KELLY B. SCOCCO
Director

THE CITY OF COLUMBUS
ANDREW J. GINTHER, MAYOR

DEPARTMENT OF PUBLIC SERVICE

PERFORMANCE CHECKS DESIGN AID

To: Designers, Contractors, and City Departments

Date: November 6, 2025

Subject: Modern Roundabout Design, Performance Check Design Aid supplemental

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111 N. Front Street | Columbus OH 43215 | (614) 645.8290 |Fax (614) 645.7805
City of Columbus 311 Call Center (614) 645-3111
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Purpose

This aid provides designers with instructions for the development of a performance checks package as required by Section 6 of Design Memo 7.04. A complete performance checks package is required to validate the horizontal and vertical geometry of a roundabout, that includes:

- Overview and Horizontal Design Diagrams
- Geometric Design Speed Diagrams
- Truck Swept Path Diagrams
- Stopping Sight Distance, Intersection Sight Distance, and View Angle Diagrams

Note: This guide is written for use with Openroads, though similar functionality exists within AutoCAD.

Overview and Horizontal Design

A series of measurements should be provided at key points such as entry and exit widths, circulating lane widths, and approach and departure widths. For multilane roundabouts a measurement of the entering and exiting tangents should be shown to check for issues arising from path overlap.

Checking for Path Overlap on Multilane Roundabout

On multilane roundabouts the potential for path overlap arises. This occurs when the natural path of a vehicle does not align correct circulatory lane. An example of path overlap is show in **Figure 1**.

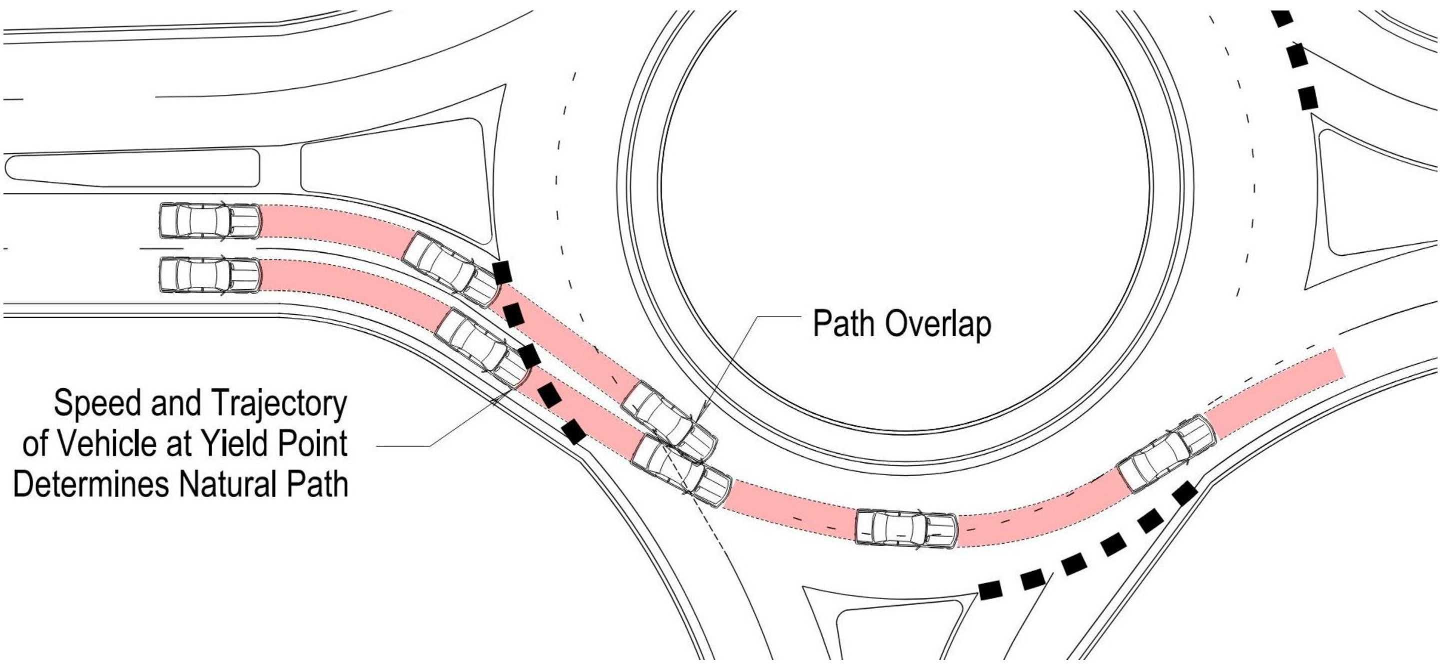

Figure 1 – Path Overlap

To check for path overlap, the designer should draw a line using the tangent snap from the entering radius to the circulating radius and from the circulating radius to the exit radius. The entry tangent should be 30 to 50-feet in length while the exit tangent should be 40 to 60-feet in length. As shown in **Figure 2** for a buffered roundabout the path overlap should be checked from the center of the entry or exit lanes as applicable.

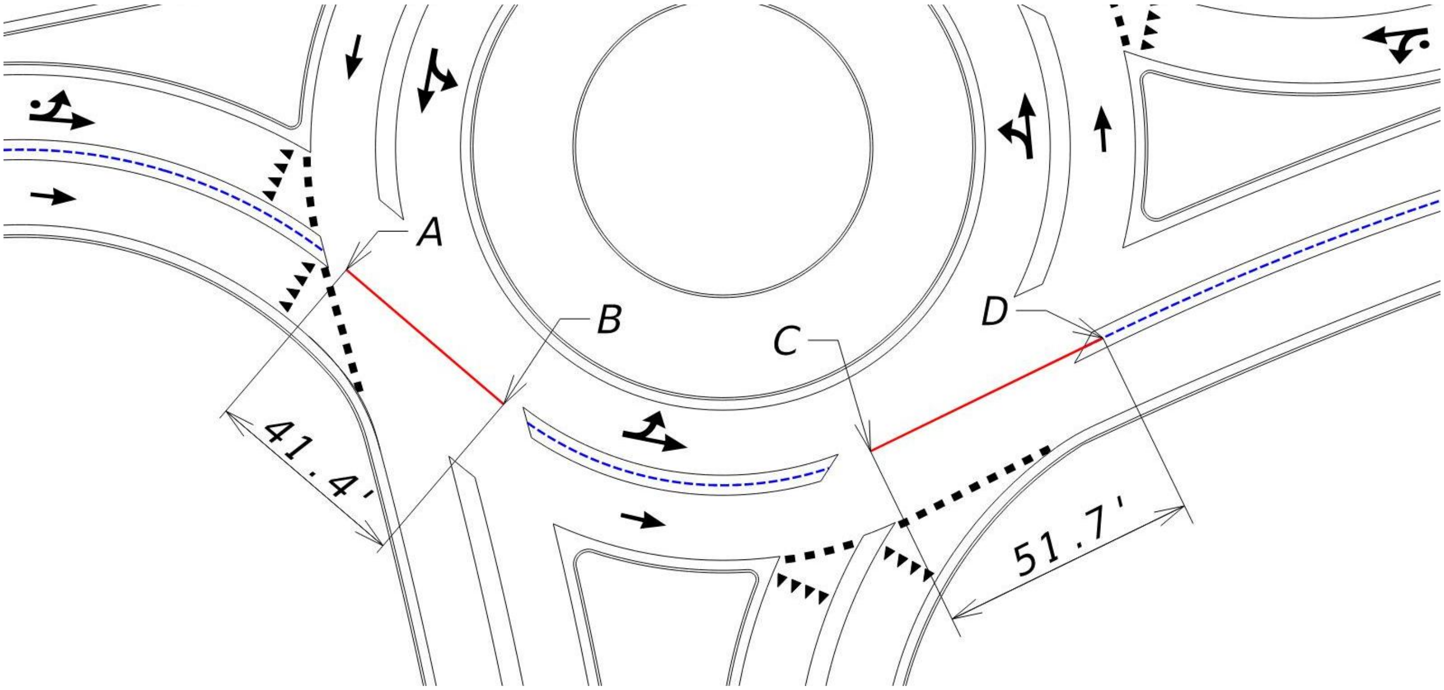

Figure 2 – Measuring Tangents to Check for Path Overlap

In this case an offset was used to find the center point of the lanes and a line was drawn tangent to Point A and Point B the length of this line was then measured and labeled. The process was repeated to draw line segment C-D. **Figure 3** shows an example roundabout with no path overlap, the vehicles are directed into the correct circulating lanes upon entry. The larger radius transitioning into a smaller radius helps to align the vehicles.

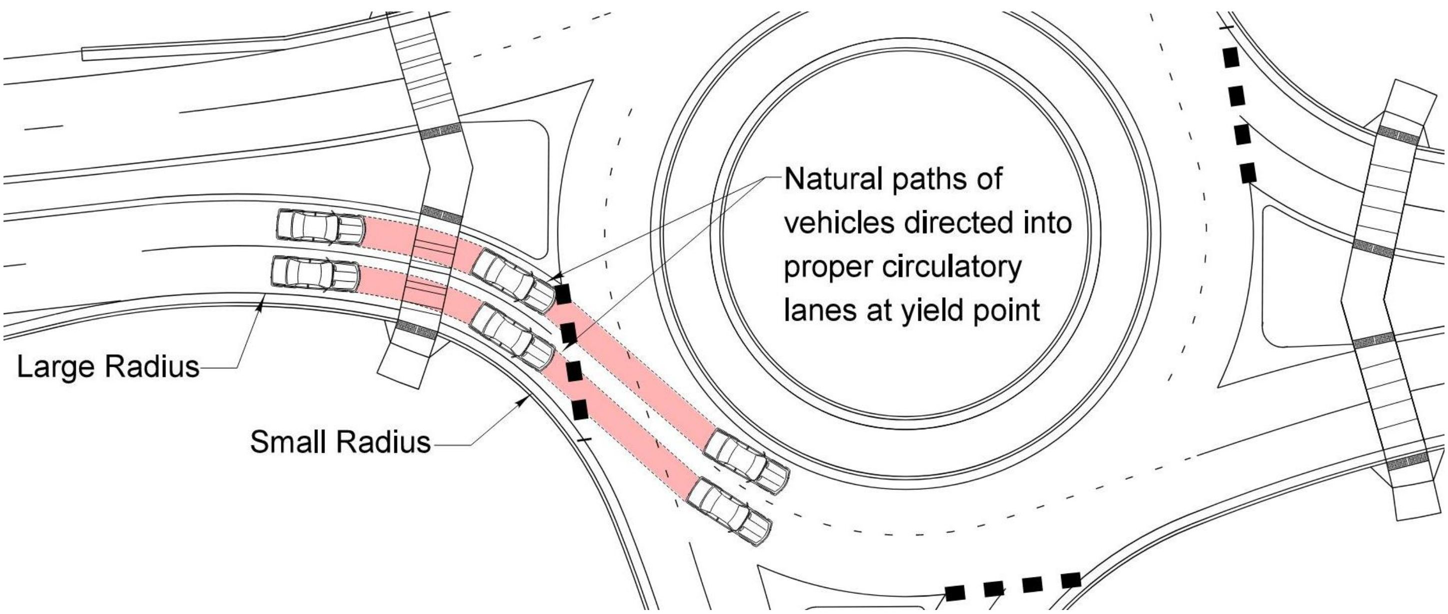

Figure 3 – Natural Path Does Not have Path Overlap

Figure 4 provides a method for avoiding path overlap. Path overlap can typically be avoided if there is approximately 5-feet between the central island curb and the extension of the splitter island curb, with the radius of that curve extension in the range of 75 to 100-feet. Another way to avoid path overlap is to add raised lane dividers to physically separate vehicles.

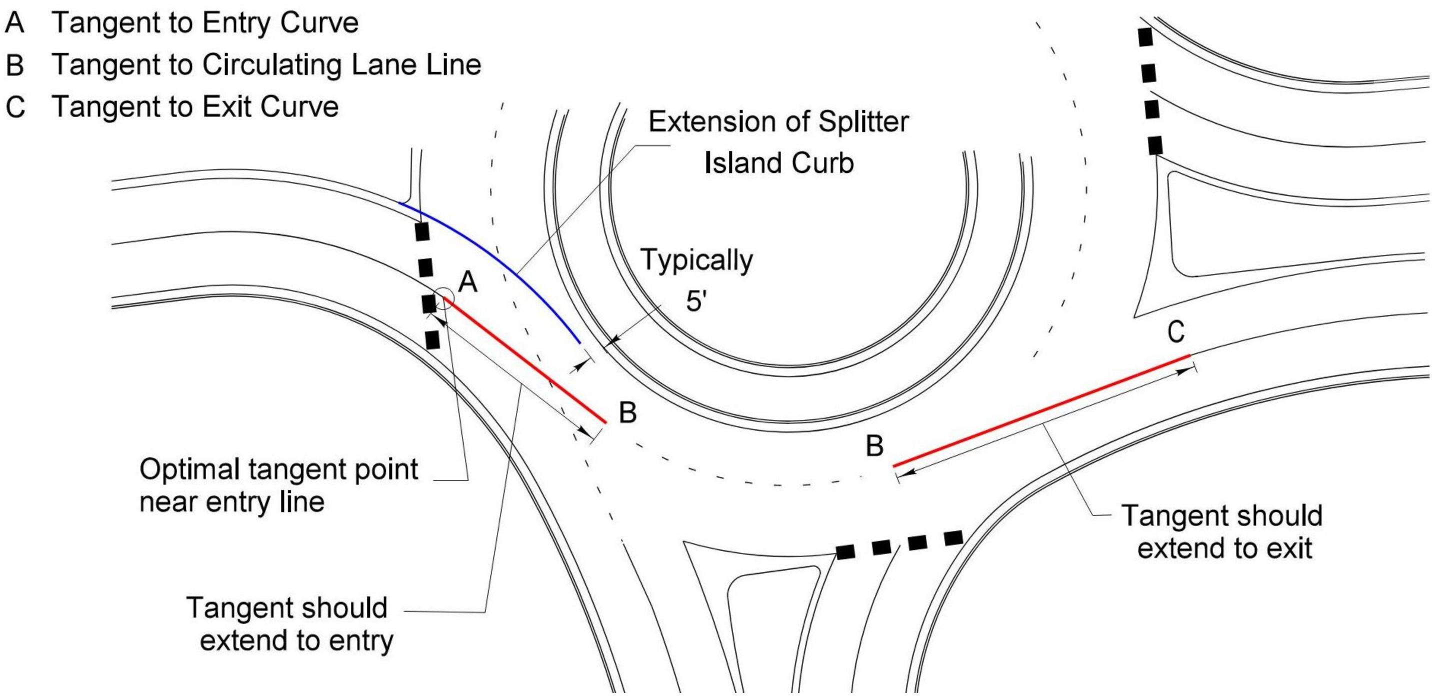

Figure 4 – Avoiding Path Overlap

Geometric Design Speeds

The geometric design speeds of a roundabout are measured by drawing the fastest path through the roundabout. The geometric speed path spline represents the path of a vehicle travelling at the maximum theoretical speed through the roundabout. This is a key measure of the safety of a roundabout. The steps for drawing the geometric speed path splines are outlined below.

