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INSTRUCTIONAL BULLETIN NO. 22-10

Chapter 2 - Geometric Design
Chapter 3 - Multimodal Design
Regarding Roundabout Guidance

Effective November 4, 2022 letting (August 24, 2022 Turn-in), the Roadway Design Guidelines, Chapter 2 Section 10 and Chapter 3 Section 409, have been updated to provide additional guidance concerning Roundabout Design. A Roundabout Design Reference Guide is available in the design documents as an added resource.

The revised sections are shown below:

Chapter 2 - Geometric Design

SECTION 10 - ROUNDABOUT DESIGN

2-1000.00 ROUNDABOUT DESIGN PRINCIPLES

A *roundabout* is a circular intersection where drivers travel counterclockwise around a center island. There are no traffic signals or stop signs in a roundabout. Drivers yield at entry to traffic in the roundabout, enter the intersection, then exit at the desired street. The design of multi-lane roundabouts minimizes weaving sections, instead using circulating lanes to direct traffic. Other circular intersections that do not meet this design approach are considered “traffic circles” or “rotary intersections”. The designs of traffic circles or rotary intersections are typically used by local agencies.

Roundabout designs should follow the principles summarized below and can consist of either a single-lane or multi-lane facility with specific elements as appropriate for its setting, either urban or rural. The design of a roundabout requires balancing the needs of existing and expected future traffic in a given location in addition to providing intersection control that is efficient and user friendly for the traveling public. The design should provide reduced and consistent speeds throughout the intersection to enhance both safety and operational performance at the intersection.

At a minimum, all roundabouts shall be designed according to the following principles:

- All entry points are yield-controlled
- Consistent speeds maintained throughout all turning movements
- Counterclockwise vehicular traffic around a center island
- Ensure proper sight distance, marking, signing, and visibility is provided
- Entering vehicles yield right-of-way to circulating vehicles
- Entry deflection employed to control speed
- Pedestrian traffic limited to designated locations along the approach legs
- Parking and private driveways prohibited within the circulatory roadway
- Splitter islands at all approaches channelize approaching and departing traffic

Roundabout designs are site specific to location; the design process should be one of iterative improvement until all design checks and project goals are satisfied. Each proposed location will require new information and analysis and may contain site specific design constraints to overcome during the project development.

The primary basis for these roundabout Design Guidelines is the National Cooperative Highway Research Program's (NCHRP) Report 672, *Roundabouts: An Informational Guide, Second Edition* (NCHRP, 2010). Other supplemental information and standards of practice have been adopted for these Design Guidelines and are laid out in the subsections that follow.

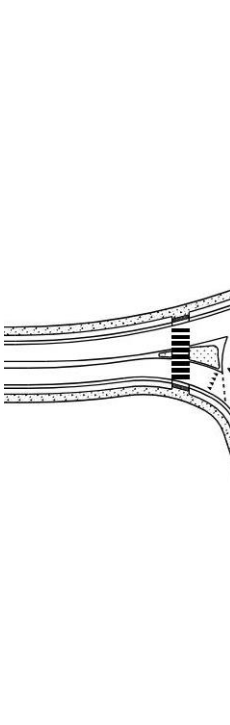
There are three tiers of roundabout classifications:

A **mini-roundabout** is typically used in neighborhood or other low speed environments and includes a single lane at each approach, a small diameter, splitter islands, and a fully traversable central island. They should not be confused with "traffic circles" or "rotary intersections".

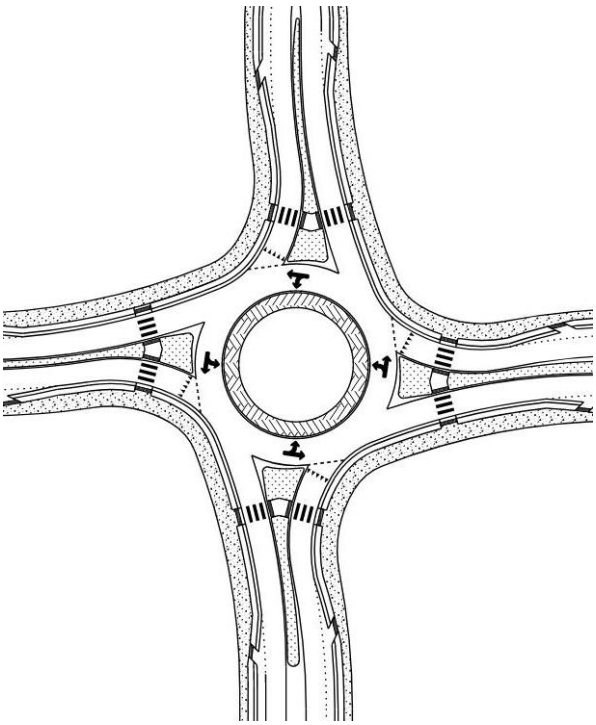
A **single-lane roundabout** is used in a normal intersection environment and includes a single lane at each approach (in addition to any right-turn bypass lanes), a standard diameter, splitter islands, and a raised central island with a truck apron.

A **multi-lane roundabout** is typically used in high volume environments and includes two lanes on at least one approach (in addition to any right-turn bypass lanes), resulting in more than one circulating lane for at least one quadrant of the roundabout. Multi-lane roundabouts most commonly include two lanes in each direction on the major street and can have either one or two lanes on the side street, colloquially referred to as a "2x1" and "2x2" roundabout, respectively. Designing roundabouts with three or more entry lanes (not including any channelized right-turn bypass lanes) on any approach should be avoided.

