



COLORADO
Department of Transportation

COLORADO DEPARTMENT OF TRANSPORTATION



Guidelines for Pedestrian Signal Timing

2024 Edition

Prepared by



ACKNOWLEDGEMENTS

FHWA (2023) *Manual on Uniform Traffic Control Devices*

U.S. Access Board 2023, *Public Right-of-Way Accessibility Guidelines*

Nitin Deshpande, CDOT Traffic Safety & Engineering

David Craft, CDOT Traffic Safety & Engineering

Chris Vokurka, CDOT Region 1

Pepper Whittlef, CDOT Region 2

Jonathan Woodworth, CDOT Region 4

Sam Sanders, CDOT Region 5

Carlos Botello, City of Thornton

Anna Bunce, City of Centennial

Matt Duncan, City of Lakewood

David DiGiacomo, City and County of Denver

Mary Hamann, City of Louisville

Matthew Koenig, City of Thornton

Jerry Luor, DRCOG

Zeke Lynch, Douglas County

Greg MacKinnon, DRCOG

Michelle Melonkis, City of Lafayette

Danny Montoya, Douglas County

Josh Sender, Adams County

Tim Weaver, City of Littleton

John Yu, City and County of Denver



COLORADO
Department of Transportation

Published on 11/04/2024

HQ Traffic Safety and Engineering Branch

2829 West Howard Place, 4th Floor

Denver, CO 80204

Telephone: (303) 757-9654

Fax: (303) 757-9219

TABLE OF CONTENTS

INTRODUCTION	1
BACKGROUND	1
PURPOSE	1
GENERAL INFORMATION	1
ACRONYMS	1
DEFINITIONS	1
APPLICABLE STATUTES	3
ADDITIONAL RESOURCES	4
PEDESTRIAN TIMING INTERVALS	4
WALK INTERVAL	5
SHORTER WALK INTERVAL CONSIDERATIONS	5
LONGER WALK INTERVAL CONSIDERATIONS	6
PEDESTRIAN CLEARANCE TIME	6
ROUNDING	7
CROSSING DISTANCE MEASUREMENT	7
MUTCD CHECK OF CHANGE AND CLEARANCE INTERVALS	9
OTHER PEDESTRIAN TIMING CONSIDERATIONS	10
SIGNAL PREEMPTION AND PEDESTRIAN TIMING	10
PEDESTRIAN RECALL	11
EXCLUSIVE PEDESTRIAN PHASE	11
LEADING PEDESTRIAN INTERVAL	11

INTRODUCTION

BACKGROUND

It is the mission of CDOT to provide the best multi modal transportation system for Colorado that most effectively and safely moves people, goods, and information. CDOT policy, state statute, and federal surface transportation regulations place a strong emphasis on creating a system for use by persons of all ages and abilities for safe and convenient access to jobs, services, schools, and recreation. The Chief Engineer Design Guidance expresses support for taking a flexible approach when designing and planning our state transportation system and helps identify resources to provide context sensitive solutions particularly related to pedestrian accommodation.

CDOT has identified goals to advance the safety of Colorado's transportation system, so all travelers arrive at their destination safely and to reduce the number of traffic-related fatalities and serious injuries. These guidelines have been developed to identify best practices for ensuring that pedestrians have sufficient time to cross to the opposing side of a traveled way at signalized pedestrian crossings.

PURPOSE

Signalized pedestrian crossings are designed to provide sufficient time for pedestrians to cross to the opposing side of a roadway. The *Guidelines for Pedestrian Signal Timing* were developed to guide staff in developing traffic signal timing at signalized pedestrian crossings. These guidelines were developed to document CDOT recommended practices and supplement the requirements for pedestrian timing intervals at signalized crossings provided in the *Manual on Uniform Traffic Control Devices* (MUTCD) developed by the Federal Highway Administration (FHWA) with the latest edition released in 2023.

The *Public Right-of-Way Accessibility Guidelines* (PROWAG), developed by the U.S. Access Board (2023), provide accessibility requirements for pedestrians at signalized pedestrian crossings. Where there are differences between the MUTCD and PROWAG, the CDOT guidelines were based on the MUTCD. When the CDOT guidelines were developed, the FHWA was reviewing the sections of the MUTCD affected by PROWAG. CDOT plans to update future versions of the CDOT guidelines to reflect any applicable updates to the MUTCD.

GENERAL INFORMATION

ACRONYMS

CDOT	Colorado Department of Transportation
FHWA	Federal Highway Association
MPH	Miles per hour
MUTCD	Manual on Uniform Traffic Control Devices
LPI	Leading Pedestrian Interval
PCT	Pedestrian Clearance Time
PDD	Pedestrian Detector Distance
PROWAG	Public Right-of-Way Accessibility Guidelines

DEFINITIONS

Buffer Interval – A short time period (2 seconds minimum) provided after the Pedestrian Change interval is displayed prior to the release of conflicting traffic movements. Pedestrian countdown timers terminate at the beginning of the buffer interval.

