



City and County of Denver

# UNCONTROLLED PEDESTRIAN CROSSING GUIDELINES

Prepared for:



**DENVER**  
THE MILE HIGH CITY

Revised April 2022

# Contents

for Denver Uncontrolled Pedestrian Crossing Guidelines

## **INTRODUCTION -- 02**

Purpose and Scope - 02

How to Use These Guidelines - 02

## **CROSSWALK BASICS -- 03**

Crosswalk Definitions - 03

Other Relevant Regulations - 03

Why Improve Crosswalks? - 07

## **EVALUATING CANDIDATE LOCATIONS -- 08**

Procedure - 08

Definition of Criteria - 09

## **TREATMENTS GUIDE -- 13**

Geometric Treatments - 13

Throat Width - 14

Marked Crosswalk Treatment Options - 14

Parking Prohibition - 20

Multi-way Stop Control - 20

Decorative Crosswalks - 20

Signing - 20

## **GLOSSARY -- 21**

# Introduction

## PURPOSE AND SCOPE

The purpose of the Uncontrolled Pedestrian Crossing Guidelines is to serve as the policy document that guides staff in determining where and how to improve an uncontrolled crosswalk within the City and County of Denver on City and County of Denver owned and maintained streets. The Uncontrolled Pedestrian Crossing Guidelines provide guidance to determine if a marked crosswalk is appropriate at a particular location, and then identify a range of enhancement treatments that may be appropriate depending on the site characteristics.

## HOW TO USE THESE GUIDELINES

These guidelines are intended to be used by City and County of Denver engineers and planners in determining whether to mark an uncontrolled crosswalk, and then to determine which treatment is most appropriate to ensure efficient function for all users and maintain pedestrian safety. When a specific location is being considered for a marked crosswalk – due to public feedback, a new development, or staff recommendation – this document serves as a guide to consistently and transparently determine an appropriate treatment, if any. It contains a background of relevant city and state regulations and design standards regarding pedestrian crosswalks. These guidelines provide the necessary references for clarifying the legal rights of people walking and people driving in crosswalk scenarios.

Once a specific location is identified, refer to the flowchart in **Figure 1** to determine



if a marked crosswalk is appropriate. The flowchart brings together various criteria to make this determination. The “Evaluating Candidate Locations” section further explains how to apply the flowchart. If a marked crosswalk is appropriate, the “Crosswalk Treatment Guide” section contains a table that serves as a guide in identifying any enhanced treatments that are recommended for that location.

# Crosswalk Basics

## CROSSWALK DEFINITIONS

Denver Revised Municipal Code Section 54-1 provides the following definition for a crosswalk:

*Crosswalk shall mean that portion of a roadway included within the prolongation or connection of the lateral lines of sidewalks at intersections, or any portion of a roadway distinctly indicated for pedestrian crossing by lines or other marking on the surface.*

The following definitions are also helpful when implementing these guidelines:

An *uncontrolled crosswalk* is a legal crosswalk across a roadway approach not controlled by a stop sign or traffic signal.

A *controlled crosswalk* is a legal crosswalk across a roadway approach controlled by a stop sign or traffic signal.

An *unmarked crosswalk* is a legal crosswalk that does not feature any traffic control markings.

A *marked crosswalk* is a legal crosswalk that features traffic control markings.

A *midblock crosswalk* is a location not at an intersection, featuring traffic control markings to indicate that it is a legal crosswalk.

It is legal for a pedestrian to cross a local street at any marked or unmarked crosswalk. It is also legal for a pedestrian to cross a roadway between intersections where at least one adjacent intersection is not controlled by a traffic signal device. An example of an illegal crossing is at an unmarked midblock location between two signalized intersections.

## OTHER RELEVANT REGULATIONS

As a consolidated city and county, both the Colorado Revised Statutes and Denver Revised Municipal Code can apply to pedestrians and crosswalks in the City and County of Denver.

## COLORADO REVISED STATUTES

The Colorado Revised Statutes (CRS) contains a section on pedestrians, within Part 8 of Title 42: Vehicles and Traffic. These statutes contain specifications on pedestrians' right of way when crossing the street, either in a marked crosswalk, unmarked crosswalk, or outside of a crosswalk. Key elements of these statutes include:

### Section 42-4-802. Pedestrians' right of way in crosswalks

(1)...When traffic control signals are not in place or not in operation, the driver of a vehicle shall yield the right of way, slowing down or stopping if need be to so yield, to a pedestrian crossing the roadway within a crosswalk when the pedestrian is upon the half of the roadway upon which the

vehicle is traveling or when the pedestrian is approaching so closely from the opposite half of the roadway as to be in danger.

(2)....No pedestrian shall suddenly leave a curb or other place of safety and ride a bicycle, ride an electrical assisted bicycle, walk, or run into the path of a moving vehicle that is so close as to constitute an immediate hazard.

### **Section 42-4-803. Crossing at other than crosswalks**

(1)....Every pedestrian crossing a roadway at any point other than within a marked crosswalk or within an unmarked crosswalk at an intersection shall yield the right-of-way to all vehicles upon the roadway.

(2)....Any pedestrian crossing a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided shall yield the right of way to all vehicles upon the roadway.

(3)....Between adjacent intersections at which traffic control signals are in operation, pedestrians shall not cross at any place except in a marked crosswalk.

## **DENVER REVISED MUNICIPAL CODE**

In addition to the Colorado Revised Statutes, Denver has adopted the Denver Revised Municipal Code (DRMC). Drivers, bicyclists and pedestrians within the City and County of Denver can be cited and prosecuted under either state statute or city municipal code. Section 54 of the municipal code specifies traffic regulations. Key elements of the municipal code include:

### **Section 54-538. Right of way in crosswalks**

(a)....When traffic-control signals are not in place or not in operation, the driver of a vehicle shall yield the right of way, slowing down or stopping if need be to so yield to a pedestrian crossing the roadway within a crosswalk when the pedestrian is upon the half of the roadway upon which the vehicle is traveling, or when the pedestrian is approaching so closely from the opposite half of the roadway as to be in danger, but no pedestrian shall suddenly leave the curb or edge of the roadway, or other place of safety and walk or run into the path of a vehicle which is so close that it is impossible for the driver to yield the right of way. A pedestrian's right of way in the crosswalk is modified under the conditions and as stated in Section 54-540.

### **Section 54-540. Right of way when crossing at other than crosswalks**

(a)....Every pedestrian crossing the roadway at any point other than within a marked or unmarked crosswalk at an intersection shall yield the right of way to all vehicles upon the roadway.