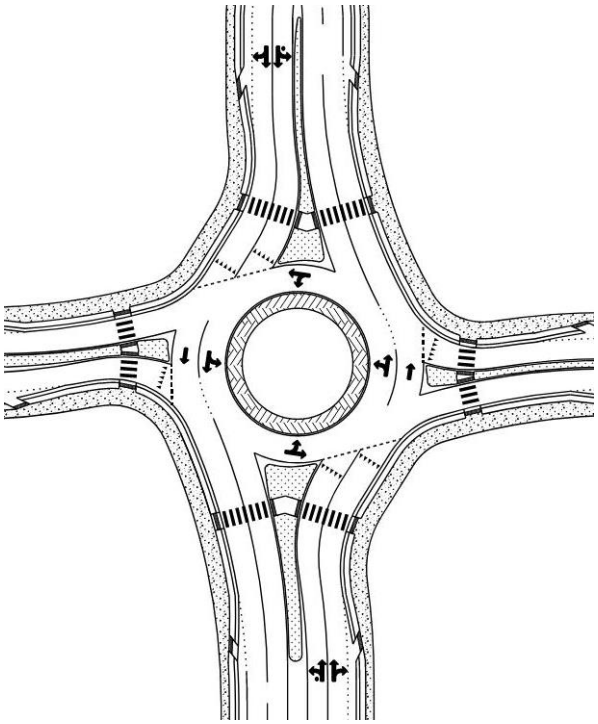
These classifications are shown in Figure 2-34. Standard Drawings RD18-RTS-1 and RD18-RTS-2 provide an overview of roundabout layouts and terminology of geometric elements.



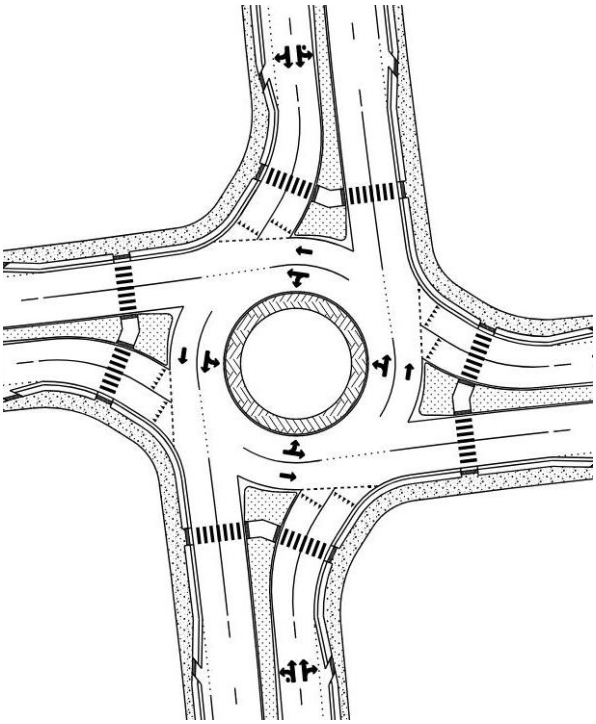
Mini-Roundabout



Single-Lane Roundabout



2x1 Multi-Lane Roundabout



2x2 Multi-Lane Roundabout

Figure 2-34
Types of Roundabouts

2-1001.00 ROUNDABOUT DESIGN PROCESS

See “Roundabout Design Reference Guide” for guidance

2-1005.00 ROUNDABOUT PLACEMENT CONSIDERATIONS

2-1005.01 DETERMINING ROUNDABOUT LOCATION

For projects utilizing a roundabout for intersection control, the optimum location, project goals, and system considerations should be reviewed before formal design begins. These additional design considerations should consider existing and proposed grades, availability and cost of right-of-way, proximity to other intersections (especially signalized intersections), railroad crossings, intersecting roadway skew angles, and private driveway locations.

It is important to remember that the center point of a roundabout does not need to coincide with where the center point of a traditional intersection would be since there is flexibility in the alignment and deflection of approaches. Designers should consider whether shifting the center point will result in reduced right-of-way impacts, most commonly in minimizing property takings at one or more corners of the intersection. Other common benefits achieved by shifting the roundabout include improved roadway grades, drainage, and entry deflection.

2-1005.02 ROUNDABOUT PROXIMITY TO OTHER INTERSECTIONS

Roundabout proximity to other types of intersection control should be considered when determining whether a location is a good candidate for a roundabout. Roundabouts result in randomized, un-platooned flow along a corridor, in contrast to the platooned flow found in a corridor with coordinated signal progression. Sending platooned flow into a yield-controlled roundabout approach can result in a spike in queue levels when platoons arrive. A roundabout’s ability to service vehicles on a given approach is relatively uniform in nature and is therefore better suited to the random arrival patterns that occur at isolated intersections and along unsignalized corridors. Therefore, the use of roundabouts within a closely spaced, coordinated signal system is strongly discouraged unless ample queue space is provided.

In other situations, the typical spacing between intersections where one or more of the intersections is a roundabout can generally be shorter than a series of signalized or stop controlled intersections since the yield-controlled nature of roundabouts minimizes the worst-case queuing that occurs. There is no absolute minimum distance between a roundabout and adjacent intersection, although in situations with two very closely spaced roundabouts the Designer should consider the feasibility of joining the two roundabouts to create an alternate configuration such as a larger circle, an oval, or a “peanut-about”. To determine a satisfactory distance between a roundabout and adjacent intersection, a queue length evaluation should be completed prior to commencing design. This queue length evaluation should include all queue lengths associated with the roundabout and any adjacent intersections. Other safety concerns such as railroad crossings should also be considered in determining roundabout spacing (See Section 2-1005.04).