Creating Fastest Paths in Openroads

Step 1: Create Offsets

The offsets are created using the copy parallel tool in the manipulate toolbox, shown in **Figure 5**, in Openroads (ORD).

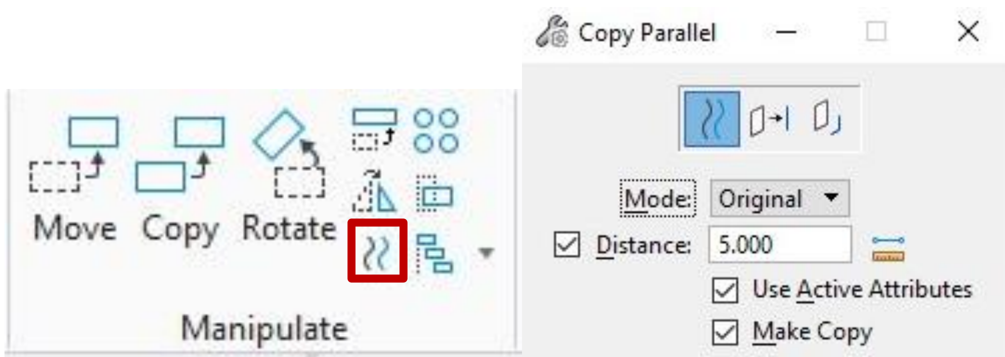

Figure 5 – Copy Parallel

An example of standard offsets needed to draw the fastest paths are shown in **Figure 6**.

A. An offset of 165-feet from the yield line/Inscribed Circle Diameter (ICD).
B. A 5-foot offset from the central island face of curb.
C. A 5-foot offset from the face of curb of the splitter islands
D. A 5-foot offset from the outside face of curb at the entries and exits.
E. A 3-foot offset from pavement markings where there is at least 2-feet of paved shoulder beyond the painted edge line when on the outside of the lane, if less than 2-feet use a 5-foot offset from the edge of pavement.

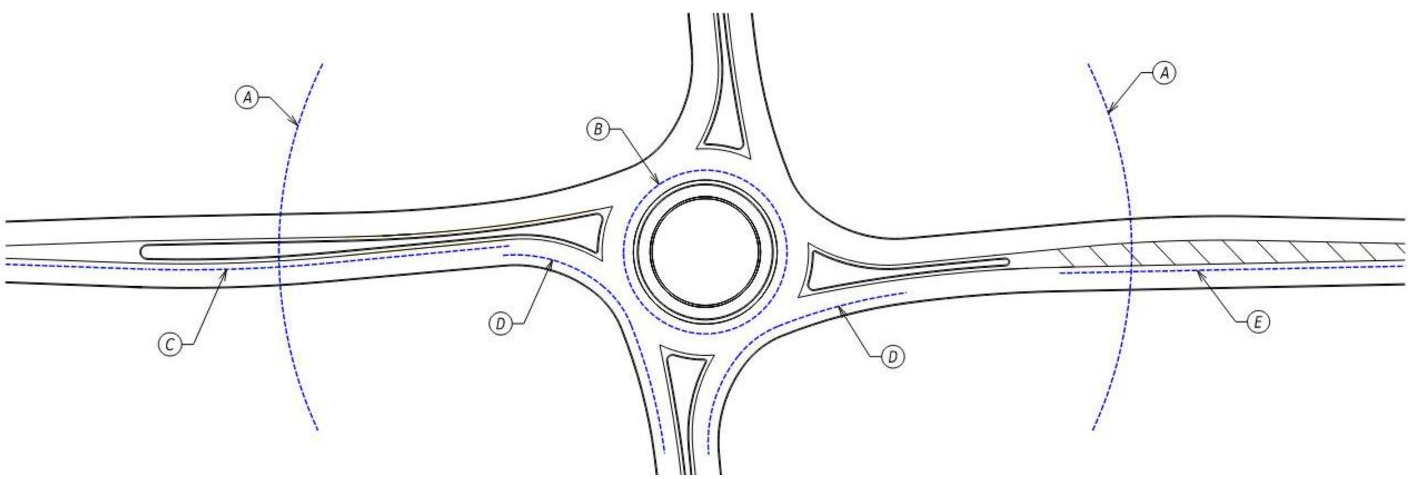

Figure 6 – Typical Offsets for a Single-Lane Roundabout

These offsets are used as a guide for the spline that is drawn to represent the geometric speed path.

Step 2: Draw the Spline

Once the offsets have been defined as in Step 1, the next step is to draw the spline. The spline represents the natural path of the center of a passenger car as it travels as quickly as possible through the roundabout. It is drawn using the B-spline by Points tool found in the placement toolbox, see **Figure 7**. The Method for drawing the spline should be by Control Points, the Input By should be Points, the Closure should be Open to draw a line rather than a shape, and the Order, or minimum number of points, should be 4.

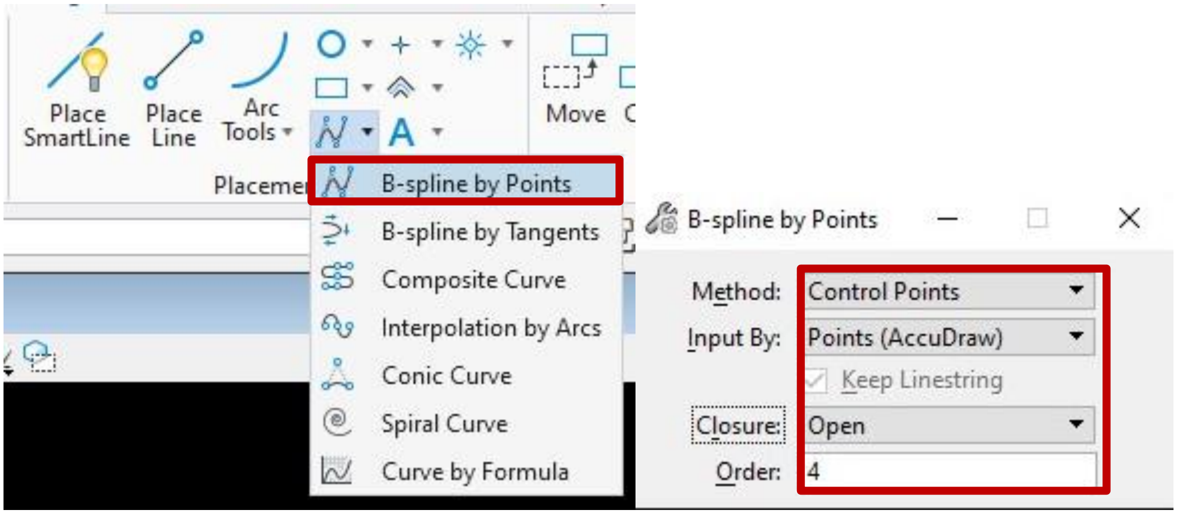

Figure 7 – B-Spline by Points Tool

The sequence for drawing the Thru spline is outlined below and displayed in **Figure 8**:

1. Choose points A, B, and C along the first offset that is either 5-feet from the face of curb of the splitter island or 3-feet from the pavement marking if the splitter island does not extend to the 165-foot offset. Point C should be at the intersection of the 165-foot ICD offset and the 5-foot offset from the inside face of curb while Points B and A are drawn at approximately 50-foot intervals from Point C along the offset line.
2. Place Point D at the 5-foot offset from face of curb at the entry.
3. Place Point E at the 5-foot offset from the central island face of curb.
4. Place Point F at the 5-foot offset from the face of curb at the exit.
5. Place Point G at the intersection of the 3-foot offset from the pavement marking or the 5-foot offset from splitter island face of curb and the 165-foot offset from the ICD. Place Points H and I at 50-foot intervals from Point G along the offset line. There may be cases where Points G, H, and I should be placed on an offset from the outside face of curb instead of the inside pavement marking or face of curb depending on the vehicle path.
6. Right click to end the placement of the spline.

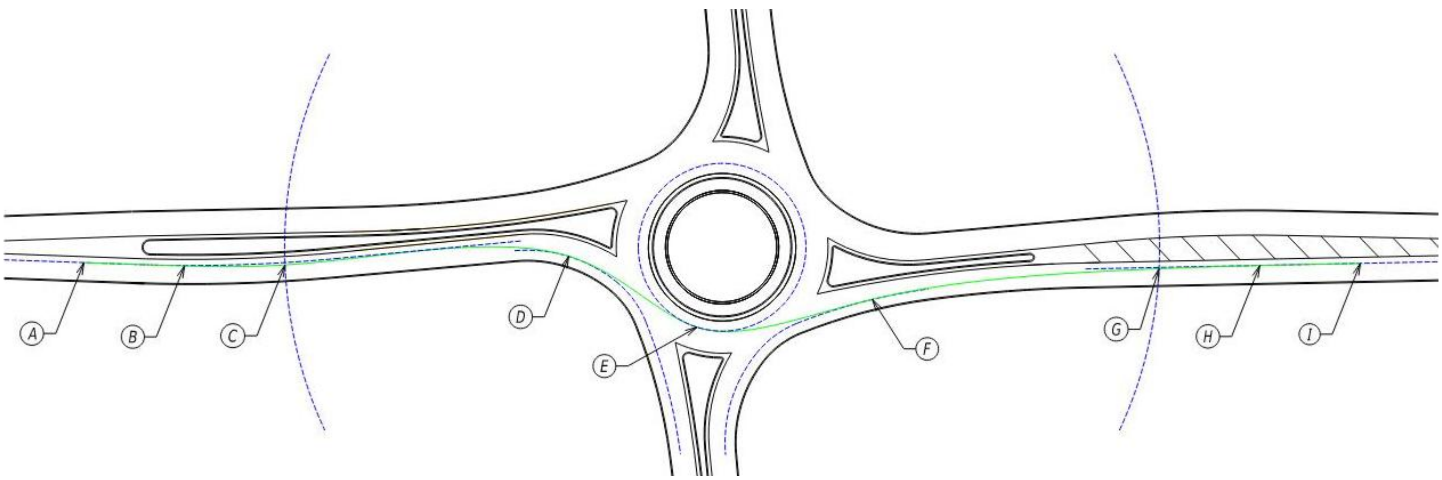

Figure 8 – Typical Point Placement on a Thru Spline

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The sequence for drawing the Left turn spline is outlined below and displayed in **Figure 9**:

1. Choose points A, B, and C along the first offset that is either 5-feet from the face of curb of the splitter island or 3-feet from the pavement marking if the splitter island does not extend to the 165-foot offset. Point C should be at the intersection of the 165-foot ICD offset and the 5-foot offset from the inside face of curb while Points B and A are drawn at approximately 50-foot intervals from Point C along the offset line.
2. Place Point D at the 5-foot offset from face of curb at the entry.
3. Place Point E and F at the 5-foot offset from the central island face of curb.
4. Place Point G at the 5-foot offset from the face of curb at the exit.
5. Place Point H at the intersection of the 3-foot offset from the pavement marking or the 5-foot offset from splitter island face of curb and the 165-foot offset from the ICD. Place Points I and J at 50-foot intervals from Point H along the offset line. There may be cases where Points H, I, and J should be placed on an offset from the outside face of curb instead of the inside pavement marking or face of curb depending on the vehicle path.
6. Right click to end the placement of the spline.

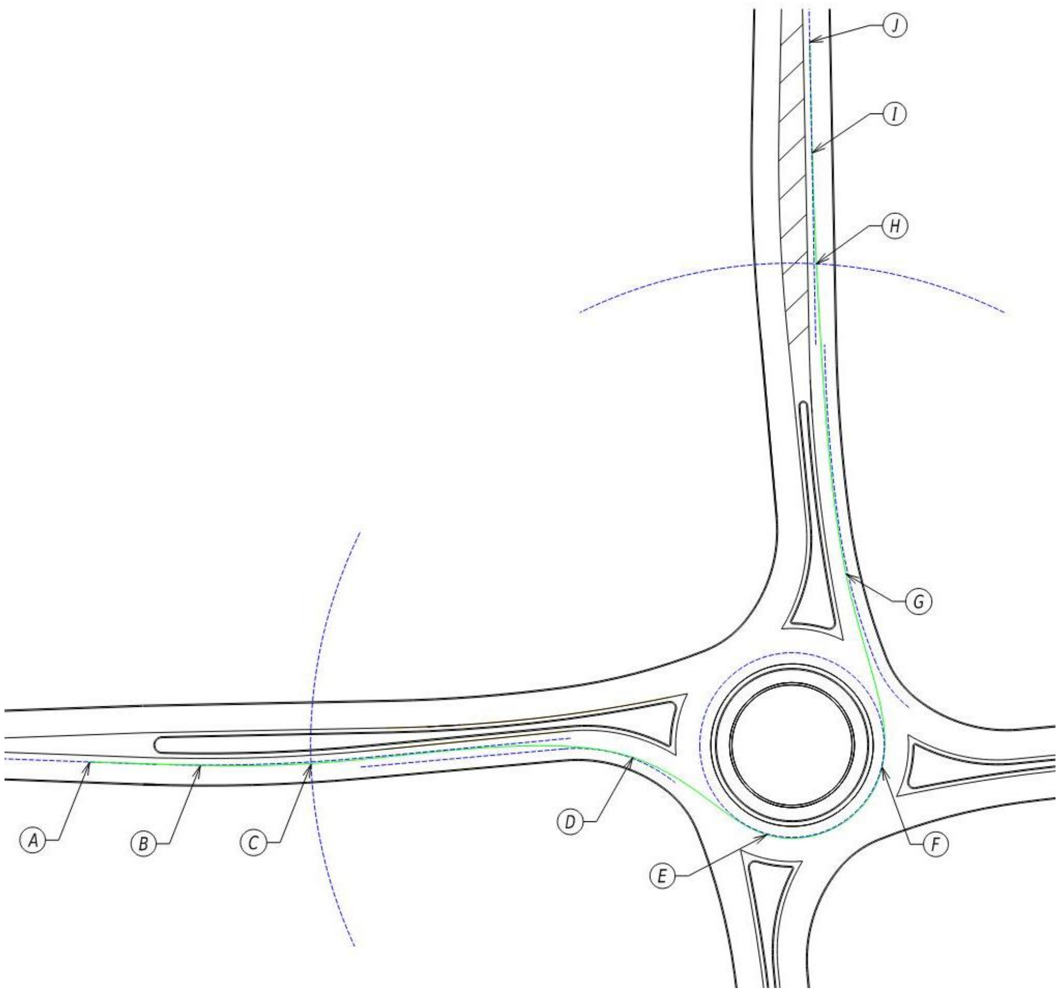

Figure 9 – Typical Point Placement on a Left-Turn Spline

The sequence for drawing the Right turn spline is outlined below and displayed in **Figure 10**:

1. Choose points A, B, and C along the first offset that is either 5-feet from the face of curb of the splitter island or 3-feet from the pavement marking if the splitter island does not extend to the 165-foot offset. Point C should be at the intersection of the 165-foot ICD offset and the 5-foot offset from the inside face of curb while Points B and A are drawn at approximately 50-foot intervals from Point C along the offset line.
2. Place Point D at the 5-foot offset from face of curb at the entry.
3. Place Point E at the 5-foot offset from the face of curb at the exit.
4. Place Point F at the intersection of the 3-foot offset from the pavement marking or the 5-foot offset from splitter island face of curb and the 165-foot offset from the ICD. Place Points G and H at 50-foot intervals from Point F along the offset line. There may be cases where Points F, G, and H should be placed on an offset from the outside face of curb instead of the inside pavement marking or face of curb depending on the vehicle path.
5. Right click to end the placement of the spline.

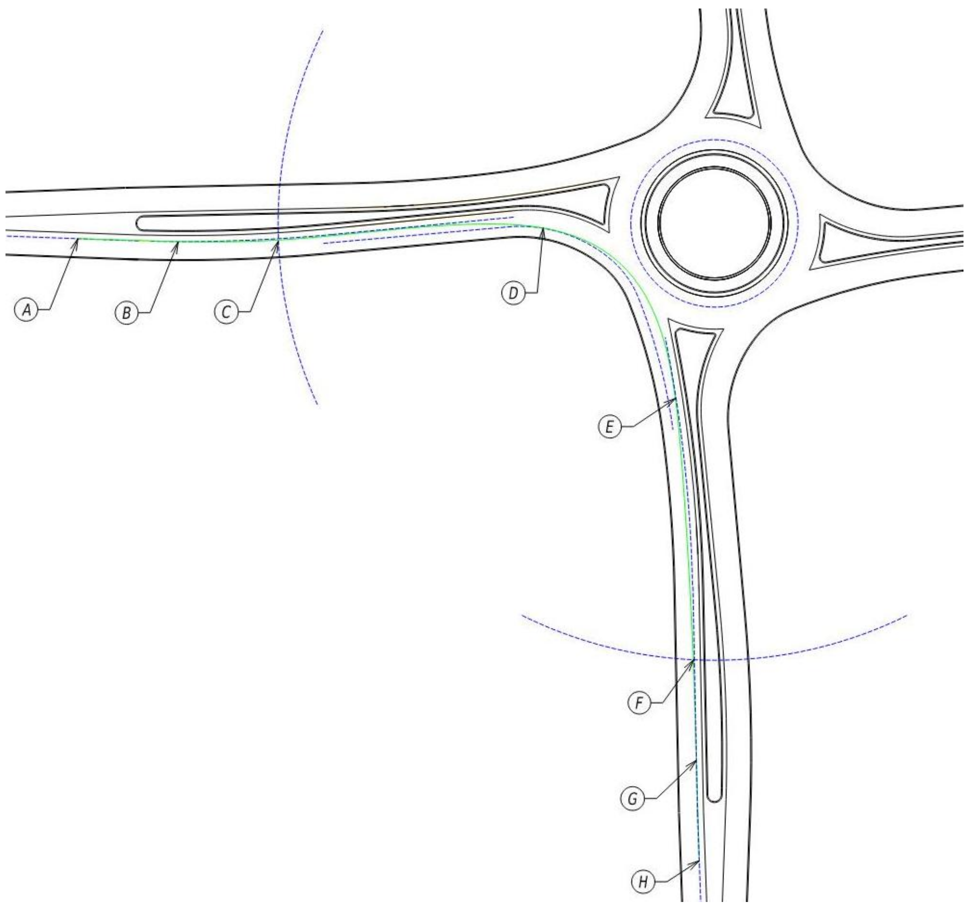

Figure 10 – Typical Point Placement on a Right-Turn Spline

Note that the right turn spline should not cross the central island offset.

Step 3: Modify the Spline

After placing the spline following the sequence outlined in Step 2, the spline must be checked to ensure that it does not cross the offsets at any point along the spline. **Figure 11** shows an area that the spline has crossed over the 5-foot offset drawn from the face of curb at the entry of the roundabout.

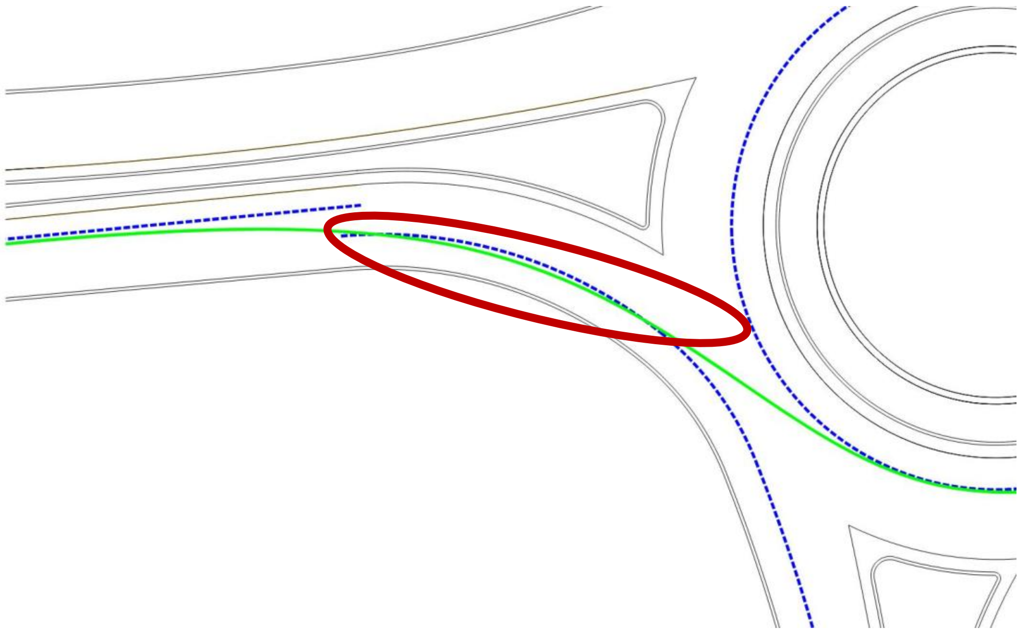

Figure 11 – Spline Crossing the 5-Foot Offset

As shown in **Figure 12**, select the spline to be manipulated. Once selected, use the control point to adjust the spline as close to the offset as possible without crossing either the 3- or 5-foot offset. This is an iterative process and should be repeated until the spline is as close as possible to all offsets and the control points without crossing the offset line, as shown in **Figures 4-6**.

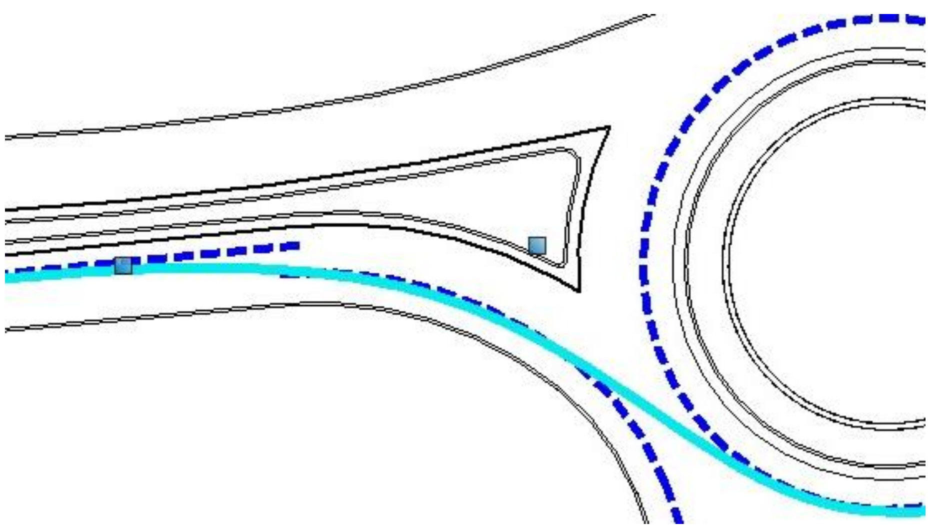

Figure 12 – Modifying the Spline

Once the spline has been defined, confirm the spline emulates the vehicles fastest/natural path through the roundabout. For example, if the designer were to follow the above steps for the design shown in **Figure 13** the resulting spline would match the red path. In this case, the green spline represents a vehicles fastest/natural path, and the spline should be drawn to align with the outside edge of pavement offsets.

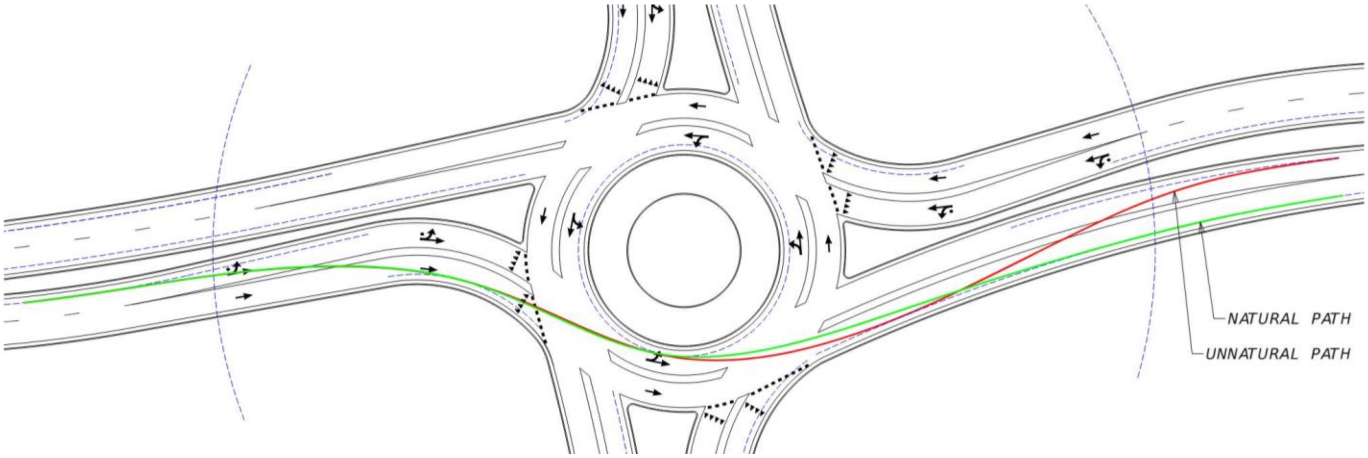

Figure 13 – Natural versus Unnatural Paths

Step 4: Measure R-Values

With the geometric speed path defined using the steps above, the R-Values can be determined. The following R-Values should be calculated for each roundabout:

- R1 (Entry Path Radius): The minimum radius on the fastest through path prior to the yield line.
- R2 (Circulating Path Radius): The minimum radius on the fastest through path around the central island.
- R3 (Exit Path Radius): The minimum radius on the fastest through path into the exit. The exit speed is the minimum of the predicted speed based on the R3 radius or acceleration from the middle of R2 to the point of interest on the exit calculated using **NCHRP 1043 Equation 9.7:**

$$V_3 = \min \begin{cases} V_{3p} \\ \dfrac{1}{1.47}\sqrt{(1.47V_2)^2 + 2a_{23}d_{23}} \end{cases}$$

  Where:
  V_3 = exit speed (mph)
  V_{3p} = V_3 speed predicted on basis of path radius (mph)
  V_2 = circulatory speed for through vehicles predicted on basis of path radius (mph)
  a_{23} = acceleration between the midpoint of V_2 path and the point of interest along V_3 path (6.9 ft/s^2)
  d_{23} = distance along the vehicle path between midpoint of V_2 path and point of interest along V_3 path (ft)

- R4 (Left Turn Path Radius): The minimum radius on the path of the left turn movement.
- R5 (Right Turn Path Radius): The minimum radius on the path of the right turn movement.

An example of the steps required to measure the R1 Value is outlined below:

1. Draw a circle with a 65 to 80-foot diameter using the Place Circle tool in the Placement Toolbox (**Figure 14**). The method of placing the circle should be Center. Use the Near Point snap to place the circle at the point of the spline that looks to have the tightest radius prior to the yield line.

