Institute of Transportation Engineers
Florida Section • District 10

FSITE/District 10 & ITS FL
2017 Joint Annual Meeting
& Awards Banquet

ITS Florida

Why Roundabouts on the Florida State Highway System?

Kevin Kuhlow, PE

Ayres Associates

FDOT Roundabout History

- 1996 One of two States with a Guide
  - roundabouts are the preferred control
- 2007 Roundabout Guide Sunsetted and Adopted 2008 FHWA Guide
  - roundabouts shall be considered
- 2012 Formally adopted NCHRP 672
  - roundabouts must be evaluated
- 2014 Provided tools for Evaluation
  - dropped “preferred” - give “equal consideration”

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Where are we now?

How many Signals are on SHS?

Roundabouts on SHS

2012 – 7 after 16 years of "preferred"

2014 – 13

2015 – 21

2016 – 29 projected

Approximately 8,500 Signals on SHS

- Based on Roadway Characteristics Inventory (RCI)

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FDOT Roundabout Policy

What is FDOT Policy?

The modern roundabout as defined in NCHRP 672 is the only circular intersection configuration that will be allowed on the SHS.

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What is not allowed?

ROTARIES/
TRAFFIC CIRCLES

TRAFFIC CALMING
CIRCLES

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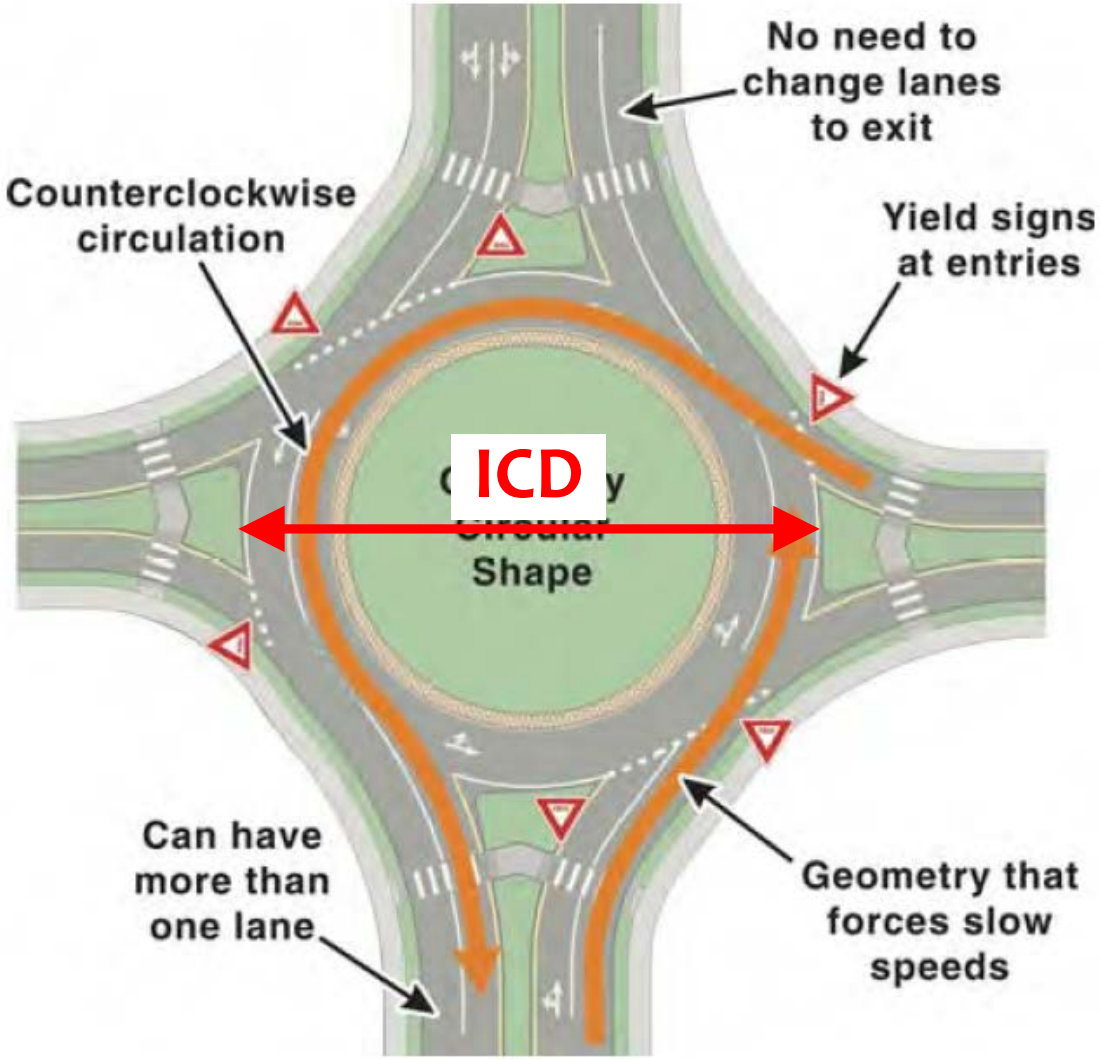
Key Roundabout Characteristics



Inscribed Circle Diameter (ICD)

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Roundabout Comparison

FDOT Policy on Number of Lanes?

Design Element	Single-Lane Roundabout	Two-Lane Roundabout
Desirable maximum entry design speed	20 to 25 mph	25 to 30 mph
Typical inscribed circle diameter	90 to 180 ft	150 to 300 ft
Typical daily service volumes on 4-leg roundabout	Up to approximately 25,000	Up to approximately 45,000

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Why Roundabouts on SHS

- Traffic Safety - Reduce injury crashes by 76%
- Traffic Calming - Reduce vehicle speeds
- Pedestrian Safety - Focus on one traffic stream
- Operational Performance - Reduce overall delay
- Operations and Maintenance – Reduce costs
- Approach Roadway Width – Reduce impacts
- Environmental Factors
- Access Management and Land Use
- Aesthetics

Why Roundabouts on SHS?

