

**GUIDELINES FOR THE INSTALLATION OF MARKED CROSSWALKS**

**Virginia Department of Transportation  
Traffic Engineering Division**

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## INTRODUCTION

The *Manual on Uniform Traffic Control Devices* (MUTCD) Section 3B.17 gives little guidance regarding when and where to mark crossing locations.

The Virginia Department of Transportation's (VDOT) *Policy for Integrating Bicycle and Pedestrian Accommodations* states that VDOT will accommodate bicyclists and pedestrians, including pedestrians with disabilities, along with motorized transportation modes in the planning, funding, design, construction, operation, and maintenance of Virginia's transportation network to achieve a safe, effective, and balanced multimodal transportation system.<sup>2</sup>

The following guidelines for the installation of marked crosswalks are intended to serve engineers and planners responsible for planning and designing pedestrian facilities in Virginia. These guidelines are not to be used as warrants, as circumstances can vary depending on location and no set of guidelines can cover every condition or guarantee improved safety.

Designers, engineers, and planners all share a responsibility to find ways for vehicles, pedestrians, and bicyclists to coexist conveniently and safely. Accommodating pedestrians with disabilities is required in the design and planning of pedestrian facilities, and compliance with the Americans with Disabilities Act (ADA) is a federal law. This law is designed to ensure that all Americans have the same access to services and facilities. The ADA requires pedestrian facilities used by the general public to be planned, designed, constructed, and maintained with the understanding that a wide range of people, including people with disabilities, will be using them and relying on them for their daily travel. By providing pedestrian facilities that are fully accessible, people with various degrees of mobility and disability may be as self-sufficient and independent as possible.<sup>3</sup> The ADA applies to all new construction and improvements to existing facilities.

The purpose of this document is to give more guidance than what is offered in the MUTCD for determining the best engineering solutions to pedestrian safety concerns, particularly with regard to the location of marked crosswalks. Specifically, this document describes guidelines relating to the marking of crosswalks at controlled locations (those controlled by signals, stop signs, and yield signs), uncontrolled locations (intersections and mid-block), and unconventional intersections and locations. It describes various crosswalk treatments and guidance as to when to use them. This document should also serve as guidance for retrofit crosswalk marking installations and installations at new and future construction projects.

## BACKGROUND

A *crosswalk* is generally defined as the portion of roadway designated for pedestrians to use in crossing the street. Crosswalks may be marked or unmarked. At intersections, a sidewalk or pedestrian walkway extension across a street defines a crosswalk (refer to the *Code of Virginia*, Section 46.2-100 for a complete definition of *crosswalk*).<sup>4</sup> There is no legal difference between marked or unmarked intersection crosswalks; however, at times, markings can be used to designate a wider crosswalk or a mid-block crosswalk.

Marking crosswalks serve two purposes: (1) they tell the pedestrian the best place to cross; and (2) they clarify that a legal crosswalk exists at a particular location. Marked crosswalks may be used to delineate preferred pedestrian paths across roadways under the following conditions:

- *At locations with stop signs or traffic signals.* Vehicular traffic might block pedestrian traffic when stopping for a stop sign or red light; marking crosswalks may help to reduce this occurrence.
- *At non-signalized street crossing locations where an engineering study dictates that the number of motor vehicle lanes, pedestrian exposure, average daily traffic (ADT), posted speed limit, and geometry of the location would make the use of specially designated crosswalks desirable for traffic/pedestrian safety and mobility.*<sup>5</sup>
- *At approved school crossings or for crossings on recommended school routes.*

Further, a marked crosswalk helps to create reasonable expectations for motorists with regard to where pedestrians may cross a roadway and the predictability of pedestrian actions and movement.

There are both advantages and disadvantages of marking crosswalks. Advantages include:

- helping pedestrians find their way across complex intersections
- designating the shortest path
- directing pedestrians to location of best sight distance.

Disadvantages include:

- possibly creating a “false sense of security” for pedestrians
- generating a greater number of pedestrian collisions at uncontrolled locations on multi-lane streets with high traffic volumes
- higher maintenance costs.<sup>6</sup>

## **GENERAL GUIDANCE**

As with any installation of traffic control devices, the most essential tool for crosswalk installation is the use of engineering judgment. Engineering judgment should be used and, if applicable, an engineering study performed when considering the marking of crosswalks. Section 1A-13 of the MUTCD describes *engineering judgment* and *engineering study*.

Crosswalk markings should not be used at all intersections. If used extensively, many marked crosswalks would be underused and motorists would tend to be desensitized to their presence. This could lead to problems at heavily used crosswalks and detract from potential safety value at these locations. Crosswalks should be used, in general, only at locations where

pedestrian activity is significant. This will ensure that motorists come to associate crosswalks and pedestrian activity.<sup>7</sup>

Intersection design is also extremely important for the safety of pedestrians. However, no single feature creates a safe intersection for pedestrians.<sup>8</sup> The first step in identifying candidate marked crosswalk locations is to identify the places people would like to walk (pedestrian desire lines) that are affected by local land uses (homes, schools, parks, commercial establishments, etc.) and the location of transit stops. This information forms a basis for identifying pedestrian crossing improvement areas and prioritizing such improvements, thereby creating a convenient, connective, and continuous walking environment.

