **When raised pavement markers substitute for solid line markings, the markers shall be equally spaced at no greater than  $N/4$ , with retroreflective or internally illuminated units at a spacing no greater than  $N/2$ .**

#### Guidance:

05 *Raised pavement markers should not substitute for right-hand edge line markings unless an engineering study or engineering judgment indicates the benefits of enhanced delineation of a curve or other location would outweigh possible impacts on bicycles using the shoulder, and the spacing of raised pavement markers on the right-hand edge line is close enough to avoid misinterpretation as a broken line during wet night conditions.*

#### Standard:

06 **When raised pavement markers substitute for dotted lines, they shall be spaced at no greater than  $N/4$ , with not less than one raised pavement marker per dotted line segment. At least one raised marker every  $N$  shall be retroreflective or internally illuminated.**

#### Option:

07 When substituting for wide lines, raised pavement markers may be placed laterally adjacent to each other to simulate the width of the line.

### Section 3B.15 Transverse Markings

#### Standard:

- 01 **Transverse markings, which include shoulder markings, word and symbol markings, arrows, stop lines, yield lines, crosswalk lines, speed measurement markings, speed reduction markings, speed hump markings, parking space markings, and others, shall be white unless otherwise provided in this Manual.**

#### Guidance:

- 02 *Because of the low approach angle at which pavement markings are viewed, transverse lines should be proportioned to provide visibility at least equal to that of longitudinal lines.*

### Section 3B.16 Stop and Yield Lines

#### Guidance:

- 01 *Stop lines should be used to indicate the point behind which vehicles are required to stop in compliance with a traffic control signal.*

#### Option:

- 02 Stop lines may be used to indicate the point behind which vehicles are required to stop in compliance with a STOP (R1-1) sign, a Stop Here For Pedestrians (R1-5b or R1-5c) sign, or some other traffic control device that requires vehicles to stop, except YIELD signs that are not associated with passive grade crossings.
- 03 Yield lines may be used to indicate the point behind which vehicles are required to yield in compliance with a YIELD (R1-2) sign or a Yield Here To Pedestrians (R1-5 or R1-5a) sign.

#### Standard:

- 04 **Except as provided in Section 8B.28, stop lines shall not be used at locations where drivers are required to yield in compliance with a YIELD (R1-2) sign or a Yield Here To Pedestrians (R1-5 or R1-5a) sign or at locations on uncontrolled approaches where drivers are required by State law to yield to pedestrians.**
- 05 **Yield lines shall not be used at locations where drivers are required to stop in compliance with a STOP (R1-1) sign, a Stop Here For Pedestrians (R1-5b or R1-5c) sign, a traffic control signal, or some other traffic control device.**
- 06 **Stop lines shall consist of solid white lines extending across approach lanes to indicate the point at which the stop is intended or required to be made.**
- 07 **Yield lines (see Figure 3B-16) shall consist of a row of solid white isosceles triangles pointing toward approaching vehicles extending across approach lanes to indicate the point at which the yield is intended or required to be made.**

#### Guidance:

- 08 *Stop lines should be 12 to 24 inches wide.*
- 09 *The individual triangles comprising the yield line should have a base of 12 to 24 inches wide and a height equal to 1.5 times the base. The space between the triangles should be 3 to 12 inches.*
- 10 *If used, stop and yield lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line at controlled intersections, except for yield lines at roundabouts as provided for in Section 3C.04 and at midblock crosswalks. In the absence of a marked crosswalk, the stop line or yield line should be placed at the desired stopping or yielding point, but should not be placed more than 30 feet or less than 4 feet from the nearest edge of the intersecting traveled way.*
- 11 *Stop lines at midblock signalized locations should be placed at least 40 feet in advance of the nearest signal indication (see Section 4D.14).*
- 12 *If yield or stop lines are used at a crosswalk that crosses an uncontrolled multi-lane approach, the yield lines or stop lines should be placed 20 to 50 feet in advance of the nearest crosswalk line, and parking should be prohibited in the area between the yield or stop line and the crosswalk (see Figure 3B-17).*

#### Standard:

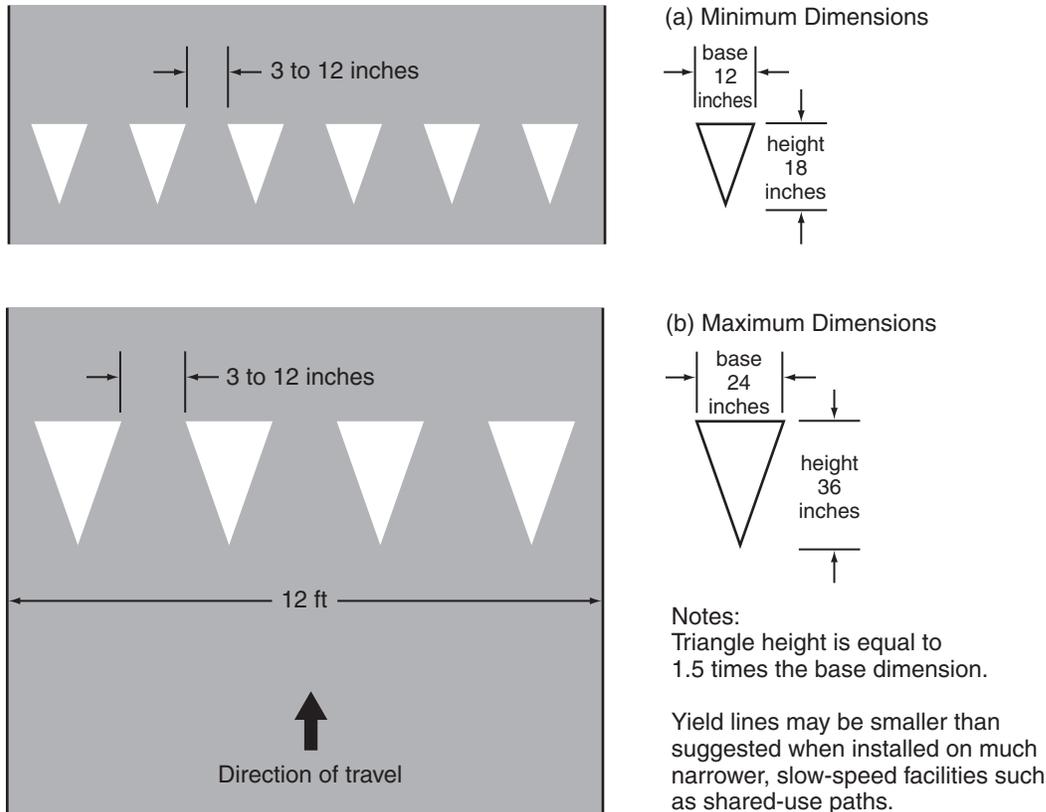
- 13 **If yield (stop) lines are used at a crosswalk that crosses an uncontrolled multi-lane approach, Yield Here To (Stop Here For) Pedestrians (R1-5 series) signs (see Section 2B.11) shall be used.**

#### Guidance:

- 14 *Yield (stop) lines and Yield Here To (Stop Here For) Pedestrians signs should not be used in advance of crosswalks that cross an approach to or departure from a roundabout.*

#### Support:

- 15 When drivers yield or stop too close to crosswalks that cross uncontrolled multi-lane approaches, they place pedestrians at risk by blocking other drivers' views of pedestrians and by blocking pedestrians' views of vehicles approaching in the other lanes.

**Figure 3B-16. Recommended Yield Line Layouts****Option:**

- 16 Stop and yield lines may be staggered longitudinally on a lane-by-lane basis (see Drawing D of Figure 3B-13).

**Support:**

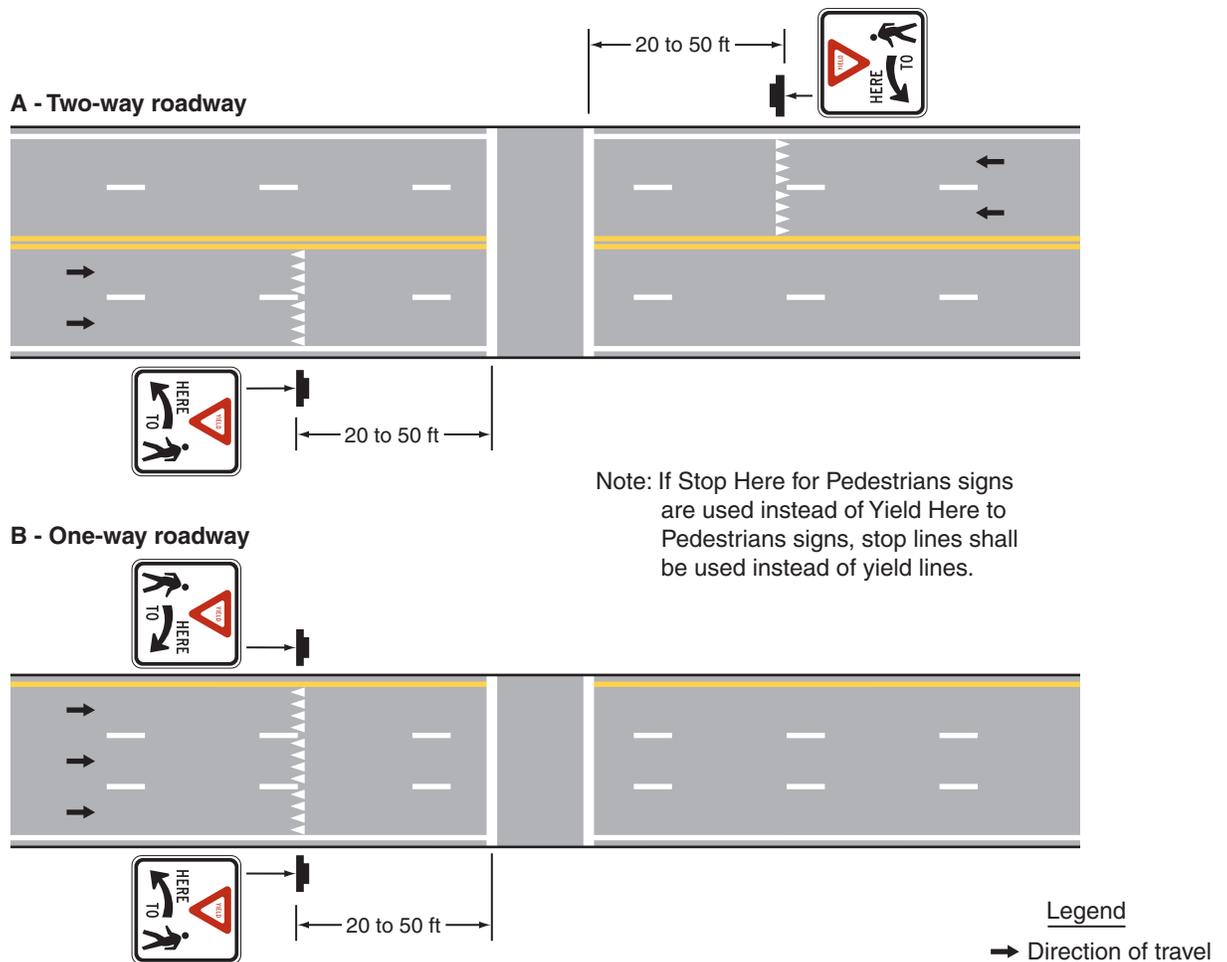
- 17 Staggered stop lines and staggered yield lines can improve the driver's view of pedestrians, provide better sight distance for turning vehicles, and increase the turning radius for left-turning vehicles.
- 18 Section 8B.28 contains information regarding the use of stop lines and yield lines at grade crossings.

**Section 3B.17 Do Not Block Intersection Markings****Option:**

- 01 Do Not Block Intersection markings may be used to mark the edges of an intersection area that is in close proximity to a signalized intersection, railroad crossing, or other nearby traffic control that might cause vehicles to stop within the intersection and impede other traffic entering the intersection. If authorized by law, Do Not Block Intersection markings with appropriate signs may also be used at other locations.

**Standard:**

- 02 **If used, Do Not Block Intersection markings (see Figure 3B-18) shall consist of one of the following alternatives:**
- A. Wide solid white lines that outline the intersection area that vehicles must not block;
  - B. Wide solid white lines that outline the intersection area that vehicles must not block and a white word message such as DO NOT BLOCK or KEEP CLEAR;
  - C. Wide solid white lines that outline the intersection area that vehicles must not block and white cross-hatching within the intersection area; or
  - D. A white word message, such as DO NOT BLOCK or KEEP CLEAR, within the intersection area that vehicles must not block.
- 03 **Do Not Block Intersection markings shall be accompanied by one or more DO NOT BLOCK INTERSECTION (DRIVEWAY) (CROSSING) (R10-7) signs (see Section 2B.53), one or more DO NOT STOP ON TRACKS (R8-8) signs (see Section 8B.09), or one or more similar signs.**

**Figure 3B-17. Examples of Yield Lines at Unsignalized Midblock Crosswalks****Section 3B.18 Crosswalk Markings**

Support:

- 01 Crosswalk markings provide guidance for pedestrians who are crossing roadways by defining and delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops.
- 02 In conjunction with signs and other measures, crosswalk markings help to alert road users of a designated pedestrian crossing point across roadways at locations that are not controlled by traffic control signals or STOP or YIELD signs.
- 03 At non-intersection locations, crosswalk markings legally establish the crosswalk.

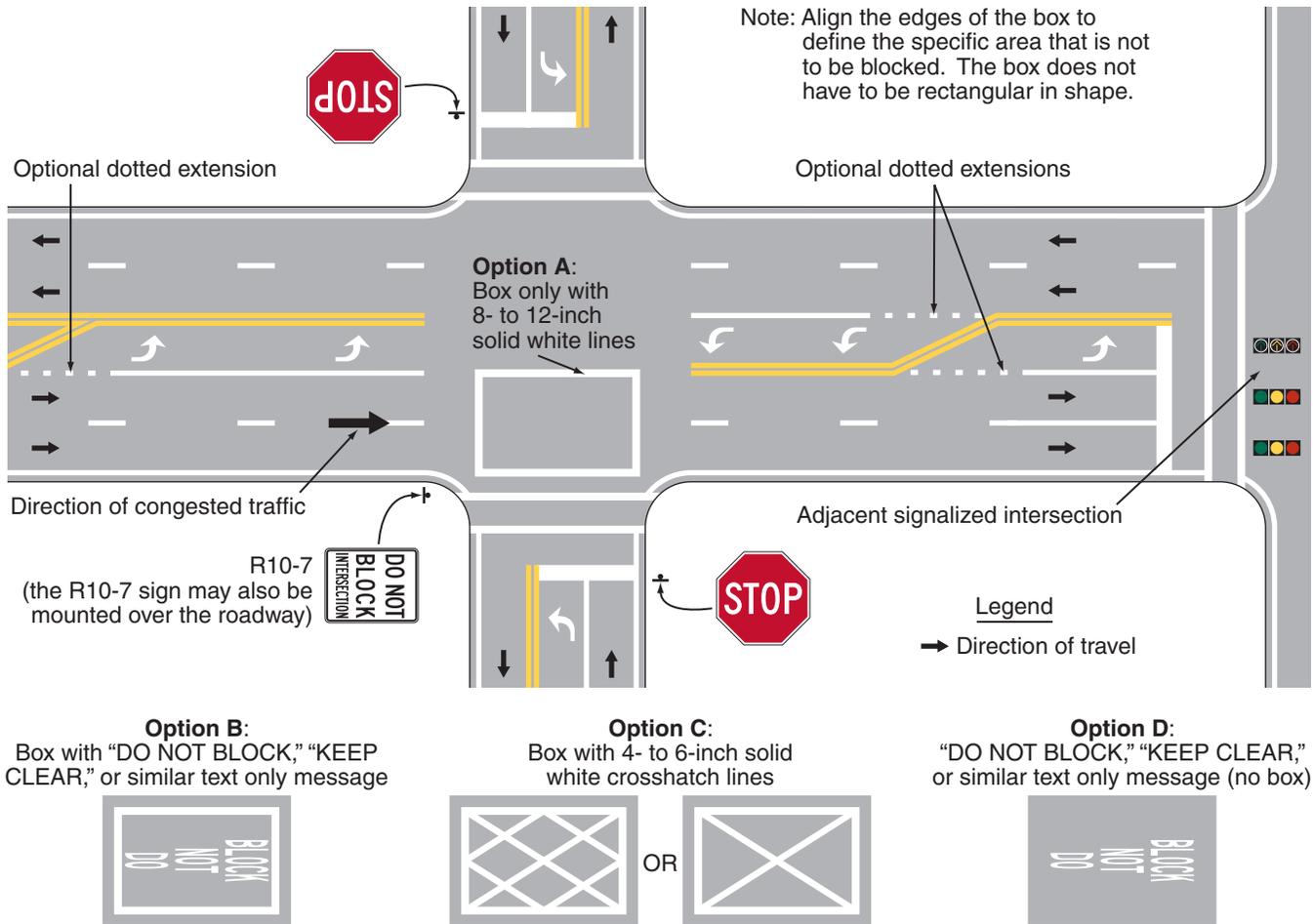
**Standard:**

- 04 **When crosswalk lines are used, they shall consist of solid white lines that mark the crosswalk. They shall not be less than 6 inches or greater than 24 inches in width.**

Guidance:

- 05 *If transverse lines are used to mark a crosswalk, the gap between the lines should not be less than 6 feet. If diagonal or longitudinal lines are used without transverse lines to mark a crosswalk, the crosswalk should be not less than 6 feet wide.*
- 06 *Crosswalk lines, if used on both sides of the crosswalk, should extend across the full width of pavement or to the edge of the intersecting crosswalk to discourage diagonal walking between crosswalks (see Figures 3B-17 and 3B-19).*
- 07 *At locations controlled by traffic control signals or on approaches controlled by STOP or YIELD signs, crosswalk lines should be installed where engineering judgment indicates they are needed to direct pedestrians to the proper crossing path(s).*

**Figure 3B-18. Do Not Block Intersection Markings**

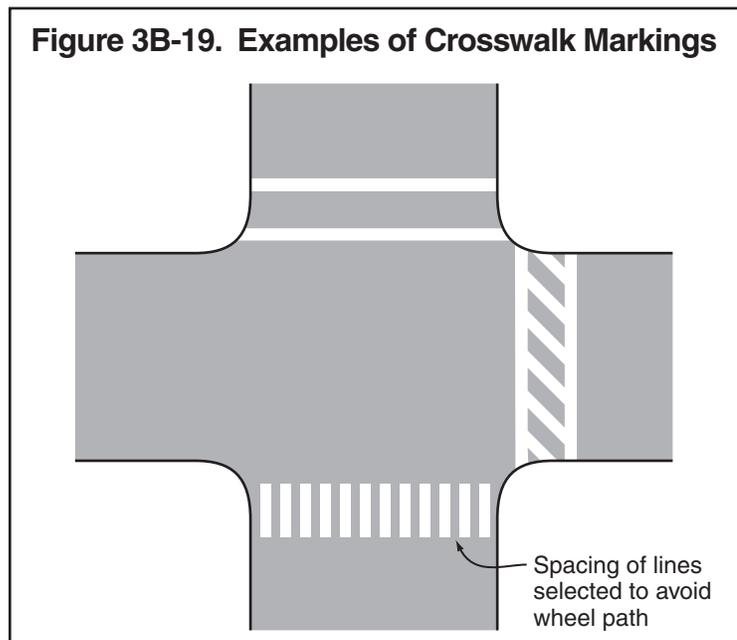


08 *Crosswalk lines should not be used indiscriminately. An engineering study should be performed before a marked crosswalk is installed at a location away from a traffic control signal or an approach controlled by a STOP or YIELD sign. The engineering study should consider the number of lanes, the presence of a median, the distance from adjacent signalized intersections, the pedestrian volumes and delays, the average daily traffic (ADT), the posted or statutory speed limit or 85<sup>th</sup>-percentile speed, the geometry of the location, the possible consolidation of multiple crossing points, the availability of street lighting, and other appropriate factors.*

09 *New marked crosswalks alone, without other measures designed to reduce traffic speeds, shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, should not be installed across uncontrolled roadways where the speed limit exceeds 40 mph and either:*

- A. *The roadway has four or more lanes of travel without a raised median or pedestrian refuge island and an ADT of 12,000 vehicles per day or greater; or*
- B. *The roadway has four or more lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater.*

**Figure 3B-19. Examples of Crosswalk Markings**



**Support:**

- 10 Chapter 4F contains information on Pedestrian Hybrid Beacons. Section 4L.03 contains information regarding Warning Beacons to provide active warning of a pedestrian's presence. Section 4N.02 contains information regarding In-Roadway Warning Lights at crosswalks. Chapter 7D contains information regarding school crossing supervision.

**Guidance:**

- 11 *Because non-intersection pedestrian crossings are generally unexpected by the road user, warning signs (see Section 2C.50) should be installed for all marked crosswalks at non-intersection locations and adequate visibility should be provided by parking prohibitions.*

**Support:**

- 12 Section 3B.16 contains information regarding placement of stop line markings near crosswalk markings.

**Option:**

- 13 For added visibility, the area of the crosswalk may be marked with white diagonal lines at a 45-degree angle to the line of the crosswalk or with white longitudinal lines parallel to traffic flow as shown in Figure 3B-19.

- 14 When diagonal or longitudinal lines are used to mark a crosswalk, the transverse crosswalk lines may be omitted. This type of marking may be used at locations where substantial numbers of pedestrians cross without any other traffic control device, at locations where physical conditions are such that added visibility of the crosswalk is desired, or at places where a pedestrian crosswalk might not be expected.

**Guidance:**

- 15 *If used, the diagonal or longitudinal lines should be 12 to 24 inches wide and separated by gaps of 12 to 60 inches. The design of the lines and gaps should avoid the wheel paths if possible, and the gap between the lines should not exceed 2.5 times the width of the diagonal or longitudinal lines.*

**Option:**

- 16 When an exclusive pedestrian phase that permits diagonal crossing of an intersection is provided at a traffic control signal, a marking as shown in Figure 3B-20 may be used for the crosswalk.

**Guidance:**

- 17 *Crosswalk markings should be located so that the curb ramps are within the extension of the crosswalk markings.*

**Support:**

- 18 Detectable warning surfaces mark boundaries between pedestrian and vehicular ways where there is no raised curb. Detectable warning surfaces are required by 49 CFR, Part 37 and by the Americans with Disabilities Act (ADA) where curb ramps are constructed at the junction of sidewalks and the roadway, for marked and unmarked crosswalks. Detectable warning surfaces contrast visually with adjacent walking surfaces, either light-on-dark, or dark-on-light. The "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (see Section 1A.11) contains specifications for design and placement of detectable warning surfaces.

**Section 3B.19 Parking Space Markings****Support:**

- 01 Marking of parking space boundaries encourages more orderly and efficient use of parking spaces where parking turnover is substantial. Parking space markings tend to prevent encroachment into fire hydrant zones, bus stops, loading zones, approaches to intersections, curb ramps, and clearance spaces for islands and other zones where parking is restricted. Examples of parking space markings are shown in Figure 3B-21.

**Standard:**

- 02 **Parking space markings shall be white.**

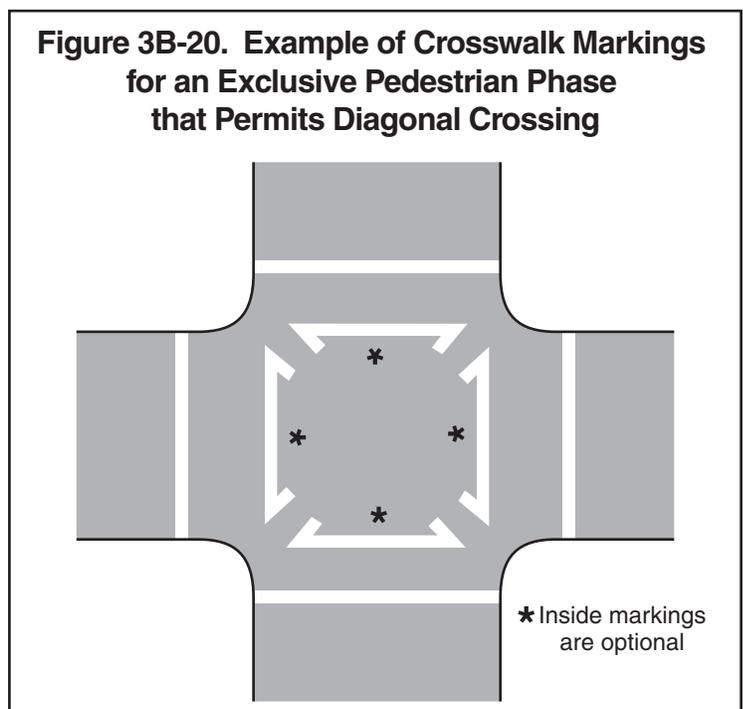
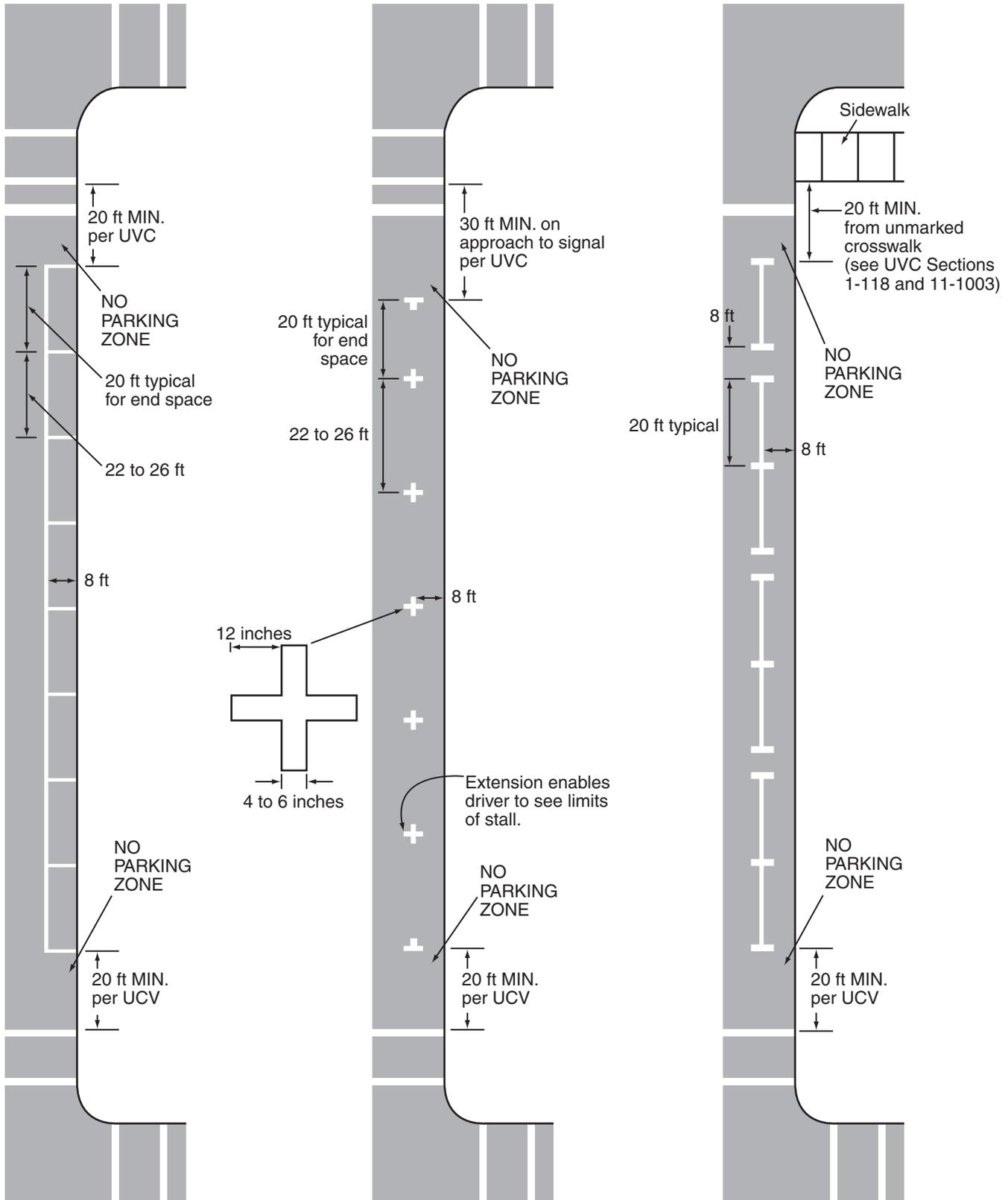


Figure 3B-21. Examples of Parking Space Markings



Option:

- 03 Blue lines may supplement white parking space markings of each parking space designated for use only by persons with disabilities.

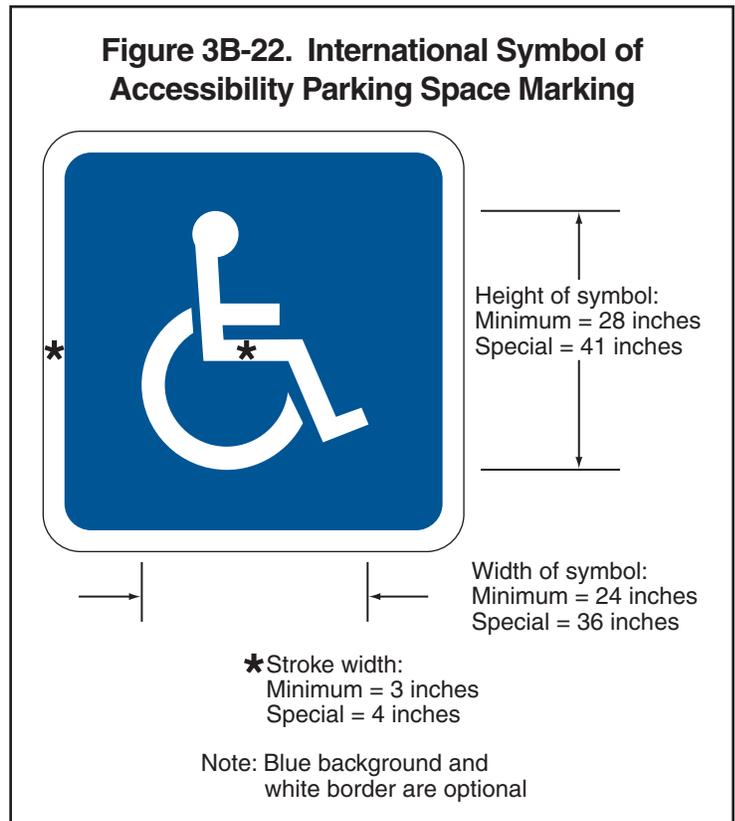
Support:

- 04 Additional parking space markings for the purpose of designating spaces for use only by persons with disabilities are discussed in Section 3B.20 and illustrated in Figure 3B-22. The design and layout of accessible parking spaces for persons with disabilities is provided in the “Americans with Disabilities Act Accessibility Guidelines (ADAAG)” (see Section 1A.11).

**Section 3B.20 Pavement Word, Symbol, and Arrow Markings**

Support:

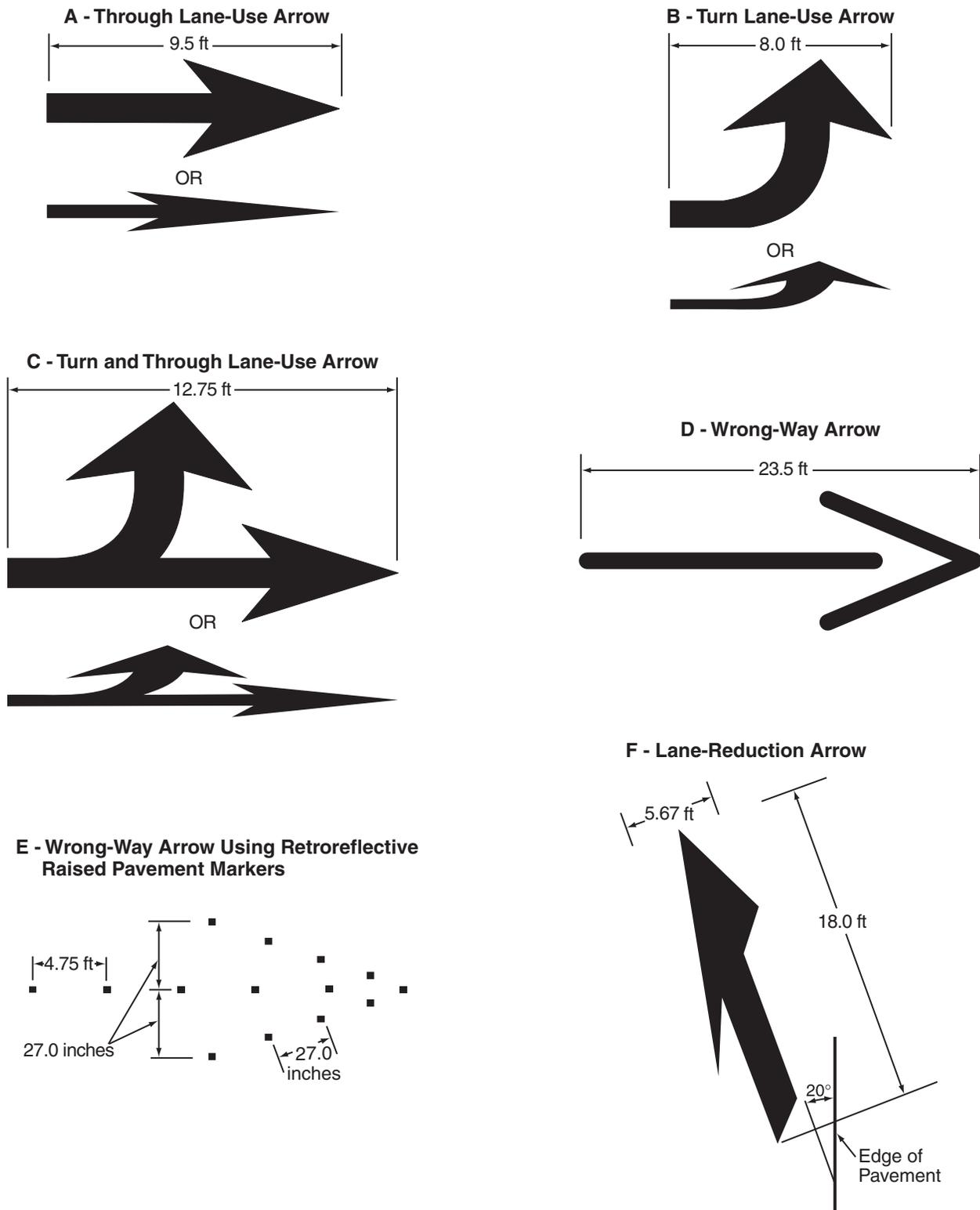
- 01 Word, symbol, and arrow markings on the pavement are used for the purpose of guiding, warning, or regulating traffic. These pavement markings can be helpful to road users in some locations by supplementing signs and providing additional emphasis for important regulatory, warning, or guidance messages, because the markings do not require diversion of the road user’s attention from the roadway surface. Symbol messages are preferable to word messages. Examples of standard word and arrow pavement markings are shown in Figures 3B-23 and 3B-24.



**Figure 3B-23. Example of Elongated Letters for Word Pavement Markings**



**Figure 3B-24. Examples of Standard Arrows for Pavement Markings**



**Notes:**

1. Typical sizes for normal installation; sizes may be reduced approximately one-third for low-speed urban conditions; larger sizes may be needed for freeways, above average speeds, and other critical locations.
2. The narrow elongated arrow designs shown in Drawings A, B, and C are optional.
3. For proper proportion, see the Pavement Markings chapter of the "Standard Highway Signs and Markings" book (see Section 1A.11).

## Option:

- 02 Word, symbol, and arrow markings, including those contained in the “Standard Highway Signs and Markings” book (see Section 1A.11), may be used as determined by engineering judgment to supplement signs and/or to provide additional emphasis for regulatory, warning, or guidance messages. Among the word, symbol, and arrow markings that may be used are the following:
- A. Regulatory:
    1. STOP
    2. YIELD
    3. RIGHT (LEFT) TURN ONLY
    4. 25 MPH
    5. Lane-use and wrong-way arrows
    6. Diamond symbol for HOV lanes
    7. Other preferential lane word markings
  - B. Warning:
    1. STOP AHEAD
    2. YIELD AHEAD
    3. YIELD AHEAD triangle symbol
    4. SCHOOL XING
    5. SIGNAL AHEAD
    6. PED XING
    7. SCHOOL
    8. R X R
    9. BUMP
    10. HUMP
    11. Lane-reduction arrows
  - C. Guide:
    1. Route numbers (route shield pavement marking symbols and/or words such as I-81, US 40, STATE 135, or ROUTE 10)
    2. Cardinal directions (NORTH, SOUTH, EAST, or WEST)
    3. TO
    4. Destination names or abbreviations thereof

**Standard:**

- 03 **Word, symbol, and arrow markings shall be white, except as otherwise provided in this Section.**
- 04 **Pavement marking letters, numerals, symbols, and arrows shall be installed in accordance with the design details in the Pavement Markings chapter of the “Standard Highway Signs and Markings” book (see Section 1A.11).**

*Guidance:*

- 05 *Letters and numerals should be 6 feet or more in height.*
- 06 *Word and symbol markings should not exceed three lines of information.*
- 07 *If a pavement marking word message consists of more than one line of information, it should read in the direction of travel. The first word of the message should be nearest to the road user.*
- 08 *Except for the two opposing arrows of a two-way left-turn lane marking (see Figure 3B-7), the longitudinal space between word or symbol message markings, including arrow markings, should be at least four times the height of the characters for low-speed roads, but not more than ten times the height of the characters under any conditions.*
- 09 *The number of different word and symbol markings used should be minimized to provide effective guidance and avoid misunderstanding.*
- 10 *Except for the SCHOOL word marking (see Section 7C.03), pavement word, symbol, and arrow markings should be no more than one lane in width.*
- 11 *Pavement word, symbol, and arrow markings should be proportionally scaled to fit within the width of the facility upon which they are applied.*

## Option:

- 12 On narrow, low-speed shared-use paths, the pavement words, symbols, and arrows may be smaller than suggested, but to the relative scale.

13 Pavement markings simulating Interstate, U.S., State, and other official highway route shield signs (see Figure 2D-3) with appropriate route numbers, but elongated for proper proportioning when viewed as a marking, may be used to guide road users to their destinations (see Figure 3B-25).

**Standard:**

14 Except at the ends of aisles in parking lots, the word STOP shall not be used on the pavement unless accompanied by a stop line (see Section 3B.16) and STOP sign (see Section 2B.05). At the ends of aisles in parking lots, the word STOP shall not be used on the pavement unless accompanied by a stop line.

15 The word STOP shall not be placed on the pavement in advance of a stop line, unless every vehicle is required to stop at all times.

**Option:**

16 A yield-ahead triangle symbol (see Figure 3B-26) or YIELD AHEAD word pavement marking may be used on approaches to intersections where the approaching traffic will encounter a YIELD sign at the intersection.

**Standard:**

17 The yield-ahead triangle symbol or YIELD AHEAD word pavement marking shall not be used unless a YIELD sign (see Section 2B.08) is in place at the intersection. The yield-ahead symbol marking shall be as shown in Figure 3B-26.

**Guidance:**

18 The International Symbol of Accessibility parking space marking (see Figure 3B-22) should be placed in each parking space designated for use by persons with disabilities.

**Option:**

19 A blue background with white border may supplement the wheelchair symbol as shown in Figure 3B-22.

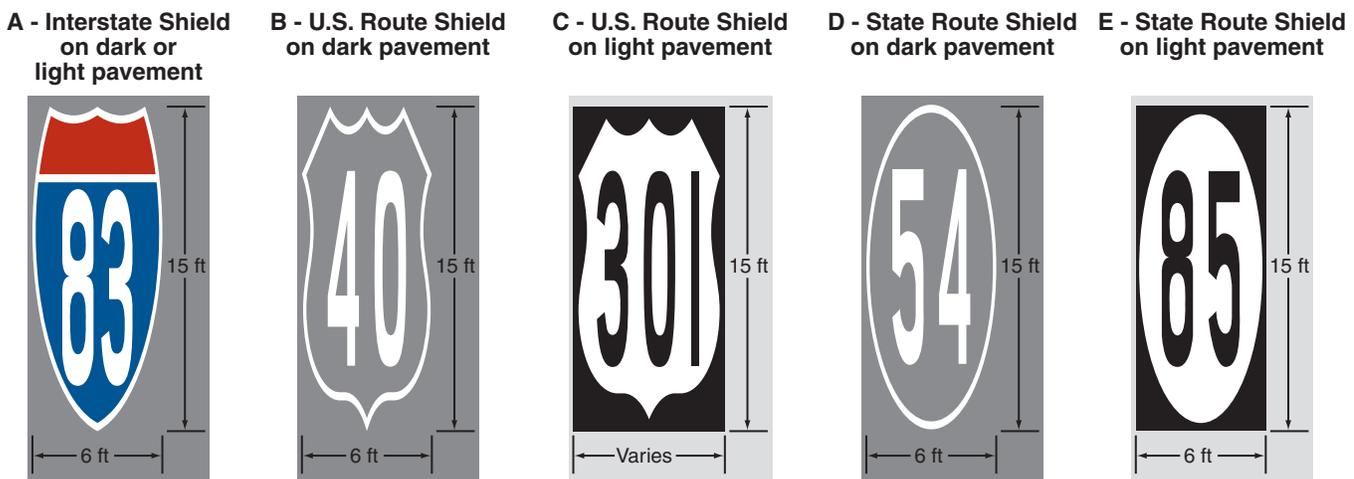
**Support:**

20 Lane-use arrow markings (see Figure 3B-24) are used to indicate the mandatory or permissible movements in certain lanes (see Figure 3B-27) and in two-way left-turn lanes (see Figure 3B-7).

**Guidance:**

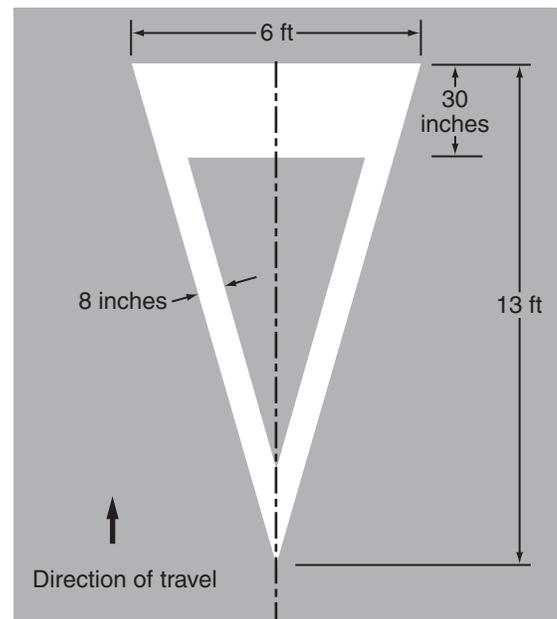
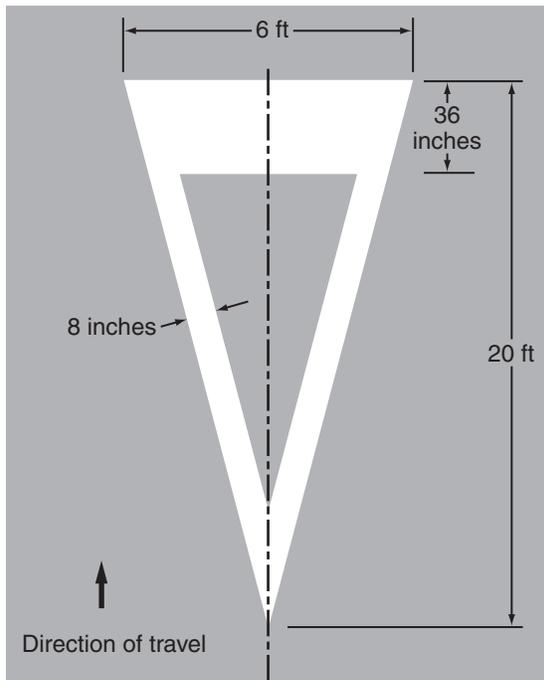
21 Lane-use arrow markings (see Figure 3B-24) should be used in lanes designated for the exclusive use of a turning movement, including turn bays, except where engineering judgment determines that physical conditions or other markings (such as a dotted extension of the lane line through the taper into the turn bay) clearly discourage unintentional use of a turn bay by through vehicles. Lane-use arrow markings should also be used in lanes from which movements are allowed that are contrary to the normal rules of the road (see Drawing B of Figure 3B-13). When used in turn lanes, at least two arrows should be used, one at or near the upstream end of the full-width turn lane and one an appropriate distance upstream from the stop line or intersection (see Drawing A of Figure 3B-11).

**Figure 3B-25. Examples of Elongated Route Shields for Pavement Markings**



**Notes:**

1. See the "Standard Highway Signs and Markings" book for other sizes and details
2. Colors and elongated shapes simulating State route shield signs may be used for route shield pavement markings where appropriate

**Figure 3B-26. Yield Ahead Triangle Symbols****A - Posted or Statutory Speed Limit of 45 mph or greater****B - Posted or Statutory Speed Limit of less than 45 mph****Option:**

- 22 An additional arrow or arrows may be used in a turn lane. When arrows are used for a short turn lane, the second (downstream) arrow may be omitted based on engineering judgment.

**Guidance:**

- 23 Where opposing offset channelized left-turn lanes exist, lane-use arrow markings should be placed near the downstream terminus of the offset left-turn lanes to reduce wrong-way movements (see Figure 2B-17).

**Support:**

- 24 An arrow at the downstream end of a turn lane can help to prevent wrong way movements.

**Standard:**

- 25 Where through lanes approaching an intersection become mandatory turn lanes, lane-use arrow markings (see Figure 3B-24) shall be used and shall be accompanied by standard signs.

**Guidance:**

- 26 Where through lanes approaching an intersection become mandatory turn lanes, ONLY word markings (see Figure 3B-23) should be used in addition to the required lane-use arrow markings and signs (see Sections 2B.19 and 2B.20). These markings and signs should be placed well in advance of the turn and should be repeated as necessary to prevent entrapment and to help the road user select the appropriate lane in advance of reaching a queue of waiting vehicles (see Drawing A of Figure 3B-11).

**Option:**

- 27 On freeways or expressways where a through lane becomes a mandatory exit lane, lane-use arrow markings may be used on the approach to the exit in the dropped lane and in an adjacent optional through-or-exit lane if one exists.

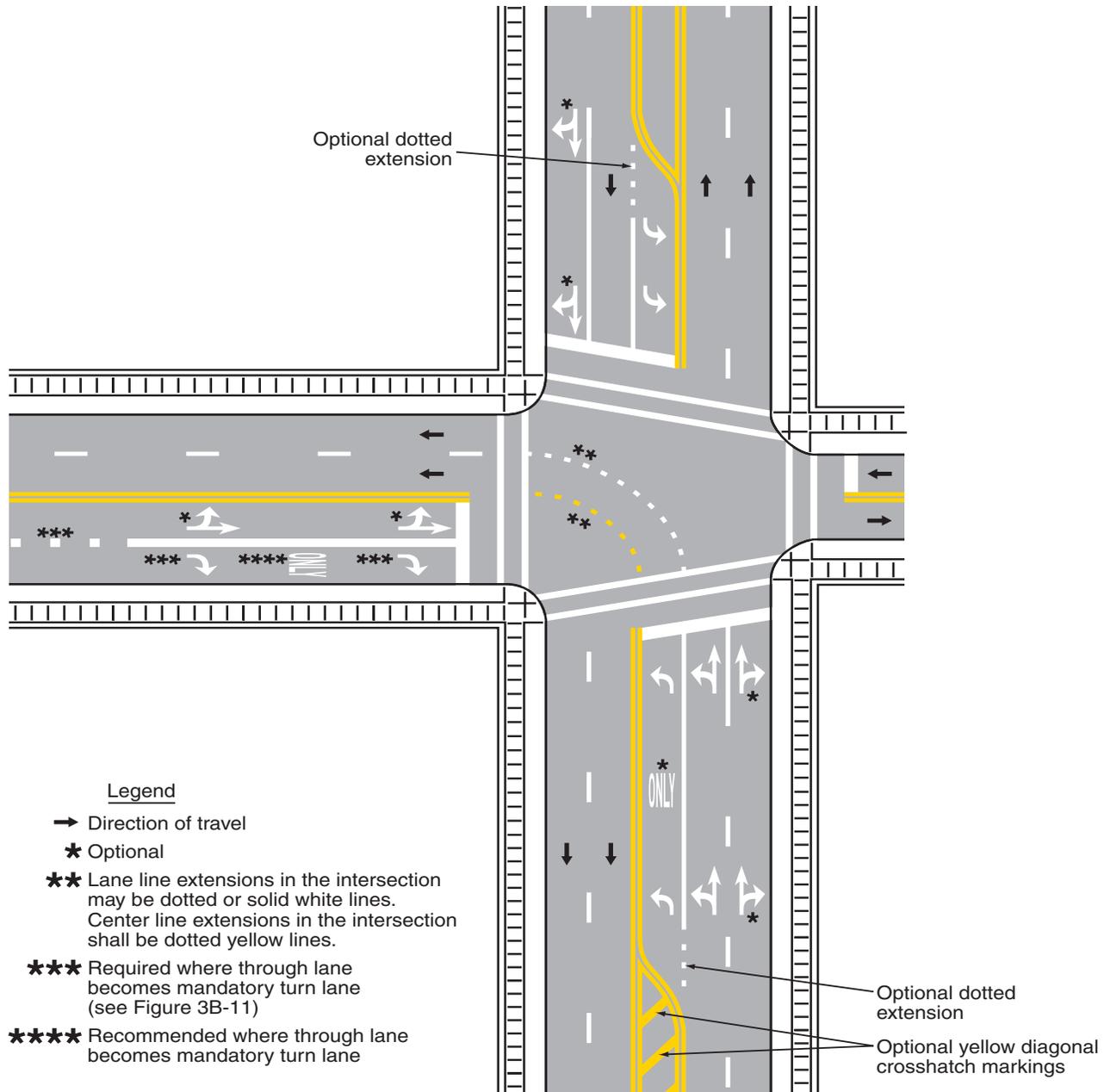
**Guidance:**

- 28 A two-way left-turn lane-use arrow pavement marking, with opposing arrows spaced as shown in Figure 3B-7, should be used at or just downstream from the beginning of a two-way left-turn lane.

**Option:**

- 29 Additional two-way left-turn lane-use arrow markings may be used at other locations along a two-way left-turn lane where engineering judgment determines that such additional markings are needed to emphasize the proper use of the lane.

**Figure 3B-27. Examples of Lane-Use Control Word and Arrow Pavement Markings**



**Standard:**

30 A single-direction lane-use arrow shall not be used in a lane bordered on both sides by yellow two-way left-turn lane longitudinal markings.

31 Lane-use, lane-reduction, and wrong-way arrow markings shall be designed as shown in Figure 3B-24 and in the “Standard Highway Signs and Markings” book (see Section 1A.11).

**Option:**

32 The ONLY word marking (see Figure 3B-23) may be used to supplement the lane-use arrow markings in lanes that are designated for the exclusive use of a single movement (see Figure 3B-27) or to supplement a preferential lane word or symbol marking (see Section 3D.01).

**Standard:**

33 The ONLY word marking shall not be used in a lane that is shared by more than one movement.

*Guidance:*

- 34 *Where a lane-reduction transition occurs on a roadway with a speed limit of 45 mph or more, the lane-reduction arrow markings shown in Drawing F in Figure 3B-24 should be used (see Figure 3B-14). Except for acceleration lanes, where a lane-reduction transition occurs on a roadway with a speed limit of less than 45 mph, the lane-reduction arrow markings shown in Drawing F in Figure 3B-24 should be used if determined to be appropriate based on engineering judgment.*

*Option:*

- 35 Lane-reduction arrow markings may be used in long acceleration lanes based on engineering judgment.

*Guidance:*

- 36 *Where crossroad channelization or ramp geometrics do not make wrong-way movements difficult, the appropriate lane-use arrow should be placed in each lane of an exit ramp near the crossroad terminal where it will be clearly visible to a potential wrong-way road user (see Figure 2B-18).*

*Option:*

- 37 The wrong-way arrow markings shown in Drawing D in Figure 3B-24 may be placed near the downstream terminus of a ramp as shown in Figures 2B-18 and 2B-19, or at other locations where lane-use arrows are not appropriate, to indicate the correct direction of traffic flow and to discourage drivers from traveling in the wrong direction.

**Section 3B.21 Speed Measurement Markings***Support:*

- 01 A speed measurement marking is a transverse marking placed on the roadway to assist the enforcement of speed regulations.

**Standard:**

- 02 **Speed measurement markings, if used, shall be white, and shall not be greater than 24 inches in width.**

*Option:*

- 03 Speed measurement markings may extend 24 inches on either side of the center line or 24 inches on either side of edge line markings at 1/4-mile intervals over a 1-mile length of roadway. When paved shoulders of sufficient width are available, the speed measurement markings may be placed entirely on these shoulders (see Drawing A of Figure 3B-10). Advisory signs may be used in conjunction with these markings.

**Section 3B.22 Speed Reduction Markings***Support:*

- 01 Speed reduction markings (see Figure 3B-28) are transverse markings that are placed on the roadway within a lane (along both edges of the lane) in a pattern of progressively reduced spacing to give drivers the impression that their speed is increasing. These markings might be placed in advance of an unexpectedly severe horizontal or vertical curve or other roadway feature where drivers need to decelerate prior to reaching the feature and where the desired reduction in speeds has not been achieved by the installation of warning signs and/or other traffic control devices.

*Guidance:*

- 02 *If used, speed reduction markings should be reserved for unexpected curves and should not be used on long tangent sections of roadway or in areas frequented mainly by local or familiar drivers, (e.g., school zones). If used, speed reduction markings should supplement the appropriate warning signs and other traffic control devices and should not substitute for these devices.*

**Standard:**

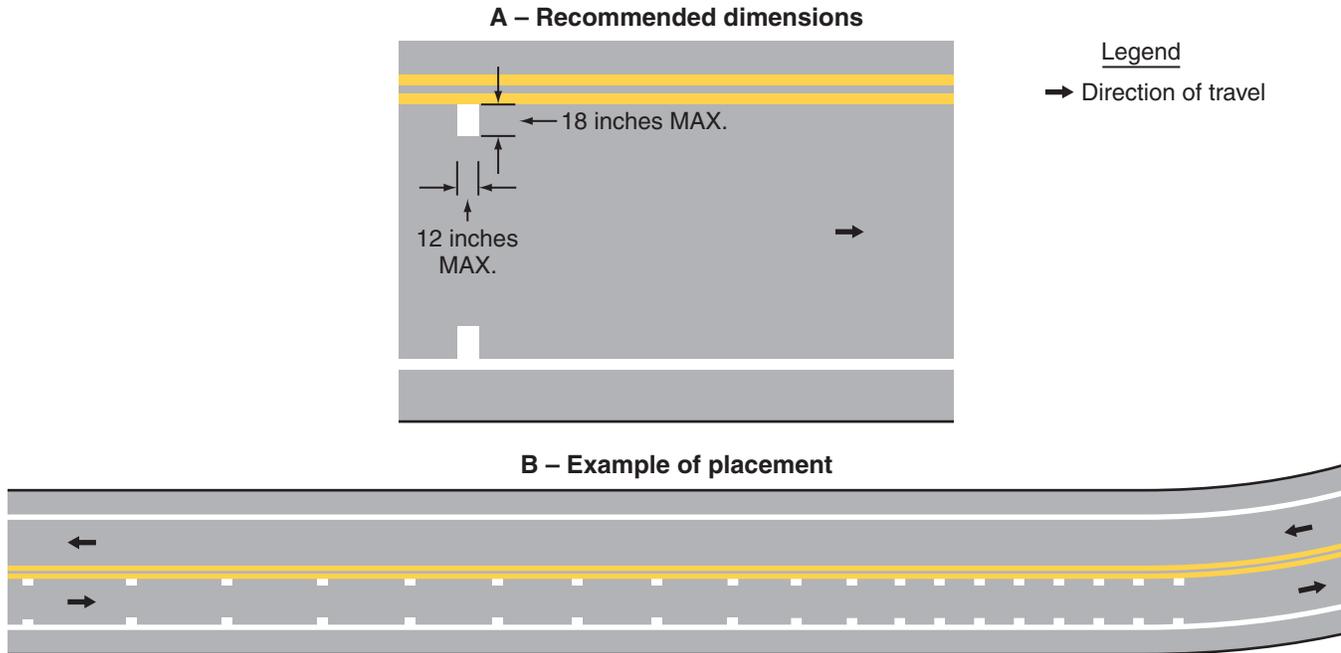
- 03 **If used, speed reduction markings shall be a series of white transverse lines on both sides of the lane that are perpendicular to the center line, edge line, or lane line. The longitudinal spacing between the markings shall be progressively reduced from the upstream to the downstream end of the marked portion of the lane.**

*Guidance:*

- 04 *Speed reduction markings should not be greater than 12 inches in width, and should not extend more than 18 inches into the lane.*

**Standard:**

- 05 **Speed reduction markings shall not be used in lanes that do not have a longitudinal line (center line, edge line, or lane line) on both sides of the lane.**

**Figure 3B-28. Example of the Application of Speed Reduction Markings**

### Section 3B.23 Curb Markings

Support:

- 01 Curb markings are most often used to indicate parking regulations or to delineate the curb.

**Standard:**

- 02 **Where curbs are marked to convey parking regulations in areas where curb markings are frequently obscured by snow and ice accumulation, signs shall be used with the curb markings except as provided in Paragraph 4.**

*Guidance:*

- 03 *Except as provided in Paragraph 4, when curb markings are used without signs to convey parking regulations, a legible word marking regarding the regulation (such as “No Parking” or “No Standing”) should be placed on the curb.*

Option:

- 04 Curb markings without word markings or signs may be used to convey a general prohibition by statute of parking within a specified distance of a STOP sign, YIELD sign, driveway, fire hydrant, or crosswalk.

- 05 Local highway agencies may prescribe special colors for curb markings to supplement standard signs for parking regulation.

Support:

- 06 Since yellow and white curb markings are frequently used for curb delineation and visibility, it is advisable to establish parking regulations through the installation of standard signs (see Sections 2B.46 through 2B.48).

**Standard:**

- 07 **Where curbs are marked for delineation or visibility purposes, the colors shall comply with the general principles of markings (see Section 3A.05).**

*Guidance:*

- 08 *Retroreflective solid yellow markings should be placed on the approach ends of raised medians and curbs of islands that are located in the line of traffic flow where the curb serves to channel traffic to the right of the obstruction.*

- 09 *Retroreflective solid white markings should be used when traffic is permitted to pass on either side of the island.*

Support:

- 10 Where the curbs of the islands become parallel to the direction of traffic flow, it is not necessary to mark the curbs unless an engineering study indicates the need for this type of delineation.

- 11 Curbs at openings in a continuous median island need not be marked unless an engineering study indicates the need for this type of marking.

Option:

- 12 Retroreflective or internally illuminated raised pavement markers of the appropriate color may be placed on the pavement in front of the curb and/or on the top of curbed as of raised medians and curbs of islands, as a supplement to or substitute for retroreflective curb markings used for delineation.

### **Section 3B.24 Chevron and Diagonal Crosshatch Markings**

Option:

- 01 Chevron and diagonal crosshatch markings may be used to discourage travel on certain paved areas, such as shoulders, gore areas, flush median areas between solid double yellow center line markings or between white channelizing lines approaching obstructions in the roadway (see Section 3B.10 and Figure 3B-15), between solid double yellow center line markings forming flush medians or channelized travel paths at intersections (see Figures 3B-2 and 3B-5), buffer spaces between preferential lanes and general-purpose lanes (see Figures 3D-2 and 3D-4), and at grade crossings (see Part 8).

**Standard:**

- 02 **When crosshatch markings are used in paved areas that separate traffic flows in the same general direction, they shall be white and they shall be shaped as chevron markings, with the point of each chevron facing toward approaching traffic, as shown in Figure 3B-8, Drawing A of Figure 3B-9, Figure 3B-10, and Drawing C of Figure 3B-15.**
- 03 **When crosshatch markings are used in paved areas that separate opposing directions of traffic, they shall be yellow diagonal markings that slant away from traffic in the adjacent travel lanes, as shown in Figures 3B-2 and 3B-5 and Drawings A and B of Figure 3B-15.**
- 04 **When crosshatch markings are used on paved shoulders, they shall be diagonal markings that slant away from traffic in the adjacent travel lane. The diagonal markings shall be yellow when used on the left-hand shoulders of the roadways of divided highways and on the left-hand shoulders of one-way streets or ramps. The diagonal markings shall be white when used on right-hand shoulders.**

*Guidance:*

- 05 *The chevrons and diagonal lines used for crosshatch markings should be at least 12 inches wide for roadways having a posted or statutory speed limit of 45 mph or greater, and at least 8 inches wide for roadways having posted or statutory speed limit of less than 45 mph. The longitudinal spacing of the chevrons or diagonal lines should be determined by engineering judgment considering factors such as speeds and desired visual impacts. The chevrons and diagonal lines should form an angle of approximately 30 to 45 degrees with the longitudinal lines that they intersect.*

### **Section 3B.25 Speed Hump Markings**

**Standard:**

- 01 **If speed hump markings are used, they shall be a series of white markings placed on a speed hump to identify its location. If markings are used for a speed hump that does not also function as a crosswalk or speed Table, the markings shall comply with Option A, B, or C shown in Figure 3B-29. If markings are used for a speed hump that also functions as a crosswalk or speed Table, the markings shall comply with Option A or B shown in Figure 3B-30.**

### **Section 3B.26 Advance Speed Hump Markings**

Option:

- 01 Advance speed hump markings (see Figure 3B-31) may be used in advance of speed humps or other engineered vertical roadway deflections such as dips where added visibility is desired or where such deflection is not expected.
- 02 Advance pavement wording such as BUMP or HUMP (see Section 3B.20) may be used on the approach to a speed hump either alone or in conjunction with advance speed hump markings. Appropriate advance warning signs may be used in compliance with Section 2C.29.

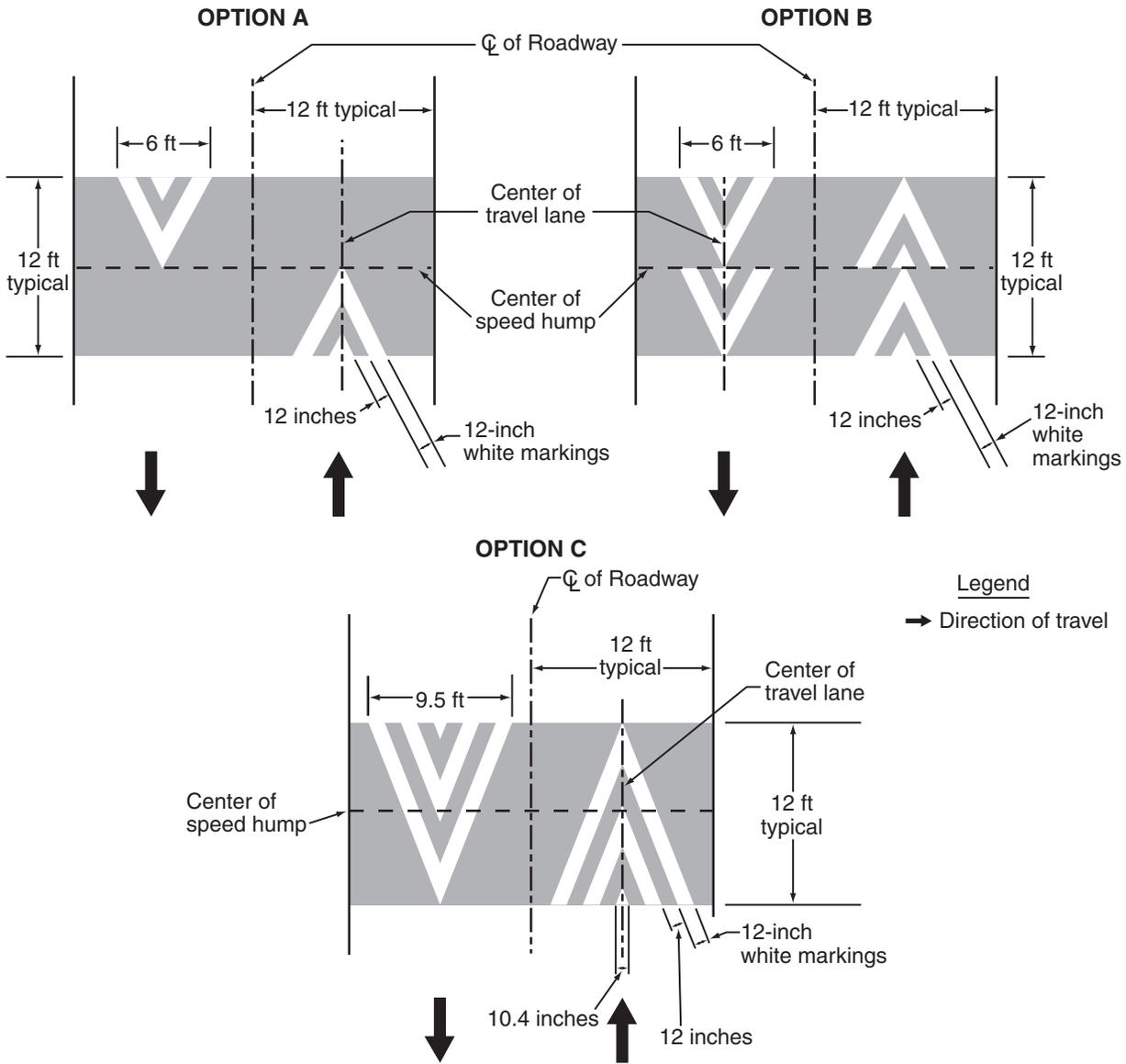
**Standard:**

- 03 **If advance speed hump markings are used, they shall be a series of eight white 12-inch transverse lines that become longer and are spaced closer together as the vehicle approaches the speed hump or other deflection. If advance markings are used, they shall comply with the detailed design shown in Figure 3B-31.**

*Guidance:*

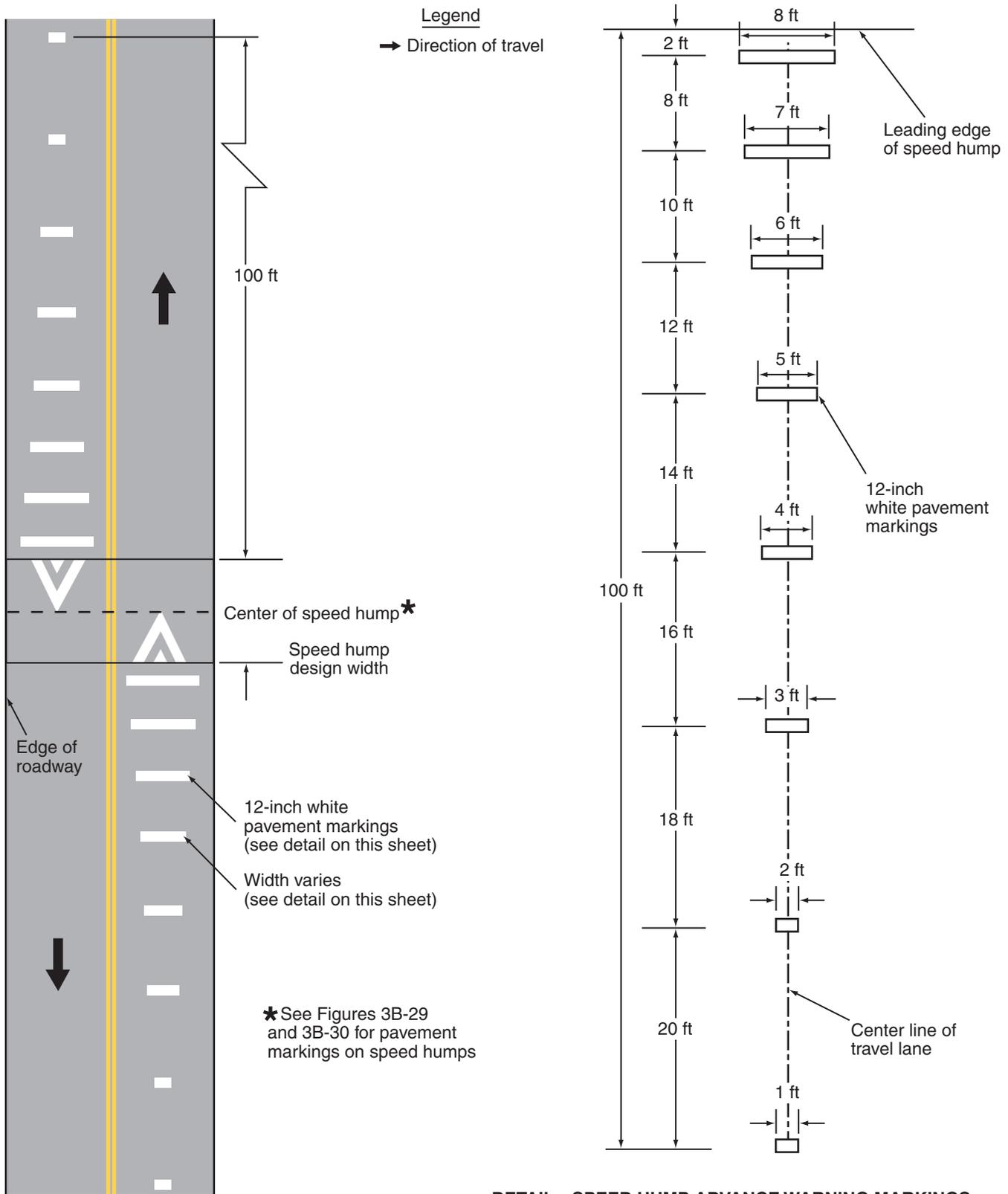
- 04 If used, advance speed hump markings should be installed in each approach lane.

**Figure 3B-29. Pavement Markings for Speed Humps without Crosswalks**





**Figure 3B-31. Advance Warning Markings for Speed Humps**



**DETAIL—SPEED HUMP ADVANCE WARNING MARKINGS**

## CHAPTER 3C. ROUNDABOUT MARKINGS

### Section 3C.01 General

#### Support:

- 01 A roundabout (see definition in Section 1A.13) is a specific type of circular intersection designed to control speeds and having specific traffic control features.

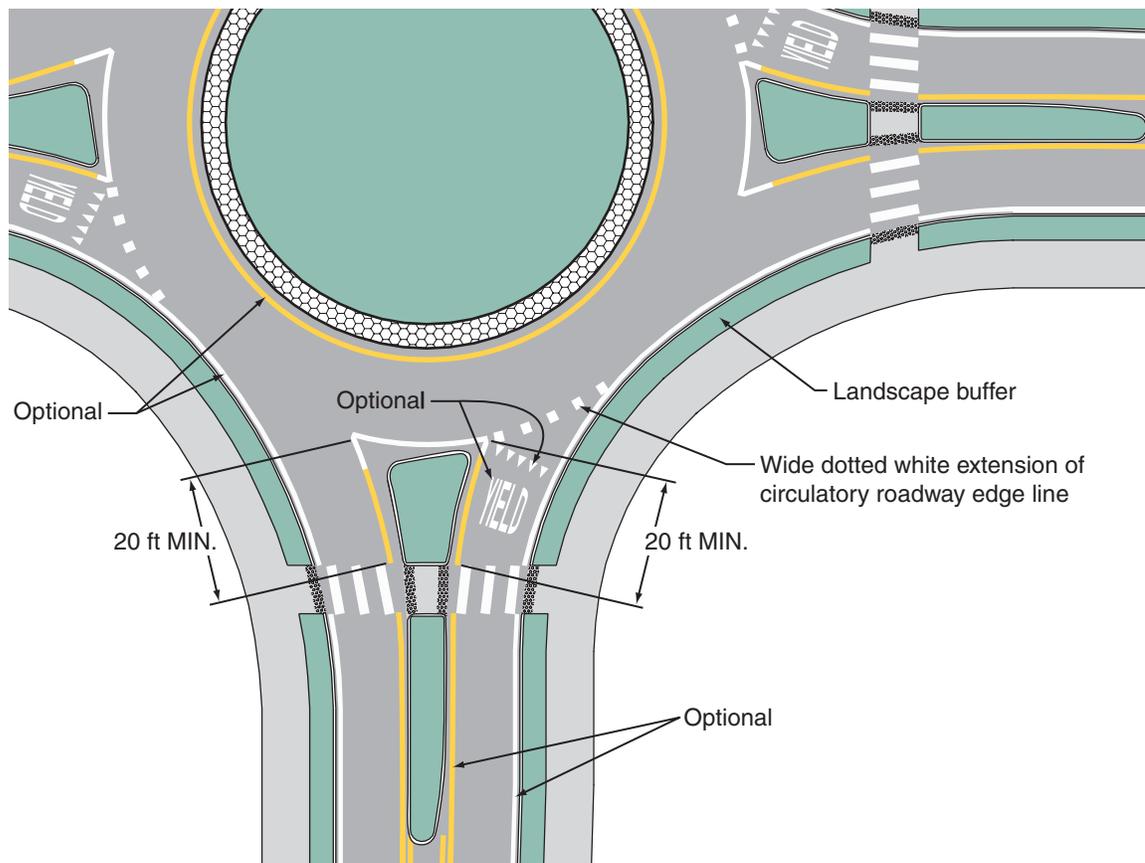
#### Guidance:

- 02 *Pavement markings and signing for a roundabout should be integrally designed to correspond to the geometric design and intended lane use of a roundabout.*
- 03 *Markings on the approaches to a roundabout and on the circular roadway should be compatible with each other to provide a consistent message to road users and should facilitate movement through the roundabout such that vehicles do not have to change lanes within the circulatory roadway in order to exit the roundabout in a given direction.*

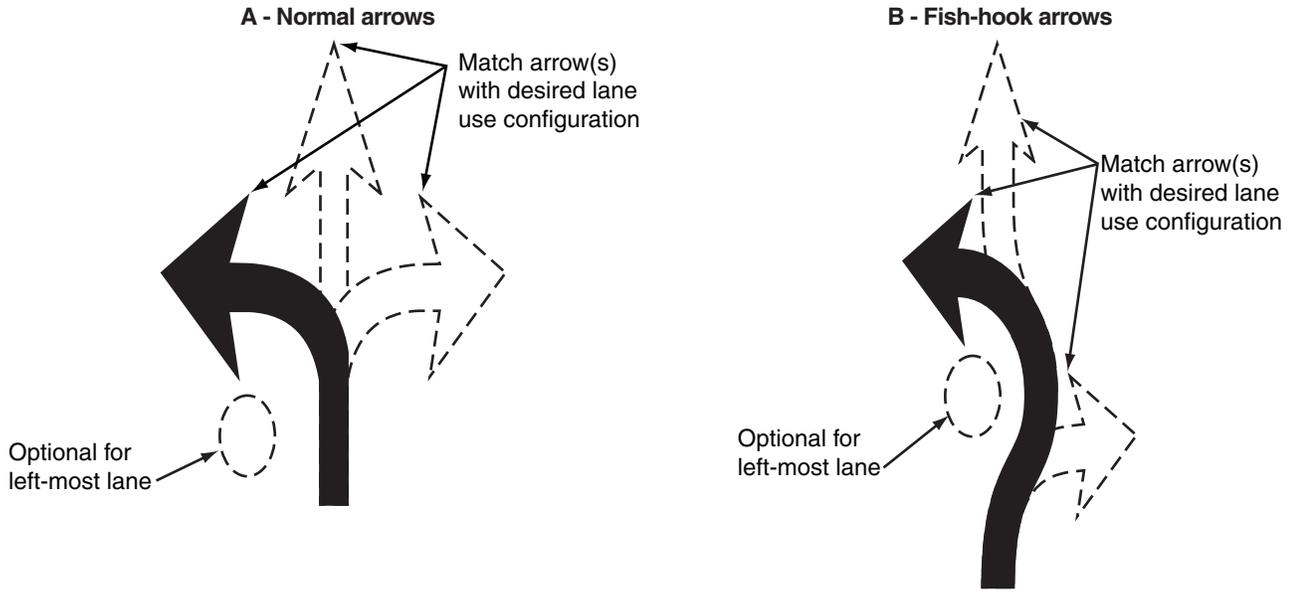
#### Support:

- 04 Figure 3C-1 provides an example of the pavement markings for approach and circulatory roadways at a roundabout. Figure 3C-2 shows the options that are available for lane-use pavement marking arrows on approaches to roundabouts. Figures 3C-3 through 3C-14 illustrate examples of markings for roundabouts of various geometric and lane-use configurations.
- 05 Traffic control signals or pedestrian hybrid beacons (see Part 4) are sometimes used at roundabouts to facilitate the crossing of pedestrians or to meter traffic.
- 06 Section 8C.12 contains information about roundabouts that contain or are in close proximity to grade crossings.

