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Chapter 2……..…….Civil Geometry

Chapter 3…….Civil Geometry - Vertical Alignment

Chapter 4……...……..Plan & Profile Sheet Geometry

Chapter 5……Creating Templates

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# Chapter 1

# Introduction to the Terrain Model


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## 1.1 Objectives

- Understand what is a Civil Terrain Model
- Learn how to import a Civil Terrain Model from a .tin
- Learn how to display a Civil Terrain Model

## 1.2 Definitions

A **Terrain Model** is a set of three-dimensional triangles mathematically computed from point data collected on the surface being modeled. Models are used to define highly irregular surfaces, particularly the surface of the earth, but can be generated for proposed surfaces, subsurface geotechnical layers, and etcetera. Terrain models are also referred to as digital terrain models (DTMs), triangulated irregular networks (TINs), or triangulated surfaces.

The MicroStation Terrain Model tools support importing and labeling terrain contours and spots on terrain models. You can import a terrain model into a DGN to use its data. Terrain models imported from the LandXML file format are supported within MicroStation. However, any manipulation or importing from Civil products must be done within Bentley Civil.

## 1.3 Terrain Model as a MicroStation Element

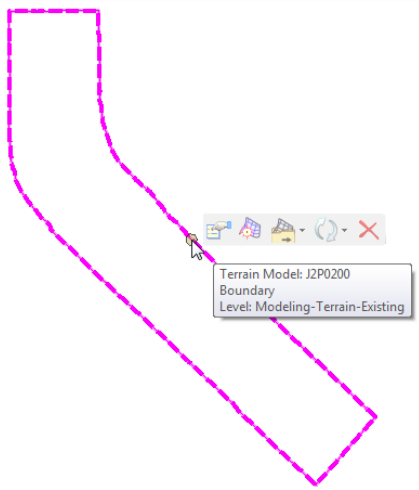
A terrain model is recognized as a MicroStation element type as of MicroStation V8i (SELECTseries 4). When you select a terrain model, the Element Selection tool Element Type tab indicates that it is a Terrain element type.

## 1.4 Terrain Models and Feature Definition

The display of terrain model properties can be controlled by using a feature definition. You can apply it to any terrain model.

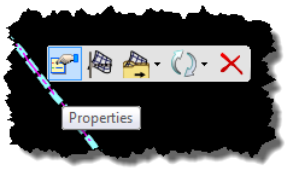
### 1.4.1 Applying an Feature Definition to a Terrain Model

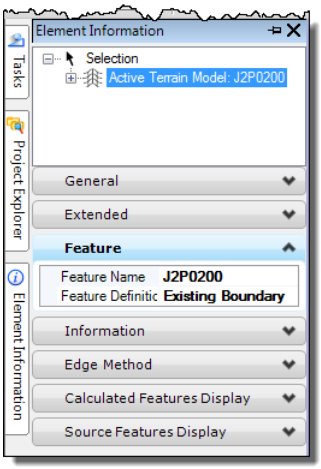
1. Open the MicroStation file where the terrain model was created.
2. Use the Element Selection tool to select the terrain model.

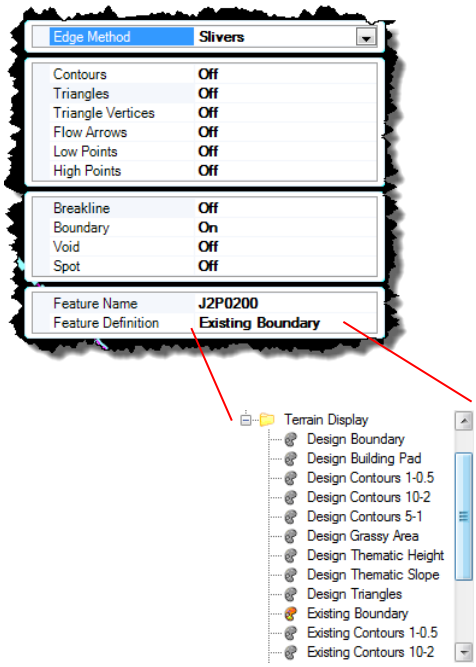



3. In the *Heads-up display* toolbox, select *Properties*.

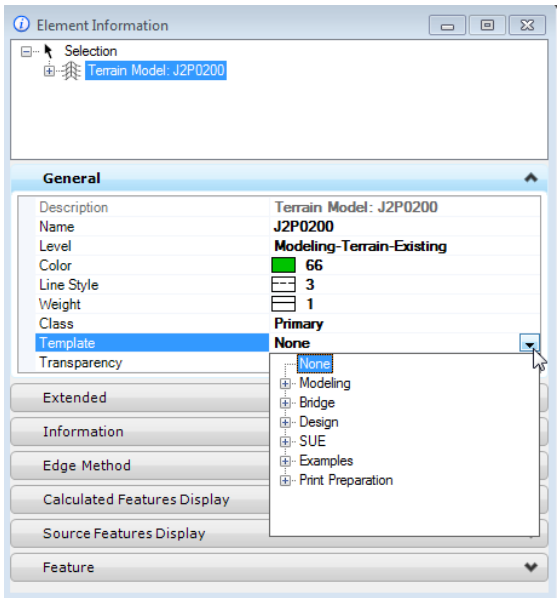
4. Or select the *Element Information* tool.



5. On the *General* tab click the arrow to the right of the Template property and select an element template.




The properties of the selected element template are applied to the terrain model.

## 1.5 Referencing Terrain Models

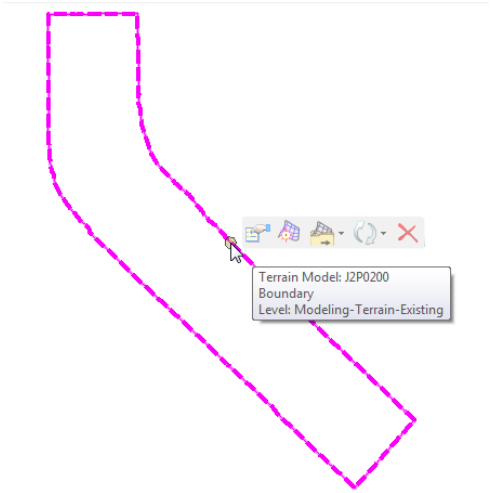
People in different job roles may want to see terrains displayed differently. For example, a designer of surfaces may need to see triangles, while a designer of drainage features may need to see contours. Rather than duplicating the terrain model in various places, the best workflow is to maintain a single terrain model and reference it into other DGN files.

When a DGN file containing a terrain model is referenced into another DGN file, you can allow the terrain model to be displayed differently in the other file. This allows the presentation to vary for different purposes, without changing the terrain model display in the original DGN file.

**To Override the Symbology of a Terrain Model**

1. Attach as a reference the DGN file containing the terrain model by selecting the References icon from the Primary Tools.

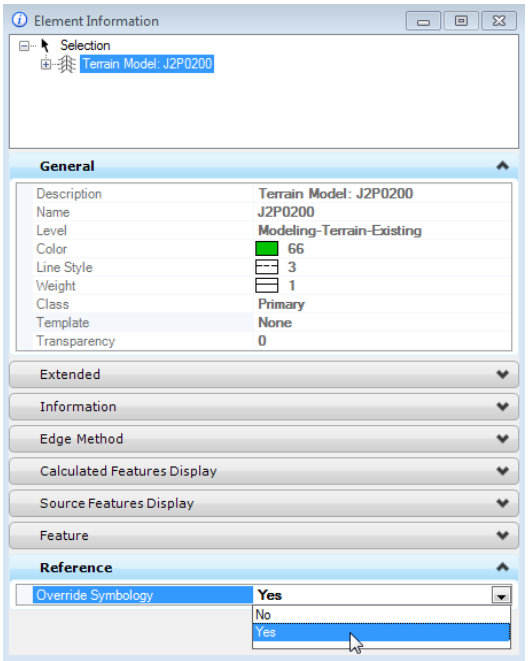
2. Select the terrain element from the MicroStation view.




3. From the Primary Tools toolbox, select the *Element Information* tool.

The Element Information dialog opens.

4. On the *Reference* tab set the *Override Symbology* property to **Yes**.




5. Change other display properties as needed or select an element template to apply to the terrain model.

The display of the terrain model changes in your DGN file according to these settings, but not in the original DGN file.

## 1.6 Overview of Civil Terrain Model

Terrains Models (TM) play a key role in Infrastructure and Mapping workflows. The data collection methods underlying these models are ever increasing in detail and coverage. Therefore, resulting terrains need to be accessible across a variety of Infrastructure and Mapping workflows.

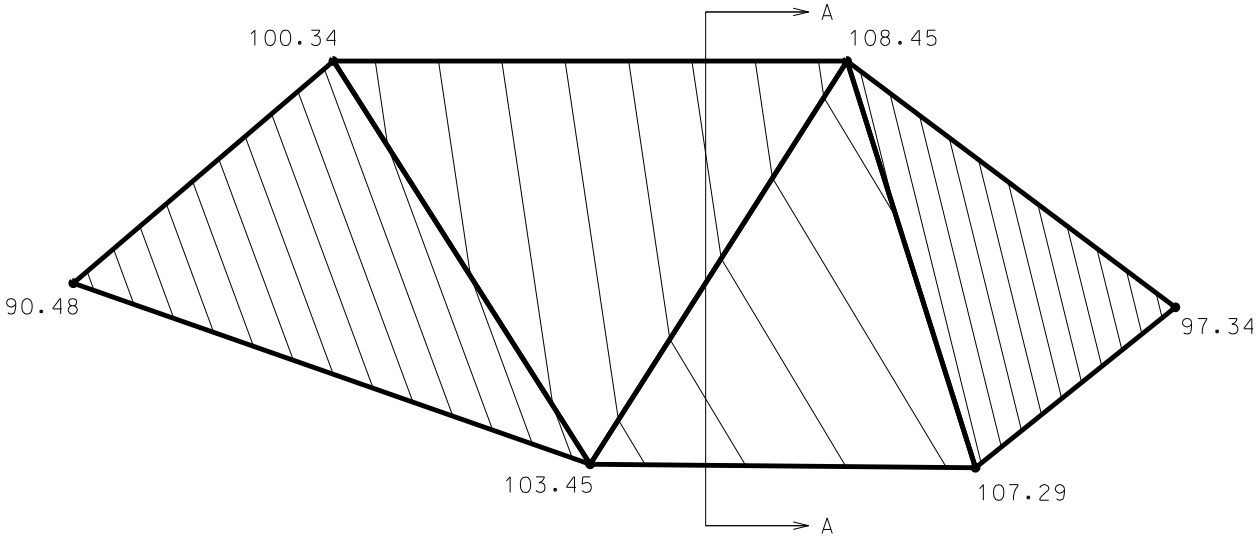
Data in a variety of formats including raw graphical elements 2D and 3D can be provided for consumption into the terrain model. The existing ground terrain model can also be used as the starting point for the creation of a proposed design terrain model using the Corridor Modeling tools.

## 1.7 Terrain Model Features

The concept of feature types is used throughout the Terrain Model tools. The available feature types are defined below.

### 1.7.1 Spot or Spot Elevation

Points (with X, Y, Z data) that have no functional relationship to any other point. Random survey shots in open terrain would be an example of random spots. Point elements such as cells, circles, and text strings are typical MicroStation elements used to graphically define spot elevations, lines,



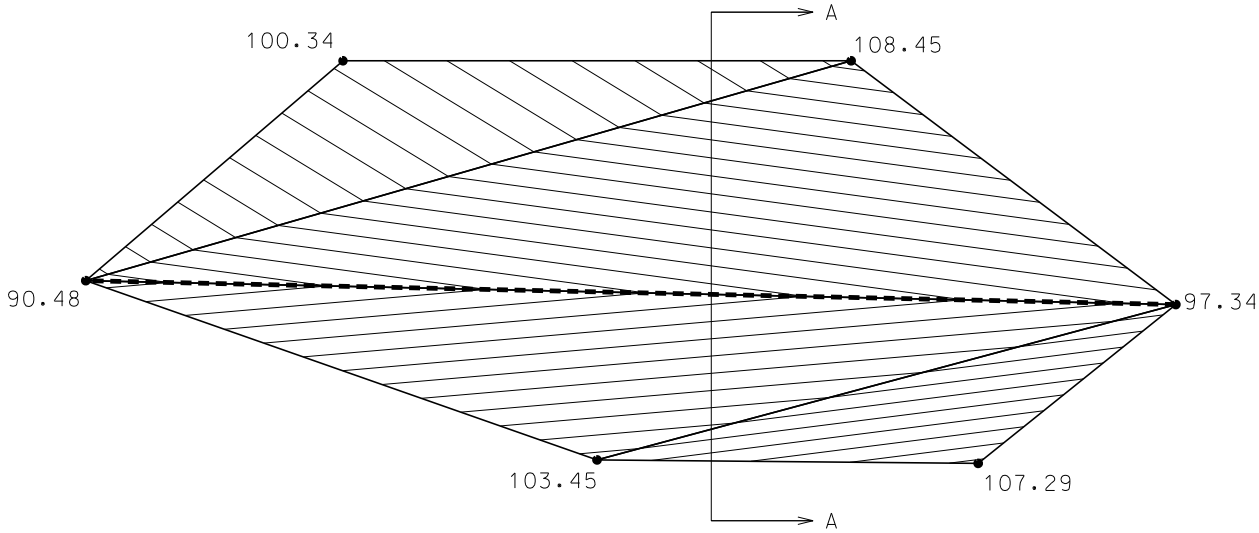

line strings, and other longitudinal elements are equally valid. The software creates a spot elevation for each vertex of each longitudinal element.

If a section is cut through this digital terrain model at the location A-A, where the elevation of the triangle leg as linearly interpolated between the triangle vertices is plotted along the distance of the section, the section would look as shown in the picture below.

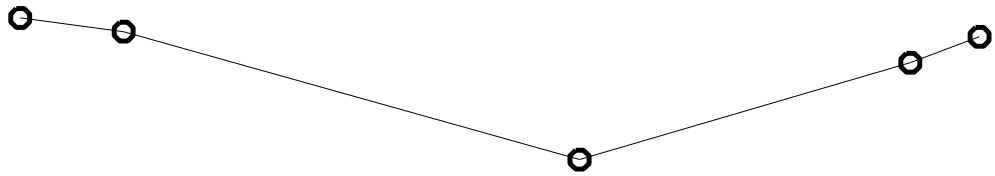
### 1.7.2 Break Lines

Breaks are used to designate linear features such as edges of pavement, ditch bottoms, ridges, etcetera where an abrupt change of slope occurs. Any longitudinal element may be defined as a break line. Triangles will not cross a break line in the terrain model.

Adding a break line to the same set of points (used in the above illustration) will produce the terrain model as shown below.




Cutting a section at the same location will produce very different results as shown in the section below.



### 1.7.3 Soft Break Line

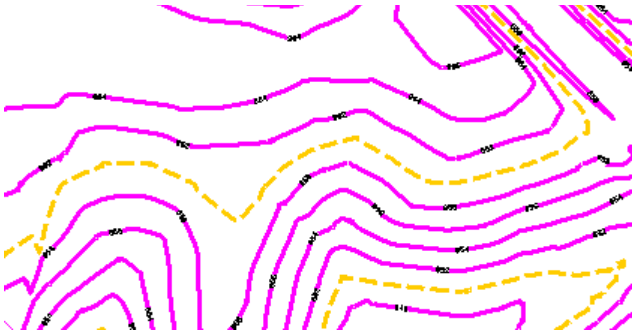
A soft break line is a break line; however, if it crosses a break line, it will not affect the triangulation and is ignored. This feature type is not frequently used. It can be used during survey collection to identify a feature that is a breakline, but is known to cross another break line, resulting in crossing breaklines.

### 1.7.4 Graphic Break Line

A graphic break line is a soft break line that is not stored in the terrain model. This feature type is not frequently used.

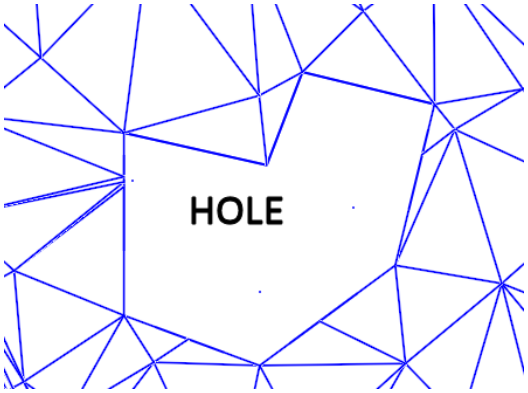
### 1.7.5 Contour

A contour is an element or set of elements of the same elevation. Contours may be used as source data to generate a terrain model, or may be computed (drawn based on terrain model). For example, you may want to create a terrain model from digitized contours from an old plan.



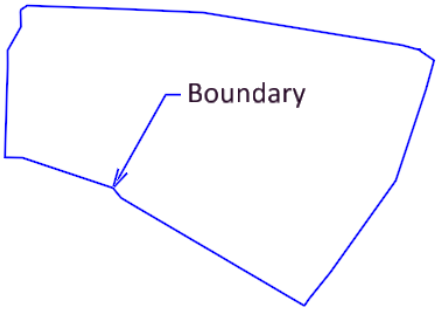
### 1.7.6 Hole

An area defined by a closed shape that demarcates a region where the current terrain is ignored and the underlying terrain is utilized. For example, holes can be used for marking areas where you would not want to disturb during a design.




### 1.7.7 Boundary

A boundary is the maximum external limits a terrain model can extend. No triangles will be created outside of this boundary. For example, a boundary can be changed on a terrain model by deleting triangles or changing the *Edge Method*. A new boundary can be added to an existing terrain model using the *Add Features* command.

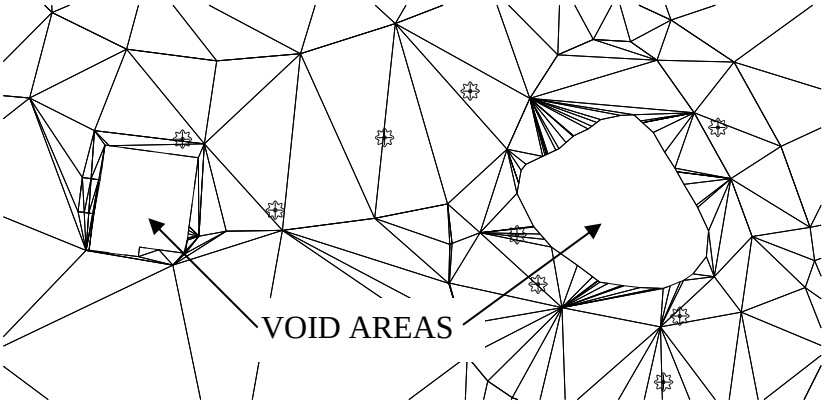


### 1.7.8 Drape Boundary

A drape boundary is a surface boundary that determines its elevations by draping on the underlying surface. For example, you may use a drape boundary to limit the extent of the triangles by drawing the boundary as an element, using the Add Features command to add the boundary to the terrain model. The new boundary would use the elevations of the underlying surface as the boundary elevations.

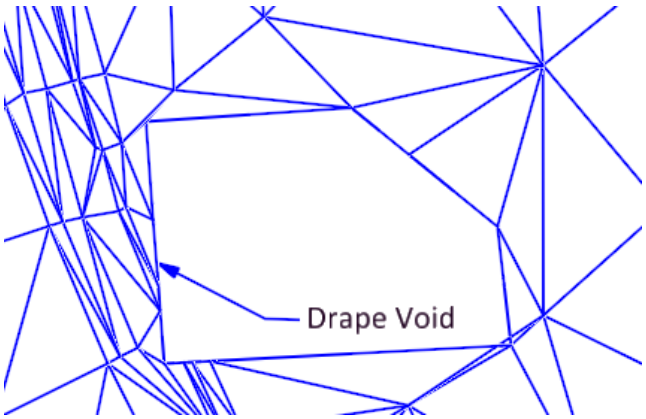
### 1.7.9 Voids

An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. The Void coordinates are included in the triangulation and void lines between successive void coordinates are inserted as drape lines on the surface. Therefore, they do not change the slope or elevations of the surface.



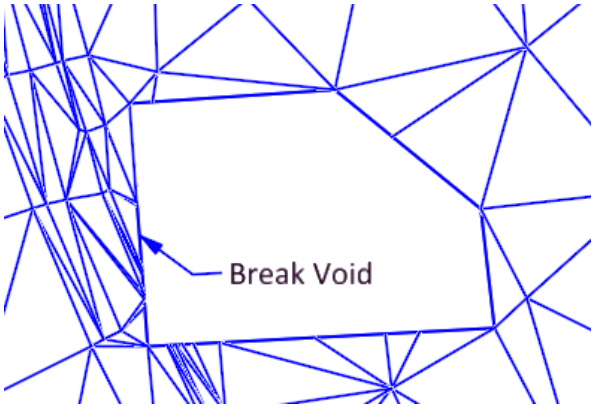

### 1.7.10 Drape Void

An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. In the drape void, the void coordinates are not included in the triangulation. Voids are inserted post triangulation. The void coordinates and lines are draped on the terrain model surface. Even though a user must provide an elevation for Drape Void vertices, the user elevations are changed to the elevation of the terrain model surface at the XY Drape Void coordinate position. For example, if you don't have accurate survey data for the void area, you may want to use the drape void.



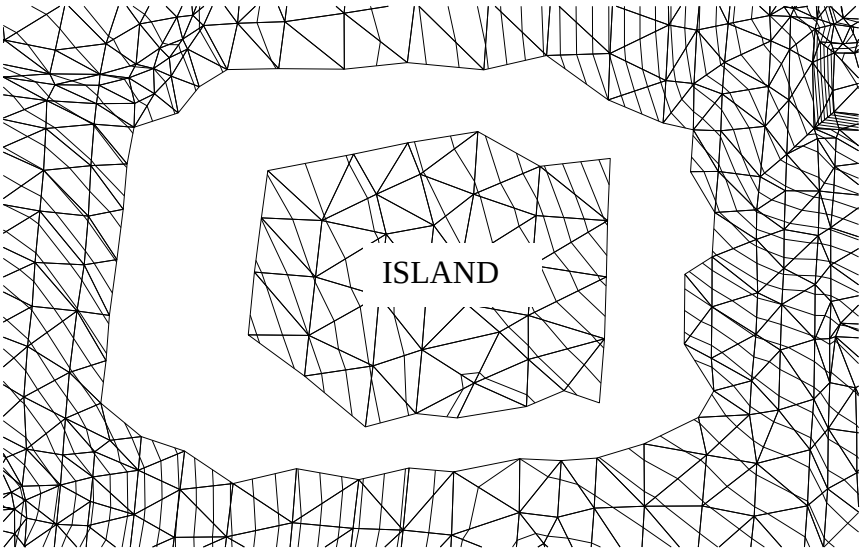
### 1.7.11 Break Void

An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. It differs from Voids and Drape Voids in that it utilizes the vertex elevations of the graphical element, while the void lines between successive void coordinates are inserted as break lines. Therefore, break voids change the slope and elevations of the surface. For example, if you have accurate survey data for the void area, you may want to use a break void. These could be used for surveyed building footprints or ponds where the points have been accurately surveyed.




### 1.7.12 Islands

An area defined by a closed shape that demarcates a region of data wholly within a void. Example, islands in the middle of rivers, lakes, etcetera.



## 1.8 Triangulation Options - Edge Method

Several of the terrain model tools utilize the triangulation options section where the Edge Method is specified.

Many of the external edge triangles are thin and narrow and not representative of the surface. This is particularly evident where the edge of the data set is concave in nature. One approach to eliminate these triangles is the use of the Edge Method.

The Edge Method defines which triangles around the edge of a Terrain Model get created.

There are two options to control the edge triangles. The terrain model is updated dynamically when the Edge Method changes so if the results are not acceptable, change the value until the results are acceptable. Only triangles along the edge of a terrain model are affected by this parameter. Interior triangles are never removed.

There are three settings for the Edge Method option: None, Remove Slivers, and Max Triangle Length.

**None** - No external triangles are deleted. Note the Maximum Triangle Side Length is ignored. There are no user defined parameters

**Slivers** - Long, thin triangles are dissolved based on a formula hard coded within the software. Note the Maximum Triangle Side Length is ignored. There are no user defined parameters.

**Max Triangle Length** - External triangles whose external edge is longer in length than the user specified distance are deleted. Note the maximum length does not apply to internal triangles, only those on the edge of the model. Specify the Maximum Triangle Length in master units.

## 1.9 Terrain Models in Element Information

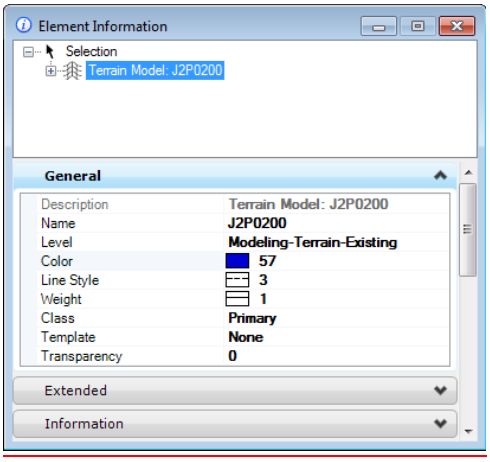
As a terrain model is a MicroStation element, a wealth of information can be found in the Element Information dialog. One important option is display on/off of terrain model features. For example, you can turn on and off the display of the contours, triangles, and voids.

The element information can be accessed by selecting *Element >Information* off of the menu or by selecting the properties option from the context sensitive toolbar that pops up when the mouse hovers over an element when the *Element Selection* tool is active.

The element information can be accessed by selecting *Element >Information* off of the menu. Some of the items in the Element Information dialog are informational and cannot be changed. Some of the items can only be changed if you are in the MicroStation file that contains the Terrain Model. Following are descriptions of the functionality of each tab in the Element Information dialog.

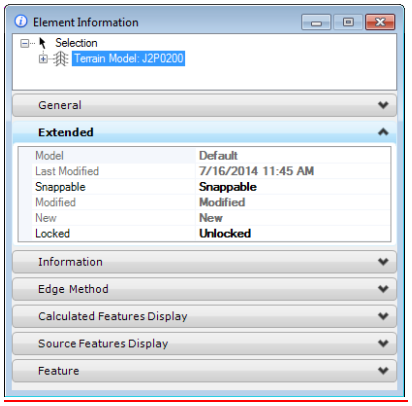
### 1.9.1 General

This displays the terrain model *Description* and *Name*. It also identifies the display symbology of the terrain model. The symbology is only used if the Feature Definition was not defined during the creation of the terrain model. You can also select a *Template* in order to change the display of the terrain model within the General tab.



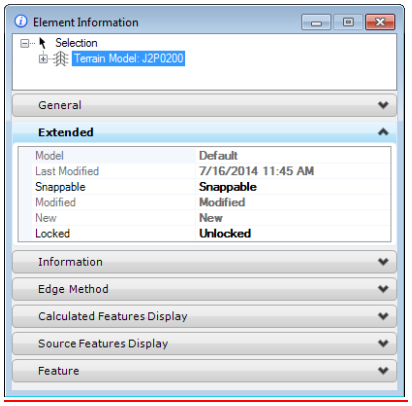
### 1.9.2 Extended

Allows you to set the terrain to *Snapable* or *Not Snapable*, *Lock* or *Unlock* the terrain, and view the model it is in, its creation date, and the modification state of the terrain.



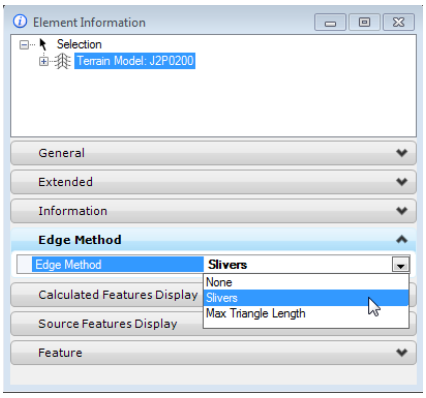

### 1.9.3 Information

Lists the X, Y, Z range of the selected terrain model. In addition, it has the number of each type of source features, i.e., the number of points, voids, or break lines.



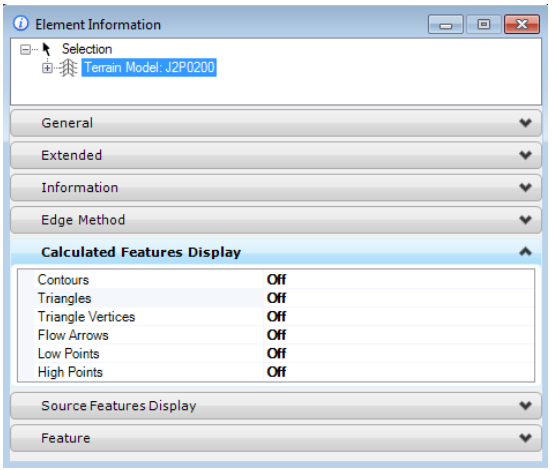

### 1.9.4 Edge Method

This displays the *Edge Method* used when creating the terrain model.



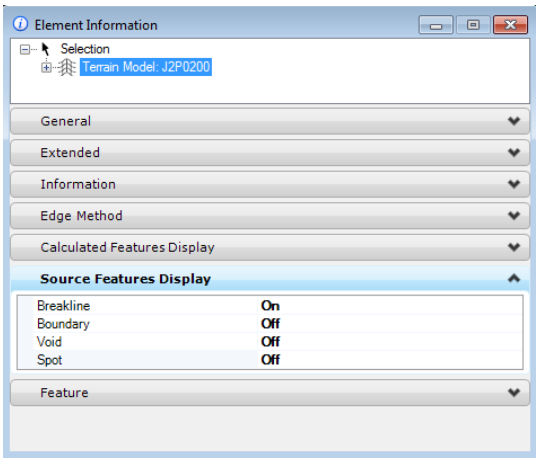
### 1.9.5 Calculated Features

Turns the display off or on for any data in the terrain model that is not source data. Example, triangles, high points, low points, and flow arrows. The change is immediately visible on the screen, it is not necessary to exit the file and re-enter.



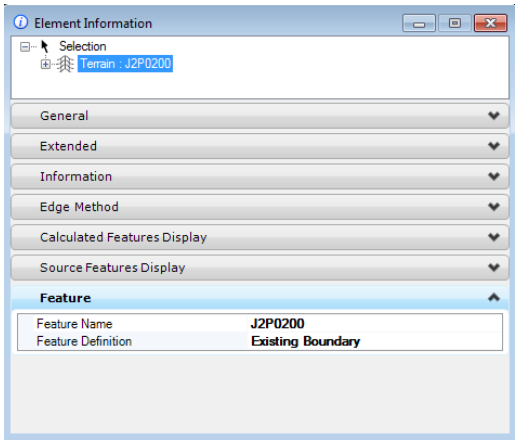

### 1.9.6 Source Features Display

Turns the display off or on for any data that was used to create the terrain model. The change is immediately visible on the screen, it is not necessary to exit the file and re-enter.



### 1.9.7 Feature

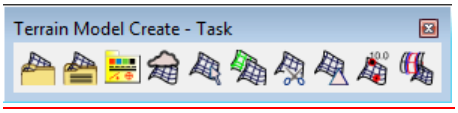
Element Information will list the feature name and feature definition of the selected terrain model.




**Quick Properties of Terrain Models**

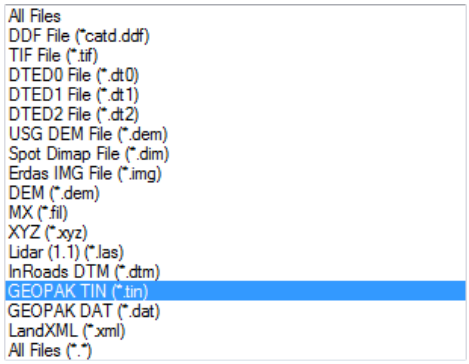
Selecting the terrain model using the Element Selection tool and clicking on Properties opens the terrain model Properties pop-up where you can set the maximum triangle length, turn on/off various graphical features and change the feature name and definition.

## 1.10 Terrain Model Create Toolset



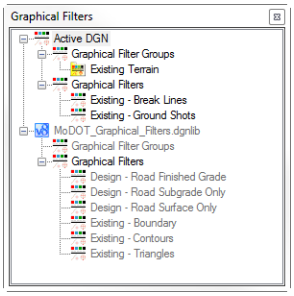

**Terrain Model Create -** Contains tools to create a terrain model from graphical elements, ASCII files, point clouds, LandXML, and import existing surface files. Tools are also available to merge two or more models together and/or to clip models.

**Create From File** creates a Terrain Model by importing an existing digital terrain model file. The file types supported include the GEOPAK .tin and .dat file types. Import options include *Import Terrain Only*, *Import Features Only* and *Import Both*. Importing features only writes the features to the design file as MicroStation graphics not tied to the Terrain Model.




**Create Terrain Model from ASCII File** creates a terrain model by importing from an ASCII file type using customized user file formats.

**Create Terrain Model by Graphical Filter** is an automated way of storing search settings for graphic elements to automate Create Terrain Model by Filter Elements. Uses the settings stored by Graphical Filter Manager to create the terrain. The Graphic Filter Manager icon is located in the Terrain Model tasks group.




**Create from Point Cloud** creates a terrain model from MicroStation Point Cloud data. The Point Cloud has to be attached to the dgn prior to being able to create a Terrain Model.

1. Select MicroStation **File >Point Clouds**.
2. Select **File** > **Attach**.

**Create from Elements** creates a terrain model from 3D graphical elements. The elements can be in a reference file.

**Create Complex Terrain Model** creates a new Complex terrain model by merging/appending multiple terrain models.

**Create Clipped Terrain Model** creates a terrain model by clipping an existing terrain model and providing an optional horizontal or vertical offset.

**Create Delta Terrain Model** creates a new terrain model using the difference between 2 terrain models or a terrain model and a plane (elevation). Vertical offsets can be assigned to the Terrain Models in the Terrain Model to Terrain Model method.

**Create Terrain by Text Level Interpolation** creates a terrain model from 2D graphics which also contain an elevation label.

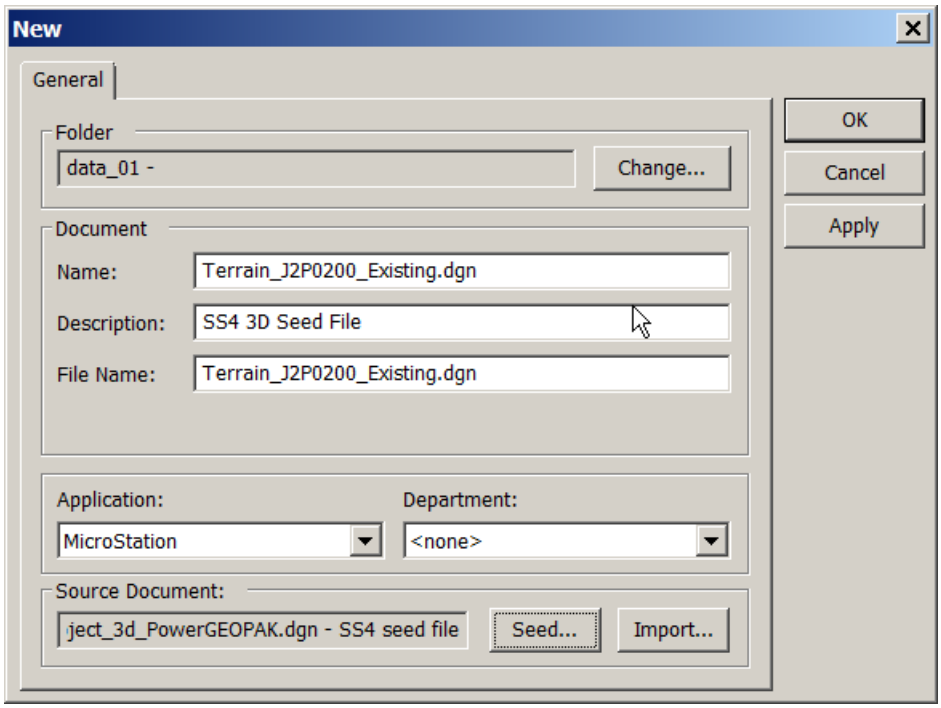
**Create Corridor Alternate Surfaces** is used to manage alternate surfaces in the template. This command is useful for the generation of surfaces to be exported to Automated Machine Control LandXML files.

## 1.11 Individual Exercise: J2P0200 Terrain Model

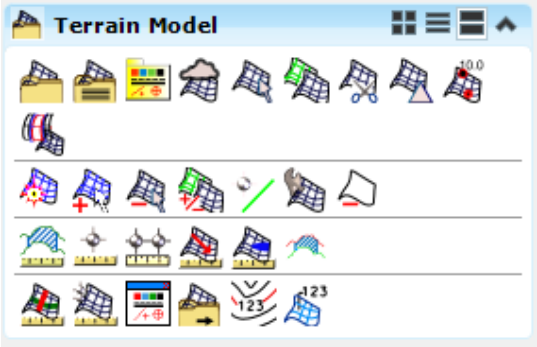
1. Within the *data_01\data* folder, open the file: **Introduction_To_Terrain_Models.dgn**
2. Select **File** > **New** and create a new MicroStation file using the *Source File:*

   ***pw:\CADD_Standards\Seed Files\Design - English\i_project_3d_PowerGEOPAK.dgn***

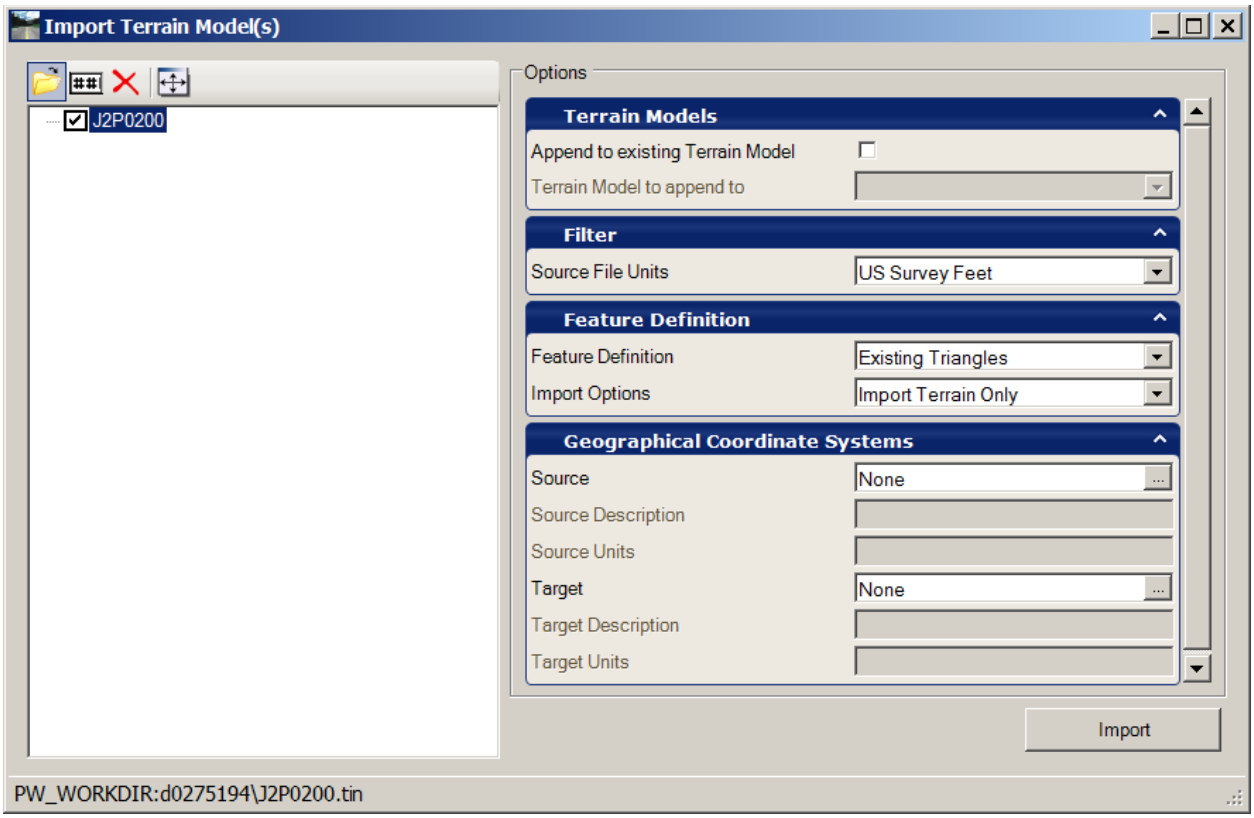
   **Note**: If this is not the default seed file, use the **Seed**… button to locate this seed file in the Projectwise.



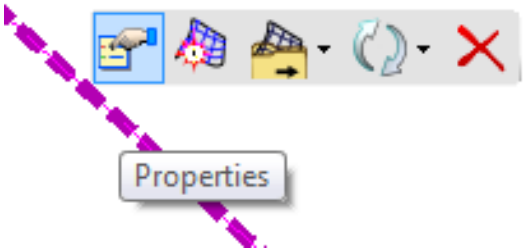

3. Key in the new file name **Terrain_J2P0200_Existing.dgn**. This will be the existing ground file for the project. It will be created in project wise.
4. In the *Folder* section, save the file to the folder **Data**
5. Select **OK**.
6. Check in the file **Introduction_To_Terrain_Models.dgn**.
7. Expand the **Terrain Model** Tasks group.
8. Select **Create From File** icon.



9. In the ***Select Files To Import*** dialog select: **J2P0200.tin**
10. Click **Add** and **OK**. This will bring up the *Import Terrain Model(s)* dialog.
11. In the Filter section, set the *Source File Units* to **US Survey Feet**.
12. Set the *Feature Definition* to **Feature Definition > Existing Triangles**.
13. Set the *Import Options* to **Import Terrain Only**.




14. Click **Import** and close the ***Import Terrain Model(s)*** dialog.
15. Fit the view.
16. Select the ***Element Selection*** tool.
17. Data point on the boundary of the Terrain Model and wait for the context sensitive menu to appear.



18. Select *Properties*.

19. Change the *Edge Method* to **Max. Triangle Length**. Set the *Length* to **150.00**.

20. **Toggle On and Off** the *Source Feature Display* items such as *Contours*, *Triangles*, *etc*. and review the display

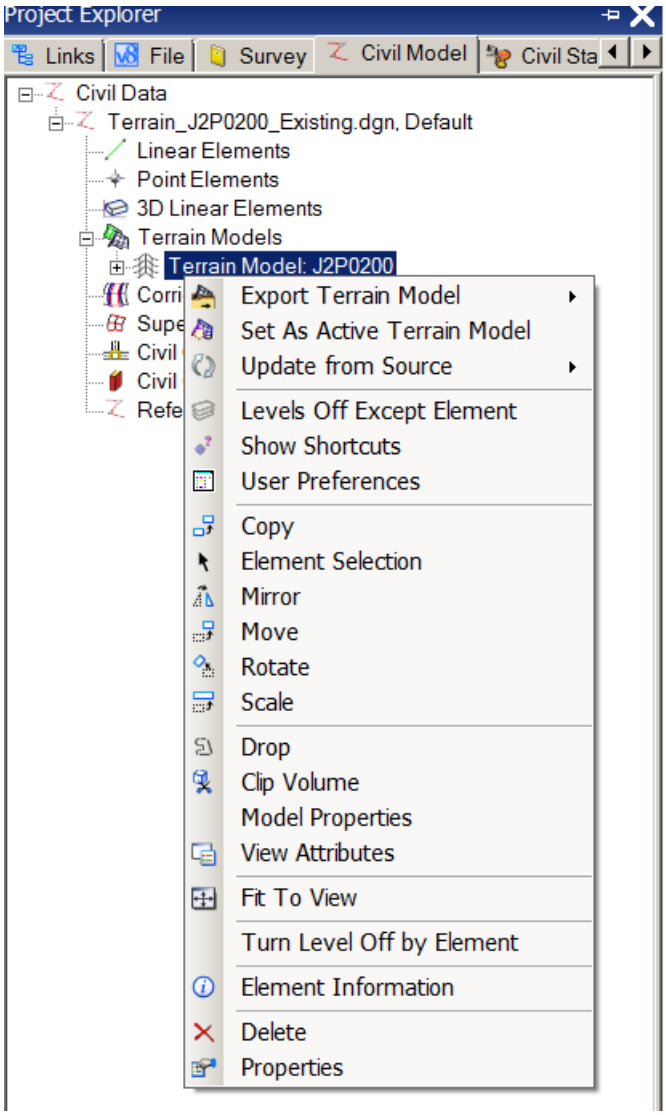
21. **Turn Off** the *Source Feature Display* items.

22. Open the Project Explorer select the **Civil Model** tab.

23. Expand the **Civil Data > Terrain_J2P0200_Existing.dgn > Terrain Models** folders.

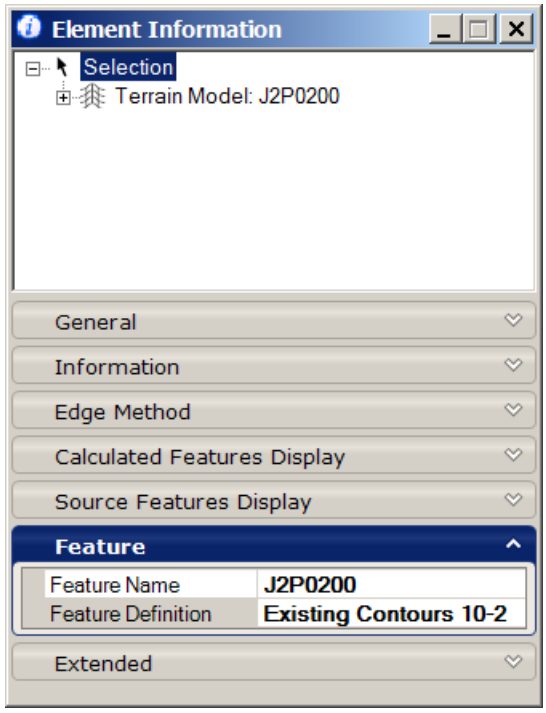
24. Expand the ***Terrain Model*** leaf. Notice that it has the source file information.

25. Right-click on the **Terrain Model:J2P0200** and review the options in the pop-up menu.

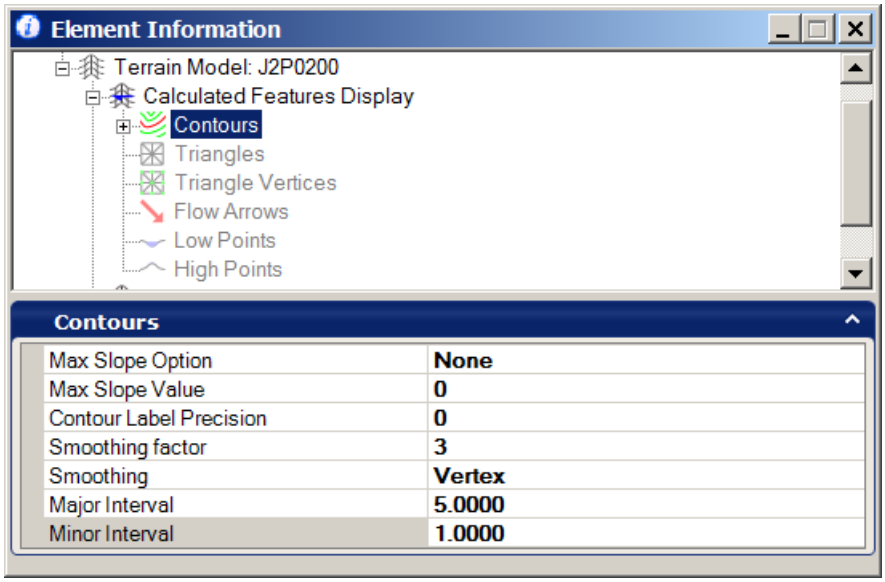



26. Select ***Element Information*** and review. Here is where the terrain model can be renamed, a new feature definition assigned, and feature display turned on/off.

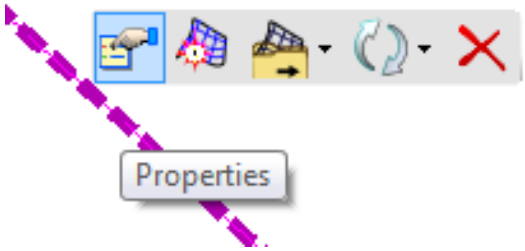
27. Expand the Feature Field and set the Feature Definition to ***Existing Contours 10-2***.




28. At the top of the Element Information Dialog expand the **Calculated Features Display** leaf and select **Contours**. Adjust the **Major and Minor** Intervals to **5 and 1**.




29. Data point on the boundary of the Terrain Model and wait for the context sensitive menu to appear.



30. Select *Properties*.
31. Set the *Feature Definition* to **Feature Definition > Existing Boundary**.
32. Select **File > Update Server Copy**.

# Chapter 2

# Civil Geometry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## 2.1 Objectives

- Understand and use Feature Definitions
- Create PI based horizontal geometry using the Complex by PI tool
- Use the OpenRoads Technology heads-up display and element manipulators
- Associate Design Standards with alignment geometry and review feedback when design standards are violated
- Import geometry from native geometry database
- Discuss using manipulators and handlers

## 2.2 Definitions

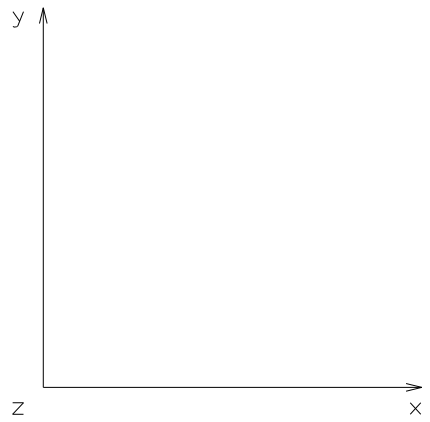
Civil Geometry is a dynamic, interactive, rules-based approach to geometry that provides an unprecedented level of associativity by preserving design intent, snaps and Civil AccuDraw input. The results of the tools are intelligent MicroStation graphic elements which can be dynamically edited and associations between elements are automatically updated.

In addition, the result of using the Civil Geometry tools are graphical geometry elements that are stored as MicroStation elements. No external geometry file is required. The MicroStation elements serve as the geometry elements with additional intelligence applied to store the rules and associations.

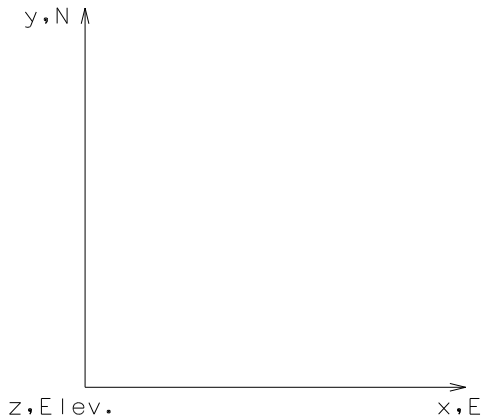
The Civil Geometry tools are installed as a part of GEOPAK. In order to be consumed by processes within GEOPAK, the civil geometry stored in the MicroStation elements must be written to the native application coordinate geometry .GPK file. This function can be configured to happen automatically based on properties of feature definitions, or it can be done manually.

### 2.2.1 Coordinate System

The Coordinate system is defined with **XYZ** Coordinates. The **X** and **Y** Coordinates define a horizontal plane, while the **Z** Civil defines the vertical dimension. All points in a civil geometry element are defined by at least an **X** coordinate and a **Y** Coordinate. If an elevation is to be stored, the **Z** Coordinate will also be defined.



The **XYZ** Coordinates can also be referred to in **Northing (N)**, **Easting (E)**, and **Elevation (Z)** Coordinates. The **Northing** Civil refers to the **Y** value, the **Easting** Civil refers to the **X** value, and the **Elevation** refers to the **Z** value.



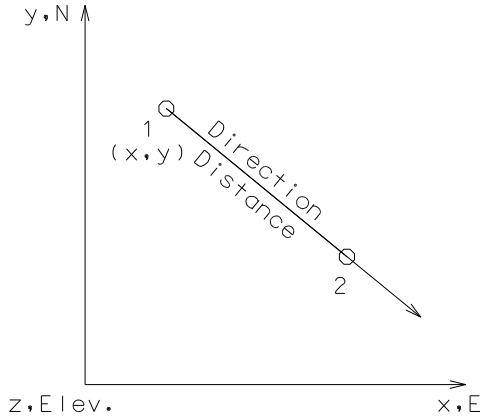

The user must be aware of the Coordinate system the data is in, and the Coordinate system that GEOPAK is using. When referring to the **XYZ** coordinate system, the Coordinates are listed as **(X, Y, Z)**. When referring to the **Northing, Easting, Elevation** coordinate system, the Coordinates are listed as **(N, E, Elev.)**. When translating this to the **XYZ** coordinate system, the Coordinates would be **(Y, X, Z)**.

## 2.2.2 Points

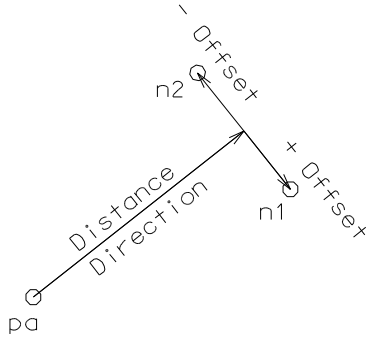
**Points** are defined by a single set of Coordinates. Each **point** will have an X and a Y Coordinate. The point may also have a Z coordinate if an elevation is defined.

**Point** names are alpha-numeric. If alphabetic characters are used, they must come before any numeric characters. The **point** name must contain at least 1 numeric character at the end of the name. Names can be up to 15 characters in length, although limiting the name to 8 characters is recommended.

**Points** can be stored from a set of Coordinates, or located from other elements. To define a point from another point, a distance and direction need to be defined.



Modifiers can be added to the direction and distance. An offset can be applied. This will locate the point at the specified distance and direction from the starting point, then perpendicular to the specified direction for the specified offset distance. A positive offset will go to the right of the specified direction, and a negative offset will go to the left of the specified direction.

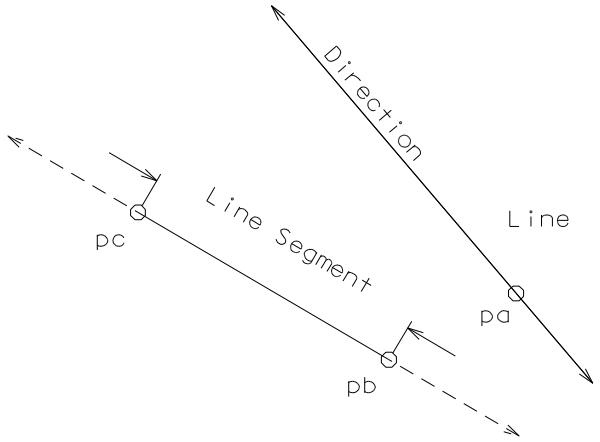



## 2.2.3 Lines and Linear Elements

**Lines** are defined by a location point and a direction, and are infinite in length.

**Civil Geometry Linear Elements** are a portion of a line that is defined by a beginning and an ending point.

**Linear Element** names can be alphanumeric up to 15 characters, but should not be numeric-alpha if the elements are going to be brought back to Native GEOPAK.



### 2.2.4 Curves

**Curves** are a segment of a circular arc. **Curves** can be defined by either the **arc method** (central angle that produces a 100' arc) or **chord definition** (central angle that produces a 100' chord). MoDOT uses the arc definition for all new alignments; however the chord definition has been used in the past, and may still be shown on old plans. This is configured in design file settings > Civil Formatting.

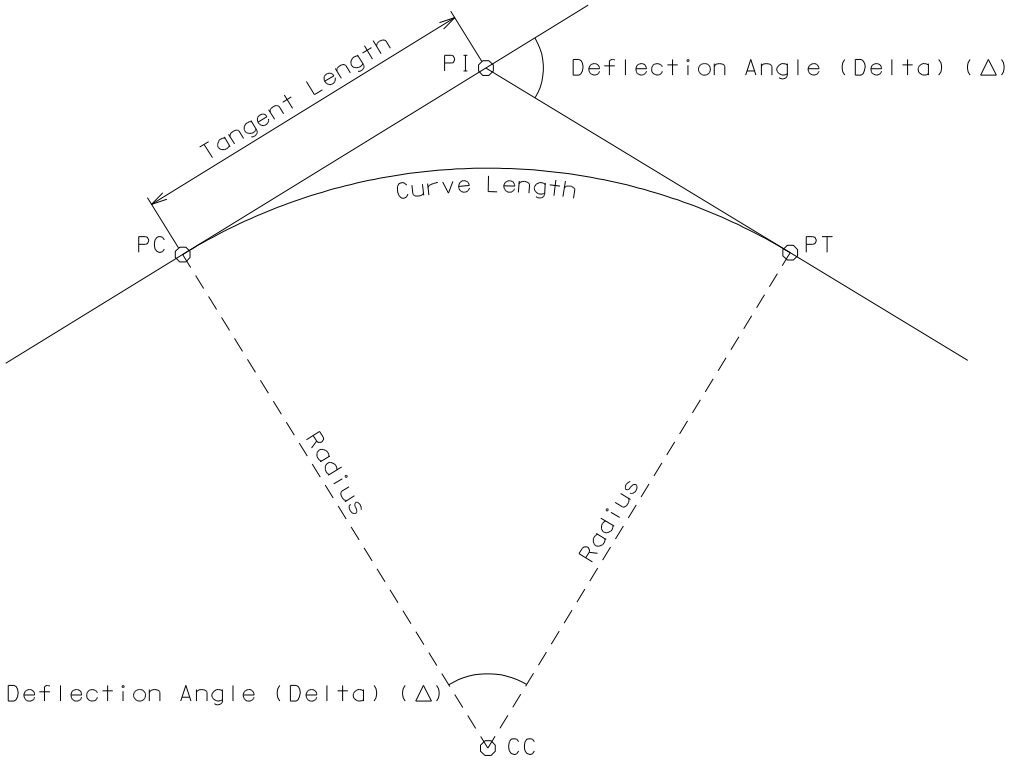
A **curve** has several points associated with it. These points help to define the **curve**, and are stored automatically when the **curve** is stored.

**PC** – Point of Curvature; Beginning of the curve.

**PT** – Point of Tangency; End of the curve.

**PI** – Point of Intersection; Point where the two tangents meet.

**CC** – Circle Center; Point at the center of the circle from which the curve is segmented.




**Curve** names can be any alpha-numeric characters up to 15 characters in length to be honored when brought back to Native GEOPAK.

### 2.2.5 Spirals

**Spirals** are a transitional curve. Typically a **spiral** will transition from a tangent (infinite radius) to a specified radius defined by a curve. **Spirals** can also transition between 2 specified radii as defined by 2 curves.

**Spiral** names can be any alpha-numeric characters up to 15 characters in length to be honored when brought back to Native GEOPAK.

Several points are also stored with a **spiral**. They are as follows:

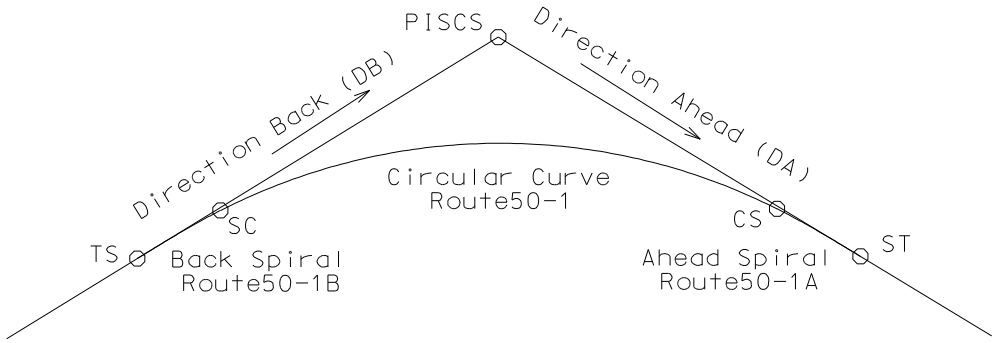
**TS** – Tangent to Spiral Point

**SC** – Spiral to Curve Point

**CS** – Curve to Spiral Point

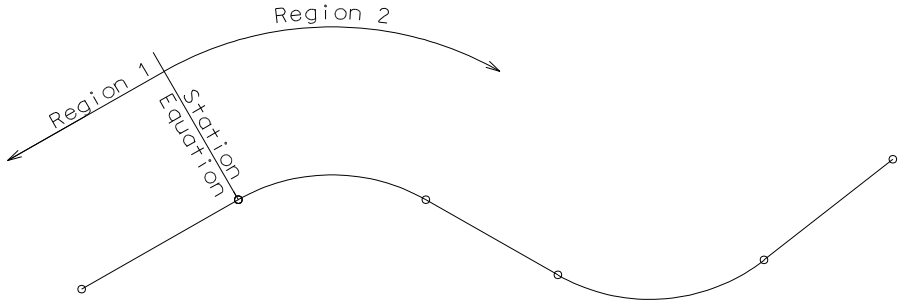
**ST** – Spiral to Tangent Point

**PISCS** – Overall Point of Intersection for the spiral-curve-spiral combination.




## 2.2.6 Chains

**Chains** are a combination of other elements. They can consist of points, curves, spirals, or other chains. Chains can represent horizontal alignments, or the horizontal location of some element. Chains have *stationing* associated with them. Locations along the chain can be determined by the stationing. If the stationing is adjusted along the chain a *station equation* is used. The *stations from the beginning of the chain to the first station equation* are referred to as **Region 1**. The *stations from the first station equation to the second station equation or the end of the chain* are referred to as **Region 2.**

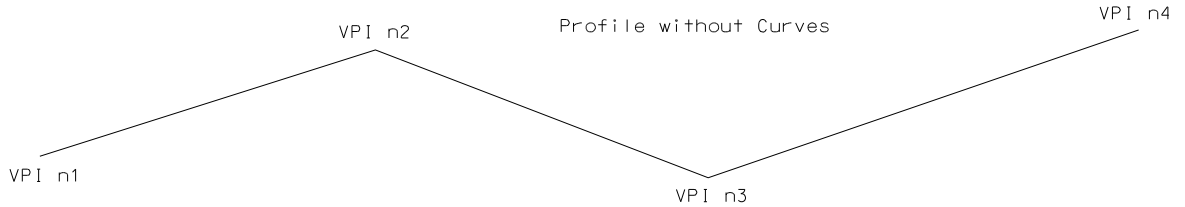


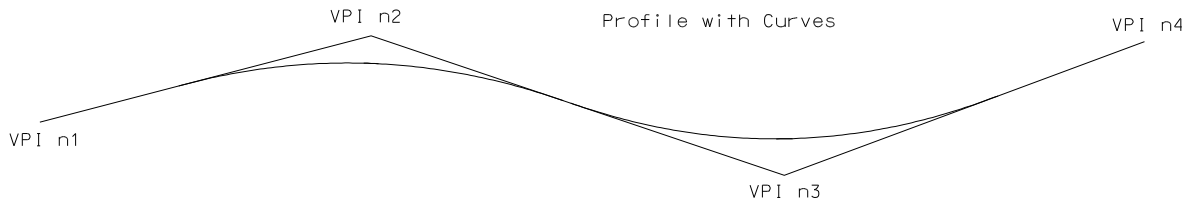

**Chain** names can be any alpha-numeric characters up to a length of 15 characters.

## 2.2.7 Profiles

**Profiles** are vertical alignments defined by stations and elevations. They are associated with some horizontal plan element. Profiles can be stored with or without vertical curves. Profiles

without curves generally represent the existing ground profile, or a ditch profile. Profiles with vertical curves are generally used as proposed corridor.




## 2.3 Open Roads Preferences

The seed files delivered in the workspace have MoDOT design file preferences configured.

### 2.3.1 Workspace Preferences

This dialog provides settings for the cursor prompt, manipulators, and various operational toggles. Enable this dialog from the *Workspace > Preferences* menu and selecting the **View Options-Civil** category.

**Manipulator Settings**

These settings allow the user to control the settings and symbology of the civil geometry manipulators and any associated text.

**Superelevation Settings**

When the super elevation components are drawn into the design file, these two options allow the user to specify whether they are to be drawn as Color Shaded Fill or Boundary Only.

**Survey Locator**

This setting is used by the Survey tools to control the display and symbology of the locator.

**Maximum Error Ellipse**

**Survey only** - This setting allows the user to specify a major error ellipse value with regard to the standard deviation resulting from a Least Squares Adjustment. Any standard deviation exceeding this limit results in a graphical flag based on this symbology.

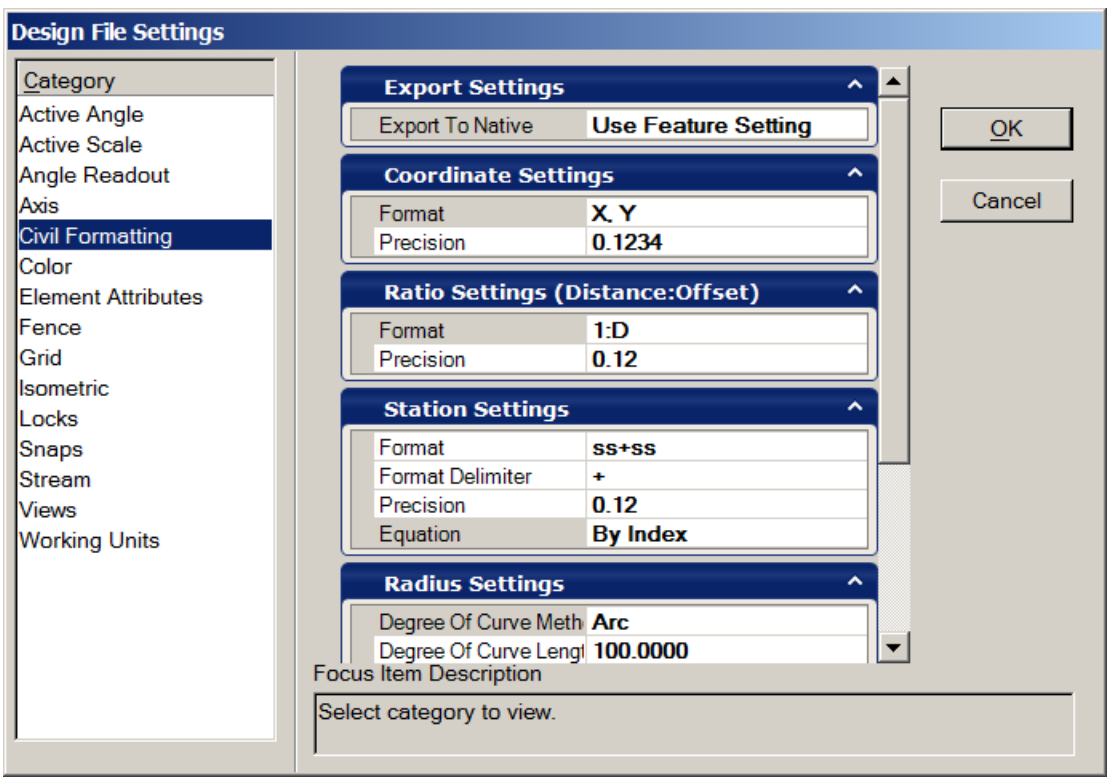
**Medium Error Ellipse**

**Survey only** - This setting allows the user to specify a medium error ellipse value with regard to the standard deviation resulting from a Least Squares Adjustment. Any standard deviation exceeding this limit results in a graphical flag based on this symbology.

**Minimum Error Ellipse**

**Survey only** - This setting allows the user to specify a minimum error ellipse value with regard to the standard deviation resulting from a Least Squares Adjustment. Any standard deviation exceeding this limit results in a graphical flag based on this symbology.

## 2.4 Design File Settings




**Design File Settings** dialog provides options for civil settings that control civil annotation within the design file. Enable this dialog from the *Settings > Design File* menu and selecting the **Civil Formatting** category.

- **Export Settings**

  When *Export to Native* is set to **Use Feature Setting**, the native geometry database (.GPK, .ALG, .FIL) will sync with civil geometry stored within the design file. For

example, the user can store an alignment in the design file and that alignment will be automatically stored in the native geometry database as well. Delete an alignment from the design file, and that alignment will be deleted from the native geometry database. The Export to Native functionality is feature based in that the option to ”Export to native” must be set to ”true” or ”false” for each particular feature.

If *Export to Native* is set to **Manual**, the native geometry database will have to be updated manually.

- **Coordinate Settings**

  Controls the display and precision of their coordinates within any of the civil dialogs. In addition, this setting also controls how any inputted coordinates are interpreted. For example, if set to “X, Y” then all coordinates are interpreted and displayed as being in the “X, Y” format. If set to “Nothing, Easting” then the same applies.

- **Ratio Settings (Distance:Offset)**

  Controls the display and precision of ratios within any of the civil dialogs. In addition, this setting also controls how any inputted ratios are interpreted. For example, if set to “1:D” then all ratios are interpreted and displayed in this format (1:100, 1:50, etcetera). If set to “D:1” then the ratios are similarly displayed and interpreted (5:1, 10:1, etcetera).

- **Station Settings**

  Controls the format, delimiter and precision of the station values to be used and displayed in the civil dialogs. **Equation** can be set to:

  **By Name -** This is the standard InRoads presentation (A100+00, B105+00, etcetera).

  **By Index -** This is the standard GEOPAK presentation (100+00 R 1, 105+00 R 2, etcetera).

- **Radius Settings**

  **Degrees of Curve Method** - Two options are available, *Arc* and *Chord*.

  **Degree of Curve Length -** This sets the standard definition of a 1 degree of curve.

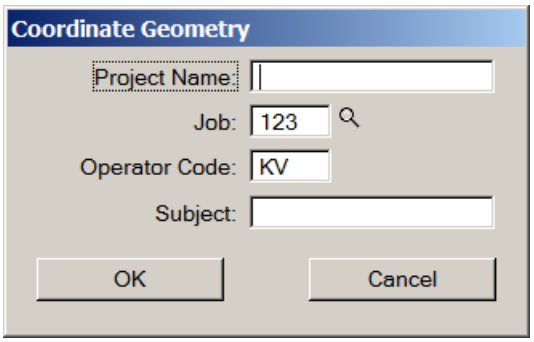
  **Radius Toggle Char -** This allows the user to specify which character will be used within the civil dialogs to ‘toggle’ between a radius definition and a degree of curve definition. The letter **d** is the default setting.

- **Profile Settings -** Controls the precision and display or input formats of slopes and ratios within a profile context. In addition, sets the default Vertical Curve Parameter Format (Radius, K Value or M Value).

## 2.5 Accessing

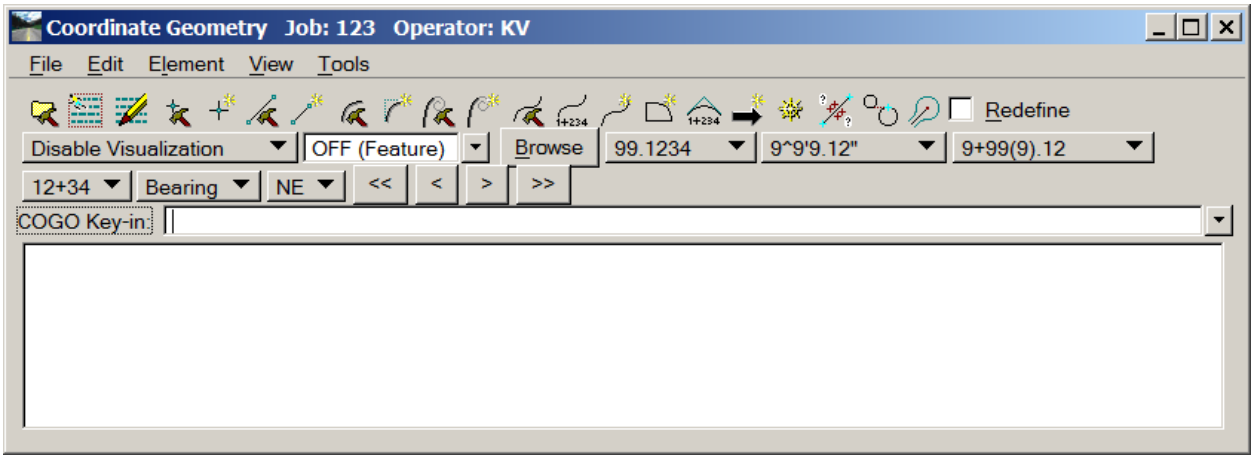
When designing with the Open Roads technology in GEOPAK the geometric data can be written back to the native .gpk. Having an active GEOPAK project facilitates this capability.

To setup *Coordinate Geometry* project values, choose the **GEOPAK > ROAD > Geometry >Coordinate Geometry** command and the data in the *Coordinate Geometry* dialog as noted below.



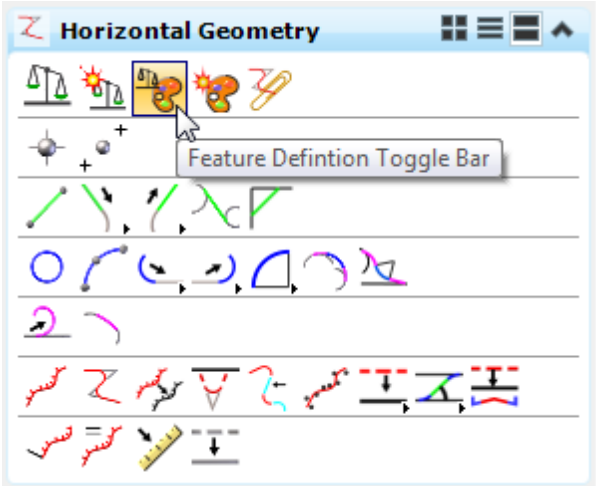

- **Project Name:** defines the name displayed on reports (60 alphanumeric characters max) (*Optional*).
- **Job:** identifies the Civil geometry database (3 alphanumeric characters, max) (*Required*).
- **Operator Code:** identifies a unique 2-character operator code. Allows multiple user access to the database. (*Required*) (User's initials suggested).
- **Subject:** description of work (48 alphanumeric characters, max) (*Optional*).

Once these parameters have been defined, the *Coordinate Geometry* dialog box will appear.

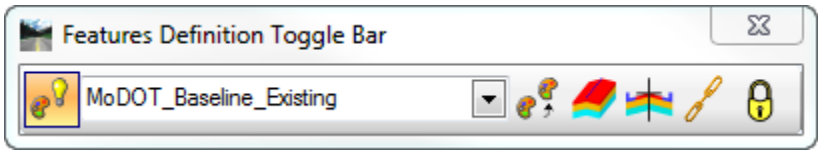


## 2.6 Features and Feature Definitions

Access the **Feature Definitions Toggle Bar** from the *Horizontal Geometry* tasks group.




Having the *Definitions Toggle Bar* open and available is very useful for expediting the association of a feature definition to a new geometry feature.

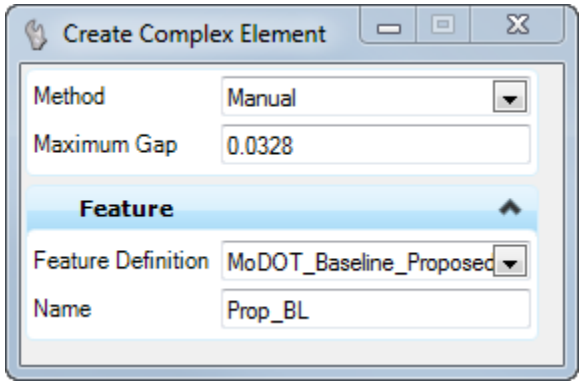



Feature definitions are used to define options when creating features. These are the items which are created in advance, usually used across multiple projects, and define symbology, annotation and quantities. The feature definition is assigned (usually) in the plan model, and optionally in profile and 3D feature definitions.

A Feature is anything that can be seen or located and is a physical part of your design representing a real world entity. Examples include curb and gutter, pavement, power lines, trees, etc.

A feature's definition is one of its properties. At any given time in the design process, the feature will have horizontal geometry, vertical geometry, 3D geometry or a combination to define its location. Generally, the feature's definition is assigned at time of creation, but can be assigned after-the-fact.

Most Civil tools have entry fields for *Feature Definition* in their dialog as illustrated below.




The rules applied to Feature Definitions are:

- If no Feature Definition is selected, the active MicroStation symbology is used and no feature is defined, but you can define a Name Prefix.
- If a Feature Definition is assigned, a Name Prefix is applied, and the symbology, attributes, and annotation defined in the feature definition are applied to the element.

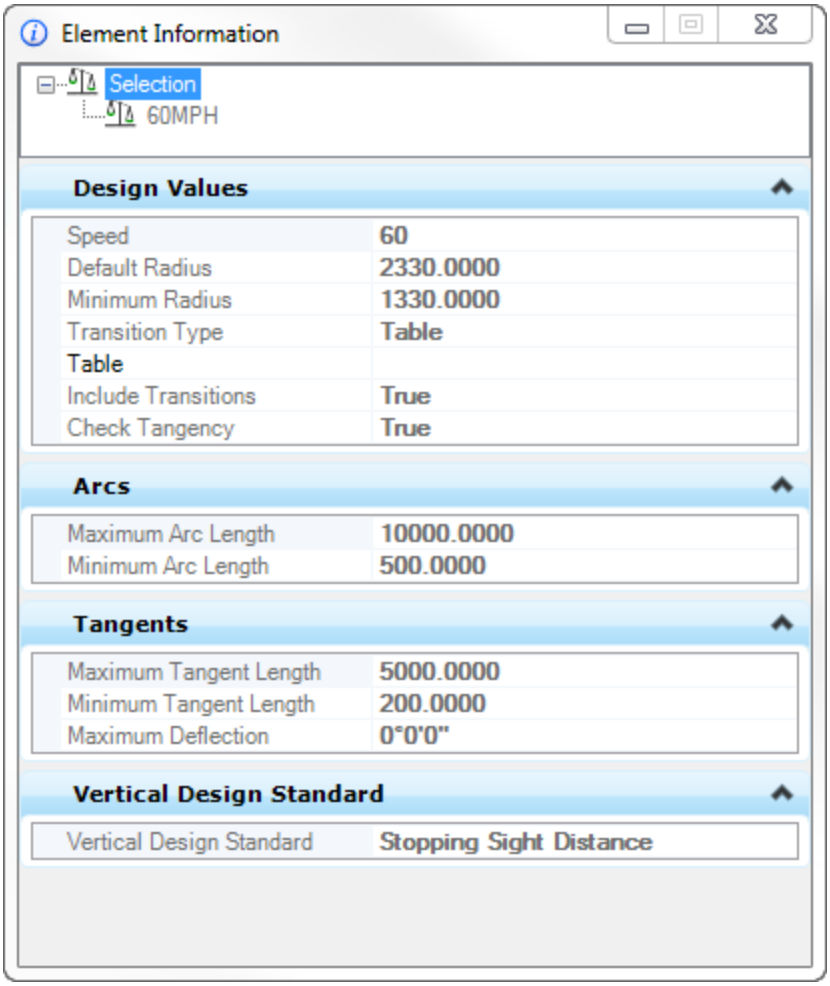
## 2.7 Design Standards

Design standards are used to monitor required curvature and other alignment checks on horizontal Civil Geometry elements and slopes and K values on vertical geometry elements. The standards are stored in a design library (DGNLIB) which can be read-only and stored in a central location for use by all users and referenced by the configuration variable MS_DGNLIBLIST. A DGNLIB is an empty file (does not contain any MicroStation elements) similar to a seed file where you can set up various MicroStation and Civil resources. An organization can utilize numerous DGNLIBs to facilitate management of their standards. For example, horizontal and vertical standards could be stored in one DGNLIB while other standards would be defined in other DGNLIBs. If utilizing both Metric and English units, you may want a separate DGNLIB for each.

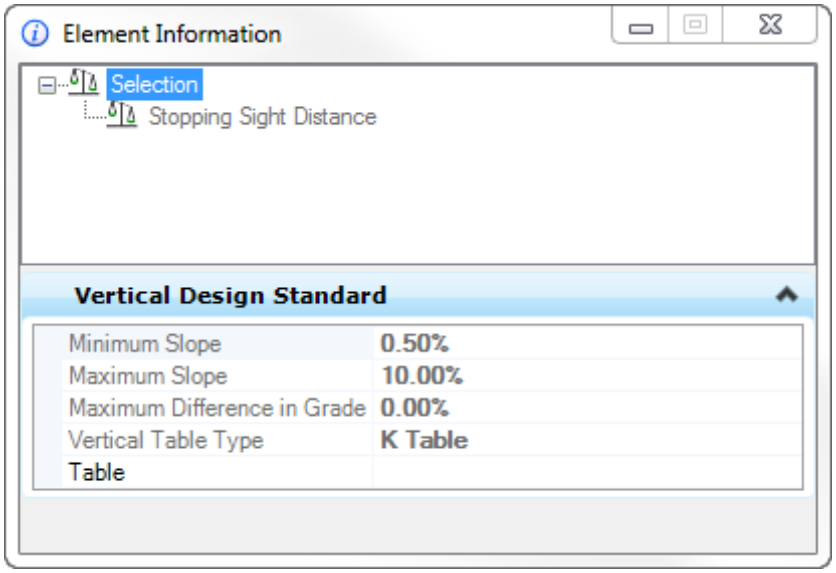
The standards are set up within the Project Explorer. Note the hierarchy from the Project Explorer is mirrored in the Design Standards Tool Bar pick lists. The hierarchy is customizable to conform to your organization's standards. As most organizations utilize AASHTO standards, the default libraries included in the installation package are based on the 2001 and 2004 versions of "A Policy on Geometric Design of Highways and Streets."

The Project Explorer is accessed by selecting *File > Project Explorer* from the main menu or from the Primary Tools menu bar. It is more efficient to complete the vertical standards first, as they are referenced when building the horizontal standards.

Right-click on the individual entry and select Properties from the pop-up menu to review the settings.



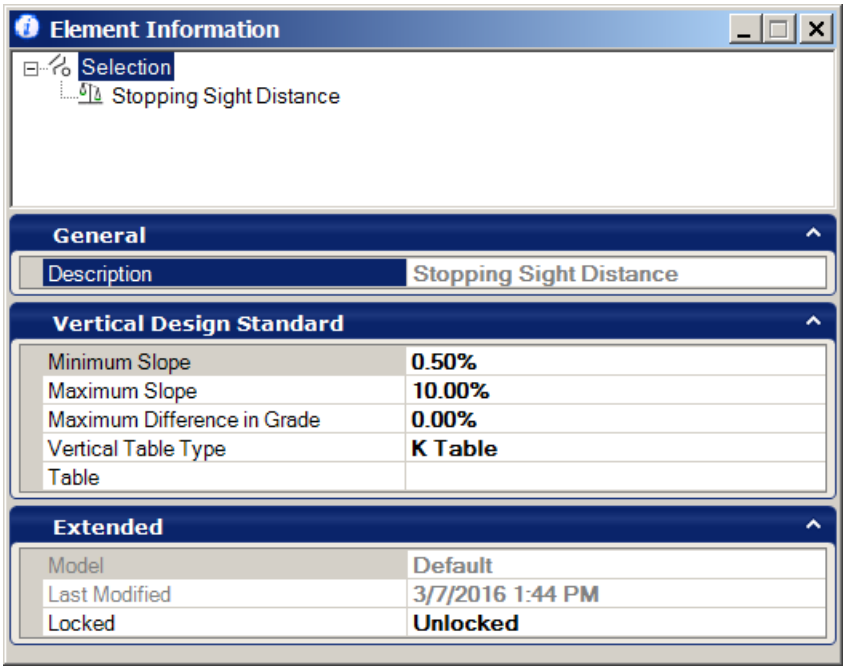

*Horizontal Design Standards Properties*




*Vertical Design Standards Properties*

## 2.8 Viewing and Accessing Horizontal and Vertical Standards

The Design Standards branch lists the design standards that are available within the active design model or a DGN library. The Design standards defines Design standards that are used to assist the designer in maintaining required curvature and other checks when performing geometric layouts and are normally based on accepted standards for a geographic area or authority, these standards are stored in DGN libraries.




The properties for each Horizontal standard are:

- **Design Values**

**Speed -** this is the design speed for the standard.

**Default Radius -** this is the radius used to populate commands when initiated.

**Minimum Radius -** this is the minimum radius for the corresponding design speed. Utilizing values lower than this radius will cause a warning to be displayed.

**Transition Type -** can be by Table or Equation.

**Table -** If transition type is table then this is used to populate the table.

**Include Transitions**

**Check Tangency**

- **Arcs**

  **Maximum Arc Length**

  **Minimum Arc Length**

- **Tangents**

  **Maximum Tangent Length**

  **Minimum Tangent Length**

  **Maximum Deflection -** the maximum angle between the lines where two tangents join without a curve.

The properties for each Vertical standard are:

- **Vertical Design Standards**

  **Minimum slope**

  **Maximum slope**

  **Maximum difference in grade**

  **Vertical Table Type**

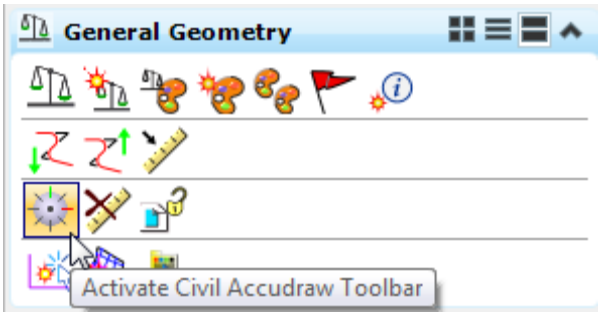
  **Table**

## 2.9 Civil AccuDraw

**Civil AccuDraw** performs many of the same functions as *MicroStation AccuDraw* but has greatly expanded capabilities for the civil designer. It allows the user to define a point location at any stage of any placement tool (MicroStation or Open Roads) and accept input that results in more sophisticated point locations.

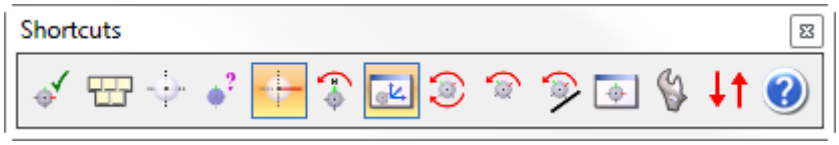
### Accessing Civil AccuDraw

Civil AccuDraw can be accessed from **Tools> Civil AccuDraw > Activate Toolbar** or from the Civil Tools task menu **General Geometry > Activate Civil AccuDraw Toolbar**.




It is recommended that the Civil AccuDraw Toolbar be docked to facilitate use.

The shortcuts have key-ins and are also mapped to icons. Having the *Shortcuts Toolbar* active and docked can also be a time saver.




**Benefits**

There are many benefits in using Civil AccuDraw.

1. It extends the drafting power of MicroStation by providing Civil point location methodologies in all the MicroStation and Civil commands. For example, a user will be able to place a cell at an offset using the normal place cell but invoking Civil AccuDraw to enter the station and offset.
2. It will eliminate the need to create temporary construction geometries just to perform more complex point locations. For example, to place a line at a given distance from 2 points a user would need to draw 2 circles at each point with the desired offset as the radius of each station and then place a line tangent to these circles, and finally delete the

unwanted circles. Civil AccuDraw provides a Distance from Point snap where the point can be identified, the offset entered, and the data point applied to the construction.

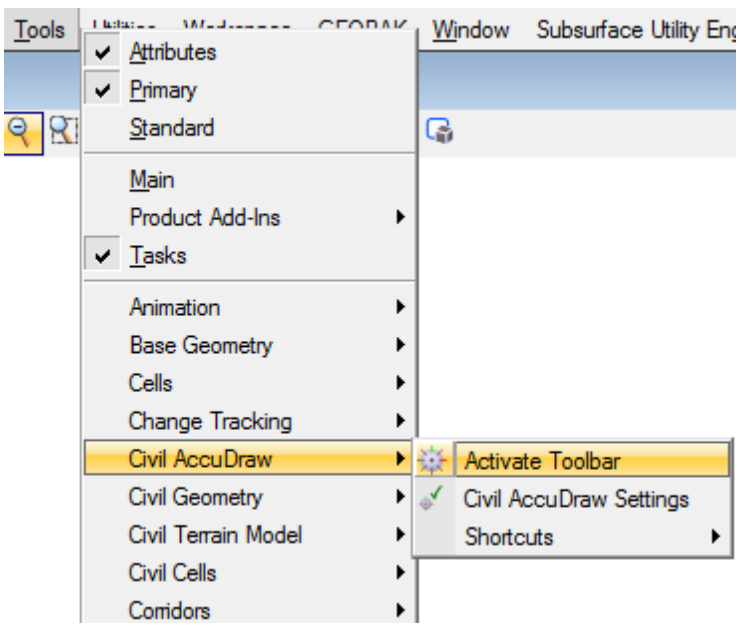
3. When used in conjunction with the Civil Geometry commands the resultant elements are constrained by rules set by the selection of the Civil AccuDraw ordinates.
4. The Civil Geometry heads up display options are enhanced when Civil AccuDraw is active and the options available are determined by the method selected.

**Use Tips with the Geometry commands**

1. Selecting the Tab key while in an entry field will change focus.
2. Selecting Enter will set the value in the field and lock it
3. Selecting the End key will unlock the field
4. Selecting the left or right arrow key will move through the favorite options.
5. Selecting the down key will bring up the associated command entry dialog in addition to the heads up display.

## 2.9.2 Civil AccuDraw Overview

1. Open any Design file (.dgn) file.
2. To open the *Civil AccuDraw Toolbar*, select **Tools > Civil AccuDraw > Activate Toolbar**




The *Civil AccuDraw* toolbox will open.

Toggle Civil AccuDraw on/off.

Drop down list of various tools including Civil AccuDraw settings and common shortcuts. This drop-down is also available by pressing space bar when any Civil AccuDraw field has focus.

These are the ordinate systems delivered in a default installation.

- Distance – Direction
- Distance – Direction Unlinked with two origin points
- Distance – Distance
- X – Y
- Dx – Dy
- Station – Offset
- DeltaStation-Offset

In a three dimensional design file there are two additional icons

Sets the elevation ordinate

ProfileOffset.

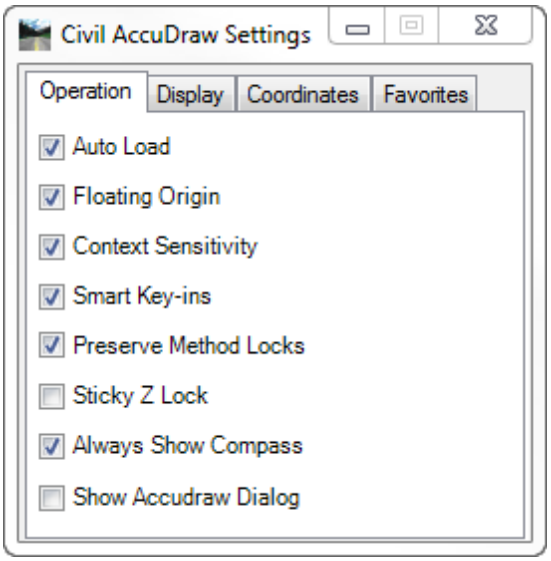
**Some differences between the MicroStation AccuDraw tool and the Civil AccuDraw tool:**

a. Civil AccuDraw compass will always point north regardless of view rotation.
b. Civil AccuDraw uses a heads-up on-screen prompt at the cursor to allow precise key-in of distance and direction. A fixed dialog box becomes available when the down arrow is selected.
c. The Civil AccuDraw compass will always be circular. MicroStation AccuDraw changes the compass to rectangular for Cartesian ordinate systems.

