Pedestrian Safety Treatments

Best Practice Guidelines

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

Office of Traffic & Safety

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Disclaimer

The Pedestrian Safety Treatments Best Practice Guidelines (PSTBPG) serve as a reference document, not a prescriptive or binding standard. It is designed to assist engineers and project teams in enhancing pedestrian safety, while allowing for flexibility in application to accommodate local conditions and professional engineering judgment.

While the guidelines provide general recommendations for specific scenarios, they are not universally applicable to all projects. Decisions on treatments should be made by comprehensively considering various factors such as roadway classification, pedestrian demand, crash data, and other relevant criteria. Metrics like crash history and pedestrian counts should be used as guiding factors rather than rigid rules. The satisfaction of a guideline recommendation or criterion does not by itself require the implementation of a specific pedestrian treatment or safety measure.

The PSTBPG should be applied proactively, in alignment with the Safe Systems Approach and Complete Streets policy. Successful implementation requires collaboration among relevant stakeholders, including design, planning, traffic, and maintenance teams, to ensure that project-specific contexts are thoroughly considered. Final treatment decisions should reflect the unique characteristics and needs of each project.

Introduction

Complete Streets policy aims to promote active transportation, improve safety, enhance mobility options, and create vibrant, livable communities. Many cities and regions have adopted complete streets policies or guidelines to ensure that new roadway projects and improvements prioritize the needs of all users. The Maryland Department of Transportation (MDOT) Complete Streets Policy was implemented in 2024 to facilitate the planning, design, and construction of transportation options that are safer and more accessible to all users of all ages and abilities who bike, walk, take transit, drive or use electric personal assistive mobility devices. The roadway geometric improvements and traffic control devices outlined in these guidelines create a toolbox of treatments for the enhancement of pedestrian safety on state-owned and -operated roadways and are applicable at uncontrolled locations as well as stop- or signal-controlled locations. This collection of treatments is intended to align with the complete streets approach and represent best practices employed by the transportation profession as well as innovative treatments used by other state departments of transportation. A literature review was conducted to define the current state of the practice and best practice treatments were selected based on applicability to the State of Maryland and the needs of the State Highway Administration (SHA).

These treatments collectively aim to create streets that are safe, accessible, and comfortable for people of all ages, abilities, and for users of all modes of transportation, promoting active lifestyles, reducing traffic congestion, and fostering vibrant, inclusive communities. While the Context Driven Access & Mobility for All Users Guide is a planning and design resource emphasizing land use context in transportation design and offering practitioners several tools to enhance pedestrian and bicycle safety specifically, these guidelines are intended to be used for day-to-day review of citizen-generated traffic operations and safety concerns to balance pedestrian mobility and safety with other roadway users. Specific thresholds are outlined for each treatment to ensure they are appropriately and consistently applied throughout SHA-maintained roadways and intersections. These thresholds, which were developed specifically for SHA, are intended to assist engineers in determining if a treatment will be effective and to ensure that no single treatment will lose its effectiveness due to overuse or improper use. While the criteria for each application are key complete streets features and provide a practical screening tool, performing a traffic engineering study may be necessary in implementing each treatment at a select location. If needed, information on sources of materials and material producers that have been qualified by SHA for use on Maryland state projects is available online.

SHA District Engineers found a need for such guidelines in order to efficiently and effectively respond to citizens' traffic operations concerns and requests, such as the installation of a marked crosswalk or enhanced treatments to an existing marked crosswalk. While marked crosswalks have many safety benefits, characteristics of the roadway, traffic volumes, vehicle speeds, etc. may increase the likelihood of crashes at a marked crosswalk, and placement of additional treatments to improve the safety of the crossing should be considered when determining whether to mark the crossing. These guidelines establish specific criteria for the use of marked crosswalks as well as guidance on other pedestrian best practice treatments to ensure that the treatments are uniformly installed on Maryland state roadways. These

guidelines can also be used as guidance on local roadways to ensure continuity between facilities and the overall pedestrian network across the state. Further, users of these guidelines should consult applicable local and state plans and policies that aim to enhance the pedestrian network. This ensures that engineers are using consistent parameters to evaluate locations in which a marked crosswalk, or other pedestrian best practice, might be beneficial. For new treatments and treatments that change roadway geometry (e.g., Pedestrian Hybrid Beacon and removal of right turn channelization), the District Community Liaison should be notified of the change to share educational resources.

The following sections outline the methodology employed to develop the guidelines, how these guidelines are organized, and how transportation professionals can best use them.

Development Process

These guidelines were developed using a four-part methodology.

1. A literature review was conducted to assess the current state of practice on pedestrian safety enhancement treatments. The list of sources is included in the Reference Section at the end of the document. The following is a summary of the sources used:

    - Highway Safety Manual (HSM)
    - Institute of Transportation Engineers (ITE)
        - Recommended Practice Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, 2010
        - Recommended Practice Design and Safety of Pedestrian Facilities
        - Alternative Treatments for Pedestrians at At-Grade Intersections
    - National Association of City Transportation Officials (NACTO)
        - Urban Street Design Guidelines, 2012
    - National Cooperative Highway Research Program (NCHRP)
        - Improving Pedestrian Safety at Unsignalized Crossings #562
    - National Manual on Uniform Traffic Control Devices, 2009
    - Maryland Manual on Uniform Traffic Control Devices, 2011
    - SHA's *Context Driven Guide: Access & Mobility for All Users*
    - U.S. Department of Transportation Federal Highway Administration
        - Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations, 2005
        - Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, 2018
        - Safe Transportation for Every Pedestrian (STEP)
    - Publications by peer state departments of transportation (DOTs) including Connecticut, Florida, Maine, Minnesota, New York, Ohio, Pennsylvania, Vermont, Virginia, Washington, and Wisconsin as well as the District of Columbia.

2. Three peer DOTs were selected to conduct interviews with them on their practices for marking crosswalks. These DOT's – the District of Columbia, Michigan, and Virginia – have developed specific guidelines on where to mark crosswalks. This includes thresholds based on roadway characteristics such as posted speed limit, annual average daily traffic, number of crossing lanes, and presence of a median and/or pedestrian refuge. Four focus questions guided the discussions: 1) why the crosswalk marking policy/guidance was needed, 2) what process was used to develop the pedestrian/crosswalk marking policy, 3) how the policy was implemented, and 4) what lessons were learned.

3. Regular meetings were held with the Best Practices Working Group consisting of SHA engineers from the Office of Traffic & Safety, Office of Highway Development, and various District Offices. The group discussed the guidelines and ensured they fit with SHA standards and policies and met the expressed needs of the Districts.

4. A test application of a draft version of the guidelines was conducted. Five locations were selected as pilot locations with input from the SHA Assistant District Engineers for Traffic (ADE-T). An inventory of the existing pedestrian infrastructure was mapped, and the treatments were applied based on existing conditions, a high-level analysis of vehicle and pedestrian volume, and readily available crash data. This step served as a vetting process as the ADE-Ts reviewed the application.

Guidelines Organization

Over thirty treatments were initially presented to the Best Practices Working Group. Out of those thirty, the group selected the following treatments based on applicability to Maryland and the needs of SHA. In the following guidelines, the *purpose* of each treatment is defined, a brief *description* is given, and the *typical applications* for each treatment are outlined. *Screening criteria* and *thresholds* define appropriate locations for the use of each treatment. The screening criteria list provides a spatial context for which the treatment is applicable. The thresholds defined for each treatment were developed specifically for SHA and provide limits such as average daily traffic or pedestrian volume that should be met for the treatment to be applied. In some cases, more than one threshold should be met and in others, any of the thresholds may be met. Additionally, an *image* of the treatment is provided for further clarification. Examples from Maryland state roads were used wherever possible.

The first treatment, *Marked Crosswalks with Warning Signs*, specifically sets guidelines on where crossings should be marked when the crossing is uncontrolled or controlled. The posted speed limit, average daily traffic, and number of crossing lanes are used to determine where a marked crosswalk is acceptable without additional treatments, where additional treatments are suggested, and where only fully controlled crossings are recommended. Additionally, six crosswalk typologies are outlined to provide examples of existing marked uncontrolled crossings equipped with supplemental treatments. The intent of the typologies is to provide examples of how the treatments can be used in combination to enhance marked crosswalk visibility and driver awareness of pedestrians, not as a specific configuration that must be followed. Note that the outlined approach can also be applied to other treatments.

The following flow charts (Figures 1-4) illustrate the process and key considerations for marking crosswalks at uncontrolled, stop-controlled, and signalized locations.

