FDM 11-26-1 Introduction

February 14, 2025

This section, in combination with the NCHRP Report 1043, Guide for Roundabouts, 2023 (NCHRP 1043), provides guidance on the design of roundabouts in Wisconsin. Engineers preparing roundabout designs in Wisconsin should be familiar with both. Where both references are cited but differences exist, the Facilities Development Manual guidance shall govern.

The FDM section numbering matches NCHRP Report 1043. Sections without supplemental information specific to Wisconsin are not included in the FDM and therefore there may be gaps in the numbering of FDM sections. FDM sections that do not have an equivalent NCHRP 1043 chapter start at FDM 11-26-X.21

FDM 11-26-2 Roundabout Characteristics and Applications

February 14, 2025

2.1 Roundabout Definition and Characteristics

The defining features of a roundabout are described in Table 2.1 and shown in Figure 2.1 and Figure 2.2. These figures are for illustrative purposes only and the features shown may not be included on all roundabouts.

Table 2.1 Roundabout Features

Feature	Description
Central island	The raised area in the center of a roundabout around which traffic circulates. The central island does not necessarily need to be circular in shape. On compact roundabouts, this area is typically fully traversable to accommodate large truck turns.
Splitter island	A raised curb island (special situations may be painted) on an approach used to separate entering traffic from exiting traffic, deflect and slow entering traffic, and to provide refuge for pedestrians crossing the road in two stages.
Circulatory roadway	The curved path used by vehicles to travel in a counterclockwise fashion around the central island.
Truck apron	The traversable portion of the central island adjacent to the circulatory roadway and overtracking pad adjacent to outside curbs. It is required to accommodate snowplows and the wheel off-tracking of large trucks and oversized overweight (OSOW) vehicles. It is paved with a contrasting color (usually red) to delineate the apron from the normal vehicle path.
Yield line	A point of demarcation separating traffic approaching the roundabout from traffic in the circulatory roadway. The yield point is usually defined by a thick (typically 18-inch wide) dotted edge line extension pavement marking.
Crosswalks	Crosswalks can be provided on all legs of a roundabout and may be angled or offset. The crossing location is set back from the yield line. The splitter island is cut to allow pedestrians, wheelchairs, strollers, and bicycles to pass through.
Bicycle treatments	Bicycle treatments at roundabouts provide bicyclists the option of traveling through the roundabout either by riding in the travel lane as a vehicle, exiting the roadway and using the crosswalk as a pedestrian, or as a cyclist using the sidepath, depending on the bicyclist's level of comfort.
Terrace	Terraces are provided at roundabouts to separate vehicular and pedestrian traffic and to encourage pedestrians to cross only at the designated crossing locations. Terraces can also significantly improve the aesthetics of the intersection as long as landscaping is placed outside the required sight limits.
Roundabout sidepath or shared-use path	Pathway for non-motorized users (pedestrians, bicyclists, skaters, etc.). At isolated roundabouts, roundabout sidepaths may be provided around the perimeter of the roundabout to provide off-roadway bicycle accommodations. In the urban environment, shared-use paths may be extended around the roundabout, or existing sidewalks may transition to a roundabout sidepath.

For additional information on Roundabout Definition and Characteristics, see NCHRP 1043 Chapter 2.1.

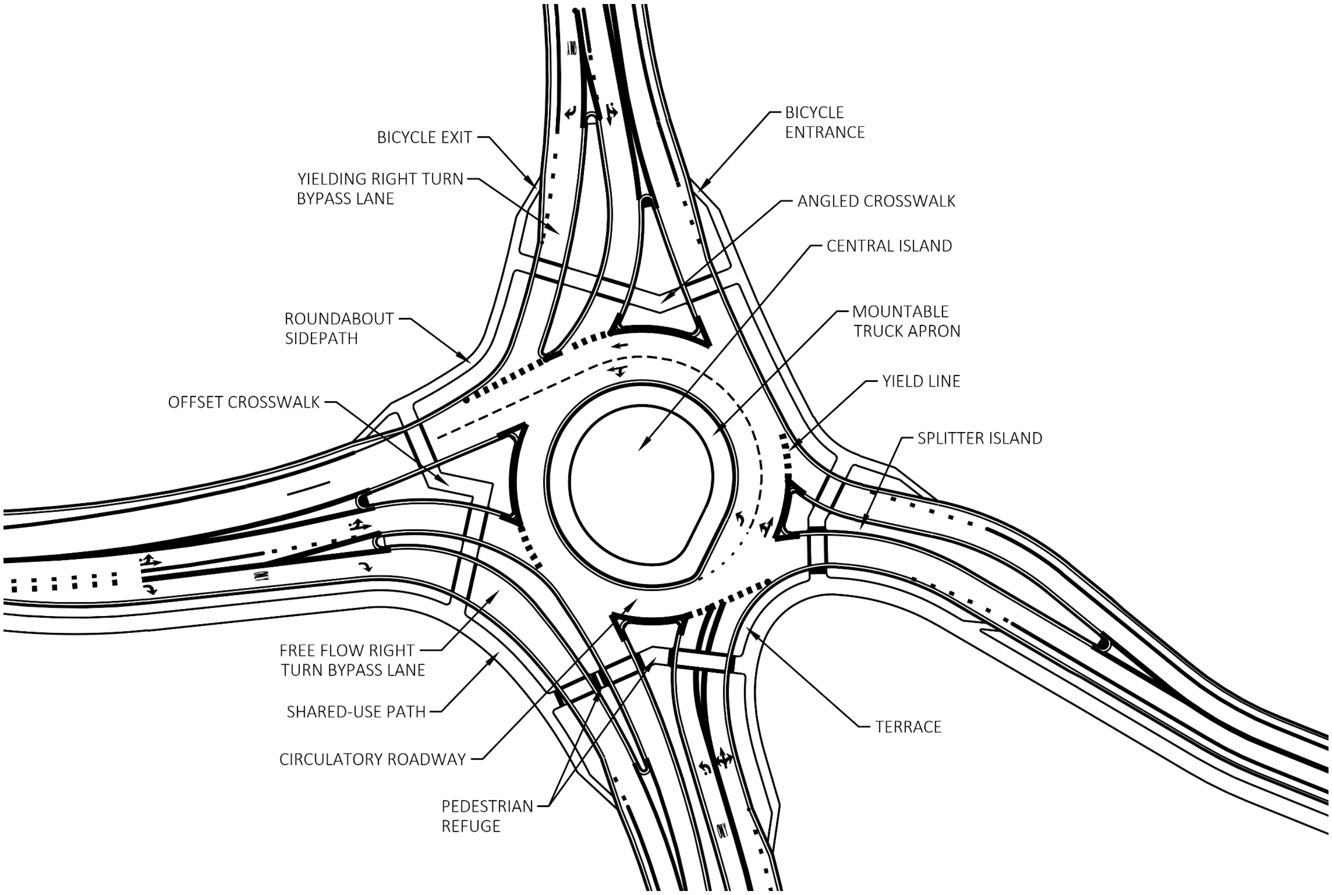


***Figure 2.1** Physical Features of a Roundabout*

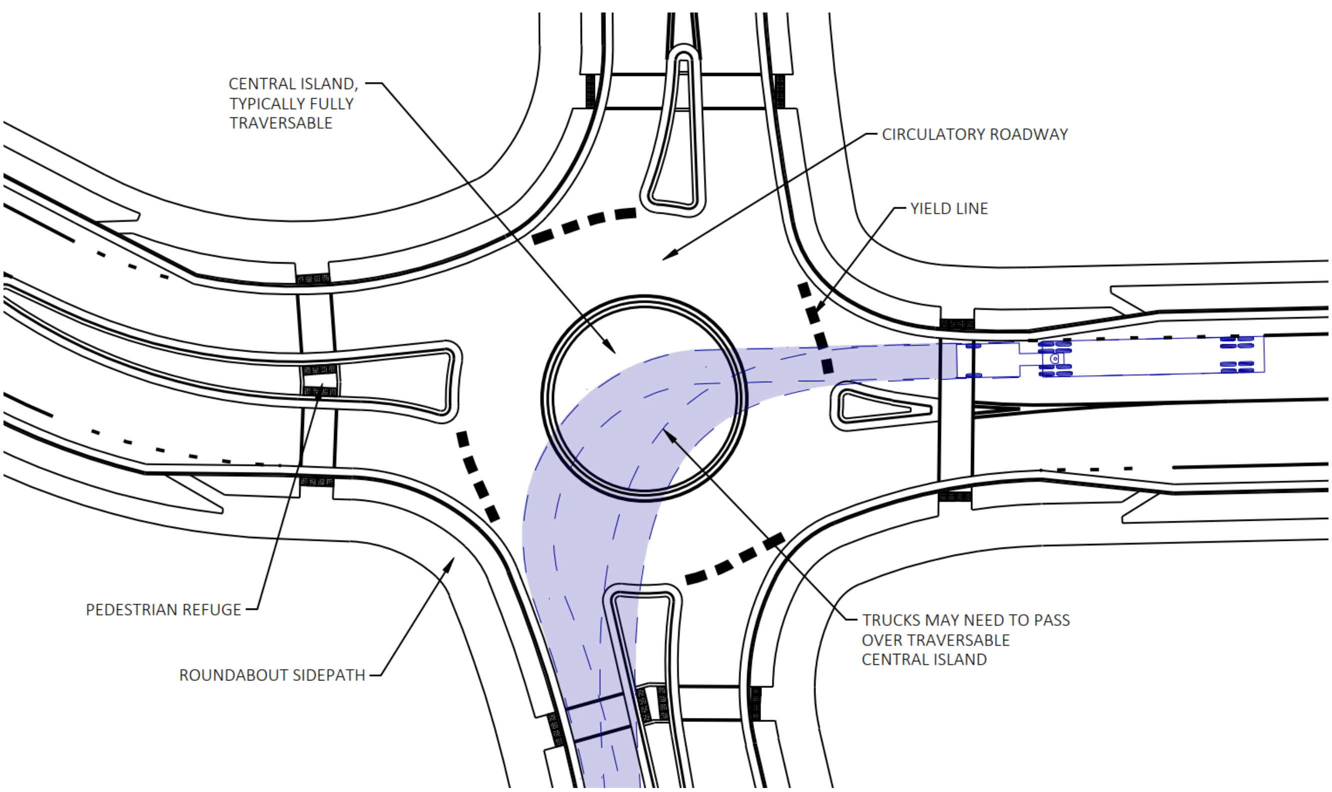


***Figure 2.2** Physical Features of a Compact Roundabout*

2.3 Roundabout Categories

2.3.1 Roundabout Types

Roundabouts are categorized by size and environment. The size of a roundabout is defined by the inscribed circle diameter (ICD), which is the measurement across the circle from splitter island flange line to splitter island flange line. Table 2.2 lists the basic roundabout types, characteristics, and suitability in Wisconsin. The Department is not currently constructing mini roundabouts as they generally are not suitable for intersections on the State Highway system.

Table 2.2 Roundabout Types

Roundabout Type	Inscribed Circle Diameter (ICD)	Central Island	Suitable for STH system	Suitable for local roads
Mini	< 80 feet	Traversable	N	Y
Compact	80 feet to 120 feet	May be traversable	Y	Y
Single-lane	> 120 feet	Non-traversable	Y	Y
Multilane	160 feet to 200 feet	Non-traversable	Y	Y

2.3.2 Roundabouts with Traversable Elements

Roundabouts with traversable elements include mini and compact roundabouts. They may be used in place of stop control or signalization at physically constrained intersections to help improve safety and reduce delays. They are typically characterized by:

- Small diameter
- Traversable central island, and in some cases traversable splitter islands (compact roundabouts may have a small, raised central island depending on the design vehicle)
- Low speed environment
- Constrained right of way that may not accommodate a larger roundabout

Smaller vehicles circulate around the roundabout in the circulatory roadway as they would at larger roundabouts, but larger vehicles may need to drive directly over the central island or the splitter islands to make certain movements.

As noted in Table 2.2, mini roundabouts are generally not suitable on the Wisconsin State Highway system.

Compact roundabouts can be considered and may be favorable in the following locations:

- On roadways where the posted speed limit is 40 mph or lower
- Congested intersections where the AADT is less than 15,000 vehicles per day
- Locations where traffic calming by reducing vehicle speeds is desired
- Existing all-way stop-controlled intersections
- Locations where intersection control is expected and visible to approaching drivers

Compact roundabouts may not be favorable at the following locations:

- As a replacement for two-way stop-controlled intersections
- Four-lane roadways
- Locations where truck percentages are expected to be higher than 5%
- Locations where U-turn truck traffic is expected
- Locations where WB-65's are expected to make a lot of turns

A compact roundabout will not operate as efficiently as a larger single-lane roundabout due to the smaller size and proximity of adjacent legs to one another. The WisDOT procedure for performing operational analysis for compact roundabouts can be found in TEOpS 16-15-20.

There is no current available research on the safety of compact or mini roundabouts in the US, but trends show that fatal and severe injury crashes are similar to single-lane roundabouts.

A compact roundabout is often considered as an alternative to a single-lane roundabout due to a desire to minimize impacts outside of the existing intersection footprint. Therefore, the existing intersection curb lines are a typical starting point for establishing the compact roundabout inscribed circle diameter.

2.4 Considerations in Building Roundabouts

Table 2.3 lists the advantages and disadvantages when considering building roundabouts versus other intersection alternatives.

Table 2.3 Considerations in Building Roundabouts

Category	Advantages	Disadvantages
Safety	Reduced number of conflict points compared to other non-circular intersections. Left turn and right angle conflicts are removed. Elimination of high angles of conflict and high operational speeds; reduces severe crashes. Reduction in conflicting speeds passing through the intersection. Reduced decision making at point of entry. Splitter islands and other geometric features provide advanced warning of the intersection. Raised level of consciousness for drivers. Facilitate U-turns that can substitute for more difficult midblock left turns.	Total crashes may increase due to more property damage crashes. Lack preemptive control for first responders. May reduce the number of available gaps for midblock unsignalized intersections and driveways.
Operations	Traffic yields, nonstop, continuous traffic flow. Can reduce the number of lanes required between intersections, including bridges between interchange ramp terminals. Can reduce side-street delay during off-peak hours.	As queues develop, drivers accept smaller gaps, which may increase crashes. Equal priority for all approaches can reduce the progression for high volume approaches. Cannot provide explicit priority to specific users (e.g., trains, emergency vehicles, transit, pedestrians) unless supplemental traffic control devices are provided.
Pedestrians & Bicyclists	Splitter islands can provide pedestrian refuge and shorter one-directional traffic crossings. Pedestrians only need to consider one direction of traffic at a time. Offset crossings can improve sightlines for pedestrians and improve visibility of pedestrians for drivers. Low speed conditions improve bicycle and pedestrian safety.	Pedestrians, especially children, elderly, and handicapped, may experience increased delay and reduced safety in securing acceptable gaps to cross. Pedestrians with vision impairments may have the most trouble establishing safe opportunities to cross due to challenges in detecting gaps and determining that vehicles have yielded at crosswalks. Longer travel path. Bicycle ramps could be confused for pedestrian ramps.
Environmental	Reduced starts and stops; reduced air pollution.	Possible impacts to natural and cultural resources due to potentially greater spatial requirements at the intersection.
Oversized-Overweight Truck Route (OSOW-TR)	Reduction of potential obstacles at intersections (traffic signals, signing, median islands).	The geometric design may be challenging to allow the navigation of OSOW vehicles. Additional right of way and paved areas may be needed to accommodate OSOW vehicles.
Aesthetics	Provide attractive entries or centerpieces to communities. Provide opportunity for landscaping or gateway to enhance the community.	Objects placed in the central island may create a safety hazard.

FDM 11-26-3 A Performance-Based Planning and Design Approach

February 14, 2025

3.6 Roundabouts in a System Context

Roundabouts may need to fit into a network of intersections with the traffic control functions of a roundabout supporting the function of nearby intersections and vice versa. Because the design of each roundabout generally follows the principles of isolated roundabout design, this guidance is at a conceptual and strategic level and generally complements the planning of isolated roundabouts. In many cases, site-specific issues will determine the appropriate roundabout design elements. Closely spaced roundabouts are characterized by the operations of one roundabout having an impact on the operations of an adjacent roundabout and may have overhead lane signs and spiral designs with additional lanes for lane balance and lane continuity issues that arise with closely spaced roundabouts in a series.

3.6.1 Interchanges

Freeway ramp junctions with arterial roads are potential candidates for roundabouts. This is especially true if the subject interchange typically has a high proportion of left turn flows from the off-ramps and to the on-ramps during certain peak periods, combined with limited queue storage space on the bridge crossing, off-ramps, or arterial approaches. In such circumstances, roundabouts operating within their capacity are particularly amenable to solving these problems when compared with other forms of intersection control.

The benefits and costs associated with this type of interchange also follow those for a single roundabout. Some potential benefits of roundabout interchanges are:

- The queue length on the off-ramps may be less than at a signalized intersection. In almost all cases, if the roundabout would operate below capacity, the performance of the off-ramp is likely to be better than if the interchange is signalized.
- The intersection sight distance is much less than what it is for other intersection treatments.
- The headway between vehicles leaving the roundabout along the on-ramp is more random than when signalized intersections are used. This more random ramp traffic allows for smoother merging behavior onto the freeway and a slightly higher performance at the freeway merge area similar to ramp metering.

There are no unique design parameters for roundabout interchanges. They are only constrained by the physical space available to the designer and the configuration selected. Several geometric configurations for ramp terminals with roundabouts exist:

- The raindrop form, which does not allow for full circulation around the center island, can be useful if grades are a design issue since they remove a potential cross-slope constraint on the missing circulatory road segments. However, raindrop shapes lack operational consistency because one entry will not be required to yield to any traffic.
- A single-point diamond interchange incorporates a large-diameter roundabout centered either over or under the freeway. While remaining somewhat compact, this solution may not be cost-effective, especially for retrofit locations, as existing overpass structures may not be adequately sized or oriented.
- Dual roundabouts are a common choice for interchange locations. This design may delay or eliminate the need for overpass reconstruction, while also allowing for easier future roundabout expansion. It offers the greatest flexibility in the location of the roundabouts while improving ramp geometry and minimizing the need for retaining walls. It may require acquiring additional right of way as this design typically requires more space than some alternatives.

Refer to FDM 11-25 and FDM 11-25 Attachment 2.1 for OSOW vehicle inventories and FDM 11-25 Table 2.1 for required intersection OSOW accommodations, including at the junction of OSOW truck routes.

Occasionally, an OSOW vehicle may have to bypass a bridge by taking the off-ramp and making a through movement and entering the on-ramp (a.k.a. “ramp-off/ramp-on”). Design the median island to accommodate the OSOW through movement when required. Refer to FDM 11-30-1 for additional guidance on interchange design.

3.6.2 Corridors with Roundabouts (and Roundabouts in Series)

In order to understand how roundabouts operate within a roadway system, it is important to understand their fundamental arrival and departure characteristics and how they may interact with other intersections and highway features. Lane use and lane balance on an approach can vary from ideal conditions where roundabouts are in a system and at times closely spaced. Sensitivity testing of alternative lane use patterns and lane designation alternatives in geometric design is necessary. Microsimulation of traffic patterns is recommended for roundabouts being treated as a system.

3.6.2.1 Planned Network, Access Management

Rather than thinking of roundabouts as an isolated intersection or replacement for signalization, identify likely network improvements early in the planning process. This is consistent with encouraging public and other stakeholder interaction to prepare or update local comprehensive or corridor plans with circulation elements. Project planning and design are likely to be more successful when they are part of a larger local planning process. Then, land-use and transportation relationships can be identified, and future decisions related to both can be applied.

Roundabouts may be integral elements in village, town, and city circulation plans with multiple objectives of improving circulation, safety, pedestrian and bicycle mobility, and access management. Roundabouts rely on the slowing of vehicles to process traffic efficiently and safely which results in a secondary feature of “calming” traffic. It can be expected that local studies and plans will be a source of requests for roundabout studies, projects, and coordination on state arterials. A potential use of arterial roundabouts is to function as gateways or entries to denser development, such as villages or towns, to indicate to drivers the need to reduce speed for upcoming conflicts including turning movements and pedestrian crossings.

Retrofit of suburban commercial strip development to accomplish access management objectives of minimizing conflicts can be a particularly good application for roundabouts. Raised medians are often designed for state arterials to minimize left turn conflicts; and roundabouts accommodate U-turns. Left turn exits from driveways onto an arterial that may currently experience long delays and require two-stage left turn movements could be replaced with a simpler right turn, followed by a U-turn at the next roundabout. Again, a package of improvements with driveway consolidation, reverse frontage, and interconnected parking lots, should be planned and designed with close local collaboration. Also, a roundabout can provide easy access to corner properties from all directions. When large volumes of U-turns are expected, avoid using compact roundabouts. Larger vehicles (e.g. WB-65) may not be able to make a U-turn at a compact roundabout.

3.6.2.2 Roundabout Departure Pattern

Traffic leaving a roundabout tends to be more random than for other types of intersection control. Downstream gaps are shorter but more frequent as compared to a signal. The slower approach and departing speeds along with the gaps allow for ingress/egress from nearby driveways or side streets. The slowing effects are diminished as vehicles proceed further downstream. However, the gaps created at the roundabout are carried downstream and vehicles tend to disperse again providing opportunities for side street traffic to enter the main line roadway.

Sometimes traffic on a side street can find it difficult to enter a main street at an unsignalized intersection. This happens when the side street is located between two signalized intersections and traffic platoons from the signalized intersections arrive at the side street intersection at approximately the same time. If a roundabout replaced one of these signalized intersections, then its traffic platoons would be dispersed, and it may be easier for traffic on the side street to enter the main street. Alternatively, when signals are well coordinated, they may provide gaps at nearby intersections and mid-block for opportunities to access the main line.

3.6.3 Mixed Roundabouts and Signals

It is generally undesirable to have a roundabout located near a signalized intersection. A strategic level traffic assessment of system conditions of a series of roundabouts is needed to determine how appropriate it is to locate a roundabout within a coordinated signal network.

If a roundabout is used in a network of coordinated signalized intersections, then it may be difficult to maintain the closely packed platoons required for signals. If a tightly packed platoon approached a roundabout, it could proceed through the roundabout as long as there was no circulating traffic or traffic upstream from the left. Only one circulating vehicle would result in the platoon breaking down. Hence, this hybrid use of roundabouts in a coordinated signalized network needs to be evaluated carefully.

There may be situations where an intersection within the coordinated signal system requires a very long cycle which is caused by a high volume of side road traffic or large percentage of turning movements and is dictating operations and reducing the overall efficiency for the coordinated system. On rare instances, replacing a signalized intersection with a roundabout may allow for the system to be split into two systems thus improving the efficiency of both halves while also improving the efficiency of the entire roadway segment. A traffic analysis is needed to evaluate each specific location.

3.6.3.1 Platooned Arrivals on Approaches

Vehicles exiting a signalized intersection tend to be grouped into platoons. Platoons, however, tend to disperse as they move down-stream. Roundabout performance is affected by its proximity to signalized intersections and the resulting distribution of entering traffic. If a signalized intersection is very close to the roundabout, it causes vehicles to arrive at the roundabout in closely spaced platoons. The volume of the arriving platoon and the capacity of the roundabout will dictate the ability of the roundabout to process the platoon. Analyze these situations carefully to achieve a proper design for the situation. Discuss proposed roundabout locations with the regional traffic section staff. Microsimulation of traffic patterns is recommended for roundabouts in close proximity (500’ or less) to traffic signals.

3.6.4 Closely Spaced Roundabouts

It is sometimes desirable to consider the operation of two or more roundabouts near each other. Closely spaced roundabouts can potentially reduce queues and balance traffic flows. The spacing between any two roundabouts is considered closely spaced if they are less than 1,000 feet from center to center. They also can accommodate a wide range of access, both public and private. In any case, the expected queue length at each roundabout becomes important. Compute the expected queues for each approach to check that sufficient queuing space is provided for vehicles between the roundabouts. If there is insufficient space, then drivers may occasionally queue into the upstream roundabout, potentially causing a reduction from the typical operations. However, the roundabout pair can be designed to minimize queuing between the roundabouts by limiting the capacity of the inbound approaches.

Closely spaced roundabouts may improve safety and accessibility to business or residential access or side streets by slowing the traffic on the major road. Drivers may be reluctant to accelerate to the expected speed on the arterial if they are also required to immediately slow again for the next roundabout. This may benefit nearby residents.

3.21 At-Grade Rail Crossings

Locating any intersection near an at-grade railroad crossing is generally discouraged. However, due to necessity, intersections are sometimes located near railroad grade crossings. When considering locating a roundabout within 1,000 feet of a railroad, contact the regional railroad coordinator early in the process. It is preferable to cross one of the legs of a roundabout and leave a typical distance of at least 100 feet from the center of the track to the yield line. Treatment should follow the recommendations of the Wisconsin MUTCD whenever possible. Consider allowing the railroad track to pass directly through the circle center of the roundabout rather than through another portion of the circulatory roadway if the at-grade crossing is not on one of the legs. Also, consider the design year traffic on the roadway, the number of trains per day, speed of trains, length of trains, type of crossing warning devices, and anticipated length of vehicular queues when evaluating the intersection control needed in close proximity to the railroad.

Refer to FDM 17-1-1 for additional railway information. Expert assistance is required to address rail pre-emption requirements of roundabouts in close proximity.

FDM 11-26-4 User Considerations — *February 14, 2025*

4.1 Pedestrians

Designing a roundabout to safely accommodate pedestrians is a priority. Therefore, the project context is important in the design of pedestrian accommodations at roundabouts. Consider the adjacent land use and destinations in the corridor (e.g., schools, hospitals, commercial, residential), area demographics (populations of non-drivers such as people with disabilities), network connectivity and continuity of sidewalks, and regional shared-use paths. If available, information on pedestrian volumes, risk exposure, or crash data should also be considered, as well as evaluating roadway characteristics (e.g., speed, number of travel lanes) that people walking will need to navigate at a roundabout. Designers should contact the regional bicycle and pedestrian coordinator for their guidance.

Pedestrian crash severity reduces with lower vehicle speed. NCHRP 1043, Chapter 7.2.4 discusses the likelihood of a pedestrian death or serious injury if hit by a vehicle. Design principles need to be applied that provide for slow entries and exits for pedestrian safety.

Due to relatively low operating speeds of 15 to 20 mph, pedestrian safety can be better with a roundabout design than with other intersection types. Table 2.3 includes advantages and disadvantages of roundabouts for pedestrians.

Proper design of the crosswalks is important for pedestrian safety and function as well as for the overall operation of the roundabout. Crosswalk placement should minimize crossing distance to reduce exposure to pedestrian-vehicle conflicts.

4.2 Bicyclists and Micromobility Users

Designing a roundabout to safely accommodate bicyclists and micromobility users is a priority. Therefore, the project context is important in the design of bicycle and micromobility user accommodations at roundabouts. Consider the adjacent land use and destinations in the corridor (e.g., schools, hospitals, commercial, residential), area demographics (populations of non-drivers such as people with disabilities), network connectivity and continuity of sidewalks, and regional shared-use paths. If available, information on bicycle volumes, risk exposure, or crash data should also be considered, as well as evaluating roadway characteristics (e.g., speed, number of travel lanes) that people biking will need to navigate at a roundabout. Designers should contact the regional or state bicycle and pedestrian coordinator for their guidance.

For information on Bicyclists and Micromobility Users, see NCHRP 1043, Chapter 4.2.

Refer to FDM 11-26-10.4 for design guidance. Information from the AASHTO Guide for the Development of Bicycle Facilities may be referenced.

4.4 Large Vehicles

Large vehicles include trucks, buses, recreational vehicles, oversized overweight vehicles, and vehicles with large dimensions like farm equipment. These vehicles can directly affect the design of a roundabout.

4.4.2 Standard Trucks

Design roundabouts for the largest vehicle that is anticipated to use the roundabout on a regular basis. All roundabouts on the STH system must accommodate a WB-65 design vehicle, which is the largest vehicle allowed on the STH system without a permit. Refer to FDM 11-25 Table 2.1 for required intersection design vehicles and check vehicles for various trucking route scenarios. See FDM 11-26-10.5 for design guidance on accommodating large trucks.

Load shifting may be problematic for the contents of any vehicle while navigating a turning maneuver. Load shifting is a common concern for liquid or semi-liquid loads where the weight of the load may shift in a manner to exacerbate overturning. It is not uncommon for a vehicle with a high center of gravity to overturn when navigating a turn at speeds that exceed the laws of mechanics. A roundabout is designed to minimize load-shifting problems with larger vehicles; however, speed is a major factor related to overturning. Minimal entry deflection resulting in high entry speeds, long tangents leading into tight curves, sharp turns at exits, excessive cross slopes, and adverse cross slopes have been the principle causes of load shifting.

4.4.3 Oversized or Overweight (OSOW) Trucks

During the preliminary design, check with local officials and the public to determine if there are any special OSOW vehicles that regularly use the route and refer to the WisDOT OSOW vehicle inventory in FDM 11-25 Attachment 2.1. Coordinate OSOW Truck Route (OSOW-TR) and routing activities with the regional freight operations engineer. The designer should also contact the regional freight engineer to provide OSOW permit history to assist with decisions on what size OSOW should be accommodated at the intersection.

Review the truck guidance provided in FDM 11-25-1.4 and FDM 11-25-2, which includes additional information related to truck routes, the OSOW-TR, and intersection design guidance.

It is becoming somewhat common to widen the truck apron along the sides to accommodate OSOW vehicle through movements. Additional pavement (behind a mountable curb) may also be provided along the right side of the entries to accommodate wheel off-tracking. Signposts may also have to be mounted in removable sleeves to provide additional lateral space for OSOW vehicles (see TEOpS Chapter 2). In rare cases, roundabouts have been designed with a gated bypass roadway to accommodate turns. See FDM 11-26-10.5.4 for design guidance to accommodate OSOW vehicles.

4.5 Emergency Vehicles

Emergency vehicles passing through a roundabout encounter the same problem as other large vehicles and may require the use of the truck apron. On emergency response routes, compare the delay for the relevant movements with alternative intersection types and controls.

Roundabouts provide the benefit of lower vehicle speeds, which may make them safer for emergency vehicles to negotiate than conventional intersections.

The Wisconsin Motorist's Handbook provides information on what to do when the driver encounters an emergency vehicle. The driver must yield the right of way for emergency vehicles using a siren, air horn or a red or blue flashing light. The driver in the circulatory roadway should exit the roundabout before pulling over. Emergency vehicles will typically find the safest and clearest path to get through an intersection. This may include driving the emergency vehicle, with caution and with lights and siren on, in the opposing lane(s) or however the operator sees as the most desirable alternative path.

FDM 11-26-5 Stakeholder Considerations — February 14, 2025

5.3 Outreach Approaches

5.3.2 Methods and Tools

5.3.2.1 Public Meetings

Public meetings provide an excellent opportunity to bring the public into the design process. It is generally desirable to present the concept layouts of all reasonable alternatives from the Intersection Control Evaluation (refer to FDM 11-25-3) on an equal basis at a public meeting and explain that a roundabout appears to be a reasonable alternative. Inform the public that no preference to any alternative is indicated at that stage, but that input to all alternatives is being gathered. Try to be as specific as possible about the real estate impacts, access impacts and anticipated operations (level of service) between the various alternatives. At this level of design, it may be important to let the public know that you do not have all the answers about the various impacts. An effective education and communication method applicable to some projects with roundabouts includes scheduling a specific time at each public involvement meeting (PIM) of approximately 10-20 minutes to explain the following:

- The project time-line
- Source(s) of funding
- Concept of roundabouts
- Why the Department has included the roundabout as an alternative
- Construction duration and possible detours or road closures

- Illustrations of how pedestrians, bicyclists, and vehicles should travel through the roundabout
- Holding open house and public information “exchange” meetings, and attending village and town board meetings or local service organizational meetings are good formats for education and consensus building

After the initial public meeting, a screening evaluation accounting for public support can be completed. At the next public meeting, the preferred alternative can then be presented.

5.3.2.2 Public Outreach Resources & Methods

The success or failure of a project can often be attributed to how well the Department included the public in its development. There are excellent resources to assist the designer in explaining roundabouts to the public and to help educate drivers:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/design.aspx

Typically, in the project planning process, multiple alternatives are considered. The alternatives generally include traffic signal, stop sign, or roundabout control; some of which are familiar to drivers and pedestrians. Presenting a comparison of traffic operations and safety between alternatives is a good way to introduce roundabouts. It is essential to inform the public of the planning process that led to the decision favoring a roundabout as the preferred traffic control. A transparent planning process engenders trust and validates the process of wise investment in infrastructure.

