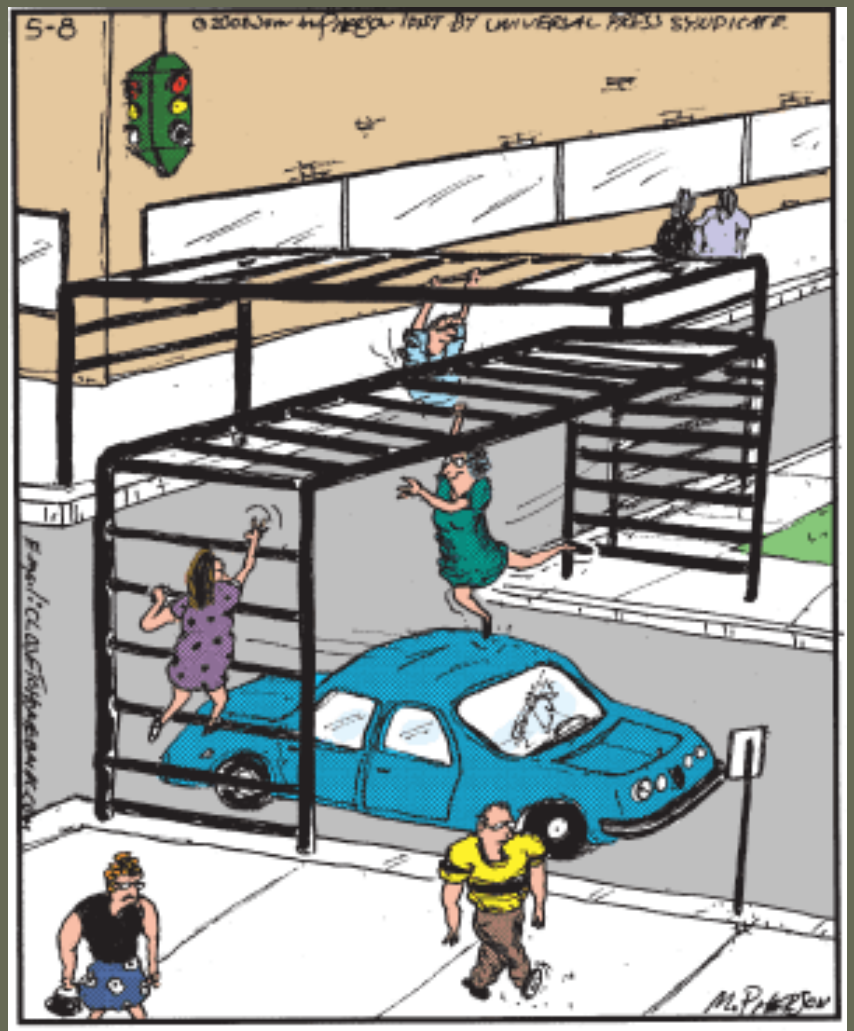


Billgeville's new pedestrian monkey bars not only reduced accidents but also whipped people into great shape.

STREET CROSSINGS

Module 4

Part 2: Countermeasures

Learning Outcomes

- At the end of this module, you will be able to:
- Identify which crossing technique is appropriate
- Ensure oft-requested solutions (crosswalks, signals, pedestrian bridges) are effective:
  - Concerned citizens and elected officials often respond to a tragic pedestrian crash asking for an immediate solution, which may or may not be appropriate.
  - This module explains why some countermeasures work, and why others don't.

Basic Street Crossing Techniques

- Crosswalks
- Illumination
- Signs
- Striping
- Medians/pedestrian islands
- Signals
- Over/undercrossings

Crosswalks

- Crosswalk FAQ's:
  - Why are they marked?
  - Where should they be marked?
  - Do marked crosswalks increase safety, or provide a "false sense of security?"

1. Why are crosswalks markings provided?

- To indicate to pedestrians where to cross
- To indicate to drivers where to expect pedestrians
- At mid-block locations, crosswalk markings legally establish the crosswalk.

2. How to determine where to mark a crosswalk?

- Crosswalk markings are commonly used to guide pedestrians and alert other road users of pedestrians at signalized locations and approaches controlled by STOP or YIELD signs
- An engineering study should be performed before crosswalk markings are installed at locations away from traffic signals or STOP signs. (MUTCD Section 3B.18)

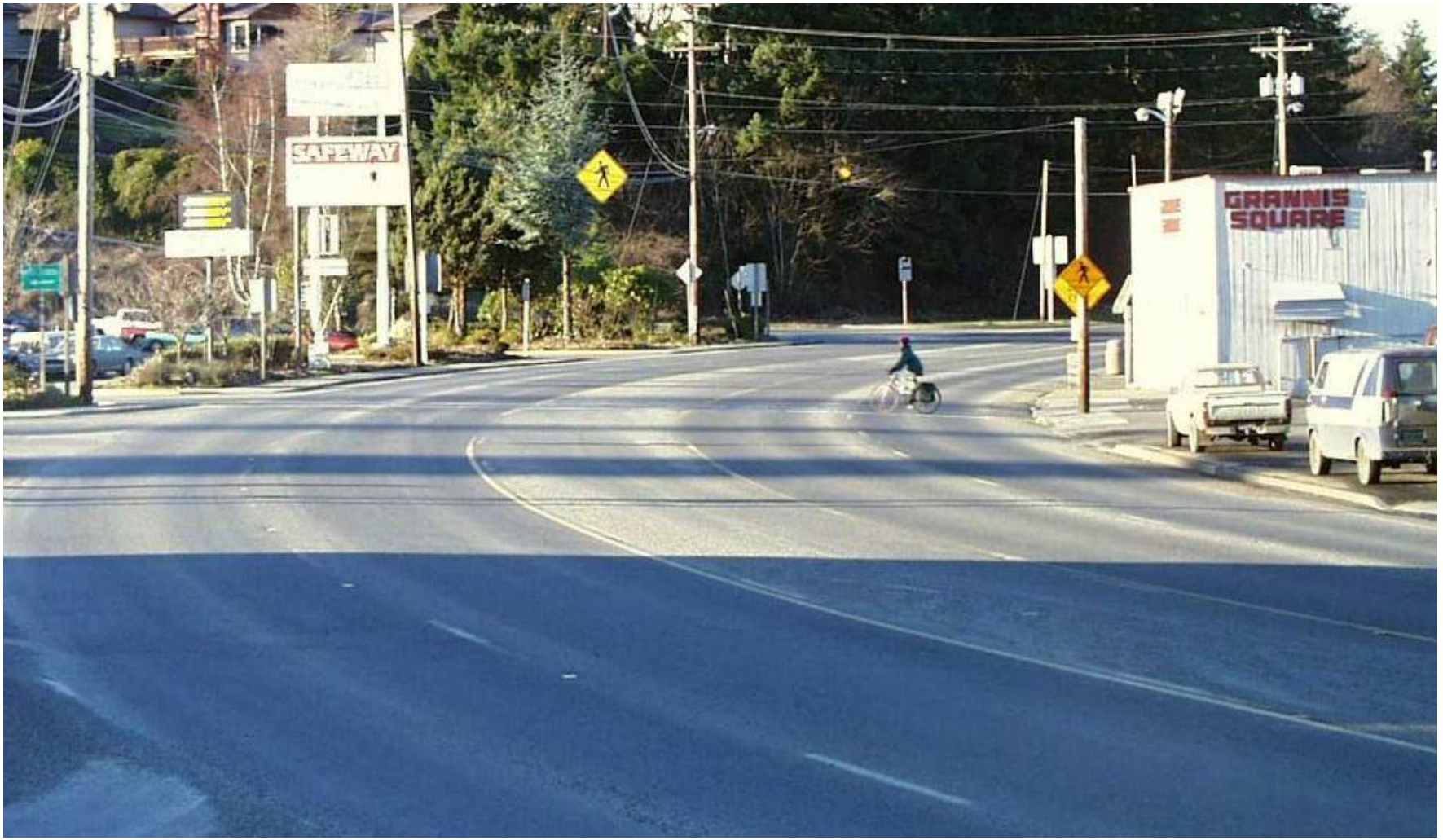
2. How to determine where to mark a crosswalk?

Consider origins and destinations

In this case, apartments across from bus stop & stores

8

Not Suitable Location for a Marked Crosswalk



Clatskanie OR

- Not a good location for a marked crosswalk:
- Poor sight distance

10

Suitable Locations for a Marked Crosswalk

- Suitable location for a marked crosswalk:
- Two-lane, high use, driver expectancy

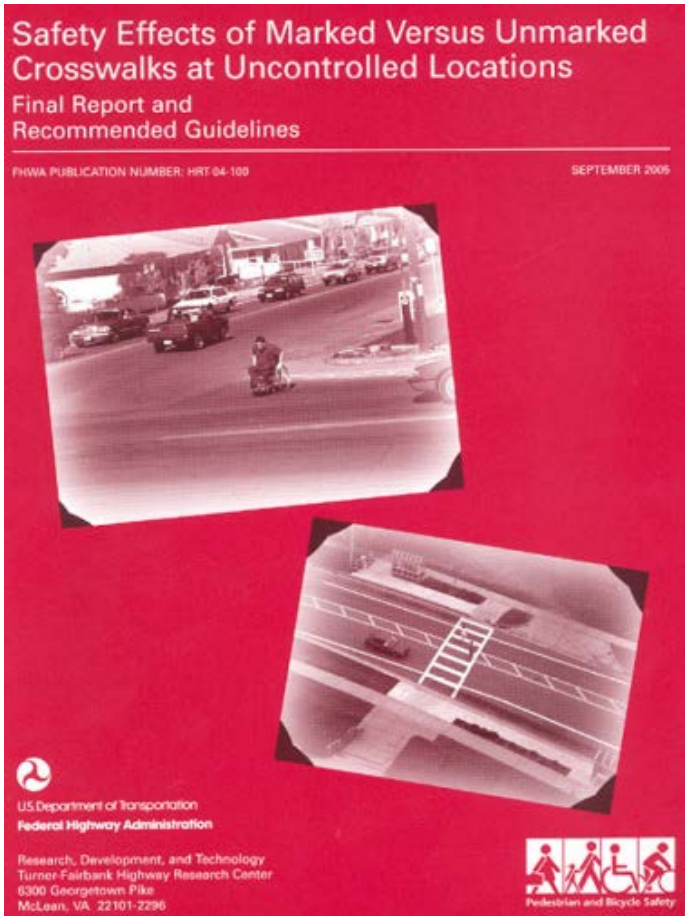
- Suitable location for a marked crosswalk:
- Slow speed, high use, driver expectancy

3. Looking or Not Looking?

Do marked crosswalks increase safety, or encourage people to cross without looking?

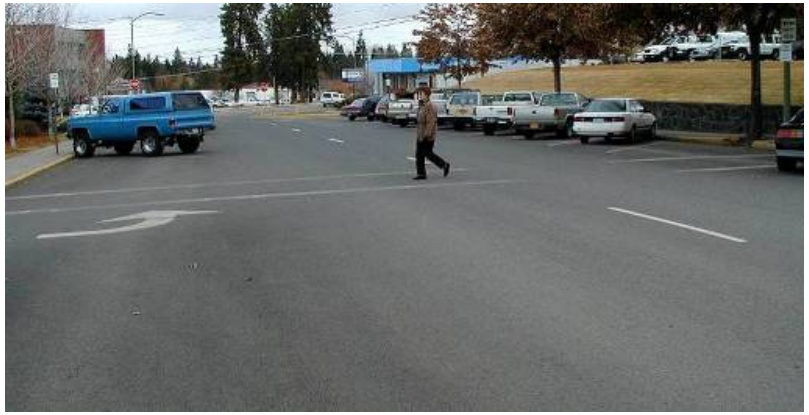
Study of Crosswalk Markings (Zegeer et al 2005)

- Marked vs. Unmarked Analysis
- Speeds < or = to 40 mph
  - Two-lane roads: No significant difference in crash rate
  - Multilane roads (3 or more lanes)
    - Under 12,000 ADT: no significant difference in crash rate
    - Over 12,000 ADT w/ no median: crashes marked > crashes unmarked
    - Over 15,000 ADT & w/ median: crashes marked > crashes unmarked



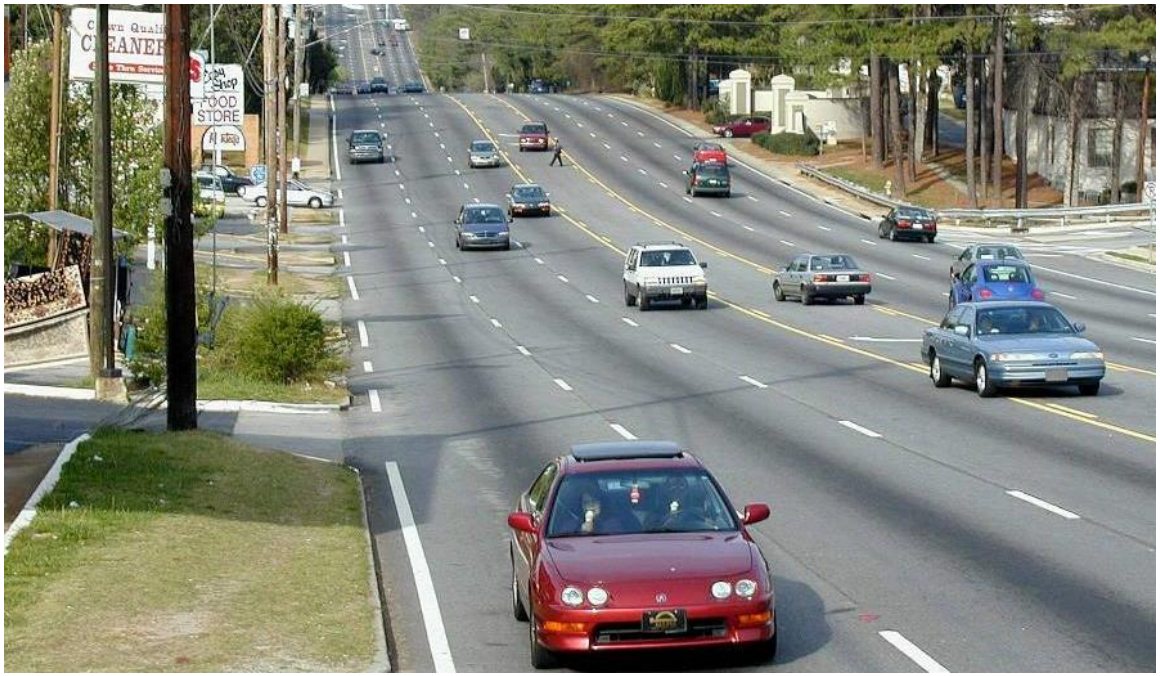
Study Results

- Median reduces crashes by 32 to 40 percent
- Pedestrians over 65 are over-represented in crosswalk crashes
- Pedestrians are not less vigilant in marked crosswalks:
  - Looking behavior increased after crosswalks installed



Study Results

- Crashes correlate with ADT & number of travel lanes.
  - Other studies have shown similar results



One explanation of higher crash rate at marked crosswalks: multiple-threat crash

1st car stops too close, masks visibility for driver in 2nd lane

Solution: advance stop bar (comes later…)

Text in the 2009 MUTCD

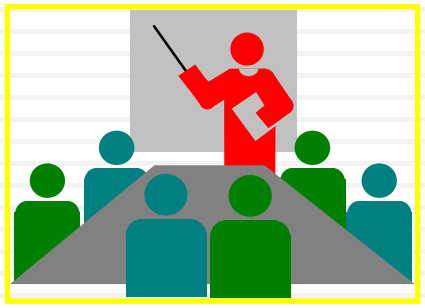
- New marked crosswalks alone, **without other measures designed to reduce traffic speeds,** shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, should not be installed across uncontrolled roadways where the speed limit exceeds 40 mph or either:
  - Has 4 or more lanes without a raised median or island and ADT of 12,000 or more, or
  - 4 or more lanes with raised median island and ADT of 15,000 or more
  - (2009 MUTCD Section 3B.18)

Increase Effectiveness Of Crosswalks With:

- Proper location
- High Visibility Markings
- Illumination
- Signing
- Advance Stop Bars
- Median Islands
- Curb Extensions
- Signals

Key Quotes from the Study Conclusion

- "When considering marked crosswalks at uncontrolled locations, **the question should not be simply, "Should I provide a marked crosswalk or not?"…**
- "Regardless of whether marked crosswalks are used, there remains the fundamental obligation to get pedestrians safely across the street. In most cases, **marked crosswalks are best used in combination with other treatments (e.g., curb extensions, raised crossing islands, traffic signals, roadway narrowing, enhanced overhead lighting, traffic calming measures)….**
- **"In all cases, the final design must accomplish the goal of getting pedestrians across the road safely…."**
- "The design question is, **"How can this task [getting pedestrians across the road safely] best be accomplished?"**



Discussion:

What are your policies & practices regarding marked crosswalks?

