

## 1.0 INTRODUCTION

### 1.1 Statement of Policy

It shall be the policy of the Town of Brookline, Department of Public Works, to provide for safe pedestrian crossings of public streets by installing and maintaining marked crosswalks at all locations where there is substantial conflict between vehicle and pedestrian movements, where significant pedestrian concentrations occur, where pedestrians would not otherwise recognize the proper place to cross, and where traffic movements are controlled.

A “marked crosswalk” is any crosswalk that is delineated by painted markings placed on the pavement for the purpose of directing pedestrians to use a particular location to cross the street. Crosswalks may be marked at intersections controlled by traffic signals or stop/yield signs (“controlled crossings”), or at locations where traffic is not controlled by signals or stop/yield signs (“uncontrolled crossings”).

### 1.2 Purpose of Guideline

The purpose of this guideline is to describe the warrants and criteria for the installation of marked crosswalks and the design specifications for crosswalk markings and signage. Compliance with these guidelines will ensure that the pavement markings and signs associated with safe pedestrian crossings are treated consistently throughout the Town of Brookline with respect to their placement, design, installation and maintenance.

This guideline incorporates the guidance and standards contained in the Manual on Uniform Traffic Control Devices (MUTCD)<sup>1</sup>, the Massachusetts Highway Department (MassHighway) Highway Design Manual and Engineering Directive<sup>2</sup> concerning the standardization of crosswalk markings, the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, and applicable Massachusetts state law.<sup>3</sup>

### 1.3 General

Marked crosswalks are viewed widely as “safety devices,” and most municipalities give the pedestrian the right-of-way when within them. However, there is strong evidence that these facts prompt many pedestrians to feel overly secure when using a marked crosswalk. As a result, pedestrians will often place themselves in a hazardous position by believing that motorists can and will stop in all cases, even when it may be impossible to do so. It is not unusual for this type of aggressive pedestrian behavior to contribute to a higher incidence of

<sup>1</sup> *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*, U.S. Department of Transportation, Federal Highway Administration, 2003. MUTCD requirements for crosswalk markings are summarized in Attachment 1.

<sup>2</sup> MassHighway Engineering Directive E-96-001, “Standardization of Crosswalk Markings,” dated 3/26/96. A copy of this Directive is provided in Attachment 2.

<sup>3</sup> Massachusetts state law (M.G.L. Chapter 89, Section 11) requires motorists to yield to pedestrians in marked crosswalks. State law also protects blind pedestrians when crossing a road (M.G.L. Chapter 90, Section 14A), and provides local officials with the authority to adopt pedestrian rules and regulations (M.G.L. Chapter 90, Section 18A). Copies of the above statutes are provided in Attachment 3.

pedestrian accidents and cause a greater number of rear-end collisions. In contrast, a pedestrian using an unmarked crosswalk generally feels less secure and less certain that the motorist will stop and thereby exercise more caution and waiting for safe gaps in the traffic stream before crossing. The end result is fewer accidents at unmarked crosswalks.

Despite the above safety issues, a marked crosswalk is a useful traffic engineering device for helping pedestrians across complex intersections, channelizing pedestrians to safe crossing locations, and minimizing their exposure to vehicular conflicts, as long as sound engineering judgment is exercised in their location and design. Crosswalk lines should not be used indiscriminately at mid-block locations away from traffic signals or stop signs. Crosswalks may be marked at mid-block locations, however, if an engineering study determines it is safe to do so, and their presence is necessary to concentrate pedestrian crossing activity at a specific location. A mid-block crosswalk is not likely to be effective if pedestrian crossings occur at random locations within a block and if vehicle volumes are low or moderate (adequate gaps are available).

Crosswalks should also not be marked on 2-lane roadways with ADT greater than 9,000 vehicles per day, or 4-lane roadways with ADT greater than 12,000 vehicles per day, unless other special treatments - such as raised median refuges, curb extensions, overhead lighting, pedestrian-activated signals or warning lights - are provided, and an engineering study concludes that pedestrian safety will be ensured by the special treatments.

#### **1.4 Traffic Engineering Study**

A traffic engineering study is required to determine if the criteria and warrants are satisfied for the installation of a marked crosswalk at a particular location, and to determine the level of marking justified. The components of a traffic engineering study will vary by location, but may include consideration of:

- Speed and volume on the street(s) involved
- Pedestrian volume, age, and level of mobility
- Location of pedestrian origins and destinations and crossing patterns
- Existing sidewalk network and sidewalk ramps
- Adequacy of sight distances (absence of sight obstructions)
- Street characteristics including grade, curvature, pavement widths, number of vehicle and bicycle lanes
- Location of adjacent driveways
- On-street parking
- Street lighting
- Location of drainage structures
- Distance to nearest marked crossing
- Traffic signal progression
- Potential for rear-end accidents