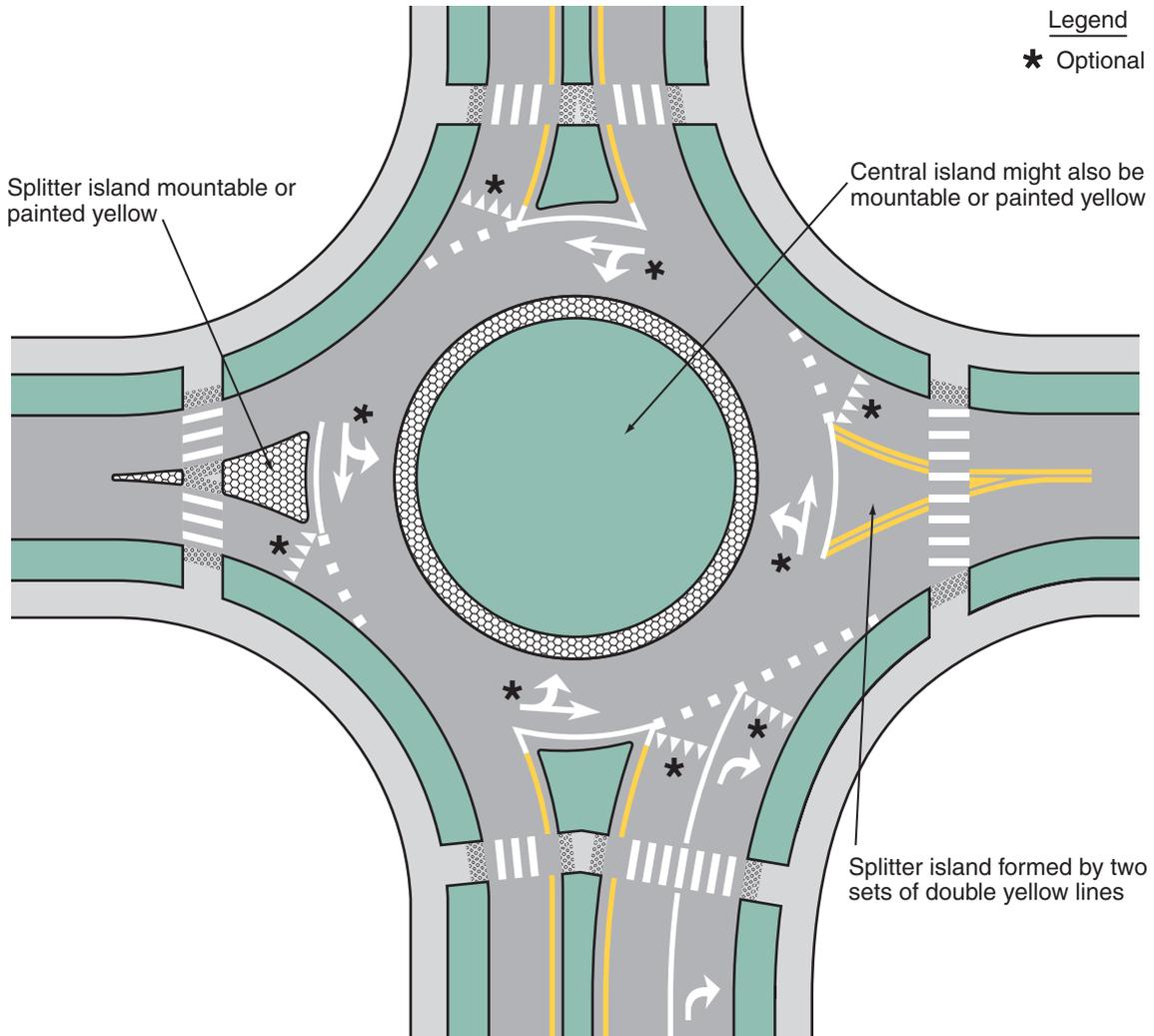
**Figure 3C-1. Example of Markings for Approach and Circulatory Roadways at a Roundabout**



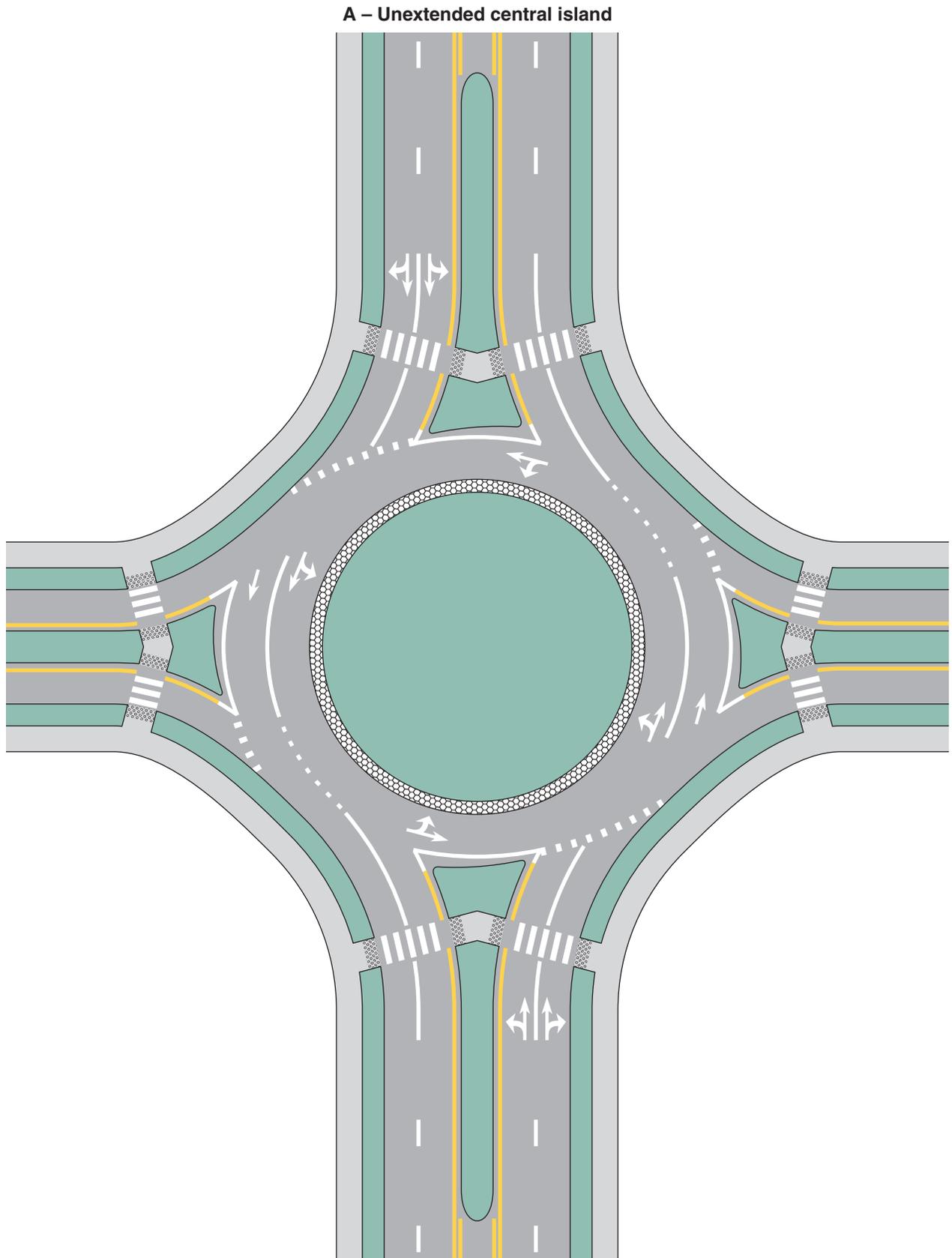
**Figure 3C-2. Lane-Use Arrow Pavement Marking Options for Roundabout Approaches**



**Figure 3C-3. Example of Markings for a One-Lane Roundabout**

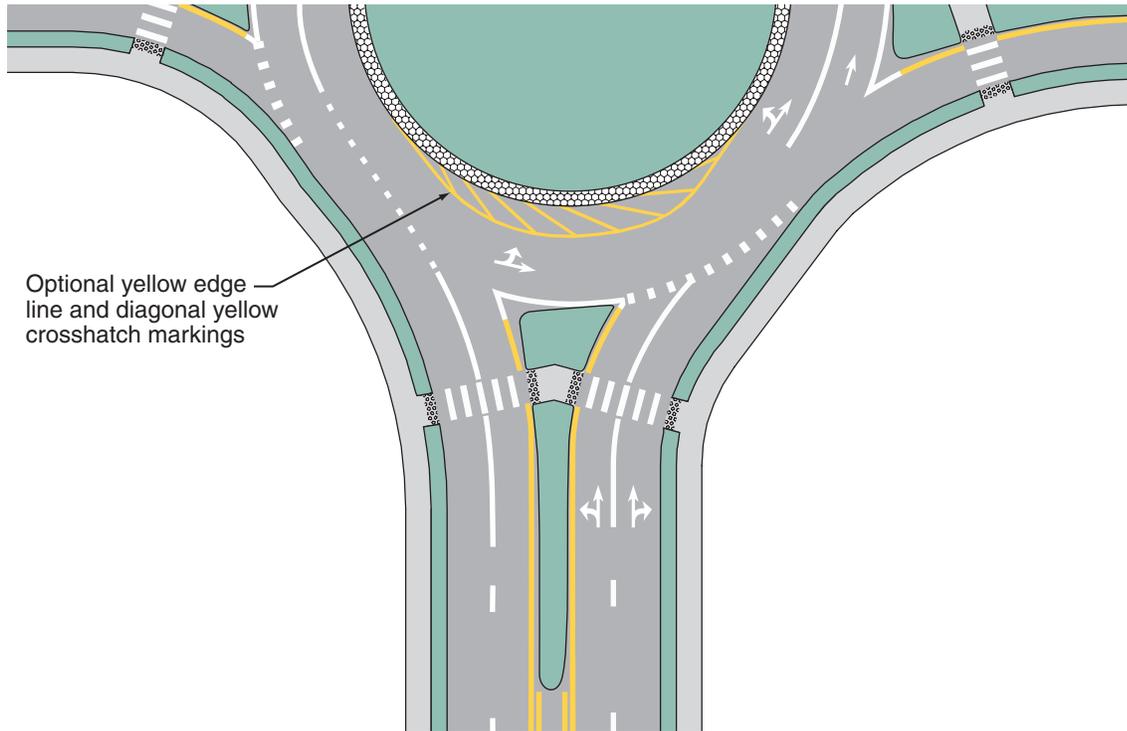


**Figure 3C-4. Example of Markings for a Two-Lane Roundabout with One- and Two-Lane Approaches (Sheet 1 of 2)**

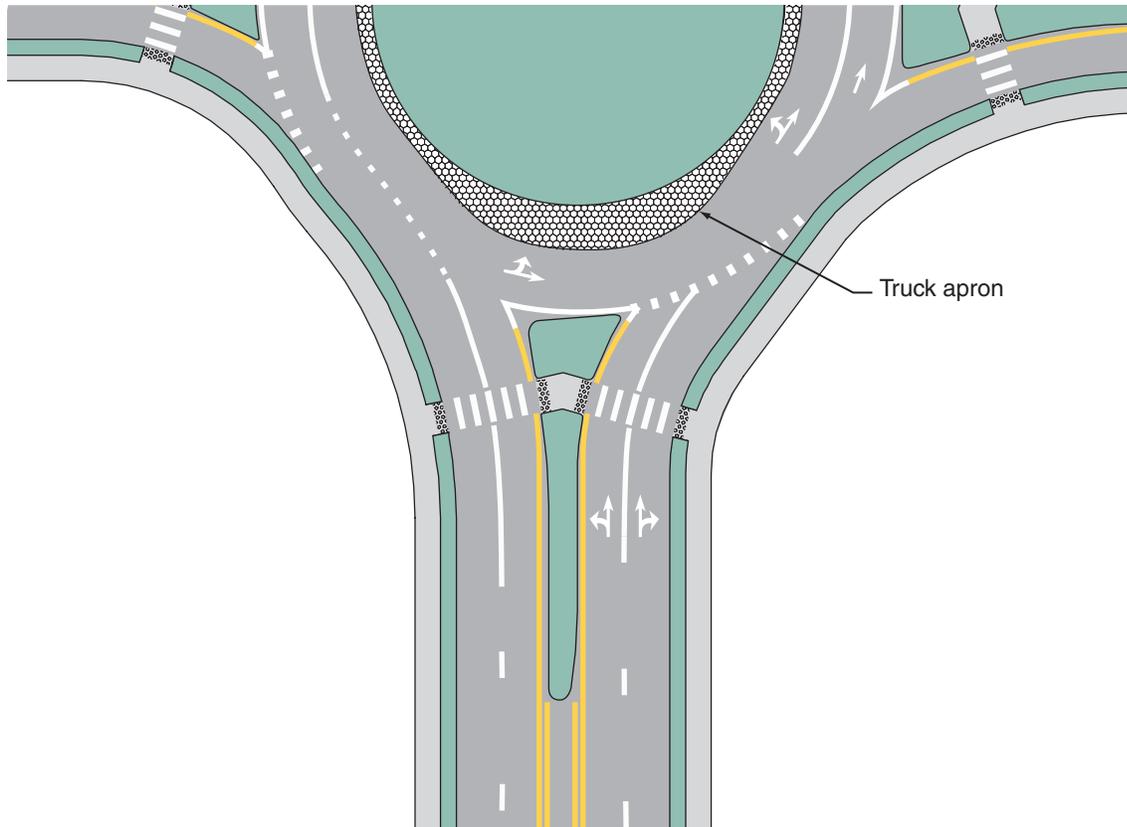


**Figure 3C-4. Example of Markings for a Two-Lane Roundabout with One- and Two-Lane Approaches (Sheet 2 of 2)**

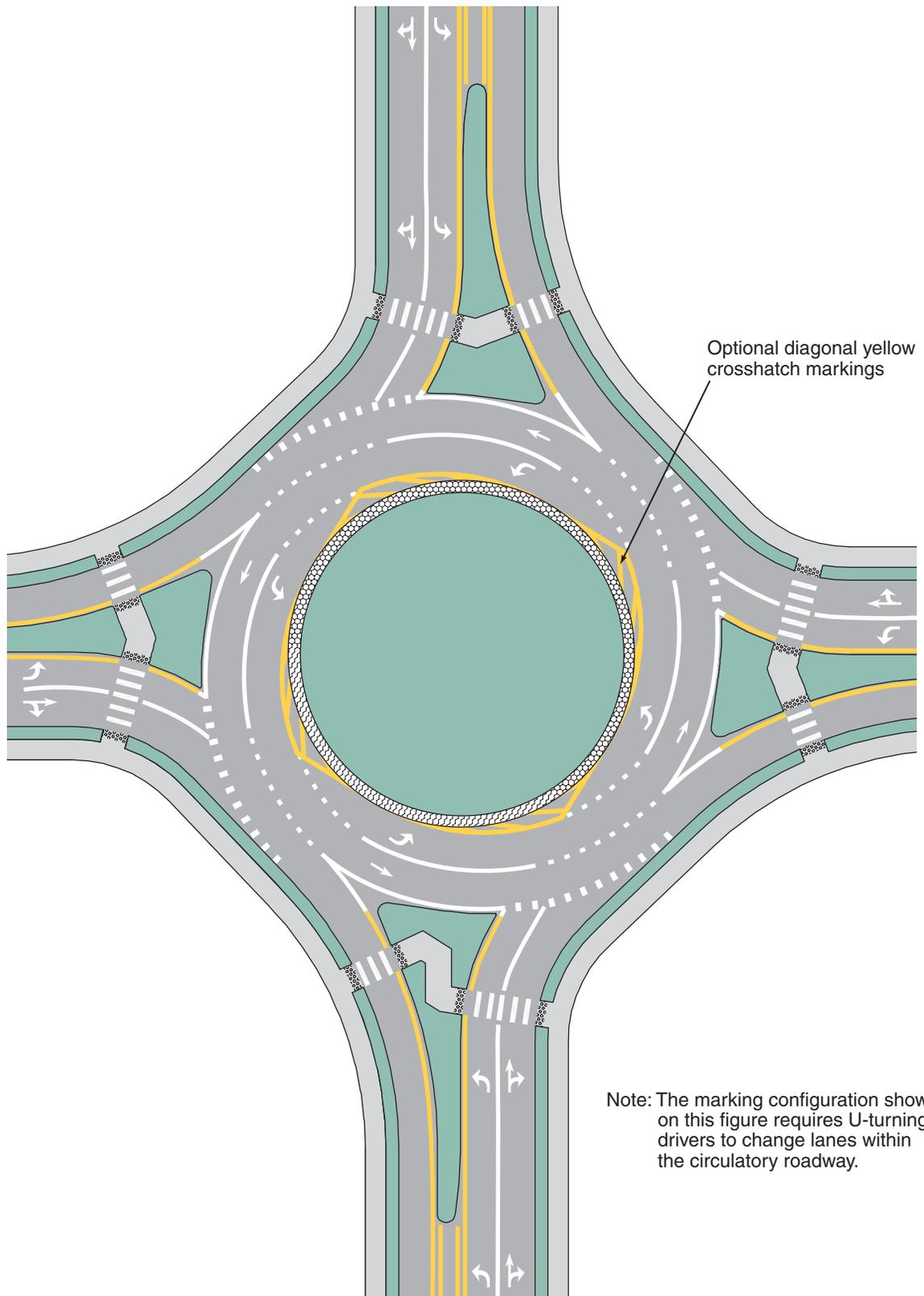
**B – Central island extended by pavement markings**



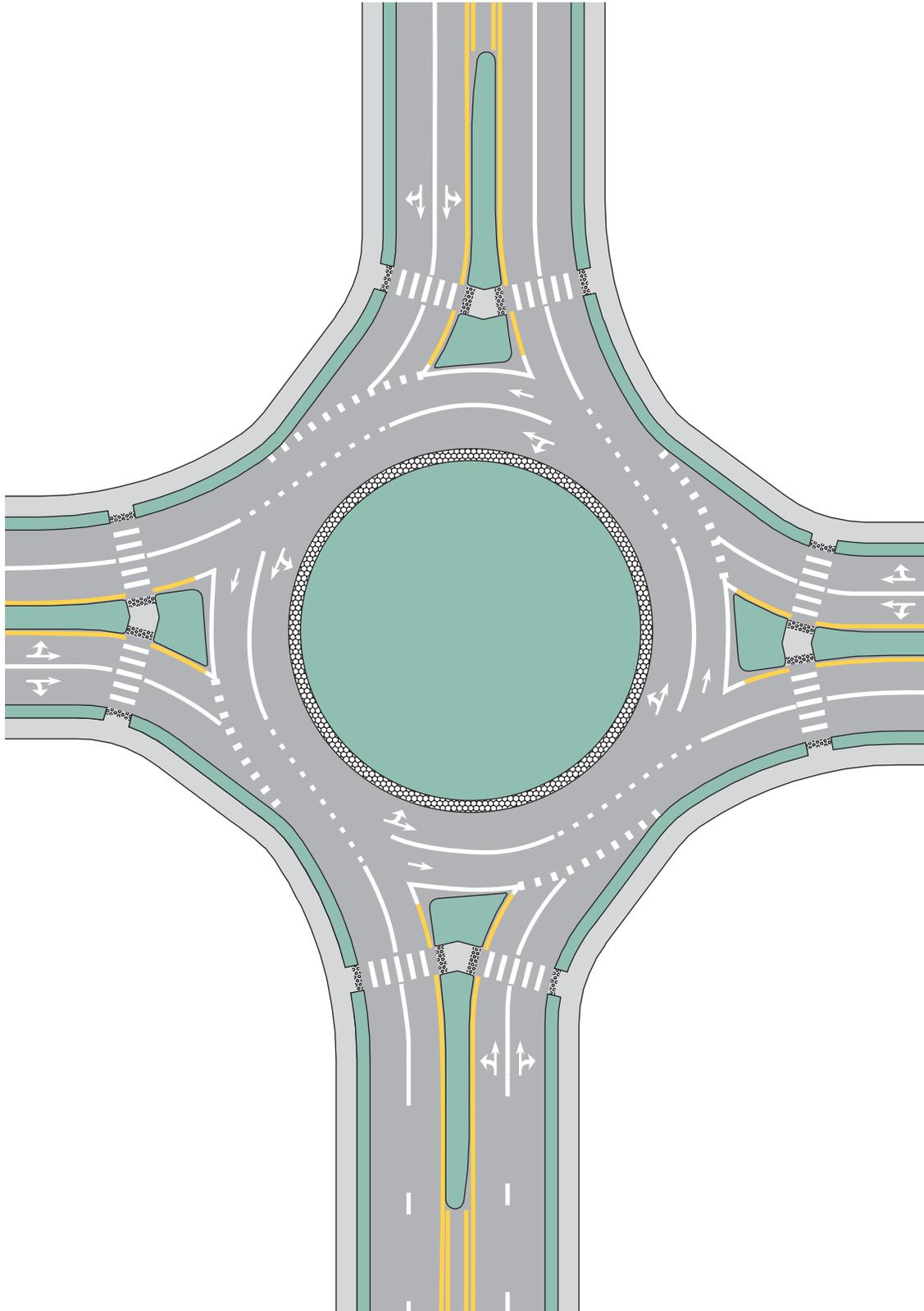
**C – Central island extended by a truck apron**



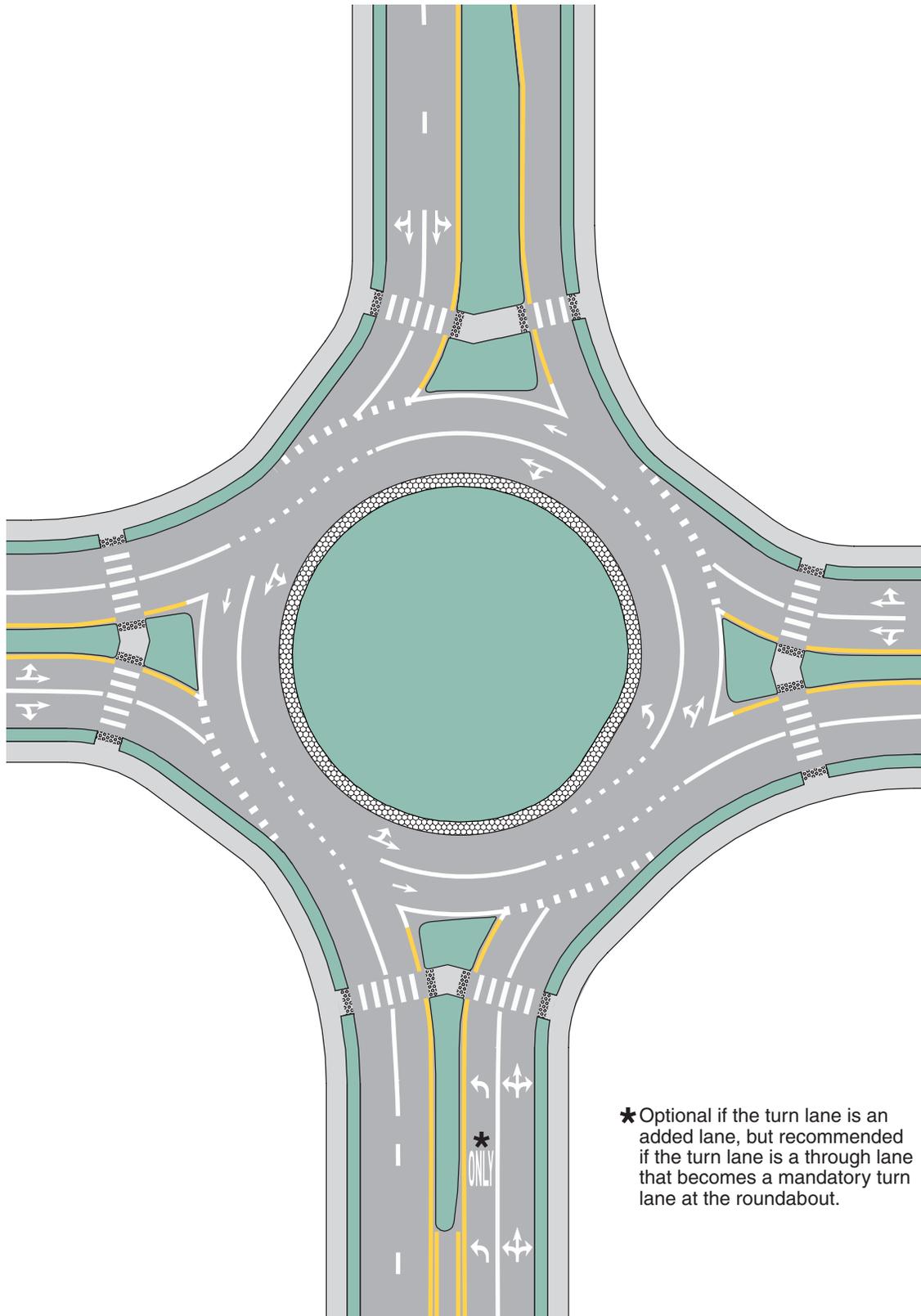
**Figure 3C-5. Example of Markings for a Two-Lane Roundabout with One-Lane Exits**



**Figure 3C-6. Example of Markings for a Two-Lane Roundabout with Two-Lane Exits**

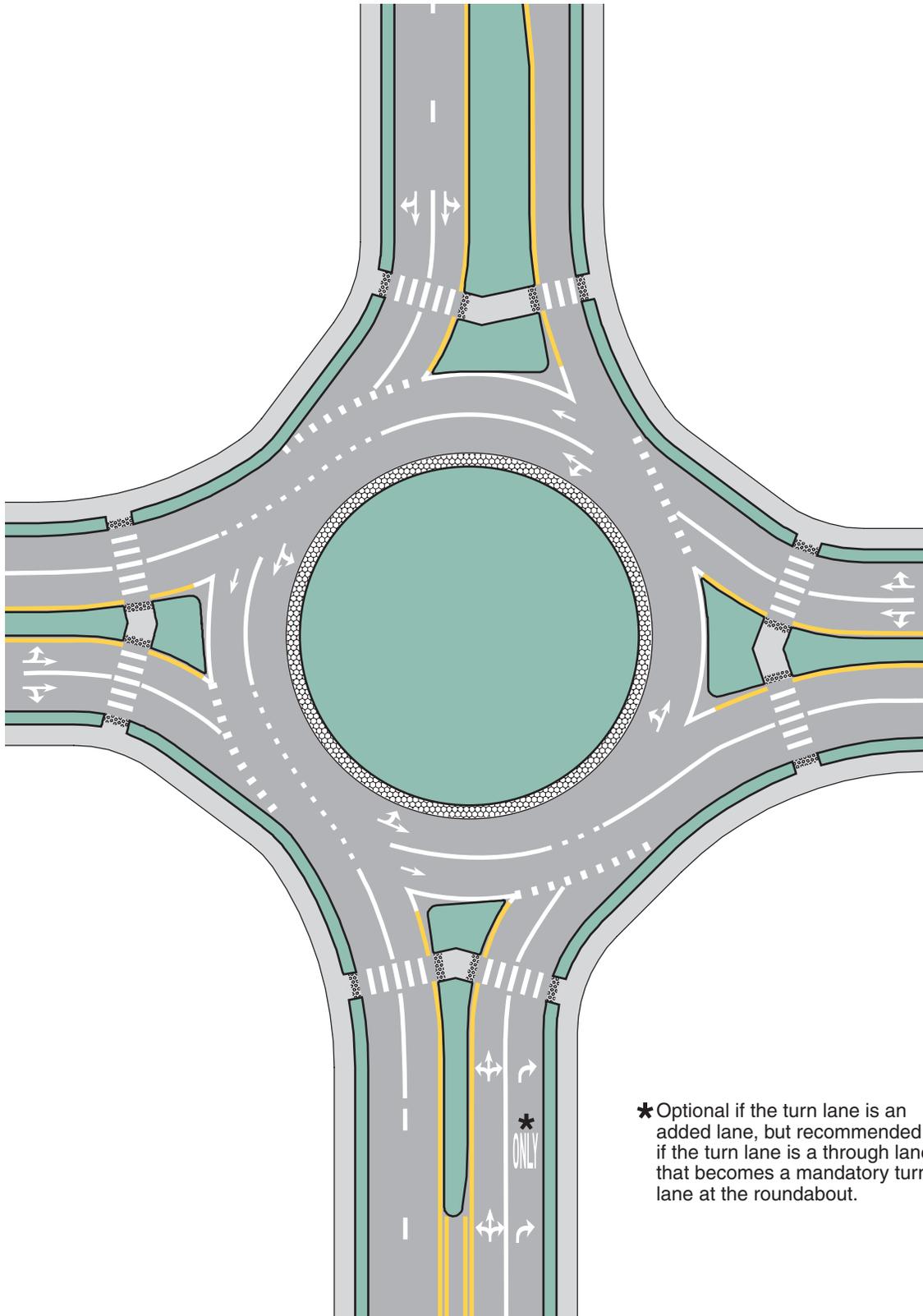


**Figure 3C-7. Example of Markings for a Two-Lane Roundabout with a Double Left Turn**



\*Optional if the turn lane is an added lane, but recommended if the turn lane is a through lane that becomes a mandatory turn lane at the roundabout.

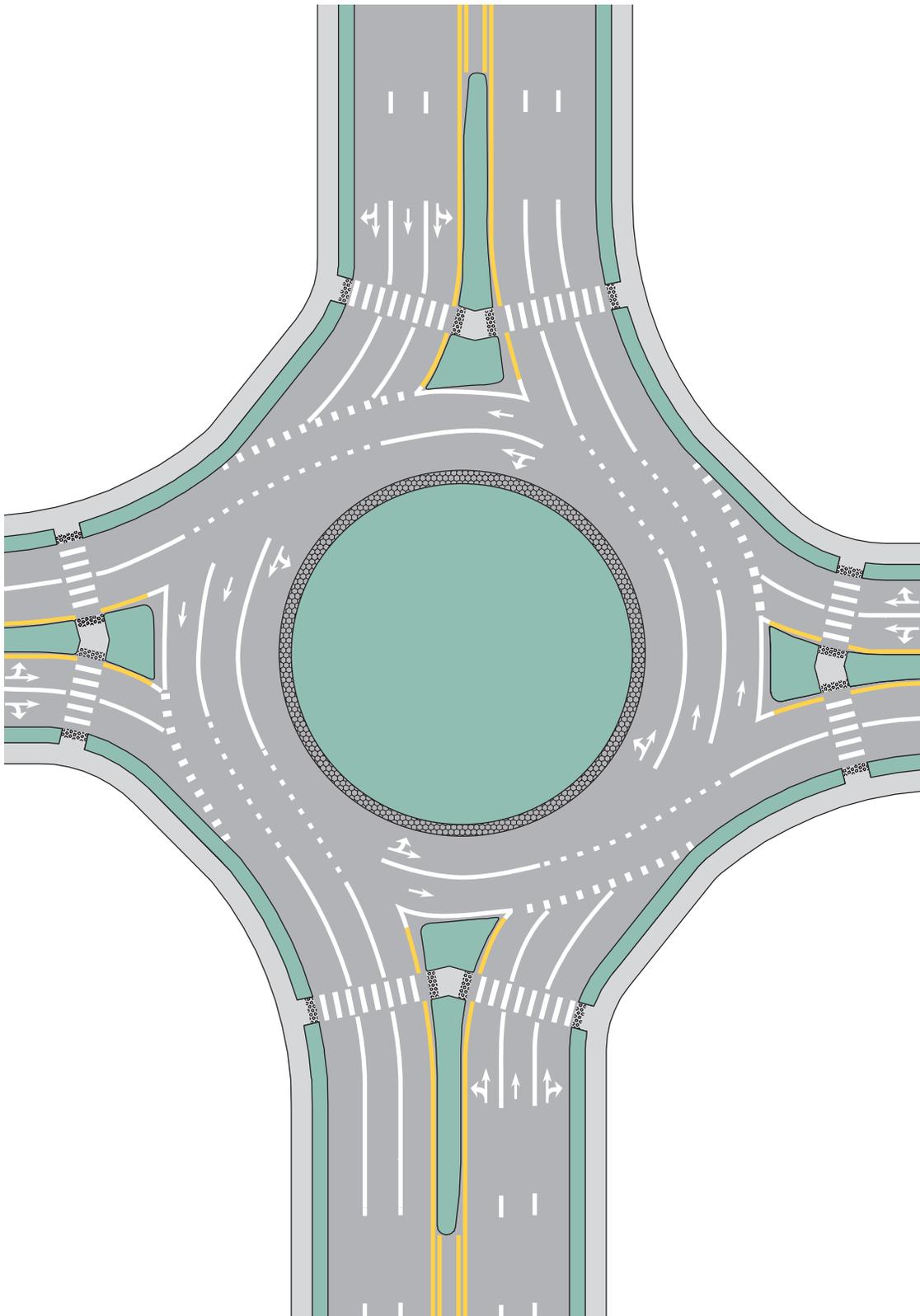
**Figure 3C-8. Example of Markings for a Two-Lane Roundabout with a Double Right Turn**



\*Optional if the turn lane is an added lane, but recommended if the turn lane is a through lane that becomes a mandatory turn lane at the roundabout.

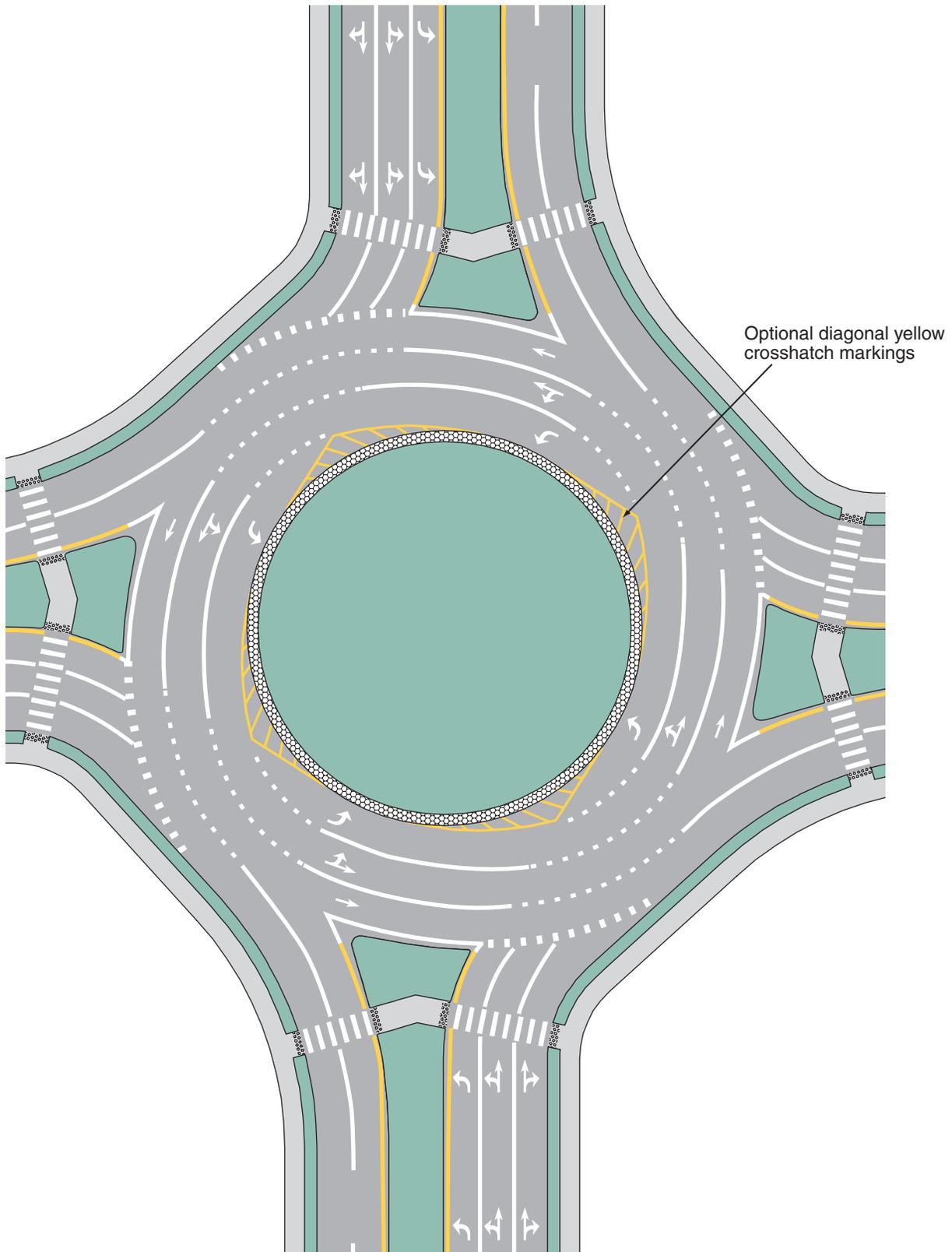


**Figure 3C-10. Example of Markings for a Three-Lane Roundabout with Two- and Three-Lane Approaches**

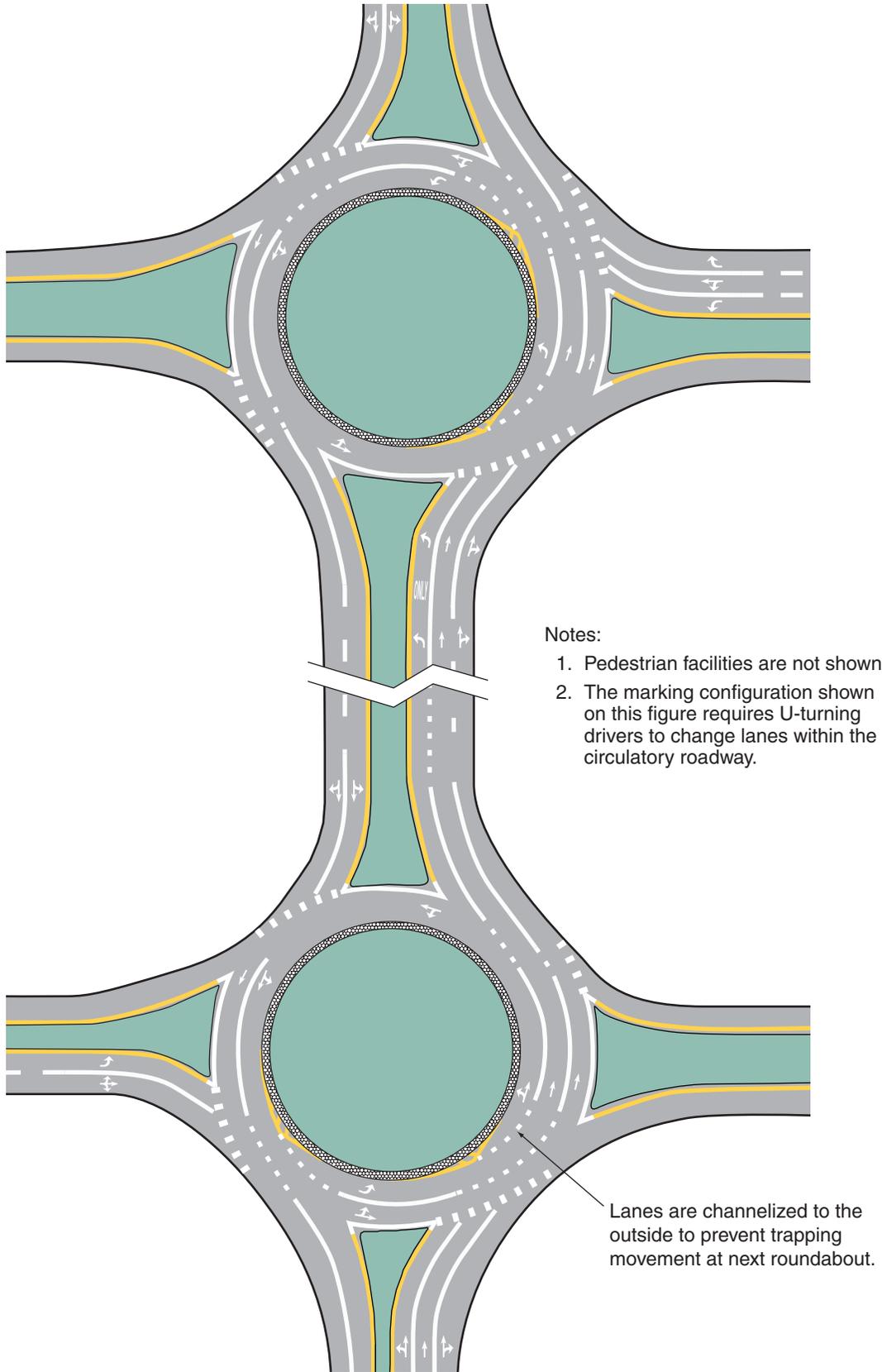




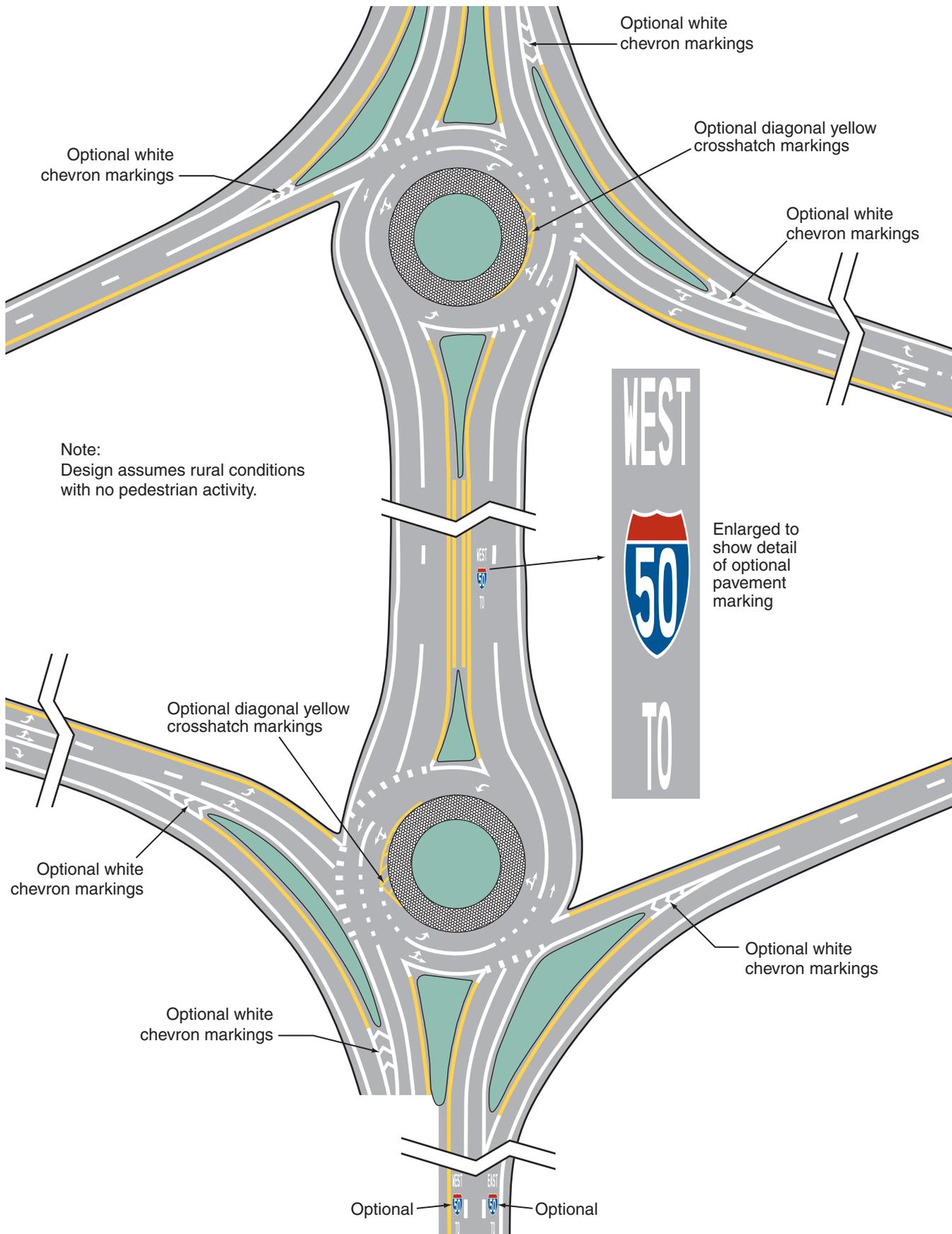
**Figure 3C-12. Example of Markings for a Three-Lane Roundabout with Two-Lane Exits**



**Figure 3C-13. Example of Markings for Two Linked Roundabouts**



**Figure 3C-14. Example of Markings for a Diamond Interchange with Two Circular-Shaped Roundabout Ramp Terminals**



### **Section 3C.02 White Lane Line Pavement Markings for Roundabouts**

#### **Standard:**

- 01 **Multi-lane approaches to roundabouts shall have lane lines.**  
 02 **A through lane on a roadway that becomes a dropped lane (mandatory turn lane) at a roundabout shall be marked with a dotted white lane line in accordance with Section 3B.04.**

#### *Guidance:*

- 03 *Multi-lane roundabouts should have lane line markings within the circulatory roadway to channelize traffic to the appropriate exit lane.*

#### **Standard:**

- 04 **Continuous concentric lane lines shall not be used within the circulatory roadway of roundabouts.**

#### Support:

- 05 Section 9C.04 contains information regarding bicycle lane markings at roundabouts.

### **Section 3C.03 Edge Line Pavement Markings for Roundabout Circulatory Roadways**

#### *Guidance:*

- 01 *A white edge line should be used on the outer (right-hand) side of the circulatory roadway.*  
 02 *Where a white edge line is used for the circulatory roadway, it should be as follows (see Figure 3C-1):*  
 A. *A solid line adjacent to the splitter island, and*  
 B. *A wide dotted line across the lane(s) entering the roundabout.*

#### **Standard:**

- 03 **Edge lines and edge line extensions shall not be placed across the exits from the circulatory roadway at roundabouts.**

#### Option:

- 04 A yellow edge line may be placed around the inner (left-hand) edge of the circulatory roadway (see Figure 3C-1) and may be used to channelize traffic (see Drawing B of Figure 3C-4).

### **Section 3C.04 Yield Lines for Roundabouts**

#### Option:

- 01 A yield line (see Section 3B.16) may be used to indicate the point behind which vehicles are required to yield at the entrance to a roundabout (see Figure 3C-1).

### **Section 3C.05 Crosswalk Markings at Roundabouts**

#### **Standard:**

- 01 **Pedestrian crosswalks shall not be marked to or from the central island of roundabouts.**

#### *Guidance:*

- 02 *If pedestrian facilities are provided, crosswalks (see Section 3B.18) should be marked across roundabout entrances and exits to indicate where pedestrians are intended to cross.*  
 03 *Crosswalks should be a minimum of 20 feet from the edge of the circulatory roadway.*

#### Support:

- 04 Various arrangements of crosswalks at roundabouts are illustrated in the figures in this Chapter.

### **Section 3C.06 Word, Symbol, and Arrow Pavement Markings for Roundabouts**

#### Option:

- 01 Lane-use arrows may be used on any approach to and within the circulatory roadway of any roundabout.  
 02 YIELD (word) and YIELD AHEAD (symbol or word) pavement markings (see Figure 3C-1) may be used on approaches to roundabouts.  
 03 Word and/or route shield pavement markings may be used on an approach to or within the circulatory roadway of a roundabout to provide route and/or destination guidance information to road users (see Figure 3C-14).

#### *Guidance:*

- 04 *Within the circulatory roadway of multi-lane roundabouts, normal lane-use arrows (see Section 3B.20 and Figure 3B-24) should be used.*  
 05 *On multi-lane approaches with double left-turn and/or double right-turn lanes, lane-use arrows as shown in Figures 3C-7 and 3C-8 should be used.*

**Option:**

- 06 If used on approaches to a roundabout, lane-use arrows may be either normal or fish-hook arrows, either with or without an oval symbolizing the central island, as shown in Figure 3C-2.

**Section 3C.07 Markings for Other Circular Intersections****Support:**

- 01 Other circular intersections include, but are not limited to, rotaries, traffic circles, and residential traffic calming designs.

**Option:**

- 02 The markings shown in this Chapter may be used at other circular intersections if engineering judgment indicates that their presence will benefit drivers, pedestrians, or other road users.

## CHAPTER 3D. MARKINGS FOR PREFERENTIAL LANES

### Section 3D.01 Preferential Lane Word and Symbol Markings

Support:

- 01 Preferential lanes are established for one or more of a wide variety of special uses, including, but not limited to, high-occupancy vehicle (HOV) lanes, ETC lanes, high-occupancy toll (HOT) lanes, bicycle lanes, bus only lanes, taxi only lanes, and light rail transit only lanes.

**Standard:**

- 02 **When a lane is assigned full or part time to a particular class or classes of vehicles, the preferential lane word and symbol markings described in this Section and the preferential lane longitudinal markings described in Section 3D.02 shall be used.**

- 03 **All longitudinal pavement markings, as well as word and symbol pavement markings, associated with a preferential lane shall end where the Preferential Lane Ends (R3-12a or R3-12c) sign (see Section 2G.07) designating the downstream end of the preferential only lane restriction is installed.**

- 04 **Static or changeable message regulatory signs (see Sections 2G.03 to 2G.07) shall be used with preferential lane word or symbol markings.**

- 05 **All preferential lane word and symbol markings shall be white and shall be positioned laterally in the center of the preferential lane.**

- 06 **Where a preferential lane use exists contiguous to a general-purpose lane or is separated from a general-purpose lane by a flush buffered space that can be traversed by motor vehicles, the preferential lane shall be marked with one or more of the following symbol or word markings for the preferential lane use specified:**

- A. **HOV lane**—the preferential lane-use marking for high-occupancy vehicle lanes shall consist of white lines formed in a diamond shape symbol or the word message HOV. The diamond shall be at least 2.5 feet wide and 12 feet in length. The lines shall be at least 6 inches in width.
- B. **HOT lane or ETC Account-Only lane**—except as provided in Paragraph 8, the preferential lane-use marking for a HOT lane or an ETC Account-Only lane shall consist of a word marking using the name of the ETC payment system required for use of the lane, such as E-Z PASS ONLY.
- C. **Bicycle lane**—the preferential lane-use marking for a bicycle lane shall consist of a bicycle symbol or the word marking BIKE LANE (see Chapter 9C and Figures 9C-1 and 9C-3 through 9C-6).
- D. **Bus only lane**—the preferential lane-use marking for a bus only lane shall consist of the word marking BUS ONLY.
- E. **Taxi only lane**—the preferential lane-use marking for a taxi only lane shall consist of the word marking TAXI ONLY.
- F. **Light rail transit lane**—the preferential lane-use marking for a light rail transit lane shall consist of the word marking LRT ONLY.
- G. **Other type of preferential lane**—the preferential lane-use markings shall consist of a word marking appropriate to the restriction.

- 07 **If two or more preferential lane uses are permitted in a single lane, the symbol or word marking for each preferential lane use shall be installed.**

Option:

- 08 Preferential lane-use symbol or word markings may be omitted at toll plazas where physical conditions preclude the use of the markings (see Section 3E.01).

*Guidance:*

- 09 *The spacing of the markings should be based on engineering judgment that considers the prevailing speed, block lengths, distance from intersections, and other factors that affect clear communication to the road user.*

Support:

- 10 Markings spaced as close as 80 feet apart might be appropriate on city streets, while markings spaced as far as 1,000 feet apart might be appropriate for freeways.

*Guidance:*

- 11 *In addition to a regular spacing interval, the preferential lane marking should be placed at strategic locations such as major decision points, direct exit ramp departures from the preferential lane, and along access openings to and from adjacent general-purpose lanes. At decision points, the preferential lane marking should be placed on all applicable lanes and should be visible to approaching traffic for all available departures. At direct exits from preferential lanes where extra emphasis is needed, the use of word markings (such as "EXIT" or "EXIT ONLY") in the deceleration lane for the direct exit and/or on the direct exit ramp itself just beyond the exit gore should be considered.*

Option:

- 12 A numeral indicating the vehicle occupancy requirements established for a high-occupancy vehicle lane may be included in sequence after the diamond symbol or HOV word message.

*Guidance:*

- 13 *Engineering judgment should determine the need for supplemental devices such as tubular markers, traffic cones, or other channelizing devices (see Chapter 3H).*

### **Section 3D.02 Preferential Lane Longitudinal Markings for Motor Vehicles**

Support:

- 01 Preferential lanes can take many forms depending on the level of usage and the design of the facility. They might be barrier-separated or buffer-separated from the adjacent general-purpose lanes, or they might be contiguous with the adjacent general-purpose lanes. Barrier-separated preferential lanes might be operated in a constant direction or be operated as reversible lanes. Some reversible preferential lanes on a divided highway might be operated counter-flow to the direction of traffic on the immediately adjacent general-purpose lanes. See Section 1A.13 for definitions of terms.

- 02 Preferential lanes might be operated full-time (24 hours per day on all days), for extended periods of the day, part-time (restricted usage during specific hours on specified days), or on a variable basis (such as a strategy for a managed lane).

**Standard:**

- 03 **Longitudinal pavement markings for preferential lanes shall be as follows (these same requirements are presented in tabular form in Table 3D-1):**
- A. **Barrier-separated, non-reversible preferential lane**—the longitudinal pavement markings for preferential lanes that are physically separated from the other travel lanes by a barrier or median shall consist of a normal solid single yellow line at the left-hand edge of the travel lane(s), and a normal solid single white line at the right-hand edge of the travel lane(s) (see Drawing A in Figure 3D-1).
  - B. **Barrier-separated, reversible preferential lane**—the longitudinal pavement markings for reversible preferential lanes that are physically separated from the other travel lanes by a barrier or median shall consist of a normal solid single white line at both edges of the travel lane(s) (see Drawing B in Figure 3D-1).
  - C. **Buffer-separated (left-hand side) preferential lane**—the longitudinal pavement markings for a full-time or part-time preferential lane on the left-hand side of and separated from the other travel lanes by a neutral buffer space shall consist of a normal solid single yellow line at the left-hand edge of the preferential travel lane(s) and one of the following at the right-hand edge of the preferential travel lane(s):
    1. A wide solid double white line along both edges of the buffer space where crossing the buffer space is prohibited (see Drawing A in Figure 3D-2).
    2. A wide solid single white line along both edges of the buffer space where crossing the buffer space is discouraged (see Drawing B in Figure 3D-2).
    3. A wide broken single white line along both edges of the buffer space, or a wide broken single white lane line within the allocated buffer space (resulting in wider lanes), where crossing the buffer space is permitted (see Drawing C in Figure 3D-2).
  - D. **Buffer-separated (right-hand side) preferential lane**—the longitudinal pavement markings for a full-time or part-time preferential lane on the right-hand side of and separated from the other travel lanes by a neutral buffer space shall consist of a normal solid single white line at the right-hand edge of the preferential travel lane(s) if warranted (see Section 3B.07) and one of the following at the left-hand edge of the preferential travel lane(s) (see Drawing D in Figure 3D-2):
    1. A wide solid double white line along both edges of the buffer space where crossing the buffer space is prohibited.
    2. A wide solid single white line along both edges of the buffer space where crossing of the buffer space is discouraged.
    3. A wide broken single white line along both edges of the buffer space, or a wide broken single white line within the allocated buffer space (resulting in wider lanes), where crossing the buffer space is permitted.
    4. A wide dotted single white lane line within the allocated buffer space (resulting in wider lanes) where crossing the buffer space is permitted for any vehicle to perform a right-turn maneuver.

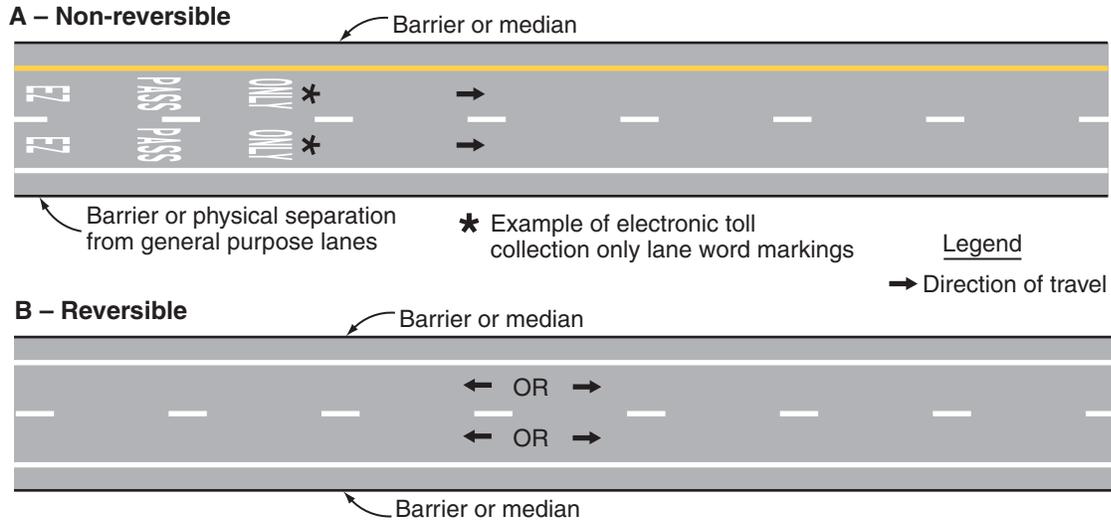
**Table 3D-1. Standard Edge Line and Lane Line Markings for Preferential Lanes**

Type of Preferential Lane	Left-Hand Edge Line	Right-Hand Edge Line
Barrier-Separated, Non-Reversible	A normal solid single yellow line	A normal solid single white line (see Drawing A of Figure 3D-1)
Barrier-Separated, Reversible	A normal solid single white line	A normal solid single white line (see Drawing B of Figure 3D-1)
Buffer-Separated, Left-Hand Side	A normal solid single yellow line	A wide solid double white line along both edges of the buffer space where crossing is prohibited (see Drawing A of Figure 3D-2) A wide solid single white line along both edges of the buffer space where crossing is discouraged (see Drawing B of Figure 3D-2) A wide broken single white line along both edges of the buffer space, or a wide broken single white line within the buffer space (resulting in wider lanes), where crossing is permitted (see Drawing C of Figure 3D-2)
Buffer-Separated, Right-Hand Side	A wide solid double white line along both edges of the buffer space where crossing is prohibited (see Drawing D of Figure 3D-2) A wide solid single white line along both edges of the buffer space where crossing is discouraged (see Drawing D of Figure 3D-2) A wide broken single white line along both edges of the buffer space, or a wide broken single white line within the buffer space (resulting in wider lanes), where crossing is permitted (see Drawing D of Figure 3D-2) A wide dotted single white line within the buffer space (resulting in wider lanes) where crossing is permitted for any vehicle to perform a right-turn maneuver (see Drawing D of Figure 3D-2)	A normal solid single white line (if warranted)
Contiguous, Left-Hand Side	A normal solid single yellow line	A wide solid double white line where crossing is prohibited (see Drawing A of Figure 3D-3) A wide solid single white line where crossing is discouraged (see Drawing B of Figure 3D-3) A wide broken single white line where crossing is permitted (see Drawing C of Figure 3D-3)
Contiguous, Right-Hand Side	A wide solid double white line where crossing is prohibited (see Drawing D of Figure 3D-3) A wide solid single white line where crossing is discouraged (see Drawing D of Figure 3D-3) A wide broken single white line where crossing is permitted (see Drawing D of Figure 3D-3) A wide dotted single white line where crossing is permitted for any vehicle to perform a right-turn maneuver (see Drawing D of Figure 3D-3)	A normal solid single white line

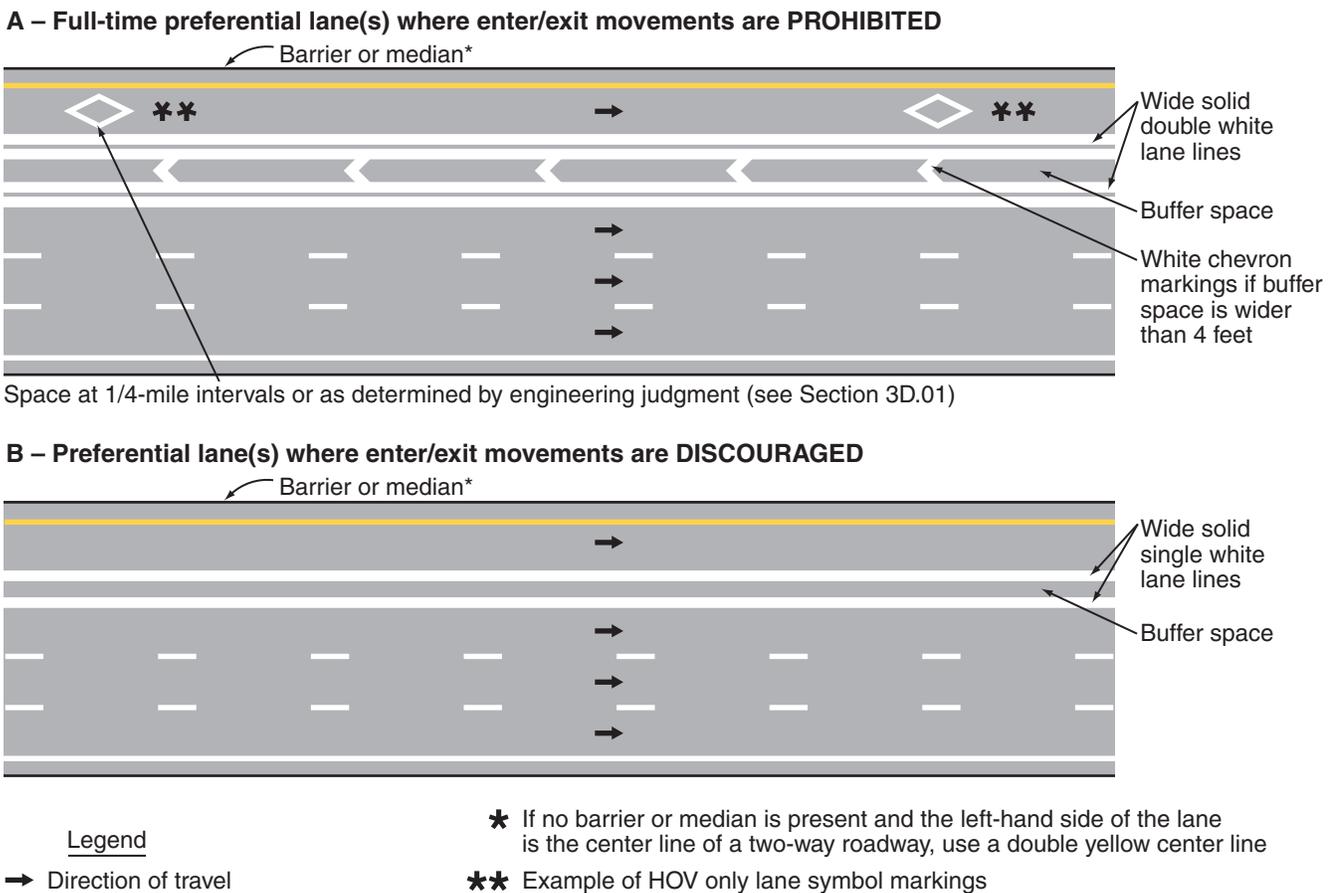
Notes: 1. If there are two or more preferential lanes, the lane lines between the preferential lanes shall be normal broken white lines.  
2. The standard lane markings listed in this table are provided in a tabular format for reference.  
3. This information is also described in Paragraph 3 of Section 3D.02.

- E. Contiguous (left-hand side) preferential lane—the longitudinal pavement markings for a full-time or part-time preferential lane on the left-hand side of and contiguous to the other travel lanes shall consist of a normal solid single yellow line at the left-hand edge of the preferential travel lane(s) and one of the following at the right-hand edge of the preferential travel lane(s):**
1. A wide solid double white lane line where crossing is prohibited (see Drawing A in Figure 3D-3).
  2. A wide solid single white lane line where crossing is discouraged (see Drawing B in Figure 3D-3).
  3. A wide solid single white lane line where crossing is permitted (see Drawing C in Figure 3D-3).
- F. Contiguous (right-hand side) preferential lane—the longitudinal pavement markings for a full-time or part-time preferential lane on the right-hand side of and contiguous to the other travel lanes shall consist of a normal solid single white line at the right-hand edge of the preferential travel lane(s) if warranted (see Section 3B.07) and one of the following at the left-hand edge of the preferential travel lane(s) (see Drawing D in Figure 3D-3):**
1. A wide solid double white lane line where crossing is prohibited.
  2. A wide solid single white lane line where crossing is discouraged.
  3. A wide broken single white lane line where crossing is permitted.
  4. A wide dotted single white lane line where crossing is permitted for any vehicle to perform a right-turn maneuver.

**Figure 3D-1. Markings for Barrier-Separated Preferential Lanes**

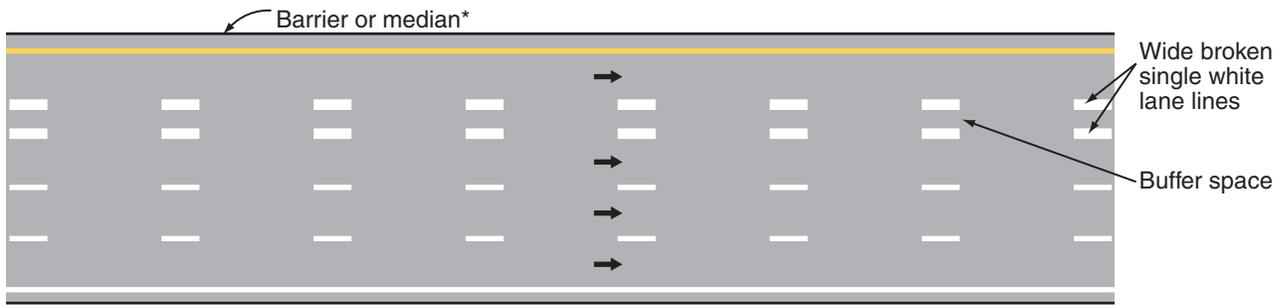


**Figure 3D-2. Markings for Buffer-Separated Preferential Lanes (Sheet 1 of 2)**

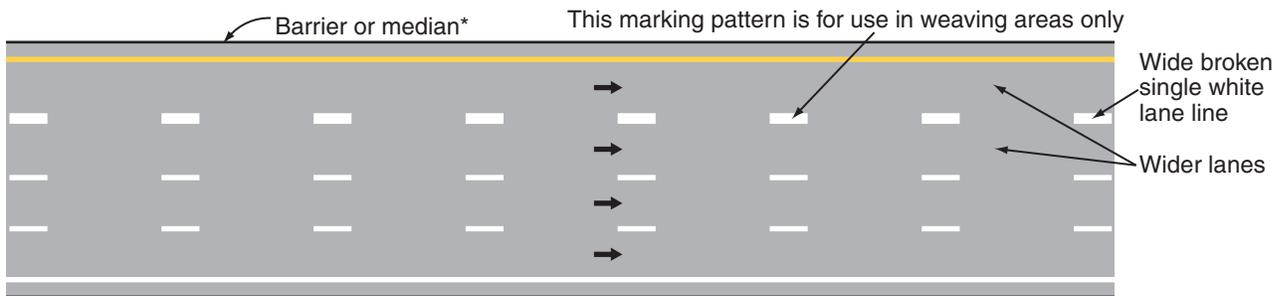


**Figure 3D-2. Markings for Buffer-Separated Preferential Lanes (Sheet 2 of 2)**

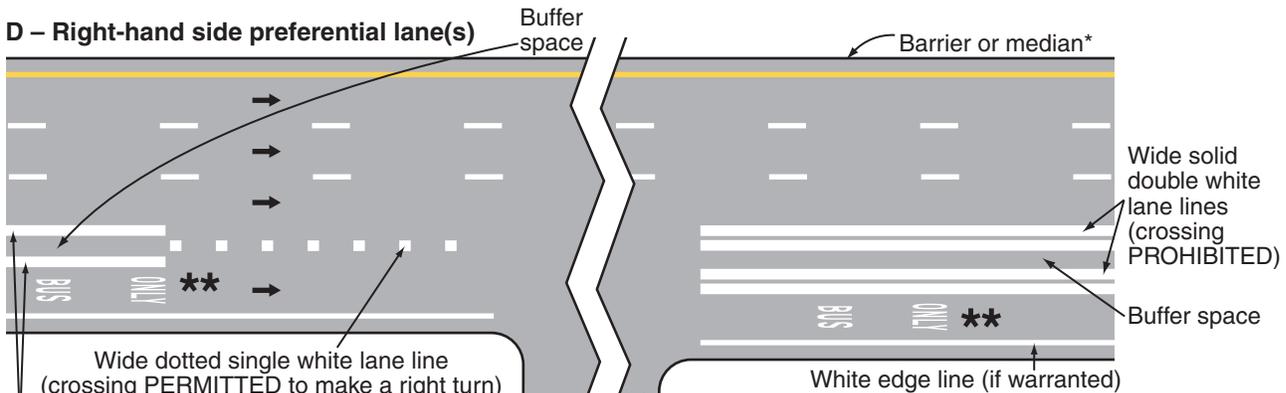
**C – Preferential lane(s) where enter/exit movements are PERMITTED**



OR



**D – Right-hand side preferential lane(s)**

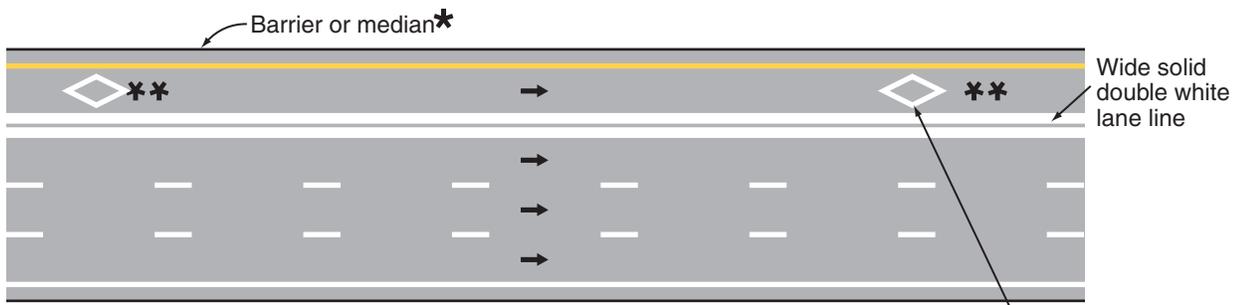


Legend  
 → Direction of travel

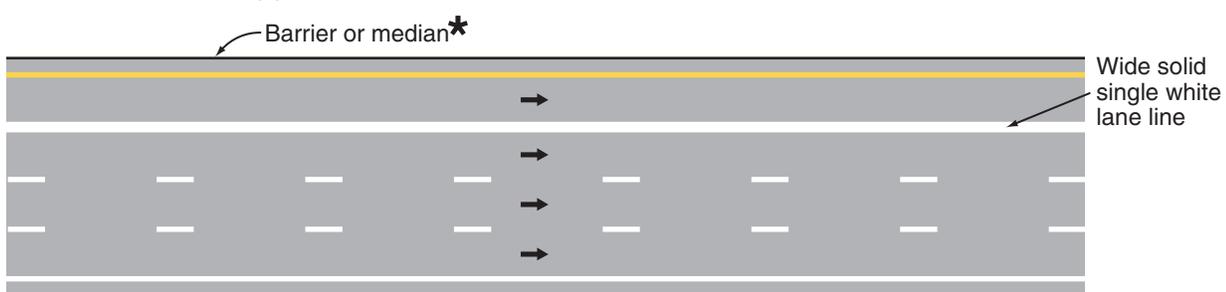
- \* If no barrier or median is present and the left-hand side of the lane is the center line of a two-way roadway, use a double yellow center line
- \*\* Example of bus lane word markings

**Figure 3D-3. Markings for Contiguous Preferential Lanes**

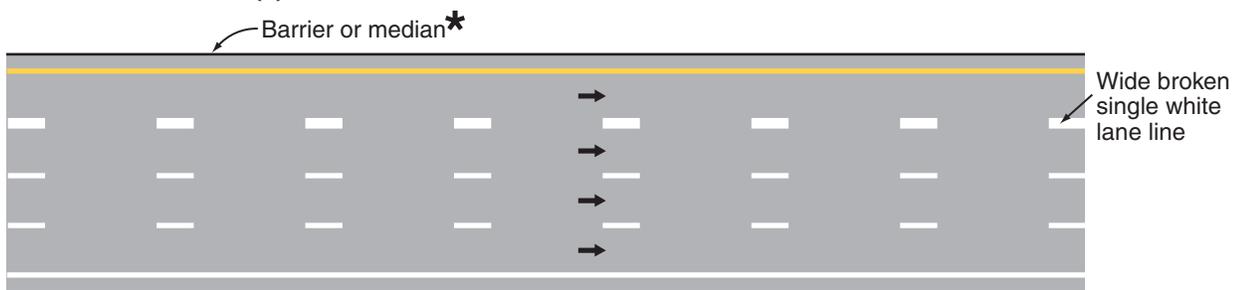
**A – Full-time preferential lane(s) where enter/exit movements are PROHIBITED**



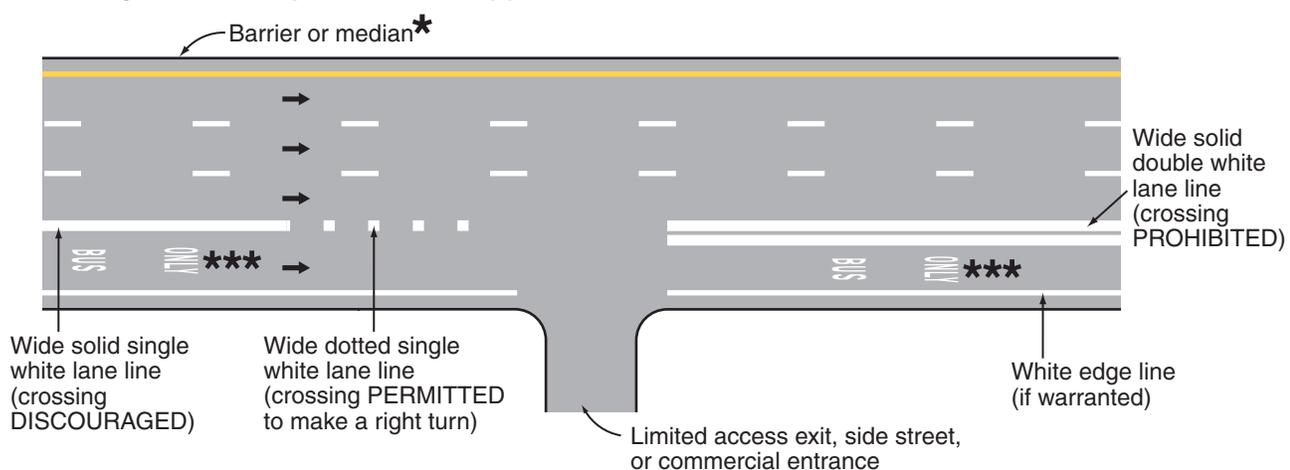
**B – Preferential lane(s) where enter/exit movements are DISCOURAGED** Space at 1/4-mile intervals



**C – Preferential lane(s) where enter/exit movements are PERMITTED**



**D – Right-hand side preferential lane(s)**



Legend

➔ Direction of travel

\* If no barrier or median is present and the left-hand side of the lane is the center line of a two-way roadway, use a double yellow center line

\*\* Example of HOV only lane symbol markings

\*\*\* Example of bus lane word markings

*Guidance:*

- 04 *Where preferential lanes and other travel lanes are separated by a buffer space wider than 4 feet and crossing the buffer space is prohibited, chevron markings (see Section 3B.24) should be placed in the buffer area (see Drawing A in Figure 3D-2). The chevron spacing should be 100 feet or greater.*

*Option:*

- 05 If a full-time or part-time contiguous preferential lane is separated from the other travel lanes by a wide broken single white line (see Drawing C in Figure 3D-3), the spacing or skip pattern of the line may be reduced and the width of the line may be increased.

**Standard:**

- 06 **If there are two or more preferential lanes for traffic moving in the same direction, the lane lines between the preferential lanes shall be normal broken white lines.**
- 07 **Preferential lanes for motor vehicles shall also be marked with the appropriate word or symbol pavement markings in accordance with Section 3D.01 and shall have appropriate regulatory signs in accordance with Sections 2G.03 through 2G.07.**

*Guidance:*

- 08 *At direct exits from a preferential lane, dotted white line markings should be used to separate the tapered or parallel deceleration lane for the direct exit (including the taper) from the adjacent continuing preferential through lane, to reduce the chance of unintended exit maneuvers.*

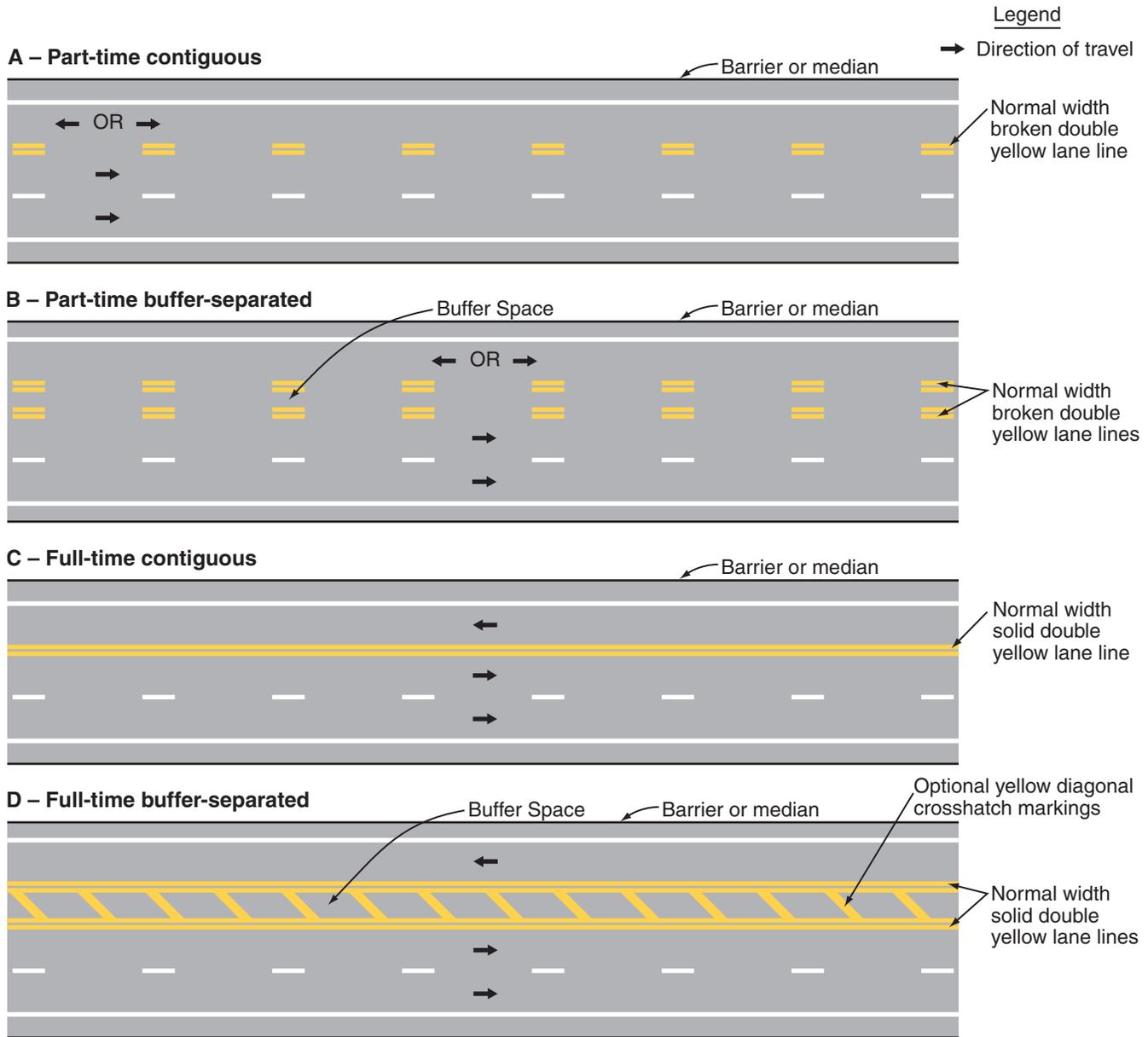
**Standard:**

- 09 **On a divided highway, a part-time counter-flow preferential lane that is contiguous to the travel lanes in the opposing direction shall be separated from the opposing direction lanes by the standard reversible lane longitudinal marking, a normal width broken double yellow line (see Section 3B.03 and Drawing A of Figure 3D-4). If a buffer space is provided between the part-time counter-flow preferential lane and the opposing direction lanes, a normal width broken double yellow line shall be placed along both edges of the buffer space (see Drawing B of Figure 3D-4). Signs (see Section 2B.26), lane-use control signals (see Chapter 4M), or both shall be used to supplement the reversible lane markings.**
- 10 **On a divided highway, a full-time counter-flow preferential lane that is contiguous to the travel lanes in the opposing direction shall be separated from the opposing direction lanes by a solid double yellow center line marking (see Drawing C of Figure 3D-4). If a buffer space is provided between the full-time counter-flow preferential lane and the opposing direction lanes, a normal width solid double yellow line shall be placed along both edges of the buffer space (see Drawing D of Figure 3D-4).**

*Option:*

- 11 Cones, tubular markers, or other channelizing devices (see Chapter 3H) may also be used to separate the opposing lanes when a counter-flow preferential lane operation is in effect.

**Figure 3D-4. Markings for Counter-Flow Preferential Lanes on Divided Highways**



## CHAPTER 3E. MARKINGS FOR TOLL PLAZAS

### Section 3E.01 Markings for Toll Plazas

Support:

- 01 At toll plazas, pavement markings help road users identify the proper lane(s) to use for the type of toll payment they plan to use, to channelize movements into the various lanes, and to delineate obstructions in the roadway.

**Standard:**

- 02 **When a lane on the approach to a toll plaza is restricted to use only by vehicles with registered ETC accounts, the ETC Account-Only lane word markings described in Section 3D.01 and the preferential lane longitudinal markings described in Section 3D.02 shall be used. When one or more ORT lanes that are restricted to use only by vehicles with registered ETC accounts bypass a mainline toll plaza on a separate alignment, these word markings and longitudinal markings shall be used on the approach to the point where the ORT lanes diverge from the lanes destined for the mainline toll plaza.**

Option:

- 03 Preferential lane-use symbol or word markings may be omitted at toll plazas where physical conditions preclude the use of the markings.

*Guidance:*

- 04 *If an ORT lane that is immediately adjacent to a mainline toll plaza is not separated from adjacent cash payment toll plaza lanes by a curb or barrier, then channelizing devices (see Section 3H.01), and/or longitudinal pavement markings that discourage or prohibit lane changing should be used to separate the ORT lane from the adjacent cash payment lane. This separation should begin on the approach to the mainline toll plaza at approximately the point where the vehicle speeds in the adjacent cash lanes drop below 30 mph during off-peak periods and should extend downstream beyond the toll plaza approximately to the point where the vehicles departing the toll plaza in the adjacent cash lanes have accelerated to 30 mph.*

Option:

- 05 For a toll plaza approach lane that is restricted to use only by vehicles with registered ETC accounts, the solid white lane line or edge line on the right-hand side of the ETC Account-Only lane and the solid white lane line or solid yellow edge line on the left-hand side of the ETC Account-Only lane may be supplemented with purple solid longitudinal markings placed contiguous to the inside edges of the lines defining the lane.

**Standard:**

- 06 **If used, the purple solid longitudinal marking described in the previous paragraph shall be a minimum of 3 inches in width and a maximum width equal to the width of the line it supplements, and ETC Account-Only preferential lane word markings (see Section 3D.01) shall be installed within the lane.**
- 07 **Toll booths and the islands on which they are located are considered to be obstructions in the roadway and they shall be provided with markings that comply with the provisions of Section 3B.10 and Chapter 3G.**

Option:

- 08 Longitudinal pavement markings may be omitted alongside toll booth islands between the approach markings and any departure markings.

## CHAPTER 3F. DELINEATORS

### Section 3F.01 Delineators

#### Support:

- 01 Delineators are particularly beneficial at locations where the alignment might be confusing or unexpected, such as at lane-reduction transitions and curves. Delineators are effective guidance devices at night and during adverse weather. An important advantage of delineators in certain locations is that they remain visible when the roadway is wet or snow covered.
- 02 Delineators are considered guidance devices rather than warning devices.

#### Option:

- 03 Delineators may be used on long continuous sections of highway or through short stretches where there are changes in horizontal alignment.

### Section 3F.02 Delineator Design

#### Standard:

- 01 **Delineators shall consist of retroreflective devices that are capable of clearly retroreflecting light under normal atmospheric conditions from a distance of 1,000 feet when illuminated by the high beams of standard automobile lights.**
- 02 **Retroreflective elements for delineators shall have a minimum dimension of 3 inches.**

#### Support:

- 03 Within a series of delineators along a roadway, delineators for a given direction of travel at a specific location are referred to as single delineators if they have one retroreflective element for that direction, double delineators if they have two identical retroreflective elements for that direction mounted together, or vertically elongated delineators if they have a single retroreflective element with an elongated vertical dimension to approximate the vertical dimension of two separate single delineators.

#### Option:

- 04 A vertically elongated delineator of appropriate size may be used in place of a double delineator.

### Section 3F.03 Delineator Application

#### Standard:

- 01 **The color of delineators shall comply with the color of edge lines stipulated in Section 3B.06.**
- 02 **A series of single delineators shall be provided on the right-hand side of freeways and expressways and on at least one side of interchange ramps, except when either Condition A or Condition B is met, as follows:**
- A. On tangent sections of freeways and expressways when both of the following conditions are met:**
1. **Raised pavement markers are used continuously on lane lines throughout all curves and on all tangents to supplement pavement markings, and**
  2. **Roadside delineators are used to lead into all curves.**
- B. On sections of roadways where continuous lighting is in operation between interchanges.**

#### Option:

- 03 Delineators may be provided on other classes of roads. A series of single delineators may be provided on the left-hand side of roadways.

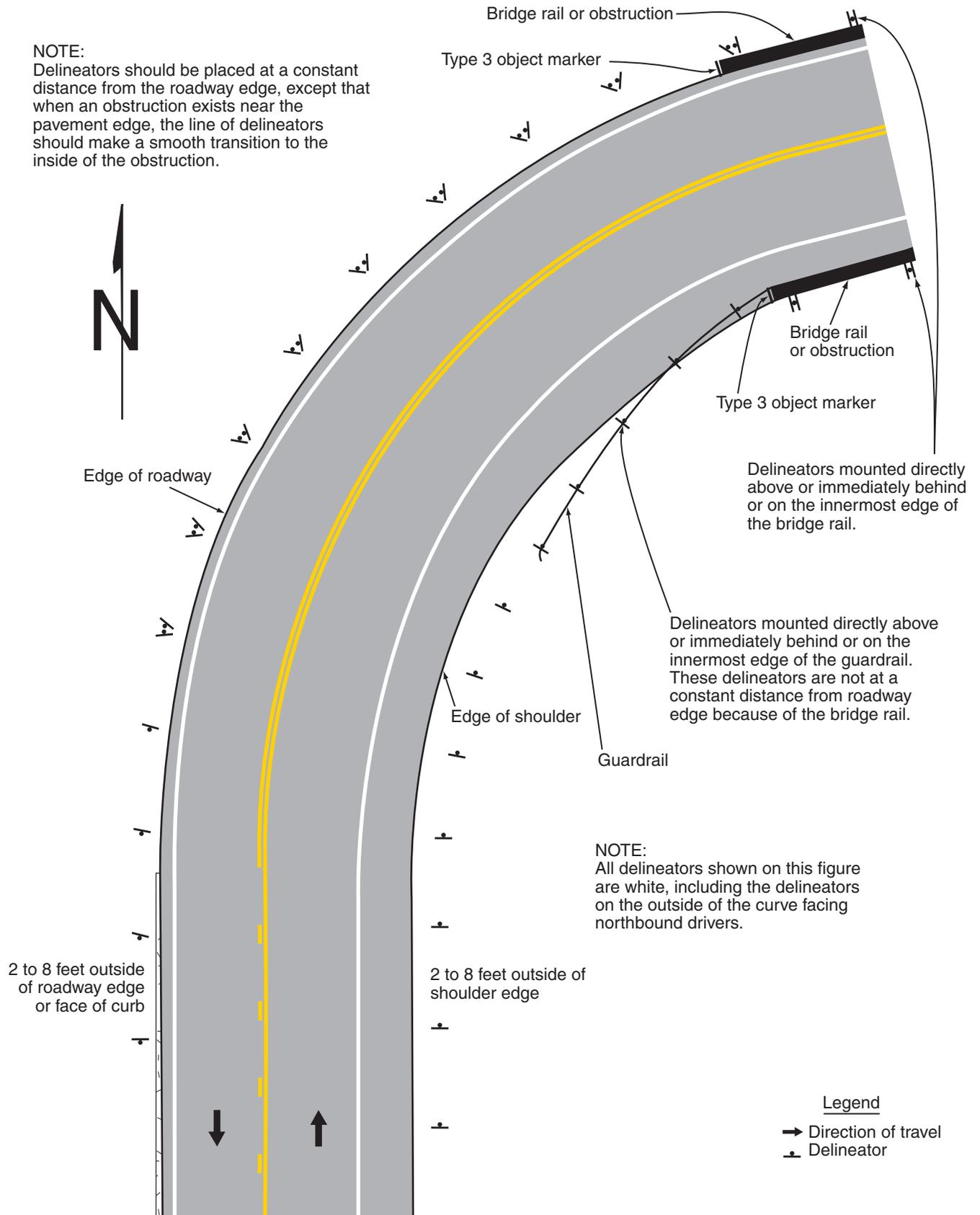
#### Standard:

- 04 **Delineators on the left-hand side of a two-way roadway shall be white (see Figure 3F-1).**

#### Guidance:

- 05 *A series of single delineators should be provided on the outside of curves on interchange ramps.*
- 06 *Where median crossovers are provided for official or emergency use on divided highways and where these crossovers are to be marked, a double yellow delineator should be placed on the left-hand side of the through roadway on the far side of the crossover for each roadway.*
- 07 *Double or vertically elongated delineators should be installed at 100-foot intervals along acceleration and deceleration lanes.*
- 08 *A series of delineators should be used wherever guardrail or other longitudinal barriers are present along a roadway or ramp.*

**Figure 3F-1. Examples of Delineator Placement**



**Option:**

09 Red delineators may be used on the reverse side of any delineator where it would be viewed by a road user traveling in the wrong direction on that particular ramp or roadway.

10 Delineators of the appropriate color may be used to indicate a lane-reduction transition where either an outside or inside lane merges into an adjacent lane.

**Guidance:**

11 *When used for lane-reduction transitions, the delineators should be installed adjacent to the lane or lanes reduced for the full length of the transition and should be so placed and spaced to show the reduction (see Figure 3B-14).*

**Support:**

12 Delineators are not necessary for traffic moving in the direction of a wider pavement or on the side of the roadway where the alignment is not affected by the lane-reduction transition.

**Guidance:**

13 *On a highway with continuous delineation on either or both sides, delineators should be carried through transitions.*

**Option:**

14 On a highway with continuous delineation on either or both sides, the spacing between a series of delineators may be closer.

**Standard:**

15 **When used on a truck escape ramp, delineators shall be red.**

**Guidance:**

16 *Red delineators should be placed on both sides of truck escape ramps. The delineators should be spaced at 50-foot intervals for a distance sufficient to identify the ramp entrance. Delineator spacing beyond the ramp entrance should be adequate for guidance according to the length and design of the escape ramp.*

**Section 3F.04 Delineator Placement and Spacing****Guidance:**

01 *Delineators should be mounted on suitable supports at a mounting height, measured vertically from the bottom of the lowest retroreflective device to the elevation of the near edge of the roadway, of approximately 4 feet.*

**Option:**

02 When mounted on the face of or on top of guardrails or other longitudinal barriers, delineators may be mounted at a lower elevation than the normal delineator height recommended in Paragraph 1.

**Guidance:**

03 *Delineators should be placed 2 to 8 feet outside the outer edge of the shoulder, or if appropriate, in line with the roadside barrier that is 8 feet or less outside the outer edge of the shoulder.*

04 *Delineators should be placed at a constant distance from the edge of the roadway, except that where an obstruction intrudes into the space between the pavement edge and the extension of the line of the delineators, the delineators should be transitioned to be in line with or inside the innermost edge of the obstruction. If the obstruction is a guardrail or other longitudinal barrier, the delineators should be transitioned to be just behind, directly above (in line with), or on the innermost edge of the guardrail or longitudinal barrier.*

05 *Delineators should be spaced 200 to 530 feet apart on mainline tangent sections. Delineators should be spaced 100 feet apart on ramp tangent sections.*

**Support:**

06 Examples of delineator installations are shown in Figure 3F-1.

**Option:**

07 When uniform spacing is interrupted by such features as driveways and intersections, delineators which would ordinarily be located within the features may be relocated in either direction for a distance not exceeding one quarter of the uniform spacing. Delineators still falling within such features may be eliminated.

08 Delineators may be transitioned in advance of a lane transition or obstruction as a guide for oncoming traffic.

*Guidance:*

- 09 *The spacing of delineators should be adjusted on approaches to and throughout horizontal curves so that several delineators are always simultaneously visible to the road user. The approximate spacing shown in Table 3F-1 should be used.*

*Option:*

- 10 When needed for special conditions, delineators of the appropriate color may be mounted in a closely-spaced manner on the face of or on top of guardrails or other longitudinal barriers to form a continuous or nearly continuous “ribbon” of delineation.

**Table 3F-1. Approximate Spacing for Delineators on Horizontal Curves**

Radius (R) of Curve	Approximate Spacing (S) on Curve
50 feet	20 feet
115 feet	25 feet
180 feet	35 feet
250 feet	40 feet
300 feet	50 feet
400 feet	55 feet
500 feet	65 feet
600 feet	70 feet
700 feet	75 feet
800 feet	80 feet
900 feet	85 feet
1,000 feet	90 feet

- Notes:
1. Spacing for specific radii may be interpolated from table.
  2. The minimum spacing should be 20 feet.
  3. The spacing on curves should not exceed 300 feet.
  4. In advance of or beyond a curve, and proceeding away from the end of the curve, the spacing of the first delineator is 2S, the second 3S, and the third 6S, but not to exceed 300 feet.
  5. S refers to the delineator spacing for specific radii computed from the formula  $S=3\sqrt{R-50}$ .
  6. The distances for S shown in the table above were rounded to the nearest 5 feet.

## CHAPTER 3G. COLORED PAVEMENTS

### Section 3G.01 General

#### Support:

- 01 Colored pavements consist of differently colored road paving materials, such as colored asphalt or concrete, or paint or other marking materials applied to the surface of a road or island to simulate a colored pavement.
- 02 If non-retroreflective colored pavement, including bricks and other types of patterned surfaces, is used as a purely aesthetic treatment and is not intended to communicate a regulatory, warning, or guidance message to road users, the colored pavement is not considered to be a traffic control device, even if it is located between the lines of a crosswalk.

#### Standard:

- 03 **If colored pavement is used within the traveled way, on flush or raised islands, or on shoulders to regulate, warn, or guide traffic or if retroreflective colored pavement is used, the colored pavement is considered to be a traffic control device and shall be limited to the following colors and applications:**
- A. **Yellow pavement color shall be used only for flush or raised median islands separating traffic flows in opposite directions or for left-hand shoulders of roadways of divided highways or one-way streets or ramps.**
  - B. **White pavement color shall be used for flush or raised channelizing islands where traffic passes on both sides in the same general direction or for right-hand shoulders.**

- 04 **Colored pavements shall not be used as a traffic control device, unless the device is applicable at all times.**

#### Guidance:

- 05 *Colored pavements used as traffic control devices should be used only where they contrast significantly with adjoining paved areas.*
- 06 *Colored pavement located between crosswalk lines should not use colors or patterns that degrade the contrast of white crosswalk lines, or that might be mistaken by road users as a traffic control application.*

## CHAPTER 3H. CHANNELIZING DEVICES USED FOR EMPHASIS OF PAVEMENT MARKING PATTERNS

### Section 3H.01 Channelizing Devices

#### Option:

- 01 Channelizing devices, as described in Sections 6F.63 through 6F.73, and 6F.75, and as shown in Figure 6F-7, such as cones, tubular markers, vertical panels, drums, lane separators, and raised islands, may be used for general traffic control purposes such as adding emphasis to reversible lane delineation, channelizing lines, or islands. Channelizing devices may also be used along a center line to preclude turns or along lane lines to preclude lane changing, as determined by engineering judgment.

#### Standard:

- 02 **Except for color, the design of channelizing devices, including but not limited to retroreflectivity, minimum dimensions, and mounting height, shall comply with the provisions of Chapter 6F.**
- 03 **The color of channelizing devices used outside of temporary traffic control zones shall be either orange or the same color as the pavement marking that they supplement, or for which they are substituted.**
- 04 **For nighttime use, channelizing devices shall be retroreflective (as described in Part 6) or internally illuminated. On channelizing devices used outside of temporary traffic control zones, retroreflective sheeting or bands shall be white if the devices separate traffic flows in the same direction and shall be yellow if the devices separate traffic flows in the opposite direction or are placed along the left-hand edge line of a one-way roadway or ramp.**

#### Guidance:

- 05 *Channelizing devices should be kept clean and bright to maximize target value.*

## CHAPTER 3I. ISLANDS

### Section 3I.01 General

#### Support:

- 01 This Chapter addresses the characteristics of islands (see definition in Section 1A.13) as traffic-control devices. Criteria for the design of islands are set forth in “A Policy on Geometric Design of Highways and Streets” (see Section 1A.11).

#### Option:

- 02 An island may be designated by curbs, pavement edges, pavement markings, channelizing devices, or other devices.

### Section 3I.02 Approach-End Treatment

#### Guidance:

- 01 *The ends of islands first approached by traffic should be preceded by diverging longitudinal pavement markings on the roadway surface, to guide vehicles into desired paths of travel along the island edge.*

#### Support:

- 02 The neutral area between approach-end markings that can be readily crossed even at considerable speed sometimes contains slightly raised (usually less than 1 inch high) sections of coarse aggregate or other suitable materials to create rumble sections that provide increased visibility of the marked areas and that produce an audible warning to road users traveling across them. For additional discouragement to driving in the neutral area, bars or buttons projecting 1 to 3 inches above the pavement surface are sometimes placed in the neutral area. These bars or buttons are designed so that any wheel encroachment within the area will be obvious to the vehicle operator, but will result in only minimal effects on control of the vehicle. Such bars or buttons are sometimes preceded by rumble sections or their height is gradually increased as approached by traffic.

#### Guidance:

- 03 *When raised bars or buttons are used in these neutral areas, they should be marked with white or yellow retroreflective materials, as determined by the direction or directions of travel they separate.*

#### Standard:

- 04 **Channelizing devices, when used in advance of islands having raised curbs, shall not be placed in such a manner as to constitute an unexpected obstacle.**

#### Option:

- 05 Pavement markings may be used with raised bars to better designate the island area.

### Section 3I.03 Island Marking Application

#### Standard:

- 01 **Markings, as related to islands, shall consist only of pavement and curb markings, channelizing devices, and delineators.**

#### Guidance:

- 02 *Pavement markings as described in Section 3B.10 for the approach to an obstruction may be omitted on the approach to a particular island based on engineering judgment.*

### Section 3I.04 Island Marking Colors

#### Guidance:

- 01 *Islands outlined by curbs or pavement markings should be marked with retroreflective white or yellow material as determined by the direction or directions of travel they separate (see Section 3A.05).*
- 02 *The retroreflective area should be of sufficient length to denote the general alignment of the edge of the island along which vehicles travel, including the approach end, when viewed from the approach to the island.*

#### Option:

- 03 On long islands, curb retroreflection may be discontinued such that it does not extend for the entire length of the curb, especially if the island is illuminated or marked with delineators or edge lines.

**Section 3I.05 Island Delineation****Standard:**

- 01 **Delineators installed on islands shall be the same colors as the related edge lines except that, when facing wrong-way traffic, they shall be red (see Section 3F.03).**
- 02 **Each roadway through an intersection shall be considered separately in positioning delineators to assure maximum effectiveness.**

**Option:**

- 03 Retroreflective or internally illuminated raised pavement markers of the appropriate color may be placed on the pavement in front of the curb and/or on the top of curbed approach ends of raised medians and curbs of islands, as a supplement to or as a substitute for retroreflective curb markings.

**Section 3I.06 Pedestrian Islands and Medians****Support:**

- 01 Raised islands or medians of sufficient width that are placed in the center area of a street or highway can serve as a place of refuge for pedestrians who are attempting to cross at a midblock or intersection location. Center islands or medians allow pedestrians to find an adequate gap in one direction of traffic at a time, as the pedestrians are able to stop, if necessary, in the center island or median area and wait for an adequate gap in the other direction of traffic before crossing the second half of the street or highway. The minimum widths for accessible refuge islands and for design and placement of detectable warning surfaces are provided in the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11).

## CHAPTER 3J. RUMBLE STRIP MARKINGS

### Section 3J.01 Longitudinal Rumble Strip Markings

Support:

01 Longitudinal rumble strips consist of a series of rough-textured or slightly raised or depressed road surfaces intended to alert inattentive drivers through vibration and sound that their vehicle has left the travel lane. Shoulder rumble strips are typically installed along the shoulder near the travel lane. On divided highways, rumble strips are sometimes installed on the median side (left-hand side) shoulder as well as on the outside (right-hand side) shoulder. On two-way roadways, rumble strips are sometimes installed along the center line.