Marked crosswalk must be visible to the DRIVER

Atlanta GA

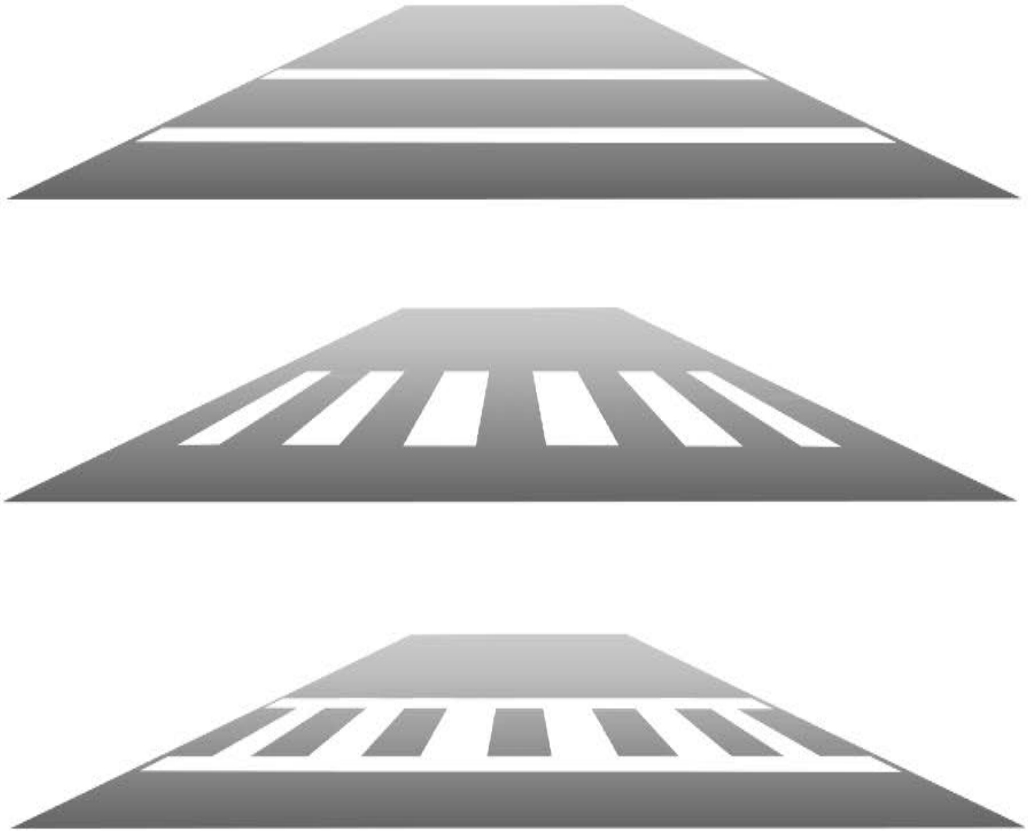
What the pedestrian sees

Marked crosswalk must be visible to the DRIVER

Atlanta GA

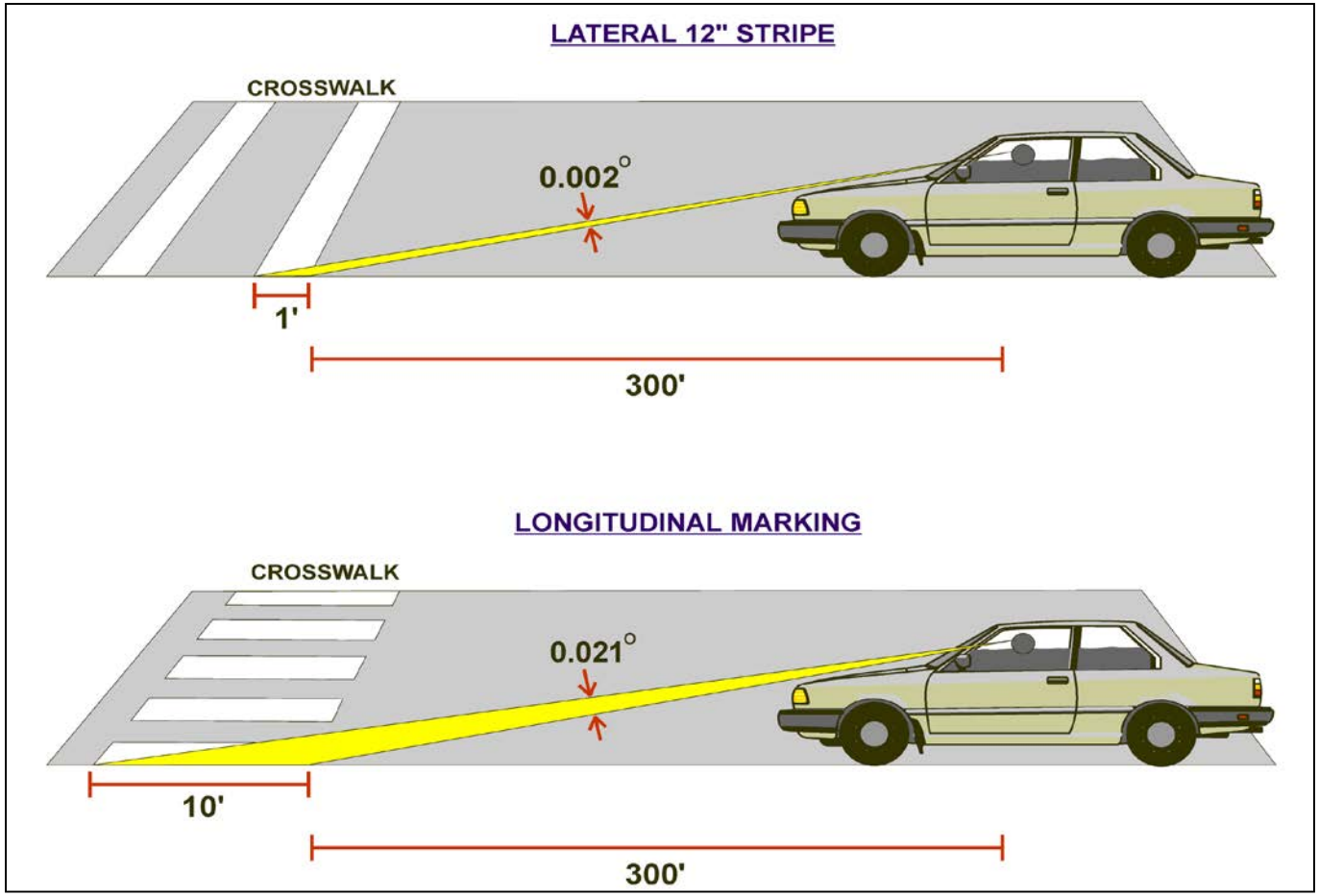
What the driver sees (same crosswalk)

Crosswalk Visibility



Crosswalk Marking Types

Crosswalk Visibility



Longitudinal markings are more visible to driver from afar

Salem OR

Longitudinal markings with transverse markings – very visible

Place longitudinal markings to avoid wheel tracks, reducing wear & tear & maintenance

Sweet Home OR

Staggered markings improve visibility from afar

Textured crosswalks: How effective are they?

In theory, more visible. Reality?

Corvallis OR

What the pedestrian sees

Corvallis OR

What the driver sees

- Brick crosswalks: prone to failure
- Difficult for wheelchair users

Mitigation Measures For Colored Crosswalks

- Supplement textured crosswalks with white lines to increase visibility

Orlando, FL

Brick street with (asphalt-coated) concrete crosswalk

- Checkerboard pattern created by alternating brushed concrete with exposed aggregate (use fine rock)

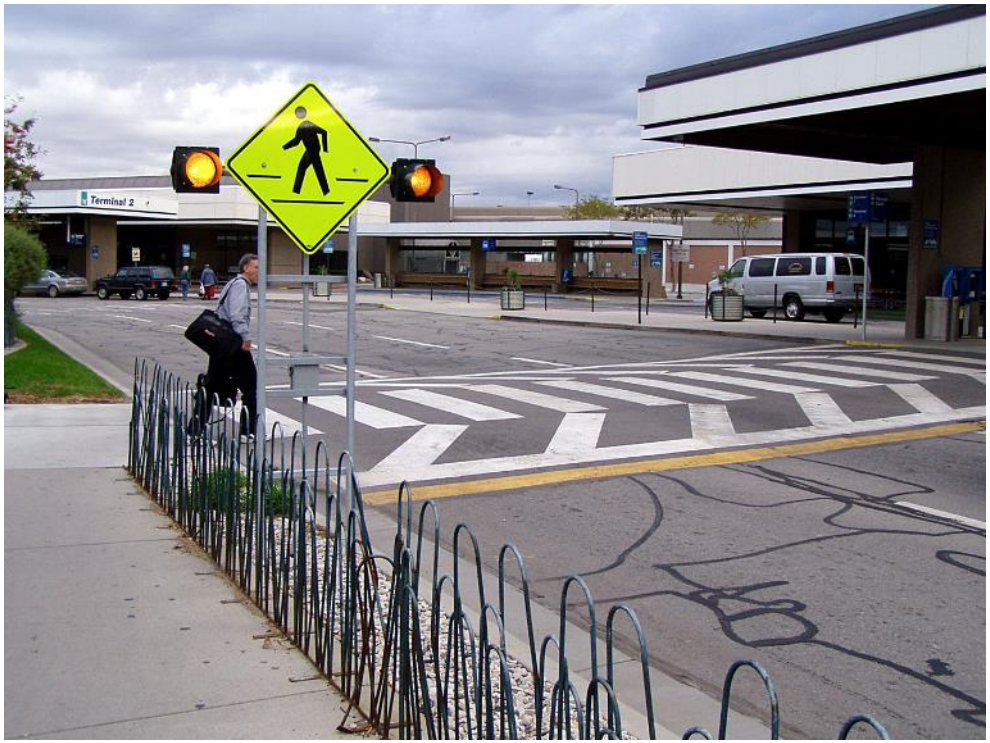
St Paul MN

Idea: Embed white crosswalk within contrasting color

St Paul MN

Driver perspective: crosswalks show up well

Raised Crosswalks



- FHWA Study "*The Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior*" -2001
- Increase pedestrian visibility & likelihood the driver yields to pedestrians especially when combined with an overhead flashing light
- Most appropriate on low speed local or neighborhood streets
- Should not be used on emergency routes, bus routes, or high speed streets
- Drainage of storm water runoff and snow plowing considerations may also be a concern with raised crosswalks

Raised Crosswalk

Table 8. Comparison of Vehicle Speeds at the Treatment and Control Sites.

CITY AND TREATMENT	50TH PERCENTILE SPEED TREATMENT SITE	50TH PERCENTILE SPEED CONTROL SITE	DIFFERENCE IN SPEEDS
Durham, NC – Research Drive Raised crosswalk	33.3 km/h (20.7 mi/h)	39.8 km/h (24.7 mi/h)	6.5 km/h (4.0 mi/h) *lower* at treatment site SIGNIFICANT[1]
Durham, NC – Towerview Drive Raised crosswalk & overhead flasher	18.5 km/h (11.5 mi/h)	38.4 km/h (23.9 mi/h)	19.3 km/h (12.4 mi/h) *lower* at treatment site SIGNIFICANT
Montgomery County, MD[2] Raised Crosswalk	34.6 km/h (21.5 mi/h)	38.6 km/h (24.0 mi/h)	4.0 km/h (2.5 mi/h) *lower* at treatment site NOT SIGNIFICANT

1 Significant at the 0.05 level or better, using a two-tailed test.

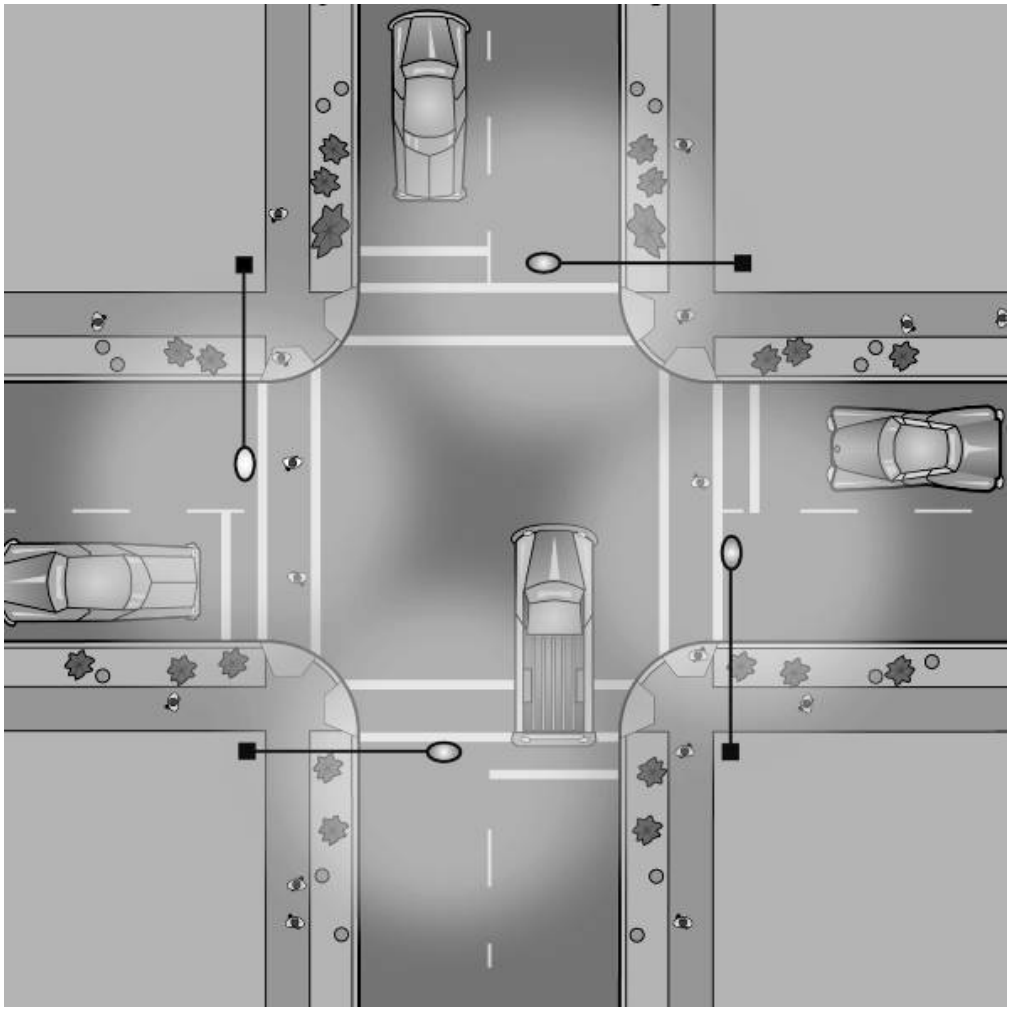
2 Vehicle speeds in Montgomery County were measured only when the staged pedestrian was present

Table 9. Pedestrians for Whom Motorists Stopped to Let Them Cross.

SITE AND TREATMENT	TREATMENT SITE	CONTROL SITE	SIGNIFICANCE
Durham, NC — Towerview Dr Raised crosswalk and overhead flasher	79.2% (159)*	31.4% (35)	• (0.000)
Montgomery County, MD Raised crosswalk	1.2% (169)	1.0% (198)	N

Illumination – Essential For Any Crossing

- Marked crosswalk?
  - Light it
- Up to 50% of pedestrian crashes occur at night

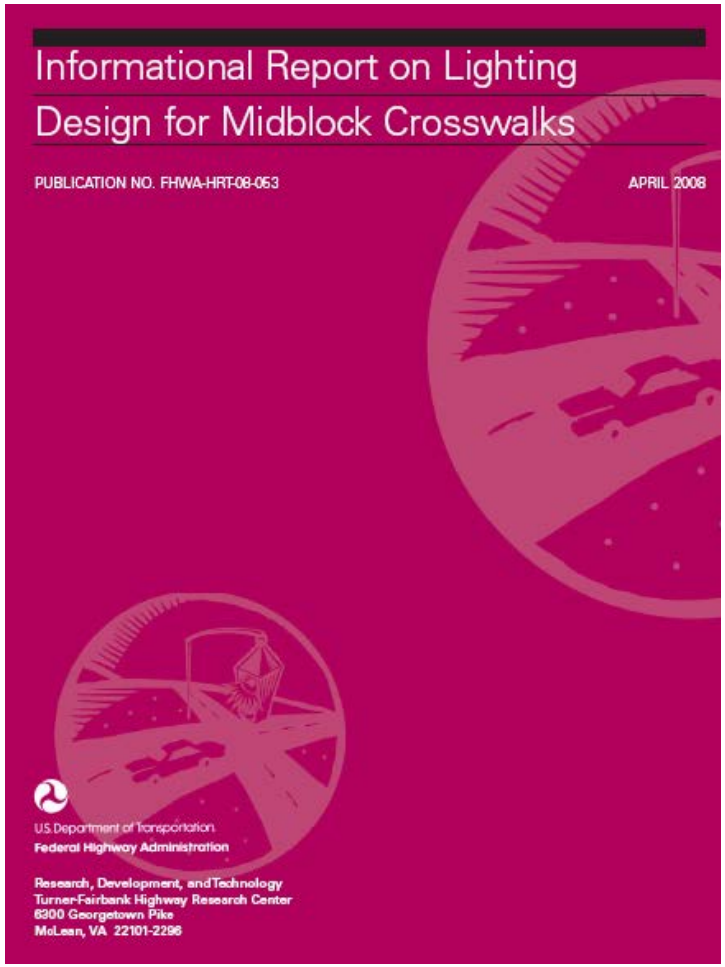


- Lighting reduces the odds of pedestrian fatalities:
  - by 42% at midblock locations
  - by 54% at intersections

Ped shows up well in well-lit crosswalk

Informational Report on Lighting Design for Midblock Crosswalks

- FHWA-HRT-08-053
  - April 2008
  - Available at https://www.fhwa.dot.gov/publications/research/safety/08053/



Sample Illustrations from FHWA Report

Fig 11. Traditional midblock crosswalk lighting layout

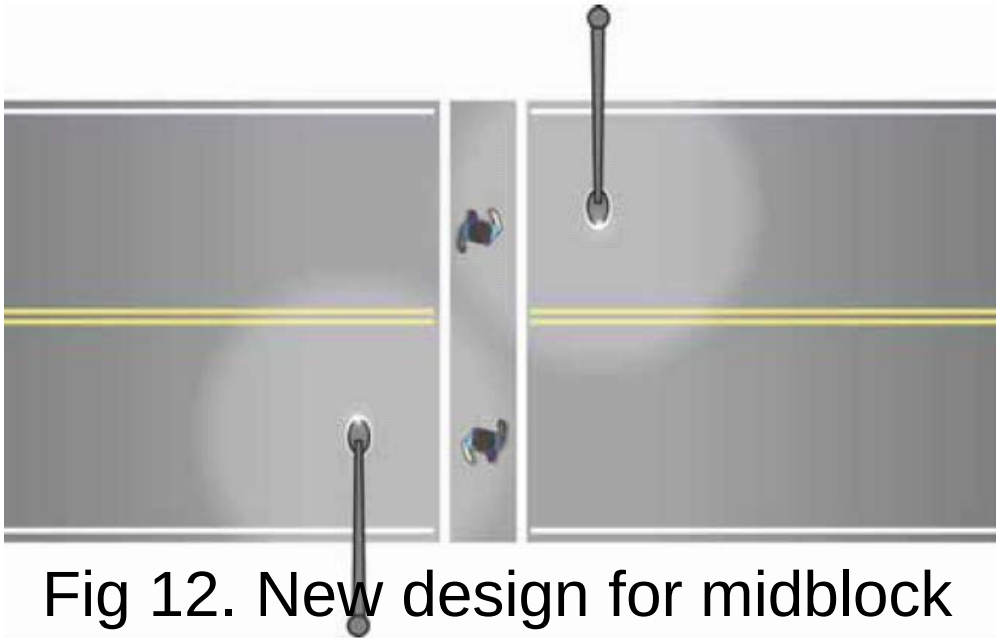
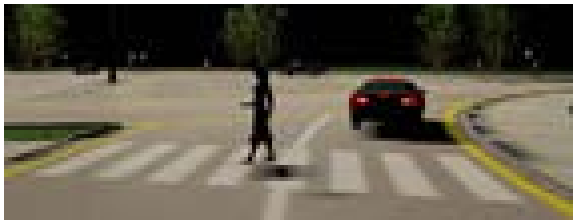


Fig 12. New design for midblock crosswalk lighting layout



Recommended lighting level: 20 lux at 5’ above pavement

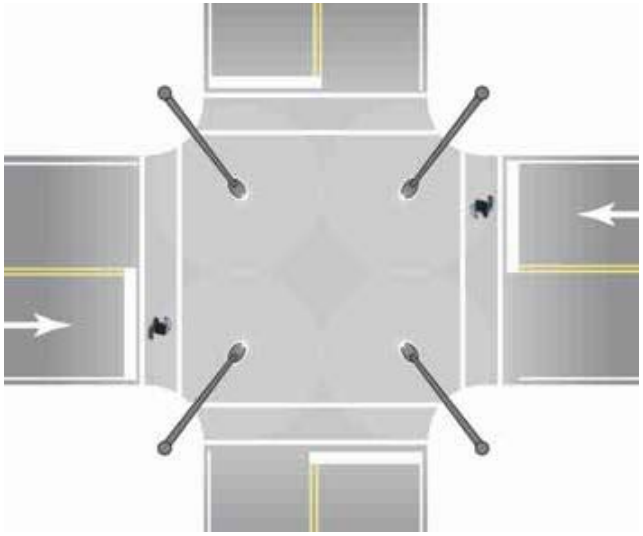


Fig 13. Traditional intersection lighting layout

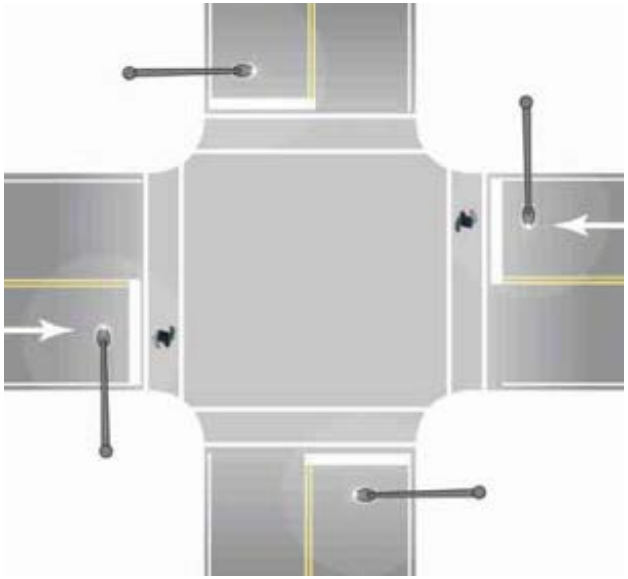


Fig 14. New design for intersection lighting layout for crosswalks.

