

# Road Design with AutoCAD® Civil 3D®

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### Introduction

AutoCAD® Civil 3D® engineering software provides civil engineering professionals with targeted solutions for a wide variety of infrastructure projects, including land development, transportation, and water projects.

This document is an overview of workflows using AutoCAD Civil 3D for basic road design. These workflows are straightforward in the creation of dynamic models and built based on applicable industry-recognized or user-defined standards.

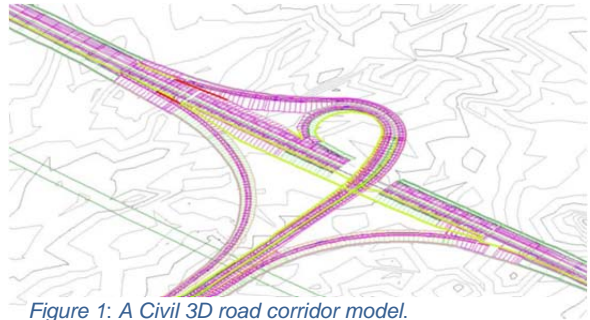


Figure 1: A Civil 3D road corridor model.

The overview begins with fundamentals and the general workflow for building road models. Then the behaviors and functionality of the overall road model and its individual components are described. Finally, an example is shown.

### About Road Design in Civil 3D

#### The General Workflow

- Create base map—Road design typically begins by creating an existing conditions surface and compiling a base map of existing conditions; information about the topography, parcels, utilities, and other potential impacts to the route design.
- Design alignment—An alignment defines the main horizontal route that typically represents the construction baseline of the roadway. Alignments may be created using field-collected survey information or from existing CAD entities such as lines, arcs, or polylines. Optionally, they may be created using the wide variety of alignment layout tools.
- Apply design criteria—Determine the design intent and the constraints that are to be placed on the alignment. This includes speed and superelevation parameters. Design criteria may be assigned at the onset of the alignment layout or at any time during the design process. Warning alerts will aid in the swift design of a conforming alignment.
- Generate existing ground profile and design grades—Display existing ground surface data for the design alignment and create the finished grades. Finished grade profiles may be created graphically using profile creation tools, or generated from a best fit analysis of existing entities or from information from an external file.
- Construct assemblies—Assemblies define the cross-sectional component of the design and are built by connecting individual subassembly objects, thereby helping to simulate the geometry and material makeup of the road as well as helping to define how it interacts with surrounding features along the route. The subassemblies are selected from the prebuilt libraries contained in the Civil 3D Tool Palette. Custom subassemblies can also be created using the Subassembly Composer.
- Build the corridor—Corridors are the resulting dynamic 3D model representation built from the combination of horizontal, vertical and cross-sectional design elements.
- Analyze resulting model—Corridors may be used to calculate earthworks and quantity takeoffs, to perform sight and visual analysis, to generate surfaces, and to extract information for construction purposes.

Individual corridor sections may be examined and edited to help accommodate unique or localized design conditions.

- Optimize design—To achieve a better design it may be necessary to adjust one or more of the corridor components. For example, you can adjust the design profile to better balance cut and fill volumes. Edits may be done using a variety of methods, such as grips, via tabular inputs, and with object-specific editing commands. In addition, since the road design is dynamic, changes made to one component affect the entire roadway model.

### About Civil 3D Corridors

Corridors combine surface, alignment, profile, and assembly information to create dynamic three-dimensional representations of route-type features, such as roads, railroads, channels, and bridges.

Corridors are the main design object of road modeling and simulation in Civil 3D. They rely on interaction with other model objects and they help to simulate behavior prescribed by assignable and customizable parameters, such as daylighting, lane widening, and superelevation schemes.

A corridor is created by applying an assembly along the horizontal and vertical path defined by the combined information of the alignment and profile. To complete the corridor, targets are specified to achieve daylighting.

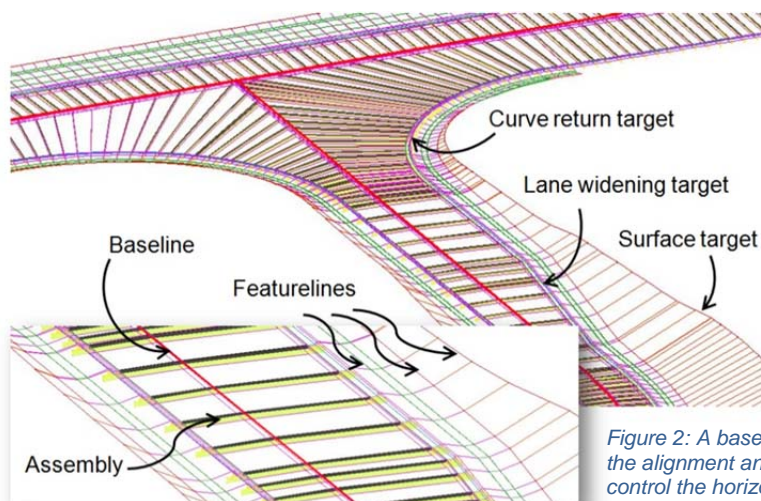
The type of corridor, such as a trench, a channel, a path, a road, or a bridge, is determined by the assembly configuration that is applied along the baseline at desired intervals. The assemblies that are used to create the corridor may contain sophisticated behavior such as conditional targeting, widening, and superelevation.

The result is a 3D model that extrudes the specified assemblies along the desired path. Feature lines connect similar points from assembly to assembly. These feature lines establish the longitudinal edges of the 3D model. Individual points in the assembly may also be assigned behavior that automatically follows prescribed targets, such as curb return alignments or lane-widening feature lines.

The resulting corridor model may be used to generate cross-section sheets, earthwork and material volumes, feature lines, and surfaces. Surfaces derived from the corridor can represent finished grades, subgrades, or any number of underlying component surfaces. These surfaces may be used for visualization, material quantity, and construction purposes.

### Components of the Corridor Object

The corridor object is built using baselines, assemblies, regions, parameters, and optional surfaces. Figure 2 shows a portion of a corridor and the components used to create it.



*Figure 2: A baseline is defined by the alignment and profile that control the horizontal and vertical aspects of the road. An assembly is then inserted to follow this path.*

The corridor components are:

- **Baseline**—A baseline defines the horizontal and vertical route. It is derived from combining the alignment and the design profile.
- **Assembly**—An assembly represents the cross-sectional design of the road. Assemblies are collections of interlocking subassemblies, which may contain dynamic design parameters such as conditional daylighting or lane widening.
- **Regions**—Individual portions of corridors enable application of different design parameters. Transitions from one region to the adjoining region automatically occur. Regions are defined by starting and ending station ranges.
- **Corridor parameters**—Corridor parameters are required to build a corridor object. These are assigned in the Corridor Properties panorama. The parameters are: region starting and ending stations, assembly name, frequency of assembly attachments along the region station range, and identifying any necessary targets to satisfy subassembly behavior.
- **Corridor targets**—By using the subassemblies parameters, the corridor has the ability to target surfaces, alignments, profiles, feature lines, polylines, and survey figures. Through this interaction, corridors can be designed to automatically tie embankments to a surface, widen a lane along an alignment, match a ditch invert to a profile, and accommodate many other design scenarios. A corridor may be modeled without a surface; however, daylighting is required to perform certain road model analysis, such as earthwork calculations. Generally speaking, targets are used when the geometry of the corridor needs to change as the design progresses along the baseline.

## About Rule-Based Design

Using AutoCAD Civil 3D, you can compare the design of road elements against recognized industry standards or user-defined standards. As designers work to lay out designs, the software provides graphic alerts and/or notification tips to help alert you when standards are not met.

This capability helps provide many benefits, including greater time savings, reduced rework due to fewer review comments, more consistency, and, above all, sound engineering design. This is made possible using design criteria and design check sets.

Design criteria may be assigned to the horizontal geometry of the centerline, for example, helping to meet the minimum radius criteria for horizontal alignments based on design speed.

Design criteria can also be assigned to profiles. The criteria considers minimum K values based on required stopping, passing, and headlight sight distance derived from design speed.

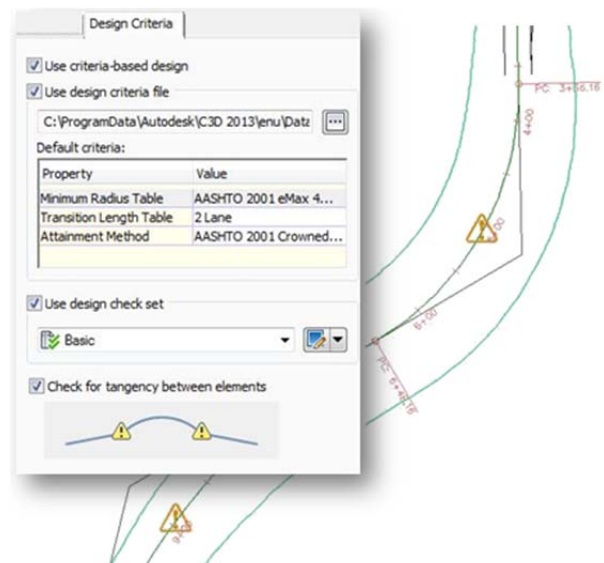


Figure 3: Design criteria and design check sets are options of Alignment and Profile Properties.

Design checks are another way to control road design as the geometry is being laid out. For example, design checks can be established that limit the minimum length of alignment tangents.

## Rule Violation Warnings

Warnings appear in several locations to help give the designer notification when a violation to the applied criteria or design checks occurs. Alert symbols are displayed at locations along the alignment or profile where the violations occur. Hovering over the symbol displays the tool tip, which gives a brief summary of the violation. The display of the warning symbol is controlled by the alignment style.

Warning symbols will also display in the entity grid view to help notify the designer of any issues. The designer can choose to correct the issues or ignore them if the design requirements permit. When the issues are resolved, the warning symbols will disappear.

A design criteria report can be generated, helping to identify whether each subentity within a given station range violates or meets the appropriate design criteria and design checks. The reporting utility is accessed in the Toolbox tab of the Toolspace.

