

# Designing for Pedestrian Safety

## Intersection Geometry

Presented by:

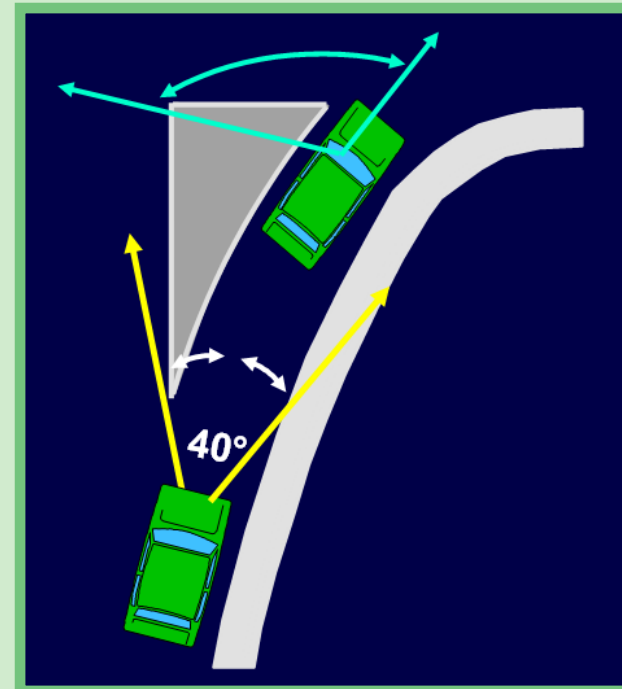
**John LaPlante**

*T.Y. Lin International, Inc*

**Keith Sinclair**

*FHWA Resource Center*

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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



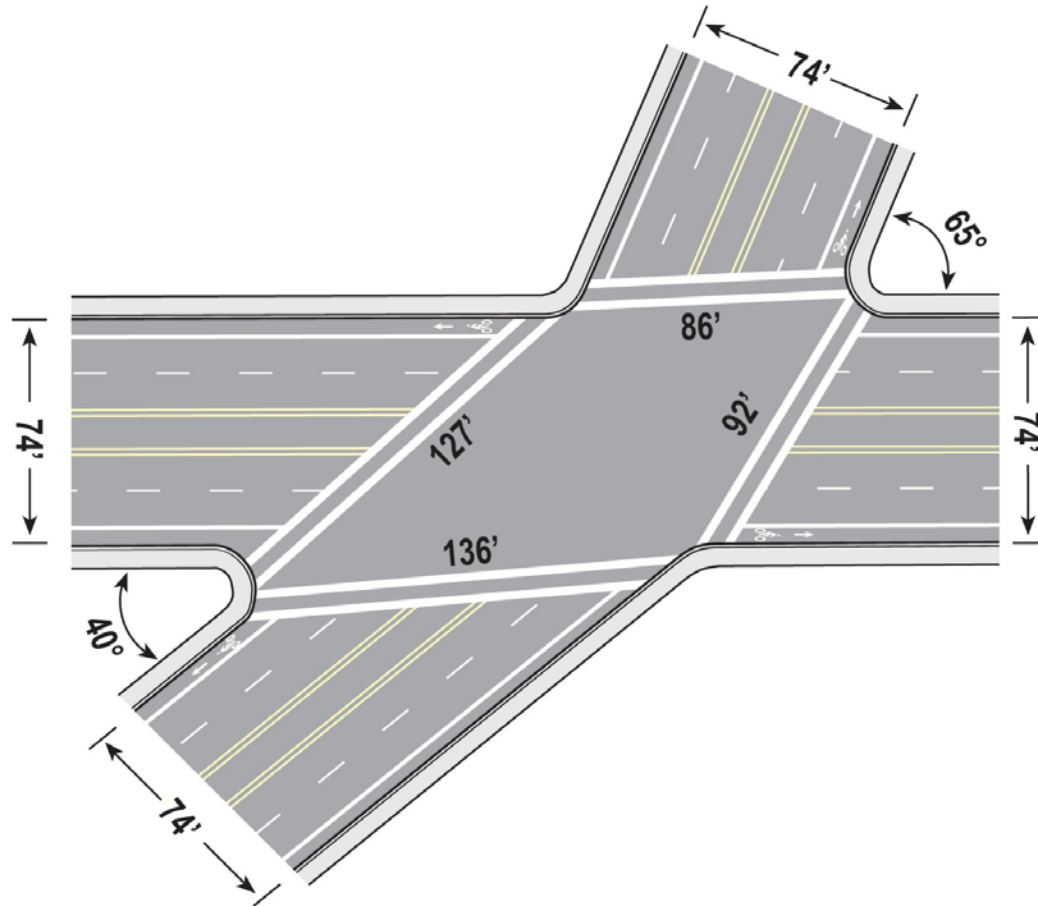
**Small, tight intersections best for pedestrians...**