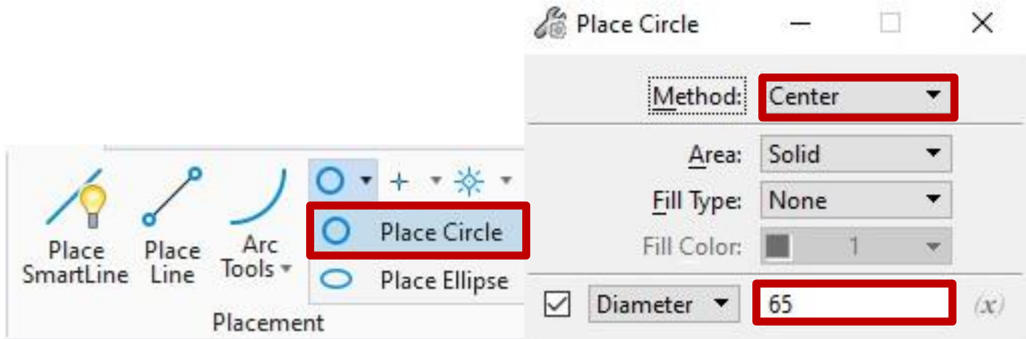

Figure 14 – Place Circle

2. Place an arc in the circle using the Method of Start, End, Mid as seen in **Figure 15**. Use the Intersect snap to select the points where the Spline crosses the circle labeled Points A and B in **Figure 16** as the start and end. The mid-point should be drawn to closely match the spline without crossing the spline at any point along the radius.

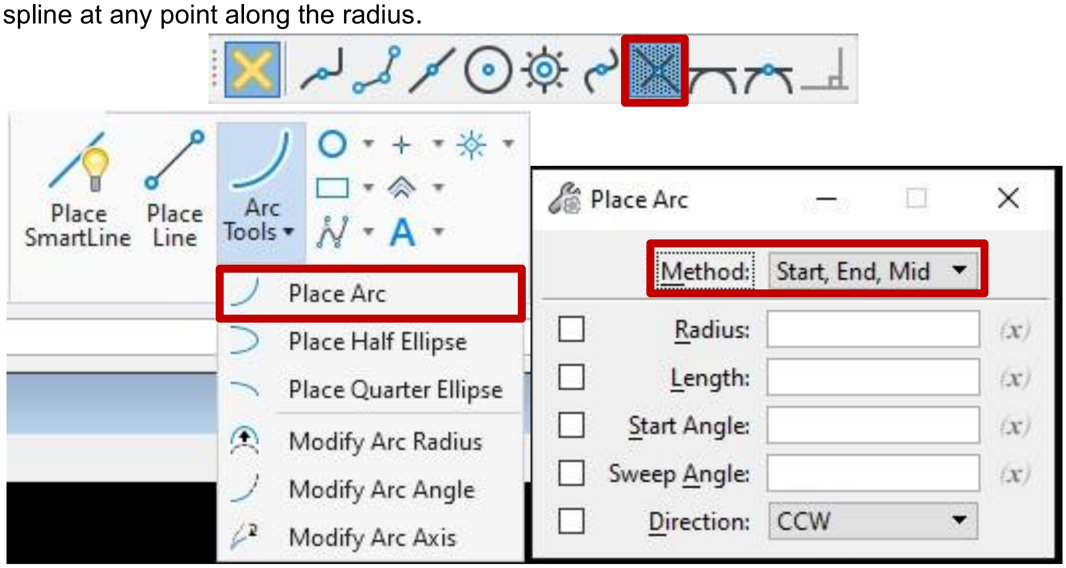

Figure 15 – Drawing the Arc

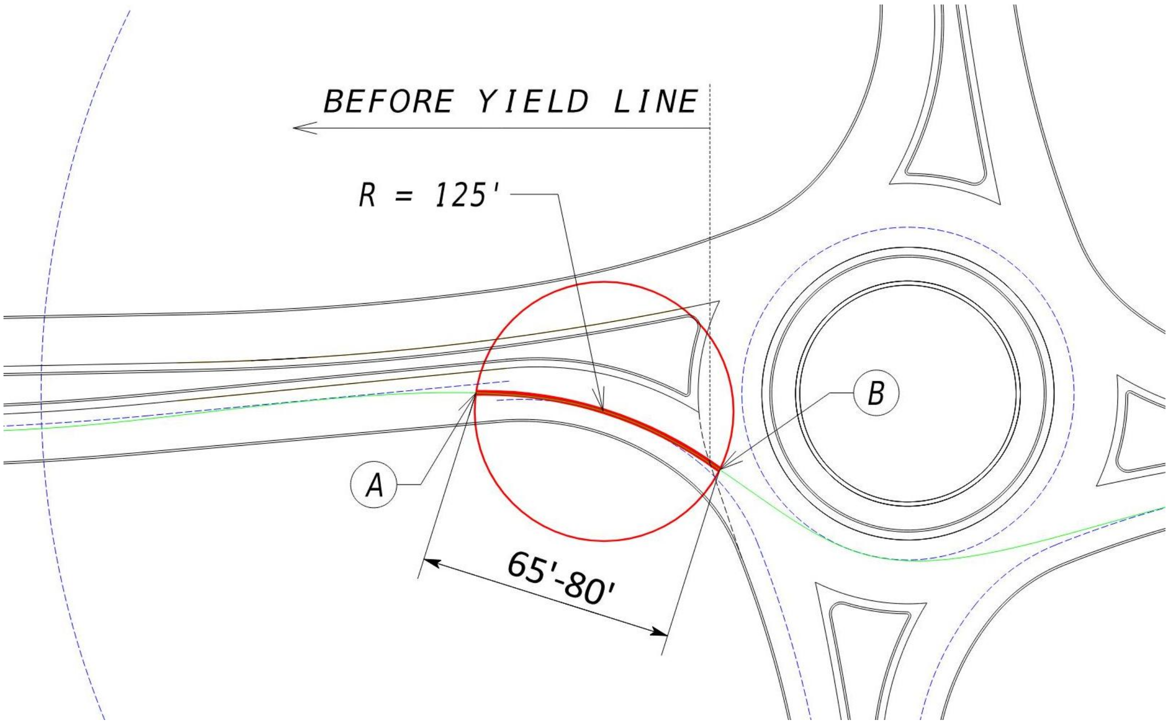

Figure 16 – Measuring the Radius

The radius of the Arc drawn should be measured and the corresponding equation applied to determine the theoretical speed that corresponds. The speeds should be calculated assuming a +2% superelevation and a -2% superelevation using **Equations 9.3** and **9.4** from NCHRP 1043 seen below. This range should be presented on the Geometric Design Speed Diagram.

Equation 9.3:

$$V = 3.4415R^{0.3861}$$
$$for\ e = +0.02, R \leq 400\ ft$$

Equation 9.4:

$$V = 3.4614R^{0.3673}$$
$$for\ e = -0.02, R \leq 400\ ft$$

Where:
V = predicted speed (mph)
R = radius of curve (ft)
e = superelevation (ft/ft)

As an example, as seen in **Figure 16,** assume a measured R1 value of 125-feet. Equations 9.3 and 9.4 from would be applied as:

- Equation 9.3 (for e = +0.02): $V = 3.4415(125)^{0.3891}$
  - $V = 23\ mph$
- Equation 9.4 (for e = -0.02): $V = 3.4614(125)^{0.3673}$
  - $V = 21\ mph$

Before the superelevation of the roundabout has been determined the upper and lower limits of the speed related to each radius should be presented.

Recommended R-Values

Recommended values for R1 through R5 are presented in **Table 1**. The corresponding speeds relating to a normal crown are also presented. Normal crown (Equation 9.3 above) is applied as a default at concept level design because there is insufficient information to determine the actual cross slopes. Applying normal crown as the default results in a more conservative design overall.

Table 1 – Recommended Radii for Geometric Speeds

Splined Geometric Speed Path Radius	**Roundabout Type**			
	Mini Roundabout (FT)	**Compact Roundabout (FT)**	**Single lane Roundabout (FT)**	**Multilane Roundabout**
R1 Entry	100 to 165 (21 to 25 MPH)	100 to 165 (21 to 25 MPH)	120 to 165 (22 to 25 MPH)	175 to 220 (26 to 28 MPH)
R2 Circulating	70 to 100 (18 to 21 MPH)	70 to 100 (18 to 21 MPH)	70 to 120 (18 to 22 MPH)	70 to 170 (18 to 26 MPH)
R3 Exit	90 to 150 (20 to 24 MPH)	90 to 150 (20 to 24 MPH)	120 to 300* (22 to 31 MPH)	120 to 300* (22 to 31 MPH)
R4 Left-Turn	Central Island Radius +5 FT	Truck Apron Radius +5 FT	Truck Apron Radius +5 FT	Truck Apron Radius +5 FT
R1 Speed – R4 Speed	10 to 12 MPH	10 to 12 MPH	10 to 12 MPH	10 to 12 MPH
R5 Right-Turn	50 to 90 (16 to 20 MPH)	50 to 90 (16 to 20 MPH)	70 to 100 (18 to 21 MPH)	70 to 170 (18 to 26 MPH)

*Where pedestrian use of an exit crosswalk is frequent (greater than 25 pedestrians per hour), adjust exit radii to reduce the R3 to less than 200 feet, except on multilane designs.

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Multilane Considerations

No Buffer or Painted Buffer

When performing fastest path checks for multilane roundabouts with no buffer separating lanes or with a flush painted buffer, the pavement markings should be ignored when drawing the geometric speed path. The driver would be assumed to cross lanes as needed to drive the fastest path through the roundabout. An example of this is presented in **Figure 17**.

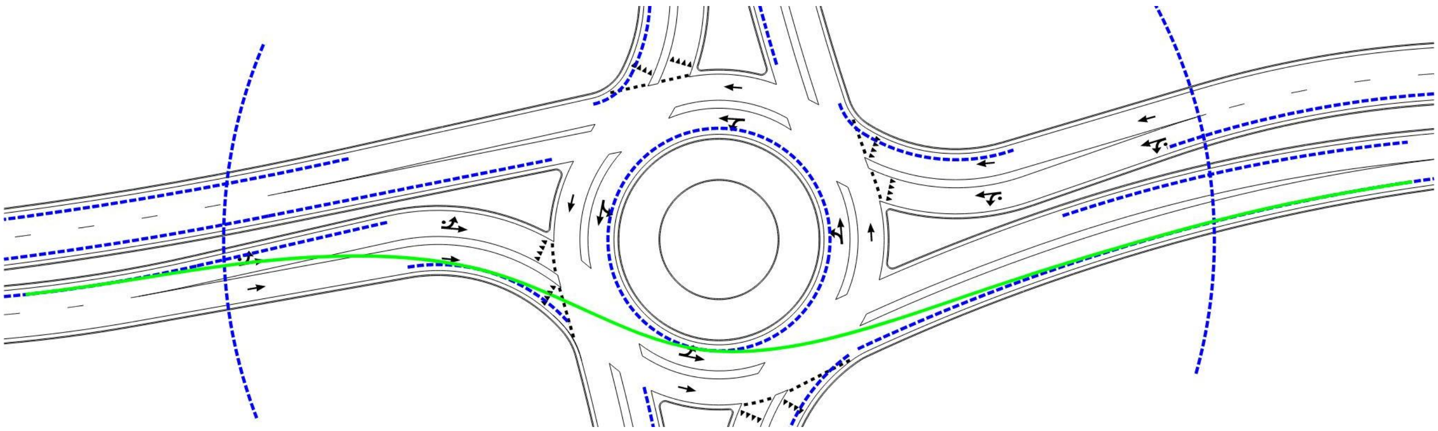

Figure 17 – Example of Spline Through a Multilane Roundabout

Raised Buffers

For multilane roundabouts with raised buffers between the lanes the geometric speed path should be checked for each lane. As seen in **Figure 18**, both the green and the magenta splines were drawn to determine which one has the fastest speed and therefore would be the controlling criteria for the roundabout design.

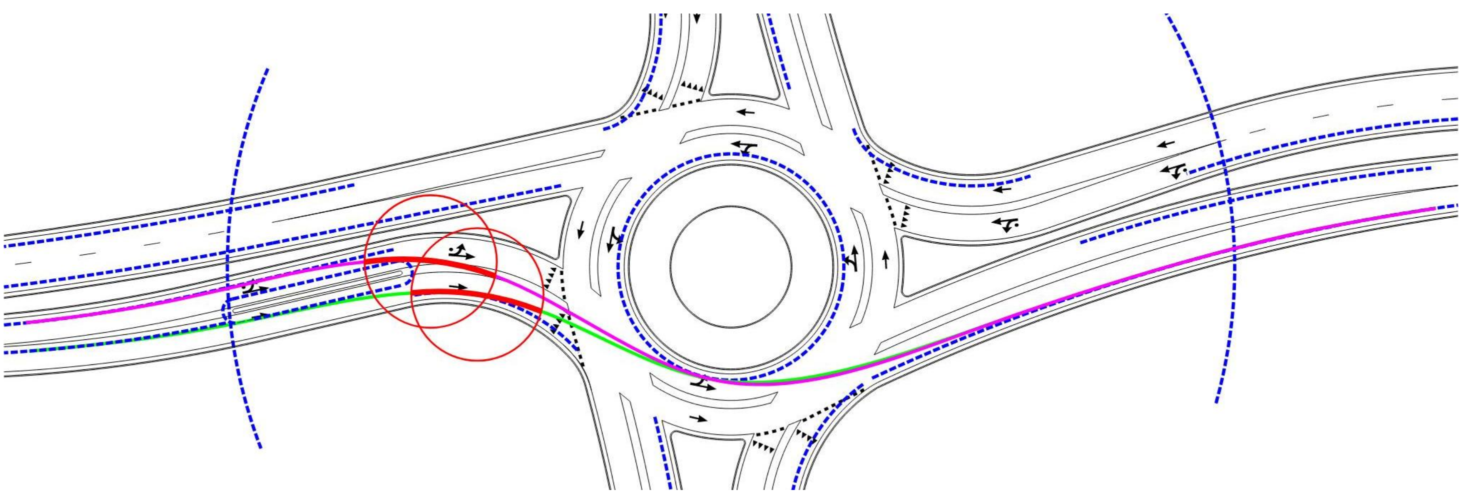

Figure 18 – Example of Spline Through a Multilane Roundabout with Raised Buffer on Approach

As with the flush buffered design presented above, the driver would be assumed to cross the paint lines but cannot cross the 5-foot offset from the raised buffer. A closer look at the 5-foot offset from the raised buffer is presented in **Figure 19**.