(b)....Any pedestrian crossing a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided, but not using such facility, shall yield the right of way to all vehicles upon the roadway.

### **Section 54-541. Crossing at right angles.**

(b)....It shall be unlawful for any pedestrian to cross a roadway in any manner other than by a direct route at right angles to the roadway edge or by the shortest route from the nearest to the opposite roadway edge, except in a marked crosswalk or where crossing at any other angle to the roadway edge is authorized by the City Traffic Engineer.

### **Section 54-542. Prohibited crossing of roadways.**

(a)...It shall be unlawful for any pedestrian to cross a roadway at any place except in a crosswalk, between adjacent intersections at which traffic-control signals are in operation; except that pedestrians may cross on area designated as a pedestrian and transit mall at any point between intersections but shall yield the right of way to vehicles lawfully within the area designated as a pedestrian and transit mall.

(b)...It shall be unlawful for any pedestrian to cross a roadway that is a through street or through highway at any place other than a crosswalk.

(c)...Except on a local street, it shall be unlawful for any pedestrian to enter a roadway and to cross all or any portion of the same in any manner other than from the nearest roadway edge; except that pedestrians alighting from stopped vehicles shall proceed by a direct route to the nearest roadway edge before crossing the roadway as provided herein.

(d)...Except on a local street, it shall be unlawful for any pedestrian to cross a roadway directly to a vehicle stopped, parked or standing on the opposite side of the roadway.

### **Section 54-458. Parking prohibited at specified places.**

It shall be unlawful for any person to stop or allow a vehicle to stand except when necessary to avoid conflict with other traffic, or in compliance with law or the directions of a police officer or traffic-control device in any of the following places:

(5)...On a crosswalk

(6)...Within twenty (20) feet of a crosswalk or stop sign at an intersection

(7)...Within thirty (30) feet upon the approach to any flashing beacon or traffic-control signal located at the side of a roadway

## **DESIGN STANDARDS**

### **MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES**

The *Manual on Uniform Traffic Control Devices* (MUTCD, Federal Highway Administration, 2009) provides support, standards and guidance for traffic control devices (including markings, signs, beacons, and signals) used for marking and enhancing crosswalks. The MUTCD provides standards and guidance for the design of these traffic control devices, and it provides key considerations based on research from "Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled

Locations" (FHWA, 2002) regarding whether enhancement devices are necessary given a roadway's characteristics. No warrants are provided for when to mark a crosswalk (this decision is left to local jurisdictions) or for most enhancements; however, application guidance for a pedestrian hybrid beacon and a pedestrian signal warrant is included. The MUTCD states:

*Crosswalk lines should not be used indiscriminately. An engineering study should be performed before a marked crosswalk is installed at a location away from a traffic control signal or an approach controlled by a STOP or YIELD sign. The engineering study should consider the number of lanes, the presence of a median, the distance from adjacent signalized intersections, the pedestrian volumes and delays, the average daily traffic (ADT), the posted or statutory speed limit or 85th-percentile speed, the geometry of the location, the possible consolidation of multiple crossing points, the availability of street lighting, and other appropriate factors.*

*New marked crosswalks alone, without other measures designed to reduce traffic speeds, shorten crossing distances, 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:*

*A. 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*

*B. 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.*

### **NATIONAL ASSOCIATION OF CITY TRANSPORTATION OFFICIALS (NACTO) URBAN STREET DESIGN GUIDE**

The City and County of Denver officially endorsed the National Association of City Transportation Officials (NACTO) *Urban Street Design Guide*. The guide offers a vision for creating a more livable city and improving the convenience of pedestrians, bicyclists, drivers, and transit users. This document provides specific guidance on the design and implementation of conventional and midblock crosswalks.

Recommendations in the NACTO *Urban Street Design Guide* include the addition of vertical elements to midblock crosswalks, increasing sight distance at crosswalks, marking the crosswalk, and the implementation of medians or pedestrian refuge islands.

Where there are conflicts between MUTCD and NACTO, standards and guidance within MUTCD take precedence.

### **FEDERAL HIGHWAY ADMINISTRATION (FHWA) GUIDE FOR IMPROVING PEDESTRIAN SAFETY AT UNCONTROLLED CROSSING LOCATIONS**

The FHWA published this guide in January 2018 with an update in July 2018 to include guidance on the Rapid Rectangular Flashing Beacon (RRFB). Its purpose is to help transportation departments develop policies or guidelines for evaluating treatments at uncontrolled pedestrian crossing locations. The suggested process for determining appropriate countermeasures includes the following steps:

1. Collect data and engage the public
2. Inventory conditions and prioritize locations
3. Analyze crash types and safety issues
4. Select countermeasures
5. Consult design and installation resources
6. Identify opportunities and monitor outcomes

Step 4 provides a table of recommended countermeasures for various roadway configurations, traffic volumes, and traffic speeds. The recommendations are all based on a compilation of past research efforts intending to evaluate the effectiveness of particular treatments under specific conditions. The 2022 update to Denver's Uncontrolled Pedestrian Crossing Guidelines

incorporated these recommendations into **Table 4**. Additionally, the Step 4 section of the FHWA guide also contains a table that lists countermeasures with the safety issues they may address, such as excessive vehicle speed or drivers failing to yield to pedestrians in crosswalks. This table may be helpful for roadway designers as a supplement to the guidance laid out in this document.

### COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) ROADWAY DESIGN GUIDE

The types of devices recommended for uncontrolled crosswalks in the CDOT *Roadway Design Guide* are similar to those recommended in this document. However, CDOT has slightly different standards with regards to the device recommended for the number of travel lanes, speed, and volume. If a street is CDOT owned, refer to the CDOT *Roadway Design Guide*.

## WHY IMPROVE CROSSWALKS?

It is important to provide designated facilities for pedestrians to use the transportation network safely and without unreasonable delay. Crosswalks provide an important connection for pedestrians. The pedestrian network should be designed in such a way that pedestrians are not unreasonably either forced to wait for a gap in traffic or walk out of their way for an enhanced crosswalk. The *Highway Capacity Manual 2010* states that when a pedestrian is forced to wait 30 seconds or longer, they are highly likely to exhibit risk-taking behavior.

Crosswalks that are appropriately marked and enhanced provide pedestrians with a convenient and safer opportunity to cross the street. Marked crosswalks are valuable in that they direct pedestrians to a designated place to cross, alert drivers as to the potential presence of pedestrians, and visually establish the crosswalk at non-intersection locations.

