



: Safe Transportation for Every Pedestrian



U.S. Department of Transportation
Federal Highway Administration

Speakers

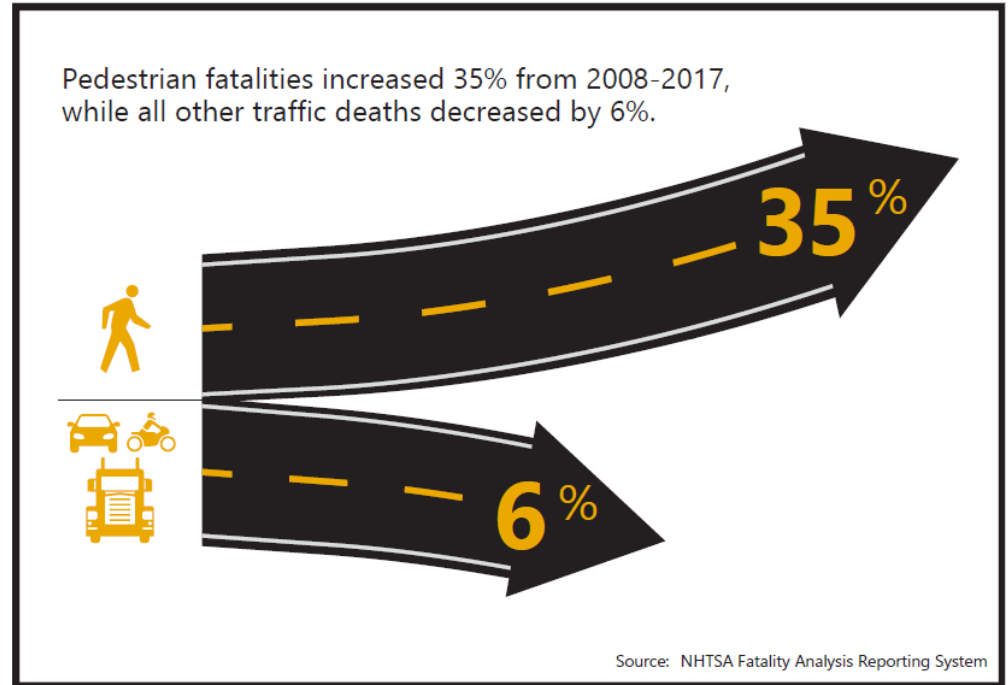
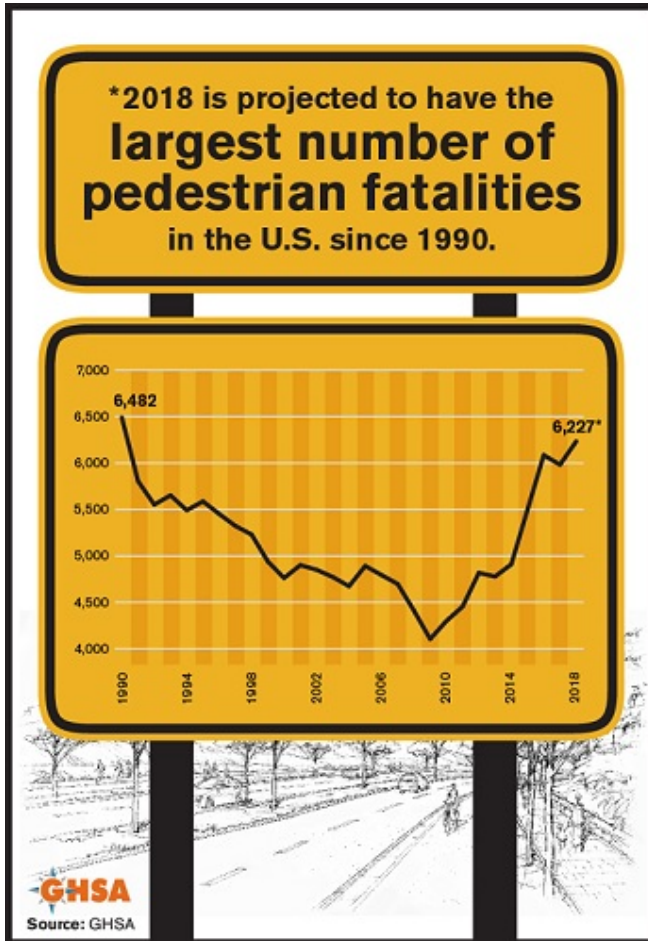
Wayne Emington

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- Located: Augusta ME
- Safety & Operations Engineer
- Wayne.Emington@dot.gov
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What you wanted:

- Discuss and illustrate the most common pedestrian safety countermeasures that are available at mid-block crossings and at intersections
- Explain how effective low-tech/low cost options (e.g., pedestrian flags, in-street signs) are compared to higher-tech ones

Are Pedestrian Fatalities Occurring?... Yes

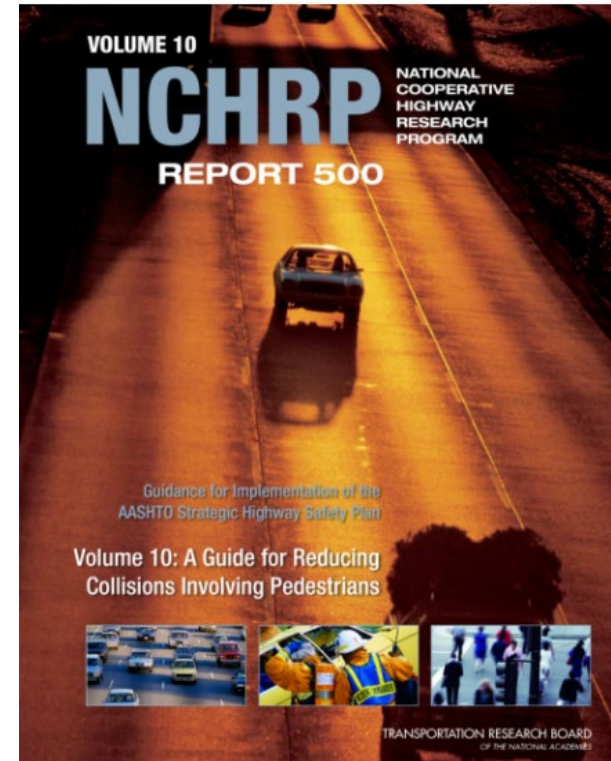


Pedestrians now account for a larger proportion of traffic fatalities (16%) than they have in the past 33 years

NCHRP 500 Volume 10: A Guide for Reducing Collisions Involving Pedestrians

OBJECTIVES:

- Reduce vehicle speed
- Improve sight distance & visibility
- Reduce pedestrian exposure
- Improve pedestrian access and mobility
- Improve safety awareness and behavior



