Chapter Nineteen
PAVEMENT MARKINGS

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Chapter Nineteen
PAVEMENT MARKINGS

Chapter Nineteen presents the Department's criteria for the selection and application of permanent pavement markings. This chapter addresses the marking materials and applications that are most frequently used by MDT.

19.1 GENERAL

Pavement markings must be uniform in design and location. They should convey an easily recognized and readily understood message. By adhering to this uniformity, the designer will increase operational efficiency and safety.

Pavement markings are complementary to other traffic control devices (e.g., highway signing). Under favorable conditions, they have excellent channelizing utility and convey information without diverting the driver's attention from the roadway. However, they also have the following limitations:

1. their visibility is substantially reduced under adverse weather conditions;
2. their visibility may be obliterated by snow and ice;
3. fading, tearing and removal may occur under heavy traffic loads; and
4. their message may be obscured by other vehicles.

These limitations should be considered when selecting pavement marking materials. The pavement marking materials selected should be consistent with the expected service life of the pavement.

19.1.1 MUTCD Context

Throughout the MUTCD, the words "shall," "should," "may," "standard," "guidance," "option" and "support" are used to indicate the appropriate application of traffic control devices. Section 2.3 defines these qualifying words.

19.1.2 Design Exceptions

The designer will be required to obtain an internal MDT design exception when the proposed pavement markings criteria does not meet the following:

1. shall conditions in this Chapter;
2. should conditions in this Chapter; and
3. MDT Policies from the Director or Chief Engineer including:

    a. Pavement Markings, and
    b. Delineation.

19.1.3 References

Chapter Nineteen presents the Department's criteria for the application of pavement markings. For additional information on pavement markings, the designer is referred to the following publications:

1. Manual on Uniform Traffic Control Devices, FHWA;
2. Standard Highway Signs, FHWA; and
3. MDT Detailed Drawings.

19.1.4 Line Types

Pavement marking line types vary depending on their application. The designer should consider the following when developing pavement marking plans for permanent roadway application:

1. Retro-reflectorization. All pavement markings shall be reflectorized by the use of glass beads, either pre-mixed, dropped-on or a combination of both methods.

2. Color. Pavement markings shall be either white or yellow conforming to the standard highway color specifications. For example, word and symbol markings, crosswalk lines, channelization lines, stop bars, parking space lines and all lane lines will be white in color. Center lines, no-passing barrier lines, medians and raised islands will be painted yellow.

3. Material. Where traffic volumes create a frequent need for maintenance, durable pavement markings should be considered. The type of material selected will depend on surface type, location and traffic conditions. See Section 19.6.

4. Orientation and Style. On the basis of application, line types will vary in thickness and width; will be oriented in a longitudinal, transverse or diagonal configuration; and will be striped as either single or double lines in a solid, broken or dotted pattern. The general functions of longitudinal lines include the following:

a. Double Line. A double line indicates maximum or special restrictions.

b. Solid Line. A solid line discourages or prohibits crossings depending on the specific application.

c. Broken Line. A broken line indicates a permissive condition.

d. Dotted Line. A dotted line provides guidance.

Figure 19.1A presents typical pavement line types and their general application. The following sections of this Chapter provide specific guidelines for the application of these markings.

Description	Color	Width in (mm)	Application
Single Broken Line	White	4 (100)	Separation of lanes on which travel is in the same direction, with crossing from one lane to the other permitted (e.g., lane lines on multi-lane roadways). The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 10 ft (3 m) segment followed by a 30 ft (9 m) gap for a total cycle length of 40 ft (12 m). Streets and multi-lane undivided roadways in urban areas should be marked with a 9 ft (2.7 m) segment followed by a 15 ft (4.5 m) gap for a total cycle length of 24 ft (7.2 m).
	Yellow	4 (100)	Separation of lanes on which travel is in opposite directions, and where overtaking with care is permitted (e.g., center line on 2-lane, 2-way rural roadways with a pavement width of 18 ft (5.5 m) or greater). The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 10 ft (3 m) segment followed by a 30 ft (9 m) gap for a total cycle length of 40 ft (12 m). Streets and multi-lane undivided roadways in urban areas should be marked with a 9 ft (2.7 m) segment followed by a 15 ft (4.5 m) gap for a total cycle length of 24 ft (7.2 m).
Single Solid Line	White	4 (100)	Separation of lanes, or of a lane and shoulder, where lane changing is discouraged (e.g., lane lines at intersection approaches, right-edge stripes).
		6 (150)	Lane lines separating a motor vehicle lane from a bike lane.
		8 (200)	Delineation of locations where crossing is strongly discouraged (e.g., separation of turn lanes from through lanes, gore areas at ramp terminals, edge lines at lane drops, painted island edges).
	Yellow	4 (100)	Delineation of left-edge lines on divided highways and ramps.
Double Solid Line	White	4-4-4* (100-100-100)*	Separation of lanes on which travel is in same direction, with crossing from one side to the other prohibited (e.g., channelization in advance of obstructions which may be passed on either side).
	Yellow	4-4-4* (100-100-100)*	Separation of lanes on which travel is in opposite directions, where overtaking is prohibited in both directions. Left-turn maneuvers across this marking are permitted. Also used in advance of obstructions which may be passed only on the right side.
Solid Line plus Broken Line	Yellow	4-4-4* (100-100-100)*	Separation of lanes on which travel is in opposite directions, where overtaking is permitted with care for traffic adjacent to the broken line, but prohibited for traffic adjacent to solid line. Used on 2-way roadways with 2 or 3 lanes. Also used to delineate edges of a 2-way left-turn lane — solid lines on the outside, broken lines on the inside. The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 10 ft (3 m) segment followed by a 30 ft (9 m) gap for a total cycle length of 40 ft (12 m). Streets and multi-lane undivided roadways in urban areas should be marked with a 9 ft (2.7 m) segment followed by a 15 ft (4.5 m) gap for a total cycle length of 24 ft (7.2) m.

** 4-4-4 (100-100-100) indicates 4 in (100 mm) lines with a 4 in (100 mm) unpainted gap between them.*

TYPICAL PAVEMENT LINE TYPES AND APPLICATIONS

Figure 19.1A

Description	Color	Width in (mm)	Application
Double Broken Line	Yellow	4-4-4* (100-100-100)*	Delineates the edges of reversible lanes. The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 10 ft (3 m) segment followed by 30 ft (9 m) gap for a total cycle length of 40 ft (12 m). Streets and multi-lane undivided roadways in urban areas should be marked with a 9 ft (2.7 m) segment followed by a 15 ft (4.5 m) gap for a total cycle length of 24 ft (7.2 m).
Single Dotted Line	Either	4 (100)	Extension of lane lines through intersections. Color same as that of line being extended. The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 24 in (600 mm) segment followed by 8 ft (2.4 m) gap for a total cycle length of 10 ft (3.0 m).
	White	4 (100)	Used to extend right-edge line of shoulder lanes through off-ramp diverging areas in problem locations. The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 24 in (600 mm) segment followed by 4 ft (1.2 m) gap for a total cycle length of 6 ft (1.8 m) which may be adjusted to meet local site conditions.
Transverse Lines	White	8 (6 min) (200 (150 min))	Crosswalk edge lines 8 ft (2.4 m) (6 ft (1.8 m) minimum) apart.
		24 (600)	Limit lines or STOP bars.
Diagonal Lines	White	24 (600)	Crosshatch markings for 1-way traffic, placed at an angle of 30°, 25 ft (7.5 m) apart, on shoulders or channelization islands to add emphasis to these roadway features.
	Yellow	24 (600)	Crosshatch markings for 2-way traffic, placed at an angle of 30°, 25 ft (7.5 m) apart, on shoulders or channelization islands to add emphasis to these roadway features.

** 4-4-4 (100-100-100) indicates 4 in (100 mm) lines with a 4 in (100 mm) unpainted gap between them.*

TYPICAL PAVEMENT LINE TYPES AND APPLICATIONS

Figure 19.1A
(Continued)

19.2 TRAVEL WAY MARKINGS

19.2.1 Center Lines

Center lines are yellow in color and are used to separate vehicles traveling in opposite directions. See the MUTCD for warranting criteria for center line applications based on the facility's functional classification, traveled way width and traffic volumes. Figure 19.2A illustrates the typical application of center lines for urban and rural facilities. Based on the type of facility, the following will apply to center lines:

1. Broken Line Pattern. Where the broken line pattern is warranted for use as a center line, the pattern is formed by a series of segments and gaps. The typical pattern for a broken line on rural roads, high-speed boulevards, controlled-access highways and Interstates is a 10 ft (3 m) segment followed by a 30 ft (9 m) gap for a total cycle length of 40 ft (12 m). In urban areas, however, use a 9 ft (2.7 m) segment followed by a 15 ft (4.5 m) gap.

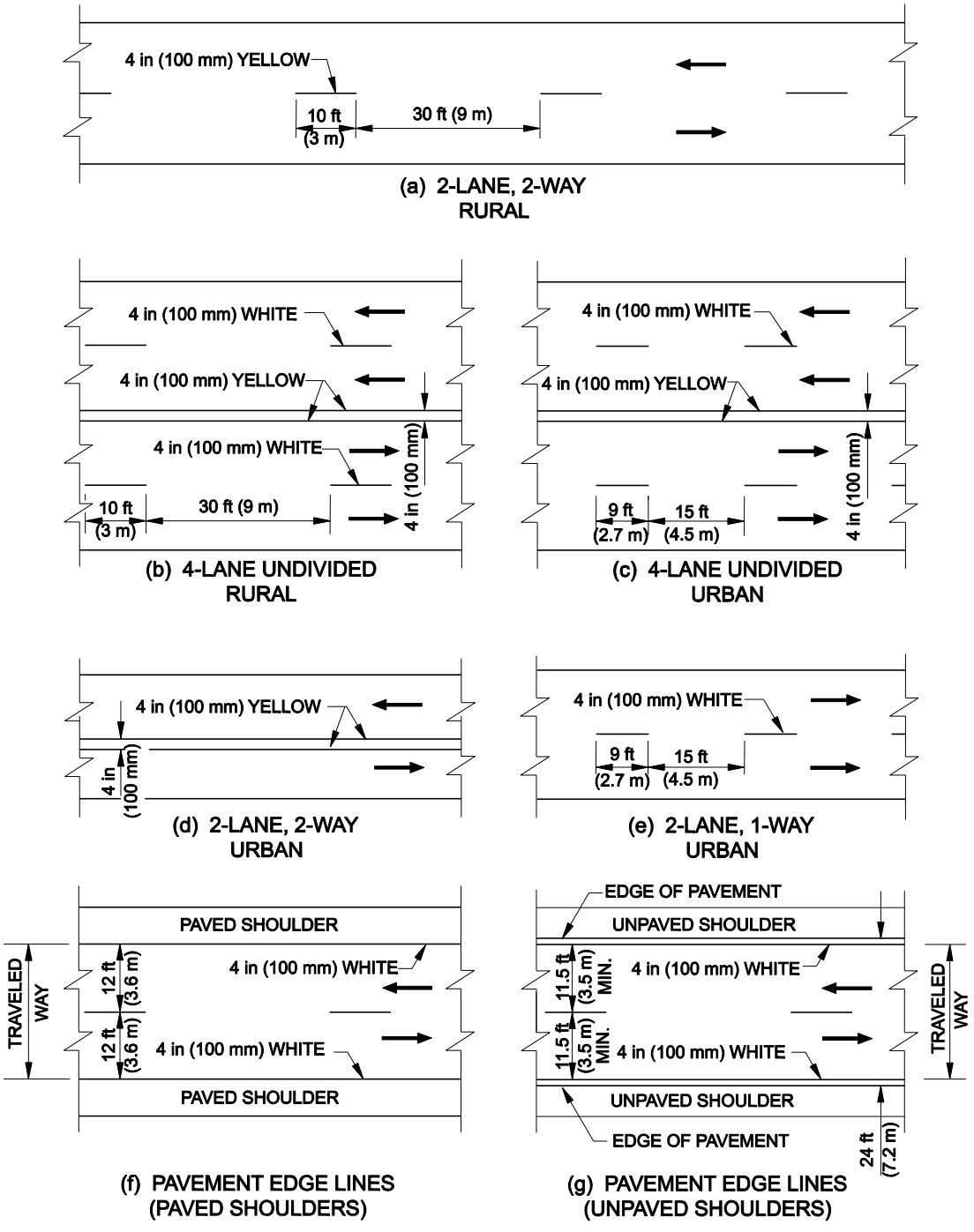
2. 4-Lane, Undivided Facilities. On 4-lane, undivided rural and urban facilities, the center line will consist of two 4 in (100 mm) wide, solid yellow lines, separated by a space of 4 in (100 mm) and centered on either side of any centered longitudinal pavement joint. Illustrations (b) and (c) of Figure 19.2A present typical applications of center lines on 4-lane, undivided rural and urban roads.

3. 2-Lane, 2-Way Rural Facilities. The center line should be a broken yellow line (see Illustration (a) of Figure 19.2A); a double line consisting of a broken line and a solid line; or a double solid yellow line. The line type used depends on the allowable passing condition at each specific location. Section 19.3 provides the designer with additional information on pavement marking applications in no-passing zones.

4. 2-Lane, 2-Way Urban Facilities. The center line should be a double solid yellow line; see Illustration (d) of Figure 19.2A.

5. 2-Lane, 1-Way Roadway. On 2-lane, 1-way roadways, the line dividing the two lanes is actually a lane line and should be a single 4 in (100 mm), broken white line as shown in Illustration (e) of Figure 19.2A. Section 19.2.2 provides additional information on lane lines.

6. Longitudinal Pavement Joints. Center lines should be placed 2 in (50 mm) on either side of a centered longitudinal pavement joint. This will minimize the need for repainting after a joint-sealing operation.



TYPICAL LONGITUDINAL PAVEMENT STRIPES

Figure 19.2A

7. Special Needs. Center line markings should be provided as necessary to meet field conditions and where engineering studies indicate a need.

8. Intersections. Center lines are typically not continued through intersections with public roads but are typically continued across private drives. A 100 ft (30 m) long no-passing center line should be provided on the paved minor approach of an intersection controlled by a stop sign.

9. Narrow Bridges. A center line marking should not be provided on any bridge with less than a 16 ft (4.9 m) width (i.e., clear width between curbs or rails, whichever is less) or less than a 18 ft (5.5 m) width if commercial vehicles are greater than 10%. These bridges are classified as 1-lane bridges. If not provided elsewhere, center line markings of the no-passing barrier line type should be provided on 2-lane narrow bridges. Section 19.3 provides additional information regarding pavement marking applications in no-passing zones.

19.2.2 Lane Lines

Lane lines are used to separate lanes of traffic traveling in the same direction. Illustrations b), c) and e) in Figure 19.2A show typical applications of lane lines. A 4 in (100 mm) wide, broken white, reflectorized line should be used for lane lines. The broken line is formed by a pattern of segments and gaps. The typical pattern for a broken line is a 10 ft (3 m) segment followed by a 30 ft (9 m) gap for a total cycle length of 40 ft (12 m). Except for high-speed divided facilities and access-controlled highways, broken lane lines on urban facilities should be marked with a 9 ft (2.7 m) segment followed by a 15 ft (4.5 m) gap. A solid white line may be used to discourage lane switching (e.g., approaches to signalized intersections).

To facilitate future maintenance operations, all lane lines should be offset at least 2 in (50 mm) from a longitudinal construction joint. Lane line markings are typically not continued through intersections with public roads but are typically continued across private drives.

19.2.3 Edge Lines

Edge lines are used to delineate the edge of traveled way. See the MUTCD for warranting criteria for edge line applications. In Figure 19.2A, illustrations f) and g) show typical applications of edge lines. Left-hand edge lines are median lines, except on one-way streets, and are discussed further in Section 19.2.4. Right-hand edge lines are typically solid, white reflectorized lines. The following presents guidelines for the placement of edge lines:

1. Roadway Widths. Solid white, 4 in (100 mm) reflectorized edge lines should be used to delineate the edges of the traveled way wherever the paved roadway width is 20 ft (6 m) or greater regardless of ADT.

2. Paved Shoulders. Both inside and outside shoulders should be striped on divided multi-lane highways. Edge lines should be placed approximately 2 in (50 mm) from the longitudinal construction joint to eliminate the need for repainting after joint-sealing operations.

3. Unpaved Shoulders. For roadways with unpaved shoulders, the edge line should be placed approximately 4 in (100 mm) from the pavement edge; see Illustration (g) in Figure 19.2A. If this results in a lane width greater than 12 ft (3.6 m), consideration should be given to revising the location of the center and edge lines so that only a 12 ft (3.6 m) lane is provided.

4. Curbs. For edge lines on roadways with curbs and no curb offset, the curb itself may be painted with white reflectorized paint or, with a curb offset, a 4 in (100 mm), solid white line may be applied to the pavement adjacent to the curb.

5. Special Needs. Edge line markings should be provided as necessary to meet field conditions and where engineering studies indicate a need (e.g., where run-off-the-road crashes are disproportionately high). Wide edge lines (i.e., greater than 4 in (100 mm) wide) should be considered at locations where greater emphasis is required. Wide edge lines can sometimes be useful in reducing run-off-the-road crashes at curves.

6. Intersections. Gaps should be provided at all public road intersections and alleys but are generally not provided at private approaches.

7. Interchanges. For edge lines at interchanges, see Section 19.4.7.

8. Uniformity. Edge lines should be located to provide a constant lane width throughout the roadway section.

9. Bridges. Edge lines should be continued across a bridge structure if the lane width across the bridge is as wide or wider than the lane width approaching the bridge. Where the lane width on the structure is less than the approaching lane width, the edge line alignment will need to be tapered. Section 19.2.6 provides additional information on taper transitions.

19.2.4 Median Lines

Median lines are required on all multi-lane divided highways. Gaps are provided at all at-grade intersections and median crossovers. The following presents median line and curb marking applications based on the median curb type:

1. Flush Median. Where the median is paved flush with the traffic lanes, a 4 in (100 mm) double solid yellow line should be applied adjacent to both sides of the median.

2. Depressed Median. Where a depressed median is adjacent to a lane that has a minimum width of 12 ft (3.6 m), a solid yellow, 4 in (100 mm) line may be applied adjacent to and parallel with the median.

3. Raised Median with Curb > 20 in (500 mm) from Traveled Way. For these facilities, provide a solid yellow, 4 in (100 mm) wide, reflectorized median line at the left edge of the travel lane. The median marking should typically be placed a minimum of 2 in (50 mm) on either side of the longitudinal construction joint between the roadway and the curb and gutter.

4. Raised Median Markings. Raised median with curb will typically not be painted. However, the curb should be painted under the following conditions:

    a. where a through travel lane adjacent to the median curb is less than 12 ft (3.6 m) measured from the face of curb. If this is the case, the curb will be painted instead of the 4 in (100 mm) yellow lane line;

    b. the curb adjacent to a left-turn lane, including the taper;

    c. the nose of every median; and

    d. any other areas deemed necessary to improve the visibility of the curb.

5. Concrete Median Barriers. Place a solid, yellow, 4 in (100 mm) median line at the left edge of the travel lane, but no closer than 4 ft (1.2 m) from the face of the concrete median barrier.

19.2.5 Channelizing Lines

Channelizing lines are used to separate traffic movement into definite paths to facilitate a safe and orderly movement. Channelizing lines may be either a solid yellow or a solid white reflectorized line. They may vary in width from 4 in to 8 in (100 mm to 200 mm) depending on field conditions and the emphasis required. Yellow channelizing

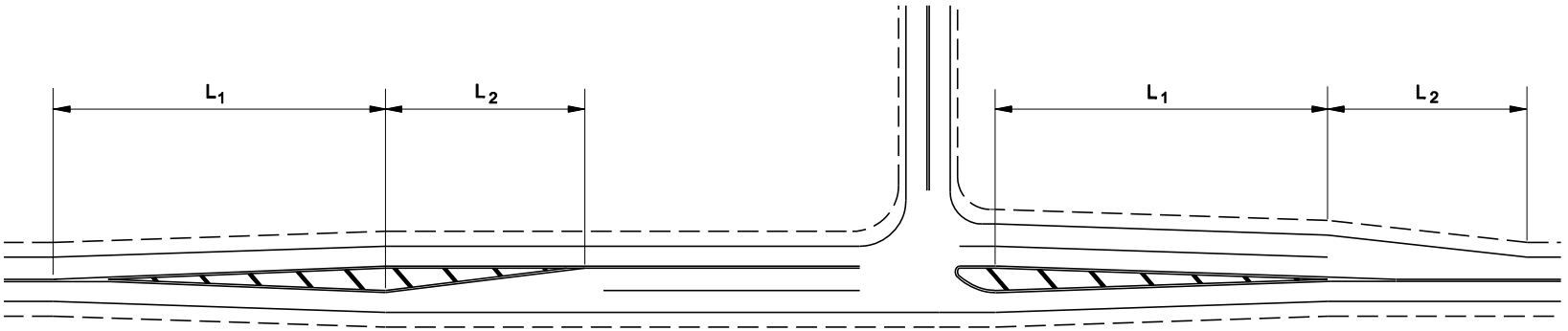
markings are used to separate opposing traffic (e.g., painted medial separators, left-turn bays). White channelizing markings are used for separating traffic traveling in the same direction (e.g., gore areas). Section 19.4 provides information on channelizing lines at intersections and interchanges.

Channelizing lines may also be used to emphasize a flush or curbed median. Channelizing lines are generally not used unless the median is at least 4 ft (1.2 m) or wider.

19.2.6 Transitions

Where transitions are necessary, pavement markings are used to guide the motorist through the transition area (e.g., in lane reduction applications where the number of through lanes is reduced). Figure 19.2B provides the minimum taper rates and lengths that should be used for transitions.

For auxiliary lane tapers (e.g., the beginning taper for left- and right-turn lanes, Interstate exits), the minimum taper should meet the criteria in Figure 19.2B.



