VIRTUAL MEETING OF THE MULTI-MODAL TRANSPORTATION BOARD
Thursday, November 5, 2020
https://zoom.us/j/93483721344 or dial: **877 853 5247 US Toll-free,**
Meeting ID: 934 8372 1344

1. Roll Call
2. Introductions
3. Review of the Agenda
4. Approval of Minutes, Meeting of **October 1, 2020**

5. **Update on ADA Parking**

6. **Best Practices Training Session**
   - Pedestrian crossings
   - Bicycle facilities
   - Traffic calming

   Presenters: **Ben Pavlevsi and Brad Strader, MKSK**
   Julie Kroll, Fleis & Vandenbrink

7. Meeting Open to the Public for items not on the Agenda
8. Miscellaneous Communications
9. Next Meeting – **December 3, 2020**
10. Adjournment

CITY OF BIRMINGHAM MULTI-MODAL TRANSPORTATION BOARD
Thursday, October 1, 2020
Held Virtually Via Zoom and Telephone Access

Minutes of the virtual regular meeting of the City of Birmingham Multi-Modal Transportation Board held Thursday, October 1, 2020.

Planning Director Ecker convened the meeting at 6:07 p.m.

1. ROLL CALL

Present: Board Members Tom Peard, Katie Schafer, Doug White, Andrew Haig; Alternate Board Member Joe Zane

Absent: Chairwoman Johanna Slanga

Administration: Jana Ecker, Planning Director
Eric Brunk, IT Manager
Laura Eichenhorn, Transcriptionist
Austin Fletcher, Assistant City Engineer
Scott Grewe, Police Commander

Fleis & Vandenbrink (F&V):
Julie Kroll
Justin Rose

MKSK: Ben Palevsky
Brad Strader

Planning Director Ecker noted Chairwoman Slanga's absence and sought nominations for a temporary Chair to run the evening's meeting. Mr. White said he would be willing to chair the meeting.

Motion by Mr. Zane
Seconded by Mr. Peard to nominate Mr. White to run the October 1, 2020 MMTB meeting.

Motion carried, 5-0.

ROLL CALL VOTE
Yeas: White, Haig, Peard, Schafer, Zane
Nays: None

2. Introductions

None.

3. Review Agenda

No changes.

4. Approval of MMTB Minutes of September 3, 2020

Motion by Mr. Peard
Seconded by Dr. Schafer to approve the MMTB Minutes of September 3, 2020 as submitted.

Motion carried, 5-0.

ROLL CALL VOTE
Yeas: Peard, Schafer, White, Haig, Zane
Nays: None

5. Southfield and Brown Intersection Improvements

Commander Grewe introduced the item.

Ms. Kroll presented the study of the item which can be found in the evening's agenda packet.

After Board discussion it was determined that Ms. Kroll's recommendations were the most likely to increase the safety of the intersection.

Mr. Palevsky ventured that if Mr. Zessin were to narrow the width of his driveway it might increase the visual distinction between his driveway and the end of Brown.

Planning Director Ecker noted that such a recommendation could be made by the Board to Mr. Zessin, with the understanding that any such change to his driveway width would have to be undertaken by Mr. Zessin.

Motion by Dr. Schafer
Seconded by Mr. Haig to install advance intersection lane control signage (R3-8) and a two-directional large arrow sign (W1-7) at the recommended locations in the report provided by F&V. The MMTB also encourages Mr. Zessin to consider narrowing the width of his driveway so as to increase the visual distinction between the driveway and the end of Brown Street.

Motion carried, 4-0.

ROLL CALL VOTE
Yeas: Schafer, White, Haig, Zane
Nays: None

Absent: Peard (lost connection during vote)

6. Bicycle Signage

Planning Director Ecker introduced the item.

Ms. Kroll summarized her study's findings. The study can be found in the evening's agenda packet.

There was no discussion of the item by the Board members.

Motion by Dr. Schafer
Seconded by Mr. Peard to recommend approval of the installation of four new R4-11 signs to be installed along Eton Street at the following locations:

- **On S. Eton, south of Maple Road on the NB side (add new sign post)**
- **On S. Eton, south of Maple Road on the SB side (mount on existing light post)**
- **On N. Eton, north of Maple Road on the NB side (add new sign post)**
- **On N. Eton, north of Maple Road on the SB side (Remove existing W11-1/W16-1P sign and replace with R4-11 sign on existing post)**

AND

To recommend approval of the addition of sharrows to be installed on N. Eton, north of Maple Road in both the NB and SB lanes.

Motion carried, 5-0.

ROLL CALL VOTE
Yeas: Schafer, Peard, White, Haig, Zane
Nays: None

7. On Street Parking on Commerce Street

Dr. Schafer recused herself from before discussion of this item began citing a conflict of interest.

Commander Grewe presented the item.

In reply to Mr. Haig, Commander Grewe stated that the Fire Department accesses The Sheridan, the assisted living facility on Lincoln, via Lincoln and not via Commerce.

Mr. Haig said he was trying to make sure there would be backup access if Lincoln were congested for any reason.

Commander Grewe stated that even if the Fire Department had to proceed via Cole they would have enough room. He explained that Commerce is 28' wide with parking on both sides, whereas many residential streets in Birmingham, per City policy, are 26' wide with parking on both sides so there would be sufficient room for the Fire Department to proceed down Commerce if need

be.

Gayle McGregor, attorney for the applicant, confirmed that the applicant would be submitting a variance request to the Board of Zoning Appeals (BZA) subsequent to tonight's MMTB discussion.

Planning Director Ecker explained that the BZA will want to see that the applicant exhausted all other resources before requesting a variance for parking spaces, and so pursuing on street-parking on Commerce is an effort towards that end.

Mr. Zane asked if there were any likely drawbacks that could stem from approving addition on-street parking on Commerce. He remarked that it seemed like it would be a positive change and would do no harm to the neighborhood.

Ms. McGregor stated that the applicant circulated a petition in favor of adding on-street parking to Commerce to the three other businesses that front on Commerce Street. She stated that three of the businesses, including the applicant, signed the petition. Dogtopia had no objection to the proposal. The owner of Dogtopia only withheld their signature only because they did not want to sign something that was being submitted to the City. Ms. McGregor noted that Dogtopia has significant off-street parking and so would not be affected by the addition of on-street parking at the opposite end of Commerce.

Motion by Mr. Zane
Seconded by Mr. Haig to remove the "No Parking" signs on the west side of Commerce from Lincoln north to the south side of the second driveway and replace them with "2 Hour Parking" signage.

Motion carried, 4-0.

ROLL CALL VOTE
Yeas: Peard, White, Haig, Zane
Nays: None
Recused: Schafer

Dr. Schafer rejoined the meeting after the vote on the item.

8. Meeting Open to the Public for items not on the Agenda

Dave Lurie reviewed the email he submitted to the MMTB which can be found in the evening's agenda packet.

Planning Director Ecker informed the Board that several City staff members would be meeting with Mr. Lurie the following day, October 2, 2020, to discuss the issues raised in his email and to generate potential solutions.

Dr. Schafer recalled that the Board had previously decided to look at potential multi-modal enhancements to roads being improved. She stated that would apply in this situation when the road is reconstructed in the future.

Assistant City Engineer Fletcher concurred with Dr. Schafer and said potential multi-modal enhancements to improved streets would absolutely be brought before the Board. He clarified that Mr. Lurie's issue was located on the stretch of Oak from Lakeside to Lakeview, however, which has not yet been improved by the City.

In reply to Mr. Peard, Assistant City Engineer stated that improving that section of Oak is on the City's radar but is several years out on the improvement schedule.

Mr. Haig said he concurred with Mr. Lurie's concerns regarding that area of Oak.

Assistant City Engineer Fletcher said he, other City staff, and the City's consultants had reviewed possible options for making that stretch of Oak safer and would be presenting it to Mr. Lurie as part of the following day's discussion.

9. Miscellaneous Communications

Mr. Palevsky informed the Board he was putting together potential multi-modal topic trainings for them. He said he would be sending the Board members a survey with potential training topics and asked them to return the survey indicating the topics they were most interested in.

Mr. White and Mr. Peard said they were looking forward to the trainings and thanked Mr. Palevsky and City staff.

10. Next Meeting – November 5, 2020

11. Adjournment

No further business being evident, the board members adjourned at 6:58 p.m.

Jana Ecker, Planning Director

Austin Fletcher, Assistant City Engineer

City of Birmingham
A Walkable Community

MEMORANDUM

DATE: October 27, 2020

TO: Multi-Modal Transportation Board

FROM: Jana L. Ecker, Planning Director
Cmdr. Scott Grewe, Police Department
Austin Fletcher, City Engineer

SUBJECT: Update on ADA Parking and Accessibility

In the spring of 2019, the City was contacted by an attorney regarding accessibility in the Central Business District (CBD) in regards to parking locations and curb ramps. A lawsuit was filed against the City and a Consent Decree was agreed to giving the City five years to correct any areas that are non-compliant with the American Disabilities Act (ADA) regarding parking spaces and curb ramps.

ADA Parking Locations

The Police Department began reviewing all 79 on street and 86 structure ADA parking locations to ensure they met the accessibility requirements. This review included determining if the parking location met the requirements for the size of the spot as well as a marked accessible area next to each space. This included reviewing that accessible area to ensure it met the requirements for a "level landing pad", meaning it could not have more than a 2% slope in any direction. Access to curb ramps to sidewalks as well as access to parking meters was reviewed.

For the on-street ADA locations, 51 locations needed some form of improvement to increase the accessibility of that particular space. Of those, some locations were moved to a more accessible location, others will, or already have, received improvements.

In the parking structures, 37 locations needed some form of improvement. Some required moving the location due to slope requirements and others needed improvements due to size of the space and/or the accessible area.

In the North Old Woodward parking structure, there are nine ADA spaces at the southernmost part of the open lot along the wall next to Willits. Only three of these spaces are ADA complaint. The six other spaces are not complaint due to the slope of the pavement in this area and need to be moved.

Curb Ramps

The Police Department also began reviewing curb ramps due to the lawsuit. It was determined that many of the City's ramps were not complaint with the current standards. Over the next five years, all ramps within the CBD must meet the ADA standards used by Michigan Department of Transportation (MDOT).

Due to the Covid-19 pandemic, it was determined that the area south of Maple, north of Brown, east of Southfield and west of Pierce would be reviewed and rebuilt since all special events were cancelled that typically brings additional foot traffic to this area. Due to the reduced pedestrian

traffic in this area, this replacement is underway. Each year, over the next four years, an area within the CBD will be reviewed and replaced as needed until all ramps are compliant.

Summary

After completing these reviews, all curb ramps identified by the Police Department as being non-complaint were submitted to the City's Engineer, Austin Fletcher and our consultants, Nowak & Fraus, for design. The City's Attorney was consulted as well as Nowak & Fraus regarding the redesign of the ADA parking spaces found out of compliance.

To date, all metered ADA spaces that required moving to a more compliant location have been moved. DPS has begun moving signage for these spaces as well as relocating bike racks and other items that may have been in an accessible area. The Police Department has contracted line painting, most which is already complete, to make the required changes.

City of Birmingham ADA Updates

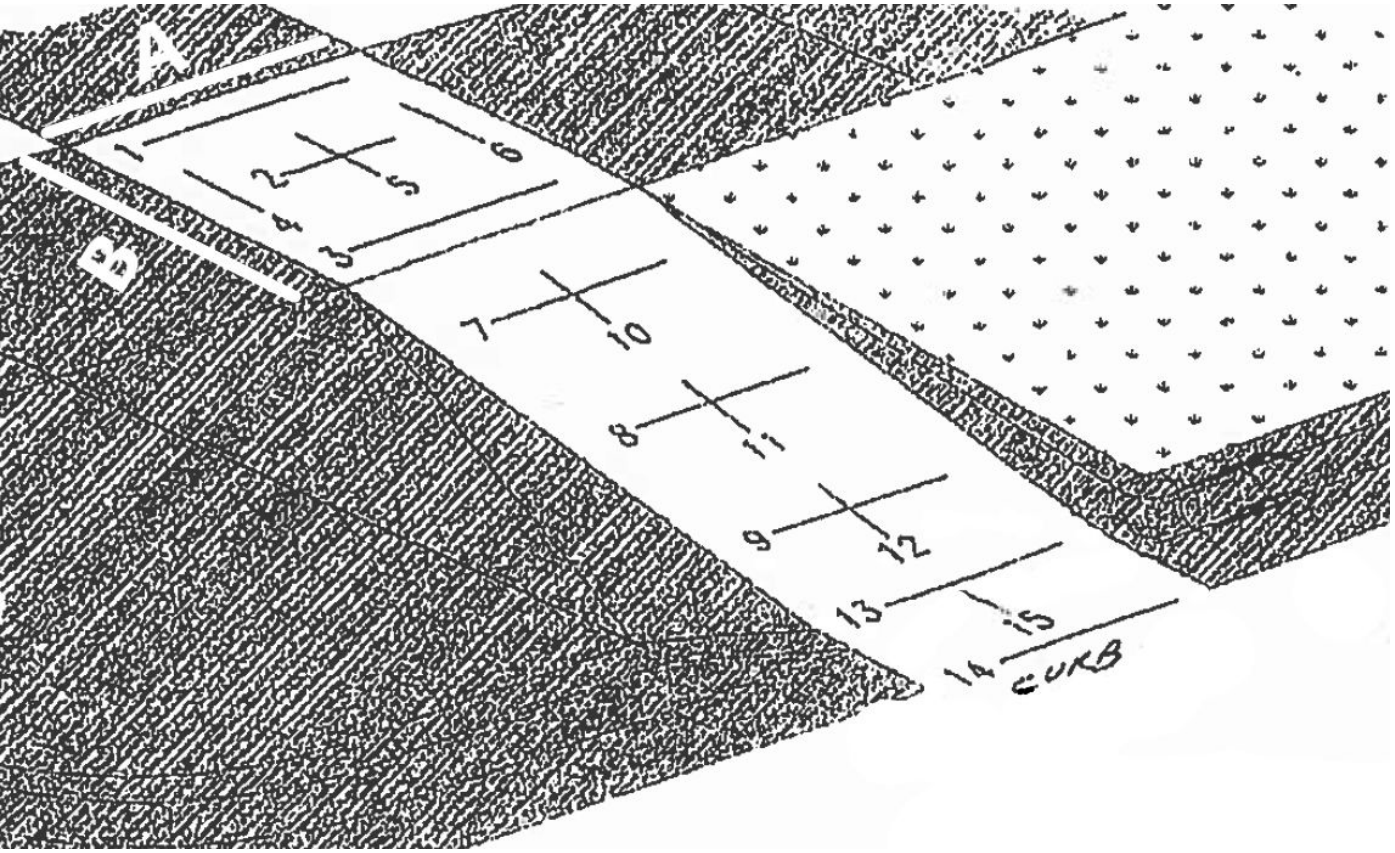
ADA Parking Space Review


GMC


RESERVED PARKING
STOP
RESERVED PARKING
PORSCHE

Curb Ramp Review

ADA Ramp Measurement Standard



Location:

Inspector:

Date:

Domes: Y or N

Dimensions of Level Landing

A

B

GRADE %
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15


NAILS
600
OPEN
588
EXIT
ONLY

Best Design Practices for

Walking and Bicycling

in Michigan

Michigan Department of Transportation

Acknowlegements

These best design practices were prepared by **T.Y. Lin International**
at the direction of the **Michigan Department of Transportation**.

Participating Agencies

Center for Education and Research in Safety
Western Michigan University
Corradino Group

Cover photo source: Ann Arbor Downtown Development Authority

Table of Contents

Introduction

The Michigan Department of Transportation (MDOT) has undertaken a research initiative to determine how to optimize pedestrian and bicycle safety while minimizing impacts to vehicular mobility. The best practices in this document provide guidance in the design of nonmotorized improvements that have been shown to reduce crashes involving pedestrians and bicyclists. This best practices report is one of several reports prepared under this research initiative. Other reports prepared include:

- *Pedestrian and Bicycle Crash Data Analysis: 2005-2010*
- *Crash Countermeasures and Mobility Effects*
- *Case Study Report*
- *Review of National Association of City Transportation Officials (NACTO) Bicycle Facilities*

These four reports will then be assembled into one final report entitled *Sharing the Road: Optimizing Pedestrian and Bicycle Safety and Vehicle Mobility Final Report.* This report also will include a review of MDOT design guides and safety reports.

This report is organized as a toolbox for planners and designers. A summary matrix is provided that provides a general comparison of the potential crash reduction, potential mobility impacts, and cost of each best practice.

Potential crashes for each best practice is summarized as either reducing or having no difference on crashes. Potential mobility effects are shown as making mobility better, making no difference, or making mobility worse for one or more modes of transportation.

Mobility is a function of speed, access, and delay. For the purposes of this report, potential mobility impacts refer to a potential change in delay as the result of implementing a best design practice. As bicyclists are considered roadway users to the same extent as motor vehicles per State of Michigan law, the determination of mobility assumes that bicyclists are traveling in the roadway unless otherwise stated.

Cost is summarized as low (up to $20,000), medium ($20,000-$100,000), and high (over $100,000). Best practices are grouped into three categories:

1. Signalized Intersections
2. Unsignalized Pedestrian Crossing Improvements
3. Corridor Improvements

Refencences are provided at the end of the document. Where applicable, references to MDOT manuals, including the Michigan Manual on Uniform Traffic Control Devices (Michigan MUTCD), are provided.

Signalized Intersection Improvements

Best Practice	Potential Crashes			Potential Mobility Effects			Cost
	Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Proper Walking Speed	No Difference	Reduce	No Difference	Worse	Better	No Difference	Low
Fixed Time Signals/ Pedestrian Push Buttons	No Difference	No Difference	No Difference	No Difference	Better	No Difference	Low
Pedestrian Countdown Signal	Reduce	Reduce	Reduce	No Difference	Better	No Difference	Low
Leading Pedestrian Interval	No Difference	Reduce	No Difference	No Difference	Better	No Difference	Low
Pedestrian-Only Phase (Scramble)	No Difference	Reduce	No Difference	Worse	Better	Worse	Low
Exclusive Left Turn Phase (Leading/Lagging)	Reduce	Reduce	Reduce	Worse	Better	Better	Low
Flashing Yellow Arrow	Reduce	No Difference	No Difference	Better	No Difference	No Difference	Low
Prohibited Left Turns (Michigan Left)	Reduce	Reduce	Reduce	Better	Better	Better	Med/High
Prohibited Right Turn on Red	Reduce	Reduce	No Difference	Worse	Better	Better	Low
Advance Stop Bar	No Difference	Reduce	No Difference	No Difference	Better	No Difference	Low
Pork Chop Island	Reduce	Reduce	No Difference	Better	Better	No Difference	Med/High
Bulb-outs	Reduce	Reduce	No Difference	No Difference	Better	No Difference	Med/High
Roundabout	Reduce	Reduce	Reduce	Better	Better	Better	High
Bicycle Signal Detection	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low/Med
Intersection Crossing Markings	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low
Bike Box	No Difference	Reduce	Reduce	No Difference	No Difference	Better	Low
Two-Stage Bike Left Turn	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low
Combined Bike/Turn Lane	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low
Bicycle Signals	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium

Cost: Low: up to $20K; Med: $20K-$100K; High: over $100K

Proper Walking Speed

What: Pedestrian signal timing is calculated using a walking speed of 3.5 feet/second or slower where there is a significant population of elderly pedestrians or pedestrians with disabilities using the signal.

