Today's presentation

- Introduction and housekeeping
- PBIC Trainings
  - http://www.walkinginfo.org/training
- Next PBIC Webinar
  - "Community Approaches to Pedestrian Safety Education"
  - Gillian Hotz and David Parisi
  - Thursday, March 18, 2010, 2:00PM E.T.
- Registration and Archives at
  - http://www.walkinginfo.org/webinars
- Questions at the end

Selecting Pedestrian Treatments at Unsignalized Crossings

by Charlie Zegeer, PBIC Director
UNC Highway Safety Research Center

Crossing Crashes

Part 1:General Principles

Why do people cross the street?

Because there's someplace good on the other side

Depoe Bay OR

People shouldn’t have to run to cross a street

Depoe Bay OR

Ideally, we'd always cross at locations with positive control

But we can't provide signals everywhere people cross

These people are not criminals…
They're simply trying to deal with a situation

Pedestrian behavior varies:
Some use crosswalks, others don't

Principle # 1

Pedestrians want & need to cross the street safely

Principle # 2

Depoe Bay OR

Drivers need to understand pedestrians' intent

Principle # 3

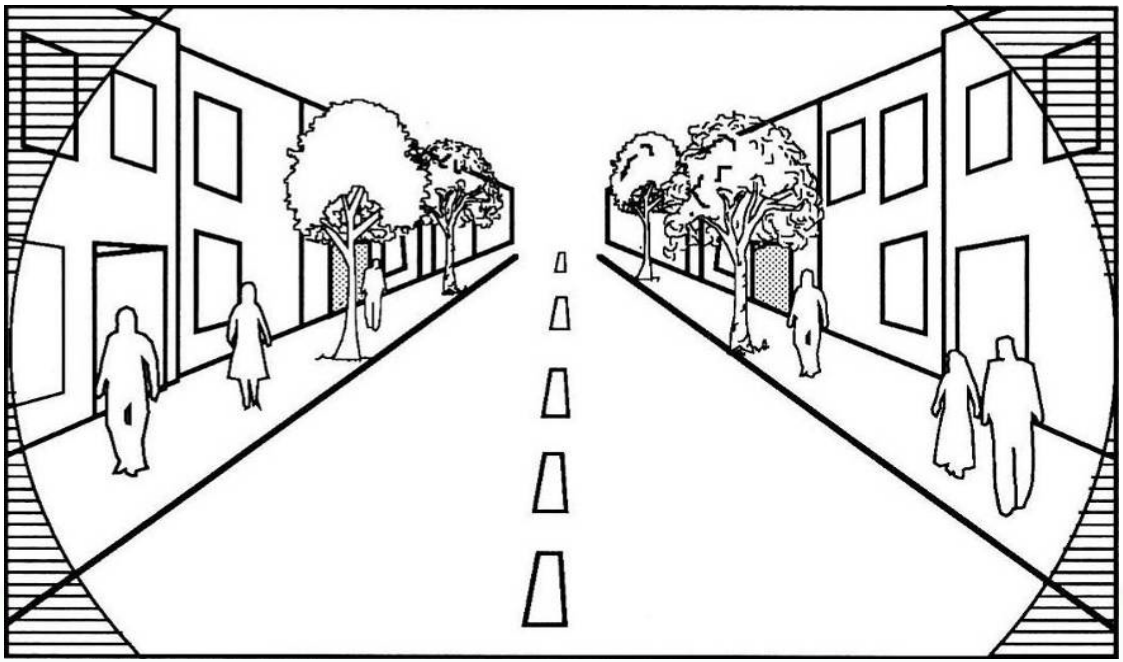
Keep Crossings Short

Impacts of long crossing distance:

- **Increases exposure time**
- **Increases vehicle-pedestrian conflict**
- **Increases vehicle delay**
- **Decreases ability of slower pedestrians to cross**

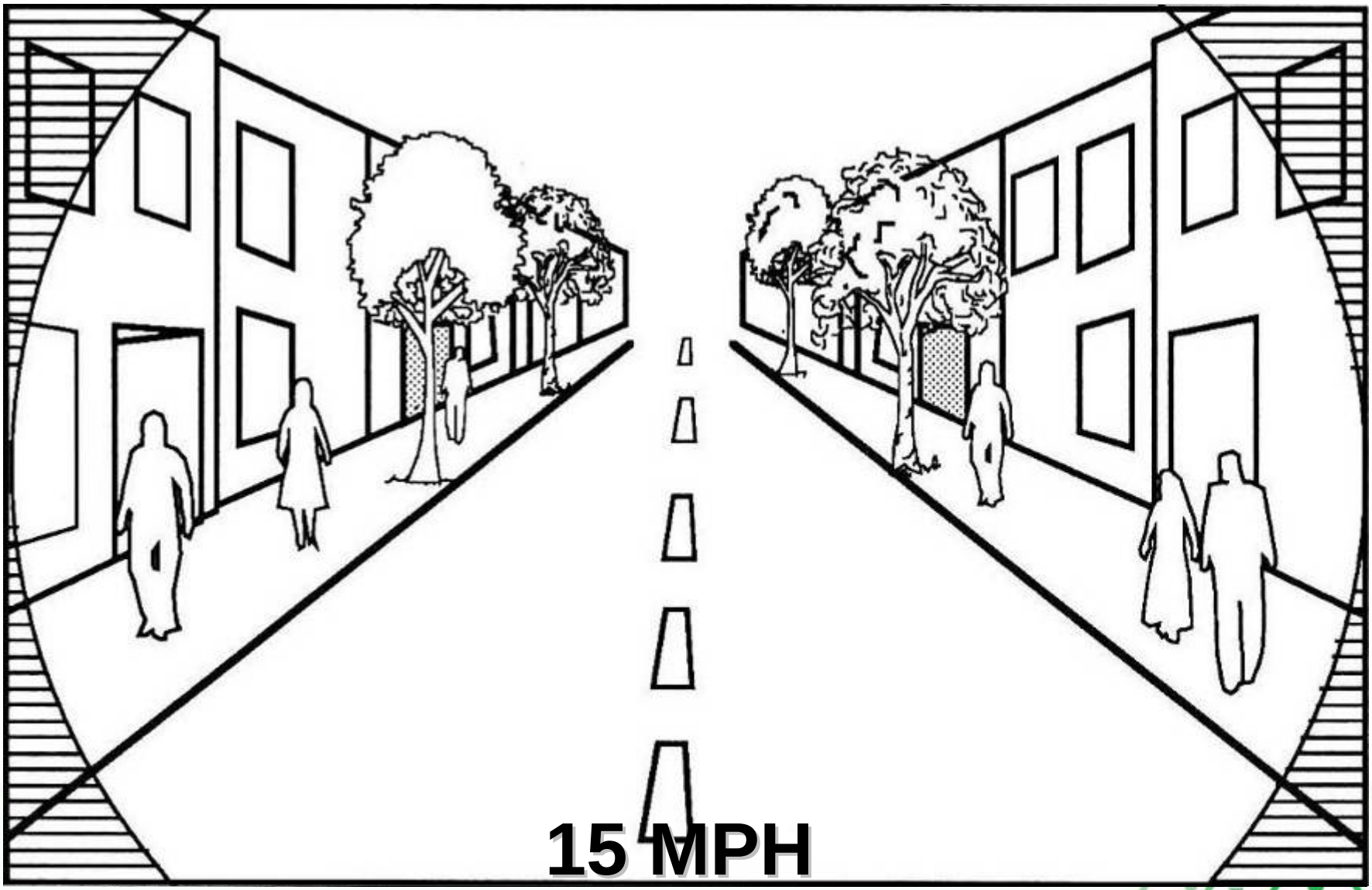
Principle # 4: Speed Matters

1. Drivers' field of vision & ability to see pedestrians
2. Drivers' ability to react and avoid a crash
3. Crash Severity



15 MPH

As speed increases, driver focuses less on surroundings



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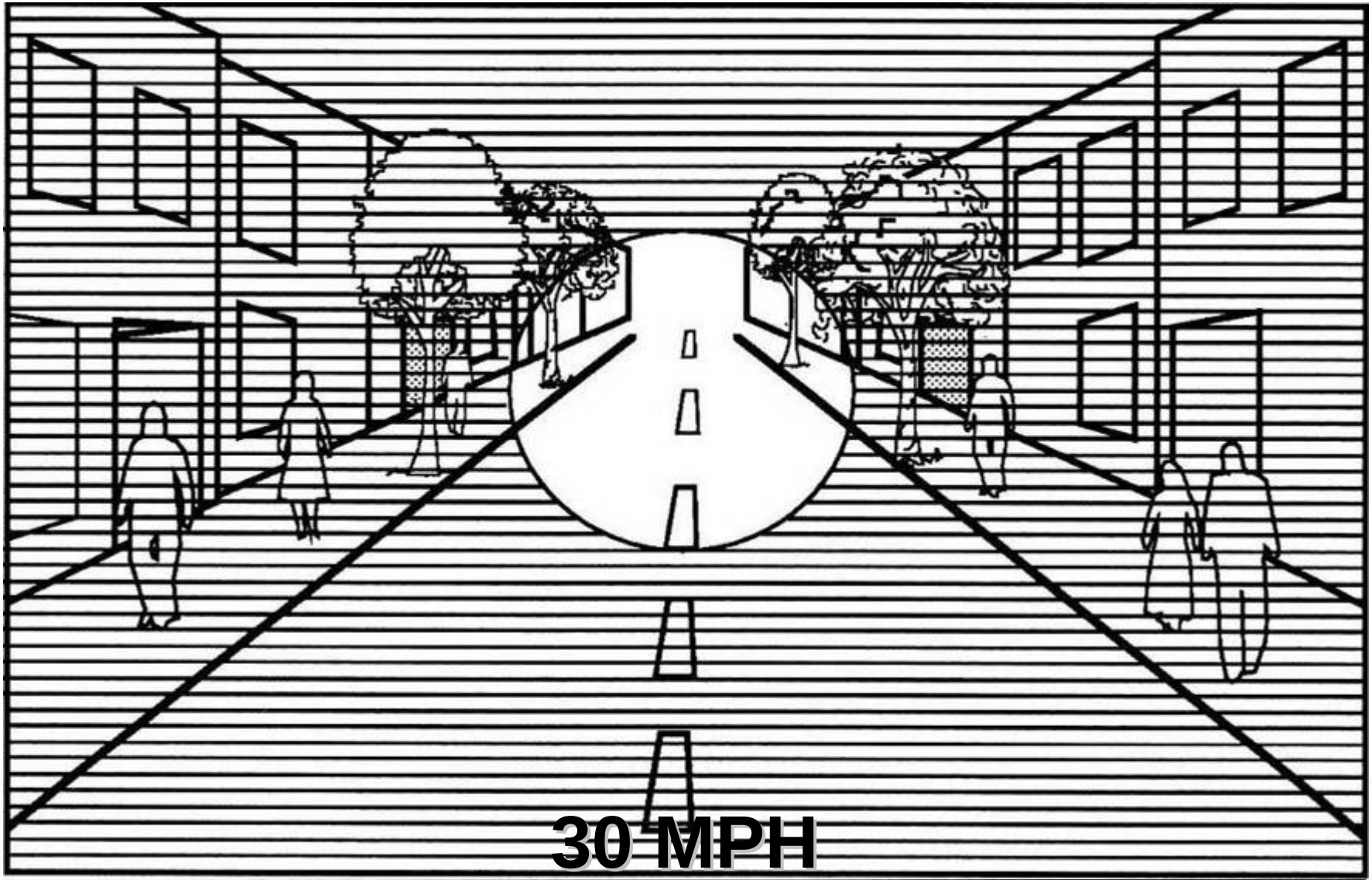
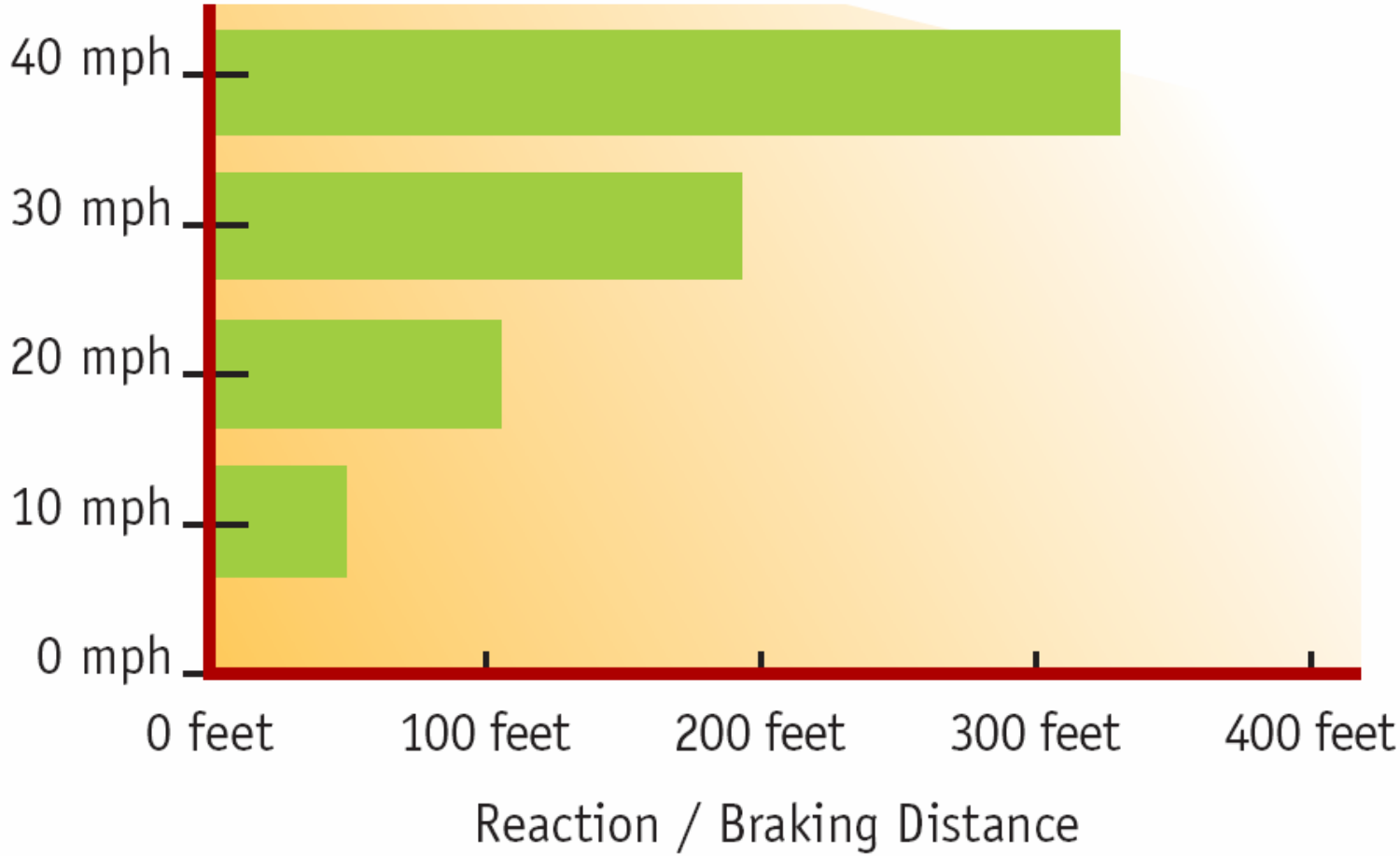


