

Designing for Pedestrian Safety

Intersection Geometry

Presented by:

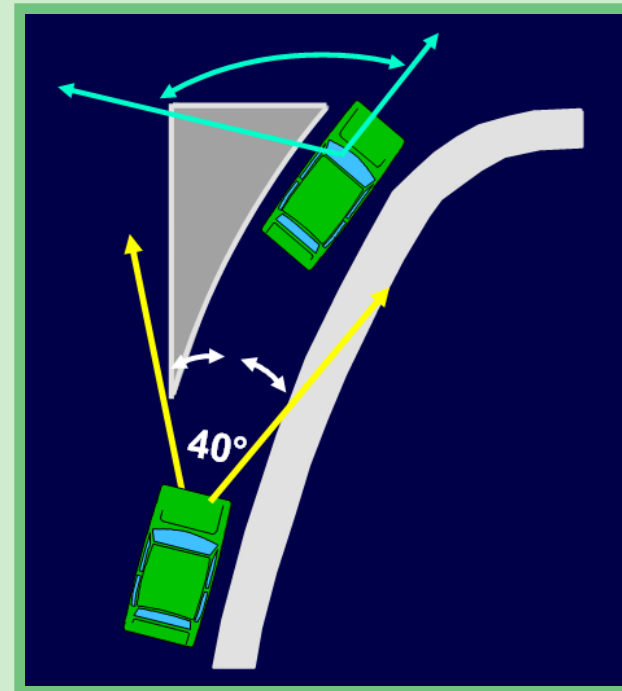
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Learning Outcomes

At the end of this module, you will be able to:

- ⇒ **Explain why tight/right angle intersections are best**
- ⇒ **Describe why pedestrians need access to all corners**
- ⇒ **Assess good crosswalk placement: where peds want to cross & where drivers can see them**
- ⇒ **Explain how islands can break up complex intersections**

Intersection Crashes

Some basic facts:

1. Most (urban) crashes occur at intersections
2. Most occur at signalized intersections
3. Most are associated with turning movements
4. Geometry matters: keeping intersections tight, simple & slow speed make them safer for everyone



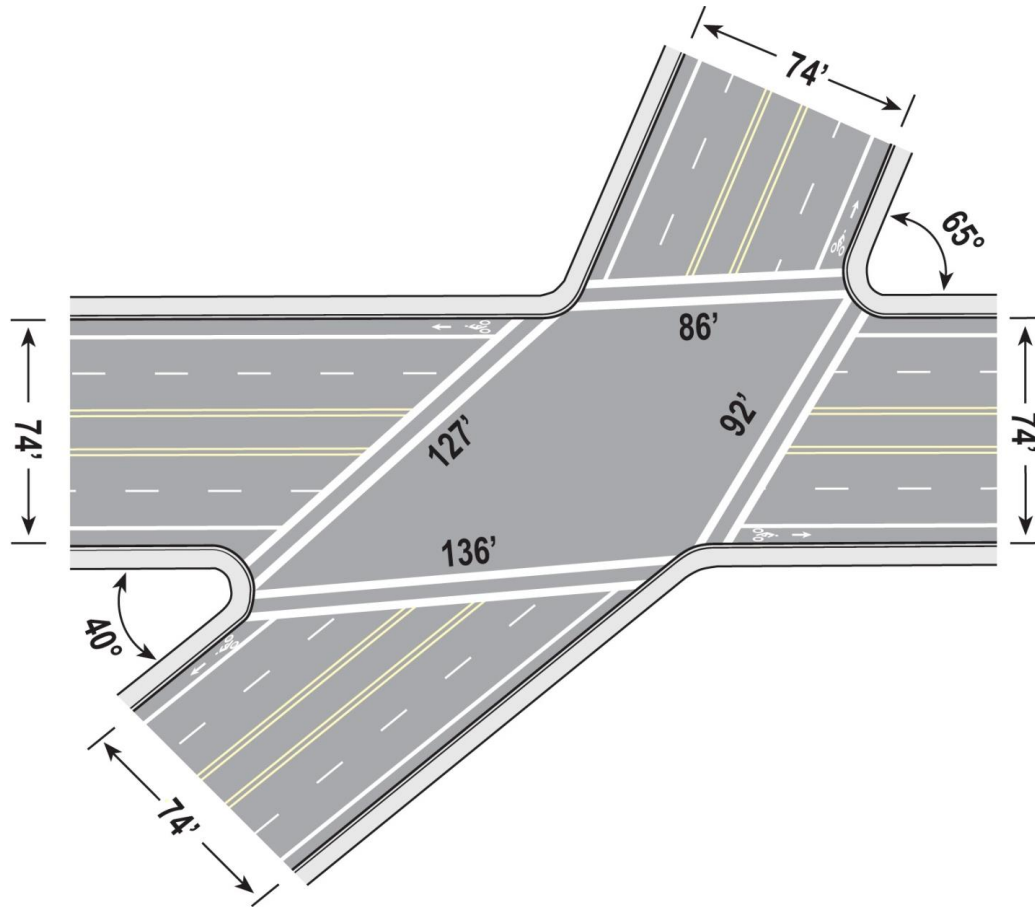
Small, tight intersections best for pedestrians...

Simple, few conflicts, slow speeds



Large intersections can work for pedestrians – with mitigation

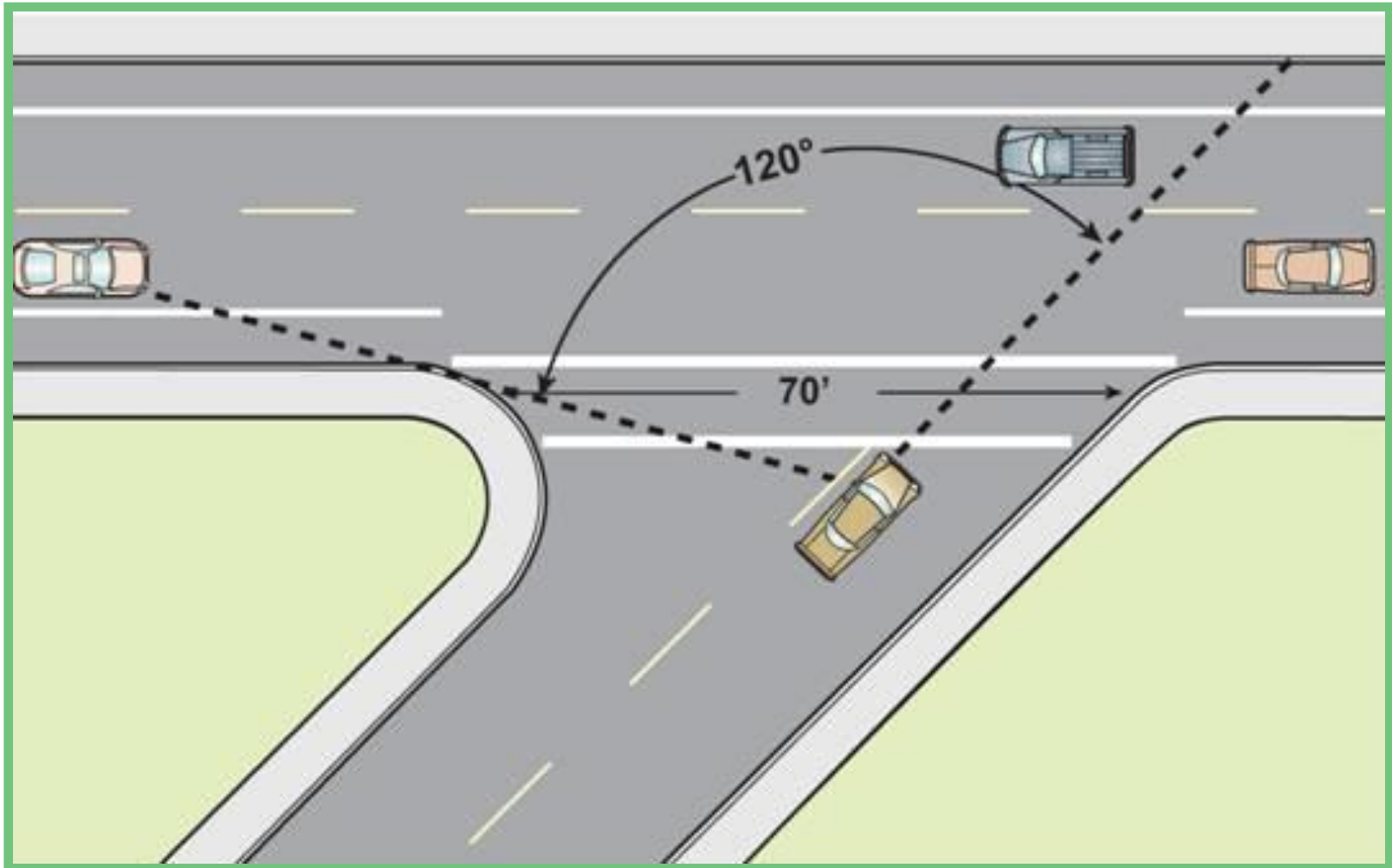
Skewed intersections



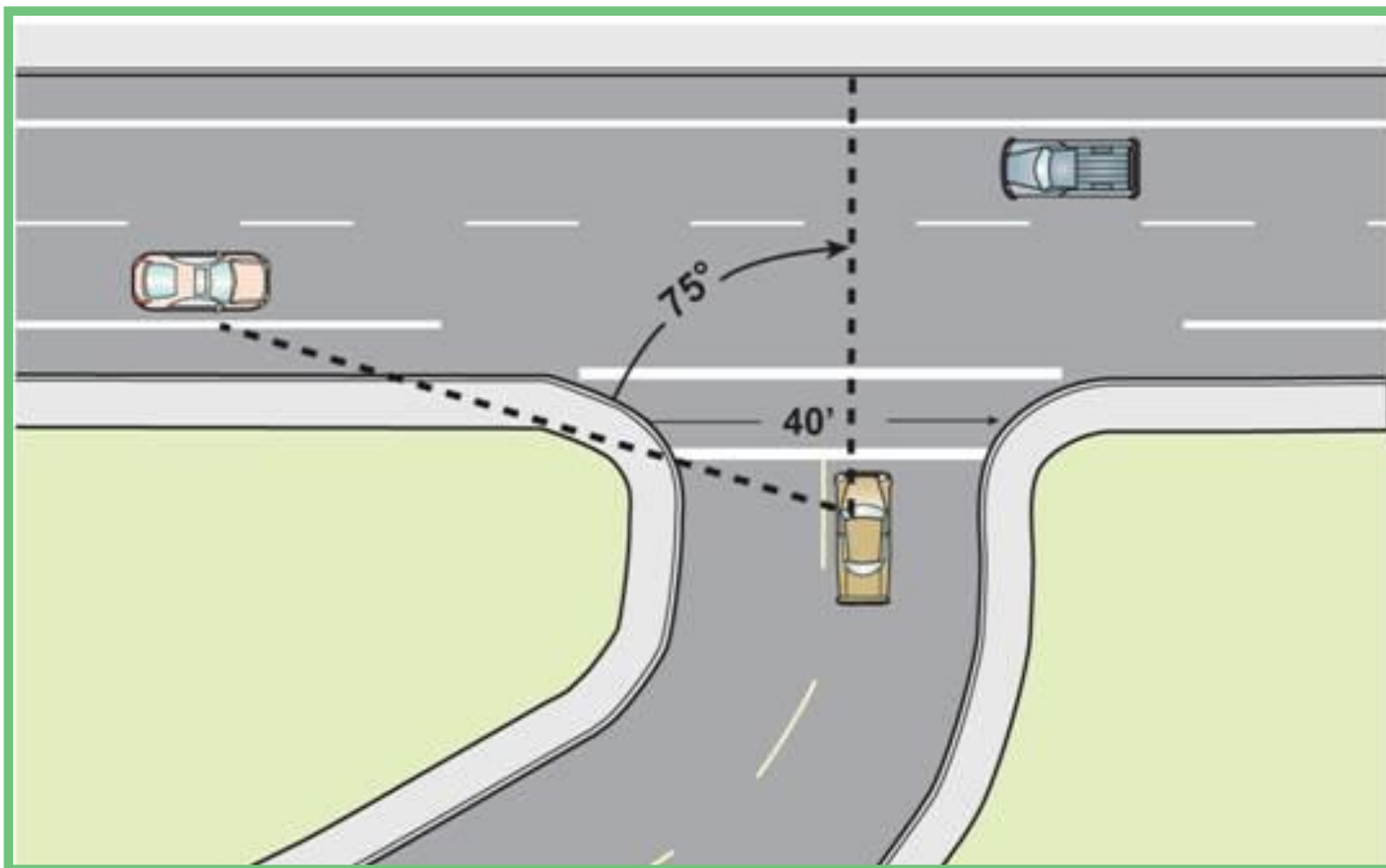
Skew increases crossing distance & speed of turning cars



Cars can turn at high speed



Skew increases crosswalk length, decreases visibility



Right angle decreases crosswalk length, increases visibility



Skewed intersection reduces visibility
Driver looks left, doesn't see pedestrian on right



Adjust skew by bringing out curb

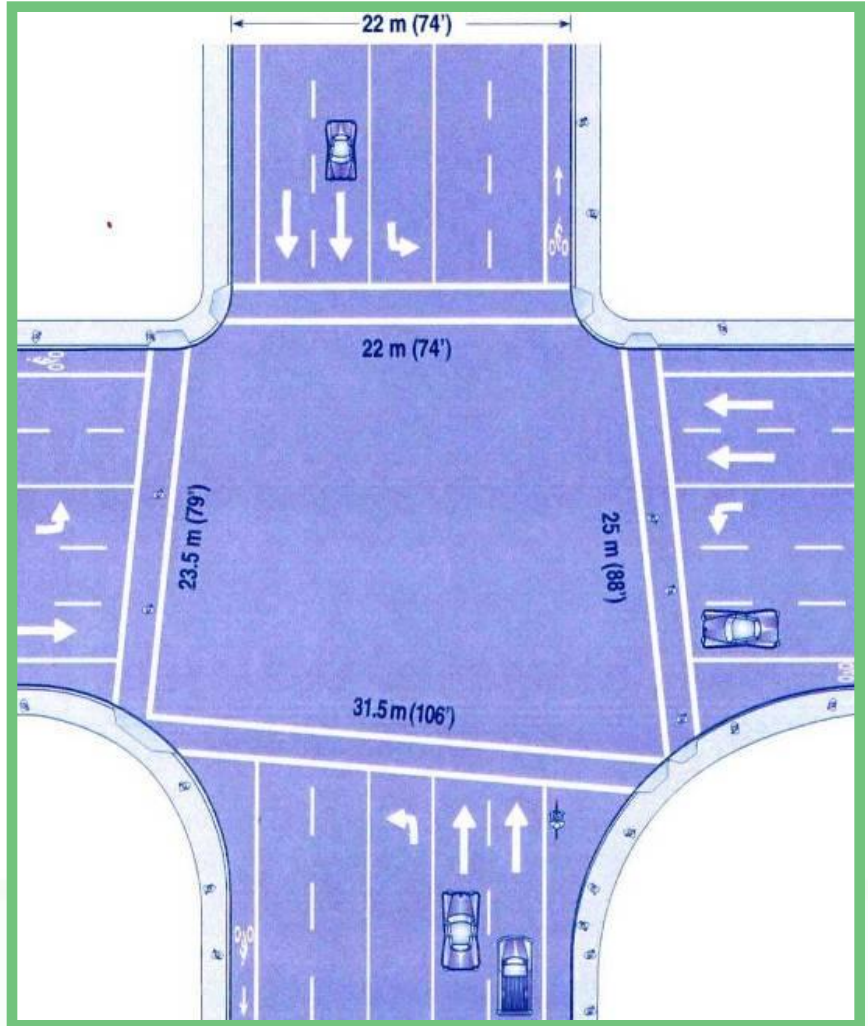


Result: driver behavior change

Curb radius – small radii are safer for pedestrians

Large radii:

