

# Developing Effective Active Transportation Projects and Programs

Support for Small Agencies and Disadvantaged Communities



## Module 6: ATP Project Design and Prioritization



## Overview

- Effective interventions that can improve conditions for active transportation
- Cutting edge approaches, new techniques
- Recent support for innovative bicycle and pedestrian facilities
- Project prioritization techniques

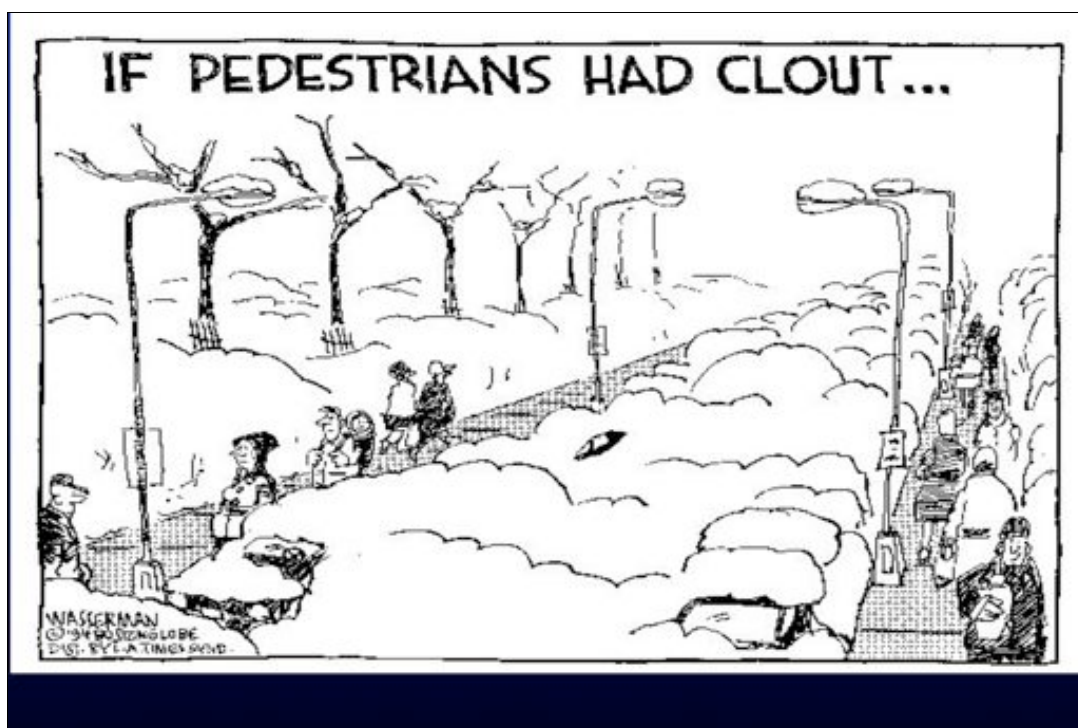
## Engineering – Education – Enforcement

- Working Together — 3 E's approach
- Comprehensive — Communicative — Cooperative
- Synergy: Each makes the other more effective

**“Right design invites right use”**



This slide is a reminder before going into engineering treatments that it's important to consider all 3 Es in developing an Active Transportation project. It's also a good reminder that each E makes the other more effective. And finally, before going into engineering interventions it's important to emphasize that the ultimate purpose of these treatments is to get the proper behavior of the user through good design.



## Five Things Cyclists Want

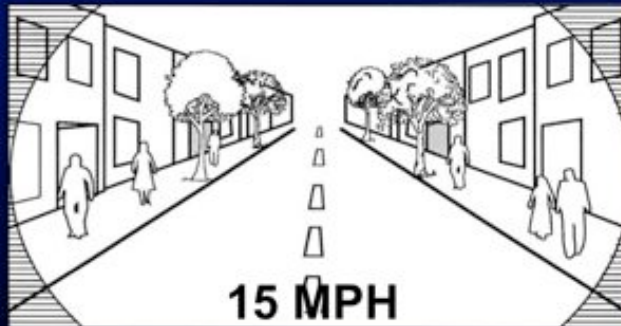
- Space
- Low Vehicle Speed
- Low Traffic Volume
- Smooth surfaces
- Minimal conflicts at intersections



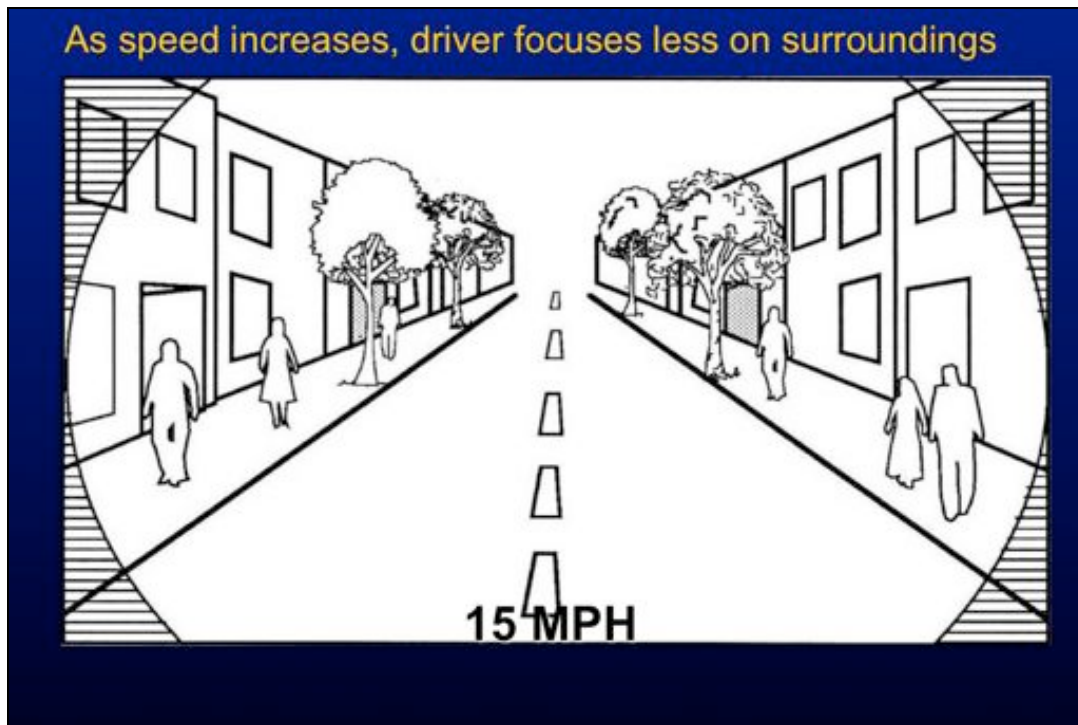
Courtesy: Dave Snyder,  
California Bicycle Coalition

## General Principle to Support Active Transportation: Reduce Vehicle Speeds

- Drivers' field of vision and ability to see pedestrians
- Drivers' ability to react and avoid a crash
- Crash Severity

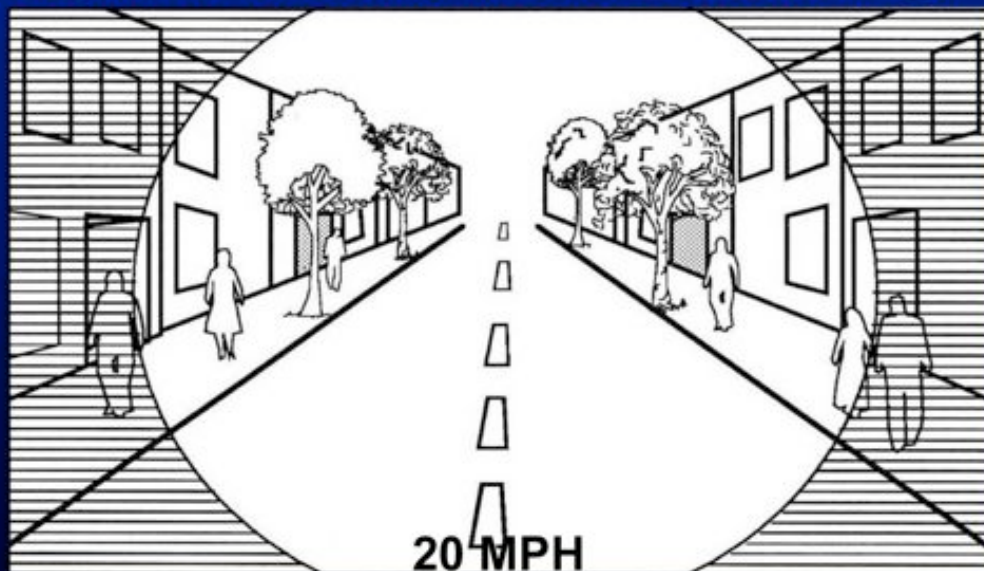


Before getting into some specific innovative designs that support active transportation it's important to discuss some broad principles. The most important of these is the need to reduce motor vehicle speed. The slides that follow illustrate three reasons why speed is so important.