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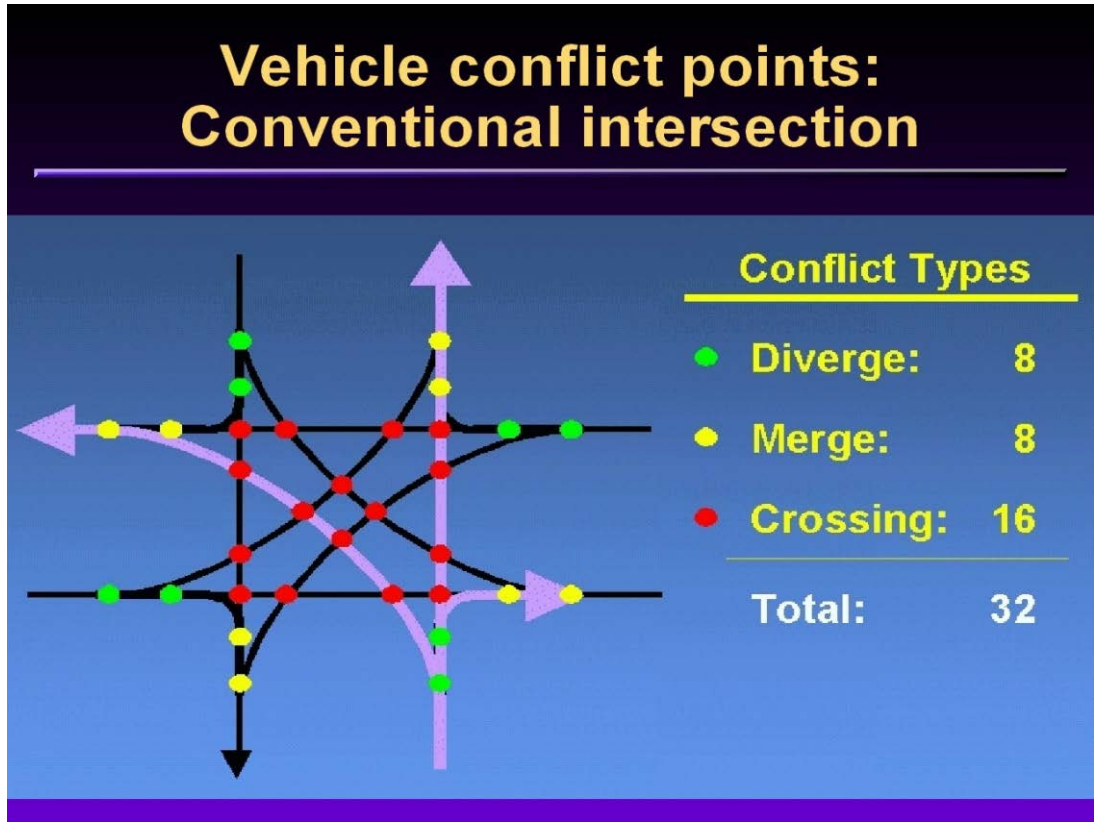
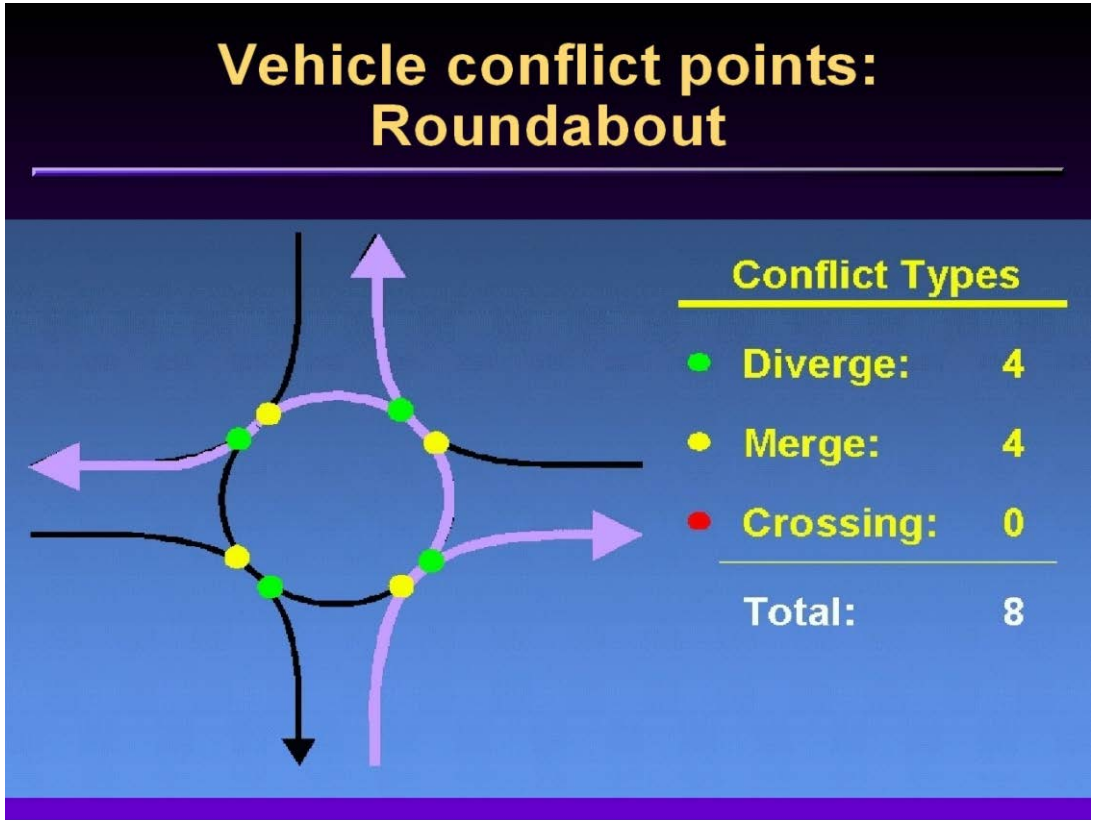
Safety Comparison

