

VIRGINIA DEPARTMENT OF TRANSPORTATION
TRAFFIC ENGINEERING DIVISION
INSTRUCTIONAL & INFORMATIONAL MEMORANDUM

GENERAL SUBJECT: Pavement Markings Signs Pedestrians	NUMBER: IIM-TE-384.1
	SUPERSEDES: IIM-TE-384.0
SPECIFIC SUBJECT: Pedestrian Crossing Accommodations at Unsignalized Approaches	DATE: August 12, 2022
	SUNSET DATE: None
APPROVAL: /original signed by/ Raymond J. Khoury, P.E. State Traffic Engineer Richmond, VA Approved August 12, 2022	

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BACKGROUND AND PURPOSE

VDOT summarizes pedestrian crash trends for a five-year period in the Pedestrian Crash Assessment, describing the predominance of fatalities and serious injuries at midblock and unsignalized crossing locations. Based on the 2014-2018 Pedestrian Crash Assessment, two-thirds (2/3) of fatal and injury pedestrian crashes occurred at unsignalized intersections or midblock locations, and 87 percent of fatalities and 78 percent of injury crashes occurred at locations where no marked crosswalk was available. VDOT completed its first Pedestrian Safety Action Plan (PSAP) in 2018, calling for improved guidance for pedestrian crossings at unsignalized locations. The PSAP reported countermeasures and mapped locations (<http://bit.ly/VDOTPSAP>) are identified as priorities for improving pedestrian safety.

This Memorandum provides consistent, uniform guidance to designers for determining when to install marked crosswalks, what type of crosswalk to install, and what other traffic control devices or geometric improvements should potentially be considered in conjunction with the marked crosswalk at unsignalized intersection approaches and unsignalized mid-block locations. Unsignalized intersections can include stop sign controlled, yield sign controlled, and uncontrolled approaches. Pedestrian accommodations include marked crosswalks as well as any facility, design feature, operational change, or maintenance activity that improves the environment in which pedestrians travel. Marked crosswalks, by themselves or in conjunction with other traffic control devices and other pedestrian accommodations, such as curb

1 ramps or landings, can provide important safety benefits for crossing pedestrians. However, studies¹
2 have demonstrated that marked crosswalks placed alone at unsignalized approaches across multi-lane
3 roadways with high vehicular AADTs are not sufficient without additional geometric pedestrian safety
4 improvements or other traffic control devices. High visibility crosswalks are more visible and provide a
5 longer perception distance allowing drivers to react.
6

7 This Memorandum updates IIM-TE 384.0 “Pedestrian Crossing Accommodations at Unsignalized
8 Locations” issued in 2016. This updated Memorandum includes substantial changes to IIM-TE-384.0.
9 Major revisions include provisions for marked crosswalks and corresponding countermeasures for multi-
10 lane roadways with posted speed limits at or over 45 miles per hour; new criteria for establishing the
11 need for a marked crosswalk; and updated guidance on the installation of high-visibility crosswalk
12 markings. This updated Memorandum provides additional guidance beyond what is in the [2009 Manual](#)
13 [on Uniform Traffic Control Devices](#) (MUTCD) and the [2011 Virginia Supplement to the MUTCD](#), latest
14 version. This document focuses on pedestrian crossing guidance for unsignalized intersection crossings
15 and mid-block crossings and should be used in conjunction with a separate IIM established for pedestrian
16 accommodations at signalized intersections.
17

18 **APPLICABLE PROJECTS and EFFECTIVE DATE**

19
20 **This IIM applies to all VDOT-maintained roads, and to crosswalks on locality-maintained roads**
21 **that are being constructed with state or federal funds.** This IIM does not apply to activities on locally
22 maintained streets that are not funded with state or federal funds, however localities must still construct
23 all crosswalk improvements in accordance with the MUTCD. Applicable projects include:

- 24 • New roadway construction projects (VDOT-administered or VDOT-funded)
- 25 • Roadway widening or improvement projects (VDOT-administered or VDOT-funded)
- 26 • Land development or locality-led projects requiring a VDOT land use permit
- 27 • Revenue-sharing projects on VDOT system

28
29 Application of this IIM is not required for other projects, such as maintenance and alteration activities.
30 However, if decisions regarding unsignalized pedestrian crossings are made as part of other VDOT
31 activities, then those decisions shall be made in accordance with this Memorandum. Table 1 summarizes
32 the effective dates for application of this updated IIM-TE-384.1.
33
34

¹ Zegeer, Charles V., et. al. *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations* (FHWA: 2009),
<http://www.fhwa.dot.gov/publications/research/safety/04100/>

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Table 1: Project Applicability & Effective Dates

Project Type	Applicability & Effective Date
Land Use Permit Projects	This updated IIM shall be in effect for all projects where the first draft of the study that recommends proposed crossing treatment(s) has not yet been submitted to VDOT as of the date of issuance for this IIM.
VDOT Construction Projects	Design-Bid-Build: This updated IIM shall be in effect for all projects for which the Public Hearing plans have not yet been finalized as of the issuance date of this updated IIM. Design-Build or PPTA: This updated IIM shall be effective for all projects for which the RFQ has not yet been published as of the issuance date of this updated IIM.
All Projects	For any of the above-referenced projects that are in development beyond the stages noted as of this updated IIM issuance date, this updated IIM may be applied if desired by the permittee (for Land Use Permit projects) or VDOT project manager (for Construction Projects). Documentation shall be provided to support any change in recommendation based on the revised criteria in this updated IIM.

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Public requests for crosswalks or other improvements are to be addressed as part of VDOT projects or activities, or as District funding resources allow for consideration and implementation. The focus of this Memorandum is crosswalk improvements. Please refer to the [VDOT Road Design Manual](#), Appendix A(1) and other IIMs and VDOT policies to determine if additional improvements related to the crosswalk are required. For additional information on application of this Memorandum, see VDOT's [IIM 384.1 Crosswalk Determination Form](#).