Marking and appropriately enhancing crosswalks is one method for creating gaps in traffic to allow pedestrians to cross the street; however, research has not conclusively shown a safety benefit of marking and appropriately enhancing crosswalks. Research studying the effectiveness of various crossing treatments measures yield compliance as a proxy for safety.

The National Cooperative Highway Research Program (NCHRP) 17-56 researched the safety effects of marked crosswalks and four treatment types including RRFBs, PHBs, pedestrian refuge islands, and advanced yield or stop markings and signs. The study concluded:

*All four of the treatment types were found to be associated with reductions in pedestrian crash risk compared to the untreated sites. PHBs with advanced yield or stop markings and signs were associated with the greatest benefit to pedestrian crash risk, followed by RRFBs, pedestrian refuge islands, and advanced yield or stop markings and signs.*

Research on the safety effects of other devices including pedestrian hybrid beacons, lane widths, road diets, and medians is already well-documented.



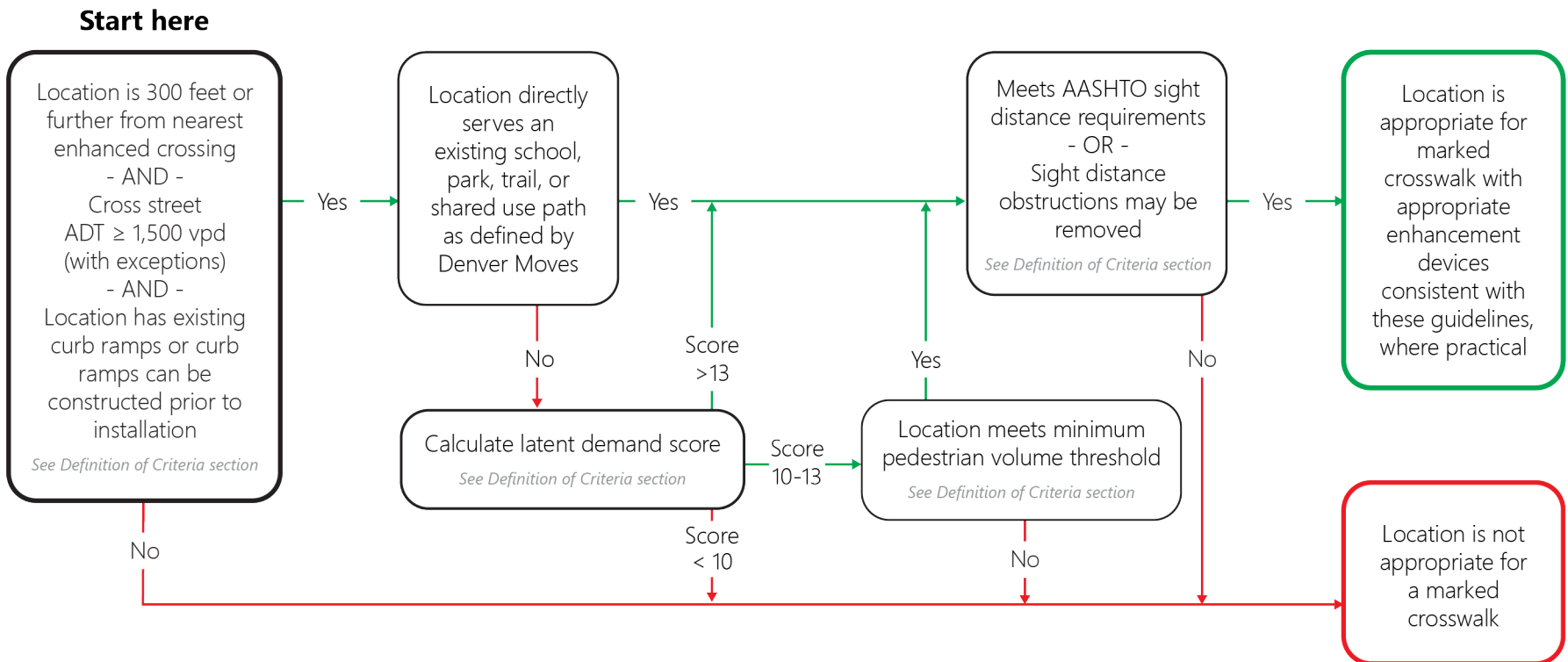
# Evaluating Candidate Locations

## PROCEDURE

Candidate crosswalk locations should be evaluated using the Candidate Location Flowchart. To use this flowchart, start on the left and proceed through each box based on whether the location in question does or does not meet the criteria. Continue until you reach the red box, meaning that the location is inappropriate for additional treatment, or a green box, meaning that a location is appropriate for additional treatment.

**Use the definitions and instructions in the subsequent section for calculating criteria in the flow chart.**

Figure 1: Candidate Location Flowchart



## DEFINITION OF CRITERIA

The following provides discussion and guidance on the criteria shown in the Candidate Location Flowchart:

### LOCATION IS 300 FEET OR FURTHER FROM NEAREST CROSSING

Use GIS, Google Earth, or visit the location to measure the distance from the proposed crosswalk to the nearest existing enhanced crossing (signalized crossing, stop-controlled crossing, or other marked crosswalk with appropriate enhancement devices). A distance of 300 feet or further is necessary for a location to qualify to be considered for a marked crosswalk.

### LOCATION MEETS VOLUME THRESHOLD

Exceptions to the 1,500 vpd minimum roadway volume may be made with City Traffic Engineer approval based on adjacent land use such as schools and parks or trail crossings.

## PEDESTRIAN INFRASTRUCTURE REQUIREMENT

Locations that are found to be appropriate for crossing improvements should have existing pedestrian curb ramps. If none exist, new pedestrian curb ramps that meet current DOTI standards are required to be constructed prior to the installation of a marked crosswalk.

Exceptions to this requirement based on special circumstances may be reviewed by DOTI's Accessibility Technical Interpretation Committee.

### LOCATION MEETS LATENT DEMAND SCORE

Acknowledging that existing infrastructure does not always allow for safe observed pedestrian activity, a latent demand score was developed to determine where enhanced pedestrian crossings could induce more pedestrian crossing activity. The latent demand score incorporates the Denver Moves Pedestrian Demand Index (Demand Score) as well as three other destination variables: proximity to activity generators (Activity Score), proximity to transit stops (Transit Score), and connections to the Denver Moves bike network (Bikeway Score).