Where: All new or rehabilitated pedestrian signals should be timed with this signal timing according to the Michigan MUTCD.

Why: Studies have shown that the previous standard walking speed of 4.0 feet/second was an average walking speed and thus was not adequate time to allow most pedestrians to cross the street.[2]

How: See Michigan MUTCD, Section 4E.05.

Image: www.pedbikeimages.org/Dan Burden

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	No Difference	Worse	Better	No Difference	Low

Fixed Time Signals or Pedestrian Push-Buttons

What: Fixed time signals have an automatic pedestrian phase built in to the signal cycle. Pedestrian push-buttons allow pedestrians to call up a pedestrian signal where they do not come up automatically.

Where: Fixed time signals should be used where pedestrian traffic is routine. Pedestrian push-buttons should be used where pedestrian crossings are infrequent and pedestrian signals are not automatic.

Why: Requiring pedestrians to call for the pedestrian signal increases their delay and should only be used where pedestrian traffic is limited. Fixed-time signals increase mobility for pedestrians.

How: Traffic signals may need to be re-programmed and/or re-timed to automatically bring up the pedestrian phase.

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	No Difference	No Difference	Better	No Difference	Low*

* If signal timing is maintained.

**If signal needs to be re-timed for pedestrian walking speeds, there may be a slight increase in motor vehicle delay.

Pedestrian Countdown Signal

What: Pedestrian countdown signals give pedestrians an indication of how much time is left to cross the street by accompanying the "flashing don't walk" signal with a countdown.

Where: Pedestrian countdown signals are required anywhere a pedestrian signal is used whenever new signals are installed or existing signals are replaced per the Michigan MUTCD.

Why: Pedestrian countdown signals have been shown to reduce all crashes at signalized intersections by 25%. They also increase the incidence of pedestrians completing their crossing before the end of the "flashing don't walk" phase.

How: Adding pedestrian countdown signals typically cost between $10,000 to $15,000 per intersection to replace all pedestrian signal heads to as little as $800 per intersection to add a countdown clock to each existing pedestrian signal head See MUTCD, Section 4E.04.

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	No Difference	Better	No Difference	Low

Leading Pedestrian Interval

What: A leading pedestrian interval (LPI) gives pedestrians a walk signal before the parallel traffic gets the green. This allows pedestrians to get into the crosswalk before turning motor vehicle traffic.

Where: LPIs should be considered where turning vehicles delay or pose a danger to pedestrians, particularly where turns have been shown to cause crashes or create a high number of conflicts with pedestrians.

Why: Where LPIs are used, pedestrians were shown to be less likely to surrender their right of way to turning vehicles and there were fewer conflicts between motorists and pedestrians crossing at the beginning of the WALK phase.[6]

How: To implement a LPI, the signal must be re-timed to allow pedestrians a WALK phase that begins in advance of the vehicular green phase. Right turn on red should be prohibited across the crosswalk where LPIs are used.

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	No Difference	No Difference	Better	No Difference	Low

Pedestrian-Only Phase (Scramble)

What: A pedestrian-only phase or pedestrian scramble allows pedestrians to walk in any direction across the intersection, including diagonally, during an exclusive phase in which only pedestrian traffic has the right of way.

Where: This treatment should be limited to intersections where pedestrian volumes are higher than vehicular volumes and where a significant percentage of pedestrians would make a diagonal crossing. Pedestrian-only phases have been shown to significantly increase motor vehicle delay.[5] Engineering judgement should be used in determining locations.

Why: Pedestrian-only phases has been shown to reduce pedestrian crashes by 34%.[1]

How: A pedestrian-only phase adds a phase to the typical traffic signal sequence during which all directions of motor vehicle traffic have a red phase and all directions of pedestrian traffic have a WALK phase. The diagonal crossing sign image to the right can provide additional information to pedestrians and motorists. The MUTCD does not preclude the use of this sign. However, there is no specific MUTCD guidance for signs of this type.

Image: Oakland Chinatown Chamber of Commerce

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	No Difference	Worse	Better	Worse	Low

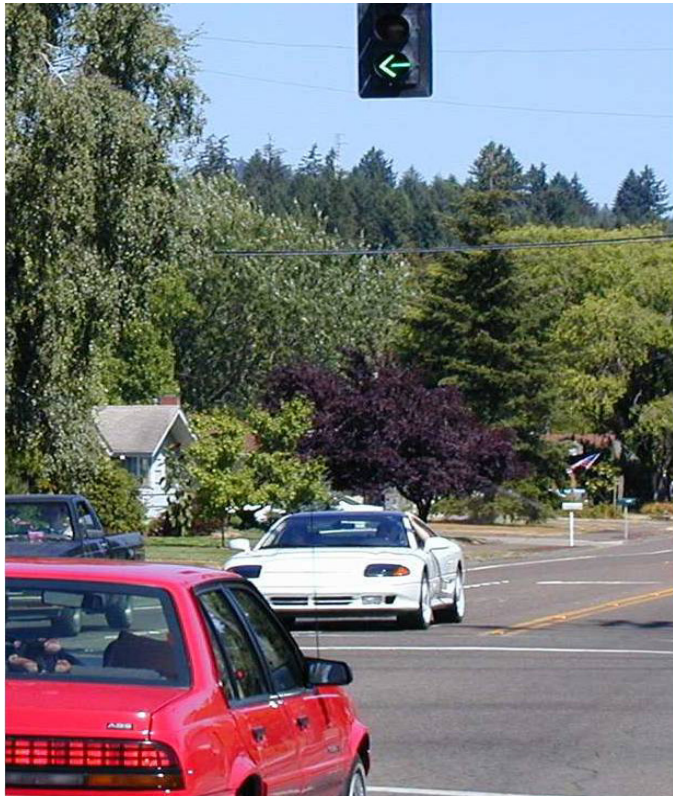
Exclusive Left Turn Phase (Leading/Lagging)

What: Left turning vehicles have an exclusive phase, indicated by a green left arrow. The phase can either be given before the green phase for through traffic (leading) or after (lagging).

Where: An exclusive left turn phase should be considered at intersections where left-turning traffic volumes are high and a Michigan Left is not feasible. A lagging left turn phase should be considered where there is a high number of conflicts between left turning vehicles and pedestrians.

Why: Exclusive left turn phases reduce conflicts between left turns and pedestrians. Pedestrians normally start to cross at the beginning of the through green interval. A lagging left-turn phase strategy allows pedestrians to clear the crossing before left-turning vehicles begin to turn.

How: The signal timing must be adjusted to allow for this exclusive phase.



Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	Worse	Better	Better	Low

Flashing Yellow Arrow

What: For permitted left turns at a signalized intersection, the signal phase is displayed as a flashing yellow arrow rather than a green ball.

Where: This treatment should be considered at intersections where pedestrian crashes have been caused by motorists making a left turn and an exclusive left turn is not desired.

Why: Crash rates at intersections where the flashing yellow arrow was used were found to be lower than intersection with the conventional green ball indication.[4]

How: A three-head signal must be replaced with a four-head signal in order to provide a flashing yellow arrow. The flashing yellow is displayed during the permitted left turn phase.

Image: www.aaroads.com

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	No Difference	No Difference	Better*	No Difference	No Difference	Low

* When installed to replace a protected left turn phase.

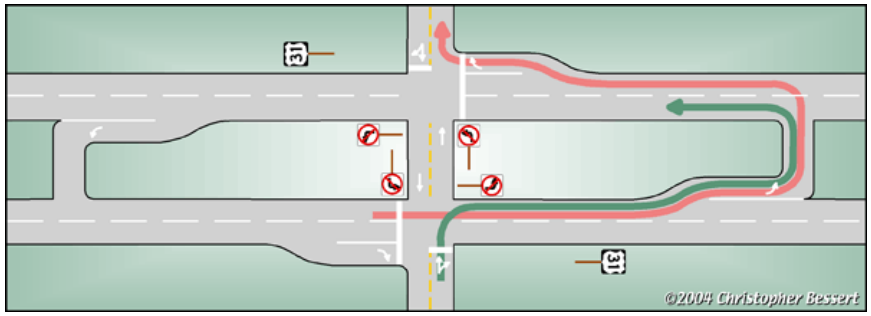
Prohibited Left Turns (Michigan Left)

What: The prohibition of left turns at signalized intersections and providing room for U-turns at median crossovers is known as a Michigan Left. The diagram to the right shows Michigan left turn movements from two approaches.

Where: Michigan Lefts can be implemented on roads with a wide center median or where the cross-street has a wide center median. Michigan Lefts should be considered where there are conflicts or crashes caused by left-turning vehicles or where improved efficiency of left turns is desired.

Why: Prohibiting left turns has been shown to reduce pedestrian intersection crashes by 10%.[3] MDOT has also found that they increase efficiency and reduce congestion and reduce the number and severity of crashes.

How: MDOT provides guidance on left-turn prohibitions in the MDOT Road Design Manual, Pavement Marking Typicals (PAVE-935-A, PAVE-990-A).



Images: www.michiganhighways.org

Image: www.michigan.gov/mdot/0,4616,7-151-9620_10694-161777--,00.html

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	Better	Better	Better*	Med/High

* This assumes that bicyclists make a two-stage left turn. The two-stage left turn is described on page 22.

Prohibited Right Turn on Red

What: Right turns on red are prohibited through the use of regulatory signs.

Where: Right turn on red restrictions should be implemented where right-turning vehicles are involved with crashes with pedestrians or rear-end or angle crashes with vehicles approaching from the left on the cross-street.

Why: Permitted right turns on red pose a threat to pedestrians crossing with the signal, as motorists wanting to turn right are looking to the left for a gap in traffic and may not see a pedestrian approaching from the right. Prohibiting right turn on red also benefits bicyclists in bike lanes, as it prevents right-turn vehicle crashes involving bicyclists.

How: Regulatory signs are posted at the intersection. See MUTCD, Section 2B.54.

Image: www.highwaytrafficsupply.com

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	No Difference	Worse	Better	Better	Low

Advance Stop Bar

What: An advance stop bar is a stop bar that is marked 15 or more feet in advance of the crosswalk at a signalized intersection, as opposed to the minimum 4-foot setback.

Where: Advance stop bars should be considered where there is a high number of conflicts between vehicles turning right on red and pedestrians. They could also be used at any intersection where improved visibility is desired.

Why: Advance stop bars improve visibility of and for pedestrians. It also gives pedestrians a little more time to get into the crosswalk and establish their position before turning vehicles enter the crosswalk space. Conflicts between drivers and pedestrians were shown to be reduced by 90%[7]

How: This tool involves marking a stop line further from the crosswalk. However, there is a maximum allowable distance; guidance in Section 3B.16 of the MMUTCD suggests that the stop bar should be placed no more than 30 feet from the near edge of the intersecting roadway.

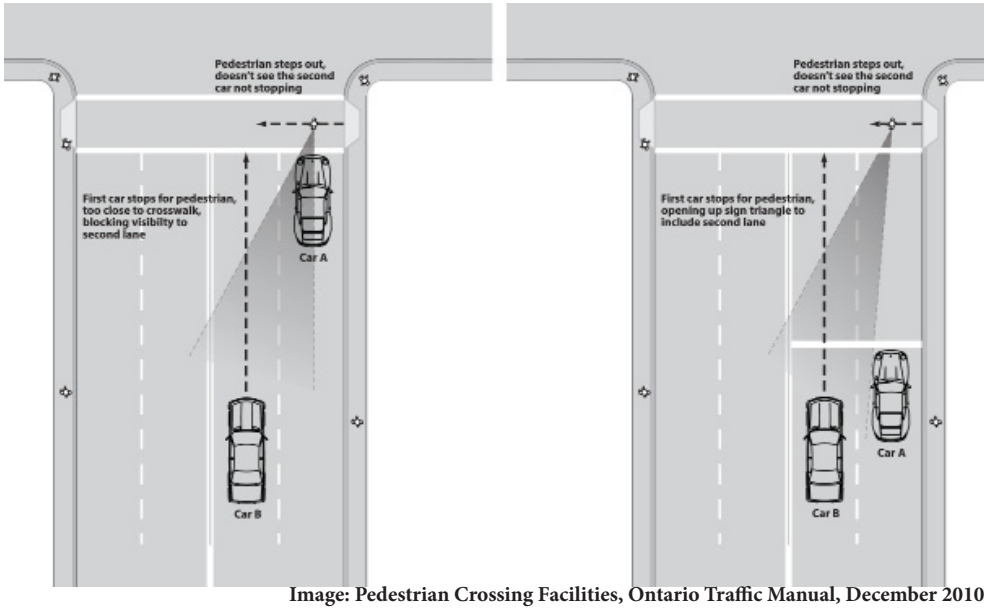


Image: Pedestrian Crossing Facilities, Ontario Traffic Manual, December 2010

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	No Difference	No Difference	Better	No Difference	Low

Pork Chop Island

What: A wedge-shaped island between a right-turn lane and through lanes at an intersection.

Where: Pork chop islands should be considered at wide intersections where channelized right turn lanes are desired, or where a large turning radius would otherwise be required to prevent large, right-turning vehicles from encroaching on opposing traffic lanes.

Why: Pork chop islands break up a pedestrian crossing, making the crossing both safer and easier. They have been shown to reduce pedestrian crashes by 29%.

How: Care should be taken to design the right-turn lane to encourage slow speeds and improve visibility of crossing pedestrians by the turning vehicles. Reference *Pedestrian Facilities Users Guide - Providing Safety and Mobility,* p. 59 for more information.

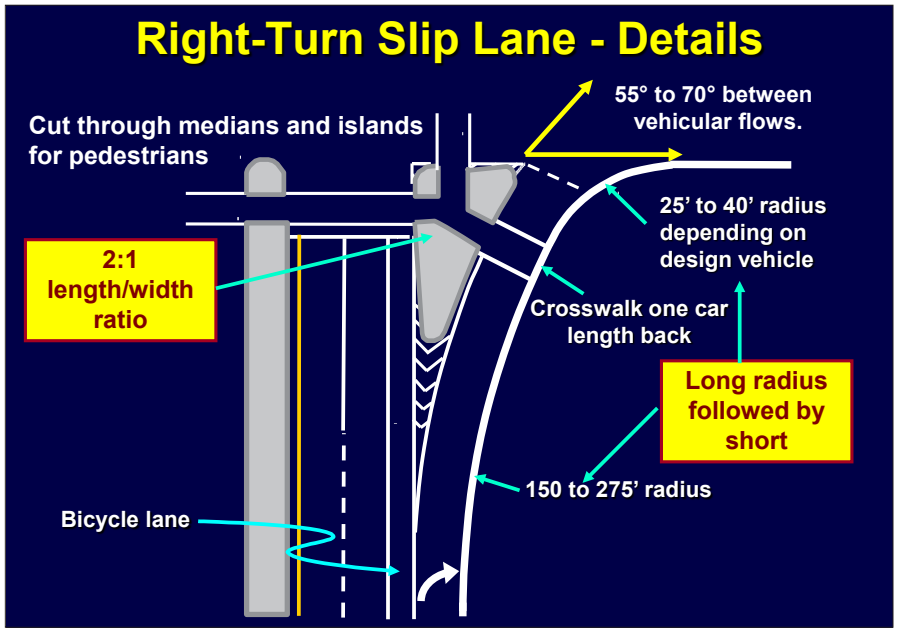


Image: AASHTO

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	No Difference	Better	Better	No Difference	Med/High

Bulb-Outs

What: Bulb-outs (also known as curb extensions or bump-outs) extend the sidewalk or planting space out into the existing roadway, taking up space in a parking lane.

Where: Bulb-outs may be used anywhere with permitted on-street parallel or angle parking. They should be considered in particular where pedestrian crossings are too long.

Why: Bulb-outs increase visibility between pedestrians and motorists. They also shorten the distance a pedestrian must cross to reach the other side of the street.

How: Curbs must be reconstructed to extend the pedestrian space. The new curb line should not encroach the traveled way where bicyclists or motor vehicles may be traveling.

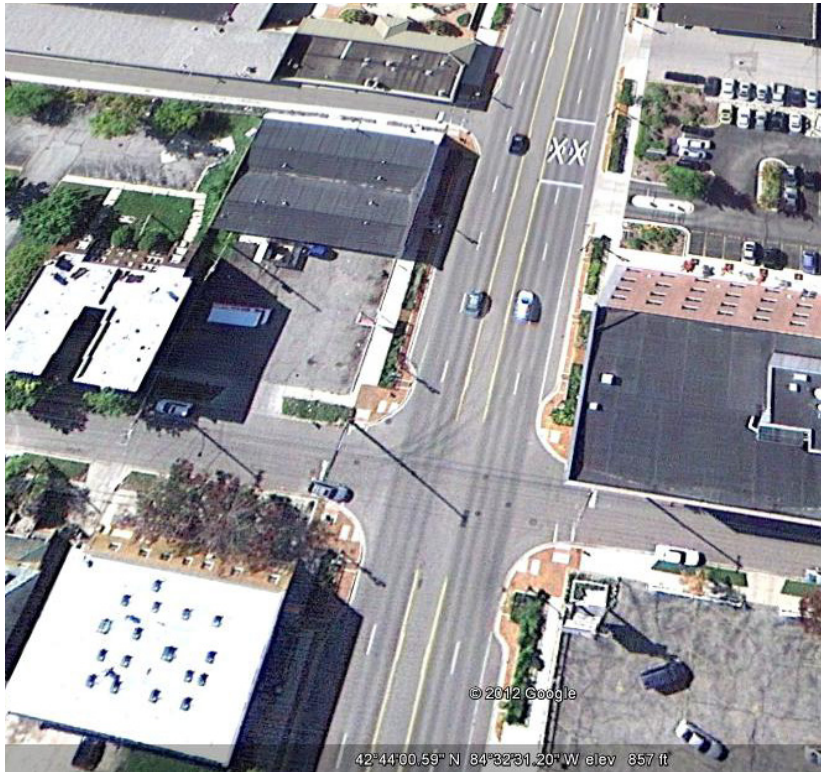


Image: Lansing, Michigan. Source: Google Earth Professional

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	No Difference	No Difference	Better	No Difference	Med/High

Roundabout

What: In place of a stop-controlled or signalized intersection, a roundabout directs straight and turning traffic through a circular intersection designed to ensure yielding upon entry and slow vehicle speeds through the roundabout.

Where: Single-lane roundabouts can handle traffic volumes up to 26,000 vehicles per day. While multi-lane roundabouts can be used for traffic volumes up to 50,000 vehicles per day, they may complicate pedestrian crossings.[8]

Why: Roundabouts reduce the number of conflict points at a typical four-leg intersection and have been shown to reduce motor vehicle crashes as well as pedestrian crashes. Below the volumes listed above, roundabouts tend to improve the efficiency of the intersection.

How: If future traffic projections identify a need for a multi-lane roundabout, the roundabout should first be installed as a single lane roundabout, with right-of-way reserved to add more lanes later when they become necessary. Refer to the *FHWA Roundabout Technical Summary* and www.michigan.gov/roundabout for more information.

