October 28-29, 2025
Orlando, FL

TRANSPORTATION SYMPOSIUM

Multilane Roundabout Design

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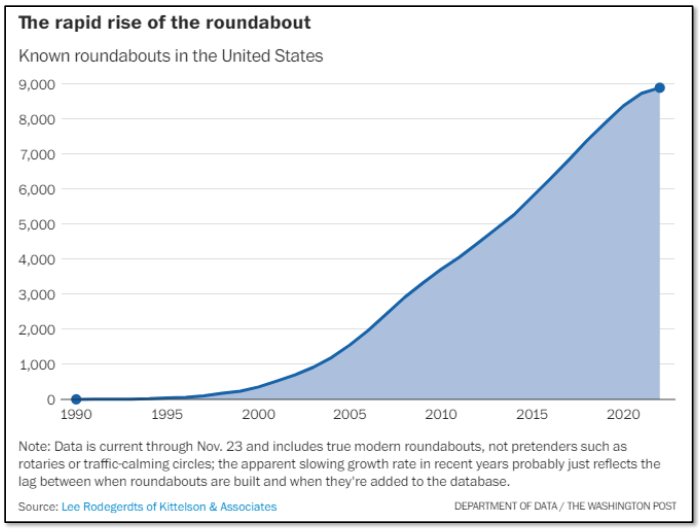
Transportation Symposium Website
SCAN ME

1

Introduction



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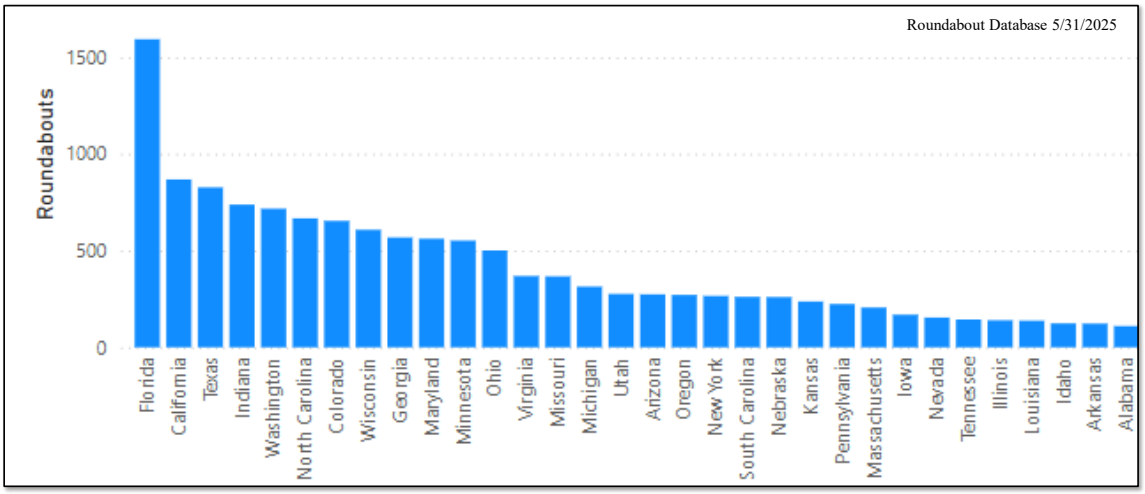

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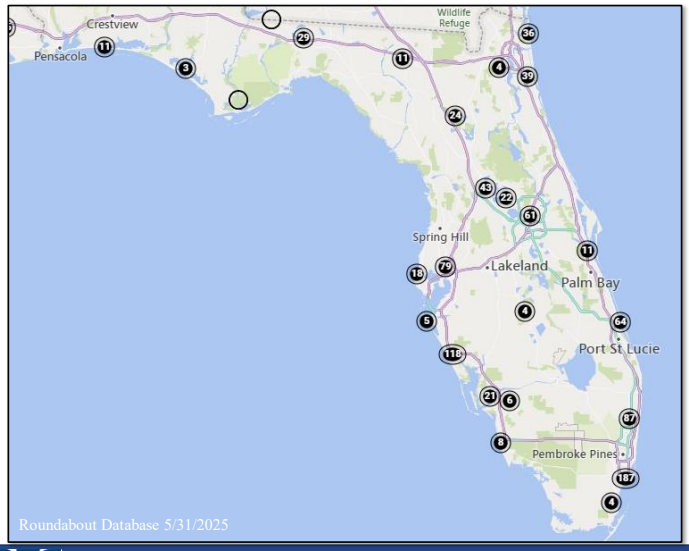

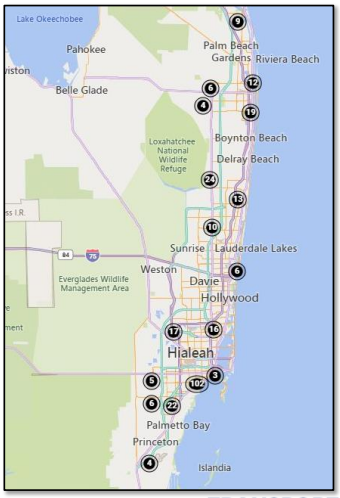

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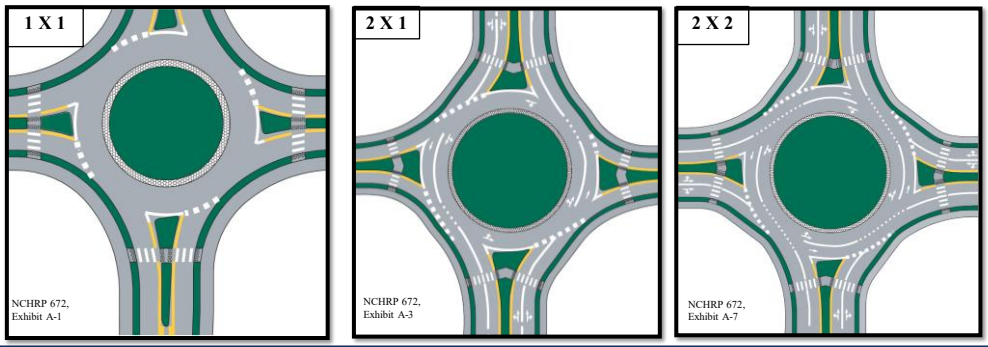
Roundabouts on Florida SHS

- Only single-lane and two-lane modern roundabouts
- Partial three-lane roundabouts may be acceptable under certain conditions



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Roundabouts Review

FDM 116 Alternative Intersection and Interchange Review

- All proposed Alternative Intersection and Interchange designs require a detailed review early and throughout the design process
- Configurations subject to this detailed review:
  - **Roundabout**
  - Median U-Turn (MUT)
  - Restricted Crossing U-Turn (RCUT)
  - Jug Handle
  - Displaced Left Turn
  - Continuous Green-T
  - Quadrant Roadway
  - Diverging Diamond Interchange (DDI)
- With Phase I submittal and designate a representative of the State Roadway Design Office as a Lead Reviewer in the ERC

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Safe System Approach

- Humans make mistakes
- Human body is vulnerable
- Design to ensure that if crashes do occur, they do not result in series human injury

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Benefits of Roundabouts

- Reduction in injury and fatal crashes
- Severe angle and turning movement collisions are avoidable!