This Memorandum may be used, but is not required to be used, to proactively evaluate corridors or locations for potential crosswalk installation prior to the initiation of applicable project activities subject to this Memorandum. This Memorandum may be a resource for studies that include pedestrian crossing assessments in the study scope and when the proposed treatments are subsequently advancing to Project Implementation stages (reference Table 32 in this [VDOT Publication Traffic Operations and Safety Analysis Manual](#) for definitions and other information).

PROCESS FLOW CHART FOR DETERMINING APPROPRIATE PEDESTRIAN CROSSING ACCOMMODATIONS AT UNSIGNALIZED APPROACHES

The following flow chart illustrates a four-step process for determining if a marked crosswalk should be provided, whether other countermeasures are needed, and what type of marking pattern is used. Additional requirements for each step are explained in more detail in the following sections of this Memorandum. Crosswalk and countermeasure design should follow the most recent information found in the American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design of Highways and Streets, hereafter referred to as the "Green Book", and the [VDOT Road Design Manual](#).

PROCESS FLOW CHART FOR DETERMINING APPROPRIATE PEDESTRIAN CROSSING ACCOMMODATIONS AT UNSIGNALIZED APPROACHES

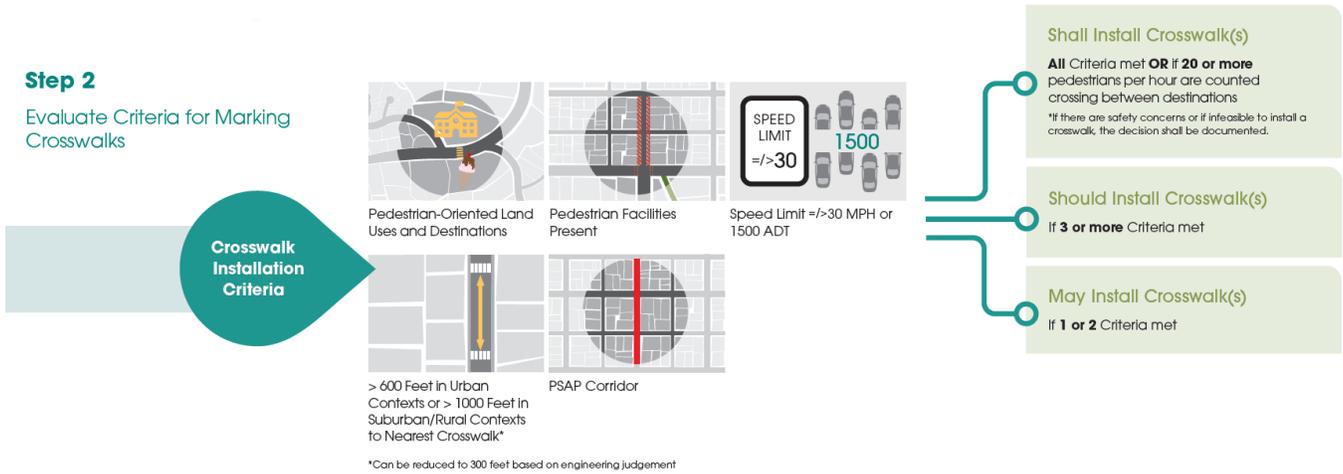
Step 1

Screen for Minimum Requirements



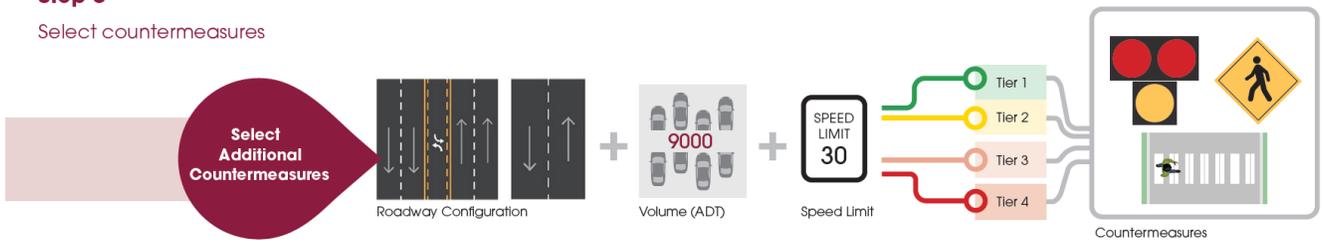
Step 2

Evaluate Criteria for Marking Crosswalks



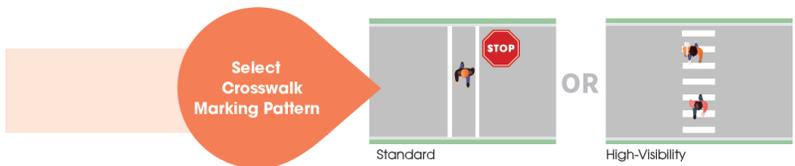
Step 3

Select countermeasures



Step 4

Select marking pattern for crosswalks



INSTALLATION OF MARKED CROSSWALKS AT UNSIGNALIZED APPROACHES

1 **All unsignalized crossings at intersections and midblock locations within the bounds of**
2 **applicable projects and activities are subject to this IIM.** In general, sections of roadway outside of
3 or between intersections are described as midblock locations. Crosswalks, whether marked or unmarked,
4 at intersections without a traffic control signal are unsignalized crossings subject to this IIM. Intersections
5 are defined in the [VDOT Road Design Manual](#) as the general area where two or more highways join or
6 cross, and midblock locations are between intersections. Driveways are not considered intersections but
7 may provide access to pedestrian-oriented land uses, and this IIM may be applied to those conditions.

8
9 Engineering judgement should be used to identify the potential candidate locations for individual
10 crossings within the bounds of applicable projects and activities. The determination of these candidate
11 locations should be based on pedestrian desire lines, field observations, and local input, in addition to
12 the guidance in this Memorandum.

13
14 Crosswalks shall only be installed where a safety screening has been performed per Step 1, below. As
15 such, all evaluations for a marked crosswalk shall first consider safety conditions of the candidate site.
16 Locations that don't meet all of the safety screening requirements shall not be evaluated further for
17 marked crosswalk installation. If a candidate location meets all of the safety screening requirements, it
18 can then be further evaluated for the potential installation of a marked crosswalk per criteria described
19 below in Steps 2 to 4 (See Process Flow Chart for Determining Appropriate Pedestrian Crossing
20 Accommodations at Unsignalized Approaches on page 4).

