CHAPTER 11: PEDESTRIAN SIGNS AND SIGNALS

Traffic signs and signals should be useful for all pedestrians. It is essential to provide signals that are phased and timed to allow senior citizens, children, and pedestrians with disabilities, who are generally slower than other pedestrians, adequate crossing time. Words on signals and signs should be visible to pedestrians of different heights (including both adults and children), large enough for those with vision impairments to read, and their messages should be simple to understand. Signs and signals should meet current accessibility guidelines.

Detailed pedestrian signal and sign guidelines are found in the Maryland Manual on Uniform Traffic Control Devices (MD-MUTCD). This is an essential source of information for the design of these elements. The following sections provide a brief overview of these topics, as they relate to sign and signal design in Maryland.

11.1 Pedestrian Warning Signs

Section 2C.41 of the MD-MUTCD provides guidance on the use of Nonvehicular Traffic Signs, including signs for use at and in advance of pedestrian crossings. See Figure 11.1 for a summary of guidance on the use of signs at pedestrian crossings (refer to the MD-MUTCD for complete information on all nonvehicular signs).

School Crossings

Part 7 of the MD-MUTCD provides detailed guidance on how to sign school crossings and will not be duplicated here. School crossings function like any other pedestrian crossing and are subject to all of the provisions set forth in this manual, including Figures 10.2 and 10.3

