CHAPTER 9

Transitions, Superelevation, Intersections, and Roundabouts

INTRODUCTION

Roadway designs must accommodate a variety of issues. These issues include road widening, cut or fill designs, and sustaining constant speeds. Civil 3D subassemblies react to changes in depth above or below the existing ground surface, transition to wider or narrower lane widths, and transitions to tilt the lanes to one side or another to safely maintain speeds through a design.

OBJECTIVES

This chapter focuses on the following topics:

- Creating a Cul-de-Sac Knuckle
- Transiting a Road to Different Lane Widths
- Superelevation Using Alignment Parameters and Design Criteria
- Creating an Intersection Design

OVERVIEW

This chapter's topics cover how Civil 3D uses a subassembly's parameters to create solutions. Additional transition alignments widen and narrow a lane's width. Superelevation is a combination of alignment properties and design criteria. The Intersection editor creates an engineering design based on user parameters (see Figure 9.1).
When creating transitioning pavement, there must be additional alignment type (offset alignments) to control the edge-of-travelway (width). In addition to horizontal alignments, some subassemblies require a vertical alignment for each horizontal transition alignment. The Create Corridor dialog box’s Set Target panel creates the alignment—assembly attachments (see Figure 9.2). Subassemblies that transition must be attached to a target object. A target object can be an alignment, 2D and 3D, feature line, or survey figure.

Civil 3D has alignment types. This allows the user to specify an alignment function by specifying its type. For example, a widening alignment controls a subassembly point. A widening alignment is a separate alignment or is associated with the centerline or other widening alignments. A widening alignment has other properties that need definition to work correctly.
When designing superelevations, design speeds are set in the alignment properties dialog box and the Superelevation calculator assigns and calculates superelevation values (see Figures 9.3 and 9.4).

FIGURE 9.2

FIGURE 9.3
Unit 1
The focus of the first unit is roadway transitioning. Civil 3D requires a second alignment to widen a lane. The unit’s example is a subdivision street knuckle. This unit introduces alignment types, transitions, and automatic lane widening.

Unit 2
This unit reviews cul-de-sac design. Civil 3D widens pavement (edge-of-travelway) with additional horizontal alignments attached to the assembly.

Unit 3
Superelevation is a common design method with roadways that carry significant traffic, have higher traveling speeds, and have safety concerns. Selecting design criteria, assigning speeds, and determining regional superelevation rules are the focus of this unit.

Unit 4
The focus of Unit 4 is designing a simple intersection.

Unit 5
The focus of Unit 5 is designing a simple roundabout.
UNIT 1: TRANSITIONS

The Basic Lane transition stock subassembly stretches according to simple transition parameters. These parameters address the pavement shape’s location and elevation as it transitions to wider or narrower pavement widths. The basic lane transition subassembly uses this simple approach to transitioning (see Figure 9.5). The subassembly’s transition value controls its behavior when an alignment affects the subassembly’s location. The values for transitioning a basic lane transition are the following: Hold elevation, change offset; Hold grade, change offset; Change offset and elevation; Hold offset and elevation; and Hold offset, change elevation.

When you specify one of the following parameters, you need to only assign a horizontal control object. The selected parameter tells the corridor generator how to calculate the ETW elevation. Only Change offset and elevation requires a profile for ETW elevation control.

Hold elevation, change offset—The offset alignment changes the pavement’s width, and the edge-of-travelway elevation is held. The pavement’s cross slope changes to maintain the pavement’s elevation.

Hold grade, change offset—The lane’s grade is held, and as the offset alignment increases the pavement width, the pavement’s edge lowers in elevation. If the alignment moves the pavement edge closer to the centerline, the pavement edge will rise in elevation to maintain the grade.

Change offset and elevation—The offset alignment (horizontal location) and its profile (vertical location) control the edge-of-travelway’s location.

Hold offset and elevation—This parameter prevents a subassembly from responding to any attached horizontal or vertical offset alignment.

Hold offset, change elevation—This parameter holds the pavement width as specified, but an offset profile controls the edge-of-travelway’s elevation.

FIGURE 9.5
Sections from an assembly that uses simple transition parameters do have issues. The main issue is the sections on the edge-of-travelway. They are always perpendicular to the centerline, but are not perpendicular to any arc in the transitional alignment (see Figure 9.6).