21
22 An engineering study shall be performed under the following circumstances:

- 23 • At all midblock locations
- 24 • Where a PHB or RRFB is being considered for the crosswalk
- 25 • Where all of the safety screening (Step 1) requirements and all five of the crosswalk installation
26 criteria (Step 2) are met at a location, but installing a crosswalk is considered infeasible.

27
28 An engineering study shall address each of the requirements and criteria within this Memorandum, to
29 support the proposed recommendations. An engineering study may include traffic and pedestrian
30 operations or in-depth crash analyses, depending on the potential implications of new traffic control
31 devices or countermeasures. Engineering studies may also consider additional options, including or in
32 addition to the countermeasures included in this IIM, that improve safety at crossings or restrict pedestrian
33 crossing activity where crossing countermeasures are infeasible. The District Traffic Engineer or their
34 designee is responsible for determining what conditions will be considered as part of the engineering
35 study or evaluation. If the crossing locations pertain to a land use permit, the permit reviewer (Land Use
36 Engineer) may conduct initial evaluations for the study location(s) prior to the DTE or designee's approval.
37 Data collection templates may be used to facilitate crosswalk engineering studies, such as the [IIM 384.1](#)
38 [Crosswalk Determination Form](#).

40 Step 1: Screen for Minimum Requirements

41
42 Locations shall be screened, and all requirements met before any crosswalk can be installed at a
43 candidate location. If any safety screening requirements are not met, a crosswalk shall not be installed,
44 and no additional evaluation of the candidate location is necessary. When the safety screening is applied
45 to a potential crosswalk location, adjacent sections of the corridor should also be reviewed to ensure that
46 the best location for the potential crosswalk(s) is selected.

47
48 Marked crosswalks **may** be considered for installation at locations where **all** of the following safety
49 screening requirements are true:

- The center of the area considered for a proposed crosswalk is at least 300 feet from the center of the closest marked crosswalk or signalized intersection stop bar. The closest marked crosswalk includes existing marked crosswalks, other marked crosswalks recommended for installation by this Memorandum, and the stop bar location at a signalized intersection (potential future signalized crosswalk location).
- Drivers have an unrestricted view* of the entire proposed crosswalk and entry points to the crosswalk, based on Stopping Sight Distance requirements. Sight distance calculations should follow the most recent information found in the AASHTO Policy on Geometric Design of Highways and Streets and [VDOT Road Design Manual](#). Pedestrians at the location of the proposed crosswalk should also have an unrestricted view of approaching vehicles, based on operating vehicle speed, traffic volumes and engineering judgement.
- If, based on the roadway configuration, operating speed, and traffic volume, the location falls into Tier 3 or Tier 4 (see Tables 3 and 4 of this IIM), other pedestrian safety countermeasures must already exist or must be provided at the time of the crosswalk installation. Implementation resources (i.e. capital project, SMART SCALE, HSIP) must be identified for additional countermeasures prior to installing crosswalks for Tier 3 or 4 locations.

*Unrestricted view should be equal to or exceeding the Stopping Sight Distance (SSD) requirements shown in **Table 2** and as per the latest effective version of [VDOT's Road Design Manual](#). If the sight distance requirements cannot be met and the crosswalk cannot be located at a place where sight distance requirements will be met, the crosswalk should not be installed except in conjunction with mitigation measures such as removing objects that obstruct sight distance, reduction of operating speed, or installation of PHB or RRFB. Special consideration should be made for locations where high pedestrian crossing is expected, such as at trail crossings and in urban contexts.

Table 2: Stopping Sight Distance Requirements Approaching Mid-Block Crosswalks or Crosswalks at Unsignalized Intersection Approaches (feet)

Operating Speed	Level Grade	Downgrades			Upgrades		
		-3%	-6%	-9%	+3%	+6%	+9%
25 mph	155	158	165	173	147	143	140
30 mph	200	205	215	227	200	184	179
35 mph	250	257	271	287	237	229	222
40 mph	305	315	333	354	289	278	269
45 mph	360	378	400	427	344	331	320
50 mph	425	446	474	507	405	388	375
55 mph	495	520	553	593	469	450	433
> 55 mph	<i>Crosswalks should not be marked across uncontrolled approaches with operating speeds greater than 55mph.</i>						

Source: This table is provided for convenience and is current as of November 2019, for the purposes of reviewing existing roadway conditions and crosswalks. For new construction, refer to Appendix A1 in the [VDOT Road Design Manual](#) to identify the correct values for stopping sight distance. Operating speed can refer to actual 85th percentile speed if speed data is available. Otherwise, operating speed can be estimated as the posted speed limit plus 7 mph or based on documented engineering judgment. For operating speeds not in 5 mph increments, users should interpolate from this table to find the minimum SSD requirements.

Step 2. Evaluate Criteria for Marking Crosswalks

Crosswalk installation criteria are used to determine whether or not a crosswalk is installed, after meeting the safety screening requirements in Step 1 (See Process Flow Chart for Determining Appropriate Pedestrian Crossing Accommodations at Unsignalized Approaches on page 4). The number of crosswalk installation criteria met after evaluation determines the requirements for installation of the crosswalk, as described below:

1 **Crosswalks shall be installed** when all crosswalk installation criteria are met or the location has 20
2 pedestrians or more per hour counted crossing between pedestrian-oriented land uses. Pedestrian
3 counts are not required, but if collected, pedestrian counts should cover a section of corridor 200 to 300
4 feet in either direction from the location being reviewed for a new crosswalk. If there are safety concerns
5 or other reasons why the crosswalk is not feasible, these shall be documented in an engineering study,
6 and a crosswalk is not required.

7
8 **Crosswalks should be installed** where three or more of the crosswalk installation criteria are met.

9
10 **Crosswalks may be installed** where one or two crosswalk installation criteria are met.