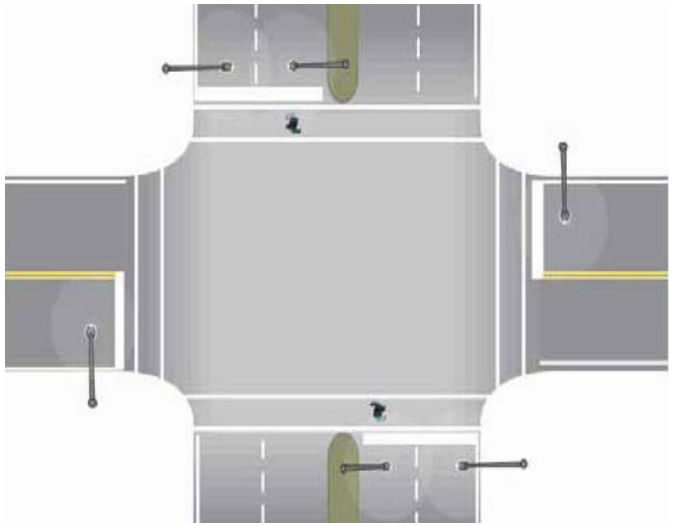


Fig 15. New design for wide roadway intersection lighting layout for crosswalks

Lummi Nation Haxton Way Pedestrian Pathway Adaptive Solar Lighting WSDOT

https://www.youtube.com/watch?v=ltR2oiQ3R9Q

Pedestrian Warning Signs MUTCD 2C.50

- "… may be used to alert road users in advance of locations where unexpected entries into the roadway might occur or where shared use of the roadway by

Guidance:

If used in advance of a pedestrian, snowmobile, or equestrian crossing, the W11-2, W11-6, W11-7, and W11-9 signs should be supplemented with plaques (see Section 2C.55) with the legend AHEAD or XX FEET to inform road users that they are approaching a point where crossing activity might occur.

W11-2*

* A fluorescent yellow-green background color may be used for this sign or plaque.

Guidance:

When a fluorescent yellow-green background is used, a systematic approach featuring one background color within a zone or area should be used. The mixing of standard yellow and fluorescent yellow-green backgrounds within a selected site area should be avoided.

Pedestrian Warning Signs – MUTCD 2C.50

Standard:

If a post-mounted W11-2, W11-6, W11-7, or W11-9 sign is placed at the location of the crossing point where pedestrians, snowmobilers, or equestrians might be crossing the roadway, a diagonal downward pointing arrow (W16-7P) plaque (see Figure 2C-12) shall be mounted below the sign. If the W11-2, W11-6, W11-7, or W11-9 sign is mounted overhead, the W16-7P plaque shall not be used.

Option:

A Pedestrian Crossing (W11-2) sign may be placed overhead or may be post-mounted with a diagonal downward pointing arrow (W16-7P) plaque at the crosswalk location where Yield Here To (Stop Here For) Pedestrians signs (see Section 2B.11) have been installed in advance of the crosswalk.

Embedded LED's in Signs

MUTCD Section 2A.07 Retroreflectivity and Illumination

- LEDs may be used individually within the legend or symbol of a sign and in the border of a sign…
- White or yellow, if used with warning signs.
- White or yellow, if used with school area signs.
- If flashed, all LED units shall flash simultaneously at a rate of more than 50 and less than 60 times per minute.

Figure 3: Example of pedestrian crossing warning sign with embedded LEDs and solar unit.

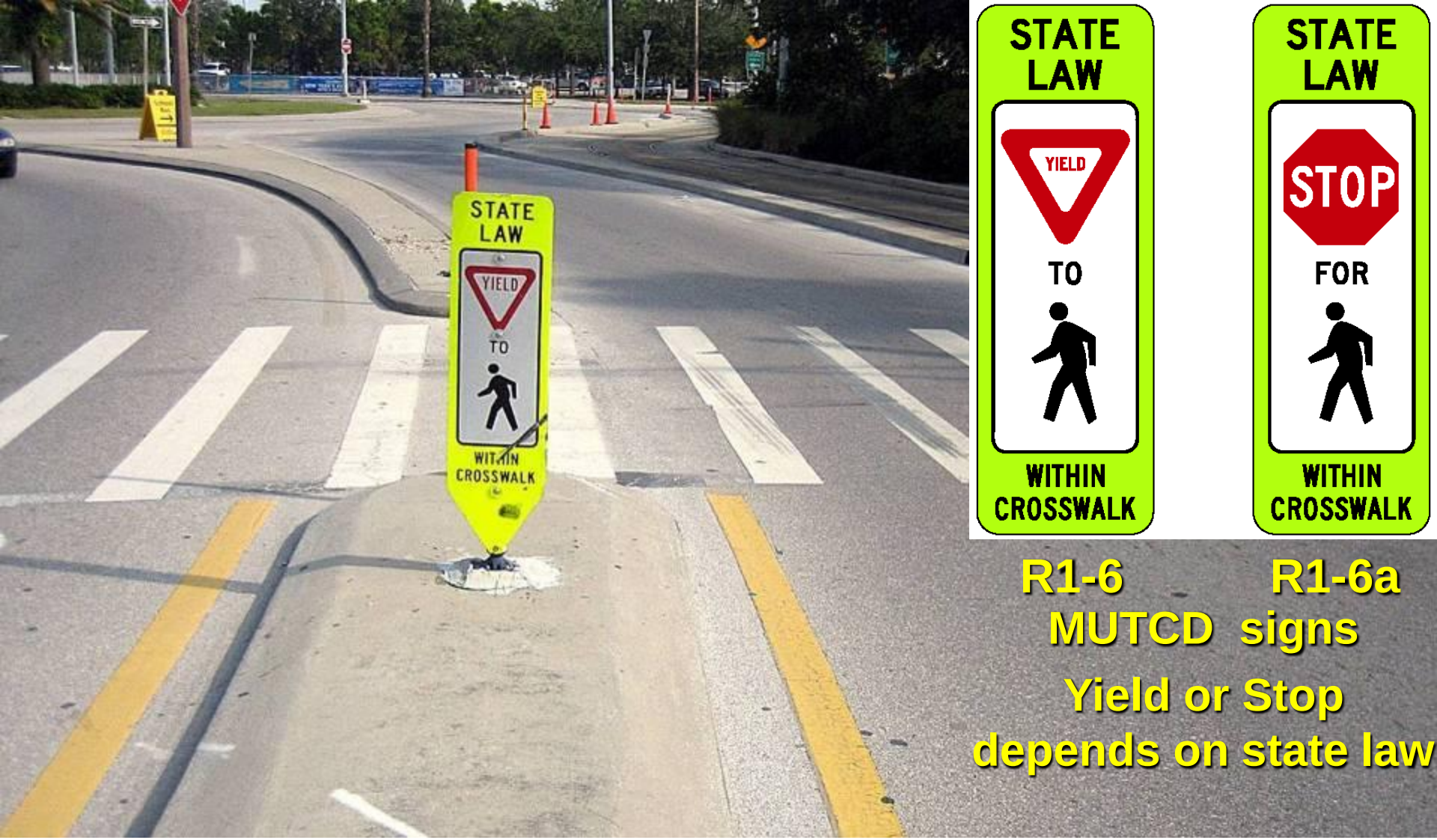
https://mutcd.fhwa.dot.gov/htm/2009r1r2/part2/part2a.htm#section2A07

Embedded LED's in Signs Research

- STOP Sign
  - 28.9% reduction number of vehicles not fully stopping
  - 52.9% reduction number of vehicles moving through intersection w/o significantly slowing

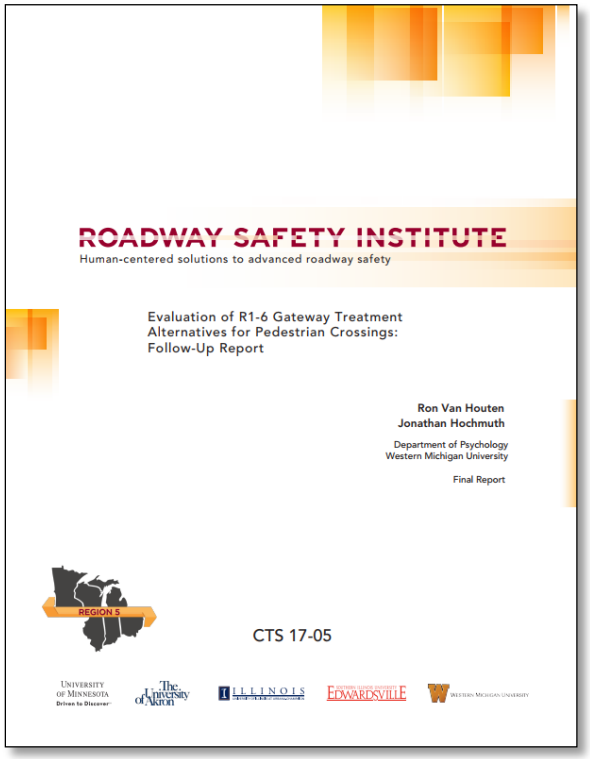
- https://safety.fhwa.dot.gov/intersection/conventional/unsignalized/tech_sum/fhwasa09006/

Figure 1: Example of stop sign with embedded LEDs and solar unit.

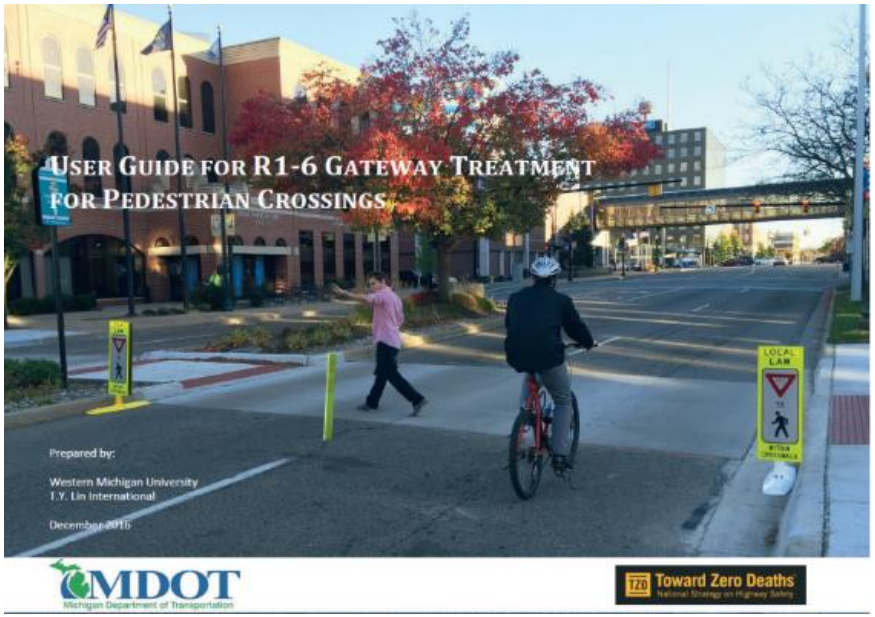


In-street pedestrian crossing signs

In Street Gateway Treatment

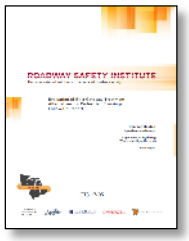


https://conservancy.umn.edu/bitstream/handle/11299/189957/CTS%2017-05.pdf?sequence=1&isAllowed=y



https://mdotcf.state.mi.us/public/tands/Details_Web/mdot_user_guide_gateway_treatment.pdf

Research Abstract key points



- Increase of drivers yielding to pedestrians at midblock and multilane urban and suburban locations from 15% to 70%
  - Increases endured without any decrement over the spring, summer and fall of 2016.
- Speed data collected showed 4 to 5 mph reduction in mean speed when motorists traversed the crosswalk when pedestrians were absent.
  - These speed changes persisted over time.
- Placing signs between 5, 10, 20, 30, and 50 ft in advance of the crosswalk were equally effective and enticed drivers to yield further ahead of the crosswalk.

Research Abstract key points cont.

- Curb type mount with a flexible rubber attachment all survived while only 58% of the flush mounted signs with a pivoting base survived.

- None of the signs mounted on top of the edge of a curb on a refuge island or median island, curb extension, or the curb on the edge of the roadway **under FHWA permission to experiment** were destroyed or damaged.

Gateway Treatment, Three–Lane Configuration Without Refuge Island	
Travel Lanes **Passing/Turn Lanes**	2 1
R1-6 Signs	4
Flexible Delineators	0
Yielding Compliance	Between 60% and 90% compliance rate if speed limit is 30mph or less for ADT up to 25,000. If the speed limit is 35 mph expect similar results if ADT is 12,000 or less. UNKNOWN above 12,000 ADT.
Approximate Cost	$1,200 for materials 20-minute installation 8 minutes to remove for winter 8 minutes to reinstall in spring

Figure 6a

General Description:

Note: By installing the gateway on the near side of the intersection, both crosswalks are covered with only four signs. Data show that a gateway at the near side crosswalk continues to be effective for the far side of the intersection, as the motorist on the far side has already passed through a gateway on the near side.

The signs on the curb side in the gutter pan would have a better chance of survival if they are moved placed between 3 and 50 feet in Advance of the crosswalk markings. This would reduce the chance of the sign being struck by a turning vehicle. Figure 6b shows a typical installation.

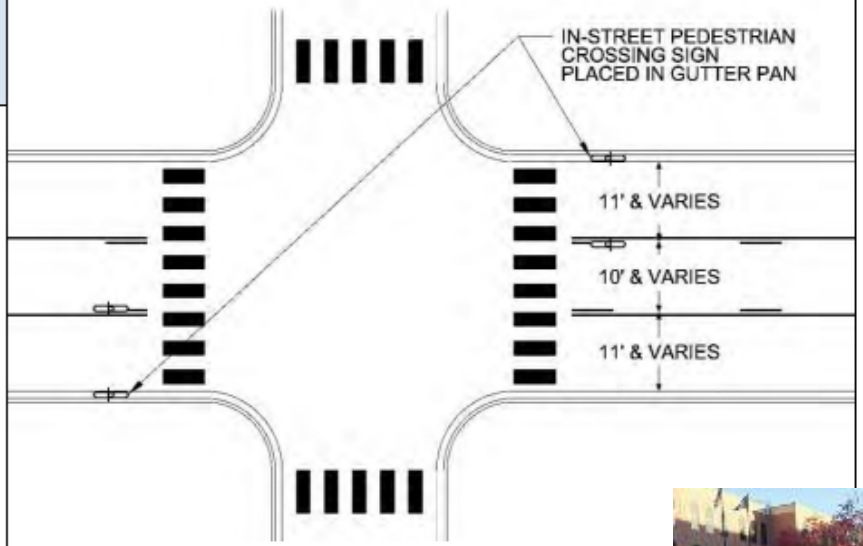


Figure 6b

Pedestrian crossing flashing beacon

College Station TX

Improves visibility of sign and crosswalk; CMF/CRF unknown

Rectangular Rapid Flash LED Beacon

Coconut Grove FL

- Studies indicate motorist yield rates increased from about 20% to 80%
- Higher yielding rates sustained even after two years of operation and no identifiable negative effects
  - St. Petersburg FL research report 2008

Rectangular Rapid Flashing Beacon New IA-21

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Correction issued 3/21/2018

Subject: **INFORMATION:** MUTCD – Interim Approval for Optional Use of Pedestrian-Actuated Rectangular Rapid-Flashing Beacons at Uncontrolled Marked Crosswalks (IA-21)

Date: MAR 2 0 2018

From: Martin C. Knopp
Associate Administrator for Operations

In Reply Refer To: HOTO-1

To: Federal Lands Highway Division Directors
Division Administrators

https://mutcd.fhwa.dot.gov/res-interim_approvals.htm#valid09

Figure 1. Example of an RRFB dark (left) and illuminated during the flash period (center and right) mounted with W11-2 sign and W16-7P plaque at an uncontrolled marked crosswalk.

- Must request and receive permission to use this new Interim Approval (1A-21) even if prior approval had been given for Interim Approval 1A-11
- A State may request Interim Approval for all jurisdictions in that State.

Interim Approval – Allowable Uses

a. Function as pedestrian-actuated conspicuity enhancement
b. Shall only be used to supplement post-mounted Pedestrian, School, Trail Crossing warning sign with diagonal downward arrow, plaque, or overhead-mounted warning sign located at or immediately adjacent to an uncontrolled marked crosswalk
d. If deemed necessary by the engineer, in event of sight distance, additional RRFB may be installed in advance of crosswalk. Shall supplement not replace.

St. Petersburg FL

IA-21 3.a For any approach two RRFB required, One on right-hand and one on left-hand of roadway. If divided highway left-hand should be installed on median if practical rather than far left-hand.

IA-21 Beacon Flashing Requirements

b. Left-hand 50ms - Both Dark 50ms - Right-hand 50ms - Both Dark – Repeat Left Right Sequence - Both 50ms – Both Dark 50ms - Both 50ms – Both Dark 250ms – Repeat from start

f. Existing RRFB units using IA-11 should be reprogrammed as part of a systematic upgrading process, such as when the units are serviced or when replaced

RRFB Video IA-11Flash Pattern

RRFB Video IA-21Flash Pattern

IA-21 5. Beacon Flashing Requirements

c. Flash rate of each individual RRFB indication, as applied over the full flashing sequence, shall not be between 5 and 30 flashes per second to avoid frequencies that might cause seizures

e. Automatic signal dimming device should be used

IA-21Beacon Operation

- 6. e.
  - Flash period shall be **immediately initiated each and every time** a pedestrian is detected through passive detection or pushbutton activated, including when pedestrians are detected while RRFB's are already flashing and when pedestrians are detected immediately after the RRFB's have ceased flashing.
- 6. f.
  - Small pilot light may be installed

Figure 2. View of pilot light to pedestrian at shared-use path crossing with median refuge. Enlargement of pilot light at right.

IA-21 Accessible Pedestrian Features

7. a. - If speech pushbutton information message is used locator tone shall be provided

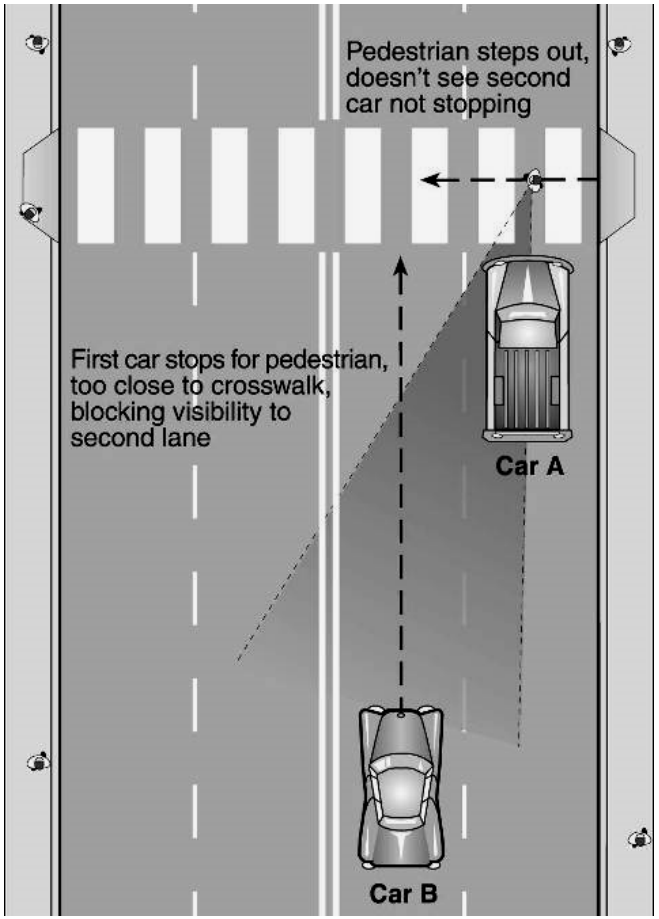
7. b. - If speech pushbutton information message is used, the audible information device shall not use vibrotactile indications or percussive indications

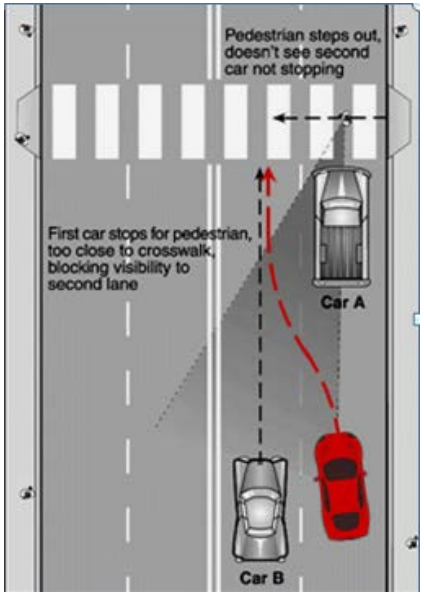
7. c. - Speech pushbutton message “Yellow lights are flashing”. Message should be spoken twice.