**Civil AccuDraw Settings**

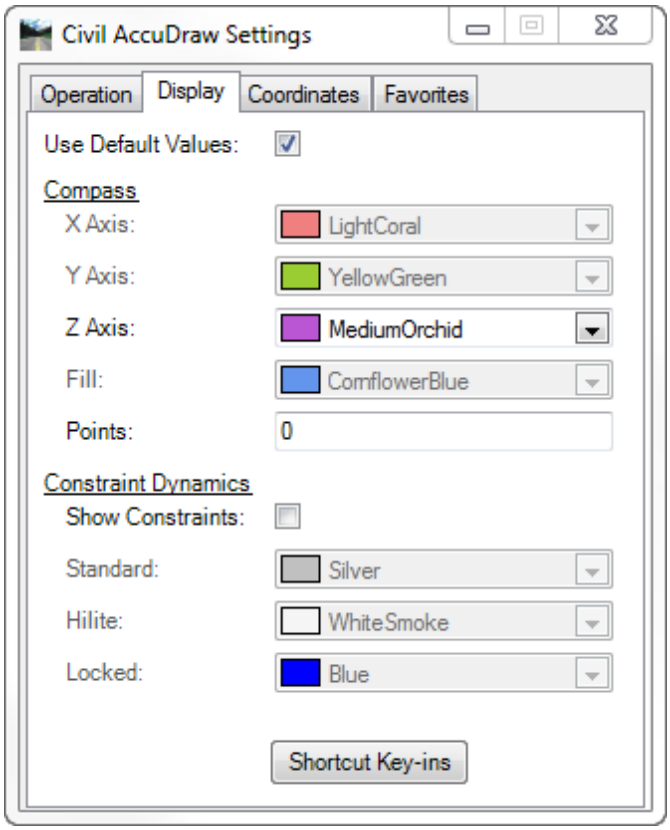
The **Operation** tab is similar to that of MicroStation AccuDraw.

- Operations of the same name have the same function in both AccuDraws.
- Selection or de-selection in one AccuDraw does not affect the selection in the other AccuDraw.
- Selecting the Show AccuDraw Dialog will result in the dialog and the heads up display both being available to the user during element placement.



The **Display** tab contains settings for:

- Color of compass axis
- **Points** configures the number of points in the compass circle
- Color of the constraint lines
- Whether you want to see the constraint lines and color of the constraint lines

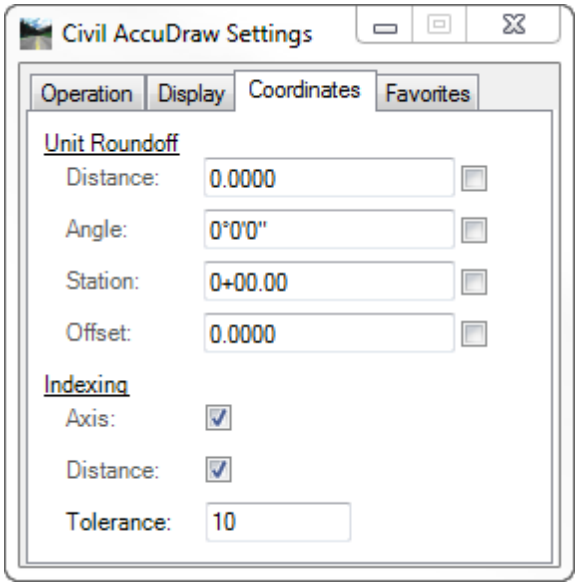



The shortcut button brings up the same shortcut list as used by MicroStation AccuDraw.

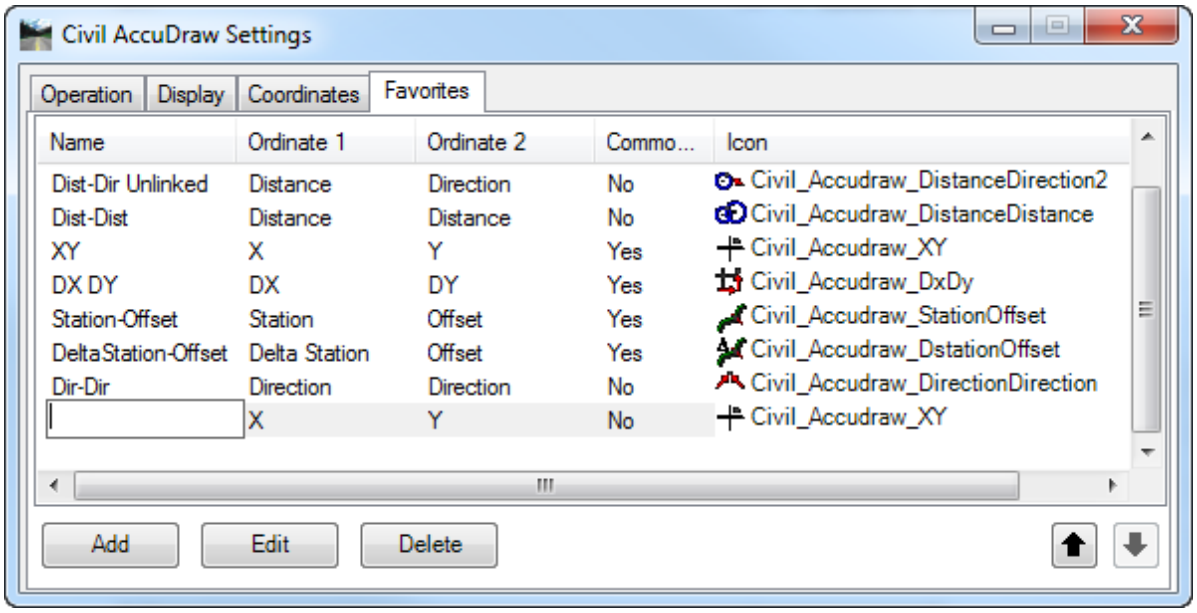
Both AccuDraws access the same shortcut.txt file.

The **Coordinates** tab contains the same round off and indexing settings as MicroStation AccuDraw and function the same way.

- Civil AccuDraw has additional settings that are provided to allow the round off of **station** and **offset** values.
- The numbers must be changed to values other than zero to be accepted.



The **Favorites** tab allows for the configuration of the most commonly used ordinate systems. It is one of the primary differentiators between Civil AccuDraw from MicroStation AccuDraw. The favorite selected determines what input fields are available during the placement of an element.




**Ordinate 1 and Ordinate 2** are the measurement methods used in determination of the coordinates.

**Common Origin** has a *Yes/No* option.

- **Yes** indicates that both ordinate measurements come from the same origin location.
- **No** indicates each ordinate has a different location.

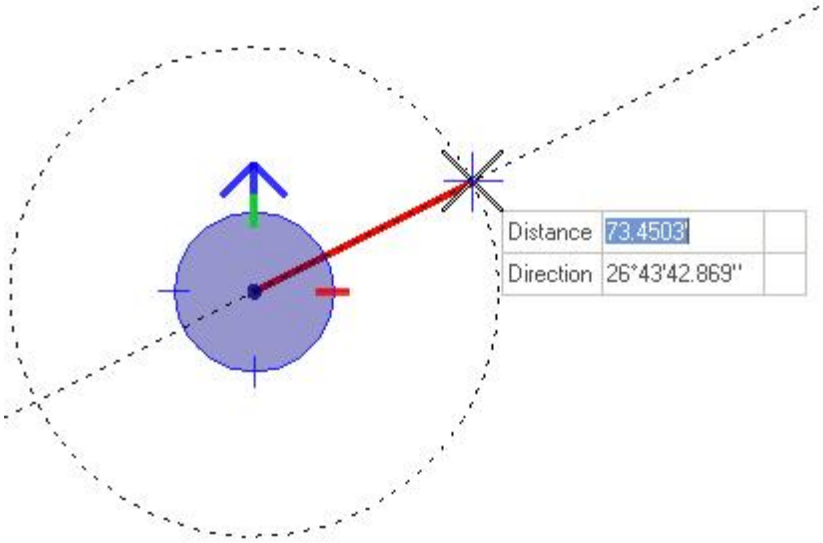
To add a new favorite:

1. Select Add
2. Key in the Name
3. Select the Ordinates.
4. Select whether the ordinates share a common origin.

## 2.9.3 Simple Linked Favorite Civil AccuDraw Workflow

A **Linked** favorite has two ordinates or measurement methods that share the **same** *Point of Beginning (POB)* or Origin.

1. Ensure *Civil AccuDraw* is active. If it is active then the first icon in the toolbox will have an orange background.
2. Set the active symbology or active feature. If no feature is assigned, the element will use *Default*.
3. Start the tool of interest and place the first point. This can be by XY= key-in or a data point. If the Civil AccuDraw XY favorite is active the X and Y fields will be available in the heads up display.
4. Select the **Dist-Dir** favorite. Entries in the distance and direction fields present a dynamic circle and line feedback for the constraints.

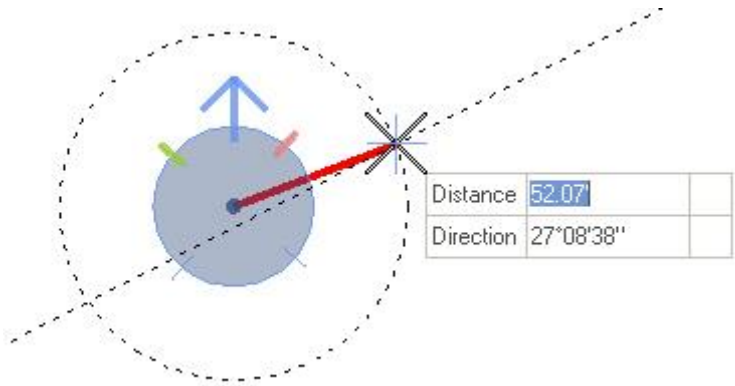



5. Key in a distance and then press the **Enter** key to lock the distance.
6. As the cursor moves over one of the compass points (north, south, east or west) there is a color change feedback indicating a compass direction locks.
7. To unlock a value use the **End** key.
8. **Data Point** to accept the value.

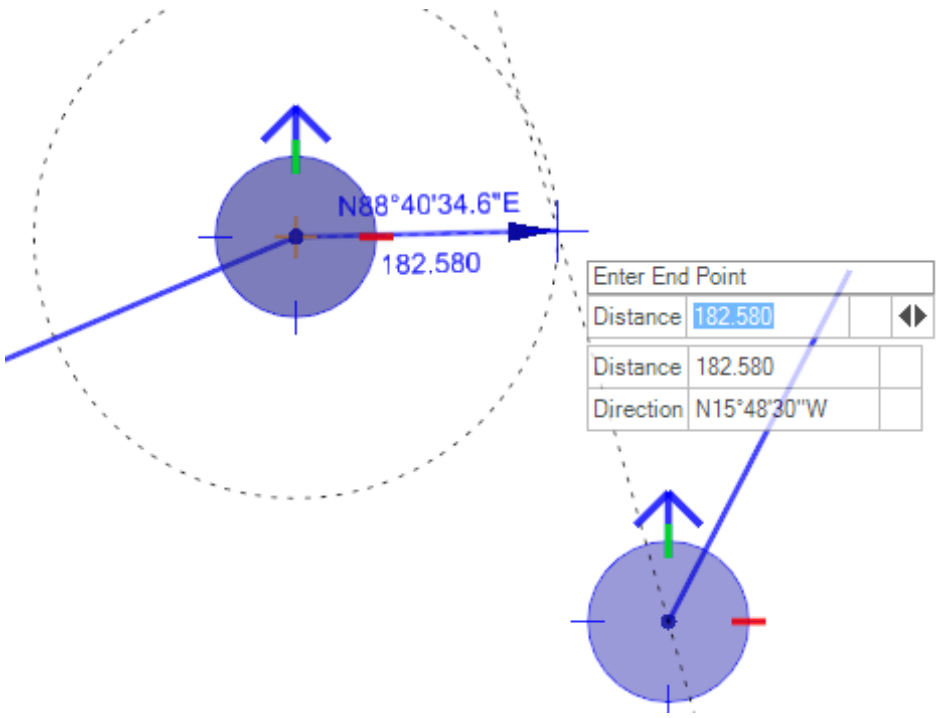
### 2.9.4 Simple Un-Linked Favorite Civil AccuDraw Workflow

An **Un-Linked** favorite has two ordinates or measurement methods each with a **unique** *Point of Beginning (POB) or Origin*.

1. Ensure Civil AccuDraw is active. If it is active then the first icon in the toolbox will have an orange background.
2. Select an element placement command.
3. Set the active symbology or active feature.
4. Start the tool of interest for example *Distance-Direction*.
5. Place the first point. This can be by XY= key-in or a data point. If the Civil AccuDraw XY favorite is active the X and Y fields will be available on the Heads Up Display.
6. With the focus in the distance field press the letter (**O**) on keyboard. Then left click on the position to set the origin for measuring distance. This could be a graphical element, a terrain Model element, a Civil Geometry Element or a data point.

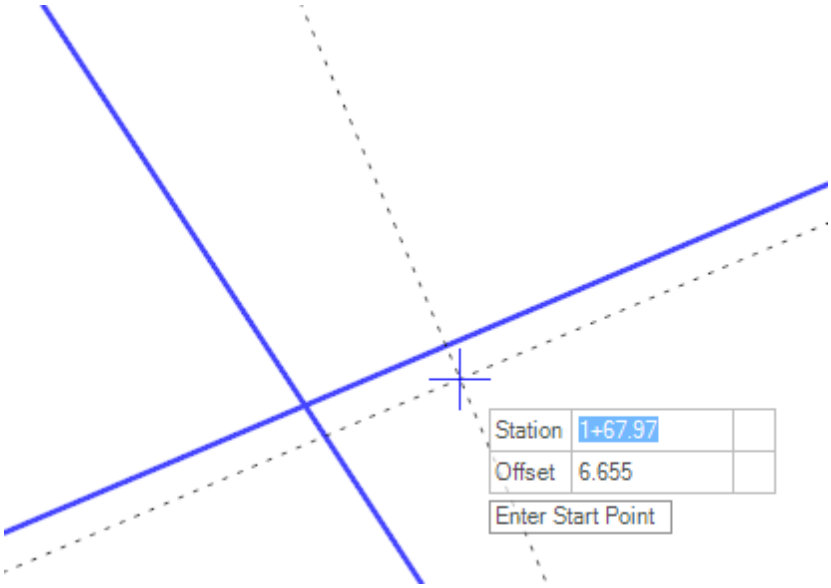



7. The origin shortcut (**O)** in Civil AccuDraw waits for a data point before setting the origin. This is to provide capability for the (O) shortcut to also choose the baseline for station offset ordinates.
8. Select the **Tab** key to move focus to the direction field, press (**O)** again, identify the location for the second ordinate point of beginning, and click a second data point to set the direction origin. This results in two independent compasses to measure the distance and direction. Both distance and direction can be locked as needed.



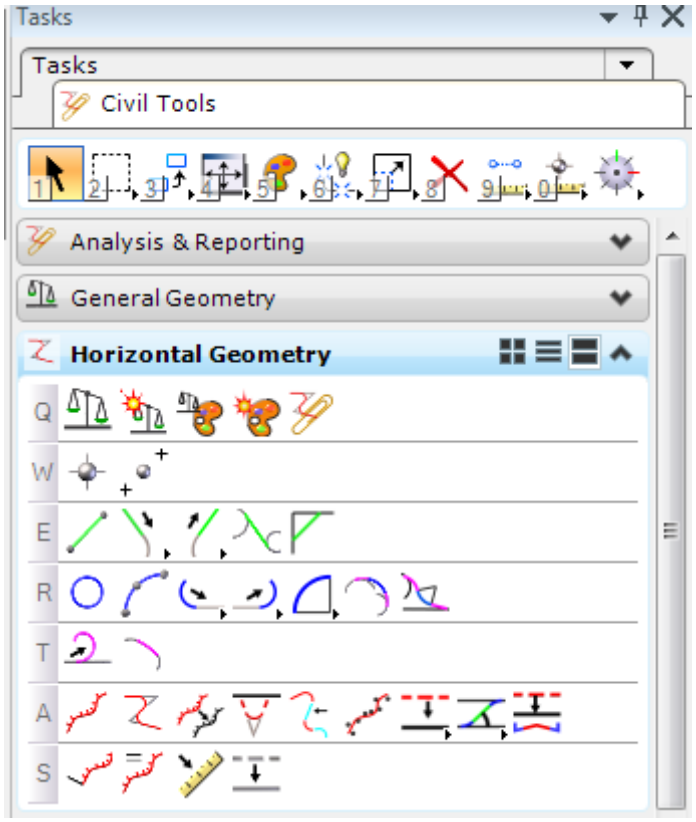
### 2.9.5 Station-Offset Linked Favorite

The **Station and Offset** linked favorite pulls the station and offset from the element identified after the origin shortcut (O) is entered. Selecting Tab will lock the value.

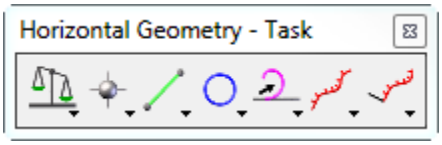


## 2.10 Civil Horizontal Geometry Commands

Civil Horizontal Geometry commands can be accessed by selecting the **Horizontal Geometry** task group from the *Civil Tools* tasks menu.




or by selecting **Tools** > **Civil Geometry** > **Horizontal Tools** > **Open as Tool Box** from the MicroStation menu.

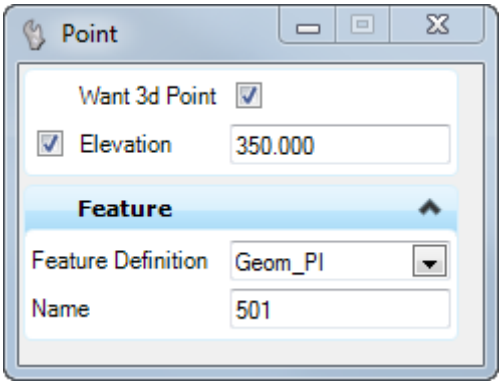


### 2.10.1 Placing Point Geometry

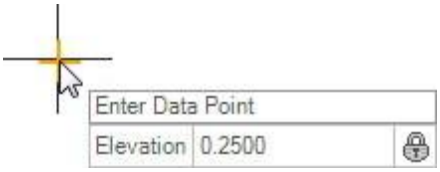
There are two point options; *Place Point* and *Equal Space Points*.

**Place Point** constructs a civil point element. The point may place a cell based on feature definition or a MicroStation point (zero length line) if no feature definition is used.

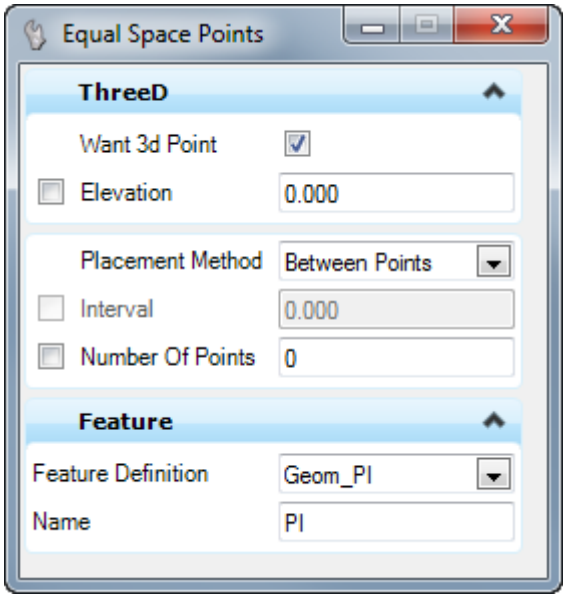
1. Open the Civil Tools task pane to the *Horizontal Geometry* section then click the **Point** icon. Selecting the Point icon will open the *Point* dialog. A 3D point can be created if given an elevation. Check the *Want 3D Point* box and enter an *Elevation* in the field provided if you wish your point to have a vertical value.




2. When you move the cursor into the View, it is equipped with a command prompt that says, *Enter Data Point*, so move the cursor to the location then place the data point to accept, or enter the XY value of the location in the MicroStation key-in field.




**Equal Space Points** inserts a specified number of points, points at a defined interval, or a combination of both into the View. These can be along an element or between two points.

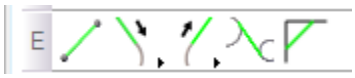


**General Workflow**

1. First select the **Placement Method** (*Between Points* or *Along Element*).
2. When using the Placement Method *Between Points*, select the location of the start point and key in the number of points. Select the location of the end point.
3. When using the Placement Method *Along Element*, select the element and select the Spacing type (Number Of Points option, Interval, Even, or Max Interval), key in the Interval or Number Of Points, and finally key in the Offset from the element

## 2.10.2 Placing Line Geometry

There are five linear element placement options



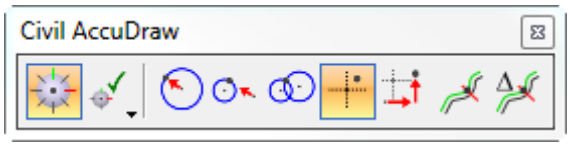
**Line Between Points** – Places a line by Distance and Direction.

The points can be defined in several ways:

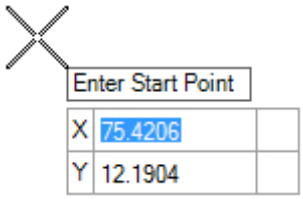
- Arbitrary Data Points on the screen
- Using Civil AccuDraw
- Snapped relative to other elements
- Previously created geometry point element
- Any of the values may be locked in the dialog when the tool starts or at any time while the tool is active. All of the values on the dialog are dynamically updated as the cursor moves

Without Civil AccuDraw active, the start point is identified and the distance and Direction entered to place the second point.

With Civil AccuDraw active and the *XY* favorite selected, a heads up prompt will provide XY key-in fields.




Changing the AccuDraw favorite will also change the heads up display presenting fields to define the location of the end point. If *Linked Distance-Direction* is selected in Civil AccuDraw then heads up display will have those fields.



**Line To Element** – This is a series of *Line To Element* commands indicated by the arrow in the right hand corner of the icon. These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the **Line to Element** icon then choose *Show/Hide Arc from Element Tools* to access the following options.

**Simple Line To Element -** Creates a line without any transition to another element at zero degrees skew angle; applicable only when the *To* element is a curve, *Offset* locked at zero.

**Spiral Line To Element** - Creates a line with a spiral transition to another element at zero degrees skew angle; applicable only when the *To* element is a curve, *Offset* locked at zero.

**Curve Line to Element -** Creates a line with an arc transition to another element at zero degrees skew angle; applicable only when the *To* element is a curve, *Offset* locked at zero.

**By Angle Line to Element -** Creates a line without any transition at user defined skew angle, *Offset* locked at zero.

**Line to Element -** Creates a line at a skew to a reference element.

**Line From Element** – This is a series of *Line From Element* commands indicated by the arrow in the right hand corner of the icon. These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the **Line From Element** icon then choose *Show/Hide Arc from Element Tools* to access the following options.

**Simple Line From Element -** Creates a line without any transition from another element at zero degrees skew angle, Applicable only when the From Element is a curve, Offset locked at zero

**Spiral-Line From Element -** Creates a line with a spiral transition from another element at zero degrees skew angle, applicable only when the From element is a curve, Offset locked at zero

**Curve-Line From Element -** Creates a line with an arc transition from another element at zero degrees skew angle, applicable only when the From element is a curve, Offset locked at zero

**By Angle Line From Element** - Creates a line without any transition from another element at a skew angle you define, Offset locked at zero

**Line From Element** - Creates a line at a skew from a base element.

**Line Between Arcs** - Constructs a line between two previously placed arcs. This tool has the ability to optionally apply a back and/or forward transition between the arc(s) and constructed line.

**Chamfer Between Elements -** Planes a corner (i.e., it alters an existing intersection by inserting a line between the elements).

### 2.10.3 Placing Arc Geometry

**Circle** - Creates a circular element based on the center point of the circle and a through point defining the radius.

**Arc Between Points** - Creates an arc between points. The most common usage is Arc between 3 points, but other variations are available. Points can be defined in several ways:

- Arbitrary Data Points on the screen
- Defined using Civil AccuDraw
- Snapped relative to other elements
- An existing geometry point element

**Simple Arc To Element** – This is a series of *Simple Arc To Element* commands indicated by the arrow in the right hand corner of the icon. These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the **Simple Arc To Element** icon then choose *Show/Hide Arc to Element Tools* to access the following options.

**Simple Arc To Element -** Constructs an arc to element with a given radius

**2 Center Arc To Element -** Constructs an arc to element with a given radius and a back transition

**Spiral Arc To Element -** Constructs a spiral to element

**Reverse Spiral Arc To Element -** Constructs a Double Spiral to an element

**Arc To Element -** Constructs an arc to element with a given radius with the addition of offset and end tangent direction

**Simple Arc From Element** – This is a series of Simple Arc From Element commands indicated by the arrow in the right hand corner of the icon. These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the **Simple Arc From Element** icon and then choose Show/Hide Arc From Element Tools to access the following options:

**Simple Arc From Element** - Constructs an arc from an element with a given radius.

**2 Center Arc From Element** - Constructs an arc from an element with a given radius and a back transition.

**Spiral Arc From Element** - Constructs a spiral from an element.

**Reverse Spiral Arc From Element** - Constructs a Double Spiral from an element.

**Arc From Element** - Constructs an arc from an element with a given radius with the addition of offset and end tangent direction.

**Simple Arc** – This is a series of Simple Arc commands indicated by the arrow in the right hand corner of the icon. These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the **Simple Arc** icon then choose Show/Hide Arc Tools to access the following options.

**Simple Arc** - Creates a radius arc without spirals or tapers at both ends, Offsets locked at zero

**Spiral-Arc-Spiral** - Creates a radius arc with spiral transitions but no tapers at both ends, Offsets locked at zero

**Taper Arc Taper** - Creates a radius arc with tapers but no transitions at both ends, Offsets locked at zero

**3 Center Arc** - Creates a radius arc with radius transitions at both ends, result is a three centered curve, Offsets locked at zero

**2 Center Arc** - Creates a radius arc with radius transitions at one end, result is a two centered curve, Offsets locked at zero

**Arc Between Elements -** Constructs an arc between two previously placed elements. This tool has the ability to optionally apply a back and/or forward transition and/or taper between the elements and the constructed arc.

**Arc Between Arcs -** Constructs an arc between two previously placed arcs. This tool has the ability to optionally apply both a back and/or forward transition between the base arcs and the constructed arc.

**Complex Transition between any Element and Arc -** Constructs an arc between two previously placed elements. This tool has the ability to optionally apply a Back Spiral and/or Ahead Transition between the elements and the constructed arc.

## 2.10.4 Placing Spiral Geometry

**Spiral From Element -** Constructs a spiral from a previously placed element, using this base element to determine tangency at one end. This tool provides chorded spirals only. Other spiral-like transitions are not supported.

**Spiral Between Elements -** Constructs a spiral (or spirals) between two base elements that determine tangency. Dependent on the configuration of the base elements, there may be:

- Single spiral that connects: A line and an arc
- Two arcs where one arc is contained entirely within the circle of the other arc
- A compound spiral between two arcs
- A reverse spiral between two arcs

This tool provides chorded spirals only. Other spiral-like transitions are not supported.

## 2.10.5 Creating Complex Geometry

**Complex By Elements -** Constructs a complex element of previously placed elements by joining them in sequence.

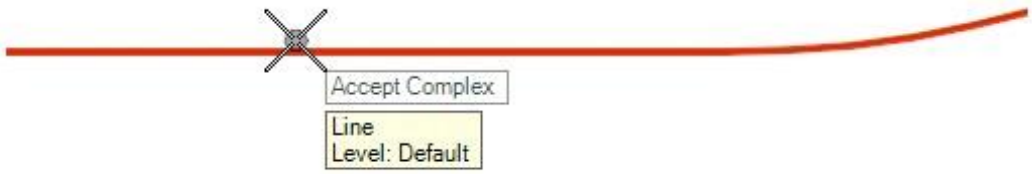
**Workflow**

1 . Click **Complex By Elements**. The *Complex Element* dialog displays.

There are two methods of operation: *Manual* and *Automatic*.

2. Using the *Automatic* method, hover over the beginning element until the directional arrow points to the desired direction. Left mouse-click to accept the chosen element.

3. At this point, the complex path will be highlighted. Left-click again to accept the complex creation or right-click to cancel.



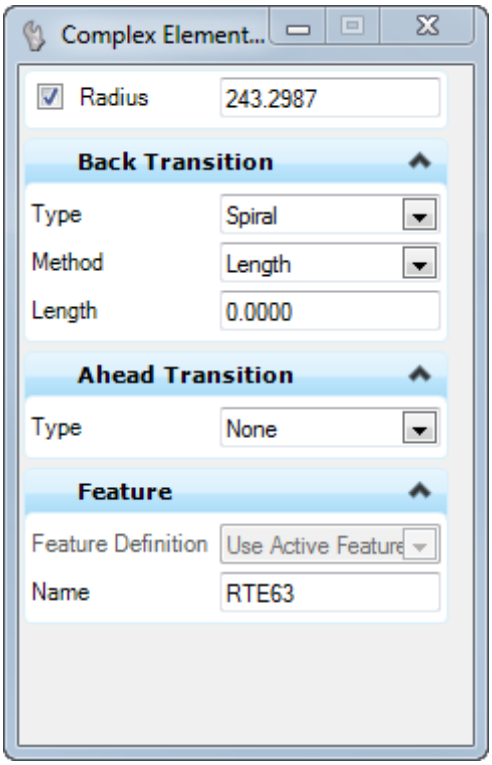

4. Alternatively, using the *Manual* method, select each element individually using the left-click.

**Complex By PI** - Creates a linear element with curves based on user input of PI (point of intersection) locations. The curves can include transitions or set the transitions to none.

The transitions on the curves can be arc transitions or chorded spirals using the following methods:

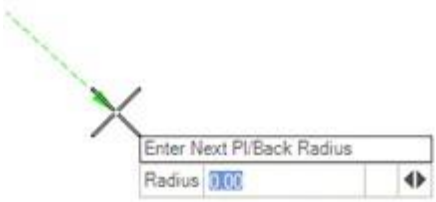
- Spiral - Length
- Spiral - A-Value
- Spiral - Deflection
- Spiral - Delta R
- Spiral - RL
- Curve - Length
- Curve - Deflection
- Curve - Delta R
- Curve - Ratio

To access these methods customize the dialog and add the method(s) of interest resulting in a customized tool.




**Workflow**

1. Click **Complex By PI**. The *Complex Element By PI* dialog displays.
2. Select the Civil AccuDraw favorite to be used in placement of the PIs and key-in the placement values in the heads up display or Data point to set the beginning of the element.
3. **Place the second PI**.




4. **Place the third PI**. Radius always applies to the PI prior to the one where the data point is currently being set. You can edit the radius by keying in a new value in the prompt. If the back and ahead transitions are set then this is a triple toggle input. Toggle with left-right arrow keys to set back and ahead transition parameters.
5. Continue to data point to add more PI points. Click the **Reset** button to stop adding PI points.

**Start Station -** Assigns stationing to an element. You assign a station value and a position along the element for that station value. This command can be used on a civil element or a plain MicroStation graphic. If this command is never run, then the beginning stationing is assumed to be zero.

**Add Station Equation -** Defines a station equation at a designated location on an element. If stationing has not been previously defined, then a zero starting station is also assigned. This command can be used on a civil element or a plain MicroStation graphic.

**Preferences**

Preferences that affect *Start Station* and *Add Station Equation* are stored as DGN settings (Settings > Design File Settings > Civil Formatting).

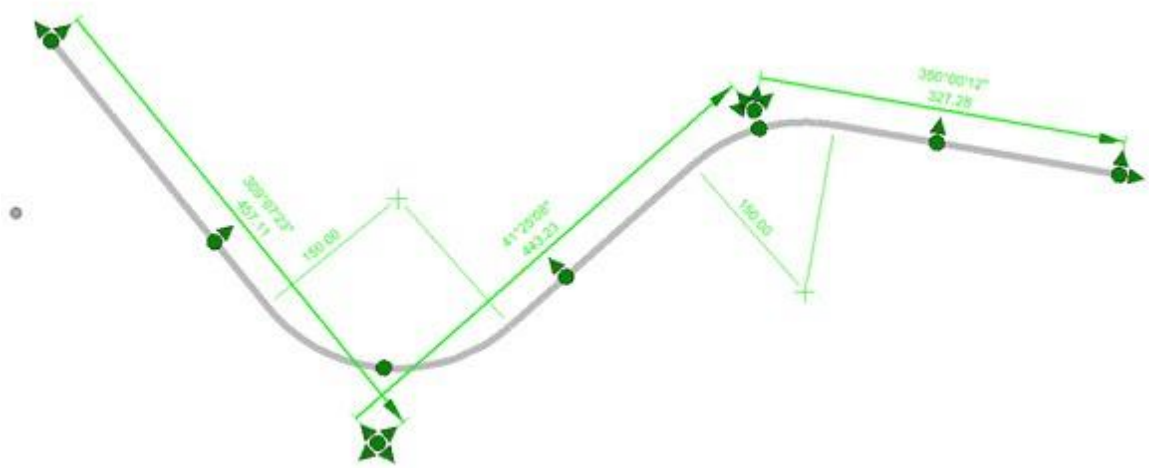
## 2.11 Editing Horizontal Geometry

Once a Civil Geometry Element is placed, selection of that element will display the appropriate manipulators, defining the element.

## Manipulators

Manipulators are available for:

- Distance and direction on each line segment
- Radius and transition parameter on each curve
- Drag handles at PI points



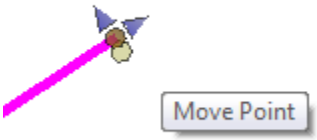
### Normal Line Manipulators

When the line is placed without any snaps and without any Civil AccuDraw constraints, you will see the onscreen manipulators as shown right. These manipulators can be used to edit the line as follows:

- The distance and direction text manipulators can be clicked to allow editing of the value
- The arrows parallel to the line can be used to extend or trim the line (i.e., change the distance)
- The end point arrows perpendicular to the line can be used to rotate the line (i.e., hold the distance and change the direction)
- The perpendicular arrow at midpoint can be used to move the line parallel
- The dot at the end points can be used to move the point without constraining the distance or direction
- The dot at the midpoint can be used to move the line in its entirety

### Snap Manipulator

When a line end point has been snapped, the normal manipulators are replaced by a snap manipulator. The end on the left was snapped by key point, so you see a single dot and an icon indicating the snap type.



You can move the snapped end in space by clicking the dot and dragging. This breaks the snap and creates a new endpoint location that might be a data point, a different snap or a Civil AccuDraw input.

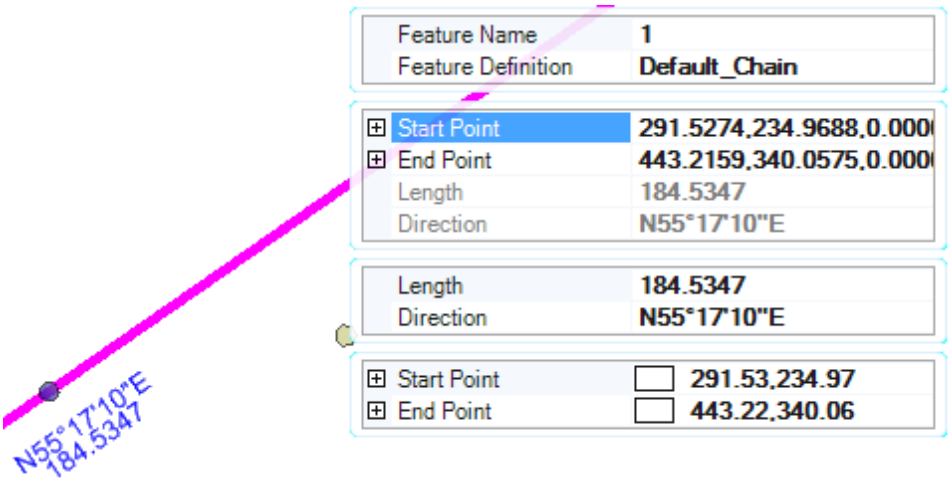
If you hover over the snapped end point dot, the normal manipulators will appear to allow extend/trim or rotate of the line. This also breaks the snap. Similarly, when a line endpoint is created by Civil AccuDraw, the normal manipulators are replaced by a single dot and the AccuDraw manipulators. The AccuDraw Manipulators are text labels that can be clicked and edited.

Hover over the dot to show the normal manipulators for rotate and trim/extend functions. This replaces the AccuDraw input with the new input values.

## 2.12 Horizontal Geometry Properties

The rule data is also accessible in the properties of the line. Select the line and click *Properties* from the heads up menu. Most data in the property pane can be edited to change the line definition. You can also select the geometry using the Element Selection tool and use the Element Information dialog to make changes

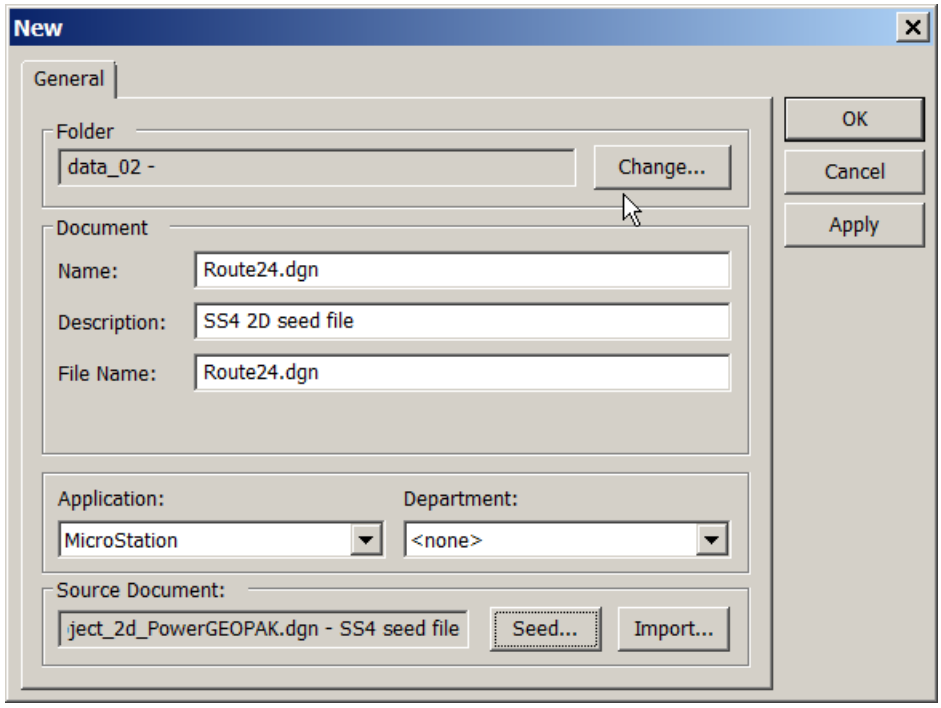
**Note**: When you review geometry the Element Information dialog displays the terrain models that the geometry belongs to, if any.



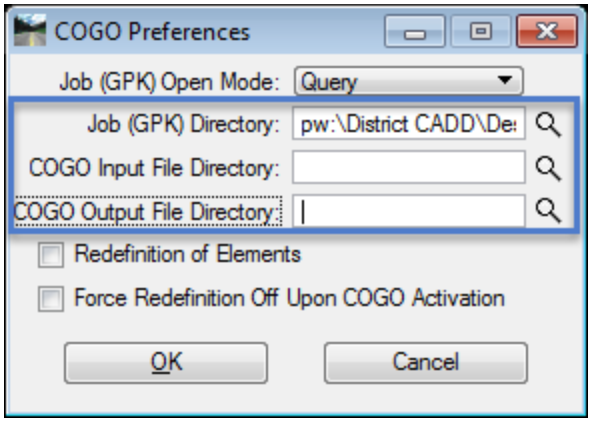
## 2.13 Individual Exercise 1: Route 24

1. Create a new MicroStation file named **Route24.dgn** using the

   ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn*** seed file from the MoDOT workspace.



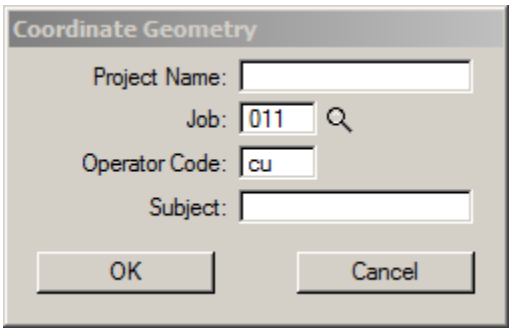

2. Go to **GEOPAK > ROAD > User Preferences**, select **COGO Preferences…** and verify the *Job (GPK) Directory*: is set to ***pw:\District CADD\Design\Randolph\J2P0200\data_02***.



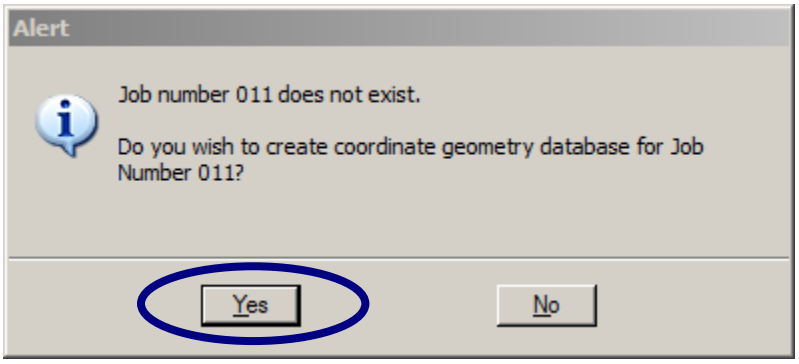
3. Click **OK** to close the *COGO Preferences* dialog.
4. Click **OK** again to close the *User Preferences* dialog.
5. Open the **Coordinate Geometry** dialog from the **GEOPAK > ROAD > Geometry** menu and enter the following values:

   *Job*: **011**

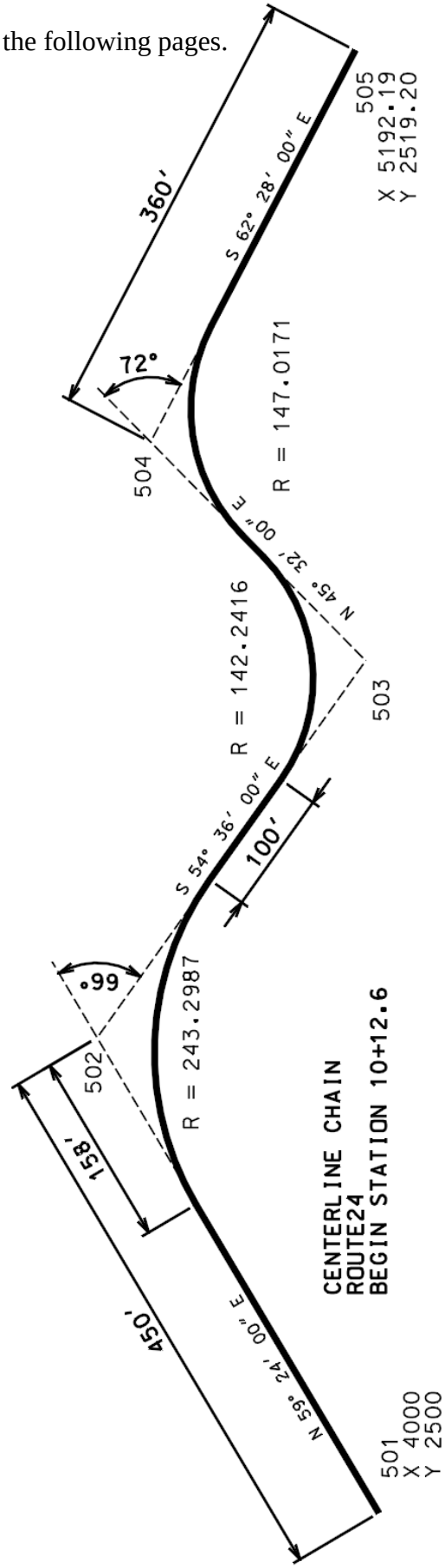
   *Operator Code:* **your initials**.




6. Click **OK** to dismiss the *Coordinate Geometry* dialog.
7. Since this Coordinate geometry database does not exist, you will get the following message. Select **Yes** in the *Alert* dialog to continue. The job will hold geometry in native format as the civil geometry is created.



Create the alignment as shown per the step outlined on the following pages.



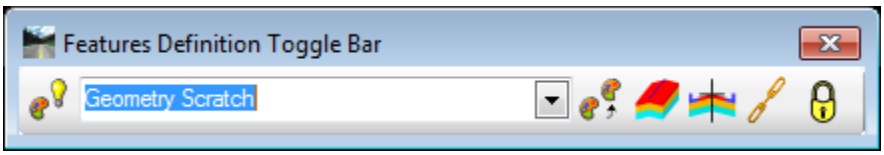
**Creating the Tangent Elements**

1. Expand the **Horizontal Geometry Toolbox** in the Tasks menu.

2. Select **Feature Definition Toggle Bar** to open the toggle bar window.

   **Hint:** the Feature Definition Toggle Bar can be docked at the top or bottom of the screen so it is easily accessible.

3. Set the active feature to **Design** > **Design Standards** > **Geometry**> **Geometry Scratch**.




4. Enable the **Use Active Feature Definition** tool on the Feature Definition Toggle bar.

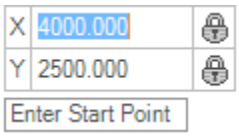
   Setting an active feature definition will cause any geometry elements created to have the active feature assigned as its Feature Definition (property).

5. Verify Civil AccuDraw is active.

6. Select the **Line Between Points** task from the *Horizontal Geometry* task group

7. Select the **XY** favorite from the Civil AccuDraw toolbar.

8. Using the heads up display, key in the coordinates of the first PI (501), **X = 4000 Y = 2500**.



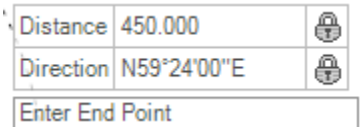

   **Hint:** After locking in a value move the mouse to ensure the value is set.

9. Data point to accept the point.

10. When prompted to *Enter End Point*, make the **Distance - Direction** favorite active in Civil AccuDraw. This will change the heads display.

11. Locate the second point (502) with a *Distance* = **450** and the *Direction* = **N59°24'00.0"E**

    **Hint:** Directions or angles can be entered in these formats DD:MM:SS or DD^MM'SS". If Bearing is the MicroStation Definition then the Alpha indicators (N S E and W) should be entered with no spaces before the DD and after the SS.




12. Data point to accept.

13. Place another line with a Start point (505) at **X = 5192.19** and **Y = 2519.20**.

14. Define the End point (504) as *Distance* = **360** and the *Direction* = **N 62°28'00.0"W**.

15. In Civil AccuDraw, make the **Direction - Direction** favorite active. This will find the intersection point based on two directions.

16. Select **Line Between Points.**

17. Select the end of the first line (point 502) drawn above to make the compass active on the end point.

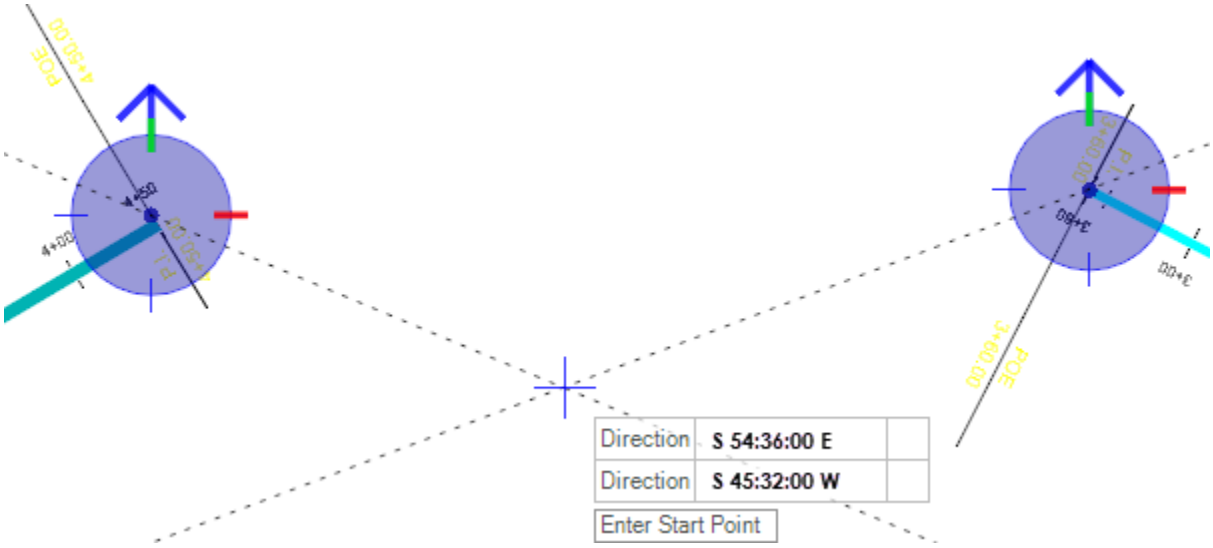
    **Hint:** To identify a civil Geometry object hover over it and let Civil AccuSnap select it for you

18. Enter the first direction as **S54:36:00E** and tab to the next Direction field.

19. Set the origin of the second point by typing the letter **O** and selecting the ending point of the second line (point 504).

    **Note:** If presented with angle instead of direction, the Civil AccuDraw compass has rotated. Key in "**T**" to rotate the compass to the top or "**V**" to rotate the compass to the View.

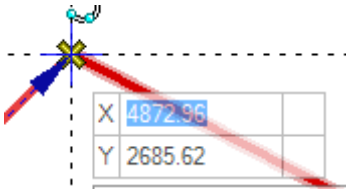
20. Enter the second direction as **S45:32:00W** and press **Tab** to view the solution.




21. Data point in the view to accept the solution and place the line.

22. Select **Line Between Points.**

23. AccuSnap to the end points of the first line placed (at 502) and second line placed (at point 504).




This completes the placement of the tangent sections. The curves for Route24 will be placed using the ***Simple Arc*** command.

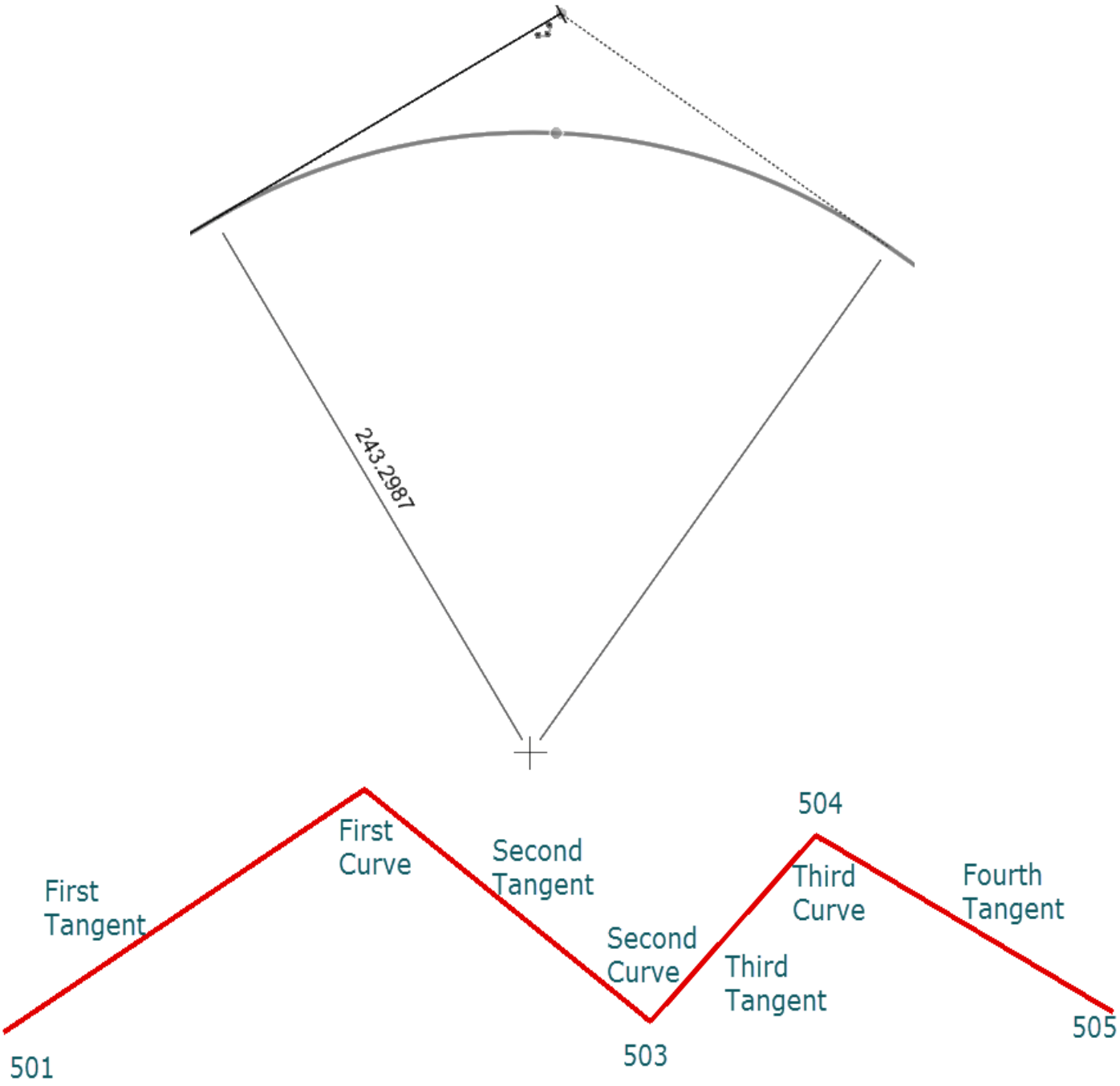
**Placing the Curves**

24. **Turn off** Civil AccuDraw

25. Select **Simple Arc.**

26. Set the *Trim/Extend* option to **Both** and left-click twice to accept the solution.

27. Enter the **243.2987** as the *Radius* for the first curve.




28. When prompted to *Locate First Element*, select the first tangent as noted in the graphic above then select the second tangent.

29. **Data Point** to accept the arc location. **Data Point** again to accept the Truncate Option.

30. Repeat steps 2-6 for the second curve with a Degree of Curve using Second and Third Tangents shown above. Second Curve **Radius is 142.2416**.

31. Repeat steps 2-6 for the third curve using Third and Fourth Tangents shown above. Third Curve **Radius is 147.0171**.

**Complex the Elements into one Chain**

32. Select the **Complex by Elements** task.

33. Set the active feature to **Design > Drafting Standards > Plan > Alignments > MoDOT_Baseline_Proposed**.

34. Set the *Method* to **Automatic**.

35. Key in **Route24** in the *Name* field.

36. When prompted to *Locate First Element*, identify the beginning of the first linear element placed. **Note**: The Arrow indicates the direction the chain will be processed.

37. If presented with the *Job Number* dialog, select **job011.gpk** and select **OK**.

**Set the beginning stationing**

38. Select the **Start Station**.

39. When prompted to *Locate Element*, select the Route24 alignment.

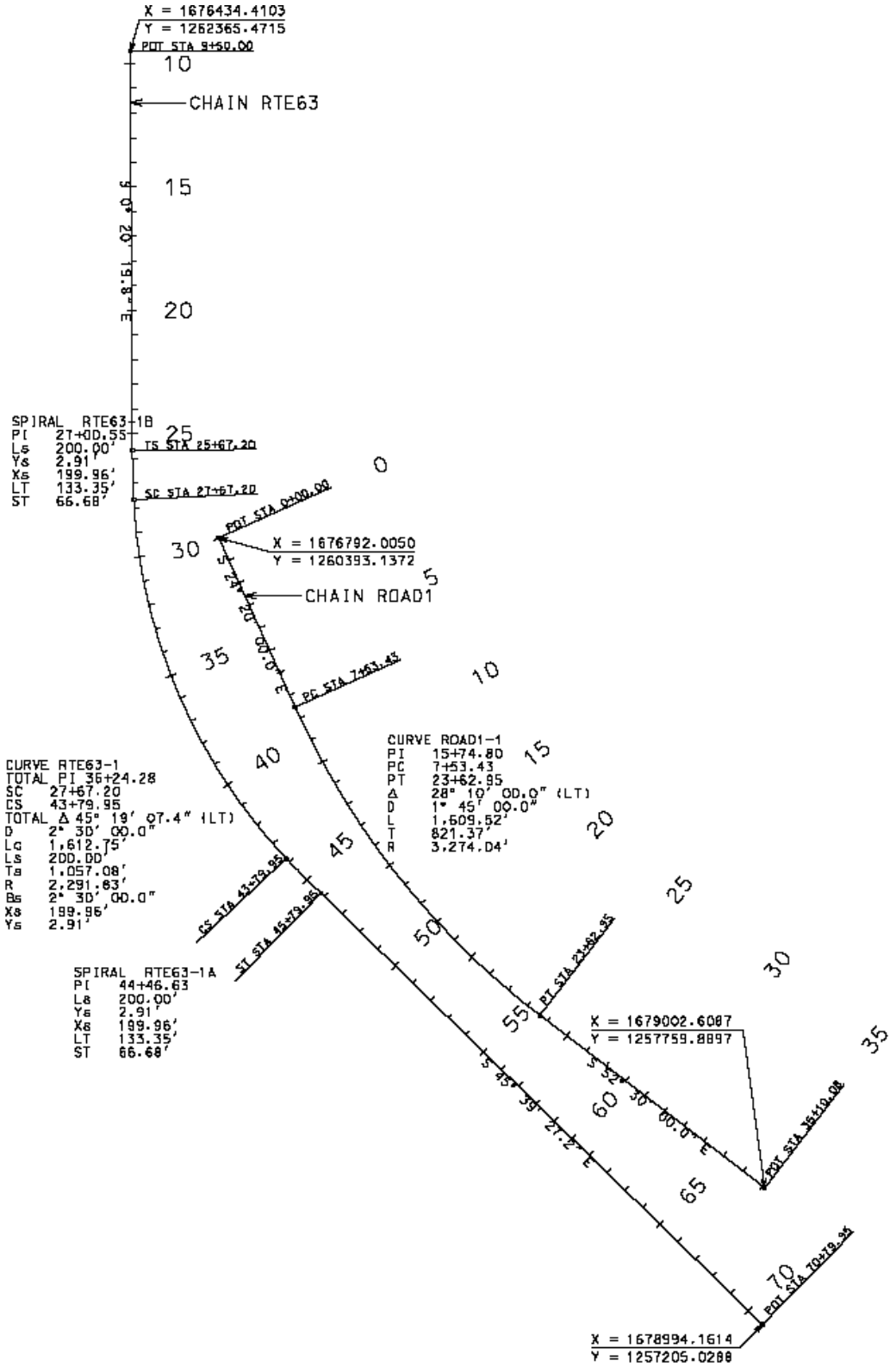
40. Set the *Start Distance* to **0**. **Data Point** to accept.

41. Enter **10+12.6** as the *Start Station*. The station can be modified in the *Element Information* dialog.

42. Verify the label for the start station has been changed to *POT STA 10+12.60*.

43. Select **File > Update Server Copy**.

## 2.14 Group Exercise 2: Road 1 Alignment



Create a new MicroStation file: **Civil_Geometry_ J2P0200.dgn**.

1. Click **Seed** and select ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn*** as the seed file
2. Save the new file to the following location:

   **Randolph\data_02\Civil_Geometry_ J2P0200.dgn**.

   **Note**: You may need to *Check In* Route24.dgn when creating the new file
3. Reference the existing Terrain model by selecting Reference **File > Tools > Attach**. Select **Terrain_J2P0200_Existing.dgn** and set the attachment method as Coincident World.
4. Click **OK**. Dismiss the Reference file dialog.
5. Select Fit View.
6. Create a new GPK using job number **200** and save it to ProjectWise as job200.gpk.

Use the *Civil Geometry* tools and follow the steps below to create the alignments as shown on the previous page.

# Road1

Beginning Point: X = **1,676,792.0050** Y = **1,260,393.1372**
Ending Point: X = **1,679,002.6087** Y = **1,257,759.8897**

Beginning station of **Road1** is **0+00.00**.

**Curve Data**

Direction Back = **S 24° 20' 00.0" E**
Degree of Curve = **1° 45' 00"**
Direction Ahead = **S 52° 30' 00.0" E**

7. Set the active feature to:

   **Design > Design Standards > Geometry > Geometry Scratch.**
8. Toggle **On** *Use Active Feature Definition*.
9. Toggle **Civil AccuDraw** to **active**.
10. Pin the **Task Menu** and expand the **Horizontal Geometry Toolbox**.
11. Use the "**Line Between Points**" tool along with **Civil AccuDraw** to place two lines that represent the two tangent sections of the Road1 alignment. Make sure these two lines are long enough so that they overlap each other. What we are attempting to do is locate the

overall PI location of the Spiral-Curve-Spiral using the intersection of the two Civil Geometry Lines.

a. Select the "**Line Between Points**" tool, and using **Civil AccuDraw** and it's **XY** function, key in the coordinates X = **1,676,792.0050,** Y = **1,260,393.1372**

b. Once the start of the alignment has been defined, continue to place the line using **Civil AccuDraw** and its **Distance-Direction** option at a bearing of **S 24° 20' 00.0" E** at a length that would extend past the PI location of the Curve (a length of at least 1,750 feet will work). When typing in a bearing use a colon "**:**" in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this step you would type **S24:20E**

Note: If "**Angle**" is display instead of "**Bearing**" in the Civil AccuDraw heads-up display select the keyboard keys "**R**" and then "**T**". This is a Civil AccuDraw shortcut to **R**otate the compass to the **T**op view.

c. Select the "**Line Between Points**" tool, and using **Civil AccuDraw** and it's **XY** function, key in the coordinates X = **1,679,002.6087**, Y = **1,257,759.8897**

d. Once the end of the alignment has been defined, continue to place the line using **Civil AccuDraw** and its **Distance-Direction** option at a bearing of **N 52° 30' 00.0" W** at a length that would extend past the PI location of the Curve (a length of at least 2,500 feet will work). When typing in a bearing use a colon "**:**" in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this step you would type **N52:30W.**

Note: If "**Angle**" is display instead of "**Bearing**" in the Civil AccuDraw heads-up display select the keyboard keys "**R**" and then "**T**". This is a Civil AccuDraw shortcut to **R**otate the compass to the **T**op view.

12. Deactivate **Civil AccuDraw**.

13. Next store the **Curve** by selecting the **Simple-Arc** tool, and defining the tool with the following parameters:

    Degree of Curve = **1° 45' 00"**

    Notes:

    - To switch from **Radius** to **Degree of Curve** or vise-versa type in a "**d**" in the Radius field and then add the degree of curve value.
    - When typing in a Degree of Curve use a colon "**:**" and place in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this example you would type **d 1:45:00** or **d 1:45** for short.

    Once the tool is defined with the correct parameters select each tangent and place the Spiral-Curve-Spiral trimming both tangents back.

14. Select **Create Complex Element** and to turn the individual element into one complex element. Name the complex element "**Road1**" with no spaces. Make sure the stationing will be flowing (getting larger) in a southerly direction.

15. Using the "**Start Station**" tool set the *Beginning Station* to **0+00.00**.

16. Make sure the MicroStation Drawing Scale is set to **1"=50'**.

17. Set the active feature to **Design > Drafting Standards > Plan > Alignments > MoDOT Baseline Proposed**.
    a. IF prompted select the **200** gpk.
18. Generate a **Horizontal Geometry Report** by “left clicking” on the alignment and selecting from the heads up menu the **Horizontal Geometry Report** Tool.
    a. Verify in the Report that the geometry is correct.
19. Select **File > Update Server Copy**.

## 2.15 Individual Exercise 3: Route63 Alignment

# Route 63

Beginning Point: X = **1,676,434.4103** Y = **1,262,365.4715**
Ending Point: X = **1,678,994.1614** Y = **1,257,205.0288**

Beginning station of **RTE63** is **9+50.00**.

**Spiral-Arc-Spiral Information**

| | |
|---|---|
| Direction Back | = **S 0° 20' 19.8" E** |
| Length of the back spiral | = **200'** |
| Degree of Curve | = **2° 30' 00"** |
| Length of the ahead spiral | = **200'** |
| Direction Ahead | = **S 45° 39' 27.2" E** |

1. Set the active feature to:

   **Design > Drafting Standards > Geometry > Geometry Scratch.**

2. Toggle **On** *Use Active Feature Definition*.

3. Toggle **Civil AccuDraw** to **active**.

4. Pin the **Task Menu** and expand the **Horizontal Geometry Toolbox**.

5. Use the "**Line Between Points**" tool along with **Civil AccuDraw** to place two lines that represent the two tangent sections of the Route 63 alignment. Make sure these two lines are long enough so that they overlap each other. What we are attempting to do is locate the overall PI location of the Spiral-Curve-Spiral using the intersection of the two Civil Geometry Lines.

   a. Select the "**Line Between Points**" tool, and using **Civil AccuDraw** and it's **XY** function, key in the coordinates X = **1,676,434.4103**, Y = **1,262,365.4715**

   b. Once the start of the alignment has been defined, continue to place the line using **Civil AccuDraw** and its **Distance-Direction** option at a bearing of **S 0° 20' 19.8" E** at a length that would extend past the Overall PI location of the Spiral-Curve-Spiral (a length of at least 4,000 feet will work). When typing in a bearing use a colon "**:**" in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this step you would type **S0:20:19.8E**

   Note: If "**Angle**" is display instead of "**Bearing**" in the Civil AccuDraw heads-up display select the keyboard keys "**R**" and then "**T**". This is a Civil AccuDraw shortcut to **R**otate the compass to the **T**op view.

c. Select the "**Line Between Points**" tool, and using **Civil AccuDraw** and it's **XY** function, key in the coordinates **1,678,994.1614** Y = **1,257,205.0288**

d. Once the end of the alignment has been defined, continue to place the line using **Civil AccuDraw** and its **Distance-Direction** option at a bearing of **N 45° 39' 27.2" W** at a length that would extend past the Overall PI location of the Spiral-Curve-Spiral (a length of at least 4,000 feet will work). When typing in a bearing use a colon "**:**" in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this step you would type **N45:39:27.2W**

Note: If "**Angle**" is display instead of "**Bearing**" in the Civil AccuDraw heads-up display select the keyboard keys "**R**" and then "**T**". This is a Civil AccuDraw shortcut to **R**otate the compass to the **T**op view.

6. Deactivate **Civil AccuDraw**.

7. Next store the **Spiral-Arc-Spiral** by selecting the **Spiral-Arc-Spiral** tool, and defining the tool with the following parameters:

| | |
|---|---|
| Length of the back spiral | = **200'** |
| Degree of Curve | = **2° 30' 00"** |
| Length of the ahead spiral | = **200'** |

Notes:

- To switch from **Radius** to **Degree of Curve** or vise-versa type in a "**d**" in the Radius field and then the degree of curve value.
- When typing in a Degree of Curve use a colon "**:**" and place in-between the **Degrees:Minutes** and **Minutes:Seconds**. For this example you would type **<u>d 2:30:00</u>** or **<u>d 2:30</u>** for short.

Once the tool is defined with the correct parameters select each tangent and place the Spiral-Curve-Spiral trimming both tangents back.

8. Select **Create Complex Element** and to turn the individual element into one complex element. Name the complex element "**Route63**" with <u>no</u> spaces. Make sure the stationing will be flowing (getting larger) in a southerly direction.

   a. IF prompted select the **200** gpk.

9. Using the "**Start Station**" tool set the *Beginning Station* to **9+50.00**.

10. Make sure the MicroStation Drawing Scale is set to **1"=50'**.

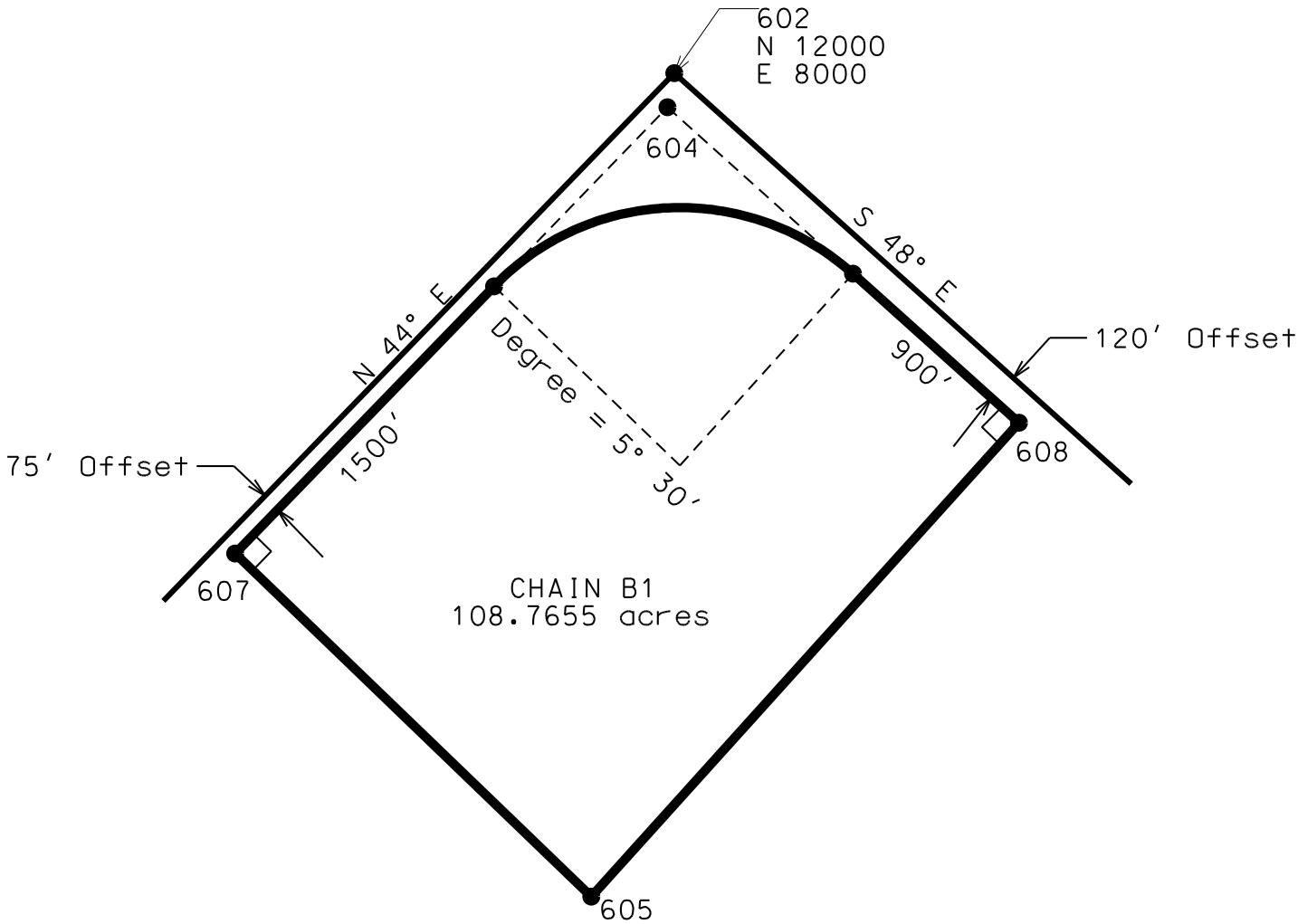
11. Set the active feature to **Design > Drafting Standards > Plan > Alignments > MoDOT Baseline Proposed**.

   a. IF prompted select the **200** gpk.

12. Generate a **Horizontal Geometry Report** by “left clicking” on the alignment and selecting from the heads up menu the **Horizontal Geometry Report** Tool.
    a. Using the report verify the Beginning and Ending coordinates are correct to 4 decimal places.
13. Select **File > Update Server Copy**.

## 2.16 Individual Exercise 3 (Optional): B1

1. Create a new MicroStation file named **B1.dgn**
2. Use the **Civil Geometry** tools to create chain B1 as shown below. Verify the area of the chain.




**Hints:**

- Angles at 604 and 605 are not 90°
- The tanget lengths of 1,500 and 900 are distances from the point of Curvature.

  Store as a Complex Linear Element and verify the area by "left clicking" on the new alignment and selecting from the heads up menu the **Horizontal Geometry Report** tool. Use a report called **Horizontal Alignment Area** to get the area of the alignment.

# Chapter 3

# Civil Geometry - Vertical Geometry

3.1 Objectives ..... 3-1
3.2 Definitions..... 3-1
3.3 Vertical Geometry..... 3-1
3.4 Group Exercise 1: Create Road1 Profile..... 3-14
3.5 Individual Exercise 2: Create Route63 Profile ..... 3-17

## 3.1 Objectives

- Create and store vertical alignments using **Vertical Geometry**

## 3.2 Definitions

The **Vertical Geometry** task group is a collection of Open Roads tools that are used to graphically create and modify proposed design profiles or modify an existing ground profile. These operations may be accomplished through a dialog box and/or by dynamic manipulation of graphic elements.

A profile may also be created with Coordinate Geometry (COGO) input in Native GEOPAK and imported into Open Roads Civil Geometry.

## 3.3 Vertical Geometry

### Open Profile Model

Use the Open Profile Model command to generate a profile view for the chosen feature and gain access to the Vertical Geometry tools.

1. Open the Civil Tools task pane, expand the Vertical Geometry task group, and then click the Open Profile Model icon.
2. Move the cursor into a view and note the command prompt to *Locate Plan Element*.
3. Select the plan element with which you wish to work in profile.
4. The cursor is now equipped with the prompt *Select or Open View*.
   a. If another View is already open, data point in it to present the selected element in profile.
   b. If another view is not open, select a view from the *View Groups* toolbar that is not being used for other models, then data point in the new View.
5. Use the Vertical Geometry tools to edit your vertical alignment.

### Set Active Profile

Use the *Set Active Profile* command to designate which of profile elements will drive the 3D model. The result is the creation of a 3D spline in the 3D model representing the combination of the Horizontal alignment plus the Design profile.

### Profile from Surface

Use the *Profiles from Surface* command to generate a profile whose elevations are determined by draping onto a surface. The surface may be a terrain model, a mesh, or mesh solid.

### Quick Profile from Surface

*Quick Profile from Surface* is a companion command that provides the same result but simplifies the input by assuming that the entire element is draped and that the offsets are zero.

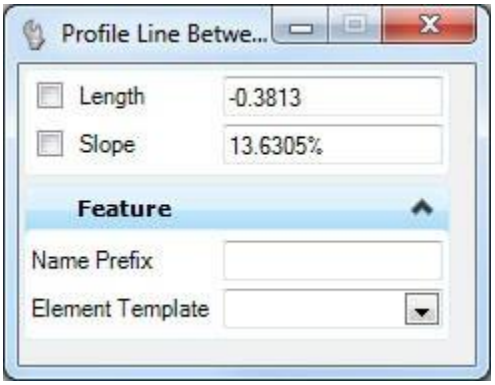
### Profile Line between Points

Use the Profile Line between Points command to construct a profile line between two designated points.

1. Open the Civil Tools task pane to the Vertical Geometry task group then click the *Profile Line Between Points* tool.

   **Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model

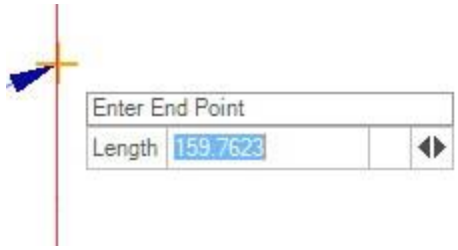
   - The *Profile Line Between Points* dialog opens.




   - Checking the box next to any field locks the associated value.

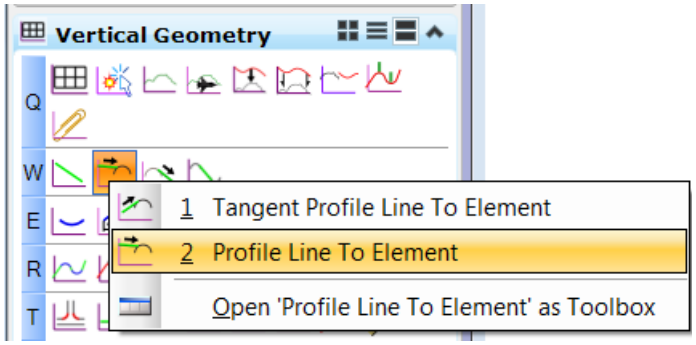
2. When you move the cursor into the Profile View, it is equipped with a prompt. Enter the Start Point in the View by data pointing (*i.e.*, left-clicking) at the desired location.

3. When prompted to *Enter End Point*, data point the location for the end of the profile line. Or you can use one of the following methods to establish the Slope or Length (choose between the two by striking the left or aright arrow keys to toggle between them):
   - Move the cursor slightly, key in the value, then data point.
   - As you move the cursor, a value is displayed on the prompt. Data point.




- **Note:** If the data entry field is locked on the Place Plan Profile between Points dialog, you cannot set a new value.

**Profile Line to Element**

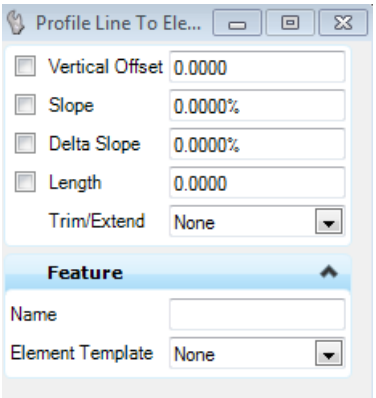



Use the *Profile Line To Element* command to construct a profile line, at a delta slope, from a designated location to a reference element.

1. Open the Civil Tools task pane to the Vertical Geometry task group then click the *Profile Line to Element* icon.

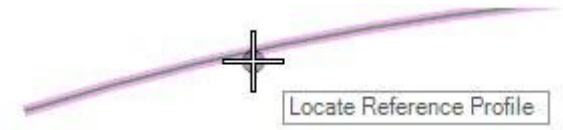
   **Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

   - The *Profile Line to Element* dialog opens.

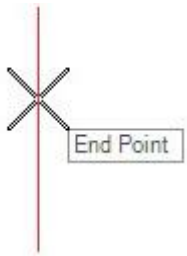



   - Checking the box next to any field locks the associated value.

2. When you move the cursor into the Profile View, it is equipped with a prompt. When prompted to *Locate Reference Profile*, move the cursor to the element to which you wish to draw a line then data point on the target element.




3. Establish the *End Point* in the View by data pointing (i.e., left-clicking) at the desired location.




4. Establish the *Vertical Offset* with one of the following methods:
   - Key in the desired distance and press the Enter key to lock then data point to accept.
   - Move the cursor to a station displayed on the prompt. Data point at the desired station.

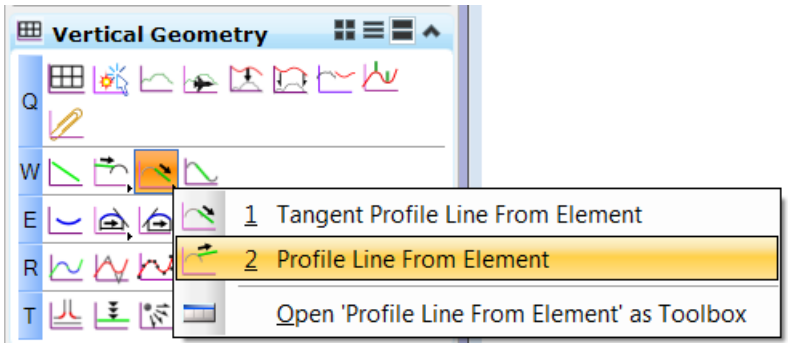
5. Use one of the following methods to establish *the Delta Slope* or *Length;* choose between the two by using the left or right arrow keys to toggle between them.
   - Key in the desired distance and strike the Enter key to lock then data point to accept.
   - As you move the cursor, a value is displayed on the prompt. Data point at the desired distance.

**Profile Line from Element**

Use the *Profile Line From Element* command to construct a profile line, at a delta slope, from a reference element to a designated location.

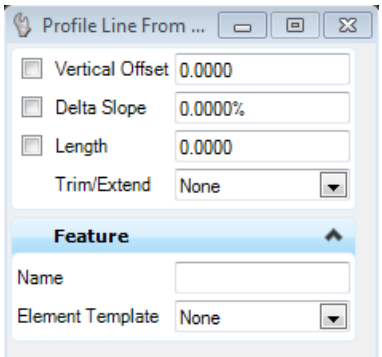
1. Open the Civil Tools task pane to the Vertical Geometry task group then click the *Profile Line From Element* tool.

   **Note:** If your View isn't in Profile mode, an error message will



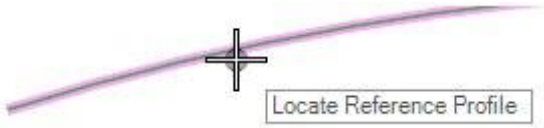
indicate that you need to open a Profile Model.

- The *Profile Line from Element* dialog opens.




- Checking the box next to any fields locks the associated value.

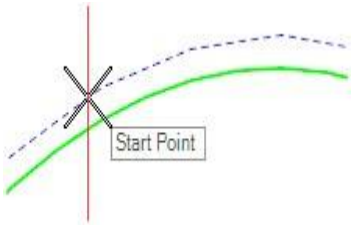
2. When you move the cursor into the Profile View, it is equipped with a command prompt requesting that you *Locate Reference Profile*, so move the cursor to the element from which you wish to draw a line then data point (*i.e.*, left-click) on it.




3. Establish the *Vertical Offset* with one of the following methods:

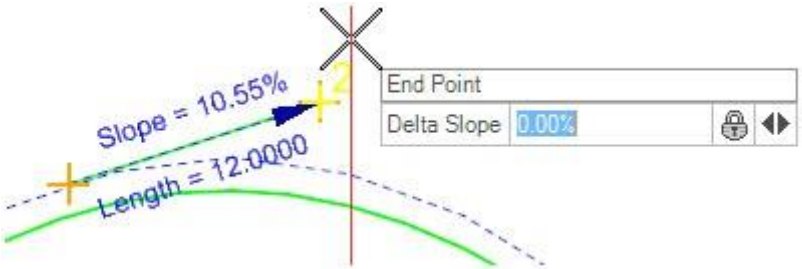
- Key in the distance and strike the Enter key to lock then data point to accept.
- As you move the cursor, a distance is displayed on the prompt. Data point at the desired distance.

4. Identify the *Start Point* along the offset line at the location where the profile line should cross. Data point at the location.

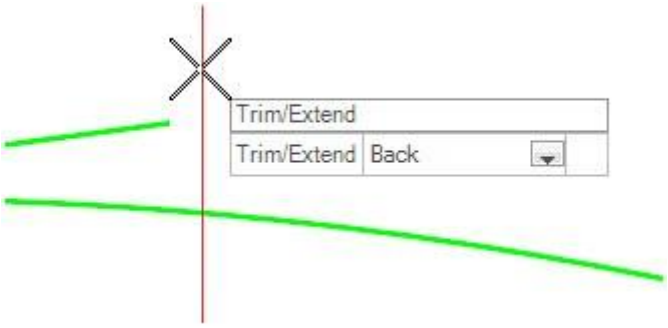



5. To establish the *Delta Slope* or *Length*, select the left or right arrow keys to toggle between them then perform one of the following:

- Key in the value then data point.
- The value is displayed on the prompt and updated as it moves. Data point at the value.

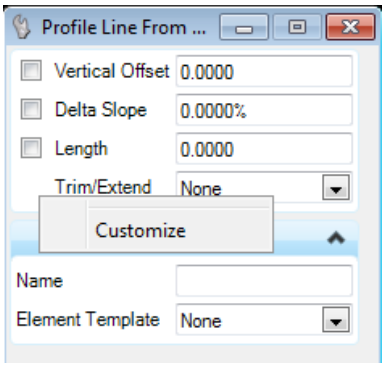



6. To trim the element at the intersection with the Profile line or to extend the element to intersect with the Profile line, strike the up or down arrow keys to choose a Trim/Extend option.

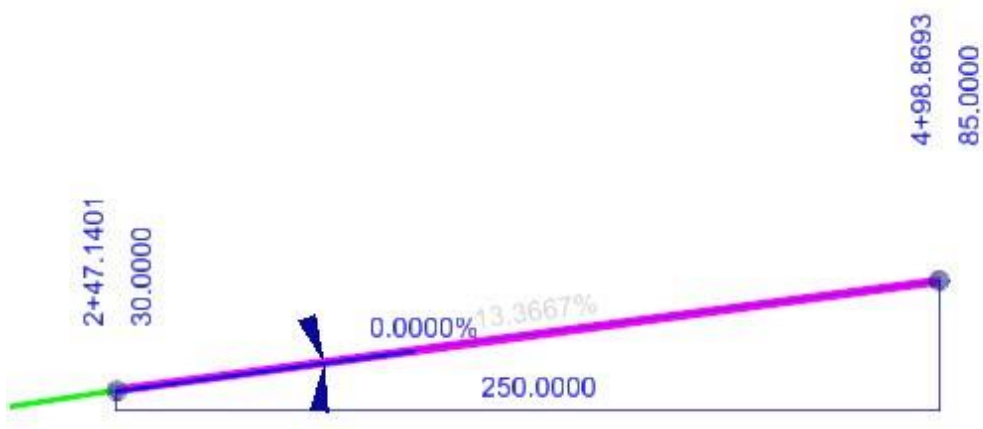



**Dialog Customization**

Right-click on the *Profile Line From Element* dialog to customize it for specific tasks or to personal preference.



**Manipulators**



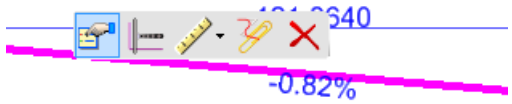

Manipulators are available for:

- Offset from base element (not shown here)
- Delta Slope
- Length
- Drag a grip to dynamically adjust start and end distance

**Properties**

To View the new element's properties, equip the Element Selection tool.

Select the element in the View then let the cursor hover over the selected element. Click the Properties icon to access rule data for the chosen element.




**Custom Tool**

These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the *Profile Line from Element* icon then choose *Show/Hide Profile Line from Element Tools* to access the following option:

**Tangent Profile Line from Element** - Creates a profile line from another element at zero deflection, applicable only when the From element is a profile curve, Offset locked at zero

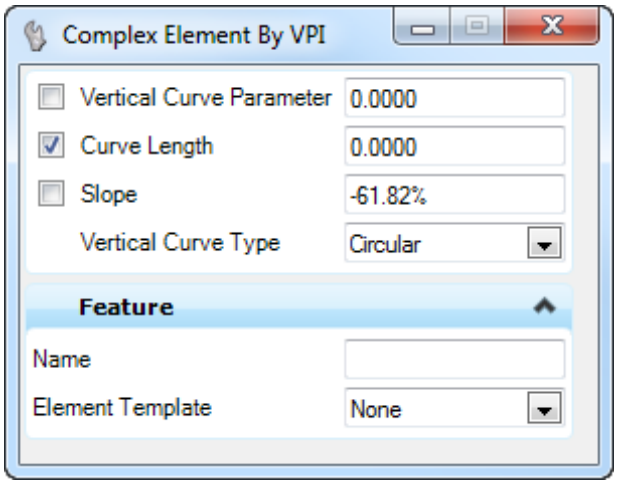
**Profile Complex by VPI**

Use the *Profile Complex by VPI* command to construct a profile complex defined by vertical points of intersection (VPI).

1. Open the Civil Tools task pane to the Vertical Geometry section then click the *Profile Complex by VPI* icon.

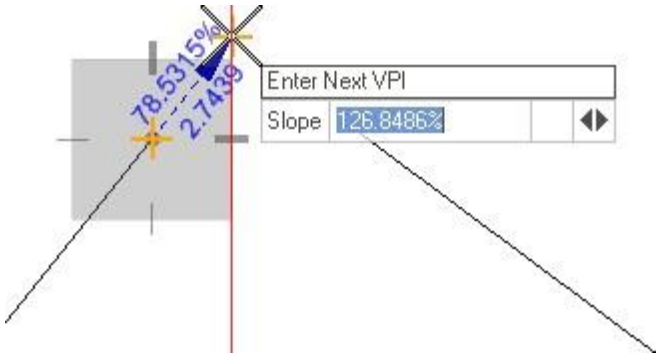
   **Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

   - The *Complex Element by VPI* dialog opens.




   - Checking the box next to any of the fields locks-in the associated value.

2. When the cursor moves into the Profile View, it is equipped with a command prompt requesting that you *Enter First PI*. Place the cursor over the initial point of intersection by data pointing at the location.
3. When prompted to *Enter Next VPI*, use one of the following methods to designate a point through which the curve must pass (navigate the options by striking the left or right arrow keys on the keyboard):




   - As the cursor moves, the value is updated in the prompt. Data point at the required value.
   - Enter a value for the *Curve Length* then strike the Enter key to lock in the value. Data point to accept.
   - Enter a value for the *Vertical Curve Parameter* then strike the Enter key to lock in the value. Data point to accept.

- Enter a value for the *Slope* then strike the Enter key to lock in the value. The slope can always be locked independently of the length or curve parameter. Data point to accept.

**Note:** The VPI can be positioned dynamically or with the aid of Civil AccuDraw. The heads up prompt can also be used to lock desired slope value from the previous VPI to the current VPI.

4. On the 3rd and subsequent VPIs, the Length and/or Curve Parameter can be used to control the curve placed at the previous VPI. For example, the length entered at the 3rd VPI prompt is used to define the curve at VPI 2 and 1.

**Vertical Curve Type**

The option for curve type can be changed in the dialog or by pressing Shift key on keyboard. Supported curve types are:

- **Parabola** - Symmetric Parabolic Curve
- **Asymmetric** - Asymmetric Parabolic Curve
- **Circular** - A simple curve defined by radius

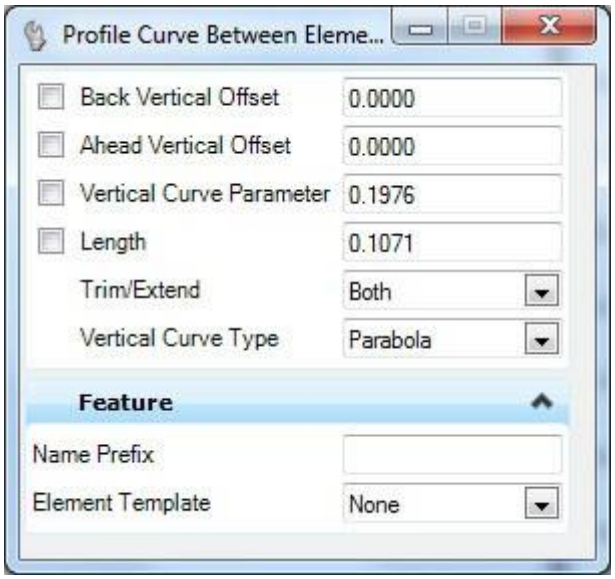
**Profile Curve between Elements**

Use the *Profile Curve Between Elements* command to constructs a vertical curve between two designated elements.

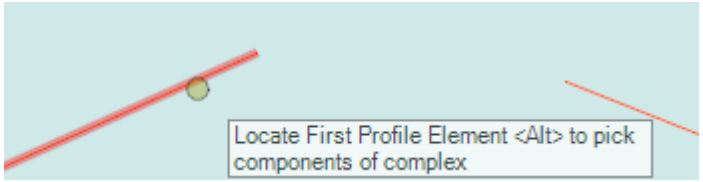
1. Open the Civil Tools task pane to the Vertical Geometry section then click the *Profile Curve Between Elements* icon.

   **Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

   - The *Profile Curve Between Elements* dialog opens.