[NCHRP 500 Vol 10: A Guide for Reducing Collisions Involving Pedestrians](#)

Marked vs. Unmarked Crosswalks at Uncontrolled Locations

Multilane roads, 12,000+ AADT:

- Marked crosswalk alone → +pedestrian crash rate

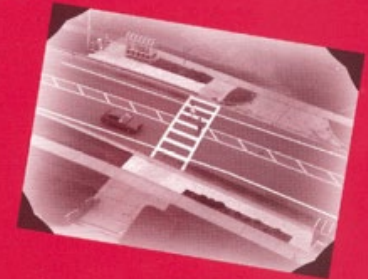
Crosswalk improvements needed to:

- Reduce vehicle speeds
- Shorten crossing distance
- Increase stop/yield rate

Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations Final Report and Recommended Guidelines

FHWA PUBLICATION NUMBER: HRT 04-100

SEPTEMBER 2005



U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296



<https://www.fhwa.dot.gov/publications/research/safety/04100/>

Posted Speed Limit and AADT

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)	① 2 4 5 6	① 5 6 7 9	① 5 6 ⑦ ⑨	① 4 5 6	① 5 6 7 9	① 5 6 ⑦ ⑨	① 4 5 6 7 9	① 5 6 7 9	① 5 6 ⑨
3 lanes with raised median (1 lane in each direction)	① 2 3 4 5	① ③ 5 7 9	① ③ 5 ⑦ ⑨	① 3 4 5 7 9	① ③ 5 ⑦ ⑨	① ③ 5 ⑦ ⑨	① ③ 4 5 7 9	① ③ 5 ⑦ ⑨	① ③ 5 ⑨
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	① 2 3 4 5 6 7 9	① ③ 5 6 7 9	① ③ 5 6 ⑨	① 3 4 5 6 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑨	① ③ 4 5 6 7 9	① ③ 5 6 ⑨	① ③ 5 6 ⑨
4+ lanes with raised median (2 or more lanes in each direction)	① ③ 5 7 8 9	① ③ 5 7 8 9	① ③ 5 8 ⑨	① ③ 5 7 8 9	① ③ 5 ⑦ 8 ⑨	① ③ 5 8 ⑨	① ③ 5 ⑦ 8 ⑨	① ③ 5 8 ⑨	① ③ 5 8 ⑨
4+ lanes w/o raised median (2 or more lanes in each direction)	① ③ 5 6 7 8 9	① ③ 5 ⑥ 7 8 9	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ 7 8 9	① ③ 5 ⑥ ⑦ 8 ⑨	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ ⑦ 8 ⑨	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ 8 ⑨

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 sign

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)**

Systemic Approach to Safety



NCHRP 893



The Spectacular Seven

STEP

Safe Transportation for Every Pedestrian

Spectacular Seven



Crosswalk Visibility Enhancements



Raised Crosswalks



Pedestrian Refuge Island



Rectangular Rapid Flashing Beacon (RRFB)



Pedestrian Hybrid Beacon (PHB)



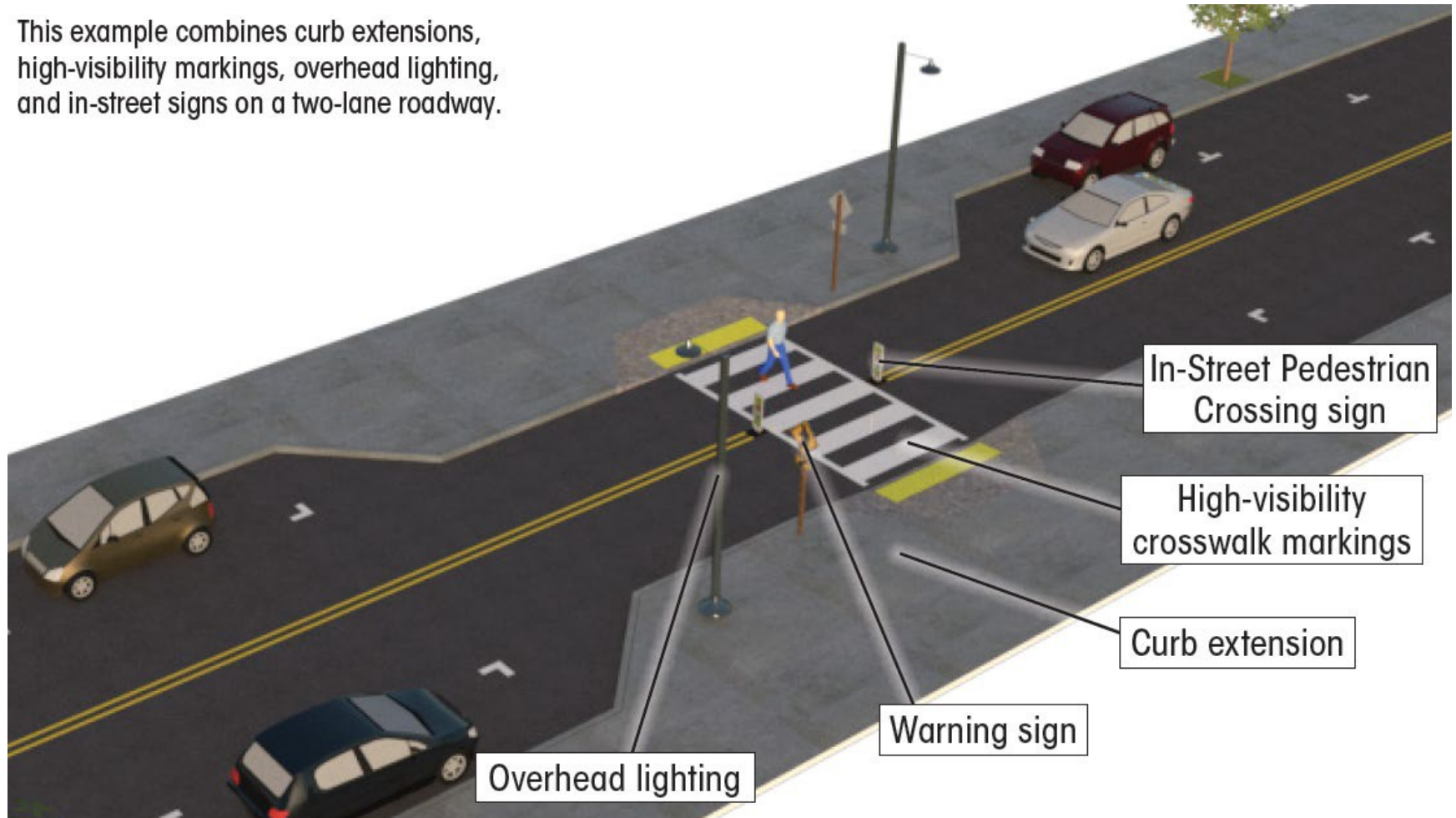
Road Diets



Leading Pedestrian Interval (LPI)

Crosswalk Visibility Enhancements

This example combines curb extensions, high-visibility markings, overhead lighting, and in-street signs on a two-lane roadway.