11 **Crosswalk Installation Criteria**

12 There are five crosswalk installation criteria, for which more detail is provided in the sections that follow:

- 13 A. Candidate location is located between two pedestrian-oriented land uses or destinations.
- 14 B. Candidate location connects to at least one pedestrian facility or pedestrian access route.
- 15 C. Candidate location is on a road with a posted speed limit equal to or greater than 30 mph OR
16 on a road with more than 1,500 vehicles per day.
- 17 D. Candidate location is more than 600 feet in urban contexts, or more than 1,000 feet in suburban
18 or rural contexts, to the nearest crosswalk.
- 19 E. Candidate location is on an identified Pedestrian Safety Action Plan (PSAP) priority corridor or
20 within the functional area of an intersection within a PSAP crash cluster. (Refer to most current
21 [VDOT PSAP location map](#))

22
23 In all cases, the [IIM 384.1 Crosswalk Determination Form](#) may be used to record determinations for these
24 criteria. Additional documentation may be required where these criteria recommend marking a
25 crosswalk(s) but an engineering study supports a decision to not mark a crosswalk(s) based on unsafe
26 conditions or feasibility challenges.

27
28 Context is a key consideration for determining whether a location meets these criteria. Since the 7th
29 edition of Green Book, a new approach for considering both functional and context classifications for
30 designing roadways is included. The following describes each context classification (See section 1.5 for
31 more information):

- 32 • Rural: Areas with lowest density, few houses or structures (widely dispersed or no residential,
33 commercial, and industrial uses), and usually large setbacks.
- 34 • Rural Town: Areas with low density but diverse land uses with commercial main street character,
35 potential for on-street parking and sidewalks, and small setbacks.
- 36 • Suburban: Areas with low to medium density, mixed land uses within and among structures
37 (including mixed-use town centers, commercial corridors, and residential areas), and varied
38 setbacks.
- 39 • Urban: Areas with high density, mixed land uses and prominent destinations, potential for some
40 on-street parking and sidewalks, and mixed setbacks.
- 41 • Urban Core: Areas with highest density, mixed land uses within and among predominately high-
42 rise structures, and small setbacks.

43 *Criterion A: Pedestrian-Oriented Land Uses and Destinations*

44
45 Pedestrian-oriented land uses and destinations, including transit stops, will generate pedestrian
46 crossings regardless of whether a marked crosswalk exists or not. When pedestrian-oriented land uses
47 exist adjacent to roadways where pedestrians are not prohibited, it is VDOT's policy to provide adequate
48 pedestrian crossing opportunities and to direct pedestrians to those locations.

1 Pedestrian-oriented land uses and destinations include, but are not limited to, sidewalks, shared use
2 paths, and trails; transit stops and rail stations; medium to high density residential; schools and university
3 campuses; parks and recreation centers; hospitals and health centers; libraries and senior centers;
4 shopping centers, convenience stores, and restaurants; hotels and tourist destinations; and parking
5 garages and convention centers; and other pedestrian origins or destinations. For the purposes of this
6 Memorandum, medium density residential development is approximately a minimum of 2 units per acre
7 (gross number of housing units per acre).
8

9 These pedestrian-oriented land uses can be major generators for pedestrian trips where development
10 density is high or where land uses are diverse. Pedestrians should be expected to cross roads where
11 complimentary destinations (such as a hotel and restaurant) are sited on opposite sides of the roadway.
12

13 Pedestrians are more likely to walk along and cross the roadway where pedestrian-oriented land uses or
14 destinations are visible and within close proximity. A ¼ mile distance between destinations is a frequently
15 cited “walkable” distance and may indicate a higher pedestrian travel demand and need for marked
16 crosswalks. However, pedestrian travel routes and travel may extend to land uses or destinations far
17 beyond properties adjacent to the roadway. To the extent possible, marked crosswalks should match
18 pedestrian desire lines by connecting pedestrian-oriented land uses using the shortest route that is
19 practical. Additionally, District Land Use should request developers to consider strategic placement of
20 developments and building entrances in locations to match pedestrian desire lines.
21

22 Installing marked crosswalks in areas where there is minimal likelihood of existing or future pedestrian
23 activity (based on adjacent land uses) is not recommended. If pedestrian-oriented land uses do not
24 currently exist on both sides of the roadway, the designer should consult with the District Planner, Land
25 Use Engineer, and/or the locality to assess whether there is a potential for a pedestrian-oriented land
26 use(s) in the near future. If the designer determines that future pedestrian-oriented land uses are planned,
27 traffic control devices should be placed where they will not conflict with a future marked crosswalk.
28

29 *Criterion B: Pedestrian Facility or Access Route*

30
31 It is preferred that pedestrian facilities (such as sidewalks or shared use paths) or other pedestrian access
32 routes parallel to the roadway be available on either end of a proposed crossing and along both sides of
33 the roadway. However, pedestrian facilities or access routes on both sides of the roadway are not
34 required to implement a crosswalk project. To satisfy this criterion, the crossing location should connect
35 between at least one pedestrian facility or access route(s) and a pedestrian-oriented land use or transit
36 service opposite the pedestrian access route.
37

38 Crosswalks may be considered in the absence of a pedestrian facility or access route on either side of
39 the road in certain situations. The following conditions are examples of locations that may require a
40 crosswalk, but don't include pedestrian facilities or access routes on both sides of the roadway. These
41 locations should also be considered and prioritized for future sidewalk installation:

- 42 • A worn path or traversable shoulder is on one side of the roadway across from a pedestrian-
43 oriented land use or transit stop(s).
- 44 • The side street approach(s) to the roadway connects to pedestrian-oriented land uses.
- 45 • The crossing is located at an accessible trail or shared use path crossing.
46

47 In accordance with the [VDOT Road Design Manual, Appendix A\(1\)](#), detectable warnings, and curb ramps
48 or level landing areas, are required to communicate where the pedestrian is entering the roadway at a
49 marked crosswalk.
50

51 If pedestrian facilities do not currently exist on both sides of the crossing, the designer should consult
52 with the District Planner and/or locality to review plans for future pedestrian facilities. The District Traffic

1 Engineer should make final determination about the location of the crosswalk(s), consistent with planned
2 facilities on both approaches to the crosswalk.

