



Innovative Intersections Barriers for Pedestrians and Bicyclists – RCUTS and Roundabouts

TZD Conference
November 2016
Melissa Barnes, PE

We all have a stake in **A**  **B**



Preface

Best practices for RCIs and roundabouts to facilitate transportation for all users



Restricted Crossing U-Turn (RCUT)

Crossing a rural divided highway using a Reduced Conflict Intersection



Left hand turn onto divided highway using a Reduced Conflict Intersection



Restricted Crossing U-Turn (RCUT)

- ▶ Decreased delay
- ▶ Increased safety
- ▶ Good capacity
- ▶ Easy signal progression
- ▶ Creates a barrier for pedestrians



Restricted Crossing U-Turn (RCUT)



Source: FHWA



Restricted Crossing U-Turn (RCUT)



Restricted Crossing U-Turn (RCUT)

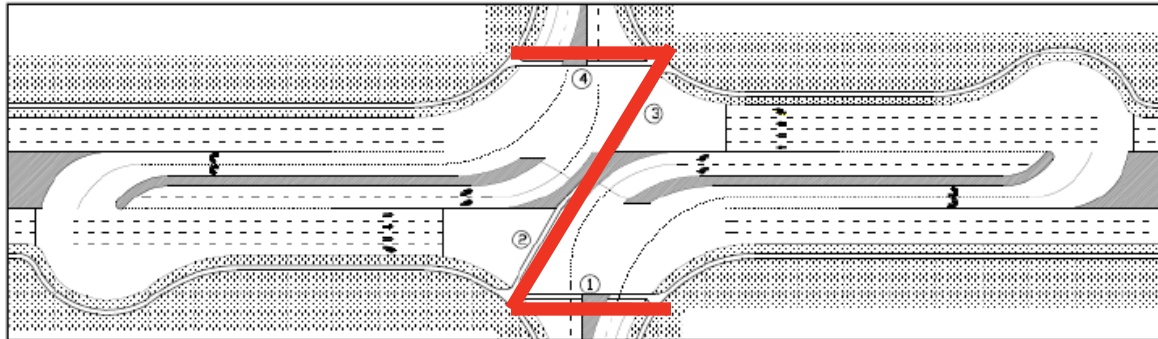


Figure 4.2. Diagonal cross.

Table 4.1. Assumed advantages and disadvantages to the pedestrian diagonal cross.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> Protected pedestrian movements. Pedestrian phases work well with two-stage traffic crossings. Expect no interruption to traffic flow. Favors a direct path between the southwest and northeast quadrants. Right turn on red from the minor street do not conflict with pedestrians any more than at a conventional intersection. 	<ul style="list-style-type: none"> Pedestrian movement from the southeast to the northwest quadrant will be longer due to the diagonal crossing length.

Pedestrian and Bicycle Accommodations on Superstreets
NCDOT 1/2014



Restricted Crossing U-Turn (RCUT)

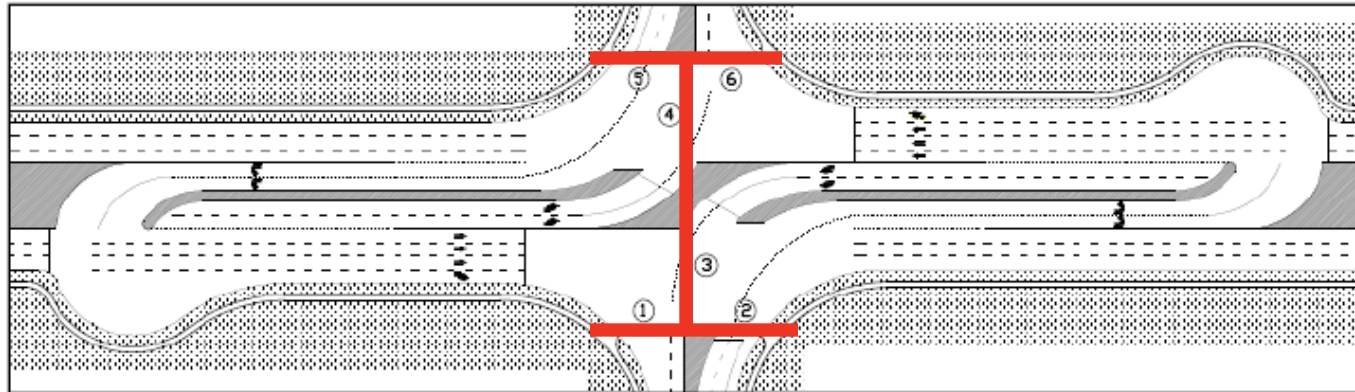


Figure 4.3. Median cross.

