

**SSTRIMM**  
**Traffic Management Manual**



Annex E  
**Pavement Markings**

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# Annex E

## Pavement Markings<sup>8</sup>

Markings on highways have important functions in providing guidance and information for the road user. Major marking types include pavement and curb markings, object markers, delineators, colored pavements, barricades, channelizing devices and islands. In some cases, markings are used to supplement other traffic control devices such as signs, signals and other markings. In other instances, markings are used alone to effectively convey regulations, guidance, or warnings in ways not obtainable by the use of other devices.

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<sup>8</sup> This Annex on markings for pavements and other objects relies heavily on the provision of the Manual on Pavement Markings, Planning and Project Development Office, Ministry of Public Highways, Republic of the Philippines, 1980. Additional reference materials that the user may also wish to consult are the following:

- International Convention on Road Signs and Signals, United Nations, Vienna Austria, November 1968.
- Manual on Uniform Traffic Control Devices, Millennium Edition (MUTCD 2000), Federal Highway Administration, United States, December 2000, and amended July 2001.

## E.1 Introduction

### E.1.1 Functions and Limitations

Markings have limitations. Visibility of the markings can be limited by debris, water on or adjacent to the markings, traffic, etc. Marking durability is affected by material characteristics, traffic volumes, weather, and location. However, under most highway conditions, markings provide important information while allowing minimal diversion of attention from the roadway.

Pavement markings can enhance roadway delineation with the addition of audible and tactile features such as bars, differential surface profiles, raised pavement markers, or other devices intended to alert the road user that a delineation on the roadway is being traversed.

### E.1.2 Standardization of Application

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

Markings that are no longer applicable for roadway conditions or restrictions and that might cause confusion for the road user shall be removed or obliterated to be unidentifiable as a marking as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

**Option.** Markings may be temporarily masked with tape until they can be removed or obliterated.

### E.1.3 Materials

Pavement and curb markings are commonly placed by using paints or thermoplastics; however, other suitable marking materials, including raised pavement markers and colored pavements, are also used. Delineators, object markers, barricades, and channelizing devices are visibly placed in a vertical position similar to signs above the roadway.

Road surface markings should be of non-skid materials and should not protrude more than 6 mm above the level of the carriageway.

The materials used for markings should provide the specified color throughout their useful life. Consideration should be given to selecting pavement marking materials that will

minimize tripping or loss of traction for pedestrians and bicyclists. Object markers and delineators should not present a vertical or horizontal clearance obstacle for pedestrians. These studs or similar devices used for marking should not protrude more than 1.5 cm above the level of the carriageway (or more than 2.5 cm in the case of studs incorporating reflex reflectors).

#### E.1.4 Colors

Markings shall be yellow, white, red, or blue. The colors for markings shall conform to the standard highway colors. Black in conjunction with one of the above colors shall be a usable color for object markers.

Black may be used in combination with the above colors where a light-colored pavement does not provide sufficient contrast with the markings.

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

## E.2 Longitudinal Pavement Markings

### E.2.1 Center Line

A center line is used to separate opposite traffic movements of a roadway and is generally placed centrally on all roads and bridges 6.0m or more in width. Under some circumstances this line may be placed off-center (e.g. where an extra uphill traffic lane is provided or parking on one side of the road only).

**Warrants for Marking Center Lines.** A center line may be marked on an urban or rural road if one or more of the following conditions are met:

- a.) Two-lane road (greater than 6.0 meters in width) carrying an Average Daily Traffic (ADT) in excess of 1000 vehicles.
- b.) Two-lane road (less than 6.0 meter but more than 5.0m in width) carrying an ADT volume in excess of 300 vehicles.
- c.) Winding roads with widths of 5.0 meters or more. Irrespective of these warrants, marking of other sections may be desirable where the following conditions apply:
  - Frequent horizontal or vertical curves, or both
  - Sub-standard curves
  - In areas subject to fog
  - On approaches to major roads
  - Where accident record indicates the need
  - Continuity of an arterial road
  - Heavy night or tourist traffic, or both.

**Center Line on Urban Roads.** The center line on a two-lane urban road where the 85th percentile speed (or speed limit) is 60 km/hr or below shall be a broken white line with a minimum width of 100mm and equal line segments of 3.0 meters and equal gaps of 4.5 meters. For high speed roads, line segments and gaps are the same as for rural roads. However, a solid white line of 200mm wide may be used in the following cases:

- a.) On roads with more than two lanes if not separated by median islands.
- b.) Around a curve where no warrant exist for yellow barrier lines.
- c.) On approaches to an intersection junction.

**Center Line on Rural Roads.** The center line on a two-lane two-way rural road or any other road where the 85th percentile speed (or speed limit) is greater than 60 kph, shall be a broken line, with a minimum width of 100 and 3.0m long with gaps of 9.0m spacing. A solid white line of 200mm wide may be used in the cases as specified for urban roads

**Center Lines at Bridges.** Where approaches to bridges are line marked, they shall be marked as follows:

- a.) If bridge is 5.0m or more between curbs, center lines (or separation line) shall be continued across the bridge.
- b.) If bridge is less than 5.0m between curbs, center lines shall be discontinued 30m from the bridge abutments.

### E.2.2 Lane Line

A lane line is used to separate adjacent lanes of traffic moving in the same direction. Lane lines on roads with an 85th percentile speed (or speed limit) of 60 km/hr or less shall be a minimum width of 100mm and 3.0 meter long with 4.5 meter gaps.

Lane lines on roads with the 85th percentile speed (or speed limit) in excess of 60 km/hr shall be 100mm wide, 3.0 meter long and 9.0 meter gaps.

Lane lines must not be continued:

- a.) Across intersections
- b.) Across side street entrances unless the street is a one-way street (in only)
- c.) Past the start of the taper at which a multi-lane road narrows down to a two-lane road. Lane lines are generally broken lines except where lane changing is to be discouraged (but not prohibited) particularly on approaches to intersections.

As a guide, lane lines should be used in the following cases:

- a.) Where the road is wide enough for two or more lanes of traffic in one direction with a two way ADT of 8000 or more (depending on whether parking is permitted);
- b.) At approaches to widened or signalized intersections;
- c.) On divided roads.

Where practicable, the following standard lane widths are desirable.

- a.) Traveled lanes: Urban 3.3m, Rural 3.7m
- b.) Traveled lane adjacent to curb: 3.7m
- c.) Parking lanes: 2.0m

A lane width defined by lane lines should only be reduced to 2.75 meters in city areas. A minimum of 2.5 meters is only permissible in special cases where a maximum number of lanes must be made available such as at a signalized intersection where provisions must be made for the most efficient storage of stopped vehicles. The center lanes on roads

without median islands should have a minimum width of 3.0 meters in urban areas and 3.5 meters in rural areas.

### E.2.3 Barrier Lines

Barrier lines may consist of either two unbroken yellow lines (usually reflectorized) or a single yellow line with a broken white line.

Double yellow lines should only be used where overtaking from both directions and all crossing movements are prohibited. Vehicles must always keep to the right of the double yellow lines.

Combination of an unbroken yellow line and white separation line have the same regulatory significance as a double unbroken yellow line for vehicles proceeding in the direction where the unbroken yellow line appears on the right of the marking, but vehicles traveling in the other direction are permitted to cross this line.

The following are the cases where barrier lines should be used:

- a.) As center lines on approaches to signalized intersections.
- b.) As center lines of multi-lane roads where overtaking must be prohibited, because of sight restrictions.
- c.) 'No-Passing' zones where there is a restricted sight distance due to horizontal or vertical curves, or both.
- d.) As center lines on approaches to railway crossings.

The size of the double yellow lines shall be 100mm in width and shall have a gap space of 100mm-150mm (max).

**No Passing Zones.** No passing zones shall be established at vertical and horizontal curves and elsewhere on two-and three-lane highways, where passing must be prohibited because of dangerously restricted sight distance or other hazardous conditions.

The legal basis for the establishment of no-passing zones is as follows:

- a.) The Ministry of Public Highways (now the DPWH) is hereby authorized to determine those portions of any highway where overtaking and passing or driving to the left at a roadway would be especially hazardous and may, by appropriate signs or markings on the roadway, indicate the beginning and end of such zones, and clearly visible to an ordinarily observant person. Every driver of a vehicle shall obey the directions thereof.
- b.) Where signs or markings are in place to define a no-passing zone, no driver shall at anytime drive on the left side of the roadway within such no-passing zones or

on the left side of any pavement striping designed to mark such no-passing zones through its length.

Table E.2-1 Roads with less than 1000 vehicles per day

85 percentile speed*	Minimum sight distance (1.15m to 1.15m) (m)	Minimum length of road with sight distance below the minimum sight distance	Minimum length of barrier lines (m)	Minimum distance between barrier lines (m)
All speeds	150	25	75	125

Table E.2-2 Roads with more than 1000 vehicles per day

85 percentile speed*	Minimum sight distance (1.15m to 1.15m) (m)	Minimum length of road with sight distance below the minimum sight distance	Minimum length of barrier lines (m)	Minimum distance between barrier lines (m)
40	120	20	60	100
50	150	25	75	125
60	180	30	90	150
70	210	35	105	175
80	240	40	120	200
90	270	45	135	225
100	300	50	150	250
110	330	55	165	280
over 110	360	60	180	300