The second step is identifying where it is safest for people to cross. Of all road users, pedestrians have the highest risk accidents because they are the least protected. National statistics indicate that pedestrians represent 14 percent of all traffic incident fatalities, whereas walking accounts for only 3 percent of total trips. Vehicle-pedestrian collisions occur most often when a pedestrian is attempting to cross the street at an intersection or mid-block location.<sup>6</sup>

### **APPLICABLE SECTIONS OF THE *CODE OF VIRGINIA***

The following excerpts from the *Code of Virginia* should be referenced when defining a crosswalk or a crossing location and when determining pedestrian and vehicular right of way.

#### **Definition of a Crosswalk<sup>4</sup>**

*Section §46.2-100* defines a crosswalk as “that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traversable roadway; or any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface.”

#### **How and Where Pedestrian Are to Cross Highways<sup>9</sup>**

*Section §46.2-923* states: “When crossing highways, pedestrians shall not carelessly or maliciously interfere with the orderly passage of vehicles. They shall cross, wherever possible, only at intersections or marked crosswalks. Where intersections contain no marked crosswalks, pedestrians shall not be guilty of negligence as a matter of law for crossing at any such intersection or between intersections when crossing by the most direct route.”

#### **Pedestrian and Vehicular Right of Way<sup>10</sup>**

*Section §46.2-924.A* states that the driver of any vehicle on a highway shall yield the right-of-way to any pedestrian crossing such highway:

1. At any clearly marked crosswalk, whether at mid-block or at the end of any block.

2. At any regular pedestrian crossing included in the prolongation of the lateral boundary lines of the adjacent sidewalk at the end of the block.
3. At any intersection when the driver is approaching on a highway or street where the legal maximum speed does not exceed 35 miles per hour.

*Section §46.2-924B* states: “No pedestrian shall enter or cross an intersection in disregard of approaching traffic. The drivers of vehicles entering, crossing, or turning at intersections shall change their course, slow down, or stop if necessary to permit pedestrians to cross such intersections safely and expeditiously. Pedestrians crossing highways at intersections shall at all times have the right-of-way over vehicles making turns into the highways being crossed by the pedestrians.”

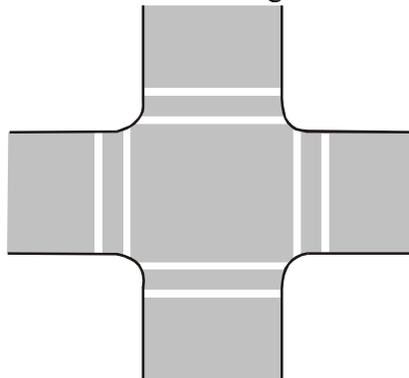
## **GUIDELINES FOR MARKING CROSSWALKS AT CONTROLLED LOCATIONS**

The following should be considered when determining the need to mark crosswalks at signalized intersections, approaches controlled by stop signs, and approaches controlled by yield signs. Engineering judgment should be used when considering the installation of marked crosswalks at controlled locations.

### **Basic Justification for Marking a Crosswalk**

- *Marked crosswalks should be considered on all approaches<sup>6</sup> near pedestrian generators.* This should be done using standard crosswalk markings (Figure 1) or high-visibility markings (see types of high-visibility crosswalks in the *Guidelines for Marking Crosswalks at Uncontrolled Locations* of these guidelines). Markings must be white and retroreflective (visible at night). For further guidance on crosswalk markings, refer to Section 3B.17 of the MUTCD.<sup>1</sup>

The installation of stop lines at crosswalk locations controlled by traffic signals or stop signs is recommended as an effective measure in reducing vehicle encroachments on the



**Figure 1. Standard Crosswalk Markings on All Approaches of an Intersection**

crosswalk. Where the crash data or observations of conflicts identify a crosswalk of particular concern, consider special treatments (refer to *Special Treatments* in this section)

and warning signs (Figure 2). Refer to Section 2C.41 of the MUTCD for further guidance on warning signs.<sup>1</sup>



**Figure 2. Pedestrian Crossing Warning Sign. Source: MUTCD, Section 2C.41.**

- *The following is an exception for considering marking crosswalks on all approaches:*

Where crossing locations have conflicting heavy right- or left-turn traffic volumes.<sup>6</sup> There are dilemmas with regard to pedestrian crossings on multi-lane, high-speed, high-volume suburban arterials. The introduction of marked crosswalks alone would essentially communicate to the pedestrian that it is reasonably safe to attempt a crossing. Typically, under these conditions, marked crosswalks alone are not sufficient to facilitate safe crossings at complex, multi-phase intersections.

In order to make at-grade pedestrian crossings as safe as they need to be at signal-controlled intersections on wide, high-volume, high-speed roadways, the incorporation of pedestrian signals, refuge medians, slip lane refuge islands, and fully protected pedestrian phasing may be considered.