Coordinated Phase – The phase (or phases) that are given a fixed minimum amount of time each cycle under a coordinated timing plan. This phase is typically the major through phase on an arterial. Coordinate phase(s) may also have an optional actuated interval following the fixed interval.

Countdown Pedestrian Signal – A timer that is displayed in conjunction with a flashing UPRAISED HAND display that informs pedestrians of the number of seconds remaining in the Pedestrian Change Interval.

Detectable Warning Surface – A standardized surface feature of truncated domes that provides an indication to individuals with disabilities that they are transitioning from the pedestrian realm to the vehicular way where there is a flush rather than a curbed connection.

Engineering Judgement – The evaluation of available pertinent information including, but not limited to, the safety and operational efficiency of all road users, and the application of appropriate principles, provisions, and practices as contained in these guidelines, the MUTCD and other sources, for the purpose of deciding upon the design, use, installation, or operation of a traffic control device. Engineering judgment is exercised by a professional engineer with appropriate traffic engineering expertise, or by an individual working under the supervision of such an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.

Flashing Don't Walk interval – An interval that follows the Walk interval and precedes the Steady Don't Walk interval during which a flashing Upraised Hand (symbolizing Don't Walk) is displayed. Under the Colorado Revised Statutes, no pedestrian shall start to cross the roadway in the direction of such signal indication, but any pedestrian who has partly completed crossing during the "Walk" indication shall proceed to the sidewalk or to a safety island, and all drivers of vehicles shall yield to any such pedestrian.

Leading Pedestrian Interval – A pedestrian interval option that starts a few seconds before the adjacent through vehicular phase, allowing pedestrians to establish a presence in the crosswalk, and thereby reducing conflicts with turning vehicles.

MUTCD – *Manual on Uniform Traffic Control Devices*, developed by FHWA to establish uniform national criteria for the use of traffic control devices that meet the needs and expectancy of road users on all streets, highways, pedestrian and bicycle facilities, and site roadways open to public travel.

Pedestrian Change Interval – An interval during which the flashing UPRAISED HAND (symbolizing DONT WALK) signal indication is displayed. It is provided for pedestrians who have partly completed crossing during the "Walk" indication to proceed to the sidewalk or to a safety island, and all drivers of vehicles to yield to any such pedestrian. The signal display consists of a Flashing Don't Walk interval with or without a pedestrian countdown timer.

Pedestrian Clearance Time – The time provided for a pedestrian crossing in a crosswalk, after leaving the curb or edge of pavement, to travel to the far side of the traveled way or to a median.

Pedestrian Crossing Distance – Distance a pedestrian is required to travel between leaving a curb and reaching the far side of a traveled way.

Pedestrian Detector Distance – Distance between the pedestrian detector location, such as a pedestrian push button, and the beginning of the pedestrian crossing.

Pedestrian Recall – A parameter used in a signal controller that places a continuous call for a pedestrian phase each time a controller is serving a conflicting phase, resulting in the controller providing Walk and Pedestrian Clearance Time intervals.

Preemption – Transfer of normal operation of a traffic control signal or a hybrid beacon to a special control mode of operation.

PROWAG – *Public Right-of-Way Accessibility Guidelines*, developed by the U.S. Access Board to ensure that pedestrian facilities located in the public right-of-way are readily accessible to and usable by pedestrians with disabilities.

Red Clearance Interval – An interval that follows a yellow interval and precedes the next conflicting green interval.

Rest in Walk – Traffic signal controller setting that maximizes the length of the Walk interval for pedestrian crossings that are concurrent with a parallel vehicular phase. Typically, in the United States, this setting can only be applied to coordinated phases. Under Rest in Walk a controller dwells in the pedestrian walk interval while a coordinated phase is green.

Steady Don't Walk Interval – Time interval after the Walk and Flashing Don't Walk intervals during which the Buffer interval and conflicting movements to a pedestrian crossing are serviced. During the Buffer interval, the Yellow Change and Red Clearance Intervals for concurrent vehicular movement may also be serviced. A steady Upraised Hand is displayed during the Steady Don't Walk interval.

Walk Interval – An interval during which the WALKING PERSON (symbolizing WALK) signal indication is displayed. While the “Walk” indication is steadily illuminated, pedestrians facing such signal may proceed across the roadway in the direction of the signal indication and are given the right-of-way by the drivers of all vehicles.

Yellow Change Interval – The first interval following the green or flashing arrow interval during which the steady yellow signal indication is displayed. Provides approaching motorists with warning that a phase is terminating. In the State of Colorado, drivers are permitted to enter the intersection during the yellow interval. Also referred to as the vehicle change interval.

APPLICABLE STATUTES

The Colorado Revised Statutes (CRS) contains pedestrians' rights and responsibilities when crossing the street at a marked and signalized crosswalk. Key elements of the CRS as pertaining to this guidance include:

Section 42-1-102. Definitions

(21) “Crosswalk” means that portion of a roadway ordinarily 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.

Section 42-4-801. Pedestrian obedience to traffic control devices and traffic regulations.

