1.0 INTRODUCTION

1.1 Statement of Policy

It shall be the policy of the City of Framingham, 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 City of Framingham 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)[1], the Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, and applicable Massachusetts state law[2].

1.3 General

Marked crosswalks are viewed widely as "safety devices," and 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 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.

[1] *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), U.S. Department of Transportation, Federal Highway Administration, 2009, or more current edition.*

[2] *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).*

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 and Figure 2)

Marked crosswalks in the City of Framingham are presently painted or marked in one of the two patterns shown in **Figures 1 and 2**: Decorative Ladder and Standard Ladder. All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design.

2.2 Crosswalk Marking Width and Color

When a decorative ladder or standard 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 yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 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 white or yellow reflectorized epoxy pavement marking material to meet MassDOT specifications or (b) a mechanically heated synthetic compound, whose specifications are available on file at the City of Framingham's Municipal Engineering Department. All crosswalk markings shall also consist of high reflectivity materials.

DECORATIVE LADDAR PATTERN

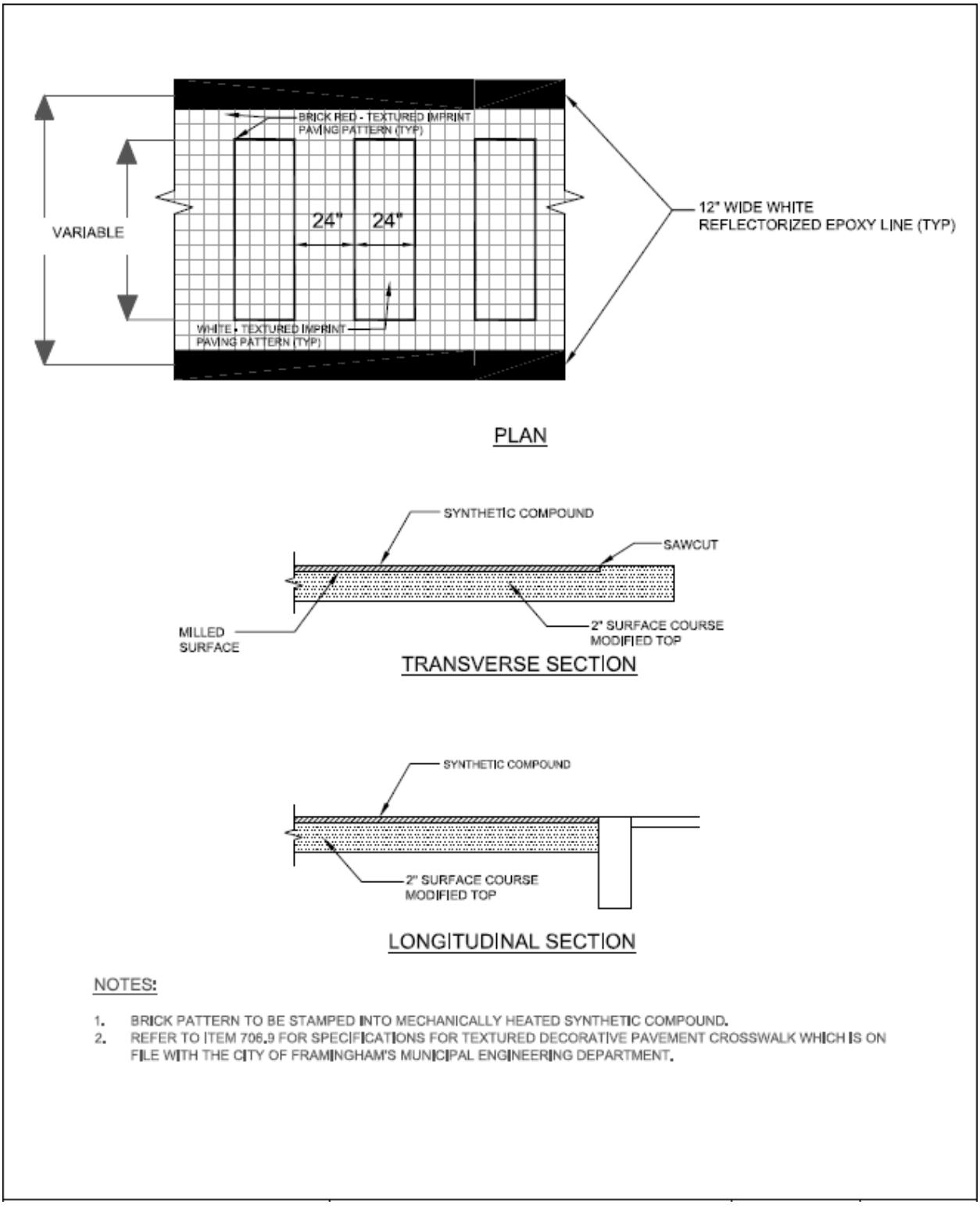
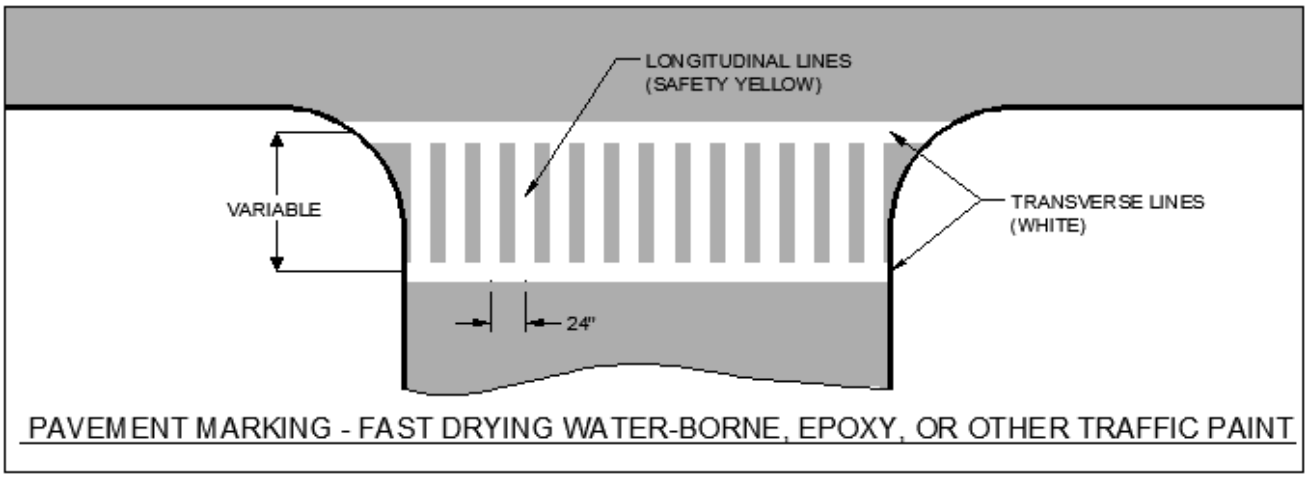