1. Increase crossing distance and
2. Make crosswalk & ramp placement more difficult

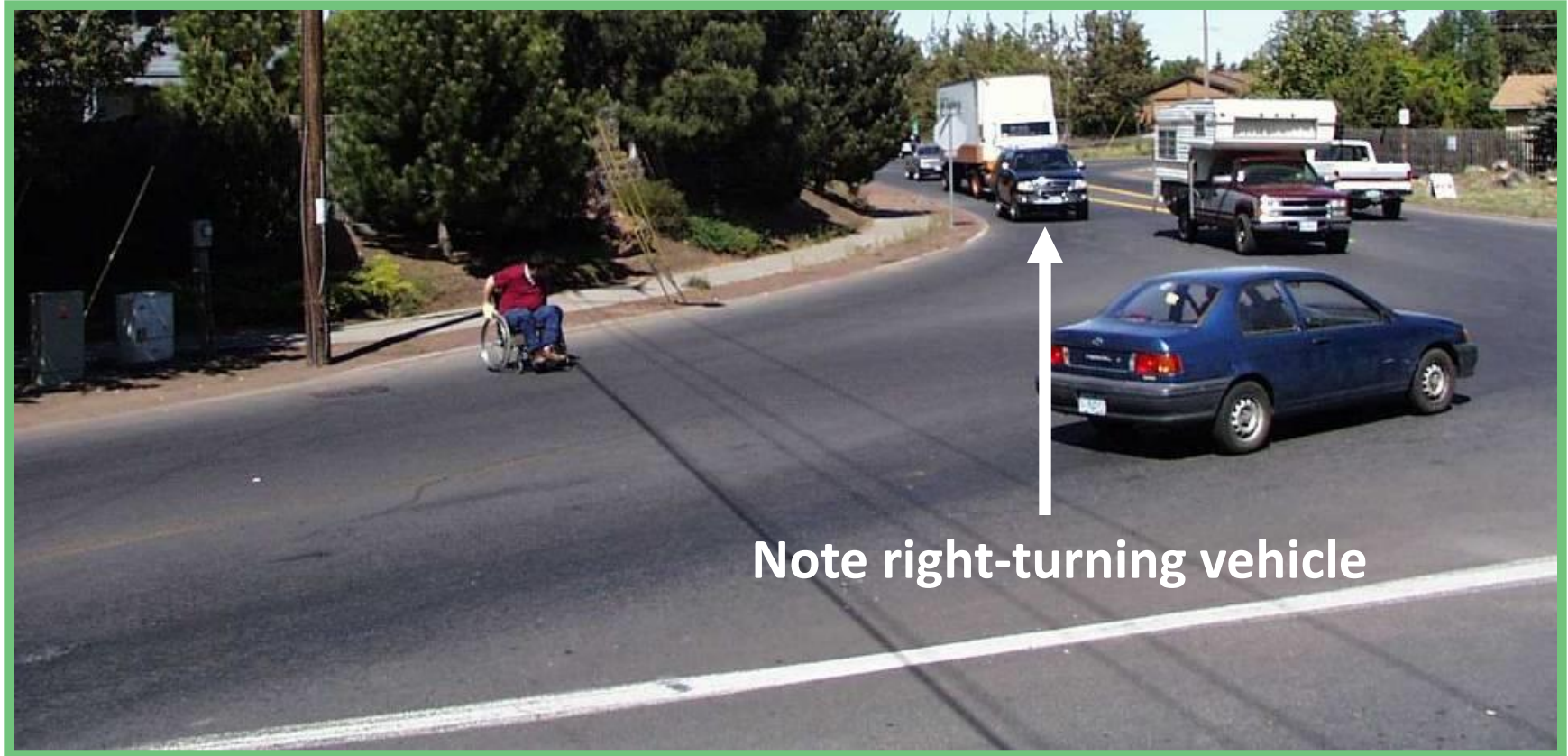


Effect of large radius on crosswalk:



It adds to crossing distance...

Effect of large radius on crosswalk:



Note right-turning vehicle

...and makes it hard to figure out where to cross

Effect of large radius on drivers



They drive fast...