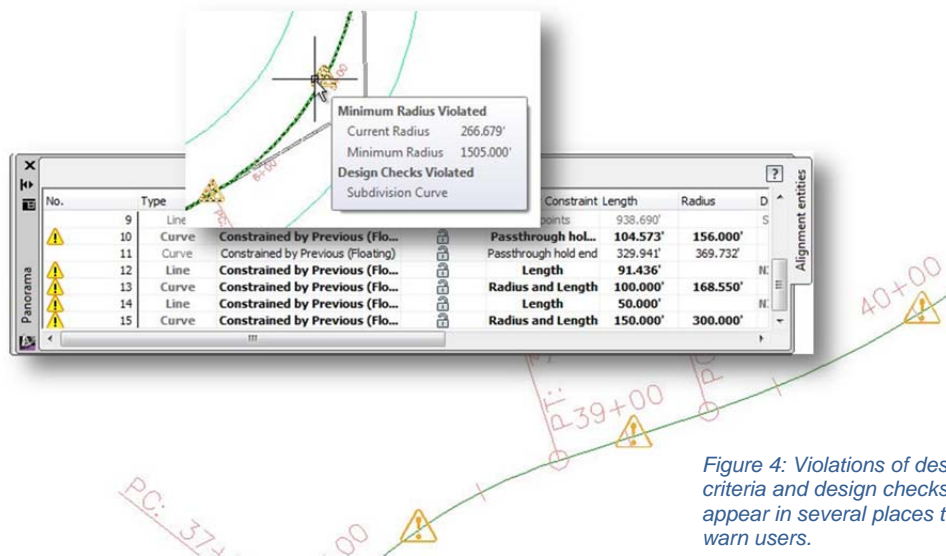


Figure 4: Violations of design criteria and design checks appear in several places to warn users.

## Design Criteria Files

AASHTO-based design criteria files are included with AutoCAD Civil 3D software. These files can be used as-is, or copied and modified to better suit specific design needs. The application of design criteria is an optional property of the alignment and profile objects, as shown in Figure 3. The Design Criteria Editor is used to create custom criteria files, as shown in Figure 5.

The default folder location for design criteria files is:  
 ...|ProgramData\Autodesk\C3D 2013\enu\Data\Corridor Design Standards\

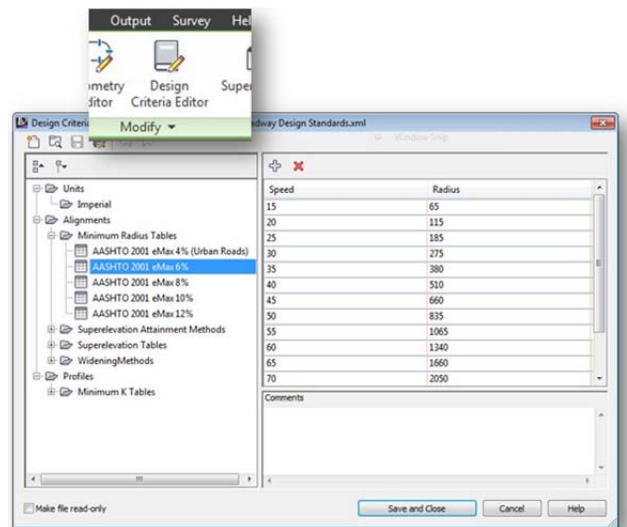


Figure 5: Editing design criteria in the Design Criteria Editor.

## About Design Checks

Design checks are another way to help track and control the road design in real time and can be used by themselves or in conjunction with design criteria files. Design checks use mathematical expressions to compare a geometric property of an alignment or profile with a predetermined value.

For example, roadway design may require that tangent road segments be longer than a specified length, or that curve radii exceed a minimal radius.

Design checks are managed through the Settings tab of the Toolspace and can be arranged into design check sets.

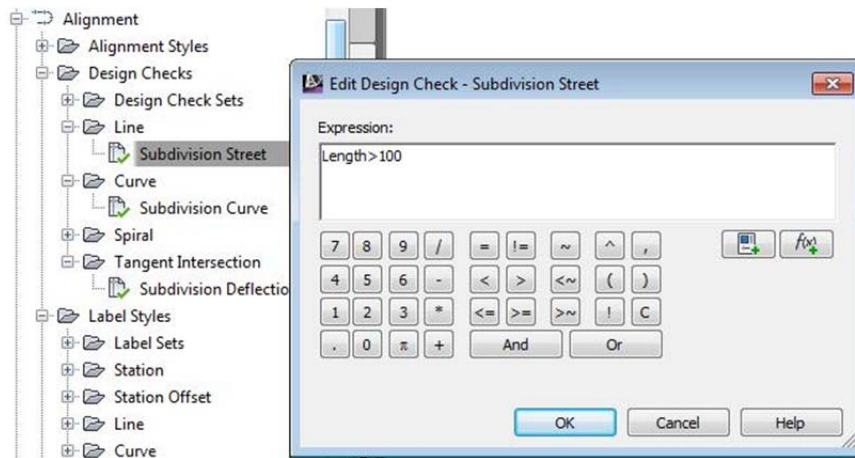


Figure 6: Design check rules are easy to modify and create. They are accessed in the Alignment or Profile collection of the Settings tab in the Toolspace.

## Alignments

Alignments define the horizontal routes for features such as channel ways, utility trenches, roads, and bridges. Their geometry is represented by straight line tangents and a variety of curve and spiral types.

When individual geometry is connected to create an alignment, rule-based design constraints may be applied.

### Alignment Creation and Editing

Alignments may be created in a variety of ways. They may be created from existing line, arc, and polyline entities, or they may be created using the Alignment Layout tools, as shown in

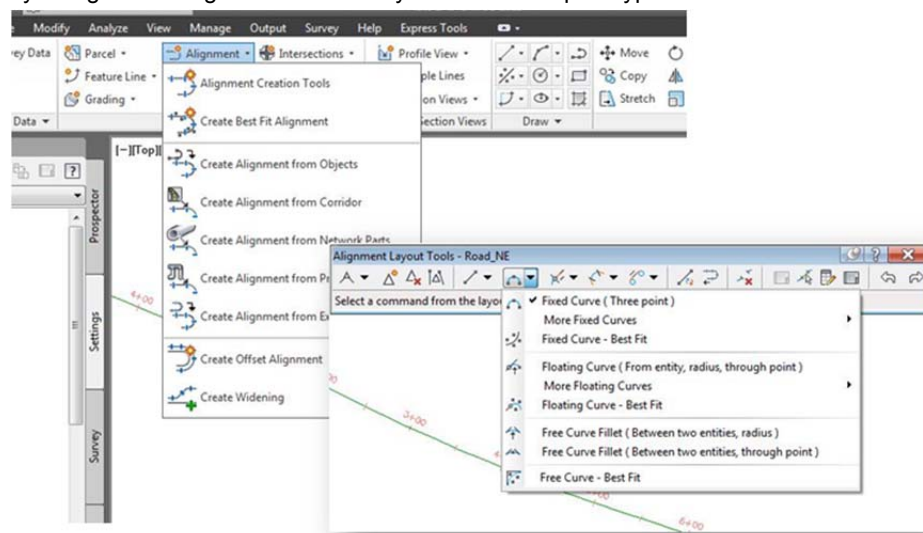


Figure 7: The Alignment Creation menu and the Alignment Layout toolbar.

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Figure 7. Alignments are edited using grip edits or alignment editing commands. Editing may also be done in tables using the alignment grid view, as shown in Figure 8.

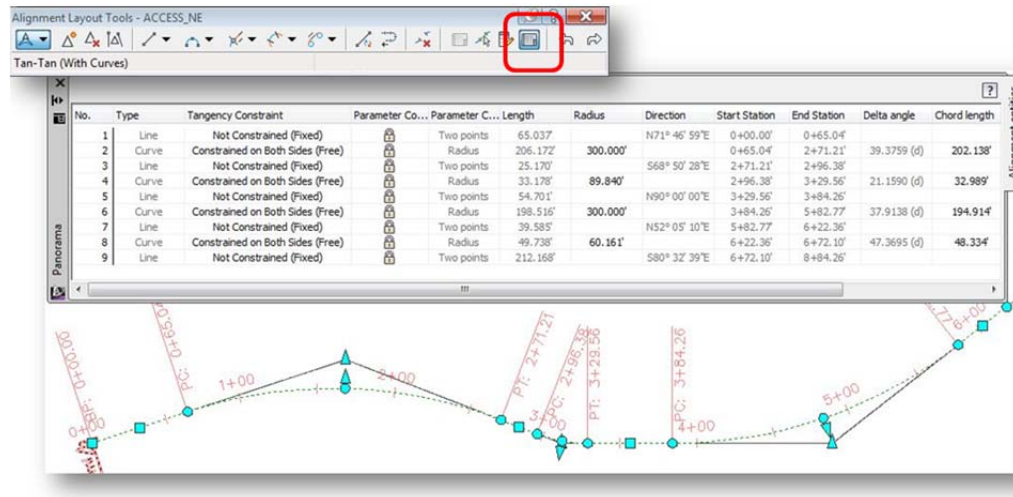


Figure 8: Alignments may be edited using graphical methods or by changing values in the Alignment entity panorama.

### Applying Design Criteria to Alignments

Design criteria can be applied at the onset of the alignment creation, or added later by using the Design Criteria tab of the Alignment Properties panel. When criteria and design checks are assigned at the onset, the designer can have the advantage of real-time warnings when violations occur.

Additional design speeds can be added as required in the Design Criteria tab of the Alignment Properties panel, as shown in Figure 9.

The use of a Design Check Set is also toggled on in the Design Criteria tab of the Alignment Properties panel. Tangency between alignment entities can also be checked via Design Criteria settings.