What should appear in the sections are curbs and sidewalks perpendicular to the offset alignment’s curve (see Figure 9.7).
To create perpendicular sections (the curb and sidewalk of Figure 9.7) for subassemblies outside the transition alignment, there must be an assembly offset. The subassemblies attached to an offset are perpendicular to the offset, not to the roadway centerline.

An assembly’s Construction tab shows the subassemblies’ attachment construction (see Figures 9.8 and 9.9).

An assembly using an offset alignment must have the outside subassemblies attached to that offset alignment, not to the assembly. When attaching a subassembly, the user must select the offset marker, not the assembly marker (see Figure 9.9).
As mentioned, a transition can also have a vertical alignment that controls the transition point’s vertical location. The basic lane transition does not need a vertical alignment, except when the transition property is set to Change Elevation.

**NOTE**
When using an offset in an assembly, Civil 3D may require a vertical alignment that provides elevations for the subassemblies outside the offset.

**NOTE**
All subassemblies, assemblies, and assembly groups should have descriptive names.

**NOTE**
Add the subassembly side to a subassembly’s name by adding it in the Subassembly Edit Feature Settings.

When creating an assembly, the user should assign meaningful names to each subassembly. When the subassembly groupings are viewed in the Assembly Properties dialog box, the subassembly names easily identify the important grouping in a potentially complex assembly. This naming rule should apply to any grouping the assembly defines (right side, left side, or offset attachments).

**IDENTIFYING OFFSET ALIGNMENTS OR OBJECTS**

An assembly offset defines a control point and, often, an attachment point for a second alignment (transitional alignment) or specified object. All subassemblies attached to the offset’s outside are perpendicular to the alignment’s path that controls the offset.

When you attach the first outside subassembly, it must be attached to the offset, not the assembly. The Assembly Properties dialog box indicates if the subassemblies are attached to the offset or the assembly.

Offset alignment or object attachments determine what corridor creation command to use. If you are creating a simple corridor with the basic lane transition, you can use Create Simple Corridor. More complex corridors require that you use Create Corridor. The Create Simple and Create Corridor commands both use a dialog box to set the names of the offset horizontal and vertical alignments or objects (see Figure 9.10).
CORRIDOR PROPERTIES

After creating the corridor, users can edit the corridor properties by adding or changing attached offset alignments (target name mapping) and/or the frequency to apply assemblies (see Figure 9.11).
CORRIDOR SECTION FREQUENCY

With a more complex corridor (containing regions, multiple offset alignments, and so on), users should increase the number of sections that create the corridor. This is done in the Frequency to Apply Assemblies dialog box of the Corridor Properties dialog box (see Figure 9.12).

OFFSETS

An offset alignment is a dynamically linked alignment to a parent alignment. The Home tab, Create Design panel’s Alignment, and Create Offset Alignment routine parametrically define a child alignment following the parent’s alignment geometry with width changes. See Figure 9.13’s right side. The offset alignment follows the parent alignment’s geometry at the specified offset distance.

An offset alignment can have a widening applied to it.

WIDENING

A roadway may have a widening to accommodate a bus stop, passing lane, or an intersection’s turning lane. A widening can be manually defined or defined through a design criteria file. The design criteria files are AASHTO formulas and table values.

You assign the widening values to an offset alignment in the Create Offset Alignment dialog box. See Figure 9.13.

The Criteria tab values set the widening file path, the widening side, the radius and transition table, criteria table, percent of superelevation, the number of lanes to add, and the wheelbase length. If you do not want to use the design criteria files, at the Criteria tab’s bottom is the toggle for and setting of a simple design check set.
A widening criteria file calculates the widening stations and width values. Manually defining the widening has you defining the incremental offset and station values to achieve the widening.

**SUMMARY**

- BasicLane with transition creates simple lane-widening designs.
- BasicLane with transition subassembly has settings to control the transition point’s offset and elevation.
- When BasicLane with transition’s Transition parameter is set to Change offset, change elevation, you must assign both an offset horizontal and vertical alignment.
- When you are using an assembly offset, the offset point must have assigned horizontal and vertical alignments.
- The first subassembly outside the assembly’s offset must attach to the offset.
- Widenings are parameter-driven transitions.
UNIT 2: CREATING A CUL-DE-SAC

Creating a cul-de-sac is similar to transitioning a roadway. In a cul-de-sac, an alignment controls the edge-of-travelway’s outside edge, and the main roadway’s centerline provides the pavement width (see Figure 9.14). When going around the cul-de-sac, the controlling alignment switches from the centerline to the edge-of-travelway and the centerline assumes the pavement widening role.

