

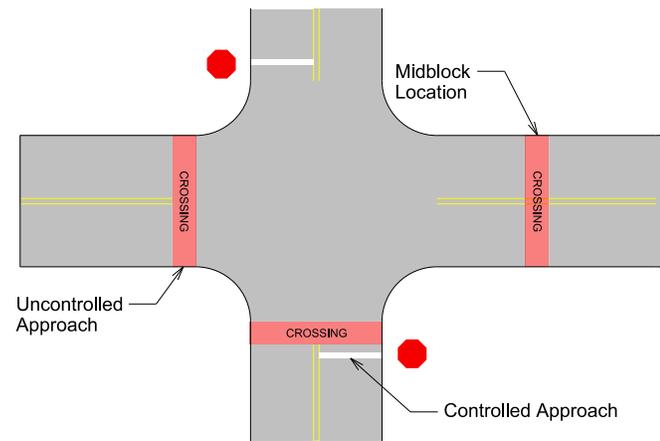
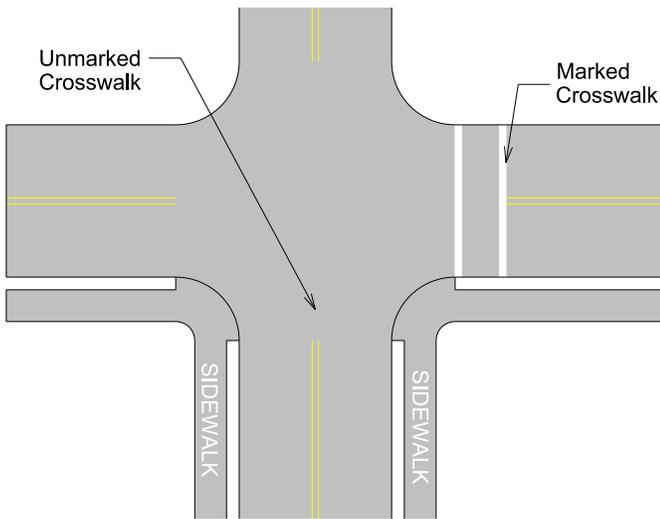


September 2014 

Crosswalks

Definitions and Overview 

Crosswalks are designated areas for pedestrians to cross roadways. A number of resources exist that provide basic guidance for the design of pedestrian crossings and are referenced throughout this bulletin. For guidance on a particular application, please contact the SDDCTEA Traffic Engineering Branch for assistance and visit the SDDCTEA website for additional information.



In general, there are two types of crosswalks—marked and unmarked. The 2009 *Manual on Uniform Traffic Control Devices (MUTCD)* includes definitions for each:

Unmarked Crosswalks: “That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line.”

Marked Crosswalks: “Any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might be supplemented by contrasting pavement texture, style, or color.”

Crosswalks typically occur at three different location types—controlled approaches, uncontrolled approaches, and midblock locations.

Crosswalk Location Types	
Controlled Approaches	Approaches to an intersection where vehicular traffic is controlled by traffic control signals, or STOP or YIELD signs
Uncontrolled Approaches	Approaches to an intersection where vehicular traffic is not controlled by any signals, signs, or markings (free flow approaches)
Midblock Locations	Locations other than at intersections where drivers are required to stop or yield to pedestrians, depending on State law (i.e., a crosswalk between two intersections).

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Placement of Marked Crosswalks ✓

Marked crosswalks are not suitable at all locations. An engineering study should be performed before a marked crosswalk is installed at either an *uncontrolled approach* or at a *midblock location*. Generally, the study should consider the following:

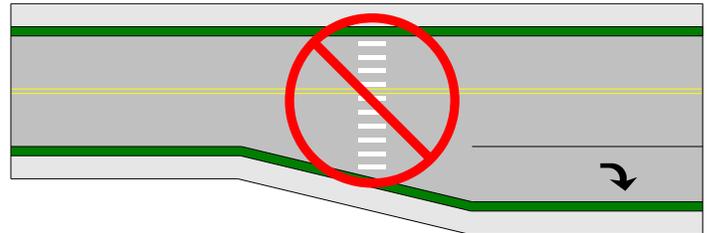
- Number of lanes
- Presence of a median
- Possible consolidation of multiple crossing points
- Posted or statutory speed limit or 85th percentile speed
- Average daily traffic (ADT)
- Distance from adjacent signalized intersections
- Pedestrian volumes and delays
- Geometry of the location
- Availability of street lighting

Per the National *MUTCD*, new marked crosswalks without other measures designed to reduce traffic speeds, shorten crossing distance, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence should not be installed across uncontrolled roadways where the speed limit exceeds 40 MPH and either:

- The roadway has four or more lanes of travel without a raised median or pedestrian refuge island and an ADT of 12,000 vehicles per day or greater; or
- The roadway has four or more lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater.

Midblock crossings are often installed in heavy pedestrian traffic areas or near major pedestrian destinations to provide more frequent crossing opportunities. Based on midblock standards provided in the proposed *DOD Supplement to the MUTCD* (as developed by SDDCTEA), a proposed crosswalk on an uncontrolled approach or at a midblock location shall satisfy the following criteria:

1. The crosswalk shall provide adequate sight distance to include vertical, horizontal, and intersection (sight distance triangle) stopping sight distance. The sight distance triangle may include the restriction of parking, vegetation, or other obstacles that would interfere with motorist and pedestrian visibility
2. The crosswalk shall not cross any part of an auxiliary lane transition. Two-way left-turn lanes are not considered auxiliary lanes.