#### **1.5 Crosswalk Maintenance**

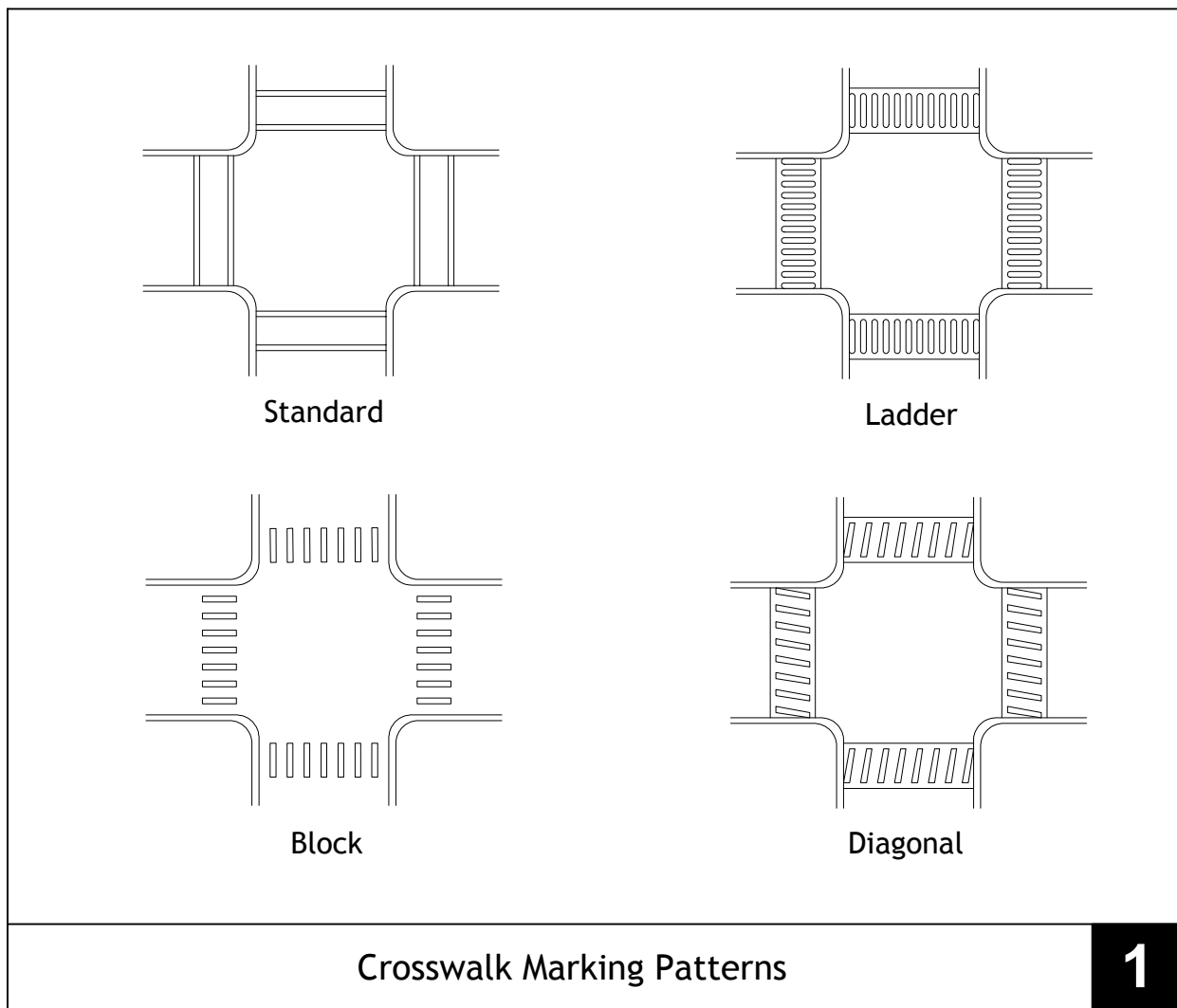
Crosswalk markings and signs should be maintained in a high state of visibility and meet reflectivity standards. All crosswalk markings and signs should be inspected at least once a

year and replaced as needed. Markings and signs for crosswalks located in school zones must be inspected prior to the beginning of the school year and replaced as needed.

## 2.0 DESIGN FEATURES OF MARKED CROSSWALKS

### 2.1 Pavement Marking Patterns (See Figure 1)

Marked crosswalks in the Town of Brookline are presently painted or marked in one of the four patterns shown in **Figure 1**: Standard, Block, Ladder, and Diagonal. All new crosswalks marked in the town shall be of either the Standard or Ladder design only, and installed in conformance with the following guidelines. Existing crosswalks of the Block or Diagonal design may be repainted in their existing pattern until such time as (re)construction of the street on which they lie requires removal of the existing crosswalk and it can be replaced with the preferred Standard or Ladder design.



## 2.2 Crosswalk Marking Width and Color

When a standard or ladder-type crosswalk is located on a residential or local street, the width of the crosswalk (distance between transverse lines) shall be 8 feet on center. When the crosswalk is located on a collector or arterial street, the width of the crosswalk shall be 10 feet on center. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall be solid white in color with a width of 12 inches.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 12 inches, and be spaced 3 feet apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

## 2.3 Crosswalk Marking Materials

It is important that crosswalk markings be visible to motorists (especially at night), not be slippery or create tripping hazards, and not be difficult to traverse by those with diminished mobility or visual capabilities. All crosswalk markings shall therefore be installed using either: (a) a chlorinated paint suitable for application on asphalt surfaces, (b) a thermoplastic paving marking material, or (c) an inlay polymer marking tape. All crosswalk markings shall also consist of high reflectivity materials.

Because it is highly reflective, durable, slip-resistant, and does not require a high level of maintenance, it shall be the policy of the Town to install marked crosswalks using inlay tape whenever possible. To the maximum extent practicable, inlay tape shall be used as the preferred marking material whenever crosswalks are installed on new or resurfaced pavements.