The common dilemmas for most agencies that want to start using roundabouts are:

- Recognized public perception of roundabouts vs. their proven performance
- Driver education: way-finding and lane choice
- Pedestrian perception of safety vs. proven conditions
- Bicyclist education
- Permitted trucking (typical large trucks)

Designers are encouraged to generate project-specific roundabout outreach materials on their region’s web site. Coordination of this effort must be through the Central Office (IT) coordinator and the web site content coordinator. Examples of resources that should be collected and distributed through various media include:

- Case studies
- Testimonials
- National and Wisconsin-specific statistics
- How-to videos
- Web-cam
- Driver training
- Website
- Brochures
- Talking points/discussion bulletins for legislators and staff to respond to calls
- Vulnerable user training materials

A strategy to apply these components requires starting with internal staff (planning, design and maintenance operations); State legislators; District Attorney, State Patrol; then moving to external stakeholders, e.g., interest groups, trucking associations and mobility advocacy groups. Finally, once a consensus is reached with internal and external stakeholders a general public meeting or outreach contact can be arranged.

Prior to any general public outreach, a local officials meeting should be held with local council members, police and fire services, senior staff, and maintenance operations staff. The general education process is exercised with this group and the project specific presentation of the engineering study that led to the choice of a roundabout as an alternative control is made. A consensus must be the goal of the local officials meeting in order that the subsequent public contact, e.g., open house goes smoothly with upper and lower tier agency agreement on why the use of a roundabout and how the project will be implemented, including proposed education for the locally affected.

Preparation for the local project public contact requires development of context specific education and outreach components. An inventory of resources that have proven effective for local project outreach is as follows:

- Scale model (1:87, 1 inch = 7.25 feet) of the layout accompanied by scale model trucks and cars
- Animation/simulation of the expected operation of the roundabout and possibly a comparison to the alternative(s)
- Renderings or visualizations

- A project location brochure
- How-to driver, pedestrian and bicycle user resources
- Talking points bulletins for local councilors that give a summary of the planning process, traces the results of studies and documents funding sources, schedule and staging of construction

When introducing compact roundabouts to local officials or the public, refrain from using the term “compact”. A compact roundabout is simply a smaller roundabout and should just be referred to as a “roundabout”. The use of the term “compact” may confuse the general public or erroneously imply that the roundabout is substandard.

FDM 11-26-7 Safety Performance Analysis — *February 14, 2025*

For information on Safety Performance Analysis, see TEOpS Chapter 12.

7.7 Assessment of Existing Roundabouts

WisDOT conducts network screening for intersections on the state trunk network on a routine basis to determine sites where the number of crashes are higher than expected, which may lead to further review. The department has conducted in-service reviews of roundabouts and found common countermeasures that could be implemented to improve the safety performance. These common countermeasures are listed in FDM 11-38 Attachment 10.3.

FDM 11-26-8 Operational Performance Analysis — *February 14, 2025*

8.1 Introduction

The growing number of roundabouts in the United States (US) has led to an increase in national and local research of roundabout operations and capacity. The National Cooperative Highway Research Program (NCHRP) published the first major study in the US on roundabout operations in the 2007 NCHRP Report 572 [1]. The findings of the NCHRP Report 572 reflect 2003 data from approximately 300 roundabouts. A Federal Highway Administration (FHWA) sponsored project [4], completed in 2015, built upon the methodologies of NCHRP Report 572 [1]. The 2015 FHWA report [4] incorporates 2012 data collection efforts and significantly increases the number of usable data points as compared to the NCHRP Report 572 [1].

This research found that driver behavior and the number of entry lanes has the largest effect on the performance of US roundabouts. The capacity and operations of US roundabouts is more sensitive to the interaction between drivers entering and circulating the roundabout and the number of entry lanes than the detailed geometric parameters (e.g., lane width, entry radius, phi angle, and inscribed circle diameter) used in the Australian [2] and UK models [3]. Although important to ensure the safety and efficiency of travel through a roundabout, the fine details of geometric design are secondary and less significant than variations in driver behavior when analyzing capacity at roundabouts in the US.

The Highway Capacity Manual 7th Edition (HCM7), Chapter 22, provides analytical procedures for the analysis of planned and existing roundabouts. The 2015 FHWA report [4] provides the foundation for the HCM7, Chapter 22 roundabout methodology. The methods of the HCM allow traffic engineers and designers to assess the operational performance of a roundabout, given information about the demand levels for motor vehicles, pedestrians and bicycles.

The following chapters provide high level guidance for roundabout designers. Detailed guidance on performing roundabout operational analysis for WisDOT is provided in TEOpS Chapter 16-15-20.

8.2 Operational Analysis Principles

A roundabout brings together conflicting traffic streams at reduced speeds, allowing the streams to cross paths safely, traverse the roundabout, and exit. Roundabouts do not have merging or weaving between conflicting traffic streams. Compactness of circle size and geometric speed control make it possible to establish priority to circulating traffic. The geometric elements, signage and pavement markings of the roundabout reinforce the rule of circulating traffic priority and provide guidance to drivers approaching, entering, and traveling through a roundabout.

Gap acceptance (i.e., headway) behavior determines the operation of vehicular traffic at a roundabout. Drivers at each approach look for and accept gaps in circulating traffic. The low speeds of a properly designed roundabout facilitate this gap acceptance process. The width of the approach roadway, the curvature of the roadway, and the volume of traffic present on a given approach govern this speed. As drivers approach the yield point, they must first yield to pedestrians and then to conflicting vehicles in the circulatory roadway. The size of the inscribed circle affects the radius of the driver's path, which in turn determines the speed at which drivers travel in the circulatory roadway.

8.6 Planning Level Analysis and Space Requirements

The inscribed circle diameter needed for a roundabout is one of the most critical space requirements when considering impacts to right of way, costs, design vehicle and others. The following table gives general inscribed circle diameters and daily service volumes for the different types of roundabouts. The typical daily service volumes ranges described in Table 8.1 are derived from Exhibit 8.2 in the NCHRP Report 1043 and are dependent on the left turn percentage of the daily service volume. For a planning level analysis, it may be appropriate to assume that three-leg roundabouts will have a capacity that is 75% of the service volumes shown in Exhibit 8.2 of the NCHRP Report 1043 Use Table 8.1 for inscribed circle diameter values to help in the initial steps of considering a roundabout as a reasonable alternative. Diameters will vary, and in some situations, may fall outside these typical ranges.

***Table 8.1** Typical Inscribed Circle Diameters and Estimated Daily Service Volumes*

Roundabout Type	Typical Inscribed Circle Diameter	Typical Daily Service Volume[1] (vpd) 4-leg roundabouts
Mini	Less than 80 ft	less than 15,000
Compact	80 – 120 ft	less than 15,000
Single-lane	120 -160 ft	less than 25,000
Multilane (2-lane entry)	160 - 215 ft	25,000 to 45,000
Multilane (3-lane entry)	215 - 275 ft	45,000 or more

[1] Capacities vary substantially depending on entering traffic volumes and turning movements.

8.6.2 Planning Estimates of Lane Requirements

If existing or projected turning-movement data is available at the planning level, the analyst should estimate the potential lane configurations of the roundabout prior to performing detailed operational analysis. Figure 8.2 shows the capacity curves for one and two-lane roundabouts. WisDOT developed the capacity curves shown in Figure 8.2 based on a 2020 research study on the operations of Wisconsin Roundabouts [5]. As shown in Figure 8.2, the capacity of each entry lane of the roundabout is based on the conflicting traffic flow in the circulatory roadway, which comprises the various turning movements from other approaches that pass in front of (and thus conflict with) the subject entry. For planning purposes, the analyst can use the capacity curves shown in Figure 8.2 to identify the potential lane configurations of the roundabout. As an example, for a given circulatory (conflicting) flow rate of 800 passenger cars per hour (pc/h) a one-lane roundabout could accommodate an entry capacity of approximately 650 pc/h/lane while the right lane of a two-lane roundabout could accommodate an entry capacity of approximately 710 pc/h/lane.

HCM7, Chapter 22 provides additional details on how to approximate capacity and lane requirements for a roundabout, including sample calculations of roundabout volumes, conversion of vehicles per hour (vph) to passenger cars per hour (pc/h), lane use, capacity, and performance measures. Use Figure 8.2 for preliminary estimation of the number of entry and circulatory lanes per approach when considering a roundabout during the Intersection Control Evaluation (ICE) and during planning studies.

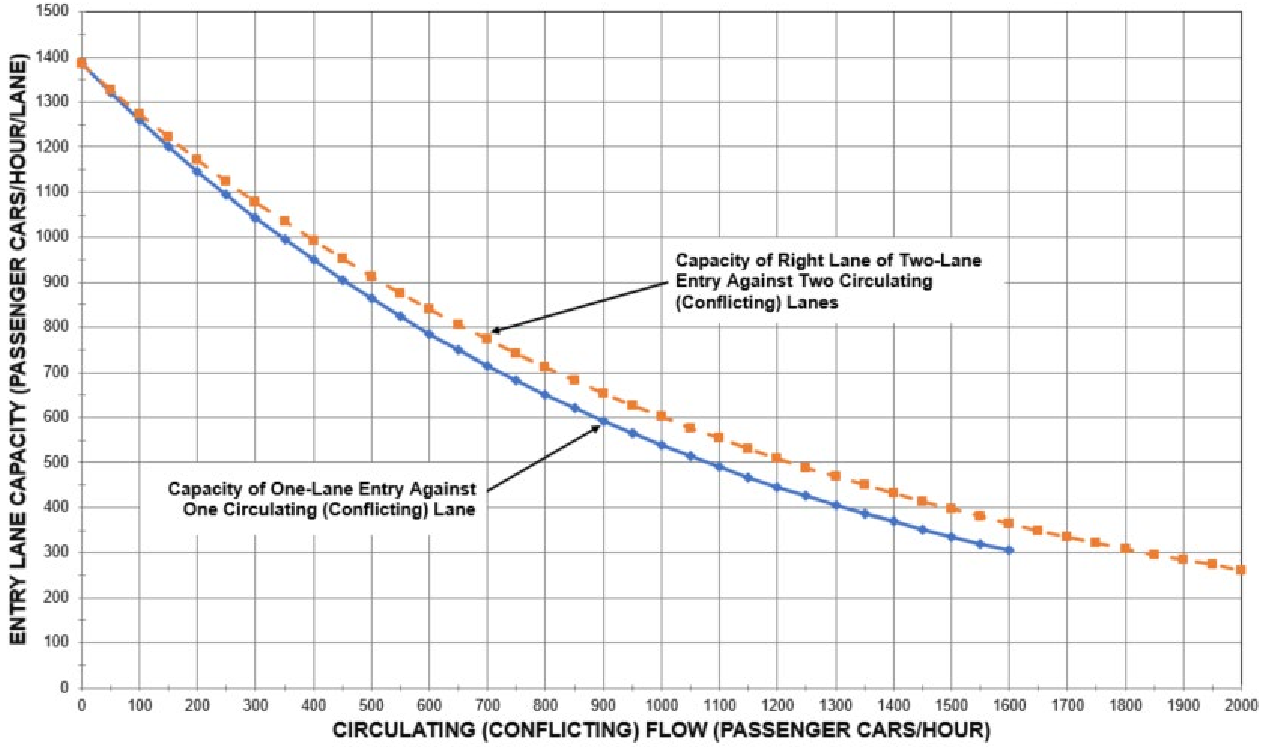


Figure 8.2 ***WisDOT Roundabout Capacity Curves (for planning purposes) [5]***

8.7 Highway Capacity Manual Analysis Techniques

For information on Highway Capacity Manual Analysis Techniques, see TEOpS Chapter 16, Section 15.

8.10 Assessment of Existing Roundabouts

The analyst shall use the HCM procedure to evaluate the capacity of existing roundabouts. For existing roundabouts experiencing delays or significant queuing, the analyst should collect the headway data to calibrate the HCM model. Consult with the Bureau of Traffic Operations Traffic Analysis and Safety Unit (BTO-TASU) for the specifications on how to collect capacity data at existing roundabouts. The results of the HCM procedure may indicate that the existing roundabout requires additional lanes to achieve increased capacity; however, depending on the site-specific conditions, it may be possible to add capacity through changes in pavement markings, signage, geometry, or a combination of the three. Changes to pavement markings, signage and geometric parameters are often less expensive and easier to implement than the construction of additional lanes. Although geometry is secondary to driver behavior in terms of its impact on the capacity of the roundabout, it may be beneficial to conduct geometric sensitivity testing. The analyst can conduct geometric sensitivity testing using SIDRA Standard, Rodel, ARCADY or other geometric sensitive tools to determine if geometric changes will increase the capacity of the existing roundabout without adding more lanes. The ability to measure the capacity of an existing roundabout in the field allows the analyst to calibrate the models (HCM-based models, microsimulation models, and other design-aid tools) to verify the true influence of geometric parameters such as radius at the entry, inscribed circle diameter, conflict angle and flare length.

8.99 References

[1] NCHRP 572, *Roundabouts in the United States*, 2007

[2] Akcelik, R., E. Chung, and M. Besley. *Roundabouts: Capacity and Performance Analysis*. Research Report ARR No. 321, 2nd ed. ARRB Transport Research Ltd, Australia, 1999

[3] *The Traffic Capacity of Roundabouts* TRRL Report LR 942, 1980. Kimber, R.M.

[4] Rodegerdts, L.A., A. Malinge, P.S. Marnell, S.G. Beaird, M.J. Kittelson, and Y.S. Mereszczak. *Assessment of Roundabout Capacity Models for the Highway Capacity Manual: Volume 2 of Accelerating Roundabout Implementation in the United States.* Report FHWA-SA-15-070. Federal Highway Administration, Washington, D.C., Sept. 2015

[5] Traffic Analysis and Design, Inc. (TADI), *Statewide Roundabout Traffic Operations Analysis*, Mar. 2020

FDM 11-26-9 Geometric Design Process and Performance Checks February 14, 2025

The geometric design of a roundabout requires the balancing of competing interests, including considerations of safety, capacity and cost. 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 by affecting driver lane choice and behavior through the roundabout. Roundabout layouts are also governed by the space and swept path requirements of the design vehicle.

Thus, designing a roundabout is a process of determining the optimal balance between safety provisions, operational performance, and accommodation of the design vehicle.

9.1 Design Process and Qualifications

NCHRP 1043, Chapter 9.1 outlines the general roundabout design process and steps that apply to most roundabout designs.

Due to the complexity of a roundabout's geometric and operational aspects, WisDOT has developed a roundabout design process which requires a Qualified Roundabout Designer (QRD) to participate in each roundabout design. A QRD must be involved with each stage of the roundabout design process.

FDM 11-26-9.1.1 describes the required proficiencies for each QRD level and the various roles the QRD may take in completing a roundabout design. FDM 11-26-9.1.2 defines the WisDOT roundabout design process and the critical design elements.

Requirements to become a QRD and a sample application are provided in Attachment 9.1. Application timeframes typically occur in the 4th quarter of even-numbered years and will be announced.

9.1.1 Roundabout Designer Requirements

A qualified designer must meet the skills, knowledge and experience level determined appropriate by the Wisconsin Department of Transportation for roundabout design. A list of QRDs for each of the following 3 levels of roundabout complexity is available on the WisDOT Consultant Resources Roundabout Design webpage.

The region will determine the appropriate QRD Level (1, 2, or 3) for specific projects based on the requirements shown in Table 9.1.

***Table 9.1* QRD Level Requirements**

QRD Level	Roundabout Design Complexity	QRD Proficiencies
Level 1	• Single-lane entries • Up to four legs	• Assess the basic capacity requirements of single-lane roundabouts using the approved analysis software per FDM 11-26-8 and TEOpS Chapter 16, Section 15 • Have the skills, knowledge, and experience to review the critical elements of design (FDM 11-26-9.1.2) pertinent to the roundabout(s) in question • Accommodate design and check vehicles (including evaluation of vertical clearance for OSOW vehicles) using software-based vehicle swept path analysis • Develop data for Roundabout Critical Design Parameters Document (Attachment 9.2) o Design parameters (widths, angles, inscribed circle diameter) o Fastest speed paths o Minimum sight parameters • Inform the region when the roundabout design exceeds the complexity stated above for a Level 1.
Level 2	• Same as Level 1, plus… • Two-lane entries • Bypass lanes • Compact roundabouts • Rehabilitation projects that involve multilane roundabouts	• Same as Level 1, plus… • Properly run the approved capacity analysis software (see FDM 11-26-8 and TEOpS Chapter 16, Section 15) and evaluate alternative lane configurations and output from the software program • Develop special signing and pavement marking needs for two-lane roundabouts • Inform the region when the roundabout design exceeds the complexity stated for a Level 2
Level 3	• All roundabout designs, including but not limited to… • Three or four-lane entries • Five or more legs • Closely spaced roundabouts where the operations of one may have an impact on the operations, signing, or marking of another • There are other multilane roundabouts in close proximity • Lane assignment or lane continuity is difficult to achieve without adding another lane • Reduction in weaving between roundabouts is desired • Queue backup into an adjacent multilane roundabout is possible • Other special needs that have been identified	• A Level 3 QRD must have the skills knowledge and experience to complete all tasks required for the most complex roundabout designs

WisDOT regions, consultants, local agencies such as a counties, townships, municipalities, and developers, etc. shall have a QRD on staff, or contract with a firm with a QRD, to provide the required sign-off on the Critical Design Parameters document for roundabout designs, as described below, for both WisDOT and WisDOT oversight projects.

QRDs may participate in different ways in order to provide the required sign-off on the Critical Design Parameters document.

1. Independently complete the roundabout design. When a WisDOT region, consultant, local agency such as a county, township, municipality etc. or a developer has a roundabout on a project they must have a QRD to oversee or complete all aspects of the plans, specifications and estimate (PS&E) package for

the roundabout according to the 3-Stage Design Process described below.

2. Assist and mentor the project team in their completion of the roundabout design. A WisDOT region, consultant or local agency such as a county, township, municipality etc. or developer that has a roundabout on the project may prefer to contract for assistance or mentoring from a QRD in the plan preparation process. The QRD must directly assist the project team addressing the critical design elements in the Roundabout Design Process described below.
3. Independently review the roundabout design prepared by a project team. When a WisDOT region, consultant, local agency such as a county, township, municipality etc. or developer has a roundabout on the project and the design is prepared without any assistance from a QRD, the roundabout designer is responsible to contract with one of the QRDs to review the critical elements of the design at each stage of the Roundabout Design Process described below. The information to be provided to the QRD at each stage of plans complete is provided below.

Coordinate the proposed roundabout design with a QRD early in the design process. It is better to allow the QRD to be proactive and in a position to suggest modifications rather than to be reactive and lose design options because the design or commitments on the project are too far along.

The QRD's review comments shall be submitted to the project team and the WisDOT region at each Stage. The critical design recommendations from the QRD should be identified clearly so the roundabout design team knows what to modify on the plans. Less critical comments will likely improve the design more toward optimal and should not be taken lightly. A discussion between the QRD, design team, and region may be needed to properly address recommendations in the plans or document the dismissal of the comment(s).

The QRD in consultation with WisDOT will determine which elements of the design are critical in the situation where a dispute may take place. Department personnel are responsible for ensuring that the QRD recommendations and comments are properly addressed by the design team.

9.1.2 The WisDOT Roundabout Design Process

The following information, including Figure 9.1, describes each of the stages of development where it is critical to have a QRD of the appropriate level involved in the roundabout design. There may be a project schedule delay or adverse cost ramifications associated with a roundabout design if each stage of the evaluation is not followed in sequence.

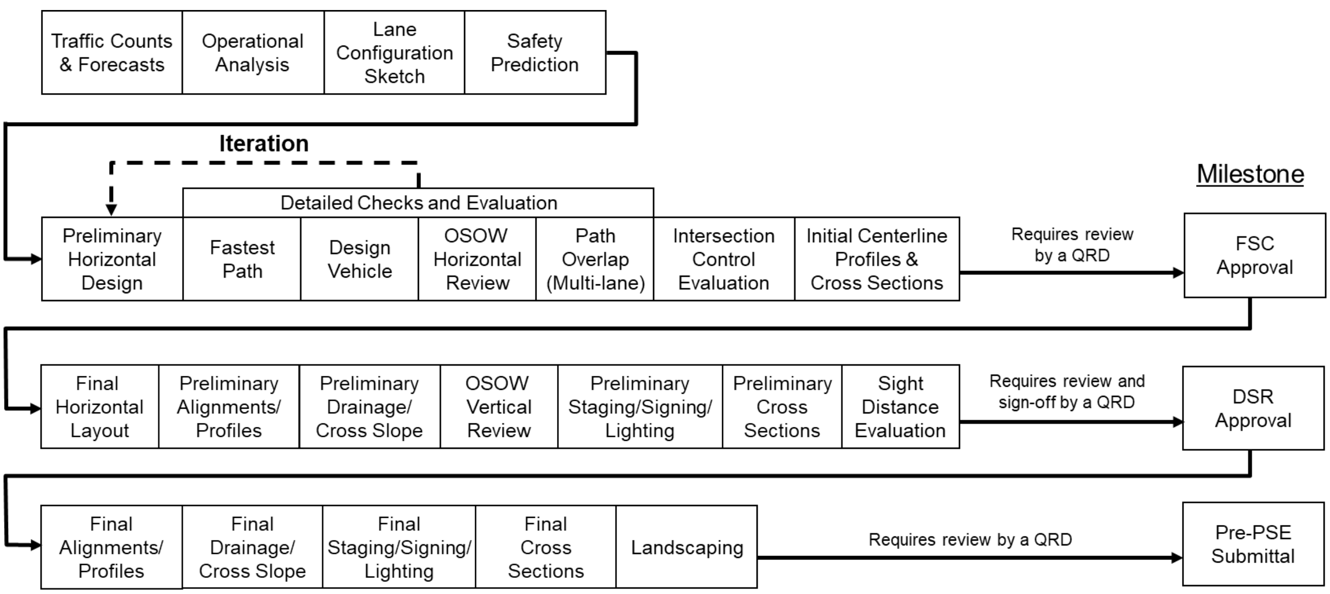


***Figure 9.1** WisDOT Roundabout Design Process*

9.1.2.1 Final Scope Certification (FSC) Approval

As shown in Figure 9.1, review of the roundabout design components by a QRD is REQUIRED prior to FSC approval. It is important that a QRD be involved prior to FSC approval to assure the project feasibility.

The roundabout design process begins with an analysis of the forecasted traffic volumes, determination of the lane configuration, and development of an Intersection Control Evaluation (ICE). A public involvement meeting (PIM) is also typically held prior to Final Scope Certification (FSC) approval to present the intersection alternatives.

The roundabout design should be developed enough for the ICE and PIM to have an idea of right of way needs, raised median locations, access accommodations, OSOW horizontal impacts, major utilities and other potential impacts. A cursory review of centerline profiles for the roadway approaches and circulatory roadway, along with initial cross sections, is also recommended prior to FSC approval to help further evaluate impacts. This initial vertical review could take place after the PIM and before FSC approval.

Review of the roundabout design components by a QRD is required prior to ICE submittals and prior to the PIM. A QRD should also be consulted in the PIM planning process, and it is advisable to have a QRD present at the PIM. Reviewer comments and concept plans should be included as part of the Final Scope Certification document. These requirements for QRD review also apply to local program projects that may not have a FSC milestone.

The critical elements of design that the QRD needs to review prior to FSC approval include:

1. Optimum location and size of circle
2. Lane configurations and operational analysis
3. Lane markings and pavement arrows for multilane roundabouts only
4. Highly developed design that shows face of curb locations, crosswalks, splitter islands, shared-use path, bike ramps, truck apron, etc. with appropriate widths
5. Accommodation of design vehicles and required check vehicles
6. Fast paths with speed calculations for R1 through R5
7. Initial centerline profiles of the circulatory and approach roadways, and initial cross sections

9.1.2.2 Design Study Report (DSR) Approval

Prior to DSR approval, complete design revisions recommended by the QRD from the previous FSC design. At this stage, a QRD is required to review the critical design elements identified below. Review comments and design adjustments shall be incorporated in the plans prior to DSR approval. The QRD shall sign the Critical Design Parameters document (Attachment 9.2) for attachment to the DSR. One of the primary critical elements of design at this stage is the vertical control with each leg having vertical profiles, circulating roadway profile, crown location, slope intercepts, central island grading, drainage consideration with inlet locations, and spot elevations.

The critical elements of design that the QRD needs to review prior to DSR approval include:

1. Horizontal design changes implemented
2. Roadway profiles on each leg
3. Circulating roadway profile
4. Crown location, cross slopes, spot elevations
5. Crosswalks, sidewalks, and curb ramps for ADA compliance
6. Vertical OSOW analysis
7. Central island grading design
8. Drainage design/inlet locations
9. Preliminary light standard locations
10. Preliminary stopping sight distance for - approach, circulatory roadway, crosswalk and exit, and the intersection sight distance
11. Signing plan, (identify the need for large green and white guide signs, overhead guide signs, or other non-typical installations)
12. Pavement marking plan for multilane roundabouts
13. Identify major utility conflicts (i.e. utility conflicts that may result in relocating the circle)
14. Preliminary typical sections
15. Consider preliminary construction staging layout and identify potential staging conflicts, such as access control, large grade differences between stages, etc. that may impact the design

9.1.2.3 Pre-PS&E Submittal

Prior to Pre-PS&E submittal, finalize the vertical, drainage, pavement marking, signing, lighting, landscaping plans, and construction staging. At this stage, a QRD is required to review the critical design elements identified below. Review comments and design adjustments shall be incorporated in the plans prior to Pre-PS&E submittal.

The critical elements of design that the QRD needs to review prior to the Pre-PS&E submittal include:

1. Final plan and profile with any vertical and horizontal control details included for field layout.

2. Final signing and pavement marking plan.
3. Final landscaping and lighting plan.
4. Final construction staging plan.

9.2 Design Principles and Objectives

For information on Design Principles and Objectives, see NCHRP 1043, Chapter 9.2.

9.3 Performance Checks Overview

Roundabout performance checks evaluate how well a design meets its performance objectives. Checks are completed throughout all steps and iterations of a roundabout design. The following sections discuss the primary roundabout performance checks.

See NCHRP 1043, Chapter 9.3 for additional information.

9.4 Geometric Speeds

Vehicular speed is foundational to roundabout safety performance and is a product of roundabout geometry. A well-designed roundabout reduces vehicle speeds upon entry and minimizes differences in relative speed between conflicting traffic streams. Ideally, the relative differences between all speeds within the roundabout will be no more than 10 to 15 mph.

See NCHRP 1043, Chapter 9.4 Geometric Speeds for information on evaluating vehicle speeds through a roundabout. Additional guidance is provided in the following sections.

9.4.1 Assessing Geometric Speed Using Fastest Paths

Fastest paths are the smoothest, fastest path possible for a single vehicle in the absence of other traffic and ignoring all lane line markings, traversing through the entry, around the central island, and out the exit. Speeds are calculated along the fastest paths at five critical points for each roundabout approach by approximating the path radius at each location. Fastest paths provide a surrogate for the potential safety performance of a design, and they provide design values for other design checks.

See NCHRP 1043, Chapter 9.4.1 for illustrations of the fastest paths and definitions of the critical path radii.

9.4.2 Developing Fastest Path Alignments

Draw fastest paths using a CAD-based spline method. Guidance is provided in Attachment 9.3.

See NCHRP 1043, Chapter 9.4.2 and Appendix A.1.2 for additional information on Developing Fastest Path Alignments.

9.4.3 Estimating Speeds from Fastest Paths

Estimate vehicle speed in accordance with NCHRP 1043, Chapter 9.4.3, Equations 9.3 and 9.4.

Where an exit design is tangential or has a large radius, calculate the R3 fastest path speed based on acceleration from the midpoint of the R2 location to the R3 location (middle of the proposed crosswalk or 50' from the ICD if a crosswalk is not present) using NCHRP 1043, Equation 9.7.

9.5 Sight Distance and Visibility

Provide stopping sight distance, intersection sight distance, decision sight distance, and view angles at roundabouts as described in NCHRP 1043, Chapter 9.5 and discussed in the following sections.

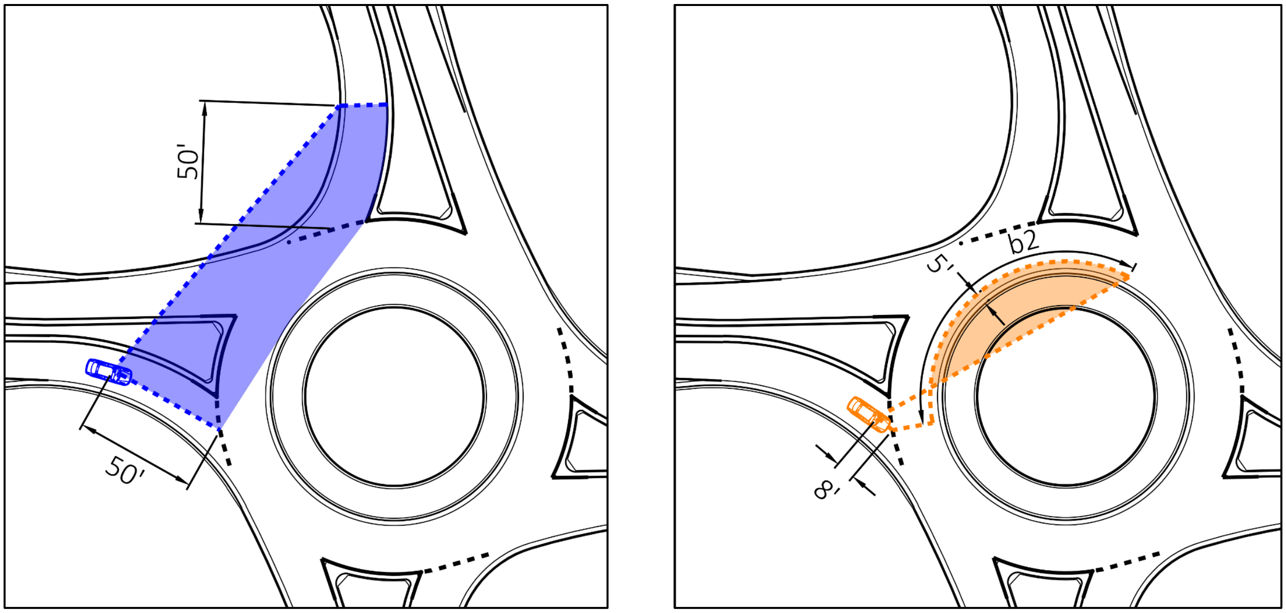
9.5.1 Stopping Sight Distance

Adequate stopping sight distance must be provided at roundabouts. Check stopping sight distance as described in NCHRP 1043, Chapter 9.5.1 and Appendix A.2.

The pedestrian waiting area shall be defined as 5 feet from the back of the curb at the center of the curb ramp. Stopping sight distance values shall be in accordance with FDM 11-10-5.1.

9.5.2 Intersection Sight Distance

NCHRP 1043, Chapter 9.5.2 describes two conditions for checking intersection sight distance. For WisDOT roundabouts, check intersection sight distance to the upstream entry following NCHRP 1043 “intersection sight distance in advance of the entry” guidance, and as illustrated in Figure 9.2a. Check intersection sight distance to the circulatory roadway following NCHRP 1043 “intersection sight distance at the entry” guidance, and as illustrated in Figure 9.2b.



(a) Sight to upstream entry ***(b) Sight to circulatory roadway***

Figure 9.2 WisDOT Intersection Sight Distance Checks

See NCHRP 1043, Chapter 9.5.2 and Appendix A.2 for more information on intersection sight distance at roundabouts.

9.5.3 Decision Sight Distance

Check decision sight distance in accordance with FDM 11-10-5.1.1.2.

See NCHRP 1043, Chapter 9.5.3 for more information on decision sight distance at roundabouts.

9.6 Vehicle Path Alignment

Vehicle path alignment is a design check specific to multilane roundabouts. The natural path of a vehicle is the path it will take based on the speed and orientation imposed by the roundabout geometry. Designers should determine the natural path by assuming the vehicles stay within their lane up to the yield point. At the yield point, the vehicle will maintain its natural trajectory into the circulatory roadway. The vehicle will then continue into the circulatory roadway and exit with no sudden changes in curvature or speed. If the roundabout geometry tends to lead vehicles into the wrong lane, this can result in operational or safety deficiencies.