The Pedestrian Demand Index estimates the latent demand for walking based on data variables known to contribute to high levels

of walking including population density, employment density, and population/employment diversity. The Demand Score is dependent on how high the Pedestrian Demand Index is at the proposed crossing location.

According to Denver Moves: Pedestrians and Trails (2019) (Goal 3: Destination Access), activity generators include schools, parks, health centers, senior centers, recreation or community centers, libraries, grocery stores, pharmacies, or neighborhood-embedded commercial districts. If a proposed crossing is within 300 feet of an activity generator or within a quarter mile of a regional park (as defined by Denver Moves), the Activity Score is increased.

Recognizing that all transit trips are also pedestrian trips, the Transit Score is calculated according to the proximity of the proposed crossing to a bus stop or rail station. Specifically, if a proposed crossing is within 300 feet of a bus stop or within 500 feet of a rail station, the Transit Score is increased.

When proposed crossings combine access with an existing or planned bikeway, this increases the Bikeway Score, as people bicycling are also vulnerable roadway users.

See **Table 1** on the next page to calculate latent demand score.

Table 1: Latent demand scoring matrix

Category	Variable	Definition	Data Source	Scoring Assignment	
Pedestrian Demand	Pedestrian Demand Index	Crossings in areas with high pedestrian demand, based on the Denver Moves Pedestrian Demand Index.	<a href="#">Pedestrian Demand Index</a>	Pedestrian Demand Index	Demand Score
				< 5	0
				5 - 6	5
				> 6	7.5
Destination Criteria	Activity Generator Destination	Crossings within 300 feet of a school, park, health center, senior center, recreation or community center, library, grocery store, pharmacy, or neighborhood-embedded commercial district; or within a quarter mile of a regional park.	Field visit, Google Maps, <a href="#">GIS data</a>	Proximity	Activity Score
				None	0
				One destination	5
	> One destination	7.5			
	Transit Destination	Crossings within 300 feet of a bus stop or 500 feet of a rail station.	Field visit, Google Maps, <a href="#">GIS data</a>	Proximity	Transit Score
				None	0
				Bus stop	2
	Rail station	5			
	Connection to Bike Network	Crossings that combine access with the existing and planned bike network.	Field visit, Google Maps, <a href="#">GIS data</a>	Location	Bikeway Score
Not on bike network				0	
On bike network	5				
<b>TOTAL</b>				<b>Score (0 - 25)</b>	

Arrive at the total score using the aforementioned criteria. Compare the total score to **Table 2**. Follow the procedure based on the score (consistent with the Candidate Location Flowchart).

**Table 2: Total latent demand score and procedure**

Total Latent Demand Score	Procedure
<10	Inappropriate for marked crosswalk. Needs City Traffic Engineer approval for variance.
10 - 13	Recommend collecting pedestrian counts to determine if location meets minimum pedestrian volume threshold.
>13	Location may be appropriate for a marked crosswalk. Advance to the next step in the flowchart.

### LOCATION MEETS MINIMUM PEDESTRIAN VOLUME THRESHOLD

In order to determine if a location meets this criterion, complete a pedestrian count during the anticipated peak hours. Count the number of pedestrians at the candidate crosswalk location and within the vicinity likely to use the crosswalk location. This typically includes pedestrians traveling within the intersection influence area, which may include pedestrians crossing downstream and upstream of the intersection depending on roadway and land use characteristics. Vulnerable pedestrians count 1.33x people towards volume thresholds when data is available. Vulnerable populations include children, the elderly, and persons with disabilities. The identification of vulnerable users will be determined by professional judgment of the individual counting in the field.

Identify the peak hour and determine if it meets one of the minimum pedestrian volume thresholds:

- 20 peds/hour in any 1 hour; or
- 18 peds/hour in any 2 hours; or
- 15 peds/hour in any 3 hours

Pedestrian counts no more than three years old can be applied, as long as the location's conditions have not significantly changed.

### LOCATION MEETS AASHTO SIGHT DISTANCE REQUIREMENTS

The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* manual (also known as the "Green Book") describes sight distance as "the length of the roadway ahead that is visible to the driver." Sight distance should be sufficient to allow for a vehicle traveling at the design speed to stop before reaching a stationary object. **Table 3**, from Chapter 3.2.2 of the AASHTO Green Book, shows the minimum sight distance required at various design speeds.

**Table 3: Stopping sight distance on level roadways**

Design Speed (mph)	Stopping Sight Distance (ft)
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495

## EXCEPTIONS TO CRITERIA

In some cases, it may be reasonable to allow exceptions to the criteria identified above. Approval from the City Traffic Engineer is required for exceptions to these criteria. Any exceptions should be appropriately documented. Any situations that are not clearly defined in this guide should also be brought to the City Traffic Engineer for review and determination. If the engineer anticipates that a location may meet the 20 pedestrians per hour requirement, the above procedure does not preclude counts from being collected. Engineering judgment should be exercised in all situations. There will be locations that should or should not be marked due to other factors including frequency of marked crosswalks along a corridor and other corridor characteristics.

# Treatments Guide

## GEOMETRIC TREATMENTS

Before implementing a marked crosswalk, staff should evaluate the feasibility of:

1. Reducing travel speed along the corridor,
2. Narrowing or eliminating travel lanes,
3. Reducing the volume on the street, or
4. Other context appropriate traffic calming measures.

Implementing one or more of these modifications may affect whether or not a marked crosswalk is appropriate (per the process for evaluating candidate locations) or may reduce the level of crossing treatment necessary (for example, a Level A device instead of Level B device, per **Table 4**). In addition to these modifications, the following geometric treatments should be considered for proposed crosswalk installations. These treatments were developed following guidance from the FHWA *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*. Drainage impacts and impacts to emergency services must be considered prior to installation.

## RAISED CROSSING OR INTERSECTION

A raised mid-block crossing or raised intersection treatment may be installed as a traffic calming measure. These improvements are appropriate on one- to three-lane roadways with fewer than 9,000 ADT and posted speeds of 30 mph or less.

## PEDESTRIAN REFUGE ISLAND

Pedestrian refuge islands are located in the center of roadways, separating traffic of opposite directions, with a pedestrian path provided perpendicular to the roadway being crossed. Pedestrian refuge islands provide the opportunity for pedestrians to cross the street in two stages, finding gaps in traffic one direction at a time. Pedestrian refuge islands can be installed on two-lane roadways and multi-lane roadways with or without an existing two-way left-turn lane. Roadways without a two-way left-turn lane typically require lane transitions in advance of the refuge island and/or removal of parking.

