Roundabout Design Standards

A Section of the Traffic Engineering Policy & Design Standards

City of Colorado Springs – Transportation Engineering

October 4th, 2005

Index

A. Introduction to Design Guide

Roundabouts are a safe and efficient form of traffic control, which can be used at many of the same locations as traffic signals or stop controls. Based on US and international studies, roundabouts reduce accidents for motor vehicles and pedestrians, and, due to the slower speeds and the reduced angles, the severity of accidents is less, with fewer injuries. Because of the advantages of roundabouts, it is the policy of the City to use roundabouts as a substitute for other types of intersection control, including intersections with no control, 2-way or all-way STOP. They should be used instead of a traffic signal at all locations where a roundabout is shown to operate as well or better than a signal wherever the roundabout can be constructed to meet these standards. Roundabouts are allowed on local streets, minor and major collectors, minor and principal arterials, but are limited to no more than two approach lanes.

Standards included herein will be used, along with engineering judgement and information from other sources, for the design of all roundabouts within the City of Colorado Springs, and for the review of designs by city staff and private consultants. Where conflicting standards exist, this design guide shall govern.

When designing roundabouts, there are several characteristics that can be standardized, such as signing and marking; while others must be adapted within the design standards to fit the demands of the location, such as approach angles and right of way restrictions. This design guide has been created to allow engineers the flexibility to design a roundabout to fit a particular site, while still maintaining consistency with other roundabouts citywide to enhance driver expectancy.

All roundabout designs will require a two step process: a preliminary design initially submitted that meets design criteria listed under both general design criteria and specific / geometric design elements as noted, and upon approval of the overall preliminary design, a final design showing all construction details and any phased construction signing & marking.

B. General Design Criteria

1. Appropriate Roadways / Locations

Roundabouts should be used where physical conditions such as approach grades and adequate right of way allow. They are limited to use on a roadway with four or fewer through lanes resulting in no more than two approach lanes. They are not appropriate when the capacity requires more than two circulating lanes. Roundabouts are also not appropriate if the use of a roundabout is expected to produce greater vehicle delay or increased difficulty for pedestrians.

Design of the approach road and roundabout must provide adequate visibility of the roundabout from a distance that will allow approaching drivers to see the roundabout, both daytime and nighttime. This decision sight distance (DSD) is the minimum distance required that which will allow deceleration from the 85% travel speed (or posted speed limit, whichever is greater) to the maximum entry speed of 20 MPH (single lane) or 25 MPH (multilane) without exceeding a deceleration rate of 10’/s/s. This is generally the same distance as the “intersection sight distance” noted in AASHTO standards, variable by approach speed.

2. Approach & Circulatory Speeds

The centerlines of the approaching roadways should generally meet near the center of the roundabout, with some offset allowed as long as the fastest path criteria are met. However, roundabouts offset significantly from

this criteria will create a difficult design, with the fastest path requiring artificial restrictions or difficult to traverse approaches. This can result in vehicles crossing lanes and/or failing to follow the lane lines on the approach or exit. Roundabouts may have three, four or five approaches. Approach roadways may be single lane, single lane with a flare out to provide an added lane at the circulating roadway (used to provide a left-only lane), single lane with a by-pass right turn lane, or two lanes without added lane. The configuration is based on the turning movement volumes.

The approach roadway section includes the roadway from the point where traffic is traveling at the speed limit to the yield point where the entering vehicles enter the inscribed circle (see figure I for explanation of the roundabout elements). This section extends to the limits of the decision sight distance (Exhibit 3-3, Section 3 AASHTO Geometric Design of Highways & Streets, 2001, avoidance maneuver B – Stop on urban roadway).

The central island shall be visible from the intersection decision sight distance both day and night without the installation of any lighting that would distract or shine directly at any vehicle operators. The minimum distance varies with the roadway classification, but generally is the same as approaching any other intersection listed in the intersection standards. The distance where the driver should be able to tell they are approaching a roundabout ranges from 450’ prior to the yield point for a local roadway to 750’ for a higher speed arterial.

Approach speeds calculated at 50’ and 150’ prior to the yield point or entrance to the circulating roadway are critical to the safe operation of the roundabout. The design should meet the maximum desirable approach speed of 20 MPH (single lane) or 25 MPH (multilane) at 50’, and 5 MPH faster than entry speed at the 150’ point. Actual operating speed maximums are controlled by the “fastest path” as noted in Figure II, which are the radii measured along the vehicle path, not along the curb flowlines. Reverse curves, landscaping, roadway narrowing, and other forms of psychological speed reduction may be required where approach speeds are high.

Design speed limitations and their respective radii through the roundabout are shown on figures II & IIA**,** included in section C – Specific / Geometric Design Elements, identified as R1, R2, R3, R4 and R5. The maximum radius and respective speeds at various locations on the travel path through the roundabout are critical to the safe operation of the roundabout. Curb & gutter, splitter islands and the central island placement control the fastest vehicle path, but are not the same radii. In addition to the overall speed limitation for operation, the maximum speed differential between any two parts of the traveled path is 12 MPH to reduce the potential for rearend accidents for vehicles turning left or exiting.

All alignment parameters, including sight distance restrictions for landscaping shall be included in the preliminary design drawings. See figure III for sight distance restrictions.

3. Design Vehicle

All roundabouts shall be designed to allow single passenger cars, pickups, SU trucks and city bus operation without the use of a truck apron. Larger trucks will require the use of a truck apron, especially on single lane roundabouts. A moving van, fire truck and/or WB 50 truck shall be used to check for the ability to navigate the roundabout using truck aprons but without striking any of the outside curbs, signs, utility structures or splitter islands.

Operation of all roundabouts shall be checked using the turning characteristics for the design vehicles in the following chart, except for state highways, or arterials near industrial areas, other areas of high truck usage, or along established truck routes, where a WB 67 truck shall apply. The turning trucks may be required to use a truck apron meeting these standards, but without causing any damage to any part of the roundabout. Generally, a multilane roundabout will not need a truck apron, as larger vehicles will use both lanes.

Road Classification	Circulatory Lanes	Design Vehicle	Roundabout Type
Local	1	SU	single lane
Collector	1	WB 40	single lane

Minor Arterial	1	WB 50	single lane
Minor Arterial	2	WB 50	multilane
Major Arterial	2	WB 50	multilane
Areas noted above, regardless of class	1-2	WB 67	single or multilane

The use of either vehicle turning templates, or plot from *Autoturn* software is allowed. All preliminary design drawings must include this turning path.

4. Pedestrian / Bicycles

All roundabouts shall be designed to allow pedestrian crossings whenever sidewalks are existing or planned at the intersection. Pedestrian crossings shall be marked and signed whenever 20 year projected pedestrian usage is equal to or exceeds 20 pedestrians per hour at any time of the day. Marked and signed crosswalks are also required for all roundabout crossings on a school route or bordering a park, shopping area or other area where pedestrian activity is expected. Lighting shall be designed to illuminate the pedestrian area without backlighting persons within the crosswalk.

In areas of unusually high pedestrian usage, supplemental active warning devices may be required, such as flashing beacons or LED supplemented signage. The warning devices may be activated either manually by the user or automatically by any approved detection / actuation technology. Where blind pedestrians are expected, the flashing beacons must be activated manually by the use of a tactile or sound emitting push button.

If the roundabout is on a street with bikelanes or a roadway with designated or planned bike lanes, the approach shall allow for the connection from the bike lane to the sidewalk, allowing the bicyclist the choice to either "claim the lane" and proceed through the roundabout as a vehicle, or exit the roadway prior to the roundabout onto the sidewalk and use the pedestrian facilities. The roadway should be reduced in width at the point where the bike lane exits from the roadway.

See Figures IV, IV-A, IV-B & VI for details of construction, signing & marking for pedestrians and bicyclists. Details of marking and signing shall be included in the final design.