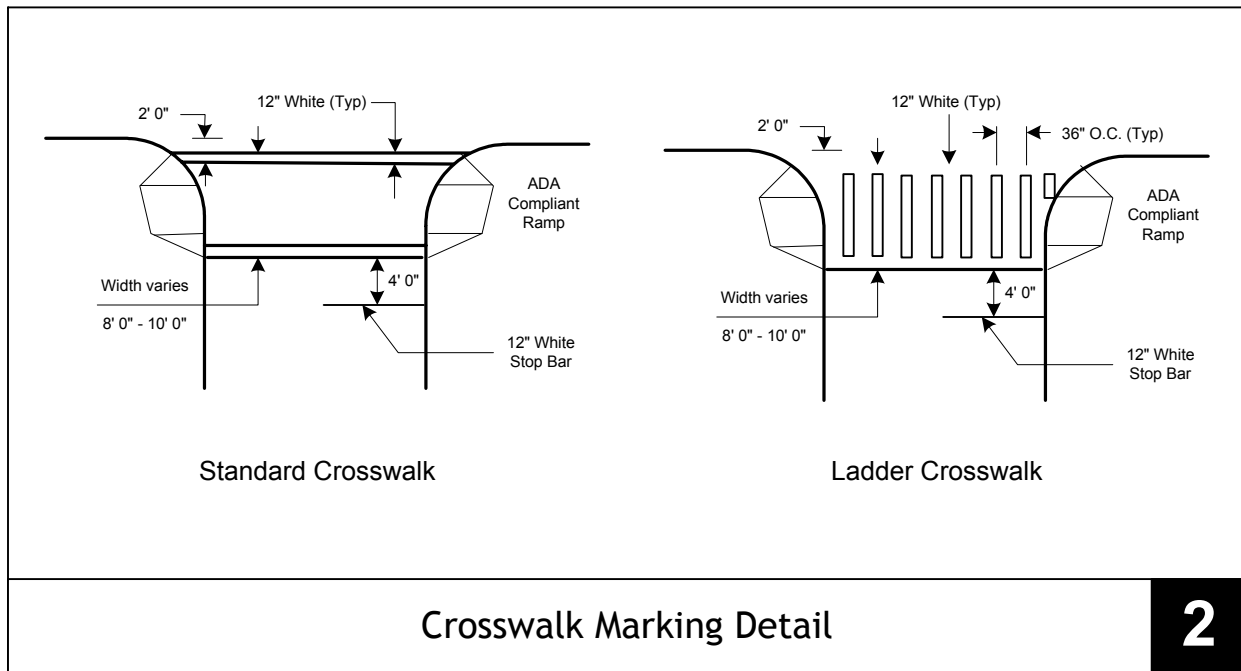
## 2.4 ADA Compliance

Where a crosswalk provides access to sidewalks, curb ramps that meet ADA Accessibility Guidelines (ADAAG), MassHighway Construction Standards, and all requirements of the Massachusetts Architectural Board (521 CMR) must be provided at both ends of the crosswalk. If a crosswalk leads to a paved shoulder, it should meet ADAAG regarding width and cross-slope (maximum 2%) to the extent feasible.

## 2.5 Use of Colored and Textured Pavement

In commercial areas or school zones, colored and textured pavement may be used to enhance the aesthetics of the crosswalks. The most common treatment is a terra cotta colored, brick pattern that is stamped into newly laid asphalt. In accordance with the MUTCD, the colors white, yellow, blue, or red shall not be used for this purpose. Transverse white crosswalk markings (standard crosswalk pattern) must be used in addition to the colored or texture pavement in order to legally establish a crosswalk location when textured pavement is used.

Granite and cobblestones are examples of materials that while aesthetically attractive, may become slippery when wet and be difficult to cross by pedestrians who are blind or use wheelchairs. The use of these materials at pedestrian crossings is not recommended.



The use of colored and textured pavement has not been proven to substantially improve the safety, or enhance the visibility to the driver, of a crosswalk. It is therefore recommended that colored and textured pavement not be used at uncontrolled mid-block locations, or on approaches to intersections that are not signalized or controlled by a stop or yield sign. Colored pavement located between crosswalk lines to emphasize the presence of the crosswalk is not considered a traffic control device.