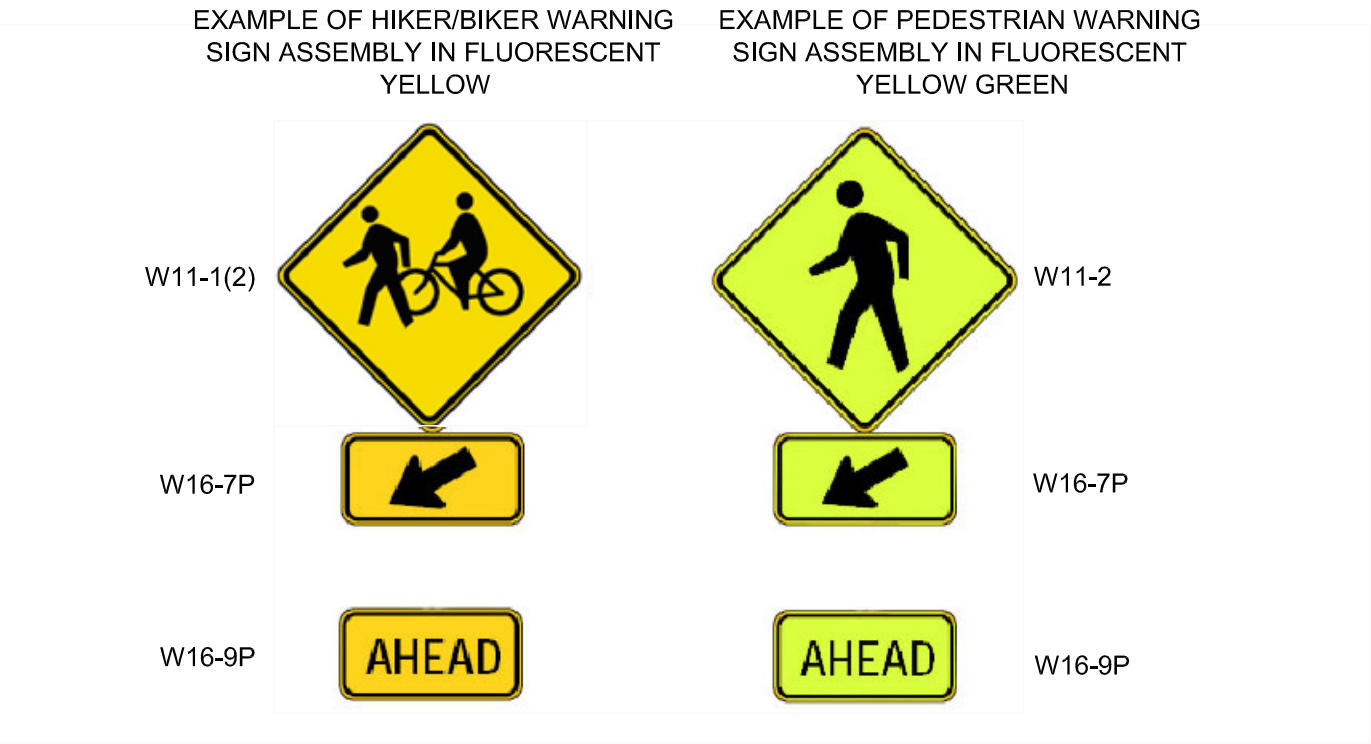
Figure 11.2 - S1-1

In-Street Pedestrian Crossing Signs

In-street pedestrian crossing signs are used at uncontrolled crossing locations to remind motorists that state law requires them to stop for pedestrians within a crosswalk. Primary guidance regarding these signs is provided in the MD-MUTCD. Figure 11.3 provides supplemental guidance regarding their use.

Fluorescent Yellow-Green Crossing Signs

The fluorescent yellow-green color may be used on pedestrian and bicycle advance warning signs. According to Part 7 of the MD-MUTCD, school crossing signs shall always have fluorescent yellow-green backgrounds. When using the yellow-green background, a systematic approach featuring only one background color within a zone or area should be used.



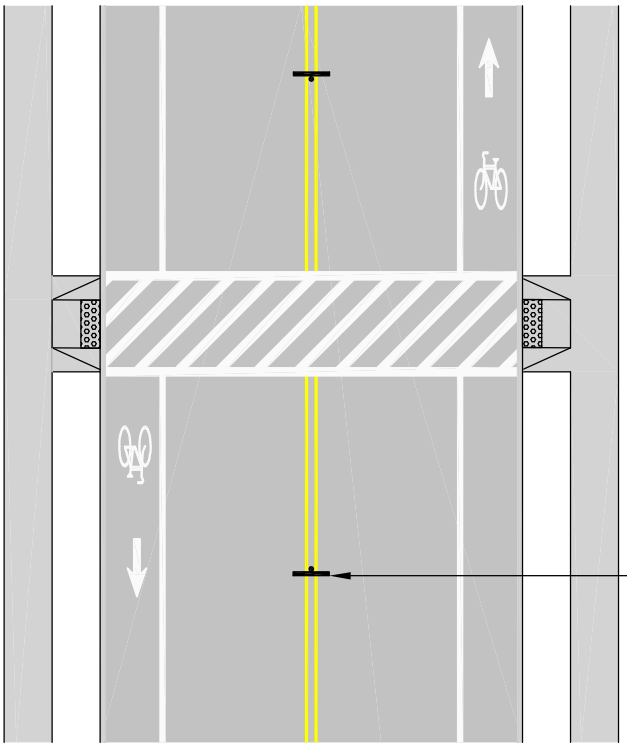
BENEFIT:
Alert motorists that they should expect pedestrians or pedestrians and/or bicyclists either at defined locations or along a segment of roadway

SUITABLE LOCATIONS:
- Pedestrian warning signs (W11-2) should be installed in areas where motorists may not expect pedestrians
- Hiker/Biker warning signs (W11-1 (2)) should be installed at trail crossings in areas where motorists may not expect pedestrians or bicyclists
- Pedestrian warning signs and hiker/biker warning signs may be installed either at mid-block locations or at uncontrolled intersections
- Pedestrian warning signs and hiker/biker warning signs may be installed in advance of the crossing and/or at the location of the crossing

DESIGN AND PLACEMENT OF SIGNS:
- Per requirements set forth in the MD-MUTCD
- When used in advance of the crossing location or locations, signs W11-2 and W11-1(2) should be supplemented with a plaque reading "AHEAD" (W16-9P)
- When used at the crossing, signs W11-2 and W11-1(2) shall be supplemented with a diagonal downward pointing arrow plaque (16-7p)
- Background may be either fluorescent yellow or fluorescent yellow-green. Fluorescent yellow-green may be used in areas of particular concern, such as along school walking routes or in high crash locations. "When a fluorescent yellow-green background is used, a systematic approach featuring one background color within a zone or area should be used. The mixing of standard yellow and fluorescent yellow-green backgrounds within a selected site area should be avoided (Maryland MUTCD)"
- When used at unmarked crosswalks the "AHEAD" (W16-9P) and diagonal downward pointing arrow (16-7p) should be used appropriately to avoid any confusion about the actual crosswalk location

Figure 11.1 - Pedestrian Crossing Signs

NOT TO SCALE



IN-STREET PEDESTRIAN CROSSING SIGN R1-6A (TYP)
- Placed in the center of the road, in front of and/or behind the crosswalk

BENEFIT:
Remind motorists of the rules of the road.