Path overlap occurs when the natural paths of vehicles in adjacent lanes overlap or cross one another. It occurs most commonly at entries, where the geometry of the right-hand lane tends to lead vehicles into the left-hand circulatory lane. However, vehicle path overlap can also occur at exits, where the exit geometry or pavement marking of the exit tends to lead vehicles from the left-hand lane into the right-hand exit lane.

See NCHRP 1043, Chapter 9.6 and Appendix A.3 for additional information on vehicle path alignment and path overlap design checks.

See FDM 11-26-10.7.4. for additional information on designing for good vehicle path alignment on multilane roundabouts.

9.7 Design Vehicles

WisDOT is a freight friendly state and accommodates not only for the typical large legal-size trucks, but also the OSOW (permitted) vehicles that use our highways. FDM 11-25-2.1 describes the types of design vehicles and check vehicles that should be accommodated at intersections, including roundabouts.

For multilane roundabouts, NCHRP 1043 describes two cases for truck accommodation: Straddle lanes and stay-in-lane. Straddle lane design is equivalent to WisDOT's Case 1 design where trucks encroach on adjacent lanes entering and circulating the roundabout. Stay-in-lane design is equivalent to WisDOT's Case 3 design where trucks stay in lane while approaching, entering, circulating, and exiting the roundabout.

See FDM 11-26-10.5.3 for additional information on accommodating trucks in multilane roundabouts.

LIST OF ATTACHMENTS

Attachment 9.1	Requirements for Qualified Roundabout Designers (QRD) and Sample Application
Attachment 9.2	Roundabout Critical Design Parameters Document
Attachment 9.3	Creating Roundabout Fastest Paths (Spline Curves)

FDM 11-26-10 Horizontal Alignment and Design — August 15, 2025

This section provides guidelines for each geometric element. Note that multilane roundabout entry design is significantly more challenging than single-lane entry design. Many of the techniques used in single-lane roundabout entry design do not directly transfer to multilane design. This procedure provides supplemental information that in some cases provides more detail and in other cases may differ slightly from guidance provided in NCHRP 1043, Chapter 10.

Compact roundabouts are also significantly more challenging than other single-lane roundabout designs. The basic principles described in the following sections that apply to single-lane roundabouts generally apply to compact roundabouts with a few exceptions. Additional guidance for compact roundabouts is discussed in FDM 11-26-10.6.8.

10.3 Horizontal Design Performance Influences

10.3.1 Alignment of Approaches and Entries

Adherence to the principles of deflection is crucial to the operation and safety of roundabouts. WisDOT considers this design element to be of the utmost importance. Figure 10.1 shows the typical composition of approach alignment and curves to generate typical speed reduction at entries.

It is recommended design practice (especially in multilane roundabouts) to provide an offset to the left of the center of the central island. In some situations, it may be appropriate to provide an offset of approximately 20 to 30 feet (or more), left of the center of the roundabout to achieve proper deflection and appropriate entry speeds.

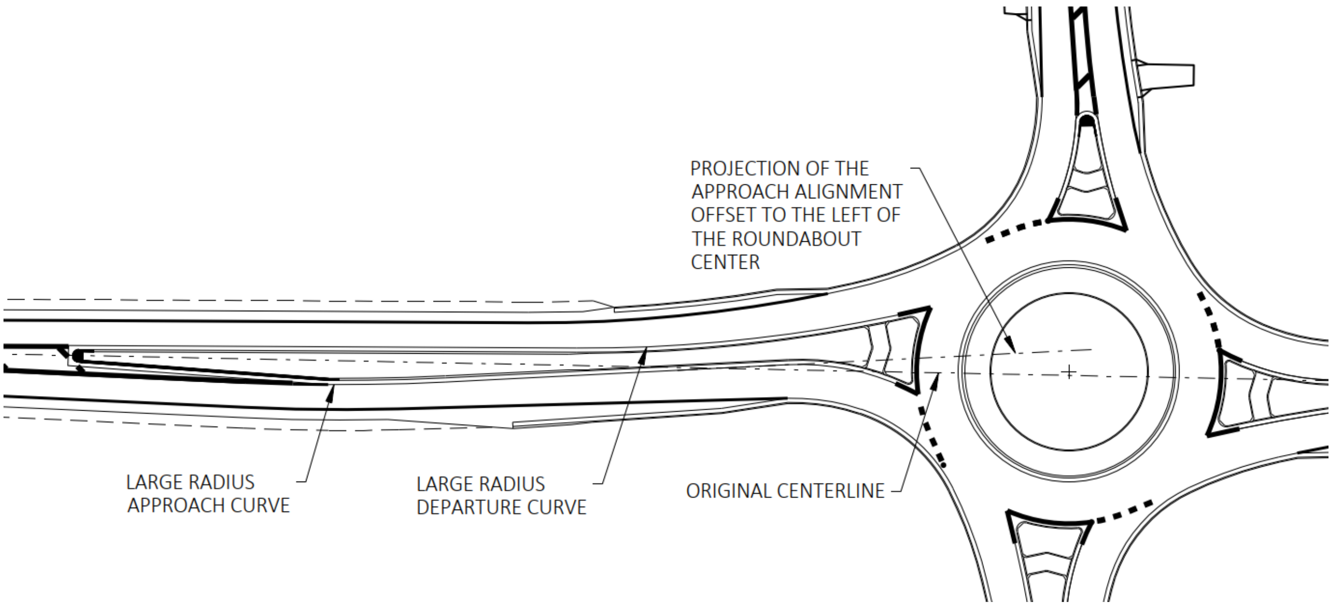


***Figure 10.1* Entry Deflection**

10.3.1.2 Impact of Cost Reduction on Roundabouts

In many cases, the process of developing and designing a roundabout may involve many design modifications, which are intended to decrease costs. While this is common to conventional design practices it can have a hidden detrimental effect on design and operations of roundabouts.

Landscaping is often considered an aesthetic feature, which can be removed from the plan to reduce overall cost. However, in some cases, landscaping can be used to reduce sight distances to only what is needed which can help reduce speeds and increase safety.

Reduction of right of way acquisition is often seen as an obvious cost reduction measure, but the trade-offs of safety and operations may not be apparent to the deciding authority. Other elements such as overhead signing (on approaches) are similarly looked at as excessive and is often replaced with terrace signing, despite the rationale that these features improve the function and safety of the intersection. Designers should be sensitive to the need for cost savings and should strive to effectively document and communicate the impact that the proposed design modifications will have on the function and safety of the roundabout. The designer should be given the opportunity to recommend an alternate modification, which will provide required cost savings while having the minimum amount of impact on function and safety.

Eliminating certain project design elements can result in lower cost and improved value without adverse effect on the safety and capacity. As an example, while it is ideal to align the legs to intersect at approximately 90-degrees (see Figure 10.2), roundabouts can be designed to leave an existing skew in place (see Figure 10.3). In some cases, the use of an oval rather than a circle can help facilitate truck turning movements (see Figure 10.4).

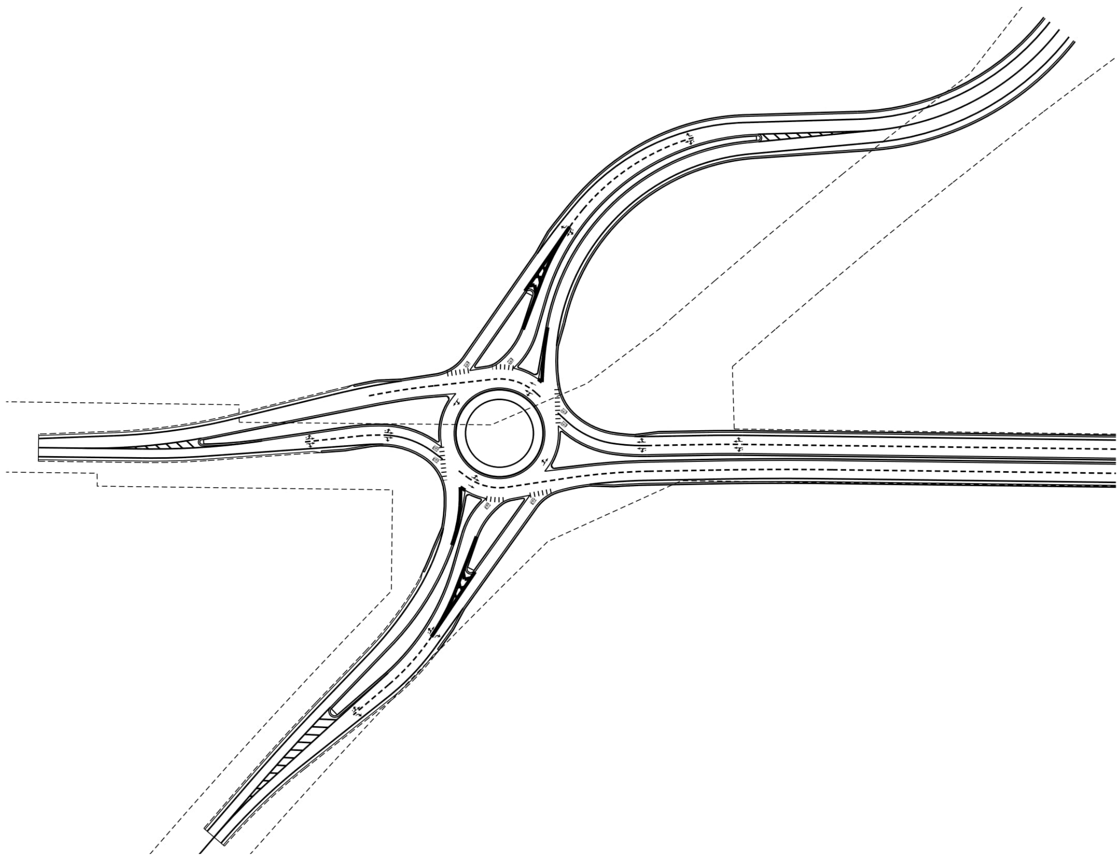


Figure 10.2 ***Squared Roundabout***

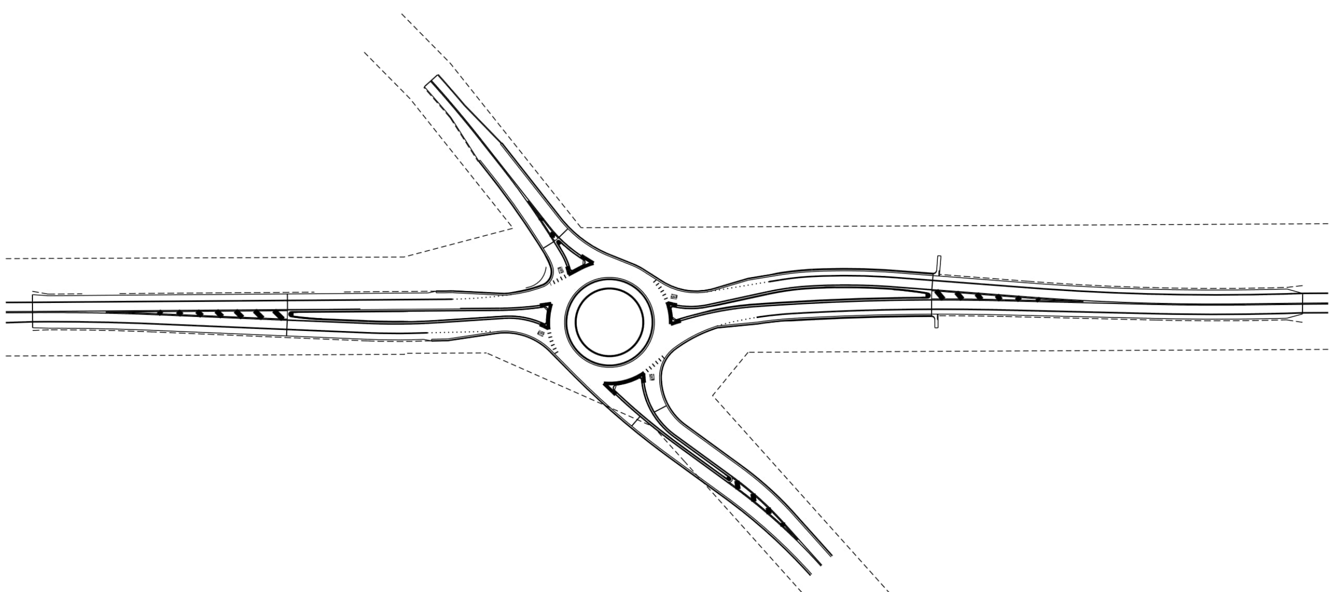


Figure 10.3 ***Skewed Roundabout***

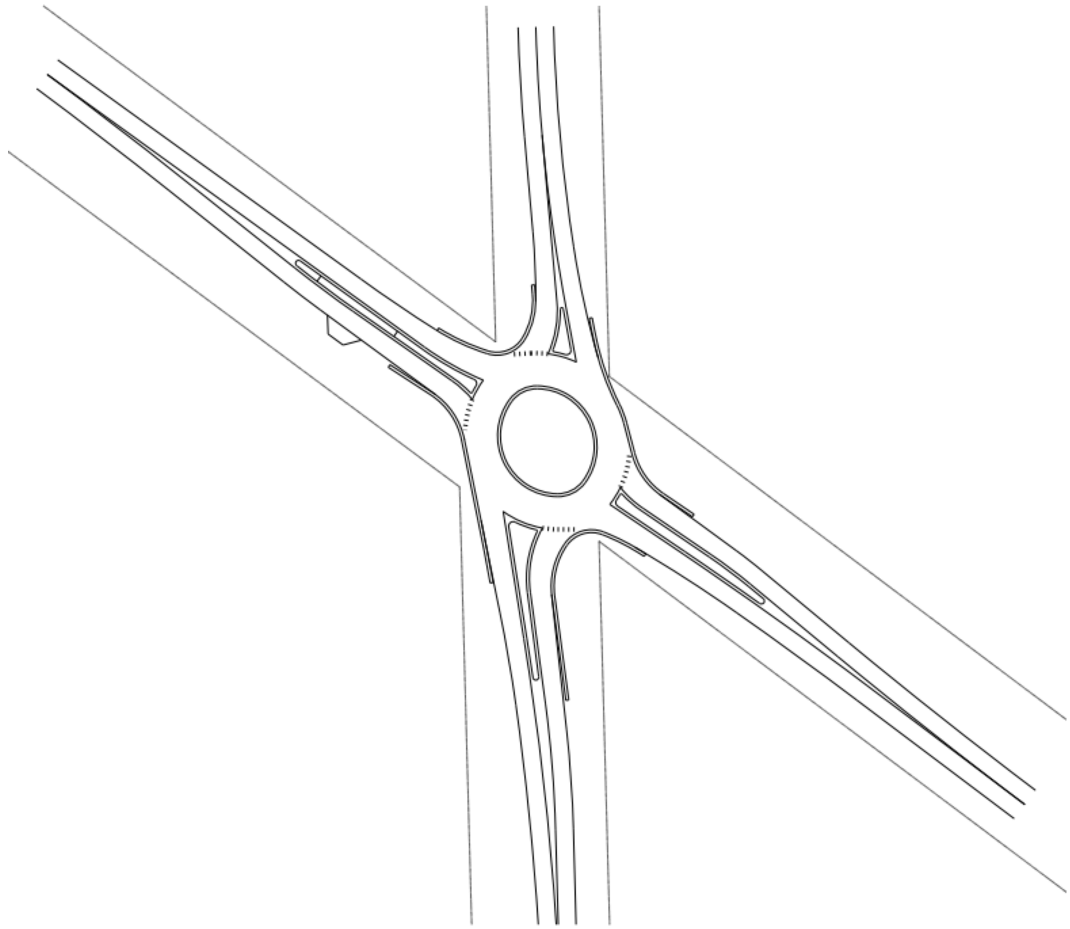


Figure 10.4 ***Oval Roundabout***

The use of compact roundabouts in place of single-lane roundabouts can also save costs. However, the operations and safety of the compact roundabout may be less than that of a single-lane roundabout. Consider the trade-offs carefully when considering a compact roundabout. The decision to use a compact roundabout rather than a single-lane roundabout should be documented in the Intersection Control Evaluation.

10.4 Design for People Walking and Biking

Roundabouts like other intersections need to accommodate bicyclists and pedestrians. The types of facilities provided vary based on the existing urban, suburban and rural conditions as well as future land uses. Evaluate regional and local land use plans including stand-alone bike and pedestrian plans for communities when determining the appropriate bike and pedestrian facilities at a roundabout. See FDM 11-46-1 for guidance on including bike and pedestrian facilities on projects.

Pedestrian accommodations include sidewalks, shared-use paths and roundabout sidepaths. See FDM 11-20-1, FDM 11-46-5, and FDM 11-46-10 for design standards on Pedestrian Facilities. See FDM 11-46-15 and Wisconsin Bicycle Facility Design Handbook for shared-use paths design standards. A sidewalk transitions to/from a roundabout sidepath as it approaches/departs an isolated roundabout. At locations with consecutive closely spaced roundabouts, a sidewalk transitions to a roundabout sidepath at the first upstream roundabout, and transitions from a roundabout sidepath at the last downstream roundabout. See FDM 11-26-10.4.1 for further design guidance.

Bicycle accommodations include bike lanes, wide curb lanes, urban paved shoulders, rural paved shoulders, shared-use paths and roundabout sidepaths. Although a shared roadway is not a bicycle accommodation, shoulders or bike lanes taper down and end just prior to the entrance to a roundabout. Tapers are necessary to help achieve proper speed control for vehicles at entry. Design requirements do not allow bike lanes or shoulders at the yield line or within the circulatory roadway of a roundabout. Bicyclists in Wisconsin have the right to use the roadway in the same manner as motor vehicles. Bicyclists may have concerns when traveling into, through, or around roundabouts depending on traffic volume, vehicle type composition, experience of the bicyclist, lighting or other factors. Therefore, a bicyclist approaching a roundabout may proceed in a travel lane (“take the lane”) or exit the roadway by way of a ramp and ride on a roundabout sidepath (or a shared-use path, if applicable). See FDM 11-26-10.4.2 for guidance on bike exit and entrance ramps. These ramps are located where the shoulder or bike lane tapers and a sidewalk transitions to/from a roundabout sidepath.

Shared-use paths are typically community or regional facilities in their own corridors that may extend for miles. Shared-use paths support a wide variety of non-motorized travelers like bicyclists, in-line skaters, roller skaters, wheelchair users, walkers, runners, people with baby strollers or people walking dogs (typically not equestrian users or motorized users - although some state trails in Wisconsin allow snowmobiles). Shared-use paths are designed for bi-directional bicycle travel. Continue a shared-use path around roundabouts (and between consecutive roundabouts if applicable) following shared-use path design criteria. See FDM 11-46-15.6 and the Wisconsin Bicycle Facility Design Handbook for more guidance on shared-use paths. Also, see FDM 11-35-1.6 and FDM 11-35 Attachment 1.1.

The roundabout splitter islands provide pedestrian refuge and pedestrian crossings. At roundabouts with high traffic volumes, or where pedestrian or bicyclist volumes are high, consider accommodating both user types by enhancing the pedestrian crossings with features such as:

- 6-inch white crosswalk marking next to colored concrete (Wisconsin MUTCD (WMUTCD), 3C, 3H, 7C.01)
- Colored concrete with 6-inch wide patterned borders with white crosswalk markings, note main walking surface is smooth
- Activated (push button or automatic detection) warning beacons (e.g., Rectangular Rapid Flashing Beacon)

10.4.1 Roundabout Sidepaths and Terraces

Roundabout sidepaths are a variant of shared-use paths that apply specifically to roundabout intersections and between consecutive closely spaced roundabouts. A roundabout sidepath is located around the perimeter of an isolated roundabout, or between consecutive closely spaced roundabouts and around their perimeters. Consecutive roundabouts are closely spaced if they are 1,000 feet or less from center to center. Roundabout sidepaths are designed with the expectation that bicyclists are traveling in a unidirectional manner (i.e. one-way bicycle travel in the same direction as traffic flow on that side of the roadway) and do not connect to shared-use paths.

Where an existing or proposed standard sidewalk approaches either end of a roundabout, provide at least an 8-foot wide roundabout sidepath when sidepath use is anticipated to be low or medium around and between the roundabout(s). The width of the sidepath should remain consistent through the roundabout(s). When two-way bicycle travel is expected, or the facility leading up to the roundabout is a shared-use path, or path use is anticipated to be high (frequent passing of users), install a 10-foot wide sidepath. There are many reasons to anticipate high use such as nearby parks, schools, universities, gas/convenience stores, restaurants, limited crossing locations, etc. Coordinate with the regional bicycle and pedestrian coordinator on the level of anticipated sidepath use.

In a suburban or rural area, there may be locations with on-road bicycle accommodations but without sidewalks (existing or proposed) (see FDM 11-46-1.3.1.4). In this case, 6-foot wide roundabout sidepaths are appropriate. Coordinate with the regional bicycle and pedestrian coordinator to determine the appropriate widths.

For a series of closely spaced roundabouts, extend the roundabout sidepath or shared-use path from the first bicycle exit ramp to the last bicycle entrance ramp, for the bicyclist to leave the roadway and travel through all roundabouts on the roundabout sidepath. Do not provide entrance ramps for bicyclists to re-enter the roadway between closely spaced roundabouts (1,000 feet or less between roundabout centers). However, provide exit ramps from the roadway to the sidepath prior to the approaching roundabout.

When the distance between any two roundabouts is greater than 1,000 feet, center to center, then the roundabout sidepath may be discontinued beyond the last roundabout. Provide entrance ramps for bicyclists to re-enter the roadway downstream from each roundabout as well as exit ramps from the roadway to the sidepath. Where pedestrian facilities are provided, existing or proposed, continue the facility (e.g., sidewalk) between the roundabouts.

For roundabouts at rural locations, sidepaths around the roundabout should be considered, but are not required. In these instances, the bike ramps and sidepaths should be discussed and displayed at an initial public meeting. If support for sidepaths is not shown, coordinate with the regional bicycle and pedestrian coordinator on whether sidepaths should be included on the project, or if a platform should be graded for future facilities (e.g., grading for a 5-foot terrace and a 6-foot sidepath). There may be situations where grading for future facilities would have extensive right of way or environmental impacts, in which case grading would not be required. Consider constructing cut-throughs and curb ramps in the splitter island for the future pedestrian crossings.

A terrace is required between roundabout sidepaths and the back of curb. Terraces should be designed to be 5 feet wide, or greater. Where space is limited, the terrace may be no less than 3 feet wide. If there is an overtracking pad adjacent to a roundabout entry or exit, a minimum terrace of 3 feet is required between the sidepath and the overtracking pad. Terraces should be planted with grass to facilitate wayfinding to aid pedestrians with visual impairments to the appropriate crossing location. Smooth concrete and most stamped concretes do not meet ADA requirements for separation per PROWAG and NCHRP 834. Detectable warning fields are not to be used as an edge treatment. Tactile walking surface indicators are an emerging edge treatment currently being researched nationally and may become a future option.

10.4.1.1 Crosswalks and Splitter Islands

Crosswalk placement at roundabouts affects all users, particularly for people with visual impairments. Research and national guidance have identified four principal tasks necessary for crossing the street, these are:

- finding the crosswalk and identifying the crossing location;
- aligning to cross in the direction of the crosswalk;
- deciding when to initiate crossing or identifying a gap in traffic; and
- maintaining alignment while crossing and staying within the crosswalk.

To facilitate these crossings, the design of the roundabout must provide the geometric and informational cues needed for pedestrians to make decisions in crossing.

For WisDOT roundabout projects, an angled crosswalk design alignment for each leg of the crosswalk is to be provided at both entry and exit lanes (Figure 10.5). Only compact roundabouts may use straight crosswalks if necessary. The cross slope of the roadway at the pedestrian street crossing (crosswalk) shall be 2% or less.

The standard angled crosswalk placement is 25-30 feet from the yield line on single-lane roundabouts, as illustrated in Figure 10.5. At multilane roundabouts, the crosswalk can be angled as shown in Figure 10.6 or offset as shown in Figure 10.7. For angled crossings on multilane roundabouts, place the crosswalk 30-50 feet from the yield line, which results in the exit crosswalk located approximately 40-60 feet from the circulating roadway. For offset crossings on multilane roundabouts, place the crosswalk 25-30 feet from the yield line and 40-60 feet from the exit. This space between the circulatory roadway and the roundabout exit crosswalk for both multilane crossing configurations allows drivers more time to react to crossing pedestrians, especially for right turning vehicles, provides more time for motorists to transition focus from exiting the roundabout to focusing on the downstream crosswalk, and allows for two vehicles to queue at the crosswalk without blocking the circulating roadway. For all single-lane and multilane crosswalk designs, the crossings should be perpendicular to the outside curb and gutter to help align pedestrians to the crossing.

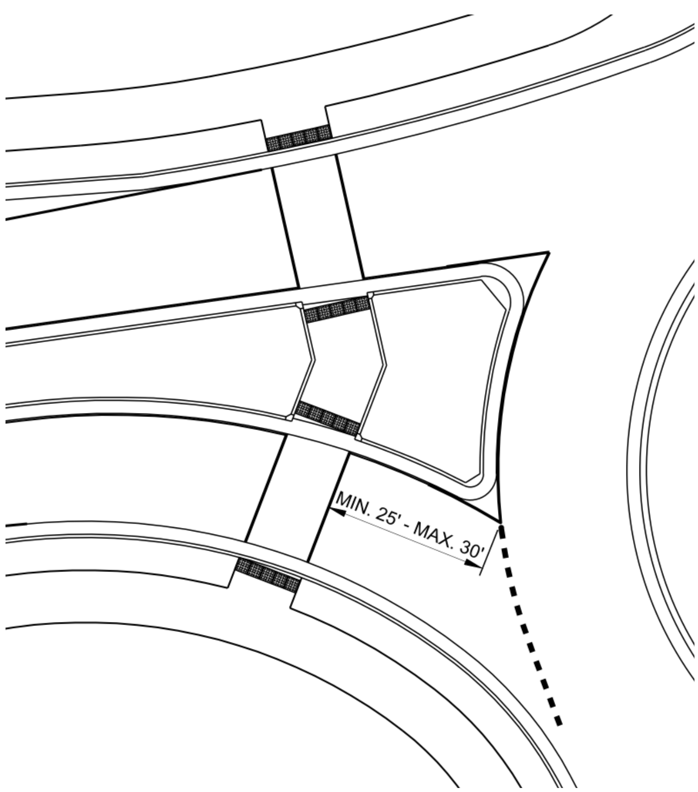


***Figure 10.5* Single-lane Angled Crosswalk Design**

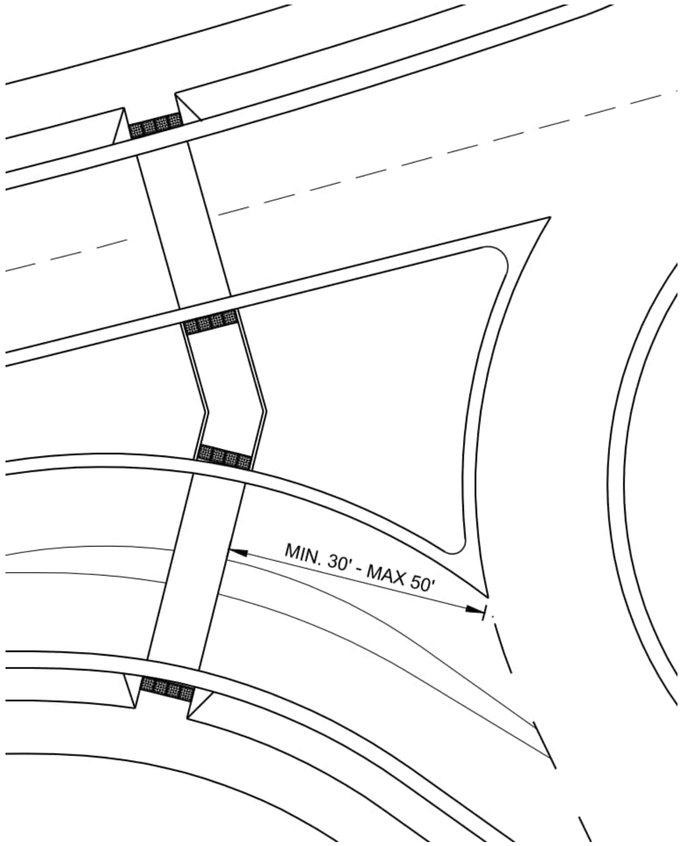


Figure 10.6 ***Multilane Angled Crosswalk Design***

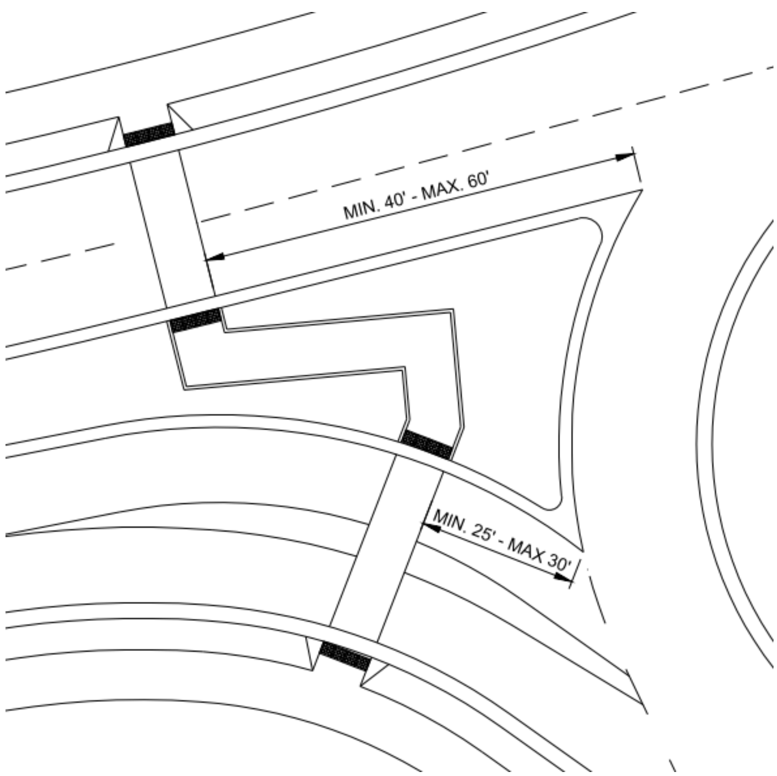


Figure 10.7 ***Multilane Offset Crosswalk Design***

Both angled and offset crosswalk designs are acceptable at multilane roundabouts. There are advantages and disadvantages for each of these crossing designs; a few are listed in Table 10.1. It is important to consider the roundabout geometrics, location context, site conditions, frequency in gaps for crossing, crossing sight distance, and ease of alignment of the crossing for people of all ages and abilities to use. Overall maintenance, including snow removal, is also a consideration. If the offset crosswalk design is used, it should be discussed and agreed upon with the maintaining authority due to the extra challenge with snow removal.

***Table 10.1* Advantages and Disadvantages of Multilane Crosswalk Types**

Category	Advantages	Disadvantages
Angled	Perpendicular alignment often easier for crossing. Minimizes crossing distance. Snow removal may be easier through the splitter island. Splitter island can be narrower, usually requiring less right of way.	If RRFB’s are installed, more separation is needed between the push buttons on the poles in the splitter island (10’ required) and the two-stage crossing is not as clearly defined. The crosswalk on the entry to the roundabout is moved farther away from the yield line, and speeds at the crosswalk location may be faster.
Offset	More clearly defines the two-stage crossing for pedestrians. If RRFB’s are installed, adequate separation of the push buttons on the poles is more easily accommodated. The crosswalk on the entry to the roundabout can remain closer to the ideal location of behind one queued vehicle.	Construction may be more difficult and costly. A wider splitter island is required which may need right-of-way. Snow removal may be challenging in the splitter island.

The width of the pedestrian cut-through in the splitter island should match the width of the approaching sidewalk or path facilities (e.g., a 10-foot wide shared-use path requires a 10-foot wide pedestrian cut-through in the splitter island). If the approaching facilities are less than 6 feet, then the splitter island cut-through shall be a minimum of 6 feet wide. The length of the pedestrian refuge within the splitter island should be a minimum of 6 feet long (between curb backs) with detectable warning fields that shall extend the full width of the crossing. Detectable warning fields in the splitter island must be separated by a minimum of 2 feet. See Figure 10.8. If rectangular rapid flashing beacons (RRFBs) will be installed with the roundabout construction, or if future RRFB installation is anticipated, a longer pedestrian refuge is required, see FDM 11-26-10.4.3.

See FDM 11-26-10.6.8 for further guidance on compact roundabouts.