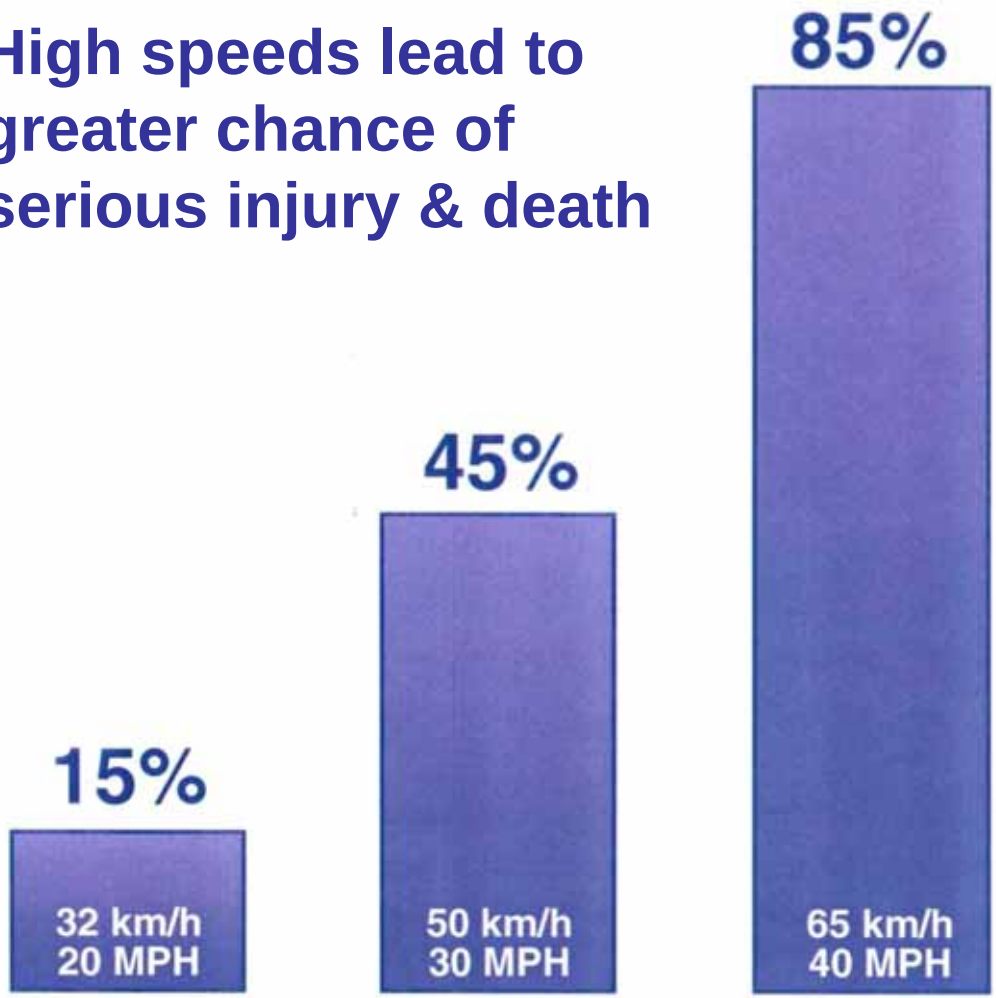
Speed Affects Crash Avoidance



High speeds equate to greater reaction and stopping distance

Speed Affects Crash Severity

High speeds lead to greater chance of serious injury & death



Pedestrians' chances of death if hit by a motor vehicle
SOURCE: *Killing Speed and Saving Lives*, UK Department of Transportation

Traffic-calming methods such as curb extensions help slow traffic

Principle # 5
Pedestrians will cross where it's most convenient

Midblock vs. Intersection

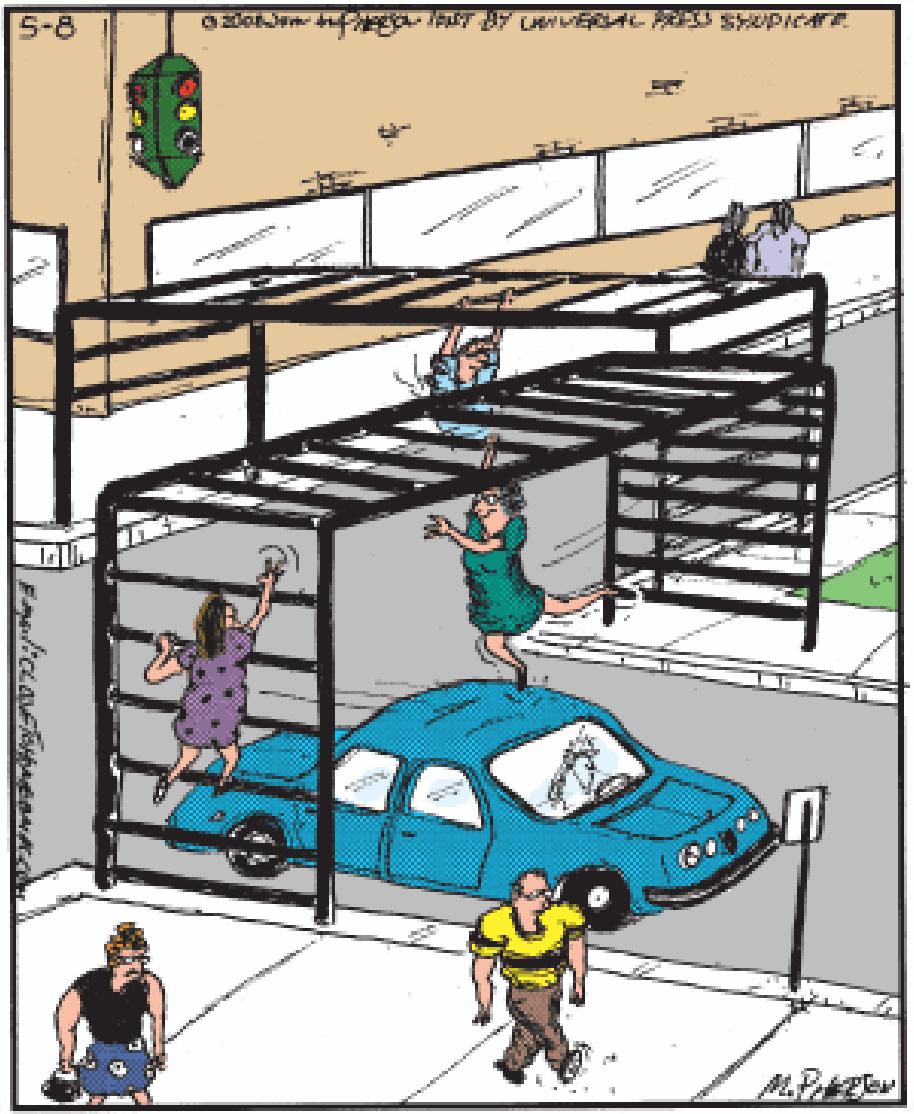
- People choose based on their perceived risk
- The data is inconclusive

Crossing Crashes

Part 2: Countermeasures

Basic Street Crossing Measures

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



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

Crosswalks

Crosswalk FAQ's:

1. **Why are they marked?**
2. **Where should they be marked?**
3. **Do marked crosswalks increase safety, or provide a "false sense of security?"**

1. Why are crosswalks provided?

- To indicate to pedestrians where to cross
- To indicate to drivers where to expect pedestrians

2. How to determine where to mark a crosswalk?

2. How to determine where to mark a crosswalk?

MUTCD Guidance on Crosswalks (2009)

- **Crosswalk markings provide guidance for pedestrians who are crossing roadways by defining and delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops.**
- **In conjunction with signs and other measures, crosswalk markings help to alert road users of a designated pedestrian crossing point across the roadway at locations that are not controlled by traffic control signals or STOP or YIELD signs. Crosswalk lines should not be used indiscriminately.**
- **An engineering study should be performed before a marked crosswalk is installed at a location away from a traffic signal or an approach controlled by a STOP or YIELD sign.**

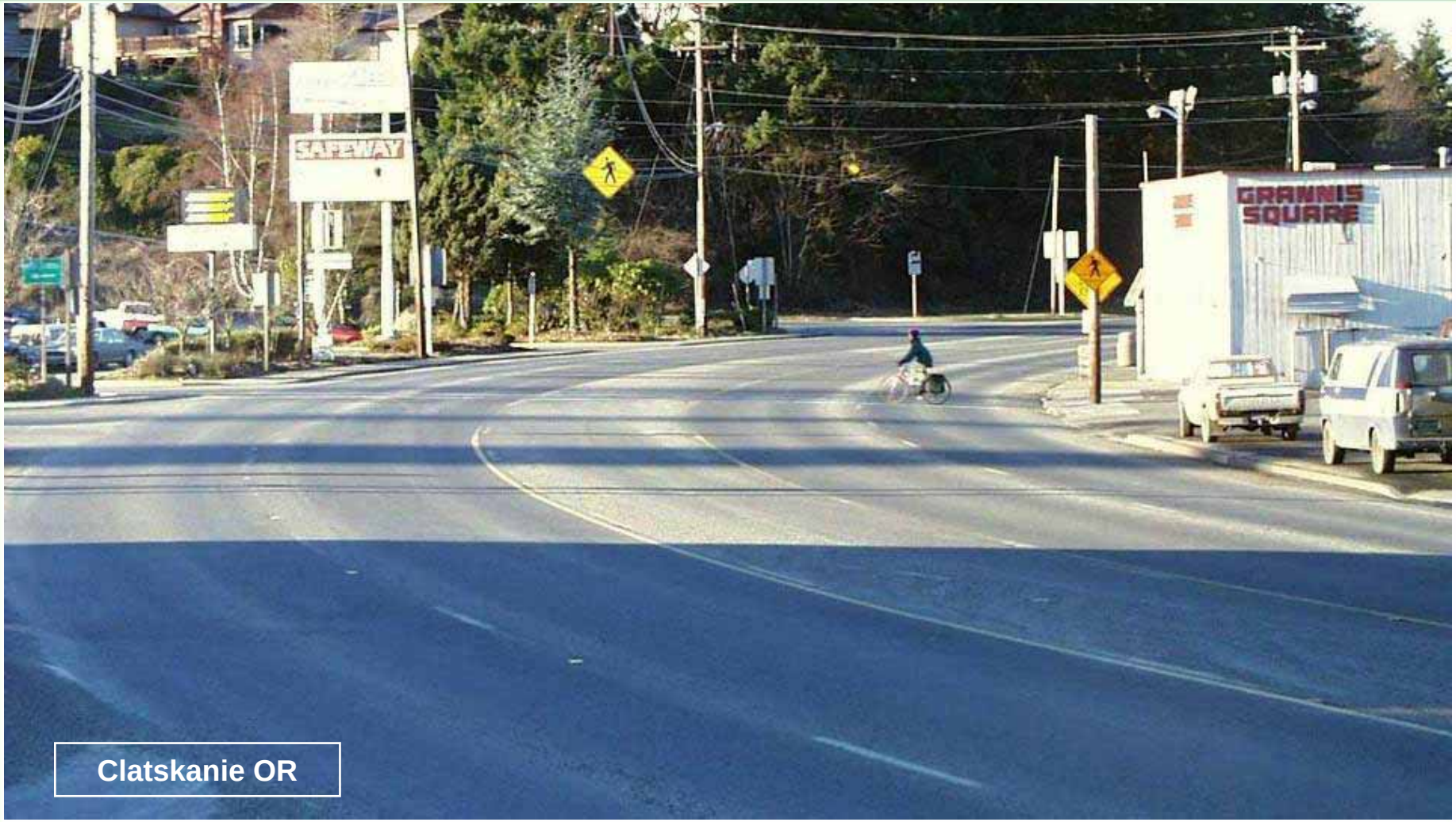
2. How to determine where to mark a crosswalk?