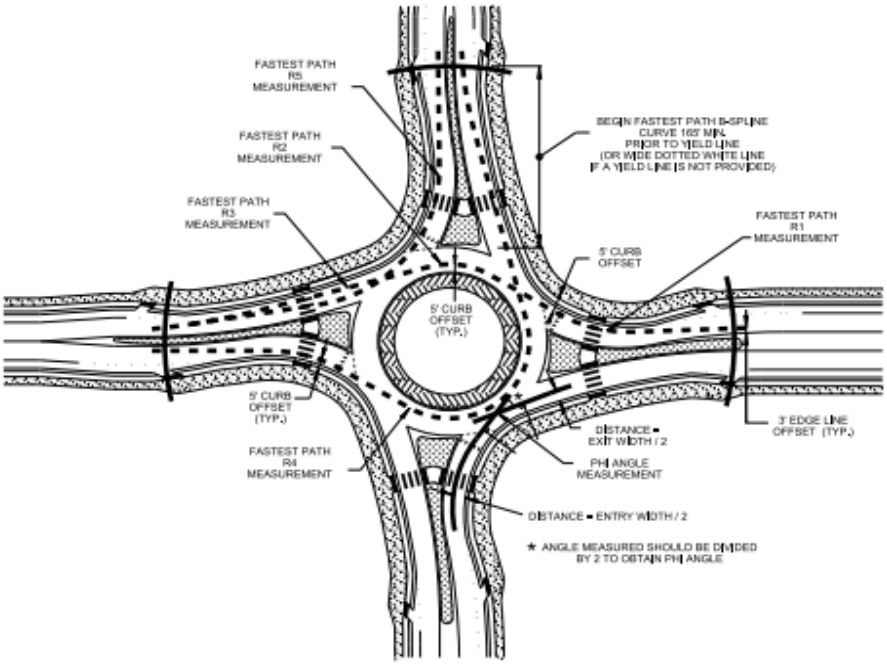
2-1005.03 ACCESS MANAGEMENT AND PRIVATE DRIVEWAYS AT ROUNDABOUTS

Parking will not be allowed within the circulatory roadway of roundabouts. The Designer should attempt to minimize or avoid locating on-street parking areas within the splitter island area (see figure 2-35) or within the transition to the splitter island. For new designs, parking should be terminated in advance of the splitter island or a minimum of 75 feet from the yield point, at the entrance to the circulatory roadway, whichever is greater.

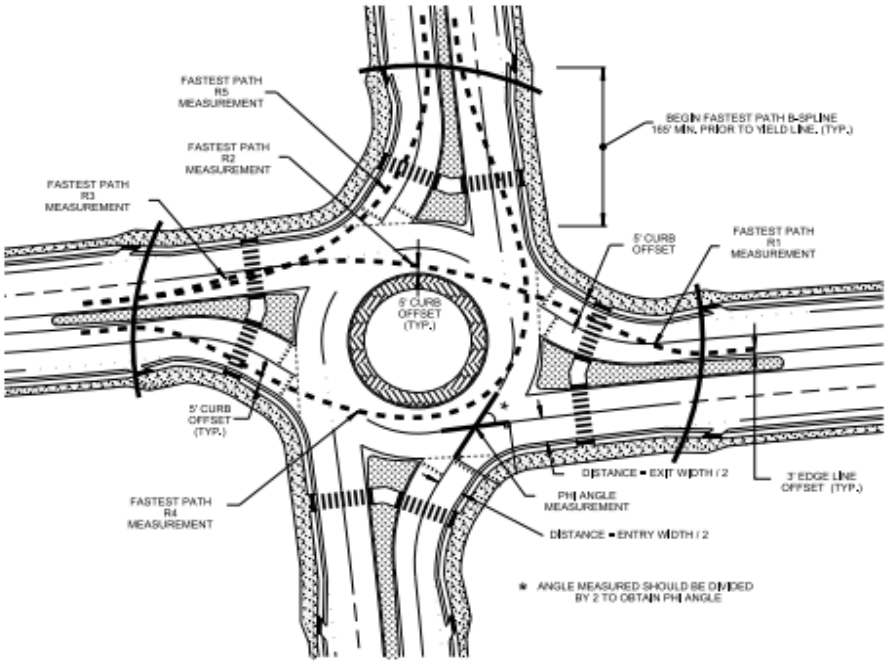
Where driveways are present, the Designer should consider methods for locating private driveways outside of the roundabout so that a vehicle cannot take direct access to the circulatory roadway from the private property. Additionally, the Designer should avoid providing private driveways anywhere along a splitter island at a roundabout approach. Where this is unavoidable, the driveway connection should be designed with a small, raised island restricting traffic to a right-in/right-out movement and the Designer should check for proper sight distance to the left of the driveway for vehicles entering or exiting the roundabout. In general, driveway placement should comply with Table 5.2, Corner Clearance Requirements, in the *Manual for Constructing Driveway Entrances on State Highways* (TDOT, 2015). Driveway access between the crosswalk and yield line at the entrance (or exit) to the roundabout will not be permitted except under extraordinary circumstances.