02 This Manual contains no provisions regarding the design and placement of longitudinal rumble strips. The provisions in this Manual address the use of markings in combination with a longitudinal rumble strip.

Option:

03 An edge line or center line may be located over a longitudinal rumble strip to create a rumble stripe.

**Standard:**

04 **The color of an edge line or center line associated with a longitudinal rumble stripe shall be in accordance with Section 3A.05.**

05 **An edge line shall not be used in addition to a rumble stripe that is located along a shoulder.**

Support:

06 Figure 3J-1 illustrates markings used with or near longitudinal rumble strips.

### Section 3J.02 Transverse Rumble Strip Markings

Support:

01 Transverse rumble strips consist of intermittent narrow, transverse areas of rough-textured or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to unusual vehicular traffic conditions. Through noise and vibration, they attract the attention of road users to features such as unexpected changes in alignment and conditions requiring a reduction in speed or a stop.

02 This Manual contains no provisions regarding the design and placement of transverse rumble strips that approximate the color of the pavement. The provisions in this Manual address the use of markings in combination with a transverse rumble strip.

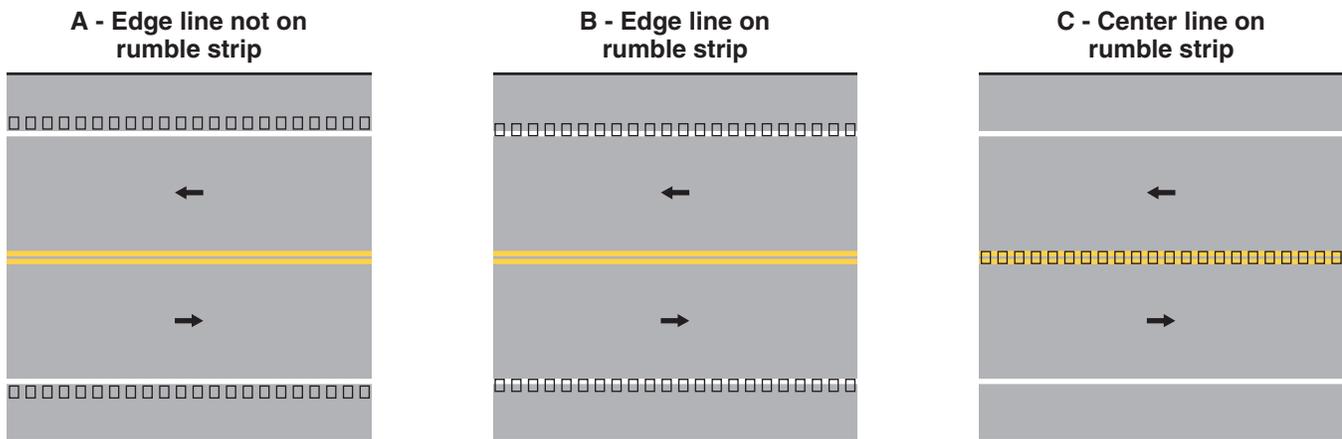
**Standard:**

03 **Except as otherwise provided in Section 6F.87 for TTC zones, if the color of a transverse rumble strip used within a travel lane is not the color of the pavement, the color of the transverse rumble strip shall be either black or white.**

*Guidance:*

04 *White transverse rumble strips used in a travel lane should not be placed in locations where they could be confused with other transverse markings such as stop lines or crosswalks.*

**Figure 3J-1. Examples of Longitudinal Rumble Strip Markings**



**Legend**

→ Direction of travel  
□□□ Rumble strip

Note: Edge line may be located alongside the rumble strip (Option A) or on the rumble strip (Option B). Center line markings may also be located on a center line rumble strip (Option C).

# PART 4

## HIGHWAY TRAFFIC SIGNALS

### CHAPTER 4A. GENERAL

#### **Section 4A.01 Types**

Support:

- 01 The following types and uses of highway traffic signals are discussed in Part 4: traffic control signals; pedestrian signals; hybrid beacons; emergency-vehicle signals; traffic control signals for one-lane, two-way facilities; traffic control signals for freeway entrance ramps; traffic control signals for movable bridges; toll plaza traffic signals; flashing beacons; lane-use control signals; and in-roadway lights.

#### **Section 4A.02 Definitions Relating to Highway Traffic Signals**

Support:

- 01 Definitions and acronyms pertaining to Part 4 are provided in Sections 1A.13 and 1A.14.

## CHAPTER 4B. TRAFFIC CONTROL SIGNALS—GENERAL

### Section 4B.01 General

Support:

- 01 Words such as pedestrians and bicyclists are used redundantly in selected Sections of Part 4 to encourage sensitivity to these elements of “traffic.”
- 02 Standards for traffic control signals are important because traffic control signals need to attract the attention of a variety of road users, including those who are older, those with impaired vision, as well as those who are fatigued or distracted, or who are not expecting to encounter a signal at a particular location.

### Section 4B.02 Basis of Installation or Removal of Traffic Control Signals

Guidance:

- 01 *The selection and use of traffic control signals should be based on an engineering study of roadway, traffic, and other conditions.*

Support:

- 02 A careful analysis of traffic operations, pedestrian and bicyclist needs, and other factors at a large number of signalized and unsignalized locations, coupled with engineering judgment, has provided a series of signal warrants, described in Chapter 4C, that define the minimum conditions under which installing traffic control signals might be justified.

Guidance:

- 03 *Engineering judgment should be applied in the review of operating traffic control signals to determine whether the type of installation and the timing program meet the current requirements of all forms of traffic.*
- 04 *If changes in traffic patterns eliminate the need for a traffic control signal, consideration should be given to removing it and replacing it with appropriate alternative traffic control devices, if any are needed.*
- 05 *If the engineering study indicates that the traffic control signal is no longer justified, and a decision is made to remove the signal, removal should be accomplished using the following steps:*
- A. *Determine the appropriate traffic control to be used after removal of the signal.*
  - B. *Remove any sight-distance restrictions as necessary.*
  - C. *Inform the public of the removal study.*
  - D. *Flash or cover the signal heads for a minimum of 90 days, and install the appropriate stop control or other traffic control devices.*
  - E. *Remove the signal if the engineering data collected during the removal study period confirms that the signal is no longer needed.*

Option:

- 06 Because Items C, D, and E in Paragraph 5 are not relevant when a temporary traffic control signal (see Section 4D.32) is removed, a temporary traffic control signal may be removed immediately after Items A and B are completed.
- 07 Instead of total removal of a traffic control signal, the poles, controller cabinet, and cables may remain in place after removal of the signal heads for continued analysis.

### Section 4B.03 Advantages and Disadvantages of Traffic Control Signals

Support:

- 01 When properly used, traffic control signals are valuable devices for the control of vehicular and pedestrian traffic. They assign the right-of-way to the various traffic movements and thereby profoundly influence traffic flow.
- 02 Traffic control signals that are properly designed, located, operated, and maintained will have one or more of the following advantages:
- A. They provide for the orderly movement of traffic.
  - B. They increase the traffic-handling capacity of the intersection if:
    1. Proper physical layouts and control measures are used, and
    2. The signal operational parameters are reviewed and updated (if needed) on a regular basis (as engineering judgment determines that significant traffic flow and/or land use changes have occurred) to maximize the ability of the traffic control signal to satisfy current traffic demands.
  - C. They reduce the frequency and severity of certain types of crashes, especially right-angle collisions.
  - D. They are coordinated to provide for continuous or nearly continuous movement of traffic at a definite speed along a given route under favorable conditions.
  - E. They are used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross.

- 03 Traffic control signals are often considered a panacea for all traffic problems at intersections. This belief has led to traffic control signals being installed at many locations where they are not needed, adversely affecting the safety and efficiency of vehicular, bicycle, and pedestrian traffic.
- 04 Traffic control signals, even when justified by traffic and roadway conditions, can be ill-designed, ineffectively placed, improperly operated, or poorly maintained. Improper or unjustified traffic control signals can result in one or more of the following disadvantages:
- A. Excessive delay,
  - B. Excessive disobedience of the signal indications,
  - C. Increased use of less adequate routes as road users attempt to avoid the traffic control signals, and
  - D. Significant increases in the frequency of collisions (especially rear-end collisions).

#### **Section 4B.04 Alternatives to Traffic Control Signals**

*Guidance:*

- 01 *Since vehicular delay and the frequency of some types of crashes are sometimes greater under traffic signal control than under STOP sign control, consideration should be given to providing alternatives to traffic control signals even if one or more of the signal warrants has been satisfied.*

*Option:*

- 02 These alternatives may include, but are not limited to, the following:
- A. Installing signs along the major street to warn road users approaching the intersection;
  - B. Relocating the stop line(s) and making other changes to improve the sight distance at the intersection;
  - C. Installing measures designed to reduce speeds on the approaches;
  - D. Installing a flashing beacon at the intersection to supplement STOP sign control;
  - E. Installing flashing beacons on warning signs in advance of a STOP sign controlled intersection on major- and/or minor-street approaches;
  - F. Adding one or more lanes on a minor-street approach to reduce the number of vehicles per lane on the approach;
  - G. Revising the geometrics at the intersection to channelize vehicular movements and reduce the time required for a vehicle to complete a movement, which could also assist pedestrians;
  - H. Revising the geometrics at the intersection to add pedestrian median refuge islands and/or curb extensions;
  - I. Installing roadway lighting if a disproportionate number of crashes occur at night;
  - J. Restricting one or more turning movements, perhaps on a time-of-day basis, if alternate routes are available;
  - K. If the warrant is satisfied, installing multi-way STOP sign control;
  - L. Installing a pedestrian hybrid beacon (see Chapter 4F) or In-Roadway Warning Lights (see Chapter 4N) if pedestrian safety is the major concern;
  - M. Installing a roundabout; and
  - N. Employing other alternatives, depending on conditions at the intersection.

#### **Section 4B.05 Adequate Roadway Capacity**

*Support:*

- 01 The delays inherent in the alternating assignment of right-of-way at intersections controlled by traffic control signals can frequently be reduced by widening the major roadway, the minor roadway, or both roadways. Widening the minor roadway often benefits the operations on the major roadway, because it reduces the green time that must be assigned to minor-roadway traffic. In urban areas, the effect of widening can be achieved by eliminating parking on intersection approaches. It is desirable to have at least two lanes for moving traffic on each approach to a signalized location. Additional width on the departure side of the intersection, as well as on the approach side, will sometimes be needed to clear traffic through the intersection effectively.

*Guidance:*

- 02 *Adequate roadway capacity should be provided at a signalized location. Before an intersection is widened, the additional green time pedestrians need to cross the widened roadways should be considered to determine if it will exceed the green time saved through improved vehicular flow.*
- 03 *Other methods of increasing the roadway capacity at signalized locations that do not involve roadway widening, such as revisions to the pavement markings and the careful evaluation of proper lane-use assignments (including varying the lane use by time of day), should be considered where appropriate. Such consideration should include evaluation of any impacts that changes to pavement markings and lane assignments will have on bicycle travel.*

## CHAPTER 4C. TRAFFIC CONTROL SIGNAL NEEDS STUDIES

### Section 4C.01 Studies and Factors for Justifying Traffic Control Signals

#### Standard:

- 01 An engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic control signal is justified at a particular location.
- 02 The investigation of the need for a traffic control signal shall include an analysis of factors related to the existing operation and safety at the study location and the potential to improve these conditions, and the applicable factors contained in the following traffic signal warrants:
- Warrant 1, Eight-Hour Vehicular Volume
  - Warrant 2, Four-Hour Vehicular Volume
  - Warrant 3, Peak Hour
  - Warrant 4, Pedestrian Volume
  - Warrant 5, School Crossing
  - Warrant 6, Coordinated Signal System
  - Warrant 7, Crash Experience
  - Warrant 8, Roadway Network
  - Warrant 9, Intersection Near a Grade Crossing
- 03 The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

#### Support:

- 04 Sections 8C.09 and 8C.10 contain information regarding the use of traffic control signals instead of gates and/or flashing-light signals at highway-rail grade crossings and highway-light rail transit grade crossings, respectively.
- Guidance:*
- 05 A traffic control signal should not be installed unless one or more of the factors described in this Chapter are met.
- 06 A traffic control signal should not be installed unless an engineering study indicates that installing a traffic control signal will improve the overall safety and/or operation of the intersection.
- 07 A traffic control signal should not be installed if it will seriously disrupt progressive traffic flow.
- 08 The study should consider the effects of the right-turn vehicles from the minor-street approaches. Engineering judgment should be used to determine what, if any, portion of the right-turn traffic is subtracted from the minor-street traffic count when evaluating the count against the signal warrants listed in Paragraph 2.
- 09 Engineering judgment should also be used in applying various traffic signal warrants to cases where approaches consist of one lane plus one left-turn or right-turn lane. The site-specific traffic characteristics should dictate whether an approach is considered as one lane or two lanes. For example, for an approach with one lane for through and right-turning traffic plus a left-turn lane, if engineering judgment indicates that it should be considered a one-lane approach because the traffic using the left-turn lane is minor, the total traffic volume approaching the intersection should be applied against the signal warrants as a one-lane approach. The approach should be considered two lanes if approximately half of the traffic on the approach turns left and the left-turn lane is of sufficient length to accommodate all left-turn vehicles.
- 10 Similar engineering judgment and rationale should be applied to a street approach with one through/left-turn lane plus a right-turn lane. In this case, the degree of conflict of minor-street right-turn traffic with traffic on the major street should be considered. Thus, right-turn traffic should not be included in the minor-street volume if the movement enters the major street with minimal conflict. The approach should be evaluated as a one-lane approach with only the traffic volume in the through/left-turn lane considered.
- 11 At a location that is under development or construction and where it is not possible to obtain a traffic count that would represent future traffic conditions, hourly volumes should be estimated as part of an engineering study for comparison with traffic signal warrants. Except for locations where the engineering study uses the satisfaction of Warrant 8 to justify a signal, a traffic control signal installed under projected conditions should have an engineering study done within 1 year of putting the signal into stop-and-go operation to determine if the signal is justified. If not justified, the signal should be taken out of stop-and-go operation or removed.
- 12 For signal warrant analysis, a location with a wide median, even if the median width is greater than 30 feet, should be considered as one intersection.

## Option:

- 13 At an intersection with a high volume of left-turn traffic from the major street, the signal warrant analysis may be performed in a manner that considers the higher of the major-street left-turn volumes as the “minor-street” volume and the corresponding single direction of opposing traffic on the major street as the “major-street” volume.
- 14 For signal warrants requiring conditions to be present for a certain number of hours in order to be satisfied, any four sequential 15-minute periods may be considered as 1 hour if the separate 1-hour periods used in the warrant analysis do not overlap each other and both the major-street volume and the minor-street volume are for the same specific one-hour periods.
- 15 For signal warrant analysis, bicyclists may be counted as either vehicles or pedestrians.

## Support:

- 16 When performing a signal warrant analysis, bicyclists riding in the street with other vehicular traffic are usually counted as vehicles and bicyclists who are clearly using pedestrian facilities are usually counted as pedestrians.

## Option:

- 17 Engineering study data may include the following:
- A. The number of vehicles entering the intersection in each hour from each approach during 12 hours of an average day. It is desirable that the hours selected contain the greatest percentage of the 24-hour traffic volume.
  - B. Vehicular volumes for each traffic movement from each approach, classified by vehicle type (heavy trucks, passenger cars and light trucks, public-transit vehicles, and, in some locations, bicycles), during each 15-minute period of the 2 hours in the morning and 2 hours in the afternoon during which total traffic entering the intersection is greatest.
  - C. Pedestrian volume counts on each crosswalk during the same periods as the vehicular counts in Item B and during hours of highest pedestrian volume. Where young, elderly, and/or persons with physical or visual disabilities need special consideration, the pedestrians and their crossing times may be classified by general observation.
  - D. Information about nearby facilities and activity centers that serve the young, elderly, and/or persons with disabilities, including requests from persons with disabilities for accessible crossing improvements at the location under study. These persons might not be adequately reflected in the pedestrian volume count if the absence of a signal restrains their mobility.
  - E. The posted or statutory speed limit or the 85<sup>th</sup>-percentile speed on the uncontrolled approaches to the location.
  - F. A condition diagram showing details of the physical layout, including such features as intersection geometrics, channelization, grades, sight-distance restrictions, transit stops and routes, parking conditions, pavement markings, roadway lighting, driveways, nearby railroad crossings, distance to nearest traffic control signals, utility poles and fixtures, and adjacent land use.
  - G. A collision diagram showing crash experience by type, location, direction of movement, severity, weather, time of day, date, and day of week for at least 1 year.
- 18 The following data, which are desirable for a more precise understanding of the operation of the intersection, may be obtained during the periods described in Item B of Paragraph 17:
- A. Vehicle-hours of stopped time delay determined separately for each approach.
  - B. The number and distribution of acceptable gaps in vehicular traffic on the major street for entrance from the minor street.
  - C. The posted or statutory speed limit or the 85<sup>th</sup>-percentile speed on controlled approaches at a point near to the intersection but unaffected by the control.
  - D. Pedestrian delay time for at least two 30-minute peak pedestrian delay periods of an average weekday or like periods of a Saturday or Sunday.
  - E. Queue length on stop-controlled approaches.

**Section 4C.02 Warrant 1, Eight-Hour Vehicular Volume**

## Support:

- 01 The Minimum Vehicular Volume, Condition A, is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal.
- 02 The Interruption of Continuous Traffic, Condition B, is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.
- 03 It is intended that Warrant 1 be treated as a single warrant. If Condition A is satisfied, then Warrant 1 is satisfied and analyses of Condition B and the combination of Conditions A and B are not needed. Similarly, if Condition B is satisfied, then Warrant 1 is satisfied and an analysis of the combination of Conditions A and B is not needed.

**Standard:**

- 04 The need for a traffic control signal shall be considered if an engineering study finds that one of the following conditions exist for each of any 8 hours of an average day:
- A. The vehicles per hour given in both of the 100 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection;
  - B. The vehicles per hour given in both of the 100 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

In applying each condition the major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of these 8 hours.

Option:

- 05 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 70 percent columns in Table 4C-1 may be used in place of the 100 percent columns.

Guidance:

- 06 The combination of Conditions A and B is intended for application at locations where Condition A is not satisfied and Condition B is not satisfied and should be applied only after an adequate trial of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

**Standard:**

- 07 The need for a traffic control signal shall be considered if an engineering study finds that both of the following conditions exist for each of any 8 hours of an average day:
- A. The vehicles per hour given in both of the 80 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection;
  - B. The vehicles per hour given in both of the 80 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.

These major-street and minor-street volumes shall be for the same 8 hours for each condition; however, the 8 hours satisfied in Condition A shall not be required to be the same 8 hours satisfied in Condition B. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.

**Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume**

**Condition A—Minimum Vehicular Volume**

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

**Condition B—Interruption of Continuous Traffic**

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

<sup>a</sup> Basic minimum hourly volume

<sup>b</sup> Used for combination of Conditions A and B after adequate trial of other remedial measures

<sup>c</sup> May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

<sup>d</sup> May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Option:

- 08 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 56 percent columns in Table 4C-1 may be used in place of the 80 percent columns.

### **Section 4C.03 Warrant 2, Four-Hour Vehicular Volume**

Support:

- 01 The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

**Standard:**

- 02 **The need for a traffic control signal shall be considered if an engineering study finds that, for each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 4C-1 for the existing combination of approach lanes. On the minor street, the higher volume shall not be required to be on the same approach during each of these 4 hours.**

Option:

- 03 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-2 may be used in place of Figure 4C-1.

### **Section 4C.04 Warrant 3, Peak Hour**

Support:

- 01 The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

**Standard:**

- 02 **This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.**
- 03 **The need for a traffic control signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:**
- A. **If all three of the following conditions exist for the same 1 hour (any four consecutive 15-minute periods) of an average day:**
    1. **The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle-hours for a one-lane approach or 5 vehicle-hours for a two-lane approach; and**
    2. **The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes; and**
    3. **The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.**
  - B. **The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 for the existing combination of approach lanes.**

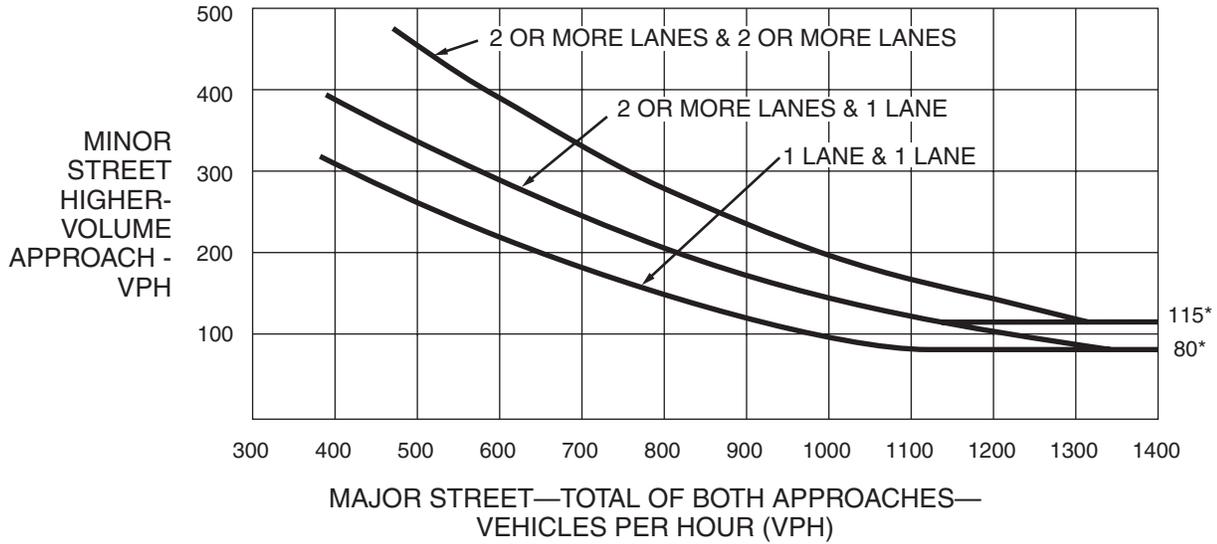
Option:

- 04 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-4 may be used in place of Figure 4C-3 to evaluate the criteria in the second category of the Standard.
- 05 If this warrant is the only warrant met and a traffic control signal is justified by an engineering study, the traffic control signal may be operated in the flashing mode during the hours that the volume criteria of this warrant are not met.

*Guidance:*

- 06 *If this warrant is the only warrant met and a traffic control signal is justified by an engineering study, the traffic control signal should be traffic-actuated.*

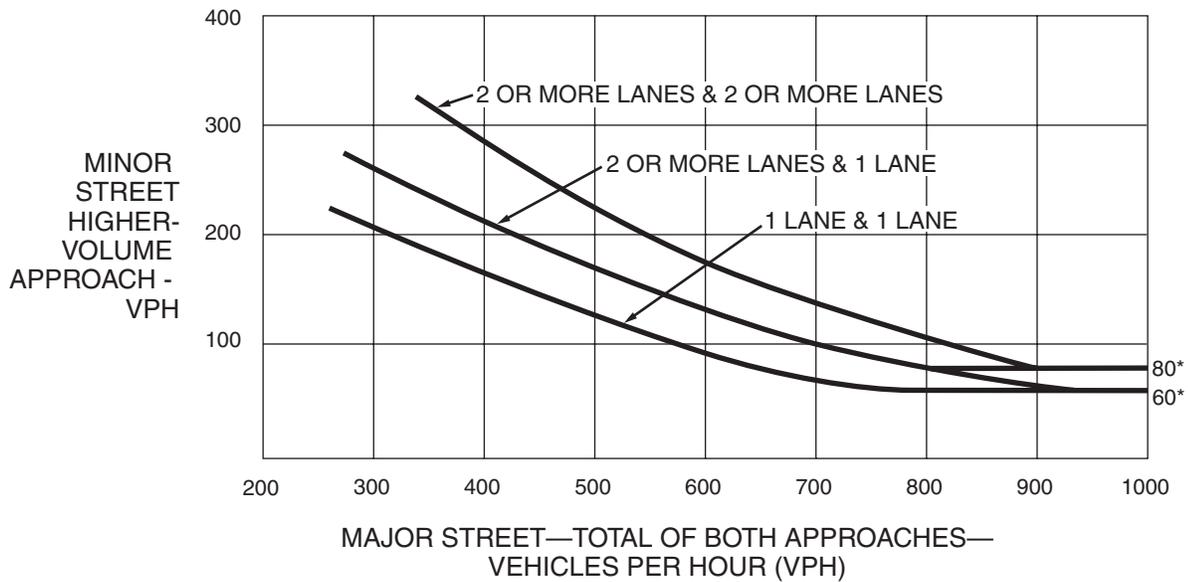
**Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume**



\*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

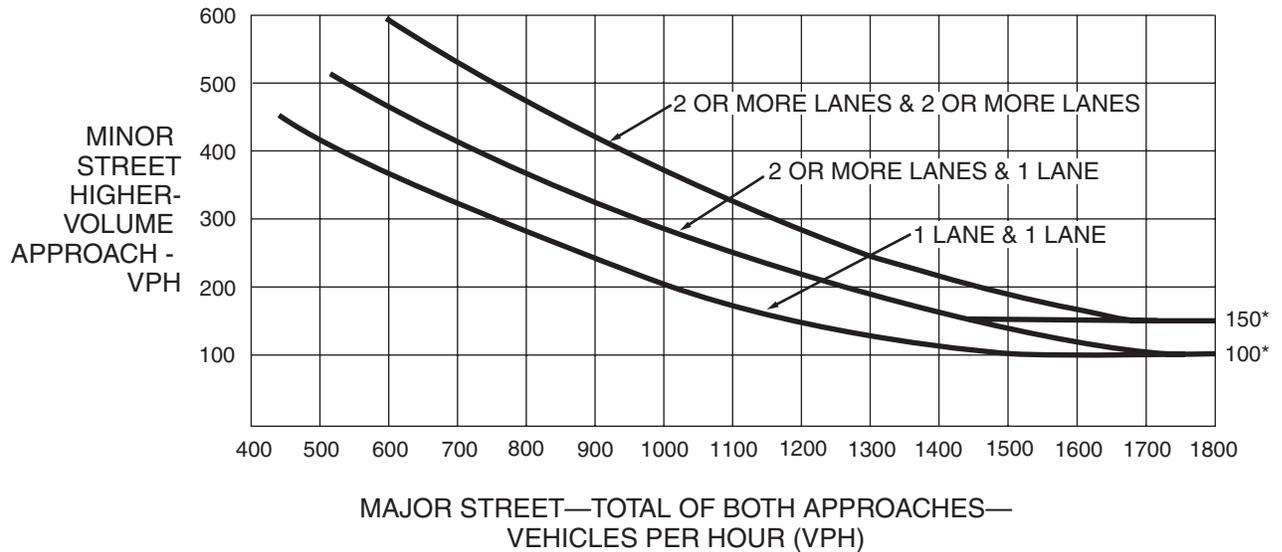
**Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)**

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



\*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

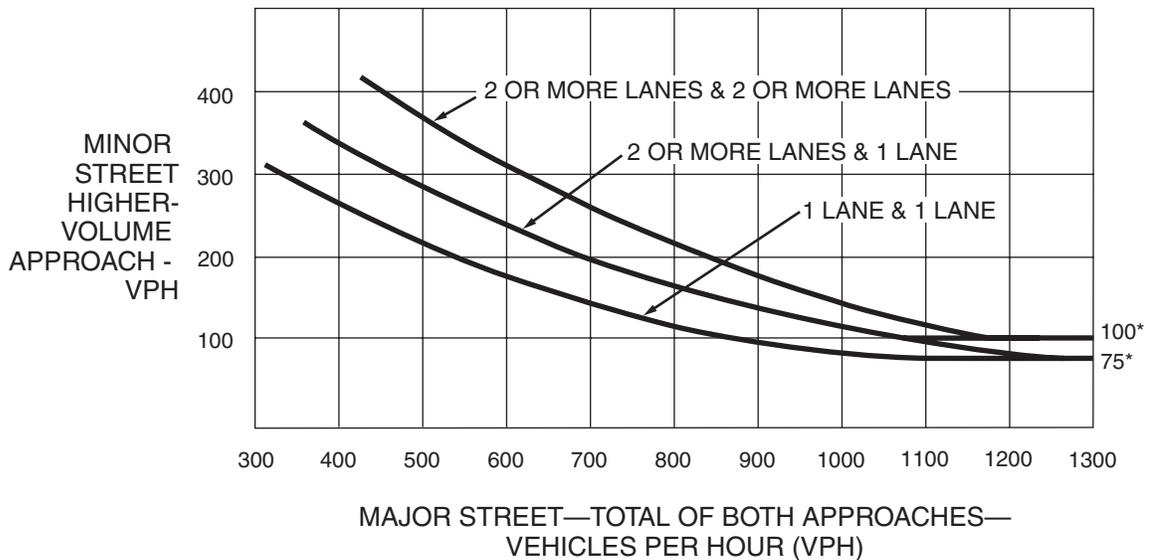
**Figure 4C-3. Warrant 3, Peak Hour**



\*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

**Figure 4C-4. Warrant 3, Peak Hour (70% Factor)**

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



\*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

### Section 4C.05 Warrant 4, Pedestrian Volume

#### Support:

- 01 The Pedestrian Volume signal warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

#### Standard:

- 02 **The need for a traffic control signal at an intersection or midblock crossing shall be considered if an engineering study finds that one of the following criteria is met:**
- A. For each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-5; or
  - B. For 1 hour (any four consecutive 15-minute periods) of an average day, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) falls above the curve in Figure 4C-7.

#### Option:

- 03 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 35 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-6 may be used in place of Figure 4C-5 to evaluate Criterion A in Paragraph 2, and Figure 4C-8 may be used in place of Figure 4C-7 to evaluate Criterion B in Paragraph 2.

#### Standard:

- 04 **The Pedestrian Volume signal warrant shall not be applied at locations where the distance to the nearest traffic control signal or STOP sign controlling the street that pedestrians desire to cross is less than 300 feet, unless the proposed traffic control signal will not restrict the progressive movement of traffic.**
- 05 **If this warrant is met and a traffic control signal is justified by an engineering study, the traffic control signal shall be equipped with pedestrian signal heads complying with the provisions set forth in Chapter 4E.**

#### Guidance:

- 06 *If this warrant is met and a traffic control signal is justified by an engineering study, then:*
- A. *If it is installed at an intersection or major driveway location, the traffic control signal should also control the minor-street or driveway traffic, should be traffic-actuated, and should include pedestrian detection.*
  - B. *If it is installed at a non-intersection crossing, the traffic control signal should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs, and should be pedestrian-actuated. If the traffic control signal is installed at a non-intersection crossing, at least one of the signal faces should be over the traveled way for each approach, parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the crosswalk or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance, and the installation should include suitable standard signs and pavement markings.*
  - C. *Furthermore, if it is installed within a signal system, the traffic control signal should be coordinated.*

#### Option:

- 07 The criterion for the pedestrian volume crossing the major street may be reduced as much as 50 percent if the 15th-percentile crossing speed of pedestrians is less than 3.5 feet per second.
- 08 A traffic control signal may not be needed at the study location if adjacent coordinated traffic control signals consistently provide gaps of adequate length for pedestrians to cross the street.

### Section 4C.06 Warrant 5, School Crossing

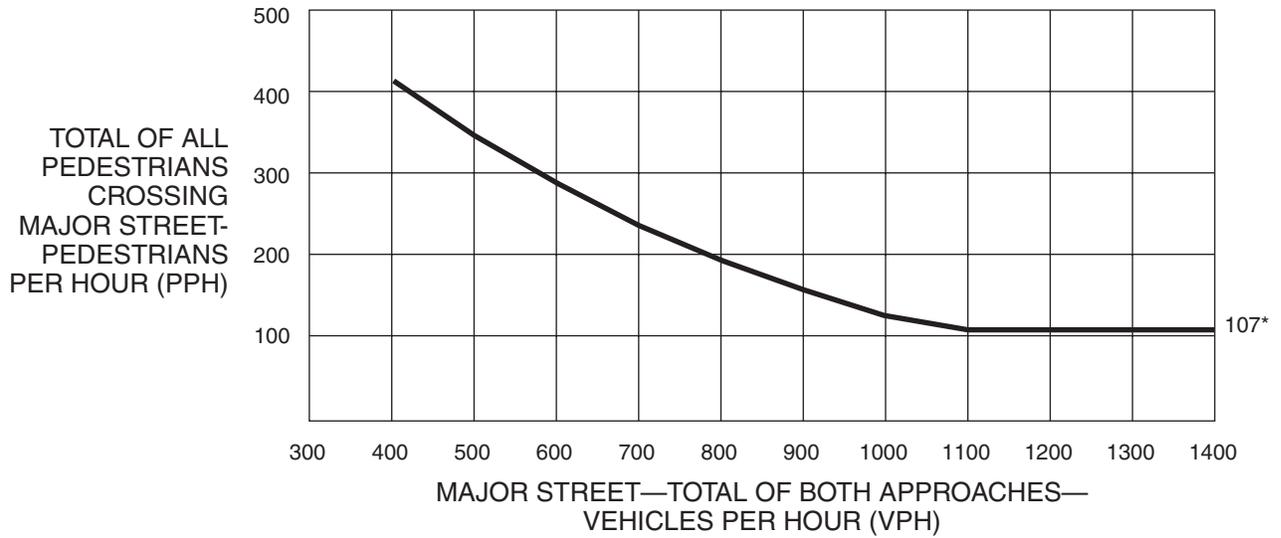
#### Support:

- 01 The School Crossing signal warrant is intended for application where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. For the purposes of this warrant, the word “schoolchildren” includes elementary through high school students.

#### Standard:

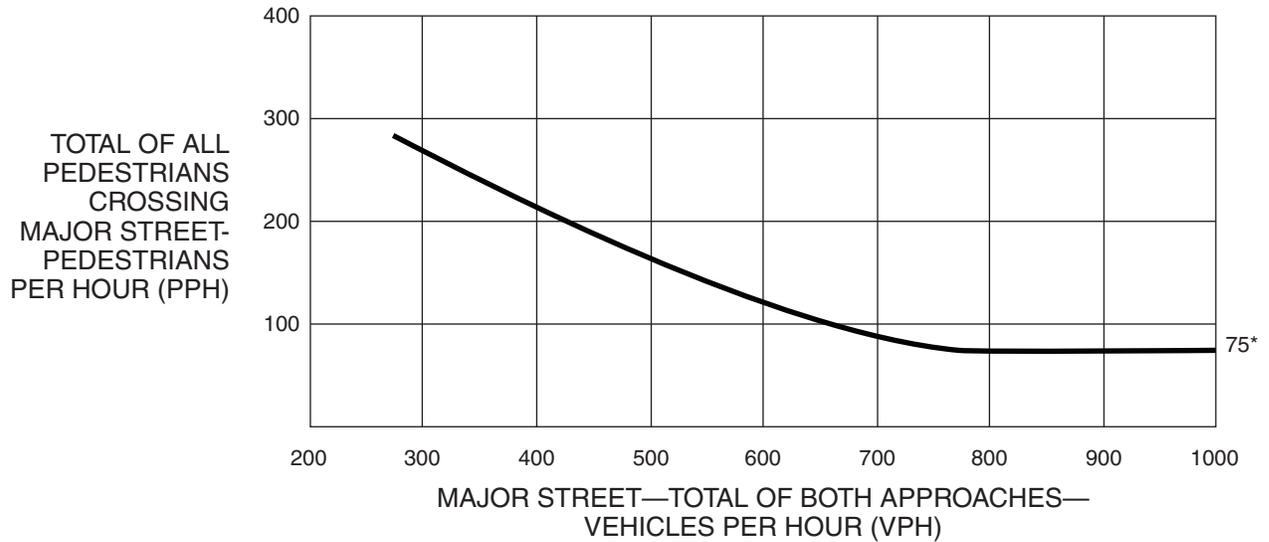
- 02 **The need for a traffic control signal shall be considered when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of schoolchildren at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the schoolchildren are using the crossing is less than the number of minutes in the same period (see Section 7A.03) and there are a minimum of 20 schoolchildren during the highest crossing hour.**

**Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume**



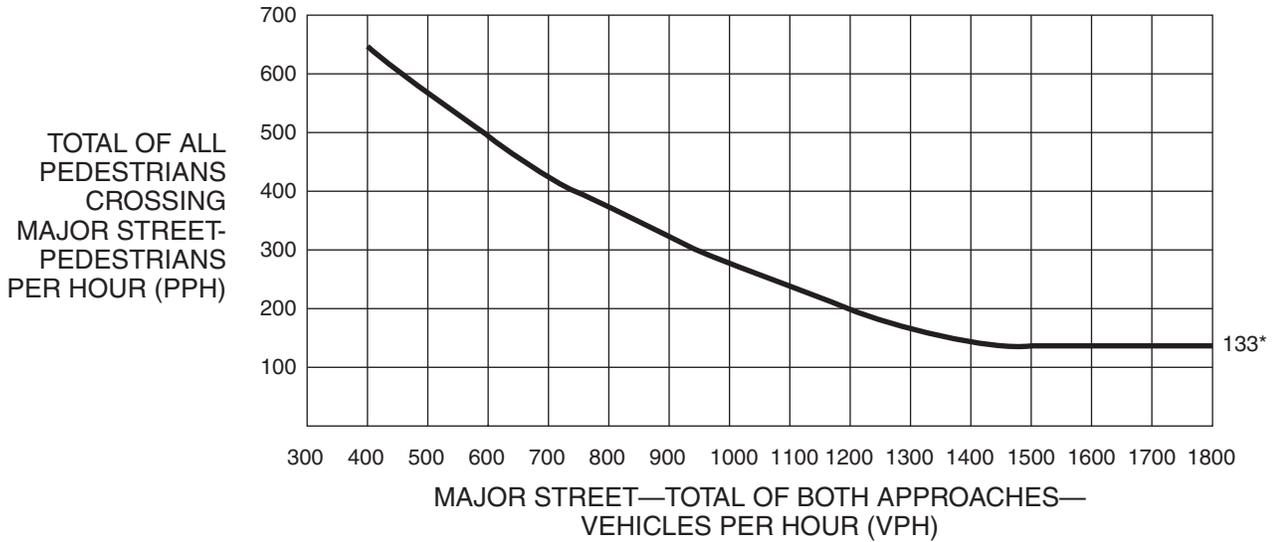
\*Note: 107 pph applies as the lower threshold volume.

**Figure 4C-6. Warrant 4, Pedestrian Four-Hour Volume (70% Factor)**



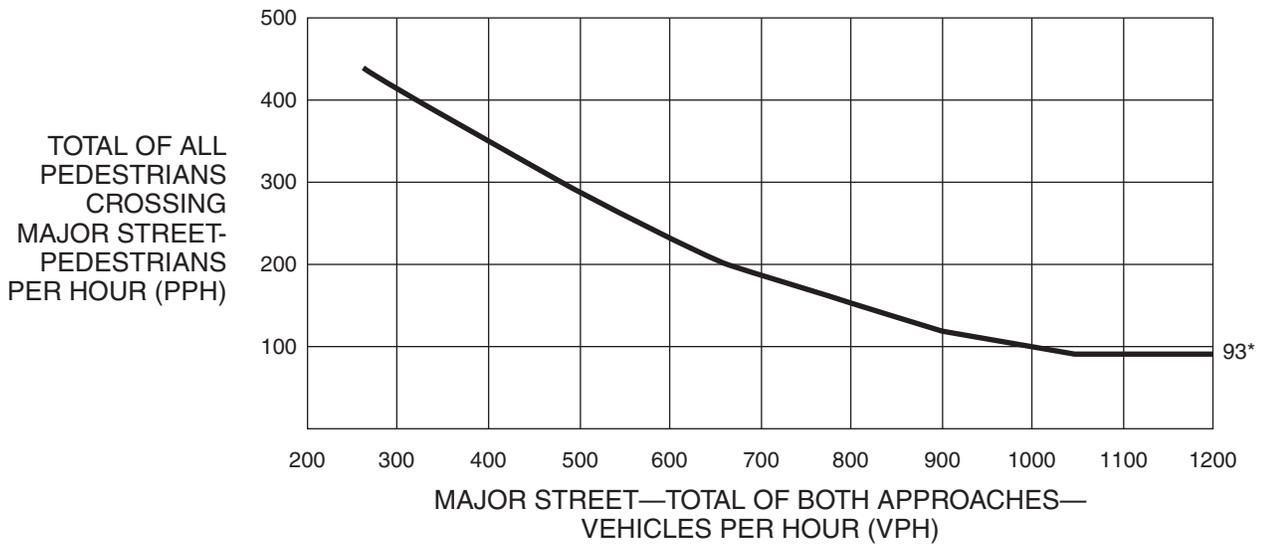
\*Note: 75 pph applies as the lower threshold volume.

**Figure 4C-7. Warrant 4, Pedestrian Peak Hour**



\*Note: 133 pph applies as the lower threshold volume.

**Figure 4C-8. Warrant 4, Pedestrian Peak Hour (70% Factor)**



\*Note: 93 pph applies as the lower threshold volume.

- 03 **Before a decision is made to install a traffic control signal, consideration shall be given to the implementation of other remedial measures, such as warning signs and flashers, school speed zones, school crossing guards, or a grade-separated crossing.**
- 04 **The School Crossing signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless the proposed traffic control signal will not restrict the progressive movement of traffic.**

*Guidance:*

- 05 *If this warrant is met and a traffic control signal is justified by an engineering study, then:*
- A. *If it is installed at an intersection or major driveway location, the traffic control signal should also control the minor-street or driveway traffic, should be traffic-actuated, and should include pedestrian detection.*
  - B. *If it is installed at a non-intersection crossing, the traffic control signal should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs, and should be pedestrian-actuated. If the traffic control signal is installed at a non-intersection crossing, at least one of the signal faces should be over the traveled way for each approach, parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the crosswalk or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance, and the installation should include suitable standard signs and pavement markings.*
  - C. *Furthermore, if it is installed within a signal system, the traffic control signal should be coordinated.*

#### **Section 4C.07 Warrant 6, Coordinated Signal System**

**Support:**

- 01 Progressive movement in a coordinated signal system sometimes necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

**Standard:**

- 02 **The need for a traffic control signal shall be considered if an engineering study finds that one of the following criteria is met:**
- A. **On a one-way street or a street that has traffic predominantly in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning.**
  - B. **On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation.**

*Guidance:*

- 03 *The Coordinated Signal System signal warrant should not be applied where the resultant spacing of traffic control signals would be less than 1,000 feet.*

#### **Section 4C.08 Warrant 7, Crash Experience**

**Support:**

- 01 The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal.

**Standard:**

- 02 **The need for a traffic control signal shall be considered if an engineering study finds that all of the following criteria are met:**
- A. **Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency; and**
  - B. **Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash; and**
  - C. **For each of any 8 hours of an average day, the vehicles per hour (vph) given in both of the 80 percent columns of Condition A in Table 4C-1 (see Section 4C.02), or the vph in both of the 80 percent columns of Condition B in Table 4C-1 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, or the volume of pedestrian traffic is not less than 80 percent of the requirements specified in the Pedestrian Volume warrant. These major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.**

Option:

- 03 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the traffic volumes in the 56 percent columns in Table 4C-1 may be used in place of the 80 percent columns.

#### **Section 4C.09 Warrant 8, Roadway Network**

Support:

- 01 Installing a traffic control signal at some intersections might be justified to encourage concentration and organization of traffic flow on a roadway network.

**Standard:**

- 02 **The need for a traffic control signal shall be considered if an engineering study finds that the common intersection of two or more major routes meets one or both of the following criteria:**
- A. **The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2, and 3 during an average weekday; or**
  - B. **The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday).**
- 03 **A major route as used in this signal warrant shall have at least one of the following characteristics:**
- A. **It is part of the street or highway system that serves as the principal roadway network for through traffic flow.**
  - B. **It includes rural or suburban highways outside, entering, or traversing a city.**
  - C. **It appears as a major route on an official plan, such as a major street plan in an urban area traffic and transportation study.**

#### **Section 4C.10 Warrant 9, Intersection Near a Grade Crossing**

Support:

- 01 The Intersection Near a Grade Crossing signal warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic control signal.

*Guidance:*

- 02 *This signal warrant should be applied only after adequate consideration has been given to other alternatives or after a trial of an alternative has failed to alleviate the safety concerns associated with the grade crossing. Among the alternatives that should be considered or tried are:*
- A. *Providing additional pavement that would enable vehicles to clear the track or that would provide space for an evasive maneuver, or*
  - B. *Reassigning the stop controls at the intersection to make the approach across the track a non-stopping approach.*

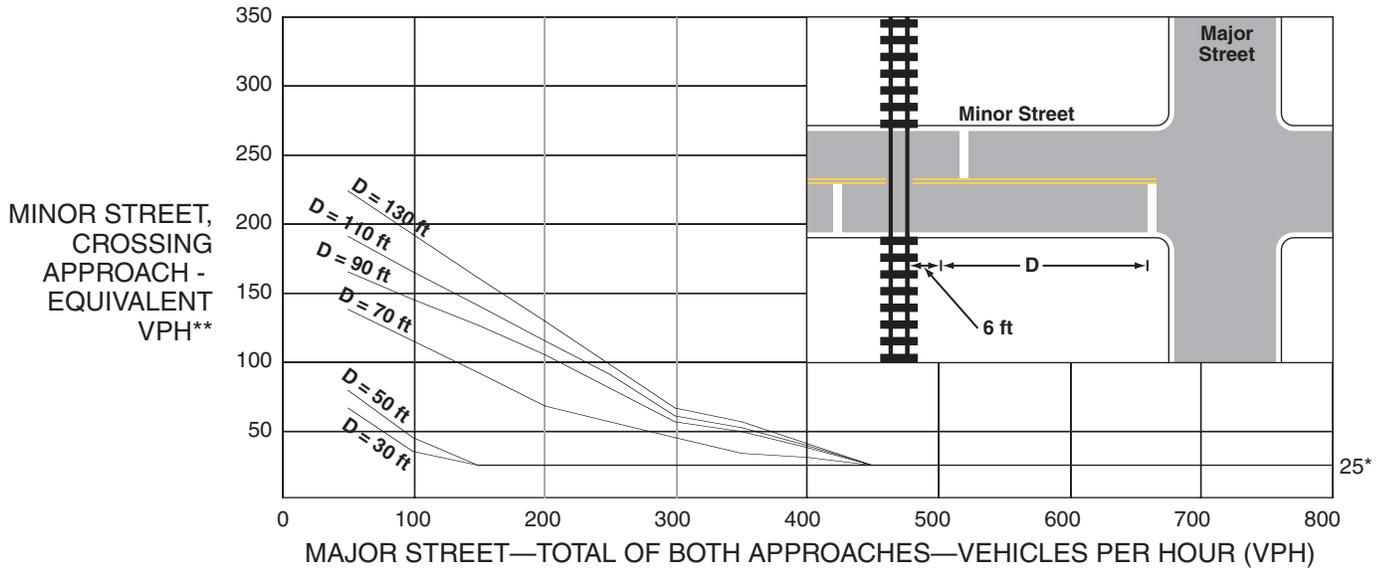
**Standard:**

- 03 **The need for a traffic control signal shall be considered if an engineering study finds that both of the following criteria are met:**
- A. **A grade crossing exists on an approach controlled by a STOP or YIELD sign and the center of the track nearest to the intersection is within 140 feet of the stop line or yield line on the approach; and**
  - B. **During the highest traffic volume hour during which rail traffic uses the crossing, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the minor-street approach that crosses the track (one direction only, approaching the intersection) falls above the applicable curve in Figure 4C-9 or 4C-10 for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance as defined in Section 1A.13.**

*Guidance:*

- 04 *The following considerations apply when plotting the traffic volume data on Figure 4C-9 or 4C-10:*
- A. *Figure 4C-9 should be used if there is only one lane approaching the intersection at the track crossing location and Figure 4C-10 should be used if there are two or more lanes approaching the intersection at the track crossing location.*

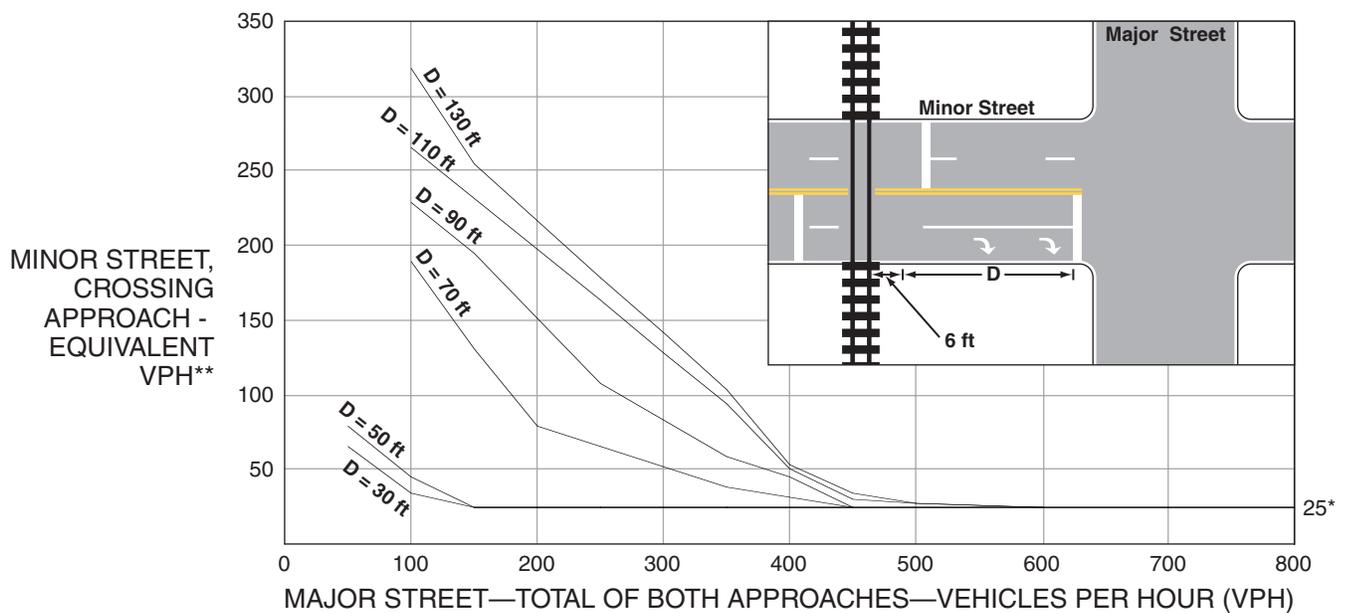
**Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)**



\* 25 vph applies as the lower threshold volume

\*\* VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

**Figure 4C-10. Warrant 9, Intersection Near a Grade Crossing (Two or More Approach Lanes at the Track Crossing)**



\* 25 vph applies as the lower threshold volume

\*\* VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

- B. After determining the actual distance  $D$ , the curve for the distance  $D$  that is nearest to the actual distance  $D$  should be used. For example, if the actual distance  $D$  is 95 feet, the plotted point should be compared to the curve for  $D = 90$  feet.
- C. If the rail traffic arrival times are unknown, the highest traffic volume hour of the day should be used.

Option:

- 05 The minor-street approach volume may be multiplied by up to three adjustment factors as provided in Paragraphs 6 through 8.
- 06 Because the curves are based on an average of four occurrences of rail traffic per day, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-2 for the appropriate number of occurrences of rail traffic per day.
- 07 Because the curves are based on typical vehicle occupancy, if at least 2% of the vehicles crossing the track are buses carrying at least 20 people, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-3 for the appropriate percentage of high-occupancy buses.
- 08 Because the curves are based on tractor-trailer trucks comprising 10% of the vehicles crossing the track, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-4 for the appropriate distance and percentage of tractor-trailer trucks.

**Standard:**

- 09 **If this warrant is met and a traffic control signal at the intersection is justified by an engineering study, then:**
  - A. The traffic control signal shall have actuation on the minor street;
  - B. Preemption control shall be provided in accordance with Sections 4D.27, 8C.09, and 8C.10; and
  - C. The grade crossing shall have flashing-light signals (see Chapter 8C).

*Guidance:*

- 10 *If this warrant is met and a traffic control signal at the intersection is justified by an engineering study, the grade crossing should have automatic gates (see Chapter 8C).*

**Table 4C-2. Warrant 9, Adjustment Factor for Daily Frequency of Rail Traffic**

Rail Traffic per Day	Adjustment Factor
1	0.67
2	0.91
3 to 5	1.00
6 to 8	1.18
9 to 11	1.25
12 or more	1.33

**Table 4C-3. Warrant 9, Adjustment Factor for Percentage of High-Occupancy Buses**

% of High-Occupancy Buses* on Minor-Street Approach	Adjustment Factor
0%	1.00
2%	1.09
4%	1.19
6% or more	1.32

\* A high-occupancy bus is defined as a bus occupied by at least 20 people.

**Table 4C-4. Warrant 9, Adjustment Factor for Percentage of Tractor-Trailer Trucks**

% of Tractor-Trailer Trucks on Minor-Street Approach	Adjustment Factor	
	D less than 70 feet	D of 70 feet or more
0% to 2.5%	0.50	0.50
2.6% to 7.5%	0.75	0.75
7.6% to 12.5%	1.00	1.00
12.6% to 17.5%	2.30	1.15
17.6% to 22.5%	2.70	1.35
22.6% to 27.5%	3.28	1.64
More than 27.5%	4.18	2.09

## CHAPTER 4D. TRAFFIC CONTROL SIGNAL FEATURES

### Section 4D.01 General

#### Support:

- 01 The features of traffic control signals of interest to road users are the location, design, and meaning of the signal indications. Uniformity in the design features that affect the traffic to be controlled, as set forth in this Manual, is especially important for the safety and efficiency of operations.
- 02 Traffic control signals can be operated in pretimed, semi-actuated, or full-actuated modes. For isolated (non-interconnected) signalized locations on rural high-speed highways, full-actuated mode with advance vehicle detection on the high-speed approaches is typically used. These features are designed to reduce the frequency with which the onset of the yellow change interval is displayed when high-speed approaching vehicles are in the “dilemma zone” such that the drivers of these high-speed vehicles find it difficult to decide whether to stop or proceed.

#### Standard:

- 03 **When a traffic control signal is not in operation, such as before it is placed in service, during seasonal shutdowns, or when it is not desirable to operate the traffic control signal, the signal faces shall be covered, turned, or taken down to clearly indicate that the traffic control signal is not in operation.**

#### Support:

- 04 Seasonal shutdown is a condition in which a permanent traffic signal is turned off or otherwise made non-operational during a particular season when its operation is not justified. This might be applied in a community where tourist traffic during most of the year justifies the permanent signalization, but a seasonal shutdown of the signal during an annual period of lower tourist traffic would reduce delays; or where a major traffic generator, such as a large factory, justifies the permanent signalization, but the large factory is shut down for an annual factory vacation for a few weeks in the summer.

#### Standard:

- 05 **A traffic control signal shall control traffic only at the intersection or midblock location where the signal faces are placed.**
- 06 **Midblock crosswalks shall not be signalized if they are located within 300 feet from the nearest traffic control signal, unless the proposed traffic control signal will not restrict the progressive movement of traffic.**

#### Guidance:

- 07 *A midblock crosswalk location should not be controlled by a traffic control signal if the crosswalk is located within 100 feet from side streets or driveways that are controlled by STOP signs or YIELD signs.*
- 08 *Engineering judgment should be used to determine the proper phasing and timing for a traffic control signal. Since traffic flows and patterns change, phasing and timing should be reevaluated regularly and updated if needed.*
- 09 *Traffic control signals within 1/2 mile of one another along a major route or in a network of intersecting major routes should be coordinated, preferably with interconnected controller units. Where traffic control signals that are within 1/2 mile of one another along a major route have a jurisdictional boundary or a boundary between different signal systems between them, coordination across the boundary should be considered.*

#### Support:

- 10 Signal coordination need not be maintained between control sections that operate on different cycle lengths.
- 11 For coordination with grade crossing signals and movable bridge signals, see Sections 4D.27, 4J.03, 8C.09, and 8C.10.

### Section 4D.02 Responsibility for Operation and Maintenance

#### Guidance:

- 01 *Prior to installing any traffic control signal, the responsibility for the maintenance of the signal and all of the appurtenances, hardware, software, and the timing plan(s) should be clearly established. The responsible agency should provide for the maintenance of the traffic control signal and all of its appurtenances in a competent manner.*
- 02 *To this end the agency should:*
- A. *Keep every controller assembly in effective operation in accordance with its predetermined timing schedule; check the operation of the controller assembly frequently enough to verify that it is operating in accordance with the predetermined timing schedule; and establish a policy to maintain a record of all timing changes and that only authorized persons are permitted to make timing changes;*

- B. *Clean the optical system of the signal sections and replace the light sources as frequently as experience proves necessary;*
- C. *Clean and service equipment and other appurtenances as frequently as experience proves necessary;*
- D. *Provide for alternate operation of the traffic control signal during a period of failure, using flashing mode or manual control, or manual traffic direction by proper authorities as might be required by traffic volumes or congestion, or by erecting other traffic control devices;*
- E. *Have properly skilled maintenance personnel available without undue delay for all signal malfunctions and signal indication failures;*
- F. *Provide spare equipment to minimize the interruption of traffic control signal operation as a result of equipment failure;*
- G. *Provide for the availability of properly skilled maintenance personnel for the repair of all components; and*
- H. *Maintain the appearance of the signal displays and equipment.*

### **Section 4D.03 Provisions for Pedestrians**

Support:

- 01 Chapter 4E contains additional information regarding pedestrian signals and Chapter 4F contains additional information regarding pedestrian hybrid beacons.

**Standard:**

- 02 **The design and operation of traffic control signals shall take into consideration the needs of pedestrian as well as vehicular traffic.**
- 03 **If engineering judgment indicates the need for provisions for a given pedestrian movement, signal faces conveniently visible to pedestrians shall be provided by pedestrian signal heads (see Chapter 4E) or a vehicular signal face(s) for a concurrent vehicular movement.**

*Guidance:*

- 04 *Accessible pedestrian signals (see Sections 4E.09 through 4E.13) that provide information in non-visual formats (such as audible tones, speech messages, and/or vibrating surfaces) should be provided where determined appropriate by engineering judgment.*
- 05 *Where pedestrian movements regularly occur, pedestrians should be provided with sufficient time to cross the roadway by adjusting the traffic control signal operation and timing to provide sufficient crossing time every cycle or by providing pedestrian detectors.*
- 06 *If it is necessary or desirable to prohibit certain pedestrian movements at a traffic control signal location, No Pedestrian Crossing (R9-3) signs (see Section 2B.51) should be used if it is not practical to provide a barrier or other physical feature to physically prevent the pedestrian movements.*

### **Section 4D.04 Meaning of Vehicular Signal Indications**

Support:

- 01 The “Uniform Vehicle Code” (see Section 1A.11) is the primary source for the standards for the meaning of vehicular signal indications to both vehicle operators and pedestrians as provided in this Section, and the standards for the meaning of separate pedestrian signal head indications as provided in Section 4E.02.
- 02 The physical area that is defined as being “within the intersection” is dependent upon the conditions that are described in the definition of intersection in Section 1A.13.

**Standard:**

- 03 **The following meanings shall be given to highway traffic signal indications for vehicles and pedestrians:**
- A. Steady green signal indications shall have the following meanings:**

- 1. Vehicular traffic facing a CIRCULAR GREEN signal indication is permitted to proceed straight through or turn right or left or make a U-turn movement except as such movement is modified by lane-use signs, turn prohibition signs, lane markings, roadway design, separate turn signal indications, or other traffic control devices.**

**Such vehicular traffic, including vehicles turning right or left or making a U-turn movement, shall yield the right-of-way to:**

- (a) Pedestrians lawfully within an associated crosswalk, and**
- (b) Other vehicles lawfully within the intersection.**

**In addition, vehicular traffic turning left or making a U-turn movement to the left shall yield the right-of-way to other vehicles approaching from the opposite direction so closely as to constitute an immediate hazard during the time when such turning vehicle is moving across or within the intersection.**

2. Vehicular traffic facing a GREEN ARROW signal indication, displayed alone or in combination with another signal indication, is permitted to cautiously enter the intersection only to make the movement indicated by such arrow, or such other movement as is permitted by other signal indications displayed at the same time.

Such vehicular traffic, including vehicles turning right or left or making a U-turn movement, shall yield the right-of-way to:

- (a) Pedestrians lawfully within an associated crosswalk, and
  - (b) Other vehicles lawfully within the intersection.
3. Pedestrians facing a CIRCULAR GREEN signal indication, unless otherwise directed by a pedestrian signal indication or other traffic control device, are permitted to proceed across the roadway within any marked or unmarked associated crosswalk. The pedestrian shall yield the right-of-way to vehicles lawfully within the intersection or so close as to create an immediate hazard at the time that the green signal indication is first displayed.
  4. Pedestrians facing a GREEN ARROW signal indication, unless otherwise directed by a pedestrian signal indication or other traffic control device, shall not cross the roadway.

**B. Steady yellow signal indications shall have the following meanings:**

1. Vehicular traffic facing a steady CIRCULAR YELLOW signal indication is thereby warned that the related green movement or the related flashing arrow movement is being terminated or that a steady red signal indication will be displayed immediately thereafter when vehicular traffic shall not enter the intersection. The rules set forth concerning vehicular operation under the movement(s) being terminated shall continue to apply while the steady CIRCULAR YELLOW signal indication is displayed.
2. Vehicular traffic facing a steady YELLOW ARROW signal indication is thereby warned that the related GREEN ARROW movement or the related flashing arrow movement is being terminated. The rules set forth concerning vehicular operation under the movement(s) being terminated shall continue to apply while the steady YELLOW ARROW signal indication is displayed.
3. Pedestrians facing a steady CIRCULAR YELLOW or YELLOW ARROW signal indication, unless otherwise directed by a pedestrian signal indication or other traffic control device shall not start to cross the roadway.

**C. Steady red signal indications shall have the following meanings:**

1. Vehicular traffic facing a steady CIRCULAR RED signal indication, unless entering the intersection to make another movement permitted by another signal indication, shall stop at a clearly marked stop line; but if there is no stop line, traffic shall stop before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, then before entering the intersection; and shall remain stopped until a signal indication to proceed is displayed, or as provided below.

Except when a traffic control device is in place prohibiting a turn on red or a steady RED ARROW signal indication is displayed, vehicular traffic facing a steady CIRCULAR RED signal indication is permitted to enter the intersection to turn right, or to turn left from a one-way street into a one-way street, after stopping. The right to proceed with the turn shall be subject to the rules applicable after making a stop at a STOP sign.

2. Vehicular traffic facing a steady RED ARROW signal indication shall not enter the intersection to make the movement indicated by the arrow and, unless entering the intersection to make another movement permitted by another signal indication, shall stop at a clearly marked stop line; but if there is no stop line, before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, then before entering the intersection; and shall remain stopped until a signal indication or other traffic control device permitting the movement indicated by such RED ARROW is displayed.

When a traffic control device is in place permitting a turn on a steady RED ARROW signal indication, vehicular traffic facing a steady RED ARROW signal indication is permitted to enter the intersection to make the movement indicated by the arrow signal indication, after stopping. The right to proceed with the turn shall be limited to the direction indicated by the arrow and shall be subject to the rules applicable after making a stop at a STOP sign.

3. Unless otherwise directed by a pedestrian signal indication or other traffic control device, pedestrians facing a steady CIRCULAR RED or steady RED ARROW signal indication shall not enter the roadway.

**D. A flashing green signal indication has no meaning and shall not be used.**

**E. Flashing yellow signal indications shall have the following meanings:**

1. Vehicular traffic, on an approach to an intersection, facing a flashing **CIRCULAR YELLOW** signal indication is permitted to cautiously enter the intersection to proceed straight through or turn right or left or make a U-turn except as such movement is modified by lane-use signs, turn prohibition signs, lane markings, roadway design, separate turn signal indications, or other traffic control devices.

Such vehicular traffic, including vehicles turning right or left or making a U-turn, shall yield the right-of-way to:

- (a) Pedestrians lawfully within an associated crosswalk, and
- (b) Other vehicles lawfully within the intersection.

In addition, vehicular traffic turning left or making a U-turn to the left shall yield the right-of-way to other vehicles approaching from the opposite direction so closely as to constitute an immediate hazard during the time when such turning vehicle is moving across or within the intersection.

2. Vehicular traffic, on an approach to an intersection, facing a flashing **YELLOW ARROW** signal indication, displayed alone or in combination with another signal indication, is permitted to cautiously enter the intersection only to make the movement indicated by such arrow, or other such movement as is permitted by other signal indications displayed at the same time.

Such vehicular traffic, including vehicles turning right or left or making a U-turn, shall yield the right-of-way to:

- (a) Pedestrians lawfully within an associated crosswalk, and
- (b) Other vehicles lawfully within the intersection.

In addition, vehicular traffic turning left or making a U-turn to the left shall yield the right-of-way to other vehicles approaching from the opposite direction so closely as to constitute an immediate hazard during the time when such turning vehicle is moving across or within the intersection.

3. Pedestrians facing any flashing yellow signal indication at an intersection, unless otherwise directed by a pedestrian signal indication or other traffic control device, are permitted to proceed across the roadway within any marked or unmarked associated crosswalk. Pedestrians shall yield the right-of-way to vehicles lawfully within the intersection at the time that the flashing yellow signal indication is first displayed.
4. When a flashing **CIRCULAR YELLOW** signal indication(s) is displayed as a beacon (see Chapter 4L) to supplement another traffic control device, road users are notified that there is a need to pay extra attention to the message contained thereon or that the regulatory or warning requirements of the other traffic control device, which might not be applicable at all times, are currently applicable.

**F. Flashing red signal indications shall have the following meanings:**

1. Vehicular traffic, on an approach to an intersection, facing a flashing **CIRCULAR RED** signal indication shall stop at a clearly marked stop line; but if there is no stop line, before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, at the point nearest the intersecting roadway where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection. The right to proceed shall be subject to the rules applicable after making a stop at a **STOP** sign.
2. Vehicular traffic, on an approach to an intersection, facing a flashing **RED ARROW** signal indication if intending to turn in the direction indicated by the arrow shall stop at a clearly marked stop line; but if there is no stop line, before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, at the point nearest the intersecting roadway where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection. The right to proceed with the turn shall be limited to the direction indicated by the arrow and shall be subject to the rules applicable after making a stop at a **STOP** sign.
3. Pedestrians facing any flashing red signal indication at an intersection, unless otherwise directed by a pedestrian signal indication or other traffic control device, are permitted to proceed across the roadway within any marked or unmarked associated crosswalk. Pedestrians shall yield the right-of-way to vehicles lawfully within the intersection at the time that the flashing red signal indication is first displayed.
4. When a flashing **CIRCULAR RED** signal indication(s) is displayed as a beacon (see Chapter 4L) to supplement another traffic control device, road users are notified that there is a need to pay extra attention to the message contained thereon or that the regulatory requirements of the other traffic control device, which might not be applicable at all times, are currently applicable. Use of this signal indication shall be limited to supplementing **STOP (R1-1)**, **DO NOT ENTER (R5-1)**, or **WRONG WAY (R5-1a)** signs, and to applications where compliance with the supplemented traffic control device requires a stop at a designated point.

**Section 4D.05 Application of Steady Signal Indications****Standard:**

- 01 When a traffic control signal is being operated in a steady (stop-and-go) mode, at least one indication in each signal face shall be displayed at any given time.
- 02 A signal face(s) that controls a particular vehicular movement during any interval of a cycle shall control that same movement during all intervals of the cycle.
- 03 Steady signal indications shall be applied as follows:
- A. A steady CIRCULAR RED signal indication:
    - 1. Shall be displayed when it is intended to prohibit traffic, except pedestrians directed by a pedestrian signal head, from entering the intersection or other controlled area. Turning after stopping is permitted as stated in Item C.1 in Paragraph 3 of Section 4D.04.
    - 2. Shall be displayed with the appropriate GREEN ARROW signal indications when it is intended to permit traffic to make a specified turn or turns, and to prohibit traffic from proceeding straight ahead through the intersection or other controlled area, except in protected only mode operation (see Sections 4D.19 and 4D.23), or in protected/permissive mode operation with separate turn signal faces (see Sections 4D.20 and 4D.24).
  - B. A steady CIRCULAR YELLOW signal indication:
    - 1. Shall be displayed following a CIRCULAR GREEN or straight-through GREEN ARROW signal indication in the same signal face.
    - 2. Shall not be displayed in conjunction with the change from the CIRCULAR RED signal indication to the CIRCULAR GREEN signal indication.
    - 3. Shall be followed by a CIRCULAR RED signal indication except that, when entering preemption operation, the return to the previous CIRCULAR GREEN signal indication shall be permitted following a steady CIRCULAR YELLOW signal indication (see Section 4D.27).
    - 4. Shall not be displayed to an approach from which drivers are turning left permissively or making a U-turn to the left permissively unless one of the following conditions exists:
      - (a) A steady CIRCULAR YELLOW signal indication is also simultaneously being displayed to the opposing approach;
      - (b) An engineering study has determined that, because of unique intersection conditions, the condition described in Item (a) cannot reasonably be implemented without causing significant operational or safety problems and that the volume of impacted left-turning or U-turning traffic is relatively low, and those left-turning or U-turning drivers are advised that a steady CIRCULAR YELLOW signal indication is not simultaneously being displayed to the opposing traffic if this operation occurs continuously by the installation near the left-most signal head of a W25-1 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC HAS EXTENDED GREEN; or
      - (c) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.
  - C. A steady CIRCULAR GREEN signal indication shall be displayed only when it is intended to permit traffic to proceed in any direction that is lawful and practical.
  - D. A steady RED ARROW signal indication shall be displayed when it is intended to prohibit traffic, except pedestrians directed by a pedestrian signal head, from entering the intersection or other controlled area to make the indicated turn. Except as described in Item C.2 in Paragraph 3 of Section 4D.04, turning on a steady RED ARROW signal indication shall not be permitted.
  - E. A steady YELLOW ARROW signal indication:
    - 1. Shall be displayed in the same direction as a GREEN ARROW signal indication following a GREEN ARROW signal indication in the same signal face, unless:
      - (a) The GREEN ARROW signal indication and a CIRCULAR GREEN (or straight-through GREEN ARROW) signal indication terminate simultaneously in the same signal face, or
      - (b) The green arrow is a straight-through GREEN ARROW (see Item B.1).
    - 2. Shall be displayed in the same direction as a flashing YELLOW ARROW signal indication or flashing RED ARROW signal indication following a flashing YELLOW ARROW signal indication or flashing RED ARROW signal indication in the same signal face, when the flashing arrow indication is displayed as part of a steady mode operation, if the signal face will subsequently display a steady red signal indication.

3. Shall not be displayed in conjunction with the change from a steady RED ARROW, flashing RED ARROW, or flashing YELLOW ARROW signal indication to a GREEN ARROW signal indication, except when entering preemption operation as provided in Item 5(a).
  4. Shall not be displayed when any conflicting vehicular movement has a green or yellow signal indication (except for the situation regarding U-turns to the left provided in Paragraph 4) or any conflicting pedestrian movement has a WALKING PERSON (symbolizing WALK) or flashing UPRAISED HAND (symbolizing DONT WALK) signal indication, except that a steady left-turn (or U-turn to the left) YELLOW ARROW signal indication used to terminate a flashing left-turn (or U-turn to the left) YELLOW ARROW or a flashing left-turn (or U-turn to the left) RED ARROW signal indication in a signal face controlling a permissive left-turn (or U-turn to the left) movement as described in Sections 4D.18 and 4D.20 shall be permitted to be displayed when a CIRCULAR YELLOW signal indication is displayed for the opposing through movement. Vehicles departing in the same direction shall not be considered in conflict if, for each turn lane with moving traffic, there is a separate departing lane, and pavement markings or raised channelization clearly indicate which departure lane to use.
  5. Shall not be displayed to terminate a flashing arrow signal indication on an approach from which drivers are turning left permissively or making a U-turn to the left permissively unless one of the following conditions exists:
    - (a) A steady CIRCULAR YELLOW signal indication is also simultaneously being displayed to the opposing approach;
    - (b) An engineering study has determined that, because of unique intersection conditions, the condition described in Item (a) cannot reasonably be implemented without causing significant operational or safety problems and that the volume of impacted left-turning or U-turning traffic is relatively low, and those left-turning or U-turning drivers are advised that a steady CIRCULAR YELLOW signal indication is not simultaneously being displayed to the opposing traffic if this operation occurs continuously by the installation near the left-most signal head of a W25-1 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC HAS EXTENDED GREEN; or
    - (c) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.
  6. Shall be terminated by a RED ARROW signal indication for the same direction or a CIRCULAR RED signal indication except:
    - (a) When entering preemption operation, the display of a GREEN ARROW signal indication or a flashing arrow signal indication shall be permitted following a steady YELLOW ARROW signal indication.
    - (b) When the movement controlled by the arrow is to continue on a permissive mode basis during an immediately following CIRCULAR GREEN or flashing YELLOW ARROW signal indication.
- F. A steady GREEN ARROW signal indication:
1. Shall be displayed only to allow vehicular movements, in the direction indicated, that are not in conflict with other vehicles moving on a green or yellow signal indication and are not in conflict with pedestrians crossing in compliance with a WALKING PERSON (symbolizing WALK) or flashing UPRAISED HAND (symbolizing DONT WALK) signal indication. Vehicles departing in the same direction shall not be considered in conflict if, for each turn lane with moving traffic, there is a separate departing lane, and pavement markings or raised channelization clearly indicate which departure lane to use.
  2. Shall be displayed on a signal face that controls a left-turn movement when said movement is not in conflict with other vehicles moving on a green or yellow signal indication (except for the situation regarding U-turns provided in Paragraph 4) and is not in conflict with pedestrians crossing in compliance with a WALKING PERSON (symbolizing WALK) or flashing UPRAISED HAND (symbolizing DONT WALK) signal indication. Vehicles departing in the same direction shall not be considered in conflict if, for each turn lane with moving traffic, there is a separate departing lane, and pavement markings or raised channelization clearly indicate which departure lane to use.
  3. Shall not be required on the stem of a T-intersection or for turns from a one-way street.

**Option:**

- 04 If U-turns are permitted from the approach and a right-turn GREEN ARROW signal indication is simultaneously being displayed to road users making a right turn from the conflicting approach to the left, road users making a U-turn may be advised of the operation by the installation near the left-turn signal face of a U-TURN YIELD TO RIGHT TURN (R10-16) sign (see Section 2B.53).
- 05 If not otherwise prohibited, a steady straight-through green arrow signal indication may be used instead of a circular green signal indication in a signal face on an approach intersecting a one-way street to discourage wrong-way turns.
- 06 If not otherwise prohibited, steady red, yellow, and green turn arrow signal indications may be used instead of steady circular red, yellow, and green signal indications in a signal face on an approach where all traffic is required to turn or where the straight-through movement is not physically possible.

**Support:**

- 07 Section 4D.25 contains information regarding the signalization of approaches that have a shared left-turn/right-turn lane and no through movement.

**Standard:**

- 08 **If supplemental signal faces are used, the following limitations shall apply:**
- A. Left-turn arrows and U-turn arrows to the left shall not be used in near-right signal faces.
  - B. Right-turn arrows and U-turn arrows to the right shall not be used in far-left signal faces. A far-side median-mounted signal face shall be considered a far-left signal for this application.
- 09 **A straight-through RED ARROW signal indication or a straight-through YELLOW ARROW signal indication shall not be displayed on any signal face, either alone or in combination with any other signal indication.**
- 10 **The following combinations of signal indications shall not be simultaneously displayed on any one signal face:**
- A. CIRCULAR RED with CIRCULAR YELLOW;
  - B. CIRCULAR GREEN with CIRCULAR RED; or
  - C. Straight-through GREEN ARROW with CIRCULAR RED;
- 11 **Additionally, the above combinations shall not be simultaneously displayed on an approach as a result of the combination of displays from multiple signal faces unless the display is created by a signal face(s) devoted exclusively to the control of a right-turning movement and:**
- A. The signal face(s) controlling the right-turning movement is visibility-limited from the adjacent through movement or positioned to minimize potential confusion to approaching road users, or
  - B. A RIGHT TURN SIGNAL (R10-10) sign (see Sections 4D.21 through 4D.24) is mounted adjacent to the signal face(s) controlling the right-turning movement.
- 12 **The following combinations of signal indications shall not be simultaneously displayed on any one signal face or as a result of the combination of displays from multiple signal faces on an approach:**
- A. CIRCULAR GREEN with CIRCULAR YELLOW;
  - B. Straight-through GREEN ARROW with CIRCULAR YELLOW;
  - C. GREEN ARROW with YELLOW ARROW pointing in the same direction;
  - D. RED ARROW with YELLOW ARROW pointing in the same direction; or
  - E. GREEN ARROW with RED ARROW pointing in the same direction.
- 13 **Except as otherwise provided in Sections 4F.03 and 4G.04, the same signal section shall not be used to display both a flashing yellow and a steady yellow indication during steady mode operation. Except as otherwise provided in Sections 4D.18, 4D.20, 4D.22, and 4D.24, the same signal section shall not be used to display both a flashing red and a steady red indication during steady mode operation.**

**Guidance:**

- 14 *No movement that creates an unexpected crossing of pathways of moving vehicles or pedestrians should be allowed during any green or yellow interval, except when all three of the following conditions are met:*
- A. *The movement involves only slight conflict, and*
  - B. *Serious traffic delays are substantially reduced by permitting the conflicting movement, and*
  - C. *Drivers and pedestrians subjected to the unexpected conflict are effectively warned thereof by a sign.*

## Section 4D.06 Signal Indications – Design, Illumination, Color, and Shape

### Standard:

- 01 Each signal indication, except those used for pedestrian signal heads and lane-use control signals, shall be circular or arrow.
- 02 Letters or numbers (including those associated with countdown displays) shall not be displayed as part of a vehicular signal indication.
- 03 Strobes shall not be used within or adjacent to any signal indication.
- 04 Except for the flashing signal indications and the pre-emption confirmation lights that are expressly allowed by the provisions of this Chapter, flashing displays shall not be used within or adjacent to any signal indications.
- 05 Each circular signal indication shall emit a single color: red, yellow, or green.
- 06 Each arrow signal indication shall emit a single color: red, yellow, or green except that the alternate display (dual-arrow signal section) of a GREEN ARROW and a YELLOW ARROW signal indication, both pointing in the same direction, shall be permitted, provided that they are not displayed simultaneously.
- 07 The arrow, which shall show only one direction, shall be the only illuminated part of an arrow signal indication.
- 08 Arrows shall be pointed:
- A. Vertically upward to indicate a straight-through movement, or
  - B. Horizontally in the direction of the turn to indicate a turn at approximately or greater than a right angle, or
  - C. Upward with a slope at an angle approximately equal to that of the turn if the angle of the turn is substantially less than a right angle, or
  - D. In a manner that directs the driver through the turn if a U-turn arrow is used (see Figure 4D-1).
- 09 Except as provided in Paragraph 10, the requirements of the publication entitled “Vehicle Traffic Control Signal Heads” (see Section 1A.11) that pertain to the aspects of the signal head design that affect the display of the signal indications shall be met.

### Guidance:

- 10 The intensity and distribution of light from each illuminated signal lens should comply with the publications entitled “Vehicle Traffic Control Signal Heads” and “Traffic Signal Lamps” (see Section 1A.11).

### Standard:

- 11 References to signal lenses in this section shall not be used to limit signal optical units to incandescent lamps within optical assemblies that include lenses.

### Support:

- 12 Research has resulted in signal optical units that are not lenses, such as, but not limited to, light emitting diode (LED) traffic signal modules. Some units are practical for all signal indications, and some are practical for specific types such as visibility-limited signal indications.

### Guidance:

- 13 If a signal indication is so bright that it causes excessive glare during nighttime conditions, some form of automatic dimming should be used to reduce the brilliance of the signal indication.

**Figure 4D-1. Example of U-Turn Signal Face**



## Section 4D.07 Size of Vehicular Signal Indications

### Standard:

- 01 There shall be two nominal diameter sizes for vehicular signal indications: 8 inches and 12 inches.
- 02 Except as provided in Paragraph 3 below, 12-inch signal indications shall be used for all signal sections in all new signal faces.

### Option:

- 03 Eight-inch circular signal indications may be used in new signal faces only for:
- A. The green or flashing yellow signal indications in an emergency-vehicle traffic control signal (see Section 4G.02);
  - B. The circular indications in signal faces controlling the approach to the downstream location where two adjacent signalized locations are close to each other and it is not practical because of factors such as high approach speeds, horizontal or vertical curves, or other geometric factors to install visibility-limited signal faces for the downstream approach;

- C. The circular indications in a signal face that is located less than 120 feet from the stop line on a roadway with a posted or statutory speed limit of 30 mph or less;
  - D. The circular indications in a supplemental near-side signal face;
  - E. The circular indications in a supplemental signal face installed for the sole purpose of controlling pedestrian movements (see Section 4D.03) rather than vehicular movements; and
  - F. The circular indications in a signal face installed for the sole purpose of controlling a bikeway or a bicycle movement.
- 04 Existing 8-inch circular signal indications that are not included in Items A through F in Paragraph 3 may be retained for the remainder of their useful service life.

### **Section 4D.08 Positions of Signal Indications Within a Signal Face – General**

Support:

- 01 Standardization of the number and arrangements of signal sections in vehicular traffic control signal faces enables road users who are color vision deficient to identify the illuminated color by its position relative to other signal sections.

**Standard:**

- 02 **Unless otherwise provided in this Manual for a particular application, each signal face at a signalized location shall have three, four, or five signal sections. Unless otherwise provided in this Manual for a particular application, if a vertical signal face includes a cluster (see Section 4D.09), the signal face shall have at least three vertical positions.**
- 03 **A single-section signal face shall be permitted at a traffic control signal if it consists of a continuously-displayed GREEN ARROW signal indication that is being used to indicate a continuous movement.**
- 04 **The signal sections in a signal face shall be arranged in a vertical or horizontal straight line, except as otherwise provided in Section 4D.09.**
- 05 **The arrangement of adjacent signal sections in a signal face shall follow the relative positions listed in Sections 4D.09 or 4D.10, as applicable.**
- 06 **If a signal section that displays a CIRCULAR YELLOW signal indication is used, it shall be located between the signal section that displays the red signal indication and all other signal sections.**
- 07 **If a U-turn arrow signal section is used in a signal face for a U-turn to the left, its position in the signal face shall be the same as stated in Sections 4D.09 and 4D.10 for a left-turn arrow signal section of the same color. If a U-turn arrow signal section is used in a signal face for a U-turn to the right, its position in the signal face shall be the same as stated in Sections 4D.09 and 4D.10 for a right-turn arrow signal section of the same color.**
- 08 **A U-turn arrow signal indication pointing to the left shall not be used in a signal face that also contains a left-turn arrow signal indication. A U-turn arrow signal indication pointing to the right shall not be used in a signal face that also contains a right-turn arrow signal indication.**

Option:

- 09 Within a signal face, two identical CIRCULAR RED or RED ARROW signal indications may be displayed immediately horizontally adjacent to each other in a vertical or horizontal signal face (see Figure 4D-2) for emphasis.
- 10 Horizontally-arranged and vertically-arranged signal faces may be used on the same approach provided they are separated to meet the lateral separation spacing required in Section 4D.13.

Support:

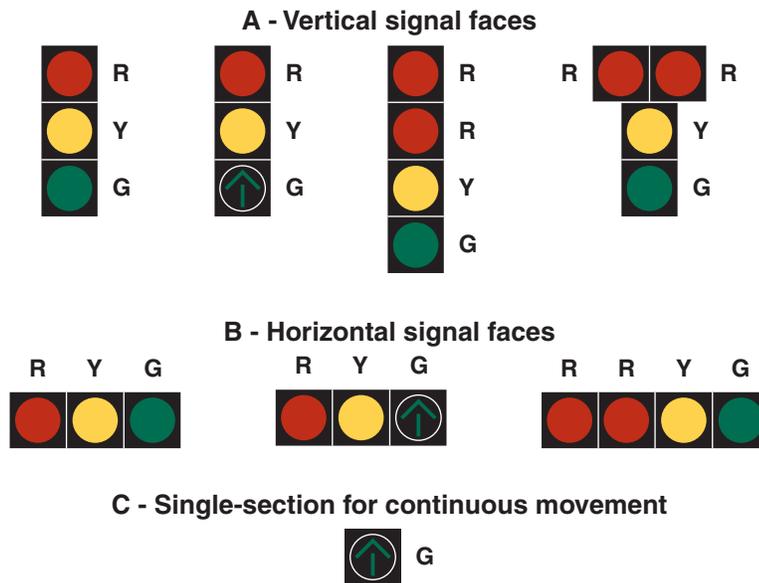
- 11 Figure 4D-2 illustrates some of the typical arrangements of signal sections in signal faces that do not control separate turning movements. Figures 4D-6 through 4D-12 illustrate the typical arrangements of signal sections in left-turn signal faces. Figures 4D-13 through 4D-19 illustrate the typical arrangements of signal sections in right-turn signal faces.

### **Section 4D.09 Positions of Signal Indications Within a Vertical Signal Face**

**Standard:**

- 01 **In each vertically-arranged signal face, all signal sections that display red signal indications shall be located above all signal sections that display yellow and green signal indications.**
- 02 **In vertically-arranged signal faces, each signal section that displays a YELLOW ARROW signal indication shall be located above the signal section that displays the GREEN ARROW signal indication to which it applies.**

**Figure 4D-2. Typical Arrangements of Signal Sections in Signal Faces That Do Not Control Turning Movements**



- 03 The relative positions of signal sections in a vertically-arranged signal face, from top to bottom, shall be as follows:

**CIRCULAR RED**

Steady and/or flashing left-turn RED ARROW

Steady and/or flashing right-turn RED ARROW

**CIRCULAR YELLOW**

**CIRCULAR GREEN**

Straight-through GREEN ARROW

Steady left-turn YELLOW ARROW

Flashing left-turn YELLOW ARROW

Left-turn GREEN ARROW

Steady right-turn YELLOW ARROW

Flashing right-turn YELLOW ARROW

Right-turn GREEN ARROW

- 04 If a dual-arrow signal section (capable of alternating between the display of a GREEN ARROW and a YELLOW ARROW signal indication) is used in a vertically-arranged signal face, the dual-arrow signal section shall occupy the same position relative to the other sections as the signal section that displays the GREEN ARROW signal indication in a vertically-arranged signal face would occupy.

Option:

- 05 In a vertically-arranged signal face, signal sections that display signal indications of the same color may be arranged horizontally adjacent to each other at right angles to the basic straight line arrangement to form a clustered signal face (see Figures 4D-2, 4D-9, 4D-11, 4D-16, and 4D-18).

**Standard:**

- 06 Such clusters shall be limited to the following:
- A. Two identical signal sections,
  - B. Two or three different signal sections that display signal indications of the same color, or
  - C. For only the specific case described in Section 4D.25 (see Drawing B of Figure 4D-20), two signal sections, one of which displays a GREEN ARROW signal indication and the other of which displays a flashing YELLOW ARROW signal indication.
- 07 The signal section that displays a flashing yellow signal indication during steady mode operation:
- A. Shall not be placed in the same vertical position as the signal section that displays a steady yellow signal indication, and
  - B. Shall be placed below the signal section that displays a steady yellow signal indication.

Support:

- 08 Sections 4F.02 and 4G.04 contain exceptions to the provisions of this Section that are applicable to hybrid beacons.

#### **Section 4D.10 Positions of Signal Indications Within a Horizontal Signal Face**

**Standard:**

- 01 In each horizontally-arranged signal face, all signal sections that display red signal indications shall be located to the left of all signal sections that display yellow and green signal indications.
- 02 In horizontally-arranged signal faces, each signal section that displays a YELLOW ARROW signal indication shall be located to the left of the signal section that displays the GREEN ARROW signal indication to which it applies.
- 03 The relative positions of signal sections in a horizontally-arranged signal face, from left to right, shall be as follows:
- CIRCULAR RED
    - Steady and/or flashing left-turn RED ARROW
    - Steady and/or flashing right-turn RED ARROW
  - CIRCULAR YELLOW
    - Steady left-turn YELLOW ARROW
    - Flashing left-turn YELLOW ARROW
  - Left-turn GREEN ARROW
  - CIRCULAR GREEN
    - Straight-through GREEN ARROW
    - Steady right-turn YELLOW ARROW
    - Flashing right-turn YELLOW ARROW
    - Right-turn GREEN ARROW
- 04 If a dual-arrow signal section (capable of alternating between the display of a GREEN ARROW and a YELLOW ARROW signal indication) is used in a horizontally-arranged signal face, the signal section that displays the dual left-turn arrow signal indication shall be located immediately to the right of the signal section that displays the CIRCULAR YELLOW signal indication, the signal section that displays the straight-through GREEN ARROW signal indication shall be located immediately to the right of the signal section that displays the CIRCULAR GREEN signal indication, and the signal section that displays the dual right-turn arrow signal indication shall be located to the right of all other signal sections.
- 05 The signal section that displays a flashing yellow signal indication during steady mode operation:
- A. Shall not be placed in the same horizontal position as the signal section that displays a steady yellow signal indication, and
  - B. Shall be placed to the right of the signal section that displays a steady yellow signal indication.