- (1) A pedestrian shall obey the instructions of any official traffic control device specifically applicable to the pedestrian, unless otherwise directed by a police officer.
- (2) Pedestrians shall be subject to traffic and pedestrian-control signals as provided in sections 42-4-604 and 42-4-802 (5).
- (3) At all other places, pedestrians shall be accorded privileges and shall be subjected to the restrictions stated in this title.

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.

- (3) 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.
- (5) Whenever special pedestrian-control signals exhibiting “Walk” or “Don't Walk” word or symbol indications are in place, as declared in the traffic control manual adopted by the department of transportation, such signals shall indicate and require as follows:
 - (a) “Walk” (steady): While the “Walk” indication is steadily illuminated, pedestrians facing such signal may proceed across the roadway in the direction of the signal indication and shall be given the right-of-way by the drivers of all vehicles.
 - (b) “Don't Walk” (steady): While the “Don't Walk” indication is steadily illuminated; no pedestrian shall enter the roadway in the direction of the signal indication.
 - (c) “Don't Walk” (flashing): Whenever the “Don't Walk” indication is flashing, no pedestrian shall start to cross the roadway in the direction of such signal indication, but any pedestrian who has partly completed crossing

during the “Walk” indication shall proceed to the sidewalk or to a safety island, and all drivers of vehicles shall yield to any such pedestrian.

ADDITIONAL RESOURCES

In addition to these guidelines, CDOT encourages the use of the following resources when developing timings for signalized pedestrian crossings on Colorado’s transportation network.

CDOT 2021, *Pedestrian Crossing Installation Guide*, Colorado Department of Transportation, www.codot.gov/safety/traffic-safety/assets/documents/cdot-pedestrian-crossing-guidelines-2021.pdf.

FHWA 2019, *Leading Pedestrian Interval (LPI)*, Federal Highway Administration, Washington, DC, <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasa19040.pdf>.

FHWA 2023, *Manual on Uniform Traffic Control Devices*, 11th edition., Section 4I, pp. 718-726, Federal Highway Administration, Washington, DC, https://mutcd.fhwa.dot.gov/kno_11th_Edition.htm.

National Academies of Sciences, Engineering, and Medicine 2015., *Signal Timing Manual*, 2nd edition., NCHRP Report 812, The National Academies Press, Washington, DC, <https://nap.nationalacademies.org/catalog/22097/signal-timing-manual-second-edition>.

National Academies of Sciences, Engineering, and Medicine 2022, *Traffic Signal Control Strategies for Pedestrians and Bicyclists*, NCHRP Research Report 969, The National Academies Press. <https://doi.org/10.17226/26491>.

U.S. Access Board 2023, *Public Right-of-Way Accessibility Guidelines*, Section R306.2, United States Access Board, Washington, DC, www.access-board.gov/prowag/technical.html.

PEDESTRIAN TIMING INTERVALS

Pedestrian timing intervals are provided to assure that sufficient time is available for pedestrians to cross a roadway at a signalized intersection or crossing. A pedestrian phase consists of four timing intervals (MUTCD Section 4I.06):

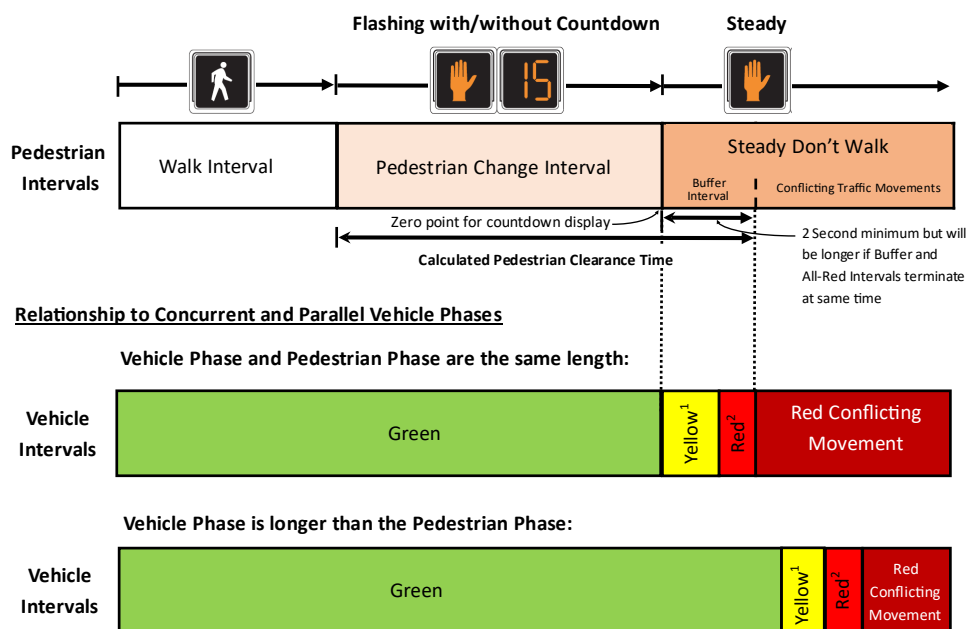
- **Walk interval**, which permits pedestrians to begin crossing and enter the crosswalk area.
- **Pedestrian Change interval**, which provides sufficient time for pedestrians that begin crossing during the Walk interval, to reach the far side of the traveled way. The signal display consists of a Flashing Don’t Walk interval with or without a countdown timer.
- **Steady Don’t Walk** interval, which includes:
 - **Buffer interval**, A short time period (2 seconds minimum) after the Pedestrian Change interval is displayed prior to the release of conflicting traffic movements. Countdown timers terminate at the beginning of the buffer interval.
 - Time during which conflicting traffic movements are serviced.
 - The Yellow Change and Red Clearance intervals for concurrent and parallel vehicle phases will be serviced during the Steady Don’t Walk interval.