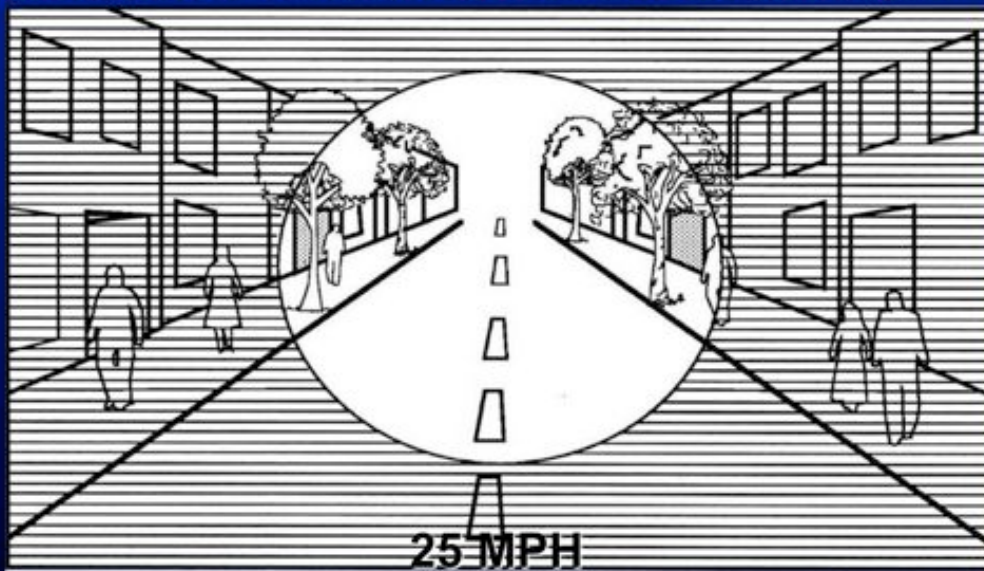


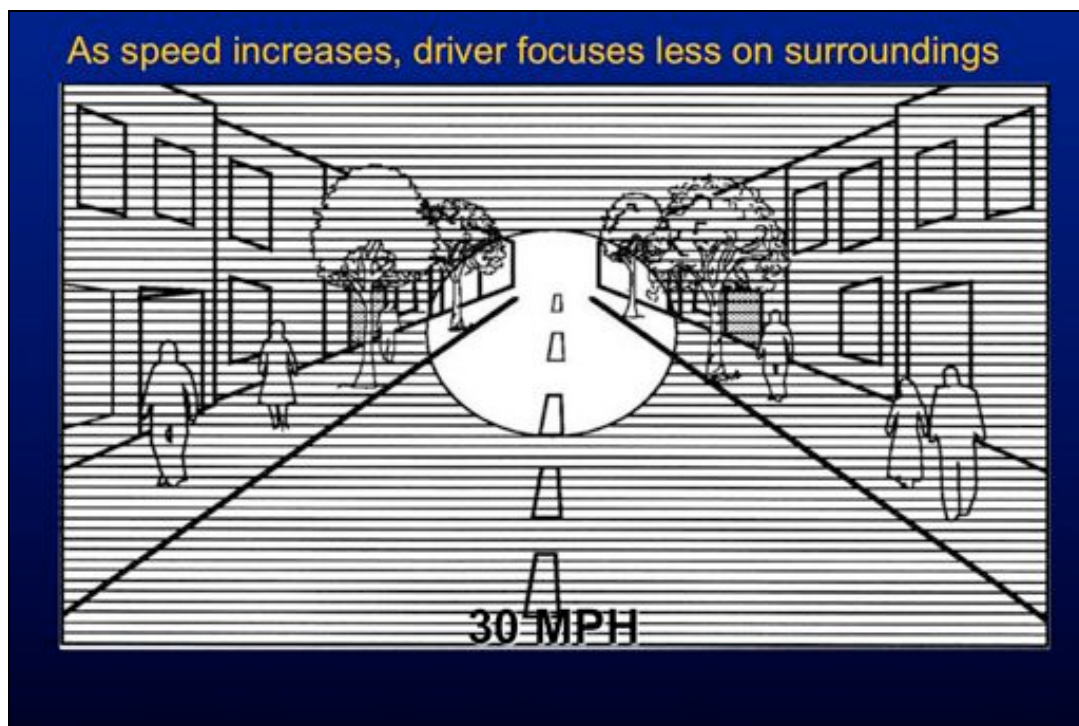
The next 4 figures illustrate how drivers concentrate less on their surroundings as speeds increase. At 15 mph, motorists are more aware of their surroundings. As motorists speed up they tend to focus more on the road ahead and are less likely to notice a pedestrian stepping into the street or a car or bicyclist entering the street from a driveway.

As speed increases, driver focuses less on surroundings

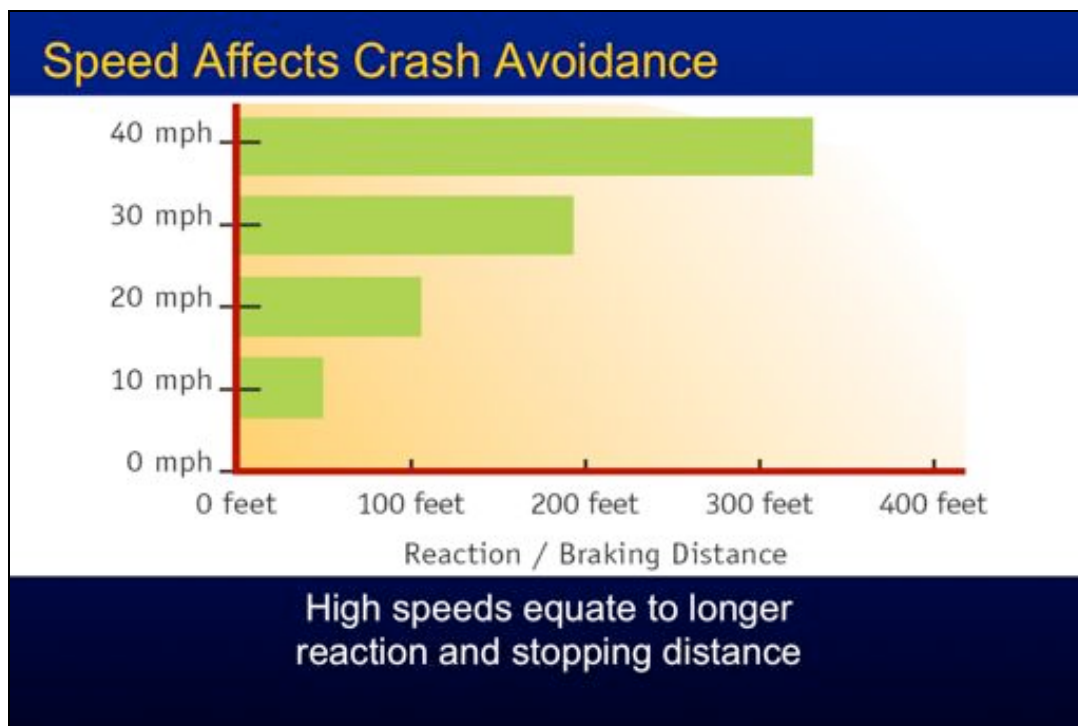


As speed increases, driver focuses less on surroundings





Finish clicking – this show how much more restricted a driver's field of vision is at just 30 mph.