**Simple, few conflicts, slow speeds**



**Large intersections can work for pedestrians – with mitigation**

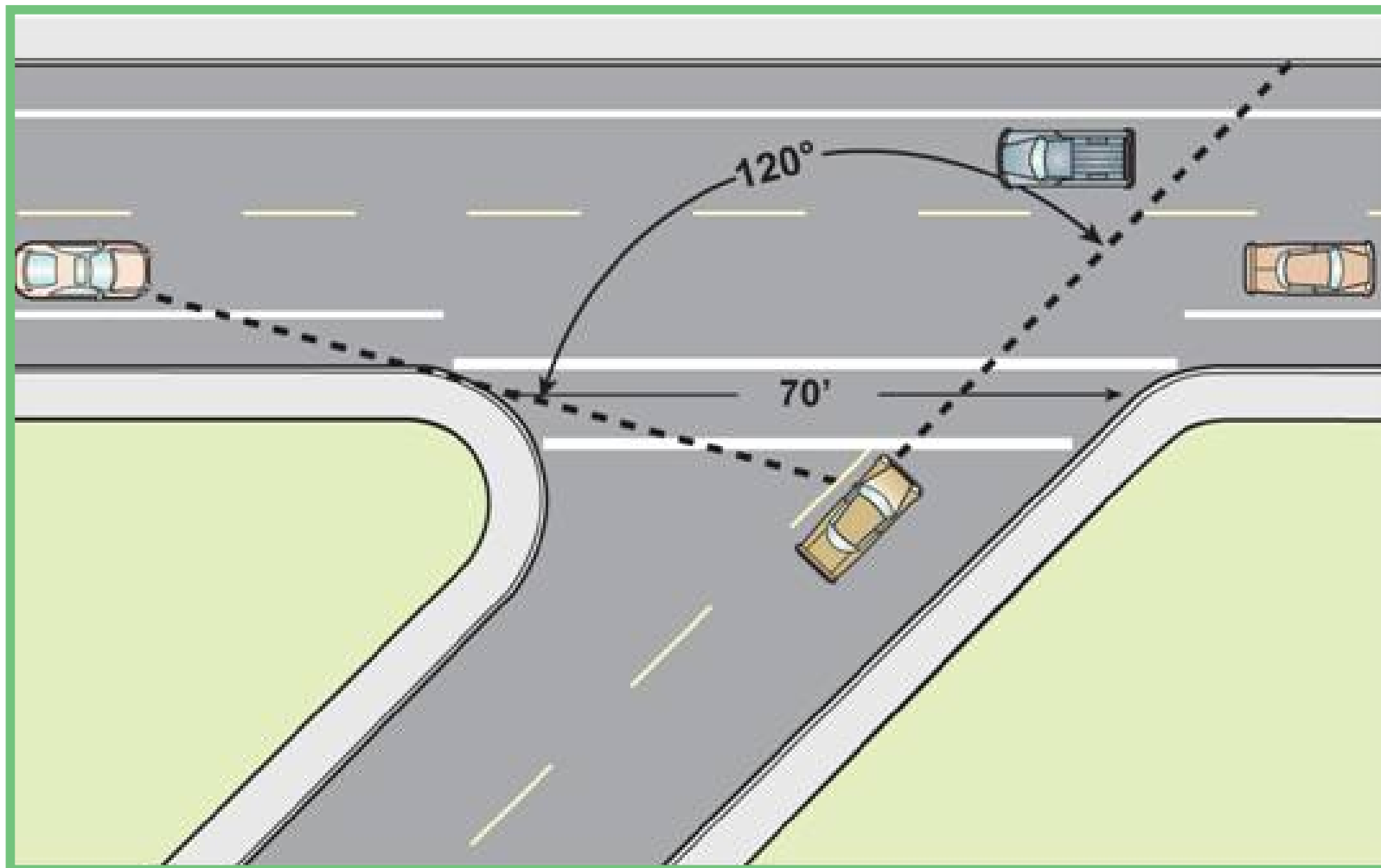
# Skewed intersections



Skew increases crossing distance & speed of turning cars

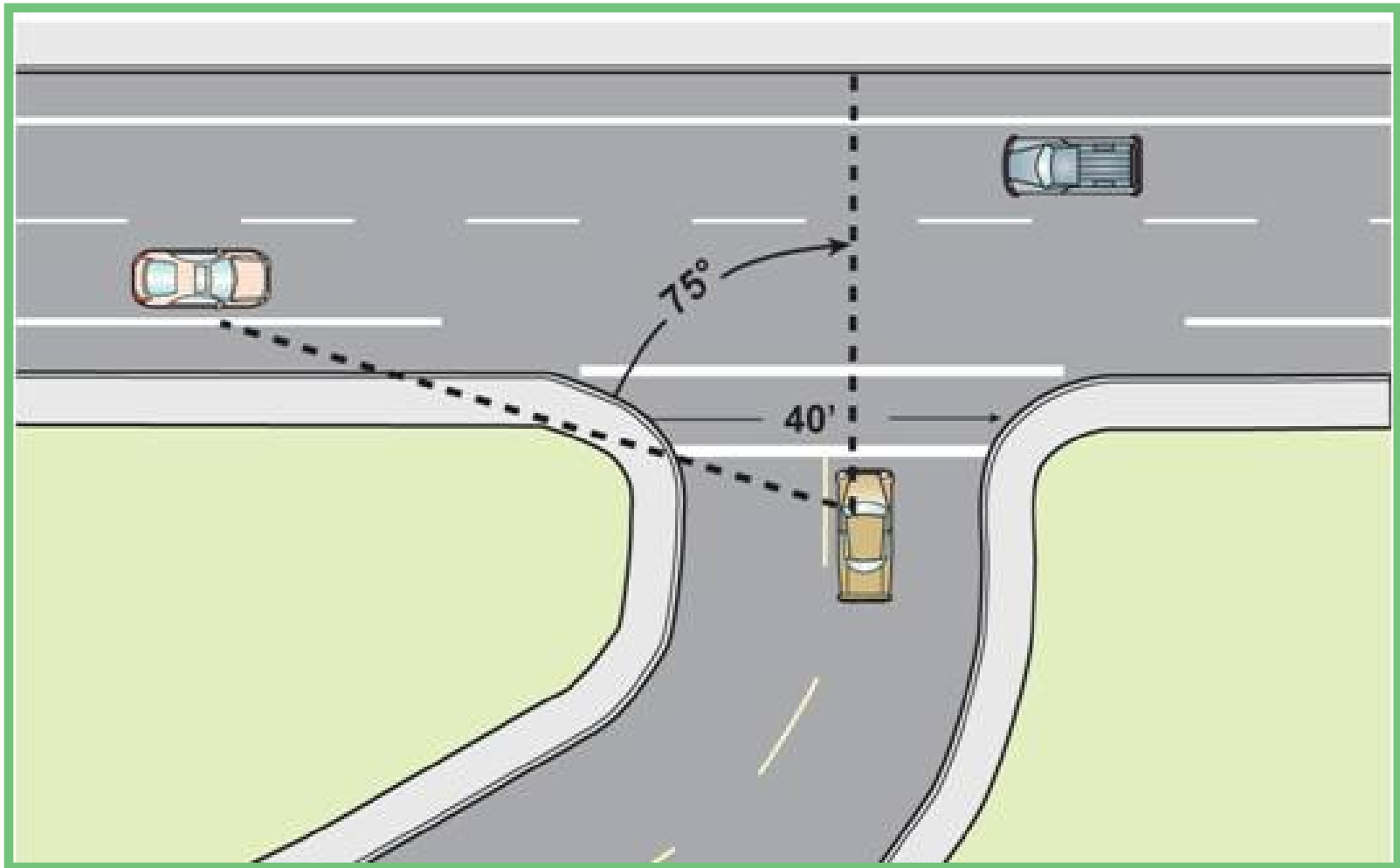


**Cars can turn at high speed**



**Skew increases crosswalk length, decreases visibility**

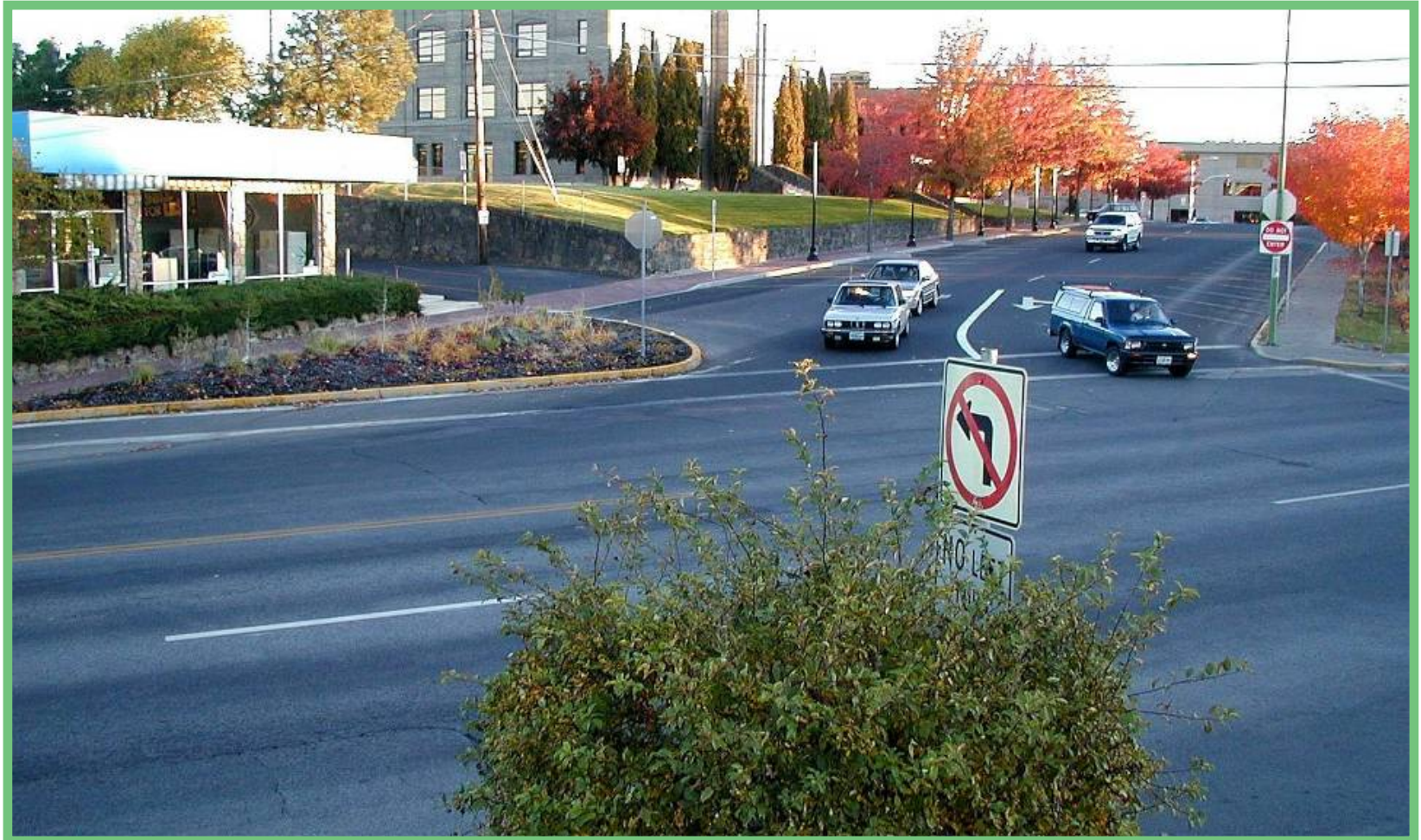




**Right angle decreases crosswalk length, increases visibility**



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



**Adjust skew by bringing out curb**

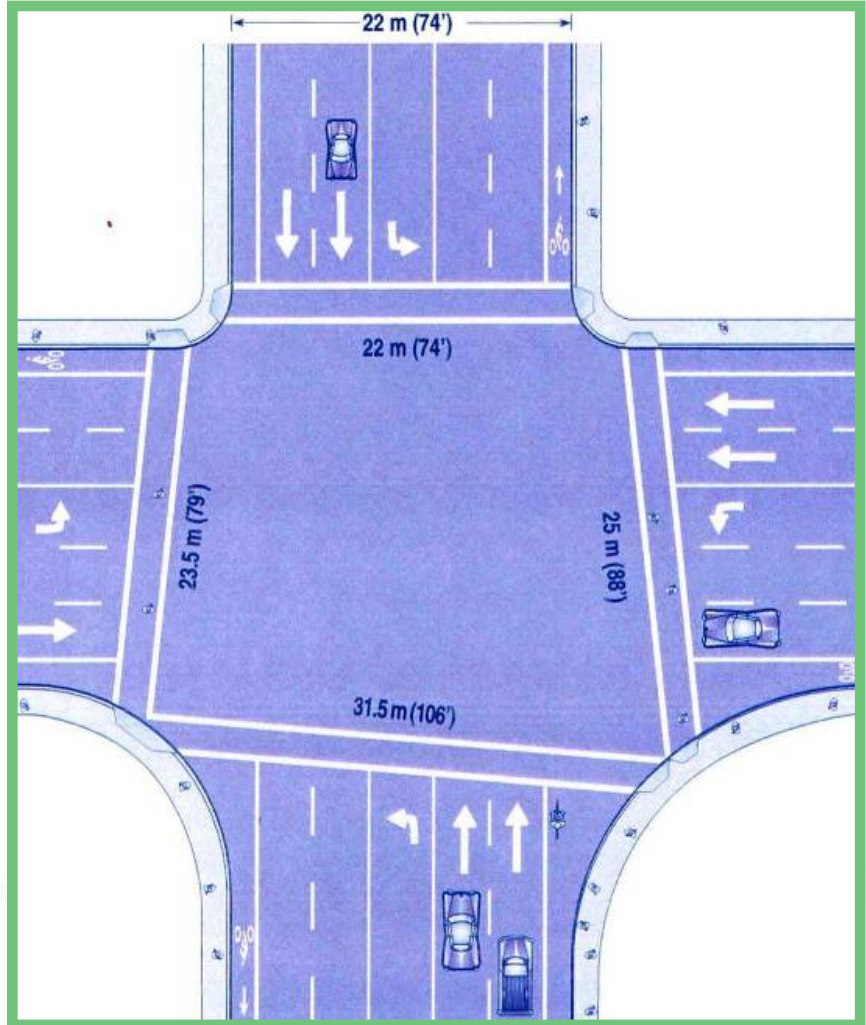


**Result: driver behavior change**

# Curb radius – small radii are safer for pedestrians

Large radii:

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

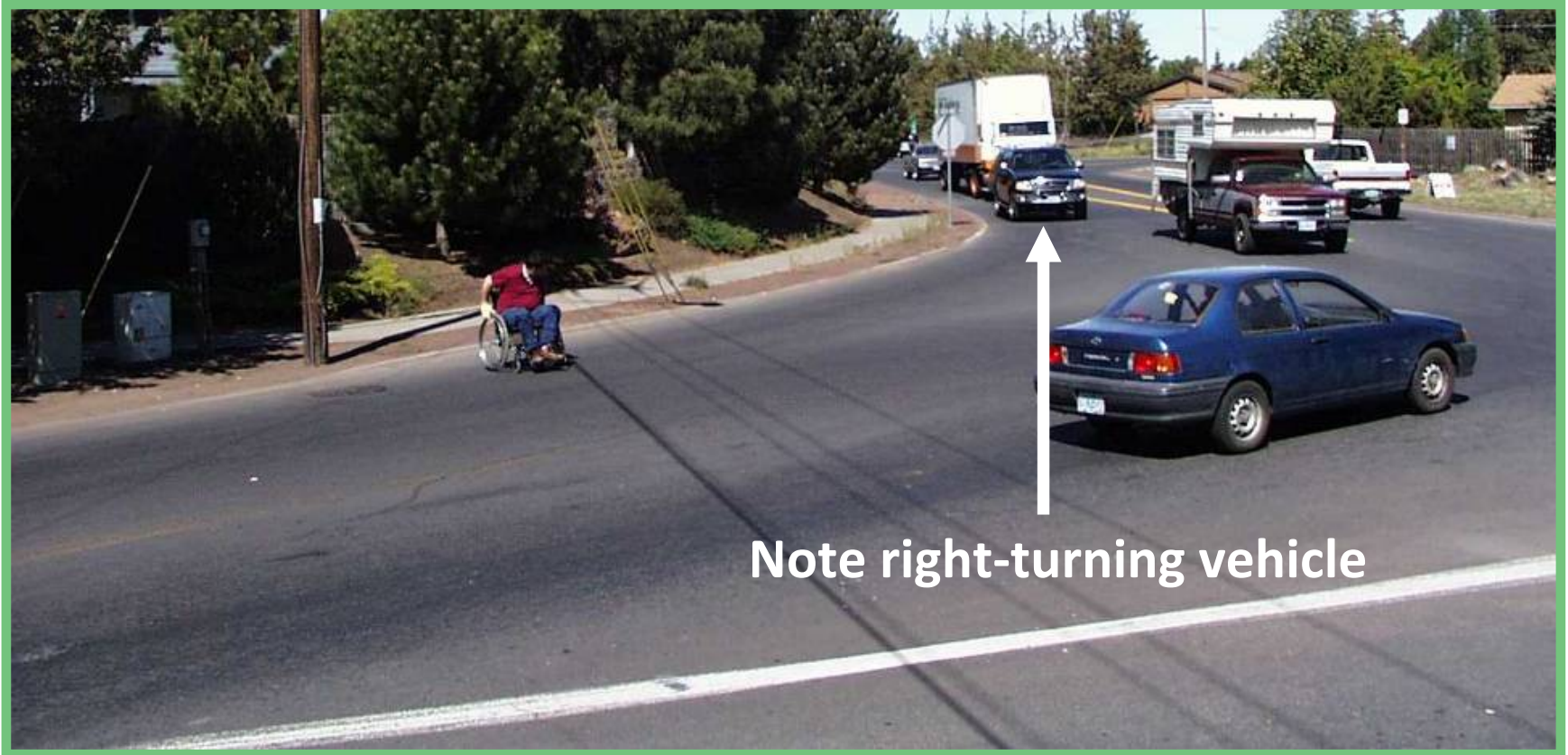


# Effect of large radius on crosswalk:



It adds to crossing distance...