FIGURE 1. MASTER FLOW CHART FOR MARKING CROSSWALKS

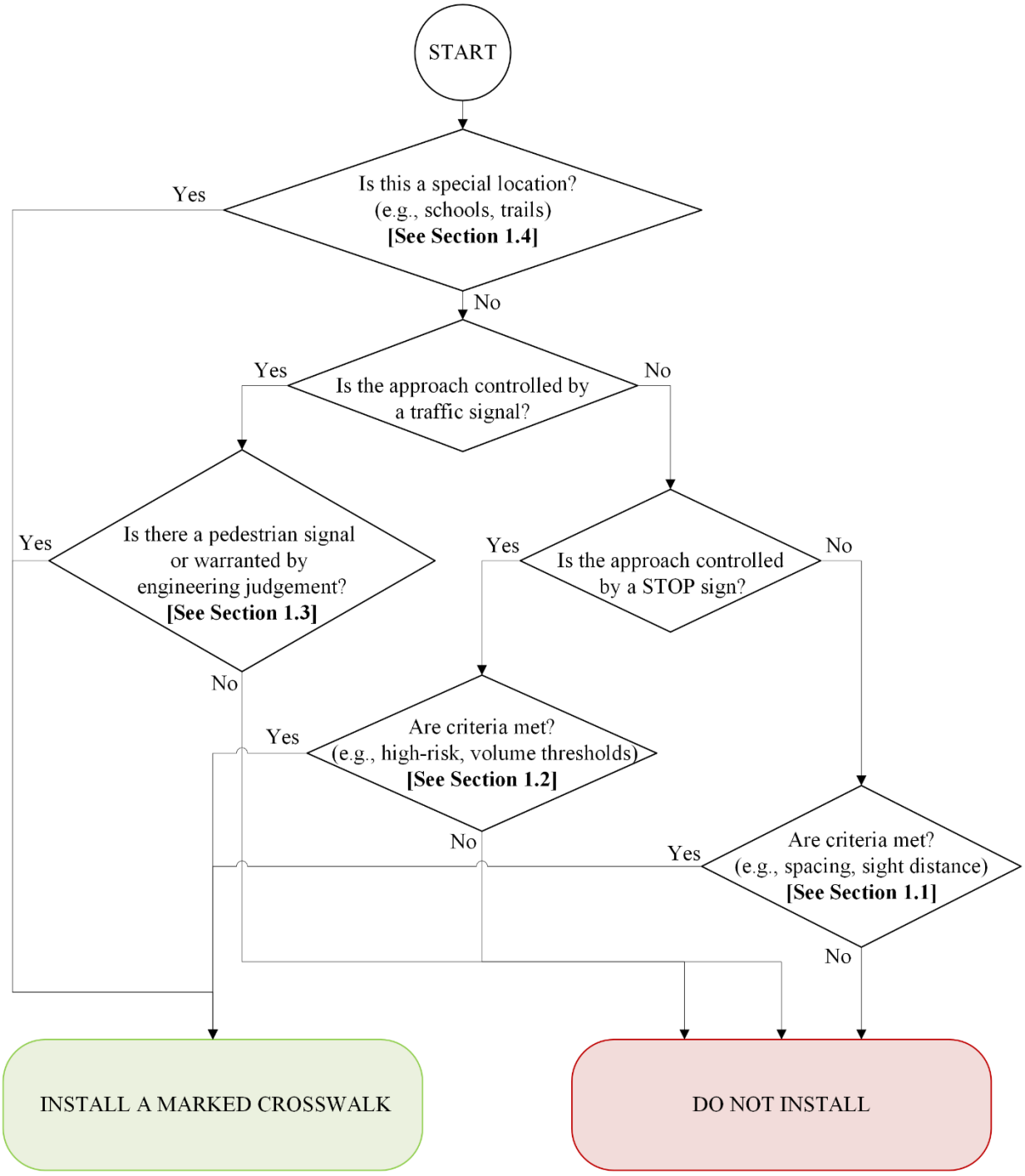


FIGURE 2. FLOW CHART FOR MARKING CROSSWALKS ON UNCONTROLLED APPROACHES
(See more details in Section 1.1)

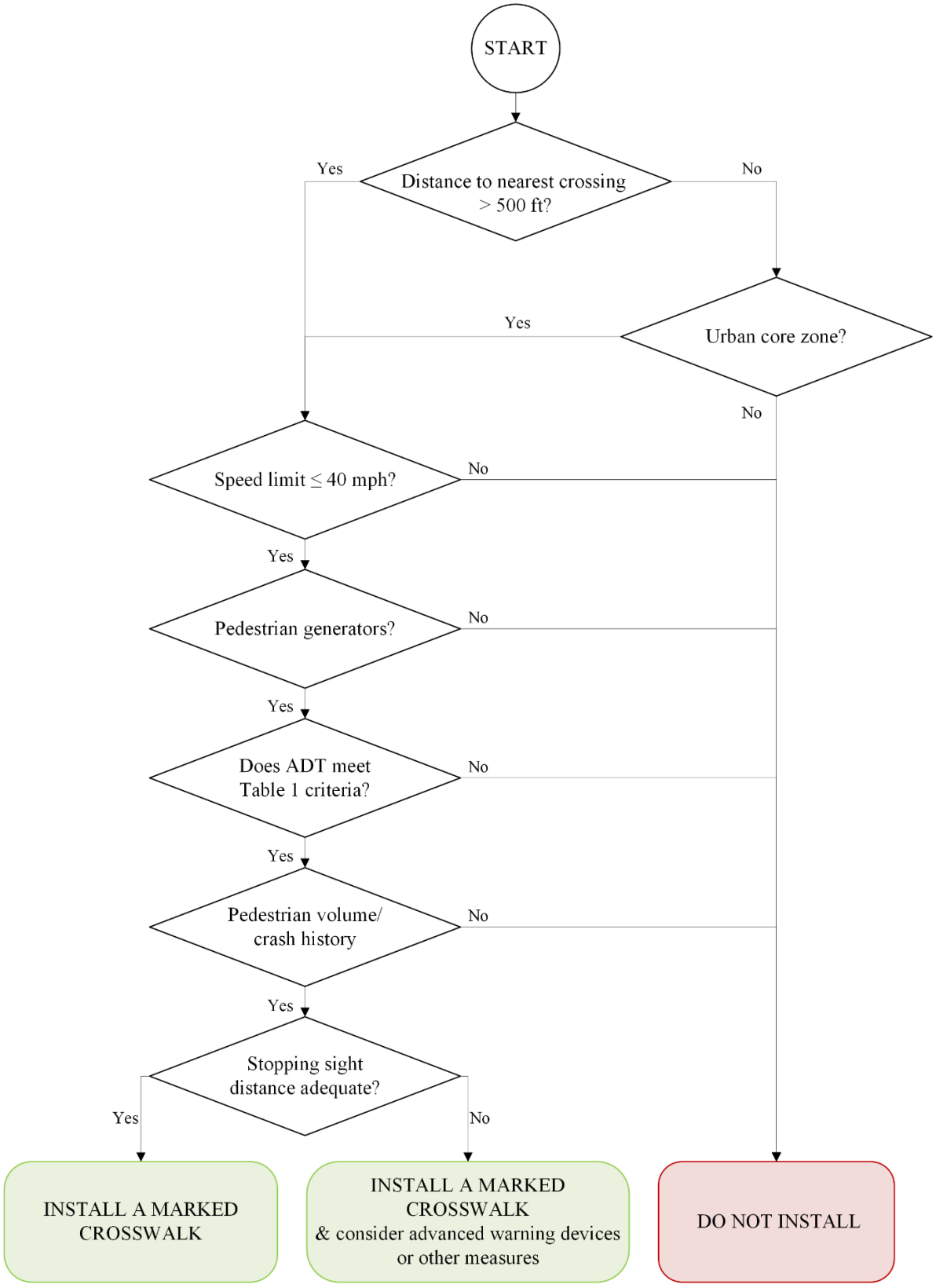


FIGURE 3. FLOW CHART FOR MARKING CROSSWALKS ON STOP-CONTROLLED APPROACHES (See more details in Section 1.2)

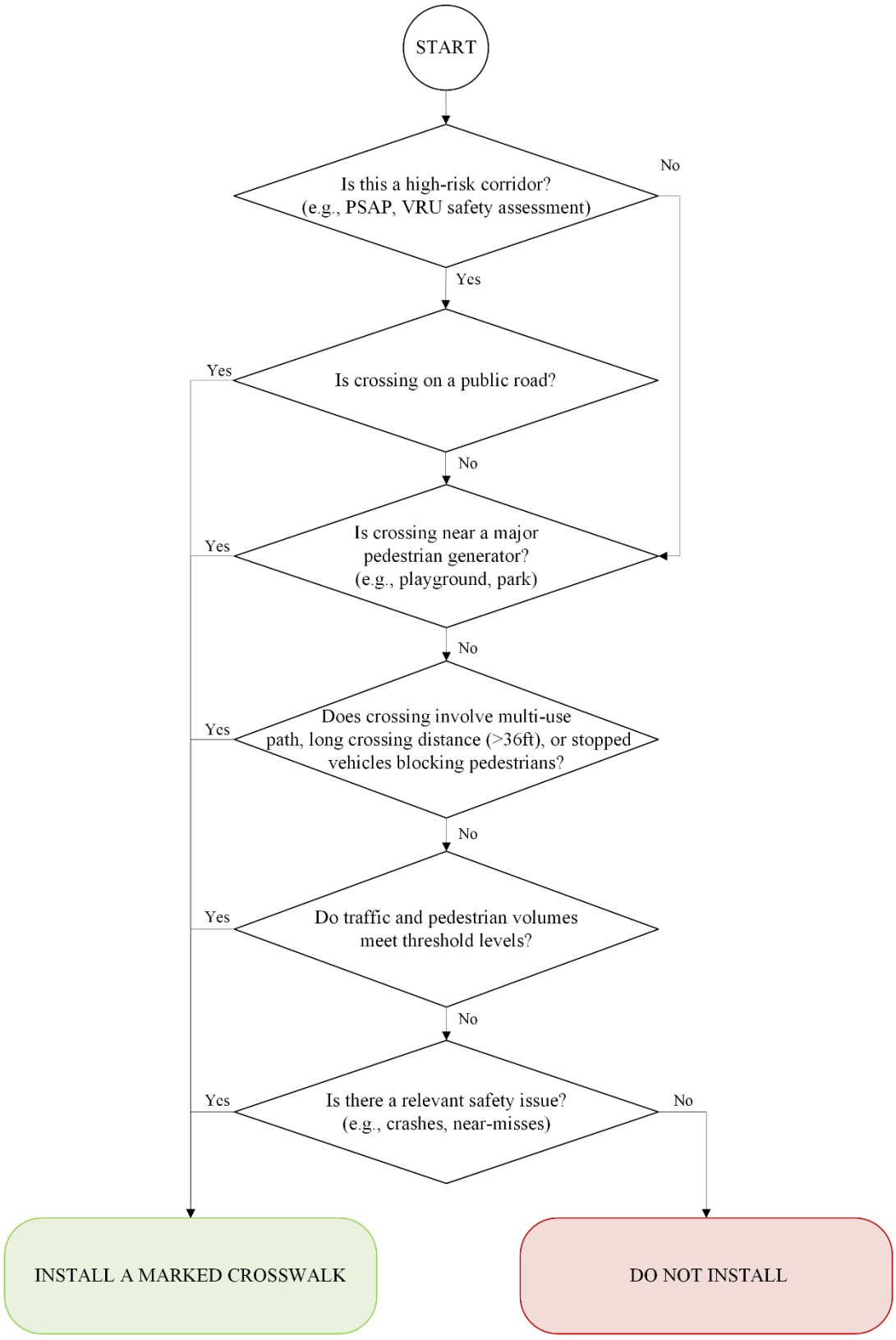
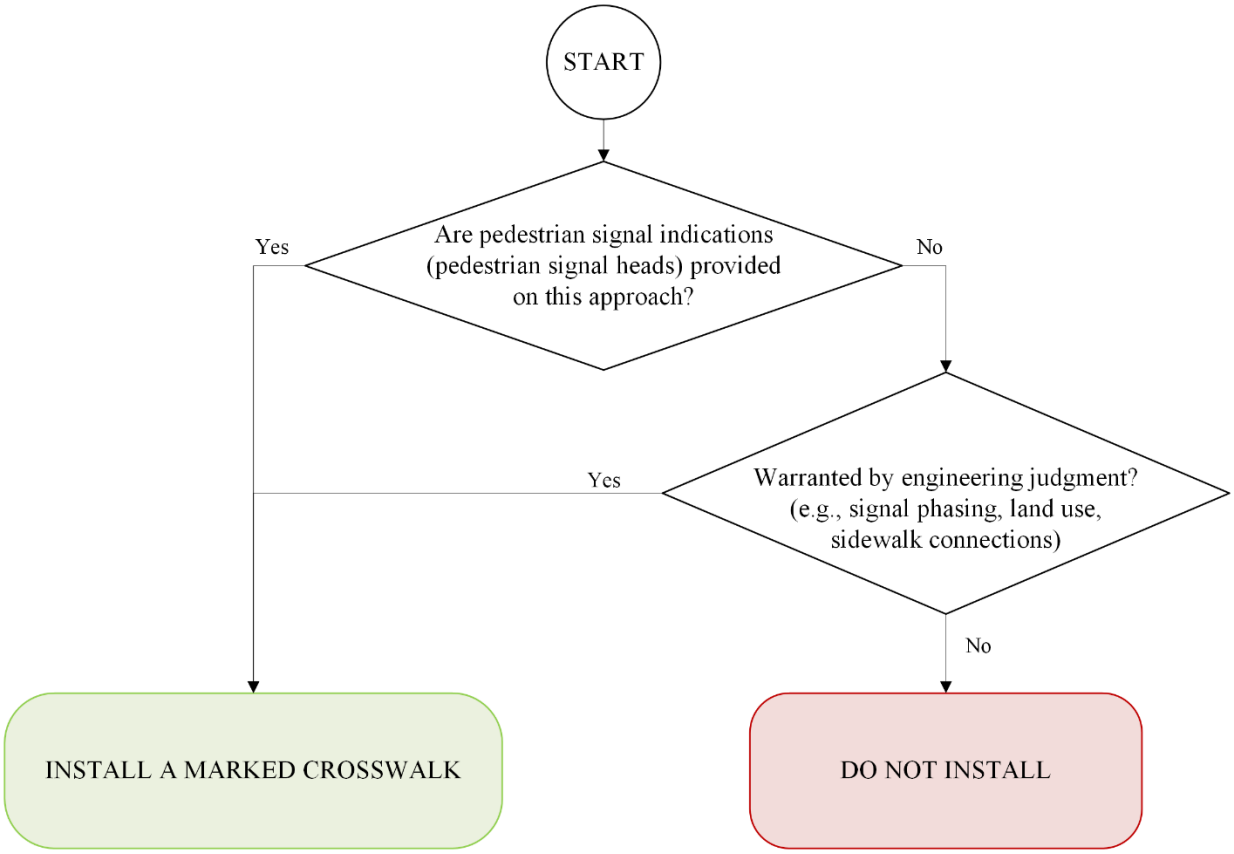


