213 Modern Roundabouts

213.1 General

This chapter provides design criteria for the geometric layout of modern roundabouts. The criteria contained in the FDM are supplemented by guidance provided in the ~~***National Cooperative Highway Research Program (NCHRP) Report 672, Roundabouts: An Informational Guide***~~***National Cooperative Highway Research Program (NCHRP) Report 1043, Guide for Roundabouts***.

Only single-lane and two-lane modern roundabouts are to be constructed on the SHS. Partial three-lane roundabouts may be acceptable under certain conditions.

Exhibit 213-1 illustrates the elements of a modern roundabout that are discussed in this chapter.

213.1.1 Roundabout Evaluation

Roundabout evaluation is governed by the Intersection Control Evaluation process. See the ***Intersection Control Evaluation (ICE) Manual*** for requirements at the following web address:

https://www.fdot.gov/traffic/TrafficServices/Intersection_Operations.shtm

Exhibit 213-1: Design Details

213.2 Operational Analysis

Use the methodology in the current edition of the ***Highway Capacity Manual (HCM)*** when conducting a roundabout operational analysis. Two commonly used software packages consistent with the ***HCM*** are HCS and SIDRA. When SIDRA is used, run the analysis in ***HCM*** mode to be consistent with ***HCM*** methodology. For more information on HCS and SIDRA, see the ***Traffic Analysis Handbook***.

To optimize safety and operation performance, provide only the lanes that are warranted through the traffic operational analysis. Inclusion of unwarranted approach, circulatory or bypass lanes increases complexity and conflict points. Provide roundabout designs that are simplistic and have pavement widths based on necessity.

Use 20-year design traffic volumes for roundabout design.

213.2.1 Stage Construction

Consider stage construction when traffic operational analysis indicates that a multi-lane roundabout will be required in the design year (20-year design life), but a single-lane roundabout would provide acceptable service for 10 to 15 years (1st resurfacing cycle). Having more lanes than what is warranted in the early years will have a negative effect on safety and operational performance.

When it is determined that staged construction will be utilized, develop the ultimate design first to assure all right-of-way needs for the ultimate project are identified. Then develop the initial design that allows for expansion in the future with minimal “throw-away” work.

213.3 Geometric Design

It is important to develop roadway geometry that encourages drivers to gradually slow down as they approach the roundabout. Roundabout design features that influence vehicular approach speeds include:

(1) Prominent landscaping in the central island serves to increase visibility of the central island and provides a visual queue to approaching drivers that they are entering a low-speed environment. Roadway approach geometry should work with the landscaping to limit line of sight beyond what is necessary to meet intersection sight distance requirements. See ***NCHRP Report 1043~~672~~, 9.5~~6.7.3~~*** for additional information.

(2) Raised splitter islands and roadside curb provide visual cuesques to establish a speed transition zone. Lengthening this transition zone on high-speed facilities can be an effective strategy for slowing traffic down prior to entering a roundabout.

(3) Geometric features (e.g., inscribed circle diameter (ICD), lane width, entry width, curb locations) introduce deflection and curvature into the driver's path and is the most effective way to slow vehicles down to a safe entry speed.

Typical ranges are as follows:

(a) Single-lane Roundabout ICD: 120' to 160' with 140' as a good starting point

(b) Two-lane Roundabout ICD: 160' to 200' with 180' as a good starting point

A chicane is a series of curves that requires the driver to turn slightly right and then slightly left while approaching the roundabout entry. Chicaning should not be excessive and used for the following:

- only to the extent necessary Achieve the desired speed control
- to Establish the splitter island andisland, and
- Ccreate an offset left alignment.

Left offset alignment designs are easier to balance speed control, provide design vehicle accommodations, and provide appropriate lane orientation to avoid path overlap at multilane entries compared to other design alignments.

Tangent sections are required between the approach reverse curves. For low-speed approaches provide a 50-foot minimum tangent between the first set of reverse curves (AR1 and AR2) and a 25-foot minimum tangent between the next set (AR2 and AR3). Tangent requirements for high-speed approach reverse curves are discussed in ***FDM 213.3.1***.

Tangent segments between reverse curves:

- Provide a smooth natural path for drivers
- Improve the alignment of the approach with the receiving circulatory roadway
- Aid and assist truck drivers in navigating the roundabout

Tangent segments between reverse curves are required for high-speed approaches as discussed in ***FDM 213.3.1***. For low-speed approaches, 50-foot desirable and 25-foot minimum tangent segments are required between reverse curves (i.e., avoid back-to-back reverse curves).

213.3.1 High-Speed Approach Geometry

Exhibit 213-2 illustrates the Department's desired geometry for a high-speed two-lane undivided highway approaching a single-lane roundabout. High-speed approach geometry uses a series of three curves upstream of the roundabout with successively smaller radii separated by tangent segments. The general approach demonstrated can be applied to high-speed two-lane roundabouts as well.

The approach roadway alignment contains three curves labeled AR1, AR2, and AR3. The Department criteria for minimum curve length on open roadway (400 feet) does not apply within the functional area of the intersection. See ***FDM 212.4*** for more information on intersection functional area.

Progressively smaller curves can be used for AR1, AR2, and AR3 when the approach roadway alignment is heavily curved.

AR1

The first curve encountered by the driver as they approach the roundabout is AR1. This curve to the right has the largest radius of the three and is intended to alert the driver that they are approaching a roundabout and need to slow down. This curve also initiates separation between the opposing traffic lanes allowing for the development of the splitter island. The PC of AR1 demarks the area of influence of the intersection. The radius of AR1 is based on the design speed of the approach leg and is determined by using ***AASHTO Greenbook 2011 Equation 3-8***. Assuming normal crown, the superelevation rate (e_{max}) is 2%. Side friction factors are dependent on speed and are determined using ***AASHTO Greenbook 2011 Figure 3-6***.

AR1 is typically not necessary for divided highway approaches because separation between opposing traffic lanes is already established.

AR2

The second curve approaching the roundabout is AR2. This curve to the left aligns the approach roadway centerline to the left of the roundabout center (offset left). An offset left design allows for proper deflection and speed control. When entering AR2, it is assumed that the driver has decelerated 15-20 mph from their approach speed.

Since the curve is to the left and the roadway cross slope is normal crown, the superelevation rate used to establish AR2 is (-)2%.

AR3

The final curve entering the roundabout is AR3. This curve to the right guides the driver into the circulatory roadway. The outer radius of the curve helps control entry speeds and is ~~The AR3 radius is~~ typically between 6~~7~~5 and 100 feet. The inside radius of the curve can be larger since it doesn't affect speed control but influences truck swept paths. ~~and is determined through the fastest path analysis.~~ At this point, it is assumed that the driver has decelerated to an operating speed between 20 and 25 mph.

Tangent Segments

Provide a tangent segment between AR1 and AR2 not less than 100 feet. Provide a tangent segment between AR2 and AR3 not less than 50 feet.

Exhibit 213-2: High Speed Approach Detail

213.3.2 Alignment of Approach Lane

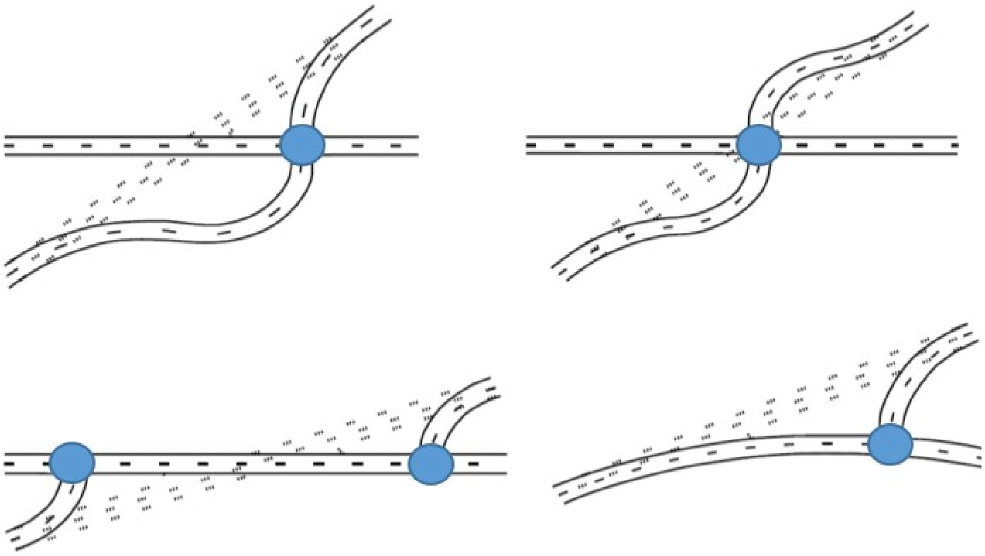
The alignment of the approach affects the amount of deflection (speed control) that is achieved, the ability to accommodate the design vehicle, and the visibility angles to adjacent legs. The optimal alignment is generally governed by the size and position of the roundabout relative to its approaches.

