AutoCAD Civil 3D 2010
Education Curriculum Instructor Guide
Unit 3: Land Development

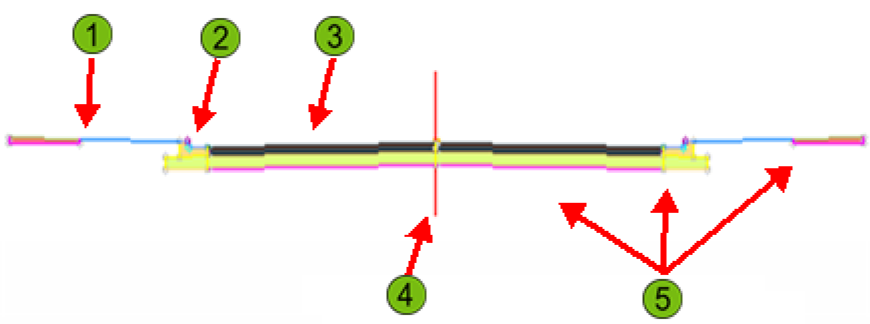
Autodesk

Lesson
5

Assemblies and Corridors

Overview

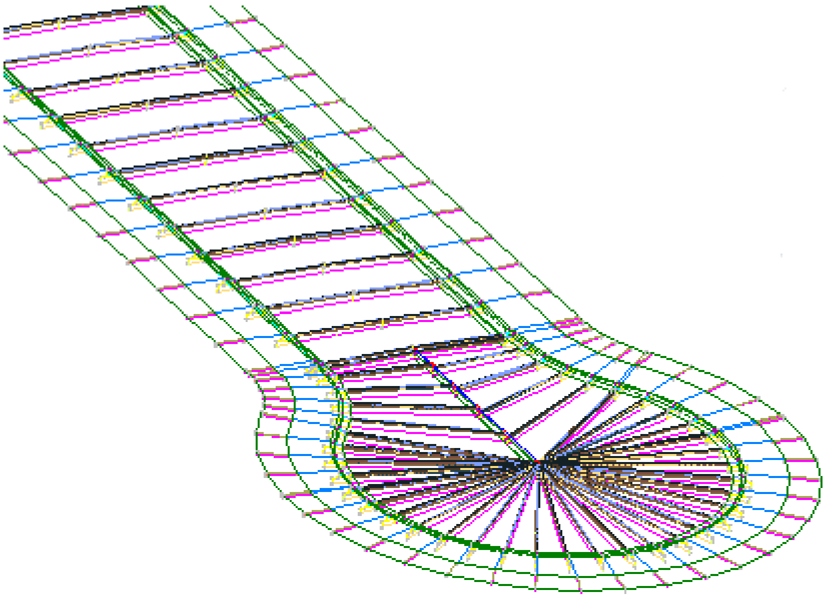
In this lesson, students learn how to create assemblies and use them to create corridor models. Once a corridor model is created, students learn how to create corridor surfaces from the model. Subassemblies are individual objects that are pieced together as a design cross section, or an assembly object. The assembly object, along with the horizontal and vertical alignment, is used to build the corridor model for a road, highway, railway, embankment, channel, or any cross section-based features. The subassemblies are logically designed, and respond dynamically in the design environment, making it easy to generate and evaluate design alternatives.



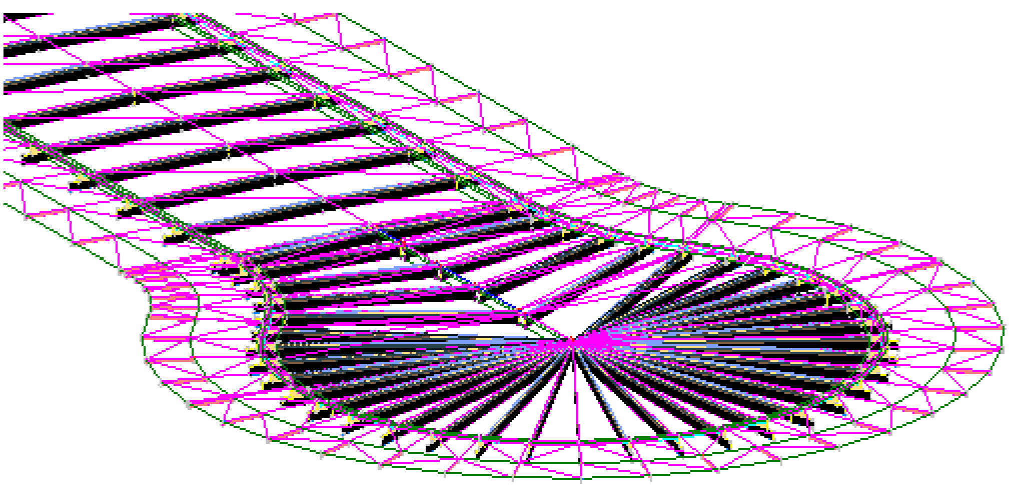
1 Sidewalk
2 Curb
3 Lane
4 Assembly
5 Subassemblies

You can use corridor models to represent any road, rail, channel, or berm design that has typical cross-section features. When you create a corridor model, you create a single object that includes all the design components and input parameters for a road or other type of feature created from a typical cross section.

A completed corridor model for a residential subdivision road with a cul-de-sac is shown in the following illustration.



Corridor surfaces are useful for design and construction tasks. You can use corridor surfaces to calculate earth cut and fill quantities, label spot elevations and slopes, and generate construction staking data.



Objectives

After completing this lesson, you will be able to:

- Describe assemblies and subassemblies.
- Describe the subassembly input and target parameters.
- Create assemblies.
- Describe a corridor model and list its components.
- Create a corridor model for a subdivision road with a cul-de-sac.
- Create a corridor surface.

Exercises

The following exercises are provided in a step by step format in this lesson:

1. Create Assemblies
2. Create a Corridor Model
3. Create a Corridor Surface

About Assemblies and Subassemblies

An assembly is an arrangement of cross-section features found on a roadway or other corridor. It represents a typical section of the corridor that you position with an alignment and a profile. You create an assembly using subassembly objects for cross-section elements such as lanes, curbs, sidewalks, shoulders, and side slopes.

A subassembly is the basic building block that makes up an assembly. A subassembly is attached to one or both sides of the assembly's baseline, and subsequent subassemblies are attached to the appropriate points of the previously attached subassemblies. An assembly can be defined by attaching all of the subassemblies to one side of a baseline, and then mirroring these subassemblies to the other side of the baseline.

Subassemblies are intelligent objects that dynamically react to changes in the design environment. Each subassembly has its own set of parameters that you can modify to change its appearance or behavior. Civil 3D provides a library of the most common, generic subassemblies that you may encounter in roadway design.