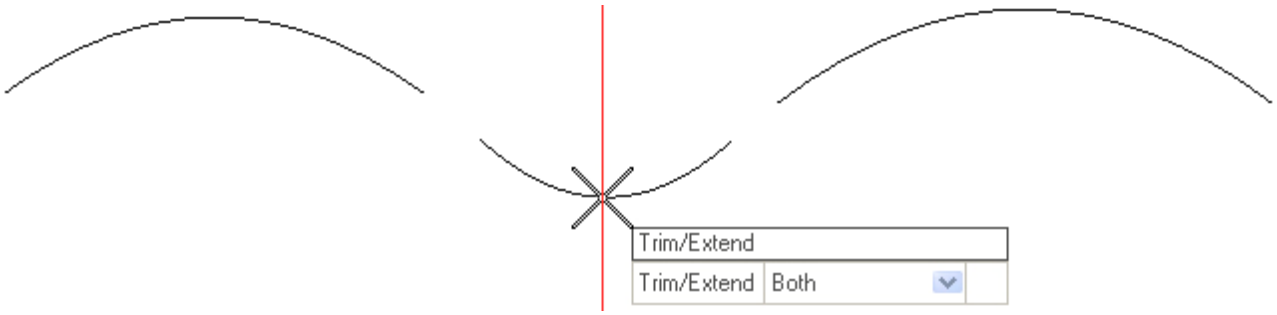


- The back and ahead elements can be lines or curves and can be attached or not. If attached the elements will be clipped based on the curve parameters selected.




- Checking the box next to any of the fields locks-in the associated value.

2. Once the cursor is in the Profile View, a command prompt requesting *Locate First Profile Element* is presented. Data point on the element that will come into the curve.
3. Set the *Back Vertical Offset* either by keying in a value or locating a distance graphically by moving the cursor.
4. When prompted to *Locate Second Profile Element*, move the cursor to the element to which the curve must extend then data point.
5. Enter the Ahead Vertical Offset.
6. Use one of the following methods to designate a point through which the curve must pass. Navigate the options by selecting the left or right arrow keys.
   - As you move the cursor, a value is displayed on the prompt. Data point at the desired value.
   - Enter a value for *Length* and select the Enter key then data point.
   - Enter a value for *Vertical Curve Parameter* and select the Enter key then data point.
7. To trim the element at the intersection of the curves or to extend the new curve to intersect with the old, your Offset value must be zero. Strike the down arrow key to choose the Both option then strike the Enter key.




**Custom Tool**

These pre-customized versions provide a simplified prompt sequence for many common construction tools. Right-click on the *Profile Curve Between Elements* icon then choose *Show/Hide Profile Curve Between Elements Tools* to access the following option:

**Parabola between Elements** - Creates a parabola between two elements, Offsets are locked at zero

**Asymmetric Parabola** - Creates an asymmetric parabola between two elements, Offsets are locked at zero

**Circular Curve between Elements** - Creates a simple profile radius between two elements, Offsets are locked at zero

**Note:** Customized versions are pre-configured to select parabola or curve types negating the need to use ALT key to cycle types.

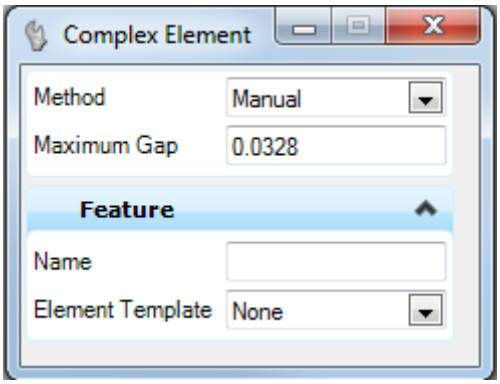
## Profile Complex by Elements

Use the *Profile Complex by Elements* command to construct a complex profile element from previously placed elements.

1. Open the Civil Tools task pane to the Vertical Geometry section then click the *Profile Complex by Elements* icon.

   **Note:** If your View isn't in Profile mode, an error message will indicate that you need to open a Profile Model.

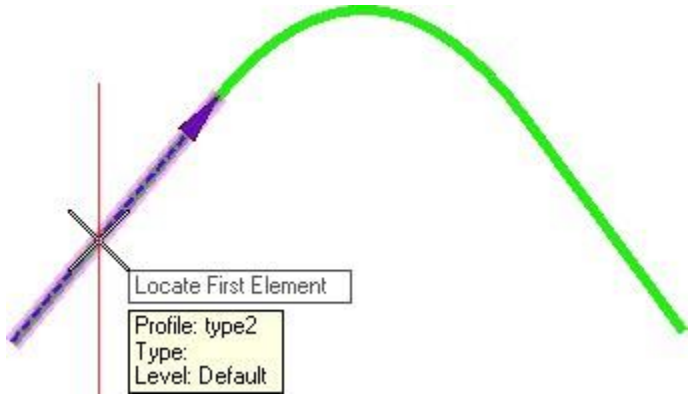
   - The *Complex Elements* dialog opens.



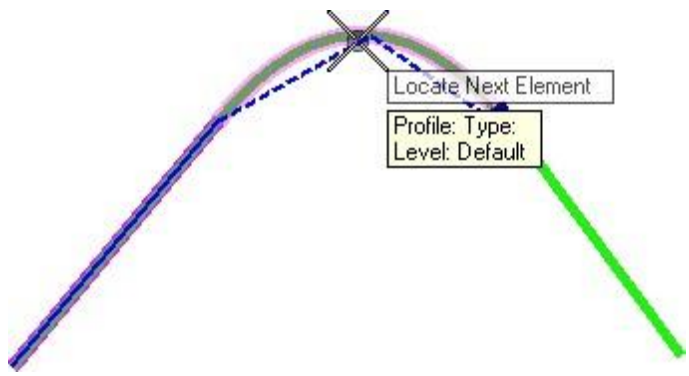

   - Checking the box next to any of the fields locks-in the associated value.

2. On the *Complex Element* dialog, expand the *Method* drop-down and choose the **Manual Option**.
   - **Manual** allows the identification of the elements to include and the direction of the elements.
   - **Automatic** will select the elements based on juxtaposition.

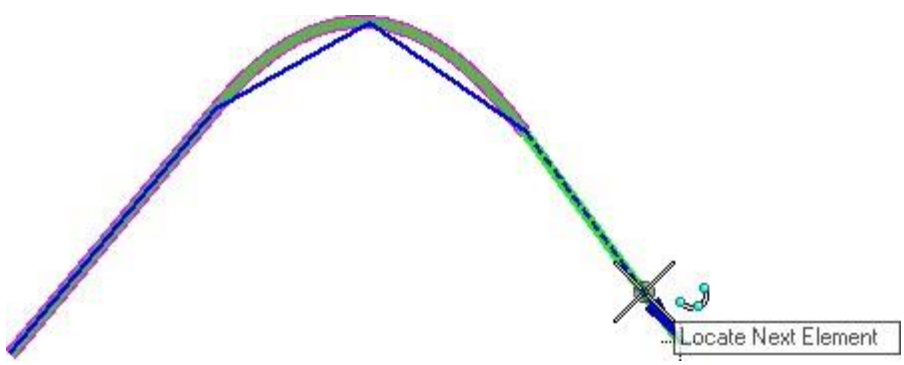
3. When you move the cursor into the Profile View, it is equipped with a command prompt requesting that you *Locate First Element*, move the cursor to one of the elements that you wish to include in the complex element and click on it.



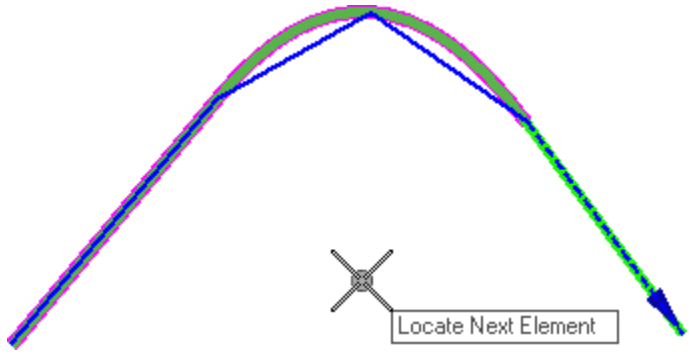

4. When prompted to *Locate Next Element*, move the cursor to another element that you wish to include in the complex element and data point.




5. When prompted to *Locate Next Element*, move the cursor to another element that you wish to include in the complex element and data point.



6. When a line appears to link the elements, data point to create the new complex element.




**Note:** The line that appears between the elements vanishes upon confirmation. It is simply a visual aid to identify the component elements.

## 3.4 Group Exercise 1: Create Road1 Profile

1. Within the ***J2P0200/data_03*** folder, open the file: **Civil_Geometry_J2P0200.dgn**
2. Select MicroStation *File* > *References* > *Tools* > *Attach*. Select the file **Terrain_J2P0200_Existing.dgn**.
3. Select the *Attachment Method* as **Coincident World**.
4. Set **J2P0200** as the active Terrain Model**.**
5. After Left Clicking on the Road1 Alignment select *Open Profile Model* from the heads up display.
6. When prompted to *Select or Open View*, select **View 8** from *View Groups* and **data point** in the view.
7. Use **Zoom** (the roller button on the mouse) and the **Pan** (hold the roller button down) to navigate around the profile model.
8. Select the **Profile Complex By VPI** task and create a "rough draft" proposed profile that has 5 VPIs. Adjustments to rough draft profile will be made in next steps.
9. Using the chart below adjust the station values for the 5 VPIs that were place in the previous step. The first and last VPI are AccuSnapped to the beginning and ending location of the exisitng ground.

| VPI | Station | Elevation | Grade | Curve Length |
|---|---|---|---|---|
| VPI #1 | 0+00.000 R1 | 824.641 | | |
| | | | -0.50% | |
| VPI #2 | 14+50.000 R1 | 817.391 | | 600 |
| | | | 4.00% | |
| VPI #3 | 23+60.000 R1 | 853.791 | | 500 |
| | | | 1.00% | |
| VPI #4 | 32+75.000 R1 | 862.941 | | 400 |
| | | | -3.64% | |
| VPI #5 | 35+10.080 R1 | 854.386 | | |

10. Using the chart above adjust the Grade values for profile that was place in the step 9.
11. Using the chart above adjust the Curve Length for the Vertical Curve defined in the profile that was place in the step 9.
12. Select the new Road 1 Propose Profile using the Heads Up display and select Profile Report. Verfify that User Profile data matches data on next page.

# VERTICAL ALIGNMENT REVIEW REPORT

```
* BENTLEY VERTICAL ALIGNMENT REVIEW
*
* Alignment name: Unnamed
* Alignment description:
* Alignment style: MoDOT_Baseline_Proposed
*
                                                        STATION   ELEVATION
Element: Linear
VPI #1                                     POB     0+00.00 R1     824.641
                                           PVC    11+50.00 R1     818.891
                                Tangent Grade:         -0.50%
                               Tangent Length:       1150.000
Element: Symmetrical Parabola
                                           PVC    11+50.00 R1     818.891
VPI #2                                     PVI    14+50.00 R1     817.391
                                           PVT    17+50.00 R1     829.391
                                          VLOW    12+16.67 R1     818.724
                                       Length:        600.000
                               Entrance Grade:         -0.50%
                                   Exit Grade:          4.00%
                           r = (g2 - g1) / L:          0.750
                           K = l / (g2 - g1):        133.333
                             Middle Ordinate:          3.375
Element: Linear
                                           PVT    17+50.00 R1     829.391
                                           PVC    21+10.00 R1     843.791
                                Tangent Grade:          4.00%
                               Tangent Length:        360.000
Element: Symmetrical Parabola
                                           PVC    21+10.00 R1     843.791
VPI #3                                     PVI    23+60.00 R1     853.791
                                           PVT    26+10.00 R1     856.291

                                       Length:        500.000
                               Entrance Grade:          4.00%
                                   Exit Grade:          1.00%
                           r = (g2 - g1) / L:         -0.600
                           K = l / (g2 - g1):        166.667
                             Middle Ordinate:         -1.875
Element: Linear
                                           PVT    26+10.00 R1     856.291
                                           PVC    30+75.00 R1     860.941
                                Tangent Grade:          1.00%
                               Tangent Length:        465.000
Element: Symmetrical Parabola
                                           PVC    30+75.00 R1     860.941
VPI #4                                     PVI    32+75.00 R1     862.941
                                           PVT    34+75.00 R1     855.663
                                         VHIGH    31+61.23 R1     861.372
                                       Length:        400.000
                               Entrance Grade:          1.00%
                                   Exit Grade:         -3.64%
                           r = (g2 - g1) / L:         -1.160
                           K = l / (g2 - g1):         86.226
                             Middle Ordinate:         -2.319
Element: Linear
                                           PVT    34+75.00 R1     855.663
VPI #5                                     POE    35+10.08 R1     854.386
                                Tangent Grade:         -3.64%
                                 Tangent Length:         35.080
```

## Group Exercise 1: Create Road 1 Profile Continued.

13. Next we are going to create the profile a second way using **Civil AccuDraw** to place the Vertical Curve information. First we need to delete the previously store profile by selecting the Road 1 Propose Profile and using the heads up disply and selecting **Delete**.

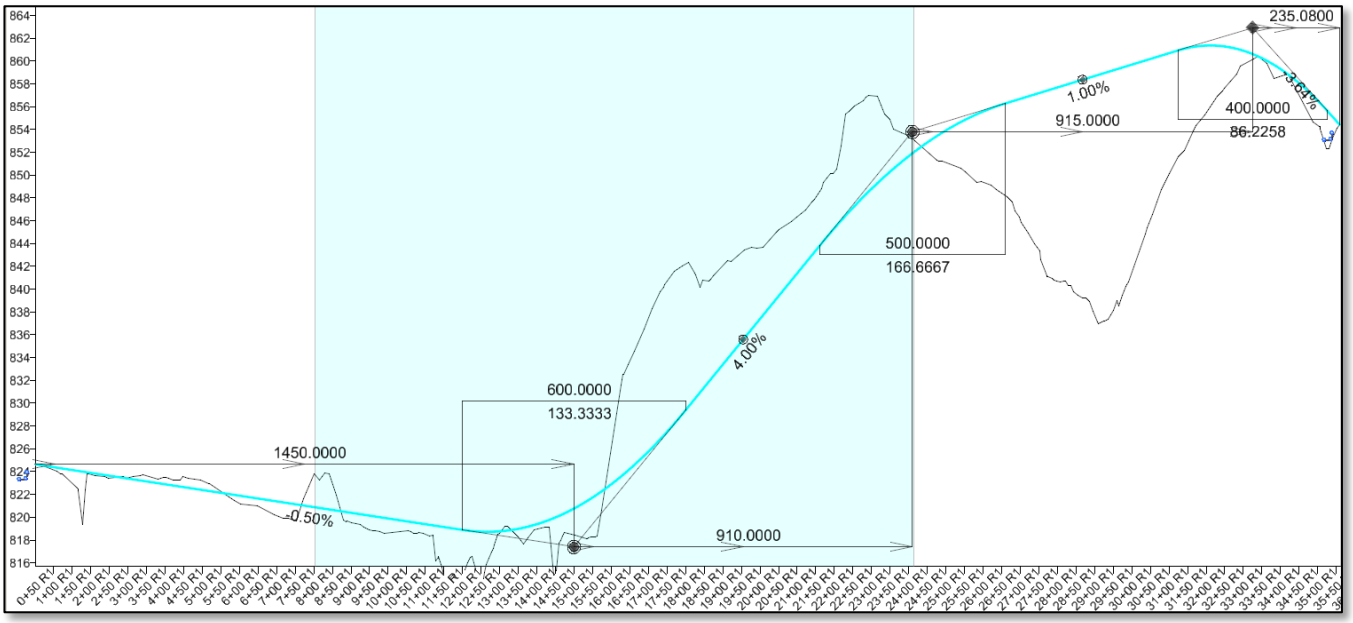
14. With Civil AccuDraw active select the **Profile Complex By PI** task.

15. This time using Civil AccuDraw and it's "**Z**" and "**Slope**" mode to create the same Road1 profile using the following criteria:

| VPI | Station | Back Grade | Elevation | Curve Length | Addition Info. |
|---|---|---|---|---|---|
| #1 | 0+00 | | 824.641 | | (Snap to begging of Ex. Profile) |
| #2 | 14+50 | -0.50% | | 600 | |
| #3 | 23+60 | 4.00% | | 500 | |
| #4 | 32+75 | 1.00% | | 400 | |
| #5 | 35+10.08 | | 854.386 | | (Snap to end of Ex. Profile) |

16. Select the new Road1 Propose Profile using the Heads Up disply and select Profile Report. Verfify that User Profile data matches data on previous page.

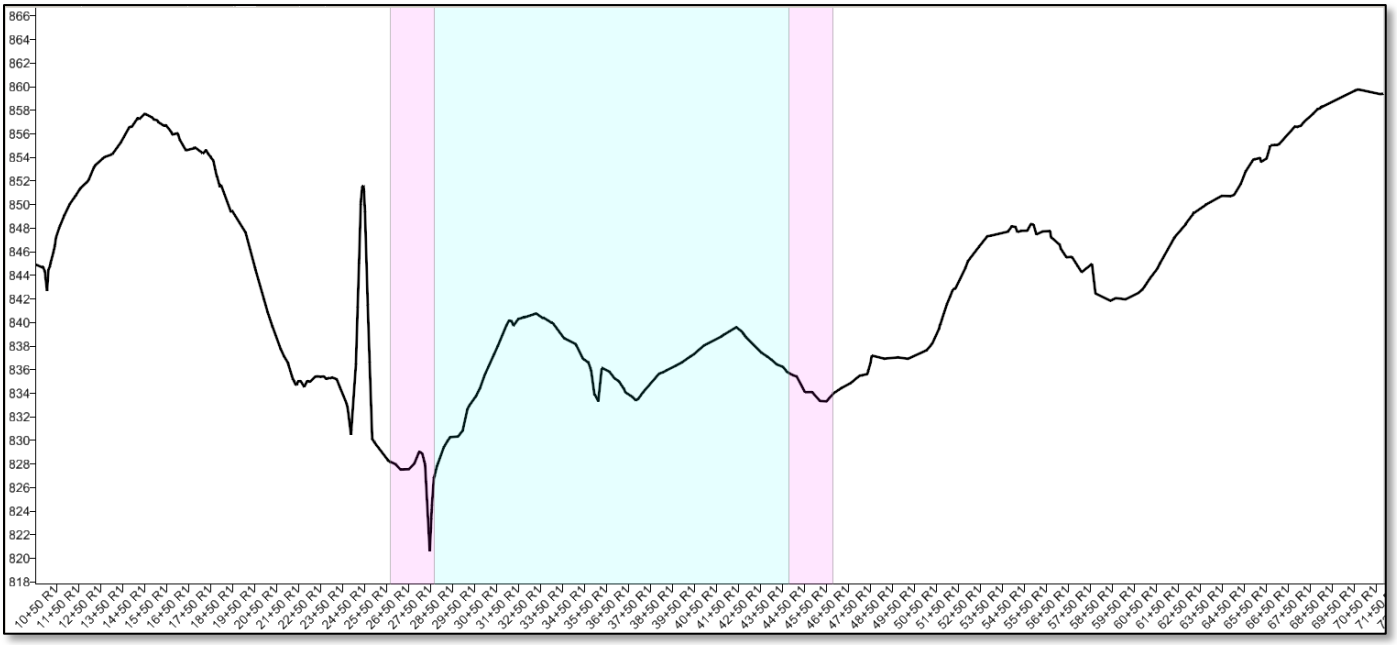
17. Select **File > Update Server Copy**.



## 3.5 Individual Exercise 2: Create Route63 Profile

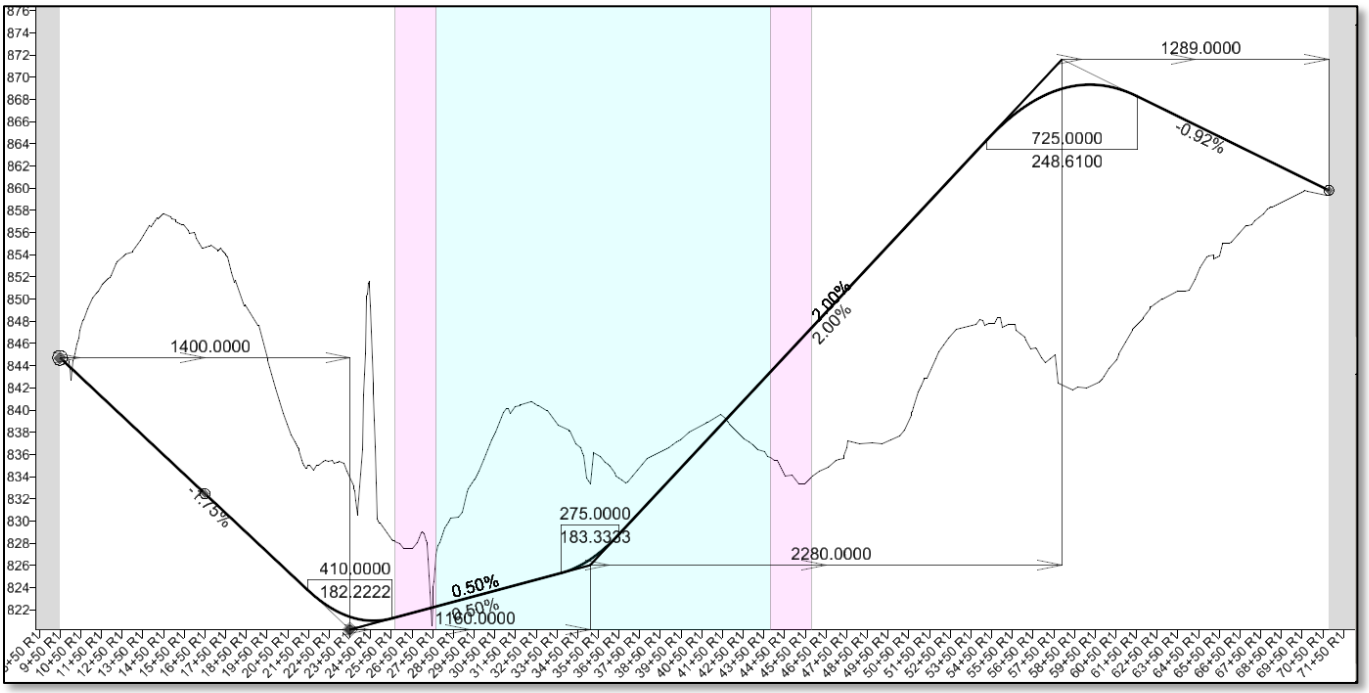
1. Within the ***J2P0200*/*data_03*** folder, open the file: **Civil_Geometry_J2P0200.dgn.**
2. Verify **J2P0200** is still the active the Terrain Model from the previous exercise**.**
3. Select ***Vertical Geometry* > *Open Profile*** model from the Civil Tools Tasks
4. When prompted to *Locate Plan Element*, select the **RTE63** alignment.
5. When prompted to *Select or Open View*, select **View 3** from *View Groups* and **Data Point** in the view.

   **Note:** If another profile already exists in the view, this will not lose any profile information for the profile currently in the window, the window will simply change the display to the profile of the current geometry selected.



6. Select the **Profile Complex By VPI** task.
7. Create the profile using the following criteria:

| VPI | Station | Back Grade | Elevation | Curve Length |
|---|---|---|---|---|
| #1 | 9+50 | | 844.71 | |
| #2 | 23+50 | | 820.21 | 410 |
| #3 | 35+10 | 0.50% | | 275 |
| #4 | 57+90 | 2.00% | | 725 |
| #5 | 70+79 | | 859.80 | |




8. Select the new Route 63 Propose Profile using the Heads Up disply and select Profile Report. Verfify that User Profile data matches data on next page.
9. Select **File > Update Server Copy**.

# BENTLEY VERTICAL ALIGNMENT REVIEW REPORT

```
* Alignment name: Unnamed
* Alignment description:
* Alignment style: MoDOT_Baseline_Proposed
*
                                                        STATION      ELEVATION
Element: Linear
                                          POB     9+50.00 R1        844.710
                                          PVC    21+45.00 R1        823.798
                                 Tangent Grade:         -1.75%
                                Tangent Length:       1195.000
Element: Symmetrical Parabola
                                          PVC    21+45.00 R1        823.798
                                          PVI    23+50.00 R1        820.210
                                          PVT    25+55.00 R1        821.235
                                         VLOW    24+63.89 R1        821.007
                                       Length:        410.000
                                 Entrance Grade:         -1.75%
                                     Exit Grade:          0.50%
                            r = (g2 - g1) / L:          0.549
                            K = l / (g2 - g1):        182.222
                              Middle Ordinate:          1.153
Element: Linear
                                          PVT    25+55.00 R1        821.235
                                          PVC    33+72.50 R1        825.322
                                 Tangent Grade:          0.50%
                                Tangent Length:        817.500
Element: Symmetrical Parabola
                                          PVC    33+72.50 R1        825.322
                                          PVI    35+10.00 R1        826.010
                                          PVT    36+47.50 R1        828.760

                                       Length:        275.000
                                 Entrance Grade:          0.50%
                                     Exit Grade:          2.00%
                            r = (g2 - g1) / L:          0.545
                            K = l / (g2 - g1):        183.333
                              Middle Ordinate:          0.516
Element: Linear
                                          PVT    36+47.50 R1        828.760
                                          PVC    54+27.50 R1        864.360
                                 Tangent Grade:          2.00%
                                Tangent Length:       1780.000
Element: Symmetrical Parabola
                                          PVC    54+27.50 R1        864.360
                                          PVI    57+90.00 R1        871.610
                                          PVT    61+52.50 R1        868.289
                                        VHIGH    59+24.72 R1        869.332
                                       Length:        725.000
                                 Entrance Grade:          2.00%
                                     Exit Grade:         -0.92%
                            r = (g2 - g1) / L:         -0.402
                            K = l / (g2 - g1):        248.610
                              Middle Ordinate:         -2.643
Element: Linear
                                          PVT    61+52.50 R1        868.289
                                          POE    70+79.00 R1        859.800
                                 Tangent Grade:         -0.92%
                                Tangent Length:        926.500
```

# Chapter 4

# Plan & Profile Sheet Geometry

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4.2 Definitions..... 4-1
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## 4.1 Objectives

- Learn how to build rules based geometry that can be used to control the transition of template points.

## 4.2 Definitions

**Point Controls** are used to override the established horizontal and vertical locations of points from the original point location on the template. Point controls are the equivalent of the criteria adhocs placed on plan graphics with D&C Manager to control widths, ditch slopes, etc. Consequently, point controls are used to control horizontal and vertical locations for EOP, EOS, sidewalks, retaining walls, barriers, special ditch profiles and ditch widths, etc.

The transitional geometric elements are created using the Civil Geometry tools.

## 4.3 Horizontal Geometry Tools for Transitional Geometry

### 4.3.1 Offsets and Tapers

Offsets and Tapers construct linear elements based on various methods of offsets from a base element. The base element may be a line, arc, spiral, or complex. There are four methods:

**Single Offset Entire Element**

The offset element maintains a constant offset along the entire length of the base element.

**Workflow**

1. Select *Single Offset Entire Element*.
2. Select the base element. Data point to accept.
3. Key in the offset.
4. **Data Point** to select **Yes** to *Mirror* or strike down arrow to choose **No** to place the offset on one side only and **Data Point**.

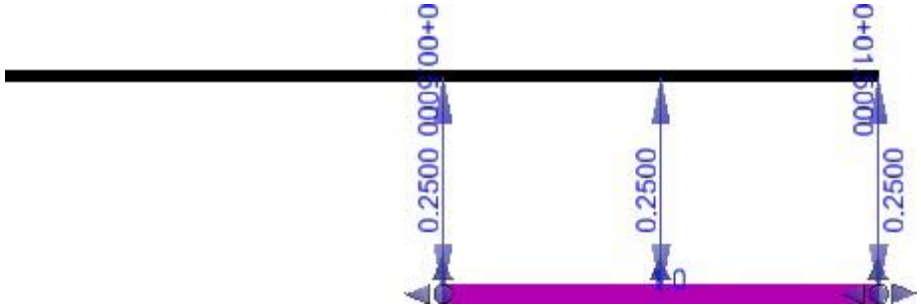
### Single Offset Partial

The offset element maintains a constant offset along the given length of the base element. The length can be defined by start and stop distance (stations) of a keyed in length.

**Workflow**

1. Select *Single Offset Partial*.
2. Select the base element. Data point to accept.
3. Key in the offset.
4. Specify the beginning station by moving the mouse to beginning station, or if using the Civil AccuDraw Station-Offset favorite, key in the station.., or press the <Alt> key to lock the beginning point to the Start station. Data point to accept.
5. Move the mouse to the ending station or press the **<Alt>** key to select the End station. Data point to accept.
6. **Data Point** to select **Yes** to *Mirror* or strike down arrow to choose **No** to place the offset on one side only and **Data Point**.

**Manipulators (Single Offset Entire or Partial Element)**




Manipulators are available for:

- Offset
- Starts distance
- End distance
- Slide End Fixed Length

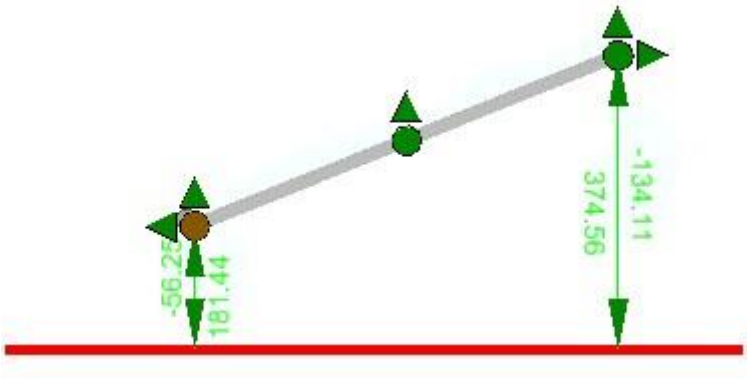
**Variable Offset Taper**

The offset is variable and defined by station and offset at each end of the offset element.

**Workflow**

1. Select the *Variable Offset Taper* placement tool.
2. Select the base element. **Data Point** to accept.
3. Select the start point, offset, and distance dynamically or by key-in. This is a dual prompt. Use left/right arrows to toggle between the two.
4. Set the end offset and distance. This is a dual prompt. Use left/right arrows to toggle between the two.

**Manipulators (Variable Offset Taper)**




Manipulators are available for:

- Start offset
- End offset
- Starts distance
- End distance

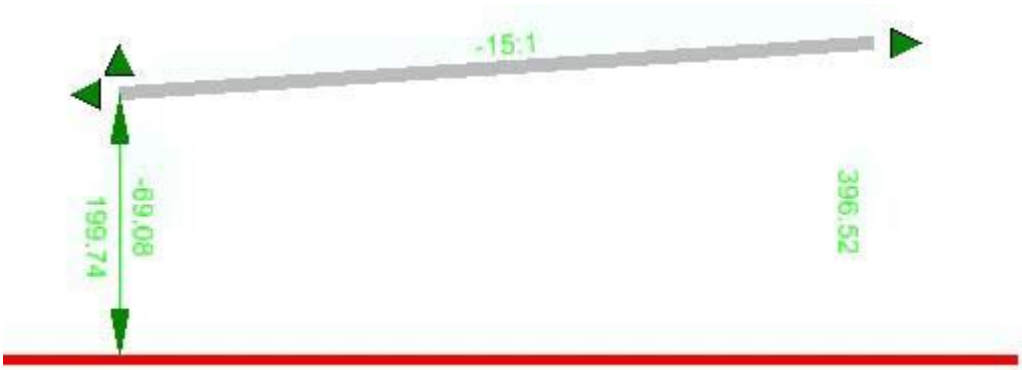
## Ratio Defined Taper

The offset element is defined by a station offset and beginning, and the end point is defined by a ratio.

### Workflow

1. Select the *Ratio Defined Taper* tool.
2. Select the base element. **Data Point** to accept.
3. Select the start point, offset, and distance dynamically or by key-in. This is a dual prompt. Use left/right arrows to toggle between the two.
4. Set the ratio and end distance. This is a dual prompt. Use left/right arrows to toggle between the two.

### Manipulators (Ratio defined Taper)




Manipulators are available for:

- Start Offset
- Starts distance
- End distance
- Ratio

### Use of ALT Key

During the operation of the command, the <**ALT**> key can be used to toggle the check marks for *Beginning of Element* and *Ending of Element*. When the prompt is for first point of the offset line, pressing <**ALT**> will toggle the check mark for *Beginning of Element*. When the prompt is for second point of the offset line, then pressing <**ALT**> will toggle the check mark for *End of Element*.

### Properties

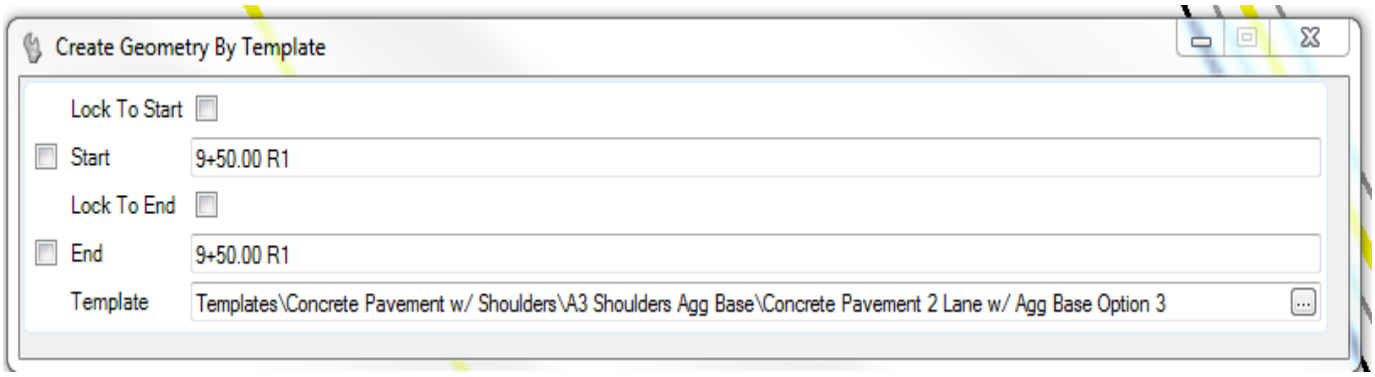
Offset Transition rule data is also accessible in the properties. The properties are identical for all methods. Changing the method in properties will expose additional manipulators on screen.

## 4.3.2 **Templates**

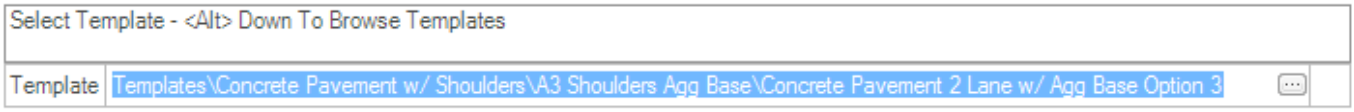
### **Create Geometry by Template**

Use the *Create Geometry by Template* command to generate geometry.

1. Open the Civil Tools task pane to the Horizontal Geometry section then click the *Create Geometry by Template* tool.
2. When you move the cursor into the view, it is equipped with a command prompt requesting that you *Locate Reference Element*. Select the element to which you wish to apply the template then data point (*i.e.*, left-click).
3. The *Create Geometry By Template* dialog opens.

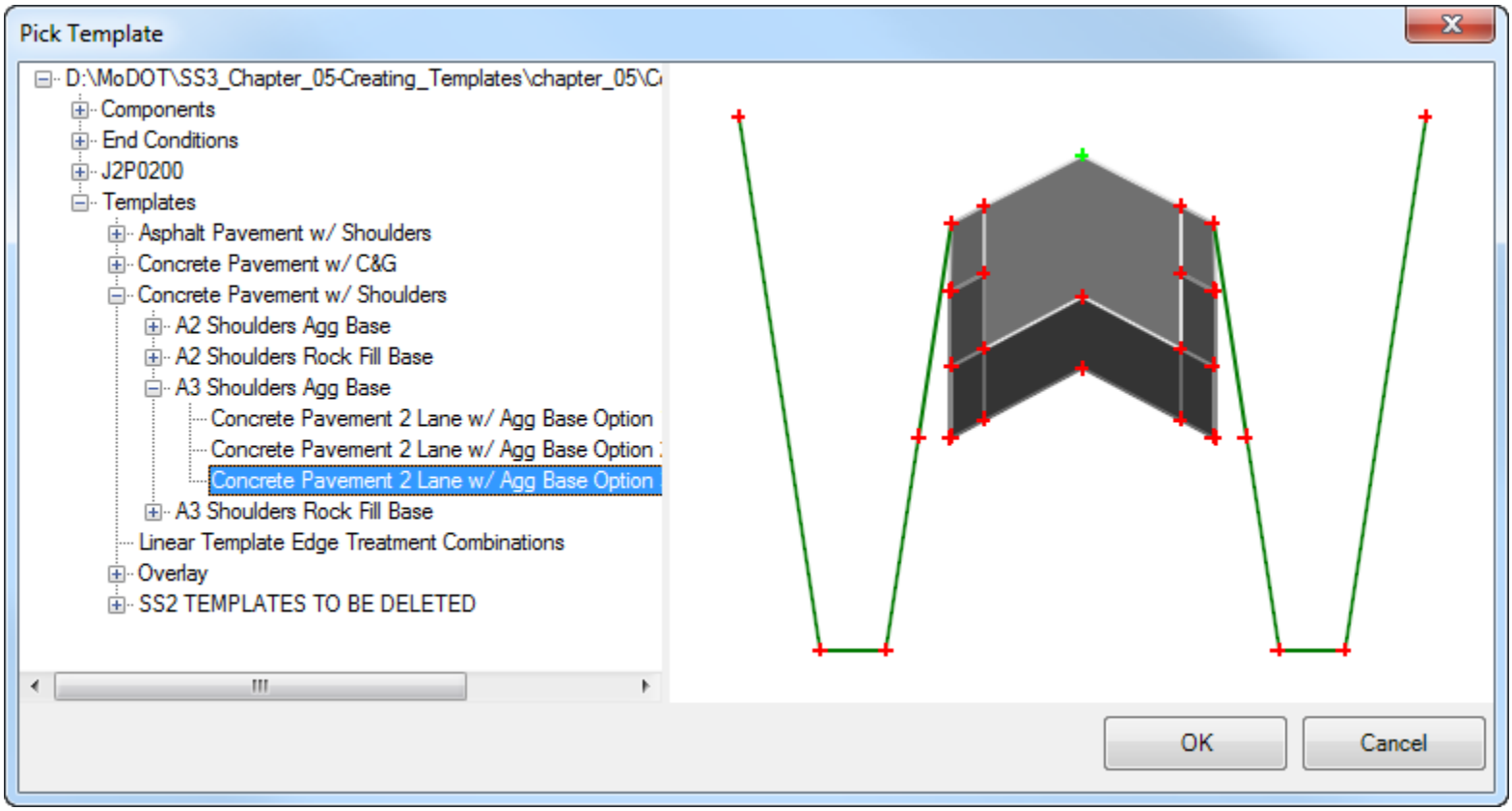



4. Checking the box next to any of the fields locks-in the associated value.
5. When prompted to *Select Template*, hold down the **Alt key and strike the down arrow** key to open the *Pick Template* dialog.



6. When the dialog opens, navigate the tree to choose from the available templates then click **OK** and data point in the view.

**Note:** The ***Select Template*** command prompt retains your last selection, so if you wish to apply multiple instances of the same template, you need only data point when the populated prompt appears.



## 4.4 Group Exercise: Creating Geometry for Road 1 Corridor

### Design File Setup

1. Within the *data_04\data* folder, open the file: **Civil_Geometry_J2P0200.dgn**.
2. Create a new file named **Plan_J2P0200.dgn** based on the 2D seed file ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn***

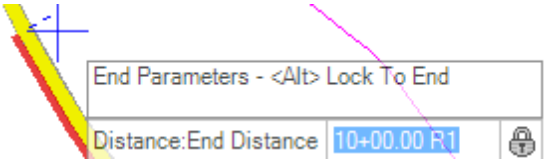
   This new file will hold the geometry that can be used for design changes to the proposed corridor.
3. Reference in the 2D Project Civil Geometry file; **Civil_Geometry_J2P0200.dgn.**
4. Reference in the 3D Project Terrain file; **Terrain_J2P0200_Existing.dgn** and set the terrain to active.

### Creating Horizontal Geometry Based on Centerline

Horizontal geometry, vertical geometry and a combination of both can be used as point controls in the corridor model. When attached to a point in a template, these geometries override the constraints put on the template point during creation. Template points and constraints are covered in detail in GEOPAK Road 1 Chapter 05 Creating Templates.

#### Create Geometry for a Right Passing Lane Proposed Edge of Pavement

5. **Turn Off** Civil AccuDraw.
6. **Toggle On** the *Use Active Feature Definition* on the Features Definition Toggle Bar.
7. Set the active feature to be **Design > Design Standards > Roadway > EOP New**.
8. **Toggle On** the *Use Active Feature Definition* on the Features Definition Toggle Bar.
9. Select the **Single Offset Partial** tool. Located under the Tasks/Horizontal Geometry tool set.
10. When prompted to *Locate Element*, select **ROAD1**
11. The offset will be **24' to the right**
12. In the dialog select "***Lock to* Start***"*.
13. When prompted to enter the *End Distance* key in **10+00.00**.




14. The passing lane is going to only be on the South Bound lane so select **No** for the *Mirror* option.

**Place a Transition Taper**

15. Select **Variable Offset Taper**. Located under the Tasks/Horizontal Geometry tool set.
16. First in the dialog set the Start and ending Offset of **24 ft. and 12 ft. to the right** respectively.
17. Secondly in same dialog set the Start and Ending station of **10+00** and "**Lock to End**" respectively.
18. When prompted to *Locate Element*, select **ROAD1** near the end of the partial offset at station **10+00 R1**.
19. When prompted for the *Start Parameters*, hover near the end of North end of the partial offset, the tool should be locked in at the location of the start point listed in the dialog.

20. Click twice to store Variable Offset Taper
21. When prompted to *Mirror* select **No**.

22. Data point to accept solution and reset to exit command.

**Complex the Proposed Edge of Pavement**

23. Set the active feature to be **Design > Design Standards > Roadway > EOP New.**
24. Select the **Complex by Elements** task.
25. In the ***Create Complex by Elements*** dialog, verify the *Method* is set to **Automatic**.
26. When prompted to *Locate First Element*, identify the beginning of the Partial Offset element with the 24 ft offset so the direction is south.
27. Both offset elements will be highlighted. Data point to Accept Complex. The new complex geometry will be created and use the symbology defined by the **EOP_New Feature Definition.**

**Placing Right of Way Line**

28. Create a new file named **Land_Boundary_J2P0200.dgn** based on the 2D seed file:

    ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn***

    This new file will hold the geometry that can be used to display Right of Way information in the Plan and XS View.

29. Reference the following files:

    **Civil_Geometry_J2P0200**.dgn.
    **Terrain_J2P0200_Existing.dgn**
    **Plan_J2P0200.dgn**

*30.* Use the Horizontal Geometry Tool **Complex By PI** to place a line with a Feature Definition of ***RW_Controlled_Access_Proposed*** at the following locations:

    a. Note: use **Civil AccuDraw** to place line accurately along the **Road1** Alignment.

| Station | Offset |
|---|---|
| 0+00 | -100 |
| 7+53.43 | -100 |
| 10+00 | -125 |
| 15+00 | -150 |
| 20+00 | -150 |
| 23+62.95 | -100 |
| 35+10.08 | -100 |

31. Select the Terrain Model **J2P0200** and make active (if not already).

32. Open the Profile View of the just placed ***RW_Controlled_Access_Proposed*** element.

33. Give the Profile the Feature Name of "Existing"

34. Set as Active the Profile.

    a. Note by setting active the Right of Way line profile, future cross section will now show a delimiter of the locations of said Right of Way line.

35. Select **File > Update Server Copy**.

## 4.5 Individual Exercise: Create Corridor Geometry for Route 63

If the edge of pavement and edge of shoulder of an existing road are required in the design file for visualization or for future corridor work you can use the transition tools explored in the Road 1 exercise. Another option to create geometry is to use a template that matches what the existing conditions are or proposed conditions. The **Create Geometry by Template** tool is used to apply a template along existing geometry to create additional geometry.

**Placing Right of Way Line Information.**

1. Continue working in **Land_Boundary_J2P0200.dgn.**
2. Use the Horizontal Geometry Tool **Complex By PI** to place a line with a Feature Definition of ***RW_Controlled_Access_Proposed*** at the following locations:
   a. Note: use **Civil AccuDraw** to place line accurately along the **Route63** Alignment.

| Station | Offset |
|---|---|
| 9+50 | 150 |
| 25+67.20 | 150 |
| 27+67.20 | 150 |
| 28+00 | 200 |
| 30+00 | 200 |
| 35+00 | 200 |
| 40+00 | 200 |
| 43+00 | 200 |
| 43+79.95 | 150 |
| 45+79.95 | 150 |
| 70+79.95 | 150 |

3. Select the Terrain Model **J2P0200** and make active (if not already).
4. Open the Profile View of the just placed ***RW_Controlled_Access_Proposed*** element.
5. Give the Profile the Feature Name of "Existing"
6. Set as Active the Profile.
   a. Note by setting active the Right of Way line profile, future cross section will now show a delimiter of the locations of said Right of Way line.
7. Select **File > Update Server Copy**.

## 4.6 Group Exercise Exporting and Plotting Profiles - Road 1

1. Open the **Civil_Geometry_J2P0200.dgn**.
2. Right Click and hold in a blank area and select **User Preferences**.
   a. Verify that the **Working Directory** is empty (clear out if needed).
3. In the User Preferences dialog select **COGO Preferences**.
   a. Verify that the **Job (GPK) Directory** is empty (clear out if needed).
4. Select the "**OK**" button twice to close the two previous preference dialogs.
5. Open Classic COGO and open the **200** gpk.
6. Select COGO Navigator and view the Chain and Profiles listed in the gpk.
7. If the **ROAD1** Chain, **ROAD1EX** or **ROAD1PR** profile is not listed, proceed to the following steps. Otherwise skip to **Step 11**.

8. Open the **ROAD1** Profile Model.
9. Select **Task > General Geometry > Export to Native.**
10. Any item listed in **Step 10** that does not exist in the 200 gpk, select and export using the **Export to Native** tool.

11. Create a new file named **Profile_J2P0200.dgn** based on the 2D seed file:

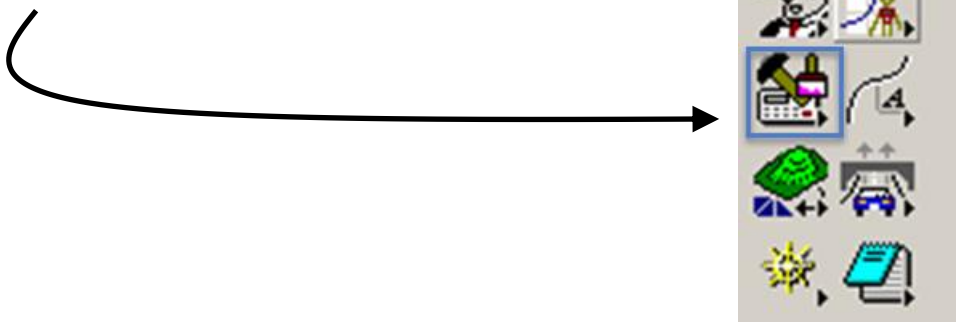
***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn***

This new file will hold the profile sheet geometry.

12. Reference in the following 2D Project dgn files:

**Civil_Geometry_J2P0200.dgn**
**Plan_J2P0200.dgn**
**Land_Boundary_J2P0200.dgn**

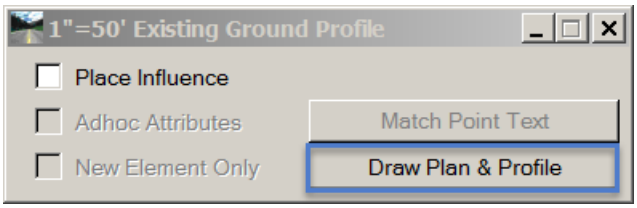
13. Move to a blank area in the drawing away from the plan geometry.
14. Open **D&C Manager** by selecting the icon in the **SS2 Tool Palette**.



15. Plot the **ROAD 1** existing ground profile using the following Design and Computation Manager item:

    ***Drafting Standards\Profile\Existing Ground Profiles\1"=50' Existing Ground Profile.***

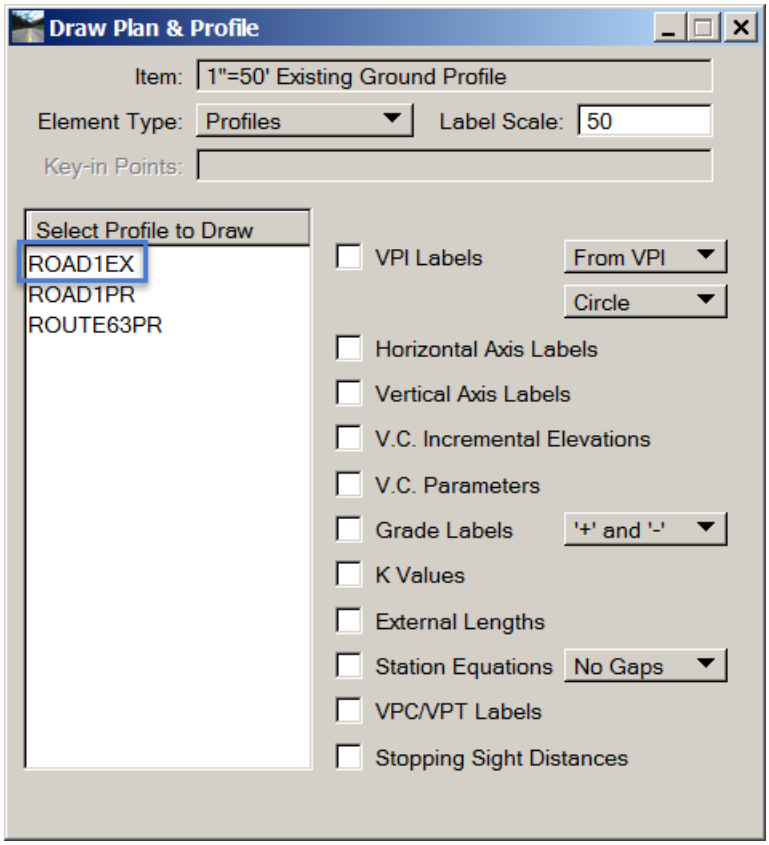
    After selecting the item in D&C Manager, Click on **Draw Plan & Profile** in the **Operations Box**.




    **Note**: If prompted select the 200 gpk

16. Be sure all options are turned off, and the **Labeling Scale** is set to **50**.

    Choose the profile **ROAD1EX**.

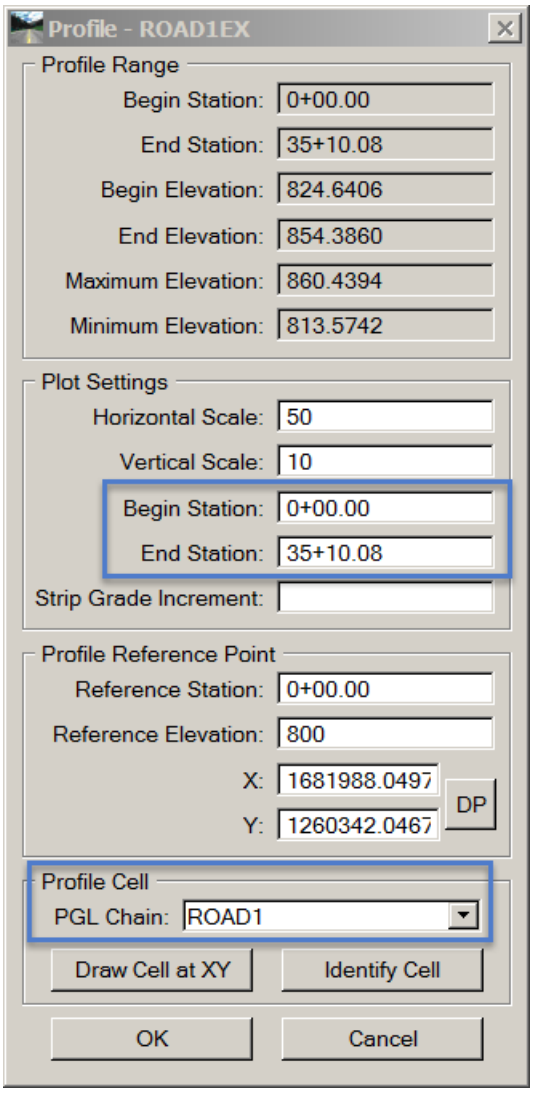


17. 16. Set the follow

    Horizontal Scale: **50**
    Vertical Scale: **10**
    DP Station: **0+00**
    DP Elevation: **800**
    DP X and Y: *Data point on the screen in an open area.*
    PGL Chain: **ROAD1**

18. Draw the Profile Cell with the Draw Cell at XY button.

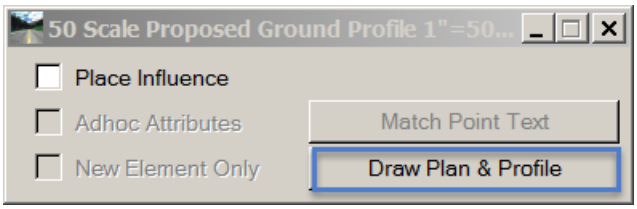
19. Draw the profile by selecting "OK".



20. Plot the proposed profile using the following Design and Computation Manager item:

***Drafting Standards\Profile\Proposed Ground Profiles\50 Scale Proposed Ground Profile 1"=50' H & 1"=10' V.***

After selecting the item in D&C Manager, Click on **Draw Plan & Profile** in the **Operations Box**.

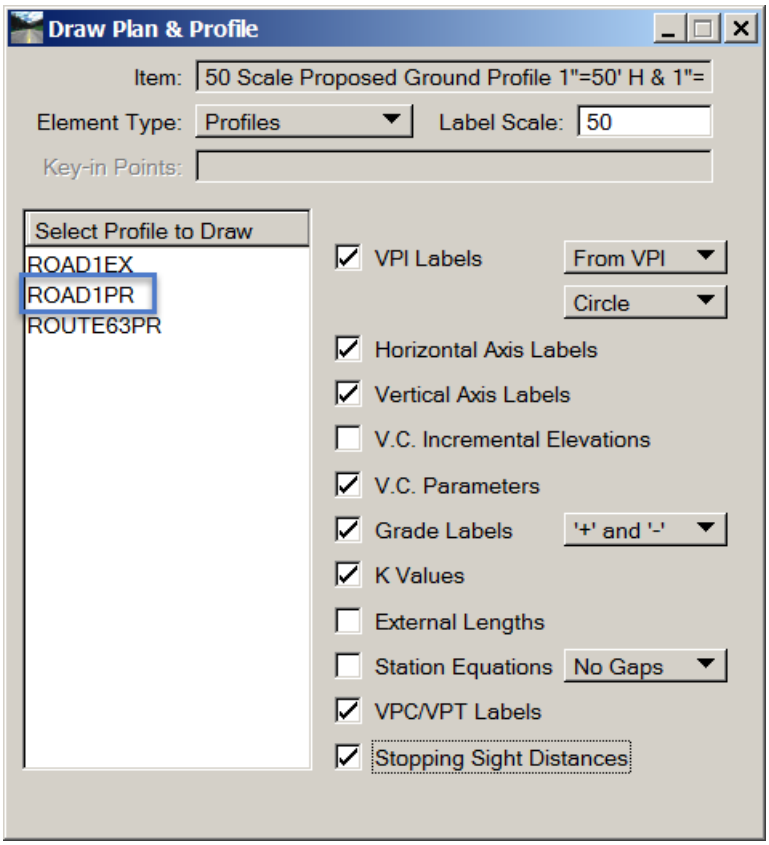



**Note**: If prompted select the **200 gpk**

21. Turn on the following options:

**VPI Labels**
**Horizontal Axis Labels**
**Vertical Axis Labels**
**V.C. Parameters**
**Grade Labels**
**K Value**
**VPC/VPT Label**
**Stopping Sight Distance**

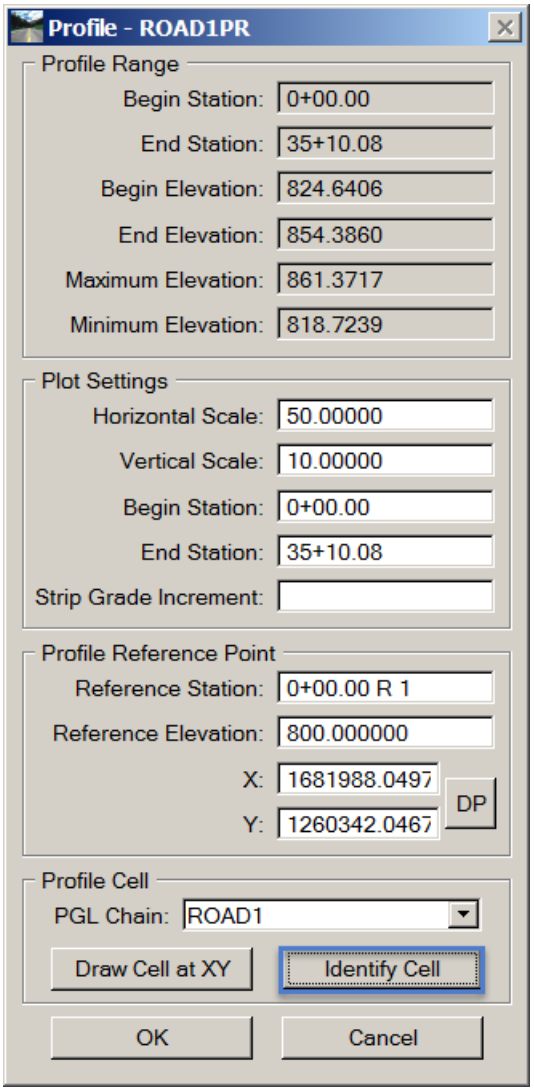
Choose the profile **ROAD1PR**.



18. (Continued)

Use the **Identify Cell** button to select the profile cell placed in step 6.

Plot the profile **ROAD1PR** by selecting the **OK** button.




22. Exit **D&C Manager**.

23. Select **File > Update Server Copy**.

## 4.7 Individual Exercise Exporting and Plotting Profiles - Route 63

1. Open the **Civil_Geometry_J2P0200.dgn**.
2. Right Click and hold in a blank area and select **User Preferences**.
   a. Verify that the **Working Directory** is empty (clear out if needed).
3. In the User Preferences dialog select **COGO Preferences**.
   a. Verify that the **Job (GPK) Directory** is empty (clear out if needed).
4. Select the "**OK**" button twice to close the two previous preference dialogs.
5. Open Classic COGO and open the **200** gpk.
6. Select COGO Navigator and view the Chain and Profiles listed in the gpk.
7. If the **ROUTE63** Chain, **ROUTE63EX** or **ROUTE63PR** profile is not listed, proceed to the following steps. Otherwise skip to **Step 11**.

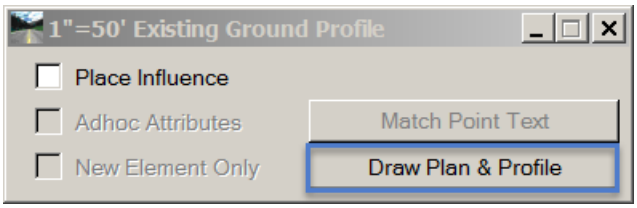
8. Open the **ROUTE63** Profile Model.
9. Select **Task > General Geometry > Export to Native.**
10. Any item listed in **Step 10** that does not exist in the **200 gpk**, select and export using the **Export to Native** tool.

11. Open the dgn file named **Profile_J2P0200.dgn**
12. Move to a blank area in the drawing away from the plan geometry.
13. Open **D&C Manager** by selecting the icon in the **SS2 Tool Palette**.

14. Plot the **ROUTE 63** existing ground profile using the following Design and Computation Manager item:

    ***Drafting Standards\Profile\Existing Ground Profiles\1"=50' Existing Ground Profile.***

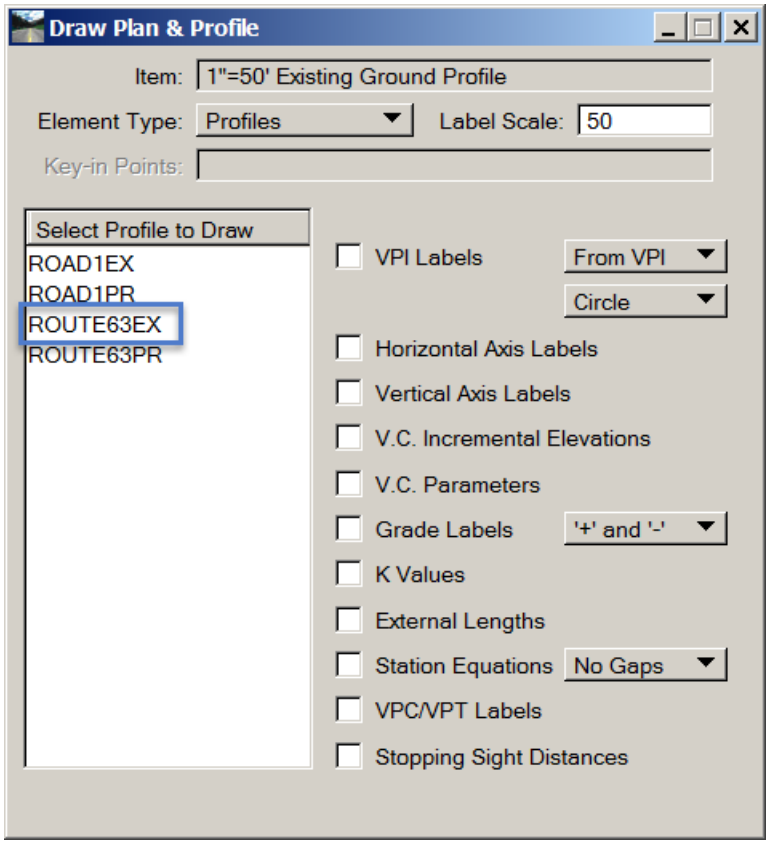
    After selecting the item in D&C Manager, Click on **Draw Plan & Profile** in the **Operations Box**.




    **Note**: If prompted select the **200 gpk**

15. Be sure all options are turned off, and the **Labeling Scale** is set to **50**.

    Choose the profile **ROUTE63EX**.

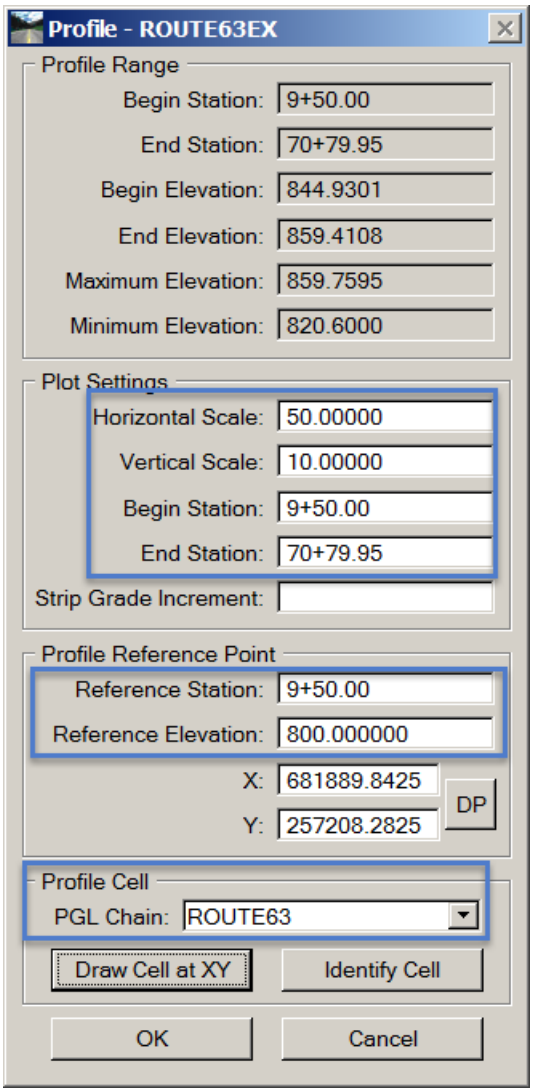


16. Set the following parameters:

    Horizontal Scale: **50**
    Vertical Scale: **10**
    DP Station: **9+50**
    DP Elevation: **800**
    DP X and Y: *Data point on the screen in an open area.*
    PGL Chain: **ROUTE63**

17. Draw the Profile Cell with the Draw Cell at XY button.

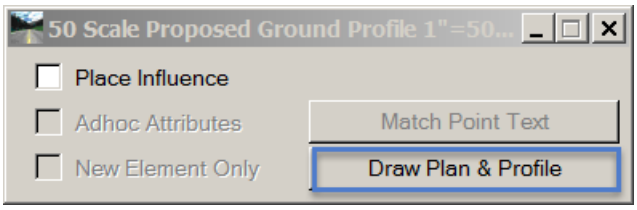
18. Draw the profile by selecting "**OK**".



19. Plot the proposed profile using the following Design and Computation Manager item:

***Drafting Standards\Profile\Proposed Ground Profiles\50 Scale Proposed Ground Profile 1"=50' H & 1"=10' V.***

After selecting the item in D&C Manager, Click on **Draw Plan & Profile** in the **Operations Box**.

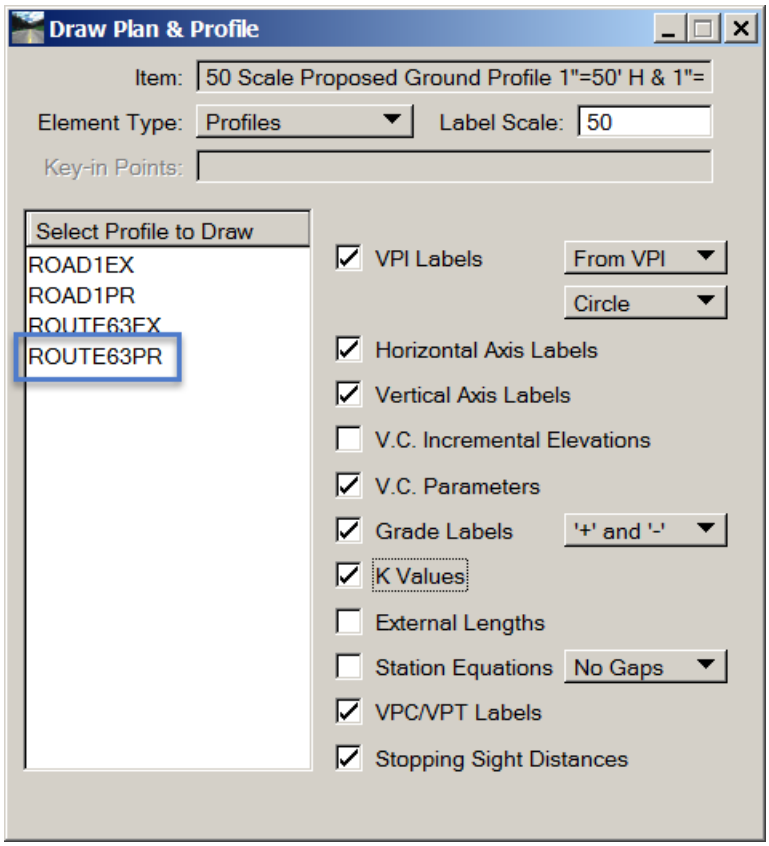



**Note**: If prompted select the **200 gpk**

20. Turn on the following options:

**VPI Labels**
**Horizontal Axis Labels**
**Vertical Axis Labels**
**V.C. Parameters**
**Grade Labels**
**K Value**
**VPC/VPT Label**
**Stopping Sight Distance**

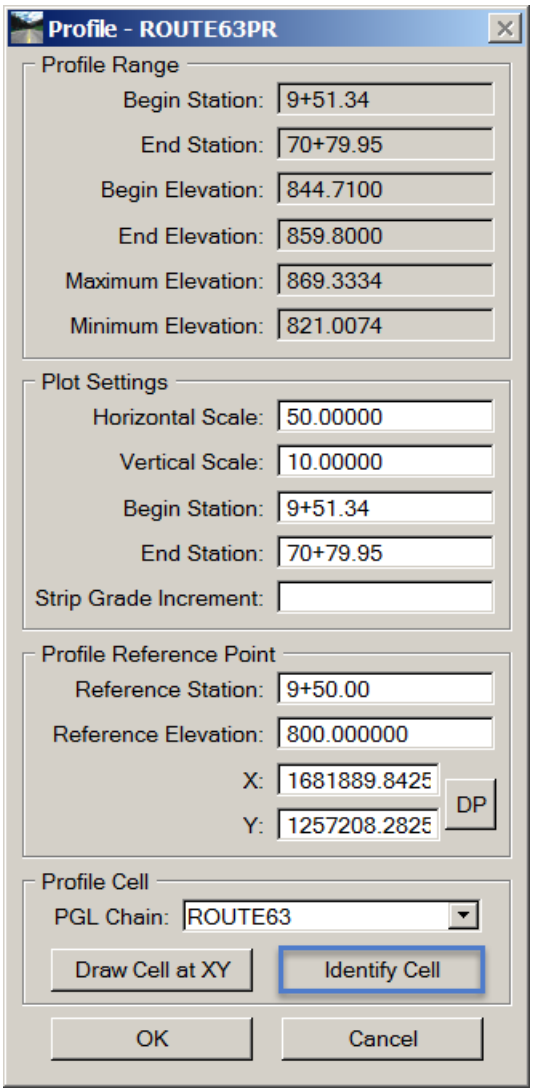
Choose the profile **ROUTE63PR**.



20. (Continued)

Use the **Identify Cell** button to select the profile cell placed in step 6.

Plot the profile **ROUTE63PR** by selecting the **OK** button.




24. Exit **D&C Manager**.

25. Select **File > Update Server Copy**.

# Chapter 5

# Creating Templates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## 5.1 Create Template Dialog

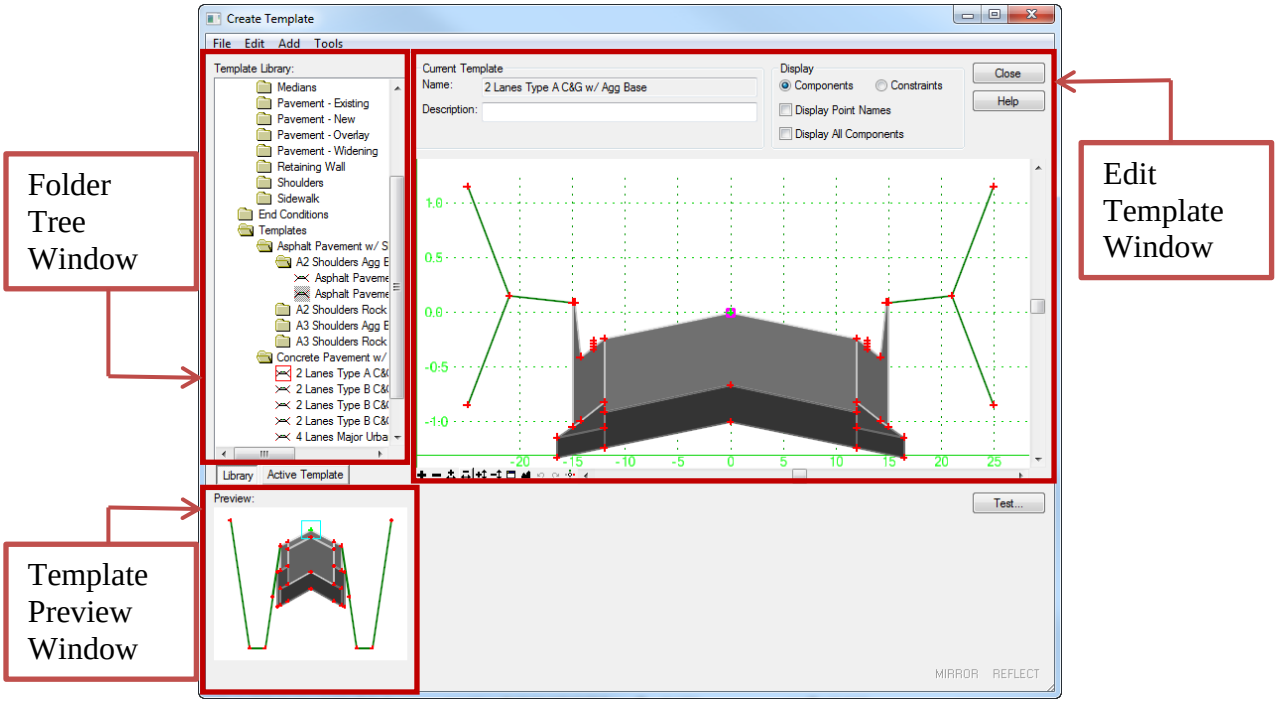
The first step to creating a 3D model is to create templates for the roadway design. Templates are dynamic typical sections used in Corridor Modeling that use transverse geometry to create 3D models. Each template contains a series of points and components that represent breaklines, which are used to create the roadway surfaces. All these points, components, and templates are stored in the template library (itl).

CADD Support has created a default template library. This library contains most used components and end conditions at MoDOT. A limited number of templates are available through this template library. The intent is for the user to assemble his/her own templates giving the districts more flexibility in their design; therefore, the default MoDOT library needs to be copied to the user's working directory using the Start Job routine when creating new projects.

The user accesses all templates available in the standard MoDOT template library. In addition, this is the tool to use to create new components and templates to be used within Roadway Designer.

To access the Create Template Dialog, select the icon through the Corridor Modeler Tools in the Civil Tools Tasks.

The Create Template Dialog is composed of three major areas: Folder Tree Window, Current Template Window, and the Template Preview Window, which are shown below.



### 5.1.1 Folder Tree Window

This view allows the user to navigate through the template library selected. The folder tree structure begins with the template library. Underneath, the user will find the following categories: Point Name List, Components Folder, End Conditions Folder, CADD Support Templates, and District User Templates. This window is completely user definable, and it has all windows capabilities like right click functions, copy, paste, drag and drop.

### 5.1.2 Point Name List

This list contains previously created names to be utilized in the creation of new points for creating components for templates. Each point on a template must be unique, so no point can have the same name. CADD Support has created a point name list for standardization.

### 5.1.3 Components

A component is a set of points defining an open or closed shape that represent different portions of the template. For example, pavement structure, curbs, gutters, shoulders, medians, retaining walls, etc. MoDOT default library has many components from which to choose to create templates. These components are organized in categories according to functionality. These components do not include side slope conditions.

### 5.1.4 End Conditions

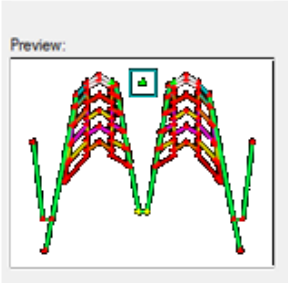
End conditions are simply side slope condition components that tie to existing ground. These include fill slope, cut slopes, ditches and/or combination thereof.

### 5.1.5 CADD support templates

The MoDOT standard template library will contain a limited number of templates. Only these templates will be housed in this folder.

### 5.1.6 District user templates

The user will save the template library in his/her working directory and will be able to modify the library by adding new templates or components. Any templates created by a district user should be stored in this folder.

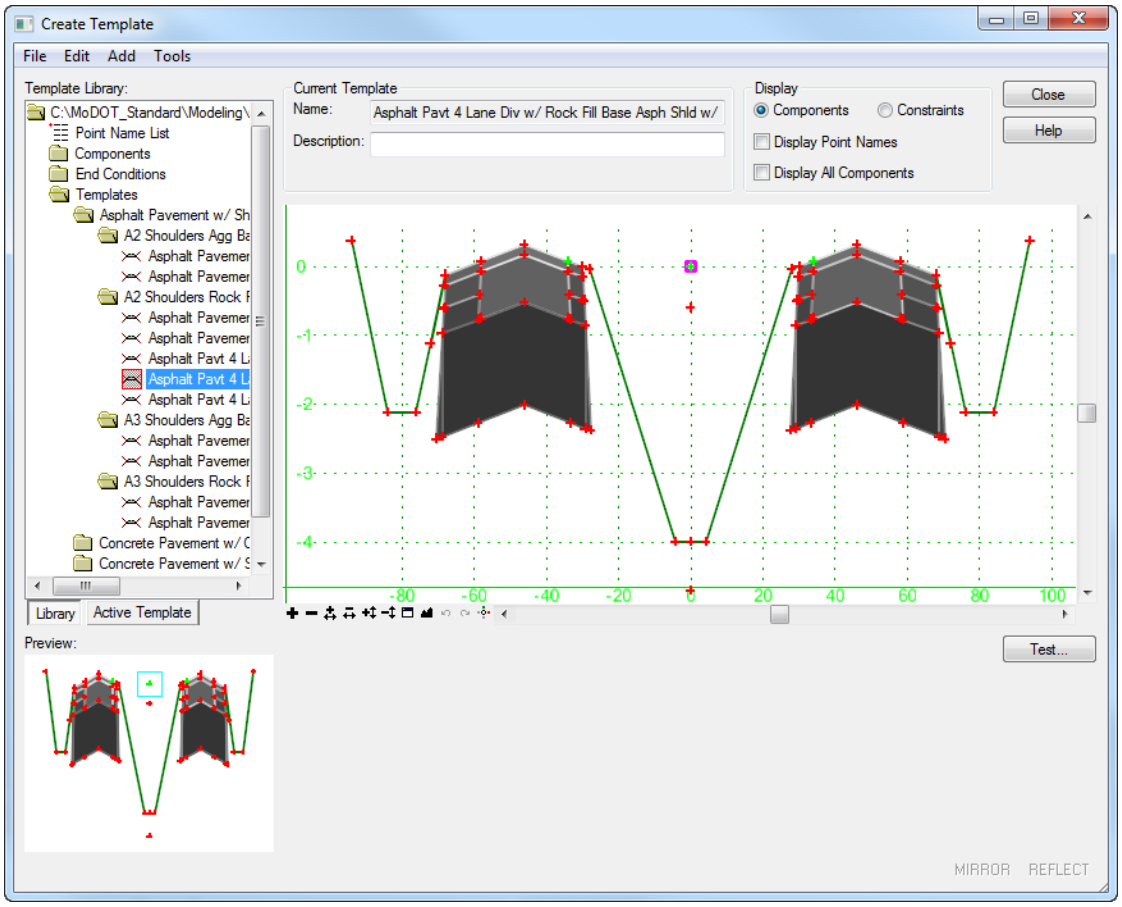



### 5.1.7 Preview Template Window

The template preview window shows the template that is highlighted in the folder tree view. A Cyan color box denotes the placement location for that template. Usually this is at the origin of the template, but the user can click on any point to move the placement point location. The user can drag and drop from the preview are to the current template window.

### 5.1.8 Current Template Window

This is the large window on the right hand side of the Create Template Dialog where templates are assembled and edited. The current template window shows the user the name, description and design of the template currently being edited, reviewed or assembled.




## 5.2 Display Options

The two radio buttons allow the user to choose what to display in the center window. The **Components** option shows the typical section component/template picture. The **Constraints** option show how each point in the component/template is constrained to each other. Constraints will be covered in another section.

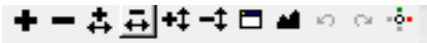
There are two check boxes the user can select for displaying various portions of the template. When the **Display Point Names** option is checked on, all the point names in the current template are displayed. Point names are long and when displayed the window can be too cluttered. Sometimes templates have hidden components controlled by certain design situations. This concept will be discussed in a later chapter. When the **Display All Components** option is selected, these hidden components are displayed.

### 5.2.1 Center Window

The center window is the main graph for creating/modifying templates. This window has its own graphics engine and so it is not a MicroStation window. The scale of the graph is dynamic and changes as you zoom in and out.

The center point of the window is marked by the dynamic origin, which is a magenta-colored box. The dynamic origin is used as a reference point and can be moved to any location in the graph.

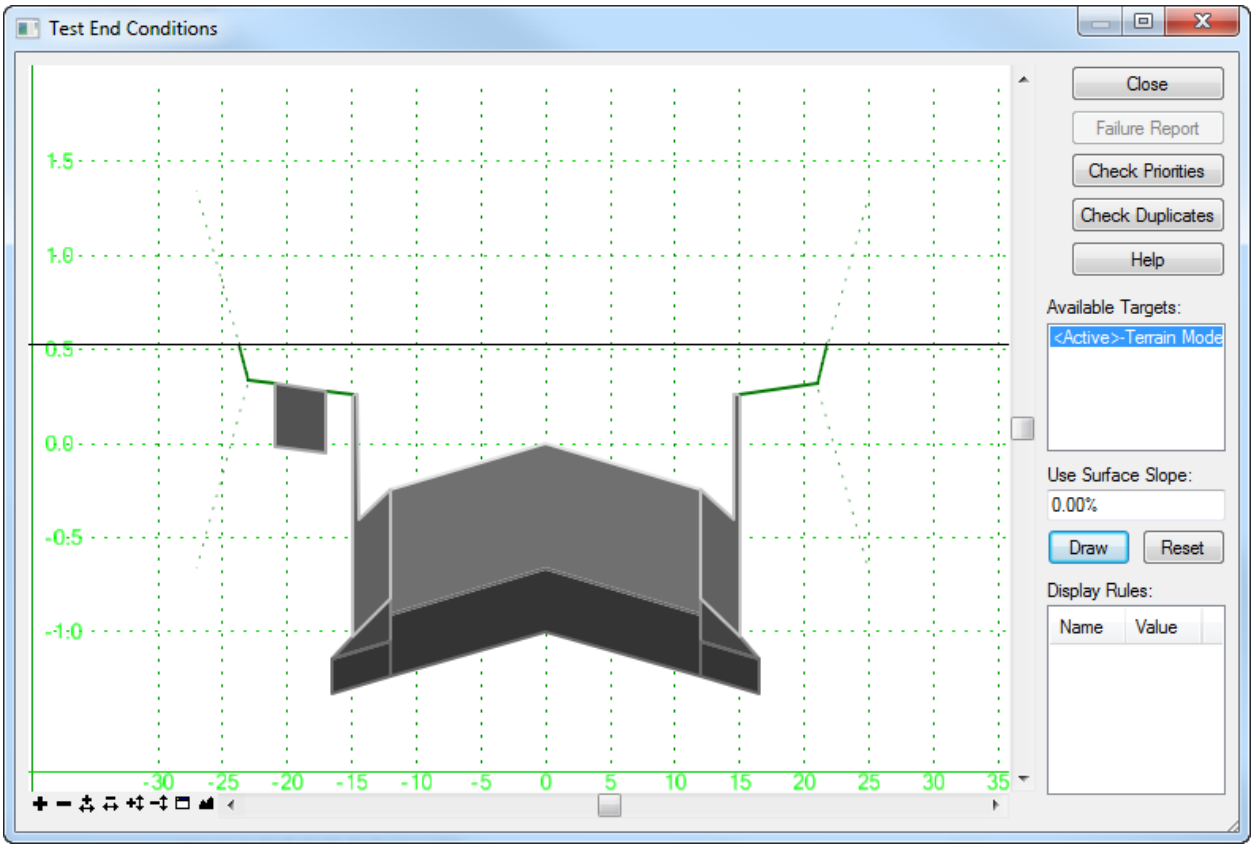
### 5.2.2 View Commands



These commands are similar to the MicroStation view commands. They allow the user to perform the standard zoom in/out, zoom in/out in the X direction, zoom in/out in the Y direction; window in an area, and fit the view, undo, redo, and set dynamic settings.

### 5.2.3 Testing End Conditions

**Test** – Opens the Test End Conditions dialog box. This tool allows the user to test the end condition solutions.




This tool displays the current template; the non-solved end conditions and their child components are displayed in dashed lines. The normal components and solved end conditions are displayed as solid lines.

The **Available Targets** area lists all of the targets available whether they are surfaces or specific styles. The user simply selects the desired target, sets the **Surface Slope**, and then clicks on **Draw** to test. The Surface Slope is the slope of the surface that is being placed. The **Reset** button clears all the drawn targets.

**Display Rules** - list the display rules for the current template. Left-click over a value to toggle between True and False. Press the Reset button to restore the original Display Rules values.

**Failure Report –** activates the Results dialog. When a template fails to get a solution on one or both sides, the results show which components failed and which end condition start points were not solved.

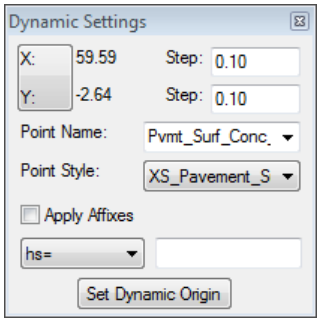
**Check Priorities –** tests the template for priority conflicts. Each end conditions starting at the same point has a priority assigned, and must be unique. When a conflict exists, a message is displayed indicating there are end conditions starting at the same point having the same priority assigned. If there are no conflicts, a message box indicating no conflicts is displayed.

**Check Duplicates –** checks for duplicate feature and component names for the given solution. If duplicate feature or component names are found, the Duplicate Feature Name List dialog is displayed. If no duplicates are found, a message to this effect is displayed.

**Close –** dismisses the dialog.

**Help –** displays the help for this dialog.

## 5.2.4 Dynamic Settings




Similarly to the MicroStation AccuDraw tool, the **Dynamic Settings** are used for precision input of the template components and to assign point names and styles when creating components.

It also serves as a compass for the cursor location with respect to the dynamic origin. The dynamic origin can be modified by using the "**Set Dynamic Origin**" at the bottom of the dialog box.

## 5.2.5 Accessing the Dynamic Settings

The Dynamic Settings can be accessed by selecting **Tools>Dynamic Settings** or by using the view control icon . The dynamic setting **Step** should be set to x = 0.1, y = 0.1 before creating templates to allow for easy dynamic positioning.

## 5.2.6 **Precision Key-In Commands**

XY = Key-in absolute coordinates (x, y)

DL = Key-in delta coordinates from last point placed (defaults to the dynamic origin if it is the first point of a component

HS = Key-in horizontal delta distance and slope from last point placed

VS = Key-in vertical delta distance and slope from last point placed

OL = Key-in delta coordinates from dynamic origin

OS = Key-in horizontal delta distance and slope from dynamic origin

### 5.2.7 Creating Templates from Components

Templates can be assembled by dragging and dropping components and end conditions into the Current Template window one at a time.

Each point on a component has a unique point name. These point names are created without being specific to "left" or "right" side of the roadway. The user assigns a prefix or suffix to determine "left" or "right" when creating the template via the Dynamic Settings.

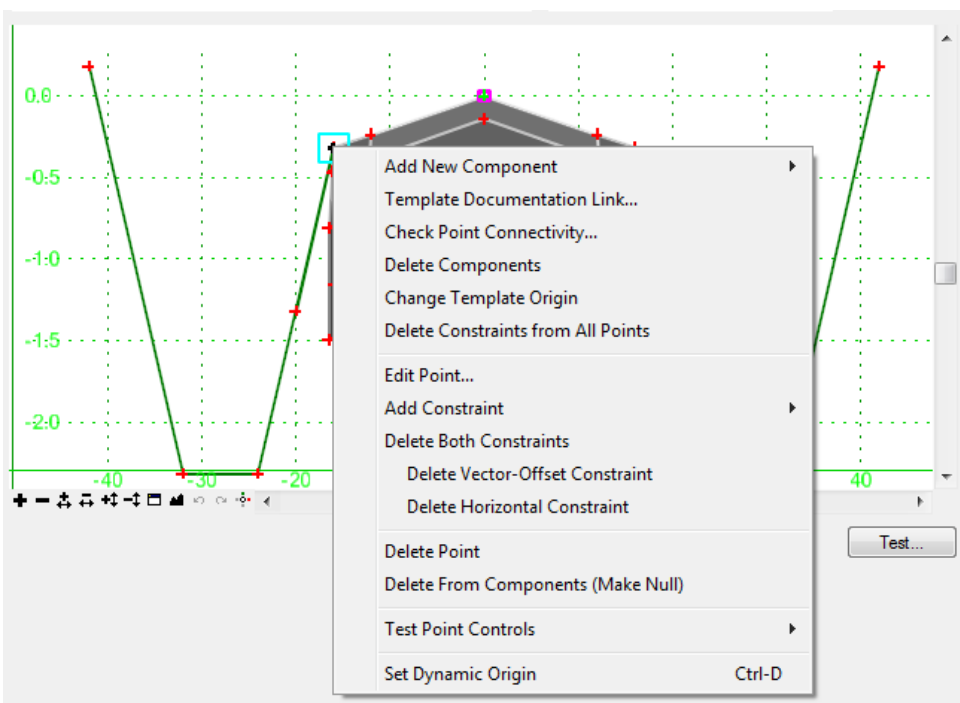
Creating components will be covered in a later chapter.

### 5.2.8 Dragging and Dropping Components

When two points coincide, a heavy white plus sign will appear. When connecting two components together, the existing connection point name will override the dropped point name. Dynamic Settings should be set before starting to drag and drop components to create a template.

Once a component is created, it can be modified by editing any property, inserting new points, or creating display rules. Once two or more components have been combined, they can also be merged.

To edit components, simply right-click between the components to access the editing commands.



**Basic Template Creation Workflow**

1. Open Template Library
2. From the folder tree view, right-click and select **Create > New Template**
3. "Drag and drop" template components
4. Merge Components
5. Verify Point Names
6. Save the Template Library

### 5.2.9 Pull Down Menus

**File –** allows the user to create a new template library, new folder, or new template; open another library, save the current library, or import a template from another library.

**Edit –** has the common Windows commands undo, redo, cut, copy, paste, clear, delete, and rename.

**Add –** has all the options for developing new components. Components are covered in a later chapter.

The Tools menu offers several tools to manage the template library, but the only two tools pertaining to the MoDOT template library are the Dynamic Settings covered in section 2.6 and the **Template Library Organizer**, which allows the user to copy components and templates from one library to another.

## 5.3 Point Constraints

Templates and components are defined by the points making their shapes. Thus point constraints are used to manage the behavior of all template points. The purpose of point constraints is to create relationships between the points in a template so that if one point moves, the other points follow in a predictable manner.

Each template point has a maximum of two constraints on it. A template point with two constraints is considered "fully constrained" and is represented graphically by a red plus sign on the template display. A template point with only one constraint is considered "partially constrained" and is represented graphically by a yellow plus sign. A point with no constraints is considered "unconstrained" and is shown as a green plus sign.

### 5.3.1 Types of Constraints

There are a total of 11 different types of constraints:

**Horizontal -** Allows the placement of a new point (or child point) a specified horizontal distance from a reference point (or parent point).

**Vertical -** Allows the placement of a new point (or child point) a specified vertical distance from a reference point (or parent point).

**Slope -** Allows the placement of a new point (or child point) using a specified slope from the reference point (or parent point). Slope constraints are absolute. Slopes going from lower-left to upper right are positive regardless of whether the child point is to the left or right of the parent.

**Horizontal Maximum -** The child point has two parent points and remains at the specified horizontal distance from the parent point that is farthest to the right (has a maximum horizontal or X value).

**Horizontal Minimum -** The child point has two parent points and remains at the specified horizontal distance from the parent point that is the farthest to the left.

**Vertical Maximum -** The child point has two parent points and remains at the specified vertical distance from the parent point that is the highest (has a maximum vertical or Y value).

**Vertical Minimum -** The child point has two parent points and remains at the specified vertical distance from the parent point that is lowest (has the minimum vertical or Y value).

**Vector-Offset -** The child point is projected onto the vector defined by two parent points. If the offset is not zero, then the child point will maintain a perpendicular offset from the parent vector at the specified offset value. Negative values indicate an offset to the left of the vector defined by the parent points. Positive values indicate an offset to the right. If the offset is zero, the child point is located on the parent vector.

**Project to Surface (to Existing Ground) -** This constraint must be used in conjunction with one of the previously defined constraints. The other constraint will define the projection direction. The child point will then be projected to the surface with the specified name. If the surface does not exist, or no solution is found, the point will remain where it is placed in the template.