3
4 *Criterion C: Speeds and Traffic Volumes*

5
6 Roads with a posted speed limit equal to or greater than 30 mph or where volumes exceed 1,500 vehicles
7 per day (AADT) pose more risk for severe injury pedestrian crashes. Marked crosswalks may be
8 considered for streets with lower posted limits, lower volume collector streets, or in non-residential areas
9 where pedestrians are expected or observed to cross frequently.

10
11 *Criterion D: Crosswalk Proximity*

12
13 Crosswalks should be placed in locations where drivers have opportunity to react and yield to a
14 pedestrian in the crosswalk, and in locations where pedestrians can be expected to cross. Pedestrians
15 are more likely to cross at a marked crosswalk that reduces time and increases their visibility when
16 travelling between destinations. Similarly, longer walking distances to marked crossings increase the
17 risks that pedestrians are willing to take to cross the roadway. Given the [MUTCD standard measure of](#)
18 [pedestrian walking speed of 3.5 ft/s](#), an additional 200 feet will add approximately one minute to a
19 pedestrian's travel time.

20
21 Per the Safety Screening Requirements in Step 1, candidate locations for crosswalks shall be more than
22 300 feet from the nearest crosswalk. Nearest crosswalk includes marked crosswalks at intersections and
23 midblock locations. This requirement does not limit the ability to mark a crosswalk on multiple legs of an
24 intersection. The distance between the candidate crossing location and the nearest intersection or
25 crosswalk should be no greater than 1000 feet. In urban contexts, the distance between the candidate
26 crossing and nearest crosswalks should be no greater than 600 feet, depending on block length. In
27 suburban or rural contexts, the distance between crosswalks will vary based on distance between
28 pedestrian-oriented land uses.

29
30 Crosswalk spacing should be determined where engineering judgement determines that the crossing(s)
31 are needed, based on destinations and context. Treatments that redirect pedestrian crossings (such as
32 landscaping or fences) may be considered where appropriate. The treatments shall be applied in
33 accordance with the [VDOT Road Design Manual](#).

34
35 *Criterion E: Pedestrian Safety Action Plan (PSAP) Corridors and Crash Clusters*

36
37 VDOT developed its first [PSAP](#) in 2018 to identify areas with significant pedestrian crash history and
38 corridors that bear characteristics of risk for pedestrian crashes (as determined by VDOT). Refer to the
39 most recently published version of the [PSAP](#) to identify crash clusters and priority corridors. Crossing
40 locations within crash clusters (within the functional area of intersections identified in a crash cluster) or
41 along priority corridors are key considerations for marking new crosswalks. The version of the PSAP that
42 is most recent at the time of initial draft study/design submittal may continue to be used for subsequent
43 submittals.

44
45 **Step 3. Select Additional Countermeasures**

46
47 Marked crosswalks across unsignalized approaches should be further evaluated for additional crossing
48 treatments or visibility enhancements at the crosswalk. The roadway configuration, posted speed limit,
49 and traffic volumes are important considerations when evaluating these treatments. Review those
50 conditions for the time when the crosswalk will be installed.

1 Engineering judgment is required to determine the number of approaches to an intersection that will be
2 marked with a crosswalk. Table 3 includes a matrix identifying a recommended countermeasure per
3 Tier for crosswalks at unsignalized approaches across undivided roadways (roads without a raised
4 median) or single lane, one-way streets. Minimum requirements and recommended additional
5 treatments are referenced per Tier below the matrix in Table 3. Table 4 includes a matrix identifying a
6 recommended countermeasure per Tier for crosswalks at unsignalized approaches across roadways
7 divided by a median or that are multi-lane, one-way streets. Minimum requirements and recommended
8 additional treatments are referenced per Tier below the matrix in Table 4.

9
10 Tables 3 and 4 are informed by national guidance including [Safety Effects of Marked Versus Unmarked](#)
11 [Crosswalks at Uncontrolled Locations \(FHWA: 2009\)](#) and the [Guide for Improving Pedestrian Safety at](#)
12 [Uncontrolled Crossing Locations \(FHWA: 2018\)](#). On controlled approaches, the parallel facility speed
13 and volume should also be a factor, especially the speed and volume of right and left-turning vehicles
14 from the primary street.

15
16 Tables 3 and 4 identify required, recommended and optional countermeasures according to four (4) tier
17 categories. Tier 1 includes countermeasures designed for roadways where drivers are more likely to
18 yield to pedestrians in the crosswalk and crash risk is lowest. The tiers increase as countermeasures
19 respond to conditions where the risk of pedestrian crashes or fatalities are highest, with Tier 4 including
20 roadway configurations and conditions that may lead to increased crash risk. The countermeasures
21 listed for each tier are listed in increasing order of effectiveness to reduce crash risk. The high-visibility
22 crosswalk is recommended or required for most types of unsignalized crossings (per this IIM). Some
23 countermeasures are installed in tandem with complimentary treatments or other countermeasures. For
24 example, the in-street sign (R1-6) should be installed with refuge islands and raised crosswalks.
25 Conversely, some treatments will be standalone, such as the PHB. Countermeasures recommended
26 for the next highest Tier may be considered, per the findings of an engineering study.

27
28 By selecting Roadway Reconfiguration (Tiers 3 or 4), the decision-maker should consider the tier
29 associated with the proposed roadway configuration (after a Roadway Reconfiguration would be
30 implemented). For example, if the current configuration is a four-lane, undivided roadway, and the
31 Roadway Reconfiguration is proposed as a three-lane (including a center turn lane); the proposed
32 roadway configuration should be reviewed for recommended countermeasures, such as the refuge
33 island.