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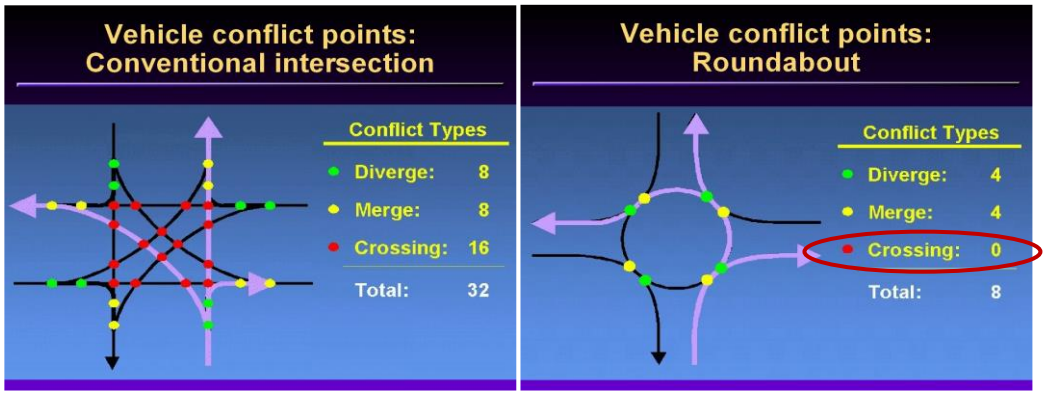
Benefits of Roundabouts

Safety Comparison – Signals vs. Roundabouts



- Crashes of this type are more severe

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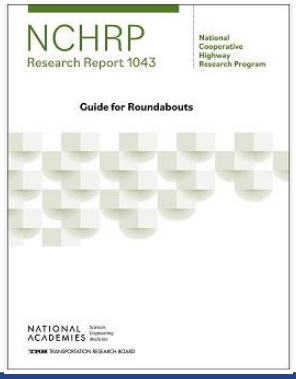
Design Guides

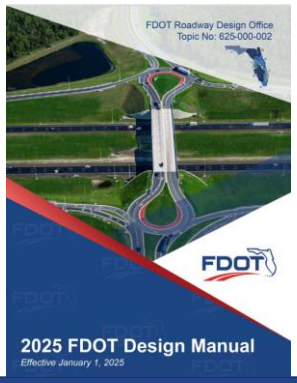
National Roundabout Guidelines

NCHRP 1043 – Guide for Roundabouts (released in 2023)



FDOT Design Manual

FDM 213 Modern Roundabouts (January 1, 2025)



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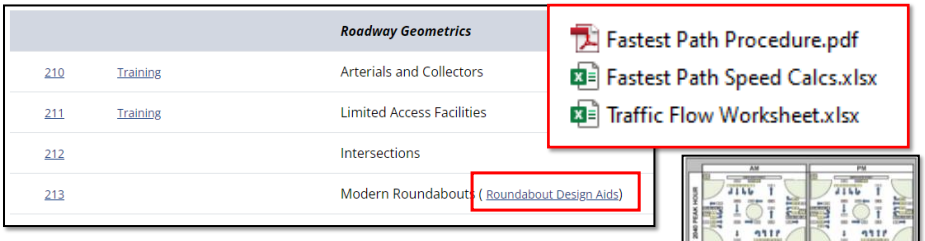
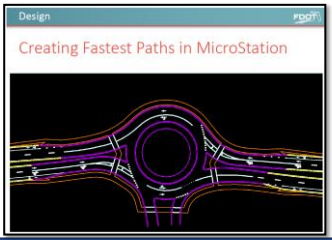
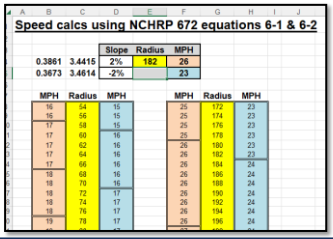
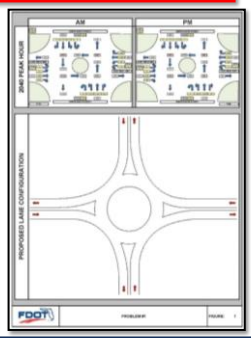
Design Guides

FDM 213 Modern Roundabouts









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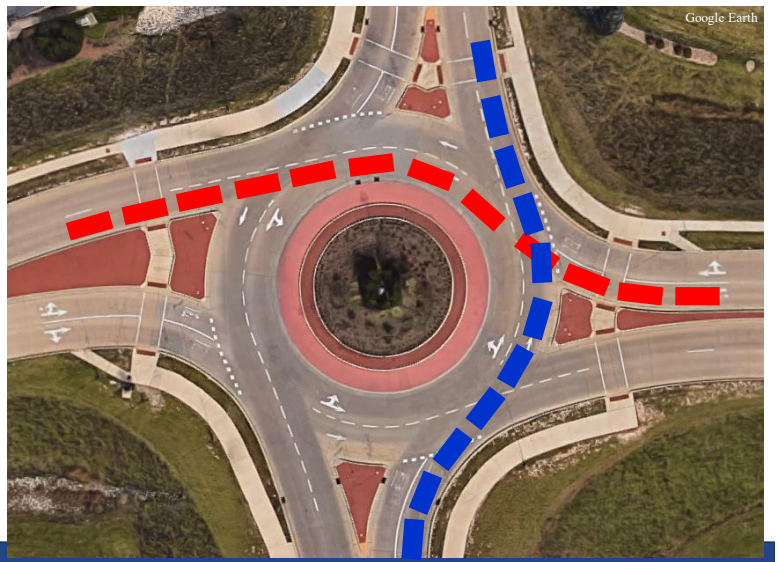
Roundabout Operation

- A roundabout brings together:
  - Conflicting traffic streams at reduced speeds
  - Allowing streams to safely cross paths
  - Traverse the roundabout and exit