FIGURE 4. FLOW CHART FOR MARKING CROSSWALKS ON SIGNAL-CONTROLLED APPROACHES (See more details in Section 1.3)



1	Treatment	Crosswalks – Marked Crosswalks with Warning Signs
1.1		At Uncontrolled Locations

PURPOSE

To designate a marked crossing location for pedestrians

TYPICAL APPLICATIONS

- Pedestrian crossings on approaches not controlled by a STOP sign or traffic signal
- Mid-block crossings

The guidance provided in Section 1.1 does not apply to school crossings, recreational hiker/biker trail crossings, and signalized intersections with pedestrian signals. See Section 1.3 or 1.4 for those applications.

SCREENING CRITERIA

- A marked crosswalk should not be installed if the distance to an adjacent designated crossing is less than 500 feet except for crossings within the same intersection and those in the Urban Core zone.
- Crossing locations should have adequate minimum stopping sight distance. Additional advanced warning devices may be installed at locations where sight distance is inadequate, or other measures can be taken to improve sight distance. This may include relocating the crossing.
- Desired crossing locations as evident from field observations and/or adjacent land uses that serve as direct pedestrian generators (e.g., park, bus stop, library, senior/community center).
- Posted speed limit less than or equal to 40 MPH. If engineers perceive that prevailing speeds are significantly higher than posted, the 85th percentile speed derived from a speed study can be used as the guide when determining treatment applications.
- Average Daily Traffic (ADT)
- A marked crosswalk should be considered if pedestrian volumes meet the criteria noted below and additional criteria are met as shown in Table 1 on the following page.
  - Greater than 20 pedestrians for a single hour, or
  - Greater than 15 physically impaired, unescorted children, and/or senior citizens for a single hour, or
  - Greater than 60 pedestrians for the highest consecutive 4-hour period, or
  - Greater than 25 pedestrians per day, with 2 or more documented crashes involving pedestrians in the most recent five-year period

1.1 At Uncontrolled Locations (Continued)

ADDITIONAL TREATMENTS

The following is a list of potential treatments that may be used at marked crossings that require additional treatments per Table 1.

- High visibility crosswalk markings
- Advanced yield/stop line
- In-pavement text warning markings
- Rumble strips
- Pedestrian refuge areas with minimum dimensions of 4 ft long by 6 ft wide
- Reduced curb radii
- Advanced warning beacons
- Pedestrian-activated warning beacons
- Automated pedestrian detection
- Narrow lanes

NOTE

A marked crosswalk alone, without other measures designed to reduce speeds, shorten crossing distances, or enhance driver awareness of the crossing and/or pedestrian presence, should not be installed across roadways with the characteristics indicated by a diamond symbol in the table below.

Note: Adding a crosswalk alone does not make a crossing safer or result in an increase in drivers stopping for pedestrians[1].

TABLE 1. CRITERIA FOR INSTALLING A MARKED CROSSWALK AND SUPPLEMENTAL TREATMENTS AT UNCONTROLLED LOCATIONS

Average Daily Traffic	Posted Speed (MPH)	2 Lanes	3 Lanes	4 or More Lanes (with raised median)	4 or More Lanes (without raised median)
≤ 10,000	25	✓	✓	✓	✓
	30/35	✓	✓	✓	✓
	40	✓	✓	✓	◇
> 10,000 and ≤ 15,000	25	✓	✓	✓	✓
	30/35	✓	✓	◇	◇
	40	✓	◇	◇	◇
> 15,000 and ≤ 20,000	25	✓	✓	◇	◇
	30/35	✓	✓	◇	◇
	40	◇	◇	◇	◇
> 20,000	25	◇	◇	◇	◇
	30/35	◇	◇	◇	◇
	40	◇	◇	◇	◇

ONLY FULLY CONTROLLED MARKED CROSSINGS OR GRADE SEPARATED PEDESTRIAN CROSSINGS ARE RECOMMENDED FOR ROADWAYS WITH SPEEDS GREATER THAN 40 MPH EXCEPT FOR ONE-WAY ONE-LANE RAMP ROADWAYS WITH FREE RIGHT TURNS.

✓ STANDARD MARKED CROSSWALK IS ACCEPTABLE

◇ REQUIRES ADDITIONAL TREATMENTS

1.2		At Controlled Locations with STOP Signs
PURPOSE		To designate a marked crossing location for pedestrians
TYPICAL APPLICATIONS		➢ Pedestrian crossings on stop-controlled approaches
SCREENING CRITERIA		A marked crosswalk should be considered if: ➢ The crossing on a public road is located at an intersection with a high-risk corridor identified by the Pedestrian Safety Action Plan (PSAP), the Vulnerable Road User (VRU) Safety Assessment, or the road safety audit. • For the crossing on a commercial entrance or a non-public road, the installation is supported by engineering judgment regarding safety needs or meets the traffic/pedestrian volume thresholds noted below. ➢ The crossing is part of the walking route within ¼ mile of a school, major park, large playground, or other major pedestrian generator. ➢ The crossing involves a multi-use path. ➢ The crossing distance is longer than 36 ft. ➢ Stopped vehicular queues often block a pedestrian crossing. ➢ On the stop-controlled road, average daily traffic (ADT) and pedestrian volumes meet the criteria noted below. • ADT >1,500 or peak-hour volume > 150 veh/hour, and • Greater than 20 pedestrians for a single hour, or • Greater than 18 pedestrians for any two hours, or • Greater than 15 pedestrians for any three hours ➢ Crash history and/or near-misses indicate a safety issue

1.3		At Controlled Locations with Traffic Signals
PURPOSE		To designate a marked crossing location for pedestrians
TYPICAL APPLICATIONS		➢ Pedestrian crossings at signalized intersections
SCREENING CRITERIA		➢ Engineering judgment should be applied to determine if a crosswalk should be marked, including the considerations of the following: • Signal phasing • Left turn or side street volume • Land use • Pedestrian generators • Sidewalk connections ➢ At a signalized intersection with pedestrian signal indications, a crosswalk should be marked along with ADA ramps.

[1] U.S. DOT Federal Highway Administration. (2005). *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*. Report No. FHWA-HRT-04-100.

1.4		Special Locations
PURPOSE		To designate a marked crossing location for pedestrians
TYPICAL APPLICATIONS		➢ School crossings, or ➢ Recreational hiker/biker trail crossings, or ➢ Roundabouts, or ➢ Ramps and channelized right turns
SCREENING CRITERIA		➢ A crosswalk should be marked at the following locations: • School crossings, or • Recreational hiker/biker trail crossings, or • Roundabouts if pedestrian facilities are provided, or • Ramps and channelized right turns if pedestrian facilities are provided.

1.5 Crosswalk Typology

INTRODUCTION

Five examples of marked *crosswalk typologies* are outlined to supplement treatment #1. Using designs and images from existing pedestrian crossings along SHA roadways, each example demonstrates specific combinations of supplemental treatments to enhance a marked crosswalk. These are meant to serve as guidelines, not strict standards to adhere to. Typologies illustrate combinations of treatments, and their selection should be based on a documented multi-criteria analysis that includes safety/crash risk, pedestrian volumes, equity score, access to transit, and cost/maintenance considerations, etc.

In general, there are three categories for pedestrian crosswalk treatments as defined below.

