

Part III. MARKINGS

A. GENERAL PRINCIPLES

3A-1 Functions and Limitations

Markings have definite and important functions to perform in a proper scheme of traffic control. In some cases, they are used to supplement the regulations or warnings of other devices such as traffic signs or signals. In other instances, they are used alone and produce results that cannot be obtained by the use of any other device. In such cases they serve as a very effective means of conveying certain regulations and warnings that could not otherwise be made clearly understandable.

Pavement markings have definite limitations. They are obliterated by snow, may not be clearly visible when wet, and may not be very durable when subjected to heavy traffic. In spite of these limitations, they have the advantage, under favorable conditions, of conveying warnings or information to the driver without diverting his attention from the roadway.

3A-2 Standardization of Application

Each standard marking shall be used only to convey the meaning prescribed for it in this Manual. Before any new highway, detour, or temporary route is opened to traffic, all necessary markings should be in place.

Markings required by road conditions or restrictions should be removed or obliterated when those conditions cease to exist or the restrictions are withdrawn. Markings no longer applicable which may create confusion in the mind of the motorist shall be removed or obliterated.

Of growing importance is the tendency of traffic authorities to accommodate variable traffic conditions with different types of operation. For this purpose, signs and signals with the ability to display variable messages have been developed. The use of variable messages in the field of markings, however, has been somewhat more limited and confined to the manual placement of flexible cones and posts, and to a few mechanically-operated devices. It is to be expected that the future will bring forth new, practical methods of conveying variable messages by means of markings. When such

need and opportunity occur, extreme care should be used to adhere to the principles set forth in this Manual.

Markings which must be visible at night shall be reflectorized unless ambient illumination assures adequate visibility. All markings on Interstate highways shall be reflectorized.

3A-3 Materials

The most common method of placing pavement, curb, and object markings is by means of paint; however, a wide variety of other suitable marking materials is available. Materials used should provide the specified color throughout their useful life.

Individual unit markers, generally less than 1" in height, may be used for pavement marking purposes. They may be placed in continuous contact or separated by spaces, a variation in pattern being used to simulate solid and broken lines, with apparent widths as specified in section 3A-6. Raised markers of over 1" in height are sometimes used to form curbs and islands and are discussed in Part V.

Marking material used in the vicinity of pedestrian activity should not present tripping or excessive slipping hazards.

3A-4 Colors

Pavement markings shall be yellow, white, or red in color.

The use of black is permitted in combination with the above colors where the pavement itself does not provide sufficient contrast. This use of black does not establish it as a standard pavement marking color but only as a means of achieving contrast on light-colored pavements.

The colors for pavement marking shall conform to the standard highway colors.

3A-5 General Principles-Longitudinal Pavement Markings

Longitudinal pavement markings shall conform to the following basic concepts:

1. Yellow lines delineate the separation of traffic flows in opposing directions or mark the left boundary of the travel path at locations of particular hazard.
2. White lines delineate the separation of traffic flows in the same direction.
3. Red markings delineate roadways that shall not be entered or used by the viewer of those markings.
4. Broken lines are permissive in character.
5. Solid lines are restrictive in character.
6. Width of line indicates the degree of emphasis.
7. Double lines indicate maximum restrictions.

8. Markings which must be visible at night shall be reflectorized unless ambient illumination assures adequate visibility.

3A-6 Widths and Patterns of Longitudinal Lines

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

1. A normal width line is 4" to 6" wide.
2. A wide line is usually twice the width of a normal line.
3. A double line consists of two normal width lines separated by a discernible space.
4. A broken line is formed by segments and gaps, usually in the ratio of 3:5. On rural highways, a commonly used standard is 15 foot segments and 25 foot gaps. Other dimensions in this ratio may be used as best suit traffic speeds and need for delineation.
5. A dotted line is formed by short segments, normally two feet in length, and gaps, normally four feet or longer.

3A-7 Types of Longitudinal Lines

The following examples illustrate the application of the principles and standards set forth in sections 3A-4 to 3A-6:

1. A normal broken white line is used to delineate the edge of a travel path where travel is permitted in the same direction on both sides of the line. Its most frequent application is as a lane line of a multilane roadway.
2. A normal broken yellow line is used to delineate the left edge of a travel path where travel on the other side of the line is in the opposite direction. A frequent application is as a center line of a two-lane, two-way roadway where overtaking and passing is permitted with due care and caution.
3. A normal solid white line is used to delineate the edge of a travel path where travel in the same direction is permitted on both sides of the line but crossing the line is discouraged and as a pavement edge marking. A frequent application is as a lane line approaching an intersection. A wide solid white line is used for emphasis where the crossing requires unusual care. It is frequently used as a line to delineate left or right turn lanes.
4. A double solid white line is used to delineate a travel path where travel in the same direction is permitted on both sides of the line, but crossing the line is prohibited. It is frequently used as a channelizing line in advance of obstructions which may be passed on either side but not encroached upon.
5. A double line consisting of a normal broken yellow line and a normal solid yellow line delineates a separation between travel paths in opposite directions where overtaking and passing is permitted with care for traffic adjacent to the broken line and is prohibited for

traffic adjacent to the solid line. This is a one direction no-passing marking. It is used on two-way, two- and three-lane roadways to regulate passing and to delineate the edges of a lane in which travel in either direction is permitted (but only as part of a left turn maneuver). In the latter application, the markings are to be placed with the solid lines on the outside and the dashed lines to the inside of the lane. Traffic adjacent to the solid line may cross this marking with care only as part of a left-turn maneuver.

6. A double line consisting of two normal solid yellow lines delineates the separation between travel paths in opposite directions where overtaking and passing is prohibited in both directions. This is a two direction no-passing marking. Crossing this marking with care is permitted only as part of a left-turn maneuver. It is frequently used as a channelizing line in advance of an obstruction which must be passed on the right and to form a channelizing island separating traffic in counter directions.

7. A double normal broken yellow line delineates the edge of a lane in which the direction of travel is changed from time to time. Its use is for a reversible lane.

8. A normal dotted line is used to delineate the extension of a line through an intersection or interchange area. It shall be the same color as the line it extends.

9. A solid yellow line delineates the left edge of a travel path to indicate a restriction against passing on the left or delineates the left edge of pavement on a divided street or highway to indicate inadequate clear space to the left of the line even for disabled vehicles or for making emergency stops.

3A-8 Transverse Markings

Transverse markings including shoulder markings, word and symbol markings, stop lines, crosswalk lines, and parking space markings shall be white except that:

1. Transverse median markings shall be yellow (sec. 3B-10).
2. Line, word and symbol markings visible only to traffic proceeding in the wrong direction on a one-way roadway shall be red.

Because of the low approach angle at which pavement markings are viewed, it is necessary that all transverse lines be proportioned to give visibility equal to that of longitudinal lines, and to avoid apparent distortion where longitudinal and transverse lines combine in symbols or lettering.

3A-9 Curb Markings

Curb markings fall into two categories: roadway delineation and parking regulations.

B. APPLICATIONS OF PAVEMENT AND CURB MARKINGS

3B-1 Center Lines

A center line separates traffic traveling in opposite directions. It need not be at the geometrical center of the pavement. In locations where a continuous center line is not required, short sections may be useful on approaches to important intersections, marked crosswalks, or railroad crossings. Center lines are frequently used around curves or over hill crests, to control the position of traffic.

The center line markings on two-lane, two-way highways shall be either:

1. a normal broken yellow line where passing is permitted (#2, sec. 3A-7), or
2. a double line consisting of a normal broken yellow line and a normal solid yellow line where passing is permitted in one direction (#5, sec. 3A-7), or
3. a double line consisting of two normal solid yellow lines where passing is prohibited in both directions (#6, sec. 3A-7).

The center line on undivided highways where four or more lanes are always available, is usually a double solid yellow line.

On a three-lane highway it is preferable to designate two lanes for traffic in one direction and mark it as illustrated in figures 3-1b, 3-1c.

Center lines are desirable on paved highways under the following conditions:

1. In rural districts on two-lane pavements 16' or more in width with prevailing speeds of greater than 35 MPH.
2. In residence or business districts on all through highways, and on other highways where there are significant traffic volumes.
3. On all undivided pavements of four or more lanes.

Center lines are also desirable at other locations where an engineering study indicates a need for them.

Applications of center lines are shown in various illustrations herein, particularly figures 3-1, 3-2, 3-3, 3-4.

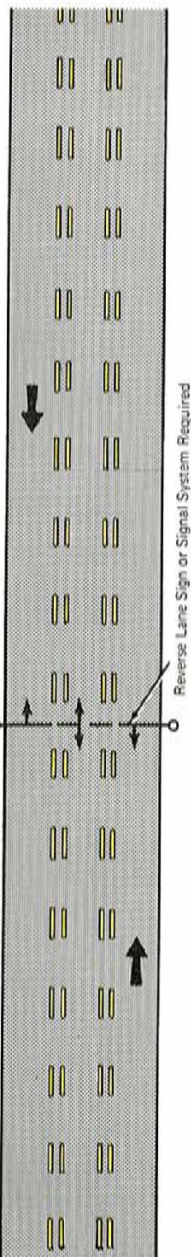
3B-2 Lane Lines

Lane lines are used to separate lanes of traffic traveling in the same direction. They should be used:

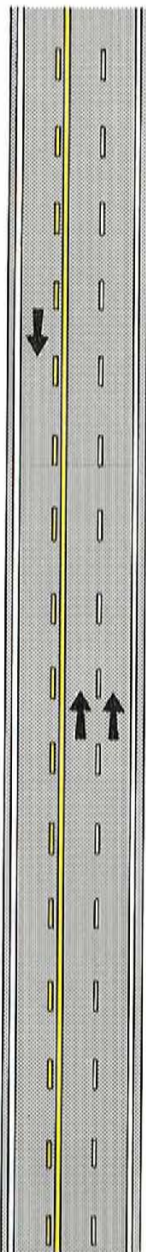
1. On all multi-lane highways.
2. At congested locations where the roadway will accommodate more lanes of traffic than would be the case without the use of lane lines.

Lane lines are usually normal broken white lines which permit lane changing with care.

a — Typical two-way marking with a reversible center lane.



b — Typical two-way marking where motorists in a single lane are permitted to pass.



c — Typical two-way marking where motorists in a single lane are not permitted to pass.

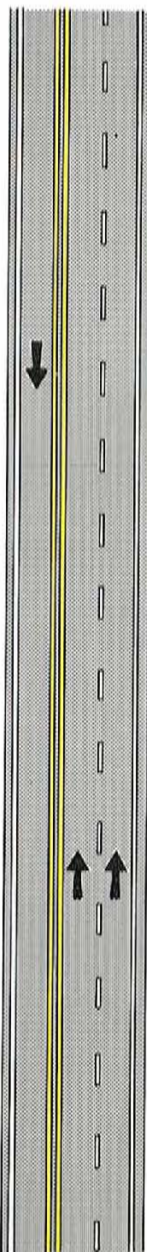
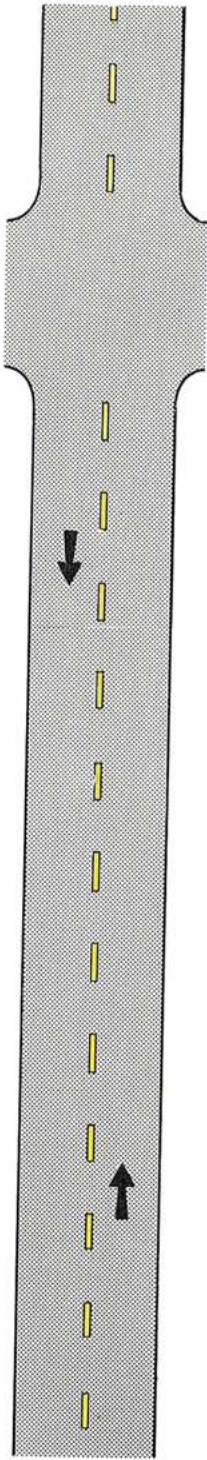


Figure 3-1. Typical two-way marking applications.

a — Typical two-lane, two-way marking with passing permitted.



b — Typical two-lane, two-way marking with passing prohibited zones.