Having perpendicular curb and sidewalk sections around the cul-de-sac means the curb and sidewalk are to the left of the edge-of-travelway and an alignment attaches to the edge-of-travelway (see Figure 9.14).

CORRIDOR SURFACES

Using more than one region for a corridor introduces corridor surface boundaries issues. When you are creating a corridor that has a single region, the boundary selection is a single feature line (daylight). When there is more than one region, selecting the boundary segments may be an interactive manual selection process. When manually identifying boundary segments, a boundary jig appears to help define the boundary. Or, you may have the option of using the corridor extents as a surface’s boundary (see Figure 9.15).
SUMMARY

- The key to cul-de-sacs is defining an assembly and attaching the curb and sidewalk subassemblies to the left side so that they are perpendicular to the cul-de-sac arc.
- The centerline horizontal and vertical alignments are the width and height for the cul-de-sac’s center.

UNIT 3: SUPERELEVATION

Superelevation allows a roadway to carry higher speeds around its horizontal curves. To maintain these higher speeds, the roadway assembly includes subassemblies that change the lanes’ cross slope (superelevate), and possibly the shoulders, toward the horizontal alignment curve’s center. The lanes’ rotation takes advantage of centrifugal force and stabilizes a vehicle passing through the curve. This design methodology is found in both highway and railway designs (see Figure 9.16).

The pavement rotation methods vary greatly, and there is no uniform standard governing their use or design. Pavement rotation can occur about the centerline, around its inside or outside lane, or, if it’s a divided highway, around the lane edges or centerline. There is usually a regulatory body document that defines the necessary distances, radii, and lengths to achieve maximum superelevation.

The American Association of State Highway & Transportation Officials (AASHTO) publishes documents that define one highway design standards set. The AASHTO “Green Book” standards are incorporated in Civil 3D as Design Criteria. These standards are modifiable and a user can create an entirely new set. The standards affect both horizontal and vertical design.

DESIGN STANDARDS FILE

The Corridor Design Standards file contains tables with critical superelevation design values. This file’s values calculate roadway cross-section rotation and check for minimum design values. The Design Standards file is an XML-based file and can be customized to accommodate differing design standards. Customization occurs in Alignment’s Design Criteria Editor.
The Design Criteria Editor sets how it evaluates a design. First, it evaluates the minimum curves along an alignment. Second, it understands the attainment method for the type of road (with or without a crown). This includes lengths between critical superelevation points expressed as formulas. Third, for a design speed and curve radius, what lane cross slope is necessary to maintain the design speed through the superelevated curve. Related to this value (the necessary cross slope) is a length to transition from normal crown to superelevation.

**Horizontal — Base Units**
The design's base units are critical to all computation. The Design Criteria Editor lists and modifies its default values (see Figure 9.17).

**FIGURE 9.17**

**Horizontal — Minimum Radius**
Design Standards contains minimum curves for design speeds and superelevation. The following is an excerpt from the file for a 4 percent superelevation, its design speeds, and the recommended minimum radii. To maintain a higher speed with a 4 percent pavement cross slope, the minimum road radius needs to lengthen to safely handle the greater speeds.

```
<MinimumRadiusTables>
<!-- Defines minimum radii for road type and design speed -->
<MinimumRadiusTable name="AASHTO 2001 eMax 4%">
<MinimumRadius speed="15" radius="70"/>
<MinimumRadius speed="20" radius="125"/>
<MinimumRadius speed="25" radius="205"/>
```

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Figure 9.18 shows how this area of the Design Standards file is displayed in the Design Criteria Editor.

**Horizontal — Superelevation Attainment Methods**

A transition length section defines the length of transition for any design speed. The length varies for each speed and radius of curve. For example, a road with a design speed of 20 and a radius of 150 needs 72 feet of transition. If the same road has a radius of 500, it needs only 37 feet of transition.

