Tooele County Roundabout Design Guidelines

Introduction

The principal objective of roundabout design is to secure the safe interchange of intersecting traffic streams with minimum delay. This is achieved by a combination of geometric layout features that are matched to the volumes of traffic in the traffic streams, their speed, and to any site constraints that apply. Engineers designing roundabouts within the County must follow accepted design and engineering practices to limit the accident potential and liability to the County. Following accepted design practices will help to ensure that roundabouts will be safe and functional and not be removed in the future and replaced by more restrictive traffic controls such as traffic signals or stop signs.

These guidelines, while adapted for use in the State of Utah, should not be followed rigidly. The design engineer should adopt only the essential portions while following all necessary aspects of the U.S. Department of Transportation's *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD).*

While these guidelines recommend certain limits for good roundabout design, they can not direct the designer to a specific optimal design within the guidelines. Before a roundabout is designed a traffic impact study and feasibility study are necessary to determine whether a roundabout is warranted for the proposed location. A capacity analysis of the proposed roundabout is necessary to determine whether the design will allow the existing and future traffic volumes as determined in the traffic impact study.

These roundabout design guidelines include design steps and design considerations necessary to design a roundabout.

Four sources of roundabout practice and guidelines were consulted to add to this report:

- *FHWA – Roundabouts: An Informational Guide 2000* is based on established international and U.S. practices and is supplemented by recent research.

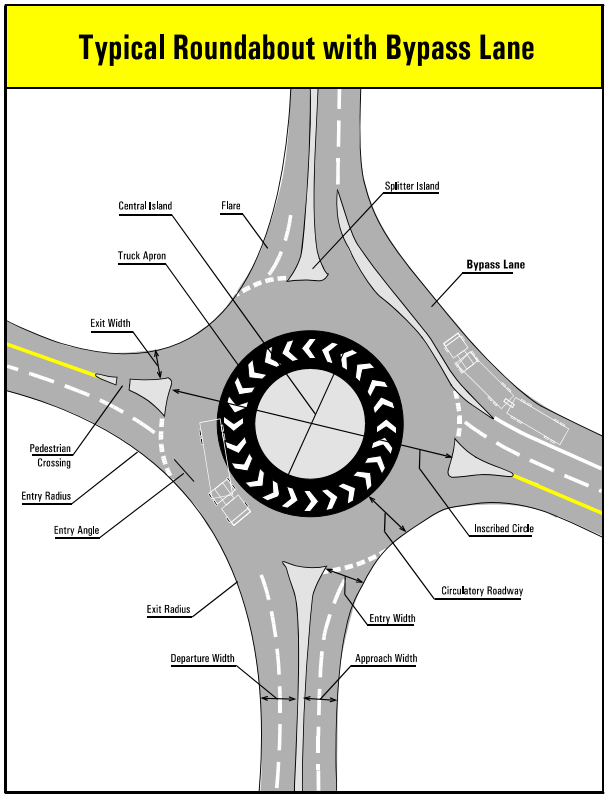
- *The Design of Roundabouts – State of the Art Review 1995* by Mike Brown is a review of roundabout guidelines worldwide published by Britain's Transport Research Laboratory.

- *Roundabout Design Guidelines 1995* by Ourston and Doctors, was created for the State of California DOT and follows the British model for roundabout design.

- *Maryland DOT Roundabout Design Guidelines 1994* is a planning and design guide for roundabout intersection design that follows Australian practices.

Roundabout Design

1.1 General



AASHTO guidelines shall be followed for turning radii, superelevation, grades, etc. If they are not followed, justification must be documented and approved by the County. Figure 1 shows the geometric elements of a typical roundabout.

Figure 1 Typical Roundabout with Bypass Lane

1.2 Roundabout Categories

Roundabouts are categorized in the FHWA guide according to their size and application. There are six categories based on size, application, and number of lanes:

- Mini-roundabouts
- Urban compact roundabouts
- Urban single-lane roundabouts
- Urban double-lane roundabouts
- Rural single-lane roundabouts
- Rural double-lane roundabouts

Roundabouts with more than two approach lanes are being designed in the state of Utah but specific guidelines are not included in this guide, although many of the same design principles apply. Table 1 summarizes and compares some basic design and operational elements for the categories of roundabouts outlined above.

Table 1
Roundabouts - Basic Design and Operational Elements

Design Element	Mini-Roundabout	Urban-Compact	Urban Single Lane	Urban Double Lane	Rural Single Lane	Rural Double Lane
Maximum entry speed	15 mph	15 mph	20 mph	25 mph	25 mph	30 mph
Max. number of entry lanes per approach	1	1	1	2	1	2
Typical Inscribed Circle Diameter	45 ft. to 80 ft.	80 ft. to 100 ft.	100 ft. to 130 ft.	150 ft. to 180 ft.	115 ft. to 130 ft.	180 ft. to 200 ft.
Typical ADT on 4-leg roundabout (veh/day)	10,000	15,000	20,000	20,000 +	20,000	20,000 +

From: *FHWA – Roundabouts: An Informational Guide 2000*

Because it has profound impacts on safety, achieving appropriate vehicular speeds through the roundabout is a critical design objective. A well-designed roundabout reduces the relative speeds between conflicting traffic streams by requiring vehicles to negotiate around a curved path. Roundabouts in Tooele County shall be designed as urban single-lane unless available right of way is a constraint. Roundabouts should be designed for projected traffic volumes. For example if current volumes warrant only a single-lane roundabout a larger Inscribed Circle Diameter (ICD) may be used to allow for future conversion to a double-lane roundabout when increased traffic volumes warrant the added capacity.