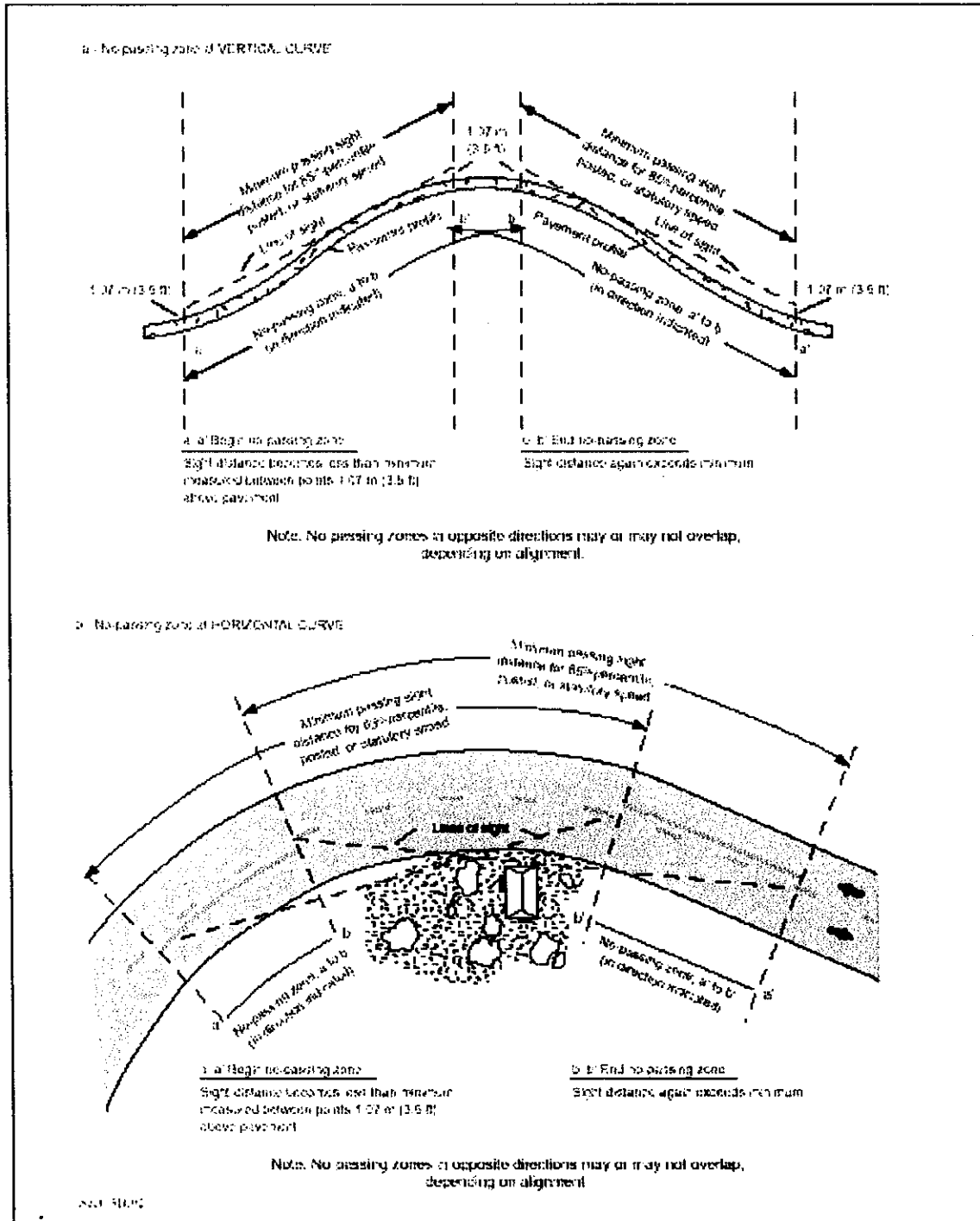
**Marking of 'No-Passing' Zones.** The method and procedures applied to marking of 'No-Passing' zones are as follows:

- a.) Vertical and horizontal curves on a two-lane sealed road shall be marked as 'No-Passing' zones in accordance with Tables E.2-1 or E.2-2 above.
- b.) Barrier lines shall not be marked unless the sight distance available falls below the appropriate minimum sight distance for at least the length shown in the tables.
- c.) If the length of road with sight distance below the minimum sight distance is less than the minimum length of barrier line shown in the tables, the additional length of the marking shall be added to the beginning of the zone.
- d.) Where the distance between the end of one barrier line and the beginning of the next barrier line restricting traveling in the same direction is less than that shown in the tables, the barrier lines shall be joined to form one continuous barrier line.



Methods for establishing 'No-Passing' Zone. The beginning and the end of barrier lines for vertical and horizontal curves shall be located as illustrated in Figure E.2-1.

Figure E.2-1 Method for Establishing "No Passing" Zones



Source: Manual on Uniform Traffic Control Devices, Millennium Edition. Federal Highway Administration. United States. December 2000.

Methods for establishing 'No-passing' zones as illustrated are as follows:

a.) Vertical Curves

- (i) Start on upgrade side of curve proceeding in direction A as shown in the sketch.
- (ii) When B's target just drops out of A's sight, mark the position of A (start of barrier line in direction A) and the position of B (end of barrier line in direction B).
- (iii) When B's target again comes into A's sight, mark the position of A (end of barrier line in direction A) and the position of B (start of barrier line in direction B).
- (iv) When the minimum sight distance is different in each direction the barrier lines must be marked out separately in each direction.
- (v) The curve is then spotted out in accordance with standard practice.

b.) Horizontal Curves

- (i) Start in advance of the curve on the pavement center line.
- (ii) When A's view of B is obstructed, mark the position of A (the start of the no passing zone for direction A) and the position of B (the end of no-passing zone for direction B)
- (iii) When A can again see B, mark the position A (end of no-passing zone for direction A) and the position of B (the start of no-passing zone for direction B).
- (iv) Before any road on which 'no-passing' zones are marked is resealed or resurfaced, the beginning and end of each barrier line in each direction should be marked by wooden or steel stakes, painted white, at the left side of the road.

c.) Climbing Lanes

A particular use of 'no-passing' lines is associated with the provisions of slow moving vehicles or climbing lanes on one side of a two-lane pavement. The center line of the two-lane pavement should be marked as follows:

- (i) Double unbroken lines where visibility is restricted for downhill traffic.
- (ii) Where visibility is unrestricted for downhill traffic the double line should be continued with an unbroken line on the side uphill traffic and a broken line on the side of downhill traffic.

### E.2.4 Edge Lines

The edge line is used to delineate the edge of the traveled way to distinguish it from the shoulder area. It should be a solid white line between 100mm and 200mm wide. Studs, or raised pavement markers may be used in conjunction with edge lines.

The purpose of installing edge lines is generally threefold:

- a.) to discourage travel on road shoulders;
- b.) to make driving safer and more assured, particularly at night and during inclement weather by providing a continuous guide for the driver;
- c.) to act as a guide past objects which are close to the edge of pavement and which constitute hazard.

On undivided roads and on roads of more than one lane, edge lines may be used to supplement center or lane lines only on pavements 6.5 meters or more in width, unless for special reasons such as poor alignment, fog or similar conditions. For pavements less than 6.5m, edge lines may be used under special conditions without lane or center lines. On divided roads, edge lines should be used at left hand edge of each pavement if the median is not curbed. They may also be used to delineate raised concrete curbs at medians or to define sealed or unsealed shoulders

Table E.2-3

Road Type	Outer Lane Width	Edge Line Width
Urban Arterial	3.5m (min)	100mm
Rural Arterial	3.5m (min) >3.5m	100mm 150- 200mm
Freeway	4.0m (min)	300mm

**Pavement Edge.** An edge line should not reduce an adjacent lane width to less than 3.5 m. Widths of edge line vary from 100mm to 300mm depending on the available lane width and the prevailing speeds of the vehicles on that road. In general the line widths applied should conform to Table E.2-3.

**Medians.** Edge lines at raised medians are 100mm wide and placed with the center of the line not more than 300mm from edge of the median curbing. The line should not reduce the adjacent lane width to less than 2.75m in urban areas and 3.5m in rural highways and expressways.

### E.2.5 Continuity Line

A continuity line is used to indicate that portion of a carriageway assigned to through traffic and which is intended to be crossed by traffic turning at an intersection, or entering or leaving an auxiliary lane at its start or finish.

This line is generally 1.0m long, 100mm-200mm wide with gaps of 3.0m.

### E.2.6 Transition Lines

Transition lines are used to guide traffic safely past obstructions on roadways such as islands, median strips, bridge piers or indicate changes in the width of the traveled portion of the roadway and an increase or reduction in traffic lanes.

Lane, edge, separation or continuity lines may be used as transition lines which ever is appropriate. Minimum transition lengths shall be in accordance with the prevailing speed of the road, as shown in the following table, Table E.2-4.

Table E.2-4

Speed (km / hr)	Minimum Length per Meter or Lateral Deviation	
	Diverging	Merging
Up to 60	9m	27m
80	12m	36m
100	15m	45m
110	17m	50m

## E.3 Transverse Markings

Transverse lines are markings across the carriageway, perpendicular to the flow of traffic. Because of the low angles at which the markings are viewed, it is necessary that all transverse lines be proportionally widened to give visibility equal to that of longitudinal or to avoid apparent distortion where longitudinal and transverse lines are combined in symbols or lettering.

Transverse lines may be classified into the following types:

- a.) Stop Lines
- b.) Give Way (Yield) lines
- c.) Pedestrian crossing markings.

### E.3.1 Stop Lines

**General.** Stop lines should be marked across the appropriate portion of the roadway at positions where vehicles are required to stop in compliance with a stop sign, traffic signals, or any other legal requirement. A Stop Line is a solid white line not less than 300mm or more than 450mm wide on urban roads and up to 600mm on rural roads.

**Placement of lines.** The positions of the stop lines are in accordance with the following situations:

- a.) Signalized intersections.  
Line to be placed 1.5 meters (center to center of line) in front of and parallel to the nearest pedestrian lane. Where there is no pedestrian crossing lane, the stop line should be at the desired stopping point, no more than 6 meters or less than 1.5 meters from the prolongation of the curb line of the intersecting road.
- b.) Isolated "Stop" Signs  
If a stop line is used in conjunction with the "STOP" sign, it should generally be placed in line with the stop sign. At an intersection or junction, such lines shall usually be placed in line with the edge of the sidewalk or shoulder. The exact location of the stop sign shall depend on the sight distance requirement of the stopping vehicle.
- c.) Pedestrian actuated signals (mid-block)  
The stop line should be placed 3.0 meters before the nearest pedestrian crossing line (see Figure
- d.) Railway Crossing

Stop lines may be supplemented by the word "STOP" marked on the carriageway. The distance between the word "STOP" and stop line should be between 10 to 25 meters.

### E.3.2 "GIVE WAY" ("YIELD") Lines

Give Way (Yield) or holding lines are markings consisting of adjacent broken white lines across the carriageway at which drivers must give way or yield to all traffic. The minimum width for holding lines should be 200mm and the maximum 600mm. The distance between the two lines should be at least 300mm. The gap between line segments shall be 600mm.