Bus stops should not be located within the functional area of a roundabout. Stops should not be placed within the circulatory roadway or within the area of the splitter islands. Pedestrian crossing areas at the splitter islands should not be used for bus stop locations. In the case of a continuous splitter island, as in a corridor where a continuous median connects the roundabout with an adjacent intersection, bus stops should not be located within 75 feet of the yield point.

The use of roundabouts along a corridor can also facilitate stronger access management practices along the corridor. The use of roundabouts compared to other traditional intersections can eliminate the need for dedicated turn lanes along the mainline, thereby reducing overall corridor width and increasing the feasibility of installing a curbed median. Providing roundabouts at major intersections also enables vehicles of all lengths to make U-turn movements, thereby reducing the inconvenience of removing direct left-turns when a median is installed. On traditional corridors with curbed medians, vehicles desiring to make a left turn out of a minor driveway are typically required to make a right turn onto the mainline followed by a U-turn to proceed in their desired direction, with similar U- and right-turn maneuvers required for inbound left turners. When used in access management corridors, a series of roundabouts can help facilitate these mainline U-turn movements in a safe and efficient manner, since U-turn movements at roundabouts are accommodated in much the same way as left turns. In fact, roundabouts are particularly conducive to accommodate U-turn movements for large trucks, where otherwise a large U-turn lane would need to be provided, since roundabouts inherently have the turning radius needed to accommodate large truck maneuvers. As such, Designers should strongly consider the use of roundabouts at key intersections within access management corridors.



DESIGN CHECKS FOR SINGLE LANE ROUNDABOUT



DESIGN CHECKS FOR MULTI-LANE ROUNDABOUT

Figure 2-35
Types of Roundabouts

2-1005.04 RAILROAD CROSSINGS AT ROUNDABOUTS

Railroad crossings can be accommodated in many intersection designs, and roundabouts are no exception provided that adequate warning and preemption devices are provided. In some circumstances, roundabouts located at railroad crossings can provide improved operations because the dynamic reallocation of capacity that is inherent in roundabouts can provide quicker recovery after a train crossing compared to other intersection types.

Although Designers should exercise caution at locations where an existing railroad line will pass through the central island or any portion of the roundabout's circulating lanes, railroad crossings can be accommodated within a roundabout in extenuating circumstances where an existing intersection is being reconstructed and an existing rail line currently passes through the intersection. Even in this case, the Designer should explore all options for shifting the center point of the roundabout within the intersection footprint (see Section 2-1005.01) or re-locating the roundabout such that the rail line crosses only one leg in proximity to the roundabout.

Any roundabout installed at or adjacent to a railroad crossing should include gate control. In addition to providing full gate control at the crossing itself, the Designer should consider two additional queuing scenarios of potential concern in determining where additional preventative measures may be appropriate. Where needed, this additional preventative measure may take the form of flashing beacons and/or gates.

1. In all cases involving a roundabout near a railroad track, the Designer should perform a queue length evaluation to ensure that the queue of vehicles on approach to the roundabout will not queue onto the active rail line. If this analysis indicates that the 95th percentile queue will stack back onto the railroad track, the roundabout should be equipped with preventative measures at all entrances to pre-empt the other entrances and provide a gap in circulating traffic for vehicles on the approach with the railroad crossing to enter the roundabout and clear the tracks.
2. The second concern relates to vehicles queued at a railroad crossing along the exit of a roundabout which may back up into the roundabout and interfere with operations of the circulating lanes. The Designer should consider how likely this blockage is and the degree to which it may impact roundabout operations. If significant impacts or safety concerns are expected, flashing beacons and/or gates may be required on one or more additional entrances to the roundabout.

2-1005.05 ROUNDABOUT CORRIDORS

A series of roundabouts can have advantages over traditional signalized corridors and should be evaluated for installation in corridor contexts. These general benefits can include a reduction in conflict points, improved safety performance, facilitation of access management strategies, and the potential for improved traffic operations in many situations. Roundabout corridors can also provide for design flexibility in urban and developing areas, most notably in how they can be shifted to adjust where right-of-way impacts occur at intersections. Roundabout corridors are also beneficial in urban and developing areas because of how they provide priority to pedestrians and cyclists crossing at the intersection.

Traffic and planning studies should be evaluated before considering a corridor containing a series of roundabouts. The design of each roundabout in a series or corridor should follow the same procedures outlined previously for individual intersections, just as a Designer would treat a series of signalized intersections. Section 2-1005.02 includes guidance regarding proximity to other intersections, and Section 2-1005.03 includes guidance on access management.

Roundabouts typically tend to have higher capacities and lower delays than traditional signalized intersections. This leads to shorter travel times through roundabout corridors than through signalized corridors. Roundabouts also exhibit un-platooned traffic flow, which can be advantageous if a corridor includes many conflicting traffic patterns.

2-1005.06 ROUNDABOUT DESIGN AT INTERCHANGES

Roundabouts can be an efficient design option for intersection control at interchange ramp locations, particularly if configured in a Double Roundabout Interchange. Unlike a typical stop or signal-controlled interchange, roundabouts generally require less space between ramps. Roundabouts may also allow for a narrower section along the surface street between the nodes of an interchange since roundabouts often do not require dedicated left-turn lanes. This may save on right-of-way costs when considering a new interchange, especially when right-of-way is constrained or when the interchange is located near a narrow structure such as an underpass or overpass.