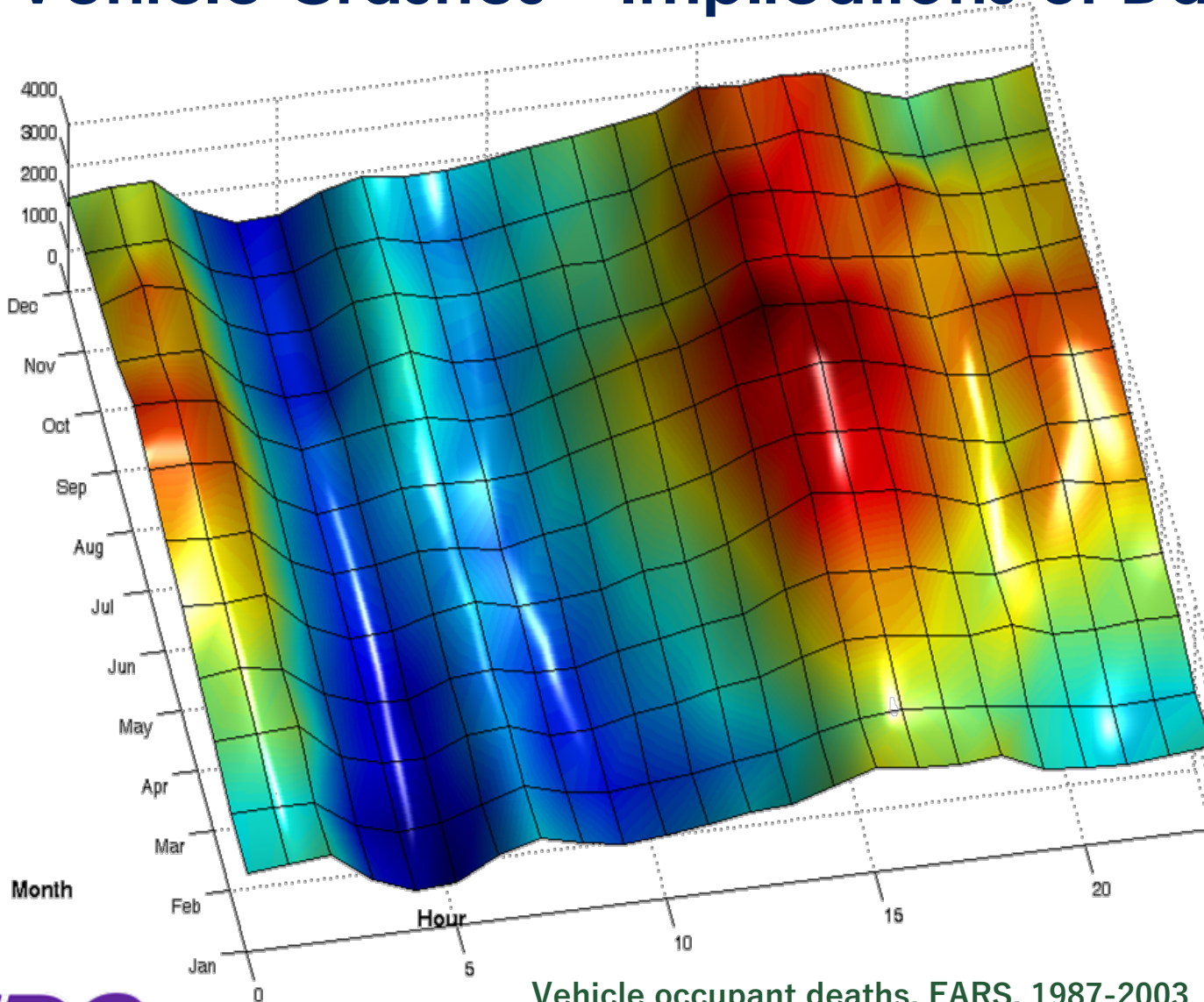


Crosswalk Visibility Enhancements



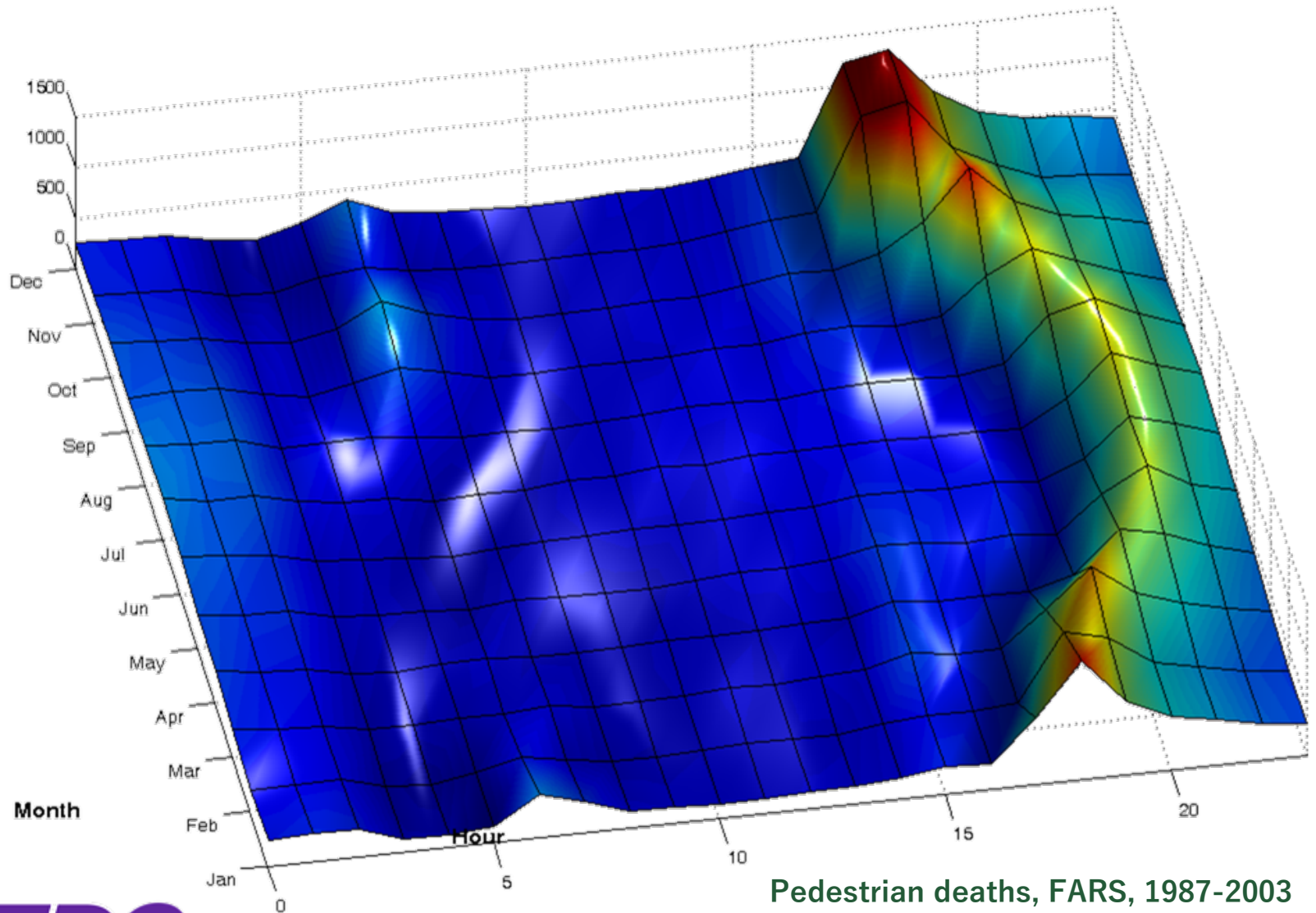
- Crosswalk Marking Style
- Pedestrian Warning Signs
- **Advance Stop or Yield Lines with Signs**
- In-Street Pedestrian Crossing Signs
- Curb Extensions
- Parking Restrictions on Crosswalk Approach
- **Lighting**