Table 4.2. Assumed advantages and disadvantages for the pedestrian median cross.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Pedestrian paths at right angles, no angled paths. • Shorter crossing distances. 	<ul style="list-style-type: none"> • The major street pedestrian path would conflict with the left turning vehicles from the major street. • An exclusive pedestrian signal phase would be required at each major street crossing, adding vehicular delay for the mainline left turn movement.

Pedestrian and Bicycle Accommodations on Superstreets
NCDOT 1/2014



Restricted Crossing U-Turn (RCUT)

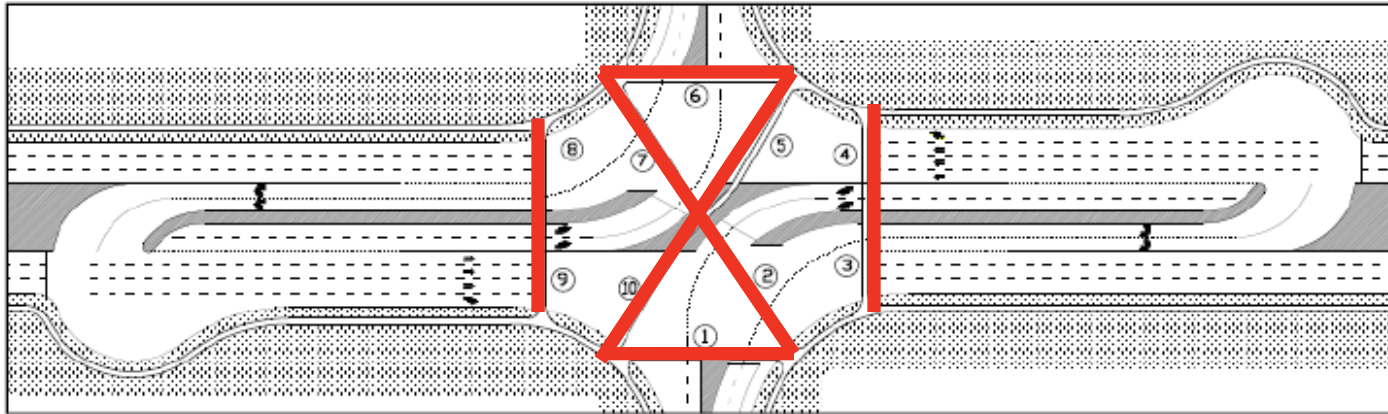


Figure 4.4. Two-stage Barnes Dance cross.

Table 4.3. Assumed advantages and disadvantages for the pedestrian two-stage Barnes Dance cross.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Direct link between all quadrants increases pedestrian access. 	<ul style="list-style-type: none"> • Major street pedestrian path would conflict with several vehicle paths and require an exclusive pedestrian signal phase. • The addition of the pedestrian signal phase would add to vehicular delay.

Pedestrian and Bicycle Accommodations on Superstreets
NCDOT 1/2014



Restricted Crossing U-Turn (RCUT)

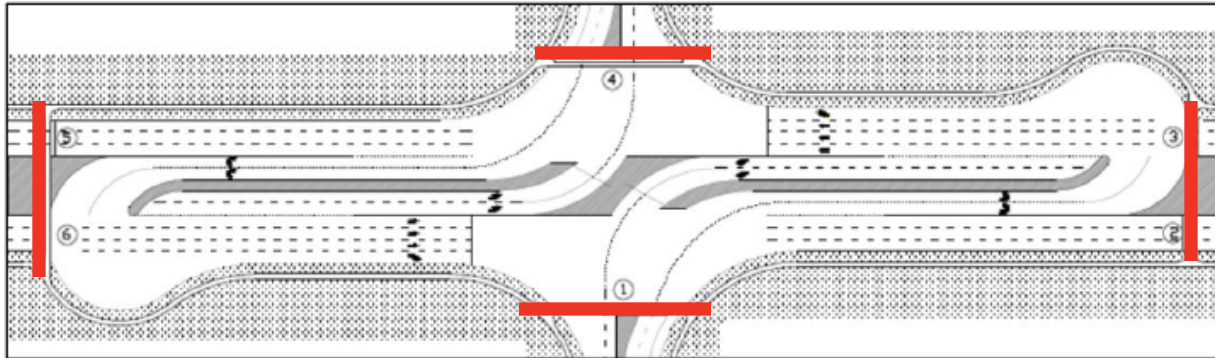


Figure 4.5. Midblock cross.