Figure 1

STANDARD LADDER PATTERN



PAVEMENT MARKING - FAST DRYING WATER-BORNE, EPOXY, OR OTHER TRAFFIC PAINT

NOT TO SCALE

NOTES:

1. CROSSWALK MARKINGS SHALL CONSIST OF SOLID WHITE OR YELLOW (AS INDICATED) LINES (BOTH TRANSVERSE AND LONGITUDINAL) 12 INCHES IN WIDTH.
2. CROSSWALKS SHALL VARY IN WIDTH FROM 8 TO 10 FEET
3. LONGITUDINAL LINES SHALL BE SPACED 24" APART ON CENTER FOR ALL NEW CROSSWALKS. EXISTING CROSSWALK REPAIRS SHALL MATCH EXISTING SPACING.
4. CROSSWALK LINES SHALL EXTEND ACROSS THE FULL WIDTH OF PAVEMENT OR TO THE EDGE OF THE INTERSECTING CROSSWALK.
5. CROSSWALKS SHALL BE MARKED AT ALL INTERSECTIONS WHERE THERE IS SUBSTANTIAL CONFLICT BETWEEN VEHICULAR AND PEDESTRIAN MOVEMENT.
6. CROSSWALK MARKINGS FOR NEW ROADWAYS SHALL BE INSTALLED USING EPOXY PAVING MARKING MATERIAL CONFORMING TO MASSDOT ENGINEERING DIRECTIVE E-05-003, DATED JUNE 16, 2005 AND TO MASSDOT STANDARD SECTION 860.
7. CROSSWALK MARKINGS FOR EXISTING ROADWAYS SHALL BE INSTALLED USING FAST DRYING WATER-BORNE TRAFFIC PAINT PAVING MARKING MATERIAL TO MEET MASSDOT SPECIFICATIONS M07.01.23 (WHITE) AND M07.01.24 (YELLOW).
8. THERMOPLASTIC SHALL NOT BE USED FOR ANY PAVEMENT MARKINGS.