US Customary

Design Speed (mph)	Taper Rate	
	Lane Reductions (L_1)	Auxiliary Lanes (L_2)
20	10:1	8:1
25	15:1	8:1
30	20:1	8:1
35	25:1	10:1
40	35:1	10:1
45	45:1	10:1
50	50:1	15:1
55	55:1	18:1
60	60:1	18:1
65	65:1	18:1
70	70:1	18:1
75	75:1	18:1

Metric

Design Speed (km/h)	Taper Rate	
	Lane Reductions (L_1)	Auxiliary Lanes (L_2)
30	10:1	8:1
40	15:1	8:1
50	20:1	8:1
60	25:1	10:1
70	45:1	10:1
80	50:1	15:1
90	55:1	18:1
100	60:1	18:1
110	70:1	18:1
120	75:1	18:1

Taper Length (L) = Taper Rate x Offset Distance

TAPER CRITERIA FOR PAVEMENT MARKINGS

Figure 19.2B

19.3 NO-PASSING ZONES

19.3.1 Pavement Markings

A no-passing line is a special type of center line. It is a 4 in (100 mm) wide, solid yellow reflectorized line that is placed adjacent to the lane that warrants the no-passing restriction. This line is separated from either another no-passing line or a broken yellow center line by a distance of 4 in (100 mm).

No-passing lines may be supplemented with the appropriate regulatory signing, see Chapter Eighteen.

19.3.2 Design Criteria

The beginning of a no-passing zone is the point at which the distance along a driver's line-of-sight to an approaching vehicle first becomes less than the minimum sight distance established for a given no-passing-zone design speed. The end of the no-passing zone is the point at which the distance along a driver's line-of-sight becomes greater than this minimum sight distance. The following presents the Department's design criteria used for determining no-passing zones:

1. Eye/Object Heights. For determining a no-passing zone, the distance along a driver's line-of-sight is measured from a 3.5 ft (1.07 m) height of eye to a 3.5 ft (1.07 m) height of object.

2. No-Passing Zone Design Speed. The no-passing zone design speed is equal to the maximum design speed for the highway system on which the segment is located. The maximum design speed should be used instead of establishing an 85th percentile speed for each segment. For 2-lane rural highways on the NHS, the no-passing zone design speed will be 70 mph (110 km/h) and, for the entire rural STP system, 60 mph (100 km/h).

3. Minimum Passing Sight Distance. Figure 19.3A provides the minimum passing sight distances that are established for a given no-passing-zone design speed. These minimum distances are sufficient to allow a passing vehicle to abort its passing maneuver. The values in Figure 19.3A should not be confused with the passing sight distances presented in Chapter Twenty-four which are geometric design criteria based on an assumption that a passing vehicle will be able to complete its passing maneuver.

US Customary	
No-Passing Zone Design Speed* (mph)	Minimum Passing Sight Distance (ft)
30	500
35	550
40	600
45	700
50	800
55	900
60	1000
65	1100
70	1200
Metric	
No-Passing Zone Design Speed* (km/h)	Minimum Passing Sight Distance (m)
50	160
60	180
70	210
80	245
90	280
100	320
110	355

** See Item #2 in Section 19.3.2 for definition of no-passing zone design speed.*

MINIMUM PASSING SIGHT DISTANCE

Figure 19.3A

4. Minimum Length. The minimum length for a no-passing zone is 500 ft (150 m). If the no-passing zone is less than 500 ft (150 m), the solid yellow pavement marking line should be extended at the beginning of the no-passing zone until the 500 ft (150 m) minimum criteria is met.

5. Gaps. If the length between successive no-passing zones in the same direction of travel is less than 1000 ft (300 m), then the gap between the no-passing zones should be closed by connecting the solid yellow pavement marking lines.

19.3.3 Warrants for Application

This Section presents the Department's criteria for warranting no-passing zones. The Section also presents the typical applications of no-passing-zone pavement markings for various roadway features:

1. Vertical and Horizontal Curves. Where center lines are installed, no-passing zones should be established on vertical and horizontal curves and elsewhere on 2-lane highways where the driver's line-of-sight is less than the minimum passing sight distance. Figures 19.3B, 19.3C and 19.3D illustrate the methods for establishing no-passing zones on vertical and horizontal curves.

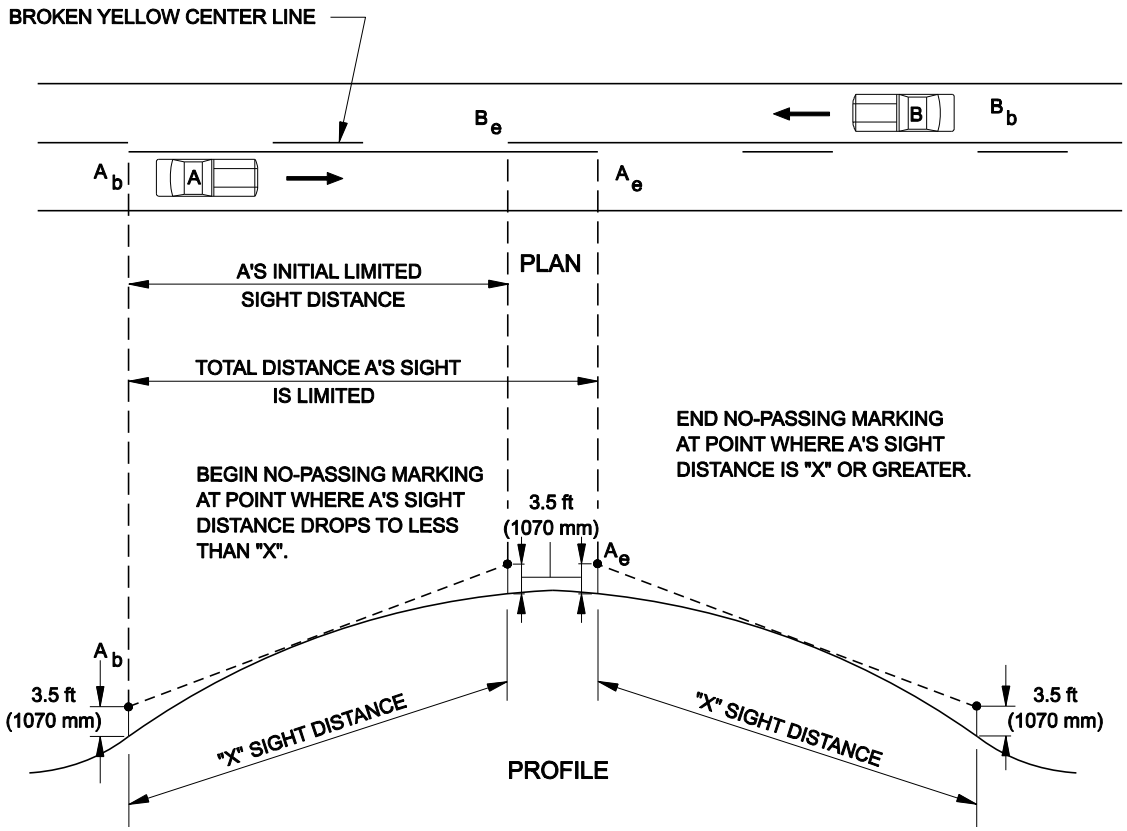
2. Urban Areas. In urban areas, passing is generally not allowed (i.e., use the double yellow center line).

3. Roadway Intersections. In general, passing should not be permitted in advance of or through intersections. The following criteria should be considered where intersections will be striped.

    a. 2-Lane, 2-Way Roadway Intersections. At intersections of 2-lane, 2-way roadways, a no-passing zone should be marked in advance of the intersection or stop bar at a minimum distance of 500 ft (150 m) for rural facilities. On the minor approach to a signalized or stop-controlled intersection, a minimum 100 ft (30 m) no-passing zone marking should be placed in advance of the intersection. For skewed intersection that are greater than 30° from perpendicular, a no-passing zone should be marked for 500 ft (150 m) on all approaches. Figure 19.3E illustrates the typical application of pavement markings for no-passing zones at 2-lane, 2-way roadway intersections.

    b. Multi-Lane Facilities. At intersections with multi-lane facilities, the flush or raised median channelizing stripes serve as the no-passing barrier. Between each approach lane, however, a solid, white reflectorized line may extend 50 ft to 100 ft (15 m to 30 m) from the stop bar to discourage lane changing on the approach to the intersection. Figure 19.4D illustrates this application.

4. Lane Transitions. Given the complex maneuvers at lane transitions, a driver should not be given the opportunity to pass other vehicles on approach to the transition. A 500 ft (150 m) no-passing zone should be provided prior to lane transition areas.



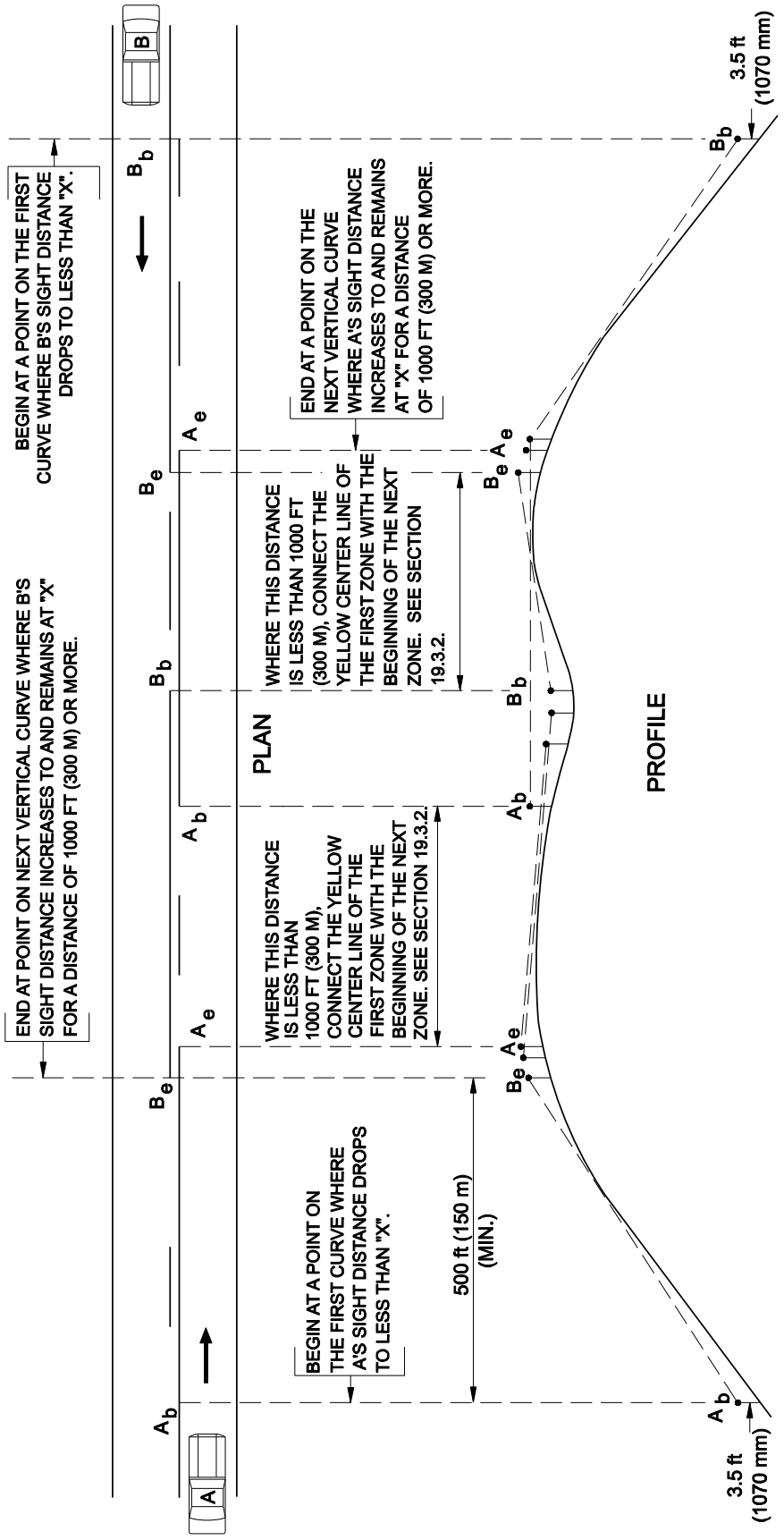
Notes:

1. *See Figure 19.3A for values of minimum passing sight distance "X."*

2. *The method of establishing the no-passing markings, as shown on the profile, is for Vehicle A's direction only. The method for Vehicle B's direction is similar.*

METHOD OF ESTABLISHING NO-PASSING ZONES ALONG A VERTICAL CURVE

Figure 19.3B

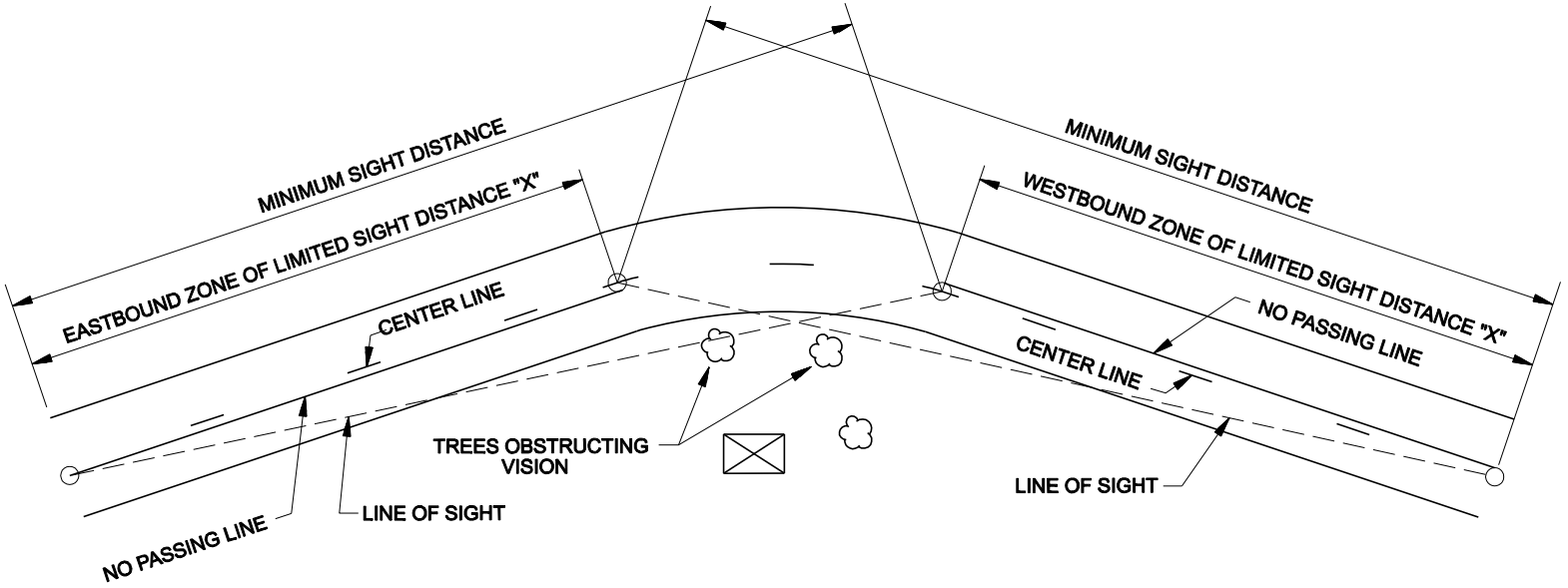


METHOD FOR ESTABLISHING NO-PASSING ZONES ALONG SUCCESSIVE VERTICAL CURVES

Figure 19.3C

Notes:

1. *See Figure 19.3A for values of minimum passing sight distance "X."*
2. *Successive horizontal curves should be similarly evaluated and marked.*

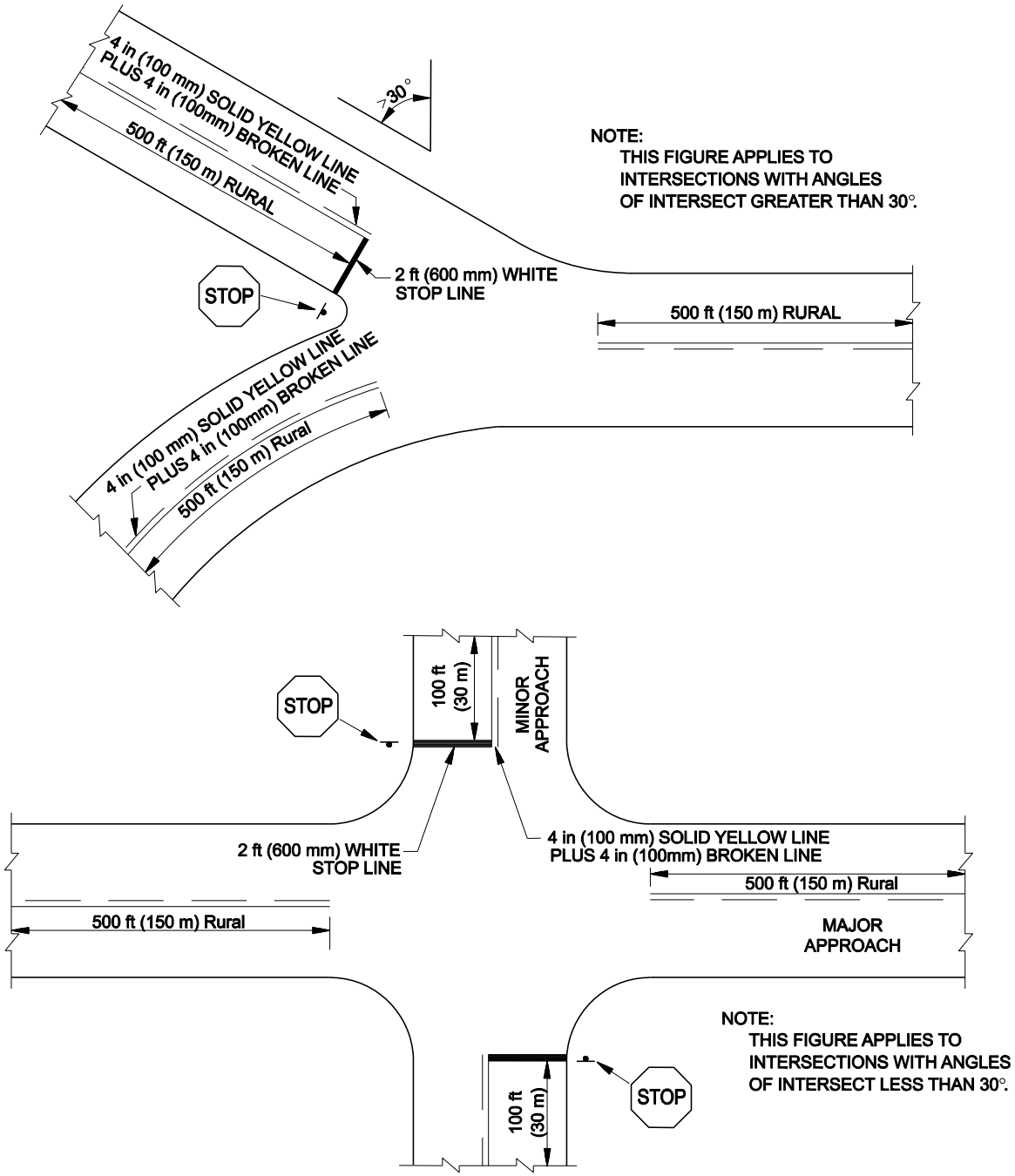


Notes:

1. *Begin the no-passing line when the measured line-of-sight becomes less than the minimum passing sight distance.*
2. *End the no-passing line when the measured line-of-sight again exceeds the minimum passing sight distance.*
3. *See Figure 19.3A for values of minimum passing sight distance "X."*
4. *The no-passing lines may or may not overlap depending on the alignment.*

METHOD FOR ESTABLISHING NO-PASSING ZONES ALONG A HORIZONTAL CURVE

Figure 19.3D



Note: Passing is generally restricted in urban areas.

NO PASSING ZONES AT INTERSECTIONS WITH PUBLIC ROADS

Figure 19.3E

5. Roadway Obstacles. Passing should not be permitted in advance of or around obstacles that are located next to or within the roadway (e.g., bridge piers). The pattern of the no-passing zone in the immediate vicinity of these obstructions should be reviewed and determined on a case-by-case basis.

6. Boundaries. A review of successive no-passing zones should be conducted to ensure that the roadway section will be properly marked (e.g., eliminating less than minimum gaps).

7. Truck-Climbing Lanes. For truck-climbing lanes, passing is not allowed for either direction throughout the entire length of the additional pavement widening (i.e., a double yellow centerline is used throughout). Figure 19.5A illustrates the pavement markings used for no-passing zones along truck-climbing lanes.

8. School and Pedestrian Crossings. No-passing zones should be marked 500 ft (150 m) in advance of rural school and pedestrian crossings. Figure 19.5C illustrates the no-passing zone markings in advance of school crossings.

9. Highway/Railroad Crossings. Passing should not be permitted in advance of or through a highway railroad crossing. The length of the no-passing zone in advance of the stop bar will be determined according to Figure 19.5D.

10. Traffic Volumes. No-passing zones may be established where opposing traffic volumes are such that it would be impractical or unsafe to allow passing maneuvers (e.g., in urban areas). This determination will be determined on a case-by-case basis.

11. Bridges. No-passing zones at bridges should be marked according to the following criteria:

    a. Full-Width Bridges. For bridge widths that meet the MDT criteria for the full roadway approach width and for other bridges where the full approach lane widths are maintained across the bridge, the need for no-passing markings will be determined based on other warrants as discussed in Section 19.3.3.

    b. Narrow Bridges. For striping purposes only, bridges widths (clear width between curbs or rails, whichever is less) equal to or less than the values shown in Figure 19.3F are classified as narrow bridges. No-passing zones should not be provided along any bridge with less than a 16 ft (4.9 m) width (i.e., clear width between curbs or rails, whichever is less) or less than a 18 ft (5.5 m) width if commercial vehicles are greater than 10%. These bridges are classified as 1-lane bridges.