Okemos, MI Image: Google Earth

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	Better	Better	Better	High*

* Cost assumes a retrofit. Cost may be similar to or less than installing a signalized intersection as part of planned roadway construction.

Bicycle Signal Detection

What: Bicycle signal detection is a modification to existing loop detectors or the addition of new loop detectors to detect the presence of bicycles at actuated and semi-actuated signalized intersections. Bicycle location markings and signage is often included to make sure bicyclists are positioned to ensure that they are detected at intersections. Conveniently-located push buttons may be substituted for automatic loop detection.

Where: Bicycle signal detection may be used wherever bicycle connectivity is desired across signalized intersections.

Why: Bicycle signal detection is helpful to reduce the likelihood that a bicyclist would attempt to cross against a signal, or to minimize delay for signalized intersections where a shorter cycle length can be used when bicyclists are not present.

How: Guidance for installation of bike signal detection markings is provided in the AASHTO *Guide for the Development of Bicycle Facilities*.

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low/Med

Intersection Bike Crossing Markings

What: On streets with bike lanes, pavement markings are continued through the intersection to indicate the intended position for bicyclists, as well as alert motorists that the bicycle facility is carried through the intersection.

Where: Intersection crossing markings should be considered at wide intersections or intersections where the intended direction for bicyclists is complex or unclear.

Why: The markings encourage bicyclists to ride in the most visible position on the roadway, and also raises motorist awareness of the presence of bicyclists.

How: The intended path may be marked using shared lane markings, colored pavement, dashed lines, or some combination. For additional background and design details, refer to the NACTO Urban Bikeway Design Guide: www.nacto.org

Image: Chicago, Illinois. Source: T.Y. Lin International

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low

Bike Box

What: A bike box provides a space for bicyclists to wait in front of the queue of vehicles at a signalized intersection. It includes an advance stop bar with markings for bicycles in the space between the stop bar and the crosswalk. The bike box may also use colored paverment to denote the space for bicyclists.

Where: Bike boxes can be used in conjunction with bike lanes and may be considered where it may be helpful to provide additional space to separate bicyclists traveling straight or making right turns, or where there is a high number of motorists making right turns. Bike boxes are also useful at complicated intersections. No Turn On Red is required at intersections where bike boxes are used.

Why: Bike boxes improve visibility of bicyclists at intersections, where they are most vulnerable. In particular, they reduce conflicts between right-turning vehicles and bicyclists.

How: Bike bixes are not yet in the MUTCD and will require FHWA approval prior to installation. For design detail information refer to the NACTO Urban Bikeway Design Guide: www. nacto.org

Image: www.pedbikeimages.org/Laura Sandt

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce	No Difference	No Difference	Better	Low

Two-Stage Bike Left Turn

What: A two-stage left turn consists of a queue box marked on the far side of at an intersection to provide a place for bicyclists to wait while making a left turn without having to move to the left-turn lane.

Where: Two-stage left turn queue boxes should be considered where a bicycle facility crosses another facility, or where the facility makes a left turn. These may be installed at intersections with or without medians. The image from NACTO to the right shows the median treatment.

Why: A two-stage left turn is helpful in providing bicyclists with flexibility in making a left turn where it may be uncomfortable or undesirable to move to the left-turn lane, or where multiple left-turn lanes exist.

How: A bicyclist enters a two-stage left turn by crossing the street on which he/she intends on making a left turn and waits in the queue box. Once across, the bicyclists waits for the green light and continues in the direction of traffic, completing the left turn in two stages. Two-stage bike left turns are not yet in the MUTCD and will require FHWA approval prior to installation.

Image: www.nacto.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low

Combined Bike/Turn Lane

What: A combined bike/turn lane most commonly occurs at an intersection where a bike lane and a right-turn lane occupy the same space.

Where: Combined bike/turn lanes should be considered only when a right-turn lane is needed along a street with a bike lane, and there is not enough street width to provide a separate bike lane to the left of the turn lane. The bike lane transitions to a shared lane condition with the motor vehicle turn lane.

Why: Combined bike/turn lanes help to identify the presence and riding location of a bicyclist. Signs help communicate the shared lane condition and that motor vehicles shall yield to bikes in these locations.

How: Pavement markings denoting the shared lane condition and signs posted "RIGHT TURN ONLY EXCEPT BIKES" or shared lane signs are posted to clarify the shared lane condition. Current guidance in the MUTCD suggests a lane drop resulting in a shared through or turn lane. Combined bike/turn lanes are not yet in the MUTCD and will require FHWA approval prior to installation. For more information, consult NACTO *Urban Bikeway Design Guide*.

Image: www.nacto.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low

Bicycle Signals

What: Bicycle signals are signals designated specifically for bicyclists. They may be actuated or pre-timed and may provide an exclusive signal phase for bicylists at an intersection.

Where: Bicycle signals may be used in areas where bicyclists are subject to different traffic control than vehicles, such as at trail crossings, cycle tracks, or bicycle boulevards.

Why: Bike signals are helpful to clarify the separation of bicycle and automobile traffic, to give bicyclists a head start in mixed traffic conditions, or where one bicycle facility transitions to another (e.g. when a shared use path transitions to an on-street bike lane.)

How: Guidance for installation of bike signals is provided in the NACTO *Urban Bikeway Design Guide*.

Image: www.pedbikeimages.org/Dan Burden

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium

Unsignalized Pedestrian Crossing Improvements

Best Practice	Potential Crash Reduction			Potential Mobility Effects			Cost
	Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Marked Crosswalk	No Difference	Reduce	Reduce	No Difference	Better	Better	Low
Advance Yield Markings	No Difference	Reduce	Reduce	No Difference	Better	Better	Low
In-roadway Yield Sign	No Difference	Reduce	No Difference	No Difference	Better	No Difference	Low
Pedestrian / Bicycle Refuge Island	Worse	Reduce	Reduce	No Difference	Better	Better	Low/Med
Rectangular Rapid Flashing Beacon	No Difference	Reduce	No Difference	No Difference	Better	No Difference	Medium
Pedestrian Hybrid Beacon	Reduce	Reduce	No Difference	No Difference	Better	Better	Med/High
Midblock Signal	No Difference	Reduce	Reduce	No Difference	Better	Better	Med/High
Roadway Illumination	No Difference	Reduce	Reduce	No Difference	Better	Better	Medium
Overpass/Underpass	No Difference	Reduce	Reduce	Better	Better	Better	High

Cost: Low: up to $20K; Med: $20K-$100K; High: over $100K

Marked Crosswalk

What: Marked crosswalks indicate to both pedestrians and motorists the intended or preferred crossing location. High-visibility pavement markings to denote the crosswalk, such as those shown at the right, are recommended.

Where: Crosswalks should be marked to indicate the intended path for a pedestrian. At uncontrolled (no stop sign or traffic signal) crossings, crosswalks may be marked on two lane roadways or roadways with less than 12,000 vehicles per day. Marked crosswalks alone are insufficient for roadways with four or more lanes and traffic volumes higher than 12,000 vehicles per day.

Why: Marked crosswalks suggest to pedestrians the most appropriate locations to cross the street. They also raise awareness of pedestrians by motorists.

How: Refer to Federal Highway Administration, *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations* for additional guidance on how and where to mark crosswalks.

Image: www.pedbikeimages.org/Tom Harned

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce *	No Difference	Better	Better *	Low/Med

* When used as a shared use path midblock crossing

Advance Yield Markings

What: At midblock crosswalks, advance yield markings improve visibility of pedestrians on multilane roadways, particularly by the motorist in the inside lane.

Where: Advance yield markings should be placed with pavement markings at midblock crosswalks on multilane roadways. The markings should be placed 20 to 50 feet in advance of the crosswalk.

Why: On multilane roadways, if a motorist in the outside lane yields or stops close to the crosswalk, that vehicle may block the view of crossing pedestrians by motorists in the inside lane. By advance the yield markings, visibility is improved and conflicts are reduced.

How: Advanced yield markings must be accompanied by a "Yield Here to Pedestrians" sign. See Michigan MUTCD Section 3B.16.

Image: www.walkinginfo.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce*	No Difference	Better	Better*	Low

* When used with a shared use path midblock crossing.

In-Roadway Yield Sign

What: In-roadway yield signs are signs placed in the center of the roadway that reinforce state law for motorists to yield to pedestrians in crosswalks at unsignalized locations.

Where: To clarify the state law for yielding to pedestrians, it can be helpful to install in-roadway yield signs at unsignalized, marked crosswalk locations. Usually, they are placed in the center of roadways with only one lane in each direction and can be used as temporary signs by school crossing guards. They work well at midblock crossings as well as unsignalized intersections.

Why: In-roadway yield signs have been shown to significantly improve motorist yielding compliance and reduce pedestrian crashes[9].

How: Refer to Michigan MUTCD Section 2B.11 for guidance on the placement of in-roadway yield signs.

Image: www.fhwa.dot.gov

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	No Difference	No Difference	Better	No Difference	Low

Pedestrian / Bicycle Refuge Island

What: Pedestrian / bicycle refuge islands are areas of the roadway where medians or curbs are constructed to protect pedestrians or bicyclists at crossings, allowing them to cross one direction of traffic at a time.

Where: Refuge islands should be considered at multilane pedestrian crossings, particularly where a painted or barrier median already exists or is proposed. At trail crossings, bicyclists also benefit from being able to cross one direction of traffic at a time.

Why: The placement of a refuge island on multilane roadways has been shown to reduce pedestrian crashes by 56%[1].

How: Guidance for the installation of a refuge island can be found in Michigan MUTCD Sections 3I.06 and 4B.04.

Image: www.pedbikeimages.org/Dan Burden

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Worse*	Reduce	Reduce	No Difference	Better	Better	Low/Med

* If the median nose is not adequately designed or delineated

Rectangular Rapid Flash Beacon

What: A rectangular rapid flashing beacon (RRFB) is a device that consists of two sets of high intensity light emitting diode (LED) lights mounted on poles on each side of an unsignalized pedestrian or bicycle trail crossing. The signals rest in the dark phase until activated by a push button and then flash in a rapid stutter flash pattern.

Where: RRFBs are recommended wherever an unsignalized crossing exists and it is necessary to provide additional notification to motorists of the presence of crossing pedestrians, or where there are insufficient gaps in vehicle traffic to provide a pedestrian crossing opportunity.

Why: RRFBs have been shown to produce an average motorist yielding compliance rate of 83% to a high of 94% for unsignalized crossings.

How: The FHWA provides guidance for the use of RRFB in conjunction with other unsignalized crossing improvements, such as advance stop or yield bars and median refuge islands.

Image: www.pedbikeimages.org/Michael Frederick

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	No Difference*	No Difference	Better	No Difference	Medium

*Potential crashes may be reduced for bicyclists if RRFB is used in conjunction with a shared use path trail crossing.

Pedestrian Hybrid Beacon

What: A pedestrian hybrid beacon consists of two red lights above a yellow light. The lights remain dark unless activated by a pedestrian waiting to cross. When activated, the yellow signal flashes to warn motorists and then the red lights are illuminated, indicating that the motorist must stop.

Where: Pedestrian hybrid beacons are appropriate where it is difficult to find a gap in traffic to make a crossing and there are a significant number of pedestrians wanting to cross at a particular location. Hybrid beacons may be used at locations with lower volumes than what is required for a midblock signal.

Why: Pedestrian hybrid beacons have been shown to reduce crashes up to 69% and motorist yielding compliance rates between 94% and 99%.[9]

How: Guidance for the installation of pedestrian hybrid beacons is provided in the Michigan MUTCD.

Image: www.pedbikeimages.org/Mike Cynecki

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	No Difference	No Difference	Better	Better	Med/High

Midblock Signal

What: A midblock signal is a full traffic signal for vehicles in one direction and pedestrians in the cross direction. The signal is often pedestrian actuated and therefore only interrupts traffic flow at times when pedestrians are wanting to cross.

Where: Midblock signals may be desired where large volumes of pedestrians are crossing midblock to access a particular destination, such as a transit station. The MUTCD has guidelines for the pedestrian volumes warranting a midblock signal.

Why: As a full traffic signal, a midblock signal has a very high compliance rate with motorists. The compliance rate for pedestrians decreases the longer a pedestrian has to wait for a WALK signal. The best compliance was found when pedestrians had to wait less than 30 seconds for the walk signal.

How: See Michigan MUTCD, Section 4C.05

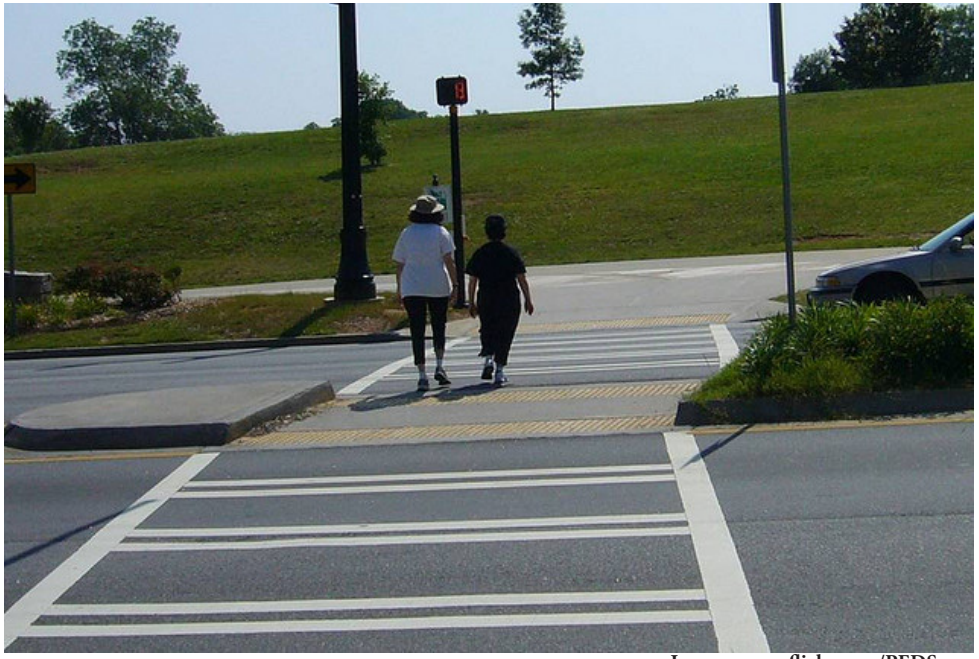


Image: www.flickr.com/PEDS.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce*	No Difference	Better	Better*	Med/High

* When used as a shared use path midblock crossing

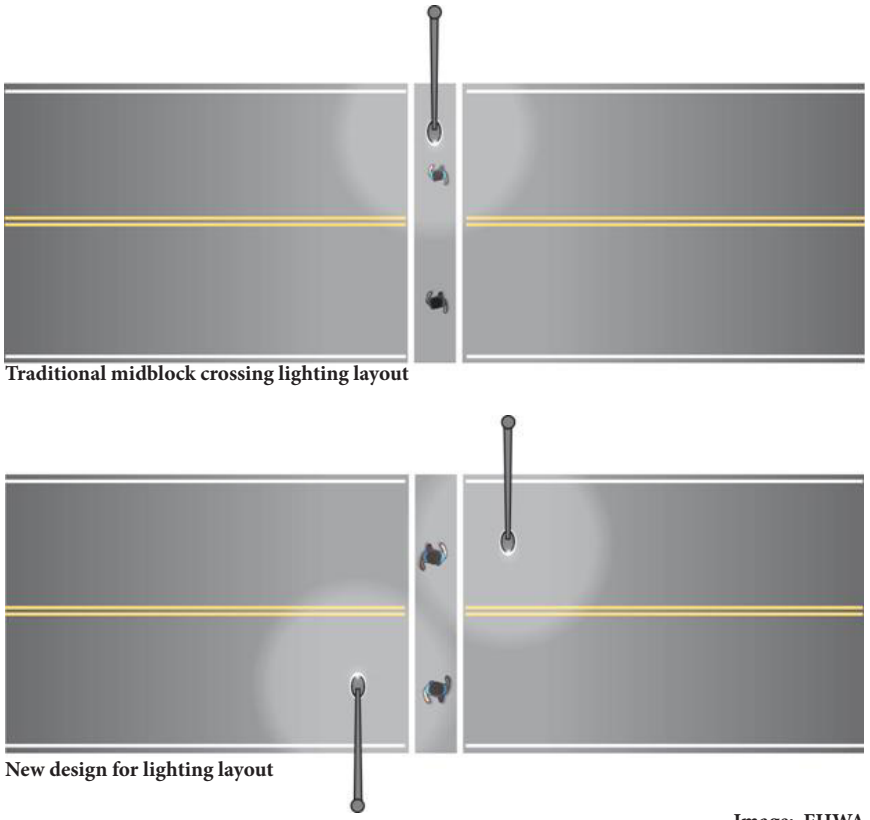
Roadway Illumination

What: Roadway illumination is the provision of sufficient overhead lighting on the roadway surface midblock crossings (as well as intersections) to make pedestrians and bicyclists more visible to motorists.

Where: Sufficient roadway illumination should be considered at all marked crossings where pedestrian and bicyclist crossing activity is observed or expected.

Why: Roadway illumination can reduce crashes associated with low light conditions and had been shown to reduce crashes at these locations by 42%-78%[1].

How: Refer to the Michigan Design Manual Section 9.03.01 for guidance on the placement of roadway lighting projects.



Traditional midblock crossing lighting layout

New design for lighting layout

Image: FHWA

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce	No Difference	Better	Better	Medium

Overpass or Underpass

What: Construction of an overpass or underpass completely separates autmobile movements from bicycle and pedestrian movements.

Where: Due to their cost, overpasses and underpasses should be considered only when at-grade treatments are not feasible due to wide crossings and high automobile volumes not subject to traffic controls, such as freeway crossings.

Why: Overpasses and underpasses have been shown to reduce all crashes by 60%-95%[1]. However, if an overpass or underpass is designed in a manner that makes it inconvenient or unappealing, such as a long detour or tunnel effect, it will not be used.

How: Guidance for the placement of overpasses and underpasses can be found in the AASHTO *Guide for the Development of Bicycle Facilities*.

Images: www.pedbikeimages.org/Dan Burden, www.pedbikeimages.org/Sree Gajula

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce	Better	Better*	Better*	High

* If designed to make pedestrian and bicycle usage a simpler and obvious choice.

Corridor Improvements

Best Practice	Potential Crash Reduction			Potential Mobility Effects			Cost
	MotorVehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Sidewalks and Paved Shoulders	Reduce	Reduce	Reduce	No Difference	Better	Better	Med/High
Road Diet	Reduce	Reduce	Reduce	No Difference	Better	Better	Low/Med
Raised Median	Reduce	Reduce	Reduce	Better	Better	Better	High
On-Street Parking	No Difference	Reduce	Reduce	No Difference	Better	Better	Low
Rear-In Diagonal Parking	Reduce	Reduce	Reduce	No Difference	No Difference	Better	Low/Med
Bike Lane	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium
Shared Lane Markings	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low
Buffered Bike Lane	No Difference	No Difference	Reduce	No Difference	Better	Better	Med/High
Colored Bike Lane	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium
Contra-flow Bike Lane	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium
Left Side Bike Lane	No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium
Cycle Track	No Difference	No Difference	Reduce	No Difference	No Difference	Better	High

Cost: Low: up to $20K; Med: $20K-$100K; High: over $100K

Sidewalks and Paved Shoulders

What: Sidewalks are facilites separated from the roadway by a curb and sometimes a setback for the exclusive use by pedestrians. Paved shoulders are paved extensions of the roadway outside the traveled way.