Advance Stop or Yield Line: Reduces Multiple-threat Crashes

Multiple Threat Crash Problem

- 1st car stops to let pedestrian cross, blocking sight lines
- 2nd car doesn't stop, hits pedestrian at high speed



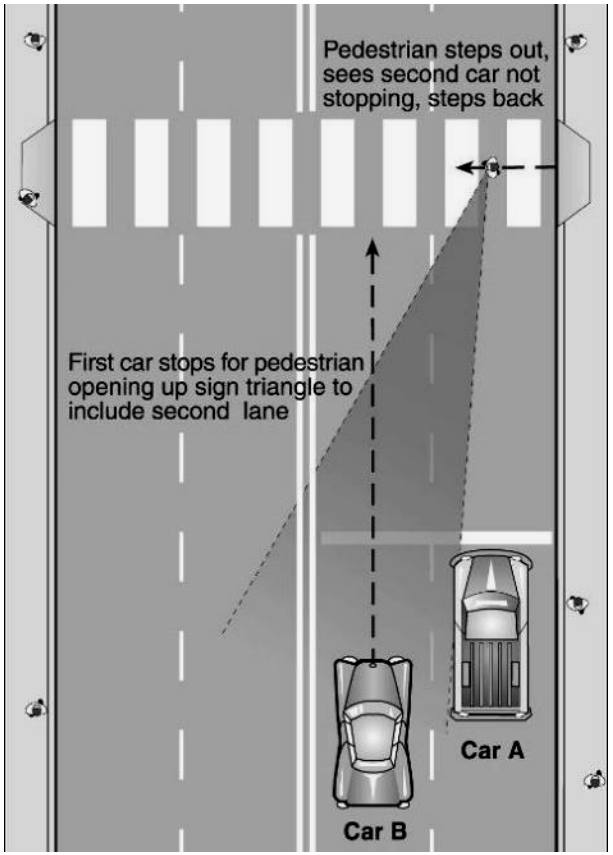


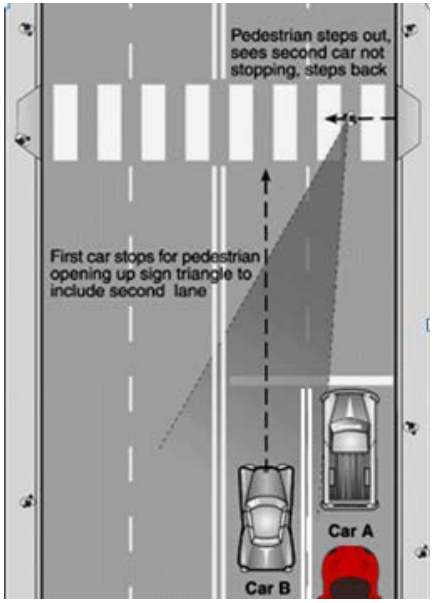
Multiple Threat Crash Solution

- Advance stop or yield line
- 1st car stops further back, opening up sight lines
- 2nd car can be seen by pedestrian
- CMF = 0.75

  (CRF of 25%)

  (NCHRP 17-56)





Signing to go along with markings

R1-5

R1-5a

(Use where local law says yield to pedestrians)

R1-5b

R1-5c

(Use where local law says stop for pedestrians)

MUTCD Sec. 2B.11 and Figure 2B-2

- Advance yield line (shark's teeth) & sign
- Consider double white lines for no passing

2009 MUTCD Section 3B.16 and Figure 3B-17

Portland OR

Advance stop line and sign

2009 MUTCD Section 3B.16

Las Vegas NV

- 20’ to 50’ setback (30’ preferred for effectiveness)
- Prohibit parking between line and crosswalk

Marking a Crosswalk Summary

When is it OK to mark a crosswalk without other treatments on roads with speed limits < or = to 40 mph?

- 2-lane roads
- Multi-lane roads w/ ADT < 12,000 (no median)
- Multi-lane roads w/ADT < 15,000 (median)

How can you increase the effectiveness of marked crosswalks?

- Marked crosswalk: Add median, advance stop line
- Textured crosswalks: Smooth and white is best
- Signs: In road; supplement with striping
- In all cases (nighttime):Illumination!

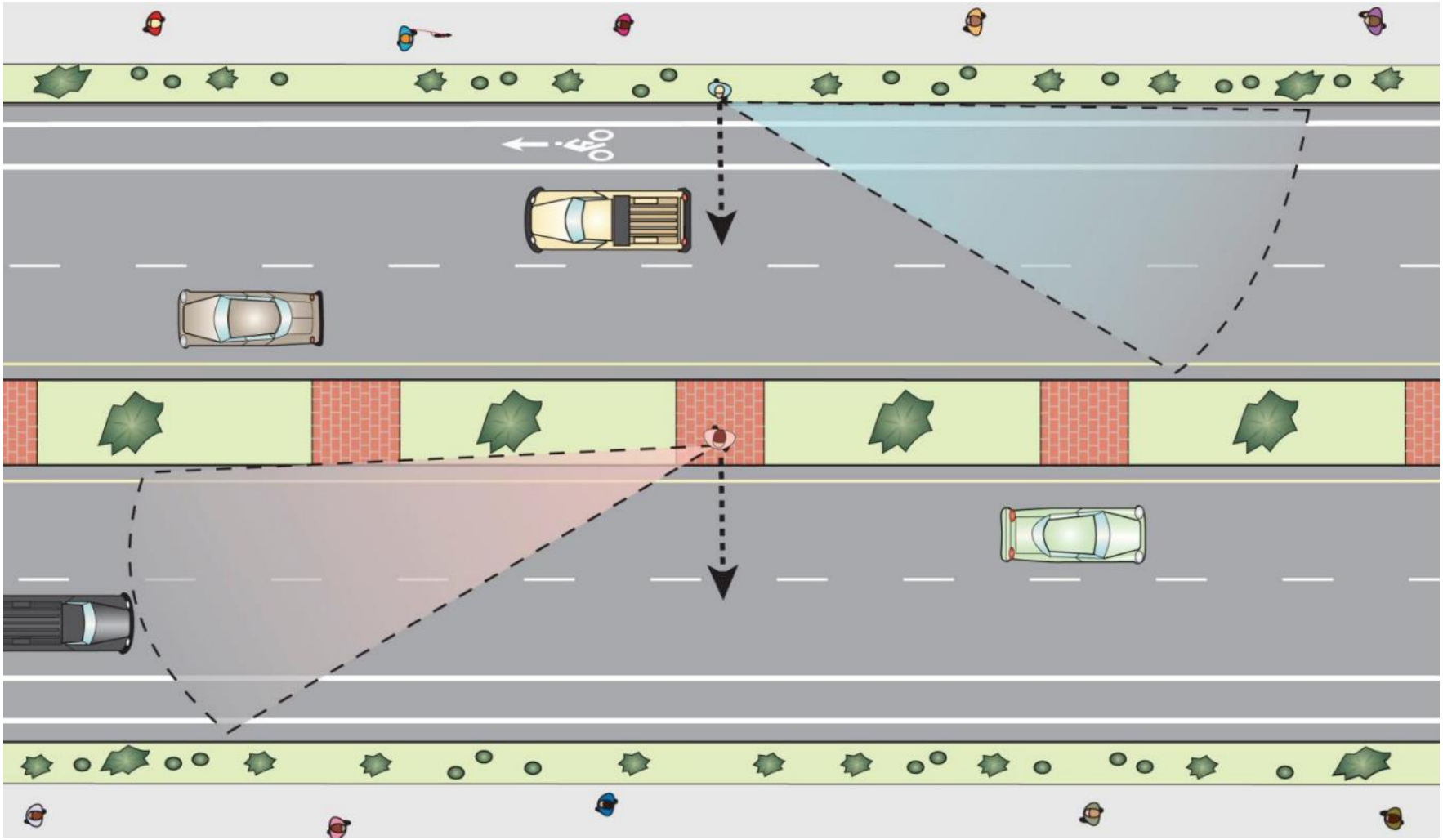
Raised Medians And Islands

Significant crash reductions:

- Marked crosswalks
  - CMF = 0.54 (CRF = 46%)

Unmarked crosswalks

  - CMF = 0.61 (CRF = 39%)



- Continuous raised median – basic principle:
- Breaks long complex crossing into two simpler crossings

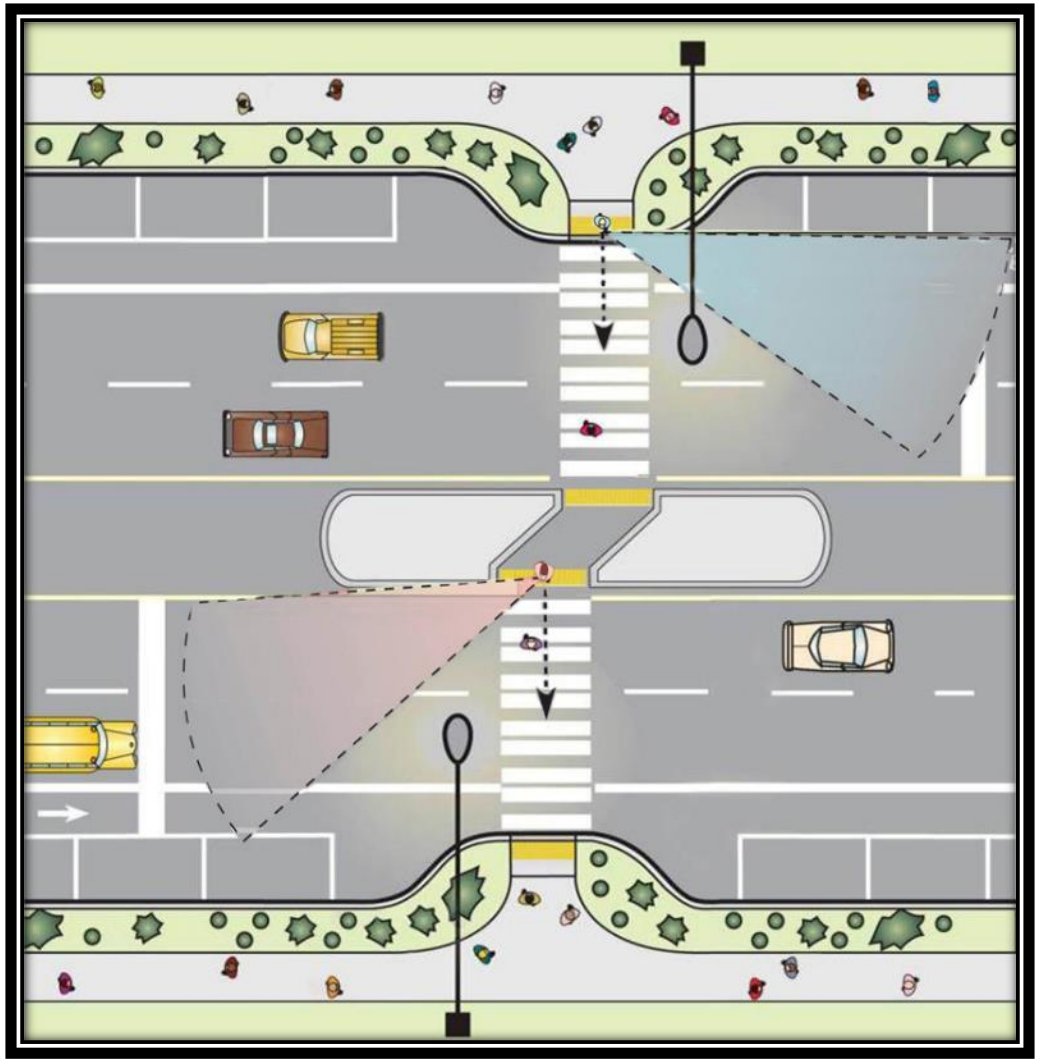
People figure out on their own how to use a median to cross in two steps

Atlanta GA

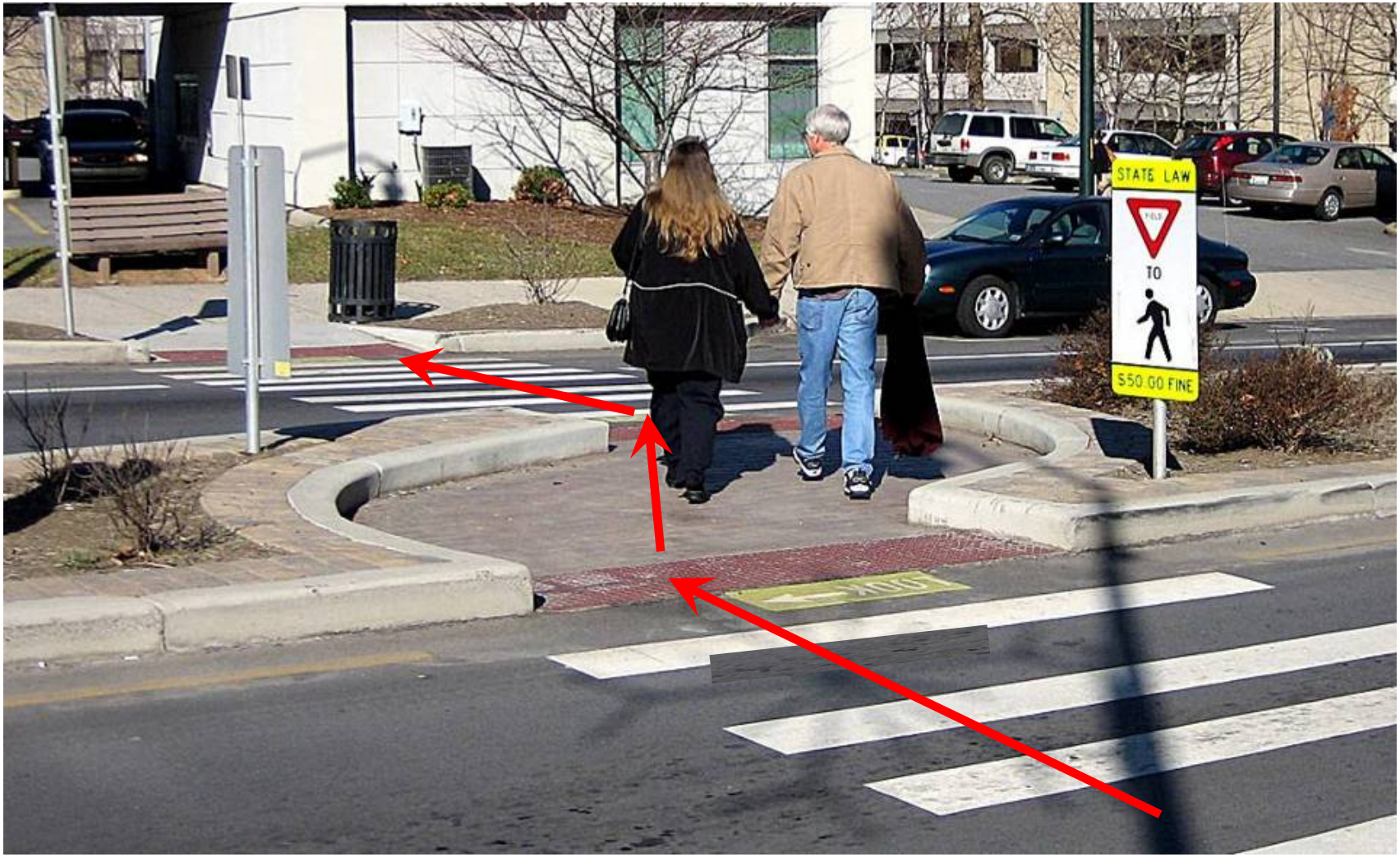
A flush median is not a refuge

Atlanta GA

Add a raised island

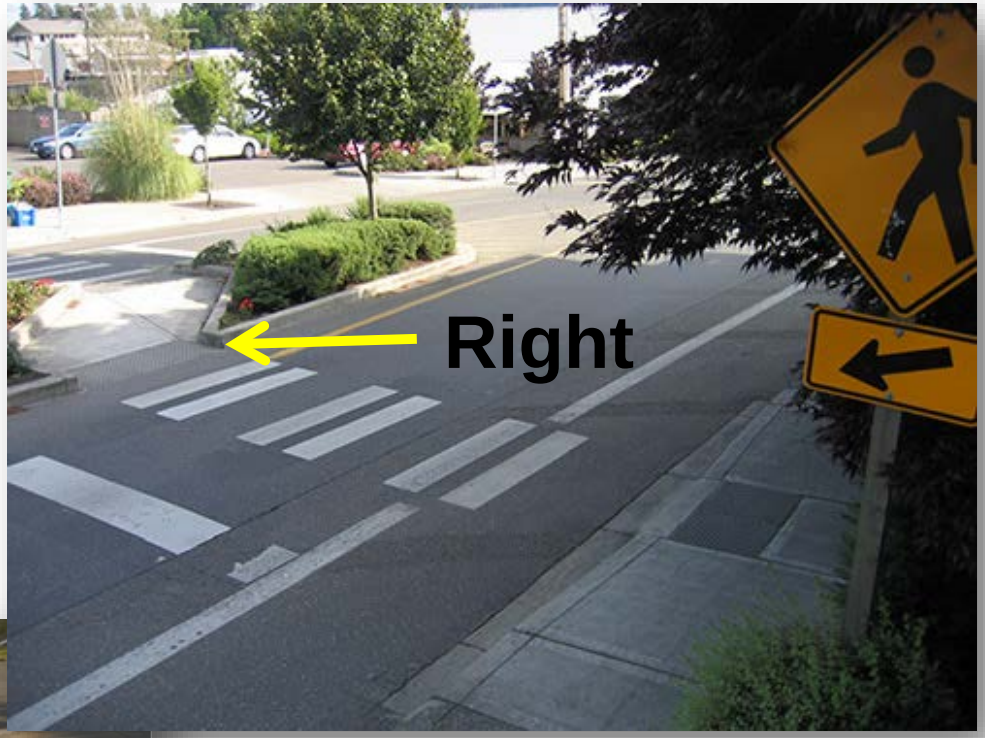


- Crossing island at marked crosswalk - same principle:
- Breaks long complex crossing into two simpler crossings



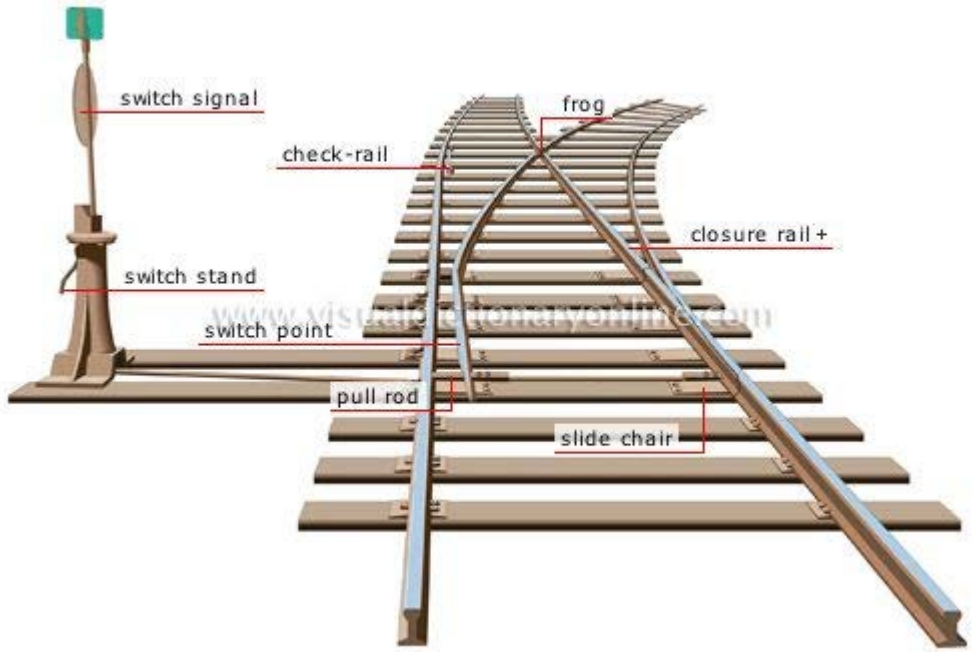
- Option: stagger or angle cut-through so pedestrians face oncoming traffic before 2nd crossing