Consider origins and destinations

In this case, apartments across from bus stop & stores

Many Locations are not Suitable for a Marked Crosswalk

Not a good location for a marked crosswalk:
No particular reason for driver to expect pedestrians



Clatskanie OR

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

Many Locations are Suitable for a Marked Crosswalk

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

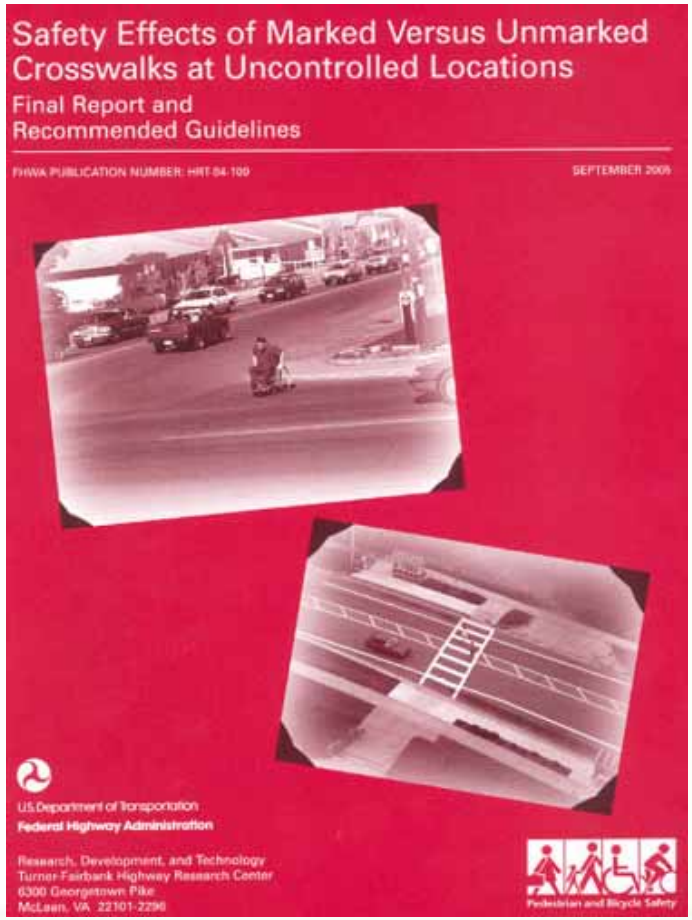
Suitable location for a marked crosswalk:
Slow speed, high use, driver expectancy

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

Results of Most Recent Study *(Zegeer et al 2002)*

Marked vs. Unmarked Analysis

- **Two-lane roads: No significant difference in crashes**
- **Multilane roads *(3 or more lanes)***
  - **Under 12,000 ADT: no significant difference in crashes**
  - **Over 12,000 ADT w/ no median: crashes marked > crashes unmarked**
  - **Over 15,000 ADT & w/ median: crashes marked > crashes unmarked**



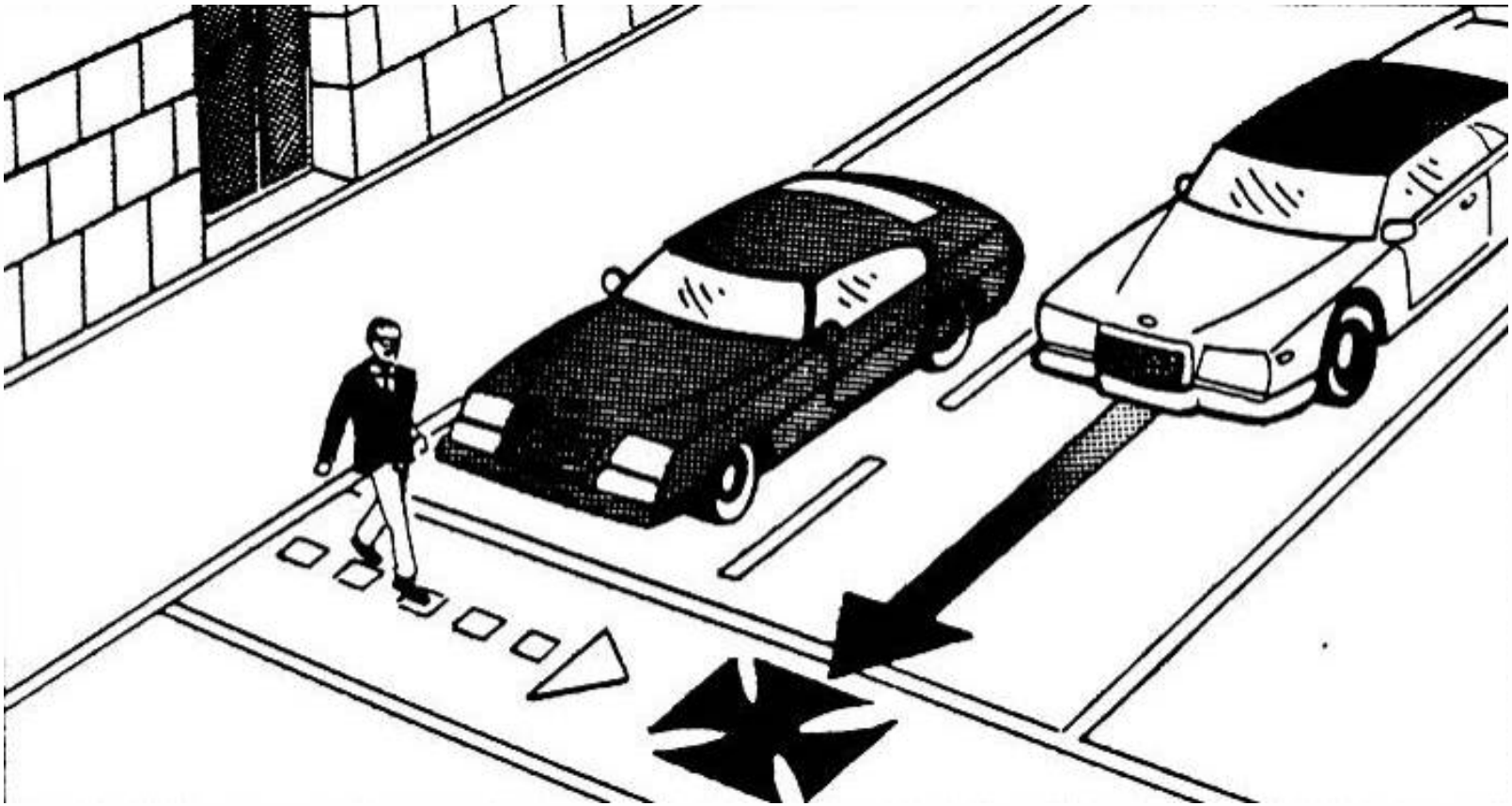
Study Results

1. **Median reduces crashes by 40%**
2. **Pedestrians over 65 are over-represented in crosswalk crashes**
3. **Pedestrians are not less vigilant in marked crosswalks:**
   - ***Looking behavior <u>increased</u> after crosswalks installed***

Study Results

4. **Crashes correlate with ADT & number of travel lanes.**
   - ***Other studies have shown same 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…)

Study Recommendations

1. OK to mark crosswalks on 2-lane roadways
2. On multi-lane roadways, marked crosswalks <u>alone</u> are not recommended on roadways with:
   - ADT > 12,000 w/o median
   - ADT > 15,000 w median*
   - Speeds greater than 40 mph
3. Use raised medians to reduce risk
4. Signals or other treatments should be considered where many young and/or elderly pedestrians

** Note: effect of advance stop bar not studied (none at any observed sites)*

Change to 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 and either:

A. The roadway has four or more lanes of travel without a raised median or pedestrian refuge island and an ADT of 12,000 vehicles per day or greater; or

B. The roadway has four or more lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater."

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?"

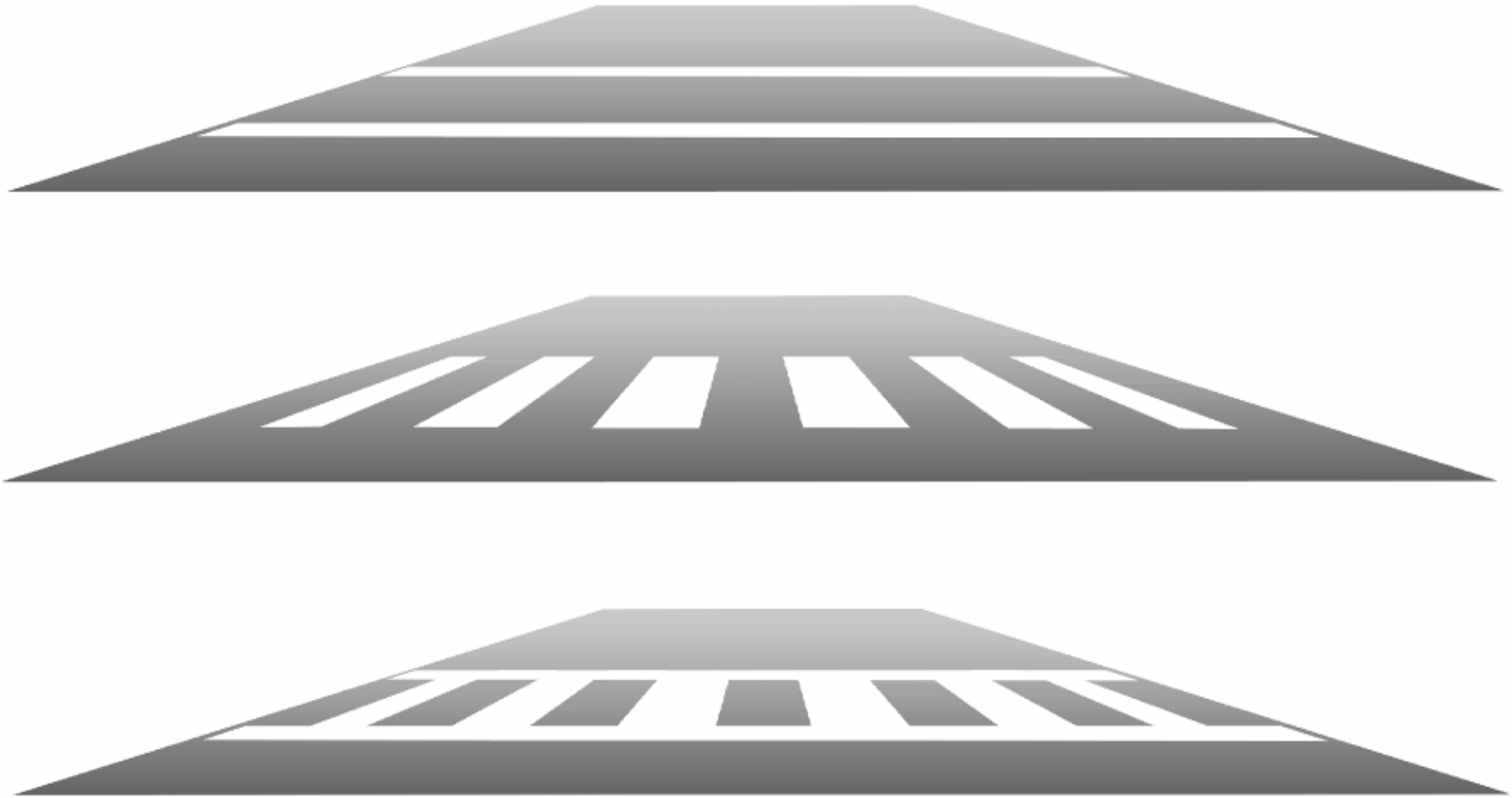
Marked crosswalk must be visible to the DRIVER