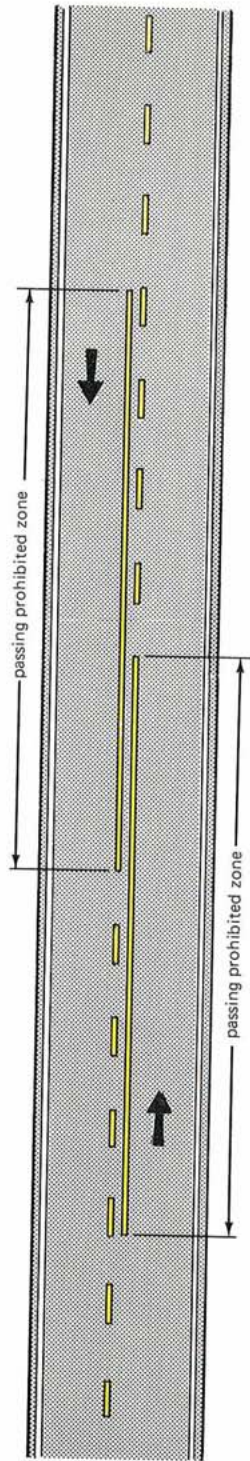
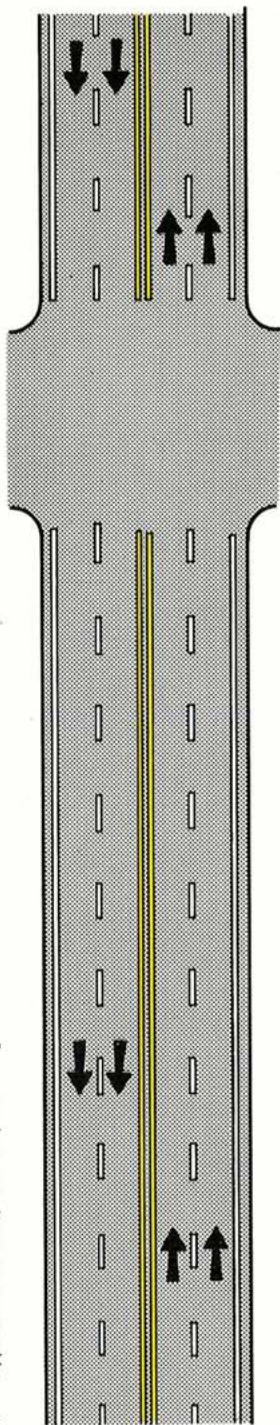


Figure 3-2. Typical 2-lane, two-way marking applications.

a - Typical multi-lane, two-way marking.



b - Typical multi-lane, two way marking with single lane left turn channelization.

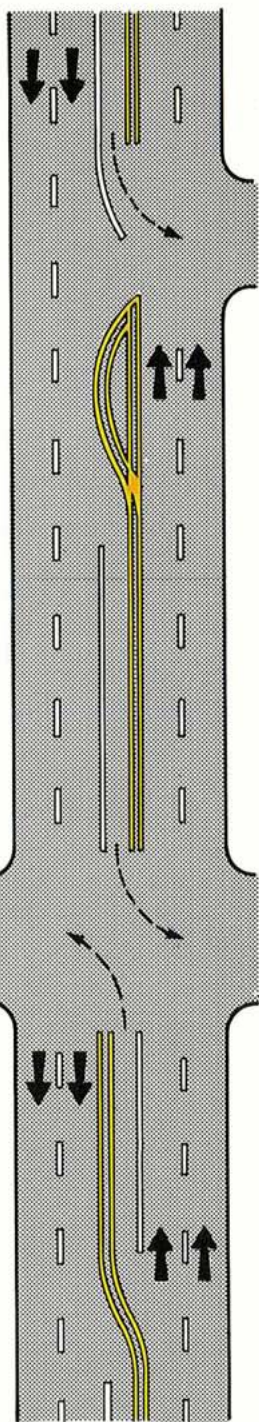
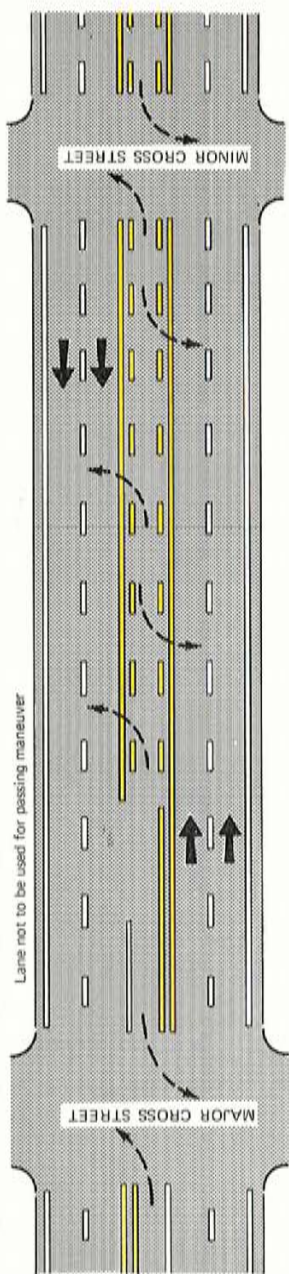


Figure 3-3. Typical multilane, two-way marking applications.

a — Typical multi-lane, two-way marking with single lane, two-way left turn channelization.



b — Typical multi-lane, two-way marking with dual lane left turn channelization.

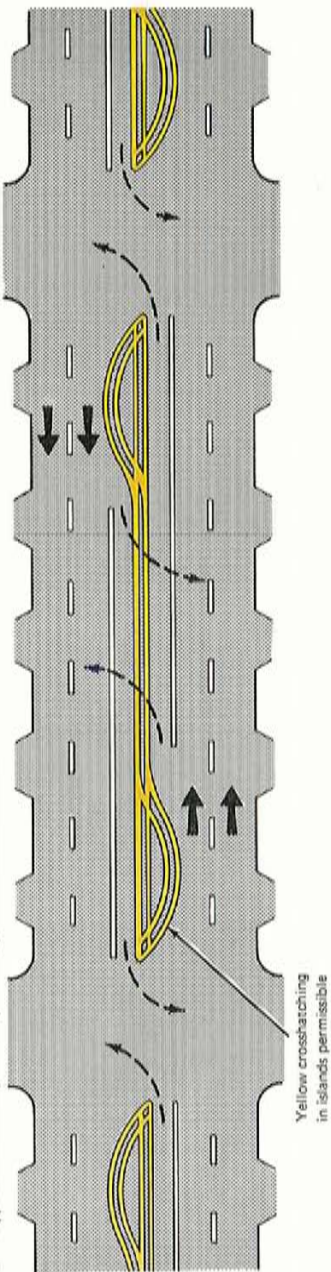


Figure 3-4. Typical multilane, two-way marking applications.

A normal solid white line may be used as the lane line in critical areas where it is advisable to discourage lane changing. Typical locations for such applications are tunnels or bridges having width restrictions and interchange areas where lane changing disrupts traffic flow.

A solid white line may be used to separate through traffic lanes from special secondary lanes, such as uphill truck lanes, left or right turn lanes and transit bus lanes.

A double solid white line shall be used when lane changing is prohibited.

The lane width defined by lane lines should normally be 12 feet. However, a reduction is permissible where a maximum number of lanes must be made available for the most efficient movement or storage of vehicles or where low operating speeds prevail.

Applications of lane lines are illustrated in figures 3-1, 3-3, 3-4, 3-5.

3B-3 No-Passing Zone Markings

Where center lines are installed, no-passing zones shall be established at vertical and horizontal curves and elsewhere on two- and three-lane highways where an engineering study indicates passing must be prohibited because of inadequate sight distances or other special conditions. Specific reference is made to section 11-307 UVC Revised—1968.

A no-passing zone shall be marked by either a one direction, no-passing marking (#5, sec. 3A-7) or a two direction, no-passing marking (#6, sec. 3A-7) as illustrated in figure 3-6a.

3B-4 Application of No-Passing Zone Markings

On a two-lane highway, the no-passing marking shall be parallel to and extended along the center line throughout the no-passing zone.

On a three-lane highway where visibility is limited or where the no-passing marking is being moved from one direction to the opposite direction, the no-passing marking shall start in advance of the no-passing zone at the left hand lane line of the center lane and shall extend diagonally across the center lane to the right hand lane line at the beginning of the no-passing zone, and thence extend along the lane line to the end of the zone (fig. 3-6b). An alternate method of marking this condition is illustrated in figure 3-6c.

The no-passing marking shall extend across the center line on a diagonal for a distance computed by the formula $L=SxW$; where L equals the length in feet, S the 85th percentile speed (off peak) in miles per hour and W the width of the center lane.