**2.6 Use of Fluorescent Yellow-Green Signs**

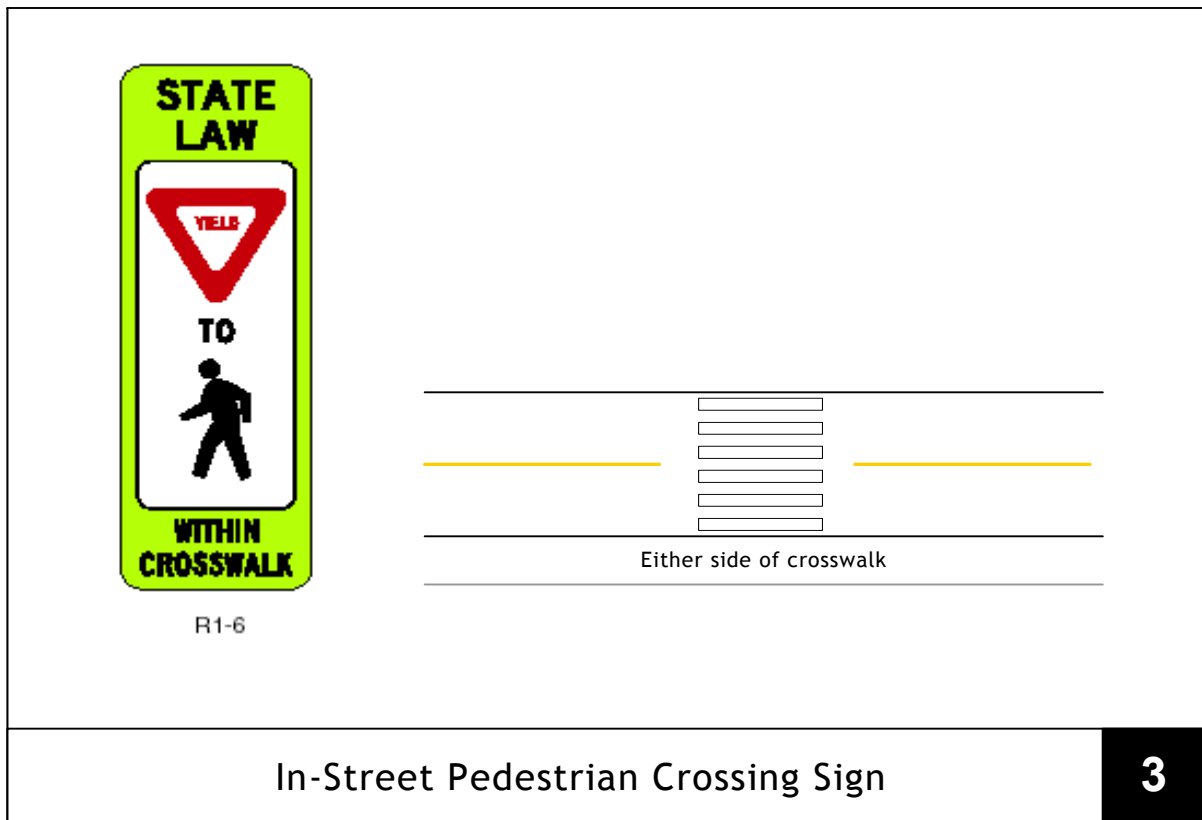
In accordance with the MUTCD (Section 2C.41), pedestrian, bicycle, and school signs and their related supplemental plaques may have a fluorescent yellow-green background with a black legend and border. However, when a fluorescent yellow-green background is used, a systematic approach featuring one background color within a zone or area should be used. The mixing of standard yellow and fluorescent yellow-green within a selected site area should be avoided.

**2.7 In-street Pedestrian Crossing Signs**

The In-street Pedestrian Crossing (R1-6) sign may be used to remind road users of the state law that a driver must yield to a pedestrian in a crosswalk at an uncontrolled pedestrian crossing. Permission to place an In-street Pedestrian Crossing sign at a particular location requires approval of the Transportation Board and the issuance of a permit by the DPW Highways Division. Guidelines for sign use and placement include:

- a. One In-street Pedestrian Crossing sign is allowed per crosswalk location;
- b. The In-street Pedestrian Crossing sign shall not be used on the approaches to a signalized intersection;

- c. The In-street Pedestrian Crossing sign should be placed at the roadway centerline adjacent to the crosswalk, not within the crosswalk itself;
- d. If a central island is provided in the street, the sign should be placed on the island;
- e. If used, the In-Street Pedestrian Crossing sign shall have a black legend (except for the red YIELD sign symbol) and border on either a white and/or florescent yellow-green background.
- f. If the In-Street Pedestrian Crossing sign is placed in the roadway, the sign support shall comply with the breakaway requirements of the latest edition of AASHTO's "Specification for Structural Supports for Highways Signs, Luminaries, and Traffic Signals."
- g. The In-Street Pedestrian Crossing sign may be used seasonably to prevent damage in winter because of plowing operations, and may be removed at night if the pedestrian activity at night is minimal.



### 3.0 MARKED CROSSWALKS AT INTERSECTIONS

#### 3.1 SIGNALIZED INTERSECTIONS

##### 3.1.1 Criteria for Installation

Intersections with a traffic signal timed for concurrent pedestrian movements shall have

crosswalks applied on the roadway approaches that have sidewalks on both sides of the approaching street. Crosswalks should not be installed where no sidewalks exist unless adequate shoulders exist for use by pedestrians. The determination of adequate shoulder should be based on an assessment of traffic volumes, adjacent land uses, and other site-specific considerations.

Intersections with a traffic signal which is not timed to accommodate concurrent or exclusive pedestrian movements, or have traffic signal heads that cannot be seen by the pedestrian, shall have crosswalks applied only on those approaches which might be used by the pedestrian.

### **3.1.2 Crosswalk Marking Pattern**

The standard crosswalk design, consisting of two transverse lines parallel to one another, shall be the preferred crosswalk design at all intersections controlled by a traffic signal. See previous Figure 2. In accordance with the MUTCD (Section 3B.17), the crosswalk lines should extend across the full width of the pavement, or to the edge of the intersection crosswalk, to discourage diagonal walking between crosswalks.

### **3.1.3 Crosswalk Marking Width and Color**

When the approach to the signalized intersection is a residential or local street, the width of the standard crosswalk shall be 8 feet on center. When the approach to the signalized intersection is a collector or arterial streets, the width of the crosswalk shall be 10 feet on center. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall be solid white in color and have a width of 12 inches. See previous Figure 2.