When designing a multi-lane roundabout near an interstate or other controlled access route approved for large trucks, the Designer should consider providing additional space within the travel lanes to accommodate a mix of trucks and passenger cars using Case 2, Case 2B, or Case 3 control vehicle accommodations, as outlined in Section 2-1002.01.

As with any interchange, sight distance should be a significant design parameter when designing tightly spaced roundabouts at interchanges. The Designer should verify that bridge abutments, piers, and/or bridge railings do not interfere with sight distance requirements. Queuing should also be evaluated when performing traffic analysis at planned roundabout interchanges to select roundabout spacing and verify that off-ramp queues will not stack back onto the freeway mainline, as with any interchange ramp terminal intersection.

2-1005.07 ROUNDABOUT CONGESTION MITIGATION MEASURE

In some situations, such as peak traffic periods, a roundabout may receive a dominant flow of traffic from a certain approach. This approach can restrict traffic at downstream approaches from entering the roundabout due to a lack of sufficient gaps in the circulating lanes. This in turn can create extremely long queues at those restricted approaches. This issue can be alleviated by installing a metering signal along the controlling approach to create gaps in traffic within the circulatory roadway. A metering signal includes a queue detector at the restricted approach or approaches and a signal at the controlling approach. The metering signal gives a red indication for a specified duration when the queue on the restricted approach reaches a designated length. Metering signals typically only operate during peak periods and are dark at other times.

NCHRP 672, *Roundabouts: An Informational Guide, Second Edition* (NCHRP, 2010) provides additional information on roundabout metering and should be consulted prior to selecting metering as a mitigation measure. Of note, NCHRP states that metering should only be considered to mitigate congestion issues at an existing roundabout. New roundabouts shall be designed to function through the design year without the need for metering. If a proposed roundabout is expected to require metering in the design year then alternative intersection designs should be pursued.

A preferable alternative to direct roundabout metering is indirectly metering the roundabout with an upstream signal on the controlling approach, although care should be taken to account for queue impacts from the upstream signal as noted in Section 2-1005.02.

2-1005.08 SPLITTER ISLANDS

Splitter islands are a key feature located on all approaches to a roundabout. They channelize entry and exit lanes, slow down traffic approaching the roundabout, and provide pedestrian refuge space. Standard splitter island lengths are noted on Standard Drawing MM-CR-4A. On high-speed approaches, splitter islands of 150 ft or more should be considered to provide additional speed control through a visual "tunneling" effect, as discussed in Section 2-1002.05. On the approach end of a roundabout, splitter islands shall either tie into a roadway median as a "continuous median" or terminate with a rounded nose designed to the standards of a traditional roadway median.

If the approach has a pedestrian crossing, splitter islands must also accommodate an adequate pedestrian refuge. Provisions for pedestrian refuge areas, including sizing and positioning, are noted in Standard Drawing MM-CR-4A.

Landscaping within splitter islands should be avoided except where the island is long and/or exceptionally wide. See RDG Chapter 3-409.00 for additional information on landscaping at roundabouts.

Standard Drawing MM-CR-4A includes splitter island details, such as splitter island corner radii. See NCHRP 672, *Roundabouts: An Informational Guide, Second Edition* (NCHRP, 2010) for more information regarding splitter island design considerations.

2-1005.09 CURBS & ROADWAY TYPICAL SECTIONS

In general, roundabouts should be graded to slope away from the center of the roundabout towards the approaches. Recommended grades for the central island, truck apron, and circulatory roadway are discussed in Section 2-1002.06 with typical sections through a single- and multi-lane roundabout provided in Standard Drawings RD18-RTS-1 and RD18-RTS-2, respectively. The typical sections also include recommended widths for these roundabout elements as well as the landscape strip, which should be provided between the sidewalk and perimeter curb if a sidewalk is included at the roundabout, as well as the sidewalk itself.

Curbs should enclose the traveled way at all roundabouts, including splitter islands and adjacent approach lanes. Gutters should be provided along curbs that receive runoff; consequently, curbs adjacent to the central island and many truck aprons can be designed as detached curbs without gutters if they do not receive runoff.

For single- and multi-lane roundabouts, the central island should be lined with a non-mountable vertical curb of the type noted as "6" Detached Concrete Curb" on Standard Drawing RP-VC-10. Truck aprons and other mountable areas, including mini-roundabout central islands, should be lined with a mountable sloping curb of the type noted as "4" Sloping Detached Concrete Curb (for Roundabout Truck Aprons Only)" on Standard Drawing RP-SC-1. The sloping curb is intended to accommodate large vehicles that need to track across the truck apron to traverse the roundabout while guiding passenger cars to remain in the circulating lanes. Splitter islands and other locations along the perimeter of the roundabout should be lined with either "6" Concrete Curb and Gutter" or "6" Detached Concrete Curb" as appropriate based on whether that section of curb receives runoff; details for both are included on Standard Drawing RP-VC-10.

2-1005.10 PAVEMENTS & SURFACE TREATMENTS

Pavement material is dependent on project conditions and the surrounding environment. If part of a larger project, the pavement material for a roundabout should typically be consistent with the remainder of the project. Generally, asphalt or concrete should be used for the traveled way within the roundabout.