An offset left alignment is typically preferred as it increases the deflection achieved at the entry. This makes it easier to balance speed control, design vehicle accommodations, and provide appropriate lane alignment to avoid path overlap at multilane entries.~~to improve speed control and is easier to remove path overlap for multi-lane entries.~~

213.3.3 Angle Between Approach Legs

The intersection angle between two roadways has a significant influence on the geometrics and operation of a roundabout. Intersection angles are to be as close to 90 degrees as practical. Consider realigning the approach legs of minor roads when the intersection angle is less than 75 degrees. ***Figure 213.3.1*** illustrates realignment configurations.

Figure 213.3.1 Realignment Configurations



213.3.4 Roadway Profiles

The profile grade of the roadways carried through the influence area of the intersection should be as flat as practical to allow the circulatory roadway pavement to slope to the outside. See ***FDM 213.3.7*** for cross slope requirements.

213.3.5 Splitter Islands

Splitter islands generally extend upstream of the yield line to the point at which entering drivers are expected to begin decelerating comfortably. ***Exhibit 213-1*** provides details for splitter islands. Splitter islands are to use Type E curb and gutter or Type I traffic separator.

Locate the crosswalk approximately 20 feet upstream from the yield line. The minimum width for the raised splitter island at crosswalks is 6 feet (between curb faces). The minimum crosswalk width in the splitter island is 10 feet. These dimensions ensure the provision of a pedestrian refuge area within the splitter island.

The minimum length of the splitter island is based on the design speed of the approach leg as follows:

- 50 feet for design speeds of 35 mph or less; 100 feet is desirable
- 100 feet for design speeds of 45 mph or less

- 200 feet for design speeds of 50 mph or greater

Extend the splitter island beyond the PT of the exit curve to discourage exiting traffic from crossing into the path of approaching traffic.

213.3.6 Approach Roadway Width

The width of the roadway at locations with curb on both sides needs to accommodate the design vehicle and be a minimum 15 feet from curb face to curb face.

213.3.7 Circulatory Roadway

The width of the circulatory roadway is determined from the number of entry lanes and the turning requirements of the design vehicle. Provide only the minimum width necessary to serve the required lane configuration. A common range for the overall width of the circulatory roadway is 28 feet to 32 feet. This tTypically accommodates a bus's turning movement without the use of the truck apron.without use of the truck apron.

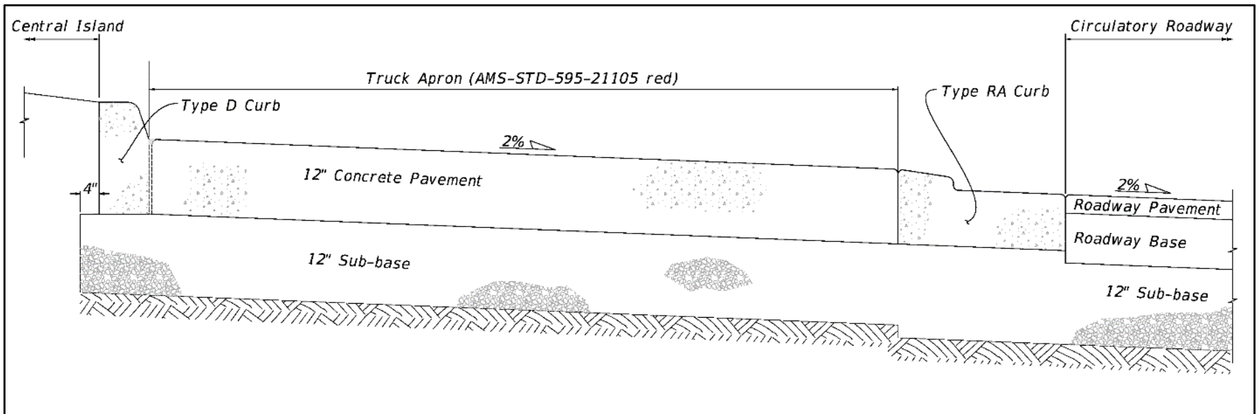
Circulatory roadway lane widths of multi-lane roundabouts do not need to be consistent and are typically range from 12 feet to 18 feet wide. The outside lane is typically larger to provide additional space for the design vehicle and to reduce entry and exit path overlap. For example, a 30 foot wide multilane circulatory roadway could have an inside lane between 12 feet and 14 feet wide and a corresponding outside lane width of 16 feet to 18 feet.

Slope the circulatory roadway away from the central island at 2%, 1% minimum.

213.3.8 Truck Apron

Use the standard truck apron design illustrated in ***Figure 213.3.2***. Indicate in the plans that the roundabout truck apron is to be red in color that closely matches AMS-STD-595-21105 red.