Further guidance in the proposed DOD Supplement states that uncontrolled approaches or midblock locations being considered for a crosswalk should satisfy the following four criteria prior to installation:

1. Pedestrian crossing volumes should meet one of the following conditions:

- 20 pedestrians per hour during the peak pedestrian hour
- 15 elderly, disabled and/or children per hour during the peak pedestrian hour
- 60 pedestrians total for the highest consecutive pedestrian 4-hour period

Note: Pedestrian counts should only include pedestrians crossing within 100 feet either side of the proposed crosswalk location in an attempt to capture all potential users of the proposed crosswalk.

2. Two-way traffic volumes should be a minimum of 1,500 ADT volume or 150 Design Hourly Volume (DHV)

3. The current pedestrian crossing is not due to a corrective gap in the sidewalk system

4. Location of midblock crossings should be 300 feet (200 feet minimum with an engineering study) from any controlled intersection (all-way signal/stop/yield control or pedestrian overpass)

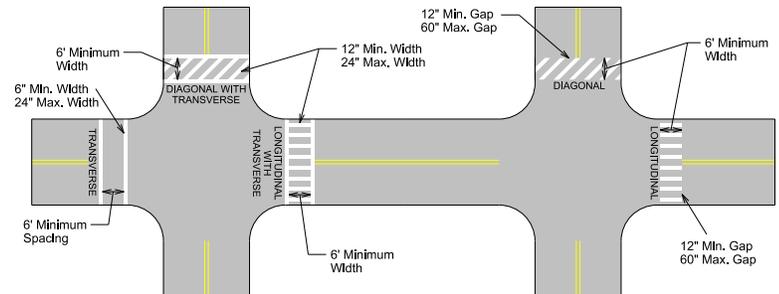


Crosswalk Markings ✓

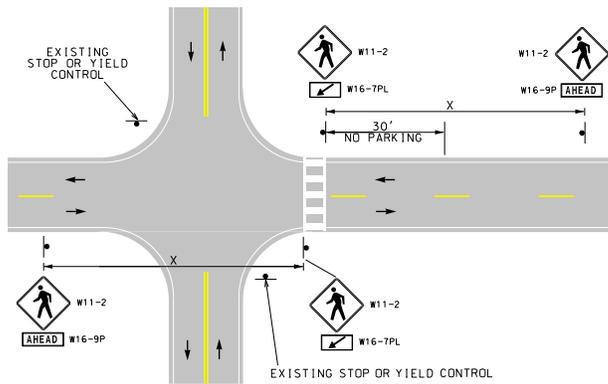
Crosswalk markings provide guidance by defining and delineating paths. At uncontrolled locations where pedestrian crossings are commonly unexpected by the road user, crosswalk markings should be considered in conjunction with signs and other measures. Markings shall consist of solid white lines no less than 6 inches or greater than 24 inches in width. Lines could consist of *transverse*, *diagonal*, or *longitudinal* markings.

The *MUTCD* allows crosswalk markings to only consist of diagonal or longitudinal lines in areas where:

- Substantial numbers of pedestrians cross without any other traffic control device
- Physical conditions of the surrounding area prompt the need for additional visibility of the crosswalk
- A pedestrian crossing may not be expected



! The design of lines and gaps should avoid vehicle wheel paths, if possible



It is important to note that other pavement markings should be in compliance with crosswalk markings, including stop and yield lines. Per the *MUTCD*, stop (yield) lines may be used to indicate the point behind which vehicles are required to stop (yield) at either a STOP (YIELD) sign or a STOP HERE FOR (YIELD HERE TO) PEDESTRIANS sign. At controlled intersections, stop or yield lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line. Signing and Striping Layouts from the SDDCTEA website indicate how various uncontrolled approaches and midblock locations should be marked.

SDDCTEA guidelines require uncontrolled approach and midblock location crosswalks to be marked with high visibility markings depending on traffic volume, number of lanes, and speed limit. The SDDCTEA website provides guidance for additional enhancements that should be applied with engineering judgment after determining that a crosswalk is warranted. Non-retroreflective colored pavement (including bricks, pavers, and other types of patterned surfaces) are purely aesthetic and are not considered a traffic control device, even if located between crosswalk lines.

Example drawing from SDDCTEA website. Please contact the SDDCTEA Traffic Engineering Branch for specific application.

Emerging Technology for Increased Crosswalk Marking Visibility: *In-Roadway Warning Lights (MUTCD Section 4N)* ➔

What is it?

- Special type of highway signal installed in the roadway surface to warn users that they are approaching a condition that might require road users to slow down and/or come to a stop

How does it work?

- Activated by push buttons, ultrasonic detectors (curb cut pad), video imaging, or bollards with infrared beams
- Will flash yellow when activated (flash rate between 50 and 60 flashes/minute)
- Can be set to stop flashing based on a predetermined time or by detection

Where can it go?

- Marked school crosswalks, marked midblock crosswalks, marked crosswalks at uncontrolled approaches, or marked crosswalks in advance of roundabouts

What are the benefits?

- Improved driver ability to detect pedestrians
- Reduced approach speeds of drivers
- Reduction in the number of pedestrian injuries and fatalities



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Crosswalk Signing

Signing is used to alert road users in advance of marked crosswalks. The signs below commonly supplement marked crosswalks.

							
MUTCD Name: Yield Here to Peds MUTCD Code: R1-5	MUTCD Name: Yield Here to Peds MUTCD Code: R1-5a	MUTCD Name: Stop Here for Peds MUTCD Code: R1-5b	MUTCD Name: Stop Here for Peds MUTCD Code: R1-5c	MUTCD Name: Turning Vehicles Yield to Peds MUTCD Code: R10-15	MUTCD Name: Crosswalk, Stop on Red MUTCD Code: R10-23	MUTCD Name: Pedestrian MUTCD Code: W11-2	MUTCD Name: Handicapped MUTCD Code: W11-9
Application: ✗ Controlled ✓ Uncontrolled	Application: ✗ Controlled ✓ Uncontrolled	Application: ✗ Controlled ✓ Uncontrolled	Application: ✗ Controlled ✓ Uncontrolled	Application: ✓ Controlled ✗ Uncontrolled	Application: ✓ Controlled ✗ Uncontrolled	Application: ✗ Controlled ✓ Uncontrolled	Application: ✗ Controlled ✓ Uncontrolled

The "Stop Here For Pedestrians" sign shall only be used where State law specifically requires a driver to stop for a pedestrian in a crosswalk. Additionally, while R10-15 can be used at signalized intersections, R10-23 shall only be used with pedestrian hybrid beacons.