#### **Section 4D.11 Number of Signal Faces on an Approach**

**Standard:**

- 01 The signal faces for each approach to an intersection or a midblock location shall be provided as follows:
- A. If a signalized through movement exists on an approach, a minimum of two primary signal faces shall be provided for the through movement. If a signalized through movement does not exist on an approach, a minimum of two primary signal faces shall be provided for the signalized turning movement that is considered to be the major movement from the approach (also see Section 4D.25).
  - B. See Sections 4D.17 through 4D.20 for left-turn (and U-turn to the left) signal faces.
  - C. See Sections 4D.21 through 4D.24 for right-turn (and U-turn to the right) signal faces.

Option:

- 02 Where a movement (or a certain lane or lanes) at the intersection never conflicts with any other signalized vehicular or pedestrian movement, a continuously-displayed single-section GREEN ARROW signal indication may be used to inform road users that the movement is free-flow and does not need to stop.

Support:

- 03 In some circumstances where the through movement never conflicts with any other signalized vehicular or pedestrian movement at the intersection, such as at T-intersections with appropriate geometrics and/or pavement markings and signing, an engineering study might determine that the through movement (or certain lanes of the through movement) can be free-flow and not signalized.

*Guidance:*

04 *If two or more left-turn lanes are provided for a separately controlled protected only mode left-turn movement, or if a left-turn movement represents the major movement from an approach, two or more primary left-turn signal faces should be provided.*

05 *If two or more right-turn lanes are provided for a separately controlled right-turn movement, or if a right-turn movement represents the major movement from an approach, two or more primary right-turn signal faces should be provided.*

*Support:*

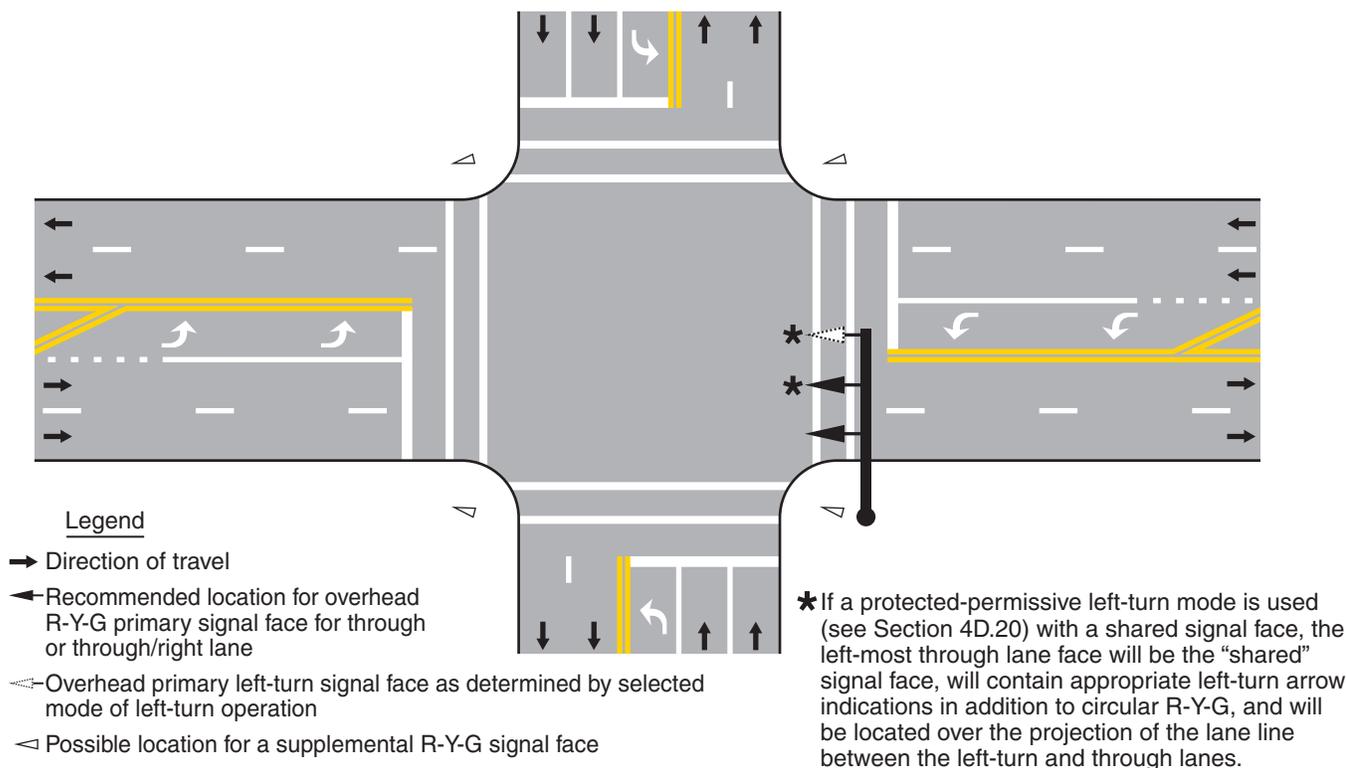
06 Locating primary signal faces overhead on the far side of the intersection has been shown to provide safer operation by reducing intersection entries late in the yellow interval and by reducing red signal violations, as compared to post-mounting signal faces at the roadside or locating signal faces overhead within the intersection on a diagonally-oriented mast arm or span wire. On approaches with two or more lanes for the through movement, one signal face per through lane, centered over each through lane, has also been shown to provide safer operation.

*Guidance:*

07 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations (see Figure 4D-3):*

- A. *The minimum number and location of primary (non-supplemental) signal faces for through traffic should be provided in accordance with Table 4D-1.*

**Figure 4D-3. Recommended Vehicular Signal Faces for Approaches with Posted, Statutory, or 85<sup>th</sup>-Percentile Speed of 45 mph or Higher**

**Notes:**

1. Signal faces for only one direction and only one possible set of geometrics (number of lanes, etc.) are illustrated. If there are fewer or more than two through lanes on the approach, see Table 4D-2.
2. Any primary left-turn and/or right-turn signal faces, as determined by Sections 4D.17 through 4D.24, should be overhead for each exclusive turn lane.
3. One or more pole-mounted or overhead supplemental faces should be considered, based on the geometrics of the approach, to maximize visibility for approaching traffic.
4. All signal faces should have backplates.

**Table 4D-1. Recommended Minimum Number of Primary Signal Faces for Through Traffic on Approaches with Posted, Statutory, or 85<sup>th</sup>-Percentile Speed of 45 mph or Higher**

Number of Through Lanes on Approach	Total Number of Primary Through Signal Faces for Approach*	Minimum Number of Overhead-Mounted Primary Through Signal Faces for Approach
1	2	1
2	2	1
3	3	2**
4 or more	4 or more	3**

NOTES: \* A minimum of two through signal faces is always required (See Section 4D.11). These recommended numbers of through signal faces may be exceeded. Also, see cone of vision requirements otherwise indicated in Section 4D.13.

\*\* If practical, all of the recommended number of primary through signal faces should be located overhead.

- B. *If the number of overhead primary signal faces for through traffic is equal to the number of through lanes on an approach, one overhead signal face should be located approximately over the center of each through lane.*
- C. *Except for shared left-turn and right-turn signal faces, any primary signal face required by Sections 4D.17 through 4D.25 for an exclusive turn lane should be located overhead approximately over the center of each exclusive turn lane.*
- D. *All primary signal faces should be located on the far side of the intersection.*
- E. *In addition to the primary signal faces, one or more supplemental pole-mounted or overhead signal faces should be considered to provide added visibility for approaching traffic that is traveling behind large vehicles.*
- F. *All signal faces should have backplates.*

08 *This layout of signal faces should also be considered for any major urban or suburban arterial street with four or more lanes and for other approaches with speeds of less than 45 mph.*

**Section 4D.12 Visibility, Aiming, and Shielding of Signal Faces**

**Standard:**

01 **The primary consideration in signal face placement, aiming, and adjustment shall be to optimize the visibility of signal indications to approaching traffic.**

02 **Road users approaching a signalized intersection or other signalized area, such as a midblock crosswalk, shall be given a clear and unmistakable indication of their right-of-way assignment.**

03 **The geometry of each intersection to be signalized, including vertical grades, horizontal curves, and obstructions as well as the lateral and vertical angles of sight toward a signal face, as determined by typical driver-eye position, shall be considered in determining the vertical, longitudinal, and lateral position of the signal face.**

*Guidance:*

04 *The two primary signal faces required as a minimum for each approach should be continuously visible to traffic approaching the traffic control signal, from a point at least the minimum sight distance provided in Table 4D-2 in advance of and measured to the stop line. This range of continuous visibility should be provided unless precluded by a physical obstruction or unless another signalized location is within this range.*

**Table 4D-2. Minimum Sight Distance for Signal Visibility**

85 <sup>th</sup> -Percentile Speed	Minimum Sight Distance
20 mph	175 feet
25 mph	215 feet
30 mph	270 feet
35 mph	325 feet
40 mph	390 feet
45 mph	460 feet
50 mph	540 feet
55 mph	625 feet
60 mph	715 feet

Note: Distances in this table are derived from stopping sight distance plus an assumed queue length for shorter cycle lengths (60 to 75 seconds).

05 *There should be legal authority to prohibit the display of any unauthorized sign, signal, marking, or device that interferes with the effectiveness of any official traffic control device (see Section 11-205 of the “Uniform Vehicle Code”).*

06 *At signalized midblock crosswalks, at least one of the signal faces should be over the traveled way for each approach.*

**Standard:**

07 **If approaching traffic does not have a continuous view of at least two signal faces for at least the minimum sight distance shown in Table 4D-2, a sign (see Section 2C.36) shall be installed to warn approaching traffic of the traffic control signal.**

**Option:**

08 *If a sign is installed to warn approaching road users of the traffic control signal, the sign may be supplemented by a Warning Beacon (see Section 4L.03).*

09 *A Warning Beacon used in this manner may be interconnected with the traffic signal controller assembly in such a manner as to flash yellow during the period when road users passing this beacon at the legal speed for the roadway might encounter a red signal indication (or a queue resulting from the display of the red signal indication) upon arrival at the signalized location.*

10 *If the sight distance to the signal faces for an approach is limited by horizontal or vertical alignment, supplemental signal faces aimed at a point on the approach at which the signal indications first become visible may be used.*

**Guidance:**

11 *Supplemental signal faces should be used if engineering judgment has shown that they are needed to achieve intersection visibility both in advance and immediately before the signalized location.*

12 *If supplemental signal faces are used, they should be located to provide optimum visibility for the movement to be controlled.*

**Standard:**

13 **In cases where irregular street design necessitates placing signal faces for different street approaches with a comparatively small angle between their respective signal indications, each signal indication shall, to the extent practical, be visibility-limited by signal visors, signal louvers, or other means so that an approaching road user’s view of the signal indication(s) controlling movements on other approaches is minimized.**

14 **Signal visors exceeding 12 inches in length shall not be used on free-swinging signal faces.**

**Guidance:**

15 *Signal visors should be used on signal faces to aid in directing the signal indication specifically to approaching traffic, as well as to reduce “sun phantom,” which can result when external light enters the lens.*

16 *The use of signal visors, or the use of signal faces or devices that direct the light without a reduction in intensity, should be considered as an alternative to signal louvers because of the reduction in light output caused by signal louvers.*

**Option:**

17 *Special signal faces, such as visibility-limited signal faces, may be used such that the road user does not see signal indications intended for other approaches before seeing the signal indications for their own approach, if simultaneous viewing of both signal indications could cause the road user to be misdirected.*

**Guidance:**

18 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal backplates should be used on all of the signal faces that face the approach. Signal backplates should also be considered for use on signal faces on approaches with posted or statutory speed limits or 85th-percentile speeds of less than 45 mph where sun glare, bright sky, and/or complex or confusing backgrounds indicate a need for enhanced signal face target value.*

**Support:**

19 *The use of backplates enhances the contrast between the traffic signal indications and their surroundings for both day and night conditions, which is also helpful to older drivers.*

**Standard:**

20 **The inside of signal visors (hoods), the entire surface of louvers and fins, and the front surface of backplates shall have a dull black finish to minimize light reflection and to increase contrast between the signal indication and its background.**

Option:

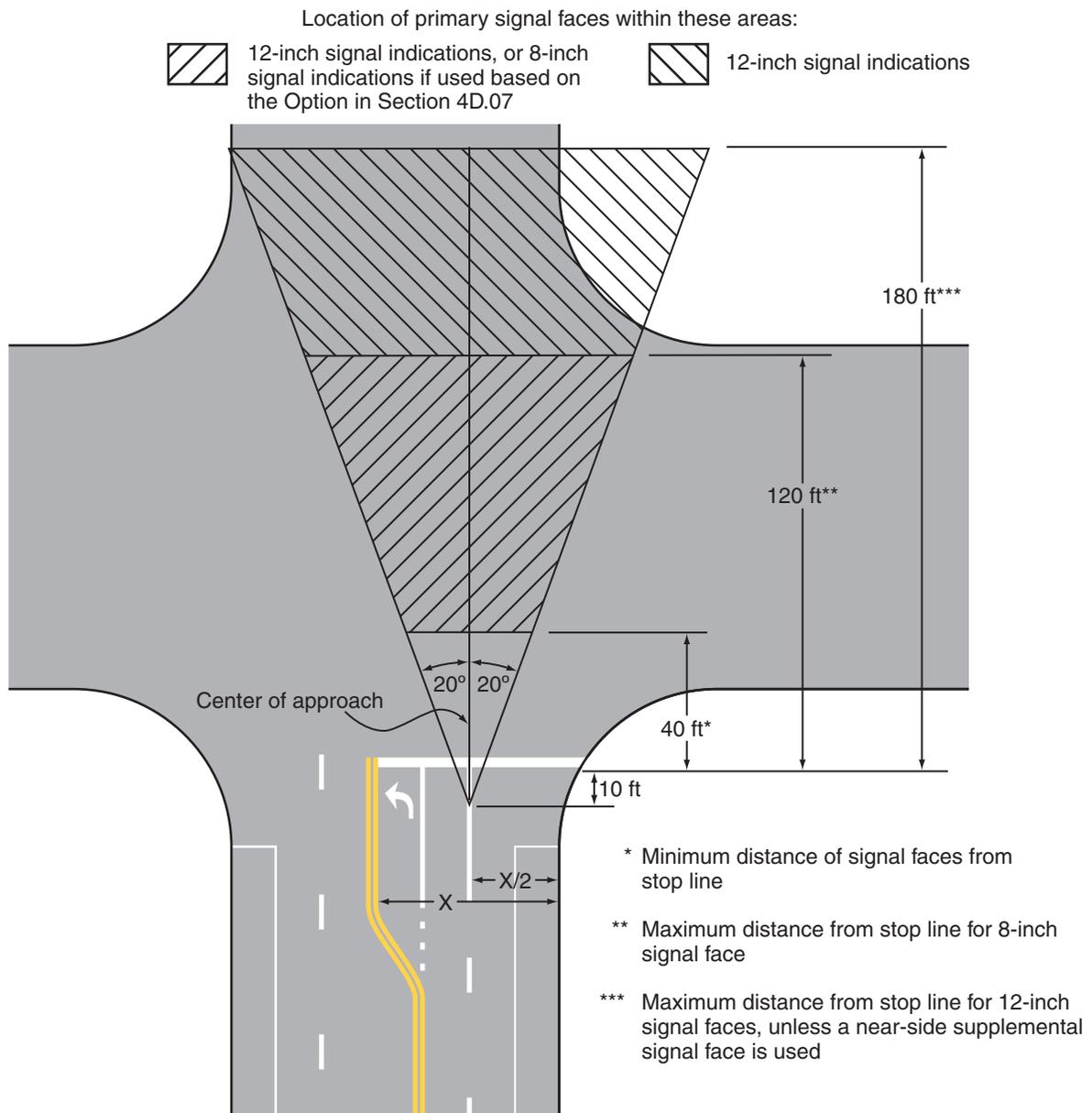
- 21 A yellow retroreflective strip with a minimum width of 1 inch and a maximum width of 3 inches may be placed along the perimeter of the face of a signal backplate to project a rectangular appearance at night.

**Section 4D.13 Lateral Positioning of Signal Faces**

**Standard:**

- 01 At least one and preferably both of the minimum of two primary signal faces required for the through movement (or the major turning movement if there is no through movement) on the approach shall be located between two lines intersecting with the center of the approach at a point 10 feet behind the stop line, one making an angle of approximately 20 degrees to the right of the center of the approach extended, and the other making an angle of approximately 20 degrees to the left of the center of the approach extended. The signal face that satisfies this requirement shall simultaneously satisfy the longitudinal placement requirement described in Section 4D.14 (see Figure 4D-4).

**Figure 4D-4. Lateral and Longitudinal Location of Primary Signal Faces**



Notes:

1. See Section 4D.11 for approaches with posted, statutory, or 85th-percentile speeds of 45 mph or higher
2. See Section 4D.13 regarding location of signal faces that display a CIRCULAR GREEN signal indication for a permissive left-turn movement on approaches with an exclusive left-turn lane or lanes

02 **If both of the minimum of two primary signal faces required for the through movement (or the major turning movement if there is no through movement) on the approach are post-mounted, they shall both be on the far side of the intersection, one on the right and one on the left of the approach lane(s).**

03 **The required signal faces for through traffic on an approach shall be located not less than 8 feet apart measured horizontally perpendicular to the approach between the centers of the signal faces.**

04 **If more than one separate turn signal face is provided for a turning movement and if one or both of the separate turn signal faces are located over the roadway, the signal faces shall be located not less than 8 feet apart measured horizontally perpendicular to the approach between the centers of the signal faces.**

*Guidance:*

05 *If a signal face controls a specific lane or lanes of an approach, its position should make it readily visible to road users making that movement.*

*Support:*

06 Section 4D.11 contains additional provisions regarding lateral positioning of signal faces for approaches having a posted or statutory speed limit or an 85th-percentile speed of 45 mph or higher.

**Standard:**

07 **If an exclusive left-turn, right-turn, or U-turn lane is present on an approach and if a primary separate turn signal face controlling that lane is mounted over the roadway, the primary separate turn signal face shall not be positioned any further to the right than the extension of the right-hand edge of the exclusive turn lane or any further to the left than the extension of the left-hand edge of the exclusive turn lane.**

08 **Supplemental turn signal faces mounted over the roadway shall not be subject to the positioning requirements in the previous paragraph.**

*Guidance:*

09 *For new or reconstructed signal installations, on an approach with an exclusive turn lane(s) for a left-turn (or U-turn to the left) movement and with opposing vehicular traffic, signal faces that display a CIRCULAR GREEN signal indication should not be post-mounted on the far-side median or mounted overhead above the exclusive turn lane(s) or the extension of the lane(s).*

**Standard:**

10 **If supplemental post-mounted signal faces are used, the following limitations shall apply:**

- A. **Left-turn arrows and U-turn arrows to the left shall not be used in near-right signal faces.**
- B. **Right-turn arrows and U-turn arrows to the right shall not be used in far-left signal faces. A far-side median-mounted signal face shall be considered a far-left signal for this application.**

#### **Section 4D.14 Longitudinal Positioning of Signal Faces**

**Standard:**

01 **Except where the width of an intersecting roadway or other conditions make it physically impractical, the signal faces for each approach to an intersection or a midblock location shall be provided as follows:**

- A. **A signal face installed to satisfy the requirements for primary left-turn signal faces (see Sections 4D.17 through 4D.20) and primary right-turn signal faces (see Sections 4D.21 through 4D.24), and at least one and preferably both of the minimum of two primary signal faces required for the through movement (or the major turning movement if there is no through movement) on the approach shall be located:**

- 1. **No less than 40 feet beyond the stop line,**
- 2. **No more than 180 feet beyond the stop line unless a supplemental near-side signal face is provided, and**
- 3. **As near as practical to the line of the driver's normal view, if mounted over the roadway.**

**The primary signal face that satisfies this requirement shall simultaneously satisfy the lateral placement requirement described in Section 4D.13 (see Figure 4D-4).**

- B. **Where the nearest signal face is located between 150 and 180 feet beyond the stop line, engineering judgment of the conditions, including the worst-case visibility conditions, shall be used to determine if the provision of a supplemental near-side signal face would be beneficial.**

*Support:*

02 Section 4D.11 contains additional provisions regarding longitudinal positioning of signal faces for approaches having a posted or 85th-percentile speed of 45 mph or higher.

*Guidance:*

03 *Supplemental near-side signal faces should be located as near as practical to the stop line.*

**Section 4D.15 Mounting Height of Signal Faces**

**Standard:**

- 01 The top of the signal housing of a vehicular signal face located over any portion of a highway that can be used by motor vehicles shall not be more than 25.6 feet above the pavement.
- 02 For viewing distances between 40 and 53 feet from the stop line, the maximum mounting height to the top of the signal housing shall be as shown in Figure 4D-5.
- 03 The bottom of the signal housing and any related attachments to a vehicular signal face located over any portion of a highway that can be used by motor vehicles shall be at least 15 feet above the pavement.
- 04 The bottom of the signal housing (including brackets) of a vehicular signal face that is vertically arranged and not located over a roadway:
  - A. Shall be a minimum of 8 feet and a maximum of 19 feet above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
  - B. Shall be a minimum of 4.5 feet and a maximum of 19 feet above the median island grade of a center median island if located on the near side of the intersection.
- 05 The bottom of the signal housing (including brackets) of a vehicular signal face that is horizontally arranged and not located over a roadway:
  - A. Shall be a minimum of 8 feet and a maximum of 22 feet above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
  - B. Shall be a minimum of 4.5 feet and a maximum of 22 feet above the median island grade of a center median island if located on the near side of the intersection.

**Section 4D.16 Lateral Offset (Clearance) of Signal Faces**

**Standard:**

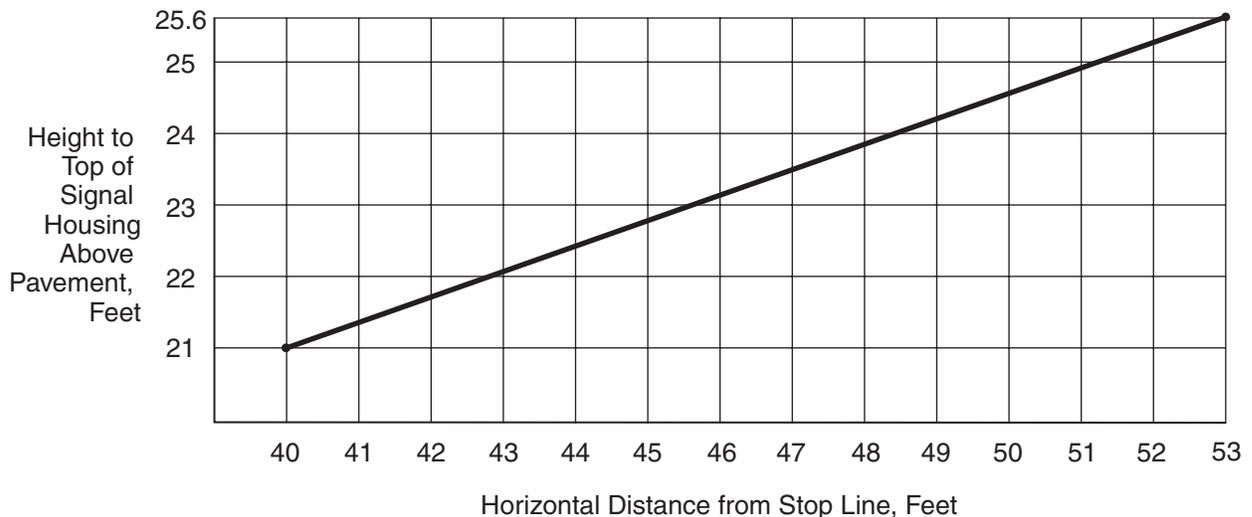
- 01 Signal faces mounted at the side of a roadway with curbs at less than 15 feet from the bottom of the housing and any related attachments shall have a horizontal offset of not less than 2 feet from the face of a vertical curb, or if there is no curb, not less than 2 feet from the edge of a shoulder.

**Section 4D.17 Signal Indications for Left-Turn Movements – General**

**Standard:**

- 01 In Sections 4D.17 through 4D.20, provisions applicable to left-turn movements and left-turn lanes shall also apply to signal indications for U-turns to the left that are provided at locations where left turns are prohibited or not geometrically possible.

**Figure 4D-5. Maximum Mounting Height of Signal Faces Located Between 40 Feet and 53 Feet from Stop Line**



## Support:

- 02 Left-turning traffic is controlled by one of four modes as follows:
- A. Permissive Only Mode—turns made on a CIRCULAR GREEN signal indication, a flashing left-turn YELLOW ARROW signal indication, or a flashing left-turn RED ARROW signal indication after yielding to pedestrians, if any, and/or opposing traffic, if any.
  - B. Protected Only Mode—turns made only when a left-turn GREEN ARROW signal indication is displayed.
  - C. Protected/Permissive Mode—both modes can occur on an approach during the same cycle.
  - D. Variable Left-Turn Mode—the operating mode changes among the protected only mode and/or the protected/permissive mode and/or the permissive only mode during different periods of the day or as traffic conditions change.

## Option:

- 03 In areas having a high percentage of older drivers, special consideration may be given to the use of protected only mode left-turn phasing, when appropriate.

**Standard:**

- 04 **During a permissive left-turn movement, the signal faces for through traffic on the opposing approach shall simultaneously display green or steady yellow signal indications. If pedestrians crossing the lane or lanes used by the permissive left-turn movement to depart the intersection are controlled by pedestrian signal heads, the signal indications displayed by those pedestrian signal heads shall not be limited to any particular display during the permissive left-turn movement.**
- 05 **During a protected left-turn movement, the signal faces for through traffic on the opposing approach shall simultaneously display steady CIRCULAR RED signal indications. If pedestrians crossing the lane or lanes used by the protected left-turn movement to depart the intersection are controlled by pedestrian signal heads, the pedestrian signal heads shall display a steady UPRAISED HAND (symbolizing DONT WALK) signal indication during the protected left-turn movement.**
- 06 **A protected only mode left-turn movement that does not begin and terminate at the same time as the adjacent through movement shall not be provided on an approach unless an exclusive left-turn lane exists.**
- 07 **A yellow change interval for the left-turn movement shall not be displayed when the status of the left-turn operation is changing from permissive to protected within any given signal sequence.**
- 08 **If the operating mode changes among the protected only mode and/or the protected/permissive mode and/or the permissive only mode during different periods of the day or as traffic conditions change, the requirements in Sections 4D.18 through 4D.20 that are appropriate to that mode of operation shall be met, subject to the following:**
- A. **The CIRCULAR GREEN and CIRCULAR YELLOW signal indications shall not be displayed when operating in the protected only mode.**
  - B. **The left-turn GREEN ARROW and left-turn YELLOW ARROW signal indications shall not be displayed when operating in the permissive only mode.**

## Option:

- 09 Additional static signs or changeable message signs may be used to meet the requirements for the variable left-turn mode or to inform drivers that left-turn green arrows will not be available during certain times of the day.

## Support:

- 10 Sections 4D.17 through 4D.20 describe the use of the following two types of signal faces for controlling left-turn movements:
- A. Shared signal face – This type of signal face controls both the left-turn movement and the adjacent movement (usually the through movement) and can serve as one of the two required primary signal faces for the adjacent movement. A shared signal face always displays the same color of circular indication that is displayed by the signal face or faces for the adjacent movement. If a shared signal face that provides protected/permissive mode left turns is mounted overhead at the intersection, it is usually positioned over or slightly to the right of the extension of the lane line separating the left-turn lane from the adjacent lane.
  - B. Separate left-turn signal face – This type of signal face controls only the left-turn movement and cannot serve as one of the two required primary signal faces for the adjacent movement (usually the through movement) because it displays signal indications that are applicable only to the left-turn movement. If a separate left-turn signal face is mounted overhead at the intersection, it is positioned over the extension of the left-turn lane. In a separate left-turn signal face, a flashing left-turn YELLOW ARROW signal indication or a flashing left-turn RED ARROW signal indication is used to control permissive left-turning movements.

- 11 Section 4D.13 contains provisions regarding the lateral positioning of signal faces that control left-turn movements.
- 12 It is not necessary that the same mode of left-turn operation or same type of left-turn signal face be used on every approach to a signalized location. Selecting different modes and types of left-turn signal faces for the various approaches to the same signalized location is acceptable.

Option:

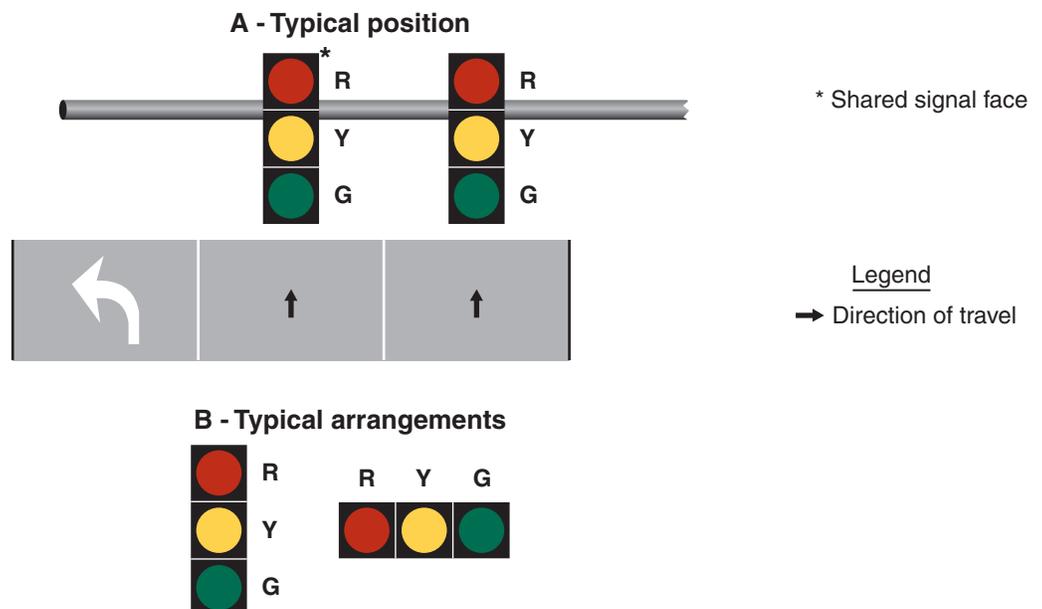
- 13 A signal face that is shared by left-turning and right-turning traffic may be provided for a shared left-turn/right-turn lane on an approach that has no through traffic (see Section 4D.25).

**Section 4D.18 Signal Indications for Permissive Only Mode Left-Turn Movements**

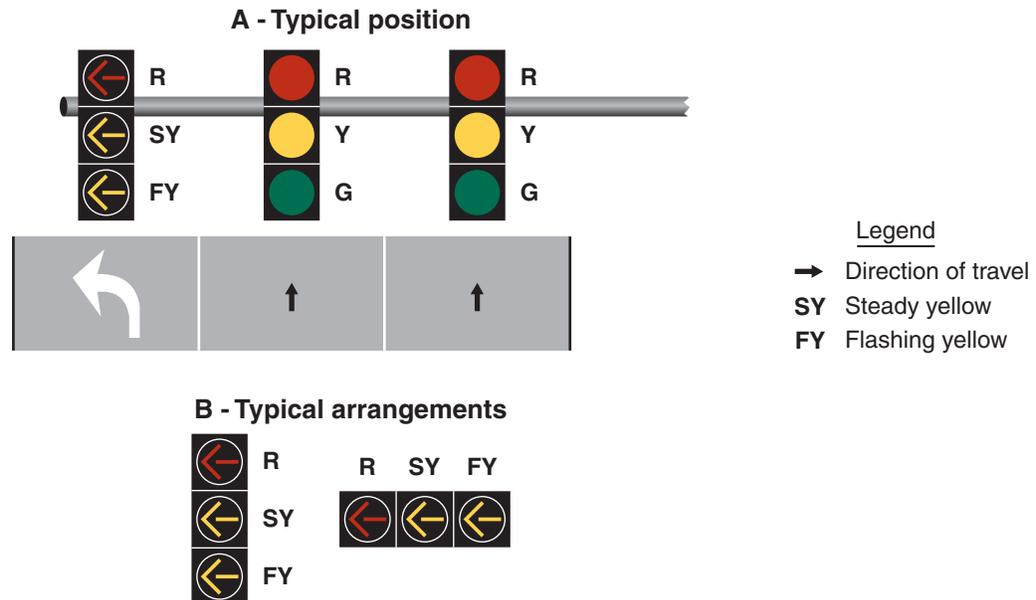
**Standard:**

- 01 **If a shared signal face is provided for a permissive only mode left turn, it shall meet the following requirements (see Figure 4D-6):**
  - A. **It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, and CIRCULAR GREEN. Only one of the three indications shall be displayed at any given time.**
  - B. **During the permissive left-turn movement, a CIRCULAR GREEN signal indication shall be displayed.**
  - C. **A permissive only shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.**
  - D. **If the permissive only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20) except that the left-turn GREEN ARROW and left-turn YELLOW ARROW signal indications shall not be displayed when operating in the permissive only mode.**
- 02 **If a separate left-turn signal face is being operated in a permissive only left-turns mode, a CIRCULAR GREEN signal indication shall not be used in that face.**
- 03 **If a separate left-turn signal face is being operated in a permissive only left-turn mode and a flashing left-turn YELLOW ARROW signal indication is provided, it shall meet the following requirements (see Figure 4D-7):**
  - A. **It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and flashing left-turn YELLOW ARROW. Only one of the three indications shall be displayed at any given time.**

**Figure 4D-6. Typical Position and Arrangements of Shared Signal Faces for Permissive Only Mode Left Turns**



**Figure 4D-7. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Permissive Only Mode Left Turns**



- B. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
- C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication.
- D. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
- E. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.
- F. During flashing mode operation (see Section 4D.30), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.
- G. If the permissive only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face with a flashing YELLOW ARROW signal indication that is used for the protected/permissive mode (see Section 4D.20) except that the left-turn GREEN ARROW signal indication shall not be displayed when operating in the permissive only mode.

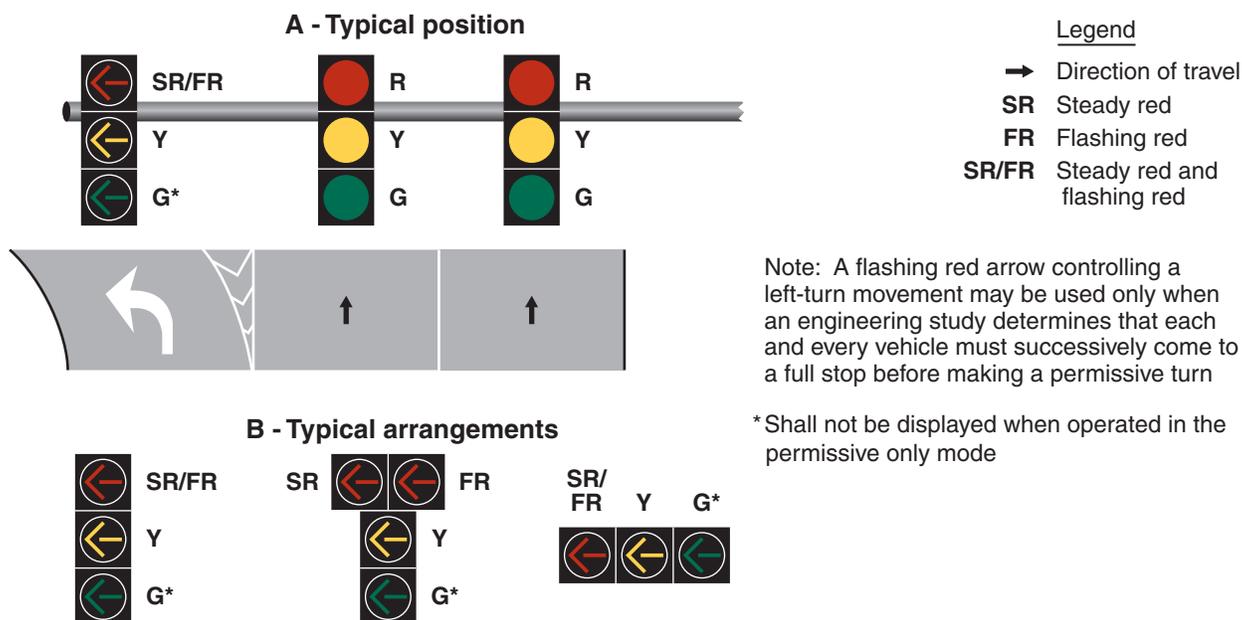
Option:

- 04 A separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.

Standard:

- 05 If a separate left-turn signal face is being operated in a permissive only left-turn mode and a flashing left-turn RED ARROW signal indication is provided, it shall meet the following requirements (see Figure 4D-8):
- A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide a three-section signal face, but shall not be displayed during the permissive only mode.
- B. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed, thus indicating that each and every vehicle must successively come to a full stop before making a permissive left turn.

**Figure 4D-8. Typical Position and Arrangements of Separate Signal Faces with Flashing Red Arrow for Permissive Only Mode and Protected/Permissive Mode Left Turns**



- C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication.
- D. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
- E. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).

Option:

- 06 The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

#### **Section 4D.19 Signal Indications for Protected Only Mode Left-Turn Movements**

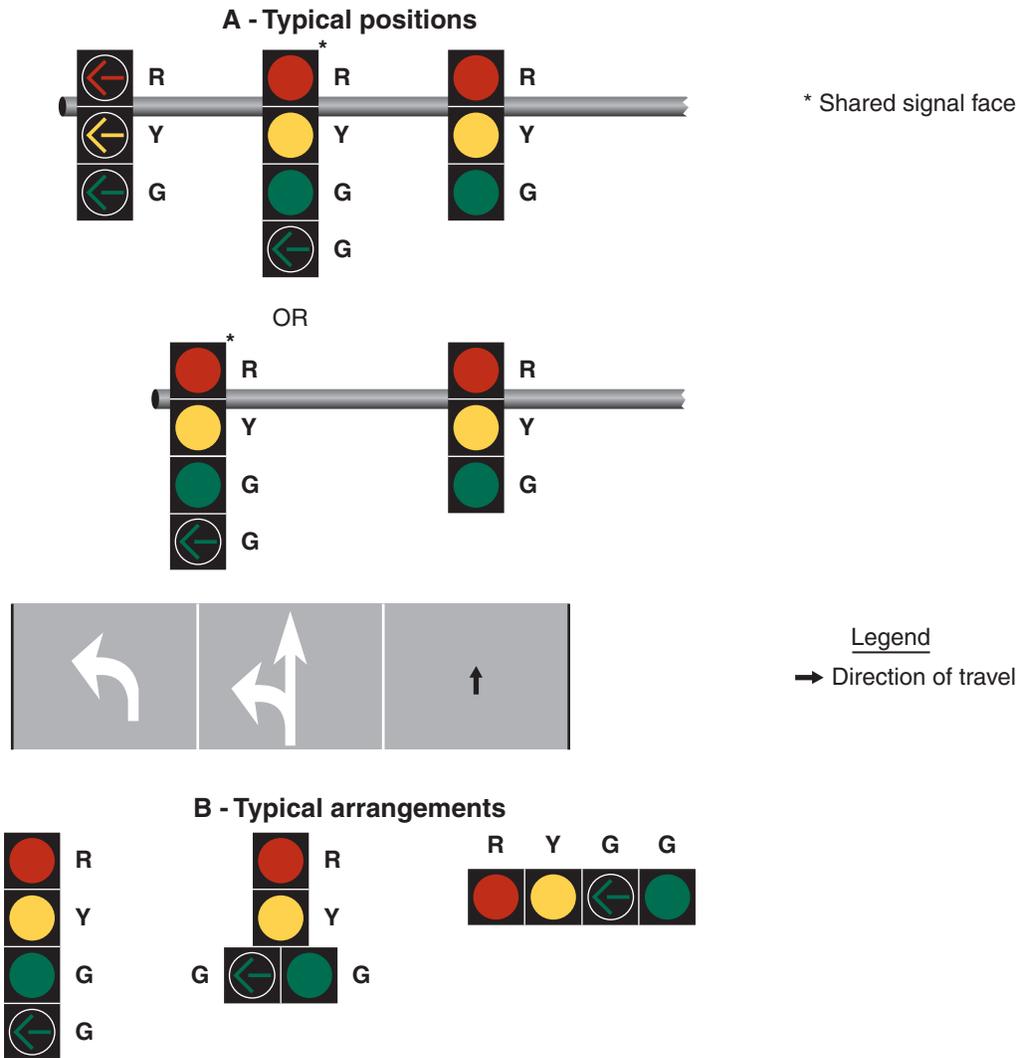
**Standard:**

- 01 A shared signal face shall not be used for protected only mode left turns unless the CIRCULAR GREEN and left-turn GREEN ARROW signal indications always begin and terminate together. If a shared signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-9):
- A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR GREEN, and left-turn GREEN ARROW. Only one of the three colors shall be displayed at any given time.
  - B. During the protected left-turn movement, the shared signal face shall simultaneously display both a CIRCULAR GREEN signal indication and a left-turn GREEN ARROW signal indication.
  - C. The shared signal face shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
  - D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20).

Option:

- 02 A straight-through GREEN ARROW signal indication may be used instead of the CIRCULAR GREEN signal indication in Items A and B in Paragraph 1 on an approach where right turns are prohibited and a straight-through GREEN ARROW signal indication is also used instead of a CIRCULAR GREEN signal indication in the other signal face(s) for through traffic.

**Figure 4D-9. Typical Positions and Arrangements of Shared Signal Faces for Protected Only Mode Left Turns**

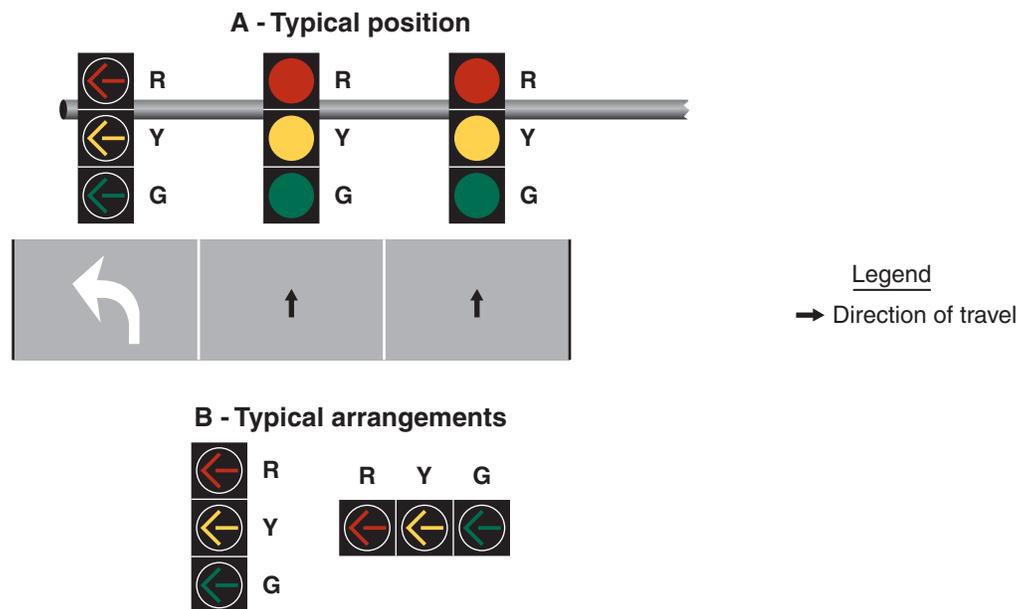


Note: Shared signal faces shall only be used for a protected-only mode left turn if the circular green and green left-turn arrow indications always begin and terminate together

**Standard:**

- 03 **If a separate left-turn signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-10):**
- A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a LEFT ON GREEN ARROW ONLY (R10-5) sign (see Figure 2B-27).**
  - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.**
  - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.**
  - D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face that is used for the protected/permissive mode (see Section 4D.20 and Figures 4D-8 and 4D-12) except that the flashing left-turn YELLOW ARROW or flashing left-turn RED ARROW signal indication shall not be displayed when operating in the protected only mode.**

**Figure 4D-10. Typical Position and Arrangements of Separate Signal Faces for Protected Only Mode Left Turns**

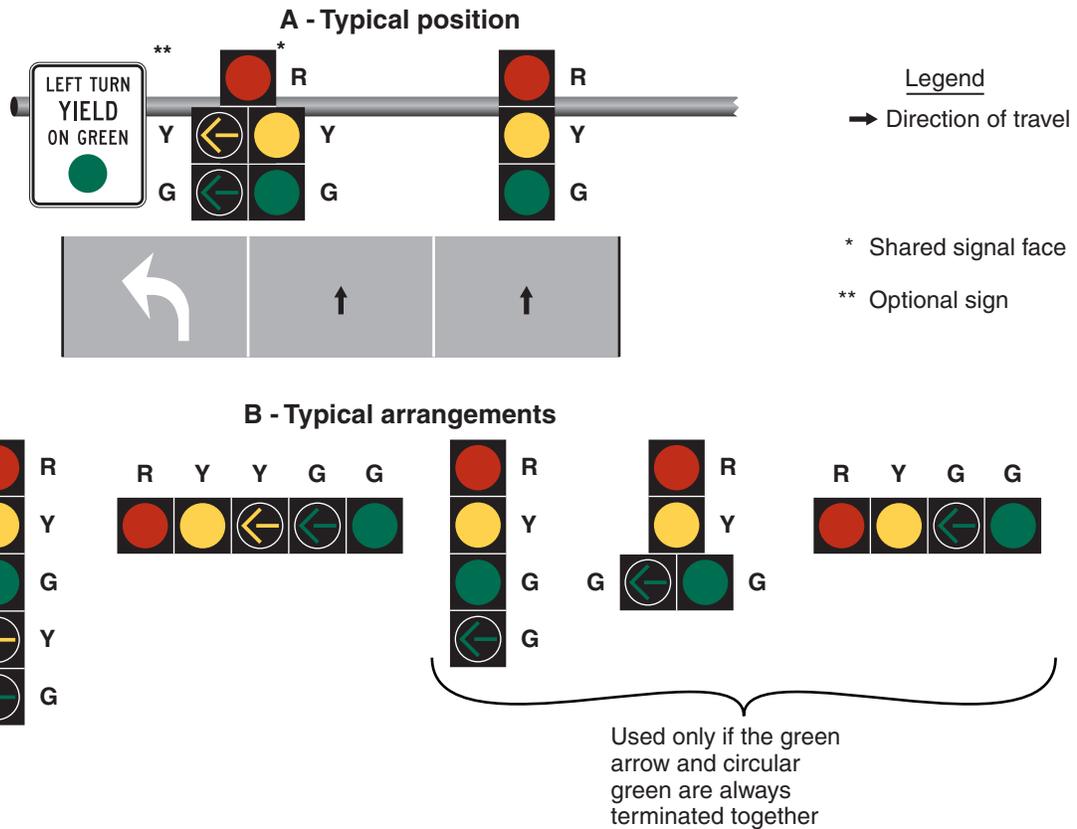


#### Section 4D.20 Signal Indications for Protected/Permissive Mode Left-Turn Movements

##### Standard:

- 01 If a shared signal face is provided for a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-11):
- It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR green, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three circular indications shall be displayed at any given time. Only one of the two arrow indications shall be displayed at any given time. If the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are always terminated together, the steady left-turn YELLOW ARROW signal indication shall not be required.
  - During the protected left-turn movement, the shared signal face shall simultaneously display a left-turn GREEN ARROW signal indication and a circular signal indication that is the same color as the signal indication for the adjacent through lane on the same approach as the protected left turn.
  - A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication, unless the left-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are being terminated together. When the left-turn GREEN ARROW and CIRCULAR GREEN signal indications are being terminated together, the required display following the left-turn GREEN ARROW signal indication shall be either the display of a CIRCULAR YELLOW signal indication alone or the simultaneous display of the CIRCULAR YELLOW and left-turn YELLOW ARROW signal indications.
  - During the permissive left-turn movement, the shared signal face shall display only a CIRCULAR GREEN signal indication.
  - A protected/permissive shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
  - A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign (see Figure 2B-27).
- 02 If a separate left-turn signal face is being operated in a protected/permissive left-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.

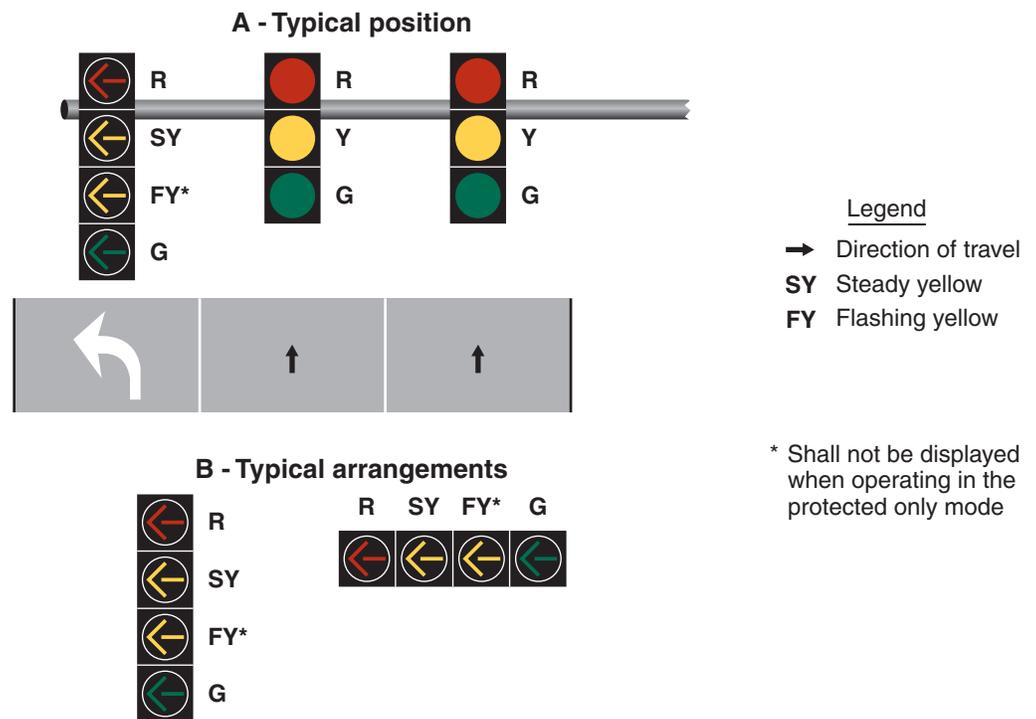
**Figure 4D-11. Typical Position and Arrangements of Shared Signal Faces for Protected/Permissive Mode Left Turns**



03 If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-12):

- A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.
- B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
- C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
- D. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
- E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.
- F. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
- G. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn YELLOW ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn YELLOW ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.

**Figure 4D-12. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Protected/Permissive Mode and Protected Only Mode Left Turns**



- H. The display shall be a four-section signal face except that a three-section signal face containing a dual-arrow signal section shall be permitted where signal head height limitations (or lateral positioning limitations for a horizontally-mounted signal face) will not permit the use of a four-section signal face. The dual-arrow signal section, where used, shall display a GREEN ARROW for the protected left-turn movement and a flashing YELLOW ARROW for the permissive left-turn movement.
- I. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.
- J. During flashing mode operation (see Section 4D.30), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.

Option:

- 04 A separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.

**Standard:**

- 05 If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-8):
- A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.
  - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
  - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
  - D. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed.

- E. A steady left-turn **YELLOW ARROW** signal indication shall be displayed following the flashing left-turn **RED ARROW** signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn **RED ARROW** indication.
- F. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn **GREEN ARROW** signal indication shall be displayed immediately upon the termination of the flashing left-turn **RED ARROW** signal indication. A steady left-turn **YELLOW ARROW** signal indication shall not be displayed between the display of the flashing left-turn **RED ARROW** signal indication and the display of the steady left-turn **GREEN ARROW** signal indication.
- G. It shall be permitted to display a flashing left-turn **RED ARROW** signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady **CIRCULAR RED** signal indications and the opposing left-turn signal faces display left-turn **GREEN ARROW** signal indications for a protected left-turn movement.
- H. A supplementary sign shall not be required. If used, it shall be a **LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27)** sign (see Figure 2B-27).

Option:

- 06 The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn **RED ARROW** signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).

#### **Section 4D.21 Signal Indications for Right-Turn Movements – General**

**Standard:**

- 01 In Sections 4D.21 through 4D.24, provisions applicable to right-turn movements and right-turn lanes shall also apply to signal indications for U-turns to the right that are provided at locations where right turns are prohibited or not geometrically possible.

Support:

- 02 Right-turning traffic is controlled by one of four modes as follows:
- A. Permissive Only Mode—turns made on a **CIRCULAR GREEN** signal indication, a flashing right-turn **YELLOW ARROW** signal indication, or a flashing right-turn **RED ARROW** signal indication after yielding to pedestrians, if any.
  - B. Protected Only Mode—turns made only when a right-turn **GREEN ARROW** signal indication is displayed.
  - C. Protected/Permissive Mode—both modes occur on an approach during the same cycle.
  - D. Variable Right-Turn Mode—the operating mode changes among the protected only mode and/or the protected/permissive mode and/or the permissive only mode during different periods of the day or as traffic conditions change.

**Standard:**

- 03 During a permissive right-turn movement, the signal faces, if any, that exclusively control U-turn traffic that conflicts with the permissive right-turn movement (see Item F.1 in Section 4D.05) shall simultaneously display steady U-turn **RED ARROW** signal indications. If pedestrians crossing the lane or lanes used by the permissive right-turn movement to depart the intersection are controlled by pedestrian signal heads, the signal indications displayed by those pedestrian signal heads shall not be limited to any particular display during the permissive right-turn movement.
- 04 During a protected right-turn movement, the signal faces for left-turn traffic, if any, on the opposing approach shall not simultaneously display a steady left-turn **GREEN ARROW** or steady left-turn **YELLOW ARROW** signal indication, and signal faces, if any, that exclusively control U-turn traffic that conflicts with the protected right-turn movement (see Item F.1 in Section 4D.05) shall simultaneously display steady U-turn **RED ARROW** signal indications. If pedestrians crossing the lane or lanes used by the protected right-turn movement to depart the intersection are controlled by pedestrian signal heads, the pedestrian signal heads shall display a steady **UPRAISED HAND** (symbolizing **DONT WALK**) signal indication during the protected right-turn movement.
- 05 A protected only mode right-turn movement that does not begin and terminate at the same time as the adjacent through movement shall not be provided on an approach unless an exclusive right-turn lane exists.
- 06 A yellow change interval for the right-turn movement shall not be displayed when the status of the right-turn operation is changing from permissive to protected within any given signal sequence.

- 07 **If the operating mode changes among the protected only mode and/or the protected/permissive mode and/or the permissive only mode during different periods of the day or as traffic conditions change, the requirements in Sections 4D.22 through 4D.24 that are appropriate to that mode of operation shall be met, subject to the following:**
- A. **The CIRCULAR GREEN and CIRCULAR YELLOW signal indications shall not be displayed when operating in the protected only mode.**
  - B. **The right-turn GREEN ARROW and right-turn YELLOW ARROW signal indications shall not be displayed when operating in the permissive only mode.**

Option:

- 08 Additional static signs or changeable message signs may be used to meet the requirements for the variable right-turn mode or to inform drivers that right-turn green arrows will not be available during certain times of the day.

Support:

- 09 Sections 4D.21 through 4D.24 describe the use of the following two types of signal faces for controlling right-turn movements:
- A. **Shared signal face** – This type of signal face controls both the right-turn movement and the adjacent movement (usually the through movement) and can serve as one of the two required primary signal faces for the adjacent movement. A shared signal face always displays the same color of circular indication that is displayed by the signal face or faces for the adjacent movement.
  - B. **Separate right-turn signal face** – This type of signal face controls only the right-turn movement and cannot serve as one of the two required primary signal faces for the adjacent movement (usually the through movement) because it displays signal indications that are applicable only to the right-turn movement. If a separate right-turn signal face is mounted overhead at the intersection, it is positioned over the extension of the right-turn lane. In a separate right-turn signal face, a flashing right-turn YELLOW ARROW signal indication or a flashing right-turn RED ARROW signal indication is used to control permissive right-turning movements.
- 10 Section 4D.13 contains provisions regarding the lateral positioning of signal faces that control right-turn movements.
- 11 It is not necessary that the same mode of right-turn operation or same type of right-turn signal face be used on every approach to a signalized location. Selecting different modes and types of right-turn signal faces for the various approaches to the same signalized location is acceptable.

Option:

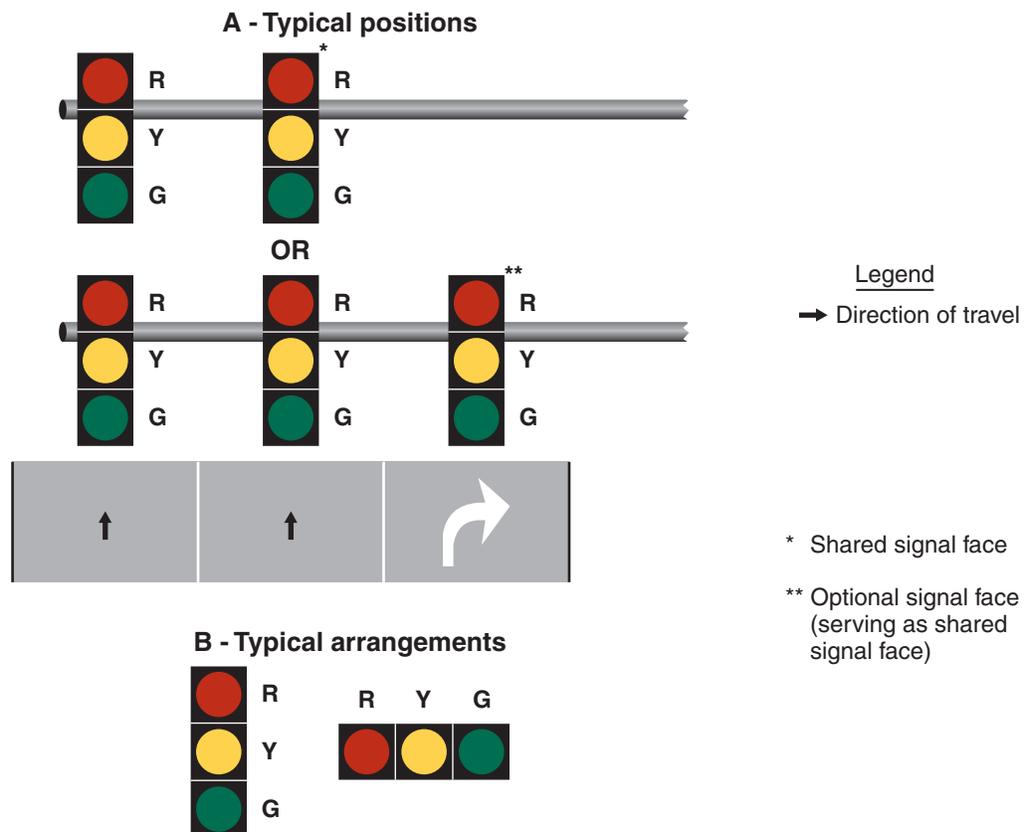
- 12 A signal face that is shared by left-turning and right-turning traffic may be provided for a shared left-turn/right-turn lane on an approach that has no through traffic (see Section 4D.25).

### **Section 4D.22 Signal Indications for Permissive Only Mode Right-Turn Movements**

**Standard:**

- 01 **If a shared signal face is provided for a permissive only mode right turn, it shall meet the following requirements (see Figure 4D-13):**
- A. **It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, and CIRCULAR GREEN. Only one of the three indications shall be displayed at any given time.**
  - B. **During the permissive right-turn movement, a CIRCULAR GREEN signal indication shall be displayed.**
  - C. **A permissive only shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.**
  - D. **If the permissive only mode is not the only right-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.24) except that the right-turn GREEN ARROW and right-turn YELLOW ARROW signal indications shall not be displayed when operating in the permissive only mode.**
- 02 **If a separate right-turn signal face is being operated in a permissive only right-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.**

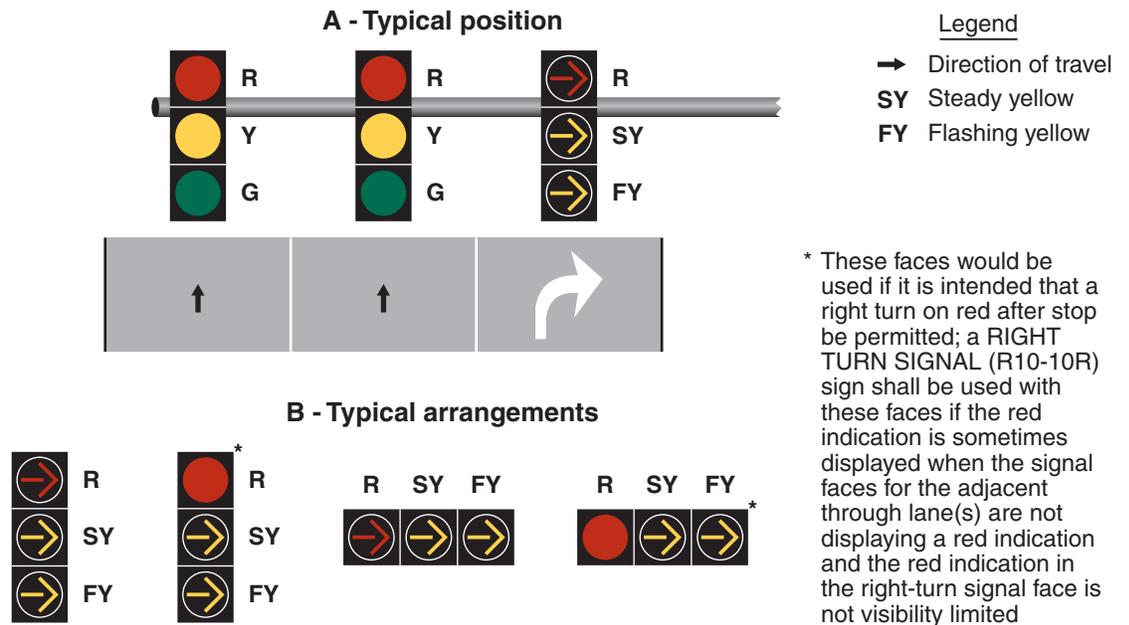
**Figure 4D-13. Typical Positions and Arrangements of Shared Signal Faces for Permissive Only Mode Right Turns**



03 If a separate right-turn signal face is being operated in a permissive only right-turn mode and a flashing right-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-14):

- A. It shall be capable of displaying one of the following sets of signal indications:
  1. Steady right-turn RED ARROW, steady right-turn YELLOW ARROW, and flashing right-turn YELLOW ARROW. Only one of the three indications shall be displayed at any given time.
  2. Steady CIRCULAR RED, steady right-turn YELLOW ARROW, and flashing right-turn YELLOW ARROW. Only one of the three indications shall be displayed at any given time. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication in the separate right-turn signal face is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).
- B. During the permissive right-turn movement, a flashing right-turn YELLOW ARROW signal indication shall be displayed.
- C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the flashing right-turn YELLOW ARROW signal indication.
- D. When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.
- E. It shall be permitted to display a flashing right-turn YELLOW ARROW signal indication for a permissive right-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications.
- F. During steady mode (stop-and-go) operation, the signal section that displays the steady right-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing right-turn YELLOW ARROW signal indication for permissive right turns.

**Figure 4D-14. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Permissive Only Mode Right Turns**



**G. During flashing mode operation (see Section 4D.30), the display of a flashing right-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady right-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.**

**H. If the permissive only mode is not the only right-turn mode used for the approach, the signal face shall be the same separate right-turn signal face with a flashing YELLOW ARROW signal indication that is used for the protected/permissive mode (see Section 4D.24) except that the right-turn GREEN ARROW signal indication shall not be displayed when operating in the permissive only mode.**

Option:

- 04 When an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive right turn, a separate right-turn signal face with a flashing right-turn RED ARROW signal indication during the permissive right-turn movement may be used.

**Standard:**

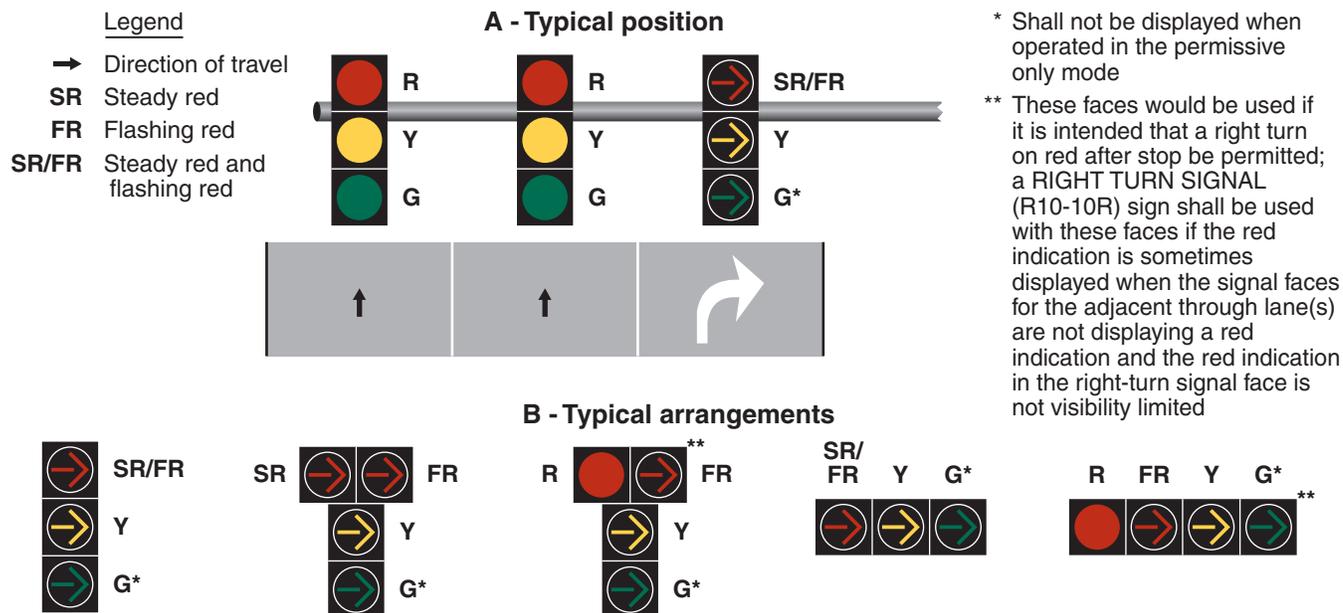
- 05 **If a separate right-turn signal face is being operated in a permissive only right-turn mode and a flashing right-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-15):**

**A. It shall be capable of displaying one of the following sets of signal indications:**

1. Steady or flashing right-turn RED ARROW, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide a three-section signal face, but shall not be displayed during permissive only mode.
2. Steady CIRCULAR RED on the left and steady right-turn RED ARROW on the right of the top position, steady right-turn YELLOW ARROW in the middle position, and right-turn GREEN ARROW in the bottom position. Only one of the four indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide three vertical positions, but shall not be displayed during permissive only mode. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication in the separate right-turn signal face is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).

**B. During the permissive right-turn movement, a flashing right-turn RED ARROW signal indication shall be displayed, thus indicating that each and every vehicle must successively come to a full stop before making a permissive right turn.**

**Figure 4D-15. Typical Position and Arrangements of Separate Signal Faces with Flashing Red Arrow for Permissive Only Mode and Protected/Permissive Mode Right Turns**



Note: A flashing red arrow controlling a right-turn movement may be used only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive turn

- C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the flashing right-turn RED ARROW signal indication.
- D. When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.
- E. The display of a flashing right-turn RED ARROW signal indication for a permissive right-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement shall be permitted.
- F. A supplementary sign shall not be required. If used, it shall be a RIGHT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).

Option:

- 06 The requirements of Item A.1 in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two right-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-15).

#### Section 4D.23 Signal Indications for Protected Only Mode Right-Turn Movements

Standard:

- 01 A shared signal face shall not be used for protected only mode right turns unless the CIRCULAR GREEN and right-turn GREEN ARROW signal indications always begin and terminate together. If a shared signal face is provided for a protected only right turn, it shall meet the following requirements (see Figure 4D-16):
- A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR GREEN, and right-turn GREEN ARROW. Only one of the three colors shall be displayed at any given time.
  - B. During the protected right-turn movement, the shared signal face shall simultaneously display both a CIRCULAR GREEN signal indication and a right-turn GREEN ARROW signal indication.
  - C. The shared signal face shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

**D. If the protected only mode is not the only right-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.24).**

Option:

02 A straight-through GREEN ARROW signal indication may be used instead of the CIRCULAR GREEN signal indication in Items A and B in Paragraph 1 on an approach where left turns are prohibited and a straight-through GREEN ARROW signal indication is also used instead of a CIRCULAR GREEN signal indication in the other signal face(s) for through traffic.

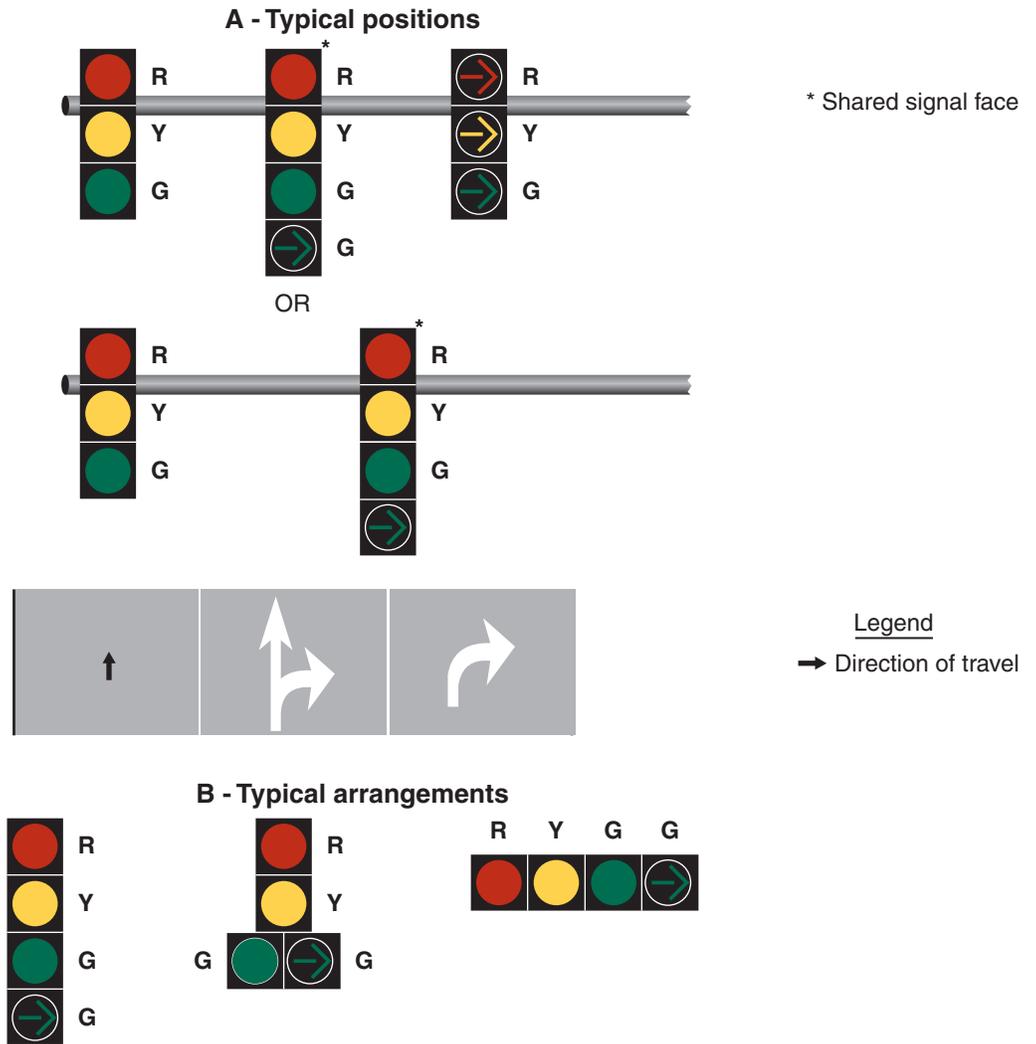
**Standard:**

03 **If a separate right-turn signal face is provided for a protected only mode right turn, it shall meet the following requirements (see Figure 4D-17):**

**A. It shall be capable of displaying one of the following sets of signal indications:**

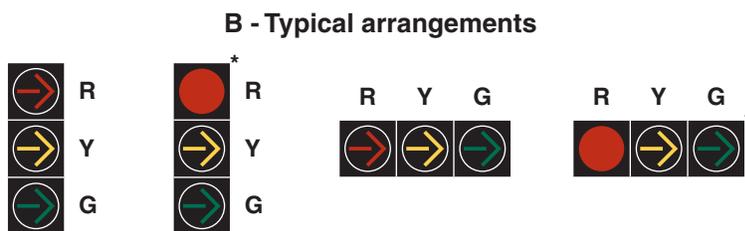
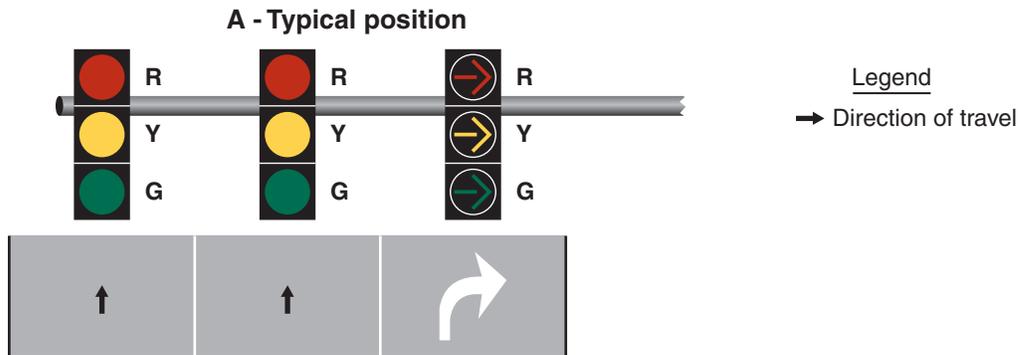
1. **Steady right-turn RED ARROW, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a RIGHT ON GREEN ARROW ONLY (R10-5a) sign (see Figure 2B-27).**

**Figure 4D-16. Typical Positions and Arrangements of Shared Signal Faces for Protected Only Mode Right Turns**



Note: Shared signal faces shall only be used for a protected-only mode right turn if the circular green and green right-turn arrow indications always begin and terminate together

**Figure 4D-17. Typical Position and Arrangements of Separate Signal Faces for Protected Only Mode Right Turns**



\* These faces would be used if it is intended that a right turn on red after stop be permitted; a RIGHT TURN SIGNAL (R10-10R) sign shall be used with these faces if the red indication is not visibility limited

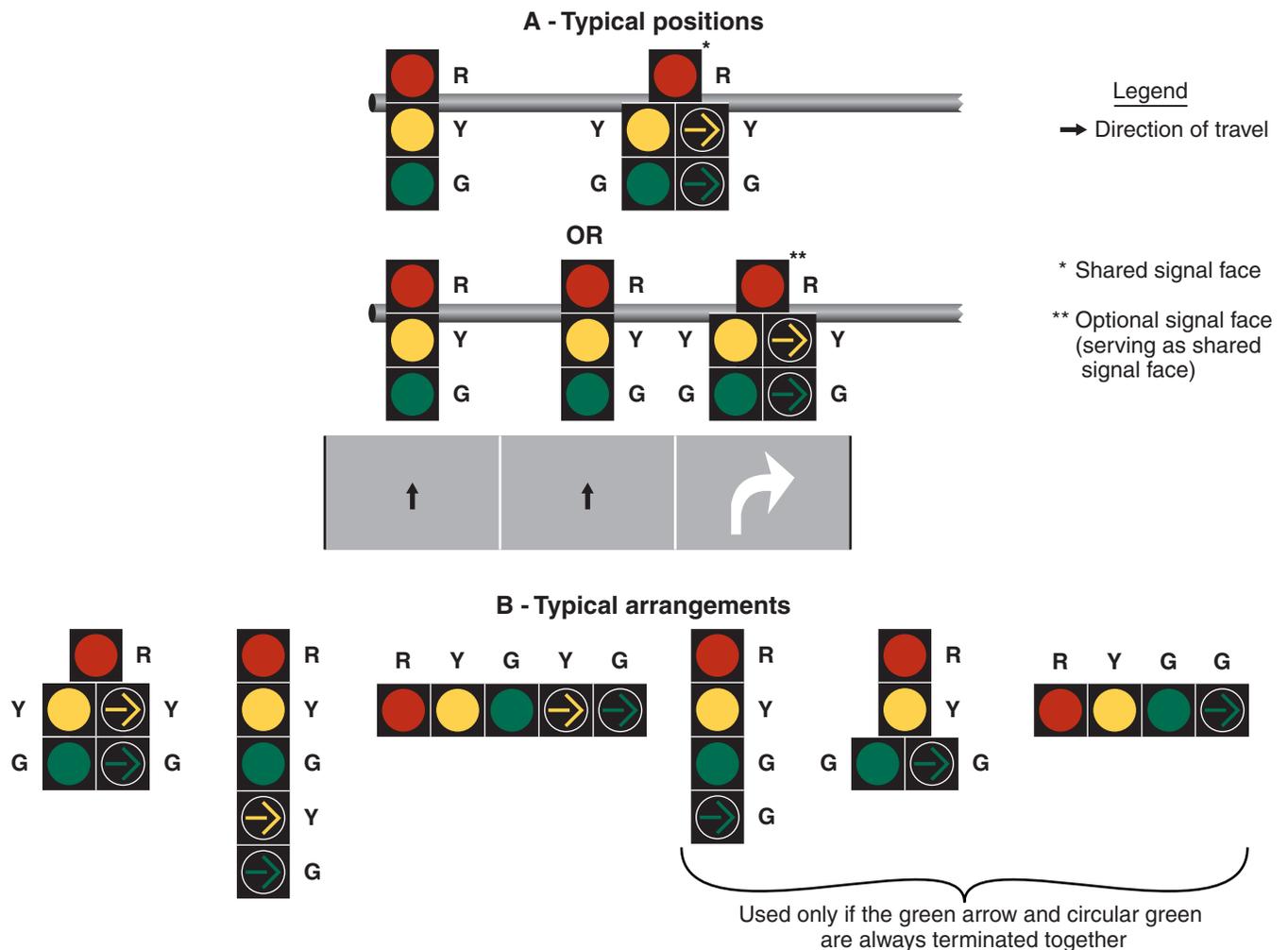
2. **Steady CIRCULAR RED, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW.** Only one of three indications shall be displayed at any given time. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).
  - B. During the protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed.
  - C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the right-turn GREEN ARROW signal indication.
  - D. When the separate signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.
  - E. If the protected only mode is not the only right-turn mode used for the approach, the signal face shall be the same separate right-turn signal face that is used for the protected/permissive mode (see Section 4D.24 and Figure 4D-19) except that a flashing right-turn YELLOW ARROW or flashing right-turn RED ARROW signal indication shall not be displayed when operating in the protected only mode.

#### **Section 4D.24 Signal Indications for Protected/Permissive Mode Right-Turn Movements**

##### **Standard:**

- 01 If a shared signal face is provided for a protected/permissive mode right turn, it shall meet the following requirements (see Figure 4D-18):
  - A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR green, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three circular indications shall be displayed at any given time. Only one of the two arrow indications shall be displayed at any given time. If the right-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are always terminated together, the steady right-turn YELLOW ARROW signal indication shall not be required.

**Figure 4D-18. Typical Positions and Arrangements of Shared Signal Faces for Protected/Permissive Mode Right Turns**



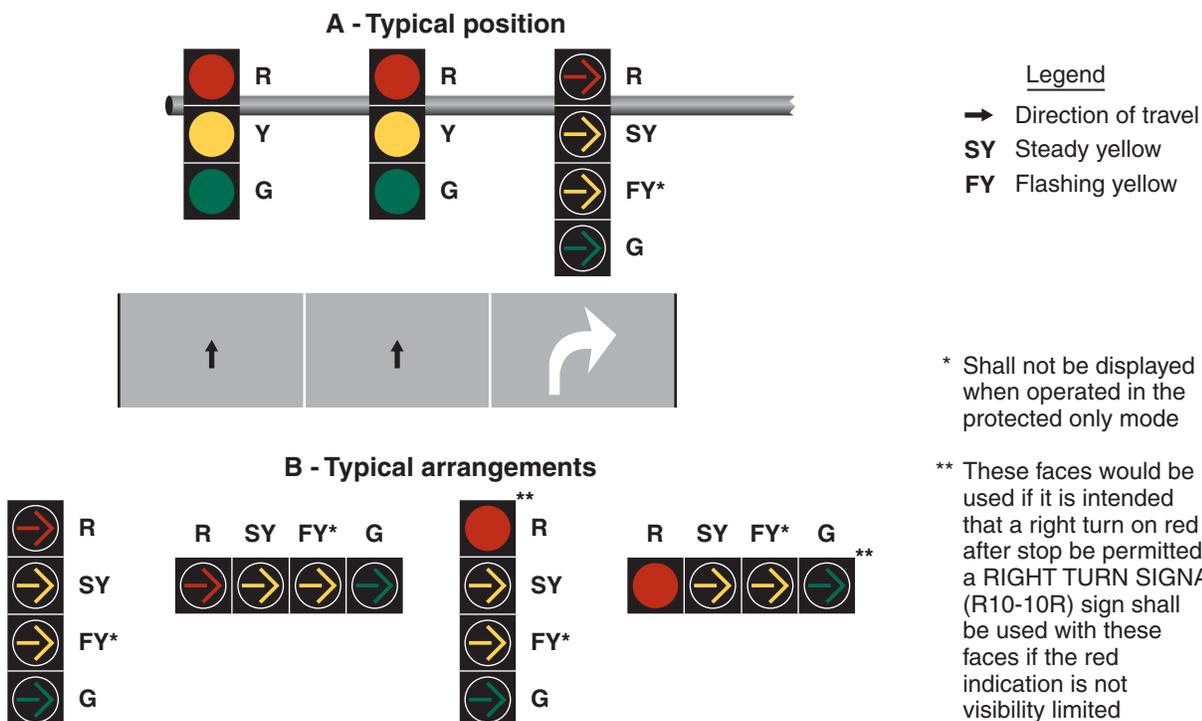
- B.** During the protected right-turn movement, the shared signal face shall simultaneously display a right-turn GREEN ARROW signal indication and a circular signal indication that is the same color as the signal indication for the adjacent through lane on the same approach as the protected right turn.
- C.** A steady right-turn YELLOW ARROW signal indication shall be displayed following the right-turn GREEN ARROW signal indication, unless the right-turn GREEN ARROW signal indication and the CIRCULAR GREEN signal indication(s) for the adjacent through movement are being terminated together. When the right-turn GREEN ARROW and CIRCULAR GREEN signal indications are being terminated together, the required display following the right-turn GREEN ARROW signal indication shall be either the display of a CIRCULAR YELLOW signal indication alone or the simultaneous display of the CIRCULAR YELLOW and right-turn YELLOW ARROW signal indications.
- D.** During the permissive right-turn movement, the shared signal face shall display only a CIRCULAR GREEN signal indication.
- E.** A protected/permissive shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

02 If a separate right-turn signal face is being operated in a protected/permissive right-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.

03 If a separate right-turn signal face is being operated in a protected/permmissive right-turn mode and a flashing right-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-19):

- A. It shall be capable of displaying one of the following sets of signal indications:
  1. Steady right-turn RED ARROW, steady right-turn YELLOW ARROW, flashing right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time.
  2. Steady CIRCULAR RED, steady right-turn YELLOW ARROW, flashing right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the four indications shall be displayed at any given time. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication in the separate right-turn signal face is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).
- B. During the protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed.
- C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the right-turn GREEN ARROW signal indication.
- D. During the permmissive right-turn movement, a flashing right-turn YELLOW ARROW signal indication shall be displayed.
- E. A steady right-turn YELLOW ARROW signal indication shall be displayed following the flashing right-turn YELLOW ARROW signal indication if the permmissive right-turn movement is being terminated and the separate right-turn signal face will subsequently display a steady red indication.
- F. When a permmissive right-turn movement is changing to a protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing right-turn YELLOW ARROW signal indication. A steady right-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing right-turn YELLOW ARROW signal indication and the display of the steady right-turn GREEN ARROW signal indication.

**Figure 4D-19. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Protected/Permmissive Mode and Protected Only Mode Right Turns**



- G. When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.
- H. It shall be permitted to display a flashing right-turn YELLOW ARROW signal indication for a permissive right-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications.
- I. A signal face containing a dual-arrow signal section in place of separate flashing right-turn YELLOW ARROW and right-turn GREEN ARROW signal sections shall be permitted where signal head height limitations (or lateral positioning limitations for a horizontally-mounted signal face) are a concern. The dual-arrow signal section, where used, shall display a GREEN ARROW for the protected right-turn movement and a flashing YELLOW ARROW for the permissive right-turn movement.
- J. During steady mode (stop-and-go) operation, the signal section that displays the steady right-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing right-turn YELLOW ARROW signal indication for permissive right turns.
- K. During flashing mode operation (see Section 4D.30), the display of a flashing right-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady right-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.

Option:

- 04 When an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive right turn, a separate signal face that has a flashing right-turn RED ARROW signal indication during the permissive right-turn movement may be used.

**Standard:**

- 05 If a separate right-turn signal face is being operated in a protected/permissive right-turn mode and a flashing right-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-15):
- A. It shall be capable of displaying one of the following sets of signal indications:
    1. Steady or flashing right-turn RED ARROW, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.
    2. Steady CIRCULAR RED on the left and steady or flashing right-turn RED ARROW on the right of the top position, steady right-turn YELLOW ARROW in the middle position, and right-turn GREEN ARROW in the bottom position. Only one of the four indications shall be displayed at any given time. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication in the separate right-turn signal face is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).
  - B. During the protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed.
  - C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the right-turn GREEN ARROW signal indication.
  - D. During the permissive right-turn movement, the separate right-turn signal face shall display a flashing right-turn RED ARROW signal indication.
  - E. A steady right-turn YELLOW ARROW signal indication shall be displayed following the flashing right-turn RED ARROW signal indication if the permissive right-turn movement is being terminated and the separate right-turn signal face will subsequently display a steady red indication.
  - F. When a permissive right-turn movement is changing to a protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing right-turn RED ARROW signal indication. A steady right-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing right-turn RED ARROW signal indication and the display of the steady right-turn GREEN ARROW signal indication.

- G. When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.
- H. It shall be permitted to display a flashing right-turn RED ARROW signal indication for a permissive right-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
- I. A supplementary sign shall not be required. If used, it shall be a RIGHT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).

Option:

- 06 The requirements of Item A.1 in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two right-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-15).

#### **Section 4D.25 Signal Indications for Approaches With Shared Left-Turn/Right-Turn Lanes and No Through Movement**

Support:

- 01 A lane that is shared by left-turn and right-turn movements is sometimes provided on an approach that has no through movement, such as the stem of a T-intersection or where the opposite approach is a one-way roadway in the opposing direction.

**Standard:**

- 02 When a shared left-turn/right-turn lane exists on a signalized approach, the left-turn and right-turn movements shall start and terminate simultaneously and the red signal indication used in each of the signal faces on the approach shall be a CIRCULAR RED.

Support:

- 03 This requirement for the use of CIRCULAR RED signal indications in signal faces for approaches having a shared lane for left-turn and right-turn movements is a specific exception to other provisions in this Chapter that would otherwise require the use of RED ARROW signal indications.

**Standard:**

- 04 The signal faces provided for an approach with a shared left-turn/right-turn lane and no through movement shall be one of the following:
- A. Two or more signal faces, each capable of displaying CIRCULAR RED, CIRCULAR YELLOW, and CIRCULAR GREEN signal indications, shall be provided for the approach. This display shall be permissible regardless of number of exclusive left-turn and/or right-turn lanes that exist on the approach in addition to the shared left-turn/right-turn lane and regardless of whether or not there are pedestrian or opposing vehicular movements that conflict with the left-turn or right-turn movements. However, if there is an opposing approach and the signal phasing protects the left-turn movement on the approach with the shared left-turn/right-turn lane from conflicts with the opposing vehicular movements and any signalized pedestrian movements, a left-turn GREEN ARROW signal indication shall also be included in the left-most signal face and shall be displayed simultaneously with the CIRCULAR GREEN signal indication.
  - B. If the approach has one or more exclusive turn lanes in addition to the shared left-turn/right-turn lane and there is no conflict with a signalized vehicular or pedestrian movement, and GREEN ARROW signal indications are used in place of CIRCULAR GREEN signal indications on the approach, the signal faces for the approach shall be:
    1. A signal face(s) capable of displaying CIRCULAR RED, YELLOW ARROW, and GREEN ARROW signal indications for the exclusive turn lane(s), with the arrows pointing in the direction of the turn, and
    2. A shared left-turn/right-turn signal face capable of displaying CIRCULAR RED, left-turn YELLOW ARROW, left-turn GREEN ARROW, right-turn YELLOW ARROW, and right-turn GREEN ARROW signal indications, in an arrangement of signal sections that complies with the provisions of Section 4D.09 or 4D.10.
  - C. If the approach has one or more exclusive turn lanes in addition to the shared left-turn/right-turn lane and there is a conflict with a signalized vehicular or pedestrian movement, and flashing YELLOW ARROW signal indications are used in place of CIRCULAR GREEN signal indications

**on the approach, the signal faces for the approach shall be as described in Items B.1 and B.2, except that flashing YELLOW ARROW signal indications shall be used in place of the GREEN ARROW signal indications for the turning movement(s) that conflicts with the signaled vehicular or pedestrian movement.**

Support:

- 05 Figure 4D-20 illustrates application of these Standards on approaches that have only a shared left-turn/right-turn lane, and on approaches that have one or more exclusive turn lanes in addition to the shared left-turn/right-turn lane.