Figure 213.3.2 Standard Truck Apron Design

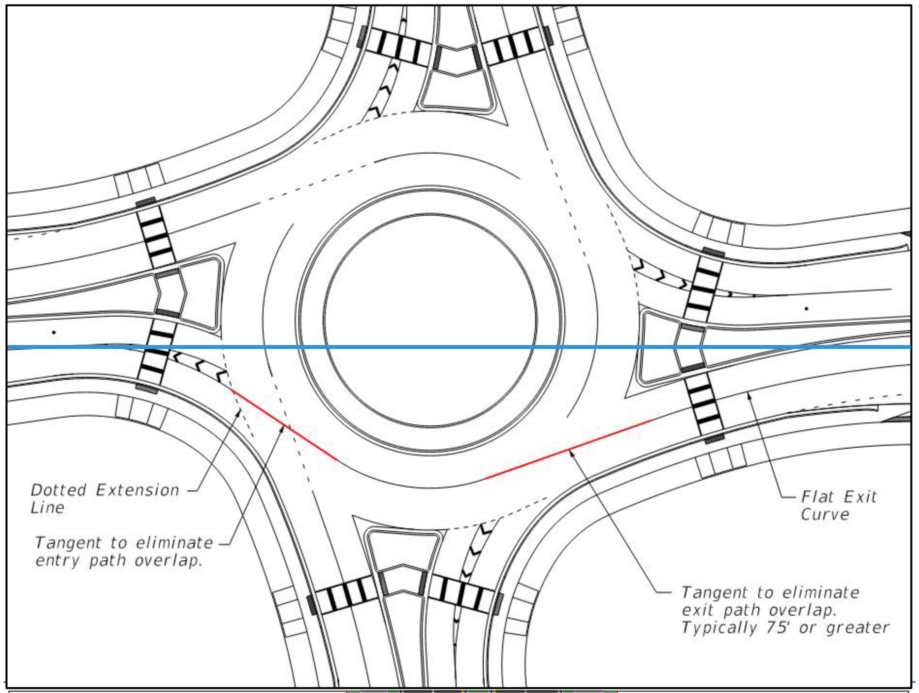


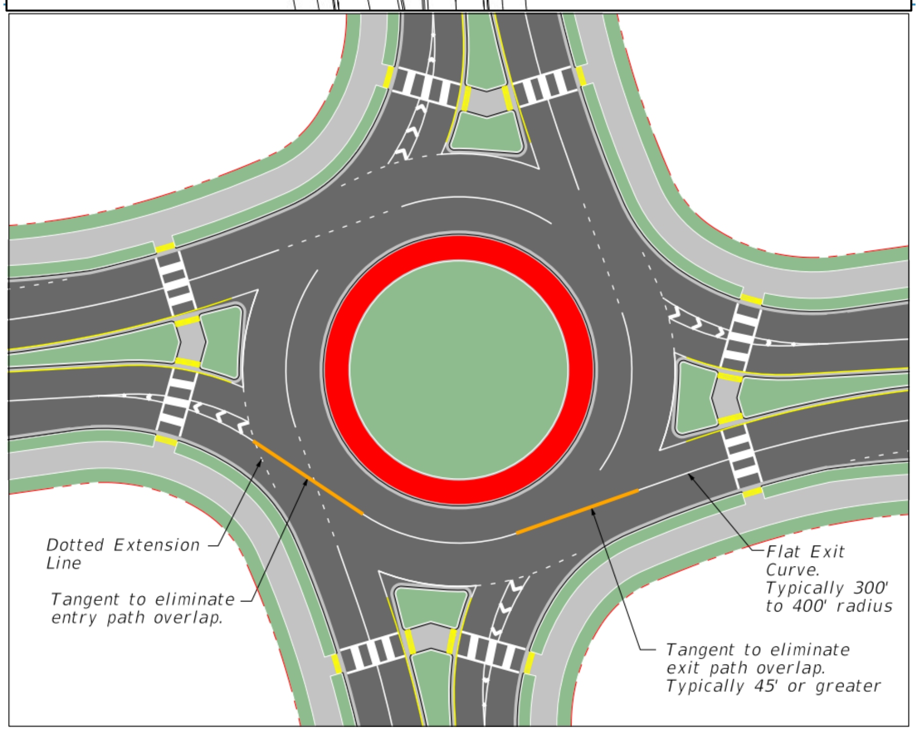
213.4 Path Overlap

The natural path of a vehicle is the path it will take based on the speed and orientation imposed by the roundabout geometry. Path overlap on multi-lane roundabouts occurs when the natural paths of vehicles in adjacent lanes overlap or cross one another; i.e., geometry leads vehicles into the wrong lane. It occurs at entries where the geometry of the right-hand lane tends to lead vehicles into the left-hand circulatory lane. Aligning the approach lanes with the receiving lanes in the circulatory roadway helps drivers maintain their natural trajectory upon entry and significantly reduces the potential for path overlap. To reduce path overlap at multi-lane entries, provide a tangent segment between the right-hand entry lane and the circulatory roadway as shown in ***Figure 213.4.1***. Extend the tangent segment beyond the dotted extension line at the entry to assure proper alignment of vehicles prior to entering the circulatory roadway.

Path overlap can also occur at multi-lane exits where the geometry or pavement markings tend to lead vehicles from the left-hand circulatory lane into the right-hand exit lane. To reduce path overlap at multi-lane exits, provide a tangent segment between the circulatory roadway and receiving lane as shown in ***Figure 213.4.1***. Providing a flat exit radius also helps drivers maintain their natural trajectory upon exiting and significantly reduces the potential for path overlap. The potential for increased speeds associated with a flatter exit design should be considered when crosswalks are provided.

Figure 213.4.1 Tangents for Path Overlap





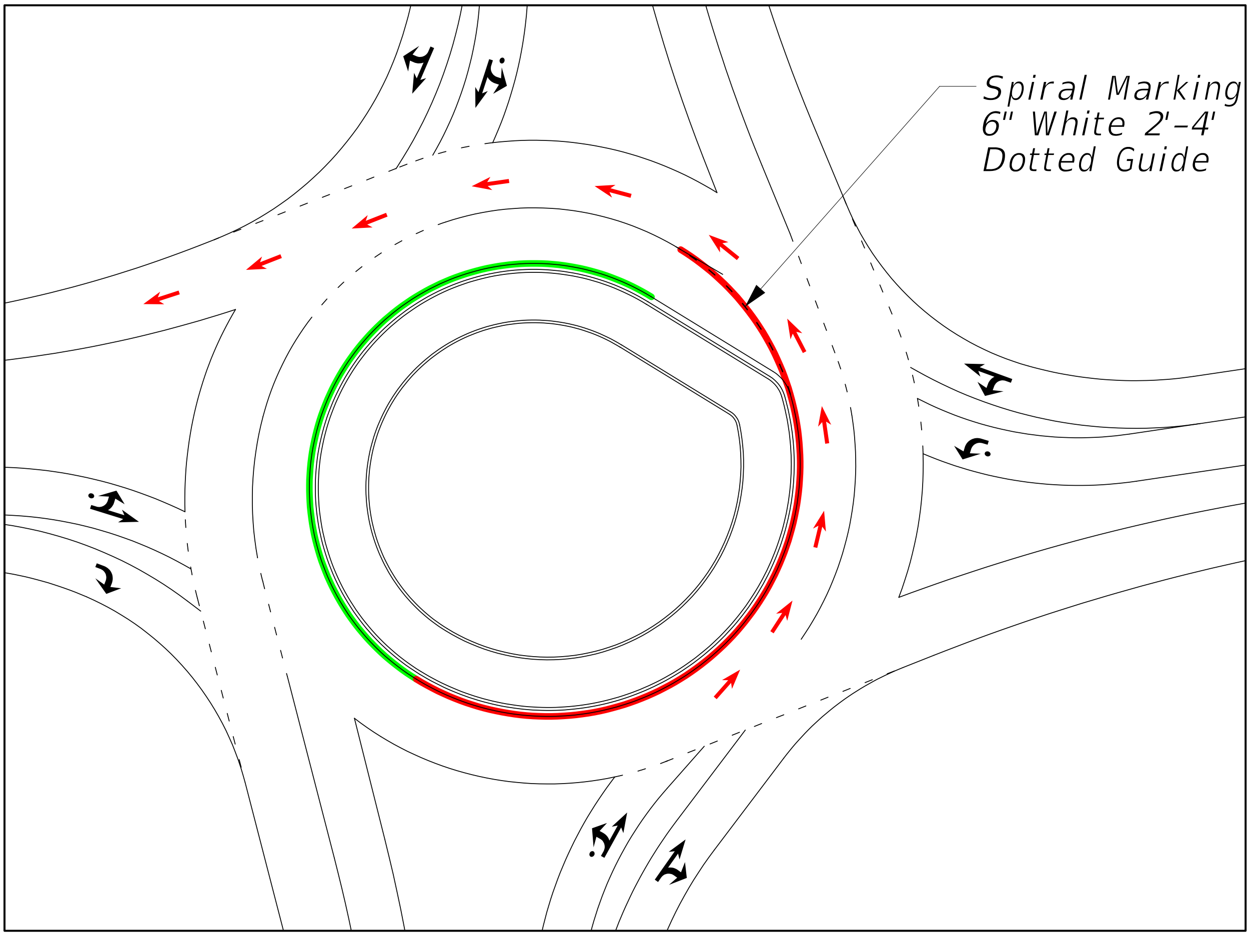
213.5 Spiral Transitions

Spiral transitions are necessary for multi-lane roundabouts when the lane configuration includes exclusive left-turn lanes. Spiral transitions are used to guide drivers into the appropriate lane for their desired exit. Drivers that enter the roundabout on the inside lane are pushed to the outside lane allowing them access to their desired exit without the need for a lane change. The inclusion of exclusive left-turn lanes and transition spirals complicate the design and should only be provided if warranted through traffic operational analysis.

Figure 213.5.1 illustrates the inclusion of a spiral transition with a lane configuration that includes two circulatory lanes and a single exit lane. The spiral geometry is developed by connecting two semi-circles with different diameters as indicated by the green and red arcs. The smaller diameter (green) represents the inside edge of travel lane adjacent to the truck apron and the larger diameter (red) is equal to the smaller diameter plus the width of the inside travel lane. The spiral transition allows for the left-turning movement as indicated by the red arrows. Also shown in the figure is the required spiral transition pavement marking.