1) *Active Warning* crossings consist of variations of a flashing beacon that is typically activated by a pedestrian, but in some cases may run continuously (Typologies A, B, C & E).
2) *Active Control* crossings refer to a treatment where pedestrians intending to use a crosswalk have the option to activate a signal that provides full and exclusive right of way for the pedestrian crossing (Typology D).
3) *Passive Warning* crossings refer to a treatment that may warn drivers of pedestrian presence but does not include supplemental lights or flashers. Signs and in-pavement markings fall under the passive warning category (Typologies A, B, C, D & E).

The examples shown in this section reflect four active warning crossings, one active control crossing, and five passive warning crossings currently in use on SHA roadways.

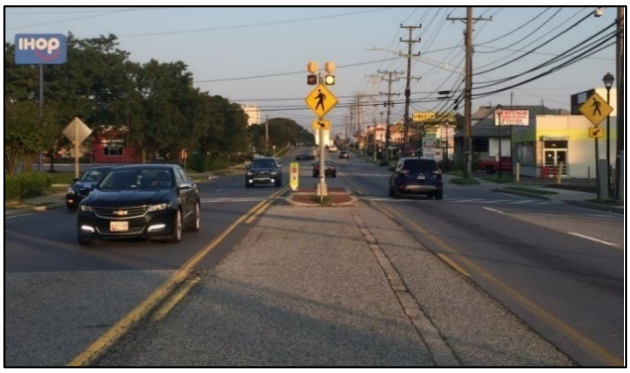
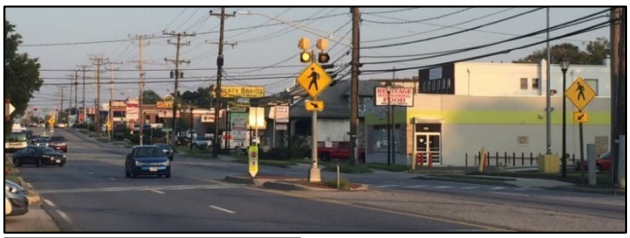
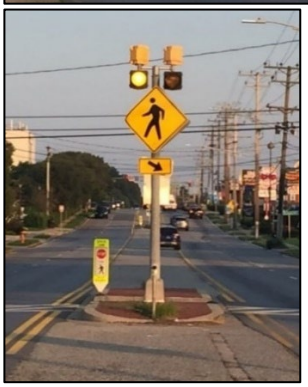
Multiple supplemental treatments incorporated into the typologies are included as individual treatments within these guidelines. For further information on typical applications, thresholds, and screening criteria for the supplemental treatments, refer to the following:

Treatment 2 – Crosswalks – Wider
Treatment 9 – Pedestrian Advanced Warning Beacons
Treatment 10 – Pedestrian Overhead Warning Beacons
Treatment 17 – Rectangular Rapid Flashing Beacon (RRFB)
Treatment 18 – Dynamic Passive Pedestrian Detection

1.5	Crosswalk Typology A	Active Warning* and Passive Warning**
LOCATION	**MD 191 – Montgomery County** *Between Offutt Ln & Strathmore St*	**TREATMENTS USED** ✓ Post-mounted pedestrian warning beacons* ✓ Advanced stop lines with R1-6a(3) "Stop Here For Pedestrians" signs ✓ Crosswalks – High Visibility[2] ✓ Parking restriction in advance of crosswalk ✓ Post-mounted pedestrian crossing warning signs** ✓ Pedestrian refuge island in median ✓ Advanced R1-9a "State Law Stop for Pedestrians in Crosswalk" sign ✓ Post-mounted advanced pedestrian crossing warning signs** ✓ Vertical delineators
CONTEXT ZONE	Urban Core	
DESCRIPTION	MD 191 between Offutt Ln and Strathmore St is an urban minor arterial with four travel lanes. The surrounding area is primarily residential with numerous apartment buildings. There are several bus stops in the area and there is a commercial downtown nearby.	
ATTRIBUTES	A mid-block crossing is located along this segment to mitigate pedestrian crashes. The mid-block crossing consists of: ➢ pedestrian-activated push buttons for post-mounted Pedestrian Warning Beacons, ➢ a high visibility 10-foot-wide crosswalk, offset so pedestrians face oncoming traffic prior to crossing, ➢ a raised center island in the center left turn lane for pedestrians to wait and cross one direction of traffic at a time, ➢ post-mounted pedestrian crossing warning signs located at the curb and on the island, and ➢ advanced stop lines along with R1-9a "Stop Here For Pedestrians" signs.	  
AVERAGE DAILY TRAFFIC	18,201[3] VEH	
POSTED SPEED LIMIT	25 MPH	

[2] NOTE – SHA policy no longer identifies diagonal crosswalk markings as high visibility. High visibility crosswalks should be continental design.

[3] Average ADT is based on the 2022 SHA Highway Location Reference Manual

1.5	Crosswalk Typology B	Active Warning* and Passive Warning**
LOCATION	**MD 26 – Baltimore County** *East of Brenbrook Road*	**TREATMENTS USED** ✓ Crosswalks – High Visibility[4] ✓ Crosswalks – Wider ✓ Post-mounted pedestrian warning beacons* ✓ Pedestrian refuge island ✓ Post-mounted pedestrian crossing warning signs**
CONTEXT ZONE	Suburban Activity Center/Traditional Town Center	
DESCRIPTION	This crossing is located on a four-lane segment of MD 26, an urban other principal arterial. It is in a commercial area with long distances between adjacent signals.	  
ATTRIBUTES	The marked crossing consists of: ➢ a diagonally hatched, 10-foot-wide crosswalk, ➢ post-mounted pedestrian warning signs at the crosswalk, ➢ pedestrian refuge island, and ➢ post-mounted pedestrian flashing beacons located in the median and facing both directions of traffic	
AVERAGE DAILY TRAFFIC	37,330[5] VEH	
POSTED SPEED LIMIT	35 MPH	

[4] NOTE – SHA policy no longer identifies diagonal crosswalk markings as high visibility. High visibility crosswalks should be continental design.

[5] ADT based on 2020 SHA Highway Location Reference Manual

1.5	Crosswalk Typology C	Active Warning* and Passive Warning**
LOCATION	**MD 410 – Prince George's County** *Sligo Creek Trail Crossing*	**TREATMENTS USED** ✓ Crosswalks – High Visibility[6] ✓ Overhead pedestrian-activated warning beacons* ✓ Overhead pedestrian and bicycle crossing warning signs** ✓ Post-mounted advanced pedestrian and bicycle crossing warning signs**
CONTEXT ZONE	Suburban Activity Center/Traditional Town Center	
DESCRIPTION	This crossing is located along MD 410 in Prince George's County, an urban other principal arterial. This crossing connects segments of the Sligo Creek Trail.	
ATTRIBUTES	The mid-block crossing consists of: ➢ An 8-foot-wide crosswalk with continental (longitudinal bar) markings, ➢ Post-mounted advanced pedestrian and bicycle crossing warning signs, and ➢ Overhead pedestrian and bicycle crossing warning signs with pedestrian-activated overhead flashing beacons facing each direction of traffic	
AVERAGE DAILY TRAFFIC	18,851[7] VEH	
POSTED SPEED LIMIT	35 MPH	

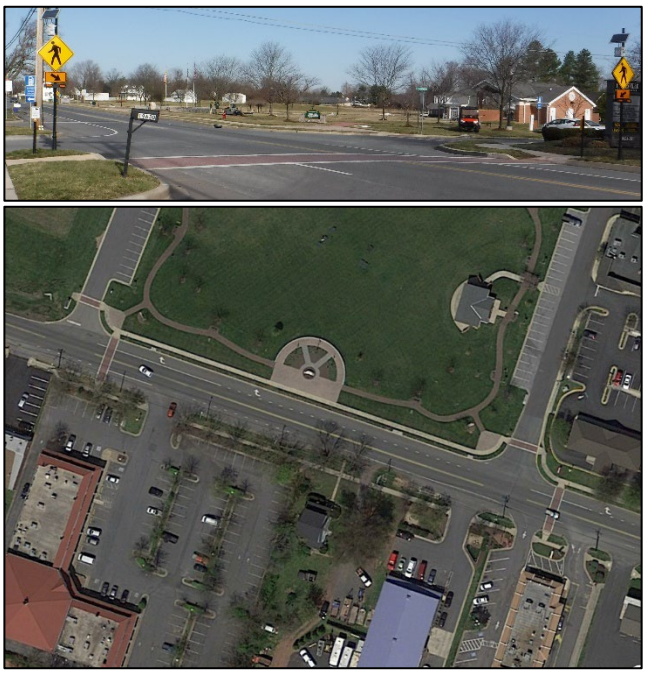
[6] NOTE – SHA policy no longer identifies diagonal crosswalk markings as high visibility. High visibility crosswalks should be continental design.

[7] ADT based on the 2020 SHA Highway Location Reference Manual

1.5	Crosswalk Typology D	Active/Passive Control* and Passive Warning**
LOCATION	**MD 586 – Montgomery County** *At Matthew Henson Trail*	**TREATMENTS USED** ✓ Advanced stop lines ✓ Crosswalks – High Visibility[8] ✓ Crosswalk lighting ✓ Overhead pedestrian-activated and passively detected traffic signal* ✓ Overhead trail crossing warning signs** ✓ Post-mounted pedestrian crossing warning signs**
CONTEXT ZONE	Suburban Activity Center/Traditional Town Center	
DESCRIPTION	This crossing is located on a five-lane divided segment of MD 586 (urban other principal arterial) within a residential area. The corridor primarily serves nearby neighborhoods.	
ATTRIBUTES	The marked crossing consists of: ➤ an 8-foot-wide crosswalk with continental (longitudinal bar) markings and post-mounted pedestrian warning signs, ➤ overhead trail crossing warning signs at the crosswalk, and ➤ overhead pedestrian-activated and passively detected traffic signal, and advanced stop lines.	
AVERAGE DAILY TRAFFIC	44,181[9] VEH	
POSTED SPEED LIMIT	45 MPH	

[8] NOTE – SHA policy no longer identifies diagonal crosswalk markings as high visibility. High visibility crosswalks should be continental design.