Figure 2

2.4 ADA Compliance

Where a crosswalk provides access between sidewalks, curb ramps that meet ADA Accessibility Guidelines (ADAAG), MassDOT 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 brick colored, brick pattern that is stamped into newly laid asphalt. 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, 2009 Edition (Section 25.50), 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.

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

All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design.

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.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 feet apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

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, 2009 Edition, the stop line should be white in color, have a width of at least 12 inches, and be marked a minimum of 4 feet in advance of the nearest crosswalk line, as measured by the gap between the stop bar and the closest crosswalk marking.

3.1.5 No Parking Zone

In accordance with the MUTCD, 2009 Edition, parking spaces shall not be marked within 30 feet of a marked crosswalk at a signalized 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

All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design.

3.2.3 Crosswalk Marking Width and Color

When the approach to the un-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 un-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.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 feet apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

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, 2009 Edition, the stop line should be white in color, have a width of at least 12 inches, and be marked a minimum of 4 feet in advance of the nearest crosswalk line, as measured by the gap between the stop bar and the closest crosswalk marking while the yield line should be white in color, shall consist of a row of solid white isosceles triangles pointing toward approaching vehicles extending across approach lanes to indicate the point at which the yield is intended or required to be made, while having each individual triangle have a base of 12 to 24 inches wide and a height equal to 1.5 times the base and having a space between the triangles of 3 to 12 inches and be marked a minimum of 4 feet in advance of the nearest crosswalk line, as measured by the gap between the stop bar and the closest crosswalk marking.

3.2.5 No Parking Zone

In accordance with the MUTCD, 2009 Edition, 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, 2009 Edition, 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 place 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 place a minimum of 20 feet in advance of the edge of the circulatory roadway.

3.3.2 Crosswalk Pattern

All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design. Either of these patterns are acceptable on roundabout approaches as long as the visibility of the crossing location is maximized.

3.3.3 Crosswalk Marking Width and Color

When the approach to the roundabout is a residential or local street, the width of the standard crosswalk shall be 8 feet on center. When the approach to the roundabout 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.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 feet apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

3.3.4 No Parking Zone

It is recommended that parking spaces shall not be marked within 20 feet of the marked crosswalk at a roundabout, as measured by the gap between the parking space and the closest crosswalk marking. To provide the necessary sight distances for safe crossings to occur, this guide recommends that parking be restricted immediately upstream of the pedestrian crosswalks as well.

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.

When used, advance pedestrian warning signs (W11-2) shall be installed at a distance of at least 100 feet but not exceeding 650 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 300 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 Geometric Design of Highways and Streets (2011) or current edition.

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

All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design. Either pattern can shall be used on uncontrolled intersection approaches as long as the visibility of the crossing location is maximized.

3.4.3 Crosswalk Marking Width and Color

When the approach to the un-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 un-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.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 feet apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

3.4.4 No Parking Zone

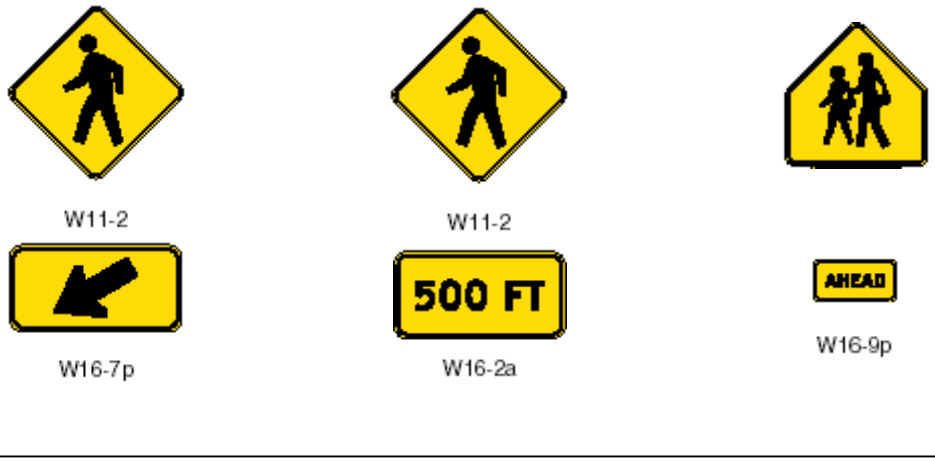
In accordance with the MUTCD, 2009 Edition, parking spaces shall not be marked within 20 feet of the marked crosswalk, as measured by the gap between the parking space and the closest crosswalk marking.