The faster a vehicle is going the more distance it takes to react and bring it to a full stop. This is a function of biology and physics... the time it takes for the brain to tell the driver to slam on the brakes and the physics of bringing a moving vehicle to a full stop. Best way to address this is by pointing out that at 20 mph a car can be brought to a full stop in about 100 feet but if you just double the speed to 40 mph then it takes more than 3 times the distance. It's an exponential equation, as shown in the graph above.

## Speed Affects Crash Severity



W.A. Leaf and D.F. Preusser, "Literature Review on Vehicle Travel Speeds and Pedestrian Injuries Among Selected Racial/Ethnic Groups," US Department of Transportation, National Highway Traffic Safety Administration (1999).

In previous slides we showed how much more difficult it is to stop a car going at a higher speed. This slide points out what happens if a pedestrian gets hit at higher speeds. Again you can compare 20 mph to 40 mph. At 20 mph most pedestrians will survive or only 5 percent will die. But if you double the speed to 40 mph then over 80 percent won't make it. Bottom line, the chances of killing or severely injuring a pedestrian increase exponentially with speed.

## Making Room for Bicycles and Pedestrians



### Road Diet or Road Right-Sizing

- Lower vehicle speeds
- Reduce number of conflicts
- Reduced conflicts/crashes
- Increase in parking utilization
- Increase in walking/bicycling

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Another broad principle worth discussing is how to make room for bikes and pedestrians on streets where some might argue there is no room for them. The first slide discusses road diets (or road right-sizing), the two that follow discuss lane widths.

The most common road diet is the one shown in before and after photos above. That is a 4-lane road in which one lane is removed, another lane is converted to a two-way, left-turn lane and the additional space is made available for a bike lane. This configuration can also work with streets that have on-street parking. Also, we have seen some road diets of 5-lane roads which are reduced to 3-lanes and extra space is taken up with angled parking. These transformations are often win-win. They typically result in reduced crashes of all types and often handle the same or higher traffic volumes as before. The reason for this is that the constraints on capacity are at the intersections, not the links between them and if the intersections are designed well to deal with turning movements they are capable of managing volumes up to 23,000 ADT. (Example: La Jolla Boulevard in San Diego where volumes remain the same after road diet from 5 to 2. Key was addition of 5 roundabouts at intersections which handle intersection traffic very efficiently.)

The list above describes some of the benefits. Below is some research

## Making Room for Bicycles and Pedestrians

- Reducing lane widths of urban streets
  - 10' and 11' lanes are just as safe as 12' lanes on urban arterials with speeds 45 mph and less
  - AASHTO Green Book allows narrower lanes:
    - 10' on lower speed arterials & collectors
    - 11' for streets with high truck volumes



"Relationship of Lane Width to Safety for Urban and Suburban Arterials": Study by Potts, Harwood, and Richard

One of the ways to find space to make streets more complete in urban areas under 45 mph is to reduce the width of lanes that might be oversized. On a multi-lane street the narrowing of lanes might provide space for bicycle lanes or wider sidewalks or on-street parking if none exists.

## Countermeasures for Crossing Crashes

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



In slides that follow we will discuss some of the countermeasures for pedestrian crossing crashes.

## Increase Effectiveness Of Crosswalks With:

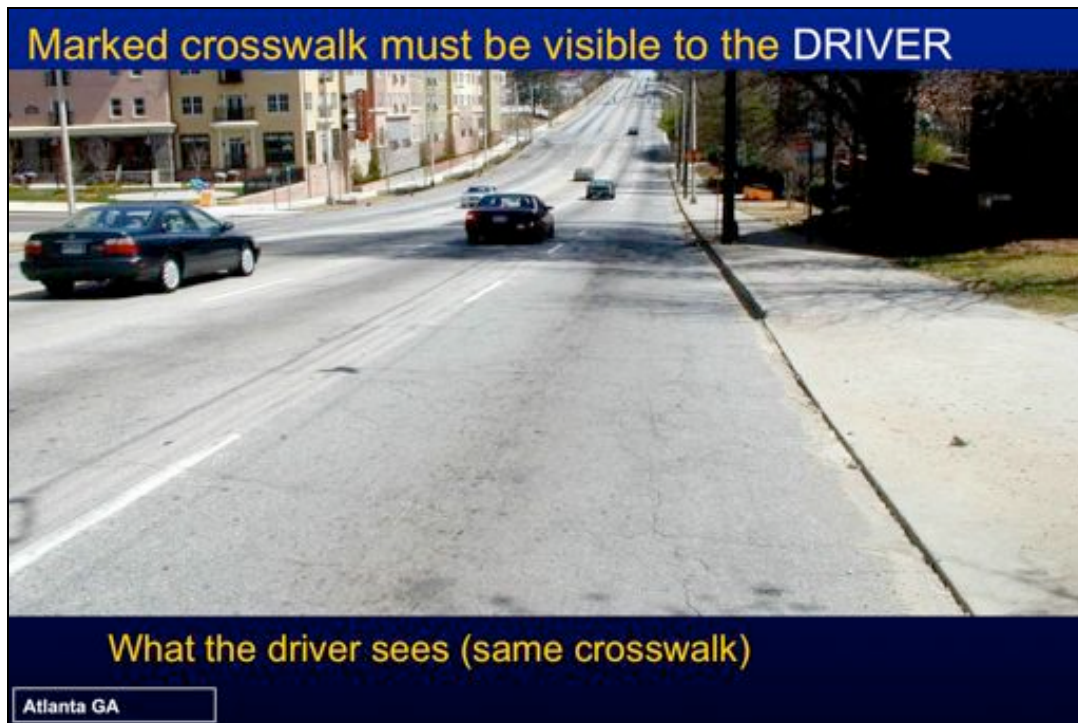
- Proper location
- High Visibility Markings
- Illumination
- Signing
- Advance Stop Bars
- Median Islands
- Curb Extensions
- Signals



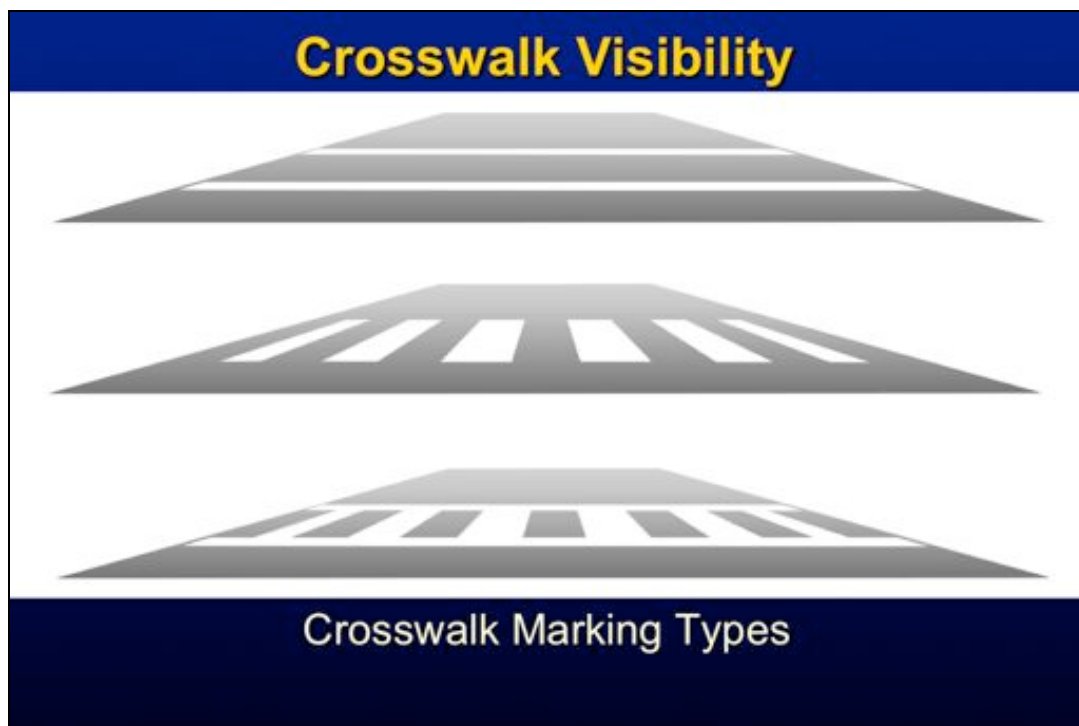
Treatments such as these help improve pedestrian safety at crosswalks. They will be covered in greater detail in the rest of this module.