5. Design Software

The appropriate design software shall be used to ensure proper design and capacity. Local street or minor collector intersections, where the roundabout is used for aesthetics or speed control and volumes are low do not require a capacity analysis. Other classifications may require some analysis by either AASidra or Rodel to analyze the roundabout in comparison with other traffic control devices. For capacity analysis or design variables on major collectors, minor or principal arterials, the use of Rodel software is required.

All preliminary designs shall be accompanied by AM and PM peak hour turning move counts for existing (or development opening) volumes and for a 20 year projection, including the electronic file from Rodel when required. Where the roundabout is near a school, shopping center or other major traffic generator, the peak hour for local traffic with the traffic generator fully developed shall be used.

6. Utilities & Drainage

Design of underground and overhead utilities shall be included on the final design. Design of water, sewer, electric and gas lines shall meet the appropriate Colorado Springs Utility (CSU) standards. Street lighting shall

follow CSU standards for pole, light fixture and type of lighting. Lighting shall be designed to illuminate any pedestrians within the crosswalks without causing a backlight effect. Lighting shall be situated to help the driver identify the general shape of the intersection and to highlight conflict points or areas of entry & exit from beyond the stopping sight distance as identified in figure III.

The following drainage standards apply to roundabouts:

1. Drainage shall comply with the City Drainage Criteria Manual. Roundabouts should be generally designed to slope away from the central island with drainage inlets located on the outer curb line. Placement of any inlets shall include consideration of the wheelpath traveling through the roundabout with the desirable location between the entrance and exit, not along the roundabout entrance, the central island, the exit or the splitter islands. Inlets within the roundabout shall be constructed with a 6-inch curb height and no extension of the gutter pan. An alternate to the standard City inlet design such as the CDOT Type R inlet is allowed to meet this criteria.

2. If the 8-inch curb height is used with the standard City inlet design, the inlet must be located outside of the roundabout and approaches to limit influence on the driver's path through the roundabout. All inlet gutter sections will be limited in width to 24 inches from lip to flowline.

7. Landscaping

Landscaping is an important part of the design, especially in the center island to provide visual awareness of the roundabout. Landscaping designs must consider pedestrian and vehicle safety, providing year around amenities for the roundabout users without causing any sight distance problems, especially on approach to pedestrian crossings.

All final designs shall include a landscaping design sheet identifying plant types, height from the top of the mature plant to the roadway surface, including the height of planter area, and minimum pruning height for the lower branches of any trees to be planted. See figure III for areas where height is restricted for sight distance reasons. Within the central island, outside of the required stopping sight distance line, the use of larger materials is encouraged to improve the driver's perception of the roundabout location and shape. Avoid distracting displays, such as signs, intricate sculptures or animated items or glare from lights that could increase the potential for accidents.

8. Other

Other design criteria include but are not limited to:

- The exit of the roundabout should be no smaller than the entry and include transition to the full width cross-section, including any on-street parking.
- Transit stops should be located downstream of the roundabout clear of the exit area, and built with a pullout, or they may be combined with the on-street parking area.

Prior to submitting the preliminary design, a pre-design meeting is recommended with City Traffic Engineering staff to identify any unusual or location-specific design criteria or design elements or other issues unique to the location.

C. Specific / Geometric Design Elements

1. Approach Roadway

The approach roadway design elements include curb alignment, median width and transition, approach flare, crosswalk location, horizontal and vertical alignment of the approach lane(s), intersection and stopping sight distance calculations, approach speed, fastest path radii, and other associated elements identified in figures I through VI. Minimum / maximum standards include the following:

Fastest Path		Single Lane		Multilane Roundabout	
		R Max	Speed	R Max	Speed
R1	Entry	86-99’	20 MPH	152-178’	25 MPH
R2	Circulating	99-116’	20	178-210’	25
R3	Exit	152-178’	25	152-178’	25
R4	Left turn	99-116’	15	178-210’	25
R4	Minimum*	18-20’	10	33-37’	13
R5	Right turn	152-178’	20	152-178’	25

*R4 has a minimum requirement to reduce rear end accidents caused by excessive speed differential

Note – radii are given as a range for various superelevation rates from 0% to 4%, positive for R1, R3 & R5, and negative for R2 and R4. Calculations for each specific roadway segment and corresponding cross slope should follow AASHTO Geometric Design of Highways & Streets, 2001 or later

Maximum grade (approach)	2% for 200’ on minor and principal arterials 4% for 100’ on minor and major collectors 4% for 50’ on local streets

Approach Decision Sight Distance (“DSD” on figure WW)	375’ for 25 MPH or less 450’ for 30 MPH 525’ for 35 MPH 600’ for 40 MPH 675’ for 45 MPH 750’ for 50 MPH

Note – Approach Decision Sight Distance, DSD, is the distance at which the driver is aware of the change in alignment caused specifically by the roundabout. If the required DSD is not available due to topographic limitations, advance warning signs will be required. Vertical alignment must be checked as well as horizontal alignment for restrictions to DSD.

Minimum Approach Tangent (approach centerline to yield line)	300’ on principal arterial 200’ on minor arterial 100’ on all collectors 50’ on local access
Min. distance to nearest access (distance from splitter island)	600’ on principal arterial 300’ on minor arterial 100’ on all collectors 30’ on local access