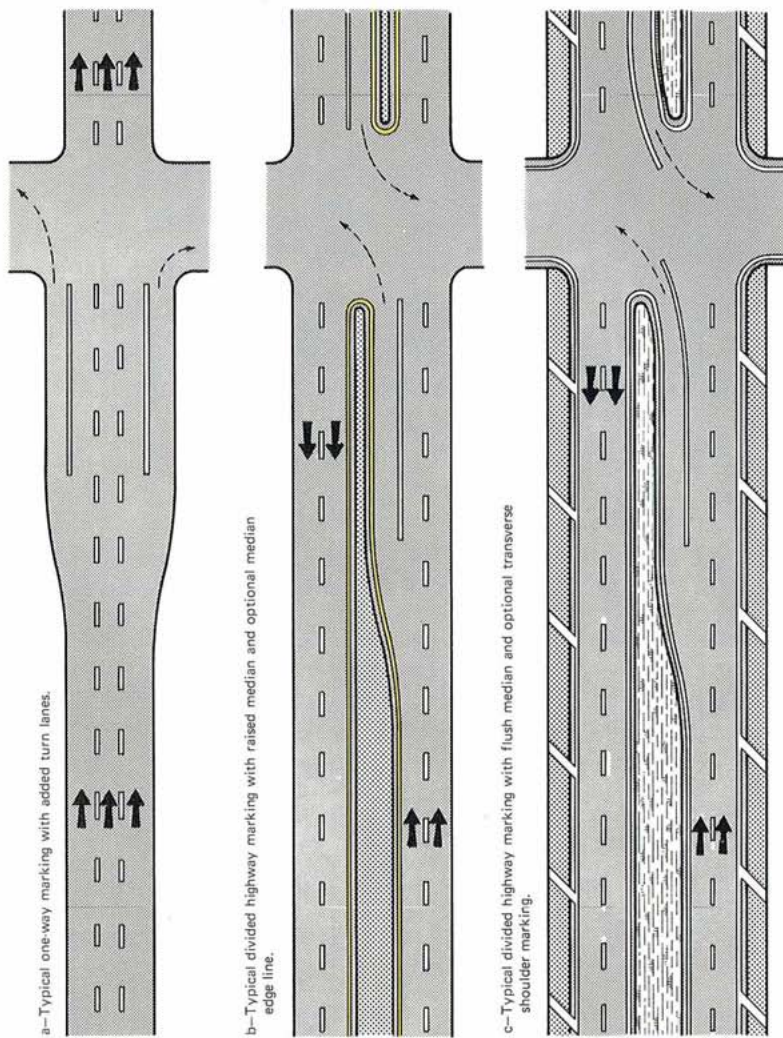


Figure 3-5. Typical one-way and divided highway marking applications

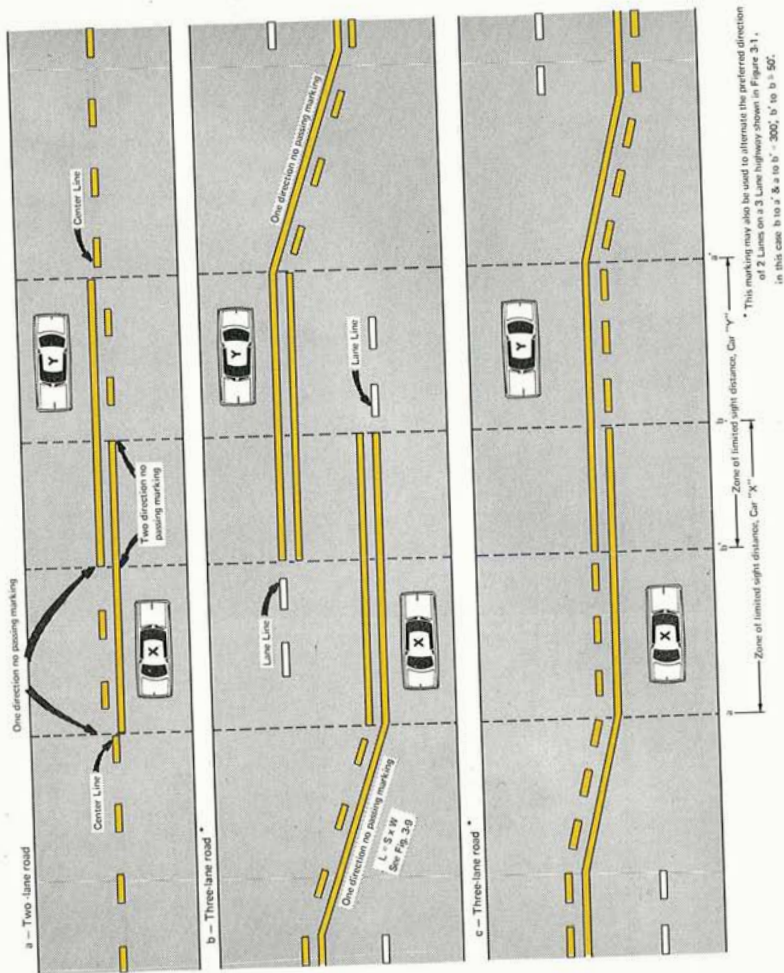


Figure 3-6. Standard pavement marking for no-passing zones.

In addition to the pavement markings here prescribed, no-passing zone signs (secs. 2B-20, 2B-21 and 2C-39) may be used to emphasize the existence and extent of a no-passing zone.

Where the distance between successive no-passing zones is less than 400 feet, the appropriate no-passing marking (one direction or two direction) should connect the zones.

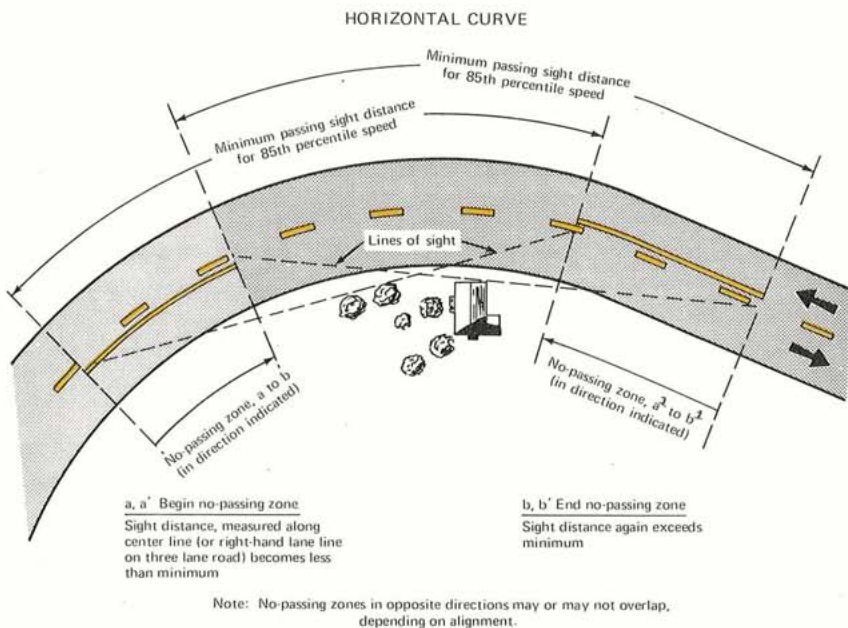
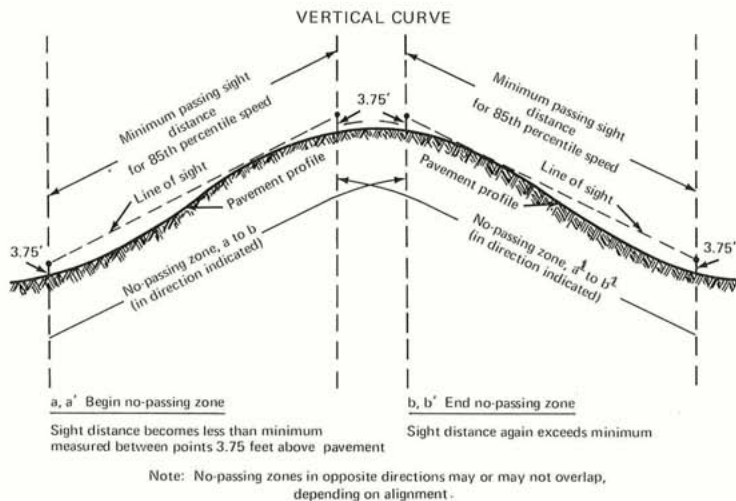


Figure 3-7. Method of locating and determining the limits of no-passing zones at vertical and horizontal curves.

The no-passing marking is also used on two-way roadways at pavement width transitions (sec. 3B-8) and on approaches to obstructions which must be passed on the right (sec. 3B-13). It may also be used on approaches to railroad grade crossings and other locations where passing should be prohibited.

3B-5 Warrants for No-Passing Zones at Curves

A no-passing zone at a horizontal or vertical curve is warranted where the sight distance, as defined below, is less than the minimum necessary for safe passing at the prevailing speed of traffic. Passing sight distance on a vertical curve is the distance at which an object 3.75 feet above the pavement surface can just be seen from a point 3.75 feet above the pavement (fig. 3-7a). Similarly passing sight distance on a horizontal curve is the distance measured along the center line (or right hand lane line of a three-lane highway) between two points 3.75 feet above the pavement on a line tangent to the embankment or other obstruction that cuts off the view on the inside of the curve (fig. 3-7b). Where center lines are installed and a curve warrants a no-passing zone, it should be so marked where the sight distance is equal to or less than that listed below for the prevailing off-peak 85 percentile speed :

85 Percentile Speed (MPH)	Minimum Passing Sight Distance (Feet)
30	500
40	600
50	800
60	1000
70	1200

The beginning of a no-passing zone (point "a," fig. 3-7) is that point at which the sight distance first becomes less than that specified in the above table. The end of the zone (point "b") is that point at which the sight distance again becomes greater than the minimum specified.

3B-6 Pavement Edge Lines

Pavement edge line markings provide an edge of pavement guide for drivers. They have a unique value as a visual reference for the guidance of drivers during adverse weather and visibility conditions. They also may be used where edge delineation is desirable to reduce driving on paved shoulders or refuge areas of lesser structural strength than adjacent pavement. Edge lines should not be continued through intersections and should not be broken for driveways.

Edge lines shall be provided on all Interstate highways and may be used on other classes of roads. The lines shall be white except that on divided highways where medians are extremely narrow or where obstructions exist to restrict the area beyond the edge line from use as an emergency refuge, the markings adjacent to the median should be yellow.

3B-7 Pavement Marking Extensions Through Intersections or Interchanges

Where road design or reduced visibility conditions make it desirable to provide control or to guide vehicles through an interchange or intersection, (such as at offset, skewed, complex multi-legged intersections or where multiple turn lanes are used) a dotted line may be used to extend markings as necessary through the interchange or intersection area (figs. 3-8a, 3-10). Where a greater degree of restriction is required, solid lane lines or channelizing lines may be continued through intersections. A frequent use for the channelizing line is to separate turning movements (figs. 3-8b, 3-8c).

3B-8 Lane Reduction Transitions

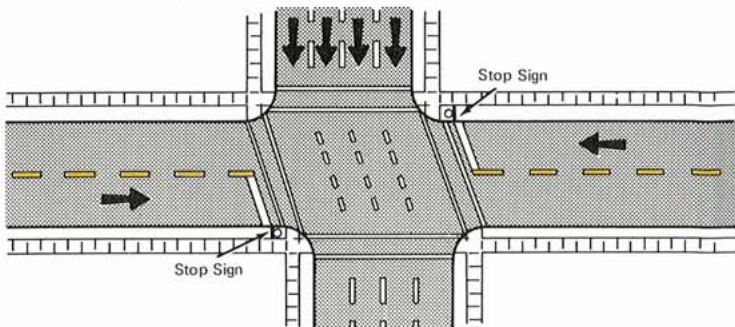
Where pavement markings are used, lane reduction markings shall be used to guide traffic at points where the pavement width changes to a lesser number of through lanes. No-passing markings shall be used to prohibit passing in the direction of the convergence, throughout the transition area. Converging lines should have a length of not less than that determined by the formula $L=SxW$, where L equals the length in feet, S the off-peak 85 percentile speed in miles per hour, and W the offset distance in feet. On new construction, where no 85 percentile speed is established, the design speed may be used.

A number of situations are possible, as illustrated in figure 3-9, depending on which lanes must be offset or terminated and the amount of offset. One or more lane lines must be discontinued, and the remaining center and lane lines must be connected in such a way as to merge traffic into the reduced number of lanes.