SUITABLE LOCATIONS:
- **Shall only be used at uncontrolled locations**
- Typically installed in areas with significant pedestrian activity, such as a business district or near a mall or transit station.
- Can be installed either at mid-block locations or at uncontrolled legs at intersections.
- Should not be used on roadways that have a clear width less than 24 feet.
- Should not be placed on roadways with posted speeds over 35 mph, or in locations that adversely affect motor vehicle turning radii.
- Should not be placed on 4 lane roadways unless the speed limit is 25 mph or less.

DESIGN AND PLACEMENT OF SIGN:
- MD-MUTCD provisions concerning mounting height are not applicable for the in-street pedestrian crossing sign
- If an island is available, the in-street pedestrian crossing sign should be placed on the island.
- Must meet AASHTO breakaway requirements
- Should be removable for roadway maintenance
- Legend text and border shall be black except for the STOP symbol. The background can be either white or flourescent yellow-green.
- In locations with higher speeds (or conditions that otherwise don't meet these criteria), the "Side of the Street Pedestrian Crossing" sign may be used (MD-MUTCD R1-6a(1)). If used, it shall be placed in advance of the crosswalk

Figure 11.3 - In-Street Pedestrian Crossing Sign

11.2 Signs at Signalized Intersections

At signalized intersections, pedestrian crash risk may increase when right-turn-on-red is permitted, or permissive left turns are permitted. Possible countermeasures include the use of no-turn-on-red (NTOR) restrictions (with signs), and TURNING TRAFFIC MUST YIELD TO PEDESTRIANS signs R10-15.

Figure 11.4 – R10-15

11.3 Pedestrian Signals

Extensive guidance and standards for pedestrian signal warrants are provided in the MD-MUTCD, and are not duplicated in this Chapter. Pedestrian signals must be designed to meet SHA's current *Accessibility Policy & Guidelines for Pedestrian Facilities along State Highways*. All new or modified traffic signal systems where pedestrian indications are warranted per the MD-MUTCD shall consider Accessible Pedestrian Signals (APS). APSs are devices that communicate information about pedestrian timing in nonvisual formats such as tones, verbal messages or vibrations. APSs are typically used in situations where there are continuous right turns, right turns on red, complex signal operations, traffic circles, wide streets, or other factors that may make it difficult for pedestrians with visual disabilities to cross safely. A study should be conducted to determine if APS is appropriate. See Section 11.4 for more information regarding APS.

Alternative Pedestrian Signal Phasing

The most common type of pedestrian signal phasing provides a "WALK" signal when traffic coming from the same direction has a green light. However, a large number of vehicle/pedestrian collisions at signalized intersections involve left- and right-turning vehicles. One phasing strategy to improve pedestrian safety is to provide a Leading Pedestrian Phase in locations with heavy volumes of right turning traffic, and frequent pedestrian crossings. During the Leading Pedestrian Phase all motor vehicle flows are stopped for 2-4 seconds while pedestrians are given the "WALK" signal. This enables pedestrians to begin the crossing movement in advance of right turning movements. A study can useful in determining if a Leading Pedestrian Phase is appropriate by comparing pedestrian safety benefits versus increased intersection delay. Also, pedestrian phasing can be complemented by geometric design changes that shorten crossing distances.

Pedestrian Signal Timing

A number of factors are used to determine the appropriate pedestrian phase for a given intersection. Each intersection is unique, and requires careful attention to the safety of all users. This section provides some guidance on this issue, however more information is provided in the MD-MUTCD and the AASHTO *Guide to the Planning, Design and Operation of Pedestrian Facilities*.

The pedestrian phase has 2 distinct time periods:

1. WALK interval – this is the beginning part of the pedestrian phase, when the pedestrian is free to leave the curb and begin the journey across the intersection. (represented by WALKING PERSON – symbolizing WALK). This interval lasts a minimum of 4 to 7 seconds, which is enough time to enable the pedestrian to leave the curb and begin the crossing movement.
2. Pedestrian clearance time – This includes the pedestrian change interval which is the time following the WALK interval and is initiated by the flashing UPRAISED HAND. The pedestrian clearance time also includes the yellow change and red

clearance intervals which is the time remaining to a conflicting green light and is indicated by a flashing or steady UPRAISED HAND symbolizing DON'T WALK. The pedestrian clearance time is usually timed using a walking rate of 3.5 feet per second.