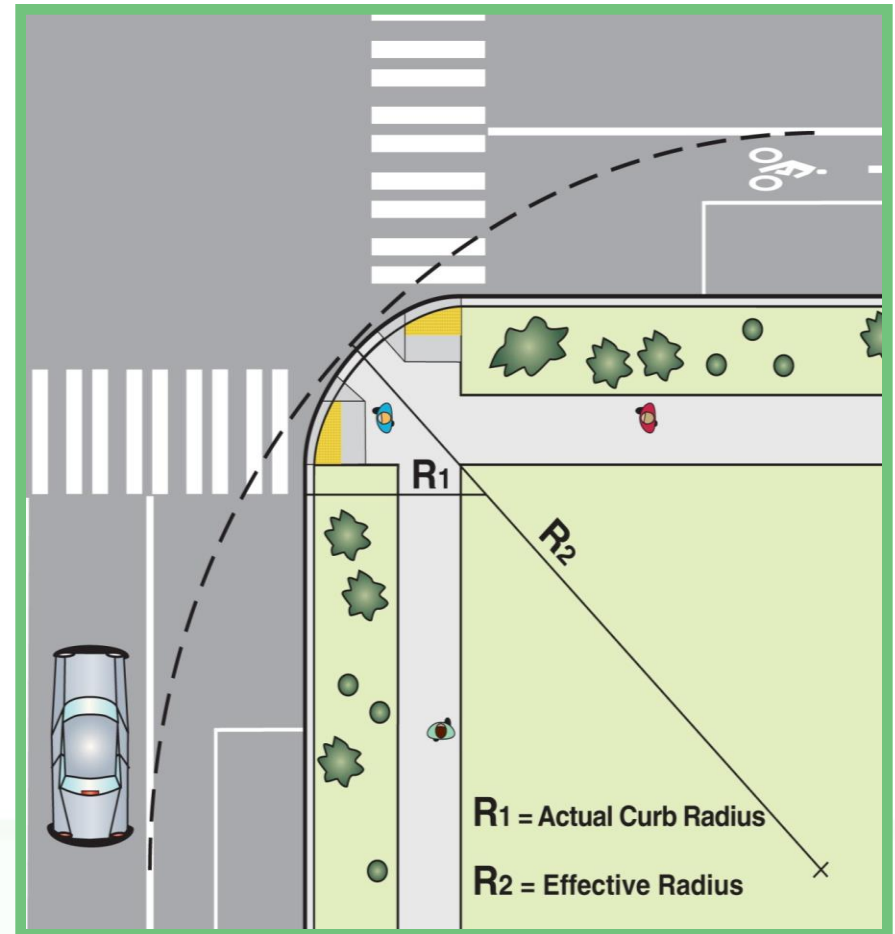
Effect of large radius on drivers



...ignoring pedestrians

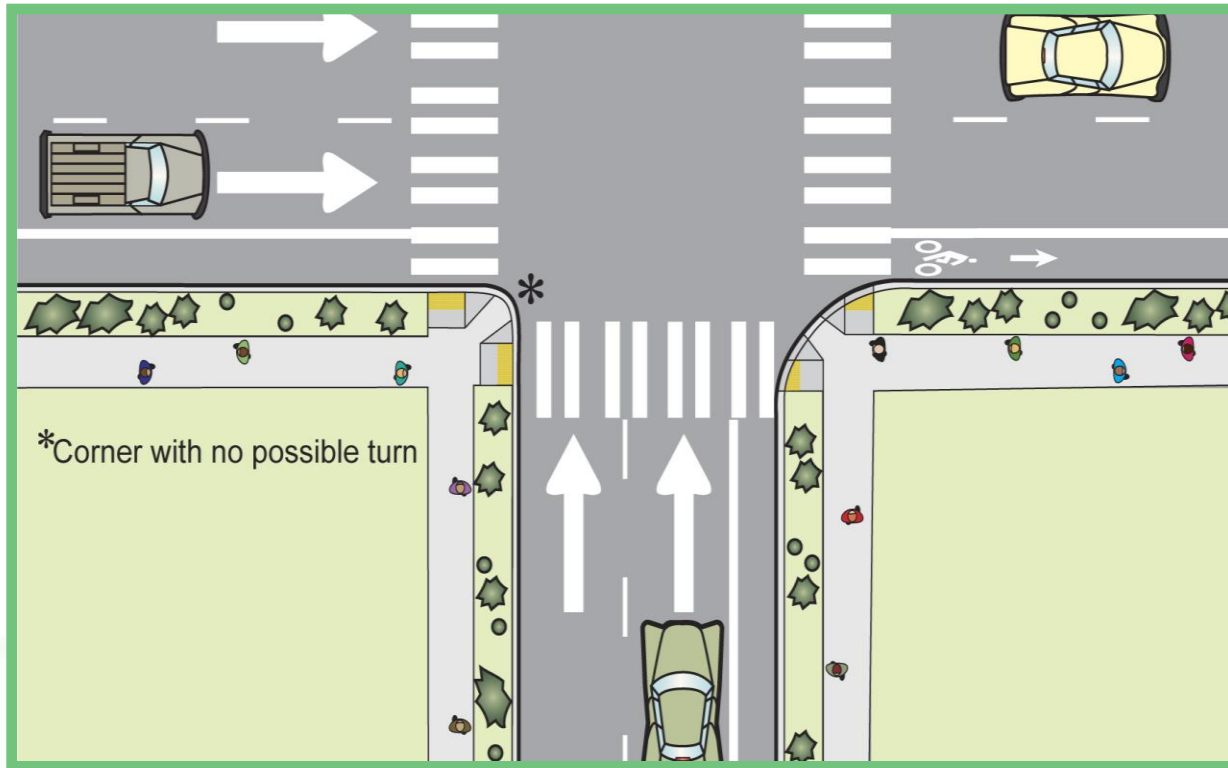
Minimize curb radius

1. Calculate effective radius:
Larger than built radius if
travel lanes offset from
curb with parking and/or
bike lane



Minimize curb radius

2. At one-way streets, corner with no turns can have tight radius



Minimize curb radius

3. Don't choose larger design vehicle than necessary
(Bus makes turn several times an hour)



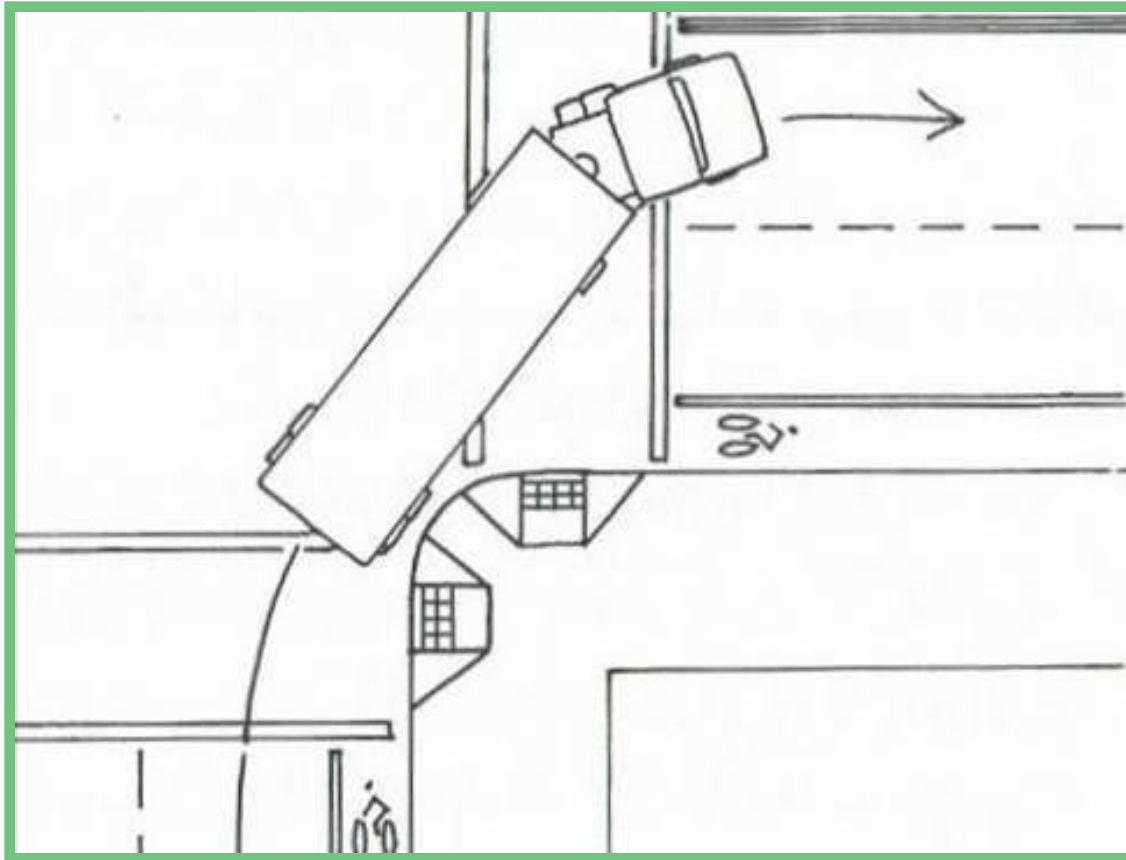
Minimize curb radius

4. Don't choose larger design vehicle than necessary
(Moving van, once or twice a year; peds cross every day)



Minimize curb radius

5. Where appropriate, let trucks use 2nd lane



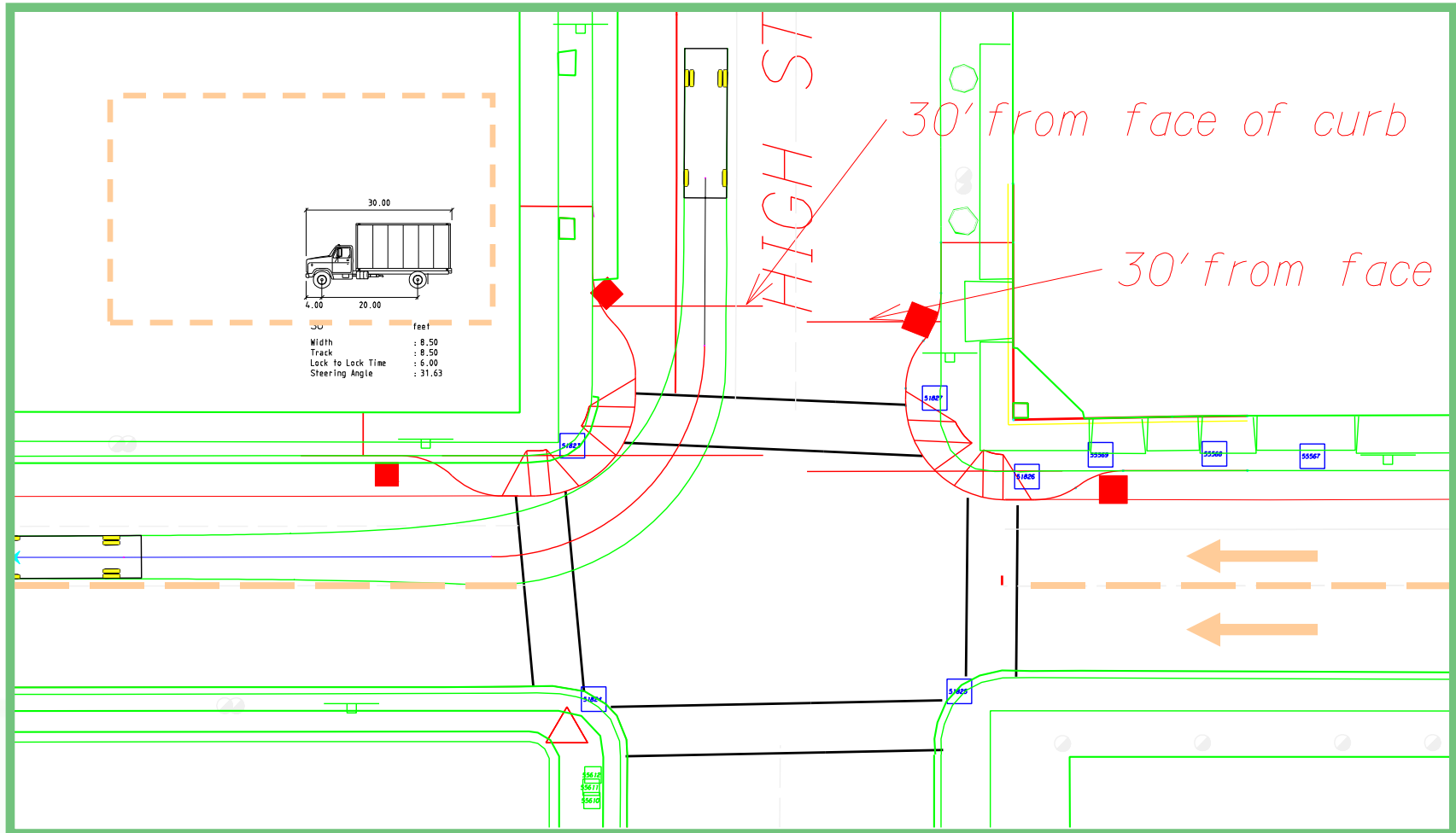
Minimize curb radius

6. Trucks can make very tight turns at slow speeds



Minimize curb radius

7. Turn common Single Unit truck (SU-30) into near lane



7. Turn less common Semi (WB-50) into 2nd lane



CRF for curb radii: not yet known

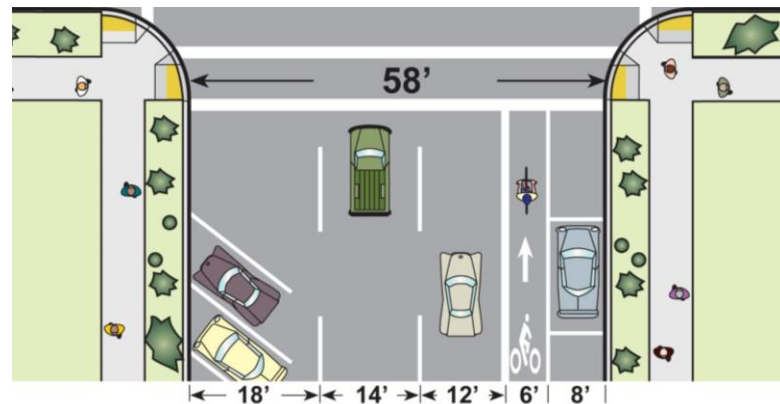
Although an exact number has not been determined, a study conducted by Zegeer et al. in Florida showed a correlation between large radii and higher pedestrian crash rates with right turning vehicles

Discussion:

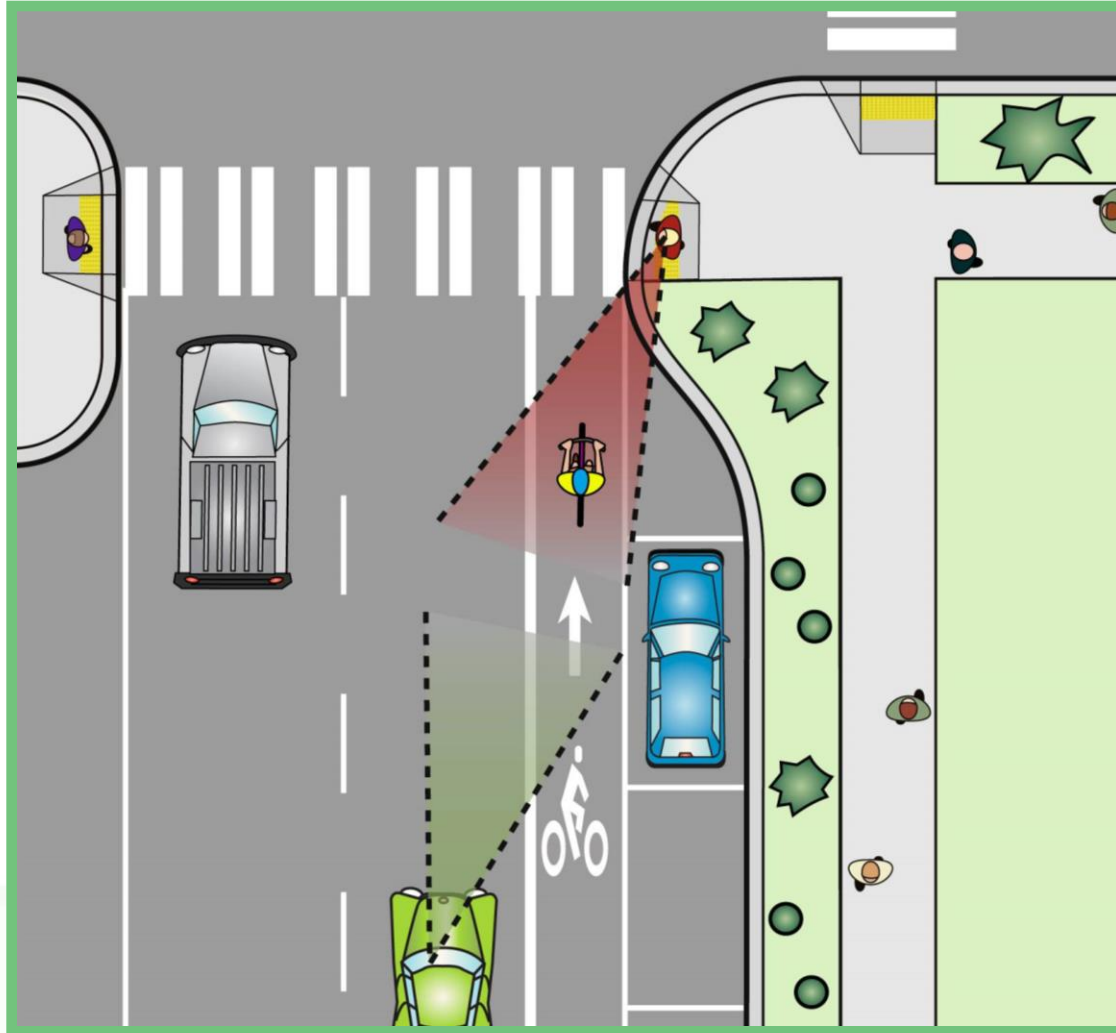
⇒ What are your policies & practices regarding corner radii?

Curb extensions

- ⇒ Most focus is on reduced crossing distance
- ⇒ Other advantages:
 - Better visibility between peds 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



Better Visibility





Pedestrians wait where they can see, in front of parked cars



Curb ext. places pedestrian where he can see and be seen



Before: high speed right-turns



After: slow speed right-turns

Curb extension and new corner radius must be designed together – see earlier radius discussion



Curb ext. increases likelihood drivers will yield to peds



Public art



Newspaper boxes



Bike parking



Street trees

**Curb extensions allow room for street furniture
But use care not to block sight lines**



Curb extensions enable signs to be moved in



Curb extensions enable signs to be moved in



Curb extensions enable signs to be moved in



Drainage solutions 1. Additional inlet



Drainage solutions 2. Slotted drain

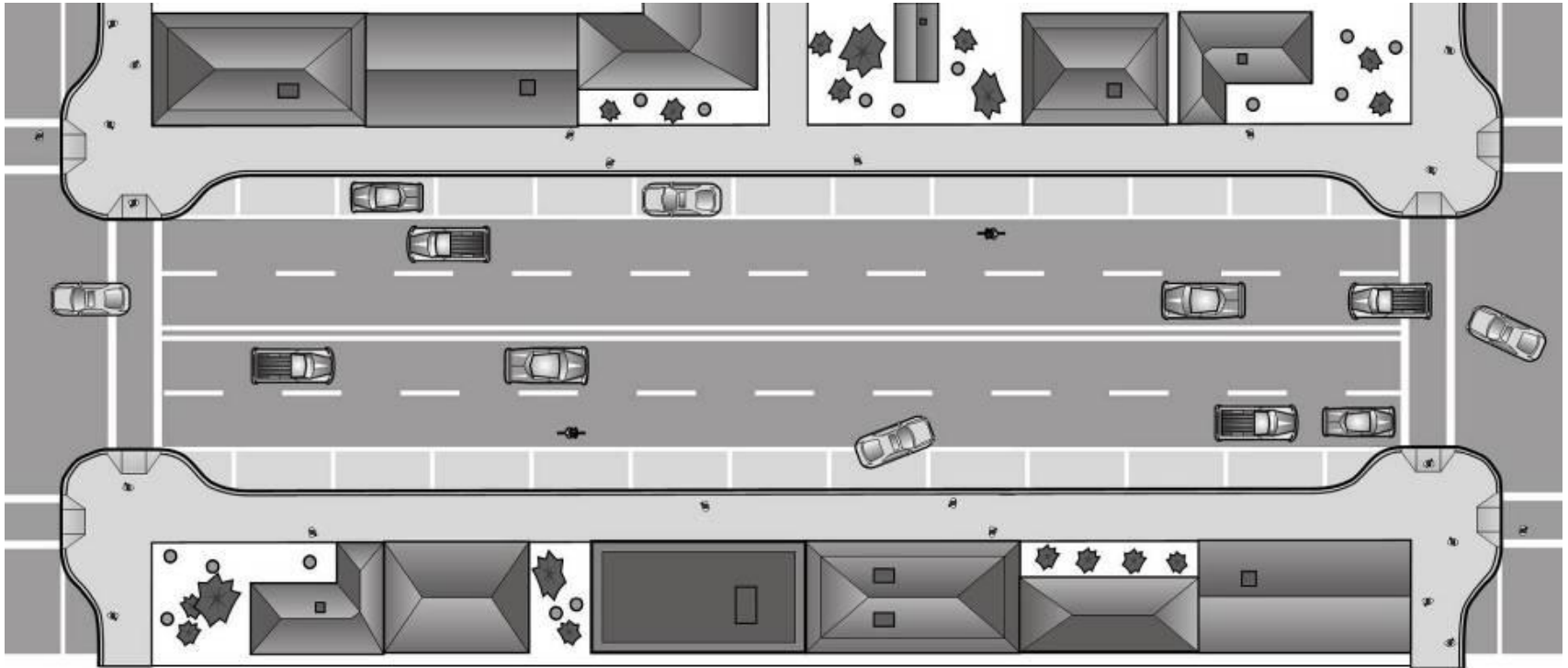


Drainage solutions 3. Leave original curb + islands



Drainage solutions 4. Same as before + plate

Curb Extension Integrated with the Sidewalk



“Parking pockets” in furniture zone have similar surface materials as the sidewalk



Before: road looks and feels wide

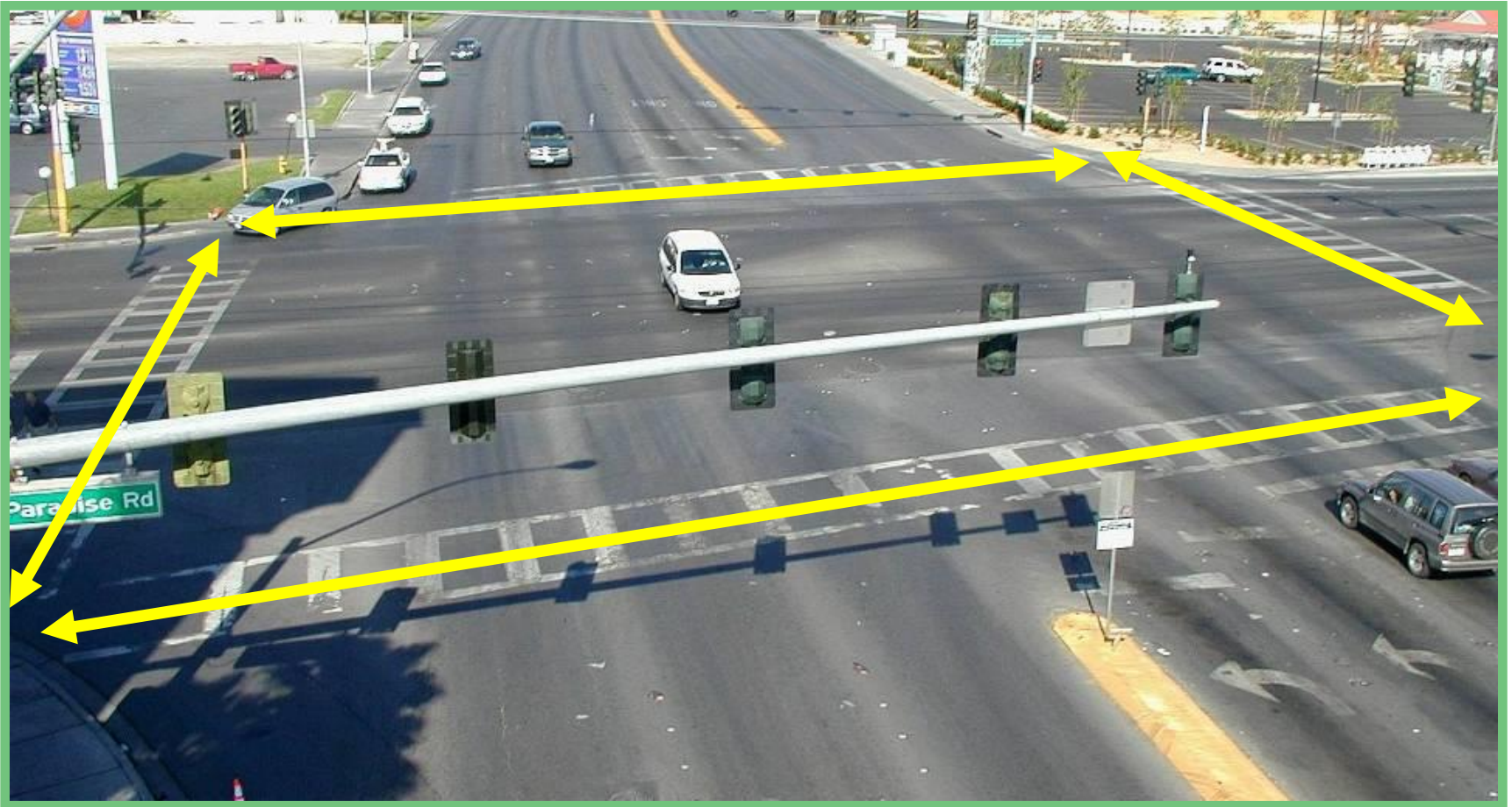


**After: curb extension integral to sidewalk
Street looks narrow even with no parked cars**

Reminder – crosswalks are provided:

1. To tell pedestrians where to cross
2. To tell drivers where to expect pedestrians





**Crosswalks should normally be placed
on all legs of an intersection**



Large intersection is capacity driven, pedestrian unfriendly...