Angled cut through: Line up ends with crosswalk direction for the blind



Medians:

- Why do medians reduce pedestrian crashes?
  - They reduce crossing distance and break up an otherwise complex task into 2 simpler crossings
- What is the crash reduction factor?
  - At marked crosswalks CMF = 0.54 (CRF = 46%)
  - At unmarked crosswalks CMF = 0.61 (CRF = 39%)
  - NCHRP 17-56 findings: CMF = 0.68 (CRF = 32%)


switch signal
frog
check-rail
closure rail +
switch stand
switch point
pull rod
slide chair

SWITCH

Pedestrian Signal

MUTCD signal warrants

1. Eight-hour vehicle volume
2. Four-hour vehicle volume
3. Peak hour
4. Pedestrian volume*
5. School crossing*
6. Coordinated signal system
7. Crash experience*
8. Roadway network
9. Intersection near a grade (rail) crossing

* = potential ped warrant

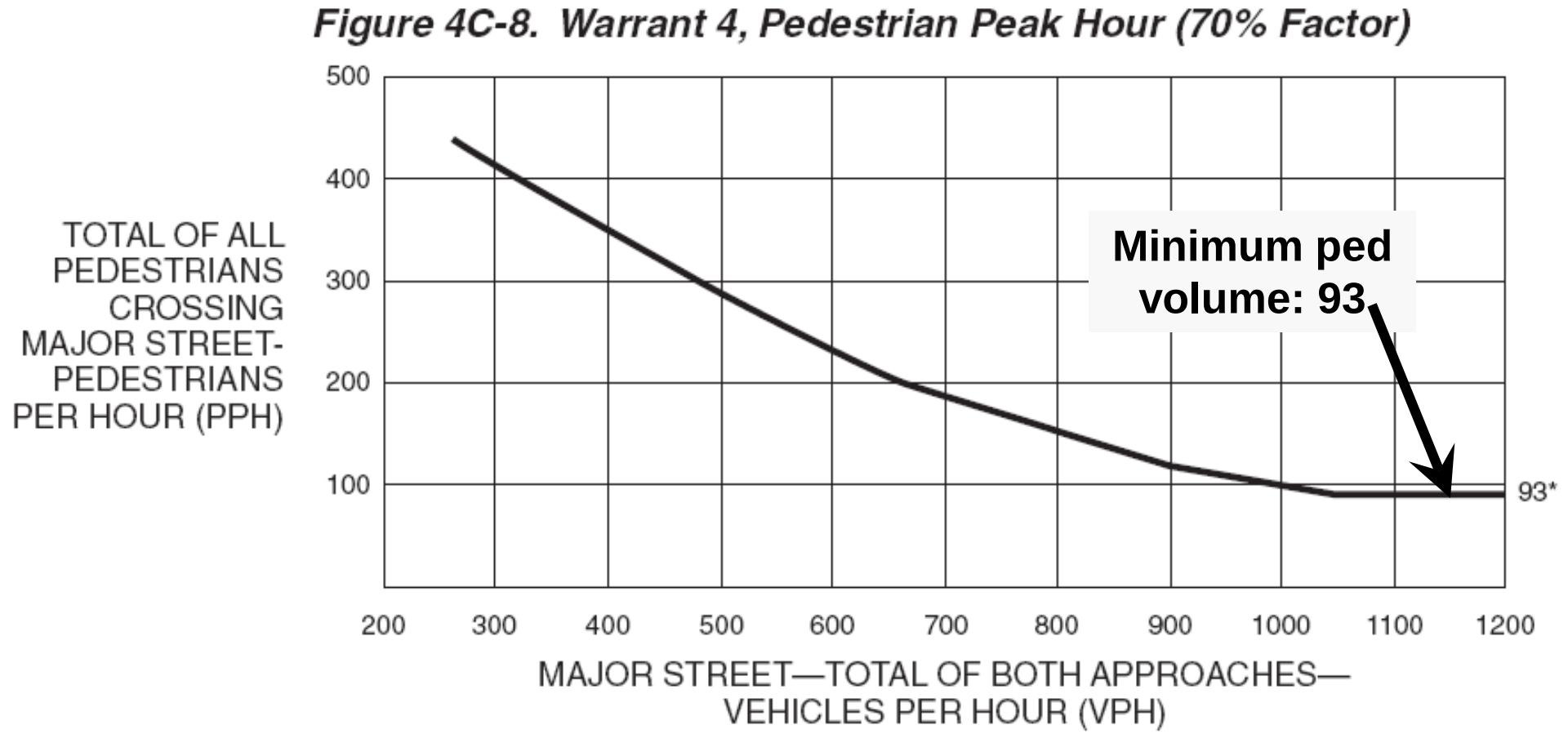
2009 MUTCD Chapter 4C

Very difficult to meet pedestrian volume warrant

Honolulu HI

You need many pedestrians

2009 MUTCD Pedestrian Volume Warrant for Speeds > than 35 mph



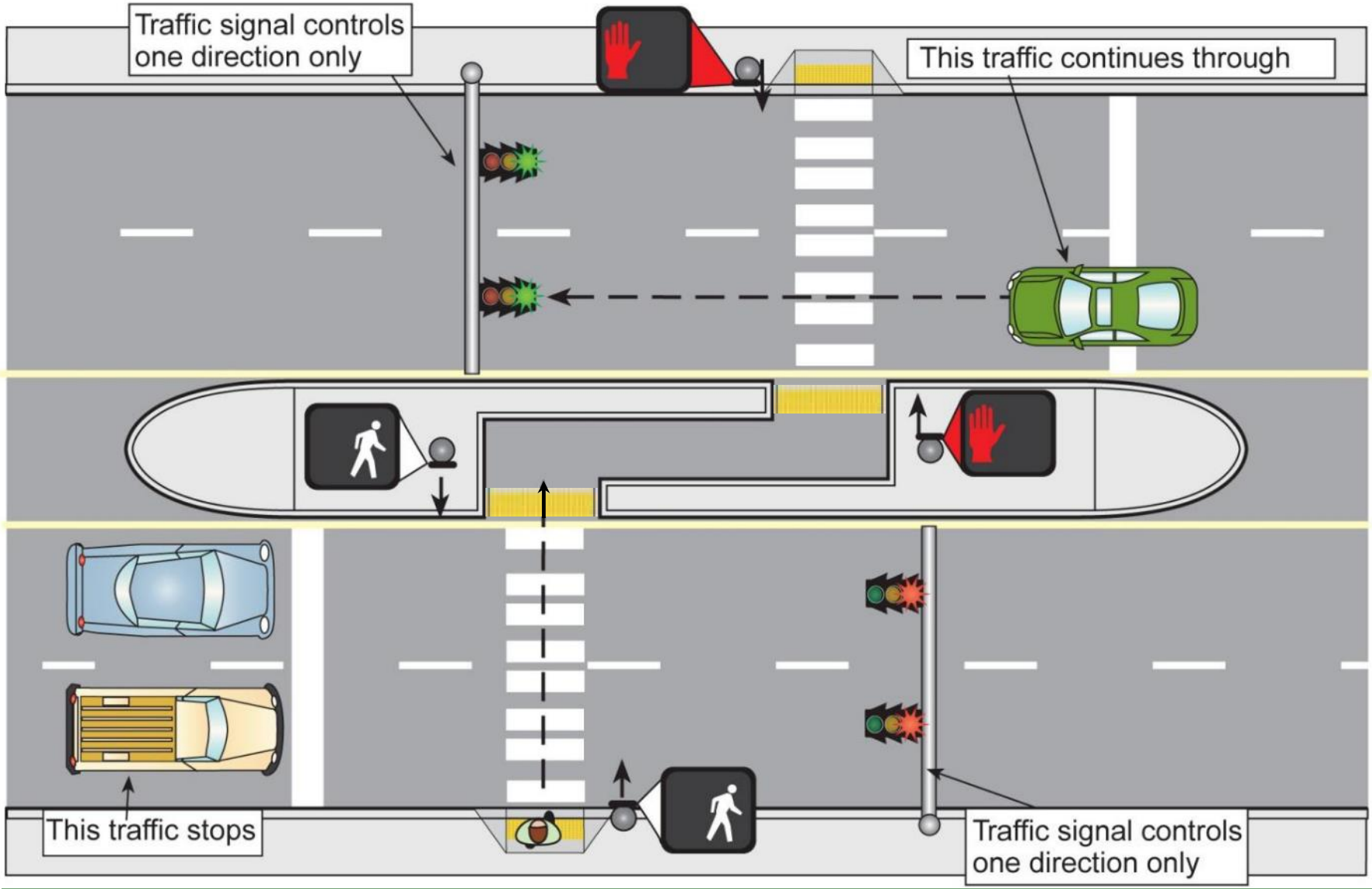
- Provide a HOT response
- Otherwise pedestrians won't wait for the light

If wait is too long, pedestrians will seek gaps

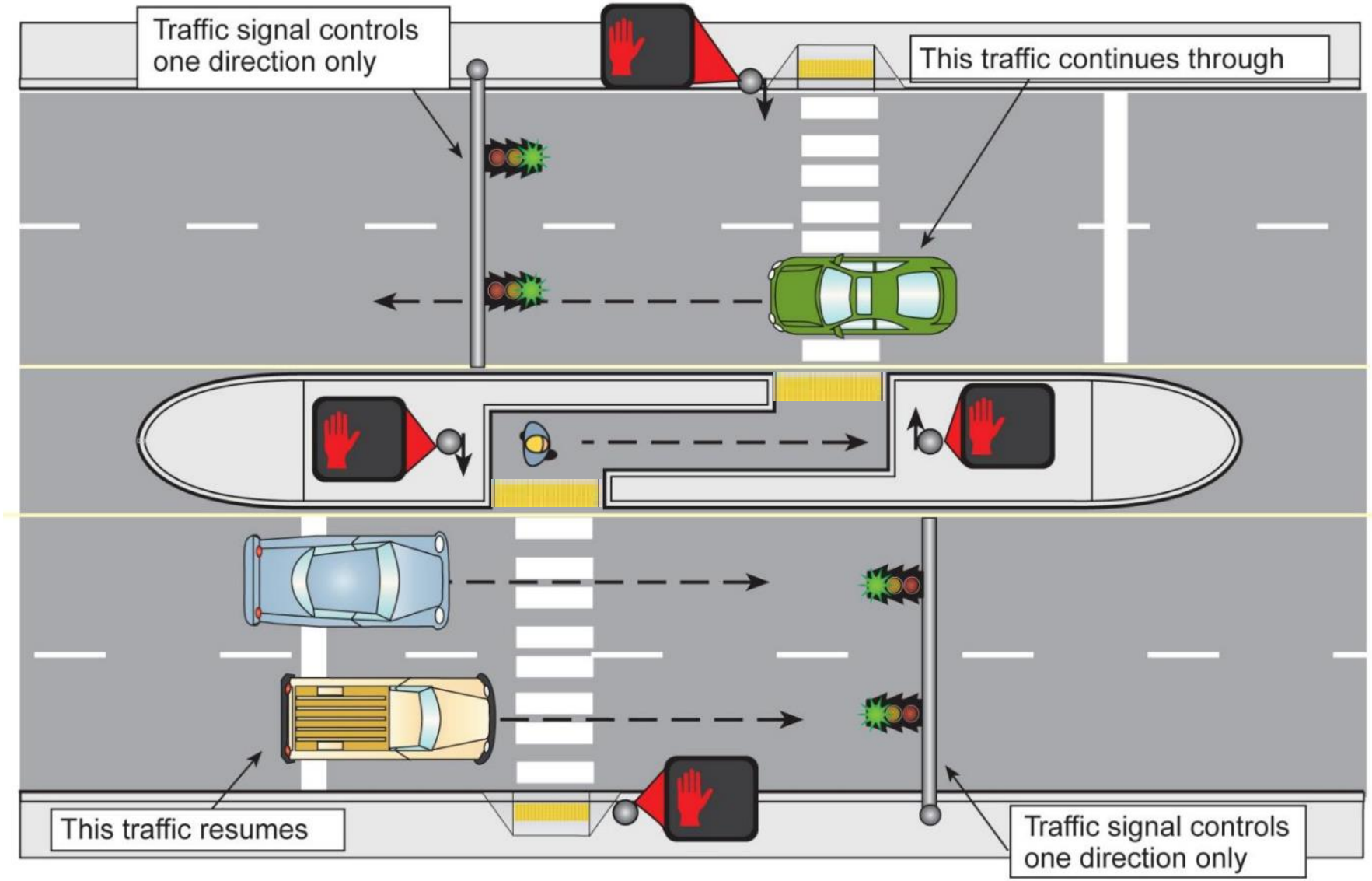
And then traffic waits for no reason

Pedestrian Signal

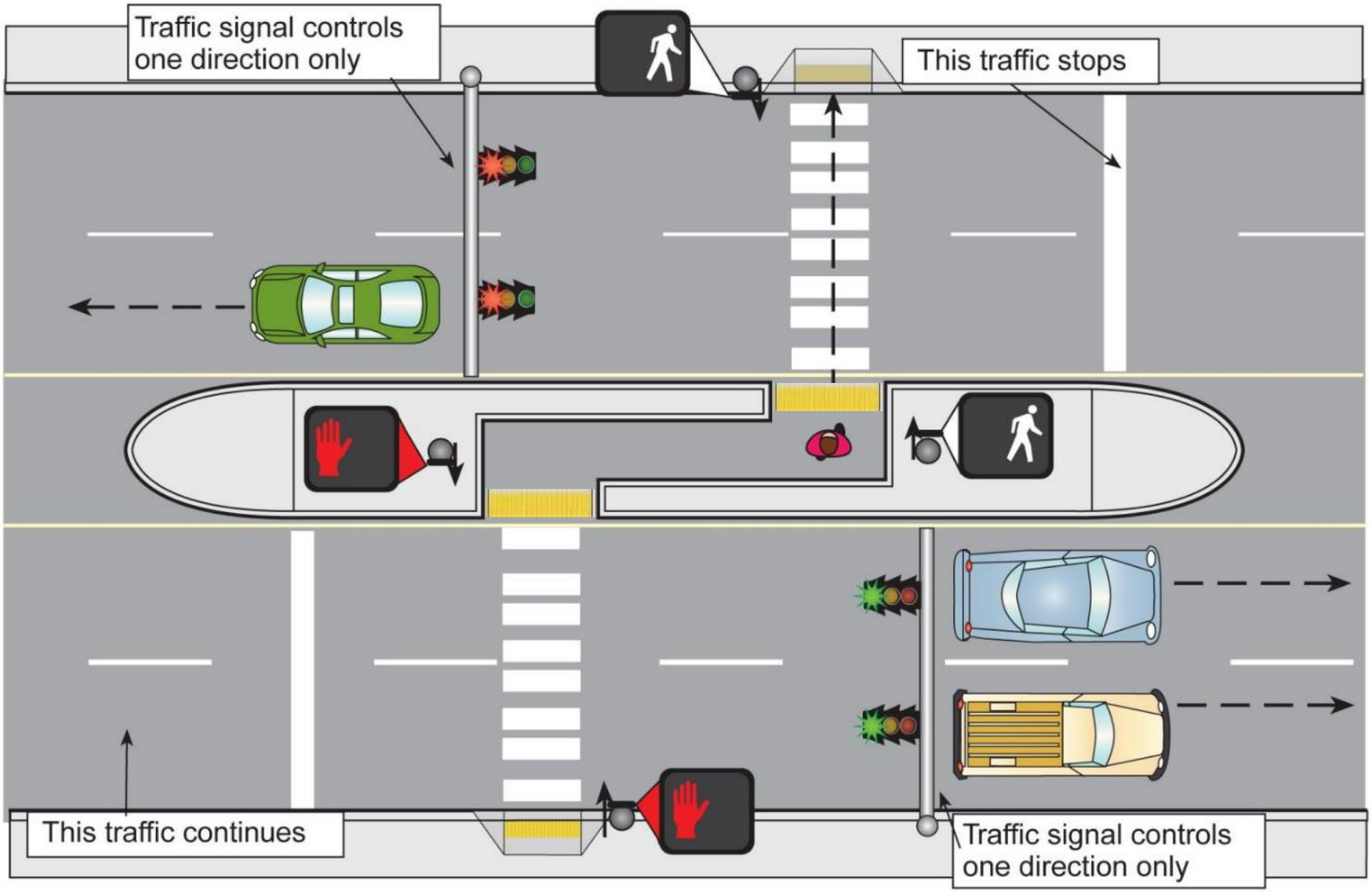
2-stage crossing increases effectiveness and disrupts traffic less



1. Ped pushes button, waits, crosses to island



2. Ped crosses to island, proceeds to 2nd button



3. Ped on island – pushes button to finish crossing

Bellevue WA

Stage 1: Ped stops traffic in one direction

Bellevue WA

Stage 1: Ped crosses to median island

Bellevue WA

Stage 1 over: Traffic in one direction resumes

Bellevue WA

Stage 2: Ped stops traffic in other direction

Bellevue WA

Stage 2 over: Traffic resumes

Bellevue WA

Detail 1: Requires ped push button on island

Bellevue WA

Detail 2: Fences force peds to walk against on-coming traffic

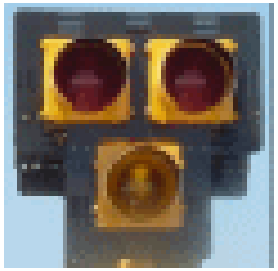
Pedestrian Hybrid Beacon aka "HAWK" (High Intensity Activated Crosswalk)

2009 MUTCD Chapter 4F Pedestrian Hybrid Beacons

PHB Sequence

1

Blank for drivers



2

Flashing yellow

3

Steady yellow

4

Steady red

5

Wig-Wag

Return to 1

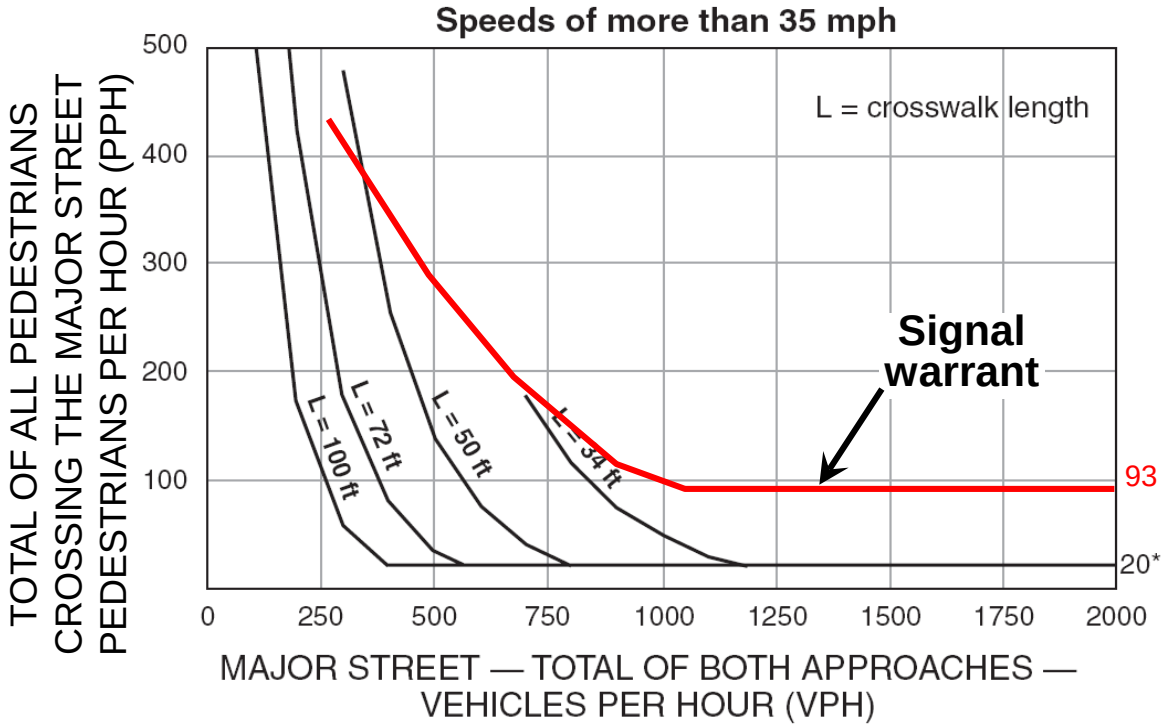
Pedestrian Hybrid Beacon Effectiveness

Table 21. Summary of motorist yielding compliance from three sources for red signal or beacon and active when present.