When the entire pedestrian phase is taken into account, the actual allowable walking speed for the entire pedestrian interval is slower than 3.5 feet per second.

With respect to pedestrian phases at signalized intersections, the Maryland MUTCD allows for timing the pedestrian phase at a reduced walking rate at locations where pedestrians typically need more time to cross the road.

New technologies (such as automated detection) can make it easier to detect slower pedestrians in the crosswalk, and adjust the signal timing accordingly, while reducing unnecessary delay to motor vehicle traffic during times when slower pedestrians are not present.

Traffic signal preemption systems should address pedestrian as well as motor vehicle clearance needs, whether the approaching vehicle is a train or an emergency vehicle.

Figure 11.5 - Pedestrian Pushbutton

Midblock Pedestrian Signals

Careful study should accompany the installation of a mid-block pedestrian signal. If existing gaps in traffic are present and adequate to facilitate a safe pedestrian crossing, installation of an actuated pedestrian signal is not advisable. Pedestrians will take an available gap in traffic and won't be inclined to use the pushbutton, resulting in a general disregard for pushbutton actuation. In locations where there are not adequate gaps in traffic, midblock pedestrian signals provide for increased pedestrian convenience and safety.

Pushbuttons at Pedestrian Signals

Within business districts, main streets, and other areas with substantial pedestrian volumes, a pedestrian signal phase should be automatic. In areas with fewer pedestrians, pushbuttons may be used to reduce delays to vehicular traffic. Pushbuttons shall be a minimum of 2" across in at least one direction. The force required to activate the buttons should not be greater than 5 pounds. It is desirable for pushbuttons to offer confirmation that the button has been pressed (see Figure 11.5). Pushbuttons at accessible pedestrian signals are discussed separately in Section 11.4.

Figure 11.6 - Countdown Signal

Countdown Signals

Pedestrian countdown signals are particularly helpful because they inform pedestrians of the amount of time remaining in order to complete the crossing (see Figure 11.6). They have been shown to reduce the number of pedestrians that are still in the crosswalk when opposing traffic receives a green signal. The MUTCD requires that no countdown be displayed during the walk interval (steady walking person symbol). The countdown display begins at the start of the flashing upraised hand and ends at the termination of that interval.

11.4 Accessible Pedestrian Signals (APS)

For the design of accessible pedestrian signals (APS), refer to the SHA-Office of Traffic & Safety (OOTS) document, "Accessible Pedestrian Signals-Design Guidelines and the Maryland MUTCD (Section 4E-10). The Assistant District Engineer-Traffic is to be contacted before addressing APS needs.

The following other references may be helpful in the design of APS:

- *Accessible Pedestrian Signals: Synthesis and Guide to Best Practice.* Available at: http://www.walkinginfo.org/aps/home.cfm
- Interim product prepared for the National Cooperative Highway Research Program (Project 3-62).
- *Building a True Community: Final Report--Public Rights-of-Way Access Advisory Committee, 2001* (PROWAAC Report)
- *Draft Public Rights-of-Way Accessibility Guidelines* (June 17, 2002)

11.5 In-Roadway Warning Lights

See Figure 11.7

In-roadway warning lights are a special type of traffic signal installed in the roadway surface to warn approaching motorists that they may need to slow down or stop. In-roadway warning lights are typically used at uncontrolled crosswalks with designated crosswalk markings which have experienced vehicle-pedestrian crashes or have high volumes of nighttime pedestrian activity.

11.6 Other Innovative Pedestrian Sign and Signal Options

Signals may be warranted by the MD-MUTCD (Warrant 4) based upon pedestrian volumes. For these situations, a full signal may be harmful to traffic operations as there may not be a pedestrian waiting to cross at each signal cycle and side street traffic volumes may not require a signal for access to the main arterial. To provide a balance between pedestrian crossing needs and vehicular movement needs some jurisdictions around the country have adopted the following modified signal types to periodically stop traffic on arterial streets.