Central island truck aprons and other mountable areas, including mountable central or splitter islands at mini-roundabouts should provide a visual contrast from the circulatory roadway, non-mountable concrete surfaces such as splitter islands, and any surrounding sidewalks so as to not be confused with a pedestrian path. This shall be accomplished by using a stamped concrete and/or colored concrete surface to present a contrast with asphalt or uncolored concrete used elsewhere in the roundabout. Where colored concrete is used for concrete truck aprons or other mountable surfaces, the color shall be FHWA Insignia Red (FS #11136, Hex #9B2F25). The use of asphalt, bricks, or pavers for truck aprons or other mountable areas is discouraged and requires design variation approval.

Landscaping within splitter islands should be avoided except where the island is long and/or exceptionally wide. See RDG Chapter 3-409.00 for additional information on landscaping at roundabouts, including allowable treatments for central islands both inside and outside of areas required for sight distance. Where splitter islands are paved, the selected pavement treatment for these areas should be visually distinct from any truck aprons or other mountable surfaces. Note that central islands and splitter islands at mini-roundabouts are frequently designed to be fully mountable and should be designed using the treatments for mountable areas described above.

Chapter 3 – Multimodal Design

3-409.00 PEDESTRIAN, BICYCLE, CONSIDERATIONS FOR ROUNDABOUTS

The number of conflict points between vehicles, pedestrians, and cyclists is reduced when a roundabout is used for intersection control. Since single lane roundabout will not have signalization to offer pedestrian phases or does not require vehicles to make a complete stop, other measures must be designed to ensure drivers and multimodal users are clearly able to see each other. Proper roundabout design should produce the reduced vehicle speeds that are needed for vehicles to yield the right of way to crosswalk users. Multi lane urban roundabouts with sidewalk facilities at both sides requires a pedestrian push-buttons with RFRB to improve safety of users.

Crosswalk and/or bicycle facilities must be included at roundabouts in locations with existing pedestrian or bicycle infrastructure or that are connected to or planned to be connected to pedestrian or bicycle networks. At rural or urban locations where current pedestrian and bicycle traffic is not significant, the plans may include measures to accommodate future needs or demands. These may include:

- Rough grading the perimeter of the roundabout to accommodate future sidewalks, landscaping buffer strip, shared-use paths, etc.
- Installing pedestrian and bicycle curb ramps or lowered curb at logical “future” locations along perimeter curbing
- Providing cut-throughs (gaps) at the splitter islands for future crosswalks
- Obtaining adequate right-of-way to accommodate future measures, including lighting

- Installing conduit across all legs and splitter islands if roadway lighting or accessible pedestrian beacons or signals are required

Sidewalk facilities at roundabouts should be designed following Section 4- Accessible Pedestrian Travel and TDOT standards; supplementary guidance for sidewalks that function as a shared path to carry bicycle traffic around a roundabout are discussed in Section 3-409.03.

3-409.01 CROSSWALK FACILITIES

Since a goal of any roundabout is to result in low and consistent speeds being maintained throughout the intersection, a properly designed roundabout will reduce the risk of vehicle-pedestrian collisions due to the slow speeds expected. In addition to speed control elements such as Entry Deflection (Section 2-1003.04) and corresponding Fastest Path checks (Section 2-1004.01), there are design elements that may be beneficial to pedestrian safety when designing the crosswalks at a roundabout, most prominently the inclusion of median refuge islands (MM-CR-4) and reduction in vehicle speeds at the crosswalk compared to a free-flowing mainline at a side-street stop intersection or at a traffic signal during the green phase. The following general design criteria should be considered for crosswalks at roundabouts:

- Minimized crossing distance to reduce pedestrian exposure to traffic.
- Crosswalks should be designed to provide pedestrians a straight walking path across the traffic lanes (90 degrees to traffic flow preferred to minimize crossing distance), including any right-turn bypass lanes.
    - When a splitter island is provided, a Designer may need to “bend” crosswalk alignments at the splitter island to provide 90-degree crossings at the entrance and exit lane.
    - The exception to this guidance is when adequate pedestrian refuge is not provided within the splitter island, such as at a mini-roundabout. In these cases, the crosswalk should proceed straight, crossing both lanes in one movement, and follow the shortest path across the roadway. In situations where the splitter island does not provide adequate refuge area, detectable warning surfaces should not be provided in the median.
- To minimize out-of-direction travel for pedestrians, crosswalks should be located as close as possible to the intersection while still maintaining required queue space for vehicles.
- Crosswalks should typically be located one vehicle length (approximately 20 feet minimum) behind the yield point, namely the wide dotted white line tangent to the ICD (Standard Drawing MM-CR-4A); this gives the driver at the yield line the ability to concentrate on entering the roundabout since they will have already traversed the crosswalk conflict point.
- Splitter islands should have a minimum width sufficient to provide an adequate pedestrian refuge area, as shown on Standard Drawing MM-CR-4A.
- The finished grade of the pedestrian crossing (refuge) areas within the splitter islands must be graded at a smooth slope which provides positive drainage in a manner that is compliant with pedestrian accessibility standards. The Designer should avoid elevating the refuge area except the minimal amount needed for proper drainage.

The design criteria noted above are illustrated on Standard Drawing MM-CR-4A, “Standard Construction Details for Roundabouts”. The general Standard Drawings for curb ramps provide details for ramps at the exterior curb cuts for crosswalks.

The Designer should note that additional design elements and crosswalk infrastructure may be necessary at roundabouts where accessible pedestrian crossings are required, as discussed in Section 3-409.02.