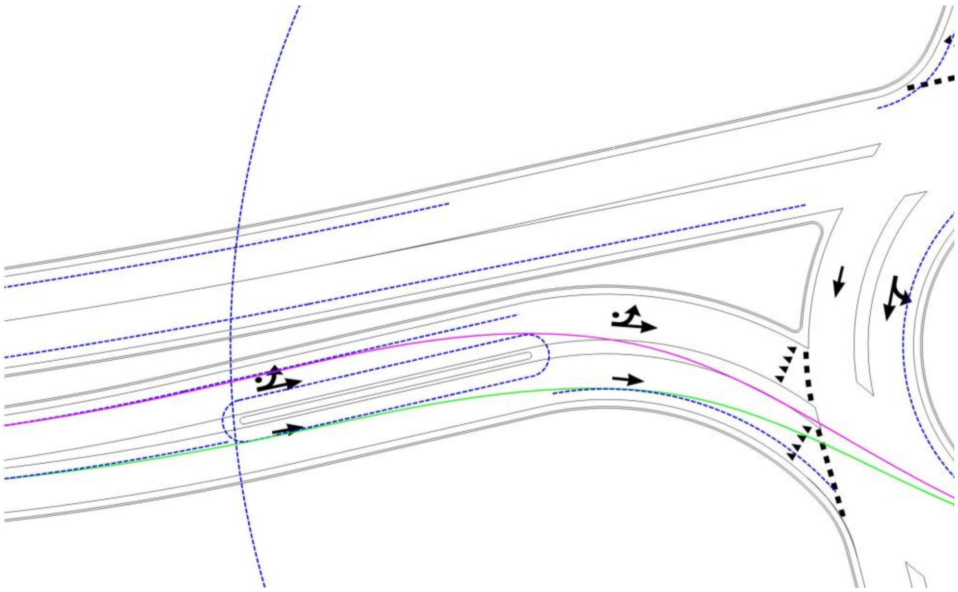

Figure 19 – Details of 5-Foot Offsets at Raised Buffers

For this example, the R1 radius would be measured for each spline as shown in **Figure 20**. The faster of the measured speeds should be used as the controlling radius for this entry.

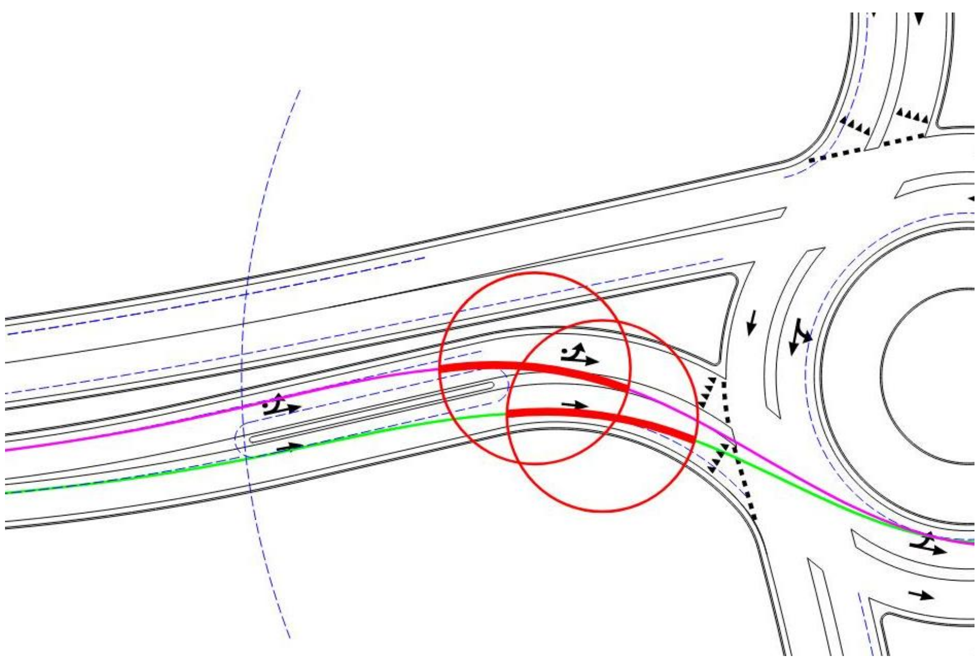

Figure 20 – Measuring the R1 Radius on a Buffered Approach

Truck Swept Paths

Truck Swept Paths are to be drawn using AUTOTurn or a similar software.

Setting the Properties

Load AUTOTurn and open the Properties Dialog box, found in the Configure Toolbox, shown in **Figure 21**.

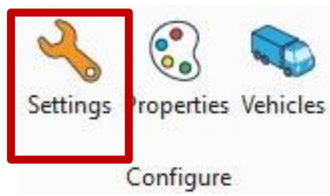

Figure 21 – AUTOTurn Configure Toolbox

In the Properties dialog box make sure Front Tires, Rear Tires, and Vehicle Body are all checked in the Envelopes Category, as show in **Figure 22**.

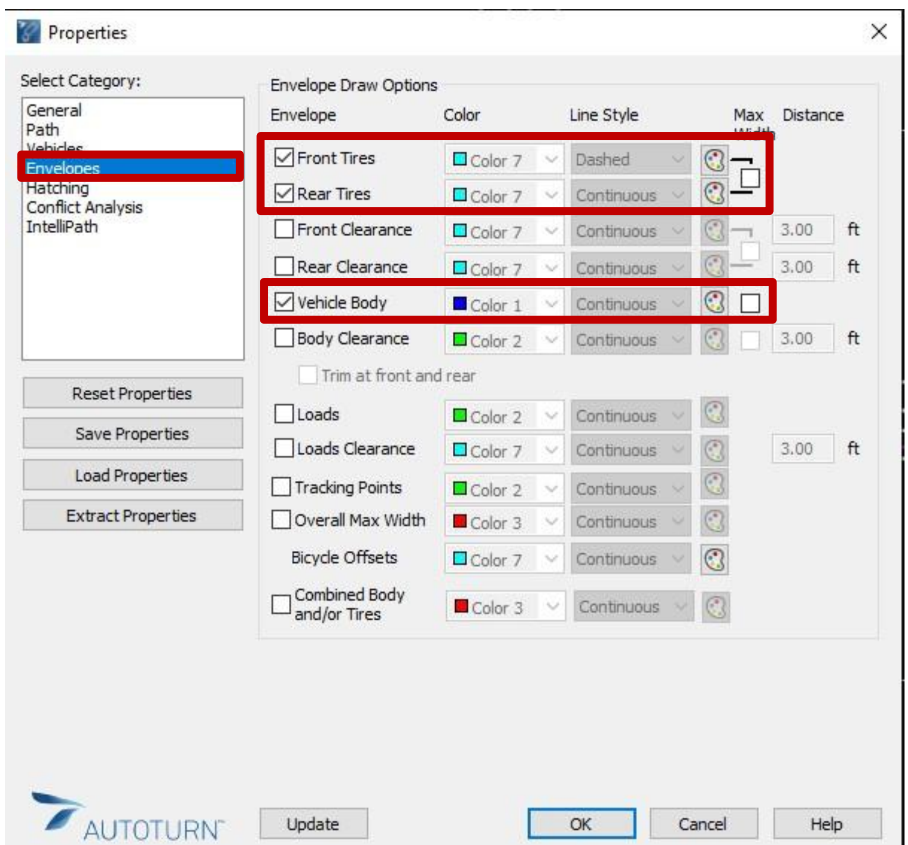

Figure 22 – Properties Dialog Box

The vehicle body is turned on to check the overhang of the vehicle. This is especially a concern with non-articulated vehicles such as buses with large front overhang to ensure it is not required to sweep over yield lines or the truck apron while moving through the roundabout.

Select Current Vehicle

Open the Vehicles Dialog box, found in the Configure Toolbox, shown in **Figure 23**.

Figure 23 – Configure Toolbox

Navigate to the appropriate design or check vehicle and click to highlight the vehicle name, select the vehicle and click OK to set it as the current vehicle.

Drawing Truck Swept Paths

General Considerations

- Maintain a 1-foot shy distance between the face of curb and the wheels of the truck.
- Non-articulated vehicles should remain in lane and should not track onto the truck apron at any point. Vehicle body or overhang should not sweep over yield lines or curbs for non-articulated vehicles.
- The front tires of articulated vehicles should remain in the lane, while the back tires can be assumed to track over the truck apron or external truck apron as necessary.
- On multilane roundabouts, left turns should be checked from the inside circulating lane to determine truck apron widths. The central island should be determined based on truck turning movements and a 5-foot offset to ensure no truck overhang.

There are many methods that could be used to draw the truck swept paths. Two methods are presented here. Drawing paths by spline results in a smoother, cleaner looking path that it useful for displays. Steering the truck using Generate Arc Path is useful when trying to fit a vehicle through a tight or difficult turn.

Method 1: Drawing Truck Swept Paths with Splines

1. Draw a spline using the B-Spline by Points tool (**Figure 24**) following the approximate path that the vehicle would take through the roundabout. The Method for drawing the spline should be by Control Points, the Input By should be Points, the Closure should be Open to draw a line rather than a shape, and the Order, or minimum number of points, should be 4.

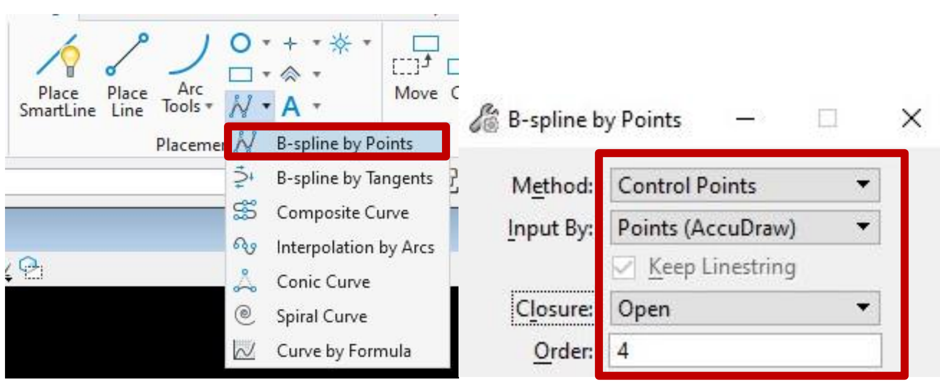

Figure 24 – B-Spline by Points

2. Choose Adaptive Simulation in the Place Toolbox (**Figure 25**) and click the beginning of the spline drawn in Step 1.

Figure 25 – Place Adaptive Simulation

The chosen vehicle will be drawn using the chosen spline as a centerline for the path as shown in **Figure 26**. The speed of the vehicle using this method is thought to be in the range of 3-5 mph.

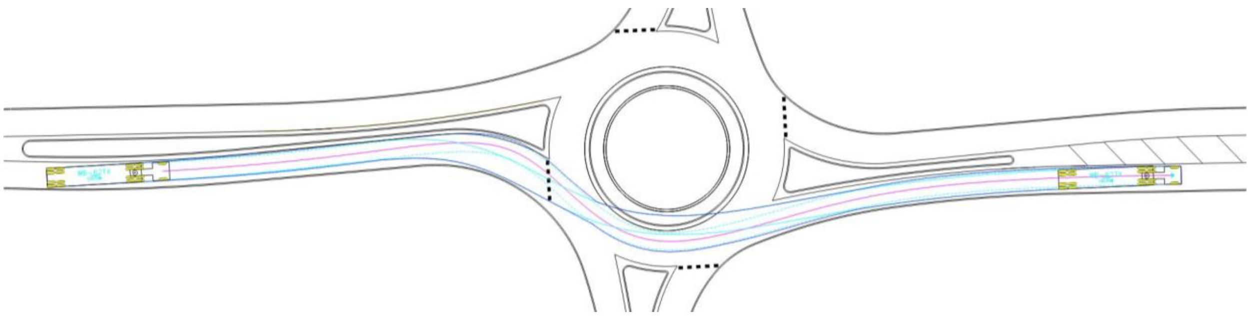

Figure 26 – Example of a Truck Swept Path by Spline

3. The spline can now be used to update the path of the vehicle by clicking on the spline and using the control points to manipulate it, which is shown in **Figure 27**.

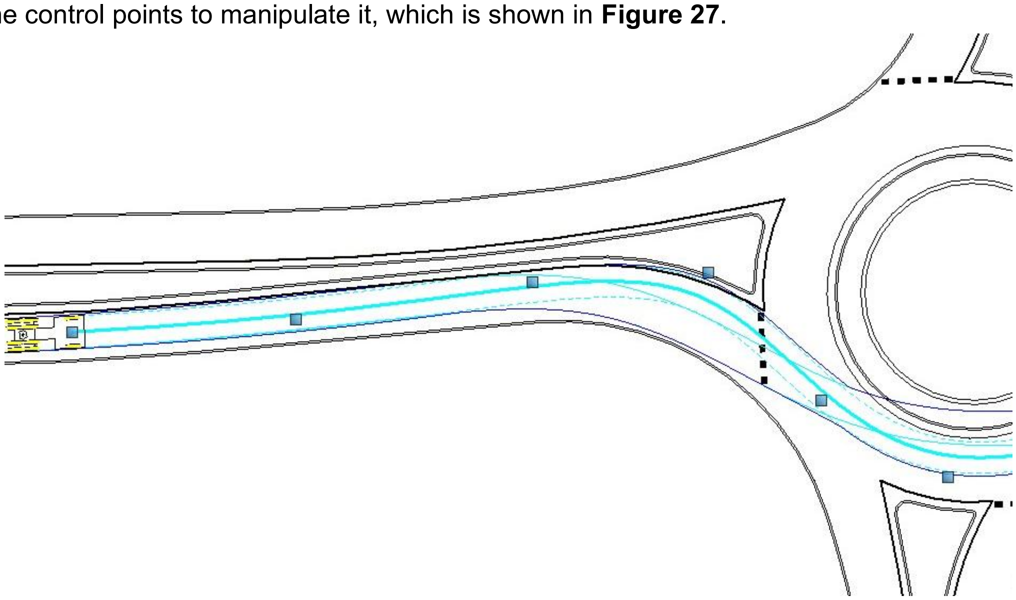

Figure 27 – Manipulating the Truck Path Spline

Continue to manipulate the spline until the truck is meeting the shy distance requirements and able to cleanly make the desired movement, as shown in **Figure 28**.