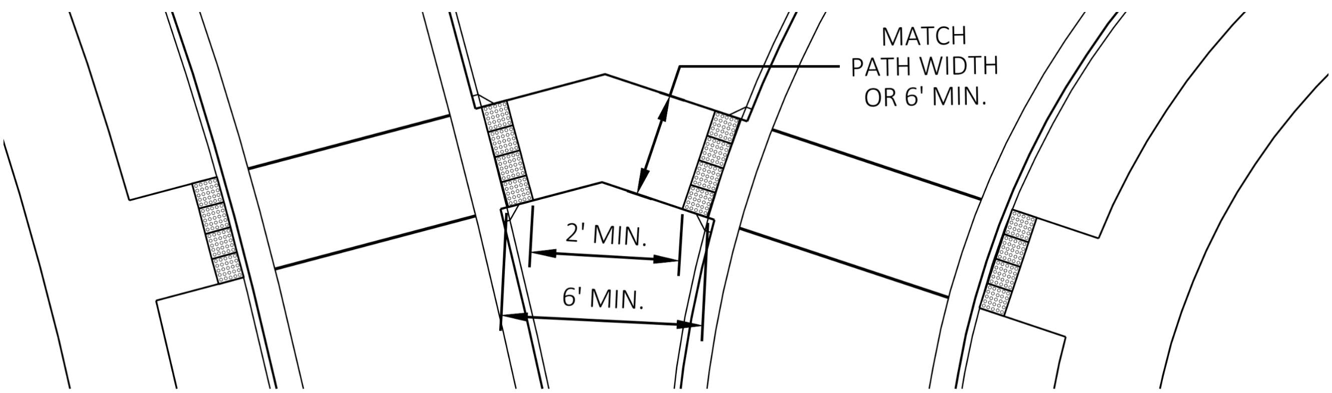


***Figure 10.8* Minimum Pedestrian Cut-through Dimensions**

10.4.1.2 Pedestrian Crossing and Overtracking Pad Design Guidance

If overtracking pads are to be provided on the outside of the roundabout, attempt to keep the crossing from going through the overtracking pad. For situations where crosswalks are not able to be placed outside the limits of overtracking pads, provide ADA compliant curb ramps within the overtracking pad. The curb ramp within the overtracking pad should remain the same concrete thickness and coloring as the rest of the overtracking pad. The detectable warning field is to be placed at the back of curb. The detectable warning field shall be yellow to provide a contrast against the red colored overtracking pad.

See Figure 10.9 for a typical design of a curb ramp through an overtracking pad.

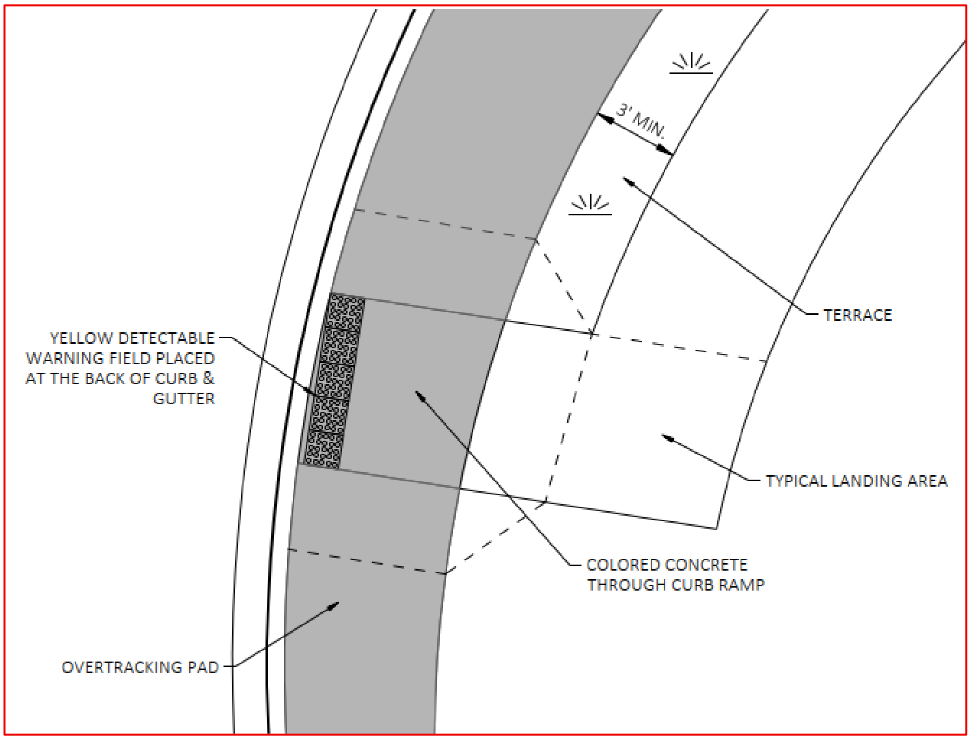


Figure 10.9 ***Curb Ramp Through an Overtracking Pad***

If the proposed outside sidewalk is not going to be installed with the initial construction of the roundabout, the overtracking pad should be sloped for future accommodation of a curb ramp and landing. Detectable warning fields should not be installed with the initial construction.

10.4.2 Bike Ramp Entrance and Bike Ramp Exit Design Guidance

End the on-road bicycle accommodations approximately 75 to 150 feet upstream of the yield line and allow the bicyclist an opportunity to leave the roadway by way of a bicycle exit ramp. More distance is needed when a right turn bypass lane is provided. The bike ramp exit should have relatively flat angles as shown so that bicyclists are not directed into the path of pedestrians. The bike ramp entrance should have relatively flat angles as shown so that bicyclists are not directed into the travel lane of motorized vehicles. The bike entrance ramp should not be directed parallel to the bike lane.

The location of bike ramps and driveway aprons need to be spaced so as not to conflict with each other.

Design the bike ramps 4 feet wide between the roadway and the roundabout sidepath such that they angle up (25 to 35 degrees) to the path where the bicycles exit the roadway and angle down (25 to 35 degrees) toward the roadway where the bicycles re-enter the roadway. See Figure 10.10.

See FDM 11-26-10.6.8.8 for further guidance on compact roundabouts.

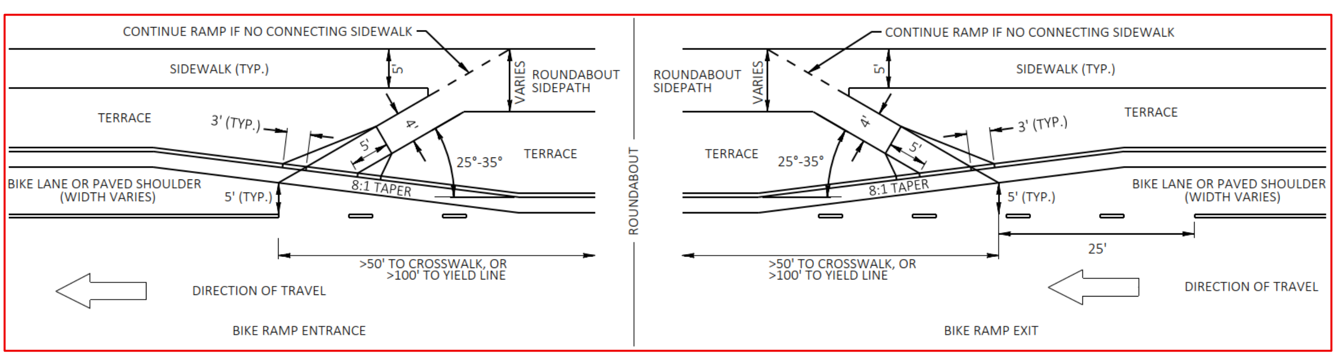


Figure 10.10 ***Bike Ramp Entrance and Exit***

10.4.3 Rectangular Rapid Flashing Beacons (RRFB) Placement Guidance

When used, RRFBs should be placed in front of/upstream of the crosswalk. RRFBs should be set up as two-staged crossings where the signal is only activated for the entry or exit that the pedestrian is crossing. Pedestrians would then be required to activate the second stage of the crossing within the splitter island to complete their crossing of the leg. RRFBs should include an audible push button and poles should be placed a minimum of 10 feet apart per ADA standards.

See TEOpS 4-5 for the design and installation of RRFBs.

See Figure 10.11 on the typical placement of RRFBs.

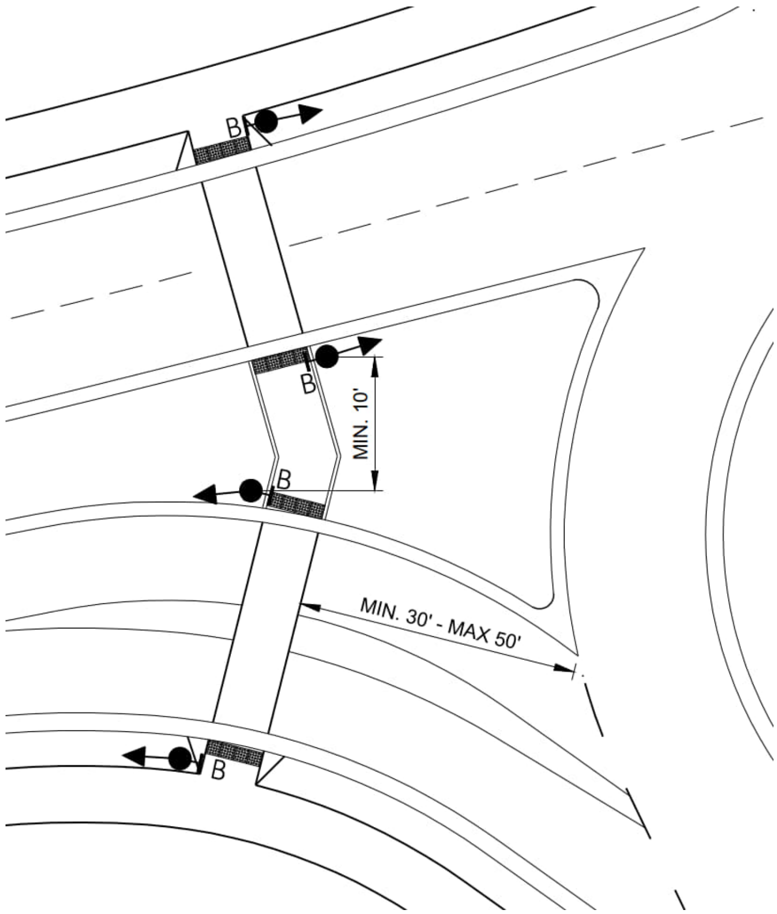


***Figure 10.11* RRFB Placement at Roundabouts**

10.4.4 Roadway Width, Clear Roadway Width of Bridges, and Underpasses between Closely Spaced Roundabouts

At a minimum, multilane roadways with a raised curb median between opposing roadways and between closely spaced roundabouts require a 2-foot median shoulder, two or more 12-foot lanes, and a 4-foot minimum outside shoulder, a 5-foot terrace adjacent to a shared-use path or roundabout sidepath. If there are trees planted in the terrace the minimum terrace width is 6-foot wide.

At a minimum, single-lane roadways with a raised curb median between opposing roadways and between closely spaced roundabouts require 19 feet minimum from curb face to curb face. This typically allows for a 2-foot median shoulder, one 12-foot lane and a 5-foot minimum shoulder on the outside, followed by a 5-foot terrace and either a roundabout sidepath or a shared-use path. If there are trees planted in the terrace the minimum terrace width is 6-foot wide. A single-lane roadway between opposing roadways and between closely spaced roundabouts without a raised curb median requires a minimum of 32 feet from curb face to curb face.

If there is an overpass structure between two closely spaced roundabouts (1,000 feet or less between roundabout centers), and a roundabout sidepath is provided around the outside of the roundabouts, then the roundabout sidepath is at least 2 feet wider on the structure (Figure 10.12). A roundabout sidepath will typically not have a barrier wall separating the path from the roadway. Vehicle travel between closely spaced roundabouts is considered a low-speed environment (40 mph or less) and bicycle travel is expected to be unidirectional thus barrier walls between the roadway and path are not required. When there is a barrier proposed between the roadway and a roundabout sidepath, the sidepath is level with the roadway (not a raised sidewalk).

See Figure 10.12 and FDM 11-35-1.6 and FDM 11-35 Attachment 1.1 pages 1 and 2. Section B-B shows a section view of a raised curb roundabout sidepath. A barrier between the roadway and roundabout sidepath is unique and may be a provision requested that requires WisDOT approval, including the regional bicycle and pedestrian coordinator.

When a shared-use path is provided around the outside of roundabouts, the shared-use path design criteria on structures are followed.

See FDM 11-46-15, FDM 11-35 Attachment 1.1 pages 1 and 2. Section B-B shows a section view of a raised curb shared-use path, and Section C-C shows a section view of the barrier wall between the roadway and the path.

See FDM 11-35-1.6.3 for required separation distance between outside travel lane and front face of barrier wall to determine the minimum barrier wall height.

The roadway and structure width will depend on the median width, lane width, number of lanes, shoulder width, and path width requirements.

For the STH system, the WisDOT minimum roadway width and clear roadway width of bridge from curb face to curb face, between two closely spaced roundabouts that are less than 1,000 feet apart, is:

- 2 lane divided (each side) - 2’ median shoulder, 12’ lane, 5’ outside shoulder = 19’
- 2 lane undivided - 4’ shoulder width, + 12’ lane +12’ lane + 4’ shoulder width = 32’, independent of ADT
- 4 lane divided (each side) - 2’ median shoulder, + 12’ inside lane, + 12’ outside lane, + 2’ shoulder = 28’
- 4 lane undivided - 4’ shoulder, 12’ outside lane, + 12’ inside lane +12 inside lane, + 12’ outside lane, + 4’ shoulder = 56’
- 6 lane divided (each side) - 2’ median shoulder, + 2 inside lanes at 12’, + 12’ outside lane, + 2’ shoulder = 40’

The above widths provide a minimum roadway width between closely spaced roundabouts.

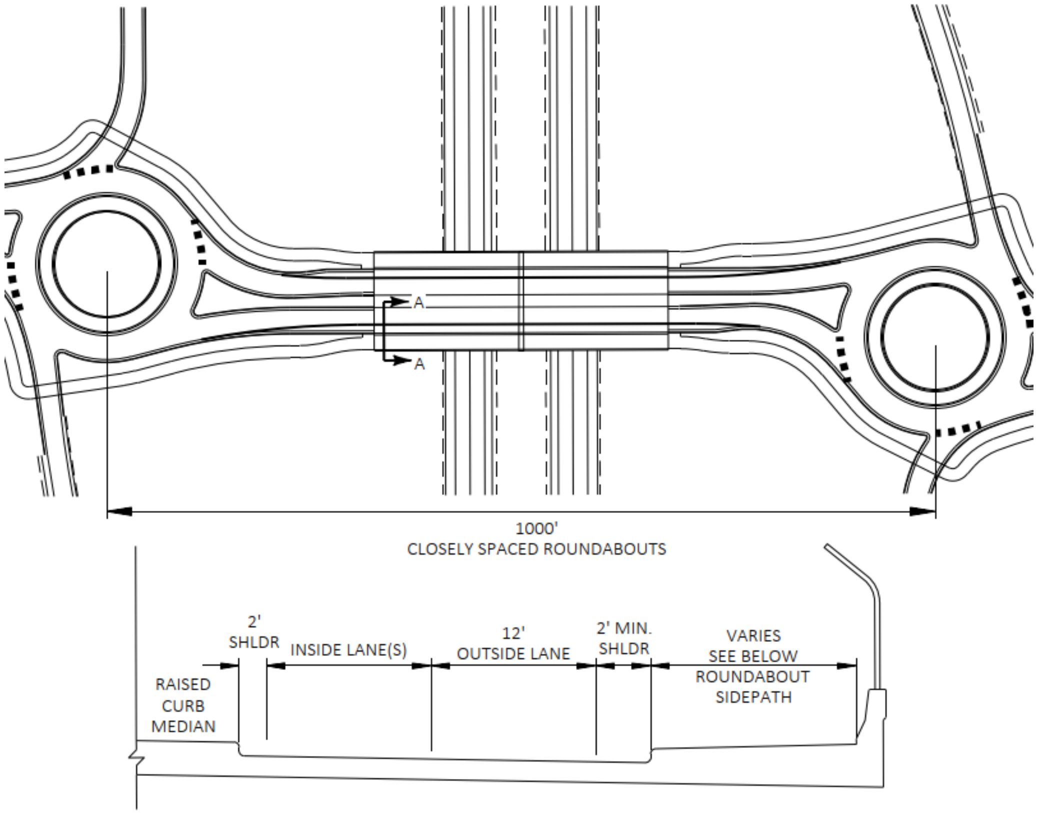
To reduce structure width, the designer should consider a narrow-raised median between the splitter islands. A 4-foot raised curb median face to face will provide an 8-foot median measured from flange line to flange line with 2-foot gutters just off the end of the structure. The distance between roundabouts should be sufficient to allow for any curved curb and gutter portion that is formed at the ends of the splitter islands to remain off the structure. The tangent narrow section in the middle between splitter islands could be 4-foot-wide face to face providing there are no signs or other roadside elements in that area.

Under structures the roundabout sidepath and terrace widths are consistently provided through and between the roundabouts. If there will be road signs, power poles, light poles or other fixtures installed along the roadside then provide at least a 5-foot-wide terrace between the curb face at the outside of the shoulder and the front of the path. The cross-section under the structure provides at least the median shoulder width, lane width(s), outside shoulder width and path width plus 2 ft. if no obstructions are in the terrace. Follow shared-use path design criteria for under structures.

The above minimum roadway widths between closely spaced roundabouts are not appropriate for rural highway applications or where the distance between consecutive roundabouts is greater than 1,000 feet. If existing or proposed sidewalk approaches between consecutive roundabouts are not closely spaced (i.e., greater than 1,000 feet between roundabout centers), provide roundabout sidepath(s) around the roundabout(s) but not between them - provide bike and pedestrian accommodations (See FDM 11-46-1).

The roadway between the roundabouts transitions to a cross-section roadway width and clear roadway width of bridges based on the design class of the roadway (See FDM 11-15-1, FDM 11-20-1, FDM 11-35-1.2, and FDM 11-46-1).

If bike or pedestrian facilities are omitted around or between roundabouts, discuss with the regional bicycle and pedestrian coordinator the need to provide an 8-foot roundabout sidepath on or under the structure. Structures have a longer life-span and even if a roundabout sidepath is not immediately included on a structure it is necessary to consider constructing a wider substructure to allow widening of the superstructure in the future to accommodate a roundabout sidepath. In such cases, the pedestrian refuge in the splitter islands should still be constructed.



ROUNDABOUT SIDEPATH ON STRUCTURE

1. 10' PATH ON APPROACH - 12' WIDE ON STRUCTURE
(HIGH BIKE/PED. USE ANTICIPATED)
2. 8' PATH ON APPROACH - 10' WIDE ON STRUCTURE
(MEDIUM TO LOW BIKE/PED. USE ANTICIPATED)
3. 6' PATH ON APPROACH - 8' WIDE ON STRUCTURE
(NO SIDEWALK CONNECTED TO PATH, RURAL OR OUTLYING AREA)

SECTION A-A

***Figure 10.12* Roundabout Sidepath**

10.5 Design for Large Trucks

10.5.1 General Considerations

WisDOT is a freight friendly state and accommodates not only for the typical large legal-size trucks, but also the OSOW (permitted) vehicles that use our highways. FDM 11-25-2.1 describes the types of design vehicles and check vehicles that should be accommodated at intersections, including roundabouts.

Accommodating turning movements for large trucks and OSOW vehicles can be challenging, especially at single-lane roundabouts.

To accommodate these vehicles, the designer will have to balance the entry width and circulating roadway width with the need for small truck aprons (overtracking pads) behind the outside curb for off-tracking. The design vehicle should stay within the curb lines, whereas the check vehicle may utilize overtracking pads. It is generally a safer design to keep the roundabout entry width as narrow as possible, usually less than 24 feet between curb faces for single lane entries

The following are guidelines to assist the designer in accommodating large trucks and OSOW vehicles at roundabouts:

1. Slope truck apron at 1% toward the roadway on all roundabouts. It should be capable of being mounted by the trailers of large trucks, but unattractive to passenger cars and smaller trucks.
2. Provide a truck apron around the central island that is a minimum of 12 feet wide on single-lane and multilane roundabouts. Additional width may be needed depending on the size of the roundabout, the size of the truck, or the skew of the intersection. The truck apron should be 12-inch thick to provide

ample structural integrity while providing adequate tie bar clearances along back of curbs. Apply ties where required per FDM 11-26-13.4.2. The 12-inch truck apron also minimizes constructability issues between compaction levels and is expected to improve long-term performance.

3. Widen the truck apron as needed to accommodate the anticipated OSOW turning maneuver. Discuss with the regional freight coordinator.

   Roundabouts must have the recommended circulatory roadway crown installed, 2/3 inward and 1/3 outward on all roundabouts, not just those on the OSOW-TR. See Figure 10.17 for cross-section clarification.

4. Keep drainage structures away from the travel path of the possible OSOW vehicle wheel tracking.
5. The compaction levels under the concrete pad along the back of curb near the entrance and in the splitter island areas must be equal to the compaction levels under the roadway and truck apron.
6. If a central island landscape buffer area is desired behind the truck apron, avoid the use of hard surfaces that look like concrete sidewalk.
7. See TEOpS Chapter 2 for guidance on removable signs at roundabouts.

For further guidance on designing for trucks at compact roundabouts, see FDM 11-26-10.6.8.2.

10.5.3 Geometric Design Guidance for Large Trucks at Multilane Roundabouts

The inscribed circle diameter, the width of the circulatory roadway, and the central island diameter are interdependent. Once any two of these are established, the remaining measurement can be determined. However, the circulatory roadway width, entry and exit widths, entry and exit radii, and entry and exit angles also play a significant role in accommodating the design vehicle and providing deflection.

Roundabouts are designed with a truck apron. Truck drivers that use the inside lane at multilane roundabouts are expected to off-track onto the truck apron.

Wisconsin law prohibits vehicles driving next to trucks on the roundabout entries or while circulating within a roundabout; however, it may be difficult at times for vehicles to avoid arriving at the roundabout entry at the same time as a truck. Therefore, multilane roundabouts can be designed in two different ways to accommodate legal-size large trucks, identified as Case 1 and Case 2

- Case 1 (straddle lanes):

  Roundabouts which are designed to allow trucks to encroach into adjacent lanes as they approach, enter, circulate, and exit the intersection. Refer to Figure 10.13 for an example of a Case 1 design. Where a single-lane roundabout approach flares to a multilane entry, Case 1 design is preferred as the truck can easily block out other vehicles as it approaches the entry, see Figure 10.14.

- Case 2:

  Roundabouts which are designed to accommodate trucks in-lane as they approach and enter the roundabout but may require trucks to encroach into adjacent lanes as they circulate and exit the intersection. Case 2 roundabouts have a painted “gore” area between lanes on the approaches. Refer to Figure 10.15 for an example of a Case 2 design. Case 2 design is preferred on four-lane facilities as these configurations can be more difficult for a truck to block out other vehicles approaching the roundabout.

Previous guidance also included Case 3, or stay-in-lane, as described in NCHRP 1043 Chapter 10.5.3. WisDOT is no longer using Case 3 roundabout designs due to the Wisconsin law mentioned above.

See Tables 10.2 and Table 10.3 for the advantages and disadvantages of Case 1 and Case 2 roundabout designs.

See Table 10.4 for typical design parameters for each of the two design cases. Refer to FDM 11-25-1.4, FDM 11-25-2 and FDM 11-26-4.4.3 for additional information on OSOW routes and vehicles.

Table 10.2 Advantages and Disadvantages for Case 1 Roundabout Designs

Advantages	Disadvantages
Wide variety of approach alignment design methods can be used More likely to fit in tight right of way locations, including built-up urban environments Potentially lower costs in some situations Less pavement marking maintenance	May result in increased delays due to trucks occupying both lanes on entries and while circulating Trucks may off-track over outside curbs, resulting in more damage and maintenance May result in additional truck-car crashes

Table 10.3 Advantages and Disadvantages for Case 2 Roundabout Designs

Advantages	Disadvantages
Surveys indicate this entry design is preferred over Case 1 by truck drivers Safety benefits at entries due to no truck encroachment Potentially less damage to curbs Trucks can maneuver more freely at entries May have greater entry capacity/less delay Can be used in urban or rural environments	Fewer approach alignment design methods can be used May require geometry with more right of way Potentially higher cost in some situations May require more pavement marking maintenance Slightly higher circulating speeds and worse lane discipline possible Requires greater designer and contractor skill Possibly lower safety in circulatory roadway due to truck encroachment

Table 10.4 Typical Design Parameters for Two-Lane Roundabouts*

	Case 1 - No lane discipline entering or circulating	Case 2 – Lane discipline entering only
ICD[A]	150-190 ft	160-210 ft
Inner Circulatory Lane Width[B]	12-14 ft	
Outer Circulatory Lane Width[B]	14-16 ft	
Approach Gore Widths	Not used	2-6 ft
Entry Width[A]	28 ft	32-35 ft
Entry Radius	65 ft or greater	80 ft or greater
Exit Widths[A]	28-32 ft	

* Based on site conditions, right of way constraints, specific design vehicle, and other factors, designers may choose to implement geometries outside these recommended ranges; however, the overall design should comply with WisDOT general roundabout design practices

[A] Measurements are from the face of curb to face of curb, (includes 2-ft gutter pans on each side)

[B] Measurements are from flange line to lane line

10.5.3.1 Geometric Design Guidance for Case 1 Roundabouts

Case 1 roundabouts are designed with a single solid white paint line dividing the entry lanes. Trucks encroach on adjacent lanes at the approaches and when circulating and exiting the roundabout. Designers should consider implementing features that would result in a clear encroachment by trucks into adjacent lanes rather than a subtle encroachment (such an approach would typically include avoiding wide lanes, long sweeping curves, large ICDs, and large radii).

Additionally, Case 1 designs can allow for the approaching roadways to have more tangential alignments with short, tighter entry radii. Figure 10.13 shows the basic design features of a Case 1 roundabout. Case 1 designs are also ideal when there is a single-lane approach flaring to a two-lane entry as illustrated in Figure 10.14.

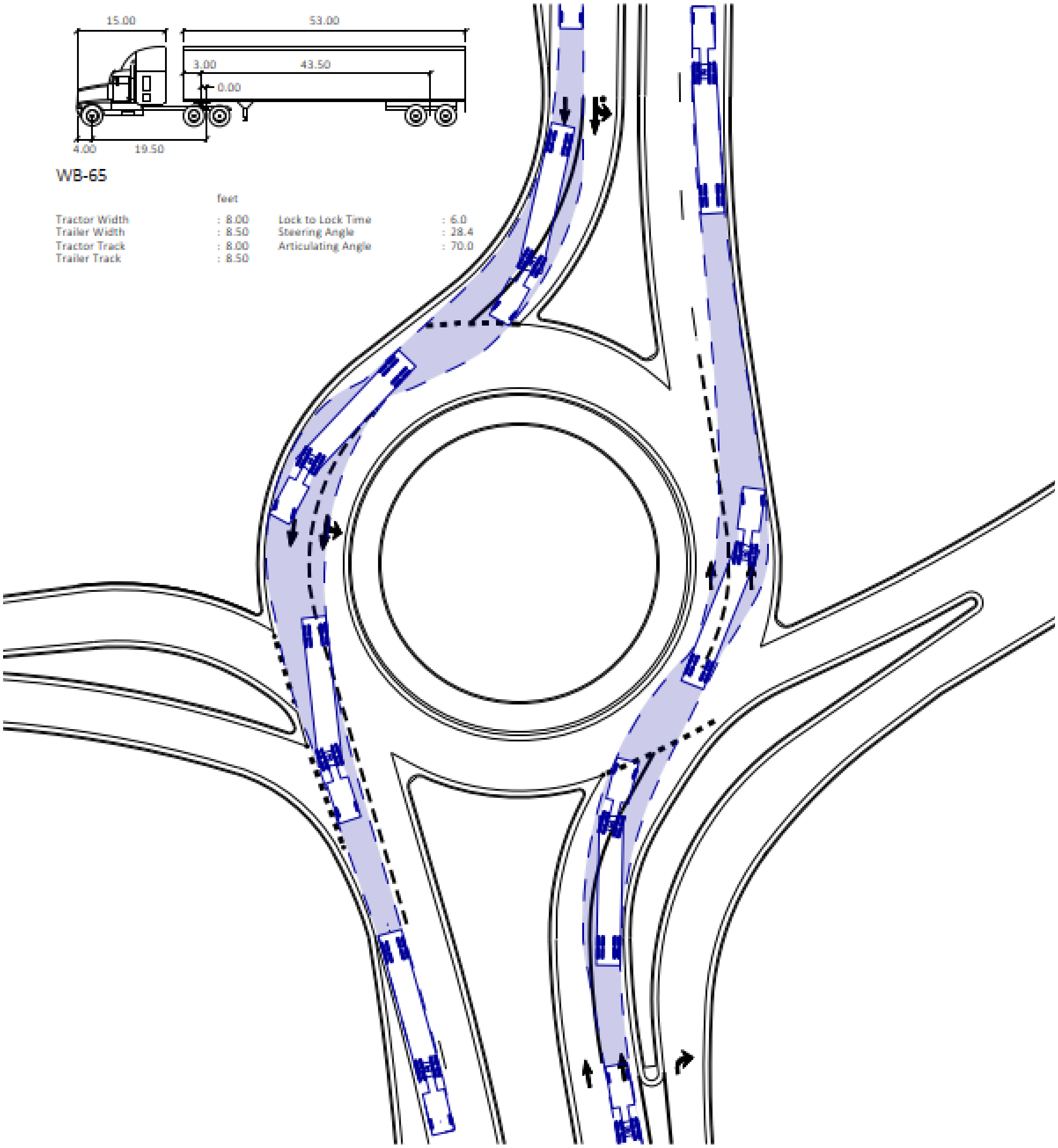


***Figure 10.13** Case 1 Roundabout Design (Single lane line dividing the entry lanes)*

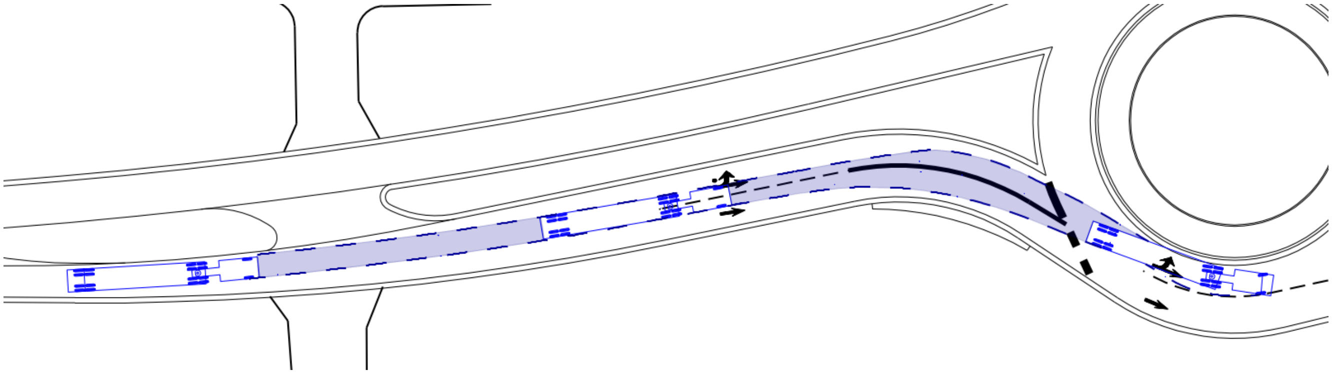


Figure 10.14 ***Case 1 Flared Entry Truck Movement***

10.5.3.2 Geometric Design Guidance for Case 2 Roundabouts

Once the primary design principles from this guidance have been met (speed control, sight distance, adequate space for a design vehicle), the designer will typically revise the design iteratively to allow trucks to stay in lane at the entry while still maintaining the primary design principles. Although there are some specific design characteristics which are unique to Case 2 roundabouts, the overall approach, methods, and iterative design process remain the same as multilane roundabouts in general. Case 2 roundabouts:

1. Often have wider entries (typically 4 to 7 feet wider) than a comparable Case 1 roundabout at the same location. The entry width should be kept as narrow as possible while still allowing trucks to stay in lane. A typical Case 2 roundabout could increase the entry width to approximately 32 to 35 feet (including gutter pan width and gore pavement marking area). The total two-lane entry width should not exceed 35 feet unless special circumstances are present. Lane widths at the entry are typically 12 feet, not including the two-foot gutter or gore area.
2. Usually have longer curve lengths than Case 1 roundabouts on the approach geometry and within the entries. Offset left alignments (i.e. alignment directed to the left of the center of the ICD) are generally preferred where possible.
3. Should avoid tight entry radii curves and closely spaced curves in opposite directions. Instead, larger, longer radii with tangent sections between curves are common with Case 2 roundabouts, resulting in gradual sweeping curvature which makes it easier for trucks to stay in lane. Optimal entry radii values will vary based on the ICD, approach alignment, and entry design method. Typically, an urban Case 2 design may have a controlling curb radius value of 90 feet or greater, while a larger rural Case 2 design may range as high as 120 feet (note: per definition above, controlling radius is not the same as the R_1 radius). The designer must still maintain other the design requirements, such as appropriate fast path speeds, while accommodating trucks in-lane on the entry. Considerable designer skill is needed to accomplish these competing objectives.
4. Often have relatively long approach width transitions to allow trucks to use more roadway width to stay in lane. Designers should ensure that the total length of the combination of the taper and the second full lane width utilized accommodates the design truck as well as queuing and capacity needs. The design of the gore area may require variable widths, including narrowing toward the entry as needed.
5. The relationship between width transitions, entry widths, lane widths, and gore widths should be carefully considered by the designer when determining how to optimally serve trucks and passenger vehicles. As a general principle, widths should be minimized while still accommodating the design truck.