At signalized intersections, pedestrian phases commonly operate parallel and concurrent to vehicle phases. Pedestrian phases may also operate separately from vehicle phases such as at mid-block signalized pedestrian crossing or at intersections with exclusive pedestrian phases.

For concurrent and parallel pedestrian and vehicle phases, the relationship between the pedestrian and vehicle timing intervals are shown in **Figure 1**. Practitioners need to determine the duration of the Walk interval and Pedestrian Clearance Time. As shown in **Figure 1**, the Pedestrian Clearance Time is equal to the sum of the Pedestrian Change and Buffer intervals. When parallel and concurrent pedestrian phases

are the same length, CDOT practice is for the Pedestrian Change interval to end at the same time as the vehicle Green interval, in which case the Buffer Time will be greater than 2 seconds.

Figure 1: Timing Intervals for Concurrent and Parallel Pedestrian and Vehicle Phases



Notes:

1. Yellow Change interval for concurrent and parallel vehicle phases.
2. Red Clearance interval for concurrent and parallel vehicle phases.

Source: Adapted from MUTCD Figure 4I-4 (FHWA 2023).

WALK INTERVAL

The Walk interval is provided to permit pedestrians to begin crossing. The Walk interval should be timed to allow a pedestrian to have sufficient time to perceive the Walk indication and enter the crosswalk area prior to the beginning of the Pedestrian Clearance Time interval. The MUTCD recommends a Walk interval of 7 seconds, but permits Walk intervals as short as 4 seconds (MUTCD Section 4I.06, Clauses 10–12). In certain situations, practitioners may need to implement longer Walk intervals.

SHORTER WALK INTERVAL CONSIDERATIONS

In some situations, it is desirable to reduce the duration of the Walk interval to less than 7 seconds. This may occur on minor street phases where pedestrian demand is low and there are constrained traffic conditions, longer crossing distances, and/or lower vehicular demand that would require less time than when a pedestrian call is activated. In some instances, reducing the Walk interval time may permit a signalized intersection to operate at a shorter cycle length (e.g., half or fractional cycling), which will help to reduce pedestrian waiting times.

For phases on major streets, there may be less need to reduce the Walk interval to the minimum or absolute minimum values when compared with minor street phases. For example, major street through phase vehicle splits may be longer and pedestrian crossing distances across minor streets shorter. At constrained intersections, reduced Walk intervals may be considered to the minimum or absolute minimum values.

Table 1: Typical Values for Pedestrian Walk Intervals

Operating conditions	Walk Interval duration (seconds)
High pedestrian activity areas (e.g., school zones, CBD areas, near special event venues, near major transit stops or stations)	10 to 15
Typical pedestrian volumes and traffic conditions	7
Where negligible pedestrian volumes occur, and intersection constraints are such that a longer Walk interval would unduly impact intersection operations.	4 to 6

Notes:

In no case shall the Walk interval be less than 4 seconds.

Consider MUTCD pedestrian timing check discussed in subsequent section of guidelines.

Source: Adapted from the MUTCD (FHWA 2023) and NCHRP Report 812 (National Academies of Sciences, Engineering, and Medicine 2015).

LONGER WALK INTERVAL CONSIDERATIONS

Where a larger group of pedestrians waits to cross, it may take longer than 7 seconds for all pedestrians to enter the crosswalk area. Examples may include locations near schools, where special events occur, major transit stops, or other areas that experience high levels of pedestrian activity.

The MUTCD provides a check to ensure that pedestrians have sufficient time to cross when waiting next to a pedestrian detector (e.g., push button), or a location 6 feet away from the beginning of the crossing if no pedestrian detector is present. Where the pedestrian detector is located further away from the crossing, it may take longer for pedestrians to enter the crosswalk and require a Walk interval longer than 7 seconds.

Some agencies also implement a rest in walk mode that can provide longer Walk intervals. Rest in walk dwells in the pedestrian walk interval while a coordinated phase (a signal phase where vehicular traffic flow is prioritized between multiple intersections) is green. Rest in walk may be used in areas with higher pedestrian activity.

PEDESTRIAN CLEARANCE TIME

The Pedestrian Clearance Time provides sufficient time for pedestrians that begin crossing during the Walk interval to reach the far side of the traveled way. Based on the MUTCD, the Pedestrian Clearance Time should be determined using **Equation 1**.

