Why Roundabouts on the Florida State Highway System?

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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”
Where are we now?

Roundabouts on SHS

2012 – 7 after 16 years of “preferred”
2014 – 13
2015 – 21
2016 – 29 projected

How many Signals are on SHS?
Approximately 8,500 Signals on SHS

Based on Roadway Characteristics Inventory (RCI)
The modern roundabout as defined in NCHRP 672 is the only circular intersection configuration that will be allowed on the SHS.
What is not allowed?

- ROTARIES/TRAFFIC CIRCLES
- TRAFFIC CALMING CIRCLES
Key Roundabout Characteristics

- Inscribed Circle Diameter (ICD)
- Counterclockwise circulation
- Yield signs at entries
- Can have more than one lane
- Geometry that forces slow speeds
- No need to change lanes to exit
# Roundabout Comparison

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

FDOT Policy on Number of Lanes?

*FDOT Policy on Number of Lanes?*
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
Safety Comparison

Signals vs. Roundabouts

Vehicle conflict points: Conventional intersection

- Diverge: 8
- Merge: 8
- Crossing: 16
Total: 32

Vehicle conflict points: Roundabout

- Diverge: 4
- Merge: 4
- Crossing: 0
Total: 8

- Crashes of this type are more severe
Traffic Safety

Severe angle and turning movement collisions are avoidable.
Traffic Safety
Less Severe Crashes

Drivers enter only when there is a safe gap in traffic.

Drivers must yield to all traffic coming from the left.

Circulating traffic has the right of way. Continue to your exit and do not stop within the roundabout.

The entering driver (red) is at fault due to failure to yield to the circulating vehicle (green). The driver in the inside lane of the roundabout can either exit or continue circulating. Entering vehicles must yield to all traffic coming from the left.

In this type of crash, the driver of the RED car is at fault for failing to obey the lane use signs and choosing the incorrect lane. Drivers wishing to turn left must be in the left (inside) lane before entering the roundabout.
## Safety Comparison

<table>
<thead>
<tr>
<th></th>
<th>Traffic Signal</th>
<th>Roundabout</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crash Severity</strong></td>
<td>🔄 Higher</td>
<td>🔄 Lower</td>
</tr>
<tr>
<td><strong>Number of Driver Decisions</strong></td>
<td>🔄 Higher</td>
<td>🔄 Lower</td>
</tr>
<tr>
<td><strong>Severity of Driver Errors</strong></td>
<td>🔄 Higher</td>
<td>🔄 Lower</td>
</tr>
<tr>
<td><strong>Traffic Calming</strong></td>
<td>Not Effective</td>
<td>Geometrics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Limit Speeds</td>
</tr>
</tbody>
</table>

♫ Higher ♫ Lower
<table>
<thead>
<tr>
<th>Crash Severity</th>
<th>Comprehensive Crash Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal (K)</td>
<td>$ 10,560,000</td>
</tr>
<tr>
<td>Severe Injury (A)</td>
<td>$ 599,040</td>
</tr>
<tr>
<td>Moderate Injury (B)</td>
<td>$ 162,240</td>
</tr>
<tr>
<td>Minor Injury (C)</td>
<td>$ 100,800</td>
</tr>
<tr>
<td>Property Damage Only (O)</td>
<td>$ 7,600</td>
</tr>
</tbody>
</table>

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

16 Conflicts

Right turn on green conflict
Red light running conflict
Left turn on green conflict
Red light running or right turn on red conflict

8 Conflicts

NCHRP 672 Exhibit 5-7

NCHRP 672 Exhibit 5-8
Pedestrian’s chances of death when hit by a vehicle

- 20 mph (32 km/h): 5%
- 30 mph (50 km/h): 40%
- 40 mph (65 km/h): 80%
- 50 mph (80 km/h): 100%

Source: NHTSA 1999
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.
Safety at Roundabouts

- Pedestrian feeling of security more closely matches their actual level of safety
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
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
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!
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
# Planning Level Analysis and Space Requirements

<table>
<thead>
<tr>
<th>Roundabout Type</th>
<th>Typical Inscribed Circle Diameter</th>
<th>Typical AADT 4-leg roundabouts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-lane</td>
<td>120 – 160 ft</td>
<td>Less than 25,000</td>
</tr>
<tr>
<td>Multilane (2-lane entry)</td>
<td>160 – 200 ft</td>
<td>25,000 to 45,000</td>
</tr>
</tbody>
</table>
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.
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
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
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

FDOT Preferred Software
SIDRA
Standard Mode
EF = 1.1 (Design Year)
Questions

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