Facility Type (2-Lane)	Traffic Volume (AADT)	US Customary		Metric	
		2-Lane Bridge Width (ft)		2-Lane Bridge Width (m)	
		Percent Commercial Vehicles			
		0-10%	> 10%	0-10%	> 10%
Collector	0-250 251-750 > 750	20 22 26	22 24 28	6.0 6.6 7.8	6.6 7.2 8.4
Arterials	0-750 > 750	24 28	26 30	7.2 8.4	7.8 9.0

Notes:

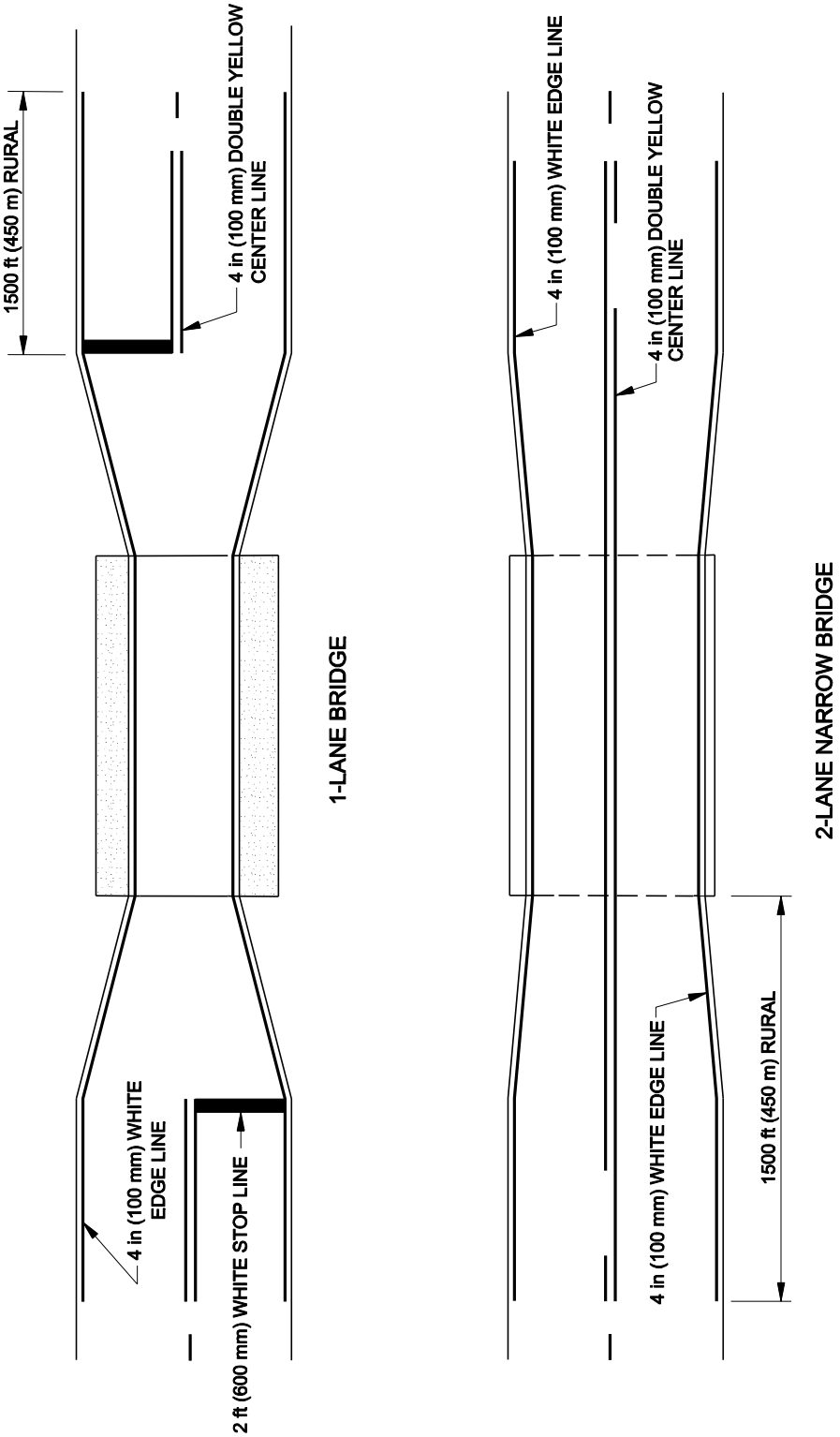
1. *On 2-lane roadways, bridges with clear widths less than 16 ft (4.9 m), or 18 ft (5.5 m) if commercial vehicles are 10% or more, are classified as 1-lane bridges.*

2. *Figure 19.3G illustrates the typical application of no-passing markings along 1-lane and 2-lane narrow bridges.*

CLASSIFICATION CRITERIA FOR NARROW BRIDGES

Figure 19.3F

Figure 19.3G illustrates the typical application of no-passing zone marking for structures which are less than 24 ft (7.2 m) in width curb to curb, with no other restrictions on passing sight distances. If center line markings are not provided elsewhere, they still should be provided on narrow 2-lane bridges. Signing for narrow bridges will be placed according to Section 18.3.3.



APPLICATION OF NO-PASSING MARKINGS ALONG NARROW BRIDGES

Figure 19.3G

Note: See Item #11 in Section 19.3.3 for definition of narrow bridge.

19.4 INTERSECTION AND INTERCHANGE MARKINGS

The following Sections provide information on the application of pavement markings at intersections and interchanges.

19.4.1 Stop Lines

The stop line will be a solid white, reflectorized line, 24 in (600 mm) wide. Stop lines should normally extend across all approach lanes and be perpendicular to the center line. If a crosswalk is present, the stop line should be placed parallel with and a minimum of 4 ft (1.2 m) in advance of the nearest crosswalk line. In the absence of a crosswalk, the stop line should be placed at the desired stopping point and, generally, perpendicular to the line-of-travel. The stop line should not be placed more than 30 ft (9 m) nor less than 4 ft (1.2 m) from the nearest crossing travel lane or point of potential conflict (e.g., crosswalk, turn lane, turning vehicular path).

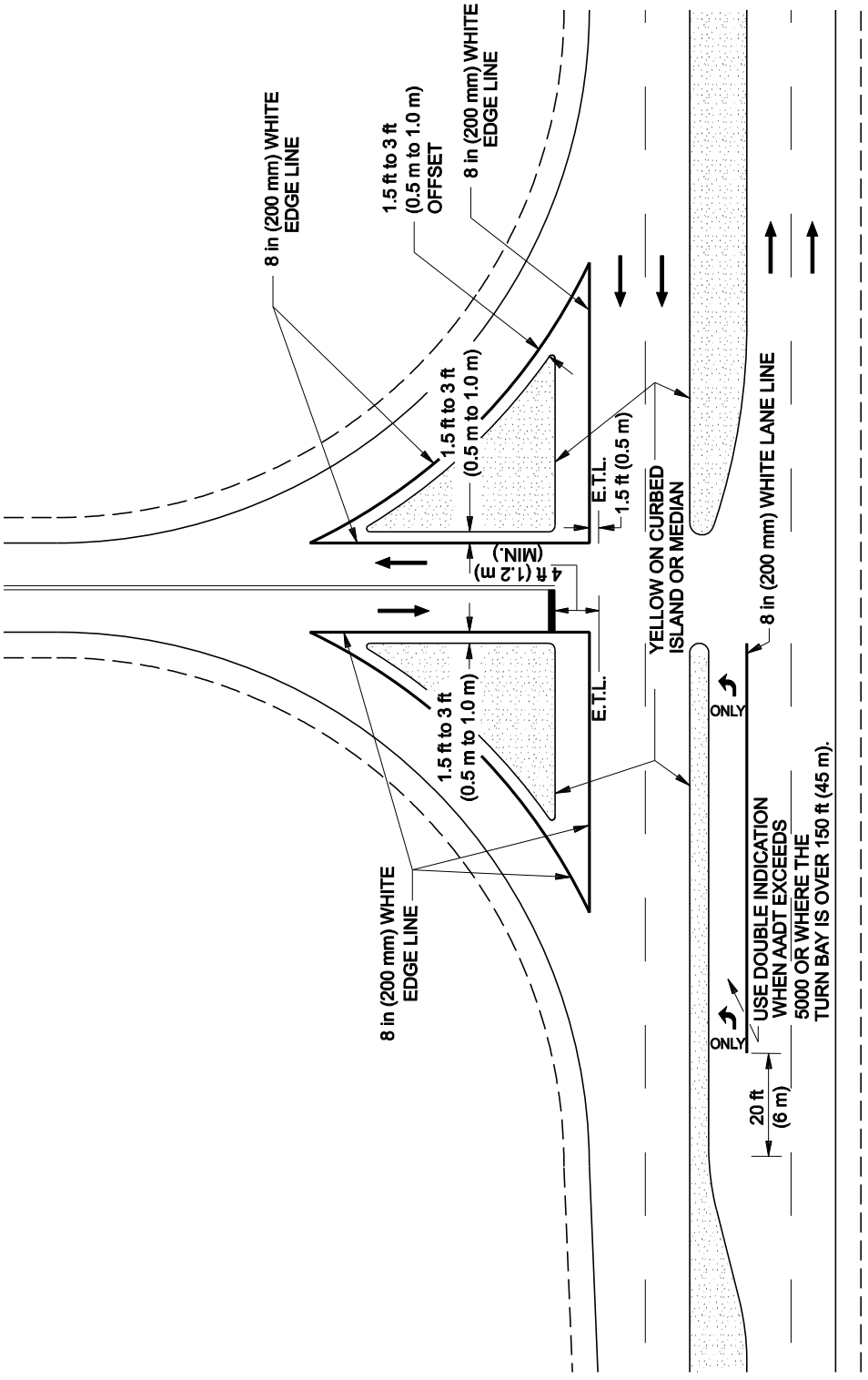
Under certain circumstances, the location of the stop line should be adjusted to fit field conditions. For example, where turning trucks are known to encroach into the opposing lane, the stop line should be placed outside the area of potential conflict. On multi-lane facilities that intersect the crossroad at an angle, it may be appropriate to stagger the stop line for each lane. This consideration is especially important at signalized intersections that have substantial clearance times.

19.4.2 Channelization Markings

Channelization markings are used to emphasize the appropriate direction of travel. Depending on their use, they may be either white or yellow, solid reflectorized lines. They may vary in width from 8 in to 24 in (200 mm to 600 mm) depending on field conditions and the emphasis required. Channelization lines are typically used in conjunction with raised or flush medial separators and medians. Figure 19.4A illustrates the typical application of channelization markings used to emphasize raised medial separators at an intersection. Figure 19.4D illustrates the use of channelizing lines to delineate a flush median.

19.4.3 Curb Markings

For roadways that have a curb and curb offset, a solid 4 in (100 mm) wide line may be applied adjacent to the curb. For roadways with a curb and no curb offset, the curb itself may be painted or the adjacent striping may be applied if the lane has a minimum width of 14 ft (4.2 m).



TYPICAL CHANNELIZATION MARKINGS AT INTERSECTIONS

Figure 19.4A

Note: The curbs of raised medians and all islands that are located in the flow of traffic should be painted solid yellow.

White paint is typically used along the right side of the traveled way. Yellow paint is typically used along the left side of the traveled way and along the curb radius of an intersection. Where curbs are painted in urban areas, they are typically either yellow or blue to indicate particular parking restrictions. Figure 19.4B illustrates the typical application of curb markings at an intersection.

19.4.4 Crosswalks

An engineering study should be used to determine the need for proper location of crosswalks. Typical locations where marked crosswalks may be used include:

1. points of significant pedestrian concentration,
2. intersection approaches (signalized or non-signalized), and
3. traffic stops that channelize pedestrians into identified corridors.

Figure 19.4C illustrates the typical pavement markings that are used at pedestrian crossings. Crosswalk lines are two parallel solid white stripes normally spaced 8 ft (2.4 m) apart but not less than 6 ft (1.8 m). The width of the crosswalk lines is normally 8 in (200 mm) but should not be less than 6 in (150 mm). The width of these lines may be increased to 24 in (600 mm) in areas where:

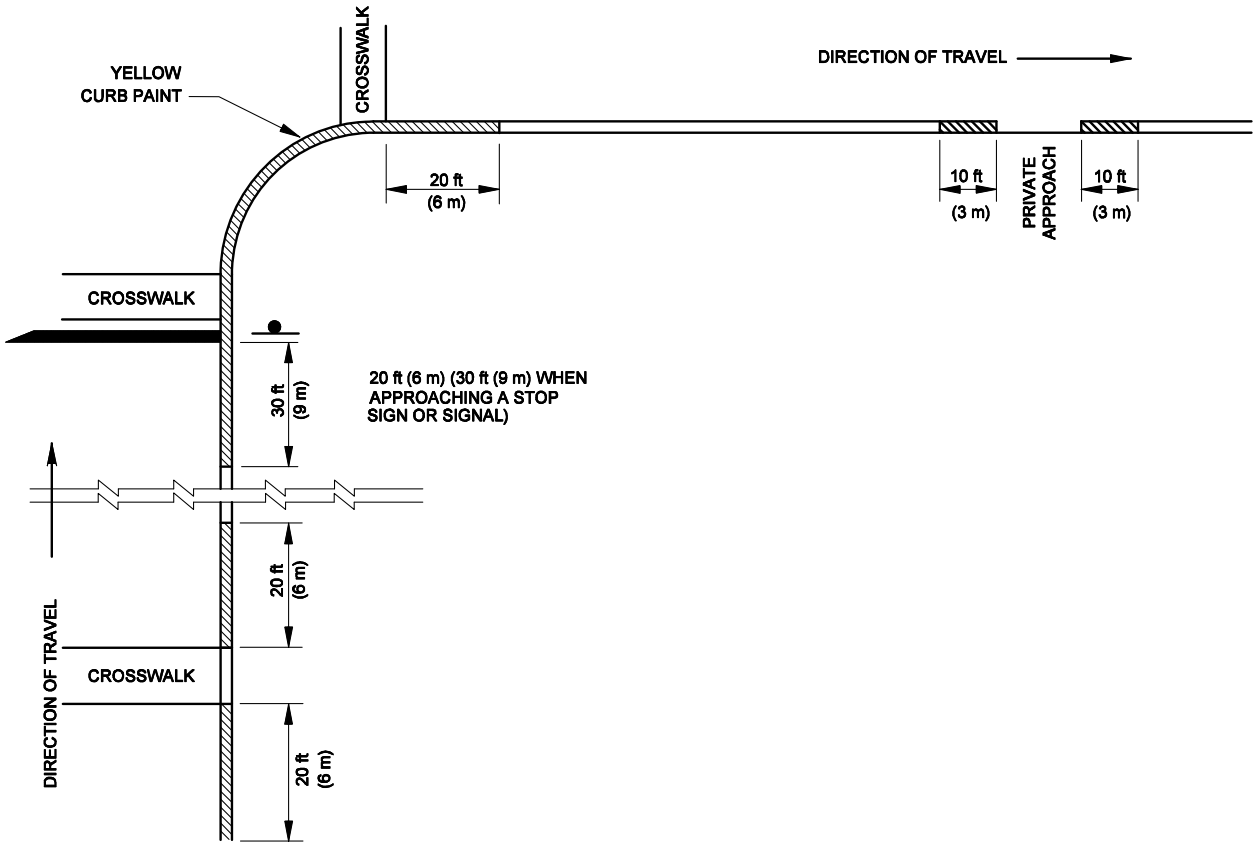
1. posted speeds exceed 35 mph,
2. where an advance stop bar is not provided, or
3. in areas where crosswalks would not normally be expected.

To discourage the improper use of a crosswalk, both lines should extend from curb to curb across the full width of the pavement. The crosswalk must encompass all curb ramps to satisfy the accessibility criteria; see Chapter Thirty-one.

For marked school crosswalks, the ladder-type crosswalk is typically used; see Figure 19.5C.

19.4.5 Lane-Use Control Markings

At multi-lane approaches to intersections, it is often necessary to mark the intersection approach to designate the permitted movements through the intersection. This is especially important at intersections that have complex geometrics and multi-phase signal operations (e.g., exclusive turn lanes, drop lanes, dual left-turn lanes). The designer should consider using lane-use arrows and “ONLY” pavement markings where:

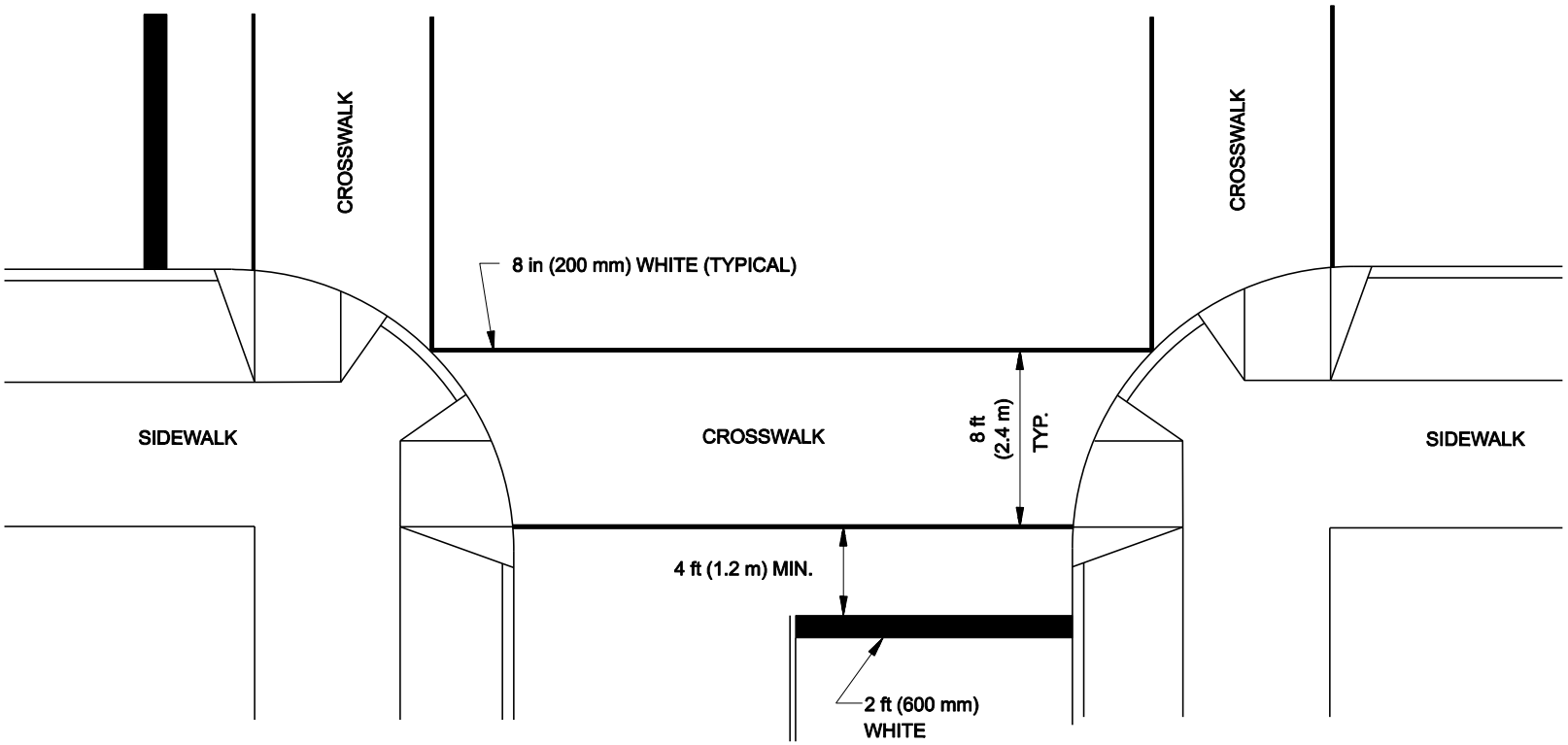


Notes:

1. *Distances may need to be increased based on an engineering investigation.*
2. *If distance are increased, provide no parking zone signs.*

TYPICAL INTERSECTION CURB MARKINGS

Figure 19.4B



Notes:

1. *The location of the crosswalk lines are dependent upon the location of the sidewalk.*
2. *Crosswalk lines from opposite crosswalks should meet at the curb line as shown above.*
3. *Ramps for the disabled must be wholly enclosed, exclusive of flared sides, within the crosswalks.*

TYPICAL PAVEMENT MARKINGS FOR PEDESTRIAN CROSSWALKS

Figure 19.4C

1. the number of lanes approaching an intersection do not continue through to the opposite side of the intersection (e.g., auxiliary turn-lanes);

2. a major intersection is signalized;

3. there is abnormal traffic pattern for an intersection approach; and

4. there is possibility of confusion at the intersection or unusual conditions.

Figure 19.4D illustrates the typical application of lane-use control markings at intersections. Directional arrows are the pavement markings typically used to designate lane-use control. The directional arrow will be used in combination with the word "ONLY" for regulatory control of exclusive lane-use designations. The word marking "ONLY" is applied to the pavement surface in advance of the arrow. These pavement markings are supplemental to the appropriate regulatory signs; see Chapter Eighteen. Section 19.4.8 provides the word and symbol pavement markings that are typically used by the Department.