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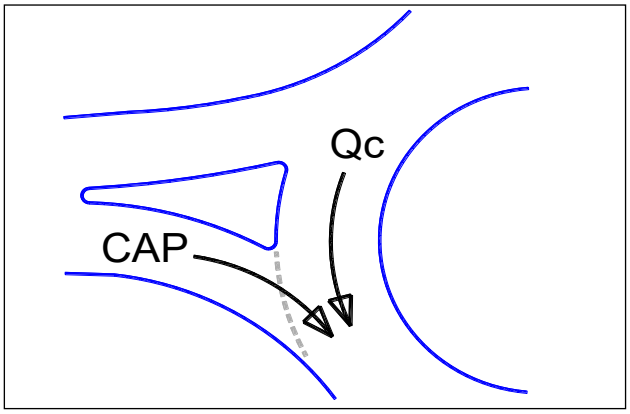
Roundabout Capacity

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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Estimated Capacity Limits

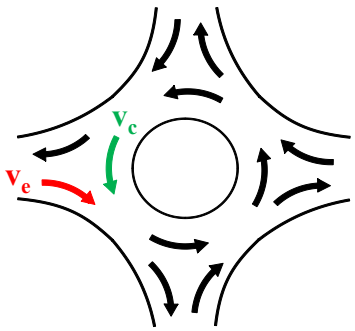
The sum of entering (V_e) plus circulating (V_c) traffic at each entry point

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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Analysis Software

Roundabouts to be analyzed with ***HCM procedures*** using one of two FDOT approved analysis tools

HCS

- ✓ 1 or 2 lane entries
- ✓ 1 lane partial right bypass
- ✓ Up to 4 approach legs

SIDRA HCM Mode

- ✓ 1 or 2 lane entries
- ✓ 1 or 2 lane partial right bypass
- ✓ Up to 8 approach legs

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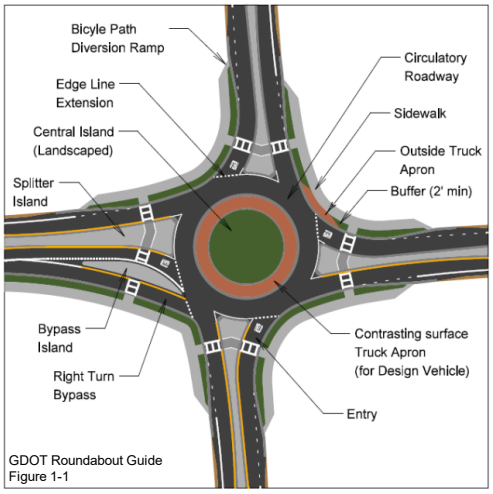
Design Overview

- The geometric design of a roundabout requires the balancing of competing design interests
- The process may require a considerable amount of iteration
- Roundabouts operate most safely when their geometry positively guides traffic to enter and circulate at slow speeds
- Poor roundabout geometry has been found to negatively impact roundabout operations



GDOT Roundabout Guide
Figure 1-1

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Principals and Objectives

1. Design to make the driving task as simple as possible
2. Slow entry speeds and consistent speeds through the roundabout by using deflection
3. Appropriate number of lanes and lane assignment to achieve adequate capacity, lane volume balance, and lane continuity
4. Smooth channelization that is intuitive to drivers and results in vehicles naturally using the intended lanes
5. Adequate accommodations for design vehicles
6. Meet the needs of pedestrians and bicyclists
7. Appropriate sight distance and visibility

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Speed Management

- Achieving appropriate vehicular speeds for entering and traveling through the roundabout is a ***critical*** design objective
  - Profound impact on safety of all users
  - Easier to use and more comfortable for pedestrians and bicyclists
- A well-designed roundabout reduces vehicle speeds upon entry and achieves consistency in the relative speeds between conflicting traffic streams

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Speed Management

- Operating speed is widely recognized as one of the most important attributes in terms of safety performance, in general:
  - Frequency of crashes is most directly tied to volume
  - Severity of crashes is most directly tied to speed
- Maximum entering design speeds based on theoretical fastest path:
  - **Single-lane = <u>20-25 mph</u>**
  - **Multilane = <u>25-30 mph</u>**

<u>Slower is better!</u>

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Assessing Vehicle Paths (Fast Paths)

- The fastest path allowed by the geometry determines the negotiation speed for that particular movement
- It is the smoothest, flattest path possible for a single vehicle, in the absence of other traffic and ignoring all lane markings, traversing through the entry, around the central island, and out the exit
- Typically, the critical fastest path is the through movement, but in some situations it maybe a right turn

Does not represent expected vehicle speeds, but rather theoretical attainable speeds for design purposes

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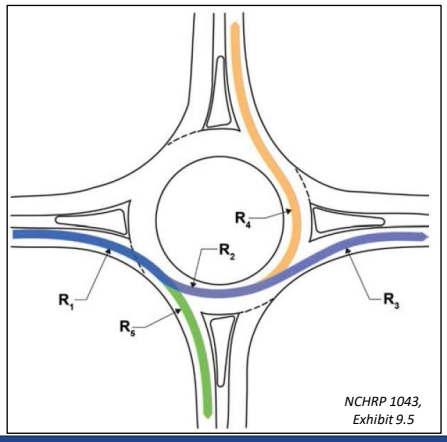
Assessing Vehicle Paths (Fast Paths)

See NCHRP 1043 Chapter 9.4 and FDM 213.6 for guidance on constructing fastest paths

Radius	Description
R_1 – Entry Path Radius	The minimum radius on the fastest through path prior to the yield line. *(This is not the same as Entry Radius.)*
R_2 – Circulating Path Radius	The minimum radius on the fastest through path around the central island.
R_3 – Exit Path Radius	The minimum radius on the fastest through path into the exit.
R_4 – Left-turn Path Radius	The minimum radius on the path of the conflicting left-turn movement.
R_5 – Right-turn Path Radius	The minimum radius on the fastest path of a right-turning vehicle.