Figure 10.15 shows the basic design features of a Case 2 roundabout.

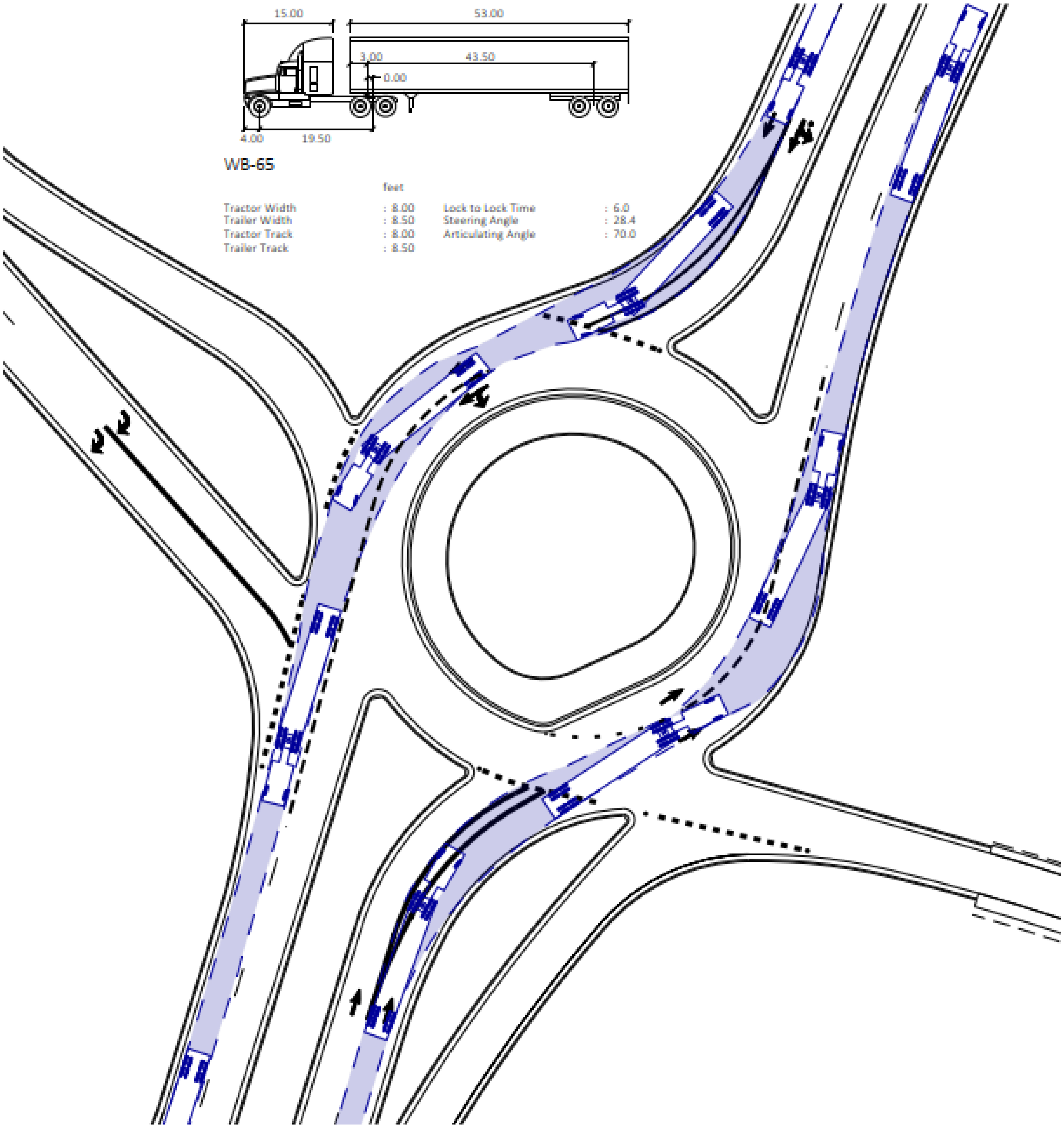


***Figure 10.15** Case 2 Roundabout Design (Gore pavement marking between entry lanes)*

10.5.4 Geometric Considerations for OSOW Vehicles

If a roundabout is located on the OSOW Truck Route or it is thought that OSOW vehicles may use the intersection, conduct a vehicle horizontal turning check and a low vertical clearance check with the OSOW vehicle inventory. AutoTurn software may be used for the horizontal checks. AutoTURN Pro may be used for horizontal analysis and is required to determine if low vertical clearance conflict points are present.

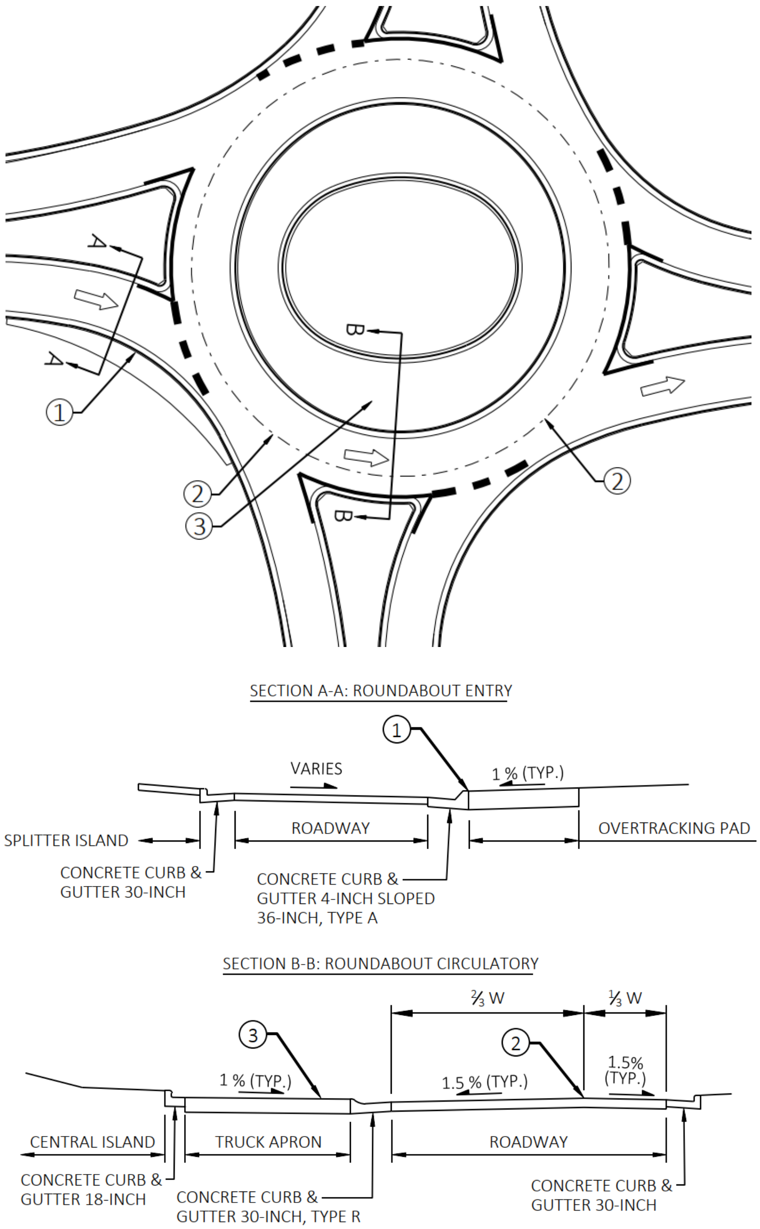
Additional guidance on horizontal accommodations for OSOW vehicles include:

- Install a 36-inch Type A 4-inch sloped curb and gutter with 8" minimum gutter thickness along the outside of the approach or the splitter islands where large vehicles may off-track onto a concrete overtracking pad located behind the curb.
- Install a 12-inch thick, red-colored concrete truck apron (overtracking pad) behind the back of curb along the outside entrance area where OSOW vehicle off-tracking is anticipated. The slope of the pad should be a maximum of 1% sloped towards the roadway. Evaluate the entrance for pedestrian crossings and placement of the concrete pad to prevent these areas from overlapping if possible (see FDM 11-26-10.4.1.2). The width of this pad will depend on the amount of off-tracking anticipated.
- The same 12-inch thick, red-colored concrete pad, without stamping, should be installed in the splitter

islands where OSOW vehicles may drive to negotiate the roundabout.

- Tie the overtracking pad to the back of curb with tie bars when the adjacent roadway pavement structure is asphalt. When the adjacent roadway pavement structure is concrete and the overtracking pad is less than 3 feet along its entire length, tie the gutter flange to the concrete pavement and the back of curb to the overtracking pad with tie bars. To limit pavement stress and crack propagation, do not tie the overtracking pad to the back of curb when the variable width is 3 feet wide or greater at any location and the adjacent roadway pavement structure is concrete.
- Signposts placed in overtracking pads located along the outside entrance area or in the splitter islands should be mounted in removable sleeves (see TEOpS Chapter 2).
- Produce a swept path diagram showing the vehicle movements and directions for the purpose of supplying the permitting office with diagrams to aid route choice.

The DST lowboy is the critical vehicle for analyzing vertical clearance at roundabouts. Use a low clearance of 5 inches for the DST lowboy evaluation. If clearance issues are found, reconfigure the slopes within the conflict areas and check the surrounding area (i.e., approaches and exits) for additional conflict points. Refer to Figure 10.16 for typical ground clearance problem areas.



General Notes:

1. Off-tracking at the entry curve/lowboy hitting the outside curb head
   a. Consider a 36-inch Type A 4-inch sloped curb and gutter with 8” minimum flange thickness and concrete overtracking pad behind the back of curb along the outside entrance area. The slope of the pad should be a maximum of 1%. Evaluate the entrance for pedestrian crossings and placement of the concrete pad to prevent these areas from overlapping.
2. Entry and exit rollover
   a. Consider flattening the circulatory roadway crown in these areas if needed, while providing approximately 2/3 sloped inward and 1/3 sloped outward.
   b. Avoid break-over grades over 3% within 200 feet of the entry yield line location and exiting the roundabout.
3. Truck Apron
   a. Slope truck apron 1% toward the roadway on all roundabouts. Consider a pill shaped central island or other shape where appropriate to accommodate the anticipated OSOW turning maneuver.
      i. Check if the vehicle can track more on the circulatory roadway. In rare situations, the designer may consider a 3-inch height Type R curb and gutter. This will require an evaluation of the inlet casting height/location (out of the vehicle path).
   b. Look at the circulatory roadway profile
      i. Keep it as flat/gentle as possible and still maintain drainage (0.75% - 1.0%).
      ii. Locate the crest away from the area(s) of concern.

***Figure 10.16* Typical Ground Clearance Problem Areas**

In some cases, abnormally long vehicles may not be able to negotiate a roundabout regardless of geometric adjustments to the truck apron and approaches when making left turns. In some cases, special median crossings may be required, which allow the vehicle to bypass the circle portion of the roundabout by traveling the opposite direction. Such maneuvers should be avoided, if possible, due to the extra planning required for escorting a vehicle in such a maneuver. Discuss such alternatives with the regional traffic section and the OSOW-TR coordinator and document route testing produced by turn analysis software for future use by the OSOW Permitting Unit.

See FDM 11-26-10.6.8.3 for further guidance on compact roundabouts.

10.5.5 Overturning Considerations for Large Vehicles

A further consideration associated with large trucks in roundabouts is the potential for overturning or shifting of loads. There is no simple solution in relation to layout geometry to completely prevent load shifting and roll-overs. Experience suggests that at roundabouts where these problems persist, there are frequently combinations of the following geometric features:

- Long straight high-speed approaches
- Inadequate entry deflection or too much entry deflection
- Low circulating flow combined with excessive visibility to the left
- Significant tightening of the turn radius partway around the roundabout (spirals with arcs that are too short).
- Cross-slope changes on the circulatory roadway or the exit
- Outward sloping cross-slope on the entire width of the circulatory roadway

A problem for some vehicles may be present even if speeds are low because of a combination of grade, geometry, sight distance and driver responsiveness. Research has shown that an articulated large goods vehicle with a center of gravity height of 8 feet above the ground can overturn on a 65-foot radius curve at speeds as low as 15 mph. See Transport Research Laboratory Report LR788.

Layouts designed to mitigate the above noted characteristics will be less prone to load shifting or load shedding. In addition, pay attention during design and construction to ensure that pavement surface tolerances are complied with and that abrupt changes in cross-slopes are avoided.

10.6 Single-Lane Roundabouts

10.6.2 Splitter Island and Approach Taper Dimensions

WisDOT’s typical splitter island configuration is shown in Figure 10.17, including standard nose radii, sloped nose types, transition noses at crosswalks, and options for sloping the splitter island.

Splitter islands can be crowned upward with a slope between 1% and 10% toward the center of the island or sloped at 1% to 10% in one direction as shown in Figure 10.17. This improves visibility of the splitter island for rural conditions. The maximum overall height above the top of the curb within the splitter island area should be approximately 18 inches from top of curb to the top of any concrete/asphaltic surface. Some islands may become quite wide near the circulating roadway, however, limit the height to 18 inches.

The approach nose separating the entering traffic and the exiting traffic shall be a Concrete Median Sloped Nose, Type 1. This splitter island nose should be 6-foot face-to-face where the R4-7 (KEEP RIGHT) sign is located. An offset to this nose should be applied in high speed situations, see FDM 11-26-10.14. The other noses at the edge of the circulatory roadway and the splitter island shall be Concrete Median Sloped Nose, Type 2. Do not provide offsets to these noses. Both sloped nose types are shown in SDD11b2. Where there is a divided highway approaching the roundabout the approach nose is eliminated.

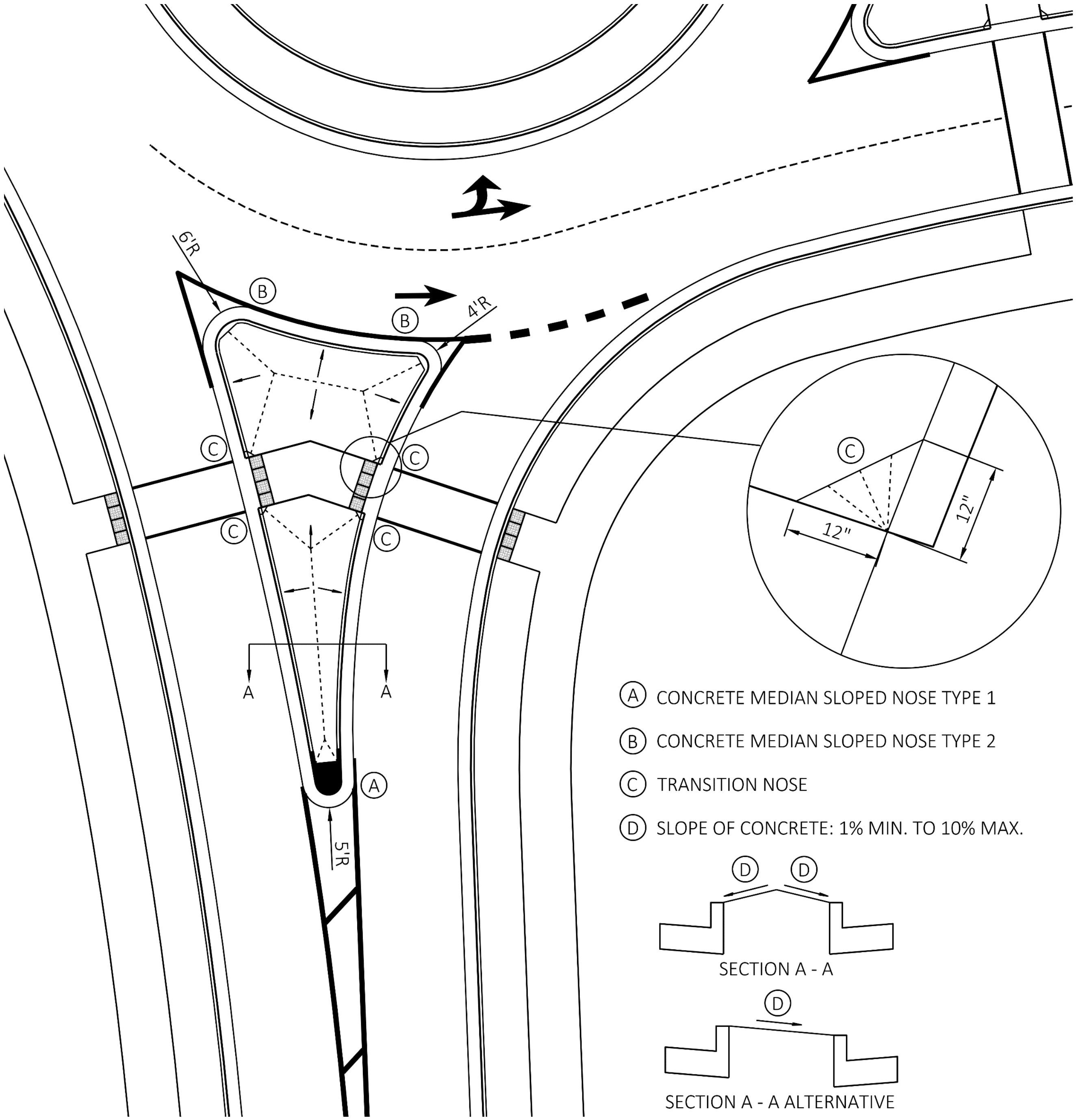


***Figure 10.17* Typical Splitter Island Configuration**

10.6.3 Approach Design

Roundabout approach design is important to provide clarity of the driving situation, that is, to make drivers aware of the roundabout with ample distance to comfortably decelerate to the appropriate speed. Therefore, designs should follow these principles:

- Provide the typical stopping sight distance of the entry point based on approach design speed.
- Align approach roadways and set vertical profiles to make the central island conspicuous.
- Splitter islands should extend upstream of the yield line to the point at which entering drivers are expected to begin decelerating.
- Approach curves should be gentle, become successively smaller as they get closer to the roundabout entry, and should be sized based on the design speed and expected speed change.
- Tangents should be used between reverse curves.
- Consider using landscaping on extended, wide splitter islands and along the roadside to create a tunneling effect.

- Provide illumination in transition to the roundabout.
- Use signs and pavement marking effectively to advise of the appropriate speed and path for drivers.

The consequences of an inconspicuous central island or splitter island is mainly loss of control crashes as motorists unfamiliar with the roundabout are not given sufficient visual information to elicit a change in speed and path.

10.6.3.1 Roadway Width

The width of the roadway at locations with curb and gutter on both sides should accommodate the design vehicle and allow for passing a stalled vehicle. The design width for entries, exits and bypass lanes is shown in 2018 GDHS, Table 3-26a, page 3-106, as a 19-foot face-face minimum and 20-foot face-face typical to allow a stalled vehicle to pass. (GDHS hyperlink is only available to WisDOT staff.)

10.6.4 Entry Design

The minimum entry radii should be approximately 65 feet. Capacity will increase with increased entry radii, but so may the entry speed. Entry radius is not R1.

NCHRP 1043 Exhibit 10.50 illustrates the composition of entry curves to produce natural entry paths. This method is useful but has limitations where large trucks making right turns will require even larger outside radii, particularly on single-lane roundabouts with narrow entry widths. In such cases, the larger outside radius may increase entry speeds undesirably. A preferred design technique for single-lane roundabouts is not to make the inside radius/arc tangential to the central island, but to create a flare in the entry such that the large truck path can preserve the outside radius which controls entry speed. The effect gives the entry a flare, typically ranging from 18 feet to 24 feet.

10.6.4.1 Entry Width

Entry width is measured perpendicularly from the outside curb face to the inside curb face nose P.C. at the splitter island point nearest to the inscribed circle.

Narrow entries tend to promote lower speeds and improved safety. However, the design vehicle (e.g. WB-65) may require a 20 to 24-foot-wide entry (curb face to curb face) for single-lane approaches to be able to make a right turn. Design single-lane roundabouts to accommodate the design vehicle without encroachment onto the truck apron or the curb and gutters.

See FDM 11-26-10.6.8.4 for further guidance on compact roundabouts.

10.6.4.2 Entry Flare

Flaring an entry from one lane to two or from two to three creates additional entry capacity without extensive mid-block widening. When lane choice options are even, or no preference is given to either lane, it is ideal to split the approach width at a point where the lane width reaches 9.5 feet or 19 feet overall (flange of curb dimensions).

The development of horizontal geometry and pavement marking of a flared entry is balanced and smooth making lane choice options obvious and entry paths clear.

See FDM 11-26-10.6.8.7 for further guidance on compact roundabouts,

10.6.6 Circulatory Roadway Width

Circulatory roadway width is the width between the outer edge of the inscribed diameter at the curb face and the central island curb face. It does not include the width of any traversable apron, which is defined to be part of the central island. The circulatory roadway width defines the roadway width, curb face to curb face, for vehicle circulation around the central island. It is desirable to accommodate buses within the circulatory roadway to avoid jostling passengers by running over a traversable central island. The circulatory roadway width does not need to remain constant. A two-lane entry may be appropriate for the major through highway, however, the minor side road may be single-lane approaches. The circulating roadway may often have a different width to accommodate the through traffic than for the side road traffic.

For further guidance on compact roundabouts, see FDM 11-26-10.6.8.5.

10.6.7 Central Island Design

The central island of a roundabout is

- always a raised, non-traversable area encircled by the roundabout circulatory roadway
- stepped up from the traversable truck apron to the non-traversable island area
- and landscaped to enhance driver recognition of the roundabout upon approach and to limit the ability of the approaching driver to see through to the other side. The inability to see through the roundabout reduces or eliminates headlight glare at night and driver distraction by other vehicles on the circulating roadway

Landscaping the central island and the roundabout area is further addressed in FDM 11-26-14.4.

See FDM 11-26-10.6.8.6 for further guidance on compact roundabouts.

10.6.8 Compact Roundabout Design

Many of the same principles are used in the design of compact roundabouts as in full-sized roundabouts. Key considerations include vehicle channelization, design vehicle paths, and intersection visibility. Given that the central island of a compact roundabout may be fully traversable, the overall design should provide channelization that naturally guides drivers to the intended path. Sub-optimum designs may result in drivers turning left in front of the central island (or driving over the top of it), improperly yielding, or traveling at excess speeds through the intersection.

The following sections provide more detail on designing compact roundabouts.

10.6.8.1 Assessing Vehicle Paths

For compact roundabouts on roads with a 25 mph speed limit or lower, the methodology of determining a fastest path is not required. However, deflection for the entering vehicle is still important. The entering vehicle should deflect to the right as they enter and travel around the central island (approach has a positive offset). Avoid negative offset approach designs that do not deflect the entering driver.

See Figure 10.18 and Figure 10.19.

For compact roundabouts on roads with 30-40 mph speed limits, the traditional methodology of measuring fast paths should be used to limit the R1 (entering) speed to 25 mph or less.

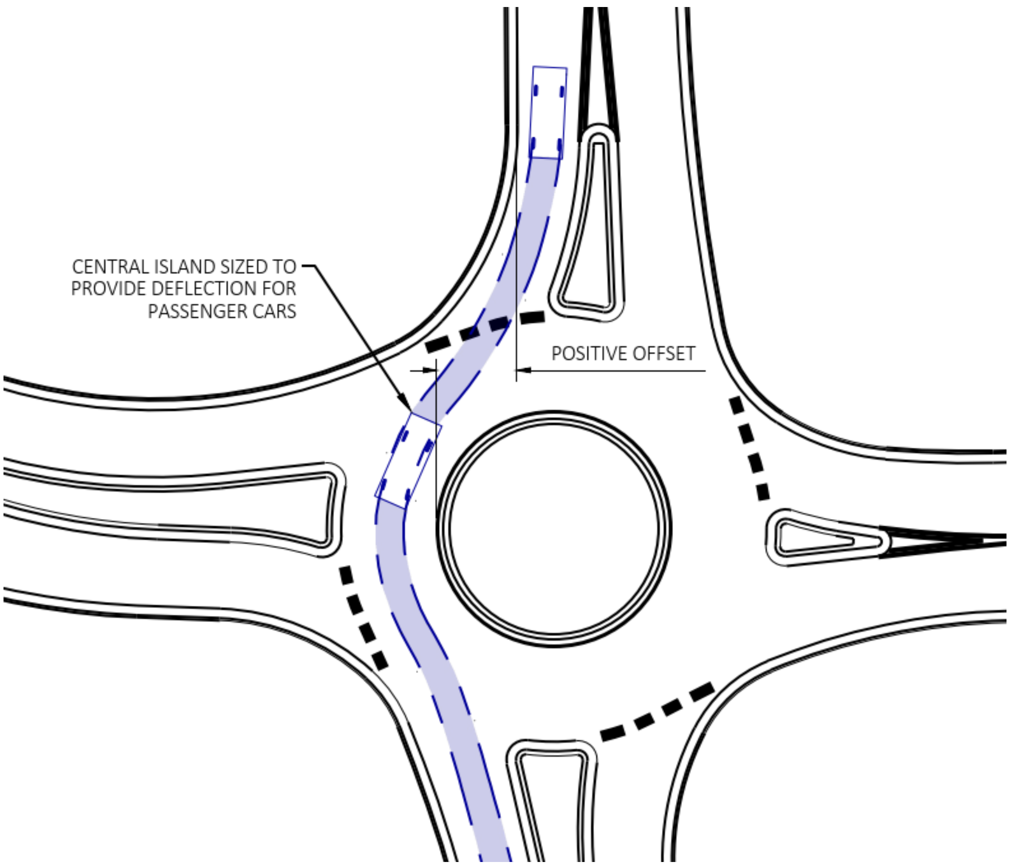


Figure 10.18 ***Proper Vehicle Deflection***

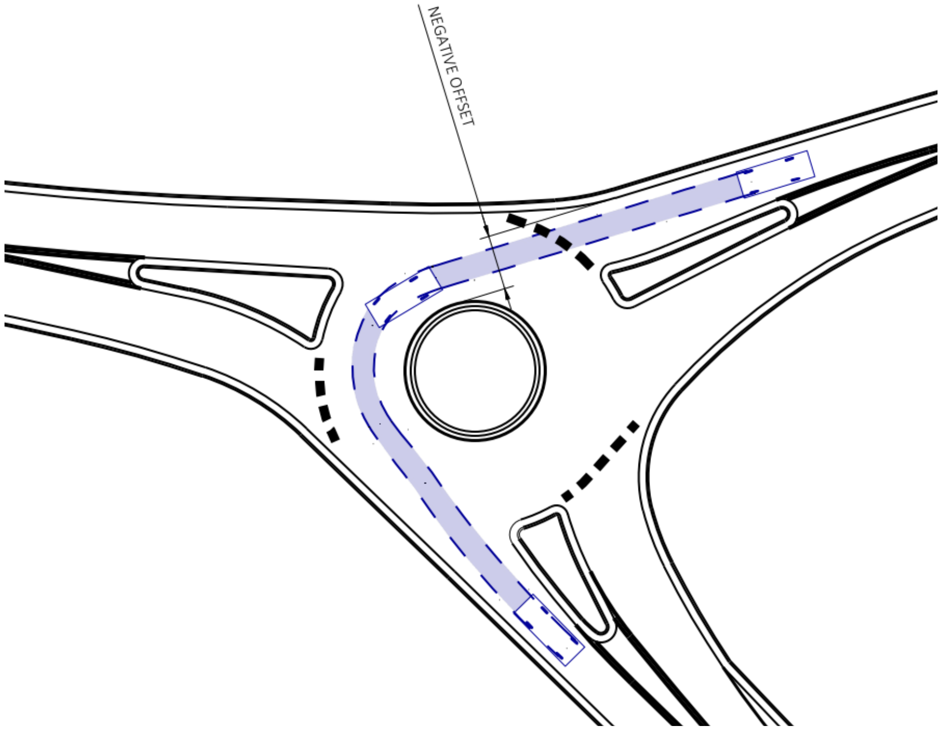


***Figure 10.19* Poor Vehicle Deflection**

10.6.8.2 Design Guidance for Large Vehicles

Unlike traditional roundabouts, the central island may be completely traversable for compact roundabouts. Larger design vehicles may make direct left turns over the central island (See Figure 10.20). The splitter islands can also be traversable. Larger design vehicles may need to traverse over the splitter islands to make certain turning movements (See Figure 10.21).