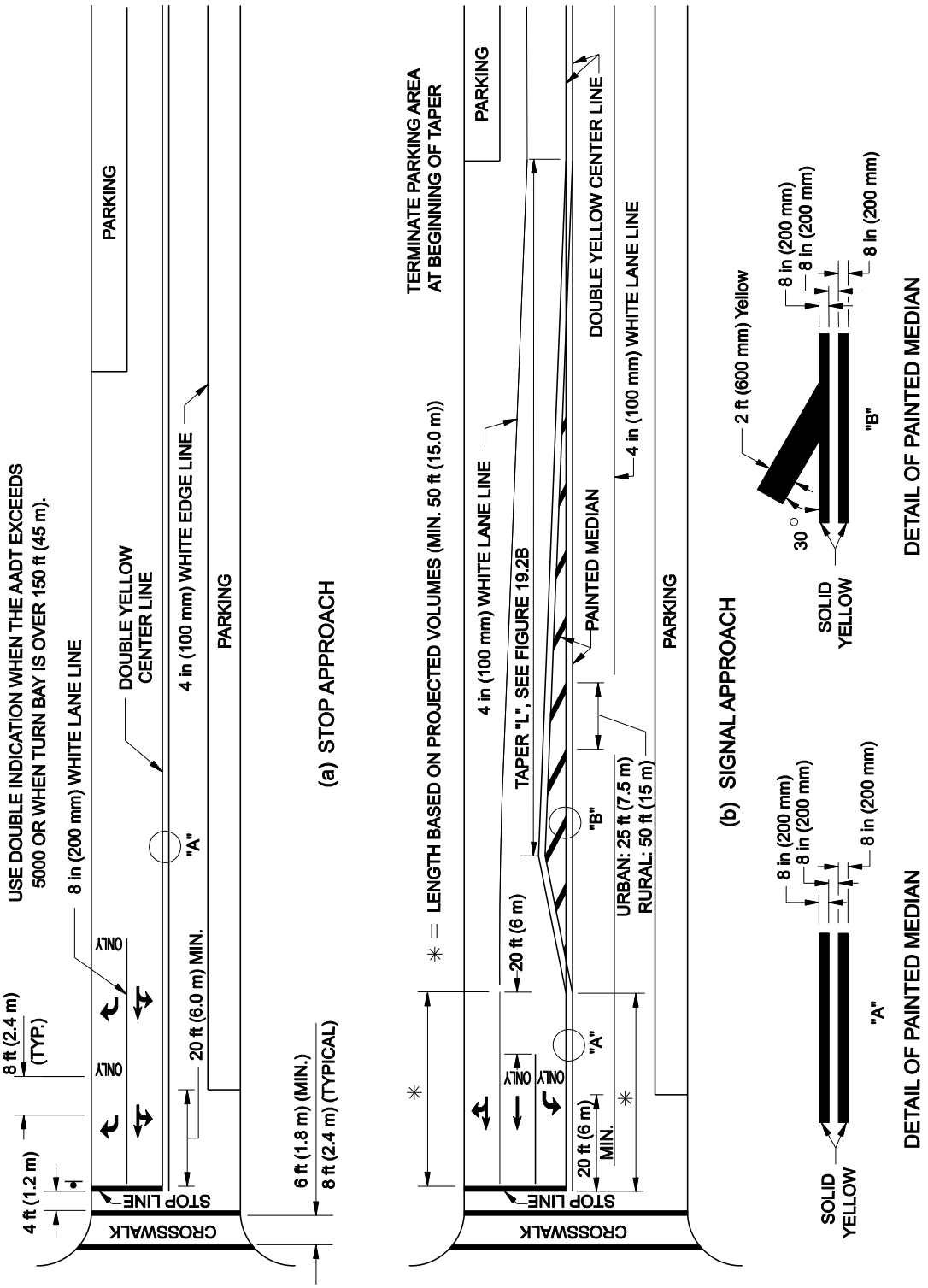
19.4.6 Multiple Turn Lanes

At intersections that have multiple turn lanes (e.g., dual left-turn lanes), a series of single, dotted lines may be used to guide the turning traffic through the intersection. These lines are an extension of the lane line and, therefore, are white in color. The dotted line is formed by a pattern of segments and gaps. The typical pattern is a 24 in (600 mm) segment followed by a 6 ft (1.8 m) gap. The radius of the dotted line as extended through the intersection should be sufficient to accommodate the turning radius of the design vehicle. Figure 19.4E illustrates the pavement marking treatment for multiple turn lanes.

19.4.7 Interchange Markings

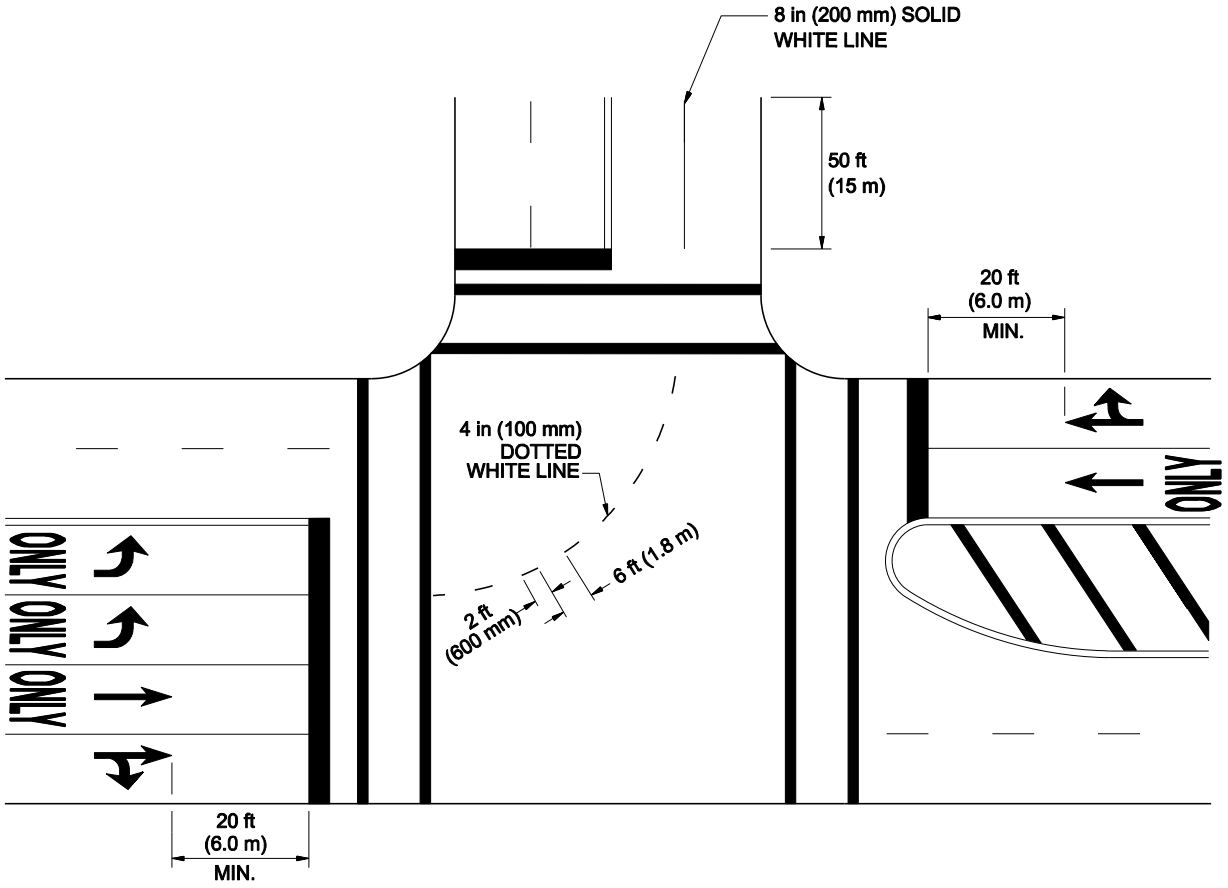
Pavement markings at interchanges are used to properly guide the motorist on and off of a high-speed facility. The following presents the Department's practices for marking pavements at interchanges:

1. Exit/Entrance Ramps. Figure 19.4F illustrates the typical pavement marking applications for taper configurations of acceleration and deceleration lanes at interchanges. Figure 19.4G illustrates the typical pavement markings applications for parallel configurations. Gore markings that are typically used at interchanges are also illustrated in Figures 19.4F and 19.4G.



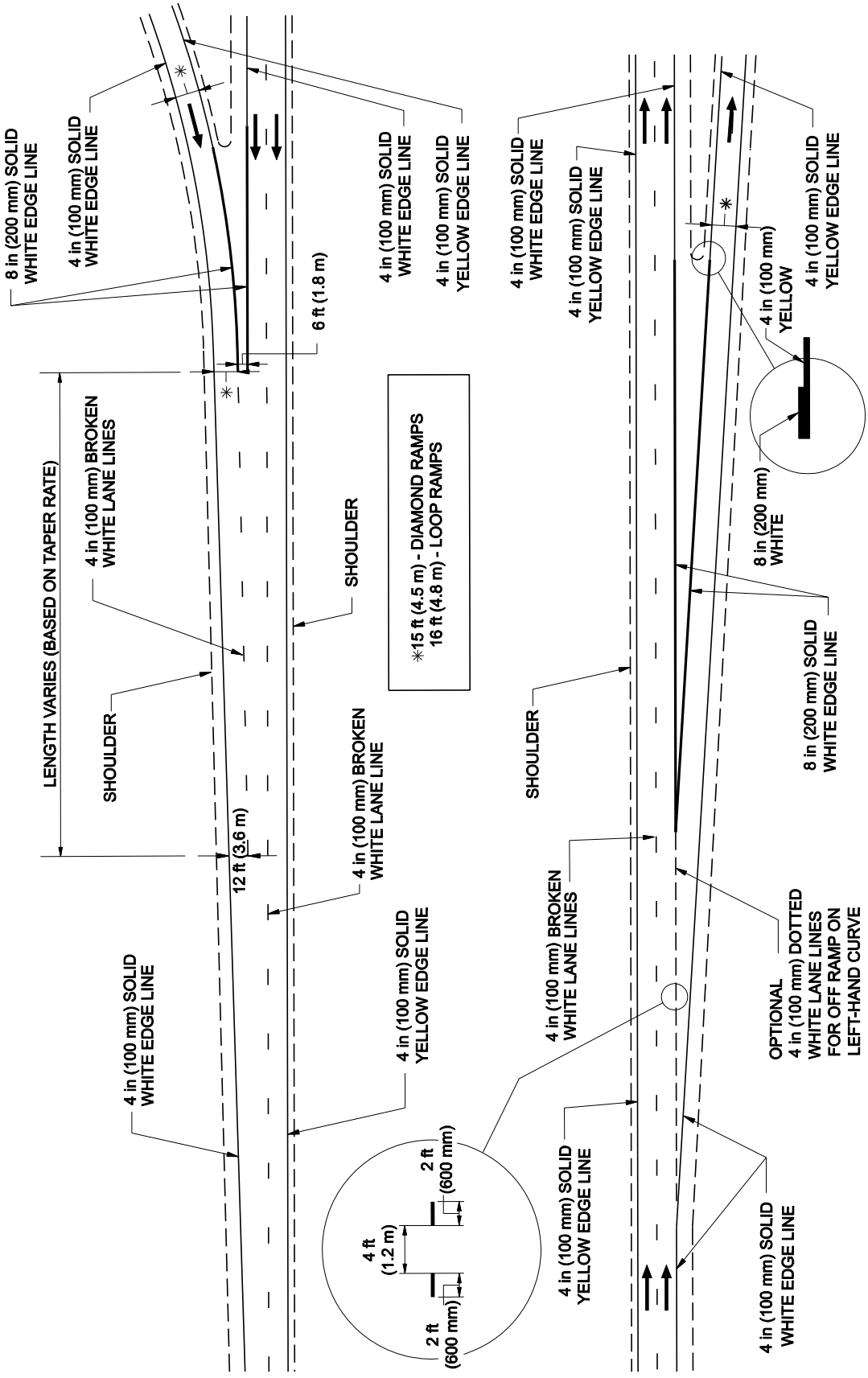
TYPICAL INTERSECTION LANE-USE CONTROL MARKINGS

Figure 19.4D



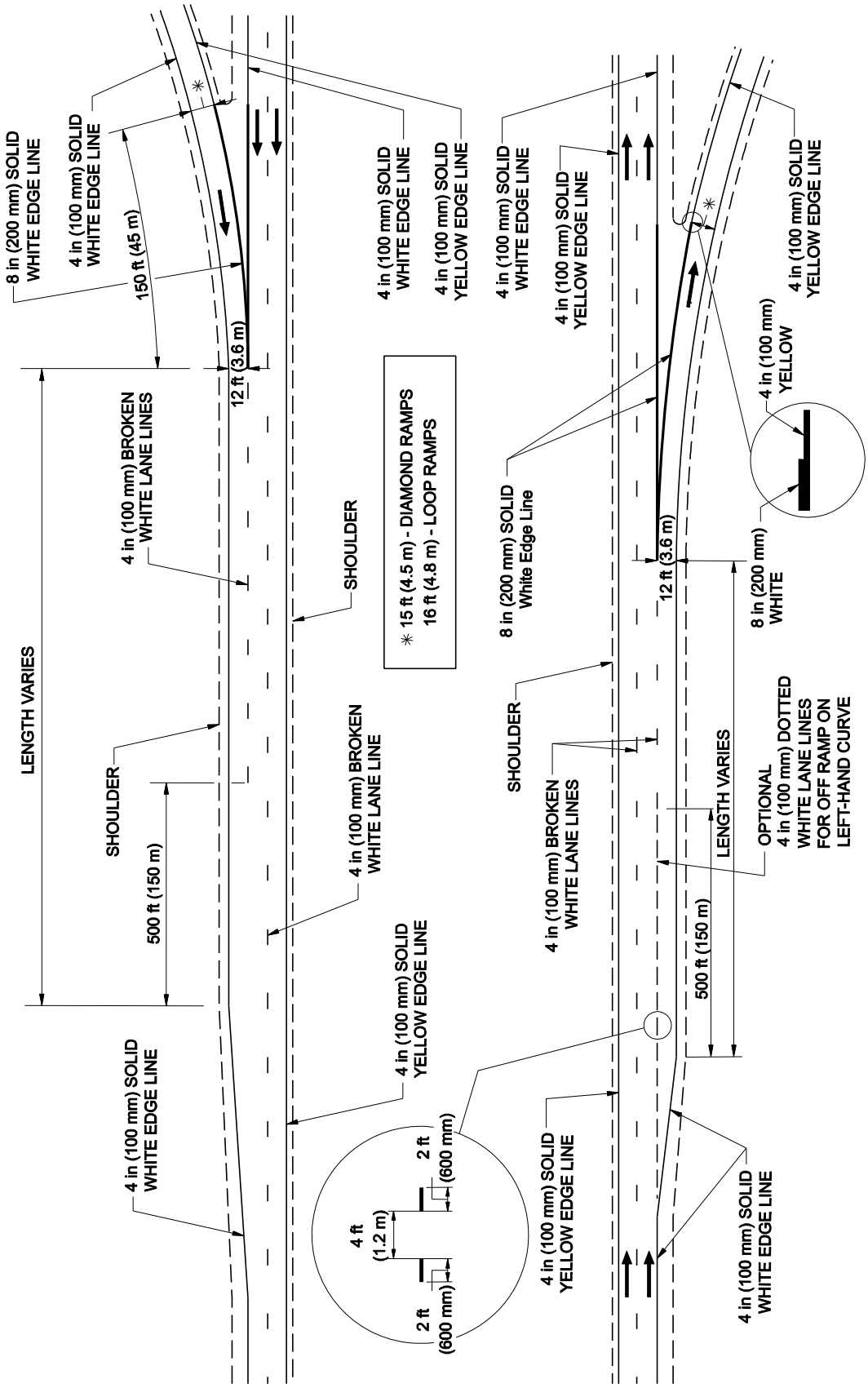
TYPICAL PAVEMENT MARKINGS FOR MULTIPLE TURN LANES

Figure 19.4E



TYPICAL TAPER ACCELERATION AND DECELERATION LANE MARKINGS

Figure 19.4F



TYPICAL PARALLEL ACCELERATION AND DECELERATION LANE MARKINGS

Figure 19.4G

2. Ramp/Cross Road Junctions. Figure 19.4H illustrates the application of supplemental pavement markings that may be used at intersections between crossing roads and exit ramps where there is a potential for wrong-way movements. The design of these markings should conform to the FHWA Standard Highway Signs and is further discussed in Section 19.4.8.

19.4.8 Special Markings

Special markings (i.e., words, symbols, arrows) are used to guide, warn and regulate traffic. Where used in a regulatory setting, these special markings are used to complement the appropriate regulatory signing. Typical applications of special markings include:

1. lane-use control at multi-lane intersections;
2. highway/railroad crossings;
3. school crossings;
4. stop controlled intersections;
5. 2-way, left-turn lanes;
6. interchange ramps; and
7. 1-way roadways.

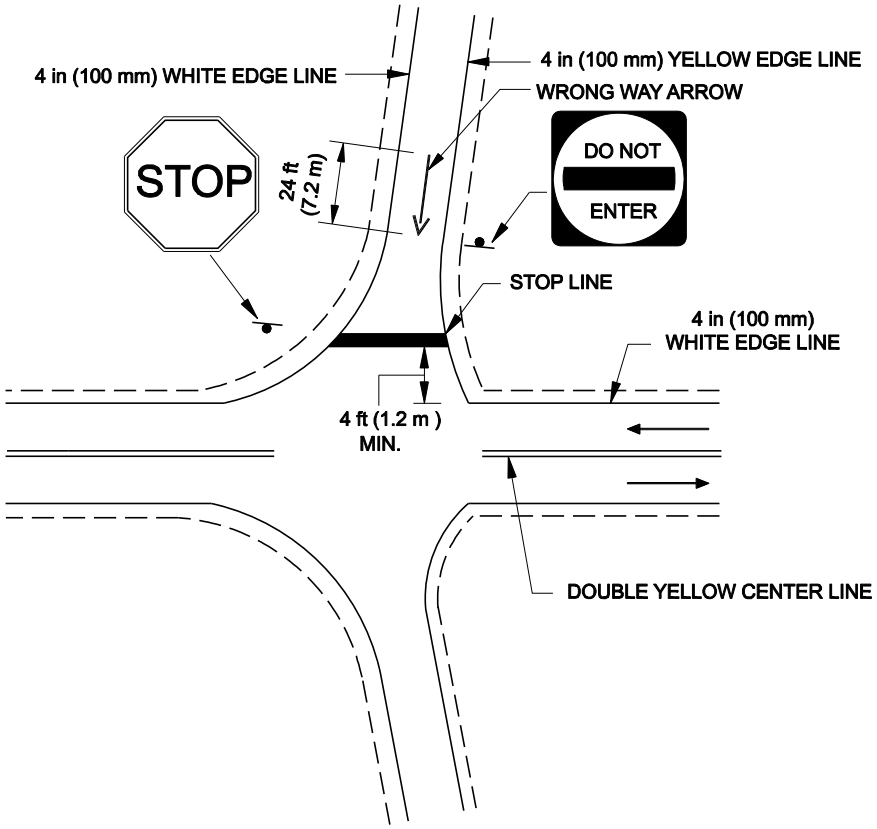
The designer is referred to the MDT Detailed Drawings for complete information on the design and layout of symbols and letters. The following presents additional information on the special markings typically used by the Department:

1. Word Markings. Figure 19.4I illustrates the design and layout of words that are typically applied to the pavement surface. These markings must be white in color. Word markings are normally 100 in (2500 mm) high, except where traffic speeds are very low. If the message consists of more than one word, it should be read “up” (i.e., the first word should be nearest to the approaching driver). Word markings should consist of no more than three lines of information.

2. Symbol Markings. Arrow markings may be used to convey either guidance or mandatory messages. The pavement marking word “ONLY” should be included where the markings allow one movement type (e.g., left turn, straight, right turn). Figure 19.4J illustrates the design and layout of typical symbol markings.

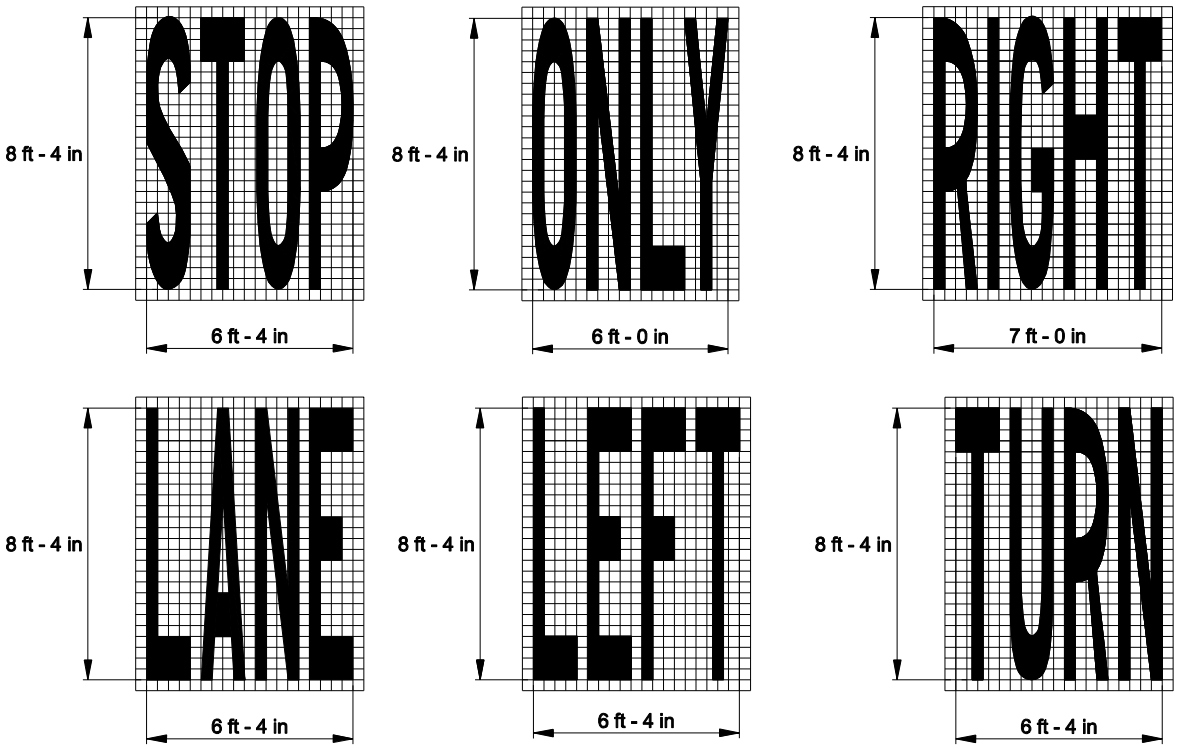
3. Intersections. At intersections, lane-control markings (i.e., words and arrows) are placed at least 20 ft (6 m) from the point where traffic stops. These special markings may be repeated in advance of mandatory turn lanes to aid motorists in selecting the selecting the appropriate lane and prevent their entrapment. The space between successive special markings will vary with the design speed, and

it is suggested that approximately four times the character height be used for low-speed facilities ($V \leq 45$ mph (70 km/h)) and up to ten times the character height for high-speed facilities ($V \geq 50$ mph (80 km/h)).



TYPICAL RAMP TERMINAL PAVEMENT MARKINGS

Figure 19.4H



NOTES:

UNLESS OTHERWISE NOTED EACH SQUARE EQUALS 4 INCHES.