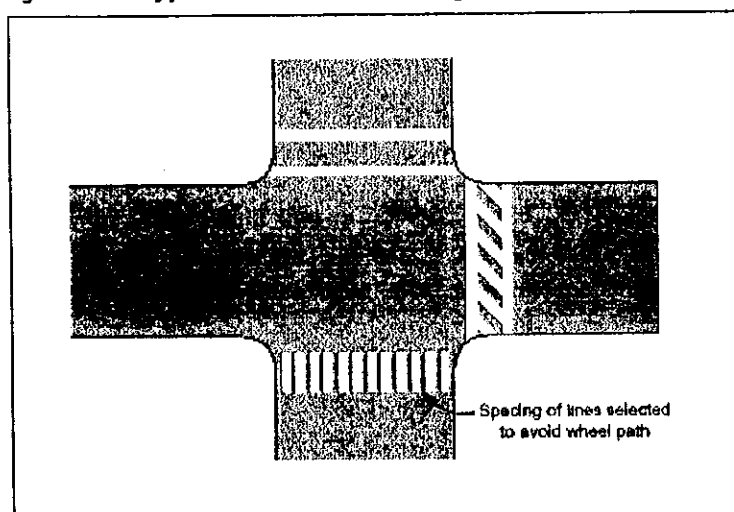
The give way lines may be supplemented by the "GIVE WAY" symbol. The distance between the base of the "GIVE WAY" triangle and the nearest Give Way line should be between 5 to 25 meters depending on the location.

### E.3.3 Pedestrian Crossing Markings

Two types of pedestrian crossings are in use:

- a.) "Zebra" crossing (non-signalized crossing)  
The marking consists of a series of longitudinal bars 300mm or 600mm wide and generally not less than 4.0m long. The bars are placed parallel to the road center line with gaps of equal width to the bar.
- b.) Crosswalks (Signalized crossing)  
Crosswalks are defined by a pair of solid white lines across the road surface not less than 4.0 meters and not more than 8.0 meters apart, 150-300mm in width. They should be used in conjunction with mid-block or intersection signals.

Figure E.3-1 **Typical Pedestrian Crossings**



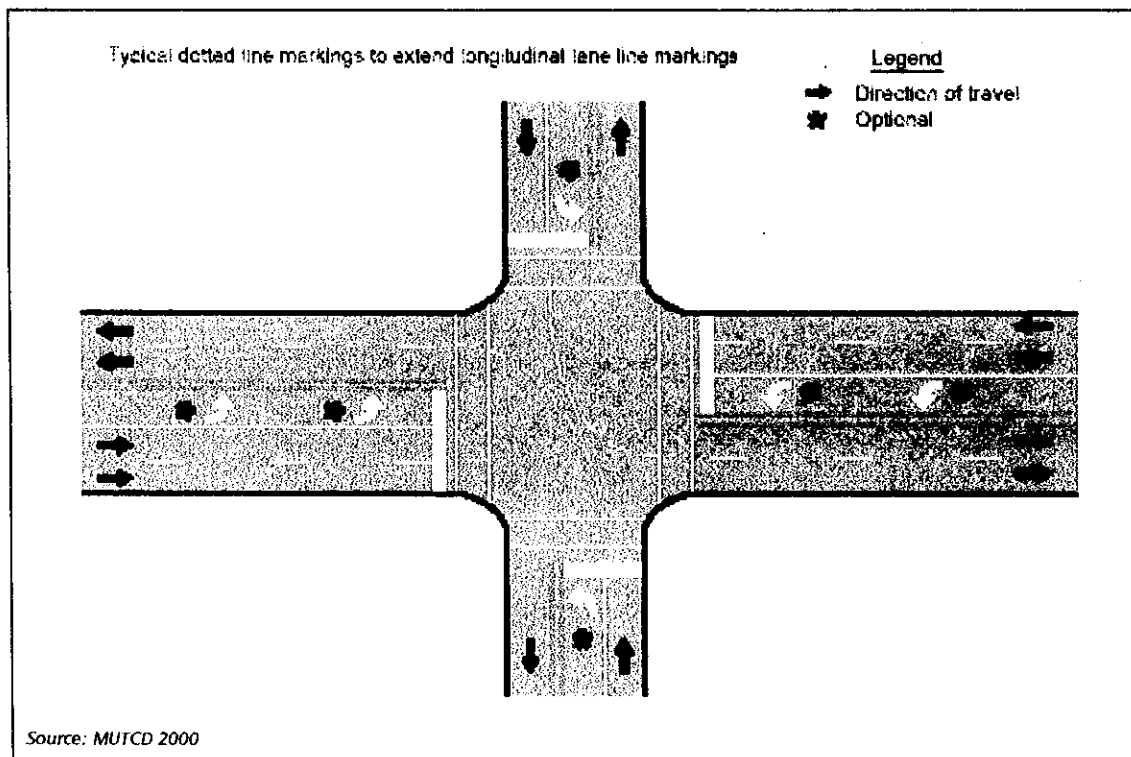
Source: MUTCD 2000

## E.4 Other Lines

### E.4.1 Turn Lines

A turn line may be used to guide vehicles through a turning movement at intersections. Turn lines, if used, should be so designed as to indicate the proper course for turning vehicles without being needlessly confusing to through traffic or traffic marking other turns. The line segments are 600mm long and 100mm wide with 600mm gaps. The line generally forms an arc and is positioned on the left hand edge of the turning lane. The line commences at the termination of the lane, edge or separation line, and shall continue up to but not cross another turn line.

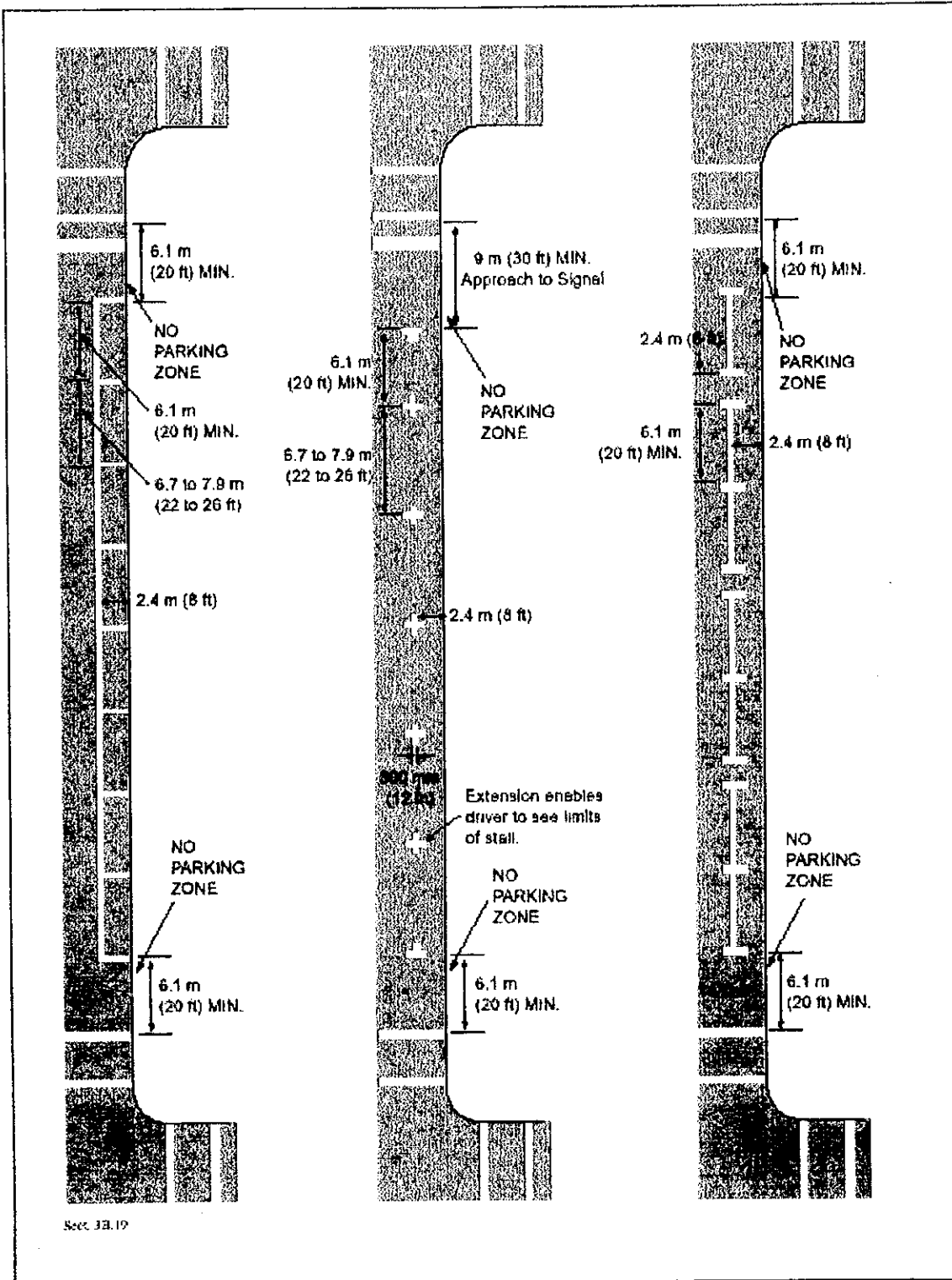
Figure E.4-1 Typical Turn Lines



### E.4.2 Parking Bay Lines

There are two types of parking bays, parallel parking and angle parking. In parallel parking without bays marked, the parking line is a 100mm wide white line, at 2.0m from and parallel to the curb. Bays, if marked, shall be also 100mm wide white line at minimum bay length of 6.0m. The end bay shall be 5.0m minimum. For angle parking, bay width shall be 2.5 meters minimum and the minimum bay length (i.e. minimum distance from curb to end of bay) shall be 4.8 meters.

Figure E.4-2 Typical Parking Space Markings





To ensure that the flow of turning traffic is not impaired, parking near intersections should be prohibited within the following distances from the boundaries of lateral roads:

- a.) Parallel Parking—5m on both approach and exit sides
- b.) Angle Parking —10m on approach side and 8m on exit side.

On approach to intersections where traffic signals are operating, a minimum distance of 20m from the traffic signal post is recommended. Angle parking should be permitted only where there is sufficient pavement width and light traffic.

#### **E.4.3 Painted Median Island**

Painted median islands are used on wide roads where light traffic volume cannot justify the installation of solid curbed median island.

The painted outline of the median shall be at least 100mm with a minimum median width of 2.0 meters. No painted median should be installed on roads less than 10 meters wide.

#### **E.4.4 Bus and PUJ Lane Line**

The Bus and PUJ lane line is an unbroken yellow line 100-300mm wide used to separate other vehicles from buses and PUJs. The Bus and PUJ lane line can be supplemented by raised pavement markers. The line is tapered at the approach to the signalized intersection. The distance between the taper and the stop line should be determined according to the capacity of the intersection and should generally be less than 100 meters.

## E.5 Other Markings

### E.5.1 Approach Markings to Islands and Obstructions

Diagonal marking on approaches to obstructions and median islands shall consist of a splayed line or lines 100mm wide extending from the center of lane line to a point of 300mm to 800mm to the right side or to both sides, of the approach end of the obstruction.