The diagram shows a large intersection with 15 lanes. A pedestrian in a pink dress is crossing the intersection. A yellow dashed line with an arrow points from the top-left corner, across the intersection, to the top-right corner, indicating the path of the pedestrian. The intersection is divided into four quadrants by a vertical and a horizontal road. The top and bottom quadrants have orange and green sections. The left and right quadrants have green and orange sections. The central area is a large gray rectangle representing the intersection. The text 'Will she wait?' is in the top center, 'Is crossing 15 lanes safer than crossing 5 lanes?' is in the middle, and 'Here's what pedestrians are expected to do' is in the bottom center. A silhouette of a person playing a double bass is in the bottom right corner.

Will she wait?

Is crossing 15 lanes safer than
crossing 5 lanes?

Here's what pedestrians
are expected to do

Crosswalk placement requires balancing several goals that sometimes compete:

⇒ **Shortest crosswalk length**

⇒ **Minimal crosswalk setback to:**

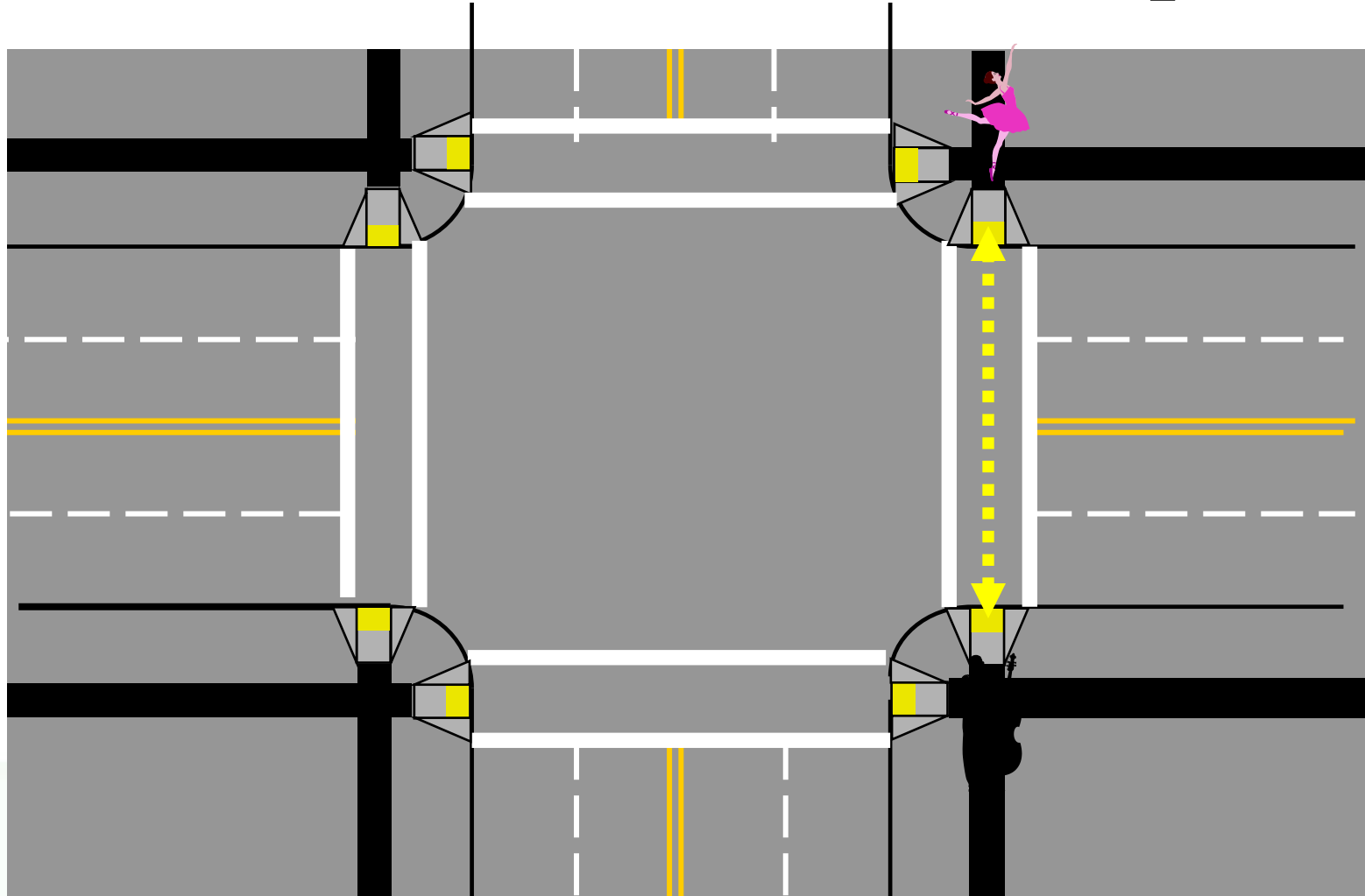
- Reduce out-of-direction travel
- Provide good sight lines between peds and motorists

⇒ **Proper ramp placement:**

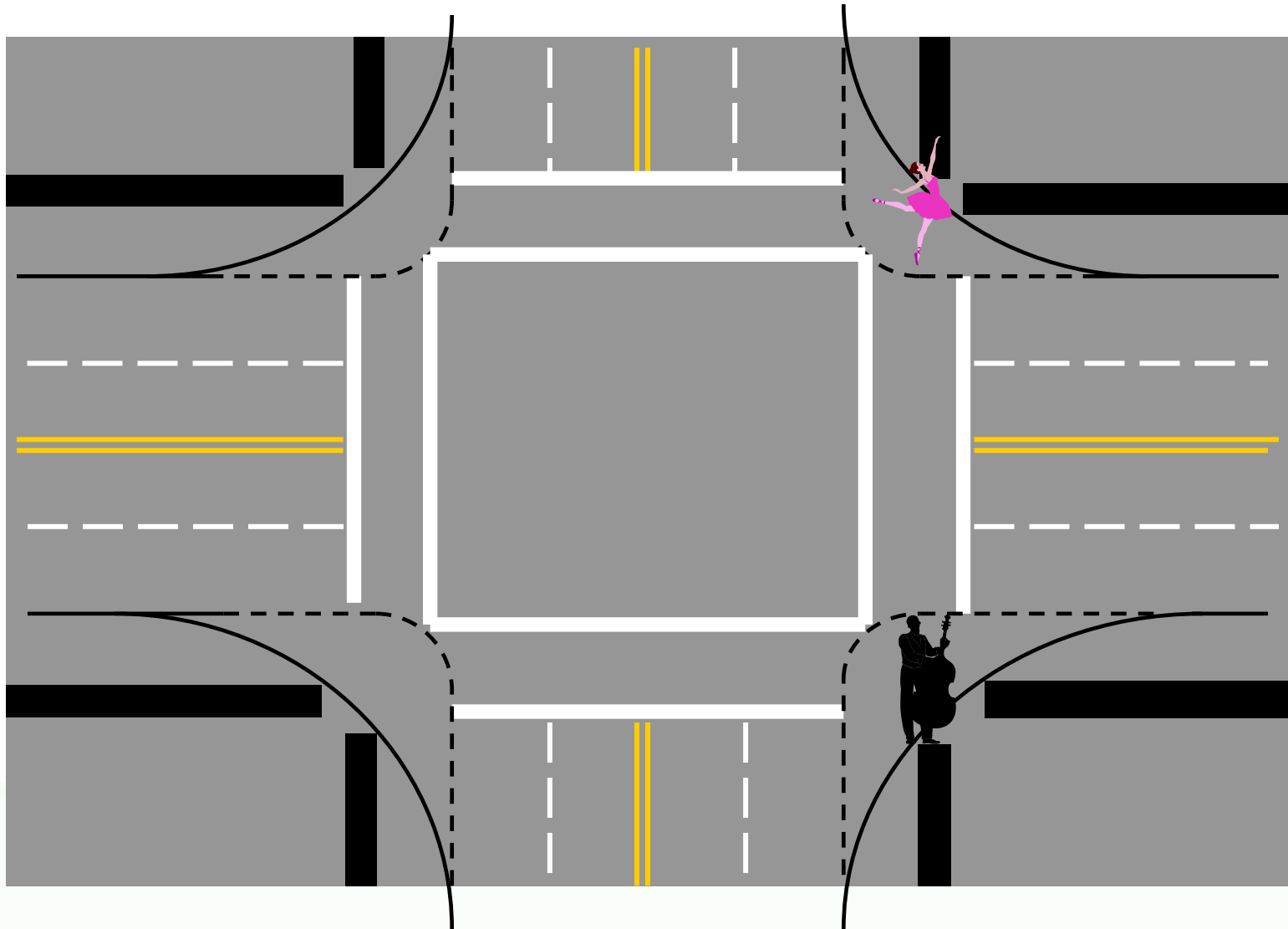
⇒ **Ramps entirely contained in crosswalk**

⇒ **Two ramps preferred whenever possible**

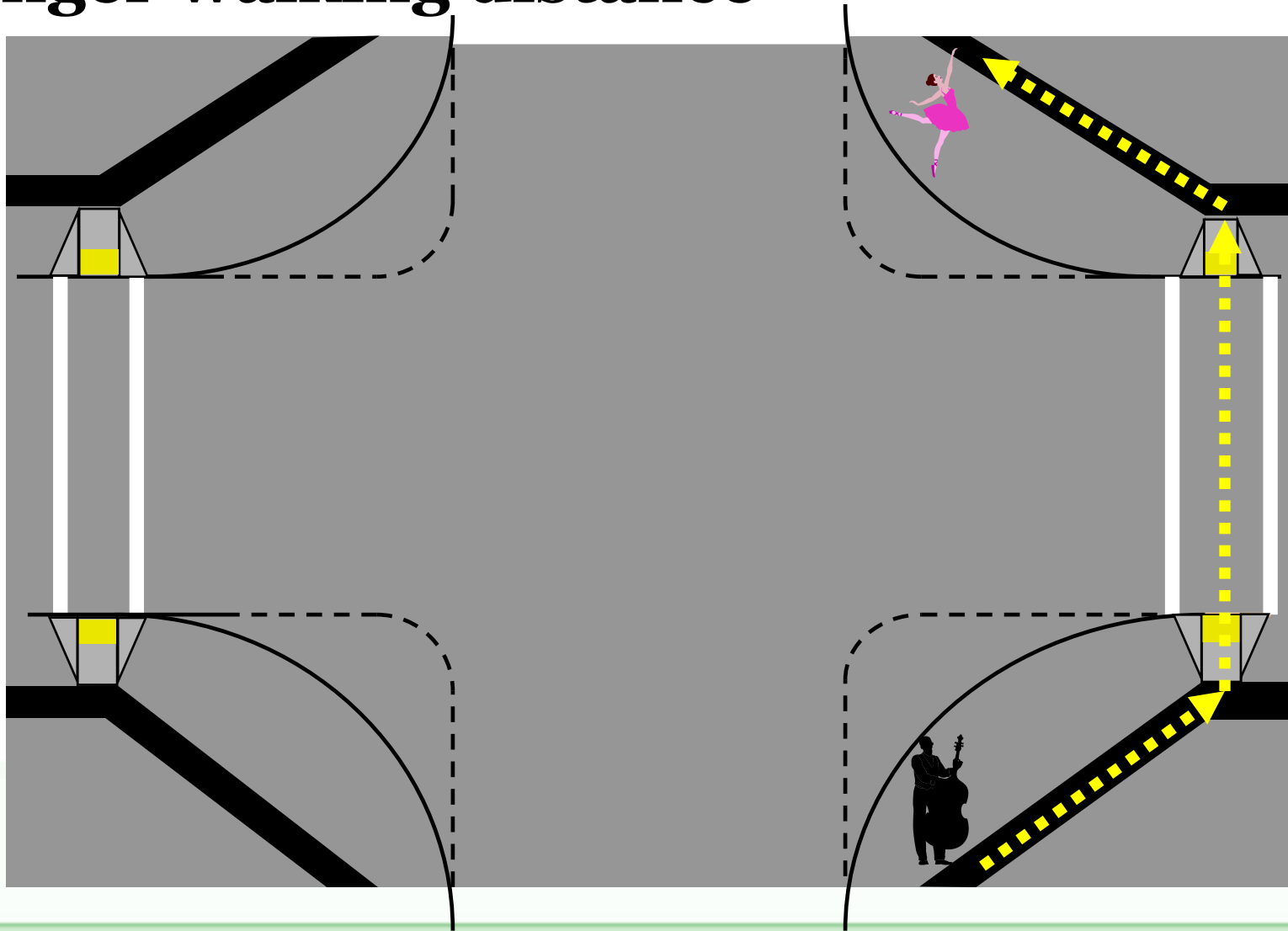
Small corner radii allow two ramps, shortest crosswalks, direct travel paths