# Effect of large radius on crosswalk:



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

# Effect of large radius on drivers



**They drive fast...**



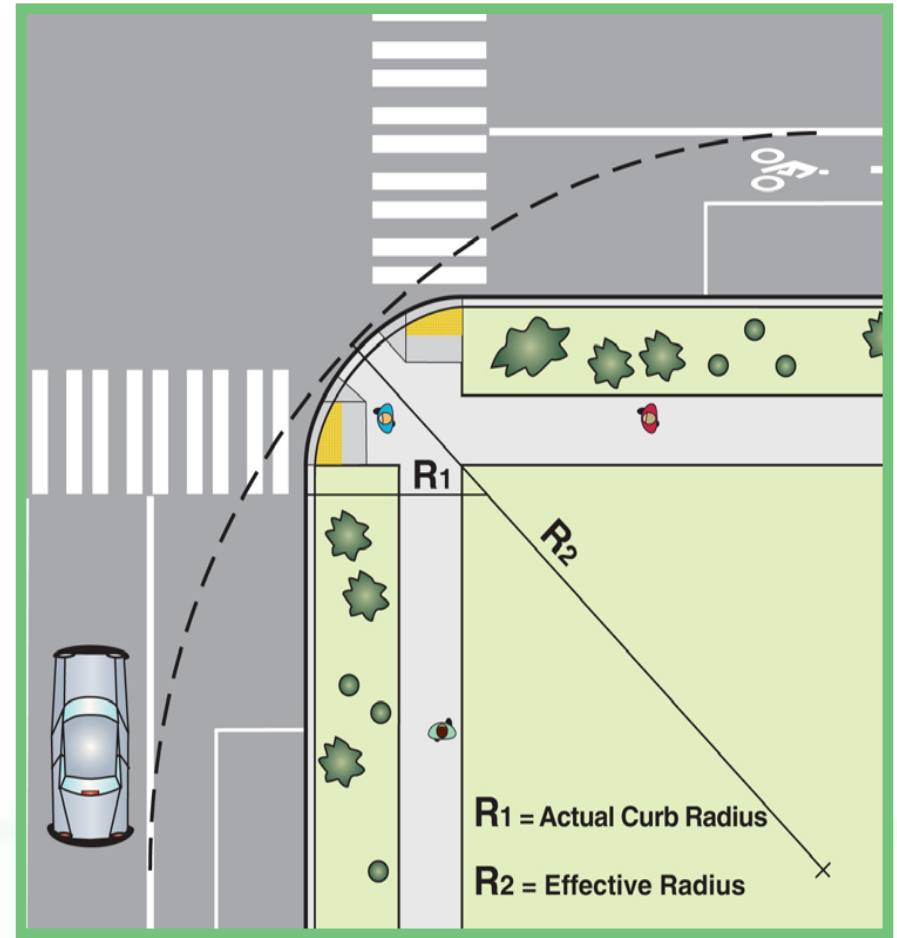
# Effect of large radius on drivers



...ignoring pedestrians

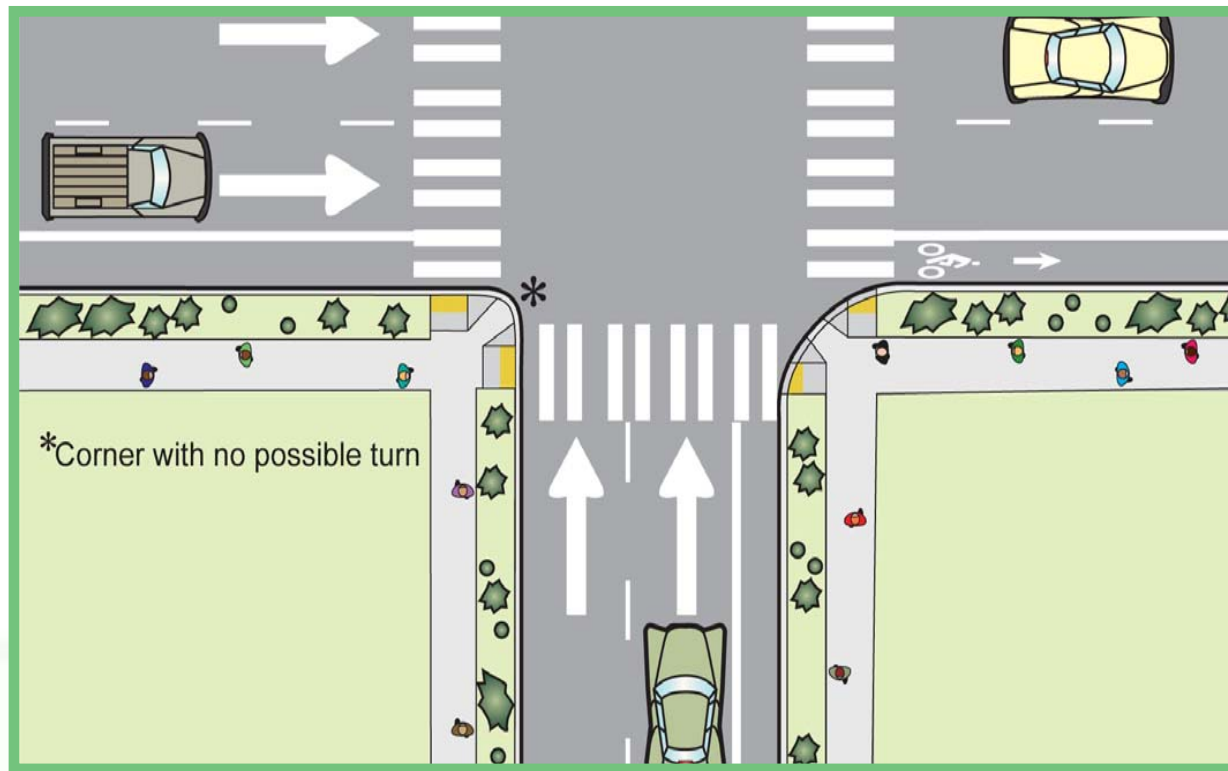
# Minimize curb radius

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)*



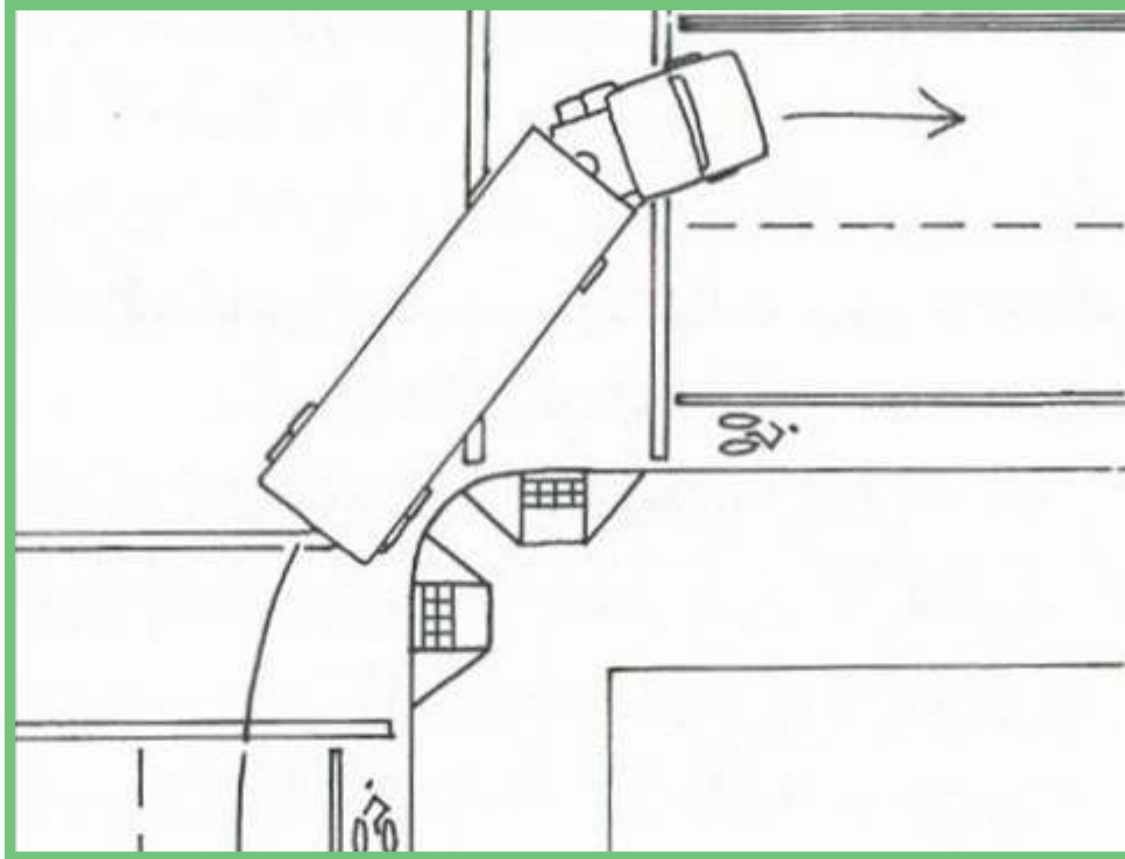
# Minimize curb radius

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



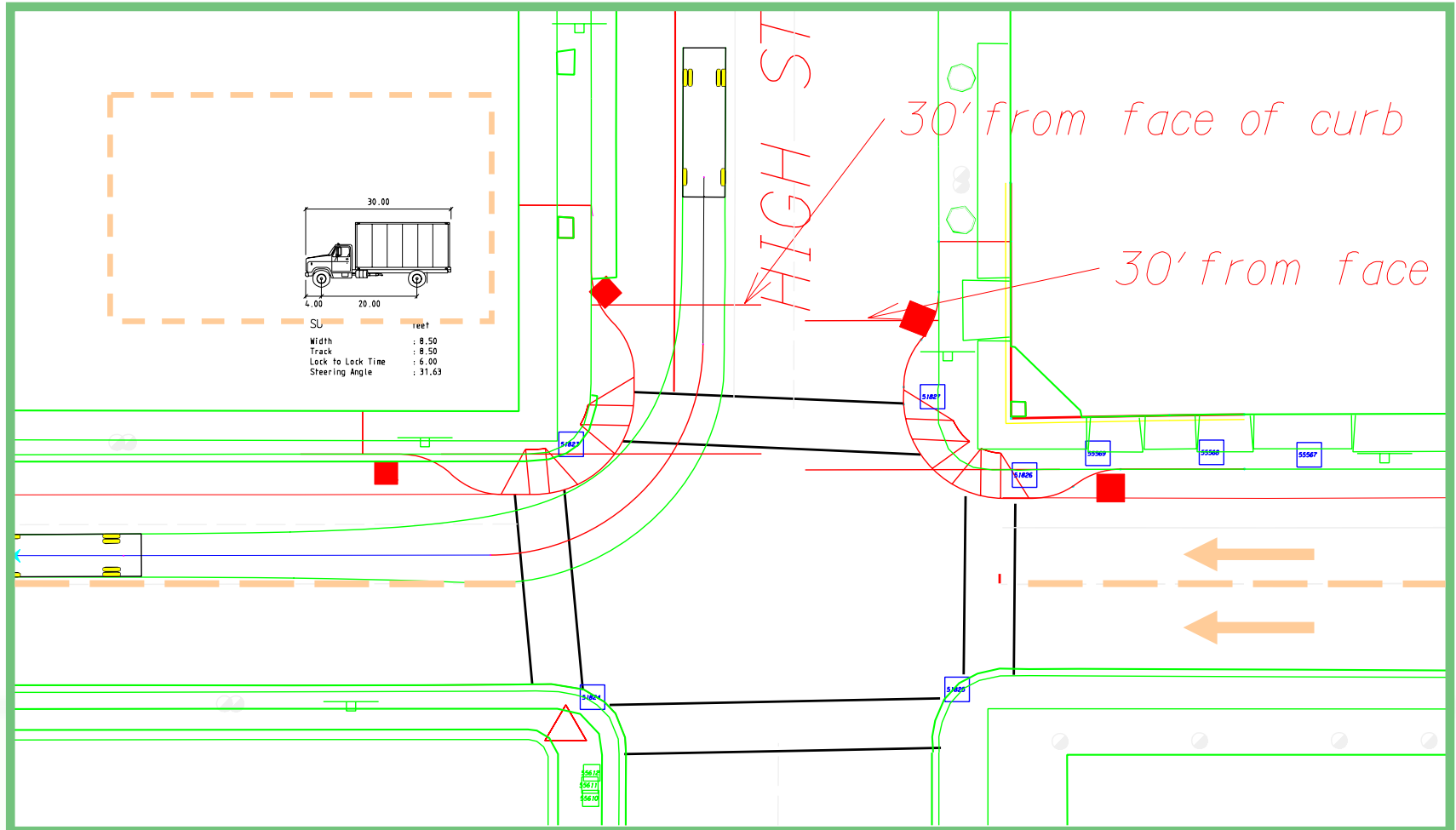
# Minimize curb radius

## 6. Trucks can make very tight turns at slow speeds



# Minimize curb radius

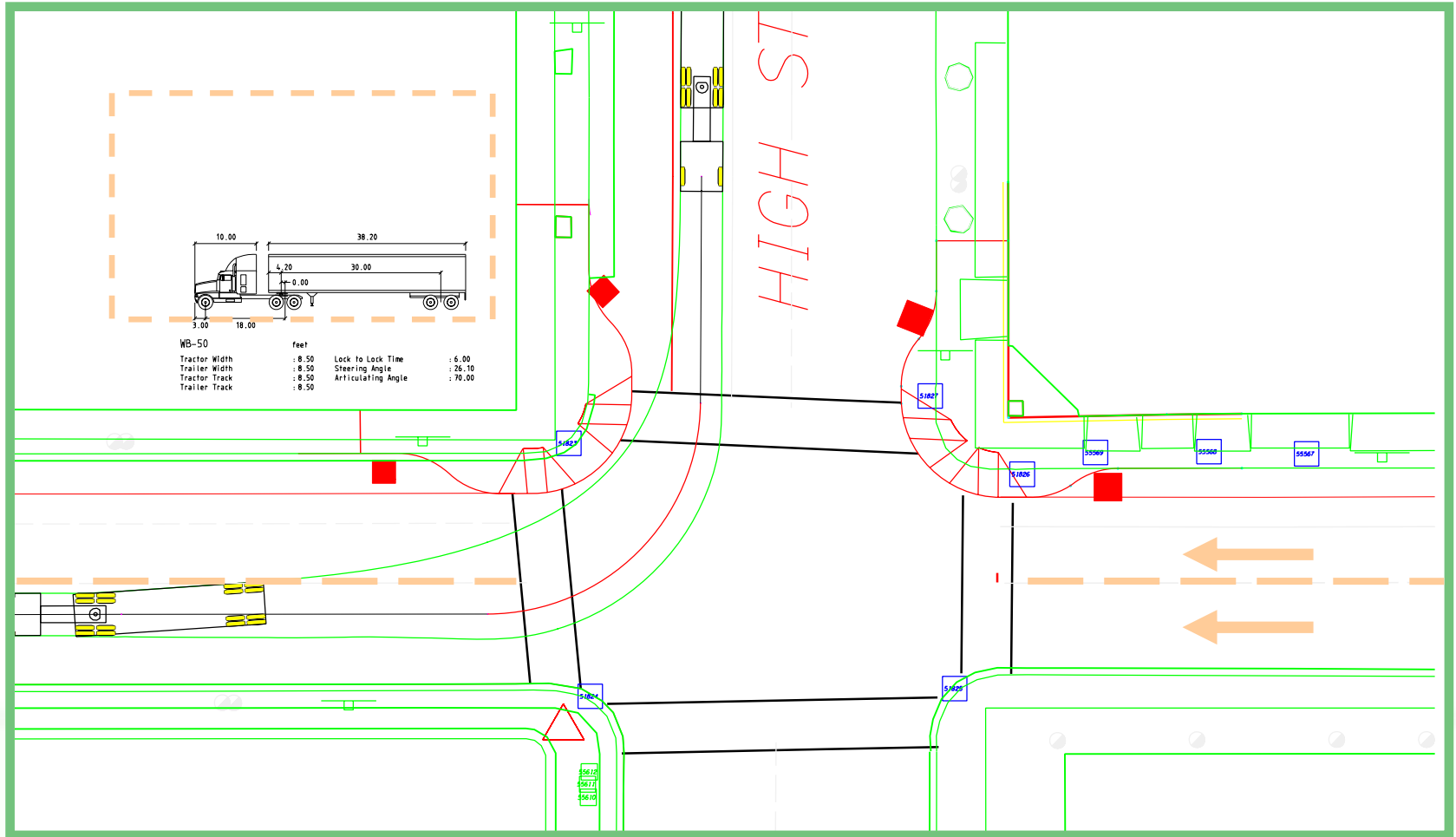
## 7. Turn common Single Unit truck (SU-30) into near lane





# Minimize curb radius

## 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?**

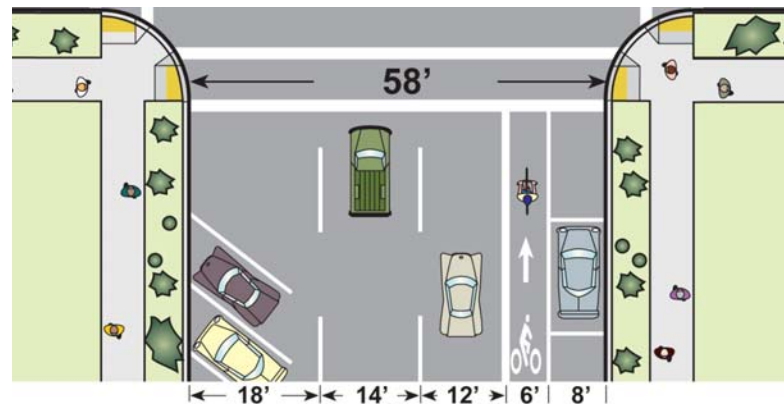
# Curb extensions

⇒ Most focus is on reduced crossing distance

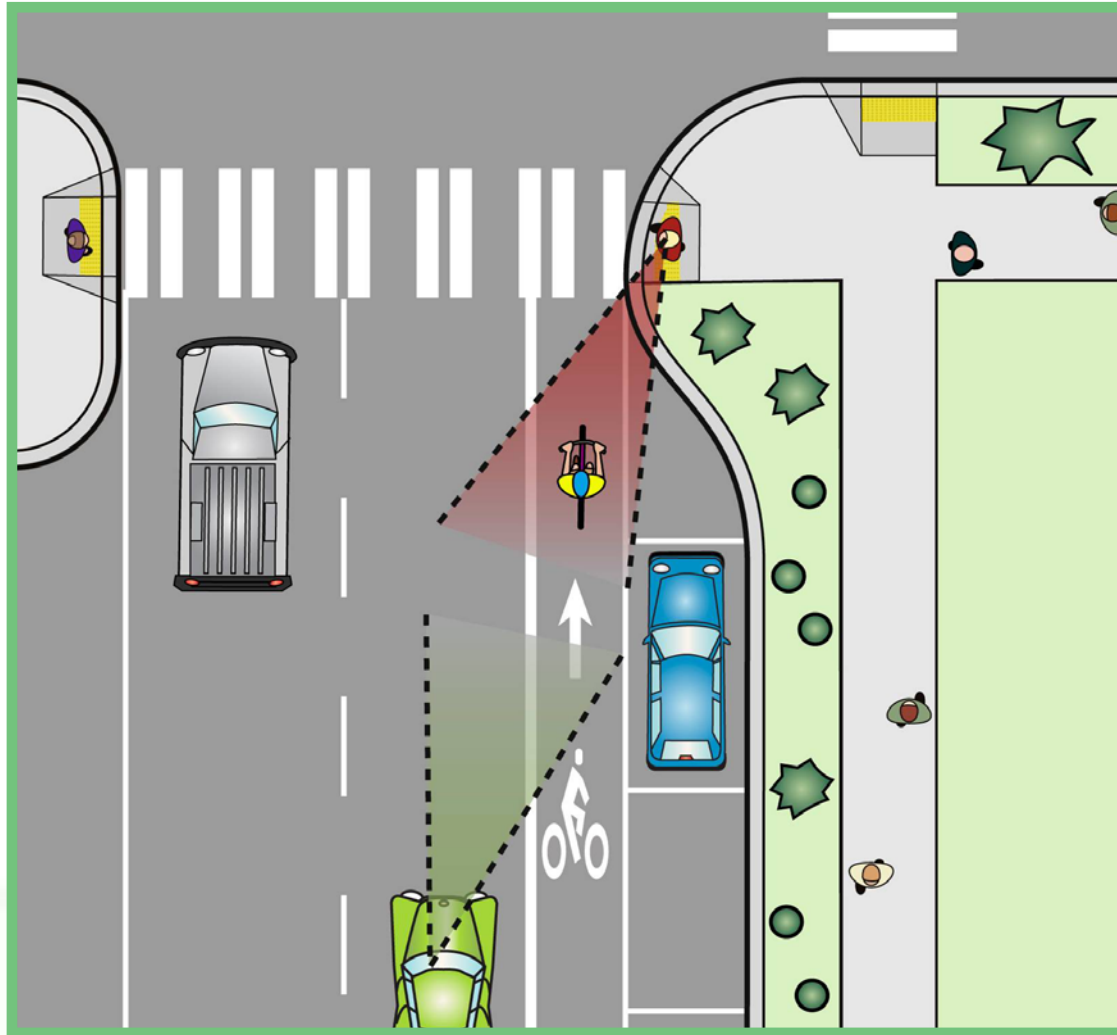
⇒ Other advantages:

- 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



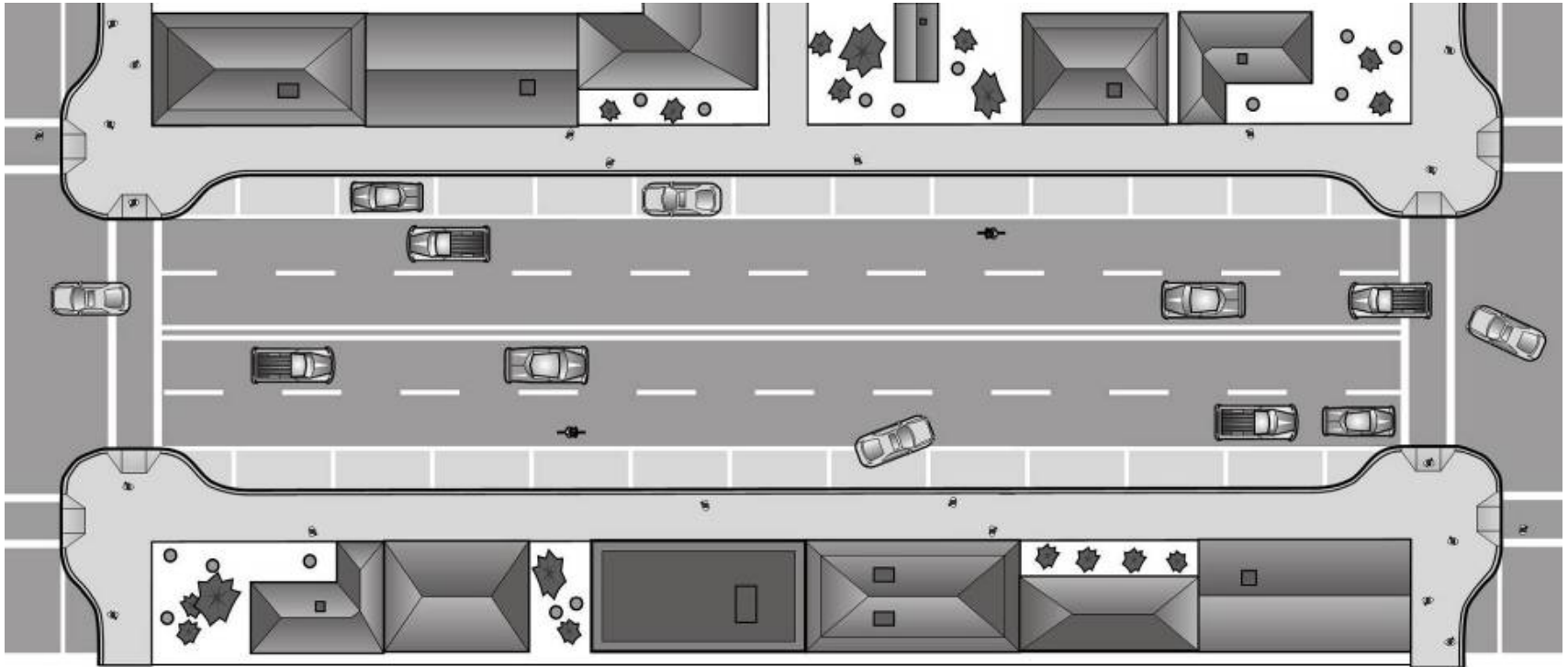
## Drainage solutions 3. Leave original curb + islands





## 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**

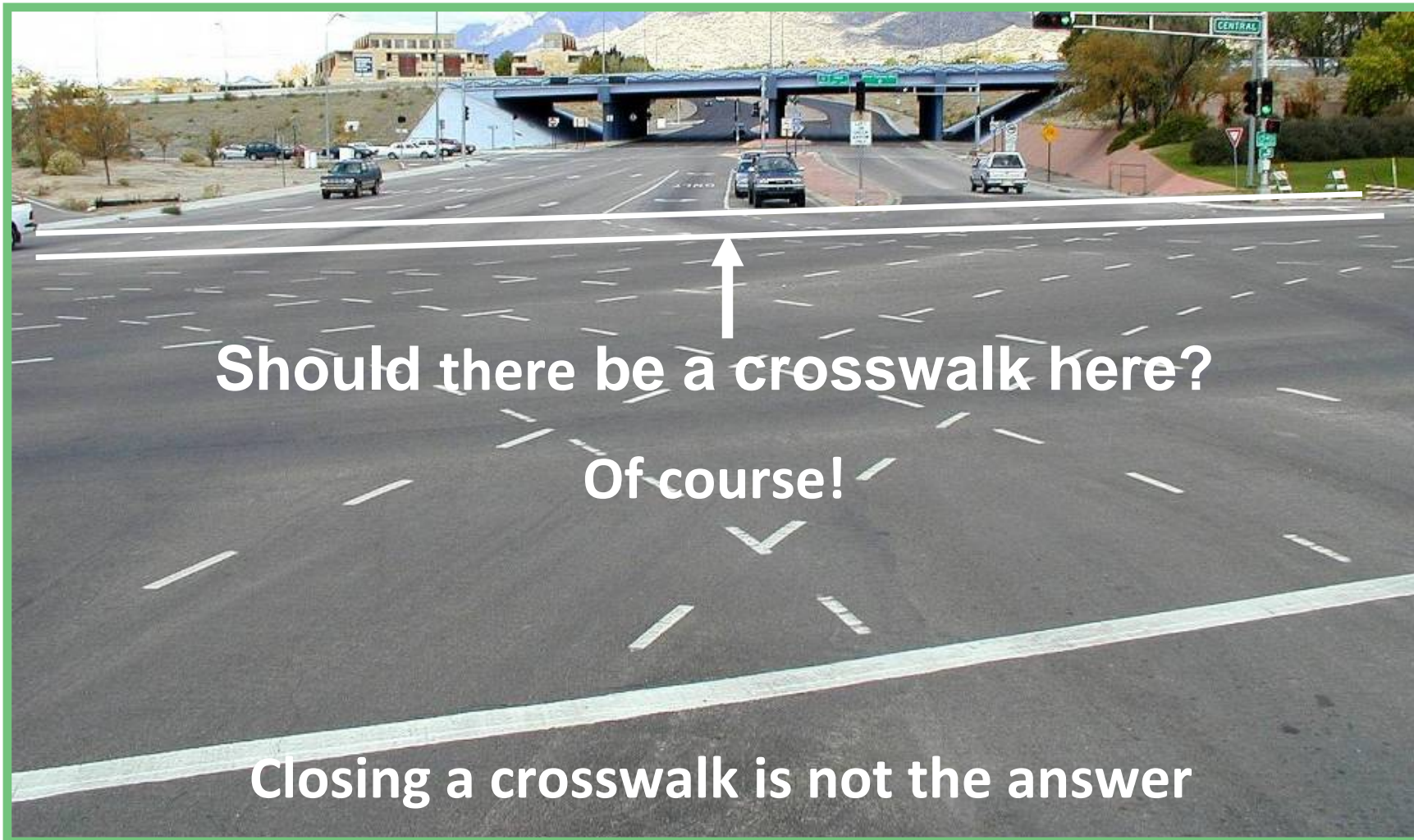
# Reminder – crosswalks are provided:

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 15-lane intersection. A vertical road on the left has a green crosswalk and a yellow dashed arrow pointing north. A horizontal road at the top has a green crosswalk and a yellow dashed arrow pointing east. A horizontal road at the bottom has a green crosswalk and a yellow dashed arrow pointing west. A pedestrian in a pink dress is crossing the horizontal road at the top. A silhouette of a person playing a double bass is on the horizontal road at the bottom. The central area is a large grey rectangle representing the intersection.

**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:**

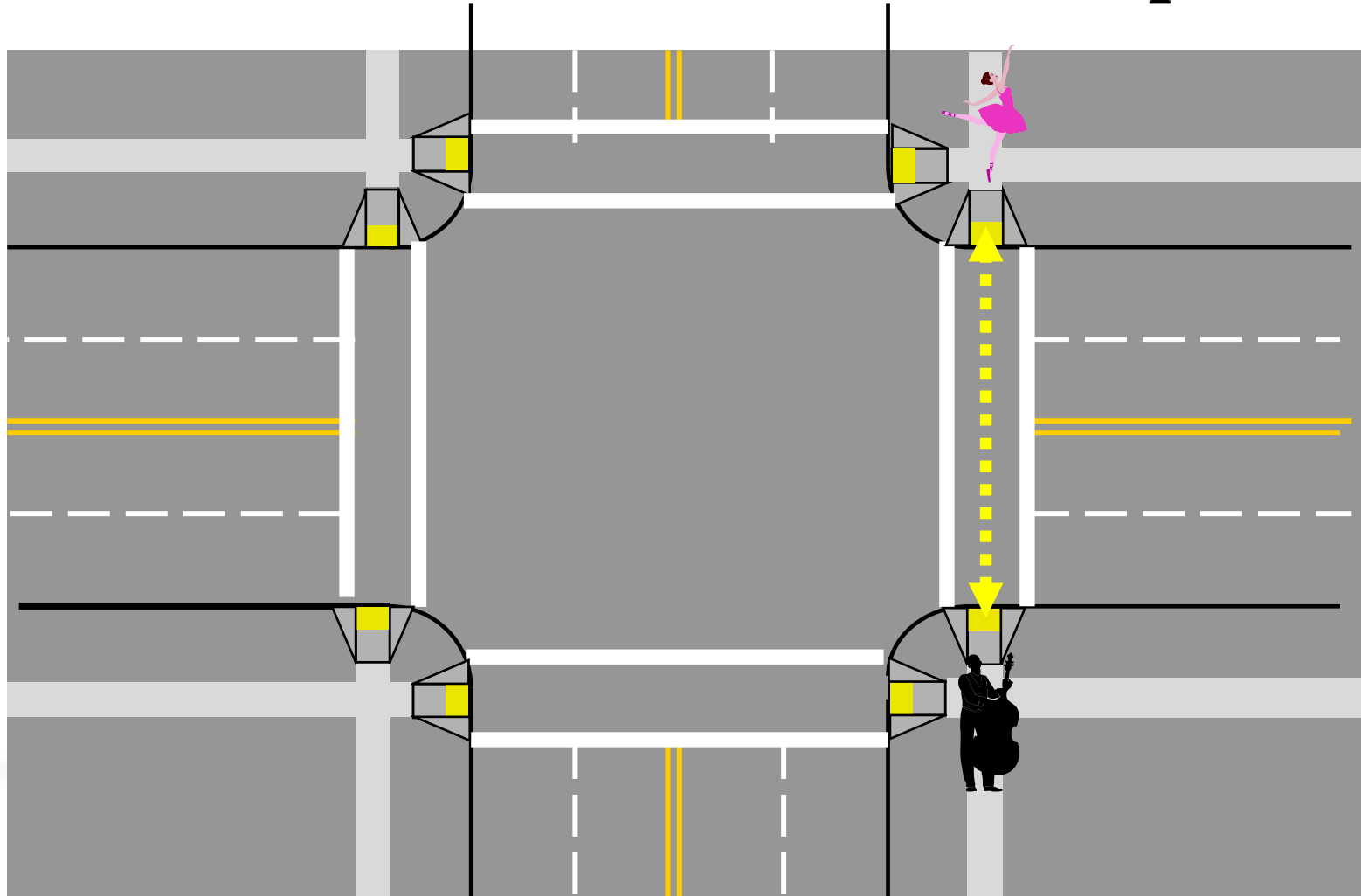
- **Reduce out-of-direction travel**
- **Provide good sight lines between peds and motorists**

⇒ **Proper ramp placement:**

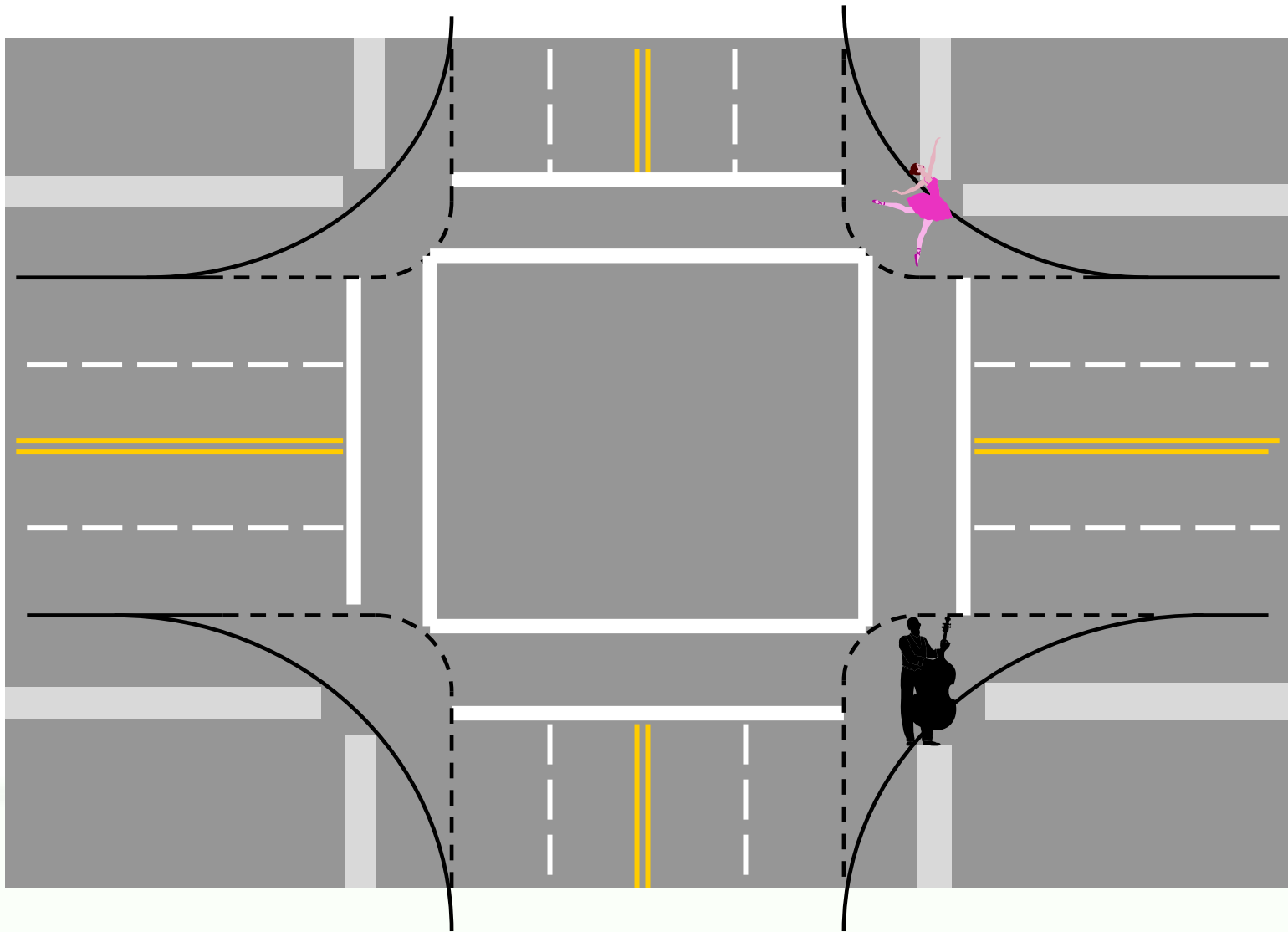
⇒ **Ramps entirely contained in crosswalk**