[9] ADT based on 2020 SHA Highway Location Reference Manual

1.5	Crosswalk Typology E	Active Warning* and Passive Warning**
LOCATION	**MD 107 – Montgomery County** *Between MD 109 and MD 28, at the Whalen Commons Site and the Library in Poolesville*	**TREATMENTS USED** ✓ Post-mounted pedestrian crossing warning signs** ✓ Rectangular Rapid Flashing Beacons (RRFB)*
CONTEXT ZONE	Rural	
DESCRIPTION	MD 107 is a major rural collector. The section through downtown Poolesville is primarily two lanes; however, the east end of the corridor expands to four lanes in some locations to accommodate turn lanes. Two marked crosswalks, 500 feet apart, are installed along this section connecting commercial establishments to public facilities including a park, library, and Town Hall.	
ATTRIBUTES	The two marked crosswalks consist of contrasting pavement banded by standard transverse lines, and post-mounted pedestrian crossing warning signs with RRFBs on either side of the crosswalks.	
AVERAGE DAILY TRAFFIC	6,195[10] VEH	
POSTED SPEED LIMIT	30 MPH	

[10] ADT based on the 2022 SHA Highway Location Reference Manual

2	Treatment	Crosswalks – Wider (Greater than ten feet in width)

PURPOSE

To increase crosswalk visibility for drivers, to provide a larger crossing zone to accommodate higher pedestrian volumes, and to deter vehicle encroachment in the pedestrian crossing zone.

DESCRIPTION

A marked crosswalk where the length of an individual longitudinal bar is greater than the typical longitudinal bar crosswalk width of ten feet. Crosswalks marked wider than ten feet may be appropriate in unique cases with high pedestrian crossing volumes or at shared-use path crossings.

TYPICAL APPLICATIONS

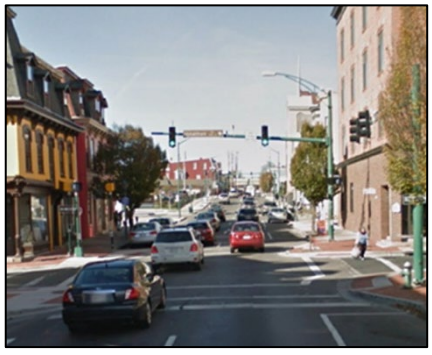
- At controlled mid-block crossings or signalized intersections within
  - I. Transit-Oriented Development Areas
  - II. Bicycle and Pedestrian Priority Areas
  - III. Urban areas (Central Business Districts)
  - IV. Trail crossings

At least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Pedestrian volume	Where pedestrian peak-hour volumes are greater than 100
b. Adjacent land use	Within ¼ mile of a pedestrian generator (e.g., senior/community center, high-volume bus stop, and transit-dependent community)

IMAGE

Location: Howard St & Conway St, Baltimore

3	Treatment	Curb Extensions
PURPOSE		To reduce pedestrian exposure by decreasing the crossing distance and increasing pedestrian visibility.
DESCRIPTION		Curb extensions are used to extend the sidewalk or other pedestrian space and shorten the crossing distance for pedestrians. They may also be used to alter the roadway geometry for speed control or channelization. Curb extensions are typically created by physical infrastructure including concrete or asphalt but can also be designated with vertical delineators such as flex posts or bollards.
TYPICAL APPLICATIONS		➢ Urban areas (Central Business Districts) ➢ Blocks with existing full-time on-street parking ➢ Suburban mid-block crossings ➢ Minor arterials or lower functional class roadways (Note: Typical Context Zones can be found in the Context Driven Toolkit.)
All the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a. Large vehicle maneuverability		Where the appropriate large vehicle (e.g., trucks, emergency vehicles, or buses) can be safely accommodated based on a turning-path analysis
In addition, at least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
b. Roadway/shoulder width		At marked mid-block crossings where the roadway or shoulder width is sufficient and the extension will not conflict with shoulder use
c. Bicycle lanes or in-lane floating bus stops		Where the extension will not negatively impact designated bicycle facilities, bicycle use on shoulders, or in-lane floating bus stops
Other considerations		
➢ Curb extensions should not adversely impact drainage.		
IMAGE		 *Location: Castle Blvd in Fairland, Montgomery County*  *Location: US 40 at Jonathan Street in Hagerstown, Washington County*

4	Treatment	Hardened Centerline
PURPOSE		Hardened centerlines, also referred to as centerline hardening or left-turn traffic calming (LTTC), use physical infrastructure to force left-turning drivers to complete slower, tighter radius turning maneuvers. They also increase left-turn motorists' visibility of pedestrians in the crosswalk by reducing obstructions created by vehicles' A-pillar.
DESCRIPTION		Use of rubber curbs and delineators or bollards on centerline(s), or slightly beyond the crosswalk, to prevent drivers from cutting diagonally across the intersection and crosswalk.
TYPICAL APPLICATIONS		➢ Urban or Suburban Areas ➢ Transit-Oriented Developments ➢ School Zones ➢ Bicycle and Pedestrian Priority Areas (Note: Typical Context Zones can be found in the Context Driven Toolkit.)
All the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a.	Signal operations	Where permissive left-turn phasing overlaps with pedestrian phasing
b.	Turning radius	Left-turning vehicles, especially single-unit box trucks (i.e., SU-30 or smaller), can complete maneuvers without traversing the proposed hardened centerlines
In addition, at least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
c.	Crossing/ vehicular volume	Where the peak-hour left-turn volume and crosswalk volume (i.e., pedestrians & bicyclists) cross-product is greater than 6,000
d.	Receiving leg	Receiving street or crosswalk width wider than 60 ft
e.	Speeds	Where left-turn speeds through the intersection exceed 25 MPH (if speed data is available)
f.	Crash history	Where the number of left-turn vehicle/pedestrian crashes is greater than or equal to two within the most recent five-year period, or a pedestrian fatality
g.	Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
h.	Pedestrian demographics	Where one-quarter of daily pedestrian crossings involves a vulnerable population (e.g., elderly, school children, or the disabled)
Other Considerations		
➢ Where median pedestrian refuge islands are desirable but cannot be physically accommodated ➢ Effective when used in conjunction with road diets, curb extensions and other pedestrian safety treatments. ➢ Only applicable on a two-way street, either where a one-way or two-way street meets a two-way street. ➢ Where pedestrian data is not available, the Short Trip Opportunity Areas may be considered.		

IMAGE

Location: 2nd Ave & Spring St, Montgomery County

5	Treatment	In-Pavement Text Markings
PURPOSE		To warn drivers of approaching crossings; frequently used on higher speed roadways where crossings are uncommon or unexpected.
DESCRIPTION		Text installed on pavement using traditional white pavement marking material to provide warning of an approaching crossing (MdMUTCD 3B.20). Commonly used messages for in-pavement text include: 1. PED XING AHEAD 2. SCHOOL ZONE
TYPICAL APPLICATIONS		➤ Suburban areas ➤ Rural areas ➤ Uncontrolled crossings
At least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a.	Sight distance[11]	Where stopping sight distance to crossings is limited
b.	Posted speed limit	Where the posted speed is greater than or equal to 35 mph
c.	Distance to nearest signalized intersection	Where the uncontrolled crossing is greater than ½ mile from a signalized intersection
d.	Crash history	Where the number of pedestrian-related crashes is greater than or equal to two within the most recent five-year period
e.	Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
IMAGE		 *Location: Along US 219 between Glendale Road and Quarry Road near Deep Creek, Garrett County*

[11] The stopping sight distance criterion is used when considered as a supplemental treatment for a required/justified crosswalk location.

6	Treatment	Advanced Stop Line

PURPOSE

To increase compliance with yielding to pedestrians in crosswalks and prevent multiple-threat crashes.

DESCRIPTION

Advanced stop lines are placed at least 20 feet, and no more than 50 feet from a mid-block crosswalk. They are effective at maximizing pedestrian visibility in a crosswalk and making all vehicles stop.

Multiple-threat crashes occur when one vehicle slows or stops to allow a pedestrian to cross the street, and vehicles traveling the same direction in an adjacent lane do not, thus causing a pedestrian crash. The stopped vehicle restricts sight distance at the crosswalk for both other vehicles and pedestrians.

Advanced stop lines also reduce the likelihood of inattentive drivers rear-ending a stopped vehicle and pushing it into a pedestrian in the crosswalk.

TYPICAL APPLICATIONS

- Uncontrolled or controlled mid-block crossings, including trail crossings
- Urban areas
- Transit-Oriented development areas
- Bicycle and pedestrian priority areas

At least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Number of crossing lanes	Where the number of mainline lanes that must be crossed by pedestrians is greater than or equal to two per direction of travel (i.e., two total lanes on a one-way road, four total lanes on a two-way road)
b. Crosswalk spacing	Minimum ¼ mile from existing marked and controlled crosswalk
c. Posted speed limit	Where the posted speed is less than or equal to 35 mph

IMAGE

Location: Along MD 185 between Woodbine St & Williams Ln, Montgomery County

7	Treatment	Narrow Lanes
PURPOSE		To reduce vehicle speeds and enhance movement and safety for pedestrians.
DESCRIPTION		Travel lane widths reduced to less than or equal to 11 feet, or increased lane and edge line pavement marking line widths (up to 10 inches wide).
TYPICAL APPLICATIONS		➢ Transit-Oriented Development Areas ➢ Bicycle and Pedestrian Priority Areas ➢ Urban areas ➢ On collector roads or roads of a lower functional class (Note: Typical Context Zones can be found in the Context Driven Toolkit.)
At least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a.	Design speed	Where the design speed is less than or equal to 45 mph
b.	Average daily traffic	Where the Average Daily Traffic is less than 25,000 vehicles

Other considerations

- Coordination and concurrence with the transit agencies are needed for primary transit corridors.
- Design flexibility may be required to accommodate freight corridors and emergency response needs.