Signals vs. Roundabouts





- Crashes of this type are more severe

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Traffic Safety

Severe angle and turning movement collisions are avoidable

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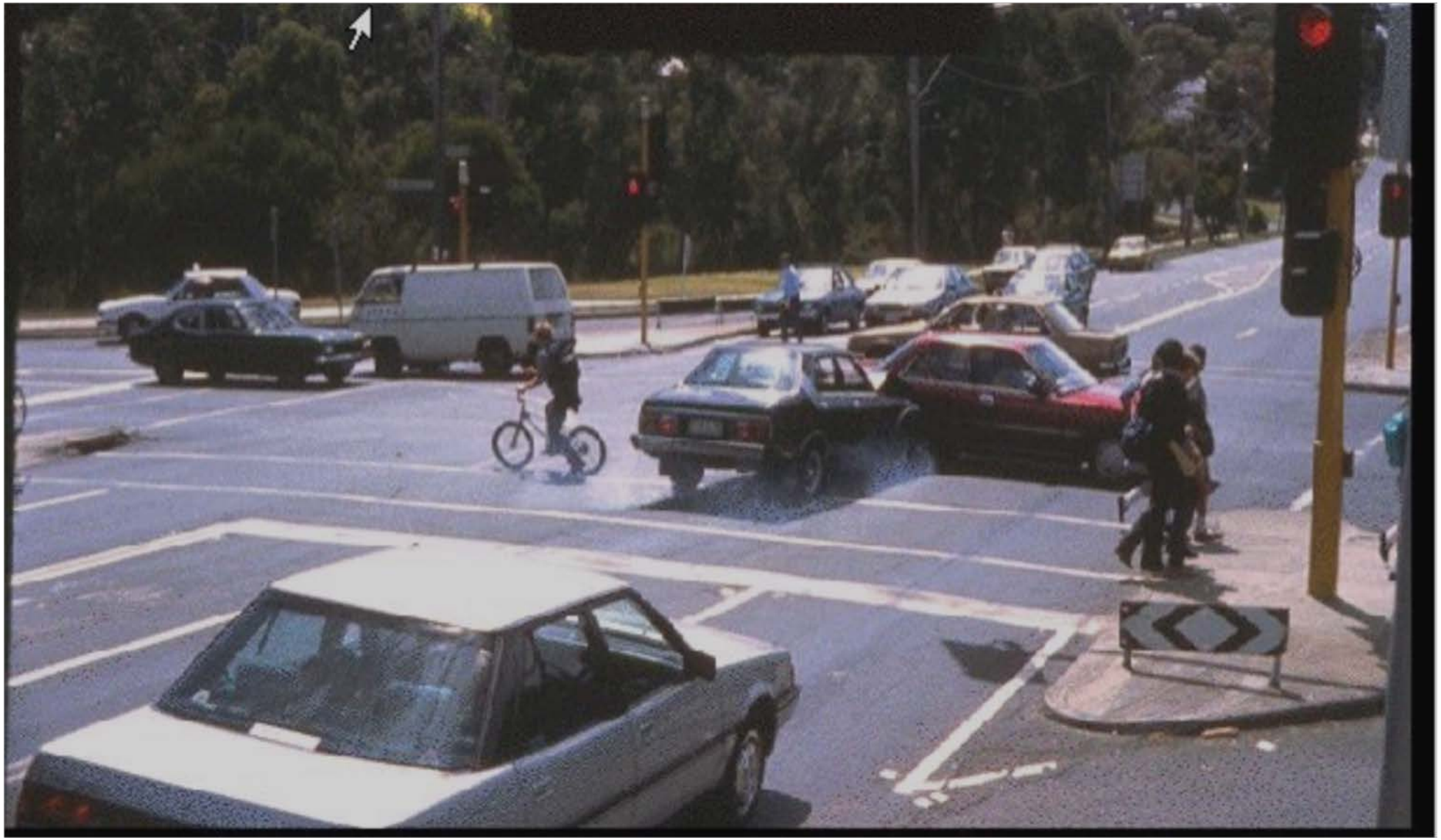
Traffic Safety