Table 4.4. Assumed advantages and disadvantages for the pedestrian midblock cross.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Offers a crossing at the midblock, which may be in addition to a crossing at the main intersection. • One of the two crossings would work well with the current vehicle signal at the U-turn. • Midblock crossings would work well for closely spaced U-turns in a corridor of multiple superstreets. • Provides a crossing opportunity at a midblock location where transit could be incorporated. 	<ul style="list-style-type: none"> • Possible added delay to the outbound vehicles from the side street movements at the midblock cross.

Pedestrian and Bicycle Accommodations on Superstreets
NCDOT 1/2014



Restricted Crossing U-Turn (RCUT)

Table 4.5. Assumed advantages and disadvantages for the bicycle U-turn option.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Bicyclists travel a shorter distance to the median cut as opposed to the vehicular U-turn. • Bicyclists' movements could work well with current vehicular signals. • The exclusive bicycle U-turn separates bicyclists from motorists, making the U-turn maneuver safer than when sharing the vehicular U-turn. • Favored by individuals on the expert panel who prefer to cycle with vehicles. 	<ul style="list-style-type: none"> • Bicyclists traveling on the left side of the street is not common, making this movement unfamiliar to bicyclists as well as vehicles. • Possible storage concerns for multiple bicyclists traveling through the median cut at the same time. • May not be a viable option for extremely long mainline left turn bays

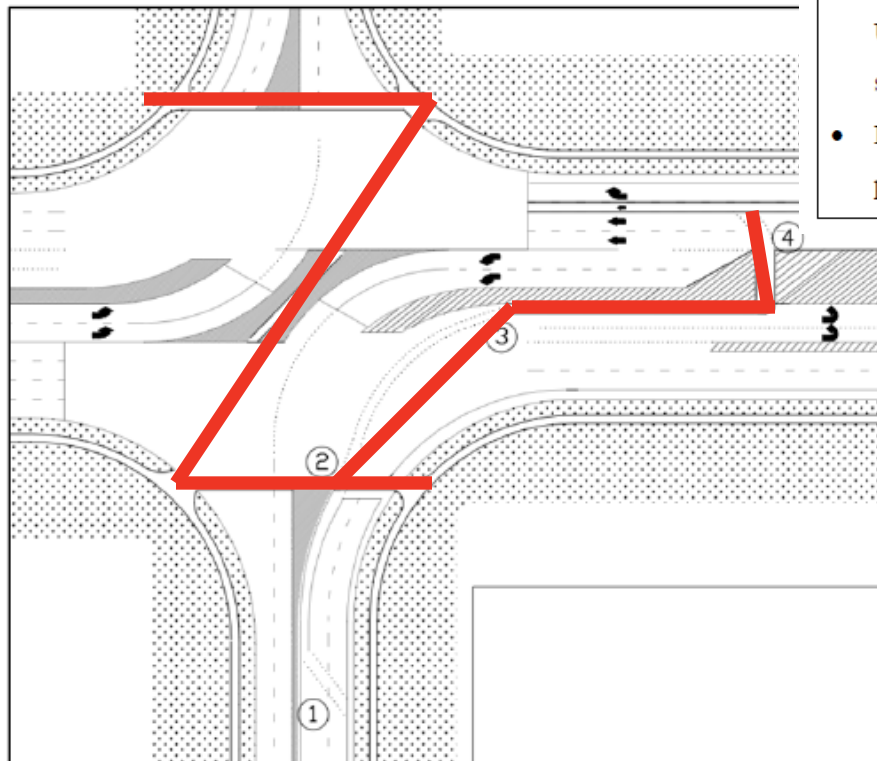


Figure 4.6. Bicycle U-turn option.