**Transition Formulas**

Civil 3D uses formulas to calculate superelevation values. The superelevation parameters’ variables are the following:

- \( e \) - The superelevation rate (from tables)
- \( t \) - The superelevation length (from tables)
- \( c \) - The normal crown lane slope (from alignment settings)
- \( s \) - The normal shoulder lane slope (from alignment settings)
These variables are a part of formulas that define different methods of superelevating a road. Civil 3D supports the following five key transition formulas:

- **LC to FS** – Level crown station (LC) to full super (FS) station (runoff)
- **LC to BC** – Level crown station (LC) to beginning of curve (BC)
- **NC to LC** – Normal crown station (NC) to level crown station (LC) (Runout)
- **LC to RC** – Level crown station (LC) to reverse crown station (RC)
- **NS to NC** – Normal shoulder station (NS) to normal crown station (NC)

The Design Criteria Editor lists and modifies these variables' values. By default, Civil 3D uses the two-thirds rule—that is, two-thirds of the transition length is along the tangent, and the remaining one-third is along the path of the curve (see Figure 9.19). The variable p contains the percentage. You set the p value in Alignment’s Edit Feature Settings.

**FIGURE 9.19**

**Horizontal – Superelevation Tables — Speed and Cross Slope**

A minimum radius table defines the smallest horizontal radius that maintains the design speed. If the roadway maintains the same speed, but contains different radii, what cross slopes does each have? What roadway lengths are needed for each curve superelevation? To answer these questions, Civil 3D references two additional tables. The first specifies the cross slope amount based on various curve radii for a fixed speed. The second specifies the required transition length. The following Design Standards file excerpt is for an urban road with a design speed of 20 and a maximum
cross slope of 4 percent (eMax). NC stands for “normal crown” and RC stands for “reverse crown.”

```xml
<DesignSpeed speed="20">
  <SuperelevationRate radius="1400" eRate="NC"/>
  <SuperelevationRate radius="1200" eRate="RC"/>
  <SuperelevationRate radius="1000" eRate="RC"/>
  <SuperelevationRate radius="900" eRate="2.1"/>
  <SuperelevationRate radius="800" eRate="2.2"/>
  <SuperelevationRate radius="700" eRate="2.3"/>
  <SuperelevationRate radius="600" eRate="2.5"/>
  <SuperelevationRate radius="500" eRate="2.6"/>
  <SuperelevationRate radius="450" eRate="2.7"/>
  <SuperelevationRate radius="400" eRate="2.9"/>
  <SuperelevationRate radius="350" eRate="3.0"/>
  <SuperelevationRate radius="300" eRate="3.2"/>
  <SuperelevationRate radius="250" eRate="3.4"/>
  <SuperelevationRate radius="200" eRate="3.7"/>
  <SuperelevationRate radius="150" eRate="3.9"/>
  <SuperelevationRate radius="125" eRate="4.0"/>
</DesignSpeed>
```

Figure 9.20 shows how this area of the Design file is displayed in the Design Criteria Editor.

**FIGURE 9.20**
The roadway pavement’s maximum rotation occurs only at the minimum curve radius for the design speed. The cross slope amount changes with the curve’s radius—the shorter the curve radius, the greater amount of cross slope needed to maintain the speed. In the previous excerpt, a curve with a radius of 125 has a cross slope of 4 percent, and a curve with a radius of 400 will need a cross slope of only 2.9 percent to maintain the speed.

**Horizontal – Transition Length Tables**
Transition Length has two tables: 2 and 4 lanes. Each table has a speed and links a radius with an overall transition length (see Figure 9.21).

**FIGURE 9.21**

**Vertical Design Criteria**
Design Criteria’s last section defines vertical curve standards by one of three methods: Stopping Sight Distance, Passing Sight Distance, or Headlight Sight Distance. Each table uses a speed to define a minimum K value (see Figure 9.22).
EDIT FEATURE SETTINGS

Alignment’s Edit Feature Settings affects the superelevating lanes and shoulders behavior (see Figure 9.23). These settings supersede the subassembly’s parameters.

FIGURE 9.22

FIGURE 9.23
Superelevation Options
The Superelevation Options list populates the Calculate/Edit Superelevation Wizard’s default values.

Corridor Type and Cross Section Shape
Corridor Type and Cross Section Shape set the roadway type (undivided/divided) and its shape (crowned/planar).

Subassembly Lanes and Shoulder Parameters
This section sets the Nominal Width and Nominal Slope % for the lane and shoulder. These values supersede the subassembly parameters.

Percent on Tangent for Tangent-Curve and Percent on Tangent for Tangent-Spiral
This section sets the amount of the superelevation achieved before entering the curve. By default, Civil 3D is a two-thirds superelevation program. That is, two-thirds of the maximum superelevation is achieved before entering the curve.