Crossing Treatment	TCRP D-08/NCHRP 3-71 Study: Compliance – Staged Pedestrian Crossing # of Sites	Range (%)	Average (%)	TCRP D-08/NCHRP 3-71 Study: Compliance – General Population Pedestrian Crossing # of Sites	Range (%)	Average (%)	Other Studies: Compliance – Literature Review (from Table L-1) # of Sites	Range (%)	Average (%)
Red Signal or Beacon									
Midblock Signal	2	97 to 100	99%	4	91 to 98	95%	NA	NA	NA
Half Signal	6	94 to 100	97%	6	96 to 100	98%	1	99	99%
HAWK Signal Beacon	5	94 to 100	97%	5	98 to 100	99%	1	93	93%
Active When Present									
In-Roadway Warning Lights	NA	NA	NA	NA	NA	NA	11	8 to 100	66%
Overhead Flashing Beacon (Pushbutton Activation)	3	29 to 73	47%	4	38 to 62	49%	10	13 to 91	52%
Overhead Flashing Beacon (Passive Activation)	3	25 to 43	31%	3	61 to 73	67%	NA	NA	74%

Excerpts from 2009 MUTCD Chapter 4F For Pedestrian Hybrid Beacons

- The CROSSWALK STOP ON RED sign shall be used
- There are **Guidelines** (similar to signal warrants) for Pedestrian Hybrid Beacons – variables include:
  - Pedestrian volume
  - Traffic speeds
  - Traffic volumes
  - Crosswalk length

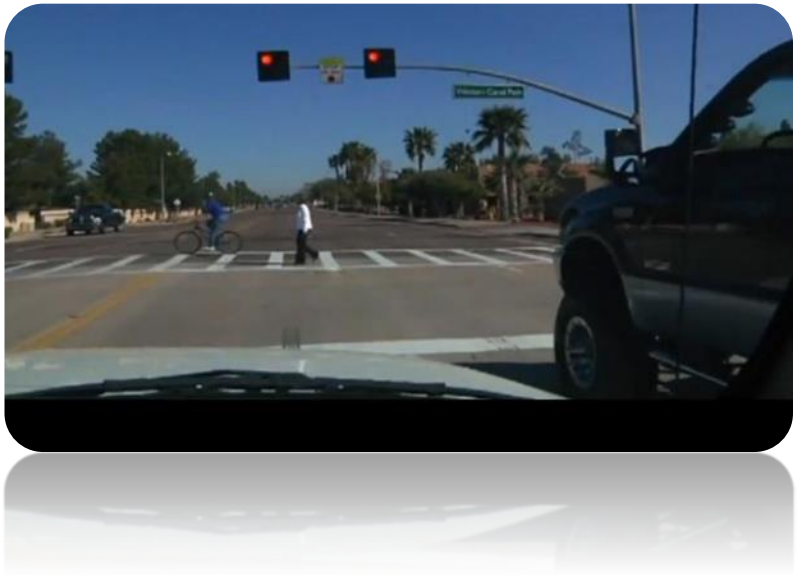


MUTCD Sections 4F.1 and 4F.2

MUTCD Section 4F.01

Standard:

- If used, PHBs shall be used in conjunction with signs and pavement markings to warn and control traffic.
- A PHB shall only be installed at a marked crosswalk.



2009 MUTCD mandated sign

- Standard:
  A CROSSWALK STOP ON RED (symbolic circular red) (R10-23) sign shall be mounted adjacent to a PHB face on each major street approach.
- Option:
  - State MUTCD's may allow other appropriate MUTCD approved ped, bike or school crossing signs

Optional Signing

MUTCD – PHB & Intersections

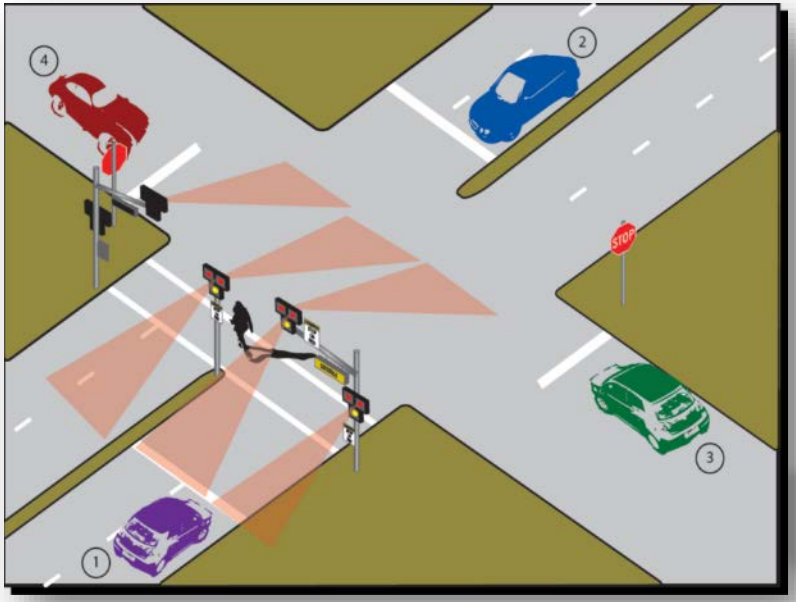
- Section 4F.02, paragraph 04
- Guidance:
  - "When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then the PHB should be installed at least 100 feet from side streets or driveways controlled by STOP or YIELD signs."
- "Guidance" not a "Standard"
- NCUTCD voted to remove that Guidance.
- Proposed Standard for next MUTCD:
  - "If a pedestrian hybrid beacon is installed at or immediately adjacent to an intersection with a side road, vehicular traffic on the side road shall be controlled by STOP signs."

MUTCD - PHB & Intersections

- "Guidance" not based on research from Tucson, AZ where PHB (HAWK) was developed
  - (HAWKs in TTI study were at local street intersections)
- 2009 MUTCD "Guidance" was not a part of the Preliminary Rulemaking
- Some State supplements have eliminated the "Guidance" statement (Arizona)
- Ultimate decision up to FHWA

One or Two crossing(s) at intersections

- If used at an intersection or driveway, the PHB crossing and signal equipment should only control <u>one</u> crossing
  - ITE Traffic Control Devices Handbook



PHB Florida Success Story

- FDOT D7 installed three PHBs along Hillsborough Ave in the Fall of 2015.

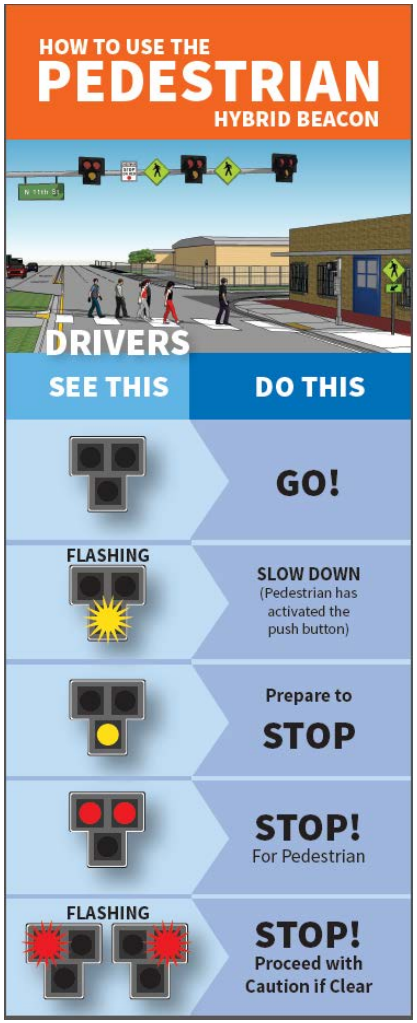
Hillsborough Ave Preliminary Crash Data

Hillsborough Ave Bicycle and Pedestrian Crashes	
Year	Crashes
2010	17
2011	20
2012	27
2013	24
2014	14
2015	19
2016	7

PHB Installed Fall of 2015

Six year average 20 crashes per year

Education Campaign



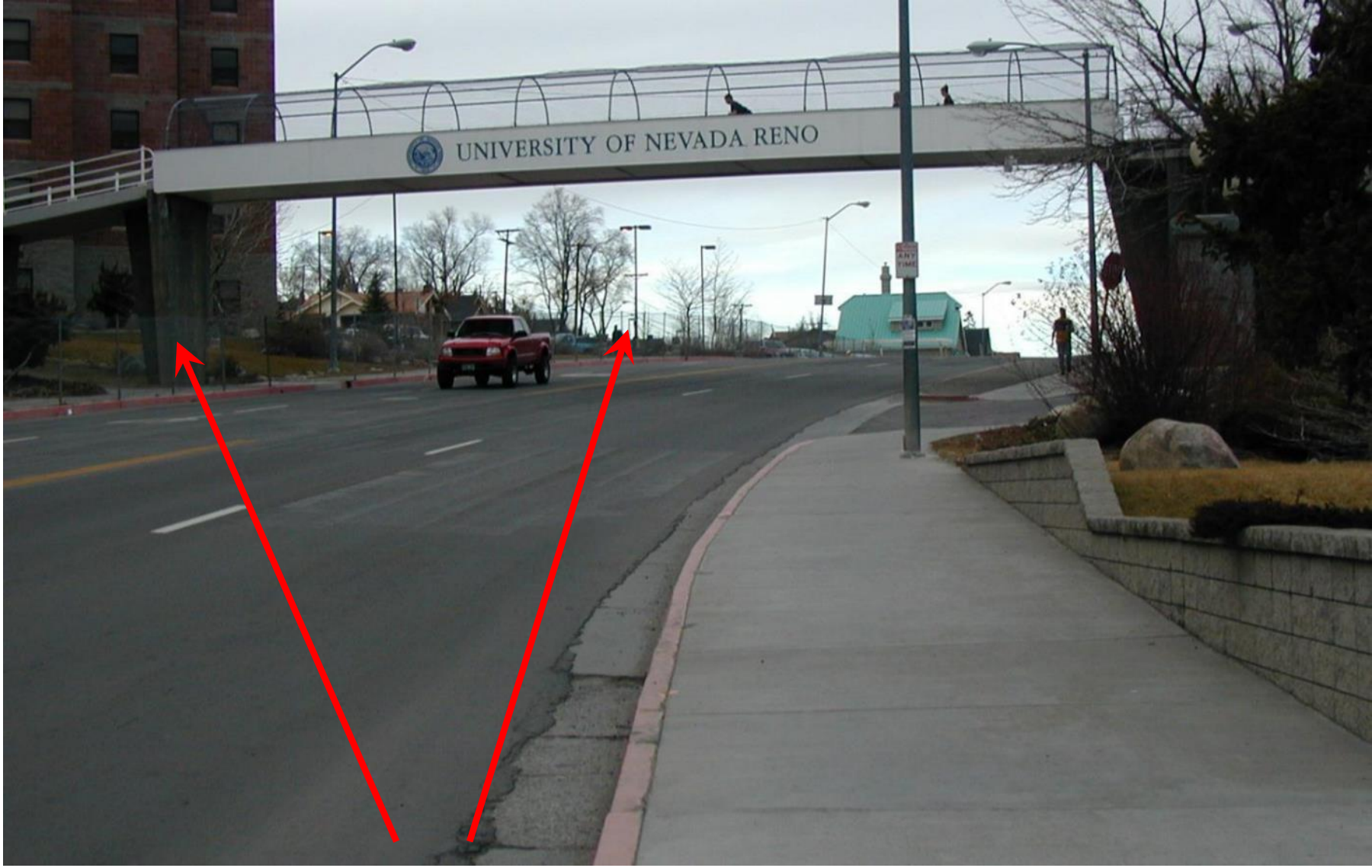
Over & Under crossings

Reno NV

In theory, grade separation = no conflicts

- In reality, pedestrians often ignore structures placing themselves in greater danger

Why don't they get used? Longer travel distance



Sometimes fences are needed to direct users

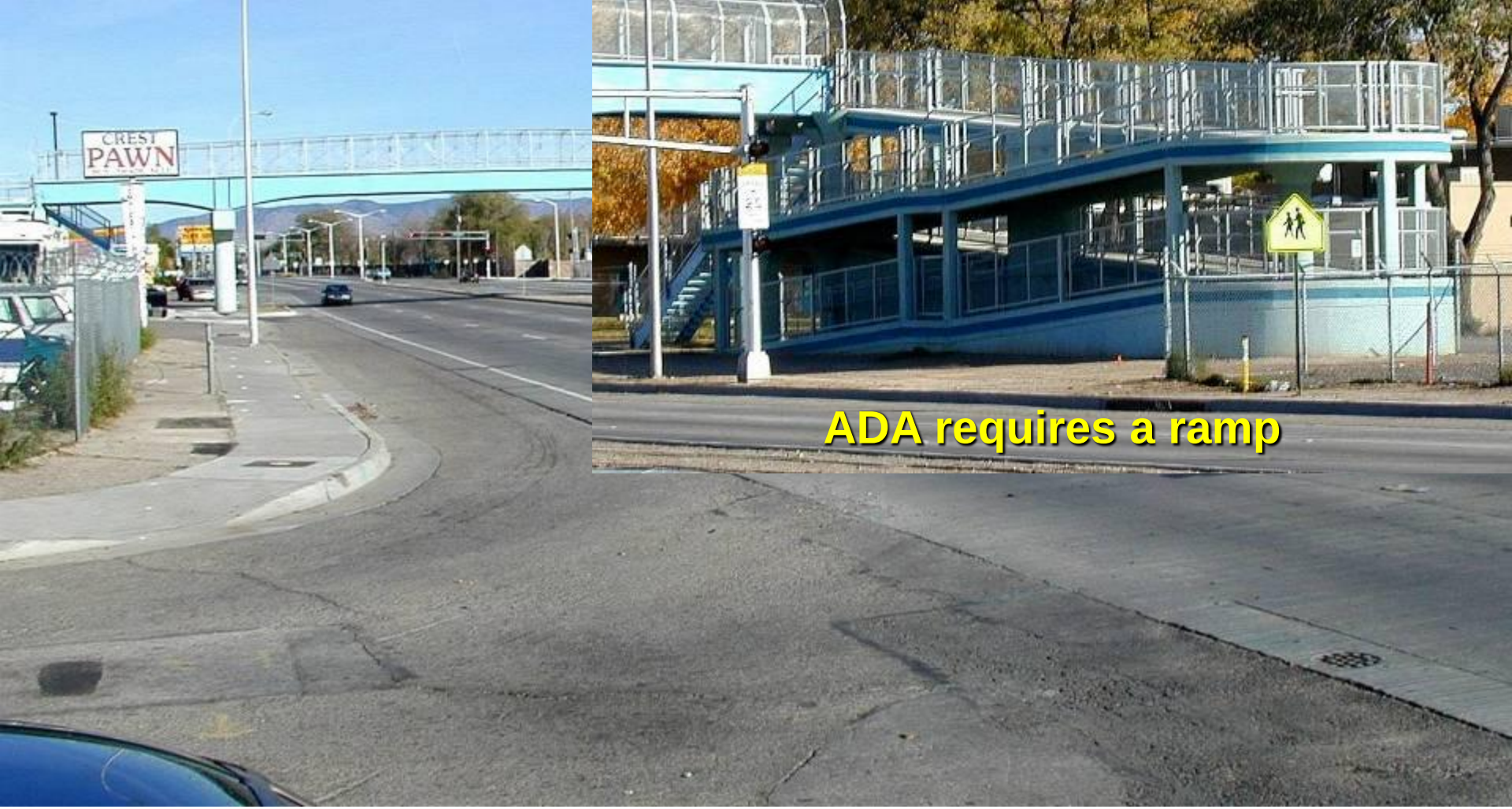
Grade separation is more useful for purposes beyond simply crossing from sidewalk to sidewalk

To connect buildings

To connect land uses

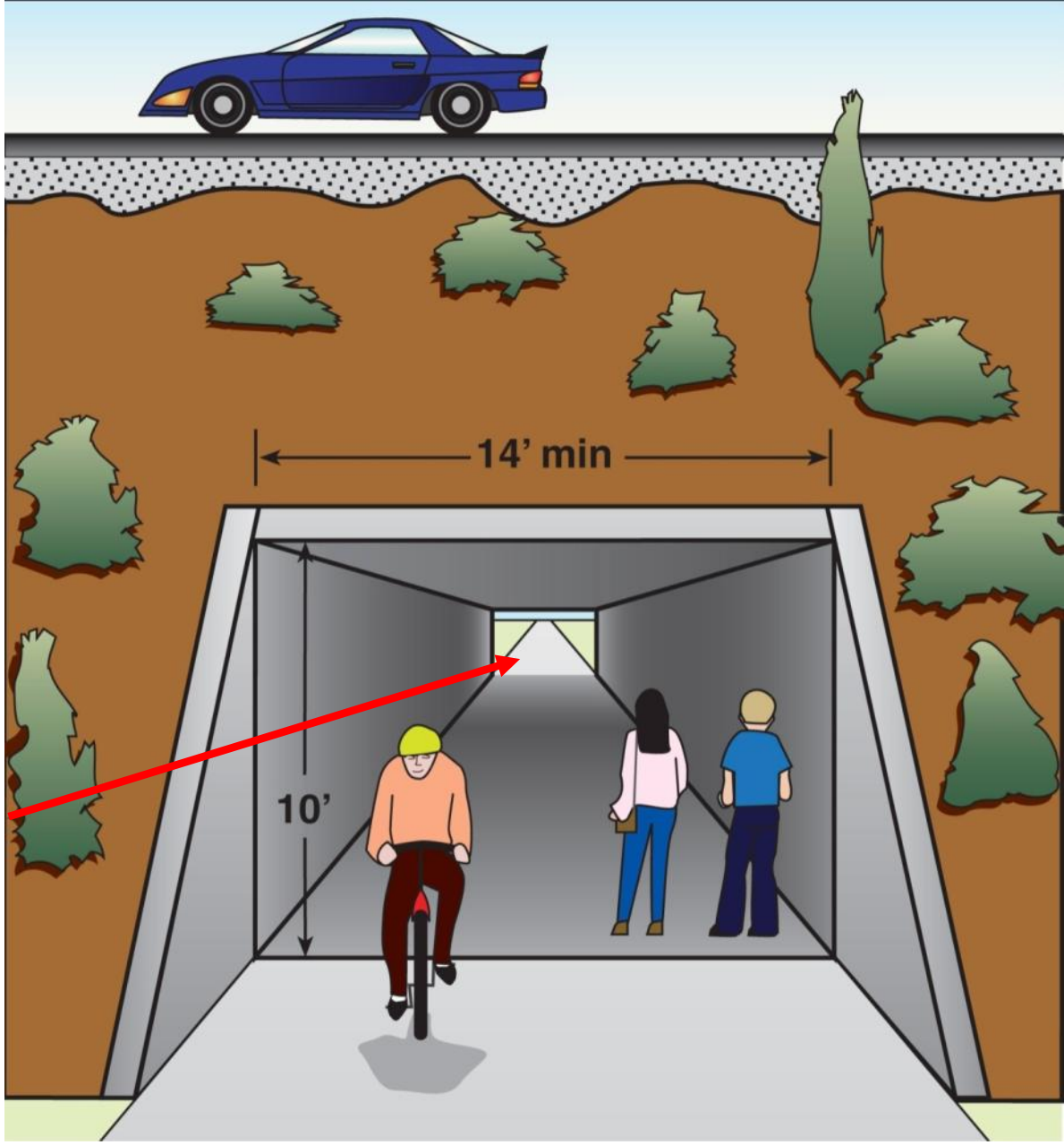
To cross freeways

Light rail stations



- Overcrossings are expensive because of their height, which requires long ramps

Undercrossings require generous dimensions to be attractive: security is the main issue



Good design practice: Users must see light at the end of the tunnel

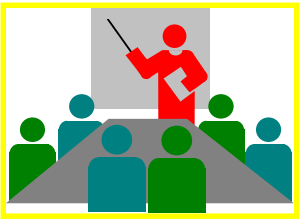
Undercrossing must not intimidate potential user

Undercrossings work best if roadway is elevated, even if it is just a small amount

Elevated roadway allows open, airy undercrossing

Undercrossings work best if well lit & attractive

Over/undercrossings



- Why are they not effective for street crossings?
  - They add out-of-direction travel
- When are they useful?
  - To connect land uses separated by a roadway
- How can you increase their effectiveness?
  - By providing a direct route
  - By providing security

Crossing treatments cost comparison:

		Effectiveness
Signing	$500 – 1,000	*
High visibility markings	$2,000 – 15,000	**
Advance stop or yield line	$1,000 – 2,000	****
Illumination	$5,000 – 15,000	****
Median Islands	$15,000 – 90,000	****
Signals (including HAWK)	$75,000 – 400,000	***
Over/undercrossings	$1,000,000 – 4,000,000	*
Proper location	“Priceless”	*****

Case Studies

- These case studies show before and after pictures of locations where agencies developed projects specifically to enhance pedestrian safety.
- Some of these examples were done based on this workshop.