1.3 Design Vehicle and the Inscribed Circle Diameter

Another important factor in determining a roundabout's layout is the need to accommodate the largest motorized vehicle likely to use the intersection. The turning path requirements of this vehicle, the *design vehicle*, will dictate many of the roundabout's dimensions. The choice of design vehicle will vary depending on the approaching roadway types and the surrounding land use characteristics. The County shall be consulted to identify the design vehicle at each site. The AASHTO *A Policy on Geometric Design of Highways and Streets* provides the dimensions and turning path requirements for a variety of common highway vehicles which were applied to roundabout design including recommended Inscribed Circle Diameter sizes as shown in Table 2.

Table 2
Inscribed Circle Diameter (ICD) Ranges

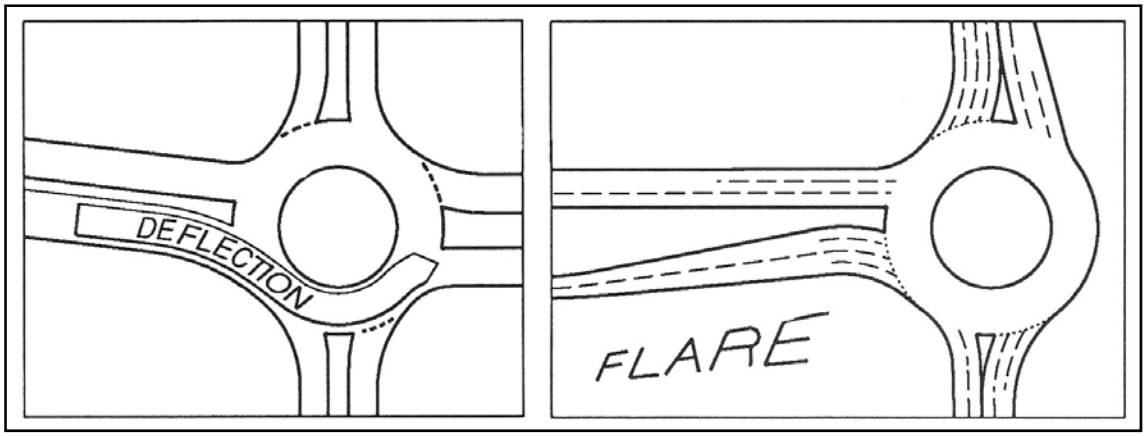
Site Category	Typical Design Vehicle	ICD Range
Mini-Roundabout	Single-Unit Truck	45-80 ft.
Urban-Compact	Single-Unit Truck/Bus	80-100 ft.
Urban Single Lane	WB-50	100-130 ft.
Urban Double Lane	WB-50	150-180 ft.
Rural Single Lane	WB-67	115-130 ft.
Rural Double Lane	WB-67	180-200 ft.

From: *FHWA – Roundabouts: An Informational Guide 2000*

At single-lane roundabouts the size of the inscribed circle diameter is largely dependent upon the turning requirements of the design vehicle. At double-lane roundabouts accommodating the design vehicle is usually not a constraint. The inscribed circle diameter of a double-lane roundabout shall be a *minimum* of 150 ft.

1.4 Entry Flare, Deflection, and Entry Width

Flare is the widening of the approach road to increase the capacity of a roundabout as seen in Figure 2. The length of the flare shall not exceed 300 feet.



From: *Roundabout Design Guidelines* 1995 by Ourston and Doctors

Figure 2 Roundabout Deflection and Flare

Adequate deflection of vehicles entering a roundabout is the most important factor influencing their safe operation. Roundabouts shall be designed so that the speeds of all vehicles are restricted to 20 mph or lower within the roundabout. This is done by adjusting the geometry of the entries and by ensuring that "through" vehicle paths are significantly deflected by one or more of the following means:

- The alignment of the entries and the shape, size and position of approach splitter islands;
- Provision of a suitable size and position of the central island;
- Offsetting alignment of opposite approach roads;
- The use of blister and vane islands.

The entries shall be designed to accommodate the design vehicle while ensuring adequate deflection. The approach curve to the roundabout shall be the same radius or smaller than the radius of the curved path that a vehicle would be expected to travel through the roundabout. It is better to give approaching drivers a clear indication of the severity of the curve they will have to negotiate, since the speed at which drivers negotiate is dependent on their perception of the sharpness of the first curve. The entry radii shall be designed tangential to the central island.

The entry radius shall be a minimum of 50 feet for single lane roundabouts and 100 feet for multi-lane roundabouts. Small entry radii result in drivers reducing their speed to a degree that they may have difficulty negotiating the roundabout or will ignore lanes lines or cut off vehicles in adjacent lanes.

The approach shall never be widened such that there are more approach lanes than circulating lanes. For example if a roundabout has two entry lanes on one approach the circulating width shall be equal to the entry width. Even though the circulating area may

be striped as one lane it shall be wide enough to effectively support two lanes. The length of flare shall be between 100 and 300 feet.

Entry width may vary depending on the design vehicle and approach roadway width. In general the entry width shall be between 11 feet and 15 feet per entry lane. The entry width shall be less than or equal to the circulating width. The number of entry lanes and their width has more impact on the capacity of a roundabout than any other design feature.

The approach curve to the roundabout shall be the same radius or smaller than the radius of the curved path that a vehicle would be expected to travel through the roundabout. The entry radii shall be designed tangential to the central island.

1.5 Entry Angle

High and low entry angles may result in increased accident potential. It is desirable to equally space the angles between entries. If possible the angle shall be between 20 and 60 degrees preferably 30 to 40 degrees. Low entry angles force drivers into merging positions in which they must either look over their left shoulders or attempt a true merge using their side mirrors. High entry angles produce excessive entry deflection and can lead to sharp breaking at entries accompanied by rear-end accidents. The best entry angle is 30 degrees.