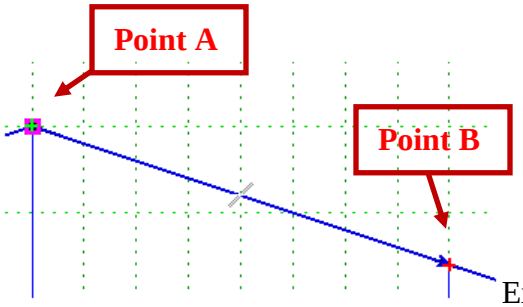
**Project to Design -** This constraint is similar to Project to Surface, except that the point is projected to the design surface of the template. A projection value is given to indicate whether the projection is to be to the left or to the right. Again, the point must also be constrained by one of the previous constraints, excluding the Project to Surface constraint, so that a direction for the projection may be determined. If no solution is found, then the point will remain where it is placed in the template.

**Angle distance -** This command is used to fully constrain a point in the template. This constraint requires two parent points, a distance, and an angle. The point is constrained to the location defined by the distance from the first parent, and the angle from the first parent relative to the vector defined by the two parent points. This constraint creates a rigid-body rotation. When selected, no other constraint types are available.

### 5.3.2 Parent-Child Point Relationship

When a template point is constrained by either one or two other points, it is considered the "child" of those reference points. The reference points are then known as the "parent" point(s).

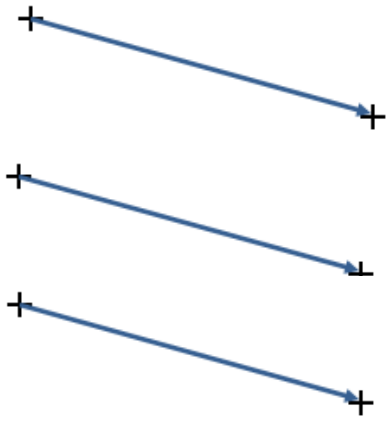
If the parent point moves, the child also moves based on the constraints established.




Example:

Point B is a child of point A. Point A is unconstrained and shown as a green plus sign on the screen. Point B is fully constrained. Point B has a horizontal and a slope constraint, and is shown as a red plus sign. In addition, the parent point (Point A) has a blue arrow pointing to the child point (Point B).

**Visual Indicators for Vertical, Horizontal and Slope Constraints**



Child is vertically constrained to parent. When the parent point moves, the child point follows at a constant vertical distance to that point.

Child is horizontally constrained to parent. When the parent point moves, the child point follows at a constant horizontal distance to that point.

Child is constrained to parent by a slope. When the parent point moves, the child point follows a constant slope with respect to the parent point.

### 5.3.3 Modifying Constraints

Once a point has been created with or without constraints in a template, it can still be modified. Modifications include: adding or deleting constraints, or changing the type of constrained originally set for a point.

## 5.4 Template Components

Templates are a grouping of several components, and each component is a set of points that defined an open or closed shape. Each component represents a material for the typical section at a particular location. Each component is given a name and assigned a Feature Definition. A Feature Definition is simply the MicroStation symbology used to draw the component both in cross section view as well as plan view.

There are six types of components: *Simple*, *Constrained*, *Unconstrained*, *Null Point*, *Overlay*, and *End Condition*.

Once created, components can be modified as desired. There is no limit to the number of points or components in a template. When templates are paired with horizontal and vertical alignments and superelevation, they define the surface of a corridor. Templates are flexible design components that allow you to model simple highway design items such as ditches and sidewalks to the more complex multi-lane highways with superelevated curves and variable side slopes.

### 5.4.1 Simple Component

A simple component is a closed parallelogram (4 constrained points) that is defined by the slope and thickness (for example, a pavement layer). In this case, if any point is moved, the entire shape moves keeping the same relationships determined by the original slope and thickness, making this a rigid shape.

### 5.4.2 Constrained

A constrained component consists of points that are all restricted to the movement of the first point. A constrained point is typically used to manage the behavior of other points in the template. When a point (parent) is moved, any constrained point (child) also moves. This restriction only affects the offset and elevation (x, y) of the restrained point and, the relationship is unidirectional (movement of child point does *not* move the parent point).

### 5.4.3 Unconstrained

An unconstrained component is open or closed-shaped with no movement restrictions. This type of component is only used for very specific purposes, such as “tracing” a previously placed component.

### 5.4.4 Null Point

A null point is a template point that is purposely not related to any particular component. It’s most often used as a reference for controlling other points. A null point is considered a “check or test point”. For example, a null point is used to check if there is an entrance to the right or left of the alignment.

### 5.4.5 Overlay

This is a special type of component that allows the user to add overlay/stripping properties in order to calculate milling, and/or leveling (overlay) quantities.

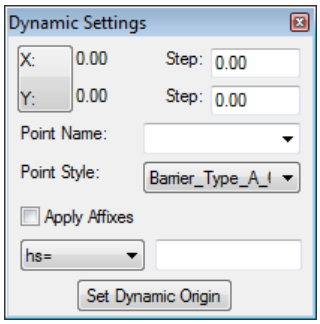
### 5.4.6 End Conditions

An end condition is a special open-shaped component that targets a surface, a surface style, an elevation, or an alignment. In other words, the end condition components are simply the fill/cut/ditch slopes or benching which tie back to ground. The integrity of end conditions can now be routinely tested while the roadway template is being created.

## 5.5 Creating Basic Components

### 5.5.1 Point Name List and Feature Definition

Each point used for creating a component must be given a name and a Feature Definition associated with such. CADD Support has created a point name list from which to select. Point naming convention is extremely important in the creation of templates, so especial attention must be paid while creating individual components.




### 5.5.2 Setting Display Options

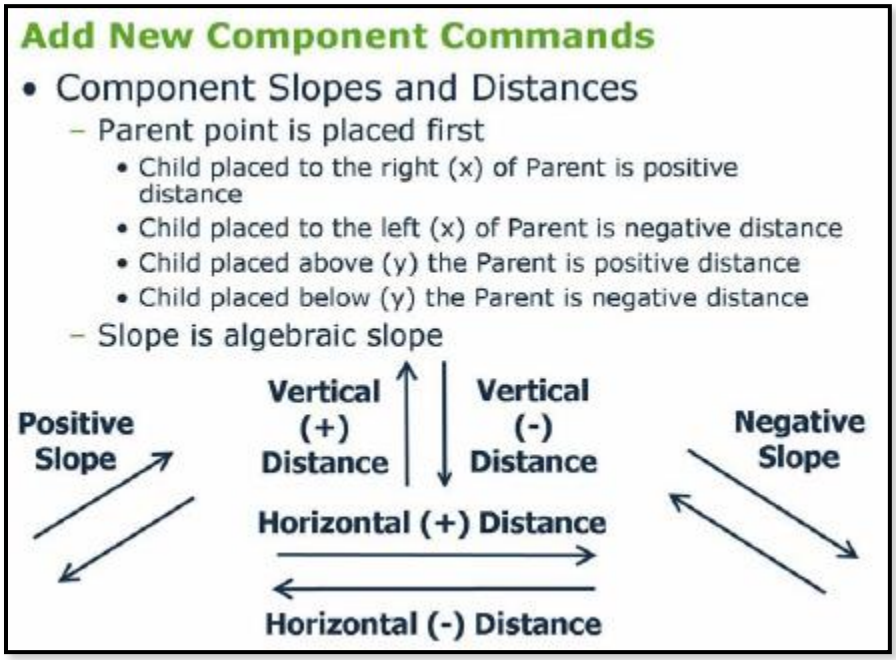
The dynamic settings need to be set prior to creating a component, end condition or template.

### Key-In

Specifies the type of key in to be performed.

- XY= key in absolute coordinates
- DL= key in delta coordinates from last point placed (defaults to the dynamic origin if it is the first point of a component.
- HS= key in horizontal delta distance and slope from last point placed.
- VS= key in vertical delta distance and slope from last point placed.
- OL= key in delta coordinates from dynamic origin.
- OS= key in horizontal delta distance and slope from dynamic origin.

## 5.6 The Sign of the Distance and Slope

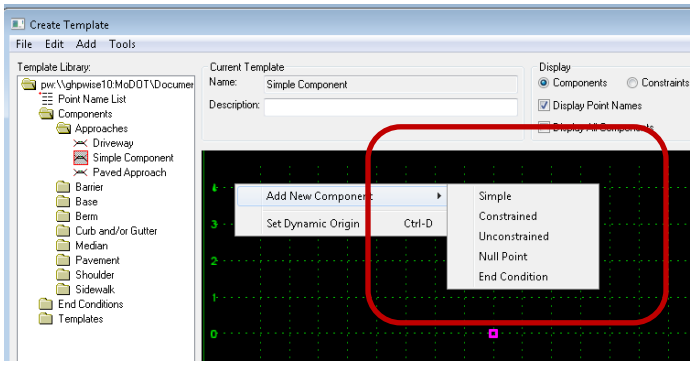



When defining components with precision input, the sign of the distance is dependent on the parent-child relationship. The parent is always the first point placed when creating template components. The distance is positive if the parent has a lower X or Y value than the child. The distance is negative if the parent has a higher X or Y value than the child. The sign of the component slope is based on the mathematical slope.

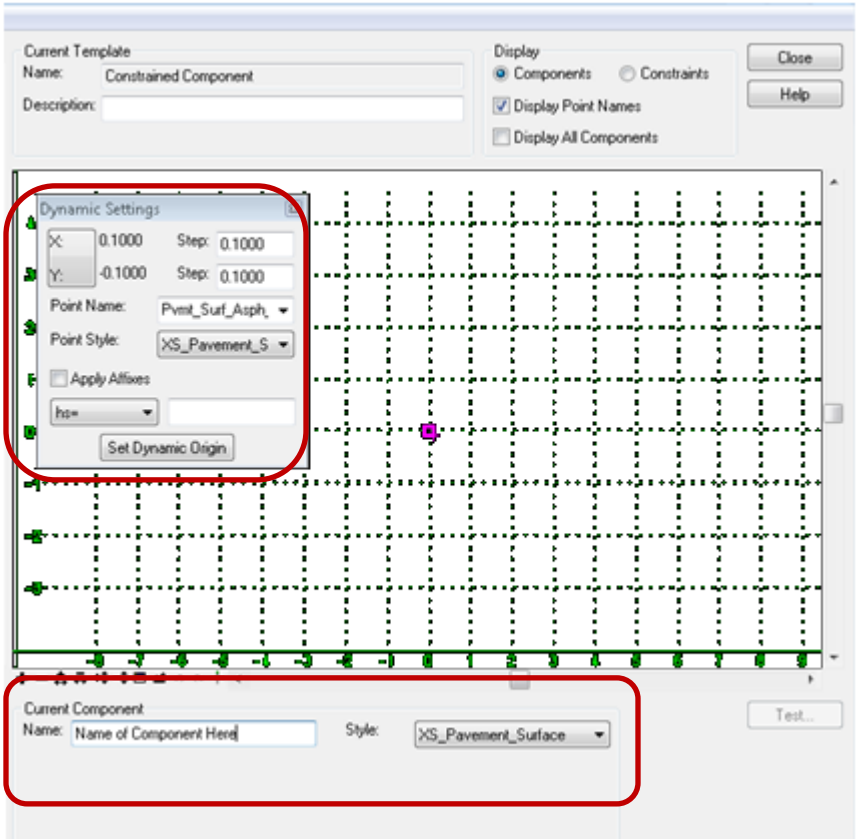
### 5.6.1 Adding Components

Adding components is a simple process guided by dialog boxes, but point name and placement must be carefully thought of before starting the process. The steps are as follow:

1. Create the component structure in the library folder tree to the left.
2. Activate and set and activate the setting display options.
3. Right click on the current template window and select **Add New Component**.
4. Select the type of component desired.

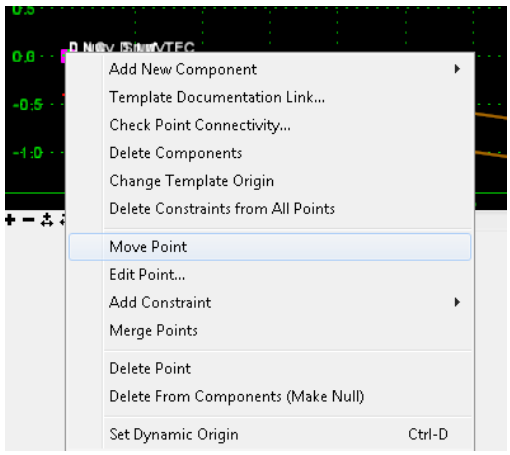


5. Populate the display setting options and current component dialog.




6. Data point to the origin to start placing the component or type 0, 0 using the x, y key-in.
7. Add points by using the precession key-in commands in the dynamic settings to finish the desired shape. For unconstrained and constrained components, once the shape has been drawn, right click and select **Finish** to complete.

Once a component has been created, it can be modified visually by adding, deleting points or taking away/adding constraints. In addition, the entire component can be deleted.

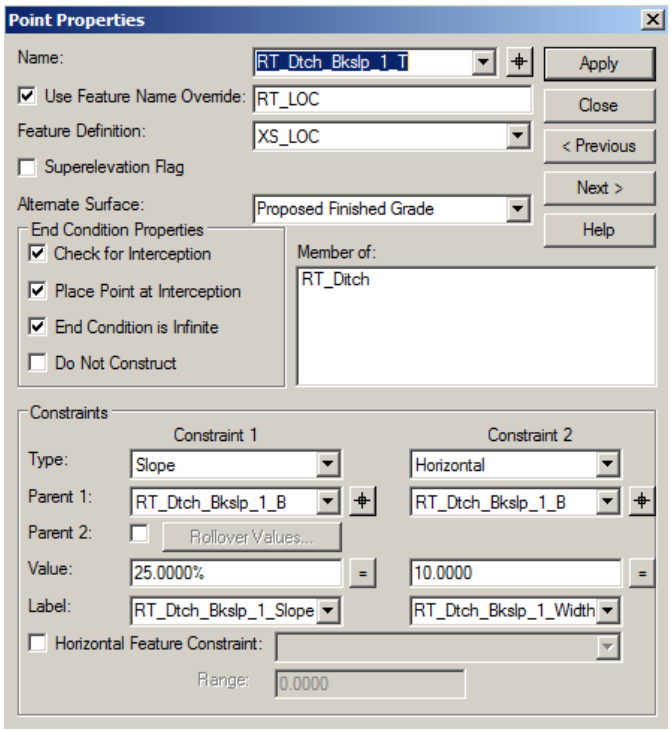



Also, the component can be modified through the point properties dialog box.

**Note:** In order to modify a component, the user must modify the points making up the component.

### 5.6.2 Point Properties Dialog

To access the *Point Properties* dialog box, right click on the point to modify and select **Edit Point**.




### 5.6.3 Basic Component Creation Workflow

1. Open a template library
2. Navigate to folder where component will be placed
3. Right click on folder, and select **Create Template**
4. Select and set dynamic settings
5. Create components by using the point names in the point list
6. Edit any points if necessary
7. Save template library

## 5.7 Creating an Overlay/Stripping Component

Creating an overlay/stripping component is similar to creating a basic component. The only difference is that overlay/stripping components are a single line "closed" components and they have additional attributes to determine overlay/milling quantities. Detail creation of an overlay/stripping component will be covered in the *Overlay Tools* chapter.

## 5.8 Creation of Basic End Conditions

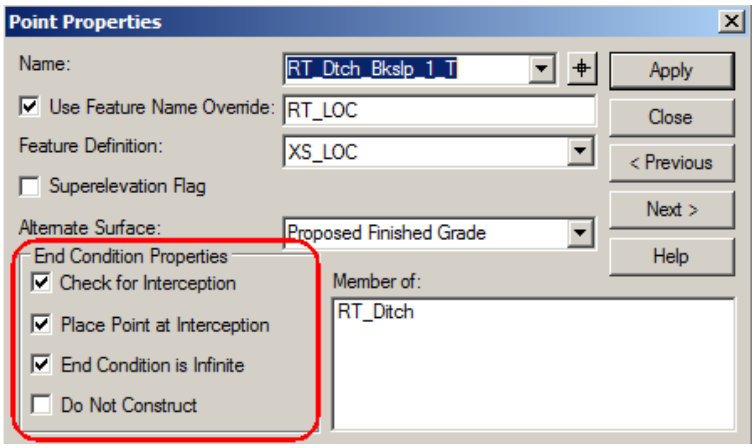
End conditions are components of the template used to create cut and fill treatments. These end condition components have a specific target such as, terrain models, elevations, horizontal and vertical alignments.

### 5.8.1 Target Types

Target types are defined only for end condition components, and are a property of that component. An end condition solution can intercept multiple targets and target types. For example when designing a special ditch, the sideslope condition "targets" the special ditch profile elevation, and then intercepts the original ground terrain model to form the ditch bottom and backslope.

### 5.8.2 End Condition Settings

End conditions will draw based on the targets and settings set. These settings are considered specifically end condition properties and are enabled/disabled through the point property dialog box. The end condition settings are described below.




**Check for Intersection** – when set, the line segment will search for the specified target. If not set, the line segment will be created at its full width regardless of whether it intersects the target, provided that one of the segments connected to this segment successfully intersects the target.

**Place Point at Interception** – when set, a point will be placed at the location of the interception. If not set, the line segment will be created at its full width, provided that one of the segments connected to this segment successfully intersects the target.

**End Condition is Infinite** – when set, the line segment will automatically be extended to intercept the target. If not set, the line segment will only extend to its maximum constraint to meet its target. This applies only to the last line segment in an end condition.

**Do Not Construct -** If set, the end point of the line segment will be used as a reference point to find a subsequent point. The point will be solved like any other end condition point, but that point will be skipped when drawing the final component segments. This is normally not set and is used only for more complex condition testing.

### 5.8.3 Testing End Conditions

Testing end conditions gives the user the ability to verify the solutions and priorities as well as testing multiple targets without using the Create Corridor tool.

When creating end conditions, the user should test to see if desired results are generated. This can be done before, during or after creation of the end condition.

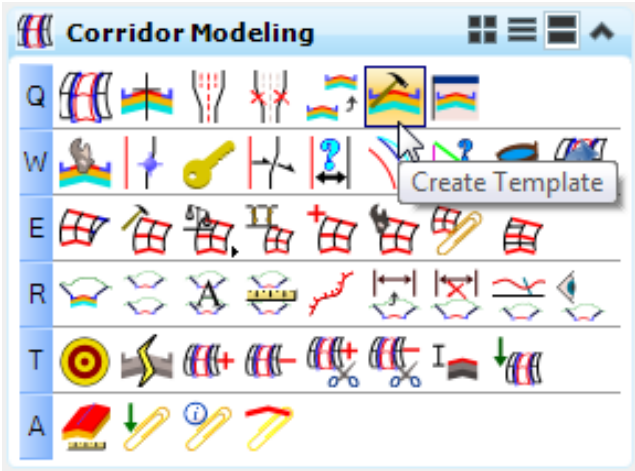
### 5.8.4 Basic End Conditions Creation Workflow

1. Open a template library
2. Navigate to the folder where templates will be stored
3. Select create template
4. Create a new template
5. Create end condition components
6. Test end conditions
7. Save the template library

## 5.9 Group Exercise 3-1: Creating a Constrained Component - Curb

1. Within the *data_05\data* folder, open the **PlanJ2P0200.dgn.**

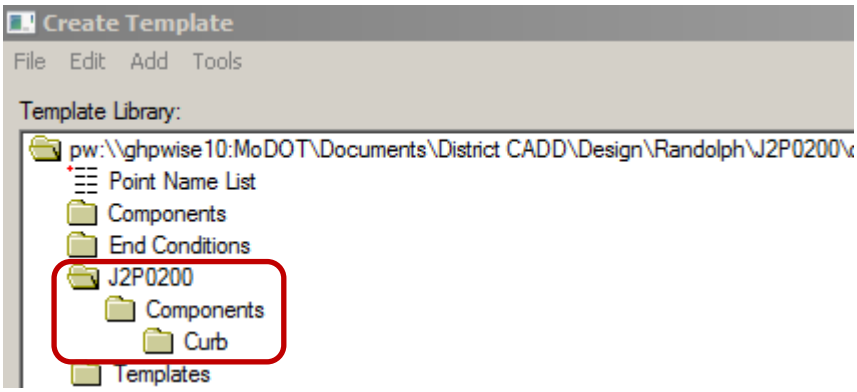
2. From the *Corridor Modeling* task group, select the **Create Template** icon.




3. Select **File > Save As** from the *Create Template* dialog menus. Save the workspace template library to **J2P0200.itl** in the **Randolph\J2P0200\Data_05** folder.

4. **Right click** on the file path at the top of the dialog and create the following folder structure:

**J2P0200 > Components > Curb**

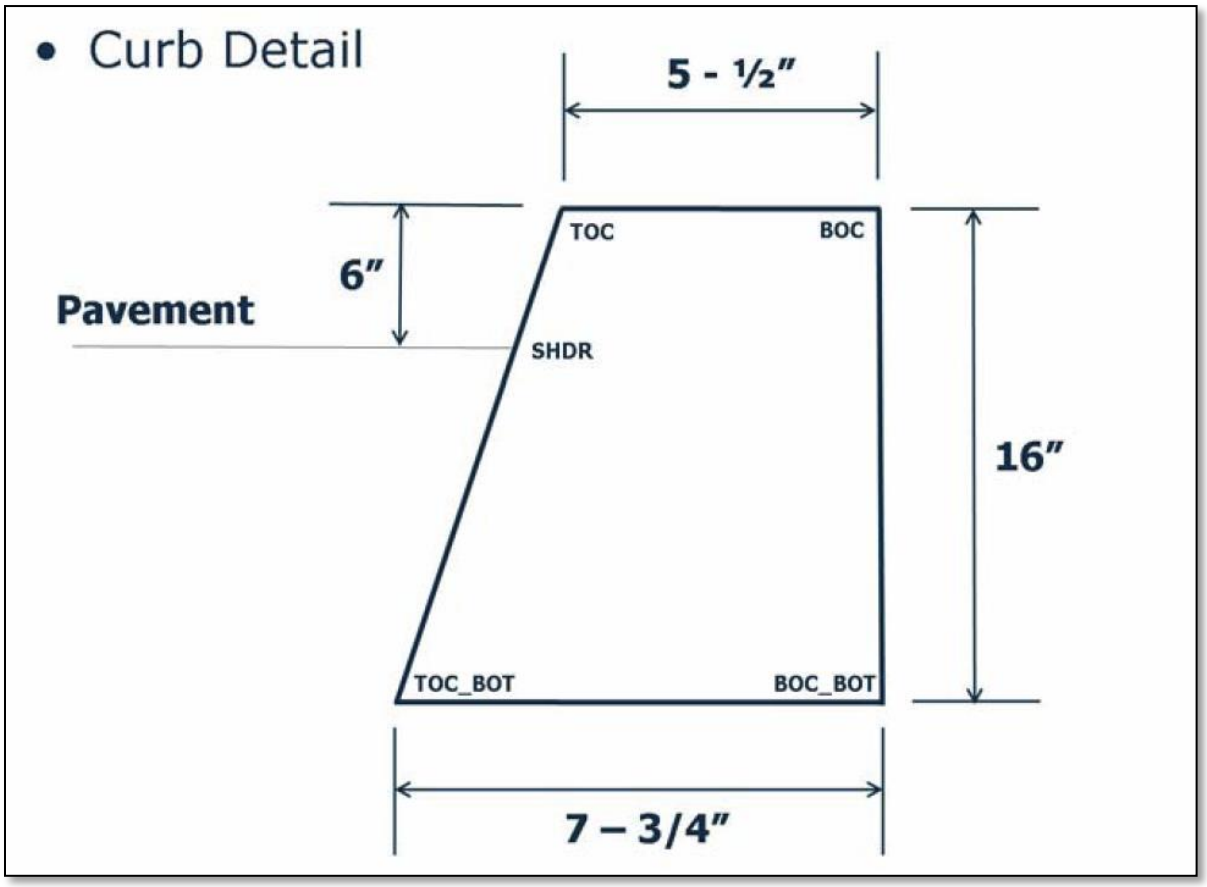



5. Within the *Curb* folder, create a new template named **Curb**.

6. If the *Dynamic Settings* dialog is not displayed, select **Tools > Dynamic Settings**. Set the step increment to **0.10**.

7. If not set, toggle **ON** the *Display Point Names* check box in *Create Template* dialog.

8. Right-click on the *Current Template* window and select **Add New Component > Constrained**.




9. Setup the Current Component portion of the *Create Template* dialog as follows:
   - *Component Name*: **CONCRETE CURB**
   - *Feature*: **XS_Curb_Surface**

10. Setup the *Dynamic Settings* dialog as follows:
   - *Point Name*: **SHDR** (key in)
   - *Style*: **XS_Curb_Surface**
   - *Apply Affixes*: **Disabled**
   - *Precision Input*: **x, y = 0, 0**
   - Press the **Enter** key

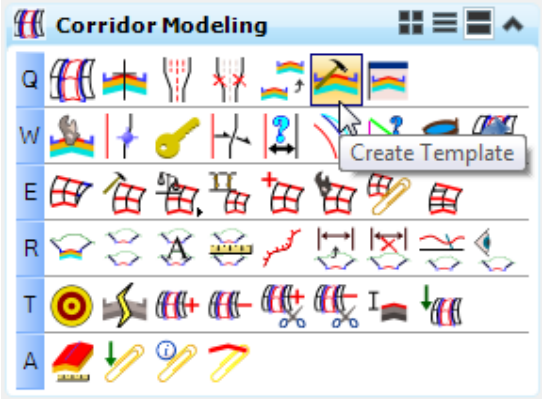
**Notes:**

- The default units for precision input are feet. You can enter other units with the proper specification, such as 6" instead of 0.5.
- Watch the prompts in the lower left corner of the Create Template dialog.
- When creating a component using precision key-in, an ESC allows you to go back.

11. Setup the Dynamic Settings dialog as follows:
    - *Point Name*: **TOC** (key in)
    - *Style*: **XS_Curb_Surface**
    - *Apply Affixes*: **Disabled**
    - *Precision Input*: **xy = 0.07,0.5** (from similar triangles)
    - Press the **Enter** key
12. Setup the Dynamic Settings dialog as follows:
    - *Point Name*: **BOC** (key in)
    - *Style*: **XS_Curb_Surface**
    - *Apply Affixes*: **Disabled**
    - *Precision Input*: **hs = 5.5",0.0**
    - Press the **Enter** key
13. Setup the Dynamic Settings dialog as follows:
    - *Point Name*: **BOC_BOT** (key in)
    - *Style*: **XS_Curb_Surface**
    - *Apply Affixes*: **Disabled**
    - *Precision Input*: **dl = 0.0,-16"**
    - Press the **Enter** key
14. Setup the Dynamic Settings dialog as follows:
    - *Point Name*: **TOC_BOT** (key in)
    - *Style*: **XS_Curb_Surface**
    - *Apply Affixes*: **Disabled**
    - *Precision Input*: **dl = -7.75",0**
    - Press the **Enter** key
15. Right-click on the *Current Template* window and select **Finish**.
16. Enable the **Display Point Names** option.
17. Save the template library.

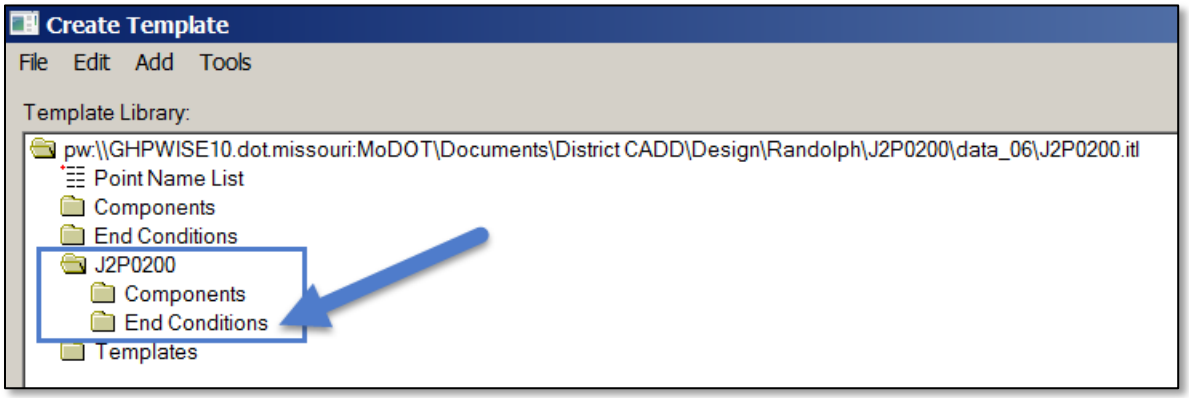
## 5.10 Group Exercise 3-2: Creating an End Condition

1. From the **Corridor Modeling** task group, select the **Create Template** icon:

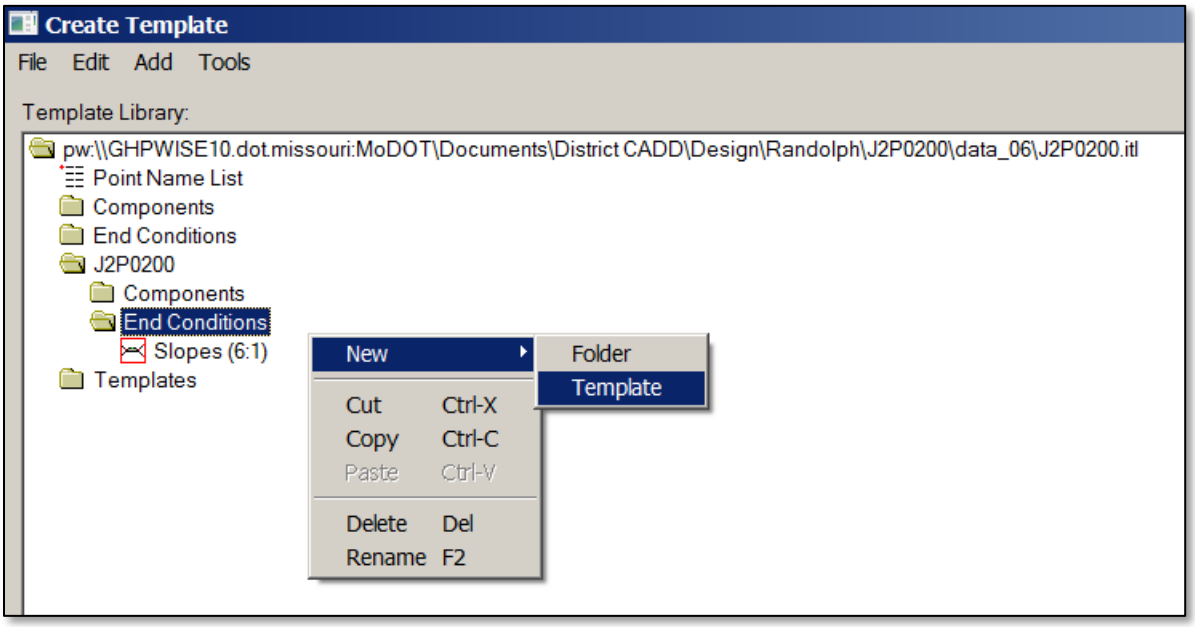



1. Select **File > Open** from the *Create Template* dialog menus. Open template library named **J2P0200.itl** from the **J2P0200/Data** folder.

2. Navigate to the **J2P0200** folder and create a new folder called **End Conditions**.



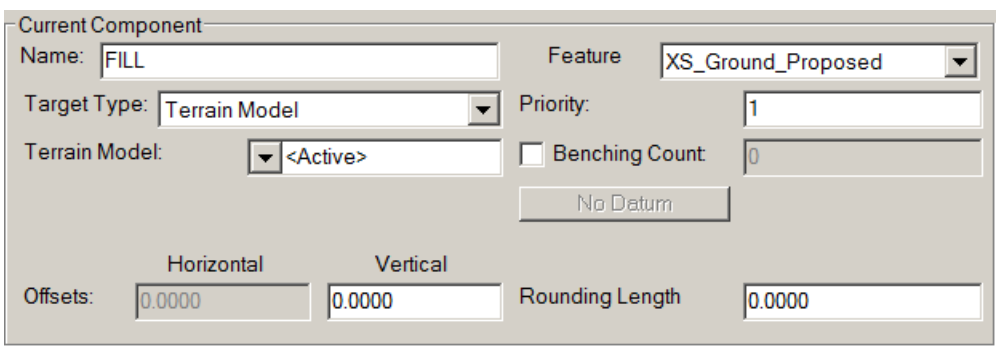
3. Within the **End Conditions** folder create a new template called **Slopes (6:1)**.




4. To create the new slope component, right-click on the *Edit Template* Window and select **Add New Component > End Condition**.

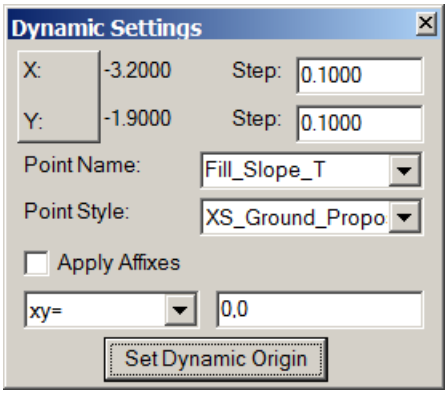
5. Setup the *Current Component* portion of the *Create Template* dialog as follows:

| | |
|---|---|
| *Name*: | **Fill** |
| *Feature*: | **XS_Ground_Proposed** |
| *Target Type*: | **Terrain Model** |
| *Priority*: | **1** |
| *Terrain Model*: | **<Active>** |



6. For the first point setup the **Dynamic Settings** dialog as follows:

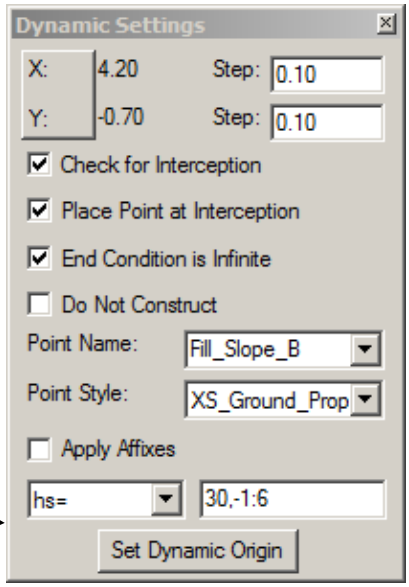
   *Point Name*: **Fill_Slope_T** (select from list)
   *Point Style*: **XS_Ground_Proposed**
   *Apply Affixes*: **Disabled**
   *Precision Input*: **xy = 0,0**




7. With your cursor in the ***xy=0,0** field*, press the **Enter** key on your keyboard.

8. For the second point setup the *Dynamic Settings* dialog as follows:

   *Check for Interception*: **Enable**
   *Place Point at interception*: **Enable**
   *End Condition is Infinite*: **Enable**
   *Do Not Construct*: **Disabled**
   *Point Name*: **Fill_Slope_B (pull-down)**
   *Point Style*: **XS Ground Proposed**
   *Apply Affixes*: **Disabled**
   *Precision Input*: **hs = 30,-1:6**



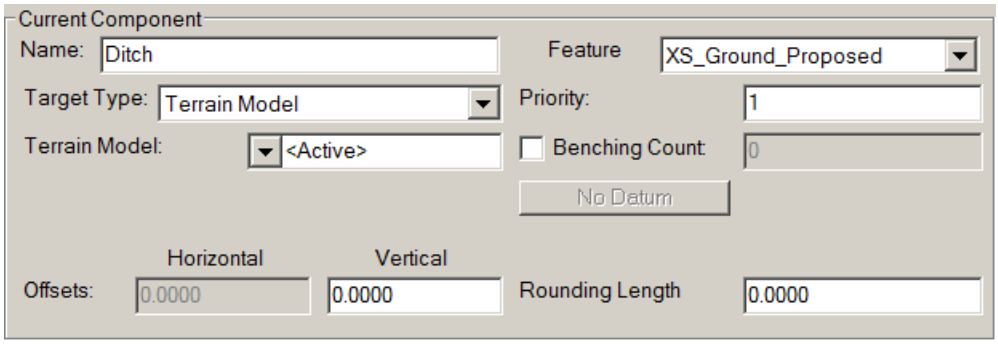

With your cursor in the *hs = 30 -1:6* field, press the **Enter** key on your keyboard.

9. Right-click on the *Edit Template* window and select **Finish**.

10. Create Ditch End Components by right-clicking in the *Current Template* window and select **Add New Component > End Condition**.

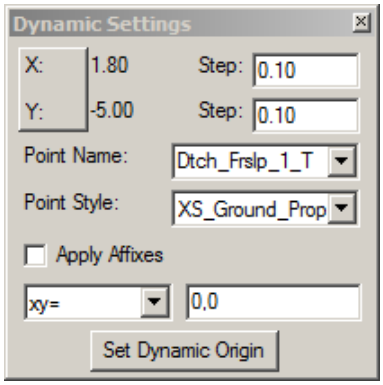
11. Setup the Current Component portion of the Create Template dialog as follows:

*Name*: **Ditch**
*Feature*: **XS Ground Proposed**
*Target Type*: **Terrain Model**
*Priority*: **1**
*Terrain Model*: **<Active>**




12. For the first point setup the *Dynamic Settings* dialog as follows:

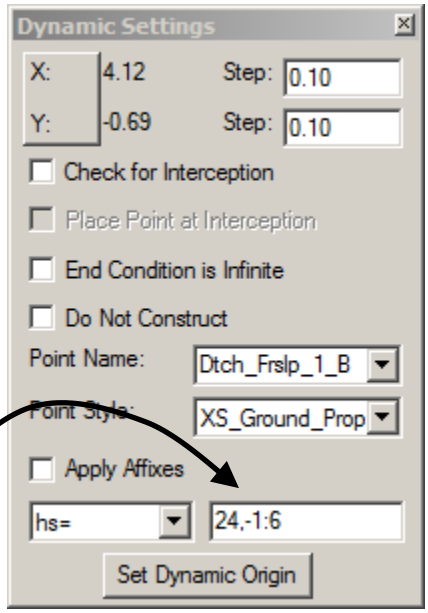
*Point Name*: **Ditch_Frslp_1_T (select from list)**
*Point Style*: **XS_Ground_Proposed**
*Apply Affixes*: **Disabled**
*Precision Input*: **xy = 0,0**




With your cursor in the *xy=0,0 field*, press the **Enter** key on your keyboard.

13. To place the **Fore-Slope bottom** point, set the *Dynamic Settings* dialog as follows:

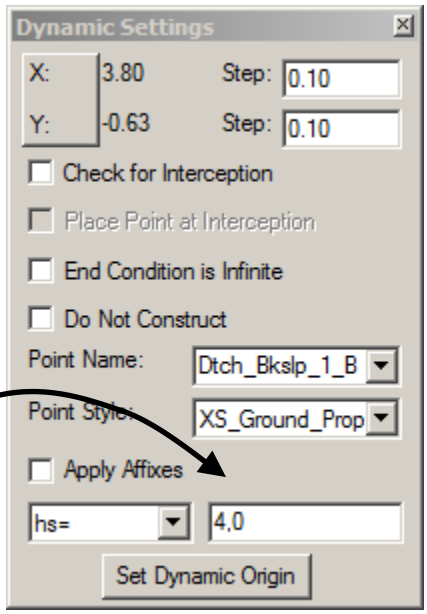
*Point Name*: **Dtch_Frslp_1_B** (select from list)
*Check for Interception*: **Disabled** (this forces this line segment to be placed)
*Place Point at Interception*: **Disable**
*End Condition is Infinite*: **Disabled**
*Do Not Construct*: **Disabled**
*Apply Affixes*: **Disabled**
*Precision Input*: **hs = 24,-1:6**




With your cursor in the *hs = 24,-1:6 field*,
Press the **Enter** key

14. To place the **Back of Ditch bottom** point, set the **Dynamic Settings** dialog as follows:

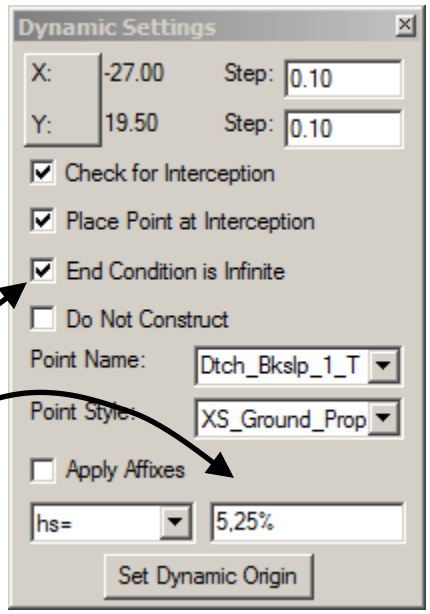
*Point Name*: **Dtch_Bkslp_1_B** (select from list)
*Check for Interception*: **Disabled** (This forces this line segment to be placed)
*Place Point at Interception*: **Disable**
*End Condition is Infinite*: **Disabled**
*Do Not Construct*: **Disabled**
*Apply Affixes*: **Disabled**
*Precision Input*: **hs = 4,0**




With your cursor in the *hs = 4,0 field*,
Press the **Enter** key.

15. To place **Slope-Stake point**, set up the **Dynamic Settings** dialog as follows:

| | |
|---|---|
| *Point Name*: | **Dtch_Bkslp_1_T** (select from list) |
| *Check for Interception*: | **Enable** |
| *Place Point at Interception*: | **Enable** |
| *End Condition is Infinite*: | **Enable** |
| *Do Not Construct*: | **Disabled** |
| *Apply Affixes*: | **Disabled** |
| *Precision Input*: | **hs = 5,25%** |



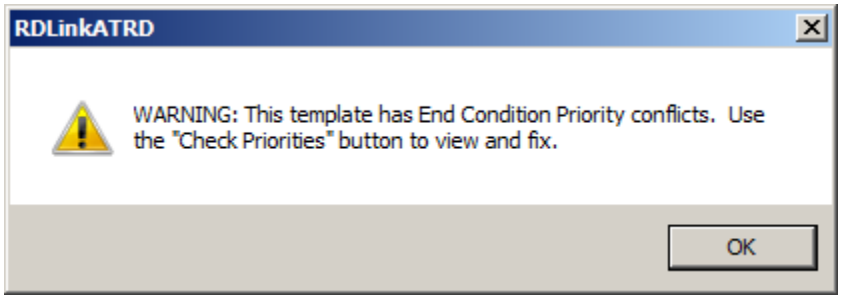

Toggle on **End Condition is Infinite**

With your cursor in the *hs = 5,25.0%*, press the **Enter** key.

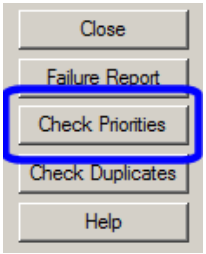
16. **Right-click** on the *Edit Template* window and select **Finish**.

17. Select **File > Save** to save the template library.

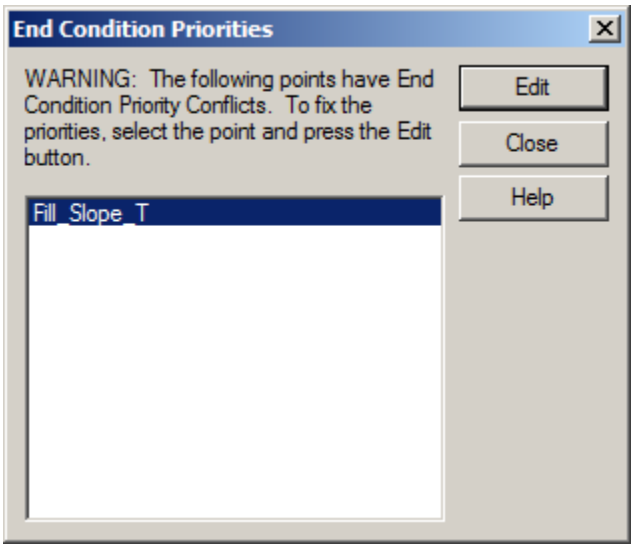
18. Test the End Conditions by selecting the *Test* button located under the *Current Template* window. A warning will be given about the template having end condition priority conflicts.




19. Select **Check Priorities** on the right side of the *Test End Conditions* window.

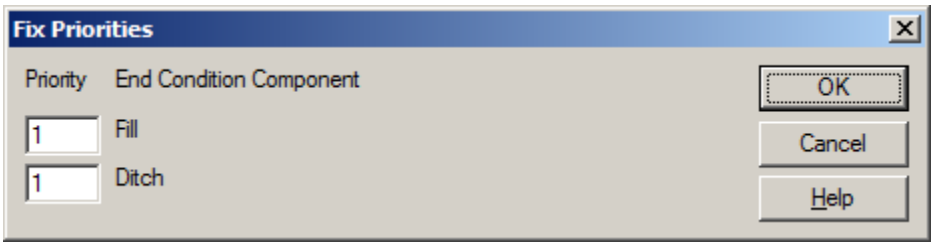


Notice the **Fill_Slope_T** point is the point that has the priority conflicts.



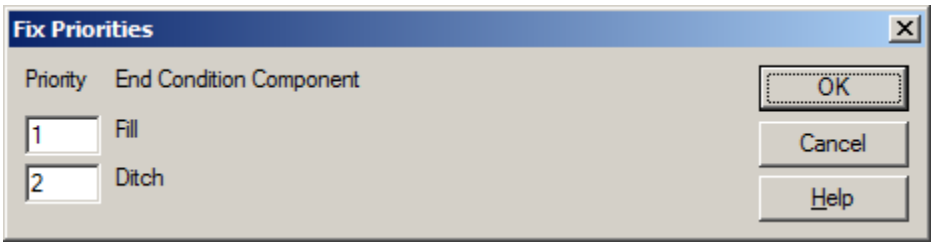

20. In the **End Condition Priorities** dialog select **Edit**.

    Notice that all the end conditions have the same priority number.




    Put your cursor in each of the fields and notice the segments highlighting.

    Assume that fill is the most desirable condition and change the Priority of the **Ditch** (or Cut) to **2**.




21. Click **OK**, and then **Close**.

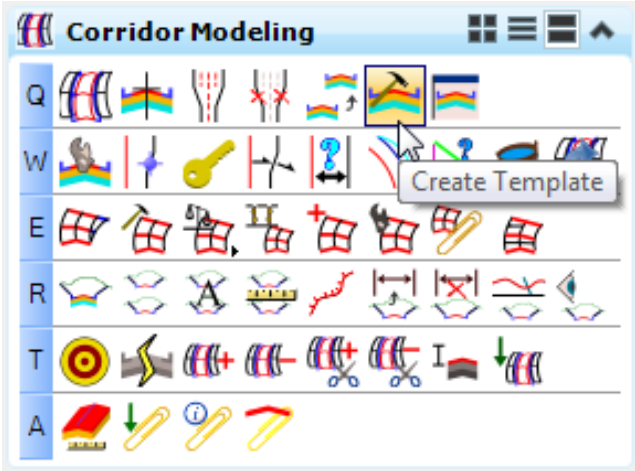
22. Click **Draw** on the right side of the **Test End Conditions** window. Move your cursor over the end conditions.

23. Close the *Test End Conditions* dialog. Save the Template Library by selecting **File** > **Save**.

24. Close the *Create Template* dialog.

## 5.11 Individual Exercise 3-3: Creating an End Condition

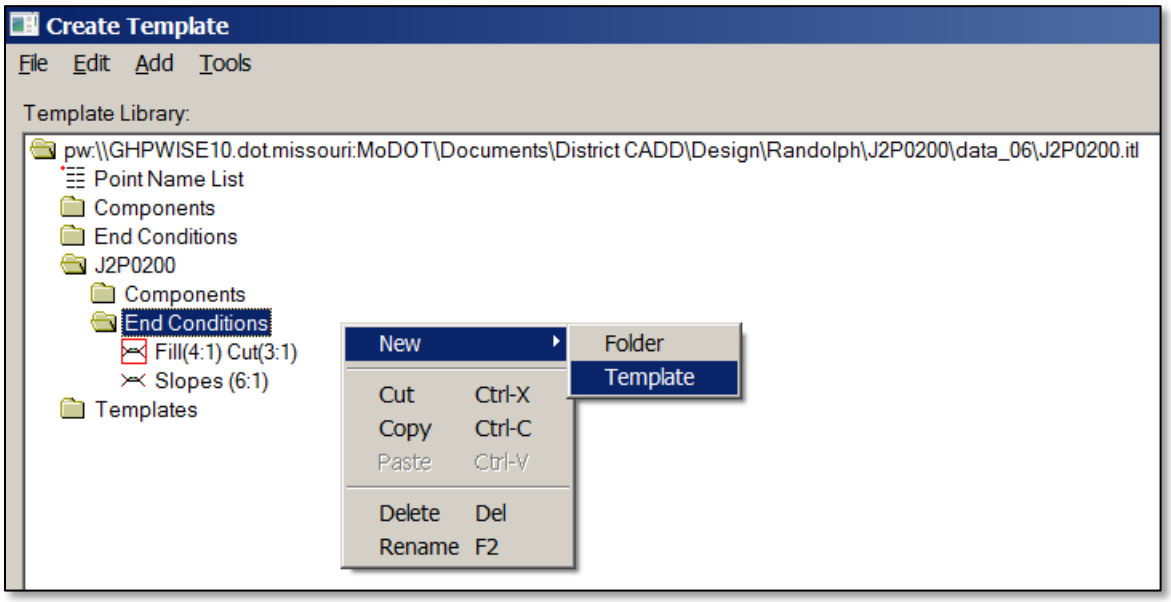
1. From the *Corridor Modeling* task group, select the **Create Template** icon:




2. Select **File > Open** from the Create Template dialog menus. Open the template library named **J2P0200.itl** from the **J2P0200/Data** folder.

3. Navigate to the **J2P0200** > **End Conditions** folder and create a new template called

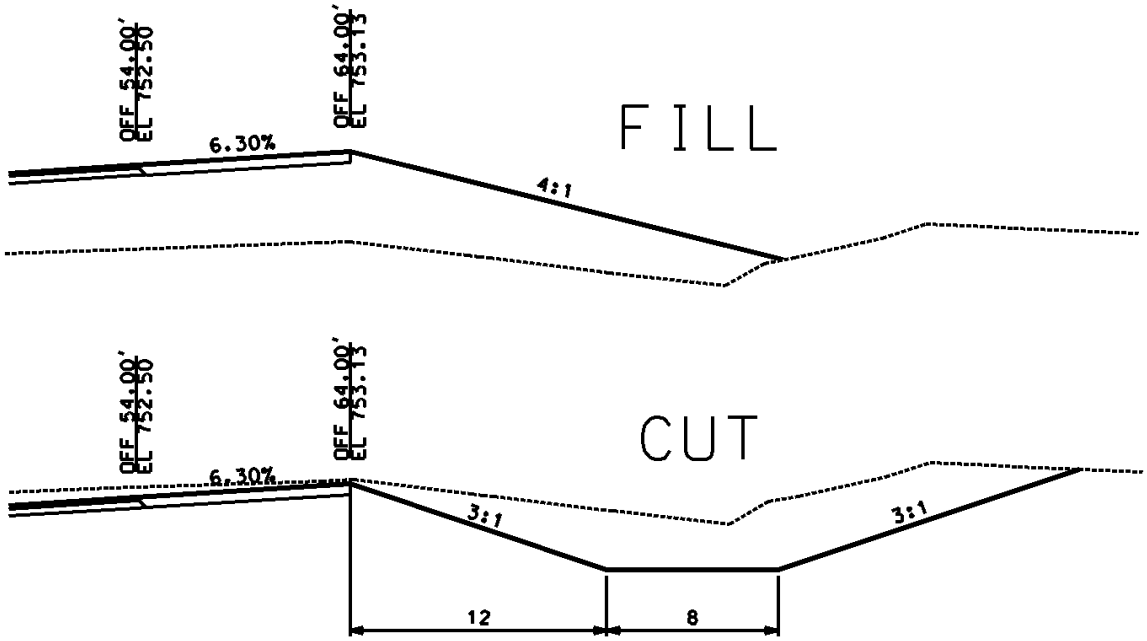
   **Fill (4:1) Cut (3:1)**



4. Create **Fill End Components** by right-clicking on the Template Window and select **Add New Component > End Condition**.

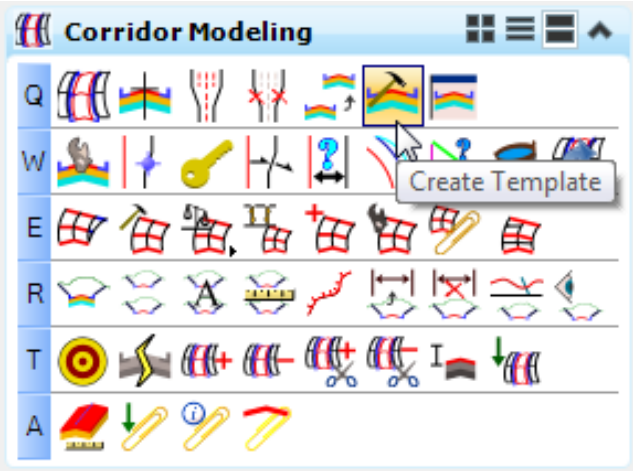
In this exercise the design criteria calls for a ***4:1 Fill*** **and** ***3:1 Ditch slope***.

Using the previous exercise create the following two end conditions. Also test end conditions to make sure there are no conflicts.



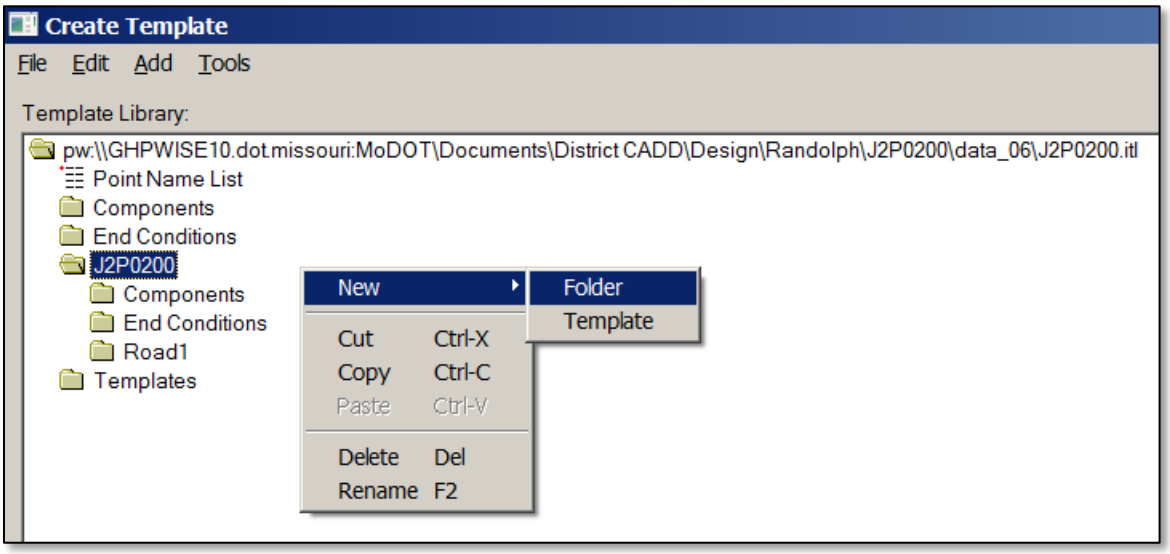
## 5.12 Group Exercise 3-4: Creating a Template

1. From the *Corridor Modeling* task group, select the **Create Template** icon:

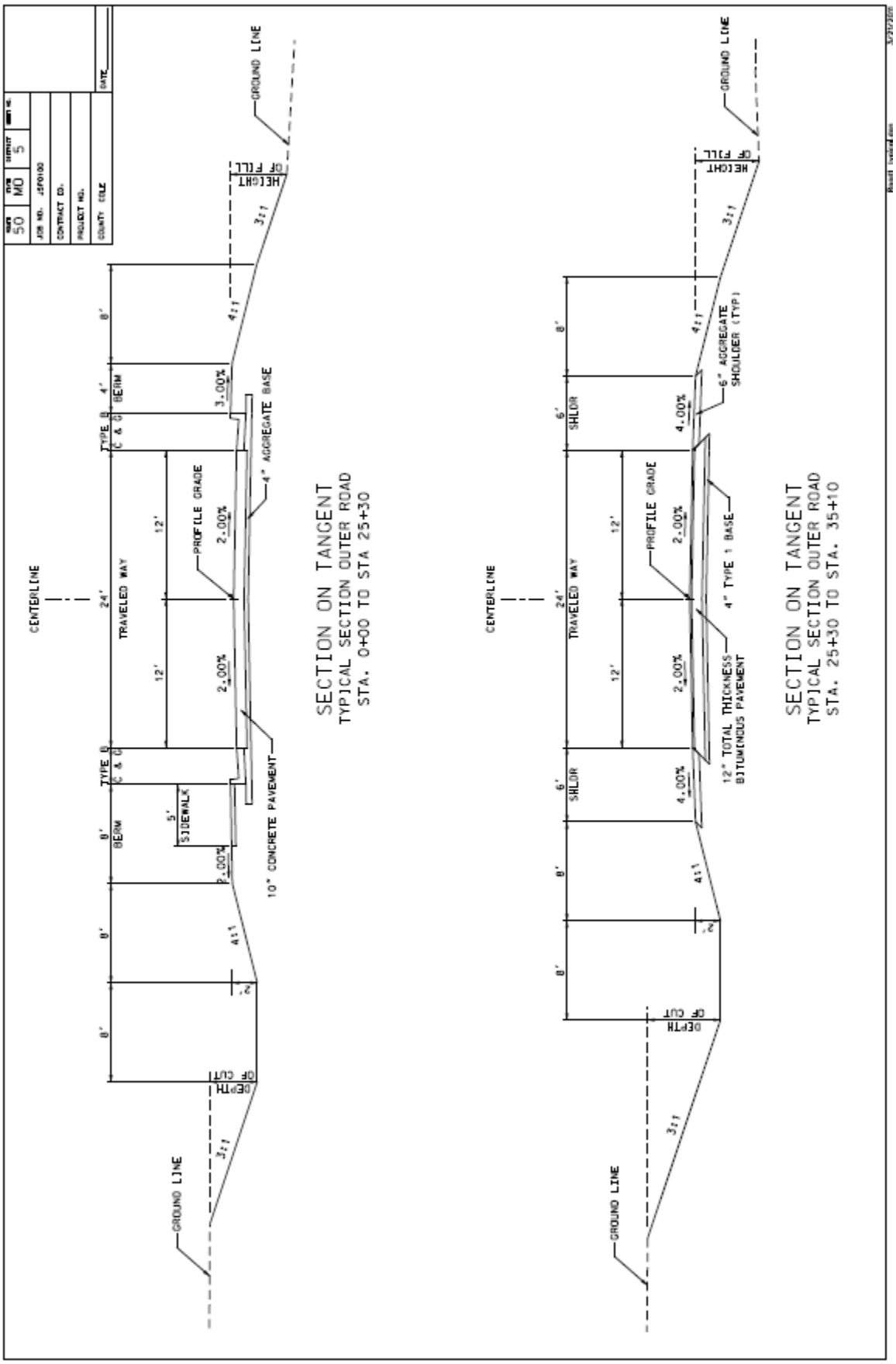



2. Select **File > Open** from the *Create Template* dialog menus. Open the template library named **J2P0200.itl** from the **J2P0200/Data_05** folder.

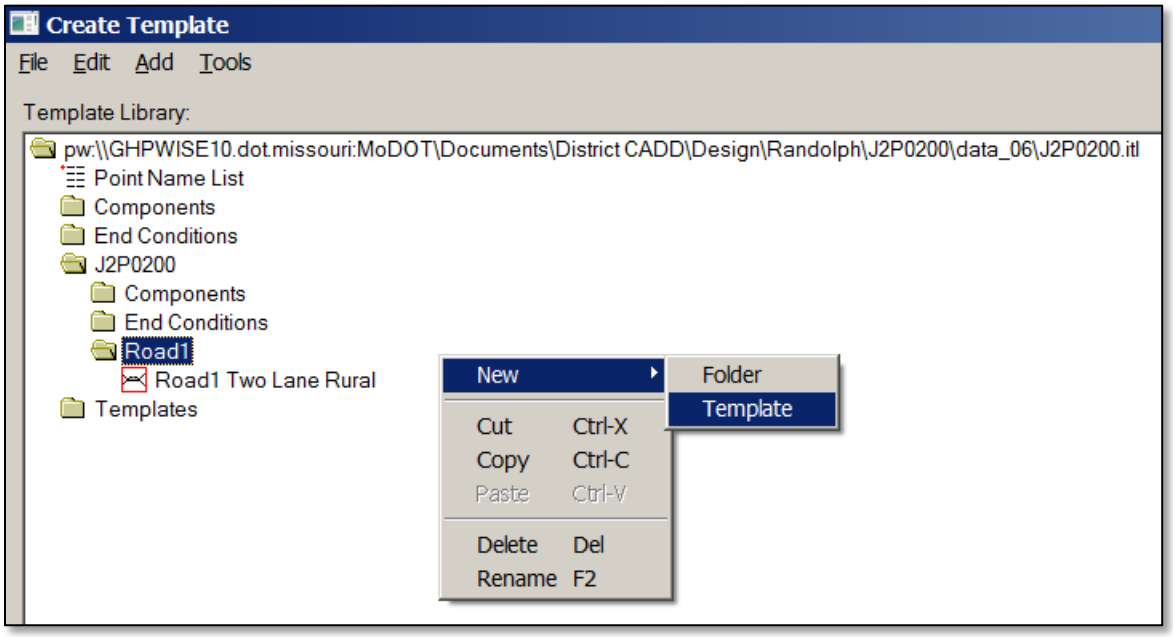
3. Navigate to the **J2P0200** folder and create a new folder called **Road1**.



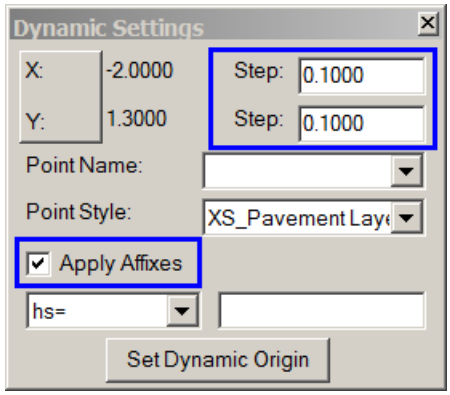

**Note:** In this exercise the User will create a template similar to the **Two Lane Rural** typical listed on the following page.


SECTION ON TANGENT
TYPICAL SECTION OUTER ROAD
STA. 0+00 TO STA 25+30
CENTERLINE
TRAVELED WAY
24'
12'
12'
PROFILE GRADE
2.00%
2.00%
TYPE B
C & G
BERM
4'
8'
3.00%
4" AGGREGATE BASE
10" CONCRETE PAVEMENT
5'
SIDEWALK
2.00%
4:1
.2
DEPTH OF CUT
HEIGHT OF FILL
3:1
GROUND LINE
SECTION ON TANGENT
TYPICAL SECTION OUTER ROAD
STA. 25+30 TO STA. 35+10
CENTERLINE
TRAVELED WAY
24'
12'
12'
PROFILE GRADE
2.00%
2.00%
SHLDR
6'
8'
4.00%
4.00%
6" AGGREGATE SHOULDER (TYP)
4" TYPE 1 BASE
12" TOTAL THICKNESS BITUMINOUS PAVEMENT
4:1
.2
DEPTH OF CUT
HEIGHT OF FILL
3:1
GROUND LINE
50
MO
5
JOB NO.
CONTRACT ID.
PROJECT NO.
COUNTY
DATE

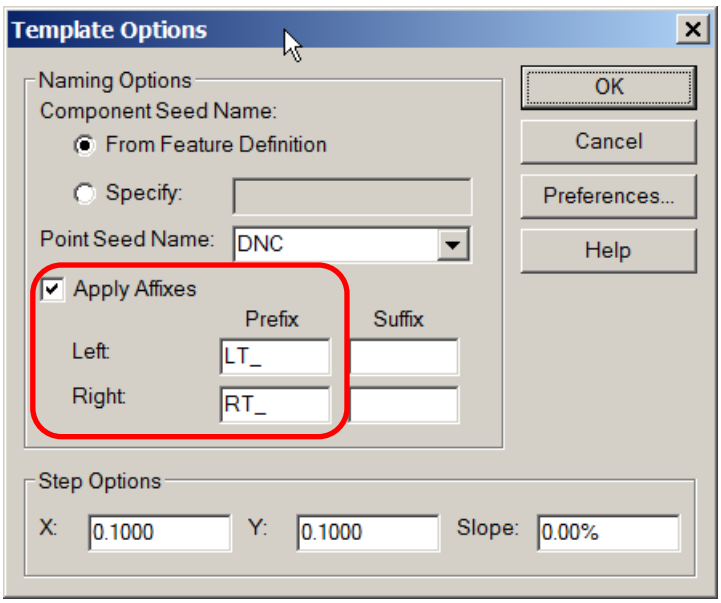
4. Within the **Road1** folder, create a new template called **Road1 Two Lane Rural** by right clicking on the **Road1** folder and selecting **New** > **Template**.




5. Set the following *Dynamic Settings*:

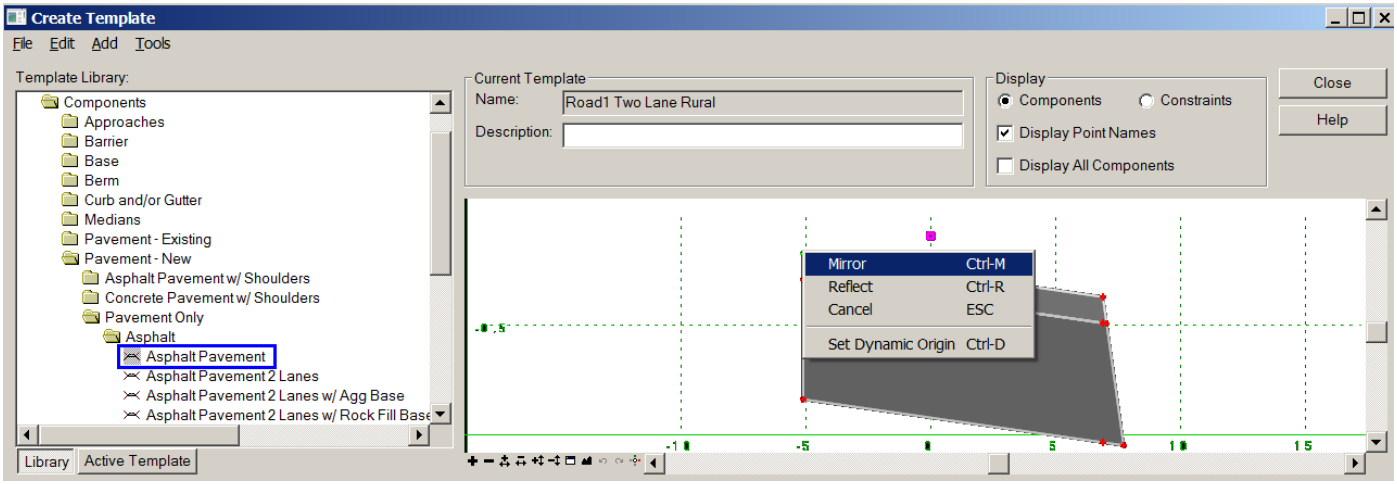


6. In *Create Template* go to **Tools** > **Options** and confirm the following Affixes are set:



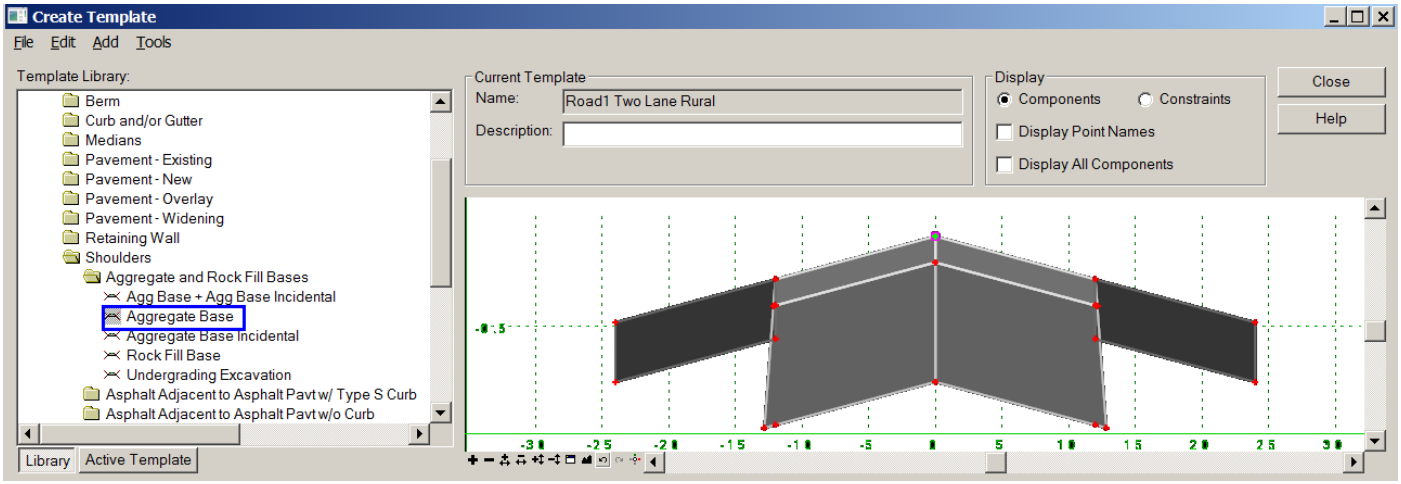

7. In *Create Template* select the **Components** > **Pavement - New** > **Pavement Only** > **Asphalt** > **Asphalt Pavement** component.

   When placing the component, right click and select **Mirror** then place the component at the **0,0** coordinate.

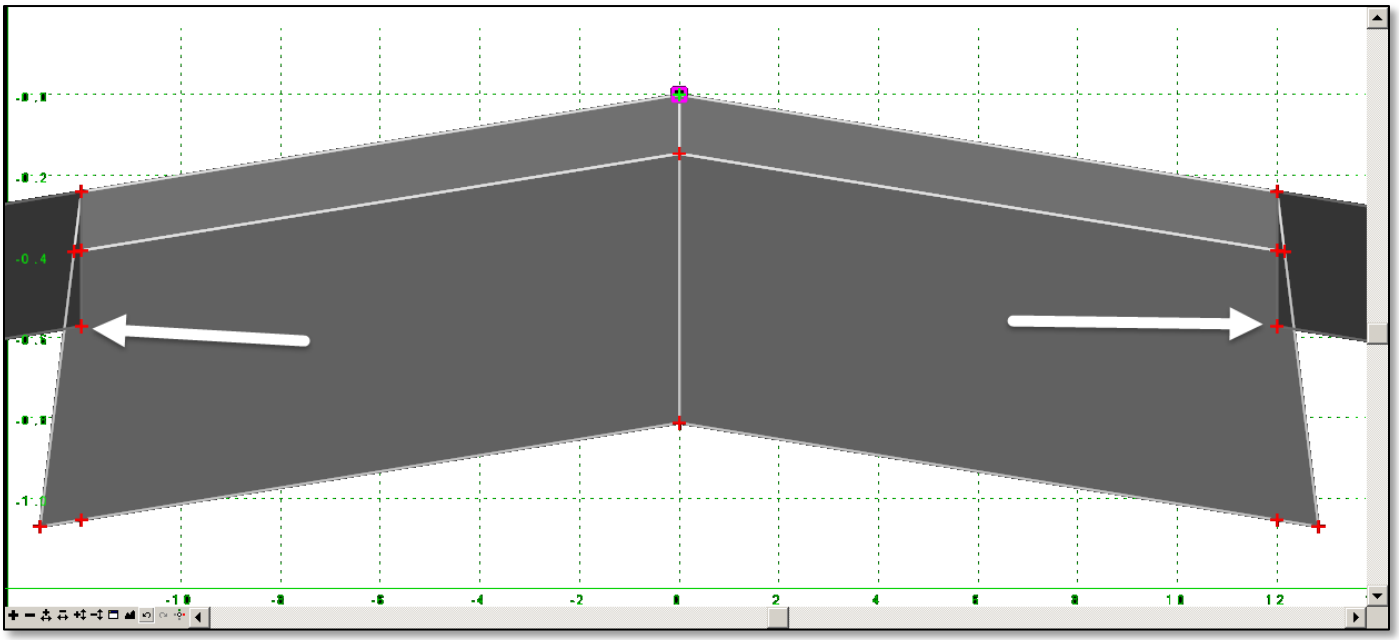



8. Select the **Components** > **Shoulders** > **Aggregate and Rock Fill Bases** > **Aggregate Base** component.

9. Place the shoulder component at the **RT_AsphSurf_T_EOP** location.

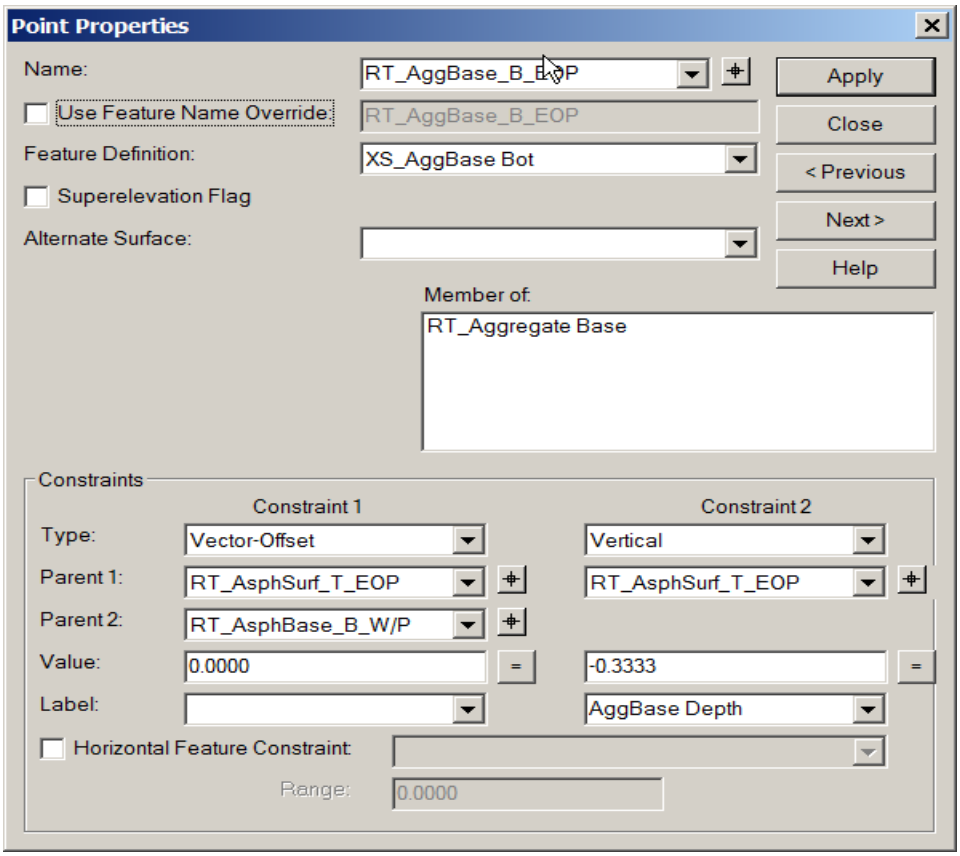


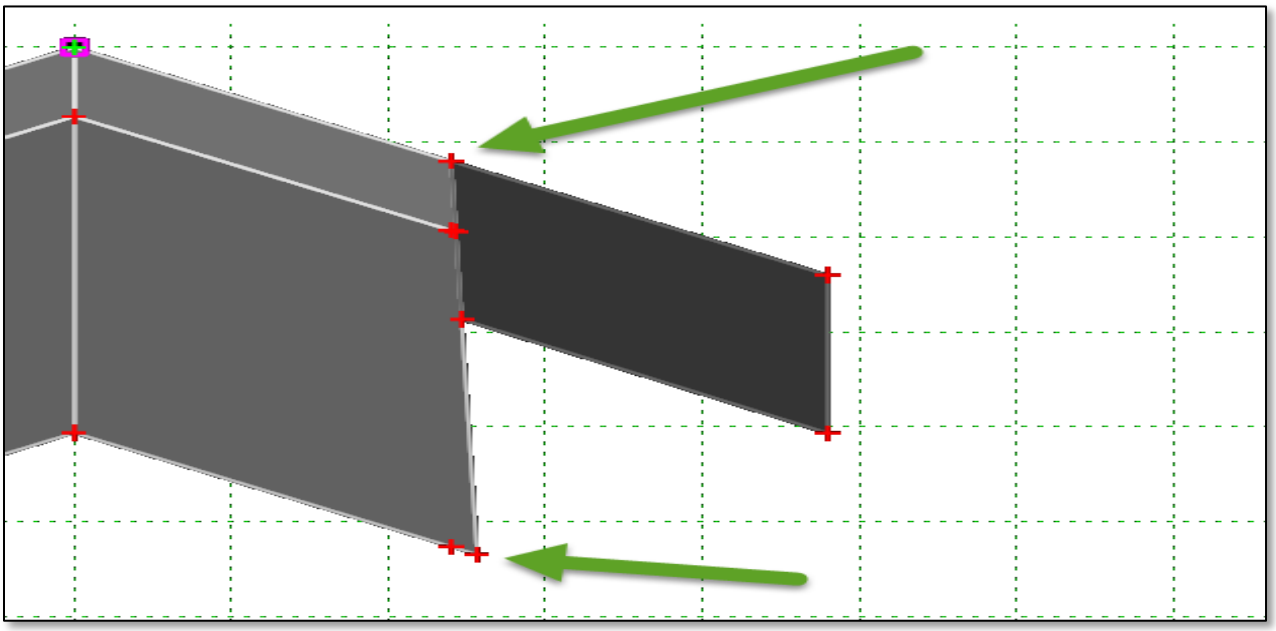

10. Modify the two lower inner shoulder point constraints to follow the pavement wedge slope.



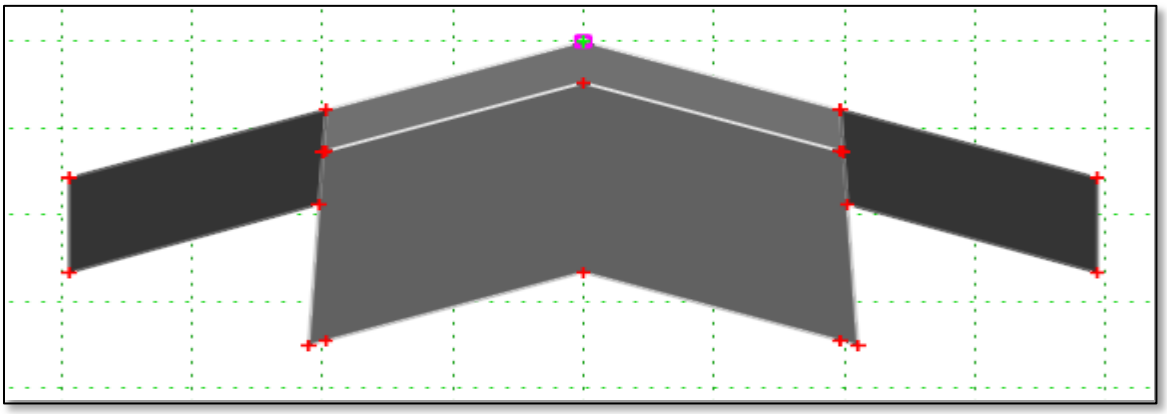
11. Double click on the point **RT_AggBase_B_EOP**. This will bring up the *Points Properties* dialog where you can edit the detail of the point.

12. In the *Point Properties* dialog, adjust the constraint that controls the **Horizontal Control** to a **Vector-Offset**. Set the *Parent* points to be the top and bottom pavement points (See below), also set vector offset *Value:* to **0.0**. Modify both shoulder points.

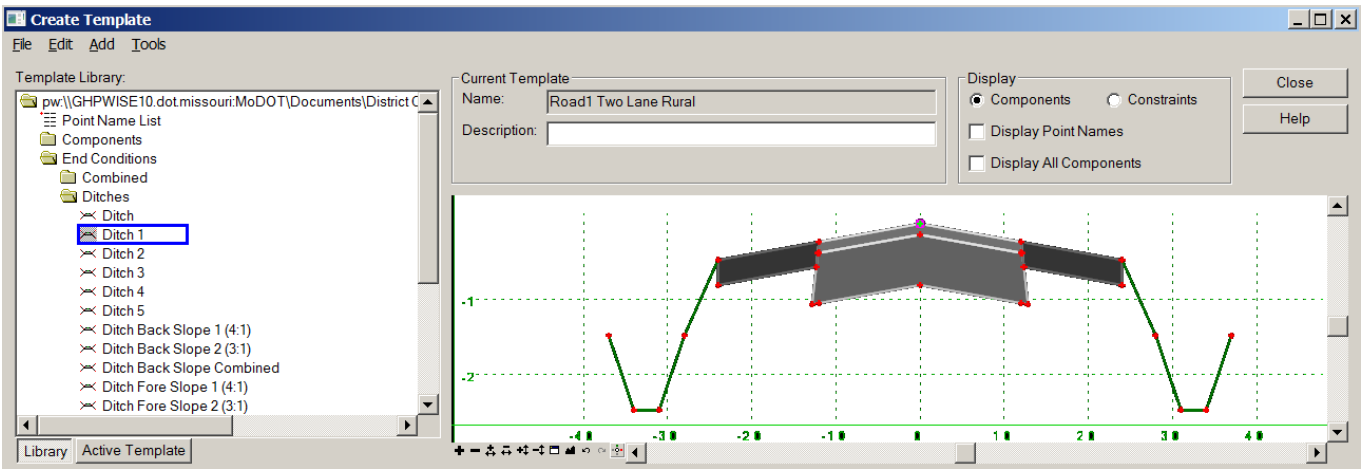


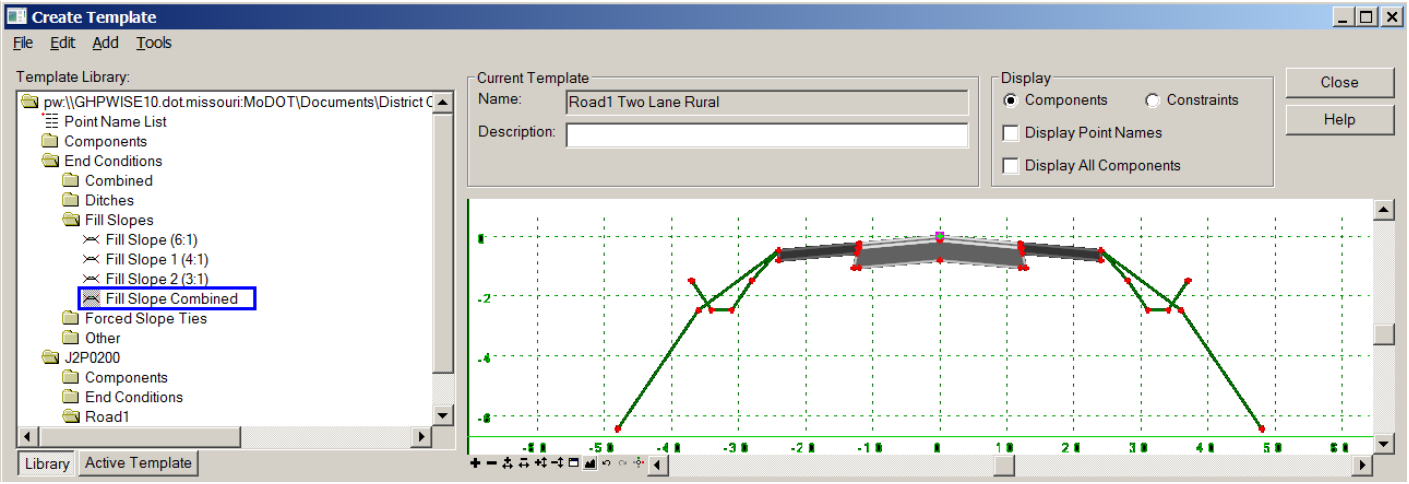
13. Merge Pavement Components.



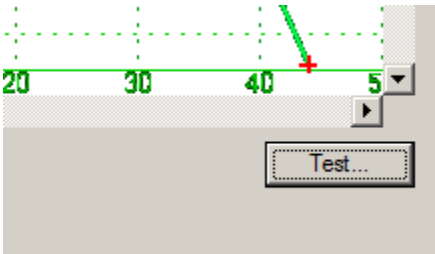
14. In the ***Create Template*** dialog, select the **End Conditions** > **Ditches** > **Ditch 1** end condition, and then place the ditch component at the **RT_AggBase_T_EOS** location.




15. Next, select the **End Conditions** > **Fill Slopes** > **Fill Slope Combined** component then place this fill component at the **RT_AggBase_T_EOS** location.



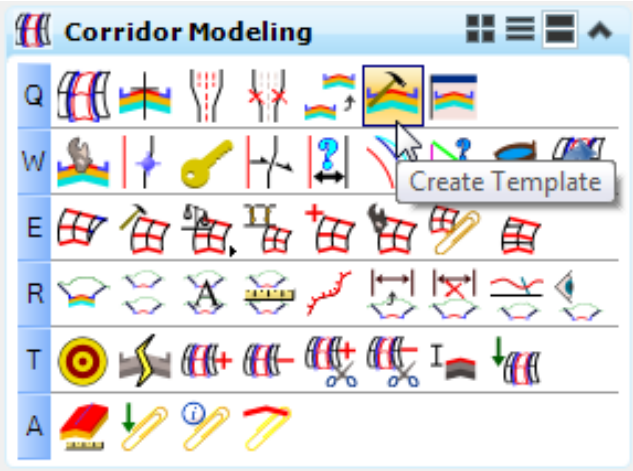
a. In **Create Template** select the **Test** button to view the End Condition Priorities.



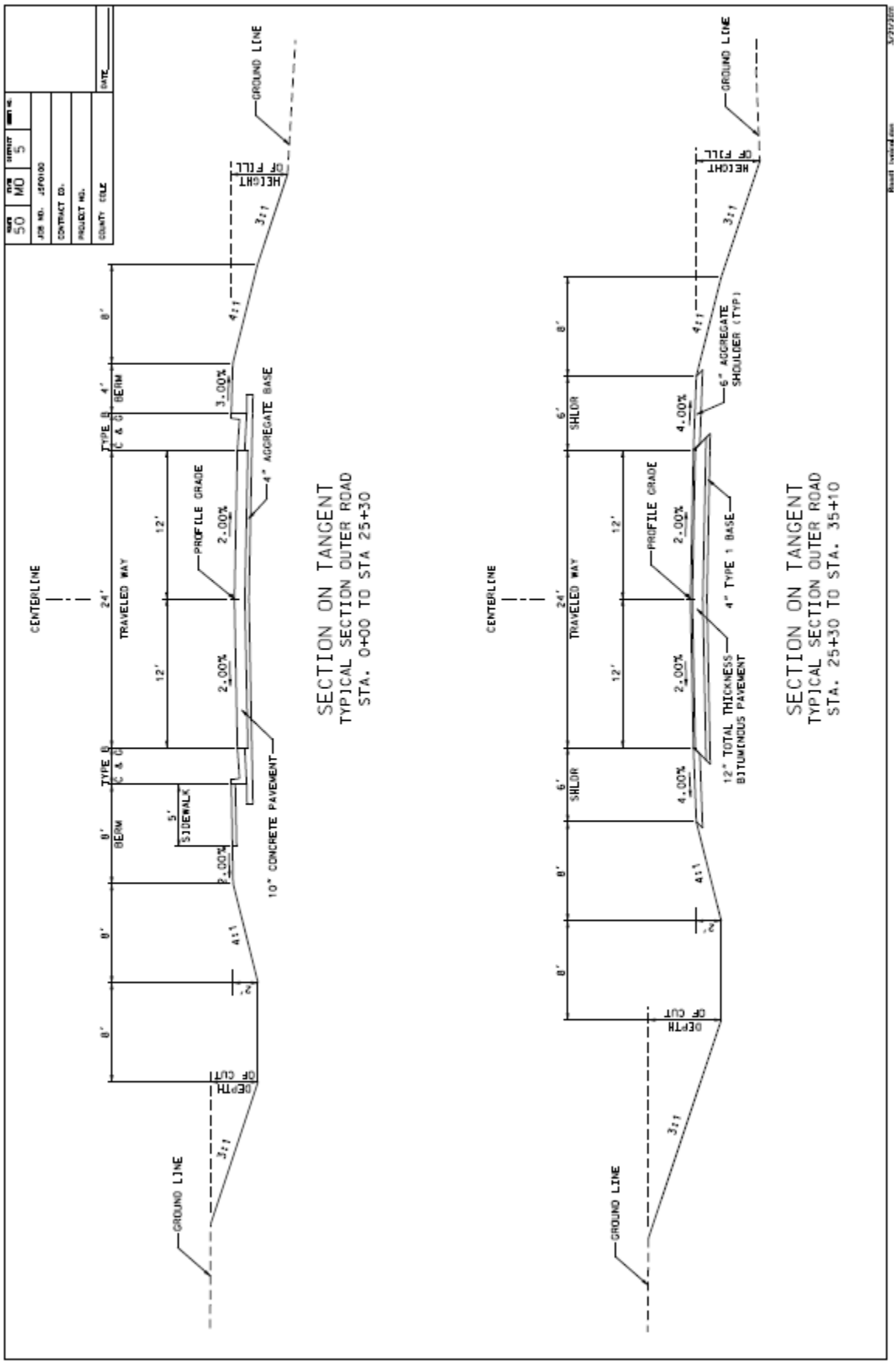

b. **Save** *Template Library*.

## 5.13 Individual Exercise 3-5: Creating a Template

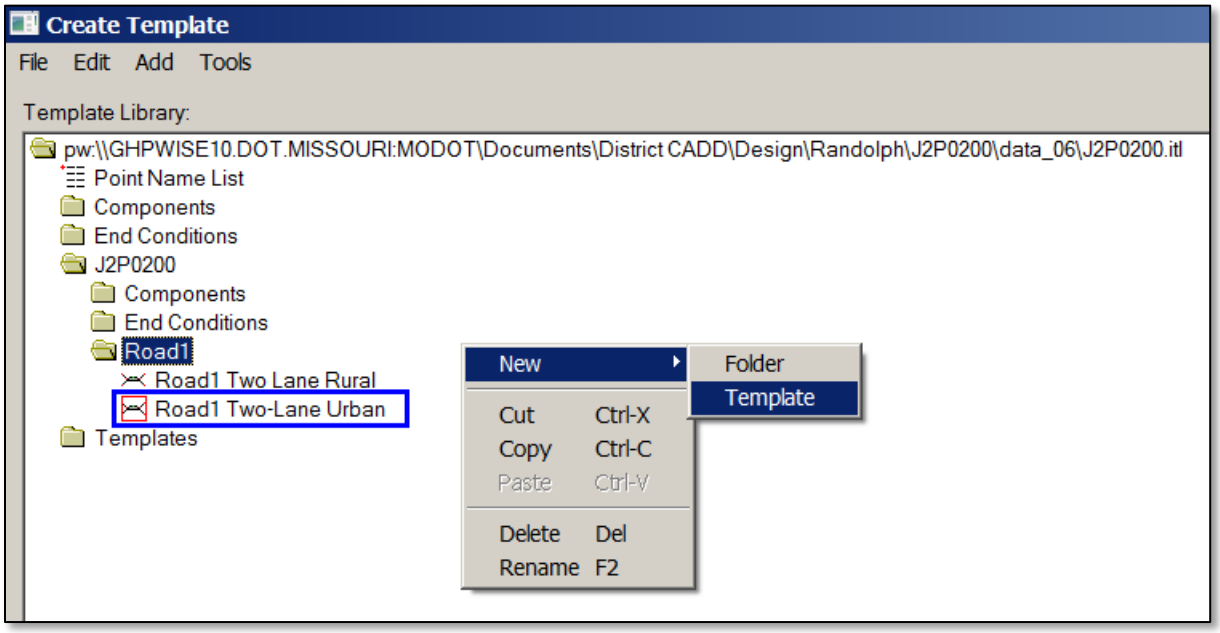
1. From the *Corridor Modeling* task group, select the **Create Template** icon:



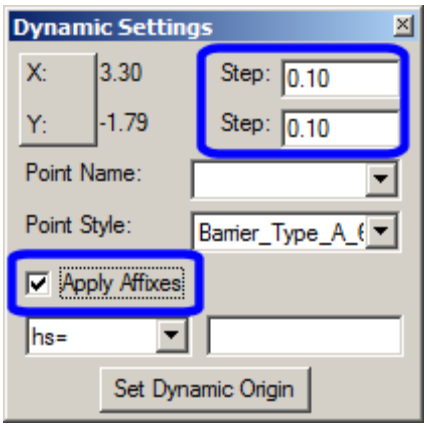

2. Select **File > Open** from the *Create Template* dialog menus. Open the template library named **J2P0200.itl** from the **J2P0200/Data_05** folder.