Where other solutions are infeasible, an alternative pedestrian crossing should be identified. It may be necessary to install barrier treatments to reinforce that pedestrians should not cross at the location without a marked crosswalk. Prohibiting crossing should be considered only in very limited circumstances, for example:

- where it would be very dangerous for pedestrians to cross, as where visibility (for pedestrians and motorists) is obstructed and the obstruction cannot be reasonably removed
- where so many legal crosswalks exist that they begin to conflict with other modes, as on an arterial street with multiple offset or T intersections.
- where there are unique considerations at a particular intersection and pedestrian mobility is not disproportionately affected by the closure.<sup>11</sup>

## Special Treatments

There are a number of innovative treatments for pedestrians at controlled intersections, mostly related to pedestrian signals. At locations with a high number of pedestrian-vehicle conflicts, the following measures are means to enhance the safety of pedestrian crossings.

- At locations where there are high numbers of turning vehicles, special treatments that may be considered include<sup>6</sup>:
  - installing animated eye light emitting diode (LED) signals
  - equipping signals with early release or pedestrian lead time
  - installing special pavement stencils onto the pavement such as “Pedestrians Look Left” and “Watch for Turning Vehicles”
  - designing or retrofitting intersections with reduced corner radii.
- At locations where there are high numbers of pedestrians around or near an intersection, special treatments that may be considered include<sup>6</sup>:
  - equipping signals with pedestrian “scramble” phases
  - implementing “No Right Turn on Red” restrictions
  - installing STOP lines or YIELD lines in advance of crosswalks.
- At locations where there are wide intersections, special treatments that may be considered include<sup>6</sup>:
  - installing additional pedestrian signal heads in a median (if possible), if the width of the crossing is greater than 60 feet
  - installing countdown signals
  - installing pedestrian refuge islands and medians
  - installing bulbouts or curb extensions.

## GUIDELINES FOR MARKING CROSSWALKS AT UNCONTROLLED LOCATIONS

This section describes guidance for the installation of marked crosswalks at uncontrolled approaches of intersections and mid-block locations. Crosswalk lines should not be used indiscriminately. An engineering study should be performed before crosswalk markings are installed at uncontrolled locations.

Pedestrian crossing warning signs should always be installed in advance of mid-block crossings. Placement of advance warning signs depends on the speed of motor vehicle traffic and other conditions, such as available sight distance. If yield lines are used in advance of a mid-block crosswalk, “Yield Here to Pedestrians” signs shall be placed 20 to 50 feet in advance of the crosswalk.<sup>1</sup> Refer to Sections 3B.17 and 2B.11 of the MUTCD for further guidance.<sup>1</sup> In-street pedestrian crossing signs can also be used at crosswalk locations to remind road users of laws

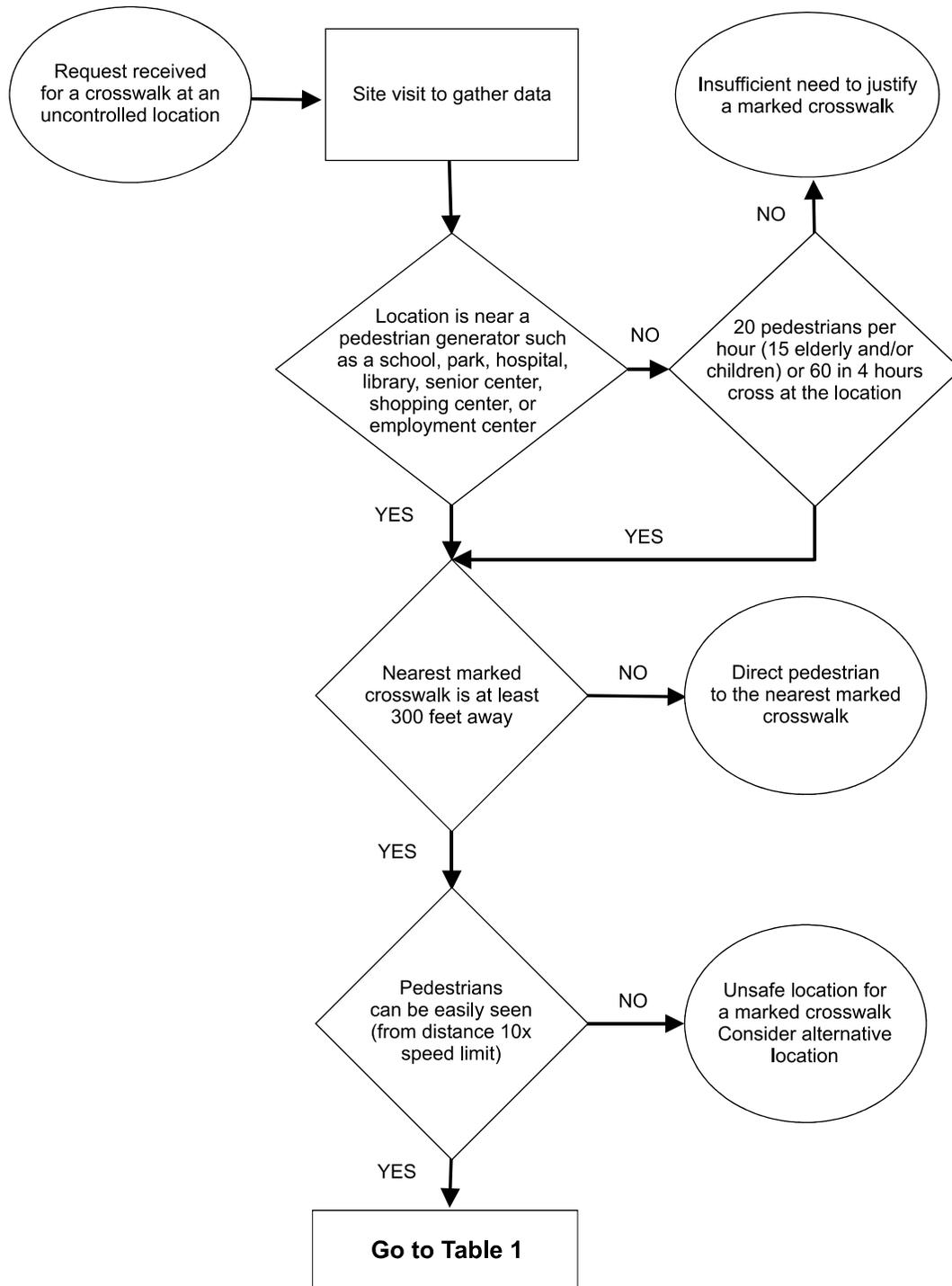
regarding right of way at an unsignalized pedestrian crossing.<sup>1</sup> Refer to Section 2B.12 of the MUTCD for further guidance on in-street pedestrian crossing signs.<sup>1</sup>