Outside/Inside Shoulder Superelevation Method
There are three shoulder superelevation methods. The first method is breakover removal. This forces the shoulder slope to match the roadway cross slope before beginning superelevation. This method also introduces additional transitional length to rotate the shoulder until it matches the lane’s slope. After matching the lane’s slope, the lane begins its transition.

The second method is to match lane slopes; the shoulder’s slope always matches the lane slopes. The third method is to maintain the shoulder’s default slope through the entire superelevation.

Criteria-Based Design Options
This section sets the default design speed, if you are using Design criteria and Design checks, and explains how to resolve speeds or radii that are not in the table (see Figure 9.24).
GENERAL TERMS
When working with superelevations, some basic terms to understand are the following:

Runout—The distance over which a lane on one side of the pavement rotates from a normal crown (NC) to no crown (level crown, or LC). Tangent runout distance is another name for runout, because the rotation occurs along the tangent before entering the curve.

Runoff—The distance over which one side of the pavement rotates from a level crown (LC) to full superelevation (FS).

Percentage of Runoff—The runoff percentage represents the amount of superelevation that occurs along the tangent before entering the curve. In Civil 3D, the default is that two-thirds of the rotation occurs along the tangent, and the remainder occurs along the entering curve.

E value—The maximum superelevation rate. The E value is either ft/ft or m/m ratio. A 0.10 E value is a 10 percent grade.

Superelevation Regions—Civil 3D considers each curve a superelevation region. When setting the superelevation parameters, users need to set them for each region (curve) of the alignment.

DESIGN RULES
The first option of the Superelevation Region is the Design rules section (see Figure 9.25). This section identifies the starting and ending station of the curve, the design speed, what Design Standards file to use, the superelevation rate table, the transition length table, and the method of attaining superelevation. The last three settings are tables in the Design Standards file.
DEFAULT OPTIONS
The Default Options section sets corridor, shoulder, and calculation rules. The first part of the section sets the corridor type and cross-section shape (see Figure 9.25). The next three entries set the lane width and grades for the lane and shoulders. The next group of values sets which assumptions to use when you have to calculate a value when the speed and curve radius is not in the Design Standards file. The last entries specify how to remove the shoulder cross grade.

WARNINGS AND ERROR MESSAGES
Civil 3D issues a warning in the Event Viewer if the curve radii and speeds exceed minimums in the Superelevation Design file. These design issues should be dealt with immediately—before you continue with the design process.

The Superelevation panel of an alignment’s Properties dialog box will indicate problems with a design by using arrows to point to the full superelevation of the region.

FIGURE 9.25

CALCULATE/EDIT SUPERELEVATION
When starting the superelevation design process, you must calculate superelevations for an alignment. To access the calculator, in the Modify tab, click the Design’s Alignment icon to display the Alignment ribbon. In the Alignment ribbon’s Modify panel, select Superelevation, and from the command list, select Calculate/Edit Superelevation.

- To calculate superelevation values, you do NOT need to have a defined vertical design and/or assembly.
• To create a corridor using the superelevation values, you MUST have a vertical
design and an assembly.

The Calculate/Edit Superelevation command prompts you to select an alignment. If
the alignment does not have superelevation data, the Edit Superelevation – No Data
Exists dialog box displays. See Figure 9.26. The dialog box has two options. The first
is to calculate superelevation and the second is to open the superelevation editor. You
must calculate superelevation first, otherwise the superelevation editor will be empty.
If the selected alignment has superelevation calculations, the Superelevation Curve
Manager displays.

![Image](image1)

**FIGURE 9.26**

When selecting Calculate superelevation now, the Calculate Superelevation wizard
displays. See Figure 9.27. The first panel, Roadway Type, sets the roadway as being
undivided crowned or planar or as divided crowned with median or divided planar
with median.

![Image](image2)

**FIGURE 9.27**
The next panel sets if the roadway is symmetrical and for each side the number of lanes and their cross slope. See Figure 9.28. When the roadway is symmetrical, you set only the values for the right side. When the roadway is asymmetrical, you set values for each side.