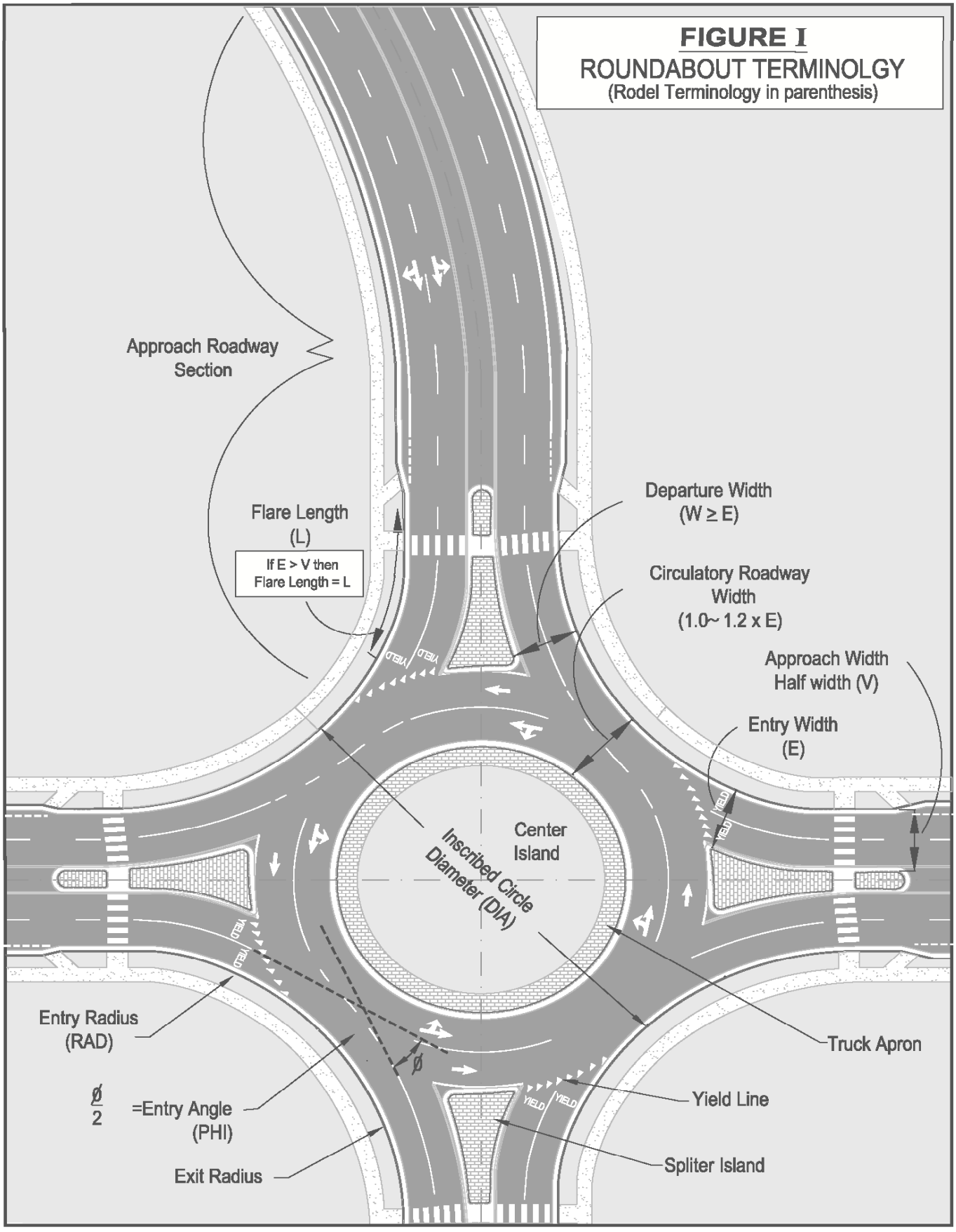


FIGURE I
ROUNDABOUT TERMINOLGY
(Rodel Terminology in parenthesis)
Approach Roadway Section
Flare Length (L)
If E > V then Flare Length = L
Departure Width (W ≥ E)
Circulatory Roadway Width (1.0~ 1.2 x E)
Approach Width Half width (V)
Entry Width (E)
Center Island
Inscribed Circle Diameter (DIA)
Entry Radius (RAD)
ø/2 =Entry Angle (PHI)
Exit Radius
Truck Apron
Yield Line
Spliter Island
YIELD

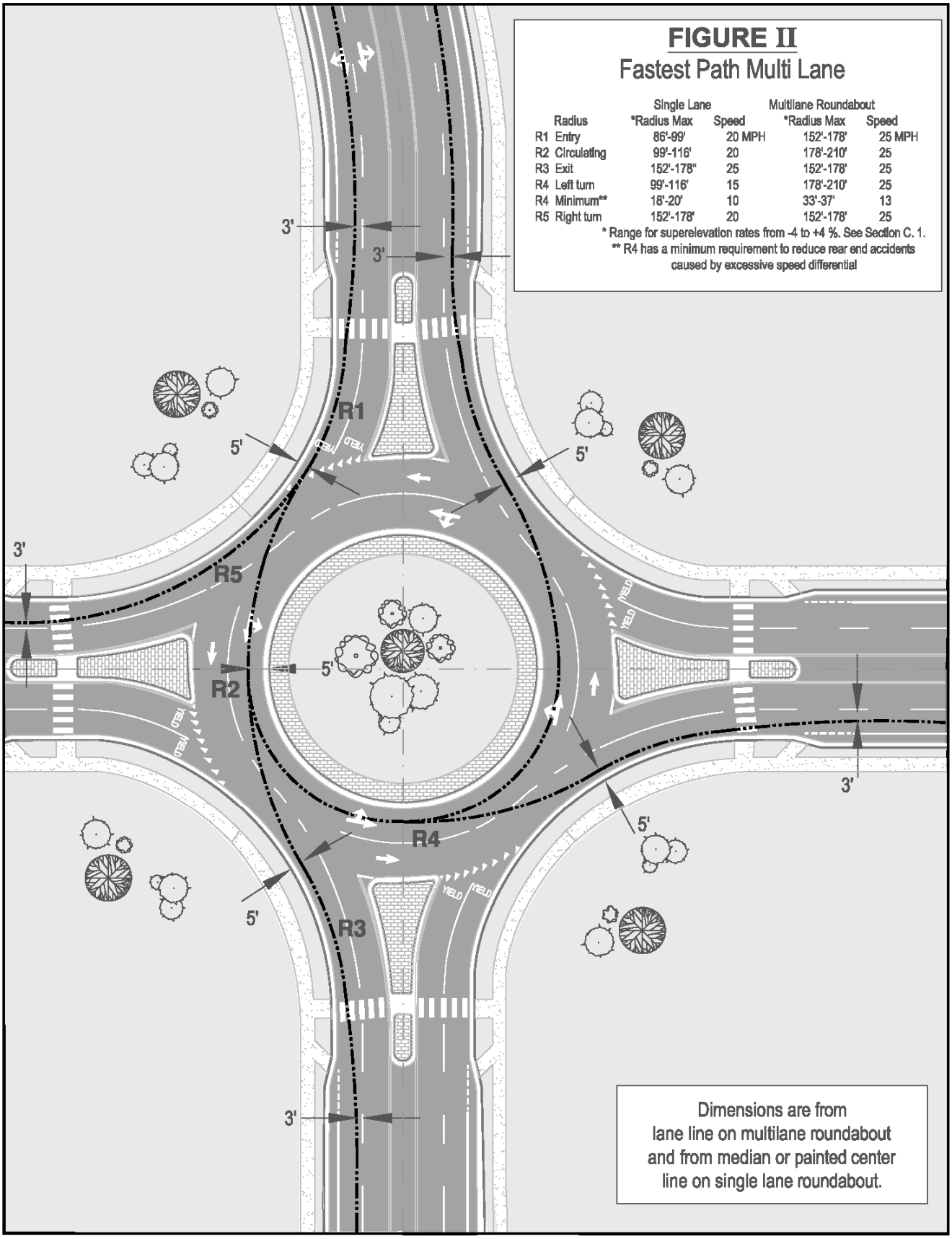


FIGURE II
Fastest Path Multi Lane
Single Lane
Multilane Roundabout
Radius
*Radius Max
Speed
*Radius Max
Speed
R1 Entry
86'-99'
20 MPH
152'-178'
25 MPH
R2 Circulating
99'-116'
20
178'-210'
25
R3 Exit
152'-178"
25
152'-178'
25
R4 Left turn
99'-116'
15
178'-210'
25
R4 Minimum**
18'-20'
10
33'-37'
13
R5 Right turn
152'-178'
20
152'-178'
25
* Range for superelevation rates from -4 to +4 %. See Section C. 1.
** R4 has a minimum requirement to reduce rear end accidents caused by excessive speed differential
3'
3'
R1
5'
5'
3'
R5
R2
5'
YIELD
YIELD
YIELD
3'
R4
5'
5'
YIELD
YIELD
R3
3'
Dimensions are from lane line on multilane roundabout and from median or painted center line on single lane roundabout.

