

IMPLEMENTING COMPLETE STREETS

DESIGN CONSIDERATIONS (Module 2)

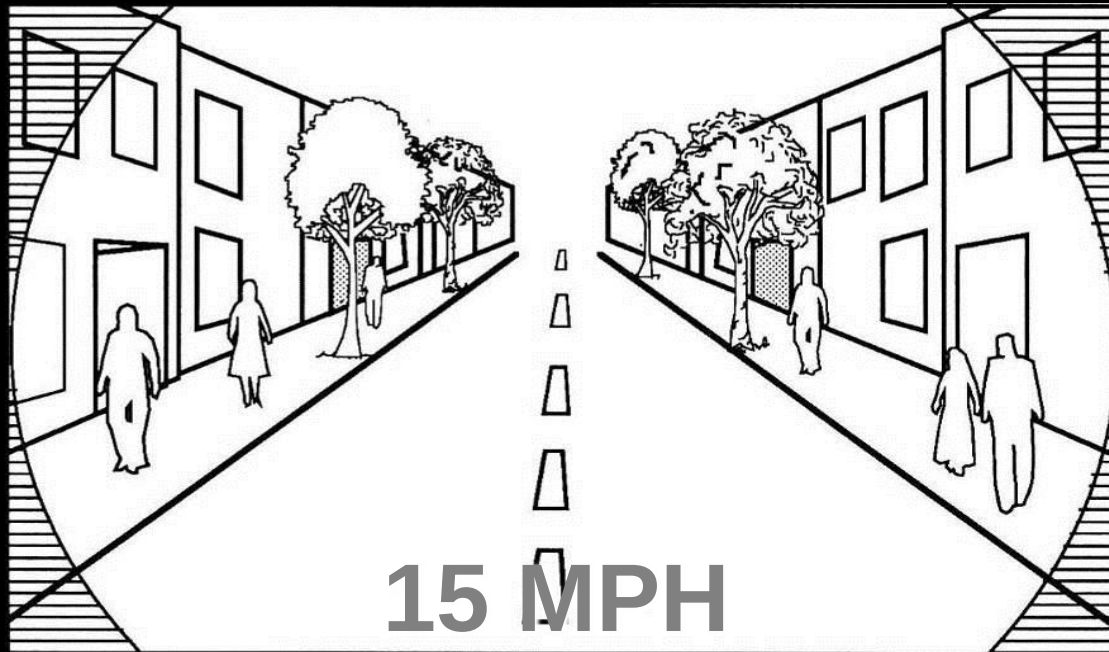
- **Safety**
- **Operations**
- **Forgotten Users**
- **Design Strategies**