NCHRP 1043, Exhibit 9.5

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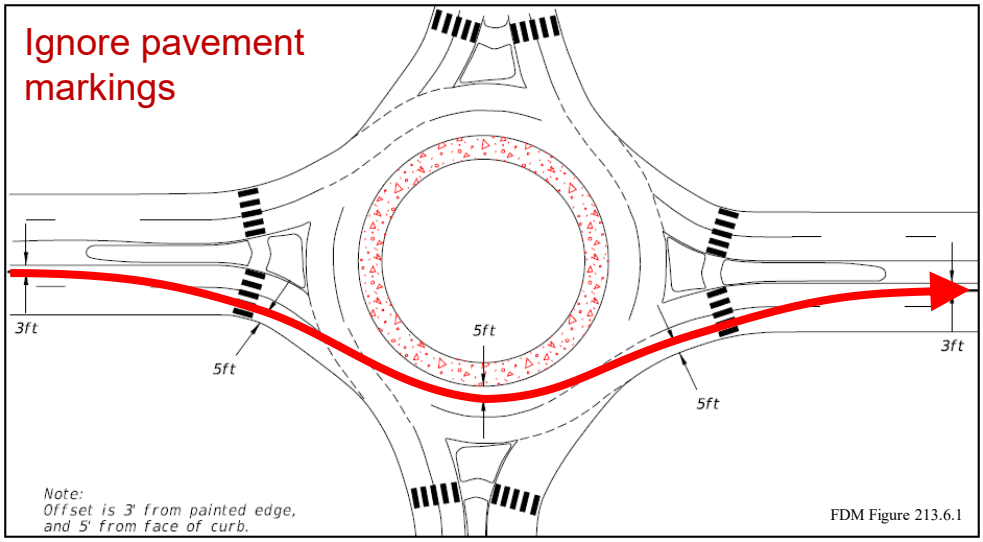
Fastest Path Through Movement - Multilane



FDM Figure 213.6.1

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Assessing Vehicle Paths (Fast Paths)

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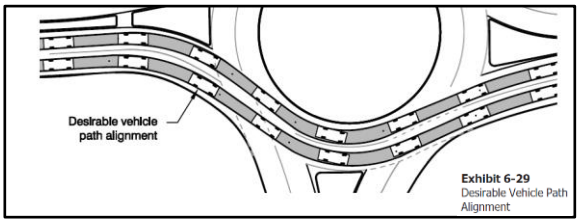
Multilane Roundabouts

- Principles and design process described previously apply to multilane roundabouts but in a more complex way
- Multiple traffic streams may enter, circulate through, and exit the roundabout side-by-side
- Designer needs to consider how these traffic streams interact with each other



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Multilane Roundabouts

- Geometry should provide adequate alignment and establish appropriate lane configurations for vehicles in adjacent entry lanes to be able to negotiate the roundabout geometry without competing for the same space
  - ✓ *If not, operational and/or safety deficiencies may occur*

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Multilane Roundabouts

- Additional key considerations for all multilane roundabouts:
  - ➢Lane arrangements to allow drivers to select the appropriate lane on entry and navigate through the roundabout without changing lanes
  - ➢Alignment of vehicles at the entrance line into the correct lane within the circulatory roadway
  - ➢Accommodation of side-by-side vehicles through the roundabout
  - ➢Alignment of legs to prevent exiting-circulating conflicts
  - ➢Accommodations for all travel modes

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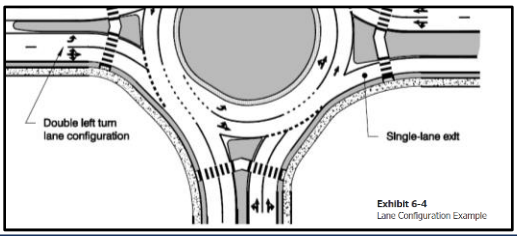
Lane Arrangement

- Ensure that the design provides the appropriate number of lanes within the circulatory roadway and on each exit to ensure lane continuity
- Movements assigned to each entering lane are key to the overall design
- Pavement markings are integral to the preliminary design process



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Inscribed Circle Diameter (ICD)

For initial section of ICD, the design vehicle and context of location should be taken into consideration

- Urban location
  - Typically, lower speeds with right-of-way constraints
- Rural location
  - Typically, higher speeds with larger vehicles

Roundabout Type	Typical Inscribed Circle Diameter
Single-lane	120 – 160 ft
Multilane (2-lane entry)	160 – 200 ft

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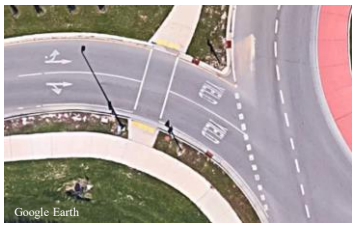
Entry Width

- Required width is dependent upon the number of lanes and the design vehicle
- Typical width for a two-lane entry ranges from 24’ to 30’
- Typical widths for individual lanes at entry range from 12’ to 15’
- Typical widths with painted gore:
  - Entry lanes = 11’ to 12’
  - Gore = 4’ to 6’

Use painted gores when providing in lane truck accommodations!



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Entry Design

- The entry curvature should balance the competing objectives of:
  - ✓ Speed control
  - ✓ Design vehicle accommodations
  - ✓ Adequate alignment of natural paths
  - ✓ Need for appropriate visibility lines
- Multilane entry radii commonly
  - 75 to 120 feet

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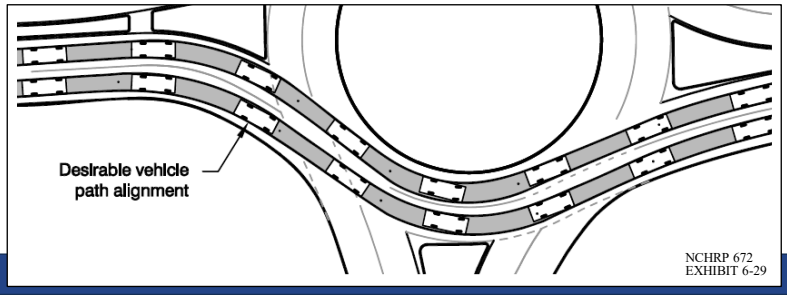
Path Overlap

- Designing multilane roundabouts is significantly more complex than single-lane roundabouts due to the additional conflicts present with multiple traffic streams in adjacent lanes:
  - Entering, Circulating, Exiting
- The *natural path* of a vehicle is the path it will take based on the speed and orientation imposed by the roundabout geometry



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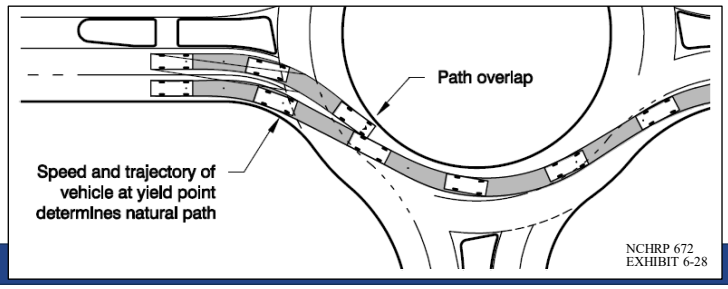
Path Overlap

- Path overlap occurs when the natural paths of vehicles in adjacent lanes overlap or cross one another
- The entry design should align vehicles into the appropriate lane within the circulatory roadway
- A good design balances entry speed and path alignment
- Common on entries, but also can occur on exits