Pedestrian and Bicycle
Accommodations on Superstreets
NCDOT 1/2014



Restricted Crossing U-Turn (RCUT)

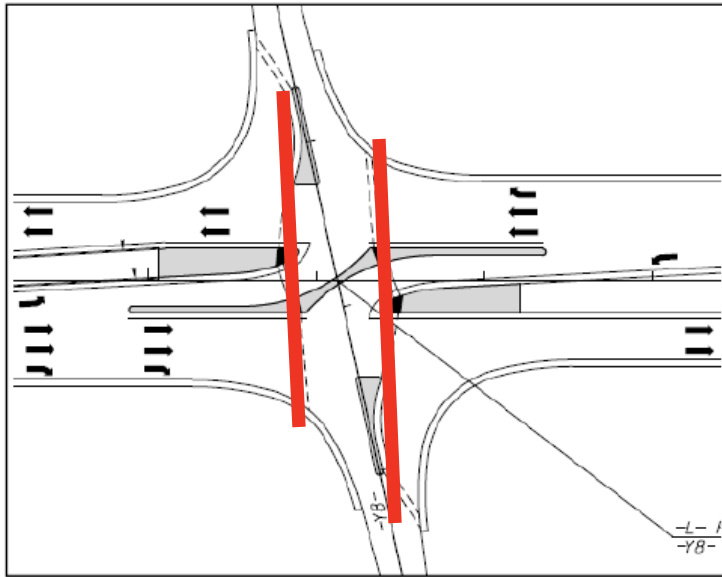


Figure 4.7. Direct cross.

Table 4.6. Assumed advantages and disadvantages to the bicycle direct cross.

Advantages:	Disadvantages:
<ul style="list-style-type: none"> • Directly crossing the major street offers the shortest distance to the bicyclists. • Bicyclists have less exposure to the major street traffic. 	<ul style="list-style-type: none"> • Traveling on the left side is an unusual lane position for bicyclists and may be unexpected to motorists. • Additional signals exclusively for bicyclists need to be installed. • Additional design consideration needed for the bicyclists crossing the major street left turns. • Four different crossing movements.

Pedestrian and Bicycle Accommodations on Superstreets
NCDOT 1/2014



Restricted Crossing U-Turn (RCUT) Treatments that Help

- ▶ LPI when signalized
- ▶ Consistently providing pedestrian cut-throughs in the median
- ▶ Slip ramps
- ▶ Unique phasing