Equation 1

$$PCT = \frac{\text{Crossing distance}}{\text{Walking speed}}$$

Where:

- PCT = Pedestrian Clearance Time (seconds)
- Crossing distance = Crossing distance (feet) for a pedestrian leaving a curb or shoulder to reach the far side of the traveled way.
- Walking speed = Pedestrian walking speed of 3.5 feet/second
Unless slower walking pedestrians are present, e.g., elderly, school children, people with disabilities, (MUTCD Section 4I.06, Clause 10).

Source: Based on MUTCD Section 4I.06 Clause 08 (FHWA 2023)

ROUNDING

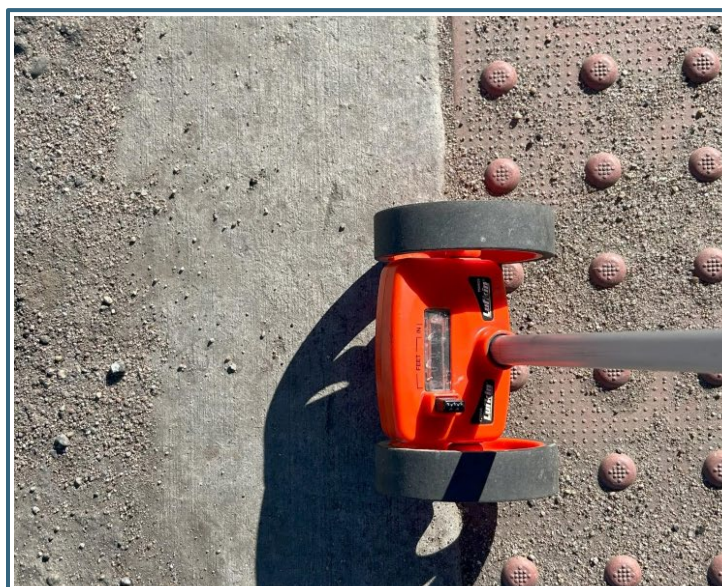
The calculated Pedestrian Clearance Time (PCT) should be **rounded up** to the nearest second. For example, if a PCT was calculated as 28.23 seconds, it should be rounded up to 29 seconds.

CROSSING DISTANCE MEASUREMENT

Crossing Distance Measurement – Curbed Crossings

For curbed crossings, it is desirable to measure crosswalks from the bottom edge of the curb ramp to the opposing bottom edge of the curb ramp (i.e., curb-to-curb). The bottom edge of a curb ramp is typically defined as the edge of the detectable warning surface (grid of truncated domes). **Figure 2** shows a typical starting point for measuring from the bottom edge of curb. However, measuring practices may vary due to the presence of channelized islands, large corner islands, crossings without curbs or other factors.

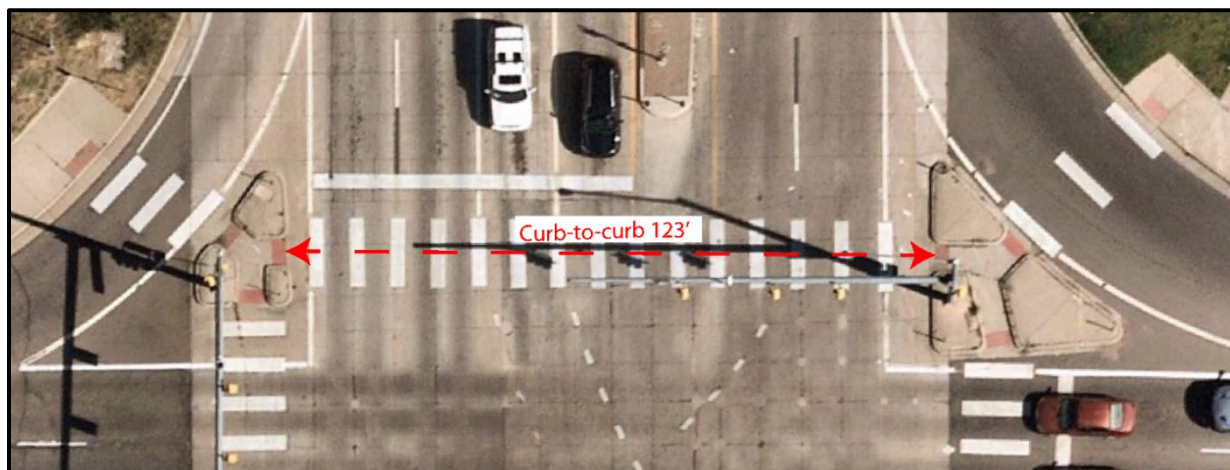
Figure 2: Bottom Edge of a Curb Ramp



Curbed Crossings with Channelization Islands

For curbed crossings where the pedestrian detectors are located on a channelization island between the right turn and through lanes, the measurement should start and end at the bottom of the curb ramp or, if a curb ramp is not provided, from the edge of the curb (**Figure 3**). The crossing distance measurement does not need to include the crossing of the channelized right turn lanes where the crossings are unsignalized. Where the pedestrian crossing across a channelized right is signalized, it will need to be considered as part of the crossing distance measurement.