The central island should be developed (shaped) using curb to enforce the spiral geometry. The use of striping to create the spiral geometry should be avoided.

Figure 213.5.1 Spiral Transition

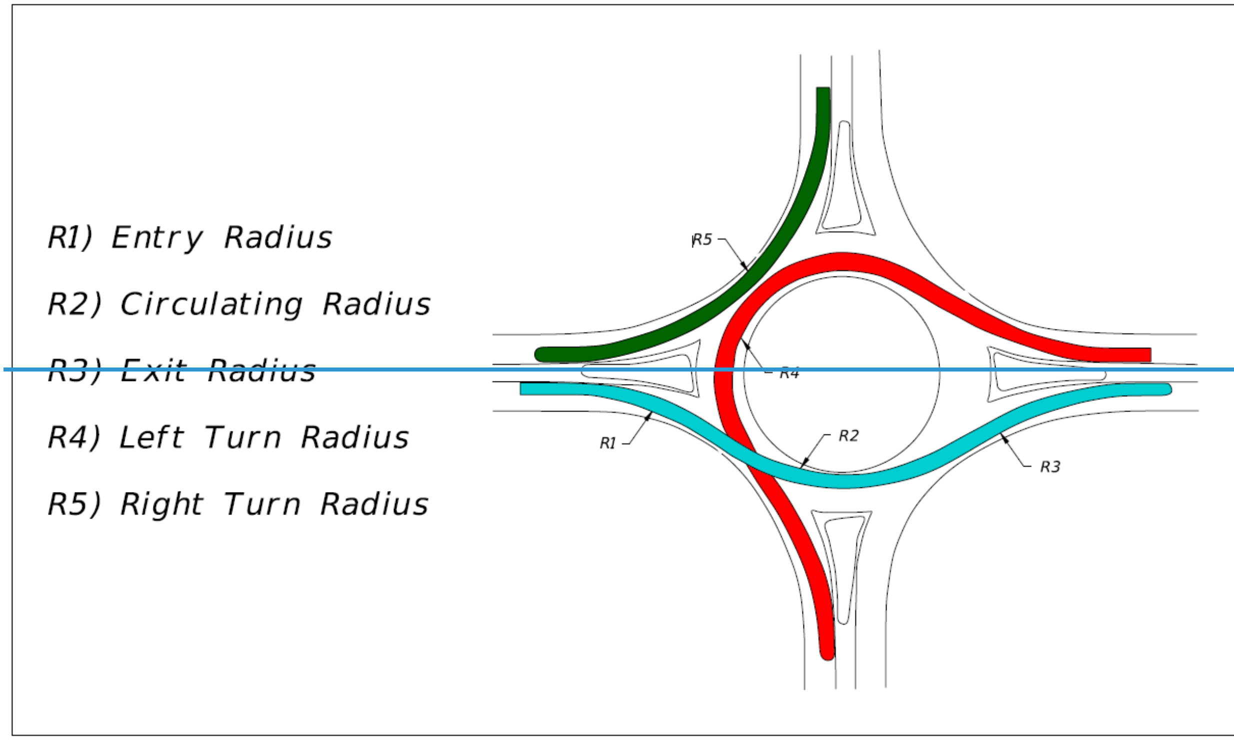


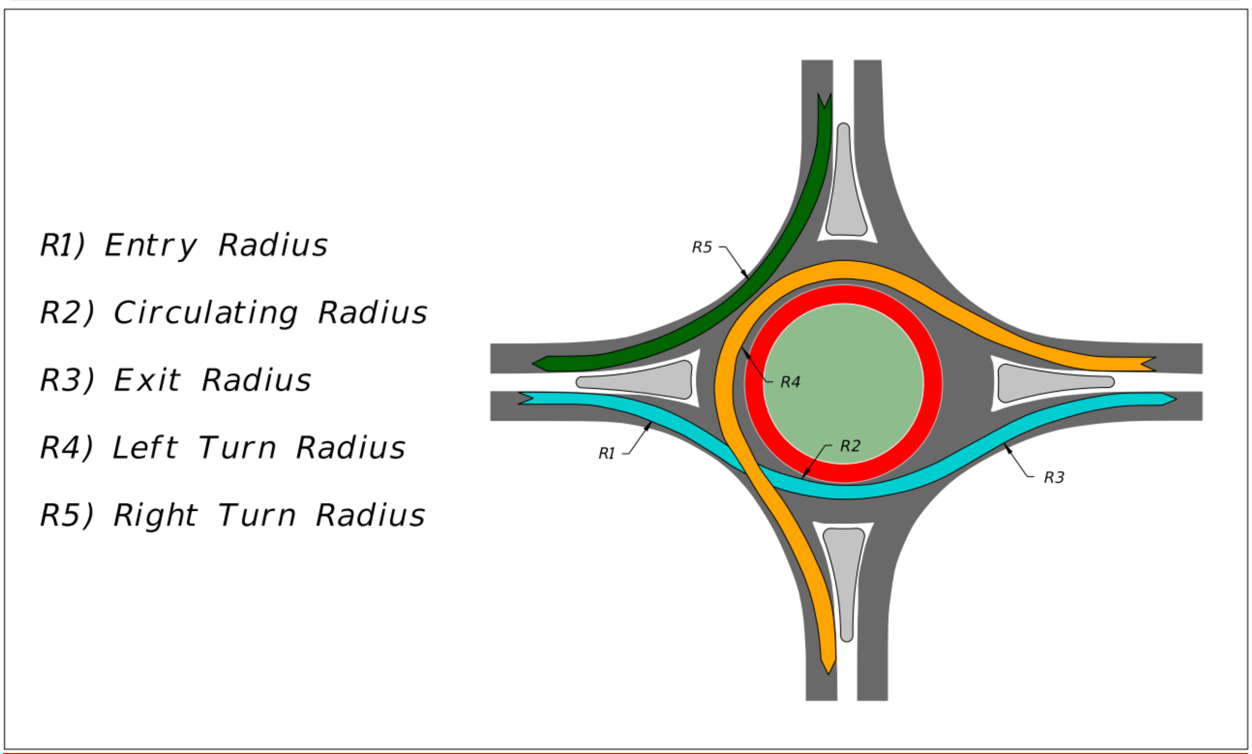
213.6 Fastest Path

Controlling speeds for vehicles entering and traveling through roundabouts is a critical design objective that significantly impacts the safety and comfort of all users. A well-designed roundabout reduces vehicle speeds upon entry and encourages consistency in the relative speeds between conflicting traffic streams. The effectiveness of speed control within a roundabout can be determined by conducting a fastest path performance check.

The fastest path is defined as the radius (R1, R2, R3, R4, and R5) that provides the smoothest and flattest path possible for a single vehicle (assumed 6 feet wide) traversing the roundabout. The fastest path does not consider lane markings when determining vehicle path; i.e., drivers will run over striping and use all available pavement. Fastest path movements are shown in ***Figure 213.6.1*** and are as follows:

Figure 213.6.1 Fastest Path Curves



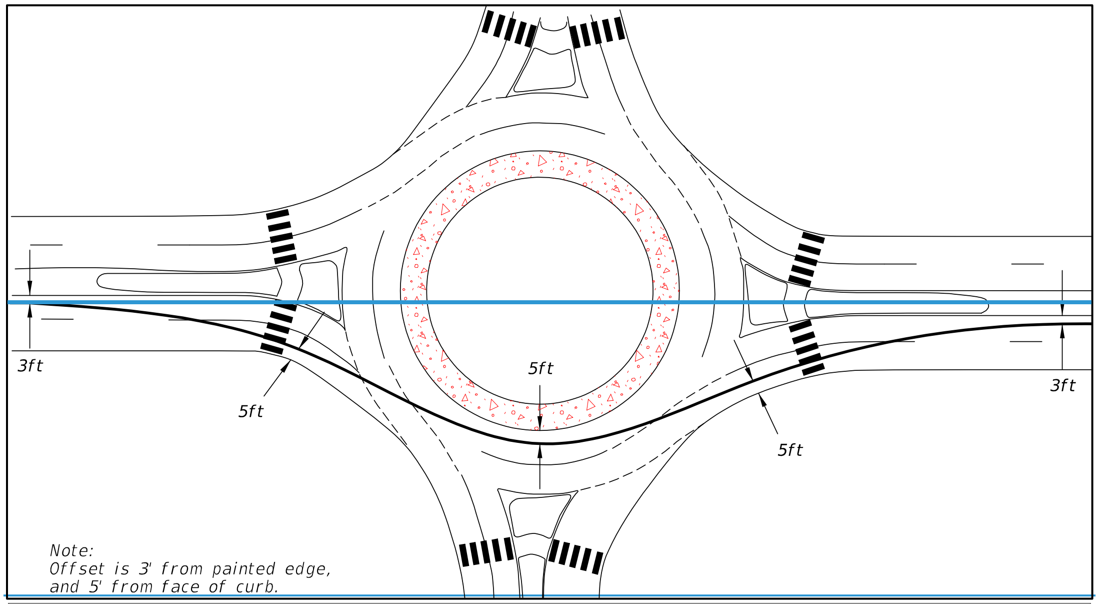


Fastest path speeds must adhere to the following:

- R1 and R5 entry speeds are not to exceed 25 mph for single-lane entries and 30 mph for multi-lane entries.
- R2 and R4 circulating speeds should be no more than 15 mph less than the entry speed and speed differentials within 10 mph are desired.
- R3 exit speeds require engineering judgement to balance the competing objectives of accommodating the design vehicle and providing a safe environment for pedestrians using the crosswalk. Where exit speeds are expected to be above 30 mph, supplemental treatments may be needed for the crosswalks.

The fastest path for the through movement (R1, R2, and R3) is illustrated in ***Figure 213.6.2***. The fastest path for the right-turn movement (R5) is illustrated in ***Figure 213.6.3***. The centerline of the vehicle path is drawn with a 5-foot offset from face of curb, or a 3-foot offset from the painted edge line.

Figure 213.6.2 Fastest Path for Through Movement



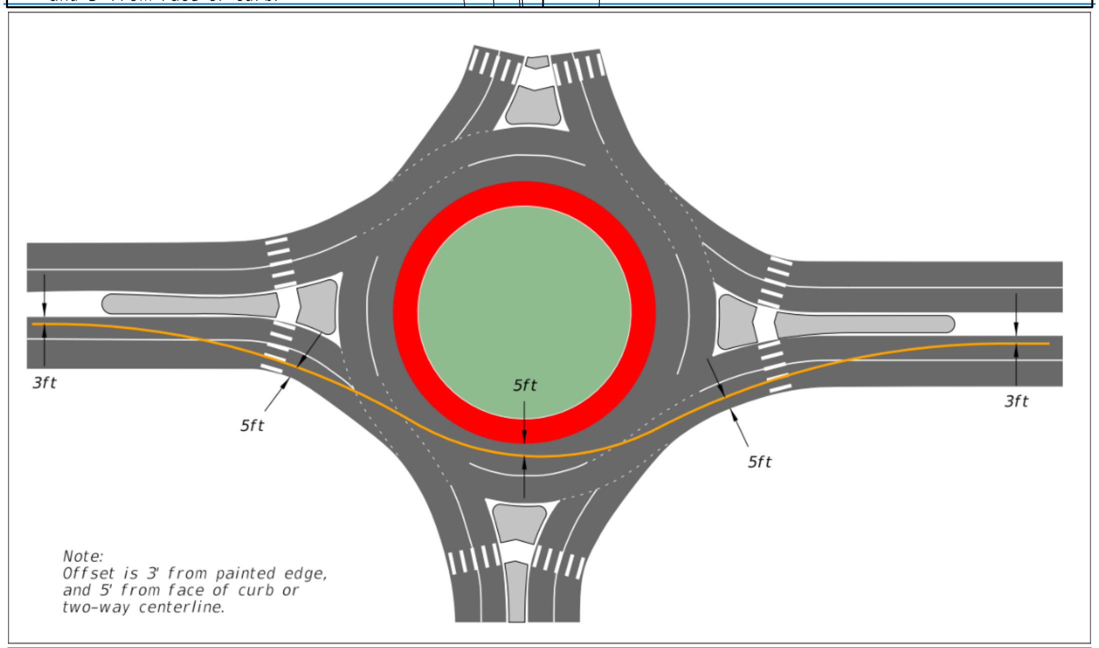
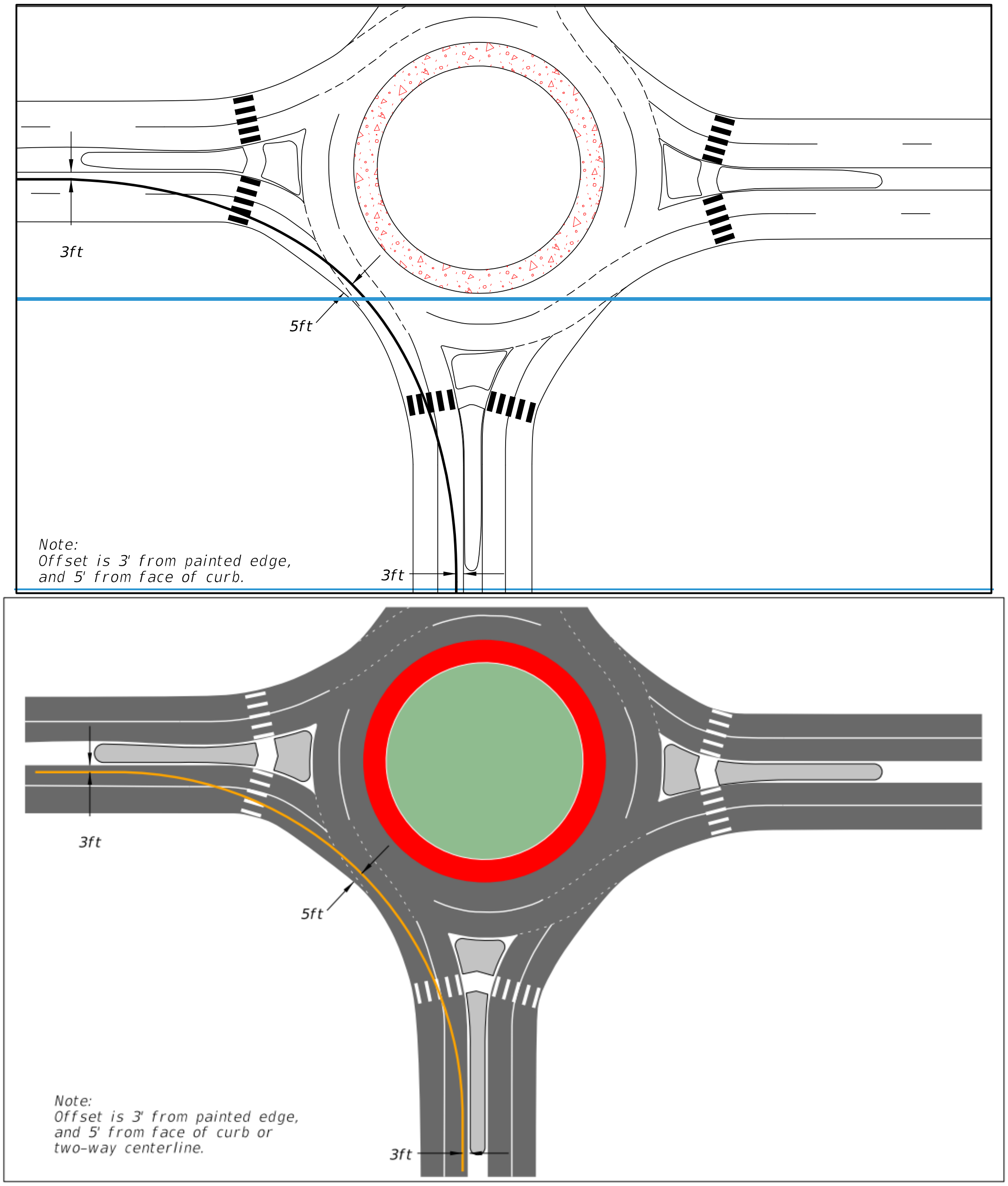


Figure 213.6.3 Fastest Path for Right-Turn Movement



213.6.1 Fastest Path Methodology

A CADD-based procedure for conducting fastest path analysis has been adopted by the Department and can be downloaded from the ***FDM*** web page. For consistency, this step-by-step procedure should be followed when determining R1, R2, R3, R4, and R5.