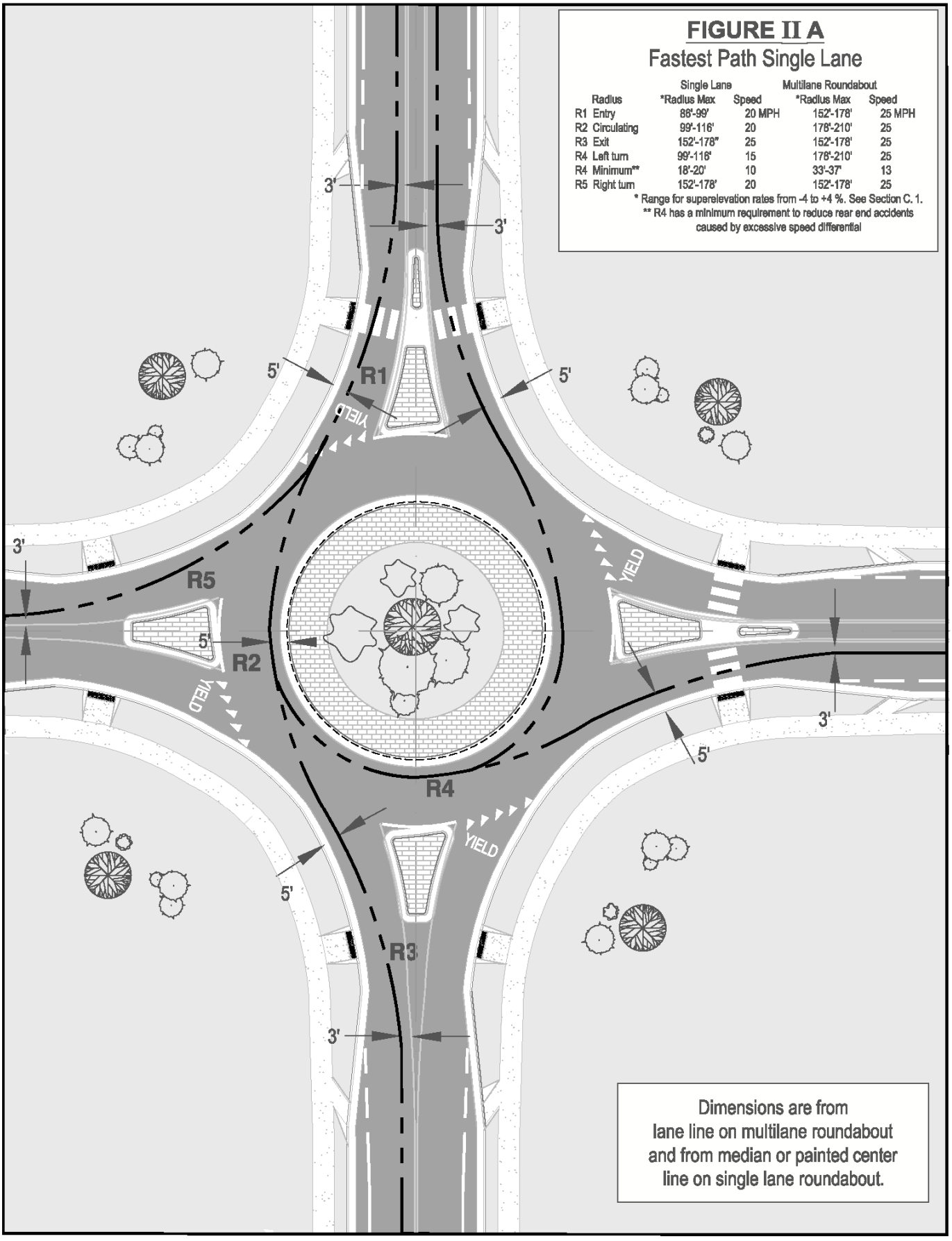


FIGURE II A
Fastest Path Single Lane
Single Lane
Multilane Roundabout
Radius
*Radius Max
Speed
*Radius Max
Speed
R1 Entry
86'-99'
20 MPH
152'-178'
25 MPH
R2 Circulating
99'-116'
20
176'-210'
25
R3 Exit
152'-178"
25
152'-178'
25
R4 Left turn
99'-116'
15
176'-210'
25
R4 Minimum**
18'-20'
10
33'-37'
13
R5 Right turn
152'-178'
20
152'-178'
25
* Range for superelevation rates from -4 to +4 %. See Section C. 1.
** R4 has a minimum requirement to reduce rear end accidents caused by excessive speed differential
3'
3'
5'
R1
5'
YIELD
3'
R5
5'
R2
YIELD
YIELD
3'
5'
R4
YIELD
5'
R3
3'
Dimensions are from lane line on multilane roundabout and from median or painted center line on single lane roundabout.

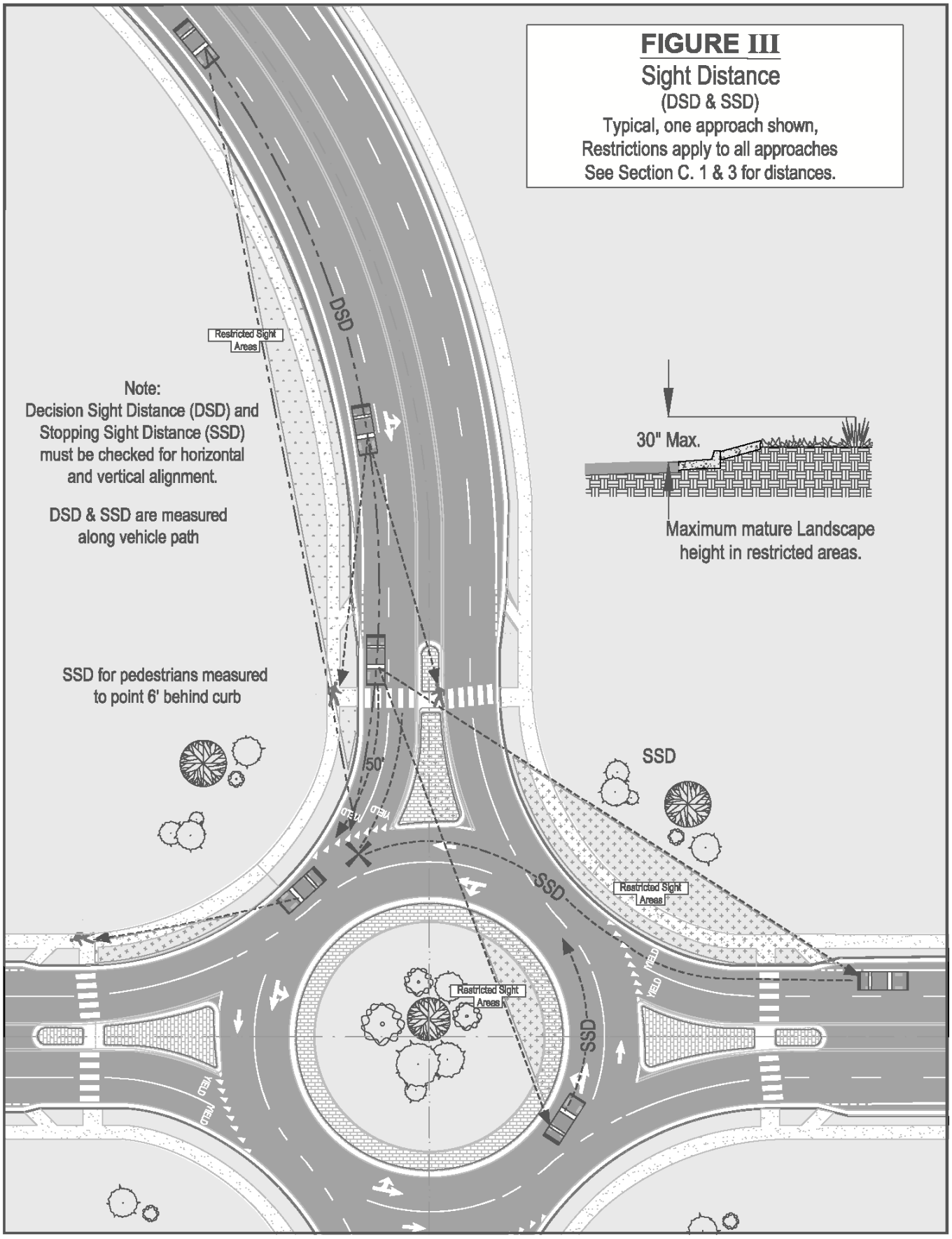


FIGURE III
Sight Distance
(DSD & SSD)
Typical, one approach shown,
Restrictions apply to all approaches
See Section C. 1 & 3 for distances.
DSD
Restricted Sight Areas
Note:
Decision Sight Distance (DSD) and Stopping Sight Distance (SSD) must be checked for horizontal and vertical alignment.
DSD & SSD are measured along vehicle path
SSD for pedestrians measured to point 6' behind curb
30" Max.
Maximum mature Landscape height in restricted areas.
150'
SSD
YIELD
Restricted Sight Areas

FIGURE IV
Standard Roundabout
Traffic Signs

R1-2

R6-1 (R)

D3-1

NOTE: Blue/Brown/Green
Service, Recreational and Cultural Intrest
Guide Signs may be required.