IMAGE

Location: Along MD 185 at W Kirke Street in Chevy Chase, Montgomery County

8	Treatment	No Turn on Red (R10-11b) signs
PURPOSE		Prohibiting right turns on red improves safety and reduces injury crashes by mitigating sight-line restrictions and/or eliminating conflicts between turning vehicles and pedestrians or bicyclists during a concurrent pedestrian (or bike signal) phase.
DESCRIPTION		SHA uses standard "No Turn on Red" sign R10-11b to inform motorists when a right-turn on red or a left-turn on red from a one-way street to a one-way street is to be prohibited.
TYPICAL APPLICATIONS		➢ Signalized intersections ➢ Urban areas ➢ Transit-Oriented Development Areas ➢ Bicycle and Pedestrian Priority Areas (Note: Typical Context Zones can be found in the Context Driven Toolkit.)
At least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a.	Sight distance	Where there is inadequate sight distance to vehicles approaching from the left (or right, if applicable)
b.	Unique geometry	Where the intersection geometry or operational characteristics of the intersection may result in unexpected conflicts (i.e., more than a four-leg intersection, multiple right turn lanes or multiple opposing left-turn lanes, parallel service roads or other features with multiple or unusual conflicts)
c.	Exclusive pedestrian/bike phase	Intersection phasing includes exclusive pedestrian or bicycle phase
d.	Pedestrian conflicts	Where a high-volume of pedestrians (50 peds/hour) may conflict with a high-volume of right-turn-on-red maneuvers (120 vehicles/hour) ▪ Pedestrian conflict data is not needed under the following context zones: • Urban Core • Urban Center • Traditional Town Center • Suburban Activity Center.
e.	Unique population	Presence of children, elderly pedestrians or people with disabilities
f.	Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
g.	Land use	Intersection is within a designated school zone
h.	Skewed intersection	Where the angle of the intersecting roadways creates difficulty for drivers to see traffic approaching from their left

i.	Two-way bike facilities	Where a turn restriction across two-way bike facilities, including shared-use paths, may be warranted due to the increased complexity and potential conflicts between turning vehicles and bicyclists

Other considerations

- Can be limited to specific times of day (e.g., school bell times, daytime hours)
- Railroad and light rail grade crossing within 200 ft: Where crossing is 200 ft or less from the turn and insufficient storage available for the volume of turning vehicles. May use dynamic sign for low volume rail crossings.
- Restricting turning movements would be beneficial at intersections with leading pedestrian interval (LPI) phasing.
- Restricting turning movements may result in reduced vehicular capacity.

IMAGE

Location: US 40 and Ridge Road in Ellicott City, Howard County

Location: MD 410 at Pearl Street in Bethesda, Montgomery County

9	Treatment	Pedestrian Advanced Warning Beacons

PURPOSE

To reduce vehicle speeds by providing drivers with advanced warning of approaching pedestrian crossing activity.

DESCRIPTION

Flashing beacons and signage placed in advance of a pedestrian crossing.

Appropriate messages on signage include:

- *Be Prepared To Stop* (W3-4) with *When Flashing* plaque (W16-13P)
- Pedestrian crossing warning sign (W11-2) with *When Flashing* plaque (W16-13P)

Audible/visual messages such as "*Push Button To Turn On Warning Lights*" may be incorporated at the crossing for use by pedestrians. Refer to the 2011 MdMUTCD Section 2B.52 for further guidance.

TYPICAL APPLICATIONS

- Suburban areas
- Rural areas
- Uncontrolled marked crossings

At least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Average daily traffic	Where Average Daily Traffic is greater than 20,000 vehicles
b. Posted speed limit	Where the posted speed is greater than or equal to 35 mph or where there is a change in speed limit approaching the pedestrian crossing
c. Crash history	Where the number of pedestrian-related crashes is greater than or equal to two within the most recent five-year period
d. Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
e. Sight distance	Where there is limited sight distance to the pedestrian crossing

IMAGE

Location: Along US 219 between Glendale Road and Quarry Road near Deep Creek, Garrett County

10	Treatment	Pedestrian Overhead Warning Beacons

PURPOSE

To warn drivers of pedestrian crossing activity and improve the visibility of the crossing.

DESCRIPTION

Flashing beacons and signage installed over the roadway, along the roadway edge just prior to the crossing, or at the crossing.

Audible/visual messages such as "*Push Button To Turn On Warning Lights*" may be incorporated at the crossing for use by pedestrians. Refer to the 2011 MdMUTCD Section 2B.51 for further guidance.

TYPICAL APPLICATIONS

- Suburban areas
- Rural areas
- Uncontrolled marked crossings

At least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Average daily traffic	Where the Average Daily Traffic is greater than 20,000 vehicles
b. Posted speed limit	Where the posted speed is greater than or equal to 30 mph and less than or equal to 40 mph.
c. Travel speeds	Where there is a desire to reduce vehicle speeds when pedestrians are present
d. Crash history	Where the number of pedestrian-related crashes is greater than or equal to two within the most recent five-year period
e. Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool

Other considerations

- Pedestrian overhead warning beacons may also be appropriate where sight distance limitations make ground-mounted devices insufficient.

IMAGE

Location: MD 500 at Jamestown Road in Hyattsville, Prince George's County
Location: MD 147 at Garnet Road in Parkville, Baltimore County

11	Treatment	Pedestrian Channelization (Non-Traversable Median or Curb Barrier)
PURPOSE		To discourage pedestrians from crossing at undesignated mid-block locations.
DESCRIPTION		Channelization barrier that prevents pedestrians from crossing at unmarked or undesignated crossing areas. Minimum median widths within which the barrier is installed should be determined in coordination with the District Engineers. The barrier must terminate at designated crossing locations. Barrier treatments include fencing or landscaping (e.g., raised planters). Sight distance must be maintained.
TYPICAL APPLICATIONS		➢ Implement only after trial of other less restrictive treatments (i.e., signage, education, enforcement, transit stop relocation, etc.) ➢ When distance between controlled crossings is greater than 500 feet ➢ Where it is implausible to install a mid-block crossing (Note: Typical Context Zones can be found in the Context Driven Toolkit.)
All the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a.	Average daily traffic	Where the Average Daily Traffic is greater than 25,000 vehicles
b.	Posted speed limit	Where the posted speed is greater than or equal to 35 mph
In addition, at least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
c.	Pedestrian volume	Where, during a vehicular off-peak hour, hourly pedestrian volumes are greater than 50 pedestrians ▪ Pedestrian volume data is not needed under the following context zones: • Urban Core • Urban Center • Traditional Town Center • Suburban Activity Center • Suburban.
d.	Number of crossing lanes	Where pedestrians must cross two or more lanes in each direction
e.	Crash history	Where the number of pedestrian-related crashes occurring mid-block is greater than two within the most recent five-year period
f.	Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
g.	Adjacent land use	Field observations/counts indicate a significant number of mid-block crossings occur despite the proximity of controlled crossings. Normally caused by pedestrian generators located on opposite sides of a roadway.

IMAGE

Location: MD 650 in Takoma Park, Montgomery County

12	Treatment	Reduced Curb Radii

PURPOSE	To facilitate lower turning speeds, shorten the crossing distance for pedestrians, and improve sight distance between pedestrians and motorists.
DESCRIPTION	Intersection curb radii geometrically reduced.
TYPICAL APPLICATIONS	➢ Transit-Oriented Development Areas ➢ Bicycle and Pedestrian Priority Areas ➢ Urban areas (Central Business Districts) (Note: Typical Context Zones can be found in the Context Driven Toolkit.)

All the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Turning speeds	Where the turning speeds are greater than 15 mph
b. Pedestrian volume	Where the pedestrian peak-hour volume is greater than 20

In addition, at least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
c. Number of crossing lanes	Where the number of mainline lanes is greater than or equal to 4
d. Roadway functional classification	Where the side street is a collector road or lower functional class

Other considerations

➢ Turning movements should be evaluated to ensure truck (i.e., SU-30 or smaller) access is maintained where needed.

IMAGE

Location: MD 97 and Hewitt Avenue in Wheaton-Glenmont, Montgomery County

13	Treatment	Remove Right Turn Channelization

PURPOSE

To reduce intersection complexity by removing an unimpeded vehicle movement that contributes to high turning speeds.

DESCRIPTION

Intersection geometry reconfigured to remove channelized right turn lanes.

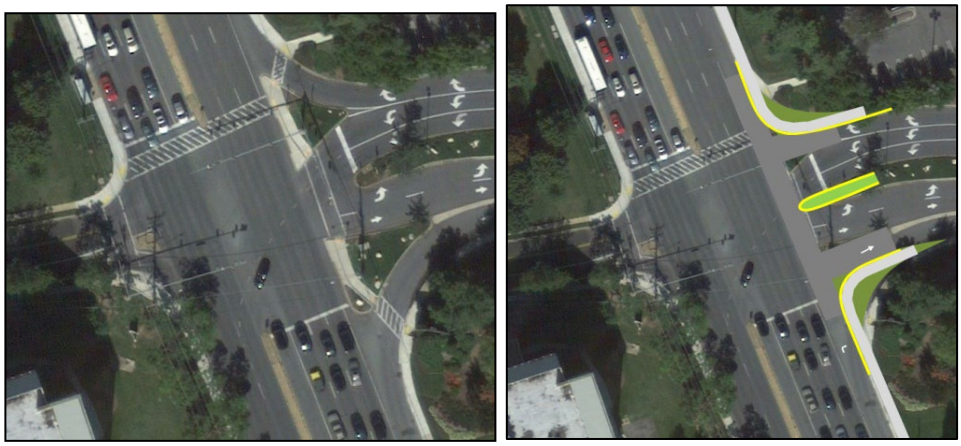
TYPICAL APPLICATIONS

- Transit-Oriented Development Areas
- Bicycle and Pedestrian Priority Areas
- Urban areas
- Suburban areas

At least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Pedestrian volume	Where pedestrian peak-hour volumes are greater than 50
b. Crash history	Where the number of pedestrian-related crashes at the intersection is greater than two within the most recent five-year period
c. Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
d. Intersection level of service	At intersections with a level of service of E or better
e. Sight distance	Where limited sight distance exists

IMAGE



Location: Maryland Route 355 and Edson Lane/Entrance to White Flint Mall, Montgomery County. Left: Existing Conditions. Right: With proposed channelization removed.

14	Treatment	Pedestrian Recall for WALK indications

PURPOSE

To provide sufficient time for pedestrian crossings during every cycle.

DESCRIPTION

Pedestrians are given a WALK signal during every cycle for all crosswalks during designated hours of the day; no push button or detection is necessary. Pedestrian Recall is useful in areas with high levels of pedestrian activity and should be used in all urban areas.

TYPICAL APPLICATIONS

- Intersections with heavy pedestrian activity
- Urban areas
- Central Business Districts
- Transit-Oriented Development Areas

All the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Intersection signal operations	Pedestrian Recall will not cause intersection operation failure and will not result in the need for a longer cycle length

In addition, at least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
b. Pedestrian volume/calls	Pedestrian calls during 80 percent of cycles for 6 consecutive hours
c. Central Business District (CBD) or Transit-Oriented Development (TOD) areas	Four of the following seven characteristics of a CBD or TOD are met for the signalized intersection: i. One-way street pairs and/or a grid roadway network ii. On-street parking (no or minimal parking lots) iii. Multi-story commercial/retail iv. Speed limit is 35 mph or less v. Three or more signals with average spacing of less than 800 feet vi. Visual features indicative of a pedestrian-friendly environment (i.e., decorative lighting, special signing, benches, planters/landscaping) vii. Heavy transit operations (subway, commuter rail, or transit center)
d. Signal location	Signalized intersection is isolated

IMAGE

15	Treatment	Leading Pedestrian Interval (LPI), also known as an Advanced Pedestrian Phase

PURPOSE

To minimize conflict between crossing pedestrians and turning vehicles by allowing pedestrians to establish their presence in the marked crosswalk prior to motorists performing turning movements.