SECTION ON TANGENT
TYPICAL SECTION OUTER ROAD
STA. 0+00 TO STA 25+30
CENTERLINE
TRAVELED WAY
24'
12'
12'
PROFILE GRADE
2.00%
2.00%
TYPE B
C & G
BERM
4'
8'
5'
SIDEWALK
2.00%
3.00%
4" AGGREGATE BASE
10" CONCRETE PAVEMENT
4:1
3:1
HEIGHT OF FILL
DEPTH OF CUT
GROUND LINE
SECTION ON TANGENT
TYPICAL SECTION OUTER ROAD
STA. 25+30 TO STA. 35+10
CENTERLINE
TRAVELED WAY
24'
12'
12'
PROFILE GRADE
2.00%
2.00%
SHLDR
6'
4.00%
4.00%
6" AGGREGATE SHOULDER (TYP)
4" TYPE 1 BASE
12" TOTAL THICKNESS BITUMENOUS PAVEMENT
4:1
3:1
HEIGHT OF FILL
DEPTH OF CUT
GROUND LINE

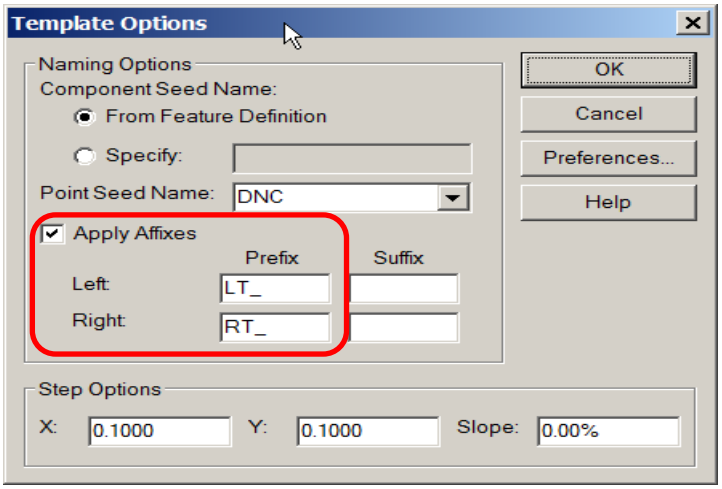
3. Navigate to the **J2P0200** > **Road1** folder and create a new template called **Road1 Two-Lane Urban** by right-clicking on the **Road1** folder.




4. Set the following *Dynamic Settings*:




5. In *Create Template* go to **Tools** > **Options** and confirm the following *Affixes* are set:



6. In **Create Template** use the following components to create the **Road1 Two-Lane Urban** template:

**Components:**

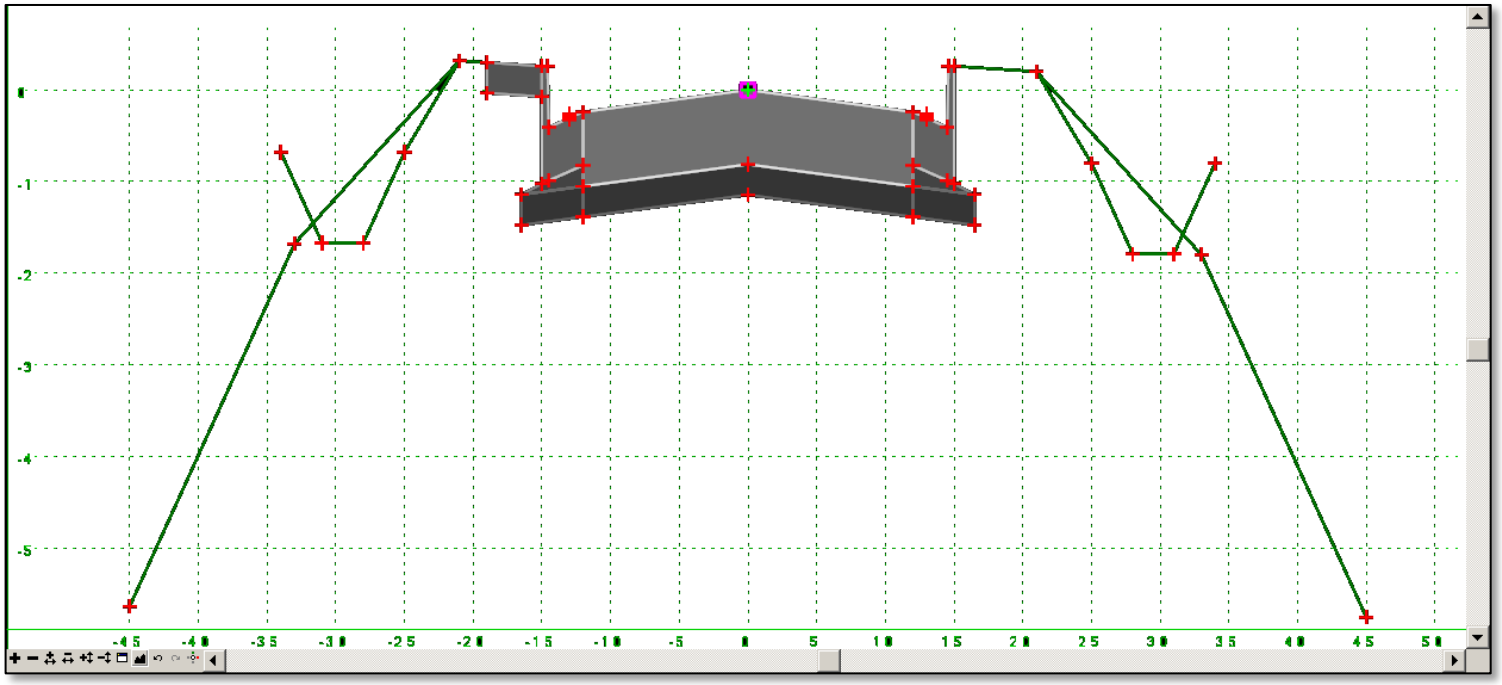
| **Left Side** | **Right Side** |
|---|---|
| Concrete Pavement w/ Agg Base | Concrete Pavement w/ Agg Base |
| Curb and Gutter Type B w/ Agg Base | Curb and Gutter Type B w/ Agg Base |
| Sidewalk w/ Outer Buffer | Berm (1%) (Sloping down away from gutter) |

**End Conditions:**

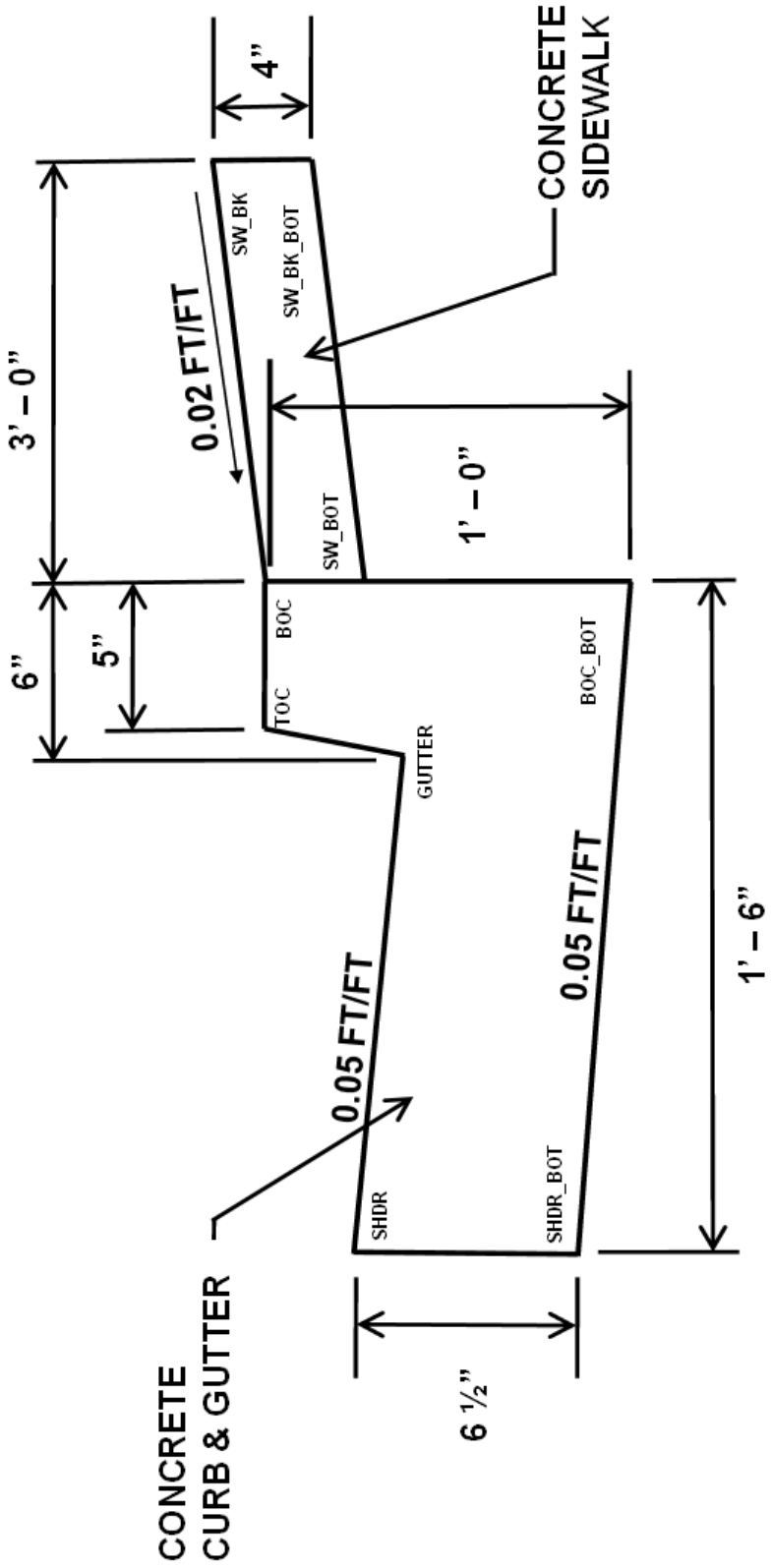
| **Left Side** | **Right Side** |
|---|---|
| Fill Slope Combined | Fill Slope Combined |
| Ditch 1 | Ditch 1 |

*Notes

a) Concrete Pavement w/ Agg Base is located in the following location:
**Components > Pavement New > Pavement Only > Concrete**
b) Merge the vertical line between common components.
c) Make the concrete thickness **9-3/4" (-0.8125')** before adding **Curb and Gutter Type B w/ Agg Base**. If you already place the Curb and Gutter select "Undo".
d) Check Priorities on End Conditions
e) Save Template Library



# Practice #2 - Adding a Constrained Component Curb & Gutter Detail



# Chapter 6

# Corridor Modeling Overview

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## 6.1 Objectives

- Create Corridor
- Assign Multiple templates to one corridor
- Create new templates from existing templates

## 6.2 Corridor Modeling Overview

The Corridor Modeling toolset is a group of highly interactive commands to create new design surfaces that represent a new roadway or other type of surface. Tools for creation, modification, management, and report functions are supported.

Corridor Modeling tools aggregate a variety of civil data. The geometry is created with the Horizontal and Vertical Geometry tools, while the existing ground is defined by a MicroStation mesh or Civil Terrain Model. Plan view elements, such as edges of pavement, shoulders, curbs, etc. can be 2D or 3D. Superelevation information is defined within a design file using standards or imported data. Templates are utilized from one or more template libraries.

Reference files can be used extensively with Corridor Modeling. On a simple project, the data may be all in one file; larger projects may have geometry in one file, plan view graphics in a second, terrain in another, superelevation in a fourth and the actual model in a fifth. All files can reference the others, to present a complete picture of the project.

When working with Corridor Modeling, you can draw in 2D or 3D. When using 2D (such as for plan-view graphics), a 3D view is automatically created and maintained. For example, when a vertical geometry element is initially defined for a horizontal geometry element, the Default-3D model is created, if there isn't one already. The 3D baseline (combination of horizontal and vertical element) is drawn into the 3D model. As template drops are added, and progressed, they are added to the 3D model automatically.

When starting to create a corridor, basic information can be used. A single template can be used, along with preliminary geometry and a high level terrain model. As the design progresses, more detail can be added. Instead of a single template drop, perhaps more templates better define the roadway. Transitions can be added to smoothly move from one template to another. There may be multiple roadways all interconnected using the target aliasing tools. All the while, as changes are made, the corridor model is updating, so you see up-to-the minute results. Simple projects may not require all the tools, and a basic corridor model may be sufficient. But all the tools are available to handle basic to complex, small-scale to large-scale projects.

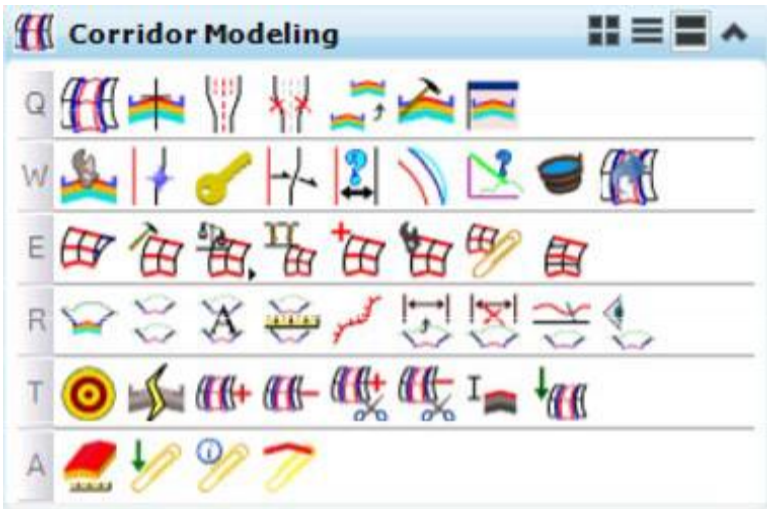
## 6.3 Prerequisites

The following are minimum requirements to use Corridor Modeling.

- One Civil horizontal element and one Civil vertical element, generally the centerline and profile of the design roadway
- One template stored in a template library

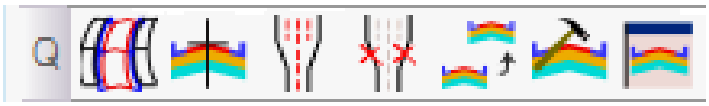
A terrain model is not required for corridor modeling. If the template includes end conditions and no terrain model is defined, the software generates as much of the model as possible, but will not complete the end condition that ties to ground and no error message is given.

## 6.4 Corridor Modeling Tools



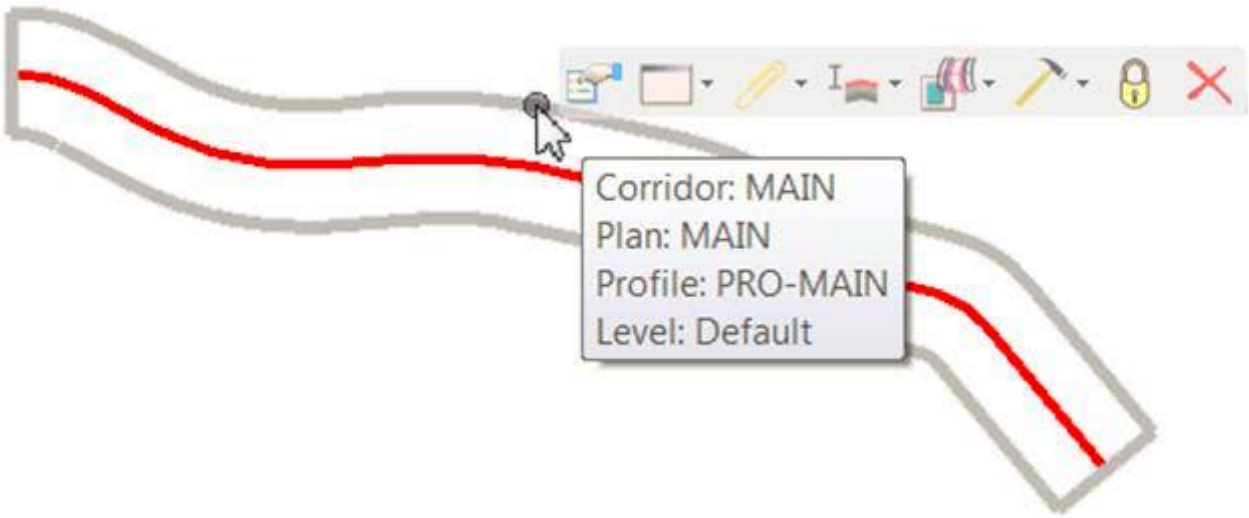

### 6.4.1 Corridor Creation Tasks

The first toolbox is used when beginning design on a corridor and includes tools for creating corridors, template drops, and transitions; along with various tools for working with the template library.




**Create Corridor** - The Create Corridor tool is the initial step in corridor design; names the corridor and identifies the geometry. No processing of templates is done within this tool; rather it's a set-up step prior to template work.

A closed shape is drawn to represent the corridor (using the full length of the civil geometry element). Station ranges to better define the corridor are utilized in the next step, template drops. When hovering over a corridor, two pop-up displays are visible:




- *Quick Properties* - displays the corridor name, horizontal geometry element (Plan), vertical geometry element (Profile), and Level of the corridor
- *Context sensitive menu* with tools applicable to corridors

After the corridor is created/drawn, the software automatically advances to the *Create Template Drop* tool.

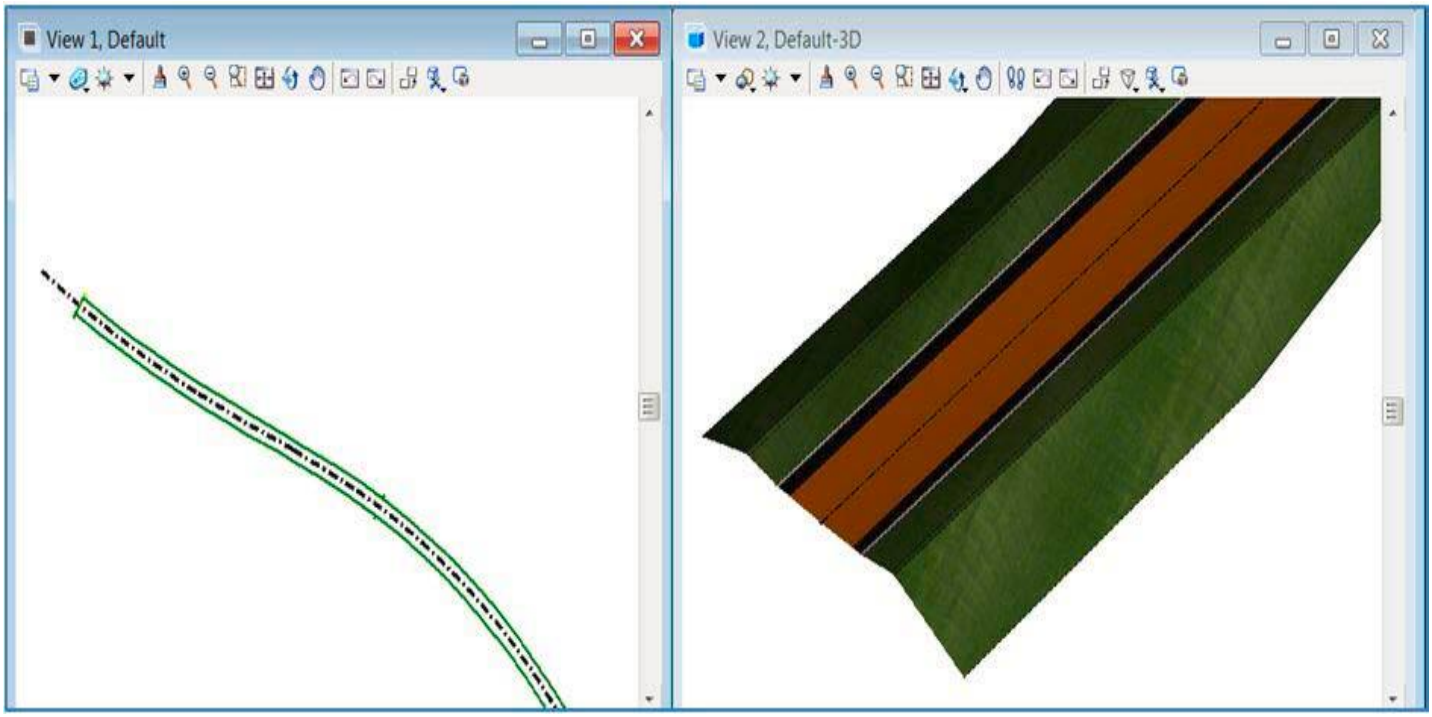
**Create Template Drop** - defines what the cross sections of the roadway look like for that portion of the road based on user-defined station range. A project may comprise of a single template drop or multiple template drops. Often, transitions are used between two template drops, rather than an abrupt change from one template to another.

Careful consideration should be given for the *Drop Interval* used for a corridor, although it can be changed at any time. It specifies the distance between each processing of the template (in master units). Generally, this value is equal to or less than (but still a multiple) of the desired interval for the final cross sections, since cross section stations should be coincident with processing stations. It is not necessary to set the interval so small that it encompasses all desired cross section stations, as stations with particular project interest can be added to the model with the use of the Key Station tool. If the model is to be used in construction, the smaller the interval, the more detailed the model, but will require more processing time.

**Note** Drop Intervals are impacted by the *Design Stages*.

- *Minimum Transition Before Drop* and *Minimum Transition After Drop* are inputs in the Create Template Drop tool. If they are non-zero, then a transition drop is created at the beginning/end of the template drop with a length greater than or equal to the value entered. The actual length is determined by how far it is between the new drop and the drop before/after the new drop. If there isn't enough space to meet the minimum, then the previous/next drop is shortened to accommodate the transition. If there is no previous/next drop, then no transition drop is created.

After completing the prompts, the corridor is automatically processed and can be viewed in both 2D and 3D views. The corridor can be rendered, if desired.




The symbology is based on the feature definitions within the template. The *Project Explorer* is also updated with the corridor information, including template drops, components and features.

## Create Template Drop Workflow

Select the **Create Template Drop** tool. This tool is automatically invoked at the end of the Create Corridor tool, but you can use it independently of the Create Corridor tool.

Select the Corridor wherein the template drop will be added.

1. **Select Template -** Select the template from the pull-down list of recently used templates, or select **<Alt> <Down>** on the keyboard to open the active template library and select the template. Data point to accept the template and move to the next prompt.
2. **Start Station -** Graphically define the start station or enter the value in the edit field. Data point to accept and move to the next prompt. The Start station can be locked by **<Enter>** after keying in the station or selecting **<Alt>**. Selecting **<Alt>** again unlocks the field.
3. **End Station -** Graphically define the end station or enter the value in the edit field. Data point to accept and move to the next prompt. The End station can be locked by **<Enter>** after keying in the station or selecting **<Alt>**. The template is copied to the new station range. Selecting **<Alt>** again unlocks the field.
4. **Drop Interval -** specifies the distance between each processing of the template (in master units). Generally, this value is equal to or less than (but still a multiple) of the desired

interval for the final cross sections, since cross section stations should be coincident with processing stations. Note that this is impacted by the *Design Stages*.

**Create Transition -** A transition is created between templates of different names, as templates generally don't instantaneously change from one template to another. This tool creates the transition by selecting the two templates drops which are adjacent to it. It does not define how to transition between the template drops, which is done in the Edit Transition tool.

If the drop interval is not the same in the two template drops, the drop interval of the lower stationed template drop is utilized. However, this can be changed in the Transition Properties.

## Create Transition Workflow

1. Select the Create Transition tool.
2. Select the first template drop adjacent to the transition. It does not matter the order in which the two template drops are selected.
3. Select the second template drop adjacent to the transition. The transition is created (and the corridor has automatically processed).

**Edit Transition -** Modifies the previously created transition between two template drops.

## Edit Transition Workflow

Editing a transition is a two-step process.

1. Connect the backbone points of the first template to the backbone points of the second template, as desired. Unconnected points are shown as thick (+) symbols; connected points are thin (+) symbols. End conditions are not shown. End condition transitions are handled through end condition exceptions.
2. Edit the transition components.

The color of the transition indicates the state of the transition.

- **Red** - indicates that none of the backbone points of the first template connect to the backbone points of the second template.
- **Yellow** - indicates that some of the backbone points are connected (initially this is done attaching points that have the same name.
- **Light Blue** - indicates that not all of the points are connected, but you have reviewed and/or edited the transition at least once.

- **Dark Blue** - indicates that all of the points on both templates are connected.

**Copy Template Drop** - As an alternate to creating and modifying a template drop, this tool copies an existing template drop to a newly defined station range along the same baseline reference.

The Copy Template Drop tool can be used as an alternate to creating and modifying a template drop, as the tool copies an existing template drop to a newly defined station range along the same baseline reference within the same corridor.

### Copy Template Workflow

1. Select the **Copy Template Drop** tool.
2. **Locate Template Drop** - Select the previously created template that you want to copy to a different location.
3. **Start Station** - Graphically define the start station or enter the value in the edit field. Data point to accept and move to the next prompt. The Start station can be locked by **<Enter>** after keying in the station or selecting **<Alt>**. Selecting **<Alt>** again unlocks the field.
4. End Station - Graphically define the end station or enter the value in the edit field. Data point to accept and move to the next prompt. The End station can be locked by **<Enter>** after keying in the station or selecting **<Alt>**. The template is copied to the new station range. Selecting **<Alt>** again unlocks the field.

**Create Template** - Opens the current template library to add a new template, delete or modify an existing template.

**Display Template -** Draws the selected template from the current template library at the user-defined data point in the drawing file using the active MicroStation symbology. All end conditions are drawn and there is no annotation. The drawing is useful as a starting point for documentation of the template library.

## 6.4.2 Corridor Modification Tasks

This toolbox contains tools for manipulation of a previously created corridor and associated template drops. These tools enable you to refine the model by adding more detailed information to respond to project-specific requirements and constraints.

**Edit Template Drop** - Opens the current template library and displays the template with the selected template drop. While the dialog is the template library interface, keep in mind that the editing is only being done to the template within the template drop, not the actual template library. Therefore, if any changes are made, the template associated with the template drop is no longer in

sync with the template library. For project specific circumstances, this may be required. The tools and options within the edit template drop function identically to those in the template library, except the File tools are not available.

If the changes are needed in the template library, use the Create Template tool.

To update the template associated with the template drop to match the template in the template library, use the Synchronize with Library tool. When this tool is used, the template from the template library overwrites the template associated with the template drop, so all changes are lost with no warning given.

## Edit Template Drop Workflow

1. Select the **Edit Template Drop** tool.
2. **Locate the Template Drop**. Select the template drop whose template needs editing. The *Editing Roadway Design Template Drop* dialog (whose interface is identical to the Template Library dialog) opens with the current template.
3. Edit as needed. Click **OK** to close the dialog. You do not have to File > Save to save your edits (most File functions are ghosted out).

**Create Point Control** These are used to override the normal locations of one or more points and or components in a cross section. Examples of this include lane widening, staying within the right-of-way, maintaining a particular slope for a ditch, and superelevation.

An example would be a ramp is merging into the main road. The ramps left edge is vertically controlled by the main road right edge of pavement. The ramps left edge is horizontally controlled by the main road right edge from 0+00 to 1+00, and then it is controlled by a horizontal alignment named rampLeft.

**Station Limits (Start/Stop) -** specifies the start and stop stations for the control.

**Control Description -** allows you to enter a description of the control.

**Point -** allows you to select the point to be controlled. Select from the list or identify the point in the cross-section using the locate button. The selected point is highlighted in plan/cross section and profile or superelevation views as applicable.

**Mode -** allows you to select the control mode: Horizontal, Vertical, or Both.

**Control Type -** specifies the type of control.

If the *Mode* is **Horizontal** or **Both**, valid control types are *Linear Geometry*, *Feature Definition*, or *Corridor Feature*.

If the *Mode* is **Vertical**, valid control types are *Linear Geometry*, *Feature Definition*, *Corridor Feature*, *Superelevation*, *Elevation Difference*, *Elevation and Grade*.

The selection combo boxes and/or field displayed depends on the selected Mode and Control Type.

**Type - Linear Geometry** If the type is Linear Geometry, a Horizontal Offsets combo box is displayed. If the mode is Both, a Vertical Offsets combo box is also displayed.

**Type - Feature Definition** If the type is Feature Definition, a Feature Definition and Range text field is displayed.

**Type - Corridor Point** For all modes, Corridor and Reference Feature combo boxes are displayed. These options allow you to set up the control of one corridor's points(s) from another corridor's point(s).

Targeting another corridor's point cannot be done simultaneously with Target Aliasing of that same corridor. If Target Aliasing has been defined, the Corridor Point is not available for selection within the Point Control dialog. This produces a recursive situation, making the corridor point control unavailable for selection until that Target Aliasing is removed.

**Type – Superelevation** This option displays a Superelevation control line combo box, and a Reference Point combo box. Superelevation control lines are stored in the roadway design, not on the alignment. The reference point is the pivot point (feature) about which the point will rotate.

**Type - Elevation Difference** This option displays Horizontal and Vertical alignment combo boxes. The vertical alignment represents a vertical difference value to be applied to the points' current elevation.

**Type - Elevation and Grade** This option displays an Elevation field, and a Grade field. The control sets elevation of the point at the start station to the elevation specified. The slope of the point's line is then at the grade specified until the end station is reached.

**Priority** - determines the order of controls on a point. This value applies only when there are conflicting controls on a point. Where there is a conflict, the control with the lower priority is applied (that is, lower numbers are applied first).

**Use as Secondary Alignment** - specifies that horizontal point controls are also used as secondary alignments. This option is available only when working with a 2D entity. If you are using a 3D object, the software skips the secondary alignment option.

**Horizontal Offsets (Start/Stop)** - specifies the start and stop horizontal offset controls for the corridor. If the values are different, then the value applied at a given station is calculated using a linear algorithm.

**Vertical Offsets (Start/Stop)** - specifies the start and stop vertical offset controls for the corridor.

**Create Key Station** - The Create Key Station tool is useful to add stations that are not coincident with the template interval, when a special circumstance of the project occurs and it's desirable to include the station in processing.

## Create Key Station Workflow

1. Select the **Create Key Station** tool.

2. **Locate Corridor** - Select the corridor for station addition. A display line dynamically running perpendicular to the baseline reference is visible.
3. **Station** - Define the key station by dynamically moving the display to the desired location (and data point) or by keying in the station, **<Enter>** and **data point** to accept. The key station is added to the *Key Station* list, and the corridor is automatically reprocessed to include the new station.

**Create Secondary Alignment** - Sets parameters for secondary alignments, which are used to modify the direction of cross section processing. Requirements include corridor selection, secondary alignment definition, beginning and ending station (in cases where only part of the alignment element is to be used) and beginning and ending offsets.

**Create Parametric Constraints** - Sets up constraint value overrides for specified station ranges.

**Create Curve Widening** - Applies horizontal controls to points to move them farther from the centerline at each curve of the controlling alignment.

**Create End Condition Exception** - Defines end condition exceptions, which are used to modify the behavior of an end condition solution without requiring the use of additional template drops.

**Corridor Objects** - One-stop viewing of data relating to corridor objects. Excellent for managing your corridor data, as it encompasses template drops, key stations, parametric constraints, point controls, various references and end condition exceptions all within one dialog.

**Process Corridor** - Processes the corridor to ensure that it is up to date.

### 6.4.3 Superelevation Tasks

This toolbox contains tools for creating, calculating, and editing superelevation lanes. Tools are also supported for importing excel (CSV) data and reporting.

**Create Superelevation Sections** - Adds a superelevation sections (generally one per curve set) for the specified station range on the baseline reference.

**Create Superelevation Lanes** - Creates color-filled lanes based on width and offsets from the baseline reference, as a precursor to superelevation calculations.

**Calculate Superelevation** - Calculates station and superelevation transitions rates based on a preferences or rules file (*.sep,*.srl). The values are augmented to the superelevation lanes, edit manipulators are created, and the color fill is recolored based on the cross slopes.

**Import Superelevation** - Optionally, imports data from a CSV file.

**Assign Superelevation to Corridor** - Associates superelevation with a corridor, so the pavement reflects the superelevation stations / cross slopes, rather than the pavement cross slope defaults in the template.

**Insert Superelevation Station/Cross slope** - Insert an individual station / superelevation transition (cross-slope) into a previously created and calculated superelevation lane.

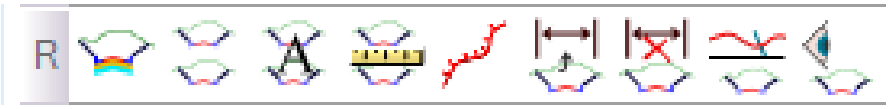
**Superelevation Editor** - Opens the superelevation editor allowing the user to edit the calculated superelevation in a tabular format.

**Superelevation Report** - Creates a superelevation XML report and opens the Bentley Civil Report Browser.

**Superelevation in Plan** - Automatically generates annotation for superelevation station information in plan view.

### 6.4.4 Corridor Cross-Sections Tasks

This toolbox contains tools to display, draw, and annotate cross sections.




**Open CrossSection View** - Using the specified baseline reference to a corridor, or any Civil horizontal geometry, creates a dynamic cross section view in the user-selected MicroStation view. The corridor interval is used for the cross section interval. The specialized view has exaggeration feature, cross section scrolling, and ability to place temporary dimension lines. These sections are not used as a basis for drawn cross sections or sheets.

**Create Cross Sections** - Extracts multiple cross sections and draws them in a matrix pattern. These sections are subsequently used for cross section sheets and earthwork calculations. The display configuration and layout is controlled by an .xin file. This is covered in detail in *Chapter_09 Cross Sections and Labeling*.

**Annotate Cross Sections** - Placed with the Create Cross Sections tool.

**End Area Volume** - Calculates the end-area volumes to compute cut, fill, and net volumes using a series of cross sections extracted along a previously defined alignment.

**Edit Station** - Allows the user to edit the cross section instance at a station.

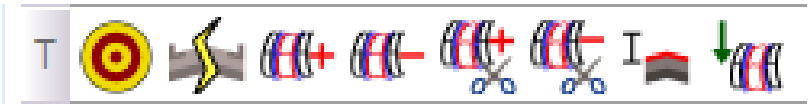
**Show Place Dimension** - Places display text (width, slope) into the dynamic cross section view, based on two data points. Multiple show place dimension elements can be placed in a single cross section view.

**Remove Temporary Dimension** - Removes dimensions in the dynamic cross section view that were placed with the Show Place Dimension tool.

**Locate Station Via Datapoint** - Places a data point (in plan view) with this tool to view a dynamic cross section at a station not included on the list.

**Cross Section Viewer** - Windows in on specified cross sections in a model. Using Cross Section Viewer, you can view a single cross section, or you can view in succession each cross section in a model.

### 6.4.5 Corridor Miscellaneous Tasks



**Define Target Aliasing** - Aliasing allows you to target other corridor surfaces or features or to set up a prioritized target list for end condition solutions on surfaces, features and alignments. This means that on a large job where the existing surface may have been broken up into more than one surface, you don't need to be concerned about where those breaks occur, and you don't need to create a different template for each existing surface. Use target aliasing to find the proper solution.

In any situation where the active surface is the target, the software looks for the mainline corridor surface and uses whichever is closer because you have turned on that option. If the **Use Closest** option is not set, then it would search for the surfaces in the order they are displayed, and it would stop as soon as a solution was found.

Target Aliasing cannot be defined with a corridor that targets that particular corridor with a Corridor Point Control. This produces a recursive situation, making the corridor unavailable for Target Aliasing until that corridor point control is removed.

| | |
|---|---|
| **Target** | lists end-condition targets for the current corridor. |
| | does not list feature definition targets. |

| | |
|---|---|
| **Surface or Corridor** | lists all the available aliases for the current target. If the target is a surface, it displays a list of alternate surfaces and corridors. If the target is a feature, then the list displays available surface features and corridor points. If the target is an alignment, it displays a list of available alignments. |
| **Aliases** | lists the aliases for the current target. The order of the list indicates the priority of the target aliases. |
| **Add, Remove, Move Up, Move Down** | activates as items are selected. The left and right buttons allow you to move items between lists. More than one item can be selected and moved. The up and down buttons allow you to change the priority of a single item in the alias list by moving up or down in the list. |
| **Use Closest** | Ignores the order of the aliases, when checked on. The solution seeks the closest alias that satisfies the solution (end condition). |

## Define Target Aliasing Target Workflow

1. Select the **Define Target Aliasing** tool.
2. Select the corridor. This opens the Target Aliasing dialog.
3. Use the *Add*, *Remove*, *Move Up*, *Move Down*, and *Use Closest* to set the Target Aliasing.

**Synchronize Template** - Updates a template within a template drop with the template of the same name from the current template library. Any changes previously made to the template in the template drop are overwritten with no warning.

**Add Corridor Reference** - The *Add Corridor Reference* tool adds graphical elements to the corridor processing. This must be done even if the feature is targeted in the template, otherwise the elements will not process. It enables only those elements associated with a particular corridor to be processed, rather than all elements of a particular feature definition. This speeds up processing, and eliminates processing of unwanted elements of the same feature definition. The elements can be selected within the tool, or a selection set can be created prior to commencing the tool.

## Add Corridor Reference Workflow

1. Select the **Add Corridor Reference** tool.
2. Select the Corridor.
3. Select the **First Reference Element** - select the graphical element to be added as a reference. Continue selecting until all elements are referenced, then reset to exit tool.

**Remove Corridor Reference** - The *Remove Corridor Reference* tool removes graphical elements from the corridor processing, but does not delete the element. The elements can be selected within the tool, or a selection set can be created prior to commencing the tool.

## Remove Corridor Reference Workflow

1. Select the **Remove Corridor Reference** tool.
2. Select the Corridor.
3. Select the **First Reference Element** - select the graphical element to be removed as a reference. Continue selecting until all elements are referenced, then reset to exit tool.

**Add Clipping Reference** - allows you to remove areas of overlap when working with multiple corridors in a single surface. For example, in a corridor intersected by a crossing roadway, clipping would be used to remove all overlapped features within the intersection.

## Add Clipping Reference Workflow

1. Select the **Add Clipping Reference** tool.
2. Select the corridor to be clipped.
3. *Locate Clipping Reference* - select elements until all are defined, then reset to complete. The corridor is processed and the clipping reference is added.

**Remove Clipping Reference** - Removes the clipping reference, reprocesses the corridor, restoring the clipping area to its previous state prior to clipping.

## Remove Clipping Reference Workflow

1. Select the **Add Clipping Reference** tool.
2. Select the Corridor where the clipping is to be removed.
3. *Locate Clipping Reference* - select elements until all are defined, then reset to complete. The corridor is processed and the clipping reference is removed.

**Overlay Vertical Adjustment** - At each processed station, this command determines the ideal PGL point based on the input criteria and the distance from the top of the template to the existing ground. Each existing ground vertex in the cross section will be tested by measuring the vertical distance between that ground point and the top of the template.

***Geometry and corridor must be in the same DGN file for this command to operate.***

This command is not available when the geometry is in a reference file because the command creates a vertical alignment and the corridor must reprocess to determine criteria for the vertical alignment.

**Import IRD** - Imports (SELECTseries 2) and prior versions of corridors contained in Roadway Designer (IRD) files.

## Import IRD Workflow

Recommendations and limitations:

1. Select the IRD file that contains the corridors to import.
2. Select the corridor to import and data point to accept.
3. If the selected corridor contains no missing dependencies, the corridor is imported. Otherwise, a *Missing Corridor Dependencies* report displays.
4. If the *Missing Corridor Dependencies* report displays, select **No** to cancel the import or select **Yes** to continue the import process. **Note**: The report can be saved to a text file for later reference.
5. If the import is canceled, resolve missing dependencies and then re-import the corridor.

**Missing Dependencies**

If a corridor is selected to be imported and it contains corridor objects with missing dependencies, a missing dependencies report displays before the corridor is imported into the design file. The report dialog allows the import to be continued or canceled by selecting Yes or No. This allows missing dependencies to be resolved before a corridor is imported.

A corridor may contain one or more corridor objects. **Corridor objects** include *template drops*, *secondary alignments*, *key stations*, *parametric constraints*, *point controls*, *end condition exceptions* and *target aliases*. Some of these object types depend on other entities in the design model. They include secondary alignments, point controls, and target aliases. If one of these objects depends on an entity that does not exist in the design model, its dependency is missing.

Example, a secondary alignment object depends on a horizontal alignment. If a corridor is imported that contains a secondary alignment whose horizontal alignment is "*Side Street 1*", the horizontal geometry named "*Side Street 1*" must exist in the design model. If it does not, that secondary alignment is missing its dependency and cannot be imported. To resolve the missing dependency the alignment "*Side Street 1*" could be imported using the Import Geometry command or one of the horizontal geometry commands could be used to create "*Side Street 1*".

Corridor object dependencies are always matched by name. They are not matched by GUID or object ids. Example: If a point control is a corridor feature point control, the corridor and the corridor feature must exist in the design model in order to import the point control. There must be a corridor in the design model whose name matches the corridor name stored in the point control, and that corridor must contain a feature whose name matches the feature name stored in the point control.

**Recommendations and Limitations**

- It is recommended that best practice rules for creating corridors be followed when importing corridors.
- Only one corridor at a time can be imported using Import IRD.
- In order to import a corridor, its baseline horizontal and profile geometry must exist in the design file or an attached reference file.
- When a corridor is imported its end conditions will always target the active terrain model, but corridors may be imported without an active Terrain Model. In that case, end conditions will target nothing.
- When importing corridors that contain secondary alignments, the ALG that contains the secondary alignment geometry must reside in the same directory as the IRD. This is because the secondary alignment geometry is a dependency that must exist in the design model and the dependency match is made by the name of the geometry. The ALG file must be accessed to look up the name of the geometry.
- In order to import a Target Alias at least one of its dependencies must exist in the design model. Missing aliases will not be imported. Example, if a target aliases a terrain model and a corridor, but only the corridor exists in the design model. The target will be imported and the corridor alias will be imported, but not the terrain model alias. If neither the terrain model nor the corridor exists then neither the target nor any aliases will be imported.

**Managing Corridor Data**

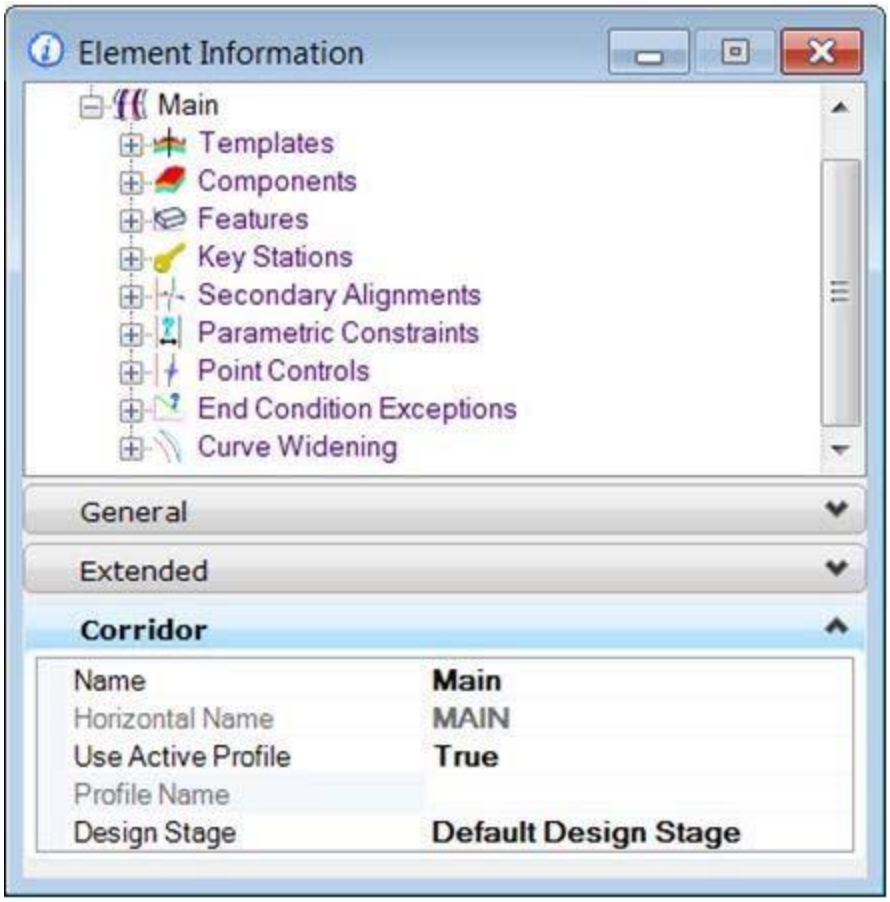
Several tools can be used to help manage the corridor model data. Depending on the tool selected, the data may be read-only or may be manipulated. These include:

**Element Info**

- Properties
- Corridor Objects - view and manage all the input objects in the corridor in one location
- Project Explorer - see all corridor information in one place
- Design Stages

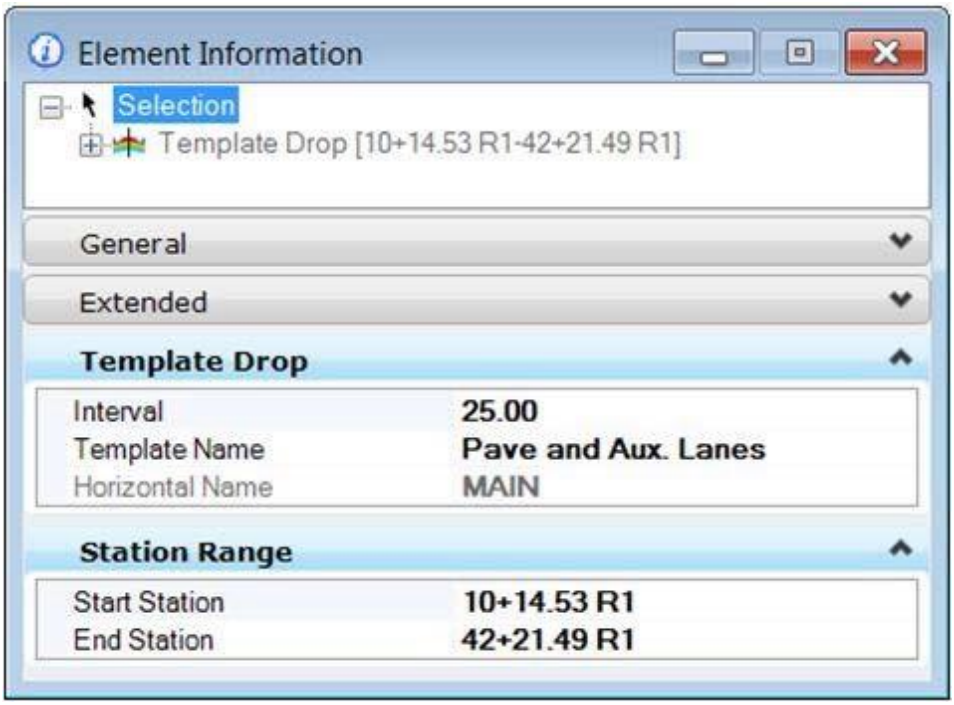
**Element Info**

Clicking on the corridor border opens the Element Information with most of the same information found in the Project Explorer Corridor. It includes the corridor tree, symbology, Corridor Info (Name, Alignment Name, Profile Name, and Design Stage).




The dialog changes as the tree is navigated, based on the current highlighted item in the tree. Much of the information can be edited, which is automatically reflected in the corridor model.

If a Template Drop is selected, the Element Information dialog reflects the template drop information, which can be edited.



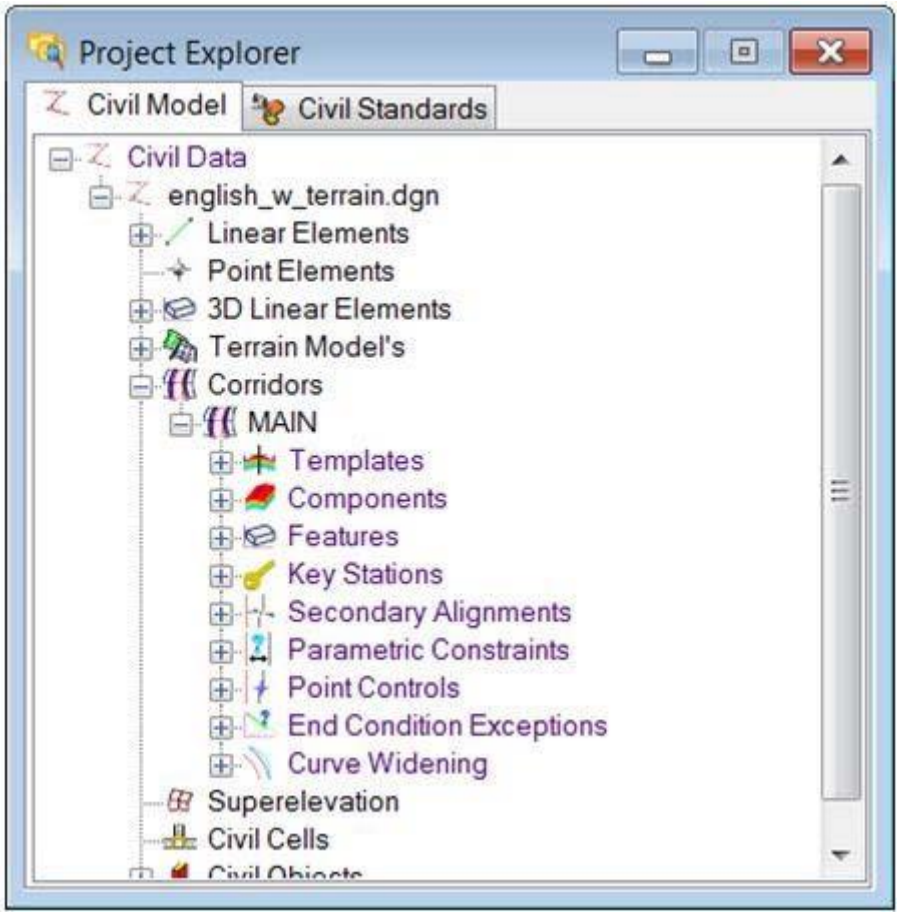
**Properties -** is similar to Element Information, as the displayed data reflects the type of element selected. For example, the data displayed when a corridor is selected is different than when a template drop is selected.

The Properties tool is accessed via the context sensitive menus. When a corridor is selected, the display shows names and design stages.

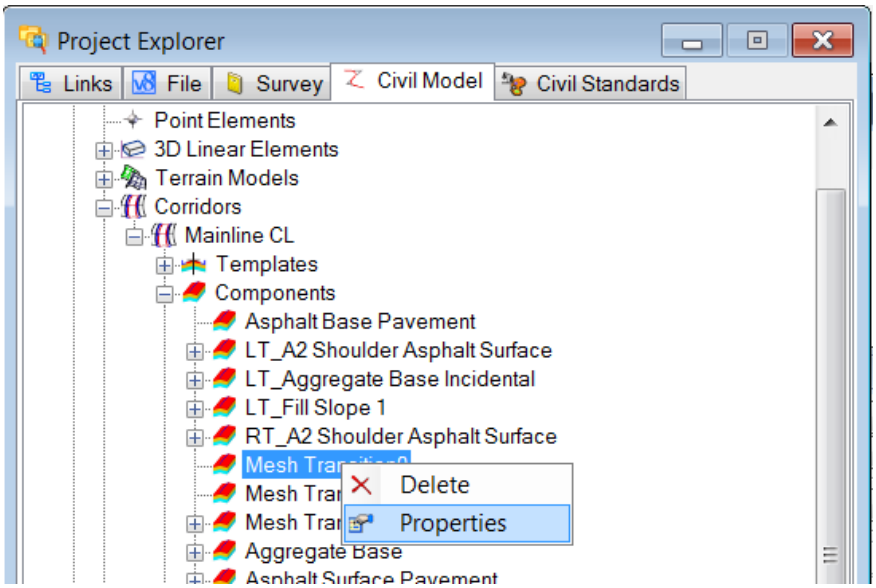
**Corridor Objects -** Allows you to view and manage all the input objects in the corridor in one location.

**Project Explorer**

The Project Explorer located in *Tools>Project Navigation>Links>Project Explorer* is another location where corridor model data is organized and displayed. As the design progresses, the information is continually created / updated automatically. The information is located under the **Civil Model** tab.



Each corridor (and associated data) is listed separately. As the tree is navigated, additional data is exposed. In addition, right-click context sensitive menus are available for common tasks and information.

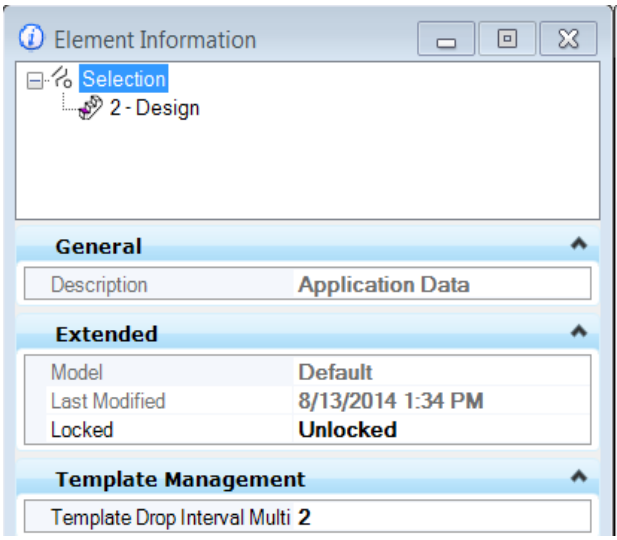


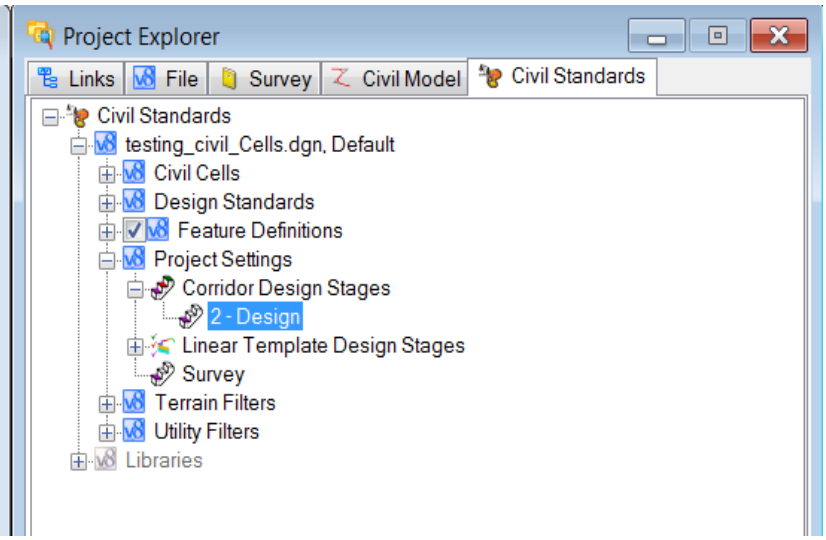
**Project Settings**

Project Settings can be located under the **Civil Standards** tab in the Project Explorer.

**Template Management**

The Template Drop Interval Multiplier can be accessed by opening the *Element Information* tool, and expanding *Project Settings* in the **Project Explorer** window, then expand the Corridor Design Stages and selecting the stage to show *Template Management*.



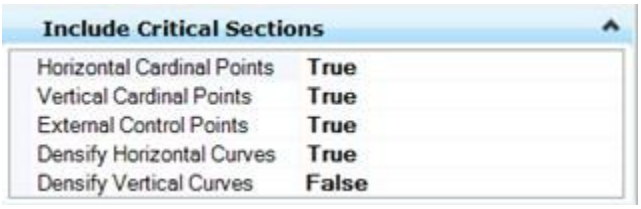

The Template Drop Interval Multiplier is used in conjunction with the Interval Drop specified when the template drop was created. Its purpose is to enable designers to use larger intervals for preliminary work and easily shorten the interval as the design is refined. To determine the interval used for processing, the Interval Drop is multiplied by the Template Drop Interval Multiplier and the result is used.

MoDOT uses the following multipliers:

| Stage | Multiplier | Resultant Processing | Description |
|---|---|---|---|
| Preliminary | 40 | 200 | As corridor is determined, areas of impacts and issues can be reviewed. |
| Design | 20 | 100 | Used for general design work, until high level of accuracy is required towards the end of the project. |
| Final | 5 | 25 | Used for cross section sheets with 25 or 50 feet between sections. |

**Include Critical Sections**

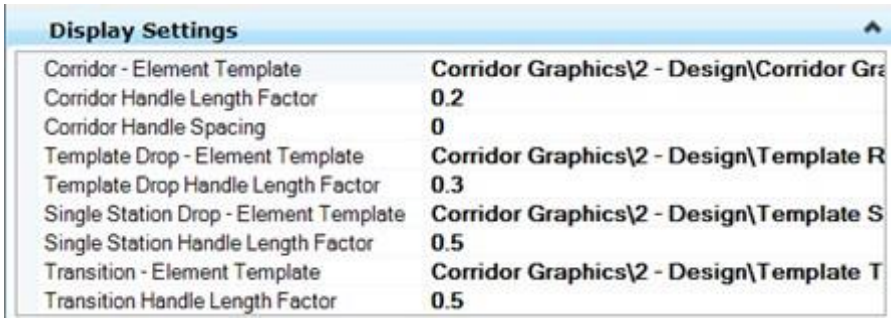
This information is also located in the *Element Information* tool when the Corridor Design Stage is selected in the *Project Settings* of **Project Explorer**.




| Option | Description |
|---|---|
| Horizontal Cardinal Points | When set to True, the location of cardinal points of the active horizontal alignment (PC, PT, CS, etc.) are used to compute a point or template drop interval location. |
| Vertical Cardinal | Points When set to True, the location of cardinal points of the active vertical alignment (VPC, VPT, VPI, etc.) are used to compute a point or template drop interval location. |
| External Control Points | When set to True, the location of horizontal and/or vertical point controls are used compute a point or template drop interval location. |
| Densify Horizontal Curves | When set to true, the processing along horizontal curves is at a closer interval. This option utilizes the CIVIL_DEFAULT_CURVE_STROKING configuration variable value, with extra points being computed based on the chord offset from the horizontal curve. The value defines the chord height used to calculate the extra points. If configuration variable is not set or Densify Horizontal Curves is set to False, the value defaults to 0.01. |

**Display Settings**

This information is also located in the *Element Information* tool when the Corridor Design Stage is selected in the *Project Settings* of **Project Explorer**.



| Display Settings | |
|---|---|
| Corridor - Element Template | Corridor Graphics\2 - Design\Corridor Gra |
| Corridor Handle Length Factor | 0.2 |
| Corridor Handle Spacing | 0 |
| Template Drop - Element Template | Corridor Graphics\2 - Design\Template R |
| Template Drop Handle Length Factor | 0.3 |
| Single Station Drop - Element Template | Corridor Graphics\2 - Design\Template S |
| Single Station Handle Length Factor | 0.5 |
| Transition - Element Template | Corridor Graphics\2 - Design\Template T |
| Transition Handle Length Factor | 0.5 |

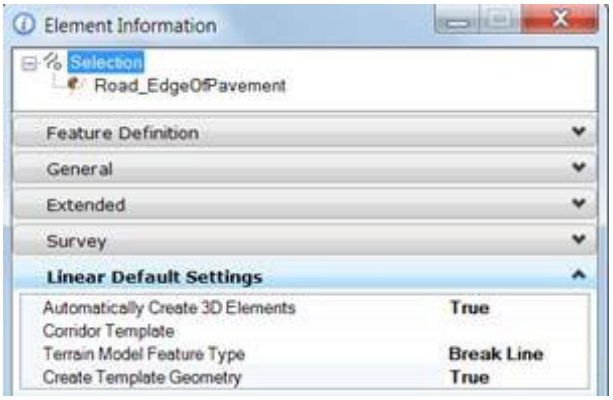
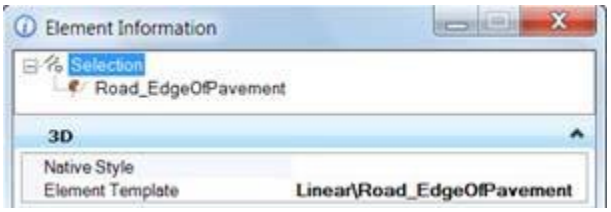
| Option | Description |
|---|---|
| Corridor - Element Template | Element template utilized to draw the corridor boundary in the Create Corridor tool. As a best practice, place the graphics for the boundaries in a construction class to allow for easily turning them off / on as needed. |
| Corridor Handle Length Factor<br>Template Drop Handle Length<br>Factor Single Station Handle | The Length Factors are a ratio of the handle length to the width of the corridor. So 1.0 would make the handle as long as the width of the corridor at that point. |
| Corridor Handle Spacing | The handle spacing either is set to a physical distance as shown or set to zero. If you set to zero you will get 11 handles per corridor regardless of its length. Any non-zero value is used as a distance between handles measured in master units along the horizontal alignment. |
| Template Drop Element Template | Element template utilized to draw the template drop boundary in the Create Template Drop tool. As a best practice, place the graphics for the boundaries in a construction class to allow for easily turning them off / on as needed. |
| Transition Element Template | Element template utilized to draw the transition boundary in the Create Transition tool. As a best practice, place the graphics for the boundaries in a construction class to allow for easily turning them off / on as needed. |

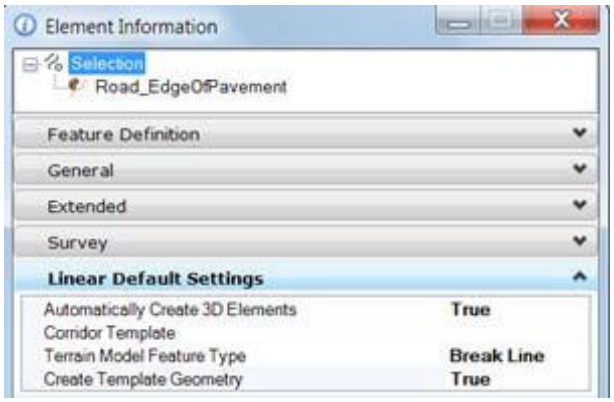
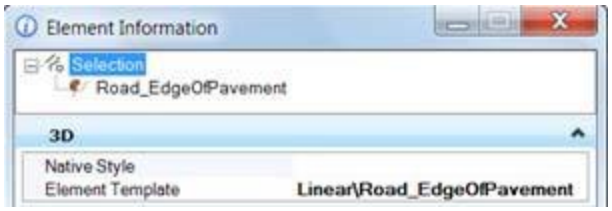
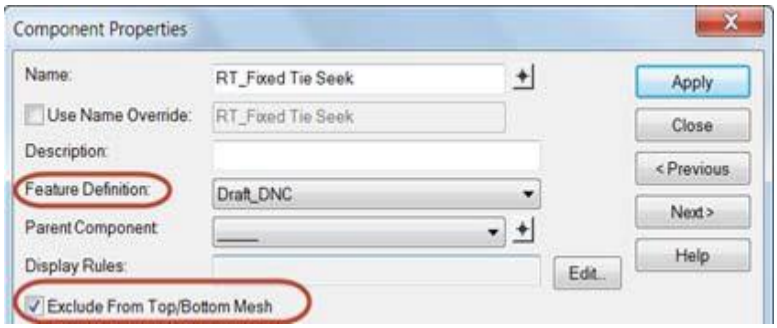
**Output Settings**

This information is also located in the *Element Information* tool when the Corridor Design Stage is selected in the *Project Settings* of **Project Explorer**.

For all options, when set to False, no elements, features, or meshes are drawn.

| Option | Description |
|---|---|
| Create Top Mesh<br>Top Mesh Feature Definition | When set to True, a mesh is created for each component in the corridor (based on its template) which has Exclude From Top / Bottom Mesh toggled OFF. The mesh is drawn using the specified Feature Definition.<br> <br><br>If Create Top Mesh is set to False, no Top Mesh Feature Definition |
| Create Bottom Mesh<br>Bottom Mesh Feature Definition | When set to True, a mesh is created for each component in the corridor (based on its template) which has Exclude From Top / Bottom Mesh toggled OFF. The mesh is drawn using the specified Feature Definition. If Create Bottom Mesh is set to False, no Bottom Mesh Feature Definition can be selected. |

| | |
|---|---|
| Create Linear Features | When set to True, 3D linear features are drawn based on Feature Definitions. First, review the Point Properties within the template:<br> <br><br>Then review the corresponding Feature Definition.<br>  <br><br>If the Create Template Geometry setting is set to True, then the linear feature is drawn, based on the 3D settings.<br>  <br> |

| | |
|---|---|
| Create Linear Features Continued |  <br>If the Create Template Geometry setting is set to True, then the linear feature is drawn, based on the 3D settings.<br>  |
| Create Component Meshes | When set to True, a mesh is created for each component in the corridor (based on its template) which has Exclude From Top / Bottom Mesh toggled On. The mesh is drawn using the specified Feature Definition in the Component Properties.<br>  |
| Include Null Point Linear Features | When set to True, linear features for null points are drawn, basis on the same criteria as Create Linear Features. |

## 6.5 Group Exercise: Creating a Corridor – Road1

**Setting up the Design files**

1. Within the **J2P0200*data_06*** folder, open the file: **Plan_J2P0200.dgn**
2. Create a new file named **Corridors_J2P0200.dgn** based on the 2D seed file ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn***. This new file will hold the proposed corridor.
3. Reference in the following files:

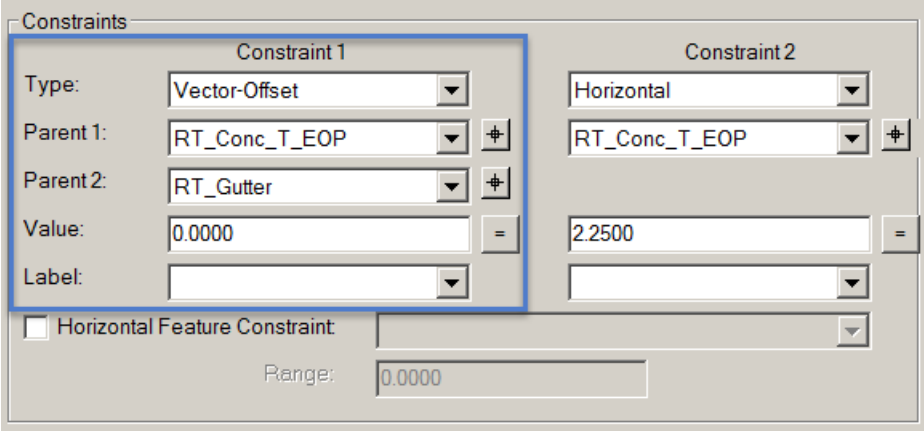
   **Terrain_J2P0200_Existing.dgn**
   **Civil_Geometry_J2P0200.dgn.**

4. Data point on the perimeter of the Terrain Model and select the **Set As Active Terrain Model** icon form the pop up menu.

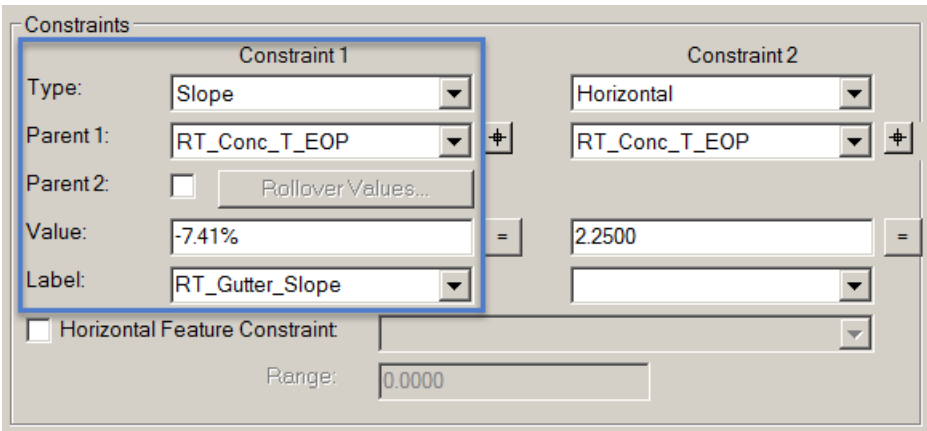
**Setting up the project template Library**

5. From *Corridor Modeling* task group of the Civil Tools task menu, select **Create Template.** Or press the <**F8**> key to open the Create Template dialog.
6. Select file open and navigate to the the project diretory and open the project template library: **J2P0200.itl**.
7. Expand the **Concrete Pavement w/ Shoulders** folder in the *Templates* folder.
8. Within this folder expand the **A2 Shoulders Agg Base** folder.
9. Right click on the **Concrete Pavement 2 Lane w/ Agg Base Option 3** template and select **Copy**.
10. Expand the **J2P0200** folder and right click on the **Road1** folder then select **Paste**.
11. Expand the **Concrete Pavement w/ C&G** folder.
12. Right click on **2 Lanes Type A C&G w/ Agg Base** and select **Copy**.
13. Expand the **J2P0200** folder and right click on the **Road1** folder and select **Paste.**
14. Once the **2 Lanes Type A C&G w/ Agg Base** is pasted in the **Road1** folder we are going to modify the 2 gutter flowline points named **RT_Curb_Surf_Flowline** & **LT_Curb_Surf_Flowline**. The project parameters call for the gutters not to super elevate with the roadway.

15. Below is the original Point Constraint for **RT_Curb_Surf_Flowline**.




16. Change to a **Slope** Constraint to **-7.41%** and add a Parametric Label of **RT_Gutter_Slope.**

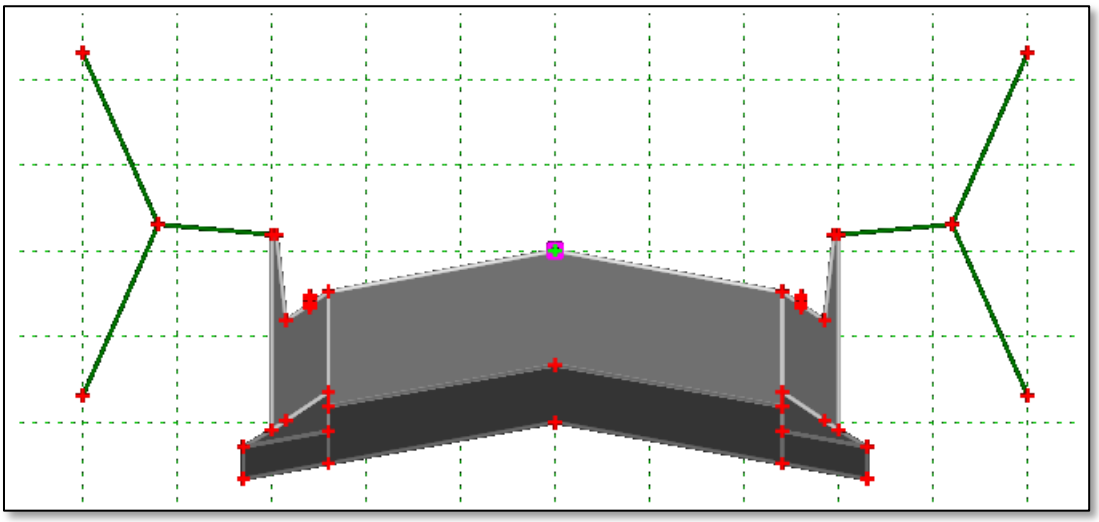



17. Select apply to update the template.

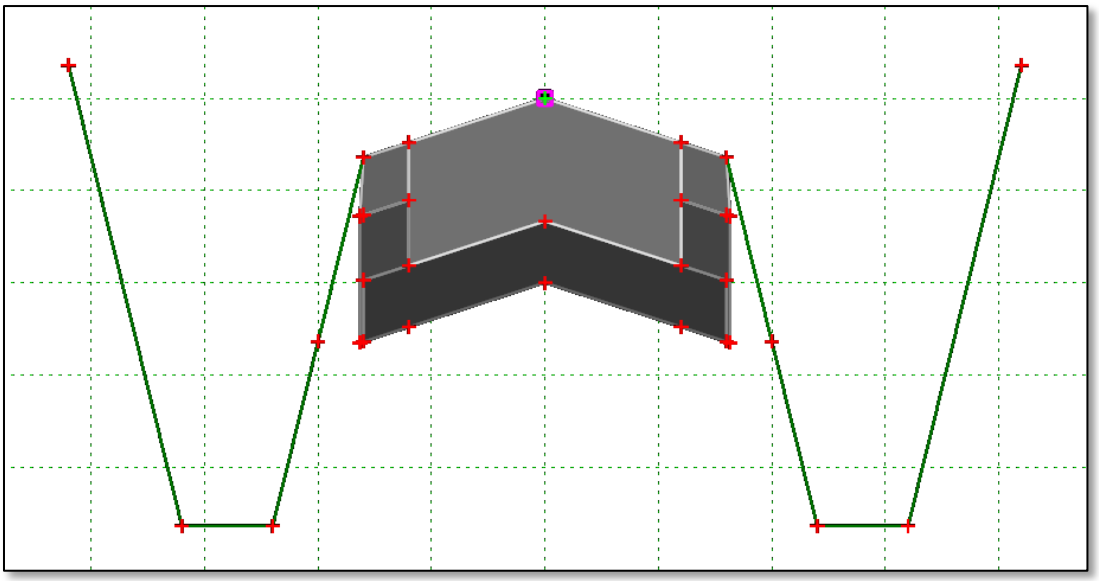
18. Edit the same flow line point on the left side.

19. Review the new ***Road1*** templates by double clicking the name in the list. Turn the Display Point names On/Off. Select **Test** to verify the end condition functionality.

2 Lanes Type A C&G w/ Agg Base



Concrete Pavement 2 Lane w/ Agg Base Option 3



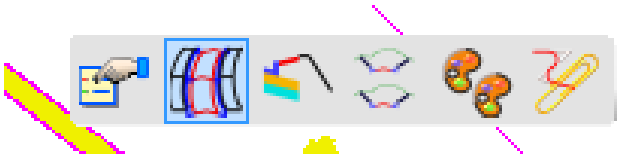
20. Select **File> Save** to save the changes to the project **J2P0200.itl**.

21. **Close** the *Create Template* dialog.

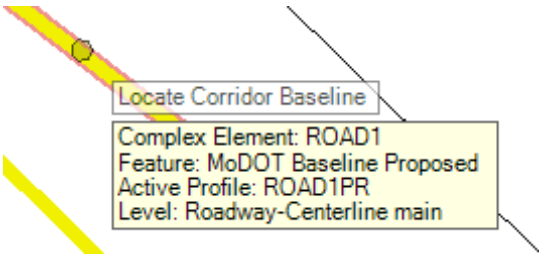
**Setting up the Corridor**

22. From *Corridor Modeling* task group, select **Create Corridor**.

    *Create Corridor* command is also available from the context sensitive pop-up menu presented when hovering over a selected horizontal civil geometry element.

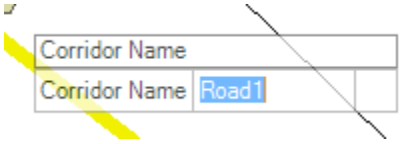


23. When prompted to *Locate Corridor Baseline*, data point on **Road1**.




24. Right-click to reset to select the active profile.

25. Name the Corridor **Road1**.

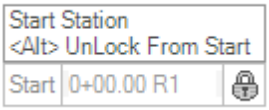



26. **Data point** to accept.

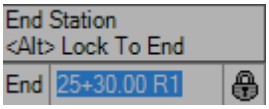
27. Select **<Alt> + Down** to pick a template or use the **Create Template Drop** dialog box.

28. Expand the project folder ***J2P0200*** and ***Road1*** folders. Select the **2 Lanes Type A C&G w/ Agg Base** template. Click **OK** to dismiss the dialog and **data point** in the view to accept the choice of template.

29. When prompted to enter the *Start Station*, select the **<Alt>** key to lock the Start Station to the start and **data point** in the view to accept it.



30. When prompted to enter the *End Station*, key in **25+30** and **Tab** to lock the value. **Data point** in the view to accept the end station.




31. When prompted for the *Interval*, key in **5** and **Tab** to lock the value and **data point** to accept the value.

32. Key in **0** (if it doesn't default to 0) for the *Minimum Transition Before Drop* and *Minimum Transition After Drop*, **data point** after each until the corridor processes. This applies the template to the *Road1* corridor for the stationing identified.

33. Select **<Alt> + Down** to pick another template or use the **Create Template Drop** dialog box.

34. Expand the folder *J2P0200* and the *Road 1* folder and select **Concrete Pavement 2 Lane w/ Agg Base Option 3** template. Click **OK** to dismiss the dialog and **data point** in the view to accept the choice of template.

35. When prompted to enter the *Start Station*, key in **25+30** and **Tab** to lock the value. **Data point** in the view to accept the start station.

36. When prompted to enter the *End Station*, select the **<Alt>** key to lock the End Station to the end and **data point** in the view to accept it.

37. When prompted for the *Interval*, key in **5** and **Tab** to lock the value and **data point** to accept the value.

38. Key in **0** (if it doesn't default to 0) for the *Minimum Transition Before Drop* and *Minimum Transition After Drop*, **data point** after each until the corridor processes. This completes the template drop for *Road1* by applying the template to the stationing identified. The corridor will process and display in both the 2D view and the 3D Isometric view.

39. Select <**F4**> to close the Create Template Drop tool down.

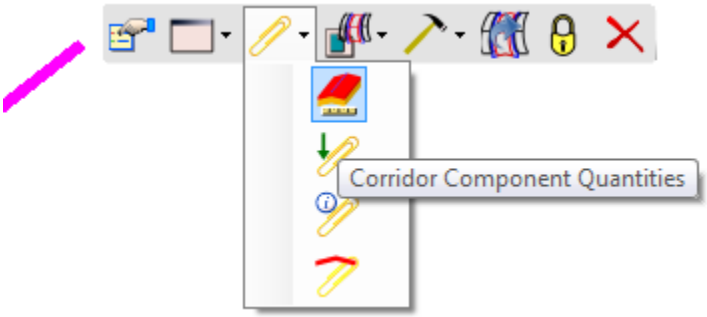
40. Press **<F6>** key to setup the 3D view.

**Hint:** If you don't see end conditions then the original ground terrain model was not active.

**Review the model and the effect of Design stages**

41. Select the corridor by picking one of the handles.

42. Select the *Corridor Component Quantities* option from the *Corridor Reports* pop-up.



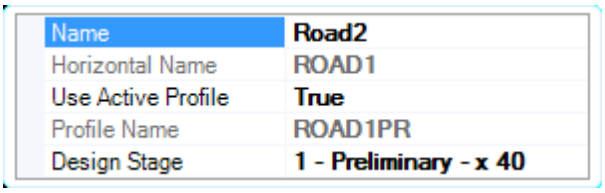

43. Key in some unit cost values.

44. Select **Report**.

45. Review the reports available. Close the *Report Browser*.

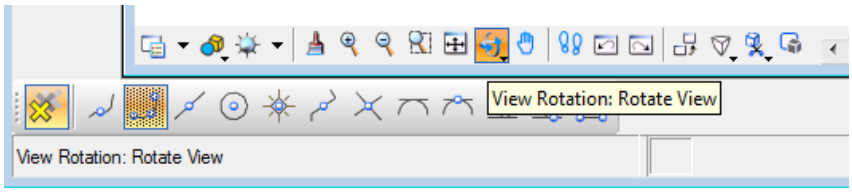
46. Display the pop-up menu again and select **Properties**.

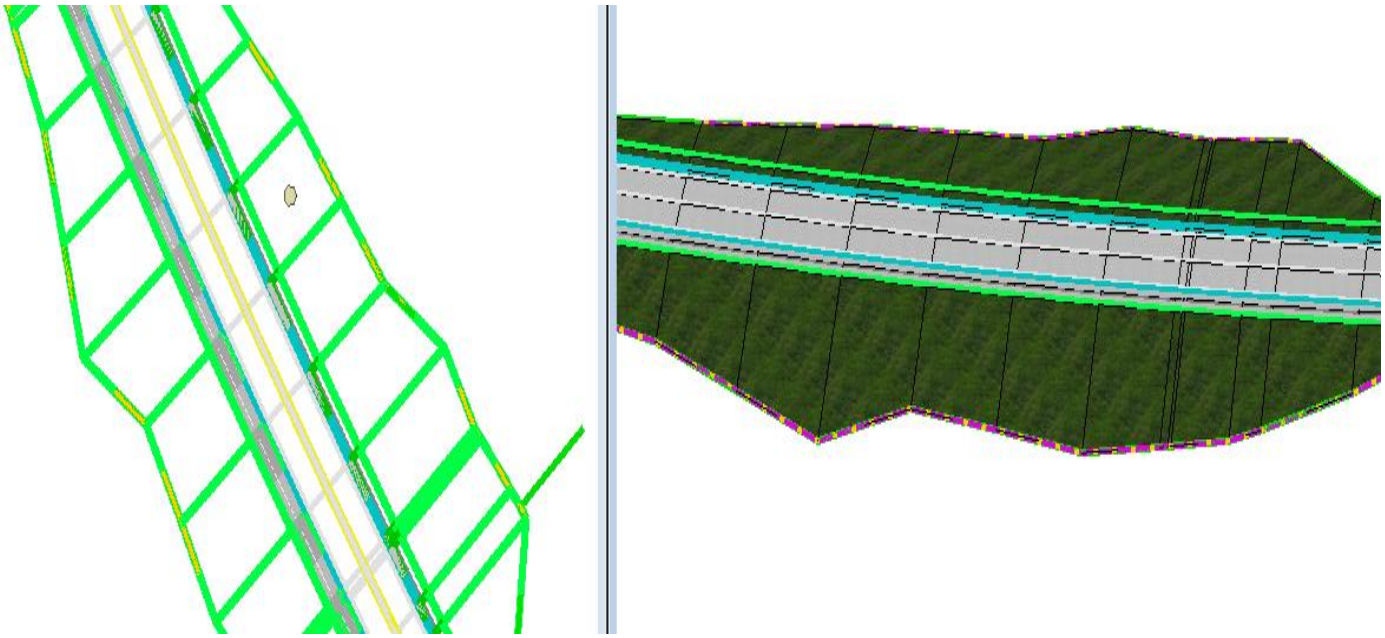
47. Select and explore the options for *Design Stage*.



| | |
|---|---|
| Name | Road2 |
| Horizontal Name | ROAD1 |
| Use Active Profile | True |
| Profile Name | ROAD1PR |
| Design Stage | 1 - Preliminary - x 40 |

48. Use the *View Rotation* tool to rotate the view to see 3D effects on the *Road1* corridor.

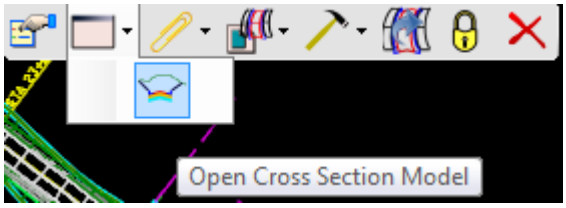


**Set up Dynamic Cross sections**

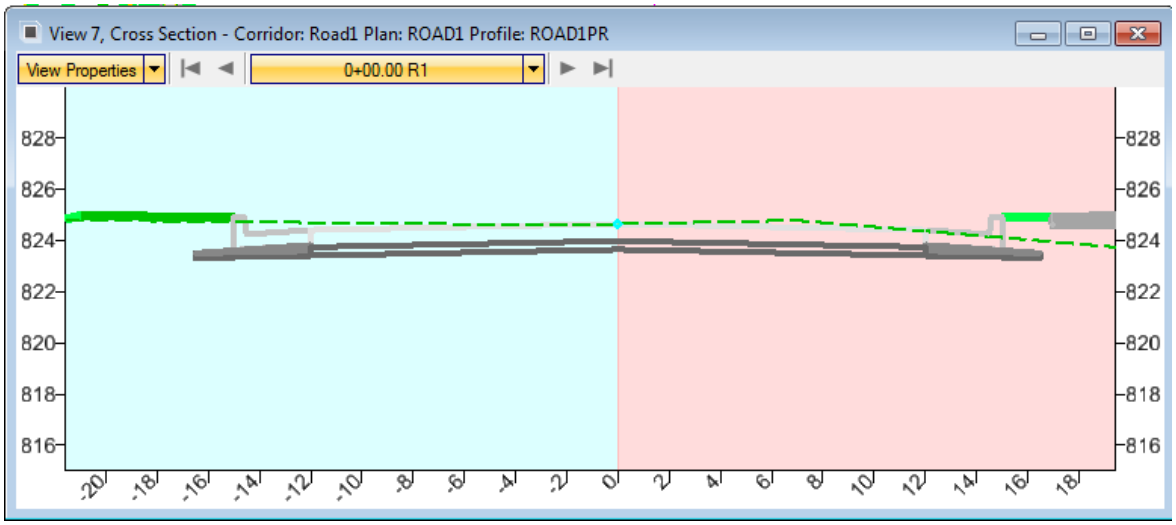
49. From *Corridor Modeling* task group, select **Open Cross Section View**.

*Open Cross Section View* command is also available from the context sensitive pop-up menu presented when hovering over a corridor handle.



50. When prompted to *Locate Corridor or Alignment*, identify the corridor by selecting a grab handle on the corridor.

51. When prompted to *Select or open View*, select a view not in use and **data point** in the view. This will present the first Cross Section of the corridor. To Navigate up and down the corridor use the arrow indicators at the top of the view. To navigate within in the view, use the mouse wheel; rolling the wheel forward zooms in, rolling back zooms out. Depressing the wheel and moving the mouse pans the view.

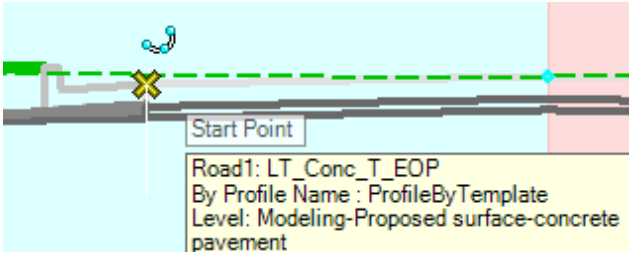



Since superelevation will be changing the slopes, having feedback to the slope at each station is useful, the next steps describe how to place a dimension line from the edge of pavement to the center line on each side of the road.

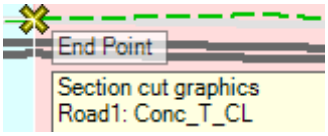
52. Select **Show Place Dimension**. Located in the *Corridor Modeling* tools in the *Civil Tools* tasks.

53. Select the **Cross Section** view.

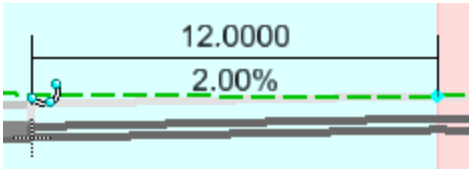
54. At the *Start Point* prompt, identify the left EOP named **LT_Conc_T_EOP**, **data point** to accept.



55. At the *End Point* prompt, identify the centerline point named **Conc_T_CL, data point** to accept.

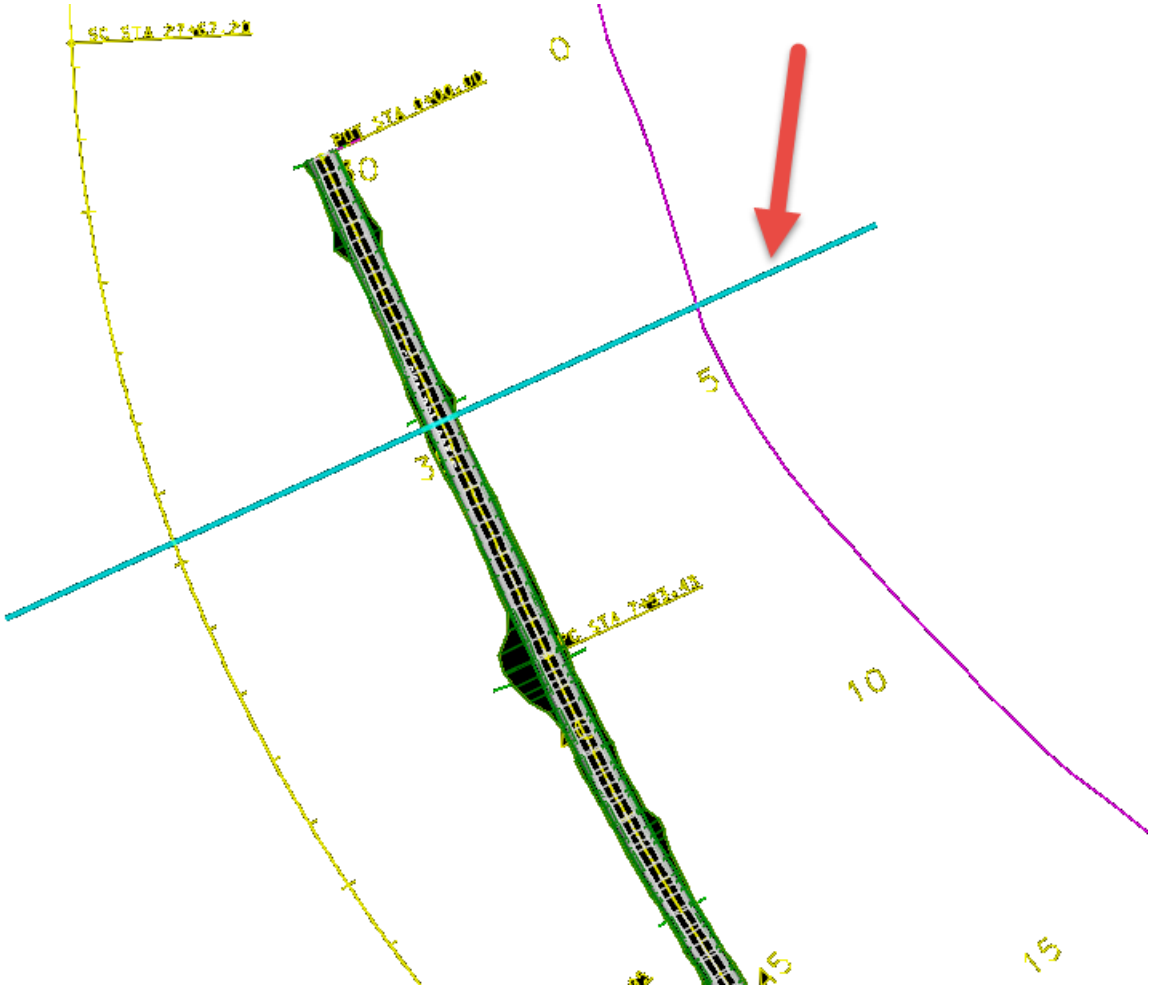



56. Place the dimension height above or below the component in a location that will be easy to read, **data point** to accept the location.