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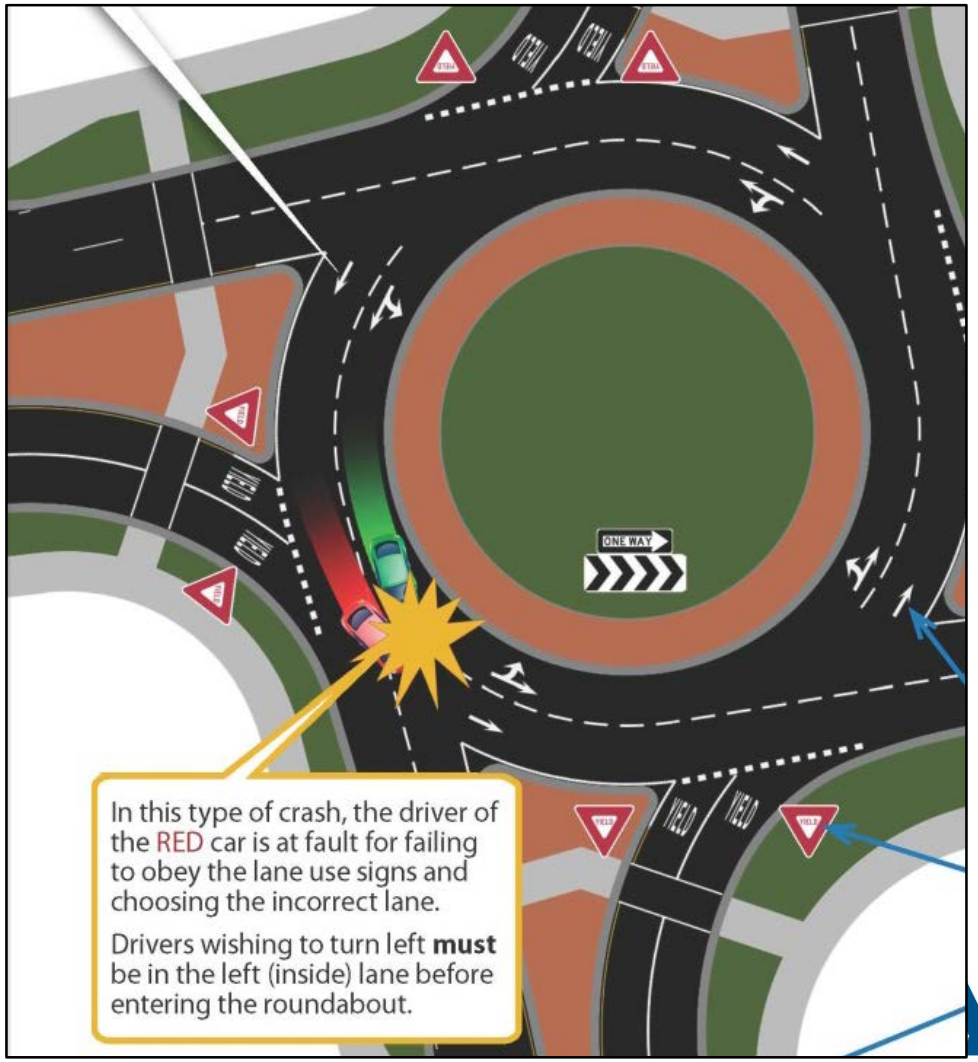
Less Severe Crashes



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Safety Comparison

	Traffic Signal	Roundabout
Crash Severity	⬆	⬇
Number of Driver Decisions	⬆	⬇
Severity of Driver Errors	⬆	⬇
Traffic Calming	Not Effective	Geometrics Limit Speeds

⬆ Higher ⬇ Lower

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FDOT KABCO Crash Costs 2011-2015

Crash Severity	Comprehensive Crash Cost
Fatal (K)	$ 10,560,000
Severe Injury (A)	$ 599,040
Moderate Injury (B)	$ 162,240
Minor Injury (C)	$ 100,800
Property Damage Only (O)	$ 7,600

SOURCE: Florida Department of Transportation State Safety Office's Crash Analysis Reporting (CAR) System, analysis years 2011 through 2015.