Safety

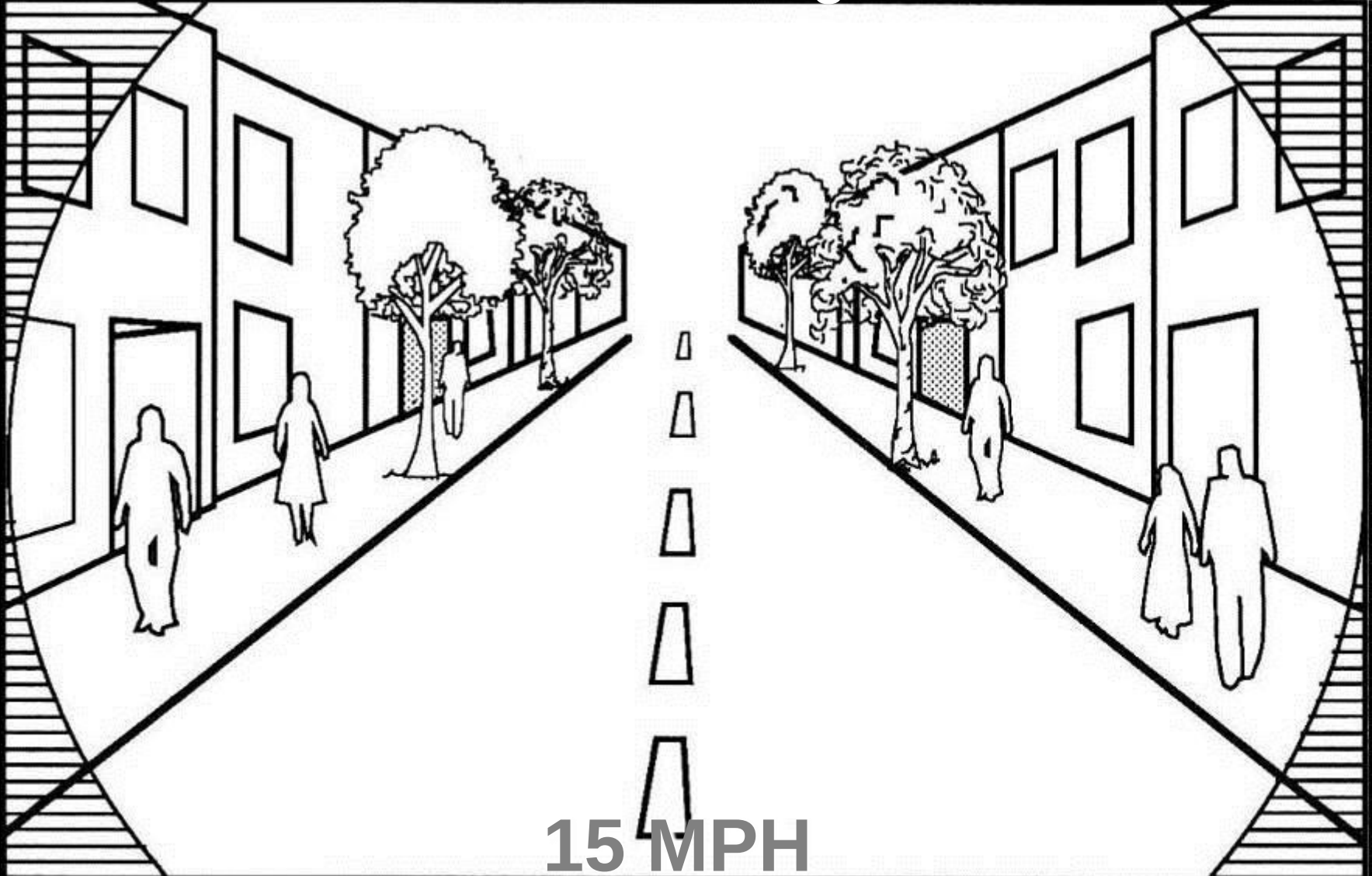
Speed Matters

Why Speed Matters

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

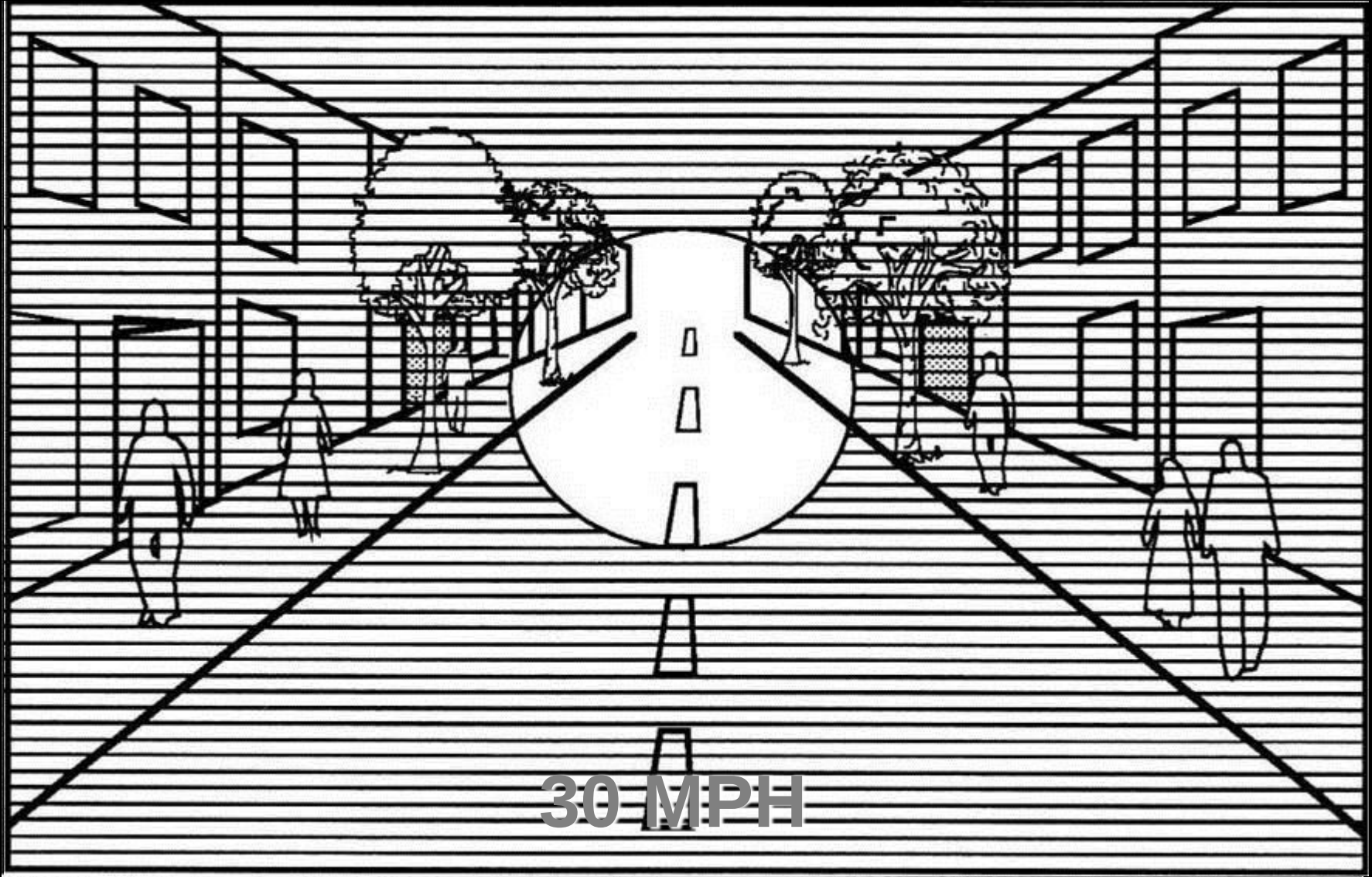


As speed increases, driver focuses less on surroundings

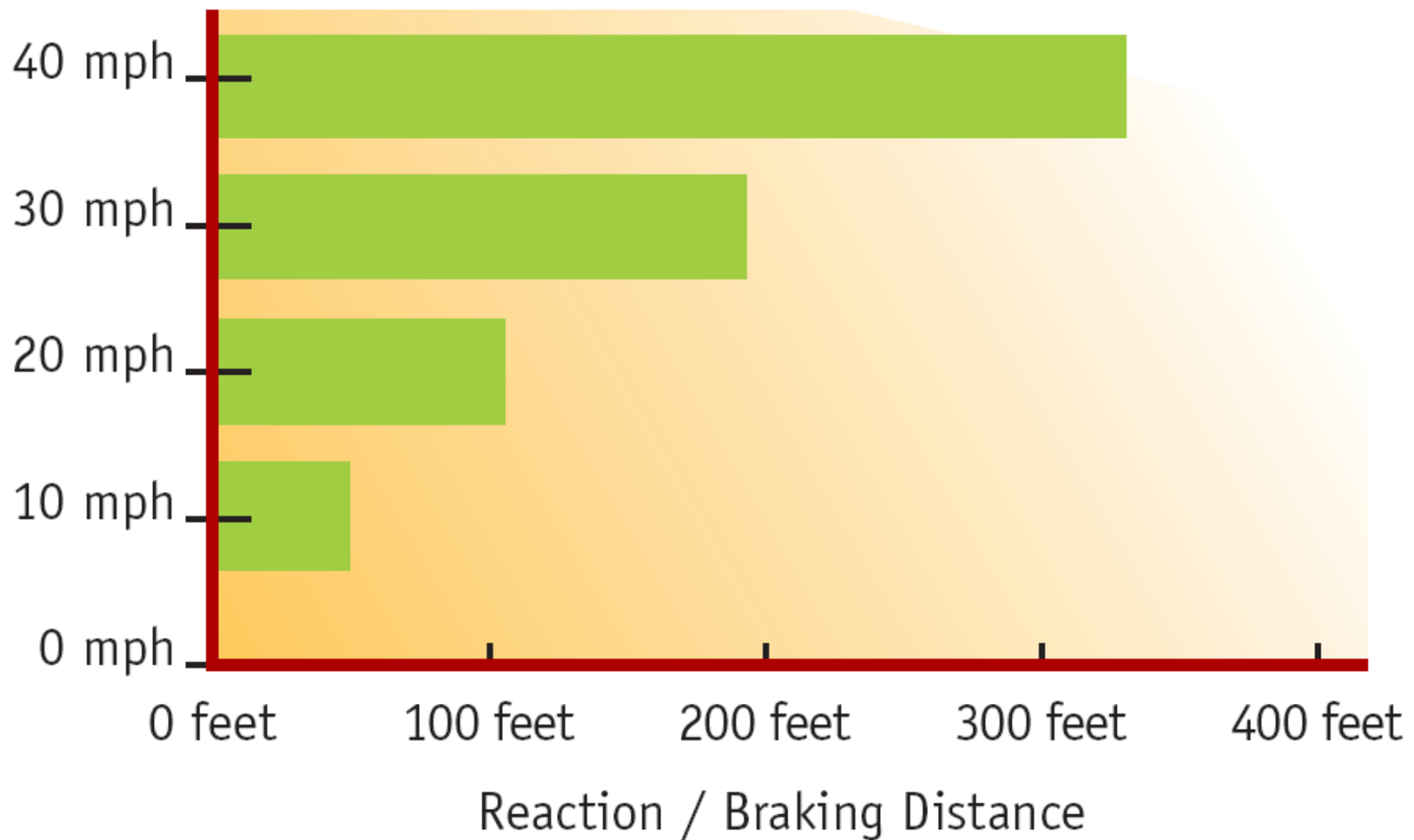


15 MPH

As speed increases, driver field of focus shrinks



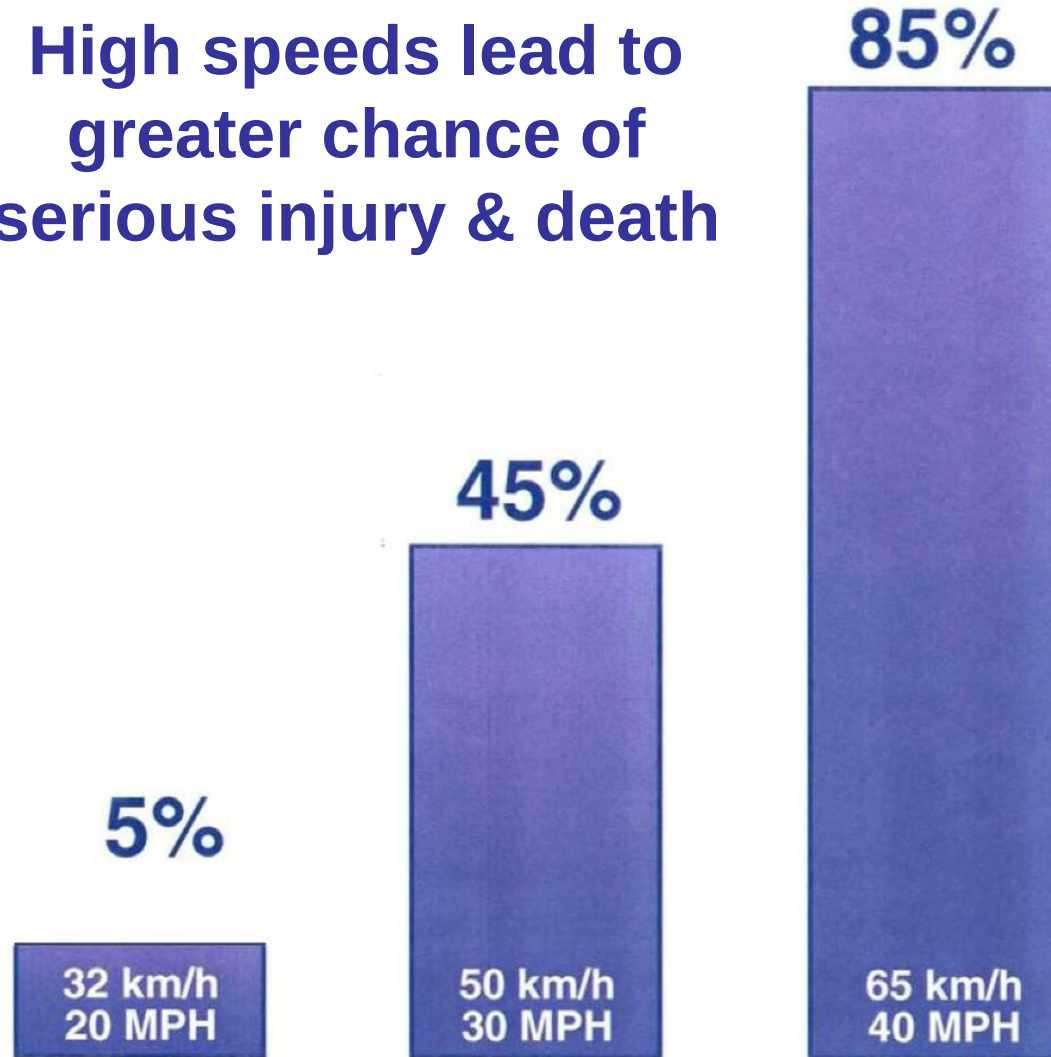
Speed Affects Crash Avoidance



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

Sources:
Killing Speed and Saving Lives,
United Kingdom DOT

Vehicle Travel Speeds and
Pedestrian Injuries;
NHTSA.DOT HS 809 021

Low Speed Urban vs. High Speed Rural

- **Streets Operate differently**
- **Should be based differently**
- **Urban Streets – Design to encourage slower, safer behavior**
- **Higher Speed – Provide extra space**
- **FHWA – Proposed Revision of Thirteen Controlling Criteria for Design**



Operations

Understanding the Concepts

Roadway Capacity Analysis

- Roadway design based on peak hour (or half hour) traffic for design year (typically 20 years hence)

Level of Service (LOS) Intervals

Signalized Intersection

Delay/Vehicle (sec)	LOS	Description
≤ 10	A	Free flow
> 10 and ≤ 20	B	Minor delays
> 20 and ≤ 35	C	Occasional delays
> 35 and ≤ 55	D	Typical urban flow
> 55 and ≤ 80	E	Practical capacity
> 80	F	Stop-and-go

Source: Highway Capacity Manual, 2000.

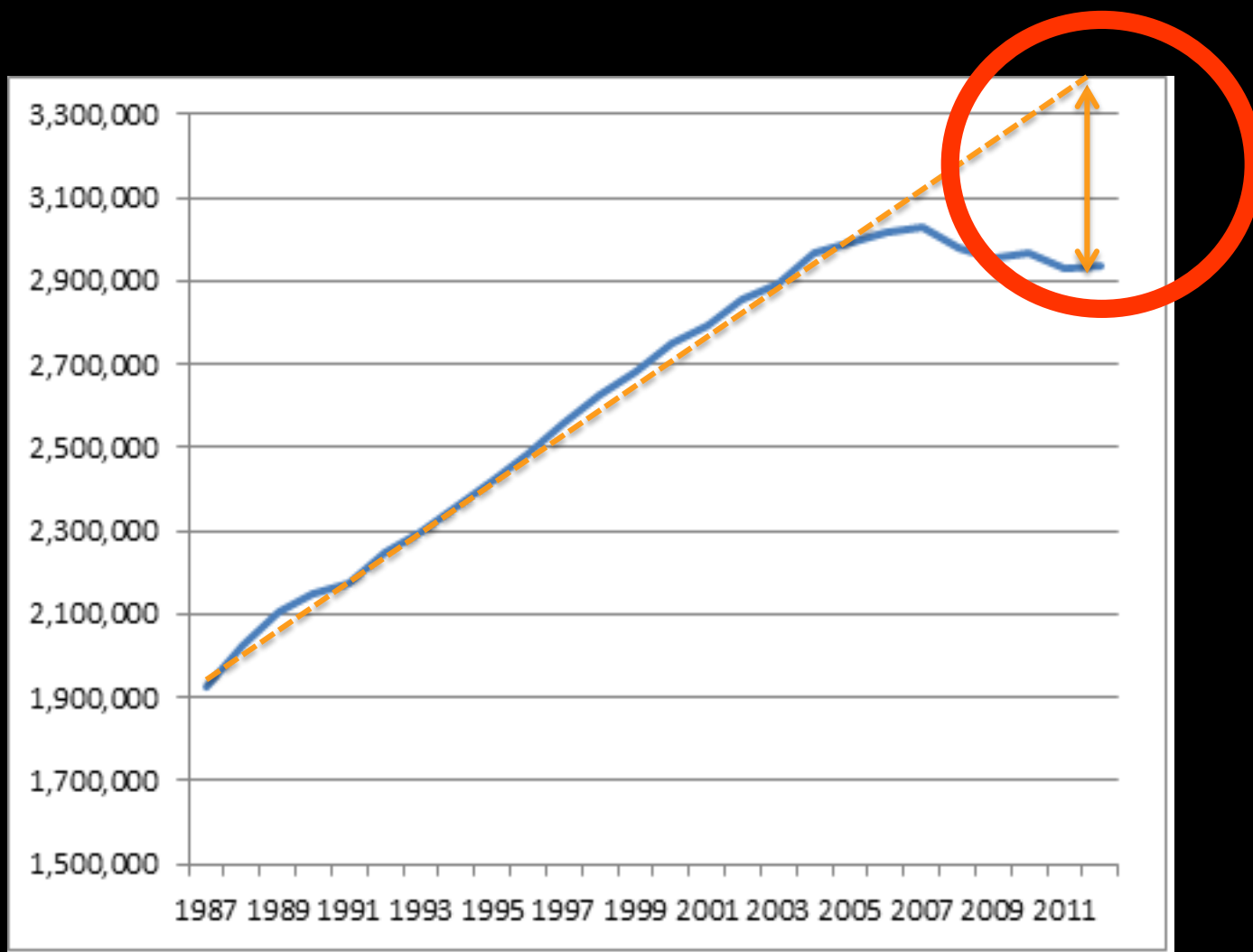
Roadway Capacity Analysis

- Designing for Level of Service C future peak hour means:
 - Increased pavement widths
 - Increased operating speeds for non-peak hours
 - Increased pedestrian crossing times, thus reducing vehicular movement times

