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CHAPTER SEVENTY-SIX

PAVEMENT MARKINGS

76-1.0 GENERAL

Markings must be uniform in design, position, and application. As with all other traffic control devices, it is imperative that markings be uniform so that they may be recognized and understood instantly. The proper use of pavement markings will reduce accidents on most facilities. New and improved markings have been demonstrated to significantly reduce nighttime and wet-pavement accidents.

This Chapter provides the Department's criteria for the application of permanent pavement markings. Chapter Eighty-three provides criteria for the use of temporary pavement markings through a construction zone.

76-1.01 MUTCD Context

Throughout the *Manual on Uniform Traffic Control Devices (MUTCD)*, the words *shall*, *should*, and *may* are used to indicate the appropriate application of traffic control devices. Section 75-1.0 defines the Department's application for these qualifying words, which also apply to pavement markings.

76-1.02 Line Types

Figure 76-1A, Types of Pavement Lines, identifies typical pavement stripes and their application. Section 76-2.0 provides additional information on the applications of these pavement markings.

76-1.03 References

For additional information on pavement markings, the designer is referred to the publications as follows:

1. *Manual on Uniform Traffic Control Devices*, FHWA;

2. *Traffic Control Devices Handbook*, FHWA;

3. *Traffic Engineering Handbook*, ITE; or

4. NCHRP Synthesis 138, *Pavement Markings: Materials and Application for Extended Service Life.*

76-1.04 Official Action

Where a new or revised pavement marking alters the regulation of an existing condition, an Official Action is required. For a State-maintained highway, the designer must coordinate and obtain an approval for the proposed change from the appropriate district traffic engineer before implementation of the proposed change. For a locally-maintained facility, approval must be obtained from the appropriate jurisdiction before implementation. Adding a new no-passing zone or revising the length of an existing no-passing zone will require an Official Action. Because pavement markings generally supplement signs, an Official Action will only be required to change the sign and will not be required to change pavement markings.

76-2.0 APPLICATIONS

The following provides guidelines for the application of pavement markings. The MUTCD provides additional guidance and illustrations for the placement of pavement markings.

76-2.01 Travelway Markings

76-2.01(01) Center Line

Each INDOT-maintained highway requires a center line. Based on the highway type, the following will apply.

1. On an undivided rural highway or city street of 4 or more lanes where there are a minimum of two lanes of moving traffic in each direction at all times, the center line consists of two 100-mm wide solid-yellow lines, separated by a space of approximately 200 mm.

2. On a 2-way, 2-lane highway or street, the center line should be a yellow broken line; a double line consisting of a yellow broken line and a solid yellow line; or double solid yellow line. The line type depends upon the allowable passing condition at each specific site.

3. The center line is not continued through intersections with public roads but is continued across driveways.

4. At a signalized intersection, a 15-m long center line should be provided on the minor facility if it has no markings.

The center line marking is placed 100 mm on either side of the longitudinal joint of the roadway. This will minimize the need for repainting after a joint-sealing operation.

For a non-INDOT highway, a center line is recommended at each of the following locations.

1. Roadway Width. In a rural area, a center line should be provided on a 2-lane roadway which has a surface width of 4.8 m or more with the prevailing speed higher than 50 km/h.

2. Divided Highway. A center line should be provided if the highway has four or more lanes.

3. Urban Area. In a residential or business district, a center line should be provided on each through highway or on other highways where there is significant traffic volume.

4. Low-Volume Road. On a paved low-volume road, a center line should be provided where the AADT is at least 300.

5. Horizontal Curve. If not provided elsewhere, a center line marking should be provided on a horizontal curve with radius of 700 m or less. The marking should begin about 300 m in advance of the PC, continue through the curve, and end about 300 m beyond the PT.

7. Bridge. If not provided elsewhere, a center line marking should be provided at a narrow bridge where the approaching roadway's width is 5.5 m or greater, including paved shoulders, or where the bridge width is less than the approaching roadway's width. The marking should begin about 300 m in advance of the restricted bridge, continue across the bridge and end about 300 m beyond the bridge.

8. Field Conditions. A center line marking should be provided as necessary to meet field conditions or where engineering studies indicate a need.

76-2.01(02) Lane Lines

Lane lines are used to separate lanes of traffic traveling in the same direction. The facility may be one roadway of a divided highway, or a one-way street. For a non-freeway facility, the lane line is a 100-mm wide broken white, reflectorized line. A lane line on a freeway is a 125-mm wide broken white, reflectorized line. A solid white line may be used if lane switching is to be discouraged (e.g., approach to a signalized intersection). A lane line should be offset 100 mm

from the longitudinal construction joint to facilitate future maintenance operations. A lane line is not continued through intersections with public roads but is continued across driveways.

76-2.01(03) Edge Lines

Edge lines are to be used on each INDOT-maintained highway. For a non-INDOT paved highway, the use of edge lines should be considered as follows:

1. along each facility of 4 or more lanes;
2. along a roadway having a paved surface width of 6.0 m or greater;
3. across a bridge with a width of 5.5 m or greater;
4. where run-off the road accidents are disproportionately high; or
5. where engineering judgment indicates a need.

The left-hand edge line is a median line and is discussed in Section 76-2.01(04). The right-hand edge line is a 100-mm wide solid white, reflectorized line. The following provides guidelines for the placement of edge lines on an INDOT or a non-INDOT facility.

1. Intersection or Driveway. Gaps must be provided at each public-road intersection, but are not provided at driveways.

2. Interchange. For edge lines at an interchange, see Section 76-2.04.

3. Paved Shoulder or Curb Offset. Edge lines should be placed approximately 100 mm from the longitudinal construction joint to eliminate the need for repainting after joint-sealing operations. For a roadway with curbs and no curb offsets, the curb itself may be painted with reflectorized solid white paint, or a 100-mm wide solid white line may be applied to the pavement adjacent to the curb.

4. Unpaved Shoulders. For a roadway with unpaved shoulders, the edge line should be placed approximately 100 mm from the pavement edge. See Figure 76-2A, Location of Edge Lines with Unpaved Shoulders. However, the edge line should be placed 0.3 m from the edge of pavement if one of the conditions exists as follows:

    a. if placing the edge line approximately 100 mm from the pavement edge would result in a lane width greater than 3.6 m; or

    b. the width from the center line to the pavement edge is a minimum of 3.3 m and the road section is without at least a 0.6-m stabilized (compacted aggregate or asphalt) shoulder, or a minimum 1.2-m usable earth shoulder.

If the above criteria results in lane widths greater than 3.9 m, consideration should be given to revising the placement of the center line and edge line so that only a 3.6-m lane is provided.

5. Uniformity. An edge line should be located to provide a constant lane width, as practical, throughout the roadway section. The widest lane practical, up to 3.6 m, should be provided.

6. Bridge. Edge lines should be continued straight across a structure if the lane widths across the bridge are as wide as or wider than the lane widths approaching the bridge. Where the lane width on the structure is less than the approaching lane width, the edge line alignment should to be tapered to meet the narrower roadway width across the bridge. Section 76-2.01(06) provides the taper lengths. The INDOT *Standard Drawings* provide additional information on the placement of traffic-control devices, including edge lines across a bridge structure.

76-2.01(04) Median Lines

Median lines are required on each divided highway of 4 lanes or more. Gaps are to be provided at each at-grade intersection or median crossover. The following provides the median line applications based on the median-curb type.

1. No Curbs. Provide a100-mm-wide solid yellow, reflectorized median line at the left edge of the travelway.

2. Curb Offsets. For a facility with curbs and curb offsets, provide a 100-mm-wide, solid yellow, reflectorized median line at the left edge of the travel lane. The median marking should be placed a minimum of 100 mm on either side of the longitudinal joint between the roadway and the curb and gutter.

3. No Curb Offsets. For a facility with curbs but no curb offsets, the curb itself may be painted with solid yellow, reflectorized paint, or a 100-mm-wide, solid yellow line may be applied to the pavement adjacent to the curb.

76-2.01(05) Channelizing Line

A channelizing line may be a solid white or solid yellow reflectorized line. It may vary in width from 100 mm to 600 mm depending on field conditions and the emphasis required. Yellow channelizing markings are used between opposing traffic. White channelizing markings are used for separating traffic traveling in the same direction. Section 76-2.03 provides information on

channelizing lines at an intersection. Section 76-2.04 provides information on channelizing lines at an interchange.

Channelizing lines may also be used to indicate a flush median or to emphasize a continuous mounded corrugated median. Channelizing lines are not used unless the median is at least 1.2 m or wider.

76-2.01(06) Lane Transition

Where a lane reduction is required, pavement markings are used to guide the motorist through the transition area. Figure 76-2B provides the minimum taper rates and lengths that should be used for a lane reduction. Figure 76-2C, Taper Length Criteria (Application), illustrates the application of the various taper types. These transition lengths are also appropriate for the pavement markings.

For a downstream taper (e.g., the beginning taper for a left- or right-turn lane, freeway exit), as defined in the *MUTCD*, the minimum taper should be 15 m.

Figure 76-2D, Transition Markings (4-Lane Undivided to 2-Lane Undivided), Figure 76-2E, Transition Markings (4-Lane Divided to 2-Lane Undivided - Right), and Figure 76-2F, Transition Markings (4-Lane Divided to 2-Lane Undivided - Left), illustrate the typical pavement marking patterns used for transitioning from 4 to 2 lanes.

76-2.01(07) Truck-Climbing Lane

Section 44-2.0 provides the Department's criteria for truck-climbing lane warrants and design. Figure 76-2G illustrates the pavement markings that should be used with a truck-climbing lane.

76-2.02 No-Passing Zone

76-2.02(01) Warrants

The following are the Department's warrants for a no-passing zone.

1. Horizontal or Vertical Curve. Where center lines are installed, no-passing zones will be established at each vertical or horizontal curve or elsewhere on a 2- or 3-lane highway where an engineering study indicates passing must be prohibited due to inadequate sight distance or other special conditions. Figure 76-2H provides the minimum distances that should be used for determining no-passing-zone markings placement. These values

provide sufficient distance for the passing vehicle to abort the passing maneuver. These values should not be confused with the minimum passing sight distances provided in Section 42-3.0, which are used for geometric design purposes and are based on the assumption that the passing vehicle will be able to complete the passing maneuver.

2. Roadway Obstacle. Passing should not be allowed prior to or around an obstacle which is located next to or within the roadway (e.g., bridge pier). The pattern of the no-passing zone in the immediate vicinity of such an obstruction will be reviewed and determined by the district traffic engineer for an INDOT highway or the local authority for a non-INDOT facility.

3. Transitions from 4 to 2 Lanes. Figure 76-2D, Transition Markings (4-Lane Undivided to 2-Lane Undivided), Figure 76-2E, Transition Markings (4-Lane Divided to 2-Lane Undivided - Right), and Figure 76-2F, Transition Markings (4-Lane Divided to 2-Lane Undivided - Left), illustrate the typical placement of no-passing zone markings in the transition area.

4. Bridge. The following no-passing zone determinations will apply at a bridge.

   a. For a bridge width that is narrower than the full approach-roadway width or for a 1-lane bridge, passing will not be allowed on the bridge. Figure 76-2 I provides minimum length for implementing the no-passing criteria in advance of the structure.

   b. For a bridge width which matches the full approach-roadway width or for narrow bridges where the full approach-lane widths are carried across the bridge, the need for no-passing markings will be determined based on the criteria in Item 1.

5. Intersection or Railroad Crossing. Passing is not allowed prior to or through a major intersection or railroad crossing. Figure 76-2 I provides the minimum lengths for implementing the no-passing criteria in advance of a major intersection or railroad crossing.

6. Gap. Figure 76-2J provides the minimum distances for passing between successive no-passing zones. If these distances cannot be attained, the no-passing zones should be connected. If the distance from the end of a preceding zone and the no-passing zone for the intersection is less than the minimum allowable gap shown in Figure 76-2J, Minimum Passing Zone Gaps, the no-passing line should be continued to the intersection.

7. Traffic Volume. A no-passing zone may be established where opposing traffic volumes are such that it would be impractical or unsafe to allow passing maneuvers (e.g., urban area). This determination will be determined for each project.

8. Boundaries. A review of the no-passing zones should be conducted for a sufficient distance prior to and beyond the marking area to ensure that the area will be properly marked (e.g., eliminating less-than-minimum gaps).

76-2.02(02) Design Criteria

The following are the Department's design criteria for determining the location of a no-passing zone.

1. Design Speed. If known, the highest of the posted speed, the 85th percentile speed, or the design speed should be used to establish the no-passing zone. If the posted speed limit is used, the speed used in determining the distances in Figures 76-2H and 76-2 I should be approximately 10 km/h higher than the posted speed. For example, if the posted speed limit is 90 km/h, use the appropriate sight distance for 100 km/h.

2. Passing Distance. Figures 76-2H and 76-2 I provide the various distances used to mark no-passing zones. The beginning of a no-passing zone is that point at which the distance first becomes less than that specified in Figures 76-2H and 76-2 I. The end of the zone is that point at which the distance again becomes greater than the minimum specified in Figures 76-2H and 76-2 I.

3. Minimum Length. The minimum length for a no-passing zone is 150 m. If the no-passing zone length, as determined above, is less than 150 m, additional no-passing markings must be added to the beginning of the no-passing zone until the 150-m minimum criteria is attained.

4. Eye and Object Height. For determining no-passing zone location, the distance is measured from a 1070-mm height of eye to a 1070-mm height of object.

76-2.02(03) Pavement Markings

A no-passing zone line is a 100 mm-width, solid yellow, reflectorized line. It is separated from a broken yellow center line with an 200-mm gap.

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The no-passing pavement markings should be extended to the end of the no-passing zone, regardless if the zone extends beyond the project limits.

Section 75-3.07 provides Department practices for supplementing no-passing lines with "No Passing Zone" signs and delineators.

76-2.02(04) No-Passing-Zone Record

A no-passing-zone record is required for Official Action purposes on an INDOT roadway and is recommended for a non-INDOT roadway. This also assists in the remarking of each no-passing zone due to worn out markings or after resurfacing. Developing the record involves taking field measurements and recording the location of the beginning and ending points of each no-passing line. In developing the written no-passing-zone record, the following should be noted for INDOT highways.

1. Beginning and Ending Points. The record should begin and end at each county line or at the extreme points of the road within the county. For an even-numbered route, the record should begin at the west county line or at the westerly beginning point of the route within the county. The record should proceed easterly and terminate at the east county line or at the easterly termination point of the route within the county. For an odd-numbered route, the record should begin at the south county line or at the southerly beginning point of the route within the county. The record should proceed northerly and terminate at the north county line or at the northerly termination point of the route within the county.