- St. Petersburg, FL – 4th Street North (US Hwy. 92)
- 3/4-mile signal spacing; No existing marked crosswalks between signals

Before: View from near Sunken Gardens entrance

After: Raised median, Signs with rapid flash beacons, Advance yield lines, High-visibility marked crosswalk

Phoenix, AZ – W. Van Buren Street. Before: 1/2-mile signal spacing; high-volume, high-speed; marked crosswalks at unsignalized intersections

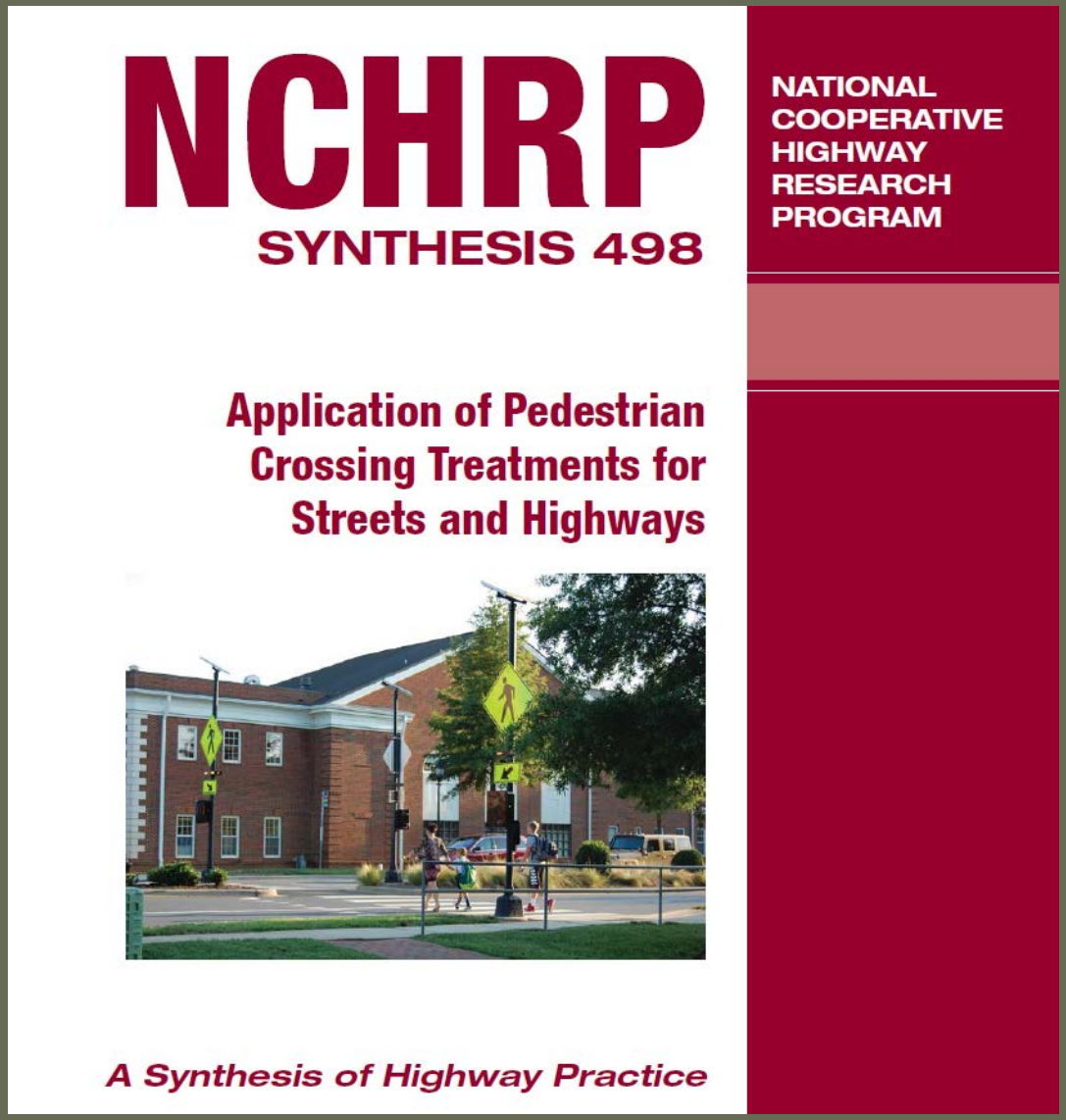
Before: No frills marked crosswalk at intersection

Before: Challenging 6-lane crossing at Community Center

After: Marked crosswalk moved to midblock location near Community Center; Raised median with stagger; advance stop lines

Phoenix, AZ

After: Raised median with stagger, Advance stop lines (not visible), Location near destination



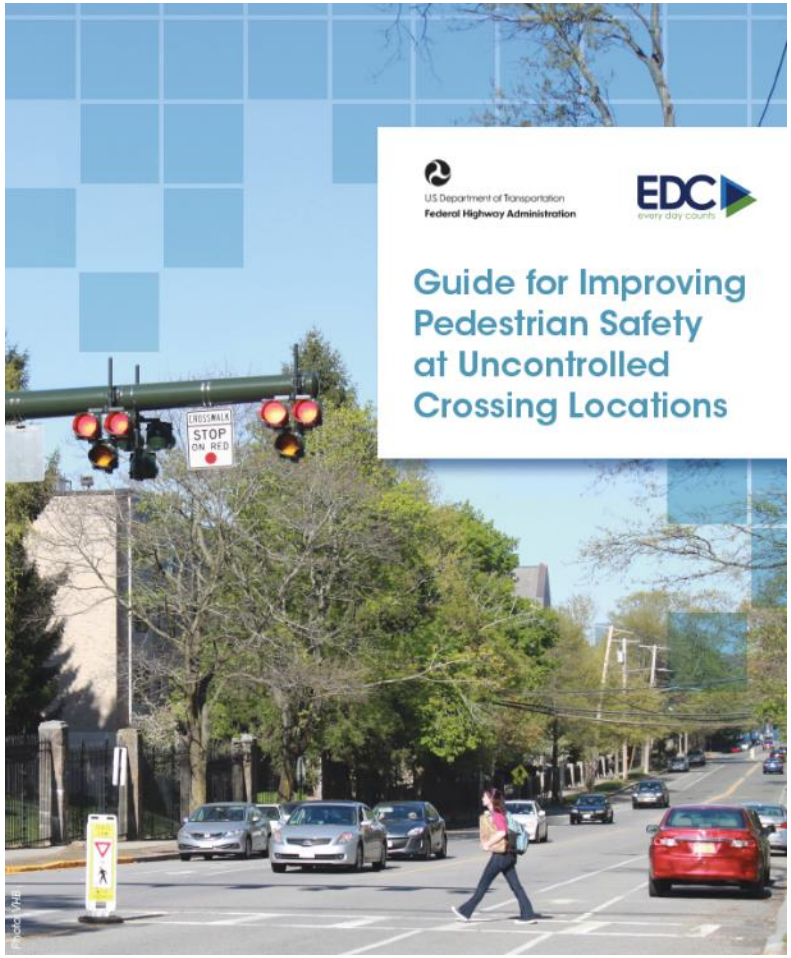
Resource for Crossing Countermeasures

- NCHRP Synthesis 498
- Summary of research findings on a wide range of crossing treatments
- Interviews with agencies revealed how prevalent the treatments are being used

http://www.trb.org/Publications/Blurbs/175419.aspx

FHWA Guide

- Provides guidance and suggested process for selecting countermeasures
- Assists agencies in developing a policy to support the installation of countermeasures at uncontrolled crossing locations



www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

Countermeasure Selection Process

- Following the process suggested in the guide offers countermeasure options based on road conditions, crash causes, and pedestrian safety issues.

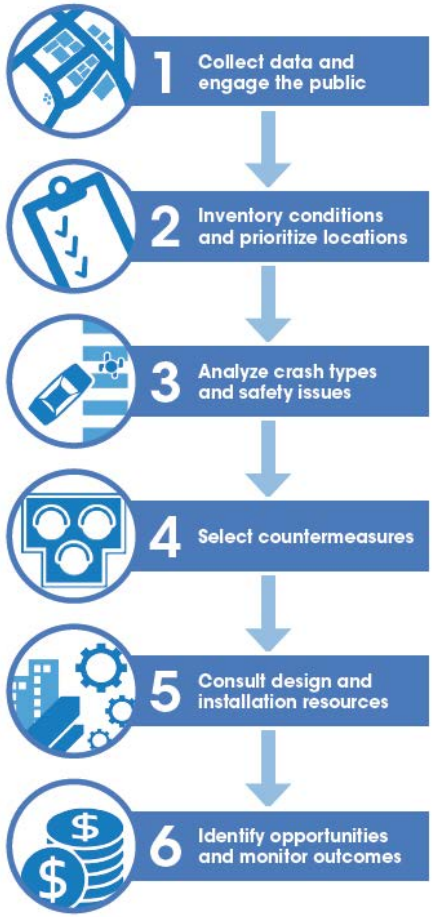


Figure 1. Process diagram for selecting countermeasures at uncontrolled pedestrian crossing locations.

Process for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations

This process follows the steps outlined in the *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* (FHWA-SA-17-072). Each numbered step includes multiple options and components below for agencies to consider; these options are not necessarily sequential, and the agency does not need to complete all activities within each step. Underlined text in the flowchart indicates a hyperlink to an online resource containing additional information.

1 Collect data and engage the public

- **Collect pedestrian crash and safety data**
  - Location and conditions
  - Crash maps
  - Crash reports
- **Review existing traffic safety plans**
  - SHSP
  - HSIP
  - HSP
- **Evaluate pedestrian accommodation and traffic safety policies**
  - Complete Streets
  - Vision Zero
- **Initiate a PSAP**
- **Review pedestrian master plans for proposed projects**
- **Document informal public comments**
- **Conduct a walkability audit**

2 Inventory conditions and prioritize locations

- **Inventory pedestrian crossings and observed traffic behavior**
- **Classify pedestrian crossings**
  - Controlled
  - Uncontrolled
- **Inventory roadway characteristics**
- **Screen the network for high-crash or high-risk locations**
  - Analyze "hot spots" or crash cluster locations
  - Develop a systemic analysis approach

3 Analyze crash types and safety issues

- **Diagram crash reports**
- **Identify crash factors**
- **Conduct an RSA**
- **Lead an informal site visit**

4 Select countermeasures

- **Review Table 1 (roadway features)**
  - AADT
  - Number of lanes
  - Median presence
  - Speed limit
- **Review Table 2 (safety issues)**
  - Conflicts at crossings
  - Excessive speed
  - Visibility issues
  - Other

5 Consult design and installation resources

- **MUTCD**
  - Part 2: Signs
  - Part 3: Markings
  - Part 4: Highway Traffic Signals
- **AASHTO Guide for the Design of Pedestrian Facilities**
- **Local design guidance and selection criteria**
  - PEDSAFE
  - Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

6 Identify opportunities and monitor outcomes

- **Identify implementation opportunities**
  - Routine maintenance activities
  - STIP
- **Consider funding options**
  - HSIP
  - Other (TAP, CMAQ, STBG)
- **Construct improvements**
  - Review design considerations
  - Conduct public outreach
- **Monitor results of implementation**
  - Track performance measures
  - Obtain public feedback
  - Analyze crash data

Abbreviations:

AADT	annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
CMAQ	Congestion Mitigation and Air Quality
HSIP	Highway Safety Improvement Program
HSP	Highway Safety Plan
MUTCD	*Manual on Uniform Traffic Control Devices*
PSAP	Pedestrian Safety Action Plan
RSA	Road Safety Audit
SHSP	Strategic Highway Safety Plan
STBG	Surface Transportation Block Grant
STIP	State Transportation Improvement Program
TAP	Transportation Alternatives Program

U.S. Department of Transportation
Federal Highway Administration

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

EDC every day counts

EDC-4 Safe Transportation for Every Pedestrian: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

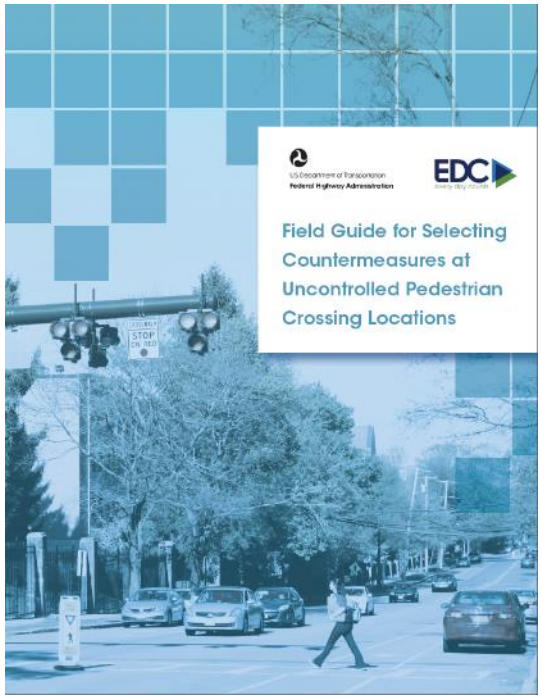


Table of Contents

Sample Inventory Form

On this example inventory form, the agency records information about roadway conditions and safety issues important to selecting countermeasures for uncontrolled crossing locations. The information added to this form is applied in Tables 1 and 2. Some information, such as pedestrian volume data, is used when reviewing MUTCD guidance for countermeasures such as the PHB.

Roadway Conditions Inventory

Speed Limit

☐ ≤ 30 mph ☐ 35 mph ☐ ≥ 40 mph

Total Vehicles per Day

Annual Average Daily Traffic (AADT): _____

Approximate Vehicles per Hour (VPH): _____

☐ AADT < 9,000
☐ AADT 9,000–15,000
☐ AADT > 15,000

Travel Lane Configuration

☐ 2 lanes without raised median
☐ 3 lanes without raised median
☐ 3 lanes with raised median
☐ 4+ lanes without raised median
☐ 4+ lanes with raised median

Crosswalk Length (feet): _____

Approximate Total Pedestrians per Hour (PPH) Crossing the Roadway: _____

Pedestrian Safety Issues Inventory

Noted conflicts at crossing locations ☐ Yes ☐ No

- History of turning movement crashes
- Observed conflicts at permitted crossings

Excessive vehicle speed ☐ Yes ☐ No

- 85th percentile speeds, per speed study
- History of speed-related crashes

Inadequate conspicuity/visibility ☐ Yes ☐ No

- Dim or dark conditions for pedestrians in the crosswalk
- Limited visibility of crosswalk due to roadway curvature or topography
- Obstructions, such as on-street parking, vegetation, and signage

Drivers not yielding to pedestrians in crosswalks ☐ Yes ☐ No

- Crash history in marked crosswalks

Insufficient separation between pedestrians and traffic ☐ Yes ☐ No

- Long crossing distance
- No buffer (e.g., landscape buffer, on-street parking, bike lanes)

2

Table 1: Application of Pedestrian Crash Countermeasures by Roadway Feature

Table 1 identifies suggested countermeasures for uncontrolled crossing locations according to roadway and traffic features. Review the corresponding worksheets for countermeasures considered for the site. The worksheets describe additional design and installation considerations for the countermeasures.

Roadway Configuration	Speed Limit								
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
2 lanes*	❶ 2 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼
3 lanes with raised median*	❶ 2 3 4 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ 3 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 4 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼
3 lanes w/o raised median†	❶ 2 3 4 5 6 7	❶ ❸ 5 6 7	❶ ❸ 5 6 ❼	❶ 3 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼	❶ ❸ 4 5 6 7	❶ ❸ 5 6 ❼	❶ ❸ 5 6 ❼
4+ lanes with raised median‡	❶ ❸ 5	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 7	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼	❶ ❸ 5 ❼
4+ lanes w/o raised median‡	❶ ❸ 5 6 7 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ 7 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8	❶ ❸ 5 ❻ ❼ 8

*One lane in each direction †One lane in each direction with two-way left-turn lane ‡Two or more lanes in each direction

Given the set of conditions in a cell,

❶ 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 the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

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 restriction on crosswalk approach, adequate nighttime lighting levels
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 Pedestrian Hybrid Beacon
8 Road Diet

This table was developed using information from: Zegeer, C. V., Stewart, J. R., Huang, H. H., Lagerwey, P. A., Feaganes, J., & Campbell, B. J. (2005), Safety effects of marked versus unmarked crosswalks at uncontrolled locations: Final report and recommended guidelines (No. FHWA-HRT-04-100); Manual on Uniform Traffic Control Devices, 2009 Edition, Chapter 4F. Pedestrian Hybrid Beacons; the Crash Modification Factors (CMF) Clearinghouse website (http://www.cmfclearinghouse.org/); and the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) website (http://www.pedbikesafe.org/PEDSAFE/).

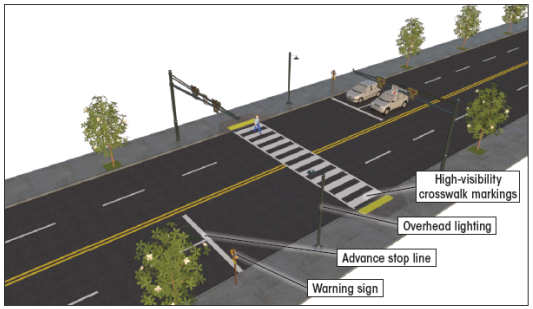
Table 2: Safety Issues Addressed per Countermeasure

Table 2 identifies the safety issues that may be addressed by suggested countermeasures for uncontrolled crossing locations. Review the corresponding worksheets for countermeasures considered for the site. The worksheets describe additional design and installation considerations for the countermeasures.

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	✓	✓	✓		✓

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

Countermeasure: Pedestrian Hybrid Beacon (PHB)



Definition

A PHB is a hybrid beacon used to control traffic and 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 indicate when pedestrians should cross and when it is safe for drivers to proceed. Refer to the PHB Tech Sheet for more information about this countermeasure.