Where: Sidewalks should be installed as part of every urban arterial and collector street where there is developed frontage. Paved shoulders should be considered on any roadway where sidewalk construction is not feasible due to grade or right-of-way constraints.

Why: When sidewalks are added to a roadway, pedestrian crashes are reduced by 88%[1]. When paved shoulders are added to the roadway, pedestrian crashes are reduced by 70%[1]. Additionally, paved shoulders can increase the pavement life of roadways and reduce cracking.

How: Sidewalks and shoulders are most cost effective when incorporated as part of roadway construction. If sidewalks cannot be provided at the time of roadway design, right-of-way should be secured and proper grading should be done in anticipation of sidewalks at a later date. Whenever roadway drainage goes from an open swale to a closed drainage system, sidewalk construction should be considered as a low cost addition to the project.

Images: www.pedbikeimages.org/Dan Burden

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	No Difference	Better	Better	Med/High

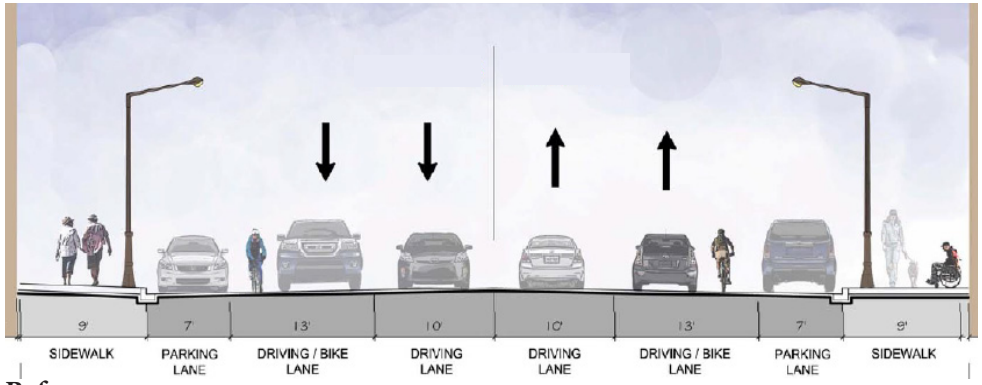
Road Diet

What: A road diet reallocates the through travel lanes of a roadway and adds a center two-way left-turn lane. A typical road diet reduces a 4-lane roadway to 3 lanes and adds bike lanes, sidewalks, or widens existing sidewalks.

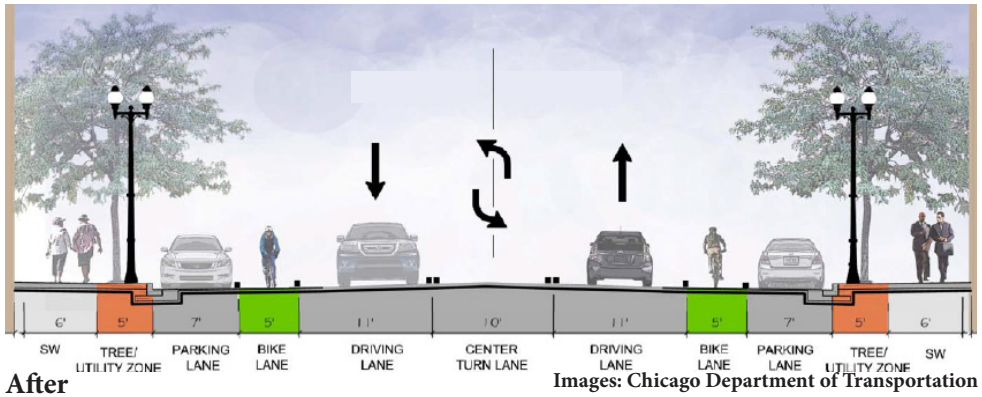
Where: Road diets can be implemented on streets with up to 20,000 vehicles per day without greatly impacting motor vehicle travel.

Why: Road diets improve safety and mobility for all users by reducing read-end, sideswipe, and left-turn crashes, and freeing up one lane in each direction for uninterrupted travel. Total crashes are reduced by 18-44%[11].

How: Because road diets are a reconfiguration of existing roadways, they are feasible on roadways with up to 15,000 ADT, and can be considered under a more detailed traffic analysis for volumes as high as 20,000 ADT.



Before



After

Images: Chicago Department of Transportation

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	No Difference	Better	Better	Low/Med*

* Minimal cost when done as part of a street resurfacing.

Raised Median

What: Raised medians provide a physical separation between lanes of opposite direction of travel. They often serve to provide a refuge in the middle of the street for pedestrians crossing.

Where: Raised medians are useful on multi-lane roadways where there is a need to improve pedestrian crossings. Medians should also be considered where there has been a history of head-on collisions or pedestrians involved in crashes while crossing.

Why: The majority of pedestrian crashes in Michigan are occurring mid-block. At unsignalized locations, raised medians were shown to reduce pedestrian crashes by 69%.

How: The design of raised medians is covered in the Michigan Design Guide Section 7.01.54 and the Michigan MUTCD Section 3I.06.

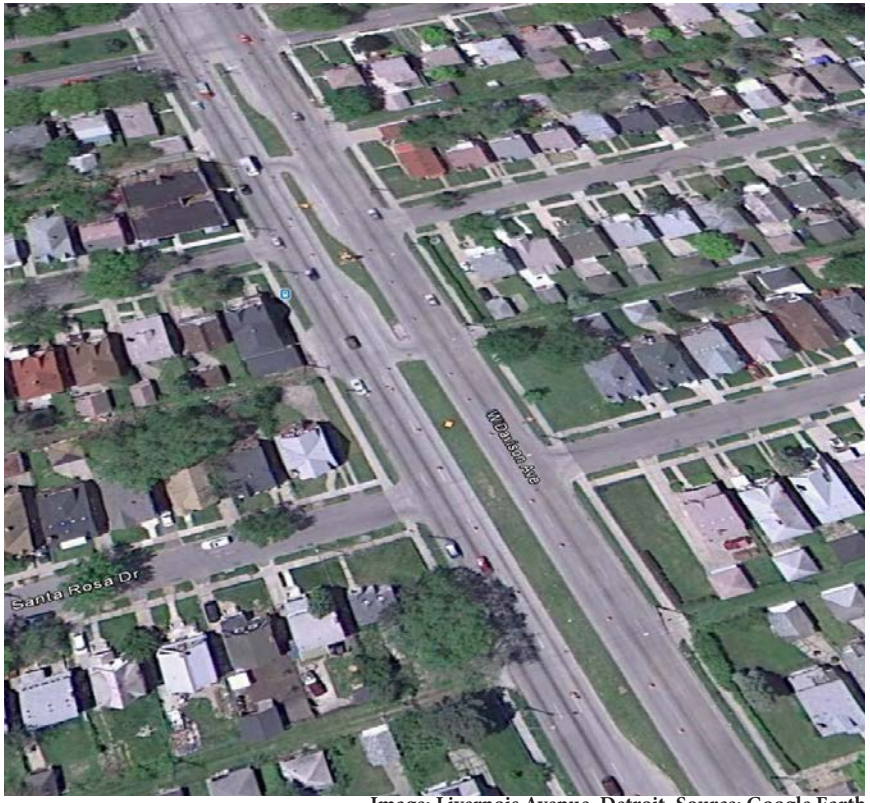


Image: Livernois Avenue, Detroit. Source: Google Earth

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	Better	Better	Better	High

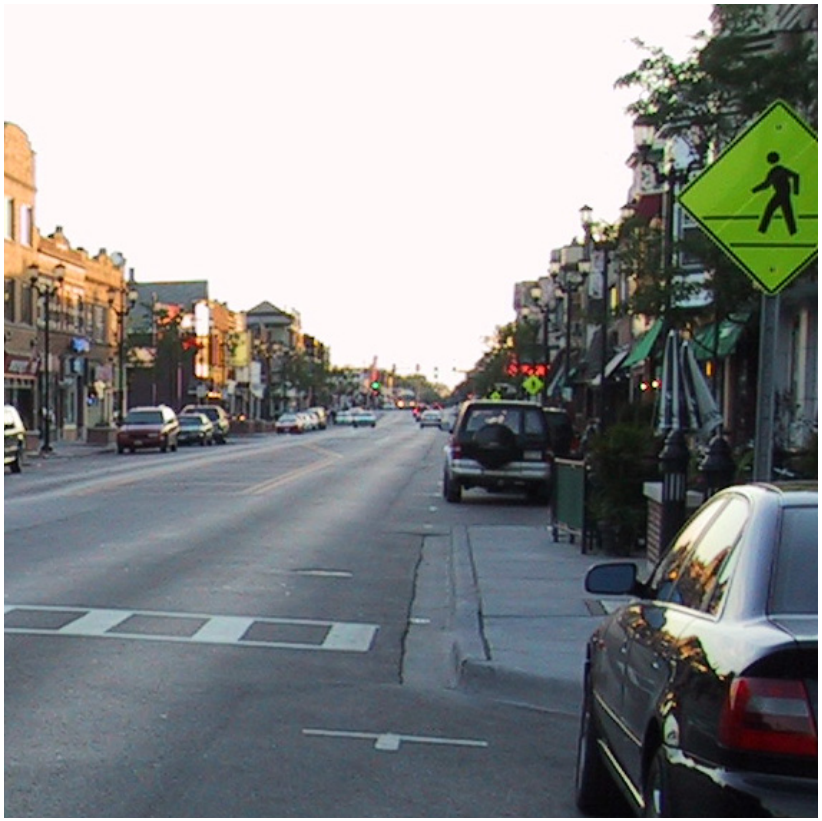
On-Street Parking

What: On-street parking is the placement of parked vehicles on the roadway closest to the curb. On-street parking may be parallel or angle parking.

Where: On-street parking can be placed on most roadways in developed areas and should be considerend whenever it is desirable to provide parking for adjacent land uses and where a buffer between pedestrians and moving vehicles is desired.

Why: The placement of on-street parking reduces travel speeds on the roadway and can reduce the severity of crashes by reducing vehicle speeds. On urban streets with posted speeds of less than 35 mph, streets with on-street parking experience less than half as many severe and fatal crashes than streets without on-street parking [15].

How: Parking lanes are usually 8 feet wide, but 7-foot parking lanes, per state law, can be allowed, particularly where adjacent to a bike lane. If the travel lane adjacent to on-street parking is less than 12 feet wide and is used by bicyclists, shared lane markings may be used to encourage bicyclists to ride outside of the "door zone." Diagonal parking is not permitted on Michigan trunk line highways.



Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	Reduce	Reduce*	No Difference	Better	Better	Low

*When bicyclists ride outside the "door zone."

Rear-In Diagonal Parking

What: Rear-in diagonal parking is the placement of angle parking where the front of the automobile is parked facing the travel lane with the back of the vehicle at the curb.

Where: Rear-in diagonal parking should be considered wherever angle parking exists or is planned.

Why: Rear-in diagonal parking eliminates the blind spots associated with angle parking which particularly helps bicyclists traveling adjacent to the parking lane. Additionally, rear-in diagonal parking directs children exiting vehicles to the curb, and loading items in the trunk also occurs at the curb.

How: Guidance for the placement of angle parking is provided by FHWA as part of *Designing Roads and Parking Areas* for the Recreational Trails Program under the Office of Planning, Environment, and Realty. Per state law, diagonal parking is not permitted on Michigan trunkline highways.

Image: www.pedbikeimages.org/Carl Sundstrom

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
Reduce	Reduce	Reduce	No Difference	No Difference	Better	Low/Med

Bike Lane

What: Bike lanes are portions of the roadway that are delineated with pavement markings for the exclusive use by bicyclists. Normally, one bike lane is provided on each side of the roadway and travels in the same direction as the automobile lane. Bike lane signs can be used to supplement the pavement markings.

Where: Bike lanes should be installed on roadways as part of a bicycle route to improve the visibility of bicyclists to motorists, provide space for bicyclists as part of a bicycle route, reduce the occurrence of wrong-way bicycling in traffic, and reduce the number of bicyclists riding on the sidewalk.

Why: The addition of bike lanes has been shown to reduce bicycle crashes by 50%[10]. Bike lanes are a much more cost-effective method of providing bicycle facilities than a sidepath, which typically requires additional right-of-way and is subject drainage and alignment issues independent of the roadway.

How: Bike lanes currently are considered a design option in the Michigan Design Manual Section 12.12. Additional guidance can be found in the AASHTO *Guide for the Development of Bicycle Facilities*.

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium

Shared Lane Markings

What: A shared lane marking is a pavement marking placed on roadways that are recommended for bicycle travel but do not have adequate space for a separate bike lane.

Where: Shared lane markings can be used on any street recommended for bicycle travel, on shared roadways where it is helpful to remind motorists of the presence of bicyclists, or in transition areas where it is important to show the recommended bicycling location for bicyclists.

Why: When applied to roadways, shared lane markings are shown to reduce the occurrence of wrong-way riding and bicycling on the sidewalk, and moving bicyclists out of the way of opening doors in the parking lane, all of which help to reduce crashes[12].

How: Guidance for the application of shared lane markings can be found in MMUTCD Section 9C.07.

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Low

Buffered Bike Lane

What: A buffered bike lane is a bike lane that is separated from traffic by a painted median with or without collapsible posts. It provides a greater horizontal separation between the bike lane and the automobile travel lane.

Where: Buffered bike lanes should be considered wherever greater separation of bicycle and automobile traffic is desired. They may be placed on either side of the bike lane (next to the through travel lane or the parking lane.)

Why: Buffered bike lanes increase the separation between bicycles and automobiles, which may be helpful on roadways with posted speeds above 35 miles per hour.

How: Refer to the NACTO *Urban Bikeway Design Guide* for guidance on the design of buffered bike lanes.

Image: www.pedbikeimages.org/Steven Faust

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	Better	Better	Med/High

Colored Bike Lane

What: A colored bike lane is a portion of a bike lane marked with high-visibility green pavement markings to identify a potential conflict area or transition area of a bicycle facility. Bike lanes are usually colored just in the vicinity of an intersection.

Where: Colored bike lanes should be considered where motor vehicles and bicyclist share a transitioning area of the roadway, such as near turn lanes or when a lane drop occurs for bicycles or motor vehicles.

Why: Colored bike lanes increase the visibility of the bicycle facility and have been shown to increase motorist yielding compliance rates by 11%, and increase bicyclist scanning the roadway for nearby vehicles[13].

How: Green colored bike lanes were given interim approval by FHWA in April 2011 and have been approved for experimental design. This means that they should be included in the next update to the MUTCD. For current information on colored bike lanes, consult the NACTO *Urban Bikeway Design Guide*.

Image: www.nactor.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium

Contra-flow Bike Lane

What: Contra-flow bike lanes are bike lanes that run in the opposite direction as automobile traffic on a street. The most common applications are on one-way streets where a contra-flow bike lane is placed to provide a link to bicycle facility to avoid placing bicyclists on high-speed or high volume arterial roadways.

Where: Contra-flow bike lanes should be considered wherever bicycle facility connectivity is needed.

Why: Contra-flow bike lanes provide a bicycle facility where demand exists, as demonstrated by wrong-way riding. Additionally, by placing bicyclists in a contra-flow lane, it reduces the likelihood of bicycling on streets not recommended for bicyclists.

How: Guidance for the placement of contra-flow bike lanes is provided in the NACTO *Urban Bikeway Design Guide*.

Image: www.nacto.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium

Left Side Bike Lane

What: Left side bike lanes are bike lanes painted on the left side of a roadway. Typically, left side bike lanes are placed on one-way streets, or on two way streets adjacent to a barrier median.

Where: Left side bike lanes are appropriate on roadways with frequent driveways, transit service, or on roadway networks with one-way pairs.

Why: Left side bike lanes reduce the need for a bicyclist to cross one or several lanes to make a left turn in areas where a bicycle facility continues to the left, or to avoid conflicting with pedestrians and transit vehicles at transit stops located on the right side of the road. However, right turns are more difficult with this design.

How: Guidance for the placement of left side bike lanes is provided in the NACTO *Urban Bikeway Design Guide*.

Image: www.pedbikeimages.org/Dan Burden

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	Medium

Cycle Track

What: A cycle track is a dedicated bicycle facility for bicycles that is physically separated from traffic. It consists of a one or two-way facility for bicycles and is separated from automobile traffic with either a pavement marking buffer, collapsible posts, a curb, a change in elevation, or a combination of these items.

Where: Cycle tracks can be considered for an urban street where a significant amount of protection and separation is desired between automobiles and bicycles. However, cycle tracks can pose a crash risk at intersections where turning automobiles cannot see bicyclists emerging from behind parked cars or standing pedestrians. In these cases, the use of bike signals is recommended.

Why: Cycle tracks physically separate bicycle and automobile traffic, which has been shown to reduce injury crashes by 28%[14].

How: Guidance for the placement of cycle tracks is provided in the NACTO *Urban Bikeway Design Guide*.

Image: www.nacto.org

Potential Crashes			Potential Mobility Improvements			Cost
Motor Vehicles	Pedestrians	Bicyclists	Motor Vehicles	Pedestrians	Bicyclists	
No Difference	No Difference	Reduce	No Difference	No Difference	Better	High

References

1. Federal Highway Administration. Desktop Reference for Crash Reduction Factors. 2007.

2. Knoblauch, R., Pietruchia, M., and Nitzburg, M. "Field Studies of Pedestrian Walking Speed and Start-Up Time." Transportation Research Record 1538. Washington, DC, 1996.

3. Gan, A., Shen, J., and Rodriguez, A., "Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects." Florida Department of Transportation, Tallahassee, FL, 2005.

4. Federal Highway Administration. Interim Approval for Optional Use of Flashing Yellow Arrow for Permissive Left Turns. IA-10, 2006.

5. Federal Highway Administration. Traffic Signal Timing Manual. 2009.

6. Van Houten, R., Retting, R.A., Van Houten, J. Farmer, C.M., and Malenfant, J.E.L. "Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Suburban Intersections." Transportation Research Record. No. 2002-10. Washington, D.C., 2000.

7. FHWA Pedestrian Facilities Users Guide-Providing Safety and mobility http://www.fhwa.dot.gov/publications/research/safety/04091/09.cfm#c913

8. Federal Highway Administration, Roundabouts: Technical Summary

9. Fitzpatrick, K., et. A., "Improving Pedestrian Safety at Unsignalized Crossings." NCHRP Report 112/562, Transportation Research Board. Washington, D.C., 2006.

10. Moritz, W. "Survey of North American Bicycle Commuters; Design and Aggregate Results." Transportation Research Record. Washington, D. C., 2003.

11. Highway Safety Information System. Evaluation of Lane Reduction "Road Diet" Measures on Crashes. Federal Highway Administration. Washington, D. C., 2011.