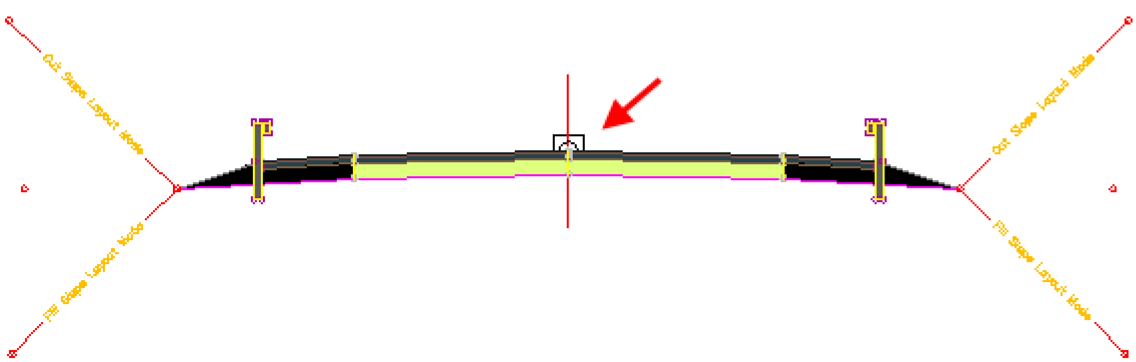
Along with using the predefined subassemblies in Civil 3D, you can also draw your own subassemblies. Civil 3D has the tools to convert your polyline shape into a subassembly. This subassembly has limited logic but can be used like any other subassembly when building an assembly. You can build your own custom subassembly with all of the parameters and functionality (or more) of those supplied in the subassembly catalog.

When you create an assembly, you can make it available for future projects and other users by saving it on a tool palette, or within the drawing template (DWT) file. You can also save collections of assemblies in an assembly set.

An assembly is made up of the following elements.

Element	Description
Baseline	The vertical line used as a display reference line for the assembly.
Baseline point	The point to which you attach subassemblies, and the point on the assembly attached to the horizontal and vertical alignment to create the corridor model. Also known as horizontal and vertical control.
Subassemblies	Cross-section element objects such as lanes, curbs, shoulders, and side slopes that you add to the assembly object. The subassemblies are added from the tool palette and attached to the assembly baseline or other subassemblies in the assembly.

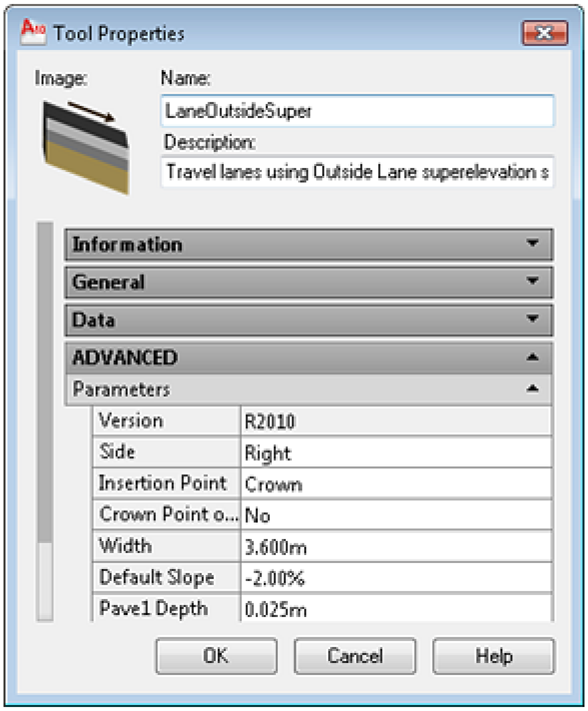
The following illustration shows a simple assembly. On either side of the baseline are subassembly objects that represent a lane, shoulder, guardrail, and cut or fill slope. In this example, the subassemblies are arranged starting from the baseline point, which is indicated by the circle with a square inside it at the midpoint of the baseline.



Subassembly Parameters

Subassemblies have input and target parameters that are used to change their geometric configuration. Subassembly input parameters control the size, shape, and geometry of the subassembly. Custom subassembly input parameters can be saved on a tool palette and also specified when you add the subassembly to an assembly.

For example, the most common subassembly for modeling a lane is the LaneOutsideSuper subassembly. The LaneOutsideSuper subassembly has input parameters that set the general configuration values for the lane such as width, pavement depth, and cross fall. The default input parameters for the LaneOutsideSuper subassembly are shown in the following illustration.



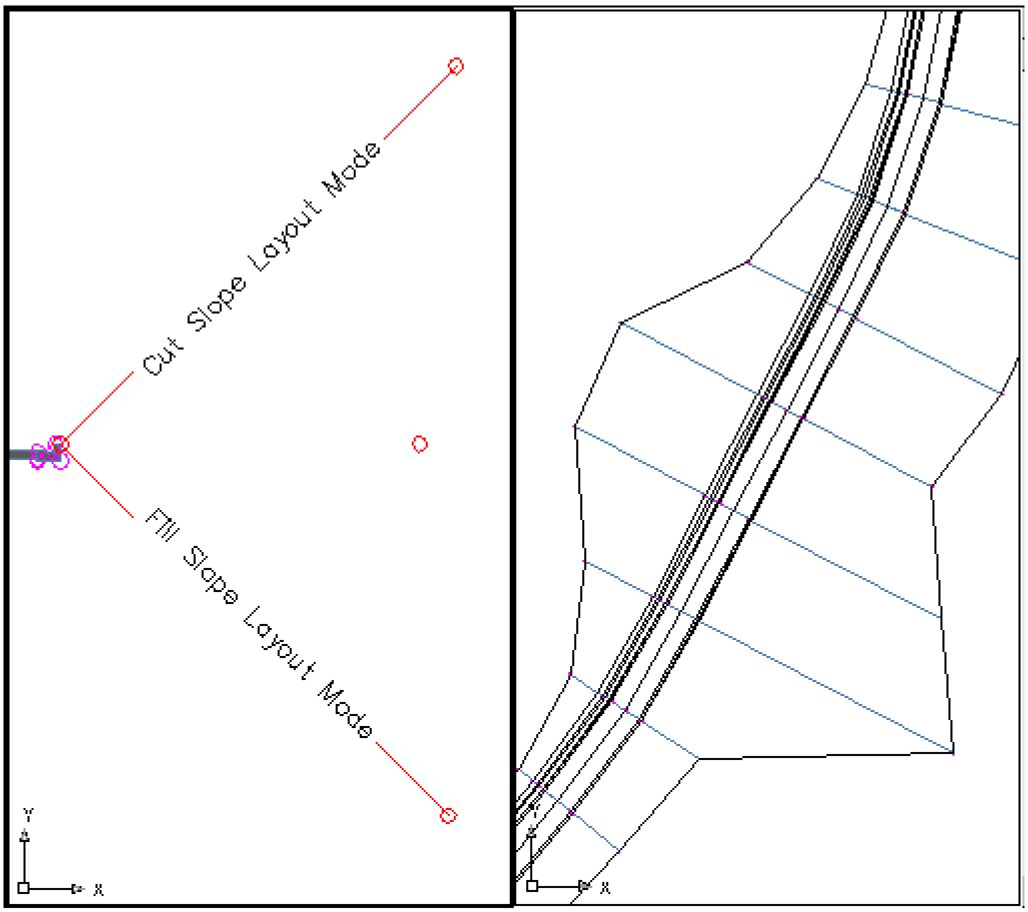
Some subassemblies have required or optional target parameters. Target parameters control how the subassembly functions. Function is determined by the object the subassembly connects to (alignment, profile, or surface). The daylighting subassemblies have required surface target parameters. You are required to specify a target surface to which the subassembly daylights.