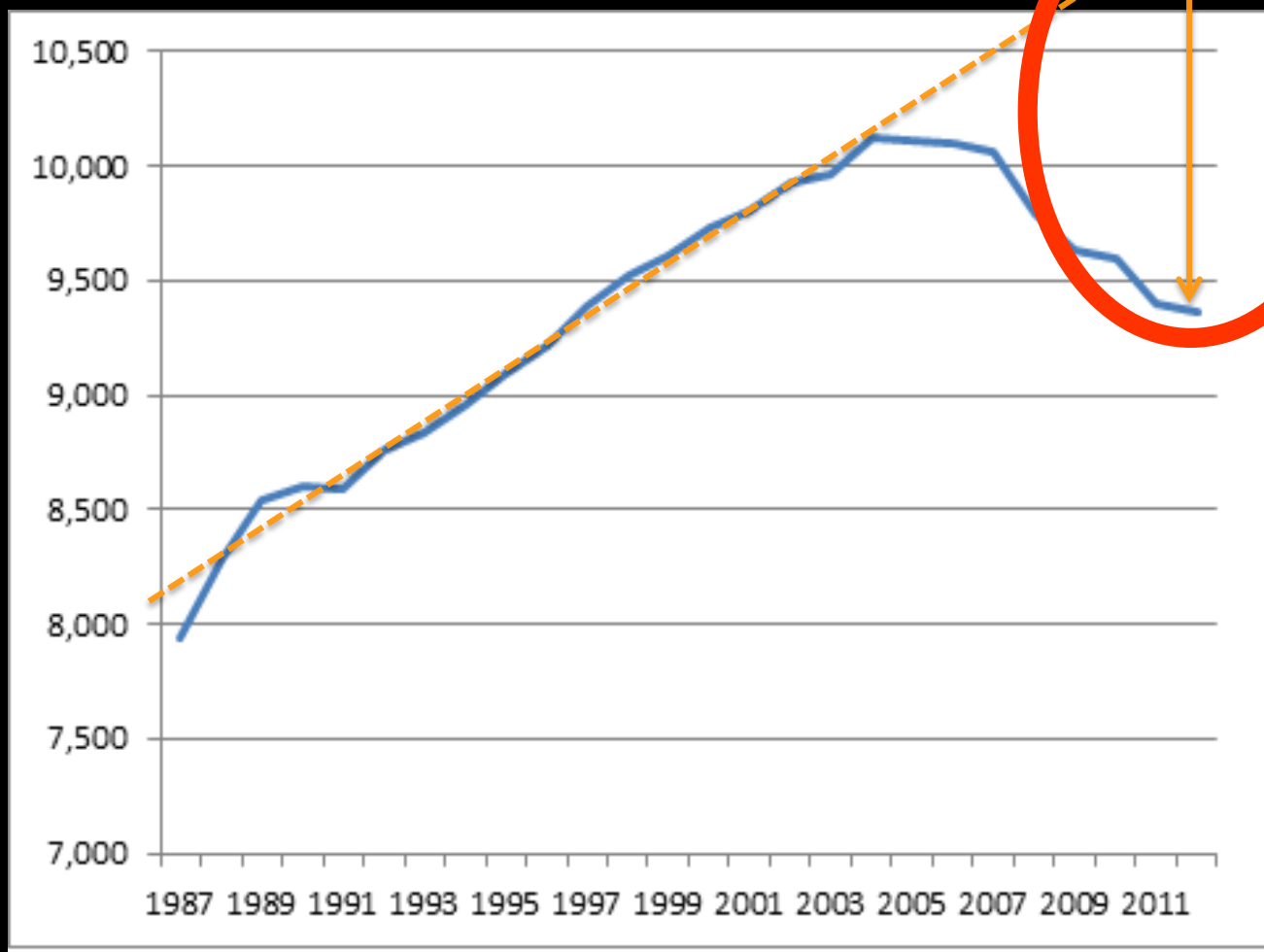


Designing urban roadways to LOS D or lower is usually the most cost effective

Total VMT is declining



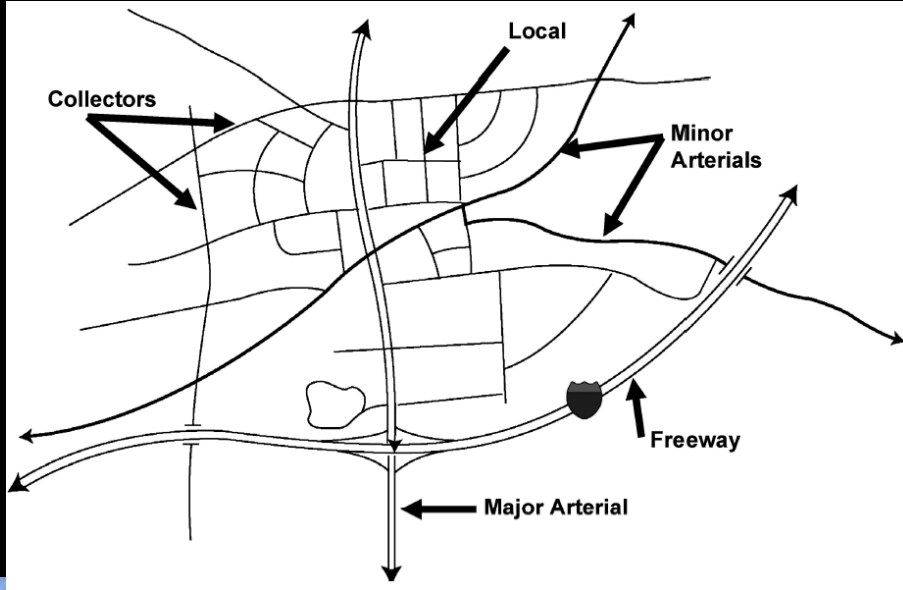
Per capita VMT is declining



LOS Isn't The Only Factor

- Level of Service is one piece of design
- Roadway should work well 24 hours a day
- Community will accept a little delay
- Combatting LOS centric mindsets
 - Pick correct analysis period
 - Peak Hour Factors
 - V/C and Queues can be better analysis tools

Use of Street Classifications



Functional classification doesn't adequately describe a street's role in a community. These 3 streets are arterials, yet look, feel, and perform very differently

Users

Pedestrians

Pedestrian Facilities

Pedestrians can get by without
sidewalks on quiet streets



Pedestrian Facilities



Shoulders serve pedestrians in rural areas
Ped Crash Reduction of 70%

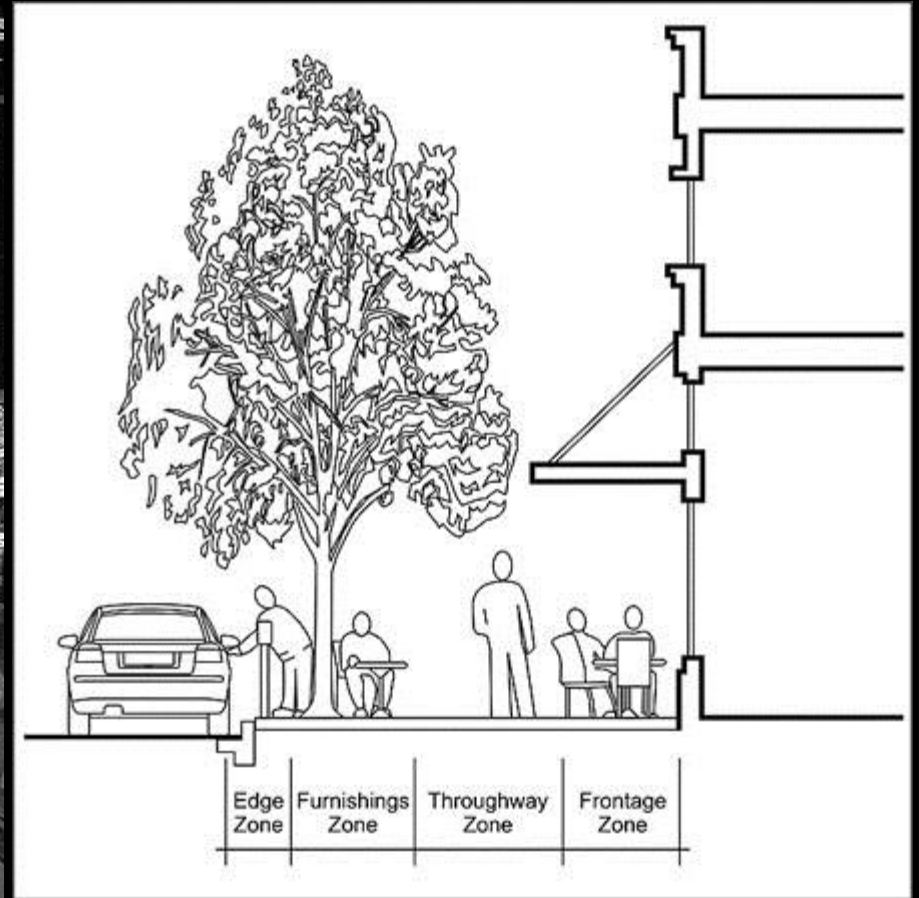
Pedestrian Facilities



Sidewalks serve pedestrians in urban areas
Ped Crash Reduction of 88%

Sidewalk Design

Understand and define the zones



Sidewalk Design – Furnishings Zone

Buffers sidewalks from street:

- » Space for trees, street furniture, and snow storage
- » Easy to meet ADA at driveways and curb ramps
- » Welcoming walking environment
- » Plantings can slow vehicle speeds



Sidewalk Design – Thoroughway Zone

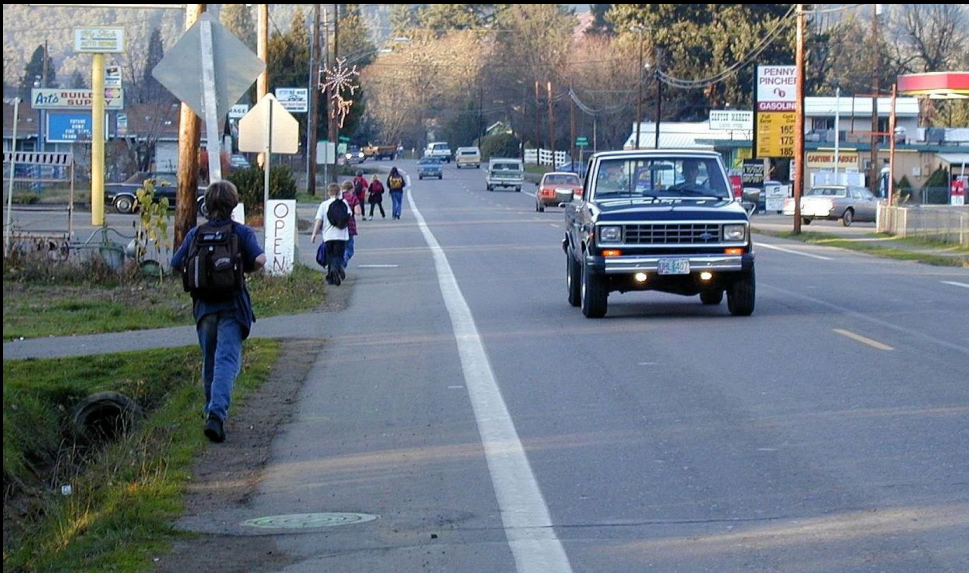
Provide at least 5 feet to allow two people to walk side by side comfortably



Sidewalk Design

Set triggers for future sidewalks

- ✓ Development densities
- ✓ Developer requirements
- ✓ Going from open to closed drainage



Sidewalk Surfaces

Surface requirements:

- Firm, stable, and slip-resistant
- Smooth – free of rough textures, large openings and gaps



Textured Surfaces

Bricks, cobblestones, textured pavement create:

- Increased rolling resistance
- Tripping hazards
- Maintenance hassles
- Painful vibrations to people with brittle bones or spinal cord injuries in wheelchairs



Driveways



If driveways aren't done right, sidewalks won't be used
(one reason given by wheelchair users using the street)

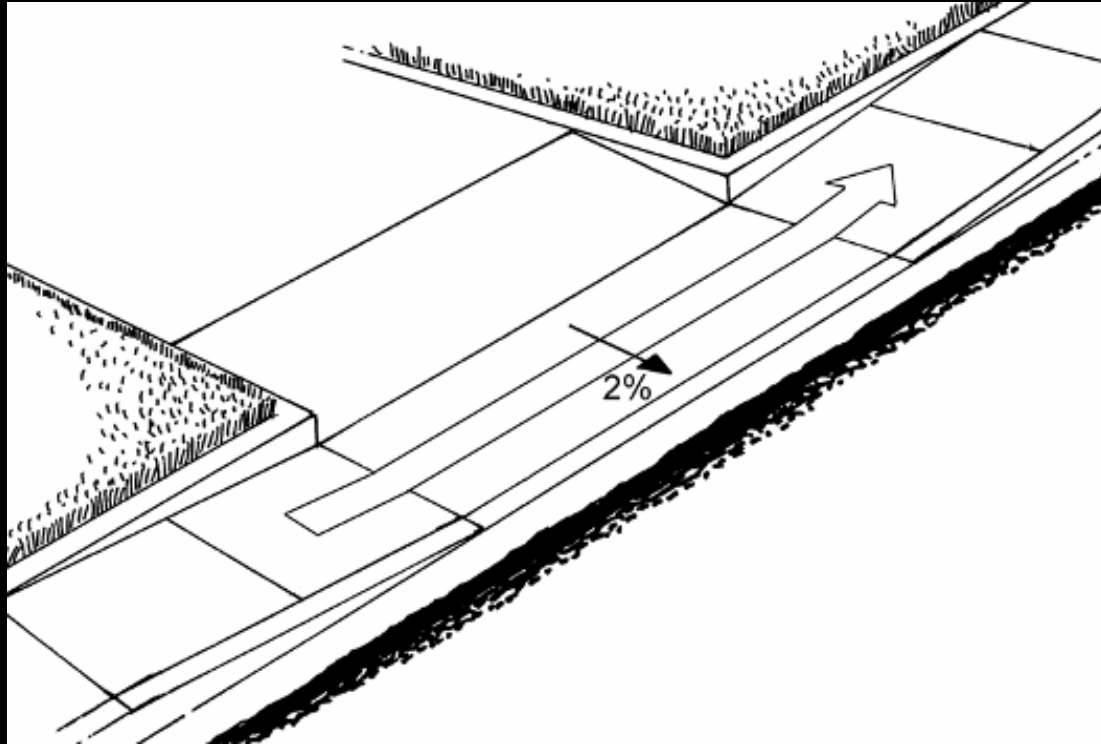
Design Solutions for Driveways

- Accessible driveway requires level pedestrian access route:
 - Cross slope: 2% maximum
 - Width: 4 ft. minimum
- Factors to consider when choosing accessible driveway option:
 - Sidewalk width
 - Planter strip width
 - Curb height
 - Available right-of-way



Solution for Narrow Sidewalks

Fully Lowered Sidewalk



Lip improves drainage and provides cue for blind pedestrians

Effect of large radius on drivers

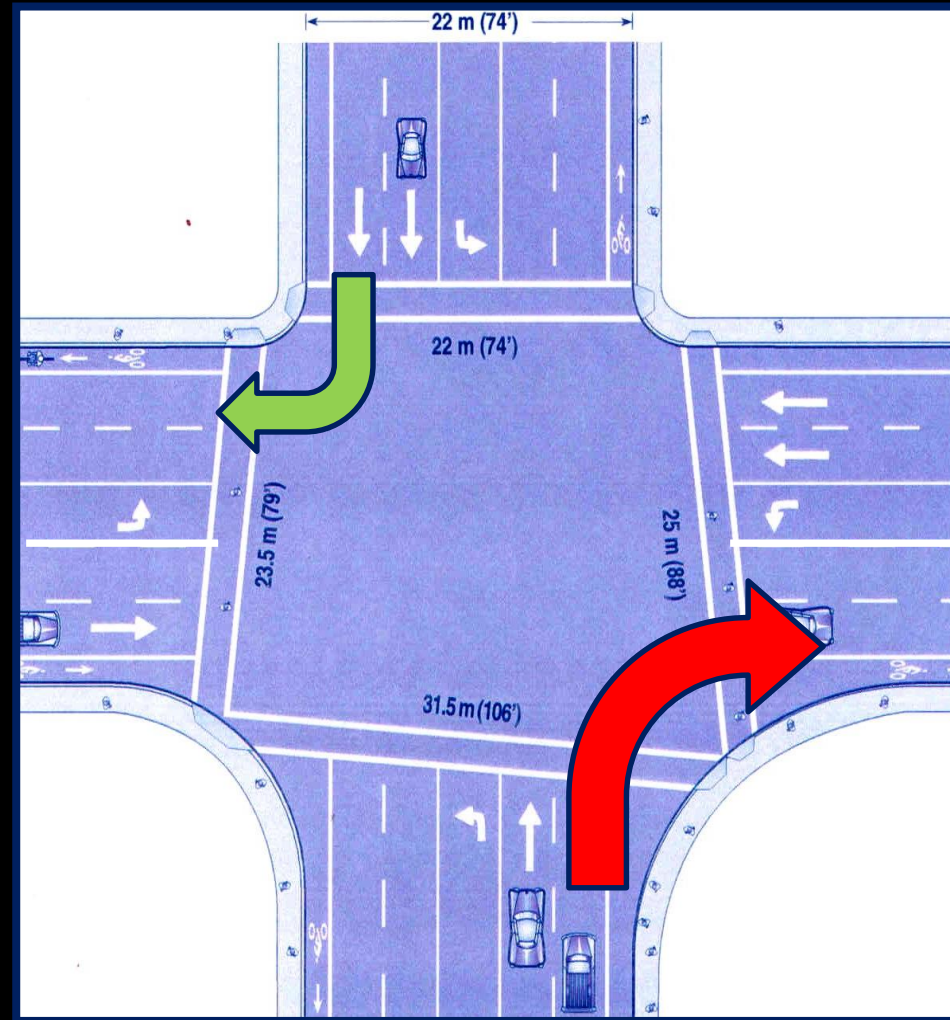


They drive fast,
ignoring pedestrians

Tighten Corner Curb Radii

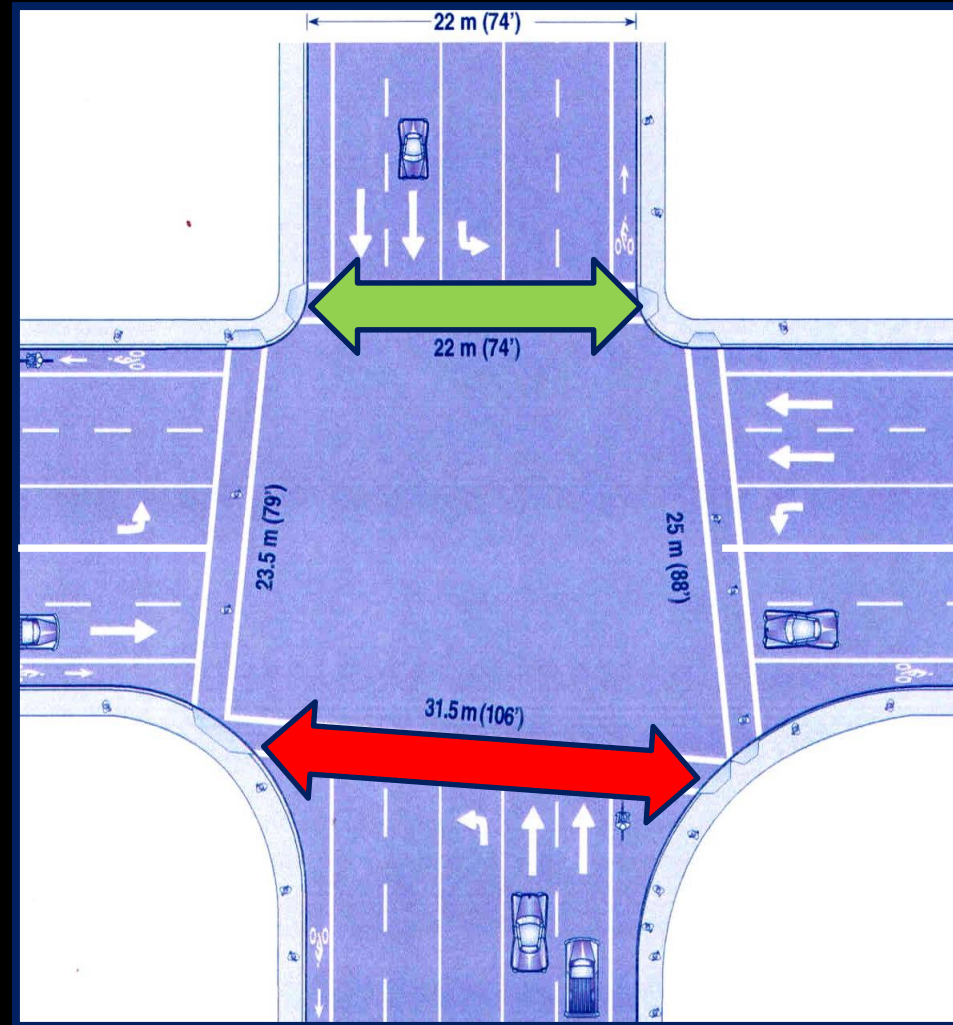
Large corner radii:

- Allow high-speed turns by cars
 - Less likely to yield
- Injury severity is higher at higher speeds



Tighten Corner Curb Radii

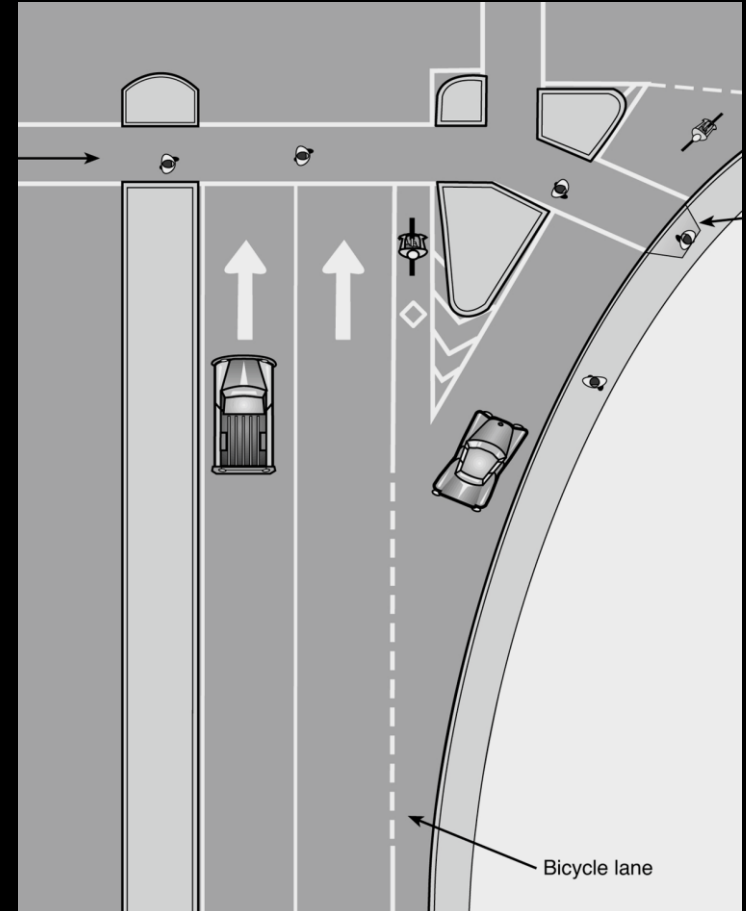
- Large corner radii:
 - Increase crossing distance
 - Longer crosswalk means more pedestrian signal time, reducing roadway capacity for vehicles



Corner “Pork Chop” Islands

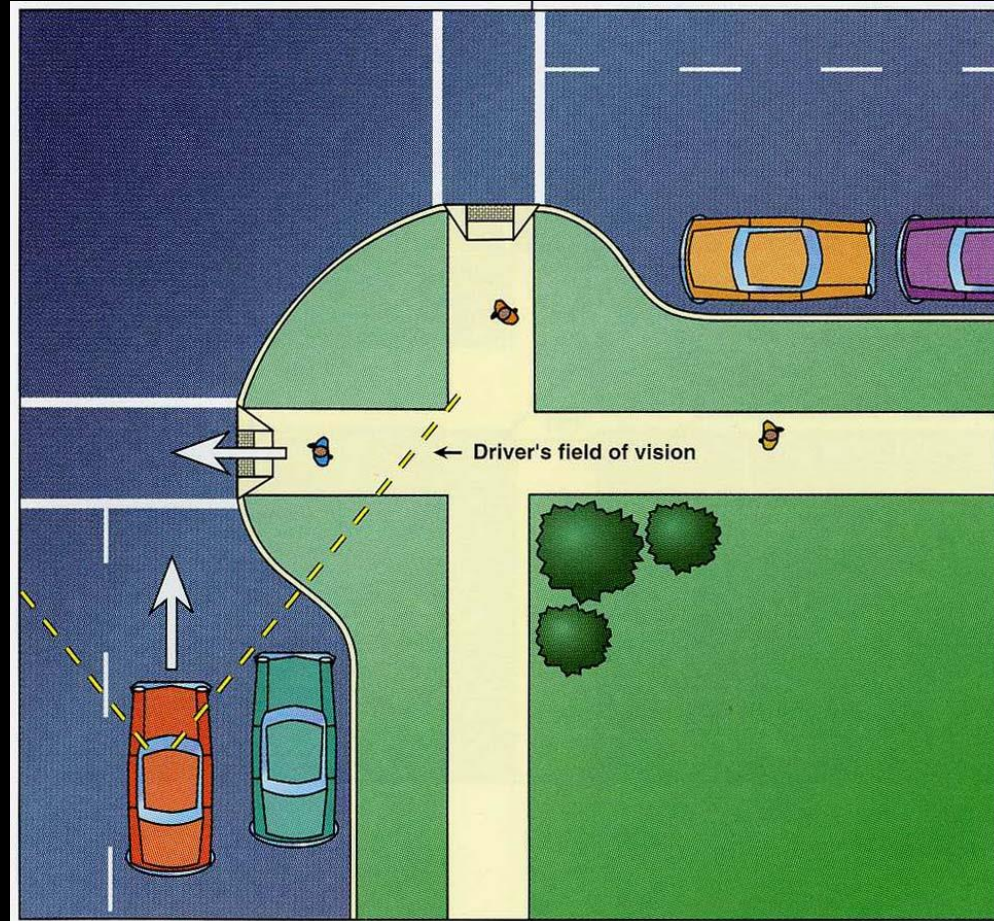
Benefits:

- Separate conflicts & decision points
- Reduce crossing distance
- Improve signal timing
- Reduce ped crashes (29%)

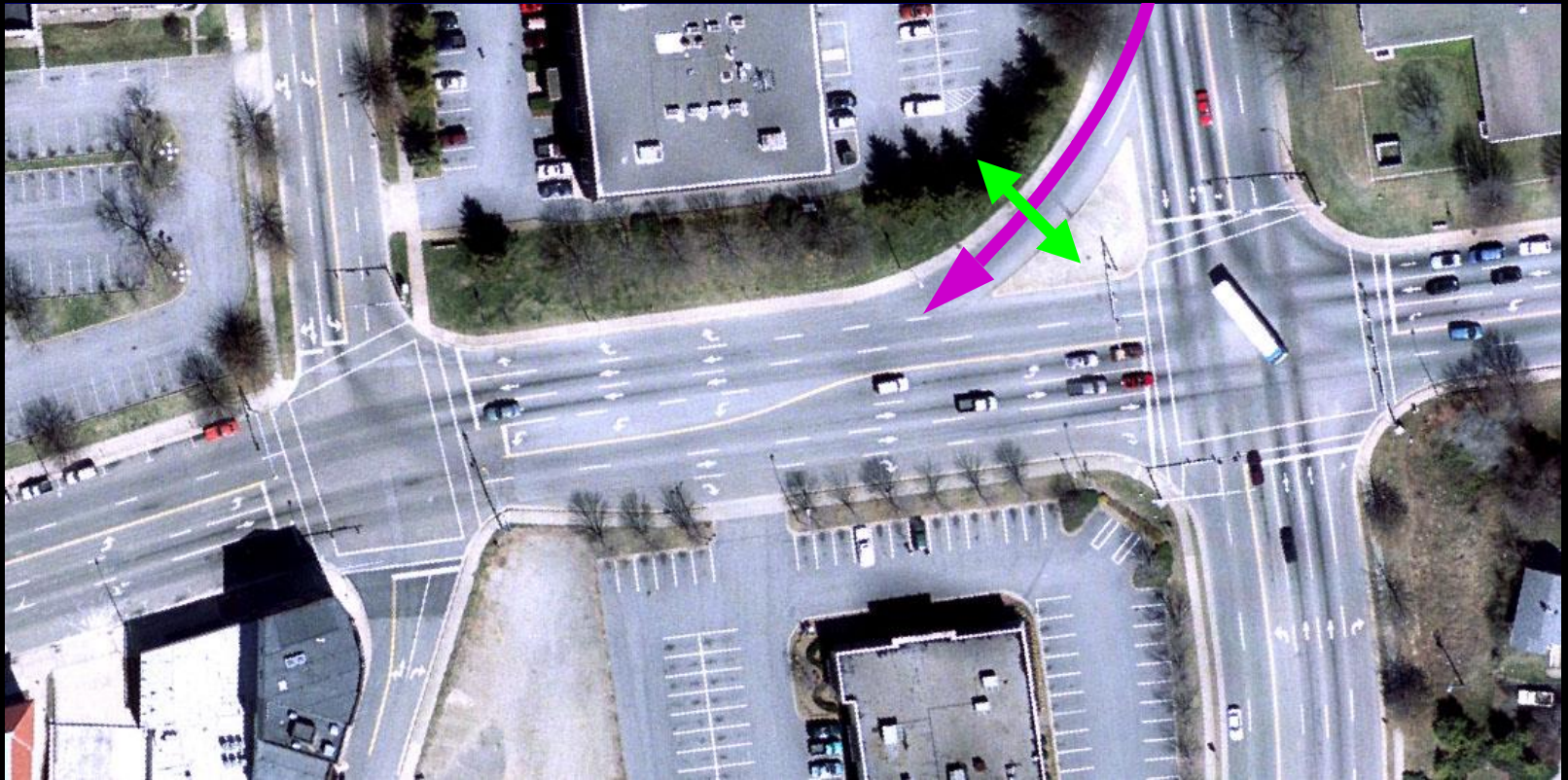


Curb Bulb-outs

- Reduce crossing distance
- Improve sight distance and sight lines
- Prevent encroachment by parked cars
- Create space for curb ramps and landings