12. Do, A. "Evaluation of Shared Lane Markings." Federal Highway Administration, Washington, D. C., 2010.

13. Hunter, W., Srinivasan, R., and Martell, C. "Evaluation of a Green Bike Lane Weaving Area in St. Petersburg, Florida." University of North Carolina Highway Safety Research Center. Chapel Hill, NC, 2008.

14. Lusk, A., Furth, P., Morency, P., Miranda-Moreno, L., Willett, W., Dennerlein, J. "Risk of injury for bicycling on cycle tracks versus in the street". Injury Prevention. 2010.

15. Marshall, W., Garrick, N., Hansen, G. "Reassessing On-Street Parking." Transportation Research Record 2046. 2008.

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U.S. Department of Transportation
Federal Highway Administration

EDC

Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

Photo: VHB

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U.S. Department of Transportation
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Safe Roads for a Safer Future
Investment in roadway safety saves lives

EDC

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16. ABSTRACT

This guide assists State or local transportation or traffic safety departments that are considering developing a policy or guide to support the installation of countermeasures at uncontrolled pedestrian crossing locations. This document provides guidance to agencies, including best practices for each step involved in selecting countermeasures. By focusing on uncontrolled crossing locations, agencies can address a significant national safety problem and improve quality of life for pedestrians of all ages and abilities. Agencies may use this guide to develop a customized policy or to supplement existing local decision-making guidelines.

The January 2018 version of this guide was updated to include the Rectangular Rapid-Flashing Beacon (RRFB). FHWA issued a new Interim Approval (IA-21) for the optional use of RRFBs in March 2018.

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pedestrian crash countermeasures, uncontrolled crossings, midblock crossings, Pedestrian Hybrid Beacon, Road Diet, crosswalk visibility enhancements, pedestrian refuge island, raised crosswalk, Rectangular Rapid-Flashing Beacon	No restrictions.

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What is the *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*?

State or local transportation or traffic safety departments should consider developing a policy or guide to support the installation of countermeasures at uncontrolled pedestrian crossing locations. This document provides guidance to agencies, including best practices for each step involved in selecting countermeasures. Agencies may use this guide to develop a customized policy or to supplement existing local decision-making guidelines.

This document was produced by the Federal Highway Administration (FHWA) as part of the Safe Transportation for Every Pedestrian (STEP) program. STEP is part of the fourth round of Every Day Counts. STEP's purpose is to help transportation agencies address crashes by promoting countermeasures with known safety benefits at uncontrolled crossing locations.

Uncontrolled pedestrian crossing locations occur where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e. traffic signal or STOP sign) is present. These common crossing types occur at intersections (where they may be marked or unmarked) and at non-intersection or midblock locations (where they must be marked as crossings). Overall, uncontrolled pedestrian crossing locations correspond to higher pedestrian crash rates, often due to inadequate pedestrian crossing accommodations.

By focusing on uncontrolled crossing locations, local and State agencies can address a significant national safety problem and improve quality of life for pedestrians of all ages and abilities. STEP promotes the following six effective and lower-cost countermeasures that communities can deploy based on their specific needs:

- Crosswalk visibility enhancements (i.e., high-visibility crosswalk markings, parking restriction on crosswalk approach, improved lighting, advance Yield Here To [Stop Here For] Pedestrians sign and yield [stop] line, In-Street Pedestrian Crossing sign, and curb extension).
- Raised crosswalk.
- Pedestrian refuge island.
- Pedestrian Hybrid Beacon (PHB).
- Road Diet.
- Rectangular Rapid-Flashing Beacon (RRFB).

These countermeasures and their safety benefits are described further in this guide. The guide also includes best practices for identifying locations and installing countermeasures at uncontrolled pedestrian crossing locations.

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List of Abbreviations

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADT	average daily traffic
CMF	crash modification factor
CRF	crash reduction factor
EDC	Every Day Counts
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
GHSA	Governors Highway Safety Association
GIS	geographic information system
HSIP	Highway Safety Improvement Program
HSP	Highway Safety Plan
MUTCD	Manual on Uniform Traffic Control Devices
NHTSA	National Highway Traffic Safety Administration
PHB	Pedestrian Hybrid Beacon
RRFB	Rectangular Rapid-Flashing Beacon
RSA	Road Safety Audit
SHSP	Strategic Highway Safety Plan
STBG	Surface Transportation Block Grant
STEP	Safe Transportation for Every Pedestrian
TZD	Toward Zero Deaths
VZ	Vision Zero

Introduction

Pedestrians are among the most vulnerable road users, accounting for approximately 16 percent of all roadway fatalities nationally in 2016, per the Fatality Analysis Reporting System (FARS).[1] Pedestrians are especially vulnerable at non-intersection locations, where 72 percent of pedestrian fatalities occur.[1]

This guide addresses safety issues at **uncontrolled pedestrian crossing locations**, which occur where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e., traffic signal or STOP sign) is present. These common crossing types occur at intersections (where they may be marked or unmarked) and at non-intersection or midblock locations (where they must be marked as crossings). Overall, uncontrolled pedestrian crossing locations correspond to higher pedestrian crash rates than controlled locations, often due to inadequate pedestrian crossing accommodations.

How to Use this Guide

The guide includes steps to assist an agency in selecting appropriate countermeasures to help improve pedestrian safety, as illustrated in Figure 1. An agency that has an established process for identifying priority locations for pedestrian safety improvements should review the guidance in Steps 3 through 6. This information is most important for selecting pedestrian crossing countermeasures. An agency that is at the beginning stages of identifying priority locations should consult each of the steps described in this guide.

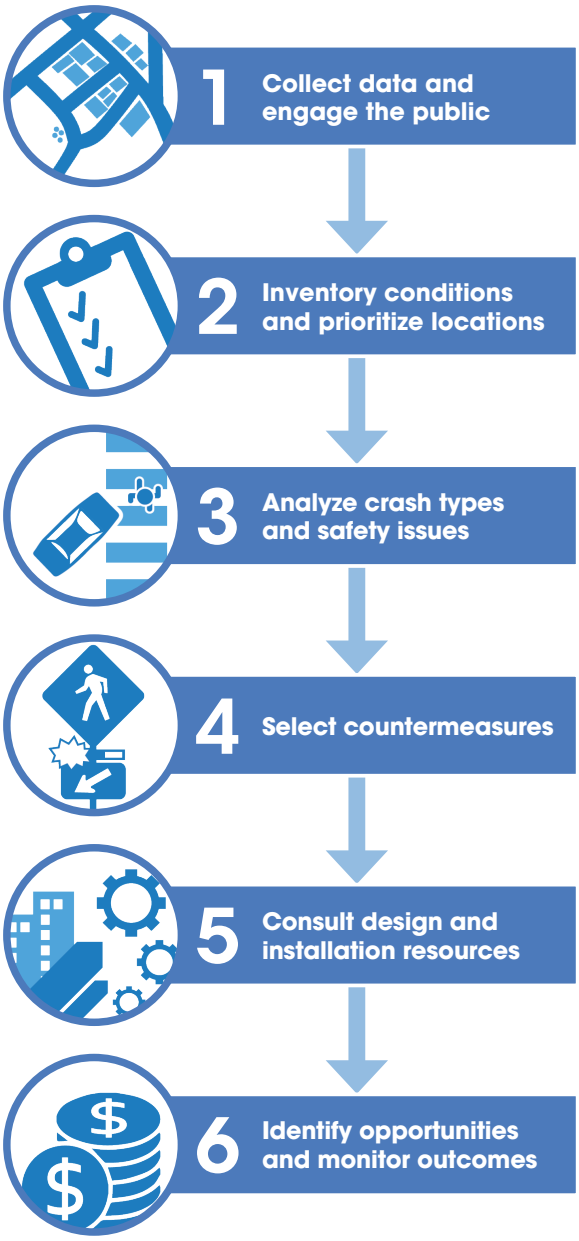


Figure 1. Process diagram for selecting countermeasures at uncontrolled pedestrian crossing locations.

[1]*NHSTA, "FARS Data Query: 2016 Data." Fatality Analysis Reporting System (FARS) Encyclopedia. (2017). https://www-fars.nhtsa.dot.gov//QueryTool/QuerySection/SelectYear.aspx*

Following the process in the guide results in possible countermeasure options based on road conditions, crash causes, and pedestrian safety issues. The guide provides two reference tables to help identify countermeasure options. Table 1 identifies countermeasures by roadway conditions such as vehicle speed limit, annual average daily traffic (AADT), and number of travel lanes. Table 2 helps further pinpoint the most appropriate countermeasures by common safety concerns such as failure to yield or excessive vehicle speeds. The guide does not include specific recommendations for countermeasures based on all criteria in design and reference manuals, such as actual speeds and pedestrian volumes. The agency should reference the Manual on Uniform Traffic Control Devices (MUTCD), American Association of State Highway and Transportation Officials (AASHTO) design guidelines, and State and local practices when selecting one or more specific countermeasures. The guide is followed by appendices including reference material for a local agency resolution and a summary of research cited for crash modification factors (CMFs).

The agency should note additional considerations for the application of this guide, such as costs to design, install, and maintain the treatments. The agency should apply engineering judgment and conduct field investigations to confirm data and observe driver and pedestrian behaviors when selecting countermeasures.

Building a safe and connected pedestrian network requires consideration of topics beyond what is included in this guide. This guide does not include methods for prioritizing sidewalk improvements, but agencies should consider giving special attention to connecting the pedestrian network with sidewalks, walkways, paved shoulders, and trails and paths. The ActiveTrans Priority Tool was created through the National Cooperative Highway Research Program and can provide agencies with automated resources to prioritize pedestrian and bicycle improvements.

Pedestrian crossings in or near school zones are not specifically addressed in this guide, as these crossings may be subject to other guidance or other considerations. Agencies may refer to the "Safe Routes to School Briefing Sheets: School Area Traffic Control" produced by the Institute of Transportation Engineers (ITE) for guidance on improving pedestrian crossings near schools.

This guide does not describe pedestrian crossing requirements per the Americans with Disabilities Act (ADA), although ADA requirements should be addressed as part of any pedestrian crossing improvements project. For more information about ADA accessibility requirements, the agency should consult the US Access Board's 1991 ADA Accessibility Guidelines (ADAAG), the 2010 Standards for Accessible Design, and the 2011 Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (proposed PROWAG).

1

Collect Data and Engage the Public

GUIDING PRINCIPLES

This section describes optional methods for describing existing pedestrian safety trends and engaging stakeholders. The following are important considerations for this step in the process of selecting countermeasures:

» Review existing plans for safety statistics and locations previously identified for safety improvements.

» Develop a resolution or policy statement in support of improving pedestrian safety at uncontrolled crossing locations.

» If a formal process is preferred, initiate a Pedestrian Safety Action Plan to engage the community and identify priority locations.

» If a less formal process is preferred, document public comments previously received or conduct a walkability audit to identify locations generally considered as less safe for pedestrians crossing.

Collect Pedestrian Crash and Safety Data

Crash reports completed by law enforcement agencies may include information about driver and pedestrian actions, as well as environmental conditions when and where the crash occurred. These data are helpful to understand safety issues in the area. Crash data may be geocoded and mapped. The agency can collect crash maps, request crash reports (as needed), and contact public health officials for other pedestrian injury data.

Review Existing Traffic Safety Plans

The Strategic Highway Safety Plan (SHSP) is a statewide-coordinated, data-driven safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. States are required to update the SHSP at least once every five years. The SHSP may include an emphasis area and strategies for improving pedestrian safety. The agency should review the SHSP for pedestrian crash statistics and strategies for pedestrian safety improvements.

The SHSP informs the State's Highway Safety Improvement Program (HSIP). The HSIP is a program of highway safety improvement

projects, activities, plans and reports. HSIP projects are selected through a data-driven approach and can include pedestrian crash countermeasures and intersection improvements. Some States set aside HSIP funding for pedestrian safety improvements, while other States use a common scoring process to consider safety projects for all travel modes. The agency should identify and understand pedestrian safety projects in the current HSIP, and consider how pedestrian safety projects are identified for potential funding and implementation. The Safety Performance Management Measures Final Rule (23 CFR 490) establishes requirements that support the HSIP, including a measure for the number of non-motorized fatalities and non-motorized serious injuries. This performance measure includes both pedestrians and bicyclists.

The State's Highway Safety Plan (HSP) must also be coordinated with the SHSP. The HSP is an annual strategy submitted by the State's Governor's Highway Safety Office to the National Highway Traffic Safety Administration (NHTSA). The HSP focuses on countermeasures that address driver and non-motorized behavior, and it provides an investment plan for activities such as law enforcement operations and public education programs. The HSP includes performance measures established by NHTSA and the Governors Highway Safety Association (GHSA), including one for pedestrian fatalities. Pedestrian safety initiatives are eligible for funding through the HSP. The agency should research pedestrian safety programs recommended in the HSP and consider how pedestrian crossing treatments can support the performance standards described in the HSP.

Evaluate Pedestrian Accommodation and Traffic Safety Policies

The agency may have a policy or guidance for how pedestrian improvements are incorporated into other roadway projects, such as a Complete Streets policy. The policy explains the process for integrating sidewalks and crossing treatments into routine street maintenance activities and large-scale highway projects. The agency should examine the linkages between Complete Streets and pedestrian safety and consider improvements to the process to better integrate pedestrian crossing improvements into roadway projects.

The agency may have adopted a policy for eliminating traffic-related fatalities, such as a Vision Zero or Toward Zero Deaths initiative. The programs focus on eliminating or significantly reducing traffic fatalities and prioritize strategies for the most vulnerable roadway users, such as pedestrians. These programs may summarize how all agency departments can improve pedestrian and traffic safety, and may include metrics that establish the need for safety at uncontrolled pedestrian crossings.

Review Pedestrian Master Plans for Proposed Projects

Another approach to identify pedestrian issues is to review existing local or regional plans, particularly those with a focus on pedestrians, for potential locations for safety projects and to identify needed countermeasures. A State or local pedestrian master plan may include recommendations for pedestrian safety projects, identified infrastructure deficiencies, and/or documentation

about safety concerns. This step leverages prior analyses and helps to identify countermeasures that that the agency is already considering.

Initiate a Pedestrian Safety Action Plan (PSAP)

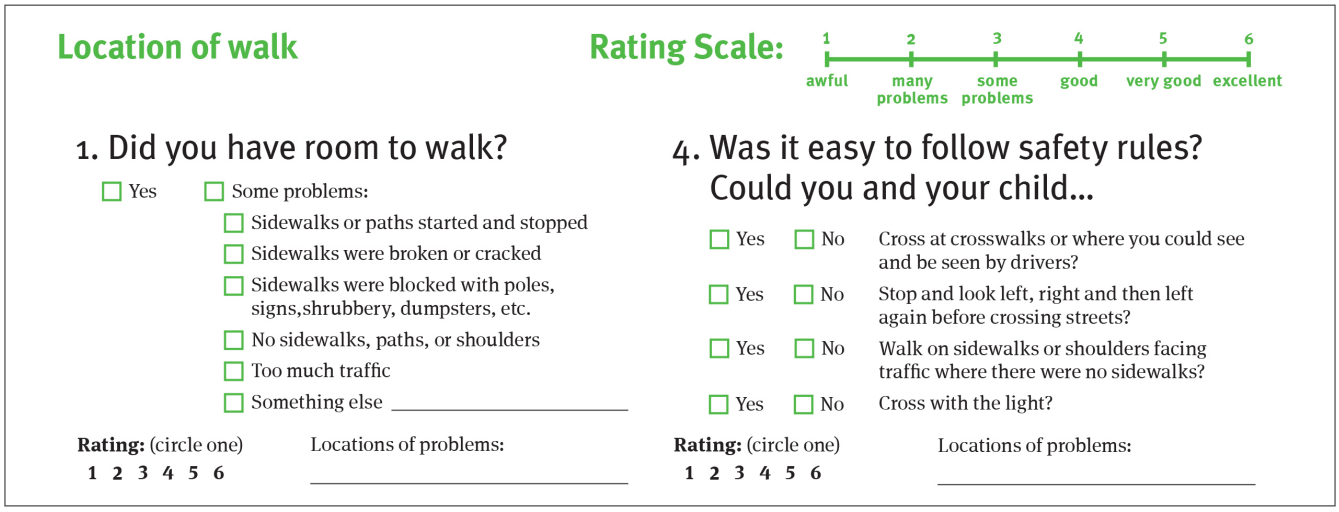
Agency leaders and community stakeholders can begin a formal process to identify priority locations and key strategies for improving pedestrian safety. The agency may initiate a PSAP to increase community awareness and support for improving pedestrian safety. A PSAP considers the input of stakeholders from multiple disciplines and uses data analysis to identify potential locations for safety improvement.

Document Informal Public Comments

The agency can identify locations of significance within a jurisdiction by collecting concerns and requests from community partners. Agencies should set up a process for receiving, tracking, and responding to input from residents and visitors. Many local governments respond with traffic calming request applications or online forms for residents with concerns about pedestrian safety on high-speed arterials or collector streets. Agencies may also consider forming a committee or work group devoted to considering pedestrian safety and mobility, such as a pedestrian advisory committee. This type of group can collect input from stakeholders and present their concerns to agency staff or decision-makers.

Conduct a Walkability Audit

Community leaders and neighbors can conduct a walkability audit at priority locations or corridors to identify deficiencies in the pedestrian network at a small area or neighborhood scale. This is an informal method for engaging stakeholders and raising awareness about pedestrian safety. Leaders can organize an event and ask participants to follow a simple checklist to assess neighborhood streets. Figure 2 shows an excerpt from a sample "walkability checklist" that agencies may use to conduct a walkability audit.



Location of walk

Rating Scale: 1 awful · 2 many problems · 3 some problems · 4 good · 5 very good · 6 excellent

1. Did you have room to walk?

☐ Yes ☐ Some problems:
- ☐ Sidewalks or paths started and stopped
- ☐ Sidewalks were broken or cracked
- ☐ Sidewalks were blocked with poles, signs,shrubbery, dumpsters, etc.
- ☐ No sidewalks, paths, or shoulders
- ☐ Too much traffic
- ☐ Something else _____

Rating: (circle one) 1 2 3 4 5 6

Locations of problems: _____

4. Was it easy to follow safety rules? Could you and your child...

☐ Yes	☐ No	Cross at crosswalks or where you could see and be seen by drivers?
☐ Yes	☐ No	Stop and look left, right and then left again before crossing streets?
☐ Yes	☐ No	Walk on sidewalks or shoulders facing traffic where there were no sidewalks?
☐ Yes	☐ No	Cross with the light?

Rating: (circle one) 1 2 3 4 5 6

Locations of problems: _____

Figure 2. Excerpt from "Walkability Checklist."

Source: Pedestrian and Bicycle Information Center. Created in collaboration with FHWA, NHTSA, National Center for Safe Routes to School, and United States Environmental Protection Agency.

RESOURCES

NHTSA Pedestrian Safety Information

NHTSA publishes annual reports summarizing the latest pedestrian fatality statistics. These statistics are based on FARS and the reports describe pedestrian fatality trends per different socioeconomic groups and for each State.

Smart Growth America – National Complete Streets Coalition

Smart Growth America, a non-governmental advocacy organization, supports the National Complete Streets Coalition. This organization provides resources to support the development and implementation of Complete Streets policies. These policies encourage pedestrian mobility and safety by promoting street design that accommodates controlled and uncontrolled crossings. For example, the Massachusetts Department of Transportation Complete Streets program assists local governments developing Complete Streets policies and implementation plans.