The width of the diagonal bars (at 45° to splayed lines or the direction of travel) is 600mm and gaps between bars should generally be 4 meters minimum on urban roads and 8m on rural roads. The total length of the splayed line depends on the width of the island or obstruction but should generally be a taper of 1 in 25 for roads on which the 85th percentile speed is below 60 kph and 1 in 50 for roads with higher 85th percentile speeds.

### E.5.2 Chevron Markings

Chevron markings are often used to guide traffic into the, right turning lanes separated by island, such as a corner island at a signalized intersection. The outline width is generally 100mm (150mm on high speed roads). Bars of 500mm to the outline in the direction of travel and spaced generally at 2-4 meters apart in urban roads. The spacing between the bar and the outline shall be 100mm (or 150mm on high speed roads).

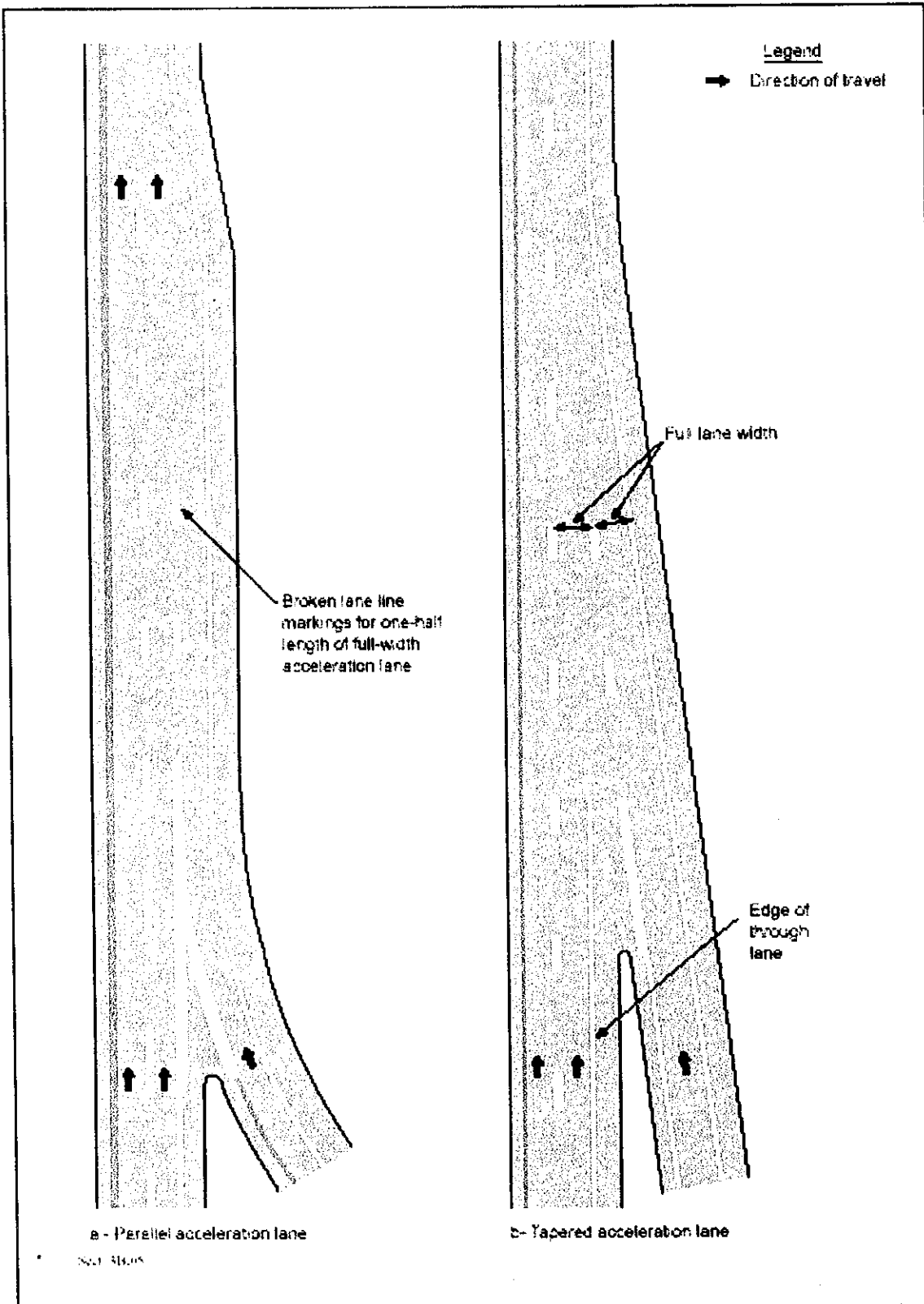
Diagonal marking on sealed shoulders or other sealed portion of the road where traffic is not desired. Such markings are of the same bar width as other diagonal markings. The spacing between bars is generally 6 meters.

### E.5.3 Marking on Exit and Entrance Ramps of Expressways

**Exit ramp marking.** A solid line at least 100mm in width shall be placed along the sides of the triangular neutral area between the edges of the main roadway and the exit ramp lane at the fore of every ramp terminal. With a parallel deceleration lane, a broken white line shall be placed from the apex of the triangular area for a distance of approximately one-half of the length of the full width deceleration lane. Diagonal markings should be used in the neutral area.

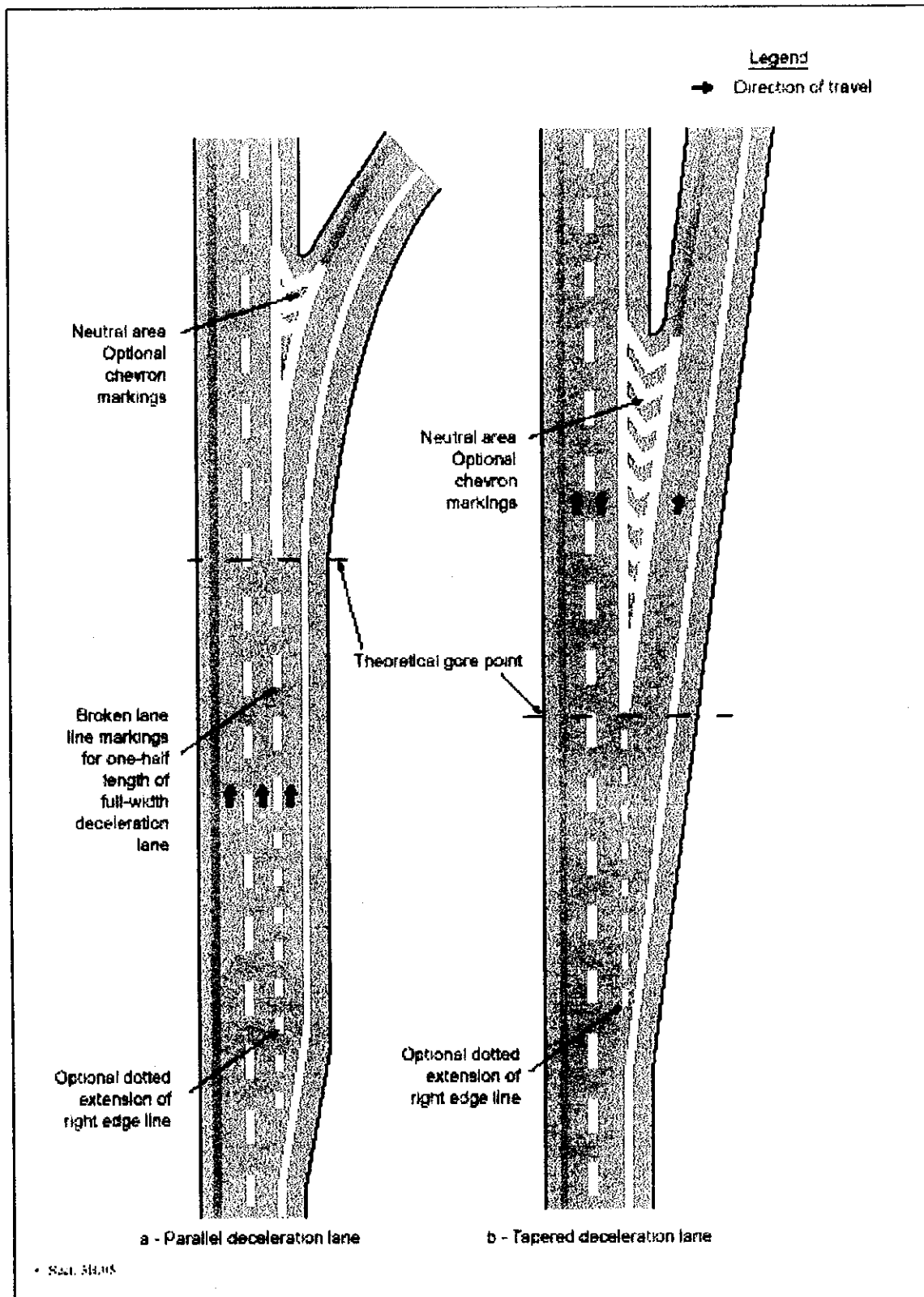
**Entrance ramp marking.** A solid white line at least 100mm in width shall be placed along the sides of the triangular neutral area adjacent to the ramp lane at the fore of every entrance ramp terminal. With parallel acceleration lanes, a broken white line but not beyond the point where the tapered line meets the outer edge of the near through lane. Examples of the uses of exit and entrance ramp markings are shown in Figures E.5-1 and E.5-2.

Figure E.5-1 Typical Entrance Ramp Marking for Expressways



Source: MUTCD 2000

Figure E.5-2 Typical Exit Ramp Marking for Expressways



#### E.5.4 Curb Markings for Parking Restrictions

The curb markings for parking restrictions shall be of solid yellow color, covering the face of the curb. Such markings are usually supplemented by parking prohibition signs to indicate the extent of the area where parking is legally prohibited at all times.