2. Measurements. The beginning reading is at zero and measurements will be made in meters. The measuring device should be calibrated to measure within 2 m per km. For a survey route of longer than 1.5 km, the record should be stopped at an intersection and reset to zero to eliminate any accumulated errors resulting from distance measuring. All of the elements noted in Item 3 below should be referenced in meters from the beginning of the record.

3. Elements to be Recorded. The recorder should note the following elements in the no-passing-zone record.

    a. The center line of each intersecting city street, county road, or State highway should be measured and recorded. The name or number of the street or road should also be recorded. The name or number of each facility which is not signed in the field should be obtained from local official agency maps or records. Federal-aid route numbers should not be recorded.

b. The recorder should locate and identify each permanent-type landmark, including railroad crossing, narrow or 1-lane bridge, obstruction, or city or town limits (as identified by a sign designating such limits).

c. Each major bridge not included above should be noted in the record under the Special Reference notation. This will allow the name of a stream or river to be identified in the record.

d. All reference markers from the roadway reference system should be noted.

A record for a non-INDOT facility may be prepared similarly to that for an INDOT highway.

76-2.03 Intersection Markings

Figure 76-2K provides an example of the markings used at intersections. The following provides additional information on intersection pavement markings.

76-2.03(01) Stop Line

For a State facility, the stop line is a 600-mm-wide, a solid white, reflectorized line. The stop line should extend across each approach lane, usually to the center line. It should be placed 1.2 m in advance of the nearest crosswalk line and should be perpendicular to the center line. The stop line will be parallel with the crosswalk lines. In the absence of a marked crosswalk, the stop line should be placed at the desired stopping point and perpendicular to the line of travel. The stop line should not be placed more than 9 m or less than 1.2 m from the nearest edge of the crossing travel lane or point of potential conflict (e.g., crosswalk, turn lane, turning vehicle path).

The location of the stop line may 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 beyond the point of potential conflict. On a facility of 4 or more lanes that intersects the cross road at an angle, it may be appropriate to stagger the stop line for each lane. This may be especially important at a signalized intersection where clearance times may be substantial.

76-2.03(02) Crosswalk Line

Crosswalk lines are solid white, reflectorized lines of not less than 150-mm width. They are used to mark both edges of the crosswalk. The distance between lines is determined by the width of the sidewalks to be connected. However, they should not be spaced less than 1.8-m apart. The crosswalk must encompass all curb ramps. For information on curb ramps and the crosswalk

width, see Section 51-1.08. The *MUTCD* provides additional information on other crosswalk types.

76-2.03(03) Channelized Island

Figure 76-2L illustrates the typical pavement markings used to delineate a raised, corrugated, triangular island. Figure 76-2M illustrates the typical pavement markings used to delineate a raised corrugated and a painted, flush elongated island.

76-2.03(04) Multiple Turn Lanes

For 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 considering the turning path of the design vehicle. These lines are the extension of the lane lines and, therefore, are the same color as the lane line.

76-2.03(05) Word or Symbol Marking

A word or symbol marking on the pavement may be used to guide, warn, or regulate traffic. It should be limited to not more than a total of three lines of information. It must be white in color. For additional information on the design and layout of word or symbol markings, see the INDOT *Standard Drawings* or the FHWA *Standard Alphabets for Highway Signs and Pavement Markings*, which are used in conjunction with the *MUTCD*.

An arrow symbol may be used to convey either guidance or a mandatory message. However, where a movement that would otherwise be legal is prohibited, the arrow marking must be accompanied by the pavement-marking word “Only.” Signs should be considered in addition to the markings where determined necessary by a field investigation. Signs or markings may be repeated in advance of mandatory turn lanes when necessary to prevent entrapment and to help the motorist select the appropriate lane before reaching the end of the line of waiting vehicles.

Pavement-marking words are 2.4-m height, except where the traffic speed is 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). At an intersection, the marking is placed approximately 6 m from the point where traffic stops. The space between words of a single message should be approximately four times the height of the characters for a low-speed road, and up to ten times the height of the characters for a high-speed road. Typical layouts are shown in Figure 76-2N, Traffic-Control Word or Symbol Markings.

76-2.04 Interchange Markings

The following provides the Department's practice for installing pavement markings at an interchange.

1. Exit Ramp. Figures 76-2 O and 76-2P provide the typical pavement markings used for a parallel or tapered exit ramp, respectively.

2. Entrance Ramp. Figures 76-2Q and 76-2R provide the typical pavement markings used for a parallel or tapered entrance ramp, respectively.

3. Gore Markings. Figure 76-2S illustrates the supplemental gore markings. For an Interstate route or other facility with a design speed of 70 km/h or higher, the gore markings should consist of 600-mm-width stripes at 12-m spacing. For a facility with a design speed of 70 km/h or lower, the gore markings should consist of 300-mm-wide stripes at 6-m spacing.

4. Ramp or Cross Road Junction. Figure 76-2T illustrates the placement of supplemental exit-ramp markings that may be used where wrong-way movements may occur. The design of these markings should be as shown on the INDOT *Standard Drawings* or the FHWA *Standard Alphabets for Highway Signs and Pavement Markings*.

76-2.05 Miscellaneous Markings

76-2.05(01) Railroad Crossing

In a rural area, the minimum distance from the railroad-crossing marking to the stop line should be the stopping sight distance. In an urban area, this distance will vary depending on the signal location and city-blocks spacing. The minimum distance should be the same as for a rural area. However, this distance is often not practical due to the need to maintain the markings within the same city block or between the nearest track and the adjacent traffic signal. This spacing should not be less than 15 m. The INDOT *Standard Drawings* provide additional details for the location of railroad-crossing markings.

On a highway of 4 lanes or more, the transverse lines should be extended across all approach lanes. The individual railroad-crossing symbols should be provided in each lane.

For a 2-way left-turn lane, the center lane should be discontinued across the railroad crossing and marked as a flush median or as a 1-way left-turn lane.

76-2.05(02) Two-Way Left-Turn Lane (TWLTL)

A TWLTL is a center lane reserved for the exclusive use of left-turning vehicles in either direction. The center lane is marked to delineate the bi-directional, left-turn movement. Section 46-5.0 provides the design requirements for a TWLTL. Figure 76-2U illustrates the typical marking pattern for a TWLTL. The pavement word and symbol marking groups should, at a minimum, be at least 120 m apart. In a rural area, the marking groups should not exceed 400 m. At a signalized or other major intersection, the TWLTL should be transitioned to an exclusive left-turn lane. Figure 76-2V illustrates the pavement markings used for this transition. See Section 75-3.05 for information on the appropriate signing for use in conjunction with a TWLTL.

76-2.05(03) School Crossing

Pavement markings for a school crossing should only be used with the appropriate signing, so therefore should not be used without the signing. The need for school-crossing signing and markings will be determined as required in conjunction with the local school officials. INDOT's practice is to replace the school-crossing markings if they are removed or covered during a project. The INDOT *Standard Dr*awings and the *MUTCD* provide additional guidance for the placement of school-crossing markings.

76-2.05(04) Bicycle Facility

The color and type of lines used for a bicycle facility will be the same color and type as determined for automobiles (e.g., yellow broken line for a 2-way bicycle facility). Broken lines for a bicycle facility should have a 1 to 3 ratio (e.g., 1-m line with a 3-m gap). A solid white line should be used to separate pedestrians and bicycles if they share a common facility. The preferential 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 76-2W, Bicycle Markings (Intersection), illustrates the AASHTO *Guide for the Development of Bicycle Facilities* recommendations on how to mark an intersection with vehicles turning right across a bike lane. The *MUTCD* and the AASHTO *Guide* provide additional guidance for marking bicycle facilities.

76-2.05(05) Parking Markings

On-street parking markings placement will be determined based on local requirements. If local requirements are unavailable, the designer should reference the *MUTCD* for details. Section 51-4.0 provides information on the design and layout of parking stalls for off-street parking. Solid white lines, of 100 mm to 150 mm wide, are used for marking parking stalls. Section 51-1.0

provides the criteria for laying out a handicapped-parking stall. The pavement markings will be white or blue.

76-3.0 PAVEMENT-MARKING MATERIALS

76-3.01 Material Types

The pavement marking materials used by INDOT are described below.

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

2. Thermoplastic. Thermoplastic markings are made from hydrocarbon or alkyd resins, pigment, and filler. The materials are heated to a high temperature and are applied in thicknesses of 2.4 mm to 4.8 mm. The material is applied to the surface and, while it is still hot, glass beads are dropped onto the mixture. Once the material cools, the glass beads are then bonded to the surface. Thermoplastic markings must be applied to a clean, dry asphalt pavement. A primer may be required to ensure satisfactory performance. Thermoplastic markings are significantly more expensive than paint, but often can last 5 or more years if applied properly. Thermoplastic is the preferred marking for a high-traffic-volume roadway due to its long life.

3. Epoxy Paint. Epoxy markings are made from a two-component epoxy resin, pigment, extenders, and fillers. The two epoxy resin components are mixed together just prior to being applied to the roadway surface. The two epoxy components produce a chemical reaction which binds them together. Materials using this type of chemical reaction are called thermoset materials. Epoxy markings are applied in thicknesses of 0.3 mm to 0.5 mm and can also be applied to a wet pavement. Glass beads are dropped onto the mixture. However, they may be applied by several different means depending on the epoxy material types used.

4. Preformed Plastic. Preformed plastic markings are premade in a factory from vinyl, pigment, and fillers, and can come in strips, words, or symbols. Glass beads are embedded into the surface of the markings at the factory. Application of the marking involves removing a protective strip, laying the marking in place, and applying pressure with a roller. Temporary tape is commonly used in a construction zone because the tape can be

easily removed. However, a common problem with some temporary preformed plastics is that they tend to break up easily and must be routinely checked for adequacy.

5. Raised Pavement Marker. A raised pavement marker (RPM) is a cube-cornered acrylic lens, tempered-glass lens, or glass-bead lens, mounted in either a plastic or iron base. It is placed with an adhesive to either the pavement surface or into a precut groove. For a temporary application, it may be placed in a plastic base and applied directly to the pavement with an adhesive. RPMs are designed to reflect the appropriate striping color (e.g., white, yellow, red) and are used as a supplement to other markings and as position guidance devices. To enhance the service life, the marker is recessed to allow a snow plow to pass over it without damage.

6. Experimental Markings. With the continued advancement of technology in pavement markings, there will always be new materials or methods available in the placement of pavement markings. The designer is encouraged to pursue the use of these new materials or procedures. However, the use of an experimental pavement marking material on a State-maintained facility must be first approved by the Highway Operations Division.

76-3.02 Applications

Figure 76-3A provides the recommended applications for the pavement-marking materials used by the Department. The following provides additional guidance on the application of the materials. For the purpose of the following discussion, transverse markings include, but are not limited to those for a crosswalk, railroad crossing, stop line, or pavement words or symbols.

76-3.02(01) Paint

Paint should be used where it can provide satisfactory, year-round visibility and where the additional cost of durable pavement markings cannot be justified. Paint should be used as follows:

1. where the average daily traffic is less than 1000 vehicles per lane;

2. where the remaining surface life of the pavement is less than three years, or where the pavement is scheduled for resurfacing within three years; or

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

76-3.02(02) Thermoplastic

Hydrocarbon and alkyd thermoplastic markings may be used on asphalt pavement under the following conditions.

1. Travelway Lines. Thermoplastic markings may be used for the center line or lane lines at a location that is not proposed or scheduled for resurfacing within the next four years. Where used for edge lines, the standard pattern is 7.4 m of line with a 0.3-m break for drainage.

2. Transverse Markings. Thermoplastic markings may be used for a location that is not proposed or scheduled for resurfacing within the next three years and where the average daily traffic is in excess of 1000 vehicles per lane.

3. Painting Cycles. Thermoplastic markings may be used on a road that requires two or more applications of paint lines per year, or on a road which requires one application of paint lines per year and the average daily traffic exceeds 3500 vehicles per lane.

4. Decision Point. Thermoplastic markings may be used where there is a need for more positive lane identification because of alignment, transitions, or channelization.

76-3.02(03) Epoxy Paint

Epoxy markings may be used for the center line, lane lines, or edge lines. They are not used for transverse markings or for marking a non-mountable island or raised curb because of problems that can develop with the intermittent application. Epoxy markings may be used as follows:

1. at a location where the average daily traffic is in excess of 1000 vehicles per lane, and the location is not proposed or scheduled for resurfacing within the next three years; or

2. at a location that is not proposed or scheduled for resurfacing within the next two years, and requires two or more applications of paint lines per year, or requires one application of paint lines per year and the average daily traffic exceeds 3500 vehicles per lane.

76-3.02(04) Preformed Plastic

The criteria for epoxy markings provided in Section 76-3.02(03) is also applicable for a permanent application of preformed plastic markings. However, they should only be used as follows:

1. there is highway illumination;
2. they can be supplemented by RPMs; or
3. they are permitted, by special provisions, on a bridge-deck overlay project.

Temporary preformed plastic markings are commonly used in a construction zone. Temporary preformed plastic markings should not be used for a permanent application.

76-3.02(05) Raised Pavement Markers (RPMs)

Snowplowable RPMs provide a supplemental method of delineation and are a positive position guidance device. They should not be used as a replacement for standard pavement markings or conventional roadside delineation. The INDOT *Standard Drawings* provide details on the placement and color locations for RPMs. In addition, the following placement considerations should be reviewed.

1. Location. Site selection should be based primarily on the need for additional alignment delineation, specifically in an area of frequently inclement weather (e.g., fog, smoke, rain) and in an area of low roadway illumination. RPMs placement should be considered where vehicles are leaving the roadway, an area showing excessive wear of existing pavement markings, an area with excessive skid marks, interchange ramp, etc.

2. Pavement Life. RPMs should not be placed at a location that is scheduled for resurfacing or reconstruction within the next four years.

3. Illumination. RPMs may not be required at a location that is illuminated.

4. Traffic Volume. RPMs should be considered where ADT exceeds 2500 for a 2-lane roadway, or 6000 for a 4-lane roadway. On a lower-volume road, an engineering investigation should be conducted to determine whether RPMs are appropriate to supplement the standard traffic-control devices.