FHWA State SHSP Resources

The FHWA Office of Safety posts a link to each State's current SHSP. This website also lists noteworthy practices. Many SHSP plans provide an emphasis on pedestrians and contain goals for reducing traffic fatalities and injuries.

The Ohio DOT 2015 SHSP has a pedestrian emphasis area that seeks to reduce fatalities and serious injuries through six strategies that include data collection, institutionalizing pedestrian accommodations, implementing proven countermeasures, and promoting law enforcement.

FHWA HSIP Resources

The HSIP includes the projects selected for implementation, an evaluation of past projects, and an annual status report. Projects can include pedestrian safety improvement programs and projects. For example, the 2016 Oregon HSIP Annual Report details how the its All Roads Transportation Safety Program sets aside funding to address systemic pedestrian crash locations.

State HSP Documents

NHTSA posts the States' current HSP outlining non-infrastructure strategies for improving roadway safety. A State HSP is likely to contain a pedestrian fatality and injury reduction goal, an associated performance measure, and describe non-infrastructure initiatives like enforcement and education programs. For example, Colorado DOT's 2017 HSP (called the 2017 Integrated Safety Plan) supports the Denver Police Department's "Decoy Pedestrian Program" to enforce driver yielding compliance at high-crash pedestrian crossings.

Vision Zero Network

This collaborative website posts case studies and tracks cities who are implementing Vision Zero plans or goals. The Vision Zero Network website also notes best practices by agencies who are working to eliminate traffic fatalities and serious injuries. Vision Zero goals are accompanied by policies, strategies, and target dates. For example, Columbia, Missouri's Vision Zero Action Plan contains an outreach campaign to educate pedestrians and drivers on new and potentially confusing infrastructure improvements like pedestrian hybrid beacons and enhanced pedestrian crosswalks.

FHWA How to Develop a Pedestrian and Bicycle Safety Action Plan (2017)

This document explains the process of developing pedestrian and bicycle safety action plans. The sources of data required for these plans may include police reports, roadway and intersection conditions, field visits of crash sites. For example, New Jersey's PSAP identified how its infrastructure prioritization programs could be revised to recognize locations with systemic pedestrian crash risk.

FHWA Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts (2016)

This resource focuses on flexibility and options for the design of pedestrian and bicycle networks designed to minimize crash conflicts, including case studies to illustrate various design treatments.

Walkability Checklist

This tool can be used by community leaders during a walkability audit to evaluate pedestrian infrastructure and traffic behavior.

2

Inventory Conditions and Prioritize Locations

GUIDING PRINCIPLES

This section describes how the agency can document field conditions (such as roadway characteristics) necessary for prioritizing locations and selecting countermeasures. The following are important considerations for this step:

» Create a worksheet or checklist of roadway characteristics to record in the field (see Figure 3).

» Document pedestrian volumes and driver behavior, especially where pedestrians are frequently expected such as at bus stop locations and near schools.

» Classify pedestrian crossings as either uncontrolled or controlled locations.

» Analyze data and create maps to show priority locations for pedestrian improvements.

Inventory Roadway Characteristics

The process of collecting roadway characteristics includes compiling geospatial data to create base maps for each of the priority sites. Roadway conditions are key criteria for selecting countermeasures. The agency may document and map the following roadway characteristics for priority sites (see Glossary for more information):

» Speeds, including posted speed limits and actual speeds (i.e., 85th percentile speeds).

» Number of travel lanes for each approach.

» Center turn lanes, medians, or refuge islands.

» Intersection turn lanes.

» Vehicle queue lengths at intersections.

» Width of roadway, from curb to curb.

» Traffic volumes (AADT or ADT).

» Large truck traffic volumes or large trucks as a percentage of total traffic.

» On-street parking, alignment, and marked or signed restrictions.

City of Boulder Pedestrian Crossing Treatment Installation Guidelines

Crossing Location Evaluation Worksheet

Rev. 11/2/11

STEP 1 - LOCATION DESCRIPTION

Major Street: _____ Crossing Location: _____

Is this a multi-use path crossing? ☐ Yes ☐ No Posted Speed Limit: _____ mph

Existing Traffic Control: ☐ Stop Sign ☐ Traffic Signal ☐ Uncontrolled

Existing Crossing Treatments (if any): _____

_____

Nearby Pedestrian Generators (School, transit stop, commercial, etc.): _____

_____

STEP 2 - PHYSICAL DATA

Roadway Configuration:
☐ 2-Lane
☐ 3-Lane w/Striped Median
☐ 3 Lane w/Raised Median
☐ 4 Lane
☐ 5 Lane w/Striped Median
☐ 5 Lane w/Raised Median
☐ 6 Lane
☐ Other: _____

Crossing Distance By Direction: _____ ft total _____ ft to median *(if applicable + note direction)* _____ ft to median *(if applicable + note direction)*

Nearest Marked or Protected Pedestrian Crossing: _____ Distance to: _____ft

(*For uncontrolled location only*) Stopping Sight Distance (SSD) = _____ ft _____ ft.

Is SSD ≥ 8x Speed Limit? ☐ Yes ☐ No If No, are improvements to SSD feasible? ☐ Yes ☐ No

Figure 3. Example crossing inventory worksheet.

Source: City of Boulder, Pedestrian Crossing Treatment Installation Guidelines (2011).

Inventory Pedestrian Crossings and Observed Traffic Behavior

The agency can also document pedestrian crossing conditions. Agency staff can visit the sites and record the following crossing site features:

- Crosswalk markings, presence, and types.
- Crosswalk distance (in feet) and crossing phase duration (in seconds).
- Signage, such as advance, crosswalk, and in-street.
- Traffic control devices and signals, such as pedestrian crossing signal, pedestrian signal detector, STOP sign, RRFB, and PHB.
- Signal phasing and restrictions, such as Leading Pedestrian Interval, split or concurrent phasing type, and turn restrictions.
- Vertical elements, such as refuge island or raised crosswalk.
- Horizontal elements, such as curb extensions, narrowed curb radii, Road Diet, or lane reconfiguration.
- Accessibility features, such as curb ramps, truncated domes, and accessible signal push buttons.
- Lighting and visibility enhancements, such as overhead lighting.
- Pedestrian volumes, including transit boarding volumes from nearby stops.
- Pedestrian crossing behaviors near important activity centers such as transit stops, schools, and in downtown districts.
- Driver behaviors at crosswalks and intersections.
- Sight distance and visual clearance of crossing.

Classify Pedestrian Crossings as Controlled or Uncontrolled

In addition to collecting inventory information about the priority sites, it is important that the agency categorize each crossing as either controlled or uncontrolled. Uncontrolled pedestrian crossing locations occur where sidewalks or designated walkways intersect a roadway at a location where no traffic control (i.e., traffic signal or STOP sign) is present. These common crossing types occur at intersections (where they may be marked or unmarked) and at non-intersection or midblock locations (where they must be marked as crossings). This guide describes countermeasures applicable to uncontrolled crossings. Some of these countermeasures can also be used for controlled crossings, and the agency should consult other guidance for specific implementation criteria at those sites.

Screen the Network for High-Crash or High-Risk Locations

By following a data-driven approach, the agency can readily explain and defend how it selected priority sites for improvement. An agency can study, or screen, the safety conditions for the road network within its jurisdiction. The screening process uses geo-coded pedestrian crash data and other information to identify different types of locations. Network screening may take the form of spot safety or systemic safety analysis. Spot safety analysis is based on crash history at individual locations and identified high-crash locations. The systemic approach analyzes crash history on an aggregate basis to identify roadways that have high-crash experience, as well as high-risk characteristics at other sites before crashes occur, so countermeasures can be selected to address these characteristics.

Analyze "Hot Spots" or Crash Cluster Locations

Spot safety analysis involves mapping the individual locations of crashes over a time period, preferably at least 5 years for pedestrian crash data. Mapping these crashes on a geographic information system (GIS) helps to visually reveal clusters, or "hot spots," of pedestrian crashes. Similarly, using the spot analysis approach may also reveal corridors or areas where pedestrian crashes tend to cluster. Grouping the clusters of crashes identified in the spot location process can show areas of potential pedestrian improvements. These areas may be corridors, roadways that share roadway design features, and/or areas of a similar land use. Figure 4 shows a map of pedestrian crash locations in an area.

Develop a Systemic Analysis Approach

Many areas may have low pedestrian crash rates, but still have a high risk for pedestrian crashes. The agency can identify these sites based on roadway characteristics combined with land use features of the area. The agency may select countermeasures to address these high-risk factors before pedestrian crashes occur.

The systemic analysis can cover different geographies; an agency may choose to analyze for an area of interest or the entire jurisdiction. Systemic analysis considers factors such as inadequate roadway design and traffic control devices, lighting conditions, vehicle speeds, and nearby pedestrian destinations. Combinations of these factors help identify countermeasures to address and prevent pedestrian crashes.

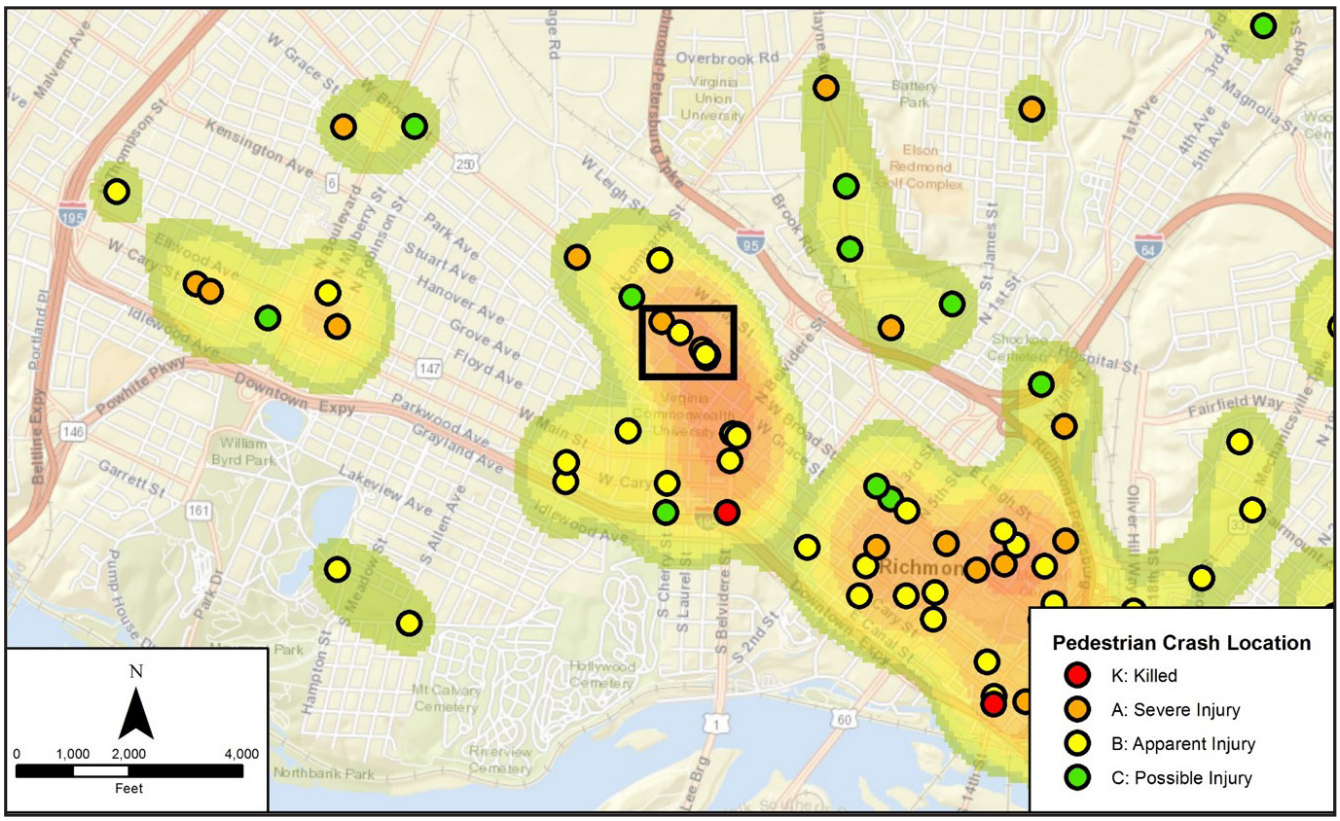
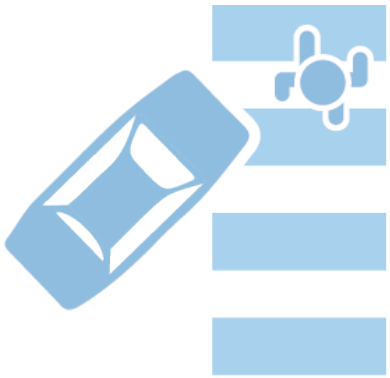


Figure 4. Crash cluster analysis map: Richmond, VA.

Source: Virginia Department of Transportation (2017).

3

Analyze Crash Types and Safety Issues



GUIDING PRINCIPLES

This section describes methods for summarizing pedestrian crash types and observed traffic safety issues. This information is important for selecting countermeasures. The following are important considerations for this step:

» Diagram crashes according to information included on crash reports (see Figure 5 for a sample diagram).

» Review the crash types described by the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE).

» Conduct a pedestrian Road Safety Audit (RSA) to formally engage representatives from various departments and interest groups.

» Lead an informal site visit to engage stakeholders and describe conditions observed in the field.

Diagram Crash Reports

Crash diagrams are created to graphically illustrate crash data associated with a given site. Each crash is plotted on a schematic of the site at the approximate location where the crash occurred. Icons are used to represent crash types so that patterns are identifiable. Spatial analysis tools like GIS can also enhance the analysis. Crash diagrams are sometimes plotted on aerial imagery and cross referenced with a tabular listing of the associated crash data so that agency staff can easily access key information. Crash diagrams are useful when there are many crashes associated with a site. An agency may not have sufficient pedestrian crash history to reveal crash patterns, but the absence of crash data does not necessarily mean a safety problem does not exist. In these cases, an agency should consider systemic analysis.

Identify Crash Factors

Whether an agency is assembling the crash diagrams or simply conducting an exercise to identify potential factors for pedestrian crashes in their jurisdiction, these factors can be considered:

» Vehicle speed.

» Compliance with regulations and traffic devices.

» Pedestrian crossing behaviors.

» Built environment or area type.

- Intersection presence and types of traffic control devices.
- Pedestrian crossing distance.
- Time of day/day of week/seasonal factors.
- Alcohol involvement by pedestrians or drivers.
- Demographics.
- Special populations, such as school-aged children, older adults, and persons with disabilities.
- Presence of transit stops.

Conduct a Road Safety Audit (RSA)

An RSA is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. An RSA considers all users of the roadway and human factors and generates a formal report and response upon its conclusion. The agency can use the field conditions inventory and crash type summary during the RSA process. RSAs typically produce multiple planning-level countermeasure recommendations for the study corridor or area.

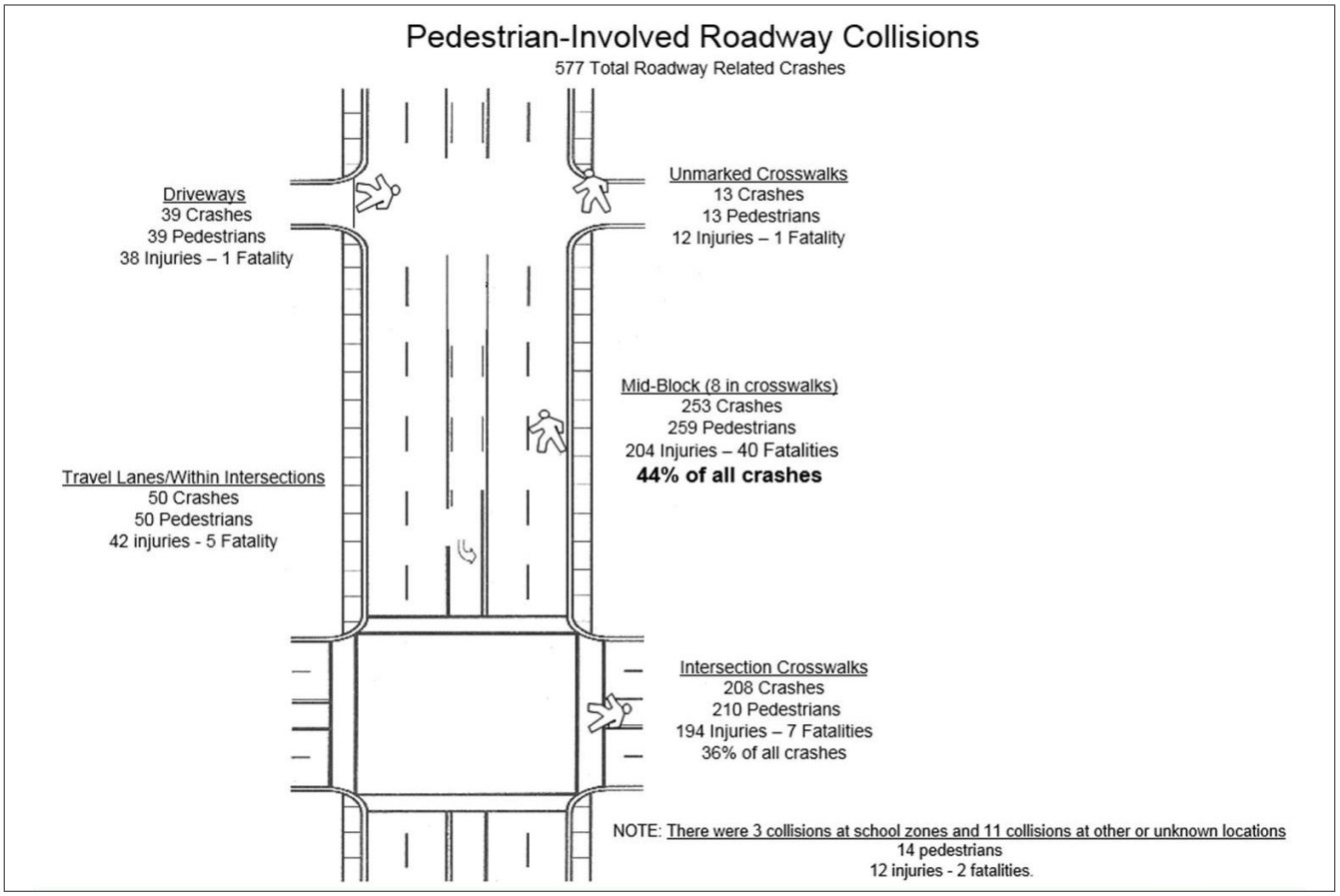


Figure 5. Pedestrian collision summary.

Source: City of Phoenix, AZ. 2015 Pedestrian Collision Summary (2015).

Like traditional RSAs, pedestrian RSAs are performed by a multidisciplinary team of experts or agency representatives, use structured prompt lists, and consider the surrounding socioeconomic and land use context. The materials for a pedestrian RSA provide more detail on pedestrian safety issues and examine elements such as signage, obstructions, signals, bus stop locations, drainage, and lighting. These tools can help identify possible deficiencies in the pedestrian network and potential locations for further investigation.