![Figure 9.28](image)

The Shoulder Control panel sets the inside/outside shoulder behavior. See Figure 9.29. There are three shoulder treatments: Breakover removal, Default slopes, and Match lane slopes. Breakover removal makes the shoulder match the lane slope during the superelevation, and when not in superelevation, the shoulder varies from the lane’s slope to its normal slope value. Default slopes means the shoulder always remains with its initial slope value. Match lane slopes means the shoulder always has the same cross slope as the lane.
The Calculate Superelevation – Attainment panel displays the setting values from the Alignment’s Edit Feature Settings for Superelevation (see Figure 9.30). Again, by default, Civil 3D is a two-thirds superelevation application. You can change any of these values before clicking the Finish button to calculate the roadway superelevation.
After calculating the alignment’s superelevation values, the Superelevation Tabular Editor displays. See Figure 9.31.

**FIGURE 9.31**

**SUPERELEVATION TABULAR EDITOR**

When calculating superelevation values for an alignment, the Superelevation Tabular Editor displays the calculated values. If you have already calculated an alignment’s superelevation values, the Calculate/Edit Superelevation command displays the Superelevation Curve Manager palette. See Figure 9.32. The palette contains the superelevation values for each alignment curve. The superelevation details are displayed when selecting the (Superelevation) Tabular Editor button at the palette’s bottom right. The Superelevation Tabular Editor panorama displays each curve’s Run In and Run Out transition values. See Figure 9.31. In the editor, you can modify the values by clicking in the cell or by clicking the pick in drawing icon at the cell’s right side. When you click this icon, the panorama hides and a station jig displays attached to your cursor. When you select the desired station, the editor redisplays with the selected value.
The panorama also allows you to import critical station values from a CSV file. At the Panorama’s top left, the Import Superelevation Data from File icon displays a browsing dialog box where you can select the file to import that contains the critical station list and the associated lane and shoulder slopes.

**SUPERELEVATION VIEW**

The Superelevation View command creates an editable critical stations band. The command first prompts you to select an alignment and, after selecting the alignment, displays the Create Superelevation View dialog box. See Figure 9.33. The dialog box sets the view name, its stations, and what superelevation elements to display and their colors. After setting the values and clicking OK, the routine prompts you for an origin point for the view.
In the drawing, when you select the band location, the graph displays editing grips for each critical superelevation point. See Figure 9.34. By changing the grips location, you modify the current superelevation cross slope values.

When you right click after selecting the Superelevation View from the shortcut menu, you can display the Superelevation Tabular Editor.

FIGURE 9.33

FIGURE 9.34
SUMMARY

- The Design Criteria shipped with Civil 3D reflects the values published in the AASHTO “Green Book.”
- The Design Criteria is an XML-based file and can be copied and edited to suit customer needs.
- The Design Criteria contains variables and formulas to accomplish roadway superelevation and transition.
- The two basic superelevation design parameters are the design speeds and roadway curve radii.
- Design Criteria evaluates a roadway design horizontally and vertically.
- If a superelevation design does not meet the criteria, the Alignment Properties dialog box will show blue arrows.
- Design Criteria marks horizontal and vertical tangents and curves that do not meet the current criteria.
- Design speeds and superelevation properties are in Alignment Properties.
- The superelevation properties should be appropriate for the assembly that is creating the roadway corridor.

UNIT 4: INTERSECTION WIZARD

Roadway intersections are essential to a roadway design. Civil 3D intersection wizard creates intersection designs. The wizard is simple to use and produces an intersection that can be edited to the user’s needs.

2D intersection rules are the following:
- Two alignments intersecting only ONCE.
- No vertical alignment or corridor objects.

3D intersection rules are the following:
- Two alignments intersecting only ONCE.
- Both with vertical design profiles.
- Both with a corridor, but not intersecting.

The resulting intersection has an entry in Prospector’s Corridor branch, but the Intersection collection lists edits the intersection.

INTERSECTION WIZARD

Civil 3D’s Intersection Wizard appears after selecting the intersection of two alignments. The Wizard has three panels: General, Geometry Details, and Corridor Regions.

General Panel
The General Panel’s top sets the Intersection’s name and description (see Figure 9.35). The panel’s middle sets the intersection style and intersection type. The two intersection types are Primary Road Crown Maintained and All Crowns Maintained. The Primary Road Crown Maintained method holds the primary roads crowned cross section while flattening the secondary road’s crown to match the elevations along
the primary roads edge-of-travelway. The All Crowns Maintained method intersects
the two road crowns and blends the two road’s edge-of-travelway elevations so they
match around a circular arc, multiple arcs, or chamfer.