Figure 3: Measuring Crosswalk Lengths – Curbed Crossing with Channelization Islands

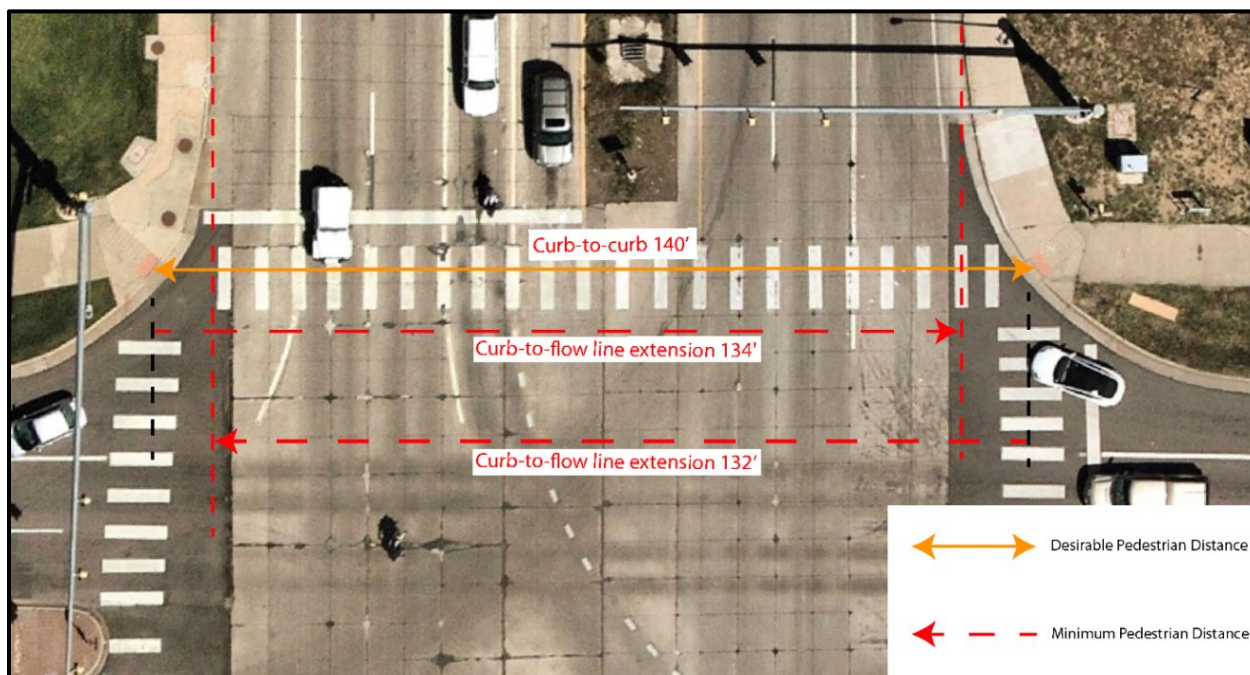


Note: For this crossing measurement, the pedestrian crossings across the channelized right turns are unsignaled and not included in the crossing distance measurement.

Curbed Crossing with Large Curb Return Radii

Many intersections on state highways have large curb return radii that cause the edge of the curb at crosswalks to be separated from the edge of the travelled way (Figure 4). At these types of intersections, it is acceptable to measure the crosswalk distance from the bottom edge of the curb to the far edge of the travelled way. This measurement should be conducted in both directions with the larger calculated distance being used as the pedestrian crossing distance.