Free Flow Right Turn Lanes



Eliminate free flow turns across
crosswalks/bikeways

Free Flow Right Turn Lanes



Eliminate free flow turns across
crosswalks/bikeways

Pedestrian Signals

- Time signals for 3.5 ft/sec walking speed
 - Recent studies found that previous 4.0 ft/sec walking speed based on average walking speeds (not 15th percentile)
- 2009 MUTCD now recommends using a pedestrian walking speed of 3.5 ft/sec for “Flashing Don’t Walk” (FDW) and 3.0 ft/sec for overall WALK plus FDW phase

Pedestrian Signals

- 50% of pedestrians in the U.S. do not understand the “Flashing Don’t Walk” really means it’s OK to continue walking

So we put signs like this to “correct” the problem



Countdown Signals

- » Pedestrian countdown signal tells pedestrians how much crossing time is left.
- » **Reduces all crashes by 25%**



Pedestrian Hybrid Beacon

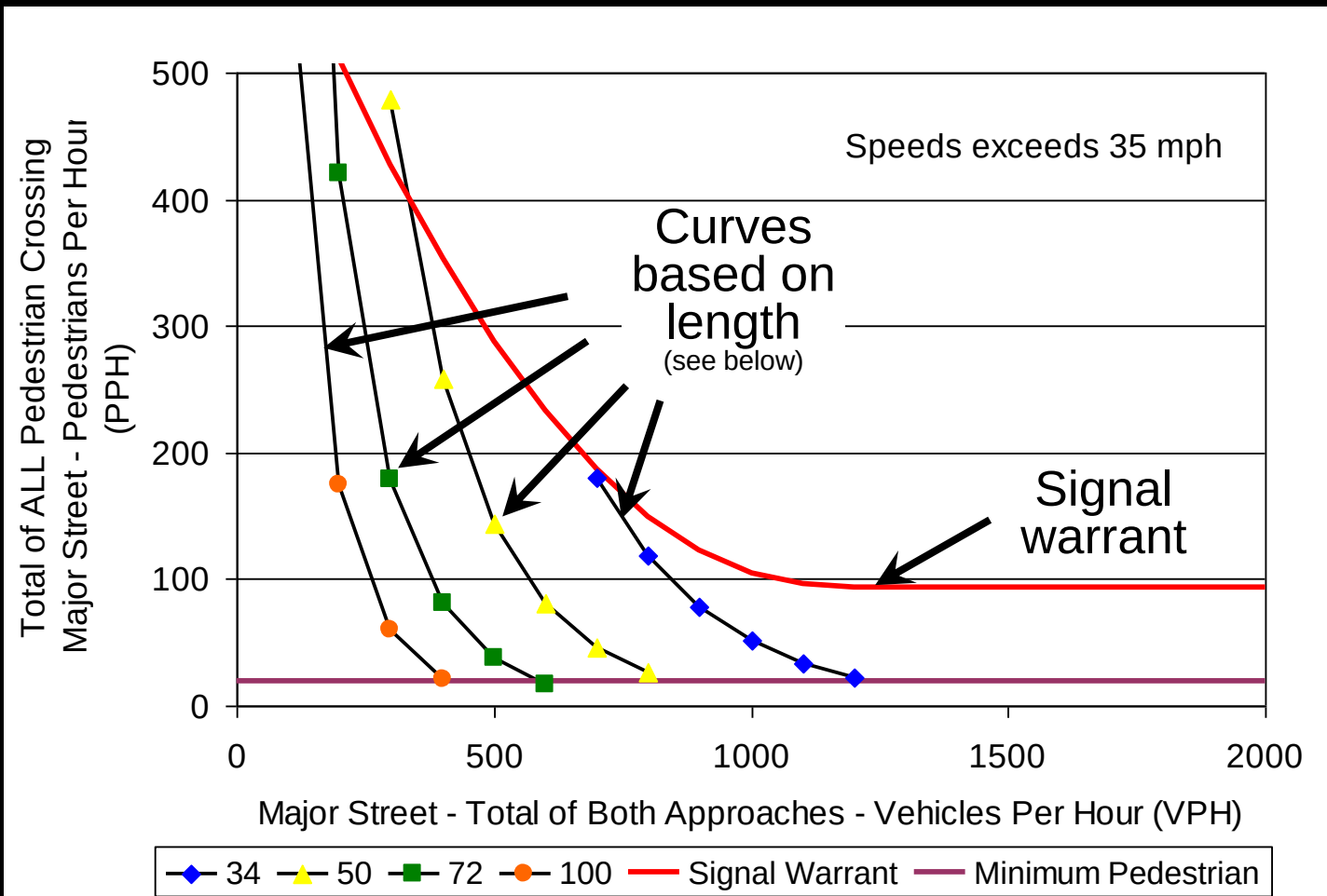
Drivers
see
Beacon



Peds see
Pedhead



Pedestrian Hybrid Beacon



2009 MUTCD Chapter 4F

Rectangular Rapid Flash Beacon

- Beacon in yellow, rectangular, and has a rapid “stutter” flash
- Beacon located between the warning sign and the arrow plaque
- Must be pedestrian activated (pushbutton or passive)
- Studies indicate **motorist yielding rates increased from 18.2% to 81.2% for 2 beacons and to 87.8% for 4 beacons** (TRB)
- Interim approval from FHWA in July 2008



Users Transit

Transit Design Issues



Bus is most common mode

Transit Design Issues



Only choice for many people

Transit Design Issues



Shelters must be accessible
(grass makes it inaccessible)

Transit Design Issues



Every bus stop is a pedestrian crossing
and all known crossing techniques apply
to every bus stop

Users Bicycles

Bikes Belong

“Bicycles may be present on all highways where they are permitted... the designer should include design features that improve the safety and comfort of the roadway for bicyclists.”

- AASHTO Bike Guide



Bikes will be on your streets, plan for them



CONTEXT MATTERS

Choose the Appropriate Design Based on your Environment

Vehicle Speed
↑

Neighborhood Greenways



Bike Lanes



Buffered Bike Lanes



Protected Bike Lanes

Shared Space
↗



Shared Lane Markings

Vehicle Volume
→

Greater Separation
↗







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Chicago
Grant Park
Thursday May 23, 2013
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ONE WAY
←

USE BIKE
SIGN

Human beings
are not
disposable.

Annual
Graduates
Lunchbox

Annual
Graduates
Lunchbox

LEFT ON
GREEN
ARROW
ONLY

Annual
Graduates
Lunchbox



Design Strategies

Making Space and Reinforcing Safe Behavior

Do we have to widen roads to fit everything?



There's room; it needs to be recaptured



Narrow Travel Lanes

AASHTO Green Book and INDOT Design Manual allow for varying lane widths:

- 9' on local urban streets
- 10' on lower speed arterials & collectors
- 11' for streets with high truck volumes
- 12' desirable, but **often not required** as minimum



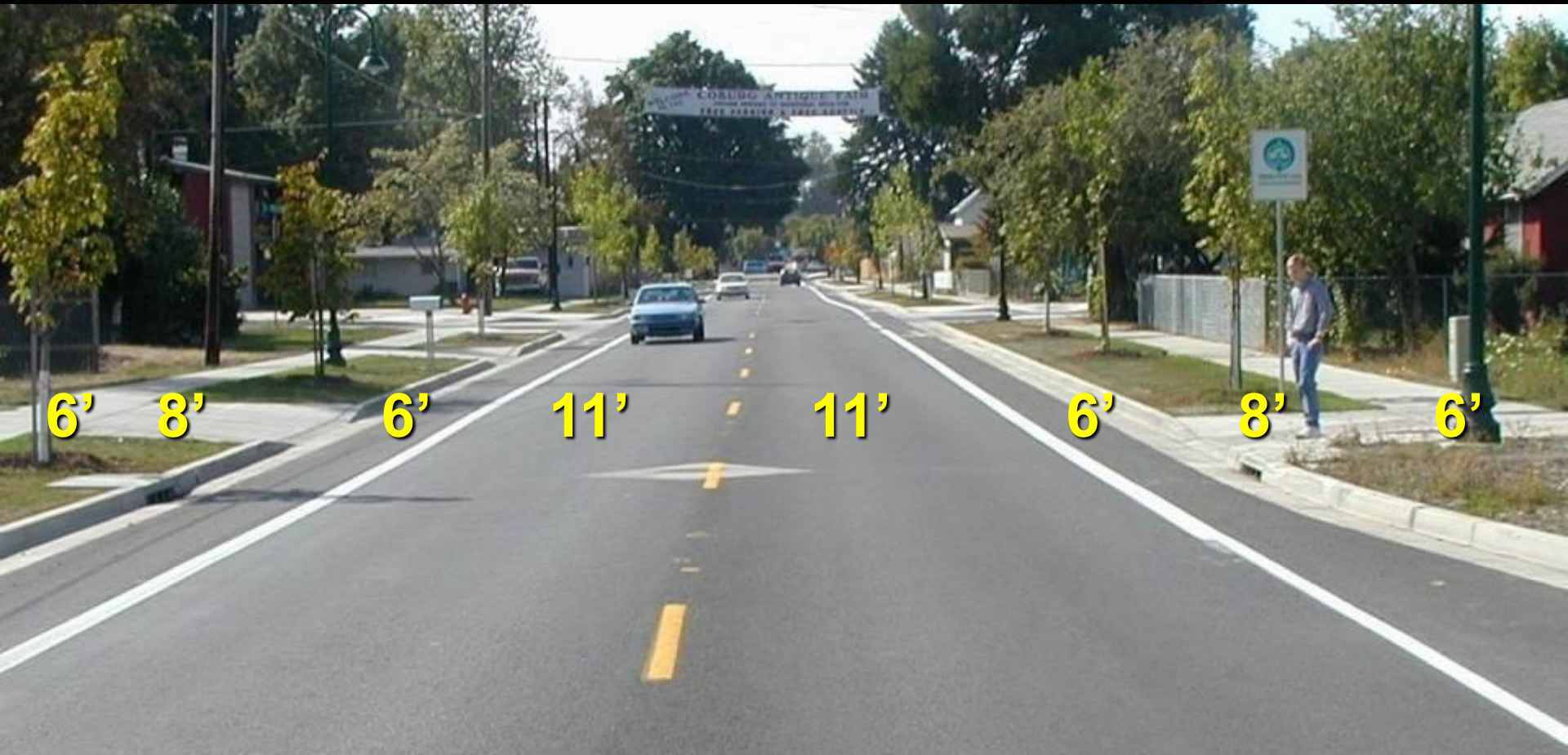
“Relationship of Lane Width to Safety for Urban and Suburban Arterials”:
Study by Potts, Harwood, and Richard