### **3.1.4 Installation of Stop Line**

When a crosswalk is installed on the approach to a signalized intersection, a stop line should also be installed. In accordance with the MUTCD (Section 3B.16), the stop line should be white in color, have a width of 12 inches, and be marked a minimum of 4 ft in advance of the nearest crosswalk line, as measured by the gap between the stop bar the closest crosswalk marking. See previous Figure 2.

### **3.1.5 No Parking Zone**

In accordance with the MUTCD (Section 3B.18), parking spaces shall not be marked within 20 feet of a marked crosswalk at an intersection, as measured by the gap between the parking space and the closest crosswalk marking.

### **3.1.6 Pedestrian Warning Signs**

In accordance with the MUTCD, there shall be no pedestrian crossing signs installed at the location of the marked crosswalks, nor any advance pedestrian warning signs installed on the approaches to the signalized intersection.

## **3.2 UNSIGNALIZED INTERSECTIONS - STOP OR YIELD CONTROLLED**

### **3.2.1 Criteria for Installation**

A crosswalk may be placed across an approach controlled by a stop or yield sign if a sidewalk exists on both sides of the roadway approach controlled by the stop or yield sign. Crosswalks should not be installed at locations where sidewalks do not exist unless adequate shoulders exist for use by pedestrians. The determination of adequate shoulder should be based upon an assessment of traffic volumes, adjacent land use patterns, and other site-specific conditions.

In general, the installation of crosswalks across the throat of driveways or minor side roads is not recommended unless there is a high potential for vehicle/pedestrian conflicts that will be mitigated by a marked crosswalk.

### **3.2.2 Crosswalk Pattern**

The ladder crosswalk design, consisting of two transverse lines parallel to one another together with longitudinal lines parallel to traffic flow, shall be the preferred crosswalk design at intersections controlled by a stop or yield sign. The crosswalk lines should extend across the full width of the pavement, or to the edge of the intersection crosswalk, to discourage diagonal walking between crosswalks. See previous Figure 2.

### **3.2.3 Crosswalk Marking Width and Color**

When a ladder crosswalk is installed, the longitudinal lines shall be solid white in color, have a width of 12 inches, and be spaced 3 ft apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible. See previous Figure 2.

### **3.2.4 Installation of Stop or Yield Line**

When a crosswalk is installed on a stop or yield-controlled approach, a stop or yield line should also be installed. In accordance with the MUTCD (Section 3B.16), the stop or yield line should be white in color, have a width of 12 inches, and be marked a minimum of 4 ft in advance of the nearest crosswalk line, as measured by the gap between the stop bar the closest crosswalk marking. See previous Figure 2.

### **3.2.5 No Parking Zone**

In accordance with the MUTCD (Section 3B.18), parking spaces shall not be marked within 20 feet of the marked crosswalk, as measured by the gap between the parking space and the closest crosswalk marking.

### **3.2.6 Pedestrian Warning Signs**

In accordance with the MUTCD, there shall be no pedestrian crossing signs installed at the location of the marked crosswalks, or any advance pedestrian warning signs installed on the stop or yield controlled approaches to the intersection.



### **3.3 UNSIGNALIZED INTERSECTION - ROUNDABOUT**

#### **3.3.1 Criteria for Installation**

A crosswalk may be placed across a roundabout approach if a sidewalk exists on both sides of the approach. Crosswalks should not be installed in the absence of sidewalks unless adequate shoulders exist for use by pedestrians. The determination of adequate shoulder should be based on an assessment of traffic volumes, adjacent land use patterns, and other site-specific conditions.

In accordance with the MUTCD, crosswalks that are marked on the approaches to a roundabout shall be placed a minimum of 25 feet in advance of the yield line, or if none, from the edge of the circulating lane.

#### **3.3.2 Crosswalk Pattern**

The ladder crosswalk design, consisting of two transverse lines parallel to one another together with longitudinal lines parallel to traffic flow, shall be used on all roundabout approaches so that the visibility of the crossing location is maximized.

#### **3.3.3 Crosswalk Marking Width and Color**

When the ladder crosswalk is installed, the longitudinal lines shall be 8 feet on center when the approach to the intersection is a residential or local street. The width of the crosswalk shall be 10 feet on center when the approach is on a collector or arterial street. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall be solid white in color and have a width of 12 inches. The longitudinal lines shall also be solid white in color, have a width of 12 inches, and be spaced 3 ft apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

#### **3.3.4 No Parking Zone**

In accordance with the MUTCD (Section 3B.18), parking spaces shall not be marked within 20 feet of the marked crosswalk, as measured by the gap between the parking space and the closest crosswalk marking.

#### **3.3.5 Pedestrian Warning Signs**

Pedestrian in crosswalk signs (W11A-2 with downward arrow plaque W16-7p) shall be installed at each end of the crosswalk location. The signs shall be placed in advance of the crosswalk adjacent to the travel lane and facing the driver.

Advance pedestrian warning signs (W11-2) shall be installed at a distance of at least 150 ft but not exceeding 700 feet in advance of the crosswalk on the approach to the roundabout. No advance warning sign is required within the roundabout. Advance pedestrian warning signs may be accompanied by supplemental plaques with the legend "AHEAD" (W16-9p) or "XXX FEET" (W16-2a).