ALL PAVEMENT MARKINGS ARE TO CONFORM TO THE REQUIREMENTS OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" AND "STANDARD HIGHWAY SIGNS" PUBLICATIONS, FROM THE FEDERAL HIGHWAY ADMINISTRATION.

ALL WORDS ARE TO BE WHITE.

USE THE SIZES OF WORDS SHOWN UNLESS SMALLER OR LARGER SIZES ARE NEEDED. THE SIZE OF WORDS MAY BE SCALED PROPORTIONATELY DOWN BY APPROXIMATELY ONE-THIRD FOR LOW-SPEED, URBAN CONDITIONS. THE MINIMUM HEIGHT OF ANY WORD IS 6 FEET. LARGER SIZES MAY BE USED FOR ABOVE AVERAGE SPEEDS AND OTHER CRITICAL LOCATIONS.

DO NOT EXCEED MORE THAN ONE LANE IN WIDTH FOR ANY PAVEMENT MARKINGS, EXCEPT IN THE CASE OF THE WORD "SCHOOL". WHEN "SCHOOL" IS EXTENDED TO THE WIDTH OF TWO LANES, SCALE THE WORD UP PROPORTIONATELY TO FIT THE APPLICATION WIDTH.

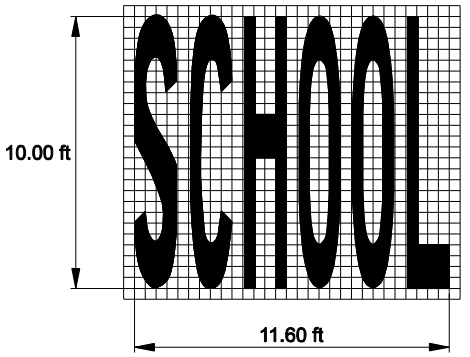
FOR MULTIPLE LINES OF INFORMATION, PLACE THE INFORMATION SO IT READS IN THE DIRECTION OF TRAVEL. DO NOT EXCEED THREE LINES OF INFORMATION AT ANY LOCATION.

WHEN WORDS AND SYMBOLS ARE USED IN COMBINATION, SPACE THEM AT LEAST FOUR TIMES THE HEIGHT OF CHARACTERS FOR LOW-SPEED ROADS, BUT NOT MORE THAN TEN TIMES THE HEIGHT OF THE CHARACTERS UNDER ANY CONDITION.

ON NARROW, LOW-SPEED BICYCLE PATHS, SIZES OF LETTERS MAY BE SMALLER THAN SUGGESTED, BUT TO THE RELATIVE SCALE.

QUANTITIES ARE BASED ON THE SIZES OF PAVEMENT MARKINGS SHOWN AND ARE FOR ESTIMATING PURPOSES ONLY.

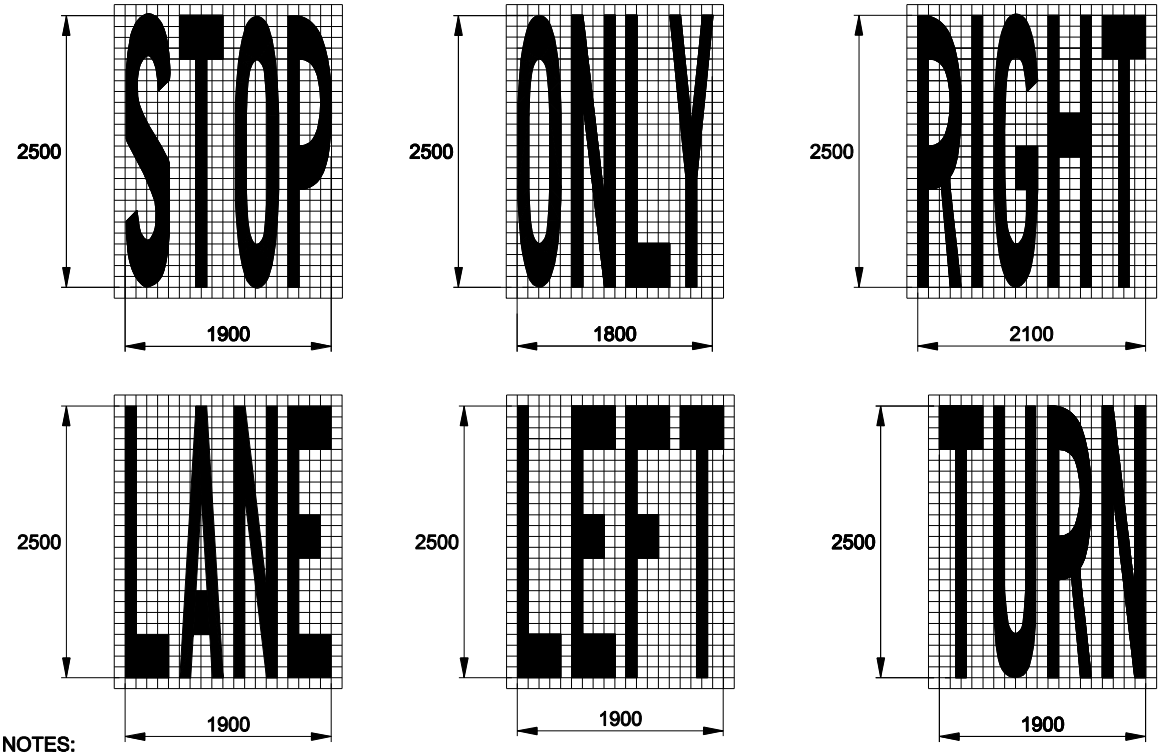
PAINT VOLUMES ASSUME A 15 MIL THICKNESS.
EPOXY VOLUMES ASSUME A 20 MIL THICKNESS.



NOTE: EACH SQUARE EQUALS 0.40 ft

QUANTITIES			
WORD	AREA (FT^2)	PAINT (GAL.)	EPOXY (GAL.)
STOP	22.77	0.21	0.28
ONLY	21.89	0.20	0.27
RIGHT	26.05	0.24	0.33
LANE	23.94	0.22	0.30
LEFT	20.00	0.19	0.25
TURN	23.98	0.22	0.30
SCHOOL	48.14	0.45	0.60

TYPICAL WORD PAVEMENT MARKINGS
(US Customary)
Figure 19.4I



NOTES:

UNLESS OTHERWISE NOTED EACH SQUARE EQUALS 100 mm.

ALL PAVEMENT MARKINGS ARE TO CONFORM TO THE REQUIREMENTS OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" AND "STANDARD HIGHWAY SIGNS" PUBLICATIONS, FROM THE FEDERAL HIGHWAY ADMINISTRATION.

ALL WORDS ARE TO BE WHITE.

USE THE SIZES OF WORDS SHOWN UNLESS SMALLER OR LARGER SIZES ARE NEEDED. THE SIZE OF WORDS MAY BE SCALED PROPORTIONATELY DOWN BY APPROXIMATELY ONE-THIRD FOR LOW-SPEED, URBAN CONDITIONS. THE MINIMUM HEIGHT OF ANY WORD IS 1.8 m. LARGER SIZES MAY BE USED FOR ABOVE AVERAGE SPEEDS AND OTHER CRITICAL LOCATIONS.

DO NOT EXCEED MORE THAN ONE LANE IN WIDTH FOR ANY PAVEMENT MARKINGS, EXCEPT IN THE CASE OF THE WORD "SCHOOL". WHEN "SCHOOL" IS EXTENDED TO THE WIDTH OF TWO LANES, SCALE THE WORD UP PROPORTIONATELY TO FIT THE APPLICATION WIDTH.

FOR MULTIPLE LINES OF INFORMATION, PLACE THE INFORMATION SO IT READS IN THE DIRECTION OF TRAVEL. DO NOT EXCEED THREE LINES OF INFORMATION AT ANY LOCATION.

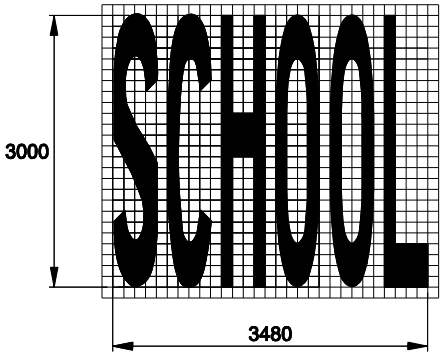
WHEN WORDS AND SYMBOLS ARE USED IN COMBINATION, SPACE THEM AT LEAST FOUR TIMES THE HEIGHT OF CHARACTERS FOR LOW-SPEED ROADS, BUT NOT MORE THAN TEN TIMES THE HEIGHT OF THE CHARACTERS UNDER ANY CONDITION.

ON NARROW, LOW-SPEED BICYCLE PATHS, SIZES OF LETTERS MAY BE SMALLER THAN SUGGESTED, BUT TO THE RELATIVE SCALE.

QUANTITIES ARE BASED ON THE SIZES OF PAVEMENT MARKINGS SHOWN AND ARE FOR ESTIMATING PURPOSES ONLY.

PAINT VOLUMES ASSUME A 0.381 mm THICKNESS.
EPOXY VOLUMES ASSUME A 0.508 mm THICKNESS.

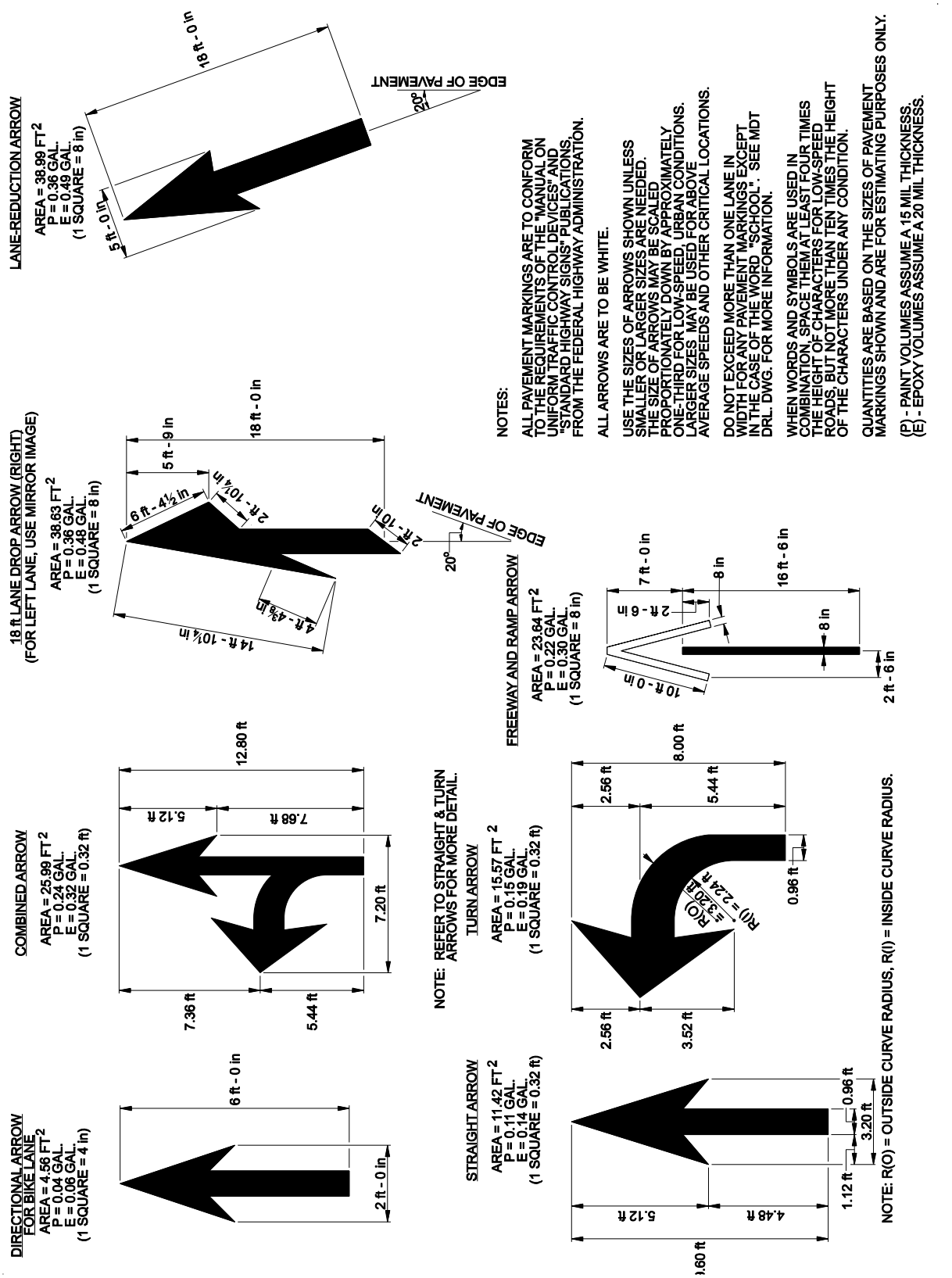
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.



EACH SQUARE EQUALS 120 mm

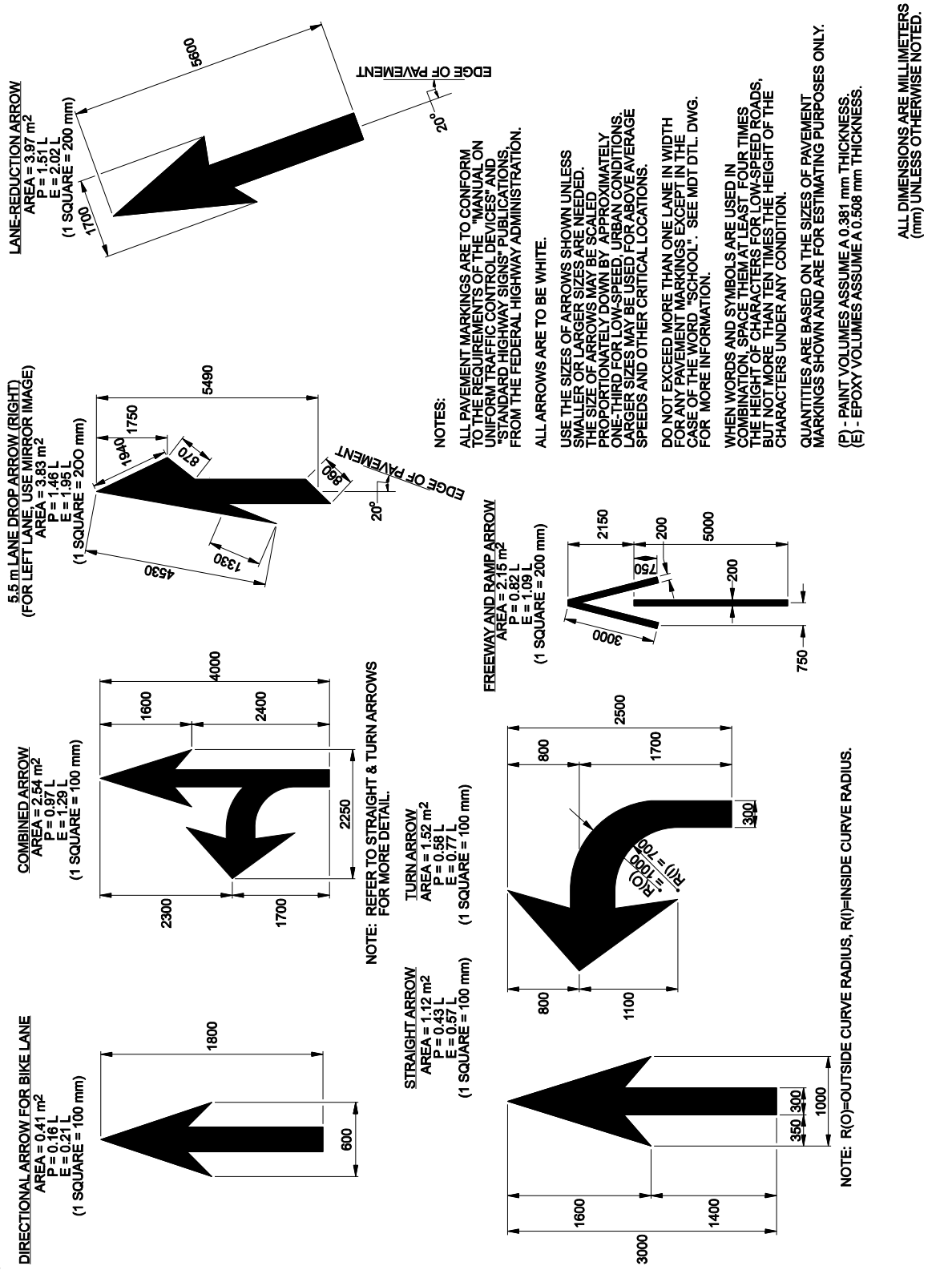
QUANTITIES			
WORD	AREA m^2	PAINT (liters)	EPOXY (liters)
STOP	2.05	0.78	1.04
ONLY	1.98	0.75	1.01
RIGHT	2.34	0.89	1.19
LANE	2.16	0.82	1.10
LEFT	1.80	0.69	0.91
TURN	2.16	0.82	1.10
SCHOOL	4.54	1.73	2.31

TYPICAL WORD PAVEMENT MARKINGS
(Metric)
Figure 19.4I



TYPICAL SYMBOL PAVEMENT MARKINGS
(US Customary)

Figure 19.4J



TYPICAL SYMBOL PAVEMENT MARKINGS
(Metric)

Figure 19.4J

19.5 MISCELLANEOUS MARKING APPLICATIONS

19.5.1 Truck-Climbing/Passing Lanes

For facilities with truck-climbing/passing lanes, the center line for both directions should be striped for no-passing throughout the entire length of the additional widening. The tapers used to introduce the additional lane should be delineated by the use of a pavement edge stripe. Care should be used in laying out the taper transitions to define the beginning and end of the widening.

Chapter Twenty-six presents the Department's criteria for warranting and designing truck-climbing lanes. Figure 19.5A illustrates the typical pavement markings that should be used for truck-climbing lanes.

19.5.2 Two-Way, Left-Turn Lanes (TWLTL)

On TWLTL, the center lane is reserved for the exclusive use of a bi-directional, left-turn movement. The TWLTL is designed to "harbor" left-turning vehicles in the median area until a gap in the opposing traffic stream becomes available. The TWLTL should be marked as illustrated in Figure 19.5B. Chapter Thirty-one provides the geometric design details for a TWLTL.

At signalized and major intersections, the TWLTL will need to be transitioned to an exclusive left-turn lane. Figure 19.5B also illustrates the pavement markings used for this transition. Chapter Eighteen provides information on the appropriate signing for use in conjunction with a TWLTL facility.

19.5.3 School Crossings

School crossings should be marked as illustrated in Figure 19.5C. A series of 8 ft (2.4 m) long, 24 in (600 mm) wide, solid white longitudinal lines should be marked across the full width of the pavement to identify the crosswalk. If practical, avoid placing the stripes in the typical vehicular wheel paths. A white stop bar 24 in (600 mm) wide should be placed 4 ft (1.2 m) in advance of and parallel to the crosswalk and span all approach lanes.

Pavement markings for school crossings should only be used with the appropriate signing. The proper signing should be in place, if practical, at the time the pavement markings are placed. In addition to sign placements shown in Figure 19.5C, school crossing signs should be placed according to the MUTCD and the following:

1. Multi-lane Facilities. For a single school crossing across a multi-lane facility, a ground-mounted School Advance Warning Assembly (S1-1 with Supplemental Plaque) sign should be placed prior to the crossing and an overhead School Crosswalk Warning Assembly (S1-1 with Diagonal Arrow) at the crossing.

2. Multiple Crossings. Where there are multiple school crossings across a facility, a School Advance Warning Assembly (S1-1 with Supplemental Plaque) sign should be placed overhead in advance of the first crossing with a ground-mounted School Crosswalk Warning Assembly (S1-1 with Diagonal Arrow) at each crossing.

3. Signalized Intersections. Where the school crossing is at a signalized intersection, the School Crosswalk Warning Assembly (S1-1 with Diagonal Arrow) should be placed on the signal pole with a ground-mounted School Advance Warning Assembly (S1-1 with Supplemental Plaque) placed in advance of the intersection.

19.5.4 Highway/Railroad Crossings

Pavement markings used in advance of highway/railroad crossings should be placed as illustrated in Figure 19.5D. These markings shall be used on all paved approaches to grade crossings where crossing signals or automatic gates are located and at all other crossings where the prevailing approach speed is 40 mph (60 km/h) or greater. The markings should also be placed at crossings where engineering studies indicate there is a significant potential for conflict between vehicles and trains.

All markings should be reflectorized white except for the no-passing centerline striping. Stop bars should extend from the solid yellow no-passing stripe to the edge of pavement. Highway/railroad crossing projects will have epoxy symbols below an AADT of 1000 vehicles per day and inlaid thermoplastic above that.

On multi-lane highways, the transverse lines should be extended across all approach lanes, and the individual highway/railroad crossing symbols provided in each lane.

19.5.5 Turnouts

Turnouts are areas located along the roadside and are designed to permit a vehicle to safely exit the travel lane and stop at a particular attraction. The following presents information on the application of pavement markings for various types of turnouts used by the Department:

1. Mailbox Turnouts. Pavement markings for mailbox turnouts should typically be marked as illustrated in Figure 19.5E.

2. Weigh Station Turnouts. Figures 18.4D and 18.4E illustrate the typical application of pavement markings for weigh stations.

3. Chain-Up Areas. Pavement markings for chain-up areas should typically be marked as illustrated in Figure 19.5F.

4. Historical Marker Turnouts. The typical pavement marking applications for historical marker turnouts are illustrated in Figure 19.5G.