Motor Vehicle Crashes – Implications of Darkness



Vehicle occupant deaths, FARS, 1987-2003

Pedestrian Crashes – Implications of Darkness



Pedestrian deaths, FARS, 1987-2003

Lighting Over Crosswalks

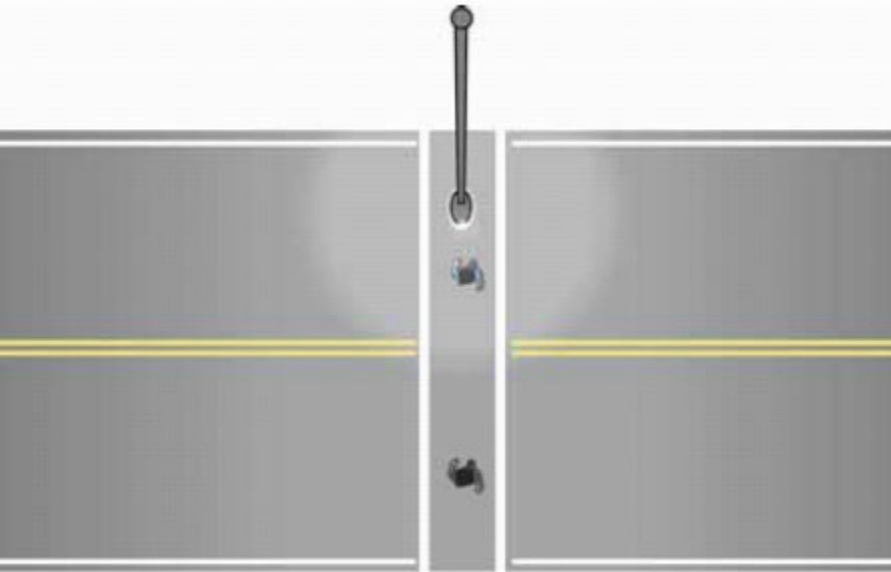


Fig 11. Traditional midblock crosswalk lighting layout

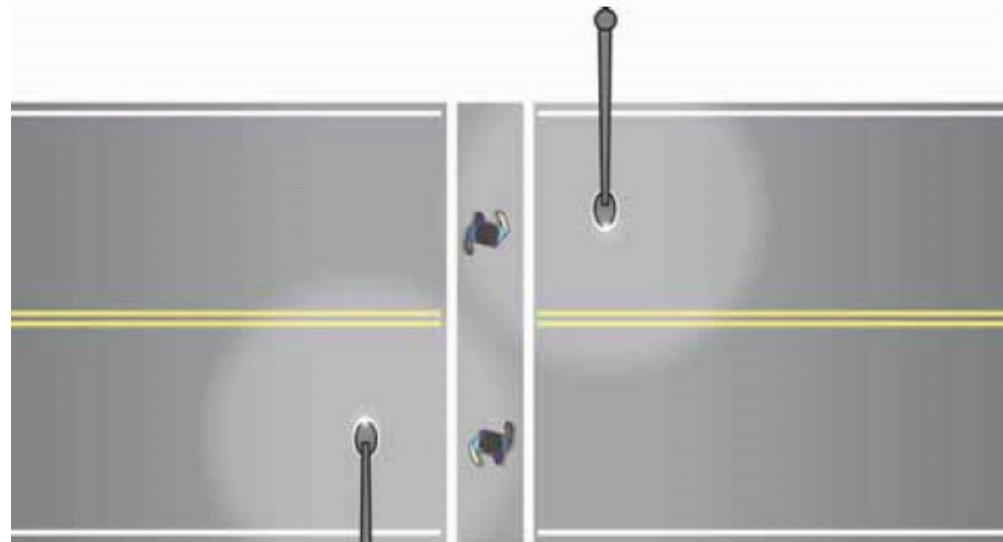
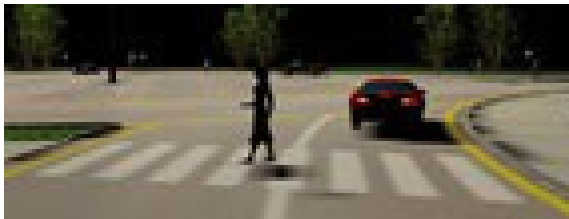