Option:

- 06 If the lane-use regulations on an approach are variable such that at certain times all of the lanes on the approach are designated as exclusive turn lanes and no lane is designated as a shared left-turn/right-turn lane:
- A. During the times that no lane is designated as a shared left-turn/right-turn lane, the left-turn and right-turn movements may start and terminate independently, and the left-turn and right-turn movements may be operated in one or more of the modes of operation as described in Sections 4D.17 through 4D.24; and
  - B. If a protected-permissive mode is used, the shared left-turn/right-turn signal face provided in Paragraph 4 may be modified to include a dual-arrow signal section capable of displaying both a GREEN ARROW signal indication and a flashing YELLOW ARROW signal indication for a turn movement(s) in order to not exceed the maximum of five sections per signal face provided in Section 4D.08.

### **Section 4D.26 Yellow Change and Red Clearance Intervals**

**Standard:**

- 01 **A steady yellow signal indication shall be displayed following every CIRCULAR GREEN or GREEN ARROW signal indication and following every flashing YELLOW ARROW or flashing RED ARROW signal indication displayed as a part of a steady mode operation. This requirement shall not apply when a CIRCULAR GREEN, a flashing YELLOW ARROW, or a flashing RED ARROW signal indication is followed immediately by a GREEN ARROW signal indication.**
- 02 **The exclusive function of the yellow change interval shall be to warn traffic of an impending change in the right-of-way assignment.**
- 03 **The duration of the yellow change interval shall be determined using engineering practices.**

Support:

- 04 Section 4D.05 contains provisions regarding the display of steady CIRCULAR YELLOW signal indications to approaches from which drivers are allowed to make permissive left turns.

*Guidance:*

- 05 *When indicated by the application of engineering practices, the yellow change interval should be followed by a red clearance interval to provide additional time before conflicting traffic movements, including pedestrians, are released.*

**Standard:**

- 06 **When used, the duration of the red clearance interval shall be determined using engineering practices.**

Support:

- 07 Engineering practices for determining the duration of yellow change and red clearance intervals can be found in ITE's "Traffic Control Devices Handbook" and in ITE's "Manual of Traffic Signal Design" (see Section 1A.11).

**Standard:**

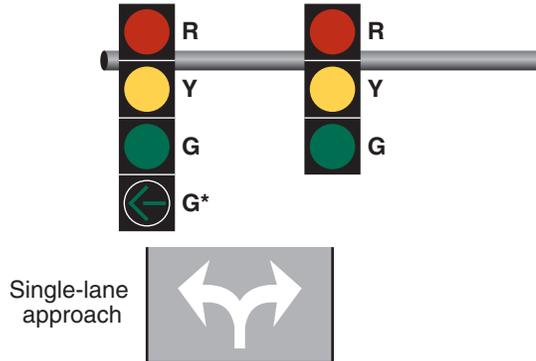
- 08 **The durations of yellow change intervals and red clearance intervals shall be consistent with the determined values within the technical capabilities of the controller unit.**
- 09 **The duration of a yellow change interval shall not vary on a cycle-by-cycle basis within the same signal timing plan.**
- 10 **Except as provided in Paragraph 12, the duration of a red clearance interval shall not be decreased or omitted on a cycle-by-cycle basis within the same signal timing plan.**

Option:

- 11 The duration of a red clearance interval may be extended from its predetermined value for a given cycle based upon the detection of a vehicle that is predicted to violate the red signal indication.
- 12 When an actuated signal sequence includes a signal phase for permissive/protected (lagging) left-turn movements in both directions, the red clearance interval may be shown during those cycles when the lagging left-turn signal phase is skipped and may be omitted during those cycles when the lagging left-turn signal phase is shown.

### Figure 4D-20. Signal Indications for Approaches with a Shared Left-Turn/Right-Turn Lane and No Through Movement (Sheet 1 of 3)

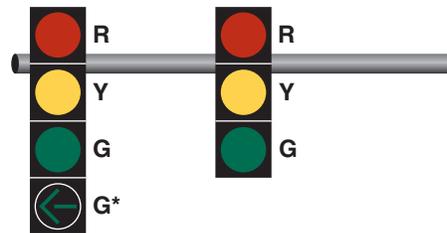
A - No conflicting vehicular or pedestrian movements



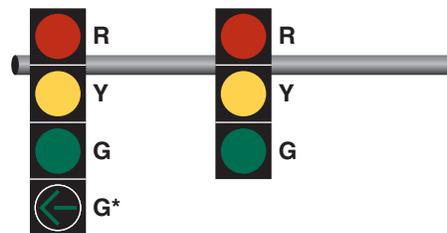
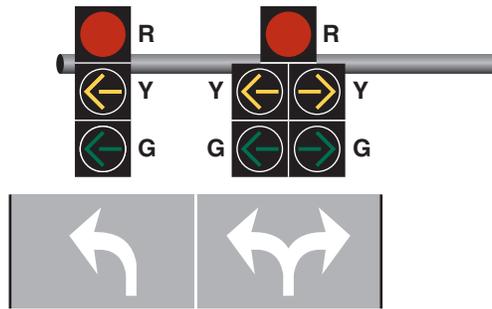
\* Left-turn GREEN ARROW section shall be included if there is an opposing one-way approach and the signal phasing eliminates conflicts.

Notes:

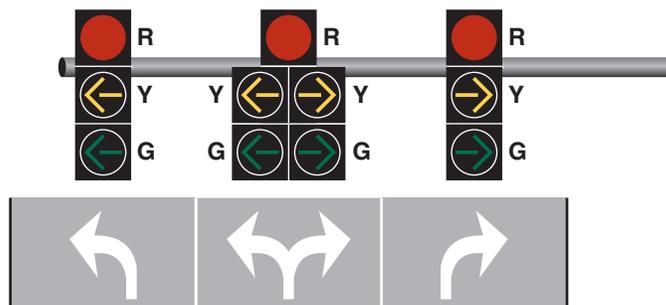
1. Horizontally-aligned signal faces may also be used.
2. Shared signal faces may also be 5 sections in a vertical straight line instead of a cluster.



OR

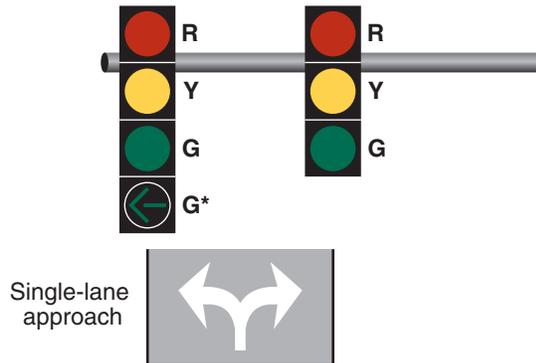


OR



### Figure 4D-20. Signal Indications for Approaches with a Shared Left-Turn/Right-Turn Lane and No Through Movement (Sheet 2 of 3)

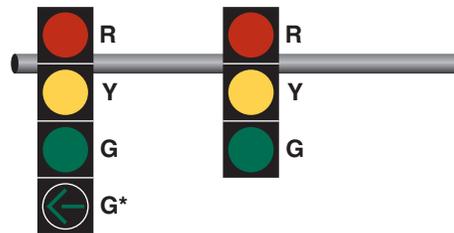
#### B - Pedestrian or vehicular conflict with one turn movement



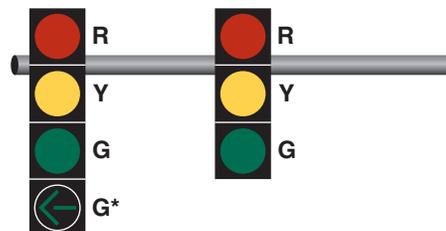
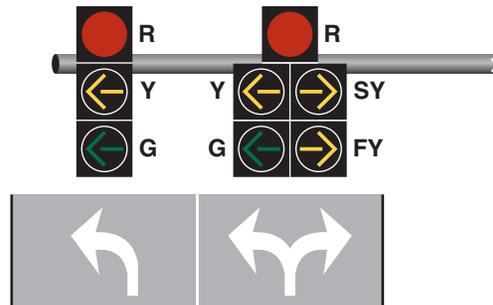
\* Left-turn GREEN ARROW section shall be included if there is an opposing one-way approach and the signal phasing eliminates conflicts.

Notes:

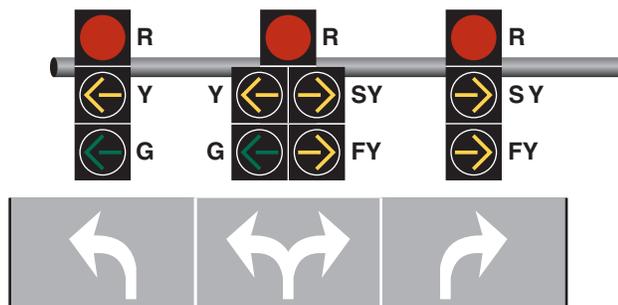
1. A conflict with the right-turn movement is illustrated.
2. Horizontally-aligned signal faces may also be used.
3. Shared signal faces may also be 5 sections in a vertical straight line instead of a cluster.



OR

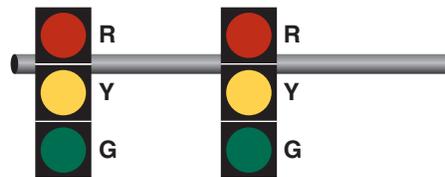
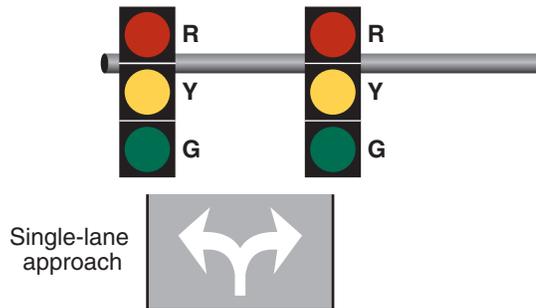


OR

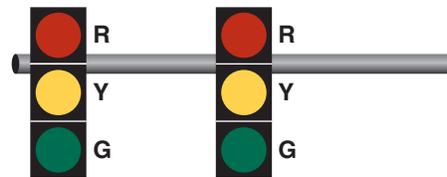
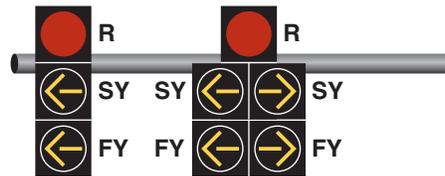


**Figure 4D-20. Signal Indications for Approaches with a Shared Left-Turn/Right-Turn Lane and No Through Movement (Sheet 3 of 3)**

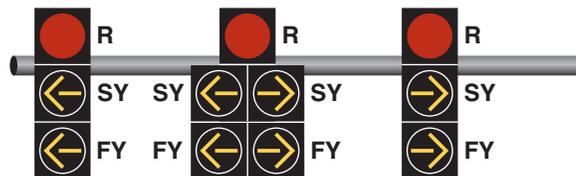
**C - Pedestrian or vehicular conflicts with both turn movements**



OR



OR



Notes:

1. Horizontally-aligned signal faces may also be used.
2. Shared signal faces may also be 5 sections in a vertical straight line instead of a cluster.

- 13 The duration of a yellow change interval or a red clearance interval may be different in different signal timing plans for the same controller unit.

*Guidance:*

- 14 *A yellow change interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds. The longer intervals should be reserved for use on approaches with higher speeds.*
- 15 *Except when clearing a one-lane, two-way facility (see Section 4H.02) or when clearing an exceptionally wide intersection, a red clearance interval should have a duration not exceeding 6 seconds.*

**Standard:**

- 16 **Except for warning beacons mounted on advance warning signs on the approach to a signalized location (see Section 2C.36), signal displays that are intended to provide a “pre-yellow warning” interval, such as flashing green signal indications, vehicular countdown displays, or other similar displays, shall not be used at a signalized location.**

*Support:*

- 17 The use of signal displays (other than warning beacons mounted on advance warning signs) that convey a “pre-yellow warning” have been found by research to increase the frequency of crashes.

### **Section 4D.27 Preemption and Priority Control of Traffic Control Signals**

*Option:*

- 01 Traffic control signals may be designed and operated to respond to certain classes of approaching vehicles by altering the normal signal timing and phasing plan(s) during the approach and passage of those vehicles. The alternative plan(s) may be as simple as extending a currently displayed green interval or as complex as replacing the entire set of signal phases and timing.

*Support:*

- 02 Preemption control (see definition in Section 1A.13) is typically given to trains, boats, emergency vehicles, and light rail transit.

- 03 Examples of preemption control include the following:

- A. The prompt displaying of green signal indications at signalized locations ahead of fire vehicles, law enforcement vehicles, ambulances, and other official emergency vehicles;
- B. A special sequence of signal phases and timing to expedite and/or provide additional clearance time for vehicles to clear the tracks prior to the arrival of rail traffic; and
- C. A special sequence of signal phases to display a steady red indication to prohibit turning movements toward the tracks during the approach or passage of rail traffic.

- 04 Priority control (see definition in Section 1A.13) is typically given to certain non-emergency vehicles such as light-rail transit vehicles operating in a mixed-use alignment and buses.

- 05 Examples of priority control include the following:

- A. The displaying of early or extended green signal indications at an intersection to assist public transit vehicles in remaining on schedule, and
- B. Special phasing to assist public transit vehicles in entering the travel stream ahead of the platoon of traffic.

- 06 Some types or classes of vehicles supersede others when a traffic control signal responds to more than one type or class. In general, a vehicle that is more difficult to control supersedes a vehicle that is easier to control.

*Option:*

- 07 Preemption or priority control of traffic control signals may also be a means of assigning priority right-of-way to specified classes of vehicles at certain non-intersection locations such as on approaches to one-lane bridges and tunnels, movable bridges, highway maintenance and construction activities, metered freeway entrance ramps, and transit operations.

**Standard:**

- 08 **During the transition into preemption control:**

- A. The yellow change interval, and any red clearance interval that follows, shall not be shortened or omitted.**
- B. The shortening or omission of any pedestrian walk interval and/or pedestrian change interval shall be permitted.**
- C. The return to the previous green signal indication shall be permitted following a steady yellow signal indication in the same signal face, omitting the red clearance interval, if any.**

- 09 **During preemption control and during the transition out of preemption control:**
- A. The shortening or omission of any yellow change interval, and of any red clearance interval that follows, shall not be permitted.
  - B. A signal indication sequence from a steady yellow signal indication to a green signal indication shall not be permitted.
- 10 **During priority control and during the transition into or out of priority control:**
- A. The shortening or omission of any yellow change interval, and of any red clearance interval that follows, shall not be permitted.
  - B. The shortening of any pedestrian walk interval below that time described in Section 4E.06 shall not be permitted.
  - C. The omission of a pedestrian walk interval and its associated change interval shall not be permitted unless the associated vehicular phase is also omitted or the pedestrian phase is exclusive.
  - D. The shortening or omission of any pedestrian change interval shall not be permitted.
  - E. A signal indication sequence from a steady yellow signal indication to a green signal indication shall not be permitted.

*Guidance:*

- 11 *Except for traffic control signals interconnected with light rail transit systems, traffic control signals with railroad preemption or coordinated with flashing-light signal systems should be provided with a back-up power supply.*
- 12 *When a traffic control signal that is returning to a steady mode from a dark mode (typically upon restoration from a power failure) receives a preemption or priority request, care should be exercised to minimize the possibility of vehicles or pedestrians being misdirected into a conflict with the vehicle making the request.*

*Option:*

- 13 During the change from a dark mode to a steady mode under a preemption or priority request, the display of signal indications that could misdirect road users may be prevented by one or more of the following methods:
- A. Having the traffic control signal remain in the dark mode,
  - B. Having the traffic control signal remain in the flashing mode,
  - C. Altering the flashing mode,
  - D. Executing the normal start-up routine before responding, or
  - E. Responding directly to initial or dwell period.

*Guidance:*

- 14 *If a traffic control signal is installed near or within a grade crossing or if a grade crossing with active traffic control devices is within or near a signalized highway intersection, Chapter 8C should be consulted.*
- 15 *Traffic control signals operating under preemption control or under priority control should be operated in a manner designed to keep traffic moving.*
- 16 *Traffic control signals that are designed to respond under preemption or priority control to more than one type or class of vehicle should be designed to respond in the relative order of importance or difficulty in stopping the type or class of vehicle. The order of priority should be: train, boat, heavy vehicle (fire vehicle, emergency medical service), light vehicle (law enforcement), light rail transit, rubber-tired transit.*

*Option:*

- 17 A distinctive indication may be provided at the intersection to show that an emergency vehicle has been given control of the traffic control signal (see Section 11-106 of the “Uniform Vehicle Code”). In order to assist in the understanding of the control of the traffic signal, a common distinctive indication may be used where drivers from different agencies travel through the same intersection when responding to emergencies.
- 18 If engineering judgment indicates that light rail transit signal indications would reduce road user confusion that might otherwise occur if standard traffic signal indications were used to control these movements, light rail transit signal indications complying with Section 8C.11 and as illustrated in Figure 8C-3 may be used for preemption or priority control of the following exclusive movements at signalized intersections:
- A. Public transit buses in “queue jumper” lanes, and
  - B. Bus rapid transit in semi-exclusive or mixed-use alignments.

## **Section 4D.28 Flashing Operation of Traffic Control Signals – General**

### **Standard:**

- 01 The light source of a flashing signal indication shall be flashed continuously at a rate of not less than 50 or more than 60 times per minute.
- 02 The displayed period of each flash shall be a minimum of 1/2 and a maximum of 2/3 of the total flash cycle.
- 03 Flashing signal indications shall comply with the requirements of other Sections of this Manual regarding visibility-limiting or positioning of conflicting signal indications, except that flashing yellow signal indications for through traffic shall not be required to be visibility-limited or positioned to minimize visual conflict for road users in separately controlled turn lanes.
- 04 Each traffic control signal shall be provided with an independent flasher mechanism that operates in compliance with this Section.
- 05 The flashing operation shall not be terminated by removal or turn off of the controller unit or of the conflict monitor (malfunction management unit) or both.
- 06 A manual switch, a conflict monitor (malfunction management unit) circuit, and, if appropriate, automatic means shall be provided to initiate the flashing mode.

### **Option:**

- 07 Based on engineering study or engineering judgment, traffic control signals may be operated in the flashing mode on a scheduled basis during one or more periods of the day rather than operated continuously in the steady (stop-and-go) mode.

### **Support:**

- 08 Sections 4E.06 and 4E.09 contain information regarding the operation of pedestrian signal heads and accessible pedestrian signal detector pushbutton locator tones, respectively, during flashing operation.

## **Section 4D.29 Flashing Operation – Transition Into Flashing Mode**

### **Standard:**

- 01 The transition from steady (stop-and-go) mode to flashing mode, if initiated by a conflict monitor (malfunction management unit) or by a manual switch, shall be permitted to be made at any time.
- 02 Programmed changes from steady (stop-and-go) mode to flashing mode shall be made under either of the following circumstances:
- A. At the end of the common major-street red interval (such as just prior to the start of the green in both directions on the major street), or
  - B. Directly from a CIRCULAR GREEN signal indication to a flashing CIRCULAR YELLOW signal indication, or from a GREEN ARROW signal indication to a flashing YELLOW ARROW signal indication, or from a flashing YELLOW ARROW signal indication (see Sections 4D.17 to 4D.24) to a flashing YELLOW ARROW signal indication in a different signal section.
- 03 During programmed changes into flashing mode, no green signal indication or flashing yellow signal indication shall be terminated and immediately followed by a steady red or flashing red signal indication without first displaying the steady yellow signal indication.

## **Section 4D.30 Flashing Operation – Signal Indications During Flashing Mode**

### *Guidance:*

- 01 When a traffic control signal is operated in the flashing mode, a flashing yellow signal indication should be used for the major street and a flashing red signal indication should be used for the other approaches unless flashing red signal indications are used on all approaches.

### **Standard:**

- 02 When a traffic control signal is operated in the flashing mode, all of the green signal indications at the signalized location shall be dark (non-illuminated) and shall not be displayed in either a steady or flashing manner, except for single-section GREEN ARROW signal indications as provided elsewhere in this Section.
- 03 Flashing yellow signal indications shall be used on more than one approach to a signalized location only if those approaches do not conflict with each other.
- 04 Except as provided in Paragraph 5, when a traffic control signal is operated in the flashing mode, one and only one signal indication in every signal face at the signalized location shall be flashed.

### **Option:**

- 05 If a signal face has two identical CIRCULAR RED or RED ARROW signal indications (see Section 4D.08), both of those identical signal indications may be flashed simultaneously.

**Standard:**

- 06 No steady indications, other than a single-section signal face consisting of a continuously-displayed GREEN ARROW signal indication that is used alone to indicate a continuous movement in the steady (stop-and-go) mode, shall be displayed at the signalized location during the flashing mode. A single-section GREEN ARROW signal indication shall remain continuously-displayed when the traffic control signal is operated in the flashing mode.
- 07 If a signal face includes both circular and arrow signal indications of the color that is to be flashed, only the circular signal indication shall be flashed.
- 08 All signal faces that are flashed on an approach shall flash the same color, either yellow or red, except that separate turn signal faces (see Sections 4D.17 and 4D.21) shall be permitted to flash a RED ARROW signal indication when the adjacent through movement signal indications are flashed yellow. Shared signal faces (see Sections 4D.17 and 4D.21) for turn movements shall not be permitted to flash a CIRCULAR RED signal indication when the adjacent through movement signal indications are flashed yellow.
- 09 The appropriate RED ARROW or YELLOW ARROW signal indication shall be flashed when a signal face consists entirely of arrow indications. A signal face that consists entirely of arrow indications and that provides a protected only turn movement during the steady (stop-and-go) mode or that provides a flashing yellow arrow or flashing red arrow signal indication for a permissive turn movement during the steady (stop-and-go) mode shall be permitted to flash the YELLOW ARROW signal indication during the flashing mode if the adjacent through movement signal indications are flashed yellow and if it is intended that a permissive turn movement not requiring a full stop by each turning vehicle be provided during the flashing mode.

**Section 4D.31 Flashing Operation – Transition Out of Flashing Mode****Standard:**

- 01 All changes from flashing mode to steady (stop-and-go) mode shall be made under one of the following procedures:
- A. Yellow-red flashing mode: Changes from flashing mode to steady (stop-and-go) mode shall be made at the beginning of the major-street green interval (when a green signal indication is displayed to through traffic in both directions on the major street), or if there is no common major-street green interval, at the beginning of the green interval for the major traffic movement on the major street.
  - B. Red-red flashing mode: Changes from flashing mode to steady (stop-and-go) mode shall be made by changing the flashing red indications to steady red indications followed by appropriate green indications to begin the steady mode cycle. These green indications shall be the beginning of the major-street green interval (when a green signal indication is displayed to through traffic in both directions on the major street) or if there is no common major-street green interval, at the beginning of the green interval for the major traffic movement on the major street.

*Guidance:*

- 02 *The steady red clearance interval provided during the change from red-red flashing mode to steady (stop-and-go) mode should have a duration of 6 seconds.*
- 03 *When changing from the yellow-red flashing mode to steady (stop-and-go) mode, if there is no common major-street green interval, the provision of a steady red clearance interval for the other approaches before changing from a flashing yellow or a flashing red signal indication to a green signal indication on the major approach should be considered.*

**Standard:**

- 04 During programmed changes out of flashing mode, no flashing yellow signal indication shall be terminated and immediately followed by a steady red or flashing red signal indication without first displaying the steady yellow signal indication.

*Option:*

- 05 Because special midblock signals that rest in flashing circular yellow in the position normally occupied by the green signal indication do not have a green signal indication in the signal face, these signals may go directly from flashing circular yellow (in the position normally occupied by the green signal indication) to steady yellow without going first to a green signal indication.

**Section 4D.32 Temporary and Portable Traffic Control Signals****Support:**

- 01 A temporary traffic control signal is generally installed using methods that minimize the costs of installation, relocation, and/or removal. Typical temporary traffic control signals are for specific purposes, such as for one-lane, two-way facilities in temporary traffic control zones (see Chapter 4H), for a haul-road intersection, or for access to a site that will have a permanent access point developed at another location in the near future.

**Standard:**

- 02 **Advance signing shall be used when employing a temporary traffic control signal.**
- 03 **A temporary traffic control signal shall:**
- A. **Meet the physical display and operational requirements of a conventional traffic control signal.**
  - B. **Be removed when no longer needed.**
  - C. **Be placed in the flashing mode when not being used if it will be operated in the steady mode within 5 working days; otherwise, it shall be removed.**
  - D. **Be placed in the flashing mode during periods when it is not desirable to operate the signal, or the signal heads shall be covered, turned, or taken down to indicate that the signal is not in operation.**

*Guidance:*

- 04 *A temporary traffic control signal should be used only if engineering judgment indicates that installing the signal will improve the overall safety and/or operation of the location.*
- 05 *The use of temporary traffic control signals by a work crew on a regular basis in their work area should be subject to the approval of the jurisdiction having authority over the roadway.*
- 06 *A temporary traffic control signal should not operate longer than 30 days unless associated with a longer-term temporary traffic control zone project.*
- 07 *For use of temporary traffic control signals in temporary traffic control zones, reference should be made to Section 6F.84.*

**Section 4D.33 Lateral Offset of Signal Supports and Cabinets***Guidance:*

- 01 *The following items should be considered when placing signal supports and cabinets:*
- A. *Reference should be made to the American Association of State Highway and Transportation Officials (AASHTO) “Roadside Design Guide” (see Section 1A.11) and to the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11).*
  - B. *Signal supports should be placed as far as practical from the edge of the traveled way without adversely affecting the visibility of the signal indications.*
  - C. *Where supports cannot be located based on the recommended AASHTO clearances, consideration should be given to the use of appropriate safety devices.*
  - D. *No part of a concrete base for a signal support should extend more than 4 inches above the ground level at any point. This limitation does not apply to the concrete base for a rigid support.*
  - E. *In order to minimize hindrance to the passage of persons with physical disabilities, a signal support or controller cabinet should not obstruct the sidewalk, or access from the sidewalk to the crosswalk.*
  - F. *Controller cabinets should be located as far as practical from the edge of the roadway.*
  - G. *On medians, the minimum clearances provided in Items A through E for signal supports should be obtained if practical.*

**Section 4D.34 Use of Signs at Signalized Locations***Support:*

- 01 *Traffic signal signs are sometimes used at highway traffic signal locations to instruct or guide pedestrians, bicyclists, or motorists. Among the signs typically used at or on the approaches to signalized locations are movement prohibition signs (see Section 2B.18), lane control signs (see Sections 2B.19 to 2B.22), pedestrian crossing signs (see Section 2B.51), pedestrian actuation signs (see Section 2B.52), traffic signal signs (see Sections 2B.53 and 2C.48), Signal Ahead warning signs (see Section 2C.36), Street Name signs (see Section 2D.43), and Advance Street Name signs (see Section 2D.44).*

*Guidance:*

- 02 *Regulatory, warning, and guide signs should be used at traffic control signal locations as provided in Part 2 and as specifically provided elsewhere in Part 4.*
- 03 *Traffic signal signs should be located adjacent to the signal face to which they apply.*

*Support:*

- 04 *Section 2B.19 contains information regarding the use of overhead lane control signs on signalized approaches where lane drops, multiple-lane turns involving shared through-and-turn lanes, or other lane-use regulations that would be unexpected by unfamiliar road users are present.*

**Standard:**

- 05 **If used, illuminated traffic signal signs shall be designed and mounted in such a manner as to avoid glare and reflections that seriously detract from the signal indications. Traffic control signal faces shall be given dominant position and brightness to maximize their priority in the overall display.**
- 06 **The minimum vertical clearance and horizontal offset of the total assembly of traffic signal signs (see Section 2B.53) shall comply with the provisions of Sections 4D.15 and 4D.16.**
- 07 **STOP signs shall not be used in conjunction with any traffic control signal operation, except in either of the following cases:**
- A. If the signal indication for an approach is a flashing red at all times, or**
  - B. If a minor street or driveway is located within or adjacent to the area controlled by the traffic control signal, but does not require separate traffic signal control because an extremely low potential for conflict exists.**

**Section 4D.35 Use of Pavement Markings at Signalized Locations****Support:**

- 01 Pavement markings (see Part 3) that clearly communicate the operational plan of an intersection to road users play an important role in the effective operation of traffic control signals. By designating the number of lanes, the use of each lane, the length of additional lanes on the approach to an intersection, and the proper stopping points, the engineer can design the signal phasing and timing to best match the goals of the operational plan.

**Guidance:**

- 02 *Pavement markings should be used at traffic control signal locations as provided in Part 3. If the road surface will not retain pavement markings, signs should be installed to provide the needed road user information.*

## CHAPTER 4E. PEDESTRIAN CONTROL FEATURES

### Section 4E.01 Pedestrian Signal Heads

Support:

- 01 Pedestrian signal heads provide special types of traffic signal indications exclusively intended for controlling pedestrian traffic. These signal indications consist of the illuminated symbols of a WALKING PERSON (symbolizing WALK) and an UPRAISED HAND (symbolizing DONT WALK).

Guidance:

- 02 *Engineering judgment should determine the need for separate pedestrian signal heads (see Section 4D.03) and accessible pedestrian signals (see Section 4E.09).*

Support:

- 03 Chapter 4F contains information regarding the use of pedestrian hybrid beacons and Chapter 4N contains information regarding the use of In-Roadway Warning Lights at unsignalized marked crosswalks.

### Section 4E.02 Meaning of Pedestrian Signal Head Indications

Standard:

- 01 **Pedestrian signal head indications shall have the following meanings:**
- A. **A steady WALKING PERSON (symbolizing WALK) signal indication means that a pedestrian facing the signal indication is permitted to start to cross the roadway in the direction of the signal indication, possibly in conflict with turning vehicles. The pedestrian shall yield the right-of-way to vehicles lawfully within the intersection at the time that the WALKING PERSON (symbolizing WALK) signal indication is first shown.**
  - B. **A flashing UPRAISED HAND (symbolizing DONT WALK) signal indication means that a pedestrian shall not start to cross the roadway in the direction of the signal indication, but that any pedestrian who has already started to cross on a steady WALKING PERSON (symbolizing WALK) signal indication shall proceed to the far side of the traveled way of the street or highway, unless otherwise directed by a traffic control device to proceed only to the median of a divided highway or only to some other island or pedestrian refuge area.**
  - C. **A steady UPRAISED HAND (symbolizing DONT WALK) signal indication means that a pedestrian shall not enter the roadway in the direction of the signal indication.**
  - D. **A flashing WALKING PERSON (symbolizing WALK) signal indication has no meaning and shall not be used.**

### Section 4E.03 Application of Pedestrian Signal Heads

Standard:

- 01 **Pedestrian signal heads shall be used in conjunction with vehicular traffic control signals under any of the following conditions:**
- A. **If a traffic control signal is justified by an engineering study and meets either Warrant 4, Pedestrian Volume or Warrant 5, School Crossing (see Chapter 4C);**
  - B. **If an exclusive signal phase is provided or made available for pedestrian movements in one or more directions, with all conflicting vehicular movements being stopped;**
  - C. **At an established school crossing at any signalized location; or**
  - D. **Where engineering judgment determines that multi-phase signal indications (as with split-phase timing) would tend to confuse or cause conflicts with pedestrians using a crosswalk guided only by vehicular signal indications.**

Guidance:

- 02 *Pedestrian signal heads should be used under any of the following conditions:*
- A. *If it is necessary to assist pedestrians in deciding when to begin crossing the roadway in the chosen direction or if engineering judgment determines that pedestrian signal heads are justified to minimize vehicle-pedestrian conflicts;*
  - B. *If pedestrians are permitted to cross a portion of a street, such as to or from a median of sufficient width for pedestrians to wait, during a particular interval but are not permitted to cross the remainder of the street during any part of the same interval; and/or*
  - C. *If no vehicular signal indications are visible to pedestrians, or if the vehicular signal indications that are visible to pedestrians starting a crossing provide insufficient guidance for them to decide when to begin crossing the roadway in the chosen direction, such as on one-way streets, at T-intersections, or at multi-phase signal operations.*

Option:

- 03 Pedestrian signal heads may be used under other conditions based on engineering judgment.

#### Section 4E.04 Size, Design, and Illumination of Pedestrian Signal Head Indications

Standard:

- 01 All new pedestrian signal head indications shall be displayed within a rectangular background and shall consist of symbolized messages (see Figure 4E-1), except that existing pedestrian signal head indications with lettered or outline style symbol messages shall be permitted to be retained for the remainder of their useful service life. The symbol designs that are set forth in the “Standard Highway Signs and Markings” book (see Section 1A.11) shall be used. Each pedestrian signal head indication shall be independently displayed and emit a single color.

- 02 If a two-section pedestrian signal head is used, the UPRAISED HAND (symbolizing DONT WALK) signal section shall be mounted directly above the WALKING PERSON (symbolizing WALK) signal section. If a one-section pedestrian signal head is used, the symbols shall be either overlaid upon each other or arranged side-by-side with the UPRAISED HAND symbol to the left of the WALKING PERSON symbol, and a light source that can display each symbol independently shall be used.

- 03 The WALKING PERSON (symbolizing WALK) signal indication shall be white, conforming to the publication entitled “Pedestrian Traffic Control Signal Indications” (see Section 1A.11), with all except the symbol obscured by an opaque material.

- 04 The UPRAISED HAND (symbolizing DONT WALK) signal indication shall be Portland orange, conforming to the publication entitled “Pedestrian Traffic Control Signal Indications” (see Section 1A.11), with all except the symbol obscured by an opaque material.

- 05 When not illuminated, the WALKING PERSON (symbolizing WALK) and UPRAISED HAND (symbolizing DONT WALK) symbols shall not be readily visible to pedestrians at the far end of the crosswalk that the pedestrian signal head indications control.

- 06 For pedestrian signal head indications, the symbols shall be at least 6 inches high.

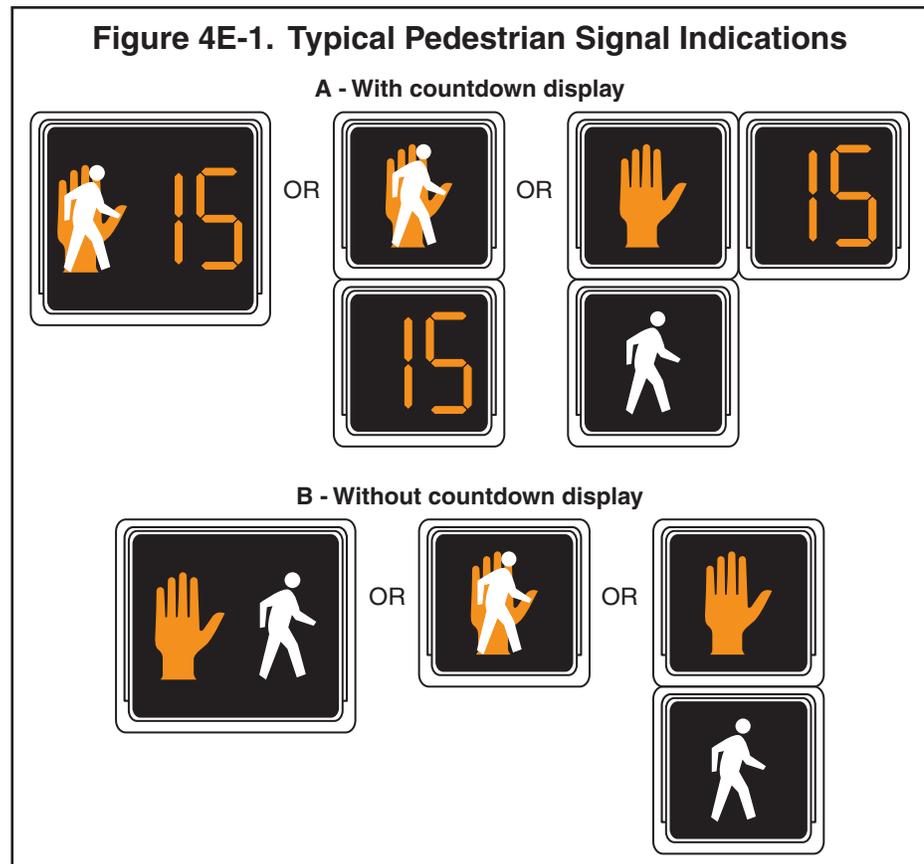
- 07 The light source of a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication shall be flashed continuously at a rate of not less than 50 or more than 60 times per minute. The displayed period of each flash shall be a minimum of 1/2 and a maximum of 2/3 of the total flash cycle.

Guidance:

- 08 Pedestrian signal head indications should be conspicuous and recognizable to pedestrians at all distances from the beginning of the controlled crosswalk to a point 10 feet from the end of the controlled crosswalk during both day and night.

- 09 For crosswalks where the pedestrian enters the crosswalk more than 100 feet from the pedestrian signal head indications, the symbols should be at least 9 inches high.

- 10 If the pedestrian signal indication is so bright that it causes excessive glare in nighttime conditions, some form of automatic dimming should be used to reduce the brilliance of the signal indication.



## Option:

- 11 An animated eyes symbol may be added to a pedestrian signal head in order to prompt pedestrians to look for vehicles in the intersection during the time that the WALKING PERSON (symbolizing WALK) signal indication is displayed.

**Standard:**

- 12 **If used, the animated eyes symbol shall consist of an outline of a pair of white steadily-illuminated eyes with white eyeballs that scan from side to side at a rate of approximately once per second. The animated eyes symbol shall be at least 12 inches wide with each eye having a width of at least 5 inches and a height of at least 2.5 inches. The animated eyes symbol shall be illuminated at the start of the walk interval and shall terminate at the end of the walk interval.**

**Section 4E.05 Location and Height of Pedestrian Signal Heads****Standard:**

- 01 **Pedestrian signal heads shall be mounted with the bottom of the signal housing including brackets not less than 7 feet or more than 10 feet above sidewalk level, and shall be positioned and adjusted to provide maximum visibility at the beginning of the controlled crosswalk.**
- 02 **If pedestrian signal heads are mounted on the same support as vehicular signal heads, there shall be a physical separation between them.**

**Section 4E.06 Pedestrian Intervals and Signal Phases****Standard:**

- 01 **At intersections equipped with pedestrian signal heads, the pedestrian signal indications shall be displayed except when the vehicular traffic control signal is being operated in the flashing mode. At those times, the pedestrian signal indications shall not be displayed.**
- 02 **When the pedestrian signal heads associated with a crosswalk are displaying either a steady WALKING PERSON (symbolizing WALK) or a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication, a steady or a flashing red signal indication shall be shown to any conflicting vehicular movement that is approaching the intersection or midblock location perpendicular or nearly perpendicular to the crosswalk.**
- 03 **When pedestrian signal heads are used, a WALKING PERSON (symbolizing WALK) signal indication shall be displayed only when pedestrians are permitted to leave the curb or shoulder.**
- 04 **A pedestrian change interval consisting of a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication shall begin immediately following the WALKING PERSON (symbolizing WALK) signal indication. Following the pedestrian change interval, a buffer interval consisting of a steady UPRAISED HAND (symbolizing DONT WALK) signal indication shall be displayed for at least 3 seconds prior to the release of any conflicting vehicular movement. The sum of the time of the pedestrian change interval and the buffer interval shall not be less than the calculated pedestrian clearance time (see Paragraphs 7 through 16). The buffer interval shall not begin later than the beginning of the red clearance interval, if used.**

## Option:

- 05 During the yellow change interval, the UPRAISED HAND (symbolizing DON'T WALK) signal indication may be displayed as either a flashing indication, a steady indication, or a flashing indication for an initial portion of the yellow change interval and a steady indication for the remainder of the interval.

## Support:

- 06 Figure 4E-2 illustrates the pedestrian intervals and their possible relationships with associated vehicular signal phase intervals.

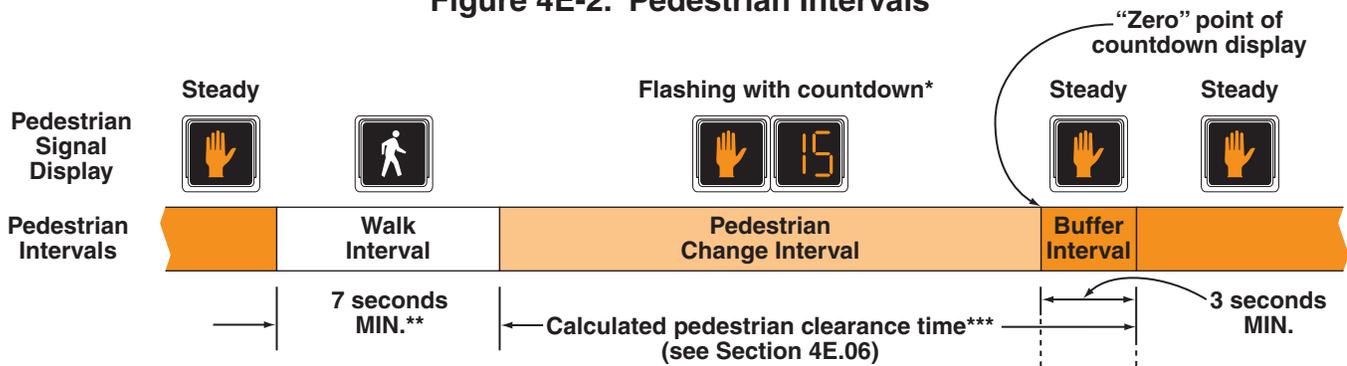
*Guidance:*

- 07 *Except as provided in Paragraph 8, the pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the curb or shoulder at the end of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3.5 feet per second to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait.*

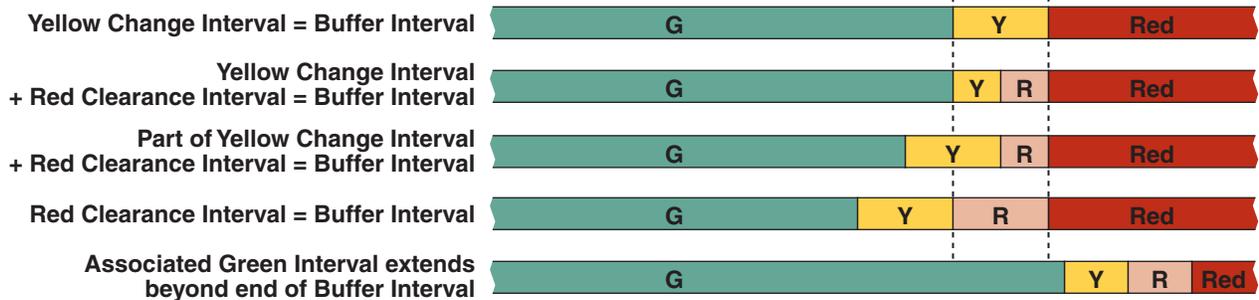
## Option:

- 08 A walking speed of up to 4 feet per second may be used to evaluate the sufficiency of the pedestrian clearance time at locations where an extended pushbutton press function has been installed to provide slower pedestrians an opportunity to request and receive a longer pedestrian clearance time. Passive pedestrian detection may also be used to automatically adjust the pedestrian clearance time based on the pedestrian's actual walking speed or actual clearance of the crosswalk.

**Figure 4E-2. Pedestrian Intervals**



**Relationship to associated vehicular phase intervals:**



**Legend**

- \* The countdown display is optional for Pedestrian Change Intervals of 7 seconds or less.
  - \*\* The Walk Interval may be reduced under some conditions (see Section 4E.06).
  - \*\*\* The Buffer Interval, which shall always be provided and displayed, may be used to help satisfy the calculated pedestrian clearance time, or may begin after the calculated pedestrian clearance time has ended.
- G** = Green Interval
  - Y** = Yellow Change Interval (of at least 3 seconds)
  - R** = Red Clearance Interval
  - Red** = Red because conflicting traffic has been released

09 The additional time provided by an extended pushbutton press to satisfy pedestrian clearance time needs may be added to either the walk interval or the pedestrian clearance time.

*Guidance:*

10 Where pedestrians who walk slower than 3.5 feet per second, or pedestrians who use wheelchairs, routinely use the crosswalk, a walking speed of less than 3.5 feet per second should be considered in determining the pedestrian clearance time.

11 Except as provided in Paragraph 12, the walk interval should be at least 7 seconds in length so that pedestrians will have adequate opportunity to leave the curb or shoulder before the pedestrian clearance time begins.

*Option:*

12 If pedestrian volumes and characteristics do not require a 7-second walk interval, walk intervals as short as 4 seconds may be used.

*Support:*

13 The walk interval is intended for pedestrians to start their crossing. The pedestrian clearance time is intended to allow pedestrians who started crossing during the walk interval to complete their crossing. Longer walk intervals are often used when the duration of the vehicular green phase associated with the pedestrian crossing is long enough to allow it.

*Guidance:*

14 The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector (or, if no pedestrian detector is present, a location 6 feet from the face of the curb or from the edge of the pavement) at the beginning of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3 feet per second to the far side of the traveled way being crossed or to the median if a two-stage pedestrian crossing sequence is used. Any additional time that is required to satisfy the conditions of this paragraph should be added to the walk interval.

Option:

- 15 On a street with a median of sufficient width for pedestrians to wait, a pedestrian clearance time that allows the pedestrian to cross only from the curb or shoulder to the median may be provided.

**Standard:**

- 16 **Where the pedestrian clearance time is sufficient only for crossing from the curb or shoulder to a median of sufficient width for pedestrians to wait, median-mounted pedestrian signals (with pedestrian detectors if actuated operation is used) shall be provided (see Sections 4E.08 and 4E.09) and signing such as the R10-3d sign (see Section 2B.52) shall be provided to notify pedestrians to cross only to the median to await the next WALKING PERSON (symbolizing WALK) signal indication.**

*Guidance:*

- 17 *Where median-mounted pedestrian signals and detectors are provided, the use of accessible pedestrian signals (see Sections 4E.09 through 4E.13) should be considered.*

Option:

- 18 During the transition into preemption, the walk interval and the pedestrian change interval may be shortened or omitted as described in Section 4D.27.

- 19 At intersections with high pedestrian volumes and high conflicting turning vehicle volumes, a brief leading pedestrian interval, during which an advance WALKING PERSON (symbolizing WALK) indication is displayed for the crosswalk while red indications continue to be displayed to parallel through and/or turning traffic, may be used to reduce conflicts between pedestrians and turning vehicles.

*Guidance:*

- 20 *If a leading pedestrian interval is used, the use of accessible pedestrian signals (see Sections 4E.09 through 4E.13) should be considered.*

Support:

- 21 If a leading pedestrian interval is used without accessible features, pedestrians who are visually impaired can be expected to begin crossing at the onset of the vehicular movement when drivers are not expecting them to begin crossing.

*Guidance:*

- 22 *If a leading pedestrian interval is used, it should be at least 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the turning traffic is released.*

- 23 *If a leading pedestrian interval is used, consideration should be given to prohibiting turns across the crosswalk during the leading pedestrian interval.*

Support:

- 24 At intersections with pedestrian volumes that are so high that drivers have difficulty finding an opportunity to turn across the crosswalk, the duration of the green interval for a parallel concurrent vehicular movement is sometimes intentionally set to extend beyond the pedestrian clearance time to provide turning drivers additional green time to make their turns while the pedestrian signal head is displaying a steady UPRAISED HAND (symbolizing DONT WALK) signal indication after pedestrians have had time to complete their crossings.

## **Section 4E.07 Countdown Pedestrian Signals**

**Standard:**

- 01 **All pedestrian signal heads used at crosswalks where the pedestrian change interval is more than 7 seconds shall include a pedestrian change interval countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change interval.**

Option:

- 02 Pedestrian signal heads used at crosswalks where the pedestrian change interval is 7 seconds or less may include a pedestrian change interval countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change interval.

**Standard:**

- 03 **Where countdown pedestrian signals are used, the countdown shall always be displayed simultaneously with the flashing UPRAISED HAND (symbolizing DONT WALK) signal indication displayed for that crosswalk.**

- 04 **Countdown pedestrian signals shall consist of Portland orange numbers that are at least 6 inches in height on a black opaque background. The countdown pedestrian signal shall be located immediately adjacent to the associated UPRAISED HAND (symbolizing DONT WALK) pedestrian signal head indication (see Figure 4E-1).**

05 **The display of the number of remaining seconds shall begin only at the beginning of the pedestrian change interval (flashing UPRAISED HAND). After the countdown displays zero, the display shall remain dark until the beginning of the next countdown.**

06 **The countdown pedestrian signal shall display the number of seconds remaining until the termination of the pedestrian change interval (flashing UPRAISED HAND). Countdown displays shall not be used during the walk interval or during the red clearance interval of a concurrent vehicular phase.**

*Guidance:*

07 *If used with a pedestrian signal head that does not have a concurrent vehicular phase, the pedestrian change interval (flashing UPRAISED HAND) should be set to be approximately 4 seconds less than the required pedestrian clearance time (see Section 4E.06) and an additional clearance interval (during which a steady UPRAISED HAND is displayed) should be provided prior to the start of the conflicting vehicular phase.*

08 *For crosswalks where the pedestrian enters the crosswalk more than 100 feet from the countdown pedestrian signal display, the numbers should be at least 9 inches in height.*

09 *Because some technology includes the countdown pedestrian signal logic in a separate timing device that is independent of the timing in the traffic signal controller, care should be exercised by the engineer when timing changes are made to pedestrian change intervals.*

10 *If the pedestrian change interval is interrupted or shortened as a part of a transition into a preemption sequence (see Section 4E.06), the countdown pedestrian signal display should be discontinued and go dark immediately upon activation of the preemption transition.*

## **Section 4E.08 Pedestrian Detectors**

*Option:*

01 Pedestrian detectors may be pushbuttons or passive detection devices.

*Support:*

02 Passive detection devices register the presence of a pedestrian in a position indicative of a desire to cross, without requiring the pedestrian to push a button. Some passive detection devices are capable of tracking the progress of a pedestrian as the pedestrian crosses the roadway for the purpose of extending or shortening the duration of certain pedestrian timing intervals.

03 The provisions in this Section place pedestrian pushbuttons within easy reach of pedestrians who are intending to cross each crosswalk and make it obvious which pushbutton is associated with each crosswalk. These provisions also position pushbutton poles in optimal locations for installation of accessible pedestrian signals (see Sections 4E.09 through 4E.13). Information regarding reach ranges can be found in the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11).

*Guidance:*

04 *If pedestrian pushbuttons are used, they should be capable of easy activation and conveniently located near each end of the crosswalks. Except as provided in Paragraphs 5 and 6, pedestrian pushbuttons should be located to meet all of the following criteria (see Figure 4E-3):*

- A. *Unobstructed and adjacent to a level all-weather surface to provide access from a wheelchair;*
- B. *Where there is an all-weather surface, a wheelchair accessible route from the pushbutton to the ramp;*
- C. *Between the edge of the crosswalk line (extended) farthest from the center of the intersection and the side of a curb ramp (if present), but not greater than 5 feet from said crosswalk line;*
- D. *Between 1.5 and 6 feet from the edge of the curb, shoulder, or pavement;*
- E. *With the face of the pushbutton parallel to the crosswalk to be used; and*
- F. *At a mounting height of approximately 3.5 feet, but no more than 4 feet, above the sidewalk.*

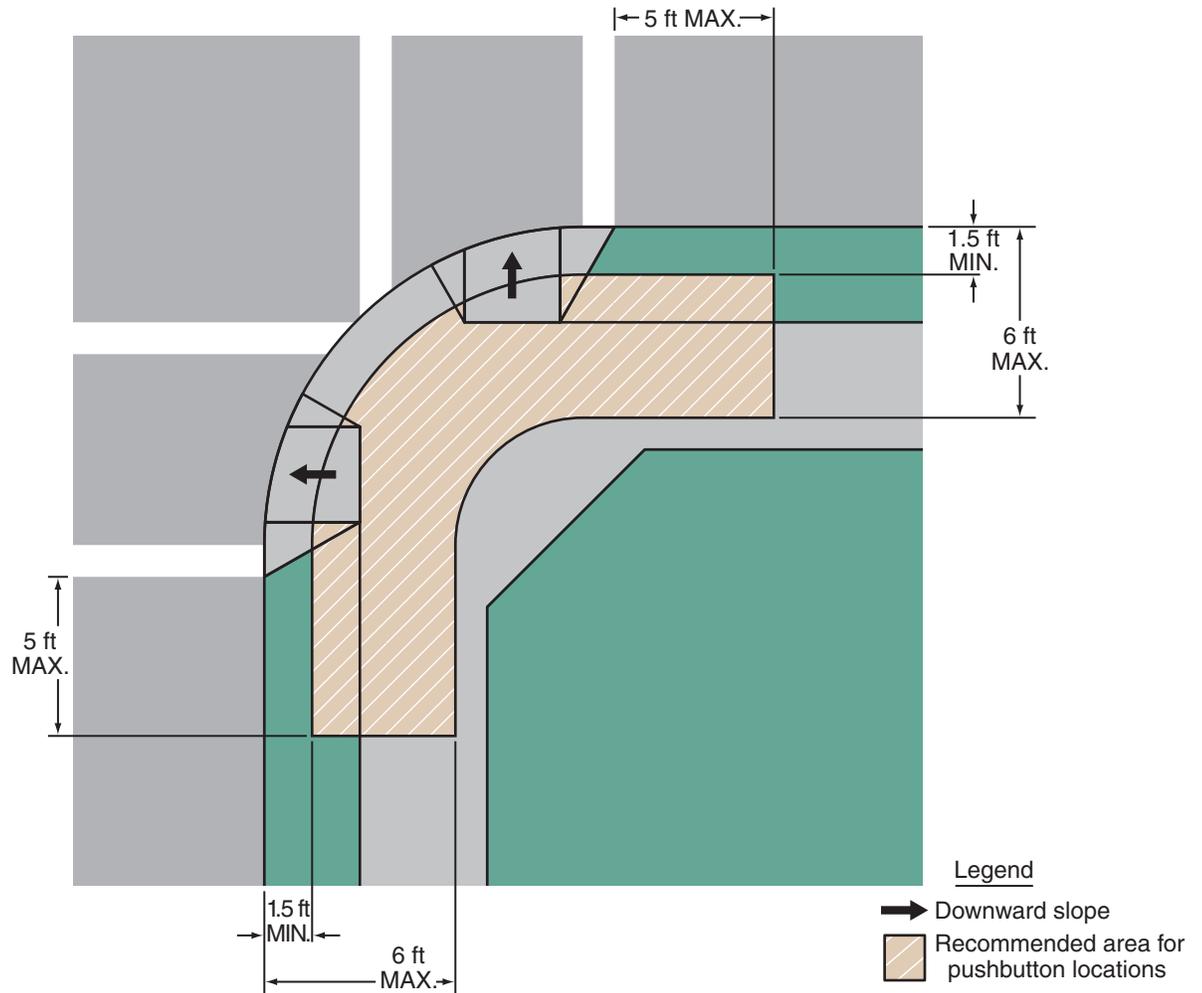
05 *Where there are physical constraints that make it impractical to place the pedestrian pushbutton adjacent to a level all-weather surface, the surface should be as level as feasible.*

06 *Where there are physical constraints that make it impractical to place the pedestrian pushbutton between 1.5 and 6 feet from the edge of the curb, shoulder, or pavement, it should not be farther than 10 feet from the edge of curb, shoulder, or pavement.*

07 *Except as provided in Paragraph 8, where two pedestrian pushbuttons are provided on the same corner of a signalized location, the pushbuttons should be separated by a distance of at least 10 feet.*

*Option:*

08 *Where there are physical constraints on a particular corner that make it impractical to provide the 10-foot separation between the two pedestrian pushbuttons, the pushbuttons may be placed closer together or on the same pole.*

**Figure 4E-3. Pushbutton Location Area****Notes:**

1. Where there are constraints that make it impractical to place the pedestrian pushbutton between 1.5 feet and 6 feet from the edge of the curb, shoulder, or pavement, it should not be further than 10 feet from the edge of curb, shoulder, or pavement.
2. Two pedestrian pushbuttons on a corner should be separated by 10 feet.
3. This figure is not drawn to scale.
4. Figure 4E-4 shows typical pushbutton locations.

**Support:**

09 Figure 4E-4 shows typical pedestrian pushbutton locations for a variety of situations.

**Standard:**

10 **Signs (see Section 2B.52) shall be mounted adjacent to or integral with pedestrian pushbuttons, explaining their purpose and use.**

**Option:**

11 At certain locations, a supplemental sign in a more visible location may be used to call attention to the pedestrian pushbutton.

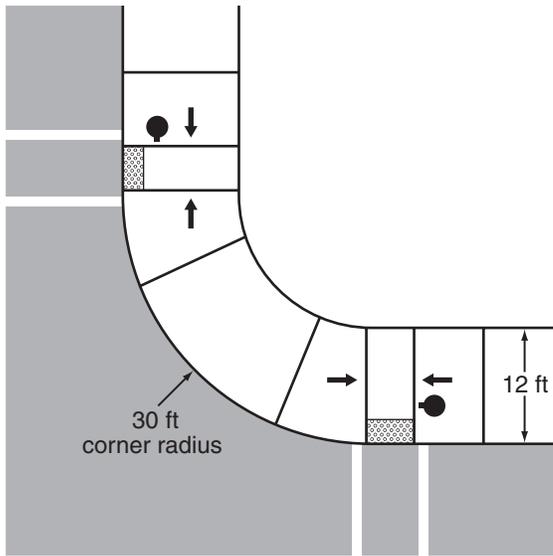
**Standard:**

12 **The positioning of pedestrian pushbuttons and the legends on the pedestrian pushbutton signs shall clearly indicate which crosswalk signal is actuated by each pedestrian pushbutton.**

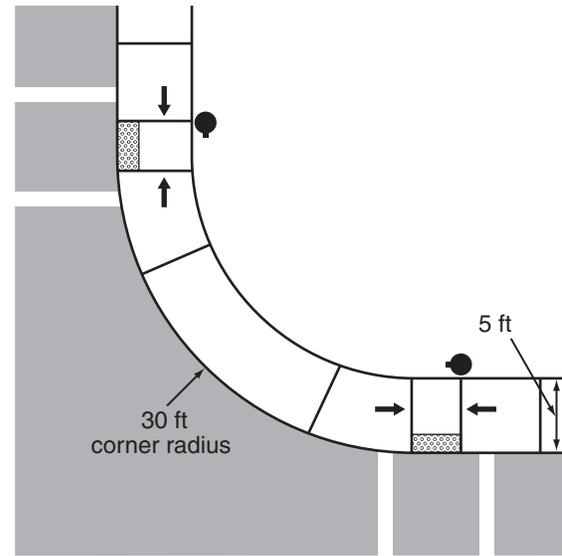
13 **If the pedestrian clearance time is sufficient only to cross from the curb or shoulder to a median of sufficient width for pedestrians to wait and the signals are pedestrian actuated, an additional pedestrian detector shall be provided in the median.**

**Figure 4E-4. Typical Pushbutton Locations (Sheet 1 of 2)**

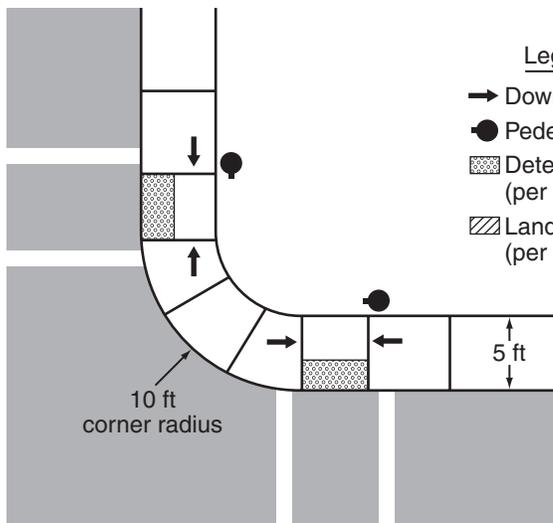
**A - Parallel ramps with wide sidewalk**



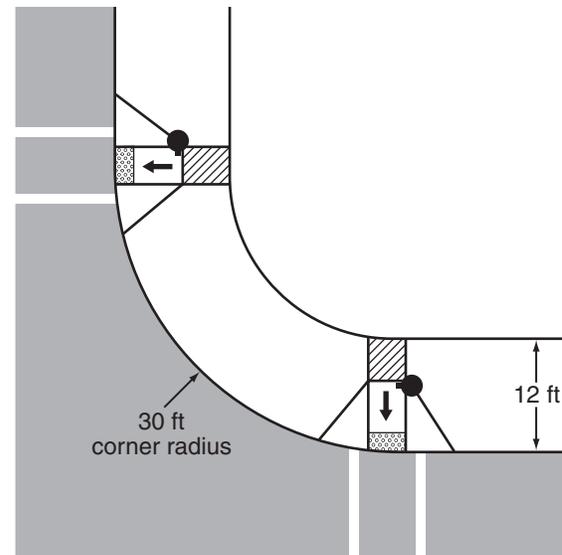
**B - Parallel ramps with narrow sidewalk**



**C - Parallel ramps with narrow sidewalk and tight corner radius**



**D - Perpendicular ramps with crosswalks far apart**



Legend

- Downward slope
- Pedestrian pushbutton
- ▨ Detectable warning (per ADAAG)
- ▩ Landing area (per ADAAG)

Notes:

1. This figure is not drawn to scale.
2. These drawings are intended to describe the typical locations for pedestrian pushbutton installations. They are not intended to be a guide for the design of curb cut ramps.
3. Figure 4E-3 shows the recommended area for pushbutton locations.

*Guidance:*

14 *The use of additional pedestrian detectors on islands or medians where a pedestrian might become stranded should be considered.*

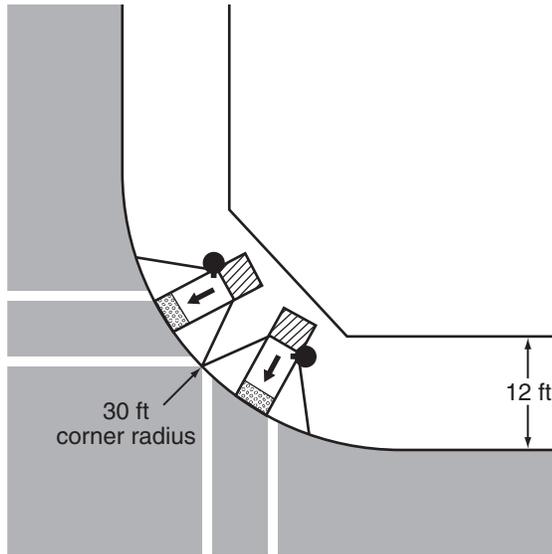
15 *If used, special purpose pushbuttons (to be operated only by authorized persons) should include a housing capable of being locked to prevent access by the general public and do not need an instructional sign.*

**Standard:**

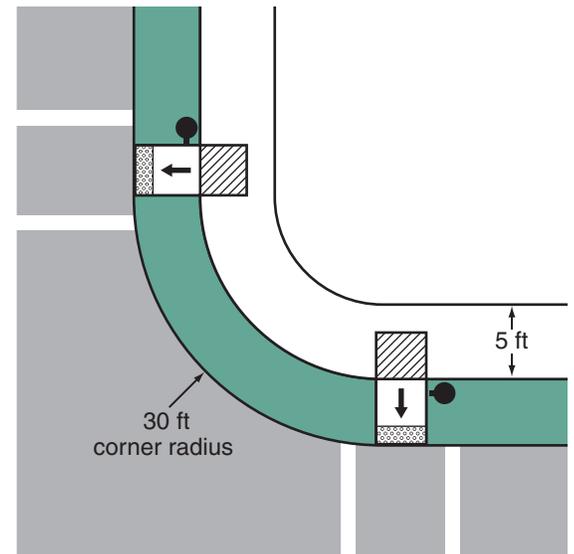
16 **If used, a pilot light or other means of indication installed with a pedestrian pushbutton shall not be illuminated until actuation. Once it is actuated, the pilot light shall remain illuminated until the pedestrian's green or WALKING PERSON (symbolizing WALK) signal indication is displayed.**

**Figure 4E-4. Typical Pushbutton Locations (Sheet 2 of 2)**

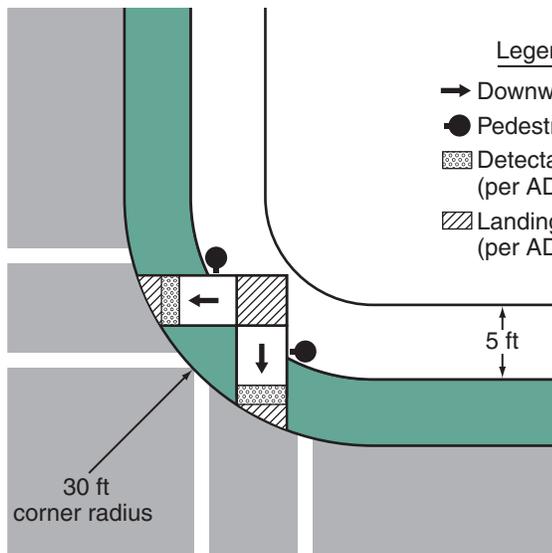
**E - Perpendicular ramps with crosswalks close together**



**F - Perpendicular ramps with sidewalk set back from road with crosswalks far apart**

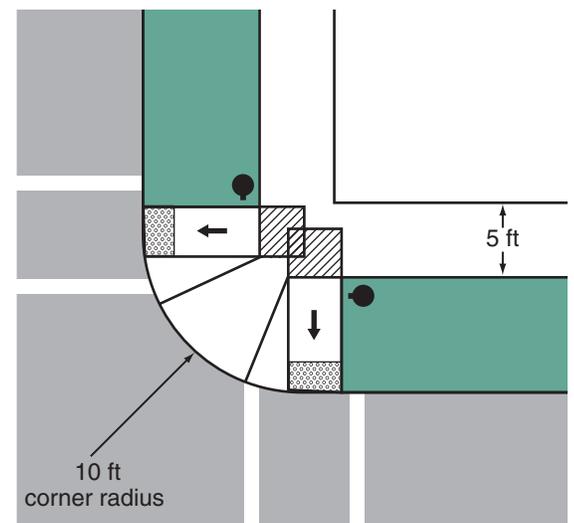


**G - Perpendicular ramps with sidewalk set back from road with crosswalks close together**



- Legend
- ➔ Downward slope
  - Pedestrian pushbutton
  - ▨ Detectable warning (per ADAAG)
  - ▩ Landing area (per ADAAG)

**H - Perpendicular ramps with sidewalk set back from road with continuous sidewalk between ramps**



**Notes:**

1. This figure is not drawn to scale.
2. These drawings are intended to describe the typical locations for pedestrian pushbutton installations. They are not intended to be a guide for the design of curb cut ramps.
3. Figure 4E-3 shows the recommended area for pushbutton locations.

17 **If a pilot light is used at an accessible pedestrian signal location (see Sections 4E.09 through 4E.13), each actuation shall be accompanied by the speech message “wait.”**

Option:

18 At signalized locations with a demonstrated need and subject to equipment capabilities, pedestrians with special needs may be provided with additional crossing time by means of an extended pushbutton press.

**Standard:**

19 **If additional crossing time is provided by means of an extended pushbutton press, a PUSH BUTTON FOR 2 SECONDS FOR EXTRA CROSSING TIME (R10-32P) plaque (see Figure 2B-26) shall be mounted adjacent to or integral with the pedestrian pushbutton.**

## Section 4E.09 Accessible Pedestrian Signals and Detectors – General

### Support:

- 01 Accessible pedestrian signals and detectors provide information in non-visual formats (such as audible tones, speech messages, and/or vibrating surfaces).
- 02 The primary technique that pedestrians who have visual disabilities use to cross streets at signalized locations is to initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, which often corresponds to the onset of the green interval. The existing environment is often not sufficient to provide the information that pedestrians who have visual disabilities need to cross a roadway at a signalized location.

### Guidance:

- 03 *If a particular signalized location presents difficulties for pedestrians who have visual disabilities to cross the roadway, an engineering study should be conducted that considers the needs of pedestrians in general, as well as the information needs of pedestrians with visual disabilities. The engineering study should consider the following factors:*
- A. *Potential demand for accessible pedestrian signals;*
  - B. *A request for accessible pedestrian signals;*
  - C. *Traffic volumes during times when pedestrians might be present, including periods of low traffic volumes or high turn-on-red volumes;*
  - D. *The complexity of traffic signal phasing (such as split phases, protected turn phases, leading pedestrian intervals, and exclusive pedestrian phases); and*
  - E. *The complexity of intersection geometry.*

### Support:

- 04 The factors that make crossing at a signalized location difficult for pedestrians who have visual disabilities include: increasingly quiet cars, right turn on red (which masks the beginning of the through phase), continuous right-turn movements, complex signal operations, traffic circles, and wide streets. Furthermore, low traffic volumes might make it difficult for pedestrians who have visual disabilities to discern signal phase changes.
- 05 Local organizations, providing support services to pedestrians who have visual and/or hearing disabilities, can often act as important advisors to the traffic engineer when consideration is being given to the installation of devices to assist such pedestrians. Additionally, orientation and mobility specialists or similar staff also might be able to provide a wide range of advice. The U.S. Access Board ([www.access-board.gov](http://www.access-board.gov)) provides technical assistance for making pedestrian signal information available to persons with visual disabilities (see Page i for the address for the U.S. Access Board).

### Standard:

- 06 **When used, accessible pedestrian signals shall be used in combination with pedestrian signal timing. The information provided by an accessible pedestrian signal shall clearly indicate which pedestrian crossing is served by each device.**
- 07 **Under stop-and-go operation, accessible pedestrian signals shall not be limited in operation by the time of day or day of week.**

### Option:

- 08 Accessible pedestrian signal detectors may be pushbuttons or passive detection devices.
- 09 At locations with pretimed traffic control signals or non-actuated approaches, pedestrian pushbuttons may be used to activate the accessible pedestrian signals.

### Support:

- 10 Accessible pedestrian signals are typically integrated into the pedestrian detector (pushbutton), so the audible tones and/or messages come from the pushbutton housing. They have a pushbutton locator tone and tactile arrow, and can include audible beaconing and other special features.

### Option:

- 11 The name of the street to be crossed may also be provided in accessible format, such as Braille or raised print. Tactile maps of crosswalks may also be provided.

### Support:

- 12 Specifications regarding the use of Braille or raised print for traffic control devices can be found in the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11).

**Standard:**

- 13 **At accessible pedestrian signal locations where pedestrian pushbuttons are used, each pushbutton shall activate both the walk interval and the accessible pedestrian signals.**

**Section 4E.10 Accessible Pedestrian Signals and Detectors – Location**

## Support:

- 01 Accessible pedestrian signals that are located as close as possible to pedestrians waiting to cross the street provide the clearest and least ambiguous indication of which pedestrian crossing is served by a device.

*Guidance:*

- 02 *Pushbuttons for accessible pedestrian signals should be located in accordance with the provisions of Section 4E.08 and should be located as close as possible to the crosswalk line furthest from the center of the intersection and as close as possible to the curb ramp.*

**Standard:**

- 03 **If two accessible pedestrian pushbuttons are placed less than 10 feet apart or on the same pole, each accessible pedestrian pushbutton shall be provided with the following features (see Sections 4E.11 through 4E.13):**
- A. A pushbutton locator tone,
  - B. A tactile arrow,
  - C. A speech walk message for the WALKING PERSON (symbolizing WALK) indication, and
  - D. A speech pushbutton information message.
- 04 **If the pedestrian clearance time is sufficient only to cross from the curb or shoulder to a median of sufficient width for pedestrians to wait and accessible pedestrian detectors are used, an additional accessible pedestrian detector shall be provided in the median.**

**Section 4E.11 Accessible Pedestrian Signals and Detectors – Walk Indications**

## Support:

- 01 Technology that provides different sounds for each non-concurrent signal phase has frequently been found to provide ambiguous information. Research indicates that a rapid tick tone for each crossing coming from accessible pedestrian signal devices on separated poles located close to each crosswalk provides unambiguous information to pedestrians who are blind or visually impaired. Vibrotactile indications provide information to pedestrians who are blind and deaf and are also used by pedestrians who are blind or who have low vision to confirm the walk signal in noisy situations.

**Standard:**

- 02 **Accessible pedestrian signals shall have both audible and vibrotactile walk indications.**
- 03 **Vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton (see Section 4E.12) that vibrates during the walk interval.**
- 04 **Accessible pedestrian signals shall have an audible walk indication during the walk interval only. The audible walk indication shall be audible from the beginning of the associated crosswalk.**
- 05 **The accessible walk indication shall have the same duration as the pedestrian walk signal except when the pedestrian signal rests in walk.**

*Guidance:*

- 06 *If the pedestrian signal rests in walk, the accessible walk indication should be limited to the first 7 seconds of the walk interval. The accessible walk indication should be recalled by a button press during the walk interval provided that the crossing time remaining is greater than the pedestrian change interval.*

**Standard:**

- 07 **Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message.**
- 08 **Audible tone walk indications shall repeat at eight to ten ticks per second. Audible tones used as walk indications shall consist of multiple frequencies with a dominant component at 880 Hz.**

*Guidance:*

- 09 *The volume of audible walk indications and pushbutton locator tones (see Section 4E.12) should be set to be a maximum of 5 dBA louder than ambient sound, except when audible beaconing is provided in response to an extended pushbutton press.*

**Standard:**

- 10 **Automatic volume adjustment in response to ambient traffic sound level shall be provided up to a maximum volume of 100 dBA.**

*Guidance:*

- 11 *The sound level of audible walk indications and pushbutton locator tones should be adjusted to be low enough to avoid misleading pedestrians who have visual disabilities when the following conditions exist:*
- A. *Where there is an island that allows unsignalized right turns across a crosswalk between the island and the sidewalk.*
  - B. *Where multi-leg approaches or complex signal phasing require more than two pedestrian phases, such that it might be unclear which crosswalk is served by each audible tone.*
  - C. *At intersections where a diagonal pedestrian crossing is allowed, or where one street receives a WALKING PERSON (symbolizing WALK) signal indication simultaneously with another street.*

*Option:*

- 12 An alert tone, which is a very brief burst of high-frequency sound at the beginning of the audible walk indication that rapidly decays to the frequency of the walk tone, may be used to alert pedestrians to the beginning of the walk interval.

*Support:*

- 13 An alert tone can be particularly useful if the walk tone is not easily audible in some traffic conditions.
- 14 Speech walk messages communicate to pedestrians which street has the walk interval. Speech messages might be either directly audible or transmitted, requiring a personal receiver to hear the message. To be a useful system, the words and their meaning need to be correctly understood by all users in the context of the street environment where they are used. Because of this, tones are the preferred means of providing audible walk indications except where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet.
- 15 If speech walk messages are used, pedestrians have to know the names of the streets that they are crossing in order for the speech walk messages to be unambiguous. In getting directions to travel to a new location, pedestrians with visual disabilities do not always get the name of each street to be crossed. Therefore, it is desirable to give users of accessible pedestrian signals the name of the street controlled by the pushbutton. This can be done by means of a speech pushbutton information message (see Section 4D.13) during the flashing or steady UPRAISED HAND intervals, or by raised print and Braille labels on the pushbutton housing.
- 16 By combining the information from the pushbutton message or Braille label, the tactile arrow aligned in the direction of travel on the relevant crosswalk, and the speech walk message, pedestrians with visual disabilities are able to correctly respond to speech walk messages even if there are two pushbuttons on the same pole.

**Standard:**

- 17 **If speech walk messages are used to communicate the walk interval, they shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies. Speech walk messages shall be used only at intersections where it is technically infeasible to install two accessible pedestrian signals at one corner separated by a distance of at least 10 feet.**
- 18 **Speech walk messages that are used at intersections having pedestrian phasing that is concurrent with vehicular phasing shall be patterned after the model: “Broadway. Walk sign is on to cross Broadway.”**
- 19 **Speech walk messages that are used at intersections having exclusive pedestrian phasing shall be patterned after the model: “Walk sign is on for all crossings.”**
- 20 **Speech walk messages shall not contain any additional information, except they shall include designations such as “Street” or “Avenue” where this information is necessary to avoid ambiguity at a particular location.**

*Guidance:*

- 21 *Speech walk messages should not state or imply a command to the pedestrian, such as “Cross Broadway now.” Speech walk messages should not tell pedestrians that it is “safe to cross,” because it is always the pedestrian’s responsibility to check actual traffic conditions.*

**Standard:**

- 22 **A speech walk message is not required at times when the walk interval is not timing, but, if provided:**
- A. **It shall begin with the term “wait.”**
  - B. **It need not be repeated for the entire time that the walk interval is not timing.**
- 23 **If a pilot light (see Section 4E.08) is used at an accessible pedestrian signal location, each actuation shall be accompanied by the speech message “wait.”**

Option:

- 24 Accessible pedestrian signals that provide speech walk messages may provide similar messages in languages other than English, if needed, except for the terms “walk sign” and “wait.”

**Standard:**

- 25 **Following the audible walk indication, accessible pedestrian signals shall revert to the pushbutton locator tone (see Section 4E.12) during the pedestrian change interval.**

### **Section 4E.12 Accessible Pedestrian Signals and Detectors – Tactile Arrows and Locator Tones**

**Standard:**

- 01 **To enable pedestrians who have visual disabilities to distinguish and locate the appropriate pushbutton at an accessible pedestrian signal location, pushbuttons shall clearly indicate by means of tactile arrows which crosswalk signal is actuated by each pushbutton. Tactile arrows shall be located on the pushbutton, have high visual contrast (light on dark or dark on light), and shall be aligned parallel to the direction of travel on the associated crosswalk.**

- 02 **An accessible pedestrian pushbutton shall incorporate a locator tone.**

Support:

- 03 A pushbutton locator tone is a repeating sound that informs approaching pedestrians that a pushbutton to actuate pedestrian timing or receive additional information exists, and that enables pedestrians with visual disabilities to locate the pushbutton.

**Standard:**

- 04 **Pushbutton locator tones shall have a duration of 0.15 seconds or less, and shall repeat at 1-second intervals.**

- 05 **Pushbutton locator tones shall be deactivated when the traffic control signal is operating in a flashing mode. This requirement shall not apply to traffic control signals or pedestrian hybrid beacons that are activated from a flashing or dark mode to a stop-and-go mode by pedestrian actuations.**

- 06 **Pushbutton locator tones shall be intensity responsive to ambient sound, and be audible 6 to 12 feet from the pushbutton, or to the building line, whichever is less.**

Support:

- 07 Section 4E.11 contains additional provisions regarding the volume and sound level of pushbutton locator tones.

### **Section 4E.13 Accessible Pedestrian Signals and Detectors – Extended Pushbutton Press Features**

Option:

- 01 Pedestrians may be provided with additional features such as increased crossing time, audible beaconing, or a speech pushbutton information message as a result of an extended pushbutton press.

**Standard:**

- 02 **If an extended pushbutton press is used to provide any additional feature(s), a pushbutton press of less than one second shall actuate only the pedestrian timing and any associated accessible walk indication, and a pushbutton press of one second or more shall actuate the pedestrian timing, any associated accessible walk indication, and any additional feature(s).**

- 03 **If additional crossing time is provided by means of an extended pushbutton press, a PUSH BUTTON FOR 2 SECONDS FOR EXTRA CROSSING TIME (R10-32P) plaque (see Figure 2B-26) shall be mounted adjacent to or integral with the pedestrian pushbutton.**

Support:

- 04 Audible beaconing is the use of an audible signal in such a way that pedestrians with visual disabilities can home in on the signal that is located on the far end of the crosswalk as they cross the street.

- 05 Not all crosswalks at an intersection need audible beaconing; audible beaconing can actually cause confusion if used at all crosswalks at some intersections. Audible beaconing is not appropriate at locations with channelized turns or split phasing, because of the possibility of confusion.

*Guidance:*

- 06 *Audible beaconing should only be considered following an engineering study at:*
- A. *Crosswalks longer than 70 feet, unless they are divided by a median that has another accessible pedestrian signal with a locator tone;*
  - B. *Crosswalks that are skewed;*
  - C. *Intersections with irregular geometry, such as more than four legs;*
  - D. *Crosswalks where audible beaconing is requested by an individual with visual disabilities; or*
  - E. *Other locations where a study indicates audible beaconing would be beneficial.*

## Option:

- 07 Audible beaconing may be provided in several ways, any of which are initiated by an extended pushbutton press.

**Standard:**

- 08 **If audible beaconing is used, the volume of the pushbutton locator tone during the pedestrian change interval of the called pedestrian phase shall be increased and operated in one of the following ways:**
- A. **The louder audible walk indication and louder locator tone comes from the far end of the crosswalk, as pedestrians cross the street,**
  - B. **The louder locator tone comes from both ends of the crosswalk, or**
  - C. **The louder locator tone comes from an additional speaker that is aimed at the center of the crosswalk and that is mounted on a pedestrian signal head.**

## Option:

- 09 Speech pushbutton information messages may provide intersection identification, as well as information about unusual intersection signalization and geometry, such as notification regarding exclusive pedestrian phasing, leading pedestrian intervals, split phasing, diagonal crosswalks, and medians or islands.

**Standard:**

- 10 **If speech pushbutton information messages are made available by actuating the accessible pedestrian signal detector, they shall only be actuated when the walk interval is not timing. They shall begin with the term “Wait,” followed by intersection identification information modeled after: “Wait to cross Broadway at Grand.” If information on intersection signalization or geometry is also given, it shall follow the intersection identification information.**

*Guidance:*

- 11 *Speech pushbutton information messages should not be used to provide landmark information or to inform pedestrians with visual disabilities about detours or temporary traffic control situations.*

## Support:

- 12 Additional information on the structure and wording of speech pushbutton information messages is included in ITE’s “Electronic Toolbox for Making Intersections More Accessible for Pedestrians Who Are Blind or Visually Impaired,” which is available at ITE’s website (see Page i).

## CHAPTER 4F. PEDESTRIAN HYBRID BEACONS

### Section 4F.01 Application of Pedestrian Hybrid Beacons

#### Support:

- 01 A pedestrian hybrid beacon is a special type of hybrid beacon used to warn and control traffic at an unsignalized location to assist pedestrians in crossing a street or highway at a marked crosswalk.

#### Option:

- 02 A pedestrian hybrid beacon may be considered for installation to facilitate pedestrian crossings at a location that does not meet traffic signal warrants (see Chapter 4C), or at a location that meets traffic signal warrants under Sections 4C.05 and/or 4C.06 but a decision is made to not install a traffic control signal.

#### Standard:

- 03 **If used, pedestrian hybrid beacons shall be used in conjunction with signs and pavement markings to warn and control traffic at locations where pedestrians enter or cross a street or highway. A pedestrian hybrid beacon shall only be installed at a marked crosswalk.**

#### Guidance:

- 04 *If one of the signal warrants of Chapter 4C is met and a traffic control signal is justified by an engineering study, and if a decision is made to install a traffic control signal, it should be installed based upon the provisions of Chapters 4D and 4E.*
- 05 *If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit pedestrians to cross, or if the speed for vehicles approaching on the major street is too high to permit pedestrians to cross, or if pedestrian delay is excessive, the need for a pedestrian hybrid beacon should be considered on the basis of an engineering study that considers major-street volumes, speeds, widths, and gaps in conjunction with pedestrian volumes, walking speeds, and delay.*
- 06 *For a major street where the posted or statutory speed limit or the 85th-percentile speed is 35 mph or less, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-1 for the length of the crosswalk.*
- 07 *For a major street where the posted or statutory speed limit or the 85th-percentile speed exceeds 35 mph, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-2 for the length of the crosswalk.*
- 08 *For crosswalks that have lengths other than the four that are specifically shown in Figures 4F-1 and 4F-2, the values should be interpolated between the curves.*

### Section 4F.02 Design of Pedestrian Hybrid Beacons

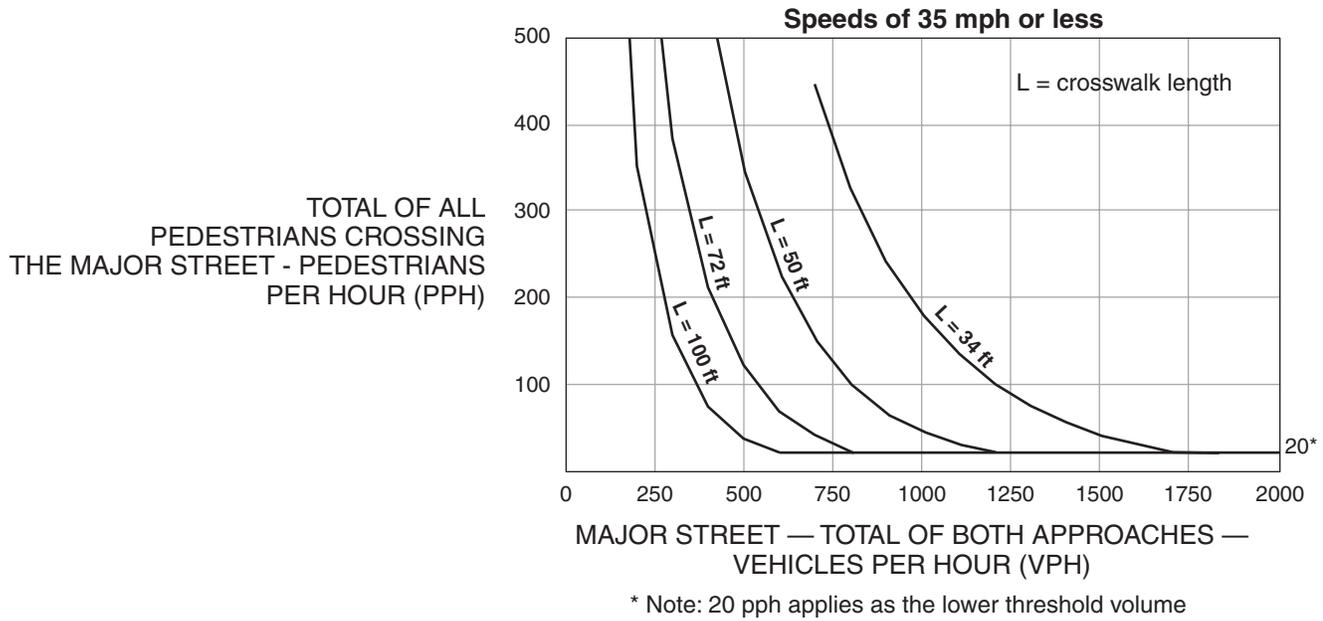
#### Standard:

- 01 **Except as otherwise provided in this Section, a pedestrian hybrid beacon shall meet the provisions of Chapters 4D and 4E.**
- 02 **A pedestrian hybrid beacon face shall consist of three signal sections, with a CIRCULAR YELLOW signal indication centered below two horizontally aligned CIRCULAR RED signal indications (see Figure 4F-3).**
- 03 **When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:**
- A. **At least two pedestrian hybrid beacon faces shall be installed for each approach of the major street,**
  - B. **A stop line shall be installed for each approach to the crosswalk,**
  - C. **A pedestrian signal head conforming to the provisions set forth in Chapter 4E shall be installed at each end of the marked crosswalk, and**
  - D. **The pedestrian hybrid beacon shall be pedestrian actuated.**

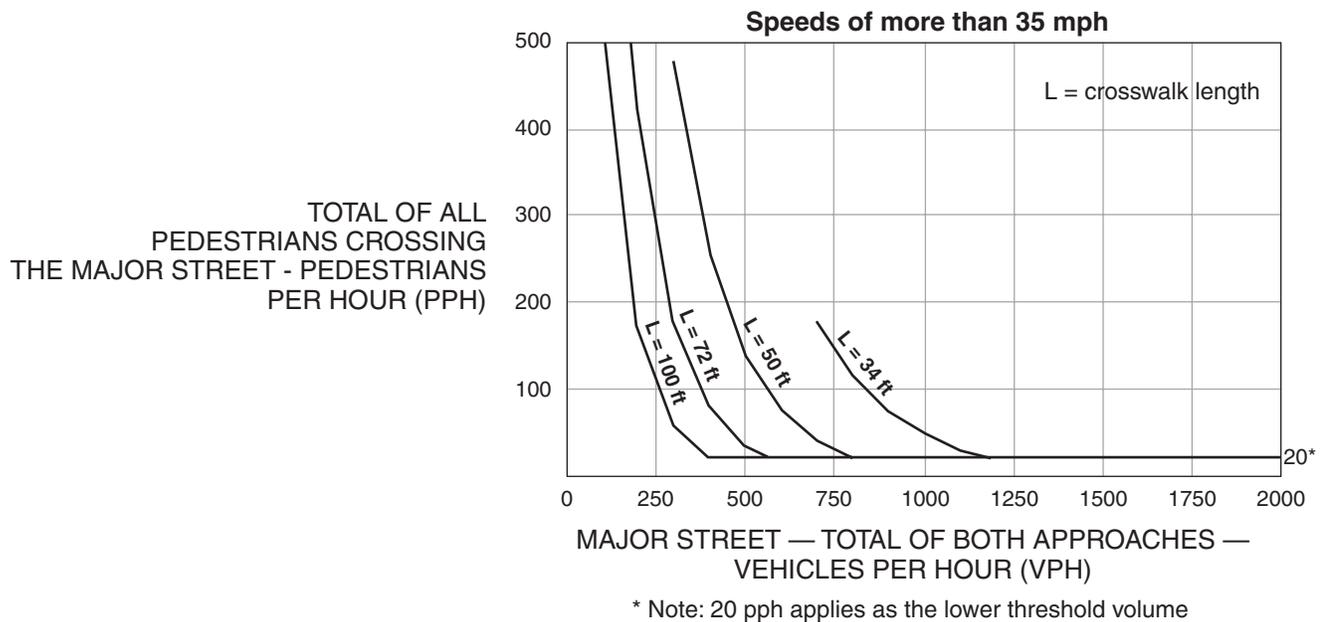
#### Guidance:

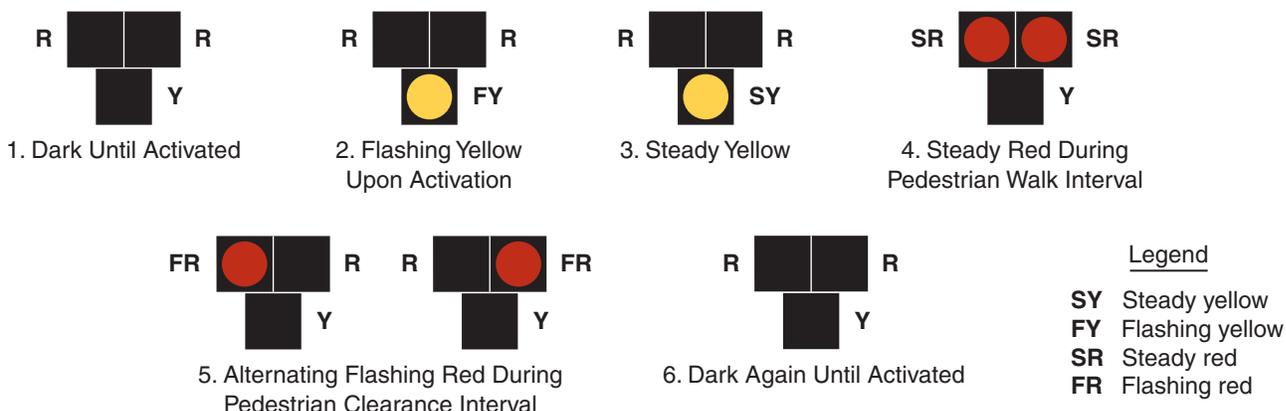
- 04 *When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:*
- A. *The pedestrian hybrid beacon should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs,*

**Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways**



**Figure 4F-2. Guidelines for the Installation of Pedestrian Hybrid Beacons on High-Speed Roadways**



**Figure 4F-3. Sequence for a Pedestrian Hybrid Beacon**

B. Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk, or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance,

C. The installation should include suitable standard signs and pavement markings, and

D. If installed within a signal system, the pedestrian hybrid beacon should be coordinated.

05 On approaches having posted or statutory speed limits or 85th-percentile speeds in excess of 35 mph and on approaches having traffic or operating conditions that would tend to obscure visibility of roadside hybrid beacon face locations, both of the minimum of two pedestrian hybrid beacon faces should be installed over the roadway.