For intersections that are generally perpendicular, the R5 fastest path could be measured using a simple 3-point arc tangent to the curb offsets.

Calculated speeds for R1, R3 and R5 are based on NCHRP 1043~~672~~ equation 6-1 with a pavement cross slope of (+)2%.

Calculated speeds for R2 and R4 are based on NCHRP 1043~~672~~ equation 6-2 with a pavement cross slope of (-)2%.

A spreadsheet has been developed to assist with these calculations and can be downloaded from the ***FDM*** web page.

213.7 Design Vehicle Accommodation (Swept Path)

Roundabouts on the SHS typically accommodate a WB-62FL design vehicle for the through movements. A smaller design vehicle may be appropriate for turning movements connecting off-system roads. See ***FDM 201.6*** for additional information on design vehicle.

Swept path diagrams assure that there is adequate pavement to accommodate the maneuvers of the design vehicle through the roundabout without over-tracking the curb. AUTOTURN is a CADD-based vehicle turning path program that is often used to determine the swept path of the design vehicle.

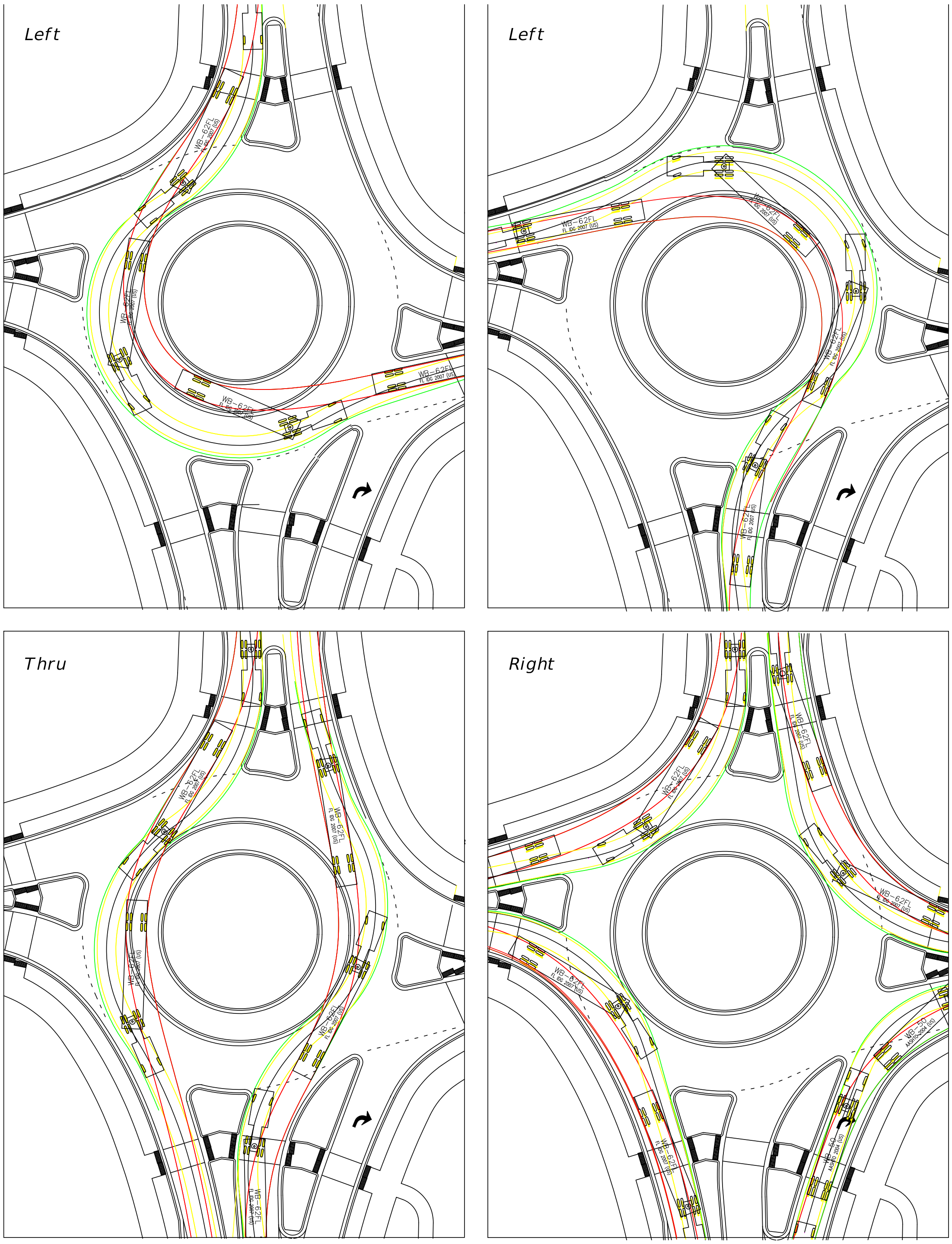
Provide swept path diagrams for the design vehicle for all turning movements. Develop travel paths using continuous smooth spline curve alignments representative of travel paths experienced in the field.

Provide a minimum 1.5-foot offset from the face of curb to the design vehicle's tire track.

213.7.1 Single-Lane Roundabout

The swept path design vehicle is required to stay within the travel lane and is prohibited from encroaching onto the splitter island, central island, or outside gutter pans. The truck trailer is permitted to mount the RA curb and use the truck apron. In very constrained conditions, truck apron can be utilized for design vehicle accommodations on the splitter islands and outside curbing. ***Figure 213.7.1*** illustrates WB-62FL design vehicle swept paths for a single-lane roundabout.

Figure 213.7.1 WB-62FL Swept Paths: Single-Lane Roundabout



213.7.2 Two-Lane Roundabout

Provide adequate pavement area for the simultaneous passage of the design vehicle and a passenger vehicle through the roundabout and for turning movements. The design vehicle must stay within the travel lanes without encroaching onto the inside or outside gutters. The truck trailer is permitted to mount the RA curb and use the truck apron. 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

It is acceptable for the design vehicle path to encroach into the adjacent travel lane within the circulatory roadway when there is sufficient space for the passenger vehicle plus two feet of clearance between the two vehicles.

213.7.2.1 Straddle Lane Design

When truck volumes are ≤ 2,000 AADT, consider using this design.

This design assumes the design vehicle uses the entire curb-to-curb width for entering, circulating, and exiting plus the truck apron as needed. Align each entering vehicle with its receiving lane and provide a clear line of sight toward conflicting vehicles.

Provide an entry width for a multilane straddle design between 24 feet to 30 feet for a two-lane entry.

213.7.2.2 Stay-In-Lane Design

Stay-in-lane design is preferred on four lane facilities because it can be harder for the design vehicle to use the entire curb-to-curb width to navigate the roundabout.

Use a painted gore when providing in-lane truck accommodations on multi-lane entries. Typical multi-lane approaches include two 12-foot lanes separated by a 6 to 7-foot painted gore, as shown in ***Exhibit 213-1***.

~~When truck volumes are very low, consider allowing the truck-trailer to command both lanes to complete the maneuver.~~

213.7.3 Exit Radius

An exit radius of 300 to 400 feet should be provided to create a smoother vehicular path and better truck accommodation. Use engineering judgement to balance the competing objectives of accommodating the design vehicle and providing a safe environment for pedestrians. Provide flat exit geometry when no pedestrian facilities are present.

213.8 Bicycle and Pedestrian Accommodation

Exhibit 213-1 provides standard details for pedestrian and bicycle facilities.