1.6 Circulating Width

The circulating width shall be constant and shall be between 1.0 and 1.2 times the maximum entry width. The circulating roadway shall generally be circular in plan. Oval shaped roundabouts are acceptable as long as tight bends are avoided.

The size of a roundabout and the circulating width is a compromise between making it small enough to provide adequate deflection while making it large enough to provide for the appropriate design vehicles.

The smallest inscribed circle diameter for a single lane roundabout is 110 feet in order to allow a WB-50 design vehicle. Roundabouts on subdivision roads may have a smaller diameter depending on the design vehicle. In all cases, the layout shall be verified using the appropriate design vehicle template or in providing a copy of an Autoturn analysis.

The recommended widths of the circulating roadway and the central island for normal roundabouts are shown in Figure 3 and Table 3.

Table 3
Turning Widths Required for Normal Roundabouts (ICD greater or equal to 110 feet)

Central Island Diameter Maximum *a* (ft)	Inscribed Circle Diameter *f* (ft)	Design Vehicle	
		WB-67 Minimum *g* (ft)	Bus Minimum *g* (ft)
256	300	22.0	17.0
235	280	22.5	17.0
213	260	23.5	17.0
191	240	24.5	17.5
169	220	25.5	17.5
147	200	26.5	18.0
135	190	27.5	18.0
123	180	28.5	18.5
111	170	29.5	19.0
99	160	30.5	19.0
86	150	32.0	19.5
74	140	33.0	20.0
57	130	36.5	20.5
40	120	40.0	21.0
20	110	45.0	22.0

*	100	*	23.0
*	95	*	23.5

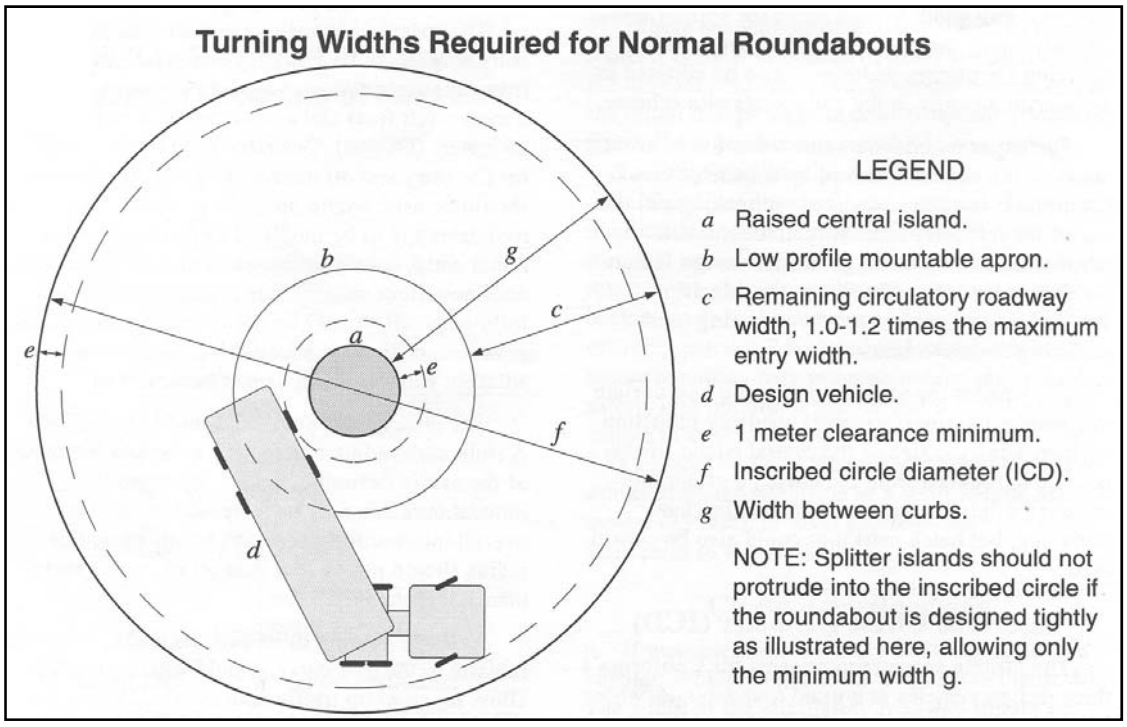
From: *The Design of Roundabouts –1995* by Mike Brown *Design vehicle requires a larger ICD

Turning widths for roundabouts on subdivision roads with diameter less than 110 feet are shown in Table 4.

Table 4
Turning Widths Required for Smaller Roundabouts (ICD less than 110 feet)

Central Island Diameter Maximum *a* (ft)	Inscribed Circle Diameter *f* (ft)	Minimum Circulatory Width *g* (ft)
56 54	110 100	22.0 23.0
50* 40*	90 80	20.0 20.0
30* 20*	70 60	20.0 20.0

From: *The Design of Roundabouts –1995* by Mike Brown * Includes 6 ft. of truck apron and or assumes the central island is completely mountable



From: *The Design of Roundabouts –1995* by Mike Brown

Figure 3 Turning Widths Required for Normal Roundabouts

1.7 Central Island, Splitter Island and Bypass Lane Design

Landscaping in the central island, splitter islands (where appropriate), and along the approaches can benefit both the public safety and community enhancement.

The landscaping of the central island and approaches shall:

- Improve the aesthetics of the area and be low maintenance;
- Make the central island more conspicuous;
- Minimize introducing hazards to the intersection, such as trees, poles, walls, guide rail, statues and large rocks;
- Avoid obscuring the form of the roundabout or the signing to the driver;
- Maintain adequate sight distances;
- Clearly indicate to the driver that they cannot pass straight through the intersection;
- Discourage pedestrian traffic through the central island; and
- Help pedestrians locate sidewalks and crosswalks.