Both W11-2 and W11-9 signs can have a fluorescent yellow-green background color; however, systemwide mixing of yellow and fluorescent yellow-green backgrounds is not recommended. In providing advance warning of a crosswalk, the *MUTCD* states that W11-2 and W11-9 signs should be supplemented with plaques with the legend "AHEAD" or "XX FEET" to inform road users that they are approaching a point where pedestrian/bicyclist crossing activity may occur. When providing warning signs at the crossing location, *MUTCD* standards indicate that a diagonal downward pointing arrow (W16-7P) plaque shall be mounted below the sign.

If pedestrian right-of-way compliance is a concern at unsignalized pedestrian crossings, either In-Street Pedestrian Crossing (R1-6 or R1-6a) or Overhead Pedestrian Crossing (R1-9 or R1-9a) signs may be used at the crosswalk location. In-Street Pedestrian Crossing and Overhead Pedestrian Crossing signs shall not be installed at signalized locations. Additionally, they shall not be placed in advance of a crosswalk to educate road users about the State law prior to reaching the crosswalk, nor shall they be installed as an educational display that is not near any crosswalk. A "YIELD TO" (R1-6/R1-9) or "STOP FOR" (R1-6a/R1-9a) legend shall be selected in accordance with State law. For more information on In-Street Pedestrian or Overhead Pedestrian Crossing signs, please refer to Section 2B.12 of the *MUTCD*.



Emerging Technology for Increased Crosswalk Marking Visibility: *Embedded LEDs in Signs (MUTCD Section 2A.07)*

What is it?

- Light Emitting Diode (LED) units may be used individually within the legend or symbol of a sign and in the border of a sign to improve conspicuity and increase the legibility of the sign face

How does it work?

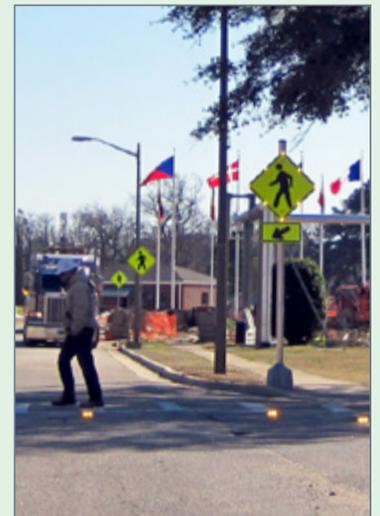
- Embedded around sign border or the words and symbols on sign
- Operate in steady or flash mode (50 to 60 flashes per minute)

Where can it go?

- Only considered at sign-controlled crosswalks (and are not a replacement for warning beacons)
- Good alternative in areas where vehicles are not stopping for pedestrians, pedestrian crossings are sporadic, and/or where lighting and sign visibility is poor

What are the benefits?

- Study showed vehicles' approach speeds decreased by an average of 7%
- Approximately 30% reduction in number of vehicles not fully stopping
- Approximately 50% reduction in number of vehicles that pass through an intersection without stopping





Crosswalk Lighting ✓

Lighting conditions at crosswalks can significantly impact pedestrian safety. Studies have shown that fatal crashes involving pedestrian-vehicle collisions at night are more than twice as likely to occur on unlit roads than on lighted roads. This indicates that the likely cause of these pedestrian crashes at night is the lack of visibility of pedestrians as they cross the road.

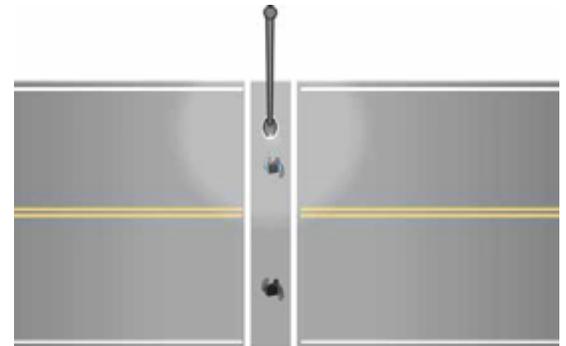
Luminaire Placement

Detailed crosswalk lighting design guidance for improving pedestrian visibility can be found in FHWA's *Informational Report on Lighting Design for Midblock Crosswalks*, (FHWA-HRT-08-053). Key elements are described in this section.

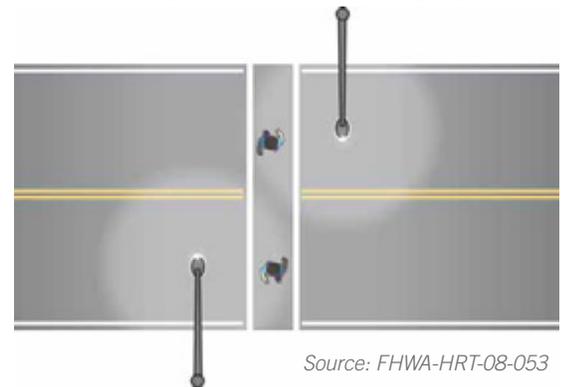
Midblock crosswalks have traditionally been illuminated by a single luminaire directly over the crosswalk as shown in the example drawing. While this provides high pavement luminance at the crosswalk, it does not adequately provide the vertical illuminance needed to make the pedestrian visible at a sufficient distance. FHWA-HRT-08-053 indicates that the luminaire should be located so that it provides 20 vertical lux at the crosswalk. The new design in the example drawing achieves this by locating the luminaires at least 10 feet from the crosswalk and placing them prior to the crosswalk from the drivers' perspective. Luminaires are required on each side of the road for roadways that have traffic traveling in both directions, particularly those without a center median.