213.8.1 Pedestrian Facilities

When there are existing or planned pedestrian facilities on the approach roadways, the following requirements apply:

(1) Provide sidewalk widths in accordance with ***FDM 222,*** or consistent with the approach sidewalk widths. When bicycle ramps are provided, the desired sidewalk width is 10 feet, but not less than 8 feet.

(2) A 5-foot setback from the back of curb to the sidewalk is desired; typically not less than 2 feet.

(3) Provide crosswalks at every approach leg.

- (a) Provide curb ramps and detectable warning surfaces consistent with ***FDM 222*** and ***Standard Plans, Index 522-002***.
- (b) Orient crosswalks perpendicular to the roadway to minimize pedestrian crossing distance.
- (c) Provide a pedestrian refuge area within the splitter island meeting the requirements of ***FDM 213.3.5***.
- (d) Provide pedestrian crosswalk lighting in accordance with ***FDM 231***.

213.8.2 Bicycle Facilities

There are several types of on-road and physically separated bicycle facilities available to accommodate bicycle travel as discussed in ***FDM 223***. The following paragraphs outline the requirements for bicycle facilities at roundabouts.

On-road bicycle facilities: On-road bicycle facilities include bicycle lanes and paved shoulders. Terminate on-road bicycle facilities at the upstream end of the roundabout and resume them at the downstream end as shown in ***Figure 213.10.1***. Locate termination points close to the roundabout where vehicular speeds are slow. Provide physically separated bicycle facilities with bike ramps at multi-lane roundabouts. This allows cyclists the option to either use the physically separated facility to cross the intersection or enter the travel lane and use the circulatory roadway to cross. Physically separated bike facilities with bike ramps are optional for single-lane roundabouts.

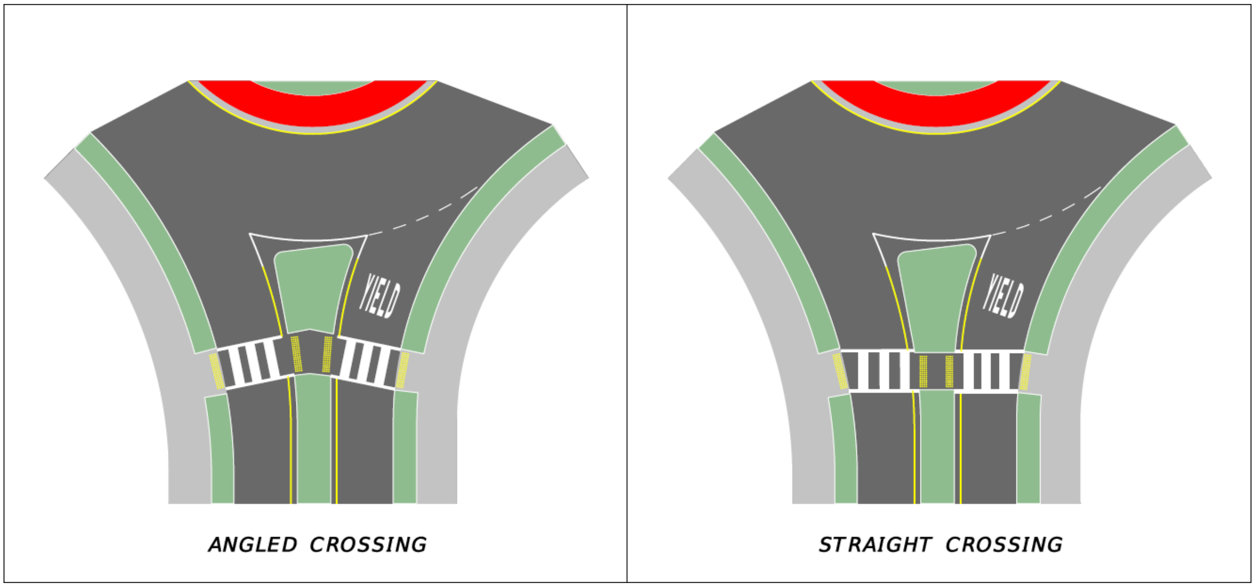
Physically separated bicycle facilities: Physically separated bicycle facilities include separated bike lanes, sidewalk level separated bike lanes, and shared use paths. Physically separated facilities should be continuous around the intersection, parallel to the curb line and follow the contours of the circular intersection. ***Figure 213.10.1*** shows a typical design for a separated bike lane. Details for sidewalk level separated bike lanes and shared use paths are similar. Separation techniques for physically separated bicycle facilities are covered in ***FDM 223***. Provide bike ramps at multi-lane roundabouts to allow cyclists on the roadway the option to use the physically separated bike facility to cross the intersection or to stay on the roadway and use the circulatory roadway to cross. Bike ramps are optional for single-lane roundabouts.

Design bike ramps in accordance with ***FDM 223.2.5***.

213.8.3 Pedestrian Crossings

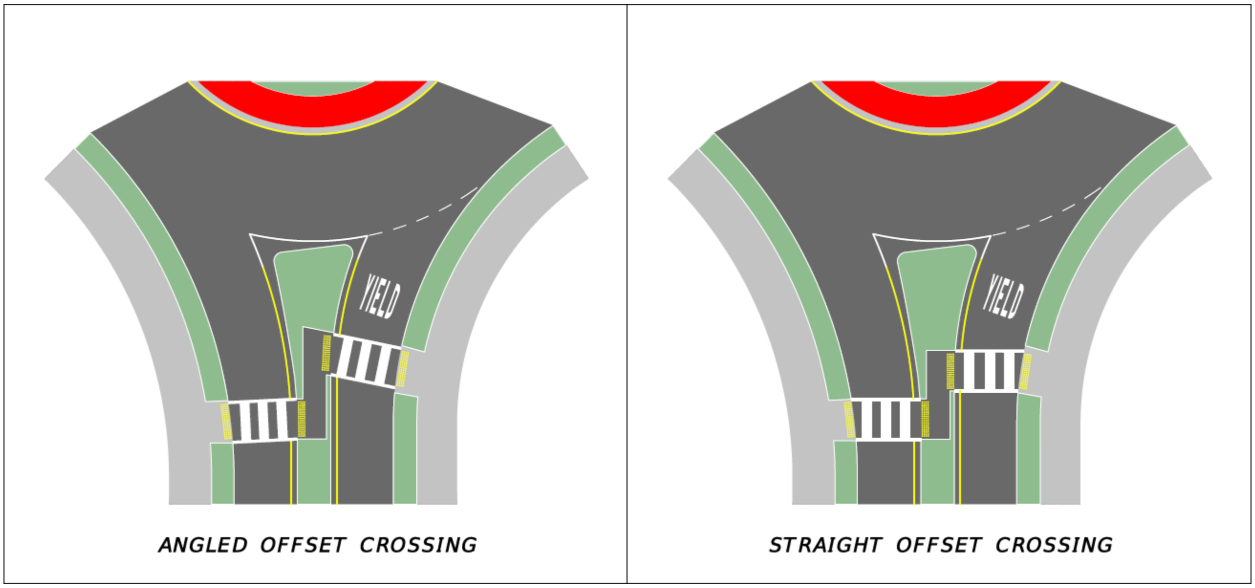
- Angled Crossings - Angled crossings are the preferred configuration because they minimize pedestrian crossing distance. When developing Angled Crossings, place each leg of the crosswalk perpendicular to the outside curb of the entry and exit lanes and locate the angle point near the center of the splitter island. See ***Figure 213.8.1*** for an illustration of angled crossings.
- Straight Crossings – Straight crossings are used when providing continuity of a major multi-use path. For straight crossings, place the entire crosswalk perpendicular to the centerline of the approach roadway. *See* ***Figure 213.8.1*** for an illustration of straight crossings.