06 On multi-lane approaches having a posted or statutory speed limits or 85th-percentile speeds of 35 mph or less, either a pedestrian hybrid beacon face should be installed on each side of the approach (if a median of sufficient width exists) or at least one of the pedestrian hybrid beacon faces should be installed over the roadway.

07 A pedestrian hybrid beacon should comply with the signal face location provisions described in Sections 4D.11 through 4D.16.

**Standard:**

08 **A CROSSWALK STOP ON RED (symbolic circular red) (R10-23) sign (see Section 2B.53) shall be mounted adjacent to a pedestrian hybrid beacon face on each major street approach. If an overhead pedestrian hybrid beacon face is provided, the sign shall be mounted adjacent to the overhead signal face.**  
Option:

09 A Pedestrian (W11-2) warning sign (see Section 2C.50) with an AHEAD (W16-9P) supplemental plaque may be placed in advance of a pedestrian hybrid beacon. A warning beacon may be installed to supplement the W11-2 sign.

*Guidance:*

10 *If a warning beacon supplements a W11-2 sign in advance of a pedestrian hybrid beacon, it should be programmed to flash only when the pedestrian hybrid beacon is not in the dark mode.*

**Standard:**

11 **If a warning beacon is installed to supplement the W11-2 sign, the design and location of the warning beacon shall comply with the provisions of Sections 4L.01 and 4L.03.**

**Section 4F.03 Operation of Pedestrian Hybrid Beacons**

**Standard:**

01 **Pedestrian hybrid beacon indications shall be dark (not illuminated) during periods between actuations.**

02 **Upon actuation by a pedestrian, a pedestrian hybrid beacon face shall display a flashing CIRCULAR yellow signal indication, followed by a steady CIRCULAR yellow signal indication, followed by both steady CIRCULAR RED signal indications during the pedestrian walk interval, followed by alternating flashing CIRCULAR RED signal indications during the pedestrian clearance interval (see Figure 4F-3). Upon termination of the pedestrian clearance interval, the pedestrian hybrid beacon faces shall revert to a dark (not illuminated) condition.**

03 **Except as provided in Paragraph 4, the pedestrian signal heads shall continue to display a steady UPRAISED HAND (symbolizing DONT WALK) signal indication when the pedestrian hybrid beacon faces are either dark or displaying flashing or steady CIRCULAR yellow signal indications. The pedestrian signal heads shall display a WALKING PERSON (symbolizing WALK) signal indication when the pedestrian hybrid beacon faces are displaying steady CIRCULAR RED signal indications. The pedestrian signal heads shall display a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication when the pedestrian hybrid beacon faces are displaying alternating flashing CIRCULAR RED signal indications. Upon termination of the pedestrian clearance interval, the pedestrian signal heads shall revert to a steady UPRAISED HAND (symbolizing DONT WALK) signal indication.**

Option:

04 Where the pedestrian hybrid beacon is installed adjacent to a roundabout to facilitate crossings by pedestrians with visual disabilities and an engineering study determines that pedestrians without visual disabilities can be allowed to cross the roadway without actuating the pedestrian hybrid beacon, the pedestrian signal heads may be dark (not illuminated) when the pedestrian hybrid beacon faces are dark.

*Guidance:*

05 *The duration of the flashing yellow interval should be determined by engineering judgment.*

**Standard:**

06 **The duration of the steady yellow change interval shall be determined using engineering practices.**

*Guidance:*

07 *The steady yellow interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds (see Section 4D.26). The longer intervals should be reserved for use on approaches with higher speeds.*

## CHAPTER 4G. TRAFFIC CONTROL SIGNALS AND HYBRID BEACONS FOR EMERGENCY-VEHICLE ACCESS

### **Section 4G.01 Application of Emergency-Vehicle Traffic Control Signals and Hybrid Beacons**

Support:

01 An emergency-vehicle traffic control signal is a special traffic control signal that assigns the right-of-way to an authorized emergency vehicle.

Option:

02 An emergency-vehicle traffic control signal may be installed at a location that does not meet other traffic signal warrants such as at an intersection or other location to permit direct access from a building housing the emergency vehicle.

03 An emergency-vehicle hybrid beacon may be installed instead of an emergency-vehicle traffic control signal under conditions described in Section 4G.04.

Guidance:

04 *If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit the timely entrance of emergency vehicles, or the stopping sight distance for vehicles approaching on the major street is insufficient for emergency vehicles, installing an emergency-vehicle traffic control signal should be considered. If one of the signal warrants of Chapter 4C is met and a traffic control signal is justified by an engineering study, and if a decision is made to install a traffic control signal, it should be installed based upon the provisions of Chapter 4D.*

05 *The sight distance determination should be based on the location of the visibility obstruction for the critical approach lane for each street or drive and the posted or statutory speed limit or 85th-percentile speed on the major street, whichever is higher.*

### **Section 4G.02 Design of Emergency-Vehicle Traffic Control Signals**

Standard:

01 **Except as otherwise provided in this Section, an emergency-vehicle traffic control signal shall meet the requirements of this Manual.**

02 **An Emergency Vehicle (W11-8) sign (see Section 2C.49) with an EMERGENCY SIGNAL AHEAD (W11-12P) supplemental plaque shall be placed in advance of all emergency-vehicle traffic control signals. If a warning beacon is installed to supplement the W11-8 sign, the design and location of the beacon shall comply with the Standards of Sections 4L.01 and 4L.03.**

Guidance:

03 *At least one of the two required signal faces for each approach on the major street should be located over the roadway.*

04 *The following size signal indications should be used for emergency-vehicle traffic control signals: 12-inch diameter for steady red and steady yellow circular signal indications and any arrow indications, and 8-inch diameter for green or flashing yellow circular signal indications.*

Standard:

05 **An EMERGENCY SIGNAL (R10-13) sign shall be mounted adjacent to a signal face on each major street approach (see Section 2B.53). If an overhead signal face is provided, the EMERGENCY SIGNAL sign shall be mounted adjacent to the overhead signal face.**

Option:

06 An approach that only serves emergency vehicles may be provided with only one signal face consisting of one or more signal sections.

07 Besides using an 8-inch diameter signal indication, other appropriate means to reduce the flashing yellow light output may be used.

### **Section 4G.03 Operation of Emergency-Vehicle Traffic Control Signals**

Standard:

01 **Right-of-way for emergency vehicles at signalized locations operating in the steady (stop-and-go) mode shall be obtained as provided in Section 4D.27.**

02 **As a minimum, the signal indications, sequence, and manner of operation of an emergency-vehicle traffic control signal installed at a midblock location shall be as follows:**

- A. The signal indication, between emergency-vehicle actuations, shall be either green or flashing yellow. If the flashing yellow signal indication is used instead of the green signal indication, it shall be displayed in the normal position of the green signal indication, while the steady red and steady yellow signal indications shall be displayed in their normal positions.
- B. When an emergency-vehicle actuation occurs, a steady yellow change interval followed by a steady red interval shall be displayed to traffic on the major street.
- C. A yellow change interval is not required following the green interval for the emergency-vehicle driveway.

03 Emergency-vehicle traffic control signals located at intersections shall either be operated in the flashing mode between emergency-vehicle actuations (see Sections 4D.28 and 4D.30) or be full-actuated or semi-actuated to accommodate normal vehicular and pedestrian traffic on the streets.

04 Warning beacons, if used with an emergency-vehicle traffic control signal, shall be flashed only:

- A. For an appropriate time in advance of and during the steady yellow change interval for the major street; and
- B. During the steady red interval for the major street.

*Guidance:*

05 *The duration of the steady red interval for traffic on the major street should be determined by on-site test-run time studies, but should not exceed 1.5 times the time required for the emergency vehicle to clear the path of conflicting vehicles.*

*Option:*

06 An emergency-vehicle traffic control signal sequence may be initiated manually from a local control point such as a fire station or law enforcement headquarters or from an emergency vehicle equipped for remote operation of the signal.

#### **Section 4G.04 Emergency-Vehicle Hybrid Beacons**

**Standard:**

01 **Emergency-vehicle hybrid beacons shall be used only in conjunction with signs to warn and control traffic at an unsignalized location where emergency vehicles enter or cross a street or highway. Emergency-vehicle hybrid beacons shall be actuated only by authorized emergency or maintenance personnel.**

*Guidance:*

02 *Emergency-vehicle hybrid beacons should only be used when all of the following criteria are satisfied:*

- A. *The conditions justifying an emergency-vehicle traffic control signal (see Section 4G.01) are met; and*
- B. *An engineering study, considering the road width, approach speeds, and other pertinent factors, determines that emergency-vehicle hybrid beacons can be designed and located in compliance with the requirements contained in this Section and in Section 4L.01, such that they effectively warn and control traffic at the location; and*
- C. *The location is not at or within 100 feet from an intersection or driveway where the side road or driveway is controlled by a STOP or YIELD sign.*

**Standard:**

03 **Except as otherwise provided in this Section, an emergency-vehicle hybrid beacon shall meet the requirements of this Manual.**

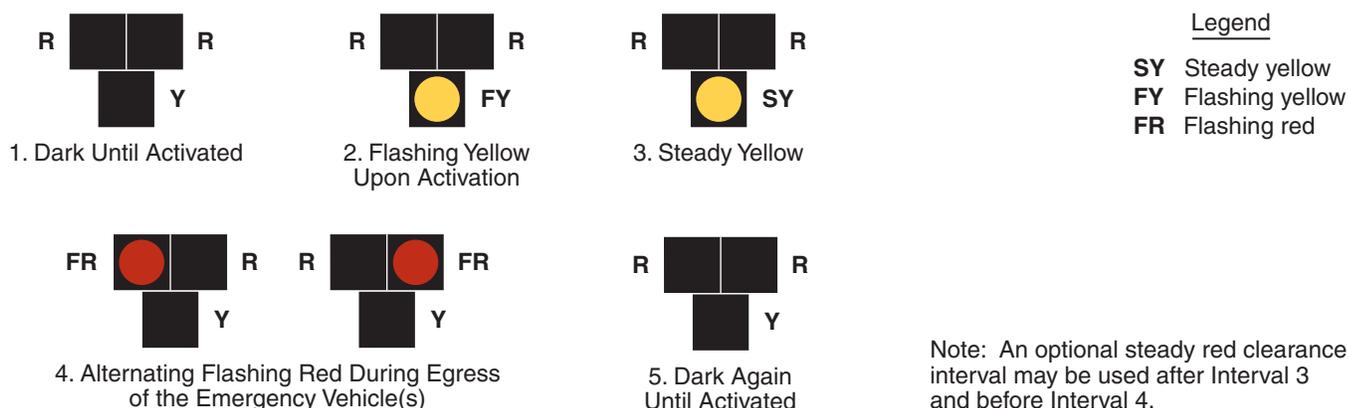
04 **An emergency-vehicle hybrid beacon face shall consist of three signal sections, with a CIRCULAR YELLOW signal indication centered below two horizontally aligned CIRCULAR RED signal indications (see Figure 4G-1).**

05 **Emergency-vehicle hybrid beacons shall be placed in a dark mode (no indications displayed) during periods between actuations.**

06 **Upon actuation by authorized emergency personnel, the emergency-vehicle hybrid beacon faces shall each display a flashing yellow signal indication, followed by a steady yellow change interval, prior to displaying two CIRCULAR RED signal indications in an alternating flashing array for a duration of time adequate for egress of the emergency vehicles. The alternating flashing red signal indications shall only be displayed when it is required that drivers on the major street stop and then proceed subject to the rules applicable after making a stop at a STOP sign. Upon termination of the flashing red signal indications, the emergency-vehicle hybrid beacons shall revert to a dark mode (no indications displayed) condition.**

*Guidance:*

07 *The duration of the flashing yellow interval should be determined by engineering judgment.*

**Figure 4G-1. Sequence for an Emergency-Vehicle Hybrid Beacon****Standard:**

- 08 **The duration of the steady yellow change interval shall be determined using engineering practices.**

*Guidance:*

- 09 *The steady yellow change interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds (see Section 4D.26). The longer intervals should be reserved for use on approaches with higher speeds.*

*Option:*

- 10 A steady red clearance interval may be used after the steady yellow change interval.
- 11 Emergency-vehicle hybrid beacons may be equipped with a light or other display visible to the operator of the egressing emergency vehicle to provide confirmation that the beacons are operating.
- 12 Emergency-vehicle hybrid beacons may be supplemented with an advance warning sign, which may also be supplemented with a Warning Beacon (see Section 4L.03).

*Guidance:*

- 13 *If a Warning Beacon is used to supplement the advance warning sign, it should be programmed to flash only when the emergency-vehicle hybrid beacon is not in the dark mode.*

**Standard:**

- 14 **At least two emergency-vehicle hybrid beacon faces shall be installed for each approach of the major street and a stop line shall be installed for each approach of the major street.**

*Guidance:*

- 15 *On approaches having posted or statutory speed limits or 85th-percentile speeds in excess of 40 mph, and on approaches having traffic or operating conditions that would tend to obscure visibility of roadside beacon faces, both of the minimum of two emergency-vehicle hybrid beacon faces should be installed over the roadway.*
- 16 *On multi-lane approaches having posted or statutory speed limits or 85th-percentile speeds of 40 mph or less, either an emergency-vehicle hybrid beacon face should be installed on each side of the approach (if a median of sufficient width exists) or at least one of the emergency-vehicle hybrid beacon faces should be installed over the roadway.*
- 17 *An emergency-vehicle hybrid beacon should comply with the signal face location provisions described in Sections 4D.11 through 4D.16.*

**Standard:**

- 18 **Stop lines and EMERGENCY SIGNAL—STOP WHEN FLASHING RED (R10-14 or R10-14a) signs (see Section 2B.53) shall be used with emergency-vehicle hybrid beacons.**

*Option:*

- 19 If needed for extra emphasis, a STOP HERE ON FLASHING RED (R10-14b) sign (see Section 2B.53) may be installed with an emergency-vehicle hybrid beacon.

## CHAPTER 4H. TRAFFIC CONTROL SIGNALS FOR ONE-LANE, TWO-WAY FACILITIES

### Section 4H.01 Application of Traffic Control Signals for One-Lane, Two-Way Facilities

**Support:**

- 01 A traffic control signal at a narrow bridge, tunnel, or roadway section is a special signal that assigns the right-of-way for vehicles passing over a bridge or through a tunnel or roadway section that is not of sufficient width for two opposing vehicles to pass.
- 02 Temporary traffic control signals (see Sections 4D.32 and 6F.84) are the most frequent application of one-lane, two-way facilities.

*Guidance:*

- 03 *Sight distance across or through the one-lane, two-way facility should be considered as well as the approach speed and sight distance approaching the facility when determining whether traffic control signals should be installed.*

**Option:**

- 04 At a narrow bridge, tunnel, or roadway section where a traffic control signal is not justified under the conditions of Chapter 4C, a traffic control signal may be used if gaps in opposing traffic do not permit the flow of traffic through the one-lane section of roadway.

### Section 4H.02 Design of Traffic Control Signals for One-Lane, Two-Way Facilities

**Standard:**

- 01 **The provisions of Chapter 4D shall apply to traffic control signals for one-lane, two-way facilities, except that:**
- A. Durations of red clearance intervals shall be adequate to clear the one-lane section of conflicting vehicles.
  - B. Adequate means, such as interconnection, shall be provided to prevent conflicting signal indications, such as green and green, at opposite ends of the section.

### Section 4H.03 Operation of Traffic Control Signals for One-Lane, Two-Way Facilities

**Standard:**

- 01 **Traffic control signals at one-lane, two-way facilities shall operate in a manner consistent with traffic requirements.**
- 02 **When in the flashing mode, the signal indications shall flash red.**

*Guidance:*

- 03 *Adequate time should be provided to allow traffic to clear the narrow facility before opposing traffic is allowed to move. Engineering judgment should be used to determine the proper timing for the signal.*

## CHAPTER 4I. TRAFFIC CONTROL SIGNALS FOR FREEWAY ENTRANCE RAMPS

### Section 4I.01 Application of Freeway Entrance Ramp Control Signals

#### Support:

- 01 Ramp control signals are traffic control signals that control the flow of traffic entering the freeway facility. This is often referred to as “ramp metering.”
- 02 Freeway entrance ramp control signals are sometimes used if controlling traffic entering the freeway could reduce the total expected delay to traffic in the freeway corridor, including freeway ramps and local streets.

#### Guidance:

- 03 *The installation of ramp control signals should be preceded by an engineering study of the physical and traffic conditions on the highway facilities likely to be affected. The study should include the ramps and ramp connections and the surface streets that would be affected by the ramp control, as well as the freeway section concerned.*

#### Support:

- 04 Information on conditions that might justify freeway entrance ramp control signals, factors to be evaluated in traffic engineering studies for ramp control signals, design of ramp control signals, and operation of ramp control signals can be found in the FHWA’s “Ramp Management and Control Handbook” (see Section 1A.11).

### Section 4I.02 Design of Freeway Entrance Ramp Control Signals

#### Standard:

- 01 **Ramp control signals shall meet all of the standard design specifications for traffic control signals, except as otherwise provided in this Section.**
- 02 **The signal face for freeway entrance ramp control signals shall be either a two-section signal face containing red and green signal indications or a three-section signal face containing red, yellow, and green signal indications.**
- 03 **If only one lane is present on an entrance ramp or if more than one lane is present on an entrance ramp and the ramp control signals are operated such that green signal indications are always displayed simultaneously to all of the lanes on the ramp, then a minimum of two signal faces per ramp shall face entering traffic.**
- 04 **If more than one lane is present on an entrance ramp and the ramp control signals are operated such that green signal indications are not always displayed simultaneously to all of the lanes on the ramp, then one signal face shall be provided over the approximate center of each separately-controlled lane.**

#### Guidance:

- 05 *Additional side-mounted signal faces should be considered for ramps with two or more separately-controlled lanes.*

#### Standard:

- 06 **Ramp control signals shall be located and designed to minimize their viewing by mainline freeway traffic.**

#### Option:

- 07 Ramp control signals may be placed in the dark mode (no indications displayed) when not in use.
- 08 Ramp control signals may be used to control some, but not all, lanes on a ramp, such as when non-metered HOV bypass lanes are provided on a ramp.
- 09 The required signal faces, if located at the side of the ramp roadway, may be mounted such that the height above the pavement grade at the center of the ramp roadway to the bottom of the signal housing of the lowest signal face is between 4.5 and 6 feet.
- 10 For entrance ramps with only one controlled lane, the two required signal faces may both be mounted at the side of the roadway on a single pole, with one face at the normal mounting height and one face mounted lower as provided in Paragraph 9, as a specific exception to the normal 8-foot minimum lateral separation of signal faces required by Section 4D.13.

#### Guidance:

- 11 *Regulatory signs with legends appropriate to the control, such as XX VEHICLE(S) PER GREEN or XX VEHICLE(S) PER GREEN EACH LANE (see Section 2B.56), should be installed adjacent to the ramp control signal faces. When ramp control signals are installed on a freeway-to-freeway ramp, special consideration should be given to assuring adequate visibility of the ramp control signals, and multiple advance warning signs with flashing warning beacons should be installed to warn road users of the metered operation.*

**Section 4L.03 Operation of Freeway Entrance Ramp Control Signals***Guidance:*

- 01 *Operational strategies for ramp control signals, such as periods of operation, metering rates and algorithms, and queue management, should be determined by the operating agency prior to the installation of the ramp control signals and should be closely monitored and adjusted as needed thereafter.*
- 02 *When the ramp control signals are operated only during certain periods of the day, a RAMP METERED WHEN FLASHING (W3-8) sign (see Section 2C.37) should be installed in advance of the ramp control signal near the entrance to the ramp, or on the arterial on the approach to the ramp, to alert road users to the presence and operation of ramp meters.*

**Standard:**

- 03 **The RAMP METERED WHEN FLASHING sign shall be supplemented with a warning beacon (see Section 4L.03) that flashes when the ramp control signal is in operation.**

## CHAPTER 4J. TRAFFIC CONTROL FOR MOVABLE BRIDGES

### Section 4J.01 Application of Traffic Control for Movable Bridges

#### Support:

- 01 Traffic control signals for movable bridges are a special type of highway traffic signal installed at movable bridges to notify road users to stop because of a road closure rather than alternately giving the right-of-way to conflicting traffic movements. The signals are operated in coordination with the opening and closing of the movable bridge, and with the operation of movable bridge warning and resistance gates, or other devices and features used to warn, control, and stop traffic.
- 02 Movable bridge warning gates installed at movable bridges decrease the likelihood of vehicles and pedestrians passing the stop line and entering an area where potential hazards exist because of bridge operations.
- 03 A movable bridge resistance gate is sometimes used at movable bridges and located downstream of the movable bridge warning gate. A movable bridge resistance gate provides a physical deterrent to road users when placed in the appropriate position. The movable bridge resistance gates are considered a design feature and not a traffic control device; requirements for them are contained in AASHTO's "Standard Specifications for Movable Highway Bridges" (see Page i for AASHTO's address).

#### Standard:

- 04 **Traffic control at movable bridges shall include both signals and gates, except in the following cases:**
- A. **Neither is required if other traffic control devices or measures considered appropriate are used under either of the following conditions:**
    1. **On low-volume roads (roads of less than 400 vehicles average daily traffic), or**
    2. **At manually operated bridges if electric power is not available.**
  - B. **Only signals are required in urban areas if intersecting streets or driveways make gates ineffective.**
  - C. **Only movable bridge warning gates are required if a traffic control signal that is controlled as part of the bridge operations exists within 500 feet of the movable bridge resistance gates and no intervening traffic entrances exist.**

### Section 4J.02 Design and Location of Movable Bridge Signals and Gates

#### Standard:

- 01 **The signal faces and mountings of movable bridge signals shall comply with the provisions of Chapter 4D except as provided in this Section.**
- 02 **Signal faces with 12-inch diameter signal indications shall be used for all new movable bridge signals.**
- Option:
- 03 Existing signal faces with 8-inch diameter lenses may be retained for the remainder of their useful service life.
- Standard:**
- 04 **Since movable bridge operations cover a variable range of time periods between openings, the signal faces shall be one of the following types:**
- A. **Three-section signal faces with red, yellow, and green signal indications; or**
  - B. **Two one-section signal faces with red signal indications in a vertical array separated by a STOP HERE ON RED (R10-6) sign (see Section 2B.53).**
- 05 **Regardless of which signal type is selected, at least two signal faces shall be provided for each approach to the movable span and a stop line (see Section 3B.16) shall be installed to indicate the point behind which vehicles are required to stop.**

#### Guidance:

- 06 *If movable bridge operation is frequent, the use of three-section signal faces should be considered.*
- 07 *Insofar as practical, the height and lateral placement of signal faces should comply with the requirements for other traffic control signals in accordance with Chapter 4D. They should be located no more than 50 feet in advance of the movable bridge warning gate.*

#### Option:

- 08 Movable bridge signals may be supplemented with audible warning devices to provide additional warning to drivers and pedestrians.

#### Standard:

- 09 **A DRAW BRIDGE (W3-6) sign (see Section 2C.39) shall be used in advance of movable bridge signals and gates to give warning to road users, except in urban conditions where such signing would not be practical.**

10 **If physical conditions prevent a road user from having a continuous view of at least two signal indications for the distance specified in Table 4D-2, an auxiliary device (either a supplemental signal face or the mandatory DRAW BRIDGE (W3-6) sign to which has been added a warning beacon that is interconnected with the movable bridge controller unit) shall be provided in advance of movable bridge signals and gates.**

Option:

11 The DRAW BRIDGE (W3-6) sign may be supplemented by a Warning Beacon (see Section 4L.03).

**Standard:**

12 **If two sets of gates (both a warning and a resistance gate) are used for a single direction, highway traffic signals shall not be required to accompany the resistance gate nearest the span opening.**

13 **Movable bridge warning gates, if used, shall be at least standard railroad size, striped with 16-inch alternate vertical, fully reflectorized red and white stripes. Flashing red lights in accordance with the Standards for those on railroad gates (see Section 8C.04) shall be included on the gate arm and they shall only be operated if the gate is closed or in the process of being opened or closed. In the horizontal position, the top of the gate shall be approximately 4 feet above the pavement.**

*Guidance:*

14 *Movable bridge warning gates should be of lightweight construction. In its normal upright position, the gate arm should provide adequate lateral clearance.*

Option:

15 The movable bridge resistance gates may be delineated, if practical, in a manner similar to the movable bridge warning gate.

**Standard:**

16 **Movable bridge warning gates, if used, shall extend at least across the full width of the approach lanes if movable bridge resistance gates are used. On divided highways in which the roadways are separated by a barrier median, movable bridge warning gates, if used, shall extend across all roadway lanes approaching the span openings.**

*Guidance:*

17 *If movable bridge resistance gates are not used on undivided highways, movable bridge warning gates, if used, should extend across the full width of the roadway.*

Option:

18 A single full-width gate or two half-width gates may be used.

Support:

19 The locations of movable bridge signals and gates are determined by the location of the movable bridge resistance gate (if used) rather than by the location of the movable spans. The movable bridge resistance gates for high-speed highways are preferably located 50 feet or more from the span opening except for bascule and lift bridges, where they are often attached to, or are a part of, the structure.

**Standard:**

20 **Except where physical conditions make it impractical, movable bridge warning gates shall be located 100 feet or more from the movable bridge resistance gates or, if movable bridge resistance gates are not used, 100 feet or more from the movable span.**

*Guidance:*

21 *On bridges or causeways that cross a long reach of water and that might be hit by large marine vessels, within the limits of practicality, traffic should not be halted on a section of the bridge or causeway that is subject to impact.*

22 *In cases where it is not practical to halt traffic on a span that is not subject to impact, traffic should be halted at least one span from the opening. If traffic is halted by signals and gates more than 330 feet from the movable bridge warning gates (or from the span opening if movable bridge warning gates are not used), a second set of gates should be installed approximately 100 feet from the gate or span opening.*

23 *If the movable bridge is close to a grade crossing and traffic might possibly be stopped on the crossing as a result of the bridge opening, a traffic control device should notify the road users to not stop on the railroad tracks.*

**Section 4J.03 Operation of Movable Bridge Signals and Gates****Standard:**

- 01 **Traffic control devices at movable bridges shall be coordinated with the movable spans, so that the signals, gates, and movable spans are controlled by the bridge tender through an interlocked control.**
- 02 **If the three-section type of signal face is used, the green signal indication shall be displayed at all times between bridge openings, except that if the bridge is not expected to open during continuous periods in excess of 5 hours, a flashing yellow signal indication shall be permitted to be used. The signal shall display a steady red signal indication when traffic is required to stop. The duration of the yellow change interval between the display of the green and steady red signal indications, or flashing yellow and steady red signal indications, shall be determined using engineering practices (see Section 4D.26).**
- 03 **If the vertical array of red signal indications is the type of signal face selected, the red signal indications shall flash alternately only when traffic is required to stop.**

*Guidance:*

- 04 *The yellow change interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds. The longer intervals should be reserved for use on approaches with higher speeds.*
- 05 *Traffic control signals on adjacent streets and highways should be interconnected with the drawbridge control if indicated by engineering judgment. When such interconnection is provided, the traffic control signals at adjacent intersections should be preempted by the operation of the movable bridge in the manner described in Section 4D.27.*

## CHAPTER 4K. HIGHWAY TRAFFIC SIGNALS AT TOLL PLAZAS

### Section 4K.01 Traffic Signals at Toll Plazas

**Standard:**

- 01 **Traffic control signals or devices that closely resemble traffic control signals that use red or green circular indications shall not be used at toll plazas to indicate the open or closed status of the toll plaza lanes.**

*Guidance:*

- 02 *Traffic control signals or devices that closely resemble traffic control signals that use red or green circular indications should not be used for new or reconstructed installations at toll plazas to indicate the success or failure of electronic toll payments or to alternately direct drivers making cash toll payments to stop and then proceed.*

### Section 4K.02 Lane-Use Control Signals at or Near Toll Plazas

**Standard:**

- 01 **Lane-use control signals used at toll plazas shall comply with the provisions of Chapter 4M except as otherwise provided in this Section.**
- 02 **At toll plazas with multiple lanes where one or more lanes is sometimes closed to traffic, a lane-use control signal shall be installed above the center of each toll plaza lane to indicate the open or closed status of the controlled lane.**

*Option:*

- 03 The bottom of the signal housing of a lane-use control signal above a toll plaza lane having a canopy may be mounted lower than 15 feet above the pavement, but not lower than the vertical clearance of the canopy structure.
- 04 Lane-use control signals may also be used to indicate the open or closed status of an Open-Road ETC lane as a supplement to other devices used for the temporary closure of a lane (see Part 6).

### Section 4K.03 Warning Beacons at Toll Plazas

**Standard:**

- 01 **Warning Beacons used at toll plazas shall comply with the provisions of Chapter 4L except as otherwise provided in this Section.**

*Guidance:*

- 02 *Warning Beacons, if used with a toll plaza canopy sign (see Section 2F.16) to assist drivers of such vehicles in locating the dedicated ETC Account-Only lane(s), should be installed in a manner such that the beacons are distinctly separate from the lane-use control signals (see Section 4M.01) for the toll plaza lane.*

*Option:*

- 03 Warning Beacons that are mounted on toll plaza islands, behind impact attenuators in front of toll plaza islands, and/or on toll booth pylons (ramparts) to identify them as objects in the roadway may be mounted at a height that is appropriate for viewing in a toll plaza context, even if that height is lower than the normal minimum of 8 feet above the pavement.

## CHAPTER 4L. FLASHING BEACONS

### Section 4L.01 General Design and Operation of Flashing Beacons

#### Support:

- 01 A Flashing Beacon is a highway traffic signal with one or more signal sections that operates in a flashing mode. It can provide traffic control when used as an intersection control beacon (see Section 4L.02) or it can provide warning when used in other applications (see Sections 4L.03, 4L.04, and 4L.05).

#### Standard:

- 02 **Flashing Beacon units and their mountings shall comply with the provisions of Chapter 4D, except as otherwise provided in this Chapter.**
- 03 **Beacons shall be flashed at a rate of not less than 50 or more than 60 times per minute. The illuminated period of each flash shall be a minimum of 1/2 and a maximum of 2/3 of the total cycle.**
- 04 **A beacon shall not be included within the border of a sign except for SCHOOL SPEED LIMIT sign beacons (see Sections 4L.04 and 7B.15).**

#### Guidance:

- 05 *If used to supplement a warning or regulatory sign, the edge of the beacon signal housing should normally be located no closer than 12 inches outside of the nearest edge of the sign.*

#### Option:

- 06 An automatic dimming device may be used to reduce the brilliance of flashing yellow signal indications during night operation.

### Section 4L.02 Intersection Control Beacon

#### Standard:

- 01 **An Intersection Control Beacon shall consist of one or more signal faces directed toward each approach to an intersection. Each signal face shall consist of one or more signal sections of a standard traffic signal face, with flashing CIRCULAR YELLOW or CIRCULAR RED signal indications in each signal face. They shall be installed and used only at an intersection to control two or more directions of travel.**
- 02 **Application of Intersection Control Beacon signal indications shall be limited to the following:**
- A. **Yellow on one route (normally the major street) and red for the remaining approaches, and**
  - B. **Red for all approaches (if the warrant described in Section 2B.07 for a multi-way stop is satisfied).**
- 03 **Flashing yellow signal indications shall not face conflicting vehicular approaches.**
- 04 **A STOP sign shall be used on approaches to which a flashing red signal indication is displayed on an Intersection Control Beacon (see Section 2B.04).**
- 05 **If two horizontally aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed simultaneously to avoid being confused with grade crossing flashing-light signals. If two vertically aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed alternately.**

#### Guidance:

- 06 *An Intersection Control Beacon should not be mounted on a pedestal in the roadway unless the pedestal is within the confines of a traffic or pedestrian island.*

#### Option:

- 07 Supplemental signal indications may be used on one or more approaches in order to provide adequate visibility to approaching road users.
- 08 Intersection Control Beacons may be used at intersections where traffic or physical conditions do not justify conventional traffic control signals but crash rates indicate the possibility of a special need.
- 09 An Intersection Control Beacon is generally located over the center of an intersection; however, it may be used at other suitable locations.

### Section 4L.03 Warning Beacon

#### Support:

- 01 Typical applications of Warning Beacons include the following:
- A. At obstructions in or immediately adjacent to the roadway;
  - B. As supplemental emphasis to warning signs;
  - C. As emphasis for midblock crosswalks;

- D. As supplemental emphasis to regulatory signs, except STOP, DO NOT ENTER, WRONG WAY, and SPEED LIMIT signs; and
- E. In conjunction with a regulatory or warning sign that includes the phrase WHEN FLASHING in its legend to indicate that the regulation is in effect or that the condition is present only at certain times.

**Standard:**

- 02 **A Warning Beacon shall consist of one or more signal sections of a standard traffic signal face with a flashing CIRCULAR YELLOW signal indication in each signal section.**
- 03 **A Warning Beacon shall be used only to supplement an appropriate warning or regulatory sign or marker.**
- 04 **Warning Beacons, if used at intersections, shall not face conflicting vehicular approaches.**
- 05 **If a Warning Beacon is suspended over the roadway, the clearance above the pavement shall be a minimum of 15 feet and a maximum of 19 feet.**

*Guidance:*

- 06 *The condition or regulation justifying Warning Beacons should largely govern their location with respect to the roadway.*
- 07 *If an obstruction is in or adjacent to the roadway, illumination of the lower portion or the beginning of the obstruction or a sign on or in front of the obstruction, in addition to the beacon, should be considered.*
- 08 *Warning Beacons should be operated only during those periods or times when the condition or regulation exists.*

*Option:*

- 09 Warning Beacons that are actuated by pedestrians, bicyclists, or other road users may be used as appropriate to provide additional warning to vehicles approaching a crossing or other location.
- 10 If Warning Beacons have more than one signal section, they may be flashed either alternately or simultaneously.
- 11 A flashing yellow beacon interconnected with a traffic signal controller assembly may be used with a traffic signal warning sign (see Section 2C.36).

**Section 4L.04 Speed Limit Sign Beacon****Standard:**

- 01 **A Speed Limit Sign Beacon shall be used only to supplement a Speed Limit sign.**
- 02 **A Speed Limit Sign Beacon shall consist of one or more signal sections of a standard traffic control signal face, with a flashing CIRCULAR YELLOW signal indication in each signal section. The signal indications shall have a nominal diameter of not less than 8 inches. If two signal indications are used, they shall be vertically aligned, except that they shall be permitted to be horizontally aligned if the Speed Limit (R2-1) sign is longer horizontally than vertically. If two signal indications are used, they shall be alternately flashed.**

*Option:*

- 03 A Speed Limit Sign Beacon may be used with a fixed or variable Speed Limit sign. If applicable, a flashing Speed Limit Sign Beacon (with an appropriate accompanying sign) may be used to indicate that the displayed speed limit is in effect.
- 04 A Speed Limit Sign Beacon may be included within the border of a School Speed Limit (S5-1) sign (see Section 7B.15).

**Section 4L.05 Stop Beacon****Standard:**

- 01 **A Stop Beacon shall be used only to supplement a STOP sign, a DO NOT ENTER sign, or a WRONG WAY sign.**
- 02 **A Stop Beacon shall consist of one or more signal sections of a standard traffic signal face with a flashing CIRCULAR RED signal indication in each signal section. If two horizontally aligned signal indications are used for a Stop Beacon, they shall be flashed simultaneously to avoid being confused with grade crossing flashing-light signals. If two vertically aligned signal indications are used for a Stop Beacon, they shall be flashed alternately.**
- 03 **The bottom of the signal housing of a Stop Beacon shall be not less than 12 inches or more than 24 inches above the top of a STOP sign, a DO NOT ENTER sign, or a WRONG WAY sign.**

## CHAPTER 4M. LANE-USE CONTROL SIGNALS

### Section 4M.01 Application of Lane-Use Control Signals

#### Support:

- 01 Lane-use control signals are special overhead signals that permit or prohibit the use of specific lanes of a street or highway or that indicate the impending prohibition of their use. Lane-use control signals are distinguished by placement of special signal faces over a certain lane or lanes of the roadway and by their distinctive shapes and symbols. Supplementary signs are sometimes used to explain their meaning and intent.
- 02 Lane-use control signals are most commonly used for reversible-lane control, but are also used in certain non-reversible lane applications and for toll plaza lanes (see Section 4K.02).

#### Guidance:

- 03 *An engineering study should be conducted to determine whether a reversible-lane operation can be controlled satisfactorily by static signs (see Section 2B.26) or whether lane-use control signals are necessary. Lane-use control signals should be used to control reversible-lane operations if any of the following conditions are present:*
- A. *More than one lane is reversed in direction;*
  - B. *Two-way or one-way left turns are allowed during peak-period reversible operations, but those turns are from a different lane than used during off-peak periods;*
  - C. *Other unusual or complex operations are included in the reversible-lane pattern;*
  - D. *Demonstrated crash experience occurring with reversible-lane operation controlled by static signs that can be corrected by using lane-use control signals at the times of transition between peak and off-peak patterns; and/or*
  - E. *An engineering study indicates that the safety and efficiency of the traffic operations of a reversible-lane system would be improved by lane-use control signals.*

#### Standard:

- 04 **Pavement markings (see Section 3B.03) shall be used in conjunction with reversible-lane control signals.**

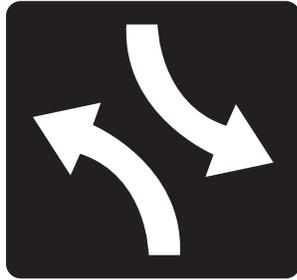
#### Option:

- 05 Lane-use control signals may also be used if there is no intent or need to reverse lanes, but there is a need to indicate the open or closed status of one or more lanes, such as:
- A. On a freeway, if it is desired to close certain lanes at certain hours to facilitate the merging of traffic from a ramp or other freeway;
  - B. On a freeway, near its terminus, to indicate a lane that ends;
  - C. On a freeway or long bridge, to indicate that a lane may be temporarily blocked by a crash, breakdown, construction or maintenance activities, or similar temporary conditions; and
  - D. On a conventional road or driveway, at access or egress points to or from a facility, such as a parking garage, where one or more lanes of the access or egress are opened or closed at various times.

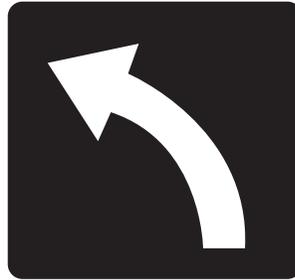
### Section 4M.02 Meaning of Lane-Use Control Signal Indications

#### Standard:

- 01 **The meanings of lane-use control signal indications shall be as follows:**
- A. **A steady DOWNWARD GREEN ARROW signal indication shall mean that a road user is permitted to drive in the lane over which the arrow signal indication is located.**
  - B. **A steady YELLOW X signal indication shall mean that a road user is to prepare to vacate the lane over which the signal indication is located because a lane control change is being made to a steady RED X signal indication.**
  - C. **A steady WHITE TWO-WAY LEFT-TURN ARROW signal indication (see Figure 4M-1) shall mean that a road user is permitted to use a lane over which the signal indication is located for a left turn, but not for through travel, with the understanding that common use of the lane by oncoming road users for left turns is also permitted.**
  - D. **A steady WHITE ONE WAY LEFT-TURN ARROW signal indication (see Figure 4M-1) shall mean that a road user is permitted to use a lane over which the signal indication is located for a left turn (without opposing turns in the same lane), but not for through travel.**
  - E. **A steady RED X signal indication shall mean that a road user is not permitted to use the lane over which the signal indication is located and that this signal indication shall modify accordingly the meaning of other traffic controls present.**

**Figure 4M-1. Left-Turn Lane-Use Control Signals**

Two-way left-turn arrow



One-way left-turn arrow

White arrows on an opaque 30 x 30-inch background

### Section 4M.03 Design of Lane-Use Control Signals

#### Standard:

- 01 All lane-use control signal indications shall be in units with rectangular signal faces and shall have opaque backgrounds. Nominal minimum height and width of each **DOWNWARD GREEN ARROW**, **YELLOW X**, and **RED X** signal face shall be 18 inches for typical applications. The **WHITE TWO-WAY LEFT-TURN ARROW** and **WHITE ONE WAY LEFT-TURN ARROW** signal faces shall have a nominal minimum height and width of 30 inches.
- 02 Each lane to be reversed or closed shall have signal faces with a **DOWNWARD GREEN ARROW** and a **RED X** symbol.
- 03 Each reversible lane that also operates as a two-way or one-way left-turn lane during certain periods shall have signal faces that also include the applicable **WHITE TWO-WAY LEFT-TURN ARROW** or **WHITE ONE WAY LEFT-TURN ARROW** symbol.
- 04 Each non-reversible lane immediately adjacent to a reversible lane shall have signal indications that display a **DOWNWARD GREEN ARROW** to traffic traveling in the permitted direction and a **RED X** to traffic traveling in the opposite direction.
- 05 If in separate signal sections, the relative positions, from left to right, of the signal indications shall be **RED X**, **YELLOW X**, **DOWNWARD GREEN ARROW**, **WHITE TWO-WAY LEFT-TURN ARROW**, **WHITE ONE WAY LEFT-TURN ARROW**.
- 06 The color of lane-use control signal indications shall be clearly visible for 2,300 feet at all times under normal atmospheric conditions, unless otherwise physically obstructed.
- 07 Lane-use control signal faces shall be located approximately over the center of the lane controlled.
- 08 If the area to be controlled is more than 2,300 feet in length, or if the vertical or horizontal alignment is curved, intermediate lane-use control signal faces shall be located over each controlled lane at frequent intervals. This location shall be such that road users will at all times be able to see at least one signal indication and preferably two along the roadway, and will have a definite indication of the lanes specifically reserved for their use.
- 09 All lane-use control signal faces shall be located in a straight line across the roadway approximately at right angles to the roadway alignment.
- 10 On roadways having intersections controlled by traffic control signals, the lane-use control signal face shall be located sufficiently far in advance of or beyond such traffic control signals to prevent them from being misconstrued as traffic control signals.
- 11 Except as provided in Paragraph 12, the bottom of the signal housing of any lane-use control signal face shall be a minimum of 15 feet and a maximum of 19 feet above the pavement grade.

#### Option:

- 12 The bottom of a lane-use control signal housing may be lower than 15 feet above the pavement if it is mounted on a canopy or other structure over the pavement, but not lower than the vertical clearance of the structure.
- 13 Except for lane-use control signals at toll plazas (see Section 4K.02), in areas with minimal visual clutter and with speeds of less than 40 mph, lane-use control signal faces with nominal height and width of 12 inches may be used for the **DOWNWARD GREEN ARROW**, **YELLOW X**, and **RED X** signal faces, and lane-use control signal faces with nominal height and width of 18 inches may be used for the **WHITE TWO-WAY LEFT-TURN ARROW** and **WHITE ONE-WAY LEFT-TURN ARROW** signal faces.

- 14 Other sizes of lane-use control signal faces larger than 18 inches with message recognition distances appropriate to signal spacing may be used for the DOWNWARD GREEN ARROW, YELLOW X, and RED X signal faces.
- 15 Non-reversible lanes not immediately adjacent to a reversible lane on any street so controlled may also be provided with signal indications that display a DOWNWARD GREEN ARROW to traffic traveling in the permitted direction and a RED X to traffic traveling in the opposite direction.
- 16 The signal indications provided for each lane may be in separate signal sections or may be superimposed in the same signal section.

#### **Section 4M.04 Operation of Lane-Use Control Signals**

##### **Standard:**

- 01 All lane-use control signals shall be coordinated so that all the signal indications along the controlled section of roadway are operated uniformly and consistently. The lane-use control signal system shall be designed to reliably guard against showing any prohibited combination of signal indications to any traffic at any point in the controlled lanes.
- 02 For reversible-lane control signals, the following combination of signal indications shall not be simultaneously displayed over the same lane to both directions of travel:
- A. DOWNWARD GREEN ARROW in both directions,
  - B. YELLOW X in both directions,
  - C. WHITE ONE WAY LEFT-TURN ARROW in both directions,
  - D. DOWNWARD GREEN ARROW in one direction and YELLOW X in the other direction,
  - E. WHITE TWO-WAY LEFT-TURN ARROW or WHITE ONE WAY LEFT-TURN ARROW in one direction and DOWNWARD GREEN ARROW in the other direction,
  - F. WHITE TWO-WAY LEFT-TURN ARROW in one direction and WHITE ONE WAY LEFT-TURN ARROW in the other direction, and
  - G. WHITE ONE WAY LEFT-TURN ARROW in one direction and YELLOW X in the other direction.
- 03 A moving condition in one direction shall be terminated either by the immediate display of a RED X signal indication or by a YELLOW X signal indication followed by a RED X signal indication. In either case, the duration of the RED X signal indication shall be sufficient to allow clearance of the lane before any moving condition is allowed in the opposing direction.
- 04 Whenever a DOWNWARD GREEN ARROW signal indication is changed to a WHITE TWO-WAY LEFT-TURN ARROW signal indication, the RED X signal indication shall continue to be displayed to the opposite direction of travel for an appropriate duration to allow traffic time to vacate the lane being converted to a two-way left-turn lane.
- 05 If an automatic control system is used, a manual control to override the automatic control shall be provided.

##### *Guidance:*

- 06 *The type of control provided for reversible-lane operation should be such as to permit either automatic or manual operation of the lane-use control signals.*

##### **Standard:**

- 07 If used, lane-use control signals shall be operated continuously, except that lane-use control signals that are used only for special events or other infrequent occurrences and lane-use control signals on non-reversible freeway lanes shall be permitted to be darkened when not in operation. The change from normal operation to non-operation shall occur only when the lane-use control signals display signal indications that are appropriate for the lane use that applies when the signals are not operated. The lane-use control signals shall display signal indications that are appropriate for the existing lane use when changed from non-operation to normal operations. Also, traffic control devices shall clearly indicate the proper lane use when the lane control signals are not in operation.

##### *Support:*

- 08 Section 2B.26 contains additional information concerning considerations involving left-turn prohibitions in conjunction with reversible-lane operations.

## CHAPTER 4N. IN-ROADWAY LIGHTS

### Section 4N.01 Application of In-Roadway Lights

Support:

- 01 In-Roadway Lights are special types of highway traffic signals installed in the roadway surface to warn road users that they are approaching a condition on or adjacent to the roadway that might not be readily apparent and might require the road users to slow down and/or come to a stop. This includes situations warning of marked school crosswalks, marked midblock crosswalks, marked crosswalks on uncontrolled approaches, marked crosswalks in advance of roundabouts as described in Chapter 3C, and other roadway situations involving pedestrian crossings.

**Standard:**

- 02 **In-Roadway Lights shall not be used for any application that is not described in this Chapter.**  
 03 **If used, In-Roadway Lights shall not exceed a height of 3/4 inch above the roadway surface.**  
 04 **When used, In-Roadway Lights shall be flashed and shall not be steadily illuminated.**

Support:

- 05 Steadily illuminated lights installed in the roadway surface are considered to be internally illuminated raised pavement markers (see Section 3B.11).

Option:

- 06 In-Roadway Lights may be flashed in a manner that includes a continuous flash of varying intensity and time duration that is repeated to provide a flickering effect (see Section 4N.02).

### Section 4N.02 In-Roadway Warning Lights at Crosswalks

Option:

- 01 In-roadway lights may be installed at certain marked crosswalks, based on an engineering study or engineering judgment, to provide additional warning to road users.

**Standard:**

- 02 **If used, In-Roadway Warning Lights at crosswalks shall be installed only at marked crosswalks with applicable warning signs. They shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.**
- 03 **If In-Roadway Warning Lights are used at a crosswalk, the following requirements shall apply:**
- A. **Except as provided in Paragraphs 7 and 8, they shall be installed along both sides of the crosswalk and shall span its entire length.**
  - B. **They shall initiate operation based on pedestrian actuation and shall cease operation at a predetermined time after the pedestrian actuation or, with passive detection, after the pedestrian clears the crosswalk.**
  - C. **They shall display a flashing yellow light when actuated. The flash rate shall be at least 50, but no more than 60, flash periods per minute. If they are flashed in a manner that includes a continuous flash of varying intensity and time duration that is repeated to provide a flickering effect, the flickers or pulses shall not repeat at a rate that is between 5 and 30 per second to avoid frequencies that might cause seizures.**
  - D. **They shall be installed in the area between the outside edge of the crosswalk line and 10 feet from the outside edge of the crosswalk.**
  - E. **They shall face away from the crosswalk if unidirectional, or shall face away from and across the crosswalk if bidirectional.**
- 04 **If used on one-lane, one-way roadways, a minimum of two In-Roadway Warning Lights shall be installed on the approach side of the crosswalk. If used on two-lane roadways, a minimum of three In-Roadway Warning Lights shall be installed along both sides of the crosswalk. If used on roadways with more than two lanes, a minimum of one In-Roadway Warning Light per lane shall be installed along both sides of the crosswalk.**

*Guidance:*

- 05 *If used, In-Roadway Warning Lights should be installed in the center of each travel lane, at the center line of the roadway, at each edge of the roadway or parking lanes, or at other suitable locations away from the normal tire track paths.*
- 06 *The location of the In-Roadway Warning Lights within the lanes should be based on engineering judgment.*

**Option:**

- 07 On one-way streets, In-Roadway Warning Lights may be omitted on the departure side of the crosswalk.
- 08 Based on engineering judgment, the In-Roadway Warning Lights on the departure side of the crosswalk on the left side of a median may be omitted.
- 09 Unidirectional In-Roadway Warning Lights installed at crosswalk locations may have an optional, additional yellow light indication in each unit that is visible to pedestrians in the crosswalk to indicate to pedestrians in the crosswalk that the In-Roadway Warning Lights are in fact flashing as they cross the street. These yellow lights may flash with and at the same flash rate as the light module in which each is installed.

**Guidance:**

- 10 *If used, the period of operation of the In-Roadway Warning Lights following each actuation should be sufficient to allow a pedestrian crossing in the crosswalk to leave the curb or shoulder and travel at a walking speed of 3.5 feet per second to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait. Where pedestrians who walk slower than 3.5 feet per second, or pedestrians who use wheelchairs, routinely use the crosswalk, a walking speed of less than 3.5 feet per second should be considered in determining the period of operation.*

**Standard:**

- 11 **If pedestrian pushbuttons are used to actuate the in-roadway lights, a Push Button To Turn On Warning Lights (with pushbutton symbol) (R10-25) sign (see Figure 2B-26) shall be mounted adjacent to or integral with each pedestrian pushbutton.**
- 12 **Where the period of operation is sufficient only for crossing from a curb or shoulder to a median of sufficient width for pedestrians to wait, median-mounted pedestrian actuators shall be provided.**

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# PART 5

## TRAFFIC CONTROL DEVICES FOR LOW-VOLUME ROADS

### CHAPTER 5A. GENERAL

#### Section 5A.01 Function

##### Standard:

- 01 A low-volume road shall be defined for this Part of the Manual as follows:
- A. A low-volume road shall be a facility lying outside of built-up areas of cities, towns, and communities, and it shall have a traffic volume of less than 400 AADT.
  - B. A low-volume road shall not be a freeway, an expressway, an interchange ramp, a freeway service road, a road on a designated State highway system, or a residential street in a neighborhood. In terms of highway classification, it shall be a variation of a conventional road or a special purpose road as defined in Section 1A.13.
  - C. A low-volume road shall be classified as either paved or unpaved.

##### Support:

- 02 Low-volume roads typically include agricultural, recreational, resource management and development such as mining and logging and grazing, and local roads in rural areas.

##### Guidance:

- 03 *The needs of unfamiliar road users for occasional, recreational, and commercial transportation purposes should be considered.*

##### Support:

- 04 At some locations on low-volume roads, the use of traffic control devices might be needed to provide the road user limited, but essential, information regarding regulation, guidance, and warning.
- 05 Other Parts of this Manual contain provisions applicable to all low-volume roads; however, Part 5 specifically supplements and references the provisions for traffic control devices commonly used on low-volume roads.

#### Section 5A.02 Application

##### Support:

- 01 It is possible, in many cases, to provide essential information to road users on low-volume roads with a limited number of traffic control devices. The focus might be on devices that:
- A. Warn of conditions not normally encountered,
  - B. Prohibit unsafe movements, or
  - C. Provide minimal destination guidance.

##### Standard:

- 02 **The provisions contained in Part 5 shall not prohibit the installation or the full application of traffic control devices on a low-volume road where conditions justify their use.**

##### Guidance:

- 03 *Additional traffic control devices and provisions contained in other Parts of the Manual should be considered for use on low-volume roads.*

##### Support:

- 04 Section 1A.09 contains information regarding the assistance that is available to jurisdictions that do not have engineers on their staffs who are trained and/or experienced in traffic control devices.

#### Section 5A.03 Design

##### Standard:

- 01 **Traffic control devices for use on low-volume roads shall be designed in accordance with the provisions contained in Part 5, and where required, in other applicable Parts of this Manual.**

- 02 **The typical sizes for signs and plaques installed on low-volume roads shall be as shown in Table 5A-1. The sizes in the minimum column shall only be used on low-volume roads where the 85th-percentile speed or posted speed limit is less than 35 mph.**

##### Guidance:

- 03 *The sizes in the oversized column should be used where engineering judgment indicates a need based on high vehicle operating speeds, driver expectancy, traffic operations, or roadway conditions.*

##### Option:

- 04 Signs and plaques larger than those shown in Table 5A-1 may be used (see Section 2A.11).

**Table 5A-1. Sign and Plaque Sizes on Low-Volume Roads (Sheet 1 of 2)**

Sign or Plaque	Sign Designation	Section	Sign Sizes		
			Typical	Minimum	Oversized
Stop	R1-1	5B.02	30 x 30	—	36 x 36
Yield	R1-2	5B.02	30 x 30 x 30	—	36 x 36 x 36
Speed Limit (English)	R2-1	5B.03	24 x 30	18 x 24	36 x 48
Do Not Pass	R4-1	5B.04	24 x 30	—	36 x 48
Pass With Care	R4-2	5B.04	24 x 30	18 x 24	36 x 48
Keep Right	R4-7	5B.04	24 x 30	18 x 24	36 x 48
Do Not Enter	R5-1	5B.04	30 x 30	—	36 x 36
No Trucks	R5-2	5B.04	24 x 24	—	30 x 30
One Way	R6-2	5B.04	18 x 24	—	24 x 30
No Parking (symbol)	R8-3	5B.05	24 x 24	18 x 18	30 x 30
No Parking	R8-3a	5B.05	18 x 24	—	24 x 30
No Parking (plaque)	R8-3cP,3dP	5B.05	24 x 18	18 x 12	30 x 24
Road Closed	R11-2	5B.04	48 x 30	—	—
Road Closed, Local Traffic Only	R11-3a	5B.04	60 x 30	—	—
Bridge Out, Local Traffic Only	R11-3b	5B.04	60 x 30	—	—
Road Closed to Thru Traffic	R11-4	5B.04	60 x 30	—	—
Weight Limit	R12-1	5B.04	24 x 30	—	36 x 48
Grade Crossing (Crossbuck)	R15-1	5F.02	48 x 9	—	—
Number of Tracks (plaque)	R15-2P	5F.02	27 x 18	—	—
Horizontal Alignment	W1-1,2,3,4,5	5C.02	30 x 30	—	36 x 36
One-Direction Large Arrow	W1-6	5C.02	36 x 18	—	48 x 24
Two-Direction Large Arrow	W1-7	5C.02	36 x 18	—	48 x 24
Chevron Alignment	W1-8	5C.02	12 x 18	—	18 x 24
Intersection Warning	W2-1,2,3,4,5,6	5C.03	30 x 30	—	36 x 36
Stop Ahead	W3-1	5C.04	30 x 30	—	36 x 36
Yield Ahead	W3-2	5C.04	30 x 30	—	36 x 36
Be Prepared to Stop	W3-4	5G.05	36 x 36	—	48 x 48
Narrow Bridge	W5-2	5C.05	30 x 30	—	36 x 36
One Lane Bridge	W5-3	5C.06	30 x 30	—	36 x 36
Hill	W7-1	5C.07	30 x 30	—	36 x 36
XX % Grade (plaque)	W7-3P	5C.07	24 x 18	—	30 x 24
Next XX Miles (plaque)	W7-3aP	5C.09	24 x 18	—	30 x 24
Pavement Ends	W8-3	5C.08	30 x 30	—	36 x 36
Truck Crossing	W8-6	5C.09	30 x 30	—	36 x 36
Loose Gravel	W8-7	5G.05	30 x 30	—	36 x 36
Rough Road	W8-8	5G.05	30 x 30	—	36 x 36
Road May Flood	W8-18	5G.05	30 x 30	—	36 x 36
Grade Crossing Advance Warning	W10-1	5F.03	30 Dia.	—	36 Dia.
Grade Crossing Advance Warning	W10-2,3,4	5F.03	30 x 30	—	36 x 36
Trains May Exceed 80 mph	W10-8	5F.06	30 x 30	—	36 x 36
Storage Space Symbol	W10-11	5F.06	30 x 30	—	36 x 36
Skewed Crossing	W10-12	5F.06	30 x 30	—	36 x 36
Entering/Crossing	W11 Series	5C.09	30 x 30	—	36 x 36
Advisory Speed (plaque)	W13-1P	5C.10	18 x 18	—	24 x 24
Dead End/No Outlet	W14-1,2	5C.11	30 x 30	—	36 x 36
Dead End/No Outlet	W14-1a,2a	5C.11	36 x 9	24 x 6	—

**Table 5A-1. Sign and Plaque Sizes on Low-Volume Roads (Sheet 2 of 2)**

Sign or Plaque	Sign Designation	Section	Sign Sizes		
			Typical	Minimum	Oversized
No Passing Zone (pennant)	W14-3	5G.05	40 x 40 x 30	—	48 x 48 x 36
Supplemental Distance (plaque)	W16-2P	5C.09	24 x 18	18 x 12	30 x 24
Diagonal Arrow (plaque)	W16-7P	5C.09	24 x 12	—	30 x 18
Ahead (plaque)	W16-9P	5C.09	24 x 12	—	30 x 18
No Traffic Signs	W18-1	5C.12	30 x 30	24 x 24	36 x 36
Road Work (with distance)	W20-1	5G.05	36 x 36	—	48 x 48
Road Closed (with distance)	W20-3	5G.05	36 x 36	—	48 x 48
One Lane Road (with distance)	W20-4	5G.05	36 x 36	—	48 x 48
Flagger	W20-7	5G.05	36 x 36	—	48 x 48
Workers	W21-1	5G.05	36 x 36	—	48 x 48
Fresh Oil	W21-2	5G.05	30 x 30	—	48 x 48
Road Machinery Ahead	W21-3	5G.05	30 x 30	—	48 x 48
Shoulder Work	W21-5	5G.05	36 x 36	—	48 x 48
Survey Crew	W21-6	5G.05	36 x 36	—	48 x 48
Utility Work (with distance)	W21-7	5G.05	36 x 36	—	48 x 48

Notes: 1. Larger sizes may be used when appropriate

2. Dimensions are shown in inches and are shown as width x height

### Standard:

- 05 **All signs shall be retroreflective or illuminated to show the same shape and similar color both day and night, unless specifically stated otherwise in other applicable Parts of this Manual. The requirements for sign illumination shall not be considered to be satisfied by street, highway, or strobe lighting.**
- 06 **All markings shall be visible at night and shall be retroreflective unless ambient illumination provides adequate visibility of the markings.**

### Section 5A.04 Placement

#### Standard:

- 01 **Except as provided in Paragraph 3, the traffic control devices used on low-volume roads shall be placed and positioned in accordance with the lateral, longitudinal, and vertical placement provisions contained in Part 2 and other applicable Sections of this Manual.**

#### Guidance:

- 02 *The placement of warning signs should comply with the guidance contained in Section 2C.05 and other applicable Sections of this Manual.*

#### Option:

- 03 A lateral offset of not less than 2 feet from the roadway edge to the roadside edge of a sign may be used where roadside features such as terrain, shrubbery, and/or trees prevent lateral placement in accordance with Section 2A.19.

#### Standard:

- 04 **If located within a clear zone, post-mounted sign supports shall be yielding, breakaway, or shielded with a longitudinal barrier or crash cushion as required in Section 2A.19.**

## CHAPTER 5B. REGULATORY SIGNS

### Section 5B.01 Introduction

Support:

- 01 The purpose of a regulatory sign is to inform highway users of traffic laws or regulations, and to indicate the applicability of legal requirements that would not otherwise be apparent.
- 02 The provisions for regulatory signs are contained in Chapter 2B and in other Sections of this Manual. Provisions for regulatory signs that are specific to low-volume roads are contained in this Chapter.

### Section 5B.02 STOP and YIELD Signs (R1-1 and R1-2)

Guidance:

- 01 *STOP (R1-1) and YIELD (R1-2) signs (see Figure 5B-1) should be considered for use on low-volume roads where engineering judgment or study, consistent with the provisions of Sections 2B.04 to 2B.10, indicates that either of the following conditions applies:*
  - A. *An intersection of a less-important road with a main road where application of the normal right-of-way rule might not be readily apparent.*
  - B. *An intersection that has restricted sight distance for the prevailing vehicle speeds.*

### Section 5B.03 Speed Limit Signs (R2 Series)

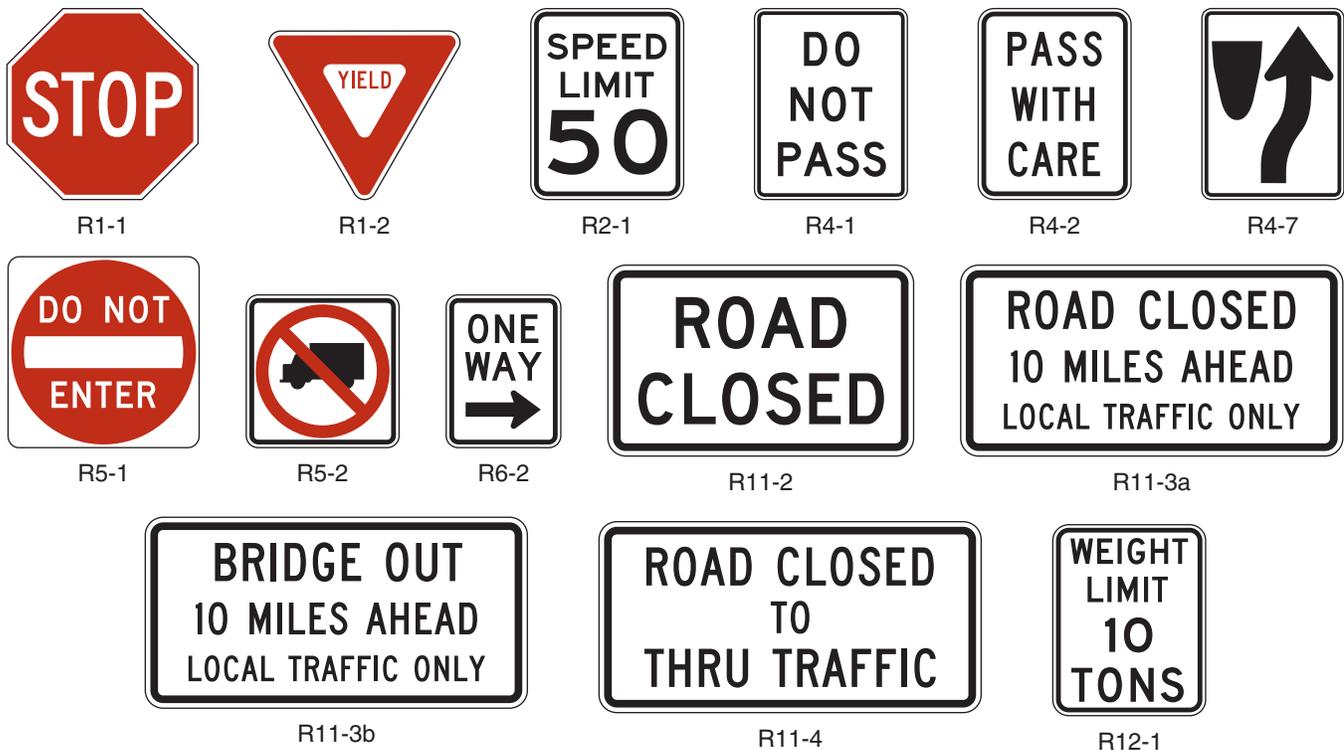
Standard:

- 01 **If used, Speed Limit (R2 series) signs (see Figure 5B-1) shall display the speed limit established by law, ordinance, regulation, or as adopted by the authorized agency following an engineering study. The displayed speed limits shall be in multiples of 5 mph.**
- 02 **Speed limits shall be established in accordance with Section 2B.13.**

Option:

- 03 Speed limit signs may be used on low-volume roads that carry traffic from, onto, or adjacent to higher-volume roads that have posted speed limits.

**Figure 5B-1. Regulatory Signs on Low-Volume Roads**



### **Section 5B.04 Traffic Movement and Prohibition Signs (R3, R4, R5, R6, R9, R10, R11, R12, R13, and R14 Series)**

Support:

- 01 The regulatory signs (see Figure 5B-1) in these series inform road users of required, permitted, or prohibited traffic movements involving turn, alignment, exclusion, and pedestrians.

**Standard:**

- 02 **If used, signs for traffic prohibitions or restrictions shall be placed in advance of the prohibition or restriction so that traffic can use an alternate route or turn around.**

*Guidance:*

- 03 *Signs should be used on low-volume roads to indicate traffic prohibitions and restrictions such as road closures and weight restrictions.*

Option:

- 04 Signs for traffic prohibitions or restrictions may be used on a low-volume road near and at the intersections or the connections with a higher class of road, and where the regulatory message is essential for transition from the low-volume road to the higher-class facility or vice versa.

### **Section 5B.05 Parking Signs (R8 Series)**

Option:

- 01 Parking signs (see Figure 5B-2) may be installed selectively on low-volume roads with due consideration of enforcement.

### **Section 5B.06 Other Regulatory Signs**

**Standard:**

- 01 **Other regulatory signs used on low-volume roads that are not discussed in Part 5 shall comply with the provisions contained in other Parts of this Manual.**

**Figure 5B-2. Parking Signs and Plaques on Low-Volume Roads**



## CHAPTER 5C. WARNING SIGNS

### Section 5C.01 Introduction

Support:

- 01 The purpose of a warning sign is to provide advance warning to the road user of unexpected conditions on or adjacent to the roadway that might not be readily apparent.
- 02 The provisions for warning signs are contained in Chapter 2C and in other Sections of this Manual. Provisions for warning signs that are specific to low-volume roads are contained in this Chapter.

### Section 5C.02 Horizontal Alignment Signs (W1-1 through W1-8)

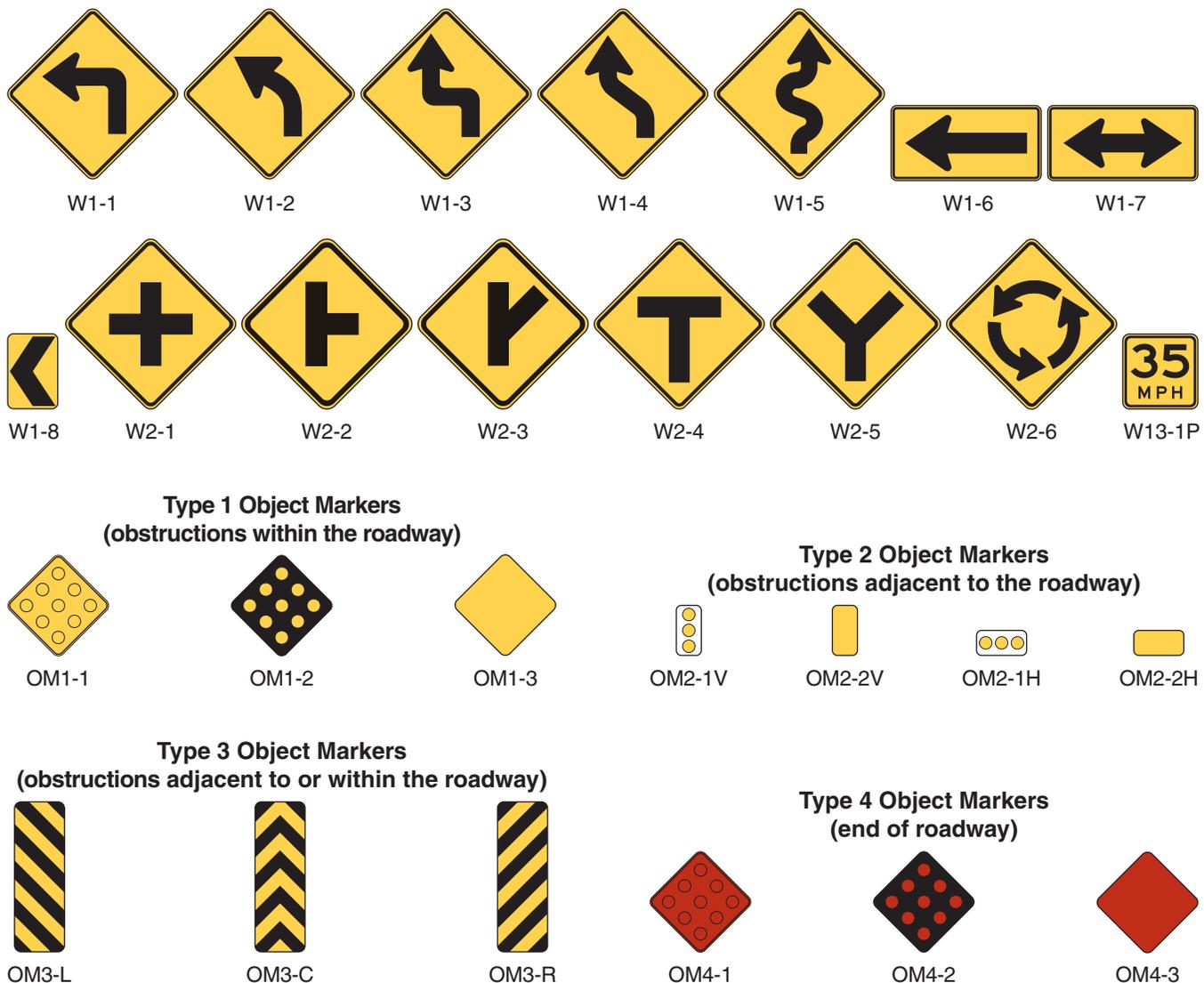
Support:

- 01 Horizontal Alignment signs (see Sections 2C.06 through 2C.12 and Figure 5C-1) include turn, curve, reverse turn, reverse curve, winding road, large arrow, and chevron alignment signs.

Option:

- 02 Horizontal Alignment signs may be used where engineering judgment indicates a need to inform the road user of a change in the horizontal alignment of the roadway.

**Figure 5C-1. Horizontal Alignment and Intersection Warning Signs and Plaques and Object Markers on Low-Volume Roads**



**Section 5C.03 Intersection Warning Signs (W2-1 through W2-6)**

Support:

- 01 Intersection signs (see Figure 5C-1) include the crossroad, side road, T-symbol, Y-symbol, and circular intersection signs.

Option:

- 02 Intersection signs may be used where engineering judgment indicates a need to inform the road user in advance of an intersection.

**Section 5C.04 Stop Ahead and Yield Ahead Signs (W3-1, W3-2)**

Standard:

- 01 A Stop Ahead (W3-1) sign (see Figure 5C-2) shall be used where a STOP sign is not visible for a sufficient distance to permit the road user to bring the vehicle to a stop at the STOP sign.
- 02 A Yield Ahead (W3-2) sign (see Figure 5C-2) shall be used where a YIELD sign is not visible for a sufficient distance to permit the road user to bring the vehicle to a stop, if necessary, at the YIELD sign.

**Section 5C.05 NARROW BRIDGE Sign (W5-2)**

Option:

- 01 The NARROW BRIDGE (W5-2) sign (see Figure 5C-2) may be used on an approach to a bridge or culvert that has a clear width less than that of the approach roadway.

**Section 5C.06 ONE LANE BRIDGE Sign (W5-3)**

Guidance:

- 01 A ONE LANE BRIDGE (W5-3) sign (see Figure 5C-2) should be used on low-volume two-way roadways in advance of any bridge or culvert:
- A. Having a clear roadway width of less than 16 feet, or
  - B. Having a clear roadway width of less than 18 feet when commercial vehicles constitute a high proportion of the traffic, or
  - C. Having a clear roadway width of 18 feet or less where the approach sight distance is limited on the approach to the structure.

Option:

- 02 Roadway alignment and additional warning may be provided on the approach to a bridge or culvert by the use of object markers and/or delineators.

**Section 5C.07 Hill Sign (W7-1)**

Option:

- 01 An engineering study of vehicles and road characteristics, such as percent grade and length of grade, may be conducted to determine hill signing requirements.

**Section 5C.08 PAVEMENT ENDS Sign (W8-3)**

Option:

- 01 A PAVEMENT ENDS (W8-3) sign (see Figure 5C-2) may be used to warn road users where a paved surface changes to a gravel or earth road surface.

**Section 5C.09 Vehicular Traffic Warning and Non-Vehicular Warning Signs (W11 Series and W8-6)**

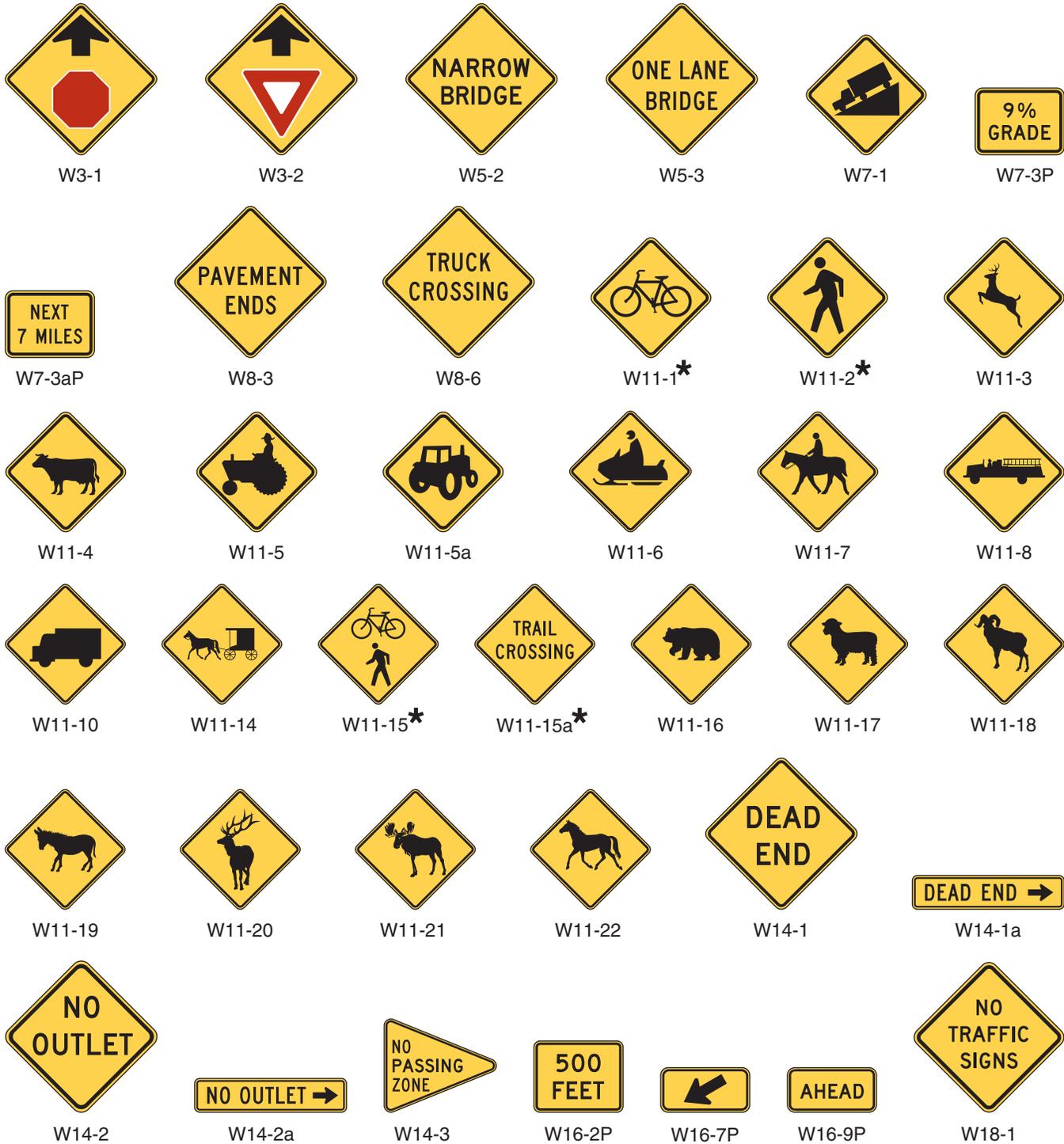
Guidance:

- 01 Vehicular Traffic Warning signs (see Figure 5C-2) should be used to alert road users to locations where frequent unexpected entries into the roadway by trucks, bicyclists, farm vehicles, fire trucks, and other vehicles might occur. Such signs should be used only at locations where the road user's sight distance is restricted or the condition, activity, or entering traffic would be unexpected.

Option:

- 02 Non-Vehicular Warning signs (see Figure 5C-2) may be used to alert road users in advance of locations where unexpected entries into the roadway or shared use by pedestrians, large animals, or other crossing activities might occur.
- 03 A W7-3aP, W16-2P, or W16-9P supplemental plaque (see Figure 5C-2), with the legend NEXT XX MILES, XX FEET, or AHEAD may be installed below a Vehicular Traffic Warning or Non-Vehicular Warning sign (see Sections 2C.49 and 2C.50) to inform road users that they are approaching a portion of the roadway or a point where crossing activity might occur.

Figure 5C-2. Other Warning Signs and Plaques on Low-Volume Roads



\* A fluorescent yellow-green background color may be used for this sign or plaque

**Standard:**

- 04 **When a Non-Vehicular Warning sign is placed at the location of the crossing point, a diagonal downward pointing arrow (W16-7P) plaque (see Figure 5C-2) shall be mounted below the sign.**

*Guidance:*

- 05 *If the activity is seasonal or temporary, the sign should be removed or covered when the condition or activity does not exist.*

**Section 5C.10 Advisory Speed Plaque (W13-1P)**

## Option:

- 01 An Advisory Speed (W13-1P) plaque (see Figure 5C-1) may be mounted below a warning sign when the condition requires a reduced speed.

**Section 5C.11 DEAD END or NO OUTLET Signs (W14-1, W14-1a, W14-2, W14-2a)**

## Option:

- 01 The DEAD END (W14-1) and NO OUTLET (W14-2) signs (see Figure 5C-2) and the DEAD END (W14-1a) and NO OUTLET (W14-2a) signs (see Figure 5C-2) may be used to warn road users of a road that has no outlet or that terminates in a dead end or cul-de-sac.

*Guidance:*

- 02 *If used, these signs should be placed at a location that gives drivers of large commercial or recreational vehicles an opportunity to select a different route or turn around.*

**Section 5C.12 NO TRAFFIC SIGNS Sign (W18-1)**

## Option:

- 01 A W18-1 warning sign (see Figure 5C-2) with the legend NO TRAFFIC SIGNS may be used only on unpaved, low-volume roads to advise users that no signs are installed along the distance of the road. If used, the sign may be installed at the point where road users would enter the low-volume road or where, based on engineering judgment, the road user might need this information.
- 02 A W7-3aP, W16-2P, or W16-9P supplemental plaque (see Figure 5C-2) with the legend NEXT XX MILES, XX FEET, or AHEAD may be installed below the W18-1 sign when appropriate.

**Section 5C.13 Other Warning Signs****Standard:**

- 01 **Other warning signs used on low-volume roads that are not discussed in Part 5, but are in this Manual, shall comply with the provisions contained in other Parts of this Manual. Warning signs that are not provided in this Manual shall comply with the provisions in Sections 2C.02 and 2C.03.**

**Section 5C.14 Object Markers and Barricades**

## Support:

- 01 The purpose of object markers is to mark obstructions located within or adjacent to the roadway, such as bridge abutments, drainage structures, and other physical objects.

*Guidance:*

- 02 *The end of a low-volume road should be marked with a Type 4 object marker in compliance with Section 2C.66.*

## Option:

- 03 A Type 3 Barricade may be used where engineering studies or judgment indicates a need for a more visible end-of-roadway treatment (see Section 2B.67).

**Standard:**

- 04 **Barricades used on low-volume roads shall comply with the provisions contained in Section 2B.67.**

## CHAPTER 5D. GUIDE SIGNS

### Section 5D.01 Introduction

#### Support:

- 01 The purpose of a guide sign is to inform road users regarding positions, directions, destinations, and routes.
- 02 The provisions for guide signs, in general, are contained in Chapters 2D through 2N and in other Sections of this Manual. Provisions for guide signs that are specific to low-volume roads are contained in this Chapter.

#### Guidance:

- 03 *The familiarity of the road users with the road should be considered in determining the need for guide signs on low-volume roads.*

#### Support:

- 04 Low-volume roads generally do not require guide signs to the extent that they are needed on higher classes of roads. Because guide signs are typically only beneficial as a navigational aid for road users who are unfamiliar with a low-volume road, guide signs might not be needed on low-volume roads that serve only local traffic.

#### Guidance:

- 05 *If used, destination names should be as specific and descriptive as possible. Destinations such as campgrounds, ranger stations, recreational areas, and the like should be clearly indicated so that they are not interpreted to be communities or locations with road user services.*

#### Option:

- 06 Guide signs may be used at intersections to provide information for road users returning to a higher class of roads.

## CHAPTER 5E. MARKINGS

### Section 5E.01 Introduction

#### Support:

- 01 The purpose of markings on highways is to provide guidance and information for road users regarding roadway conditions and restrictions.
- 02 The provisions for markings and delineators, in general, are contained in Part 3 and in other Sections of this Manual. Provisions for markings that are specific to low-volume roads are contained in this Chapter.

### Section 5E.02 Center Line Markings

#### Standard:

- 01 **Where center line markings are installed, no-passing zone markings in compliance with Section 3B.02 shall also be installed.**

#### Guidance:

- 02 *Center line markings should be used on paved low-volume roads consistent with the principles of this Manual and with the policies and practices of the road agency and on the basis of either an engineering study or the application of engineering judgment.*

#### Option:

- 03 Center line markings may be placed on highways with or without edge line markings.

### Section 5E.03 Edge Line Markings

#### Support:

- 01 The purpose of edge line markings is to delineate the left-hand or right-hand edge of the roadway.

#### Guidance:

- 02 *Edge line markings should be considered for use on paved low-volume roads based on engineering judgment or an engineering study.*

#### Option:

- 03 Edge line markings may be placed on highways with or without center line markings.
- 04 Edge line markings may be placed on paved low-volume roads for roadway features such as horizontal curves, narrow bridges, pavement width transitions, curvilinear alignment, and at other locations based on engineering judgment or an engineering study.

### Section 5E.04 Delineators

#### Support:

- 01 The purpose of delineators is to enhance driver safety where it is desirable to call attention to a changed or changing condition such as abrupt roadway narrowing or curvature.

#### Option:

- 02 Delineators may be used on low-volume roads based on engineering judgment, such as for curves, T-intersections, and abrupt changes in the roadway width. In addition, they may be used to mark the location of driveways or other minor roads entering the low-volume road.

### Section 5E.05 Other Markings

#### Standard:

- 01 **Other markings, such as stop lines, crosswalks, pavement legends, channelizing devices, and islands, used on low-volume roads shall comply with the provisions contained in this Manual.**

## CHAPTER 5F. TRAFFIC CONTROL FOR HIGHWAY-RAIL GRADE CROSSINGS

### Section 5F.01 Introduction

#### Support:

- 01 The provisions for highway-rail grade crossing traffic control devices are contained in Part 8 and in other Sections of this Manual.
- 02 Traffic control for highway-rail grade crossings includes all signs, signals, markings, illumination, and other warning devices and their supports along roadways either approaching or at highway-rail grade crossings. The purpose of this traffic control is to promote a safer and more efficient operation of both rail and highway traffic at highway-rail grade crossings.

### Section 5F.02 Grade Crossing (Crossbuck) Sign and Number of Tracks Plaque (R15-1, R15-2P)

#### Support:

- 01 In most States, the Grade Crossing (Crossbuck) (R15-1) sign (see Figure 5F-1) requires road users to yield the right-of-way to rail traffic at a highway-rail grade crossing.

#### Standard:

- 02 The Crossbuck (R15-1) sign shall be used at all highway-rail grade crossings, except as otherwise provided in Section 8B.03. For all low-volume roads, Crossbuck signs shall be used on the right-hand side of each approach. If there are two or more tracks, the supplemental Number of Tracks (R15-2P) plaque (see Figure 5F-1) shall display the number of tracks and shall be installed below the Crossbuck sign.
- 03 A strip of retroreflective white material not less than 2 inches in width shall be used on the back of each blade of each Crossbuck sign for the length of each blade, at all highway-rail grade crossings, except those where Crossbuck signs have been installed back-to-back.
- 04 A vertical strip of retroreflective white material, not less than 2 inches in width, shall be used on each support at passive highway-rail grade crossings for the full length of the front and back of the support from the Crossbuck sign or Number of Tracks plaque to within 2 feet above the ground, except on the side of those supports where a STOP (R1-1) or YIELD (R1-2) sign or flashing lights have been installed or on the back side of supports for Crossbuck signs installed on one-way streets.