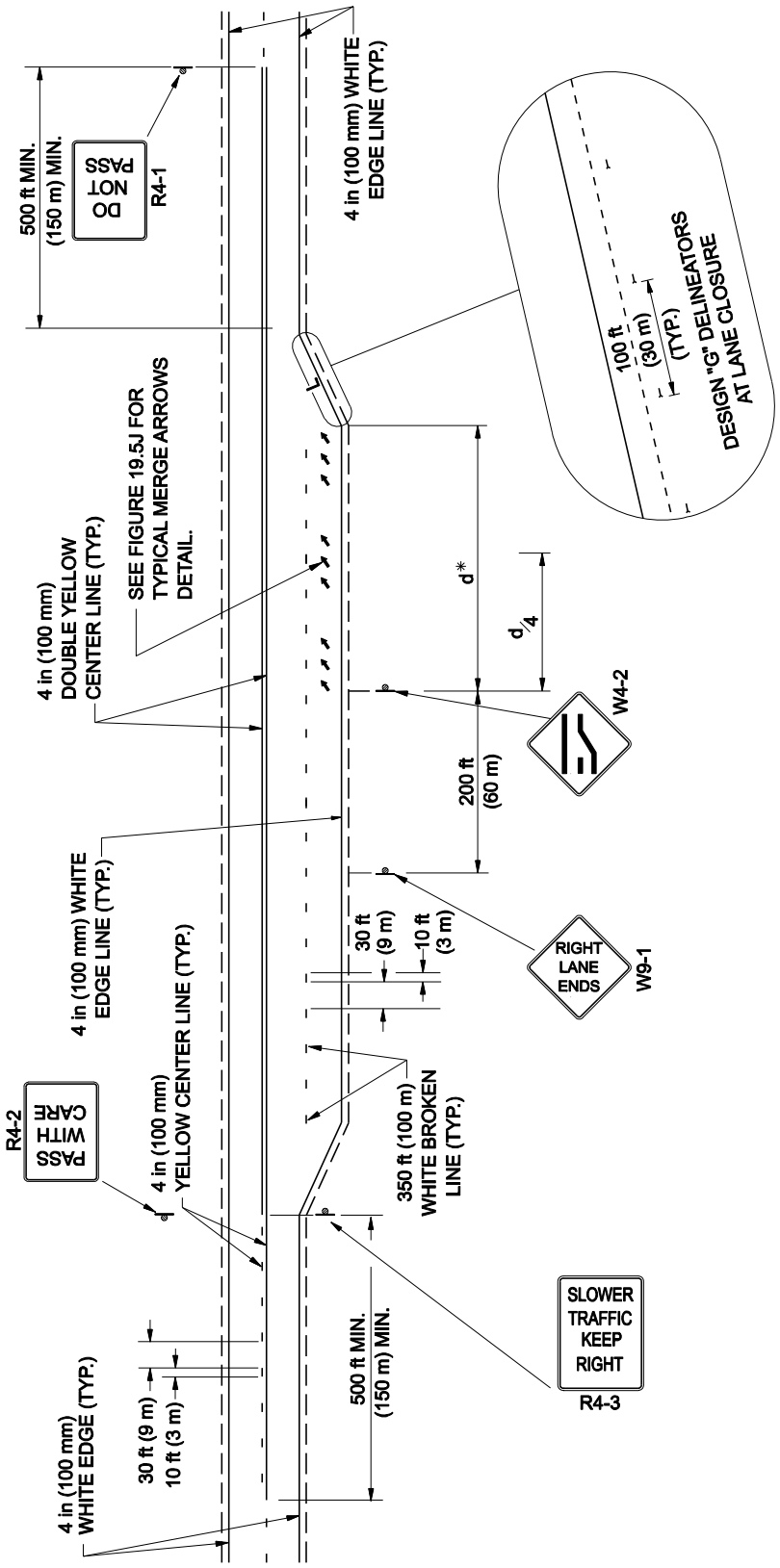
19.5.6 Bicycle Facilities

The color and type of lines used for bicycle facilities will be the same as that determined for automobiles (e.g., broken yellow line for 2-way bike paths). Broken lines for bicycle paths should have a 1 to 3 ratio (e.g., 3 ft (0.9 m) line with a 9 ft (2.7 m) gap. A solid white line should be used to separate pedestrians and bicycles if they share a common facility.

The bike lane symbol as defined in the MUTCD must be provided where bicycles and motor vehicles share the same facility and a separate bike lane is provided. Figure 19.5H illustrates the AASHTO Guide for the Development of Bicycle Facilities recommendations on how to mark an intersection with vehicles turning right across bike lanes. The MUTCD and the AASHTO Guide provide additional guidance for marking bicycle facilities.

19.5.7 Parking

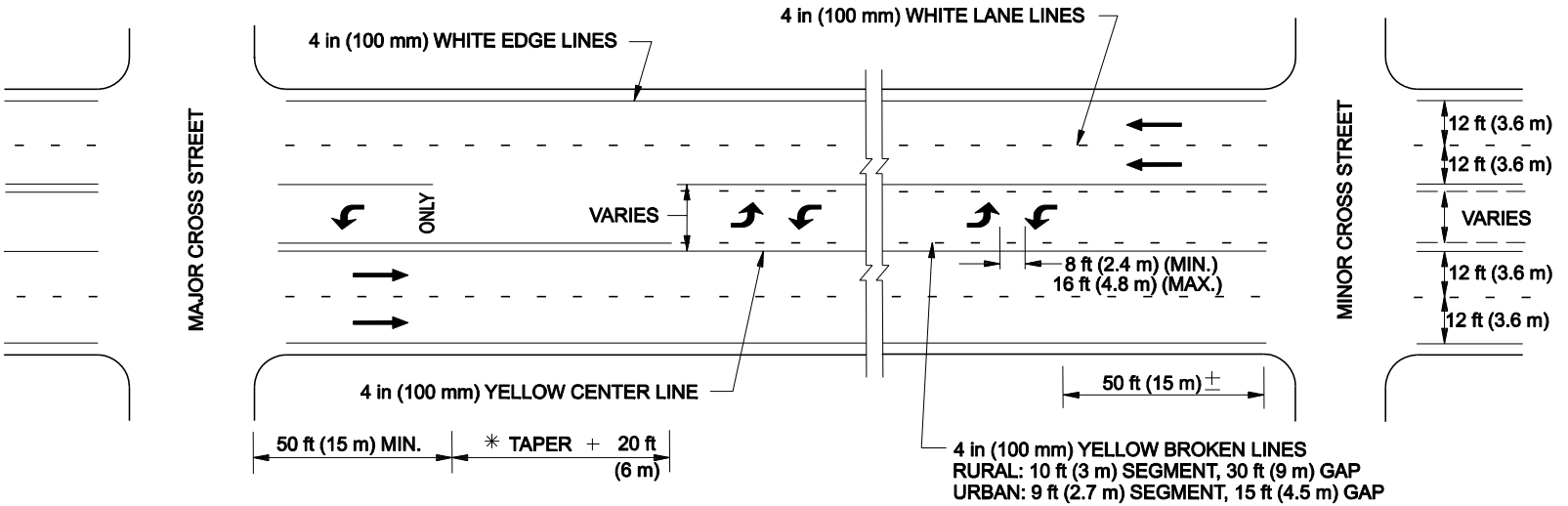
Although the Department does not normally mark on-street parking spaces, Figure 19.5I illustrates the normal limits of these zones, as well as typical on-street and off-street parking space striping. See Section 31.4 for additional guidance on parking. Parking limits in relation to intersections should conform to this figure to provide sufficient sight distance and minimize interference with vehicles that are moving in and out of parking stalls.



TYPICAL PAVEMENT MARKINGS FOR TRUCK-CLIMBING/PASSING LANES

Figure 19.5A

**d = See Figure 18.3A, Condition A for applicable distance.*

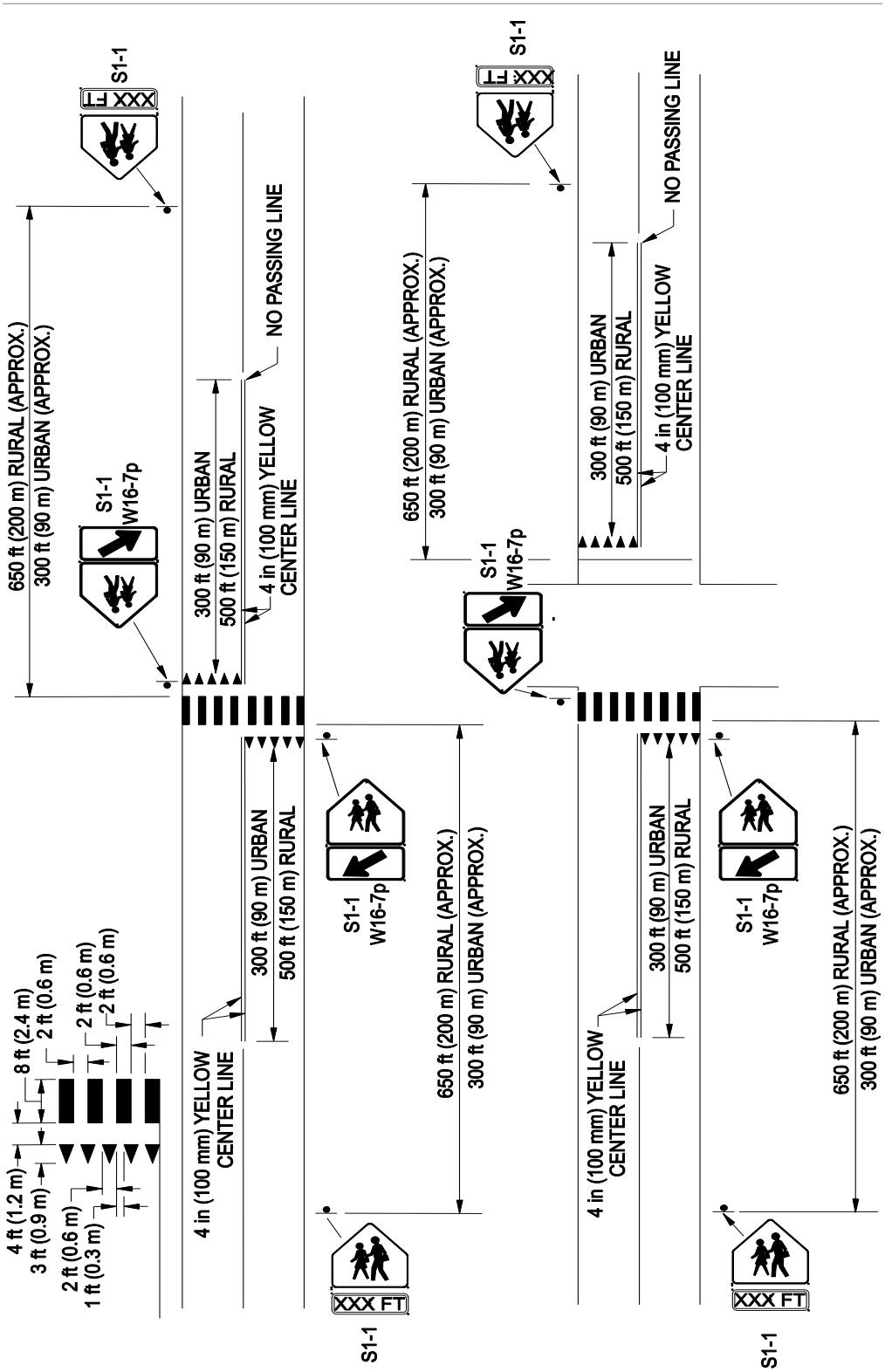


Notes:

1. *Turn arrow sets should be placed 50 ft (15 m) from intersections or the end of turn bays.*
2. *A minimum of two sets of arrows should be used per block.*
3. *Spacing between arrow sets will typically be 500 ft (150 m) in urban areas and 1300 ft (400 m) in rural areas (if not broken by blocks).*
4. *See Section 18.2.6 for placement of two-way, left-turn only signs.*

TYPICAL TWO-WAY, LEFT-TURN LANE PAVEMENT MARKINGS

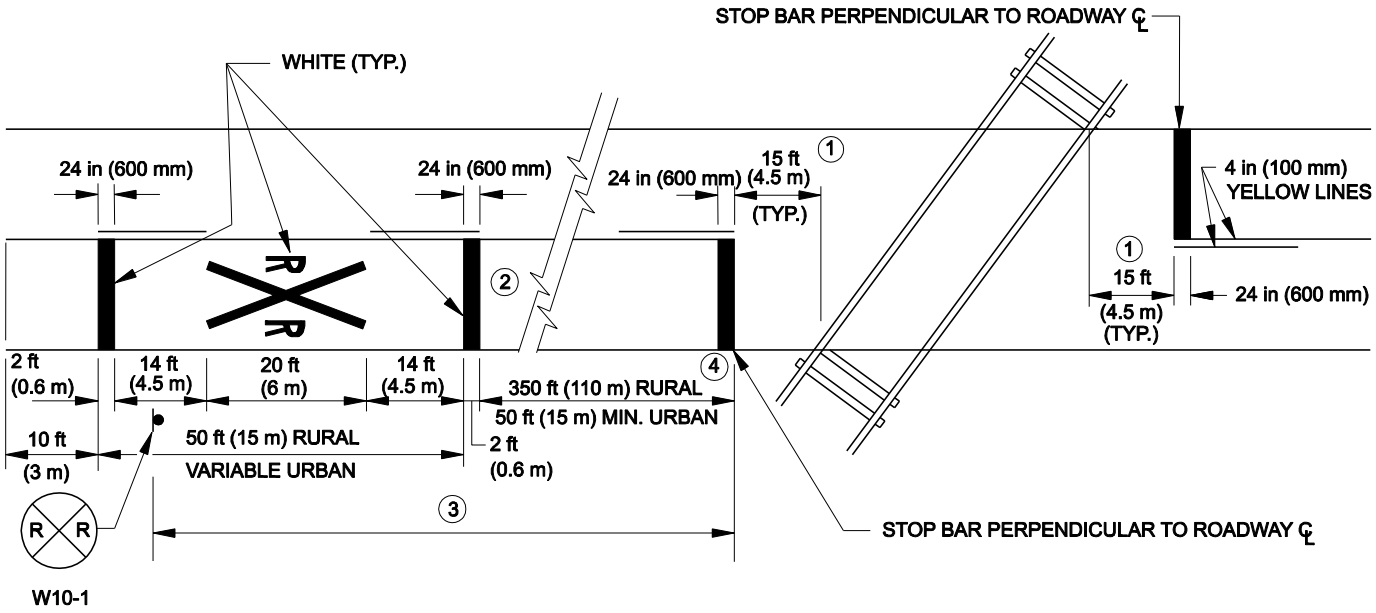
Figure 19.5B



SCHOOL CROSSINGS
(Signing AND Pavement Markings)

Figure 19.5C

Note: When advanced school crossing flashing beacons are mounted on sign S1-1, its location may vary from project to project but will normally be placed 150 ft (45 m) in advance of the crosswalk.

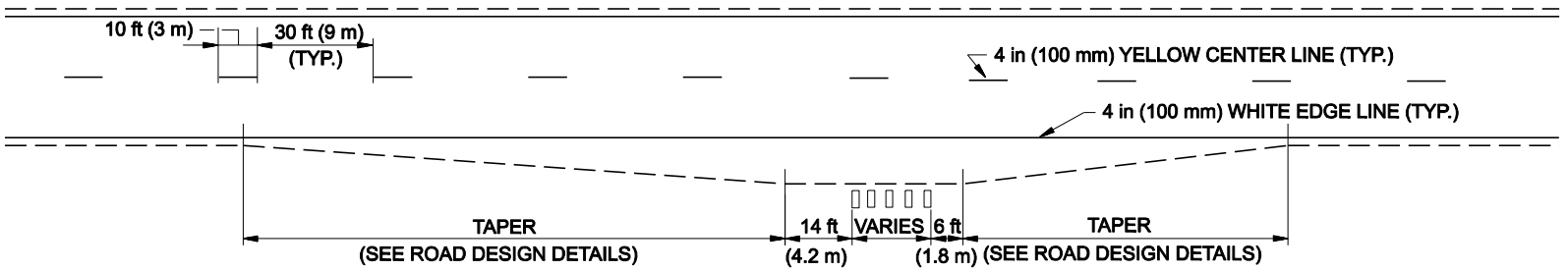


Notes:

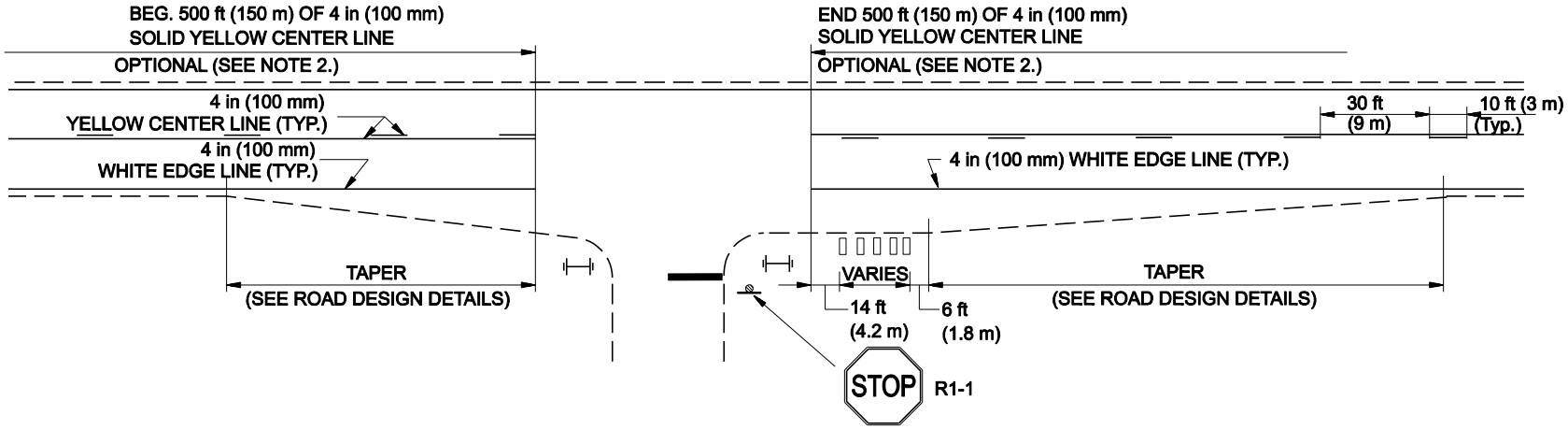
1. *If gate is present, use 8 ft (2.4 m) between the gate and the stop bar.*
2. *On multi-lane roads the transverse bands should extend across the approach lanes, and individual R X R symbols should be used in each approach lane.*
3. *For signalized crossings, see Figure 18.3A, Condition B (stop condition). For unsignalized crossings, See Figure 18.3A, Condition A.*
4. *Distance may vary depending on the placement of the W10-1 sign; see Comment 3.*

TYPICAL PAVEMENT MARKINGS AT HIGHWAY/RAILROAD GRADE CROSSINGS

Figure 19.5D



(a) TYPICAL MAIL BOX TURN-OUT (1)



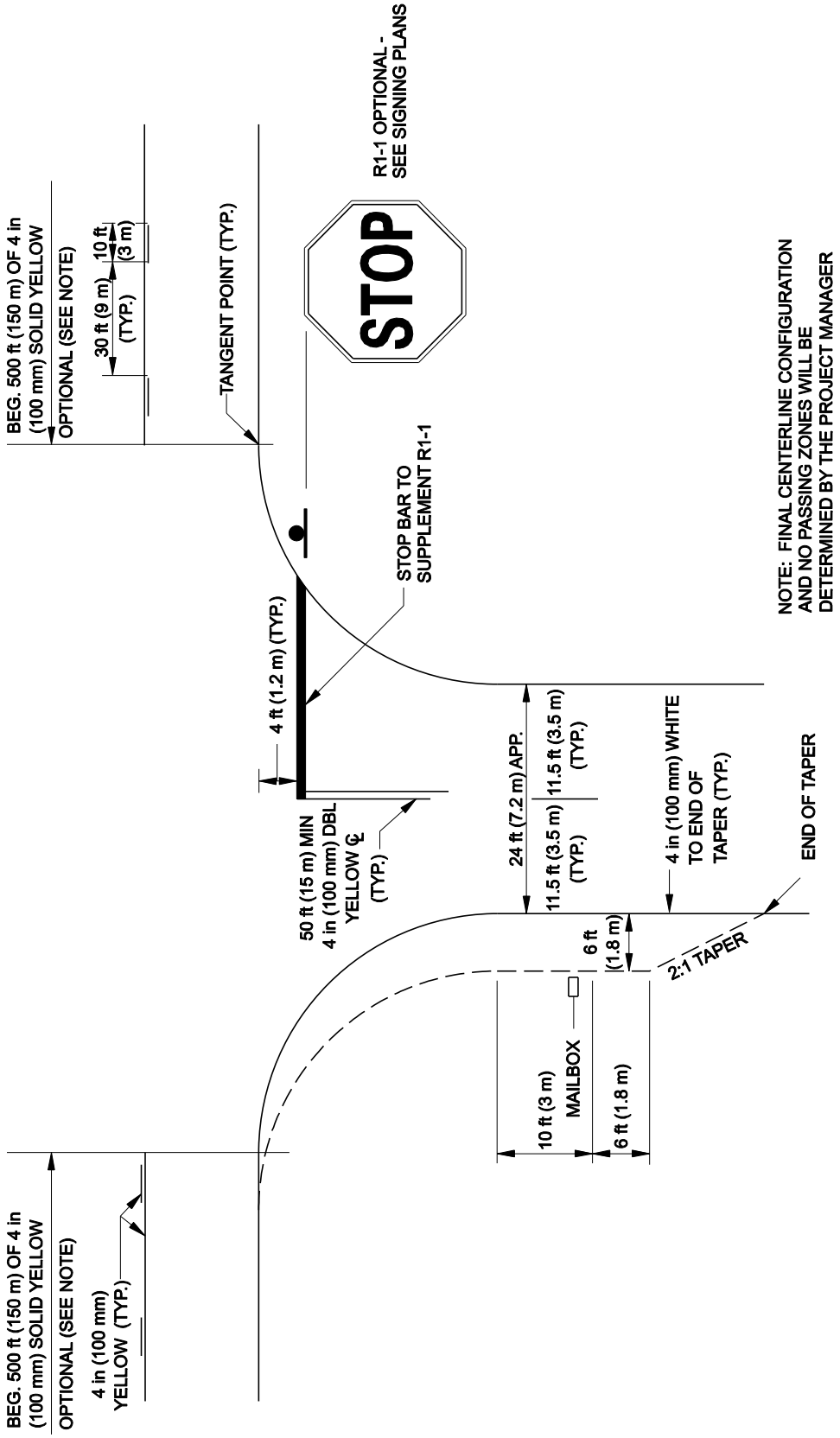
(b) TYPICAL MAIL BOX TURN-OUT AT APPROACH