5. Spacing. The spacing for RPMs on a tangent section is 24 m. Spacing for center line RPMs used in conjunction with a no-passing zone may be reduced to 12 m. Six RPMs at 12-m spacing (72 m) may be used in advance of and following a delineated no-passing zone. Consideration should be given to connecting two locations or zones of RPMs where the distance between them is less than 900 m. See the INDOT *Standard Drawings* for additional details for spacing at other locations.

6. Special Locations. RPMs should not be used exclusively with edge lines or gore markings. RPMs may be used at a pavement transition, 1-way or narrow bridge, special channelization area, or where there is strong justification for installation of the devices.

7. Blue Retroreflectors. An RPM with blue retroreflectors should be specified where a fire hydrant is located within the roadway's right of way. Such an RPM should be specified only for a roadway where RPMs with yellow or white retroreflectors are to be installed.

The RPM should be placed at an approximately right angle to the fire-hydrant location. It should be a two-way marker visible in both directions of travel. It should be placed in addition to RPMs with yellow or white retroreflectors.

For a two-lane, two-way roadway, the RPM should be placed within the transverse limits of the center-line marking.

For a 3-lane roadway with a bidirectional left-turn lane, the RPM should be placed within the transverse limits of the yellow markings on the hydrant side of the bidirectional left-turn lane.

For a roadway of 4 lanes or more, the RPM should be placed within the transverse limits of the lane-line marking nearest the fire hydrant, but should not be placed within the transverse limits of the pavement-edge line.

Local-public-agency (LPA) standards, if such exist, should be applied to a road under LPA jurisdiction. The district traffic engineer should be contacted to determine if an LPA's standards, if such exist, should apply on a Department-maintained route within the LPA's jurisdiction.

The locations of RPMs with blue retroreflectors should be shown on the plans. Quantities for such RPMs should therefore be incorporated into the quantities for other RPMs.

76-3.02(06) Surface Conditions

Most pavement markings can be placed on either an asphalt or concrete pavement. Pavement markings on an asphalt surface tend to last longer than those on a concrete surface. Hot-applied thermoplastic pavement-marking materials should not be placed on a concrete surface.

76-4.0 OBJECT MARKERS AND DELINEATORS

76-4.01 Object Markers

76-4.01(01) Types

An object marker is used to mark an obstruction which is 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 450-mm or larger diamond-shaped panel with one of the arrangements as follows.

    a. Reflectors with Yellow Background. This marker consists of 9 yellow, 75-mm diameter reflectors arranged symmetrically on a yellow diamond-shaped panel.

    b. Reflectors with Black Background. This marker consists of 9 yellow, 75-mm diameter reflectors arranged symmetrically on a black diamond-shaped panel.

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

2. Type 2. A type 2 object marker can be either a 150-mm x 300-mm reflectorized yellow rectangular panel, or a 150-mm x 300-mm white rectangular panel with three, yellow 75-mm diameter reflectors. Either type can be arranged vertically or horizontally. A type 2 marker may be made larger to meet special conditions.

3. Type 3. A type 3 object marker consists of a 300-mm x 900-mm rectangular panel with alternating black and reflectorized yellow stripes sloping downward at an angle of 45 deg toward the side of the obstruction on which traffic is to pass. For an object on the right-hand side, the stripes should begin at the upper right side of the panel and slope downward to the lower left side. For an object on the left-hand side, the stripes should begin at the upper left side and slope downward to the lower right side.

4. End-of-Road Marker. An end-of-road marker is similar to a type 1 marker except that the reflectors and background colors are red instead of yellow. This marker is used at the end of a roadway where there is no alternative vehicular path.

76-4.01(02) Application

The following provides guidelines for the application of an object marker.

1. Mounting Height. For marking an object which is 2.4 m or less from the roadway, the bottom of the marker should be approximately 1.2 m above the surface of the nearest travel lane. For an object which is greater than 2.4 m from the roadway, the bottom of the marker may be 1.2 m above the ground. Adjustments may be made to the mounting height to meet field conditions.

2. Object in the Roadway. An obstruction within the roadway should be marked with either a type 1 or a type 3 object marker. An obstacle with large surfaces (e.g., bridge pier) 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. Object Adjacent to the Roadway. A type 2 or type 3 object marker may be used where an object is relatively close to the roadway (e.g., bridge pier, bridge abutment, culvert headwall, shoulder drop-off, gore, small island). The inside edge of the marker should be in line with the inner edge of the obstruction.

76-4.02 Delineators

Delineators are light retro-reflecting devices mounted along the roadside, which are used to guide the motorist, particularly where the alignment might be confusing, or at a pavement-width transition. Delineators are defined according to the number of reflecting devices on the post. For example, a type D2 delineator consists of two yellow or white delineators on a post. The delineator itself can be either a 75-mm diameter reflective element or a rectangle unit that substitutes for two circular units.

76-4.02(01) Application

The following are the guidelines for the application of delineators.

1. Color. The delineator color should match the color of the edge line. For example, if the edge line is white, the delineator will be white. For the median side of a divided highway, the delineator, if used, must be yellow. Red delineators may be used on the reverse side of a delineator post to alert a motorist who may be traveling the wrong way on a one-way roadway (e.g., ramp).

2. Freeway. Single delineators should be provided on the outside-shoulder side of a freeway or on at least one side of each interchange ramp. Yellow single delineators may also be provided on the left side of the ramp.

3. Interchange. Single delineators should be provided along the outside of each curve on an interchange ramp. Double or vertically-elongated delineators should be installed at 30-m intervals along each acceleration or deceleration lane.

4. Detour. Delineators should be provided along a temporary roadway (e.g., crossover, temporary runaround) to guide the motorist through the construction zone. See the INDOT *Standard Drawings* for additional details.

5. Median Crossover. For a median crossover, a double yellow delineator should be placed on the median side of the through roadway and on the far side of the crossover.

6. Transition. Delineators should be used to guide the motorist through a lane-narrowing transition or lane merge. Figure 76-2D, Transition Markings (4-Lane Undivided to 2-Lane Undivided), Figure 76-2F, Transition Markings (4-Lane Divided to 2-Lane Undivided - Left), Figure 76-2G, Truck-Climbing Lane Markings, and the *INDOT Standard Drawings* provide illustrations on where to place delineators within these transition areas. 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 delineators in the area will be determined as required for each project.

8. Guardrail. Barrier delineators are required on each run of median barrier, temporary concrete barrier, or concrete railing or metal beam guardrail.

9. Island. Delineators may be used to outline a raised island. A solid yellow reflectorized panel should be used where the island channelizes traffic to the right. Where traffic may pass on either side of the island, a solid white reflectorized panel should be used. A continuous median island is not delineated unless deemed necessary.

10. No-Passing Zone. The end of the no-passing zone is indicated on the right side of the roadway with three, horizontally aligned, white delineators.

11. Raised Pavement Markers. Delineators may be removed along a roadway where raised pavement markers are used for a substantial distance.

76-4.02(02) Delineator Placement and Spacing

The INDOT *Standard Drawings* provide criteria for the placement of delineators next to a roadway with curbs or a roadway with no curbs. They also illustrate the placement of delineators next to a roadway approaching a narrow bridge. In addition to the INDOT *Standard Drawings*, the designer should consider the following.

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

2. Placement. Delineators should be placed at a constant distance from the roadway edge unless guardrail or another obstruction intrudes into the space between the pavement edge and the extension of the line of delineators. Delineators should not be placed less than 0.6 m or more than 2.4 m from the outside edge of the shoulder.

3. Spacing. For a tangent section, delineators should be spaced from 60 m to 160 m apart. On a freeway or other divided facility, the delineator spacing should be 120 m. Where normal uniform spacing is interrupted by a driveway, cross road, etc., the delineator should be moved to either side provided the distance does not exceed one-quarter of the normal spacing. If this criterion is exceeded, the delineator should be deleted.

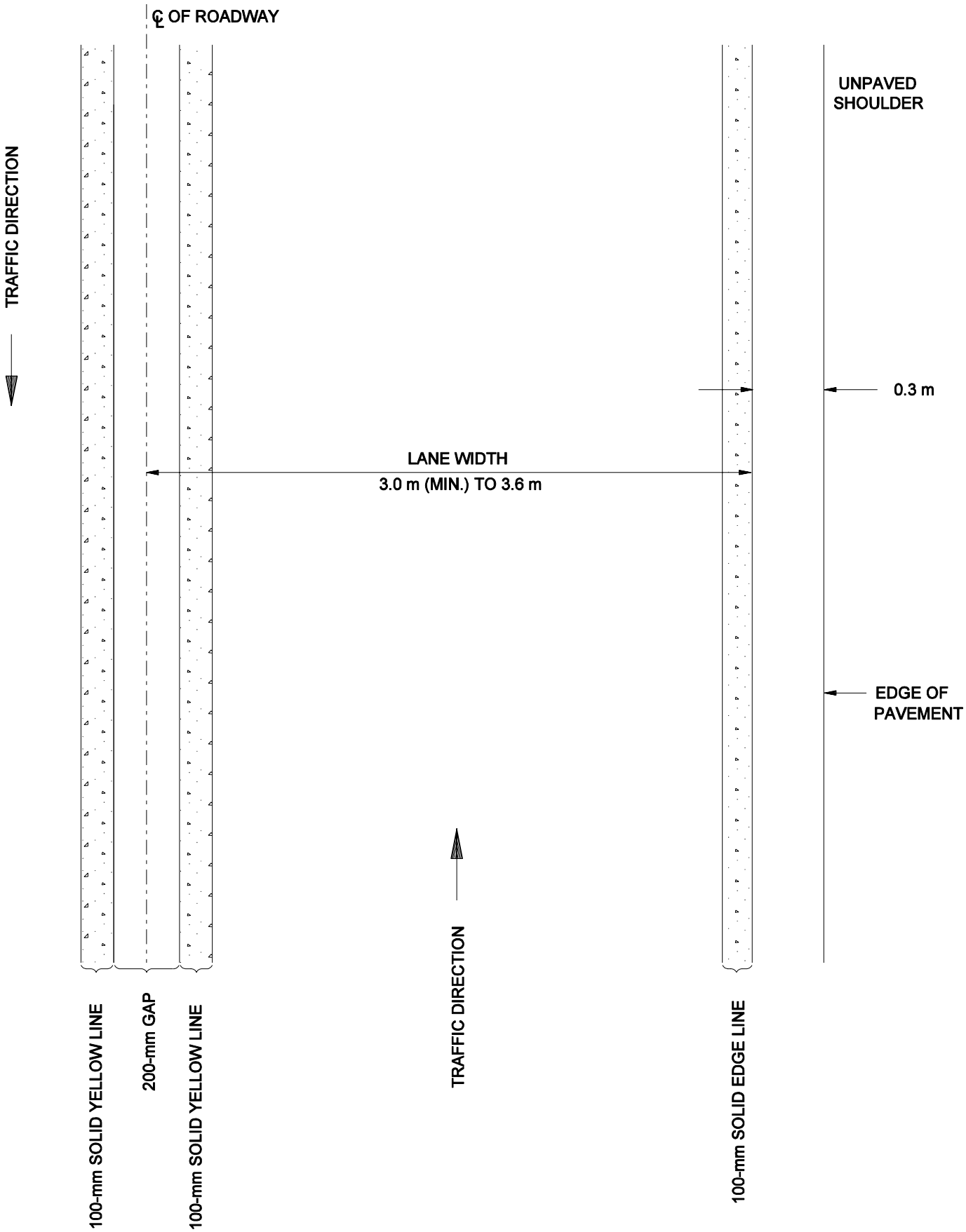
   For a horizontal curve, the delineator spacing should be adjusted so that several delineators will always be visible to the driver. Figure 76-4A provides the recommended maximum spacing for delineators around a horizontal curve.

DESCRIPTION	COLOR	WIDTH (mm)	APPLICATION
Single Broken Line	White	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 multilane roadways). The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 3-m segment followed by a 9-m gap for a total cycle length of 12 m.
		125	Separation of freeway lanes on which travel is in the same direction, with crossing from one lane to the other permitted. The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 3-m segment followed by a 9-m gap for a total cycle length of 12-m.
	Yellow	100	Separation of lanes on which travel is in opposite directions, and where overtaking with care is permitted (e.g., centerline on 2-lane, 2-way roadways). The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 3-m segment followed by a 9-m gap for a total cycle length of 12 m.
Single Solid Line	White	400	Separation of lanes, or of a lane and shoulder, where lane changing is discouraged (e.g., lane lines at intersection approaches, right-edge stripes).
		150	Lane lines separating a motor vehicle lane from a bike lane.
		200	Delineation of locations where crossing is strongly discouraged (e.g., separation of turn lanes from through lanes, gore areas at ramp terminals, paved turnouts, edge lines at lane drops, painted island edges).
	Yellow	100	Delineation of left-edge lines on divided highways, 1-way roads and ramps.
Double Solid Lines	White	100-200-100*	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	100-200-100*	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	100-200-100*	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 two-way left-turn lane — solid lines on the outside, broken lines on the inside.
Double Broken Line	Yellow	100-200-100*	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 3-m segment followed by 9-m gap for a total cycle length of 12 m.

DESCRIPTION	COLOR	WIDTH (mm)	APPLICATION
Single Dotted Line	Either	100	Extension of lane lines through intersections. Color same as that of line being extended. Also used to extend right-edge line of freeway 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 0.6-m segment followed by 2.4-m gap for a total cycle length of 3.0 m.
	White	200	Separation of through lane and auxiliary lane or dropped lane. The broken or dashed line is formed by a pattern of segments and gaps. The typical pattern is a 0.6-m segment followed by 2.4-m gap for a total cycle length of 3.0 m.
Transverse Lines	White	150 (min)	Crosswalk edge lines (minimum 1.8-m apart).
		600	Limit lines or stop lines.
Diagonal Lines	White	300	Crosshatch markings for 1-way traffic, placed at an angle of 45°, at 6-m apart, on shoulders or channelization islands to add emphasis to these roadway features for design speeds less than 70 km/h.
		600	Crosshatch markings for 1-way traffic, placed at an angle of 45°, at 12-m apart, on shoulders or channelization islands to add emphasis to these roadway features for design speeds of 70 km/h or greater.
	Yellow	300	Crosshatch markings for 2-way traffic, placed at an angle of 45°, at 6-m apart, on shoulders or channelization islands to add emphasis to these roadway features for design speeds less than 70 km/h.
		600	Crosshatch markings for 2-way traffic, placed at an angle of 45°, at 12-m apart, on shoulders or channelization islands to add emphasis to these roadway features for design speeds of 70 km/h or greater.