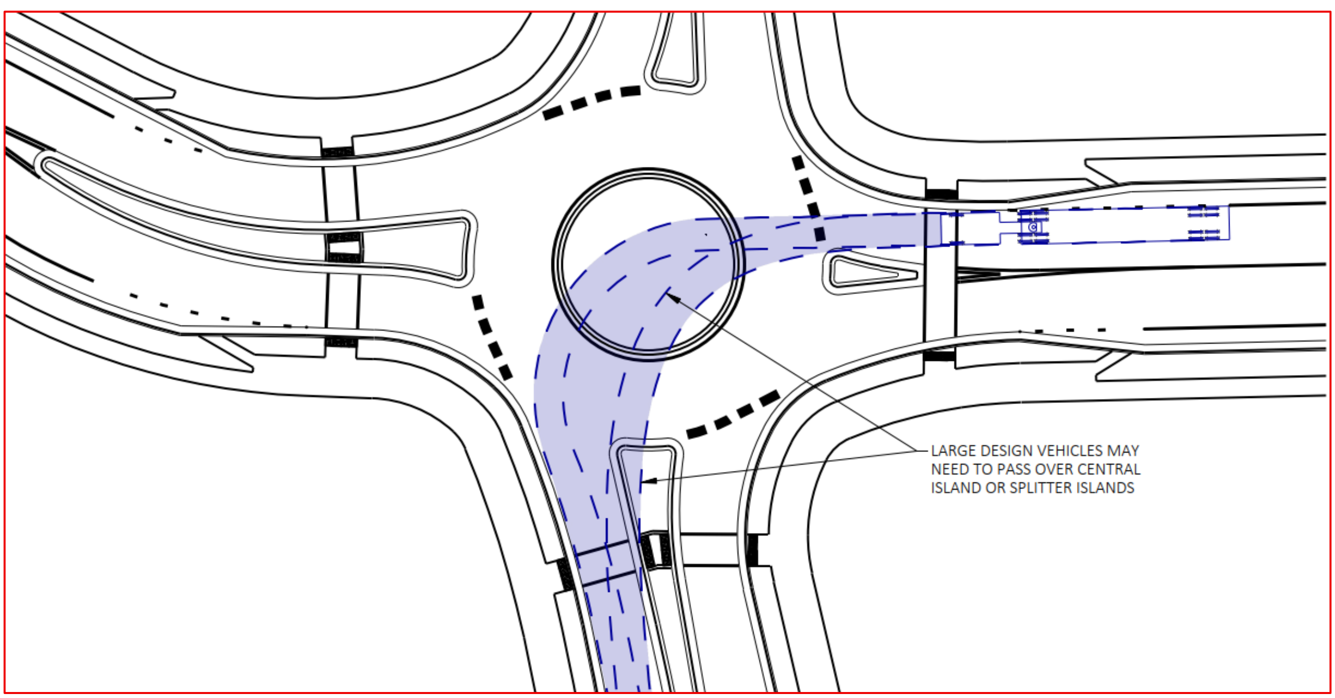


***Figure 10.20* Large Design Vehicle Overtracking, Left Turn**

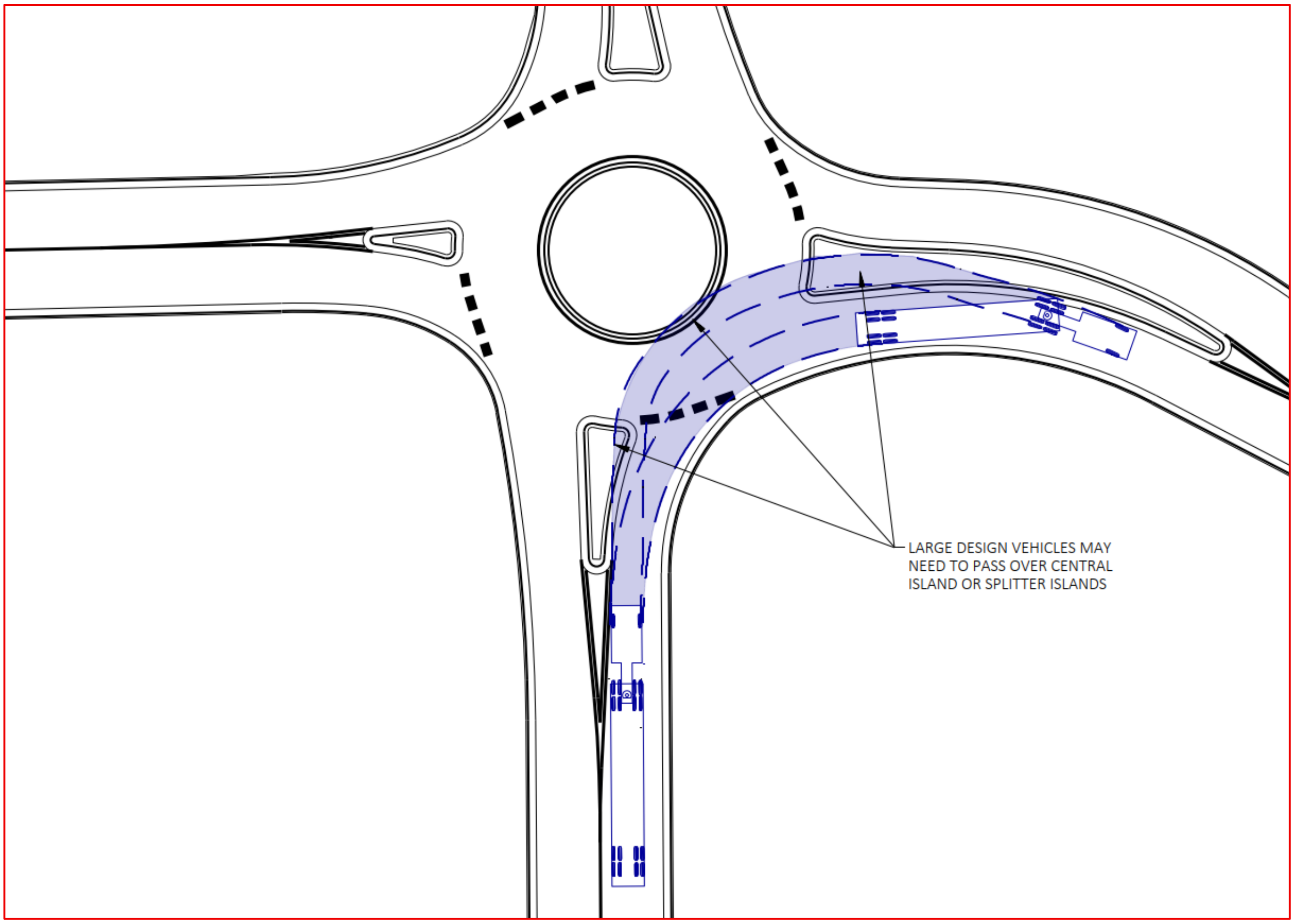


***Figure 10.21** Large Design Vehicle Overtracking, Right Turn*

If large check vehicles are expected to make turns at the intersection, the addition of overtracking pads to the outside may be necessary to accommodate right turns (see FDM 11-26-10.5.4). As this is done, the benefits of the compact roundabout become less (larger, more impactful footprint) and a larger traditional roundabout may be better suited for the location. These factors should be reviewed when completing the ICE.

10.6.8.3 Vertical Considerations for OSOW Vehicles

As with larger roundabouts, the compact roundabout should be designed to accommodate the necessary OSOW vehicles, including the vertical clearance checks.

10.6.8.4 Entry Width

Unlike standard single-lane designs, a compact roundabout may require the WB-65 to encroach onto the truck apron or the curb and gutters for making right or left turns. The entries should be designed for WB-65 through movements to not encroach onto the truck apron or curb and gutters. This allows the designer to minimize the entry width to help promote slower speeds at the entry of the roundabout. The compact roundabout entry width, measured perpendicularly from the outside curb face to the inside curb face nose P.C. at the splitter island point nearest to the inscribed circle, should be no less than 18 feet and no more than 24 feet.

10.6.8.5 Circulatory Width

The circulatory roadway width may be narrower than larger roundabouts to help promote slower speeds, similar to the entry widths. The width can range from 20 feet to 24 feet, measured from the outer edge of the inscribed diameter at the curb face and the central island curb face. It is desirable to accommodate buses within the circulatory roadway to avoid jostling passengers by running over a traversable central island.

10.6.8.6 Central Island

The central island of a compact roundabout will in most cases be completely traversable. It should be constructed using the same material as used for truck aprons discussed in FDM 11-26-13.2. With some of the larger compact roundabouts (ICD 100-feet to 120-feet), a small non-traversable central island with a standard truck apron may be possible depending on the size and turning movements of the design vehicle. In those cases, refer to FDM 11-26-10.6.7.

10.6.8.7 Entry Curves

Since the inscribed circle diameter of a compact roundabout is smaller, the entry radii may be smaller to help control entry speeds and to better facilitate turning movements. The minimum entry curve radii should be approximately 50 feet.

10.6.8.8 Bike Ramp Entrance and Bike Ramp Exit Design Guidance

Similar to larger roundabouts, bike ramp entry and exit ramps should be provided where possible when sidewalks, shared-use paths, or roundabout sidepaths are present or being proposed. When sidewalks or shared-use paths are present approaching the intersection, sidewalks should be included around the roundabout with pedestrian crossings. However, the use of a compact roundabout is often in an urban setting with tight physical constraints that may not allow for wider sidepaths to be placed around the roundabout. In those tightly constrained urban environments, the designer may choose to not install bike ramps and allow the bicyclists to use the travel lane through the compact roundabout. If a bicycle or shared-use path is present, then bike ramps should be installed. Decisions on the use of bike ramps should be discussed with the regional bicycle and pedestrian coordinator and documented accordingly.

10.6.8.9 Splitter Islands

As with larger roundabouts, splitter islands are generally used at compact roundabouts to align vehicles, encourage deflection and proper circulation, and provide pedestrian refuge when possible. Splitter islands should be raised but may be traversable. Raised splitter islands with pedestrian refuge are preferred (See Figure 10.22).

In some cases, the splitter island may be too narrow for a pedestrian refuge. In those cases, the crosswalk should be straight across the road to provide the most direct and shortest path across the road and detectable warning fields should not be used. (See Figure 10.22).

On minor side streets (less than 1,000 AADT), when the existing roadway is narrow, the use of paint to delineate the splitter island is acceptable but should be avoided if at all possible (See Figure 10.23).

The splitter island should be designed with a curved entry to assist in guiding vehicles into the circle. In some cases where a large design vehicle is making right turns, the curb line may be straight into the circle and pavement marking used to help curve vehicles into the circle (See Figure 10.24).

Whenever possible, the curved splitter island curb should be used.

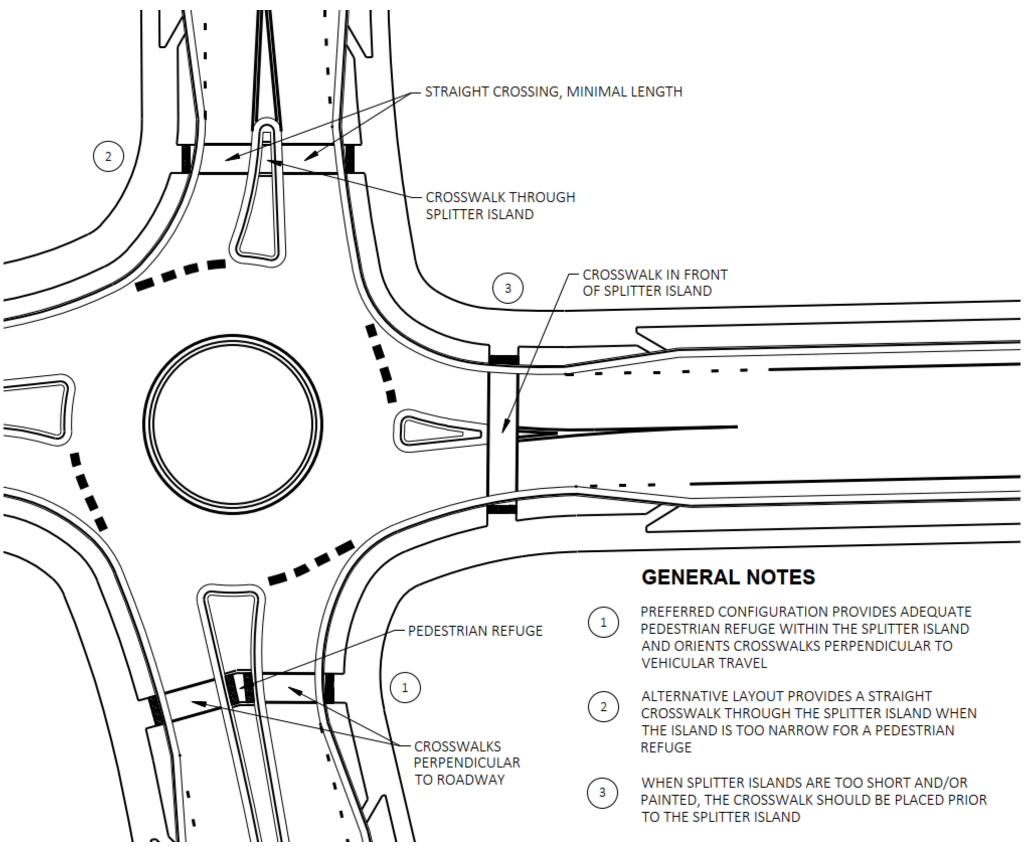


***Figure 10.22** Splitter Island Options*

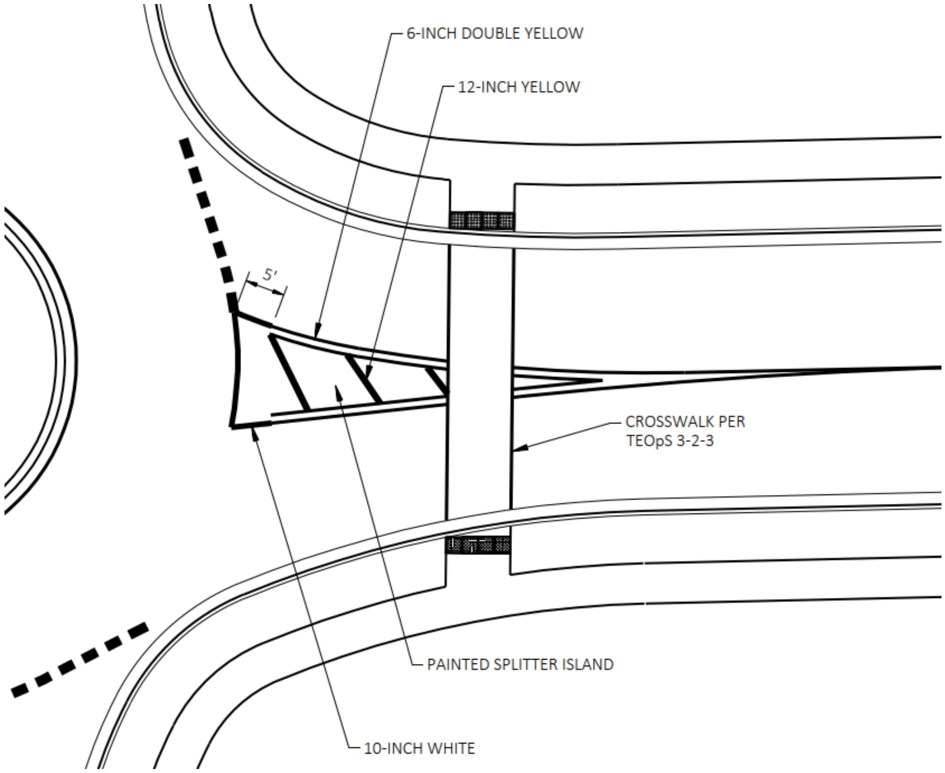


***Figure 10.23** Painted Splitter Island Alternative*

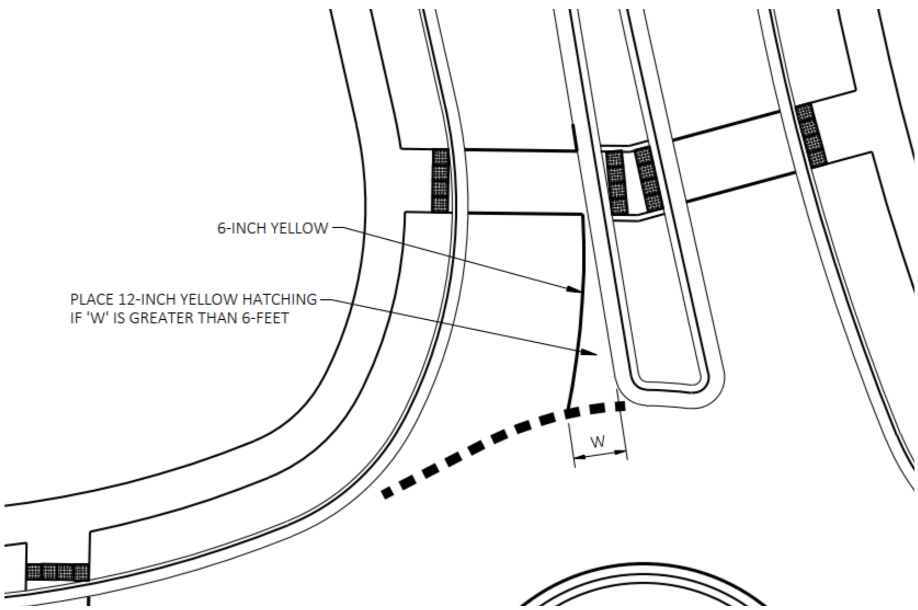


***Figure 10.24** Large Vehicle Accommodation Alternative*

10.6.8.10 Right Turn Lanes

Right turn lanes can be used with compact roundabouts when capacity needs dictate or when other geometric layouts do not allow the design vehicle to make right turns. This can be especially useful when intersecting roads have an acute angle which makes right turns more difficult. The use of right turn lanes at compact roundabouts is limited to Yielding Right Turn Bypass Lanes as described in FDM 11-26-10.9.1. An example is shown in Figure 10.25.

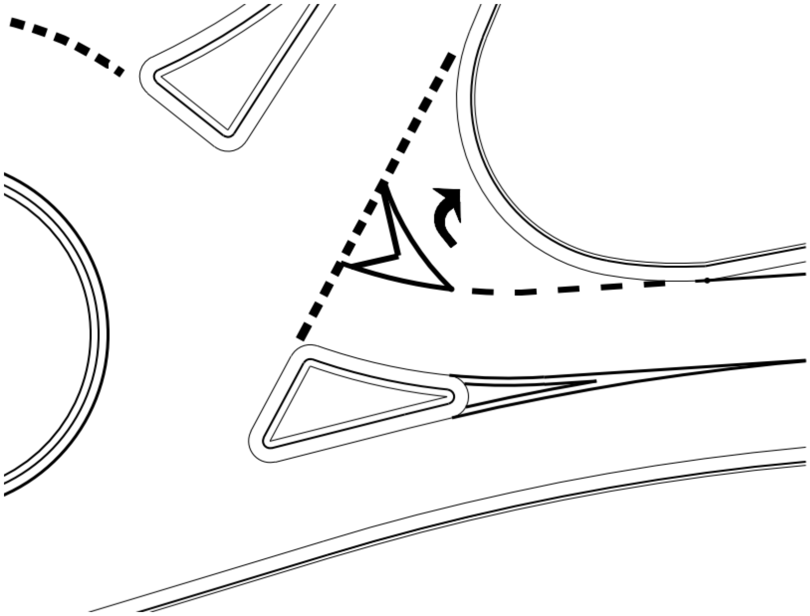


Figure 10.25 ***Yielding Bypass Right Turn Lane***

10.7 Multilane Roundabouts

10.7.4 Design Method to Avoid Path Overlap

Figure 10.26 shows the preferred method to avoid path overlap in multilane entries.

The location of the entry curve directly affects path overlap. If it is located too close to the circulatory roadway, it can result in path overlap. However, if it is located too far away from the circulatory roadway, it can result in drivers accelerating to the yield point. To avoid path overlap, the typical tangent length is 40-ft to 50-ft or two car lengths for the entry path tangent and 40-ft and greater for exit path tangent. The minimum tangent length to avoid entry and exit path overlap is 25-ft or one car length.

As a rule of thumb path overlap can be avoided if there is typically 5 feet between the face of the central island curb and the extension of the face of curb on the splitter island (See Figure 10.26).

See NCHRP Chapter 9.6, Chapter 10.7.4, Appendix A-3, and FDM 11-26-9.6 for additional information on Vehicle Path Alignment.

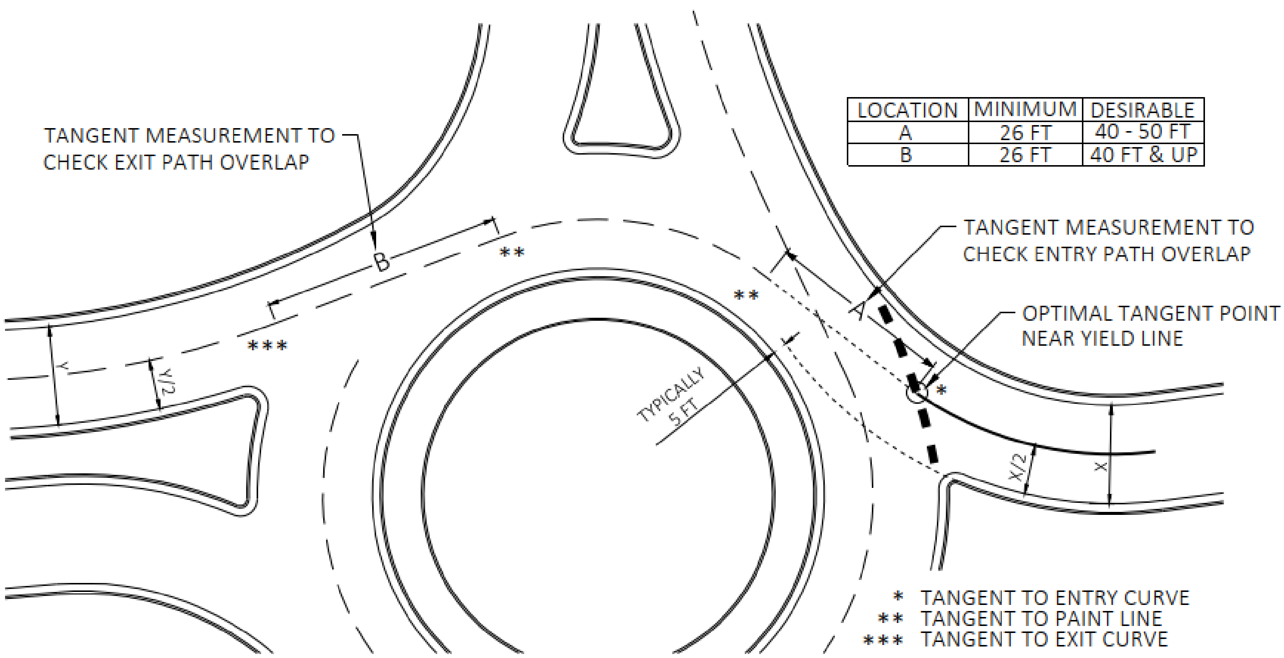


Figure 10.26 ***Method for Checking Path Overlap***

10.7.7 Spirals

Spirals are designed to prevent vehicles from becoming trapped on the inside lane and then drivers making a quick lane change to exit. They should only be considered where the geometry and traffic volumes warrant the use of a spiral. Spirals require considerable engineering judgment to design and locate properly. Although they are intended to guide drivers, they may be confusing to properly understand and not always intuitive to the driver.

Small compact two-lane circles do not function as well with spiral designs because the lengths of arcs are too short to guide drivers to 'spiral out'. In such cases speed reduction occurs in the circulatory roadway where the spiral often begins. Drivers are more likely to turn tight across the spiral rather than follow it to the next outside lane. Spirals can be very effective on larger circles where the spiraling curves are longer, intuitive to drivers and more easily detectable.

A spiral should be developed from the central island with curb and gutter.

See NCHRP 1043, Chapter 10.7.7 for additional spiral information.

10.7.9 Exit Tapers

Tapering the number of lanes on an exit from two lanes to one lane or from three lanes to two lanes allows for additional roundabout capacity without extensive mid-block widening. The continuous flow nature of roundabouts typically results in less saturated traffic streams exiting the intersection. This is in sharp contrast to a signalized intersection where platoons of traffic are much more concentrated, and consequently typically require more downstream distance to merge. Speeds are also much slower for traffic exiting roundabouts which eliminates the need for long parallel section downstream of the roundabout exit.

Design exit tapers from roundabouts based on the anticipated in lane exiting speed, not the fastest path, typically in the range of 15 to 25 mph. Merging taper rates should be based on the lengths shown in FDM 11-25 Attachment 2.3, typically 20:1 to 30:1. The length of full width lanes beyond the circulating roadway to beginning the merging taper may vary between 100 and 300 feet depending on volume, potential for upstream lane choice, and other factors that may be unique to the site. The farther the full lane widths are extended upstream, the potential for increase in speed and the potential for a longer merge taper (See Figure 10.27).

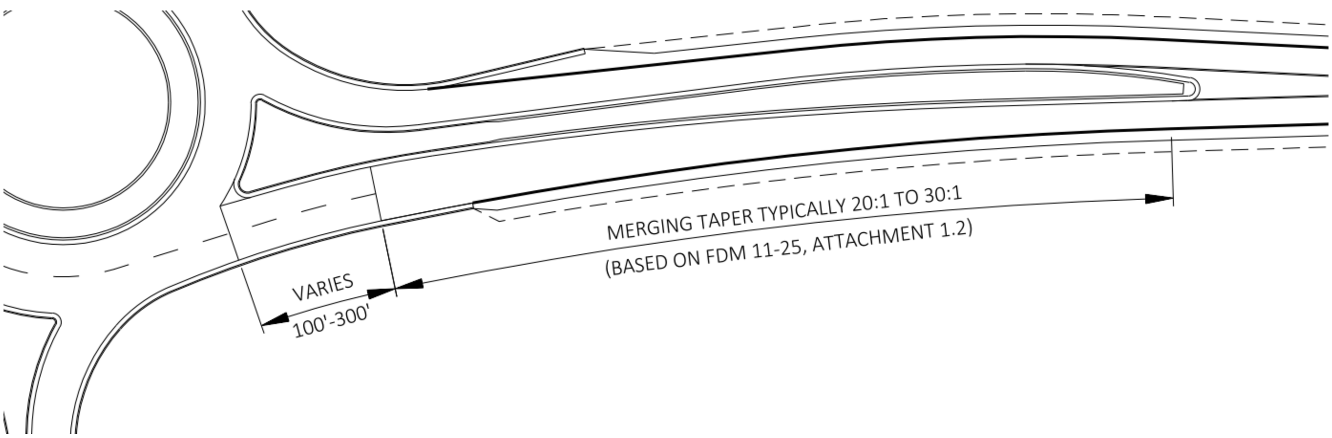


***Figure 10.27* Exit Lane Taper**

10.9 Bypass Lanes

Right turn bypass lanes should only be used when capacity needs dictate or when other geometric layouts fail to provide acceptable traffic operations or accommodations for the design vehicle. The decision to use right turn bypass lanes should consider pedestrian and right of way constraints. Choosing the proper alternative is dictated by the volume of right turns and the available space. For further guidance on compact roundabouts, see FDM 11-26-10.6.8.10.

Bypass lanes can be yielding or free flow to provide for heavy right turn demand.

10.9.1 Yielding Right Turn Bypass Lane

A yielding right turn bypass lane with a curbed vane island requires approaching vehicles to yield to traffic leaving the adjacent exit, see Figure 10.28(a). This alternative 'snags' the right turner from making a through movement while preserving good sight to the left for circulating/exiting traffic. An intersection angle of 70 degrees or higher is typical.

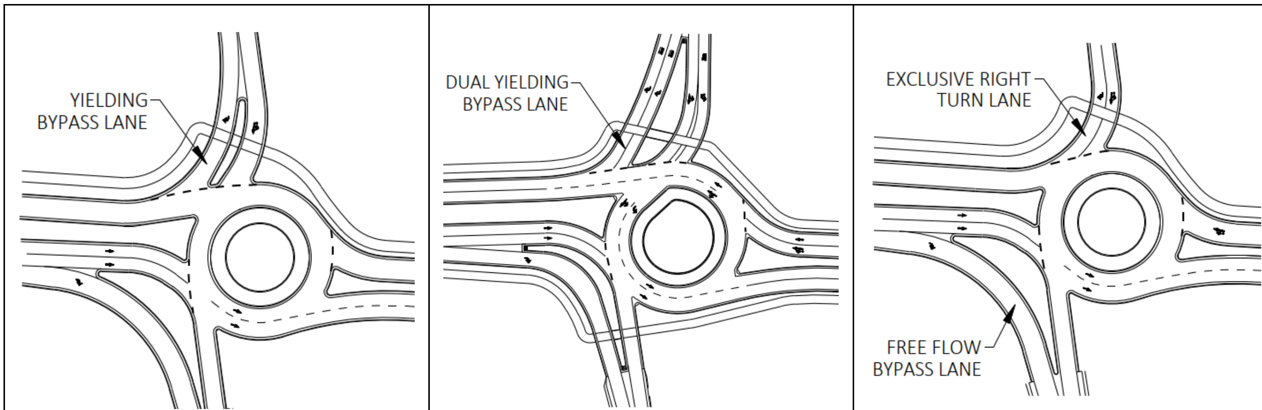
Dual yielding right turn bypass lanes with a curbed vane island may also be an appropriate alternative to accommodate heavy right turn demand, especially at interchange ramp terminals, see Figure 10.28(b). Dual yielding right turn bypass lanes may be problematic for pedestrians and should only be used at locations where there is not a crosswalk near the exit receiving the dual right turning vehicles. Pedestrians may have a hard time seeing a vehicle turning right from the left lane of the dual right turn entry.

When designing dual yielding right turn bypass lanes, special attention is required to ensure that vehicles in both right turning lanes have adequate sight of vehicles in the circulatory roadway. Speeds of vehicles in the right turn lanes also need to be well controlled. Use a smaller entry radius to help reinforce that vehicles exiting the roundabout have the right of way. This will also minimize the potential for rear end crashes associated with larger right turn radii. Like the guidance provided for a Case 1 design, allow the design vehicle to encroach into adjacent lanes on the entry and exit while making the right turn.

In some situations, the curbed vane island may be removed to create an exclusive right turn lane, see Figure 10.28(c). This helps keep the overall roundabout layout compact while still accommodating the heavy right turn movement. An exclusive right turn lane should be 'snagged' from making a through movement while preserving good sight to the left for circulating/exiting traffic. A painted gore may be included to help 'snag' the right turn movement and provide more space for turning trucks.

10.9.2 Free Flow Right Turn Bypass Lane

Free flow right turn bypass lanes allow vehicles to bypass the roundabout and enter their own lane on the exit, see Figure 10.28(c). The dedicated exit lane may then merge downstream (referred to as a merging bypass lane in NCHRP 1043) or continue downstream (referred to as an add-lane bypass lane in NCHRP 1043). A high right turn demand when coupled with other approaching traffic may indicate the need for a free flow right turn bypass lane to avoid a wider, faster entry. Free flow right turn bypass lanes are not advised in environments where bicycle and pedestrian use is intended and should be avoided, if possible. If free flow right turn bypass lanes are used, keep vehicle speeds slow by using a small right turn radius and consider supplemental crossing treatments.



(a) Yielding Right Turn Bypass Lane (SB Movement)

(b) Dual Yielding Right Turn Bypass Lane (SB Movement)

(c) Exclusive Right Turn Lane (SB Movement) and Free Flow Right Turn Bypass Lane (EB Movement)

***Figure 10.28* Bypass Lane Configurations**

10.11 Access Management

Management of access to arterial roads is vital to creating a safe and efficient transportation system for motorists, bicyclists, and pedestrians. Access guidance is provided through the regional access coordinator, FDM Chapter 7, and the WisDOT Traffic Impact Analysis (TIA) Guidelines.

The operational characteristics of roundabouts may offer advantages when compared to existing conventional approaches to access management. Some roundabout benefits include:

- Increased capacity along arterial roads
- Reduction of traffic congestion and delay
- Improved safety
- More efficient use of land
- Savings on infrastructure investments

For example, connecting two roundabout intersections with a raised median will preclude lefts in/out from the side street or business access to protect main-line capacity and improve safety. U-Turns are not problematic at roundabouts (except possibly at compact roundabouts due to the smaller size) and can increase safety. This provides the typical capacity protection and safety along the mainline with less impact to business accessibility.

Preliminary design for any intersection including roundabouts should include a comprehensive access management plan for the site. Consider the possible need to realign/relocate existing driveways and include their associated costs in the project's preliminary estimate. Account for pedestrian accessibility and safety during all stages in the development of a comprehensive access management plan.

10.11.4 Physical and Functional Intersection Area

See FDM 11-25-2.2 for definitions of physical and functional areas at a roundabout.

10.11.5 Corner Clearance and Driveway Location Considerations

Corner clearance represents the distance that is provided between an intersection and the nearest driveway. See FDM 11-25-2.5 for guidance on corner clearance to driveways.

Driveway access to the circulating roadway may be allowed and should be reviewed with the regional access coordinator. The preferred method to accommodate driveways at the circulating roadway is as a leg of the roundabout, including providing a splitter island and speed control similar to a standard roadway leg of the roundabout.

Direct driveway access to the circulating roadway (curb cut) is not recommended; however, some situations may dictate the need for a direct driveway and must be analyzed on a case-by-case basis and discussed with the regional access coordinator. For a driveway to be located with direct access (curb cut) into the circulatory roadway of a roundabout, the following items should exist:

- No alternative access points are reasonable.
- Residential or low traffic volume business driveway with traffic volumes low enough that the likelihood of erratic vehicle behavior is minimal. Driveways with higher traffic volumes, or higher proportion of unfamiliar drivers should be designed as a regular roundabout approach with a splitter island

10.11.6 Interchange Ramps

According to FDM 11-5-5, a distance of 1,320 feet between a ramp terminal and any adjacent intersection is required. This distance (1,320 feet) is typically needed to provide progression for a series of signalized intersections. Roundabouts need less space between adjacent intersections to operate at a high level of service.

Operational concerns at an interchange resulting from reduced access spacing, such as traffic blocking an adjacent intersection, can be better understood through the analysis of forecasted queue lengths. Queue lengths for a roundabout should be predicted with the use of traffic modeling and the impacts to the adjacent intersections reviewed using other appropriate traffic modeling software. A traffic analysis is required to justify a distance less than 1,320 feet between a ramp terminal and any adjacent intersection.

10.12 Parking

Prohibit on-street parking; within 75 feet of the roundabout entry/exit or further depending on site-specific conditions. Factors that influence the decision to prohibit on-street parking near a roundabout may include: adjacent access, location of pedestrian crossing, and approach or departing curvature. Generally, it is not typical to allow parking on either side of the roadway within the splitter island area or in the transition to the splitter island.

10.13 Bus Stop Placement

Bus stops on the exit side (far side) are preferred and should be constructed with pull-outs. They should be located beyond the pedestrian crossing to improve visibility of pedestrians to other exiting vehicles. Far-side stops result in the crosswalk being behind the bus, which provides for better sight lines for vehicles exiting the roundabout to pedestrians and keeps bus patrons from blocking the progress of the bus when they cross the street.