### **Basic Justification for Marking a Crosswalk**

Crossings should be marked where *all* of the following are the case<sup>6</sup>:

- Sufficient demand exists to justify the installation of a crosswalk. Uncontrolled crossings should be identified as a candidate for marking if there is a demonstrated need for a marked crosswalk. Need can be demonstrated by either of the following:
  - The crosswalk would serve 20 pedestrians per hour during the peak hour, 15 elderly and/or children per hour, or 60 pedestrians total for the highest consecutive 4-hour period; or
  - The crossing is on a direct route to or from a pedestrian generator, such as a school (refer to section 7C.03 of the MUTCD)<sup>1</sup>, library, hospital, senior center, shopping center, park, employment center, and transit center or service.
- The location is 300 feet or more from another crossing location or a controlled crossing location.
- The location has sufficient sight distance (sight distance in feet should be greater than 10 times the speed limit) and/or sight distance will be improved prior to crosswalk marking.
- Safety considerations do not preclude a crosswalk.

Figure 3 and Table 1 should be used to determine if special treatments are needed to ensure safe crossing at uncontrolled locations.



**Figure 3. Flowchart for Justifying Installation of Marked Crosswalks at Uncontrolled Intersections.** Adapted from City of Stockton Public Works Department, *Pedestrian Safety and Crosswalk Installation Guidelines*. Stockton, California, 2003.

**Table 1. Recommendations for Considering Marked Crosswalks and Other Needed Pedestrian Improvements at Uncontrolled Locations<sup>a</sup>**

	≤ 9,000 ADT			> 9,000 ADT to ≤ 12,000 ADT			> 12,000 ADT to ≤ 15,000 ADT			> 15,000 ADT		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph <sup>b</sup>
2 lanes												
3 lanes												
+ +4 lanes, raised median <sup>c</sup>												
+ +4 lanes, no median												

 **Candidate sites for marked crosswalks.** Marked crosswalks must be installed carefully and selectively. First, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, but a more in-depth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, etc., may be needed at other sites. If the speed limit is less than or equal to 30 mph, use **Level 1** or **Level 2** devices. If the speed limit exceeds 30 mph, use **Level 2** devices. *Refer to Level 1 and Level 2 devices in the Special Treatments section.*

 **Probable candidate sites for marked crosswalks.** Pedestrian crash risk may increase if marked crosswalks are added without other pedestrian facility enhancements. Add **Level 3** or **Level 4** devices if feasible. *Refer to Level 3 and Level 4 devices in the Special Treatments section.*

 **Marked crosswalks alone are insufficient, since pedestrian crash risk may increase if only marked crosswalks are provided.** Consider using **Level 5** devices if feasible. If not feasible, use multiple treatments from **Level 2**, **Level 3**, or **Level 4** devices. *Refer to Level 5 devices in the Special Treatments section.*

<sup>a</sup>These guidelines include intersection and mid-block locations with no traffic signal or stop sign on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median. Crosswalks should not be installed at locations that could present an increased safety risk to pedestrians, such as where there is poor site distance, complex or confusing designs, substantial volumes of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make a crossing safer or necessarily result in more drivers stopping for pedestrians. Whenever marked crosswalks are installed, it is important to consider other pedestrian facility enhancements, as needed, to improve the safety of the crossing (for example, raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic calming measures, curb extensions). **These are general recommendations; an engineering study should be performed to determine where to install marked crosswalks.**

<sup>b</sup>Where the posted speed limit or 85<sup>th</sup> percentile speed exceeds 40 mph, marked crosswalks alone should not be used at uncontrolled intersections with an ADT greater than 15,000.