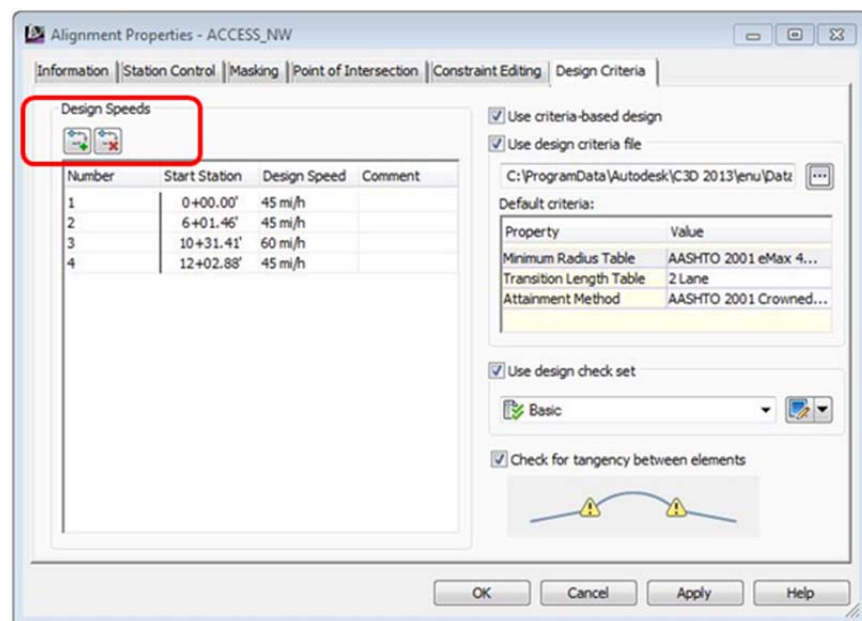


Figure 9: Adding design speeds to the alignment criteria.

For real-time warnings during the layout of the alignment, the Use criteria-based design and Use design check set options are selected at the onset of alignment creation, as shown in Figure 10.

### About Superelevation

Superelevation is the banking of a curve to help counterbalance the centrifugal forces that a vehicle experiences while traveling through a curve.

When superelevation parameters are applied to the alignment object, the resulting corridor model will rotate and warp the cross-sectional links and shapes to reflect the raising of one edge of the travel way above the other.

The corridor relies on the behavior of subassemblies to adjust their final shape and position accordingly. Many out-of-the-box Civil 3D subassemblies support superelevation.

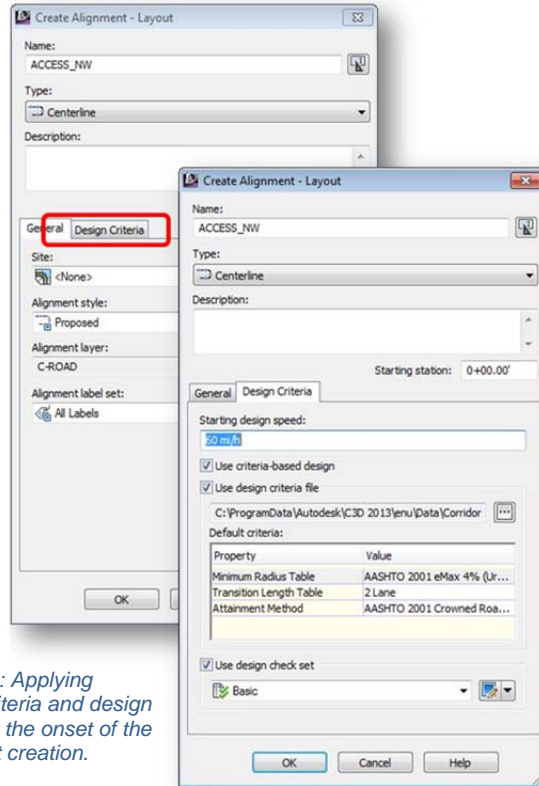


Figure 10: Applying design criteria and design checks at the onset of the alignment creation.

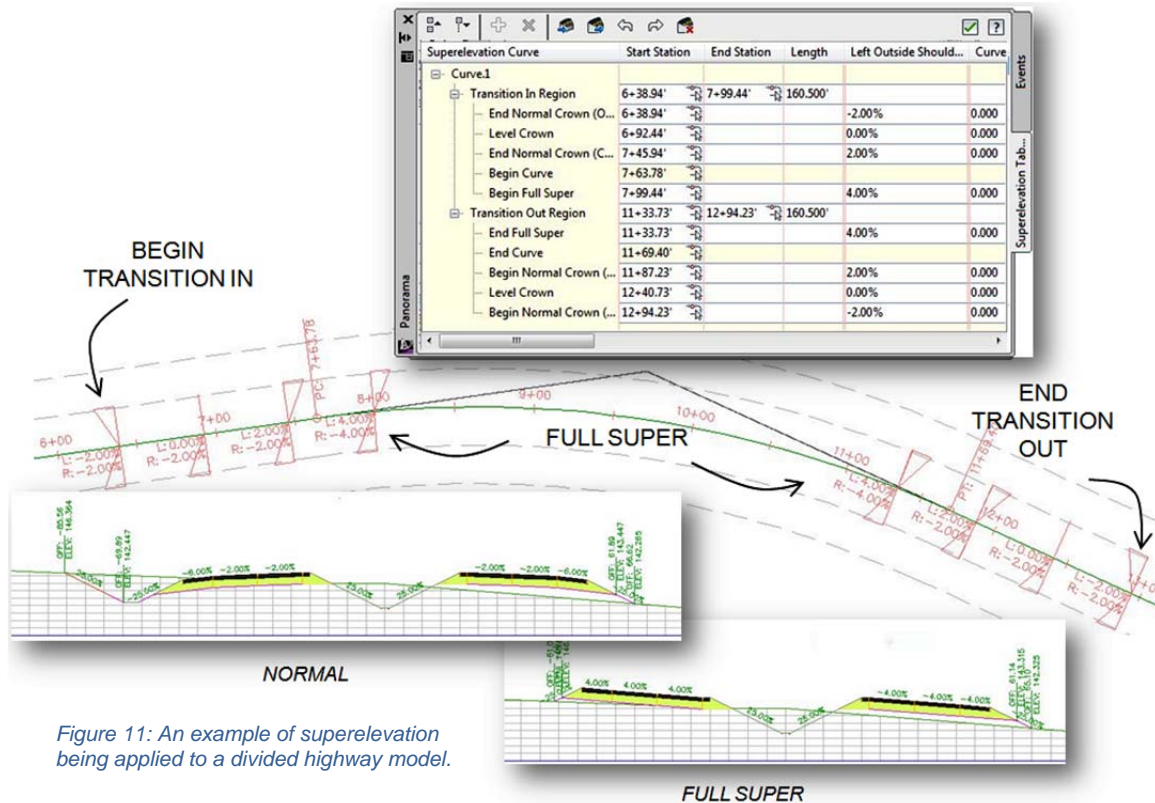


Figure 11: An example of superelevation being applied to a divided highway model.



## Superelevation Attainment Methods

AutoCAD Civil 3D supports two methods of superelevation attainment:

- Standard: used on undivided, crowned roadways and divided roadways with crowned or planar sections.
- Planar: used on undivided, planar-section roadways, such as ramps and service roads.

The attainment method uses a series of formulas to calculate the length of the transition regions that transform the road from normal crown to full superelevation. Using formulas to establish relationships between maximum superelevation rates, runoff and runout lengths, and other variables, each specific transition region can be calculated. These values are obtained from the assigned design criteria file.

## The Superelevation Wizard

The Superelevation wizard helps you define superelevation using a four-step process with visual cues at each step in the process. As options are selected, the associated configuration image will react to display the method scheme, as shown in Figure 12.

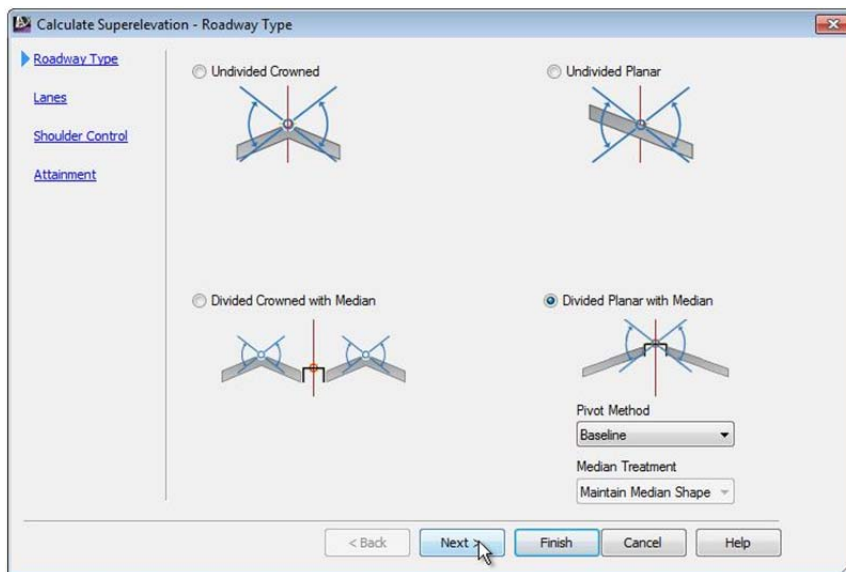


Figure 12: The first task in the Superelevation wizard is to select the roadway type. The images change to reflect a schematic representing the methods and options selected.

The wizard specifies roadway type, number of lanes, shoulder control, and attainment method for calculating superelevation.

The Superelevation wizard is used to:

- Calculate the superelevation for all curves or a selected curve in an alignment
- Store the design criteria in the superelevation curve manager for review or editing after data is calculated

The designer should have a well-defined concept of the design and desired superelevation behavior before starting the wizard. However, if design intent changes it is easy to reapply the Superelevation wizard to existing data, and there is a warning prompt to verify that all existing values will be overwritten.

### Editing and Displaying Superelevation Data

Superelevation values for individual curves are displayed and edited using the Superelevation Curve Manager. It is accessed by selecting the alignment either in the drawing or from the Prospector tab.

A grid view of all superelevation values for the entire alignment may also be used for review and editing. The grid view is launched by selecting the View Tabular Editor in the alignment context commands, as shown in Figure 14.