**Note:** This places the same dimension on all cross sections.

**Note:** The blue line on the alignment represents the location of the cross-section.




57. **Close** *View 7*.

58. **Save Settings** on the design file. The corridor is stored as MicroStation data; no .ird file is created.

    ***Important!*** If you delete the graphics, you delete the corridor and both the 2D and the 3D display.

    **Note:** The User might notice there is no superelevation applied to the corridor, this is covered in the next chapter.

59. Select **File > Update Server Copy**.

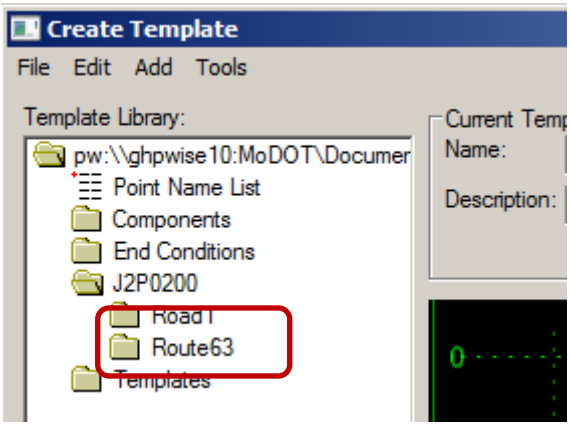
## 6.6 Individual Exercise: Creating a Corridor for Route63

1. Continue working in **Corridors_J2P0200.dgn.**

2. From *Civil Tools* task menu under *Corridor Modeling*, select **Create Template**.

3. Select **File > Open** and navigate to the location of the project template file **J2P0200.itl** and open the file.

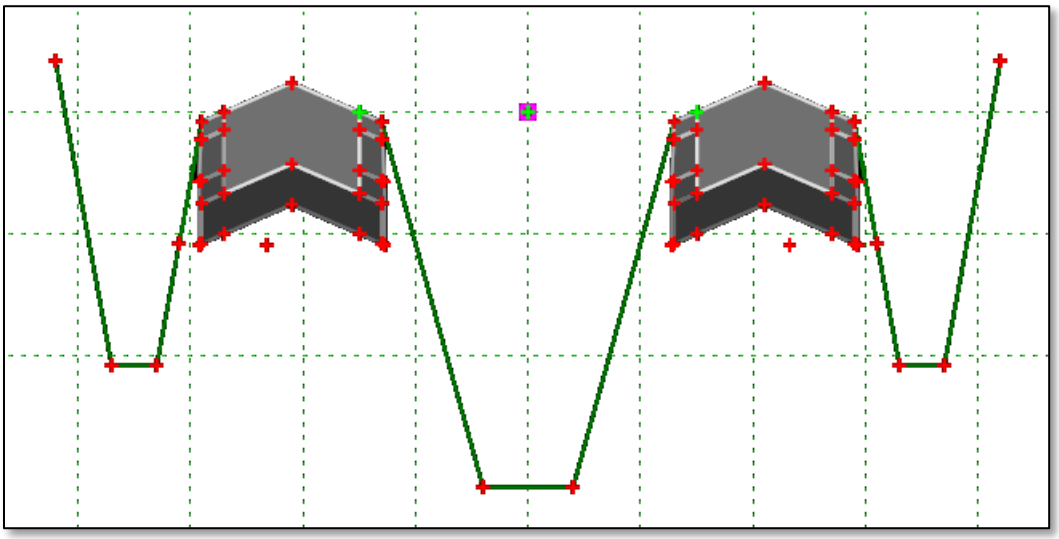
4. In **Create Template** dialog right-click on the ***J2P0200*** folder, select **New > Folder** and create a folder called **Route63**.



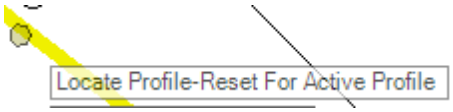

5. Expand the ***Templates > Concrete Pavement w/ Shoulders*** folder.

6. Expand the ***A3 Shoulders Agg Base*** folder.

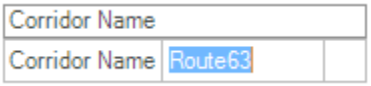
7. Right click on the ***Concrete Pavement 4 Lane Divided w/ Agg Base Option 3*** template and select **Copy**.



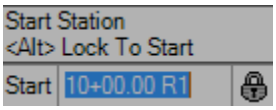
8. Right click on the **Route63** folder and select **Paste**.
9. Test the template by clicking **Test**.
10. **Save** your changes to the **J2P0200.itl** and then close the *Create Template* dialog.
11. From ***Corridor Modeling*** task group, select **Create Corridor**
12. When prompted to *Locate Corridor Baseline*, data point on **Route63**.
13. Right-click to reset to select the *Active Profile*.



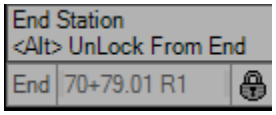

14. Name the corridor **Route63**.




15. **Data point** to accept.
16. Select **<Alt> + Down** to pick a template or use the **Create Template Drop** dialog box.
17. Expand the folder *J2P0200* and the *Route63* folder.
18. Select the **Concrete Pavement 4 Lane w/ Agg Base Option 3** template. Click **OK** to dismiss the dialog and **data point** in the view to accept the choice of template
19. When prompted to enter the *Start Station*, key in **10+00 R1**, **Tab** to lock the station, and **Data point** in the view to accept.




20. When prompted to enter the *End Station*, select the **<Alt>** key to lock the End Station to the end and **data point** in the view to accept it.



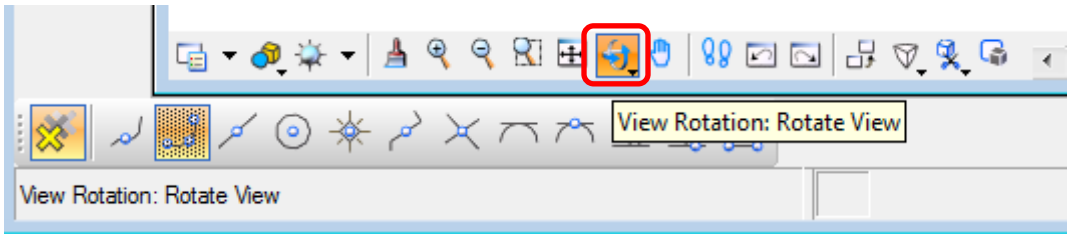

21. When prompted for the *Interval*, key in **5** and **Tab** to lock the value.
22. Key in **0** (if it doesn't default to 0) for the *Minimum Transition Before Drop* and *Minimum Transition After Drop*, **data point** after each until the corridor processes. The corridor will process and display in both the 2D view and the 3D Isometric view. This applies the template to the *Route63* corridor.

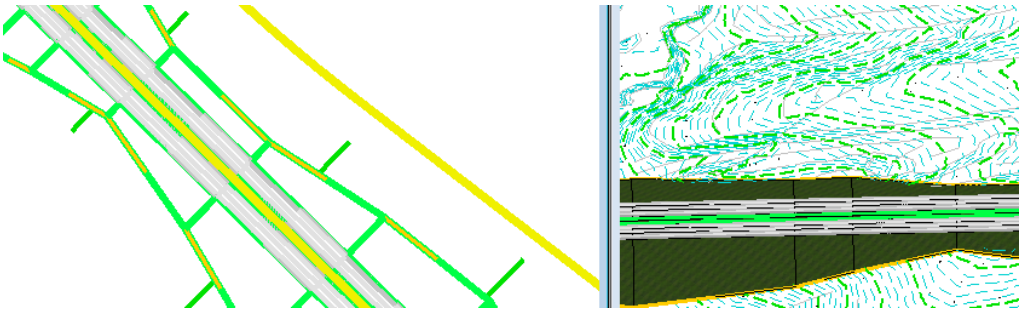
23. Select <**F4**> to close the Create Template Drop tool down.

24. Select the Corridor and from the *Properties* pop-up menu, select and explore different design stages.

25. If the 3D View is not open select <F6> key to open a 3D view of the corridors.

26. Using the *View Rotation* tool, rotate the view to see 3D effects of *J2P0200 Route 63* corridor.



**Set up Dynamic Cross sections**

27. Select **Open Cross Section View** from the *Corridor Modeling* task group, to review the dynamic cross sections.

28. When prompted to *Locate Corridor or Alignment*, identify the **Route63** corridor by selecting a grab handle on the corridor.

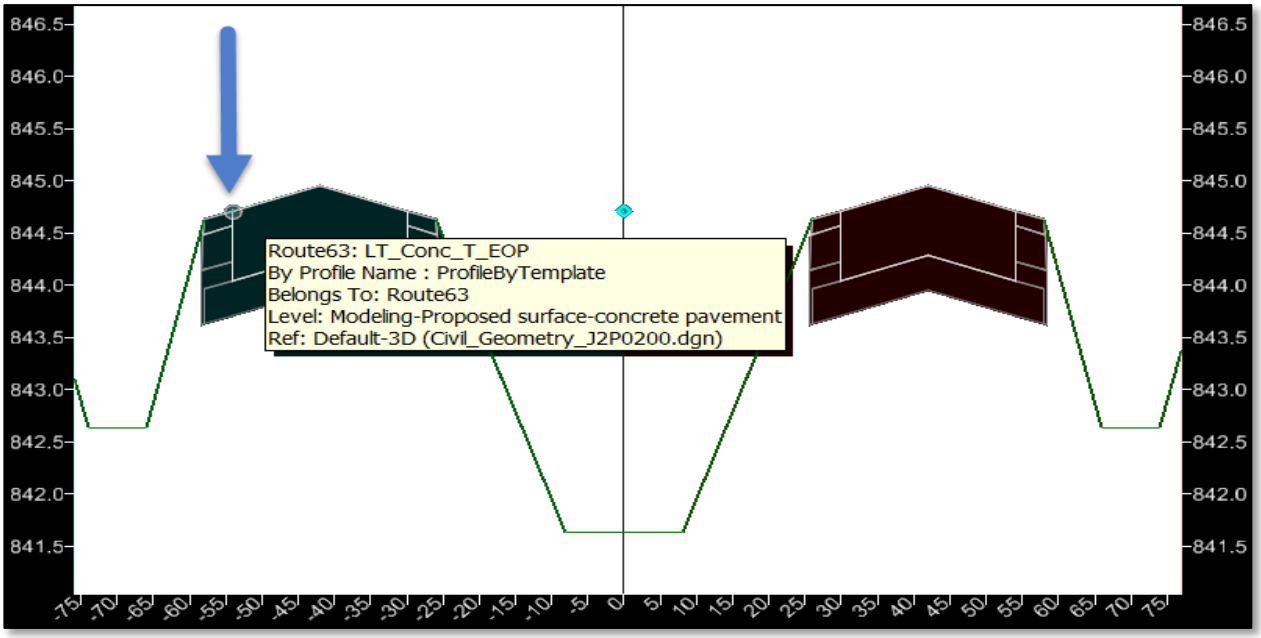
29. When prompted to *Select or Open View*, select a view not in use, (View 8) and **data point** in the view. This will present the first Cross Section of the corridor. To navigate up and down the corridor, use the arrow indicators at the top of the view. To navigate within in the view, use the mouse wheel; rolling the wheel forward zooms in, rolling back zooms out. Depressing the wheel pans the view.

Since superelevation will be changing the slopes, having feedback to the slope at each station is useful, the next steps describe how to place a dimension line from the edge of pavement to the center line on each side of the road.

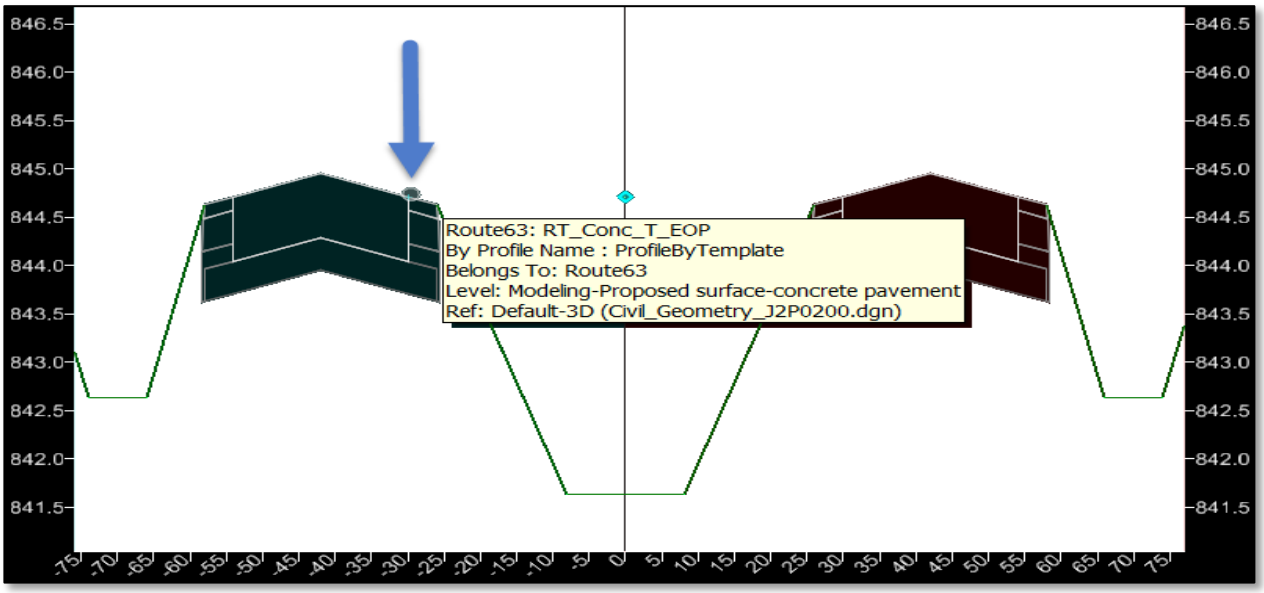
30. Select **Show Place Dimension** from the *Corridor Modeling* task group.

31. Select the Cross Section view.

32. At the *Start Point* prompt, identify the **left EOP** named **LT_Conc_T_EOP**.

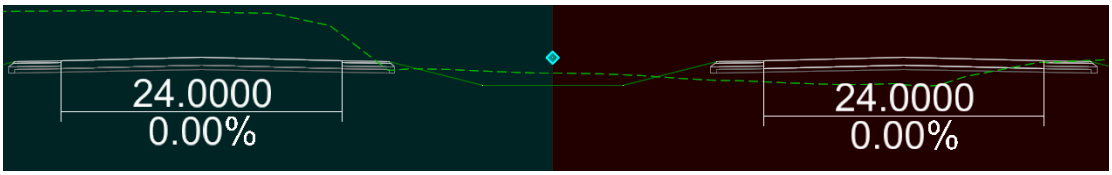



33. At the *End Point* prompt, identify the **right EOP** named **RT_Conc_T_EOP**.



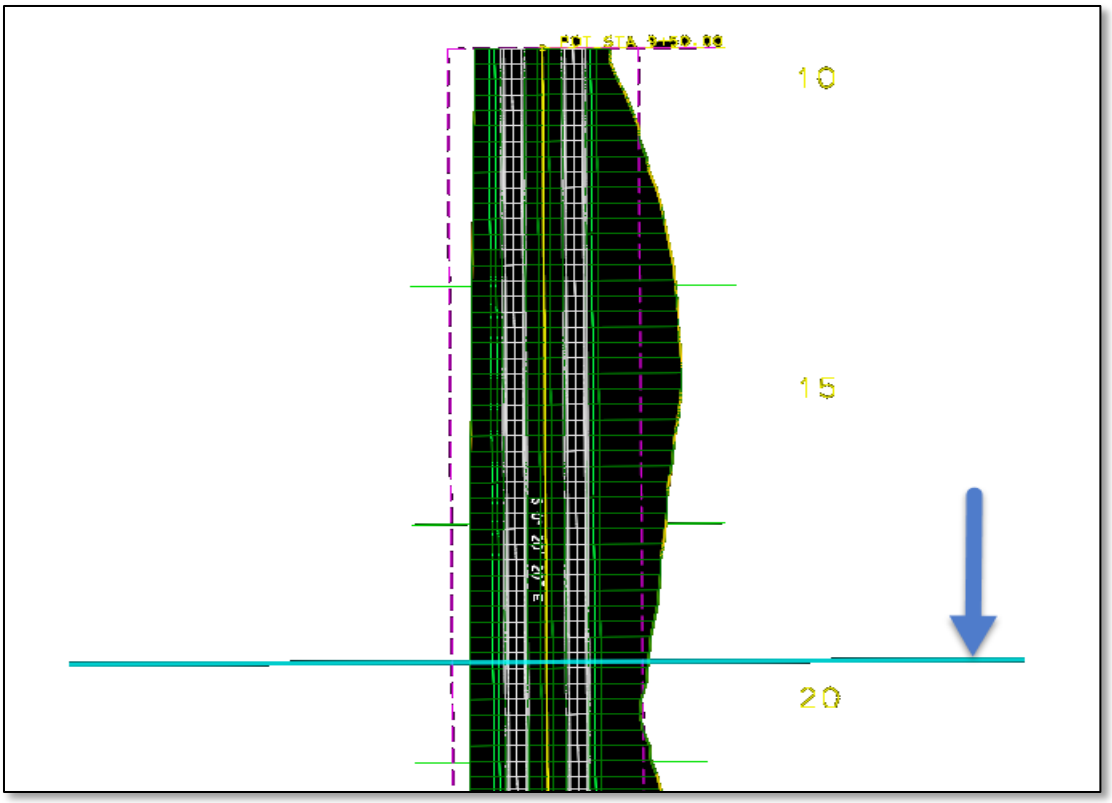
34. Place the dimension height above or below the component in a location that will be easy to read, **data point** to accept the location.

35. Do this for both the North bound and the South bound lanes of *Route 63*.




**Note:** This places the same dimension on all cross sections.

**Note:** The blue line on the alignment represents the location of the cross-section.




36. **Close** View 8.

37. **Compress** and **Save Settings** on the design file. The corridor is stored as MicroStation data; no .ird file is created.

***Important!*** If you delete the graphics, you delete the corridor and both the 2D and the 3D display.

**Note:** The User might notice there is no superelevation applied to the corridor, this is covered in the next chapter.

38. Select **File > Update Server Copy**.

# Chapter 7

# Superelevation

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7.2 Overview ..... 7-1
7.3 Prerequisites ..... 7-1
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7.6 Stationing and Decimal Place Settings ..... 7-3
7.7 Create the Super Section(s) ..... 7-3
7.7.1 Create Superelevation Lanes ..... 7-4
7.7.2 Calculate Superelevation Transitions and Cross Slopes ..... 7-4
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7.7.4 Add Auxiliary Lanes ..... 7-4
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## 7.1 Objectives

- Create a superelevation section and lane
- Calculate superelevation using a SEP file, or import data from CSV file
- Review / edit the data utilizing the table editor
- Assign the superelevation information to a corridor

## 7.2 Overview

Superelevation tools calculate how much banking to apply to curves and spirals in the horizontal alignment to help offset centrifugal force. These commands also compute how the road will make the transition from normal crown to a fully banked curve and back again.

Superelevation can be calculated in two ways:

**Rules-based –** using a set of preferences (**SEP** file) the station and associated cross slopes of the transitions are based on design speed, curvature, and other design parameters. As the design progresses and parameters change (i.e., design speed exceptions) superelevation can be reprocessed to the revised parameter(s).

**Import –** using a comma separate values (**CSV**) file to import the station and associated cross slope of each transition. In this option, the rules are not utilized; the data is simply applied to the superelevation lanes.

The result of superelevation is a DGN file of graphic superelevation lanes with cross slope attributes. This file can be referenced to a corridor model and associated, so the superelevation transitions are incorporated into the corridor model. The superelevation data can be in its own DGN file, or can be drawn into any of the other project DGN files with geometry, corridor, etc.

## 7.3 Prerequisites

In order to create superelevation, the following are minimum requirements:

- One Civil horizontal geometry element
- Superelevation preferences (an **SEP** file set) - each of these preference files calls out other files within it so be sure you have the entire set

In order to add the superelevation data to a corridor, you will need:

- Superelevation lanes
- Corridor whose template has superelevation flags for control points (for association step)

Superelevation data is drawn using the active MicroStation attributes, so no features or element templates are used or supported. Therefore, turning off the level with superelevation data removes it from the active view.

## 7.4 Settings

The following two sets of settings are utilized within the superelevation tools. It is prudent to set them prior to drawing lanes. There are no required values; these are user preference.

- fill settings for superelevation lanes
- decimal place settings for element handlers

## 7.5 Fill Settings

Located under *Workspace> Preferences* from the main MicroStation or Power product menu, the **View Options - Civil** listing provides options for the superelevation fill.

| Option | Description |
|---|---|
| **Color Shaded Fill** | Color Shaded Fill Color fills superelevation lanes AFTER calculations are complete. The coloring is hard-coded based on the cross slope:<br><br>slope < -10% =blue<br><br>-10% <= slope <= -0.5% = Calculated color between green and blue<br><br>-0.5% < slope < 0.5% = white<br><br>0.5% <= slope <= 10% = Calculated color between red and yellow slope > 10% = dark red<br><br>Based on the side of road, the colors flip. In addition to setting this option, the View Attribute for Fill must also be toggled on. |
| **Boundaries Only** | In this option, only the outside boundary of each lane is displayed and can be selected. |
| **None** | No superelevation lanes / edit handlers are displayed; however, they are still in the file. To display them, set to one of the other two options. |

## 7.6 Stationing and Decimal Place Settings

Located under *Settings > Design File* from the main MicroStation or Power GEOPAK product menu, the Civil Formatting category listing has options for controlling display of element handlers. These settings are not unique to superelevation; the same settings are used throughout the Civil products.

| Option | Description |
|---|---|
| **Station Settings:** | Used for section and lane edit handlers. |
| Format | Controls the number of places after the delimiter. |
| Format Delimiter | Controls the delimiter, generally the plus (+) sign. |
| Precision | Defines the number of decimal places for stationing. |
| **Profile Settings:** | Used for lane edit handlers. |
| Slope Format | Used for cross slope edit handlers. Generally set to percentage for superelevation. |
| Slope Precision | Defines number of decimal places in cross slope edit handlers. |

**Superelevation General Workflow**

The general workflow for superelevation is described in the following steps. Steps 4-6 can be done in a different order and not all steps are required.

1. Create the super section(s).
2. Define the lanes with *Create Superelevation Lanes*.
3. Calculate superelevation transitions and cross slopes.
4. Review and edit as needed.
5. Add auxiliary lanes.
6. Associate to a corridor.

## 7.7 Create the Super Section(s)

In this first step, the Civil horizontal geometry element is identified, and station limits of the superelevation are defined. Station limits are useful if the horizontal geometry element is substantially longer than the project limits.

In a basic project where the through lane pavement configuration is consistent (i.e., all 2 lane rural with a few turn lanes), a single section may be used. However, if there are significant changes to the road, i.e., changing from 2 lane rural to 4 lane divided, separate sections should be created.

The general rule is to create a new section if you are using rule-based calculations and the through lane configuration or pivot method changes. The changes should be based on the through lanes, as auxiliary lanes such as turn lanes, ramp entrances and exits and truck climbing lanes are handled independently. If you are importing superelevation, one section can be used for an entire alignment.

### 7.7.1 Create Superelevation Lanes

Once the section is defined, define the lanes. Focus on the through lanes, as the turn lanes and intermittent lanes can be added at any time. Lanes are defined by selection of the horizontal geometry and offsets. Default cross slope, used for subsequent calculations, is also defined. The result of this step is that graphic lanes (filled with green and yellow, no choice of colors) are drawn.

### 7.7.2 Calculate Superelevation Transitions and Cross Slopes

In this step, there are two options: **rule-based** and **imported** data. Generally, one method would be selected, however, you can use rule-based for part of the project and import other parts (although this would be confusing).

The rules-based tool uses a preferences file (**SEP** file) to compute the station and cross slopes of transitions, while the import superelevation method uses a comma separate values (**CSV**) file containing the station and cross slopes, which were calculated by an exterior program (or manually). The inputs vary depending on the method used and the preferences within the SEP file.

The result of this step is the augmentation of station/cross slopes of transitions to the lanes created in the previous step. It is easy to see the results if the fill is toggled on as the lanes change from solid yellow and green to a gradient coloring, based on cross slopes.

### 7.7.3 Review and Edit as Needed

There are several ways to review the superelevation data and edit if desired. Highlighting a section displays station and cross slope values for review and editing. Stationing can be changed dynamically by selecting the gray wedge and dragging to the desired station. Each lane can be manipulated independently of the adjacent lanes. The station can all be keyed into the edit field. Slopes can be changed by keying the slope into the edit field.

The superelevation editor is another way to edit the data, in a tabular format. Any changes made in the editor are automatically synced with the graphic lanes and vice versa. The fields in the editor can be customized so unused or unwanted fields can be hidden. Any data in gray cannot be edited, due to constraints used during calculations with the SEP method.

### 7.7.4 Add Auxiliary Lanes

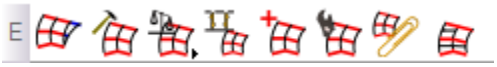
At any time during the process, additional lanes can be added in any section. Primary lanes (those lanes that are rule based) or auxiliary lanes (those with user-specified cross slopes) can be added. The result of this step is graphic superelevated primary or auxiliary lanes.

### 7.7.5 Associate to a Corridor

At any time during the process, the superelevated lanes can be associated with a corridor. If the superelevated lanes are in a different file than the corridor, you must be in the corridor file with the super lanes attached as a reference. They can both be in the same file.

The result of this step is the superelevated pavement is reflected in the corridor model.

## 7.8 Accessing Superelevation Tools



From the *Corridor Modeling* task group

**Create Superelevation Sections** - In this tool the Civil horizontal geometry element is identified and station limits of the superelevation are defined. Station limits are useful if the horizontal geometry element is substantially longer than the project limits.

**Determination of Sections**

If you are importing superelevation, one section can be used for an entire alignment. The advantage of curve sets for each curve versus one large section is the ability to reprocess rules for a single curve set or two. Since rules are not used in an imported project, separate curve sets serve no useful purpose aside from shorter, piecemeal reports and more granularities in the editor.

In a basic rules-based project where the through lane pavement configuration is consistent (i.e., all 2 lane rural with a few turn lanes), a single section may be used. However, if there are significant changes to the road, i.e., changing from 2 lane rural to 4 lane divided, separate sections should be created.

The general rule is to create a new section if you are using rule-based calculations and the through lane configuration or pivot/rotation method changes. The changes should be based on the through lanes, as auxiliary lanes such as turn lanes, ramp entrances and exits and truck climbing lanes are handled independently. However, the auxiliary lanes must be drawn within a single section.

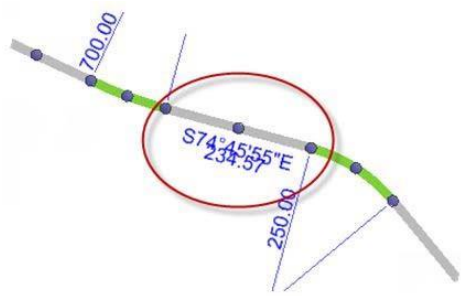
**Workflow**

1. Select **Create Superelevation Section.**
2. Follow the heads-up prompts.

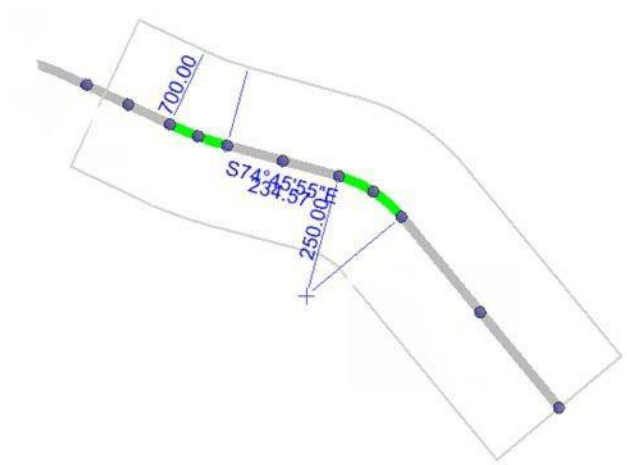
| Prompt | User Action |
|---|---|
| **Name** | Name each section, suggestions include alignment name which can be appended -1, 2, etc. for projects with multiple sections. |
| **Locate Reference Element** | Select the Civil horizontal element to be used as a basis for superelevation lanes and calculations. |
| **Start Station** | Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the section. The station can also be keyed in and locked |
| **End Station** | Graphically define (based on the dashed line perpendicular to the reference element) the ending of the section. The station can also be keyed in and locked |
| **Minimum Tangent Length** | Enter a value (in master units). If the tangent distance between two adjacent curves is less the specified value, the two curves and adjacent tangent are drawn into one curve set. If the tangent distance between two adjacent curves is greater the specified value, each curve and half of the adjacent tangent are drawn into each curve set. At the completion of this prompt, the sections are drawn and the software automatically advances to the Create Superelevation Lanes tool |

**Minimum Tangent Length**

This variable defines the minimum tangent between curves and is the determining factor on how curve sets are defined. When using rule-based calculations, there are times when you need to reprocess part of the superelevation calculations, perhaps due to a horizontal geometry change or design speed revision. If your project is one big section, then reprocessing is performed on the entire section, and overwrites any manual editing. For flexibility, curve sets enable the processing of one curve or multiple curves, while leaving manually manipulated sets intact. In the following example, the distance between curves is 234.57 master units.




The following results illustrate the impact of the **Minimum Tangent Length.**




*One curve set created (Min. Tangent Distance = 235*

*Two curve sets created (Min. Tangent Distance = 225*

*This line separates the two superelevation sections.*
*Example: first section may have a speed limit of 30 mph and the second section may have a speed limit of 25 mph. Using the Minimum Tangent Length will allow for separate superelevation sections to accomplish the task.*

**Create Superelevation Lanes** - At any time during the process, additional lanes can be added in any section. Primary lanes (those lanes that are rule based) or auxiliary lanes (those with user-specified cross slopes) can be added. The result of this step is graphic superelevated primary or auxiliary lanes.

**Workflow for Through Lanes**

1. Select the **Create Superelevation Lanes** tool.
2. Follow the heads-up prompts.

| Prompt | User Action |
|---|---|
| **Locate First Superelevation Section** | Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included. |
| **Locate Next Superelevation Section or Reset to Complete** | Continue selecting sections until all are highlighted, then reset to move to the next prompt. |
| **Enter Lane Name** | Name each lane, suggestions include RT or LT which can be appended - 1, 2, etc. for projects with multiple lanes. |
| **Select Side of Centerline** | Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included. |
| **Inside Edge Offset** | Enter the offset (in master units) from the baseline reference. If the lane edge is the baseline reference, enter 0. |
| **Width** | Enter the width of the lane (in master units). |
| **Normal Cross Slope** | Enter the default cross slope to be used for calculations (in percent format). It not necessary to add the percent sign. |
| **Name** | The prompts are looping again, so you can define multiple lines with a single selection of the tool. You may need to move the cursor slightly for the prompt to appear. When you have no additional lanes to define, reset to exit the tool. |

*Two lanes defined, yellow and green; one each side of baseline reference (red)*

### Adding Lanes

At any time during the process, additional lanes can be added in any section. Primary lanes (those lanes that are rule based) or auxiliary lanes (those with user-specified cross slopes) can be added using the Create Superelevation tool, but within a single section. When a single section is selected, the prompts change to reflect adding an individual lane. The result of this step is graphic superelevated primary or auxiliary lane. The lane needs to be associated to the corridor, similar to the through lanes.

### Workflow for Individual Lane

1. Select the Create Superelevation Lanes tool.
2. Follow the heads-up prompts:

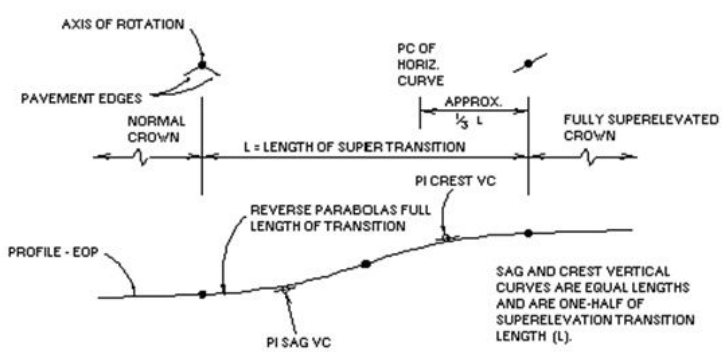
| Prompt | User Action |
|---|---|
| **Locate First Superelevation Section** | Select the first section. |
| **Locate Next Superelevation Section or Reset to Complete** | Reset to move to the next prompt. |
| **Type** | Options include: Primary (calculations based on rules) or Auxiliary (based on user- defined). After the selection, the dialog/heads-up prompts change to reflect the selection. |
| **Application Type (Aux. lane only)** | How to define cross-slope:<br>**None** - no cross slopes are assigned.<br>**Constant** - Fixed slope of specified value. If lane is transition, use this option, and then modify one end in the editor or graphically after creation.<br>**Follow Adjacent** - Projects cross slopes from adjacent lane to this lane. |
| **Select Side of Centerline** | Right or left |
| **Inside Edge Offset** | Enter the offset (in master units) from the baseline reference. If the lane edge is the baseline reference, enter 0. |
| **Width** | Enter the width of the lane (in master units). If the lane is of varying widths, you can use the widest width, or narrower than the width. In both cases, the template can control the width by parametric constraints or graphical features. |
| **Start Station** | Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the lane. Station can be keyed in and locked. |
| **End Station** | Graphically define (based on the dashed line perpendicular to the reference element) the end of the lane. Station can be keyed in and locked. |
| **Normal Cross Slope** | Enter the default cross slope to be used for calculations (in percent format). It is not necessary to add the percent sign. |

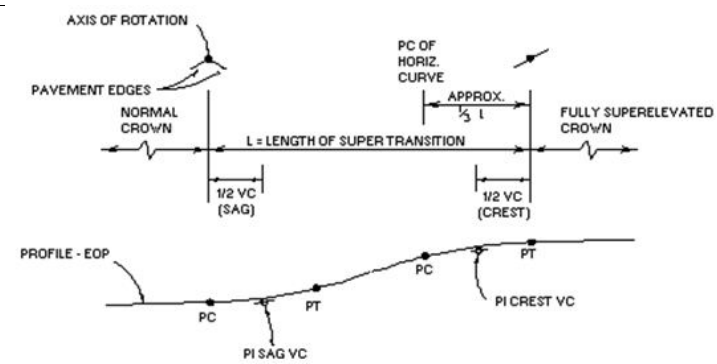
## Calculate Superelevation

The rules-based tool uses a preferences file (SEP) to compute the station and cross slopes of transitions.

### Workflow

1. Select **Calculate Superelevation**.
2. Follow the heads-up prompts for SEP file.

| Prompt | User Action |
|---|---|
| **Locate First Superelevation Section** | Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included. |
| **Locate Next Superelevation Section; or Reset to Complete** | Continue selecting sections until all are highlighted, then reset to move to the next prompt. |
| **Standards File Name** | Select the SEP containing the superelevation standards/parameters. Use <ALT> <DOWN> to open the File Manager to select directory/file. Data prompt to accept and move to the next prompt. |
| Note: The prompts below and their options may vary based on the options within the SEP file. | |
| **e Selection**<br>**L Selection** | The available e and length Selection fields are filled in according to the SEP file. Those combo boxes determine which table within the .sep file will be used for computation. |
| **Design Speed** | Design Speed is to be used either in the tables or equations for e and length computations. |
| **Pivot Method** | Rotation only |
| **Transition ID** | Linear or a variety of parabolic options, based on the settings in the SEPs. If the SEP file is set to parabolic, then the following options are supported:<br><br>Parabolic reverse curve - This symmetrical option utilizes the parabolic transition with no tangent and the length of each parabola is one-half the transition length.<br><br>  <br><br><br>Parabolic Reverse Nonsymmetrical Curve 1 - Lengths of the two parabolas are specified: Sag parabolic Length (L1) =45 and Crest Parabolic Length (L2) = 55. The Tangent Length = Transition Length - (L1+L2) as depicted below. |

| | |
|---|---|
| |  <br>Parabolic Reverse Nonsymmetrical Curve 2 - Lengths of the two parabolas are specified: Sag parabolic Length (L1) =30 and Crest Parabolic Length (L2) = 40. The Tangent Length = Transition Length - (L1+L2) as depicted above.<br><br>The values of the parabolic lengths are set by configuration variables by default. To change the values, add the configuration variable and the desired values. |
| **Number of Lanes** | Used to determine when adjustment factors are applied. |
| **Facility** | Divided or undivided: determines which values to use for Distribute Over and % on Tangent options. |
| **Ease Length** | Not utilized in SEP files. |
| **Add Constraints** | Not supported in SEP files. |
| **Open Editor** | When calculations are complete and lanes updated, the superelevation editor is opened and populated with the new calculated lanes. |

### Import Superelevation

In lieu of using rule-based superelevation transitions, the data may be imported from a CSV file, where calculations are done outside of the Civil products and just the results are imported. In this case, rules do not apply, so no SEP is needed or specified.

Entire projects can be imported, in which case, only one superelevation section is needed. However, you can also import just a turn lane or two, or part of your project. Keep in mind the superelevation section and lanes must be created prior to importing, and lane names associated with the graphics must match the names in the import file.

The Windows delimiter value is used, which is generally set to comma; however, if you are experiencing difficulties, you may want to verify this on your workstation or laptop.

If a file is imported twice, duplicate lanes are not created; rather the values of the import file overwrite any values (including manual edits) of lanes.

The file format of the comma separated values file is:

| Data | Description |
|---|---|
| **Superelevation Lane** | Links the data to an existing superelevation lane. |
| **Station** | Units should match design file.<br>Station equations supported based on the sections reference alignment. |
| **Cross Slope** | Formatted as a double value : ±0.0 (i.e. -2% == -0.02) |
| **Pivot About** | Enumerated list: {LS,RS} LS = left side<br><br>RS = right side |

The following details the optional information:

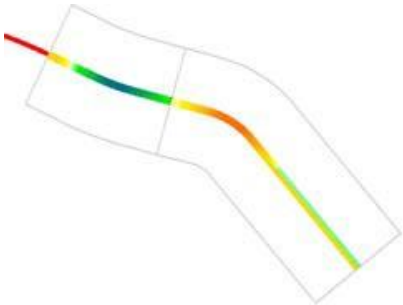
| Data | Description |
|---|---|
| **Point Type** | Enumerated list:<br>{NC,NCIN,NCOUT,LC,LCIN,LCOUT,RC,RCIN,RCOUT,FS,FSIN,FSOUT,U}<br><br>NC = Normal Crown, LC = Level Crown, RC = Reverse Crown, FS = Full Super, U = Undefined |
| **Transition Type** | Enumerated list : {L,PC,PRC,BRC,CRC,SRC}<br><br>L = Linear, PC = Parabolic Curve, PRC = Parabolic Reverse Curve, BRC = Biquadratic Reverse Curve, CRC = Cubic Reverse Curve, SRC = Symmetrical Reverse Curve |
| **Non-Linear Curve Length** | Default Value = 0.0<br><br>Only pertinent for transition type: parabolic curve or symmetrical reverse curve. |

**Workflow**

1. Create the **CSV** file, based on file format.
2. Create superelevation section and lanes, ensuring the lane names match those used in the CSV file.
3. Select the **Import Superelevation** tool.
4. Follow the heads-up prompts:

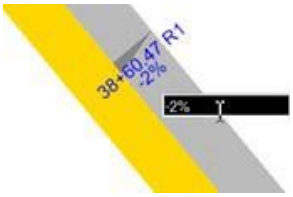
| Prompt | User Action |
|---|---|
| **Locate First Superelevation Section** | Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included. |
| **Locate Next Superelevation Section or Reset to Complete** | Continue selecting sections until all are highlighted, then reset to move to the next prompt. |
| **Import File Name** | Use <ALT> <DOWN> to open the File Manager to select directory / CSV file. |

The results look identical to those of the calculated superelevation lanes. All functionality (i.e., editor, graphic manipulation, etc.) supported for calculation lanes is also supported for imported lanes, aside from reprocessing.



**Editing Lanes**

There are several ways to review the superelevation data and edit if desired. Highlighting a section displays station and cross slope values for review and editing. Stationing can be changed dynamically by selecting the gray wedge and dragging to the desired station. Each lane can be manipulated independently of the adjacent lanes. The station can all be keyed into the edit field. Slopes can be changed by keying the slope into the edit field.



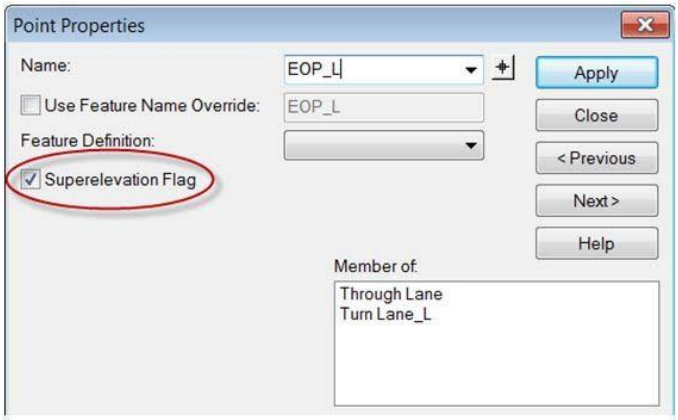
## Assign Superelevation to Corridor

At any time during the process, the superelevated lanes can be associated with a corridor. If the superelevated lanes are in a different file than the corridor, you must be in the corridor file with the super lanes attached as a reference. They can both be in the same file.

The result of this step is the superelevated pavement is reflected in the corridor model.

**Workflow**

1. Verify that the template has the *Superelevation Flag* set for all pavement points used as candidate superelevation points. This flag is used for automatically setting the point controls. To discover if the Flag has been applied to the template, Open the Edit Template Drop and select the Template Drop handle. Once inside the Editor, double click on the EOP point.

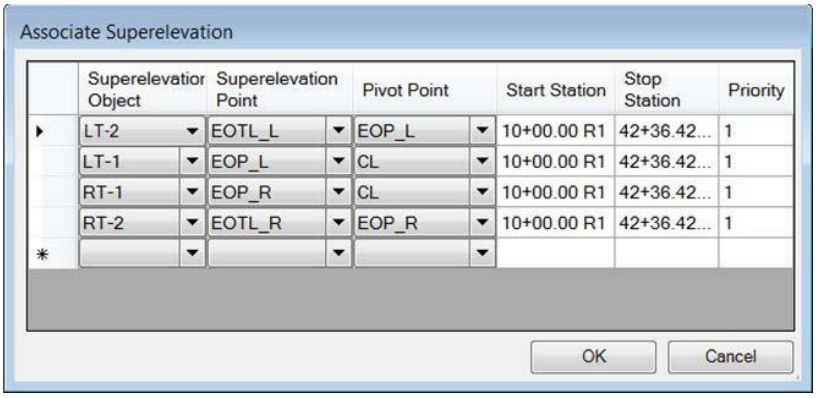



2. From within the DGN containing the corridor model, select the **Assign Superelevation to Corridor** tool.
3. Follow the heads-up prompts.

Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included.

| Prompt | User Action |
|---|---|
| **Locate First Superelevation Section** | Select the first section. In lieu of selecting each section individually, drag your cursor diagonally across all desired sections. Your diagonal defines a square wherein the entire section must be encompassed in order to be included. |
| **Locate Next Superelevation Section or Reset to Complete** | Continue selecting sections until all are highlighted, then reset to move to the next prompt. |
| **Locate Corridor** | Select the corridor wherein the superelevation transitions are to be applied. |

The *Associate Superelevation* dialog is displayed.




1. If the information is correct, click **OK**. If not, click **Cancel** and review the template. Superelevation has been incorporated into the corridor model.
2. Generate a dynamic cross section view to see the superelevation.

## Insert Superelevation/Cross slope

There may be times when an additional station and cross slope transition need to be added to an existing superelevation lane. Rather than deleting the lane and recreating it, *the Insert Superelevation Station/Cross-slope* tool can be used.

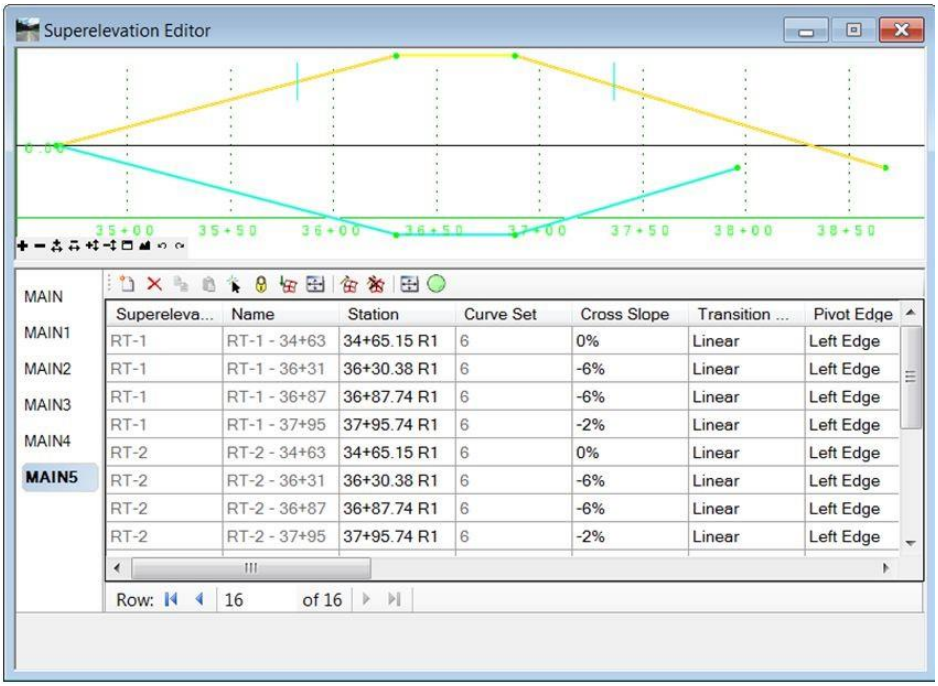
### Workflow

1. Select **Superelevation Station/Cross-slope**.
2. Follow the heads-up prompts.

| Prompt | User Action |
|---|---|
| **Locate Superelevation** | Select a previously created superelevation lane that has superelevation calculations already assigned. |
| **Locate Reference Element** | Select the Civil horizontal element to be used as a basis for superelevation lanes and calculations. |
| **Start Station** | Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the section. The station can be keyed in and locked. |

## Superelevation Editor

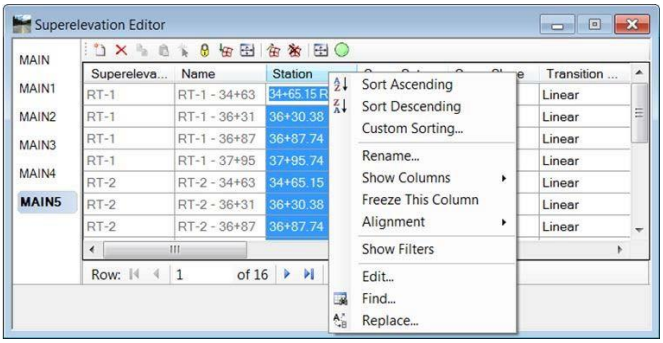
The superelevation editor is another way to edit the data, in a tabular format. Any changes made in the editor are automatically synced with the graphic lanes and vice versa. Any data in gray cannot be edited, due to constraints used during calculations with the SEP method.




| Supereleva... | Name | Station | Curve Set | Cross Slope | Transition ... | Pivot Edge |
|---|---|---|---|---|---|---|
| RT-1 | RT-1 - 34+63 | 34+65.15 R1 | 6 | 0% | Linear | Left Edge |
| RT-1 | RT-1 - 36+31 | 36+30.38 R1 | 6 | -6% | Linear | Left Edge |
| RT-1 | RT-1 - 36+87 | 36+87.74 R1 | 6 | -6% | Linear | Left Edge |
| RT-1 | RT-1 - 37+95 | 37+95.74 R1 | 6 | -2% | Linear | Left Edge |
| RT-2 | RT-2 - 34+63 | 34+65.15 R1 | 6 | 0% | Linear | Left Edge |
| RT-2 | RT-2 - 36+31 | 36+30.38 R1 | 6 | -6% | Linear | Left Edge |
| RT-2 | RT-2 - 36+87 | 36+87.74 R1 | 6 | -6% | Linear | Left Edge |
| RT-2 | RT-2 - 37+95 | 37+95.74 R1 | 6 | -2% | Linear | Left Edge |

The editor is opened by selecting the tool, then selecting the superelevation section(s). The curve sets are listed along the left side. Highlighting any curve set populates the table. Colored points indicate:

- **Red** - fully constrained
- **Yellow** - partially constrained
- **Green** - not constrained




Between the diagram and the table are numerous short-cut icons to the superelevation tools.

The superelevation diagram at the top is display only. Right click on the superelevation diagram to display the Superelevation Display List dialog.

The fields in the editor can be customized so unused or unwanted fields can be hidden. This is accomplished by right-clicking on any Header in the tabular data area to open the pop-up menu.

## Superelevation Report

Superelevation reports can be generated for a single or multiple sections. Reports are displayed in the Civil Report browser.

**Workflow**

1. Select **Superelevation Report**.
2. Follow the heads-up prompts.

| Prompt | User Action |
|---|---|
| Name | Name each section, suggestions include alignment name which can be appended -1, 2, etc. for projects with multiple sections. |
| Locate Reference Element | Select the Civil horizontal element to be used as a basis for superelevation lanes and calculations. |
| Start Station | Graphically define (based on the dashed line perpendicular to the reference element) the beginning of the section. The Station can also be keyed in and locked. |

## Display Superelevation In Plan

Use the *Display Superelevation in Plan* command to automatically generate annotation for superelevation station information in plan view.

The command uses the MicroStation active symbology to display the lines and the text. The user sets active text height and width, color, line weight, and line spacing. The line spacing is used to offset the text from the top and bottom of the superelevation lines. The justification is hardcoded to be center bottom to the right of the alignment and center top to the left for the station values. The cross slope value is displayed using left center justification.

The arrow head uses the active text height to determine its height.

All text, offsets, and the height of the arrow head are scaled by the MicroStation annotation scale factor.

**Workflow**

1. Select Display Superelevation in Plan.
2. Follow the heads-up prompts.

## 7.9 Group Exercise – Road 1 Superelevation

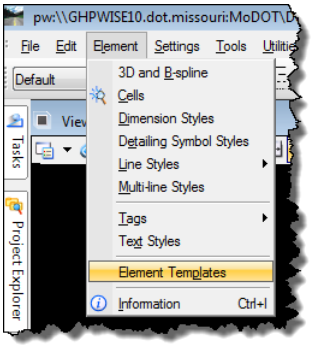
1. Within the ***J2P0200\data_07*** folder, open the file: **Corridors_J2P0200.dgn**
2. Create a new file named **Superelevation_J2P0200.dgn** based on the following 2D seed file:

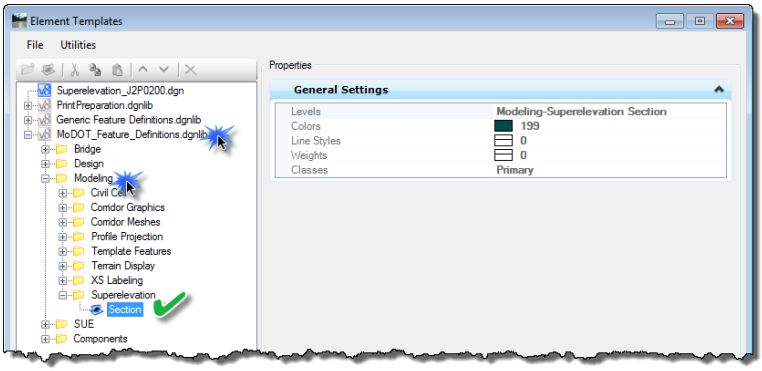
   ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn***.
3. Reference in the following file:

   **Civil_Geometry_J2P0200.dgn**

### Create Superelevation Sections

4. Change the Primary Attributes by selecting the Superelevation Element Template from the Element pull down, navigating to the Section option and then double clicking.

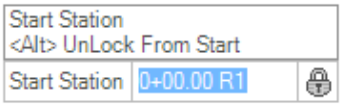


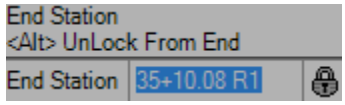

5. From the *Corridor Modeling* task choose **Create Superelevation Sections**.
6. When prompted for the *Name* key in **Road1** and **data point** or **tab** to accept.

7. When prompted to *Locate Reference Element* data point on the **Road1** horizontal geometry.

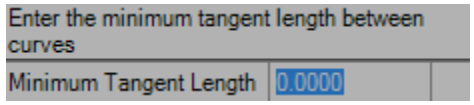
8. When prompted to enter the *Start Station* either select the beginning of Road, key in **0** for the station **or** press the **Alt** key to lock to the beginning station. **Data point** to accept.



9. When prompted to enter the *End Station* either select the end of Road, key in **3510.08** for the station **or** press **Alt** to lock to the ending station. **Data point** to accept.




10. There is only one curve on this section of Road1so there is no tangent length between curves. Therefore enter a **Minimum Tangent Length** of 0. **Data point** to accept.



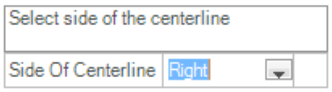

**Note:** If the geometry had multiple curves with different design speed then you would create multiple Superelevation Sections.

**Create Superelevation Lanes**

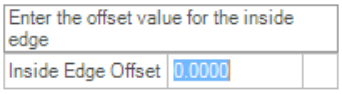
11. When prompted *Enter Lane Name*, key in **South** (stationing starts at the north end of Road1). **Data point** to accept.

12. Verify *Type* is set to **Primary**. **Data point** to accept.

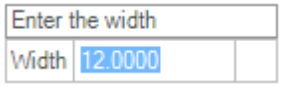
13. When prompted to *Select side of the centerline*, select **Right** from the drop-down menu by using the down arrow. **Data point** to accept.



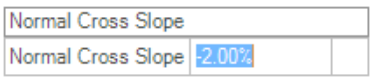

14. There is no offset. So when prompted to *Enter the offset value for the inside* edge, enter **0.00**. **Data point** to accept.




15. In the *Enter the Width* field, key in the width of the lane. This value is based on the template assigned to the corridor. Key in **12.00**. **Data point** to accept.




In the *Normal Cross Slope* dialog, enter a normal cross slope of **-2%**. **Data point** to accept.



16. When prompted to *Enter Lane Name*, enter **North**. **Data point** to accept.

17. Set the *Type* to **Primary**. **Data point** to accept.

18. Set the *Side of Centerline* to **Left**. **Data point** to accept.

19. There is no offset. Set the *Inside Edge Offset* to **0.00**. **Data point** to accept.

20. Enter a *Width* of **12**. **Data point** to accept.

21. Enter a *Normal Cross Slope* of **-2%**. **Data point** to accept.

22. **Reset** to continue.

**Calculate Superelevation**

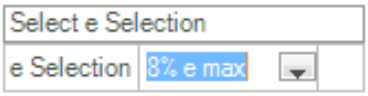
**23.** Open the **Calculate Superelevation** Tool.

24. Select **<Alt> + Down** or use the dialog box to pick the **MoDOT_Standard_Plans-Undivided.sep** file delivered in the workspace.

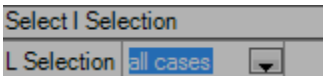
***T:\MoDOT_Workspace\Gpk_Std\Superelevation\ MoDOT_Standard_Plans-Undivided.sep***

**Data point** to accept.

25. In the *Select e Selection* prompt select **8% e max** by using the down arrow**. Data point** to accept.

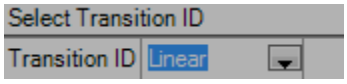



26. For *L Selection* select **all cases**. **Data point** to accept.

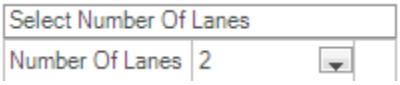



27. *Select a Design Speed* of **50**. **Data point** to accept.

28. For *Transition ID* select **Linear**. **Data point** to accept.

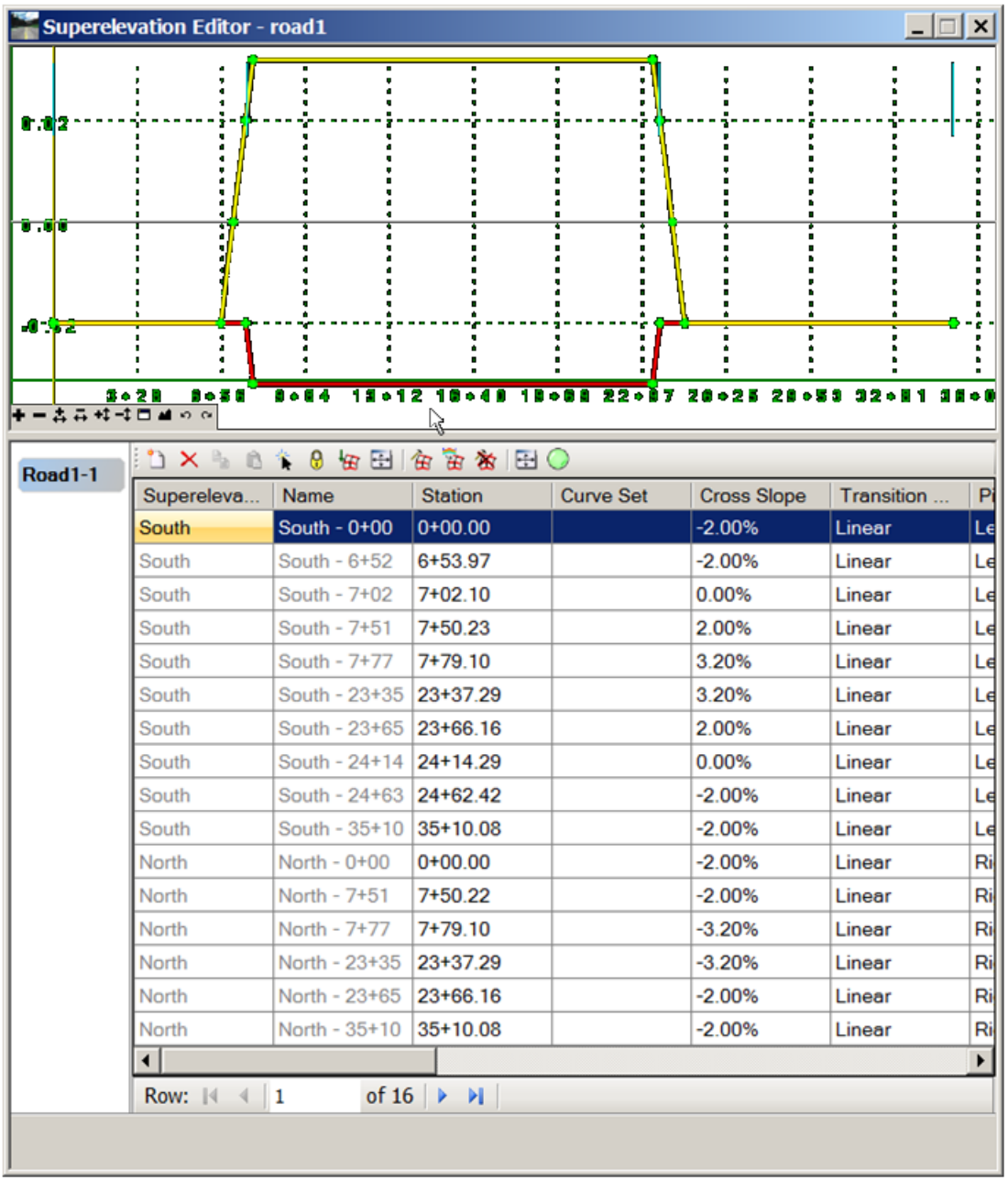



29. Select **2** for the *Number Of Lanes*. **Data point** to accept.



30. Select **Undivided** in the *Select Facility* option. **Data point** to accept.

31. Select **Yes** for the ***Open Editor***. This brings up the *Superelevation Editor* dialog. Facilitating adjustments to stations to full super, slopes etc.




| Supereleva... | Name | Station | Curve Set | Cross Slope | Transition ... | Pi |
|---|---|---|---|---|---|---|
| South | South - 0+00 | 0+00.00 | | -2.00% | Linear | Le |
| South | South - 6+52 | 6+53.97 | | -2.00% | Linear | Le |
| South | South - 7+02 | 7+02.10 | | 0.00% | Linear | Le |
| South | South - 7+51 | 7+50.23 | | 2.00% | Linear | Le |
| South | South - 7+77 | 7+79.10 | | 3.20% | Linear | Le |
| South | South - 23+35 | 23+37.29 | | 3.20% | Linear | Le |
| South | South - 23+65 | 23+66.16 | | 2.00% | Linear | Le |
| South | South - 24+14 | 24+14.29 | | 0.00% | Linear | Le |
| South | South - 24+63 | 24+62.42 | | -2.00% | Linear | Le |
| South | South - 35+10 | 35+10.08 | | -2.00% | Linear | Le |
| North | North - 0+00 | 0+00.00 | | -2.00% | Linear | Ri |
| North | North - 7+51 | 7+50.22 | | -2.00% | Linear | Ri |
| North | North - 7+77 | 7+79.10 | | -3.20% | Linear | Ri |
| North | North - 23+35 | 23+37.29 | | -3.20% | Linear | Ri |
| North | North - 23+65 | 23+66.16 | | -2.00% | Linear | Ri |
| North | North - 35+10 | 35+10.08 | | -2.00% | Linear | Ri |

32. **Compress** the file and **Save Settings**.

**Assign Superelevation to Corridor**

Once the superelevation is created based on the alignment it must be tied to the corridor. Assigning the superelevation requires the editing of the corridor model therefore the dgn file with the corridor model must be open. Having the superelevation in a separate design file allows one user to work on super and another to work on the corridors. Also the superelevation reference can be turned off when viewing is not required.

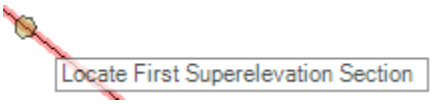
33. Select **File > Open** and select the **Corridor_J2P0200.dgn**.

34. Attach the **Superelevation_J2P0200.dgn** by opening the *References* dialog box and clicking Tools>Attach…, use the attachment method **Coincident – World** and **No Nesting**.

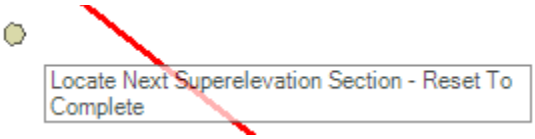
35. Close the *References* dialog box.

36. Select the **Assign Superelevation to Corridor** in the *Corridor Modeling* task group.

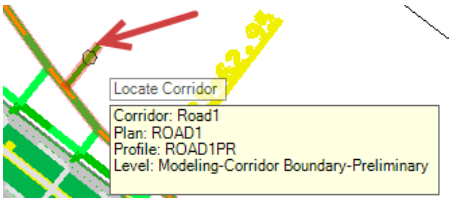
37. When prompted to *Locate First Superelevation Section* **data point** on the **Road1 s**uper section.



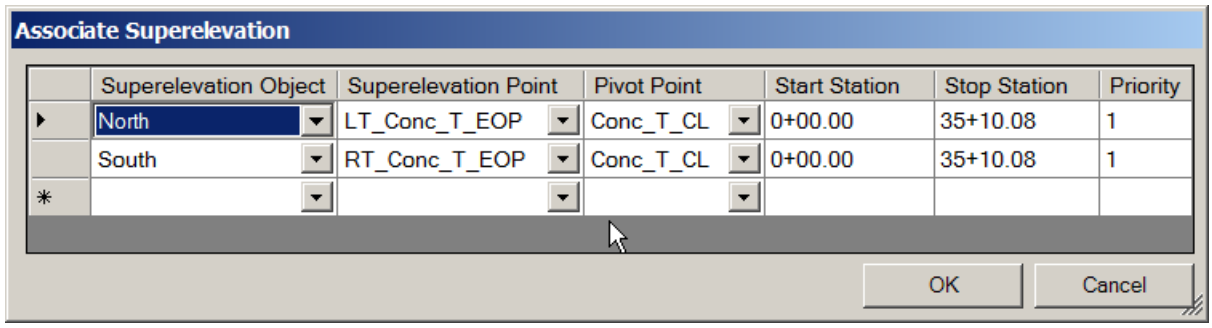

38. There is only one section, when prompted, **Reset** to Complete.




39. When prompted to *Locate Corridor*, identify one of the corridor grab handles. These extend from the outside edge of the corridor.



40. A dialog with a list of the Superelevation objects will display. Review to verify. If changes to Stations, priorities, or points are required, they can be made here. If correct click **OK**.




41. **Reset** when prompted to *Locate First Superelevation Section*.

42. Select **File** > **References**.

43. Click on the frame of **View 1**.

44. **Turn off** the display of reference file named: **Superelevation_J2P0200.dgn**.

45. **Open View 7** which contains the dynamic cross sections and review the superelevated sections.

46. Select **File** > **Update Server Copy**

## 7.10 Individual Exercise - Route 63 Superelevation

1. Within the ***J2P0200\data_07*** folder, open the file: **Superelevation_J2P0200.dgn**

### Create Superelevation Sections

2. From the ***Corridor Modeling*** task group select the **Create Superelevation Sections**.
3. When prompted for the name key in **Route63**. **Data point** to accept.
4. When prompted to *Locate Reference Element*, select the **RTE63** horizontal geometry.
5. When prompted for the *Start Station*, press **Alt** to lock to the beginning station. **Data point** to accept.
6. When prompted for the *End Station*, press **Alt** to lock to the ending station. **Data point** to accept.
7. There is only one curve on this section of RTE63 so there is no tangent length between curves. Therefore enter a **Minimum Tangent Length** of 0. **Data point** to accept.

### Create Superelevation Lanes

8. When prompted to *Enter Lane Name*, enter **NBInside.** **Data point** to accept.
9. Set the *Type* to **Primary**. **Data point** to accept.
10. Set the *Side of Centerline* to **Left**. **Data point** to accept.
11. The offset value for the inside edge is 30'. Set the *Inside Edge Offset* to **30.00.** **Data point** to accept.
12. In the *Enter the width* dialog, key in **12.000** for the width of the lane. **Data point** to accept. This value is based on the template assigned to the corridor.
13. Enter a *Normal Cross Slope* of **+2%.** **Data point** to accept.
14. When prompted to *Enter Lane Name*, key in **NBOutside**. **Data point** to accept.
15. Set the *Type* to **Primary**. **Data point** to accept.
16. Set the *Side of Centerline* to **Left**. **Data point** to accept.
17. Set the *Inside Edge Offset* to **42.00**. **Data point** to accept.
18. In the *Enter the Width* key in the **12.000** width of the lane. **Data point** to accept.
19. Enter a *Normal Cross Slope* of **-2%**. **Data point** to accept.
20. When prompted to *Enter Lane Name*, key in **SBOutside**. **Data point** to accept.

21. Set the *Type* to **Primary**. **Data point** to accept.
22. Set the *Side of Centerline* to **Right**. **Data point** to accept.
23. Set the *Inside Edge Offset* to **42.00**. **Data point** to accept.
24. In the *Enter the Width* key in the **12.000** for the width. **Data point** to accept.
25. Enter a *Normal Cross Slope* of **-2%**. **Data point** to accept.
26. When prompted to *Enter Lane Name*, key in **SBInside**. **Data point** to accept.
27. Set the *Type* to **Primary**. **Data point** to accept.
28. Set the *Side of Centerline* to **Right**. **Data point** to accept.
29. Set the *Inside Edge Offset* to **30.00**. **Data point** to accept.
30. In the *Enter the Width*, key in the **12.000** for the width. **Data point** to accept. This value is based on the template assigned to the corridor.
31. Enter a *Normal Cross Slope* of +**2%**.
32. **Reset** to continue.

**Calculate Superelevation**

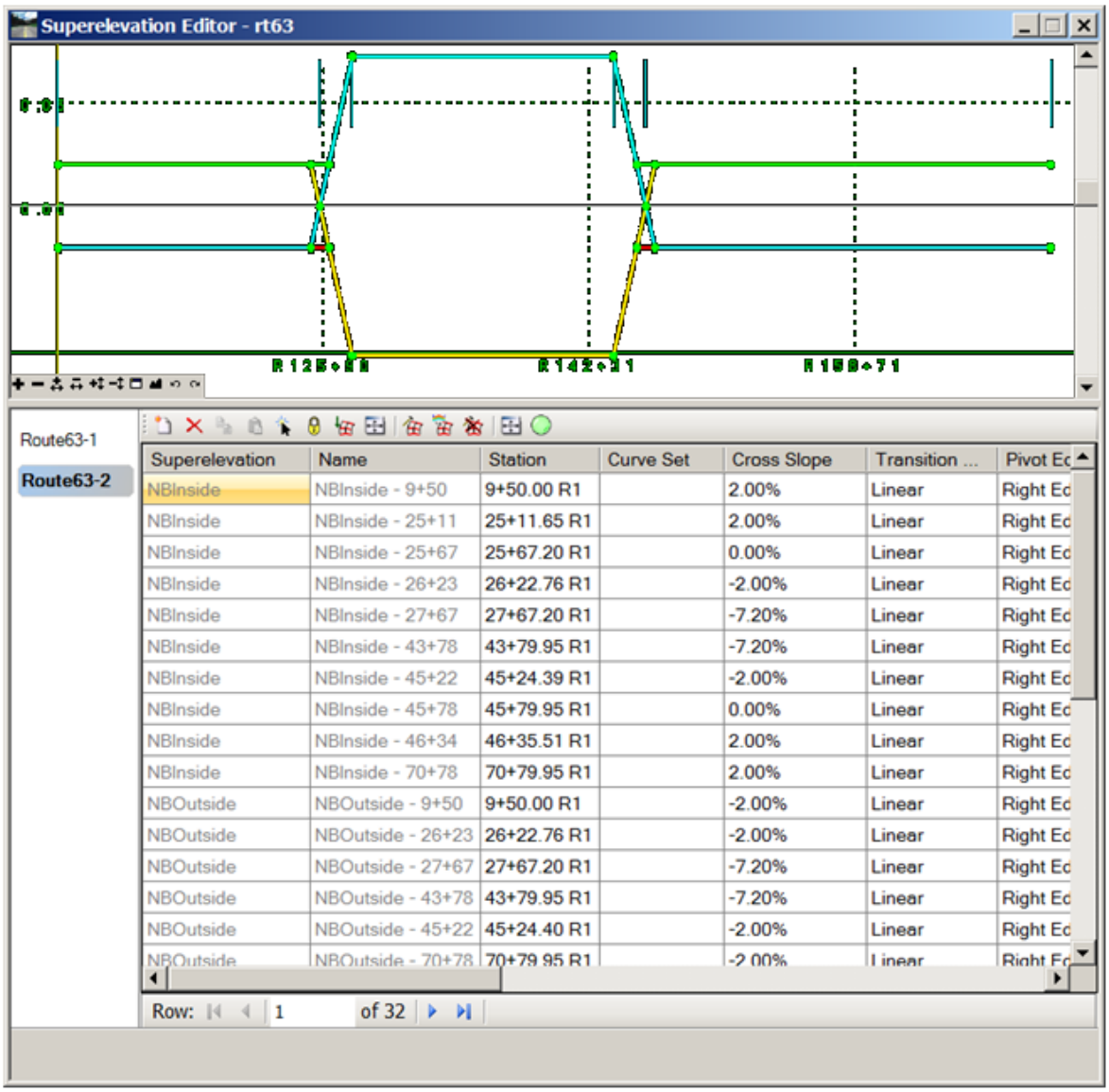
33. Select **<Alt> + Down** or use the dialog box to pick the **MoDOT_Standard_Plans-Divided.sep** file delivered in the workspace.

    ***T:\MoDOT_Workspace\Gpk_Std\ MoDOT_Standard_Plans-Divided.sep*.**

    **Data point** to accept.

34. In the *Select e Selection* prompt, select **8% e max**. **Data point** to accept.
35. For the *L Selection*, select **all cases**. **Data point** to accept.
36. Set a *Design Speed* of **70**. **Data point** to accept.
37. For the *Transition ID*, select **Linear**. **Data point** to accept.
38. Select **4** for the *Number Of Lanes*. **Data point** to accept.
39. Select **Divided** for the *Select Facility* option. **Data point** to accept.

40. Select **Yes** for the *Open Editor* option. **Data point** to accept. This brings up the *Superelevation Editor* dialog for facilitating adjustments to stations, slopes etc.




**Assign Superelevation to Corridor**

Once the superelevation is created based on the alignment it must be tied to the corridor. Assigning the superelevation requires the editing of the corridor model therefore the dgn file with the corridor model must be open. Having the superelevation in a separate design file allows one user to work on super and another to work on the corridors. Also the superelevation reference can be turned off when viewing is not required.

41. Open the **Corridors_J2P0200.dgn** file.

42. Turn on the display of the **Superelevation_J2P0200.dgn** file in **View 1** in the *References* dialog box.

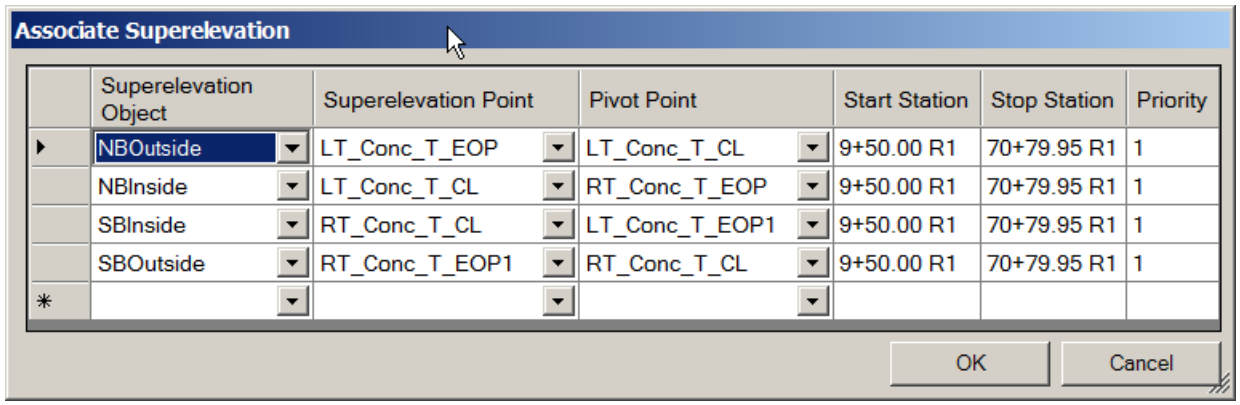
43. Select the **Assign Superelevation to Corridor** in the *Corridor Modeling* task group.

44. When prompted to *Locate First Superelevation Section*, **data point** on the **Route63** Super Section.

45. **Reset** to complete.

46. When prompted to *Locate Corridor*, select one of the Corridor grab handles. These extend from the outside edge of the corridor.

47. A dialog with a list of the Superelevation objects will display. Review to verify. If changes to Stations, priorities, or points are required they can be made here. If correct, click **OK**.




| | Superelevation Object | Superelevation Point | Pivot Point | Start Station | Stop Station | Priority |
|---|---|---|---|---|---|---|
| ▸ | NBOutside | LT_Conc_T_EOP | LT_Conc_T_CL | 9+50.00 R1 | 70+79.95 R1 | 1 |
| | NBInside | LT_Conc_T_CL | RT_Conc_T_EOP | 9+50.00 R1 | 70+79.95 R1 | 1 |
| | SBInside | RT_Conc_T_CL | LT_Conc_T_EOP1 | 9+50.00 R1 | 70+79.95 R1 | 1 |
| | SBOutside | RT_Conc_T_EOP1 | RT_Conc_T_CL | 9+50.00 R1 | 70+79.95 R1 | 1 |
| * | | | | | | |

48. **Reset** when prompted to *Locate First Superelevation Section*.

49. **Open View 8** which contains the dynamic cross sections and review the superelevated sections.

50. Select **File > Update Server Copy**

# Chapter 8

# Designing with Corridor Modeling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8.3 Basic Workflow for Creating a New Corridor ..... 8-2
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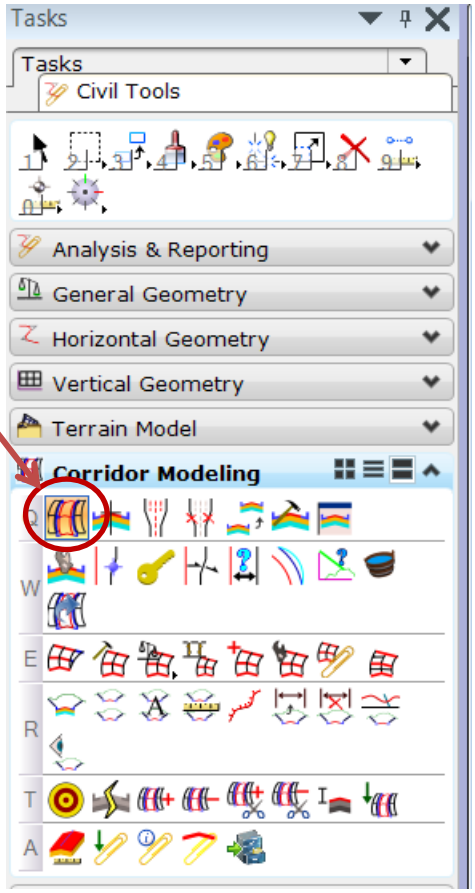
## 8.12 Objectives

The purpose of this chapter is to show the user how to use the multiple tools available in Corridor Modeling task group to achieve desired results for the design of the corridor.

## 8.13 Create Corridor




Creating a corridor, using the Create Corridor command, is the first step in creating a corridor model. One corridor should be established for each alignment. The corridor is saved in the MicroStation Design file.

The following are the steps and prompts used by the Create Corridor command:

1. When using the Create Corridor command, you are first prompted to *Locate Corridor Baseline*. Simply select the appropriate horizontal geometry.
2. You will then be prompted to *Locate Profile-Reset For Active Profile*. If the horizontal geometry has the appropriate profile active, simply reset. You can select a different profile from a profile view.
3. You will then be prompted to key in the *Corridor Name*. The name of the corridor should be the name of the horizontal geometry.
4. You will then be prompted to *Select Template*. Hold down the Alt key and press the Down Arrow on your keyboard. This will bring up the *Pick Template* dialog. Select the appropriate template and click OK.
5. You will then be prompted to select the *Start Station*. To move to the beginning of the horizontal geometry, press the Alt key on your keyboard. You can also key in the appropriate Start Station or move your cursor to location in the CAD view.
6. You will then be prompted to select the *End Station*. To move to the end of the horizontal geometry, press the Alt key on your keyboard. You can also key in the appropriate End Station or move your cursor to location in the CAD view.
7. You will then be prompted to key in the *Drop Interval*. The Drop Interval represents how often to perpendicularly process the template along the geometry. The Drop Interval should be a number that divides evenly into the cross section interval (ex. 10, 25).
8. You will then be prompted to key in *Start Transition – Minimum Transition Before Drop*. If more than one template is being used for the project, the Start Transition – Minimum Transition Before Drop option represents the length of transition between the template selected in Step 4 and a different template located before the one selected in Step 4.
9. You will then be prompted to key in *Stop Transition – Minimum Transition After Drop*. If more than one template is being used for the project, the Stop Transition – Minimum

Transition After Drop option represents the length of transition between the template selected in Step 4 and a different template located after the one selected in Step 4.

10. To add different templates, repeat Step 4 to Step 9. If you are adding different templates after you exit the Create Corridor command, use the Create Template Drop command to add different templates.

## 8.14 Basic Workflow for Creating a New Corridor

1. Select the **Create Corridor** icon from the *Corridor Modeling* tasks group.
2. Select the horizontal geometry and reset for the active profile.
3. Key in the **Corridor Name**.
4. Select the appropriate template.
5. Key in the corridor start and stop stations.
6. Key in the transition lengths.

## 8.15 Multiple Templates

*Create Corridor* is a versatile tool that allows the user to use multiple design templates for one corridor. The user should review the corridor and identify the possible locations for changes in the template before starting the corridor design in using the Create Corridor tool.

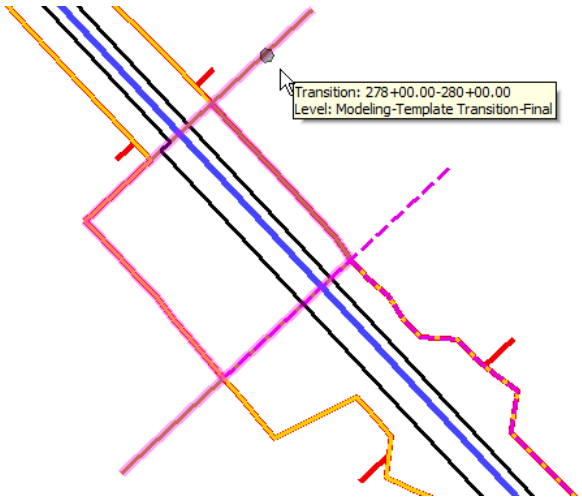
### 8.15.1 Multiple Template Drops

Anytime there is a situation where the design changes, for example from a 2-lane to 4-lane, or from rural to urban; the user needs to insert or "*drop*" multiple templates in the corridor to achieve the desired results. This is accomplished thru the *Create Template Drop* icon from the *Corridor Modeling* tasks group.

The *Create Template Drop* command has prompts similar to the Create Corridor command.

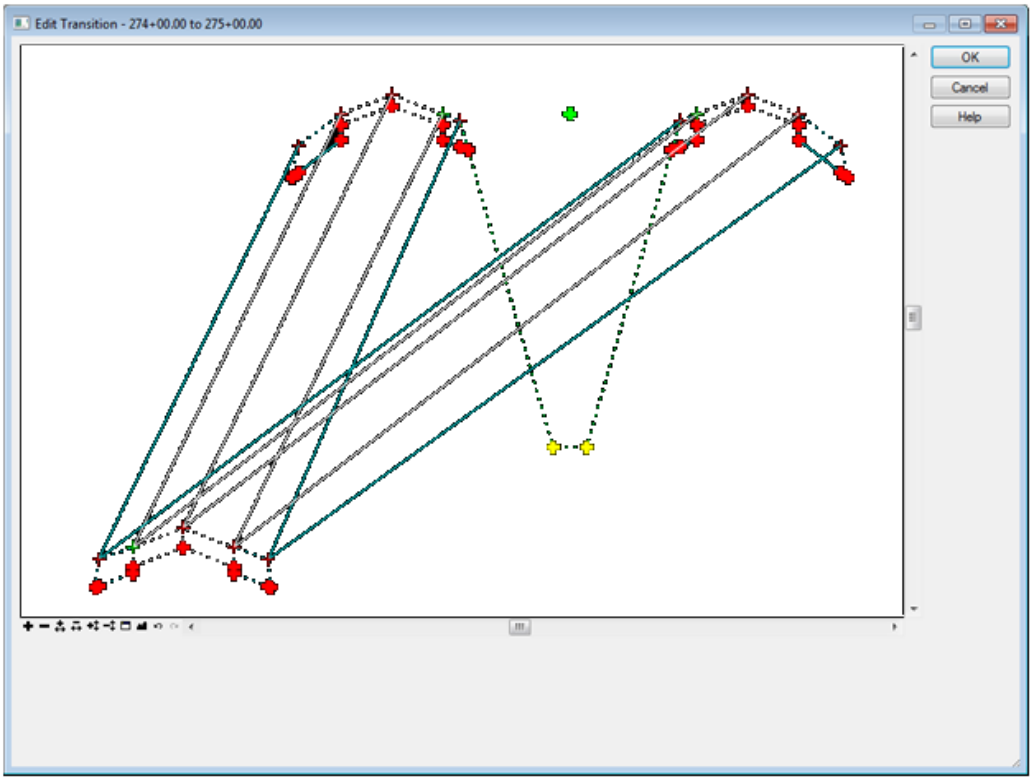
## 8.16 Template Transitioning

When multiple templates are used within one corridor, a transition from one to the other is introduced, and it will be shown in the MicroStation view. The transition will be abrupt until the transition is fully defined using the **Edit Transition** icon from the *Corridor Modeler* tasks group. These transitions are shown as an object between the template drops.

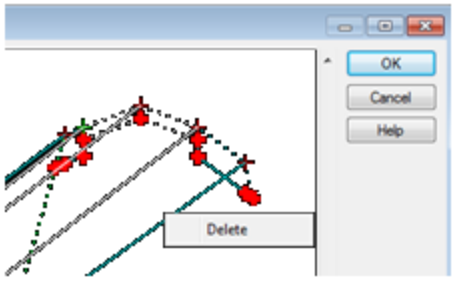



### 8.16.1 Transition Editing

To review the transition areas, use the Edit Transition tool and select the transition when prompted. This displays the *Edit Transition* dialog which shows the point connections between the two templates.




Bold color points indicate no connection. Point connections can be made by clicking on any bold color point followed by a click on appropriate connecting point. A single point can have more than one connection to that point. To remove a connection line, right-click on the line and select Delete.

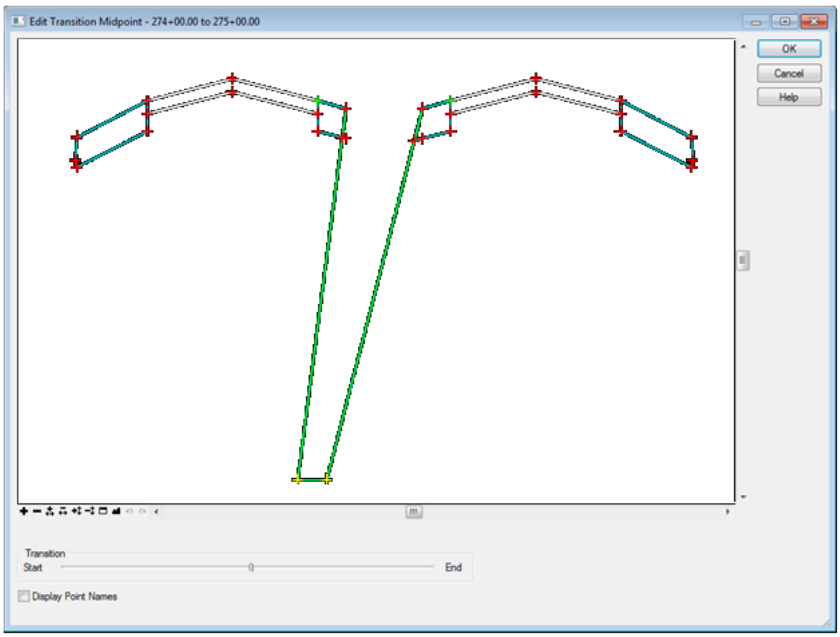



This window provides a 3D view and it can be manipulated using the view controls located at the bottom of the view. To move the template in the view, right-click on any template point and select Move Template. Moving template makes it easier to edit.

## 8.16.2 Transition Testing

After the points are connected, the transitioning is reviewed and edited in the Edit Transition Midpoint dialog. This dialog displays a cross section view of two templates as they transition. The display starts at the transition midpoint between the two templates, but can be viewed at the beginning, ending or any point in between.

If the user desires to change point properties, double click on any point to bring the Point Properties dialog.



## 8.17 Template Point Controls

Point controls are used to override the established horizontal and vertical locations of points from the original point location on the template. Point controls are the equivalent of the criteria adhocs placed on plan graphics with D&C Manager to control widths, ditch slopes, etc. Point controls then are used to control horizontal and vertical locations for EOP, EOS, sidewalks, retaining walls, barriers, special ditch profiles and ditch widths, etc.

The *Create Point Control* icon can be accessed thru the *Corridor Modeling* tasks group.

**Point Controls** are used to override the normal locations of one or more points and or components in a cross section. Examples of this include lane widening, staying within the right-of-way, maintaining a particular slope for a ditch, and superelevation.

An example would be a ramp is merging into the main road. The ramps left edge is vertically controlled by the main road right edge of pavement. The ramps left edge is horizontally controlled by the main road right edge from 0+00 to 1+00, and then it is controlled by a horizontal alignment named rampLeft.

The following are the prompts for the *Create Point Control* command:

**Locate Corridor** Selects the corridor where the point controls are applied.

**Station Limits (Start/Stop)** Specifies the start and stop stations for the control.

**Control Description** Allows you to enter a description of the control.

**Point** Allows you to select the point to be controlled. Select from the list or identify the point in the cross-section using the locate button. The selected point is highlighted in plan/cross section and profile or superelevation views as applicable.

**Mode** Allows you to select the control mode: Horizontal, Vertical, or Both.

**Control Type** Specifies the type of control.

If the mode is **Horizontal** or **Both**, valid control types are *Linear Geometry*, *Feature Definition*, or *Corridor Feature*.

If the mode is **Vertical**, valid control types are *Linear Geometry*, *Feature Definition*, *Corridor Feature*, *Superelevation*, *Elevation Difference*, *Elevation and Grade*.

The selection combo boxes and/or field displayed depends on the selected *Mode* and *Control Type*.

**Type - Linear Geometry** If the type is Linear Geometry, a Horizontal Offsets combo box is displayed. If the mode is Both, a Vertical Offsets combo box is also displayed.

**Type - Feature Definition** If the type is Feature Definition, a Feature Definition and Range text field is displayed.

**Type - Corridor Point** For all modes, Corridor and Reference Feature combo boxes are displayed. These options allow you to set up the control of one corridor's points(s) from another corridor's point(s).

Targeting another corridor's point cannot be done simultaneously with Target Aliasing of that same corridor. If Target Aliasing has been defined, the Corridor Point is not available for selection within the Point Control dialog. This produces a recursive situation, making the corridor point control unavailable for selection until that Target Aliasing is removed.

**Type – Superelevation** This option displays a Superelevation control line combo box, and a Reference Point combo box. Superelevation control lines are stored in the roadway design, not on the alignment. The reference point is the pivot point (feature) about which the point will rotate.

**Type - Elevation Difference** This option displays Horizontal and Vertical alignment combo boxes. The vertical alignment represents a vertical difference value to be applied to the points' current elevation.

**Type - Elevation and Grade** This option displays an Elevation field, and a Grade field. The control sets elevation of the point at the start station to the elevation specified. The slope of the point's line is then at the grade specified until the end station is reached.

**Priority** Determines the order of controls on a point. This value applies only when there are conflicting controls on a point. Where there is a conflict, the control with the lower priority is applied (that is, lower numbers are applied first).

**Use as Secondary Alignment** Specifies that horizontal point controls are also used as secondary alignments. This option is available only when working with a 2D entity. If you are using a 3D object, the software skips the secondary alignment option.

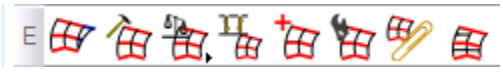
**Horizontal Offsets (Start/Stop)** Specifies the start and stop horizontal offset controls for the corridor. If the values are different, then the value applied at a given station is calculated using a linear algorithm.

**Vertical Offsets (Start/Stop)** Specifies the start and stop vertical offset controls for the corridor.

## 8.18 Superelevation

The superelevation points create a special type of point control.

This toolbox contains tools for creating, calculating, and editing superelevation lanes. Tools are also supported for importing CSV data and reporting.



**Create Superelevation Sections** - Adds a superelevation sections (generally one per curve set) for the specified station range on the baseline reference.