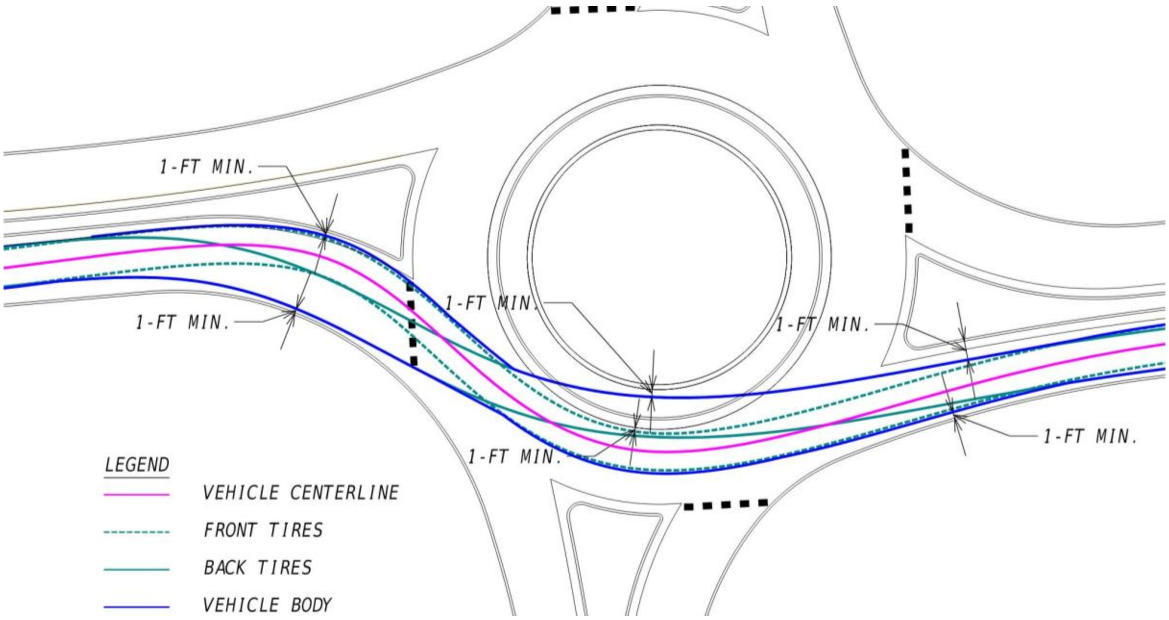

Figure 28 – Offsets to Face of Curb

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Method 2: Drawing Truck Swept Paths with Generate Arc Path

The Generate Arc Path Method has the designer placing the vehicle by choosing points. This provides the opportunity to line the vehicle up and see where the tires would fall as the vehicle is placed. This method also allows the user to see the projected arc of the vehicle which can assist in making tighter turns.

1. Select Generate Arc Path in the SmartPaths Toolbox (**Figure 29**).

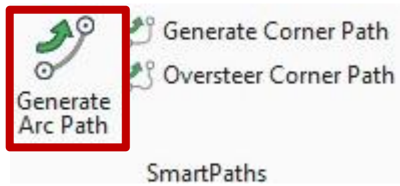

Figure 29 – Generate Arc Path

2. AUTOTurn will show the selected vehicle at the pointer. Select a point in the middle of the lane of the approach. Click once to place the vehicle, drag the mouse to determine the direction the vehicle should point and click again to begin drawing the path.
3. In the SmartPath Tools dialog box, check the Preview Arc Path button, set the speed to a value between 3 and 5 mph, and uncheck both Turn Wheels From Stop and Force Straight Line. These choices are shown in **Figure 30**.

Figure 30 – SmartPath Tool Dialog Box

4. Move the cursor in the direction the vehicle is traveling and click to place points for the vehicle to follow. Checking Preview Arc Path in Step 3 allows the user to see where the tires and vehicle body would fall following the smallest turning radius of the chosen vehicle, see **Figure 31**. This is a useful guide when navigating tight movements.

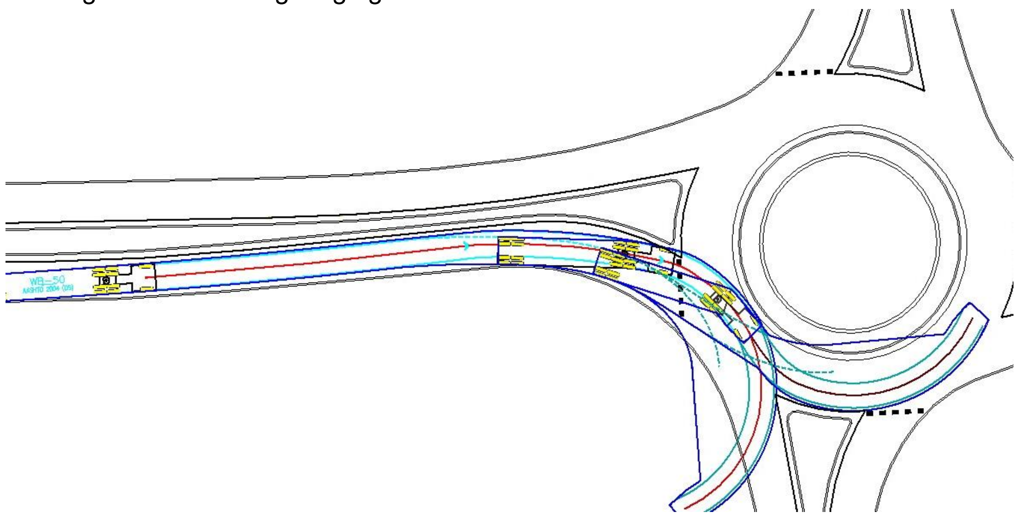

Figure 31 – Example of Preview Arc Path

5. After moving through the circulatory roadway and exit path, right-click to end the placement.
6. To edit the movement after completion, choose the Path Control button in the Edit Toolbox (**Figure 32)** and click on the previously drawn vehicle path.

Figure 32 – Path Control

As shown in **Figure 33**, there will be several options along the path of the vehicle.

- Click any Blue dot to move the chosen Node.
- Click any Red X to delete the associated Node.
- Click the Magenta triangle to adjust the starting angle of the truck.
- Click any Green + sign to add a Node.

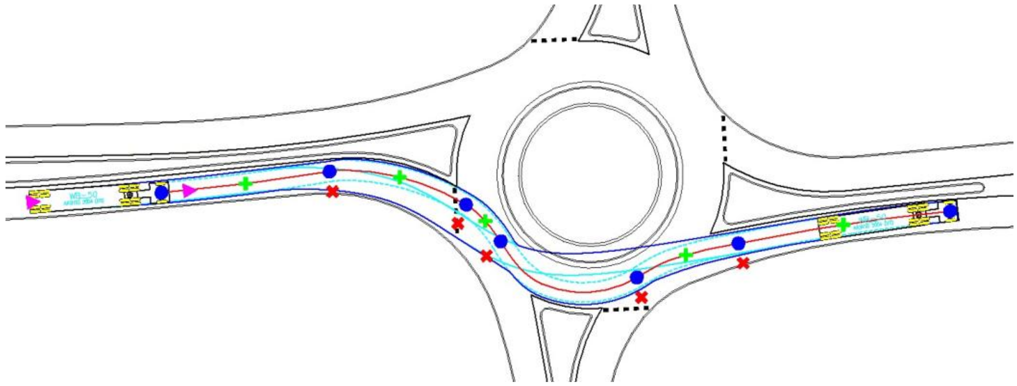

Figure 33 – Available Options to Adjust Truck Paths

These options can be used as needed to smooth the path and ensure the shy distance requirements are met.

Multilane Considerations

Multilane roundabouts are designed as either Straddle Lanes or Stay-In-Lane when it comes to truck movements. An example of Stay-In-Lane is shown in **Figure 34**, notice that the truck can drive in all of the flush buffer to successfully make the movement through the entry of the roundabout.

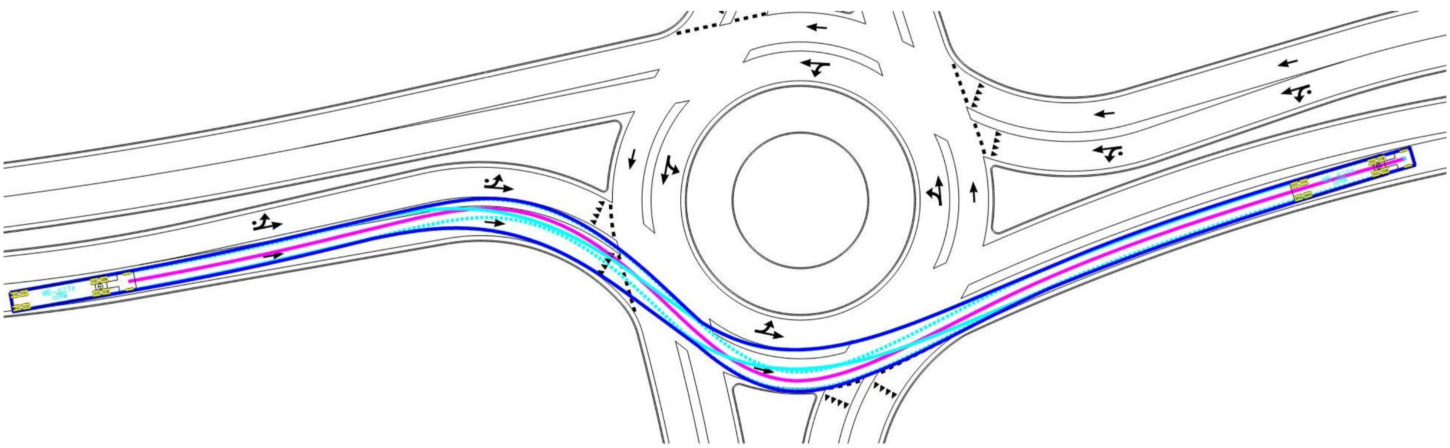

Figure 34 – Stay-In-Lane Design: Through Movement

In comparison, with a Straddle-Lane design, the truck is assumed to use as much of the adjacent lanes as necessary to complete the movement as shown in **Figure 35** and **Figure 36**.

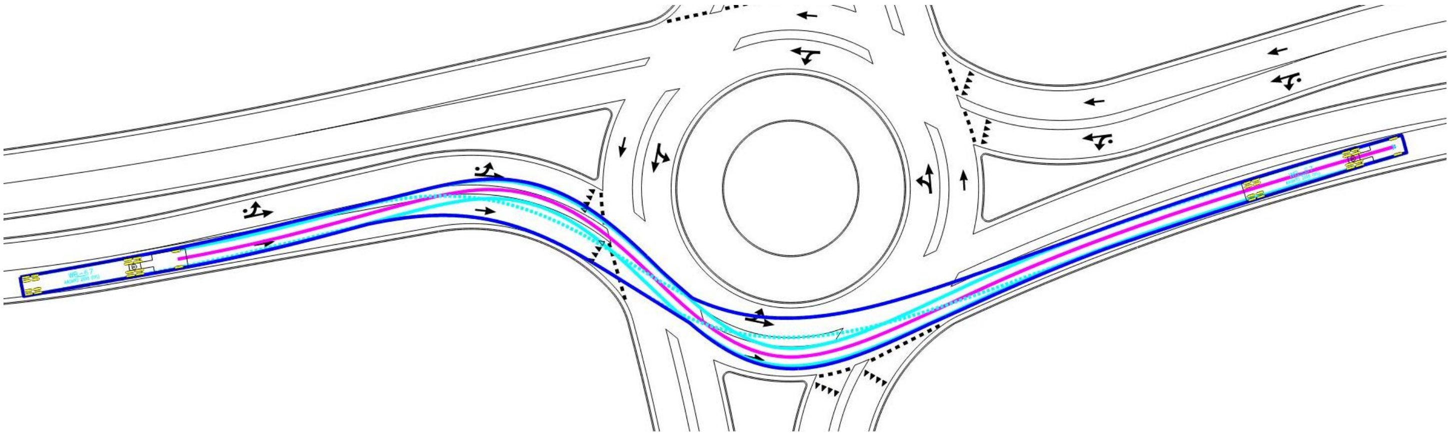

Figure 35 – Straddle Lanes Design: Through Movement

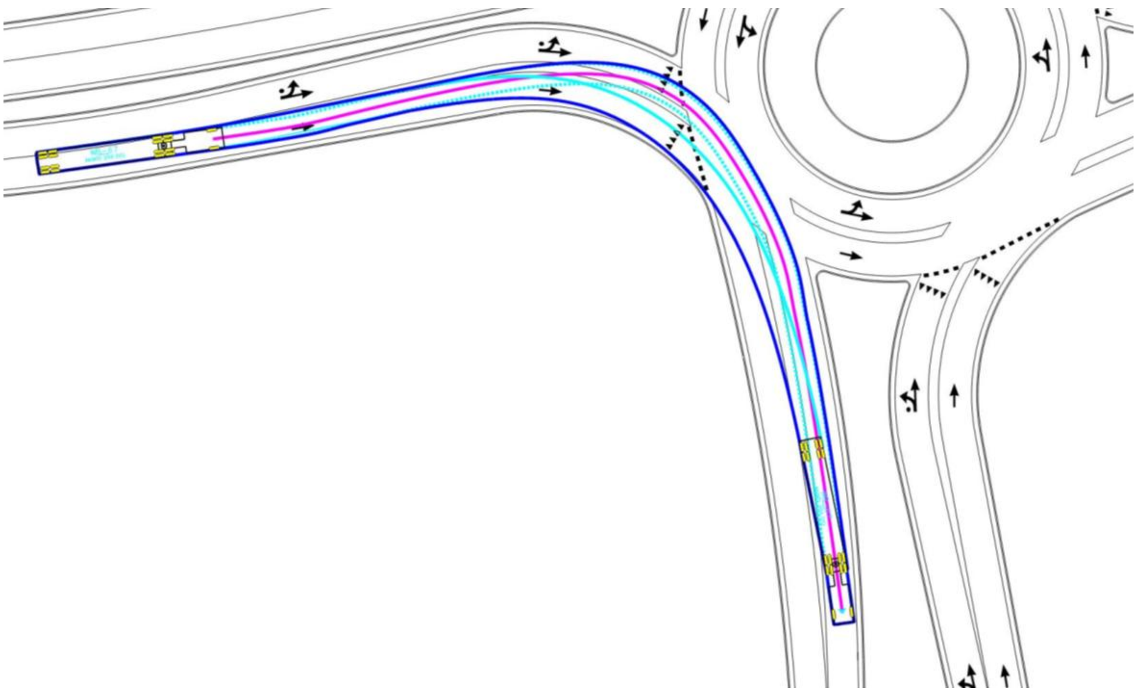

Figure 36 – Straddle Lanes Design: Right Turn Movement

Vehicle Profiles

To display the vehicle profile for the performance checks package, make sure the correct vehicle is selected as described above and choose the insert profile button, as shown in **Figure 37**, in the Report Toolbox.