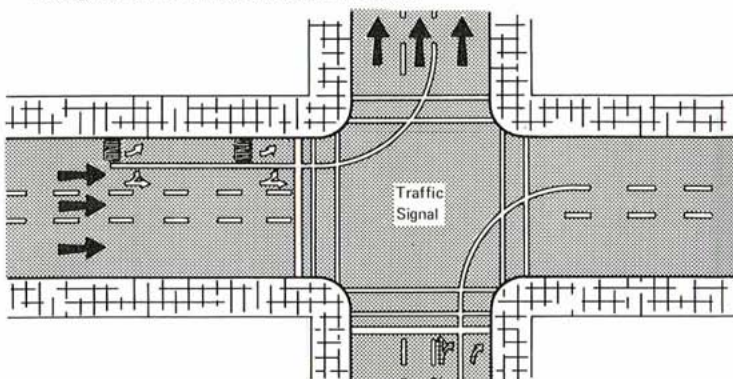
Lane lines should be discontinued one-quarter of the distance between the Pavement Width Transition sign (sec. 2C-18) and the point of convergence. Edge lines should be installed from the location of the warning sign, past the beginning of the narrower roadway (fig. 3-9).

Pavement markings at pavement-width transitions supplement the standard signs.

a—Typical pavement marking with offset lane lines continued through the intersection and optional crosswalk lines and stop limit lines.



b—Typical pavement marking with optional double turn lane lines, pavement messages, crosswalk lines, and stop limit lines.



c—Typical pavement marking with optional turn lane lines, crosswalk lines, and stop limit lines.

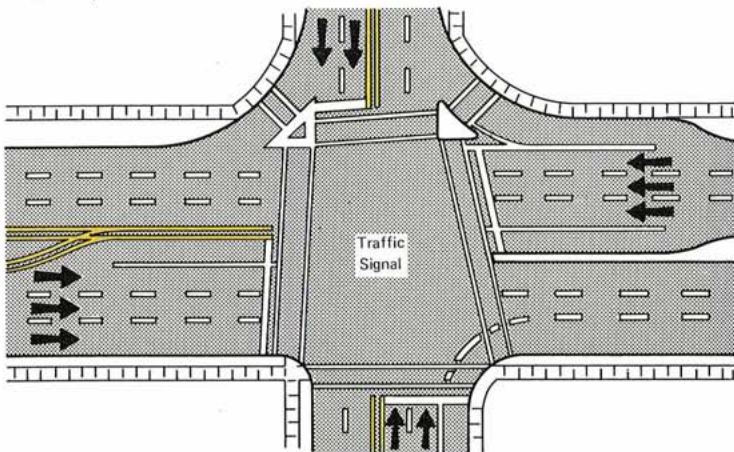
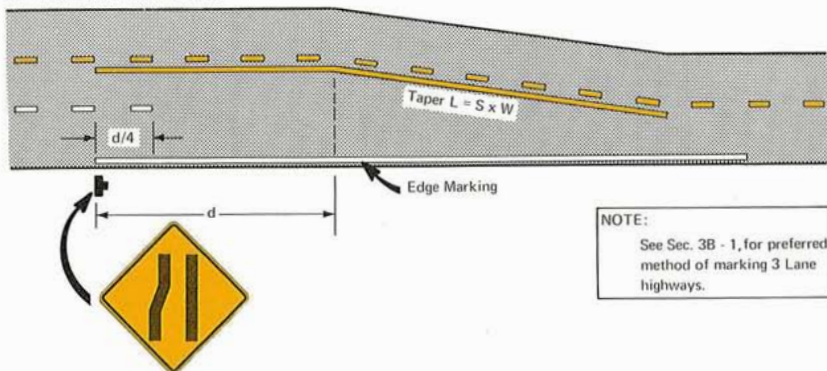


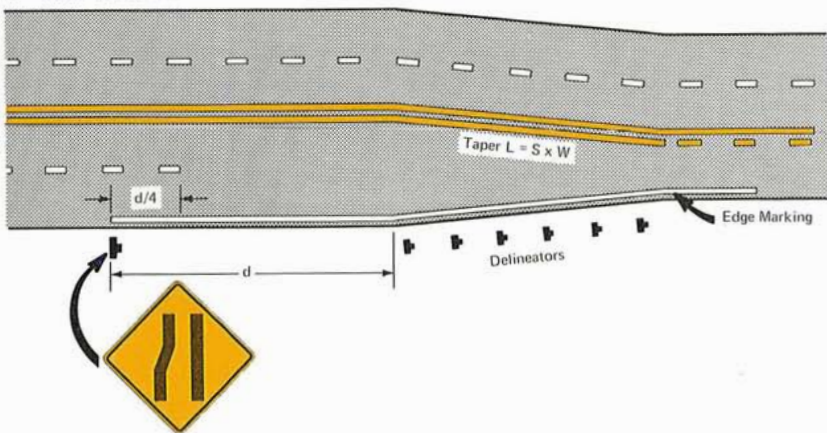
Figure 3-8. Typical pavement marking applications.

a - From 3 lanes to 2 lanes

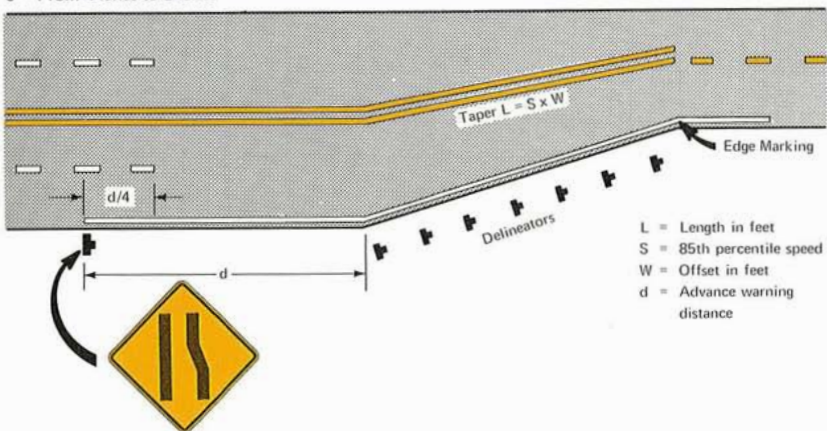


NOTE:
See Sec. 3B - 1, for preferred
method of marking 3 Lane
highways.

b - From 4 lanes to 3 lanes



c - From 4 lanes to 2 lanes



L = Length in feet
S = 85th percentile speed
W = Offset in feet
d = Advance warning
distance

Figure 3-9. Typical pavement-width transition markings and signs.

3B-9 Channelizing Line

The channelizing line shall be a wide or double solid white line.

The channelizing line may be used to form traffic islands where travel in the same direction is permitted on both sides. Other markings in the island area such as crosshatching shall be white.

Typical examples of channelizing line applications are shown in figures 3-3, 3-4, 3-5, 3-8, 3-12.

3B-10 Median Islands Formed by Pavement Markings

Two double yellow lines shall be used to form continuous median islands where these islands separate travel in opposite directions. Other markings in the median island area such as crosshatching shall be yellow (sec. 3A-8).

3B-11 Marking of Interchange Ramps

Channelizing lines at exit ramps of expressways provide a neutral area which reduces the probability of collision with the curb nose and also directs exiting traffic at the proper angle for smooth divergence into the ramp. The channelizing line promotes safe and efficient merging with the through traffic at entrance ramps (fig. 3-11).

For exit ramps, channelizing lines should be placed along both sides of the neutral area between the main roadway and the exit ramp lane. With a parallel deceleration lane, a lane line should be extended from the beginning of the channelizing line for a distance of approximately one-half the length of the full width deceleration lane. White markings may be placed in the neutral area for special emphasis.

For entrance ramps, a channelizing line should be placed along the side of the neutral area adjacent to the ramp lane. With a parallel acceleration lane, a lane line should be extended from the end of the channelizing line for a distance approximately one-half the length of the full width acceleration lane. With a tapered acceleration lane, a lane line may be placed to extend the channelizing line, but not beyond a point where the tapered lane meets the near side of the through traffic lane (fig. 3-11).

3B-12 Combination Lane and Center Line Markings for Unique Applications

It is sometimes necessary to use markings in certain combinations not previously described for special applications intended to improve traffic operations.

For reversible lane markings, each edge of the lane shall be marked by the use of a normal broken double yellow line with the

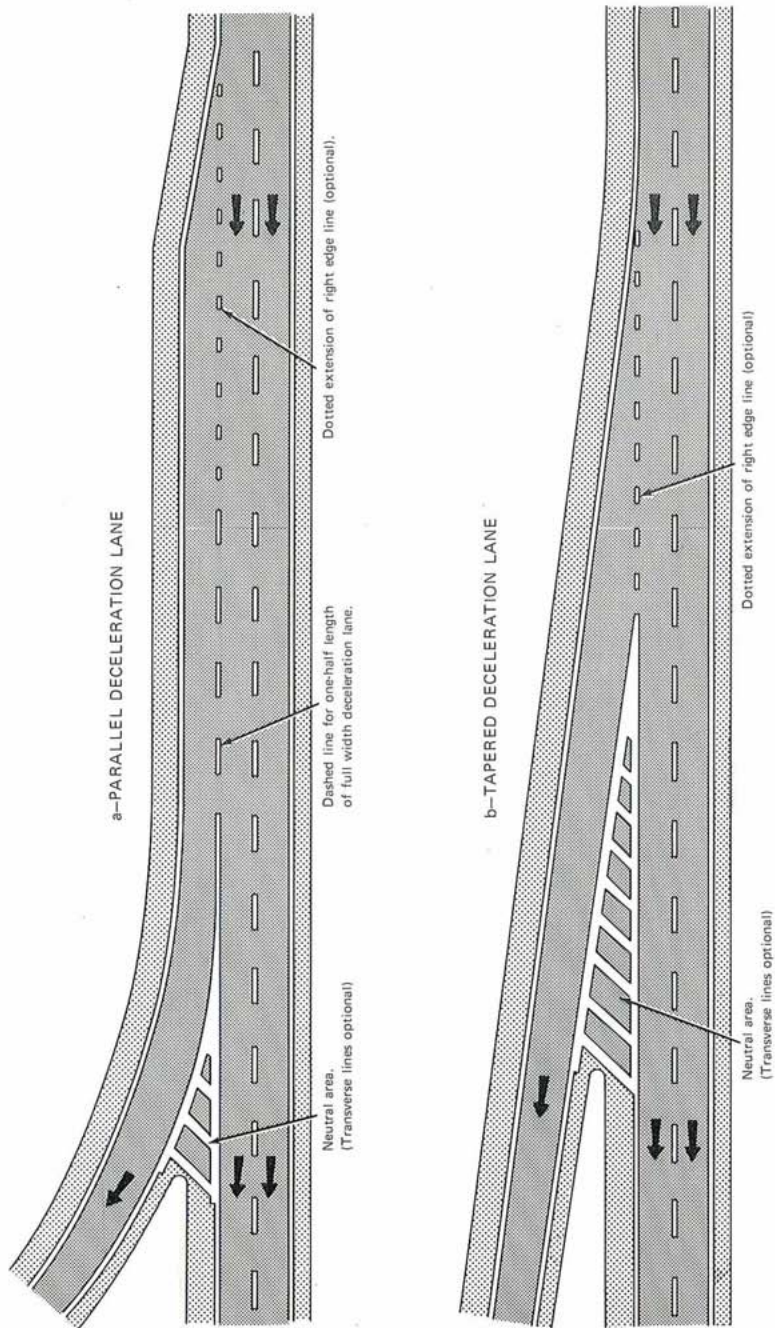


Figure 3-10. Typical exit ramp markings.