Specific research has not been performed to evaluate the lighting levels needed for drivers to detect pedestrians within crosswalks located at intersections; however, FHWA-HRT-08-053 suggests 30 vertical lux as a conservative estimate of the lighting level required for adequate visibility.

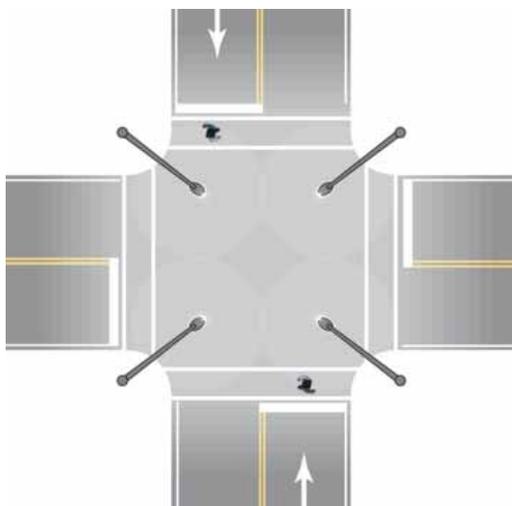
A traditional intersection lighting design as shown in the example drawing typically positions luminaires to provide a high level of pavement illuminance such that the potential conflict areas for the vehicles within the intersection are well-lit. However, this design lights the side of the pedestrian facing the intersection and does not light the side of the pedestrian facing the approaching vehicle. As shown in the new design in the example drawing, FHWA-HRT-08-053 indicates that luminaires should be located away from the intersection to provide vertical illuminance on the approach side of the pedestrian. This placement provides for positive contrast of the pedestrian and allows the luminaires to be augmented by the vehicle headlamps.



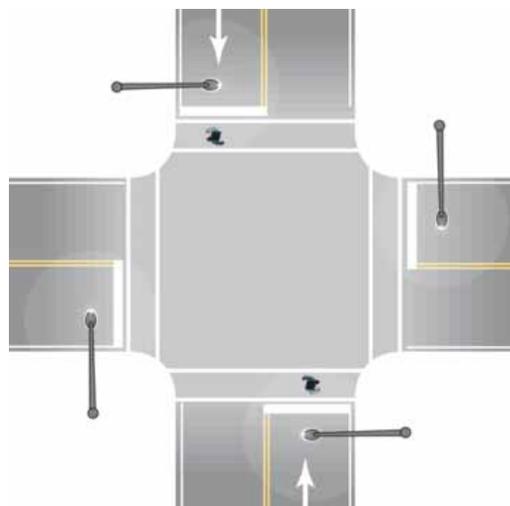
Above: Traditional midblock crosswalk lighting layout
Below: New design for midblock crosswalk lighting layout



Source: FHWA-HRT-08-053



Left: Traditional intersection lighting layout



Source: FHWA-HRT-08-053

Right: New design for intersection lighting layout for crosswalks

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Crosswalk Signalization

In cases where pedestrians experience excessive delay in crossing the major street, pedestrian crossing signalization may need to be considered. Since signalization can be an expensive recommendation, an engineering study of traffic conditions, pedestrian characteristics, and physical characteristics should be performed. If pedestrian traffic control signals will be used at an intersection, then the entire intersection should be signalized.

Is a Signal Warranted?

The *MUTCD* (Section 4C.01) provides nine warrants to justify the consideration of traffic control signals. It clearly states, however, that “The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.” Out of the nine available warrants, two directly involve pedestrian crossings (intersection or midblock) – **Warrant 4 (Pedestrian Volume)** and **Warrant 5 (School Crossing)**.

Warrant 4: Pedestrian Volume

To satisfy Warrant 4, vehicular volume on the major street and pedestrian volume crossing the major street need to meet established thresholds.

The need for a traffic control signal at an intersection or midblock crossing shall be considered if an engineering study finds that one of the following criteria is met:

- For each of any 4 hours of an average day, the number of vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street all fall above the curve in Figure 4C-5 of the *MUTCD*; or
- For 1 hour (any four consecutive 15-minute periods) of an average day, the number of vehicles per hour on the major street and the corresponding pedestrians per hour crossing the major street falls above the curve in Figure 4C-7 of the *MUTCD*