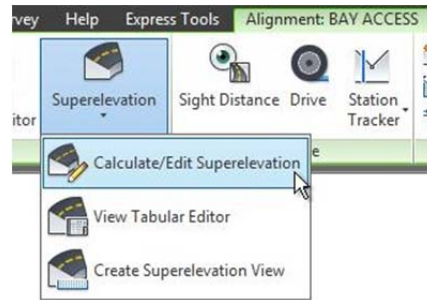


Figure 13: Launching the Superelevation wizard.

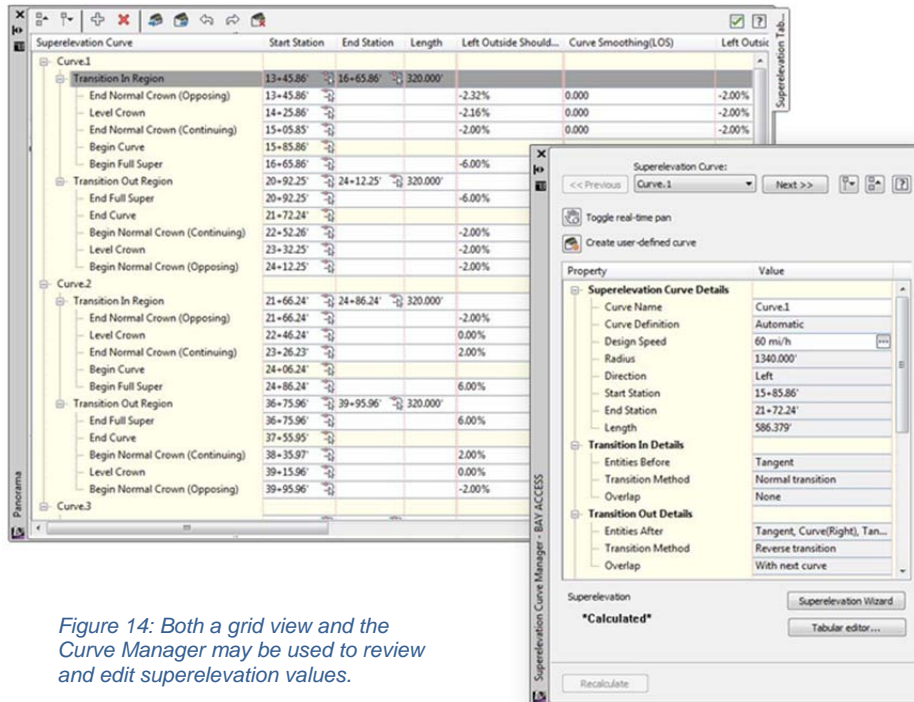


Figure 14: Both a grid view and the Curve Manager may be used to review and edit superelevation values.

### Profiles

Profiles define the surface elevation along an alignment. Design grade profiles are defined using tangents and vertical crest and sag curves.

Profile geometry may be controlled using design criteria that specify three types of minimum K tables based on stopping sight distance, passing sight distance, and headlight sight distance (K-value represents the horizontal distance along which a one percent change in grade occurs on the vertical curve).

Additional criteria and design checks can include slopes and curves that are designed for safe or comfortable driving at a particular speed, or for sag curve drainage considerations.

## Applying Design Criteria Files to Profiles

Design criteria is applied to profiles using methods similar to the ones used for alignments; criteria and design checks can be applied at the onset of design or afterwards.

If the profile's parent alignment uses design criteria, that design criteria file is automatically applied to the profile by default.

## Assemblies

Assemblies represent the cross-sectional composition of the road design. Assemblies are collections of individual subassembly components representing items such as medians, lanes, curbs, sidewalks, and shoulders. An example is shown in Figure 15.

The assembly object serves as the baseline to which the designer snaps together any number of premade subassembly pieces from the Civil 3D Tool Palette.



Figure 15: An assembly is made of up a combination of subassemblies such as sidewalks, curbs, and lanes.

Assemblies may contain functionality that is critical in the building of complex road systems, such as intersections, conditional daylighting, and superelevation. An example of an assembly with conditional daylighting is shown in Figure 16. The steepness of the cut condition is automatically adjusted when a rock type surface is encountered.

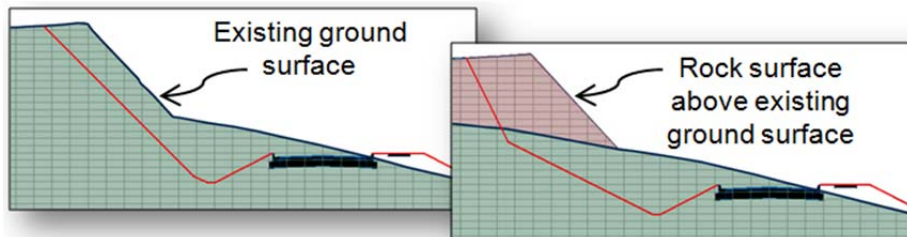


Figure 16: This assembly example has conditional daylighting functionality. The slope of the cut condition is automatically adjusted to accommodate different surface types.

## Subassemblies

AutoCAD Civil 3D contains an extensive collection of subassemblies for a wide variety of road design applications. The scope of their application ranges from simple marked points and generic links to very sophisticated superelevated lane objects with axis of rotation options. Custom subassemblies can also be made from AutoCAD® entities or by using the Subassembly Composer.

The basic components of subassemblies are points, links, and shapes. Their geometry and behavior are controlled by input parameters.

## Road Design Using AutoCAD Civil 3D

Parameters vary depending on the intended function of the subassembly. Some parameters are static, manually entered values, while others are derived automatically from another object or entity within the drawing. For example, a lane width may be assigned to follow a meandering polyline instead of holding a fixed value. This is an example of a target parameter. Surfaces are also common parameters, as they are needed to calculate the daylighting.

Subassemblies can also be tied to the superelevation parameters of the alignment. As the corridor is built, any subassemblies that reference superelevation will recognize the information contained in the alignment and respond to it. For example, subassembly lane objects will automatically adjust their cross-slopes throughout transition and full superelevation regions along the alignment curves.

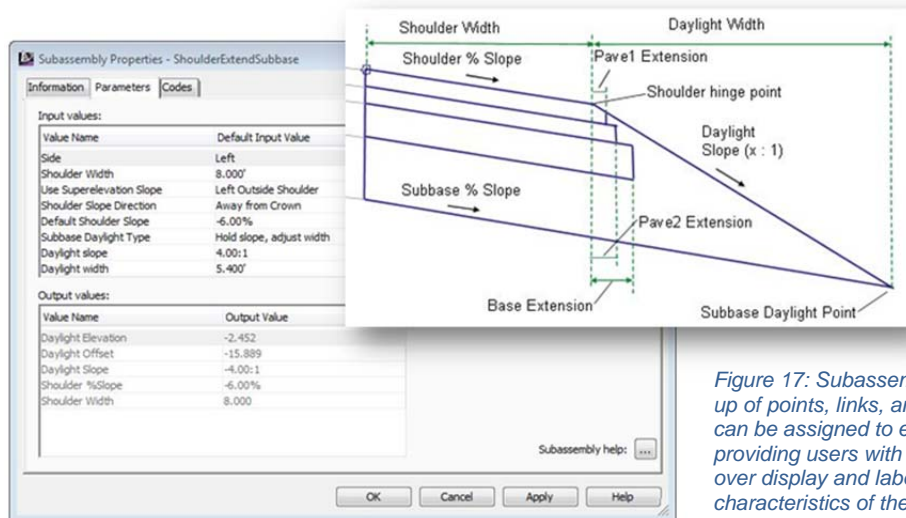


Figure 17: Subassemblies are made up of points, links, and shapes. Styles can be assigned to each component, providing users with greater control over display and labeling characteristics of the subassembly.

Styles are used to control the appearance and labeling of the individual point, link, and shape components of the subassemblies. The many styles required are grouped into Code Sets. Code Set settings are located in the General collection on the Settings tab of the Toolspace, as shown in Figure 18.

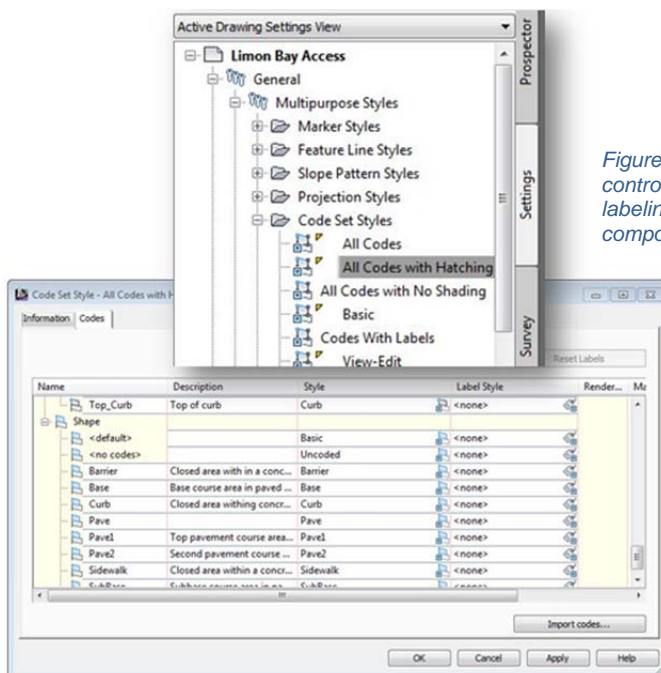


Figure 18: Code Set styles control the appearance and labeling of subassembly components.

### Using Point, Link, and Shape Codes

Points, links, and shapes are the basic building blocks of subassemblies, and they each have assigned codes. Codes are used for many purposes. For example, point codes can control the creation of corridor feature lines, such as a daylight line, as shown in Figure 19.