DESCRIPTION

Also known as an *advanced pedestrian phase*, pedestrian signals are timed to give pedestrians the WALK indicator prior to the green indicator for vehicles.

LPIs are evaluated by individual crossing or leg.

TYPICAL APPLICATIONS

- Transit-Oriented Development Areas
- Bicycle and Pedestrian Priority Areas
- Urban areas (Central Business Districts)
- Suburban areas

(Note: Typical Context Zones can be found in the Context Driven Toolkit.)

At least one of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Crash history	Where the number of pedestrian-related crashes due to turning vehicle conflicts is greater than or equal to two within the most recent five-year period, or a pedestrian fatality, on individual crossing
b. Pedestrian demographics	Where pedestrian volume is in a posted school zone/crossing or near a facility that generates elderly/physically impaired pedestrian traffic
c. Potential conflict	Locations with significant motorist noncompliance with yielding to pedestrians with right of way
d. Sight visibility	Where limited sight visibility adversely affects drivers' ability to recognize pedestrians crossing (e.g., large corner radius)

OR the following threshold should be met

SCREENING CRITERIA	THRESHOLD
e. Crossing/Vehicular volume	Where the peak-hour left-turn volume and crosswalk volume (i.e., pedestrians & bicyclists) cross-product is greater than 6,000

Other considerations

- LPI should not significantly impact vehicle traffic operations with causing queue spillover or degrading the intersection level of service more than 2 levels.
- LPI should not be installed where existing leading protected and permissive left-turn phasing exists.
- LPI should be accompanied by APS.
- LPI should be considered at one-way or T-intersections where left-turning motorists do not have opposing traffic and may not slow or yield to pedestrians.
- If none of the above are satisfied, a "TURNING TRAFFIC YIELD TO PEDESTRIANS" sign may be considered.

IMAGE

Location: US 1 and Jefferson Street in Hyattsville, Prince George's County

16	Treatment	Pedestrian Hybrid Beacon (PHB)
PURPOSE		To provide a controlled pedestrian crossing where a full signal is not warranted
DESCRIPTION		A three-section overhead beacon activated by pedestrians, signaling drivers to stop. Unless activated, the beacon remains dark. The crossing must be supplemented by a marked crosswalk and appropriate signage. **Signal Pattern** 1. *Beacon remains dark until activated by push button* 2. *Beacon flashes yellow when activated by push button* 3. *Beacon turns to a steady yellow* 4. *Beacon turns to a steady red in association with pedestrian WALK phase* 5. *Beacon turns to an alternating flashing red in association with pedestrian clearance intervals. Motorists may continue through the intersection if clear of pedestrians* 6. *Beacon turns dark at the end of alternating flashing red phase*

TYPICAL APPLICATIONS		➢ Mid-block locations along arterial roadways
		➢ Useful in locations where traditional crosswalk signage and markings do not result in adequate yielding by motorists
		➢ Where the deployment or cost of a full traffic signal is not warranted but the following challenges may exist for pedestrians
		  ➢ Insufficient gaps for pedestrians to cross
		  ➢ Approaching vehicle speed is too high and uncomfortable
		  ➢ Pedestrians experience excessive delay
		(Note: Typical Context Zones can be found in the Context Driven Toolkit.)

SCREENING CRITERIA		a. Pedestrian volume on major street b. Vehicle volume on major street c. Posted speed limit d. Crosswalk length (must be associated with a marked crosswalk)
THRESHOLD		The Maryland MUTCD provides specific guidance on when PHBs are warranted (see Chapter 4F of the 2011 MdMUTCD) and is summarized below. A pedestrian hybrid beacon may be considered if the plotted point representing *vehicles per hour* on the major street (total of both approaches) and the corresponding total of all *pedestrians crossing the major street for one hour* (any four consecutive fifteen-minute periods) of an average day, falls above the applicable curve in Figure 4F-1 or Figure 4F-2 (figure choice dependent on the *posted speed limit*) for the *length of the crossing*. NOTE – Recent updates to the MdMUTCD allow the criteria for all *pedestrians crossing the major street* to be reduced by as much as 50% if the 15th-percentile crossing speed of pedestrians is less than 3.5 ft/s. Where there is a divided street with medians of sufficient width for pedestrians to wait, the criteria for *vehicles per hour* on the major street may be applied separately to each direction of traffic.

IMAGE

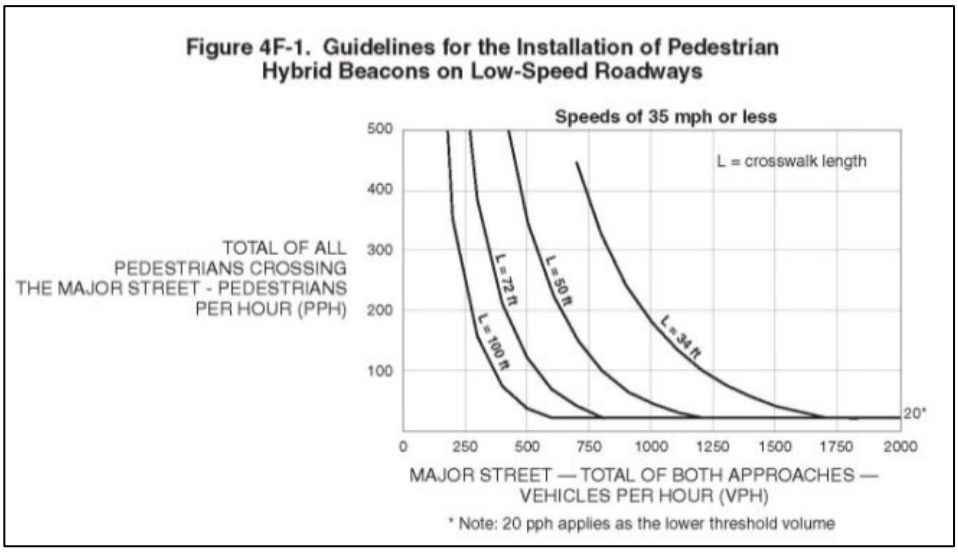


Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways
Speeds of 35 mph or less
L = crosswalk length
TOTAL OF ALL PEDESTRIANS CROSSING THE MAJOR STREET - PEDESTRIANS PER HOUR (PPH)
500
400
300
200
100
L = 72 ft
L = 50 ft
L = 34 ft
L = 100 ft
20*
0
250
500
750
1000
1250
1500
1750
2000
MAJOR STREET — TOTAL OF BOTH APPROACHES — VEHICLES PER HOUR (VPH)
* Note: 20 pph applies as the lower threshold volume

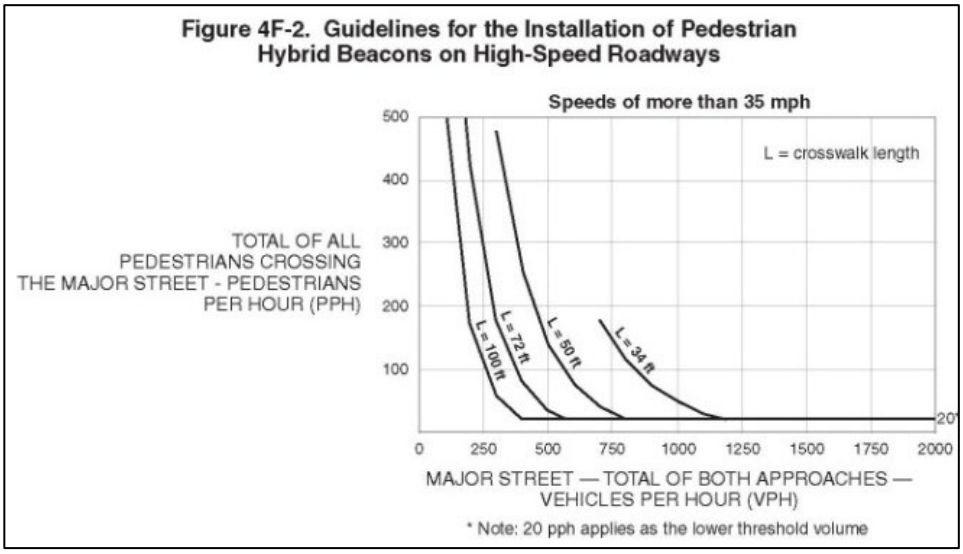


Figure 4F-2. Guidelines for the Installation of Pedestrian Hybrid Beacons on High-Speed Roadways
Speeds of more than 35 mph
L = crosswalk length
TOTAL OF ALL PEDESTRIANS CROSSING THE MAJOR STREET - PEDESTRIANS PER HOUR (PPH)
500
400
300
200
100
L = 72 ft
L = 50 ft
L = 34 ft
L = 100 ft
20*
0
250
500
750
1000
1250
1500
1750
2000
MAJOR STREET — TOTAL OF BOTH APPROACHES — VEHICLES PER HOUR (VPH)
* Note: 20 pph applies as the lower threshold volume

16	Example	Pedestrian Hybrid Beacon (PHB)

LOCATION

MD 410 – Montgomery County
At entrance to Bethesda Chevy Chase High School

DESCRIPTION

This crossing is in the Bethesda CBD, at an unsignalized T-intersection and entrance to Bethesda Chevy Chase High School. MD 410 is a one-way, three-lane road; however, a curb extension narrows the crossing to two lanes. The side street has a marked crosswalk but no further treatments.

ATTRIBUTES

The crossing consists of:

- A high visibility, crosswalk,
- post-mounted school crossing warning signs,
- an advanced stop line (~30 ft),
- pedestrian signal heads with push buttons, and
- pedestrian hybrid beacon.