<sup>c</sup>The raised median or refuge island must be at least 4 feet (1.2 meters) wide and 6 feet (1.8 meters) long to adequately serve as a refuge area for pedestrians.

Adapted from Zegeer, C.V., Stewart, R.J., Huang, H.H., and Lagerwey, P.A. *Safety Effects of Marked Vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines*. FHWA-RD-01-075. Federal Highway Administration, Washington, D.C., 2002.

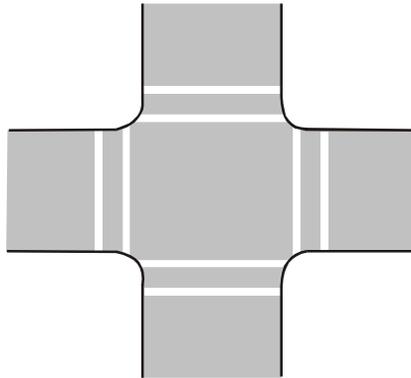
## Special Treatments

There are a number of innovative treatments for pedestrians at uncontrolled crossing locations. Level 1 devices are typically less costly to install and are found at locations with potentially lower levels of vehicle/pedestrian conflict. Level 2 through 5 devices can be more costly to install and are used at locations with an ascending order of potential vehicle/pedestrian conflicts.

### Level 1 Devices

#### *Standard Crosswalk*

Standard crosswalks (Figure 4) consist of two parallel lines and can be used at uncontrolled intersections. They are not to be used at mid-block crossings. Refer to section 3B.17 of the MUTCD for further guidance on standard crosswalks<sup>1</sup>.



**Figure 4. Standard Crosswalk**

#### *Raised Mid-Block Crosswalk*

Raised mid-block crossings (Figure 5) are sometimes constructed to provide a well-defined pedestrian crossing and to calm traffic. This type of crossing is suitable for only low-speed, low-volume local streets, since the raised crossing is essentially functioning as a speed table or hump.

Raised crossings enhance pedestrian safety by creating a vertical pavement undulation that forces motorists to slow down when approaching. They can function as an extension of the sidewalk and allow pedestrians to cross at a constant grade without the need for curb ramps or median cut-throughs. Raised crossings should have a 6-foot (1.8-meter) parabolic approach transition, raising the vehicle to 3 to 4 inches (7.6 to 10.2 centimeters) above the nominal pavement grade. The flat section of the crossing table should be 10 to 12 feet (3.0 to 3.7 meters) wide. Raised crossings need to be highly visible, either striped as a mid-block crossing or constructed of a contrasting pavement design. Raised crossings should be signed with advance warning signs and pedestrian crossing signs in the same manner as other mid-block crossings.<sup>12</sup>



**Figure 5. Raised Mid-block Crossing.** From <http://pedbikeimages.org/> Portland Office of Transportation. Reprinted with permission.

### *Rumble Strips*

Rumble strips are series of intermittent, narrow, transverse areas of a rough-textured, slightly raised, or depressed road surface that are installed to alert road users to unusual traffic conditions.<sup>1</sup> They can be used as a temporary traffic control device in areas of temporary, unexpected crosswalks. Rumble strips should be placed in advance of a crosswalk. Because of maintenance issues, rumble strips should be used only in special circumstances.

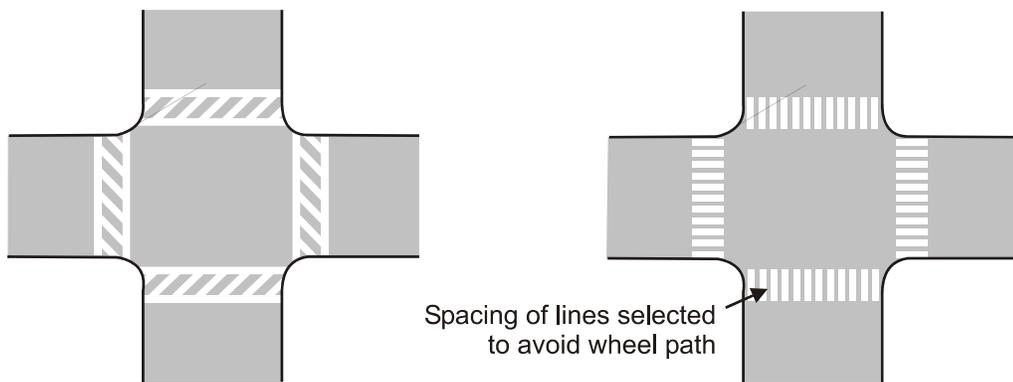
### **Level 2 Devices<sup>6</sup>**

#### *High-Visibility Crosswalks*

High-visibility crosswalks should be white and retroreflective (visible at night). They include the textured pavement crosswalks (Figure 6), “zebra” and “continental” crosswalks (Figure 7), and “triple-four” crosswalks (Figure 8). Textured pavement crosswalks are composed of stamped concrete or asphalt or brick pavers placed in a pattern and are outlined with white, retroreflective markings. These types of crosswalks can increase driver awareness of pedestrian activity by improving visibility and creating a different audible tone. The treatment can also improve the aesthetics of crosswalk installations. Disadvantages include higher construction and maintenance costs and the lack of smooth, accessible surfaces for pedestrians.<sup>13</sup>



**Figure 6. Example of a Textured Pavement Crosswalk.** From [www.pedbikeimages.org](http://www.pedbikeimages.org) / Dan Burden. Reprinted with permission.