**100-200-100 indicates typical width in mm of the lines and the 200-mm unpainted gap between them*

Types of Pavement Lines
Figure 76-1A



LOCATION OF EDGE LINES
(Unpaved Shoulders)

Figure 76-2A

Design Speed (km/h)	Merging-Taper Rate
30	10:1
40	10:1
50	15:1
60	20:1
70	45:1
80	50:1
90	55:1
100	60:1
110	70:1

Taper Type		Minimum Taper Length
Upstream	Merging Taper (Lane Drop)	*L*
	Lane-Shift Taper	½ *L*
	Shoulder Taper	1/3 *L*
	Two-Way Traffic Taper	30 m
Downstream		15 m / lane [2]

Notes:

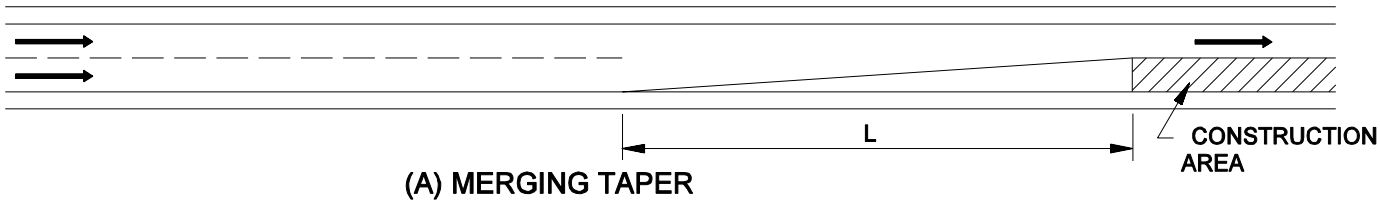
1. *Taper Length,* L = *Merging-Taper Rate x Offset Distance*

[2] *The desirable length is 30 m / lane.*

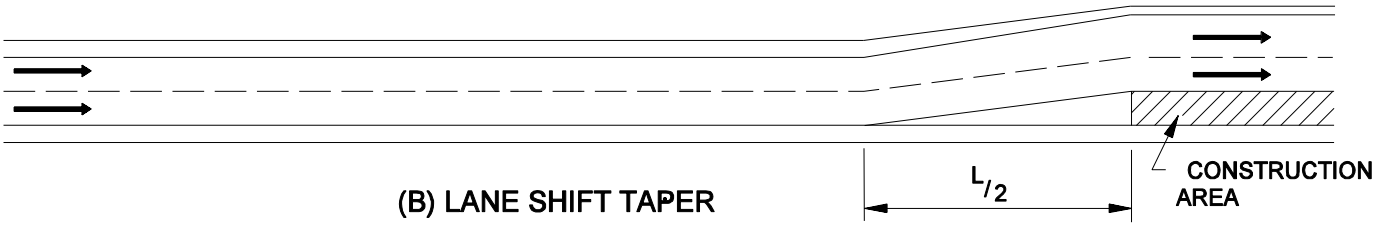
3. *Figure 76-2C illustrates the various types of tapers.*

LONGITUDINAL TAPER RATE AND LENGTH

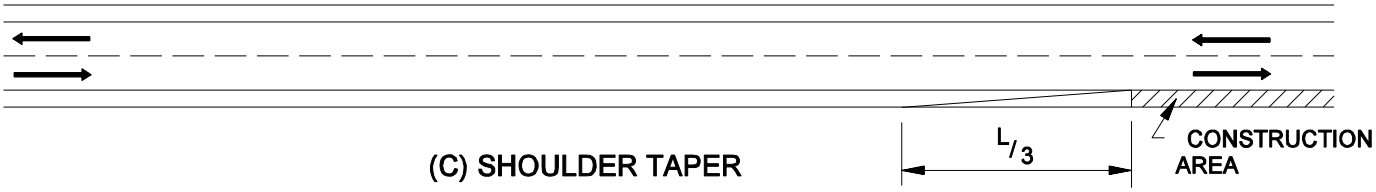
Figure 76-2B



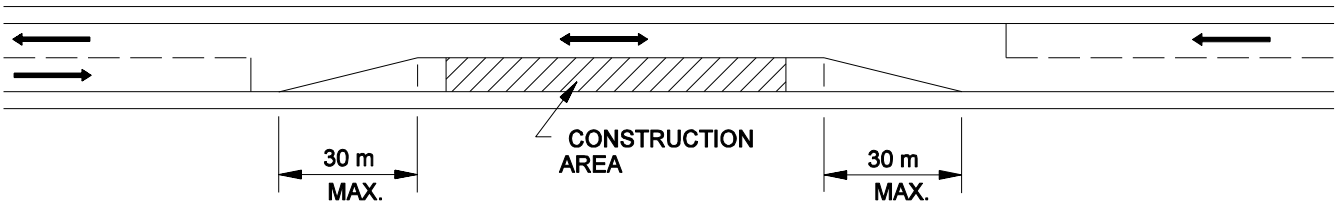
(A) MERGING TAPER



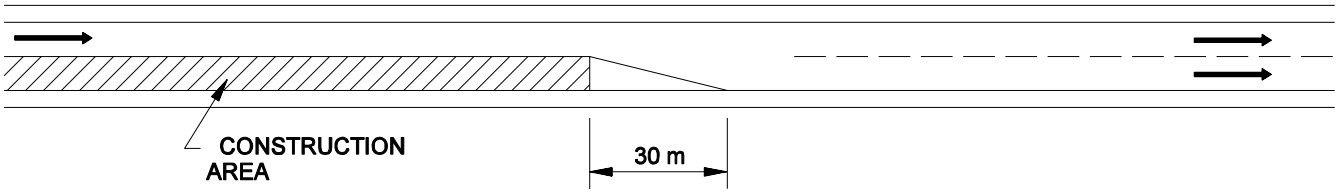
(B) LANE SHIFT TAPER



(C) SHOULDER TAPER



(D) TWO-WAY TRAFFIC TAPER



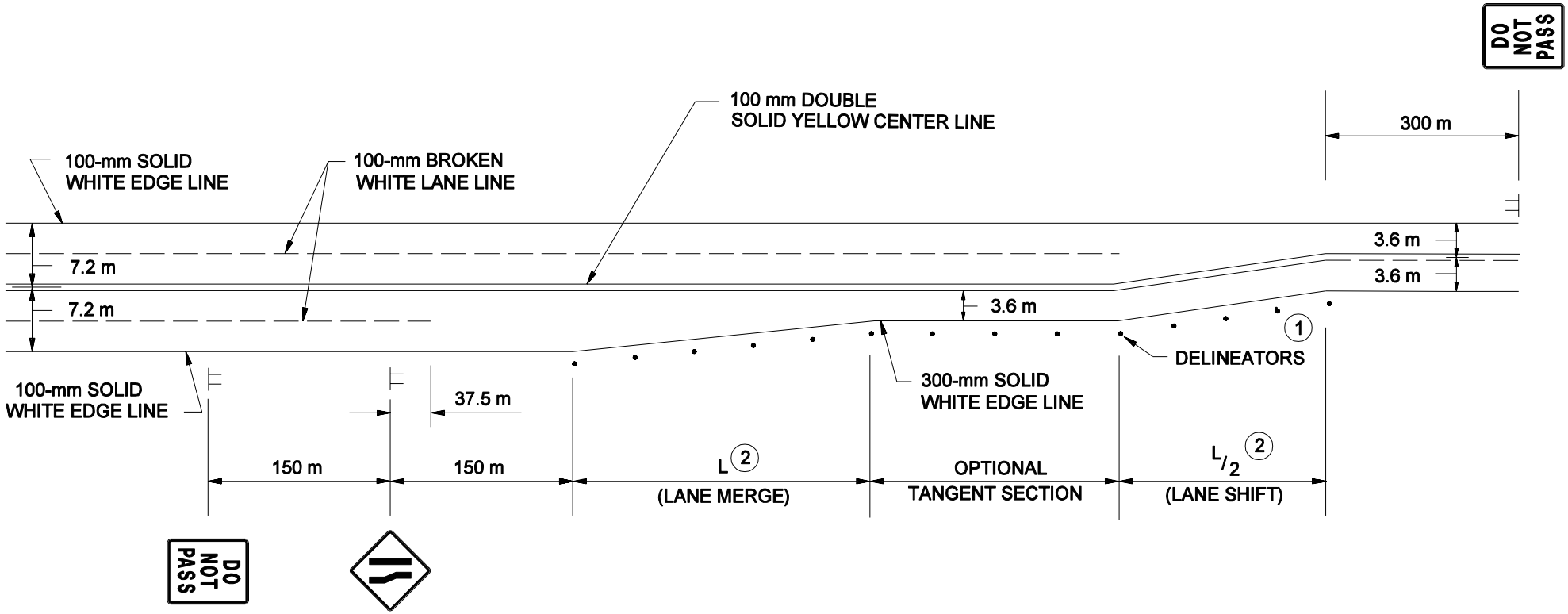
(E) DOWNSTREAM TAPER (OPTIONAL)

Notes:

1. *Length "L" determined from 76-2B.*
2. *Figures may apply to situations other than construction zones.*

TAPER LENGTH CRITERIA
(Application)

Figure 76-2C



① SEE SECTION 76-4.0 FOR DELINEATOR SPACING.

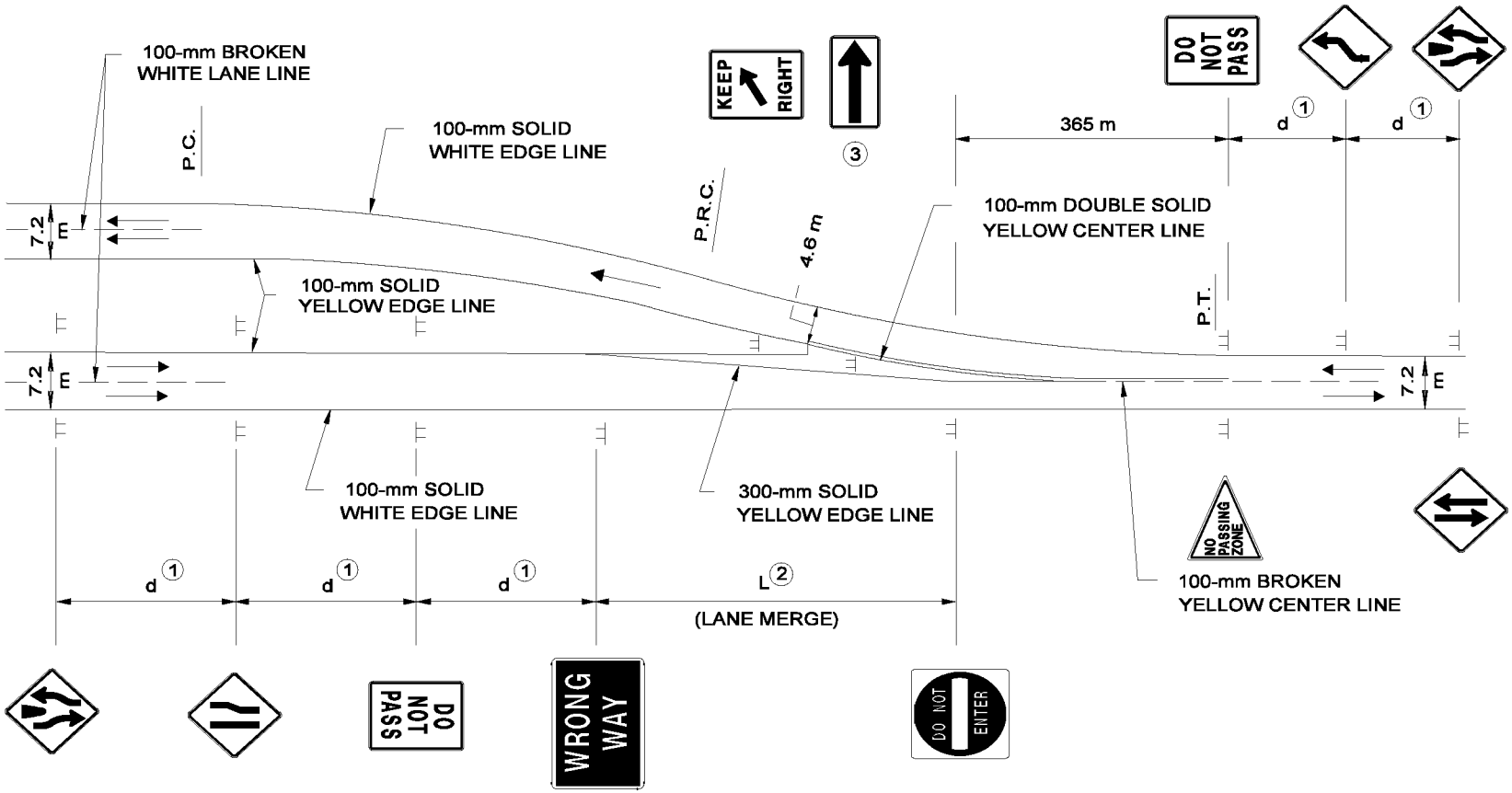
② SEE FIGURE 76-2B FOR TAPER LENGTH.

Notes:

1. *RPM's are desirable along all edge and center lines within the transition area.*
2. *Adjustments to the signing and pavement marking locations may be required to meet field conditions.*

TRANSITION MARKINGS
(4-Lane Undivided to 2-Lane Undivided)

Figure 76-2D



1 d = ADVANCE WARNING DISTANCE, SEE FIGURE 75-4A.