⇒ **Two ramps preferred whenever possible**

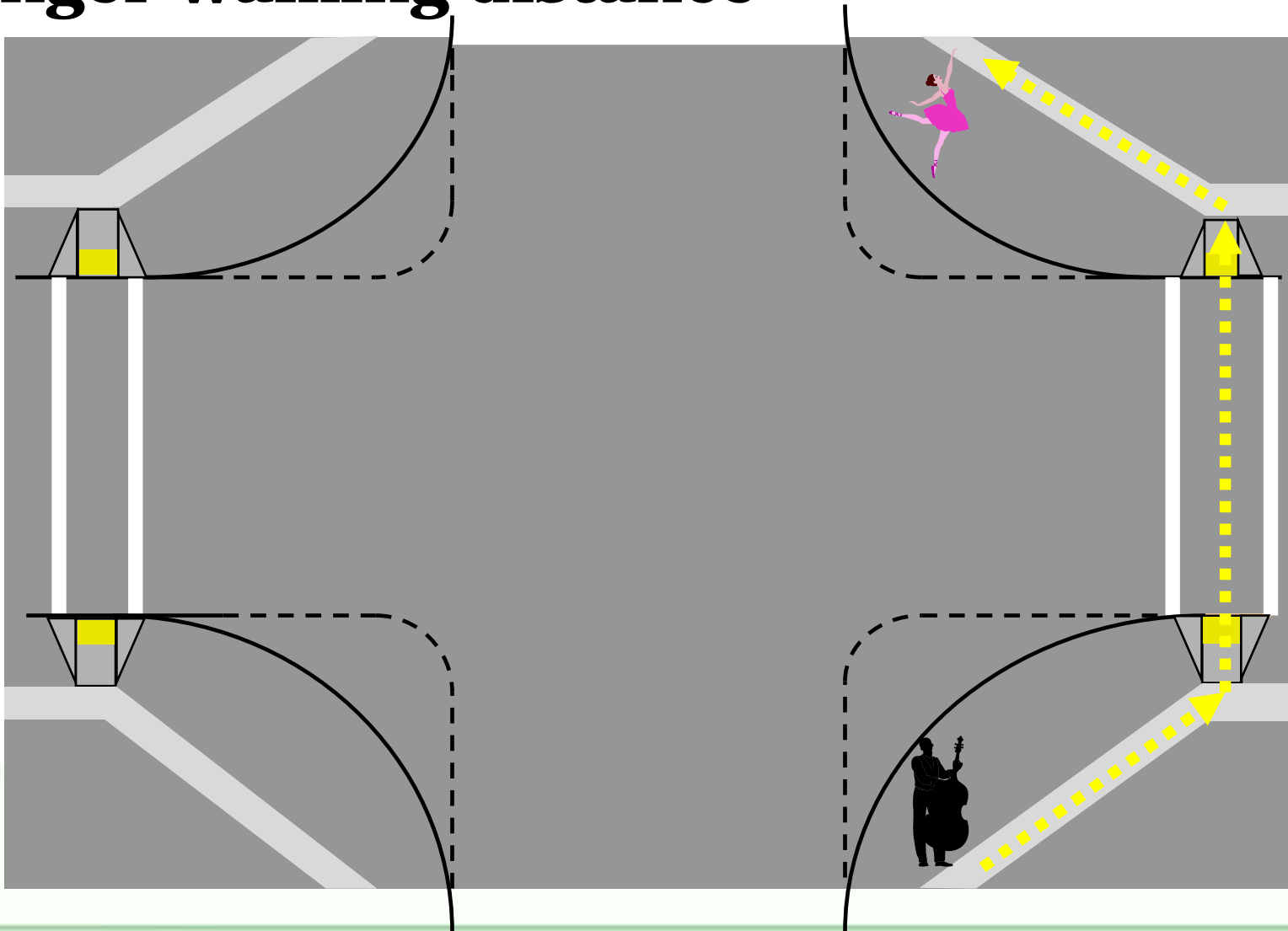
# Small corner radii allow two ramps, shortest crosswalks, direct travel paths



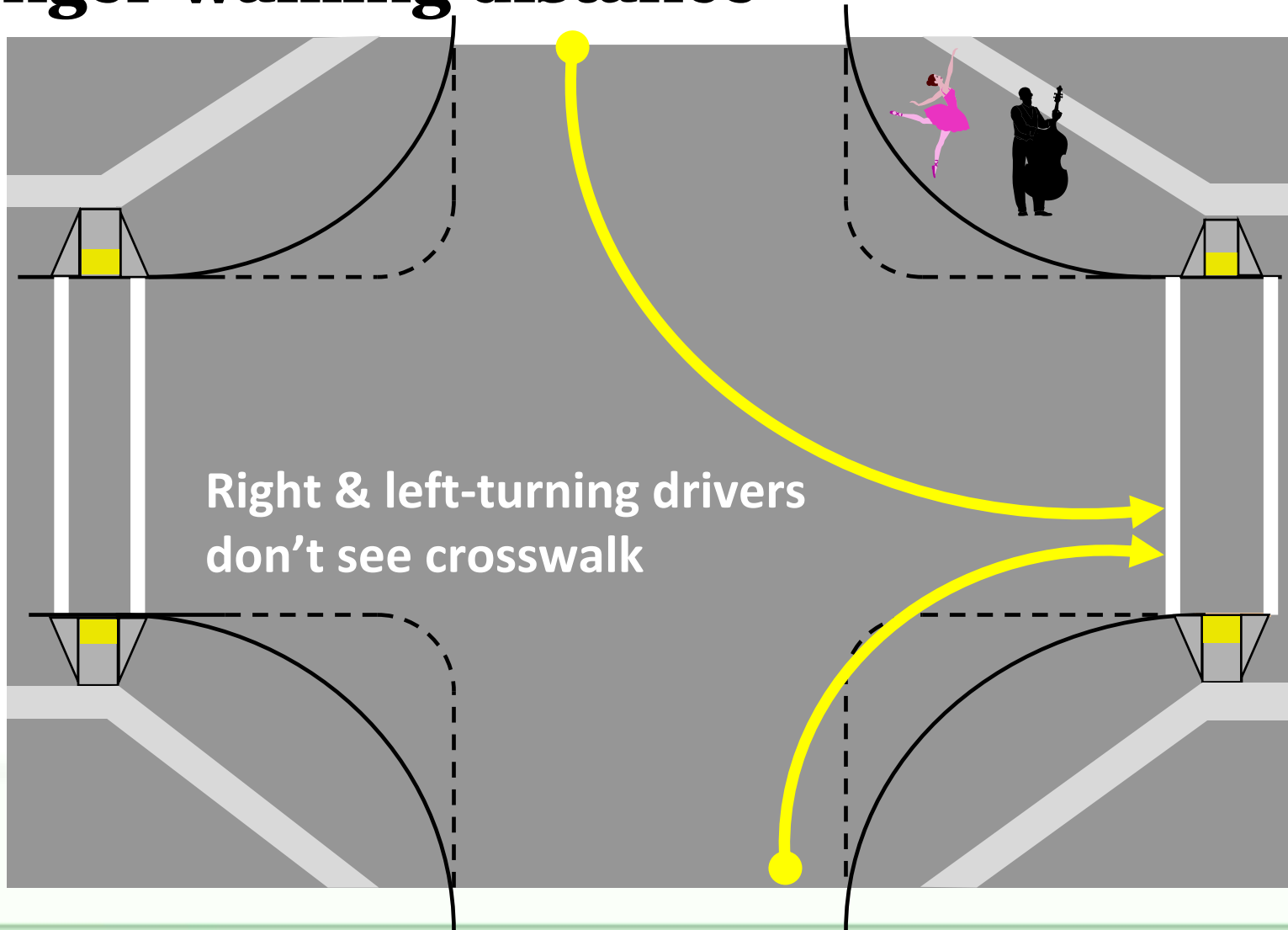
# Larger radii create large undefined areas