Central island design elements include the following:

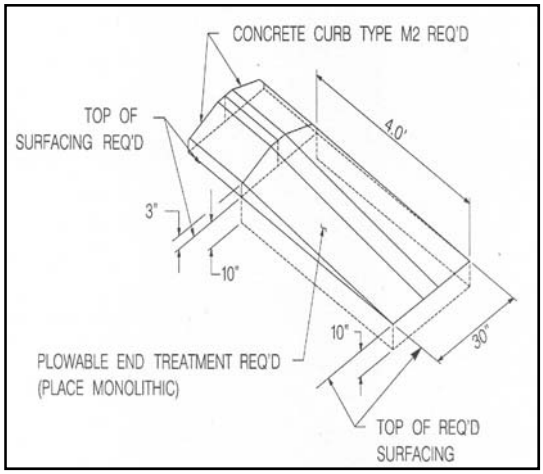
- The slope of the central island shall not exceed 6:1 per the requirements of the AASHTO *Roadside Design Guide*.

- *Truck aprons (Optional)*: truck aprons are an optional design usually reserved for intersections with a limited amount of right-of-way. Vehicles tend to avoid the aprons and the need for the apron can be determined by running the design vehicle through the designed intersection using truck-turning templates. The material used for the apron shall be different than the material used for the sidewalks so that pedestrians are not encouraged to cross the circulatory roadway

- Raised splitter islands shall be provided on all roundabouts. They provide shelter for pedestrians, guide traffic into the roundabout, and deter left-turns from dangerous short cuts through the roundabout.

- In high speed areas the splitter islands should be relatively long (200 feet +/-) to give early warning to drivers that they are approaching an intersection and must slow down. Curbs should be placed on the right-hand side for at least half the length of the Splitter Island to strengthen the funneling effect. Barrier curb is appropriate on the right-hand side of roundabout entries, on the outer edge of the roundabout circle, and for the central island.

- The curbs on the splitter islands shall be UDOT M2 mountable curbs. Snow plowable ends may be required at some locations depending on Tooele County requirements (Figures 4 and 5). The splitter islands may have textured concrete or flat grass between the curbs.



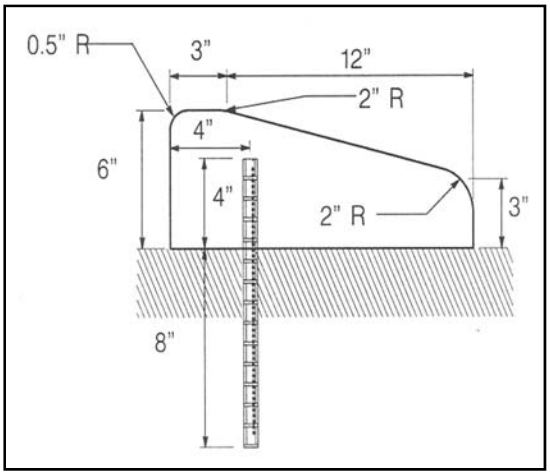


Figure 4 Type M2 Curb

Figure 5 Plowable End Curb

- On arterial roundabouts, the splitter islands shall be at least 6 feet wide to shelter a pedestrian and be a reasonable target to be seen by approaching traffic. A minimum area of 700 ft^2 should be provided on arterial road approaches.

- *Landscaping*: no planting higher than 6" shall be installed within the visibility envelopes on each approach. Although landscaping is often useful to improve the conspicuity of central islands this can also obstruct circulatory visibility. If this is the case then limited penetration into the sight triangles by vegetative growth of a dispersed nature would be acceptable. For roundabouts of 131' ICD or smaller, because of the small diameter of the central islands, they shall be graded low enough so that with vegetation present drivers can see completely across the central island from all approaches.

- *Pedestrian crossings* shall be located to provide adequate visibility.

- Storm drain runoff shall be controlled to reduce sheet flow across the roundabout. Storm drain inlets may be needed along the outer edge of the circle.

- It is important that the layout of the roundabout is clearly visible to approaching drivers and this is best achieved by sloping the crossfall away from the central island. This generally means accepting negative superelevation for left turning and through vehicles in the circulating roadway, but avoids depressing the central island thereby reducing its visibility to approaching traffic.

- As a general practice, a minimum pavement crossfall of 0.025 to 0.3 ft/ft shall be adopted for the circulating roadway. Designing superelevation to slope away from the central island often simplifies the detailed design of pavement levels and avoids inlets around the central island.

Bypass or Continuous (Slip) lanes may be used to separate heavy right turning traffic from traffic in a roundabout by providing an auxiliary lane. The right turn entry conditions can be improved by constructing a splitter island between the bypass lane and the main circle. To be fully effective, the layout must ensure that the circulating traffic and the right turning traffic does not conflict. This may be accomplished by adding an approach lane to the roundabout. The exclusion of this right turning traffic will increase the capacity of the roundabout.

1.8 Sight Distance

A sight distance review shall be made so that poor crossfall design or sign location does not restrict sight distance. Stopping sight distance is the distance along a roadway required for a driver to perceive and react to an object in the roadway and to brake to a complete stop before reaching the object. Stopping sight distance shall be provided at every point within a roundabout and on each entering and exiting approach. Stopping sight distances as they apply to roundabouts are given in Table 5. These distances are applicable to the following locations:

- Approach sight distance (Figure 6a);
- Sight distance on circulatory roadway (Figure 6b);
- Sight distance to crosswalk on exits (Figure 6c).
- Intersection sight distance (Figure 6d).