Fig 12. New design for midblock crosswalk lighting layout



Recommended lighting level: 20 lux at 5' above pavement

Add Overhead Lighting: CMF



Photo source: Youtube screen capture SWARCO

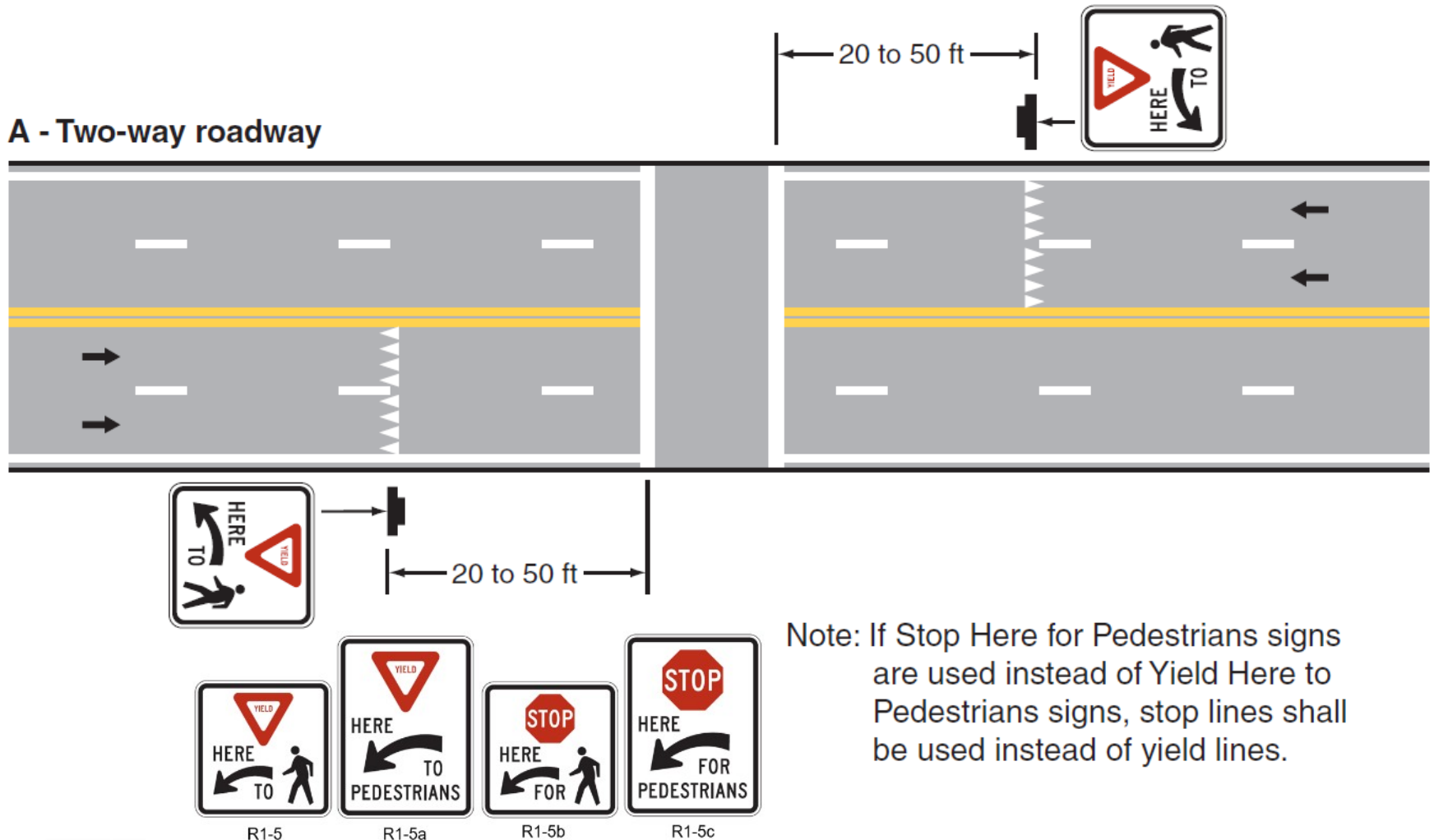
CMF 0.77

- Severity: Injury
- Crash Type: Pedestrian
- 5 star rating

https://safety.fhwa.dot.gov/ped_bike/tools_solve/hwas18041/

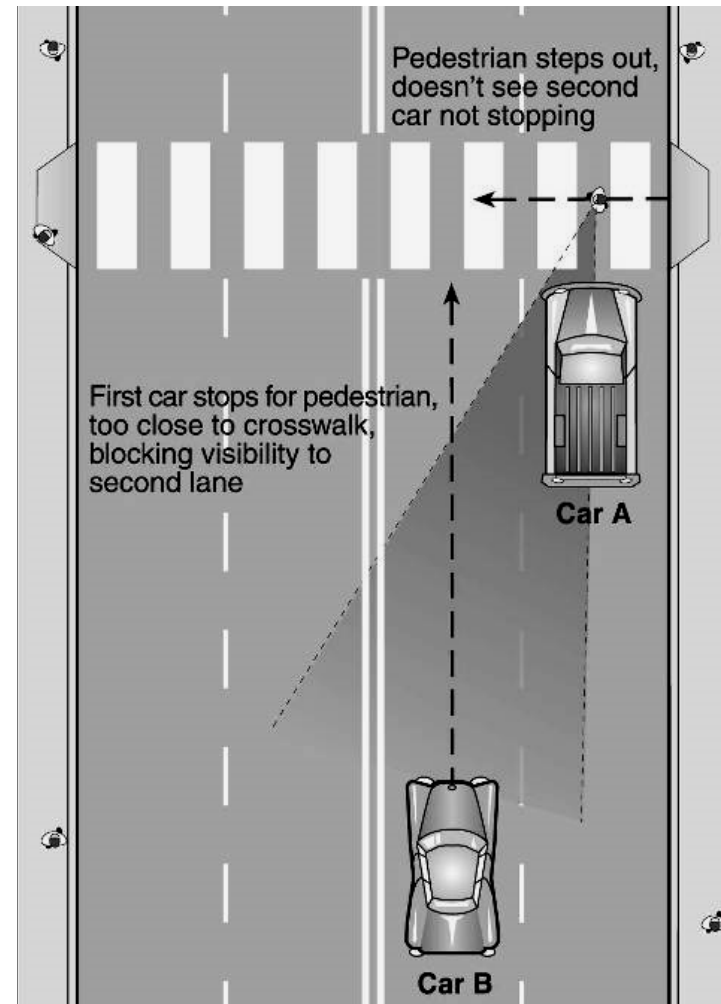
MUTCD Figure 3B-17

Figure 3B-17. Examples of Yield Lines at Unsignalized Midblock Crosswalks



Multiple Threat Crash Problem

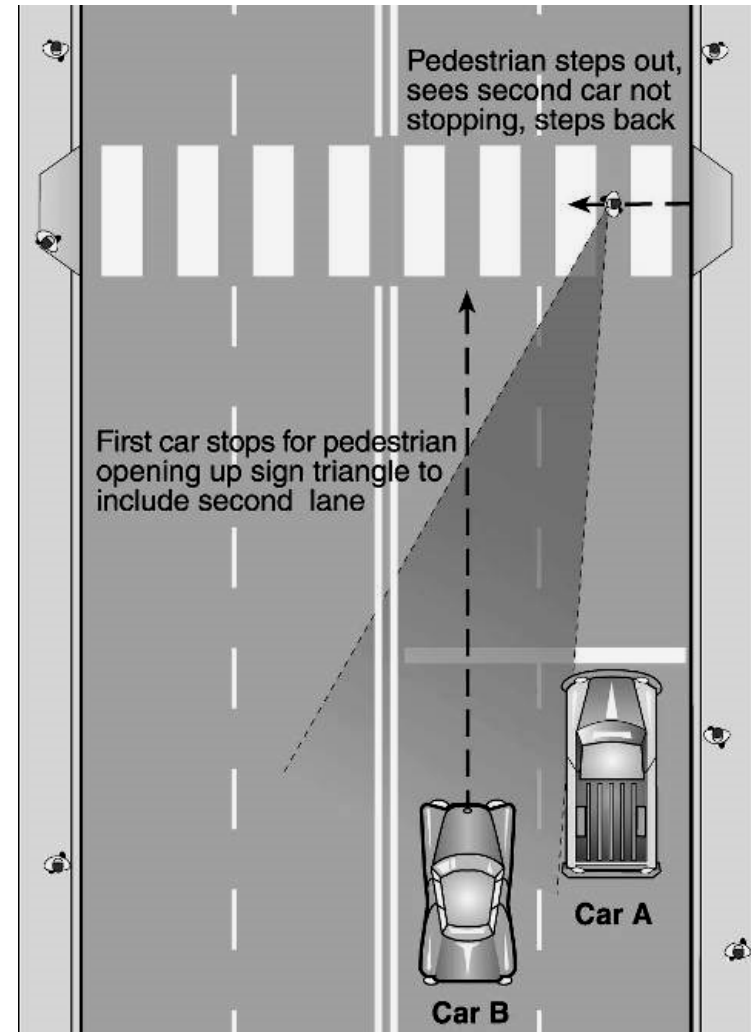
- 1st car stops to let pedestrian cross, blocking sight lines
- 2nd car doesn't stop, hits pedestrian at high speed



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



Advanced Stop/Yield: CMF

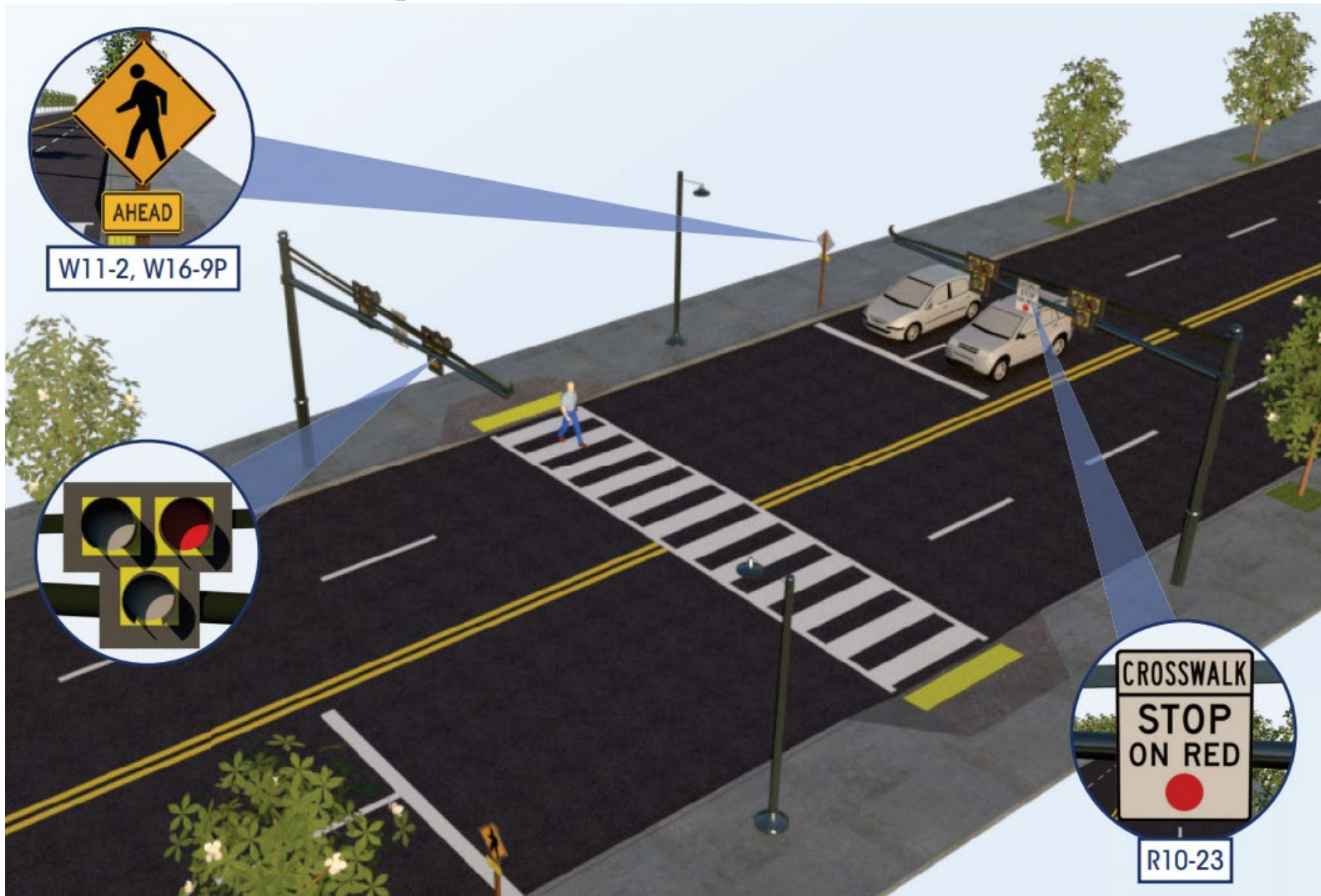
CMF 0.75



- Severity: All
- Crash Type: Pedestrian
- 3 star rating

https://safety.fhwa.dot.gov/ped_bike/tools_solve/hwasa18041/

Pedestrian Hybrid Beacon



Pedestrian Hybrid Beacons (PHB)



CMF: 0.45

- Severity: All
- Crash Type: Ped
- 4 star rating



1
Blank for
drivers



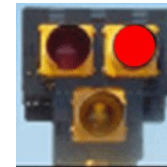
2
Flashing
yellow



3
Steady yellow



4
Steady red



5
Wig-Wag



Return
to 1



NCHRP 841 Development of CMF for Uncontrolled Pedestrian Crossing Treatments

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP RESEARCH REPORT 841

Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments

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Research sponsored by the American Association of State Highway and Transportation Officials
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2017

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Table S-1. Recommended CMFs.