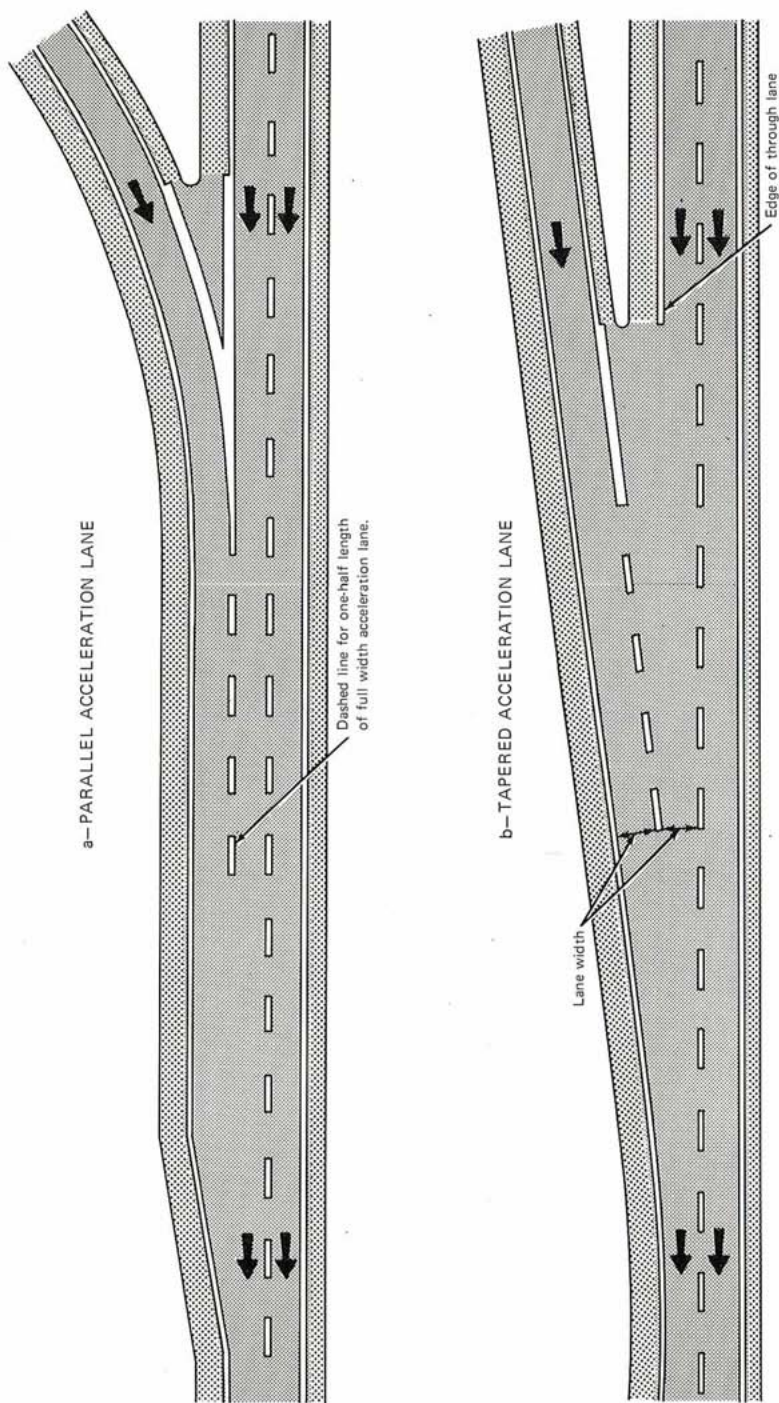
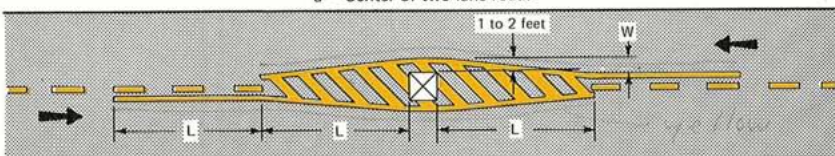


Figure 3-11. Typical entrance ramp markings.

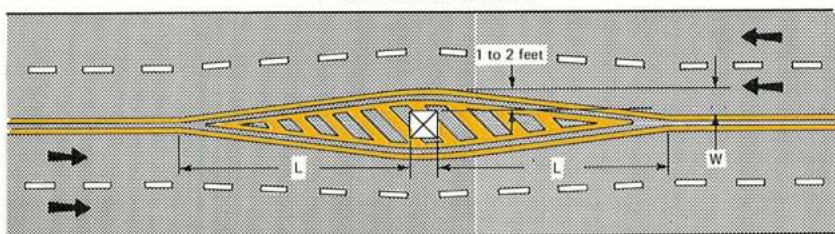
gaps and segments adjacent to one another. Signs and/or signals shall be used to supplement the pavement markings (fig. 3-1a).

A two-way left turn lane is a lane reserved in the center of a highway for exclusive use of left turn vehicles and shall not be used for

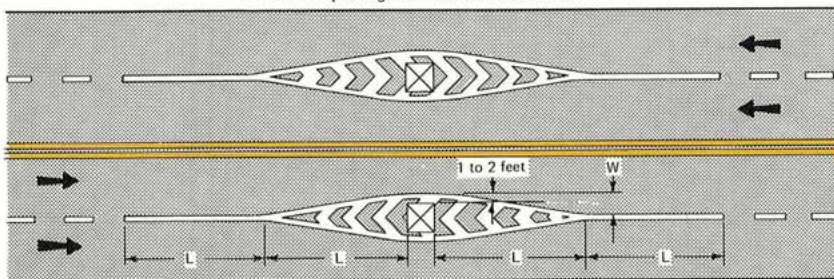
a - Center of two-lane road.



b - Center of four-lane road.



c - Traffic passing both sides of obstruction



$$L = S \times W$$

S = 85th percentile speed in miles per hour

W = Offset distance in feet

Minimum length of: L = 100 feet in urban areas

L = 200 feet in rural areas

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

either wide, solid white line or a double solid white line

Figure 3-12. Typical approach markings for obstructions in the roadway.

passing and overtaking or travel by a driver except to make a left turn. The lane may be used by drivers making the left turn in either direction. A two-way left turn lane shall be marked as shown in figure 3-4a by a single direction, no-passing marking on each edge of the lane. This is generally used on a five lane highway where there are two lanes of through traffic in each direction. Signs should be used with the pavement markings (sec. 2B-17).

3B-13 Approach to an Obstruction

Pavement markings shall be used to guide traffic on the approach to fixed obstructions within a paved roadway. An obstruction may be so located that all traffic must keep to the right of it, or it may be between two lanes of traffic moving in the same direction. The markings in either case must be designed to guide traffic away from the obstruction. The use of channelizing lines or no-passing markings are generally effective. Obstruction approach markings for bridge supports, refuge islands, median islands, and channelization islands shall consist of a diagonal line, or lines, extending from the center line of lane line to a point 1 to 2 feet to the right side, or to both sides, of the approach end of the obstruction (fig. 3-12).

The length of the diagonal markings should be determined by the formula $L=S \times W$ where L equals the length in feet, S the off-peak 85 percentile speed in miles per hour, and W the width of the offset in feet. The minimum length of the diagonal shall be 100 feet in urban areas and 200 feet in rural areas.

If traffic is required to pass only to the right of the obstruction, the marking shall consist of a no-passing marking at least twice the length of the diagonal portion determined by the formula above.

A painted median island may be installed in advance of the obstruction by placing yellow markings in the triangular area between the markings.

If traffic may pass either to right or left of the obstruction, the markings shall consist of two channelizing lines diverging from the lane line, one to either side of the obstruction for a length determined by a formula $L=S \times W$. In advance of the point of divergence, a wide, solid white line or double white line shall be extended in place of the broken lane line for a distance equal to the length of the diverging lines.

It may be desirable where traffic is permitted to pass to both right and left of an obstruction, to place additional white markings in the triangular area between the markings as shown in figures 3-10 and 3-12.

3B-14 Stop Lines

Stop lines are solid white lines, normally 12 to 24 inches wide, extending across all approach lanes.

Stop lines should be used in both rural and urban areas where it is important to indicate the point, behind which vehicles are required to stop, in compliance with a STOP sign, traffic signal, officers' direction, or other legal requirement.

Stop lines, where used, should ordinarily be placed 4 feet in advance of and parallel to the nearest crosswalk line. In the absence of a marked crosswalk, the Stop line should be placed at the desired stopping point, in no case more than 30 feet or less than 4 feet from the nearest edge of the intersecting roadway.

If a stop line is used in conjunction with a STOP sign, it should ordinarily be placed in line with the STOP sign. However, if the sign cannot be located exactly where vehicles are expected to stop, the Stop line should be placed at the stopping point.

3B-15 Crosswalks and Crosswalk Lines

Crosswalk markings at signalized intersections and across intersectional approaches on which traffic stops, serve primarily to guide pedestrians in the proper paths. Crosswalk markings across roadways on which traffic is not controlled by traffic signals or STOP signs, must also serve to warn the motorist of a pedestrian crossing point. At non-intersectional locations, these markings legally establish the crosswalk.

Crosswalk lines shall be solid white lines, marking both edges of the crosswalk. They shall be not less than 6 inches in width and should not be spaced less than 6 feet apart. Under special circumstances where no advance stop line is provided or where vehicular speeds exceed 35 MPH or where crosswalks are unexpected, it may be desirable to increase the width of the crosswalk line up to 24" in width. Crosswalk lines on both sides of the crosswalk should extend across the full width of pavement to discourage diagonal walking between crosswalks (fig. 3-13a).

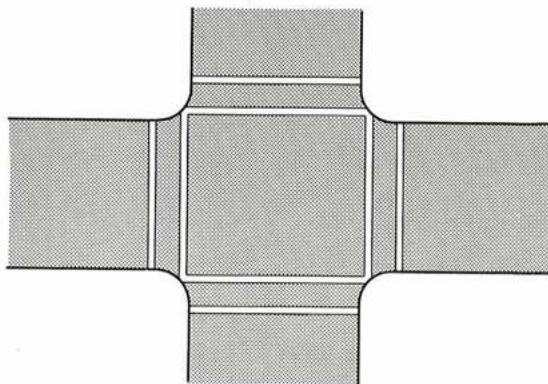
Crosswalks should be marked at all intersections where there is substantial conflict between vehicle and pedestrian movements. Marked crosswalks should also be provided at other appropriate points of pedestrian concentration, such as at loading islands, mid-block pedestrian crossing, and/or where pedestrians could not otherwise recognize the proper place to cross.

Crosswalk markings should not be used indiscriminately. A careful engineering study should be required before they are installed at locations away from traffic signals or STOP signs.

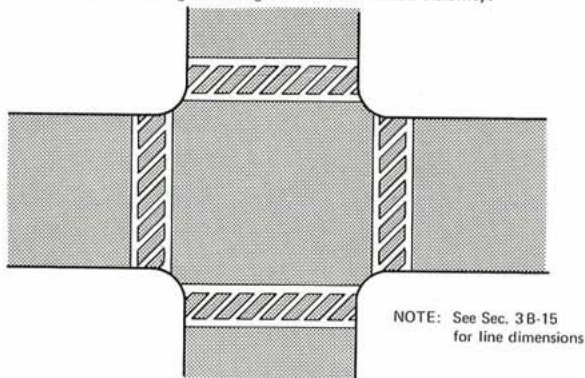
Since non-intersectional pedestrian crossings are generally unexpected by the motorist, warning signs (sec. 2C) should be installed and adequate visibility provided by parking prohibitions.