R1-6

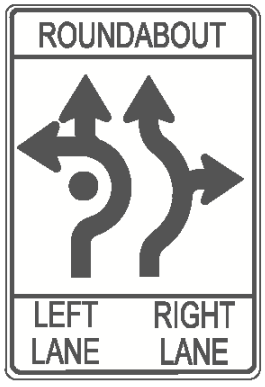
W11-2

W2-6

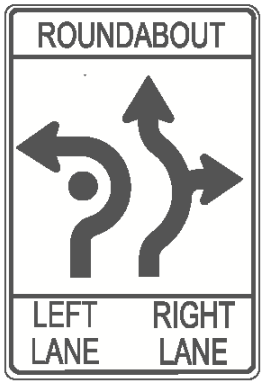
OR

W13-1 (15mph)
Single Lane

W13-1 (20mph)
Multi Lane



R3-8c (r1)
Standard multi lane



R3-8c (r2)
Use with single approach
plus left turn lane

R3-8c (r3)
Use with dual left turns

NOTE: Signage for alternate configurations to be approved.

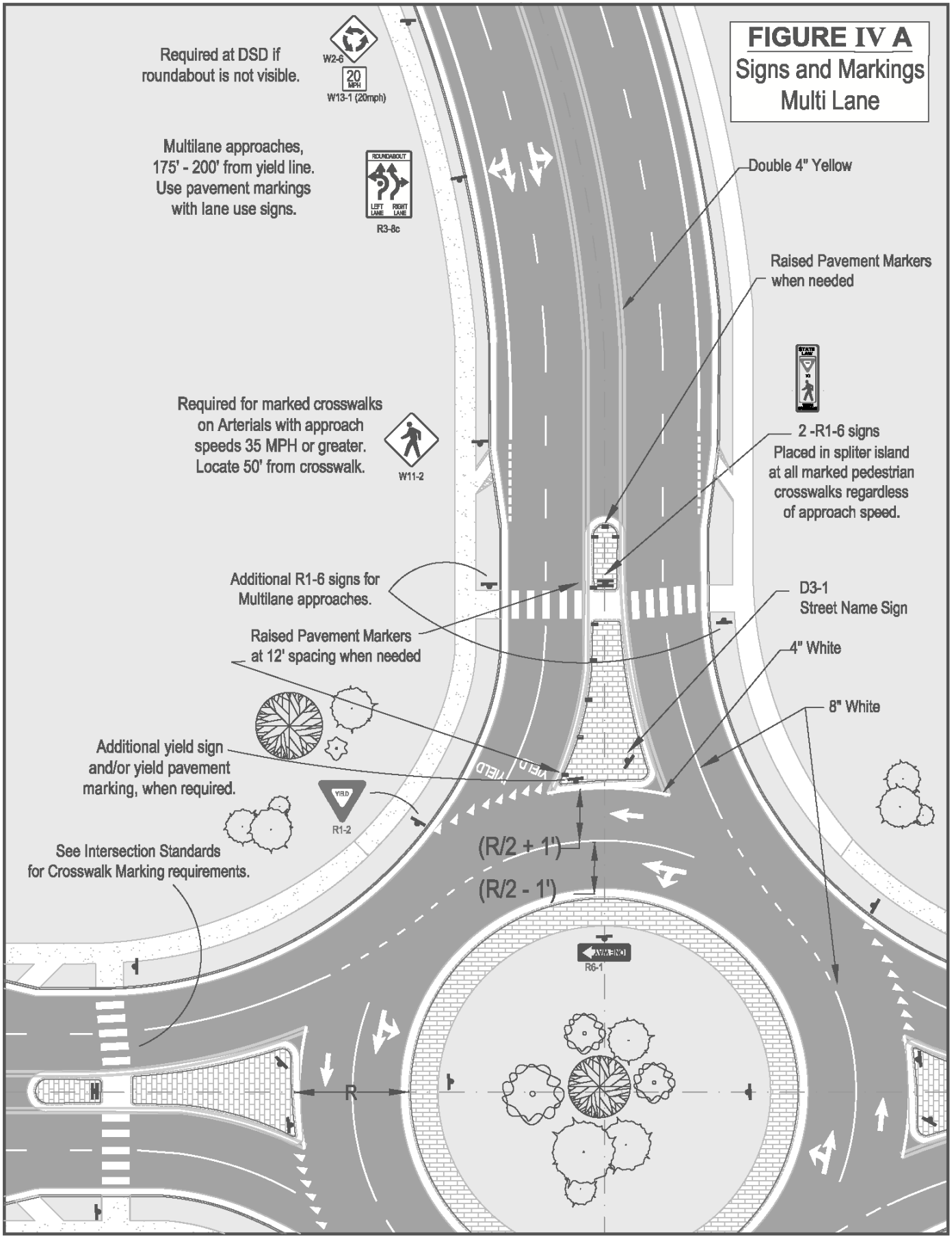


FIGURE IV A
Signs and Markings
Multi Lane
Required at DSD if roundabout is not visible.
W2-6
20 MPH
W13-1 (20mph)
Multilane approaches, 175' - 200' from yield line. Use pavement markings with lane use signs.
ROUNDABOUT
LEFT LANE
RIGHT LANE
R3-8c
Double 4" Yellow
Raised Pavement Markers when needed
Required for marked crosswalks on Arterials with approach speeds 35 MPH or greater. Locate 50' from crosswalk.
W11-2
2 -R1-6 signs Placed in spliter island at all marked pedestrian crosswalks regardless of approach speed.
Additional R1-6 signs for Multilane approaches.
D3-1
Street Name Sign
Raised Pavement Markers at 12' spacing when needed
4" White
8" White
Additional yield sign and/or yield pavement marking, when required.
YIELD
R1-2
See Intersection Standards for Crosswalk Marking requirements.
(R/2 + 1')
(R/2 - 1')
R6-1
R