FHWA Every Day Counts

FHWA Every Day Counts



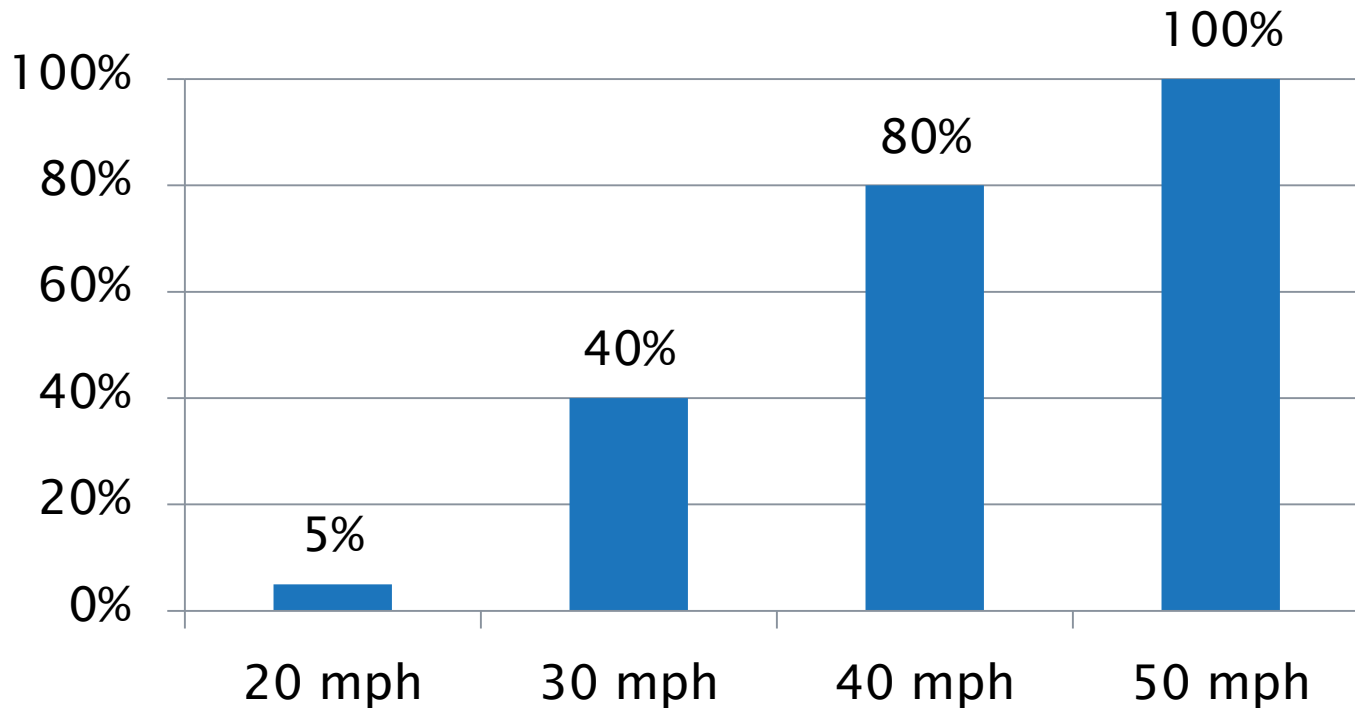
Roundabouts

- ▶ Reduced delay
- ▶ Increased safety, especially with single-lane roundabouts
- ▶ Slower speeds (Energy = $\frac{1}{2} \times \text{mass} \times \text{speed} \times \text{speed}$)



Roundabouts

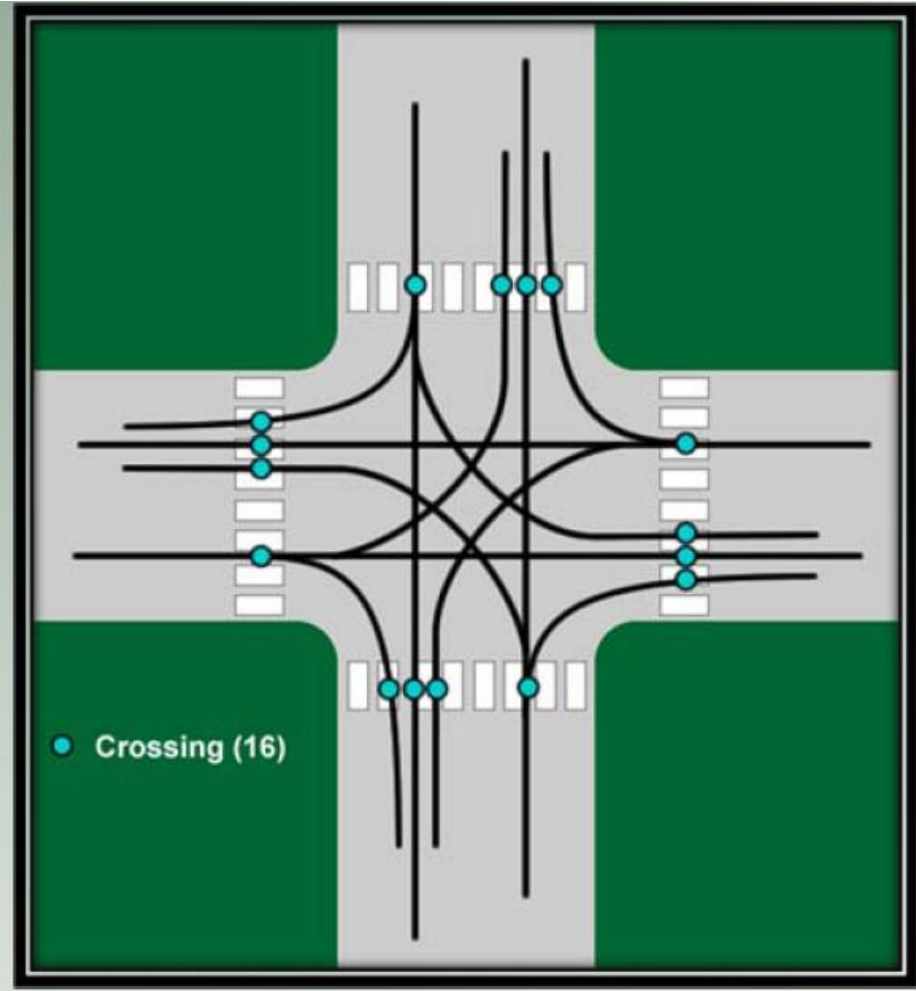
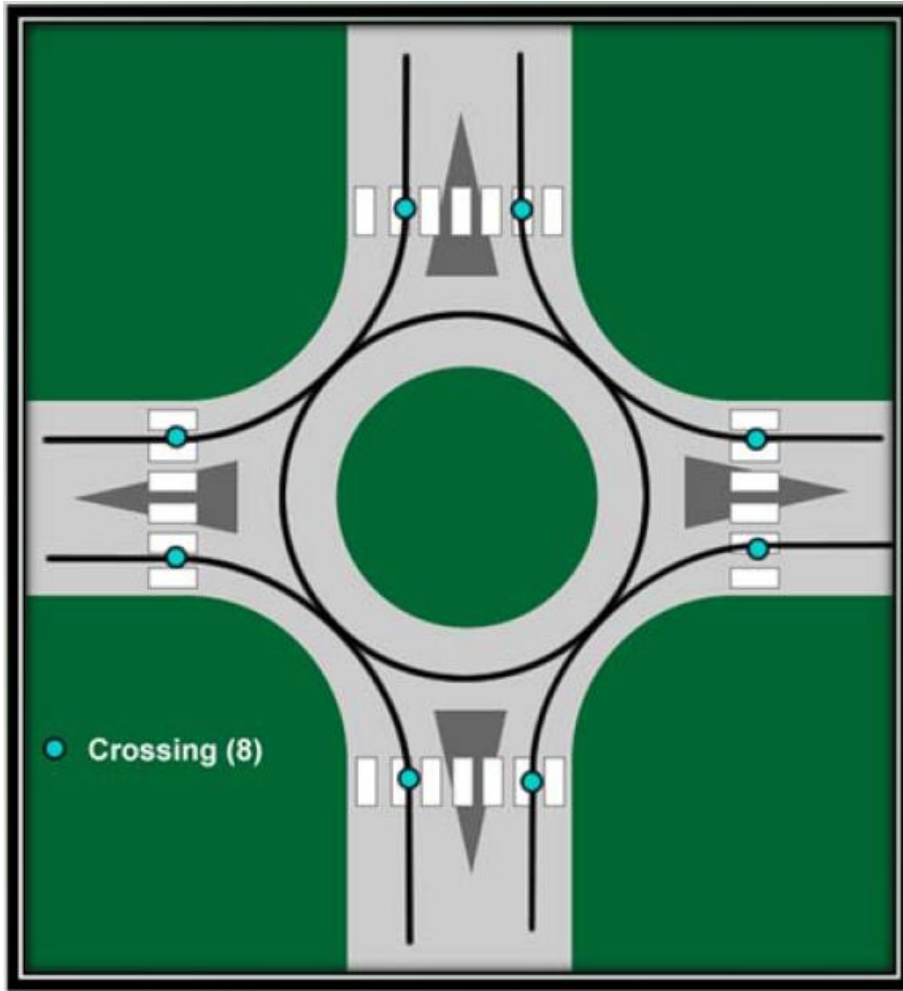
Chance of Pedestrian Death If Hit By a Motor Vehicle