**Figure 7. “Zebra” Crosswalk (Left) and “Continental” Crosswalk (Right).**

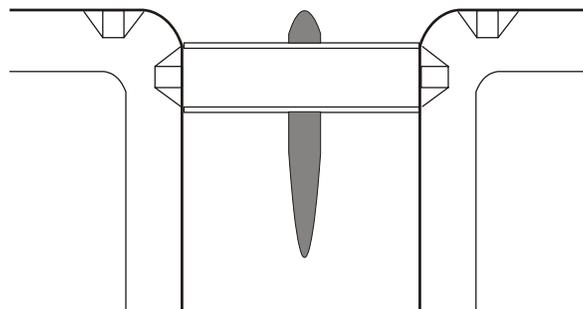


**Figure 8.** “Triple-Four” Crosswalk. From [www.pedbikeimages.org/](http://www.pedbikeimages.org/) Dan Burden. Reprinted with permission.

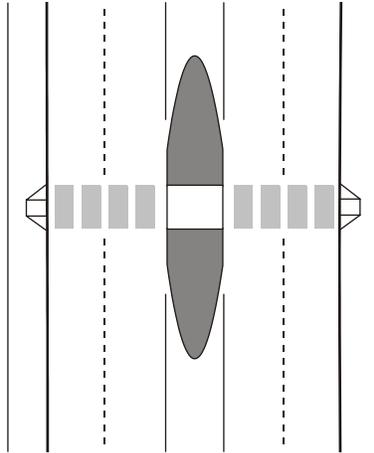
### Level 3 Devices<sup>6</sup>

#### *Refuge Islands*

Refuge islands (Figures 9 and 10) allow pedestrians to cross one segment of the street to a relatively safe location out of the travel lanes and then continue across the next segment in a separate gap. At unsignalized crosswalks on a two-way street, a median refuge island allows the crossing pedestrian to tackle each direction of traffic separately. This can significantly reduce the time a pedestrian must wait for an adequate gap in the traffic stream.<sup>11</sup> A pedestrian pushbutton should be placed in the median of signalized mid-block crossings where the crossing distance exceeds 60 feet (18.2 meters). Curb ramps or cut-throughs should be provided for accessibility.<sup>14</sup> Refer to VDOT’s *Guidelines for the Placement of Curb Ramps for Accessible Routes and Continuous Passages* on when and how to use curb ramps.<sup>15</sup>



**Figure 9.** Typical Median Refuge Island at an Intersection, with Median Nose and At-Grade Passage for a Crosswalk.



**Figure 10. Typical Median Refuge Island at Mid-Block, with At-Grade Passage for Crosswalk.**

*Split Pedestrian Crossover (SPXO)*

The SPXO (Figure 11) is a pedestrian refuge that channels pedestrians to cross one half of the street; enter the island at one end; walk toward the flow of traffic; and exit at the other end to cross the second half of the street. This special treatment is primarily used at mid-block locations and is especially beneficial at or near transit connections.

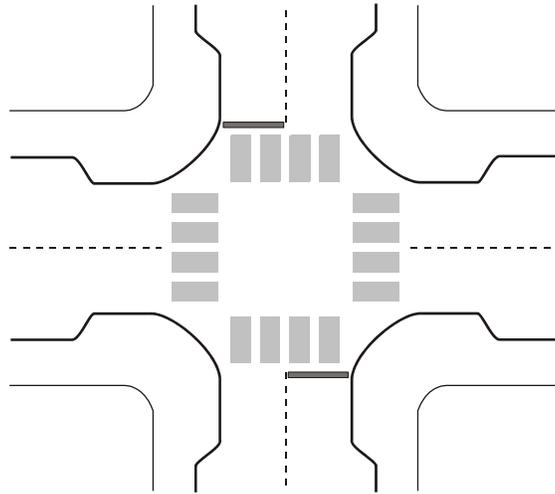


**Figure 11. Example of a Split Pedestrian Crossover.** From [www.pedbikeimages.org/](http://www.pedbikeimages.org/) Dan Burden. Reprinted with permission.

*Bulbouts*

**Intersections**

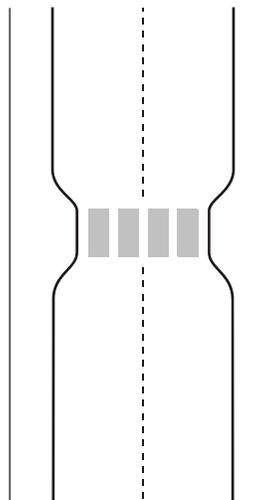
At an intersection, each corner of the bulbout (Figure 12) is extended into the intersection by approximately 7 to 8 feet to shorten the crossing distance for pedestrians and raise their visibility to motorists.