### Section 5F.03 Grade Crossing Advance Warning Signs (W10 Series)

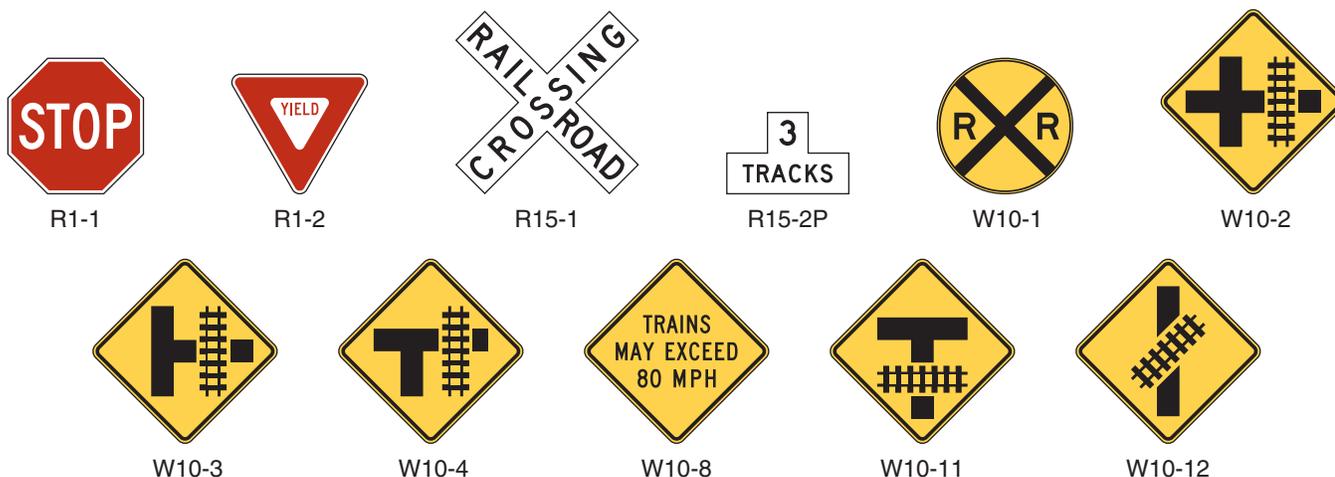
#### Standard:

- 01 Except as provided in Paragraph 2, a Grade Crossing Advance Warning (W10-1) sign (see Figure 5F-1) shall be used on all low-volume roads in advance of every highway-rail grade crossing.

#### Option:

- 02 The Grade Crossing Advance Warning sign may be omitted for highway-rail grade crossings that are flagged by train crews.
- 03 The W10-2, W10-3, and W10-4 signs (see Figure 5F-1) may be used on low-volume roads that run parallel to railroad tracks to warn road users making a turn that they will encounter a highway-rail grade crossing soon after making the turn.

Figure 5F-1. Highway-Rail Grade Crossing Signs and Plaques for Low-Volume Roads



**Section 5F.04 STOP and YIELD Signs (R1-1, R1-2)****Standard:**

- 01 **The use and application at passive highway-rail grade crossings on low-volume roads of Crossbuck Assemblies with YIELD (R1-2) signs or STOP (R1-1) signs shall comply with the provisions of Section 8B.04.**
- 02 **At all highway-rail grade crossings where YIELD or STOP signs are installed, Yield Ahead (W3-2) or Stop Ahead (W3-1) signs shall also be installed if the criteria for their installation in Section 2C.36 is met.**

**Section 5F.05 Pavement Markings***Guidance:*

- 01 *Pavement markings at highway-rail grade crossings should be used on paved low-volume roads, particularly if they are already deployed at most other highway-rail grade crossings within the immediate vicinity, or when the roadway has center line markings.*

**Section 5F.06 Other Traffic Control Devices****Standard:**

- 01 **Other traffic control devices that are used at highway-rail grade crossings on low-volume roads, such as other signs, signals, and illumination that are not in this Chapter, shall comply with the provisions contained in Part 8 and other applicable Parts of this Manual.**

## CHAPTER 5G. TEMPORARY TRAFFIC CONTROL ZONES

### Section 5G.01 Introduction

#### Guidance:

- 01 *The safety of road users, including pedestrians and bicyclists, as well as personnel in work zones, should be an integral and high priority element of every project in the planning, design, maintenance, and construction phases. Part 6 should be reviewed for additional criteria, specific details, and more complex temporary traffic control zone requirements. The following principles should be applied to temporary traffic control zones:*
- A. *Traffic movement should be disrupted as little as possible.*
  - B. *Road users should be guided in a clear and positive manner while approaching and within construction, maintenance, and utility work areas.*
  - C. *Routine inspection and maintenance of traffic control elements should be performed both day and night.*
  - D. *Both the contracting agency and the contractor should assign at least one person on each project to have day-to-day responsibility for assuring that the traffic control elements are operating effectively and any needed operational changes are brought to the attention of their supervisors.*
- 02 *Traffic control in temporary traffic control zones should be designed on the assumption that road users will only reduce their speeds if they clearly perceive a need to do so, and then only in small increments of speed. Temporary traffic control zones should not present a surprise to the road user. Frequent and/or abrupt changes in geometrics and other features should be avoided. Transitions should be well delineated and long enough to accommodate driving conditions at the speeds vehicles are realistically expected to travel.*
- 03 *A temporary traffic control plan (see Section 6C.01) should be used for a temporary traffic control zone on a low-volume road to specify particular traffic control devices and features, or to reference typical drawings such as those contained in Part 6.*

#### Support:

- 04 Applications of speed reduction countermeasures and enforcement can be effective in reducing traffic speeds in temporary traffic control zones.

### Section 5G.02 Applications

#### Guidance:

- 01 *Planned work phasing and sequencing should be the basis for the use of traffic control devices for temporary traffic control zones. Part 6 should be consulted for specific traffic control requirements and examples where construction or maintenance work is planned.*

#### Support:

- 02 Maintenance activities might not require extensive temporary traffic control if the traffic volumes and speeds are low.

#### Option:

- 03 The traffic applications shown in Figures 6H-1, 6H-10, 6H-11, 6H-13, 6H-15, 6H-16, and 6H-18 of Part 6 are among those that may be used on low-volume roads.

#### Support:

- 04 Table 6H-3 provides distances for the advance placement of the traffic control devices shown in the typical applications.

#### Option:

- 05 For low-volume roadways with speeds of 30 miles per hour or less, a minimum distance of 100 feet may be used for the advance placement distance and the distance between signs shown in the typical applications.
- 06 For temporary traffic control zones on low-volume roads that require flaggers, a single flagger may be adequate if the flagger is visible to approaching traffic from all appropriate directions.

### Section 5G.03 Channelization Devices

#### Standard:

- 01 **Channelization devices for nighttime use shall have the same retroreflective requirements as specified for higher-volume roadways.**

#### Option:

- 02 To alert, guide, and direct road users through temporary traffic control zones on low-volume roads, tapers may be used to move a road user out of the traffic lane and around the work space using the spacing of devices that is described in Section 6F.63.

## Section 5G.04 Markings

### Guidance:

- 01 *Pavement markings should be considered for temporary traffic control zones on paved low-volume roads, especially roads that had existing pavement markings or that have a surfaced detour or temporary roadway.*

### Option:

- 02 Interim pavement markings may be omitted in a temporary traffic control zone if they are not needed based on the criteria for these markings in Section 6F.78.

## Section 5G.05 Other Traffic Control Devices

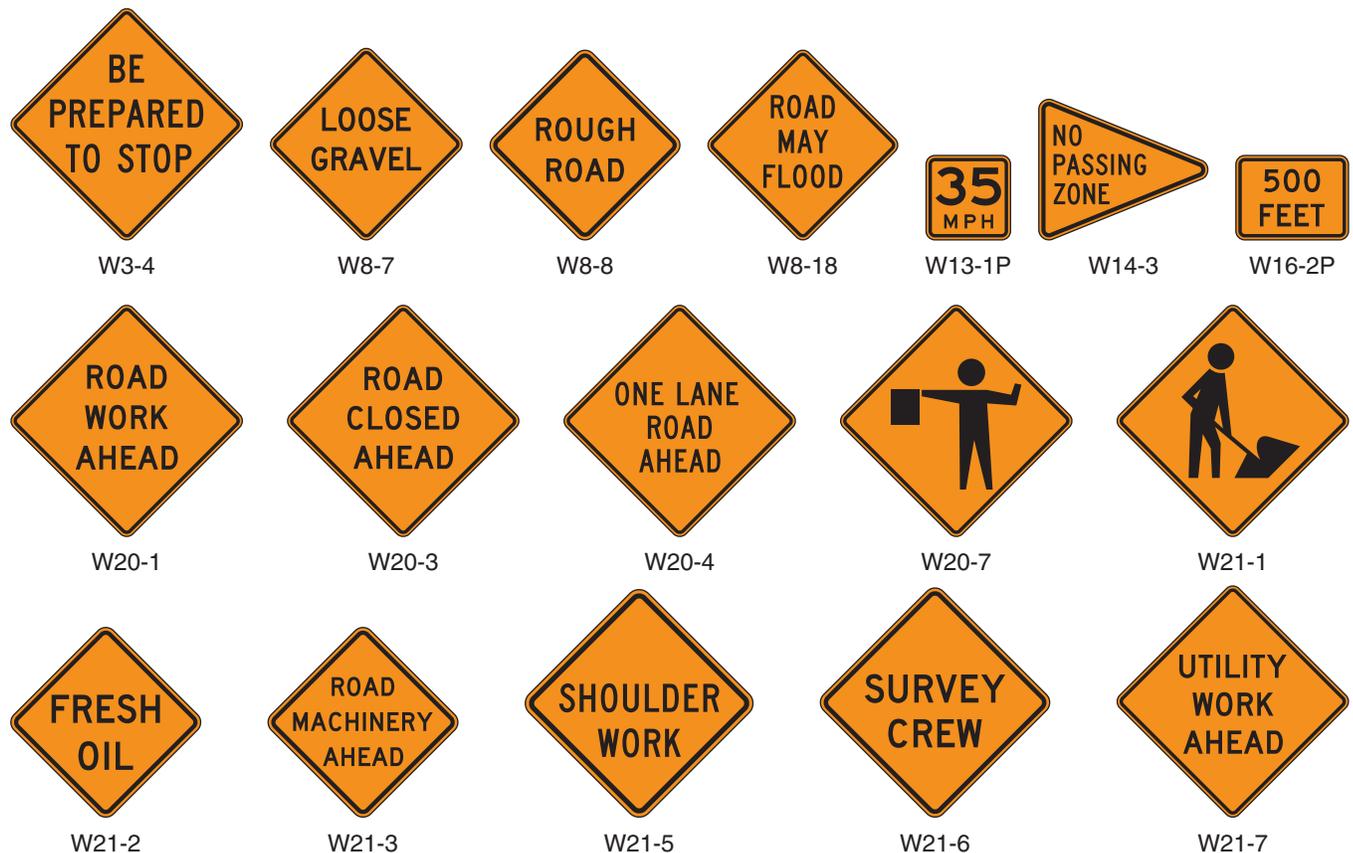
### Standard:

- 01 **Other traffic control devices, such as other signs, signals, and illumination that are used on low-volume roads in temporary traffic control zones, but are not described in Part 5, shall comply with the provisions contained in other Parts of this Manual.**

### Support:

- 02 Some of the signs that might be applicable in a temporary traffic control zone on a low-volume road are shown in Figure 5G-1.

**Figure 5G-1. Temporary Traffic Control Signs and Plaques on Low-Volume Roads**



## CHAPTER 5H. TRAFFIC CONTROL FOR SCHOOL AREAS

### Section 5H.01 Introduction

Support:

- 01 The provisions for school traffic control devices are contained in Part 7 of this Manual.

**Standard:**

- 02 **The sizes of school signs and plaques on low-volume roads shall be in accordance with Section 7B.01 and Table 7B-1.**

# PART 6

## TEMPORARY TRAFFIC CONTROL

### CHAPTER 6A. GENERAL

#### Section 6A.01 General

Support:

- 01 Whenever the acronym “TTC” is used in Part 6, it refers to “temporary traffic control.”

**Standard:**

- 02 **The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel (see definition in Section 1A.13), including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.**

Support:

- 03 When the normal function of the roadway, or a private road open to public travel, is suspended, TTC planning provides for continuity of the movement of motor vehicle, bicycle, and pedestrian traffic (including accessible passage); transit operations; and access (and accessibility) to property and utilities.
- 04 The primary function of TTC is to provide for the reasonably safe and effective movement of road users through or around TTC zones while reasonably protecting road users, workers, responders to traffic incidents, and equipment.
- 05 Of equal importance to the public traveling through the TTC zone is the safety of workers performing the many varied tasks within the work space. TTC zones present constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the workers and incident management responders on or near the roadway (see Section 6D.03). At the same time, the TTC zone provides for the efficient completion of whatever activity interrupted the normal use of the roadway.
- 06 Consideration for road user safety, worker and responder safety, and the efficiency of road user flow is an integral element of every TTC zone, from planning through completion. A concurrent objective of the TTC is the efficient construction and maintenance of the highway and the efficient resolution of traffic incidents.
- 07 No one set of TTC devices can satisfy all conditions for a given project or incident. At the same time, defining details that would be adequate to cover all applications is not practical. Instead, Part 6 displays typical applications that depict common applications of TTC devices. The TTC selected for each situation depends on type of highway, road user conditions, duration of operation, physical constraints, and the nearness of the work space or incident management activity to road users.
- 08 Improved road user performance might be realized through a well-prepared public relations effort that covers the nature of the work, the time and duration of its execution, the anticipated effects upon road users, and possible alternate routes and modes of travel. Such programs have been found to result in a significant reduction in the number of road users traveling through the TTC zone, which reduces the possible number of conflicts.
- 09 Operational improvements might be realized by using intelligent transportation systems (ITS) in work zones. The use in work zones of ITS technology, such as portable camera systems, highway advisory radio, variable speed limits, ramp metering, traveler information, merge guidance, and queue detection information, is aimed at increasing safety for both workers and road users and helping to ensure a more efficient traffic flow. The use in work zones of ITS technologies has been found to be effective in providing traffic monitoring and management, data collection, and traveler information.

**Standard:**

- 10 **TTC plans and devices shall be the responsibility of the authority of a public body or official having jurisdiction for guiding road users. There shall be adequate statutory authority for the implementation and enforcement of needed road user regulations, parking controls, speed zoning, and the management of traffic incidents. Such statutes shall provide sufficient flexibility in the application of TTC to meet the needs of changing conditions in the TTC zone.**

Support:

- 11 Temporary facilities, including pedestrian routes around worksites, are also covered by the accessibility requirements of the Americans with Disabilities Act of 1990 (ADA) (Public Law 101-336, 104 Stat. 327, July 26, 1990. 42 U.S.C. 12101-12213 (as amended)).

*Guidance:*

- 12 *The TTC plan should start in the planning phase and continue through the design, construction, and restoration phases. The TTC plans and devices should follow the principles set forth in Part 6. The management of traffic incidents should follow the principles set forth in Chapter 6I.*

*Option:*

- 13 TTC plans may deviate from the typical applications described in Chapter 6H to allow for conditions and requirements of a particular site or jurisdiction.

*Support:*

- 14 The provisions of Part 6 apply to both rural and urban areas. A rural highway is normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians. An urban street is typically characterized by relatively low speeds, wide ranges of road user volumes, narrower roadway lanes, frequent intersections and driveways, significant pedestrian activity, and more businesses and houses.
- 15 The determination as to whether a particular facility at a particular time of day can be considered to be a high-volume roadway or can be considered to be a low-volume roadway is made by the public agency or official having jurisdiction.

## CHAPTER 6B. FUNDAMENTAL PRINCIPLES

### Section 6B.01 Fundamental Principles of Temporary Traffic Control

Support:

- 01 Construction, maintenance, utility, and incident zones can all benefit from TTC to compensate for the unexpected or unusual situations faced by road users. When planning for TTC in these zones, it can be assumed that it is appropriate for road users to exercise caution. Even though road users are assumed to be using caution, special care is still needed in applying TTC techniques.
- 02 Special plans preparation and coordination with transit, other highway agencies, law enforcement and other emergency units, utilities, schools, and railroad companies might be needed to reduce unexpected and unusual road user operation situations.
- 03 During TTC activities, commercial vehicles might need to follow a different route from passenger vehicles because of bridge, weight, clearance, or geometric restrictions. Also, vehicles carrying hazardous materials might need to follow a different route from other vehicles. The Hazardous Materials and National Network signs are included in Sections 2B.62 and 2B.63, respectively.
- 04 Experience has shown that following the fundamental principles of Part 6 will assist road users and help protect workers in the vicinity of TTC zones.

Guidance:

- 05 *Road user and worker safety and accessibility in TTC zones should be an integral and high-priority element of every project from planning through design and construction. Similarly, maintenance and utility work should be planned and conducted with the safety and accessibility of all motorists, bicyclists, pedestrians (including those with disabilities), and workers being considered at all times. If the TTC zone includes a grade crossing, early coordination with the railroad company or light rail transit agency should take place.*

Support:

- 06 Formulating specific plans for TTC at traffic incidents is difficult because of the variety of situations that can arise.

Guidance:

- 07 *The following are the seven fundamental principles of TTC:*
1. *General plans or guidelines should be developed to provide safety for motorists, bicyclists, pedestrians, workers, enforcement/emergency officials, and equipment, with the following factors being considered:*
    - A. *The basic safety principles governing the design of permanent roadways and roadsides should also govern the design of TTC zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and TTC devices as nearly as possible comparable to those for normal highway situations.*
    - B. *A TTC plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by an official who is knowledgeable (for example, trained and/or certified) in proper TTC practices.*
  2. *Road user movement should be inhibited as little as practical, based on the following considerations:*
    - A. *TTC at work and incident sites should be designed on the assumption that drivers will only reduce their speeds if they clearly perceive a need to do so (see Section 6C.01).*
    - B. *Frequent and abrupt changes in geometrics such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers, should be avoided.*
    - C. *Work should be scheduled in a manner that minimizes the need for lane closures or alternate routes, while still getting the work completed quickly and the lanes or roadway open to traffic as soon as possible.*
    - D. *Attempts should be made to reduce the volume of traffic using the roadway or freeway to match the restricted capacity conditions. Road users should be encouraged to use alternative routes. For high-volume roadways and freeways, the closure of selected entrance ramps or other access points and the use of signed diversion routes should be evaluated.*
    - E. *Bicyclists and pedestrians, including those with disabilities, should be provided with access and reasonably safe passage through the TTC zone.*
    - F. *If work operations permit, lane closures on high-volume streets and highways should be scheduled during off-peak hours. Night work should be considered if the work can be accomplished with a series of short-term operations.*
    - G. *Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur if significant impacts to roadway operations are anticipated.*
  3. *Motorists, bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing TTC zones and incident sites. The following principles should be applied:*

- A. *Adequate warning, delineation, and channelization should be provided to assist in guiding road users in advance of and through the TTC zone or incident site by using proper pavement marking, signing, or other devices that are effective under varying conditions. Providing information that is in usable formats by pedestrians with visual disabilities should also be considered.*
- B. *TTC devices inconsistent with intended travel paths through TTC zones should be removed or covered. However, in intermediate-term stationary, short-term, and mobile operations, where visible permanent devices are inconsistent with intended travel paths, devices that highlight or emphasize the appropriate path should be used. Providing traffic control devices that are accessible to and usable by pedestrians with disabilities should be considered.*
- C. *Flagging procedures, when used, should provide positive guidance to road users traversing the TTC zone.*
4. *To provide acceptable levels of operations, routine day and night inspections of TTC elements should be performed as follows:*
  - A. *Individuals who are knowledgeable (for example, trained and/or certified) in the principles of proper TTC should be assigned responsibility for safety in TTC zones. The most important duty of these individuals should be to check that all TTC devices of the project are consistent with the TTC plan and are effective for motorists, bicyclists, pedestrians, and workers.*
  - B. *As the work progresses, temporary traffic controls and/or working conditions should be modified, if appropriate, in order to provide mobility and positive guidance to the road user and to provide worker safety. The individual responsible for TTC should have the authority to halt work until applicable or remedial safety measures are taken.*
  - C. *TTC zones should be carefully monitored under varying conditions of road user volumes, light, and weather to check that applicable TTC devices are effective, clearly visible, clean, and in compliance with the TTC plan.*
  - D. *When warranted, an engineering study should be made (in cooperation with law enforcement officials) of reported crashes occurring within the TTC zone. Crash records in TTC zones should be monitored to identify the need for changes in the TTC zone.*
5. *Attention should be given to the maintenance of roadside safety during the life of the TTC zone by applying the following principles:*
  - A. *To accommodate run-off-the-road incidents, disabled vehicles, or emergency situations, unencumbered roadside recovery areas or clear zones should be provided where practical.*
  - B. *Channelization of road users should be accomplished by the use of pavement markings, signing, and crashworthy, detectable channelizing devices.*
  - C. *Work equipment, workers' private vehicles, materials, and debris should be stored in such a manner to reduce the probability of being impacted by run-off-the-road vehicles.*
6. *Each person whose actions affect TTC zone safety, from the upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make. Only those individuals who are trained in proper TTC practices and have a basic understanding of the principles (established by applicable standards and guidelines, including those of this Manual) should supervise the selection, placement, and maintenance of TTC devices used for TTC zones and for incident management.*
7. *Good public relations should be maintained by applying the following principles:*
  - A. *The needs of all road users should be assessed such that appropriate advance notice is given and clearly defined alternative paths are provided.*
  - B. *The cooperation of the various news media should be sought in publicizing the existence of and reasons for TTC zones because news releases can assist in keeping the road users well informed.*
  - C. *The needs of abutting property owners, residents, and businesses should be assessed and appropriate accommodations made.*
  - D. *The needs of emergency service providers (law enforcement, fire, and medical) should be assessed and appropriate coordination and accommodations made.*
  - E. *The needs of railroads and transit should be assessed and appropriate coordination and accommodations made.*
  - F. *The needs of operators of commercial vehicles such as buses and large trucks should be assessed and appropriate accommodations made.*

**Standard:**

- 08 **Before any new detour or temporary route is opened to traffic, all necessary signs shall be in place.**
- 09 **All TTC devices shall be removed as soon as practical when they are no longer needed. When work is suspended for short periods of time, TTC devices that are no longer appropriate shall be removed or covered.**

## CHAPTER 6C. TEMPORARY TRAFFIC CONTROL ELEMENTS

### Section 6C.01 Temporary Traffic Control Plans

#### Support:

- 01 A TTC plan describes TTC measures to be used for facilitating road users through a work zone or an incident area. TTC plans play a vital role in providing continuity of effective road user flow when a work zone, incident, or other event temporarily disrupts normal road user flow. Important auxiliary provisions that cannot conveniently be specified on project plans can easily be incorporated into Special Provisions within the TTC plan.
- 02 TTC plans range in scope from being very detailed to simply referencing typical drawings contained in this Manual, standard approved highway agency drawings and manuals, or specific drawings contained in the contract documents. The degree of detail in the TTC plan depends entirely on the nature and complexity of the situation.

#### Guidance:

- 03 *TTC plans should be prepared by persons knowledgeable (for example, trained and/or certified) about the fundamental principles of TTC and work activities to be performed. The design, selection, and placement of TTC devices for a TTC plan should be based on engineering judgment.*
- 04 *Coordination should be made between adjacent or overlapping projects to check that duplicate signing is not used and to check compatibility of traffic control between adjacent or overlapping projects.*
- 05 *Traffic control planning should be completed for all highway construction, utility work, maintenance operations, and incident management including minor maintenance and utility projects prior to occupying the TTC zone. Planning for all road users should be included in the process.*
- 06 *Provisions for effective continuity of accessible circulation paths for pedestrians should be incorporated into the TTC process. Where existing pedestrian routes are blocked or detoured, information should be provided about alternative routes that are usable by pedestrians with disabilities, particularly those who have visual disabilities. Access to temporary bus stops, travel across intersections with accessible pedestrian signals (see Section 4E.09), and other routing issues should be considered where temporary pedestrian routes are channelized. Barriers and channelizing devices that are detectable by people with visual disabilities should be provided.*

#### Option:

- 07 Provisions may be incorporated into the project bid documents that enable contractors to develop an alternate TTC plan.
- 08 Modifications of TTC plans may be necessary because of changed conditions or a determination of better methods of safely and efficiently handling road users.

#### Guidance:

- 09 *This alternate or modified plan should have the approval of the responsible highway agency prior to implementation.*
- 10 *Provisions for effective continuity of transit service should be incorporated into the TTC planning process because often public transit buses cannot efficiently be detoured in the same manner as other vehicles (particularly for short-term maintenance projects). Where applicable, the TTC plan should provide for features such as accessible temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, including persons with disabilities, if applicable (see Section 8A.08 for additional light rail transit issues to consider for TTC).*
- 11 *Provisions for effective continuity of railroad service and acceptable access to abutting property owners and businesses should also be incorporated into the TTC planning process.*
- 12 *Reduced speed limits should be used only in the specific portion of the TTC zone where conditions or restrictive features are present. However, frequent changes in the speed limit should be avoided. A TTC plan should be designed so that vehicles can travel through the TTC zone with a speed limit reduction of no more than 10 mph.*
- 13 *A reduction of more than 10 mph in the speed limit should be used only when required by restrictive features in the TTC zone. Where restrictive features justify a speed reduction of more than 10 mph, additional driver notification should be provided. The speed limit should be stepped down in advance of the location requiring the lowest speed, and additional TTC warning devices should be used.*
- 14 *Reduced speed zoning (lowering the regulatory speed limit) should be avoided as much as practical because drivers will reduce their speeds only if they clearly perceive a need to do so.*

## Support:

- 15 Research has demonstrated that large reductions in the speed limit, such as a 30 mph reduction, increase speed variance and the potential for crashes. Smaller reductions in the speed limit of up to 10 mph cause smaller changes in speed variance and lessen the potential for increased crashes. A reduction in the regulatory speed limit of only up to 10 mph from the normal speed limit has been shown to be more effective.

**Section 6C.02 Temporary Traffic Control Zones**

## Support:

- 01 A TTC zone is an area of a highway where road user conditions are changed because of a work zone, an incident zone, or a planned special event through the use of TTC devices, uniformed law enforcement officers, or other authorized personnel.
- 02 A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC device.
- 03 An incident zone is an area of a highway where temporary traffic controls are imposed by authorized officials in response to a traffic incident (see Section 6I.01). It extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where road users return to the original lane alignment and are clear of the incident.
- 04 A planned special event often creates the need to establish altered traffic patterns to handle the increased traffic volumes generated by the event. The size of the TTC zone associated with a planned special event can be small, such as closing a street for a festival, or can extend throughout a municipality for larger events. The duration of the TTC zone is determined by the duration of the planned special event.

**Section 6C.03 Components of Temporary Traffic Control Zones**

## Support:

- 01 Most TTC zones are divided into four areas: the advance warning area, the transition area, the activity area, and the termination area. Figure 6C-1 illustrates these four areas. These four areas are described in Sections 6C.04 through 6C.07.

**Section 6C.04 Advance Warning Area**

## Support:

- 01 The advance warning area is the section of highway where road users are informed about the upcoming work zone or incident area.

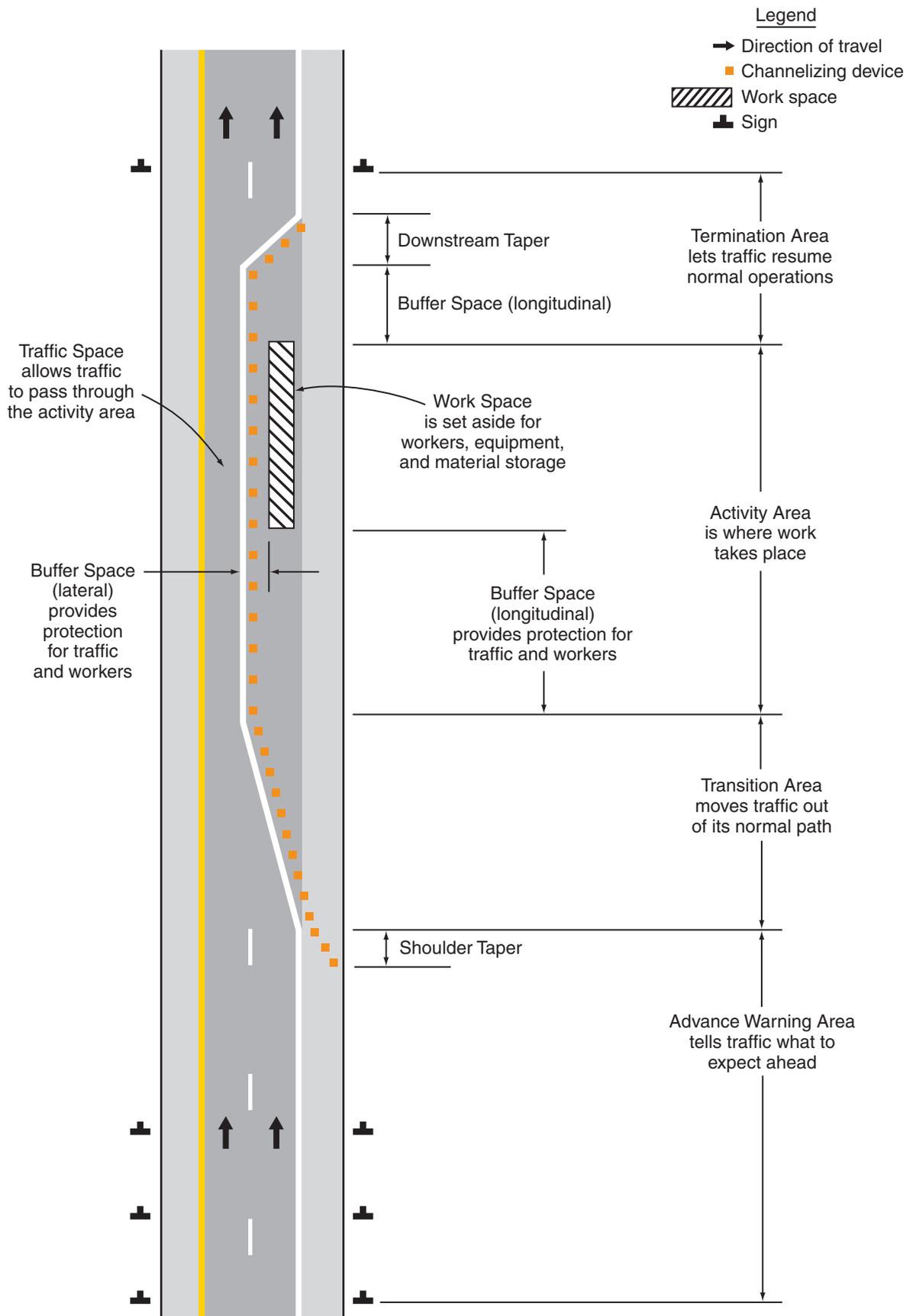
## Option:

- 02 The advance warning area may vary from a single sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to a series of signs in advance of the TTC zone activity area.

*Guidance:*

- 03 *Typical distances for placement of advance warning signs on freeways and expressways should be longer because drivers are conditioned to uninterrupted flow. Therefore, the advance warning sign placement should extend on these facilities as far as 1/2 mile or more.*
- 04 *On urban streets, the effective placement of the first warning sign in feet should range from 4 to 8 times the speed limit in mph, with the high end of the range being used when speeds are relatively high. When a single advance warning sign is used (in cases such as low-speed residential streets), the advance warning area can be as short as 100 feet. When two or more advance warning signs are used on higher-speed streets, such as major arterials, the advance warning area should extend a greater distance (see Table 6C-1).*
- 05 *Since rural highways are normally characterized by higher speeds, the effective placement of the first warning sign in feet should be substantially longer—from 8 to 12 times the speed limit in mph. Since two or more advance warning signs are normally used for these conditions, the advance warning area should extend 1,500 feet or more for open highway conditions (see Table 6C-1).*
- 06 *The distances contained in Table 6C-1 are approximate, are intended for guidance purposes only, and should be applied with engineering judgment. These distances should be adjusted for field conditions, if necessary, by increasing or decreasing the recommended distances.*

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



**Table 6C-1. Recommended Advance Warning Sign Minimum Spacing**

Road Type	Distance Between Signs**		
	A	B	C
Urban (low speed)*	100 feet	100 feet	100 feet
Urban (high speed)*	350 feet	350 feet	350 feet
Rural	500 feet	500 feet	500 feet
Expressway / Freeway	1,000 feet	1,500 feet	2,640 feet

\* Speed category to be determined by the highway agency

\*\* The column headings A, B, and C are the dimensions shown in Figures 6H-1 through 6H-46. The A dimension is the distance from the transition or point of restriction to the first sign. The B dimension is the distance between the first and second signs. The C dimension is the distance between the second and third signs. (The "first sign" is the sign in a three-sign series that is closest to the TTC zone. The "third sign" is the sign that is furthest upstream from the TTC zone.)

#### Support:

07 The need to provide additional reaction time for a condition is one example of justification for increasing the sign spacing. Conversely, decreasing the sign spacing might be justified in order to place a sign immediately downstream of an intersection or major driveway such that traffic turning onto the roadway in the direction of the TTC zone will be warned of the upcoming condition.

#### Option:

08 Advance warning may be eliminated when the activity area is sufficiently removed from the road users' path so that it does not interfere with the normal flow.

### **Section 6C.05 Transition Area**

#### Support:

01 The transition area is that section of highway where road users are redirected out of their normal path. Transition areas usually involve strategic use of tapers, which because of their importance are discussed separately in detail.

#### Standard:

02 **When redirection of the road users' normal path is required, they shall be directed from the normal path to a new path.**

#### Option:

03 Because it is impractical in mobile operations to redirect the road user's normal path with stationary channelization, more dominant vehicle-mounted traffic control devices, such as arrow boards, portable changeable message signs, and high-intensity rotating, flashing, oscillating, or strobe lights, may be used instead of channelizing devices to establish a transition area.

### **Section 6C.06 Activity Area**

#### Support:

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

02 The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream. Work spaces are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

#### Option:

03 The work space may be stationary or may move as work progresses.

#### Guidance:

04 *Since there might be several work spaces (some even separated by several miles) within the project limits, each work space should be adequately signed to inform road users and reduce confusion.*

#### Support:

05 The traffic space is the portion of the highway in which road users are routed through the activity area.

06 The buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

*Guidance:*

07 *Neither work activity nor storage of equipment, vehicles, or material should occur within a buffer space.*

*Option:*

08 Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of road user flow. The activity area may contain one or more lateral or longitudinal buffer spaces.

09 A longitudinal buffer space may be placed in advance of a work space.

10 The longitudinal buffer space may also be used to separate opposing road user flows that use portions of the same traffic lane, as shown in Figure 6C-2.

11 If a longitudinal buffer space is used, the values shown in Table 6C-2 may be used to determine the length of the longitudinal buffer space.

*Support:*

12 Typically, the buffer space is formed as a traffic island and defined by channelizing devices.

13 When a shadow vehicle, arrow board, or changeable message sign is placed in a closed lane in advance of a work space, only the area upstream of the vehicle, arrow board, or changeable message sign constitutes the buffer space.

*Option:*

14 The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figures 6C-1 and 6C-2, or such areas as excavations or pavement-edge drop-offs. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows.

*Guidance:*

15 *The width of a lateral buffer space should be determined by engineering judgment.*

*Option:*

16 When work occurs on a high-volume, highly congested facility, a vehicle storage or staging space may be provided for incident response and emergency vehicles (for example, tow trucks and fire apparatus) so that these vehicles can respond quickly to road user incidents.

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

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

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

**Section 6C.07 Termination Area**

*Support:*

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

*Option:*

02 An END ROAD WORK sign, a Speed Limit sign, or other signs may be used to inform road users that they can resume normal operations.

03 A longitudinal buffer space may be used between the work space and the beginning of the downstream taper.

**Section 6C.08 Tapers**

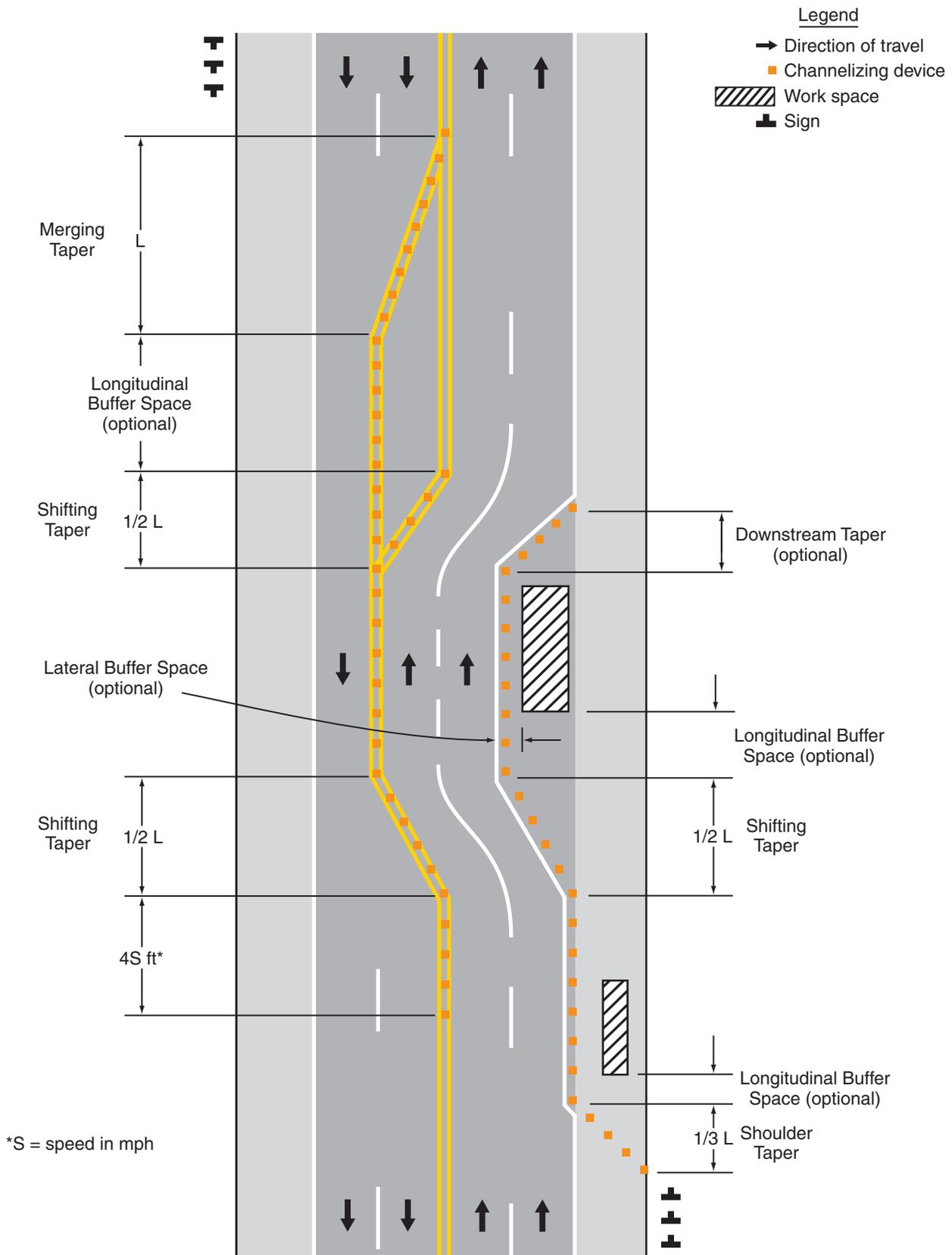
*Option:*

01 Tapers may be used in both the transition and termination areas. Whenever tapers are to be used in close proximity to an interchange ramp, crossroads, curves, or other influencing factors, the length of the tapers may be adjusted.

*Support:*

02 Tapers are created by using a series of channelizing devices and/or pavement markings to move traffic out of or into the normal path. Types of tapers are shown in Figure 6C-2.

Figure 6C-2. Types of Tapers and Buffer Spaces



03 Longer tapers are not necessarily better than shorter tapers (particularly in urban areas with characteristics such as short block lengths or driveways) because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The test concerning adequate lengths of tapers involves observation of driver performance after TTC plans are put into effect.

*Guidance:*

04 *The appropriate taper length (L) should be determined using the criteria shown in Tables 6C-3 and 6C-4.*

05 *The maximum distance in feet between devices in a taper should not exceed 1.0 times the speed limit in mph.*

*Support:*

06 A merging taper requires the longest distance because drivers are required to merge into common road space.

*Guidance:*

07 *A merging taper should be long enough to enable merging drivers to have adequate advance warning and sufficient length to adjust their speeds and merge into an adjacent lane before the downstream end of the transition.*

*Support:*

08 A shifting taper is used when a lateral shift is needed. When more space is available, a longer than minimum taper distance can be beneficial. Changes in alignment can also be accomplished by using horizontal curves designed for normal highway speeds.

*Guidance:*

09 *A shifting taper should have a length of approximately 1/2 L (see Tables 6C-3 and 6C-4).*

*Support:*

10 A shoulder taper might be beneficial on a high-speed roadway where shoulders are part of the activity area and are closed, or when improved shoulders might be mistaken as a driving lane. In these instances, the same type, but abbreviated, closure procedures used on a normal portion of the roadway can be used.

*Guidance:*

11 *If used, shoulder tapers should have a length of approximately 1/3 L (see Tables 6C-3 and 6C-4). If a shoulder is used as a travel lane, either through practice or during a TTC activity, a normal merging or shifting taper should be used.*

*Support:*

12 A downstream taper might be useful in termination areas to provide a visual cue to the driver that access is available back into the original lane or path that was closed.

*Guidance:*

13 *If used, a downstream taper should have a minimum length of 50 feet and a maximum length of 100 feet with devices placed at a spacing of approximately 20 feet.*

*Support:*

14 The one-lane, two-way taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction.

*Guidance:*

15 *Traffic should be controlled by a flagger or temporary traffic control signal (if sight distance is limited), or a STOP or YIELD sign. A short taper having a minimum length of 50 feet and a maximum length of 100 feet with channelizing devices at approximately 20-foot spacing should be used to guide traffic into the one-lane section, and a downstream taper should be used to guide traffic back into their original lane.*

**Table 6C-3. Taper Length Criteria for Temporary Traffic Control Zones**

Type of Taper	Taper Length
Merging Taper	at least L
Shifting Taper	at least 0.5 L
Shoulder Taper	at least 0.33 L
One-Lane, Two-Way Traffic Taper	50 feet minimum, 100 feet maximum
Downstream Taper	50 feet minimum, 100 feet maximum

Note: Use Table 6C-4 to calculate L

**Table 6C-4. Formulas for Determining Taper Length**

Speed (S)	Taper Length (L) in feet
40 mph or less	$L = \frac{WS^2}{60}$
45 mph or more	$L = WS$

Where: L = taper length in feet  
 W = width of offset in feet  
 S = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph

Support:

- 16 An example of a one-lane, two-way traffic taper is shown in Figure 6C-3.

### **Section 6C.09 Detours and Diversions**

Support:

- 01 A detour is a temporary rerouting of road users onto an existing highway in order to avoid a TTC zone.

Guidance:

- 02 Detours should be clearly signed over their entire length so that road users can easily use existing highways to return to the original highway.

Support:

- 03 A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work area.

### **Section 6C.10 One-Lane, Two-Way Traffic Control**

**Standard:**

- 01 **Except as provided in Paragraph 5, when traffic in both directions must use a single lane for a limited distance, movements from each end shall be coordinated.**

*Guidance:*

- 02 *Provisions should be made for alternate one-way movement through the constricted section via methods such as flagger control, a flag transfer, a pilot car, traffic control signals, or stop or yield control.*

- 03 *Control points at each end should be chosen to permit easy passing of opposing lanes of vehicles.*

- 04 *If traffic on the affected one-lane roadway is not visible from one end to the other, then flagging procedures, a pilot car with a flagger used as described in Section 6C.13, or a traffic control signal should be used to control opposing traffic flows.*

Option:

- 05 If the work space on a low-volume street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the worksite, the movement of traffic through a one-lane, two-way constriction may be self-regulating.

### **Section 6C.11 Flagger Method of One-Lane, Two-Way Traffic Control**

*Guidance:*

- 01 *Except as provided in Paragraph 2, traffic should be controlled by a flagger at each end of a constricted section of roadway. One of the flaggers should be designated as the coordinator. To provide coordination of the control of the traffic, the flaggers should be able to communicate with each other orally, electronically, or with manual signals. These manual signals should not be mistaken for flagging signals.*

Option:

- 02 When a one-lane, two-way TTC zone is short enough to allow a flagger to see from one end of the zone to the other, traffic may be controlled by either a single flagger or by a flagger at each end of the section.

*Guidance:*

- 03 *When a single flagger is used, the flagger should be stationed on the shoulder opposite the constriction or work space, or in a position where good visibility and traffic control can be maintained at all times. When good visibility and traffic control cannot be maintained by one flagger station, traffic should be controlled by a flagger at each end of the section.*

### **Section 6C.12 Flag Transfer Method of One-Lane, Two-Way Traffic Control**

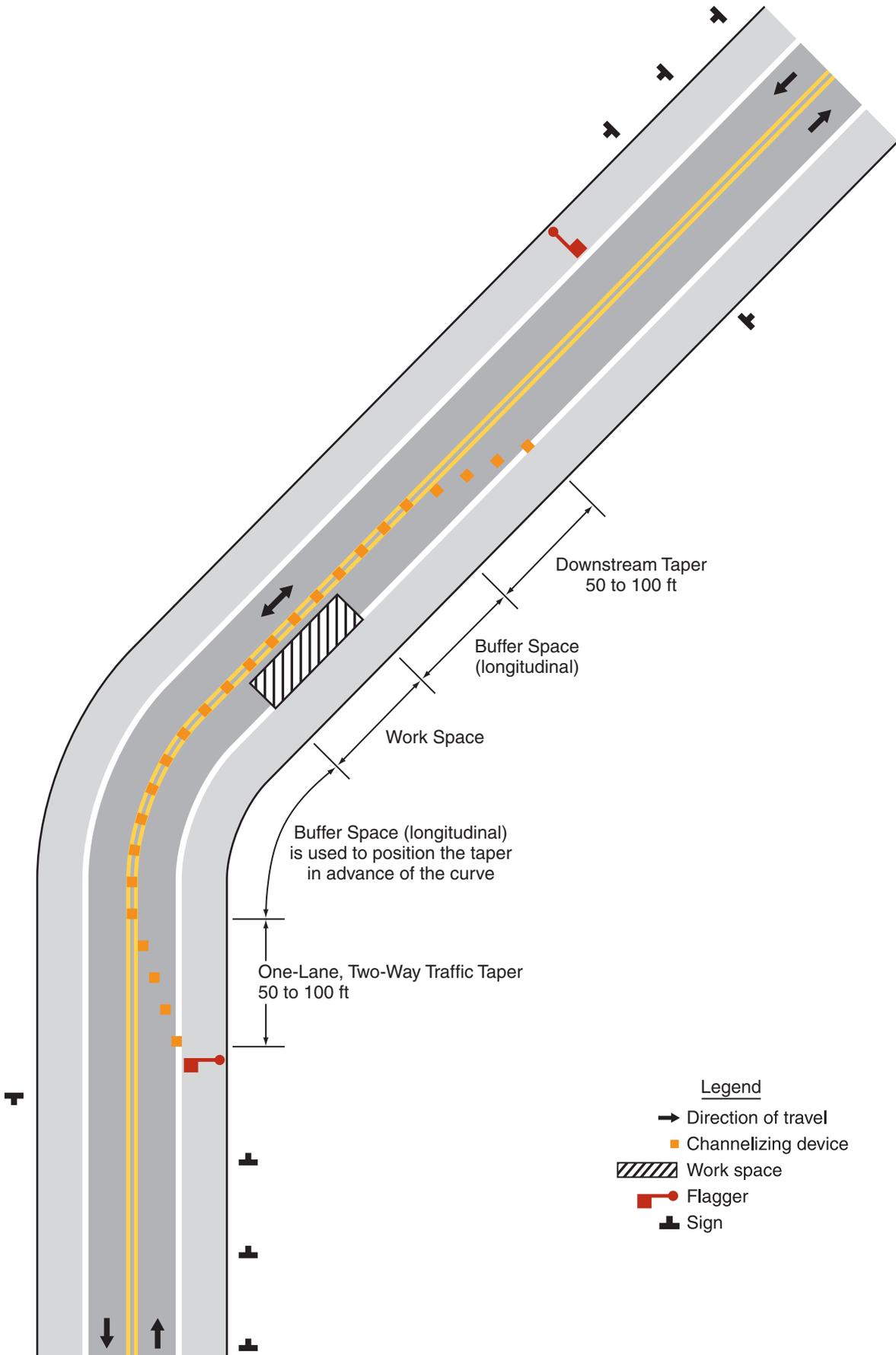
Support:

- 01 The driver of the last vehicle proceeding into the one-lane section is given a red flag (or other token) and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that traffic can be permitted to move in the other direction. A variation of this method is to replace the use of a flag with an official pilot car that follows the last road user vehicle proceeding through the section.

*Guidance:*

- 02 *The flag transfer method should be employed only where the one-way traffic is confined to a relatively short length of a road, usually no more than 1 mile in length.*

Figure 6C-3. Example of a One-Lane, Two-Way Traffic Taper



**Section 6C.13 Pilot Car Method of One-Lane, Two-Way Traffic Control**

## Option:

- 01 A pilot car may be used to guide a queue of vehicles through the TTC zone or detour.

*Guidance:*

- 02 *The pilot car should have the name of the contractor or contracting authority prominently displayed.*

**Standard:**

- 03 **The PILOT CAR FOLLOW ME (G20-4) sign (see Section 6F.58) shall be mounted on the rear of the pilot vehicle.**

- 04 **A flagger shall be stationed on the approach to the activity area to control vehicular traffic until the pilot vehicle is available.**

**Section 6C.14 Temporary Traffic Control Signal Method of One-Lane, Two-Way Traffic Control**

## Option:

- 01 Traffic control signals may be used to control vehicular traffic movements in one-lane, two-way TTC zones (see Figure 6H-12 and Chapter 4H).

**Section 6C.15 Stop or Yield Control Method of One-Lane, Two-Way Traffic Control**

## Option:

- 01 STOP or YIELD signs may be used to control traffic on low-volume roads at a one-lane, two-way TTC zone when drivers are able to see the other end of the one-lane, two-way operation and have sufficient visibility of approaching vehicles.

*Guidance:*

- 02 *If the STOP or YIELD sign is installed for only one direction, then the STOP or YIELD sign should face road users who are driving on the side of the roadway that is closed for the work activity area.*

## CHAPTER 6D. PEDESTRIAN AND WORKER SAFETY

### Section 6D.01 Pedestrian Considerations

#### Support:

- 01 A wide range of pedestrians might be affected by TTC zones, including the young, elderly, and people with disabilities such as hearing, visual, or mobility. These pedestrians need a clearly delineated and usable travel path. Considerations for pedestrians with disabilities are addressed in Section 6D.02.

#### Standard:

- 02 **The various TTC provisions for pedestrian and worker safety set forth in Part 6 shall be applied by knowledgeable (for example, trained and/or certified) persons after appropriate evaluation and engineering judgment.**
- 03 **Advance notification of sidewalk closures shall be provided by the maintaining agency.**
- 04 **If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.**

#### Option:

- 05 If establishing or maintaining an alternate pedestrian route is not feasible during the project, an alternate means of providing for pedestrians may be used, such as adding free bus service around the project or assigning someone the responsibility to assist pedestrians with disabilities through the project limits.

#### Support:

- 06 It must be recognized that pedestrians are reluctant to retrace their steps to a prior intersection for a crossing or to add distance or out-of-the-way travel to a destination.

#### Guidance:

- 07 *The following three items should be considered when planning for pedestrians in TTC zones:*
- A. *Pedestrians should not be led into conflicts with vehicles, equipment, and operations.*
  - B. *Pedestrians should not be led into conflicts with vehicles moving through or around the worksite.*
  - C. *Pedestrians should be provided with a convenient and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or footpath(s).*
- 08 *A pedestrian route should not be severed and/or moved for non-construction activities such as parking for vehicles and equipment.*
- 09 *Consideration should be made to separate pedestrian movements from both worksite activity and vehicular traffic. Unless an acceptable route that does not involve crossing the roadway can be provided, pedestrians should be appropriately directed with advance signing that encourages them to cross to the opposite side of the roadway. In urban and suburban areas with high vehicular traffic volumes, these signs should be placed at intersections (rather than midblock locations) so that pedestrians are not confronted with midblock worksites that will induce them to attempt skirting the worksite or making a midblock crossing.*

#### Support:

- 10 Figures 6H-28 and 6H-29 show typical TTC device usage and techniques for pedestrian movement through work zones.

#### Guidance:

- 11 *To accommodate the needs of pedestrians, including those with disabilities, the following considerations should be addressed when temporary pedestrian pathways in TTC zones are designed or modified:*
- A. *Provisions for continuity of accessible paths for pedestrians should be incorporated into the TTC plan.*
  - B. *Access to transit stops should be maintained.*
  - C. *A smooth, continuous hard surface should be provided throughout the entire length of the temporary pedestrian facility. There should be no curbs or abrupt changes in grade or terrain that could cause tripping or be a barrier to wheelchair use. The geometry and alignment of the facility should meet the applicable requirements of the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11).*
  - D. *The width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility. When it is not possible to maintain a minimum width of 60 inches throughout the entire length of the pedestrian pathway, a 60 x 60-inch passing space should be provided at least every 200 feet to allow individuals in wheelchairs to pass.*

- E. *Blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing devices such as audible information devices, accessible pedestrian signals, or barriers and channelizing devices that are detectable to the pedestrians traveling with the aid of a long cane or who have low vision. Where pedestrian traffic is detoured to a TTC signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals should be considered for crossings along an alternate route.*
- F. *When channelization is used to delineate a pedestrian pathway, a continuous detectable edging should be provided throughout the length of the facility such that pedestrians using a long cane can follow it. These detectable edgings should comply with the provisions of Section 6F.74.*
- G. *Signs and other devices mounted lower than 7 feet above the temporary pedestrian pathway should not project more than 4 inches into accessible pedestrian facilities.*

**Option:**

- 12 Whenever it is feasible, closing off the worksite from pedestrian intrusion may be preferable to channelizing pedestrian traffic along the site with TTC devices.

**Guidance:**

- 13 *Fencing should not create sight distance restrictions for road users. Fences should not be constructed of materials that would be hazardous if impacted by vehicles. Wooden railing, fencing, and similar systems placed immediately adjacent to motor vehicle traffic should not be used as substitutes for crashworthy temporary traffic barriers.*
- 14 *Ballast for TTC devices should be kept to the minimum amount needed and should be mounted low to prevent penetration of the vehicle windshield.*
- 15 *Movement by work vehicles and equipment across designated pedestrian paths should be minimized and, when necessary, should be controlled by flaggers or TTC. Staging or stopping of work vehicles or equipment along the side of pedestrian paths should be avoided, since it encourages movement of workers, equipment, and materials across the pedestrian path.*
- 16 *Access to the work space by workers and equipment across pedestrian walkways should be minimized because the access often creates unacceptable changes in grade, and rough or muddy terrain, and pedestrians will tend to avoid these areas by attempting non-intersection crossings where no curb ramps are available.*

**Option:**

- 17 A canopied walkway may be used to protect pedestrians from falling debris, and to provide a covered passage for pedestrians.

**Guidance:**

- 18 *Covered walkways should be sturdily constructed and adequately lighted for nighttime use.*
- 19 *When pedestrian and vehicle paths are rerouted to a closer proximity to each other, consideration should be given to separating them by a temporary traffic barrier.*
- 20 *If a temporary traffic barrier is used to shield pedestrians, it should be designed to accommodate site conditions.*

**Support:**

- 21 Depending on the possible vehicular speed and angle of impact, temporary traffic barriers might deflect upon impact by an errant vehicle. Guidance for locating and designing temporary traffic barriers can be found in Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11).

**Standard:**

- 22 **Short intermittent segments of temporary traffic barrier shall not be used because they nullify the containment and redirective capabilities of the temporary traffic barrier, increase the potential for serious injury both to vehicle occupants and pedestrians, and encourage the presence of blunt, leading ends. All upstream leading ends that are present shall be appropriately flared or protected with properly installed and maintained crashworthy cushions. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly.**
- 23 **Normal vertical curbing shall not be used as a substitute for temporary traffic barriers when temporary traffic barriers are needed.**

**Option:**

- 24 Temporary traffic barriers or longitudinal channelizing devices may be used to discourage pedestrians from unauthorized movements into the work space. They may also be used to inhibit conflicts with vehicular traffic by minimizing the possibility of midblock crossings.

**Support:**

- 25 A major concern for pedestrians is urban and suburban building construction encroaching onto the contiguous sidewalks, which forces pedestrians off the curb into direct conflict with moving vehicles.

*Guidance:*

- 26 *If a significant potential exists for vehicle incursions into the pedestrian path, pedestrians should be rerouted or temporary traffic barriers should be installed.*

**Support:**

- 27 TTC devices, jersey barriers, and wood or chain link fencing with a continuous detectable edging can satisfactorily delineate a pedestrian path.

*Guidance:*

- 28 *Tape, rope, or plastic chain strung between devices are not detectable, do not comply with the design standards in the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11), and should not be used as a control for pedestrian movements.*

- 29 *In general, pedestrian routes should be preserved in urban and commercial suburban areas. Alternative routing should be discouraged.*

- 30 *The highway agency in charge of the TTC zone should regularly inspect the activity area so that effective pedestrian TTC is maintained.*

**Section 6D.02 Accessibility Considerations****Support:**

- 01 Additional information on the design and construction of accessible temporary facilities is found in publications listed in Section 1A.11 (see Publications 12, 38, 39, and 42).

*Guidance:*

- 02 *The extent of pedestrian needs should be determined through engineering judgment or by the individual responsible for each TTC zone situation. Adequate provisions should be made for pedestrians with disabilities.*

**Standard:**

- 03 **When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier that is detectable by a person with a visual disability traveling with the aid of a long cane shall be placed across the full width of the closed sidewalk.**

**Support:**

- 04 Maintaining a detectable, channelized pedestrian route is much more useful to pedestrians who have visual disabilities than closing a walkway and providing audible directions to an alternate route involving additional crossings and a return to the original route. Braille is not useful in conveying such information because it is difficult to find. Audible instructions might be provided, but the extra distance and additional street crossings might add complexity to a trip.

*Guidance:*

- 05 *Because printed signs and surface delineation are not usable by pedestrians with visual disabilities, blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing audible information devices, accessible pedestrian signals, and barriers and channelizing devices that are detectable to pedestrians traveling with the aid of a long cane or who have low vision.*

**Support:**

- 06 The most desirable way to provide information to pedestrians with visual disabilities that is equivalent to visual signing for notification of sidewalk closures is a speech message provided by an audible information device. Devices that provide speech messages in response to passive pedestrian actuation are the most desirable. Other devices that continuously emit a message, or that emit a message in response to use of a pushbutton, are also acceptable. signing information can also be transmitted to personal receivers, but currently such receivers are not likely to be carried or used by pedestrians with visual disabilities in TTC zones. Audible information devices might not be needed if detectable channelizing devices make an alternate route of travel evident to pedestrians with visual disabilities.

*Guidance:*

- 07 *If a pushbutton is used to provide equivalent TTC information to pedestrians with visual disabilities, the pushbutton should be equipped with a locator tone to notify pedestrians with visual disabilities that a special accommodation is available, and to help them locate the pushbutton.*

**Section 6D.03 Worker Safety Considerations****Support:**

- 01 Equally as important as the safety of road users traveling through the TTC zone is the safety of workers. TTC zones present temporary and constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for workers on or near the roadway.
- 02 Maintaining TTC zones with road user flow inhibited as little as possible, and using TTC devices that get the road user's attention and provide positive direction are of particular importance. Likewise, equipment and vehicles moving within the activity area create a risk to workers on foot. When possible, the separation of moving equipment and construction vehicles from workers on foot provides the operator of these vehicles with a greater separation clearance and improved sight lines to minimize exposure to the hazards of moving vehicles and equipment.

*Guidance:*

- 03 *The following are the key elements of worker safety and TTC management that should be considered to improve worker safety:*
- A. *Training—all workers should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, and placement.*
  - B. *Temporary Traffic Barriers—temporary traffic barriers should be placed along the work space depending on factors such as lateral clearance of workers from adjacent traffic, speed of traffic, duration and type of operations, time of day, and volume of traffic.*
  - C. *Speed Reduction—reducing the speed of vehicular traffic, mainly through regulatory speed zoning, funneling, lane reduction, or the use of uniformed law enforcement officers or flaggers, should be considered.*
  - D. *Activity Area—planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the exposure to risk.*
  - E. *Worker Safety Planning—a trained person designated by the employer should conduct a basic hazard assessment for the worksite and job classifications required in the activity area. This safety professional should determine whether engineering, administrative, or personal protection measures should be implemented. This plan should be in accordance with the Occupational Safety and Health Act of 1970, as amended, “General Duty Clause” Section 5(a)(1) - Public Law 91-596, 84 Stat. 1590, December 29, 1970, as amended, and with the requirement to assess worker risk exposures for each job site and job classification, as per 29 CFR 1926.20 (b)(2) of “Occupational Safety and Health Administration Regulations, General Safety and Health Provisions” (see Section 1A.11).*

**Standard:**

- 04 **All workers, including emergency responders, within the right-of-way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to work vehicles and construction equipment within the TTC zone shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107–2004 publication entitled “American National Standard for High-Visibility Safety Apparel and Headwear” (see Section 1A.11), or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure, except as provided in Paragraph 5. A person designated by the employer to be responsible for worker safety shall make the selection of the appropriate class of garment.**

**Option:**

- 05 Emergency and incident responders and law enforcement personnel within the TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled “American National Standard for High-Visibility Public Safety Vests” (see Section 1A.11), or equivalent revisions, and labeled as ANSI 207-2006, in lieu of ANSI/ISEA 107-2004 apparel.

**Standard:**

- 06 **When uniformed law enforcement personnel are used to direct traffic, to investigate crashes, or to handle lane closures, obstructed roadways, and disasters, high-visibility safety apparel as described in this Section shall be worn by the law enforcement personnel.**

07 **Except as provided in Paragraph 8, firefighters or other emergency responders working within the right-of-way shall wear high-visibility safety apparel as described in this Section.**

Option:

- 08 Firefighters or other emergency responders working within the right-of-way and engaged in emergency operations that directly expose them to flame, fire, heat, and/or hazardous materials may wear retroreflective turn-out gear that is specified and regulated by other organizations, such as the National Fire Protection Association.
- 09 The following are additional elements of TTC management that may be considered to improve worker safety:
- A. Shadow Vehicle—in the case of mobile and constantly moving operations, such as pothole patching and striping operations, a shadow vehicle, equipped with appropriate lights and warning signs, may be used to protect the workers from impacts by errant vehicles. The shadow vehicle may be equipped with a rear-mounted impact attenuator.
  - B. Road Closure—if alternate routes are available to handle road users, the road may be closed temporarily. This may also facilitate project completion and thus further reduce worker vulnerability.
  - C. Law Enforcement Use—in highly vulnerable work situations, particularly those of relatively short duration, law enforcement units may be stationed to heighten the awareness of passing vehicular traffic and to improve safety through the TTC zone.
  - D. Lighting—for nighttime work, the TTC zone and approaches may be lighted.
  - E. Special Devices—these include rumble strips, changeable message signs, hazard identification beacons, flags, and warning lights. Intrusion warning devices may be used to alert workers to the approach of errant vehicles.

Support:

- 10 Judicious use of the special devices described in Item E in Paragraph 9 might be helpful for certain difficult TTC situations, but misuse or overuse of special devices or techniques might lessen their effectiveness.

## CHAPTER 6E. FLAGGER CONTROL

### Section 6E.01 Qualifications for Flaggers

*Guidance:*

- 01 *Because flaggers are responsible for public safety and make the greatest number of contacts with the public of all highway workers, they should be trained in safe traffic control practices and public contact techniques. Flaggers should be able to satisfactorily demonstrate the following abilities:*
- A. *Ability to receive and communicate specific instructions clearly, firmly, and courteously;*
  - B. *Ability to move and maneuver quickly in order to avoid danger from errant vehicles;*
  - C. *Ability to control signaling devices (such as paddles and flags) in order to provide clear and positive guidance to drivers approaching a TTC zone in frequently changing situations;*
  - D. *Ability to understand and apply safe traffic control practices, sometimes in stressful or emergency situations; and*
  - E. *Ability to recognize dangerous traffic situations and warn workers in sufficient time to avoid injury.*

### Section 6E.02 High-Visibility Safety Apparel

**Standard:**

- 01 **For daytime and nighttime activity, flaggers shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107–2004 publication entitled “American National Standard for High-Visibility Apparel and Headwear” (see Section 1A.11) and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. The apparel background (outer) material color shall be fluorescent orange-red, fluorescent yellow-green, or a combination of the two as defined in the ANSI standard. The retroreflective material shall be orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of 1,000 feet. The retroreflective safety apparel shall be designed to clearly identify the wearer as a person.**

*Guidance:*

- 02 *For nighttime activity, high-visibility safety apparel that meets the Performance Class 3 requirements of the ANSI/ISEA 107–2004 publication entitled “American National Standard for High-Visibility Apparel and Headwear” (see Section 1A.11) and labeled as meeting the ANSI 107-2004 standard performance for Class 3 risk exposure should be considered for flagger wear.*

**Standard:**

- 03 **When uniformed law enforcement officers are used to direct traffic within a TTC zone, they shall wear high-visibility safety apparel as described in this Section.**

*Option:*

- 04 **In lieu of ANSI/ISEA 107-2004 apparel, law enforcement personnel within the TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled “American National Standard for High-Visibility Public Safety Vests” (see Section 1A.11) and labeled as ANSI 207-2006.**

### Section 6E.03 Hand-Signaling Devices

*Guidance:*

- 01 *The STOP/SLOW paddle should be the primary and preferred hand-signaling device because the STOP/SLOW paddle gives road users more positive guidance than red flags. Use of flags should be limited to emergency situations.*

**Standard:**

- 02 **The STOP/SLOW paddle shall have an octagonal shape on a rigid handle. STOP/SLOW paddles shall be at least 18 inches wide with letters at least 6 inches high. The STOP (R1-1) face shall have white letters and a white border on a red background. The SLOW (W20-8) face shall have black letters and a black border on an orange background. When used at night, the STOP/SLOW paddle shall be retroreflectorized.**

*Guidance:*

- 03 *The STOP/SLOW paddle should be fabricated from light semi-rigid material.*

**Support:**

- 04 **The optimum method of displaying a STOP or SLOW message is to place the STOP/SLOW paddle on a rigid staff that is tall enough that when the end of the staff is resting on the ground, the message is high enough to be seen by approaching or stopped traffic.**

## Option:

- 05 The STOP/SLOW paddle may be modified to improve conspicuity by incorporating either white or red flashing lights on the STOP face, and either white or yellow flashing lights on the SLOW face. The flashing lights may be arranged in any of the following patterns:
- A. Two white or red lights, one centered vertically above and one centered vertically below the STOP legend; and/or two white or yellow lights, one centered vertically above and one centered vertically below the SLOW legend;
  - B. Two white or red lights, one centered horizontally on each side of the STOP legend; and/or two white or yellow lights, one centered horizontally on each side of the SLOW legend;
  - C. One white or red light centered below the STOP legend; and/or one white or yellow light centered below the SLOW legend;
  - D. A series of eight or more small white or red lights no larger than 1/4 inch in diameter along the outer edge of the paddle, arranged in an octagonal pattern at the eight corners of the border of the STOP face; and/or a series of eight or more small white or yellow lights no larger than 1/4 inch in diameter along the outer edge of the paddle, arranged in a diamond pattern along the border of the SLOW face; or
  - E. A series of white lights forming the shapes of the letters in the legend.

**Standard:**

- 06 **If flashing lights are used on the STOP face of the paddle, their colors shall be all white or all red. If flashing lights are used on the SLOW face of the paddle, their colors shall be all white or all yellow.**
- 07 **If more than eight flashing lights are used, the lights shall be arranged such that they clearly convey the octagonal shape of the STOP face of the paddle and/or the diamond shape of the SLOW face of the paddle.**
- 08 **If flashing lights are used on the STOP/SLOW paddle, the flash rate shall be at least 50, but not more than 60, flashes per minute.**
- 09 **Flags, when used, shall be red or fluorescent orange/red in color, shall be a minimum of 24 inches square, and shall be securely fastened to a staff that is approximately 36 inches in length.**

*Guidance:*

- 10 *The free edge of a flag should be weighted so the flag will hang vertically, even in heavy winds.*

**Standard:**

- 11 **When used at nighttime, flags shall be retroreflectorized red.**

## Option:

- 12 When flagging in an emergency situation at night in a non-illuminated flagger station, a flagger may use a flashlight with a red glow cone to supplement the STOP/SLOW paddle or flag.

**Standard:**

- 13 **When a flashlight is used for flagging in an emergency situation at night in a non-illuminated flagger station, the flagger shall hold the flashlight in the left hand, shall hold the paddle or flag in the right hand as shown in Figure 6E-3, and shall use the flashlight in the following manner to control approaching road users:**
- A. **To inform road users to stop, the flagger shall hold the flashlight with the left arm extended and pointed down toward the ground, and then shall slowly wave the flashlight in front of the body in a slow arc from left to right such that the arc reaches no farther than 45 degrees from vertical.**
  - B. **To inform road users to proceed, the flagger shall point the flashlight at the vehicle's bumper, slowly aim the flashlight toward the open lane, then hold the flashlight in that position. The flagger shall not wave the flashlight.**
  - C. **To alert or slow traffic, the flagger shall point the flashlight toward oncoming traffic and quickly wave the flashlight in a figure eight motion.**

**Section 6E.04 Automated Flagger Assistance Devices**

## Support:

- 01 Automated Flagger Assistance Devices (AFADs) enable a flagger(s) to be positioned out of the lane of traffic and are used to control road users through temporary traffic control zones. These devices are designed to be remotely operated either by a single flagger at one end of the TTC zone or at a central location, or by separate flaggers near each device's location.

- 02 There are two types of AFADs:
- A. An AFAD (see Section 6E.05) that uses a remotely controlled STOP/SLOW sign on either a trailer or a movable cart system to alternately control right-of-way.
  - B. An AFAD (see Section 6E.06) that uses remotely controlled red and yellow lenses and a gate arm to alternately control right-of-way.
- 03 AFADs might be appropriate for short-term and intermediate-term activities (see Section 6G.02). Typical applications include TTC activities such as, but not limited to:
- A. Bridge maintenance;
  - B. Haul road crossings; and
  - C. Pavement patching.

**Standard:**

- 04 **AFADs shall only be used in situations where there is only one lane of approaching traffic in the direction to be controlled.**

- 05 **When used at night, the AFAD location shall be illuminated in accordance with Section 6E.08.**

*Guidance:*

- 06 *AFADs should not be used for long-term stationary work (see Section 6G.02).*

**Standard:**

- 07 **Because AFADs are not traffic control signals, they shall not be used as a substitute for or a replacement for a continuously operating temporary traffic control signal as described in Section 6F.84.**

- 08 **AFADs shall meet the crashworthy performance criteria contained in Section 6F.01.**

*Guidance:*

- 09 *If used, AFADs should be located in advance of one-lane, two-way tapers and downstream from the point where approaching traffic is to stop in response to the device.*

**Standard:**

- 10 **If used, AFADs shall be placed so that all of the signs and other items controlling traffic movement are readily visible to the driver of the initial approaching vehicle with advance warning signs alerting other approaching traffic to be prepared to stop.**

- 11 **If used, an AFAD shall be operated only by a flagger (see Section 6E.01) who has been trained on the operation of the AFAD. The flagger(s) operating the AFAD(s) shall not leave the AFAD(s) unattended at any time while the AFAD(s) is being used.**

- 12 **The use of AFADs shall conform to one of the following methods:**

- A. An AFAD at each end of the TTC zone (Method 1), or
- B. An AFAD at one end of the TTC zone and a flagger at the opposite end (Method 2).

- 13 **Except as provided in Paragraph 14, two flaggers shall be used when using either Method 1 or Method 2.**

*Option:*

- 14 A single flagger may simultaneously operate two AFADs (Method 1) or may operate a single AFAD on one end of the TTC zone while being the flagger at the opposite end of the TTC zone (Method 2) if both of the following conditions are present:

- A. The flagger has an unobstructed view of the AFAD(s), and
- B. The flagger has an unobstructed view of approaching traffic in both directions.

*Guidance:*

- 15 *When an AFAD is used, the advance warning signing should include a ROAD WORK AHEAD (W20-1) sign, a ONE LANE ROAD (W20-4) sign, and a BE PREPARED TO STOP (W3-4) sign.*

**Standard:**

- 16 **When the AFAD is not in use, the signs associated with the AFAD, both at the AFAD location and in advance, shall be removed or covered.**

*Guidance:*

- 17 *A State or local agency that elects to use AFADs should adopt a policy, based on engineering judgment, governing AFAD applications. The policy should also consider more detailed and/or more restrictive requirements for AFAD use, such as the following:*

- A. Conditions applicable for the use of Method 1 and Method 2 AFAD operation,
- B. Volume criteria,
- C. Maximum distance between AFADs,

- D. *Conflicting lenses/indications monitoring requirements,*
- E. *Fail safe procedures,*
- F. *Additional signing and pavement markings,*
- G. *Application consistency,*
- H. *Larger signs or lenses to increase visibility, and*
- I. *Use of backplates.*

### **Section 6E.05 STOP/SLOW Automated Flagger Assistance Devices**

#### **Standard:**

- 01 A STOP/SLOW Automated Flagger Assistance Device (AFAD) (see Section 6E.04) shall include a STOP/SLOW sign that alternately displays the STOP (R1-1) face and the SLOW (W20-8) face of a STOP/SLOW paddle (see Figure 6E-1).
- 02 The AFAD's STOP/SLOW sign shall have an octagonal shape, shall be fabricated of rigid material, and shall be mounted with the bottom of the sign a minimum of 6 feet above the pavement on an appropriate support. The size of the STOP/SLOW sign shall be at least 24 x 24 inches with letters at least 8 inches high. The background of the STOP face shall be red with white letters and border. The background of the SLOW face shall be diamond shaped and orange with black letters and border. Both faces of the STOP/SLOW sign shall be retroreflectorized.
- 03 The AFAD's STOP/SLOW sign shall have a means to positively lock, engage, or otherwise maintain the sign assembly in a stable condition when set in the STOP or SLOW position.
- 04 The AFAD's STOP/SLOW sign shall be supplemented with active conspicuity devices by incorporating either:
- A. White or red flashing lights within the STOP face and white or yellow flashing lights within the SLOW face meeting the provisions contained in Section 6E.03; or
  - B. A Stop Beacon (see Section 4L.05) mounted a maximum of 24 inches above the STOP face and a Warning Beacon (see Section 4L.03) mounted a maximum of 24 inches above, below, or to the side of the SLOW face. The Stop Beacon shall not be flashed or illuminated when the SLOW face is displayed, and the Warning Beacon shall not be flashed or illuminated when the STOP face is displayed. Except for the mounting locations, the beacons shall comply with the provisions of Chapter 4L.

#### **Option:**

- 05 Type B warning light(s) (see Section 6F.83) may be used in lieu of the Warning Beacon during the display of the SLOW face of the AFAD's STOP/SLOW sign.

#### **Standard:**

- 06 If Type B warning lights are used in lieu of a Warning Beacon, they shall flash continuously when the SLOW face is displayed and shall not be flashed or illuminated when the STOP face is displayed.

#### **Option:**

- 07 The faces of the AFAD's STOP/SLOW sign may include louvers to improve the stability of the device in windy or other adverse environmental conditions.

#### **Standard:**

- 08 If louvers are used, the louvers shall be designed such that the full sign face is visible to approaching traffic at a distance of 50 feet or greater.

#### **Guidance:**

- 09 The STOP/SLOW AFAD should include a gate arm that descends to a down position across the approach lane of traffic when the STOP face is displayed and then ascends to an upright position when the SLOW face is displayed.

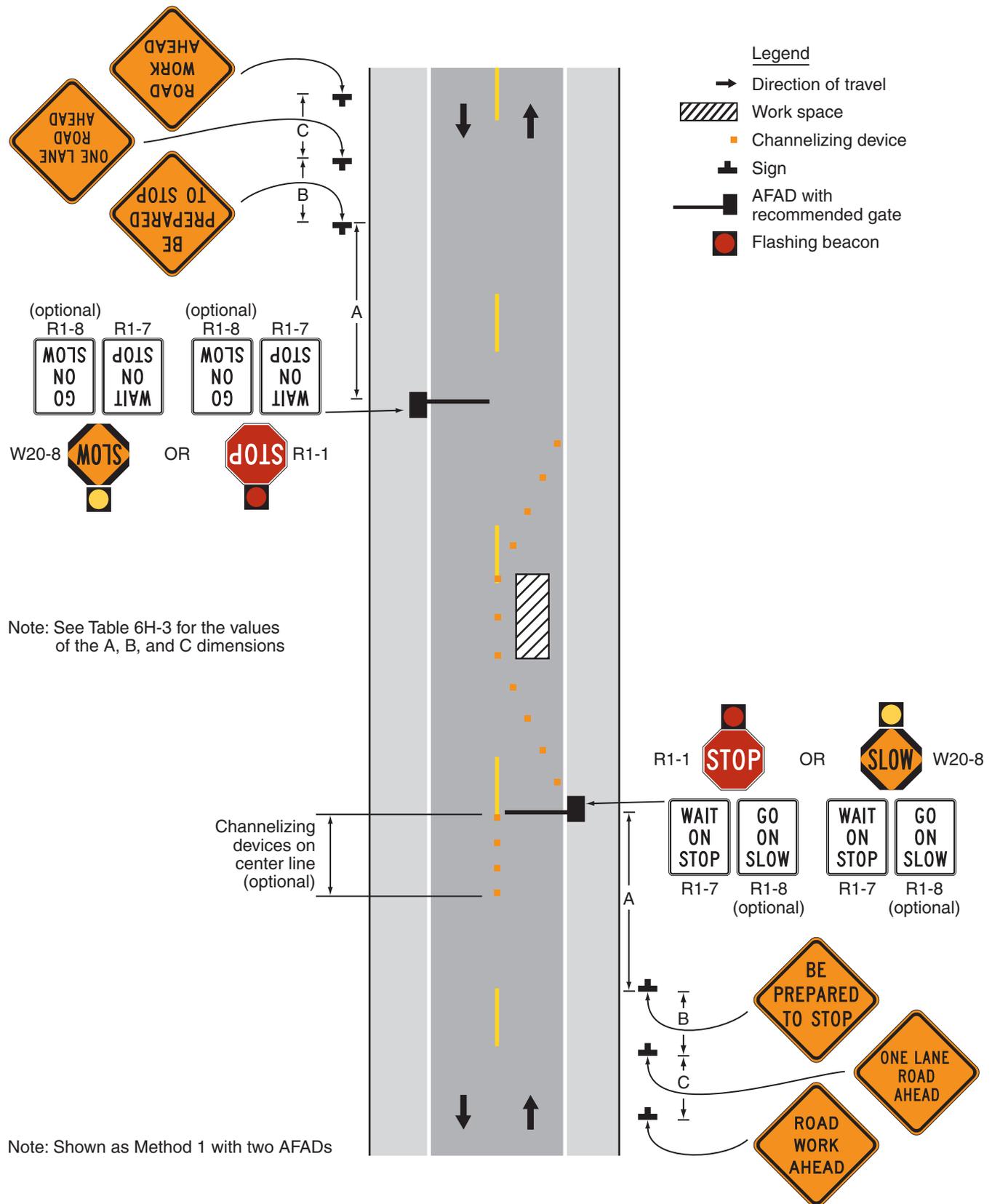
#### **Option:**

- 10 In lieu of a stationary STOP/SLOW sign with a separate gate arm, the STOP/SLOW sign may be attached to a mast arm that physically blocks the approach lane of traffic when the STOP face is displayed and then moves to a position that does not block the approach lane when the SLOW face is displayed.

#### **Standard:**

- 11 Gate arms, if used, shall be fully retroreflectorized on both sides, and shall have vertical alternating red and white stripes at 16-inch intervals measured horizontally as shown in Figure 8C-1. When the arm is in the down position blocking the approach lane:
- A. The minimum vertical aspect of the arm and sheeting shall be 2 inches; and
  - B. The end of the arm shall reach at least to the center of the lane being controlled.

**Figure 6E-1. Example of the Use of a STOP/SLOW Automated Flagger Assistance Device (AFAD)**



12 **A WAIT ON STOP (R1-7) sign (see Figure 6E-1) shall be displayed to road users approaching the AFAD.**

Option:

13 **A GO ON SLOW (R1-8) sign (see Figure 6E-1) may also be displayed to road users approaching the AFAD.**

**Standard:**

14 **The GO ON SLOW sign, if used, and the WAIT ON STOP sign shall be positioned on the same support structure as the AFAD or immediately adjacent to the AFAD such that they are in the same direct line of view of approaching traffic as the sign faces of the AFAD. Both signs shall have black legends and borders on white backgrounds. Each of these signs shall be rectangular in shape and each shall be at least 24 x 30 inches in size with letters at least 6 inches high.**

15 **To inform road users to stop, the AFAD shall display the STOP face and the red or white lights, if used, within the STOP face shall flash or the Stop Beacon shall flash. To inform road users to proceed, the AFAD shall display the SLOW face and the yellow or white lights, if used, within the SLOW face shall flash or the Warning Beacon or the Type B warning lights shall flash.**

16 **If STOP/SLOW AFADs are used to control traffic in a one-lane, two-way TTC zone, safeguards shall be incorporated to prevent the flagger(s) from simultaneously displaying the SLOW face at each end of the TTC zone. Additionally, the flagger(s) shall not display the AFAD's SLOW face until all oncoming vehicles have cleared the one-lane portion of the TTC zone.**

### **Section 6E.06 Red/Yellow Lens Automated Flagger Assistance Devices**

**Standard:**

01 **A Red/Yellow Lens Automated Flagger Assistance Device (AFAD) (see Section 6E.04) shall alternately display a steadily illuminated CIRCULAR RED lens and a flashing CIRCULAR YELLOW lens to control traffic without the need for a flagger in the immediate vicinity of the AFAD or on the roadway (see Figure 6E-2).**

02 **Red/Yellow Lens AFADs shall have at least one set of CIRCULAR RED and CIRCULAR YELLOW lenses that are 12 inches in diameter. Unless otherwise provided in this Section, the lenses and their arrangement, CIRCULAR RED on top and CIRCULAR YELLOW below, shall comply with the applicable provisions for traffic signal indications in Part 4. If the set of lenses is post-mounted, the bottom of the housing (including brackets) shall be at least 7 feet above the pavement. If the set of lenses is located over any portion of the highway that can be used by motor vehicles, the bottom of the housing (including brackets) shall be at least 15 feet above the pavement.**

Option:

03 **Additional sets of CIRCULAR RED and CIRCULAR YELLOW lenses, located over the roadway or on the left-hand side of the approach and operated in unison with the primary set, may be used to improve visibility and/or conspicuity of the AFAD.**

**Standard:**

04 **A Red/Yellow Lens AFAD shall include a gate arm that descends to a down position across the approach lane of traffic when the steady CIRCULAR RED lens is illuminated and then ascends to an upright position when the flashing CIRCULAR YELLOW lens is illuminated. The gate arm shall be fully retroreflectorized on both sides, and shall have vertical alternating red and white stripes at 16-inch intervals measured horizontally as shown in Figure 8C-1. When the arm is in the down position blocking the approach lane:**

**A. The minimum vertical aspect of the arm and sheeting shall be 2 inches; and**

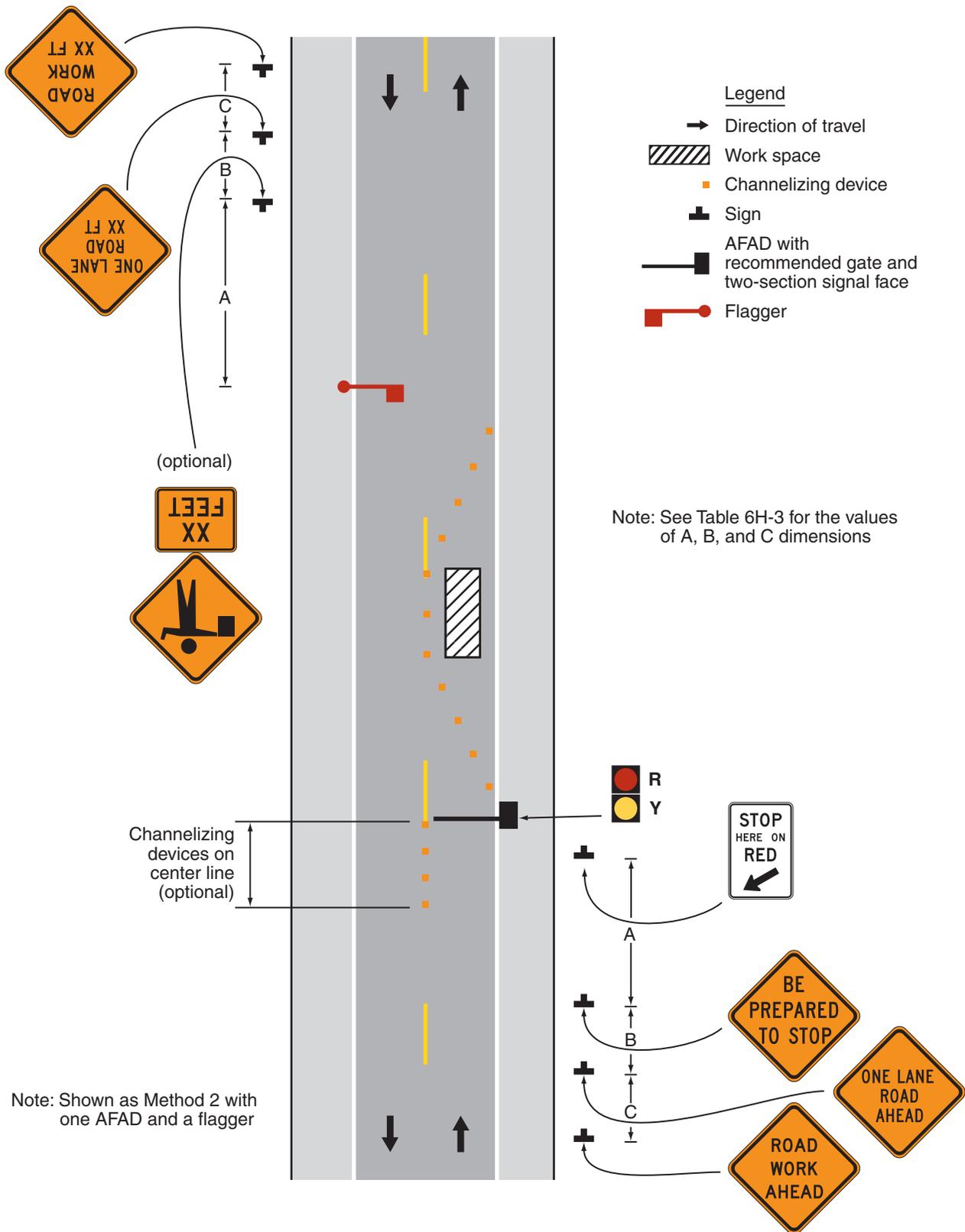
**B. The end of the arm shall reach at least to the center of the lane being controlled.**

05 **A Stop Here On Red (R10-6 or R10-6a) sign (see Section 2B.53) shall be installed on the right-hand side of the approach at the point at which drivers are expected to stop when the steady CIRCULAR RED lens is illuminated (see Figure 6E-2).**

06 **To inform road users to stop, the AFAD shall display a steadily illuminated CIRCULAR RED lens and the gate arm shall be in the down position. To inform road users to proceed, the AFAD shall display a flashing CIRCULAR YELLOW lens and the gate arm shall be in the upright position.**

07 **If Red/Yellow Lens AFADs are used to control traffic in a one-lane, two-way TTC zone, safeguards shall be incorporated to prevent the flagger(s) from actuating a simultaneous display of a flashing CIRCULAR YELLOW lens at each end of the TTC zone. Additionally, the flagger shall not actuate the AFAD's display of the flashing CIRCULAR YELLOW lens until all oncoming vehicles have cleared the one-lane portion of the TTC zone.**

**Figure 6E-2. Example of the Use of a Red/Yellow Lens Automated Flagger Assistance Device (AFAD)**



- 08 **A change interval shall be provided as the transition between the display of the flashing CIRCULAR YELLOW indication and the display of the steady CIRCULAR RED indication. During the change interval, the CIRCULAR YELLOW lens shall be steadily illuminated. The gate arm shall remain in the upright position during the display of the steadily illuminated CIRCULAR YELLOW change interval.**
- 09 **A change interval shall not be provided between the display of the steady CIRCULAR RED indication and the display of the flashing CIRCULAR YELLOW indication.**

*Guidance:*

- 10 *The steadily illuminated CIRCULAR YELLOW change interval should have a duration of at least 5 seconds, unless a different duration, within the range of durations recommended by Section 4D.26, is justified by engineering judgment.*

### **Section 6E.07 Flagger Procedures**

**Support:**

- 01 The use of paddles and flags by flaggers is illustrated in Figure 6E-3.