Conventional design – from the inside out



Add up (wide) travel lanes, run out of ROW
Result: one narrow curbside sidewalk

Proposed design – from the outside in



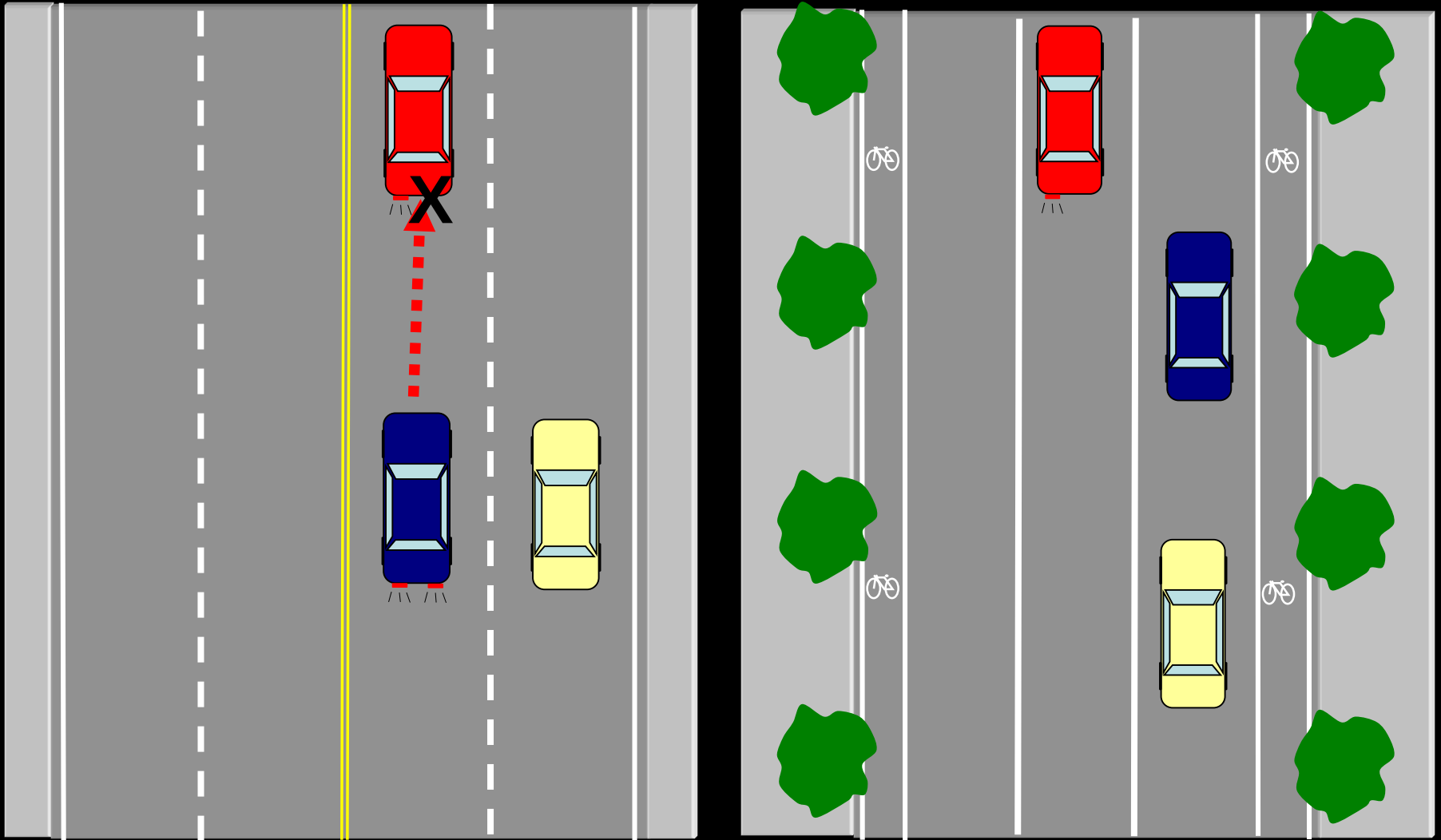
Add up desirable elements, fit in ROW; result:
nice sidewalks, bike lanes, adequate travel lanes

Remove Excess Capacity (Road Diets)



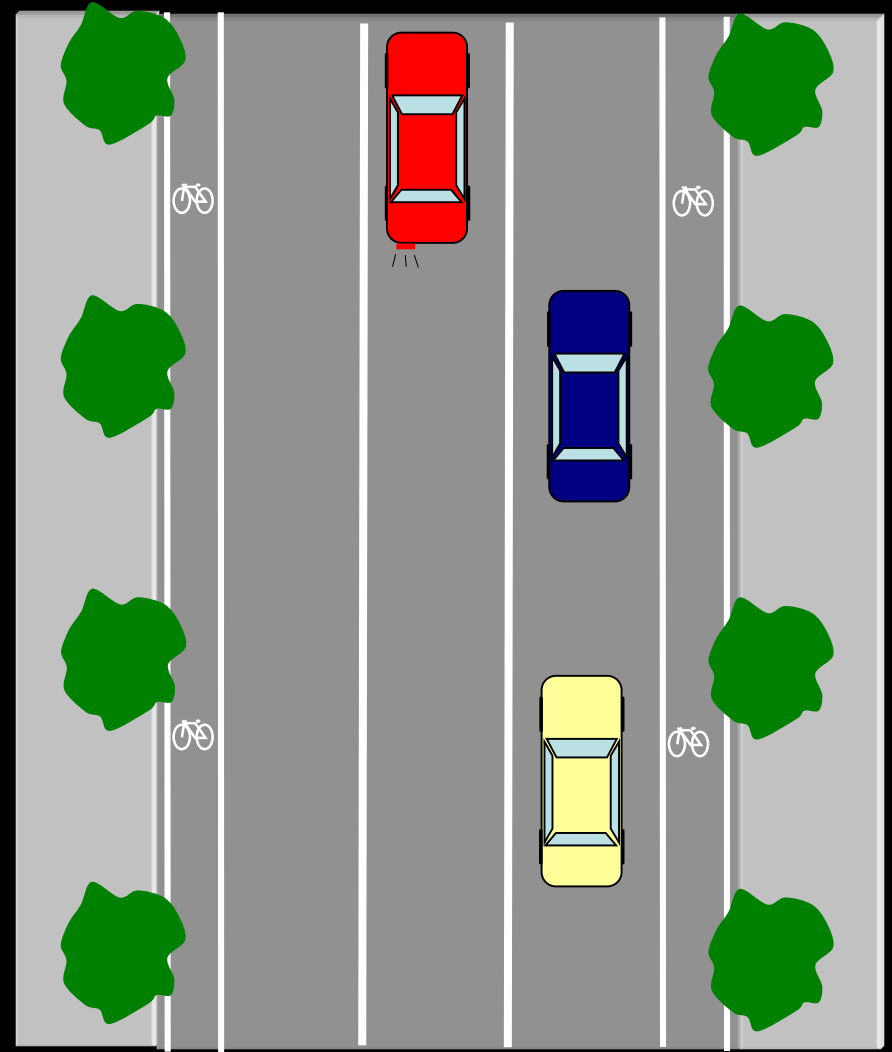
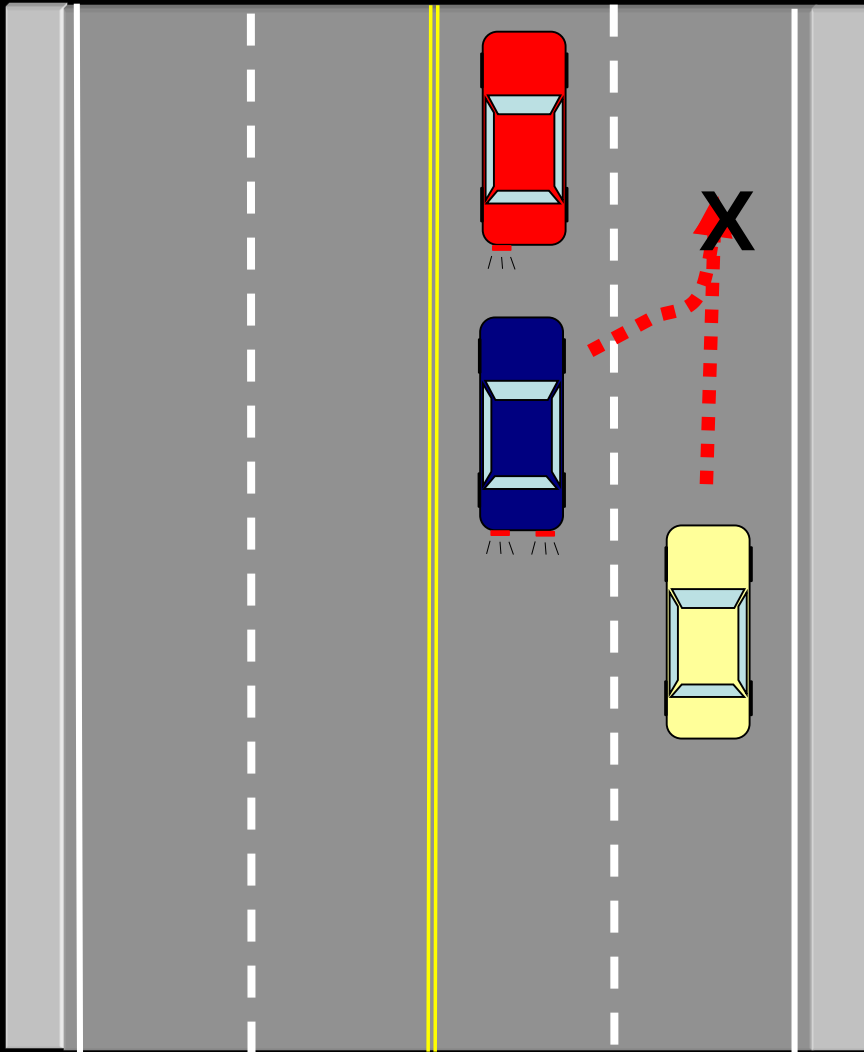
Convert 4-Lane Road to 3-Lane and TWLTL
29% crash reduction