In order for marked crosswalks to be effective it's important that they be visible not only to the pedestrian but also to the motorists. In this case the crosswalk marking is visible to a pedestrian waiting to cross...

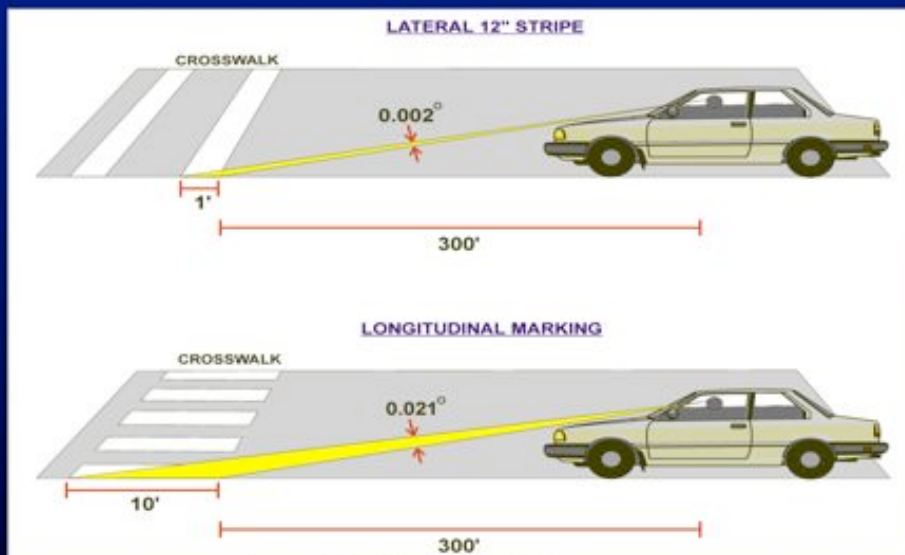


... but the same crosswalk is virtually invisible to the driver. Yet it is the driver who is expected to react to this traffic control device.



The visibility of crosswalks to the driver varies by type; those with markings parallel to the driver's viewpoint are the most visible.

## Use High Visibility Crosswalks



Longitudinal markings are more visible to driver from afar

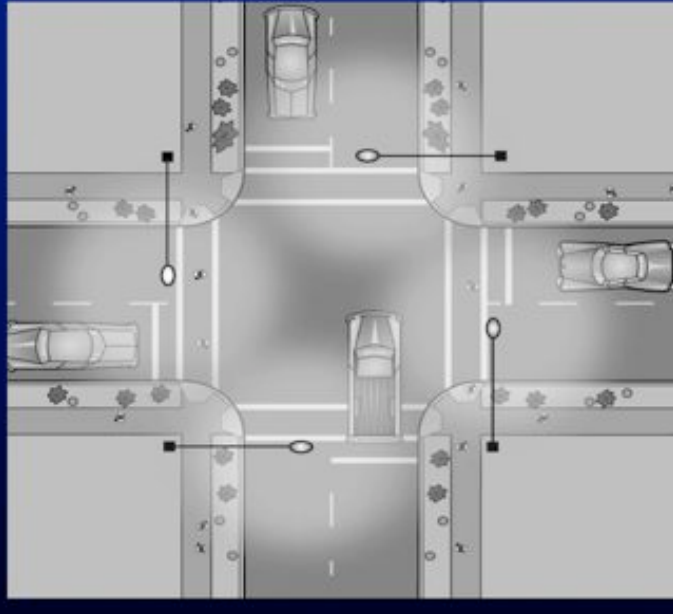
Wide longitudinal lines offer more surface area to be seen by the driver.

## Illumination – Essential For Any Crossing

Marked crosswalk?

— Light it.

Up to 50% of  
pedestrian crashes  
occur at night



It's important that the driver see the pedestrian at night; proper illumination makes the pedestrian visible. Pedestrian crashes occur disproportionately at night: about 4 times more risk in relation to exposure.

## Lighting Location is Important

**Old Way**



Figure 11. Drawing. Traditional midblock crosswalk lighting layout.

**New Way**



Figure 12. Drawing. New design for midblock crosswalk lighting layout.



**Old Way**

Figure 13. Drawing. Traditional intersection lighting layout.



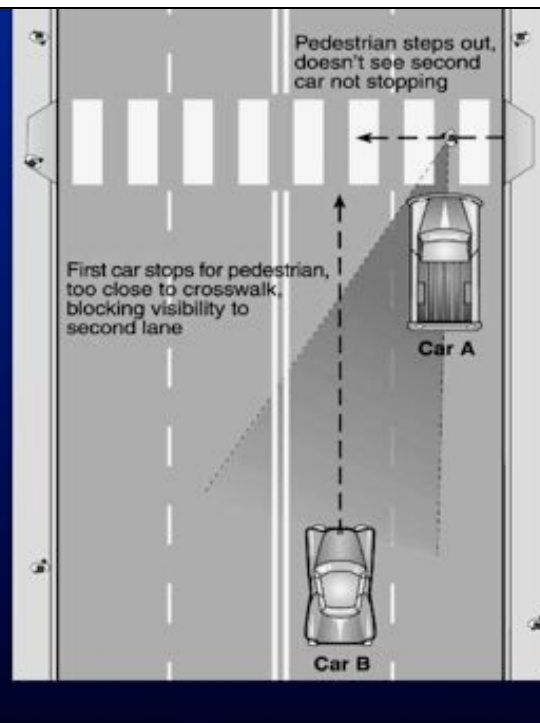
**New Way**

Informational Report on Lighting Design for Midblock Crosswalks  
([www.tfhr.gov/safety/pubs/08053/08053.pdf](http://www.tfhr.gov/safety/pubs/08053/08053.pdf))

## Multiple Threat Crash Problem

Explanation for why crashes increase at marked crosswalks

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

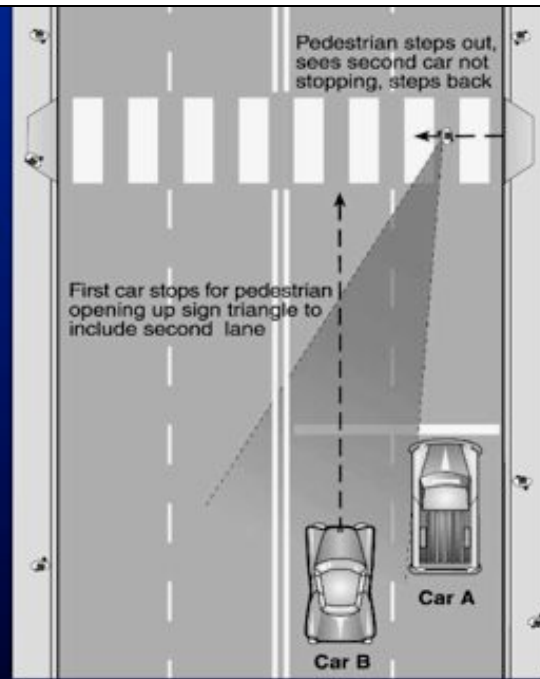


On multiple lane streets we need to make sure that the marked crosswalk doesn't create a multiple threat crash. This plan view illustrates what happens in this situation.