## SPLIT PEDESTRIAN CROSSOVER MEDIAN REFUGE ISLAND (AKA Z-CROSSING)

The split pedestrian crossover median refuge island is similar to the pedestrian refuge island, except the crosswalks are offset on either side of the median creating a staggered pedestrian path. This configuration forces pedestrians to turn within the median to walk towards oncoming traffic prior to crossing the second half of the roadway.

## CURB EXTENSIONS

Curb extensions are elongations of the sidewalk that narrow the roadway. They shorten the crossing distance for pedestrians while also making pedestrians more visible to drivers. Visually narrowing the roadway has also been shown to slow vehicular traffic.

## THROAT WIDTH

Throat width, or clear width, is the distance between curb faces or flowlines at an intersection. Minimum throat width dimensions at two-way, single lane intersection approaches are as follows:

- Striping only: 20 feet minimum
- Striping plus vertical elements (flex posts): 20 feet minimum plus 2-foot offset for flex posts from striping (24 feet)
- Hard vertical curb faces: minimum 25 feet (two-way), 20 feet (one-way)

Adjustments to these widths may be needed based on roadway characteristics, Denver Fire requirements, and design vehicle turning envelope requirements. The minimum width of a curb extension is 5 feet from flowline to center of stripe. Flex posts cannot be installed in gutter or drainage pans. Refer to the Denver Fire Code Amendments for information on clear space requirements that need to be met along roadway segments. These widths vary based on land use and other factors.

## MARKED CROSSWALK TREATMENT OPTIONS

Once it has been determined that a marked crosswalk should be installed (using the flowchart in **Figure 1** and engineering judgment) and feasibility of geometric treatments have been evaluated, the appropriate crosswalk treatment should be determined. There are three levels of treatment enhancements for marked crosswalks.

**Table 4** on the next page outlines which level of treatment to apply based on traffic volumes, speed limit (assuming the speed limit is set at the 85th percentile speed), and roadway configuration. Designations were determined from compliance rates in related research and engineering judgment. Previously performed speed studies no more than three years old can be applied, as long as the location's conditions have not significantly changed. The table also includes possible geometric enhancements the engineer should consider along with a marked crosswalk.

When applying **Table 4** at an uncontrolled intersection leg on a signalized corridor, Level A may be upgraded to B with approval of the City Traffic Engineer. Level A may also be upgraded to B if a gap study reveals insufficient gaps to safely cross. When using **Table 4**, the analyst may consider unusual site conditions such as block length, median width, roadway gradient, adjacent land use, or other aspects that distinguish the crossing from typical consideration.

**Table 4: Recommended treatment at marked crosswalks**

Roadway Type	Vehicle ADT ≤9,000			Vehicle ADT >9,000 to 15,000			Vehicle ADT ≥15,000		
	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph	≤30 mph	35 mph	40 mph
<b>2 Lanes</b> (1 lane in each direction)	A 1 2 4 6	A 4 6	B 4 6	A 4 6	A 4 6	C 4 6	B 4 6	B 4 6	C 4 6
<b>3 lanes with raised median / Single lane one-ways</b> (1 lane in each direction)	A 1 2 3 6	A 3 6	B 3 6	B 2 3 6	B 3 6	B 3 6	B 2 3 6	B 3 6	C 3 6
<b>3 lanes w/o raised median</b> (1 lane in each direction with a left-turn lane)	A 1 2 3 4 6	A 3 4 6	C 3 4 6	B 3 4 6	B 3 4 6	C 3 4 6	C 3 4 6	C 3 4 6	C 3 4 6
<b>4+ lanes with raised median</b> (2 or more lanes in each direction)	A 3 5 6	A 3 5 6	C 3 5 6	B 3 5 6	B 3 5 6	C 3 5 6	C 3 5 6	C 3 5 6	C 3 5 6
<b>4+ lanes w/o raised median/ Multilane one-ways</b> (2 or more lanes in each direction)	A 3 4 5 6	B 3 4 5 6	C 3 4 5 6	B 3 4 5 6	B 3 4 5 6	C 3 4 5 6	C 3 4 5 6	C 3 4 5 6	C 3 4 5 6

**Geometric Enhancements:**

1. Raised Crosswalk
2. In-street pedestrian sign
3. Advanced “yield here to” markings & signage
4. Pedestrian refuge island
5. Road diet
6. Curb Extensions

Level	Treatment
A	Markings & Signage
B	RRFB
C	PHB or Signal

**Notes:**

Refer to the table instructions on the previous page for more information on how to use this table, such as when exceptions may be required or permitted. Explore geometric enhancements prior to the implementation of the treatment identified in the table.

The recommendations in this table were updated based off of research summarized in the Federal Highway Administration’s Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (FHWA-SA-17-072).

When applying this table at an uncontrolled intersection leg on a signalized corridor, Level A may be upgraded to B with approval of the City Traffic Engineer. Level A may also be upgraded to B if a gap study reveals insufficient gaps to safely cross.



## LEVEL A: MARKINGS & SIGNING

The most basic treatment for a location that qualifies for a marked crosswalk is markings and signing only.

- Markings should be standard continental markings.
- Signing should be W11-2 with W16-7P placards.
- Where a crossing exists in a school zone, use S1-1 in place of W11-2.
- Where a bikeway or trail crossing exists, use W11-15 and W16-7P. A W11-15P supplemental plaque may be mounted below the W11-15.
- On two and three lane roadways without a median, signs should be mounted adjacent to the pedestrian ramp behind the curb.
- On multilane roadway approaches, add advanced yield lines (20 to 50 feet in advance, as identified by the MUTCD) and R1-5 signs with a fluorescent yellow-green STATE LAW border.
- Where a median is present and there are more than two lanes in each direction, the W11-2, W11-15, or S1-1 signs and W16-7P placards should be mounted both adjacent to the pedestrian crossing above the curb and in the median.