Treatment	Crash Type	Recommended CMF		Study Basis
		Estimate	Standard Error	
Refuge Island	Pedestrian	0.685	0.183	Median from two studies
	Total	0.742	0.071	Cross-section
	All Injury	0.714	0.082	Cross-section
	Rear-End/Sideswipe Total	0.741	0.093	Cross-section
	Rear-End/Sideswipe Injury	0.722	0.106	Cross-section
Advanced YIELD or STOP Markings and Signs	Pedestrian	0.750	0.230	Median from two studies
	Total	0.886	0.065	Before-after
	Rear-End/Sideswipe Total	0.800	0.076	Before-after
PHB	Pedestrian	0.453	0.167	Median from two studies
PHB + Advanced YIELD or STOP Markings and Signs	Pedestrian	0.432	0.134	Median from two studies
	Total	0.820	0.078	Before-after
	Rear-End/Sideswipe Total	0.876	0.111	Before-after
RRFB	Pedestrian	0.526	0.377	Cross-section

<http://www.trb.org/Main/Blurbs/175381.aspx>



FHWA Pedestrian Countermeasure Toolbox

FHWA-SA-18-041
September 2018

Toolbox of Pedestrian Countermeasures and Their Potential Effectiveness

Introduction

This issue brief documents estimates of the crash reduction that might be expected if a specific countermeasure or group of countermeasures is implemented with pedestrian crashes. The crash reduction estimates are presented as Crash Modification Factors (CMFs). Some of the crash reduction estimates are also presented for turn crashes, certain crash severities, or total crashes.

Traffic engineers and other transportation professionals can use the information in this issue brief when asking the following types of question: What change in pedestrian crashes (and/or other crash types) can be expected with the implementation of various countermeasures?

Crash Modification Factors (CMFs)

A CMF is the proportion of crashes that are expected to remain after the countermeasure is implemented. For example, an expected 20 percent reduction in crashes would be represented by a CMF of $(1.00 - 0.20) = 0.80$. In some cases, the CMF is negative, i.e., the countermeasure is expected to lead to a percentage increase in crashes.

One CMF estimate is provided for each countermeasure. Where multiple CMFs are available from the literature, selection criteria were used to choose which CMF to use in this issue brief:

- First, CMFs from studies that took into account regression to the mean traffic volume were preferred over studies that did not.
- Second, CMFs from studies that provided additional information about the conditions under which the countermeasures were applied (e.g., road type, area type) were preferred over studies that did not.

Where these criteria could not be met, a CMF may still be provided. In these cases, it is recognized that the estimate of the CMF may not be as reliable, but is the best available. The CMFs in this issue brief may be periodically updated as new information becomes available.

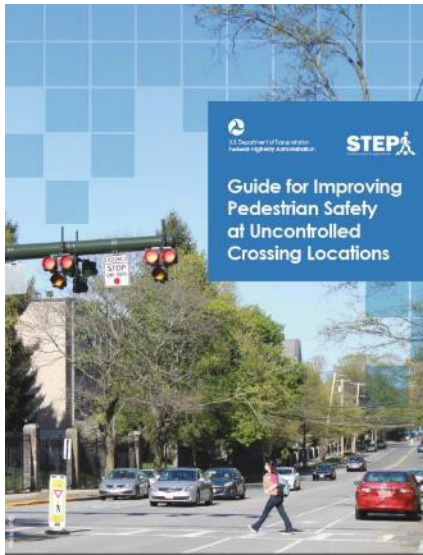
TABLE 3. SIGNS, MARKINGS, AND OPERATIONAL COUNTERMEASURES

COUNTERMEASURE	CRASH SEVERITY	CMF FOR CRASH TYPE (SE)			REFERENCE NUMBER	CMF ID	STAR RATING
		ALL	LEFT TURN	PEDESTRIAN			
Add Overhead Lighting	Injury Crashes	—	—	0.77	7	199	5
Improve Pavement Friction (Skid Treatment with Overlay)	Fatal/Injury	—	—	0.97	6	—	—
Increase Enforcement	All	—	—	0.77	16	—	—
Prohibit Right-Turn-on-Red	All	0.97	—	—	7	199	5
Prohibit Left Turns	All	—	—	0.9	6	—	—
Restrict Parking Near Intersections (to Off-Street)	All	—	—	0.7	6	—	—
High-Visibility Crosswalk	All	—	—	0.52 (0.17)	2	4658	3
Convert Parallel Lane to High-Visibility Crosswalk (School Zone)	All	—	—	0.63	5	2697	3
Advanced Stop/Yield	All	—	—	0.75 (0.230)	17	9017	3
Rectangular Rapid-Flashing Beacon (RRFB)	All	—	—	0.53 (0.377)	17	9024	2



U.S. Department of Transportation
Federal Highway Administration

STEP Guides and Tech Sheets



Crosswalk Visibility Enhancements

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN
CONVENTIONAL TECH SHEET

Key lighting conditions: Avoid lighting conditions that create glare, such as headlights or street lighting, which can reduce the visibility of crosswalk markings to high-visibility crosswalk markings.

Crosswalk visibility: High-visibility crosswalk markings can reduce the risk of collisions by up to 23-48%.

FEATURES:

- High-visibility marking increases visibility and is more consistent with the standard pavement.
- Painted crosswalk markings are more visible than standard pavement markings.
- Address to be used to identify the crosswalk.
- Use of reflective materials to increase visibility.
- Use of reflective materials to increase visibility.
- Use of reflective materials to increase visibility.

OTHER USED MARKS:

- Crosswalk visibility markings.
- High-visibility crosswalk markings.
- High-visibility crosswalk markings.

Raised Crosswalk

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN
CONVENTIONAL TECH SHEET

Level and/or raised crosswalks with high speeds: Level and/or raised crosswalks with high speeds can reduce the risk of collisions by up to 45%.

FEATURES:

- Level and/or raised crosswalks with high speeds can reduce the risk of collisions by up to 45%.
- Level and/or raised crosswalks with high speeds can reduce the risk of collisions by up to 45%.
- Level and/or raised crosswalks with high speeds can reduce the risk of collisions by up to 45%.

OTHER USED MARKS:

- Level and/or raised crosswalks with high speeds.
- Level and/or raised crosswalks with high speeds.
- Level and/or raised crosswalks with high speeds.

Pedestrian Refuge Island

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN
CONVENTIONAL TECH SHEET

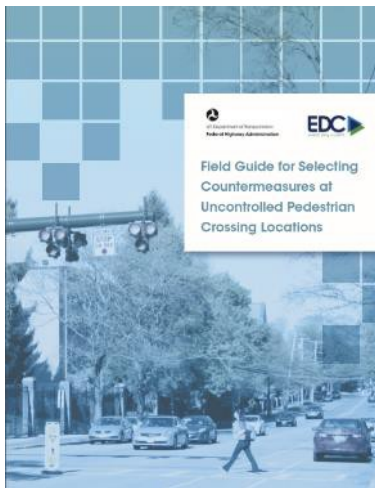
A pedestrian refuge island can reduce the risk of collisions by up to 32%.

FEATURES:

- A pedestrian refuge island can reduce the risk of collisions by up to 32%.
- A pedestrian refuge island can reduce the risk of collisions by up to 32%.
- A pedestrian refuge island can reduce the risk of collisions by up to 32%.