## Multiple Threat Crash Solution

Advance stop/yield line

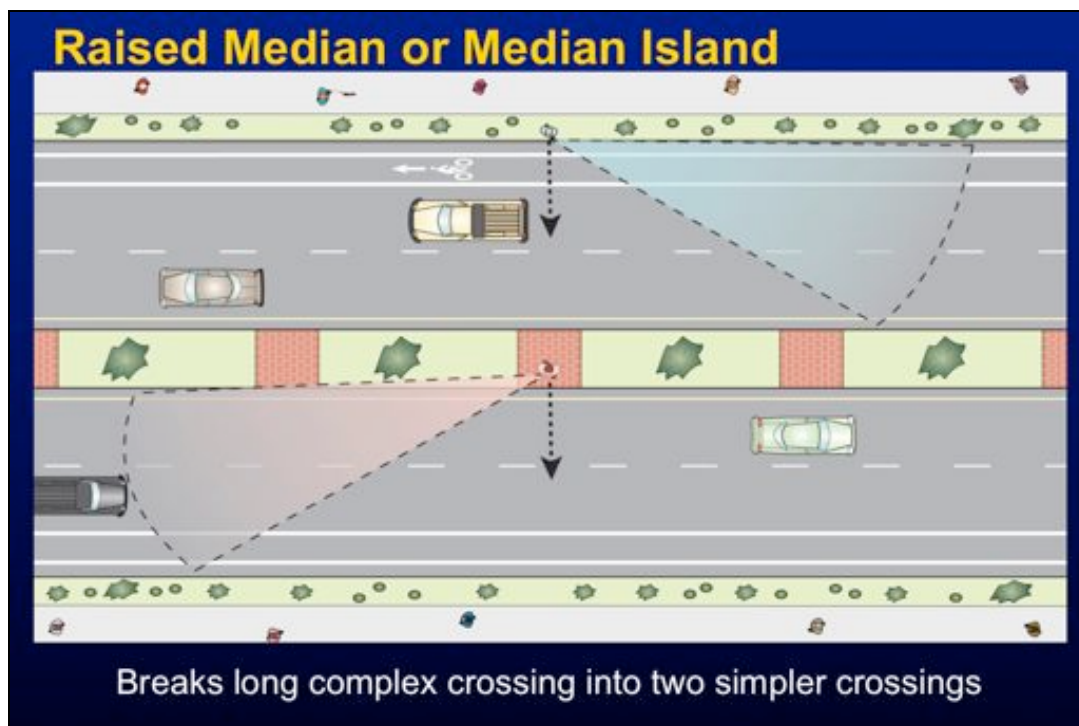
- 1st car stops further back, opening up sight lines
- 2nd car can be seen by pedestrian



The solution is quite simple: Placing the stop or yield line far enough in advance so that visibility isn't blocked. The advance stop bar has proven very effective at preventing multiple-threat crashes. In most cases the crash is avoided because the pedestrian stepped back and took evasive action (rarely can a car traveling at 40 MPH +/- stop in time if the driver has to react at the last second).



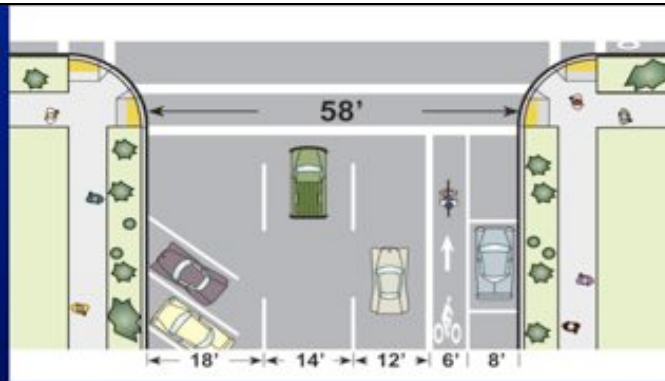
Here's an example of an advance yield markings (shark's teeth) are also shown in the MUTCD. States with a yield to pedestrian law should use the shark's teeth (yield line) rather than a stop bar.



Continuous medians or median islands are another way to help pedestrians get across the street safely. The basic principle behind a median or median island is that the pedestrian crosses half the roadway at a time, simplifying the task of assessing an adequate gap, making the crossing much safer. The pedestrian looks left, crosses to the island, looks right, crosses 2<sup>nd</sup> half. Much easier than finding a gap long enough to cross all lanes at once.

## Curb extensions

Most focus has been on reduced crossing distance

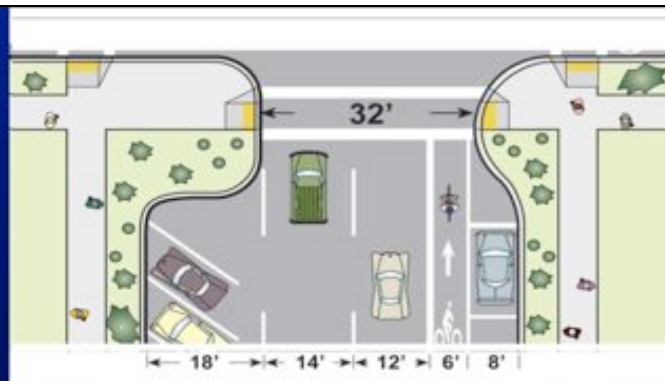


At intersections, curb extensions help pedestrians in several ways.

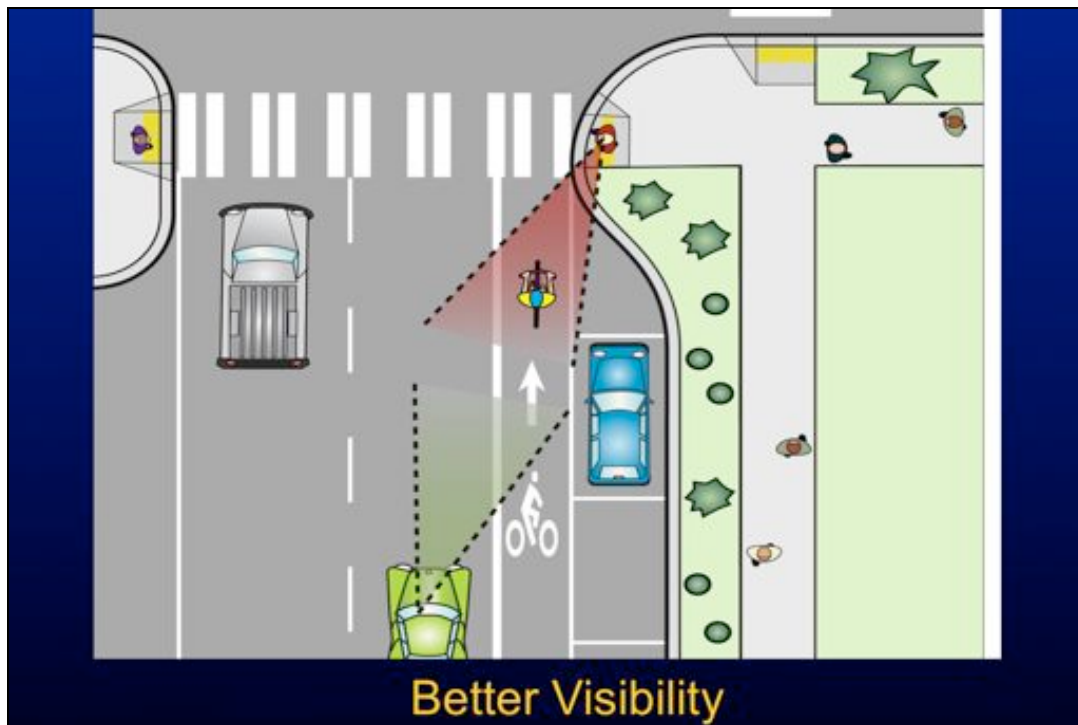
### Other advantages:

- Better visibility between pedestrians, cyclists and motorists
- Traffic calming
- Room for street furniture

Curb extensions should be the width of the parking lane and not encroach on bike lanes or travel lanes