### 3.4 UNSIGNALIZED INTERSECTION - UNCONTROLLED APPROACHES

#### 3.4.1 Criteria for Installation

A crosswalk should not be installed at an intersection on a roadway approach that is not regulated by a traffic signal, a stop sign, or a yield sign unless all of the following criteria are met:

- a. The speed limit is 40 mph or less; and,
- b. There are 20 or more pedestrians using the crossing per hour during the peak AM and PM periods of vehicular traffic (lesser volumes may be considered if a large percentage of the pedestrian population consists of young, elderly, or disabled pedestrians); and,
- c. The ADT (average daily traffic) for the roadway (both directions combined) exceeds 3,000 vehicles per day; and,
- d. A sidewalk or adequate shoulder for use by pedestrians (as determined by traffic volumes, adjacent land uses and other site specific considerations) exists on both sides of the roadway approach; and,
- e. There is not another crosswalk across the same roadway within 200 ft of the intersection; and,
- f. Adequate stopping sight distance (equal to or exceeding that for the posted speed) is available in both directions. Because a driver must be able to see either the crosswalk or the pedestrian warning sign, the sight distance should be measured from the driver's perspective to the outer edges of the travel lane so that an approaching driver can see a pedestrian at any point on the crosswalk. The adequacy of stopping sight distances shall be determined in accordance with the guidance contained in the AASHTO "Green Book" - A Policy on the Design of Highways and Streets (2001).

When a crosswalk is proposed in conjunction with a new development, change in land use, or new pedestrian facilities, an engineering study may be used to predict whether or not the above criteria will be met once the development or facility has been constructed and is fully occupied.

Crosswalks should not be marked on 3 or 4 lane roadways with ADT greater than 9,000 vehicles per day unless other safety features - such as raised median refuges, traffic calming measures, or overhead lighting - are provided, and an engineering study concludes that pedestrian safety will be enhanced by their presence.

#### 3.4.2 Crosswalk Pattern

The ladder crosswalk design, consisting of two transverse lines parallel to one another together with longitudinal lines parallel to traffic flow, shall be used on all uncontrolled intersection approaches so that the visibility of the crossing location is maximized.

#### 3.4.3 Crosswalk Marking Width and Color

When the ladder crosswalk is installed, the longitudinal lines shall be 8 feet on center when the approach to the intersection is a residential or local street. The width of the crosswalk shall be 10 feet on center when the approach is on a collector or arterial street. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall

be solid white in color and have a width of 12 inches. The longitudinal lines shall also be solid white in color, have a width of 12 inches, and be spaced 3 ft apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

### 3.4.4 No Parking Zone

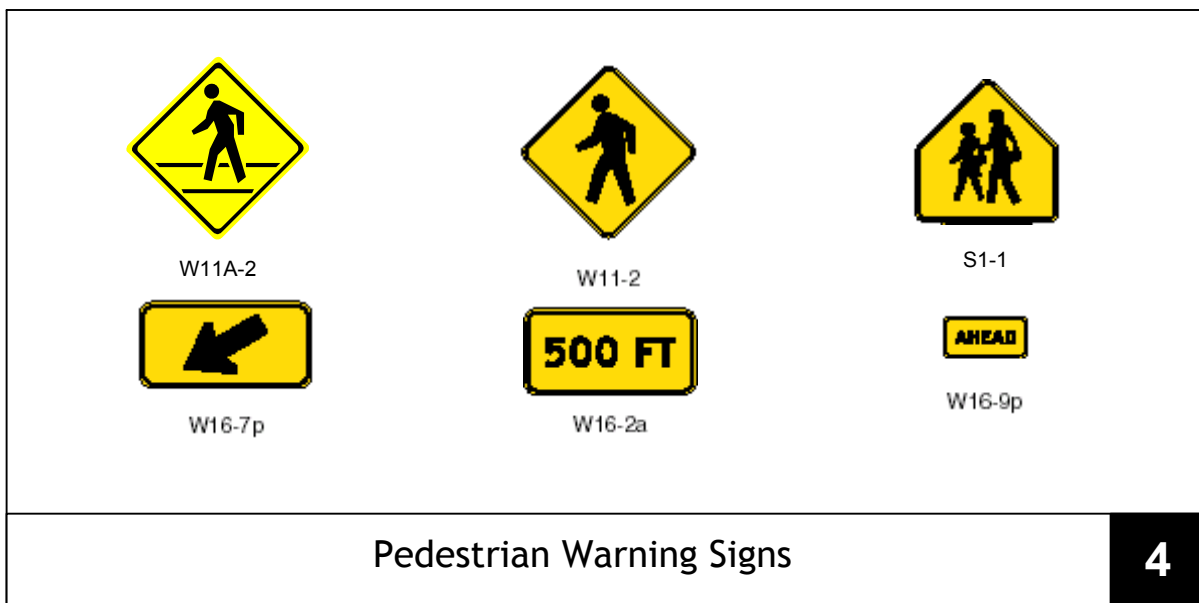
In accordance with the MUTCD (Section 3B.18), parking spaces shall not be marked within 20 feet of the marked crosswalk, as measured by the gap between the parking space and the closest crosswalk marking.

### 3.4.5 Pedestrian Warning Signs

Pedestrian in crosswalk signs (W11A-2 with downward arrow plaque W16-7p) shall be installed at each end of the crosswalk location. The signs shall be placed in advance of the crosswalk adjacent to the travel lane and facing the driver.