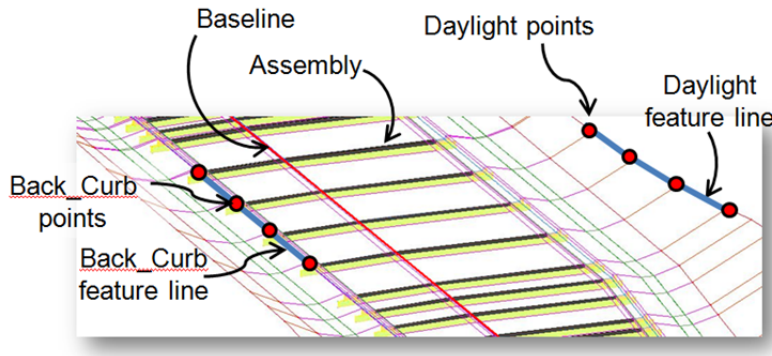
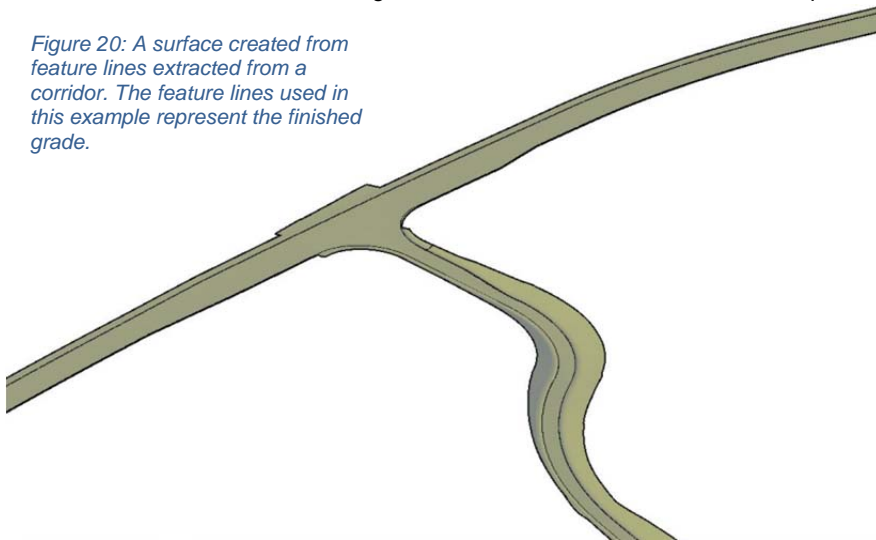


Figure 19: Using point codes to create corridor feature lines.

When the corridor is built, the matching point codes from the subassemblies are connected from assembly to assembly, creating corridor feature lines. These feature lines inherit the same name of the point code from which they are derived.

This robust corridor model information is used to create surfaces representing finished grades, subgrades, and materials. The surface shown in Figure 26 was created from feature lines representing the finished grade.

Figure 20: A surface created from feature lines extracted from a corridor. The feature lines used in this example represent the finished grade.



Effective use of point, link, and shape code styles can greatly improve the efficiency of documenting and displaying roadway designs throughout the entire project.

Additionally, link codes can be assigned a render material for visualization purposes and an area fill material for hatching purposes within the drawing.

Codes can also be used to automate the labeling of section views, as shown in Figure 21.

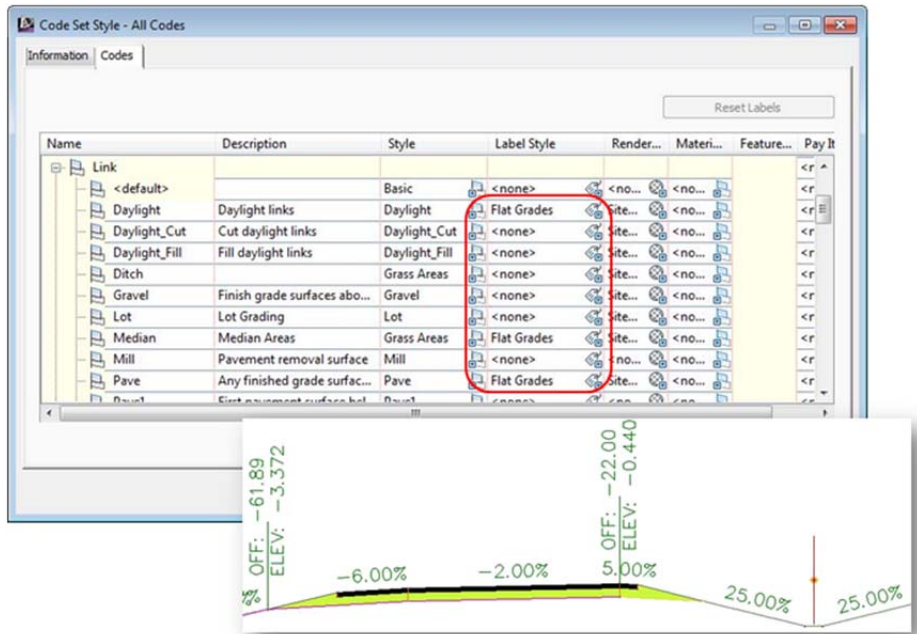


Figure 21: Using point and link codes to automate section view labeling.

## Using Targets

Many AutoCAD Civil 3D subassemblies have the ability to interact with other objects in the drawing through target parameters. For instance, all daylighting subassemblies require the use of a surface target parameter. The job of the daylight subassembly is to seek out and intersect with a given surface according to the instructions provided by the input parameters.

Many different daylighting scenarios can be modeled using the daylight subassemblies provided with AutoCAD Civil 3D software. For example, some daylight subassemblies will seek out a surface and tie to it while maintaining a given width for the daylight embankment. Others can automatically create benches, ditches, and berms, and/or adjust the slope, depending on the material being excavated.

Other subassemblies, such as lanes, medians, and sidewalks, have the ability to target feature lines, alignments, and survey figures to control width and change shape as they progress along the corridor. A turning lane, for example, can be modeled using a transition subassembly along with a feature line target representing the edge of the travel way. As the feature line moves away from the road centerline, the subassembly widens to create the additional lane.

Slope or elevation targets can also be utilized with some assemblies to control the vertical aspect of the road design. For instance, a profile could be applied to the edge of the travel way to control its elevation and at the same time the alignment is controlling its horizontal position.

Some subassemblies can even target a marked point, enabling them to seek out a specific location on another subassembly and connect to it, such as seeking out a marked point on an access ramp assembly and automatically creating a swale between the two roadways.

### Axis of Rotation Pivot Methods

Pivot point locations are not always at the insertion point of an assembly. When the pivot point location needs to be specified at the inside edge of a curve, the outside edge of a curve, or always on the left or right edge of a roadway, special subassemblies must be used that contain pivot functionality, and the ability to support axis of rotation (AOR) at prescribed pivot point locations. Subassemblies that are used between the pivot point and the baseline raise or lower the profile grade line to accommodate the pivot point. All of the subassemblies comprising the pivoting assembly must have the ability to support the axis of rotation calculation.

Subassemblies that support AOR display the possible pivot point locations when they are added to the assembly construction. The symbol appears as a half diamond shape flag with a line to the pivot spot on the subassembly, as shown in Figure 12. The desired pivot location is set in the subassembly parameters.

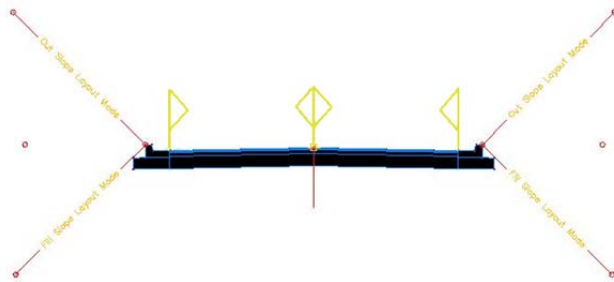


Figure 12: An assembly displaying possible pivot point locations.

### Criteria-Based Design with Superelevation Example

Developing a four-lane divided road with alignment and profile design criteria and superelevation is demonstrated in the following overview. This example does not include the use of a special Axis of Rotation.

The design begins with the creation of the baseline alignment.

On the Home tab:

*Alignment > Alignment Creation Tools*

In the Create Alignment dialog, name and set the general options for the alignment, then select the Design Criteria tab. On the Design Criteria tab set the design speed and toggle on the Use criteria-based design option. Now you can apply design criteria and or design checks, as shown in Figure 22.

In this example, the design speed is 60 miles per hour and the criteria is defined based on a standardized file using standard AASHTO formulas. The Basic design check set is also selected.

Criteria-based design is now invoked and violation alert symbols can be displayed when alignment entities are not in compliance.

Alignment geometry is edited graphically using grips and glyphs, which represent different geometry points, or in the grid view where values may be accessed directly, as shown in Figure 23.

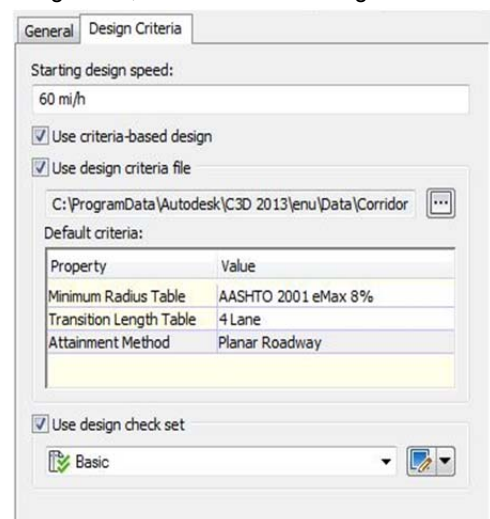


Figure 22: Apply criteria before the alignment is drawn.

No.	Type	Tangency Constraint	Parameter Co...	Parameter Constraint	Length	Radius	Minimum Radius	Design Speed
1	Line	Not Constrained (Fixed)		Two points	1585.864'			60 mi/h
2	Curve	Constrained on Both Sides (Free)		Radius	586.379'	1340.000'	1340.000'	60 mi/h
3	Line	Not Constrained (Fixed)		Two points	402.152'			60 mi/h
4	Curve	Constrained by Previous (Floating)		Radius	933.585'	1021.133'	1340.000'	60 mi/h
5	Curve	Constrained on Both Sides (Free)		Three points	1104.798'	696.048'	1340.000'	60 mi/h

Minimum Radius Violated:  
Radius (1021.133') should be greater than or equal to 1340.000'.

Figure 23: Violations also appear in the Alignment entity vista.