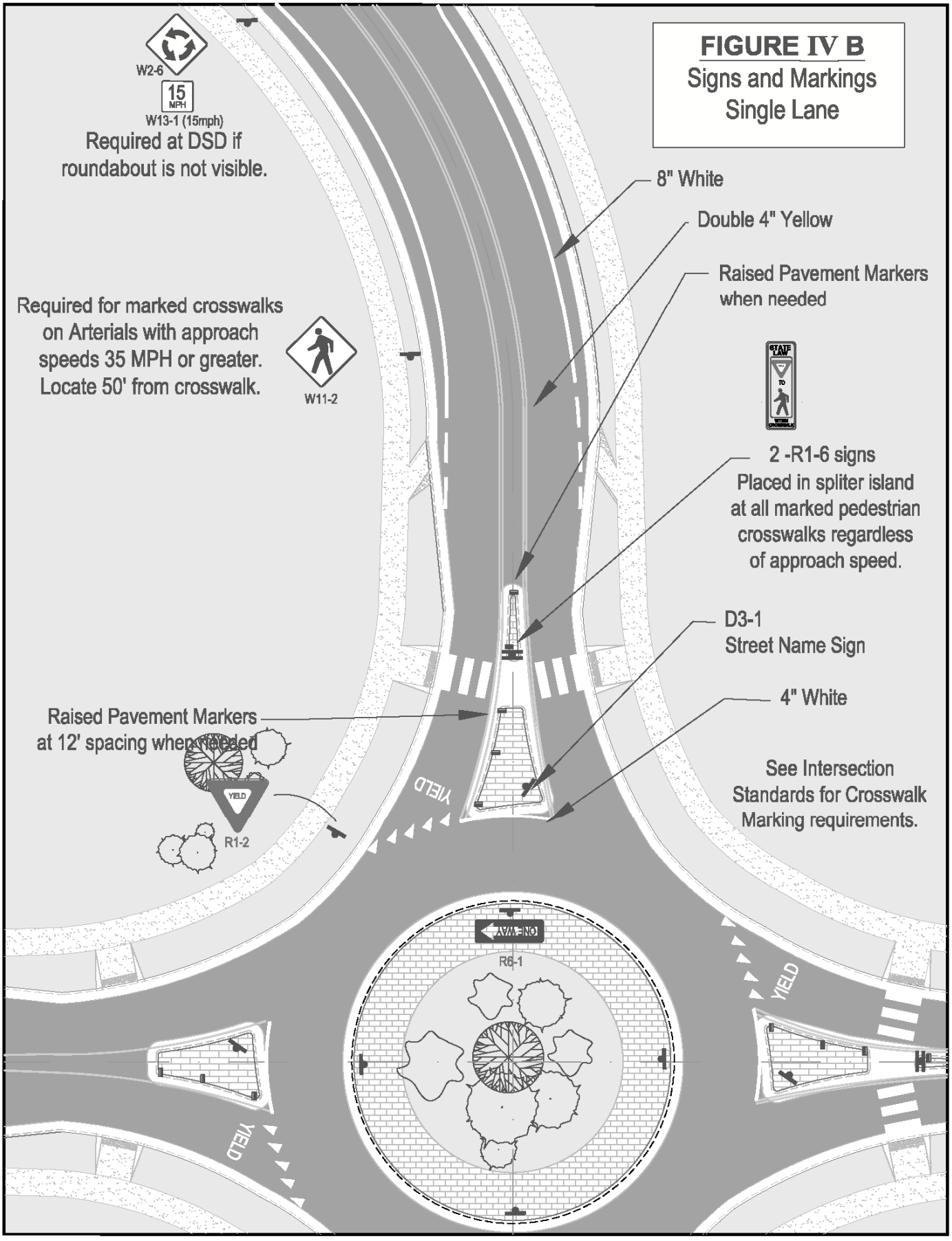
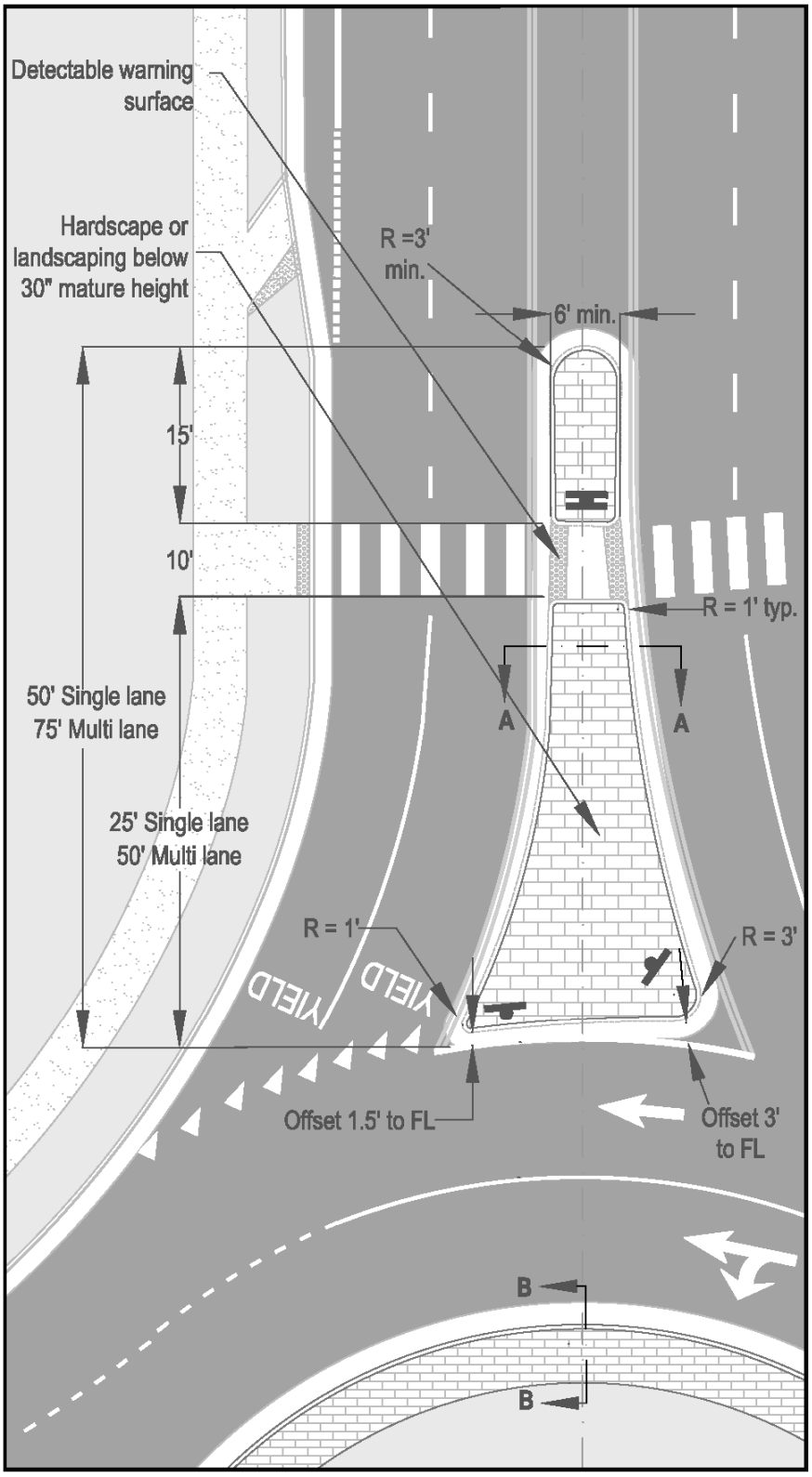
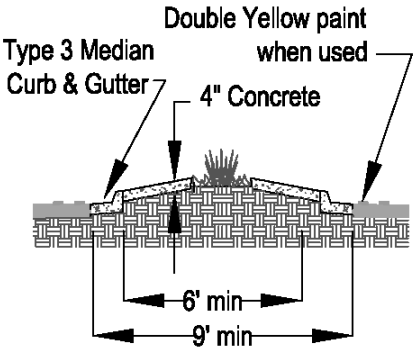


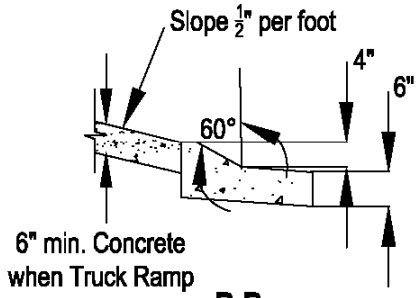
FIGURE IV B
Signs and Markings
Single Lane
W2-6
15
MPH
W13-1 (15mph)
Required at DSD if
roundabout is not visible.
8" White
Double 4" Yellow
Raised Pavement Markers
when needed
Required for marked crosswalks
on Arterials with approach
speeds 35 MPH or greater.
Locate 50' from crosswalk.
W11-2
STATE LAW
TO
WITHIN CROSSWALK
2 -R1-6 signs
Placed in spliter island
at all marked pedestrian
crosswalks regardless
of approach speed.
D3-1
Street Name Sign
4" White
Raised Pavement Markers
at 12' spacing when needed
YIELD
R1-2
See Intersection
Standards for Crosswalk
Marking requirements.
ONE-WAY
R6-1
YIELD
YIELD