Advance pedestrian warning signs (W11-2) shall be installed at a distance of at least 150 ft but not exceeding 700 feet in advance of the crosswalk, in either direction. Advance pedestrian warning signs may be accompanied by supplemental plaques with the legend "AHEAD" (W16-9p) or "XXX FEET" (W16-2a).

At locations along an established route to school, a school crossing sign (S1-1) may be used instead of the pedestrian warning sign (W11-2).



## 4.0 MARKED CROSSWALKS AT MID-BLOCK LOCATIONS

### 4.1 SCHOOL CROSSINGS

Crosswalks should be marked at locations on established routes to a school (if the school has established a school route plan) where there exists a conflict between vehicles and school children, or where students would not otherwise know the proper place to cross the street. The following guidance applies only to locations adjacent to schools.

#### 4.1.1 Criteria for Installation

All of the following criteria should be met before installing a crosswalk at a mid-block location on an established school route:

- a. The speed limit is 40 mph or less; and,
- b. A sidewalk or adequate shoulder for use by pedestrians (as determined by traffic volumes, adjacent land uses and other site specific considerations) exists on both sides of the roadway approach; and,
- c. There is not another crosswalk across the same roadway within 200 ft of the proposed location; and,
- d. Adequate stopping sight distance (equal to or exceeding that for the posted speed) is available in both directions. Because a driver must be able to see either the crosswalk or the school crossing sign, the sight distance should be measured from the driver's perspective to the outer edges of the travel lane so that an approaching driver can see a pedestrian at any point on the crosswalk. The adequacy of stopping sight distances shall be determined in accordance with the guidance contained in the AASHTO "Green Book" - A Policy on the Design of Highways and Streets (2001).

Crosswalks should not be marked on 2-lane roadways with ADT greater than 9,000 vehicles per day, or 4-lane roadways with ADT greater than 12,000 vehicles per day, unless other special treatments - such as raised median refuges, curb extensions, overhead lighting, pedestrian-activated signals or warning lights - are provided, and an engineering study concludes that pedestrian safety will be ensured by the special treatments.

While there is no minimum pedestrian volume for a school crossing, it is recommended that a trained crossing guard be present whenever there is crossing activity by students.

When a crosswalk is proposed in conjunction with a new development, change in land use, or new pedestrian facilities, an engineering study may be used to predict whether or not the above criteria will be met once the development or facility has been constructed and is fully occupied.

#### 4.1.2 Crosswalk Pattern

The ladder crosswalk design, consisting of two transverse lines parallel to one another together with longitudinal lines parallel to traffic flow, shall be used on all uncontrolled intersection approaches so that the visibility of the crossing location is maximized.

### 4.1.3 Crosswalk Marking Width and Color

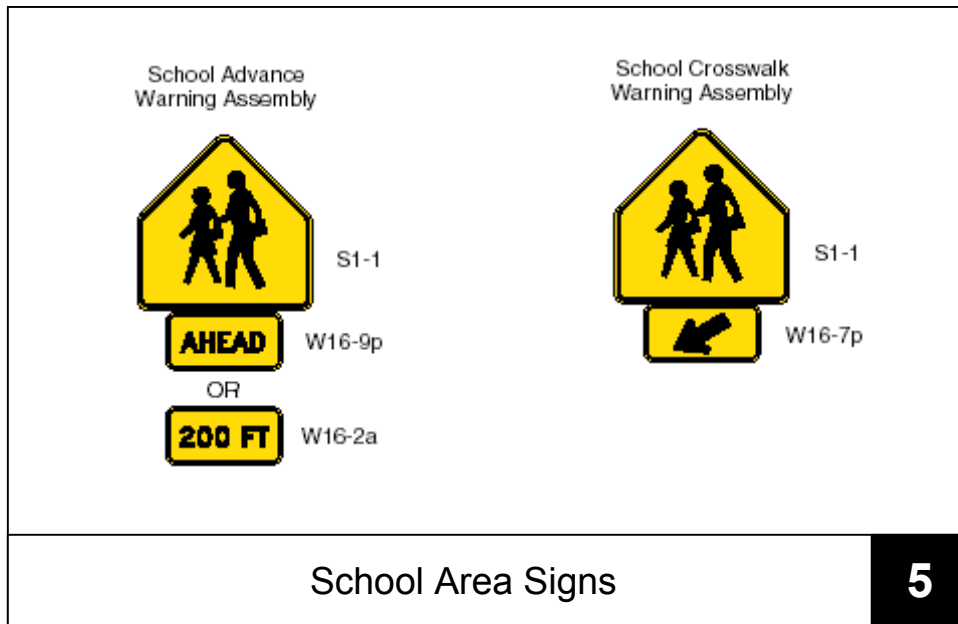
When the ladder crosswalk is installed, the transverse lines shall be 8 feet on center when the approach to the intersection is a residential or local street. The width of the crosswalk shall be 10 feet on center when the approach is on a collector or arterial street. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall be solid white in color and have a width of 12 inches. The longitudinal lines shall also be solid white in color, have a width of 12 inches, and be spaced 3 ft apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

### 4.1.4 No Parking Zone

In accordance with the MUTCD (Section 3B.18), parking spaces shall not be marked within 20 feet of the marked crosswalk, as measured by the gap between the parking space and the closest crosswalk marking. If a bulb-out is present, the gap may be reduced to 10 feet. Parents should be discouraged from using the area adjacent to the crosswalk for pick-ups and drop-offs.