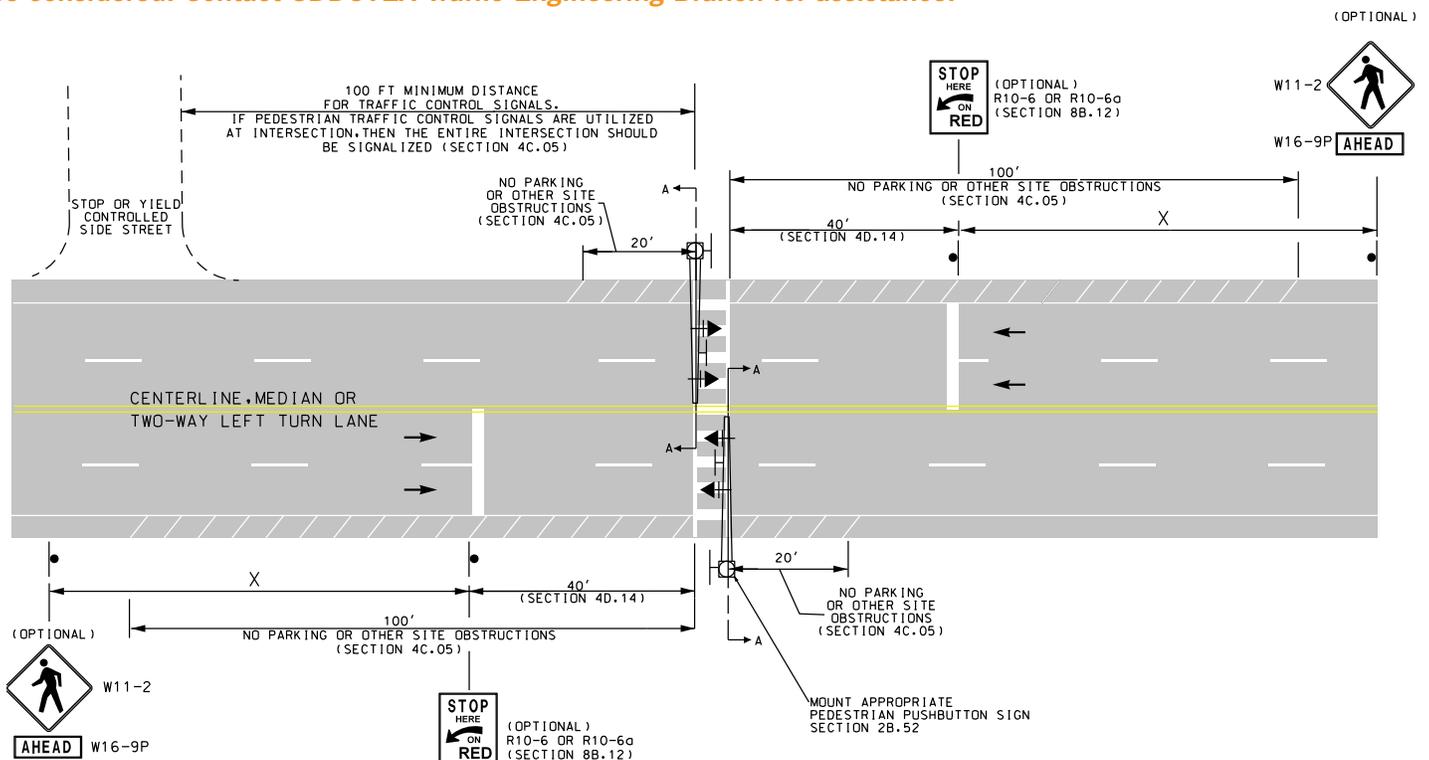
Warrant 5: School Crossing

Warrant 5 is intended for application where schoolchildren (defined as elementary through high school students) cross a major street.

The need for a traffic control signal shall be considered when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of schoolchildren at an established school crossing across the major street shows that:

1. The number of adequate gaps in the traffic stream during the period when the school children are using the crossing is less than the number of minutes in the same period; and
2. There are a minimum of 20 schoolchildren during the highest crossing hour

If a traffic control signal is warranted at a crosswalk, design and placement of signals as illustrated below must be considered. Contact SDDCTEA Traffic Engineering Branch for assistance.

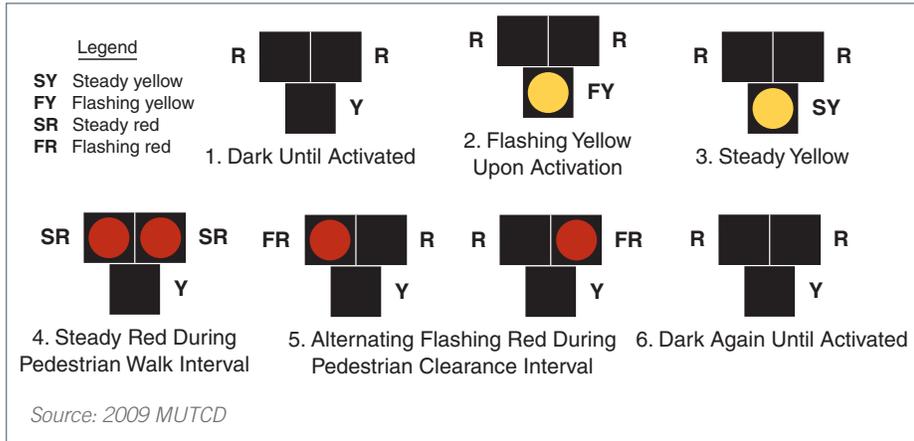


Example drawing from SDDCTEA website. Please contact the SDDCTEA Traffic Engineering Branch for specific application.



Pedestrian Hybrid Beacons

An alternative to traffic control signals along uncontrolled approaches and midblock locations is the use of pedestrian hybrid beacons (*MUTCD* Section 4F). Pedestrian hybrid beacons are a special type of hybrid beacon used to assist pedestrians in crossing a street or highway at a marked crosswalk. This *MUTCD* graphic depicts the general process for how pedestrian hybrid beacons control vehicular traffic when activated by a pedestrian.



Pedestrian hybrid beacons are effective at locations that do not meet a traffic control warrant, and locations that may meet a traffic control warrant, but a decision was made not to install a traffic signal. Although their application is still an emerging technology, their effectiveness thus far has shown reductions in total crashes, pedestrian related crashes, and overall crash severity.

Guidance on the design/placement of pedestrian hybrid signals can be found on the SDDCTEA website.