Cost of Crashes

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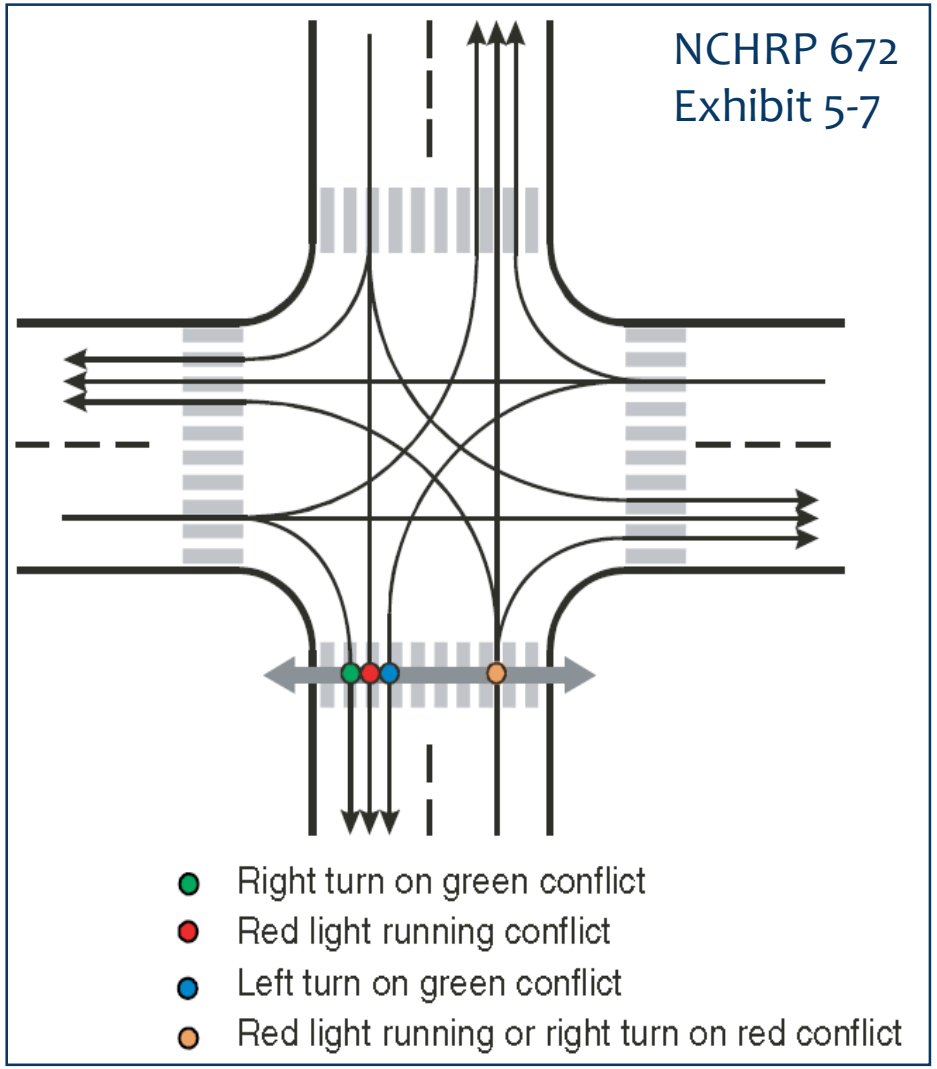
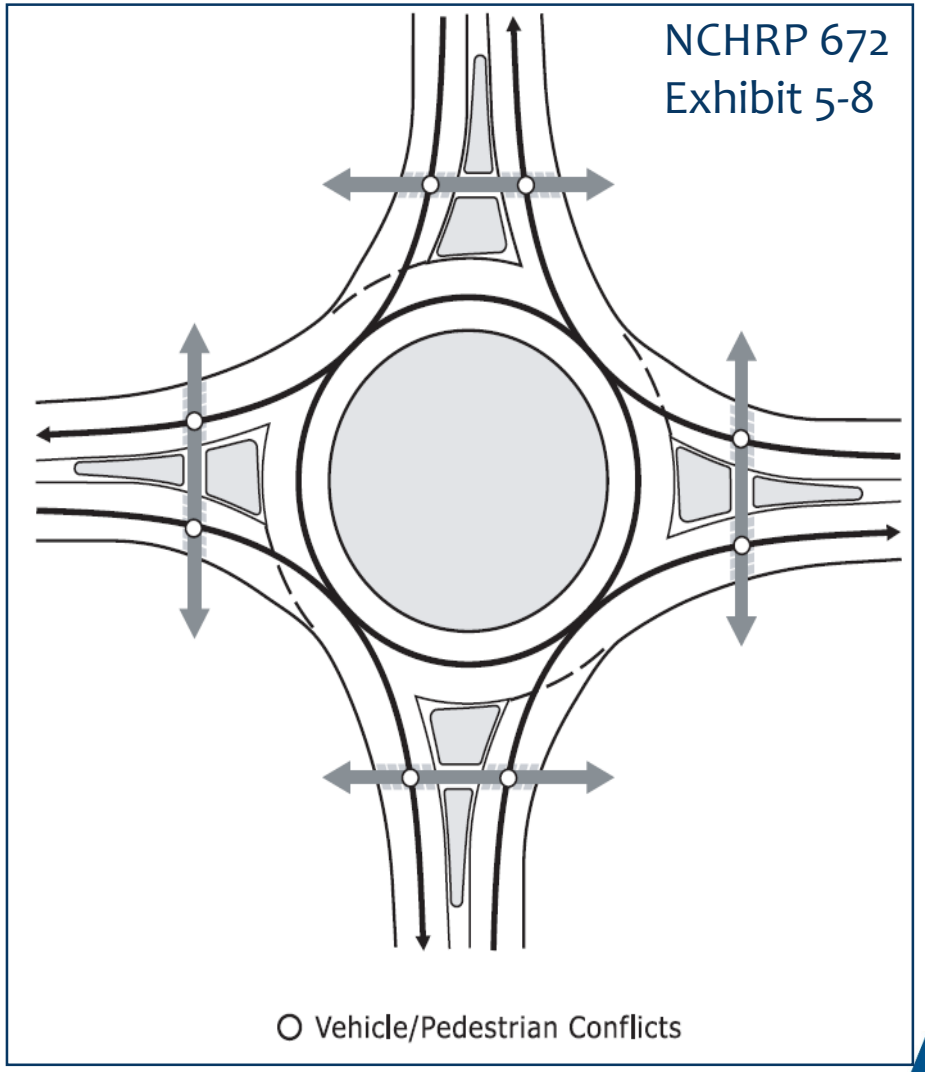
Vehicle-Pedestrian Conflicts



16 Conflicts



8 Conflicts

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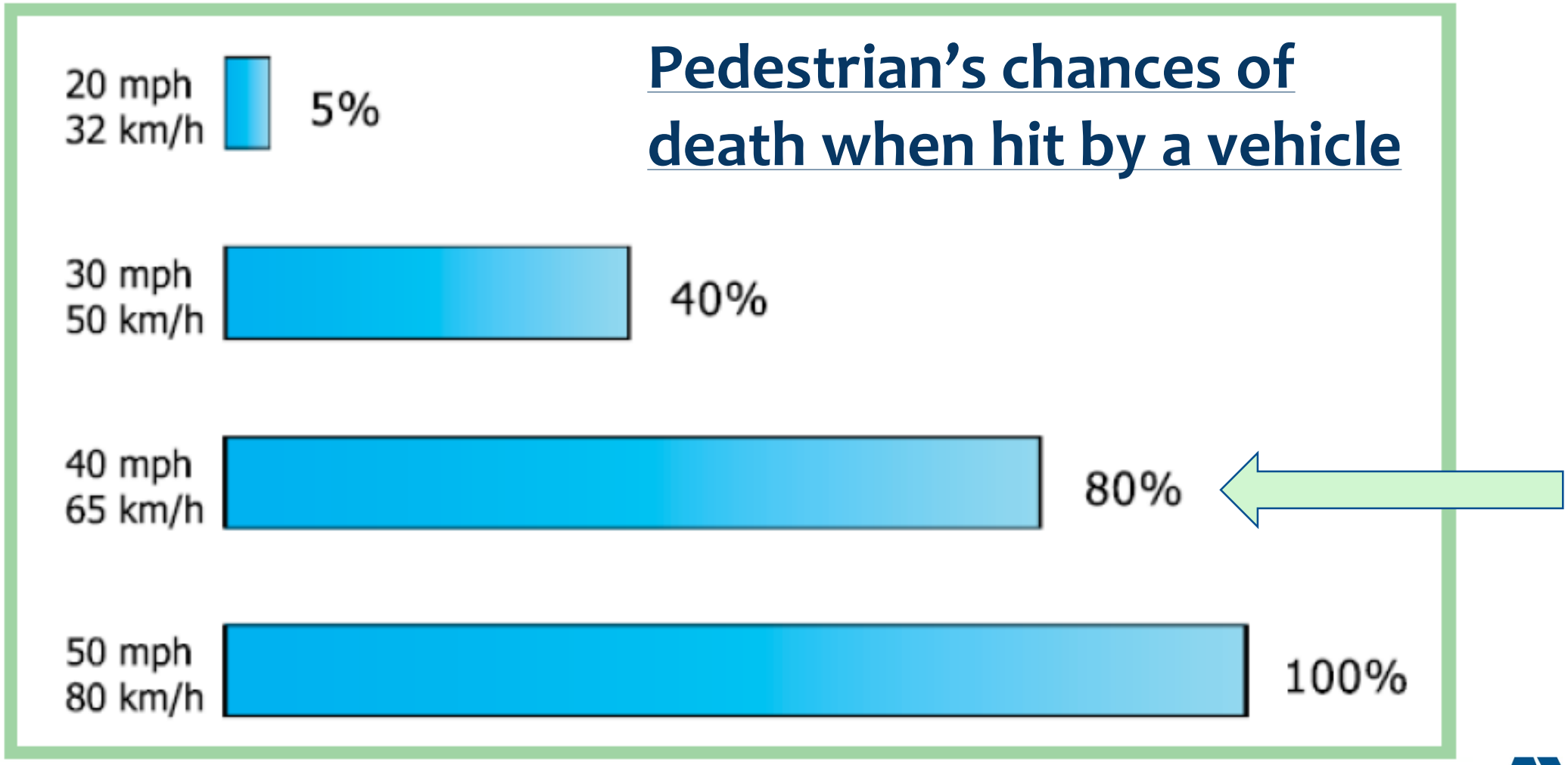
Speed and Crash Severity