Notes:

1. *Pavement markings will be placed as shown for mailbox turnouts not regulated by stop or yield signs.*
2. *Final center line configuration and no-passing zone markings will be determined on a case-by-case basis by the Project Manager.*

TYPICAL PAVEMENT MARKINGS FOR MAILBOX TURNOUTS

Figure 19.5E

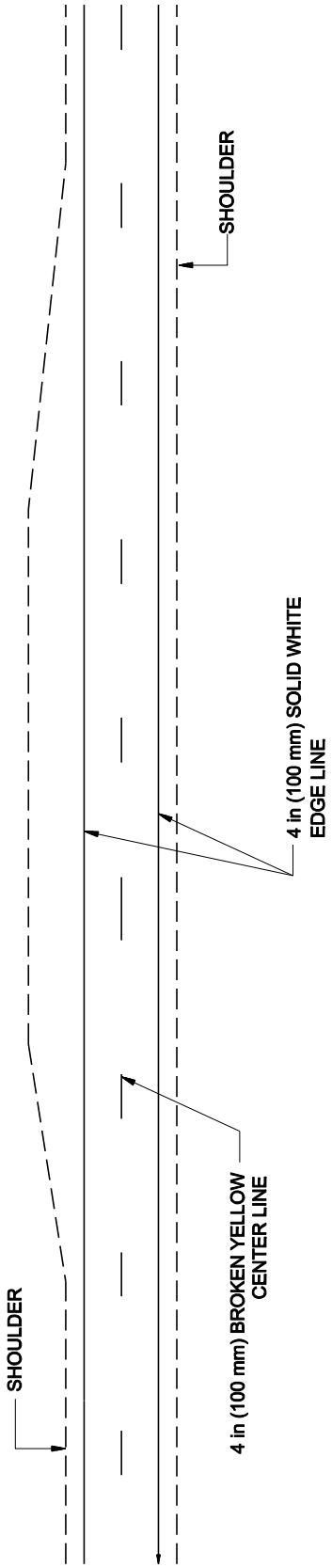


(c) TYPICAL MAIL BOX TURN-OUT AT APPROACH

TYPICAL PAVEMENT MARKINGS FOR MAILBOX TURNOUTS

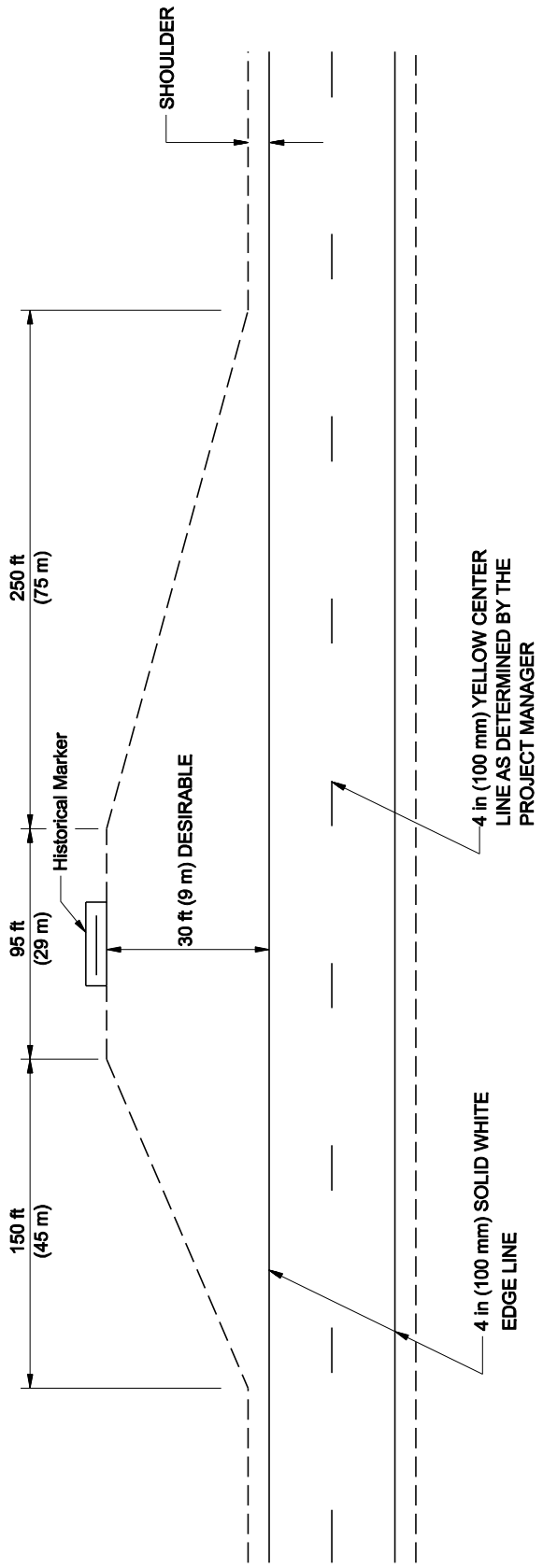
(Continued)

Figure 19.5E



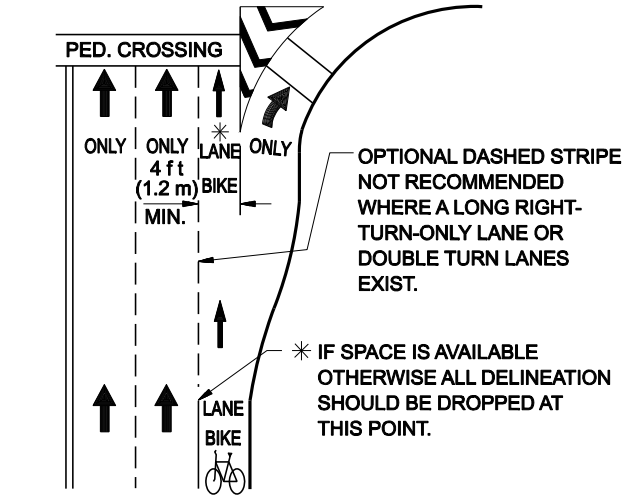
TYPICAL PAVEMENT MARKINGS FOR CHAIN-UP AREAS

Figure 19.5F

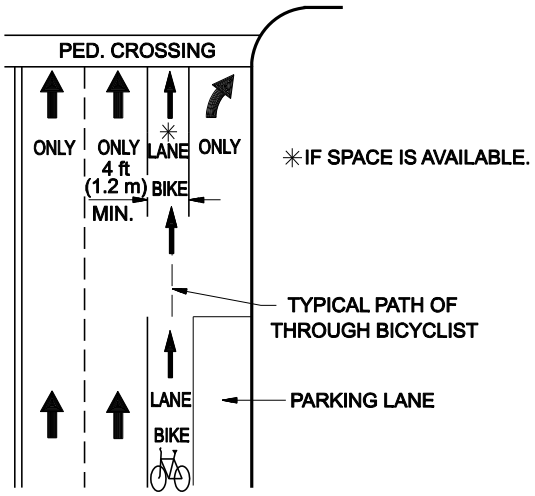


TYPICAL PAVEMENT MARKINGS FOR HISTORICAL MARKER TURNOUTS

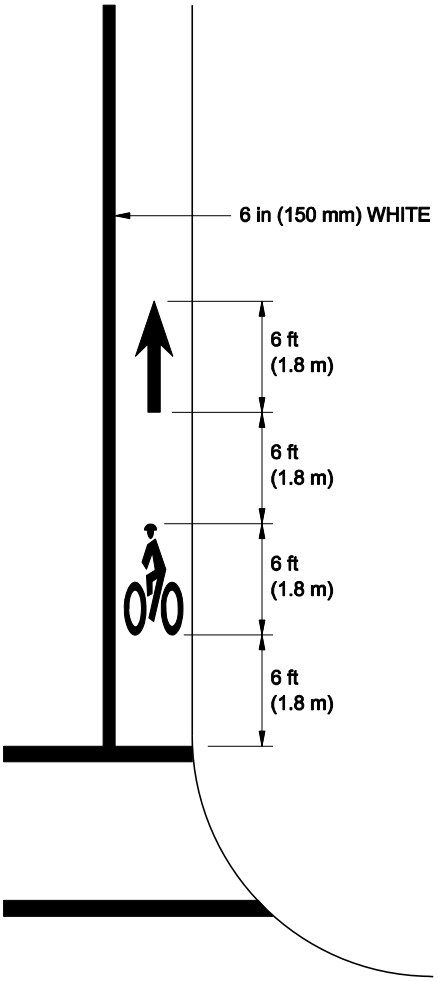
Figure 19.5G



RIGHT-TURN-ONLY LANE



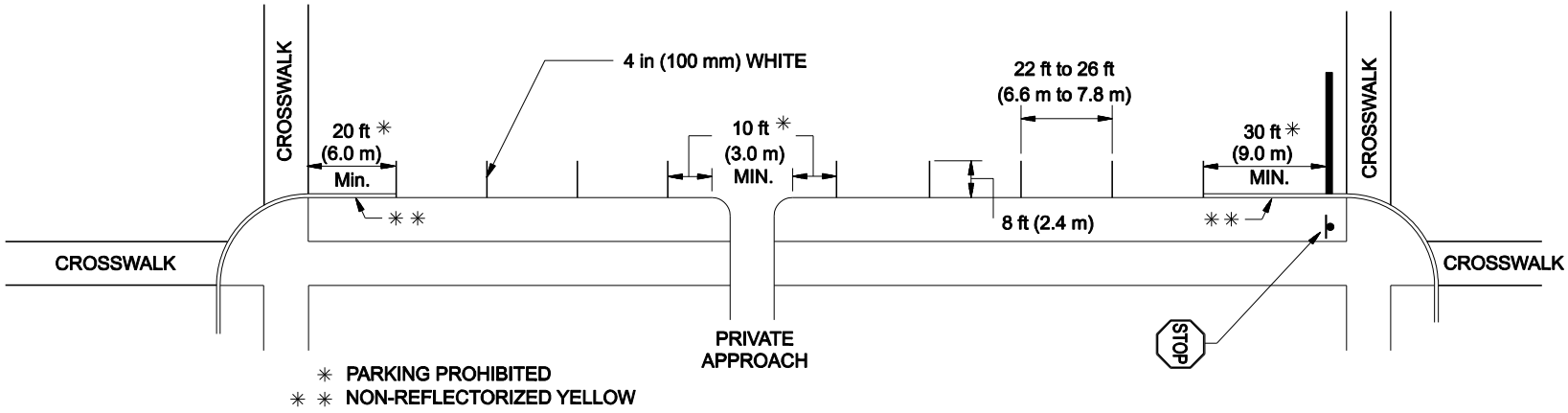
PARKING LANE BECOMES RIGHT-TURN-ONLY LANE



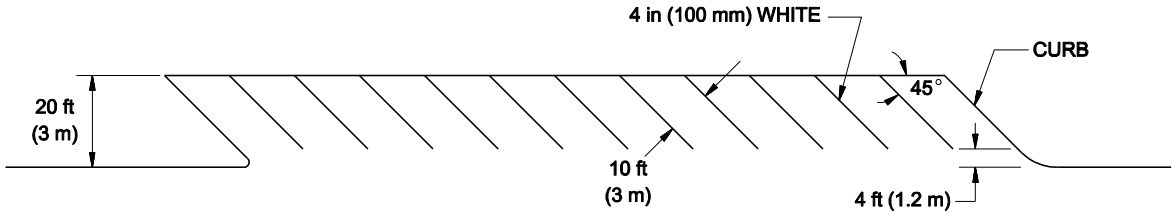
AFTER INTERSECTION

BICYCLE MARKINGS
(Intersections)

Figure 19.5H



ON-STREET PARKING

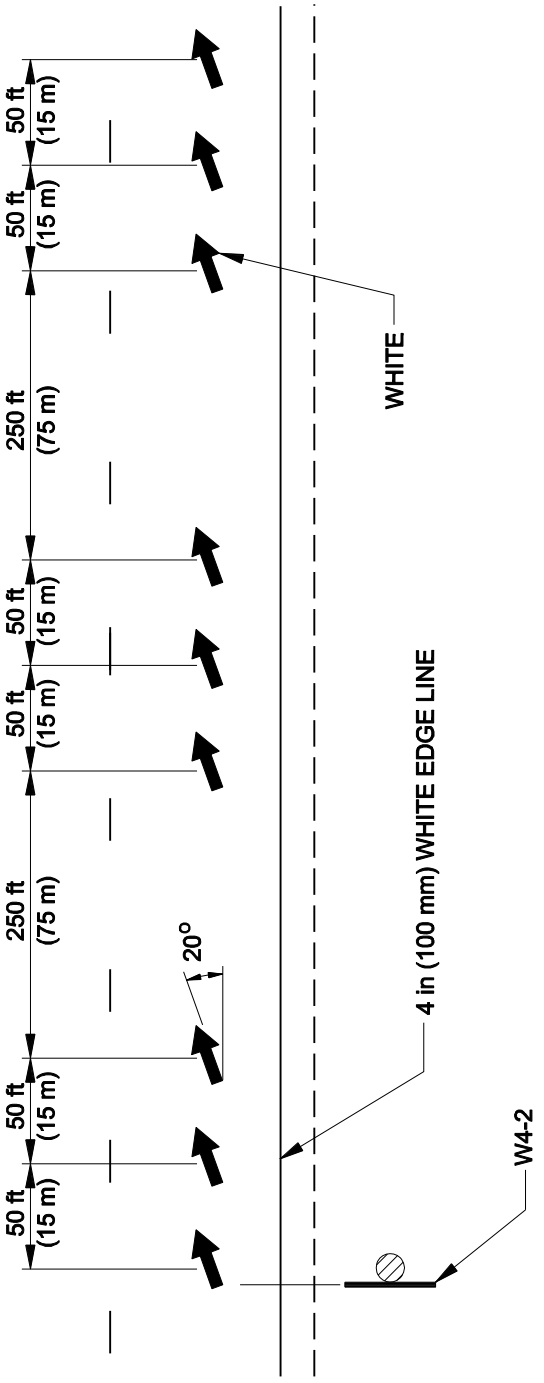


OFF-STREET ANGLED PARKING

Note: See Chapter Thirty-one for more information regarding on-street and off-street parking.

TYPICAL PAVEMENT MARKINGS FOR ON-STREET AND OFF-STREET PARKING

Figure 19.5I



MERGE ARROWS DETAIL

Figure 19.5J

19.6 PAVEMENT MARKING MATERIALS

19.6.1 Material Types

MDT is currently using several types of pavement marking materials. Recommended locations for each pavement marking type are presented in the previous sections of this Chapter. All pavement marking materials must meet the criteria in the MDT Standard Specifications. The application of pavement marking materials used by MDT is described below:

1. Paint. Quick-drying paint is typically applied as a 4 in (100 mm) or wider white or yellow stripe. Glass beads are dropped onto the wet paint which then bond to the drying paint surface. The use of glass beads greatly enhances the retro-reflectivity of the paint stripe. Per unit cost, paint-applied markings are significantly cheaper than any other method. One of the major disadvantages of paint is that it can be quickly worn away on high-volume roadways and, therefore, often needs to be reapplied more than once a year.

2. Epoxy Paint. Epoxy paint is typically made from a two-component epoxy resin, pigment, extenders and fillers. The two epoxy resin components are mixed together just before application to the roadway surface. The epoxy components produce a chemical reaction that binds them together. Materials having this type of chemical reaction are called thermoset materials. Epoxy markings can be applied to wet pavements. Glass beads are typically dropped onto the mixture; however, they may be added by several different means depending on the epoxy material being used.

3. Preformed Plastic. Preformed plastic markings are typically pre-made in a factory from vinyl, pigment and fillers and are available in strips, words or symbols. Glass beads are commonly embedded into the surface of the markings at the factory. Application of the marking typically involves removing a protective strip, laying the marking in place and applying pressure with a roller. Temporary tape is commonly used in construction zones because the tape can be easily removed. However, a common problem with some temporary preformed plastic tape is that it tends to break up easily and must be routinely checked for adequacy.

4. Raised/Recessed Pavement Markers. Raised and recessed pavement markers (RPMs) are typically cube-cornered acrylic lenses, tempered-glass lenses or glass-bead lenses, mounted in either a plastic or iron base. They are commonly placed with an adhesive to either the pavement surface or into a precut groove. For temporary application, they may be placed in a plastic base and applied directly to the pavement with an adhesive. RPMs are designed to reflect the

striping colors (e.g., white, yellow, red) and are used to supplement other markings and as position guidance devices. To enhance the service life, recessed markers are designed to allow a snow plow to pass over the marker.

19.6.2 Applications

See the current MDT Pavement Marking Policy and the MDT Standard Specifications for the recommended applications for the various pavement marking materials used by the Department. The following sections provide additional guidance on the application of these various materials. For the purpose of the following sections, special markings include, but are not limited to, crosswalks, highway/railroad crossing markings, stop lines, pavement words and symbol markings.

19.6.2.1 Definitions

The following definitions apply to the pavement marking applications that are typically used by the Department:

1. Intersections. At intersections, lane-control markings (i.e., words and arrows) are placed at least 20 ft (6 m) from the point where traffic stops. These special markings may be repeated in advance of mandatory turn lanes to aid motorists in selecting the correct lane.

2. Interim Paint. Interim paint is a term used to describe the temporary application of pavement markings before the final pavement markings are applied. For example, when a surfacing contract includes seal and cover, it will include an application of interim paint followed by the final pavement markings.

3. Final Pavement Marking. Final pavement marking is a term used to describe the durable markings which are applied after a facility is completed or completely refurbished and ready to complete its useful pavement life.

19.6.2.2 Paint

Paint should be used at all locations where it can provide good, year-round visibility and where the additional cost of durable pavement marking materials cannot be justified. In general, paint should be used:

1. typically where the remaining service life of the pavement is less than three years, or where the pavement is scheduled for resurfacing within three years

2. as an interim marking on chip seals pavements; and/or

3. for marking non-mountable islands and raised curbs.

19.6.2.3 Inlaid Thermoplastic

Hydrocarbon inlaid thermoplastic markings may be used on both rural and urban bituminous pavement surfaces for all markings, including longitudinal strips and/or transverse markings. The use of inlaid thermoplastic markings will be determined on a case-by-case basis at the time of the project scoping.

19.6.2.4 Epoxy Paint

Epoxy paint should be used for the all longitudinal stripes and transverse markings on all concrete pavement surfaces. Epoxy paint should be used for the final markings on both urban and rural bituminous pavements. Epoxy markings may be used at locations that are not proposed or scheduled for resurfacing within the next three to four years.

19.6.2.5 Preformed Plastic

Preformed plastic markings may be used on urban concrete pavement surfaces. The use of preformed plastic markings will be determined on a case-by-case basis at the time of the project scoping.

Temporary preformed plastic markings are commonly used in construction zones and should not be used for permanent applications.

19.6.2.6 Recessed Pavement Markers (RPMs)

Snowplowable RPMs provide supplemental delineation and are positive position guidance devices. They should not be used as a replacement for standard pavement markings or conventional roadside delineation. The following application guidelines should be considered:

1. Location. Site selection should be based primarily on the need for additional alignment delineation, specifically in areas of frequent inclement weather (e.g., fog, smoke, rain) and in areas of low roadway illumination. Typical areas that should be considered for placement of RPMs include:

    a. areas showing excessive wear of existing pavement markings (e.g., mountain passes);

b. high-crash locations which are correctable by better nighttime delineation;

c. rural, lane-reduction transitions; and

d. interchange ramps, freeway gores and bifurcations.

2. Pavement Life. Due to the cost of their installation, RPMs should only be used in conjunction with new construction and overlay projects.

3. Illumination. RPMs typically are not used at locations that are illuminated.

4. Spacing. The MUTCD provides the spacing criteria for RPMs.

5. Application. RPMs may be used for center lines, edge lines, gore markings, etc. based on site-by-site conditions. Edge line application may require special consideration.

19.6.2.7 Surface Conditions

In general, most pavement markings can be used with both bituminous and concrete pavements. It should be noted, however, that pavement markings on bituminous surfaces tend to last longer than those on concrete surfaces. Hot applied thermoplastic pavement marking materials should not be placed on concrete surfaces.

19.7 OBJECT MARKERS

19.7.1 Types

Object markers are used to mark obstructions that are within or adjacent to the roadway. Where deemed necessary, one or more of the following object markers should be used:

1. Type 1. A Type 1 object marker consists of a 18 in (450 mm) or larger diamond panel with one of the following arrangements:

   a. Reflectors/Yellow Background. This marker consists of 9 yellow, 3 in (75 mm) diameter reflectors arranged symmetrically on a yellow diamond panel.

   b. Reflectors/Black Background. This marker consists of 9 yellow, 3 in (75 mm) diameter reflectors arranged symmetrically on a black diamond panel.

   c. Reflectorized Sheeting. This marker is a yellow diamond panel with a reflective sheeting and no reflectors.

2. Type 2. Type 2 object markers can be either a 6 in x 12 in (150 mm x 300 mm) reflectorized, yellow rectangular panel or a 6 in x 12 in (150 mm x 300 mm) white rectangular panel with three, yellow 3 in (75 mm) diameter reflectors. Either type can be arranged vertically or horizontally. Type 2 markers may be larger to meet special conditions.

3. Type 3. A Type 3 object marker consists of a 12 in x 36 in (300 mm x 900 mm) rectangular panel with alternating black and reflectorized yellow stripes sloping downward at an angle of 45° toward the side of the obstruction on which traffic will pass. The minimum width for the yellow stripe is 3 in (75 mm). For objects on the right side, the stripes should begin at the upper right side of the panel and slope downward to the lower left side. For objects on the left side of the panel, the stripes should begin at the upper left side and slope downward to the lower right side.

4. End-of-Road Markers. End-of-road markers are similar to the Type 1 markers except that the reflectors are red. The background color may be red or black. This marker is used at the end of a roadway where there is no alternative vehicular path.

19.7.2 Application

The following provides guidelines for the application of object markers:

1. Mounting Height. For locating object markers 8 ft (2.4 m) or less from the roadway, the bottom of the object marker should be approximately 4 ft (1.2 m) above the surface of the nearest travel lane. For objects greater than 8 ft (2.4 m) from the roadway, the bottom of the object marker may be 4 ft (1.2 m) above the ground. Adjustments may be made to the mounting height to meet field conditions.