34
35 Crossings located at Tier 3 or 4 locations require an engineering study to make final determination of
36 countermeasures to be installed with the marked crosswalk. ADTs referenced in Tables 3 and 4 are
37 based on the total volumes for all travel lanes associated with a combined roadway segment, as
38 determined by VDOT. ADTs may be recorded separately for each direction of travel for a divided
39 roadway. The designer should confirm the assignment of ADTs for divided roadways and combine
40 ADTs for each direction of travel, as necessary. Tables 3 and 4 include reference to recommended
41 countermeasures per Tier, and optional countermeasures that may be considered where the
42 recommended is not appropriate to the context or site. The following notes explain each
43 countermeasure and additional considerations for engineering review:

44
45 ADV: Advance yield markings and R1-5 signs (ADV). Advance yield markings and signs shall be used
46 as per the MUTCD (3B.16).

47
48 PHB: Pedestrian Hybrid Beacon, should be installed with Refuge Island on 4- or 6- lane divided roads
49 or 5-lane roads.

- 1 RD: Roadway Reconfiguration to 3-Lane or 2-lane divided roads, should be installed with Refuge
2 Island on Tier 3 or 4 roads. Refer to [FHWA and VDOT guidance for Roadway Reconfigurations \(Road](#)
3 [Diets\)](#) for additional considerations.
4
- 5 RI: Refuge Island should be installed with In Street Signs on 2-lane divided roads.
6
- 7 RRFB: Rectangular Rapid Flashing Beacon, should be installed with Refuge Island, where applied to
8 Tier 3 or 4 roads.
9
- 10 TC: Traffic Calming Measures, including raised crosswalks for roads with posted speed limit lower than
11 35 mph. Refer to [VDOT Traffic Calming Guide for Neighborhood Streets for more information and](#)
12 [specifications](#). Traffic calming measures and speed management techniques should be considered for
13 all locations, appropriate to the roadway type and development context. Speed management
14 techniques may be deployed along a corridor or at specific locations, using strategies such as
15 explained by [VDOT Bicycle and Pedestrian Treatments](#) resource information.
16
- 17 VE: Visibility Enhancements, including but not limited to In-street signs, parking restriction, or curb
18 extension. Parking restriction applies to roads with on street parking, and shall be used in compliance
19 with the MUTCD (2B and 3B). Curb extension may be used where on street parking or wide travel
20 lanes provide space.
21

Table 3: Recommendations for Considering Marked Crosswalks and Other Needed Pedestrian Improvements Across Unsignalized Approaches (Undivided/Single-Lane Roads)

Table 3 includes reference to the minimum and recommended countermeasures per Tier, and optional countermeasures that may be considered where the recommended is not appropriate to the context or site. Crossings located at Tier 3 or 4 locations require an engineering study to make final determination of countermeasures to be installed with the marked crosswalk.

Roadway Configuration (# is total N of lanes)		Roadway ADT and Speed Limit											
		1,500 to 9,000 VPD			9,000 to 12,000 VPD			12,000 to 15,000 VPD			More than 15,000 VPD		
		≤ 30 MPH	35 MPH	≥ 40 MPH	≤ 30 MPH	35 MPH	≥ 40 MPH	≤ 30 MPH	35 MPH	≥ 40 MPH	≤ 30 MPH	35 MPH	≥ 40 MPH*
Single lane, one-way street		VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC	VE/TC
2 Lanes (undivided two-way street)		VE/TC	VE/TC	VE/RRFB	VE/TC	VE/TC	VE/RRFB	VE/TC	VE/RRFB	VE/RRFB	VE/RRFB	VE/RRFB	PHB
3 Lanes (center turn lane)		VE/TC	VE/RI	RI/RRFB	VE/RI	RI/RRFB	RI/RRFB	RI/RRFB	RI/RRFB	PHB/RD	RI/RRFB	PHB/RD	PHB/RD
4 Lanes (two-way street without median)		RD/RRFB	RD/RRFB	PHB/RD	RD/RRFB	RD/RRFB	PHB/RD	RD/RRFB	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD
5 Lanes (center turn lane)		RD/RRFB	PHB/RD	PHB/RD	RD/RRFB	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD
6 Lanes+ (two-way street without median)*		PHB/RD	PHB/RD	PHB/RD	RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD	PHB/RD

*all 15,000 vpd lane roadways with speeds 45 and 55 mph = Tier 4

- Tier 1** High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and consideration of the following:
 - Recommended: Visibility Enhancements (VE)**
 - Optional, if Recommended is not appropriate: Traffic Calming Measures (TC)
- Tier 2** High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and consideration of the following:
 - Recommended: Refuge Island (RI), and/or**
 - Recommended: Rectangular Rapid Flashing Beacon (RRFB)**
 - Optional, if Recommended is not appropriate: Visibility Enhancements (VE)
 - Optional, if Recommended is not appropriate: Advance yield markings and R1-5 signs (ADV)
- Tier 3** High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and inclusion of one or more of the following:
 - Recommended: Roadway Reconfiguration (RD), and/or**
 - Recommended: Pedestrian Hybrid Beacon (PHB)**
 - Optional, if Recommended is not appropriate: Advance yield markings and R1-5 signs (ADV)
 - Optional, if Recommended is not appropriate: Rectangular Rapid Flashing Beacon (RRFB)
- Tier 4** High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and inclusion of one or more of the following:
 - Recommended: Pedestrian Hybrid Beacon (PHB), and/or**
 - Recommended: Roadway Reconfiguration (RD)**
 - Optional, if Recommended is not appropriate: Review for Signal

Table 4: Recommendations for Considering Marked Crosswalks and Other Needed Pedestrian Improvements Across Unsignalized Approaches (Divided or One-Way Roads)

Table 4 includes reference to minimum and recommended countermeasures per Tier, and optional countermeasures that may be considered where the recommended is not appropriate to the context or site. Crossings located at Tier 3 or 4 locations require an engineering study to make final determination of countermeasures to be installed with the marked crosswalk.