**Figure 12. Bulbouts at an Intersection.**

**Mid-Block Locations**

At mid-block locations, bulbouts (Figure 13) are extended into the street by approximately 7 to 8 feet to shorten the crossing distance for pedestrians and raise their visibility to motorists.



**Figure 13. Bulbouts at a Mid-Block Location.**

## Level 4 Devices<sup>6</sup>

### *Overhead Signs and Flashing Beacons*

Overhead signs can be various signs showing the universal pedestrian symbol, including standard yellow, fluorescent yellow, and LED displays that hang from a mast arm and extend over the street. Flashing beacons should accompany the overhead signs (Figure 14). A flashing beacon provides a relatively low-cost treatment for mid-block pedestrian crossings. The flashing light alerts drivers in advance of potential pedestrians without forcing them to stop unless there is actually a pedestrian in the crosswalk. This sort of device can be used on roadways with higher vehicular volumes without causing undue delay to drivers. Flashing beacons are most effective if they are operating only during times when there is a clear need to alert motorists, such as when pedestrians are actually present (rather than constantly flashing).<sup>3</sup> This can be done by using pedestrian pushbuttons (Figure 15) or passive activation. Refer to Section 4K.03 in the MUTCD for further guidance on flashing beacons.<sup>1</sup>



**Figure 14. Overhead Sign with Flashing Beacons.** From [www.pedbikeimages.org/](http://www.pedbikeimages.org/) ITE Pedestrian Bicycle Council. Reprinted with permission.



**Figure 15. Pedestrian Pushbutton for Flashing Beacon Operation.** From [www.pedbikeimages.org/](http://www.pedbikeimages.org/) Dan Burden. Reprinted with permission.

### *In-Roadway Warning Lights (IRWLs)*

IRWLs (Figure 16) should be installed with a flashing sign at the crosswalk and an advanced flashing sign ahead of the crosswalk. They should also be installed with advance audible warning devices for motorists, such as rumble strips. Refer to VDOT's *Guidelines for the Installation of In-Roadway Warning Lights* for further guidance.<sup>16</sup>



**Figure 16. In-Roadway Warning Lights at a Mid-block Crosswalk.** From [www.pedbikeimages.org](http://www.pedbikeimages.org) / ITE Pedestrian Bicycle Council. Reprinted with permission.

### **Level 5 Devices<sup>6</sup>**

#### *Pedestrian-Actuated Signals*

Pedestrian-actuated signals (Figure 17) should be placed at mid-block locations where vehicle and pedestrian volumes warrant a signal. Refer to Section 4C.05 Warrant 4, Pedestrian Volume of the MUTCD for further guidance on mid-block pedestrian-actuated signals.<sup>1</sup>

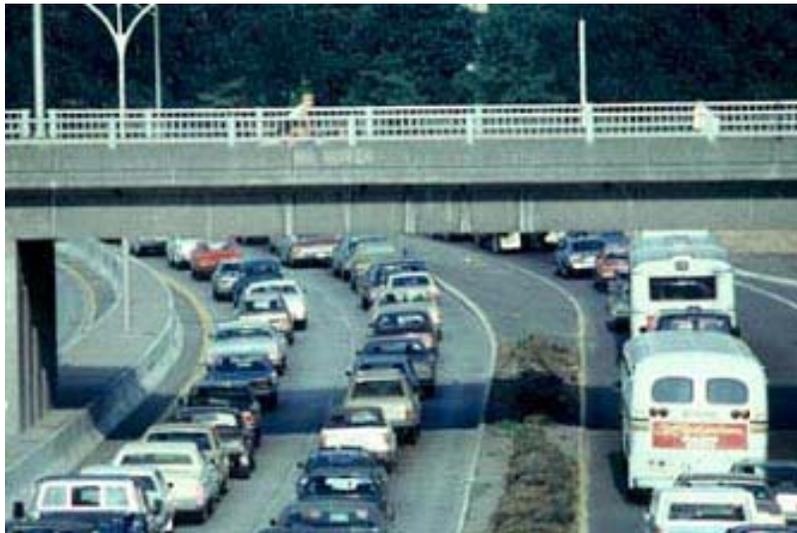


**Figure 17. Pedestrian-Actuated Mid-block Signal.** From [www.pedbikeimages.org](http://www.pedbikeimages.org) / ITE Pedestrian Bicycle Council. Reprinted with permission.

## *Grade-Separated Crossings*

The purpose of grade-separated crossings is to separate pedestrian travel from vehicular travel completely. These crossing facilities should be used only where it is not possible to provide an at-grade facility. Examples are crossing a freeway or major highway (Figures 18 and 19), a rail yard, or a waterway. Grade-separated crossings should:

- be accessible.
- have minimal grade changes
- have a clear passage width of at least 3.7 meters (12 feet).<sup>11</sup>



**Figure 18. Grade-Separated Crossing (Bridge) Over a Major Highway.** From [www.pedbikeimages.org/](http://www.pedbikeimages.org/) Dan Burden. Reprinted with permission.