Lead an Informal Site Visit

An alternative to a formal RSA is an on-site evaluation of pedestrian conditions including representatives from multiple agency departments and stakeholder interest groups. An informal on-site evaluation can collect information about pedestrian crossings and traffic operations at the neighborhood or area-wide scale. Law enforcement, public health, community groups, neighborhood residents, street or transportation departments, planning, emergency response, schools, and public transportation agencies can be involved in the process. The findings from this informal evaluation should be documented and shared with participants.

RESOURCES

FHWA Model Road Safety Audit Policy (2014)

This resource outlines the steps typically taken to conduct an RSA and the roles of the stakeholders. Identifying safety issues is an element of the RSA that is accompanied by suggestions on how to enhance the specific road's safety.

Pedestrian RSA Guidelines and Prompt Lists (2007)

This resource complements practices for RSAs with additional guidance and a field manual for a pedestrian-focused RSA. An RSA team will use the knowledge of a diverse team, analysis of crash data, and a site visit to identify pedestrian safety issues.

Pedestrian RSA Case Studies (2009)

This website provides links to several examples of RSAs focused on identifying pedestrian safety risks and improvement strategies. For example, the City of Tucson, Arizona conducted an RSA of roadways with PHBs to improve the countermeasures' visibility and usability.

PEDSAFE: Pedestrian Crash Typing

PEDSAFE provides definitions for 12 key pedestrian crash types identified by the software package, the Pedestrian and Bicycle Crash Analysis Tool (PBCAT). PBCAT is still used by many agencies but may not be compatible with some current operating systems.

4

Select Countermeasure(s)

GUIDING PRINCIPLES

This section can help the agency select countermeasures based on information previously collected and assessed. The agency can use the following resources to select countermeasures:

» First, reference Table 1 to compare roadway and vehicle speed characteristics to countermeasure options.

» Then, reference Table 2 to compare crash types and other observed safety issues to countermeasure options.

» Review Appendix B for more information about countermeasure CRFs and CMFs.

Application of Countermeasures by Roadway Feature

Table 1 includes a comprehensive matrix and list of STEP pedestrian crash countermeasures suggested for application at uncontrolled crossing locations per roadway and traffic features. The countermeasures are assigned to specific matrix cells based on safety research, best practices, and established national guidelines. When a pedestrian crossing is established, the agency should review the countermeasure options in the cells before selecting the optimal group of crossing treatments. The agency should consider the previously obtained characteristics such as pedestrian volume, operational speeds, land use context, and other site features when selecting countermeasures.

The agency should also reference the MUTCD and other national, State, and local guidelines when making the final selection of countermeasures.

For example, the agency may evaluate a 5-lane road with no raised median, an AADT of 12,000, and a 35 mph posted speed limit. The matrix recommends the agency strongly consider high-visibility crosswalks, adequate lighting, and parking restrictions on the approaches. In addition, the agency should strongly consider adding advance Yield Here To (Stop Here For) Pedestrians signs and yield (stop) lines, pedestrian refuge islands, and PHBs. Other candidate treatments include implementing a Road Diet along the corridor and adding curb extensions.

Table 1 provides initial countermeasure options for various roadway conditions. Each matrix cell indicates possibilities that may be appropriate for designated pedestrian crossings. Not all of the countermeasures listed in the matrix cell should necessarily be installed at a crossing.

For multi-lane roadway crossings with vehicle AADTs exceeding 10,000, a marked crosswalk alone is typically insufficient (Zegeer, 2005). Under such conditions, more substantial crossing improvements (such as the refuge island, PHB, and RRFB) are also needed to prevent an increase in pedestrian crash potential.

Table 1. Application of pedestrian crash countermeasures by roadway feature.

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5 7 9	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 9	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 9	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

**Refer to Chapter 4, 'Using Table 1 and Table 2 to Select Countermeasures,' for more information about using multiple countermeasures.*

***It should be noted that the PHB and RRFB are not both installed at the same crossing location.*

This table was developed using information from: Zegeer, C.V., J.R. Stewart, H.H. Huang, P.A. Lagerwey, J. Feaganes, and B.J. Campbell. (2005). Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines. FHWA, No. FHWA-HRT-04-100, Washington, D.C.; FHWA. Manual on Uniform Traffic Control Devices, 2009 Edition. (revised 2012). Chapter 4F, Pedestrian Hybrid Beacons. FHWA, Washington, D.C.; FHWA. Crash Modification Factors (CMF) Clearinghouse. http://www.cmfclearinghouse.org/; FHWA. Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE). http://www.pedbikesafe.org/PEDSAFE/; Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.; Thomas, Thirsk, and Zegeer. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington, D.C.; and personal interviews with selected pedestrian safety practitioners.

Safety Issues Addressed per Countermeasure

The results of the crash analysis, road safety audit, and/or stakeholder input provide the agency with a better understanding of the risk factors at uncontrolled crossing locations. The countermeasures listed in this guide can improve the visibility of crossing locations and reduce crashes, and they each address at least one additional safety concern associated with a higher risk of collision and/or severe injury. These additional safety issues include the following: excessive vehicle speed, inadequate conspicuity/visibility, drivers not yielding to pedestrians in crosswalks, and insufficient separation from traffic.

Table 2 shows the specific safety issues that each countermeasure may address. For example, the addition of PHBs has been consistently shown to improve motorist yielding by 90 percent or greater, when compared with no traffic control or warning type devices.

Table 2. Safety issues addressed per countermeasure.

Pedestrian Crash Countermeasure for Uncontrolled Crossings	Safety Issue Addressed				
	Conflicts at crossing locations	Excessive vehicle speed	Inadequate conspicuity/ visibility	Drivers not yielding to pedestrians in crosswalks	Insufficient separation from traffic
Crosswalk visibility enhancement	✓	✓	✓	✓	✓
High-visibility crosswalk markings*	✓		✓	✓	
Parking restriction on crosswalk approach*	✓		✓	✓	
Improved nighttime lighting*	✓		✓		
Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*	✓		✓	✓	✓
In-Street Pedestrian Crossing sign*	✓	✓	✓	✓	
Curb extension*	✓	✓	✓		✓
Raised crosswalk	✓	✓	✓	✓	
Pedestrian refuge island	✓	✓	✓		✓
Pedestrian Hybrid Beacon	✓	✓	✓	✓	
Road Diet	✓	✓	✓		✓
Rectangular Rapid-Flashing Beacon	✓		✓	✓	✓

*These countermeasures make up the STEP countermeasure "crosswalk visibility enhancements." Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.

Using Table 1 and Table 2 to Select Countermeasures

Table 1 provides initial countermeasure options for various roadway conditions. Each matrix cell indicates possibilities that may be appropriate for designated pedestrian crossings. Not all of the countermeasures listed in the matrix cell should necessarily be installed at a crossing. Agency officials should also review safety issues referenced in Table 2, the surrounding land development context, pedestrian travel patterns, countermeasure effectiveness, and costs when considering what countermeasure(s) are best suited for the crossing.

A marked crosswalk is useful to show pedestrians and drivers preferred crossing locations. However, for multi-lane roadway crossings where vehicle AADTs are in excess of 10,000, a marked crosswalk alone is typically not sufficient (Zegeer, 2005). Under such conditions, more substantial crossing improvements are also needed to prevent an increase in pedestrian crash potential. Examples of more substantial treatments include the refuge island, PHB, and RRFB. Refer to the symbols used in Table 1 for when a marked crosswalk should be paired with one or more of the other countermeasures described.

To further increase visibility of pedestrian crossings, agencies often integrate multiple countermeasures. For example, the Pedestrian Hybrid Beacon is often installed in conjunction with advance stop markings and signs. Also, Road Diets present opportunities for adding pedestrian refuge islands and curb extensions at key crossing locations. Agencies should consider roadway geometry and the MUTCD when integrating multiple countermeasures.

Countermeasure Descriptions

This subsection describes considerations for implementation of each of the countermeasures included in Tables 1 and 2. The agency can review other guidance—such as the MUTCD, the AASHTO Pedestrian Guide, and/or agency policies and practices—to identify and select countermeasures for implementation.

Crosswalk visibility enhancements

High-visibility crosswalks may include a variety of crosswalk striping designs, such as ladder, continental, or bar pairs. A high-visibility crosswalk is much easier for an approaching motorist to see than the traditional parallel lines. The agency should strongly consider providing high-visibility crosswalks at all established midblock pedestrian crossings. The high-visibility markings may be supplemented with the pedestrian crossing warning signs (sign W11-2 in the MUTCD) on each approach to the crosswalk. MUTCD Section 2C.50—*Non Vehicular Warning Signs* and Section 3B.18—*Crosswalk Markings* provide additional information.

The agency should also strongly consider implementing parking restrictions on the crosswalk approach at all established

pedestrian crossings (both approaches) so there is adequate sight distance for motorists on the approaches to the crossings and ample sight distance for pedestrians attempting to cross. The minimum setback is 20 feet where speeds are 25 mph or less, and 30 feet between 26 mph and 35 mph. If this cannot be done, the curbs should be "bulbed out" to allow the pedestrian to see past the parked vehicle along the street. Adjacent bus stops should be placed downstream of the crosswalk and not on the crosswalk approach.

The agency should consider providing an appropriate level of lighting at all established pedestrian crossings. Consideration should be given to placing the lights 10 to 15 feet in advance of the crosswalk on both sides of the street and on both approaches to better light the front of the pedestrian and avoid silhouette lighting (where possible).

In-street Pedestrian Crossing sign

In-street signs are placed in the middle of the road at a crossing and are often used in conjunction with refuge islands. These signs may be appropriate on 2-lane or 3-lane roads with speed limits of 30 mph or less. On higher-speed, higher-volume, and/or multilane roads, this treatment may not be as visually prominent; therefore, it may be less effective (drivers may not notice the signs in time to stop in advance of the crosswalk). For such roadways, more robust treatments will be needed. When making the choice to use these signs, the agency should consider making a plan and securing a funding source for the maintenance and prompt replacement of damaged signs. The MUTCD permits in-street pedestrian signs for installation on centerlines and along lane lines. MUTCD Section 2B.12—*In-Street and Overhead Pedestrian Crossing Signs* contains additional information about these signs.

Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line

Advance Yield Here To (Stop Here For) Pedestrians signs are placed between 30 and 50 feet in advance of the marked crosswalk along with the stop line or "shark's teeth" yield line. This is a candidate treatment for any uncontrolled pedestrian crossing, and should be strongly considered for any established pedestrian crossing on roads with four or more lanes and/or roads with speed limits of 35 mph or greater. Stop Here For Pedestrians signs should only be used where the law specifically requires that a driver must stop for a pedestrian in a crosswalk. MUTCD Section 2B.11—*Yield Here To Pedestrians Signs and Stop Here For Pedestrians Signs* and Section 3B.16—*Stop and Yield Lines* contain additional information.

Curb extension

A curb extension or "bulbout" extends the sidewalk or curb line into the street or parking lane, thus reducing the street width and improving sight distance between the driver and pedestrian. A curb extension is a candidate treatment for any uncontrolled pedestrian crossing, particularly where parking lanes exist. Curb extensions should not extend into paths of travel for bicyclists.

Raised crosswalk

Raised crosswalks function as an extension of the sidewalk and allow a pedestrian to cross the street at a constant grade. A raised crosswalk is typically a candidate treatment on 2-lane or 3-lane roads with speed limits of 30 mph or less and AADTs below 9,000. Raised crossings are generally

avoided on truck routes, emergency routes, and arterial streets. Drainage needs to be accommodated. See MUTCD Section 3B.25—*Speed Hump Markings* for additional information about markings that can be used alongside raised crosswalks.

Pedestrian refuge island

A pedestrian island is typically constructed in the middle of a 2-way street and provides a place for pedestrians to stand and wait for motorists to stop or yield. This countermeasure is highly desirable for midblock pedestrian crossings on roads with four or more lanes, and should be considered for undivided crossings of four or more lanes with speed limits of 35 mph or greater and/or AADTs of 9,000 or greater. Median islands may also be a candidate treatment for uncontrolled pedestrian crossings on 3-lane or 2-lane roads, especially where the street is wide and/or where vehicle speed or volumes are moderate to high. Consideration should be given to creating a two-stage crossing with the island to encourage pedestrians to cross one direction of traffic at a time and look towards oncoming traffic before completing the second part of the crossing. The minimum pedestrian refuge island width is approximately 6 feet. MUTCD Section 3B.10—*Approach Markings for Obstructions*, Section 3B.18—*Crosswalk Markings*, and Section 3B.23—*Curb Markings* provide additional information.

Pedestrian Hybrid Beacon (PHB)

A PHB head consists of two red lenses above a single yellow lens, and is used in conjunction with pedestrian signal heads installed at each end of a marked crosswalk. Figure 6 shows a rendering of a PHB. The PHB has been referred to as the High-Intensity Activated crossWalK beacon (HAWK), but the MUTCD refers to this device as the PHB.

Unlike a traffic signal, the PHB rests in dark until a pedestrian activates it via pushbutton or other form of detection. When activated, the beacon displays a sequence of flashing and solid lights that control vehicular traffic while the pedestrian signal heads indicate the pedestrian walk interval and a pedestrian clearance interval.

The PHB should meet the installation guidelines—based on speed, pedestrian volume, vehicular volume, and crossing length—as provided in Section 4F.01 of the MUTCD (See Figure 4F-1 for speeds of 35 mph or less; Figure 4F-2 for speeds greater than 35 mph). Research indicates that PHBs are most effective at roads with three or more lanes that have AADTs above 9,000. PHBs should be strongly considered for all midblock crossings where the roadway speed limits are equal to or greater than 40 mph. Refer to Table 1 for other conditions where PHBs should be strongly considered. It should be noted that the PHB and RRFB are not both installed at the same crossing location.

PHBs have also been installed successfully at intersections under certain conditions. Since the current MUTCD guidance is to locate PHBs at least 100 feet away from an intersection, engineering judgment/ engineering study must be carefully applied if considering an installation at an intersection.

Figure 6. Rendering of a PHB.

Source: FHWA STEP Countermeasure Tech Sheets.
(Note: Drawing not to scale.)

Road Diet

A road diet reconfigures the roadway. A frequently-implemented Road Diet involves converting a 4-lane, undivided roadway into a 3-lane roadway with a center turn lane. This is a candidate treatment for any undivided road with wide travel lanes or multiple lanes that can be narrowed or repurposed to improve pedestrian crossing safety.

After conducting a traffic analysis to consider its feasibility, the agency may determine that a Road Diet is a good candidate for use on roads with four or more lanes and traffic volumes of approximately 20,000 or less. In some cases, agencies have successfully implemented Road Diets on roads with AADTs of up to 25,000. By reducing the width of the roadway, pedestrians benefit from shorter crossing distances and often bike lanes or streetscape features can be added. Road Diets are often effectively accomplished during pavement resurfacing.

Rectangular Rapid-Flashing Beacon (RRFB)

An RRFB is a pedestrian-actuated conspicuity enhancement used in combination with a pedestrian, school, or trail crossing warning sign to improve safety at uncontrolled, marked crosswalks. The device includes two rectangular-shaped yellow indications, each with an LED-array-based light source, that flash with high frequency when activated.

RRFBs may be used to enhance the conspicuity of standard pedestrian and school crossing warning signs at uncontrolled marked crosswalks. RRFBs are placed on both ends of a crosswalk. If the crosswalk contains a pedestrian refuge island or other type of median, an RRFB should be placed to the right of the crosswalk and on the median (instead of the left side of the crosswalk). The RRFB's irregular flashing pattern pattern is unlit when not activated and can be activated manually by pedestrians using a push button or passively by a pedestrian detection system. This device is not currently included in the MUTCD, but FHWA has issued Interim Approval 21 (IA-21) for the use of the RRFB. State and local agencies must request and receive permission to use this interim approval before they can use the RRFB. IA-21 provides additional information about the conditions of use, including dimensions, placement, and flashing requirements. IA-21 does not provide guidance or criteria based on number of lanes, speed, or traffic volumes.

The RRFB is a treatment option at many types of established pedestrian crossings. Research indicates RRFBs can result in motorist yielding rates as high as 98 percent at marked crosswalks. However, yielding rates as low as 19 percent have also been noted. Compliance rates varied most per the city location, posted speed limit, crossing distance, and whether the road was one- or two-way.[1] RRFBs are particularly effective at multilane crossings with speed limits less than 40 mph. Consider the PHB instead of RRFBs for roadways with higher speeds. Table 1 provides specific conditions where practitioners should strongly consider the PHB instead of the RRFB.

[1]*Fitzpatrick, K., M. Brewer, R. Avelar, and T. Lindheimer.* Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon. *Report No. TTI-CTS-0010. Texas A&M Transportation Institute, College Station, Texas. June 2016.* https://static.tti.tamu.edu/tti.tamu.edu/documents/TTI-CTS-0010.pdf

RESOURCES

PEDSAFE, Pedestrian Safety Guide and Countermeasure Selection System
This online tool includes links to research studies, crash reduction statistics, and case studies for nearly 70 pedestrian safety countermeasures. Its Countermeasure Selection Tool provides countermeasure recommendations for uncontrolled crossing locations based upon variables such as AADT, vehicle speed, and number of lanes.

Manual on Uniform Traffic Control Devices (MUTCD)
This manual provides transportation engineers and planners with detailed guidance for the design and application of traffic control devices, including signage, roadway markings, and intersection controls. Refer to the specific sections of the MUTCD listed in the countermeasure descriptions and consult State-level supplements for additional information.

FHWA Road Diet Desk Reference (2015)
This resource includes sample policy, case studies, and design guidance for agencies and decision-makers considering Road Diets. The benefits of Road Diets include reducing vehicle speeds, reducing number of lanes to cross, and allocating space for pedestrian refuge islands.

Highway Safety Manual
This manual provides detailed guidance for the collection, analysis, and evaluation of roadway crash data, as well as related CMFs and treatment selection guidance.

FHWA Design Resource Index
This resource directs practitioners to the specific location of information about pedestrian and bicycle treatments or countermeasures, across various design guidelines published by organizations such as AASHTO, the Institute of Transportation Engineers, and National Association of City Transportation Officials.

Informational Brief: Treatments for Uncontrolled Marked Crosswalks (2017)
FHWA provided this information about optional treatments for uncontrolled pedestrian crossing locations.

TCRP REPORT 112/NCHRP REPORT 562: Improving Pedestrian Safety at Unsignalized Crossings (2006)
This document recommends treatments to improve safety for pedestrians crossing high-volume, high-speed roadways at unsignalized intersections, with particular focus on roadways served by public transportation.

NHTSA "A Primer for Highway Safety Professionals" (2016)
This resource outlines a comprehensive approach to improving safety for bicyclists and pedestrians and offers a summary of the most frequently used engineering, enforcement, and education safety measures. The resource identifies how certain treatments may be placed in relation to other treatments, such as the coordinated installation of a pedestrian refuge island and lighting.

CMF Clearinghouse
The CMF Clearinghouse is an online database of countermeasures and corresponding CMFs. The database describes the confidence of the study that produced the CMF with an assigned "star quality rating." The clearinghouse includes CMFs for most of the STEP countermeasures.