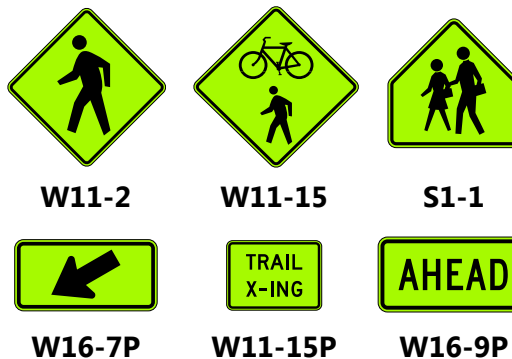
## LEVEL B: RAPID RECTANGULAR FLASHING BEACON

Rapid Rectangular Flashing Beacons (RRFBs) are generally designated for locations with higher traffic volumes, higher traffic speeds, and more travel lanes.

- Follow all markings and signage guidance listed for Level A.
- On two and three lane roadways without a median, signs and RRFBs should be mounted above the curb adjacent to the pedestrian crossing location. The push buttons shall be placed per accessibility requirements.
- On multilane roadway approaches, overhead RRFBs are optional.
- Where a median is present, signs and RRFBs should be mounted both at the roadside and in the median. RRFBs can be passively activated or activated with a push button.

### Standard Pedestrian Crossing Signage

Fluorescent yellow-green (FYG) color is preferred for all new installations, as opposed to traditional yellow.



## LEVEL C: PEDESTRIAN HYBRID BEACON OR SIGNAL

Full traffic signals or pedestrian hybrid beacons (PHBs) (also known as “HAWK” signals) should be used where Level A or Level B devices are not effective for providing safe and efficient crossings.

- Follow all markings and signage guidance listed for Level A.
- The 2009 Edition of the Manual on Uniform Traffic Control Devices (MUTCD) provides guidance on the installation of PHBs for major streets. Use **Figure 2** for roadways where the 85th percentile speed is 35 mph or less, and **Figure 3** for roadways greater than 35 mph. Determine the number of vehicles in the peak hour on both approaches of the major street. Determine the number of pedestrians in the peak hour. Measure the length of the proposed crosswalk. If the plotted point falls above the line of the respective crosswalk length shown in **Figures 2 and 3**, then a pedestrian hybrid beacon is recommended.

## MUTCD PEDESTRIAN HYBRID BEACON APPLICATION GUIDANCE

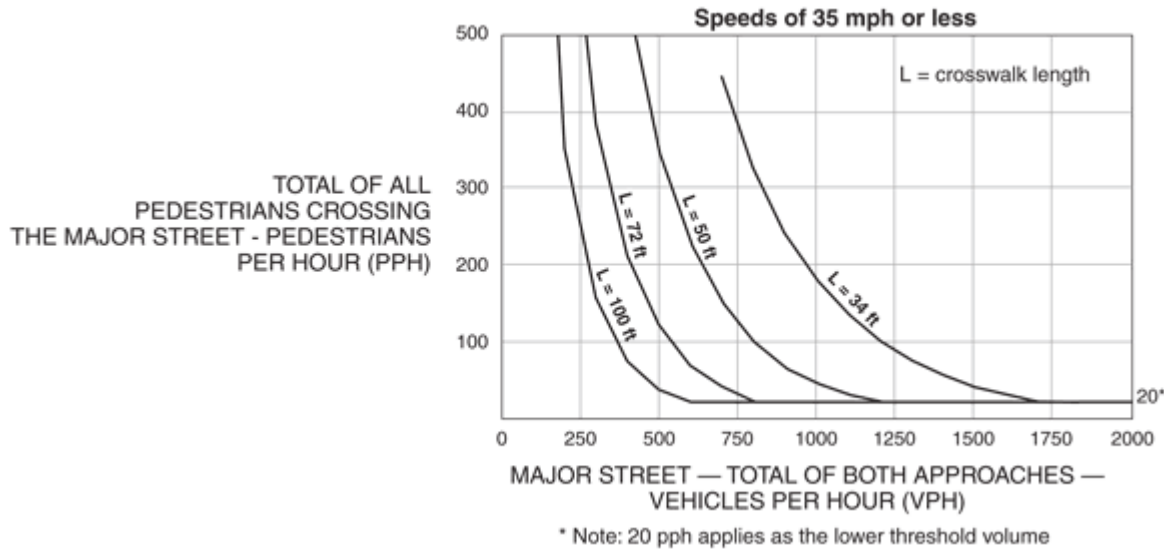


Figure 2: MUTCD guidelines for the installation of pedestrian hybrid beacons on low-speed roadways

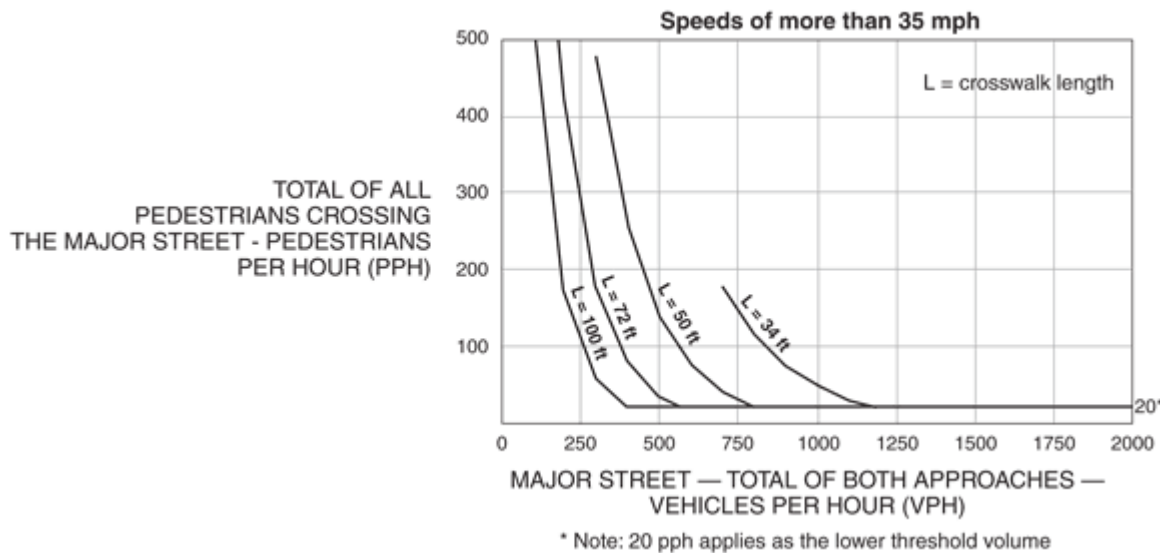
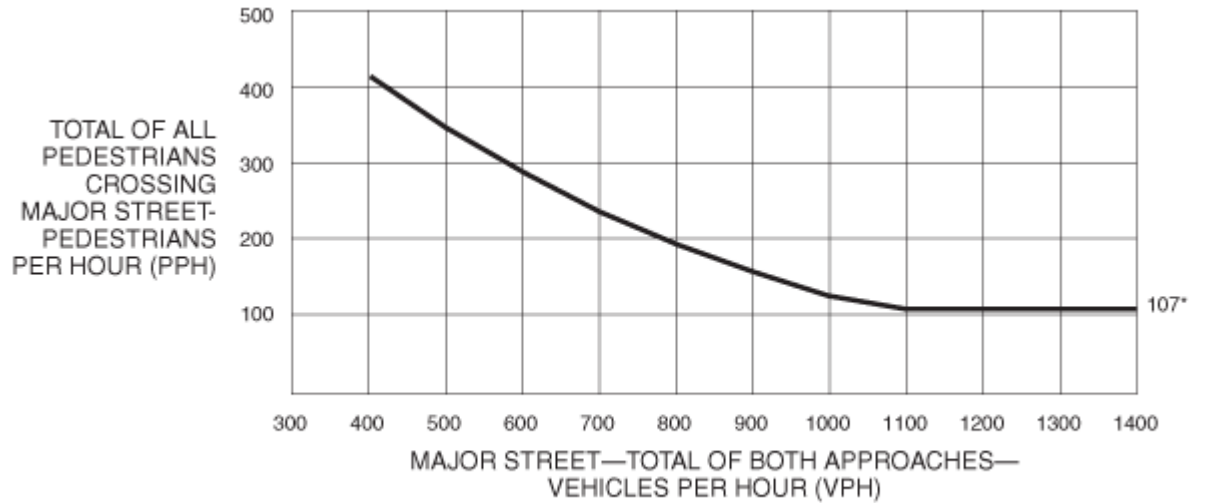