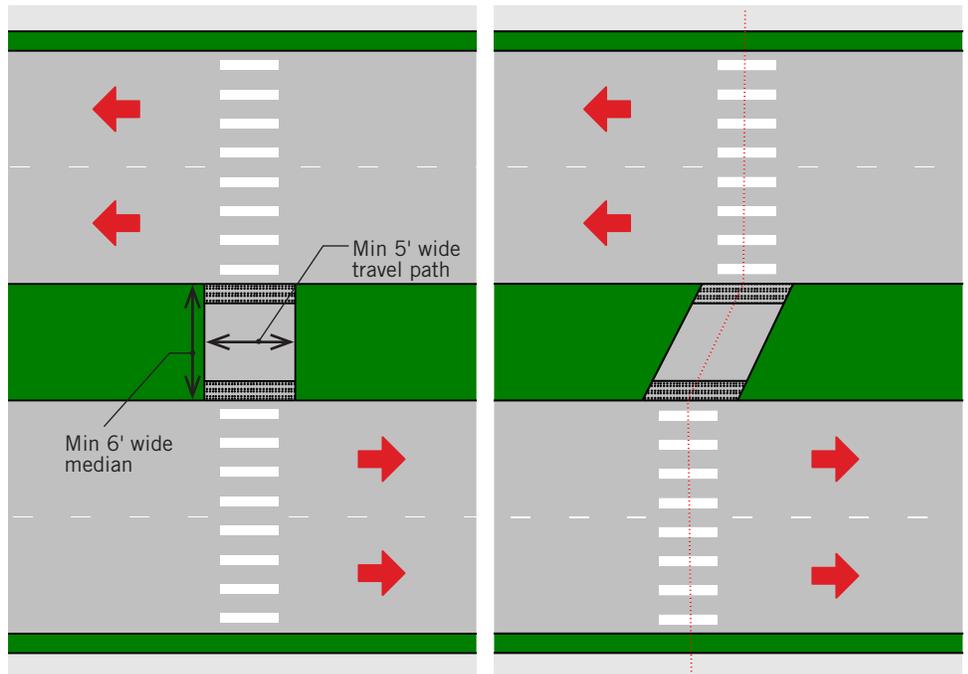
Pedestrian Refuges

If an engineering study deems that gaps in traffic approaching the crosswalk are not adequate to safely accommodate a complete pedestrian crossing, a pedestrian island may be considered. A pedestrian island is a raised island located in the center of a roadway to provide refuge to pedestrians who are attempting to cross the facility. Pedestrian islands allow pedestrians to find an adequate gap in one direction of traffic at a time.

Per AASHTO, median refuges should be at least 6 feet wide. Median and island cut-throughs should provide 5-foot-wide travel paths to allow adequate room for pedestrian passage, turning, or platooning. The *MUTCD* and American Disabilities Act Accessibility Guidelines (ADAAG) provides guidance on the appropriate installation and design of pedestrian control features at midblock pedestrian islands.

At midblock crossings, staggered midblock crosswalks also can be considered.

A staggered midblock crosswalk is where the crosswalk is offset on either side of the median. This forces pedestrians to turn and face oncoming traffic before turning again to cross the second half of the crosswalk. One challenge is providing visually impaired pedestrians the ability to detect changes in direction of the walkway leading to the road; to address this, appropriate detectable warning surfaces and/or railings should be considered.



Raised medians and pedestrian islands are one of the Federal Highway Administration's nine proven safety countermeasures

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Pedestrian Control Features and ADA Compliance ✓

Pedestrian control features include infrastructure that assists a pedestrian in crossing a roadway. It is critical that all control features comply with ADAAG published at www.ada.gov. *MUTCD* guidance on pedestrian control features can be found in Section 4E. The most common pedestrian control features include:

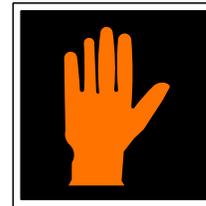
- Pedestrian Signal Heads
- Pedestrian Crossing Signs and Traffic Signal Pedestrian and Bicycle Actuation Signs
- Pedestrian Detectors
- Curb Ramps and Detectable Surfaces

Pedestrian Signal Heads: Pedestrian Signal Heads provide signal indications exclusively intended for controlling pedestrian traffic (i.e., “WALK” and “DON’T WALK”).

Per the *MUTCD*, Pedestrian Signal Heads shall be used in conjunction with vehicular traffic control signals (i.e., not by themselves) if any of the following are met:



Steady WALKING PERSON (Symbolizes WALK)



Flashing UPRAISED HAND (Symbolizes DON'T WALK unless already crossing the street)



Steady UPRAISED HAND (Symbolizes DON'T WALK)

1. A traffic control signal is justified by an engineering study and meets either Warrant 4 or Warrant 5
2. An exclusive signal phase is programmed into the signal timing of a traffic control signal for pedestrian crossings only
3. The signalized intersection is an established school crossing
4. Engineering judgment determines that signal timing is confusing for pedestrians to understand when they are safely able to cross (i.e., crossing the major street when the minor street is going)

MUTCD Section 4E.06 details how pedestrian timings and signal phases are determined. In general, the walk interval (“walking person”) should be a minimum of 7 seconds. Pedestrian clearance time is calculated as the time it takes a pedestrian to cross the street, assuming a walking speed of 3.5 feet-per-second. The pedestrian change interval (“flashing upraised hand”) should represent the calculated pedestrian clearance time minus a buffer interval (“steady raised hand”) of at least 3 seconds. See *MUTCD* Figure 4E-2 for further information on the relationship between pedestrian intervals and vehicular phase intervals.

Some Pedestrian Signal Heads have the ability to display a crossing interval countdown. This type of display shall be used when the pedestrian change interval (pedestrian clearance time minus any additional buffer) is more than 7 seconds. The ADAAG encourages the use of *accessible pedestrian signals* where there is a need to accommodate pedestrians with visual impairments. This technology incorporates audible signals with standard pedestrian signal heads to indicate when it is appropriate to cross.