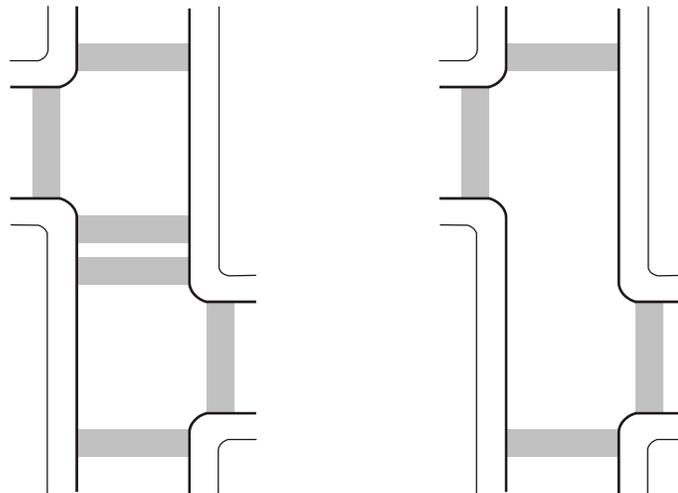
**Figure 19. Grade-Separated Crossing (Tunnel) Under a Roadway.** From [www.pedbikeimages.org/](http://www.pedbikeimages.org/) Dan Burden. Reprinted with permission.

## GUIDELINES FOR MARKING CROSSWALKS AT UNCONVENTIONAL INTERSECTIONS AND LOCATIONS

The geometric characteristics of an intersection are very important to the safe movement of pedestrian and vehicular traffic. There are many instances where the geometries of an intersection are not conventional, i.e., in the form of two intersecting perpendicular lines. The following guidelines describe additional treatments and/or practices for crosswalk markings at T, offset, and skewed intersections at controlled and uncontrolled approaches of an intersection. Guidance is also provided for the placement of crosswalks on hills and curves.

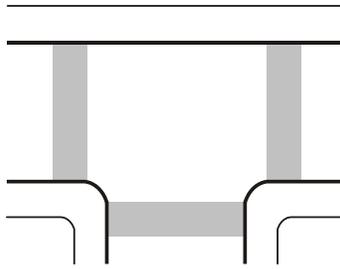
### T and Offset Intersections

At closely spaced T and offset intersections, overall pedestrian safety and convenience may be increased by selectively enhancing some crosswalks while eliminating others. The offset intersection on the left of Figure 20 shows a typical offset intersection with all legal crosswalks marked. The offset intersection on the right of Figure 20 shows a more practical and effective application of marked crosswalks at offset intersections. In general, enhancement of the outer crosswalks and elimination of the inner crosswalks would be the preferred design at most offset intersections. However, other configurations may be chosen based on the particular site.<sup>11</sup>



**Figure 20. Typical Offset Intersection Showing All Legal Crosswalks (left) and a More Practical and Effective Crosswalk Application (right).**

Figure 21 shows all legal crosswalks at a T intersection. This crosswalk design is useful in highly urbanized areas with heavy pedestrian volumes and heavy right turns from the eastbound leg of the T. In rural areas or in situations where vehicular and pedestrian volumes are low, it may be appropriate to mark only the right portion of the upper leg of the T and across the lower portion of the T.



**Figure 21. All Legal Crosswalks at a T Intersection.**

### **Skewed Intersections**

At skewed intersections, crosswalks should, whenever possible, be installed so that they form 90-degree angles with the curb. Perpendicular (90 degree) crosswalks minimize the walking distance and, therefore, the pedestrian exposure to vehicle conflicts. They also better accommodate the needs of pedestrians with visual disabilities who are usually accustomed to perpendicular crossings.<sup>17</sup>

On highly skewed roadways, there is a trade-off between making a 90-degree crossing of a roadway and matching the junction of the roads. This skew adds another 10 to 30 feet (3.1 to 9.2 meters) to the crossing width. By dropping back to a 90-degree crossing, the crosswalk may end up 10 feet (3.1 meters) or even 30 feet (9.2 meters) from the intersection. This creates one of two problems. Either the motorist tends to move closer to the intersection, thus blocking the intersection, or he or she picks up high speed that endangers the pedestrian on the right-turn leg of the intersection. Therefore, crosswalks need to be kept close to the turning traffic so that pedestrians stay within the driver's line of sight. If this cannot be achieved, it is essential to stay as close as practicable.<sup>14</sup>

### **Hills and Curves**

If at all possible, crosswalks should not be placed on hills where vertical stopping sight distances are restricted. Motorists need at least 4 seconds to detect, react, and slow down for a pedestrian in a crosswalk. At locations where crosswalks are needed, placement at the top of a hill is much better than just below the crest.

Likewise, if at all possible, crosswalks should not be placed on curves where horizontal stopping sight distances are restricted. Placement where the motorists have been slowed by a curve and are therefore able to view the pedestrian is desirable. However, there will be locations where crosswalks are needed along a corridor with curves. In these instances, installation of a refuge or median island will help slow the motorist and provide a low conflict crossing for pedestrians. The refuge or median island should begin before the curve. If inadequate vertical or horizontal stopping sight distances exist, the use of traffic calming measures (such as the refuge or median island) to reduce a vehicles speed or special signing, beacons, and signalization should be considered.<sup>14</sup>

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