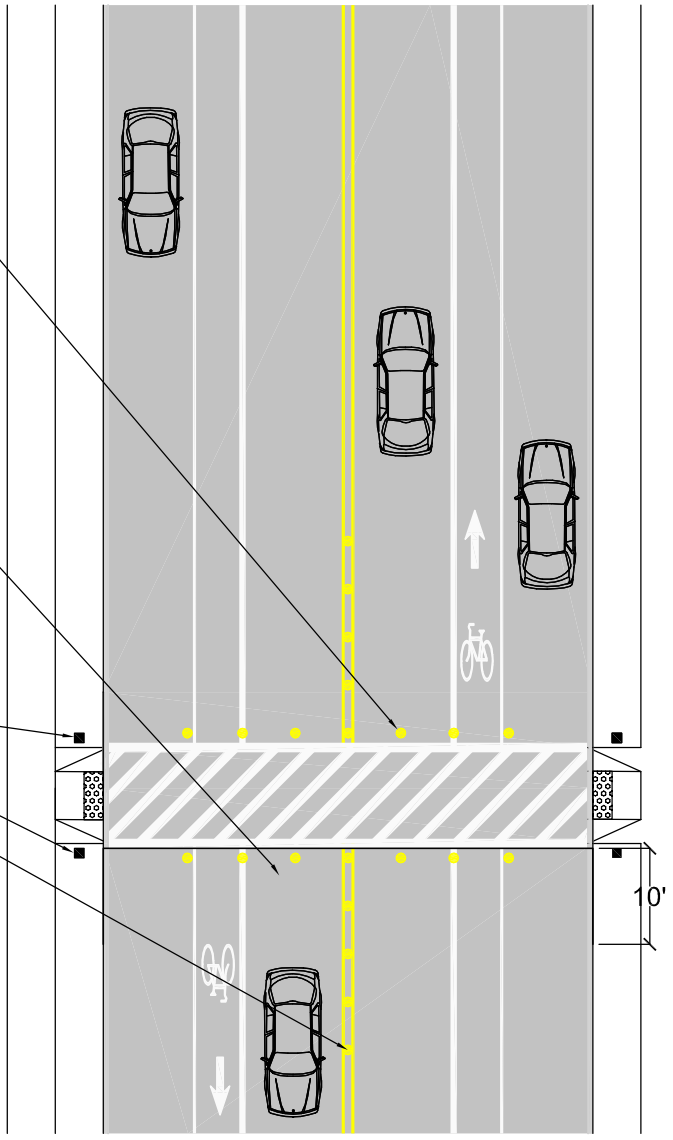
IN-ROADWAY WARNING LIGHT
if unidirectional, face away from crosswalk
if bidirectional, face both directions of vehicular traffic

ACCEPTABLE AREA FOR LIGHTS
Lights may be placed in the area
between the edge of the crosswalk line
and 10' from the edge of the crosswalk

OPTIONAL STOP BAR
Note that advanced Stop Bars are optional with the use of In-Roadway Warning Lights

PASSIVE DETECTION BOLLARDS

OPTIONAL ADVANCE WARNING LIGHTS (TYP)
- Along centerline, 5' on center
- Flash sequentially



REQUIRED NUMBER AND POSITION OF LIGHTS

Roadway Configuration	MInImum Number of Lights Per Approach	Recommended Number of Lights Per Approach	Side(s) of Crosswalk
One-lane, one way	2 Lights	3 Lights	Approach Side
Two-lane	3 Lights	5 Lights	Both Sides
More than two lanes	1 Lights Per Lane	1 Light Per Lane and Each Edge	Both Sides

SUITABLE LOCATIONS:
In-Roadway Warning Lights should only be installed if the following criteria are met:
- Use only at uncontrolled crosswalks with designated crosswalk markings. They shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.
- The marked crosswalk must be justified according to SHA marked crosswalk guidelines
- SHA crosswalk guidelines call for an engineering treatment (per Section 10.2)
- The crossing has experienced vehicle-pedestrian crashes
- Alternative safety measures have been used and proven unsuccessful, or they are determined not feasible
- The 85th percentile of vehicles approaching the crosswalk from either direction should not be more than 40 mph
- The average daily traffic (ADT) on the street being crossed should be between 5,000 and 30,000 vehicles per day, or vehicular volume through the crossing should exceed 200 vehicles per hour in urban areas or 140 vehicles per hour in rural areas during peak-hour usage
- The existing stopping sight distance from both directions should not be less than the required minimums as specified in the State Highway Access Manual
- Should be prioritized at locations with high volumes of nighttime pedestrian activity
- The site should not be scheduled for resurfacing within a two-year time frame