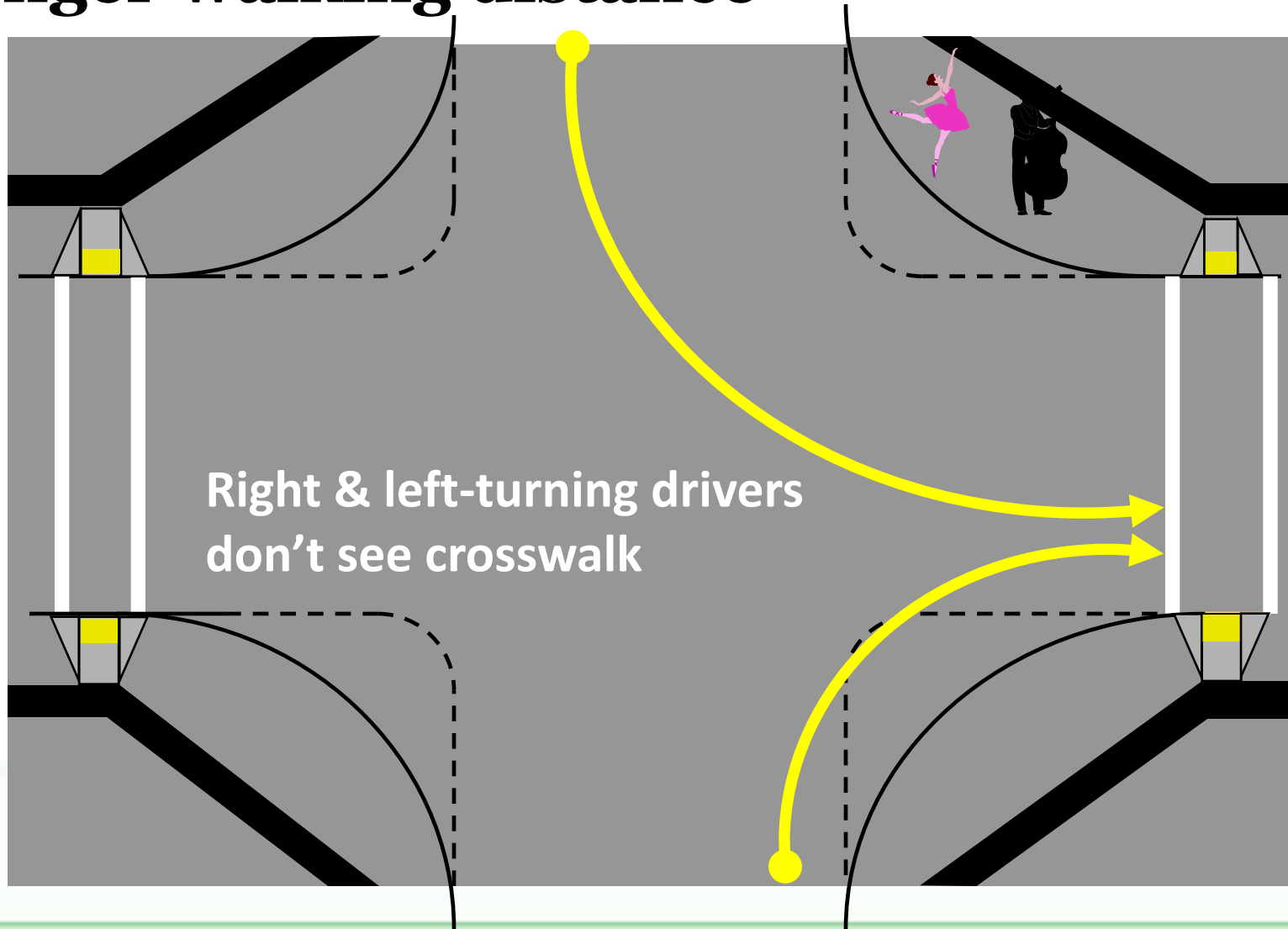
Larger radii create large undefined areas



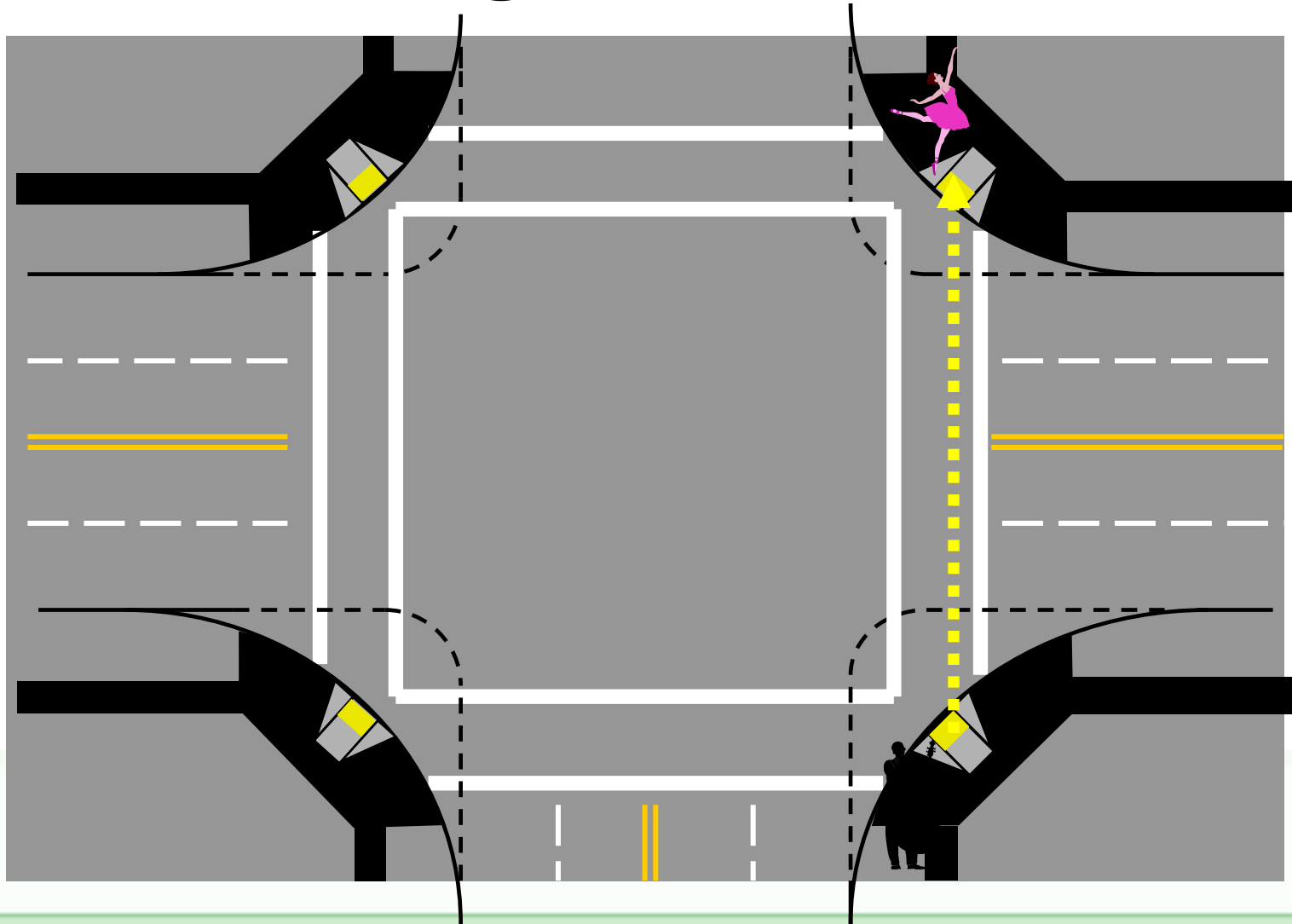
Crosswalks at shortest crossing = longer walking distance



Crosswalks at shortest crossing = longer walking distance

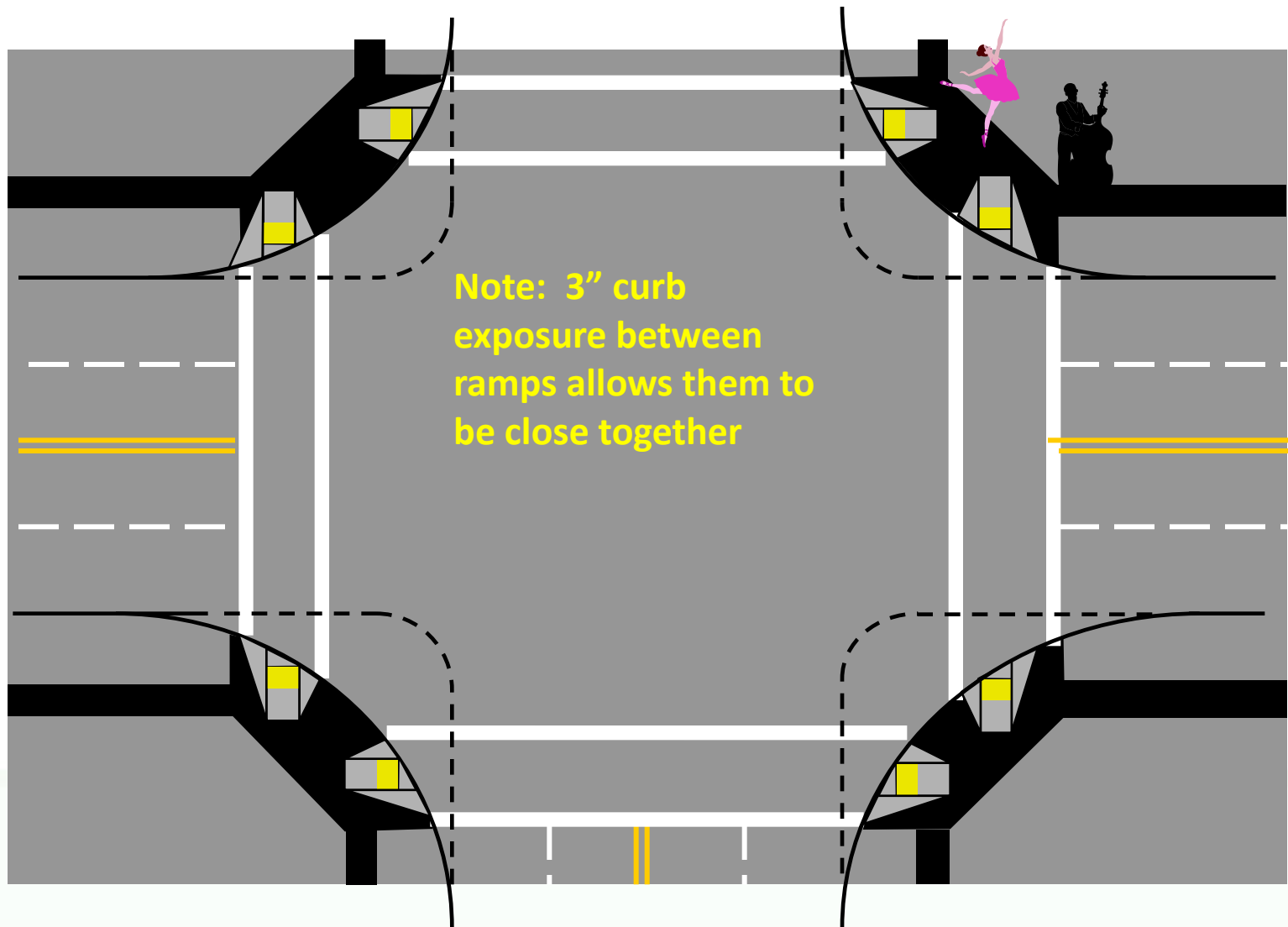


Single ramp reduces crosswalk setback but lengthens crosswalk



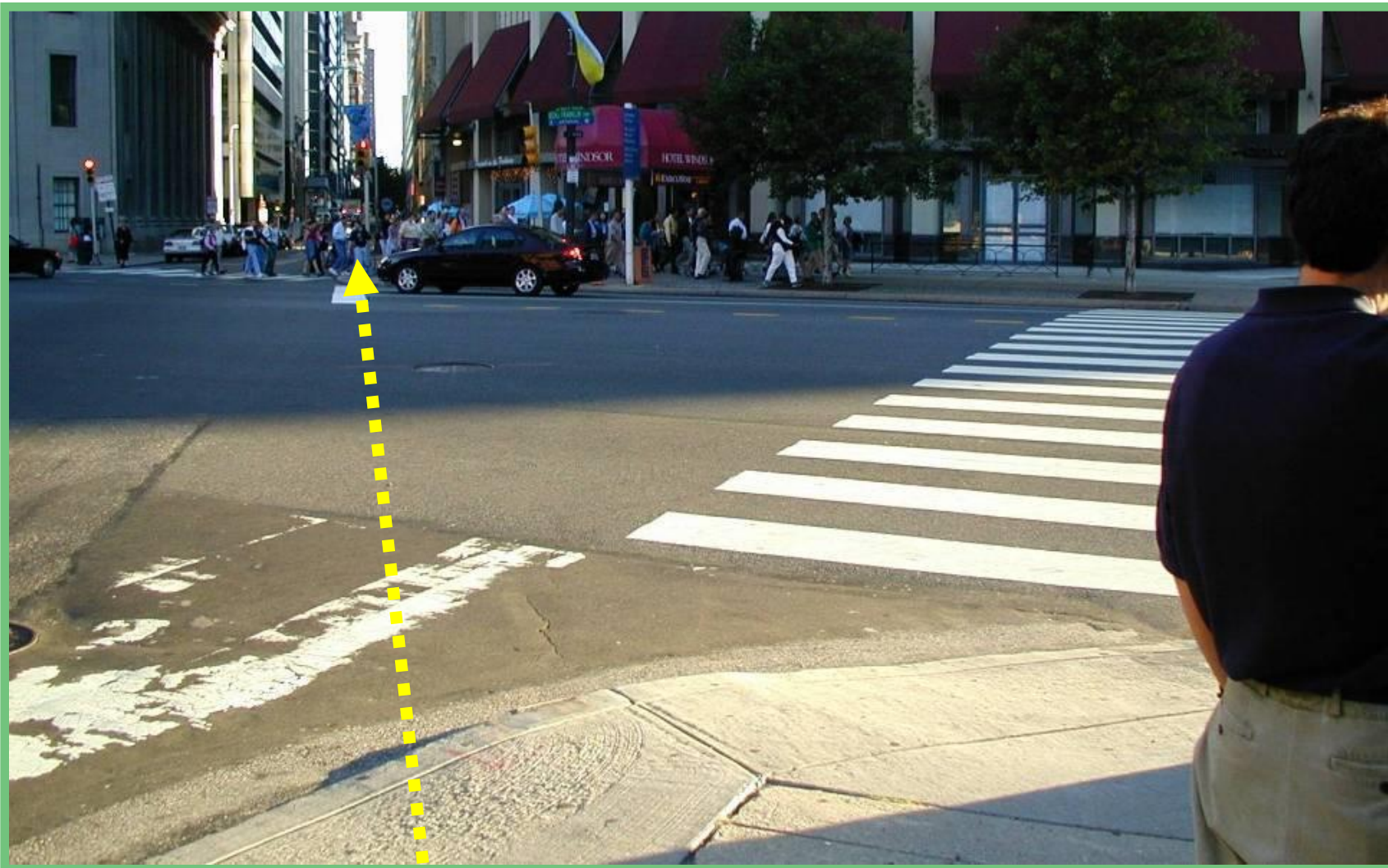
Note:
Crosswalk length and setback are greater with large radii than with small radii

Balancing the goals works best





Crosswalk placement: Observe pedestrians



Crosswalk placement: Think like a pedestrian

“When in doubt, paint it out!”