FIGURE V
Construction Details



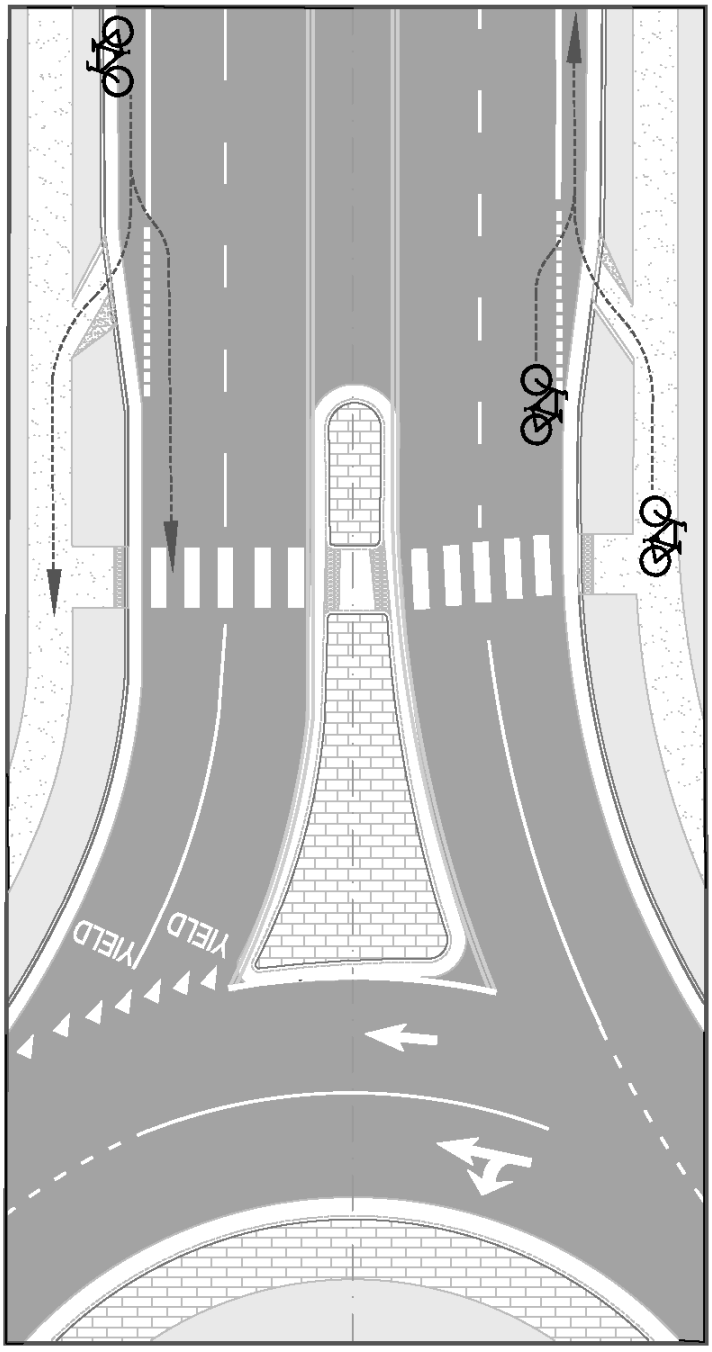


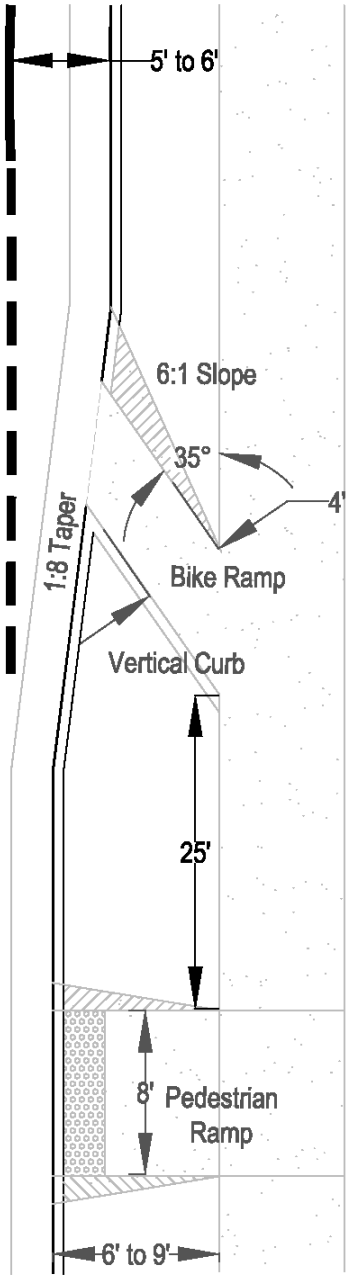
A-A
Typical Spliter Island Detail



B-B
Typical Truck Apron Detail

FIGURE VI
Bicycle Path and Ramp Detail





2. Circulating Roadway

The circulating roadway, that portion of the roundabout between the central island and the inscribed circle is the portion of the roadway used by vehicular traffic. The inscribed circle of the roundabout, which encloses the circulating roadway, shall be large enough to accommodate all road users without exceeding the fastest path maximum radii. Generally, the design of the inscribed circle will be from 130' to 200' for multilane roundabouts, and from 80' to 130' for single lane roundabouts. The outside edge of the circulating roadway is within and generally the same size as the inscribed circle.

The circulating roadway shall be from 1.0 to 1.2 times the approach roadway width at the entry to the roundabout. Super-elevation for the circulatory road should generally be no greater than -0.02 , although a super-elevation of up to -0.04 may be approved if conditions warrant. Adverse super elevation is preferred for the circulatory road as it provides a smoother transition for motorists, better drainage, and helps keep speeds to an acceptable level.

Roundabouts may be designed and built in stages, with the initial size of the inscribed circle large enough for a multilane roundabout, with an oversized central island that restricts the circulating roadway to one lane. In this case, it is likely that a truck apron will be needed.

Bypass lanes should be avoided if possible, due to the difficulty for pedestrians (especially sight impaired) to safely cross three roadways instead of the usual two in other roundabouts. If the capacity analysis with Rodel indicates that the existing and shorter range projected volumes will operate at level D or better, the roundabout should be built without a bypass. If the 20 year projected volumes show the need for a bypass, adequate right of way shall be included to accommodate the future expansion and the bypass will be built when the operating LOS exceeds level C.

3. Sight Distance

Stopping Sight Distance (SSD) is the distance between the hazard and the approaching driver, measured along the vehicle path. It is used to assess safety for vehicle to vehicle and vehicle to pedestrian or bicycle hazards. Every conflict point at the intersection must be checked, based on vehicle speed near the conflict area for obstructions of the required visibility area – see figure III.

SSD for the approach and yield at the roundabout are based on AASHTO standards for urban roadways, Section 9 of the 2001 geometric design manual, Case A for sight distance to the left, and Section 3, Ex 3-1 for SSD relating to pedestrians. Horizontal and vertical alignment must be checked.

Stopping Sight Distance	15 MPH	80'
	20 MPH	115
	25 MPH	155
	30 MPH	200
	35 MPH	250
	40 MPH	305
	45 MPH	360

4. Splitter Islands

Splitter islands provide proper deflection of vehicular traffic for speed control and pedestrian refuge areas. They are required on all roundabouts, with paint only allowed as an option on mini-roundabouts and 6" high mountable curb on all other roundabouts. They shall be a minimum of 50' long (measured from the outside edge of the circulator

road) if there is a pedestrian crossing. The alignment of the splitter island should incorporate a tangent extension of the splitter island flowline meeting the outside flowline of the central island. See figure V

Splitter islands where crosswalks exist or are projected shall have a minimum 6'x6' pedestrian refuge (an 8'x8' refuge is preferable). Crosswalks should be 25' from the yield line for single lane roundabouts, and 45 – 50' for multilane roundabouts. On multilane approaches, the crosswalks should be radial to the traveled way to improve visibility for pedestrians.

The curb face along the circulating roadway should be offset from the traveled way a distance of 3' on the approach side next to the circulating roadway tapering to 1.5' at the intersection of the entry and the approach. Island nose radii shall meet the dimensions as shown in figure V

5. Central Island

Central islands are the most visible part of the roundabout for approaching vehicles and establish the shape and size of the roundabout. Their size is critical to the correct operation of the roundabout.

Central island diameter for a multilane roundabout should be designed for each case to assure that the deflection for entering vehicles results in meeting the maximum fastest path requirements. Generally, the central island diameter will be between 65' and 135' for a multilane roundabout and between 50' and 100' for a single lane roundabout.