The lane subassemblies have optional width and elevation target parameters that can be alignments and profiles. You can optionally override the lane width input parameter by targeting an alignment. This is how you vary the width of the lane in a lane taper. You can also optionally override the default slope input parameter by targeting a profile to change the lane cross fall.

Examples

For daylighting subassemblies that are used to project match slopes to surfaces, you are required to specify a surface model as the target parameter. Without the target parameter, the subassembly would not function. Lane subassemblies have optional target parameters such as lane width. A default input parameter for a lane subassembly is the lane width. The optional lane width target parameter would use another alignment to override the default lane width value. This is useful when pavement widths vary at turning lanes and lane tapers.

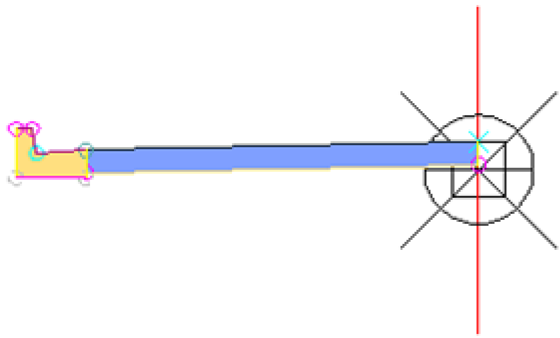
The most common subassembly to daylight to a surface is called BasicSideSlopeCutDitch. The BasicSideSlopeCutDitch subassembly has a required target parameter for a surface. When you create the corridor model with an assembly that contains BasicSideSlopeCutDitch, you must specify the target surface for the daylighting subassembly. This is shown in the following illustration.



The image on the left shows the subassembly as part of the right side of an assembly, attached to a curb and gutter. The image on the right shows the result of the logic built into the subassembly when it is used in a corridor model. The width of the slope adjusts to account for changes in the terrain.

Creating Assemblies

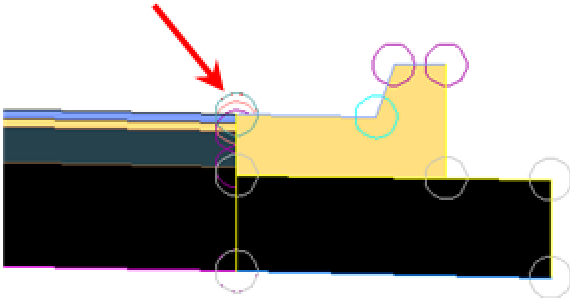
You create an assembly by adding the assembly to the drawing area, and then using the baseline and baseline point as a visual guide for the addition of subassemblies. Sets of subassemblies are included in the tool palettes. You can also select subassemblies from the subassembly catalog and place them on the tool palettes. The following illustration shows a basic assembly with baseline, basic lane, and curb and gutter subassemblies.



Process Description

To create an assembly you launch the Create Assembly command from the ribbon, assign a name to the assembly, and insert the assembly to the drawing. The assembly object is shown in the following illustration.

After you insert the assembly object you begin by adding the subassemblies to the assembly. The first subassemblies you add are added to the assembly and you can pick any part of the assembly object. As you move away from the assembly you need to add subassemblies to other subassemblies. You select the subassembly markers as insertion points for the other subassemblies. In the following illustration, the arrow points to one of subassembly markers.



Guidelines

Keep the following guidelines in mind when you create assemblies.

- For every subassembly that you add to your assembly, you should read the Help file to understand how the subassembly behaves and which default settings you can modify.
- Modify the default subassembly input parameters on the tool palette to suit common design configurations.
- Rename the subassemblies on the tool palette to clearly indicate key geometric properties, such as width, slope, and grade.
- Subassemblies added to the assembly are organized into assembly groups. When you select the assembly object to add subassemblies, a new assembly group is created. When you modify the properties of the assembly, rename the groups with indicative names, such as LEFT, RIGHT, and so on.
- To create a mirror image of a subassembly or group of subassemblies, use the Mirror command, which is available on the shortcut menu.
- Once the assembly is complete, you should go back and rename each of the subassemblies to give them descriptive names. This may not seem important early in a project when you have a simple assembly, but roadway jobs can get very complex. Numerous assemblies can be applied to any one alignment. It is good practice to document the components of an assembly so that other team members working on the project understand the parts and their functions.

About Corridor Models

A corridor model is a three-dimensional representation of the design for a roadway, railway, or other transportation facility. Corridors can also be used to model channels, berms, and any other civil engineering feature that can be represented with a typical section. You create a corridor model with an alignment, a layout profile, and an assembly. By incorporating constraints and rules into the corridor design, you can manage and control how the corridor model interacts with the terrain and other alignments and profiles.

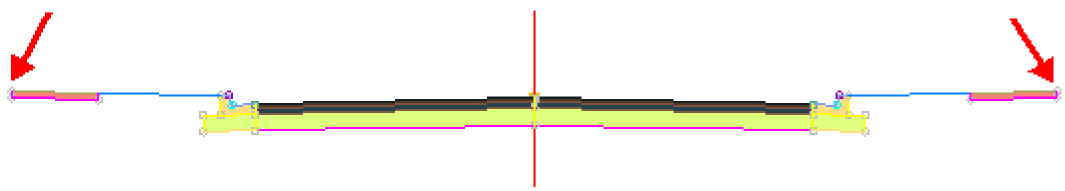
When you create a corridor, you can create complex models for transportation facilities such as roads, highways, and railways by adding corridor regions or referencing more than one alignment baseline. Almost any condition that your design may call for can be modeled by using the corridor functionality.

Definition of Subdivision Corridor Models

Many large subdivision designs are created based on developing an interim grading surface that accounts for site topography and drainage constraints. The subdivision roads are usually the spine of the subdivision and are designed first. The layout profiles are designed to match surface profiles generated from an interim grading surface.

Unlike road and highway corridor models, the assemblies used to create subdivision corridor models typically do not include daylighting subassemblies and therefore do not interact with surface models. Subdivision corridor models are usually calculated up to the right-of-way and are essentially floated through space along the horizontal and vertical alignments.