2 SEE FIGURE 76-2C FOR TAPER LENGTHS.

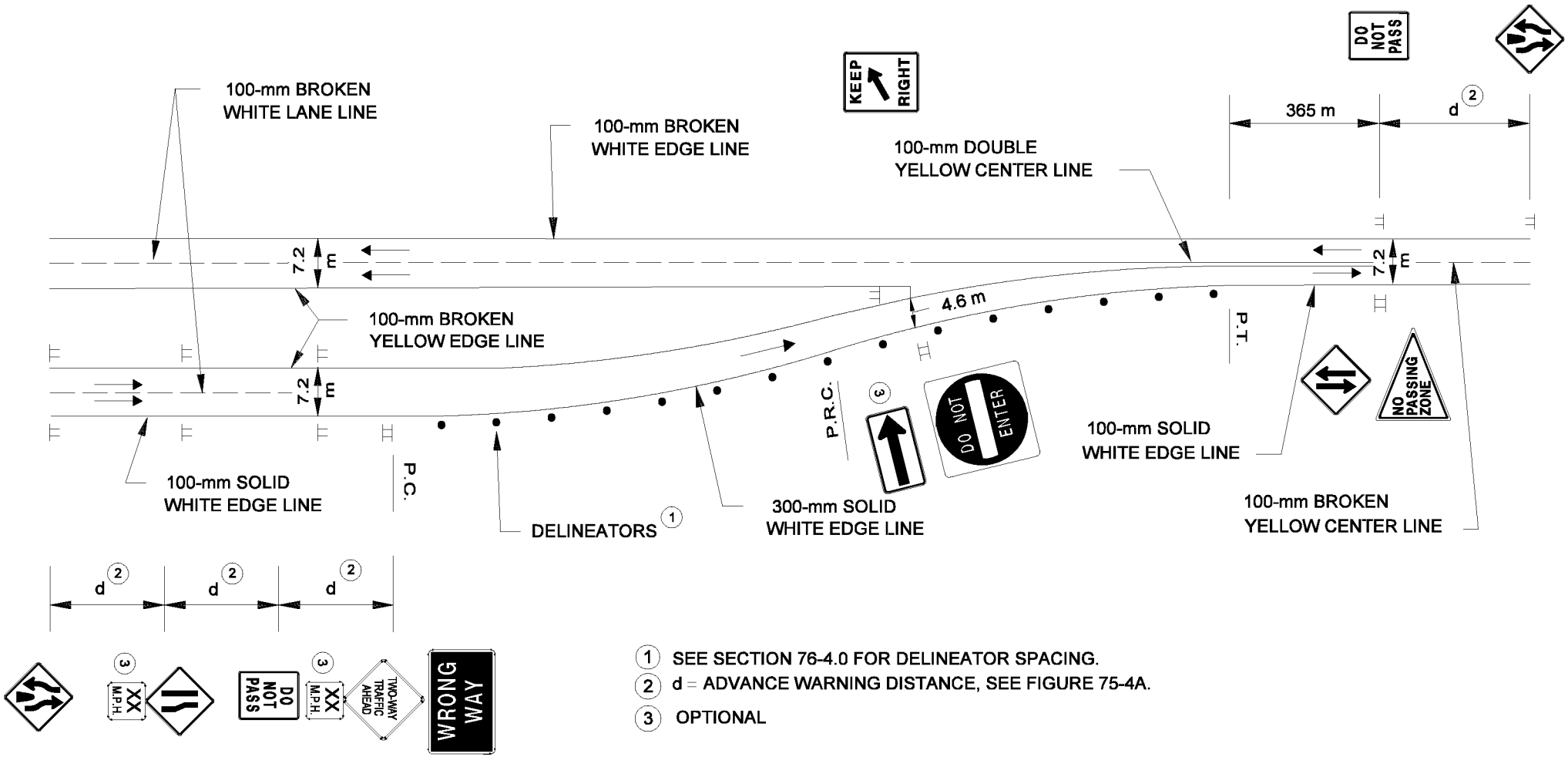
3 OPTIONAL

Notes:

1. *RPM's are desirable along all edge and center lines within the transition area.*
2. *Adjustments to the signing and pavement marking locations may be required to meet field conditions.*
3. *This transition design should only be used for existing conditions.*

TRANSITION MARKINGS
(4-Lane Undivided to 2-Lane Undivided --- Right)

Figure 76-2E



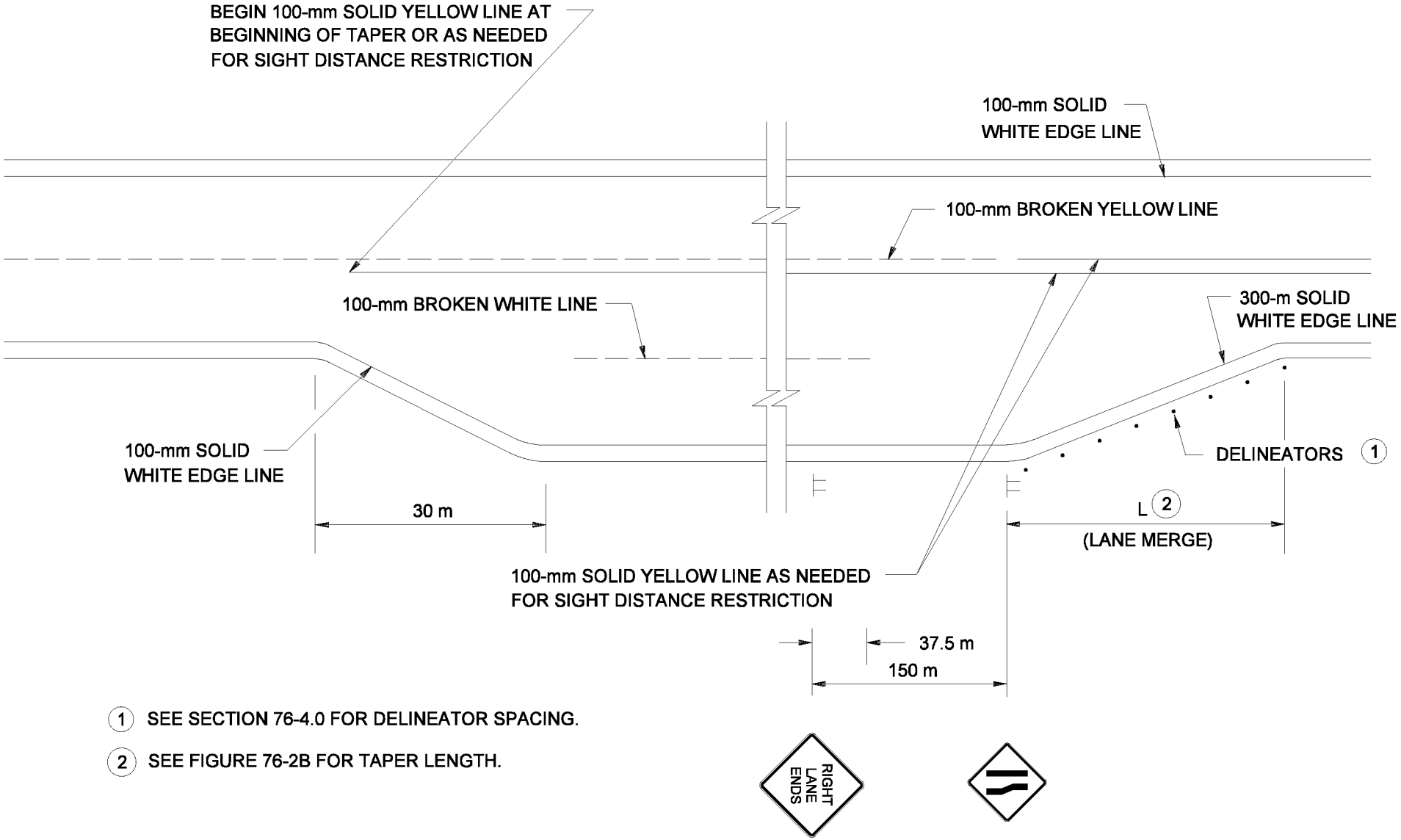
(1) SEE SECTION 76-4.0 FOR DELINEATOR SPACING.
(2) d = ADVANCE WARNING DISTANCE, SEE FIGURE 75-4A.
(3) OPTIONAL

Notes:

1. *RPM's are desirable along all edge and center lines within the transition area.*
2. *Adjustments to the signing and pavement marking locations may be required to meet field conditions.*

TRANSITION MARKINGS
(4-Lane Undivided to 2-Lane Undivided --- Left)

Figure 76-2F



(1) SEE SECTION 76-4.0 FOR DELINEATOR SPACING.

(2) SEE FIGURE 76-2B FOR TAPER LENGTH.

TRUCK-CLIMBING LANE MARKINGS

Figure 76-2G

Speed (km/h)	Minimum Distance (m)			
	Passing Sight Distance [1]	Stopping Sight Distance [2]	Aborted Passing Maneuver [3]	
			APM-A	APM-B
40	270	50	90	90
50	345	65	130	110
60	410	85	170	130
70	485	105	205	150
80	540	130	245	170
90	615	160	280	190
100	670	185	320	205
110	730	220	360	225

1. AASHTO Passing Sight Distance; see Section 42-3.01.
2. AASHTO Stopping Sight Distance; see Section 42-1.02.
3. Report No. FHWA RD-81-093, *No-Passing-Zone Treatments for Special Geometrics and Traffic-Operational Situations.*

Notes:

APM-A *is the distance for a vehicle which is aborting a pass, slows down, gets behind the slower vehicle, and then both vehicles come to a stop. Both vehicles decelerate but at different rates. This is measured from where the pass-aborting vehicle begins to slow down to where it stops.*

APM-B *is the distance for a vehicle which is aborting a pass, slows down, then gets behind the slower vehicle. The slower vehicle maintains a constant speed, and the passing vehicle decelerates to the speed of the slower vehicle. This is measured from where the pass-aborting vehicle begins to slow down to where it reaches the slower vehicle's speed.*

NO-PASSING-ZONE DISTANCES

Figure 76-2H

FEATURE	MINIMUM CRITERIA (1)	MARK NO-PASSING ZONE THROUGH FEATURE
Horizontal or Vertical Curve	MUTCD	Yes
Major Intersection	SSD	No
Minor Intersection	0	--
Obstruction (center-of-roadway or median underpass pier, etc.)	(2)	Yes
Railroad Crossing (Rural)	SSD + 25 m	Yes
Railroad Crossing (Urban)	Variable	Yes
One-Lane Bridge	APM-A	No
Narrow Bridge	APM-B	Yes
Stop Intersection (where required)	SSD	No

(1) *See Figure 76-2H for minimum length*

(2) *See MUTCD Section 3B-13 for additional information*

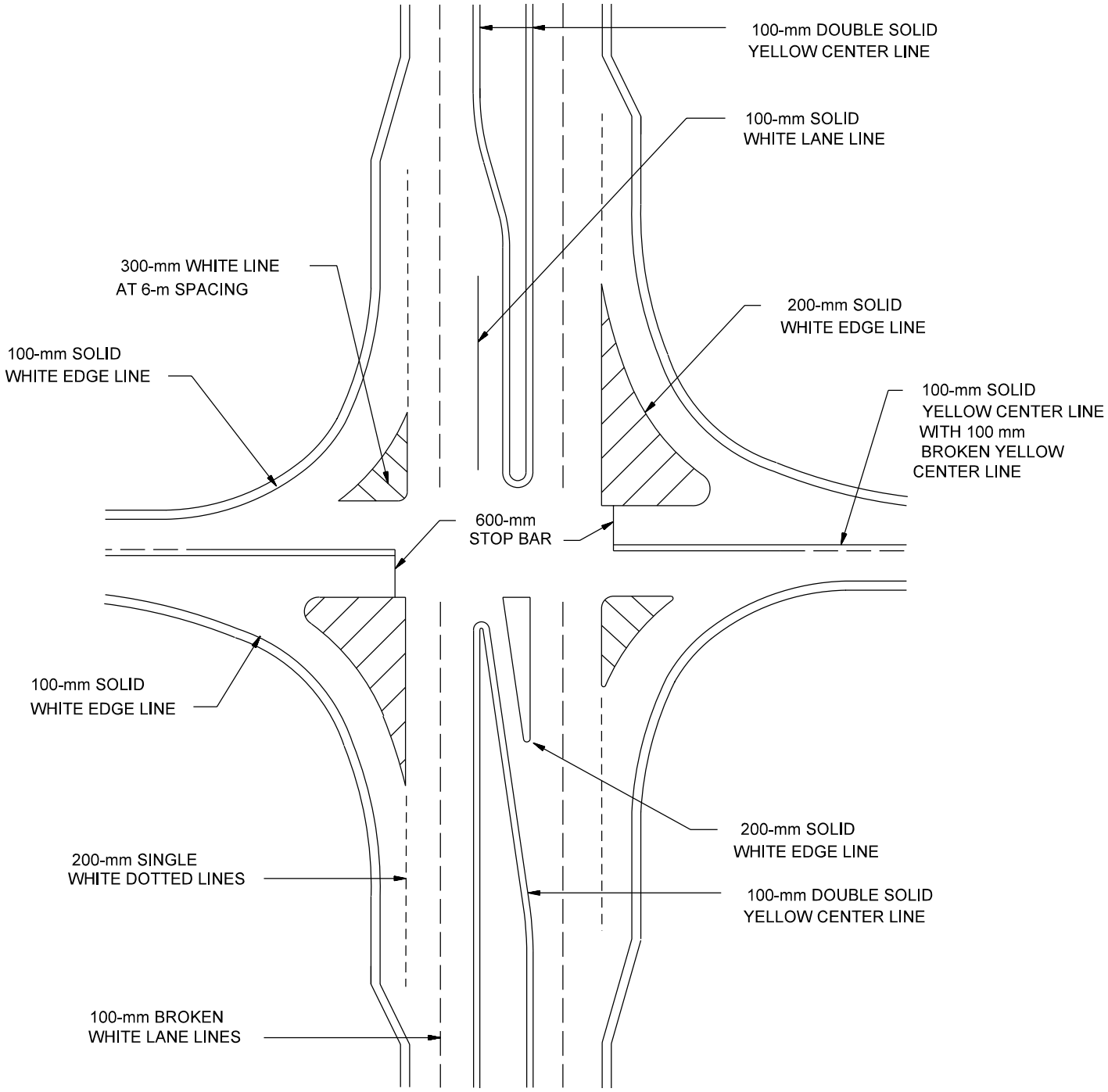
NO-PASSING-ZONE DISTANCE APPLICATIONS

Figure 76-2 I

Design Speed (km/h)	Minimum Allowable Gap (m)
50	125
60	145
70	165
80	185
90	220
100	260
110	300

