INTERSECTION GEOMETRY
Learning Outcomes

At the end of this module, you will 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 can break up complex intersections
Intersection Crashes

Some basic facts:

1. Most (urban) crashes occur at intersections
2. 40% 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

Designing for Pedestrian Safety – Intersection Geometry
Cars can turn at high speed
Skew increases crosswalk length, decreases visibility
Right angle decreases crosswalk length, increases visibility

Designing for Pedestrian Safety – Intersection Geometry
Skewed intersection reduces visibility

Driver looks left, doesn’t see pedestrian on right

Designing for Pedestrian Safety – Intersection Geometry
Adjust skew by bringing out curb

Designing for Pedestrian Safety – Intersection Geometry
Result: driver behavior change

Designing for Pedestrian Safety – Intersection Geometry
Curb radius – small radii are safer for pedestrians

- Large radii:
  - Increase crossing distance and
  - Make crosswalk & ramp placement more difficult
Effect of large radius on crosswalk:

- Additional area to cross
- + Higher speed turns

It adds to crossing distance...

Designing for Pedestrian Safety – Intersection Geometry
Effect of large radius on crosswalk:

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

Note right-turning vehicle
Effect of large radius on drivers

They drive fast, 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

3. Don’t choose larger design vehicle than necessary

Moving van, once or twice a year; peds cross every day
Minimize curb radius

4. Where appropriate, let trucks use 2nd lane
Minimize curb radius

5. Trucks can make very tight turns at slow speeds
Minimize curb radius

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

Designing for Pedestrian Safety – Intersection Geometry
Minimize curb radius

6.b Turn less common Semi (WB-50) into 2nd lane
Minimize Curb Radius w/Truck Apron
Minimize Curb Radius w/ Truck Apron
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

Designing for Pedestrian Safety – Intersection Geometry
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

Designing for Pedestrian Safety – Intersection Geometry
Curb extension and new corner radius must be designed together – see earlier radius discussion.

After: slow speed right-turns
Curb ext. increases likelihood drivers will yield to peds

Designing for Pedestrian Safety – Intersection Geometry
- Curb extensions allow room for street furniture
- But use care not to block sight lines
Curb extensions enable signs to be moved in

Designing for Pedestrian Safety – Intersection Geometry
Drainage solutions 1. Additional inlet

Designing for Pedestrian Safety – Intersection Geometry
Drainage solutions 2. Slotted drain

Designing for Pedestrian Safety – Intersection Geometry
Drainage solutions 3. Leave original curb + islands

Designing for Pedestrian Safety – Intersection Geometry
Drainage solutions 4. Same as before, plus plate
Curb Extension Integrated with the Sidewalk

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

Designing for Pedestrian Safety – Intersection Geometry
Before: road looks and feels wide

Designing for Pedestrian Safety – Intersection Geometry
After: curb extension integral to sidewalk
Street looks narrow even with no parked cars
More examples: curb extension integral to sidewalk
Reminder – crosswalks are provided:
1. To indicate to pedestrians where to cross
2. To indicate to drivers where to expect pedestrians
Crosswalks should normally be placed on all legs of an intersection.
Should there be a crosswalk here?

Of course!

Closing a crosswalk is not the answer

Large intersection is capacity driven, pedestrian unfriendly...
Here’s what pedestrians are expected to do

Will she wait?

Is crossing 15 lanes safer than crossing 5 lanes?
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

Right & left-turning drivers don’t see crosswalk
Single ramp reduces crosswalk setback but lengthens crosswalk
Balancing the goals works best

Note: 3” curb exposure between ramps allows them to be close together

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

Corvallis OR

Designing for Pedestrian Safety – Intersection Geometry
“When in doubt, paint it out!”

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

Designing for Pedestrian Safety – Intersection Geometry
5-56 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

Designing for Pedestrian Safety – Intersection Geometry
Right-Turn Slip Lane: Design for Pedestrians

Old Way

Wide Angle

High speed, head turner = low visibility of pedestrians

New way

Tighter angle

55 to 60 degree angle between vehicle flows.

Slow speed, good angle = good visibility of pedestrians

Designing for Pedestrian Safety – Intersection Geometry
Right-Turn Slip Lane - Details

- Cut through medians and islands for pedestrians
- 2:1 length/width ratio
- Bicycle lane
- 55° to 70° between vehicular flows
- 25’ to 40’ radius depending on design vehicle
- Crosswalk one car length back
- Long radius followed by short
- 150 to 275’ radius

Designing for Pedestrian Safety – Intersection Geometry
Drivers naturally trace the right island shape

Designing for Pedestrian Safety – Intersection Geometry
... instead of here

Designing for Pedestrian Safety – Intersection Geometry
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

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

Designing for Pedestrian Safety – Intersection Geometry
Not acceptable

Acceptable, not great

St Paul  MN

Designing for Pedestrian Safety – Intersection Geometry
Best:

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

St Paul  MN
Designing for Pedestrian Safety – Intersection Geometry
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

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