Table 5
Stopping Sight Distance (From: NCHRP Report 400)

Speed (mph)	Sight Distance (ft.)
15	80
20	110
25	150

30	200
35	250
40	300
45	360
50	430
55	500

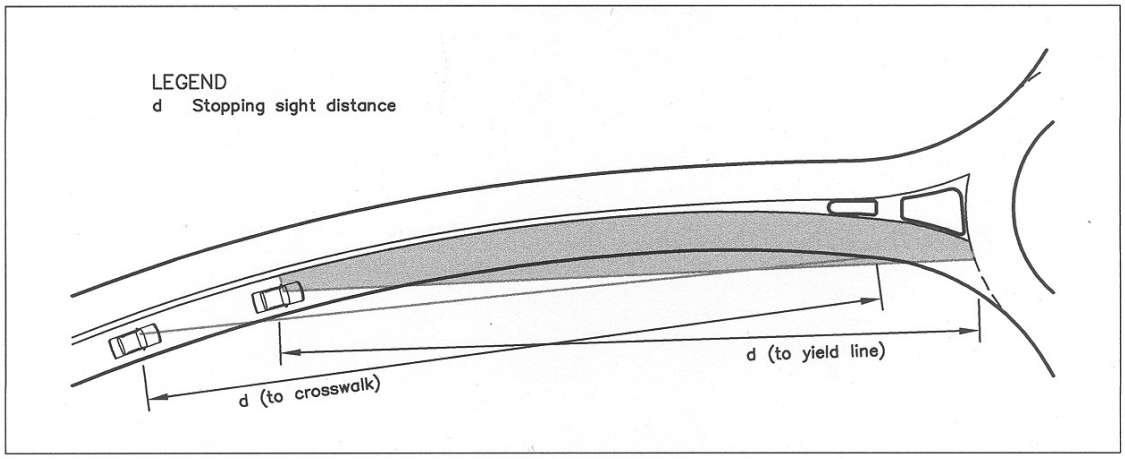


Figure 6a. Approach Sight Distance

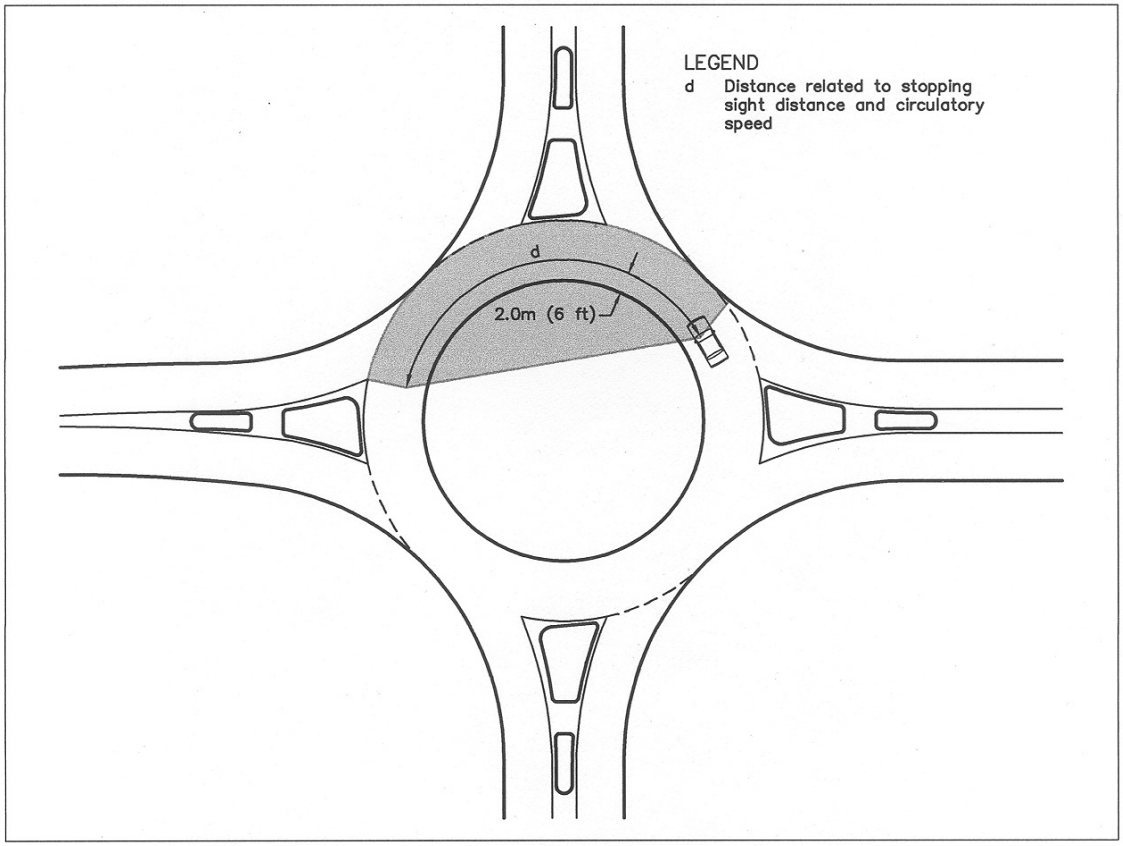


Figure 6b. Sight Distance on Circulatory Roadway

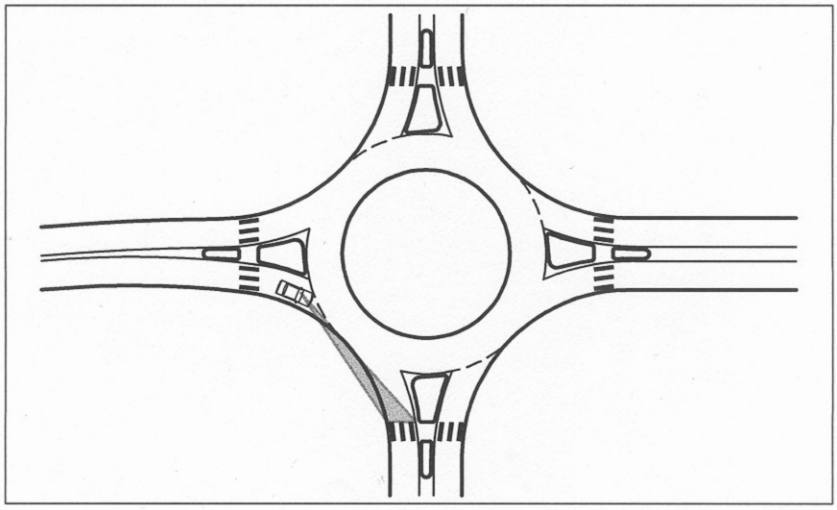


Figure 6c. Sight Distance to Crosswalk on Exit

Intersection sight distance is the distance required for a driver without the right of way to perceive and react to the presence of conflicting vehicles. Intersection sight distance is achieved through the establishment of sight triangles that allow a driver to see and safely react to potentially conflicting vehicles. At roundabouts the only locations requiring evaluation of intersection sight distance are the entries.

Figure 6d presents a diagram showing the method for determining intersection sight distance. The sight distance triangle has two conflicting approaches that must be checked independently. These distances are included in Table 6 for the conflicting approach speeds.

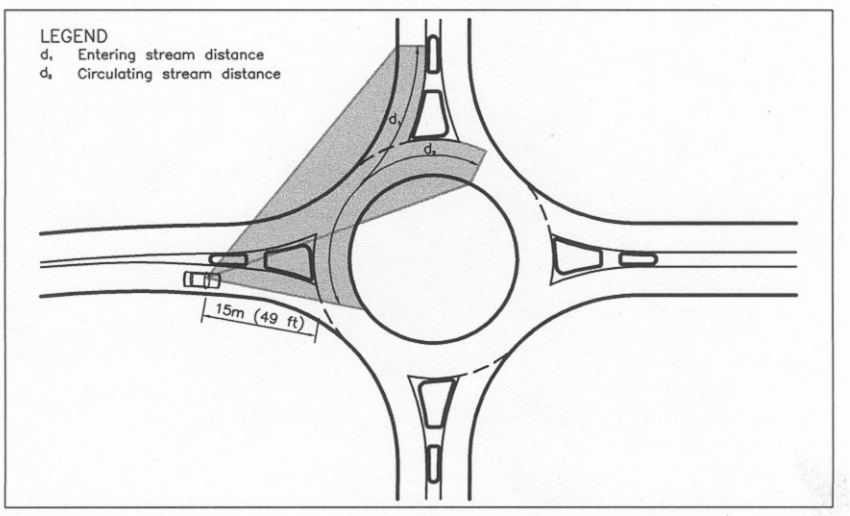


Figure 6d. Intersection Sight Distance

Table 6
Intersection Sight Triangle Distances

Conflicting Approach Speed (mph)	Sight Distance (ft.)
35	95
45	140
55	190
65	240
75	290

From: *FHWA – Roundabouts: An Informational Guide 2000*

Table 7 is used to show the sight distance needed based on the roundabout size (Inscribed Circle Diameter

Table 7
Sight Distance in Relation to Roundabout Size

Inscribed Circle Diameter (ft.)	Sight Distance (ft.)
<131	Whole Intersection
131-197	131
197-328	164
>328	230

From: *FHWA – Roundabouts: An Informational Guide 2000*

To enhance the prominence of the roundabout, the curbs on both the splitter island and central island shall be light colored or painted white. To improve driver recognition, the central island may be mounded and/or reflectorized chevron pavers may be used, provided the overall height does not obstruct visibility or hide drivers' view of the overall layout.

It is better to position a roundabout in a sag vertical curve rather than on a crest. Unlike other cross intersections, roundabouts require drivers to change their path and speed, thus it would be important to avoid locating roundabouts just over a crest where the layout is obscured from the view of approaching vehicles. However there is no evidence that roundabouts on hilltops are intrinsically dangerous if the correct signs and visibility standards have been provided on the approach to the "Yield" line. Roundabouts should not be normally sited immediately at the bottom of long descents where the downgrade is significant for large trucks and loss of control could occur.