Three crash types can be reduced by going from 4 to 3 lanes



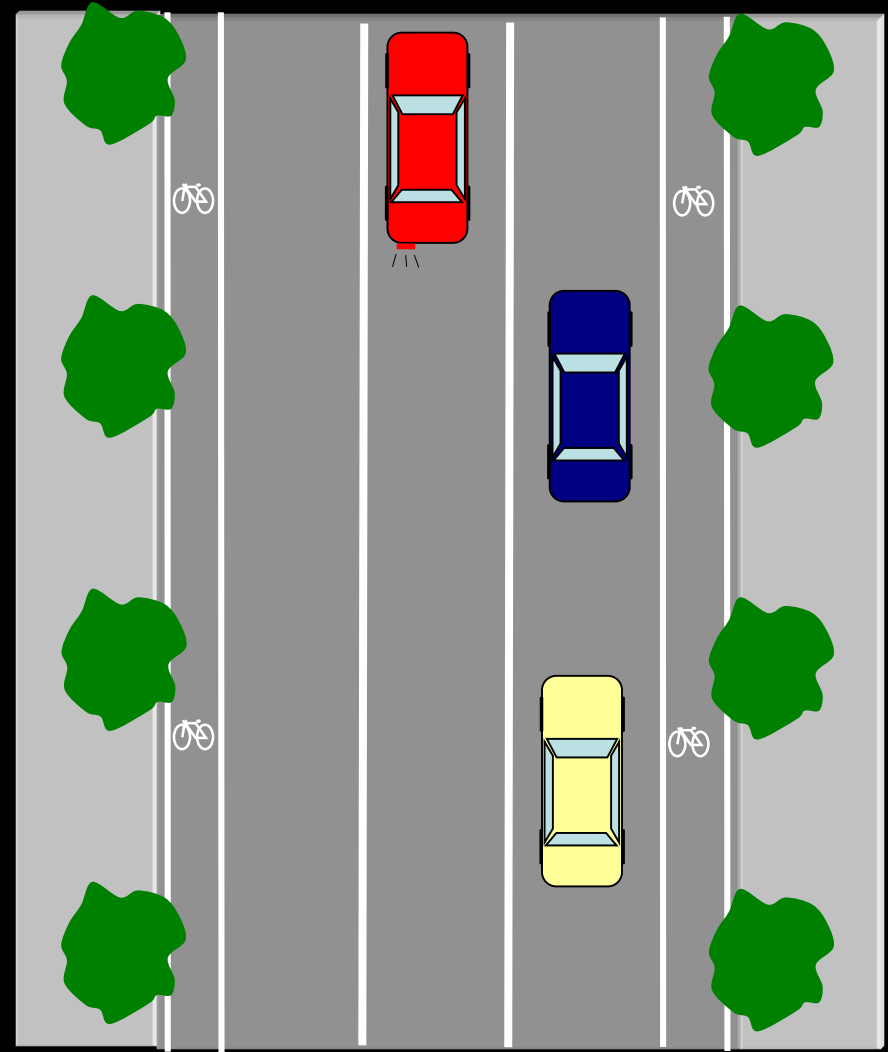
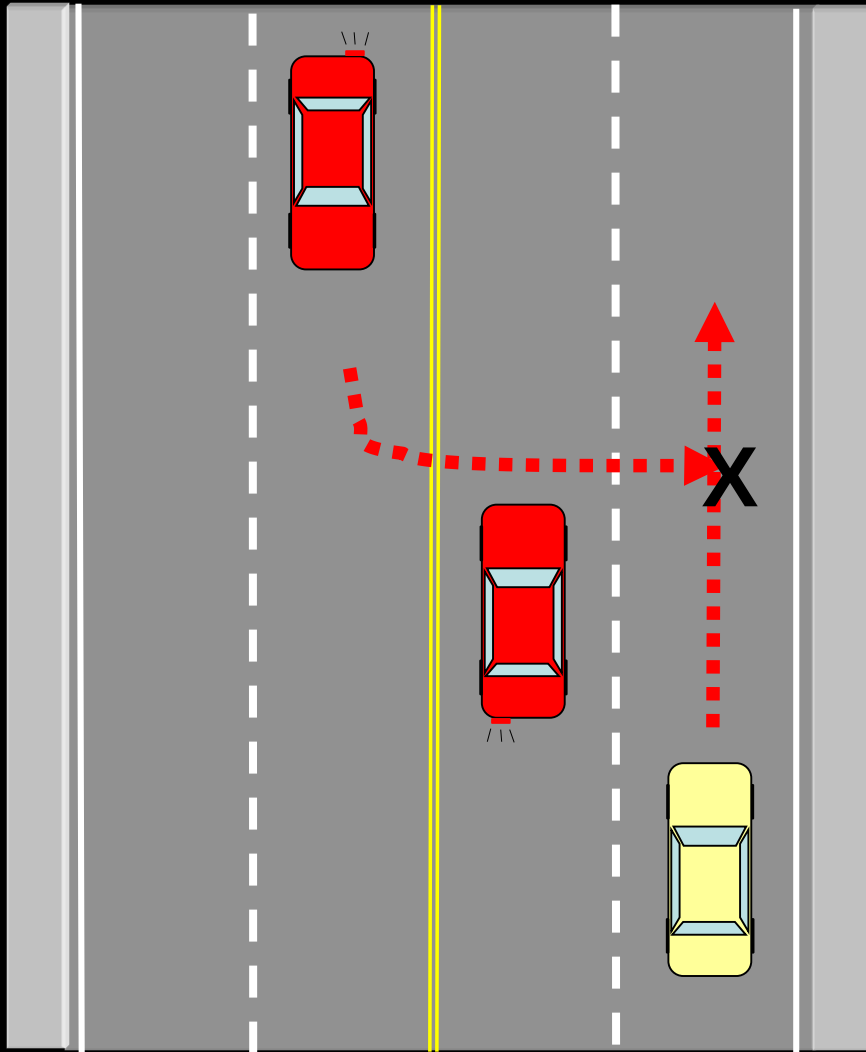
1. Rear enders

Three crash types can be reduced by going from 4 to 3 lanes



2. Side swipes

Three crash types can be reduced by going from 4 to 3 lanes



3. Left turn/broadside

Handles 20,000 ADT



Mission District, San Francisco
North-South ADT



- Which road carries more traffic?
- Which road produces higher speed?
 - ✓ **4-lane: Faster driver can pass others**
 - ✓ **2-lane: Slower driver sets speed**
- Which road produces higher crash rate?
- Which is better for bicyclists? Peds? Businesses?

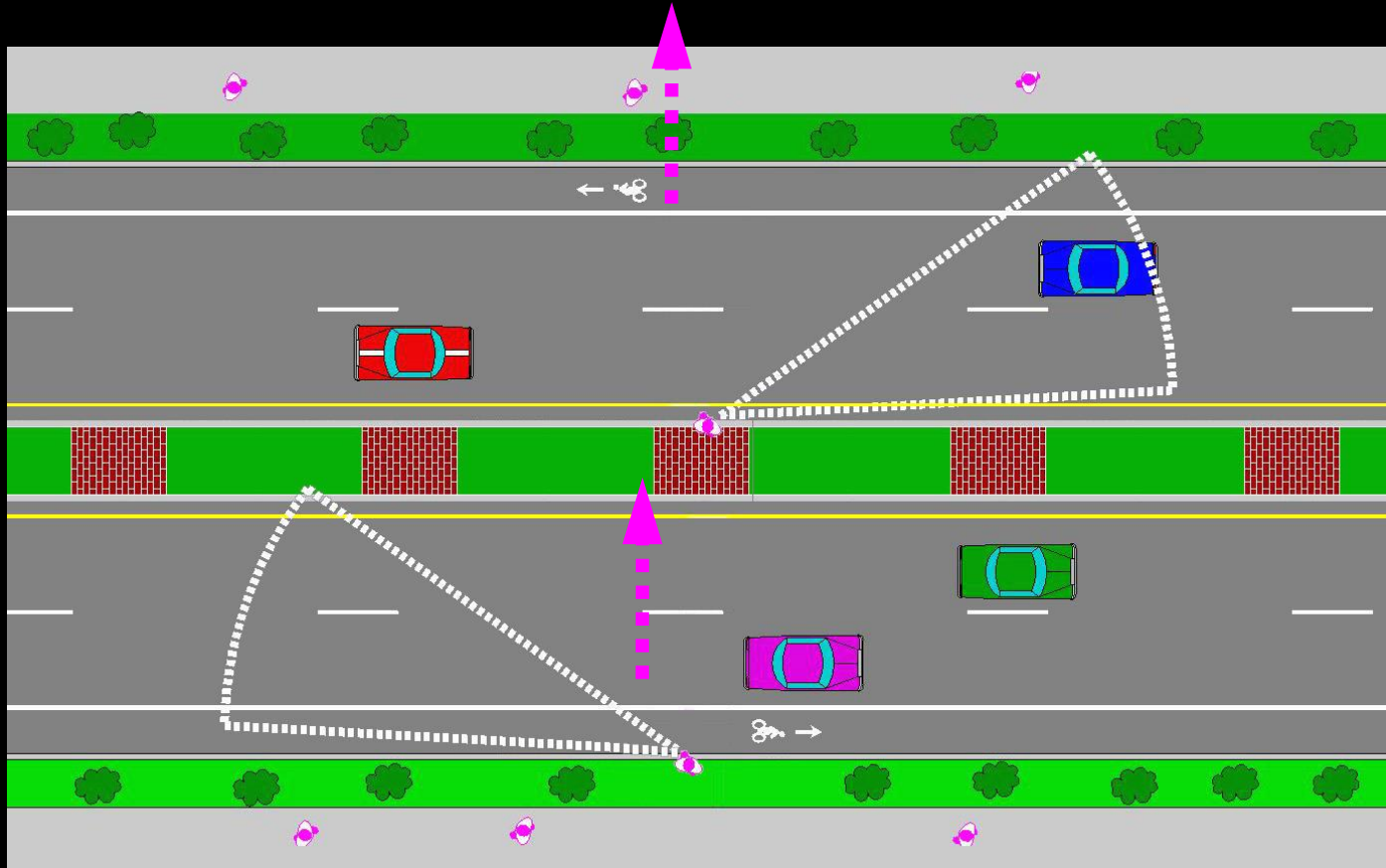


Use Signal Progression to Reinforce Target Speeds



How to Make Room and Control Speeds

Raised Medians



Continuous raised median
40% reduction in pedestrian crashes



How to Make Room and Control Speeds

Median/Parkway Landscaping



On-Street Parking Removal?



Eliminating on-street parking encourages cars to go faster and discourages neighborhood business

Design Strategies Recap

- **Narrow lanes first**
- **Remove excess capacity**
- **Use concrete medians**
- **Use signals to reinforce safe behavior**
- **Removing parking isn't encouraged**



Complete Streets



- Are sensitive to the community
- Serve all who potentially will use the street
- Will **save money** if fully implemented

End of Module