Pedestrian Crossing Signs and Traffic Signal Pedestrian and Bicycle Actuation Signs: These two groups of signs are used to display crossing related information to pedestrians and bicyclists (*MUTCD* 2B.51 and 2B.52). Pedestrian Crossing Signs (R9-2, R9-3, and R9-3a) are used to limit pedestrian crossings to specific locations, while Traffic Signal Pedestrian and Bicycle Actuation Signs (R10-1 through R10-4 and R10-24 through R10-26) are intended to display pedestrian and bicyclist actuation information.

MUTCD Name: Cross Only at Crosswalks MUTCD Code: R9-2 Application: ✓ Limit ped crossings ✗ Display ped/bike actuation info	MUTCD Name: No Pedestrian Crossing MUTCD Code: R9-3 Application: ✓ Limit ped crossings ✗ Display ped/bike actuation info	MUTCD Name: No Pedestrian Crossing MUTCD Code: R9-3a Application: ✓ Limit ped crossings ✗ Display ped/bike actuation info	MUTCD Name: Cross Only On Green MUTCD Code: R10-1 Application: ✗ Limit ped crossings ✓ Display ped/bike actuation info	MUTCD Name: Pedestrian Signs and Plaques MUTCD Code: R10-2, 3, 3b, 3c, 3d, 4 Application: ✗ Limit ped crossings ✓ Display ped/bike actuation info	MUTCD Name: Pedestrian Signs MUTCD Code: R10-3a, 3e, 3f, 3g, 3h, 3i, 4a Application: ✗ Limit ped crossings ✓ Display ped/bike actuation info	MUTCD Name: Bike Push Button for Green Light MUTCD Code: R10-24, 26 Application: ✗ Limit ped crossings ✓ Display ped/bike actuation info	MUTCD Name: Push Button To Turn On Warning Lights MUTCD Code: R10-25 Application: ✗ Limit ped crossings ✓ Display ped/bike actuation info



Pedestrian Detectors: Pedestrian detectors can take the form of either a pushbutton or passive detection device.

- Passive Detection Device – Device that can detect the presence of a pedestrian without requiring the pedestrian to push a button.

The mounting height and location of pushbuttons is critical for easy activation for all users. They should be unobstructed and located between 1.5 and 6 feet from the edge of the curb, adjacent to a level all-weather surface. The mounting height should be between 3.5 and 4 feet.

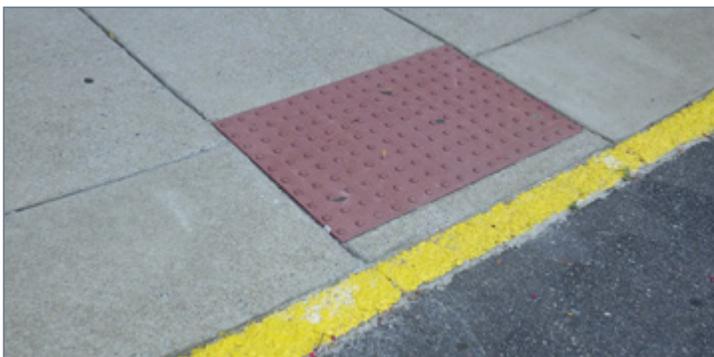
Curb Ramps and Detectable Surfaces: Typically, the ADA defines requirements for pedestrian facilities throughout the United States; however, the Department of Defense (DoD) has adopted Architectural Barriers Act (ABA) Accessibility Standards (2004), which covers facilities designed, built, or altered with Federal funds or leased by Federal agencies. In an effort to address design elements found in public rights-of-way and not covered by the ADA and ABA guidelines, the United States Access Board published "Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way" (PROWAG) in July 2011 and provided a public comment period. These guidelines have not yet been issued and adopted by the DoD and therefore are not mandatory or enforceable but are considered best practices. If the PROWAG is not used, DoD installations, at a minimum, should use the 1998 with 2002 supplements ADAAG.



! Only about 50% of pedestrians actually push the buttons based on a past FHWA research project

Curb ramps are required at all street crossings per Title II of the ADAAG:

- According to the *ADA Best Practices Tool Kit for State and Local Governments*, a curb ramp is “a short ramp cutting through a curb or built up to it.”
- According to the *ADA Best Practices Tool Kit for State and Local Governments*, state and local governments must provide curb ramps at pedestrian crossings and at public transportation stops where walkways intersect a curb to allow people with disabilities to cross streets safely. To comply with ADAAG requirements, the curb ramps provided must meet specific standards for width, slope, cross slope, placement, and other features. In constructing facilities such as walkways and pedestrian crossings, state and local governments can choose between two sets of standards – the ADA Standards for Accessible Design (ADA Standards) or the Uniform Federal Accessibility Standards (UFAS). Both of these standards have been deemed to comply with the requirements of Title II.



! Guidance does not specify a particular color but requires the detectable warning to be a color that contrasts with the sidewalk

- Under the ADA Standards, curb ramps are required to have detectable warnings that extend the full width and depth of the curb ramp.

When marking a crosswalk, it is important that crosswalk markings be located such that the curb ramps are within the extension of the crosswalk markings. Guidance for curb ramp design and placement can be found in Section 406 of the 2010 ADA Standards for Accessible Design. Detectable warning surfaces (raised truncated domes in a rectangular array) are used to mark boundaries between pedestrian and vehicular ways where there is no raised curb; therefore, these surfaces are installed within the curb ramps. Detectable warning surfaces are required for marked and unmarked crosswalks.

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Traffic Calming to Promote Pedestrian Crossing Safety ✓

Traffic calming measures also can have a positive impact on pedestrian crossing safety. Some examples are described below.