Source: NHTSA 1999

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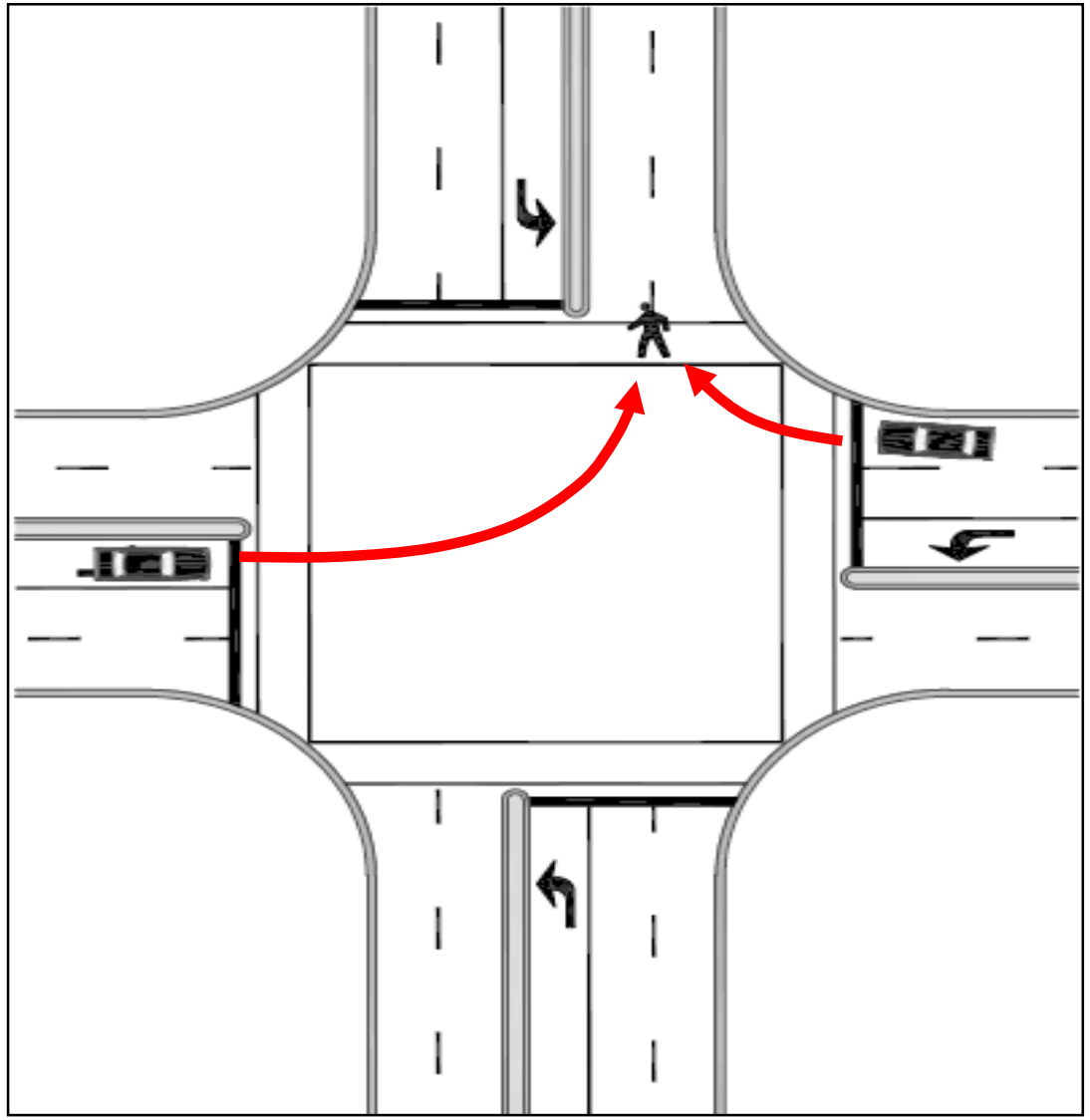
Safety at Signalized Intersection



- Pedestrian experiences an exaggerated level of security because the signals tell them it's safe to cross
- Most crashes occur when drivers turn left or right across the crosswalk while the pedestrian has a **WALK** indication