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.

When used, advance pedestrian warning signs (W11-2) shall be installed at a distance of at least 100 feet but not exceeding 650 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).



Pedestrian Warning Signs

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 300 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 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 Geometric Design of Highways and Streets (2011) or current edition.

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, but not required that a trained crossing guard be present whenever there is a crossing activity by students across major roadways.

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

All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design. Either pattern can shall be used on uncontrolled intersection approaches as long as the visibility of the crossing location is maximized.

4.1.3 Crosswalk Marking Width and Color

When the approach to the un-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 un-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.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 feet apart on center. The marking location of the longitudinal lines should avoid the wheel paths whenever possible.

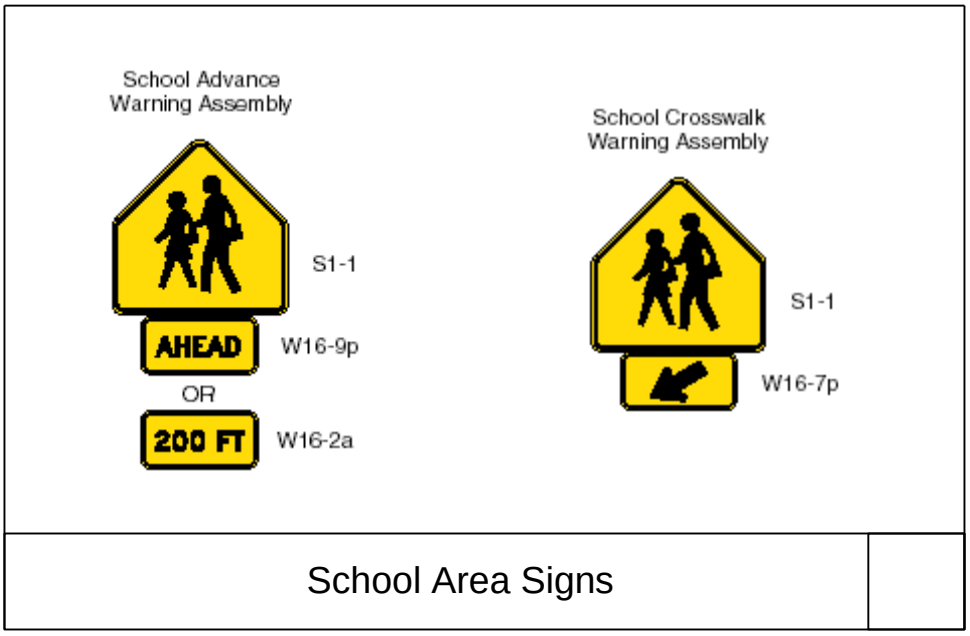
4.1.4 No Parking Zone

In accordance with the MUTCD, 2009 Edition, 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.



School Area Signs

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 100 feet but not exceeding 650 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 85th 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[3];

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[4]; and,

f. The proposed crosswalk location must have adequate street lighting near the crosswalk already in existence or scheduled for installation; and,

g. 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 Geometric Design of Highways and Streets (2011) or current edition.

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.

[3] *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.*

[4] *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.*

4.2.2 Crosswalk Pattern

All new crosswalks marked in the City shall be of either of the styles previously mentioned, 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 Decorative Ladder or Standard Ladder design. Either pattern can shall be used on uncontrolled intersection approaches as long as the visibility of the crossing location is maximized.

4.2.3 Crosswalk Marking Width and Color

When the approach to the un-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 un-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.

When a ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid yellow in color, have a width of 12 inches, and be spaced 2 feet apart on center. When the decorative ladder-type crosswalk is installed, the longitudinal lines or bars shall be solid white in color, have a width of 24 inches, and be spaced 4 feet 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, 2009 Edition, 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.

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 100 feet but not exceeding 650 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).

5.0 PEDESTRIAN HYBRID BEACONS

Pedestrian Hybrid Beacons otherwise known as a HAWK (High-Intensity Activated crosswalk beacon) signal is a special type of hybrid beacon used to warn and control traffic at an un-signalized location to assist pedestrians in crossing a street or highway at a marked crosswalk.