**Geometry Details**
The Geometry Details panel sets the primary and secondary alignment. You change
the alignments status by selecting the alignment’s name and clicking the Up/Down
arrows on the panel’s top right. When both roads continue after the intersection, you
can make either the primary alignment or the secondary alignment. You can change
the primary/secondary roadway designation in this panel. When creating a Tee inter-
section, the road that continues after the intersection is the primary road and the re-
mainng roadway is the secondary road.

The Offsets and Curb Returns section defines pavement widening values (offsets) for
the intersection. The offsets values widen one or both sides of one or both intersec-
tion alignments (see Figure 9.36).

![Create Intersection - General panel](image)

**FIGURE 9.35**
Offset Parameters

When clicking the Offset Parameter button, the Intersection Offset Parameters dialog box displays (see Figure 9.37). This dialog box sets the offset alignment length (it can be for the entire length of both intersecting alignments or only the length of the intersection), use of an existing alignment, a name format of the offset alignment, and the offset distance from the centerline. The toggle just below these settings defines the offset’s length, for intersection length this toggle is off, for the entire alignment length toggle is on. When selecting each item, the item highlights in the dialog box preview area or in the drawing.

- Even if not using offset alignment, you must toggle them on to create curb return alignments.
Curb Return Parameters

The Intersection Curb Return Parameters dialog box sets the curb return type and its radii. At the dialog box’s top is a quadrant designation identifying each curb return’s location with its parameters and displays the quadrant’s location in the drawing. The Next and Previous buttons at the top focus the dialog box parameters to all intersection quadrants (see Figure 9.38). In the main portion of the dialog box are the curve type and its radii. A curb return can be a single circular radius, a chamfer, or a 3-Centered arcs. 3-Centered arcs are three compound curves with specified lengths and radii. While specifying these values, the drawing displays graphics relative to the values being set.

At the dialog box’s top are the Widen turn lane toggles. When toggled on, the editor uses the offset values from the Intersection Offset Parameters dialog box.
Offset and Curb Profiles
The offset and curb profile section defines initial profiles for the offset and return design between the intersecting roadways.

Lane Slope Parameters
The Lane Slope Parameters dialog box defines the profile that transitions from one roadway's cross slope to the intersecting roadway's cross slope (see Figure 9.39). By default, it is the lane subassembly's default cross slope.

Curb Return Parameters
The Curb Return Parameters dialog box sets values for the vertical tangents defining the curb returns profile. The incoming and outgoing tangent length sets the length of the tangent transitioning from one roadway to the next. The Next and Previous buttons at the top display each intersection design quadrant.
Corridor Regions

This panel defines how to create the intersection and what assemblies to use (see Figure 9.40). The panel’s top toggles the intersection’s creation as a corridor or as alignments with profiles. An intersection can be added to an existing corridor or be its own new corridor. If you are adding to an existing corridor, you select the corridor’s name from a drop-list. In this area, you must also identify which surface is the daylight surface.

The middle portion sets the assembly set, its path, or creates a new assembly set. An Assembly set is an external file containing the name and path to drawings containing specific task assemblies, curve fillet assembly, road part section, and so on.

You can create your own sets from assemblies in the current drawing. Autodesk suggests using their set until you are comfortable with the intersection design process. Your assemblies should reside in a drawing dedicated to intersection design and not production. When saving the set, Civil 3D writes an XML file to Civil 3D’s data area.

The Assembly set assigns specific assemblies to different intersection regions. As you select each region, the dialog box previews the region and the assembly.
INTERSECTION SETTINGS

An intersection has many Civil 3D setting values.

Edit Drawing Settings — Object Layers

The Edit Drawing Settings - Object Layers dialog box lists two layers for intersections. The first layer, Intersections, is the object’s layer in a drawing. The second layer is Intersection Labels and is used if the intersection label layer is set to 0 (zero). If the label has a specified layer, that layer is used instead of this one.

Edit Feature Settings

The intersection feature settings set the default object and label styles and the naming formats.

Intersection Styles

The intersection style defines the marker type and layer for an intersection.

Intersection Label Styles

Currently, an intersection label is the intersection’s name and the alignments creating the intersection.

Command Settings — Create Intersection

The CreateIntersection command settings define all of the values for the Intersection Wizard (see Figures 9.41 and 9.42).
FIGURE 9.41
The Intersection Wizard uses parameters to define an intersection.