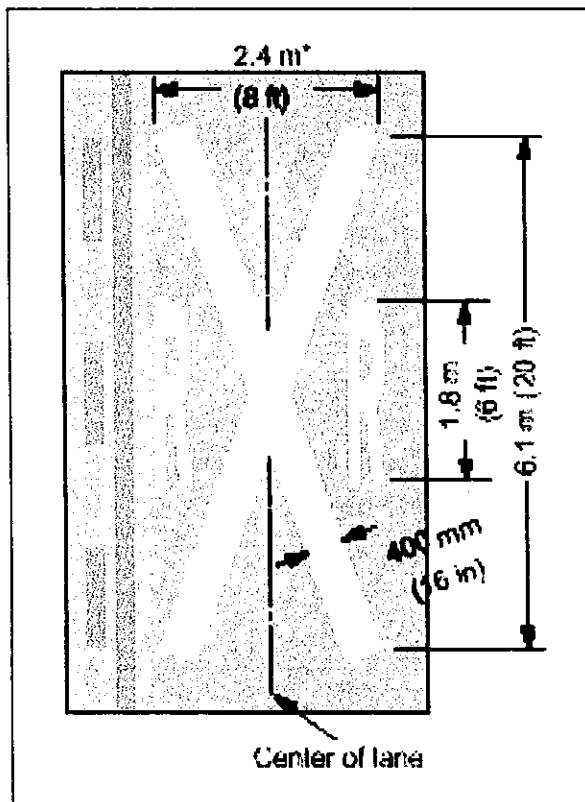
#### E.5.5 Approach to Railroad Crossing

Pavement markings consisting of a cross, the letter RR, a "No-Passing" zone marking, and a double solid stop bar at a distance of 3.0m to 12.0m in front of and parallel to the railway line, shall be placed on all paved approaches to railroad crossings. Such markings shall be white except the NO PASSING barrier line which shall be yellow.

Where there are boom gates at the signal controlled crossings, stop bars are to be marked parallel to the boom gates. These markings are auxiliary to the standard international sign for railroad advance warning and the crossing signals for gates.

The design of railroad pavement markings is illustrated in Figure E.5-1.

Figure E.5-1 Grade Crossing Pavement Markings



Source: MUTCD 2000

## E.6 Messages and Symbols

### E.6.1 Messages

Messages when used should be limited to as few words as possible, never more than three. They shall only be used to supplement other traffic control devices. The distance between words is variable depending on the message and location at which it is based. (Usually twice the length of the word if achievable).

The first word of the message is to be nearest the motorist on rural roads. In urban low speed areas, the order is optional.

Messages are white in color with letters or numerals used on roads in urban areas shall be at least 2.5m and on high speed highways, they may need to be at least 5 meters.

Messages generally in use are:

- STOP
- KEEP CLEAR
- SCHOOL
- PED XING
- RAILROAD XING
- SIGNAL AHEAD
- NO RIGHT (LEFT) TURN
- BUS & PUJ LANE

### E.6.2 Symbols

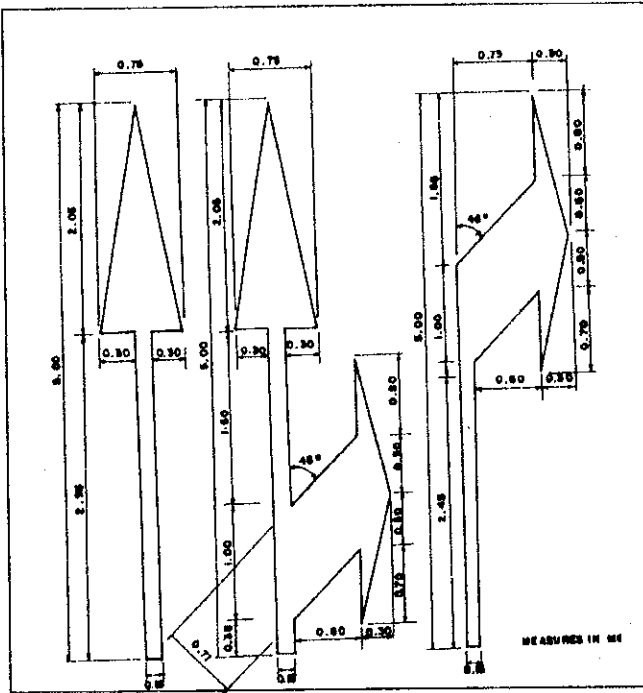
**"GIVE WAY" (Yield) Symbol.** The symbol used to supplement the give way sign consist of an isosceles triangle having two equal sides of 3.1m and a base 1.0m. Outline width is 450mm at the base and 150mm for the sides. The distance of the symbol from the holding line is between 5 and 25 meters depending on the location and vehicle speeds on that road.

**Pavement Arrow.** Pavement arrows are used for lane use control. White in color, they are generally 5 meters in length on urban roads and 7.5 meters on high-speed roads. The sizes and arrow heads are illustrated in Figure E.6-1. For half turn movements, the stems of the straight arrows can be bent to suit the particular direction of movement.

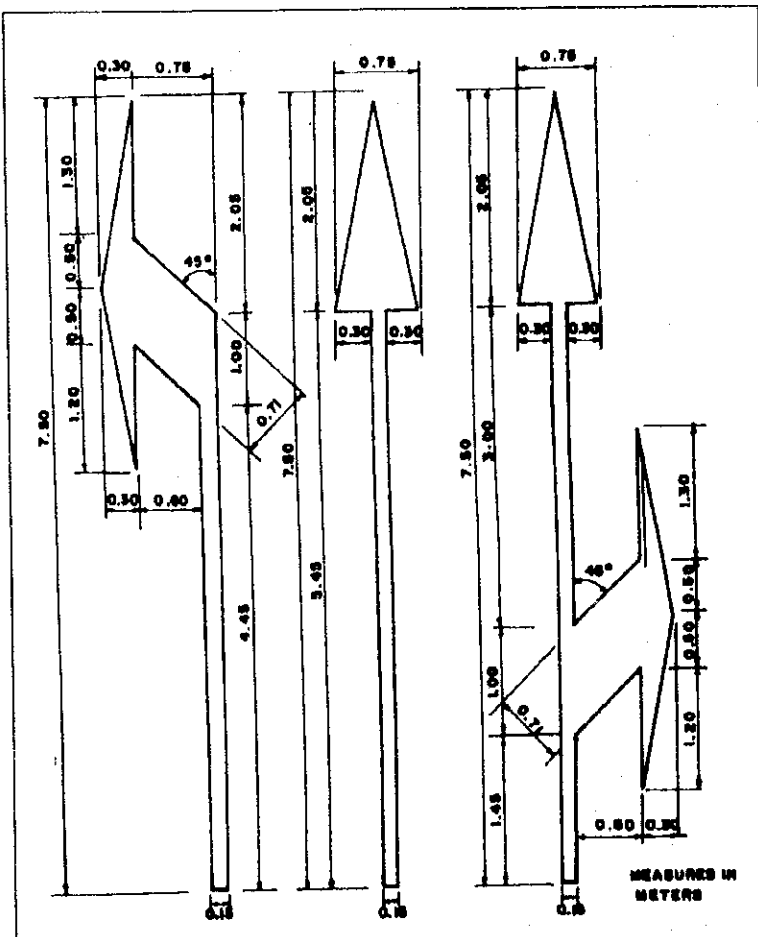
The first set of arrows should be placed at a distance of 15m from the stop bar and the subsequent sets should be placed at 45m apart.

Figure E.6-1 **Pavement Arrows**

For Roads with  
Speed Limit  
60 km/hr  
or less



For Roads with  
Speed Limit over 60  
km/hr



Source: DPWH Manual on Pavement Markings

### E.6.3 Numerals

The only numerals should be used are those associated with speed limits at locations to supplement speed limit signs which are continuously disregarded by drivers or which are obscured and cannot be resited easily.



## E.7 Object Markings

### E.7.1 Application of object markings

Object markers are used to mark physical obstructions in or near a roadway that constitute serious hazard to traffic. Installations designed for the control of traffic shall also be adequately marked. Typical obstructions of this character are bridge supports, monuments, traffic islands, beacon, signal and sign support, loading islands, railroads and draw-bridge gate, and posts of narrow bridges, underpass piers and abutments, culvert headwalls, poles, trees, rocks, and structures giving restricted and overhead clearance.

Judgment must be exercised in the marking of objects off the roadway, but it may be noted that even where they are theoretically at a safe distance from the roadway, marking them may prevent serious accidents and facilitate night driving. In addition to markings, a guardrail should be placed in advance of solid obstructions to deflect runaway vehicles and reduce the severity of impact. Guardrails should be painted white and reflectorized.

When used, object markers may consist of an arrangement of one or more of the following types:

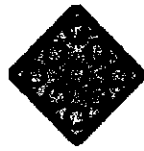
Type 1 – either a marker consisting of nine yellow retroreflectors, each with a minimum diameter of 75mm, mounted symmetrically on a yellow or black diamond panel 450mm or more on a side; or on an all-yellow retroreflective diamond panel of the same size.

Type 2 – either a marker consisting of three yellow retroreflectors, each with a minimum diameter of 75mm, arranged either horizontally or vertically on a white panel; or on an all-yellow retroreflective panel, measuring at least 150mm x 300mm.

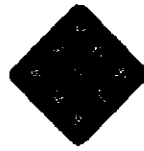
Type 3 – a striped marker, 300mm x 900mm, consisting of a vertical rectangle with alternating black and retroreflective yellow stripes sloping downward at an angle of 45 degrees toward the side of the obstruction on which traffic is to pass. The minimum width of the yellow stripe shall be 75mm.

A better appearance can be achieved if the black stripes are wider than the yellow stripes. Type 3 object markers with stripes that begin at the upper right side and slope downward to the lower left side are designated as right object markers (OM-3R). Object markers with stripes that begin at the upper left side and slope downward to the lower right side are designated as left object markers (OM-3L).

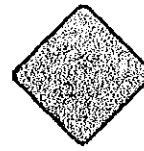
When used for marking objects in the roadway or objects that are 2.4m or less from the shoulder or curb, the mounting height to the bottom of the object marker should be at least 1.2m above the surface of the nearest traffic lane. When used to mark objects more than 2.4m from the shoulder or curb, the mounting height to the bottom of the object marker should be at least 1.2m above the ground.



OM1 1



OM1 2



OM1 3

**Type 1 Object Markers**



OM2 1V



OM2 2V



OM2 1H



OM2 2H

**Type 2 Object Markers**



OM 3L



OM 3C



OM 3R

**Type 3 Object Markers**



OM4 1



OM4 2



OM4 3

**End of Road Markers**

Source: MUTCD 2000

### E.7.2 Objects within the Roadway

Obstructions in the roadway, if not illuminated shall be marked with reflectorized hazard markers. For additional emphasis it is advisable also to mark obstructions other than islands with reflectorized white paint with not less than five alternating black and reflectorized white stripes. The stripes shall slope downward at an angle of 45 degrees towards the side of the obstruction on which traffic shall be uniform and not less than 100mm in width. A large surface, such as a bridge pier, may require stripes of 300mm.

In addition to the marking on the face of an obstruction in the roadway, warning of approach to the hazard shall be given by line markings on the pavement.

