1 - Pedestrian and Bicyclist Accommodations

Accommodating non-motorized users is a Department priority. Therefore, give special consideration to locations where:

- Pedestrian volumes are high
- There is a presence of young, elderly or visually impaired citizens wanting to cross the road
- Pedestrians are experiencing particular difficulty in crossing and being delayed excessively.

Also, consider the adjacent land use near the roundabout location, such as schools, playgrounds, hospitals, and residential neighborhoods. These sites may warrant additional treatments as presented below. Prior to determining whether bicycles and/or pedestrian concerns will be a factor in the design of the roundabout, the designer is strongly encouraged to contact the Region or State Bicycle and Pedestrian Coordinator for their guidance.

1.1 - Pedestrians

Research conducted in Europe and presented in the FHWA Roundabout Guide [1] indicates fewer pedestrian accidents with less severity occur at roundabout intersections when compared to signalized and unsignalized intersections with comparable volumes. Design principles need to be applied that provide for slow entries and exits for pedestrian safety.

In general, due to relatively low operating speeds of 15 to 20 mph, pedestrian safety is generally better with a roundabout design than with other intersection types. Table 1 lists the advantages and disadvantages of roundabouts as related to pedestrians.

Table 1. Roundabout Advantages and Disadvantages for Pedestrians

Advantages	Disadvantages
Vehicle speed is reduced as compared to other intersections.	Vehicle traffic is yield controlled so traffic does not necessarily come to a full stop. Therefore, pedestrians may be hesitant to use the cross walk at first.
Pedestrians have fewer conflict points than at other intersections. Pedestrians are responsible for judging their crossing opportunities. This requires more alertness and may be considered an advantage.	May be unsettling to the pedestrian, depending on age, mobility, visual impairments, and ability to judge gaps in traffic.
The splitter island gore allows pedestrians to resolve conflicts with entering and exiting vehicles separately and simplifies the task of crossing the roadway. Crossing is often accomplished with less wait than at signalized intersections.	Pedestrians at first glance may have to adjust to the operation of a roundabout. Part of this adjustment includes the crosswalk location, which is behind the first stopped vehicle or approximately 20 feet from the yield point.

Choosing the appropriate crossing location for pedestrians is a delicate balance between their safety and convenience, and operation of the roundabout. Pedestrians want crossing locations as close to the intersection as possible to minimize out-of-direction travel. The further the crossing is from the roundabout, the more likely that pedestrians will choose a shorter route that may put them in greater danger. Both crossing location and crossing distance are important. Minimize crossing distance to reduce exposure to pedestrian-vehicle conflicts.

In general, locate the pedestrian crossing one car length or approximately 20 feet upstream from the yield point [2003 MUTCD, Section 3B.24]. This helps to reduce decision-making problems for drivers and avoids creating a queue of vehicles waiting to enter the roundabout. However, for pedestrian safety the crossing should not be located too far back from the yield line such that entering vehicle speeds are insufficiently reduced or exiting

vehicles are accelerating. It may be appropriate to design the pedestrian crossing at two or three car lengths from the yield point at some multi-lane entries. Make the crossing perpendicular to the direction of traffic on multi-lane entrances and exits to minimize pedestrian travel and exposure time. On single-lane roundabouts it may be appropriate to provide a crosswalk straight through the splitter island.

At roundabouts with high traffic volumes, or where pedestrian volumes are high, the pedestrian crossing could be enhanced with features such as standard crosswalk pavement marking, colored concrete with patterned borders, 6-inches wide if used, 6-inch white crosswalk marking next to colored concrete [2005 Wisconsin MUTCD Supplement, Section 3E.01] light bollards at entries/exits, and activated (push button or automatic detection) warning signals. In areas with very high pedestrian volumes, consider accommodating both users in the same facility with an overpass or underpass. See FHWA Roundabout Guide, Chapter 4, Exhibit 4-7 and Exhibit 4-8 for pedestrian effects on entry capacity. Consult with the Region and State Traffic Engineer, to concur that appropriate treatment is applied.

The greatest challenge lies with the continual movement of traffic, and the inability of some pedestrians to judge gaps in an oncoming travel stream. This is especially true of children, the elderly or the disabled. These types of pedestrians generally prefer larger gaps in the traffic stream, and walk at slower speeds than other pedestrians. In recognition of pedestrians with disabilities, pedestrian crossings at roundabouts should be designed to comply with Americans with Disabilities Act (ADA) mandated accessibility standards. See the FHWA Roundabout Guide, Chapter 5, Section 5.3.3 Pedestrians and 2003 MUTCD, Section 3B.17.

The “pedestrian hybrid signal” sometimes referred to as the HAWK crosswalk signal may be considered where there is an identified or demonstrated need to accommodate the visually impaired. At the time of this publication the HAWK crosswalk signal is experimental and requires a “request to experiment” from FHWA to install this system. It is anticipated that the proposed 2009 MUTCD will include this device and once it is published the “request to experiment” will no longer be required.

1.2 - Bicyclists

The experience in other countries with bicyclists at roundabouts has been mixed with regard to safety. The Insurance Institute for Highway Safety reports that roundabouts provide a 10 percent reduction in bicycle crashes at 24 signalized intersections that were converted to roundabouts in the U.S. Multi-lane entry roundabouts may be more problematic than single lane entries. However, all multi-lane high capacity roundabouts in the U.S. have experienced a good bicycle safety record.