What the pedestrian sees

Marked crosswalk must be visible to the DRIVER

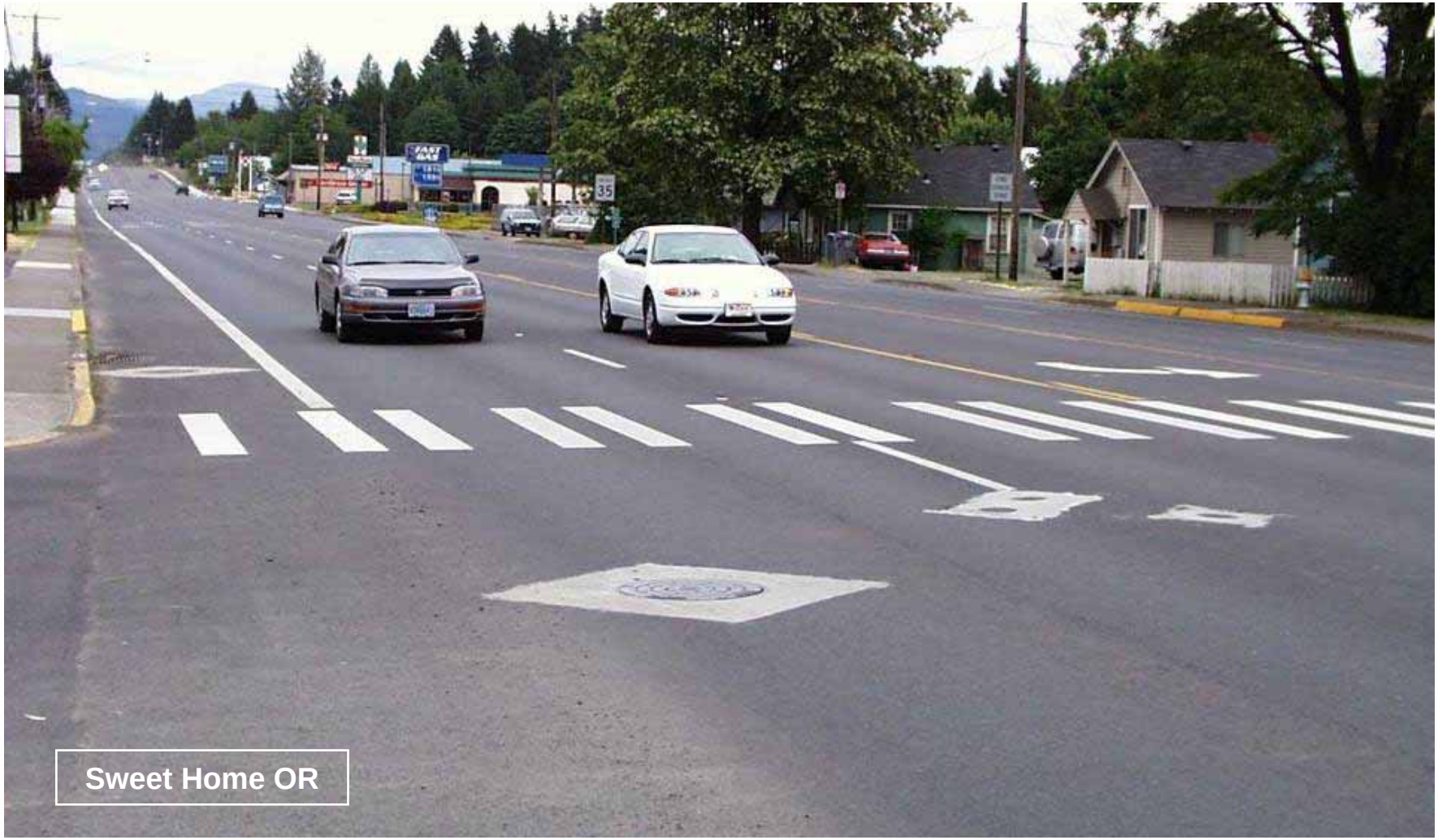
What the driver sees **(same crosswalk)**

Crosswalk Visibility



Crosswalk Marking Types

Longitudinal markings with transverse markings – very visible



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

Sweet Home OR

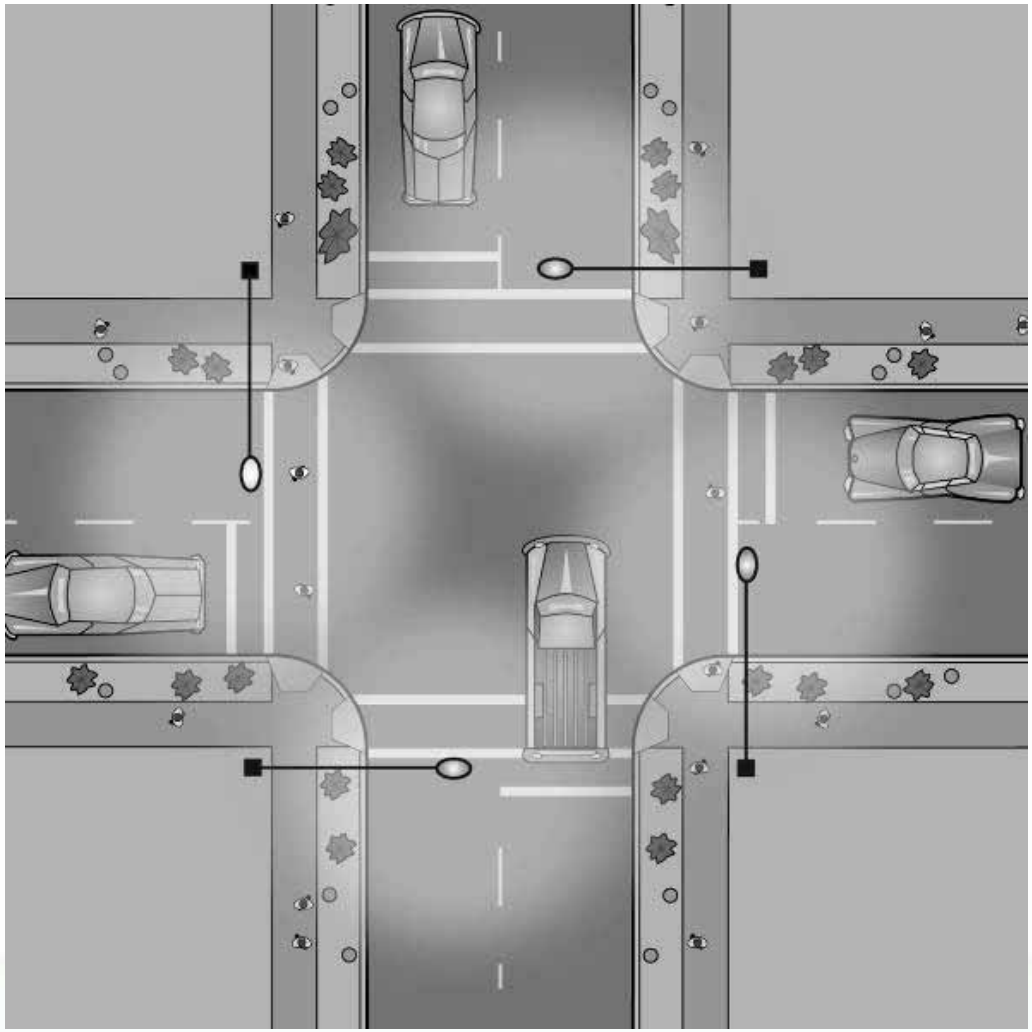
Staggered ladder improves visibility from afar

Illumination – Essential For Any Crossing

Marked crosswalk?

- Light it.

Up to 50% of ped crashes occur at night



Lighting reduces the odds of pedestrian fatalities:

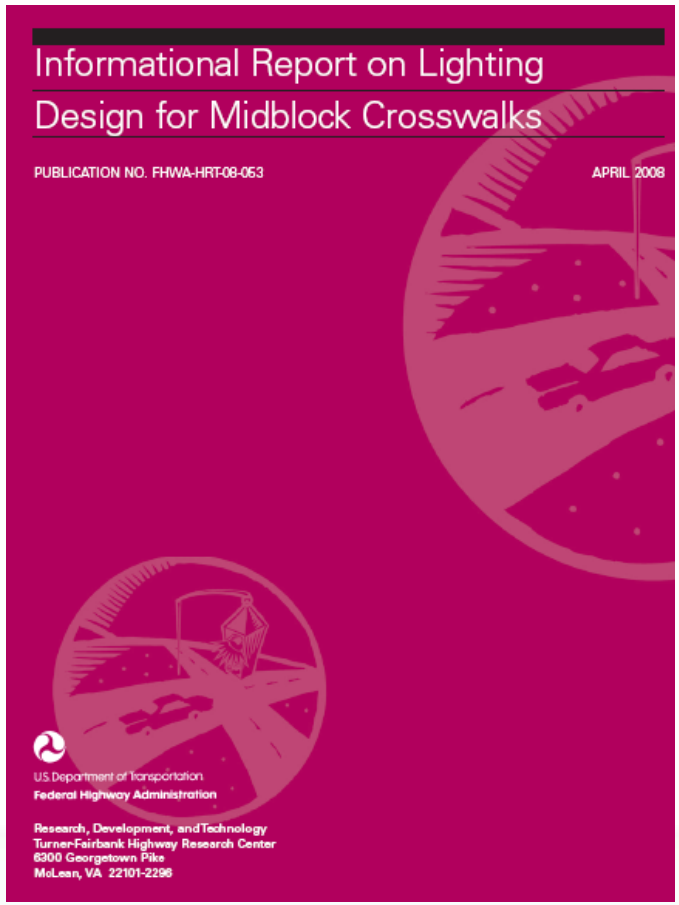
by 42% at midblock locations

by 54% at intersections

Informational Report on Lighting Design for Midblock Crosswalks

FHWA-HRT-08-053

April 2008



Sample Illustrations from New FHWA Report

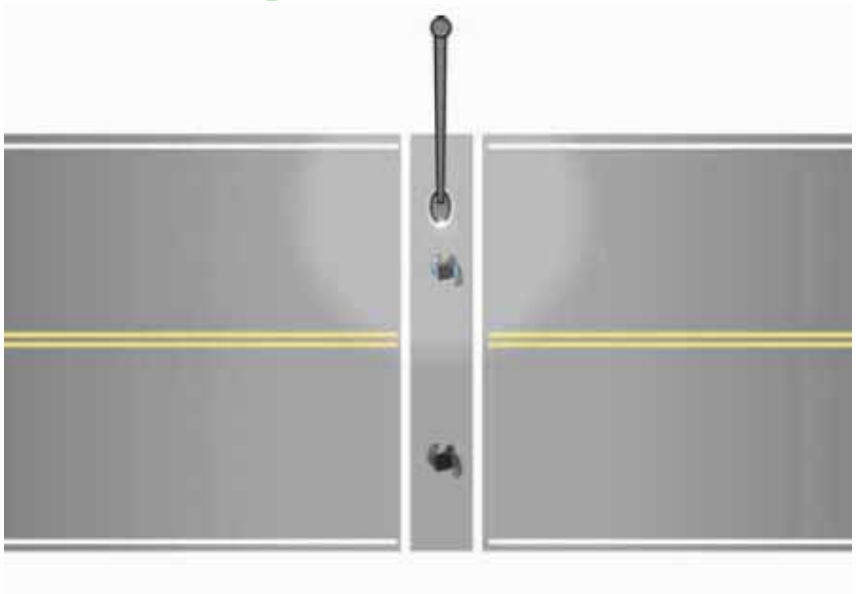


Fig 11. Traditional midblock crosswalk lighting layout

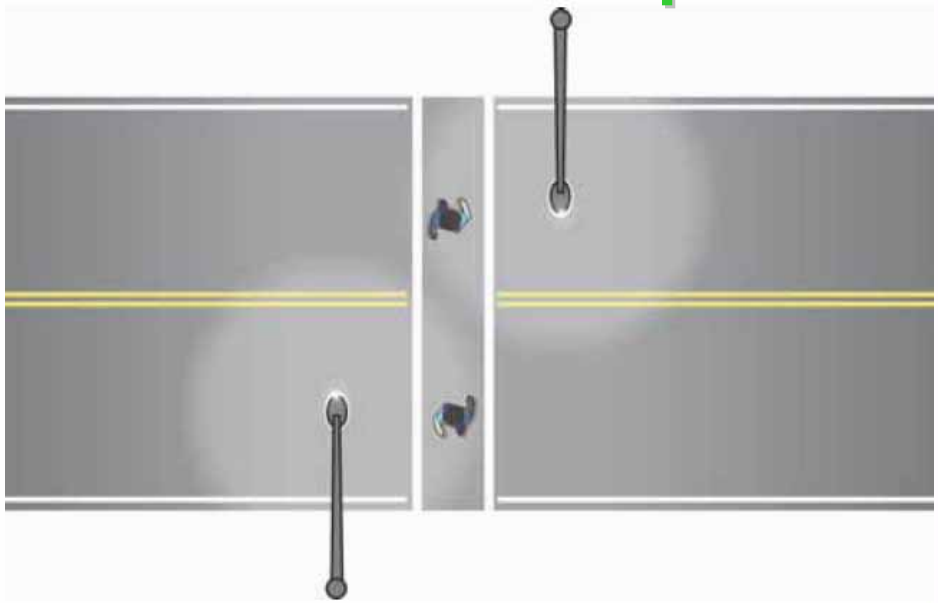


Fig 12. New design for midblock crosswalk lighting layout

Recommended lighting level: 20 lux at 5’ above pavement

Available at http://www.tfhrc.gov/safety/pubs/08053/08053.pdf

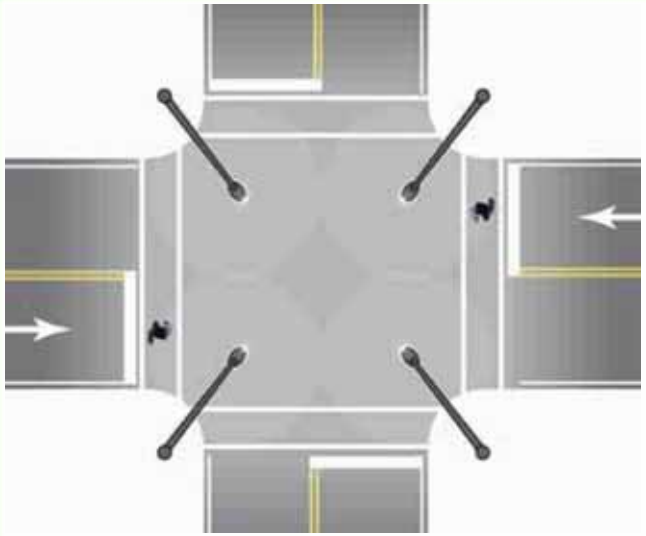


Fig 13. Traditional intersection lighting layout

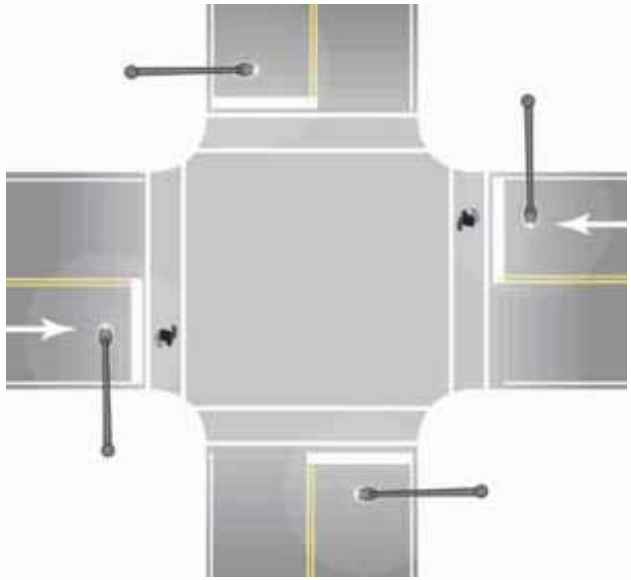


Fig 14. New design for intersection lighting layout for crosswalks.

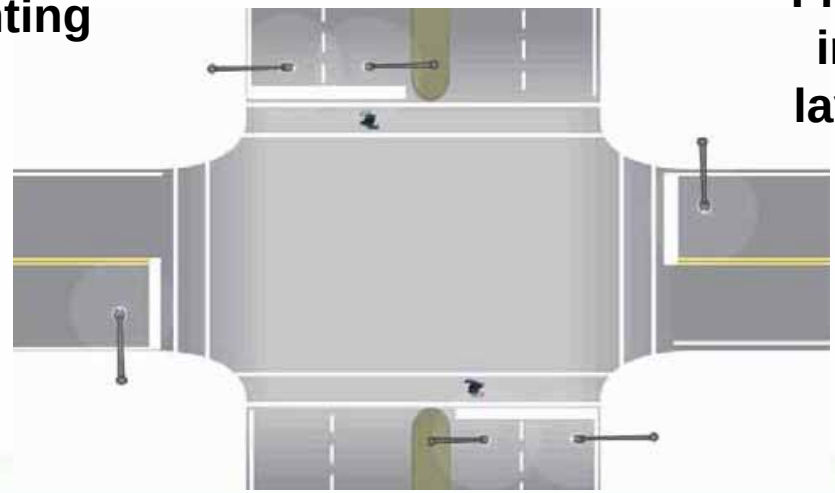
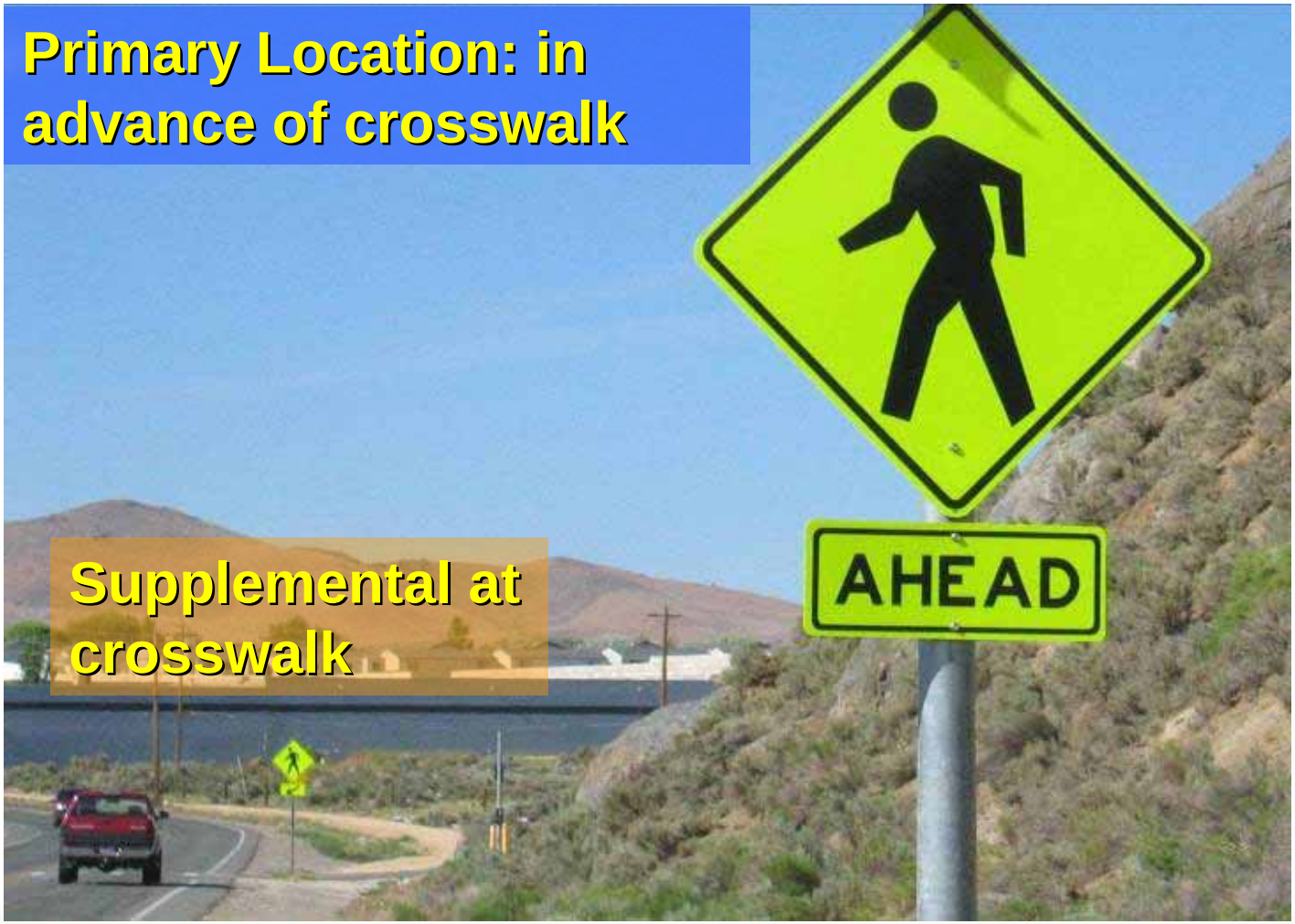


Fig 15. New design for wide roadway intersection lighting layout for crosswalks

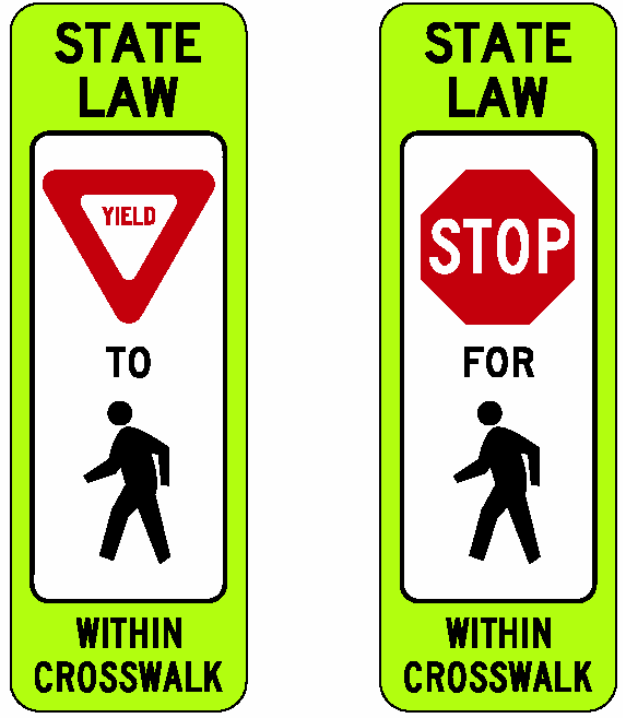
Ped crossing signs: old vs. new MUTCD standards

Old

New



Placement



R1-6 R1-6a
MUTCD signs
Yield or Stop
depends on state law

Tampa, FL

In-street pedestrian crossing signs

Tampa FL

In-street signs increase yield rates, especially on slow-speed streets

Rectangular Rapid Flash LED Beacon

- Received Interim approval to MUTCD with separate warrants for use
- Studies indicate motorist yield rates increased from about 20% to 80%
- Beacon is yellow, rectangular, and has a rapid “wig-wag” flash
- Beacon located between the warning sign and the arrow plaque
- Must be pedestrian activated (pushbutton or passive)

Coconut Grove FL

Beacons required on the both right side and on the left side or in a median if practical

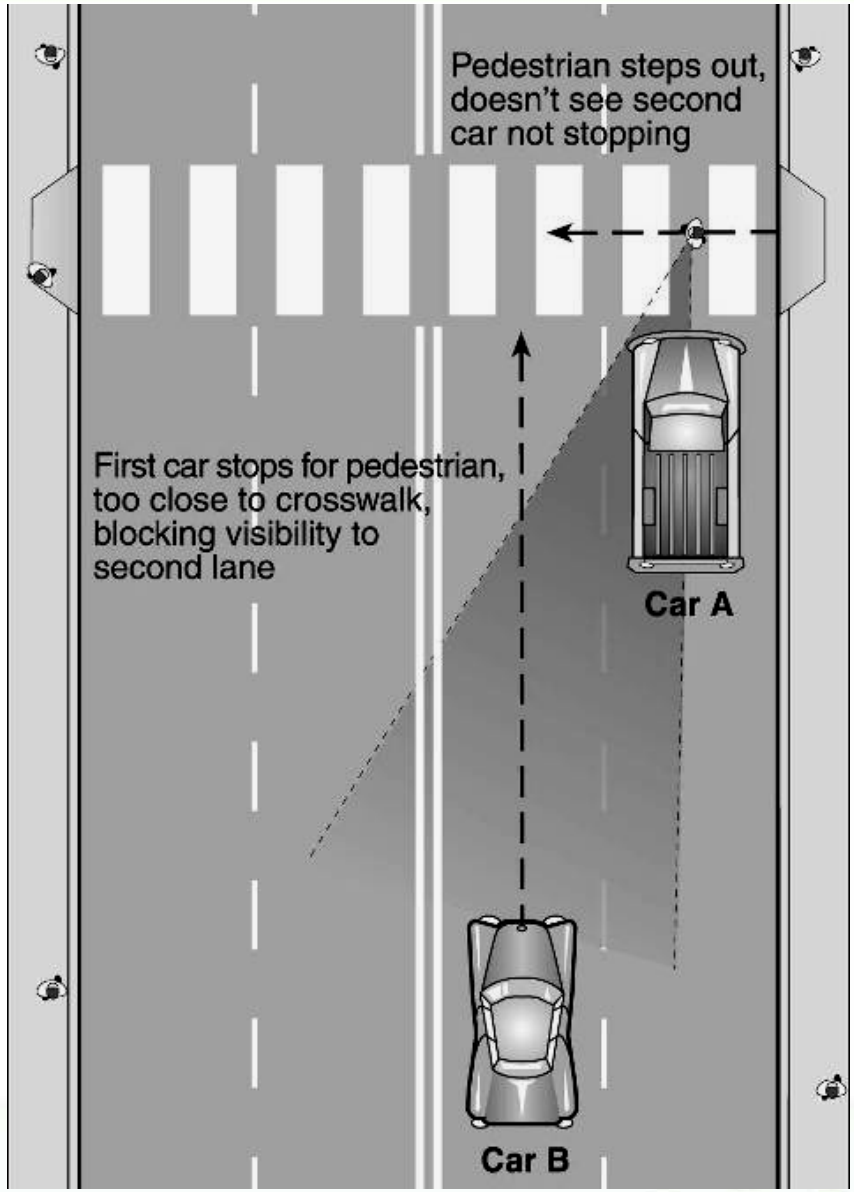
Advance Stop or Yield Line:

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

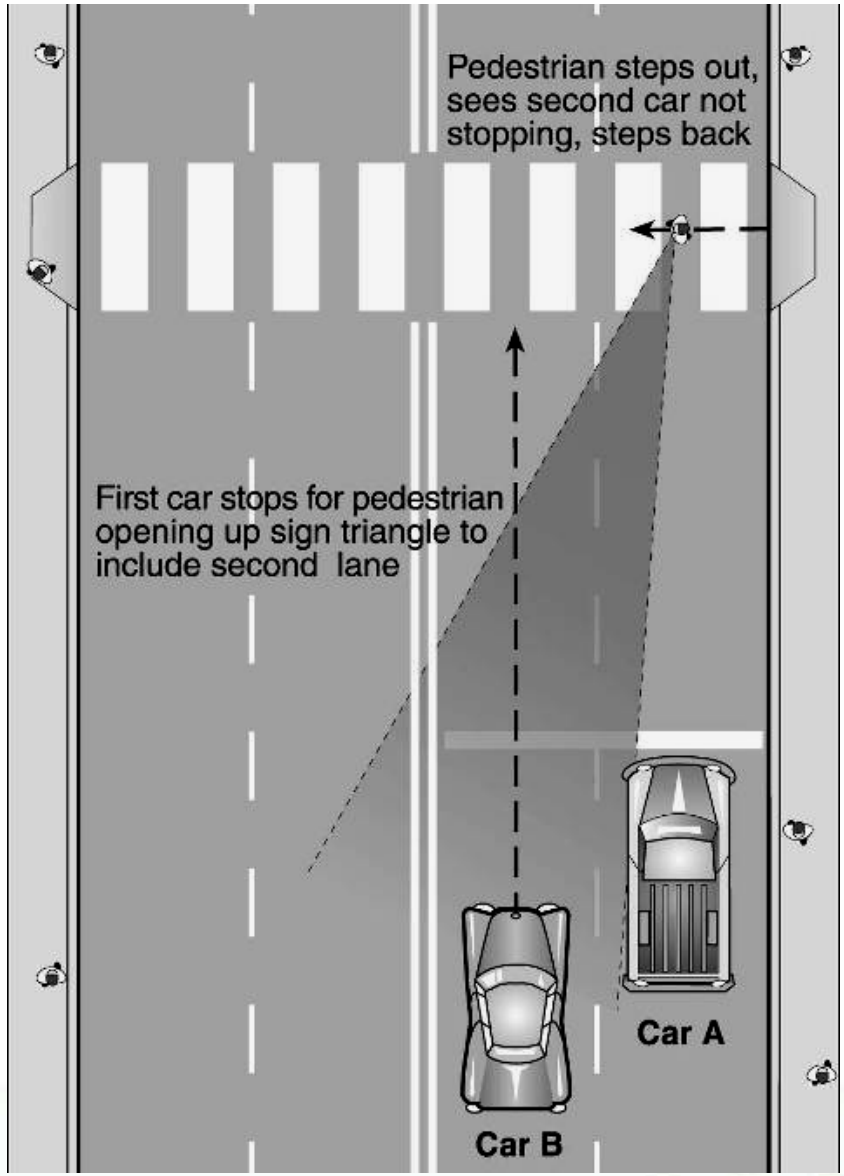


Multiple Threat Crash Solution

Advance stop/yield line

1st car stops further back, opening up sight lines

2nd car can be seen by pedestrian



R1-5

R1-5a

Signs in the 2003 MUTCD (Use where local law says yield to pedestrians)

R1-5b

R1-5c

Signs in the 2009 MUTCD (Use where local law says stop for pedestrians)

Tampa FL

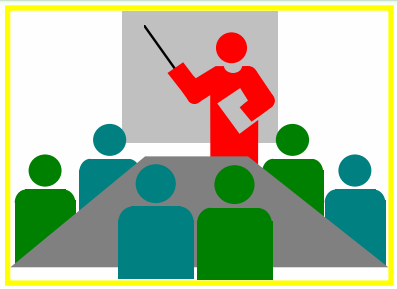
Advanced yield line (shark's teeth) & sign

Eugene OR

Advanced stop line and sign

MUTCD recommends 20’ to 50’ setback

30’ preferred for maximum effectiveness



Marking a Crosswalk Summary

When is it OK to mark a crosswalk without other treatments?

- **2-lane roads < 40 mph**
- **Multi-lane roads w/ ADT < 12,000 or 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***

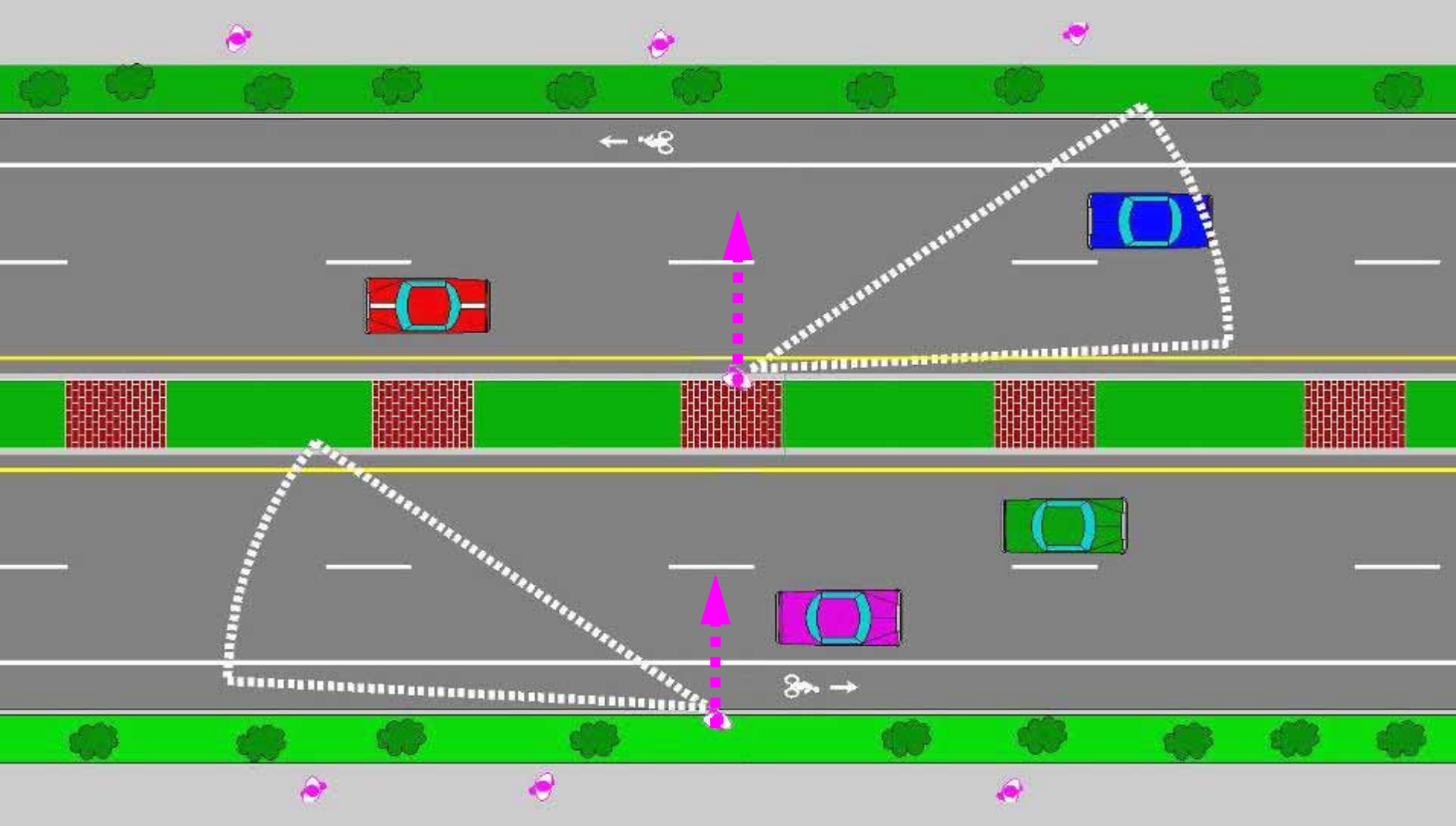
Signs: ***In road; supplement with striping***

In all cases (nighttime): ***Illumination!***

Raised Medians And Islands Reduce Pedestrian Crashes:

At marked crosswalks CRF = 46%

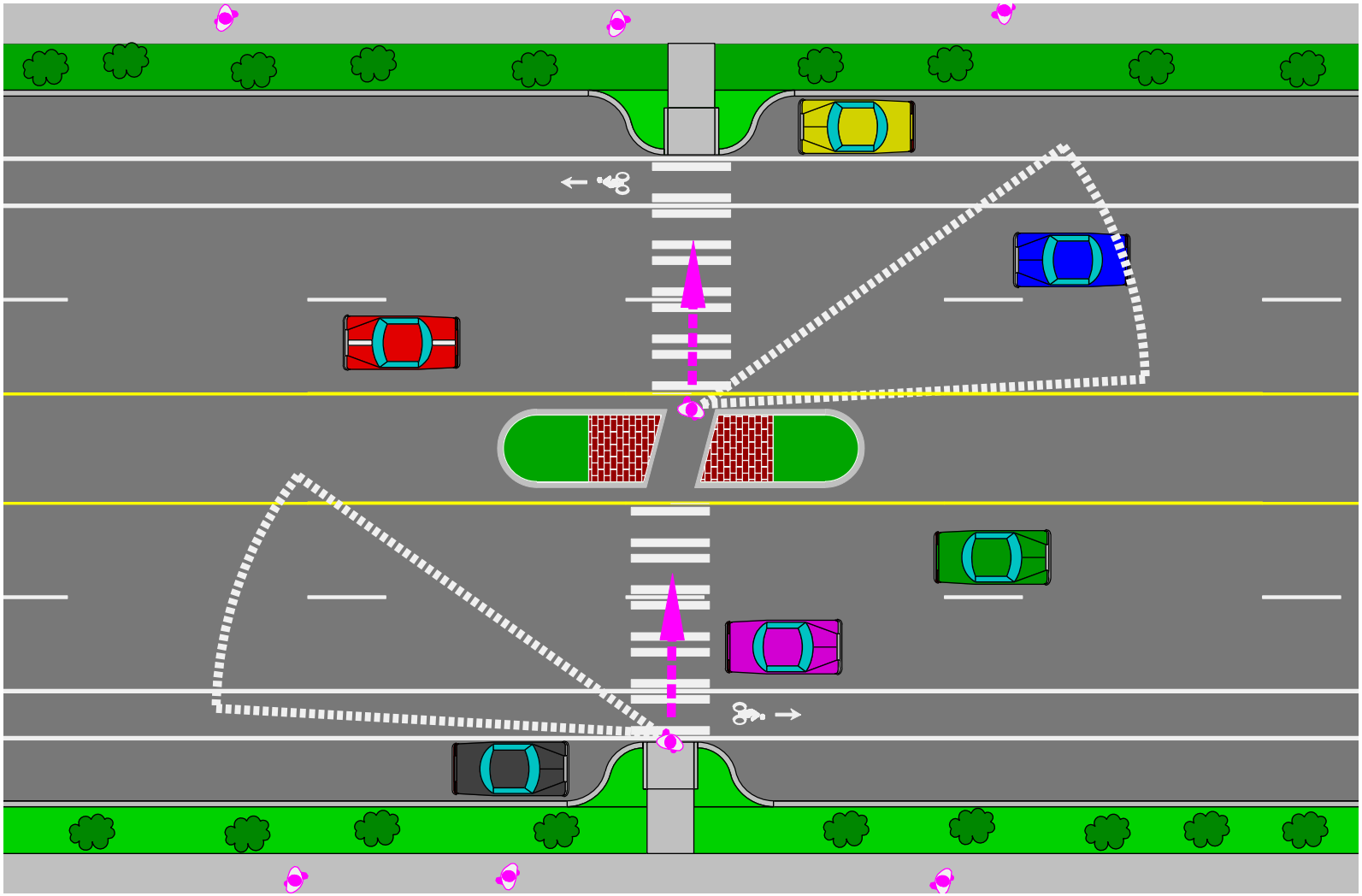
At unmarked crosswalks CRF = 39%



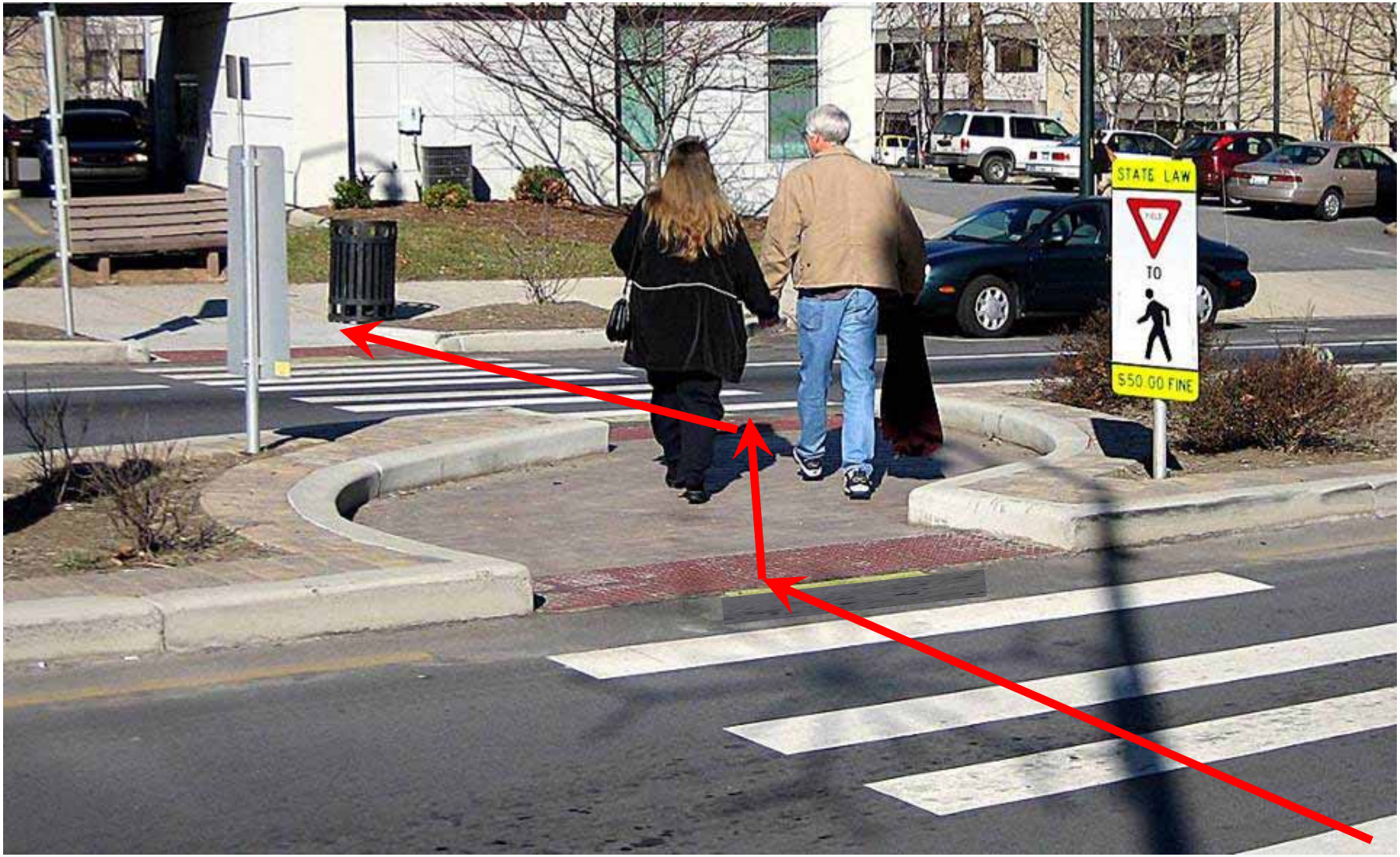
Continuous raised median – basic principle:
Breaks long complex crossing into two simpler crossings

A flush median is not a refuge

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

Pedestrian Signal

Now easier to meet pedestrian volume warrant

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

Stage 1: Ped stops traffic in one direction

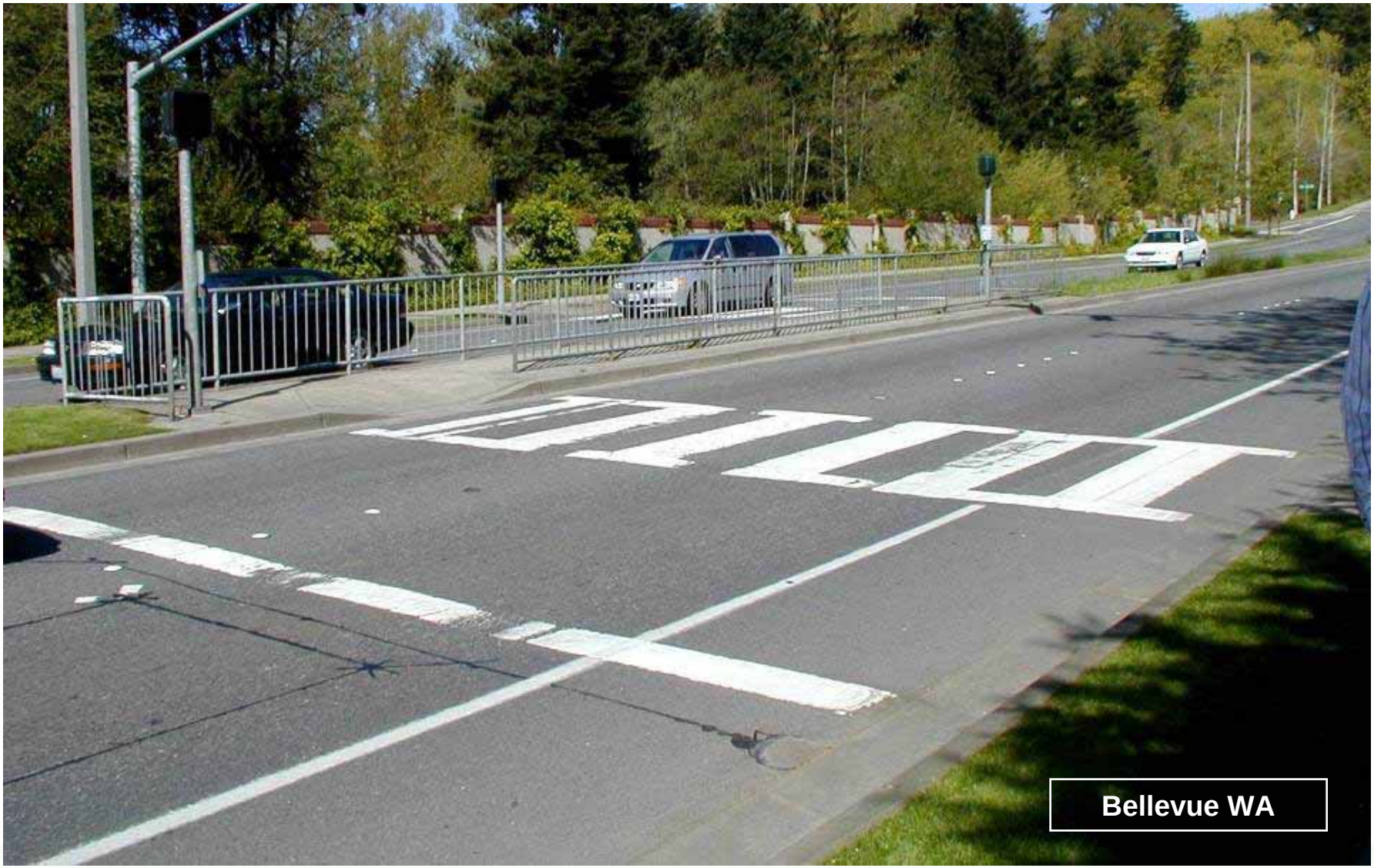
Stage 1: Ped crosses to median island

Stage 1 over: Traffic in one direction resumes

Stage 2: Ped stops traffic in other direction

Stage 2 over: Traffic resumes

Detail 1: Requires ped push button on island



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

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

Included in current 2009 MUTCD

Drivers see Hybrid Beacon

Peds see Pedhead

Hybrid Beacon Sequence

1

Blank for drivers

4

Steady red

2

Flashing yellow

5

Wig-Wag

3

Steady yellow

Return to 1

Over & Undercrossings

Reno NV

In theory, grade separation = no conflicts

In reality, pedestrians often ignore structures
Placing themselves in greater danger

Sometimes fences are needed to direct users

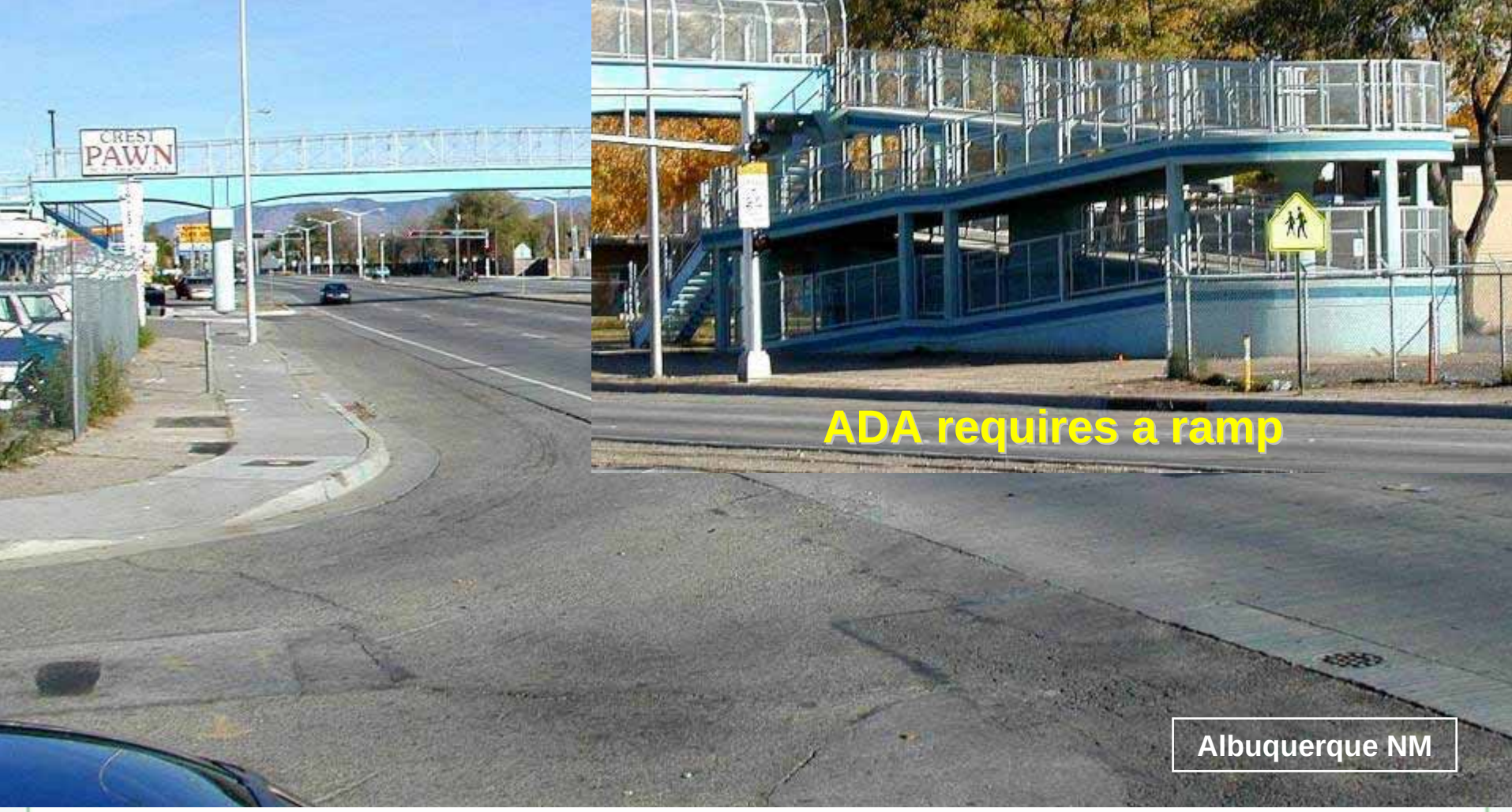
Grade separation is more useful for purposes beyond simply crossing from sidewalk to sidewalk