Where an obstruction lies in the direct lines of traffic it shall be marked and whenever practical, illuminated by a floodlight so constructed that it will adequately light the object but will not throw a glare in the face of traffic approaching from either direction. When floodlighting is not practical, reflective hazard markers shall be used. A flashing yellow beacon may be used at unusually hazardous obstructions.

### E.7.3 Marking on Curbs

Reflectorized yellow should be used on curbs of all islands located in the line of traffic flows especially on curbs directly ahead of traffic at 'T' and offset intersections.

### E.7.4 Objects adjacent to the roadway

Hazard markers either as signs or painted markings are to be used on objects so close to the edge of the roadway as to constitute definite hazard. These include such encroachments as underpass piers, abutments, culvert headwalls, utility poles and ornamental buildings, etc.

Other adjacent objects which are not likely to be hit unless a vehicle runs off the road, such as guardrails, trees and rocks may be painted white, but reflectorized.

## **E.8 Raised Pavement Markers**

### **E.8.1 General**

Raised pavement markers are small dome shaped devices which are fixed to the pavement surface to stimulate or supplement painted pavement markings. The markers can be reflective or non-reflective.

Raised pavement markers generally have heights of at least 10mm mounted on or in a road surface that is intended to be used as a positioning guide or to supplement or substitute for pavement markings.

Raised pavement markers are generally not obscured at night under wet conditions and the reflective types are more brilliant than reflectorized paint markings.

### **E.8.2 Warrants for use**

Because of the high cost of installation and maintenance, use of raised pavement marking may be considered only in hilly areas where fog and rain are frequently the cause of traffic accidents.

### **E.8.3 Raised pavement markers as vehicle positioning guides with other longitudinal markings**

The substitution of painted lines by raised pavement markers should occur where necessary and is usually reserved for lane lines where the visual, auditory and tactile effect of the markers help to keep the motorists in a given lane. The markers used for this purpose are a combination of reflective and non-reflective markers.

The raised pavement markers are used as positioning guides with longitudinal line markings without necessarily conveying information to the road user about passing or lane-use restrictions. They are particularly useful when placed at regular intervals in gaps along a line and may help to define the line particularly at night or under foggy or wet conditions. In such applications, markers may be positioned between the two lines of a one-way or two-way no-passing zone marking or positioned in line with or immediately adjacent to single solid or broken centerline or lane line markings.

A typical spacing for such applications is  $2N$ , where  $N$  equals the length of one line segment plus one gap. Where it is desired to alert the road user to changes in the travel path, such as on sharp curves or on transitions that reduce the number of lanes or that shift traffic laterally, the spacing may be reduced to  $N$  or less.

#### E.8.4 Raised pavement markers supplementing other markings

The use of raised pavement markers for supplementing longitudinal line markings should conform to the following:

##### Lateral Positioning

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

##### Longitudinal Spacing

1. When supplementing solid line markings, raised pavement markers at a spacing no greater than  $N$  should be used, except when supplementing left edge line markings, a spacing no greater than  $N/2$  should be used. Raised markers should not supplement right edge line markings.
2. When supplementing broken line markings, a spacing no greater than  $2N$  should be used. However, when supplementing broken line markings identifying reversible lanes, a spacing no greater than  $N$  should be used.
3. When supplementing dotted line markings, a spacing appropriate for the application should be used.
4. When supplementing longitudinal line markings through at-grade intersections, one raised pavement marker for each short line segment should be used.
5. When supplementing edge line extensions through freeway interchanges, a spacing of  $N/2$  should be used.

Raised pavement markers also may be used to supplement other markings for channelizing islands or approaches to obstructions.

#### E.8.5 Raised pavement markers substituting for pavement markings

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

If used, the pattern and color of the raised pavement markers should simulate the pattern and color of the markings for which they substitute. The normal spacing of raised pavement markers, when substituting for other markings, should be determined in terms of the standard length of the broken line segment.

The side of a raised pavement marker that is visible to traffic proceeding in the wrong direction may be red. When raised pavement markers substitute for broken line markings, a group of four or five markers equally spaced at  $N/12$ , or at the one-third points of the

line segment if  $N$  is other than 12m, with at least one retroreflective or internally-illuminated marker per group shall be used. When raised pavement markers substitute for solid lane line markings, the markers shall be equally spaced at no greater than  $N/8$ , with retroreflective or internally-illuminated units at a spacing no greater than  $N/2$ .

Raised pavement markers should not substitute for right edge line markings.

When raised pavement markers substitute for dotted lines, they shall be spaced at  $N/8$ , with not less than one raised pavement marker per dotted line. At least one raised marker every  $N$  shall be retroreflective or internally-illuminated. When substituting for wide lines, raised pavement markers may be placed laterally adjacent to each other to simulate the width of the line.

## E.9 Hazard Markers

### E.9.1 General

Hazard markers are rectangular in shape and generally consist of a series of alternate black and white bands. The white portion is always reflectorized, but the reflective material may cover only the central portion of each white band in order to achieve a balance between the areas of black and white under headlight illumination. The bands may consist of either diagonal strips where only a target is required, or of chevrons where directional as well as target, properties are desirable. Markers are either installed metal signs or as painted markings on the object to be marked.

### E.9.2 Types of Hazard Markers

**Directional.** Directional markers are used at road hazards where it is necessary to emphasize to approaching traffic the direction to be taken if the marker appears in the drivers' line of approach. The direction is indicated by chevrons, which may point to the left or right as required.

Typical uses are:

- a.) At rotondas and traffic islands which involve the deflection of traffic paths
- b.) On through carriageways where one or more traffic lanes end abruptly (e.g. at a narrow bridge).
- c.) On substandard curves (two or more markers may be used to emphasize the curve).
- d.) At dead-end streets.
- e.) At T junctions..

**Width Markers.** Width markers are erected in pairs on either sides of a hazard formation which narrows over structures such as culverts, bridge piers or end posts.

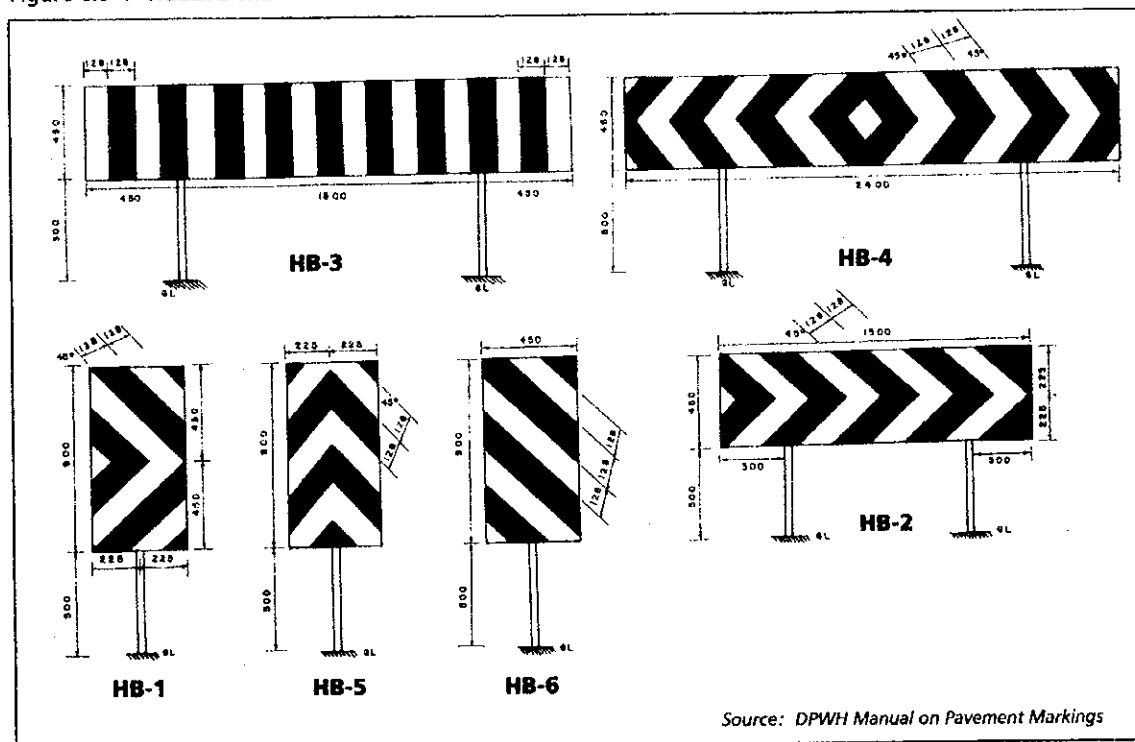
They are warranted where the clearance from the normal pavement width to vertical obstructions is:

- a.) 600mm or less for a pavement 7.4m wide
- b.) 1m or less for a pavement 6.2m wide or
- c.) 1.2m or less for a pavement 5.6m wide.

Width markers should generally be erected on the line of vertical obstruction. Where wide curbs or footings exist special consideration should be given to the position of the marker. Each width marker is normal 450mm x 900mm but this may be viewed to suit a particular condition.

**Vertical obstruction markers.** Vertical obstruction markers are erected singly on utility poles, central bridge piers or other vertical obstructions which are so close to the carriageway as to be a hazard. The dimensional proportions may be viewed to fit the particular obstruction.

Figure E.9-1 Hazard Markers



### E.9.3 Usage

- HB-1** To be used at the ends of narrow obstructions
- HB-2** To be used at the ends of wide obstructions
- HB-3** To be used where no through traffic is allowed
- HB-4** To be used where traffic can proceed on either side of a wide obstruction
- HB-5** To be used where traffic can proceed on either side of a narrow obstruction
- HB-6** To be erected singly or in pairs on utility poles, central bridge piers or other vertical obstructions, on or near the carriageway.

All retroreflective material shall be Class I Silver White.



## E.10 Delineators

### E.10.1 General

Delineators are small reflective panels or buttons mounted on guide posts or guard fence as an effective aid for night driving. Delineators are particularly beneficial at locations where the alignment might be confusing or unexpected, such as at lane reduction transitions and curves. Delineators are effective guidance devices at night and during adverse weather. An important advantage of delineators in certain locations is that they remain visible when the roadway is wet.

Delineators are considered guidance devices rather than warning devices.

### E.10.2 Design and Application

Delineators are made of reflective material capable of reflecting light clearly visible under normal atmospheric condition from a distance of 300-500 meters when illuminated by the upper beam of standard automobile head lamps. They are mounted above the roadway surface and along the side of the roadway in a series to indicate the alignment of the roadway. Delineators shall consist of retroreflector units that are capable of clearly retroreflecting light under normal atmospheric conditions from a distance of 300 m when illuminated by the high beams of standard automobile lights. Retroreflective elements for delineators shall have a minimum dimension of 75mm.