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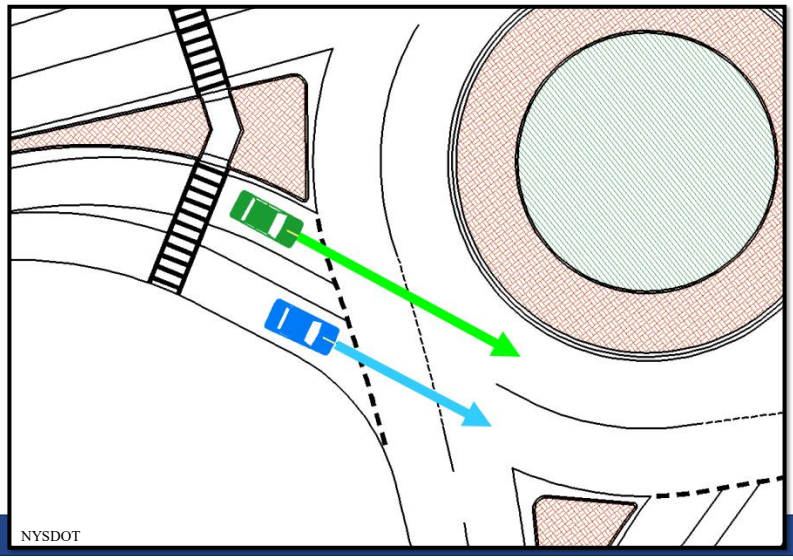
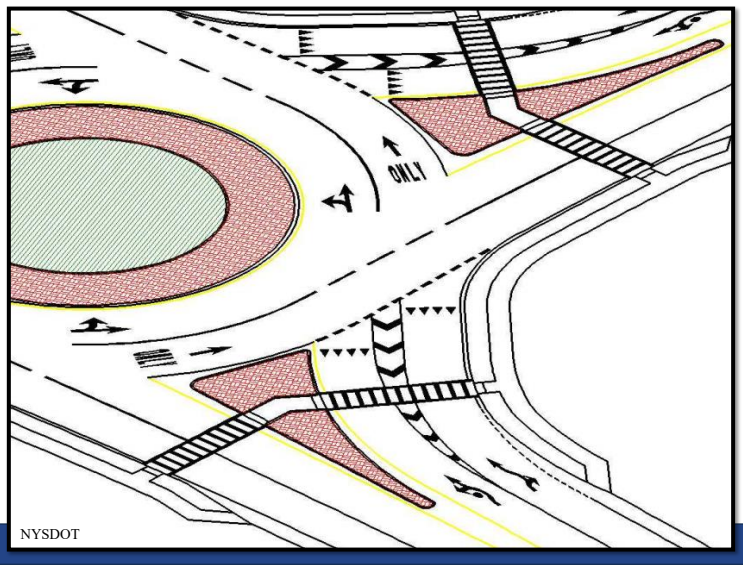
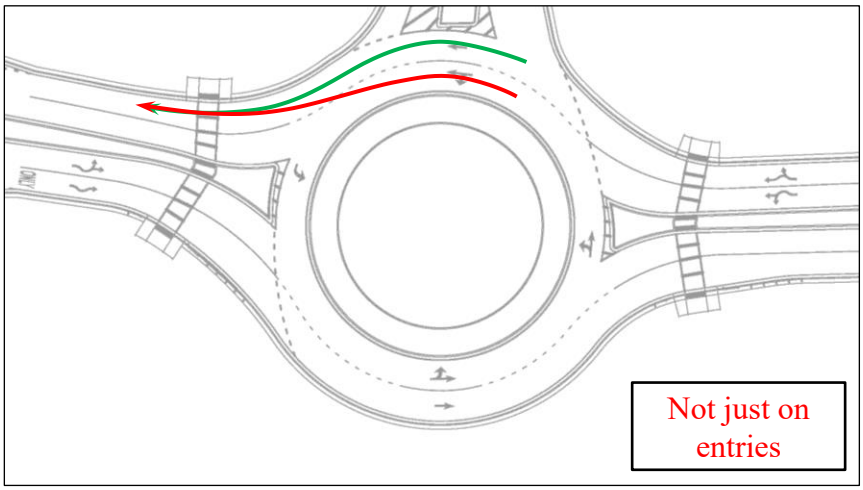
Path Overlap



Path Overlap



Path Overlap



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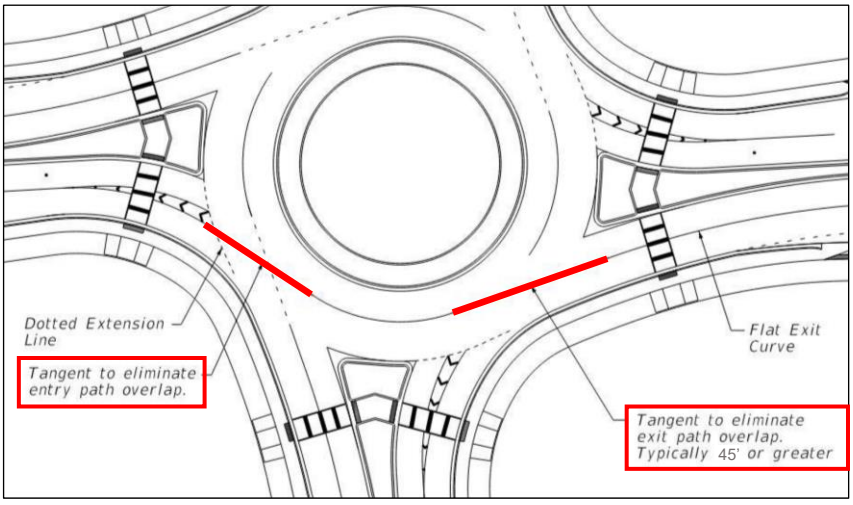
Path Overlap



FDM Figure 213.4.1 Tangents for Path Overlap

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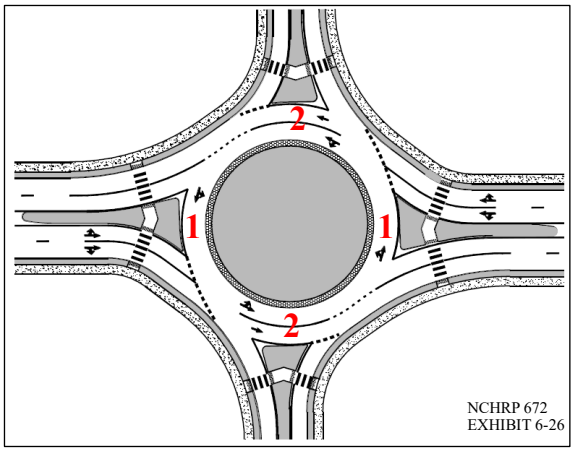
Circulatory Roadway Width