Figure 213.8.1 Angled and Straight Crossings



(4) Offset Crossings - Offset crossings ***(Figure 213.8.2)*** are used at multi-lane roundabouts where supplemental crossing treatments such as Pedestrian Hybrid Beacons or Rectangular Rapid Flashing Beacons (RRFBs) are proposed. For RRFBs ~~wWhen developing offset crossings~~, locate the approach lane crosswalk 20 feet to 40 feet from the outside of the ICD and the exiting lane crosswalk 50 feet from the outside of the ICD ~~for RRFBs~~. For Pedestrian Hybrid Beacons, locate the approach crosswalk 20 feet to 40 feet from the outside of the ICD and locate the exiting crosswalk 60 feet to 70 feet from the outside of the ICD for the exiting lane crosswalk. This design is intentionally opposite the similar "Z-Crossing" found at midblock locations. The longer distance at the exit allows for a 2-car queue between the crosswalk and roundabout. Also, the longer distance allows drivers more time to perceive and react to pedestrians in the crosswalk.

Figure 213.8.2 Offset Crossings



213.9 Landscaping

Create a mounded central island that slopes upward from the truck apron using a slope no flatter than 1:10 and no steeper than 1:6. Provide varying height trees and plants in the central island to enhance driver recognition of the roundabout upon approach. On large roundabout center islands, varying heights, and uneven slopes can increase visual awareness of the roundabout and enhance aesthetics.

Provide quality space above and below ground for trees and other desirable vegetation to grow. Do not construct roundabout center islands on existing road pavement and base. Assure that the soil conditions will support the health and growth of selected trees and plants. Place trees and palms near the center of the central island and not less than 6 feet from the face of Type D curb. Place shrubs in a simple arrangement to help increase visual awareness of the roundabout.

Coordinate the landscape design in the early stages of plans development to assure that landscaping will be fully integrated into the roundabout design.

Additional information regarding roundabout landscaping is in Chapter 9 of ~~*NCHRP 672*~~*NCHRP 1043*.

213.9.1 Plant Selection

Select a diverse, low maintenance mix of ***Florida Friendly*** plant species. Select trees that are 6-feet in height or taller when installed; palm trees 12-feet or taller. The use of native tree species is encouraged. Select shrubs that will recover or regenerate naturally after mechanical damage. Select trees and plants with a variety of height, color, form, and texture. Select trees that will continue to grow in value after establishment without routine irrigation.

Plants placed in splitter islands must not exceed 18-inches in height at full maturity; i.e., do not encroach on sight distance requirements.

If more decorative plantings are requested by local agencies or groups, a maintenance agreement should be obtained.

213.10 Signing and Pavement Markings

Well-designed signing and pavement markings will enhance safety and traffic operations by clarifying the rules of the road and proper lane assignments to drivers as they navigate through the roundabout.

Use the standard left-turn arrow with a circular dot on the left-most lane of the approach to multi-lane roundabouts as shown in ***Standard Plans, Index 711-001***. Use standard arrows within the circulatory roadway.

Follow the details presented in ***Exhibits 213-3, 213-4, 213-5, and Figure 213.10.1*** when developing roundabout signing and pavement marking plans to promote consistency throughout the state.

Figure 213.10.1 shows roundabout signs and pavement markings with the bicycle lane. There are options for green or no green-colored pavement markings depending on the location and conditions. This figure also identifies features that should be included in the design of street crossings.

Additional measures will~~may~~ be needed to induce yielding to bicyclists and pedestrians at crossing locations of multi-lane roundabouts or roundabouts where exit geometry may prompt faster exiting speeds and reduced chances of yielding by motorists. Provide supplemental treatments~~Consider devices~~ such as a Rectangular Rapid Flashing Beacons or a Pedestrian Hybrid Beacons at multi-lane roundabout crossings.

Figure 213.10.1 Roundabout S&PM with Separated Bicycle Lane

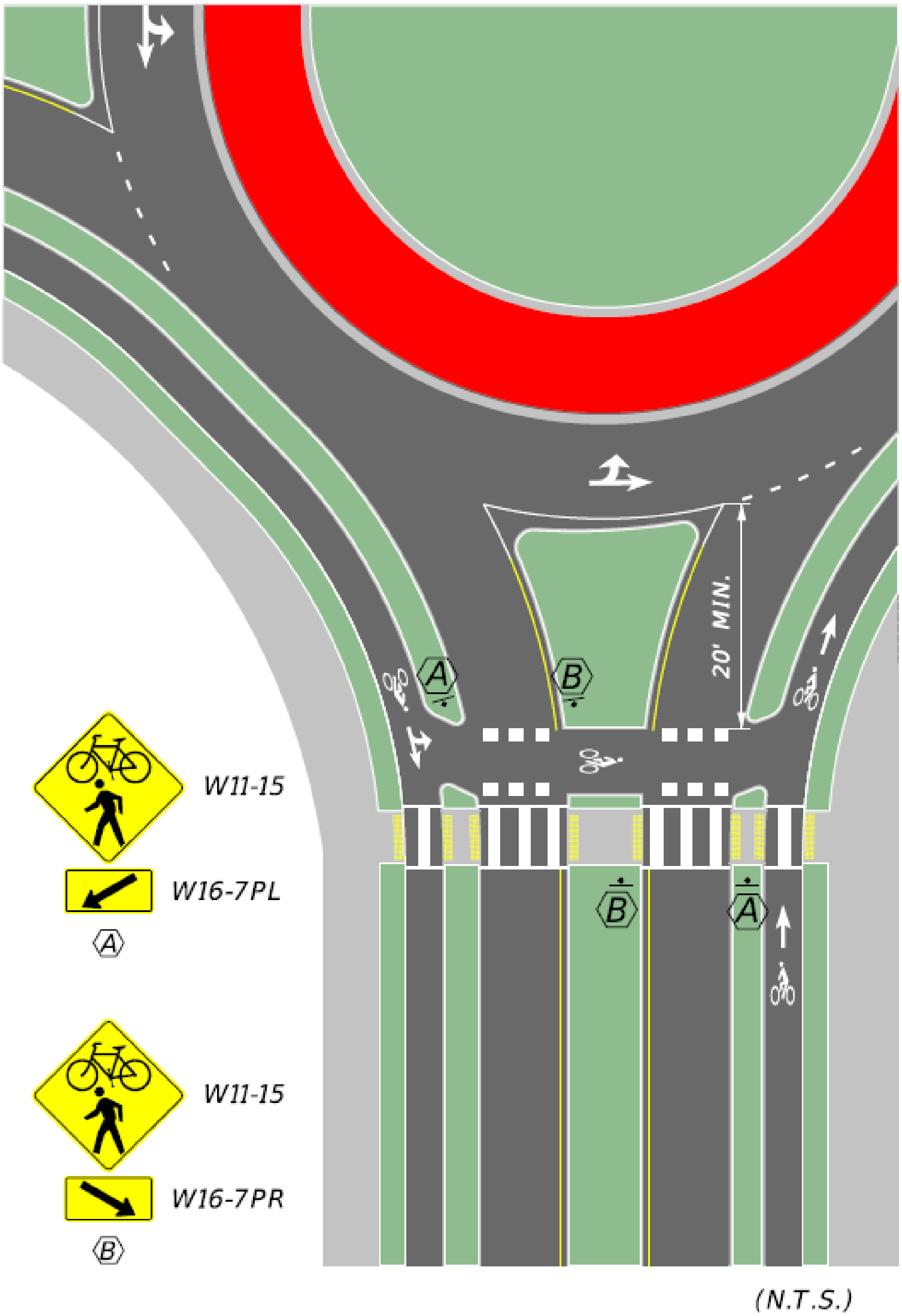


Exhibit 213-3: Roundabout S&PM

Exhibit 213-4: Roundabout S&PM

Exhibit 213-5: Roundabout S&PM

213.11 Lighting

Nighttime illumination of roundabouts is required. Provide a minimum of 1.5 foot-candles on the roadway surface within the circulatory roadway and at least 200 feet in advance of the splitter islands.

See ***FDM 231.3.3*** for additional lighting requirements when pedestrian facilities are provided.

213.12 Community Aesthetic Features

Communities commonly desire to place public art or other large aesthetic objects within the central island. These types of features are acceptable provided that:

- Objects are located outside the required sight triangles,
- Objects are not less than 6 feet from the inside edge of the truck apron, and
- Approval is granted through the process outlined in ***FDM 127***.

Fountains and other water spraying features are not permitted.