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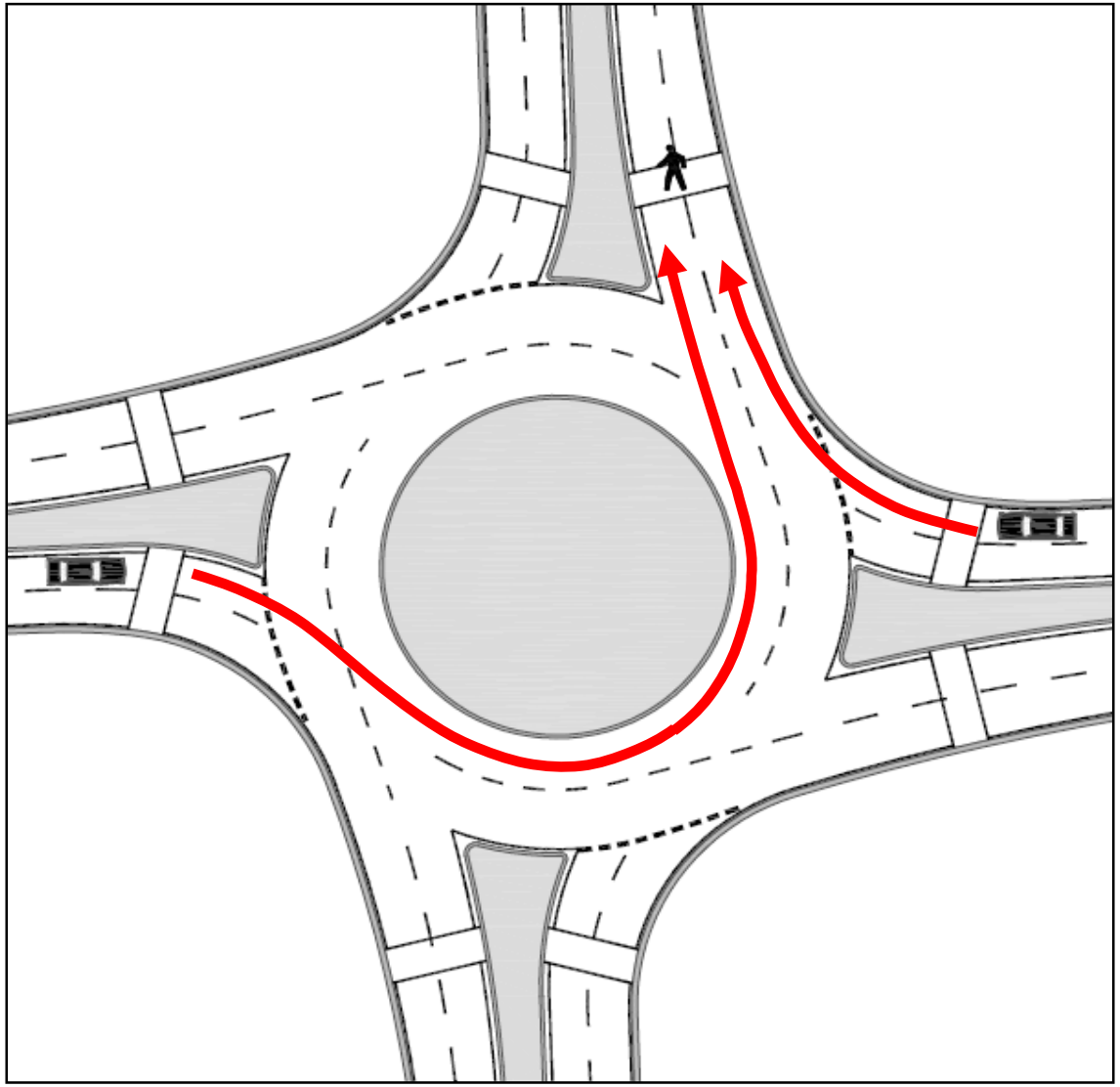
Safety at Roundabouts



- Pedestrian feeling of security more closely matches their actual level of safety

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Pedestrian Roundabout Accommodations

Pros

- ✓ Low speed environment allows more time to react
- ✓ Shorter crossing distances – Reduced exposure
- ✓ Reduced conflict points
- ✓ Crossing one direction of travel at a time
- ✓ Splitter island provides refuge
- ✓ No signal delay

Cons

- ✓ Uninterrupted flow, can be difficult to assess gaps
- ✓ Disabled, children, and older adults may have difficulty
- ✓ Entries/exits with more than one lane may be difficult to cross
- ✓ Low driver yield compliance

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Operational Performance

- Typically have lower overall delay than signalized and all-way stop-controlled intersections
- Delay reduction is often most significant during non-peak traffic periods
- Often results in reduced lane requirements between intersections (freeway interchanges-bridge under or over)

Pros

- ✓ Capacity
- ✓ Level of Service
- ✓ Reduced Delay
- ✓ Speed Control

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Roundabout Operation

- A roundabout brings together conflicting traffic streams at reduced speeds, allowing the streams to safely cross paths, traverse the roundabout, and exit
- Modern roundabouts do not have merging or weaving between conflicting traffic streams
- Vehicles at each approach must yield right-of-way to circulating vehicles and accept gaps in circulating traffic
- Compactness of circle size and geometric speed control make it possible to establish priority to circulating traffic
- *Ensure geometry creates the correct operations!*

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Levels of Analysis

- **Planning level**
  - Based on daily volumes (AADT)
  - Determine necessary number of lanes
- **Operational level**
  - Based on peak hour volumes
  - Determine capacity of each entry and overall intersection

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Planning Level Analysis and Space Requirements

Roundabout Type	Typical Inscribed Circle Diameter	Typical AADT 4-leg roundabouts
Single-lane	120 – 160 ft	Less than 25,000
Multilane (2-lane entry)	160 – 200 ft	25,000 to 45,000