To calculate and apply the superelevation values to the alignment, the Superelevation wizard is used. Using the wizard is a four-step process with visual cues at each step that reflect each parameter to be set.

By selecting the alignment in the drawing, the Superelevation wizard is accessed using the Superelevation > Calculate/Edit Superelevation menu option found in the Modify panel. This wizard will be used to calculate curve values for the entire alignment. Additional values can be added manually when necessary, using alignment curve management tools.

The designer should have a well-defined concept of the design and desired superelevation behavior before starting the wizard. However, if design intent changes, it is an easy process to recalculate using the Superelevation wizard.

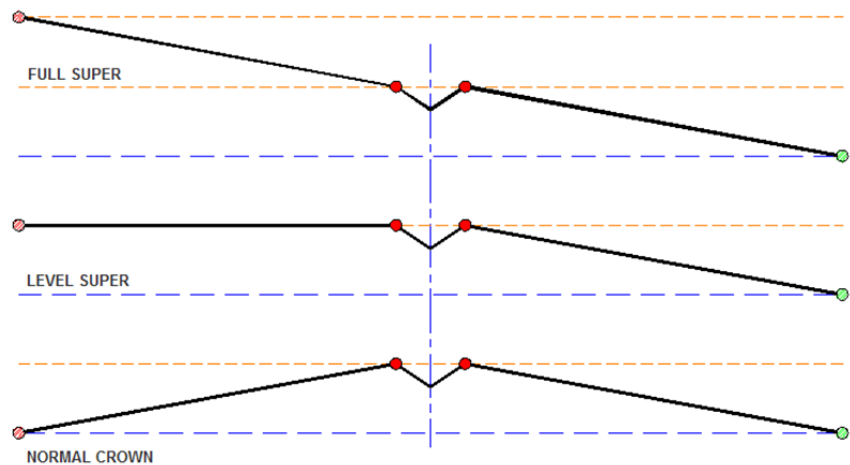


Figure 24 – This is a schematic of the superelevation design intent for this example.

The first step in the wizard defines the roadway type and the desired pivot method.

We will use the Divided Planar with Median road type and set the Pivot Method to Baseline. This will enable us to create an assembly where each lane can pivot at the inside edge of the travel way while maintaining the shape of the median.

The remaining steps are used to verify or modify the lanes, the shoulder control, and the attainment methods. Additionally, options for automatic curve smoothing and resolving overlaps are available. The Planar Roadway attainment method will be used for this example.

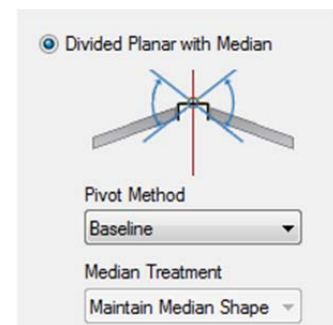
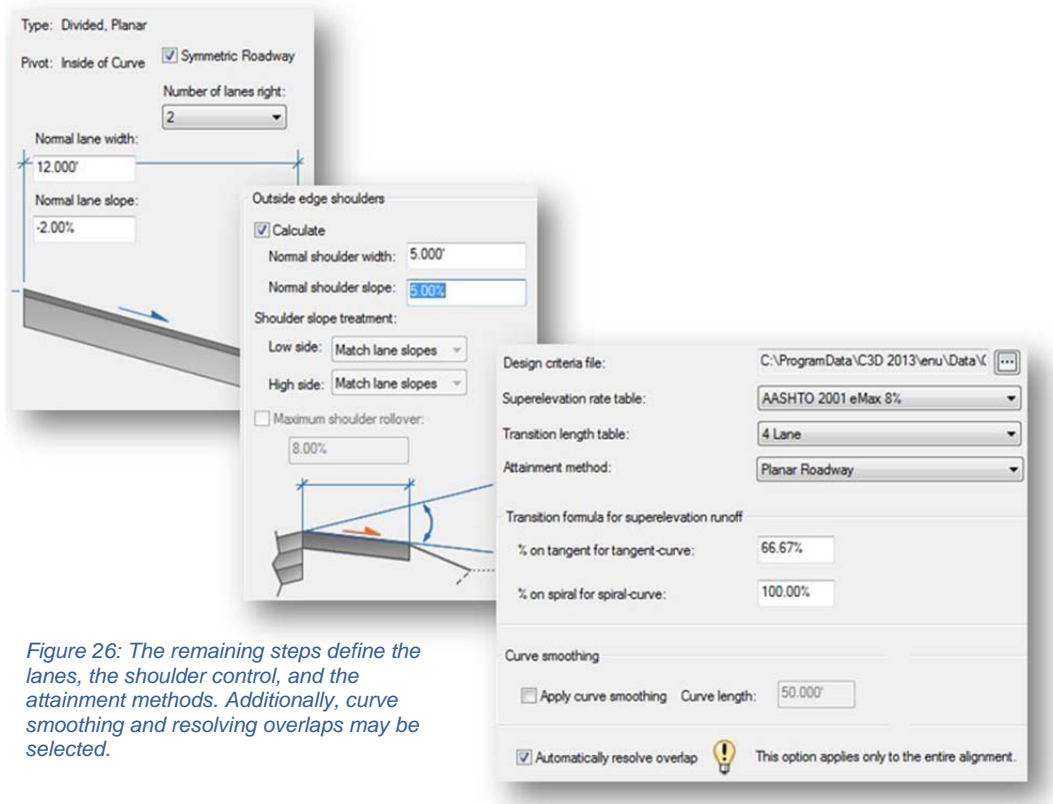


Figure 25: In the first step of the Superelevation wizard, the type of roadway, the pivot method, and the median treatment are defined.



## Road Design Using AutoCAD Civil 3D

When the wizard is completed, the calculated values are displayed in a grid view and superelevation labels appear at the associated stations along the alignment.



## Road Design Using AutoCAD Civil 3D

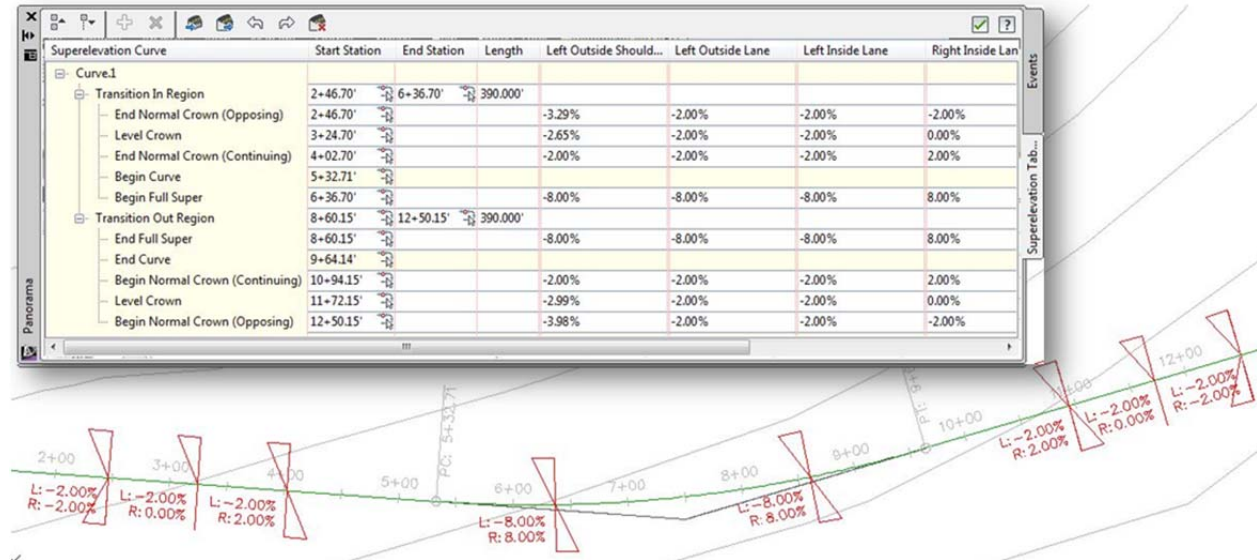


Figure 27: The resulting superelevation values are displayed in the Superelevation Tabular Editor and superelevation labels have been added to the alignment in the drawing.

Next an assembly needs to be built. In this example we will create a four-lane divided road with a depressed median. We have developed our superelevation so the pivot point is at the baseline.

When the planar roadway assembly is built, the following parameters must be set in a particular manner:

- Use Superelevation
- Slope Direction
- Potential Pivot

The LaneOutsideSuperWithWidening parameter is used here to create the four lanes. The divided lanes attach to the median subassembly MedianDepressedShoulderExt. A shoulder and standard daylighting is used on the outsides, depicted in Figure 28.

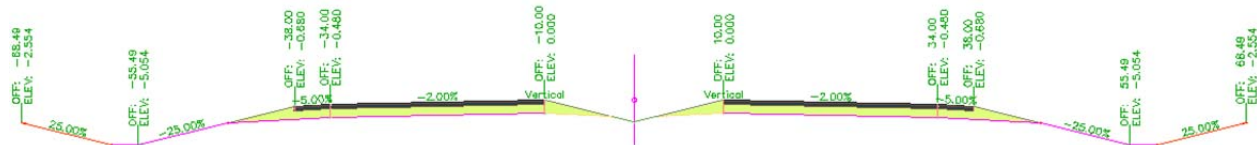


Figure 28: The assembly in this example uses two LaneOutsideSuperWithWidening subassemblies, with one on each side.

The assembly is started from the Home tab:

Assembly > Create Assembly

The assembly is named and a Code Set style selected.

Next the Tool Palette is used to select the subassemblies. The Tool Palette is launched from the Home tab or by pressing Ctrl + 3 keys.

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The best practice in building assemblies is to start and complete one side at a time. The right construction of the assembly is shown in Figure 29.