A typical assembly for a subdivision corridor model is shown in the following illustration. The right-of-ways are indicated by the arrows.



Additional Components

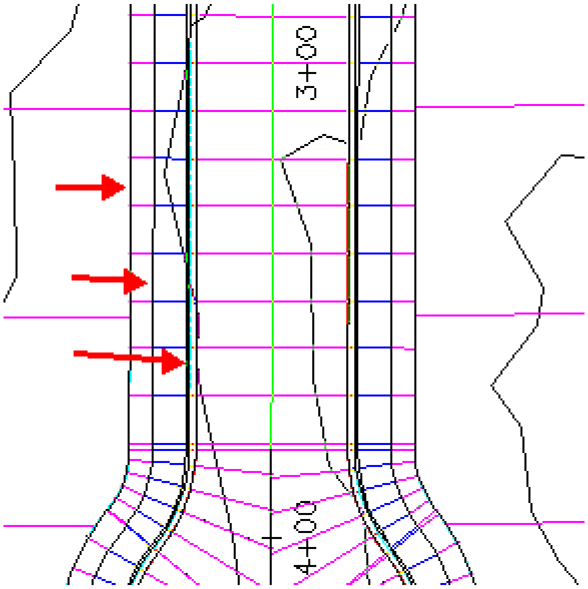
In addition to the alignment, layout profile, and the assembly, corridors are also comprised of feature lines, regions, and baselines.

Feature lines are the longitudinal lines along the corridor that are used to represent typical cross-section points such as road crowns, pavement edges, gutter flow lines, sidewalk edges, and daylighting lines. Feature lines are part of the corridor model and are created by connecting the subassembly points of the corridor assembly.

Corridor regions are independent station ranges to which you can apply different assemblies to model differing cross-section configurations.

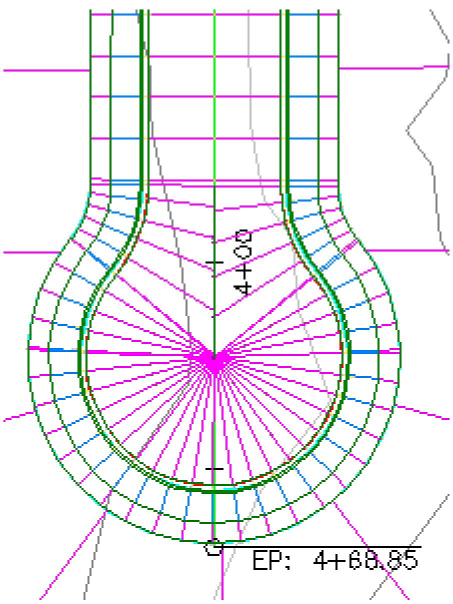
The baseline is the alignment that is used to control the creation of a corridor model. A corridor model can be constructed from several baselines. A corridor for a subdivision road with a cul-de-sac uses a centerline alignment baseline for the main section of the road, and an edge of pavement alignment baseline for the cul-de-sac.

The following illustration shows feature lines on a corridor model for a subdivision road with a cul-de-sac.



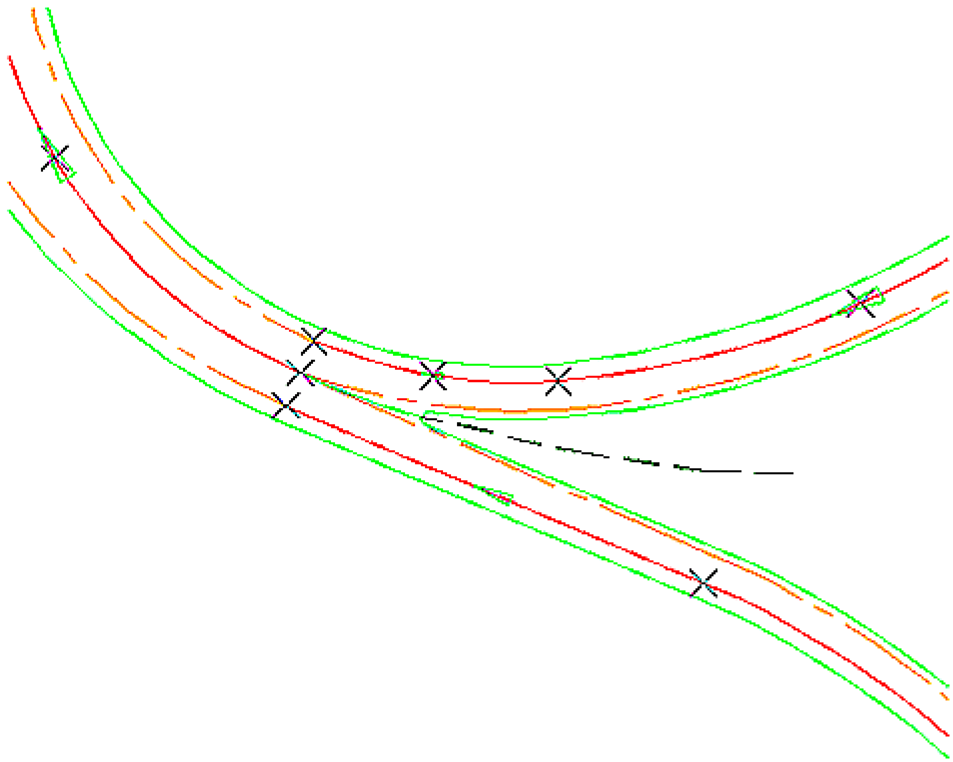
Corridor Examples

A corridor model of a cul-de-sac is shown in the following illustration.