Figure 4: Curbed Crossings at Intersections with Large Curb Return Radii

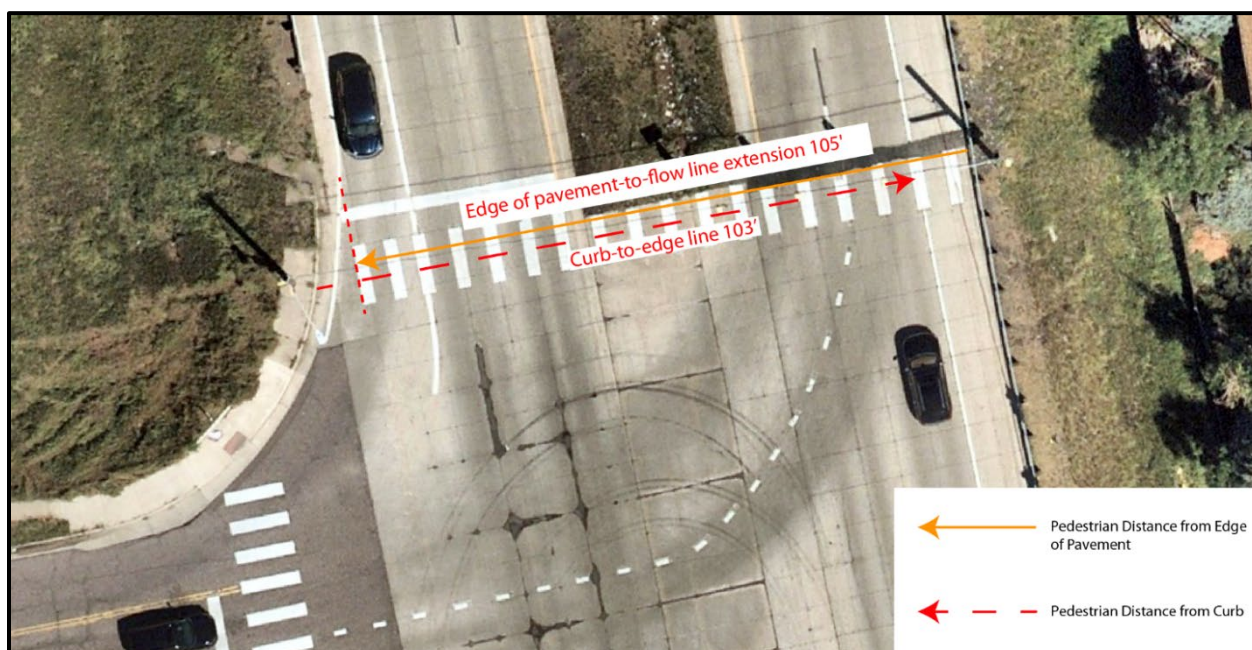


Crossings Without Curbs

For crossings without curbs, pedestrians will typically wait at the edge of the pavement. The MUTCD identifies that for crossings without curbs the pedestrian clearance time should be sufficient to allow pedestrians who started crossing from the edge of pavement with sufficient time to cross.

An example of a crossing measurement without a curb is shown in **Figure 5**. At the example intersection, the east side of the crosswalk does not have a curb and crosses a paved shoulder. The crossing distance measurement should start from the edge of the pavement. The crossing should be measured in both directions and the longer distance of the two should be applied to determine the Pedestrian Clearance Time. In this example, the crossing distance measured from the edge of pavement would result in the longer crossing distance.

Figure 5: Measuring Crosswalk Lengths – Crossing without Curbs



WALKING SPEED

The MUTCD (Section 41.06 Clause 07) identifies that the Pedestrian Clearance Time should be based on a walking speed of 3.5 feet per second to allow a pedestrian who left the curb or edge of pavement at the end of the Walk interval to at least reach the far side of the traveled way or to a median of sufficient width for pedestrians to wait. However, the MUTCD notes that where pedestrians who walk slower than 3.5 feet per second, or use wheelchairs, routinely use a crossing, a walking speed of less than 3.5 feet per second should be considered. Practitioners should consider crossings where pedestrians such as elderly, children, or people with disabilities routinely use a pedestrian crossing when determining an appropriate walking speed.

The MUTCD (Section 41.06 Clause 08) notes that a walking speed of up to 4 seconds may be used where an extended push button press function has been installed to allow slower pedestrians to request and receive a longer Pedestrian Clearance Time. Additionally, it notes that passive pedestrian detection may be used to automatically adjust the Pedestrian Clearance Time. However, these functionalities or associated pedestrian timing adjustments have not typically been installed and implemented by CDOT.

MUTCD CHECK OF CHANGE AND CLEARANCE INTERVALS

The MUTCD (FHWA 2023) provides a check to ensure that pedestrians located next to a pedestrian detector or 6 feet away from the beginning of a crossing should have sufficient time to cross (MUTCD Section 4I.06, Clause 14). **Equation 2** applies the MUTCD guidance to complete this check.

If the calculated value from the left side of **Equation 2** is less than the sum of the Walk and Pedestrian Clearance Time (right side of the equation), the MUTCD suggests that any additional time be added to the Walk interval to meet this condition.

Section 4I.05 Clause 4 of the MUTCD provides guidance on the placement of pedestrian detectors noting that pedestrian push buttons should be located not further than 10 feet from the edge of the associated curb ramp.

Equation 2

$$\frac{\text{Crossing distance} + PDD}{\text{Pedestrian check speed}} \leq \text{Walk} + PCT$$

Where:

- Crossing distance = Crossing Distance (feet) calculated using the CDOT recommended practice
- PDD = Pedestrian Detector Distance (feet): Distance between the pedestrian detector (e.g., push button location) and the beginning of the crossing. Where no pedestrian detector is present, 6 feet should be used in the calculation.
- Pedestrian check speed = MUTCD recommended speed of 3 feet per second.
- Walk = Walk Interval (seconds)
- PCT = Pedestrian Clearance Time (seconds)

Source: Based on MUTCD Section 4I.06, Clause 14 (FHWA 2023).

OTHER PEDESTRIAN TIMING CONSIDERATIONS

SIGNAL PREEMPTION AND PEDESTRIAN TIMING

Signal preemption consists of transferring normal traffic signal control to a special signal control mode used for serving railroad crossings, emergency vehicle passage, mass transit vehicle passage or other special tasks.

Section 4F.19 Clause 4 of the MUTCD provides recommendations for the transition of pedestrian timing to preemption control. It identifies that any pedestrian Walk interval and/or pedestrian change interval may be shortened or omitted during the transition into preemption control. However, the shortening or omission of the pedestrian change interval during the transition to preemption should be avoided to minimize the impacts on pedestrian safety.