- Minimum sign height in center island: the bottoms of sign panels within the circular islands shall be 6.6 feet above the roadway or 2.4 feet above a drivers' average eye height (3.4 feet).

- Pedestrian crossing visibility: At the yield line drivers of all vehicles should be able to see the full width of a pedestrian crossing at the next exit of the

roundabout. The crossings shall be one to three car lengths away from the yield line.

1.9 Vertical Alignment, Drainage and Cross Slope

Elements of vertical alignment design for roundabouts include profiles, superelevation, approach grades, and drainage.

Profiles. The vertical design of a roundabout begins with the development of approach roadway and central island profiles. The development of each profile is an iterative process that involves tying the elevations of the approach roadway profiles into a smooth profile around the central island.

Superelevation. As a general practice, a cross slope of 2 percent away from the central island shall be used for the circulatory roadway. This technique of sloping outward is recommended for four main reasons:

- It promotes safety by raising the elevation of the central island and improving its visibility;
- It promotes lower circulating speeds;
- It minimizes breaks in the cross slopes of the entrance and exit lanes; and
- It helps drain surface water to the outside of the roundabout.

Grades. It is generally not desirable to locate roundabouts in locations where grades through the intersection are greater than four percent. At locations where a constant grade must be maintained through the intersection, the circulatory roadway may be constructed on a constant-slope plane. This means, for instance, that the cross slope may vary from +3 percent on the high side of the roundabout (sloped toward the central island) to –3 percent on the low side (sloped outward). Care must be taken when designing roundabouts on steep grades. On approach roadways with grades steeper than –4 percent, it is more difficult for entering drivers to slow or stop on the approach.