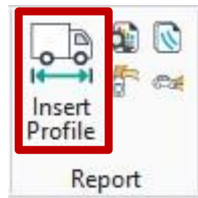

Figure 37 – Insert Profile Tool

Click Use Current Vehicle on the Insert Profile dialog box and data point in your default view to place the chosen vehicle (**Figure 38**).

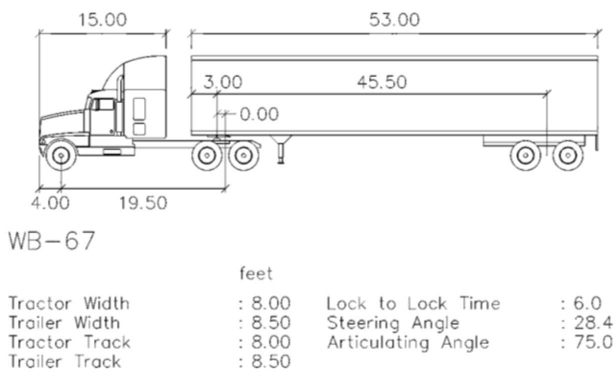

Figure 38 – Example Truck Profile

This section left blank intentionally.

Stopping Sight Distance, Intersection Sight Distance, and View Angle

Sight distances must account for height of eye and heights of objects. This is for the purpose of user safety and to establish limits to planting scheme/landscaping for mounded central island and splitter islands.

Stopping Sight Distance (SSD)

Stopping sight distances shall be calculated based on approach speed and **NCHRP 1043 Equation 9.9:**

$$d = 1.47Vt + 1.075\frac{V^2}{a}$$

Where:
d = Stopping Sight Distance, ft
V = design speed, mph
t = perception-brake reaction time, 2.5s
a = driver deceleration, 11.2 ft/s^2

Approach SSD to the Yield Line and Crosswalk

The approach stopping sight distance (**Figure 39**) should be drawn from the yield line or the crosswalk as applicable.

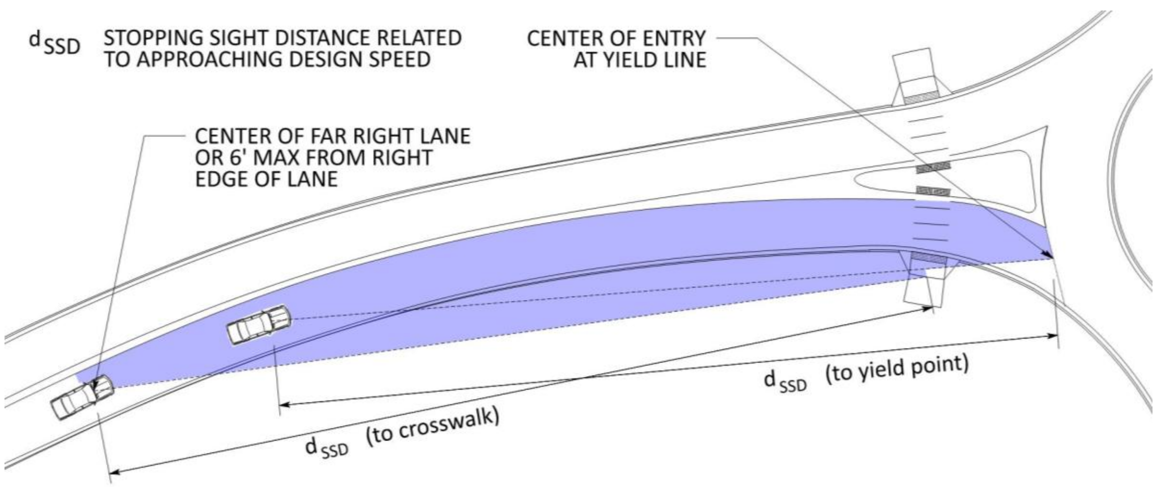

Figure 39 – Approach Stopping Sight Distance

Drawing Tips:

Approach SSD to the Yield Line:

1. Find the Approach SSD (d_{SSD}) using **NCHRP 1043 Equation 9.9**.
2. Find the center of the entry at the yield line by offsetting the radius at the entry and using the 'construct line at active angle' tool (**Figure 40**) with an angle of 0.0° and the Method From Point. If the entry is two lanes, find the center of each lane individually.

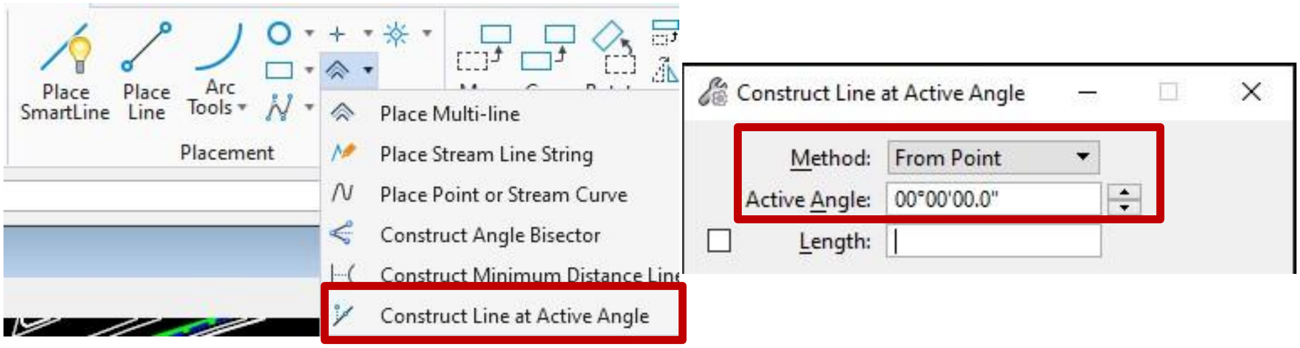

Figure 40 – Construct Line at Active Angle

3. Center a circle with radius d_{SSD} on the center of the entry at the yield line.
4. If the lane lane is less than 12-feet wide split the lane in half and offset the edge of the lane, if the lane is greater than 12-feet wide offset a maximum of 6-feet from the inside edge of the lane.
5. Draw a line from the center of the circle to the intersection of the circle and the offset lane lines. **Note: for roundabouts with two or more approach lanes the stopping sight distance should be checked for each lane individually using the steps outlined above.**

Approach SSD to the Crosswalk

1. Find the Approach SSD (d_{SSD}) using **NCHRP 1043 Equation 9.9**.
2. Center a circle with radius d_{SSD} on the intersection of the crosswalk paint line (farthest from the yield line) and the face of curb.
3. Draw a line from the center of the circle to the intersection of the circle and the offset lane lines drawn as in Step 4 above.

SSD to the Crosswalk on Exit

Stopping sight distance to the downstream crosswalk shall be calculated using the measured speed for the right turn (R5) along the right turn geometric speed path. This is shown in **Figure 41.**

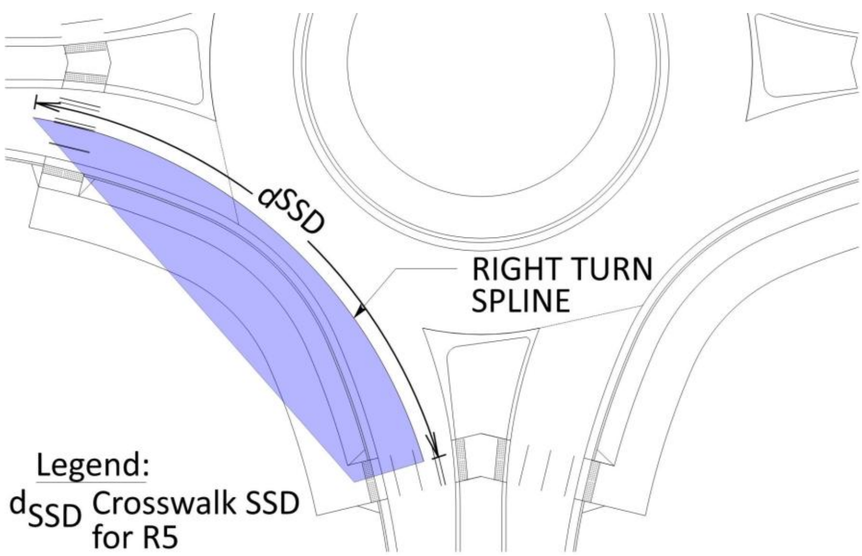

Figure 41 – Stopping Sight Distance to the Downstream Crosswalk

Drawing Tips:

1. Calculate the Crosswalk SSD based on the R5 value by using **NCHRP 1043 Equation 9.9**.
2. Trim the right turn geometric speed path to the near side of the downstream crosswalk.
3. Measure d_{SSD} along the right turn geometric speed path using the 'Point at Distance Along' tool shown in **Figure 42**.

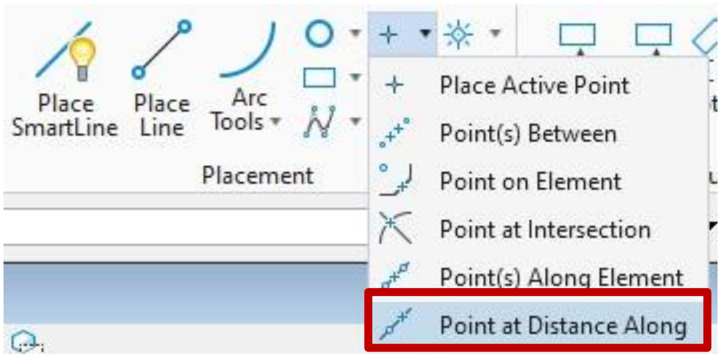

Figure 42 – Point at Distance Along Tool

4. Draw a line from the point drawn in Step 3 to the face of curb using a perpendicular snap.
5. Connect the end of the geometric speed path on the near side of the crosswalk to the end of the line at the face of curb that is perpendicular to the point drawn in Step 3.

SSD Around the Circulatory Roadway

Circulating stopping sight distance can be used to determine which areas within the central island require low lying landscaping and which areas do not have limitations on planting heights. The circulating stopping sight distance is calculated using the R4 circulating speed and follows a path that is a 5-foot offset from the face of curb of the circulatory roadway, seen in **Figure 43** . This shape can then be rotated around the circle.

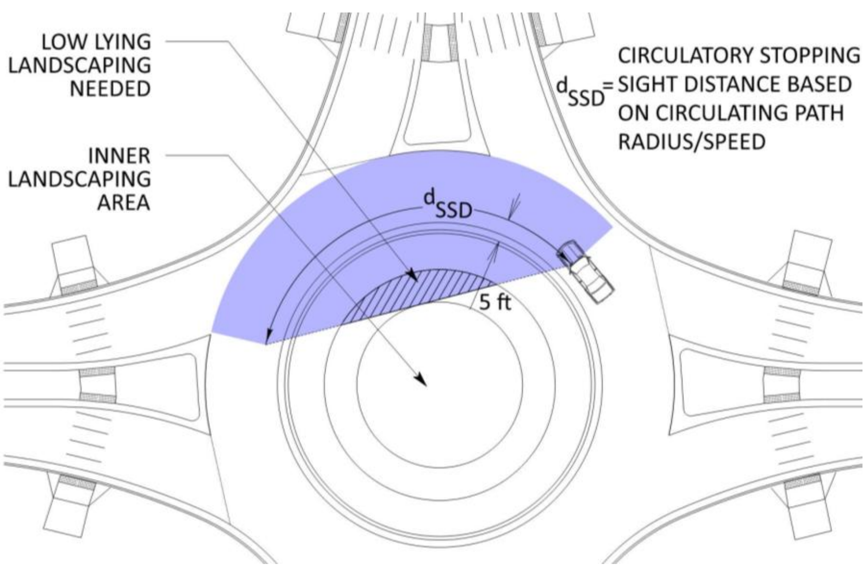

Figure 43 – Circulating Stopping Sight Distance

Drawing Tips:

1. Calculate the Circulatory SSD (d_{SSD}) based on R4 using **NCHRP 1043 Equation 9.9**.
2. Offset the central island face of curb 5-feet and measure d_{SSD} along the offset line using the Point at Distance Along tool.
3. Connect both ends of the offset line to form the sight line.
4. Repeat Steps 2 and 3 for a minimum of four intervals around the central island.

Tip: If R4 is consistent, rotate the first offset arc and sight line from Steps 2 and 3 around the center point of the central island to get at least four intervals around the central island.

Vertical SSD Checks

Vertical sight distance checks shall be performed along the SSD sight lines, using a driver eye height of 3.5 feet and an object height of 2 feet. An example of this is shown in **Figure 44**.

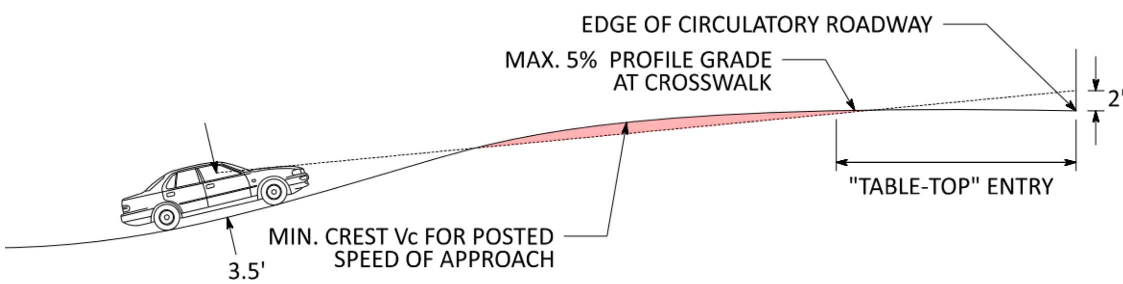

Figure 44 – Vertical Sight Distance

To perform vertical sight distance checks before any topographic survey is available Google Earth can be used. This is a preliminary measure but can give a rough idea of any potential sight distance issues that may arise. To check sight distance in Google Earth, first place a path along the sight distance line the tool for this is shown in **Figure 45**. Click to place points along the sight distance line and save the path when complete.