Roadway and Site Information

Strongly consider this countermeasure if the roadway(s) are described by one of the following sets of conditions:

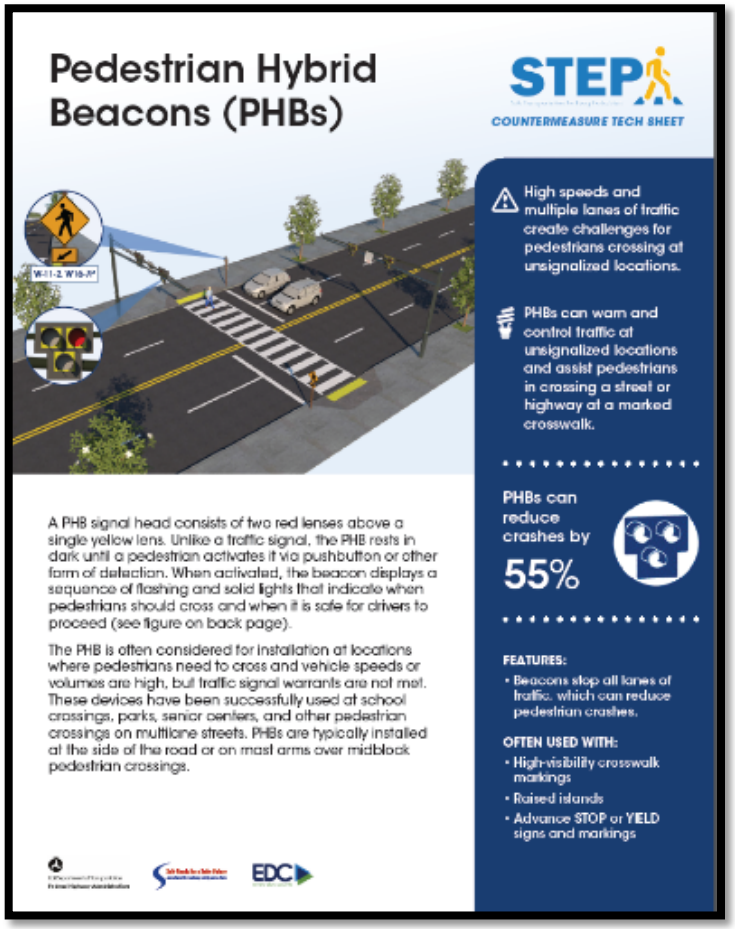
- ☐ AADT of at least 15,000 + 4 or more lanes + any speed limit
- ☐ AADT of at least 9,000 + 3 or more lanes (with or without median) + ≥ 35 mph speed limit
- ☐ Any AADT + any number of lanes + ≥ 40 mph speed limit

Safety Issues and Behaviors

This countermeasure may help address the following traffic behaviors or safety issues observed at the site:

- ☐ Drivers not yielding to pedestrians in crosswalks
- ☐ Noted conflicts at crossing locations

STEP Tech Sheets



Pedestrian Hybrid Beacons (PHBs)

STEP
COUNTERMEASURE TECH SHEET

A PHB signal head 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. When activated, the beacon displays a sequence of flashing and solid lights that indicate when pedestrians should cross and when it is safe for drivers to proceed (see figure on back page).

The PHB is often considered for installation at locations where pedestrians need to cross and vehicle speeds or volumes are high, but traffic signal warrants are not met. These devices have been successfully used at school crossings, parks, senior centers, and other pedestrian crossings on multilane streets. PHBs are typically installed at the side of the road or on mast arms over midblock pedestrian crossings.

High speeds and multiple lanes of traffic create challenges for pedestrians crossing at unsignalized locations.

PHBs can warn and control traffic at unsignalized locations and assist pedestrians in crossing a street or highway at a marked crosswalk.

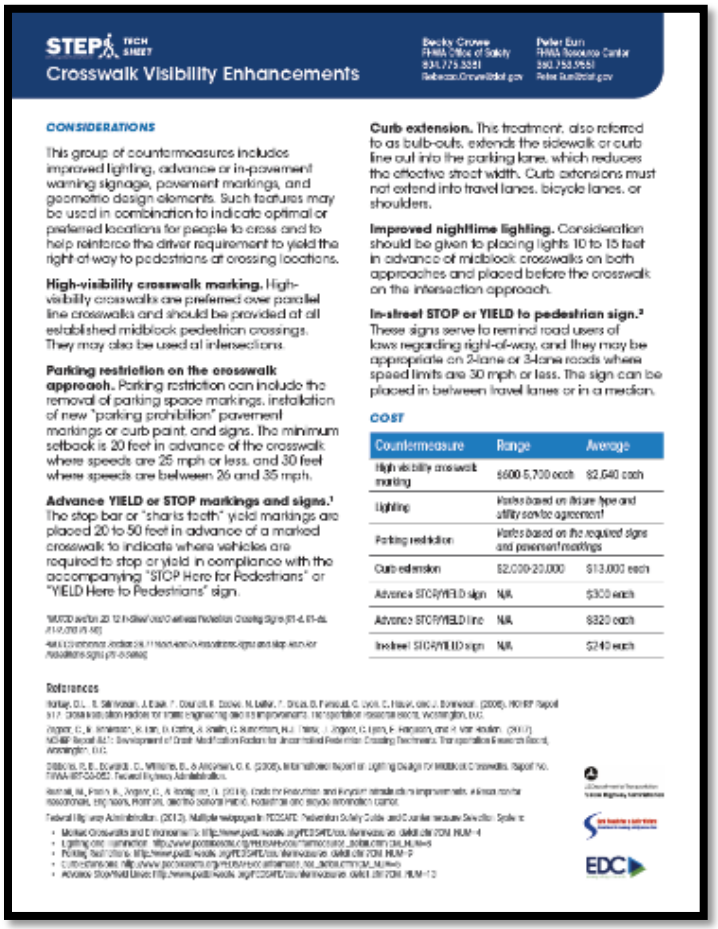
PHBs can reduce crashes by 55%

FEATURES:

- Beacons stop all lanes of traffic, which can reduce pedestrian crashes.

OFTEN USED WITH:

- High-visibility crosswalk markings
- Raised islands
- Advance STOP or YIELD signs and markings



STEP TECH SHEET

Crosswalk Visibility Enhancements

Becky Crowe
FHWA Office of Safety
Peter Eun
FHWA Resource Center

CONSIDERATIONS

This group of countermeasures includes improved lighting, advance or in-pavement warning signage, pavement markings, and geometric design elements. Such features may be used in combination to indicate optimal or preferred locations for people to cross and to help reinforce the driver requirement to yield the right of way to pedestrians at crossing locations.

High-visibility crosswalk marking. High-visibility crosswalks are preferred over parallel line crosswalks and should be provided at all established midblock pedestrian crossings. They may also be used at intersections.

Parking restriction on the crosswalk approach. Parking restriction can include the removal of parking space markings, installation of new "parking prohibition" pavement markings or curb paint, and signs. The minimum setback is 20 feet in advance of the crosswalk where speeds are 25 mph or less, and 30 feet where speeds are between 26 and 35 mph.

Advance YIELD or STOP markings and signs.[1] The stop bar or "shark's tooth" yield markings are placed 20 to 50 feet in advance of a marked crosswalk to indicate where vehicles are required to stop or yield in compliance with the accompanying "STOP Here for Pedestrians" or "YIELD Here to Pedestrians" sign.

Curb extension. This treatment, also referred to as bulb-outs, extends the sidewalk or curb line out into the parking lane, which reduces the effective street width. Curb extensions must not extend into travel lanes, bicycle lanes, or shoulders.

Improved nighttime lighting. Consideration should be given to placing lights 10 to 15 feet in advance of midblock crosswalks on both approaches and placed before the crosswalk on the intersection approach.

In-street STOP or YIELD to pedestrian sign.[2] These signs serve to remind road users of laws regarding right-of-way, and they may be appropriate on 2-lane or 3-lane roads where speed limits are 30 mph or less. The sign can be placed in between travel lanes or in a median.

COST

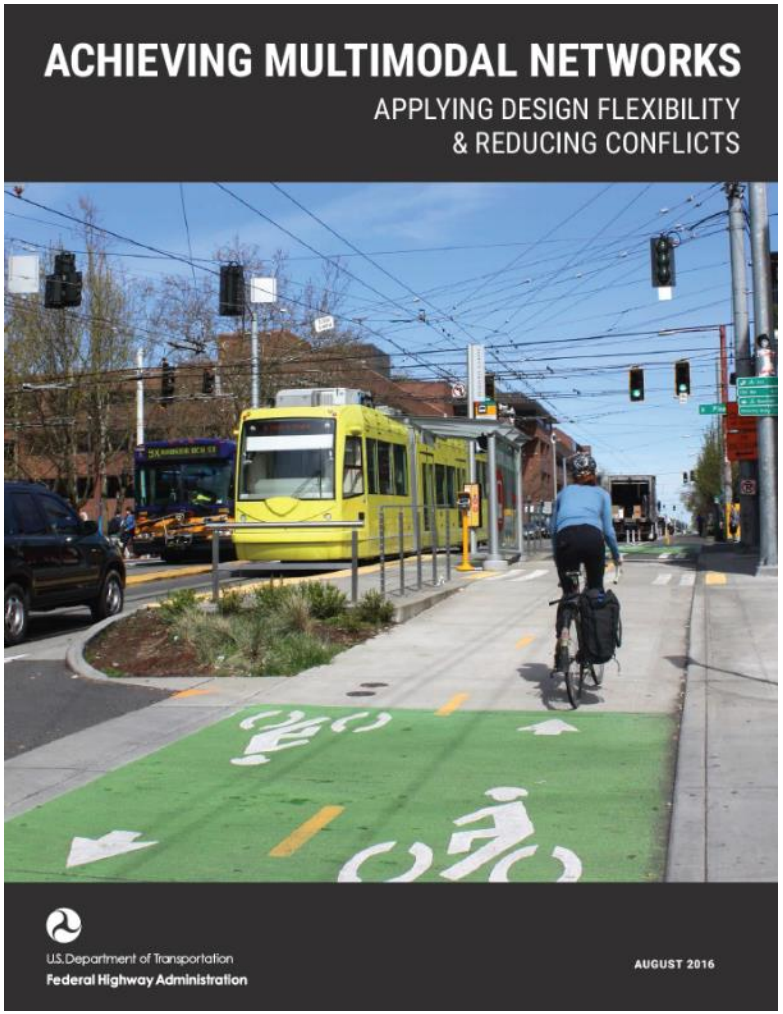
Countermeasure	Range	Average
High visibility crosswalk marking	$600-5,700 each	$2,040 each
Lighting	Varies based on fixture type and utility service agreement	
Parking restriction	Varies based on the required signs and pavement markings	
Curb extension	$2,000-20,000	$13,000 each
Advance STOP/YIELD sign	N/A	$300 each
Advance STOP/YIELD line	N/A	$320 each
In-street STOP/YIELD sign	N/A	$240 each

References

https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step_tech_sheet.pdf

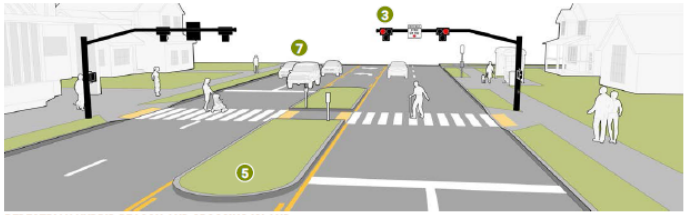
Achieving Multimodal Networks

- 24 design topics: 2 Parts
- 12 design topics on design flexibility
- 12 topics on measures to reduce conflicts between modes

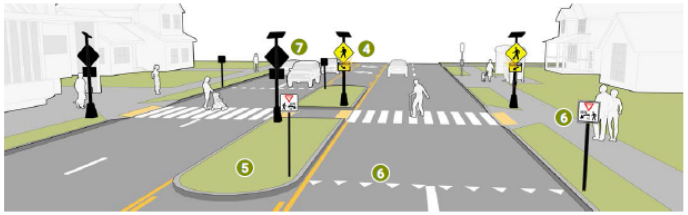


https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/multimodal_networks/

Design Flexibility



PEDESTRIAN HYBRID BEACON AND CROSSING ISLAND



RECTANGULAR RAPID FLASHING BEACON AND CROSSING ISLAND

RECTANGULAR RAPID FLASHING BEACONS

At uncontrolled crossings where a signal or pedestrian hybrid beacon is not warranted, cost prohibitive, or deemed unnecessary designers should consider supplementing pedestrian, bicycle/pedestrian, or school crossing warning signs with Rectangular Rapid Flashing Beacons (RRFBs). 4 Generally, this treatment should be used with caution at crossings with more than two lanes without a refuge. **FWHA Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks** found an 88-percent average compliance rate for motorists yielding to pedestrians at crossings with RRFBs; this rate was sustained after 2 years **(2010, p. 9)**.

PEDESTRIAN CROSSING ISLANDS

Raised medians or pedestrian crossing islands are a Proven Safety Countermeasure and have demonstrated a 46-percent reduction in pedestrian crashes. Pedestrian refuge areas or islands 5 allow pedestrians to cross the street in two stages and significantly reduce the distance a pedestrian must cross at one time. The **AASHTO Pedestrian Guide** states that a crossing island should be considered "where the crossing exceeds 60 ft" **(2004, p. 90)**. **FHWA Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations** found that providing raised medians on multilane roads "can significantly reduce the pedestrian crash rate and also facilitate street crossing" **(2005, p. 55)**. However, on roadways with a raised median and volumes exceeding 15,000 ADT, a marked crosswalk is appropriate only with additional crossing treatments. Crossing islands should be a minimum of 6 feet wide **(ITE Designing Walkable Urban Thoroughfares 2010, p. 141)**. At locations where bicycles may be crossing, such as where a shared use path crosses a roadway, "10 ft is preferred in order to accommodate a bicycle with a trailer" **(AASHTO Bike Guide 2012, p. 5-48)**.

ADVANCE YIELD/STOP LINES AND SIGNING

Advance yield/stop lines and signing 6 can be installed at locations where there are concerns about multiple threat crashes. 7 They indicate to drivers the appropriate location to yield or stop so that they do not "place pedestrians at risk by blocking other drivers' views of pedestrians and by blocking pedestrians' views of vehicles approaching in the other lanes" **(MUTCD 2009, Sec. 3B.16)**. Additionally, parking should be prohibited in between the yield or stop line and the crosswalk to increase visibility.

CASE STUDIES

I STREET AT MAKEMIE PLACE, SW
WASHINGTON, DC

A Safe Routes to School action plan for Amidon-Bowen Elementary School evaluated the intersection of Makemie Place and I Street SW for a potential crosswalk. Prior to the study, schoolchildren had to cross I Street SW at one of two signalized intersections approximately 600 feet apart to access the main school entrance. The City installed a marked crosswalk halfway between these intersections at the T-intersection of Makemie Place SW along with warning signs, a crossing island, and curb extensions to increase driver awareness of the crossing, reduce vehicle speeds, and increase the pedestrian queuing area. This crossing also connected bus stops on both sides of I Street SW. Crosswalk signs were installed as part of an experiment and are non-compliant.

IMPROVEMENT PLAN FOR UNCONTROLLED MARKED CROSSWALKS
SEATTLE, WA

In 2001, the City of Seattle completed a detailed inventory analysis of 622 marked crosswalks at uncontrolled locations. Crosswalks were rated based on traffic volume, number of lanes, and speed. In 2002, the City released a multi-year Improvement Plan for Uncontrolled Marked Crosswalks that addressed identified deficiencies. Rather than just decide "yes" or "no" on whether to mark a crosswalk, the improvement plan asks "what are the most effective measures that can be used to help pedestrians safely cross the street?" The plan was implemented over a period of six years. Deficiencies were addressed with signing, markings, crossing islands, road and lane diets, rectangular rapid flash beacons, pedestrian signals, and other ADA improvements.

SE BUSH STREET AND 122ND AVENUE PEDESTRIAN HYBRID BEACON
PORTLAND, OR

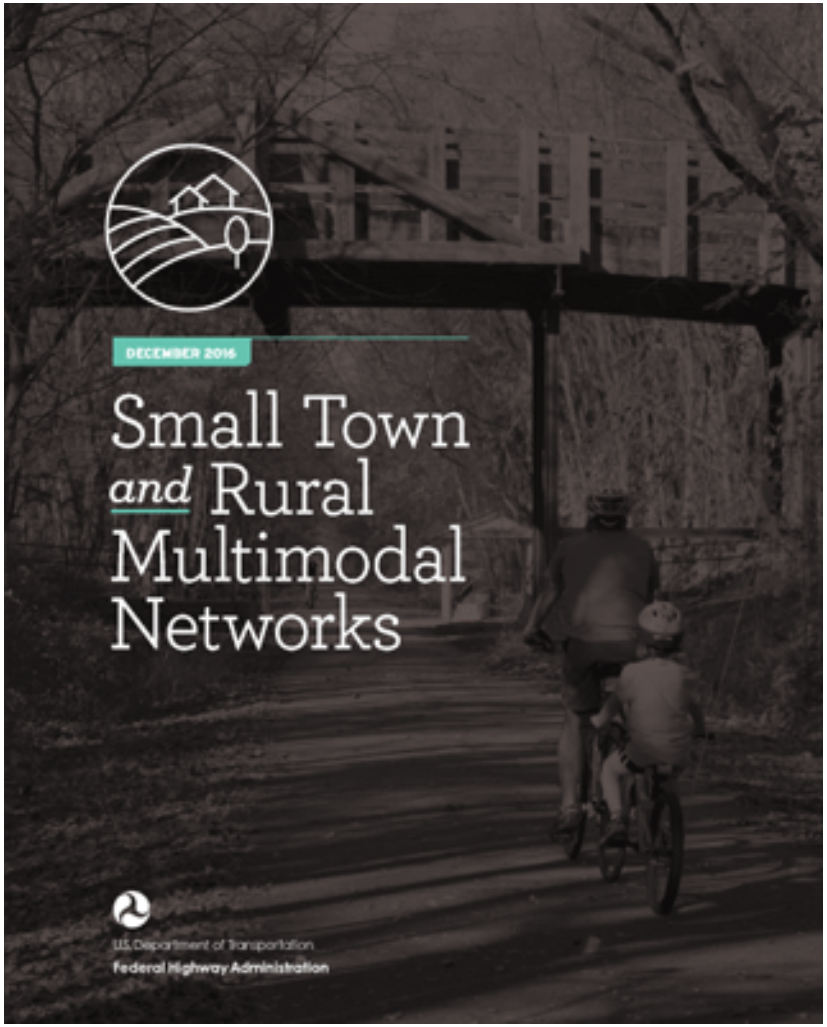
As part of the SE Bush neighborhood greenway project, the Portland Bureau of Transportation installed a pedestrian hybrid beacon at the SE Bush Street crossing of 122nd Avenue in July 2012. Counts at this location did not meet the pedestrian hybrid beacon warrant prior to installation. However, engineers designed the intersection to accommodate 50–100 bicycle and pedestrian crossings during the peak hour based on previous experience where bicycle and pedestrian volumes increased following installation of other neighborhood greenways in the City. December 2013 counts indicated that pedestrian hybrid beacon warrants are satisfied at this location.

Source: Scott Batson, City of Portland Bureau of Transportation

Small Town and Rural Multimodal Networks

- FHWA-HEP-17-024
- https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/

- Resource and Idea book to support safe, accessible, comfortable, and active travel
- Bridges design and practice
- Examples & project implementation



Multimodal Main Streets

The ITE Walkable Urban Thoroughfares Guide 2010 recommends the following design details for walkable and bikeable commercial main streets:

- **Minimum sidewalk width:** 6 ft (1.8 m)
- **Furnishing zone:** 6 ft (1.8 m)
- **Target travel speed:** 25 mi/h (40 km/h)
- **Number of through lanes:** 2
- **Lane Width:** 10–11 ft (3.0–3.3 m)
- **Parallel On-Street Parking Width:** 7–8 ft (2.1–2.4 m)
- **Bike facility:** 5–6 ft (1.5–1.8 m) min

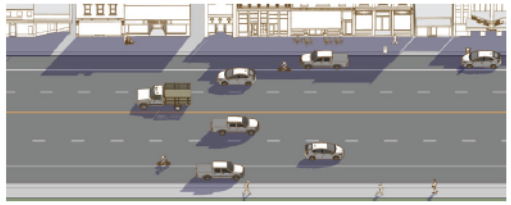
Multimodal Main Streets

FOUR-LANE STREET SCENARIOS

Figure 5-8. The following concepts illustrate potential design options for main streets with multiple travel lanes in each direction.

EXISTING CONDITIONS FOUR-LANE

Rural highways are often widened through town centers, providing multiple travel lanes to reduce impediments to through traffic. These configurations may encourage inappropriately high-speed travel and erratic behavior in the vicinity of pedestrian and bicycle activity.



ROAD DIET

A four-lane to three-lane road diet can balance the needs of through travel and local community access, while increasing safety.

Road diets are an FHWA Proven Safety Countermeasure. For more information on road diets, refer to the FHWA Resurfacing Guide 2016 and the FHWA Road Diet Guide 2014.

STREETSCAPE EXPANSION WITH BIKE LANES

Narrowing and consolidating excess space dedicated to motor vehicles can provide room to expand sidewalk areas.

Road diets are an FHWA Proven Safety Countermeasure. For more information on roadway reconfigurations, refer to the FHWA Road Diet Guide 2014. Refer to the ITE Walkable Urban Thoroughfares Guide 2010 for more information on sidewalk configuration.

Learning outcomes: Street Crossings

- You should now be able to:
- Identify which crossing techniques are appropriate
- To ensure oft-requested solutions (crosswalks, signals, ped bridges) are effective

Questions?