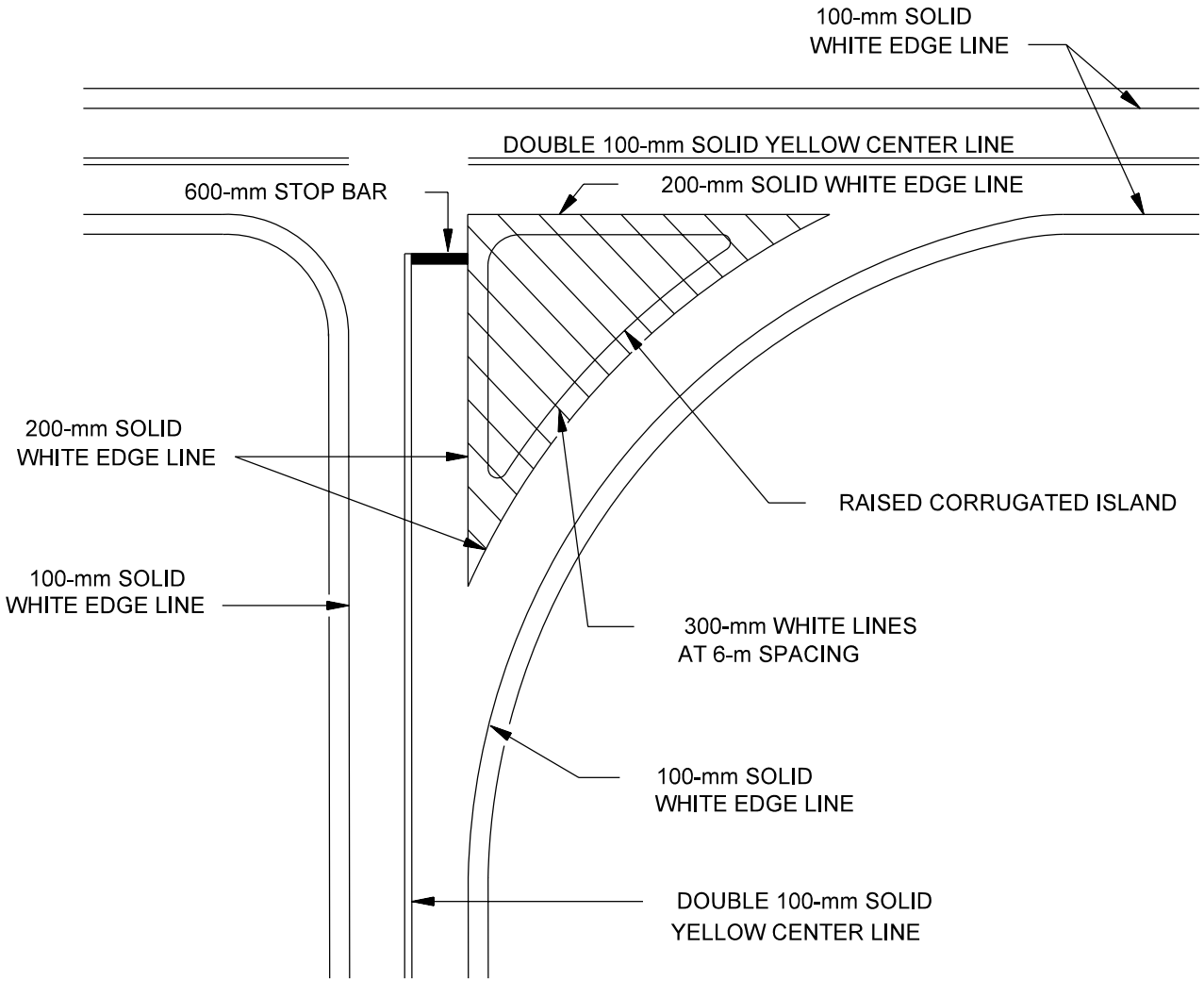
MINIMUM PASSING-ZONE GAP

Figure 76-2J



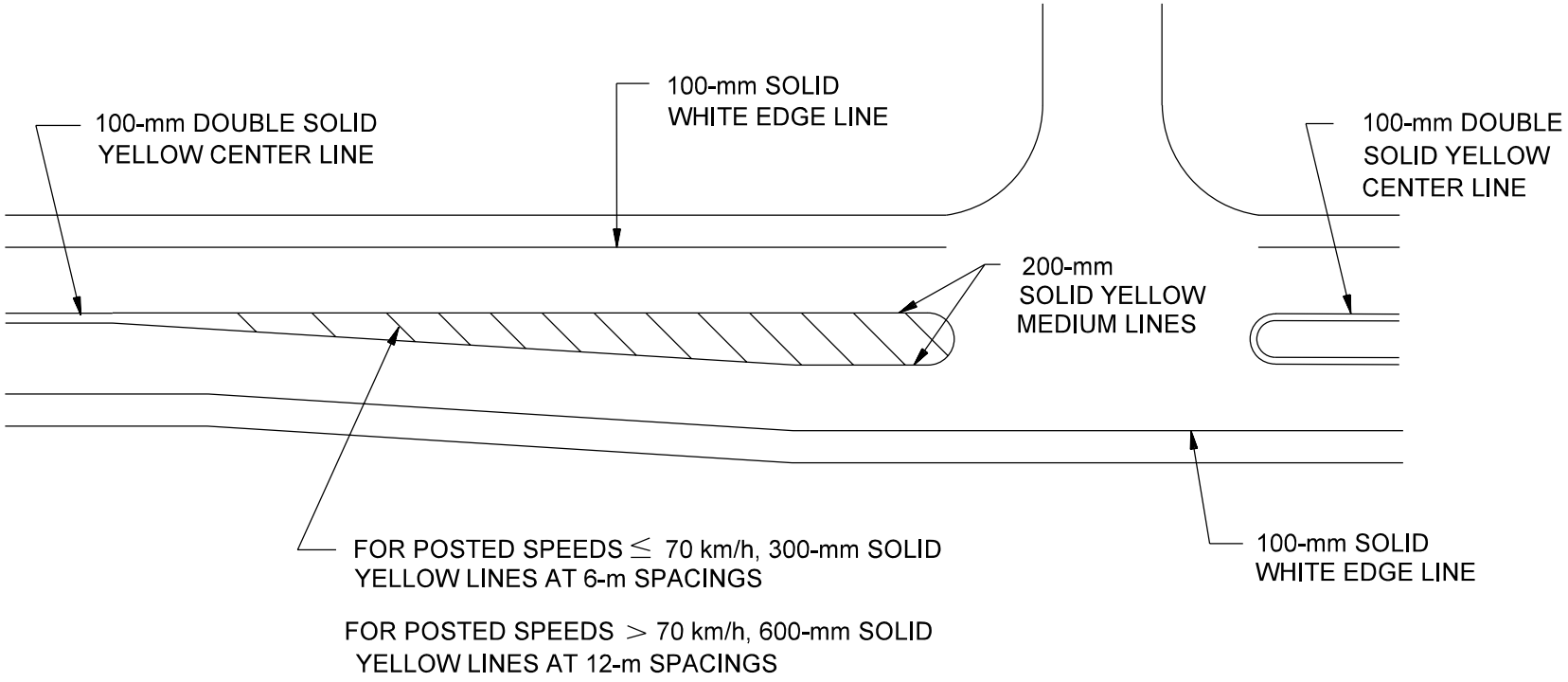
SAMPLE INTERSECTION MARKINGS

Figure 76-2K



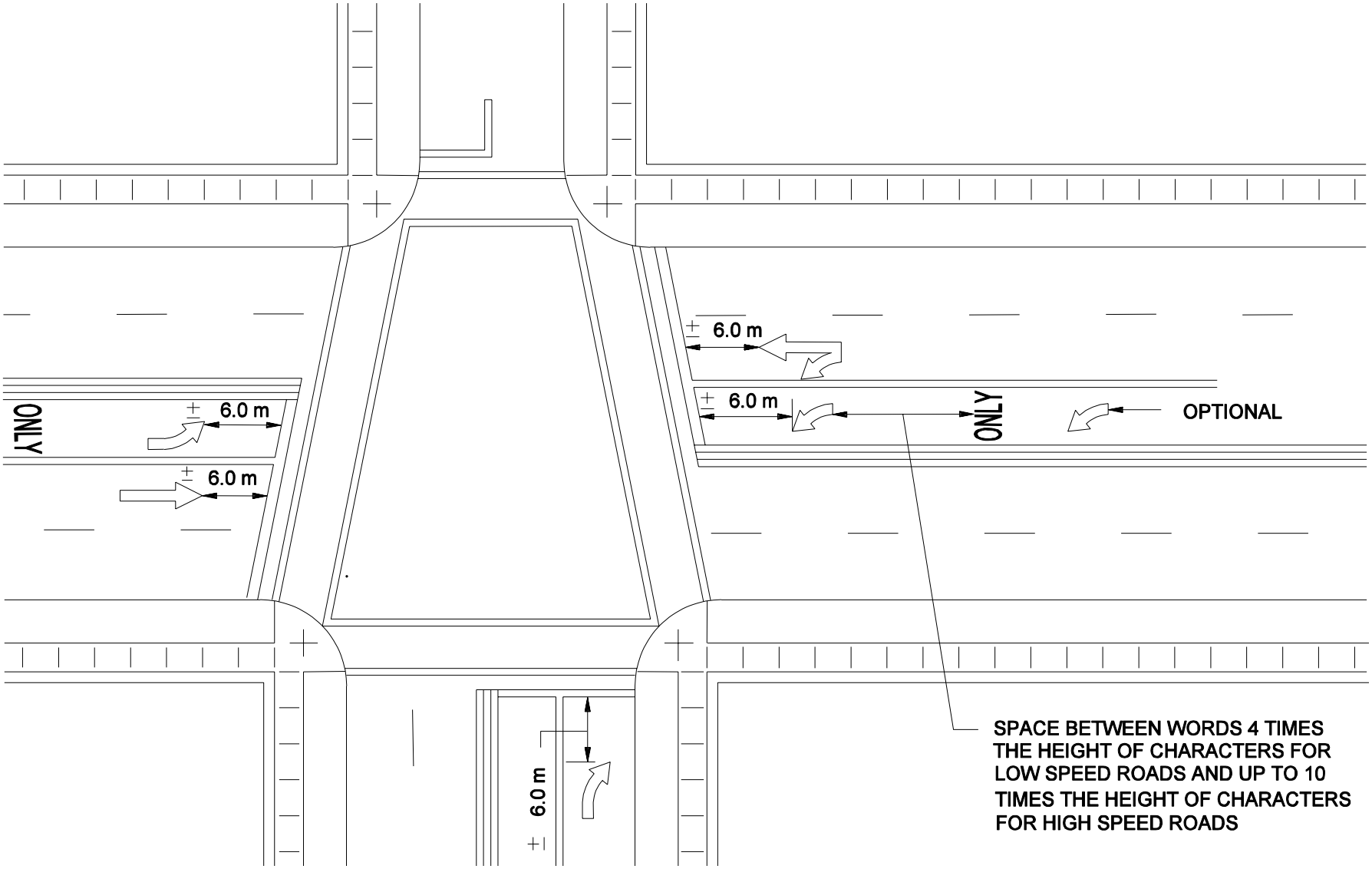
CHANNELIZED ISLAND MARKINGS
(Triangular Island)

Figure 76-2L



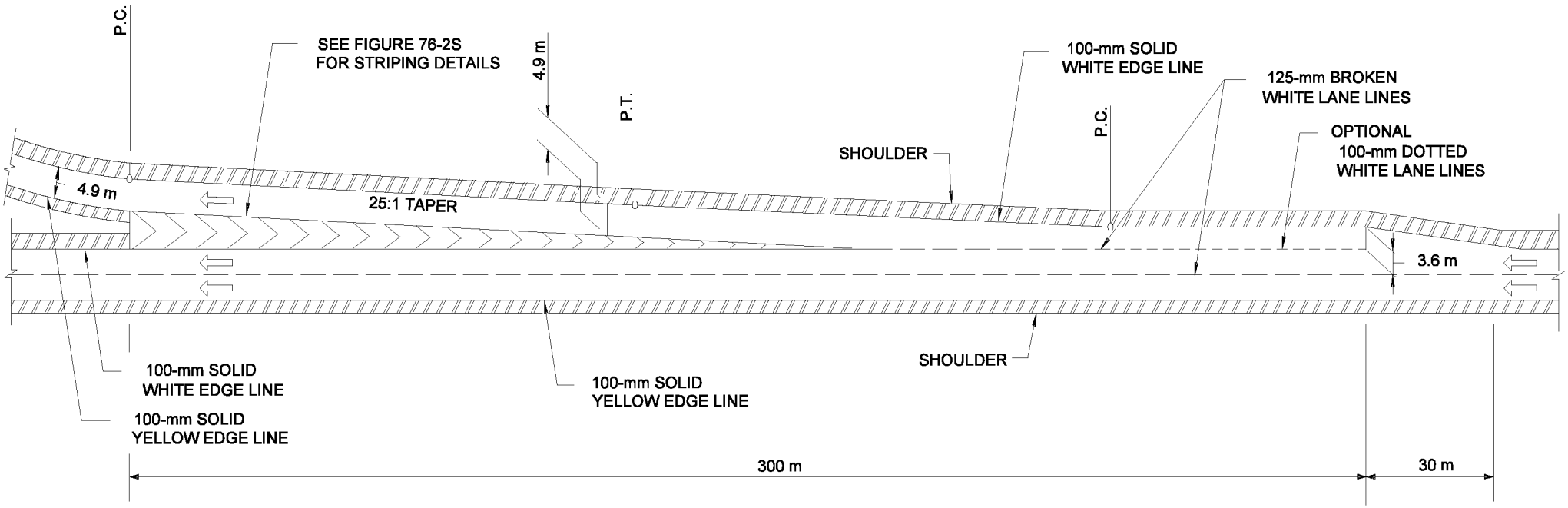
CHANNELIZED ISLAND MARKINGS
(Flush or Raised Corrugated Elongated Islands)

Figure 76-2M



TRAFFIC CONTROL WORD/SYMBOL MARKINGS

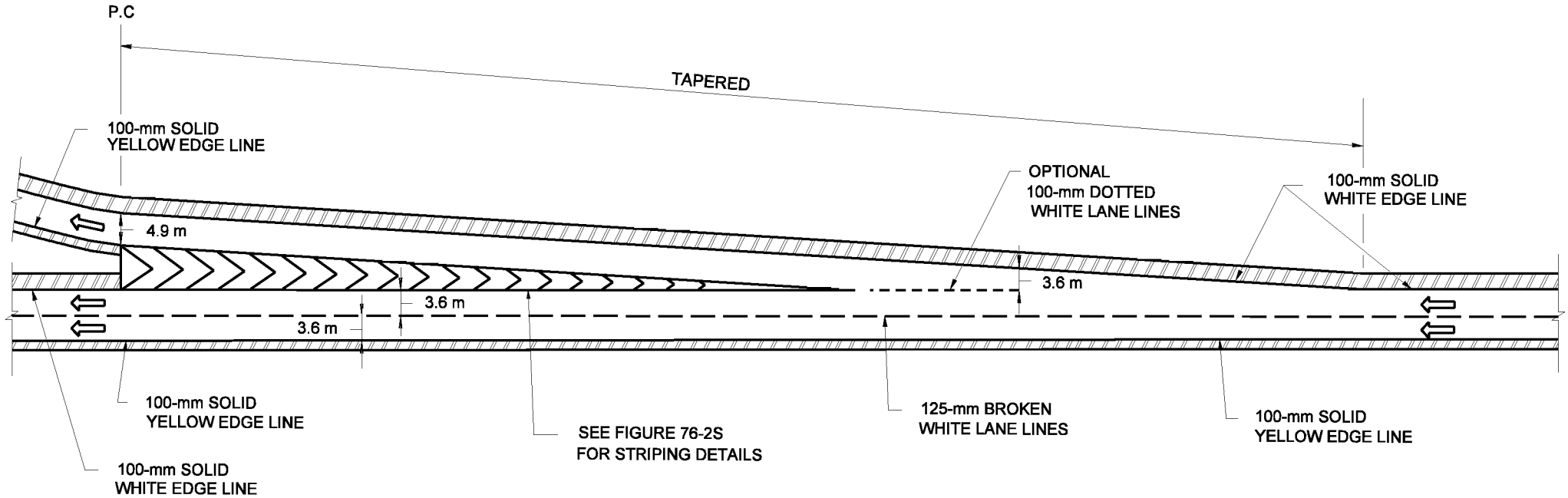
Figure 76-2N



Note: See INDOT Standard Drawings for RPM Locations.