To connect buildings

To connect land uses

To cross freeways

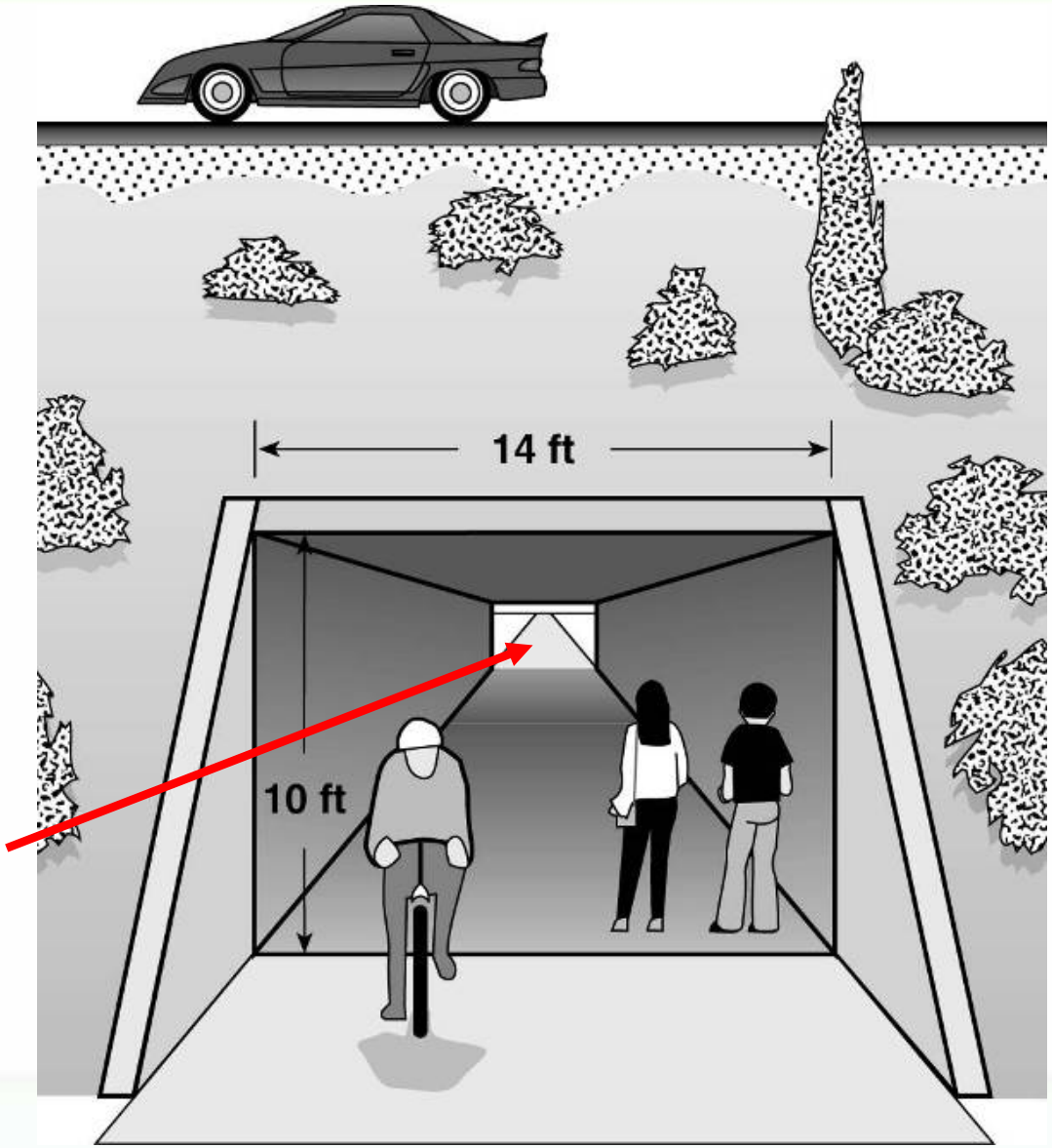
Light rail stations



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

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

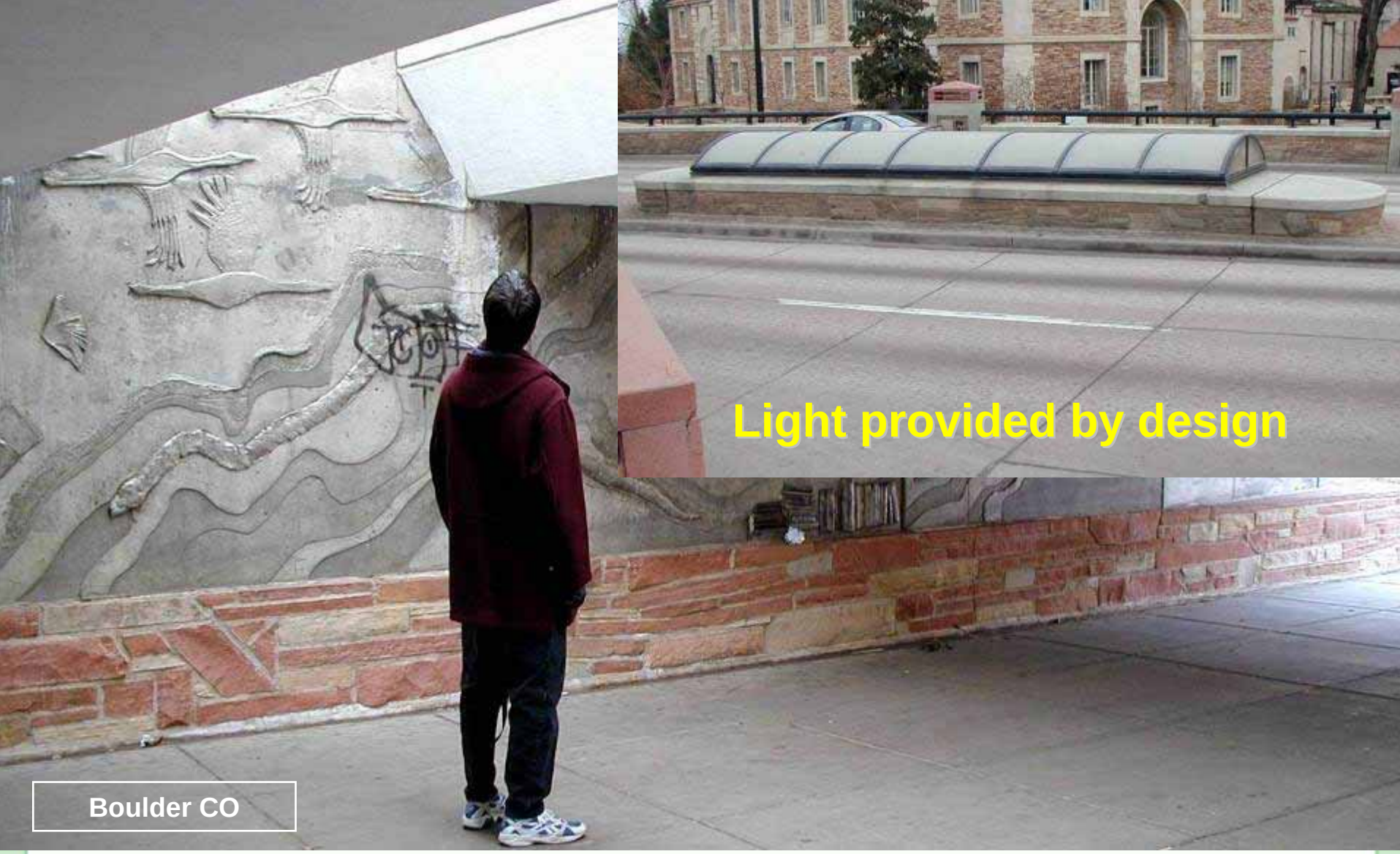
Users must see light at the end of the tunnel



Undercrossing must not intimidate potential user

Boulder CO

Elevated roadway allows open, airy undercrossing



Undercrossings work best if well lit & attractive

Over/undercrossings should be a last resort

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 major roadway

How can you increase their effectiveness?

- By providing a direct route
- By providing security

Crossing treatments cost comparison:

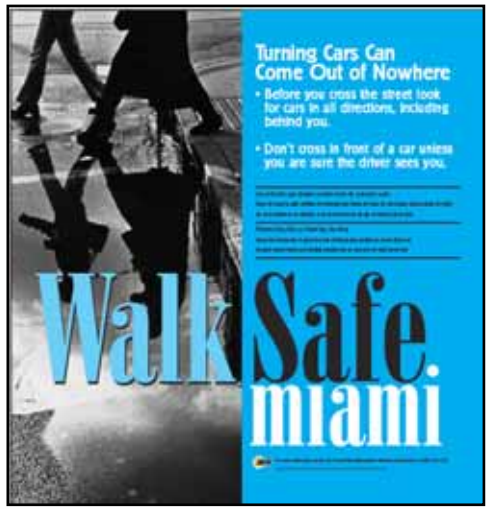
		Effectiveness
Signing	$500 – 1,000	*
High visibility markings	$2,000 – 15,000	**
Advance stop bars	$1,000 – 2,000	****
Illumination	$5,000 – 15,000	****
Median Islands	$10,000 – 30,000	****
Signals	$35,000 – 150,000	***
Over/undercrossings	$500,000 – 2,000,000	*
Proper location	“Priceless”	*****

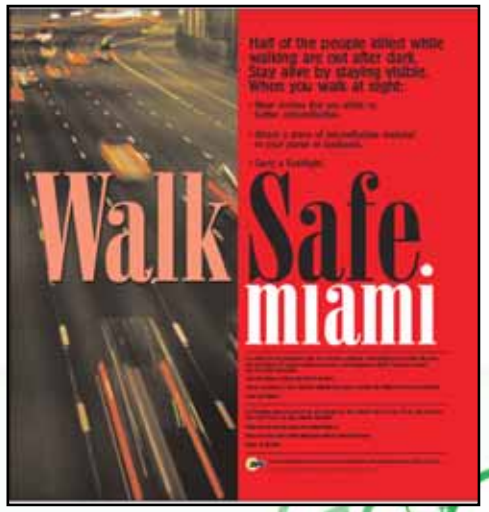
“Right design invites right use”

PBIC Livable Communities Webinar Series

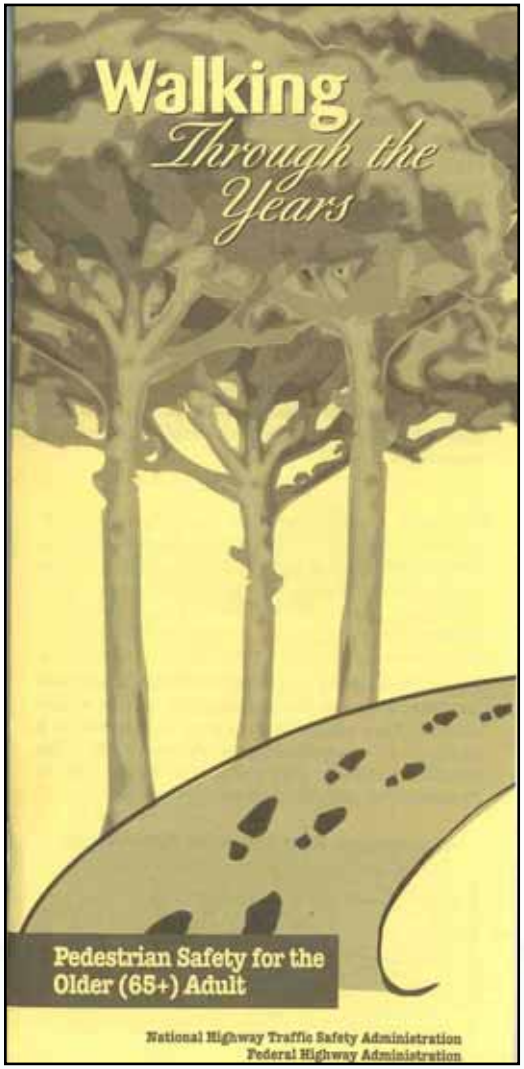
Pedestrian and Bicycle Information Center

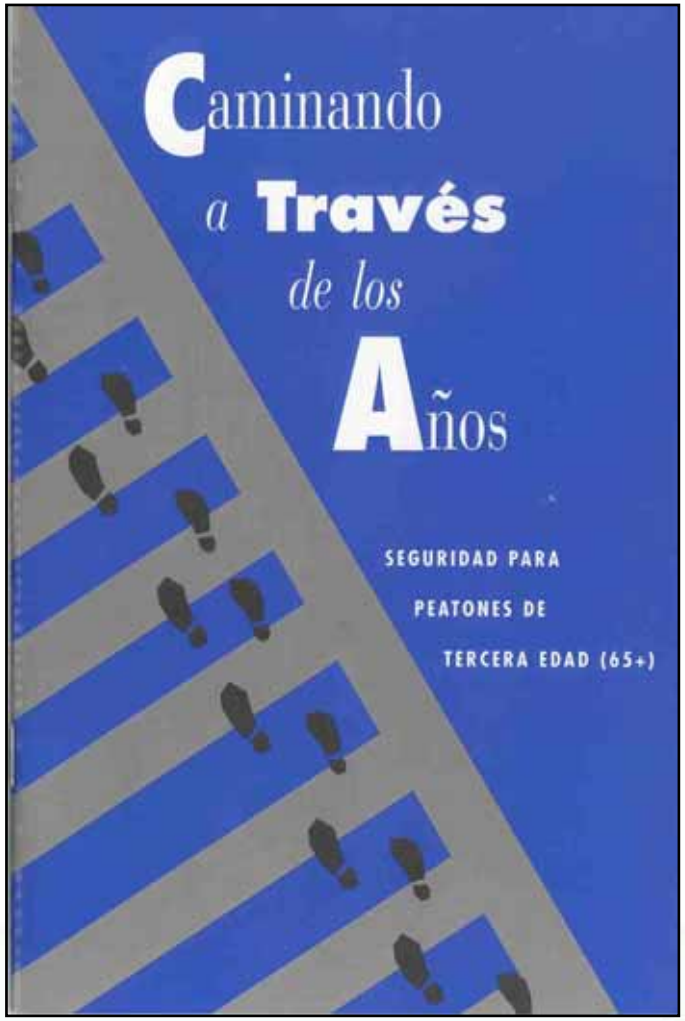
Education: Transit Riders





Education: The Elderly





Driver Education & Enforcement

IN DANGER: As cars make their turns, a pedestrian navigates the crosswalk in the 7300 block of Collins Avenue in Miami Beach. Another pedestrian was killed nearby earlier this month.

Yield to pedestrians, police warn

Sign for Crosswalks at Uncontrolled Sites

Sign for Crosswalks at Traffic Signals

Questions?

Thank you!

- Additional Resources
  - **Engineering solutions: http://www.walkinginfo.org/engineering**
  - **FAQs: http://www.walkinginfo.org/faqs, subject heading "engineering"**
  - **2- and 3-day Training courses: "Designing and Planning for Pedestrian Safety" http://www.walkinginfo.org/training**

- Next PBIC Livable Communities Webinar:
  - "Community Approaches to Pedestrian Safety Education"
  - **Thursday, March 18, 2-3:30pm ET**
  - **Register at http://www.walkinginfo.org/webinars**

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- Questions?
  - **Call Jeremy Pinkham, UNC Highway Safety Research Center, 919-843-4859**
  - **Write to webinars@hsrc.unc.edu**