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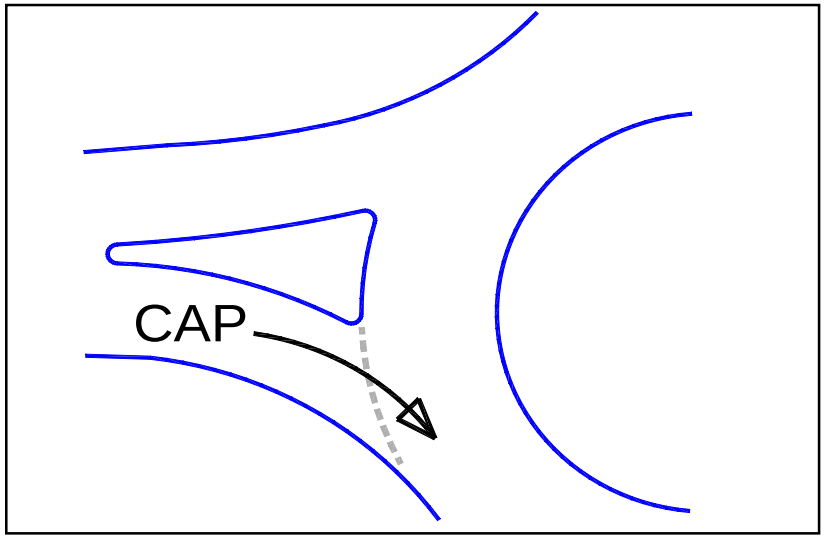
Operational Level Analysis

- Analysis of all peak hour periods is critical to assess the level of performance at each entry and the roundabout as a whole
- The capacity of a roundabout entry depends on two factors:
  1. Circulating flow in the roundabout that conflicts with the entry flow
  2. Number of entering lanes on the approach to the circulatory roadway



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Operational Level Analysis

- Each approach leg of the roundabout is evaluated individually to determine the number of entry lanes
- The number of lanes within the circulatory roadway is then based on the number of lanes needed to provide lane continuity
- Balance the traffic use of each lane; otherwise some lanes may be overloaded, while others are underutilized

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Capacity Limits

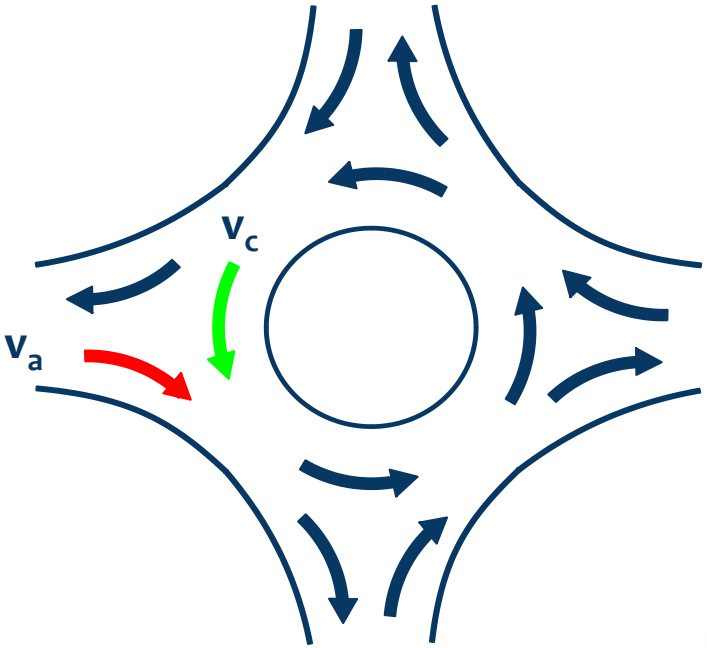
The sum of entering (V_a) plus circulating (V_c) traffic at each entry point

Estimate of Lane Capacity

1,000 vph or less
- **Single lane** should work

1,000 vph to 1,300 vph
- **Single lane** may work

1,300 vph to 1,800 vph
- **2 lanes** should work



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Operational Analysis Methodology

Gather Volumes, PHF, and Truck %

Enter Forecasted Peak Hour Volumes into Traffic Flow Worksheet

Determine Number of Entry Lanes and Lane Configuration

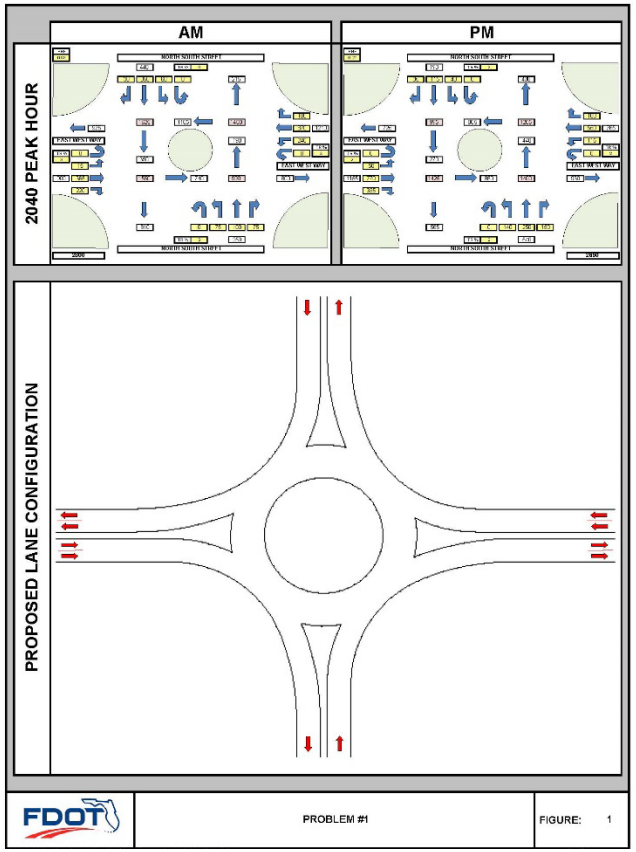
Draw Lane Configuration Sketch

Operational Analysis

Report on Operational Analysis

Single lane

Multilane



FDOT Preferred Software

SIDRA

Standard Mode

EF = 1.1 (Design Year)

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Questions

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