Roadway Configuration (# is total N of lanes)		Roadway ADT and Speed Limit											
		1,500 to 9,000 VPD			9,000 to 12,000 VPD			12,000 to 15,000 VPD			More than 15,000 VPD		
		≤ 30 MPH	35 MPH	≥ 40 MPH	≤ 30 MPH	35 MPH	≥ 40 MPH	≤ 30 MPH	35 MPH	≥ 40 MPH	≤ 30 MPH	35 MPH	≥ 40 MPH*
2 Lanes with raised median		VE/TC	VE/RI	RRFB/RI	VE/TC	VE/RI	RRFB/RI	VE/RI	RRFB/RI	RRFB/RI	RRFB/RI	RRFB/RI	PHB
2 Lanes One-Way		VE/ADV	ADV/RRFB	RD/RRFB	VE/ADV	RD/RRFB	RD/PHB	ADV/RRFB	RD/RRFB	RD/PHB	RD/RRFB	RD/RRFB	RD/PHB
4 Lanes (two-way street with median)		RD/RRFB	RD/RRFB	RD/PHB	RD/RRFB	RD/RRFB	RD/PHB	RD/RRFB	RD/RRFB	RD/PHB	RD/RRFB	RD/PHB	RD/PHB
3 Lanes One-Way		RD/RRFB	RD/RRFB	RD/PHB	RD/RRFB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB
6+ Lanes (two-way street with median)		RD/RRFB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB	RD/PHB

Tier 1

High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and consideration of the following:

Recommended: Visibility Enhancements (VE)

Optional, if Recommended is not appropriate: Refuge Island (RI)

Optional, if Recommended is not appropriate: Traffic Calming Measures (TC)

Optional, if Recommended is not appropriate: Advance yield markings and R1-5 signs (ADV)

Tier 2

High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and consideration of the following:

Recommended: Rectangular Rapid Flashing Beacon (RRFB)

Optional, if Recommended is not appropriate: Refuge Island (RI)

Optional, if Recommended is not appropriate: Advance yield markings and R1-5 signs (ADV)

Tier 3

High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and inclusion of one or more of the following:

Recommended: Roadway Reconfiguration (RD), and/or

Recommended: Pedestrian Hybrid Beacon (PHB)

Optional, if Recommended is not appropriate: Advance yield markings and R1-5 signs (ADV) not to be considered for 5 or 6 lane roads.

Optional, if Recommended is not appropriate: Rectangular Rapid Flashing Beacon (RRFB) with Refuge Island on 4 lane divided roads.

Tier 4

High Visibility Crosswalk with W11-2, S1-1 (School), or W11-15 (Trail) signage is required and inclusion of one or more of the following:

Recommended: Pedestrian Hybrid Beacon (PHB), and/or

Recommended: Roadway Reconfiguration (RD)

Optional, if Recommended is not appropriate: Review for Signal

1 Step 4. Select Crosswalk Marking Pattern

2
3 Marked crosswalk patterns can be divided into two general categories: standard, transverse lines (two
4 parallel lines) and high visibility crosswalks (HVCs). Standard, transverse lines crosswalks use the two
5 parallel lines pattern. High-visibility crosswalks have bar-pairs or longitudinal lines. Permissible crosswalk
6 marking patterns that may be used on VDOT-maintained roadways are shown Table 5.

7
8 According to [an FHWA study](#)², high-visibility crosswalks can have up to double the detection distance
9 (for drivers approaching the crosswalk) compared to transverse or basic crosswalks - an 8 second
10 increase in detection distance for a 30 mph approach. However, some high-visibility crosswalk marking
11 materials can also become slick when wet, potentially resulting in a loss of traction for vehicles
12 (particularly motorcyclists and bicyclists) in the travel lanes as well as for pedestrians crossing the
13 crosswalk. High-visibility crosswalks can lose some of their enhanced effectiveness if they become worn
14 by vehicle traffic. Consider long term maintenance when selecting crosswalk marking patterns.

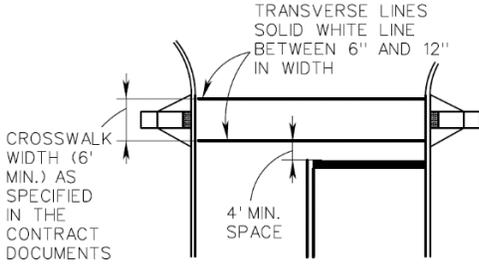
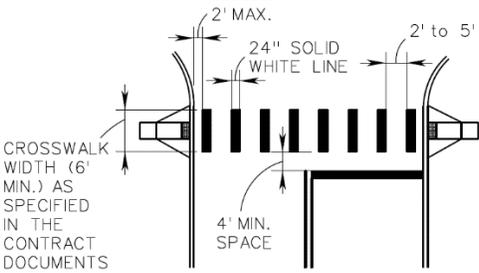
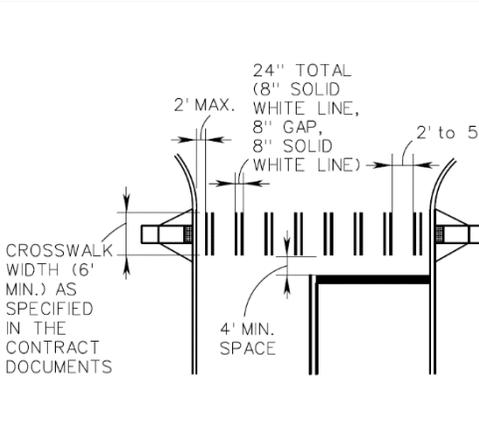
15
16 A high-visibility crosswalk pattern **shall be** installed at all unsignalized crossings, with the exception of
17 STOP controlled approaches. Standard, transverse lines (two parallel lines) crosswalks should be
18 installed for STOP-controlled approaches, except where engineering judgment determines the need for
19 high-visibility crosswalks.

20
21 Crosswalk markings shall be the same width as the pedestrian facility on either side of the roadway or at
22 least six feet wide (per [MUTCD Section 3B.18 Crosswalk Markings](#)) Wider crosswalks than described
23 above should be provided at locations with heavy pedestrian volumes during peak periods, to avoid
24 creating situations where pedestrians are “crowded out” of the crosswalk.