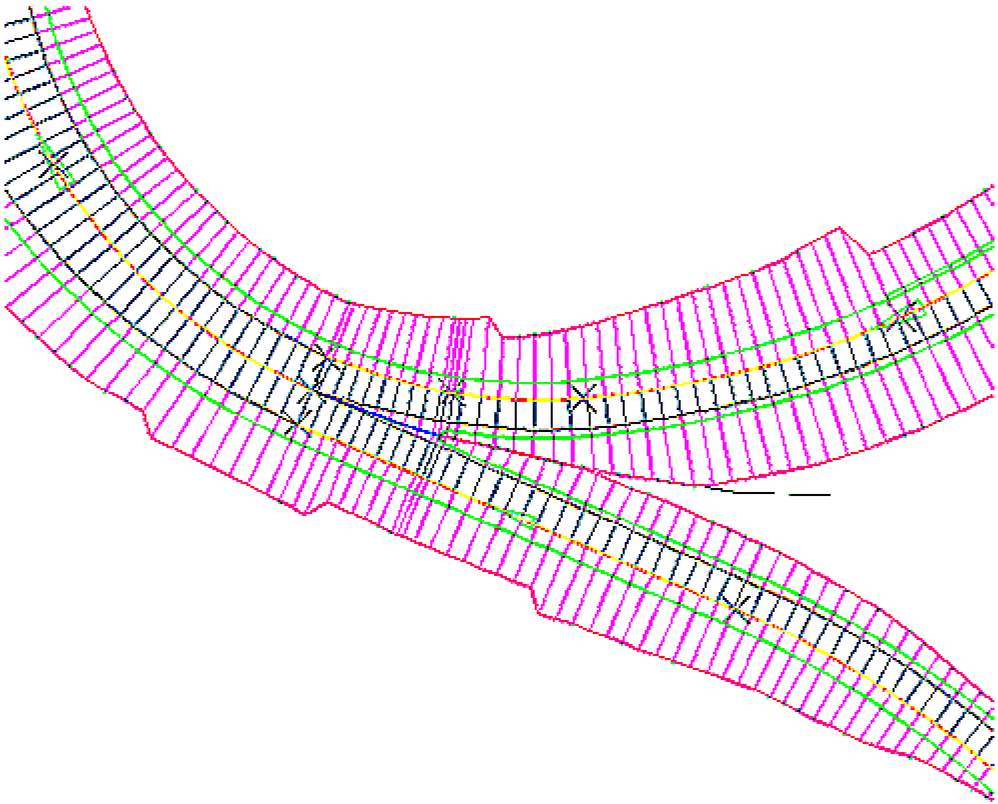


Complex Corridor Examples

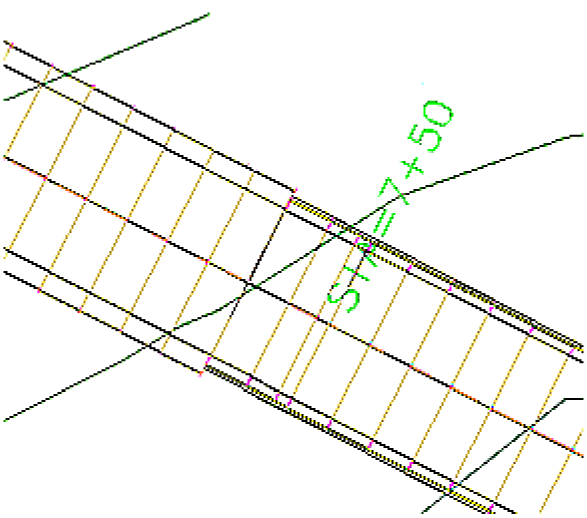
The illustration shows three centerline alignments that represent an on-ramp (entering from the top right corner), an off-ramp, and the two-lane road where the two ramps join. The alignments for the on- and off-ramps end at precisely the same location as the beginning of the two-lane segment, which creates a continuous corridor from the three segments. The illustration shows the same alignments after a corridor is created. Different assemblies are applied along the alignments to create a single corridor with lanes and ditches that merge together seamlessly. Each alignment is associated with the corridor model by using a different baseline entry in the corridor properties. The illustration shows a transition between regions in a corridor. The upper region of the corridor uses an assembly with a plain shoulder. The lower region uses a similar assembly that has a curb and gutter instead of the paved shoulder.



The illustration shows the same alignments after a corridor is created. Different assemblies are applied along the alignments to create a single corridor with lanes and ditches that merge together seamlessly. Each alignment is associated with the corridor model by using a different baseline entry in the corridor properties.

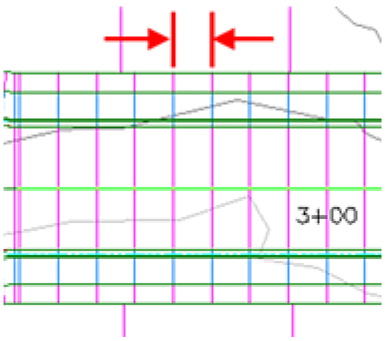


The illustration shows a transition between regions in a corridor. The upper region of the corridor uses an assembly with a plain shoulder. The lower region uses a similar assembly that has a curb and gutter instead of the paved shoulder.



Creating Corridor Models

To create a corridor model, you must specify an alignment, a vertical alignment, and an assembly. The assembly is processed along the horizontal alignment at a pre-specified *assembly insertion frequency*, which is the increment along the alignment where the assembly is inserted to create the corridor. This is shown in the following illustration.



The assembly insertion frequency is not related to the increment at which cross sections can be created, and can be changed when you modify the properties of the corridor.

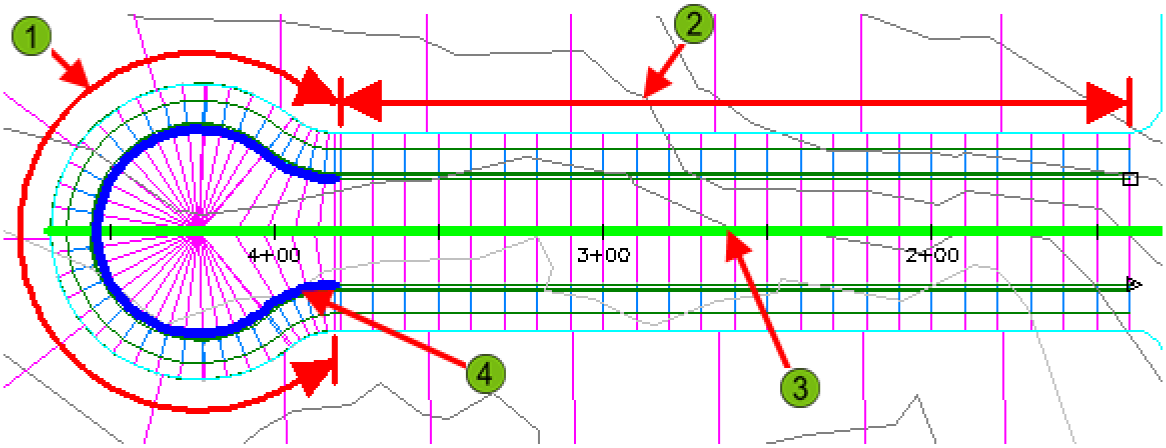
The alignment you specify when you create the corridor is called a *baseline*. The baseline is the alignment that is used to control the creation of a corridor model. You can specify multiple baselines when creating a corridor. This is how you create a corridor that incorporates a cul-de-sac. Complex corridor models can incorporate several baselines.

If the assembly you use has subassemblies that require target assignments, such as the daylight subassemblies, when you create the corridor you have the option to specify the targets. The target for a daylight subassembly would be a surface model. Typically, subdivision assemblies do not use daylight subassemblies.

Corridor regions are segments of a corridor that are defined by an independent station range and assembly. When you use multiple corridor regions, you can use multiple assemblies to model the corridor over a different station range. This makes it easy to model widely variable cross-section configurations with a single corridor model.