2. Objects in the Roadway. Obstructions within the roadway should be marked with either a Type 1 or a Type 3 object marker. Obstacles with large surfaces (e.g., bridge piers) may be painted with reflectorized paint in a pattern similar to the Type 3 object marker. Appropriate signing may be used instead of the object marker to direct traffic to one or both sides of the obstruction.

3. Objects Adjacent to the Roadway. Type 2 or Type 3 object markers may be used where objects are relatively close to the roadway (e.g., bridge piers, bridge abutments, culvert headwalls, shoulder dropoffs, gores, small islands). The inside edge of the marker should be in line with the inner edge of the obstruction.

19.8 DELINEATORS

Delineators are light retroreflective devices mounted along the roadside, which are used to guide motorists. Delineators are typically used at the following locations:

1. along tangent sections of major roadways,
2. along sharp horizontal and short vertical curves,
3. at pavement width transitions,
4. where the road alignment might be confusing, and
5. along sections through mountain passes.

An important advantage of delineators is that they remain visible when the roadway is wet or snow-covered. The MDT Detailed Drawings illustrate the various types of delineators that are used by the Department. The following sections provide the designer with additional information on these delineators and their application, placement and spacing.

19.8.1 Types

There are three basic types of delineators as follows:

1. Standard Delineator. The standard delineator consists of a single or double (i.e., mounted back to back) light, retroreflective diamond or vertical rectangular lens mounted at the top of a metal "U" post. The lens' size typically ranges from 4 in to 12 in (100 mm to 300 mm). The standard delineator has nine different designs that are designated Design "A" through Design "J" (note that the Department does not maintain a Design "I" delineator). These delineators serve the majority of the longitudinal delineation functions along highway sections.

2. Snow Poles. Snow poles are special delineation devices that are used exclusively along highway sections through mountain passes. The typical snow pole is made from treated wood and is 4 in x 4 in (100 mm x 100 mm) in cross-section with a top diameter of 2 in to 3 in (50 mm to 75 mm). They are considerably taller than the standard delineator and have strict placement criteria. Snow poles serve the unique function of delineating roadways in areas that have heavy and substantially deep snow (e.g., mountain passes). They also serve as a very important travel guide for snow plow operators.

3. Flexible Guide Posts. Flexible guide posts are delineator posts that are used to delineate highways and roads where impact is a main consideration (e.g., raised median noses, high snow areas, on and off ramps, sharp horizontal curves). Their special attribute is their ability to sustain multiple impacts and ease of

maintenance. They may have 4 in (100 mm) flat surface or a 3 in (75 mm) diameter tube and include reflective sheeting (Type III). The design will vary according to the manufacturer. The designer is referred to the MDT Detailed Drawings for additional information regarding the design and placement of flexible guide posts. They may be used in sections with high incidence of off-road crashes.

19.8.2 Application

Figure 19.8A illustrates the delineator types and their typical applications. The following presents additional guidelines for the application of delineators:

1. Color. Match the delineator color with the color of the edge line. For example, if the edge line is white, the delineator will be white. For the left side of divided highways, if used, the delineator must be yellow. Red delineators are typically used along truck escape ramps but also may be used on the reverse side of any delineator post for motorists who may be traveling the wrong way on 1-way roadways (e.g., ramps).

2. Interstate Highways. Single white delineators should be provided on the right side of Interstates and at least on one side of interchange ramps. Single yellow delineators may also be provided on the left side for guidance.

3. 2-Lane, 2-Way Roadways. Delineators used on 2-lane, 2-way through roadways should be single white reflector units placed on the right side of the roadway. Yellow reflector units may be placed on the left side of the facility, particularly at sharp right-hand horizontal curves.

4. Median Crossovers. For median crossovers, double yellow delineators should be placed on the left side of the through roadway and on the far side of the crossover.

5. Interchanges. Single, vertical rectangular delineators should be installed at 100 ft (30 m) intervals along acceleration and deceleration lanes and along the outside or both sides of tangent portions of interchange ramps. Where delineators are used only on one side of a curved interchange ramp, the delineators should be placed on the outside of the curve. Where the curves reverse in direction, delineators should be used on the outside of each curve and overlap in the area of the directional change.

Type	Color	Size/Description	Application
Design “A”	White	4 in x 4 in (100 x 100 mm) single, diamond reflector	Continuous delineation along roadway and along right shoulders of Interstate and non-Interstate routes.
Design “B”	Yellow	8 in x 4 in (200 x 100 mm) single, vertical rectangular reflector	Along left shoulders of Interstate ramps.
Design “C”	White	4 in x 4 in (100 x 100 mm) double, diamond reflector, one reflector skewed 20 degrees out from post surface	Curves with radius less than 550 ft (170 m); place delineators along outside and inside of curve.
Design “D”	Yellow	8 in x 4 in (200 x 100 mm) double, vertical rectangular reflector	On non-Interstate routes at approaches with stop or yield signs. On Interstate routes at ramp termination with crossroad. At the taper points of major turnouts (e.g., historic marker turnouts).
Design “E”	Yellow	6 in x 12 in (150 x 300 mm) single, horizontal, rounded-diamond reflector	Special and rare use. Formerly used at gores and island noses.
Design “F”	White	4 in x 4 in (100 x 100 mm) double, diamond reflector	Curves with radius 550 ft to 750 ft (170 m to 230 m), place delineators along outside and inside of curve. Curves with radius 750 ft to 1500 ft (230 m to 450 m), place delineators along outside of curve only.
Design “G”	White	8 in x 4 in (200 x 100 mm) single, vertical rectangular reflector	Along right shoulders of Interstate ramps.
Design “H”	Yellow	4 in x 4 in (100 x 100 mm) single, diamond reflector	Along left shoulders of Interstate routes.
Design “J”	Red	8 in x 4 in (200 x 100 mm) single, vertical rectangular reflector	Along truck escape ramps only.

Notes:

1. *The Department does not maintain a Design “I” delineator.*
2. *For additional information on delineators, see the MDT Detailed Drawings.*

DELINEATOR TYPES AND TYPICAL APPLICATIONS

Figure 19.8A

6. Transitions. Delineators should be used to guide the motorist through lane-narrowing transitions and for lane merges. Where continuous delineation is provided on one or both sides of the highway, the delineation should be continued through the transition area and a closer spacing may be warranted.

7. Lighting. Where lighting is provided, the need to use delineation in the area will be determined on a case-by-case basis.

8. Barriers. Delineators are required on all concrete median barriers, temporary concrete median barriers, concrete railings and metal beam rail.

9. Recessed Pavement Markers. Delineators may be removed along roadways where recessed pavement markers are used for a substantial distance.

10. Truck Escape Ramps. Red delineators should be placed on both sides of truck escape ramps. The delineators should be spaced at 50 ft (15 m) intervals for a distance sufficient to identify the ramp entrance. Spacing beyond the entrance should be adequate for guidance.

11. Horizontal Curves. For curves with a radius from 750 ft to 1500 ft (230 m to 450 m), place delineators along the outside of the curve only. For curves with a radius less than 750 ft (230 m), place delineators along both sides of the curve.

19.8.3 Placement and Spacing

19.8.3.1 General Criteria

The MDT Detailed Drawings provide criteria for the placement and spacing of delineators. In addition, the designer should consider the following Department guidelines:

1. Height. The top of the delineator should be placed so that the top of the reflecting head is approximately 4 ft (1.2 m) above the pavement surface of the nearest travel lane.

2. Placement. Delineators should be placed at a constant distance from the roadway edge unless guardrail or other obstructions intrude into the space between the pavement edge and the extension of the line of delineators. Typically, delineators should not be placed less than 24 in (600 mm) or more than 6 ft (1.8 m) from the outside of the shoulder on non-Interstate highways. On rural highways, the lateral clearance will typically be 4 ft (1.2 m). Lateral clearance for delineators on Interstates should be 6 ft (1.8 m).

3. Spacing. For tangent sections, delineators should normally be spaced between 200 ft to 530 ft (60 m to 160 m) apart. On Interstate highways and other divided facilities, the delineator spacing should be 400 ft (120 m). Where normal uniform spacing is interrupted by driveways, crossroads, etc., the delineator should be moved to either side provided the distance does not exceed one-quarter of the normal spacing. If this criteria is exceeded, the delineator may be removed.

For horizontal curves, the delineator spacing should be adjusted so that several delineators will always be visible to the driver. Figure 19.8B provides the recommended maximum spacing for delineators around horizontal curves. Figure 19.8C illustrates a convenient field method for determining the radius of a horizontal curve. The spacing around curves should not be less than 20 ft (6 m) nor greater than 300 ft (90 m).

19.8.3.2 Interstate Highways

The following presents the Department's guidelines for the placement and spacing of delineators along Interstate highways. Variations of this typical treatment may be justified in mountain pass sections where snow poles may be used in lieu of the standard delineator (see Section 19.8.3.5):

1. Outside Shoulders. Interstate highways should be continuously delineated along the outside shoulders with standard delineators mounted 4 ft (1.2 m) above the pavement surface and with a lateral clearance of 6 ft (1.8 m) from the edge of the paved shoulder.

2. Inside Shoulders. The delineator spacing and offset along the inside shoulder of Interstate highways should be the same as that for the outside shoulder, with placement being measured midway between the delineators of the outside shoulder. The inside shoulders of Interstate highways should be delineated in three distinct areas as follows:

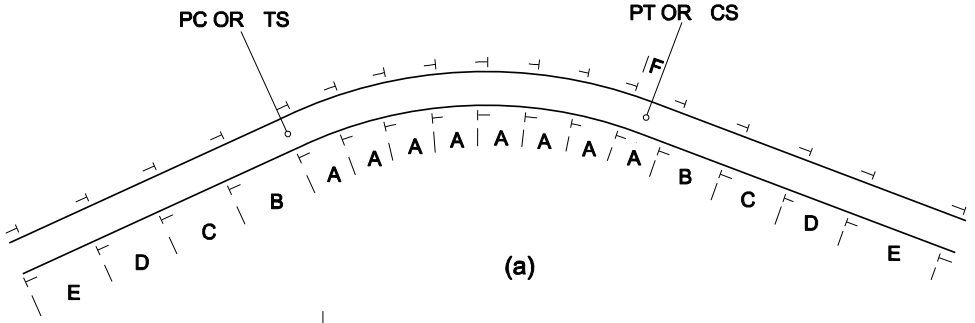
    a. where there is a split of 10 ft (3 m) or more in directional profile elevation;

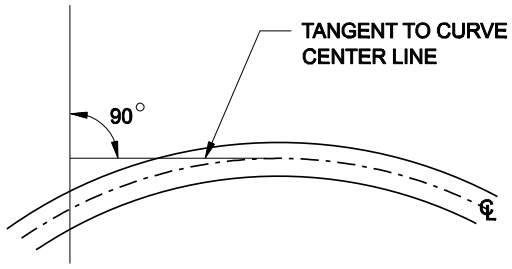
    b. where the median width exceeds 150 ft (45 m); and/or

    c. at every interchange starting at the taper transition of the off-ramp and proceeding, at either a spacing of 400 ft (120 m) along a tangent section or according to Figure 19.8B along a horizontal curve, to a point near the end of the taper of the on-ramp. Delineator spacing adjustments are not needed if the delineation does not end exactly at that point.

3. Tangent Sections. Delineator spacing along tangent sections of Interstate highways should be 400 ft (120 m).

Radius of Curve ft (m)		Spacing on Curve ft (m)		Spacing on Both Approach Tangents ft (m)									
		A		B		C		D		E			
Over 5729	(1750 & Up)	300	(90)	400	(120)	400	(120)	400	(120)	400	(120)		
2860-5729	(900-1749)	255	(65)	400	(120)	400	(120)	400	(120)	400	(120)		
1910-2859	(600-899)	160	(50)	320	(95)	400	(120)	400	(120)	400	(120)		
1430-1909	(450-599)	130	(40)	260	(75)	400	(120)	400	(120)	400	(120)		
950-1429	(300-449)	110	(35)	220	(65)	330	(100)	400	(120)	400	(120)		
720-949	(200-299)	90	(25)	185	(55)	275	(80)	400	(120)	400	(120)		
480-719	(150-199)	75	(20)	150	(45)	230	(70)	300	(90)	400	(120)		
290-479	(100-149)	60	(20)	125	(35)	185	(55)	300	(90)	400	(120)		
0-289	(0-100)	45	(15)	90	(25)	140	(40)	275	(80)	400	(120)		





(b)

Notes:

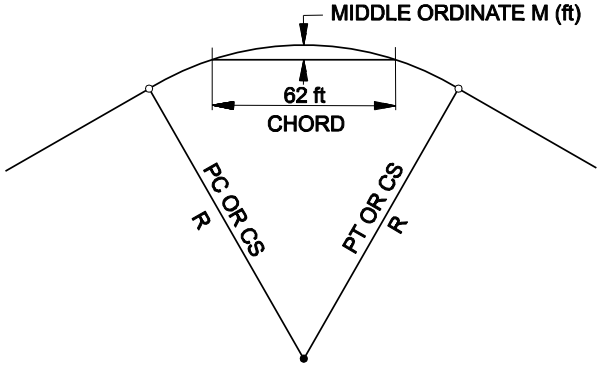
1. *Illustration (a) shows the location of delineators as they relate to the values in the table above. If the distance "F" in Illustration (a) is greater than 20 ft (6 m), then add one delineator at "A" spacing.*

2. *Delineator faces should be positioned perpendicular to a tangent with the center line of the curve as shown in Illustration (b).*

SUGGESTED MAXIMUM SPACING FOR DELINEATORS ON HORIZONTAL CURVES

Figure 19.8B

US CUSTOMARY							
M (in)	**R (ft)**	**M (in)**	**R (ft)**	**M (in)**	**R (ft)**	**M (in)**	**R (ft)**
0.25	23064	5.25	1099	10.50	550	21	275
0.50	11532	5.50	1049	11.00	525	22	263
0.75	7688	5.75	1003	11.50	502	23	252
1.00	5766	6.00	961	12.00	481	24	241
1.25	4613	6.25	923	12.50	462	25	232
1.50	3844	6.50	887	13.00	444	26	223
1.75	3295	6.75	855	13.50	428	27	215
2.00	2883	7.00	824	14.00	412	28	207
2.25	2563	7.25	796	14.50	398	29	200
2.50	2307	7.50	769	15.00	385	30	193
2.75	2097	7.75	744	15.50	373	32	182
3.00	1922	8.00	721	16.00	361	34	171
3.25	1774	8.25	699	16.50	350	36	162
3.50	1648	8.50	679	17.00	340	38	153
3.75	1538	8.75	659	17.50	330	40	146
4.00	1442	9.00	641	18.00	321	45	130
4.25	1357	9.25	624	18.50	312	50	117
4.50	1282	9.50	607	19.00	304	55	107
4.75	1214	9.75	592	19.50	297	60	99
5.00	1153	10.00	577	20.00	289	65	91



Note: The values in the table above are based on a 62 ft chord length. At this chord length, the relationship between the curve radius and the middle ordinate is as follows:

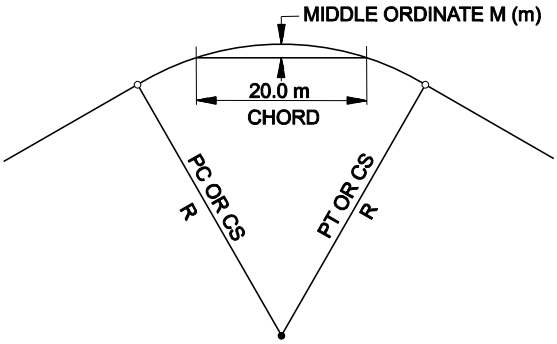
$$R = \frac{M}{24} + \frac{5766}{M} \qquad M = 12\left(R - \sqrt{R^2 - 961}\right)$$

where: R = curve radius (ft)
M = middle ordinate (in)

FIELD METHOD FOR DETERMINING HORIZONTAL CURVE RADIUS (US Customary)

Figure 19.8C

METRIC							
M (mm)	**R (m)**	**M (mm)**	**R (m)**	**M (mm)**	**R (m)**	**M (mm)**	**R (m)**
7	7143	55	909	210	238	420	119
8	6250	60	833	220	227	440	114
9	5556	65	769	230	218	460	109
10	5000	70	714	240	208	480	104
11	4545	75	667	250	200	500	100
12	4167	80	625	260	192	550	91
13	3846	85	588	270	185	600	84
14	3571	90	556	280	179	650	77
15	3333	95	526	290	173	700	72
16	3125	100	500	300	167	750	67
17	2941	110	455	310	161	800	63
18	2778	120	417	320	156	850	59
19	2632	130	385	330	152	900	56
20	2500	140	357	340	147	950	53
25	2000	150	333	350	143	1000	51
30	1667	160	313	360	139	1100	46
35	1429	170	294	370	135	1200	42
40	1250	180	278	380	132	1300	39
45	1111	190	263	390	128	1400	36
50	1000	200	250	400	125	1500	34



Note: The values in the table above are based on a 20.0 m chord length. At this chord length, the relationship between the curve radius and the middle ordinate is as follows:

$$R = \frac{M}{2000} + \frac{50\,000}{M} \qquad M = 1000\left(R - \sqrt{R^2 - 100}\right) \text{ for } R > 10$$

where: R = curve radius (m)
M = middle ordinate (mm)

FIELD METHOD FOR DETERMINING HORIZONTAL CURVE RADIUS (Metric)

Figure 19.8C

4. Horizontal Curves. Spacing through horizontal curves should be according to Figure 19.8B.

5. Metal Beam Rail. Where metal beam rail is used, it should be delineated by means of reflective delineators as shown in the MDT Detailed Drawings. Attach delineators to the wood blockout every 25 ft (7.62 m) with the reflectorized surface facing oncoming traffic. Post-mounted delineators are used in addition to the metal beam rail mounted delineators.

6. Concrete Barriers. Concrete barriers should be continuously delineated. Mounting height of the delineators should be 32 in (800 mm) above the pavement surface. Placement of the delineator should be on the connecting pin between two 10 ft (3 m) sections of concrete barrier at 100 ft (30 m) intervals.

7. Frontage Roads/Crossovers. Frontage roads and interchange crossroads should be evaluated, for purposes of delineation, on the basis of current use and other contributing factors. Normal treatment on these roadways will be along the outside of horizontal curves that have a radius 1500 ft (450 m) or less.

8. Snow Poles. In mountain pass areas, the snow pole should be considered in lieu of the standard delineator as discussed in Section 19.8.3.5.

19.8.3.3 Non-Interstate Highways

Non-Interstate highways should be evaluated for delineation by means of a sliding scale analysis. A 10 mile (16 km) section should be used for the purpose of evaluation and it should be advanced every 1 mile (2 km) between each evaluation point. The following criteria should be used to determine delineation needs:

1. AADT 900 vpd or Greater. Standard delineators should be placed along the shoulder and mounted 4 ft (1.2 m) above the pavement surface with a lateral clearance of 2 ft to 6 ft (0.6 m to 1.8 m) from the edge of the paved shoulder. The normal offset should be 4 ft (1.2 m) but may vary to a minimum of 2 ft (0.6 m) in areas with adverse inslopes. The spacing on tangent sections should be 400 ft (120 m). The spacing through horizontal curves should be according to Figure 19.8B. Delineators should be placed continuously regardless of any guardrail installation.

2. AADT less than 900 vpd. Standard delineators should be placed only on the outside of horizontal curves that have a radius 1500 ft (450 m) or less. Post-mounted, back-to-back reflectors should be mounted 4 ft (1.2 m) above the

pavement surface. The offset and spacing should be as outlined in Item #1 above. See MDT Detailed Drawings for additional details.

3. Snow Poles. In mountain pass areas, the snow pole should be considered in lieu of the standard delineator as discussed in Section 19.8.3.5.

4. Unpaved Highways. Unpaved highways are generally not delineated. However, the potential hazards and predicted use of each individual section must be individually evaluated. The road conditions, traffic conditions, weather conditions, location and other pertinent factors should be included in the evaluation.

5. Special Conditions. Roadway sections, whether they are paved or unpaved and regardless of consideration to AADT, may be continuously or partially delineated as deemed necessary by special conditions and sound engineering judgment.

19.8.3.4 Existing Highway Facilities

The Department has in the past installed delineators under varying criteria. Although the 4 ft (1.2 m) mounting height remains consistent, the spacing and lateral clearance differ considerably throughout the State. The maintenance of existing delineators should conform to the guidelines in this Section with the following exceptions:

1. AADT 900 vpd or Greater. Interstate highways and non-Interstate roadway sections having continuous delineation at a spacing of either 265 ft (80.5 m) or 300 ft (91.5 m) should be maintained at that spacing. However, where the 200 ft (60 m) typical spacing exists, every other delineator should be removed as it becomes appropriate. Delineator offsets less than 6 ft (1.8 m) should be maintained so that there will be continuity throughout the roadway section.

2. AADT less than 900 vpd. Delineators along non-Interstate roadways in this traffic volume range should be maintained only along horizontal curves that have a radius of 1500 ft (450 m) or less and at recognized hazard locations. The remainder of the delineators should be removed only after they become ineffective through damage or age. See MDT Detailed Drawings for additional details.

3. Horizontal Curves. Non-Interstate facilities with delineators only along horizontal curves should be maintained only if the curve radius is 1500 ft (450 m) or less. Delineators at recognized hazard locations should also be maintained. The existing spacing and offset of delineators along these roadways should also be maintained. See MDT Detailed Drawings for additional details.

19.8.3.5 Snow Poles

The standard snow pole height is 8 ft (2.4 m) above the pavement surface, but heights of 10 ft (3.0 m) and 12 ft (3.6 m) may be used as other conditions warrant. Snow poles will have two reflectors per pole, one at 4 ft (1.2 m) above the pavement and the second at the top of the pole. Snow poles should have a lateral clearance of 8 ft (2.4 m) regardless of roadside barrier installation. Clearances less than 8 ft (2.4 m) should be avoided, if practical. They should be spaced 400 ft (120 m) along tangent sections and according to Figure 19.8B along horizontal curves. Snow poles should be used in mountain pass areas along Interstate highways and non-Interstate facilities or where otherwise warranted.