PARALLEL EXIT RAMP MARKINGS

Figure 76-2O

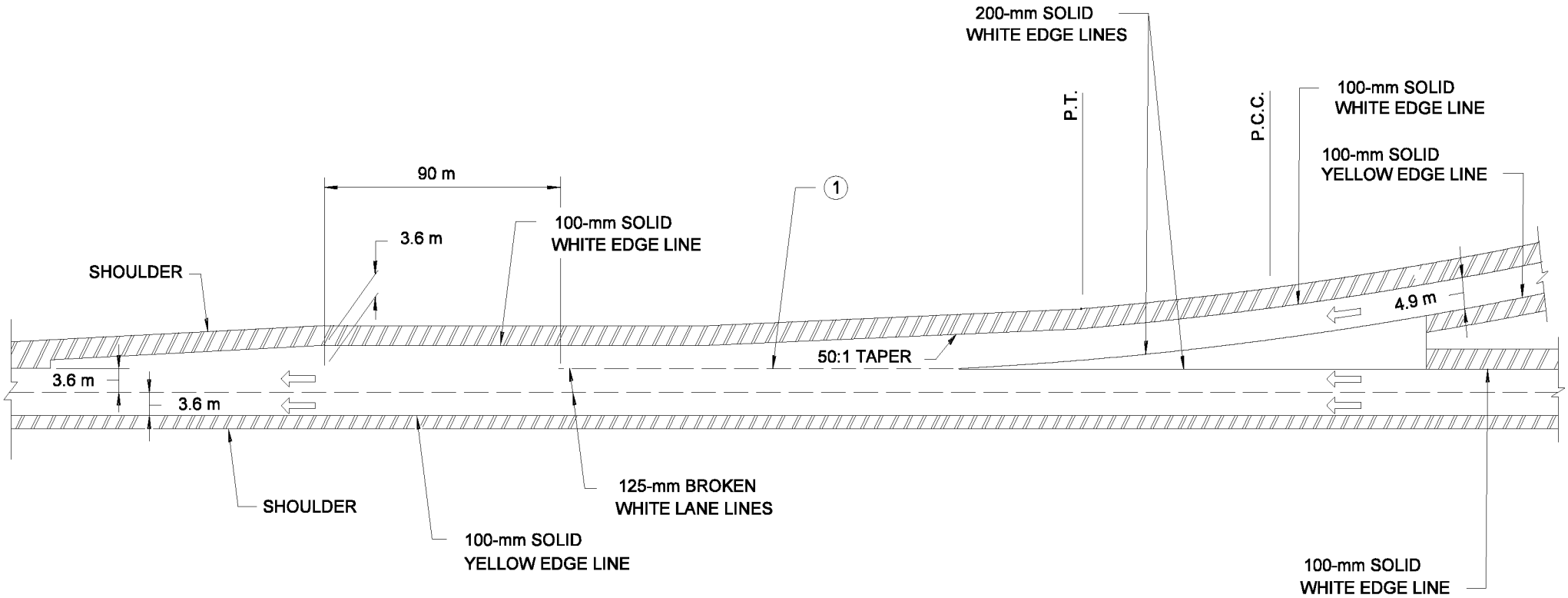


Notes:

1. *See INDOT Standard Drawings for PM Locations.*
2. *This figure applies to existing tapered exit ramps.*

TAPERED EXIT RAMP MARKINGS

Figure 76-2P

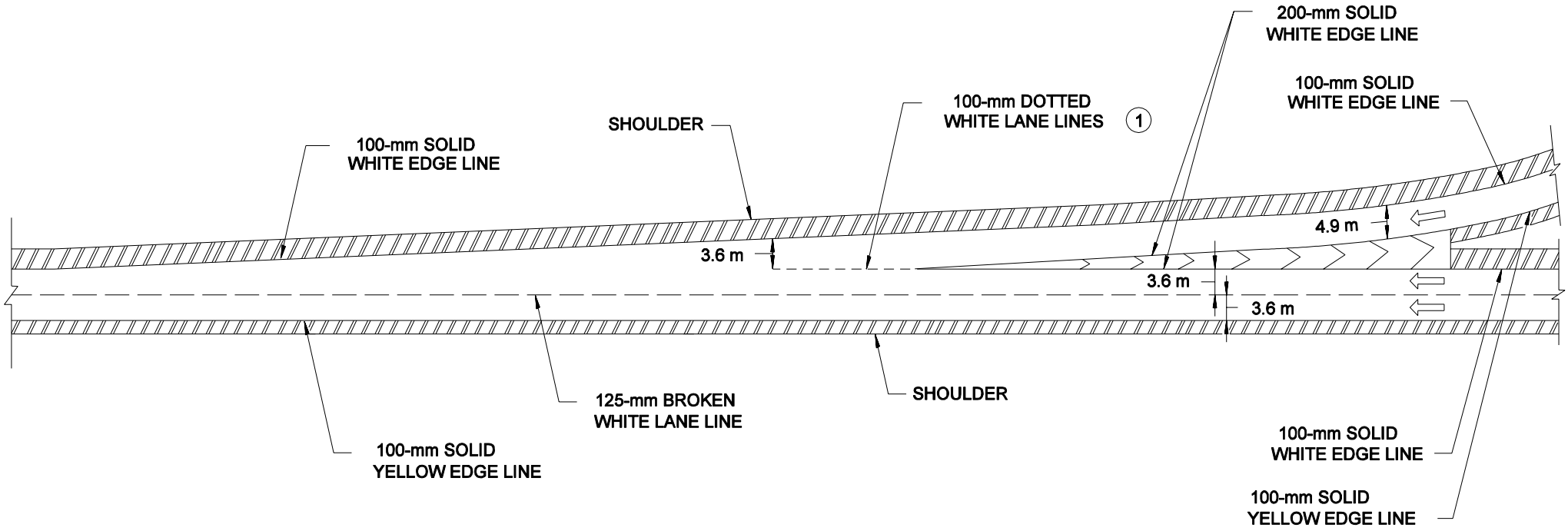


(1) USE 200-mm SOLID WHITE EDGE LINES FOR WEIGH STATION OR FOR ENTRANCE RAMPS WITH TRUCK VOLUMES GREATER THAN 15 %.

Notes: See INDOT Standard Drawings for RPM Locations.

PARALLEL ENTRANCE RAMP MARKINGS

Figure 76-2Q



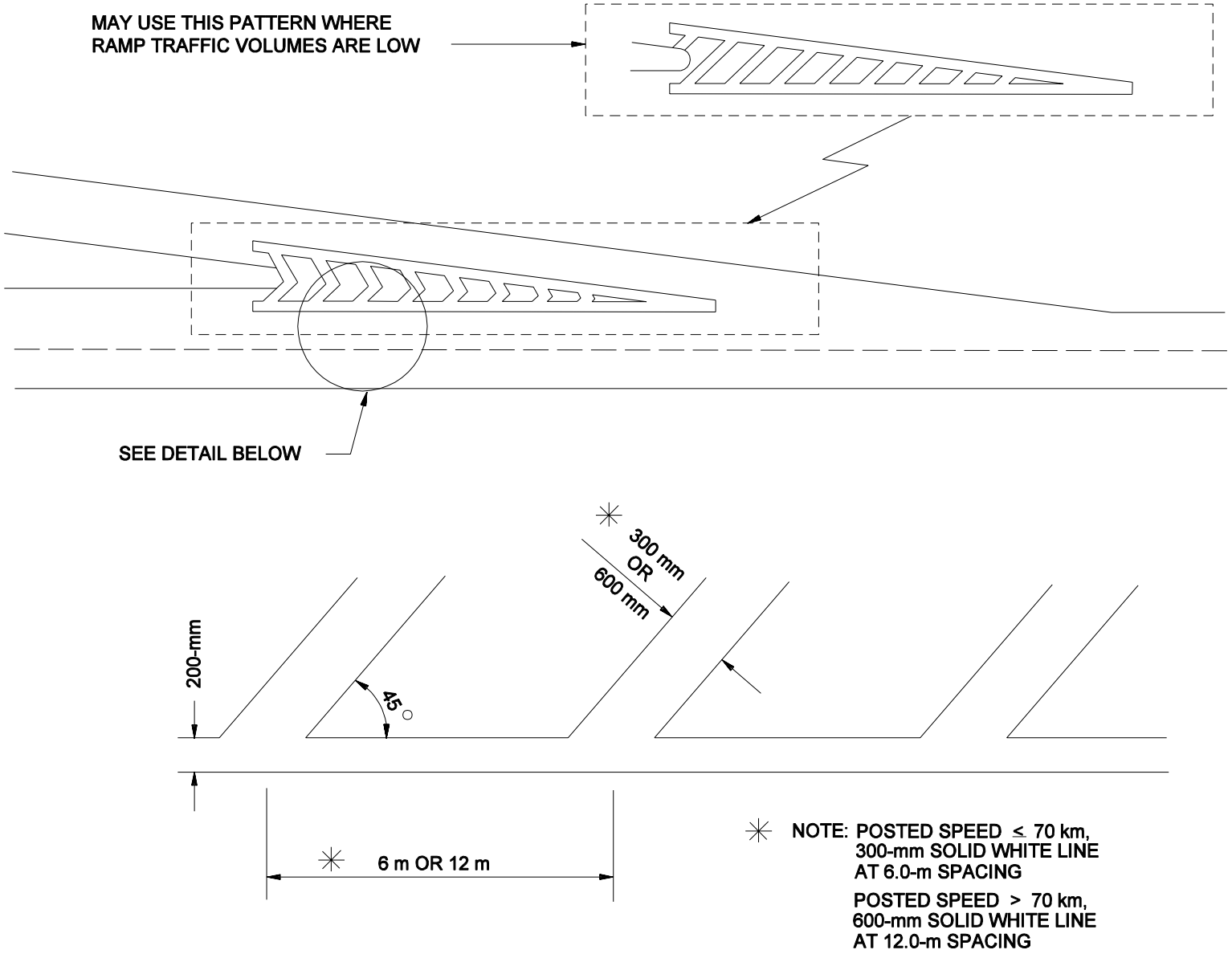
1 USE 200-mm SOLID WHITE EDGE LINES FOR WEIGH STATION RAMPS OR FOR ENTRANCE RAMPS WITH TRUCK VOLUMES GREATER THAN 15 %.

Notes:

1. *See INDOT Standard Drawings for RPM Locations.*
2. *This figure only applies to existing tapered entrance ramps.*

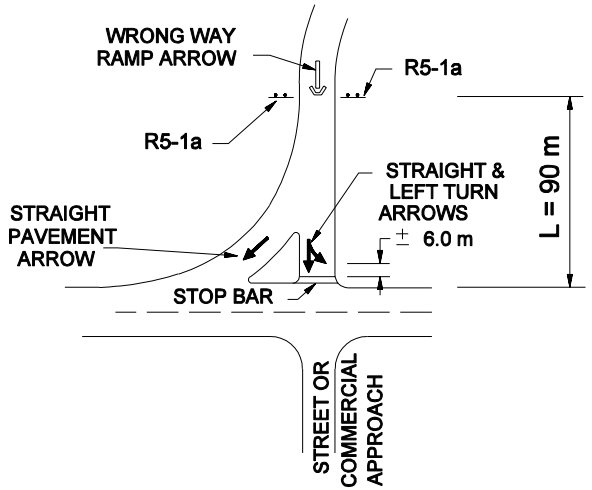
TAPERED ENTRANCE RAMP MARKINGS

Figure 76-2R

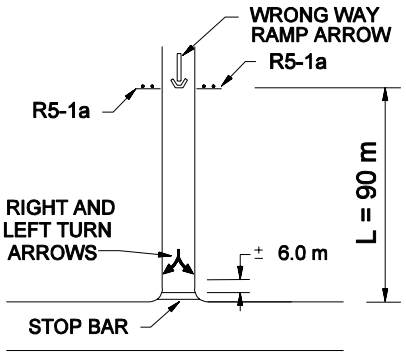


EXIT GORE MARKINGS

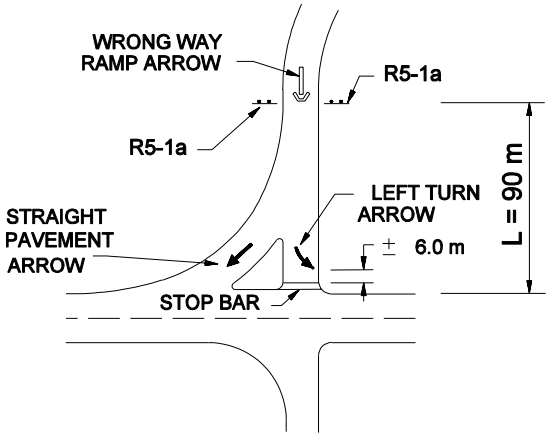
Figure 76-2S



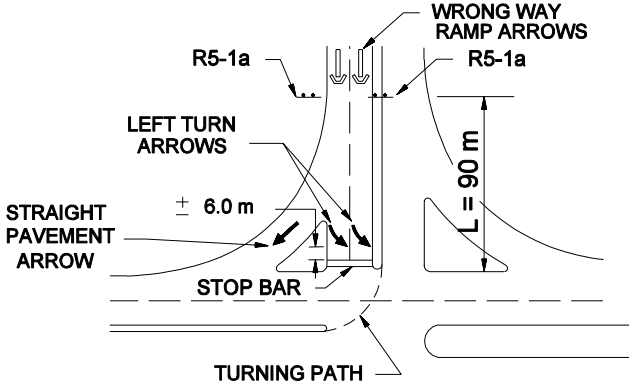
DETAIL "A"