The operation of a bicycle through a roundabout presents challenges to the bicyclist similar to that of traditional signalized intersections especially for turning movements. As with pedestrians, one of the difficulties in accommodating bicyclists is their wide range of skills and comfort levels in mixed traffic. While experienced bicyclists may have no difficulty maneuvering through a roundabout, less experienced bicyclists may have difficulty and discomfort mixing with vehicles, and are more safely accommodated as pedestrians on the adjacent shared use path. The complexity of vehicle interactions within a roundabout could leave a cyclist vulnerable, and for this reason, designated bike lane markings within the circulatory roadway shall not be used [2003 MUTCD, Section 3B.24]. Effective designs that constrain motorized vehicles to speeds more compatible with bicycle speeds, around 15 – 20 mph, are much safer for bicyclists.

Design features such as proper entry curvature, and entry width help to slow traffic entering the roundabout. Providing a ramp from the roadway to a shared-use path prior to the intersection allows a bicyclist to exit the roadway and proceed around the intersection safely through the use of cross walks if the bicyclist is uncomfortable mixing with vehicles.

Bicyclists are often less visible and therefore more vulnerable when merging into and diverging from multilane roundabouts. Therefore, it is recommended that a wider shared-use pedestrian-bicycle path, separate from the circulatory roadway, be built where bicycle use is expected. While this will likely be more comfortable for the casual bicyclist, the experienced commuter bicyclist will be slowed down by having to cross as a pedestrian at the cross walk and may choose to continue to traverse a multilane roundabout as a vehicle.

Try to provide bicyclists the choice of proceeding through the roundabout as either a vehicle or as a pedestrian. In general, bicyclists are better served by being treated by roundabout designers as vehicles. However, when entering traffic volumes are projected to be large (i.e., greater than 12,000 AADT), look at other options such as shared-use paths, which provide a physical separation from vehicles around the periphery of the roundabout.

The following guidance is intended for shared-use paths at roundabouts.

1. Construct a widened sidewalk, or separate shared-use path around the outside of a roundabout to accommodate bicyclists who prefer not to travel through the roundabout.
2. Begin and end the shared-use path approximately 50 to 150 feet upstream of the yield point to allow

the bicyclist an opportunity to transition onto the path away from the circulatory roadway itself. More room may be needed when a flared entrance is provided.

3. Right turn free flow lanes for vehicles may be problematic for bicyclists so try to avoid them if possible in high bicycle areas.
4. Provide a ramp or other suitable connection between this sidewalk or path and the bike lane, shoulders or road surface on the approaching and departing roadway. Show the bike exit ramp generally having a 25 to 35 degree departure angle range from the roadway. Show the bike entrance ramp generally having a 25 to 35 degree angle range toward the roadway. Also see FDM 11-26-1, Figure 1. The bike ramp entrance should be relatively flat such that bicyclists are not directed into the travel lane of motorized vehicles but not parallel to the bike lane.
5. Make the shared-use path or sidewalk the same width as an attached multi-use path or, when not connected, maintain a minimum of 8 feet. A 6-foot wide path may be acceptable if pedestrian use is very low. The shared use path pavement design should consider the type of maintenance equipment used for snow removal.
6. Review the 1999 AASHTO Guide for Development of Bicycle Facilities, page 64, and the Wisconsin Bicycle Facility Design Handbook or consult with the Region or State Bicycle and Pedestrian Coordinator for more detail on the design requirements for bicycle and shared-use path design.

Grade Separation (overpasses or underpasses) for bicyclists may be considered for high-capacity roundabouts, with high bicyclist volumes. For information on permanent public trails crossing rural public roads refer to FDM 11-55-15.

2 - Transit, Large Vehicle and Emergency Vehicle Considerations

2.1 - Transit

Transit considerations at roundabouts are similar to those for any other intersection configuration. A properly designed roundabout will readily accommodate buses. If possible, locate bus stops downstream of the roundabout and far enough away to prevent traffic from backing up into the roundabout. Coordinate bus stop locations with the community. Provide bus pullouts, if possible, to remove the buses from the traffic stream.

2.2 - Large and Oversized Vehicles

Design roundabouts for the largest vehicles that can routinely be anticipated. On the state trunk highway system the design vehicle is a WB-65. During the preliminary design, check with local officials and the public to determine if there are any special oversized vehicles that regularly use the route. (i.e. wide farm equipment, mobile home manufacture, wind power or utility poles, concrete girders etc.)

Roundabouts are designed with a truck apron to accommodate wheel tracking of larger vehicles. Multilane roundabouts can be designed in two different ways to accommodate large trucks. One way to design a multilane roundabout is to assume a truck will use two lanes to enter, circulate and exit the roundabout. Alternatively, a roundabout can be designed so that trucks can remain in one lane as they traverse the intersection. This approach is less commonly used since overall geometry must be larger, possibly resulting in increased ROW needs, higher cost, and a potential for increases in certain types of crashes. In rare cases, roundabouts have been designed with a gated roadway through the center island to accommodate oversized vehicles.

The Department produces a map showing designated truck routes in Wisconsin. It is located at www.dot.wisconsin.gov/travel/maps/docs/truck-routes.pdf In addition, administrative rule TRANS 276 also lists those routes designated for use by trucks. In some special situations there may be other local considerations for a design vehicle larger than a WB-65.

A well-designed roundabout will address load-shifting problems with larger vehicles. Problems such as inadequate entry deflection leading to high entry speeds, long tangents leading into tight curves, sharp turns at exits, excessive cross slopes, and adverse cross slopes have been the principal causes of load shifting. Right turns are also problematic for trucks, as they tend to run over sidewalks and splitter islands to make the turn.

2.3 - Emergency Vehicles

Emergency vehicles passing through a roundabout encounter the same problem as other large vehicles and may require the use of a traversable 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 Motorists 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 if possible. 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.

3 - References

[1] "Roundabouts: An Informational Guide," Publication No. FHWA-RD-00-067, June 2000