Creating Corridors with a Cul-de-Sac

A corridor model for a subdivision road with a cul-de-sac incorporates two baselines. The first baseline controls the creation of the corridor for the main part of the road and is usually the road centerline alignment. The second baseline controls the creation of the corridor cul-de-sac and is usually the edge of pavement or gutter alignment around the cul-de-sac. This is shown in the following illustration.



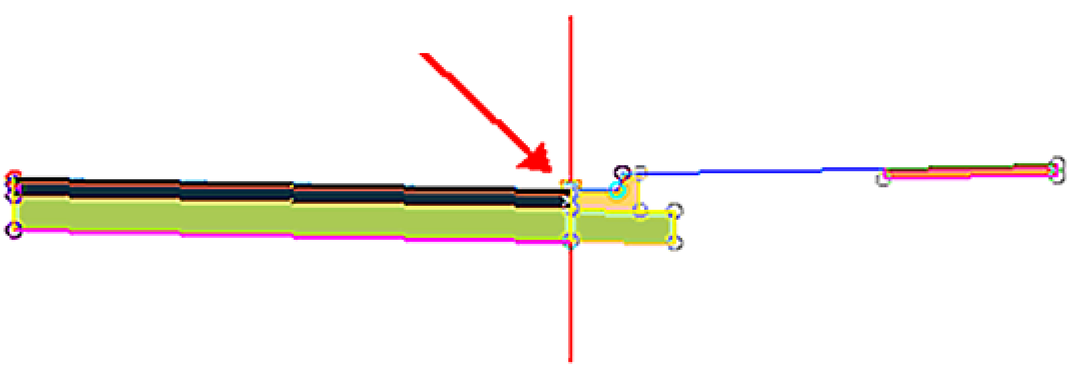
1 Second Baseline Region 1

2 First Baseline Region 1

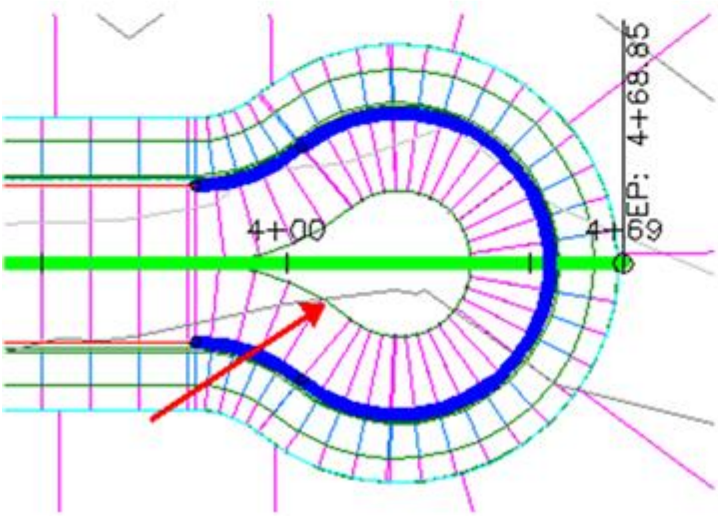
3 First Baseline

4 Second Baseline

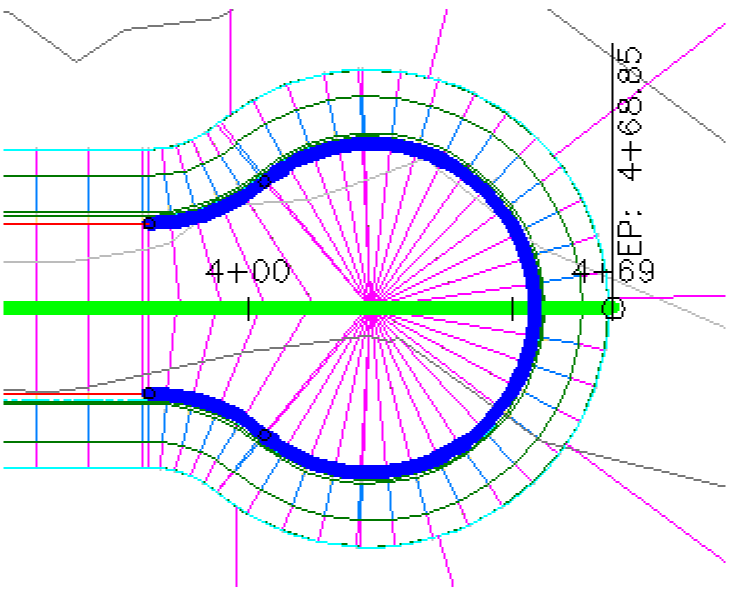
The assembly that you process along the first baseline represents a symmetrical cross section up to the right-of-way locations. The assembly you process along the second baseline for the cul-de-sac is an asymmetrical cross section with the baseline at the edge of pavement location. The assembly baseline is indicated by the arrow in the following illustration.



The lane subassembly in the cul-de-sac assembly has a fixed width. The width of the lane subassembly and the elevation of the inside crown is overridden by assigning the optional alignment and profile target to the centerline alignment and profile of the cul-de-sac alignment. This essentially stretches the lane back to the centerline alignment and elevation in the cul-de-sac. The following illustration shows the completed cul-de-sac without targets assigned to the lane subassembly.



When you assign targets to the lane subassembly on the asymmetrical assembly for the second corridor region, the lane stretches back to the centerline alignment location and elevation. This is shown in the following illustration.



Keep the following guidelines in mind when you create corridor models:

- When you create a corridor model, you can use the Create Corridor command or the Create Simple Corridor command. Both commands result in the same object. However, the Create Simple Corridor command offers fewer input options to create the corridor.

- When you create the corridor model, make sure that you specify a station range for each region so that you can assign the appropriate target. Ensure that you have layout profile data for the station range over which the corridor regions are created.
- Use representative naming conventions for alignments, profiles, corridors, and corridor regions. This makes it easier to create and manage corridor data.