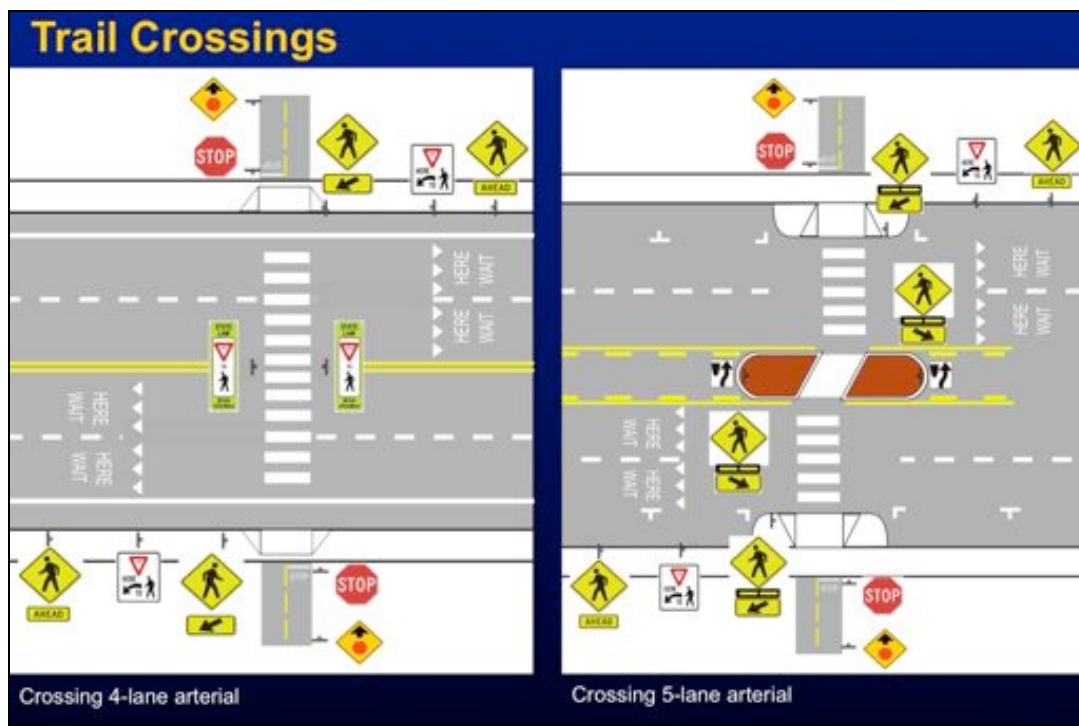
... as shown here.



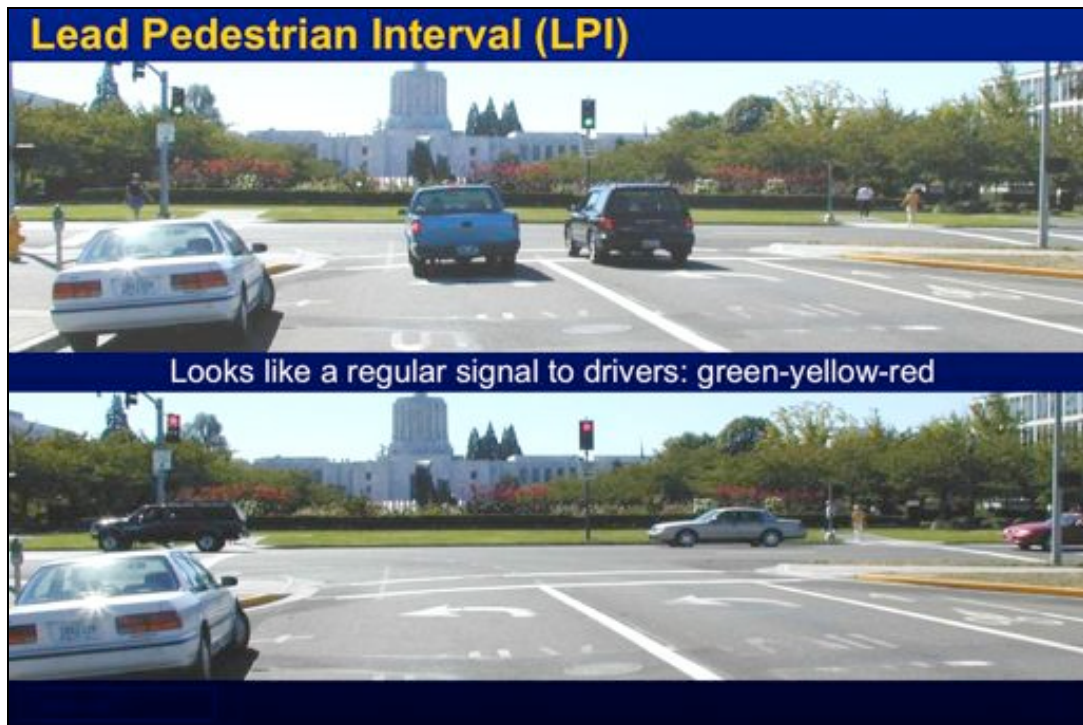
This slide focuses on how curb extensions improve visibility.



In this example from Venice, Florida we also see how curb extensions can help calm traffic by requiring vehicles entering or exiting a street to slow down.



This image shows some recommended treatments to help bicyclists or pedestrians cross multi-lane roadways.



The Lead Pedestrian Interval (LPI) is a simple signal timing tweak that enables pedestrians to get a head start and avoid the conflicts that occur when pedestrians and turning vehicles start their movements simultaneously. In this example, there is a heavy left turn movement from a one-way street to another.



LPI gives pedestrians a bit of a head start, let them start crossing before motor vehicles do. This means pedestrians are already 10-15 feet into the crosswalk when vehicles start their turns. This enables drivers to see the pedestrians; when pedestrians are present, drivers wait their turn.

## Rectangular Rapid Flashing Beacons (RRFB)

- Supplement warning signs at unsignalized intersections or mid-block crosswalks.
- Increase driver yielding behavior



## Pedestrian Hybrid Beacon aka “HAWK” (High Intensity Activated Crosswalk)



2009 MUTCD Chapter 4F Pedestrian Hybrid Beacons

Tucson AZ

The Pedestrian Hybrid Beacon is another tool to help pedestrians cross the street.