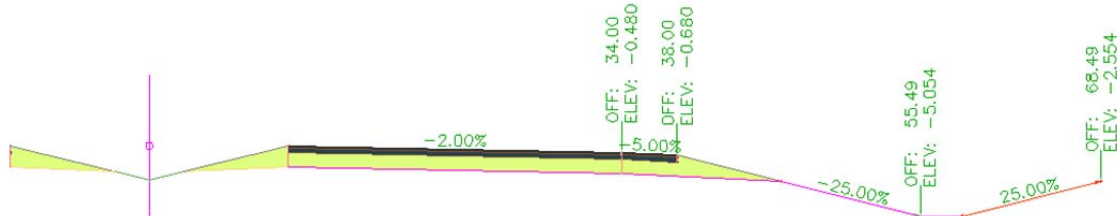


Figure 29: Details of the right side of the assembly used in this example. Notice the median subassembly attaches to the baseline and extends to the right and left.

The right side is started by connecting to the depressed median subassembly. This subassembly supports superelevation; however, in this example the median shape will be maintained so the centerline pivot parameter will be set to *Pivot-about-inside-edge-of-traveled-way*. The parameters used are shown in Figure 30.

Input values:

Value Name	Default Input Value
Ditch Width	0.00'
Ditch Slope	4.00:1
Hold Ditch Slope	Hold ditch sideslopes, shift ditch from center
Centerline Pivot	Pivot about inside edge-of-traveled-way
Shoulder Slope Direction	Away from Crown
Left Median Width	10.00'
Right Median Width	10.00'

Figure 30: The first construction in the assembly is the median that connects to the baseline. These are the parameters set for the MedianDepressedShoulderExt subassembly.

Next is the addition of the right lanes. The LaneOutsideSuperWithWidening subassembly is used for both lanes, as both lanes maintain a constant slope. The settings are shown in Figure 31.

Input values:

Value Name	Default Input Value
Side	Right
Insertion Point	Crown
Crown Point on Inside	No
Width	24.00'
Default Slope	-2.00%
Pave1 Depth	0.08'
Pave2 Depth	0.08'
Base Depth	0.33'
Subbase Depth	1.00'
Wheelbase Length	33.00'
Number of Travel Lanes	2

Figure 31: LaneOutsideSuperWithWidening parameter settings for the two right lanes of the assembly. The number of Travel lanes is set to 2.

## Road Design Using AutoCAD Civil 3D

The remaining subassemblies on the right are a shoulder and daylighting. These are represented in this example using the ShoulderExtendSubbase and DaylightStandard. The parameters for the shoulder are shown in Figure 32. The default daylight parameters are used without change.

Input values:

Value Name	Default Input Value
Side	Right
Shoulder Width	4.00'
Use Superelevation Slope	Right Outside Shoulder
Shoulder Slope Direction	Away from Crown
Default Shoulder Slope	-5.00%
Subbase Daylight Type	Hold slope, adjust width
Daylight slope	4.00:1
Daylight width	5.00'
Subbase - Use Superelev...	Outside shoulder slope
Default Subbase Slope	-5.00%

Figure 32: ShoulderExtendSubbase parameter settings for the right shoulder.

The right side of the assembly is complete and the same process may be repeated to construct the left side, or the entire right side may be selected and the Mirror Subassembly command may be used, as shown in Figure 33. In both cases the individual subassembly parameters must be edited to reflect the proper side the subassembly is on.

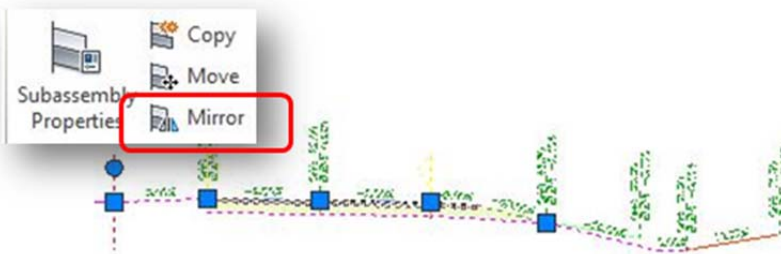


Figure 33: The Mirror Subassembly command may be used to quickly build the left side of the assembly. The properties of the mirrored subassemblies are then edited to reflect the proper left side parameters.

A good practice when creating a centered assembly is to rename the subassemblies to reflect the side of the assembly they are on, as shown in Figure 34.

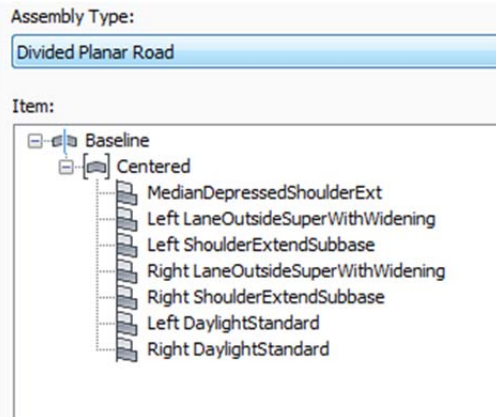


Figure 34: The subassemblies used in this assembly example.

Before building the corridor for this example, a design profile must be created. Similar to alignments, profiles may also have design criteria and design checks assigned. When initializing the profile creation, a dialog similar to the one for alignments shown in Figure 22 is used to select desired criteria. As the profile is laid out, similar warnings alerts are displayed to enable on-the-fly fixes. A typical profile violation is shown in Figure 35.

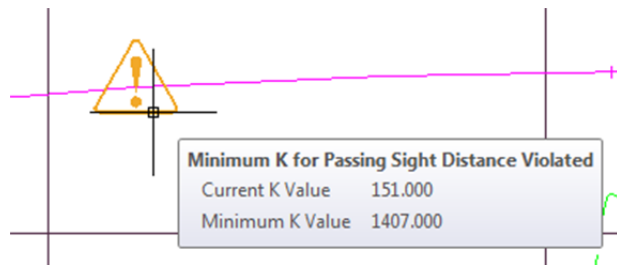


Figure 35: A warning for criteria violation on a design profile.

The Create Corridor is started from the Home tab:

With the three necessary objects in place—an alignment, a profile, and an assembly—a target surface is selected and the corridor model is built.

The View/Edit tool is used to examine the resulting corridor and check the superelevation conditions along the curve and transition regions along the alignment.

A good tip to display the section views consistently is to set the view to a specific Offset and Elevation. This will keep the view focused and zoomed in the area of interest. Scroll and pan into the desired area, then pick the option to set the view as shown in Figure 36.



Figure 36: To keep views consistent when viewing corridor section results, use the Zoom to an Offset and Elevation option.

Since you set multiple views in the Section Editor, you can select the stations where the superelevation labels are placed on the alignment from the View/Edit controls. The results of this road design through the stages of superelevation are shown in Figure 37.

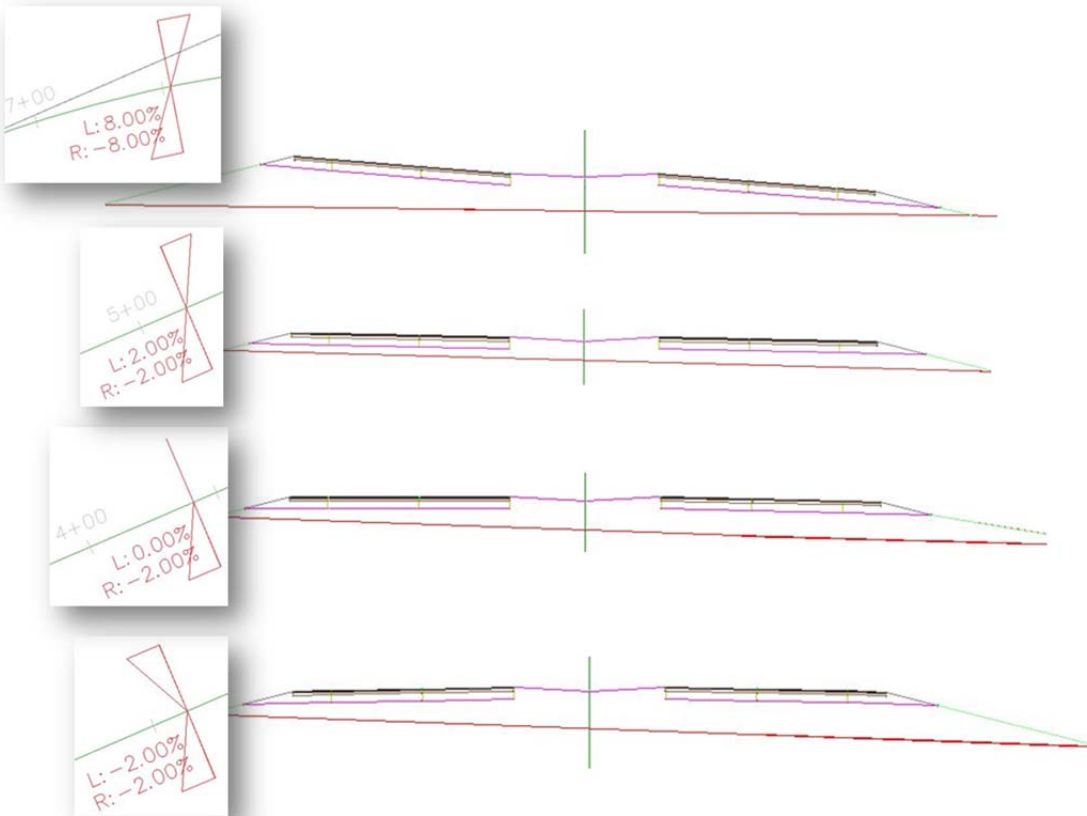


Figure 37: The resulting corridor section views showing the superelevation pivot condition at the inside edge of the travel way.

## Using the Subassembly Composer

The Autodesk Subassembly Composer for AutoCAD Civil 3D is a tool that can be used to create custom subassemblies or to modify existing subassemblies, without the need for sophisticated programming knowledge. Civil 3D users may now use their own design geometry and add conditional behavior to create custom, fully functioning subassemblies.

These subassemblies may be saved and added to an existing Civil 3D subassembly catalog. All of this can be accomplished without the need for traditional .NET programming skills.

### Installation

The Autodesk Subassembly Composer is a standalone application.

It may be installed from the following executable file, which is included with the AutoCAD Civil 3D 2013 installation files.