3-409.02 ACCESSIBLE PEDESTRIAN CROSSINGS

Care should be taken in the design of splitter island pedestrian refuge areas to ensure that visually impaired pedestrians are guided to and properly aligned with the second crosswalk of a two-stage crossing. Standard Drawing MM-CR-4A provides a detail of pedestrian refuge areas at splitter islands.

Supplementary guidance for Designers on accessible pedestrian infrastructure at roundabouts can be found in Section 4.1 of NCHRP Research Report 834, *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Disabilities* (NCHRP, 2016).

Crosswalks at roundabouts can present risks for visually impaired pedestrians due to the uncertainty over gap detection and determining whether a driver will yield to pedestrian traffic. Where an accessible pedestrian crossing is required at a roundabout crosswalk, the Designer should assess whether a pedestrian traffic control device is appropriate to notify approaching drivers that a pedestrian is present and provide audible feedback to the pedestrian.

NCHRP Research Report 834, *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Disabilities* (NCHRP, 2016), provides guidance on appropriate pedestrian traffic control devices for accessible crosswalks and builds upon the *Proposed Public Right-of-Way Accessibility Guidelines*, or PROWAG (U.S. Access Board, 2011), which has been adopted by TDOT. According to these sources, pedestrian traffic control devices should be considered for crosswalks at multi-lane roundabout approaches. Crosswalks at single-lane roundabout entries and exits generally do not require advanced pedestrian accommodations beyond the provision of accessible crosswalk design and markings unless there are site-specific factors that merit the consideration of a pedestrian traffic control device, such as entry or exit speeds (*V1*, *V3*, *V4*, or *V5* per Section 2-1004.01) in excess of 30 mph.

Per NCHRP Research Report 834 and the associated FHWA Technical Report FHWA-SA-15-069, *Evaluation of Rectangular Rapid-Flashing Beacons at Multilane Roundabouts* (FHWA, 2015), the following pedestrian traffic control devices should be considered for installation at multi-lane roundabout approaches, listed from greatest to least impact:

- Pedestrian Signal
- Pedestrian Hybrid Beacon (PHB), also known as a High-Intensity Activated Crosswalk (HAWK) Beacon
- Rectangular Rapid-Flashing Beacon (RRFB)
- Raised Crosswalk

Recommended thresholds for Designers to consider the installation of a pedestrian traffic control device at a roundabout crosswalk are provided in Figure 3-6.

Raised Crosswalks may be considered in combination with RRFB or Pedestrian Signal/PHB traffic control if additional visibility and/or speed control is needed. Where used, the impacts of raised crosswalks on the approach/departure capacity should be assessed to verify that the selected roundabout laneage can handle the expected traffic volumes with raised crosswalks in place. Raised Crosswalks may not be desirable on some roadways, particularly those serve to truck traffic or emergency vehicle (fire truck or ambulance).

It should be noted that in high-noise environments, visually impaired pedestrians may not be able to distinguish between traffic at the crosswalk and background traffic or other conflicting noise. In these situations, the Designer should consider implementing a more impactful pedestrian traffic control device such as a pedestrian signal or PHB to ensure that vehicles stop for pedestrians and visually impaired pedestrians do not need to rely on listening for gaps in traffic.

Supplementary guidance for Designers on pedestrian traffic control devices for accessible crossings at roundabouts can be found in Section 4.2 of NCHRP Research Report 834, *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Disabilities* (NCHRP, 2016).