**Create Superelevation Lanes** - Creates color-filled lanes based on width and offsets from the baseline reference, as a precursor to superelevation calculations.

**Calculate Superelevation** - Calculates station and superelevation transitions rates based on a preferences or rules file (*.sep,*.srl). The values are augmented to the superelevation lanes, edit manipulators are created, and the color fill is recolored based on the cross slopes.

**Import Superelevation** - Optionally, imports data from a CSV file.

**Assign Superelevation to Corridor** - Associates superelevation with a corridor, so the pavement reflects the superelevation stations / cross slopes, rather than the pavement cross slope defaults in the template.

**Insert Superelevation Station/Cross slope** - Insert an individual station / superelevation transition (cross-slope) into a previously created and calculated superelevation lane.

**Superelevation Editor** - Opens the superelevation editor allowing the user to edit the calculated superelevation in a tabular format.

**Superelevation Report** - Creates a superelevation XML report and opens the Bentley Civil Report Browser.

**Superelevation in Plan** - Automatically generates annotation for superelevation station information in plan view.

## 8.19 Parametric Constraints

Parametric constraints are used to override the original constraint values established in the template from the library being used. The **Create Parametric Constraint** icon can be accessed from the *Corridor Modeling* tasks group.

The parametric constraints are the equivalent of a re-definable variable. So, the names of the parametric constraints established in MoDOT Template Library mirrors the criteria names as much as possible.

Parametric Constraints are setup in the template and applied to the corridor using the **Create Parametric Constraint** command.

The prompts for the **Create Parametric Constraint** command are as follows:

**Locate Corridor –** select the corridor where you want the Parametric Constraints applied.

**Start/End Station -** Specify the start/end station for the override.

**Constraint Label -** Lists all labeled constraints in the design. The selected label receives the override.

**Start/Stop Value -** Specifies the constraint value and can be transitioning from the first parametric value at the start and stop values.

## 8.20 Design Changes

The lifecycle of a roadway project is long, and complex. Changes must be done to accommodate for unforeseen situations or to stay within budget. The Corridor Modeling tools offers the flexibility to allow these design changes.

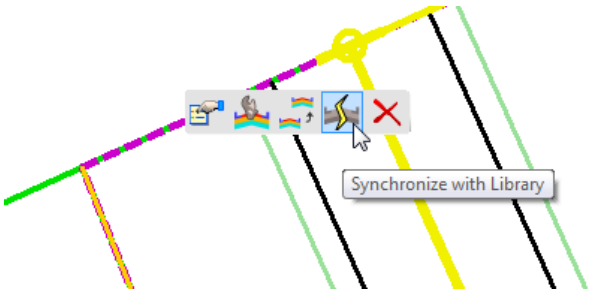
### 8.20.1 Geometry Changes

Once the horizontal and vertical geometry are created and used by a corridor, the user can go back and change the geometry. Any changes will be reflected in the corridor design.

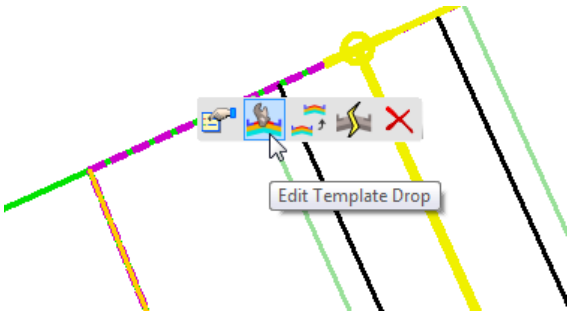
### 8.20.2 Template Library Synchronization

Changes to the template can be made either in the Corridor or in the Template Library. Where a user makes the changes for his/her template depends on the circumstances and needs to be reviewed on a case by case basis.

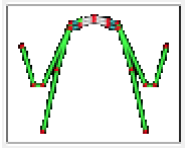
Any changes made in the template library can be obtained by synchronizing the template drops with the library. This is accomplished by selecting the template drop on the corridor in the plan view and selecting **Synchronize with Library** icon from the heads-up menus.




Changes can be made to a template used in a corridor by using the **Edit Template** command. The **Edit Template** command can either be accessed by selecting the template drop on the corridor in the plan view and selecting **Edit Template** icon from the heads-up menus or from the *Corridor Modeling* tasks group.



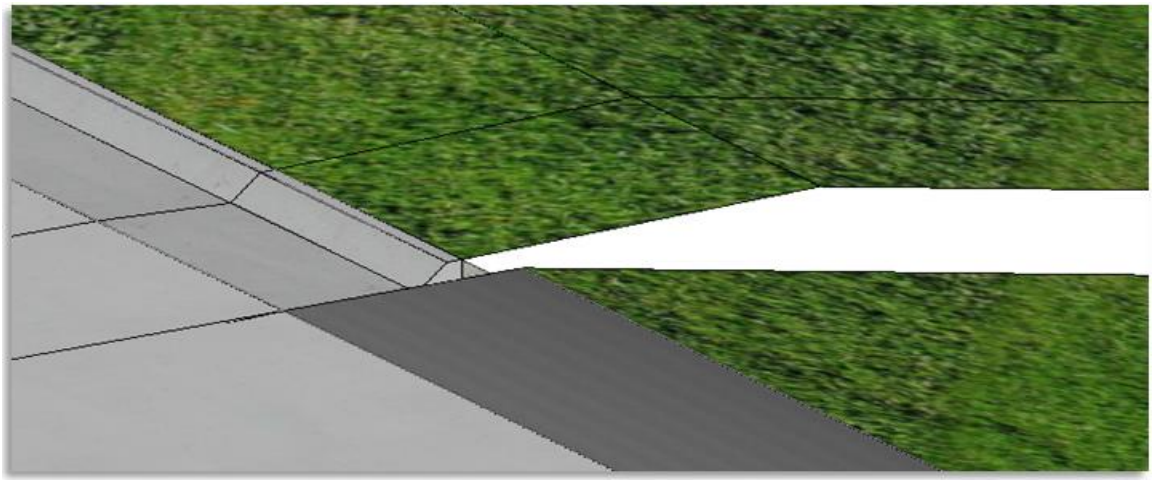

## 8.21 Basic Design Workflow with Corridor Modeling Tools



1. Set up a corridor
2. Insert template drops as needed
3. Create any template point controls
4. Design superelevation
5. Set parametric constraints as needed
6. Review design
7. Make revisions as needed and re-review

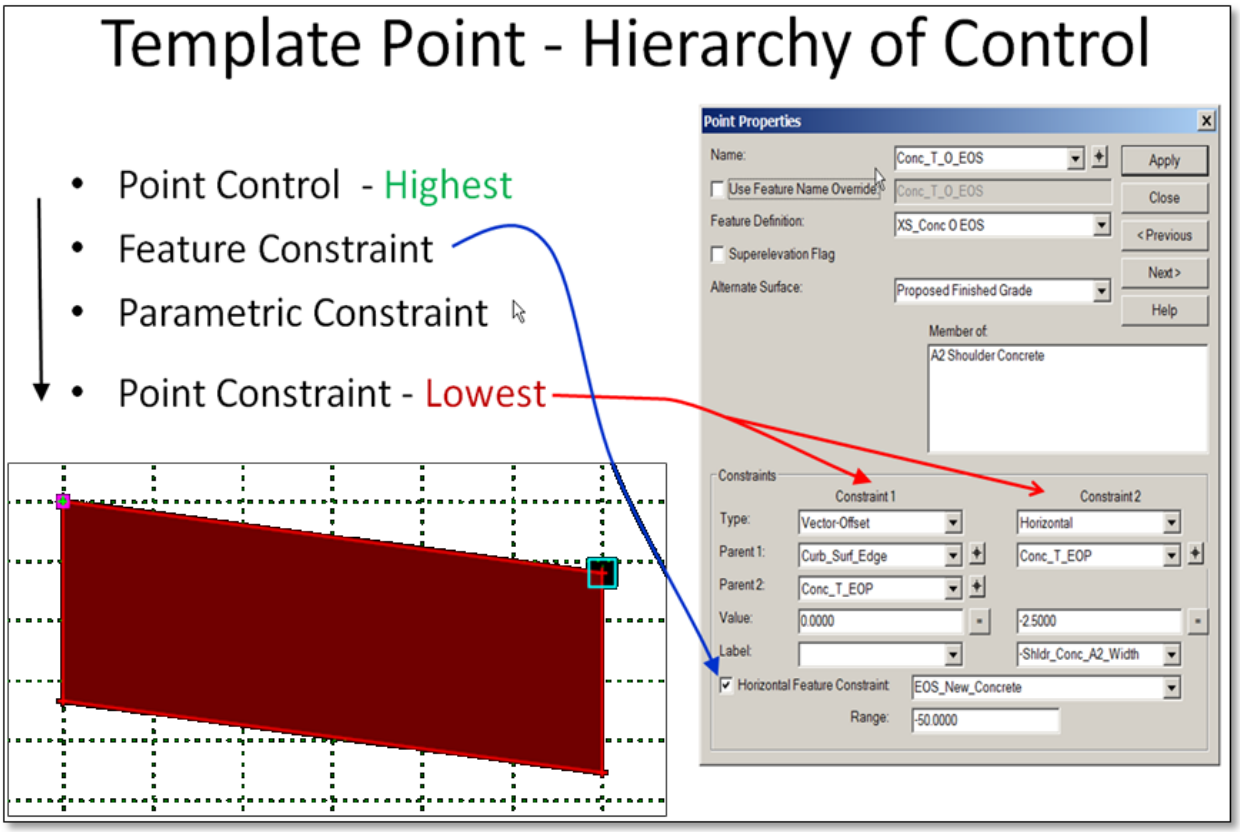
## 8.22 Group Exercise: Road-1 Parametric Constraints (Left Side)

**Parametric Constraints: Resolving transition between templates -** Below is an image of an adjoining Curb and Gutter and Shoulder Section.

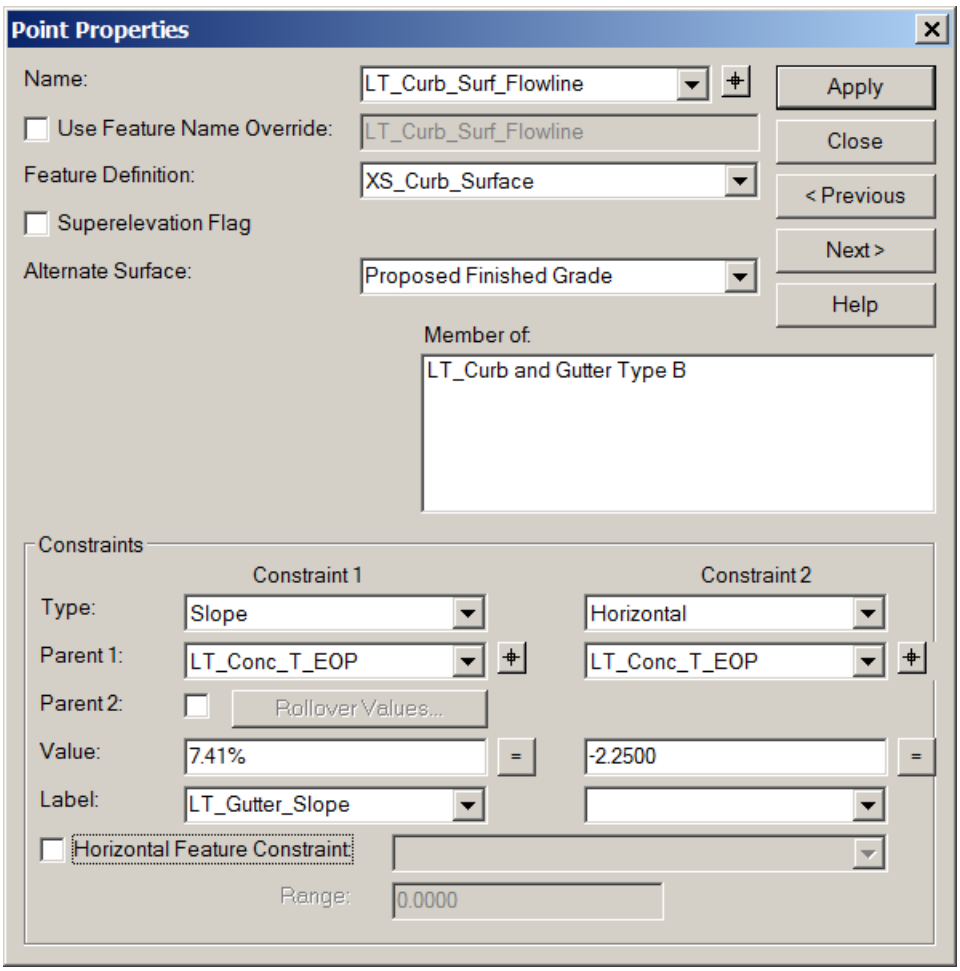


**Note:** 1) In this exercise we will use a number of Parametric Constraints to fix the gaps between the two template drops. Remember a Parametric Constraint will override the Point Constraint values.

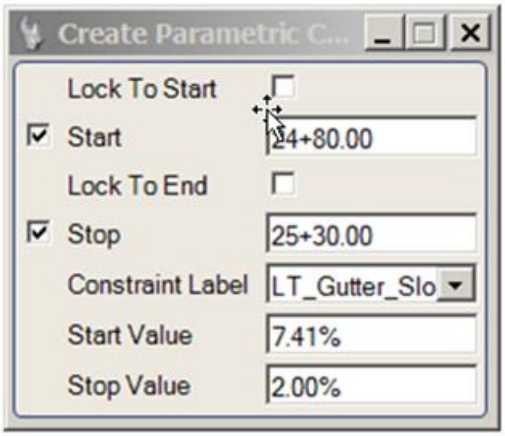
2) The goal of this section is to transition the differences between the two templates over a distance.



1. Within the ***Randolph\data_08*** *folder*, open the file: **Corridors_J2P0200.dgn**
2. Click on the one of the **Road 1** Template Drop Handlers with the range of **0+00** to **25+30** and edit the template.
3. Review the Point Properties Dialog for the **LT_Curb_Surf_Flowline** Point.

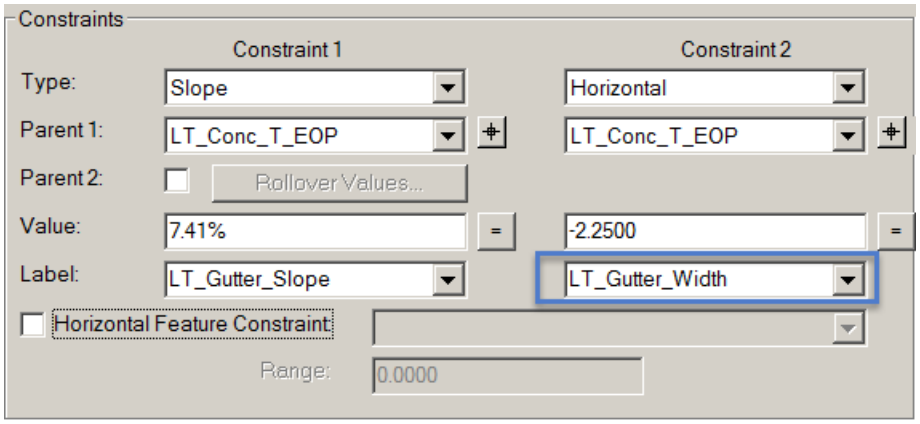



4. **Resolving Gutter Slope -** Using the Parametric Label in the Point Properties for the **LT_Curb_Surf_Flowline** point add the following Parametric Constraint:

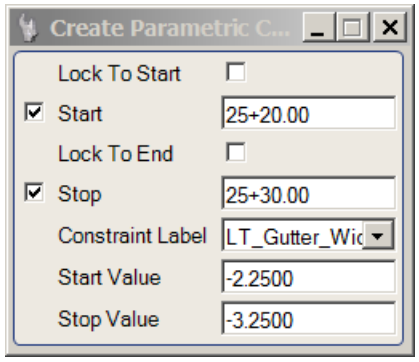



| | |
|---|---|
| Start: | 24+80 |
| Stop: | 25+30 |
| Constraint Label: | LT_Gutter_Slope |
| Start Value: | 7.41% |
| Stop Value: | 2.00% |

5. **Resolving the Gutter Width -** Add a Parametric Label to the **LT_Curb_Surf_Flowline** point called **LT_Gutter_Width** that will control the Horizontal width of the Gutter.

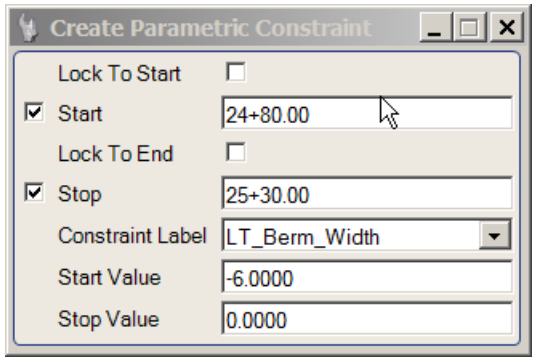



6. Using the Parametric Label in the Point Properties for the **LT_Curb_Surf_Flowline** point add the following **Parametric Constraint**:



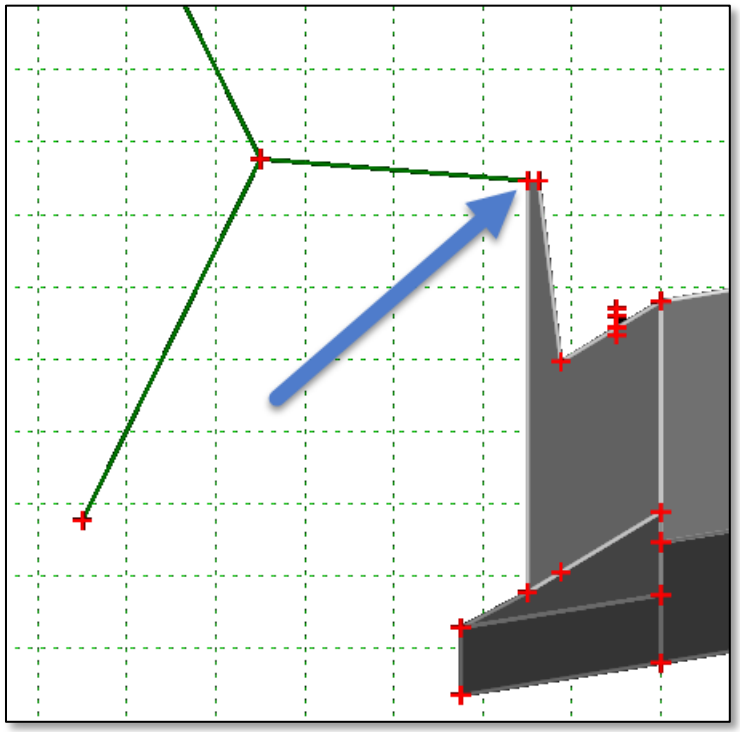

| | |
|---|---|
| Start: | 25+20 |
| Stop: | 25+30 |
| Constraint Label: | LT_Gutter_Width |
| Start Value: | -2.25 |
| Stop Value: | -3.25 |

7. **Removing Berm Width -** Using the Parametric Label in the Point Properties for the **LT_Berm_B** point add the following Parametric Constraint:



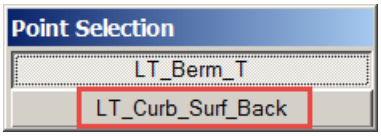

| | |
|---|---|
| Start: | 24+80 |
| Stop: | 25+30 |
| Constraint Label: | LT_Berm_Width |
| Start Value: | -6.00 |
| Stop Value: | 0.00 |

8. **Resolving Berm Location –** Right click on the Left Berm Line insert a point and place it on top of the point adjacent to the Back of Curb:

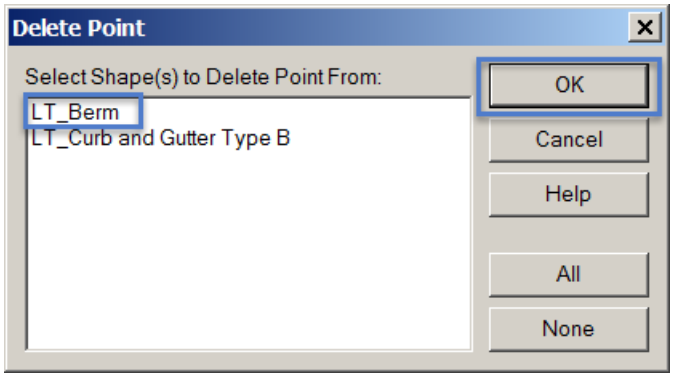


9. Double click on newly place point and open the Point Properties dialog. Rename the point to **LT_Berm_T**

10. Right click on newly place point and select **Delete Point**. Delete the **LT_Curb_Surface_Back** point:

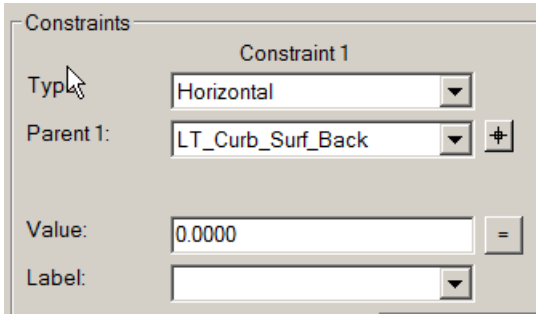



Delete the **LT_Berm** Shape (Component) from the Point.

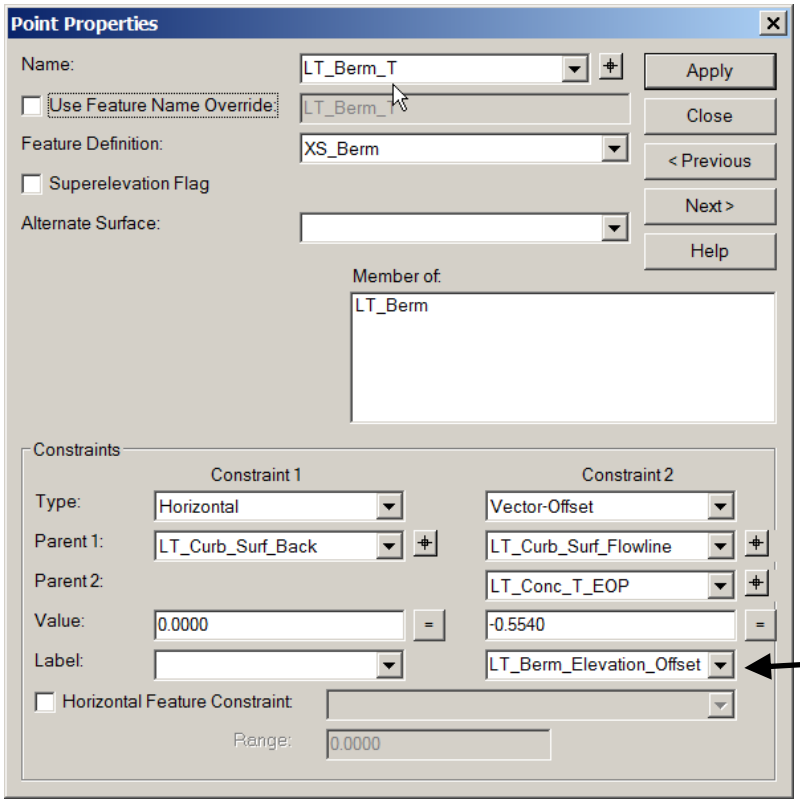


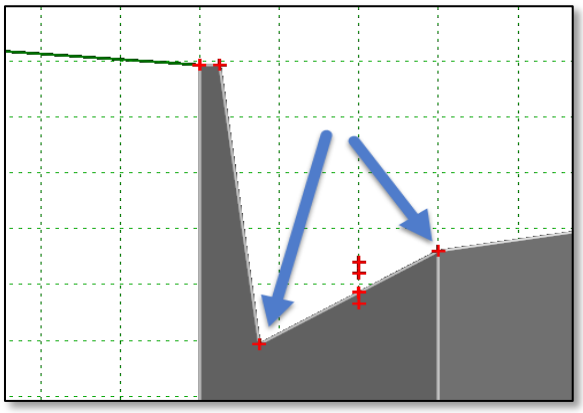
Note: The **LT_Curb_Surface_Back point** was included in both the Berm and Curb components.

11. Right click on the point **LT_Berm_T** and add a **Horizontal Constraint** with the Parent Point being the **LT_Curb_Surface_Back**.




12. Right click on the point **LT_Berm_T** and add a **Vector Offset Constraint** with the Parent Points being the **LT_Curb_Surf_Flowline** and the **LT_Conc_T_EOP** points.

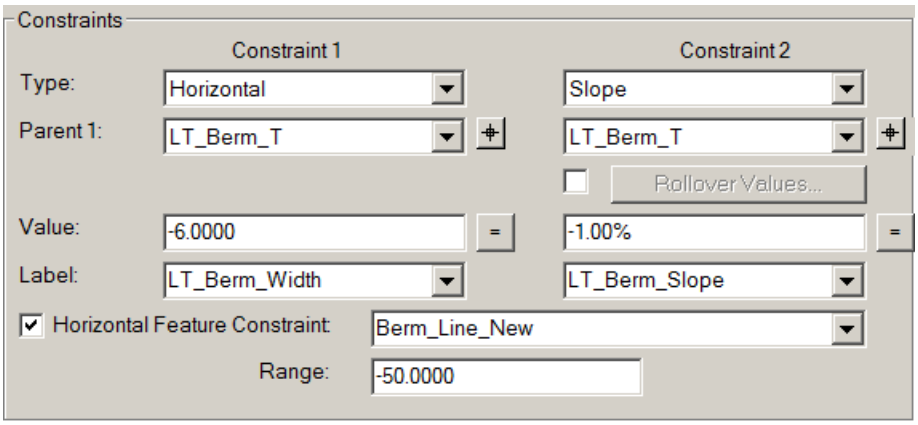


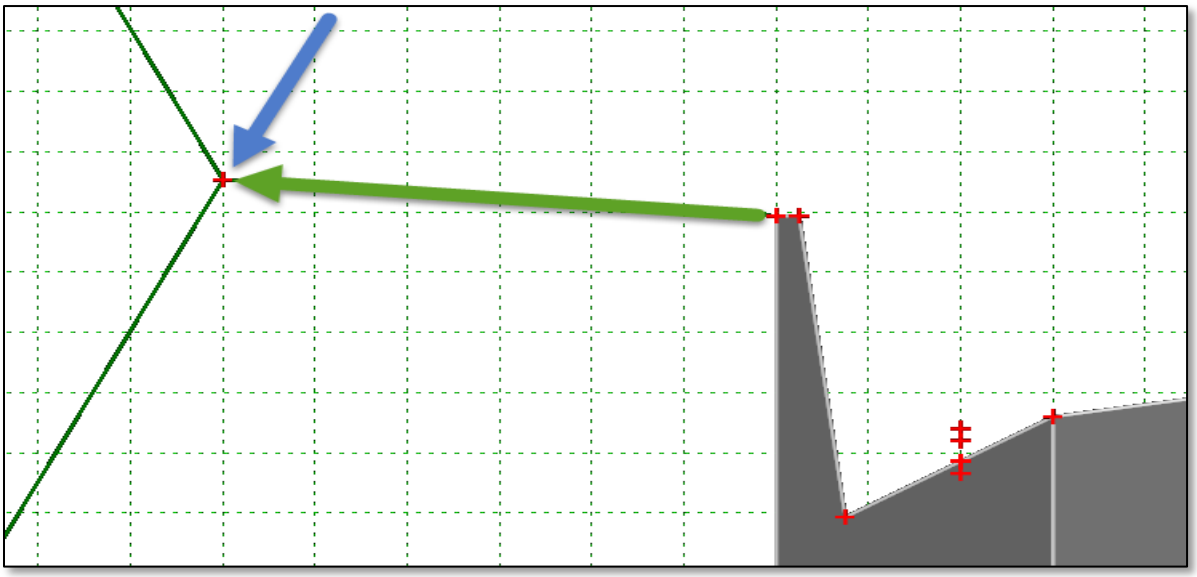



13. Add in a **Parametric Label** for the **Vector Offset Constraint** called the following:

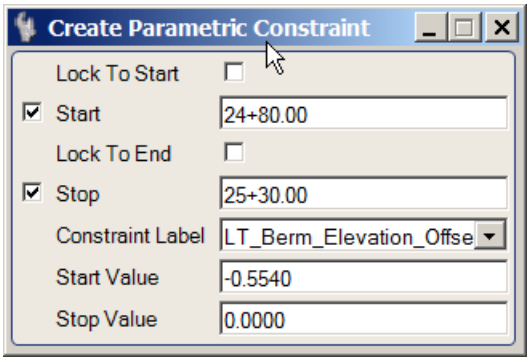
**LT_Berm_Elevation_Offset**

14. Edit the **LT_Berm_B** point so that its parent point is the newly created **LT_Berm_T** point.



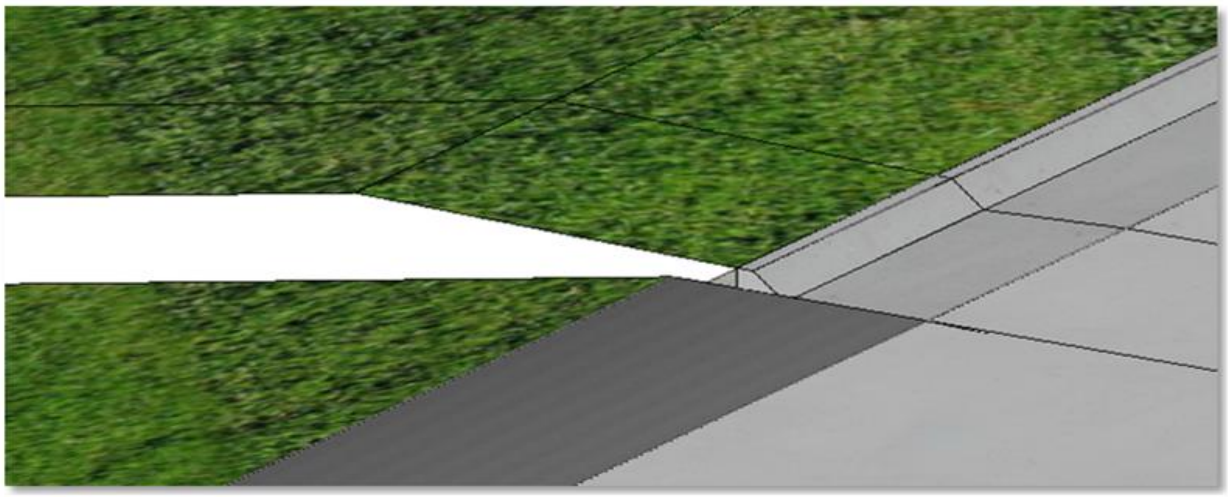
15. **Lowering the Berm -** Using the Parametric Label in the Point Properties for the **LT_Berm_T** point add the following Parametric Constraint:



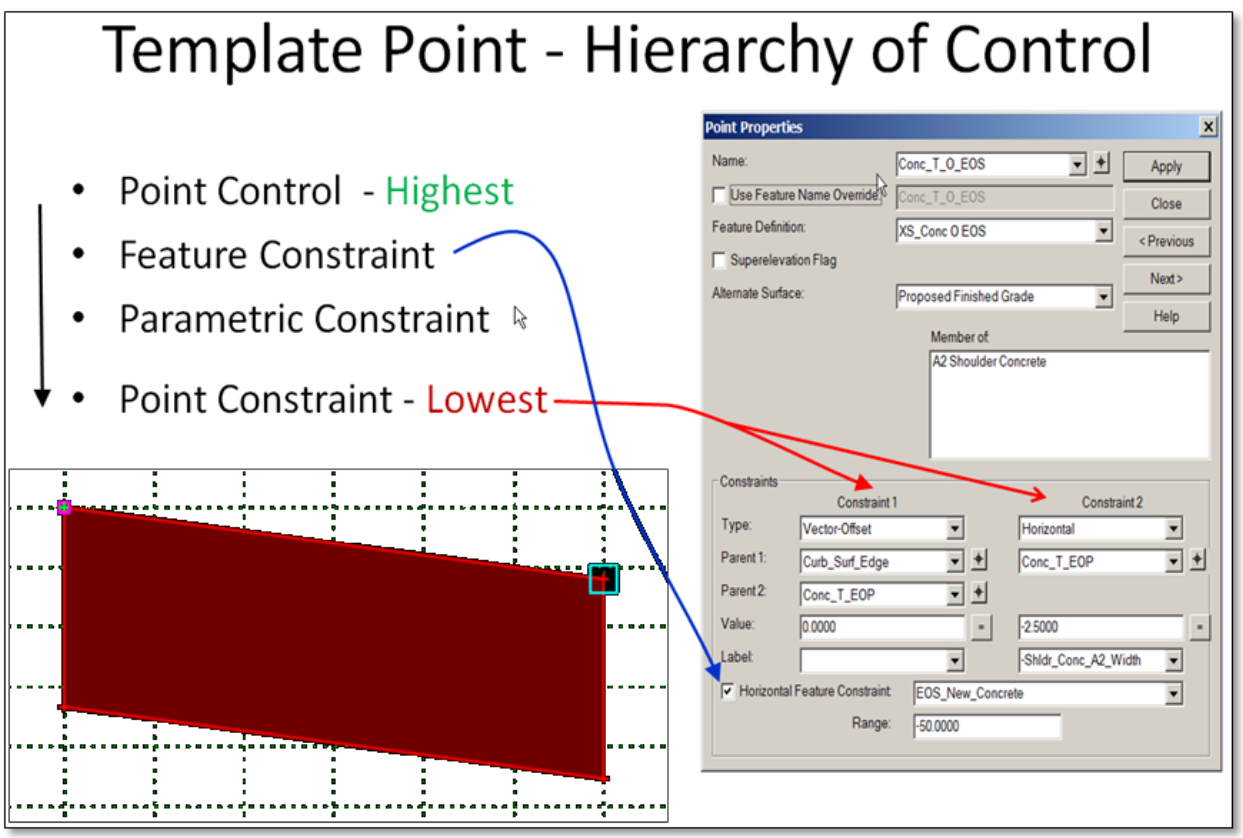

| | |
|---|---|
| Start: | 24+80 |
| Stop: | 25+30 |
| Constraint Label: | LT_Berm_Elevation_Offset |
| Start Value: | -0.5540 |
| Stop Value: | 0.00 |

## 8.23 Individual Exercise: Road-1 Parametric Constraints (Right Side)

**Parametric Constraints: Resolving transition between templates -** Below is an image of an adjoining Curb and Gutter and Shoulder Section.



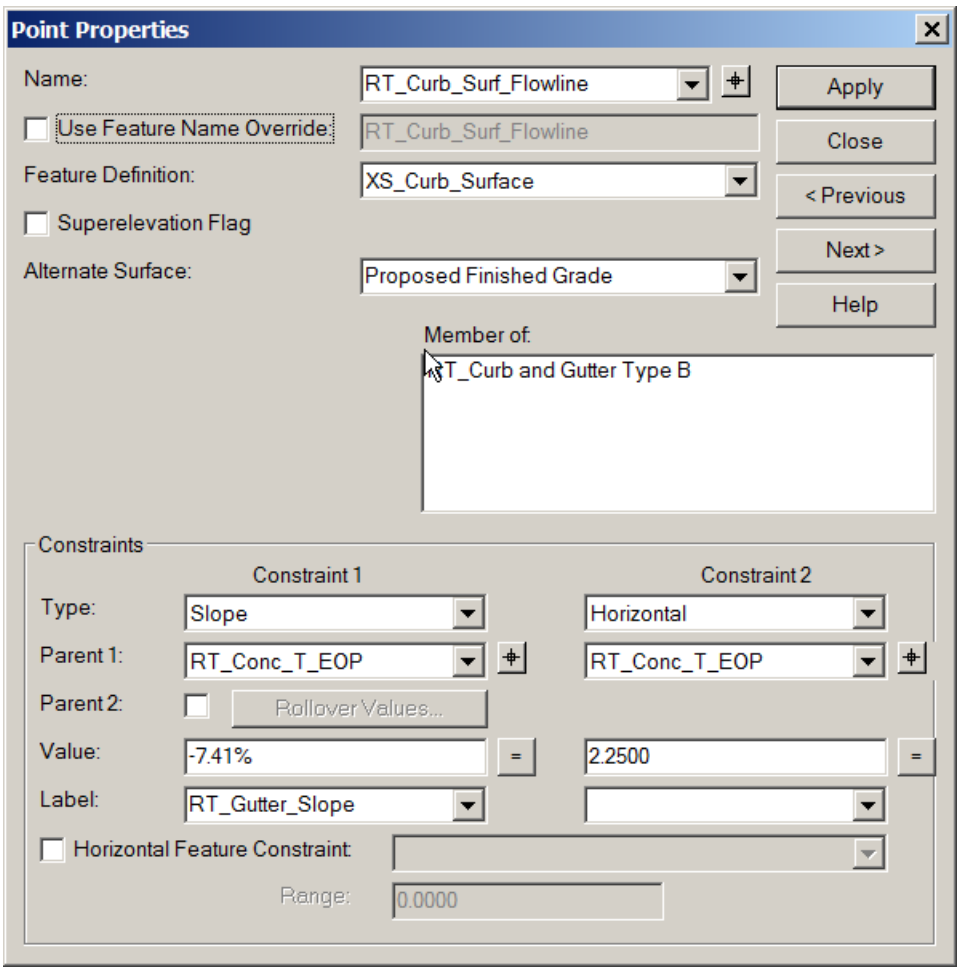
- In this exercise we will use a number of Parametric Constraints to fix the gaps between the two template drops. Remember a Parametric Constraint will override the Point Constraint values.
- The goal of this section is to transition the differences between the two templates over a distance.



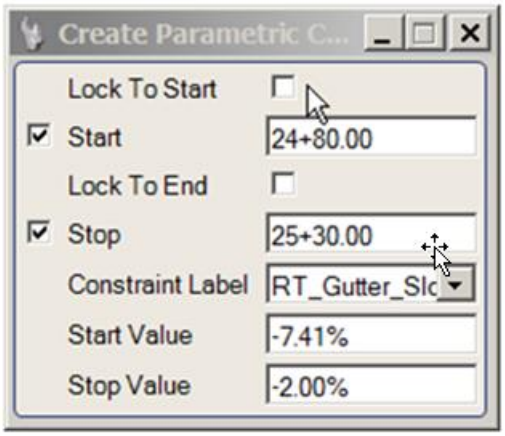
1. Within the ***Randolph\data_08*** *folder*, open the file: **Corridors_J2P0200.dgn**

2. Click on the one of the **Road 1** Template Drop Handlers with the range of **0+00** to **25+30** and edit the template.

3. Review the Point Properties Dialog for the **RT_Curb_Surf_Flowline** Point.

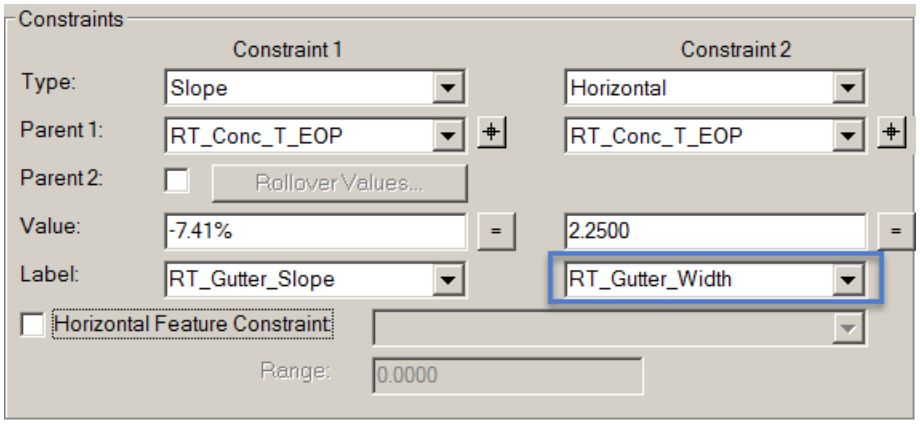



4. **Resolving Gutter Slope -** Using the Parametric Label in the Point Properties for the **RT_Curb_Surf_Flowline** point add the following Parametric Constraint for the Right side:

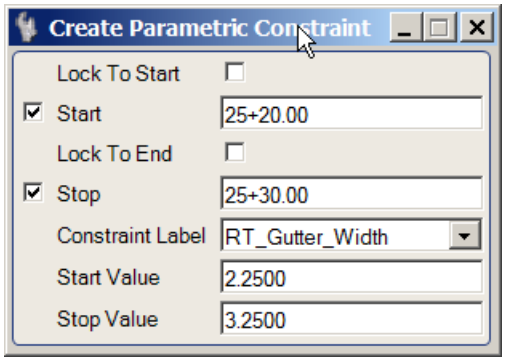



| | |
|---|---|
| Start: | 24+80 |
| Stop: | 25+30 |
| Constraint Label: | RT_Gutter_Slope |
| Start Value: | -7.41% |
| Stop Value: | -2.00% |

5. **Resolving the Gutter Width -** Add a Parametric Label to the **RT_Curb_Surf_Flowline** point that will control the Horizontal width of the Gutter.

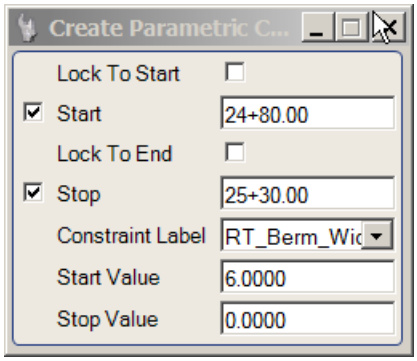



6. Using the Parametric Label in the Point Properties for the **RT_Curb_Surf_Flowline** point add the following Parametric Constraint:



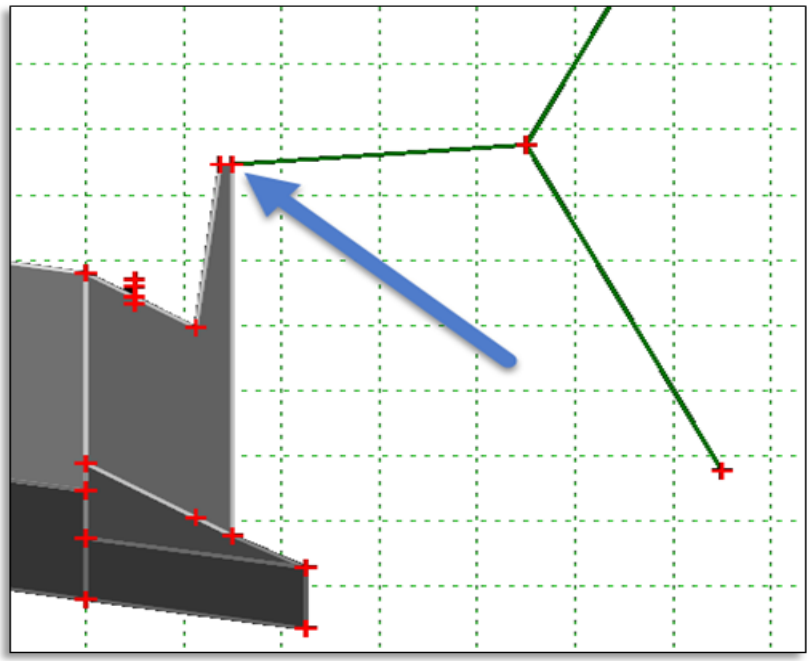

| | |
|---|---|
| Start: | 25+20 |
| Stop: | 25+30 |
| Constraint Label: | RT_Gutter_Width |
| Start Value: | 2.25 |
| Stop Value: | 3.25 |

7. **Removing Berm Width -** Using the Parametric Label in the Point Properties for the **RT_Berm_B** point add the following Parametric Constraint:



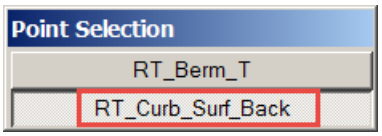

| | |
|---|---|
| Start: | 24+80 |
| Stop: | 25+30 |
| Constraint Label: | RT_Berm_Width |
| Start Value: | 6.00 |
| Stop Value: | 0.00 |

8. **Resolving Berm Location –** Right click on the Right Berm Line insert a point and place it on top of the point adjacent to the Back of Curb:

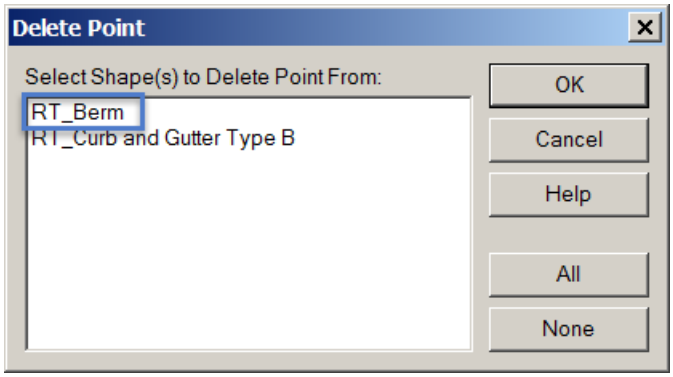


9. Double click on newly place point and open the Point Properties dialog. Rename the point to **RT_Berm_T**

10. Right click on newly place point and select **Delete Point**. Delete the **RT_Curb_Surface_Back** point:

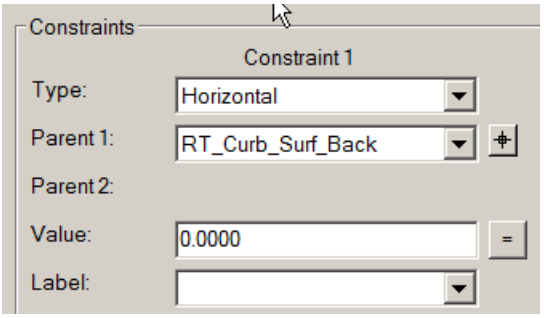



Delete the **RT_Berm** Shape (Component) from the Point.

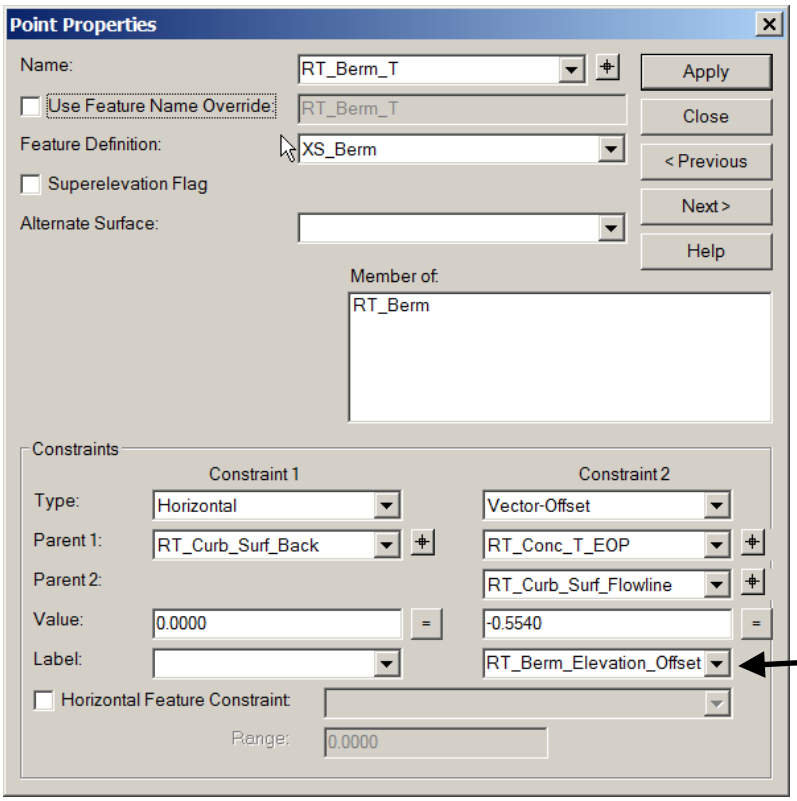


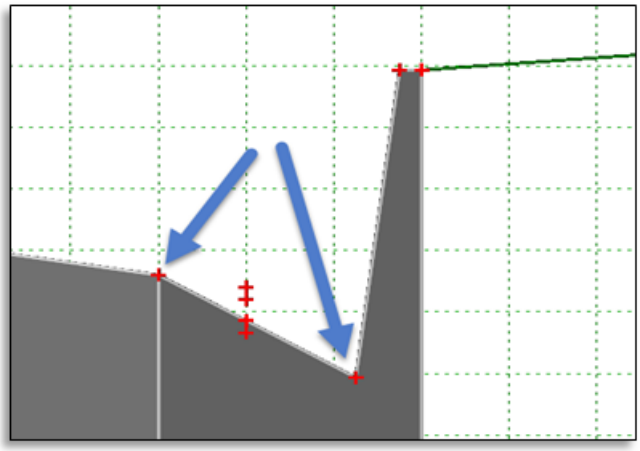

Note: The **RT_Curb_Surface_Back point** was included in the both Berm and Curb components.

11. Right click on the point **RT_Berm_T** and add a **Horizontal Constraint** with the Parent Point being the **RT_Curb_Surface_Back**.




12. Right click on the point **RT_Berm_T** and add a **Vector Offset Constraint** with the Parent Points being the **RT_Curb_Surf_Flowline** and the **RT_Conc_T_EOP** points.

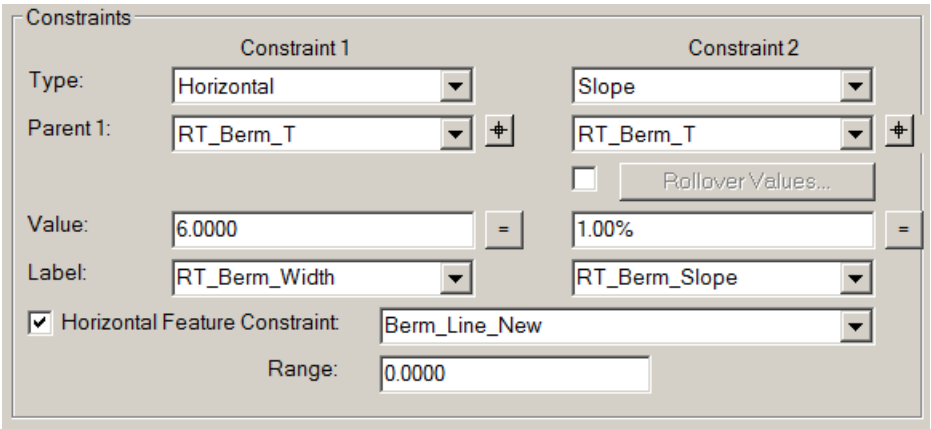


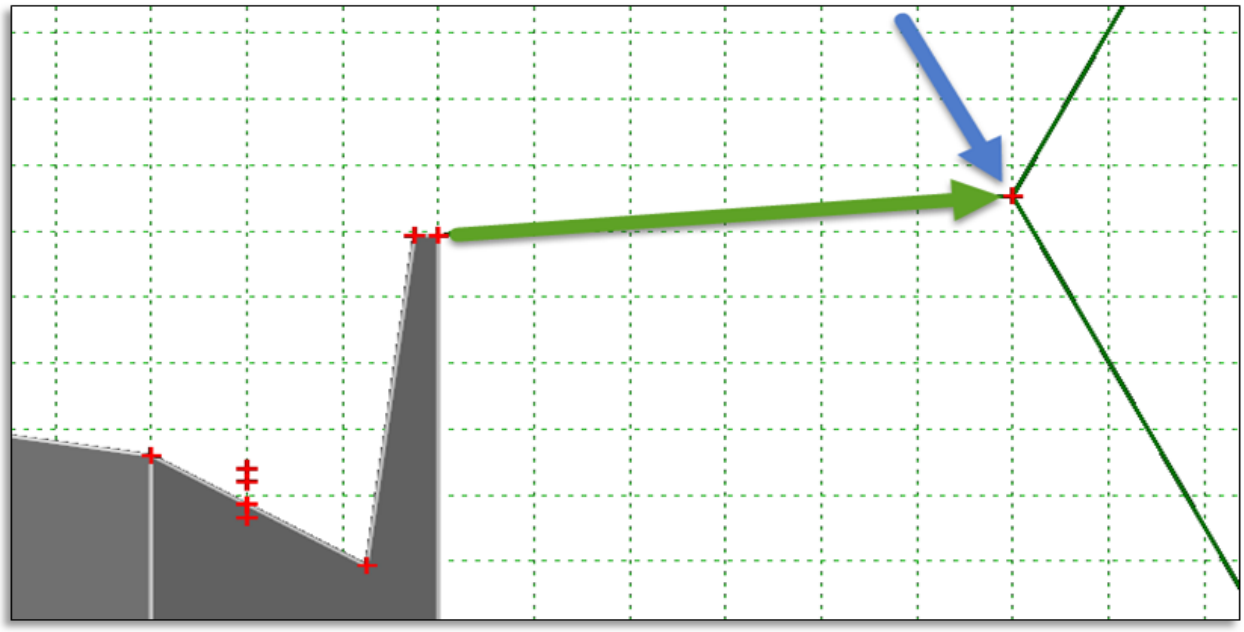



13. Add in a **Parametric Label** for the **Vector Offset Constraint** called the following:

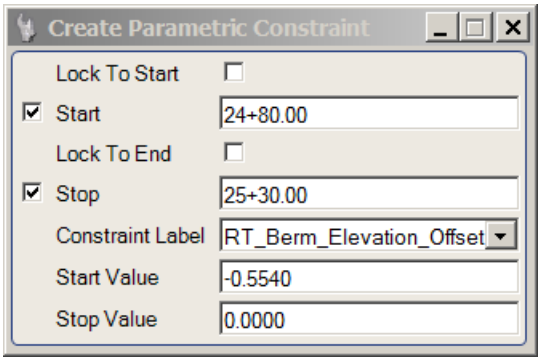
**RT_Berm_Elevation_Offset**

14. Edit the **RT_Berm_B** point so that its parent point is the newly created **RT_Berm_T** point.



15. **Lowering the Berm -** Using the Parametric Label in the Point Properties for the **RT_Berm_T** point add the following Parametric Constraint:

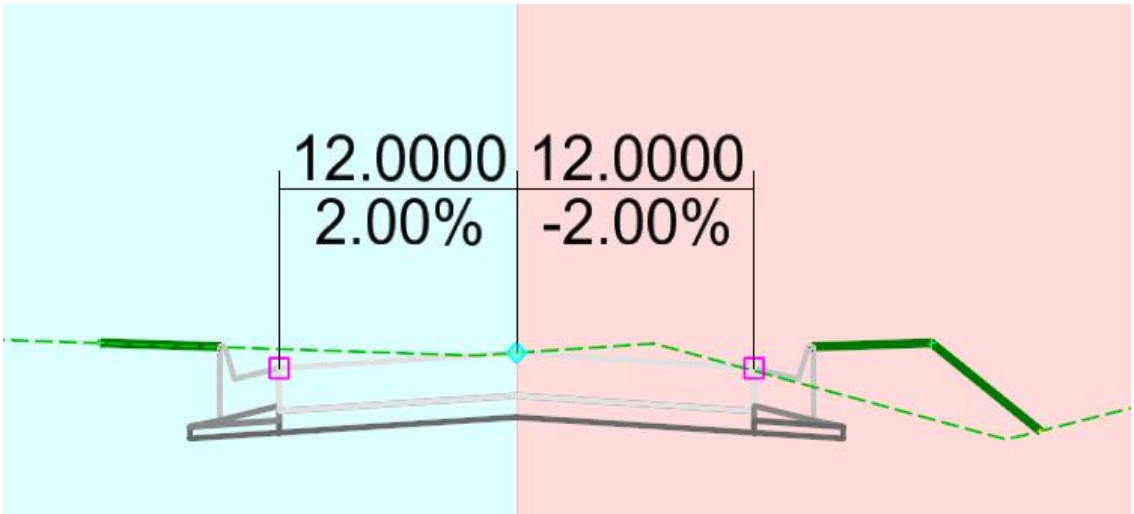



| | |
|---|---|
| Start: | 24+80 |
| Stop: | 25+30 |
| Constraint Label: | RT_Berm_Elevation_Offset |
| Start Value: | -0.5540 |
| Stop Value: | 0.00 |

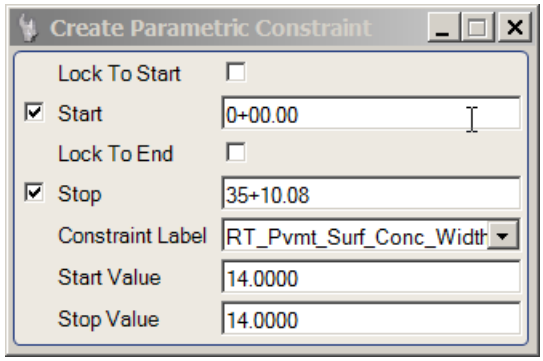
## 8.24 Group Exercise: Horizontal Feature Constraint

1. Within the ***Randolph\data_08*** *folder*, open the file: **Corridor_J2P0200.dgn**

2. Within the **Corridor Modeling Task** tools, select the **Open Cross Section** Tool to view cross sections of Road 1. The current the Template is set up to draw 12ft lanes.

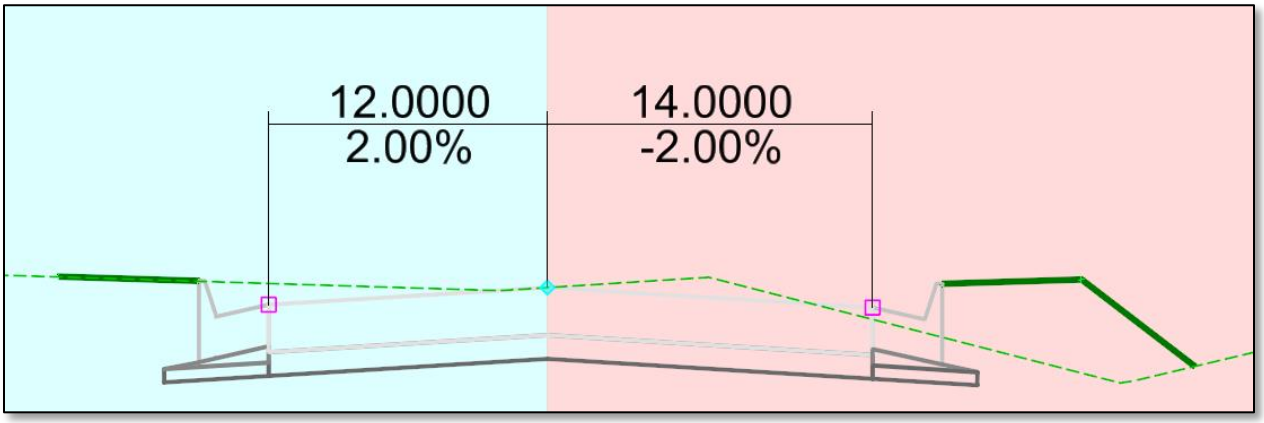


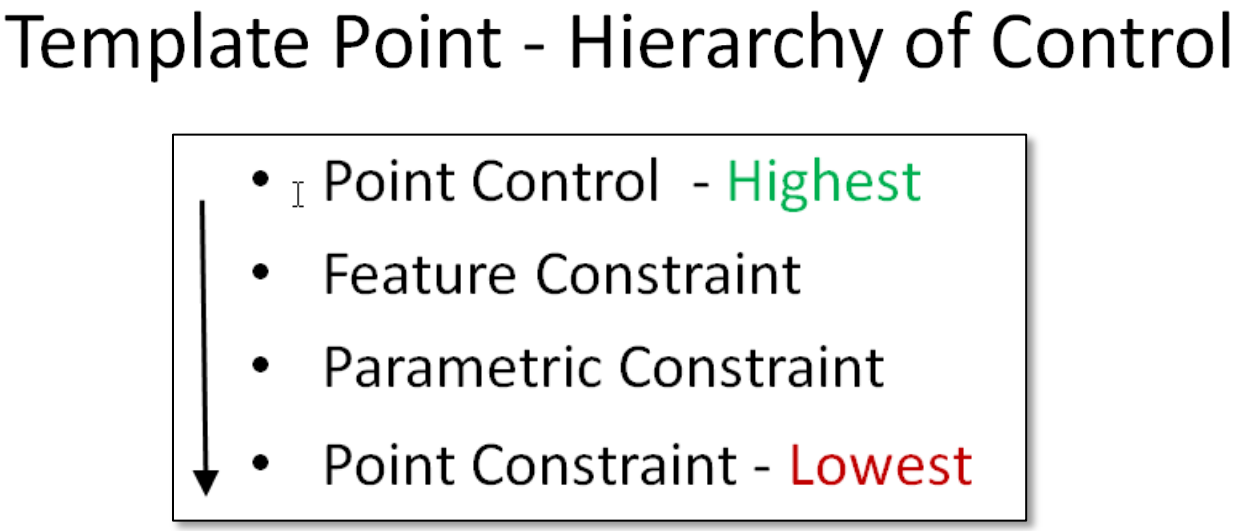

3. **Widen the Pavement Right Width –** Within the **Road 1** Template, use the Parametric Label in the EOP Point Properties for the **RT_Conc_T_EOP** point. Add the following Parametric Constraint:




| | |
|---|---|
| Start: | Lock to Start |
| Stop: | Lock to End |
| Constraint Label: | RT_Pvmt_Surf_Conc_Width |
| Start Value: | 14.00 |
| Stop Value: | 14.00 |

4. Once again within the **Corridor Modeling Task** tools, select the **Open Cross Section** Tool to view cross sections of Road 1. The User should see that the Parametric Constraint overruled the current Template Setting of 12ft lanes on the Right side.



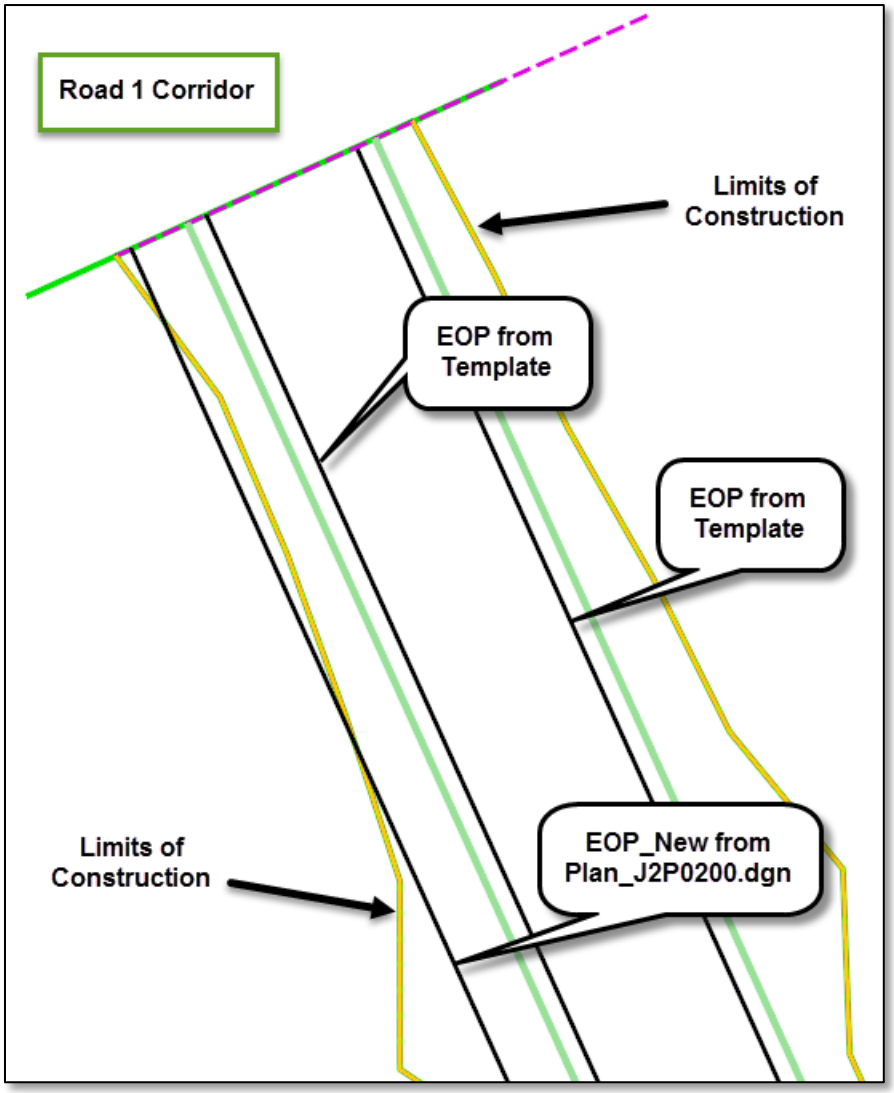




5. In View 1 (Default), reference in the following file:

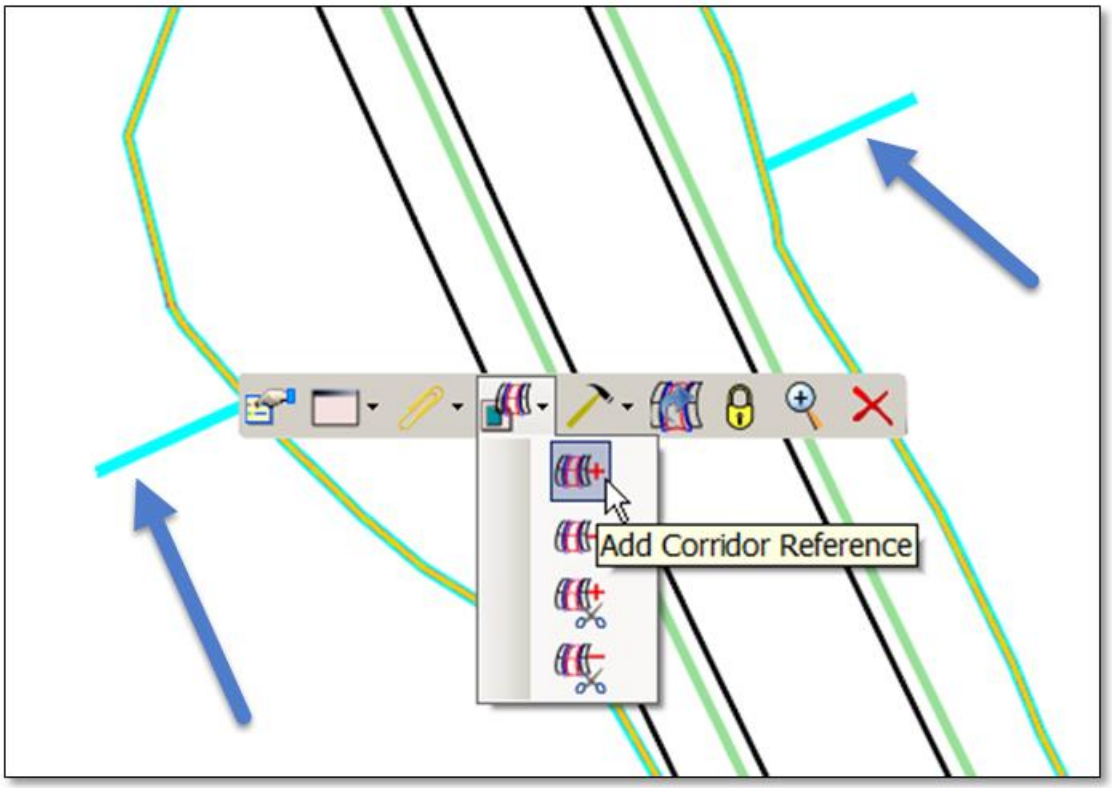
   **Plan_J2P0200.dgn**

6. After selecting **View 1**, turn off the display of all reference files except for **Plan_J2P0200.dgn**

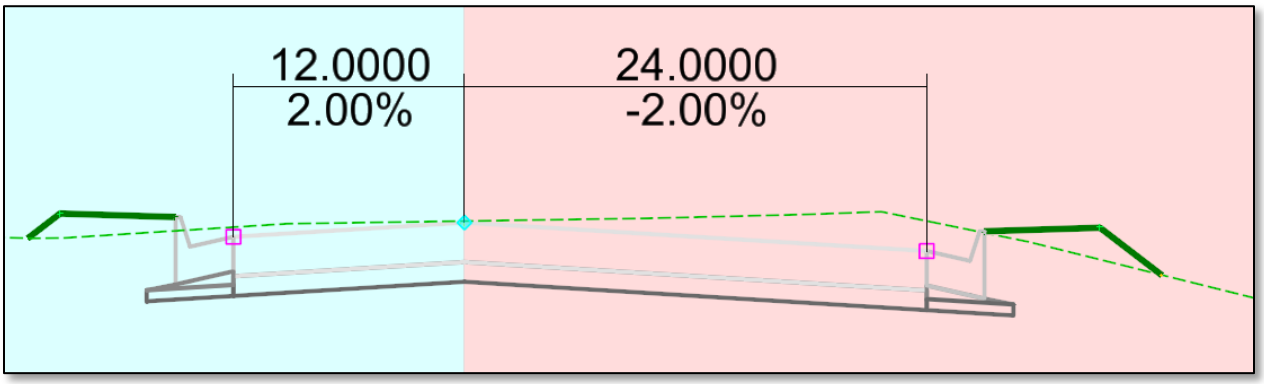
   Note: The goal of this exercise is to have the Template Edge of Pavement follow the Feature Definition Line **EOP_New** drawn in the Plan File.



7. Within the **Road 1 Corridor** select one of the Corridor Grips to be up the Heads up Tools go to the Corridor Reference Pull-down and select "**Add Corridor Reference**".

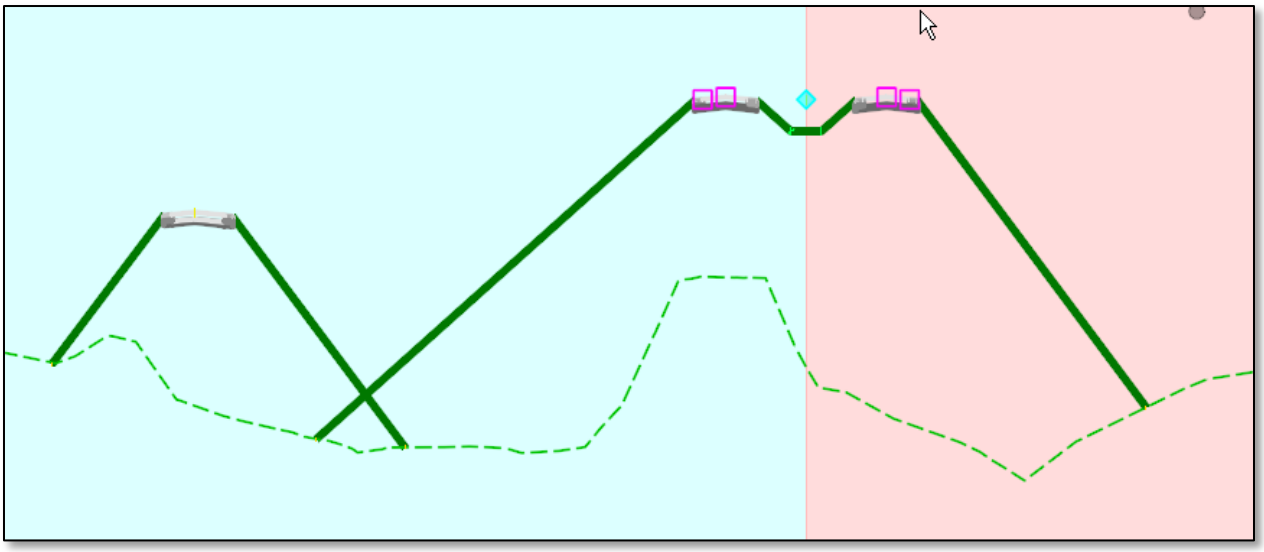



8. Once again within the **Corridor Modeling Task** tools, select the **Open Cross Section** Tool to view cross sections of Road 1. The User should see that the Horizontal Feature Constraint has overruled the Parametric Constraint, which overruled the current Template Setting of 12ft.



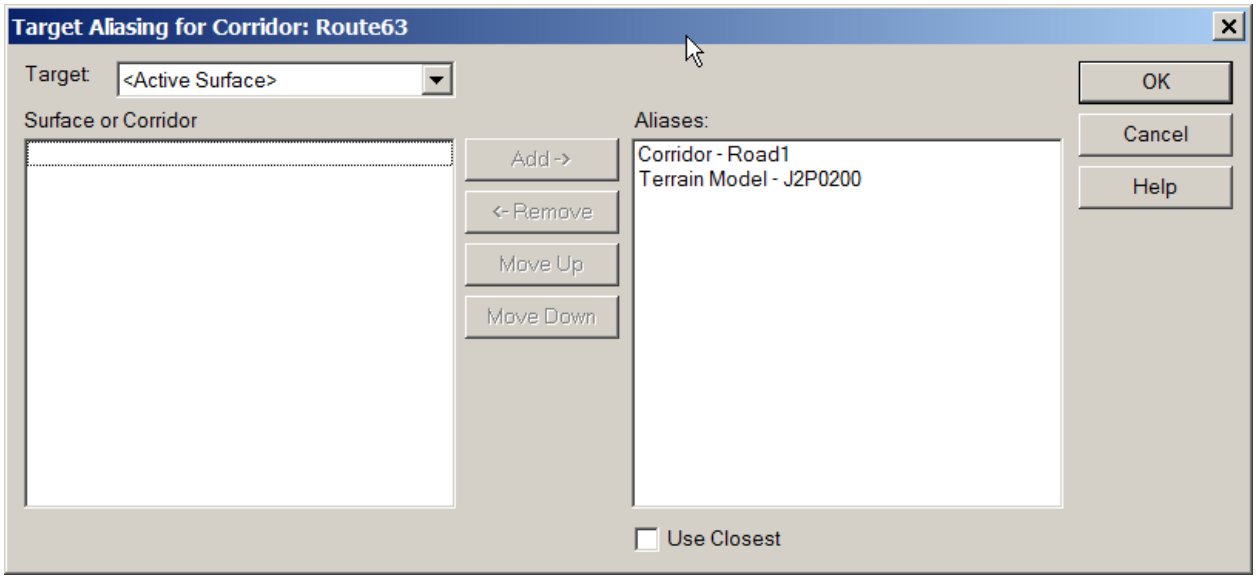
## 8.25 Group Exercise: Target Aliasing and Corridor Clipping

1. Within the **Randolph\data_08** folder, open the file: **Corridors_J2P0200.dgn**
2. Select the **Locate Station Via Datapoint** icon from the ***Corridor Cross Section*** tasks group.
3. Select the **Route 63** corridor when prompted to ***Locate Corridor or Alignment***.
4. Key in **60+00 R1** for the station and click to accept.
5. Open another MicroStation View and **data point** in the view to display the cross section.

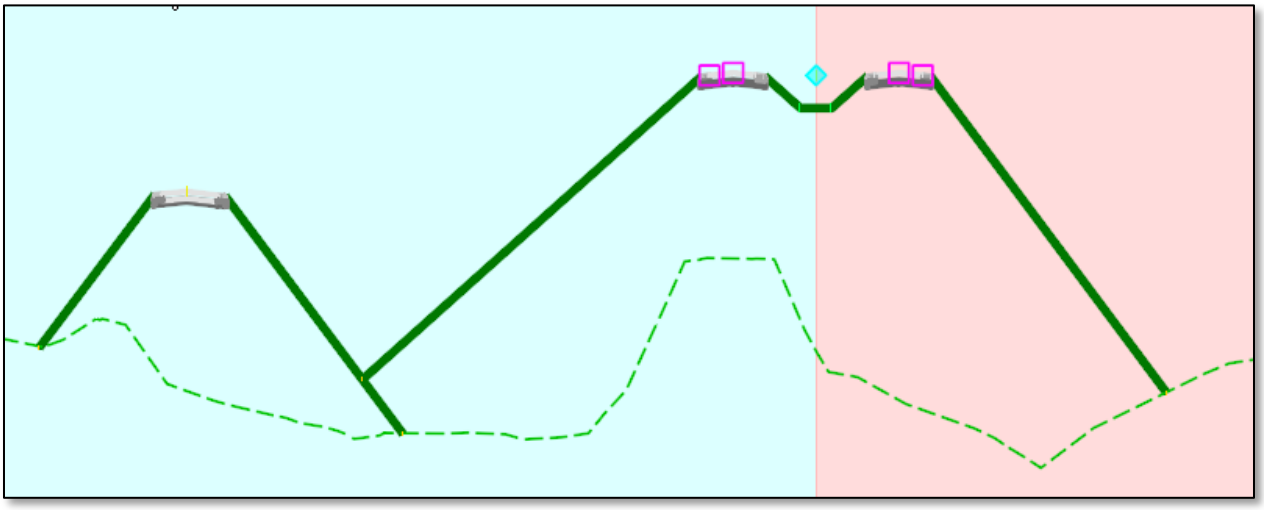


6. Select the **Define Target Aliasing** icon from the ***Corridor Misc***. tasks group.
7. Select the **Route63** corridor when prompted to ***Locate Corridor***.
8. Select the ***Corridor – Road 1*** and click the **Add** button.

9. Select the ***Terrain Model – J2P0200*** and click the **Add** button and click **OK**.




10. Review the Cross Section.



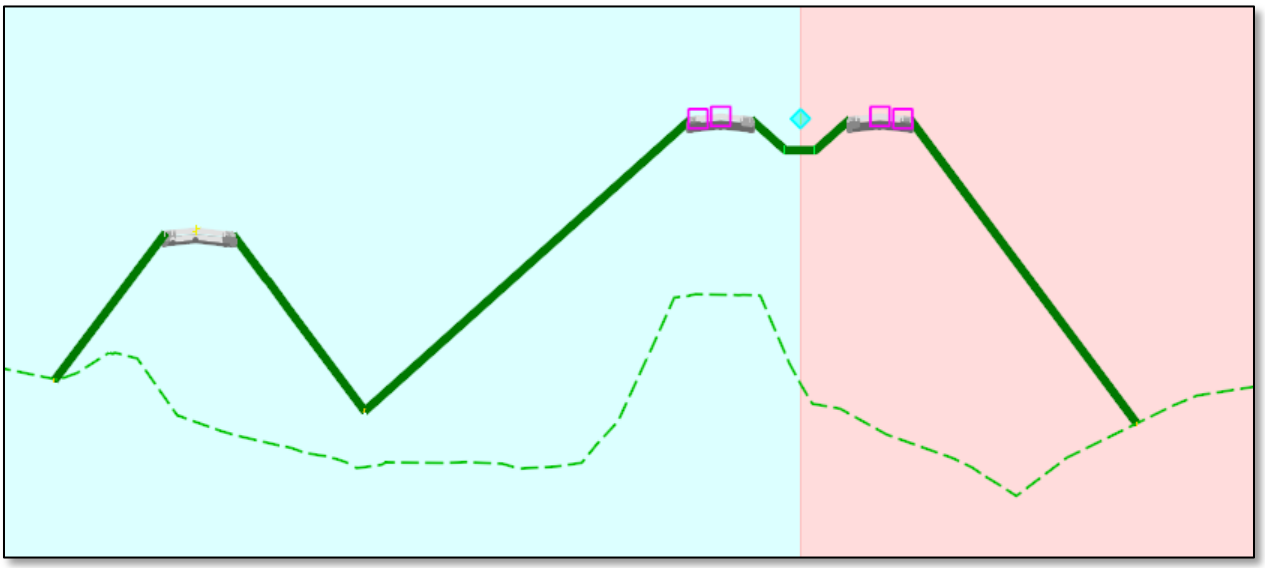
11. Select the **Add Clipping Reference** icon from the ***Corridor Misc*** tasks group.

12. Select the **Road 1** Corridor when prompted to ***Select Corridor To Be Clipped***.

13. Select the **Route 63** Corridor when prompted to ***Locate First Clipping Reference*** and **reset** to complete.

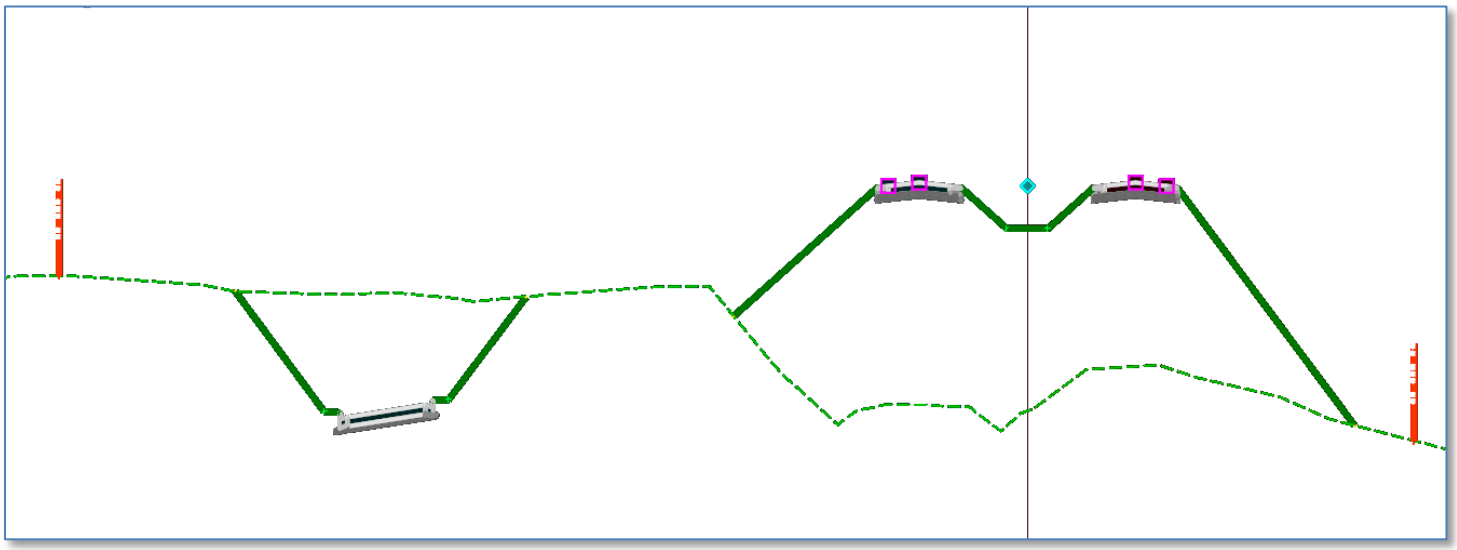
14. Review the cross section.

**Note: You may have to move to the next station to refresh the cross section view to see the Clipping Reference.**



## 8.26 Group Exercise: View Right of Way in Plan and XS View

1. Within the **Randolph\data_08** folder, open the file: **Corridors_J2P0200.dgn**
2. In View 1 (Default), reference in the **Land_Boundary_J2P0200.dgn**.
3. Select the **Open Cross Section View** icon from the ***Corridor Cross Section*** tasks group.
4. Select the **Route 63** corridor when prompted to ***Locate Corridor or Alignment***.
5. Open another MicroStation View and **data point** in the view to display the cross section.
6. Review Right of Way Line Information.



Note: Below is a list of Right of Way Lines that will draw in a Cross Section View.

| | |
|---|---|
| R/W_Property_Limit_Access_Existing | Section_Line |
| R/W_Controlled_Access_Existing | State_Line |
| R/W_Controlled_Access_Proposed | Township/Range_Line |
| R/W_Line_EXISTING | US_Survey_Line |
| R/W_Line_Proposed | |
| R/W_No_Right Of Access_Existing | Easement (Exist.) |
| R/W_No_Right_Of_Access_Proposed | Easement (Permanent Line Access) |
| R/W_Temporary_Access_Existing | Easement (Permanent) |
| R/W_Temporary_Access_Proposed | Easement (Temporary) |

# Chapter 9

# Cross Sections & Labeling

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9.2 Cross Sections Overview ..... 9-1
9.3 Create Cross Sections ..... 9-2
9.4 Create Cross Sections Dialog ..... 9-4
9.5 Annotate Cross Sections ..... 9-13
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9.8 Individual Exercise 5-1: Cutting Route 63 Cross Sections and Annotation ..... 9-27

## 9.9 Objectives

- Create cross sections along a previously designed corridor.
- Annotate proposed cross sections.

## 9.10 Cross Sections Overview

Corridor Modeling Cross Section commands extract, display, annotate, and update cross sections. These commands also allow you to export data from cross sections to a surface.

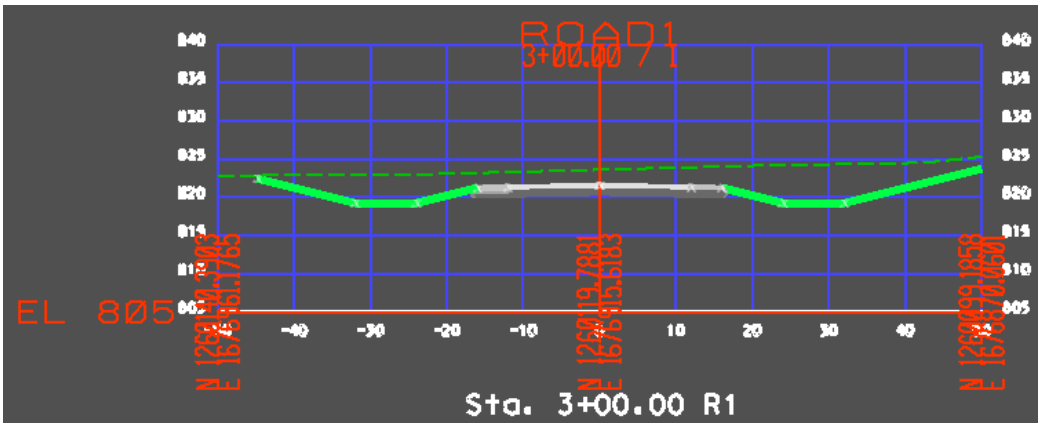
A cross section is a two-dimensional window of graphics representing a planar section of a three-dimensional (3-D) model. Typically, the 3-D objects displayed in cross section are terrain models and objects such as the existing terrain or a proposed road. The graphics showing a terrain model in a cross section is a cross section surface.

Cross sections are extracted across a horizontal alignment or some other linear feature. (Cross sections can be extracted at a skewed angle, but they are typically perpendicular to the alignment). The width of the cross section window is defined relative to the linear feature. For example, you might want your cross sections to span the range from 50 feet left of the alignment to 50 feet right of the alignment. The height of the cross section represents a range of elevation, for example from 380 to 400 feet.

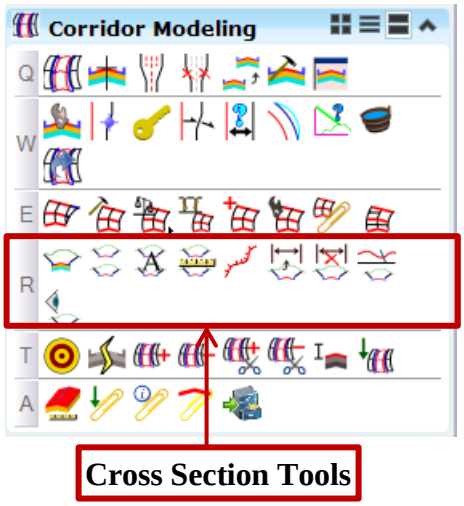
When you create one or more cross sections, you choose which surfaces to display. Each cross section displays the selected surfaces as they pass through the window. Each surface is represented in the cross section by a data line known as a cross section surface.

Cross sections serve several purposes during a project. They allow you to examine your model in detail. For example, you can verify that a ditch you have designed is being placed properly or that your roadway side slope is at the correct grade. You can annotate the points and lines in cross sections by slope as well as offset and elevation.

Other important uses for cross sections are computing cut and fill volumes.



## 9.11 Create Cross Sections




Extracts multiple cross sections and draws them in a matrix pattern. These sections are subsequently used for cross section sheets and earthwork calculations. Only the surfaces that you select when you initiate the command are displayed in the cross sections.

Typically, you use this command to extract cross sections along the active horizontal alignment; however, this command can generate cross sections along graphic elements.

Features are projected based on *Feature Definition Settings*.

**Symbology**

The **Create Cross Sections** command determines the surface symbology from a terrain model or an object. This gives predictable symbology results since the terrain model is driving the symbology.

The cross section creation application requires the selection of an alignment in which the user desires to cut cross sections along. In any given design, the user has the option to create all of their planimetrics and alignments in a 2D model or a 3D model. If the user decides to work in 2D, then a 3D model will be automatically created in the background for the user and maintained by the product as design changes are made. In this scenario, the user should reference in the 2D model because that is where the alignment is stored.

A 2D model is used for design as suggested as a "Best Practice". When cross sections are created, the application "slices" the 3D model to determine the components to display on the cross section. It is required to reference in the proposed alignment. If that alignment is in the 2D model, then simply referencing that model is not sufficient. In our 2D design model, we have referenced in automatically the 3D model once vertical geometry is created. For the **Create Cross Section** application to have access to this 3D model, it must be referenced to the cross section drawing as well. The most efficient way to accomplish this and make sure no references are missed.

Finally, once the design model is attached, the user should at this time set each level display to the desired preference. The create cross section application works on a WYSIWYG premises. ***For example*:** suppose in your design, a guardrail was placed in your 3D model. However, it was not desired to see this guardrail on your proposed cross sections. By simply turning this level off and saving your settings, when cross sections are created, this level will not be displayed. The level settings need to be made at the 3D model level. Once each level setting is verified, make sure to **Save Settings** in the DGN file for those preferences to be remembered.

The **Create Cross Section** application acts as a "cookie cutter" based on a WYSIWYG functionality. The Create Cross Section application slices through the 3D design model at specified even intervals or customized cross section locations. It is important that a template drop location exists in the design corridor at each station location where proposed cross sections are intended to be generated. We do this to avoid interpolation between template drop locations. For

example, if a design called for a template drop every 20 feet but the user wanted to create cross sections at a 10 foot interval, every other section would be interpolated and risks a chance of the proposed finished grade and existing ground not precisely connecting. In the MoDOT workspace, several design stages exist that may be assigned to any Corridor, which will directly affect the template drop interval multiplier.

Corridor Design Stages directly affect the interval of template drops. When creating a Corridor, one of the prompts will ask the user for the Template Drop Interval. The user should always key in the desired final interval. Then, based on the selected Corridor Design Stage selected, the template drop interval will be increased by the design stage template drop interval multiplier. ***For example***, the template drop interval multiplier for the Preliminary Design Stage is 40. So if a user puts in a final template drop interval of 10 and then selects the Preliminary Design stage, the corridor design will contain a template drop every 400 feet or 10 x 40 = 400. This concept has been adopted to allow for very fast model processing in the Preliminary Design stage. Consequently, the multiplier for the Design Stage is set to 2, and the multiplier for the Final Design Stage is set to 1. These settings are stored in a DGNLib for Project Settings in the included MoDOT_workspace. Each customer will likely want to review and modify these settings based on their individual workflows for in-house design work.

When cross sections are created, the application automatically creates a DGN Drawing Model and writes the cross sections to that Model. The user is granted the opportunity to name the Drawing Model before it gets created. By default, the name will correspond to the name of the alignment the cross sections are being developed along. It is acceptable practice to cut multiple sets of cross sections in the same DGN file. Each time cross sections are created, they will be drawn to a new and differently named DGN Drawing Model.

Each DGN file contains one or more models, each of which has its own set of eight views. You can create a model as a 2D or 3D Design type, as a 2D Drawing type or as a 2D or 3D Sheet type. Sheet models let you attach references to create a set of working drawings for the model file. Icons at the top of the Models dialog give you access to its various functions.

Finally, the created proposed cross sections are not presently “dynamic”. Thus, if the design model changes, the user would be required to re-create the cross sections. GEOPAK SS4 does contain a Dynamic Cross Section viewer, which does dynamically update as the model undergoes continued design updates. Before re-creating the proposed cross sections, the user may choose to delete the previously created DGN Drawing Model. If the user intends to create an output of cross sections, such as, creating cross section sheets, legacy tools must be used.
GEOPAK>ROAD>Cross Sections.