Figure 11.7 - In-Roadway Warning Lights
(Sheet 1 of 2)

DESIGN AND PLACEMENT OF IN-ROADWAY WARNING LIGHTS:

- Lights should be located along the crosswalk at the center of each travel lane, at the centerline of the roadway, at the edge of the roadway or parking lanes, and at other suitable locations away from the normal tire track paths
- Do not place lights in the center of bicycle lanes, or the normal path of bicycles if bicycles are allowed to share the lane
- Lights should face approaching vehicles

NOTES:

Activation:

- An automatic pedestrian activation system is more effective than a push-button system

Maintenance:

- This device requires continual maintenance to ensure that the system is operating properly

Public Education:

- Public education for the proper use of In-Roadway Warning Lights is required

Optional:

- If desired, advanced warning prior to a crosswalk may be provided with additional in-roadway warning lights (as shown in the graphic) or with advanced warning signs
- Additional guidance may be necessary to steer pedestrians between the passive detection bollards, in the form of signs or channelization devices
- Stop bars are optional in advance of the in-roadway warning lights

Figure 11.7 - In-Roadway Warning Lights
(Sheet 2 of 2)

Pedestrian Crossing Signal at Intersections with Minor Roadways

This type of signal functions exactly like an ordinary traffic signal at an intersection except that on the minor approaches there are pedestrian signals but no vehicular signals. Vehicles on the minor approaches are controlled by a stop sign.

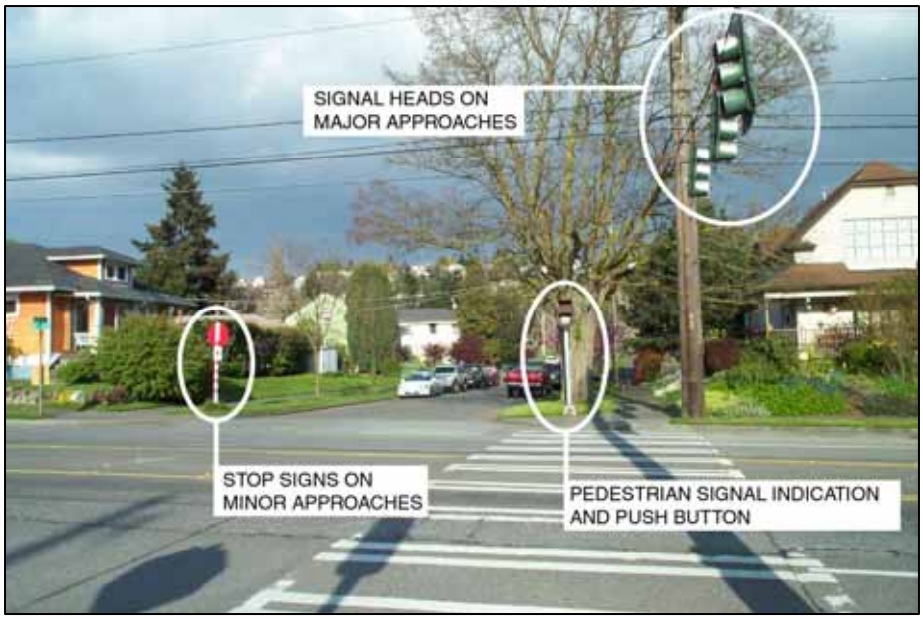


Figure 11.8 – Example of a Pedestrian Crossing Signal
(Photo by Charles Zegeer)

Placement:
Pedestrian crossing signals, as shown in Figure 11.8, are particularly suited for crosswalks over multi-lane, higher speed or volume roadways at intersections with minor streets controlled by stop signs. This type of signal is distinct from a normal mid-block crosswalk signal because it occurs at a minor road intersection.

Design of Vehicular Signal:
Standard traffic signal head with the following 3-lens configuration:
Red – Yellow – Green

Design of Pedestrian Signal:
Standard pedestrian countdown signal head

Operation:

- The signal is activated when a pedestrian presses a button
- The vehicular signal remains green until a pedestrian presses the pushbutton. The light then turns yellow and then red for the motorists at which time the traditional pedestrian "WALK" phase begins. Vehicles at minor legs of the intersection are controlled with stop signs.