Figure 3: MUTCD guidelines for the installation of pedestrian hybrid beacons on high-speed roadways

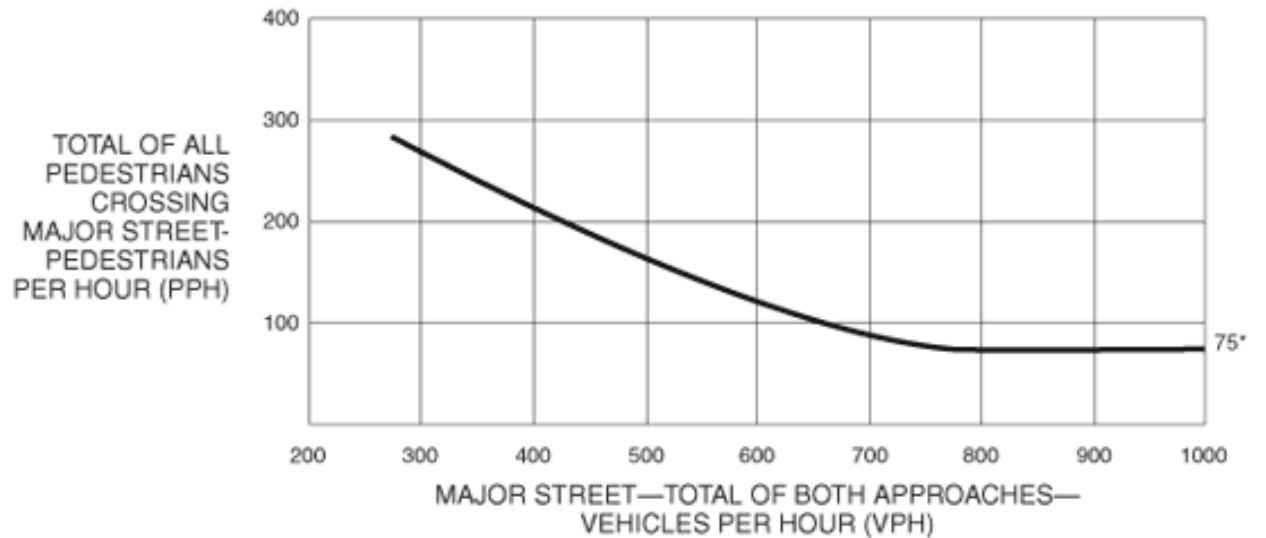
The 2009 Edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) also provides warrants for the installation of pedestrian signals. The following four figures show the number of pedestrians per hour crossing the major street necessary to warrant a pedestrian signal based on the number of vehicles per hour on the major street. **Figures 4 and 5** show the warrant for the four hour volumes and **Figures 6 and 7** show the warrant for the peak hour. **Figures 5 and 7** show the warrant when a location has a posted speed limit or the 85th percentile speed on the major street exceeds 35 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000. These circumstances are referred to as the 70 percent factor.

**Figure 4: MUTCD warrants for the installation of pedestrian signal for four hour volumes**



\*Note: 107 pph applies as the lower threshold volume.

**Figure 5: MUTCD warrants for the installation of pedestrian signal for four hour volumes (70 percent factor)**



\*Note: 75 pph applies as the lower threshold volume.