...\\X64\COMPONENTS\SAC2013\C3D\_SUBASSEMBLYCOMPOSER.EXE

The Autodesk Subassembly Composer may also be installed with Autodesk® Infrastructure Design Suite 2011 and 2012. It appears as an optional selection in the subcomponents list when AutoCAD Civil 3D 2013 is configured.

### Compatibility

The Autodesk Subassembly Composer creates *.ptk* file types that are converted for use in Civil 3D. To use these files in AutoCAD Civil 3D 2011 and 2012, the Support Pack for AutoCAD Civil 3D 2011 & 2012 is required.

This support pack is a freeware application that may be [downloaded](#) from:

[www.autodesk.com/civil3d-support](http://www.autodesk.com/civil3d-support)

Data and Downloads → Utilities and Drivers

### Procedure for Using Subassembly Composer

A project is started and the name of the subassembly, the optional help file, and the optional image are set.

Design the subassembly by dragging and dropping components from the Toolbox into the Flowchart panel. The Flowchart is used to organize the elements that comprise the subassembly. Elements include geometry, parameters, variables, conditional decisions, and behavioral actions.

Each subassembly parameter is named and its variable type is assigned. For example, a width parameter would be a double type, a slope parameter would be a grade or slope type, and a right or left parameter would be a string type.

Targets are added. These may be offset, elevation, or surface targets.

## Road Design Using AutoCAD Civil 3D

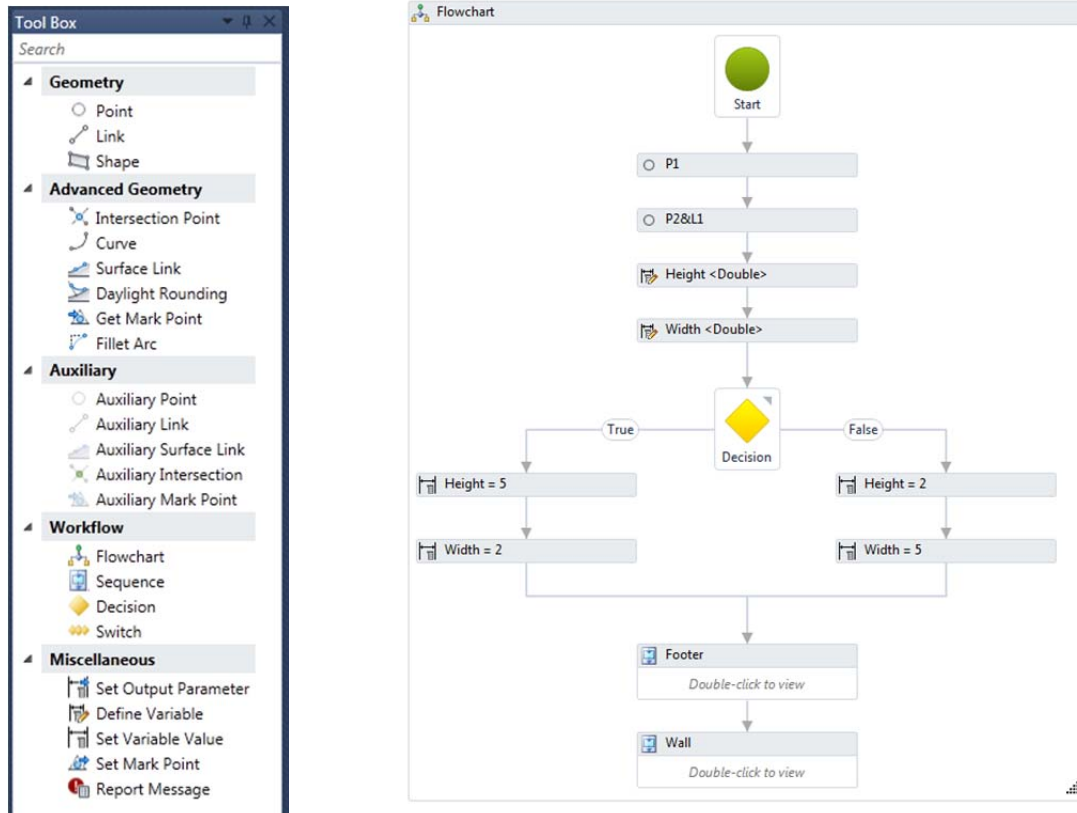


Figure 38: Custom subassembly design may now be done using the Autodesk Subassembly Composer. With little need for programming knowledge, the subassembly geometry and behavior may be created by dragging and dropping elements from the Toolbox into the Flowchart.

As the subassembly is being built, a preview panel displays the geometry and helps simulate the behavior with any applied targets.

When the design is completed, the entire project can be saved as a .pkt file type. The PKT file is a collection of all the files needed by Civil 3D to give full functionality to the assembly, and to generate its appearance on the Tool Palette. The PKT files are converted into ATC files upon import into Civil 3D.

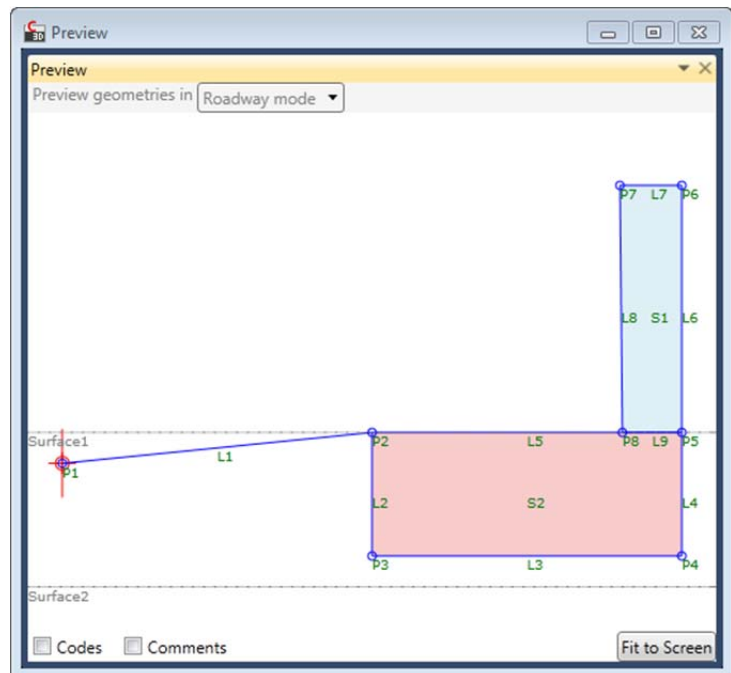


Figure 39– The Preview panel of the Autodesk Subassembly Composer displays the geometry, codes, and targeting behavior for the custom subassembly design.



### Importing a Custom Subassembly into Civil 3D

In Civil 3D, a custom subassembly may be imported directly onto the desired collection on the Tool Palette. To do this, open the desired palette tab, use the pop-up menu, and click Import Subassemblies.

Once imported, the subassembly is ready for use. If an image and description were included in the Packet Settings definition, that information is displayed on the palette panel.

Note: If you wish to use a custom subassembly created using the Autodesk Subassembly Composer 2011 or 2012 versions on a computer that does not have the Autodesk Subassembly Composer installed, you must install the [Autodesk Subassembly Composer Support Pack for AutoCAD Civil 3D](#). The support pack is not required for Autodesk Subassembly Composer 2013.

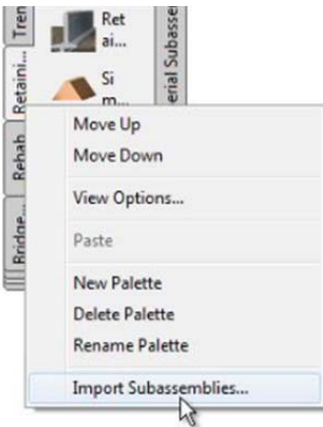


Figure 40: Use the pop-up menu in the desired palette tab to import subassemblies.

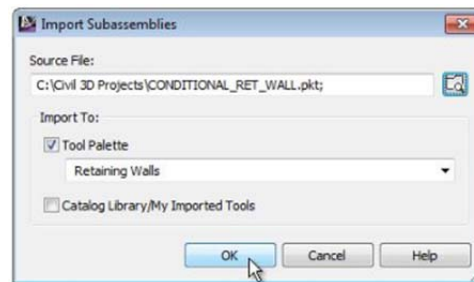


Figure 41: When importing subassemblies into Civil 3D, the import options enable the import to Tool Palette and Catalog.

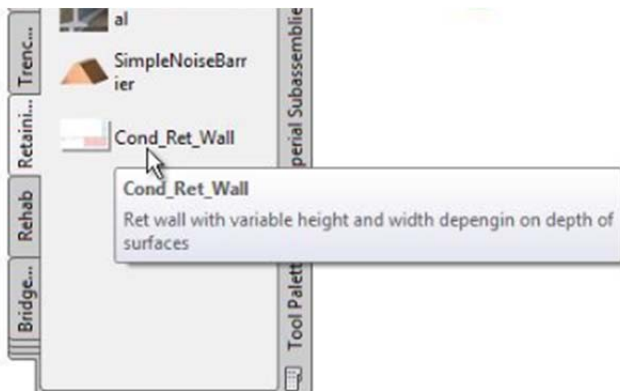


Figure 42: The imported subassemblies appear along with the existing subassemblies in Civil 3D.

## Summary and Conclusion

The solutions for road design in AutoCAD Civil 3D software make defining, annotating, and analyzing your road design more efficient and help your design comply with sound engineering standards.

Using criteria-based design, road modeling with real-time analysis and designer feedback helps expedite the design process and minimizes problematic issues.

Additionally, a good understanding of subassemblies and their functions enables the efficient construction of more accurate, construction-ready corridor models. Utilizing points, links, shapes, codes, target parameters, and road models, which can be tailored to your designs needs, will automate many repetitive and/or difficult road design tasks, such as labeling and updating cross section sheets.

This document has given you an overview of the core components and methods that are used when modeling roads. After reading this document, you should be able to begin building your own dynamic, criteria-based roadway designs and understand why Autodesk and BIM for Infrastructure can help you and your company gain a competitive edge.