**Standard:**

- 02 **Flaggers shall use a STOP/SLOW paddle, a flag, or an Automated Flagger Assistance Device (AFAD) to control road users approaching a TTC zone. The use of hand movements alone without a paddle, flag, or AFAD to control road users shall be prohibited except for law enforcement personnel or emergency responders at incident scenes as described in Section 6I.01.**
- 03 **The following methods of signaling with paddles shall be used:**
- A. **To stop road users, the flagger shall face road users and aim the STOP paddle face toward road users in a stationary position with the arm extended horizontally away from the body. The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.**
  - B. **To direct stopped road users to proceed, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body. The flagger shall motion with the free hand for road users to proceed.**
  - C. **To alert or slow traffic, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body.**

**Option:**

- 04 To further alert or slow traffic, the flagger holding the SLOW paddle face toward road users may motion up and down with the free hand, palm down.

**Standard:**

- 05 **The following methods of signaling with a flag shall be used:**
- A. **To stop road users, the flagger shall face road users and extend the flag staff horizontally across the road users' lane in a stationary position so that the full area of the flag is visibly hanging below the staff. The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.**
  - B. **To direct stopped road users to proceed, the flagger shall face road users with the flag and arm lowered from the view of the road users, and shall motion with the free hand for road users to proceed. Flags shall not be used to signal road users to proceed.**
  - C. **To alert or slow traffic, the flagger shall face road users and slowly wave the flag in a sweeping motion of the extended arm from shoulder level to straight down without raising the arm above a horizontal position. The flagger shall keep the free hand down.**

*Guidance:*

- 06 *The flagger should stand either on the shoulder adjacent to the road user being controlled or in the closed lane prior to stopping road users. A flagger should only stand in the lane being used by moving road users after road users have stopped. The flagger should be clearly visible to the first approaching road user at all times. The flagger also should be visible to other road users. The flagger should be stationed sufficiently in advance of the workers to warn them (for example, with audible warning devices such as horns or whistles) of approaching danger by out-of-control vehicles. The flagger should stand alone, away from other workers, work vehicles, or equipment.*

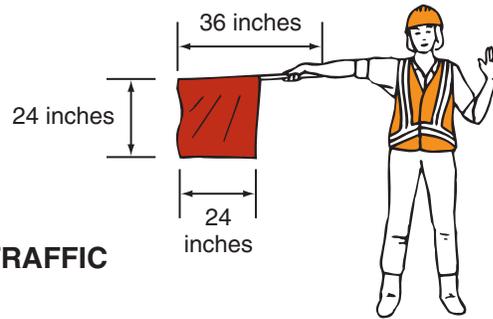
**Option:**

- 07 At spot lane closures where adequate sight distance is available for the reasonably safe handling of traffic, the use of one flagger may be sufficient.

**Figure 6E-3. Use of Hand-Signaling Devices by Flaggers**

**PREFERRED METHOD  
STOP/SLOW Paddle**

**EMERGENCY SITUATIONS ONLY  
Red Flag**



**TO STOP TRAFFIC**



**TO LET  
TRAFFIC PROCEED**



**TO ALERT AND  
SLOW TRAFFIC**

*Guidance:*

- 08 *When a single flagger is used, the flagger should be stationed on the shoulder opposite the spot lane closure or work space, or in a position where good visibility and traffic control can be maintained at all times.*

**Section 6E.08 Flagger Stations**

**Standard:**

- 01 **Flagger stations shall be located such that approaching road users will have sufficient distance to stop at an intended stopping point.**

*Option:*

- 02 The distances shown in Table 6E-1, which provides information regarding the stopping sight distance as a function of speed, may be used for the location of a flagger station. These distances may be increased for downgrades and other conditions that affect stopping distance.

*Guidance:*

- 03 *Flagger stations should be located such that an errant vehicle has additional space to stop without entering the work space. The flagger should identify an escape route that can be used to avoid being struck by an errant vehicle.*

**Standard:**

- 04 **Except in emergency situations, flagger stations shall be preceded by an advance warning sign or signs. Except in emergency situations, flagger stations shall be illuminated at night.**

**Table 6E-1. Stopping Sight Distance as a Function of Speed**

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

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

## CHAPTER 6F. TEMPORARY TRAFFIC CONTROL ZONE DEVICES

### Section 6F.01 Types of Devices

#### Guidance:

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

#### Support:

02 FHWA policy requires that all roadside appurtenances such as traffic barriers, barrier terminals and crash cushions, bridge railings, sign and light pole supports, and work zone hardware used on the National Highway System meet the crashworthy performance criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features." The FHWA website at "<http://safety.fhwa.dot.gov/programs/roadsideHardware.htm>" identifies all such hardware and includes copies of FHWA acceptance letters for each of them. In the case of proprietary items, links are provided to manufacturers' websites as a source of detailed information on specific devices. The website also contains an "Ask the Experts" section where questions on roadside design issues can be addressed.

03 Various Sections of the MUTCD require certain traffic control devices, their supports, and/or related appurtenances to be crashworthy. Such MUTCD crashworthiness provisions apply to all streets, highways, and private roads open to public travel. Also, State Departments of Transportation and local agencies might have expanded the NCHRP Report 350 crashworthy criteria to apply to certain other roadside appurtenances.

04 Crashworthiness and crash testing information on devices described in Part 6 are found in AASHTO's "Roadside Design Guide" (see Section 1A.11).

05 As defined in Section 1A.13, "crashworthy" is a characteristic of a roadside appurtenance that has been successfully crash tested in accordance with a national standard such as the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

#### Standard:

06 **Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide road users, placed on, over, or adjacent to a street, highway, private roads open to public travel (see definition in Section 1A.13), pedestrian facility, or bikeway by authority of a public body or official having jurisdiction.**

07 **All traffic control devices used for construction, maintenance, utility, or incident management operations on a street, highway, or private road open to public travel (see definition in Section 1A.13) shall comply with the applicable provisions of this Manual.**

### Section 6F.02 General Characteristics of Signs

#### Support:

01 TTC zone signs convey both general and specific messages by means of words, symbols, and/or arrows and have the same three categories as all road user signs: regulatory, warning, and guide.

#### Standard:

02 **The colors for regulatory signs shall follow the Standards for regulatory signs in Table 2A-5 and Chapter 2B. Warning signs in TTC zones shall have a black legend and border on an orange background, except for the Grade Crossing Advance Warning (W10-1) sign which shall have a black legend and border on a yellow background, and except for signs that are required or recommended in Parts 2 or 7 to have fluorescent yellow-green backgrounds. Colors for guide signs shall follow the Standards in Table 2A-5 and Chapter 2D, except for guide signs as otherwise provided in Section 6F.55.**

#### Option:

03 Where the color orange is required, the fluorescent orange color may also be used.

#### Support:

04 The fluorescent version of orange provides higher conspicuity than standard orange, especially during twilight.

#### Option:

05 Existing warning signs that are still applicable may remain in place.

06 In order to maintain the systematic use of yellow or fluorescent yellow-green backgrounds for pedestrian, bicycle, and school warning signs in a jurisdiction, the yellow or fluorescent yellow-green background for pedestrian, bicycle, and school warning signs may be used in TTC zones.

07 Standard orange flags or flashing warning lights may be used in conjunction with signs.

**Standard:**

08 **When standard orange flags or flashing warning lights are used in conjunction with signs, they shall not block the sign face.**

09 **Except as provided in Section 2A.11, the sizes for TTC signs and plaques shall be as shown in Table 6F-1. The sizes in the minimum column shall only be used on local streets or roadways where the 85th-percentile speed or posted speed limit is less than 35 mph.**

## Option:

10 The dimensions of signs and plaques shown in Table 6F-1 may be increased wherever necessary for greater legibility or emphasis.

**Standard:**

11 **Deviations from standard sizes as prescribed in this Manual shall be in 6-inch increments.**

## Support:

12 Sign design details are contained in the “Standard Highway Signs and Markings” book (see Section 1A.11).

13 Section 2A.06 contains additional information regarding the design of signs, including an Option allowing the development of special word message signs if a standard word message or symbol sign is not available to convey the necessary regulatory, warning, or guidance information.

**Standard:**

14 **All signs used at night shall be either retroreflective with a material that has a smooth, sealed outer surface or illuminated to show the same shape and similar color both day and night.**

15 **The requirement for sign illumination shall not be considered to be satisfied by street, highway, or strobe lighting.**

## Option:

16 Sign illumination may be either internal or external.

17 Signs may be made of rigid or flexible material.

**Section 6F.03 Sign Placement***Guidance:*

01 *Signs should be located on the right-hand side of the roadway unless otherwise provided in this Manual.*

## Option:

02 Where special emphasis is needed, signs may be placed on both the left-hand and right-hand sides of the roadway. Signs mounted on portable supports may be placed within the roadway itself. Signs may also be mounted on or above barricades.

## Support:

03 The provisions of this Section regarding mounting height apply unless otherwise provided for a particular sign elsewhere in this Manual.

**Standard:**

04 **The minimum height, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement, of signs installed at the side of the road in rural areas shall be 5 feet (see Figure 6F-1).**

05 **The minimum height, measured vertically from the bottom of the sign to the top of the curb, or in the absence of curb, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of signs installed at the side of the road in business, commercial, or residential areas where parking or pedestrian movements are likely to occur, or where the view of the sign might be obstructed, shall be 7 feet (see Figure 6F-1).**

06 **The minimum height, measured vertically from the bottom of the sign to the sidewalk, of signs installed above sidewalks shall be 7 feet.**

## Option:

07 The height to the bottom of a secondary sign mounted below another sign may be 1 foot less than the height provided in Paragraphs 4 through 6.

*Guidance:*

08 *Neither portable nor permanent sign supports should be located on sidewalks, bicycle facilities, or areas designated for pedestrian or bicycle traffic. If the bottom of a secondary sign that is mounted below another sign is mounted lower than 7 feet above a pedestrian sidewalk or pathway (see Section 6D.02), the secondary sign should not project more than 4 inches into the pedestrian facility.*

**Table 6F-1. Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 1 of 3)**

Sign or Plaque	Sign Designation	Section	Conventional Road	Freeway or Expressway	Minimum
Stop	R1-1	6F.06	30 x 30*	—	—
Stop (on Stop/Slow Paddle)	R1-1	6E.03	18 x 18	—	—
Yield	R1-2	6F.06	36 x 36 x 36*	—	30 x 30 x 30
To Oncoming Traffic (plaque)	R1-2aP	6F.06	36 x 30	48 x 36	24 x 18
Wait on Stop	R1-7	6E.05	24 x 30	24 x 30	—
Go on Slow	R1-8	6E.05	24 x 30	24 x 30	—
Speed Limit	R2-1	6F.12	24 x 30*	36 x 48	—
Fines Higher (plaque)	R2-6P	6F.12	24 x 18	36 x 24	—
Fines Double (plaque)	R2-6aP	6F.12	24 x 18	36 x 24	—
\$XX Fine (plaque)	R2-6bP	6F.12	24 x 18	36 x 24	—
Begin Higher Fines Zone	R2-10	6F.12	24 x 30	36 x 48	—
End Higher Fines Zone	R2-11	6F.12	24 x 30	36 x 48	—
End Work Zone Speed Limit	R2-12	6F.12	24 x 36	36 x 54	—
Movement Prohibition	R3-1,2,3,4,18,27	6F.06	24 x 24*	36 x 36	—
Mandatory Movement (1 lane)	R3-5	6F.06	30 x 36	—	—
Optional Movement (1 lane)	R3-6	6F.06	30 x 36	—	—
Mandatory Movement (text)	R3-7	6F.06	30 x 30*	—	—
Advance Intersection Lane Control	R3-8	6F.06	Varies x 30	—	—
Do Not Pass	R4-1	6F.06	24 x 30	36 x 48	—
Pass With Care	R4-2	6F.06	24 x 30	36 x 48	—
Keep Right	R4-7	6F.06	24 x 30	36 x 48	—
Narrow Keep Right	R4-7c	6F.06	18 x 30	—	—
Stay in Lane	R4-9	6F.11	24 x 30	36 x 48	—
Do Not Enter	R5-1	6F.06	30 x 30*	36 x 36	—
Wrong Way	R5-1a	6F.06	36 x 24*	42 x 30	—
One Way	R6-1	6F.06	36 x 12*	54 x 18	—
One Way	R6-2	6F.06	24 x 30*	36 x 48	—
No Parking (symbol)	R8-3	6F.06	24 x 24	36 x 36	—
Pedestrian Crosswalk	R9-8	6F.13	36 x 18	—	—
Sidewalk Closed	R9-9	6F.14	24 x 12	—	—
Sidewalk Closed, Use Other Side	R9-10	6F.14	24 x 12	—	—
Sidewalk Closed Ahead, Cross Here	R9-11	6F.14	24 x 18	—	—
Sidewalk Closed, Cross Here	R9-11a	6F.14	24 x 12	—	—
Road Closed	R11-2	6F.08	48 x 30	—	—
Road Closed - Local Traffic Only	R11-3a,3b,4	6F.09	60 x 30	—	—
Weight Limit	R12-1,2	6F.10	24 x 30	36 x 48	—
Weight Limit (with symbols)	R12-5	6F.10	24 x 36	36 x 48	—
Turn and Curve Signs	W1-1,2,3,4	6F.16	36 x 36	48 x 48	30 x 30
Reverse Curve (2 or more lanes)	W1-4b,4c	6F.48	36 x 36	48 x 48	30 x 30
One-Direction Large Arrow	W1-6	6F.16	48 x 24	60 x 30	—
Chevron	W1-8	6F.16	18 x 24	30 x 36	—
Stop Ahead	W3-1	6F.16	36 x 36	48 x 48	30 x 30
Yield Ahead	W3-2	6F.16	36 x 36	48 x 48	30 x 30
Signal Ahead	W3-3	6F.16	36 x 36	48 x 48	30 x 30
Be Prepared to Stop	W3-4	6F.16	36 x 36	48 x 48	30 x 30
Reduced Speed Limit Ahead	W3-5	6F.16	36 x 36	48 x 48	30 x 30

**Table 6F-1. Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 2 of 3)**

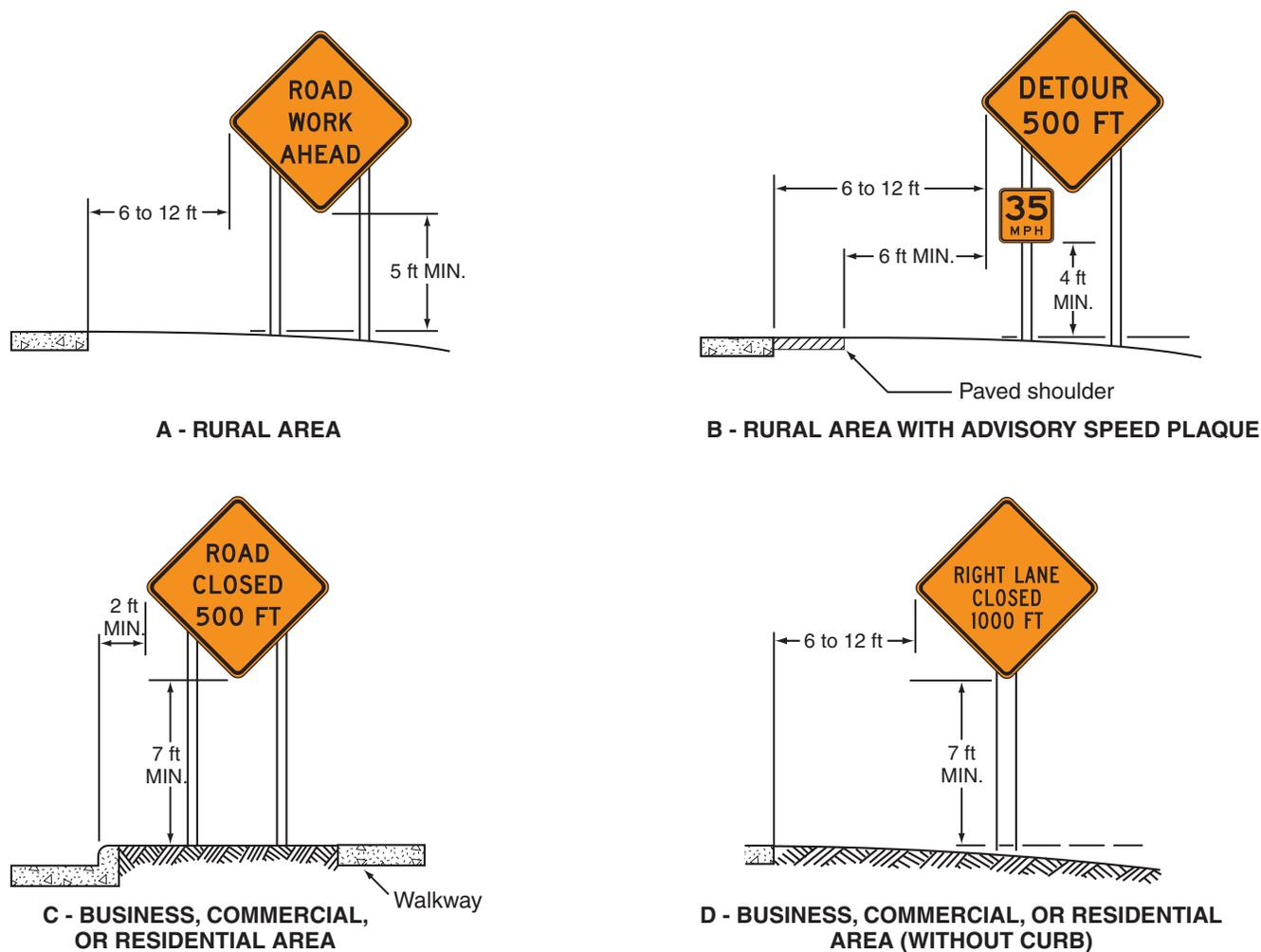
Sign or Plaque	Sign Designation	Section	Conventional Road	Freeway or Expressway	Minimum
XX MPH Speed Zone Ahead	W3-5a	6F.16	36 x 36	48 x 48	30 x 30
Merging Traffic	W4-1,5	6F.16	36 x 36	48 x 48	36 x 36
Lane Ends	W4-2	6F.24	36 x 36	48 x 48	30 x 30
Added Lane	W4-3,6	6F.16	36 x 36	48 x 48	30 x 30
No Merge Area (plaque)	W4-5P	6F.16	18 x 24	24 x 30	—
Road Narrows	W5-1	6F.16	36 x 36	48 x 48	30 x 30
Narrow Bridge	W5-2	6F.16	36 x 36	48 x 48	30 x 30
One Lane Bridge	W5-3	6F.16	36 x 36	48 x 48	30 x 30
Ramp Narrows	W5-4	6F.26	36 x 36	48 x 48	30 x 30
Divided Highway	W6-1	6F.16	36 x 36	48 x 48	30 x 30
Divided Highway Ends	W6-2	6F.16	36 x 36	48 x 48	30 x 30
Two-Way Traffic	W6-3	6F.32	36 x 36	48 x 48	30 x 30
Two-Way Traffic	W6-4	6F.76	12 x 18	12 x 18	—
Hill (symbol)	W7-1	6F.16	36 x 36	48 x 48	30 x 30
Next XX Miles (plaque)	W7-3aP	6F.53	24 x 18	36 x 30	—
Bump	W8-1	6F.16	36 x 36	48 x 48	30 x 30
Dip	W8-2	6F.16	36 x 36	48 x 48	30 x 30
Pavement Ends	W8-3	6F.16	36 x 36	48 x 48	30 x 30
Soft Shoulder	W8-4	6F.44	36 x 36	48 x 48	30 x 30
Slippery When Wet	W8-5	6F.16	36 x 36	48 x 48	30 x 30
Truck Crossing	W8-6	6F.36	36 x 36	48 x 48	30 x 30
Loose Gravel	W8-7	6F.16	36 x 36	48 x 48	30 x 30
Rough Road	W8-8	6F.16	36 x 36	48 x 48	30 x 30
Low Shoulder	W8-9	6F.44	36 x 36	48 x 48	30 x 30
Uneven Lanes	W8-11	6F.45	36 x 36	48 x 48	30 x 30
No Center Line	W8-12	6F.47	36 x 36	48 x 48	30 x 30
Fallen Rocks	W8-14	6F.16	36 x 36	48 x 48	30 x 30
Grooved Pavement	W8-15	6F.16	36 x 36	48 x 48	30 x 30
Motorcycle (plaque)	W8-15P	6F.54	24 x 18	30 x 24	—
Shoulder Drop Off (symbol)	W8-17	6F.44	36 x 36	48 x 48	30 x 30
Shoulder Drop-Off (plaque)	W8-17P	6F.44	24 x 18	30 x 24	—
Road May Flood	W8-18	6F.16	36 x 36	48 x 48	24 x 24
No Shoulder	W8-23	6F.16	36 x 36	48 x 48	30 x 30
Steel Plate Ahead	W8-24	6F.46	36 x 36	48 x 48	30 x 30
Shoulder Ends	W8-25	6F.16	36 x 36	48 x 48	30 x 30
Lane Ends	W9-1,2	6F.16	36 x 36	48 x 48	30 x 30
Center Lane Closed Ahead	W9-3	6F.23	36 x 36	48 x 48	30 x 30
Grade Crossing Advance Warning	W10-1	6F.16	36 dia.	—	—
Truck	W11-10	6F.36	36 x 36	48 x 48	30 x 30
Double Arrow	W12-1	6F.16	30 x 30	—	—
Low Clearance	W12-2	6F.16	36 x 36	48 x 48	30 x 30
Advisory Speed (plaque)	W13-1P	6F.52	24 x 24	30 x 30	18 x 18
On Ramp (plaque)	W13-4P	6F.25	36 x 36	36 x 36	—
No Passing Zone (pennant)	W14-3	6F.16	48 x 48 x 36	64 x 64 x 48	40 x 40 x 30
XX Feet (plaque)	W16-2P	6F.16	24 x 18	30 x 24	—
Road Work (with distance)	W20-1	6F.18	36 x 36	48 x 48	30 x 30

**Table 6F-1. Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 3 of 3)**

Sign or Plaque	Sign Designation	Section	Conventional Road	Freeway or Expressway	Minimum
Detour (with distance)	W20-2	6F.19	36 x 36	48 x 48	30 x 30
Road (Street) Closed (with distance)	W20-3	6F.20	36 x 36	48 x 48	30 x 30
One Lane Road (with distance)	W20-4	6F.21	36 x 36	48 x 48	30 x 30
Lane(s) Closed (with distance)	W20-5,5a	6F.22	36 x 36	48 x 48	30 x 30
Flagger (symbol)	W20-7	6F.31	36 x 36	48 x 48	30 x 30
Flagger	W20-7a	6F.31	36 x 36	48 x 48	30 x 30
Slow (on Stop/Slow Paddle)	W20-8	6E.03	18 x 18	—	—
Workers	W21-1,1a	6F.33	36 x 36	48 x 48	30 x 30
Fresh Oil (Tar)	W21-2	6F.34	36 x 36	48 x 48	30 x 30
Road Machinery Ahead	W21-3	6F.35	36 x 36	48 x 48	30 x 30
Slow Moving Vehicle	W21-4	6G.06	36 x 18	—	—
Shoulder Work	W21-5	6F.37	36 x 36	48 x 48	30 x 30
Shoulder Closed	W21-5a	6F.37	36 x 36	48 x 48	30 x 30
Shoulder Closed (with distance)	W21-5b	6F.37	36 x 36	48 x 48	30 x 30
Survey Crew	W21-6	6F.38	36 x 36	48 x 48	30 x 30
Utility Work Ahead	W21-7	6F.39	36 x 36	48 x 48	30 x 30
Mowing Ahead	W21-8	6G.06	36 x 36	48 x 48	30 x 30
Blasting Zone Ahead	W22-1	6F.41	36 x 36	48 x 48	30 x 30
Turn Off 2-Way Radio and Cell Phone	W22-2	6F.42	42 x 36	42 x 36	—
End Blasting Zone	W22-3	6F.43	42 x 36	42 x 36	36 x 30
Slow Traffic Ahead	W23-1	6F.27	48 x 24	48 x 24	—
New Traffic Pattern Ahead	W23-2	6F.30	36 x 36	48 x 48	30 x 30
Double Reverse Curve (1 lane)	W24-1	6F.49	36 x 36	48 x 48	30 x 30
Double Reverse Curve (2 lanes)	W24-1a	6F.49	36 x 36	48 x 48	30 x 30
Double Reverse Curve (3 lanes)	W24-1b	6F.49	36 x 36	48 x 48	30 x 30
All Lanes	W24-1cP	6F.49	24 x 24	30 x 30	—
Road Work Next XX Miles	G20-1	6F.56	36 x 18	48 x 24	—
End Road Work	G20-2	6F.57	36 x 18	48 x 24	—
Pilot Car Follow Me	G20-4	6F.58	36 x 18	—	—
Work Zone (plaque)	G20-5aP	6F.12	24 x 18	36 x 24	—
Exit Open	E5-2	6F.28	48 x 36	48 x 36	—
Exit Closed	E5-2a	6F.28	48 x 36	48 x 36	—
Exit Only	E5-3	6F.29	48 x 36	48 x 36	—
Detour	M4-8	6F.59	24 x 12	30 x 15	—
End Detour	M4-8a	6F.59	24 x 18	24 x 18	—
End	M4-8b	6F.59	24 x 12	24 x 12	—
Detour	M4-9	6F.59	30 x 24	48 x 36	—
Bike/Pedestrian Detour	M4-9a	6F.59	30 x 24	—	—
Pedestrian Detour	M4-9b	6F.59	30 x 24	—	—
Bike Detour	M4-9c	6F.59	30 x 24	—	—
Detour	M4-10	6F.59	48 x 18	—	—

\* See Table 2B-1 for minimum size required for signs facing traffic on multi-lane conventional roads

- Notes: 1. Larger signs may be used wherever necessary for greater legibility or emphasis  
 2. Dimensions are shown in inches and are shown as width x height

**Figure 6F-1. Height and Lateral Location of Signs—Typical Installations****Standard:**

09 Where it has been determined that the accommodation of pedestrians with disabilities is necessary, signs shall be mounted and placed in accordance with Section 4.4 of the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11).

10 Signs mounted on barricades and barricade/sign combinations shall be crashworthy.

*Guidance:*

11 Except as provided in Paragraph 12, signs mounted on portable sign supports that do not meet the minimum mounting heights provided in Paragraphs 4 through 6 should not be used for a duration of more than 3 days.

*Option:*

12 The R9-8 through R9-11a series, R11 series, W1-6 through W1-8 series, M4-10, E5-1, or other similar type signs (see Figures 6F-3, 6F-4, and 6F-5) may be used on portable sign supports that do not meet the minimum mounting heights provided in Paragraphs 4 through 6 for longer than 3 days.

*Support:*

13 Methods of mounting signs other than on posts are illustrated in Figure 6F-2.

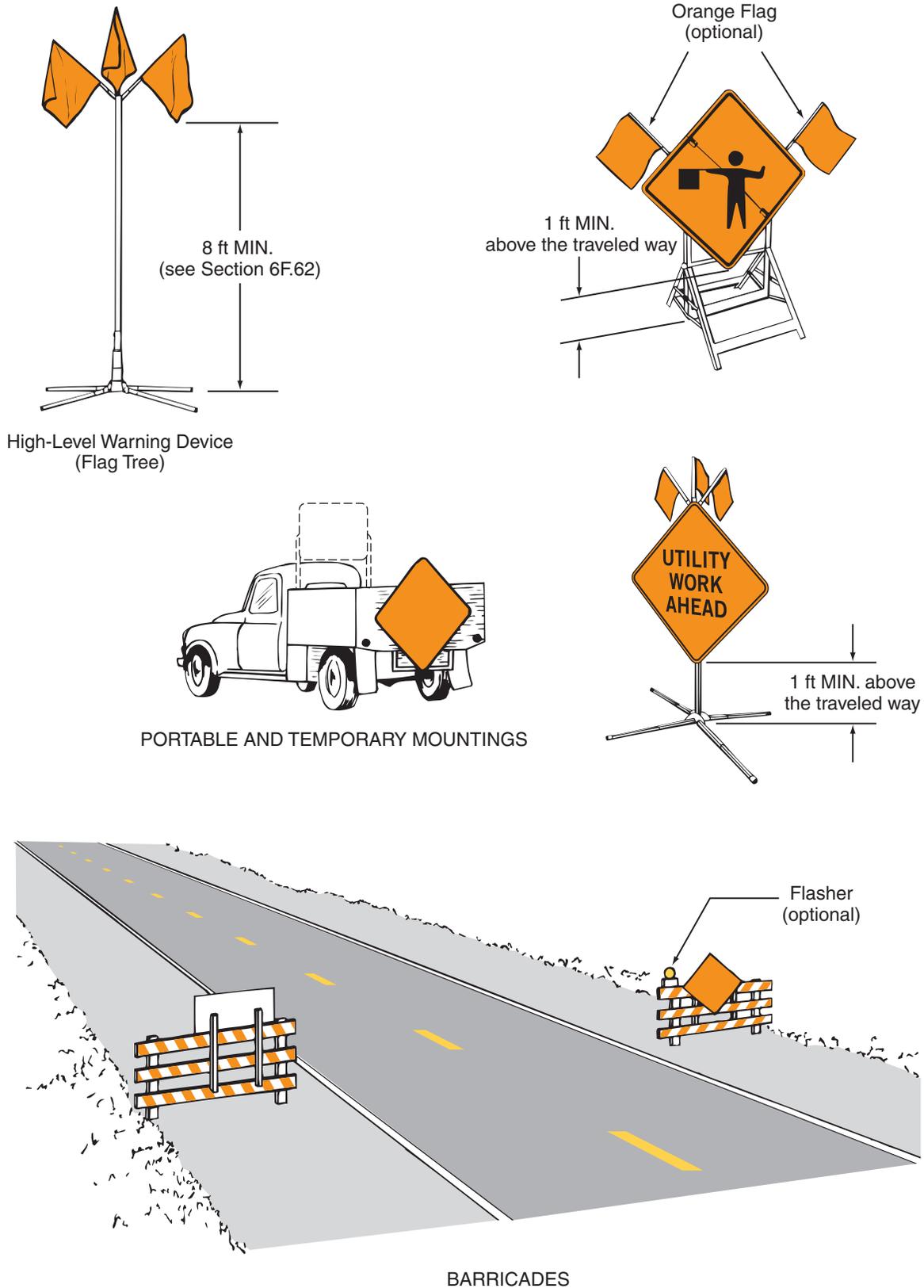
*Guidance:*

14 Signs mounted on Type 3 Barricades should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails.

**Standard:**

15 Sign supports shall be crashworthy. Where large signs having an area exceeding 50 square feet are installed on multiple breakaway posts, the clearance from the ground to the bottom of the sign shall be at least 7 feet.

Figure 6F-2. Methods of Mounting Signs Other Than on Posts



- 16 **The bottom of a sign mounted on a barricade, or other portable support, shall be at least 1 foot above the traveled way.**

Option:

- 17 For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, or a trailer stationed in advance of the TTC zone or moving along with it.

Support:

- 18 If alterations are made to specific traffic control device supports that have been successfully crash tested in accordance with NCHRP Report 350, the altered supports might not be considered to be crashworthy.

#### **Section 6F.04 Sign Maintenance**

*Guidance:*

- 01 *Signs should be properly maintained for cleanliness, visibility, and correct positioning.*
- 02 *Signs that have lost significant legibility should be promptly replaced.*

Support:

- 03 Section 2A.08 contains information regarding the retroreflectivity of signs, including the signs that are used in TTC zones.

#### **Section 6F.05 Regulatory Sign Authority**

Support:

- 01 Regulatory signs such as those shown in Figure 6F-3 inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.

**Standard:**

- 02 **Regulatory signs shall be authorized by the public agency or official having jurisdiction and shall conform with Chapter 2B.**

#### **Section 6F.06 Regulatory Sign Design**

**Standard:**

- 01 **TTC regulatory signs shall comply with the Standards for regulatory signs presented in Part 2 and in the FHWA's "Standard Highway Signs and Markings" book (see Section 1A.11).**

Support:

- 02 Regulatory signs are generally rectangular with a black legend and border on a white background. Exceptions include the STOP, YIELD, DO NOT ENTER, WRONG WAY, and ONE WAY signs.

Option:

- 03 The ONE WAY sign may be either a horizontal or vertical rectangular sign.

#### **Section 6F.07 Regulatory Sign Applications**

**Standard:**

- 01 **If a TTC zone requires regulatory measures different from those existing, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory signs. This change shall be made in compliance with applicable ordinances or statutes of the jurisdiction.**

#### **Section 6F.08 ROAD (STREET) CLOSED Sign (R11-2)**

*Guidance:*

- 01 *The ROAD (STREET) CLOSED (R11-2) sign (see Figure 6F-3) should be used when the roadway is closed to all road users except contractors' equipment or officially authorized vehicles. The R11-2 sign should be accompanied by appropriate warning and detour signing.*

Option:

- 02 The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for ROAD (STREET) CLOSED where applicable.

*Guidance:*

- 03 *The ROAD (STREET) CLOSED sign should be installed at or near the center of the roadway on or above a Type 3 Barricade that closes the roadway (see Section 6F.68).*

Figure 6F-3. Regulatory Signs and Plaques in Temporary Traffic Control Zones  
(Sheet 1 of 2)



R1-1



R1-2



R1-2aP



R1-7



R1-8



G20-5aP



R2-1



R2-6P



R2-6aP



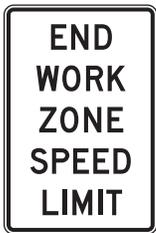
R2-6bP



R2-10



R2-11



R2-12



R3-1



R3-2



R3-3



R3-4



R3-5



R3-6



R3-7



R3-8



R3-18



R3-27



R4-1



R4-2



R4-7



R4-7c



R4-9



R5-1



R5-1a



R6-1



R6-2

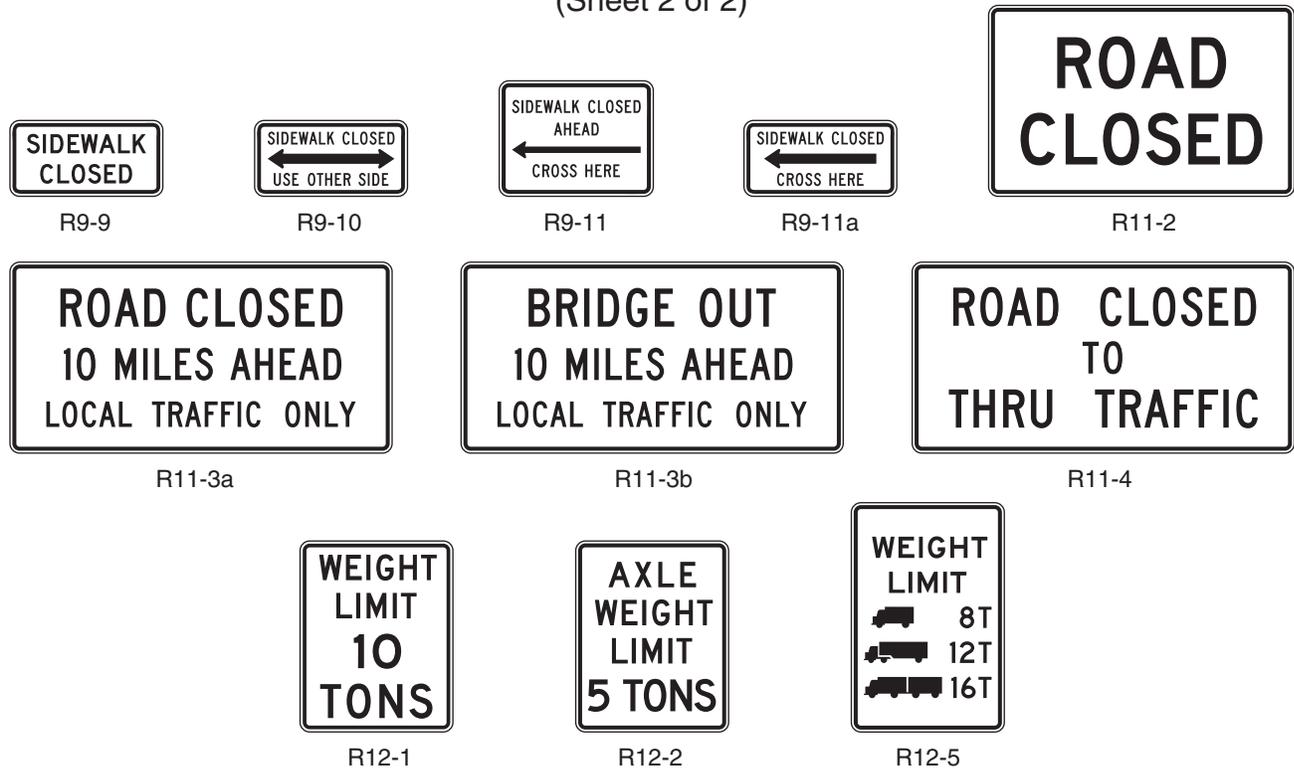


R8-3



R9-8

**Figure 6F-3. Regulatory Signs and Plaques in Temporary Traffic Control Zones**  
(Sheet 2 of 2)



**Standard:**

- 04 The ROAD (STREET) CLOSED sign shall not be used where road user flow is maintained through the TTC zone with a reduced number of lanes on the existing roadway or where the actual closure is some distance beyond the sign.

**Section 6F.09 Local Traffic Only Signs (R11-3a, R11-4)**

*Guidance:*

- 01 The Local Traffic Only signs (see Figure 6F-3) should be used where road user flow detours to avoid a closure some distance beyond the sign, but where local road users can use the roadway to the point of closure. These signs should be accompanied by appropriate warning and detour signing.
- 02 In rural applications, the Local Traffic Only sign should have the legend ROAD CLOSED XX MILES AHEAD, LOCAL TRAFFIC ONLY (R11-3a).

*Option:*

- 03 In urban areas, the legend ROAD (STREET) CLOSED TO THRU TRAFFIC (R11-4) or ROAD CLOSED, LOCAL TRAFFIC ONLY may be used.
- 04 In urban areas, a word message that includes the name of an intersecting street name or well-known destination may be substituted for the words XX MILES AHEAD on the R11-3a sign where applicable.
- 05 The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for the words ROAD (STREET) CLOSED on the R11-3a or R11-4 sign where applicable.

**Section 6F.10 Weight Limit Signs (R12-1, R12-2, R12-5)**

**Standard:**

- 01 A Weight Limit sign (see Figure 6F-3), which shows the gross weight or axle weight that is permitted on the roadway or bridge, shall be consistent with State or local regulations and shall not be installed without the approval of the authority having jurisdiction over the highway.
- 02 When weight restrictions are imposed because of the activity in a TTC zone, a marked detour shall be provided for vehicles weighing more than the posted limit.

**Section 6F.11 STAY IN LANE Sign (R4-9)**

## Option:

- 01 A STAY IN LANE (R4-9) sign (see Figure 6F-3) may be used where a multi-lane shift has been incorporated as part of the TTC on a highway to direct road users around road work that occupies part of the roadway on a multi-lane highway.

**Section 6F.12 Work Zone and Higher Fines Signs and Plaques**

## Option:

- 01 A WORK ZONE (G20-5aP) plaque (see Figure 6F-3) may be mounted above a Speed Limit sign to emphasize that a reduced speed limit is in effect within a TTC zone. An END WORK ZONE SPEED LIMIT (R2-12) sign (see Figure 6F-3) may be installed at the downstream end of the reduced speed limit zone.

## Guidance:

- 02 A *BEGIN HIGHER FINES ZONE (R2-10) sign (see Figure 6F-3) should be installed at the upstream end of a work zone where increased fines are imposed for traffic violations, and an END HIGHER FINES ZONE (R2-11) sign (see Figure 6F-3) should be installed at the downstream end of the work zone.*

## Option:

- 03 Alternate legends such as BEGIN (or END) DOUBLE FINES ZONE may also be used for the R2-10 and R2-11 signs.
- 04 A FINES HIGHER, FINES DOUBLE, or \$XX FINE plaque (see Section 2B.17 and Figure 6F-3) may be mounted below the Speed Limit sign if increased fines are imposed for traffic violations within the TTC zone.
- 05 Individual signs and plaques for work zone speed limits and higher fines may be combined into a single sign or may be displayed as an assembly of signs and plaques.

**Section 6F.13 PEDESTRIAN CROSSWALK Sign (R9-8)**

## Option:

- 01 The PEDESTRIAN CROSSWALK (R9-8) sign (see Figure 6F-3) may be used to indicate where a temporary crosswalk has been established.

**Standard:**

- 02 **If a temporary crosswalk is established, it shall be accessible to pedestrians with disabilities in accordance with Section 6D.02.**

**Section 6F.14 SIDEWALK CLOSED Signs (R9-9, R9-10, R9-11, R9-11a)**

## Guidance:

- 01 *SIDEWALK CLOSED signs (see Figure 6F-3) should be used where pedestrian flow is restricted. Bicycle/Pedestrian Detour (M4-9a) signs or Pedestrian Detour (M4-9b) signs should be used where pedestrian flow is rerouted (see Section 6F.59).*
- 02 *The SIDEWALK CLOSED (R9-9) sign should be installed at the beginning of the closed sidewalk, at the intersections preceding the closed sidewalk, and elsewhere along the closed sidewalk as needed.*
- 03 *The SIDEWALK CLOSED, (ARROW) USE OTHER SIDE (R9-10) sign should be installed at the beginning of the restricted sidewalk when a parallel sidewalk exists on the other side of the roadway.*
- 04 *The SIDEWALK CLOSED AHEAD, (ARROW) CROSS HERE (R9-11) sign should be used to indicate to pedestrians that sidewalks beyond the sign are closed and to direct them to open crosswalks, sidewalks, or other travel paths.*
- 05 *The SIDEWALK CLOSED, (ARROW) CROSS HERE (R9-11a) sign should be installed just beyond the point to which pedestrians are being redirected.*

## Support:

- 06 These signs are typically mounted on a detectable barricade to encourage compliance and to communicate with pedestrians that the sidewalk is closed. Printed signs are not useful to many pedestrians with visual disabilities. A barrier or barricade detectable by a person with a visual disability is sufficient to indicate that a sidewalk is closed. If the barrier is continuous with detectable channelizing devices for an alternate route, accessible signing might not be necessary. An audible information device is needed when the detectable barricade or barrier for an alternate channelized route is not continuous.

### **Section 6F.15 Special Regulatory Signs**

Option:

- 01 Special regulatory signs may be used based on engineering judgment consistent with regulatory requirements.

*Guidance:*

- 02 *Special regulatory signs should comply with the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.*

### **Section 6F.16 Warning Sign Function, Design, and Application**

Support:

- 01 TTC zone warning signs (see Figure 6F-4) notify road users of specific situations or conditions on or adjacent to a roadway that might not otherwise be apparent.

**Standard:**

- 02 **TTC warning signs shall comply with the Standards for warning signs presented in Part 2 and in FHWA's "Standard Highway Signs and Markings" book (see Section 1A.11). Except as provided in Paragraph 3, TTC warning signs shall be diamond-shaped with a black legend and border on an orange background, except for the W10-1 sign which shall have a black legend and border on a yellow background, and except for signs that are required or recommended in Parts 2 or 7 to have fluorescent yellow-green backgrounds.**

Option:

- 03 Warning signs used for TTC incident management situations may have a black legend and border on a fluorescent pink background.

- 04 Mounting or space considerations may justify a change from the standard diamond shape.

- 05 In emergencies, available warning signs having yellow backgrounds may be used if signs with orange or fluorescent pink backgrounds are not at hand.

*Guidance:*

- 06 *Where roadway or road user conditions require greater emphasis, larger than standard size warning signs should be used, with the symbol or legend enlarged approximately in proportion to the outside dimensions.*

- 07 *Where any part of the roadway is obstructed or closed by work activities or incidents, advance warning signs should be installed to alert road users well in advance of these obstructions or restrictions.*

- 08 *Where road users include pedestrians, the provision of supplemental audible information or detectable barriers or barricades should be considered for people with visual disabilities.*

Support:

- 09 Detectable barriers or barricades communicate very clearly to pedestrians who have visual disabilities that they can no longer proceed in the direction that they are traveling.

Option:

- 10 Advance warning signs may be used singly or in combination.

- 11 Where distances are not displayed on warning signs as part of the message, a supplemental plaque with the distance legend may be mounted immediately below the sign on the same support.

### **Section 6F.17 Position of Advance Warning Signs**

*Guidance:*

- 01 *Where highway conditions permit, warning signs should be placed in advance of the TTC zone at varying distances depending on roadway type, condition, and posted speed. Table 6C-1 contains information regarding the spacing of advance warning signs. Where a series of two or more advance warning signs is used, the closest sign to the TTC zone should be placed approximately 100 feet for low-speed urban streets to 1,000 feet or more for freeways and expressways.*

- 02 *Where multiple advance warning signs are needed on the approach to a TTC zone, the ROAD WORK AHEAD (W20-1) sign should be the first advance warning sign encountered by road users.*

Support:

- 03 Various conditions, such as limited sight distance or obstructions that might require a driver to reduce speed or stop, might require additional advance warning signs.

Option:

- 04 As an alternative to a specific distance on advance warning signs, the word AHEAD may be used.

**Figure 6F-4. Warning Signs and Plaques in Temporary Traffic Control Zones**  
(Sheet 1 of 3)



W1-1



W1-2



W1-3



W1-4



W1-4b



W1-4c



W1-6



W1-8



W3-1



W3-2



W3-3



W3-4



W3-5



W3-5a



W4-1



W4-2



W4-3



W4-5



W4-5P



W4-6



W5-1



W5-2



W5-3



W5-4



W6-1



W6-2



W6-3



W6-4



W7-1

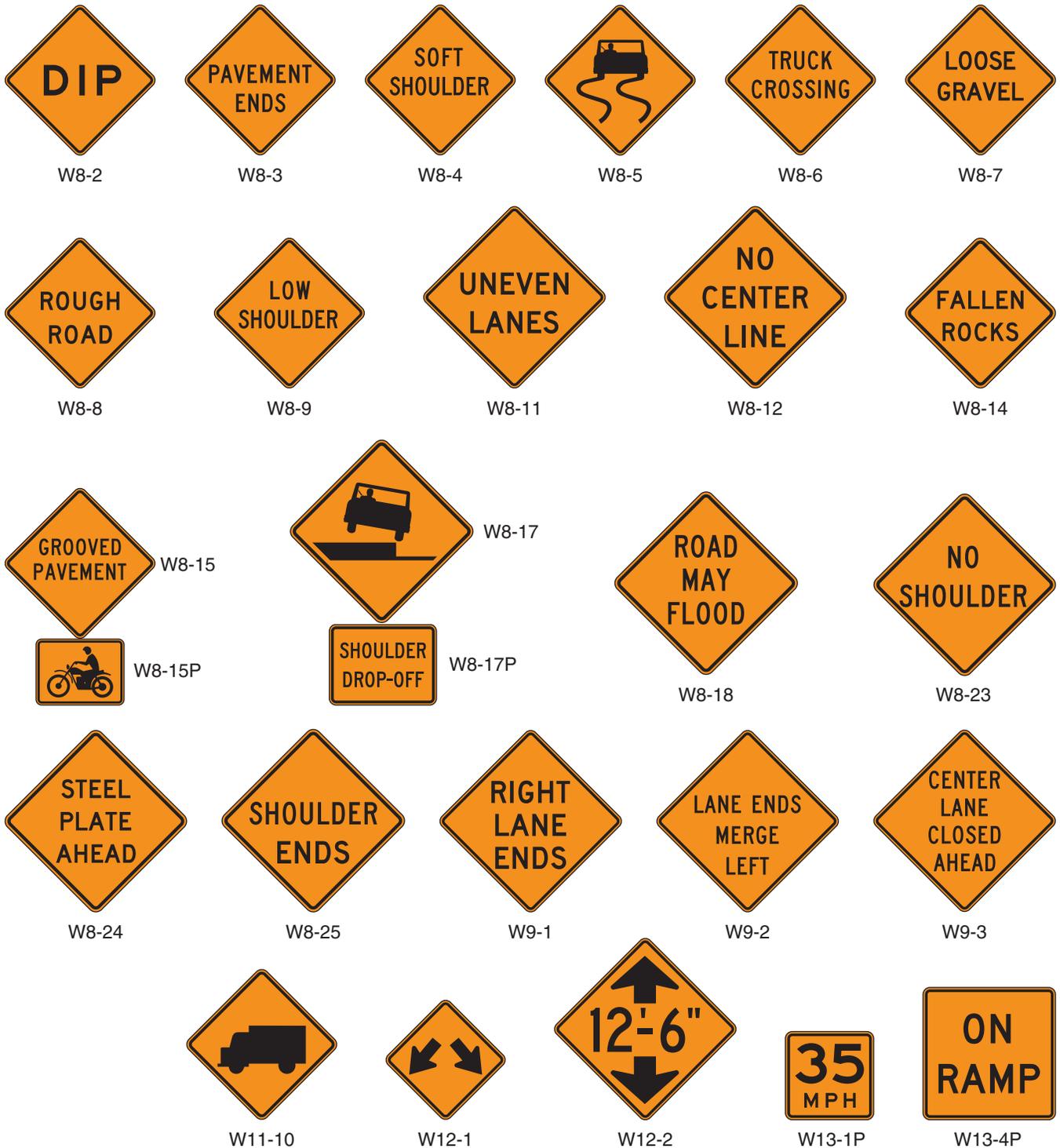


W7-3aP

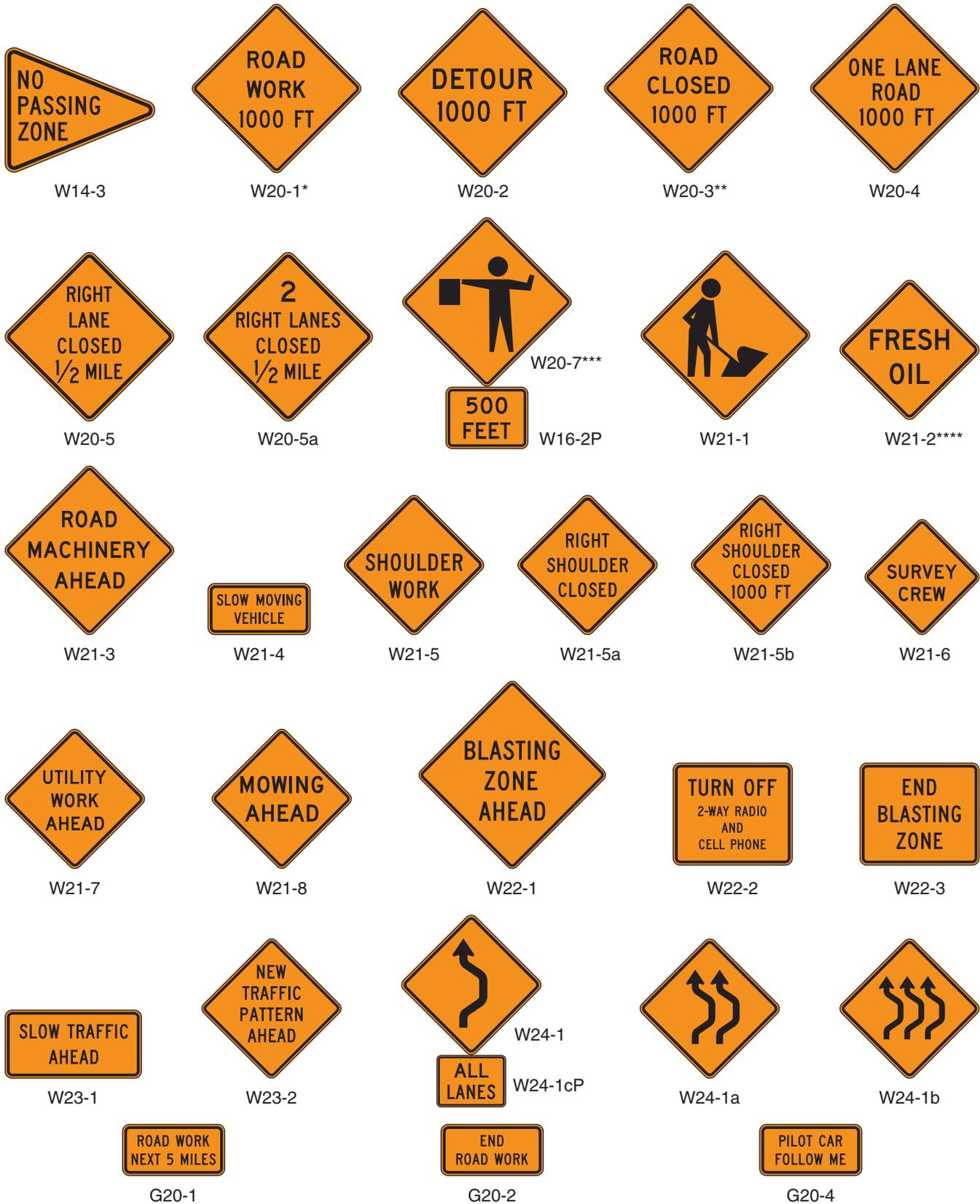


W8-1

**Figure 6F-4. Warning Signs and Plaques in Temporary Traffic Control Zones**  
(Sheet 2 of 3)



**Figure 6F-4. Warning Signs and Plaques in Temporary Traffic Control Zones (Sheet 3 of 3)**



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

**Support:**

- 05 At TTC zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.

**Option:**

- 06 Utility work, maintenance, or minor construction can occur within the TTC zone limits of a major construction project, and additional warning signs may be needed.

**Guidance:**

- 07 *Utility, maintenance, and minor construction signing and TTC should be coordinated with appropriate authorities so that road users are not confused or misled by the additional TTC devices.*

**Section 6F.18 ROAD (STREET) WORK Sign (W20-1)****Guidance:**

- 01 *The ROAD (STREET) WORK (W20-1) sign (see Figure 6F-4), which serves as a general warning of obstructions or restrictions, should be located in advance of the work space or any detour, on the road where the work is taking place.*
- 02 *Where traffic can enter a TTC zone from a crossroad or a major (high-volume) driveway, an advance warning sign should be used on the crossroad or major driveway.*

**Standard:**

- 03 **The ROAD (STREET) WORK (W20-1) sign shall have the legend ROAD (STREET) WORK, XX FEET, XX MILES, or AHEAD.**

**Section 6F.19 DETOUR Sign (W20-2)****Guidance:**

- 01 *The DETOUR (W20-2) sign (see Figure 6F-4) should be used in advance of a road user detour over a different roadway or route.*

**Standard:**

- 02 **The DETOUR sign shall have the legend DETOUR, XX FEET, XX MILES, or AHEAD.**

**Section 6F.20 ROAD (STREET) CLOSED Sign (W20-3)****Guidance:**

- 01 *The ROAD (STREET) CLOSED (W20-3) sign (see Figure 6F-4) should be used in advance of the point where a highway is closed to all road users, or to all but local road users.*

**Standard:**

- 02 **The ROAD (STREET) CLOSED sign shall have the legend ROAD (STREET) CLOSED, XX FEET, XX MILES, or AHEAD.**

**Section 6F.21 ONE LANE ROAD Sign (W20-4)****Standard:**

- 01 **The ONE LANE ROAD (W20-4) sign (see Figure 6F-4) shall be used only in advance of that point where motor vehicle traffic in both directions must use a common single lane (see Section 6C.10). It shall have the legend ONE LANE ROAD, XX FEET, XX MILES, or AHEAD.**

**Section 6F.22 Lane(s) Closed Signs (W20-5, W20-5a)****Standard:**

- 01 **The Lane(s) Closed sign (see Figure 6F-4) shall be used in advance of that point where one or more through lanes of a multi-lane roadway are closed.**
- 02 **For a single lane closure, the Lane Closed (W20-5) sign (see Figure 6F-4) shall have the legend RIGHT (LEFT) LANE CLOSED, XX FEET, XX MILES, or AHEAD. Where two adjacent lanes are closed, the W20-5a sign (see Figure 6F-4) shall have the legend XX RIGHT (LEFT) LANES CLOSED, XX FEET, XX MILES, or AHEAD.**

**Section 6F.23 CENTER LANE CLOSED AHEAD Sign (W9-3)**

Guidance:

- 01 The CENTER LANE CLOSED AHEAD (W9-3) sign (see Figure 6F-4) should be used in advance of that point where work occupies the center lane(s) and approaching motor vehicle traffic is directed to the right or left of the work zone in the center lane.

**Section 6F.24 Lane Ends Sign (W4-2)**

Option:

- 01 The Lane Ends (W4-2) symbol sign (see Figure 6F-4) may be used to warn drivers of the reduction in the number of lanes for moving motor vehicle traffic in the direction of travel on a multi-lane roadway.

**Section 6F.25 ON RAMP Plaque (W13-4P)**

Guidance:

- 01 When work is being done on a ramp, but the ramp remains open, the ON RAMP (W13-4P) plaque (see Figure 6F-4) should be used to supplement the advance ROAD WORK sign.

**Section 6F.26 RAMP NARROWS Sign (W5-4)**

Guidance:

- 01 The RAMP NARROWS (W5-4) sign (see Figure 6F-4) should be used in advance of the point where work on a ramp reduces the normal width of the ramp along a part or all of the ramp.

**Section 6F.27 SLOW TRAFFIC AHEAD Sign (W23-1)**

Option:

- 01 The SLOW TRAFFIC AHEAD (W23-1) sign (see Figure 6F-4) may be used on a shadow vehicle, usually mounted on the rear of the most upstream shadow vehicle, along with other appropriate signs for mobile operations to warn of slow moving work vehicles. A ROAD WORK (W20-1) sign may also be used with the SLOW TRAFFIC AHEAD sign.

**Section 6F.28 EXIT OPEN and EXIT CLOSED Signs (E5-2, E5-2a)**

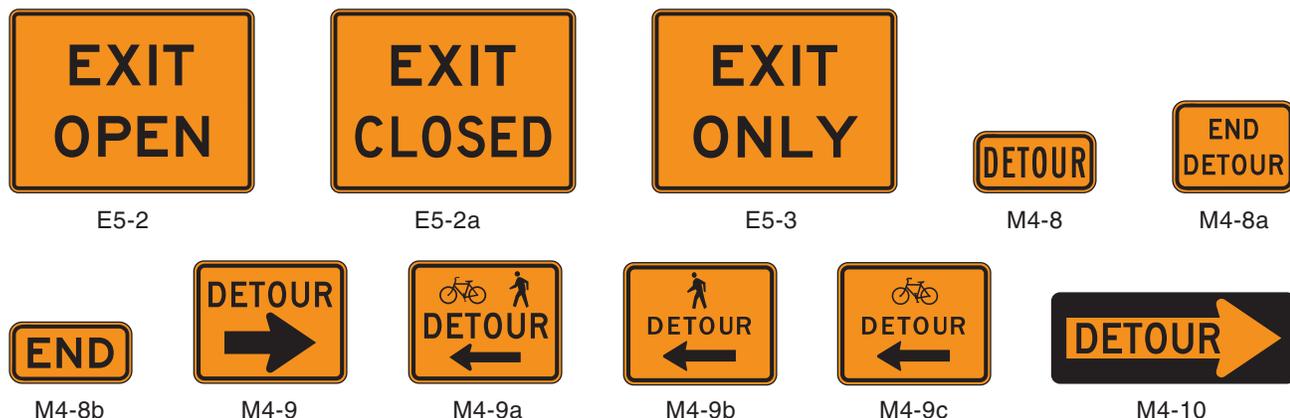
Option:

- 01 An EXIT OPEN (E5-2) or EXIT CLOSED (E5-2a) sign (see Figure 6F-5) may be used to supplement other warning signs where work is being conducted in the vicinity of an exit ramp and where the exit maneuver for vehicular traffic using the ramp is different from the normal condition.

Guidance:

- 02 When an exit ramp is closed, an EXIT CLOSED sign panel with a black legend and border on an orange background should be placed diagonally across the interchange/intersection guide signs.

**Figure 6F-5. Exit Open and Closed and Detour Signs**



**Section 6F.29 EXIT ONLY Sign (E5-3)**

Option:

- 01 An EXIT ONLY (E5-3) sign (see Figure 6F-5) may be used to supplement other warning signs where work is being conducted in the vicinity of an exit ramp and where the exit maneuver for vehicular traffic using the ramp is different from the normal condition.

**Section 6F.30 NEW TRAFFIC PATTERN AHEAD Sign (W23-2)**

Option:

- 01 A NEW TRAFFIC PATTERN AHEAD (W23-2) sign (see Figure 6F-4) may be used on the approach to an intersection or along a section of roadway to provide advance warning of a change in traffic patterns, such as revised lane usage, roadway geometry, or signal phasing.

Guidance:

- 02 *To retain its effectiveness, the W23-2 sign should be displayed for up to 2 weeks, and then it should be covered or removed until it is needed again.*

**Section 6F.31 Flagger Signs (W20-7, W20-7a)**

Guidance:

- 01 *The Flagger (W20-7) symbol sign (see Figure 6F-4) should be used in advance of any point where a flagger is stationed to control road users.*

Option:

- 02 A distance legend may be displayed on a supplemental plaque below the Flagger sign. The sign may be used with appropriate legends or in conjunction with other warning signs, such as the BE PREPARED TO STOP (W3-4) sign (see Figure 6F-4).
- 03 The FLAGGER (W20-7a) word message sign with distance legends may be substituted for the Flagger (W20-7) symbol sign.

**Section 6F.32 Two-Way Traffic Sign (W6-3)**

Guidance:

- 01 *When one roadway of a normally divided highway is closed, with two-way vehicular traffic maintained on the other roadway, the Two-Way Traffic (W6-3) sign (see Figure 6F-4) should be used at the beginning of the two-way vehicular traffic section and at intervals to remind road users of opposing vehicular traffic.*

**Section 6F.33 Workers Signs (W21-1, W21-1a)**

Option:

- 01 A Workers (W21-1) symbol sign (see Figure 6F-4) may be used to alert road users of workers in or near the roadway.

Guidance:

- 02 *In the absence of other warning devices, a Workers symbol sign should be used when workers are in the roadway.*

Option:

- 03 The WORKERS (W21-1a) word message sign may be used as an alternate to the Workers (W21-1) symbol sign.

**Section 6F.34 FRESH OIL (TAR) Sign (W21-2)**

Guidance:

- 01 *The FRESH OIL (TAR) (W21-2) sign (see Figure 6F-4) should be used to warn road users of the surface treatment.*

**Section 6F.35 ROAD MACHINERY AHEAD Sign (W21-3)**

Option:

- 01 The ROAD MACHINERY AHEAD (W21-3) sign (see Figure 6F-4) may be used to warn of machinery operating in or adjacent to the roadway.

**Section 6F.36 Motorized Traffic Signs (W8-6, W11-10)**

Option:

- 01 Motorized Traffic (W8-6, W11-10) signs may be used to alert road users to locations where unexpected travel on the roadway or entries into or departures from the roadway by construction vehicles might occur. The TRUCK CROSSING (W8-6) word message sign may be used as an alternate to the Truck Crossing (W11-10) symbol sign (see Figure 6F-4) where there is an established construction vehicle crossing of the roadway.

Support:

- 02 These locations might be relatively confined or might occur randomly over a segment of roadway.

**Section 6F.37 Shoulder Work Signs (W21-5, W21-5a, W21-5b)**

Support:

- 01 Shoulder Work signs (see Figure 6F-4) warn of maintenance, reconstruction, or utility operations on the highway shoulder where the roadway is unobstructed.

**Standard:**

- 02 **The Shoulder Work sign shall have the legend SHOULDER WORK (W21-5), RIGHT (LEFT) SHOULDER CLOSED (W21-5a), or RIGHT (LEFT) SHOULDER CLOSED XX FT or AHEAD (W21-5b).**

Option:

- 03 The Shoulder Work sign may be used in advance of the point on a non-limited access highway where there is shoulder work. It may be used singly or in combination with a ROAD WORK NEXT XX MILES or ROAD WORK AHEAD sign.

*Guidance:*

- 04 *On freeways and expressways, the RIGHT (LEFT) SHOULDER CLOSED XX FT or AHEAD (W21-5b) sign followed by RIGHT (LEFT) SHOULDER CLOSED (W21-5a) sign should be used in advance of the point where the shoulder work occurs and should be preceded by a ROAD WORK AHEAD sign.*

**Section 6F.38 SURVEY CREW Sign (W21-6)***Guidance:*

- 01 *The SURVEY CREW (W21-6) sign (see Figure 6F-4) should be used to warn of surveying crews working in or adjacent to the roadway.*

**Section 6F.39 UTILITY WORK Sign (W21-7)**

Option:

- 01 The UTILITY WORK (W21-7) sign (see Figure 6F-4) may be used as an alternate to the ROAD (STREET) WORK (W20-1) sign for utility operations on or adjacent to a highway.

Support:

- 02 Typical examples of where the UTILITY WORK sign is used appear in Figures 6H-4, 6H-6, 6H-10, 6H-15, 6H-18, 6H-21, 6H-22, 6H-26, and 6H-33.

**Standard:**

- 03 **The UTILITY WORK sign shall carry the legend UTILITY WORK, XX FEET, XX MILES, or AHEAD.**

**Section 6F.40 Signs for Blasting Areas**

Support:

- 01 Radio-Frequency (RF) energy can cause the premature firing of electric detonators (blasting caps) used in TTC zones.

**Standard:**

- 02 **Road users shall be warned to turn off mobile radio transmitters and cellular telephones where blasting operations occur. A sequence of signs shall be prominently displayed to direct operators of mobile radio equipment, including cellular telephones, to turn off transmitters in a blasting area. These signs shall be covered or removed when there are no explosives in the area or the area is otherwise secured.**

**Section 6F.41 BLASTING ZONE AHEAD Sign (W22-1)****Standard:**

- 01 The **BLASTING ZONE AHEAD (W22-1)** sign (see Figure 6F-4) shall be used in advance of any TTC zone where explosives are being used. The **TURN OFF 2-WAY RADIO AND CELL PHONE** and **END BLASTING ZONE** signs shall be used in sequence with this sign.

**Section 6F.42 TURN OFF 2-WAY RADIO AND CELL PHONE Sign (W22-2)****Standard:**

- 01 The **TURN OFF 2-WAY RADIO AND CELL PHONE (W22-2)** sign (see Figure 6F-4) shall follow the **BLASTING ZONE AHEAD** sign and shall be placed at least 1,000 feet before the beginning of the blasting zone.

**Section 6F.43 END BLASTING ZONE Sign (W22-3)****Standard:**

- 01 The **END BLASTING ZONE (W22-3)** sign (see Figure 6F-4) shall be placed a minimum of 1,000 feet past the blasting zone.

**Option:**

- 02 The **END BLASTING ZONE** sign may be placed either with or preceding the **END ROAD WORK** sign.

**Section 6F.44 Shoulder Signs and Plaque (W8-4, W8-9, W8-17, and W8-17P)****Option:**

- 01 The **SOFT SHOULDER (W8-4)** sign (see Figure 6F-4) may be used to warn of a soft shoulder condition.
- 02 The **LOW SHOULDER (W8-9)** sign (see Figure 6F-4) may be used to warn of a shoulder condition where there is an elevation difference of 3 inches or less between the shoulder and the travel lane.

**Guidance:**

- 03 *The **Shoulder Drop Off (W8-17)** sign (see Figure 6F-4) should be used when an unprotected shoulder drop-off, adjacent to the travel lane, exceeds 3 inches in depth for a continuous length along the roadway, based on engineering judgment.*

**Option:**

- 04 A **SHOULDER DROP-OFF (W8-17P)** supplemental plaque (see Figure 6F-4) may be mounted below the **W8-17** sign.

**Section 6F.45 UNEVEN LANES Sign (W8-11)****Guidance:**

- 01 *The **UNEVEN LANES (W8-11)** sign (see Figure 6F-4) should be used during operations that create a difference in elevation between adjacent lanes that are open to travel.*

**Section 6F.46 STEEL PLATE AHEAD Sign (W8-24)****Option:**

- 01 A **STEEL PLATE AHEAD (W8-24)** sign (see Figure 6F-4) may be used to warn road users that the presence of a temporary steel plate(s) might make the road surface uneven and might create slippery conditions during wet weather.

**Section 6F.47 NO CENTER LINE Sign (W8-12)****Guidance:**

- 01 *The **NO CENTER LINE (W8-12)** sign (see Figure 6F-4) should be used when the work obliterates the center line pavement markings. This sign should be placed at the beginning of the TTC zone and repeated at 2-mile intervals in long TTC zones.*

**Support:**

- 02 Section 6F.78 contains information regarding temporary markings.

**Section 6F.48 Reverse Curve Signs (W1-4 Series)***Guidance:*

- 01 *In order to give road users advance notice of a lane shift, a Reverse Curve (W1-4, W1-4b, or W1-4c) sign (see Figure 6F-4) should be used when a lane (or lanes) is being shifted to the left or right. If the design speed of the curves is 30 mph or less, a Reverse Turn (W1-3) sign should be used.*

**Standard:**

- 02 **If a Reverse Curve (or Turn) sign is used, the direction of the reverse curve (or turn) shall be appropriately illustrated. Except as provided in Paragraph 3, the number of lanes illustrated on the sign shall be the same as the number of through lanes available to road users.**

*Option:*

- 03 Where two or more lanes are being shifted, a W1-4 (or W1-3) sign with an ALL LANES (W24-1cP) plaque (see Figure 6F-4) may be used instead of a sign that illustrates the number of lanes.
- 04 Where more than three lanes are being shifted, the Reverse Curve (or Turn) sign may be rectangular.

**Section 6F.49 Double Reverse Curve Signs (W24-1 Series)***Option:*

- 01 The Double Reverse Curve (W24-1, W24-1a, or W24-1b) sign (see Figure 6F-4) may be used where the tangent distance between two reverse curves is less than 600 feet, thus making it difficult for a second Reverse Curve (W1-4 series) sign to be placed between the curves. If the design speed of the curves is 30 mph or less, Double Reverse Turn signs should be used.

**Standard:**

- 02 **If a Double Reverse Curve (or Turn) sign is used, the direction of the double reverse curve (or turn) shall be appropriately illustrated. Except as provided in Paragraph 3, the number of lanes illustrated on the sign shall be the same as the number of through lanes available to road users.**

*Option:*

- 03 Where two or more lanes are being shifted, a W24-1 (or Double Reverse Turn sign showing one lane) sign with an ALL LANES (W24-1cP) plaque (see Figure 6F-4) may be used instead of a sign that illustrates the number of lanes.
- 04 Where more than three lanes are being shifted, the Double Reverse Curve (or Turn) sign may be rectangular.

**Section 6F.50 Other Warning Signs***Option:*

- 01 Advance warning signs may be used by themselves or with other advance warning signs.
- 02 Besides the warning signs specifically related to TTC zones, several other warning signs in Part 2 may apply in TTC zones.

**Standard:**

- 03 **Except as provided in Section 6F.02, other warning signs that are used in TTC zones shall have black legends and borders on an orange background.**

**Section 6F.51 Special Warning Signs***Option:*

- 01 Special warning signs may be used based on engineering judgment.

*Guidance:*

- 02 *Special warning signs should comply with the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.*

**Section 6F.52 Advisory Speed Plaque (W13-1P)***Option:*

- 01 In combination with a warning sign, an Advisory Speed (W13-1P) plaque (see Figure 6F-4) may be used to indicate a recommended speed through the TTC zone.

**Standard:**

- 02 **The Advisory Speed plaque shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used with orange TTC zone signs, this plaque shall have a black legend and border on an orange background. The sign shall be at least 24 x 24 inches in size when used with a sign that is 36 x 36 inches or larger. Except in emergencies, an Advisory Speed plaque shall not be mounted until the recommended speed is determined by the highway agency.**

### **Section 6F.53 Supplementary Distance Plaque (W7-3aP)**

#### Option:

- 01 In combination with a warning sign, a Supplementary Distance (W7-3aP) plaque (see Figure 6F-4) with the legend NEXT XX MILES may be used to indicate the length of highway over which a work activity is being conducted, or over which a condition exists in the TTC zone.
- 02 In long TTC zones, Supplementary Distance plaques with the legend NEXT XX MILES may be placed in combination with warning signs at regular intervals within the zone to indicate the remaining length of highway over which the TTC work activity or condition exists.

#### Standard:

- 03 **The Supplementary Distance plaque with the legend NEXT XX MILES shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used with orange TTC zone signs, this plaque shall have a black legend and border on an orange background. The sign shall be at least 30 x 24 inches in size when used with a sign that is 36 x 36 inches or larger.**

#### Guidance:

- 04 *When used in TTC zones, the Supplementary Distance plaque with the legend NEXT XX MILES should be placed below the initial warning sign designating that, within the approaching zone, a temporary work activity or condition exists.*

### **Section 6F.54 Motorcycle Plaque (W8-15P)**

#### Option:

- 01 A Motorcycle (W8-15P) plaque (see Figure 6F-4) may be mounted below a LOOSE GRAVEL (W8-7) sign, a GROOVED PAVEMENT (W8-15) sign, a METAL BRIDGE DECK (W8-16) sign, or a STEEL PLATE AHEAD (W8-24) sign if the warning is intended to be directed primarily to motorcyclists.

### **Section 6F.55 Guide Signs**

#### Support:

- 01 Guide signs along highways provide road users with information to help them along their way through the TTC zone. The design of guide signs is presented in Part 2.

#### Guidance:

- 02 *The following guide signs should be used in TTC zones as needed:*
- A. *Standard route markings, where temporary route changes are necessary,*
  - B. *Directional signs and street name signs, and*
  - C. *Special guide signs relating to the condition or work being done.*

#### Standard:

- 03 **If additional temporary guide signs are used in TTC zones, they shall have a black legend and border on an orange background.**

#### Option:

- 04 Guide signs used in TTC incident management situations may have a black legend and border on a fluorescent pink background.
- 05 When directional signs and street name signs are used in conjunction with detour routing, these signs may have a black legend and border on an orange background.
- 06 When permanent directional signs or permanent street name signs are used in conjunction with detour signing, they may have a white legend on a green background.

### **Section 6F.56 ROAD WORK NEXT XX MILES Sign (G20-1)**

#### Guidance:

- 01 *The ROAD WORK NEXT XX MILES (G20-1) sign (see Figure 6F-4) should be installed in advance of TTC zones that are more than 2 miles in length.*

#### Option:

- 02 The ROAD WORK NEXT XX MILES sign may be mounted on a Type 3 Barricade. The sign may also be used for TTC zones of shorter length.

#### Standard:

- 03 **The distance displayed on the ROAD WORK NEXT XX MILES sign shall be stated to the nearest whole mile.**

**Section 6F.57 END ROAD WORK Sign (G20-2)***Guidance:*

01 When used, the END ROAD WORK (G20-2) sign (see Figure 6F-4) should be placed near the downstream end of the termination area, as determined by engineering judgment.

*Option:*

02 The END ROAD WORK sign may be installed on the back of a warning sign facing the opposite direction of road users or on the back of a Type 3 Barricade.

**Section 6F.58 PILOT CAR FOLLOW ME Sign (G20-4)****Standard:**

01 The PILOT CAR FOLLOW ME (G20-4) sign (see Figure 6F-4) shall be mounted in a conspicuous position on the rear of a vehicle used for guiding one-way vehicular traffic through or around a TTC zone (see Section 6C.13).

**Section 6F.59 Detour Signs (M4-8, M4-8a, M4-8b, M4-9, M4-9a, M4-9b, M4-9c, and M4-10)****Standard:**

01 Each detour shall be adequately marked with standard temporary route signs and destination signs.

*Option:*

02 Detour signs in TTC incident management situations may have a black legend and border on a fluorescent pink background.

03 The Detour Arrow (M4-10) sign (see Figure 6F-5) may be used where a detour route has been established.

04 The DETOUR (M4-8) sign (see Figure 6F-5) may be mounted at the top of a route sign assembly to mark a temporary route that detours from a highway, bypasses a section closed by a TTC zone, and rejoins the highway beyond the TTC zone.

*Guidance:*

05 The Detour Arrow (M4-10) sign should normally be mounted just below the ROAD CLOSED (R11-2, R11-3a, or R11-4) sign. The Detour Arrow sign should include a horizontal arrow pointed to the right or left as required.

06 The DETOUR (M4-9) sign (see Figure 6F-5) should be used for unnumbered highways, for emergency situations, for periods of short durations, or where, over relatively short distances, road users are guided along the detour and back to the desired highway without route signs.

07 A Street Name sign should be placed above, or the street name should be incorporated into, a DETOUR (M4-9) sign to indicate the name of the street being detoured.

*Option:*

08 The END DETOUR (M4-8a) or END (M4-8b) sign (see Figure 6F-5) may be used to indicate that the detour has ended.

*Guidance:*

09 When the END DETOUR sign is used on a numbered highway, the sign should be mounted above a route sign after the downstream end of the detour.

10 The Pedestrian/Bicycle Detour (M4-9a) sign (see Figure 6F-5) should be used where a pedestrian/bicycle detour route has been established because of the closing of a pedestrian/bicycle facility to through traffic.

**Standard:**

11 If used, the Pedestrian/Bicycle Detour sign shall have an arrow pointing in the appropriate direction.

*Option:*

12 The arrow on a Pedestrian/Bicycle Detour sign may be on the sign face or on a supplemental plaque.

13 The Pedestrian Detour (M4-9b) sign or Bicycle Detour (M4-9c) sign (see Figure 6F-5) may be used where a pedestrian or bicycle detour route (not both) has been established because of the closing of the pedestrian or bicycle facility to through traffic.

**Section 6F.60 Portable Changeable Message Signs****Support:**

01 Portable changeable message signs (PCMS) are TTC devices installed for temporary use with the flexibility to display a variety of messages. In most cases, portable changeable message signs follow the same provisions for design and application as those given for changeable message signs in Chapter 2L. The information in this Section describes situations where the provisions for portable changeable message signs differ from those given in Chapter 2L.

- 02 Portable changeable message signs are used most frequently on high-density urban freeways, but have applications on all types of highways where highway alignment, road user routing problems, or other pertinent conditions require advance warning and information.
- 03 Portable changeable message signs have a wide variety of applications in TTC zones including: roadway, lane, or ramp closures; incident management; width restriction information; speed control or reductions; advisories on work scheduling; road user management and diversion; warning of adverse conditions or special events; and other operational control.
- 04 The primary purpose of portable changeable message signs in TTC zones is to advise the road user of unexpected situations. Portable changeable message signs are particularly useful as they are capable of:
- A. Conveying complex messages,
  - B. Displaying real time information about conditions ahead, and
  - C. Providing information to assist road users in making decisions prior to the point where actions must be taken.
- 05 Some typical applications include the following:
- A. Where the speed of vehicular traffic is expected to drop substantially;
  - B. Where significant queuing and delays are expected;
  - C. Where adverse environmental conditions are present;
  - D. Where there are changes in alignment or surface conditions;
  - E. Where advance notice of ramp, lane, or roadway closures is needed;
  - F. Where crash or incident management is needed; and/or
  - G. Where changes in the road user pattern occur.

*Guidance:*

- 06 *The components of a portable changeable message sign should include: a message sign, control systems, a power source, and mounting and transporting equipment. The front face of the sign should be covered with a protective material.*

**Standard:**

- 07 **Portable changeable message signs shall comply with the applicable design and application principles established in Chapter 2A. Portable changeable message signs shall display only traffic operational, regulatory, warning, and guidance information, and shall not be used for advertising messages.**

Support:

- 08 Section 2L.02 contains information regarding overly simplistic or vague messages that is also applicable to portable changeable message signs.

**Standard:**

- 09 **The colors used for legends on portable changeable message signs shall comply with those shown in Table 2A-5.**

Support:

- 10 Section 2L.04 contains information regarding the luminance, luminance contrast, and contrast orientation that is also applicable to portable changeable message signs.

*Guidance:*

- 11 *Portable changeable message signs should be visible from 1/2 mile under both day and night conditions.*

Support:

- 12 Section 2B.13 contains information regarding the design of portable changeable message signs that are used to display speed limits that change based on operational conditions, or are used to display the speed at which approaching drivers are traveling.

*Guidance:*

- 13 *A portable changeable message sign should be limited to three lines of eight characters per line or should consist of a full matrix display.*

- 14 *Except as provided in Paragraph 15, the letter height used for portable changeable message sign messages should be a minimum of 18 inches.*

Option:

- 15 For portable changeable message signs mounted on service patrol trucks or other incident response vehicles, a letter height as short as 10 inches may be used. Shorter letter sizes may also be used on a portable changeable message sign used on low speed facilities provided that the message is legible from at least 650 feet.

- 16 The portable changeable message sign may vary in size.

*Guidance:*

- 17 *Messages on a portable changeable message sign should consist of no more than two phases, and a phase should consist of no more than three lines of text. Each phase should be capable of being understood by itself, regardless of the order in which it is read. Messages should be centered within each line of legend. If more than one portable changeable message sign is simultaneously legible to road users, then only one of the signs should display a sequential message at any given time.*

*Support:*

- 18 Road users have difficulties in reading messages displayed in more than two phases on a typical three-line portable changeable message sign.

**Standard:**

- 19 **Techniques of message display such as animation, rapid flashing, dissolving, exploding, scrolling, travelling horizontally or vertically across the face of the sign, or other dynamic elements shall not be used.**

*Guidance:*

- 20 *When a message is divided into two phases, the display time for each phase should be at least 2 seconds, and the sum of the display times for both of the phases should be a maximum of 8 seconds.*

- 21 *All messages should be designed with consideration given to the principles provided in this Section and also taking into account the following:*

A. *The message should be as brief as possible and should contain three thoughts (with each thought preferably shown on its own line) that convey:*

1. *The problem or situation that the road user will encounter ahead,*
2. *The location of or distance to the problem or situation, and*
3. *The recommended driver action.*

B. *If more than two phases are needed to display a message, additional portable changeable message signs should be used. When multiple portable changeable message signs are needed, they should be placed on the same side of the roadway and they should be separated from each other by a distance of at least 1,000 feet on freeways and expressways, and by a distance of at least 500 feet on other types of highways.*

**Standard:**

- 22 **When the word messages shown in Tables 1A-1 or 1A-2 need to be abbreviated on a portable changeable message sign, the provisions described in Section 1A.15 shall be followed.**

- 23 **In order to maintain legibility, portable changeable message signs shall automatically adjust their brightness under varying light conditions.**

- 24 **The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable.**

- 25 **Portable changeable message signs shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs.**

- 26 **The mounting of portable changeable message signs on a trailer, a large truck, or a service patrol truck shall be such that the bottom of the message sign shall be a minimum of 7 feet above the roadway in urban areas and 5 feet above the roadway in rural areas when it is in the operating mode.**

*Guidance:*

- 27 *Portable changeable message signs should be used as a supplement to and not as a substitute for conventional signs and pavement markings.*

- 28 *When portable changeable message signs are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.*

- 29 *Portable changeable message signs should be sited and aligned to provide maximum legibility and to allow time for road users to respond appropriately to the portable changeable message sign message.*

- 30 *Portable changeable message signs should be placed off the shoulder of the roadway and behind a traffic barrier, if practical. Where a traffic barrier is not available to shield the portable changeable message sign, it should be placed off the shoulder and outside of the clear zone. If a portable changeable message sign has to be placed on the shoulder of the roadway or within the clear zone, it should be delineated with retroreflective TTC devices.*

- 31 *When portable changeable message signs are used in TTC zones, they should display only TTC messages.*

- 32 *When portable changeable message signs are not being used to display TTC messages, they should be relocated such that they are outside of the clear zone or shielded behind a traffic barrier and turned away from traffic. If relocation or shielding is not practical, they should be delineated with retroreflective TTC devices.*
- 33 *Portable changeable message sign trailers should be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.*

### **Section 6F.61 Arrow Boards**

#### **Standard:**

- 01 **An arrow board shall be a sign with a matrix of elements capable of either flashing or sequential displays. This sign shall provide additional warning and directional information to assist in merging and controlling road users through or around a TTC zone.**

#### *Guidance:*

- 02 *An arrow board in the arrow or chevron mode should be used to advise approaching traffic of a lane closure along major multi-lane roadways in situations involving heavy traffic volumes, high speeds, and/or limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.*
- 03 *If used, an arrow board should be used in combination with appropriate signs, channelizing devices, or other TTC devices.*
- 04 *An arrow board should be placed on the shoulder of the roadway or, if practical, farther from the traveled lane. It should be delineated with retroreflective TTC devices. When an arrow board is not being used, it should be removed; if not removed, it should be shielded; or if the previous two options are not feasible, it should be delineated with retroreflective TTC devices.*

#### **Standard:**

- 05 **Arrow boards shall meet the minimum size, legibility distance, number of elements, and other specifications shown in Figure 6F-6.**

#### *Support:*

- 06 Type A arrow boards are appropriate for use on low-speed urban streets. Type B arrow boards are appropriate for intermediate-speed facilities and for maintenance or mobile operations on high-speed roadways. Type C arrow boards are intended to be used on high-speed, high-volume motor vehicle traffic control projects. Type D arrow boards are intended for use on vehicles authorized by the State or local agency.

#### **Standard:**

- 07 **Type A, B, and C arrow boards shall have solid rectangular appearances. A Type D arrow board shall conform to the shape of the arrow.**
- 08 **All arrow boards shall be finished in non-reflective black. The arrow board shall be mounted on a vehicle, a trailer, or other suitable support.**

#### *Guidance:*

- 09 *The minimum mounting height, measured vertically from the bottom of the board to the roadway below it or to the elevation of the near edge of the roadway, of an arrow board should be 7 feet, except on vehicle-mounted arrow boards, which should be as high as practical.*
- 10 *A vehicle-mounted arrow board should be provided with remote controls.*

#### **Standard:**

- 11 **Arrow board elements shall be capable of at least a 50 percent dimming from full brilliance. The dimmed mode shall be used for nighttime operation of arrow boards.**

#### *Guidance:*

- 12 *Full brilliance should be used for daytime operation of arrow boards.*

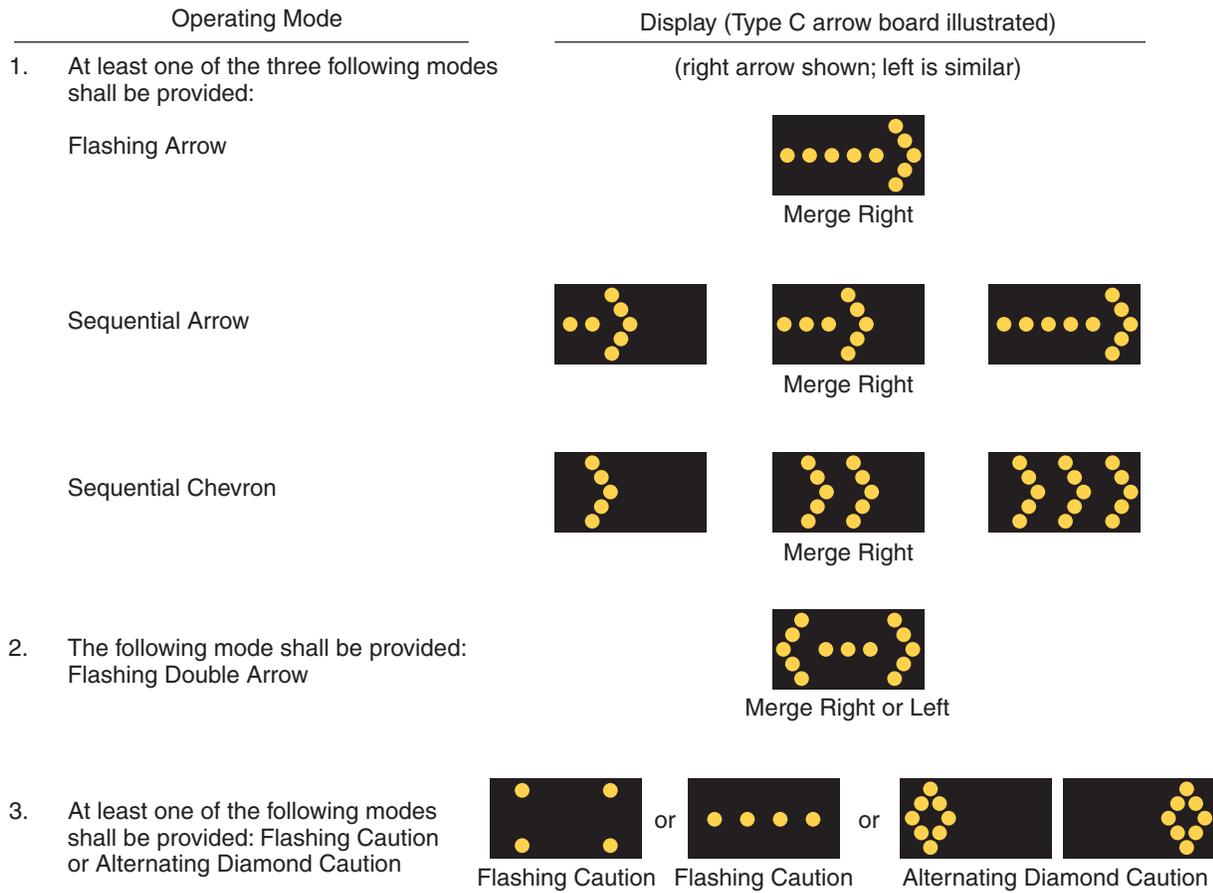
#### **Standard:**

- 13 **The arrow board shall have suitable elements capable of the various operating modes. The color presented by the elements shall be yellow.**

#### *Guidance:*

- 14 *If an arrow board consisting of a bulb matrix is used, the elements should be recess-mounted or equipped with an upper hood of not less than 180 degrees.*

**Figure 6F-6. Advance Warning Arrow Board Display Specifications**



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

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