AVERAGE DAILY TRAFFIC

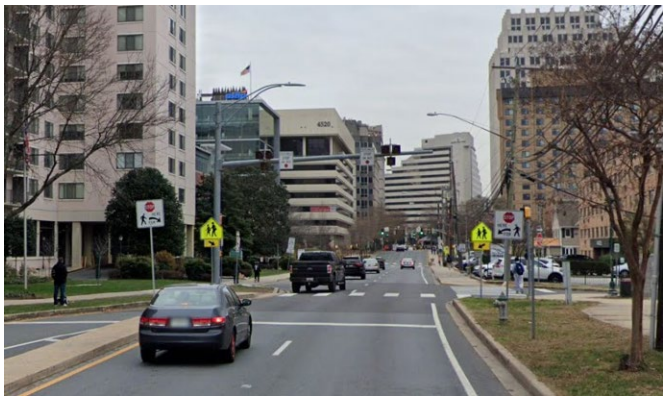
11,961[12] VEH

POSTED SPEED LIMIT

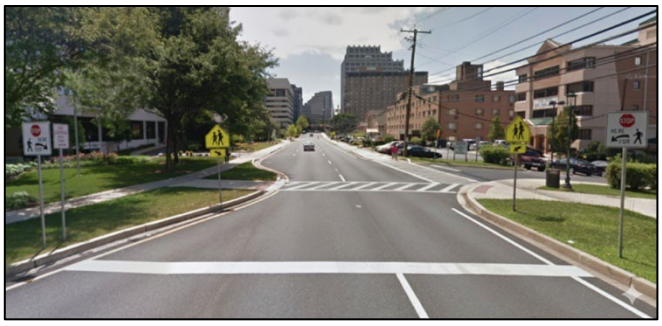
25 MPH

TREATMENTS USED

- ✓ Pedestrian Hybrid Beacon (PHB)
- ✓ Crosswalk – High Visibility
- ✓ Advanced Stop Line



After installation of PHB (July 2017)



Before installation of PHB

FLASHING OPERATION

Normal

Mainline: Dark

Once Activated

Mainline:

Flashing Yellow, Steady Yellow, Steady Red for vehicular traffic (WALK for pedestrians), Alternating Flashing Red for vehicular traffic (DON'T WALK for pedestrians), then Dark

[12] ADT based on the 2020 SHA Highway Location Reference Manual

17	Treatment	Rectangular Rapid Flashing Beacon (RRFB)

PURPOSE

To increase driver awareness of a pedestrian crossing.

DESCRIPTION

Flashing, yellow, rectangular LEDs that are activated by a pedestrian push button and supplement a marked crosswalk with pedestrian (W11-2), school (S1-1) or trail (W11-15) crossing warning signs. The assembly is installed on both sides of the roadway immediately at the crosswalk and in the median on divided roadways. Warning signs may be post-mounted or overhead. If post-mounted, they should be accompanied by a diagonal downward arrow plaque (W16-7P).

TYPICAL APPLICATIONS

- Marked, uncontrolled intersections or mid-block crossings
- Where Maryland Pedestrian Signal or Pedestrian Hybrid Beacon (PHB) is requested but not warranted

(Note: Typical Context Zones can be found in the Context Driven Toolkit.)

At least two of the following thresholds should be met

SCREENING CRITERIA	THRESHOLD
a. Average daily traffic	Where the Average Daily Traffic is less than 15,000 vehicles
b. Posted speed limit	Where the posted speed is less than or equal to 35 mph
c. Number of crossing lanes	Where the total number of lanes is less than or equal to four on an undivided roadway and less than or equal to six on a divided roadway
d. Crash history	Where the number of pedestrian-related crashes is greater than or equal to two within the most recent five-year period
e. Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
f. Pedestrian demographics	Where one-quarter of daily pedestrian crossing volume involves a special population (e.g., senior, or school children)

Other considerations

- If sight distance is a concern, the FHWA Interim Approval 21 permits installation of supplemental advanced RRFB assemblies to provide upstream warning. However, other treatments may be more appropriate.

IMAGE

Location: Rhode Island Avenue and Cherokee Street, Prince George's County

18	Treatment	Dynamic Passive Pedestrian Detection
PURPOSE		To detect approaching and/or waiting pedestrians at crosswalks and place a "call" to the existing traffic control device.
DESCRIPTION		Passive, or automatic pedestrian detection is placed at crosswalks to identify humans and prompt a warning beacon, walk signal, Pedestrian Hybrid Beacon (PHB) or Rectangular Rapid Flashing Beacon (RRFB) without pedestrians needing to press a button. Dynamic Passive Pedestrian Detection (DPPD) may adjust the pedestrian clearance time, if necessary, or cancel the call when the pedestrian leaves the detection zone (i.e., walks away or jaywalks) to improve pedestrian safety and efficiency in some controllers. Depending upon application, an audible/visual message acknowledging pedestrian presence and a signal call may be incorporated at the crossing. An audible message may be used to indicate a canceled call and prompt users to return to the waiting zone.
TYPICAL APPLICATIONS		➢ Urban Area ➢ Transit-Oriented Developments ➢ School Zones ➢ Bicycle and Pedestrian Priority Areas ➢ Trail crossings ➢ Mid-block crossings
At least one of the following thresholds should be met		
SCREENING CRITERIA		**THRESHOLD**
a.	Traffic control device compliance	Where existing compliance rates with pedestrian-activated devices are less than 50%
b.	Signal operations	Where other types of pedestrian-friendly signal operations such as leading pedestrian intervals, recall, etc. are not practical
c.	Crash history	Where the number of pedestrian-related crashes is greater than or equal to two within the most recent five-year period
d.	Crash potential	Where a pedestrian crossing is identified as a high-risk location based on field observations, a conflict analysis, or a predictive tool
e.	Unique modal conflicts	Where special modes or traffic patterns are present such as light rail, transitways, trails or similar.
f.	Pedestrian demographics	Where one-quarter of daily pedestrian crossings involves a vulnerable population (e.g., senior, or school children)
Other Considerations		
➢ Special community needs where religious observations restrict the use of technology at certain times		

IMAGE

Location: MD 586 at Matthew Henson Trail, Montgomery County

Trade-Offs & Costs Associated with Each Treatment

#	*Treatment*	External Trade-Offs	Internal Costs
1	*Crosswalks – Marked Crosswalks with Warning Signs at Uncontrolled Locations*	• Does not provide exclusive right of way to pedestrians (e.g., mandatory stopping of through vehicles) • Enforcement may be required • Characteristics of the roadway, traffic volumes, vehicle speeds, etc. may increase the likelihood of crashes at a marked crosswalk.	• Installing a marked crosswalk may require additional treatments such as raised islands, advanced or overhead warning beacons, advanced stop lines, in-pavement markings, etc. • Must have adequate placement of warning signs (visibility, tree limb removal, overcrowding of signs, etc.) • Unjustified marked crosswalks increase maintenance costs and do not increase pedestrian safety
2	*Marked Crosswalks - Wider*	• Reduces vehicle queue storage available • Allows more pedestrians in the roadway at the same time	• May impact drainage, ADA ramps and/or pedestrian push button accessibility • May require modification of vehicle detection zones
3	*Curb Extensions*	• Creates more difficult turning maneuvers and access for emergency vehicles, buses, and trucks • May require restricting U-turns • Potential negative impact to on-street parking • Potential negative impact to on-street bike lanes	• May impact drainage, utilities and ADA ramps • Increased maintenance and/or landscaping costs • May need modifications to maintain adequate drainage • Potential impediment to snow removal operations

#	*Treatment*	External Trade-Offs	Internal Costs
4	*Hardened Centerline*	• Creates more difficult turning maneuvers and access for emergency vehicles, buses, and trucks • May require restricting U-turns	• Increased maintenance cost • Potential impediment to snow removal operations
5	*In-Pavement Text Markings*	• Less visible than signs or active warning devices in certain lighting and weather conditions • Limited message content due to required letter size and lane width	• Additional maintenance costs
6	*Advanced Stop Line*	• Less visible than signs or active warning devices in certain lighting and weather conditions	• Additional maintenance costs
7	*Narrow Lanes*	• May require bus and/or truck access restriction • May result in larger vehicles infringing on adjacent lanes • May reduce travel width for bikes • May result in lower travel speeds/additional travel time	
8	*No Turn on Red (R10-11b) signs*	• May require revised signal phasing • May significantly increase vehicle delay	

#	*Treatment*	External Trade-Offs	Internal Costs
9/10	*Pedestrian Advanced/Overhead Warning Beacons*	• Only provides enhanced warning, does not require motorists to stop • Need to be pedestrian-activated for most effective use, but pedestrians may not always choose to activate before crossing	• Hardware and maintenance costs
11	*Pedestrian Channelization (Median or Curb Barrier)*	• May trap pedestrians along median or between curb and sidewalk • Height of fencing may block view of businesses • Height of fencing may restrict vehicle sight distance • May discourage pedestrian activity if comfort level drops	• Significant costs for ornamental fencing types • May create maintenance issues (e.g., snow removal)
12	*Reduced Curb Radii*	• May require truck restrictions on side streets • Makes turning movements more difficult for larger vehicles (delivery trucks, buses, emergency vehicles, etc.) • Slows vehicle turning movements, which may increase delay at the intersection	• May impact drainage, utilities and ADA curb ramps

#	*Treatment*	External Trade-Offs	Internal Costs
13	*Remove Right Turn Channelization*	• May increase vehicle delay even if right turn lanes are maintained • May require revised signal phasing and/or longer pedestrian clearance times • May increase direct pedestrian crossing distance (e.g., more lanes without refuge) • May impact access for larger vehicles (e.g., emergency vehicles, buses, and trucks) • Increased pedestrian clearances may increase delay	• May impact drainage, utilities and ADA curb ramps
14	*Pedestrian Recall for WALK indications*	• May result in changes to cycle lengths and additional delay for vehicles	• Signal retiming efforts
15	*Leading Pedestrian Interval (LPI), also known as an Advanced Pedestrian Phase*	• Does not eliminate vehicle conflicts for the entire pedestrian crossing • Reduces vehicle capacity • Does not prevent vehicles from turning on red	
16	*Pedestrian Hybrid Beacon (PHB)*	• Increased vehicle delay on mainline and side street • Will still result in pedestrian delay if signal is in coordination	• Maintenance, power costs and utility impacts • Signal timing coordination
17	*Rectangular Rapid Flashing Beacon (RRFB)*	• Does not provide exclusive right of way to pedestrians	• Maintenance costs

#	*Treatment*	External Trade-Offs	Internal Costs
18	*Dynamic Passive Pedestrian Detection*	• Reliability	• Maintenance costs

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