For added visibility, the area of the crosswalk may be marked with white diagonal lines at a 45° angle or with white longitudinal

a – Standard crosswalk marking.



b – Crosswalk marking with diagonal lines for added visibility.



c – Crosswalk marking with longitudinal lines for added visibility.

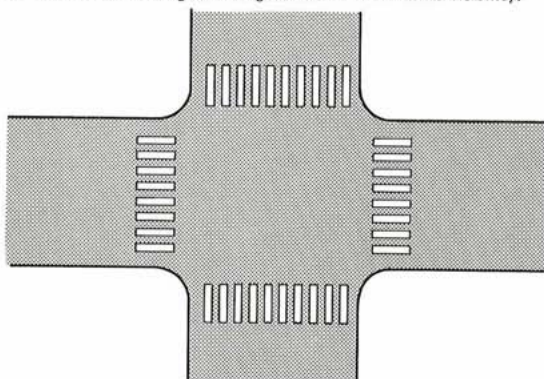
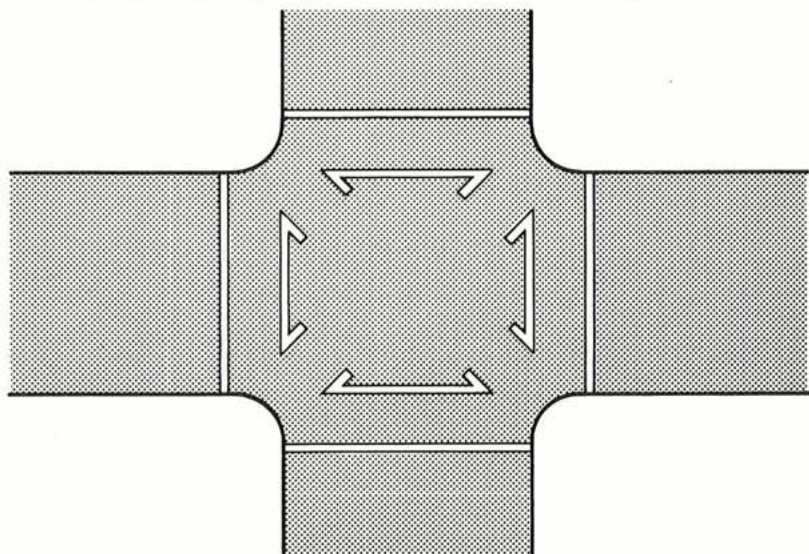


Figure 3-13. Typical crosswalk markings.

a – Crosswalk marking that outlines pedestrian travel paths.



b – Crosswalk marking that outlines the edge of pedestrian travel area.

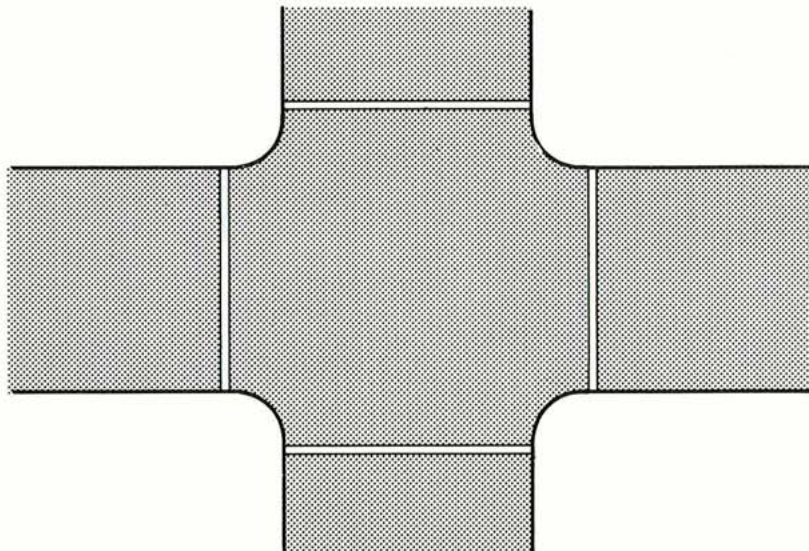


Figure 3-14. Typical crosswalk marking for exclusive pedestrian phase.

lines at a 90° angle to the line of the crosswalk (figs. 3-13b, 13c). These lines should be approximately 12" to 24" wide and spaced 12" to 24" apart. When diagonal or longitudinal lines are used to mark a crosswalk, the transverse crosswalk lines may be omitted. This type of marking is intended for use at locations where substantial numbers of pedestrians cross without any other traffic control device, at locations where physical conditions are such that added visibility of the crosswalk is desired or at places where a pedestrian crosswalk might not be expected. Care should be taken to insure that crosswalks with diagonal or longitudinal lines used at some locations do not weaken or detract from other crosswalks (where special emphasis markings are not used) (fig. 3-13a). When an exclusive pedestrian phase signal, which permits diagonal crossing, is installed at an intersection, a unique marking may be used for the crosswalk (fig. 3-14).

3B-16 Approach to Railroad Crossing

Pavement markings in advance of a railroad crossing shall consist of an X; the letters, RR; a no-passing marking and certain transverse lines. They should be placed on all paved approaches to railroad crossings. These markings, if physically feasible, shall be placed at all grade crossings where railroad highway grade crossing signals or automatic gates are operating, and at all other crossings where the prevailing speed of highway traffic is 40 MPH or greater.

The markings shall also be placed at crossings where engineering studies indicate there is a significant potential conflict between vehicles and trains. At minor crossings or in urban areas, these markings may be omitted if engineering study indicates that other devices installed provide suitable protection. Such markings shall be white except for the no-passing markings.

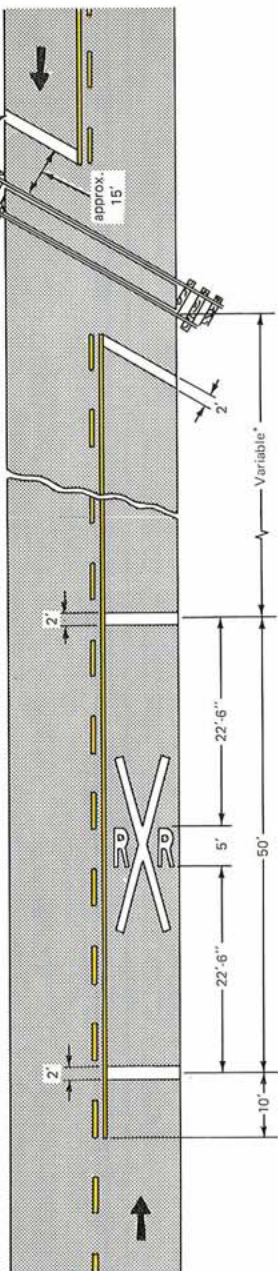
The design of railroad crossing pavement markings shall be essentially as illustrated in figure 3-15. The symbols and letters are elongated to allow for the low angle at which they are viewed.

3B-17 Parking Space Markings

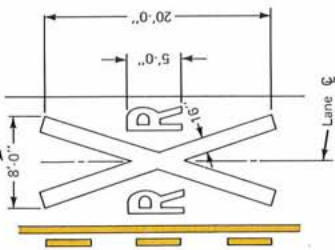
Parking space markings shall be white.

The marking of parking space limits on urban streets encourages more orderly and efficient use of parking spaces where parking turnover is substantial and tends to prevent encroachment on fire hydrant zones, bus stops, loading zones, approaches to corners, clearance spaces for islands and other zones where parking is prohibited. Typical parking space markings are shown in figure 3-16.

Stop line parallel to tracks, or 8 feet from and parallel to gate, if present



Width may vary according to lane width.



*The distance from the railroad crossing marking to the nearest track will vary according to the approach speed and the sight distance of the vehicular traffic approaching, but probably should be not less than 50 feet.

A three-lane roadway should be marked with a centerline for two-lane operation on the approach to a crossing.

On multi-lane roads the transverse bands should extend across all approach lanes, and individual RXR symbols should be used in each approach lane.

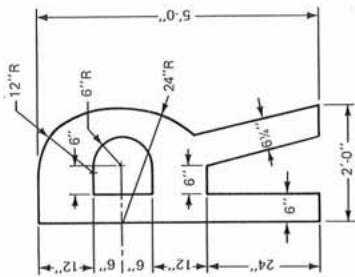


Figure 3-15. Typical pavement markings at railroad-highway grade crossings.

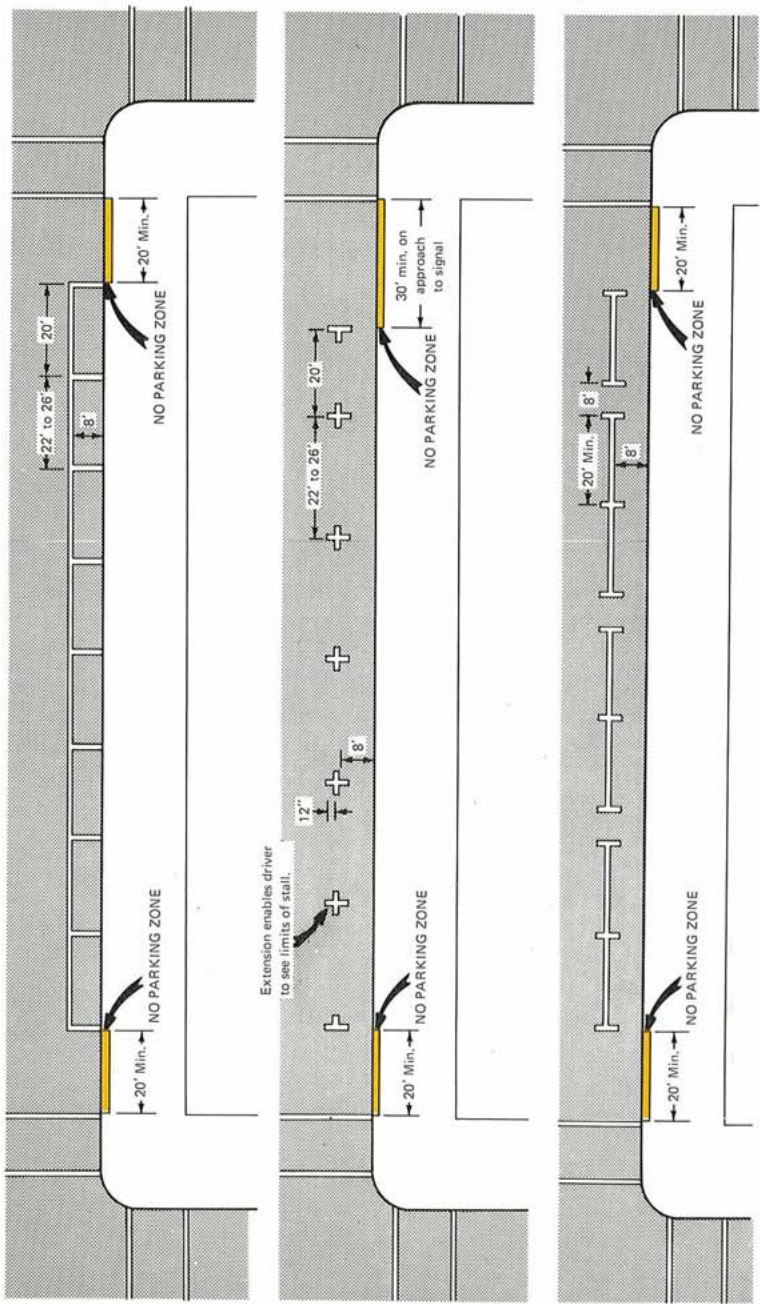


Figure 3-16. Typical parking-space-limit markings.