OTHER USED MARKS:

- Pedestrian refuge island.
- Pedestrian refuge island.
- Pedestrian refuge island.



Rectangular Rapid-Flashing Beacon (RRFB)

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN
CONVENTIONAL TECH SHEET

High speeds and pedestrian crossings: High speeds and pedestrian crossings can reduce the risk of collisions by up to 47%.

FEATURES:

- High speeds and pedestrian crossings can reduce the risk of collisions by up to 47%.
- High speeds and pedestrian crossings can reduce the risk of collisions by up to 47%.
- High speeds and pedestrian crossings can reduce the risk of collisions by up to 47%.

OTHER USED MARKS:

- Rectangular Rapid-Flashing Beacon (RRFB).
- Rectangular Rapid-Flashing Beacon (RRFB).
- Rectangular Rapid-Flashing Beacon (RRFB).

Road Diet

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN
CONVENTIONAL TECH SHEET

Multiple lanes on a road: Multiple lanes on a road can reduce the risk of collisions by up to 19-47%.

FEATURES:

- Multiple lanes on a road can reduce the risk of collisions by up to 19-47%.
- Multiple lanes on a road can reduce the risk of collisions by up to 19-47%.
- Multiple lanes on a road can reduce the risk of collisions by up to 19-47%.

OTHER USED MARKS:

- Road Diet.
- Road Diet.
- Road Diet.

Pedestrian Hybrid Beacons (PHBs)

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN
CONVENTIONAL TECH SHEET

High speeds and pedestrian crossings: High speeds and pedestrian crossings can reduce the risk of collisions by up to 55%.

FEATURES:

- High speeds and pedestrian crossings can reduce the risk of collisions by up to 55%.
- High speeds and pedestrian crossings can reduce the risk of collisions by up to 55%.
- High speeds and pedestrian crossings can reduce the risk of collisions by up to 55%.

OTHER USED MARKS:

- Pedestrian Hybrid Beacon (PHB).
- Pedestrian Hybrid Beacon (PHB).
- Pedestrian Hybrid Beacon (PHB).



https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4step_tech_sheet.pdf

Technical Assistance

- STEP Action Plans
- STEP Workshops
- Road Safety Assessments
- Facilitated Discussions
- Localized STEP Charts
- Systemic Project Discussions
- Scan Tours
- Peer Exchanges
- Virtual Meetings

Resources

- EDC4 STEP Website

- https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

- EDC5 STEP Website

- https://www.fhwa.dot.gov/innovation/everydaycounts/edc_5/step2.cfm

- FHWA Pedestrian Safety Website

- https://safety.fhwa.dot.gov/ped_bike/

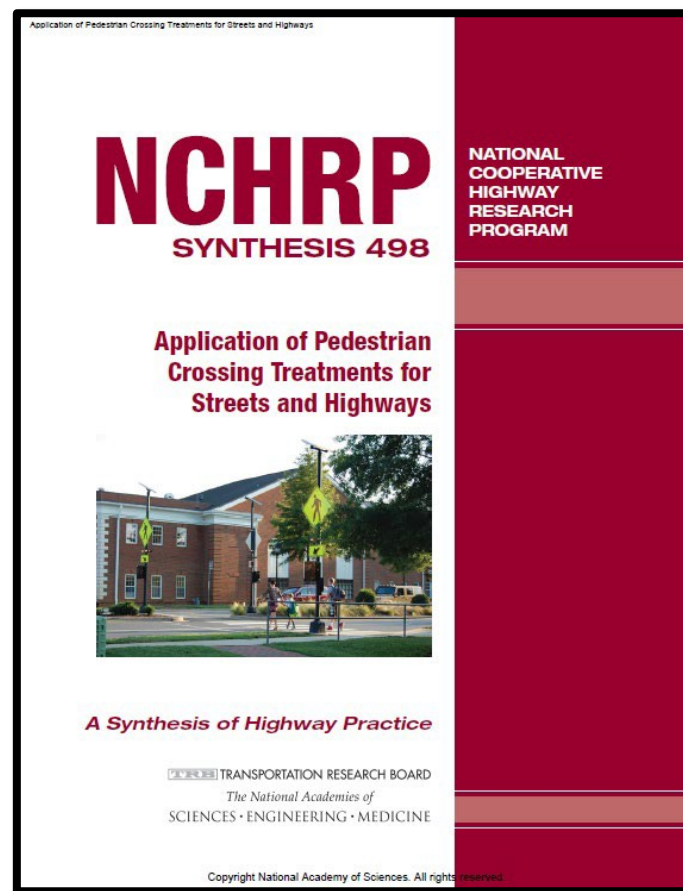
- PBIC Website

- www.pedbikeinfo.org

NCHRP Synthesis 498 (December 2016)

Developed by

1. Surveying State DOT's, Local Transportation Agencies
2. Identifying & synthesizing effective practices and policies
3. Comprehensive literature review of safety evidence for more than 25 pedestrian crossing treatments



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

Traffic Calming ePrimer

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Program Contact

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(202) 366-5892

Traffic Calming ePrimer

The Traffic Calming ePrimer is a free, online resource openly available for public use. The ePrimer presents a thorough review of current traffic calming practice and contains the information needed to understand this complex field. The ePrimer is presented in eight distinct modules developed to allow the reader to move between each to find the desired information, without a cover-to-cover reading. The ePrimer presents:

- a definition of traffic calming, its purpose, and its relationship to other transportation initiatives (like complete streets and context sensitive solutions);
- illustrations and photographs of 22 different types of traffic calming measures;
- considerations for their appropriate application, including effects and design and installation specifics;
- research on the effects of traffic calming measures on mobility and safety for passenger vehicles, emergency response, public transit, and waste collection vehicles, and pedestrians and bicyclists;
- examples and case studies of both comprehensive traffic calming programs and neighborhood-specific traffic calming plans;
- case studies that cover effective processes used to plan and define a local traffic calming program or project and assessments of the effects of individual and series of traffic calming measures.

Traffic Calming ePrimer Table of Contents: to view a module, click its plus button +.

Click to expand and view modules [View All +](#)

Module 1 Purpose and Organization of ePrimer +	Module 5 Effects of Traffic Calming Measures on Non-Personal Passenger Vehicles +
Module 2 Traffic Calming Basics +	Module 6 Effects of Traffic Calming Measures on Non-Motorized Users +
Module 3 Toolbox of Individual Traffic Calming Measures +	Module 7 Traffic Calming Programs and Planning Processes +
Module 4 Effects of Traffic Calming Measures on Motor Vehicle Speed and Volume +	Module 8 Traffic Calming Case Studies +

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

https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm



**Thank You
Walk & Cross Safely**