About Corridor Surfaces

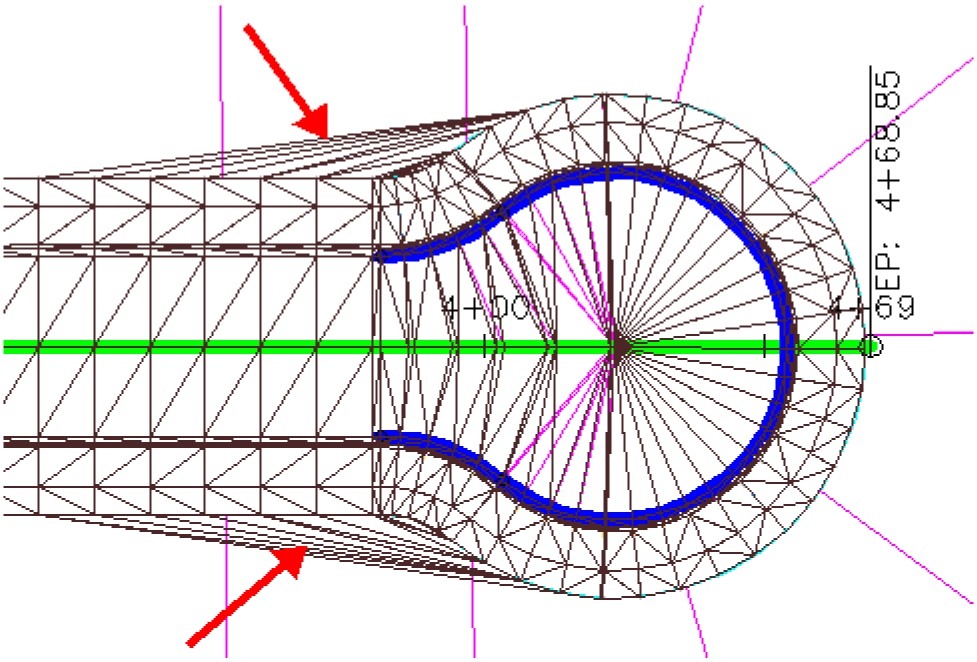
After you create a corridor model, you can create corridor surfaces. You can use a corridor surface for earth cut and fill volume calculations, finished grade elevation and slope labels, and for calculating pipe network structure rim and invert elevations.

A corridor surface represents a finished layer of a corridor design. It is a Civil 3D surface object created from the links or feature lines of a corridor model. Corridor surfaces are dynamic and automatically update when the corridor changes. They are displayed in the Surfaces collection on the Prospector tab of the Toolspace window. Corridor surfaces can be displayed, annotated, and sampled just like regular surfaces.

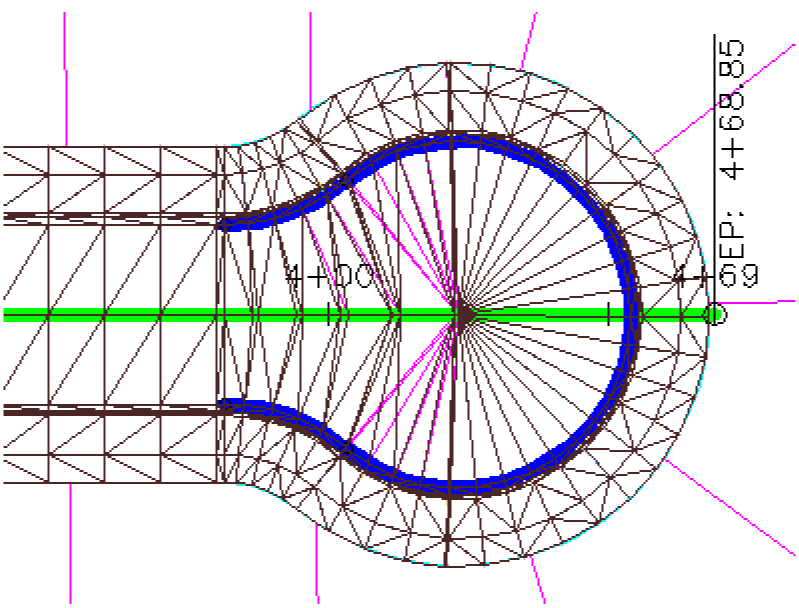
Surface Boundary

You create a corridor surface boundary to contain the triangulation of points within the limits of the boundary. To automatically create a corridor surface boundary, you modify the properties of the corridor.

For a residential subdivision road corridor, the surface boundary is at the right-of-way line. The following illustration shows a corridor top surface of a residential subdivision road without a boundary defined. The arrows point to the triangulation lines that are outside the surface boundary.



The following illustration shows the same corridor top surface with the boundary defined. In this case, the triangulation lines are contained by the boundary of the corridor surface.



Creating Corridor Surfaces

You use corridor data to create a corridor surface. When you create a corridor surface, you can use either the subassembly links or the corridor feature lines as corridor data. The most common corridor data is the subassembly links.

To create a corridor surface you modify the corridor properties and use commands available on the Surfaces tab of the Corridor Surface dialog box. The most common corridor surfaces incorporate the Top subassembly links and the Datum subassembly links.

Corridor surfaces using the Top subassembly links can be used for the following:

- Creating finished design contours.
- Labeling finished spot elevations and slopes.
- Creating finished grade construction staking data.

Corridor surfaces using the Datum subassembly links can be used for the following:

- Calculating earth cut and fill quantities.
- Creating subgrade construction staking data.

Keep the following guidelines in mind when you create corridor surfaces:

- You typically create corridor surfaces from either the Top links or the Datum links.
- You can use the corridor extents to create an outer boundary for the corridor surface.

Key Terms

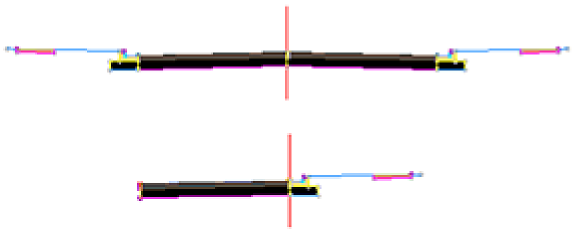
Subassembly	A subassembly represents a single component of a road cross section such as a lane, curb structure, or sidewalk. Subassemblies are assembled to create the assembly. You can choose from over a hundred subassemblies in Civil 3D.
Assembly	An assembly is created from subassemblies and represents the typical cross-section configuration of the proposed road. An assembly for a subdivision road may consist of two lane subassemblies (one for each side), two gutter subassemblies, and two sidewalk subassemblies.
Typical Cross Section	The typical cross section is the engineering detail that shows the configuration of the proposed cross section for a road. These details

	include widths, depths, slopes, grades, and materials. Offset locations on a typical cross section are referenced from the road centerline. Civil 3D represents typical cross sections with an assembly.
Corridor Model	Corridor models are created from a design horizontal alignment, proposed vertical alignment, and an assembly. A corridor model can represent any linear designed feature, but is most commonly used for road design.
Corridor Surface	Corridor surfaces are design surfaces that can be created directly from a corridor model. You can create surfaces for the different depths of a corridor model. Corridor surfaces are displayed in the Surfaces collection.
Baseline	A baseline is the controlling alignment, profile, and assembly for corridor creation. A corridor can be created using multiple baselines. For example, a corridor model for a road with a cul-de-sac consists of two baselines. One baseline is used to model the main road section and the other baseline is used to model the cul-de-sac.
Region	A corridor region is represented by a station range for a baseline. Baselines can have multiple regions. You can assign a different assembly, assembly insertion frequencies, and targets for corridor regions.
Frequency	The frequency is the interval at which assemblies are inserted to create the corridor model. You can assign different intervals for tangents, curves, spirals, and profiles curves.
Targets	Some subassemblies enable you to assign targets. A target is used to control a specific property of a subassembly. For example, the width of a lane subassembly can vary by assigning a target alignment, or a catch slope subassembly could determine fill or cut conditions based on the target ground surface.
Corridor Feature Line	Corridor feature lines are the 3D longitudinal lines that run the length of the corridor. Corridor feature lines are created from the points on the subassemblies.
Grading Feature Line	A grading feature line is a feature line that is used exclusively for grading purposes. A grading feature line can be created using feature line commands or can be extracted from a corridor model. Grading feature lines are typically created at the property line locations.