Required truck aprons shall not exceed -0.08 superelevation. They shall be constructed with a 4" high mountable curb sloped back at a 60 degree angle and rounded at the top, with 12" spill gutter for new roundabouts. Key-in curb only, without gutter pan, will be allowed for retrofit of existing intersections for the central island with drainage away from the curb.

Truck aprons should be constructed of concrete, contrasting in texture and color from the road, easy to maintain, and able to withstand loads of turning trucks (i.e. minimum 6" decorative, contrasting concrete, such as exposed aggregate, colored, and/or patterned concrete, etc.). Brick, cobblestone or other individually placed paving materials are not allowed.

Elevation drawings of the central island shall be included with the preliminary plans for review. The central island not including any truck apron shall be a minimum of 2' above the surrounding roadway outside of the sight distance restricted areas, and shall be of contrasting texture and colors to the roadway and the background. They shall be designed for low maintenance (restrict the use of sod or other high maintenance surfaces).

6. Signing & Marking

Signing - See figures IV-A and IV-B for sign locations.

All signs shall conform to *Manual on Uniform Traffic Control Devices* (MUTCD) as modified by the latest recommended roundabout signing standards and by these design standards.

- Advance roundabout warning signs with advisory speed plaques are required whenever topography or driver distraction precludes adequate advance visibility of the roundabout – see Approach Decision Sight Distance in paragraph C-1 for distances. They may also be used temporarily or permanently whenever a roundabout is modified or a new roundabout constructed as a retrofit to an existing intersection.

- Yield signs shall be placed on the right side of the road at the point where vehicles are to yield when entering the roundabout. Supplemental yield signing in the splitter island may be required due to alignment or sight distance problems where a single yield is not adequate. Supplemental signs noting "To Traffic in

Circle" may be required to be added to the yield signs on multilane roundabouts. "YIELD" pavement marking may be required where field observation warrants.

- Lane assignment signs depicting the lanes maneuvering around the roundabout are shown in Figure IV shall be provided on all multi-lane approaches, including single lane approaches with auxiliary turn lanes.

- Street name signs with a minimum of 6" lettering shall be placed on the splitter islands oriented toward traffic on the circulatory roadway. Flag type guide signs indicating the correct directional exit for service, recreational and cultural destinations are required for major destination routes.

- Advanced directional guidance signs (as depicted in the following figure) shall be used as required for the junction of numbered routes.

- See paragraph B-4 for required pedestrian crossings. Pedestrian signage is required where pedestrian usage meets minimum requirements. All marking, signing and supplemental warning devices shall meet MUTCD standards as modified and shown in the detail drawings in this design guide.

Marking - All pavement markings shall conform to *Manual on Uniform Traffic Control Devices* (MUTCD) as modified by the latest recommended roundabout guidelines and these design standards.

- Lane use pavement markings, including arrows and solid or dashed lines shall be used on all multilane roundabouts. See figure IV for their correct placement.

- Yield triangles shall be used to mark the location at which drivers must yield to circulating traffic. The yield markings shall be curved along the outline of the circulatory road and shall have triangles oriented toward approaching drivers as depicted in the following figure. Supplemental "YIELD" pavement marking may be required where field observations indicate a significant number of vehicles do not yield.

- Yellow edge lines shall be placed along the left edge of the approach roadway along the edge of the splitter islands if the splitter island is installed within a painted median. For multilane roundabouts only, yellow edge lines are required around the central island, and white edge lines are required along the right side of the splitter island outlining the circulating roadway.

- Pedestrian crossings should be marked with ladder style markings consisting of 2' x 8' markings placed to accommodate the wheel path.

- Retroreflective raised pavement markers (RRPM) may be required on the central island and splitter islands where sight distance and/or lighting indicates improved warning is needed for nighttime operation.

7. Landscaping Design Elements

Splitter islands shall be hardscape or contain low level vegetation with a maximum height of the curb, splitter island structure and landscaping, at maturity, of 30” above the roadway (see figure III).

The central island should contain vertical features outside of the stopping sight distance restriction area, visible to approaching traffic both day and night, to reduce approach speeds.

New roundabouts with landscaping shall have a maintenance agreement with the City Parks Department, providing for maintenance, or they shall have guaranteed funding for maintenance of the landscaping by private organizations (i.e. homeowners associations, property management agencies, etc.). Retrofit roundabouts shall have low-maintenance landscaping or a maintenance agreement similar to new roundabouts.

Landscaping and design elements shall be aesthetically pleasing, shall fit within the context of the surrounding area, shall not distract drivers, and shall not interfere with pedestrian safety.

D. Definitions

Central Island—the raised area in the center of a roundabout around which traffic circulates.

Fastest Path Radius—the minimum radius on the fastest through path around the central island measured 5' from any flowline.

Circulating Volume—the total volume in a given period of time on the circulatory roadway immediately prior to an exit.

Circulatory Roadway Width—the width between the outer flowline of the circulatory roadway and the central island, not including the width of any apron.

Deflection—the change in trajectory of a vehicle imposed by geometric features of the roadway.

Departure Width—the width of the roadway used by departing traffic downstream of the roundabout. The departure width is typically no more than the total roadway width.

Decision Sight Distance – from AASHTO Geometric Design manual, section 3. , the distance from the intersection where the driver recognizes that they are approaching an obstacle that will require a maneuver or stop.

Design Vehicle—the largest vehicle that can reasonably be anticipated to use a facility.

Entry Flare—the widening of an approach to provide additional capacity at the yield line and storage.

Entry Path Radius—the minimum radius on the fastest through path prior to the yield line, measured 5' from any flowline, noted as R1

Entry Radius—the minimum radius of curvature of the outside or right curb at the entry.

Entry Speed—the speed a vehicle is traveling at as it crosses the yield line.

Entry Width—the width of the entry where it meets the inscribed circle, measured perpendicularly from the right edge of the entry to the intersection point of the left edge line and the inscribed circle.

Exit Path Radius—the minimum radius on the fastest through path into the exit, measured 5' from any flowline, noted as R3

Exit Radius—the minimum radius of curvature of the outside right curb at the exit.

Exit Width—the width of the exit where it meets the inscribed circle, measured perpendicularly from the right edge of the exit to the intersection point of the left edge line and the inscribed circle.

Inscribed Circle - the circle forming the outer edge of the circulatory roadway used to define the size of a roundabout, measured between the outer edges of the circulating roadway. It is the diameter of the largest circle that can be inscribed within the outline of the intersection.

Multilane Roundabout—a roundabout that has at least one entry with two or more lanes, and a circulatory roadway that can accommodate more than one vehicle traveling side-by-side.

Right-Turn Bypass Lane—a lane provided adjacent to, but separated from, the circulatory roadway, that allows right-turning movements to bypass the roundabout. Also known as a right-turn slip lane.

Roundabout – an intersection with 3 or more approach legs, generally circular in shape where continuos flow of traffic is allowed through the use of the yield and merge maneuvers.

Sight Triangle—an area required to be free of obstructions to enable visibility between conflicting movements.

Single-Lane Roundabout—a roundabout that has single lanes on all entries and one circulatory lane.

Splitter Island—a raised or painted area on an approach used to separate entering from exiting traffic, deflect and slow entering traffic, and provide storage space for pedestrians crossing that intersection approach in two stages.

Stopping Sight Distance—the distance measured along the centerline of travel on a roadway required for a driver using the sight triangle or sight line to perceive and react to an object in the roadway and to brake to a complete stop before reaching that object.

Truck Apron – a raised, colored and/or textured concrete surface next to the outside curb of the central island designed to allow large trucks to turn with their rear wheels leaving the roadway and riding up onto the apron area.

Two-Stage Crossing—a process in which pedestrians cross a roadway by crossing one direction of traffic at a time, waiting in a pedestrian refuge between the two traffic streams if necessary before completing the crossing.