The use of bus pull-outs has some trade-offs to consider.

- A positive feature of a bus pullout is that it reduces the likelihood of queuing behind the bus into the roundabout
- A possible negative feature is that a bus pullout may create sight line challenges for the bus driver to see vehicles approaching from behind when attempting to merge into traffic

It may also be possible at multilane roundabouts in slow-speed urban environments to include a bus stop without a bus pullout immediately after the crosswalk, as exiting traffic has an opportunity to pass the waiting bus. In a traffic-calmed environment, or close to a school, it may be appropriate to locate the bus stop at a position that prevents other vehicles from passing the bus while it is stopped.

If a bus stop must be located upstream of the roundabout (near side), it should be placed far enough away from the splitter island, such that a vehicle overtaking the stationary bus has adequate space. If the approach is a single-lane and capacity is not an issue, the bus stop could be placed at the pedestrian crossing. Near-side stops provide the advantage of having a potentially slower speed environment where vehicles are slowing down, compared to a far-side location where vehicles may be accelerating upon exiting the roundabout. Near-side stops are not recommended for entries with more than one lane because vehicles in the lane next to the bus may not see pedestrians.

The decisions regarding transit stop location must be coordinated with the local transit authority.

10.14 Treatment for High-Speed Approaches

High-speed approaches (posted speed limit of 45 mph or greater) are often comprised of a series of curves that become successively smaller to encourage drivers to reduce speeds. The roadway curvature, pavement marking gore, introduction of a splitter island, signing, lighting, and landscaping help to increase driver awareness that conditions are changing, and speed reduction is required. Follow the design guidance discussed in this section and illustrated in Figure 10.29 for a typical high-speed roundabout approach. Splitter islands on high-speed approaches shall be a minimum of 250 feet long, unless the approach is not a STH and the AADT is less than 2,000 vehicles, as discussed in FDM 11-26-10.14.1.

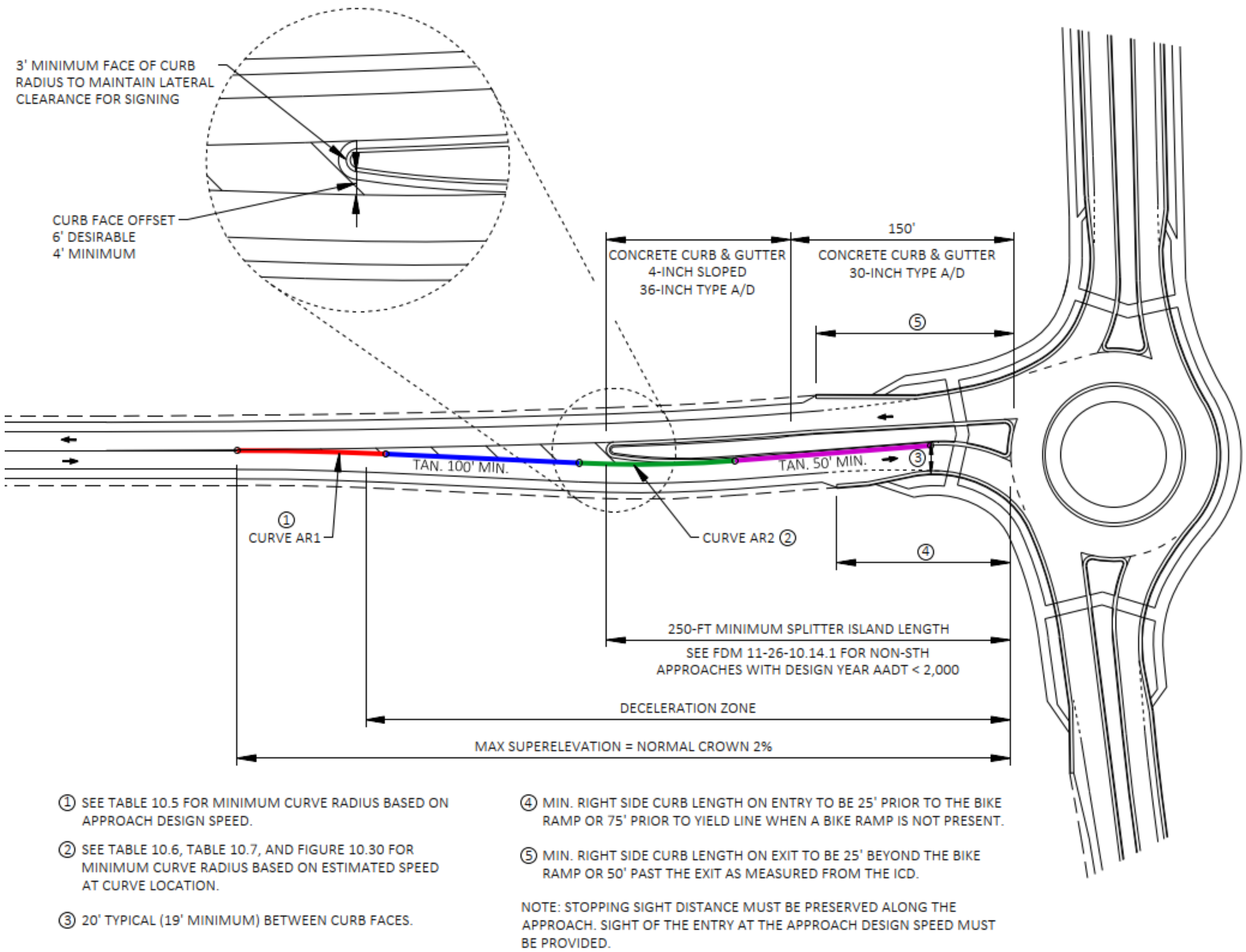


***Figure 10.29* High-speed (45 mph Posted Speed or Greater) Roundabout Approach**

Superelevation of curves on approaches to high-speed roundabouts is counterproductive to the objective of transitional speed reduction, and approach curves should be designed to use a 2% normal crown.

The first curve in the development of a typical high-speed approach is AR1. This curve typically begins within 1,000 feet of the roundabout yield line. Design AR1 to have a 2% normal crown using the minimum radii values listed in Table 10.5 for the given approach design speed.

The second curve in the development of a typical high-speed approach is AR2. Design AR2 for 2% normal crown based on the estimated speed at the midpoint of the curve. Determine estimated speed by establishing speed contours based on deceleration from the approach roadway design speed to 0 mph at the yield line. Table 10.6 provides deceleration speed contour distances as measured from the yield line. Use the faster speed contour adjacent to the AR2 midpoint and Table 10.7 to determine the minimum radius for AR2. Figure 30 illustrates the use of speed contours to determine the estimated speed at the midpoint of AR2.

Tangents shall be included between reverse curves. The minimum tangent length between AR1 and AR2 is 100 feet. The minimum tangent length between AR2 and the entry curve is 50 feet.

Depending on existing roadway geometrics and other site-specific constraints, a roundabout approach may not follow the typical layout shown in Figure 10.29. Additional notes on approach development include:

- Depending on the circle location and development of the splitter island, the roundabout approach geometrics may not include curve AR1. In this scenario, use the guidance for the second curve AR2.
- Successively smaller curves can be used for AR1 or AR2 based on the speed contours.
- If the existing roadway is superelevated, it is recommended to transition from the existing superelevation to normal crown by the beginning of curve AR2.

Table 10.5 Minimum Approach Radii for Curve AR1

Approach Roadway Design Speed	AR1 Minimum Approach Radius (Curve to the Right)
50 mph	1050 ft
55 mph	1350 ft
60 mph	1750 ft

(Source: Based on rounded values from 2018 GDHS Equation 3-8 and Figure 3-4, hyperlinks only available to WisDOT staff.)

Table 10.6 Distance from Yield Line to Speed Contour (ft)

Approach Roadway Design Speed (mph)	Total Deceleration Length to 0 mph (ft)	Speed Contour (mph)				
		50	45	40	35	30
50	360	360	290	230	175	125
55	410	340	275	215	165	120
60	460	325	260	205	160	115

(Source: Developed from 2018 GDHS Figure 2-34, hyperlinks only available to WisDOT staff.)

Table 10.7 Minimum Approach Radii for Curve AR2

Estimated Speed	AR2 Minimum Approach Radius (Curve to the Left)
25 mph	200 ft
30 mph	350 ft
35 mph	550 ft
40 mph	800 ft
45 mph	1050 ft
50 mph	1400 ft
55 mph	1850 ft
60 mph	2400 ft

(Source: Based on rounded values from 2018 GDHS Equation 3-8 and Figure 3-4, hyperlinks only available to WisDOT staff.)

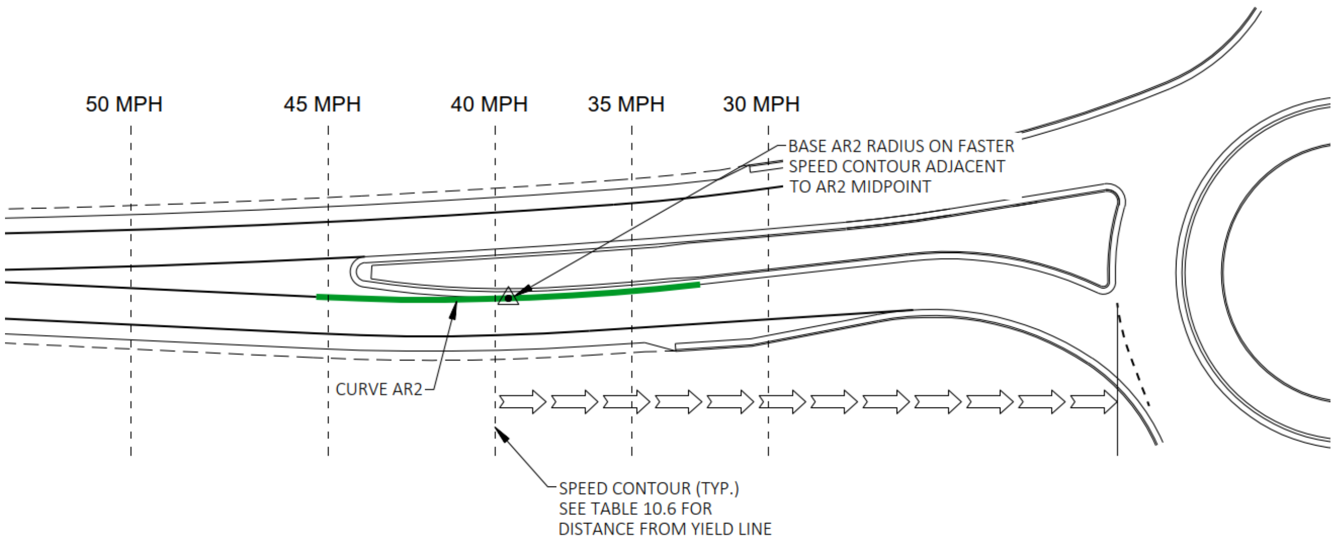


***Figure 10.30* Development of Deceleration Speed Contours**

10.14.1 Low Volume, Non-STH Side Road Approaches

For an intersection having non-STH side road approaches with low traffic volumes, a reduction in roundabout approach construction length - including the splitter island length - may be appropriate if meeting all these side road conditions:

- Design year AADT is less than 2,000
- Must be single-lane roundabout entry
- Existing side road intersection control is stop-controlled, as motorists are already conditioned to yield to mainline traffic
- Typical stopping sight distance (SSD) is attained or exceeded at all approaches

If all the above conditions are met, continue evaluating the non-STH roundabout approaches based on post-construction side road posted speeds and other considerations cited below.

Where side road roundabout approaches have posted speeds 45 mph and higher, provide a combination of alignment deflection or offset and non-superelevated curvature that spans the deceleration distance from the entry. This will produce gradual deceleration to avoid forcing all the reduction in speed to be completed through the curvature at the roundabout.

The length of roundabout splitter island should be a minimum of 200 feet for design year AADT between 1,000 and 2,000 vehicles, and a minimum of 100 feet for design year AADT less than 1,000 vehicles. Always verify that the side road approach and entry condition, including the roundabout splitter island, provide deflection per the design principles of FDM 11-26-10 to safely and effectively slow traffic.

Where side road roundabout approaches have posted speeds 40 mph and lower, use a lower minimum 50-foot raised splitter island (typical 100-foot) length to alert drivers of the upcoming roundabout. A splitter island also provides refuge for crossing pedestrians and needs to be long enough to contain the pedestrians. Always verify that the side road approach and entry condition, including the roundabout splitter island, provide deflection per the design principles of FDM 11-26-10 to safely and effectively slow traffic.

During preliminary design, consider whether any major development is planned along the side road. Any significant development may result in additional trips and more unfamiliar drivers. Field running speed assessments may be used to ascertain current side road speed conditions and determine prudent splitter length selection. Additionally, assess current access locations along with the real estate, environmental and utility impacts with the selected side road approach lengths. Document all findings in the DSR, including any known future local land development plans and whether access control is planned along the side road.

For non-STH roundabout approaches with traffic volumes greater than 2,000 AADT, apply the high-speed roundabout approach design principles as prescribed under FDM 11-26-10.14 and Figure 10.29.

10.21 Clear Zone

Clear zone guidance for roundabout installations requires consideration of the approach speeds, fastest path speeds, adjacent side slopes leading into and through the roundabout, and average daily traffic on the facility. The guidance for the determination of clear zone is provided in the current AASHTO Roadside Design Manual and FDM 11-15, Attachments 1.9 and 1.10.

The vehicle speed approaching an intersection and the speed allowed through an intersection, along with the ADT and side slopes, will determine the required clear zone. A traffic signal-controlled intersection allows vehicles to go through the intersection at the posted speed, does not require the vehicle to reduce speed as it approaches the intersection, and therefore the clear zone is maintained through the intersection. A stop sign controlled intersection located in a high speed rural condition will require less clear zone as the vehicle slows down to stop. As the approaching vehicle reduces speed it may be appropriate and typical to reduce the corresponding clear zone. The designer has the responsibility to balance the need for clear zone and right of way acquisition.

The yield condition for a roundabout and the fastest path design speed approaching and traveling through the roundabout are similar to the stop sign controlled intersection. The horizontal geometrics leading to and through the roundabout intersection requires the vehicle to slow down leading to the approach and through the roundabout. The approaching speed transition distance for a roundabout is determined by the posted highway speed and the deceleration needed to enter the roundabout in accordance with the fastest speed path calculation, R_1 value. FDM 11-26-10.14 and Figure 10.29 show how to determine the roundabout approach layout for high-speed highways. The design speed to use for clear zone around the perimeter of the roundabout is the average of the entry speed (R_1) and the circulating path speed (R_2) values. The maximum average entry speed (R_1) and circulating speed (R_2) for any type of roundabout is approximately 25-30 mph. The average fast path, $\left(\frac{R_1+R_2}{2}\right)$, of approximately 25-30mph will produce a clear zone between 7 and 18 feet depending on ADT.

The exit ramps from an interchange are also considered to be low speed in close proximity of the approach to the roundabout. In an urban environment, lateral clearance is typically used rather than clear zone to determine the minimum distance to fixed objects such as power poles, light poles, fire hydrants, trees etc. In a rural environment, it is typical to use a clear zone based on the design speed, ADT and slopes. The side slopes adjacent to a roundabout are generally quite flat to accommodate a small terrace and a shared-use path around the perimeter. When the shared-use path is not installed at the time of the roundabout the area should be graded such that at some time in the future the path could be installed. The side slopes in the approach area having an approach speed of 40mph or less and the perimeter of the roundabout, outside of the shared-use path, should be 4:1 (recoverable slope) but may be steeper depending on meeting the clear zone requirement and local impacts.

Central island clear zone is considered to be within a low-speed environment therefore needs to meet the lateral clearance for urban streets, typically 2 feet back from the face of curb. Having stated this, WisDOT believes the approach speed and site context need to factor into the central island landscaping design. See FDM 11-26-14.4.1, for additional guidance on central island landscaping.

FDM 11-26-11 Vertical Alignment and Cross-Section Design — February 14, 2025

11.2 Profile Development

As drivers decelerate into the roundabout entry, lower design speeds can be used for profile development. Base minimum vertical curve design parameters on the estimated speed at a given location along the approach using speed contours as described in FDM 11-26-10.14.

See NCHRP 1043, Chapter 11.2 for additional profile development information.

11.3 Roadway Grade Considerations

Roundabouts typically should be constructed on relatively flat or rolling terrain with an approach grade that is typically less than 3%, but not greater than 5%. Grades approaching 4% and steeper terrain may require greater transitions to provide an appropriate grade through the intersection. If possible and practical, avoid grades in excess of 3% within the area of the approach where vehicles may be required to stop. When crosswalks are present, the profile through the crosswalk area should be 2% or less when possible. In some situations, it may be difficult to get the profile to be 2% or less. Designers should try to decrease the slope as much as possible, but it must be less than 5% to meet ADA requirements.

11.4 Transverse and Cross-Slope Design

The most critical vertical design area of the roundabout is the portion of roadway from the approach end of the splitter island to the circulatory roadway. This area requires special attention by the designer to ensure that the user can safely enter the circulatory roadway, especially for OSOW vehicles. This area usually requires pavement warping or cross-slope transitions to provide an appropriate cross-slope transition rate through the entire transition area and within the circulatory roadway.

It is typical to match the exit grades and the entry grades. Adjustments to the circulatory roadway cross-slope may be required to meet these criteria but should be balanced with the effects on the circulatory roadway.

11.4.1 Outward Sloping Circulatory Roadway

The circulatory roadway of single-lane and multilane roundabouts should not be sloped entirely to the outside. Crown the circulatory roadway following guidance in FDM 11-26-11.4.2.

11.4.2 Crowned Circulatory Roadway

The profile grades along the central island should generally not exceed 4%, (typically 3% or less).

- Compact Roundabout – See FDM 11-26-11.4.5.
- Single-lane Roundabout – crown the roundabout circulating roadway with a 1.5% cross-slope with approximately 2/3 width sloping toward the central island and 1/3 width sloping outward (See Figure 11.1).
- Multilane Roundabout – Same crown guidance applies where possible. However, when considering factors such as paver screed width, contraction joint location for concrete pavement, pavement marking location, and the total width of the circulatory roadway, it may be a challenge to comply with the 2/3 sloping inward and 1/3 sloping outward. The preferred alternative (independent of pavement type) on multilane roundabouts is to slope the inside lane, or left lane, toward the central island and slope the outside lane (typically wider lane) to the outside. This alternative will allow the contraction joint on concrete pavement to generally coincide with the lane line pavement marking and allow asphalt pavement roundabouts to be similar in design.

The crown vertical design feature provides good drivability, keeps water from draining across the circulating roadway which is particularly important in a northern climate with freeze-thaw cycles, and provides a smooth transition in/out of the approaches and departures. This 'crown' also reduces the probability of load shifting or truck overturning.

The typical truck apron slope is one percent toward the circulatory roadway (See Figure 11.1). Greater slopes than one percent should not be used on OSOW routes.

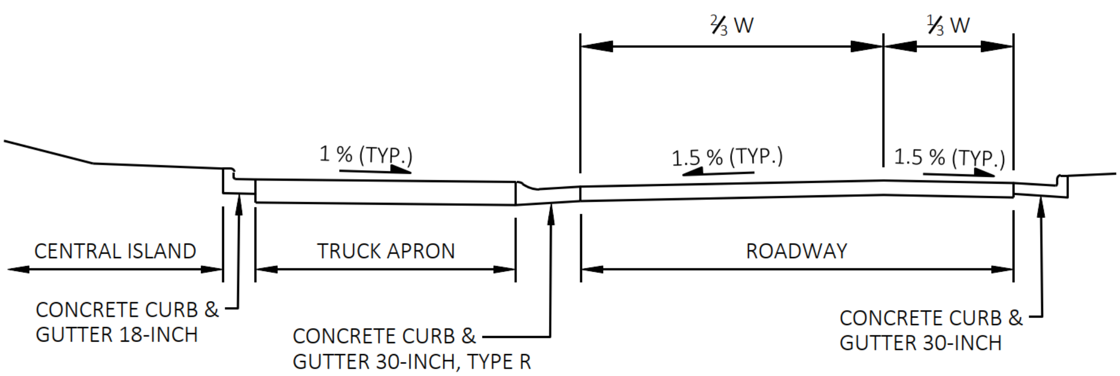


Figure 11.1 Circulatory Roadway Typical Section

11.4.5 Transverse and Cross-Slope Design for Compact Roundabouts

Circulatory Roadway

The circulatory roadway of a compact design should not contain a crown and should be sloped outward from the central island. The slope should typically be 1.5% but should be no less than 1% and no greater than 3%. This is done to help keep vehicle speeds slow and eliminate the need for storm inlets within the central island. See Figure 11.2. Since the roadway is sloping away from the center, the profile around the central island should still be designed with a minimum grade of 0.8% to ensure drainage along the splitter island curb and gutter at the ICD.

Central Island

A high point should be placed in the middle of the central island to assist with driver sight of the island. As shown in Figure 11.2, the center of the island should be raised if possible from the highest point of the profile around the circle. The high point of the central island does not need to be placed in the center of the circle. The maximum slope across any point of the central island should not exceed 4%. If dictated by vertical clearance when doing the OSOW vertical checks, the central island can be sloped straight across from one side to the other if the slope is at least 0.5%, as shown in Figure 11.3. This should only be incorporated if achieving a high point is not possible.

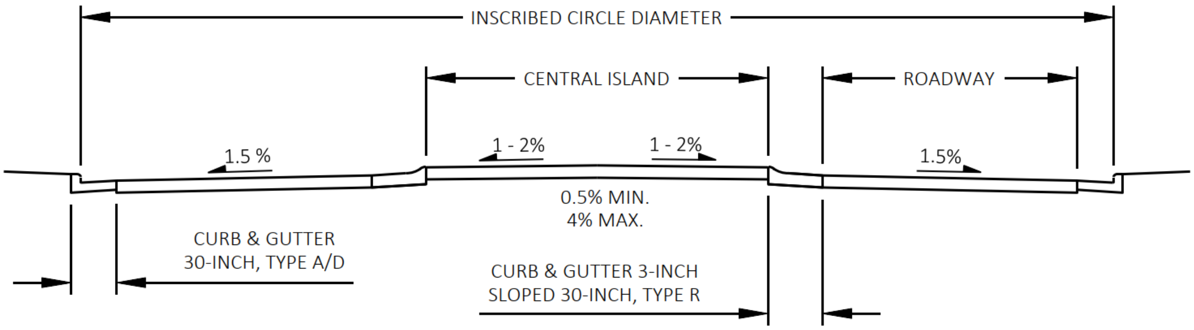


***Figure 11.2* Domed Central Island**

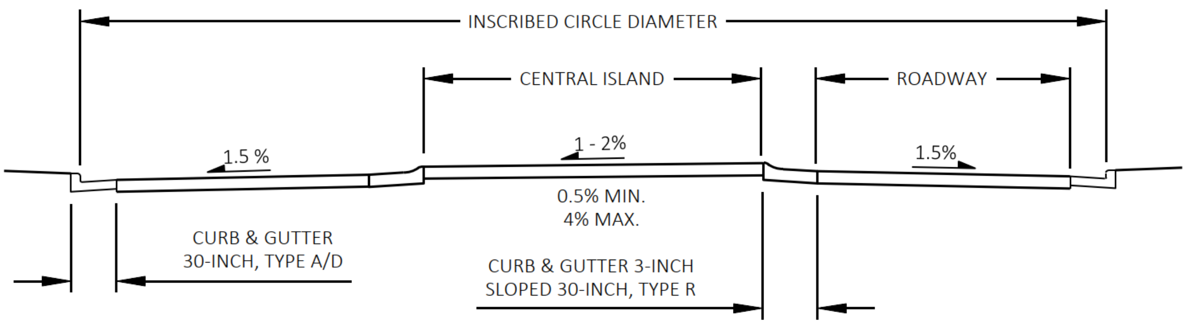


***Figure 11.3* Single Slope Central Island**

FDM 11-26-12 Traffic Control Devices and Applications *February 14, 2025*

12.21 Signing

The overall concept for roundabout signing is similar to general intersection signing. Proper regulatory control, advance warning, and directional guidance are required to provide positive guidance to roadway users. Attachment 12.1 shows sample signing layouts for single-lane, compact, and multilane roundabouts. Locate signs where roadway users can easily see them when they need the information in advance of the condition. Sign location should be checked so they are not in conflict with vehicle turning movements, the swept path of vehicles with a long overhang, or vehicle navigation on the OSOW Truck Route. Signs should never obscure pedestrians, motorcyclists or bicyclists.

Signing needs differ for urban and rural applications and for different categories of roundabouts. On connecting highways coordinate sign selection with the regional traffic section and local agency to maintain consistency on the facility.

The signing and pavement marking can get complex on roundabout projects. To assist project managers and contractors, the designer should use a minimum of 40 scale drawings for signing and pavement marking plan sheets.

The Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), the Wisconsin Manual on Uniform Traffic Control Devices (WMUTCD), Wisconsin DOT Traffic Engineering, Operations and Safety Manual (TEOpS) and appropriate sign plate details govern the design and placement of signs.

12.22 Pavement Marking

Pavement marking is an important component of single and multilane roundabouts, particularly for complex and high-volume roundabouts Pavement marking is part of a “whole system” to consider, meaning that various design concepts from geometric design, to signing, and pavement marking should complement each other.

Typical pavement marking for roundabouts consists of delineating the entries, exits, bike lane accommodations (only on approaches and exits), and marking the circulatory roadway. Single-lane roundabouts need no lane arrows or circulatory roadway pavement marking, except to continue edge line marking on the approaches. Attachment 12.2 shows example pavement marking layouts for common roundabout lane configurations. In order for roundabout markings to be effective and sustainable, they must:

- Be integrated with and preferably designed at the same time as the roundabout geometry
- Be configured to guide proper usage of the roundabout
- Help the motorist identify the correct lane as early as possible using lane arrows on multilane

approaches and circulatory roadways

- Be designed and implemented collaboratively between regional traffic operations and project development staff with expertise in roundabouts and knowledge of maintenance considerations

Based on findings from the Department's pavement making evaluation, mark all roundabouts and their approaches with epoxy pavement marking. See TEOpS 3-10-1 for further guidance on pavement marking selection.

Markings not covered in this policy shall follow practices established by standard detail drawings or require the approval of the regional traffic engineer in collaboration with others who have knowledge of the design of roundabouts. On connecting highways, (local jurisdiction), coordinate pavement marking with the regional traffic engineer and the local agency to maintain consistency on the facility.

It is very important to make sure field layout and pavement marking application on the circulatory pavement is located and positioned correctly. A pavement marking layout detail showing the exact locations is required on all multilane roundabouts. Consider wheel tracking when developing the pavement marking layout detail.

Proper pavement marking within the circulatory roadway will help prevent drivers from improperly turning left from the outer lane, thus reducing exit crashes. Complex lane configurations should be reviewed by an experienced roundabout designer and the regional traffic engineer.

LIST OF ATTACHMENTS

FDM 11-26-13 Curb and Pavement Details *February 14, 2025*

13.1 Roadway Pavement Type

Pedestrian paths or crosswalks should not be stamped as this is not normally ADA compliant.

See FDM 14-10-35 for additional information relating to pavement type and design.

13.2 Truck Apron Material

The truck apron and any overtracking pads shall be red colored concrete conforming to Standard Spec 405.

13.3 Pavement Jointing

See FDM 14-10-35 for information relating to concrete jointing, pavement design, tie bar location, dowel bar location, contraction joint layout, and other pavement guidance.

13.4 Curb Type

13.4.1 Approach Curbs

Low speed approaches (40 mph posted speed limit and lower) should incorporate 6-inch vertical face curbs, on both sides of the roadway. The purpose of the vertical face curbs is to control the fastest speed paths at the roundabout entrances and exits. Where OSOWs need to overtrack the entry curb, a mountable curb and gutter with an overtracking pad may be used in limited situations to better accommodate truck tires.

See FDM 11-26-10.5.4 for suitable curb type adjacent to an outside entry overtracking pad and FDM 11-26-13.4.2 for curb type adjacent to the truck apron.

High-speed approaches to roundabouts usually occur where there is a rural cross-section (45 mph posted speed limit and greater). Provide 6-inch vertical face curbs (30-inch Type A or D) on the splitter islands within 150 feet of the roundabout entry; the remaining splitter island length shall be 4-inch mountable curb (36-inch Type A or D). See Figure 10.29 for additional information and for guidance on the minimum lengths of curb adjacent to the roundabout entries and exits.

Consider drainage in the area of the curb/gutter by providing a flume or inlet structure.

See FDM 11-26-13.4.4 for further guidance on compact roundabouts.

13.4.2 Curb and Gutter Separating the Circulatory Roadway from the Truck Apron

Use Curb & Gutter 4-Inch Sloped 30-Inch Type R, between the circulating roadway and the truck apron shown in SDD 8D1. Use a Type T inlet casting on the drainage structure, as shown in SDD 8A5. This curb and gutter is gentle to large truck tires but should be unfriendly for SUVs and autos to traverse. When the circulatory roadway is concrete it shall be tied to the gutter flange with tie-bars, but not to the truck apron. When the circulatory roadway is asphalt, the apron shall be tied to the back of curb with tie-bars.

13.4.3 Curb at the Inside of the Truck Apron or Edge nearest the Central Island

This curb shall be a reverse-slope 18-inch curb and gutter. The adjacent pavement will be a concrete truck apron. There may be situations when this inside curb could be deleted, but this is rare and should be addressed in the DSR.

13.4.4 Compact Roundabout Curb Types

Due to the smaller inscribed circle diameters of compact roundabouts, larger vehicles may need to overtrack the splitter islands. If the need for trucks to overtrack the splitter island is determined necessary, install Curb & Gutter 4-inch Sloped 36-Inch Type A/D with 8" minimum gutter thickness and 12-inch thick red-colored concrete without stamping in the areas of overtracking. The use of reverse slope on the gutter may be desirable to eliminate the need for storm inlets along the splitter island.

For the central island curb, use Curb & Gutter 3-Inch Sloped 30-Inch Type R with reverse gutter slope. As mentioned in FDM 11-26-11.4.5, the circulating roadway should not be crowned, and the use of 4-inch sloped curb would be more pronounced and challenging for low clearance vehicles.

If a small non-traversable central island with a standard truck apron is possible as discussed in FDM 11-26-10.6.8.6, use a reverse-slope 18-inch curb and gutter on the inside edge of the truck apron as discussed in FDM 11-26-10.4.3.

On the outside of the compact roundabout, Curb & Gutter 30-Inch Type A/D should be used except in areas where outside overtracking areas are needed. In that case, Curb & Gutter 4-Inch Sloped 36-Inch Type A should be used (See Figure 13.1) and tie bars should be provided as discussed in FDM 11-26-10.5.4.