3B-18 Pavement Word and Symbol Markings

Word and symbol markings on the pavement may be used for the purpose of guiding, warning, or regulating traffic. They should be limited to not more than a total of three lines of words and/or symbols. They shall be white in color.

Word and symbol markings should not be used for mandatory messages except in support of standard signs. Symbol arrows indicating a single mandatory movement shall include the word "ONLY." Signs or markings should be repeated in advance of mandatory turn lanes when necessary to prevent entrapment and to help motorists select the appropriate lane before reaching the end of the line of waiting vehicles.

Symbol messages are generally preferable to word messages. The letters and symbols should be greatly elongated in the direction of traffic movement because of the low angle at which they are viewed by approaching drivers. Large letters, symbols and numerals should be used, 8 feet or more in height; and, if the message consists of more than one word, it should read "up," i.e., the first word should be nearest to the driver.

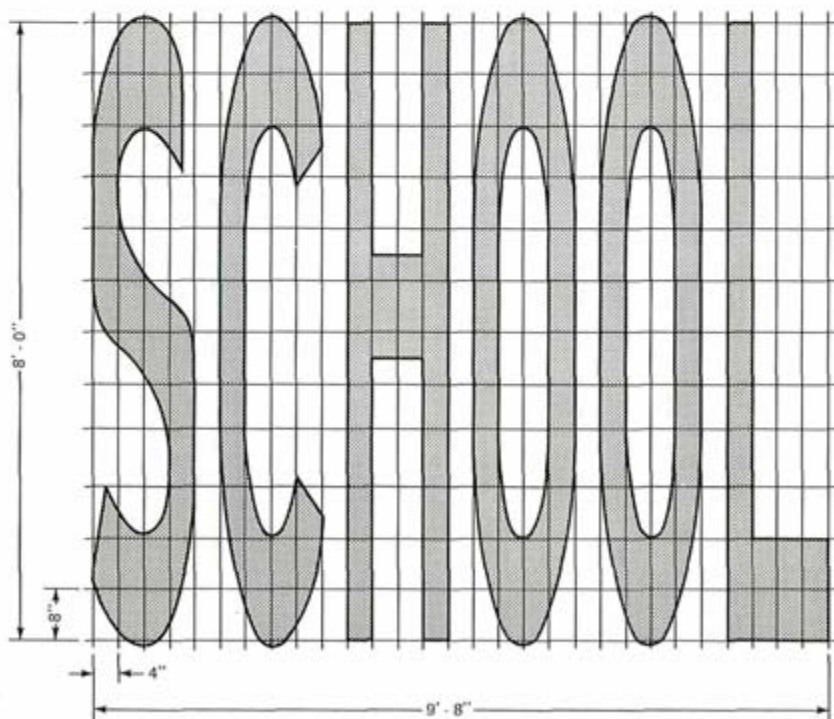


Figure 3-17. Elongated letters for pavement marking.

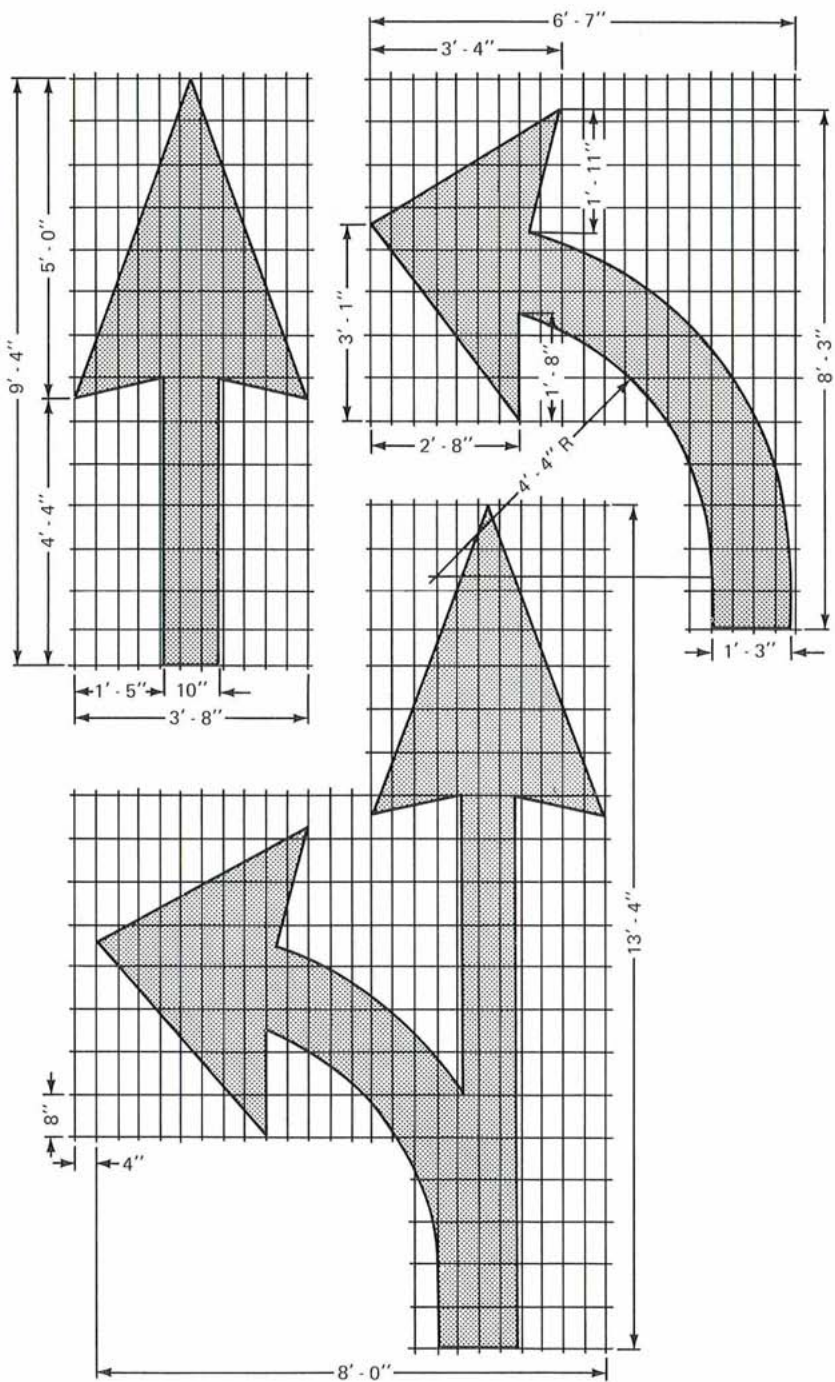


Figure 3-18. Elongated arrows for pavement markings.

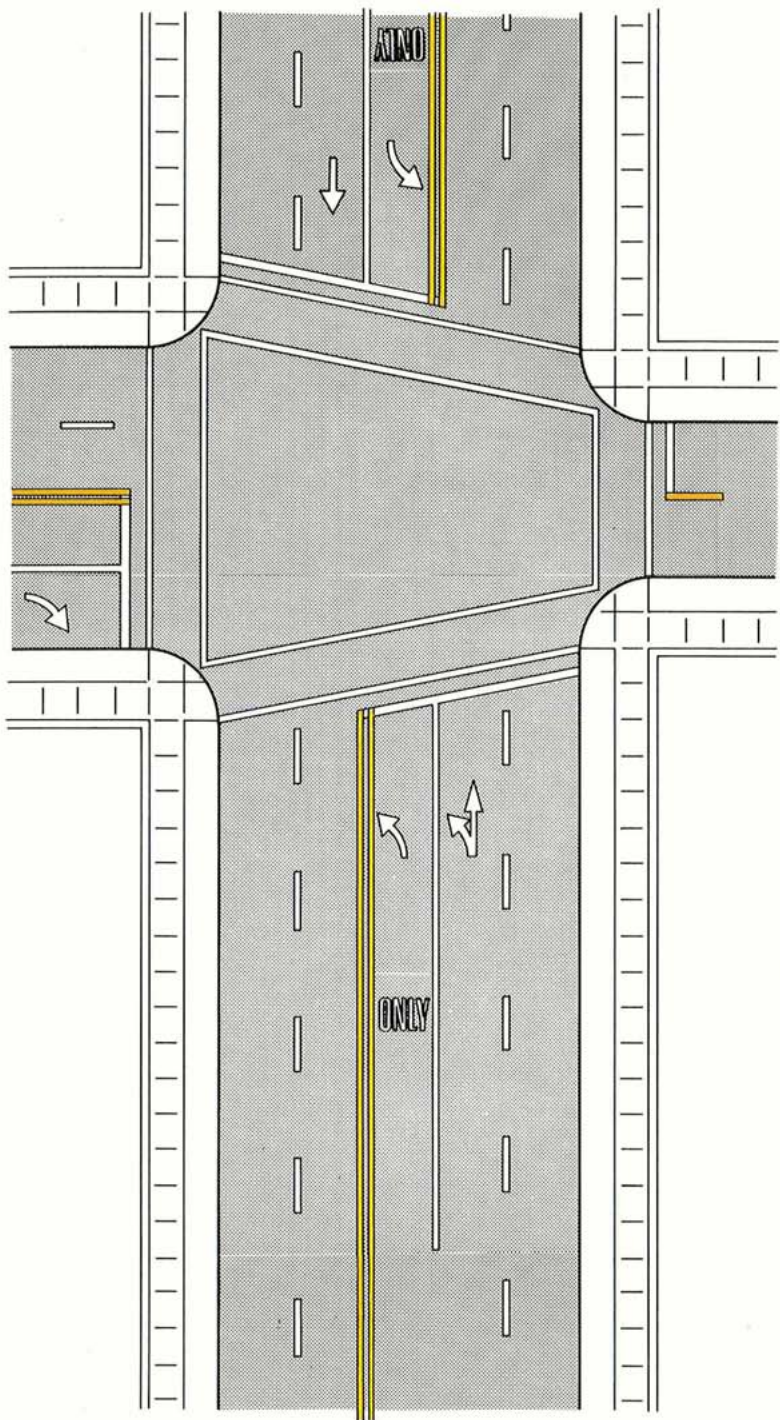


Figure 3-19. Typical lane-use-control word and symbol markings.

C. OBJECT MARKINGS

3C-1 Object Marker Design

When obstructions within or adjacent to the roadway require marking, the marker shall consist of an arrangement of one or more of the following designs:

Type 1—Either a marker consisting of nine yellow reflectors, each with a minimum dimension of approximately 3", mounted symmetrically on an 18" yellow or black diamond panel; or an all yellow reflective diamond panel of the same size. Type 1 markers may be larger if conditions warrant.

Type 2—Either a marker consisting of three yellow reflectors, each with a minimum dimension of approximately 3", arranged either horizontally or vertically; or an all yellow reflective panel, 6" x 12". Type 2 markers may be larger if conditions warrant.