### 4.1.5 School Crossing Signs

A School Crossing Warning Assembly (SCWA) consisting of a School Crossing Sign (S1-1) with a diagonal downward arrow plaque (W16-7p) shall be installed at each end of the crosswalk location. The signs shall be placed in advance of the crosswalk adjacent to the travel lane and facing the driver. The SCWA shall not be used at marked crosswalks other than those adjacent to schools or on established school routes. The SCWA shall not be installed on intersection approaches controlled by a traffic signal or stop sign.



A School Advance Warning Assembly consisting of a School Crossing Sign (S1-1) and a supplemental plaque with the legend “AHEAD” (W16-9p) or “XXX FEET” (W16-2a) shall be

installed at a distance of at least 150 ft but not exceeding 700 feet in advance of the crosswalk, in either direction.

## 4.2 NON-SCHOOL CROSSINGS

Crosswalk lines should not be used indiscriminately at locations away from traffic signals or stop signs. Crosswalks may be marked at mid-block locations only if an engineering study determines it is safe to do so, and their presence is necessary to concentrate pedestrian crossing activity at a specific location and position pedestrians to be more visible by motorists.

Crosswalks should not be marked on 2-lane roadways with ADT greater than 9,000 vehicles per day, or 4-lane roadways with ADT greater than 12,000 vehicles per day, unless other special treatments - such as raised median refuges, curb extensions, overhead lighting, pedestrian-activated signals or warning lights - are provided, and an engineering study concludes that pedestrian safety will be ensured by the special treatments.

### 4.2.1 Criteria for Installation

All of the following criteria should be met before installing a crosswalk at an uncontrolled, mid-block location:

- a. The 85<sup>th</sup> percentile speed of traffic at the marked crosswalk location must be less than 40 mph; and,
- b. The pedestrian volume at the location of the crosswalk must be more than 30 pedestrians per hour (pph) during the peak pedestrian hour (lesser volumes may be considered if a large percentage of the pedestrian population consists of young, elderly, or disabled pedestrians); or 15 pph for each of 4 hours; and,
- c. The ADT (average daily traffic) for the roadway (both directions combined) must exceed 3,000 vehicles per day; or the number of unimpeded vehicle time gaps that equal or exceed the pedestrian crossing times in an average 5-minute period during the peak vehicle hour must be greater than 4;<sup>4</sup>
- d. A sidewalk or adequate shoulder for use by pedestrians, or a distinct pedestrian destination such as a recreation field, must exist on both sides of the roadway approach; and,
- e. Another crosswalk across the same roadway cannot exist within 300 ft of the proposed location;<sup>5</sup> and,
- f. The proposed crosswalk location must have adequate street lighting near the crosswalk already in existence or scheduled for installation; and,

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<sup>4</sup> The pedestrian crossing time is calculated by dividing the curb-to-curb street width by 4 feet per second, and the average number of gaps per five-minutes period is equal to the total usable gap time in seconds divided by pedestrian crossing time multiplied by 12.

<sup>5</sup> Mid-block crosswalks should be located, as much as possible, mid-way between stop or signal-controlled intersections except where there are special trip generation/destinations directly across from each other and all other criteria are met. Special pedestrian trip generators include schools, senior citizen facilities, and community facilities such as parks and libraries.

- g. Adequate stopping sight distances (equal to or exceeding that for the posted speed) must be available in both directions. The adequacy of stopping sight distances shall be determined in accordance with the guidance contained in the AASHTO "Green Book" - A Policy on the Design of Highways and Streets (2001).

When a crosswalk is proposed in conjunction with a new development, change in land use, or new pedestrian facilities, an engineering study may be used to predict whether or not the above criteria will be met once the development or facility has been constructed and is fully occupied.

#### **4.2.2 Crosswalk Pattern**

The ladder crosswalk design, consisting of two transverse lines parallel to one another together with longitudinal lines parallel to traffic flow, shall be used on all uncontrolled intersection approaches so that the visibility of the crossing location is maximized.

#### **4.2.3 Crosswalk Marking Width and Color**

When the ladder crosswalk is installed, the transverse lines shall be 8 feet on center when the approach to the intersection is a residential or local street. The width of the crosswalk shall be 10 feet on center when the approach is on a collector or arterial street. In accordance with the MUTCD, all transverse lines, regardless of their marking material, shall be solid white in color and have a width of 12 inches. The longitudinal lines shall also be solid white in color, have a width of 12 inches, and be spaced 3 ft apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

#### **4.2.4 No Parking Zone**

In accordance with the MUTCD (Section 3B.18), parking spaces should not be marked within 20 feet of the marked crosswalk, as measured by the gap between the parking space and the closest crosswalk marking. If a bulb-out is present, the gap may be reduced to 10 feet.

#### **4.2.5 Pedestrian Warning Signs**

Pedestrian in crosswalk signs (W11A-2 with downward arrow plaque W16-7p) shall be installed at each end of the crosswalk location. The signs shall be placed in advance of the crosswalk adjacent to the travel lane and facing the driver.

Advance pedestrian warning signs (W11-2) shall be installed at a distance of at least 150 ft but not exceeding 700 feet in advance of the crosswalk, in either direction. Advance pedestrian warning signs may be accompanied by supplemental plaques with the legend "AHEAD" (W16-9p) or "XXX FEET" (W16-2a).