Drivers see  
Hybrid  
Beacon



Pedestrians  
see  
Pedestrian  
Signal Head

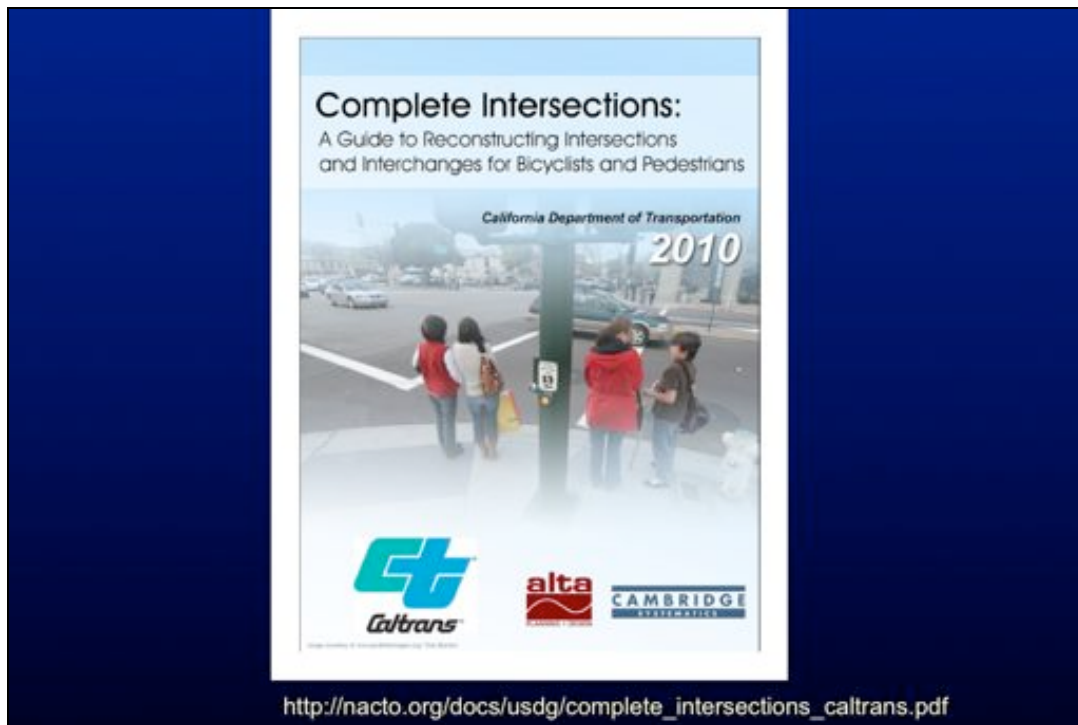


Tucson AZ

## Pedestrian Hybrid Beacon Sequence



California MUTCD, 2014 Edition, Chapter 4F

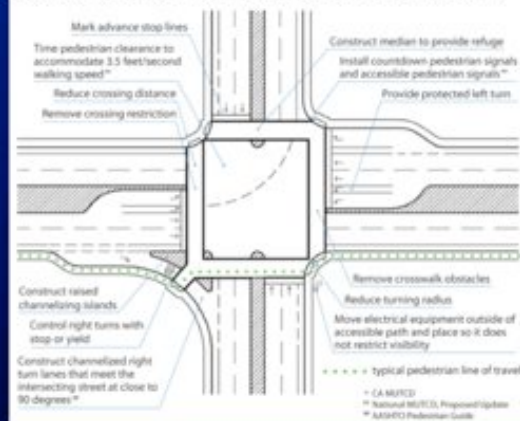


This Caltrans guide has very useful information about how to make intersections work better for all users.

## Complete Intersections: Guiding Principles

- Observe: Watch how intersection is being used
- Pedestrians/Bicyclists Will Be There
- Tee It Up: Bring intersections to 90-degree angle
- One Decision at a Time (e.g. median, pork chop island)
- Slow it Down
- Shorten Crossings
- Improve Visibility
- Keep it Direct: Avoid closing crossings
- Light at Night
- Access for All

Figure 3.2 Common Intersection Treatments for Pedestrians



## Example: Reconfigured Ramp Terminus



- Large angle = wide crossing and high-speed turns
- Tight angle = short crossing and slow speed turns

This photo shows an example of a reconfigured freeway. The area with low vegetation is where the old ramp used to be.

## California: Recent Support for Innovative Bicycle and Pedestrian Facilities

- Caltrans endorsement of National Association of City Transportation Officials (NACTO) Guides
- AB 1193 – Protected Bikeways Act
- 3-Foot Passing Law
- Revisions to CA Highway Design Manual (HDM) and CA Manual on Uniform Traffic Control Devices (MUTCD)
- Upcoming Revisions to HDM

The section that follows discusses some of the recent changes in California that support innovative bicycle and pedestrian facilities.

## Caltrans Endorsement of NACTO Guides

- Urban Bikeway Design Guide
  - Innovative treatments for bike boulevards, signs, pavement markings, and intersections



## Caltrans Endorsement of NACTO Guides

- Urban Street Design Guide
  - Design of streets, intersections, and “design controls” (includes functional classification, performance measures and design speed)



## Temporary Curb Extensions



San Francisco, CA

# **Urban Street Design Guide**



OVERVIEW

OCTOBER 2012

## **What's to Come**

The NACTO Urban Street Design Guide has been designed to enable the street from multiple perspectives, from the bird's-eye view to the granular details. This overview is the first product in the development of a design guide for urban streets. The chapters highlight, explore, illustrate some of the greatest street design practices around the country and synthesize these national efforts.

Street network design principles will be discussed mainly as they relate to the design of individual corridors. Materials, lighting and street furniture are emphasized here due to their inherently local character and application.

The NACTO Urban Street Design Guide is slated for release in Summer 2013.

### **Outline for the 2013 NACTO Urban Street Design Guide**

Items highlighted in **bold** are discussed in this overview.

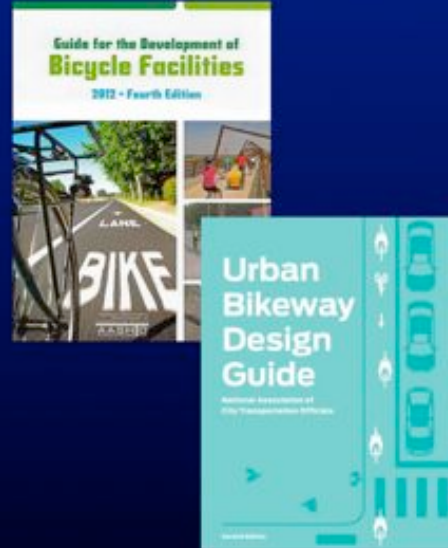
Streets and Intersections	Critical Issues	Treatments & Elements
<ul style="list-style-type: none"> <li>• Very Large Streets</li> <li>• Large Streets</li> <li>• Medium Streets</li> <li>• Small Street</li> <li>• Very Small Streets</li> <li>• Access and Maneuverability</li> <li>• Pedestrian Streets</li> <li>• Shared Streets and Home Zones</li> <li>• Transit Streets</li> <li>• Compact Intersections</li> <li>• Reorganizing Intersections</li> <li>• Multi-lane Intersections</li> <li>• Public Places</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Speed and Safety</b></li> <li>• <b>Design vs. Target Speed</b></li> <li>• Corner Design and Turning Radii</li> <li>• Lane Width</li> <li>• Flare/Lane</li> <li>• Crosswalks and Crossings</li> <li>• Level of Service</li> <li>• Curbside Management</li> <li>• Design and Control Vehicle</li> <li>• Functional Classification</li> <li>• One-way vs. Two-way</li> <li>• Traffic Control Devices</li> <li>• Visibility and Sightlines</li> <li>• Clear Zones</li> <li>• Access Management</li> <li>• On-ramps</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Materials, Materials &amp; Street</b></li> <li>• <b>Lighting</b></li> <li>• <b>Low Impact Design</b></li> <li>• <b>Minimizing the Curb</b></li> <li>• <b>Bus Stops</b></li> <li>• <b>Stormwater Management</b></li> <li>• <b>Parking</b></li> <li>• <b>Stakeholder Collaborations</b></li> </ul>

NACTO Urban Street Design Guide Overview 5

Available free, online at [nacto.org/usdg](http://nacto.org/usdg)

# AB 1193 – Protected Bikeways Act

- Local discretion: Design guidance other than Caltrans HDM may be used if alternative is:
  - Approved by registered engineer
  - Adopted by resolution at public hearing; and
  - Supported by guidelines established by national association of transportation officials



# AB 1193 – Protected Bikeways Act

- Created Class 4 “protected bikeway” or “cycle track”
  - Caltrans to develop design standards by January 2016



## California Examples of Cycletracks



Long Beach



Long Beach



Ripon



Temple City

## 3-Foot Passing Law



Photo Credit: Napa County Bicycle Coalition

## CA Manual on Uniform Traffic Control Devices (MUTCD)

- Buffered bicycle lanes
- Contraflow bicycle lanes
- Bicycle lane extensions through intersections
- Updated crossing time guidance for seniors and people with disabilities
- Crosswalk enhancements across uncontrolled intersections

The slides that follow show some innovative treatments that are supported by the California MUTCD.

## Buffered Bicycle Lanes

- Provides greater distance between bicyclists and motor vehicles.
- Contributes to bicyclist perception of safety



Where parking is permitted, one line is dashed (crossing double white lines violates CVC)

## Contraflow Bicycle Lanes

- Provides additional connectivity for bicycle facility network
- Reduces wrong-way riding



## Bicycle Lane Extension through Intersection

- Helps guide bicyclists through intersections
- Reduces conflicts between bicyclists and turning motorists



## Pedestrian Updates to MUTCD

- Updated crossing time guidance for seniors and people with disabilities
  - 2.8 feet/second should be used where older or disabled pedestrians routinely use the crosswalk (Sec. 4E.06.10a)
- Crosswalk enhancements across uncontrolled intersections
  - Should include additional safety enhancements designed to reduce traffic speeds, shorten crossing distances, enhance driver awareness, and/or provide active warning of pedestrian presence (Sec. 3B.18.09)

## Future HDM Revisions

Currently approved for experimental use

- Bike boxes
- 2-stage turn queue boxes
- Bicycle signal faces
- Green sharrows

These are some future revisions to the California Highway Design Manual.