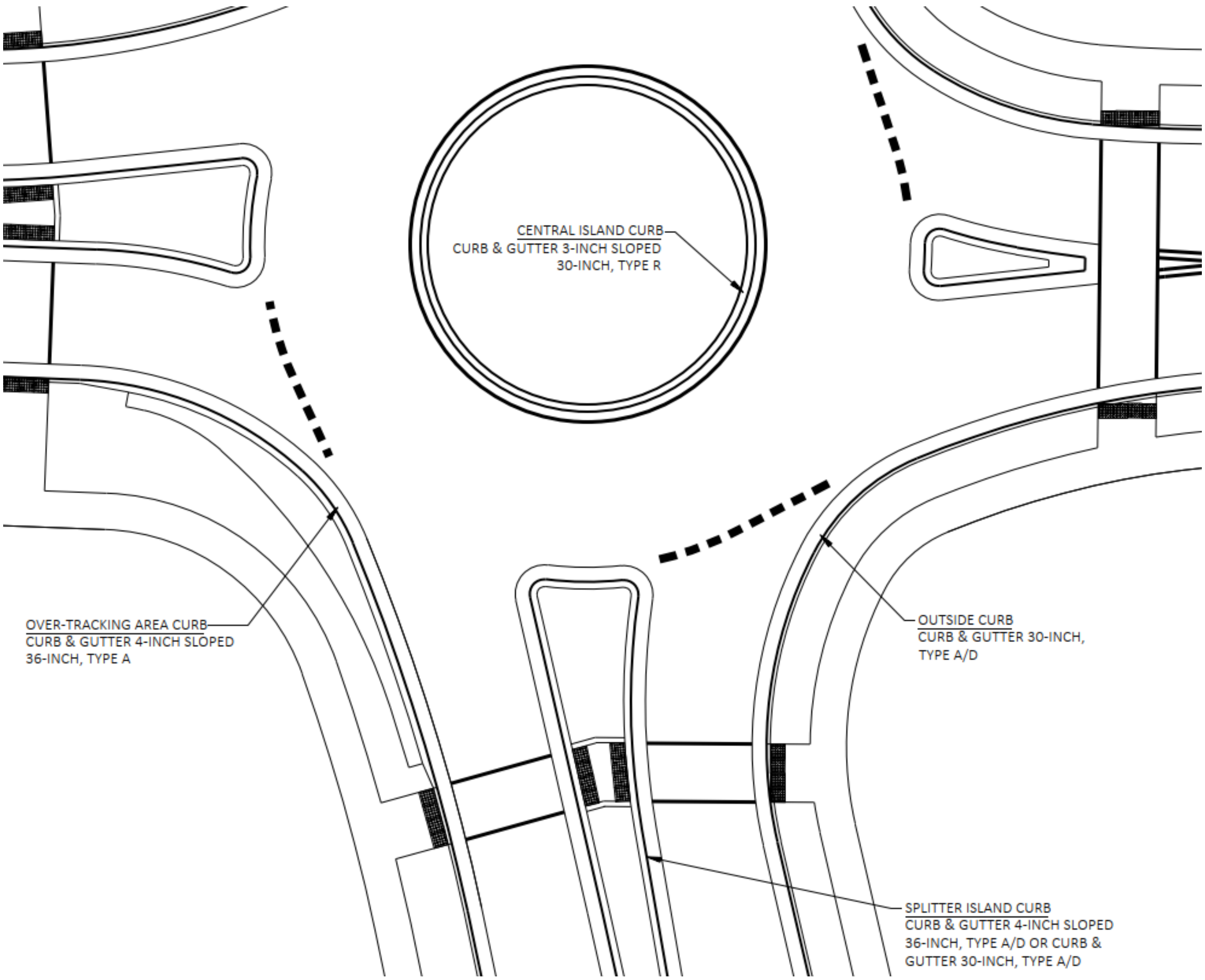


***Figure 13.1* Compact Roundabout Curb & Gutter Selection**

13.5 Splitter Islands with Sloped Noses

Colored concrete pavement could be used for splitter islands and may be stamped, if not a walking surface, but stamping pattern must be specified in the special provisions.

See FDM 11-26-10.6.2 for additional information on splitter islands.

FDM 11-26-14 Illumination and Landscaping February 14, 2025

14.1 General Illumination Considerations

See TEOpS 11-1 for guidance on illumination of roundabouts

Illumination of compact roundabouts should follow the same procedures as for larger roundabouts.

14.4 Landscaping

14.4.1 Central Island Landscaping and Other Aesthetic Treatments

Roundabout landscape elements are vital to the proper operation of the roundabout and should be in place when open to traffic. This does not apply to roundabouts with traversable central islands (i.e., compact roundabouts).

14.4.1.1 Landscape Elements

The Department’s primary approach to central island landscaping is mounding the earth and (optionally) providing low-level plantings.

The purposes of landscape elements in the roundabout are to:

- Make the central island conspicuous to drivers as they approach the roundabout
- Clearly indicate to drivers that they cannot pass straight through the intersection
- Restrict the ability of a driver to view traffic from across the roundabout through mounding of the earth and optional plantings
- Require motorists to focus toward on-coming traffic from the left
- Help break headlight glare
- Discourage pedestrian traffic through the central island
- Improve and complement the aesthetics of the area

Landscape elements at roundabouts contribute to lower entering speeds which improves the overall safety of the intersection.

When designing landscaping for a roundabout it is important to:

- Minimize driver distraction
- Consider maintenance requirements early in the program stages of development
- Develop a formal municipal agreement describing the landscaping and maintenance requirements for roundabouts elements early in the scoping process and prior to design of the facility
- Maintain adequate sight distances
- Avoid obscuring the view to signs
- Minimize fixed objects such as trees, poles, or guard rail
- Refer to FDM 11-26-14.4.2.1 for reference to Department-approved plant materials

Refer to Figure 14.1 for the general layout of the central island.

Design the slope of the central island with a minimum grade of 4% and a maximum of 6:1 sloping upward toward the center of the circle. Design the central island area so that the earth surface forms a mound that is a minimum of 3.5-feet to a maximum of 6-feet in height, measured from the circulating roadway surface at the curb flange. Keep the outside 6-10 feet of the central island free from landscape features to provide a minimum level of roadside safety, snow storage, and unobstructed sight distance. In some situations, this central island area may need to maintain a low profile beyond 6-10 feet to allow OSOW vehicle loads to pass over the central island without the axles passing over the central island, (i.e. 165-foot girder, wind turbine parts).

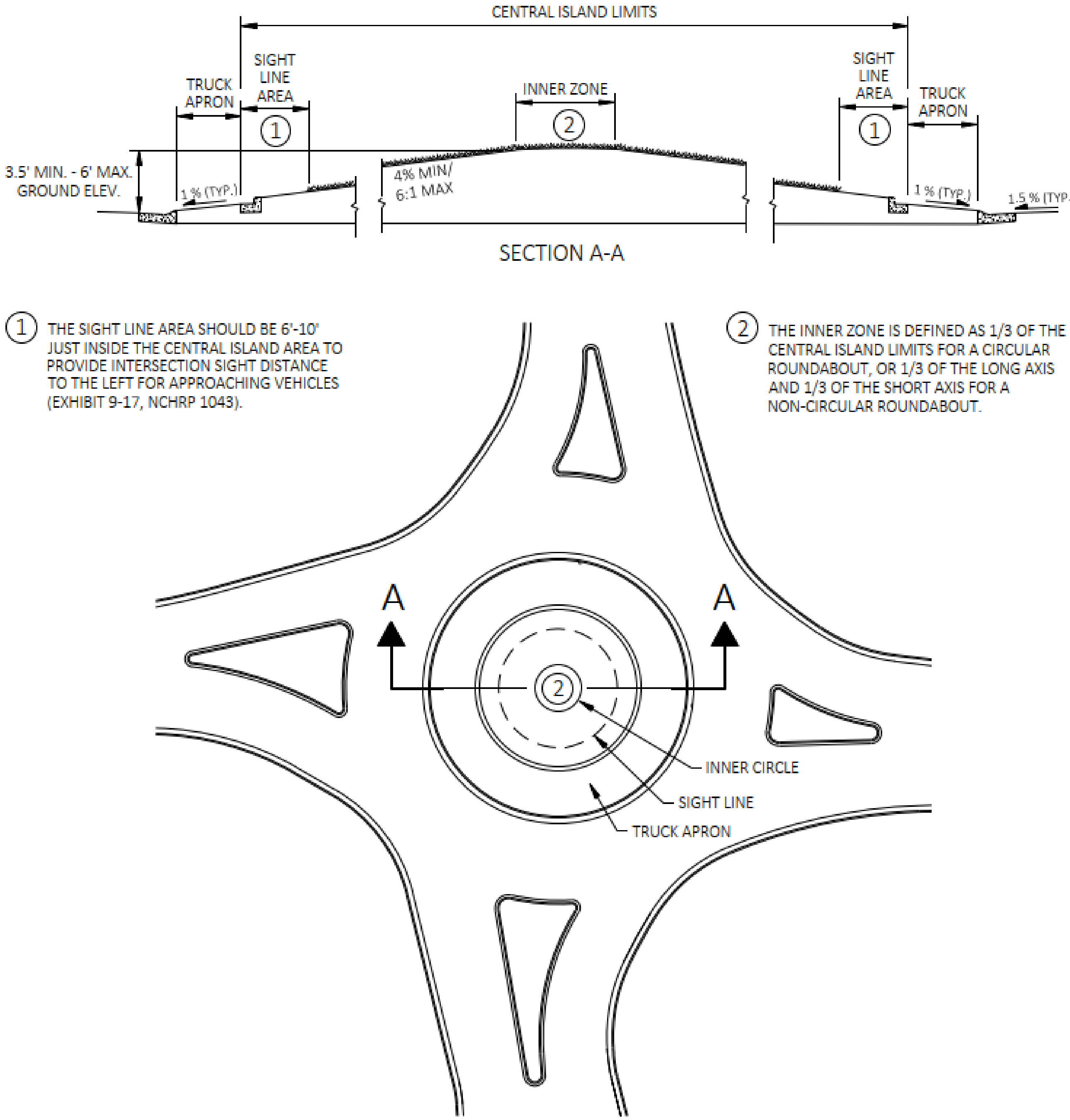


***Figure 14.1* Central Island Landscaping**

14.4.1.2 Other Aesthetic Treatments

Under certain conditions, WisDOT will allow a municipality to provide additional, non-standard landscaping and/or aesthetic treatments to the roundabout central island in addition to the earth mounding and low-level plantings. For purposes of determining allowable central island landscaping treatments, two conditions are identified:

- **Condition A - Roundabouts where any of the approach legs have a posted speed greater than 35 mph**

  [Note: Tangent interchange exit ramps (e.g. diamond interchange ramps) departing from high-speed freeways and expressways will be considered as having a posted ramp termini approach speed exceeding 35 mph. Designers may consider slower ramp termini approach speeds of 35 mph or less for exit ramps with sharper ramp curvature (e.g. loop ramps) that reduce operational speeds prior to the ramp termini.]

Required central island landscaping for Condition A:

- Earth mounding

Allowable central island landscaping for Condition A:

- Low-level plantings

All other aesthetic treatments are prohibited. This includes, but is not limited to –

- concrete, stone, boulders, or wood walls
- fixed objects, including trees having a mature diameter greater than 4-inches

- **Condition B - Roundabouts where all the approach legs have a posted speed 35 mph or less**

  Aesthetic treatments or non-standard design treatments as described below may be considered in the inner zone only (See Figure 14.1). The inner zone is defined as 1/3 of the central island limits for a circular roundabout, or 1/3 of the long axis and 1/3 of the short axis for a non-circular roundabout.

  Required central island landscaping for Condition B:

  - Earth mounding

  Allowable central island landscaping for Condition B:

  - Low-level plantings
  - In addition to plantings, certain aesthetic treatments or non-standard design treatments (including but not limited to holiday trees, art representing local heritage or other gateway features, etc.) may be considered in the inner 1/3 of the central island area (see Figure 14.1) if all the following conditions are met:
    - The aesthetic treatment must be requested, planned, designed, and maintained by the local municipality/community
      See HMM 2-15-06 Section 3.1.
      - For proposed roundabouts, the aesthetic treatment could be constructed as part of the improvement project
      - For constructed roundabouts, the aesthetic treatment will be constructed by the municipality/community
    - Any aesthetic feature must be static, i.e., no moving part or parts, including no moving reflector disks
    - Any sign that a municipality wishes to include within the central island is within state right-of-way and is covered under the provisions of TEOpS 2-1-41
    - Aesthetic features shall not interfere with any WisDOT traffic signs
    - Aesthetic features shall not interfere with intersection sight distance or vision corners, including driveways
    - Any lighting in the island shall be solar powered. If the center traffic island landscaping has solar lighting, the lighting shall not interfere with motorists' vision. Breakaway or yielding lighting materials may be required.
    - Water fountains/features are prohibited. They could cause water on the pavement and/or spray mist, both of which could create a safety hazard for drivers in the circulating roadway. Water service is permitted for irrigation purposes only; not to supply water fountains/ features.
    - Attractions such as street furniture, benches, monuments, historic plaques, etc. are prohibited. They could encourage passersby to go to the central island thereby possibly distracting drivers from the driving task and endangering pedestrians.
    - Seasonal/temporary aesthetic treatments (e.g., holiday trees) which the municipality adds to the central island and subsequently removes according to a set schedule.

14.4.2 Landscape Design

Landscape design is an important aspect of roundabout operation. Before starting the landscape design first determine the maintaining authority and comply with the intersection sight distance as described in FDM 11-26-

9.5. More flexibility is allowed on projects that are not maintained by WisDOT.

Low-to-the-ground landscape plantings in the splitter islands and approaches can both benefit public safety and enhance the visual quality of the intersection and the community. In general, unless the splitter islands are very long or wide they should not contain trees, planters, or light poles.

Landscape plantings on the approaches to the roundabout can enhance safety by making the intersection more conspicuous and by countering the perception of a high-speed through traffic movement. Avoid landscaping within 50 feet in advance of the yield point. Plantings in the splitter islands (where appropriate) and on the right and left side of the approaches (except within 50 feet of the yield point) can help to create a funneling effect and induce a decrease in speeds approaching the roundabout. Low profile landscaping in the corner radii can help to channelize pedestrians to the crosswalk areas and discourage pedestrian crossings to the central island.

14.4.2.1 Owned, Operated, and Maintained by WisDOT

The goal for State-owned and maintained roundabouts is to achieve a landscape design that enhances the safety around the central island and splitter islands with little or no landscape maintenance required over time. Landscape design elements should minimize areas of mulch and planted vegetation that require maintenance.

Low maintenance planting plans for roundabout landscapes are required. Vegetation approved for use by the department requires minimum maintenance and has been demonstrated to tolerate highway site conditions.

The central island earth berm may be planted with trees and shrubs, a prairie grass mixture that doesn't require mowing, or both. Plant materials approved for use by the Department, including trees and shrubs listed in FDM 27-25 Attachment 1.3 are approved for use on roundabouts owned, operated and maintained by the Department. Certain native grasses are also approved at roundabouts and are included in the grasses portion of the "Table of Native Seed Mixtures" in Standard Spec 630.

Locations of plant materials shall be selected for salt tolerance and be located to allow for sufficient snow storage in the winter. Snow removal operations typically radiate out from the central island. Plant materials shall not be placed to impede snow removal practices.

The uses of pre-emergent herbicides are recommended for use in plant bed and "hardscape" areas. Follow label instructions provided on the product container for use and application procedures.

Contact the Highway Maintenance and Roadside Management Section in the Bureau of Highway Operations for additional landscape design guidance.

14.4.2.2 Owned by WisDOT but Maintained by Others

Landscape design requests in excess of FDM 11-26-14.4.2.1 will be considered only upon receipt of a formal, signed project agreement prior to design of the facility and are the sole responsibility of the requesting municipality. These agreements are to be obtained in the planning stages of the project.

14.4.2.3 Local Roads and Connecting Streets

Landscape design costs in excess of the Department's design criteria described in FDM 11-26-14.4.2.1 on local roads and connecting streets are the sole responsibility of the municipality.

FDM 11-26-15 Construction and Maintenance — *February 14, 2025*

15.2 Stakeholders Engagement and Construction

The Transportation Management Plan (See FDM 11-50-5) will advise the public whenever there is a change in traffic patterns. Education and driver awareness campaigns are especially important for a roundabout because a roundabout will be new to most motorists. The regional communication manager coordination through both design and construction is typically vital to the success of a project. Provide brochures on how to drive, walk and bicycle through a roundabout. The following are some specific suggestions to help alleviate initial driver confusion:

- Hold public information meetings prior to construction
- Prepare news releases/handouts detailing what the motorist can expect before, during, and after construction
- Consider the creation of a project website, flash animation graphics, traffic simulation recording (such as SimTraffic, VISSIM, etc.) or the use of social media before and during construction
- Install portable changeable message signs or fixed message during construction and before construction begins. Advise drivers of anticipated changes in traffic patterns for about one week prior to the implementation of the new pattern.
- Use Wisconsin 511, news media (and Highway Advisory Radio, if available) to broadcast current status of traffic patterns and changes during construction. Also, if appropriate, establish a web site, to post up-to-date traffic and construction information.

15.5 Construction Staging

The Transportation Management Plan (See FDM 11-50-5) will consider detouring traffic away from the intersection during construction of the project. A detour will significantly reduce the construction time and cost, increase the safety of the construction personnel, and provide for an overall better finished product.

It is typical to complete construction as soon as possible to minimize the time the public is faced with an unfinished layout or where the traffic priority may not be obvious. If possible, all work, including the installation of splitter islands and pavement marking, should be done before the roundabout is open to traffic.

If it is not possible to detour all approaches, detour as many approaches as possible. Carefully consider construction staging during the design of the roundabout if it must be built under traffic. Minimize the number of stages if at all possible. Staging should accommodate the design vehicle and maintain sightlines.

Prior to the work that would change the traffic patterns to that of a roundabout, certain peripheral items may be completed including permanent signing (covered), lighting, and some pavement markings that reflect actual conditions. These items, if installed prior to the construction of the central island and splitter islands, would expedite the opening of the roundabout and provide additional safety during construction.

As is the case with any construction project, install appropriate traffic control devices as detailed in the project plans and the Standard Specifications. This traffic control shall remain in place as long as it applies and be removed when it no longer applies to the condition. Maintain consistent traffic control; do not change between stop and yield control multiple times during construction.

Stage the construction as follows unless a different staging plan is approved during design:

- Install and cover proposed signing
- Remove or mask pavement markings that do not conform to the intended travel path
- Construct outside widening if applicable
- Reconstruct approaches if applicable
- Construct splitter islands and delineate the central island. Uncover the signs at this point and operate the intersection as a roundabout
- Finish construction of the central island

If it is necessary to leave a roundabout in an uncompleted state overnight, mark, delineate, and sign the roadway in such a way as to clearly outline the intended travel path. Remove or cover pavement markings that do not conform to the intended travel path.

15.6 Work Zone Traffic Control

Roundabouts pose unique challenges when maintenance work is performed in or around these facilities. Each roundabout is unique so develop the traffic control plan to meet the specific conditions of the location, traffic volumes, duration, and work operation. Consider detour and staging as alternatives since they may provide better service for traffic movement.

During the design of temporary traffic control in roundabout work zone it is essential that the intended travel path for motorists, bicyclists, and pedestrians is clearly identifiable.

Ensure turning radii can accommodate the design vehicle. SDD 15D21 and SDD 15D31 show example device spacing at turning radii and curve transitions.

Work zone traffic control should be designed using the WMUTCD, part 6, temporary traffic control:

https://wisconsindot.gov/dtsdManuals/traffic-ops/manuals-and-standards/wmutcd/mutcd-ch06.pdf

There are occasions when guidance may be provided by law enforcement personnel or using flagging operation depending on the complexity of the work in the roundabout.

Schedule work during off-peak hours to minimize traffic within the roundabout if feasible. A roundabout is not designed to hold stopped or waiting traffic during roadwork. Flagging or a detour may be required if it is likely that work may block traffic from using the circular roadway of a roundabout. Notify emergency services and law enforcement if work is anticipated to cause delays.

SDD 15D37 provides general guidance on the signing and device requirements for maintenance work in and around a roundabout location.

Work in a roundabout may involve any of the situations listed below.

- If work is within the roundabout, initial advance warning (ROAD WORK AHEAD) signs are required for each approach leg.
- If work occurs within the roundabout island and all work vehicles are out of the travel lanes and center island apron, a single “ROAD WORK AHEAD” sign is required per approach.
- If any of the roadway approaches cannot access the intersection due to workspace, a detour may be

required. For short closures of less than 15 minutes or less, traffic may be held in place.

- If the center island apron will be impacted by the work or equipment, treat it as a shoulder closure for the duration of the work but consider diverting semi-trailer truck traffic due to large vehicle wheel tracking.
- If work occurs in an approach leg, a minimum of two flaggers should be used to control traffic. High approach volumes may require additional flaggers in the remaining legs. Use the “ROAD WORK AHEAD, BE PREPARED TO STOP” and the Flagger symbol signs in advance of each leg.
- If travel width of at least 10’ can be maintained for shoulder work on an approach lane, the lane can remain open to traffic. Close the workspace with shoulder taper and tangent cones/drums. An initial advance sign and a “SHOULDER (SIDEWALK) CLOSED” sign are required unless the work lasts less than 15 minutes.
- If work is in a multilane roundabout, and work can be done without closing both travel lanes, flaggers may not be needed. Appropriate signs for the lane closure at each entry are required. Merge traffic into one lane prior to entry into the roundabout. See the details in SDD 15D12 and part 6 of the WMUTCD for merging details.

  https://wisconsindot.gov/dtsdManuals/traffic-ops/manuals-and-standards/wmutcd/mutcd-ch06.pdf
- If the splitter islands are raised, cones may not be needed along the approaches. In these situations, the flagger may have to move ahead on the splitter island so that traffic can maneuver into the roundabout.

When establishing the limits of the work zone ensure maximum possible sight distance to the flagger station, based on the posted speed limit. Motorists should have a clear line of sight from the flagger symbol sign to the flagger.

If sidewalks are impacted, provide a detour or temporary walkway that is a smooth, continuous hard surface (firm, stable and slip resistant) throughout the entire length of the temporary walkway. The following examples are typical work activities expected to occur in/around a roundabout.

Case A - Work Zone at the Entrance to a Roundabout

Two-way traffic should be maintained if possible. If not, entering traffic should be stopped using a flagger or a detour route provided.

In the case of a work zone illustrated in Figure 15.1, use channelizing devices to direct traffic to the proper travel path and restrict traffic to one lane going towards the roundabout. Advance warning signs “ROAD WORK AHEAD, NARROW LANES (if lanes are less than 10’), barricade with Lane Closed signs should be used. If no suitable detours are available, it may be necessary to adopt an alternating one-way layout.

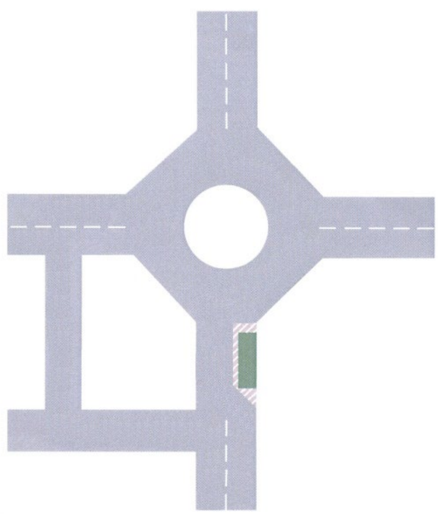


***Figure 15.1* Work Zone at Entrance to Roundabout**

Case B - Work Zone in the Circulatory Area of a Roundabout

Refer to Figure 15.2

If possible, maintain all movements. Separate the work area from traffic using channelizing devices and advance warning sign such as “ROAD WORK AHEAD.”

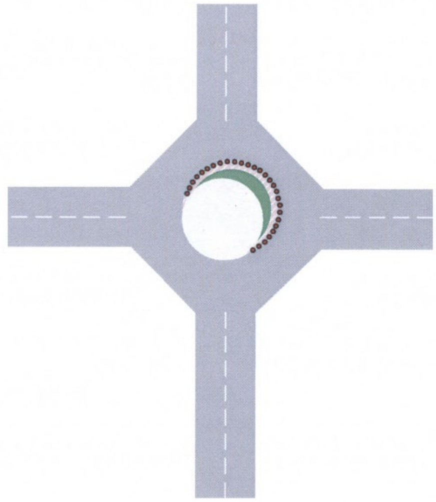


***Figure 15.2* Work Zone in the Circulatory Area of a Roundabout**

Case C - Work Zone Completely Obstructing the Circulatory Area of a Roundabout

Refer to Figure 15.3 and the traffic control, 2-lane roundabout information in SDD 15D37.

At night, flagger stations should be illuminated except in emergencies. Portable changeable Message Signs should be considered as part of the traffic control plan to provide clear guidance to motorists on all approaches of the roundabout.

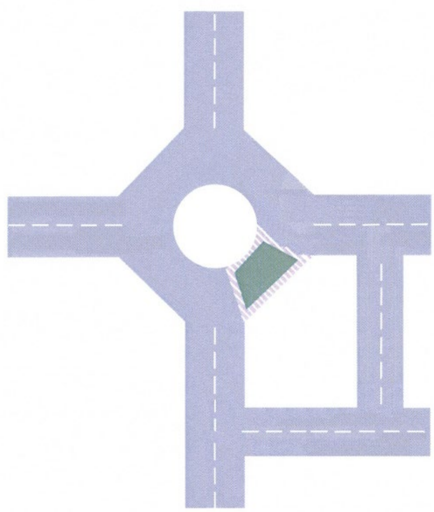


***Figure 15.3* Work Zone Completely Obstructing the Circulatory Area of a Roundabout**

Case D - Work Zone at the Exit from a Roundabout

Refer to Figure 15.4

Channelize traffic around the work area using appropriate channelizing devices. Provide buffers space if roadway width allows. Two-way traffic past the work area should be maintained if possible, otherwise the road should be operated as an exit only from the roundabout, and a signed detour route provided.

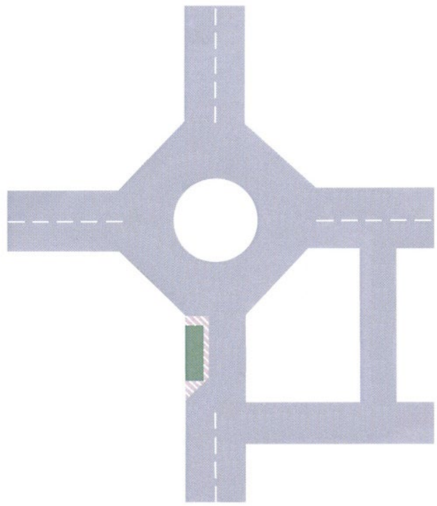


***Figure 15.4* Work Zone at the Exit from a Roundabout**

15.6.1 Pavement Markings During Construction

Because of the confusion of a work area and the change in traffic patterns, pavement markings must clearly show the intended travel path. Misleading pavement markings shall be removed or covered in accordance with the Wisconsin Standard Specifications. As new pavement courses are placed consider specifying in the plans that splitter island delineation and broken white lines on the outside edge of the circulatory roadway be marked the same day the pavement course is placed according to Wisconsin Standard Specifications.

When pavement markings are not practical, or misleading markings cannot be adequately deactivated, use closely spaced channelizing devices to define both edges of the travel path.

When possible, pavement markings used within the work zones should be the same layout type and dimension as those to be used in the final layout. Additional pavement markings may be necessary to avoid confusion from changing traffic patterns used in staging.

15.6.2 Signing During Construction

Construction signing for a roundabout should conform to the WMUTCD and the Standard Detail Drawings. Provide all necessary signing for the efficient movement of traffic through the work area, including pre-construction signing advising the public of the planned construction, and any regulatory and warning signs necessary for the movement of traffic outside of the immediate work area.

The permanent roundabout signing may be installed, where practicable, during the first construction stage so that it is available when the roundabout is operable, but these signs must be covered until they are needed. Consider using portable changeable message signs when traffic patterns change.

15.6.3 Lighting During Construction

Providing temporary lighting at a roundabout during construction may be appropriate at a given location but is not a requirement. Factors to consider when reviewing a location may include the following:

- adjacent lighting conditions,
- staged construction vs detour route,
- traffic volumes during the evening,
- mixture of use such as pedestrians, bicyclists, and trucks,
- when the circulatory roadway is open to traffic and vehicles are yielding on entry.

Temporary traffic control devices such as drums, signs, and markings will typically provide enough visibility to eliminate the need for temporary lighting.

15.7 Maintenance

15.7.1 Landscaping Maintenance

Maintenance responsibilities for roundabouts will vary by ownership. Roundabouts are located on the local road system, on connecting state highways, and state highways.

15.7.1.1 Owned, Operated, and Maintained by WisDOT

All maintenance costs and operations of roundabout landscaping owned, operated and maintained by the department are the responsibility of the department, except as provided below. Landscape design elements and guidance have been outlined to minimize maintenance and operational costs to the department. Plants shown on the approved list have been selected to best meet these needs, FDM 27-25 Attachment 1.3. FDM 11-26-14.4.1 and Figure 14.1 provide detailed layout dimensions of the area to be planted within the central island area.

Only those landscape maintenance operations necessary to maintain the safe operation of the department roundabout will be undertaken.

15.7.1.2 Owned by WisDOT but Maintained by Others

Municipalities often request special landscaping. Landscape requests in excess of requirements contained in FDM 11-26-14.4.2.1 are the responsibility of the requesting municipality. Such requests will be considered only upon receipt of a formal, signed municipal agreement approved by the department prior to the design of those roundabouts. This procedure shall be completed early in the planning stages of project development.

15.7.1.3 Local Roads and Connecting Streets

Maintenance and operating costs of roundabouts located on local roads and connecting streets are the responsibility of the local government.

15.7.3 Curb and Sidewalk

15.7.3.1 Shared-Use Path Maintenance

For urban, suburban, outlaying and rural locations, a roundabout sidepath or shared-use path is provided accordingly; see FDM 11-26-10.4.1. Facilities may be omitted if conditions are met as described in FDM 11-46-1. Appropriate cost share policies apply and maintenance agreements with the local unit of government are required, unless refusal to maintain omission conditions are met. (See FDM 11-46-1.) If conditions are met to omit facilities, grading for future facilities apply as detailed in FDM 11-26-10.4.1 and cut-through crossing are to be provided in splitter islands. The cost of the path installation and maintenance after the original roadway improvement is the responsibility of the local unit of government. There have been situations where changes in land use, local government leadership, public attitudes and/or increases in pedestrian or bicycle volumes – override initial objections and create a strong desire to install the path.

FDM 11-26-16 Plan Preparation and Design Aides — *February 14, 2025*

16.1 Plan Preparation

16.1.1 Plan Preparation Considerations

The overall concept of roundabout plan preparation is similar to other intersection types (see example plan sheets in FDM 11-26-50). The designer should provide the following plan information when designing roundabouts. At a minimum, roundabout plans should include the following plan details:

- Layout details for any alignments utilized for the roundabout
- Layout details for any crosswalks and bike ramps if utilized
- Elevation at low points, high points, island noses, and 25-foot intervals within circulatory roadway
- Provide one 1” = 40’ scale plan sheet for each concrete roundabout in the plans (1” = 20’ scale is preferred if it will fit on one sheet). Plan sheet will be used by the contractor to prepare the concrete transverse joint details. This plan sheet must show all curb and gutter lines, longitudinal joint lines, proposed pavement marking lane lines, surface utilities such as manhole covers, valve box covers, and inlet covers in the concrete circulatory roadway and concrete truck apron.
- Storm sewer plans
- Landscaping and erosion control plans
- Permanent signing plans
- Lighting plans
- Pavement marking, and pavement marking-layout plans

16.1.2 Alignment Plans

When considering the location of alignments, the designer should consider their usefulness in generating cross-sections, profiles, layout details, and ease of use during construction layout. Alignments along both flange lines of the splitter islands are required. The designer should also consider additional alignments for the following locations:

- Along the curb and gutter flange line located between the truck apron and the circulatory roadway
- Along the curb and gutter flange lines at locations where the width is varying from the main alignments (usual from bike ramp to bike ramp)
- Along the curb and gutter flange lines for both sides of right turn bypass lanes
- Along the back of sidewalks or shared-use paths where the distance from the back of curb varies
- On OSOW routes: Along the inside of the central island and along the back of additional pavement placed outside the entry/exit curbs

16.1.3 Profile Information

The designer should consider placing profiles on all of the alignments mentioned above. Some general guidelines for creation of the profiles are:

- It is ideal from a drivability and safety perspective to design and construct the circular component of the roundabout in one plane (planar) with one low point and one high point around the circle
- Once the circulatory roadway profile is established, the approach and exit leg profiles can be adjusted to match the outside edge of the circulatory roadway
- Varying of cross-slopes may be done on the circulating lane(s), but the variance from 1.5% should generally be minimized where possible except where OSOW profile and grading design governs (see FDM 11-26-30.5.6). Varying of cross-slopes may require the approach and exit profiles to be modified.
- The designer should also complete a profile on the outside edges to verify a smooth transition from the approach roadway, roundabout and exit roadway. The designer may have to adjust profiles or cross-slopes on the approach, in the roundabout or on the roundabout exit if there are major kinks in the profile.

16.1.4 Typical Sections

At a minimum, roundabout plans should include typical sections at the following:

- Approaches and exits to the roundabout
- Within the splitter island
- Within the central island

The plans should include a sufficient number of cross-sections through the roundabout to allow for accurate construction of the roundabout.

16.2 Design Aides

16.2.1 Example Plan Sheets

Example plan sheets of the above information will aid the designer when completing roundabout plans. The plan sheets provided are examples and should only be used as guidance:

- Project Overview (page 1)
- Typical Section (page 2)
- Construction Details *(no example)*
- Pavement Elevation - Concrete (page 3)
- Pavement Elevation - Asphalt (page 4)
- Erosion Control (page 5)
- Storm Sewer (page 6)
- Landscaping (page 7)
- Permanent Signing (pages 8 & 9)
- Lighting (page 10)
- Pavement Marking (page 11)
- Construction Staging (page 12)
- Alignment (pages 13 & 14)
- Plan and Profile (page 15)
- Cross-Sections (page 16)