PEDESTRIAN RECALL

Pedestrian recall is a parameter used in a signal controller that places a continuous call for a pedestrian phase, resulting in the controller providing Walk and Pedestrian Clearance Time intervals. Two common applications of pedestrian recall include:

- Malfunctioning pedestrian detection or no pedestrian detection present – A pedestrian recall ensures that a phase will display a Walk and Pedestrian Clearance Time interval every cycle when pedestrian detection is malfunctioning or unavailable.
- High pedestrian activity – Pedestrian recall is sometimes applied in locations with high pedestrian activity such as in downtown areas or near schools during arrival and dismissal periods.

EXCLUSIVE PEDESTRIAN PHASE

While pedestrian phases typically operate parallel and concurrent to vehicle phases, signal timing may be configured to provide an exclusive pedestrian phase. During an exclusive pedestrian phase, all vehicle phases are simultaneously prevented from entering the intersection while a pedestrian phase or pedestrian phases for multiple crossings operate. An exclusive phase does not permit pedestrians to cross diagonally across an intersection.

A variation of an exclusive pedestrian phase, referred to as a Barnes dance or scramble crossing, permits pedestrians to cross an intersection diagonally. Diagonal crossings provide pedestrians with more direct crossing movements. However, the trade-off is that the pedestrian crossing distance must be measured diagonally, which will typically increase the pedestrian clearance time.

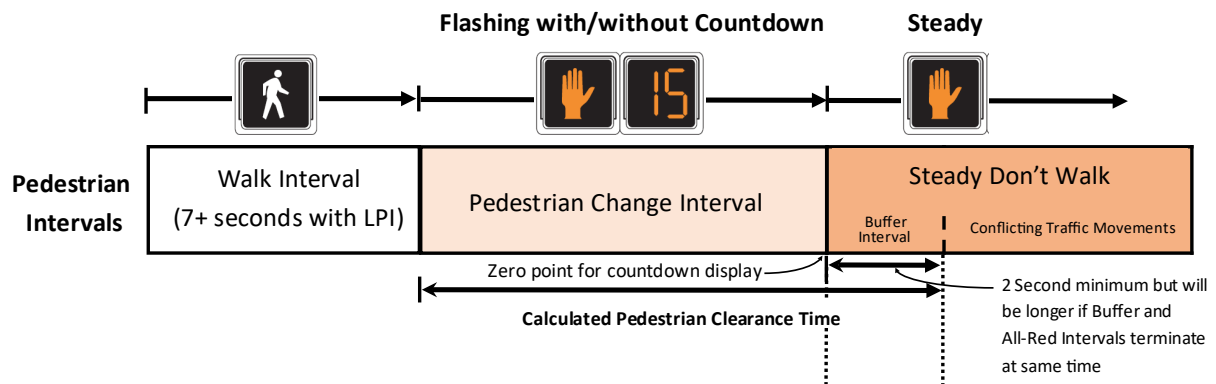
Exclusive pedestrian and Barnes dance phases eliminate conflicts between pedestrians and vehicles. Suitable locations include downtown areas, major sporting/entertainment venues, shopping centers or other areas with high pedestrian and vehicular turning traffic volumes.

LEADING PEDESTRIAN INTERVAL

Leading Pedestrian Intervals (LPIs) are short (typically 3 seconds to 7 seconds) intervals that are provided during the Walk interval to give pedestrians a head start before vehicles in a parallel direction are given a green signal display. LPIs have been found to reduce the likelihood of conflicts or crashes between pedestrians in a crosswalk with left- or right-turning vehicles (FHWA 2019).

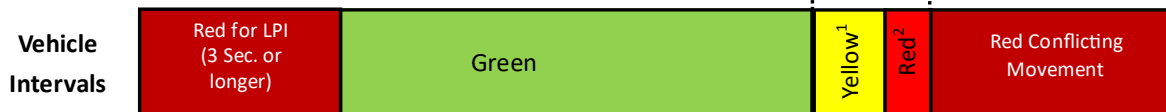
Section 4I.06, Clauses 19 to 24, of the MUTCD provide guidance on LPIs noting that LPIs should be at least 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic, or if a large corner radius is present, to travel far enough for pedestrians to establish their position ahead of turning traffic before the start of the vehicular green. Where LPIs are implemented, the Walk interval duration should be at least 7 seconds. **Figure 6** shows the relationship between LPIs and other signal timing intervals.

Figure 6: Pedestrian and Vehicle Timing Intervals with LPIs



Relationship to Concurrent and Parallel Vehicle Phases with LPI

Vehicle Phase and Pedestrian Phase are the same length:



Vehicle Phase is longer than the Pedestrian Phase:



Notes:

¹ Yellow change interval.

² Red clearance interval.

Source: Adapted from MUTCD Figure 4I-4 (FHWA 2023).

This page left blank intentionally.

ADD THIS PAGE WHEN THERE IS AN ODD NUMBER OF PAGES ONLY AS INSIDE BACK COVER.



COLORADO
Department of Transportation