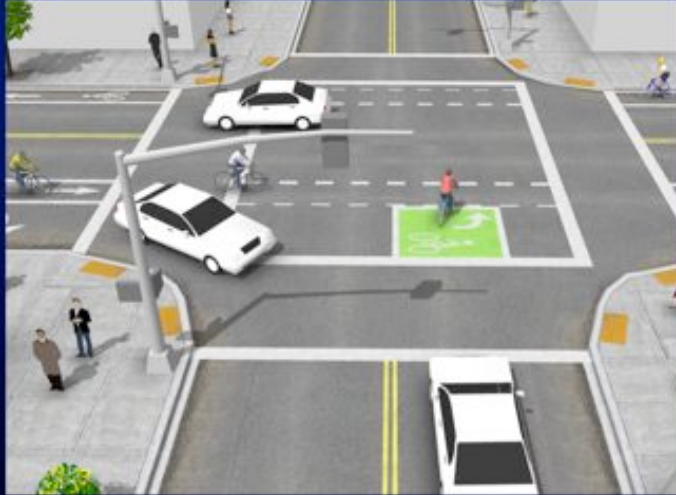
## Bike Boxes

- Improves visibility of bicyclists to motorists
- Facilitates bicyclist left turns
- Reduces right-hook conflicts with turning vehicles



## 2-Stage Turn Queue Boxes

- Assists bicyclists making 2-stage left turn
- Reduces conflicts between bicyclists and motor vehicles



## Bicycle Signal Faces

- Separates bicycle movements from other modes at signalized intersections



## Green Sharrows

- Increase visibility of sharrows to all roadway users



## Project Prioritization Tools

- Humboldt County Association of Governments SRTS Prioritization Tool
- San Francisco SRTS Prioritization Tool
- National Center for SRTS: Safety-based prioritization of schools for SRTS Infrastructure Projects
- New York City DOT Safe Streets for Seniors

These are some examples of how communities can prioritize projects.

## Humboldt CAG Prioritization Tool

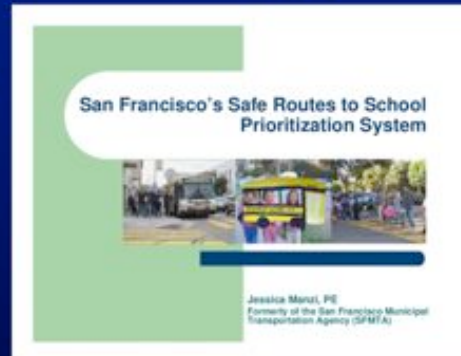
[www.hcaog.net/sites/default/files/](http://www.hcaog.net/sites/default/files/)

[hcaog\\_sr2s\\_prioritizn\\_tool\\_report\\_final\\_draft\\_0.pdf](#)

- Combines GIS-based spatial data and qualitative matrix to understand school's readiness to proceed with SR2S programs. Three categories of criteria:
  - School readiness for SR2S projects and programs (gathered through school SR2S inventory calls and SR2S parent surveys).
  - School internal need (demographic factors within the school that may indicate need for SR2S programs).
  - School external need (physical and socioeconomic factors in the immediate vicinity of school)

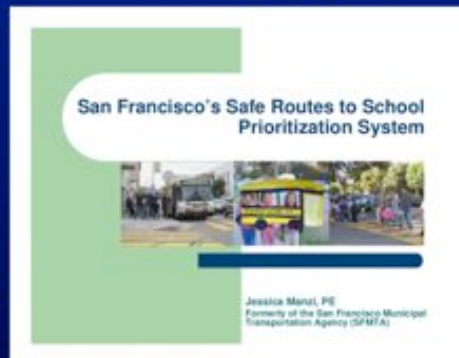
# San Francisco SRTS Prioritization System

- Infrastructure changes:  
Prioritize schools with a lot of kids walking and safety concerns
  - Step 1: Compile Data (enrollment, % who walk, pedestrian crashes)
  - Step 2: Classify schools into 5 tiers (Calculate quartiles walkers and ped crashes)
  - Step 3: Reality Check
  - Step 4: Rank within tiers OR Feasibility screen



# San Francisco SRTS Prioritization System

- Non-Infrastructure projects:  
Prioritize schools with the highest potential for more walkers
  - Step 1: Compile Data  
(enrollment, % w/in 1 mile, % who walk, # non-walkers)
  - Step 2: Rank by non-walkers
  - Step 3: Solicit participation



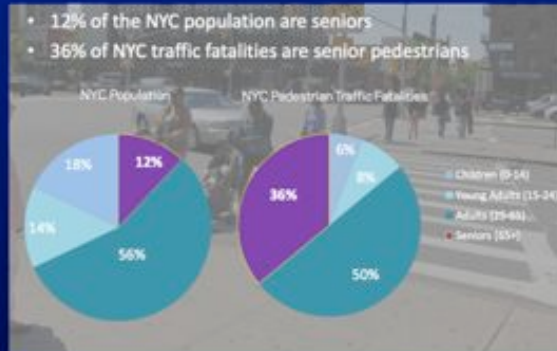
## National Center for SRTS Prioritization Tool for Infrastructure Projects

[www.saferoutesinfo.org/sites/default/files/resources/  
Prioritizing\\_Infrastructure\\_Projects.PDF](http://www.saferoutesinfo.org/sites/default/files/resources/Prioritizing_Infrastructure_Projects.PDF)

- Step 1: Prioritize Schools
  - Worksheet to record key factors
    - Crash history
    - Safety concerns
    - Current or potential use
  - Assign schools to groups
- Step 2: Conduct field reviews of highest priority schools

## NYC Safe Streets for Seniors

- 12% of population are seniors; 36% of traffic fatalities are senior pedestrians
- Identified senior pedestrian issues
  - Not enough time to cross
  - Broken/Missing ped ramps
  - Faded/Hard-to-see markings
  - Poor drainage in crosswalks
  - Turning vehicles fail to yield



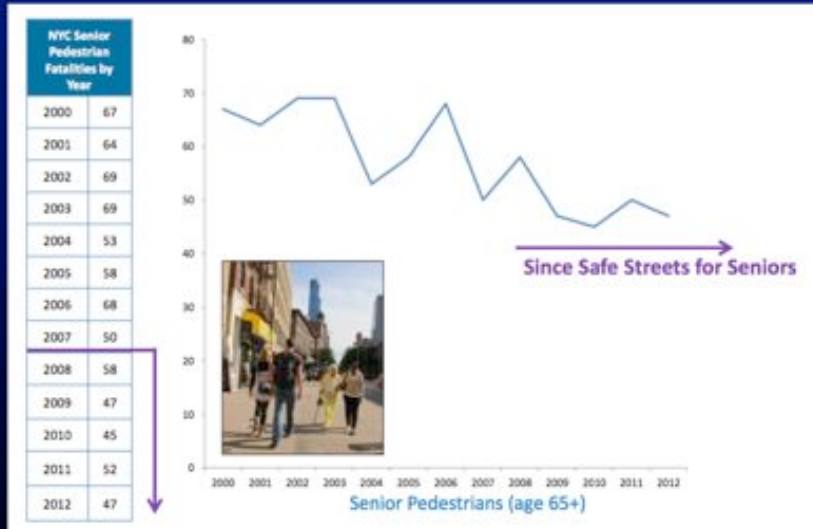
## NYC Safe Streets for Seniors

- GIS mapping of Senior Severe Injury Density
  - Used to select top priority focus areas
- Developed Toolbox
  - Daylighting
  - Countdown Signals
  - Signal Timing
  - Ped Safety Islands
  - Road Diet
  - Sidewalk Extension



# NYC Safe Streets for Seniors

- Tracked results by year



Questions/Comments?