# Crosswalks at shortest crossing = longer walking distance

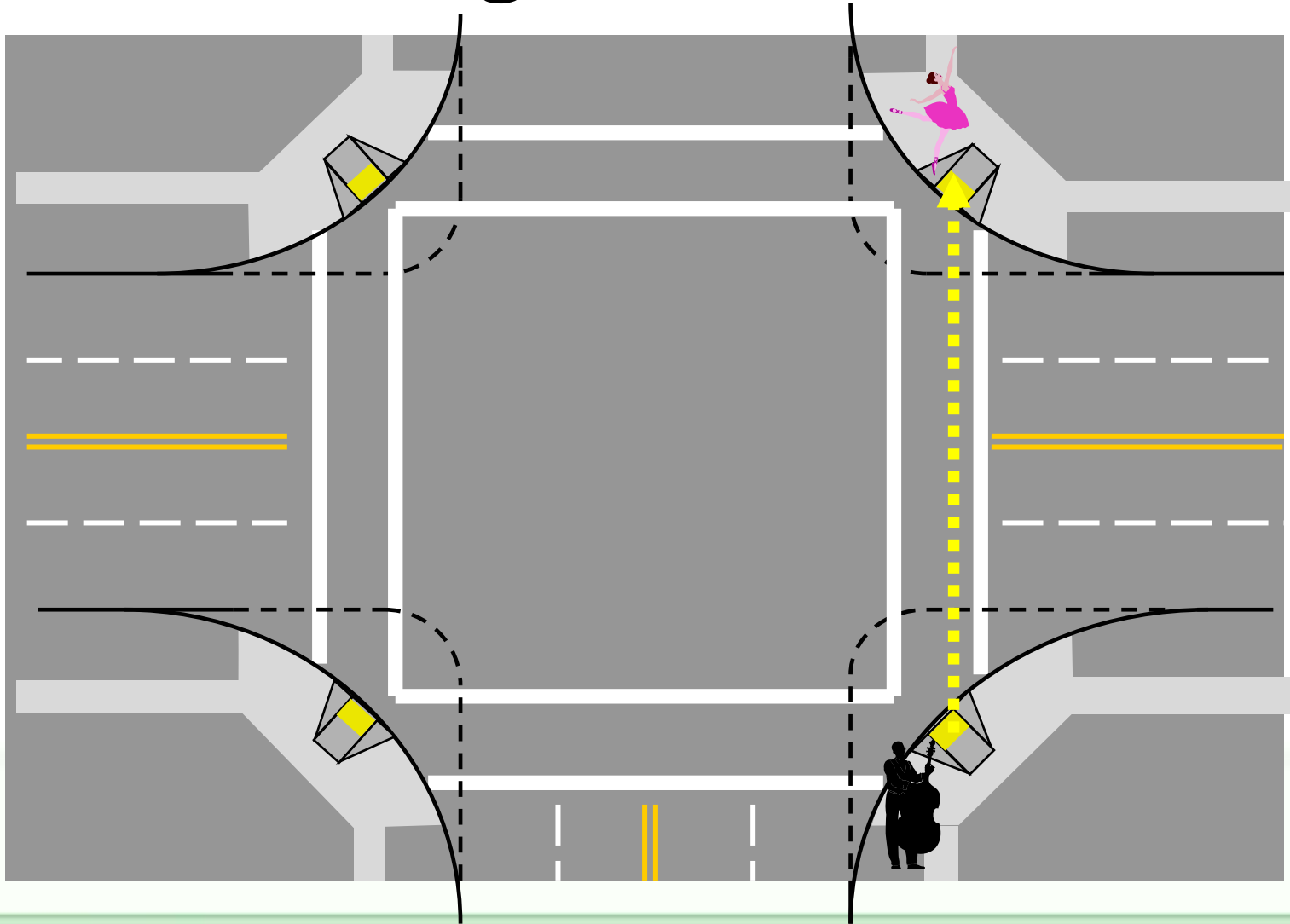


# Crosswalks at shortest crossing = longer walking distance

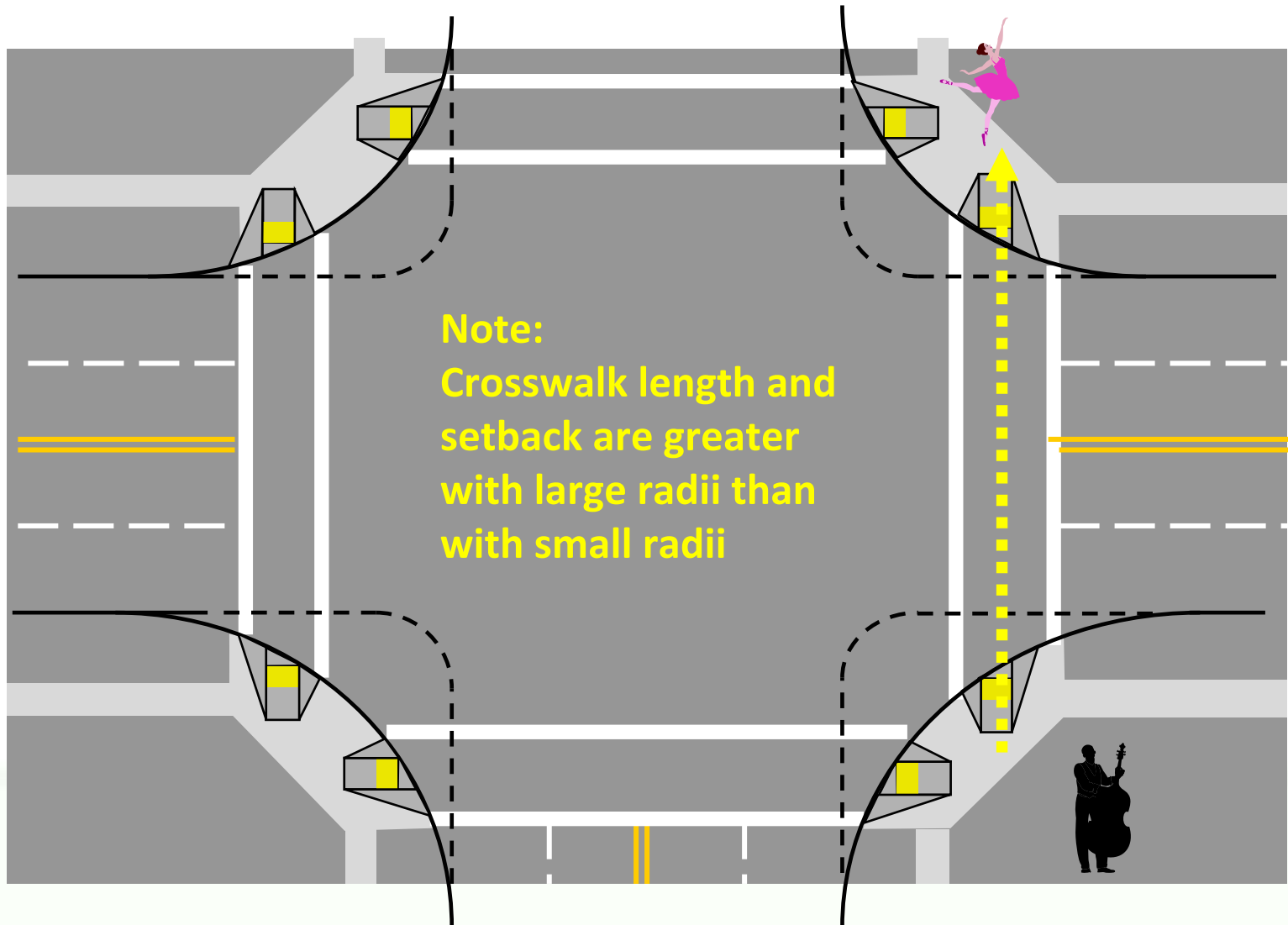


Right & left-turning drivers  
don't see crosswalk

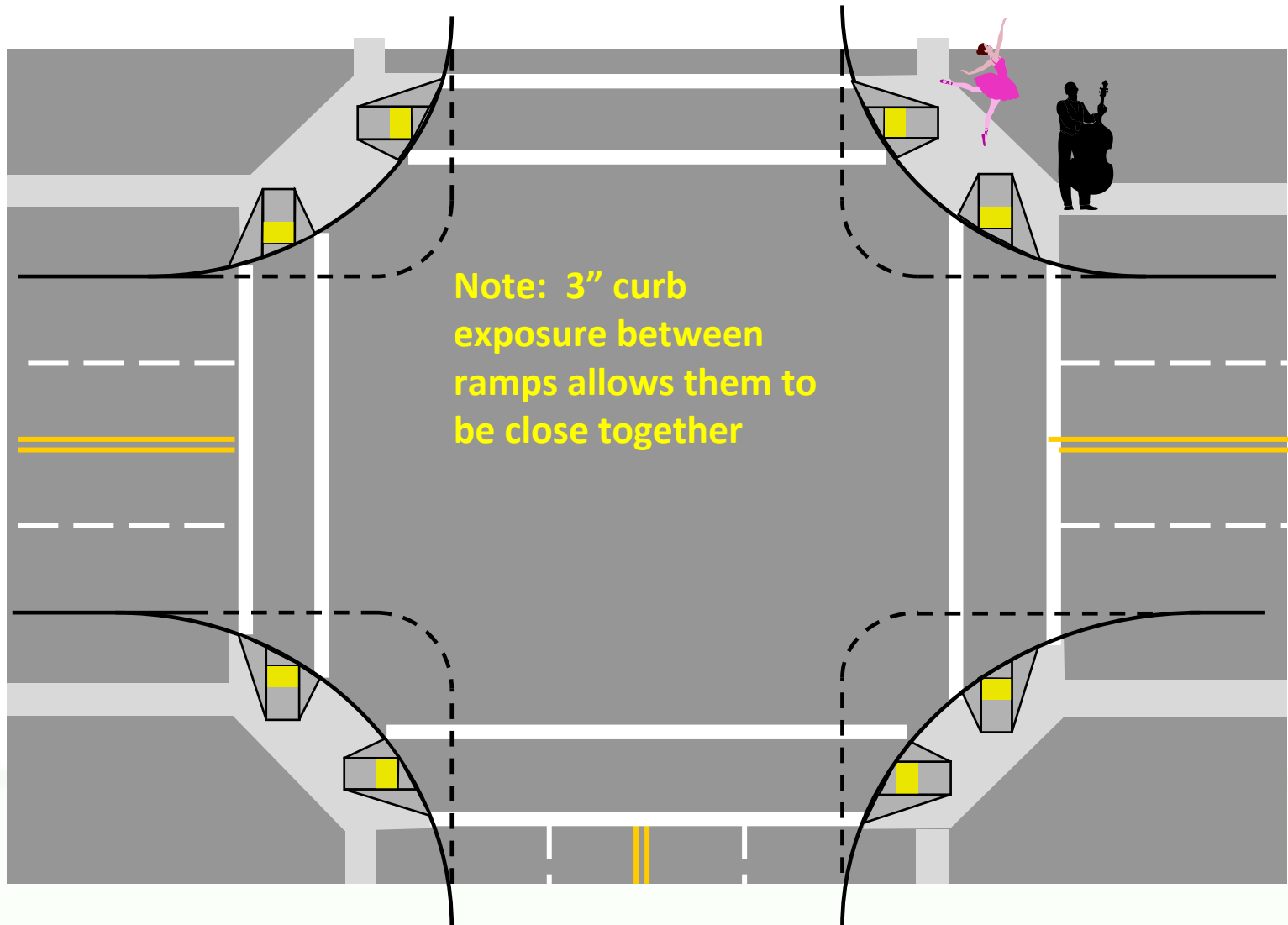
# Single ramp reduces crosswalk setback but lengthens crosswalk



# Balancing the goals works best



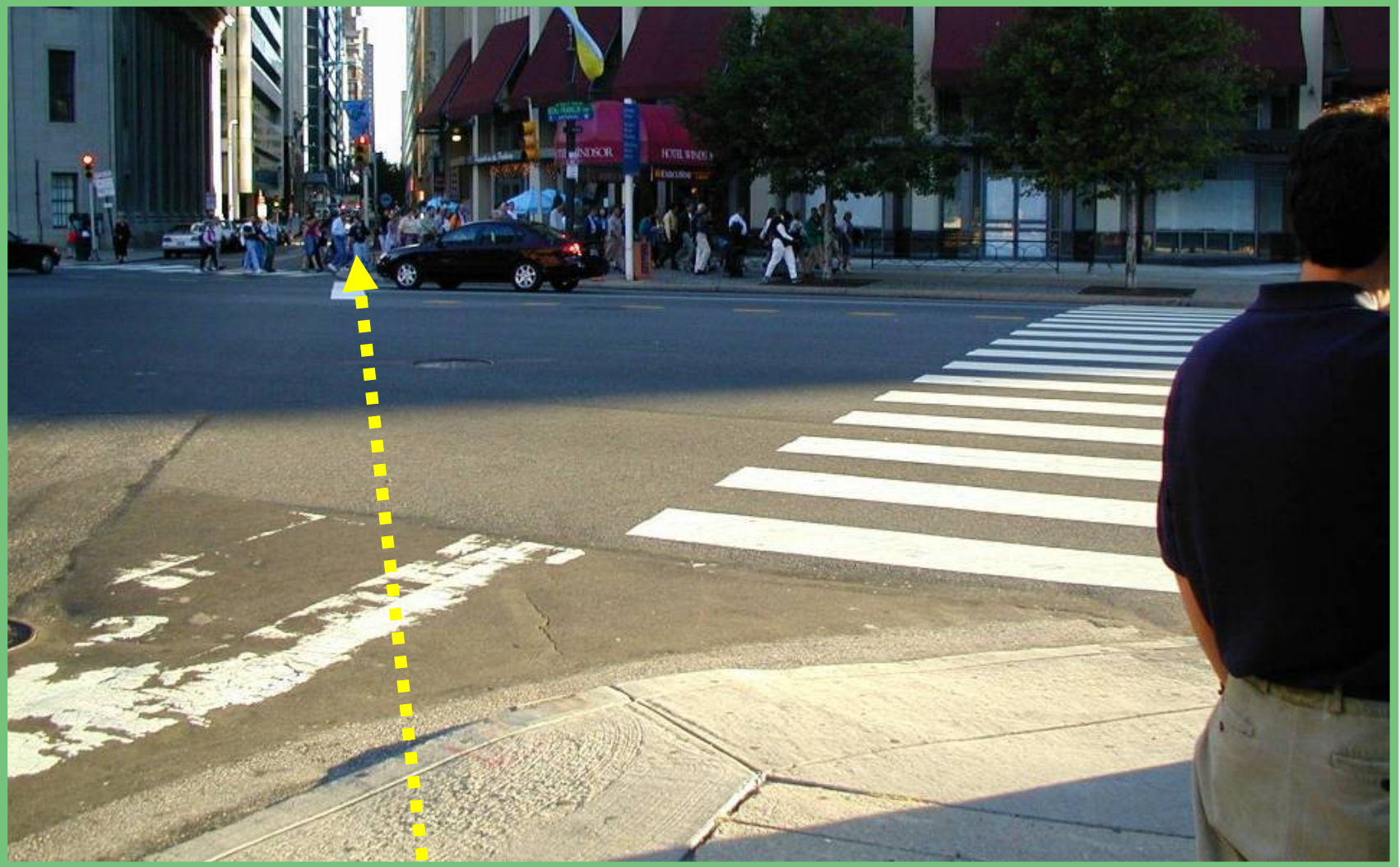
# Balancing the goals works best







## 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**

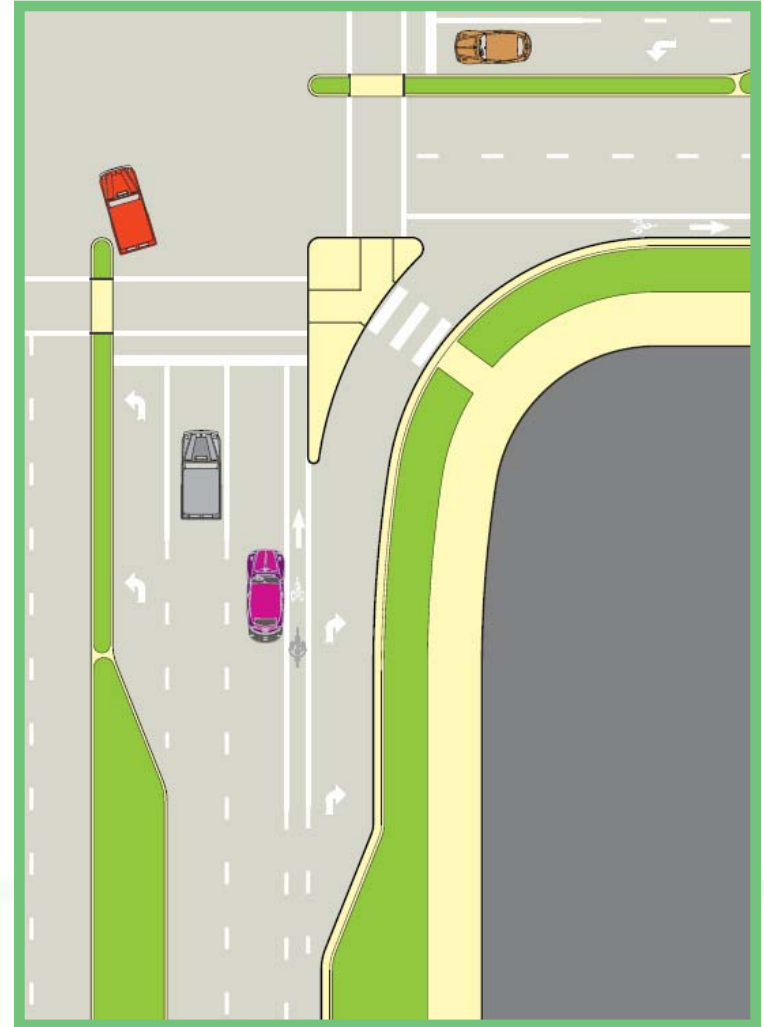
# Discussion:

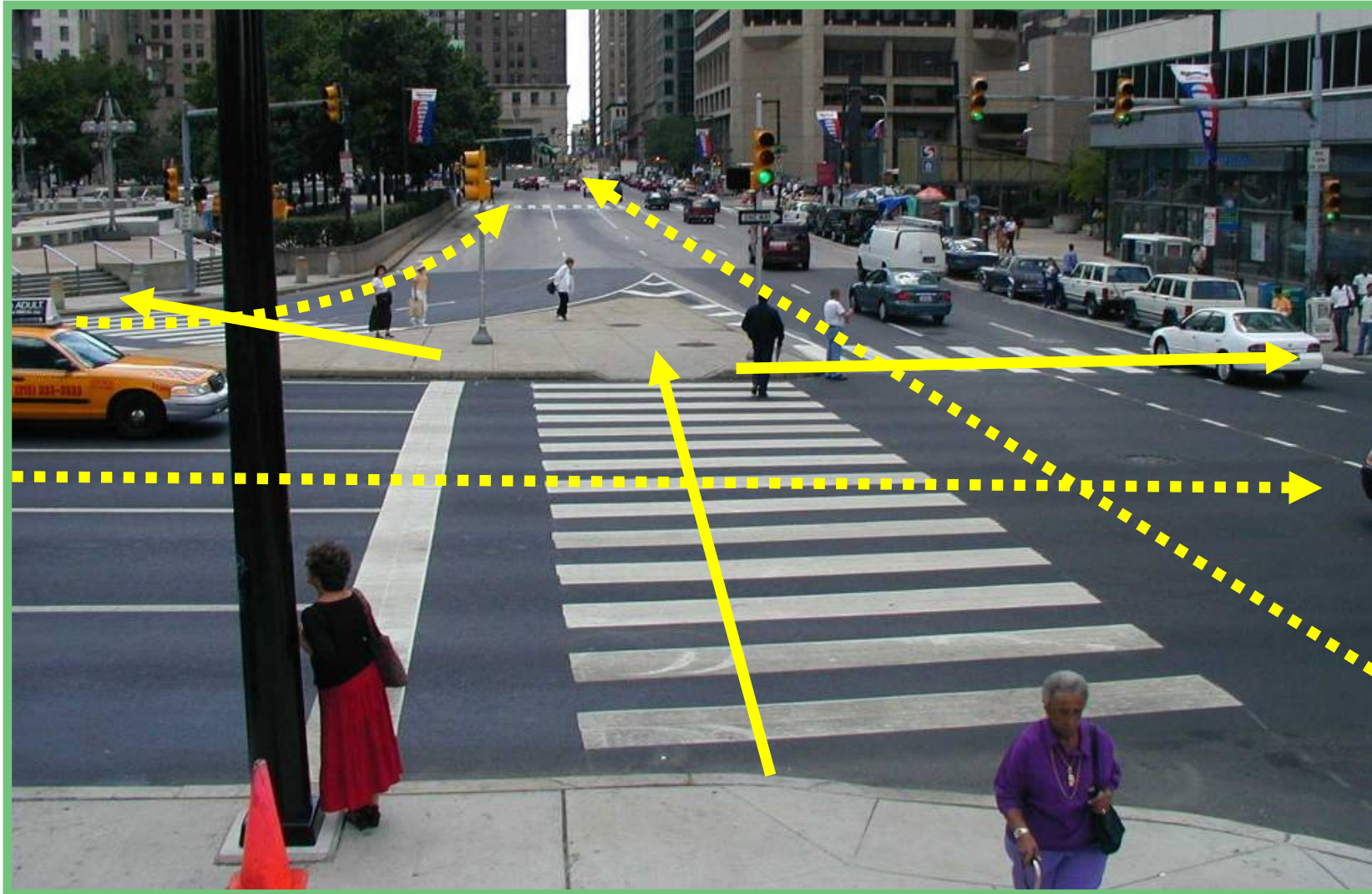
⇒ What are your policies & practices regarding crosswalk placement?