**Crosswalks can have odd shapes to take
pedestrians where they want to go**

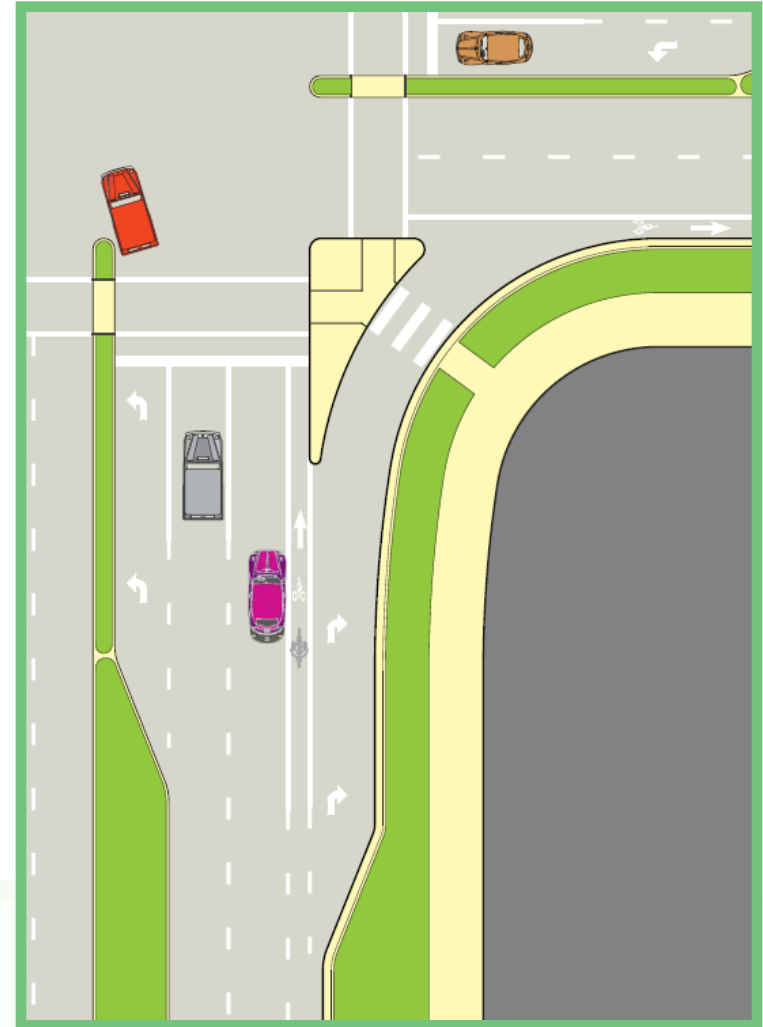
Discussion:

⇒ What are your policies & practices regarding crosswalk placement?

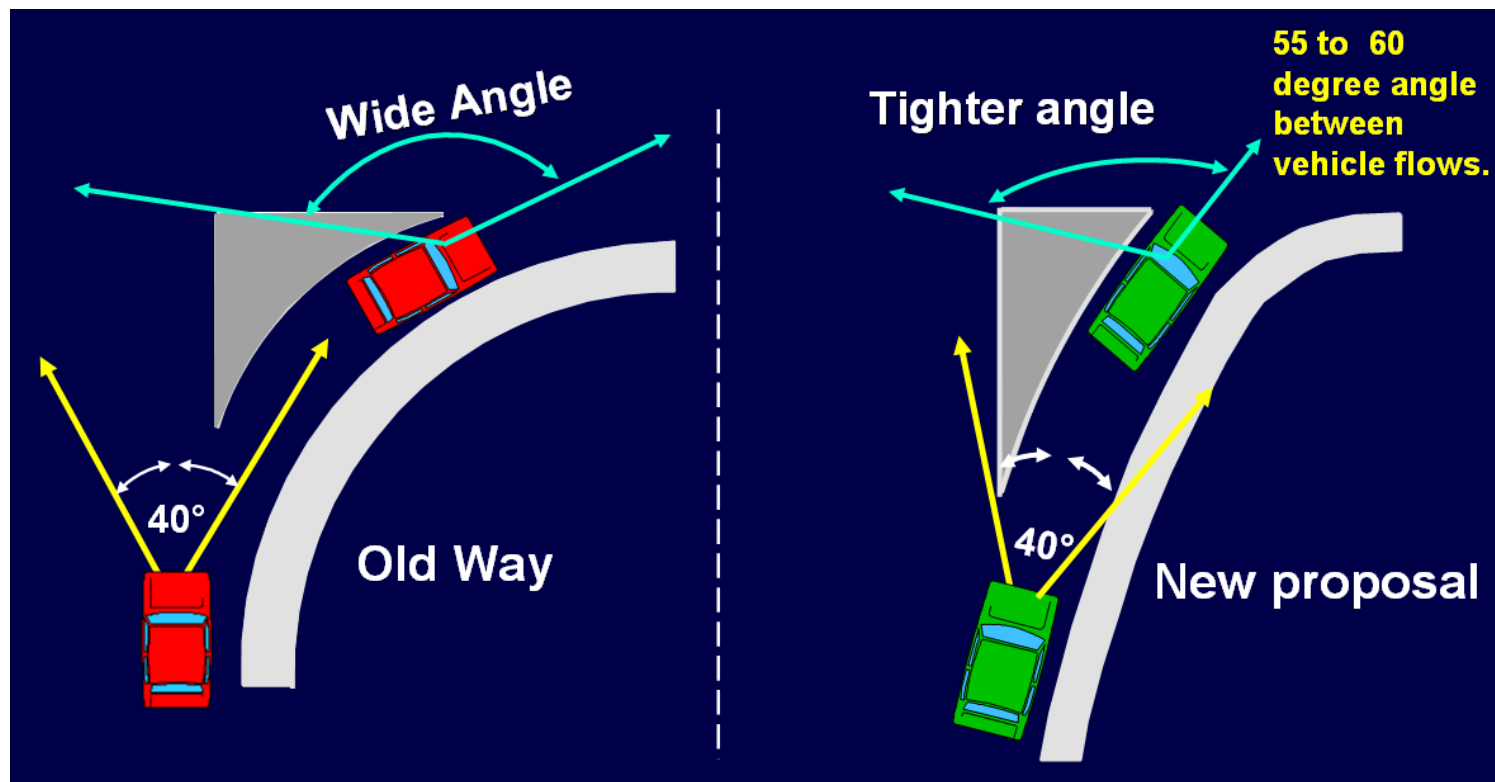
Pedestrian Islands

Benefits:

- ⇒ Separate conflicts & decision points
- ⇒ Reduce crossing distance
- ⇒ Improve signal timing
- ⇒ Reduce crashes



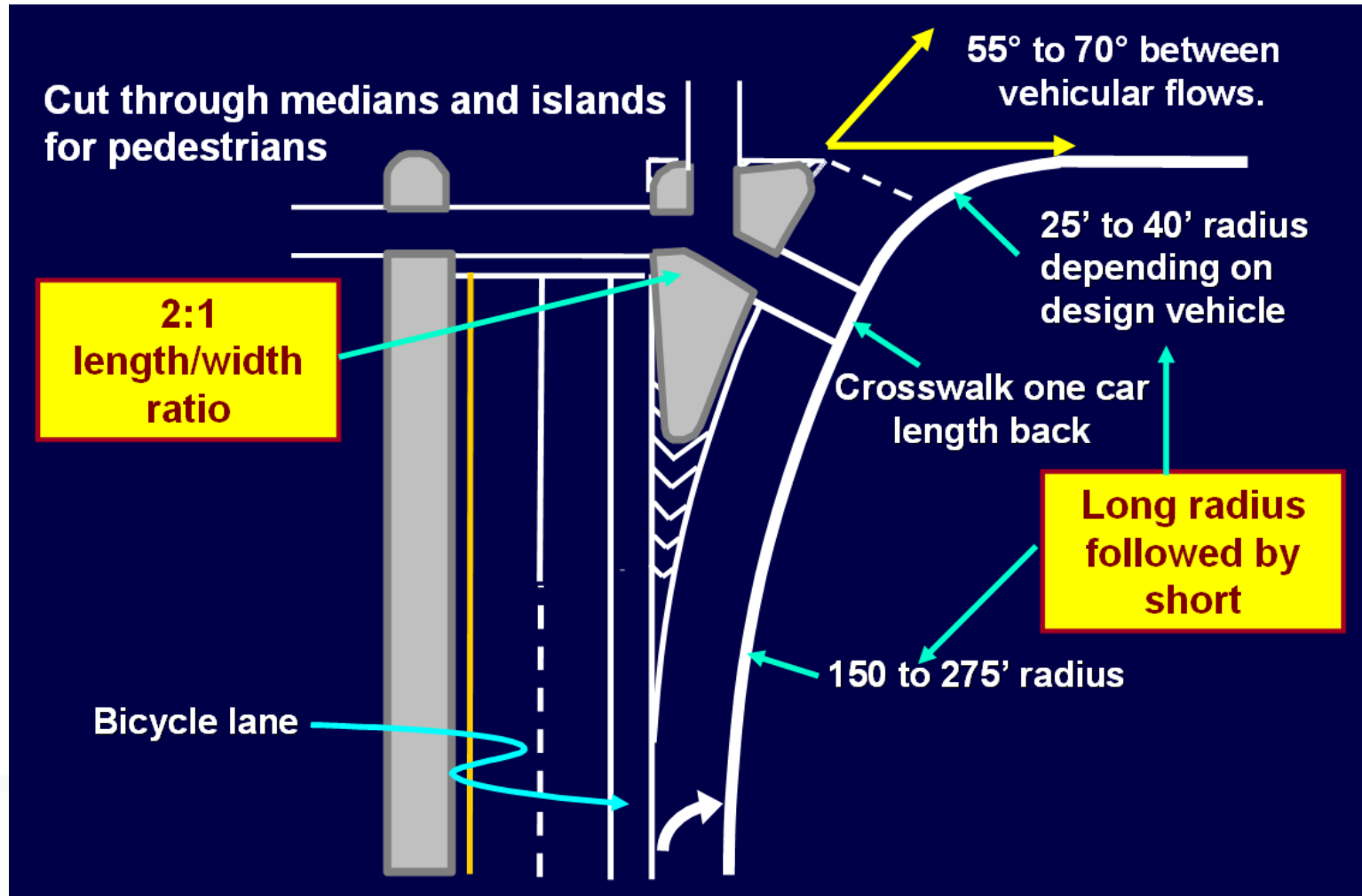
Right-Turn Slip Lane: Design for Pedestrians



High speed, head turner =
low visibility of pedestrians

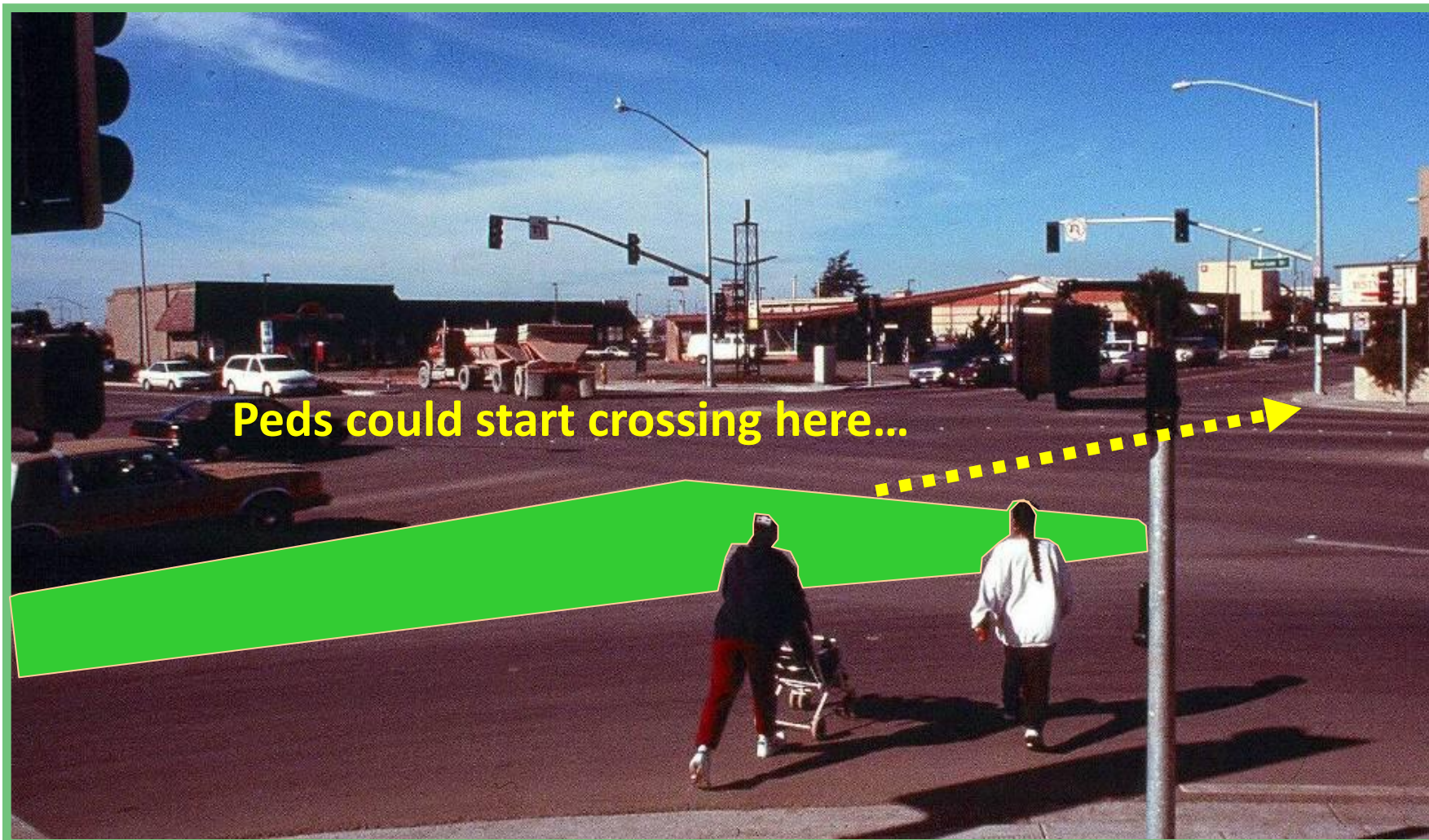
Slow speed, good angle =
good visibility of pedestrians