Literature Review on Vehicle Travel Speeds and Pedestrian Injuries – Final Report DOT HS 809 021, October 1999



Roundabouts



Source – Roundabouts: An Informational Guide (FHWA)



Roundabouts

- ▶ MN – 25 pedestrian crashes, only 1 serious in 10 years
 - Number of roundabouts varied, up to around 300
- ▶ Melbourne, Australia study
 - Roughly the same size/population as 7 county Metro
 - ~4,000 roundabouts
 - 1996–2000
 - 57 total ped crashes
 - 0 fatalities
 - 32% required hospitalization



Roundabouts

- ▶ Increased pedestrian safety
 - Shorter crossing distances
 - Pedestrians only look in one direction
 - Driver at signals watch the light
 - Drivers at typical intersections tend to look left and turn right
 - Pedestrian crossing separated from intersection – allows for one step at a time. Shorter crossing distances
 - Two-stage crossings



Roundabouts

- ▶ Decreased pedestrian safety
 - Vehicles don't stop
 - ADA concerns
 - Become a barrier without facilities



Roundabouts



Source: kitsapsun.com



Roundabouts



Source: kitsapsun.com



Roundabouts

▶ Pedestrian

- PROWAG and the new AASHTO Pedestrian Guide will require beacons or signals on multilane roundabouts.
- Eliminate pedestrian barriers, regardless of volume. Set the bar low!

▶ Bicycle

- Slip ramps important



Source: greatergreaterwashington.org



Questions?

Melissa Barnes, PE
MnDOT State Pedestrian and Bicycle Safety Engineer
Melissa.barnes@state.mn.us