# Pedestrian Islands

## Benefits:

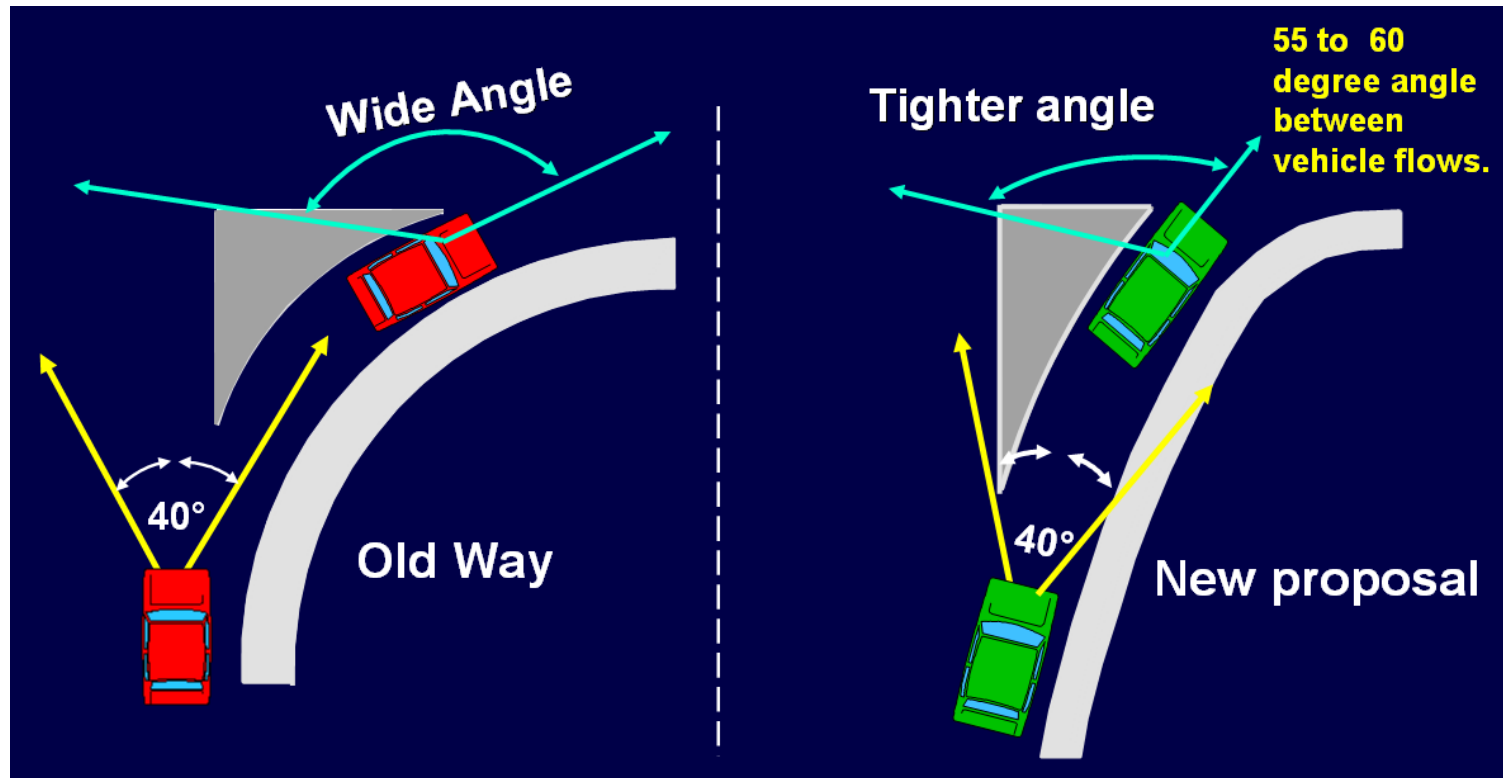
- ⇒ Separate conflicts & decision points
- ⇒ Reduce crossing distance
- ⇒ Improve signal timing
- ⇒ Reduce crashes





**Imagine the signal timing without island**

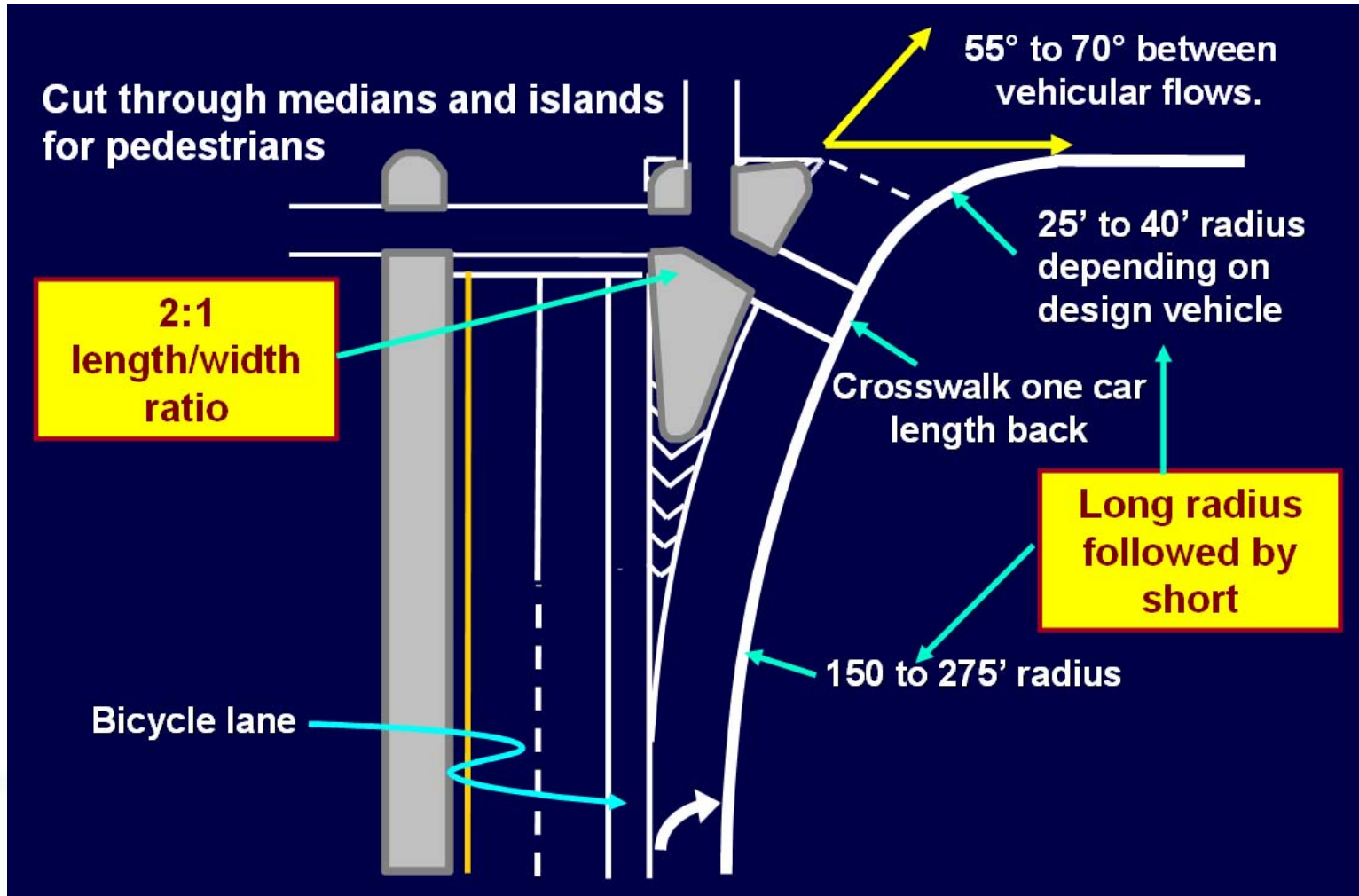
# Right-Turn Slip Lane: Design for Pedestrians



High speed, head turner =  
low visibility of pedestrians

Slow speed, good angle =  
good visibility of pedestrians

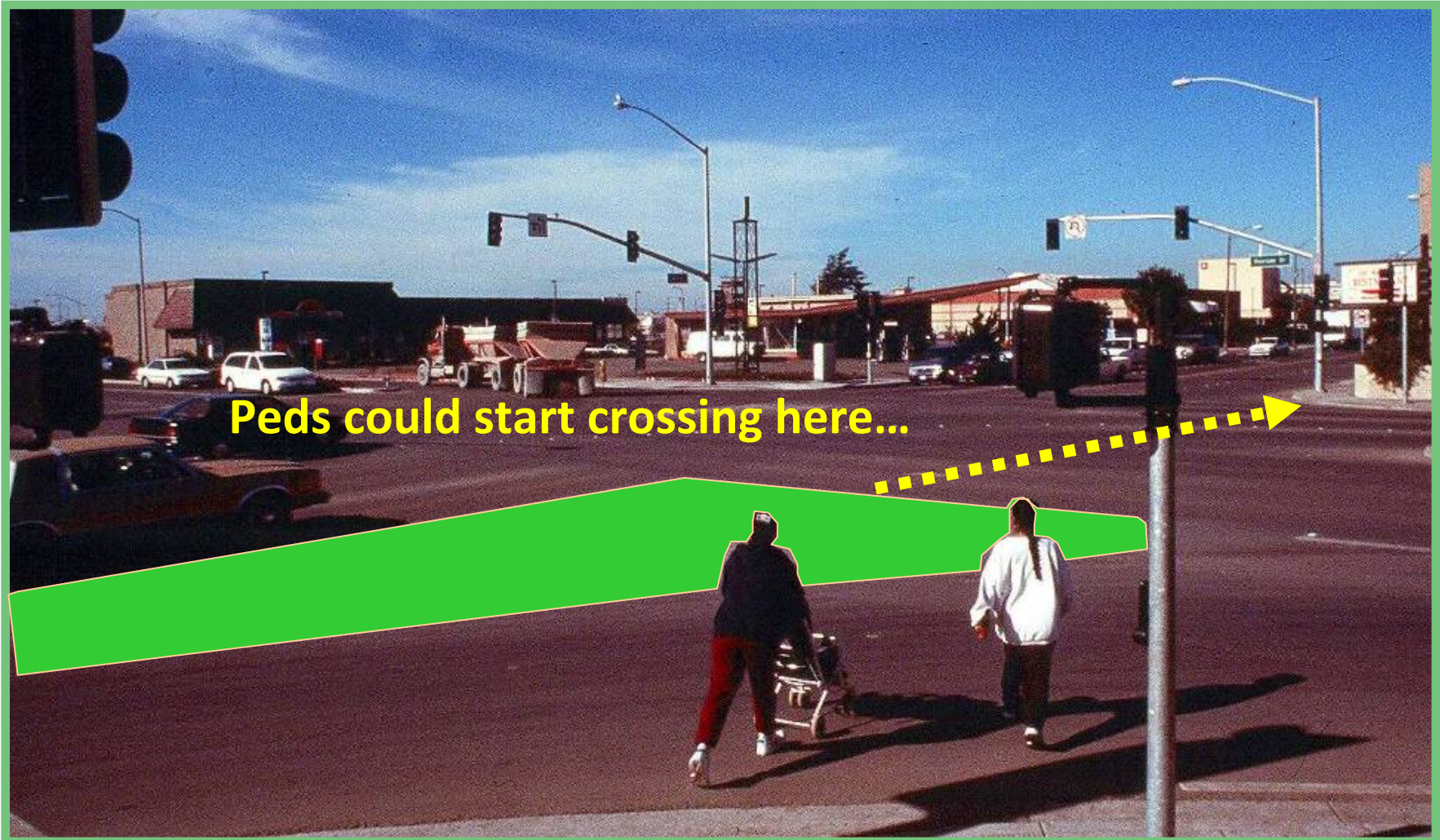
# Right-Turn Slip Lane - Details







**Drivers naturally trace the right island shape**



Peds could start crossing here...