- Does not need to remain constant!
- Provide only the minimum width necessary to serve the required lane configuration
  - Major movement may have 2 lanes circulating
  - Minor may have only 1 lane



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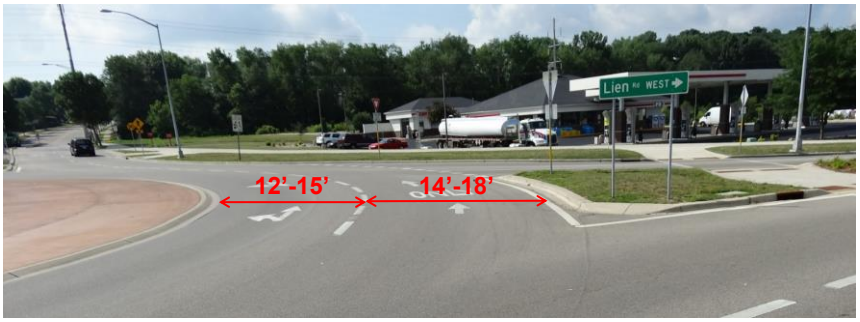
Circulatory Roadway Width

- Usually governed by the type of vehicles that need to be accommodated adjacent to one another
- Typical lane widths range from 12’ to 18’
- Typical total circulating width ranges from 28’ to 32’



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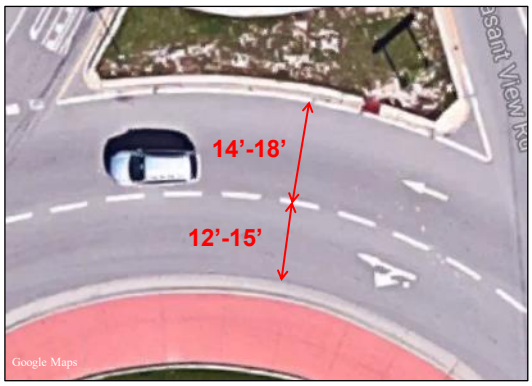
Circulatory Roadway Width

- Outside lane typically larger
  - ➢ They don't have to be 15'/15'
  - ➢ Provides additional space for larger vehicles
  - ➢ Improves entry and exit path tangents



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Design Vehicle Accommodations

- Large trucks, buses, and emergency vehicles often dictate many of the roundabout's dimensions, particularly single-lane roundabouts
- Design vehicle should be identified at the start of a project
- Design vehicle should be evaluated early in the design process

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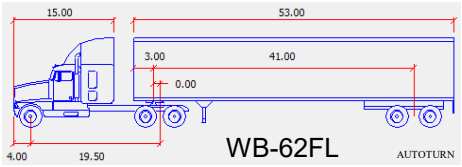
Design Vehicle Accommodations

Roundabouts on the Florida SHS:

- Desirable to accommodate a **WB-62FL** for all movements
- At a minimum accommodate:
  - ✓ **WB-62FL** for the through movement on the SHS
  - ✓ A smaller design vehicle may be appropriate for:
    - ➢ Through movements on the minor road
    - ➢ Turning movements to and from the minor road



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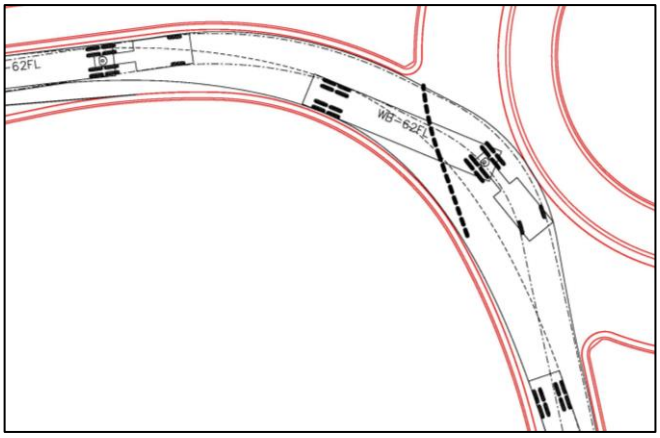
Design Vehicle Accommodations

- ✓ CAD-based computer program should be used to determine the swept path of the design vehicle through each of the turning movements
- ✓ Develop travel paths using continuous smooth alignments representative of actual travel paths



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Design Vehicle Accommodations - Multilane

- Considerations should be made for both tracking on the entry/exit and within the circulatory roadway
- Percentage of trucks and lane utilization is an important consideration
- Frequency of a particular design vehicle is also an important to consideration
- Determine whether the design will allow trucks to use two lanes or accommodate them to stay within their own lane

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Design Vehicle Accommodations - Multilane

FDOT Policy

- Provide adequate pavement area for the simultaneous passage of the design vehicle and a passenger vehicle through the roundabout and for turning movements
- Design vehicle swept paths must stay within the travel lanes
- Provide a minimum of 18-inches of clearance between curb faces and the outside edge of the design vehicles tire track

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Design Vehicle Accommodations - Multilane

FDOT Policy

- Develop swept path diagrams for all turning movements in the following combinations:
  - ✓ Design vehicle in the outside lane and passenger vehicle in the inside lane
  - ✓ Design vehicle in the inside lane and passenger vehicle in the outside lane
- *When truck volume is very low, consider allowing the design vehicle to command both lanes*

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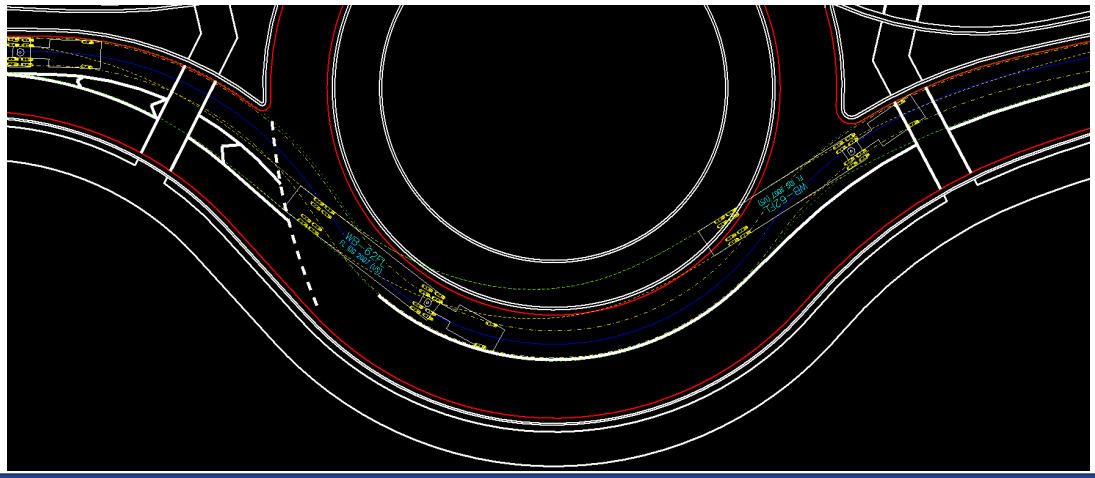
Design Vehicle Accommodations - Multilane