Drainage. With the circulatory roadway sloping away from the central island, inlets will generally be placed on the outer curbline of the roundabout. However, inlets may be required along the central island for a roundabout designed on a constant grade through an intersection. As with any intersection, care shall be taken to ensure that low points and inlets are not placed in crosswalks. If the central island is large enough, inlets may be needed in the central island.

1.10 Pedestrians and Bicycles

Pedestrian crosswalks are provided to increase pedestrian safety and convenience without incurring excessive delays to traffic. These objectives will only be achieved if crosswalks are sited to attract the maximum number of pedestrians who would otherwise

cross the road at random locations, and also to give drivers adequate opportunity to recognize them in time to stop safely.

When entries are flared, pedestrian crossings shall be located before the flaring. Crosswalks required near the exits of roundabouts can cause inconvenience and reduced capacity for both pedestrians and drivers. Crosswalks shall only be located on exits where a sidewalk is provided. They shall be located a distance of one to three car lengths from the roundabout.

The marking of crosswalks at roundabouts is important to consider. If paint is used to mark a crosswalk, zebra type markings are required. If lines are painted across the road (as two parallel stripes), vehicles may believe the crosswalk is another yield line and stop for the line when no pedestrians are present. An alternate paving material such as red brick pavers may be used.

Flashing crosswalk-warning signs may be necessary to improve pedestrian visibility. If the number of pedestrians crossing is high, pedestrian activated (pushbutton) signals can be installed at locations at least 66 feet from the circle. Handrails may be used where a sidewalk runs parallel or adjacent to the roundabout circle to guide pedestrians towards the recommended crosswalk location.

Bicyclists are the most vulnerable users of roundabouts and special attention needs to be paid to them. There are several safety concerns for bicyclists in roundabouts. Bicycle lanes on the approach roads to a roundabout may be dropped in the roundabout, carried through the roundabout, or carried around the roundabout on a separate bicycle paths. Bike ramps may be provided to allow an alternative for bikes entering the roundabout to exit the roundabout and ride around the intersection on the sidewalk at a safe distance from traffic.

Pedestrian/bicycle undercrossings or overcrossings may be warranted given the roundabout location's topography and the presence of a bicycle trail traversing the intersection.

Where possible, sidewalks shall be set back from the edge of the circulatory roadway in order to discourage pedestrians from crossing to the central island. The sidewalk shall be designed so that pedestrians will be able to clearly find the intended path to the crosswalks. A recommended set back distance of 6 ft. shall be used, and the area between the sidewalk and curb can be planted with low shrubs or grass.

1.11 Lighting

Roundabout intersections shall provide a minimum of 2.0 foot-candles depending on light placement and pole height. A lighting analysis shall be provided as part of the design drawings. Good street lighting is a standard safety element of modern roundabout design. Motorists approaching at night must see that the intersection has a central island and that vehicles can not drive straight through the intersection. Good street lighting is needed so

that cyclists, motorcyclists, and pedestrians can be seen within the roundabout and on the entries at night. For this reason lighting shall be located on each approach to illuminate a minimum distance of 150 feet behind the yield lines. Streetlights evenly spaced in a ring around the outside of roundabouts and along the approaches to roundabouts works the best. Mounting height shall be uniform throughout the intersection and not less than lights placed on the adjacent approach roads.

Desirable lighting features include:

- Lights shall be located so that they provide good illumination on the approach nose of splitter islands, the conflict area where traffic streams separate at points of exit.

- Particular attention shall be given to the lighting of the pedestrian crossing areas.

- Lighting poles shall not be placed within splitter islands, on the central island directly opposite an entry roadway, or on the right-hand perimeter immediately downstream of an entry point.

1.12 Signs

A sign and pavement-marking plan will be submitted to the County for their approval. The sign size, type and materials used will be included in the submittal. The locations and types of signs and pavement markings will be included in the submittal to the County and are subject to their approval and review.

Uniformity of signing is an important part of roadway and intersection design and will help to protect the County from lawsuits due to accidents. The 1988 edition of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) was followed as much as possible for this guide. Although roundabout signage is not covered in the current MUTCD, the signs and pavement markings used for a roundabout may be selected from the current MUTCD based on engineering judgement and common practice. As the MUTCD is updated to include signing and pavement markings for roundabouts, the County should update existing installations.

The following signs and applications recommended below are subject to these conditions:

YIELD sign: A (36” R1-2) *YIELD* sign is required on each entry. One sign is sufficient on the right side of a single lane entry and two are required one on each side of a multi-lane entry.

YIELD AHEAD sign: a (36”X36” W3-2A) *YIELD AHEAD* sign shall be provided on all approaches to the roundabout in advance of the yield sign. These signs provide drivers with advance warning that a *YIELD* sign is approaching.

A Roundabout Ahead sign, combined with an advisory speed plate no higher than the design speed of the circulatory roadway. The size of the sign shall be (36"X36" W3-2A) combined with the advisory speed sign (W13-1). The purpose of the Roundabout Ahead sign is to convey to a driver that the driver is approaching an intersection with the form of a roundabout.

Chevron Plate: A long chevron board of yellow and black W-Chevrons are required on the central island opposite every entry. Black on yellow (6.75' x 1.5') panel. Care shall be taken to sign height.

ONE-WAY signs: (3' X 1' R6-1) required on central islands opposite every entry above the Chevron plates.

KEEP RIGHT signs: (18" X 24" R4-7a) KEEP RIGHT text version signs are required at the nose of each splitter island.