Figure 6: MUTCD warrants for the installation of pedestrian signal at peak hour

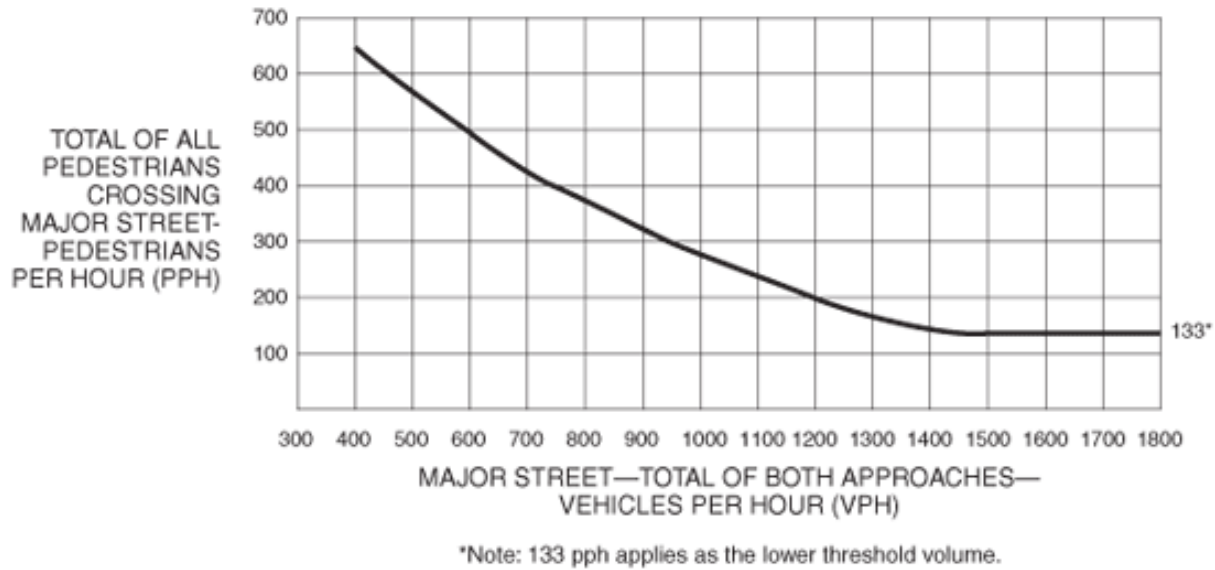
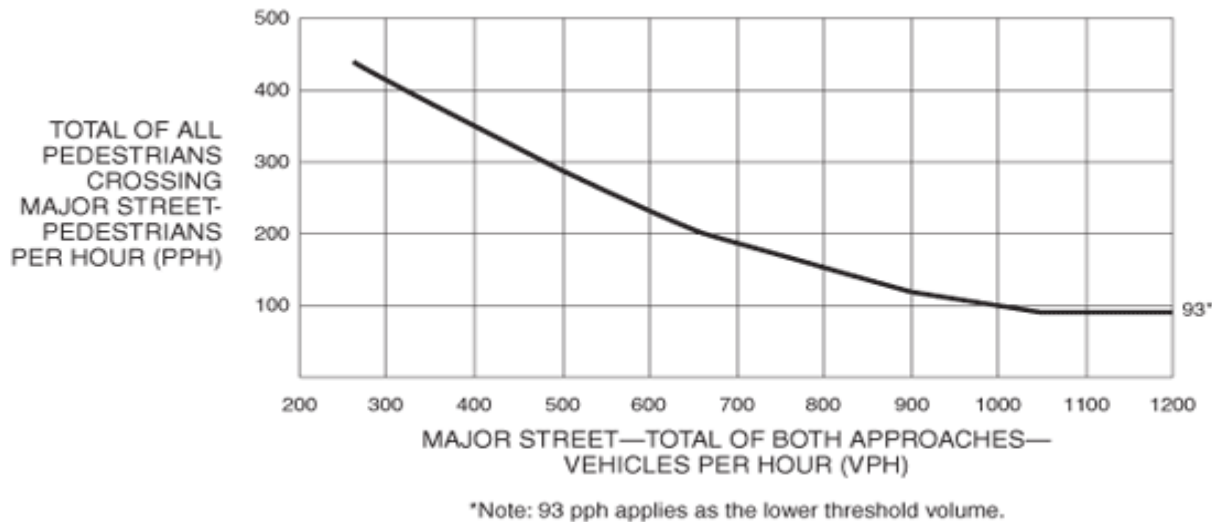


Figure 7: MUTCD warrants for the installation of pedestrian signal at peak hour (70 percent factor)



## PARKING PROHIBITION

In accordance with Denver Revised Municipal Code Section 54-458, parking is prohibited on a crosswalk, within 20 feet of a crosswalk, or within 30 feet from a flashing beacon or traffic control signal (such as at a railroad crossing). These restrictions should be implemented as appropriate with crosswalk markings or enhancements.

## MULTI-WAY STOP CONTROL

The City has a policy in place allowing multi-way stops at intersections based on specific criteria. Marked crosswalks will also be installed at these multi-way stops. At locations that meet the multi-way stop control policy's criteria where this document would otherwise suggest a Level A, B, or C treatment, a multi-way stop may be an appropriate alternate treatment.

## DECORATIVE CROSSWALKS

Decorative crosswalks should not be used in place of continental markings at uncontrolled crosswalks. An effectiveness study showed a statistically significant (37 percent) increase in safety with the use of continental crosswalks as compared to standard markings. This proven safety benefit of continental crosswalks defends the use continental markings instead of decorative markings at uncontrolled crosswalks.

## SIGNING

The signing associated with each level of treatment is previously described in this section. The signs are pictured below.

Because crosswalk locations have already met the sight distance requirements, as shown in Table 3, locations should therefore have the appropriate perception-reaction time (PRT). However, additional advanced signage may be provided where an engineering study or engineering judgment deems it necessary. It is important to avoid placing too many signs, as research shows that an overabundance of signs reduces their effectiveness.

### ADVANCED SIGNAGE AND MARKINGS

On roadways with multilane approaches, add advanced yield lines and Yield Here to Pedestrians (R1-5) signage 20 to 50 feet in advance, as identified by the MUTCD. Denver uses the fluorescent yellow-green (FYG) border for these signs.

Along roadways with posted speed limits of 35 mph or higher, additional advanced warning signage consisting of W11-2, W11-15, or S1-1 with a W16-9P AHEAD plaque is recommended.

## IN-STREET YIELD SIGNAGE

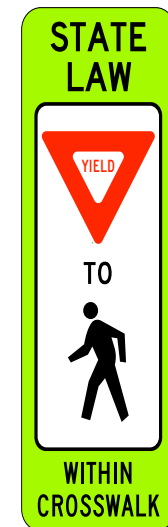
In-street Yield to Pedestrian Signs (R1-6) may be installed either in the roadway between travel lanes or on a median. Signs with an FYG border is standard for new installations in Denver. This treatment is recommended on 2 to 3 lane two-way roadways with posted speeds of 30 mph or less. Where vehicle volumes are 9,000 ADT or greater, in-street signage should only be installed if a median is present to avoid excessive maintenance costs. Maintenance factors may determine when/where these are placed. If repetitive replacement of the signs is required, they may be permanently removed.

### Standard Pedestrian Yield Signage

FYG is standard for all new installations.



R1-5



R1-6

# Glossary

**AASHTO** American Association of State Highway and Transportation Officials

**ADA** Americans with Disabilities Act

**CRS** Colorado Revised Statutes

**DRMC** Denver Revised Municipal Code

**HCM** Highway Capacity Manual

**MUTCD** Manual on Uniform Traffic Control Devices

**NACTO** National Association of City Transportation Officials

**PHB** Pedestrian Hybrid Beacon

**RRFB** Rapid Rectangular Flashing Beacon