- Truck in left lane



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Design Vehicle Accommodations - Multilane

- Truck in right lane

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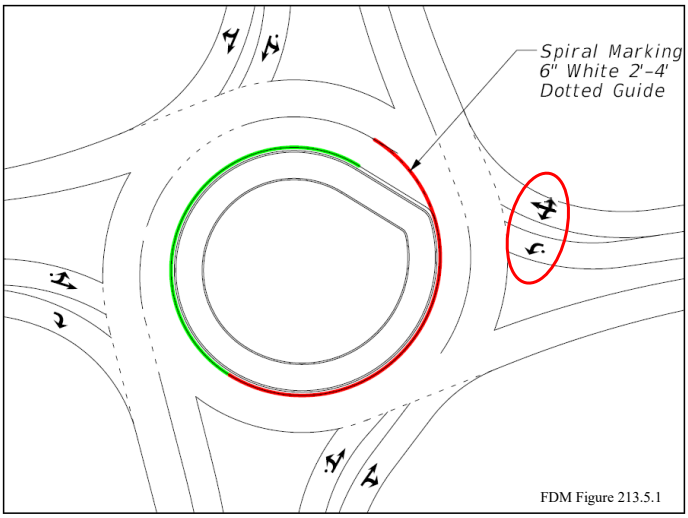
Spirals

- Typically necessary when there are exclusive left-turn lanes
- Spiral transitions lead drivers into the appropriate lane for their desired exit
- Enable vehicles to reach their intended exits <u>without needing to change lanes</u>



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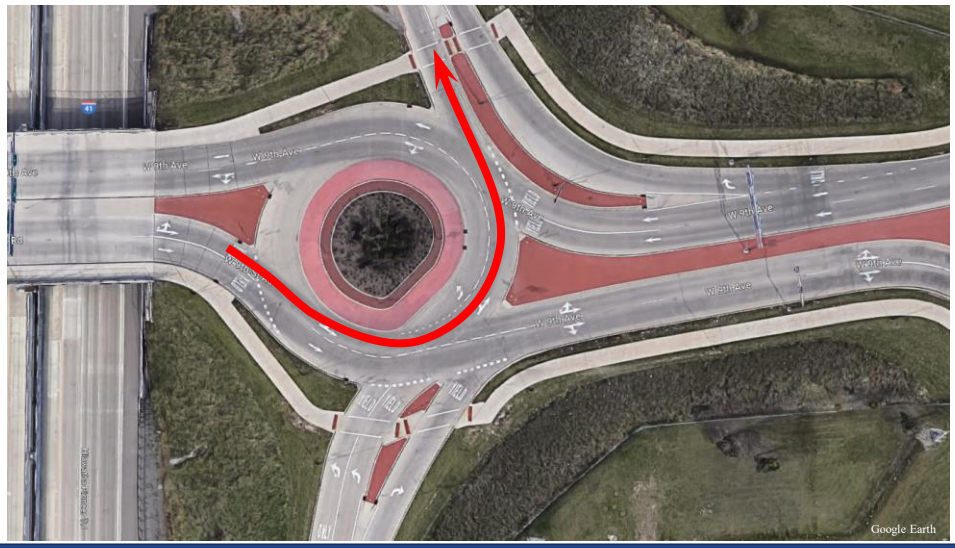
Spirals



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Exit Design

- As with the entries, the design of exit curvature is more complex at multilane roundabouts
- Conflicts can occur between exiting and circulating vehicles if appropriate lane assignments are not provided
- Exit radii are usually larger than the entry radii and are typically used to promote good vehicle path alignment
- Balanced by the need to maintain slow speeds through the pedestrian crossing on exit

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Exit Design

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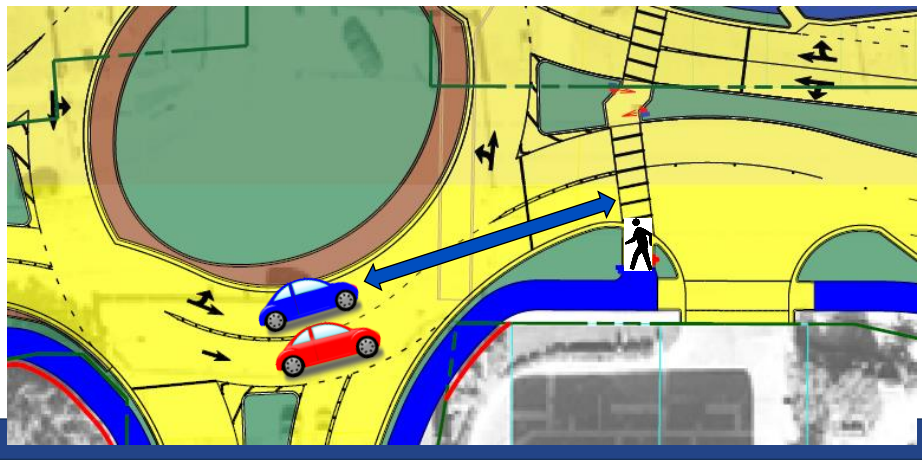
Exit Design

- Highly curved exits may shadow pedestrians from multilane exiting traffic



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Exit Design

- Highly curved exits may also have path overlap

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Exit Tapers

- Tapering the number of lanes on an exit from 2 lanes to 1 lane allows for additional capacity without excessive mid-block widening
- Roundabouts continuous flow typically results in less saturated traffic streams exiting
- Speeds are much slowing exiting roundabouts which eliminates the need for a long parallel section downstream of an exit

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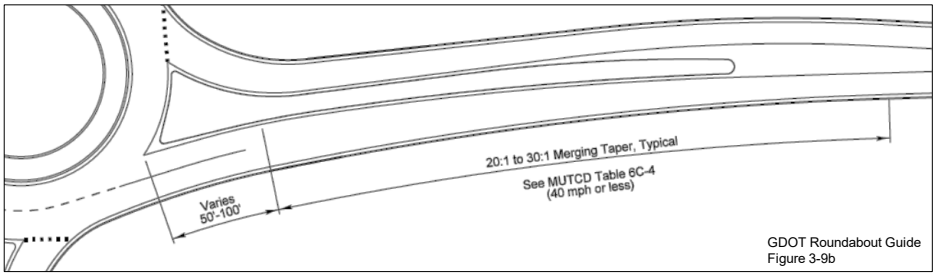
Exit Tapers