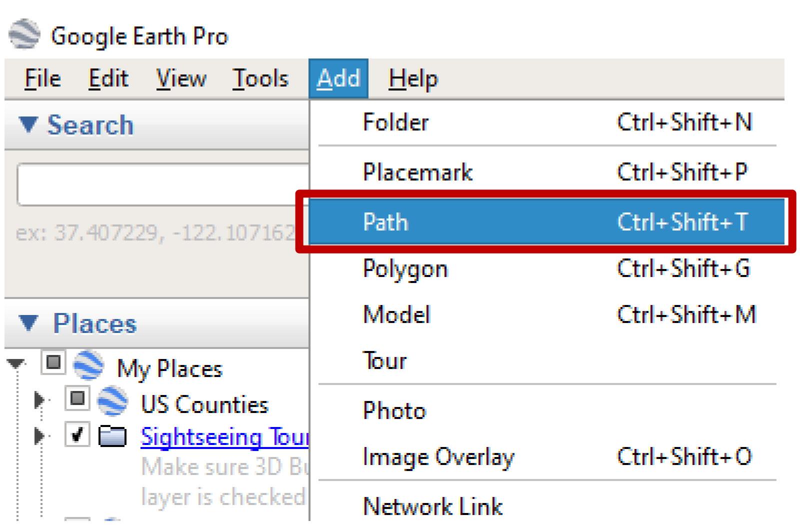

Figure 45 – Google Earth Add Path Tool

Once the path is saved, right click on the name and select Show Elevation Profile as shown in **Figure 46.**

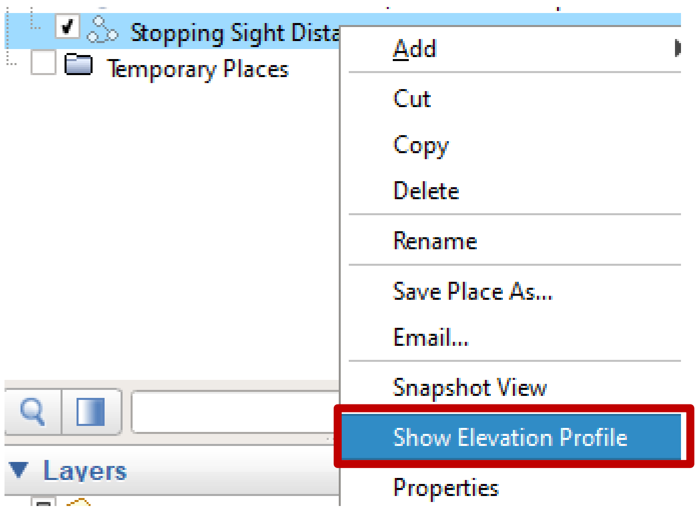

Figure 46 – Google Earth Show Elevation Profile

The ground elevation will now be shown, as in **Figure 47**, and the designer can analyze the information provided to determine if any sight distance issues may arise over the course of the project. These vertical sight distance checks should be repeated once an accurate topographic survey is available for the project.

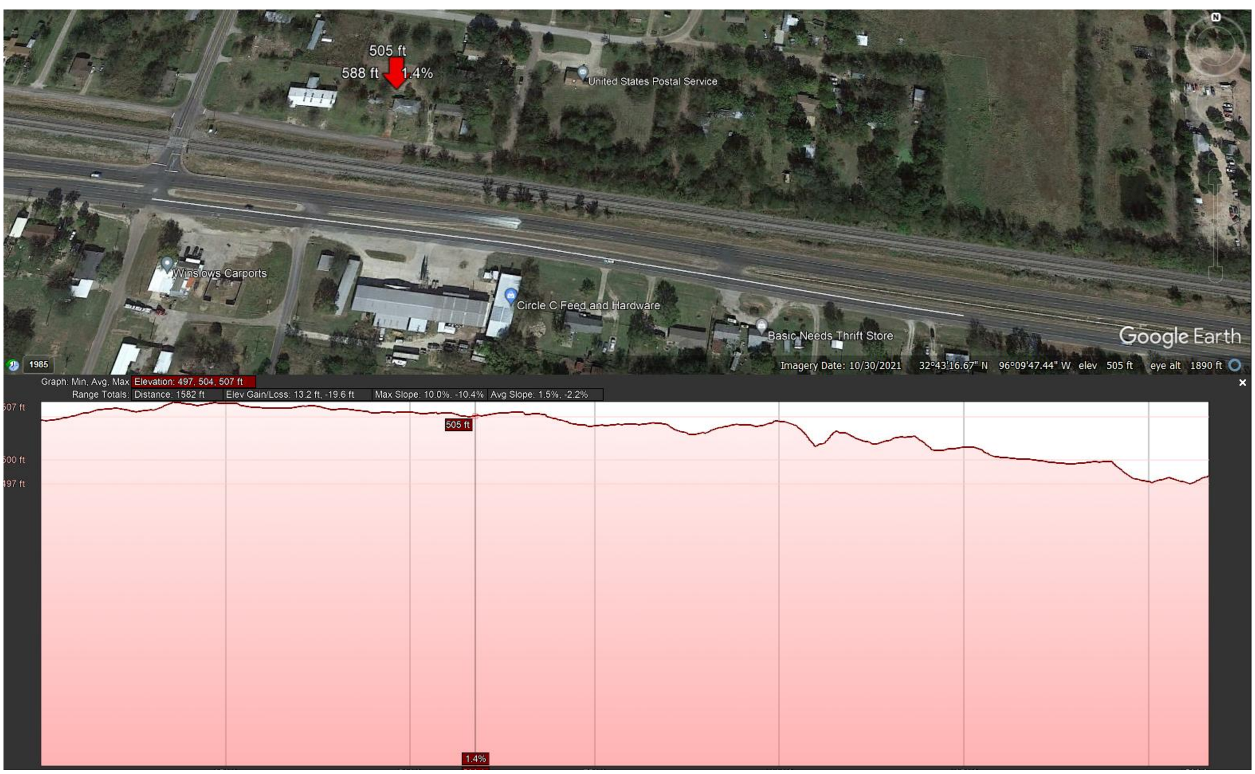

Figure 47 – Google Earth Existing Ground Elevation Profile Along a Path

Intersection Sight Distance (ISD)

The entering and circulating intersection sight distance should be checked as shown in **Figure 48**. Steps for calculating the entering and circulating ISDs are shown below.

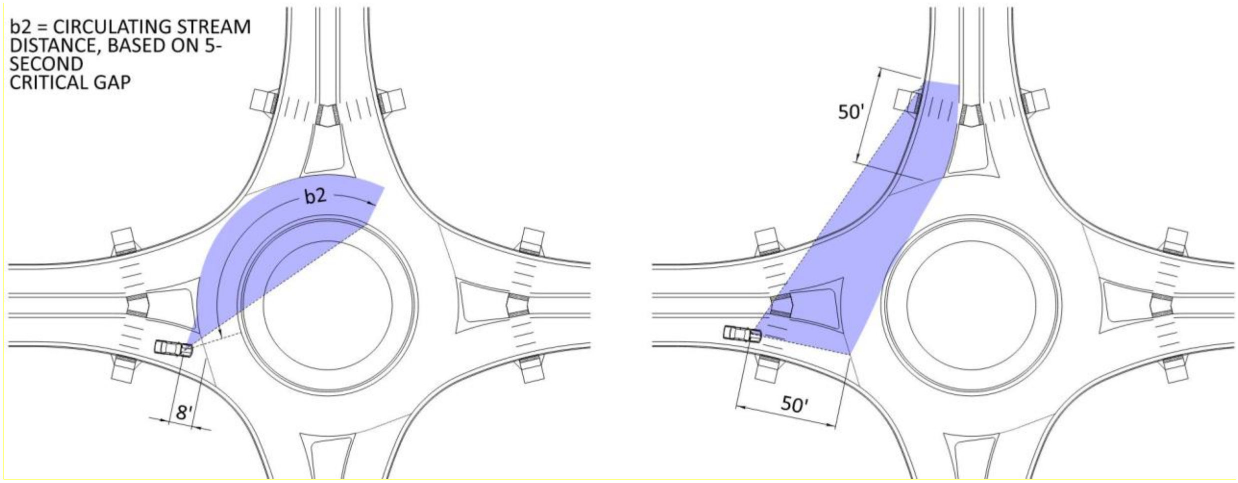

Figure 48 – Intersection Sight Distance

Entering Intersection Sight Distance

1. Offset the approach and upstream yield lines 50-feet.
2. Offset the outer face of curb 5-feet.
3. Draw a line from the intersection of the offset face of curb line and the offset yield line to the intersection of the upstream offset yield line and the outside face of curb. See **Figure 49** for an example.

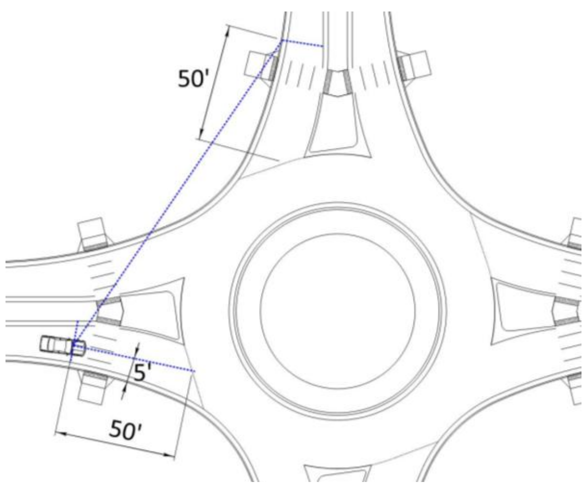

Figure 49 – Drawing the Entering ISD

Circulating Sight Distance

1. Calculate Circulating ISD using **NCHRP 1043 Equation 9.12**:

$$b_2 = 1.47V_{circ}t_g$$

Where:
b_2 = length of circulating branch of sight triangle (ft)
V_{circ} = speed of circulating vehicles based on R4 (mph)
t_g = design headway (s, assumed to be 5.0 s)

2. Offset the yield line 8-feet, draw a line from the intersection of the offset and the yield line perpendicular to the face of curb of the central island.
3. Offset the central island face of curb 5-feet. For spiral roundabouts, follow the lanes lines (offset the lane lines 3-feet until the spiral disappears, then offset the face of curb 5-feet).
4. Trim the arcs from Step 3 to the perpendicular line drawn in Step 2.
5. Measure b_2 along the arcs starting at the perpendicular line using the Point at Distance Along tool.
6. Draw the Circulating ISD sight line from the point found in Step 5 to 8-feet behind the yield line representing a driver at yield scanning the circulatory roadway for oncoming circulating traffic.

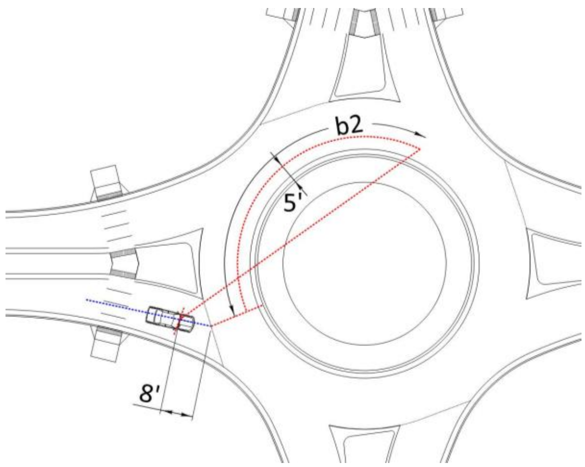

Figure 50 – How to Draw Circulating Intersection Sight Distance

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Entering Vehicle View Angle

The view angle of the entering vehicle is checked to ensure that a driver at the yield line, turning their head no more than 105 degrees, can see any oncoming entering or circulating vehicles. **Figure 51** illustrates the vehicle positions to check sight to the left.

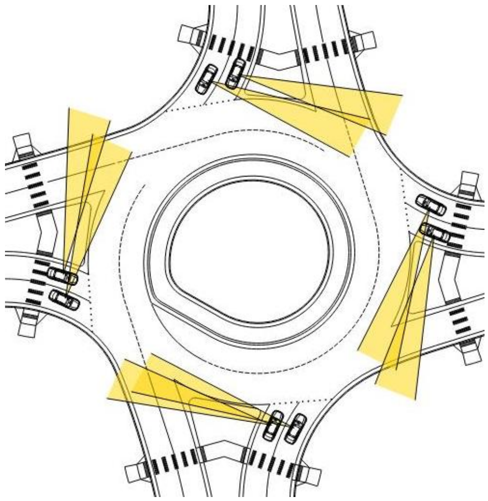

Figure 51 – Entering Vehicle View Angle

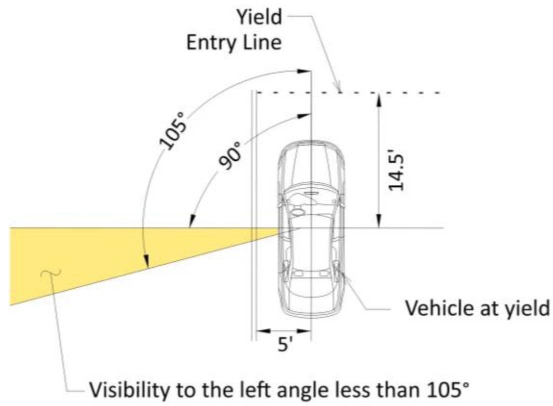

Figure 52 – Drawing Tips for View Angle

Figure 52 shows a detailed view of the vehicle placement for the view angle check. Steps for drawing the view angle lines are provided below.

1. Offset the yield line 14.5-feet and the left face of curb 5-feet.
2. Draw a line from the intersection of the offset yield line and face of curb that is aligned to a vehicles natural path. This line represents a driver's eye facing forward while at the yield line.
3. Rotate the line from Step 2 105° counterclockwise. The driver should be able to see all oncoming vehicles within this 105° window.

References

1. NCHRP Research Report 1043: Guide for Roundabouts. National Cooperative Highway Research Program, Transportation Research Board, National Academics of Sciences, Engineering, and Medicine, Washington DC., 2023.
2. Roundabout Design Guide. Georgia Department of Transportation. Revision 2.3, 2023.
3. Facilities Development Manual. Wisconsin Department of Transportation, 2023