! **Pedestrian crash severity is lower at low motor vehicle speeds. If a pedestrian is struck by a car traveling at 40 mph, there is an 85% likelihood that the pedestrian will be killed. This percentage drops to 45% at 30 mph and 5% at 20 mph.**

Curb Extensions

Curb extensions narrow the roadway and reduce the crossing distance by providing an extension of the sidewalk area into the parking lane. As curb extensions bring pedestrians out from behind parked cars, pedestrians and motorists are able to better see each other.

Source: <http://www.fhwa.dot.gov/publications/research/safety/04091/09.cfm>



Raised Pedestrian Crosswalks

Raised pedestrian crosswalks bring motor vehicles up to the pedestrian level by extending the sidewalk across the road. They improve accessibility by allowing a pedestrian to cross at nearly a constant grade without the need for a curb ramp and make pedestrians more visible to approaching vehicles.

Source: http://guide.saferoutesinfo.org/engineering/raised_pedestrian_crosswalks.cfm



Chokers and Chicanes

Chokers and chicanes consist of parallel or offsetting curb extensions, which effectively reduce road width. These treatments are intended to reduce motor vehicle speeds and make drivers aware of pedestrian activity.

Source: http://guide.saferoutesinfo.org/engineering/chokers_and_chicanes.cfm



School Zones ✓

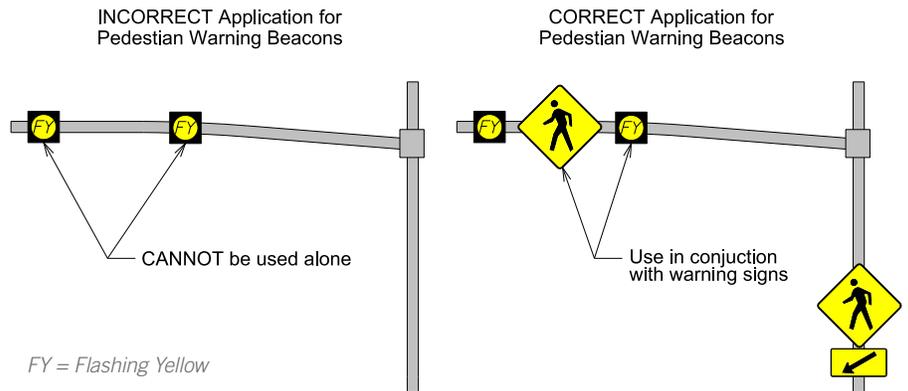
The *MUTCD* defines a school zone as a designated roadway segment approaching, adjacent to, and beyond school buildings or grounds, or along which school related activities occur. Engineering measures that should be involved within the development of a school zone traffic control plan include:

- Crossing Supervision (adult, law enforcement officers, etc...)
- Appropriate Signing
- Crosswalk Markings
- Warning Beacons

Section 7B of the *MUTCD* illustrates the appropriate signs that should be used within school zones. All school zone signs must have a fluorescent yellow-green background with a black legend and border, unless otherwise noted specifically in the *MUTCD*. In-street signs (R1-6, R1-6a, R1-6b, and R1-6c) can be used at unsignalized school crossings. While research on the effectiveness of in-street school crossing signs is not available, research on the effectiveness of in-street pedestrian crossing signs shows that these signs increase driver yielding rates.



Per the *MUTCD*, “Crosswalk pavement markings must be present along all established routes to a school where there is substantial conflict between motorists, bicyclists, and student movements; where students are encouraged to cross between intersections; where students would not otherwise recognize the proper place to cross; or where motorists or bicyclists might not expect students to cross.” Engineering studies should be performed before the installation of a marked crosswalk is completed within a school zone. Midblock crossings should be avoided in school zones since non-intersection school crossings are generally unexpected by motorists.



Warning beacons are an effective tool to increase driver awareness of warning/regulatory signs or markers within a school zone. A warning beacon shall only be used to supplement an appropriate warning or regulatory sign or marker. For crosswalks, warning beacons can be set with a timer to flash only during crossing times, increasing awareness of the marked and signed crosswalk. Pedestrian hybrid beacons can be an alternative considered within school zones. For additional guidance on school zones, please contact the SDDCTEA Traffic Engineering Branch, refer to Section 7 of the *MUTCD*, or visit the Safe Routes to School (SRTS) Online Guide at guide.saferoutesinfo.org.

Remedies to Common Pedestrian Crossing Issues ★

Issue	Countermeasure Options
Pedestrians cannot completely cross roadway during allotted “WALK” time	<ul style="list-style-type: none"> • Increase crossing times so that people who walk slowly will have sufficient time to cross before the signal indication changes • Provide a pedestrian refuge
Pedestrians experience conflicts with right-turning vehicles	<ul style="list-style-type: none"> • Prohibit right-turn-on-red movements with a NO TURN ON RED sign (<i>MUTCD</i> R10-11) • Maintain right-turn-on-red movements with a TURNING VEHICLES YIELD TO PEDESTRIANS sign (R10-15) or a CROSSWALK, STOP ON RED sign (<i>MUTCD</i> R10-23)
Pedestrians are not using marked crosswalks when crossing	<ul style="list-style-type: none"> • Provide sidewalks/walkways and curb ramps • Install pedestrian control features • Provide accessible pedestrian signals and detectors • Implement an enforcement campaign
Pedestrians cannot be seen by motorists from behind parked cars or other obstructions	<ul style="list-style-type: none"> • Eliminate screening by physical objects • Provide curb extensions or raised pedestrian crosswalks • Restrict additional parking • Install pedestrian hybrid beacons
Vehicles are encroaching into marked crosswalks	<ul style="list-style-type: none"> • Increase crosswalk visibility by installing diagonal or longitudinal markings • Increase crosswalk visibility by installing In-Roadway Warning Lights • Restripe stop or yield lines and install appropriate signing • Install flashing warning beacons or embedded LEDs in signs

TRAFFIC ENGINEERING & HIGHWAY SAFETY BULLETIN



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