25
26

² Fitzpatrick, K., et al. *Crosswalk Marking Field Visibility Study (FHWA: 2010)*,
<http://www.fhwa.dot.gov/publications/research/safety/pedbike/10067/10067.pdf>

1 **Table 5 –Permissible Crosswalk Types on VDOT-maintained Roadways**

Type	Class	Design details	Sketch
Transverse Lines (two parallel lines)	Standard	<ul style="list-style-type: none"> The transverse lines shall be between 6" and 12" in width. Typically, VDOT uses 6" width, however 8", 10", or 12" widths can be used to increase the visibility of the lines. 	
Longitudinal Lines ("continental")	High-Visibility	<ul style="list-style-type: none"> Longitudinal lines should be spaced to avoid the wheel paths of through vehicles. 	
Bar Pairs	High-Visibility	<ul style="list-style-type: none"> Identical to Longitudinal Lines crosswalk, but uses pairs of 8" lines with 8" gap (8/8/8 pattern) in lieu of a 24" longitudinal line. Spacing between the 8/8/8 bar pairs shall be the same as the requirements of PM-3 for spacing between Longitudinal Lines. The bar pairs should be spaced to avoid the wheel paths of through vehicles. 	

2 *Source: Standard Drawing PM-3, VDOT 2016 Road and Bridge Standards*

3
4
5 Other high-visibility marking patterns, such as "ladder" or "zebra" markings, shall not be used except
6 when necessary to match the pattern of other adjacent marked crosswalks. **The recommended marking
7 pattern for high visibility crosswalks is the bar pair.**

8
9 Bar Pairs crosswalks have several advantages over Longitudinal Lines crosswalks:

- 10
- 11 • [An FHWA study](#) of the Bar Pairs pattern concluded that it behaves comparably with the Longitudinal Lines pattern in terms of driver recognition and behavior,
 - 12 • Similar cost as Longitudinal Lines crosswalks (although installation is slightly more complicated, the Bar Pairs crosswalk uses less marking material),
 - 13 • Easier for motorcyclist/bicyclist traffic to avoid traveling over the pavement marking material, which may be slippery when wet,
 - 14 • Easier for pedestrians to avoid stepping directly on the pavement marking material, which may be slippery.

15
16
17
18
19 If an existing standard crosswalk is upgraded to a high-visibility crosswalk independent of a roadway
20 resurfacing project, the transverse lines may be retained to eliminate the need for pavement marking
21 eradication. The transverse lines should not be restored when the roadway is resurfaced.

1 **Aesthetic Treatments Between Crosswalk Lines**

2
3 Aesthetic treatments do not meet high visibility crosswalk marking requirements unless retro-reflective
4 materials are used with appropriate contrast. Aesthetic treatments are not eligible for HSIP or other
5 project funds administered by VDOT.

6
7 Localities may request the use of aesthetic treatments, such as stamped concrete, brick pavers, or
8 thermoplastic patterned inlays, between the crosswalk lines. Such requests will be evaluated as per the
9 latest edition of L&D Instructional & Informational Memorandum [IIM-LD-218](#). Such aesthetic treatments
10 by themselves do not constitute a marked crosswalk; they shall be edged by Standard, transverse (two
11 parallel lines) white lines to legally establish the marked crosswalk and also to provide visual contrast
12 between the pavement and the aesthetic treatment.

13
14 As per [Section 3G.01 of the 2009 MUTCD](#), aesthetic or colored pavement between crosswalk lines
15 should not use colors or patterns that degrade the contrast of the white transverse crosswalk lines or that
16 might be mistaken by road users as a traffic control application. In addition, as per [FHWA Official](#)
17 [Interpretation 3\(09\)-24\(I\)](#), aesthetic treatments must consist of muted earth-tone colors, and cannot have
18 random/unsystematic elements, pictographs, or multiple colors.

19
20 **Additional Considerations for Unsignalized Crosswalks**

21
22 Alternative intersections or interchange ramps, such as roundabouts and interchanges, have features
23 that require additional consideration for pedestrian crossings. High visibility marked crosswalks shall be
24 provided across all legs of a roundabout (both entrances and exits) where the location meets conditions
25 described in Step 1 and 2 of this Memorandum. Note that neighborhood traffic circles that do not meet
26 the design criteria for a modern roundabout (e.g. lack of splitter islands) are not required to include
27 marked crosswalks. For information about interchanges with multiple merging and diverging ramps, refer
28 to [NCHRP Research Report 948](#) and [VDOT Road Design Manual Appendix A\(3\)](#) for specific guidance.

References and Terms

KEY TERMS

crosswalk - the portion of roadway designated for pedestrians to use in crossing the street, including both marked and unmarked (implied) crosswalks

high-visibility crosswalk: a crosswalk marking pattern such as longitudinal lines (“continental”) or bar pairs

pedestrian access route – a continuous and unobstructed path of travel provided for pedestrians with disabilities within or coinciding with a pedestrian circulation path.

pedestrian crossing countermeasure(s) – safety treatments applied at crosswalks to increase driver yielding, pedestrian crossing compliance, or pedestrian visibility. Visual examples are available at [PEDSAFE \(Pedestrian Safety Guide and Countermeasure Selection System\)](#)

pedestrian facility – routes or access areas available for pedestrian travel outside the vehicle travelway between road crossings, including sidewalks, curb ramps, and wide shoulders.

standard crosswalk – a crosswalk marking pattern that consist of (2) parallel lines that are typically 6” in width, but can use 8”-12” widths

unsignalized approach – a part or leg of an intersection (of two roadways or a roadway and pedestrian facility) that is not controlled by a traffic signal

uncontrolled approach – a part of leg of an intersection (of two roadways or a roadway and pedestrian facility) that is not controlled by a regulatory sign (STOP or Yield) or traffic signal

uncontrolled crossing – a pedestrian crossing where the roadway approach is not controlled by a regulatory sign (STOP or Yield) or traffic signal

KEY REFERENCES

[2009 MUTCD with Revisions](#)

[2011 Virginia Supplement to the MUTCD With Revisions](#)

[VDOT Road Design Manual \(latest effective version\)](#)

[2016 VDOT Road and Bridge Standards](#)

[Instructional & Informational Memorandum IIM-LD-218, Latest Revision](#)

[FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations](#)

[FHWA Crosswalk Marking Field Visibility Study](#)

[VDOT PSAP](#)