Figure 11.9 - Hawk Signal in Tucson, Arizona
(Photo by Richard B. Nassi)

High Intensity Activated Crosswalk (HAWK) Signals

The HAWK (**H**igh-intensity **A**ctivated Cross**W**al**K**) signal is similar to the pedestrian crossing signal but has a different signal operation. In the City of Tucson, Arizona, the signal, combined with a media campaign has generated a high driver yield rate, increasing compliance from 30 percent, under normal conditions to 93 percent over an eight-month study period. This treatment is profiled in ITE's *Traffic Control Devices Handbook*.

Placement:
The HAWK signal is particularly suited for uncontrolled crossings of multi-lane, higher speed or volume roadways where there is a need to provide occasional pedestrian crossings without inordinate delay to motor vehicles (i.e. school crossings).

Design of Vehicular Signal:
Traffic signal head with the following 3-lens configuration:
Dark-flashing yellow-solid yellow-solid red-flashing red-dark

Design of Pedestrian Signal:
Standard pedestrian countdown signal head

Operation:
The HAWK signal remains dark for vehicles and a DON'T WALK signal is shown for pedestrians until it's activated. The signal proceeds in the following manner upon activation by a pedestrian:

- A flashing yellow light alerts the driver that conditions are changing and to use caution. (Pedestrians see a steady "DON'T WALK" signal)
- A steady yellow light alerts drivers that they should prepare to stop.
- A steady red light gives the clear signal to motorists to stop for pedestrians (pedestrians receive the "WALK" signal)
- After a set interval, a wigwag flashing red signal (i.e. top and bottom alternating red flash) is used to indicate to drivers to stop and only proceed after pedestrians have cleared the crosswalk (pedestrians receive the flashing "DON'T WALK" signal).

Pelican Crossings
PELICAN (pedestrian light control activated) crossings are used at midblock locations with pedestrian refuge islands. This type of signal is valuable because it minimizes vehicular delay and is relatively easy to fit within an existing arterial synchronization system.

Figure 11.10 - Pelican Signal in Tucson, Arizona
(Photo by Richard B. Nassi)

Placement:
The PELICAN signal is particularly suited for midblock crossings of multi-lane, higher speed or volume roadways.

Design of Vehicular Signal:
Standard traffic signal head with the following 3-lens configuration:
Red – Yellow – Green.

Design of Pedestrian Signal:
Standard pedestrian countdown signal head on each crossing leg

Operation:
The PELICAN signal remains green for vehicles and "DON'T WALK" is displayed for pedestrians until the signal is activated. The signal proceeds in the following manner upon activation:

- Upon activation by a pedestrian, the signal enters into a programmed countdown mode to activate the solid yellow light to alert drivers that they should prepare to stop. (Pedestrians see a steady "DON'T WALK" signal)
- A steady red light gives the clear signal to motorists to stop for pedestrians (pedestrians receive the "WALK" signal)
- A flashing yellow then indicates that drivers may proceed through the crosswalk if not occupied by a pedestrian.
- Pedestrians cross in two stages, first to a raised median island and then to another signalized crossing point where they press another button and the process repeats

Toucan Crossings

Toucan Crossings (**Two can** cross the roadway). This signal was developed to assist pedestrians and bicyclists with crossing an arterial type roadway where a full traffic control signal is not warranted. This is the only signal that provides a push button or other type of detection for bicyclists as well as a push button for pedestrians. The separate detection for pedestrians and bicyclists allows for the clearance interval to change depending on the speed of the user crossing the roadway.

Figure 11.11 - Toucan Signal in Tucson, Arizona
(Photo by Richard B. Nassi)

Placement:
The TOUCAN signal is particularly suited for crossings of multi-lane, higher speed or volume roadways at a point where a bicycle route or shared use pathway crosses the roadway.

Design of Vehicular Signal:
Traffic signal head with a 3-lens configuration of either Red-Yellow-Red or Red – Yellow- Green depending whether the PELICAN or HAWK function is used.

Design of Pedestrian Signal:
Standard pedestrian countdown signal head

Design of Bicycle Signal:
Standard traffic signal with bicycle symbol in each lens.
Red—Yellow—Green

Figure 11.12 - Example Bicycle Signal Head

Operation:
The operation may follow either the PELICAN or HAWK signal with the following modifications:

- The signal is activated by detection (pedestrian and/or bicycle detection)
- The length of the crossing time provided is adjusted to the mode detected (walking speed 3-3.5 feet/sec, or bicycling speed between 5-15 mph