- Design exit tapers based on the anticipated in lane exiting speed, not the fastest path



GDOT Roundabout Guide
Figure 3-9b

  - The farther the full lane widths are extended downstream, the higher the speeds and need for longer merge taper

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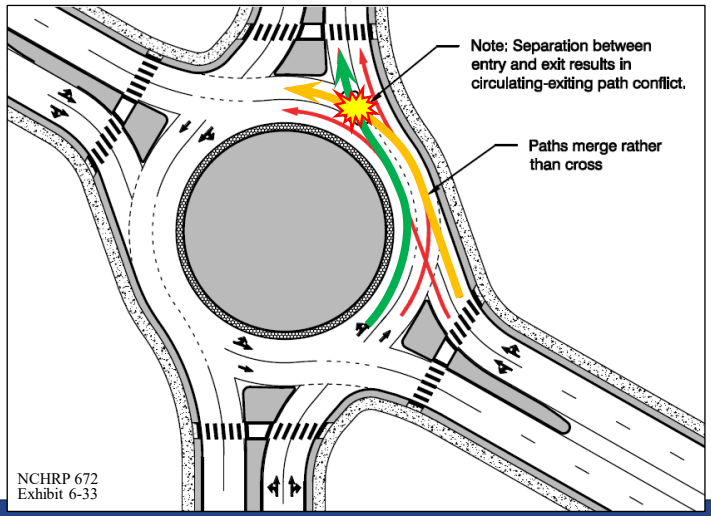
Separation between Legs



NCHRP 672
Exhibit 6-33

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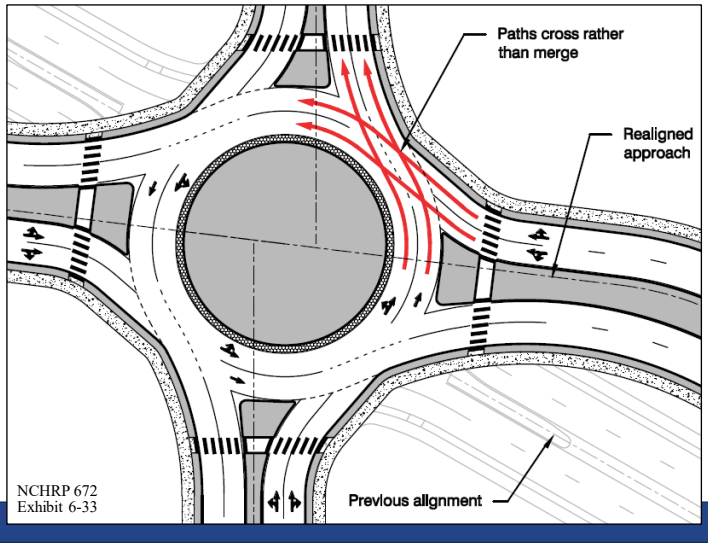
Separation between Legs



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January 2026 FDM 213 Updates

- Updated all references from NCHRP 672 to NCHRP 1043
- Updated signing and pavement markings exhibits per new MUTCD 11th edition
- Expanded guidance on high-speed approach AR2 design
- Introduced new AR2 design concept of Speed Contours
- Added additional guidance on circulatory lane widths
- Expanded guidance on the multilane roundabout design concepts of Straddle Lane and Stay-in-Lane
- Supplemental crosswalk treatments (e.g., RRFBs, PHBs, etc.) are now mandatory for multilane roundabout crosswalks

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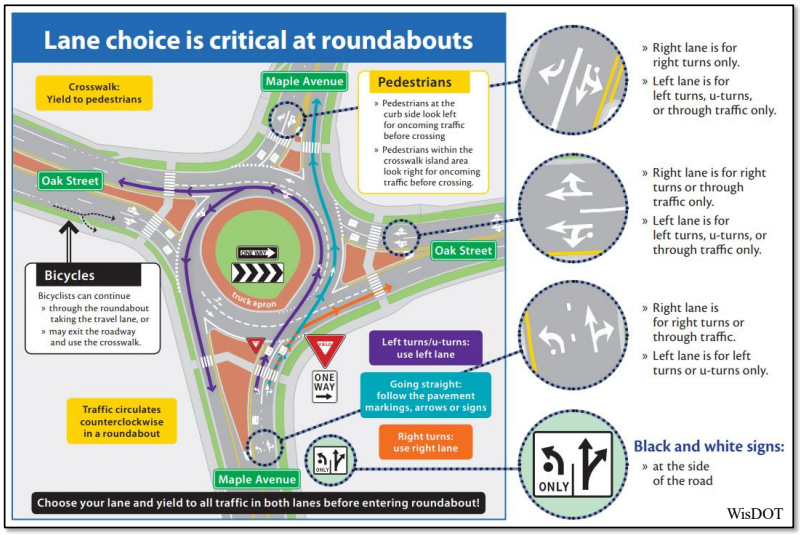
Safety Message: Driving a Roundabout

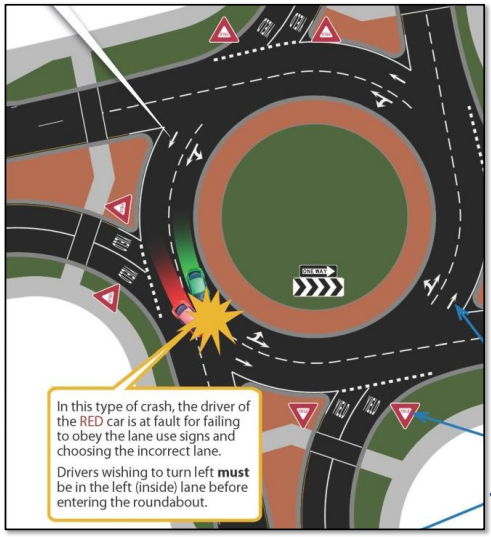
1. Slow down. Obey traffic signs.
2. Yield to pedestrians and bicyclists.
3. Yield to traffic on your left already in the roundabout.
4. Enter the roundabout when there is a safe gap in traffic.
5. Keep your speed low within the roundabout.
6. As you approach your exit, turn on your right turn signal.
7. Yield to pedestrians and bicycles as you exit.

Safety Message: Driving a Multilane Roundabout



1. Choose the proper lane before entering and stay in your lane
2. Yield to <u>all lanes</u> in the circulatory roadway
3. Yield right-of-way to large vehicles

Safety Message: Multilane Roundabout Crashes



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SCAN ME

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