Curb returns can be a circular arc, chamfer, or a combination of three radii.

An intersection can be its own corridor or integrated in one of the intersection roadway’s corridor.

The new intersection is the roundabout. A roundabout lessens the types of intersection collisions, reduces the speed through the intersection, and allows for more flow through the intersection. There are standards for roundabouts, but each state may put their imprint on the design standards.

Civil 3D uses an external standards file to populate the Roundabout Wizard. Civil 3D locates the file in the Data’s Corridor Design Standards folder. The Imperial
and Metric folder contains the file Autodesk Civil 3D Imperial or Metric Roundabouts Preset.xml. This file contains the standard values for different roundabout radii. When selecting a roundabout radius, the wizard reads the standards file and populates the appropriate settings.

You can add to the standards file or create your own file reflecting your standard values.

**ROUNDABOUT WIZARD**

The roundabout wizard creates only a 2D roundabout representation. There are limited vertical design capabilities. The roundabout is a series of alignments that have associated polylines. The polylines allow you to grip edit the roundabout geometry. For example, grip editing the radius polyline changes the roundabout’s overall radius.

You start the roundabout wizard from the Home tab, Create Design panel’s Intersection icon. When clicking the Intersection icon, a command list displays. When selecting the Roundabout command, the routine prompts for an intersection point. After selecting the point, the Roundabout Wizard displays. See Figure 9.43.

![Figure 9.43](image-url)
The first panel, Circulatory Road, displays the current values for the roundabout. The left side values set the radii for the roundabout, its lanes, markings, number of lanes, Civil 3D site, and alignment layer, style, and label set.

The dialog box's top right can load Autodesk or User defined standards files.

The next panel, Approach Roads, displays the settings for one of the approach roads. See Figure 9.44. In the Figure, there are two approach roads: one from north to south and one from east to west.

These settings reflect the values for a 45-foot radius roundabout. The left side values affect the approach road and the right side affects the entry road. The panel's top displays the connecting radius. The panel's bottom sets the alignment style, name, layer, and label styles. Also at the top is a button that applies the current setting values to all roundabout approach roads.

![Create Roundabout - Approach Road](image)

**FIGURE 9.44**
The next panel, Islands, sets the values for each roundabout approach’s islands. See Figure 9.45. Again, after setting the values for one approach’s islands, you can apply the settings to all roundabout approaches.

The settings affect the size, shape, and fillets applied to the islands. Included in the settings are values for crosswalks passing through the island.

![Create Roundabout - Islands](image)

**FIGURE 9.45**

The final wizard panel, Markings and Signs, sets the markings (pavement, island, and crosswalk) and signage names and locations for each approach. See Figure 9.46. At the panel’s top is a button that applies the current settings to all approaches. Or, you can cycle through each approach setting that approach’s unique values.
The Roundabout is a custom object and, as such, responds to interactive grip editing. When you select a roundabout polyline element, it displays grips. Manipulating the grip’s position affects the roundabout in some way. Each grip has pre-assigned responsibilities. For example, selecting the roundabout’s radius grip allows you to redefine the roundabout’s radius. When selecting a new radius, the approach and entry roads and island all change according to the edit. See Figure 9.47.
DRAW SLIP LANE

Some roundabouts have an additional right or left turn lanes that take traffic from the roundabout’s central loop. A slip lane connects from a roundabout’s entrance lane to the adjacent exit lane. The lane is defined by two alignments (right and left side), and polylines over the alignments provide the grip-editing capabilities.

When creating a slip lane, you start by changing to the Ribbon’s Modify tab and click the Alignment’s icon. In the Alignment’s ribbon, the Modify Roundabout panel, select the Add Slip Lane icon to start the routine. The routine first prompts for an entry lane. After selecting the entry lane, the routine prompts you to select an exit lane. After selecting the lanes, the routine displays the Add Slip Lane dialog box. See Figure 9.48.

The critical values are the deceleration and acceleration distances and the lane’s radius. The larger the lane’s radius, the further the lane is from the roundabout’s outer edge.
SUMMARY

- The Roundabout Wizard uses external file parameters to set its default values.
- If having two alignments passing through a roundabout, you add the remaining approaches with the add approach command.
- The Add Slip Lane command places a right or left turn lane between an entry and exit approach.
- A Slip Lane removes traffic from having to pass through the roundabout’s central lanes.

The next chapter focuses on the grading tools in Civil 3D.