Pedestrian Crossing signs: (36"X36" W11-2a) are required at all pedestrian crossings at entries, exits, and right-turn bypass lanes.

Street signs: the street signs shall be placed near driver eye height (3.4 feet high) on the exits on the splitter islands (18" X 60" D1-1).

Guide signs: A diagrammatic sign (D1-3) may be used on the main entry into a roundabout. This sign should be limited to main entrances and sign letter height and location are subject to County review.

No parking signs: are optional but may be required on bypass lanes and other locations as determined by the County.

Tooele County street sign standards shall be followed

1.13 Pavement Markings

Typical pavement markings for roundabouts consist of delineating the entries and the circulatory roadway. As with signing, the (MUTCD) governs the design and placement of pavement markings. The following markings are required during construction and after completion of roundabout final pavement coat.

Yield lines: Yield lines shall be used to demarcate the entry approach from the circulatory roadway. Yield lines shall be located along the inscribed circle diameter. No yield lines shall be placed to demarcate the exit from the circulatory roadway. The yield line pavement marking shall be 16-in. wide stripes with 3-ft. segments and 3-ft. gaps. Paint shall be white.

Yield Word Markings: Pavement word markings are used to supplement the signing and yield line marking. This includes the word YIELD painted on the entrance to the roundabout immediately prior to the yield line.

Pedestrian Crosswalk Markings: shall be installed at all pedestrian crossing locations within roundabouts. Zebra type markings shall be provided. The Zebra type markings use a series of lines parallel to the flow of traffic. These lines shall be 24” wide and 30” apart. The Zebra markings shall be spaced so that they avoid the vehicle tire tracks. Marked crosswalks are not needed at locations where the crosswalk is distinguished from the roadway by visually contrasting pavement colors and textures.

A recommended roundabout sign and pavement-marking layout is shown in Figure 7.

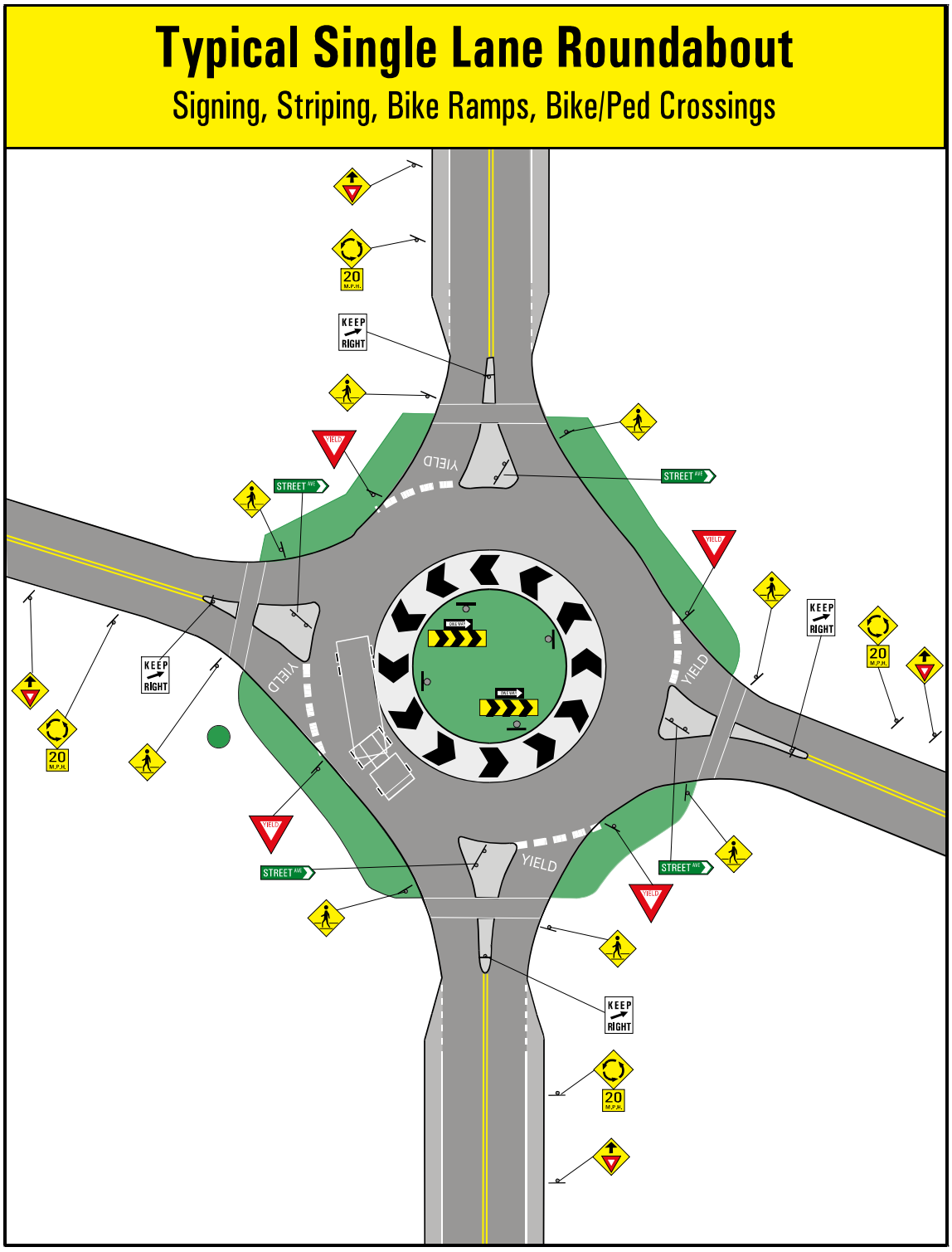


Figure 7 Typical Roundabout Signing and Striping