Right-Turn Slip Lane - Details

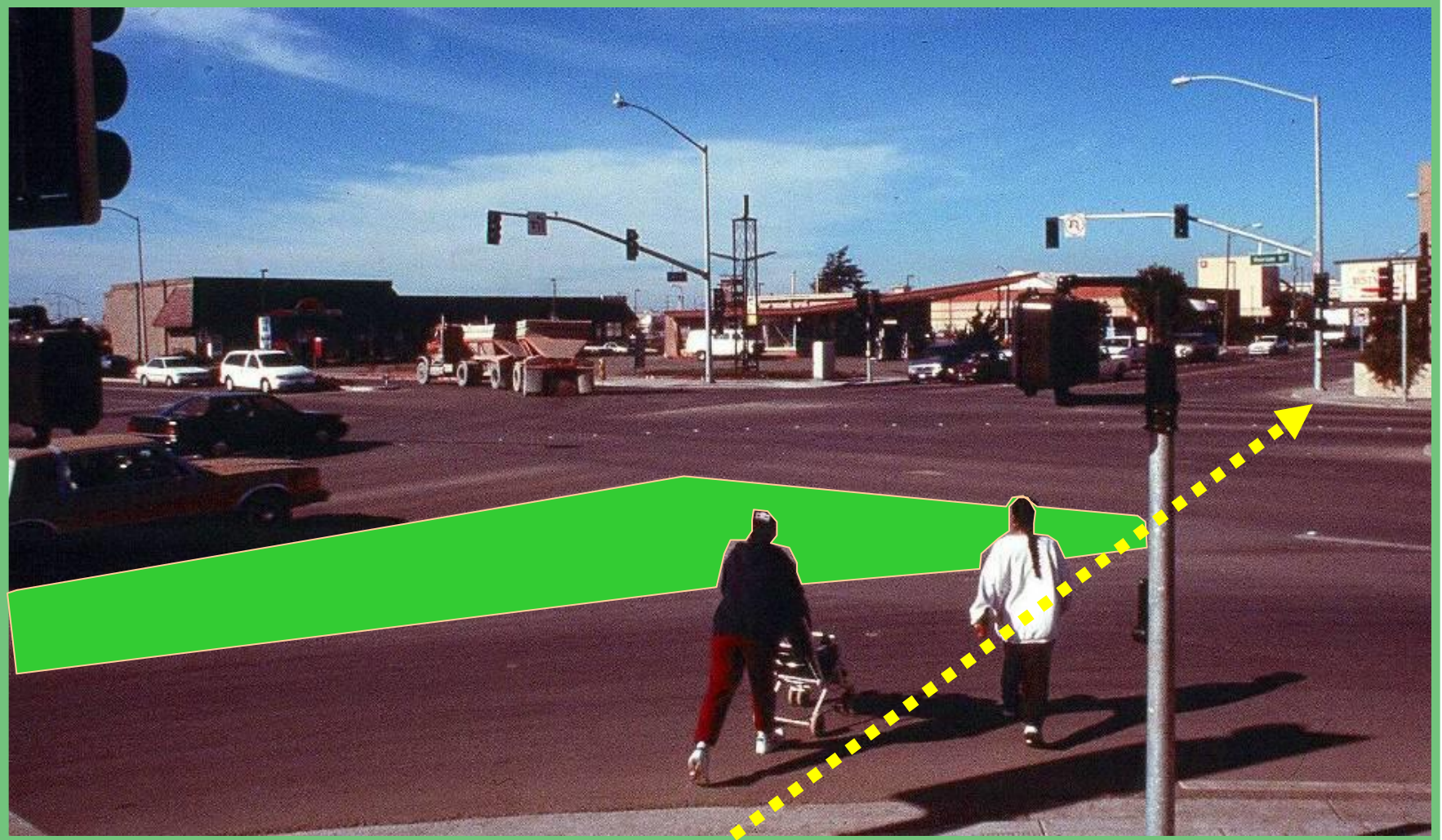




Drivers naturally trace the right island shape



Peds could start crossing here...



... instead of here

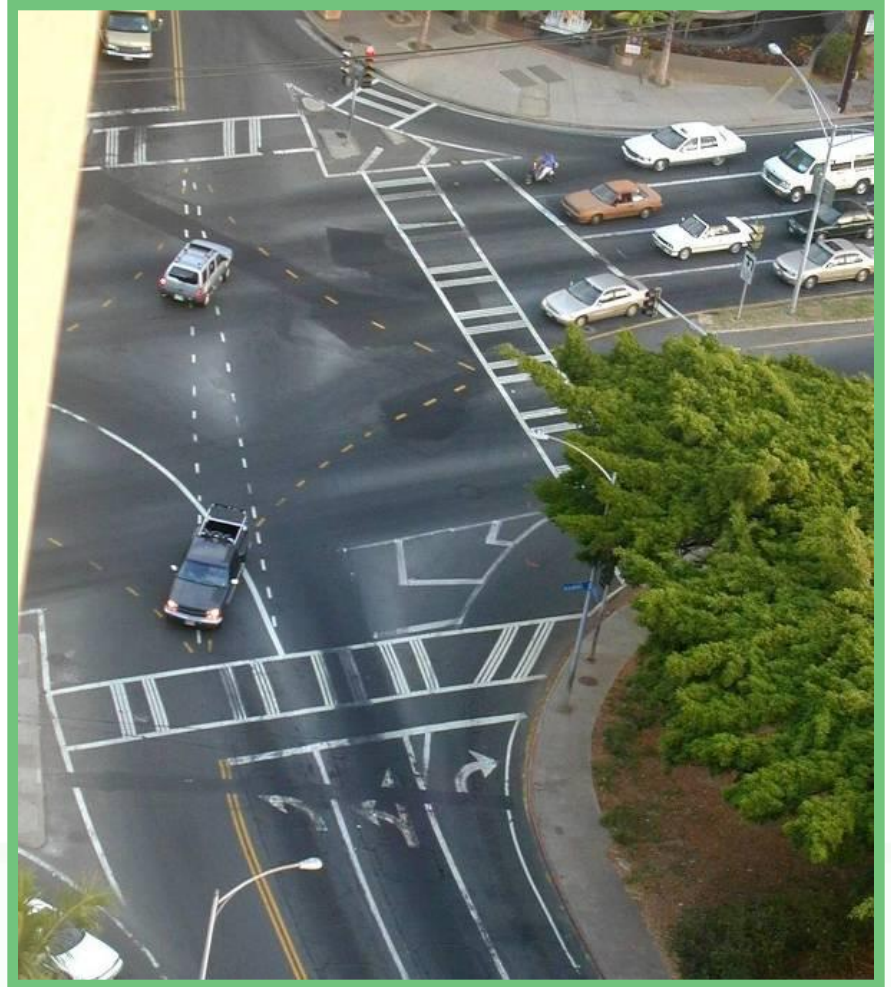


Should we mark this crosswalk?



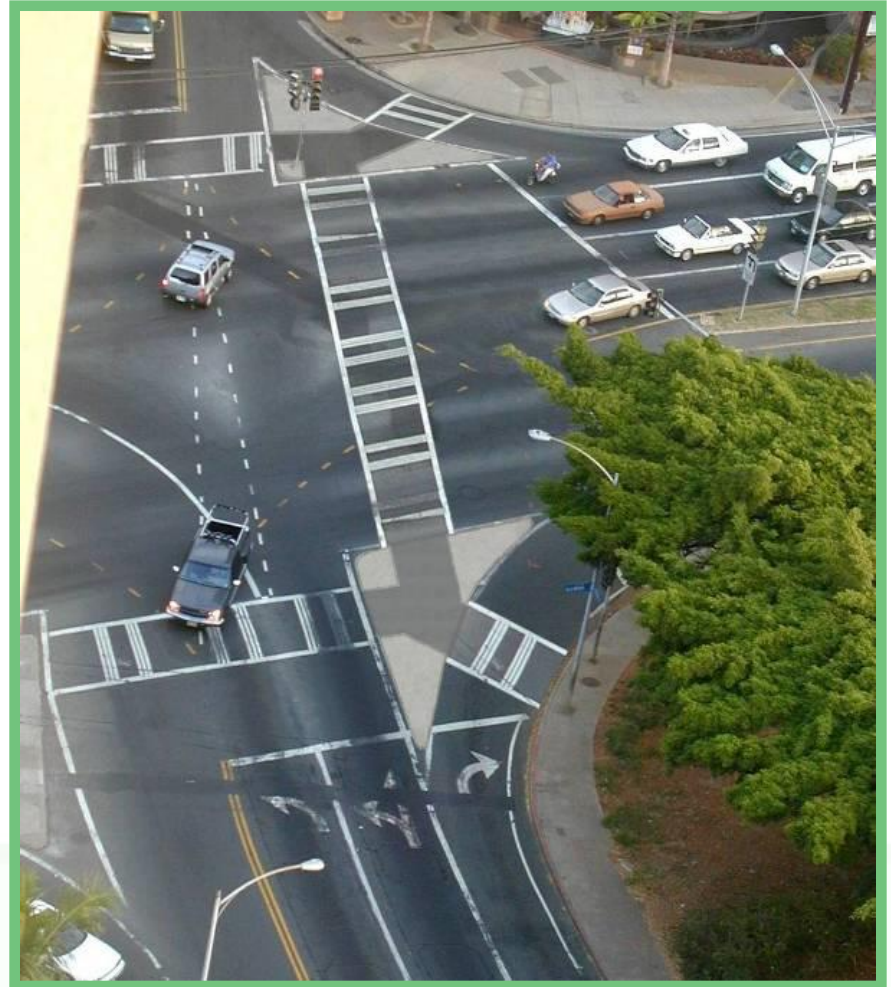
**Yes: It's a yield-controlled approach,
and it may not be clear where peds cross.**

Raised islands can improve a large multi-lane intersection



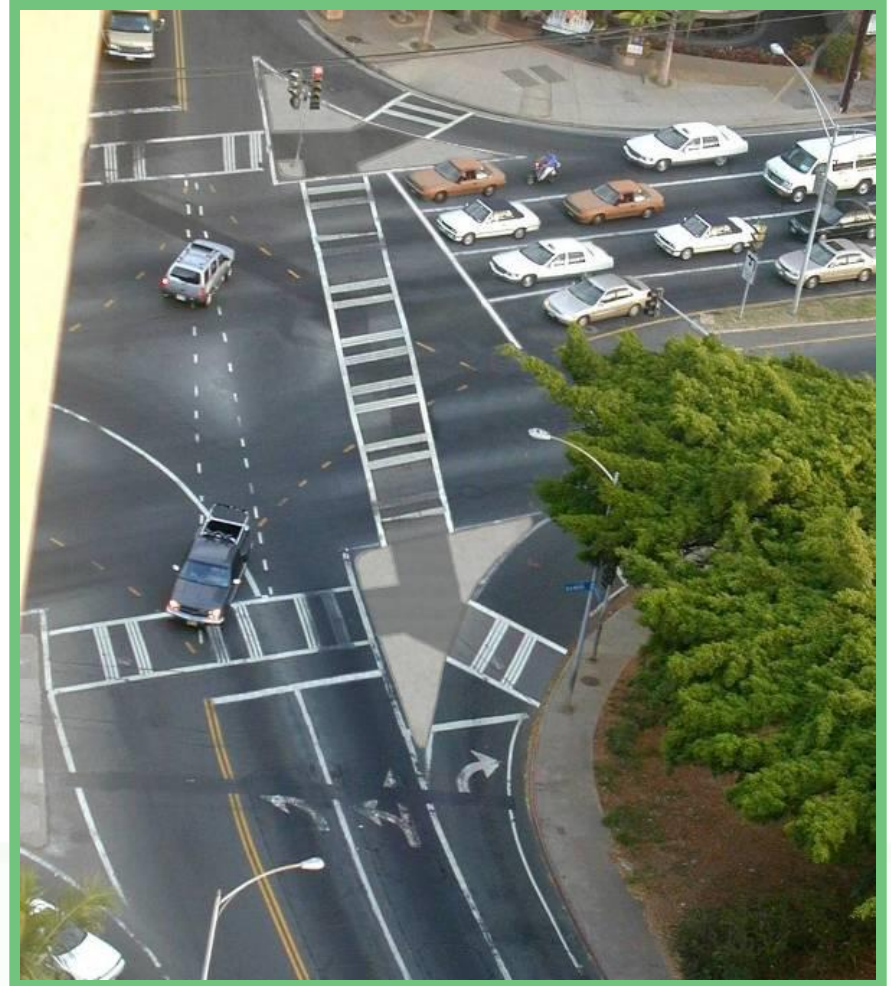
Raised islands can improve a large multi-lane intersection