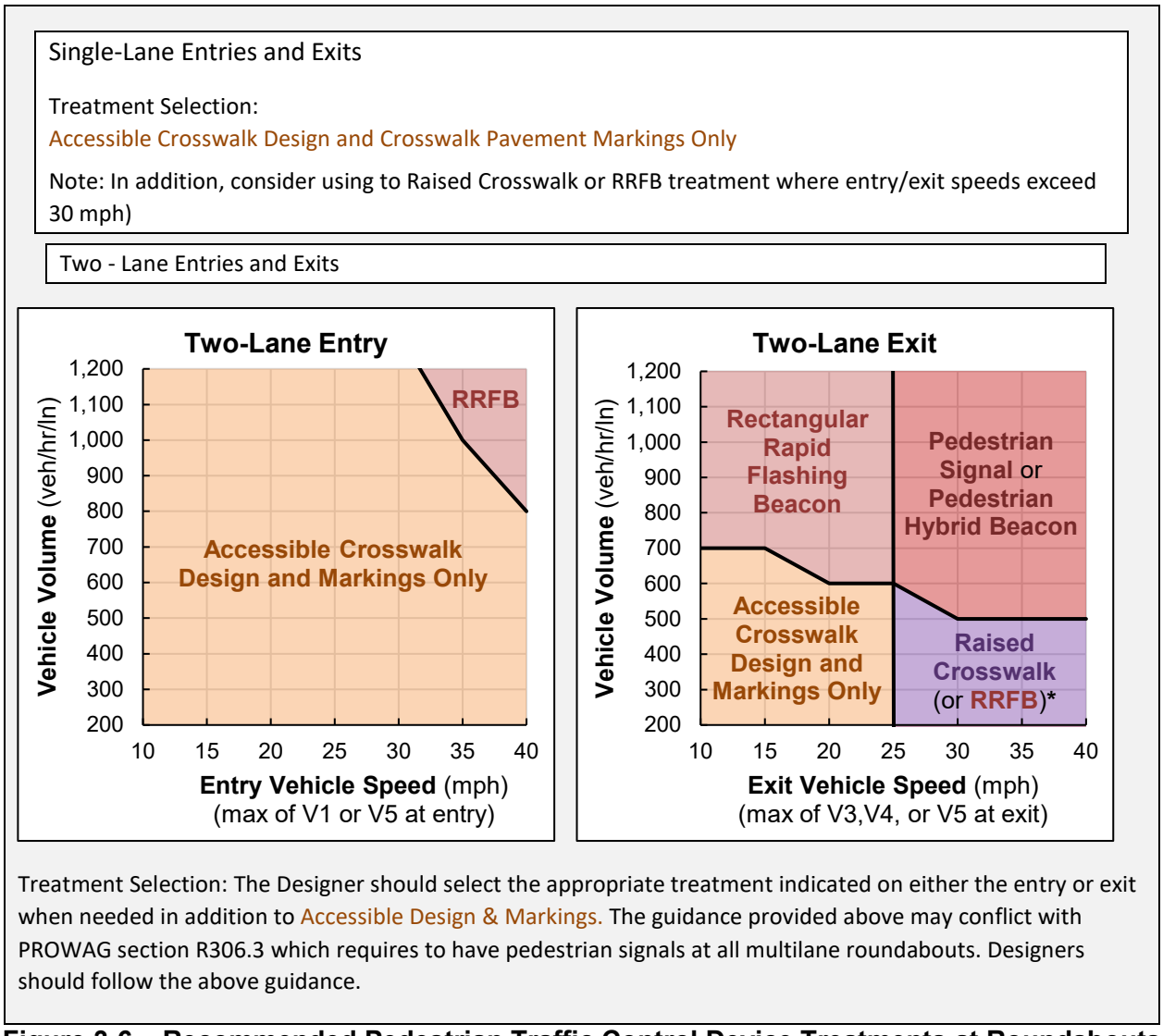


Figure 3-6 – Recommended Pedestrian Traffic Control Device Treatments at Roundabouts

Adapted from: *Guidelines for the Planning and Design of Roundabouts* (MassDOT, 2020)

If a pedestrian traffic control signal or beacon is appropriate at an accessible pedestrian crossing, pushbutton-activated audible warnings should be provided to accompany the signal or beacon since visually impaired pedestrians generally rely on audio cues more than other pedestrians. Supplementary guidance on pushbutton design and audible warnings at pedestrian signals or beacons is included in Section 3-410.00 and Chapter 13 of the TDOT *Traffic Design Manual*.

Per FHWA-SA-15-069, *Evaluation of Rectangular Rapid-Flashing Beacons at Multilane Roundabouts* (FHWA, 2015), the audible warning message accompanying a RRFB should be “yellow lights are flashing” to accurately convey the nature of the visual beacon and avoid giving visually impaired pedestrians a false sense that vehicles will stop, despite the fact that pedestrians have the right of way at roundabouts.

3-409.03 BICYCLE FACILITIES

Consideration shall be given to integrating bicycle facilities into new construction and reconstruction of roadway projects as appropriate for the context and function of the transportation facility.

Bicyclists should be given a choice when approaching a roundabout of either going through the roundabout and mixing with the vehicles in the circulatory roadway or exiting the roadway prior to entering the roundabout and continuing around the roundabout on a shared-use path with pedestrians. For optimal safety, bicyclists should be provided with shared-use paths, typically in the form of a sidewalk, around the perimeter of the roundabout, although it should be noted that cyclists are legally allowed to choose to remain in the roadway where shared-use paths are provided.

A shared-use path adjacent to the roundabout should be a minimum of 10 feet wide to accommodate bicycle and pedestrian use. If the provided path is less than 8 feet in width, the path would be classified as a sidewalk and cyclists should be directed to dismount. Unless instructed otherwise by TDOT, the Designer should provide bicycle lane exit ramps on each approach for exiting the roadway to the shared-use path, and then bicycle lane entrance ramps for re-entering the roadway, bicycle lane, or roadway shoulder on the far side of the roundabout.

For locations with on-street bicycle facilities, such as urban areas with delineated bike lanes or rural locations where a roadway shoulder is being used for a bike route, the shoulder or bike lane must not continue through the roundabout. The bicycle facility must terminate prior to the roundabout and a bicycle lane exit ramp should be provided to allow cyclists the option of exiting the roadway to a multi-use path around the roundabout or remaining on the roadway. Riders choosing to continue through the roundabout will be required to merge with vehicular traffic in both position and speed.

Where a bicycle lane exit ramp (the ramp the bicyclist uses to exit the roadway prior to the roundabout) is provided, the ramp should be located at least 100 feet prior to the yield point, (Standard Drawing MM-CR-4A). A minimum of 50 feet after a pedestrian crosswalk, the bicycle lane entrance ramp should be provided to reenter the roadway downstream of the roundabout. A bicycle lane exit ramp detail is included in Standard Drawing MM-CR-4A.

If the roundabout is being designed at a location where there is a designated shared-use path, the design should include those geometric features detailed on Standard Drawing MM-TS-3. To minimize confusion between bicycle lane ramps and pedestrian ramps, bicycle ramps should be as physically distinct from pedestrian ramps in location and geometry as possible. Detectable warning surfaces should be placed at the top of the bicycle ramps rather than at the bottom as is the practice with pedestrian ramps.

Additionally, the Designer should refer to the latest version of the AASHTO Guide for the Development of Bicycle Facilities.

Updated Links:

Chapter 2

Chapter 3

Roundabout Design Reference Guide

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July 8, 2022