NCHRP Report 841: Development of CMFs for Uncontrolled Pedestrian Crossing Treatments (2017)
This report describes the safety benefits and CMFs for four types of pedestrian crossing treatments—rectangular rapid flashing beacons, PHBs, pedestrian refuge islands, and advance crosswalk signs and pavement markings.

NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways (2016)
This is a compilation of existing practices regarding the selection and implementation of pedestrian crossing improvements, as well as a literature review of research on more than 25 pedestrian crossing treatments.

5

Consult Design and Installation Resources

GUIDING PRINCIPLES

This section identifies additional resources that refine countermeasure options for priority sites. The following are important considerations for this step:

» Consult the MUTCD for recommendations for signage and roadway markings for all countermeasures.

» Review the MUTCD (Part 4) for more considerations, including pedestrian volumes and vehicle operating speeds, for the installation of PHBs.

» Consult local and national design guidance for the preferred width and placement of these countermeasures.

Review Agency Design Guidelines

The agency can review and, if needed, enhance local guidance for traffic engineers and roadway designers to follow when installing countermeasures. The agency's roadway design manual can include details, such as design and installation guidance, for each of the countermeasure options. The agency may also consider creating additional warrant and threshold guidance for countermeasures such as the Road Diet, considering local conditions.

Consult the MUTCD

The agency may focus on three parts of the MUTCD for additional considerations when installing countermeasures:

» Part 2: Signs.

» Part 3: Markings.

» Part 4: Highway Traffic Signals (includes detailed guidance for installing Pedestrian Hybrid Beacons based on traffic speeds, traffic volumes, and pedestrian volumes).

RESOURCE

AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, 1st Edition (2004)

This guide provides recommendations for the planning, design, and operation of accommodations for pedestrians on public rights-of-way. This guide also discusses the impact of land use and site design on pedestrian safety and connectivity.

6

Identify Opportunities and Monitor Outcomes

GUIDING PRINCIPLES

This section describes possible options for funding and implementation of the countermeasures described in this guide. The following are important considerations for this step:

» Review the State's HSIP process for considering and funding pedestrian crossing countermeasures.

» Review local traffic calming and land development policies for opportunities to install pedestrian crossing countermeasures.

» Consider the costs to design, install, and maintain selected countermeasures.

» Collect usage and crash data for at least three years after countermeasures are installed at priority sites.

» Continue to monitor priority sites not funded for countermeasure installation.

» Provide information to the public about planned countermeasure projects. Information should address the safety benefits and possible impacts to traffic operations.

Consider Funding Options

A major consideration when selecting a safety project or program is identifying and securing the funding to design, construct, operate, and maintain the project or program. FHWA, NHTSA, and other Federal agencies distribute funding to States and other jurisdictions for transportation safety projects. If local funding is scarce, agencies may approach the State Departments of Transportation for safety improvement funding consideration. Some projects may require a local match to leverage State or Federal dollars. The agency may consider the following steps:

» Submit high-priority pedestrian crash locations as HSIP projects.

» Consider other State safety funding programs for low-cost pedestrian safety improvements.

» Address gaps in pedestrian accommodations through other State or Federal funding programs such as Transportation Alternatives Program, Congestion Mitigation and Air Quality, and Surface Transportation Block Grant (STBG).

Identify Opportunities for Successful Implementation

The agency can look beyond safety-focused funding programs to help implement countermeasures. By incorporating safety treatments into roadway maintenance or traffic operation projects, the agency can realize cost savings. For example, the agency should consider how resurfacing and operational projects may include countermeasures such as Road Diets and pedestrian crossing signal improvements.

The agency can also engage the community prior to programing the project. The treatments are likely to affect traffic operations, and the public may respond negatively to the change without sufficient notice and education. The agency can develop public education materials describing the benefits and costs of the countermeasures. Law enforcement, pedestrian safety advocates, public health officials, and other community partners may be able to help distribute the materials.

It is important for the agency to work with local partners to coordinate early in the process of designing or improving a roadway to identify opportunities for improved pedestrian crossing safety. If the agency has a Complete Streets policy in place, the policy describes how pedestrian crossing treatments and sidewalks are incorporated into roadway projects. Roadway project design should identify locations and countermeasure options for pedestrian crossings. Developing preliminary cost estimates early for these improvements will help local partners make decisions about funding for pedestrian crossing treatments.

The agency can also work with land developers to incorporate pedestrian crossing treatments into site plans and connecting roadways. Land development policies provide an opportunity to integrate pedestrian and multimodal improvements, connectivity, and accommodations into site plans and nearby roadways. The agency can examine development policies or ordinances for requirements to install sidewalks and pedestrian crossing treatments.

Construct Improvements

The public may have questions about the improvements as construction activities begin. The agency should post information about the improvements and a timeline for construction to a public-facing website and consider issuing a press release about the project. The agency should also provide detailed information to neighbors and business owners impacted by construction activities about the project. Pedestrians will maintain access through the work zone area by way of temporary walkways, curb ramps, and traffic control signage.

The agency may consider phasing in the improvements. For example, a refuge island can be implemented initially by pavement markings and flexible delineators in the center lane. The agency can later add a raised median and appropriate landscaping at the refuge island.

Monitor Results of Implementation

The agency should consider monitoring the impacts of countermeasures per defined performance measures. Specific performance measures can be outlined in plans, such as a PSAP. The PSAP may

also list priority locations and proposed countermeasures.

The first measure of success for a project or program is public support. States and local governments can prepare public information for countermeasures that are new to the community or may change traffic patterns. Public information about the projects may describe the crash history or risks noted at the site, as well as the benefits of the proposed countermeasure.

States and local government can also collect and analyze crash and traffic data related to countermeasure sites for at least 3 years following the installation of the project. This time allows for data to be collected to compare crash rates and severity with the same data collected before the installation. The agency should work with their State HSIP to evaluate projects by continuing to collect data, and it is essential that the treatment installation date be documented. In addition to the safety performance of the treatment, agency staff should consider assessing the durability and life cycle maintenance needs for in-service devices.

In addition to crash data, it is important to collect data on pedestrian volumes, traffic speeds, and interactions between pedestrians and drivers. Pedestrian volume data can help demonstrate the benefits of implementing safety countermeasures. Information about traffic speeds and behaviors also help confirm the effectiveness of installing these countermeasures. As more pedestrian crossing treatments are implemented, State and local agencies can use these data to research the effectiveness of countermeasures and best practices for installation. Evaluation also helps an agency demonstrate the value of the investment in countermeasures to community leaders and the public.

RESOURCES

FHWA Federal-aid Program Administration

This website includes links to guidance for local and State governments administering federally-funded projects, such as those funded by HSIP or STBG.

FHWA Guidebook for Developing Pedestrian and Bicycle Performance Measures (2016)

This resource identifies a wide variety of potential metrics for setting goals, prioritizing projects and evaluating outcomes of bicycle and pedestrian plans, including plans for pedestrian safety improvements. Performance measures may include pedestrian levels of service or pedestrian fatality rates.

FHWA Pedestrian and Bicycle Funding Opportunities Summary (2016)

This resource includes a matrix comparing eligibility of various federal transportation funding programs for different types of bicycle and pedestrian projects.

NCHRP Report 803: Pedestrian and Bicycle Transportation Along Existing Roads—ActiveTrans Priority Tool Guidebook (2015)

This resource includes an interactive tool and guidance to help agencies prioritize pedestrian and bicycle improvements, including safety projects, either as standalone or incidental to a roadway project.

Glossary

Annual Average Daily Traffic (AADT)

The total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year.

Average Daily Traffic (ADT)

The average 24-hour volume of traffic passing a point or segment of a highway in both directions.

Complete Streets

Complete Streets are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. (Smart Growth America, National Complete Streets Coalition.)

Controlled pedestrian crossing

A pedestrian crossing where motorists are required to stop by either a STOP sign, traffic signal, or other traffic control device.

Crash modification factor (CMF)

A multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure. If available, calibrated or locally developed State estimates may provide a better estimate of effects for the State. (Crash Modification Factors Clearinghouse.)

Crash reduction factor (CRF)

The percentage crash reduction that might be expected after implementing a given countermeasure at a specific site.

Curb extensions

A roadway edge treatment where a curb line is bulbed out toward the middle of the roadway to narrow the width of the street. Curb extensions are sometimes called "neckdowns."

Highway Safety Improvement Program (HSIP)

A Federal-aid program with the purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned roads and roads on tribal land. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads with a focus on performance. (FHWA.)

High visibility crosswalk

A pedestrian crossing location marked by patterns such as zebra, ladder, or continental markings as described by the MUTCD.

Marked crosswalk

A pedestrian crossing that is delineated by white crosswalk pavement markings.

Parking restriction

Parking restriction can include the removal of parking space markings, installation of new "parking prohibition" pavement markings or curb paint, and signs.

Pedestrian Hybrid Beacon (PHB)

A traffic control device with a face that consists of two red lenses above a single yellow lens. Unlike a traffic signal, the PHB rests in dark until a pedestrian activates it via pushbutton or other form of detection.

Raised crosswalk

Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations.

Rectangular Rapid-Flashing Beacon (RRFB)

RRFBs are pedestrian-actuated conspicuity enhancements used in combination with a pedestrian, school, or trail crossing warning sign to improve safety at uncontrolled, marked crosswalks. The device includes two rectangular-shaped yellow indications, each with an LED-array-based light source, that flash with high frequency when activated. RRFBs are placed on both ends of a crosswalk. If the crosswalk contains a pedestrian refuge island or other type of median, an RRFB should be placed to the right of the crosswalk and on the median (instead of the left side of the crosswalk). The flashing pattern is pedestrian-activated by pushbuttons or automated detection and is unlit when not activated.

Refuge island

A median with a refuge area that is intended to help protect pedestrians who are crossing the road. This countermeasure is sometimes referred to as a crossing island or pedestrian island.

Road Diet

A roadway reconfiguration resulting in a reduction in the number of travel lanes. The space gained by eliminating lanes is typically used for other uses and travel modes. (FHWA.)

Road Safety Audit (RSA)

A formal examination of an existing or future road or intersection by a multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. (FHWA.)

Toward Zero Deaths (TZD)

TZD is a traffic safety framework that seeks to eliminate highway fatalities by engaging diverse safety partners and technology to address traffic safety culture. (See also: Vision Zero.)

Uncontrolled pedestrian crossing

An established pedestrian crossing that does not include a traffic signal, beacon, or STOP sign to require that motor vehicles stop before entering the crosswalk.

Vehicle queue

A line of stopped vehicles in a single travel lane, commonly caused by traffic control at an intersection.

Vision Zero (VZ)

Similar to TZD, Vision Zero is a vision to eliminate traffic fatalities and serious injuries within the transportation system. VZ employs comprehensive strategies to address roadway design, traffic behavior, and law enforcement.

Appendix A: Framework for a Resolution Supporting Pedestrian Safety

Agency policies respond to a need or opportunity, such as pedestrian safety crash and fatality trends. A resolution may help decision-makers, including elected officials or appointed commissioners, better understand the need for pedestrian crash countermeasure policy or design guidance.

The following is a list of possible elements for a local or Statewide resolution in support of a pedestrian crossing policy. These elements may be developed into "Whereas" statements or be included as explanatory text introducing the policy. The list of resolution elements is presented as four categories covering a spectrum of pedestrian safety issues.

1. Example statistics that may raise awareness of pedestrian safety trends.

» Percent pedestrian fatalities of total traffic fatalities.

» Number of total pedestrian crashes/ fatalities per year.

» Percent of pedestrian crashes occurring outside the intersection.

SAMPLE LANGUAGE

"Whereas the number of pedestrian crashes per year and the percent of pedestrian fatalities out of all traffic fatalities in [*State*] demonstrate the need for improved pedestrian safety at roadway crossings…"

2. List of broad issues that agencies commonly consider when discussing pedestrian safety and crash countermeasures.

» Safety is a priority for all road users.

» Crossings are essential to a complete network for pedestrian mobility.

» Pedestrian safety is part of overall quality of life and improved public health.

» Improvements to pedestrian safety often improve safety for all road users.

» Pedestrian countermeasures are genreally lower-cost treatments.

» Many pedestrian crash countermeasures have been evaluated as highly effective.

SAMPLE LANGUAGE

"Whereas [*Agency/State*] recognizes that safety is a priority for all road users, and improvements to pedestrian safety often improve safety for all road users…"

3. List of example planning documents that frequently discuss Statewide pedestrian safety concerns and may include statistics or other compelling reasons for implementing pedestrian crossing treatments.

» State Strategic Highway Safety Plan includes pedestrian safety as an emphasis area.

» State Highway Safety Plan includes pedestrian safety programs or enforcement support.

» State Roadway Design Manual includes guidance for countermeasure design.

» Highway Safety Improvement Program includes safety performance targets for non-motorists.

SAMPLE LANGUAGE

"Whereas [*State*]'s Strategic Highway Safety Plan addresses pedestrian safety as an emphasis area…"

4. List of Statewide opportunities for promoting, planning, and funding the construction of pedestrian crossing treatments.

» Highway Safety Improvement Program includes specific focus or funding for pedestrian crash countermeasures.

» Complete Streets Policy directs the inclusion of pedestrian accommodations as part of other transportation projects.

» Vision Zero or Towards Zero Deaths initiative strives to reduce or eliminate all traffic-related fatalities, including pedestrians.

SAMPLE LANGUAGE

"Whereas [*Agency*]'s Highway Safety Improvement Program includes specific funding for pedestrian crash countermeasures…"

Appendix B: CRF and CMF Summary Table

Table 3. CRFs and CMFs by countermeasure.

Countermeasure	CRF	CMF	Basis	Reference
Crosswalk visibility enhancement[1]	—	—	—	—
Advance STOP/YIELD signs and markings	25%	0.75	Pedestrian crashes[2]	Zegeer, et. al. 2017
Add overhead lighting	23%	0.77	Total injury crashes	Harkey, et. al. 2008
High-visibility marking[3]	48%	0.52	Pedestrian crashes	Chen, et. al., 2012
High-visibility markings (school zone)[3]	37%	0.63	Pedestrian crashes	Feldman, et. al. 2010
Parking restriction on crosswalk approach	30%	0.70	Pedestrian crashes	Gan, et. al., 2005
In-street Pedestrian Crossing sign	UNK	UNK	N/A	N/A
Curb extension	UNK	UNK	N/A	N/A
Raised crosswalk (speed tables)	45%	0.55	Pedestrian crashes	Elvik, et. al., 2004
	30%	0.70	Vehicle crashes	
Pedestrian refuge island	32%	0.68	Pedestrian crashes	Zegeer, et. al., 2017
PHB	55%	0.45	Pedestrian crashes	Zegeer, et. al., 2017
Road Diet – Urban area	19%	0.81	Total crashes	Pawlovich, et. al., 2006
Road Diet – Suburban area	47%	0.53	Total crashes	Persaud, et. al., 2010
RRFB	47%	0.53	Pedestrian crashes	Zegeer, et. al. 2017

[1]This category of countermeasure includes treatments which may improve the visibility between the motorist and the crossing pedestrian.

[2]Refers to pedestrian street crossing crashes, and does not include pedestrians walking along the road crashes or "unusual" crash types.

[3]The effects of high-visibility pavement markings (e.g., ladder, continental crosswalk markings) in the "after" period is compared to pedestrian crashes with parallel line markings in the "before" period.

References

1. Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. *NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments.* NCHRP, Transportation Research Board, Washington, DC, 2017.

2. Harkey, D.L., R. Srinivasan, J. Baek, F. Council, K. Eccles, N. Lefler, F. Gross, B. Persaud, C. Lyon, E. Hauer, and J. Bonneson. *NCHRP Report 617: Accident Modification Factors for Traffic Engineering and ITS Improvements.* NCHRP, Transportation Research Board, Washington, DC, 2008.

3. Chen, L., C. Chen, R. Ewing, C.E. McKnight, R. Srinivasan, and M. Roe. "Safety Countermeasures and Crash Reduction in New York City—Experience and Lessons Learned." *Accident Analysis and Prevention*, 2012.

4. Feldman, M., J. Manzi, and M. Mitman. "An Empirical Bayesian Evaluation of the Safety Effects of High-Visibility School (Yellow) Crosswalks in San Francisco, California." *Transportation Research Record: Journal of the Transportation Research Board,* No. 2198, Transportation Research Board, Washington, D.C., 2010, pp. 8-14.

5. Gan, A., J. Shen, and A. Rodriguez. "Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects." Final report. Florida Department of Transportation, Tallahassee, FL, 2005.

6. Elvik, R., P. Christensen, and A. Amundsen. "Speed and Road Accidents An Evaluation of the Power Model." Transportokonomisk Institutt, Oslo, Norway, 2004.

7. Pawlovich, M.D., W. Li, A. Carriquiry, and T. Welch. "Iowa's Experience with Road Diet Measures—Use of Bayesian Approach to Assess Impacts on Crash Frequencies and Crash Rates." *Transportation Research Record: Journal of the Transportation Research Board,* No. 1953, Transportation Research Board, Washington, D.C., 2006.

8. Persaud, B., B. Lan, C. Lyon, and R. Bhim. "Comparison of empirical Bayes and full Bayes approaches for before–after road safety evaluations." *Accident Analysis & Prevention,* Volume 42, Issue 1, 2010, pp. 38-43.

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July 2018, Updated

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives

EDC

City of Birmingham
A Walkable Community

Jana Ecker <jecker@bhamgov.org>

Re: New Parking rules in TC

1 message

Joe Valentine <Jvalentine@bhamgov.org> Tue, Oct 13, 2020 at 10:29 AM
To: Stuart Jeffares <stuartjeffares@gmail.com>
Cc: Jana Ecker <jecker@bhamgov.org>

Thanks Stuart. Appreciate you passing this along. Jana, please share with DPZ.

Thanks,
Joe

On Tue, Oct 13, 2020 at 9:53 AM Stuart Jeffares <stuartjeffares@gmail.com> wrote:

> These were approved last Monday (10/6)
>
> Also at Monday's city commission meeting…
> > Commissioners voted 4-3 to approve a recommendation from the planning commission to eliminate minimum parking requirements for residential properties, with Mayor Jim Carruthers and Commissioners Roger Putman and Brian McGillivary opposed. Traverse City currently requires residential properties to include at least one parking space per dwelling unit. Under the new policy, developers will have the option to include residential parking if desired, but are no longer required to do so. The change goes into effect October 15.
>
> > Commissioners voted 6-1 to approve a significant overhaul of the city's parking system, which is managed by the Downtown Development Authority (DDA). McGillivary was the sole 'no' vote against the proposal. Instead of having fixed year-round parking rates and a 'one-size-fits-all' approach to the system, the DDA will now charge parking rates based on demand, including higher prices for premium spots and peak times of year. City commissioners approved a 'ceiling' – or a maximum rate for different types of parking spaces – with the DDA then having flexibility to make price changes up to that ceiling based on demand. As part of the new system, a same-day discount for paying parking tickets will be eliminated, garage and surface permits separated out (garage permit holders will no longer be able to park in surface lots), and electric vehicle owners required to pay for parking. The changes will be implemented on a rolling basis in the coming weeks, with updates posted to the DDA website.
>
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