A pedestrian hybrid beacon may be considered for installation to facilitate pedestrian crossings at a location that does not meet traffic signal warrants, or at a location that meets traffic signal warrants in regards to pedestrian volume or school crossings but a decision is made to not install a traffic control signal. If used, pedestrian hybrid beacons shall be used in conjunction with signs and pavement markings to warn and control traffic at locations where pedestrians enter or cross a street or highway. A pedestrian hybrid beacon shall only be installed at a marked crosswalk.

According to the 2009 version of the MUTCD, if one of the signal warrants of Chapter 4C is met and a traffic control signal is justified by an engineering study, and if a decision is made to install a traffic control signal, it should be installed based upon the provisions of Chapters 4D and 4E. If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit pedestrians to cross, or if the speed for vehicles approaching on the major street is too high to permit pedestrians to cross, or if pedestrian delay is excessive, the need for a pedestrian hybrid beacon should be considered on the basis of an engineering study that considers major-street volumes, speeds, widths, and gaps in conjunction with pedestrian volumes, walking speeds, and delay.

For a major street where the posted or statutory speed limit or the 85th-percentile speed is 35 mph or less, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-1 for the length of the crosswalk.

For a major street where the posted or statutory speed limit or the 85th-percentile speed exceeds 35 mph, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-2 for the length of the crosswalk. For crosswalks that have lengths other than the four that are specifically shown in Figures 4F-1 and 4F-2, the values should be interpolated between the curves.

6.0 RRFB's (RECTANGULAR RAPIB FLASHING BEACON)

6.1 General

According to the National Highway Traffic Safety Administration, there were a total of 14,340 pedestrian fatalities and 193,000 pedestrian injuries resulting from pedestrian vehicle crashes nationwide during the 2004-2006 period. Rectangular Rapid Flash Beacons (RRFB) can enhance safety by reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts.

RRFBs are pedestrian-actuated conspicuity enhancements used in combination with a pedestrian, school, or trail crossing warning sign to improve safety at uncontrolled, marked crosswalks. The devices include two rectangular-shaped yellow indications, each with an LED-

array-based light source, that flash with high frequency when activated. The RRFB design differs from the standard flashing beacon by utilizing:

- A different shape
- A much faster rapid-pulsing flash rate
- A brighter light intensity

The RRFB is a treatment option at many types of established pedestrian crossings. RRFBs are particularly effective at multilane crossings with speed limits less than 40mph.

The Federal Highway Administration has issued interim approval for the use of the RRFB (IA-21). State and local agencies must request and receive permission to use this interim approval before they can use the RRFB.

As of this 2020 Edition, MassDOT has been granted statewide application of RRFBs. Municipalities need to notify MassDOT when one is installed.

6.2 Implementation Considerations

- RRFBs are placed on both sides of a crosswalk below the pedestrian crossing sign and above the arrow indication pointing at the crossing.
- Including RRFBs on the roadside increases driver yielding behavior significantly. Including RRFBs on a center island or median as well can further increase driver yielding behavior, although with a lower marginal benefit than roadside beacons.
- RRFBs can use manual push-buttons or automated passive (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.
- RRFBs typically receive power by standalone solar panel units, but may also be wired to a traditional power source.

6.3 Potential Benefits

- RRFBs are a lower cost alternative to traffic signals and hybrid signals that are shown to increase driver yielding behavior at crosswalks significantly when supplementing standard pedestrian crossing warning signs and markings.
- An official FHWA-sponsored experimental implementation and evaluation conducted in St. Petersburg, Florida found that RRFBs at pedestrian crosswalks are dramatically more effective at increasing driver yielding rates to pedestrians than traditional overhead beacons.
- The novelty and unique nature of the stutter flash may elicit a greater response from drivers than traditional methods.
- The addition of RRFB may also increase the safety effectiveness of other treatments, such as the use of advance yield markings with YIELD (or STOP) HERE FOR PEDESTRIANS signs. These signs and markings are used to reduce the incidence of multiple-threat crashes at crosswalks on multi-lane roads (i.e., crashes where a vehicle in one lane stops to allow a pedestrian to cross the street while a vehicle in an adjacent lane, traveling in

the same direction, strikes the pedestrian), but alone they only have a small effect on overall driver yielding rates.

6.3 Potential Benefits

- Cost is approximately $10,000 to $15,000 for purchase and installation of two units (one on either side of a street). This includes solar panels for powering the units, pad lighting, indication units (for both sides of street) with RRFBs in the back and front of each unit, signage on both approaches, all posts, and either passive infrared detection or push buttons with audio instructions.
- Costs would be proportionately higher for additional units placed on a median island, etc.