Exercise 1: Create Assemblies

In this exercise, students create two assemblies for the Cedar Cove cul-de-sac corridor. One is required for the tangent section, and the other is required for the bulb at the end of the cul-de-sac.

The completed drawing is as shown.



For this exercise, open *...\I_AssembliesCorridors-EX1.dwg (M_AssembliesCorridors -EX1.dwg).*

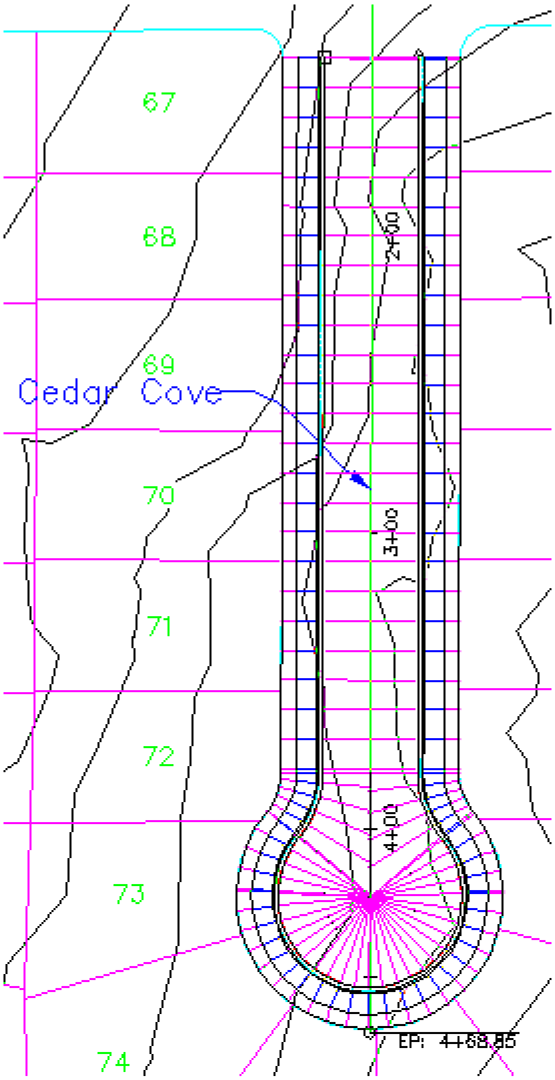
Configure Your Workspace

Start by configuring your workspace. To create assemblies, students need to view the AutoCAD Object Properties window with the tool palettes.

Exercise 2: Create a Corridor Model

In this exercise, students create a corridor model for a subdivision road with a cul-de-sac.

The completed drawing is as shown.

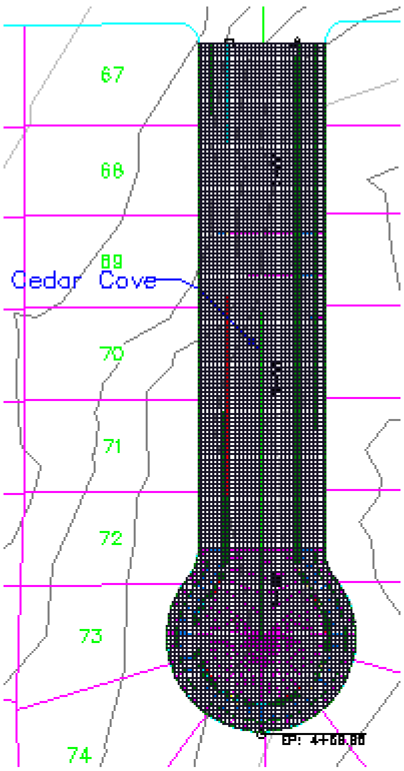


4. For this exercise, open *...\I_AssembliesCorridors-EX2.dwg (M_AssembliesCorridors-EX2.dwg).*

Exercise 3: Create a Corridor Surface

In this exercise, students create a top corridor surface for the Cedar Cove corridor.

The completed drawing is as shown.



For this exercise, open *…\I_AssembliesCorridors-EX3.dwg (M_AssembliesCorridors-EX3.dwg).*

Assessment

Challenge Exercise

Instructors provide a master or challenge exercise for students to do based on this lesson.

Questions

1. What is a typical section? What types of information does a typical section convey?
2. What is a subassembly? Offer some examples.
3. What happens if the default design parameters for the Civil 3D subassemblies do not satisfy the requirements of the typical section?
4. Detail the process for creating an assembly.
5. What are a baseline and a region?
6. Explain the significance of targets.
7. Why would an engineer create a top surface for a corridor model?

Answers

1. A typical section represents the design parameters for the cross section of a road. A typical section specifies the parts that make up the road cross section. The information a typical section conveys includes section component widths, grades, slopes, pavement structure depths, and materials.
2. The subassembly represents a component of a typical cross section. Examples of subassemblies include lanes, shoulders, curbs, sidewalks, and barriers.
3. Subassemblies have parameters with values that can be edited. For example, you can modify the width, slope, and pavement structure depths for lane subassemblies.
4. You first need to locate the subassemblies on a tool palette. You can use the default tool palettes that come with Civil 3D. You can also create your own and copy the subassemblies from the Subassembly Catalog to the new tool palette. The next step is to modify the parameter values on the tool palette. Finally, you create an assembly in the drawing and add subassemblies from the tool palette.
5. A baseline is the alignment that controls the creation of the corridor model. Each baseline has an assigned profile. You can use multiple baselines to create a corridor model. A subdivision road with a cul-de-sac uses a baseline for the main section and another baseline for the cul-de-sac. Within each baseline you have multiple regions, which are represented by independent station ranges. You can assign a different assembly, frequency, and target mapping within each region.
6. Some subassemblies allow for target mapping. This means that the subassembly can interact with another Civil 3D object. For example, you can control the width of the lane subassemblies by assigning a target alignment to control the width. This is how you achieve lane width transitions using the same assembly.

7. A top surface for a corridor model can be used to calculate manhole rim and invert elevations for pipe runs. It can also be used to label design spot elevations and grades.

Lesson Summary

In this lesson, students learned how to work with assemblies and corridors. First, students created two assemblies from subassemblies, and then students created a corridor model of a subdivision road with a cul-de-sac. From the corridor model, students created a corridor surface for the top of the corridor and for the datum of the corridor.

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