DETAIL "B"



DETAIL "C"



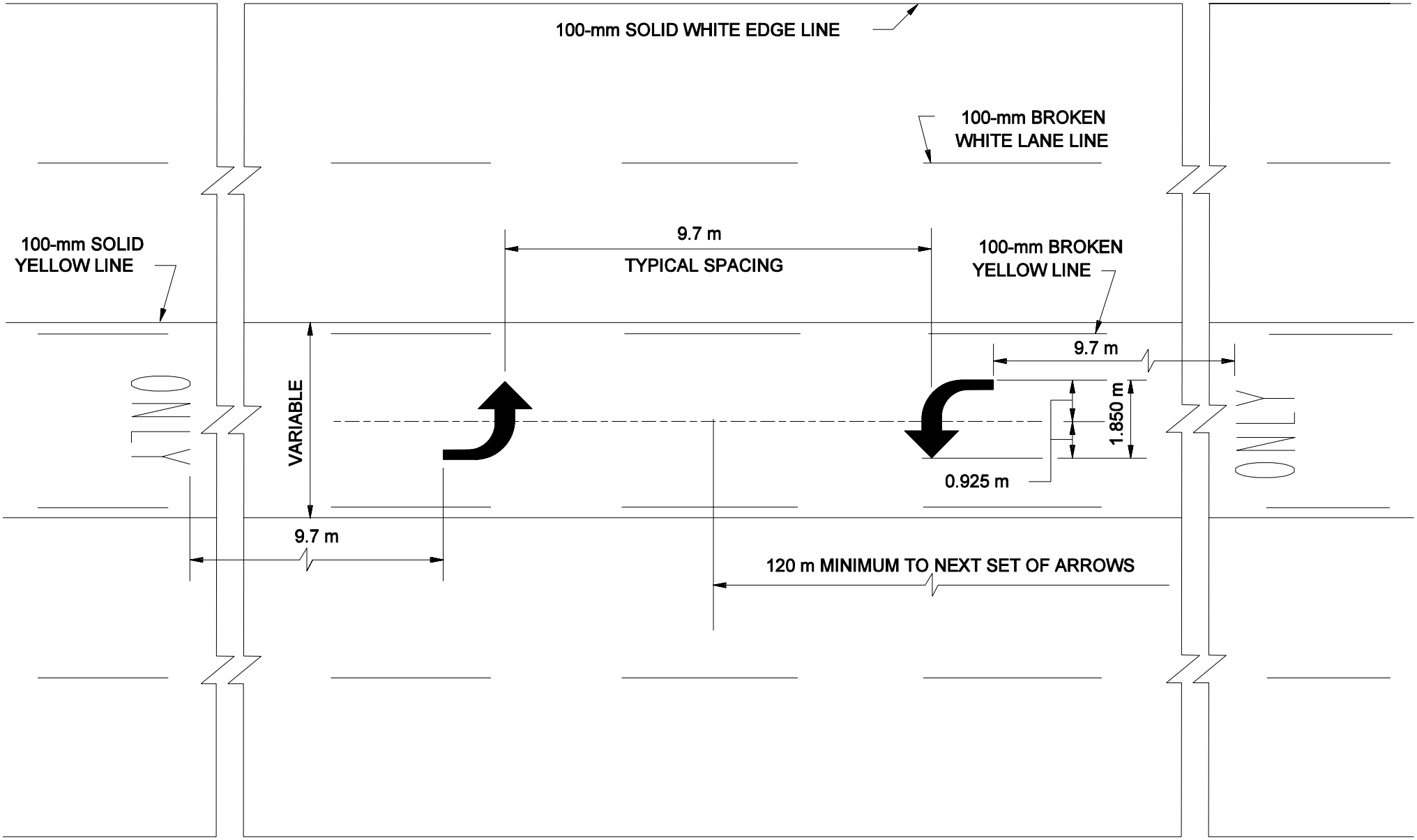
DETAIL "D"

Notes:

1. *See INDOT Standard Drawings for RPM Locations.*
2. *R5-!a is a "WRONG WAY " sign.*

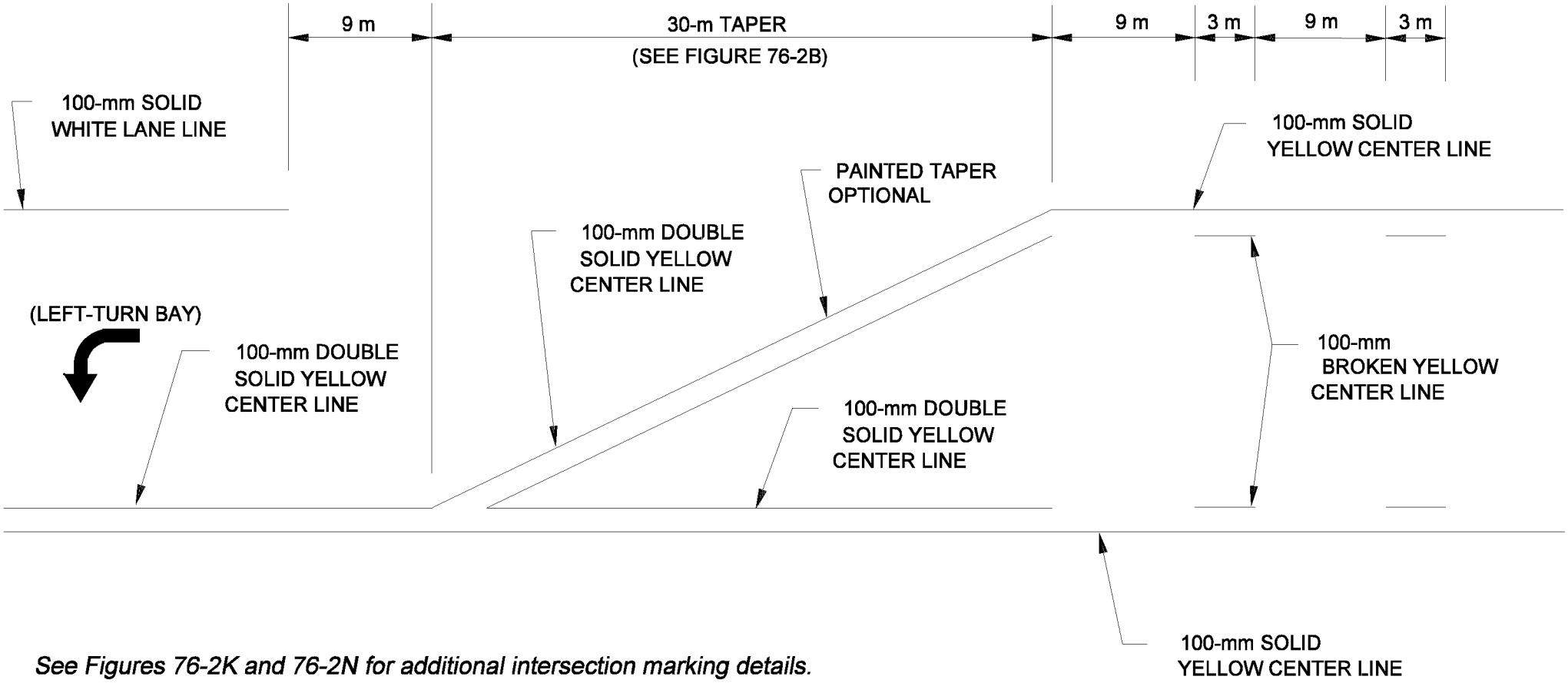
WRONG-WAY MARKINGS

Figure 76-2T



TWO-WAY LEFT-TURN LANE MARKINGS

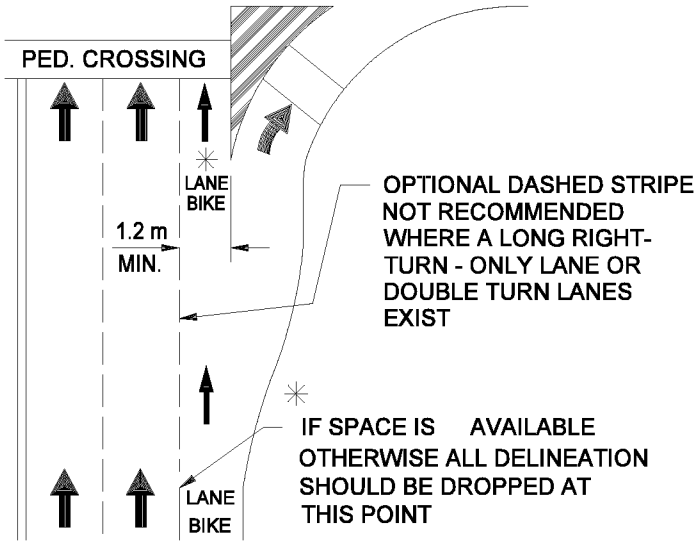
Figure 76-2U



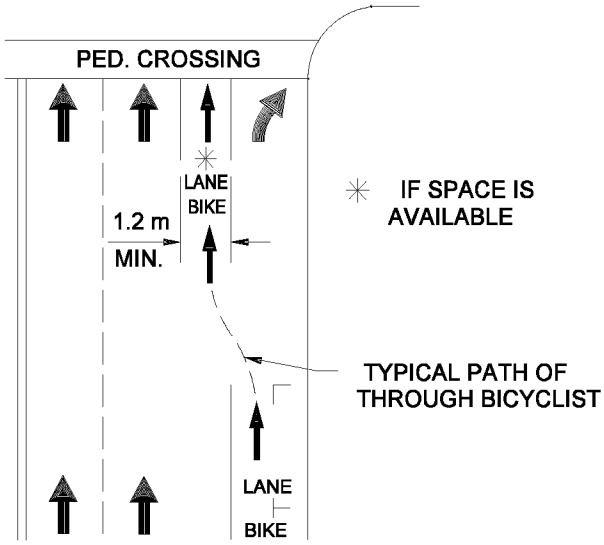
See Figures 76-2K and 76-2N for additional intersection marking details.

TWO-WAY LEFT-TURN LANE TRANSITION MARKINGS
(TWLTL to Exclusive Left-Turn Lane)

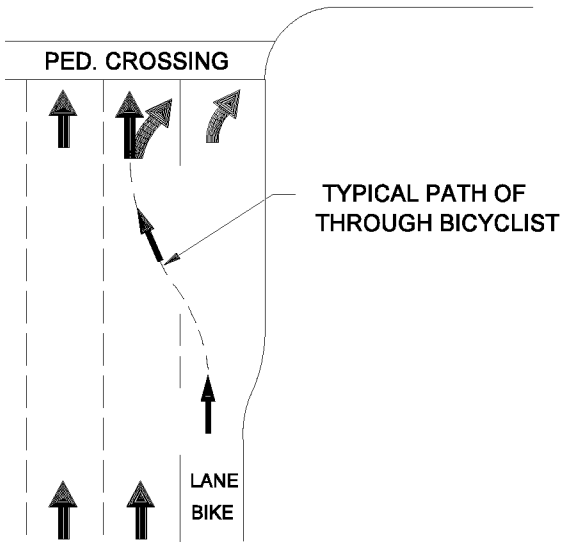
Figure 76-2V



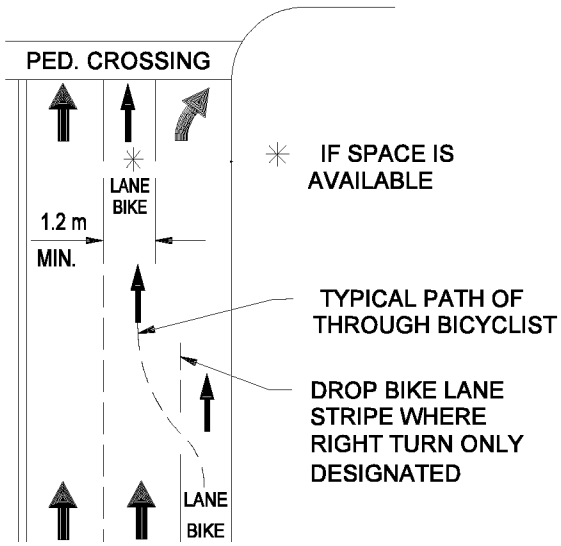
RIGHT-TURN-ONLY LANE



PARKING LANE BECOMES
RIGHT-TURN-ONLY LANE



OPTIONAL DOUBLE
RIGHT-TURN-ONLY LANE



RIGHT LANE BECOMES
RIGHT-TURN-ONLY LANE

BICYCLE MARKINGS
(Intersections)

Figure 76-2W

Application [1]	Material Type				
	Paint	Thermoplastic	Epoxy	Preformed Plastic	Raised Pavement Markers
ADT per lane	< 1000	> 1000	> 1000	> 1000	> 2500, 2-lane > 6000, 4-lane
Pavement Surface Life	< 3 Years	≥ 4 Years	≥ 3 Years	≥ 3 Years	≥ 4 Years
Edge Lines	X	X [2]	X	X	X
Center Line	X	X	X	X	X
Transverse Markings	X	X		X	
Concrete Pavement	X		X	X	X
Asphalt Pavement	X	X		X	X

Notes:

[1] *Other applications or restrictions may apply; see Section 76-3.02 for additional information.*

[2] *Edge lines must be broken for drainage purposes.*

RECOMMENDED PAVEMENT-MARKING APPLICATIONS

Figure 76-3A

CURVE RADIUS (m)	SPACING ON CURVE (m)
25	6
50	10
75	13
100	16
125	18
150	20
175	22
200	23
225	25
250	26
275	27
300	29

Note: Spacing for a specific radius not shown may be interpolated from the table and rounded to the nearest meter. The minimum spacing should not be less than 6 m nor greater than 90 m. The spacing of the first delineator approaching a curve should be placed at 2S, the second 3S, and the third 6S, but the distance should not exceed 90 m. S refers to the delineator spacing for a specific radius computed from the formula $S = 1.7\sqrt{R - 15}$.

SUGGESTED MAXIMUM SPACING FOR DELINEATORS ON A HORIZONTAL CURVE

Figure 76-4A