Delineators may be used on long continuous sections of highway or through short stretches where there are changes in vertical and/or horizontal alignment or in pavement width.

When used on through roadways, delineators shall be single white reflective units 100mm x 50mm placed on the right-hand side of a two-way and on both sides of a one-way road. Where delineators are used on the left at a hazardous right hand curve on a two-way road, they may be bi-directional; i.e. delineators with two faces, visible from both directions or two delineators mounted back to back.

### E.10.2 Delineator Placement and Spacing

Generally delineators are placed on posts or guard fence near the edge of the shoulder at a height such that the lower edge of the reflecting bend should not be less than 500mm above the pavement surface level. Delineators should be located at intervals not exceeding 300m with closer spacing on curves and should be approximately 300mm from the outer edge of the shoulder.

Elongated retroreflective units of appropriate size may be used in place of two retroreflectors mounted as a unit.

Figure E.10-1 Typical Delineator Installation

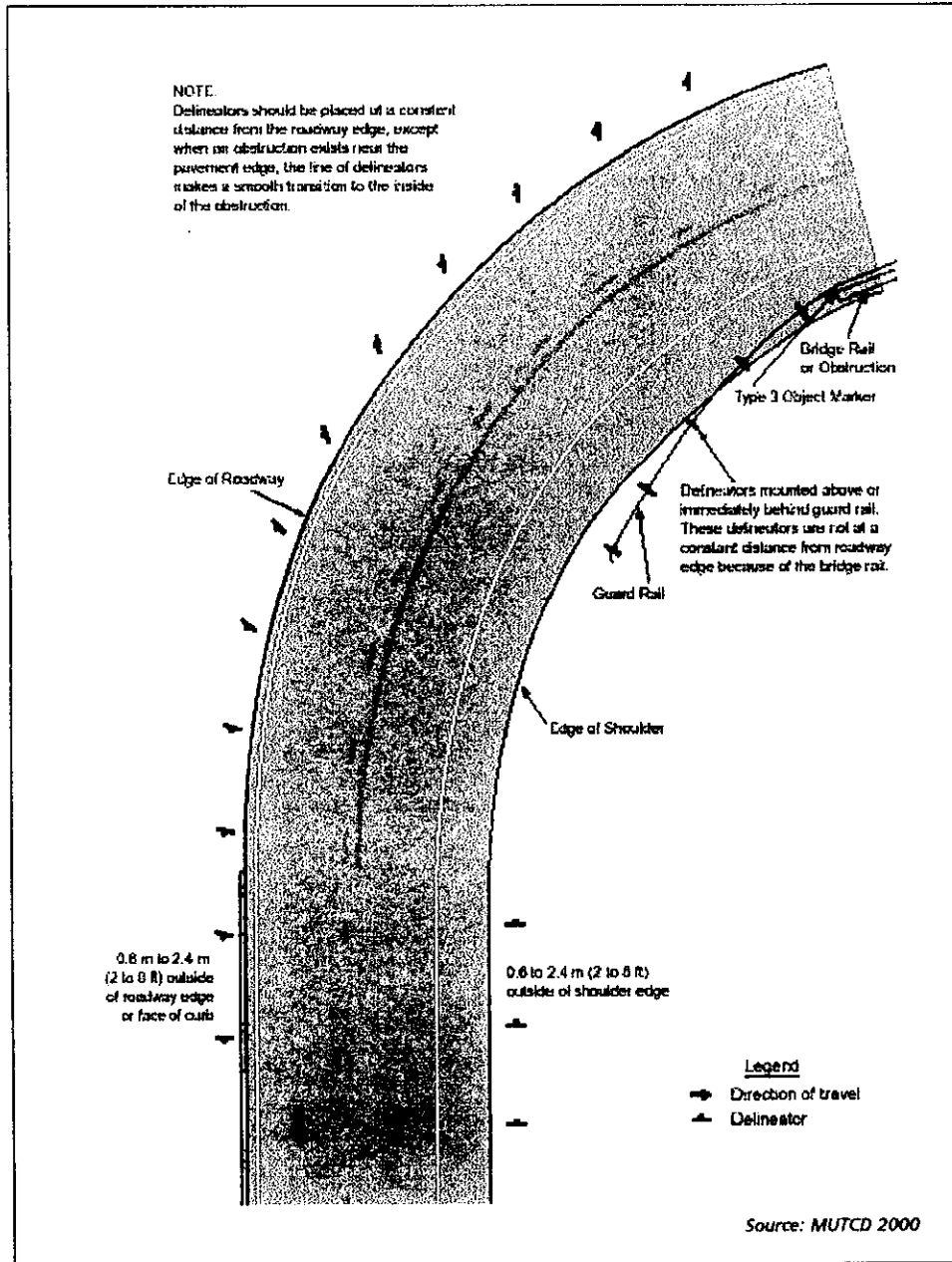


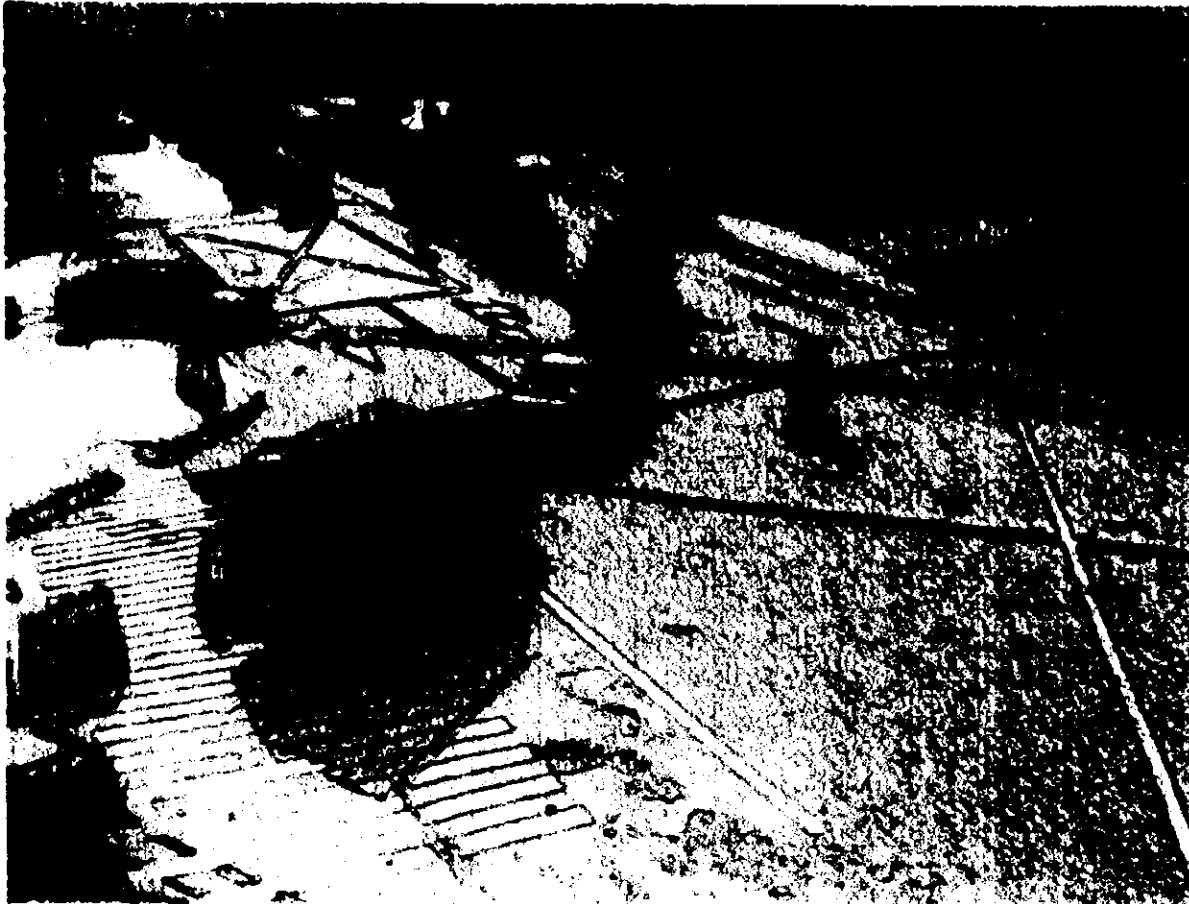
Table E.10-1 **Approximate Spacing for Delineators on Horizontal Curves**

<b>Radius, R of Curve (meters)</b>	<b>Approximate Spacing, S on Curve (meters)</b>
15	6
35	8
55	11
75	13
95	15
125	18
155	20
185	22
215	24
245	26
275	27
305	29

Source: MUTCD 2000

Spacing for specific radii may be interpolated from Table E.10-1. The minimum spacing should be 6m. The spacing on curves should not exceed 90m. In advance of or beyond a curve, and proceeding away from the end of the curve, the spacing of the first delineator is 2S, the second 3S, and the third 6S but not to exceed 90m. "S" refers to the delineator spacing for specific radii computed from the formula  $S=1.7\sqrt{R-15}$ .

**SSTRIMM**  
**Traffic Management Manual**



**Annex F**  
**Cost Items**

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# Annex F

## **Cost Items**

This Annex presents typical Traffic Improvement Project cost items. It attempts to give a detailed breakdown of the different items that need to be costed prior to implementation. This Annex supplements the discussion given in Section 3.1 of the Manual.

Although all efforts to provide a complete listing were undertaken, no claim is made that this is an exhaustive list.

## F.1 Data Collection and Surveys

### F.1.1 Research and Survey Proper

Item	Typical unit of measure
A. Researcher	person-days
B. Survey Supervisor	person-days
C. Interviewers	person-days
D. Area Coordinators	person-days
E. Survey Personnel	person-days
F. Insurance for field personnel	person-day
G. Transportation	person-day
H. Vehicle Rental (travel time surveys)	vehicle-days
I. Public Transport fare (public transport surveys)	pax-km
J. Printing of field survey sheets	pc.
K. Printing of questionnaires (for interview surveys)	pc.
L. Printing of survey manual	pc.
M. Plastic Envelopes	pc.
N. Pencils	pc.
O. ID cards	pc.
P. Flashlights (for night shift)	pc.
Q. Clipboards	pc.
R. Erasers, sharpeners, etc	pc.
S. Staplers, etc.	pc.
T. Rental of click-type counters	pc.
U. Raincoats for field personnel	

### F.1.2 Editing / Coding

Item	Typical unit of measure
A. Editors	person-days
B. Coders	person-days
C. Overtime Contingency	% of manpower cost
D. Supplies - maps	pc.
E. Supplies - ball pens	pc.
F. Supplies - envelopes	pc.
G. Supplies - storage boxes	pc.