Type 3—Striped marker consisting of a vertical rectangle approximately 1 foot by 3 feet in size with alternating black and reflectorized yellow or white stripes sloping downward at an angle of 45° toward the side of the obstruction on which traffic is to pass. The minimum width of the yellow or white stripe shall be 3 inches. A better appearance can be achieved if the black stripes are wider than the yellow or white stripes.

3C-2 Objects in the Roadway

Obstructions within the roadway, shall be marked with a Type 1 or Type 3 object marker.

For additional emphasis a large surface such as a bridge pier may be painted with diagonal stripes, 12 inches or greater in width, similar in design to the Type 3 object marker. The alternating black and reflectorized yellow or white stripes shall be sloped down at an angle of 45° toward the side of the obstruction which traffic is to pass. Where a sign is used with the diagonal stripes, the stripe markings should be discontinued to leave a 3-inch space around the outside of the sign.

Appropriate signs (secs. 2B-24, 2C-34) directing traffic to one or both sides of the obstruction may be used in lieu of the object marker. In addition to markings on the face of an obstruction in the roadway, warning of approach to the obstruction shall be given by appropriate pavement markings (sec. 3B-13).

—Where the vertical clearance of an overhead structure exceeds the maximum legal height of vehicle by less than one foot the clearance in feet and inches should be clearly marked on the structure (sec. 2C-35).

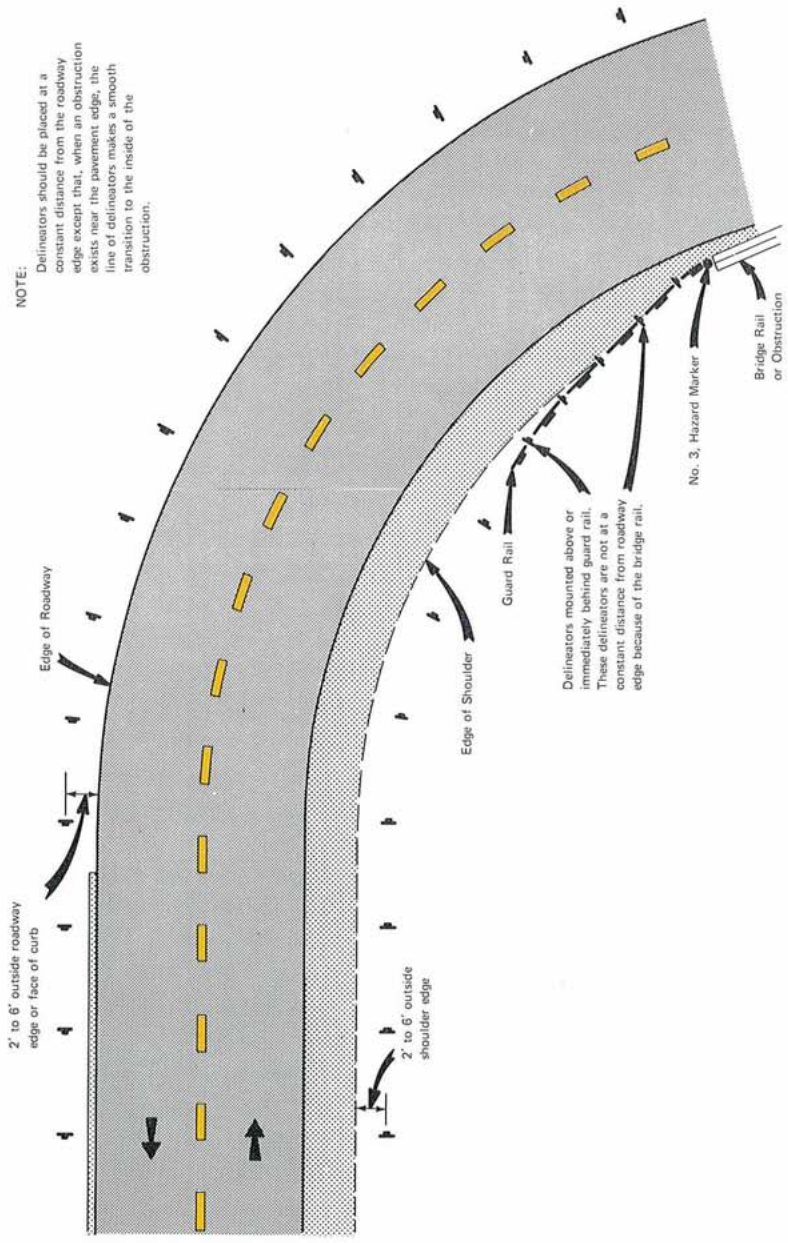


Figure 3-20. Typical delineator installation.

3C-3 Objects Adjacent to the Roadway

Objects not actually in the roadway may be so close to the edge of the road that they need a marker. These include underpass piers, bridge abutments, handrails and culvert headwalls. In some cases there may not be a physical object involved, but other roadside conditions such as narrow shoulder drop-offs, gores, small islands and abrupt changes in roadway alignment may make it undesirable for a driver to leave the roadway. Type 2 or 3 object markers are intended for use at such locations. The inside edge of the marker shall be in line with the inner edge of the obstruction.

Standard warning signs (sec. 2C) should also be used where applicable. Typical applications of markers for roadside obstructions are shown in figure 3-20.

3C-4 End of Roadway

The marker for the end of a roadway, at which point there is no alternate vehicular path, shall be either a marker consisting of nine red reflectors, each with a minimum dimension of approximately 3", mounted symmetrically on an 18 inch square, red or black panel; or an 18 inch square reflectorized red-panel. More than one marker or a larger marker may be used at the end of the roadway where conditions warrant. The minimum mounting height of this marker shall be four feet. Appropriate advance warning signs should be used.

D. DELINEATION

3D-1 Delineators

Road delineation markers are effective aids for night driving and are to be considered as guide markings rather than warning devices. Delineators may be used on long continuous sections of highway or through short stretches where there are changes in horizontal alignment, particularly where the alignment might be confusing, or at pavement width transitions. An important advantage of delineators, in certain areas, is that they remain visible when the roadway is wet or snow-covered.

3D-2 Design

Delineators shall consist of reflector units capable of clearly reflecting light under normal atmospheric conditions from a distance of 1,000 feet when illuminated by the upper beam of standard automobile lights. Reflective elements for delineators shall have a minimum dimension of approximately 3 inches. Elongated reflective

units of appropriate size may be used in place of two reflectors mounted as a unit.

3D-3 Curb Markings for Delineation

Reflectorized solid yellow should be placed on the curbs of islands located in the line of traffic flow where the curb serves to channel traffic to the right of the obstruction. Reflectorized solid white should be used when traffic may pass on either side of the island.

Where the curbs of the islands become parallel to the direction of traffic flow it is not necessary to mark the curbs unless a study indicates the need for this type of delineation. Where these curbs are marked, the colors shall conform to the general principles of markings (sec. 3A-5).

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

3D-4 Delineator Application

Delineators used on through two-lane, two-way roadways shall be single white reflector units on the right side. Single white reflector units may be placed on the left side of the two-way roadways particularly at sharp right-hand curves.

On through roadways of expressway type facilities, single white delineators shall be placed on the right side. If used on the left side for additional guidance, they shall be white also. Where median crossovers are provided for official or emergency use on freeways and where these crossovers are to be marked, a double yellow delineator should be placed on the left side of the through roadway on the far side of the crossover for each roadway.

Double or vertically elongated yellow delineators shall be spaced at 100 foot intervals along acceleration and deceleration lanes and along the outside or both sides of tangent portions of interchange ramps. Where delineators are used only on one side of an interchange ramp, and the ramp is curved, the delineators shall be placed on the outside of the curve, with appropriate spacing as set forth in table III-1. On curved ramps, where the curves reverse direction, delineators should be used on the outside of each curve and should overlap in the area of the direction change.

Red delineators may be used on the reverse side of any delineator whenever it would be viewed by a motorist traveling in the wrong direction on that particular ramp or roadway.

Delineators of the appropriate color (white for through roadways and yellow for interchange ramps) may be used to indicate the narrowing of the pavement where either an outside or inside lane merges into an adjacent lane. The delineators should be used adjacent to the lane affected for the full length of the convergence

and should be so placed and spaced to show the width reduction (fig. 3-9). Delineation is not necessary for the traffic moving in the direction of a wider pavement or on the side of the roadway where the alignment is not affected by the convergence. On a highway with continuous delineation on either or both sides, delineators should be carried through the transition and a closer spacing may be warranted.

Delineation shall be optional on sections of roadway between interchanges where fixed-source lighting is in operation.

3D-5 Delineator Placement and Spacing

Delineators, if used, shall be mounted on suitable supports so that the top of the reflecting head is about 4 feet above the near roadway edge. They shall be placed not less than 2 or more than 6 feet outside the outer edge of the shoulder, or if appropriate, in the line of the guardrail.

Delineators should be placed at a constant distance from the edge of the roadway except that, where a guardrail or other obstruction intrudes into the space between the pavement edge and the extension of the line of delineators, the delineators should be in line with or inside the innermost edge of the obstruction. Typical delineator installations are shown in figure 3-20.

Normally, delineators should be spaced 200 to 528 feet. When normal uniform spacing is interrupted by driveways, cross roads, etc., delineators falling within such areas may be moved in either direction, a distance not exceeding one-quarter of the normal spacing. Delineators still falling within such areas should be eliminated.

Spacing should be adjusted on approaches and throughout horizontal curves so that several delineators are always visible to the driver. Table III-1 shows suggested maximum spacing for delineators at horizontal curves. (See next page). *Spacing table*

Table III-1. Suggested maximum spacing for delineators at horizontal curves.

E. COLORED PAVEMENTS

3E-1 Colored Pavements

When used for guidance and regulation of traffic, colored pavement surfaces are traffic control devices. Situations occur where colored pavements could supplement other traffic control devices. They should be used only where they contrast significantly with adjoining paved areas. Where colored pavements are used, the guidance or control provided shall be applicable at all times.

3E-2 Colors

The use of the following colors for pavements shall be limited to the purposes noted:

1. Red shall be used only on the approaches to a STOP sign which is in use 24 hours a day. The length of colored surface should be

related to the 85-percentile approach speed of traffic and give the driver a two to four second advance warning.

2. Yellow shall be used only for medians separating traffic flows in opposite directions.

3. White shall be used for delineation on shoulders, on channelizing islands where traffic flows pass on both sides in the same general direction, and for crosswalks.

TABLE III-1 Suggested Maximum Spacing for Highway Delineators On Horizontal Curves

(Distance in Feet Rounded to the Nearest 5 Feet)

Radius of Curve (in feet)	Spacing On Curve (in feet)	Spacing in Advance & Beyond Curve (in feet)		
		1st	2nd	3rd
50	20	40	65	125
150	30	60	90	180
200	35	70	110	215
250	40	85	125	250
300	50	95	145	290
400	55	110	170	300
500	65	125	190	300
600	70	140	210	300
700	75	150	230	300
800	80	165	245	300
900	85	175	260	300
1,000	90	185	275	300

Spacing for specific radii not shown may be interpolated from table or computed from the formula $S=3\sqrt{R-50}$. The minimum spacing should be 20 feet. The spacing on curves should not exceed 300 feet. The spacing of the first delineator approaching a curve is 2 S, the second 3 S, and the third 6 S but not to exceed 300 feet. If a spacing less than 300 feet is used approaching the curve, the distance shown above should be adjusted accordingly.