... instead of here

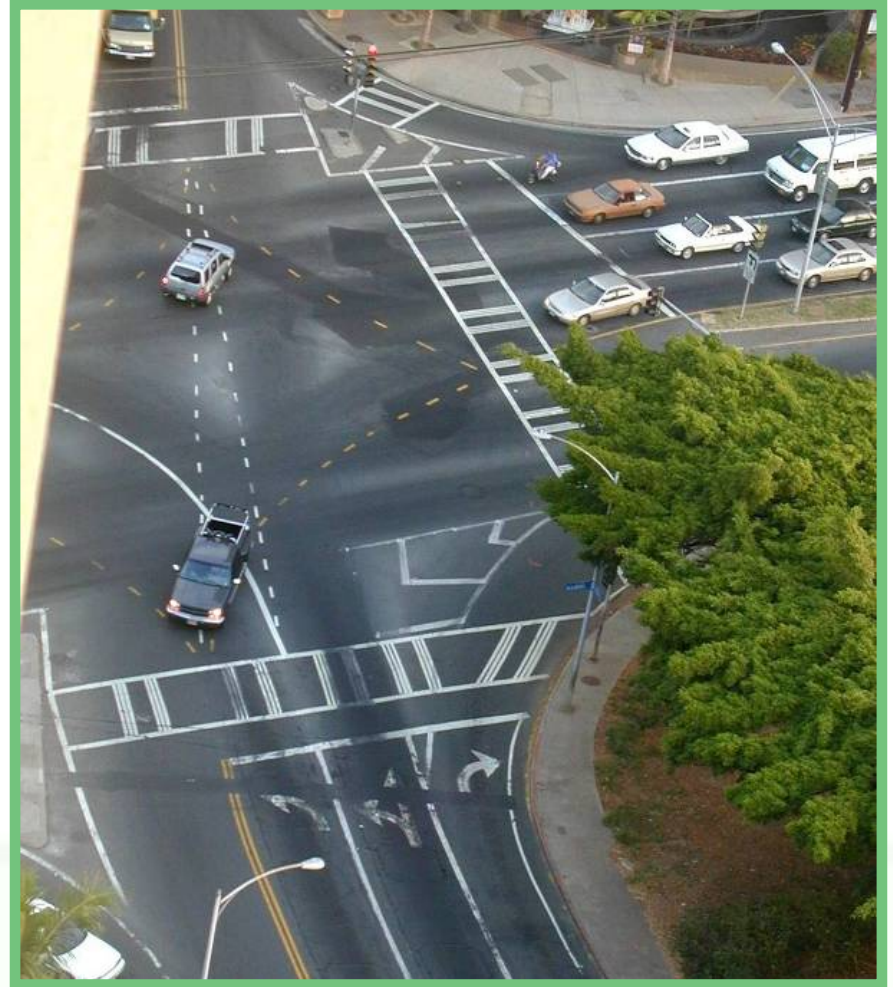


**Should we mark this crosswalk?**



**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



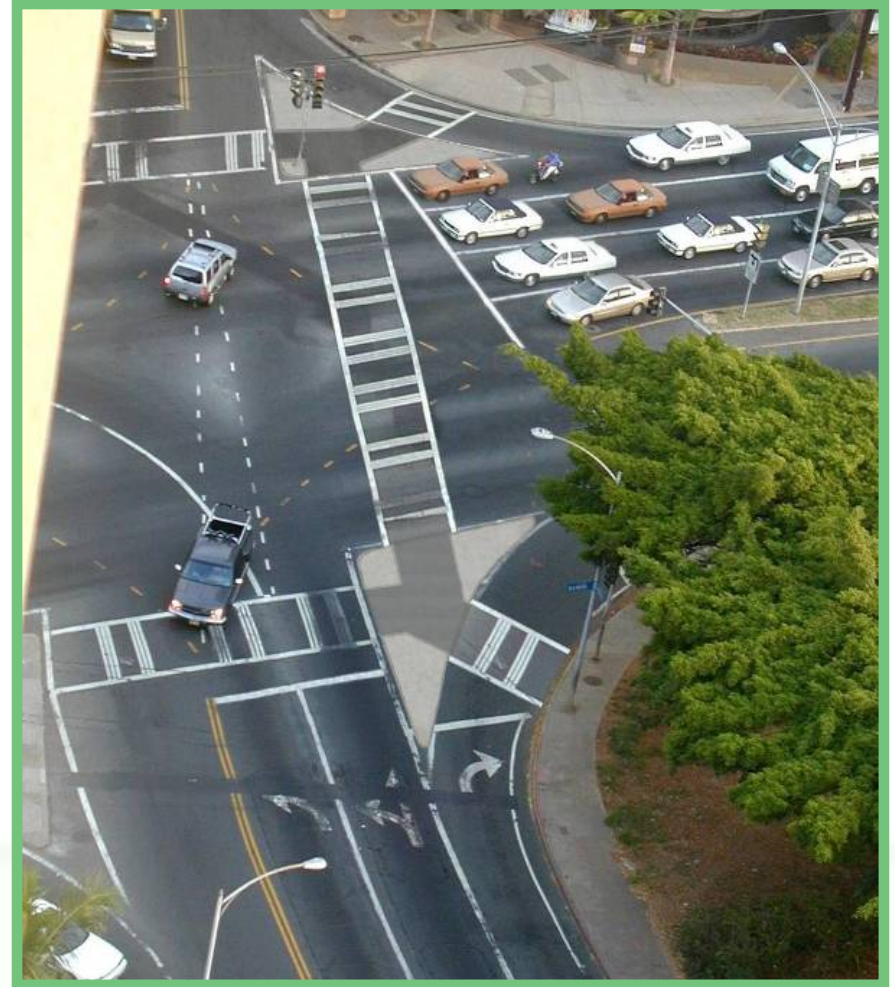
# Raised islands can improve a large multi-lane intersection

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 Okay**



**Not acceptable**



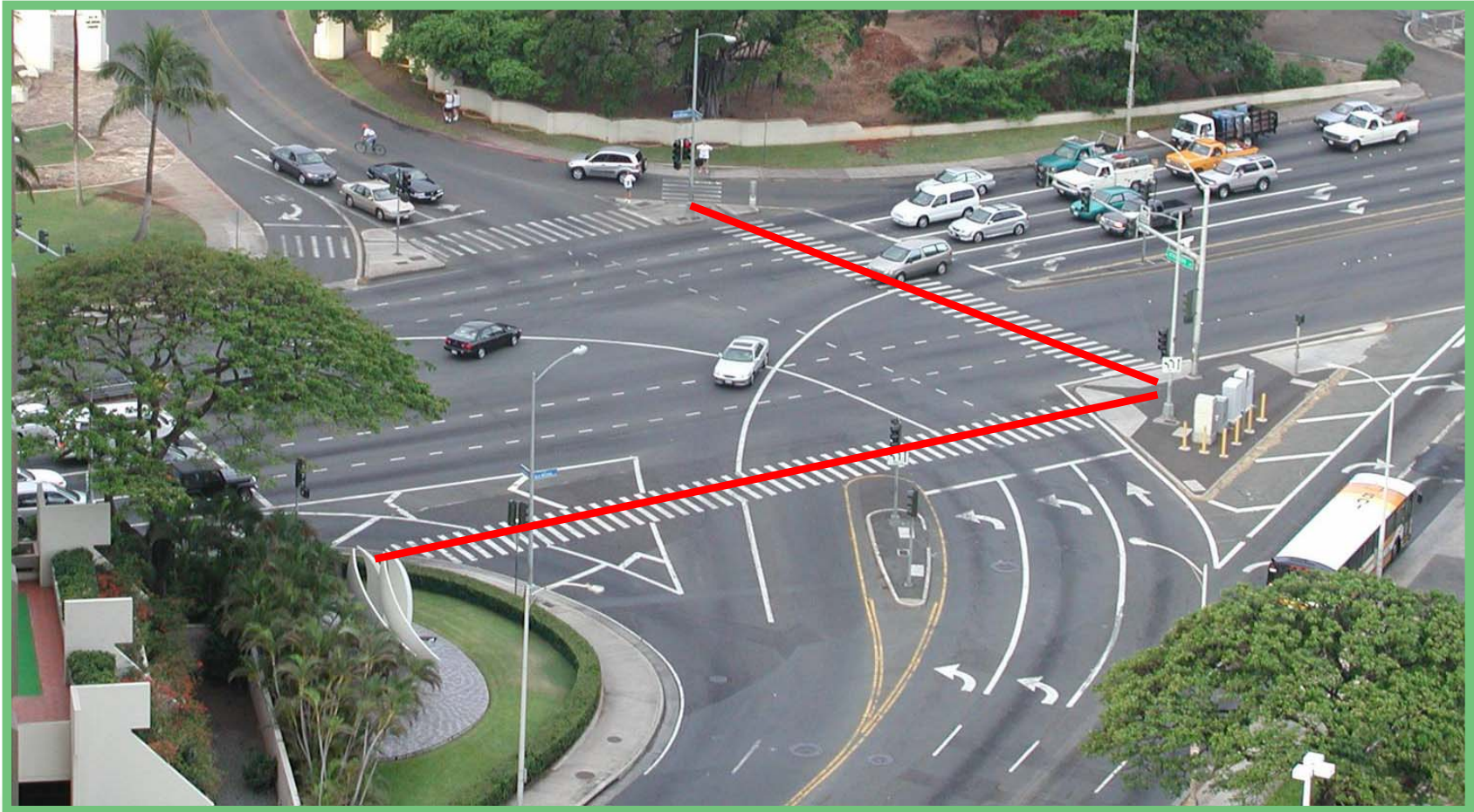
**Acceptable, not great**

# Best:

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

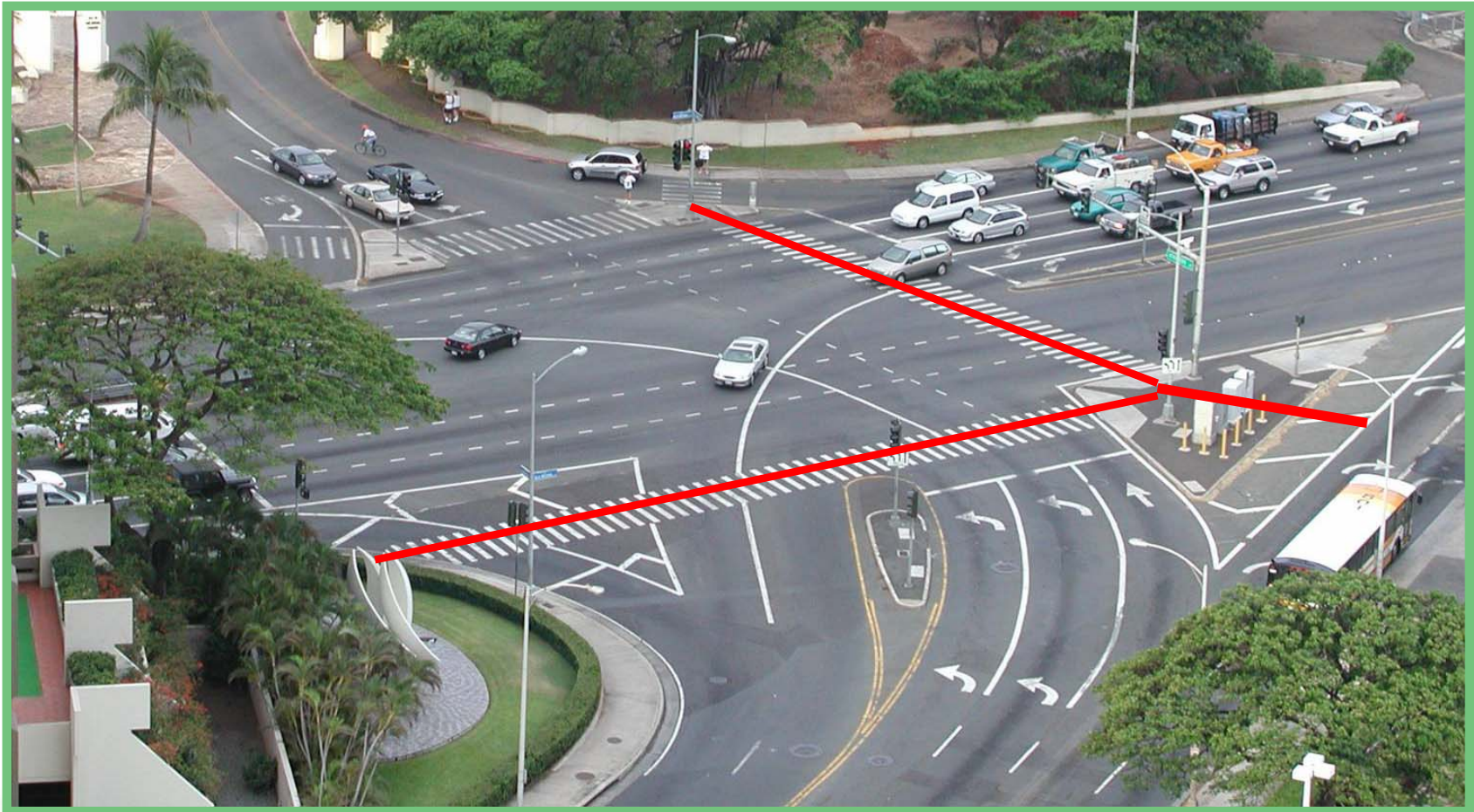


# How to place a crosswalk at porkchop island



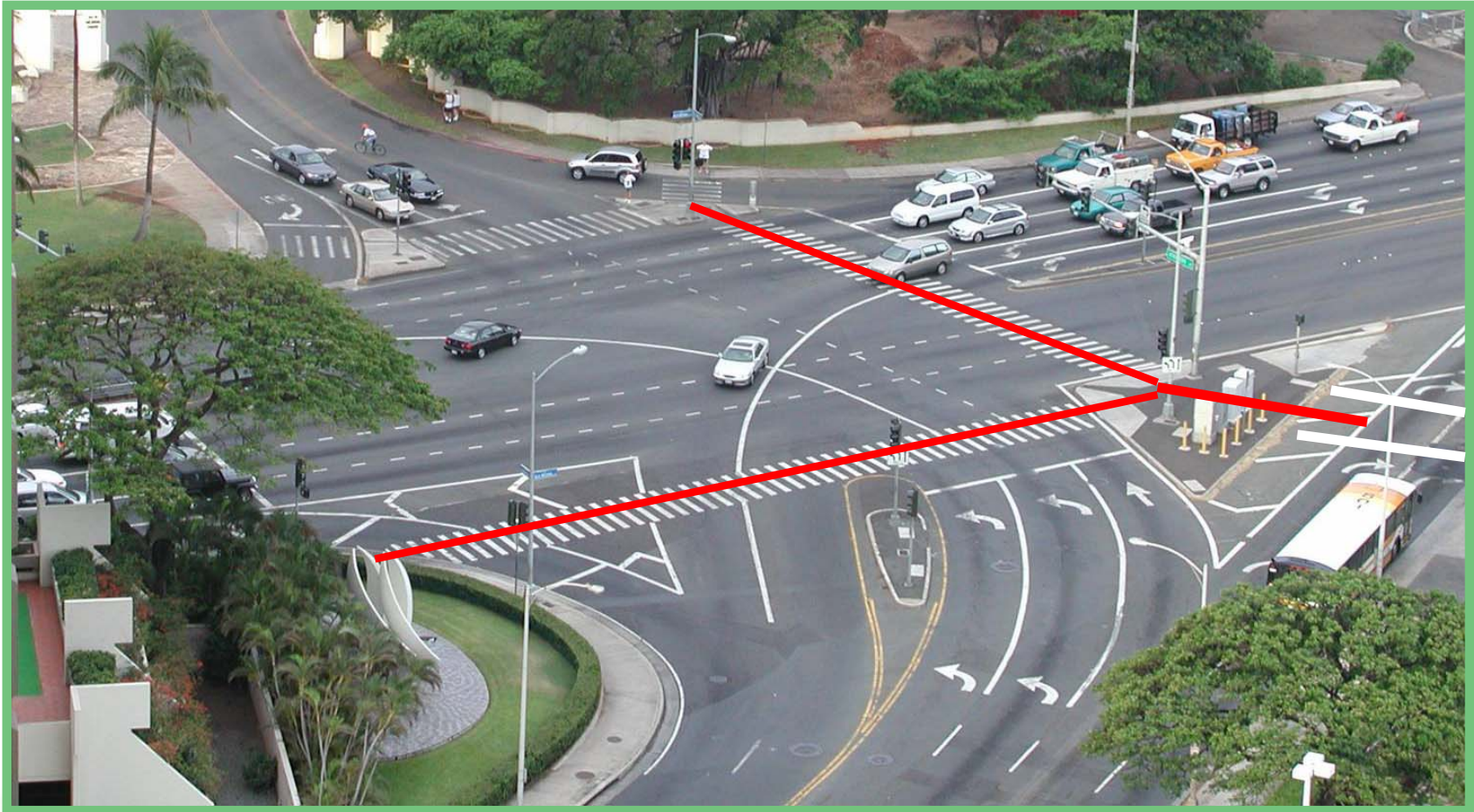
1. Place crosswalks to island

# 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?*