1. Build raised islands between thru & RT lanes to separate ped/driver conflicts. Consolidate two crosswalks into one.



Raised islands can improve a large multi-lane intersection

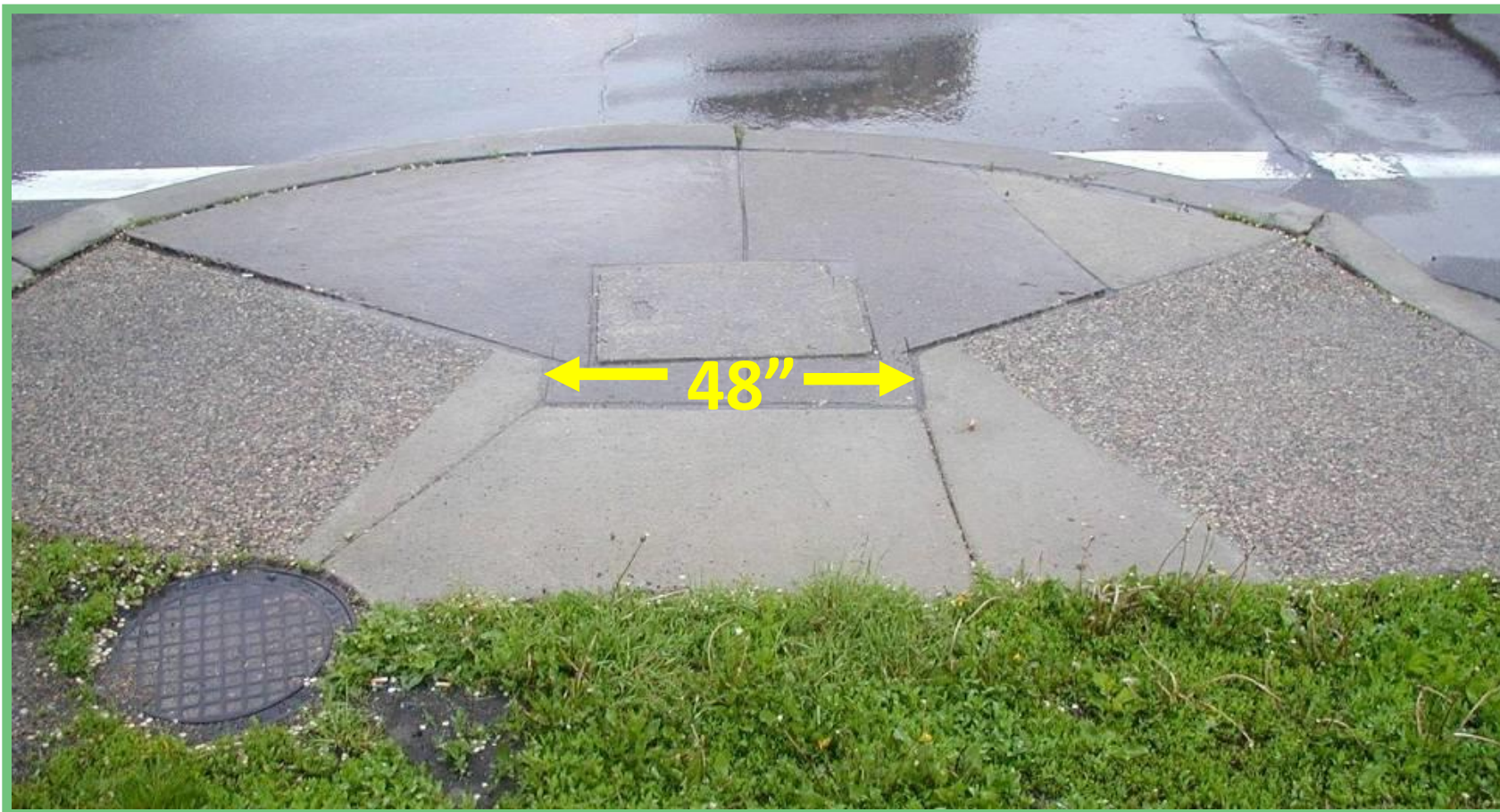
- 1. Build raised islands between thru & RT lanes to separate ped/driver conflicts. Consolidate two crosswalks into one.**
- 2. Move stop bar forward to improve capacity and safety for motorists**



Island Design Details



- ⇒ Cut-through preferred over ramps
- ⇒ Truncated domes at cut-throughs
- ⇒ 8' or more preferred width – 6' minimum



With ramps, provide at least 48" level area





Not acceptable



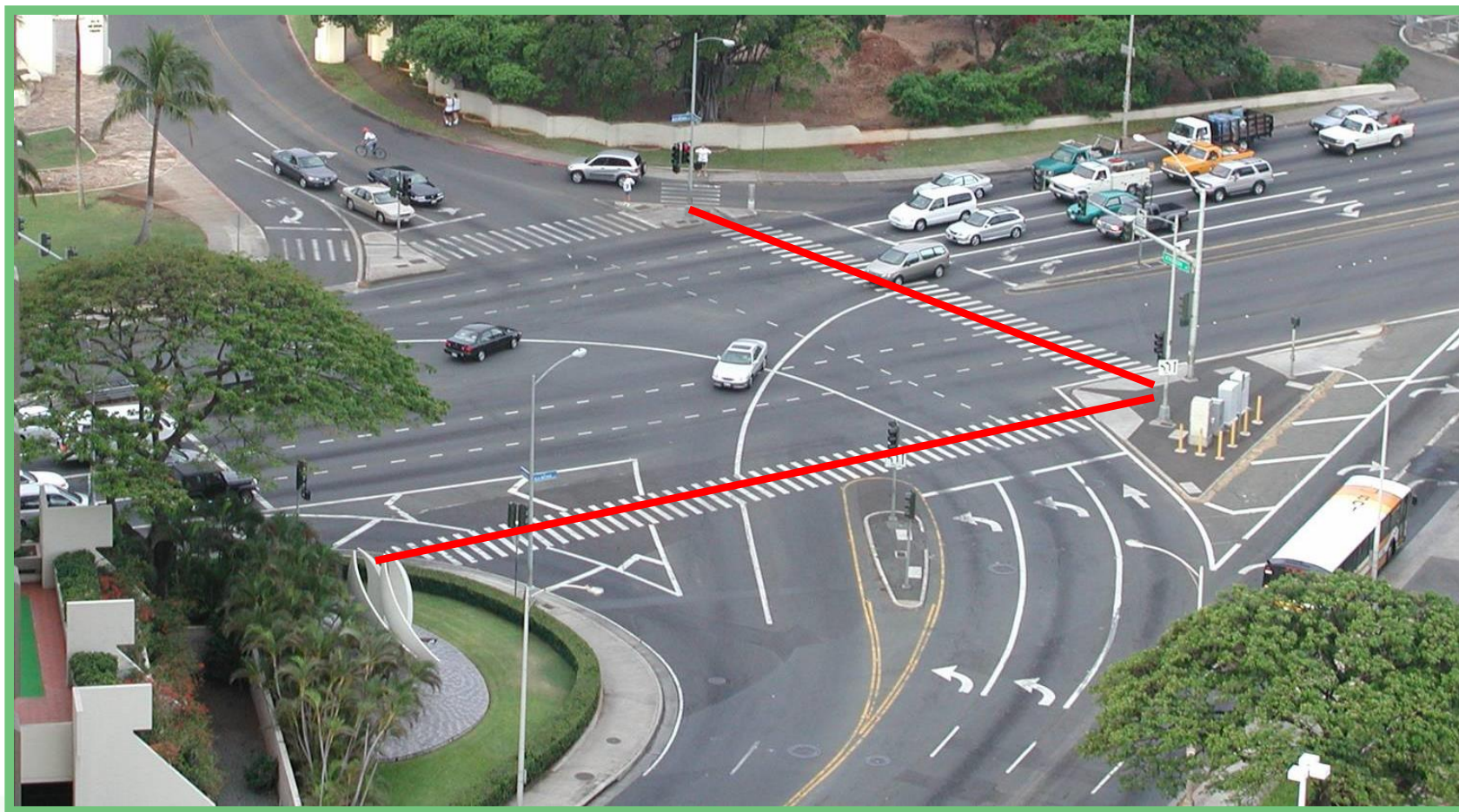
Acceptable, not great

Best:

- ⇒ **Bullet nose protects pedestrians from high-speed left-turning cars**

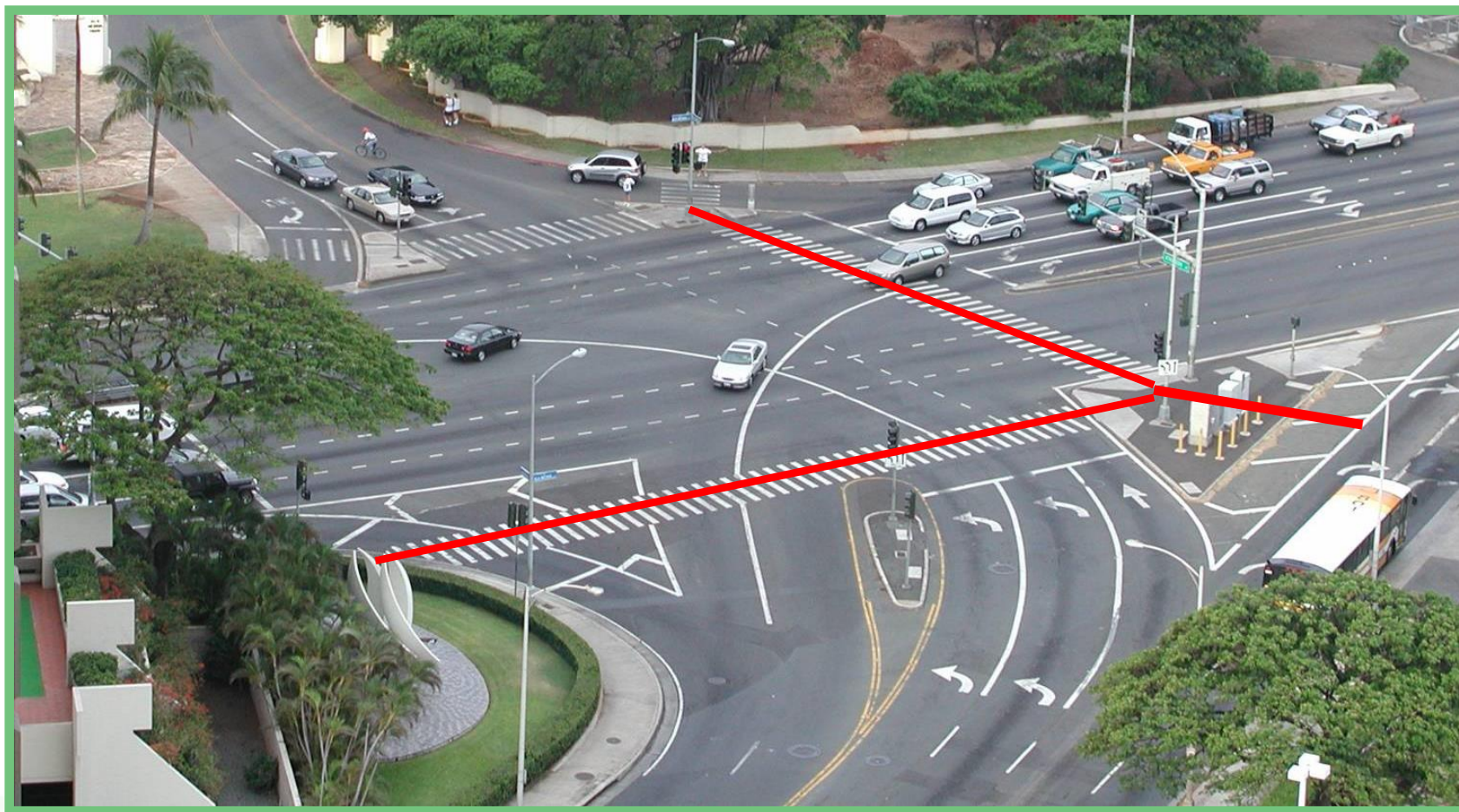


How to place a crosswalk at porkchop island



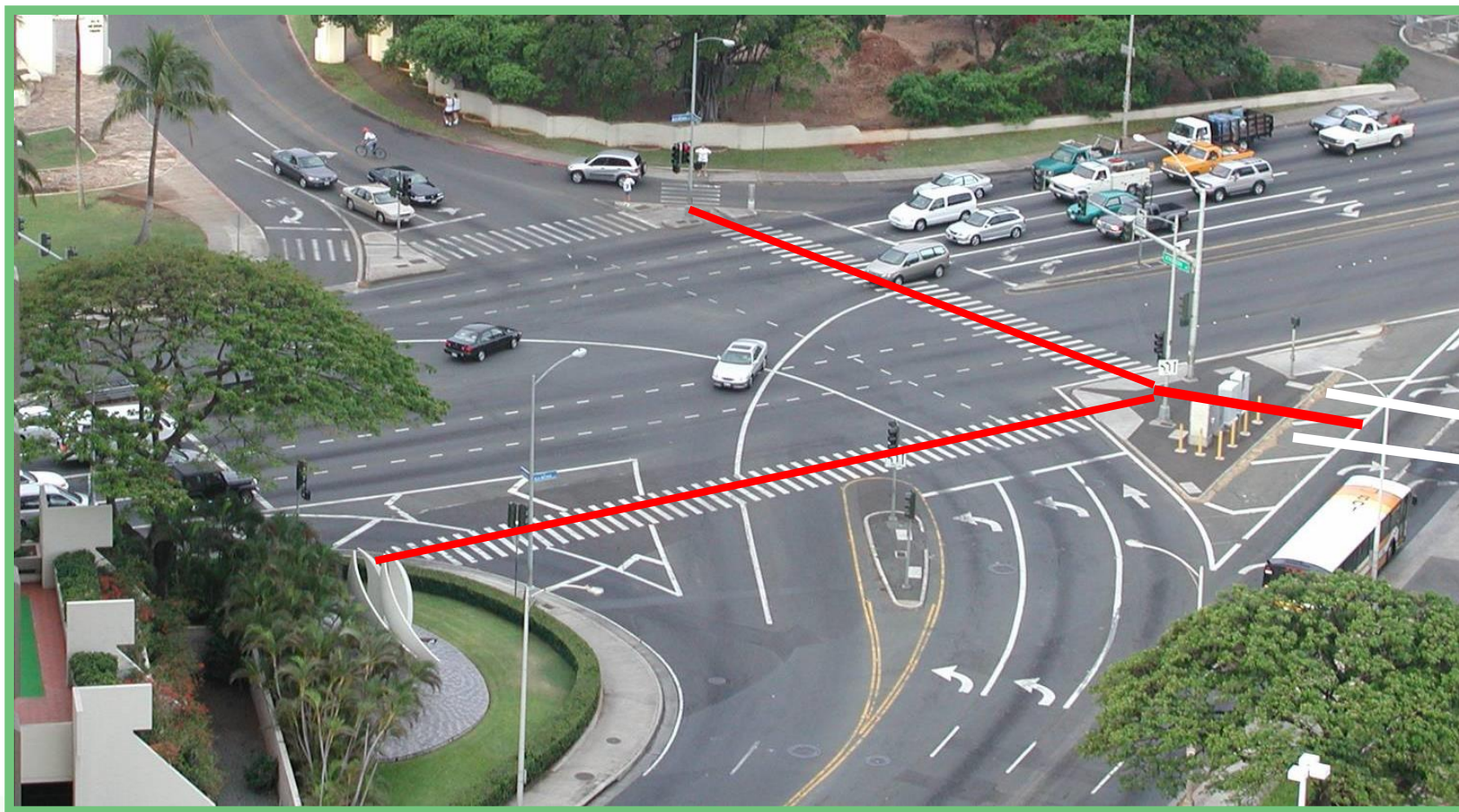
1. Place crosswalks to island

How to place a crosswalk at porkchop island



2. Trace 3rd line where they meet

How to place a crosswalk at porkchop island



3. Place 3rd crosswalk there

Discussion:

⇒ What are your policies & practices regarding providing pedestrian islands?

Intersection Geometry: Recap of Design Measures

⇒ Should pedestrians have access to all corners?

- Yes

⇒ Why?

- Otherwise peds will dash across anyway

⇒ Intersection geometry should be?

- Tight (small radii); right angles

⇒ How do you break up complex intersections?

- With islands

⇒ Where should you place crosswalks?

- Where pedestrians want to cross and where drivers can see them

Intersection Geometry

Learning Outcomes

You should now be able to:

1. Explain why tight/right angle intersections are best
2. Describe why pedestrians need access to all corners
3. Assess good crosswalk placement: where peds want to cross & where drivers can see them
4. Explain how islands break up complex intersections

Questions?