## F.1.3 Encoding

Item	Typical unit of measure
A. Checkers	person-days
B. Encoders	person-days
C. Overtime Contingency	% of manpower cost
D. Supplies -diskettes	pc.
E. Supplies - IDs	pc.
F. Supplies - ball pens	pc.
G. Rental of Computers	per pc per day
H. Rental of other computer peripherals	per item per day

## F.2 Traffic Management Equipment

- | Item                                     |
|------------------------------------------|
| A. Reflectorized Gloves                  |
| B. Reflectorized vests                   |
| C. Rubber Boots                          |
| D. Raincoats                             |
| E. Megaphones                            |
| F. Rechargeable batteries for megaphones |
| G. Battery charger                       |
| H. Traffic Cones                         |
| I. Traffic Safety Barriers               |



### F.3 Traffic Signs

Description	DPWH Code	Size (mm)	Latest Quote	
			Supplied Price	Installed Price
1 One Way	R2 – 8R	900 x 300	2,212.00	2,543.80
2 One Way	R2 – 8L	900 x 300	2,212.00	2,543.80
3 No Loading/Unloading Anytime	R5 – 6	450 x 750	2,590.00	2,978.50
4 Jeepney Stop	R5 – 9	550 x 800	3,164.00	3,638.60
5 Bus/PUJ Stop	R5 – 10	550 x 800	3,164.00	3,638.60
6 Keep Intersection Open	R5 – 12	600 x 900	3,724.00	4,282.60
7 Turn Right Anytime With Care	S2 – 3	600 x 750	3,220.00	3,703.00
8 No Right Turn on Red Signal	S2 – 6	600 x 880	3,640.00	4,186.00
9 Pedestrian Crossing	W6 – 1	600 x 900	3,850.00	
10 Stop Sign	R1 – 1	600 x 750	2,716.00	3,123.40
11 Directional Sign (disc type)	R2 – 1	600 x 880	2,716.00	3,123.40
12 Directional Sign (disc type)	R2 – 2	750 each side	2,716.00	3,123.40
13 Directional Sign (disc type)	R2 – 3	600 diameter	2,716.00	3,123.40
14 Directional Sign (disc type)	R2 – 4	600 diameter	2,716.00	3,123.40
15 Directional Sign (disc type)	R2 – 5	600 diameter	2,716.00	3,123.40
16 No Entry	R3 – 1	600 diameter	2,716.00	3,123.40
17 No Left Turn	R3 – 13	600 diameter	2,716.00	3,123.40
18 No Right Turn	R3 – 14	600 diameter	2,716.00	3,123.40
19 No U-Turn	R 3 – 15	600 diameter	2,716.00	3,123.40
20 No Overtaking	R3 – 16	600 diameter	2,716.00	3,123.40
21 No Parking	R5 – 1	600 diameter	2,716.00	3,123.40

## F.4 Pavement Markings

Item	Unit of measure	Quoted Price
A. Thermoplastic 100mm white line	meters	PHP 75.00
B. Thermoplastic 150mm white line	m.	85.00
C. Thermoplastic 200mm white line	m.	150.00
D. Thermoplastic 300mm white line	m.	165.00
E. Thermoplastic 450mm white line	m.	250.00
F. Thermoplastic 100mm yellow line	m.	75.00
G. Thermoplastic 150mm yellow line	m.	85.00
H. Thermoplastic 200mm yellow line	m.	150.00
I. Thermoplastic Straight Arrow	pc.	930.00
J. Thermoplastic Left Arrow	pc.	970.00
K. Thermoplastic Right Arrow	pc.	970.00
L. Thermoplastic Left -Through Arrow	pc.	1,370.00
M. Thermoplastic Right-Through Arrow	pc.	1,370.00
N. Thermoplastic Butterfly (Left-Right Arrow)	pc.	1,370.00

## F.5 Engineering Works

### F.5.1 Earthworks

Item	Typical unit of measure
A. Clearing & Grubbing	hectare
B. Removal of Existing Structures/Buildings (Light)	square meter (sq. m.)
C. Removal of Existing Structures/Buildings (Medium)	sq.m.
D. Removal of Existing Structures/Buildings (Heavy)	sq.m.
E. Removal of Existing Manhole/Catch Basin	piece
F. Removal of Existing RCPC, 600-900 mm dia. & Larger	linear meter (l.m.)
G. Break and Remove Existing AC Pavement	sq.m.
H. Break and Remove Existing PCC Pavement	sq.m.
I. Removal of Existing Concrete Curb	l.m.
J. Removal of Existing Concrete Curb & Gutter	l.m.
K. Removal of Existing Sidewalk	sq.m.
L. Unsuitable Excavation	cubic meter (cu.m.)
M. Earth Cut and Dispose Surplus	cu.m.
N. Earth Cut to Fill	cu.m.
O. Embankment From Borrow	cu.m.
P. Subgrade Preparation	sq.m.

## F.5.2 Pavement

Item	Typical unit of measure
A. Aggregate Subbase	cu.m.
B. Crushed Aggregate Base Course	cu.m.
C. Portland Cement Treated Base	cu.m.
D. Bituminous Prime Coat, Cut-back Asphalt	metric ton (m.t.)
E. Bituminous Tack Coat, Emulsified Asphalt	m.t.
F. Bituminous Concrete Surface Course	m.t.
G. Portland Cement Concrete Pavement, 230 mm thick	sq.m.
H. Portland Cement Concrete Pavement, 250 mm thick	sq.m.
I. Portland Cement Concrete Pavement, 280 mm thick	sq.m.
J. Portland Cement Concrete Pavement, 300 mm thick	sq.m.
K. Portland Cement Concrete Pavement, 350 mm thick	sq.m.

## F.5.3 Bridge Structures

Item	Typical unit of measure
A. P. S. Conc. Pile, Furnished & Driven (400mm x 400mm)	l.m.
B. P. S. Conc. Pile, Furnished & Driven (450mm x 450mm)	l.m.
C. Test Pile, Furnished and Driven (400mm x 400mm)	each
D. Concrete Railing	l.m.
E. Structural Steel (Furnished, Fabricated & Erected)	kg.
F. Reinforcing Steel	kg.
G. Concrete Class A for Bridge Structures (3,500 psi)	cu.m.
H. Concrete Class A for Other Structures (3,000 psi)	cu.m.
I. Lean Concrete	cu.m.
J. P. S. Concrete Girder, Type IV (L=25 m)	each
K. Pedestrian Bridge (Overpass)	sq.m.
L. Bridge Structure (River Crossing, RCDG)	sq.m.
M. Bridge Structure (River Crossing, SIB)	sq.m.
N. Bridge Structure (River Crossing/Flyover, PCDG, Spread Ftgs.)	sq.m.
O. Bridge Structure (River Crossing/Flyover, PCDG, Ftgs On Piles)	sq.m.
P. Bridge Structure (River Crossing/Flyover, PCDG, Bored Piles)	sq.m.

#### F.5.4 Drainage Works

Item	Typical unit of measure
A. Reinforced Concrete Pipe Culverts, 610 mm dia.	l.m.
B. Reinforced Concrete Pipe Culverts, 760 mm dia.	l.m.
C. Reinforced Concrete Pipe Culverts, 910 mm dia.	l.m.
D. Reinforced Concrete Pipe Culverts, 1070 mm dia.	l.m.
E. Reinforced Concrete Pipe Culverts, 1220 mm dia.	l.m.
F. Reinforced Concrete Pipe Culverts, 1520 mm dia.	l.m.
G. Granular Bedding	cu.m.
H. Concrete Lined Ditch, w=0.50 m	l.m.
I. Drainage Manhole for 600-900mm Ø Pipe	each
J. Clean/Repair Exist. Drainage Pipe Culverts (600-900mm Ø)	l.m.
K. Grouted Riprap, Class A	cu.m.
L. Stone Masonry	cu.m.
M. Rechannel/Dredge Waterway	cu.m.

#### F.5.5 Miscellaneous Structures

Item	Typical unit of measure
A. Concrete Curb	l.m.
B. Concrete Gutter	l.m.
C. Combination Concrete Curb and Gutter	l.m.
D. Concrete Sidewalk	sq.m.
E. Median Island, ht.=0.15	sq.m.
F. Metal Beam Guardrail	l.m.
G. Metal Beam Guardrail End Piece	each
H. Fencing (Chainlink Fence Fabric inc. Posts)	l.m.
I. Road Signs, (Warning & Regulatory, 0.50 sq.m.)	each
J. Road Signs, (Warning & Regulatory, 0.50 - 1.0 sq.m.)	each
K. Road Signs, (Warning & Regulatory, 1.0 - 2.0 sq.m.)	each
L. Informatory Signs (1.0 - 2.0 sq. m.)	each
M. Informatory Signs (2.0 - 3.0 sq. m.)	each
N. Project Signs	no.
O. Pavement Markings, Reflective	sq.m.
P. Pavement Markings, Non-Reflective	sq.m.
Q. Pavement Markings, Thermoplastic	sq.m.
R. Reflectorized Pavement Studs	each

## F.6 Signalization

Item	Typical unit of measure
A. Intersection Improvement (signalization, new)	no.
B. Intersection Improvement (signal replacement/synchronization)	no.
C. Intersection Improvement (re-timing/coordination of signals)	no.
D. Street Lighting (Undercarriage/Flyovers/Street Luminaire)	no.
E. Street Lighting (Double Arm Post inc. Luminaires)	no.
F. Street Lighting (Single Arm Post inc. Luminaires)	no.
G. Relocation of Utilities (Electric Poles)	no.

## F.7 Design and Supervision

Item	Typical unit of measure
A. Engineering Design Services	4 %
B. Construction Supervision	8 %
C. Physical Contingencies	10 %

## F.8 Right of Way

Item	Typical unit of measure
A. R-O-W acquisition, residential areas	sq.m.
B. Affected residential structures / buildings	-
C. Middle income residential structures / buildings	sq.m.
D. Low income residential structures / buildings	sq.m.
E. Relocation of affected squatter families	no.
F. Commercial land areas	sq.m.
G. Affected commercial structures / buildings	sq.m.
H. Industrial land areas	sq.m.
I. Affected industrial structures / warehouses, factories	sq.m.
J. Affected industrial structures / warehouses, warehouses	sq.m.
K. All other land areas (agricultural/public/institutional centers)	sq.m.