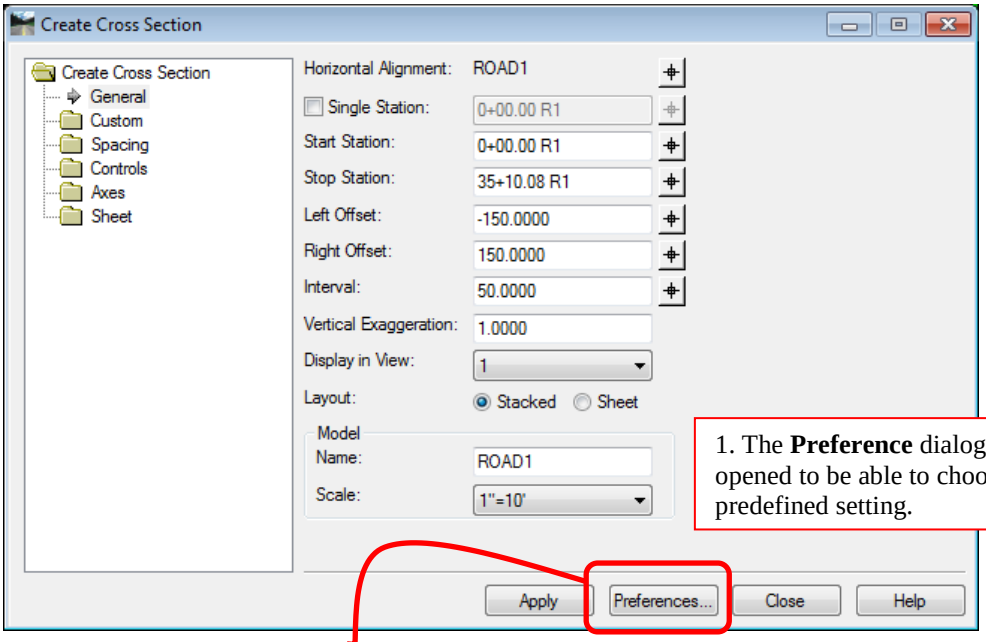
## Cross Section Workflow

1. Create a new cross section DGN file.
2. Reference in the proposed design to the cross section DGN file.
3. Setting the appropriate levels on or off for cross section display preferences.
4. Create the proposed cross sections from the 3D design model.

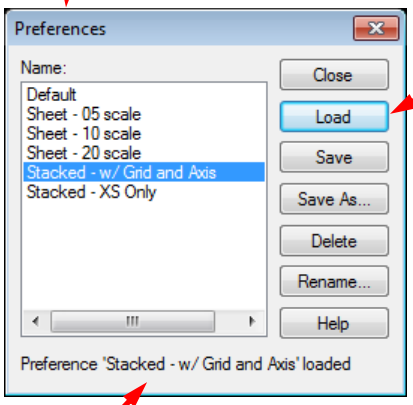
5. Navigate the proposed cross sections.
6. Annotate the proposed cross sections.
7. Compute end-area volumes of the proposed cross sections.

## 9.12 **Create Cross Sections Dialog**

### General Leaf

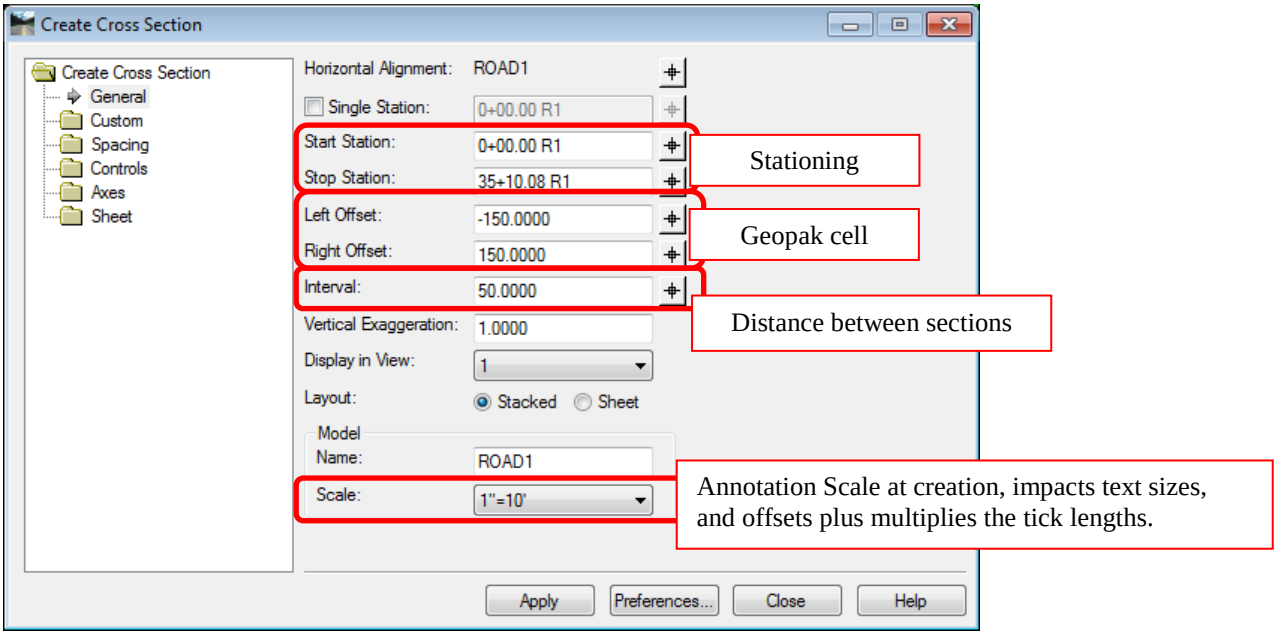



1. The **Preference** dialog must be opened to be able to choose a predefined setting.

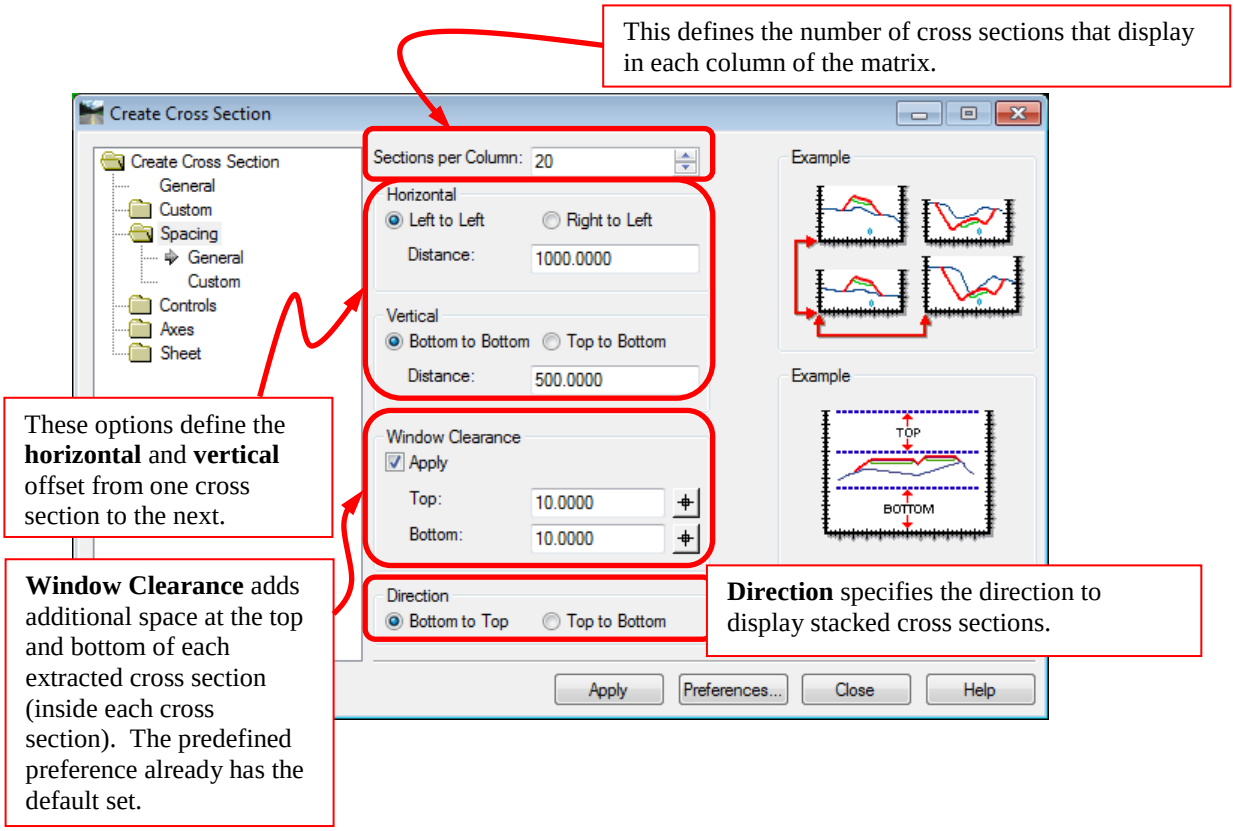



2. Select a preference then select the **Load** button to load the preference.

3. **MoDOT** utilizes 3 different scaled sheet labels, 1 Geopak cross section cell and 1 Geopak cross section cell with a grid and axis.
When you choose a predefined setting it will show you which setting has been selected in the Preferences dialog at the bottom.

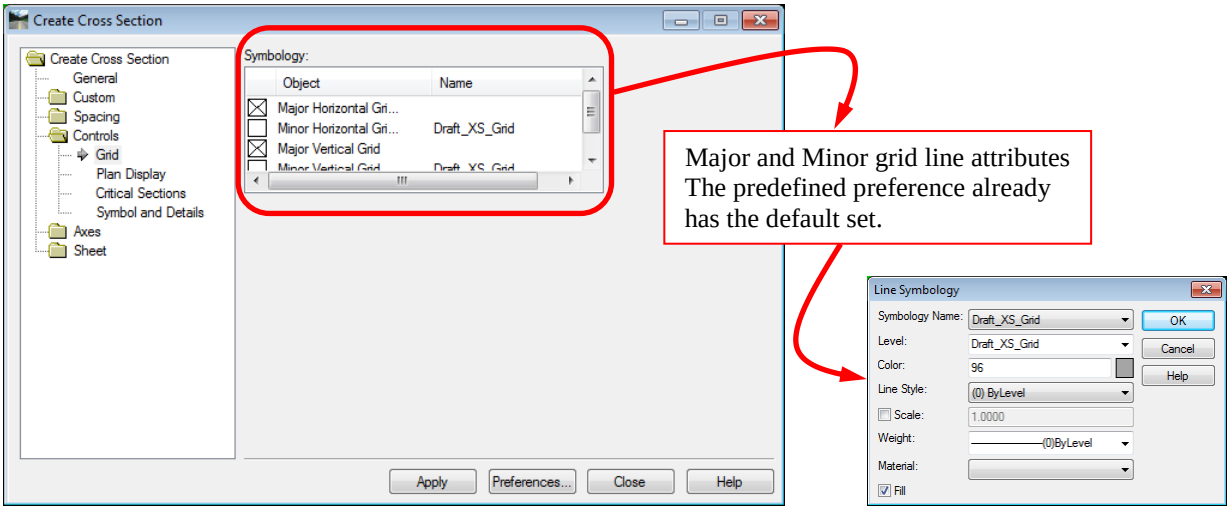



**Spacing Leaf** - Use this dialog to define the settings for stacked or sheet modes.

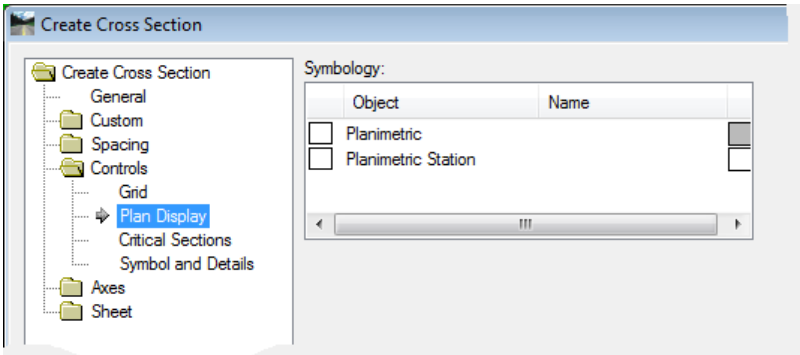


## Controls Leaf

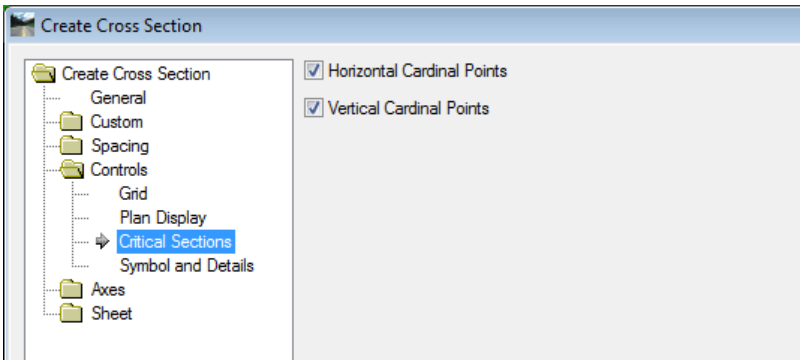
**Grid -** Use this dialog to control the display of grid lines in the cross section. You can display grid lines to correspond to major or minor ticks marks (which are defined on the Axes General leafs), and you can optionally clip horizontal and vertical grid lines so that they display only within the bounds of the cross-section surface data.




**Plan Display** – If checked on, this option will create elements and/or labels in the Plan.DGN.



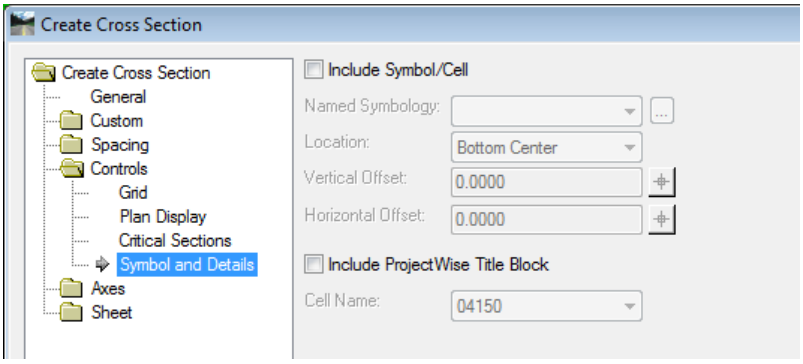

**Critical Sections –** Use this dialog to control the occurrence of critical sections in cross sections.



**Horizontal Cardinal Points -** extracts cross sections at the cardinal points of the horizontal alignment specified on the General leaf (PC, PT, and so forth).

**Vertical Cardinal Points -** extracts cross sections at the cardinal points of the active vertical alignment corresponding to the horizontal alignment specified on the General leaf.

**Symbols and Details** – This option is not used within the MoDOT default set up.




## Axes Leaf - General

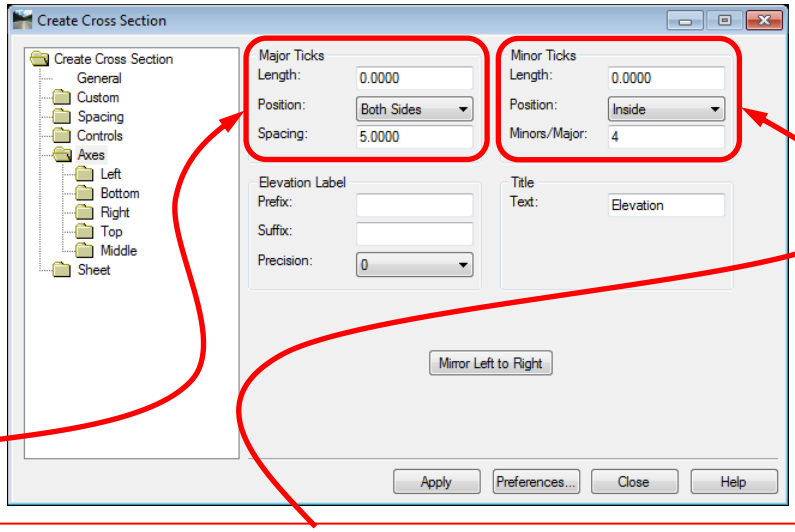
Use this dialog to control which parts of each cross section axis to display and in what format. For each axis, you can display a number of features, including the axis line itself, a title text string and title box (next to the axis), annotation text for the data associated with the axis, and the major and minor ticks that are displayed along the axis.

**Major Ticks**

**Length** - defines the length of major tick marks. If the length is zero, the tick length will be one half of the label text height.

**Position** - places major tick marks inside, outside, or on both sides of each axis.

**Spacing** - specifies the distance between major ticks along the axis. For top and bottom cross section axes, a major tick is always placed at the axis endpoints, regardless of the stationing values at those points, while for top and bottom cross section axes, a major tick is always placed first at the centerline point. This parameter determines how to place all subsequent major tick marks along the axis.

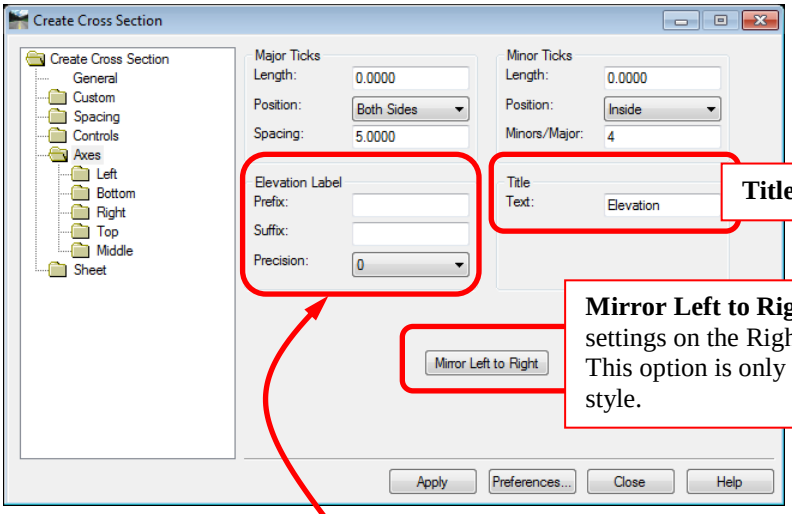



**Minor Ticks**

**Length** - defines the length of minor tick marks. If the length is zero, the tick length will be one half of the label text height.

**Position** - places minor tick marks inside, outside, or on both sides of the axis.

**Minors/Major** - specifies the number of minor tick marks to display between




**Title Text** - specifies text for individual axis.

**Mirror Left to Right** - displays the identical settings on the Right axis.
This option is only available if the label uses a text style.

**Elevation Label** - defines a text string for each axis other than the bottom axis. The stationing value serves as the title for the bottom axis.

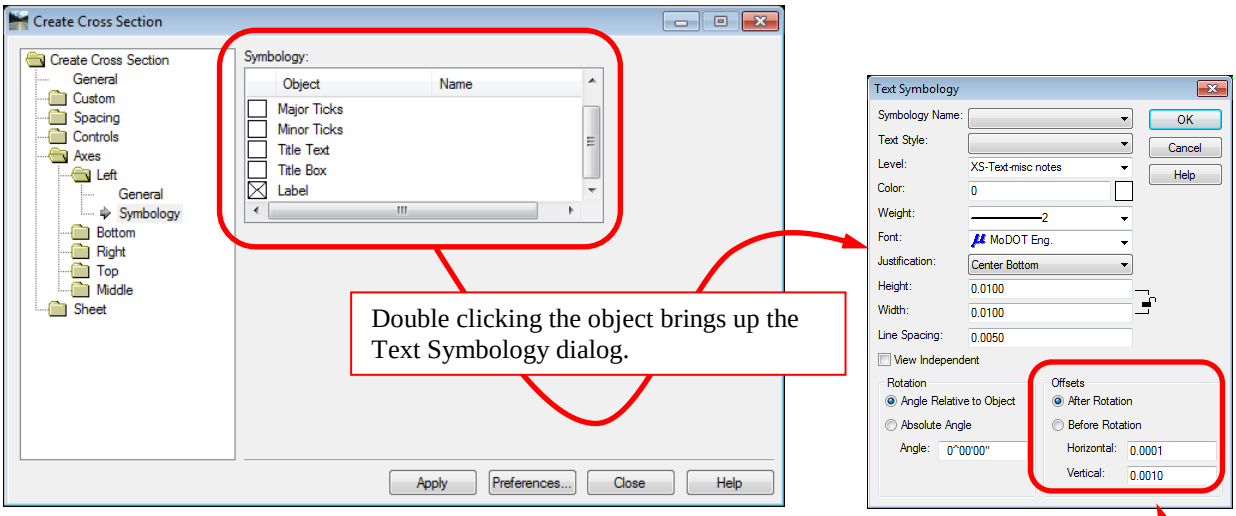
**Prefix** - specifies a text string to place at the beginning of the axis annotation text.

**Suffix** - specifies a text string to append to the axis annotation text.

**Precision** - specifies the number of digits to follow the decimal point in the axis annotation text.

## Axes Leaf – Symbology

Use this dialog to specify the symbology settings for the Axes. These settings have been set up to MoDOT's standards once the preference has been selected.




Double clicking the object brings up the Text Symbology dialog.

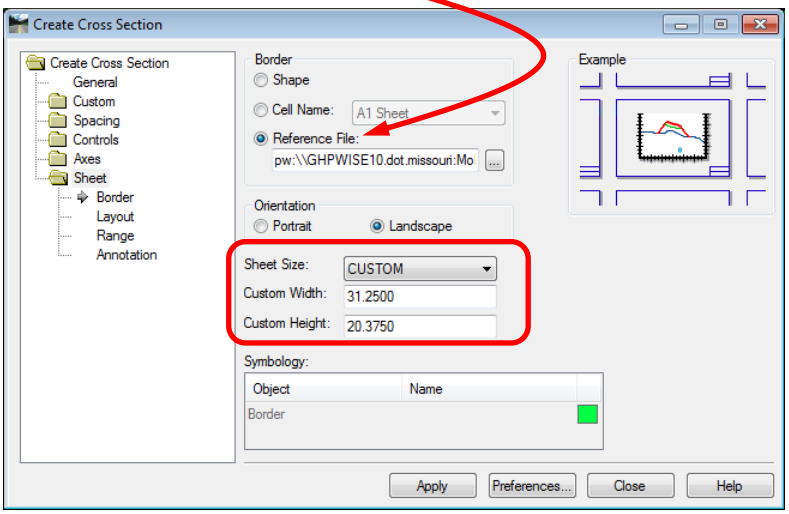
Offsets of Horizontal and Vertical control where the text is located on the sheets.

## Sheet Leaf

### Border

pw:\\GHPWISE10.dot.missouri:MoDOT\Documents\CADD_Standards\Borders\MoDOT_DE_2008.dgn

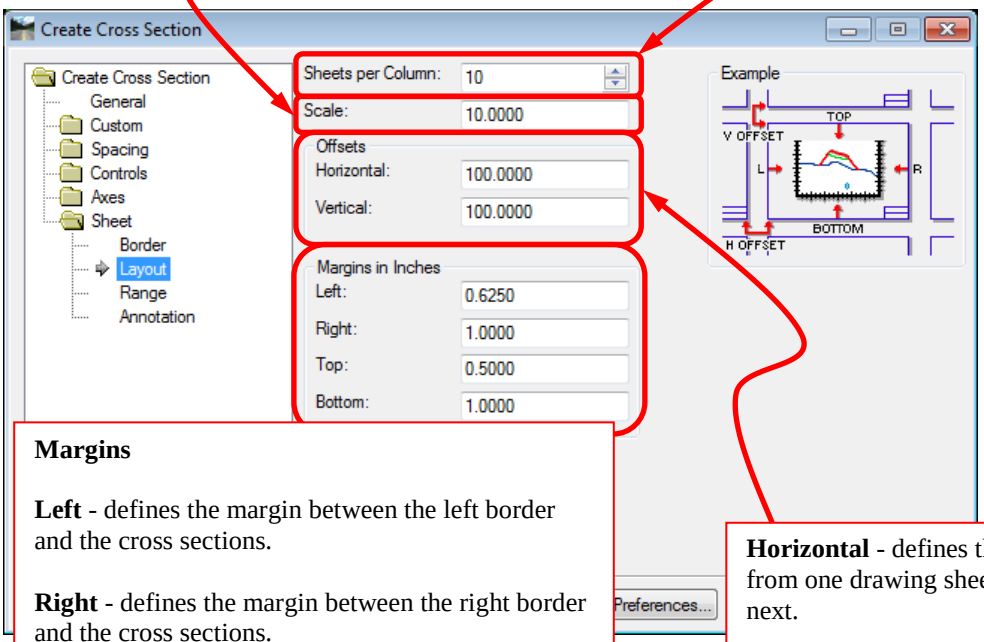
MoDOT's border file located in ProjectWise is attached with using the "read only" option checked on.




### Layout

**Scale** - defines the size exaggeration for the cross section.

**Sheets per Column** - defines the number of sheets per column for stacking sheets. If 1 is selected, sheets are placed horizontally and if a number greater than the number of sheets produced is selected for sheets per column, sheets are placed vertically. This gives you the ability to create sheets in a grid display instead of a long row or column for plotting.




**Margins**

**Left** - defines the margin between the left border and the cross sections.

**Right** - defines the margin between the right border and the cross sections.

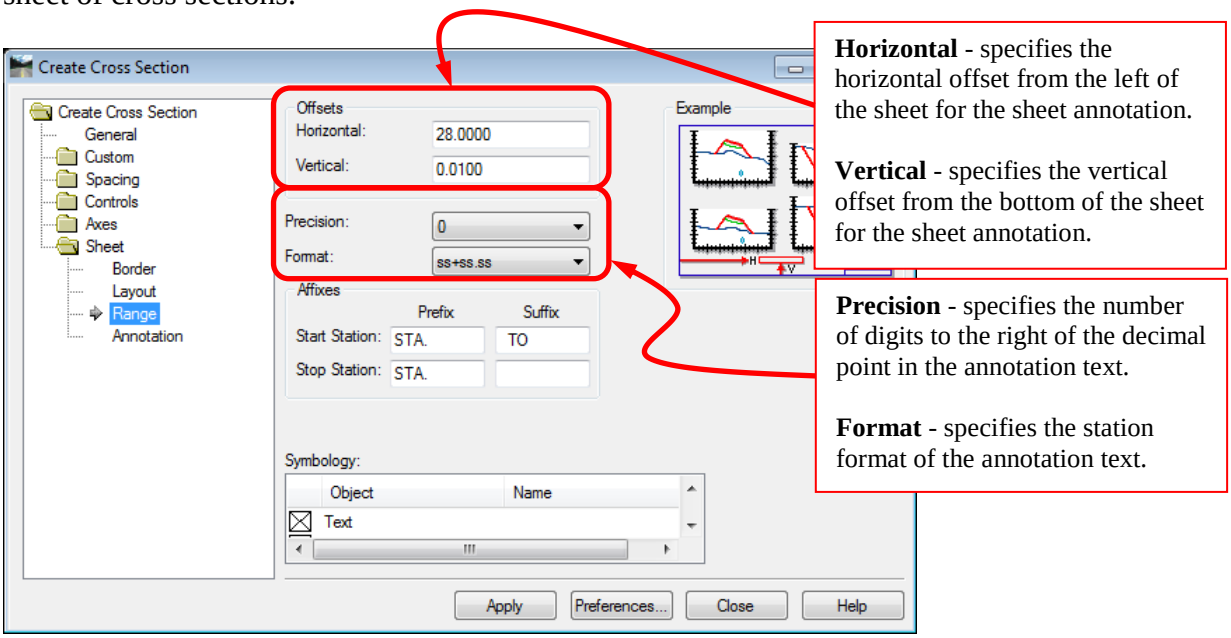
**Top** - defines the margin between the top border and the cross sections.

**Bottom** - defines the margin between the bottom border and the cross sections.

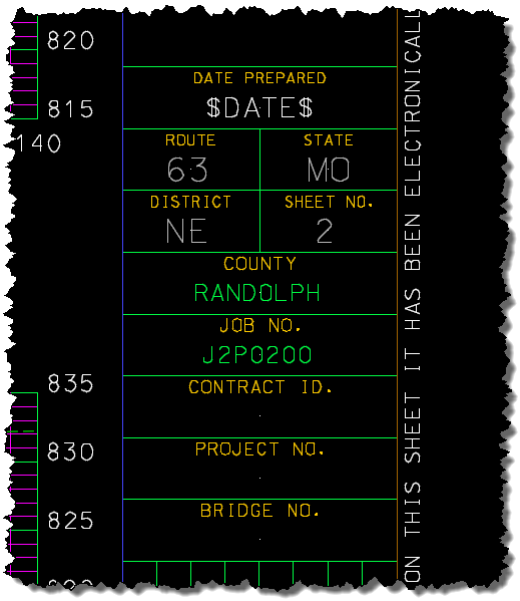
**Horizontal** - defines the horizontal offset from one drawing sheet outline to the next.

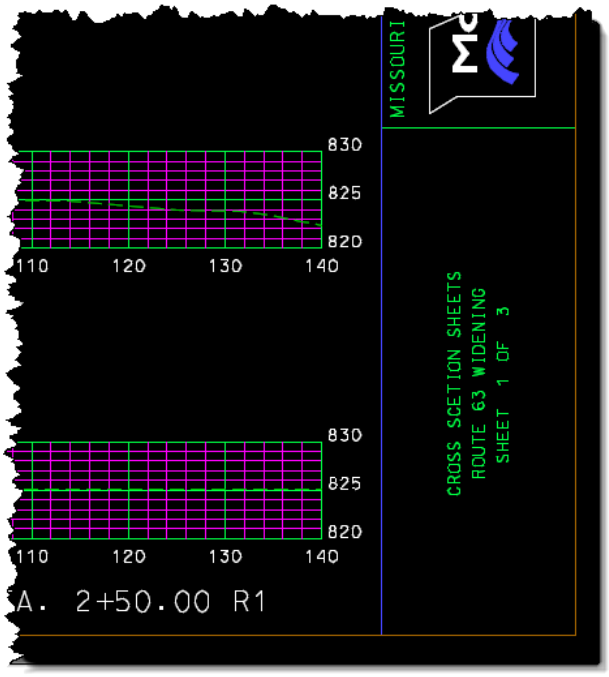
**Vertical** - defines the vertical offset from one drawing sheet outline to the next.

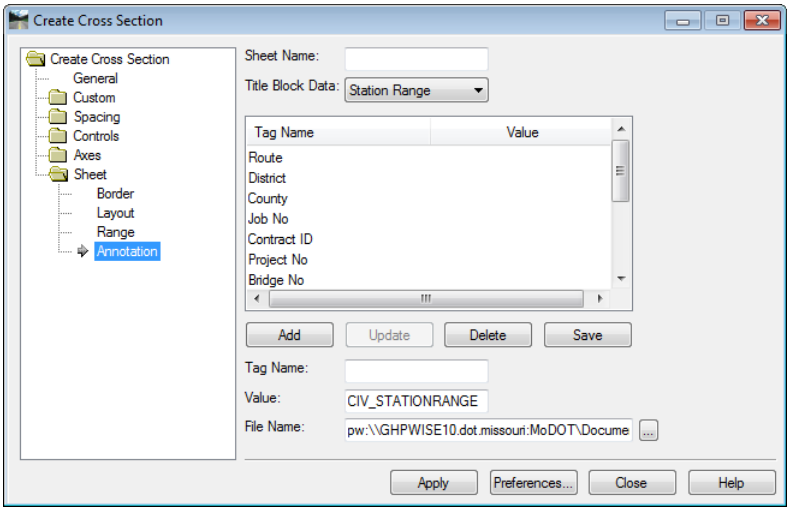
**Range** - Use this dialog to specify the settings for displaying station range annotation on each sheet of cross sections.



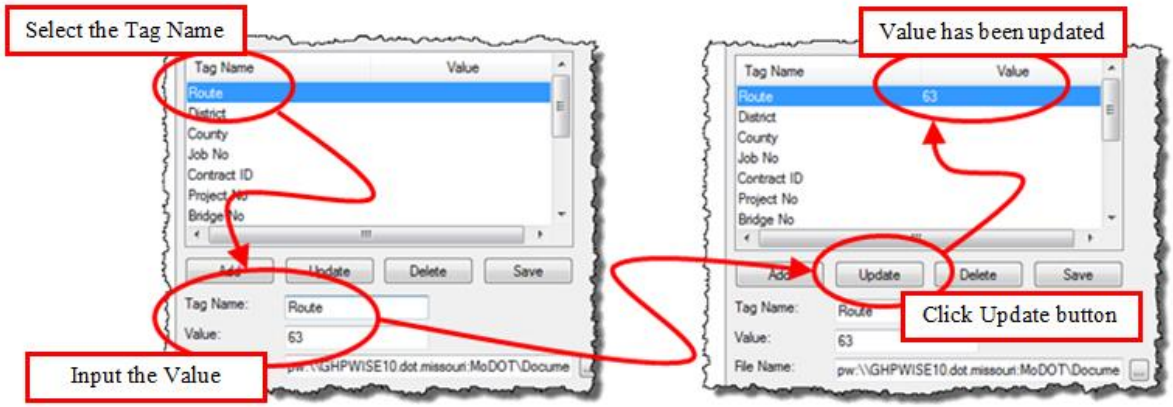

**Annotation** - Use this dialog to define settings for title block annotation that is automatically generated on cross section sheets. You can also define unique fields for annotation, such as project name, and so on. This feature is available only when borders are attached as reference files, and the tags are in the referenced border



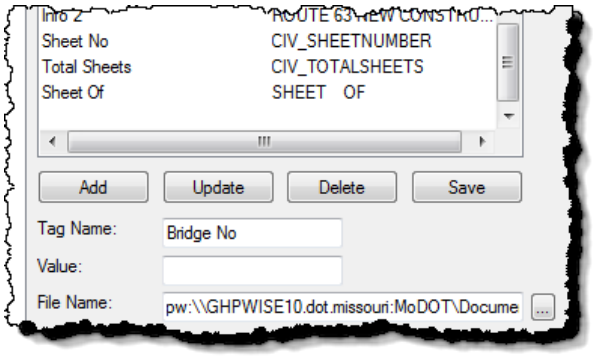



The Tag values will need to be filled out the title block information.
Select a Tag Name and enter a value then select the "Update" button to apply the changes to the tool settings.



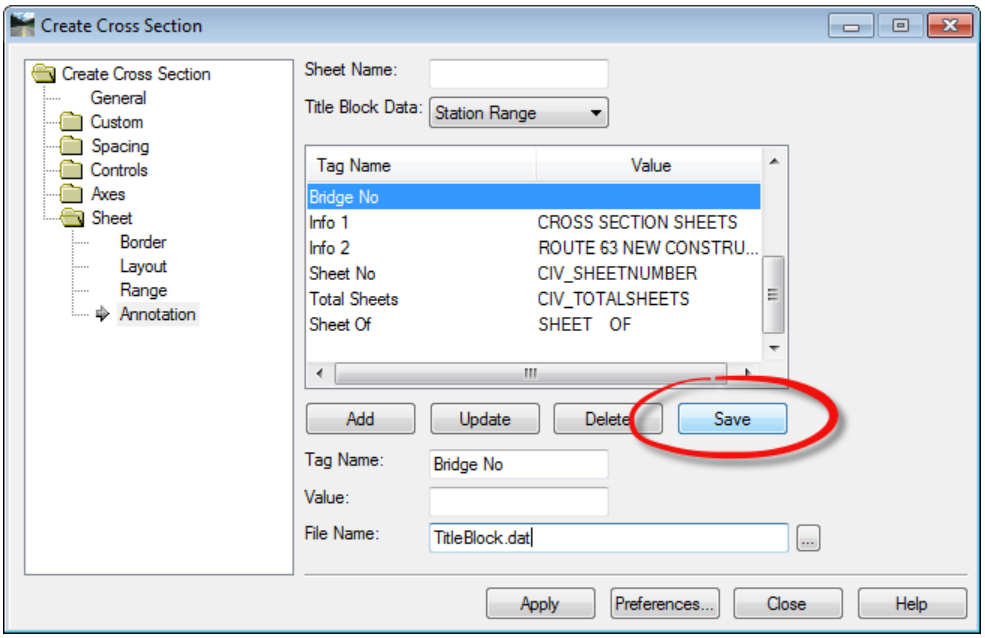

**Note – If a field is left blank then it will not place any text where the Tag location was defined.

The last 3 Tags will be predefined with the value needed to compute the sheet number and total sheets along with the verbiage "SHEET OF."



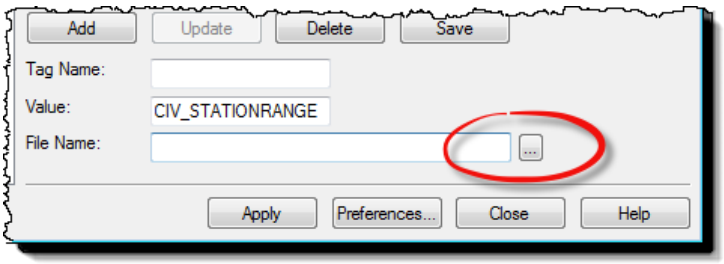
After the Tag values are completed the user can save a DAT file which saves the dialog information so that the values can be easily recalled and used again.

The attached DAT file will be the default MoDOT.DAT file that resides on the T:\MoDOT_Workspace\Modeling\Cross Sections and cannot be overwritten so you will need to save a copy to your Job > Data folder.




Once the file is saved your data folder the tool will revert back to that location when opening the tool the next time.

The pick button allows the user to load the MoDOT default DAT file by navigating to the T:\MoDOT_Workspace\Modeling\Cross Sections folder and selecting the MoDOT.DAT file.




Once the cross sections have been defined, the information has been defined in the dialog and the DAT file saved to the data folder the tool is ready to use.

Click on the Apply button to create the cross section model. The border will be referenced into the model with instances created for each sheet that is created.

The title block information will be filled out according to your settings and the informational block will be created in the lower right, vertically with the defined settings that were defined in the dialog.

*****Note*** – The Make PDF Request can only handle 50 borders at one time so it is recommended that you run all the cross sections in one model and then save as a copy (some may have 3 files for cross sections) from the original.

Open the model containing the cross sections and remove the extra cross sections leaving the cross sections needed for the Make PDF Request tool.

## 9.13 Annotate Cross Sections

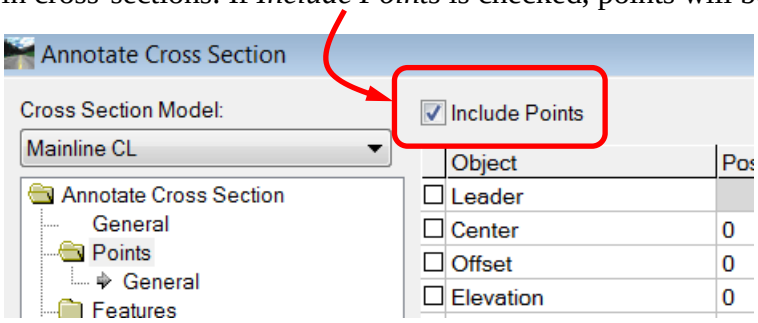
Annotate Cross Sections places text describing the characteristics of cross sections that were previously placed in the drawing file. These characteristics can include slope, width, elevation, and offsets. The cross sections may have been placed with any of the cross-section extraction and display options. Annotation allows you to know the characteristics of your design as you examine cross sections.

Annotation for features obeys the design file annotation scale factor.

**Which Elements Are Annotated?**

The following controls what annotation appears in the cross section:

The ***Points, Features, and Segments*** leafs are used as master switches to turn on or off annotation for points, segments, or features. For example, if *Include Points* is not checked, no point annotation appears in cross sections. If *Include Points* is checked, points will be annotated.

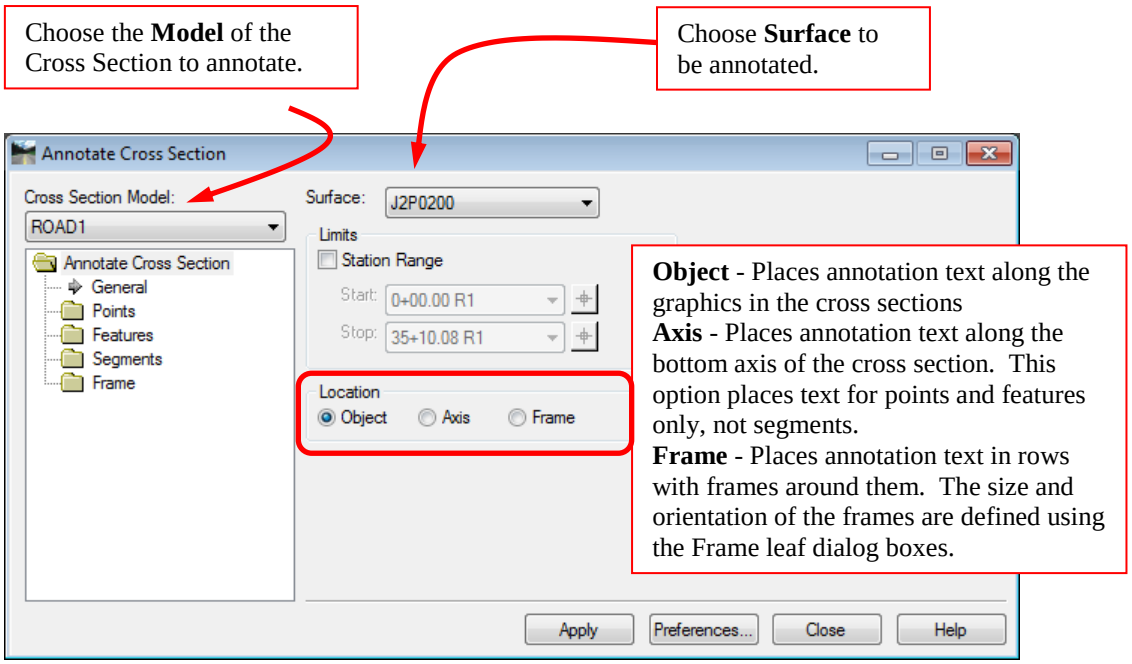



The parameters on the *Points, Features, Segments, and Frame* leafs restrict which elements are annotated.

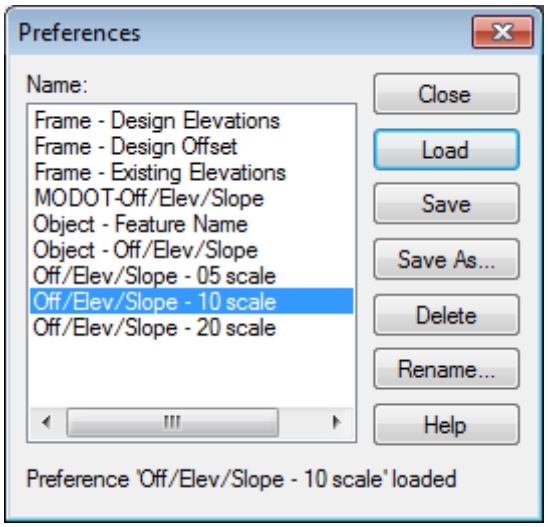
The Annotate Cross Section command can annotate multiple surfaces in a single pass. On the General dialog is a list view, which lists each surface in the cross section set and a preference. The preference listed is either the active preference for the command or the preference defined in *Surface Properties* for that surface, depending on style lock. This list view allows you to select multiple surfaces to annotate.

The Annotate Cross Section application has the ability to label any particular cross section model present in the active DGN file including models that are not active. In addition, we have the

ability to label any surface found within all models of our DGN file. The annotation application is highly versatile to meet many different types of labeling needs. For example, the cross section annotation application can label the individual objects along the cross section, along a bottom axis, or in a frame mode. It is possible to label points along a surface, crossing linear features, and component segments like the slopes of a proposed pavement for example. The supported combinations are endless regarding all that can be labeled along a cross section.



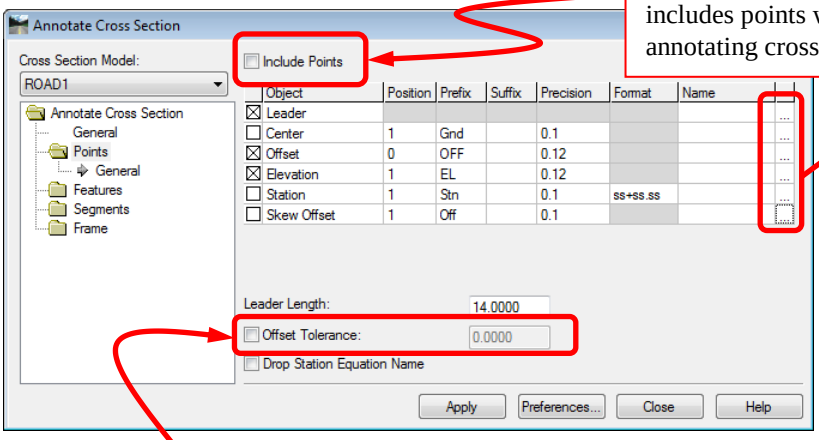

Preferences are stored in the MoDOT workspace in a XIN file. Several preferences are provided in the MoDOT workspace. The scales of 5, 10 and 20 support the cross section settings in the MoDOT create cross section tool.

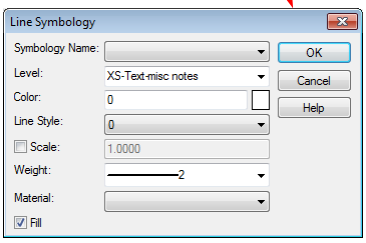


**Points** – Used to label points on cross sections.

**Include Points** - If checked, includes points when annotating cross sections.

The last column in the grid is the means of access to the symbology dialog.

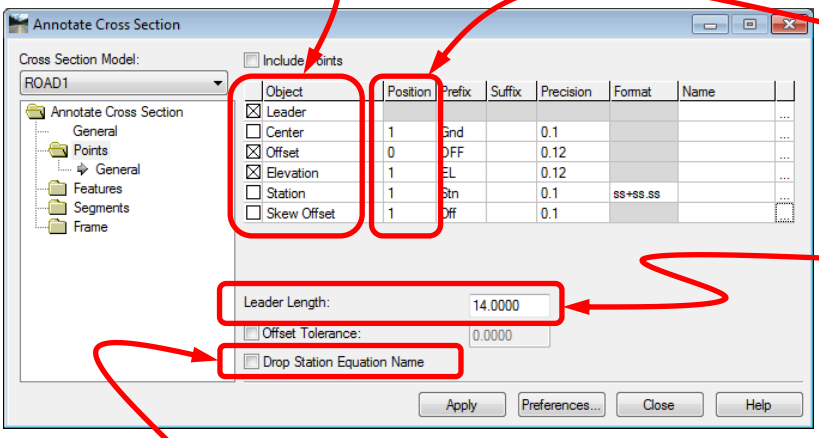



**Offset Tolerance** - if checked, will not annotate points within the defined tolerance. This applies to points coming from the surface line or from the ASCII file.

**Object** - displays object attributes in rows. The first column has check boxes indicating which attributes are to be included in the annotation.
**Leader** - leader line for the annotation to follow.
**Center** - annotation of the centerline (zero offset) of the cross section.
**Offset** - annotation of the offset of any point in the cross section.
**Elevation** - annotation of the elevation of any point in the cross section.
**Station** - the station of the feature relative to the alignment.
**Skew Offset** - annotation of the offset of each point in the cross section. The offset is measured along the cross section (not by normal projection).

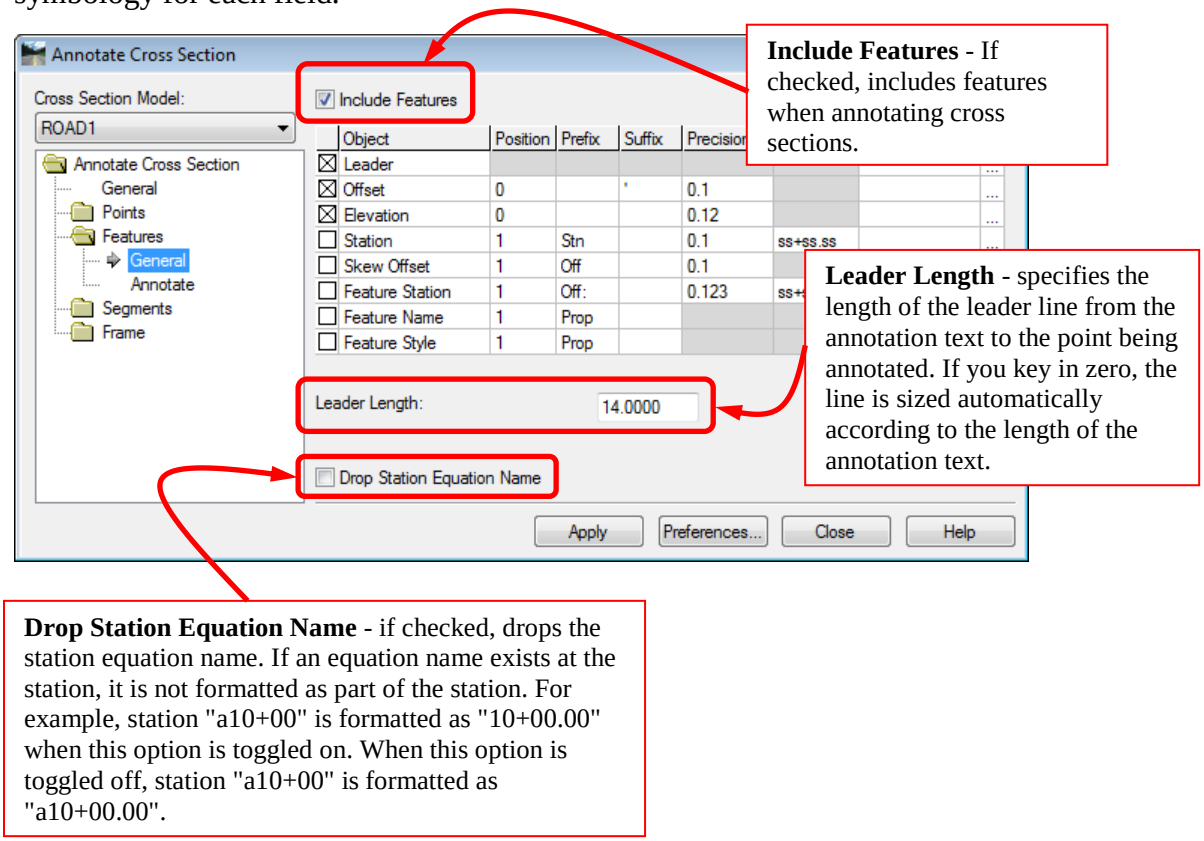
**Position** - controls the position of the annotation text. A value of zero does not affect the text position. A value of 1 moves the text so that it displays one line above its original position. A value of 2 moves the text two lines above its original position, and so forth. Negative values move the text in the opposite direction.




**Leader Length** - specifies the length of the leader line from the annotation text to the point being annotated. If you key in zero, the line is sized automatically according to the length of the annotation text.

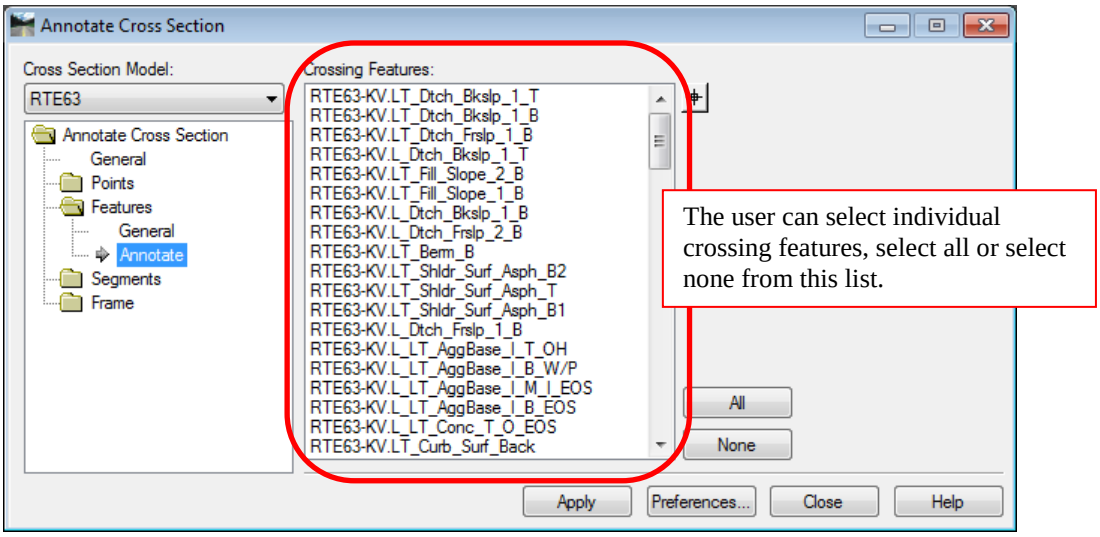
**Drop Station Equation Name** - if checked, drops the station equation name. If an equation name exists at the station, it is not formatted as part of the station. For example, station "a10+00" is formatted as "10+00.00" when this option is toggled on. When this option is toggled off, station "a10+00" is formatted as "a10+00.00".

**Features** - This dialog box is designed to use the grid control. As on the Points and Segments dialogs the fields for position, prefix, suffix and precision are combined into one control with the symbology for each field.

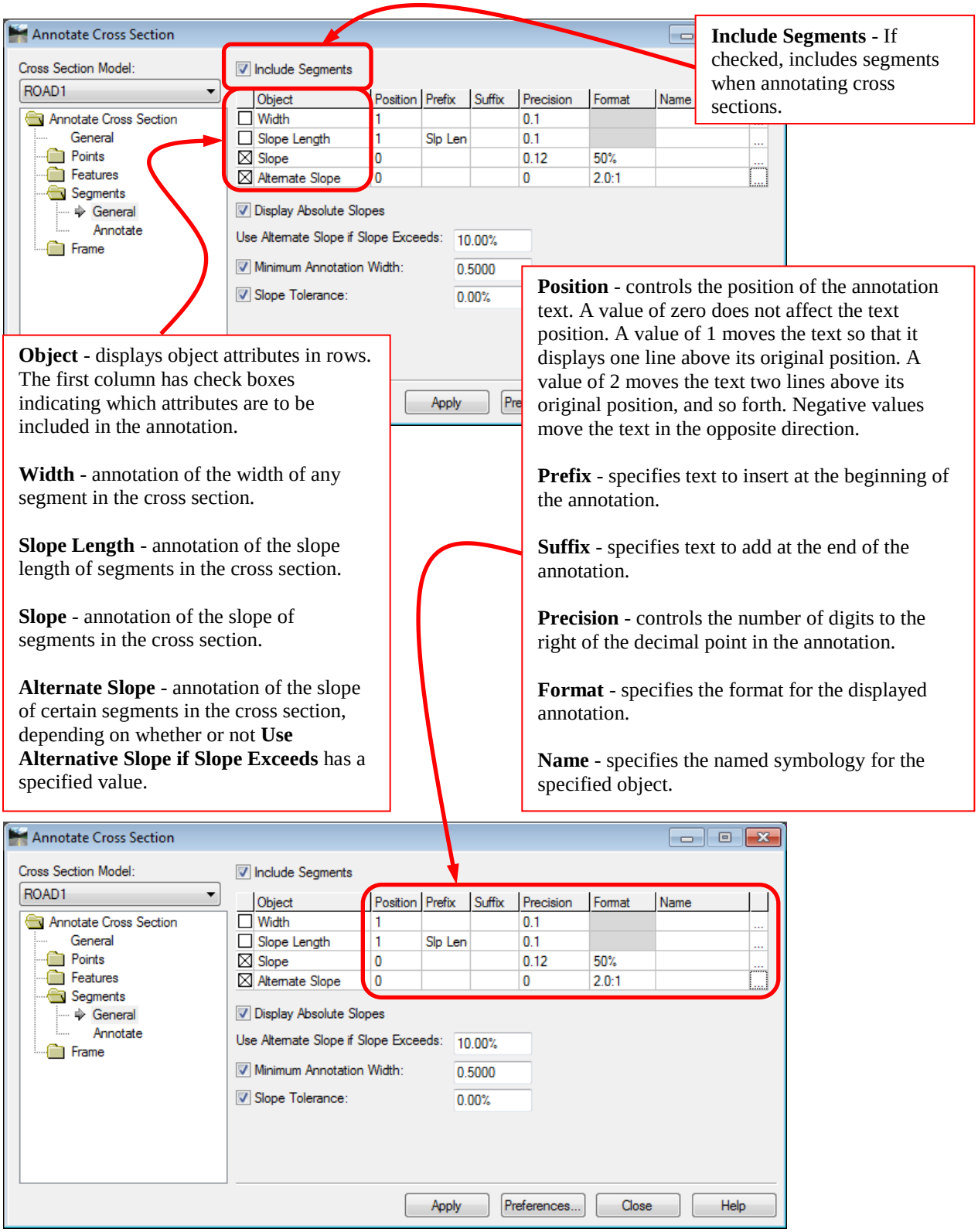


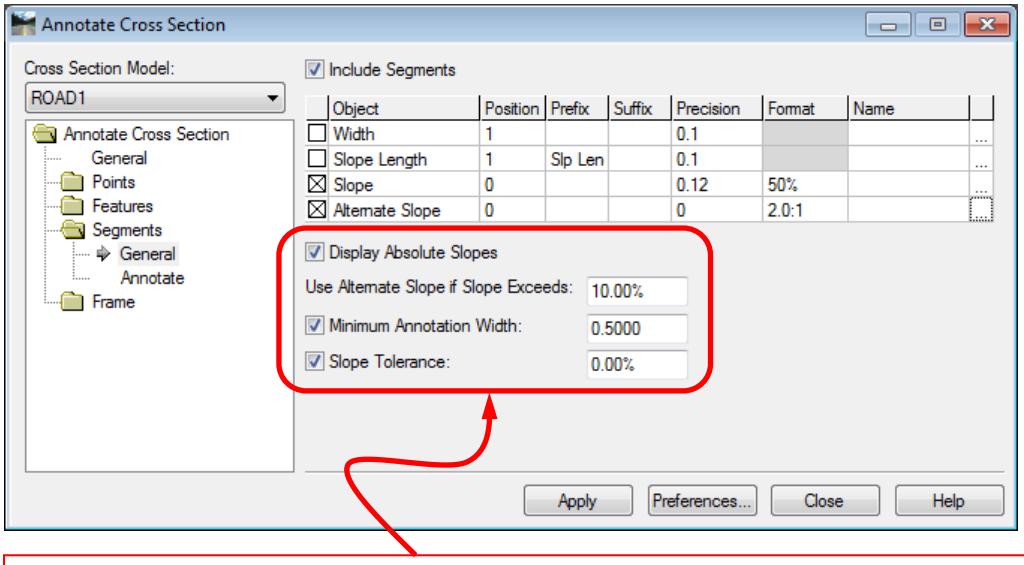

The following controls what annotation appears in the cross section:

The Points, Features, and Segments leafs are used as master switches to turn on or off annotation for points, segments, or features. For example, if the Include Points is not checked, no point annotation appears in cross sections.



**Segments** - The Segments General leaf is designed to use the grid control. As on the Points dialog, the fields for position, prefix, suffix, precision, and format are combined into one control with the symbology for each field. The appropriate tolerances are added to the Segments dialog.






**Display Absolute Slopes** - if checked, displays the absolute values of slopes.

**Use Alternate Slope if Slope Exceeds** - allows a different set of parameters to control slope annotation depending on whether or not each slope of each segment is greater than or less than a specified value. This option allows you to annotate all segments whose slopes are less than 20%, for example, using one set of parameters, while using another set of parameters to annotate all segments whose slopes are greater than 20%. The two sets of parameters involved are those in the Slope column and those in the Alternate Slope column in the Display Controls group box. Specify any slope you want for the "r;slope exceeds" value.

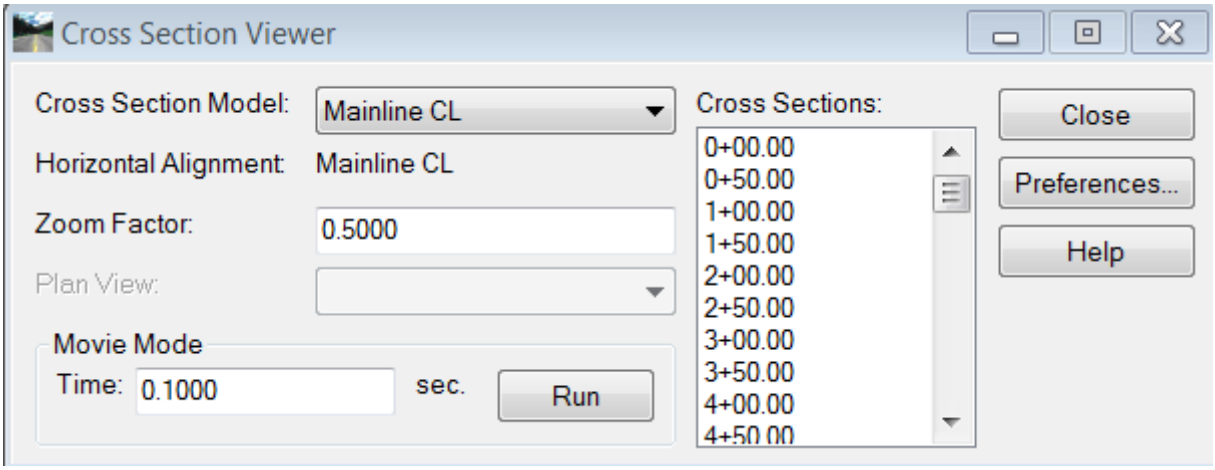
**Minimum Annotation Width** - if a segment's width is less than the defined value it will not be annotated.

**Slope Tolerance** - if checked, activates the slope tolerance check. If the difference in slope on adjacent segments is less than the slope tolerance only one slope value will be displayed.

Using MoDOT's default preferences will allow for quick and easy annotations.

## 9.14 Cross Section Viewer

The Cross Section Viewer command windows in on specified cross section set in the Model. Using the Cross Section Viewer, you can view a single cross section, or you can view in succession each cross section in a model. The latter method, called *Movie Mode*, displays each cross section for a specified time.




**Dialog Options**

**Cross Section Model** defines which set of cross sections to view. Select one of the available models.

**Horizontal Alignment** displays the horizontal alignment associated with the selected cross section.

**Zoom Factor** defines the zoom factor for adjusting the drawing file view. Enter a value greater than 1.0 to zoom out from the cross sections. Enter a value less than 1.0 to zoom in toward the cross sections. Only applies to the cross section view.

**Plan View** shows the plan location of the cross section viewed. Draws a temporary line in the plan view where the cross section is located and centers that line in the plan view.

**Movie Mode Time** specifies the time for viewing each cross section in the selected cross section set. You can enter time values in tenths of a second.

**Run** starts the movie mode of the cross section viewer. Selecting the <Esc> cancels the run

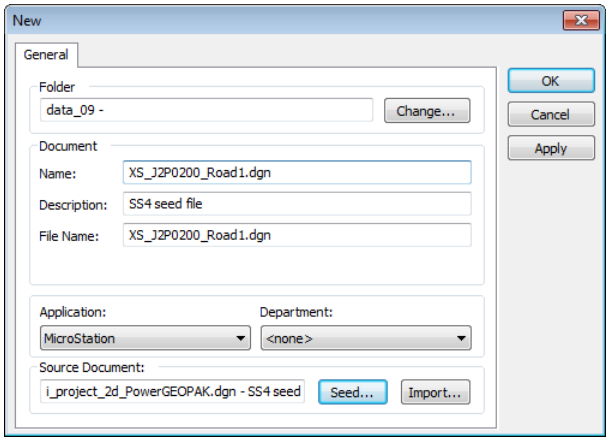
**Cross Sections** lists each cross section in the selected cross section set. Select a single cross section to immediately view it

## 9.15 Group Exercise: Cutting Road1 Cross Sections and Annotation

### Create a New Cross Section Design File

1. Within the J2P0200*data_09* folder, open the file: **Plan_J2P0200.dgn**
2. Select **File > New** and create a new MicroStation file named **XS_ J2P0200_Road1.dgn**

   Using the seed file: *pw:\CADD_Standards\Seed Files\Design - English**i_project_2d_PowerGEOPAK.dgn***




3. Select **OK** to create the new dgn file.

### Attaching the Design as a Reference File

4. In the file **XS_J2P0200_Road1.dgn** created above.
5. Choose **File** > **References** in the MicroStation pull down menu or use the MicroStation icon .
6. In the *References* dialog menu choose **Tools** > **Attach**.
7. Select the files in your current working directory;

   ***Civil_Geometry_J2P0200.dgn***

   ***Corridor_J2P0200.dgn***

   ***Land_Boundaries_J2P0200.dgn***

   ***Pattern_Lines_J2P0200.dgn***

   ***Superelevation_J2P0200.dgn***

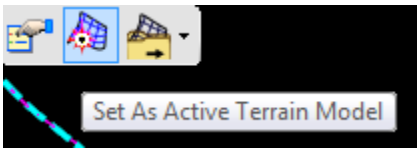
   ***Terrain_J2P0200_Existing.dgn***

   Then click the ***OK*** button

8. Close the *References* dialog.

9. MicroStation **Fit View** to pan to the project location.

10. With the *Element Selection* tool, **data point** on the Existing ground perimeter and set the Existing terrain model as the ***Active Terrain Model*** using the heads up display.



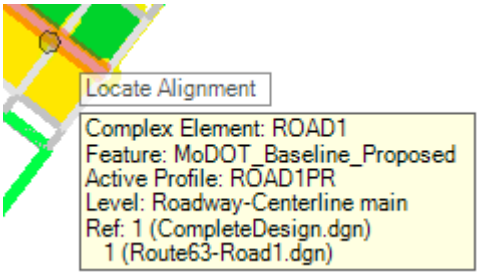

11. Window in to the Road1 corridor.

**Create the Cross Sections**

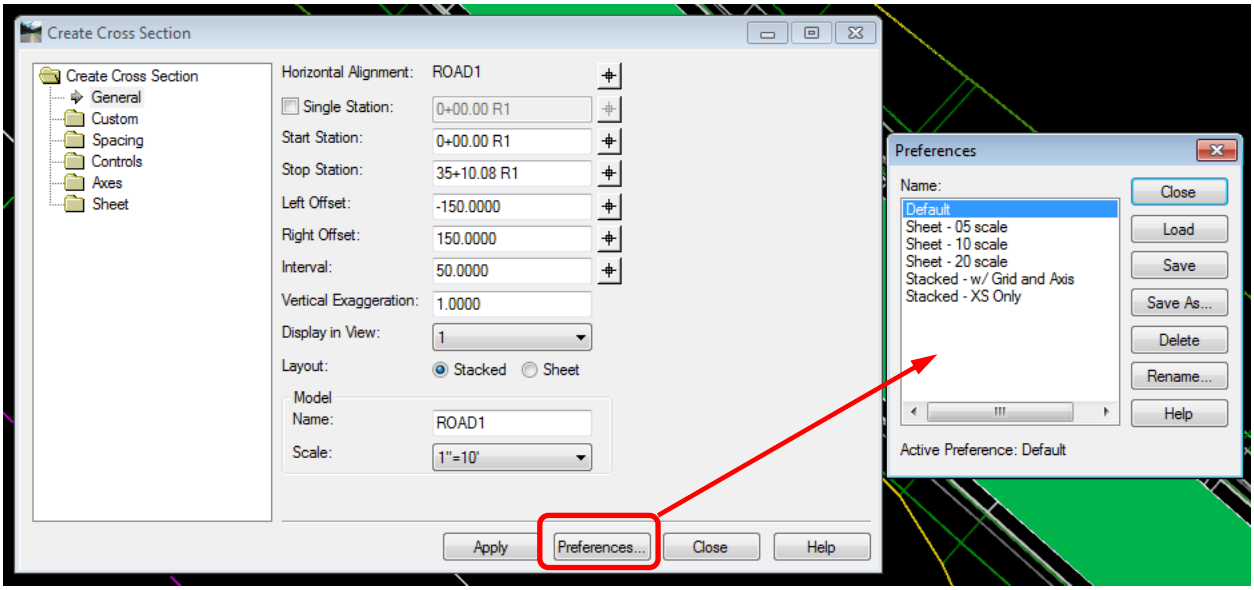
12. Continue in the same design file ***XS_J2P0200_Road1.dgn***.

13. From the *Corridor Modeling* tasks group, select the **Create Cross Sections** command

14. When prompted to *Locate Alignment*, **data point** on the centerline of **Road1**.




15. Located at the bottom of the *Create Cross Section* dialog, select **Preferences**.



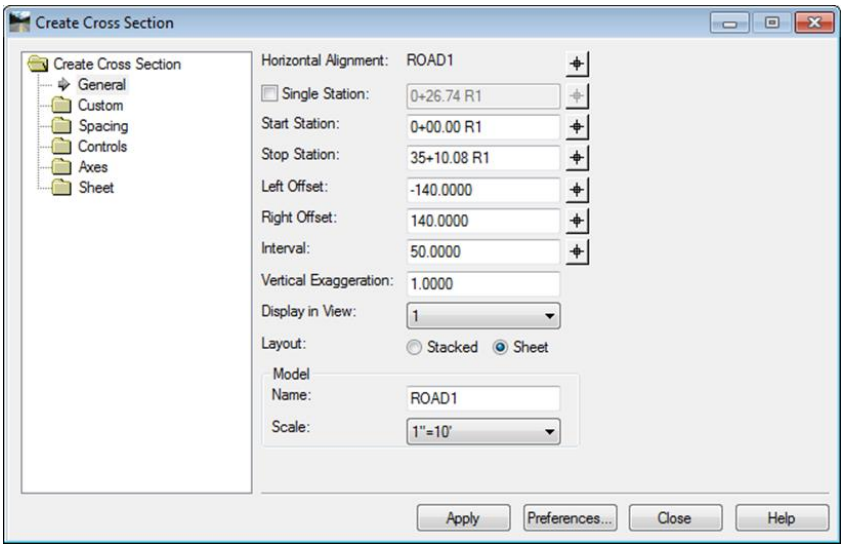

16. In the *Preferences* dialog select the preference titled **Sheet – 10 Scale**.

17. In the *Preferences* dialog, click **Load** to utilize the selected preferences in the previous step.

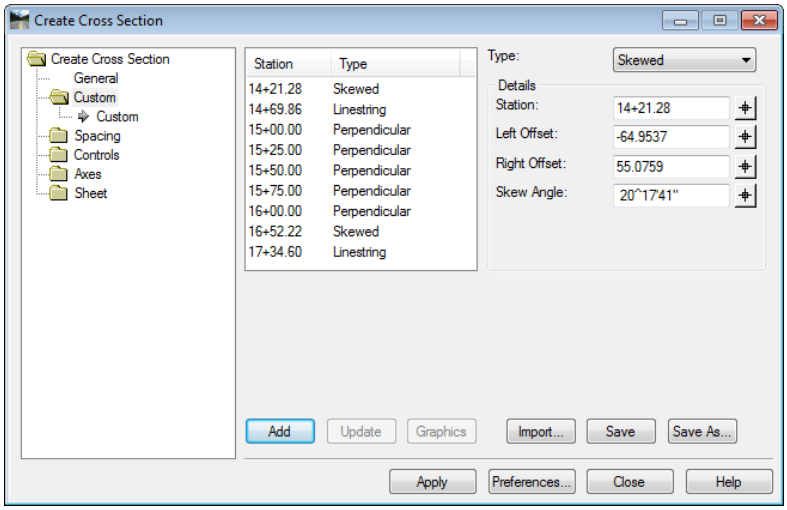
*Preferences are predefined settings stored in the active XIN settings file. These preferences will be used for creating, annotating and computing end area volumes on proposed cross sections.*

18. **Close** the *Preferences* selection dialog.

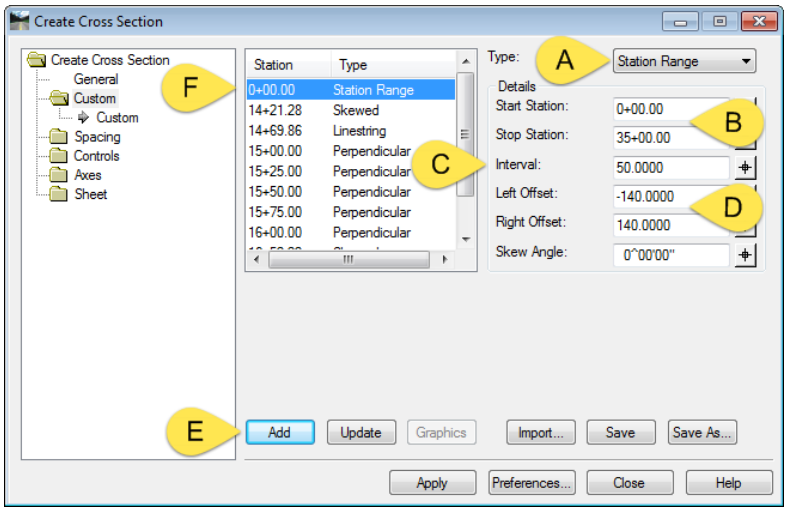
19. In the *Create Cross Section* dialog, verify the General settings as shown below.




20. Select the Custom leaf and fill in the following values by selecting the elements on the level ***Geopak-Pattern line 1***:



Also add a station range of cross sections from 0+00 to 35+00




A – **Select Station Range** from the pull down

B – **Edit** the **start station** 0+00 and **stop stationing** 35+00

C – **Set** the Interval to 50’

D – **Edit** the **left offset** -140 and the **right offset** 140

E – Add the Station Range to the list by clicking the **Add** button

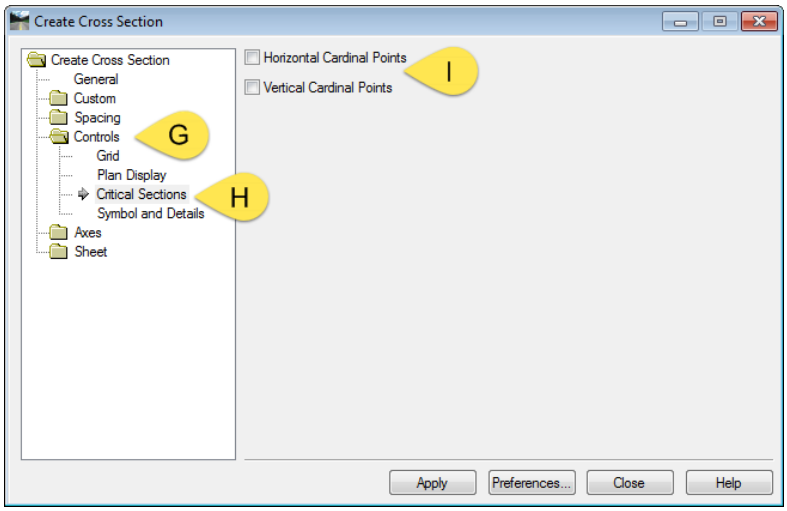
F – The entry will **display** in the list

21. Remove the Cardinal Points

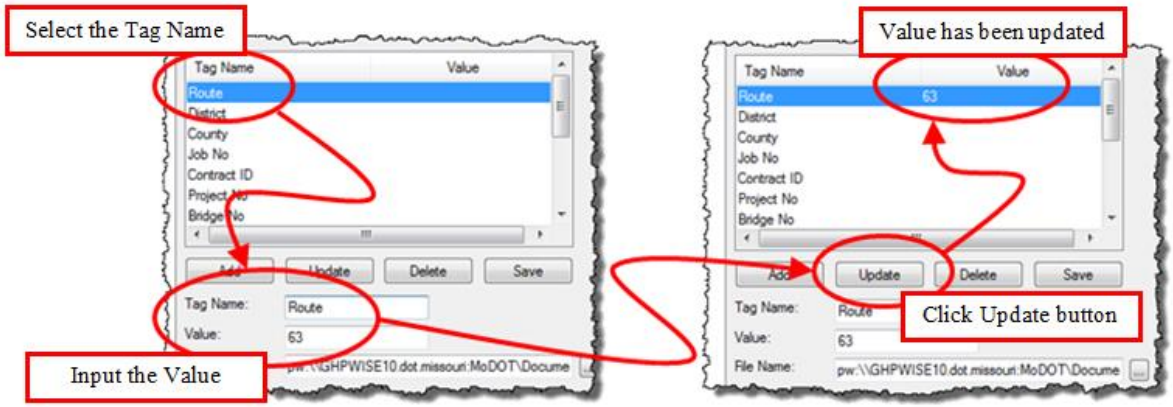
G - **Navigate** to the Controls leaf

H - **Select** the Critical Sections option

I - **Uncheck** the Horizontal and Vertical Cardinal Points.



22. Open the Sheet leaf (folder) and select the ***Annotation*** option. Change the Tag Values to include the following:




Route = ROAD1

District = NE

County = RANDOLPH

Job No. = J2P0200

Contract ID = (leave blank)

Project No. = (leave blank)

Bridge No. = (leave blank)

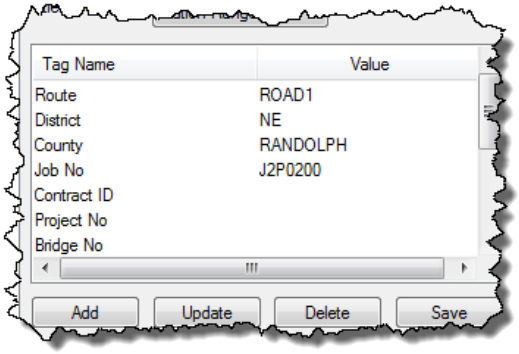
Info 1 = CROSS SECTION SHEETS

Info 2 = ROAD1 CONSTRUCTION

Sheet No. = (use default)

Total Sheets = (use default)

Sheet Of = (use default)




23. In the *Create Cross Section* dialog, click **Apply** to create the cross sections into a new DGN Drawing Model entitled ROAD1.

24. **Close** the *Create Cross Section* dialog after the cross sections have been generated.

Note: New cross sections will need to be created if edits are needed. This may be done in the Cross Section Model if the tool is still open but if the tool has been closed then you will need to open the Default Model.

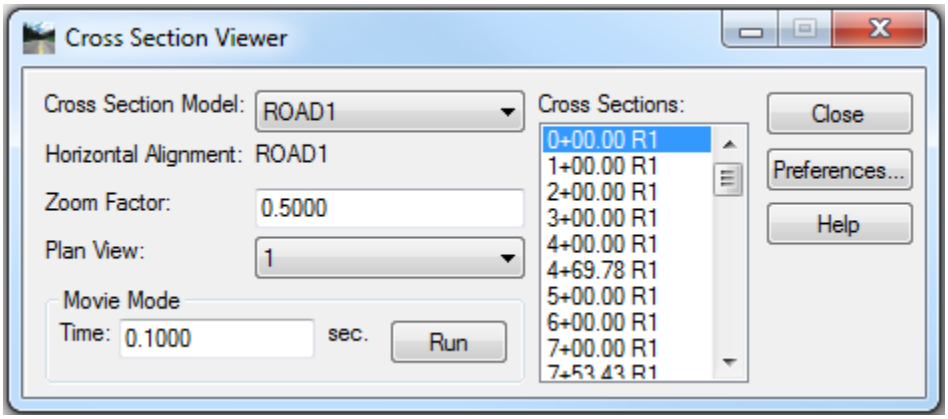
**View the Cross Sections**

25. Continue in the same design file *XS_Road1.dgn.*

26. From the *Corridor Modeling* task group, select the **Cross Section Viewer** tool.

27. In the *Cross Section Viewer* dialog, verify the *Cross Section Model:* setting is set to your active Cross Section Drawing Model *Road1*.

28. Populate the *Cross Section Viewer* dialog as shown.




29. Select **Run** to automatically scan through the cross sections.

30. Now select any individual cross section station from the list and notice how the view updates to the selected cross section station value.

31. **Close** the *Cross Section Viewer* dialog.

**Annotate the Cross Sections**

32. Continue in the same design file *XS_Road1.dgn.*

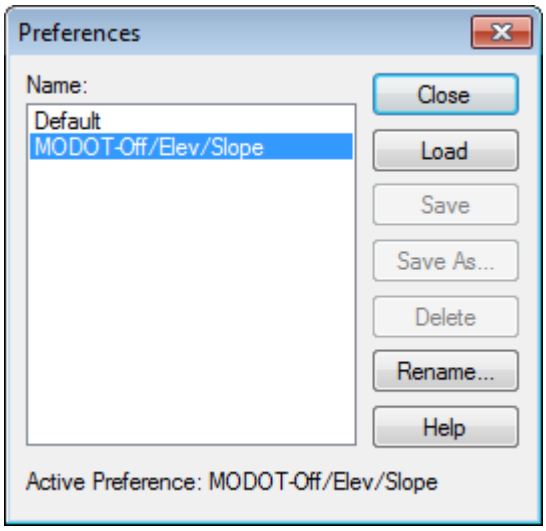
33. From the *Corridor Modeling* task group, select the **Annotate Cross Sections** tool.

34. Located at the bottom of the *Annotate Cross Section* dialog, click **Preferences**.

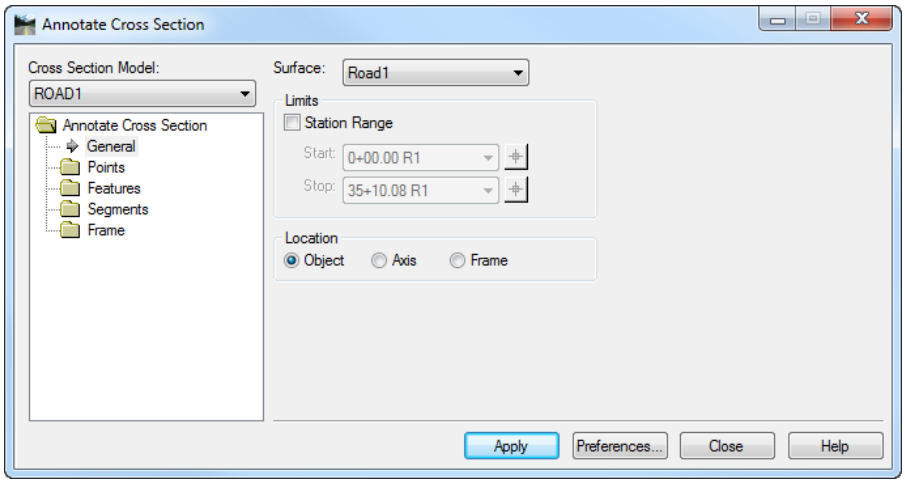
35. In the *Preferences* dialog, select the preference entitled **MODOT-Off/Elev/Slope**.

36. In the *Preferences* dialog click **Load**, to utilize the selected preferences in the previous step. Preferences are predefined settings stored in the active XIN settings file. These preferences will be used for creating, annotating and computing end area volumes on proposed cross sections.

37. **Close** the *Preferences* dialog.

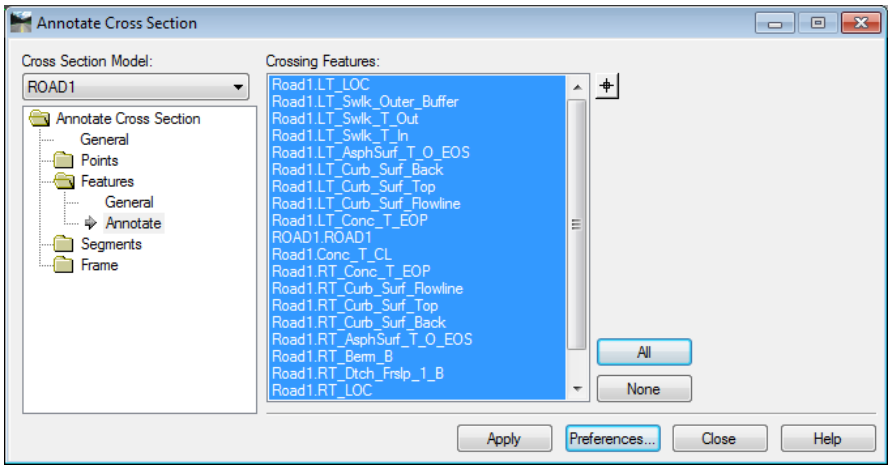


38. In the *Annotate Cross Section* dialog, complete the *General* settings as shown.




39. Expand the *Features* folder and select **Annotate** on the left hand side of the dialog.

40. Select all of the *Crossing Features* as shown below.




41. Expand the *Segments* folder and select **Annotate** on the left hand side of the dialog.

42. Select a few Crossing Features using the pick button to show offset/elevations to label.

43. In the *Annotate Cross Section* dialog, select **Apply** to annotate the cross sections in the selected DGN Drawing Model labeling offsets, elevations, and slopes. The cross section annotation labels are automatically made part of a MicroStation Graphic Group. Additionally, only the selected Features are labeled, so if none are selected all the slopes are labeled.

44. **Close** the *Annotate Cross Section* dialog.

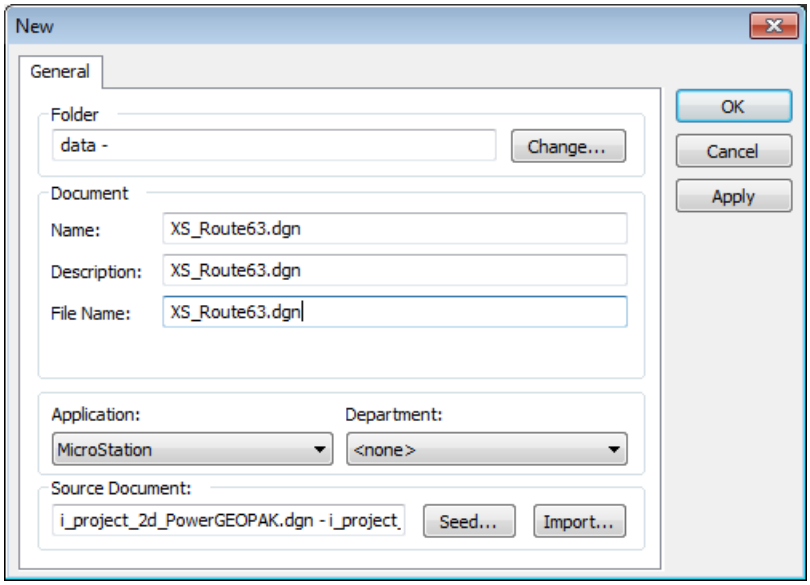
45. In the MicroStation tool bar select **Settings** > **Drawing Scale**. Change the setting from 1”=10’ to 1”=20’. What happens to the text size? Return the setting back to the original setting of 1”=10’ when complete.

## 9.16 Individual Exercise 5-1: Cutting Route 63 Cross Sections and Annotation

### Create a new Cross Section Design File

1. Select **File** > **New** and create a new MicroStation file named **XS_J2P0200_Route63.dgn**

   Using the seed file: *pw:\CADD_Standards\Seed Files\Design - English**i_project_2d_PowerGEOPAK.dgn***




2. Select **OK** to create the new dgn file.

### Attaching the Design as a Reference File

3. In the file **XS_J2P0200_Route63.dgn** created above.
4. Choose **File** > **References** in the MicroStation pull down menu or use the MicroStation icon .
5. In the *References* dialog menu choose **Tools** > **Attach**.
6. Select the files in your current working directory;

   ***Civil_Geometry_J2P0200.dgn***

   ***Corridor_J2P0200.dgn***

   ***Land_Boundaries_J2P0200.dgn***

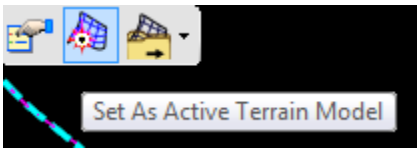
   ***Superelevation_J2P0200 then*** click **OK**

   ***Terrain_J2P0200_Existing.dgn***

7. Close the *References* dialog.

8. Use the MicroStation **Fit View** to pan to the project location.

9. With the *Element Selection* tool, **data point** on the Existing ground perimeter and set the Existing terrain model as the ***Active Terrain Model*** using the heads up display.




10. Window in towards the bottom of the project to see the area we will be identifying on the alignment.

**Create the Cross Sections**

11. Continue in the same design file *XS_Route63.dgn.*

12. From the *Corridor Modeling* tasks group, select **Create Cross Sections** command

13. When prompted to *Locate Alignment* **data point** on the centerline of **Route 63**.

14. Select **Preferences** at the bottom of the *Create Cross Section* dialog.

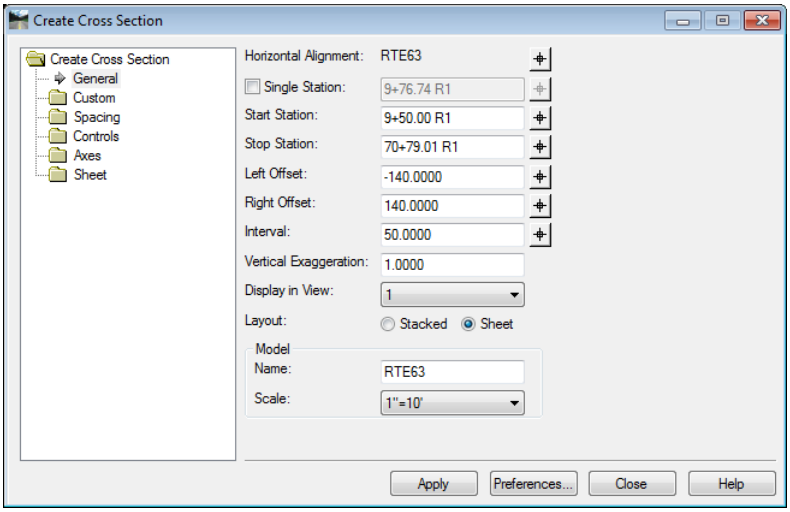
15. In the *Preferences* dialog, select the preference entitled **Sheet – 10 Scale**.

16. Click **Load** to utilize the selected preferences in the previous step.

    Preferences are predefined settings stored in the active XIN settings file. These preferences will be used for creating, annotating and computing end area volumes on proposed cross sections.

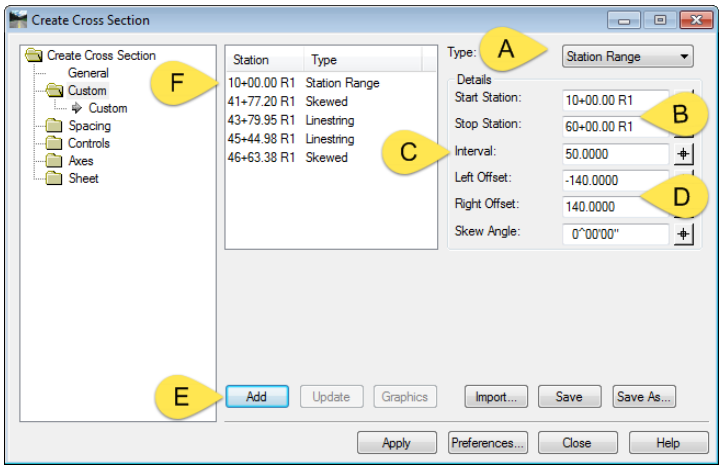
17. **Close** the *Preferences* dialog.

18. In the *Create Cross Section* dialog, complete the General settings as shown.



19. Select the Custom leaf and fill in the values by selecting the elements on the level ***Geopak-Pattern line 2***:

    Also add a station range of cross sections from 10+00 to 60+00




A – **Select Station Range** from the pull down

B – **Edit** the **start station** 10+00 and **stop stationing** 60+00

C – **Set** the Interval to 50’

D – **Edit** the **left offset** -140 and the **right offset** 140

E – Add the Station Range to the list by clicking the **Add** button

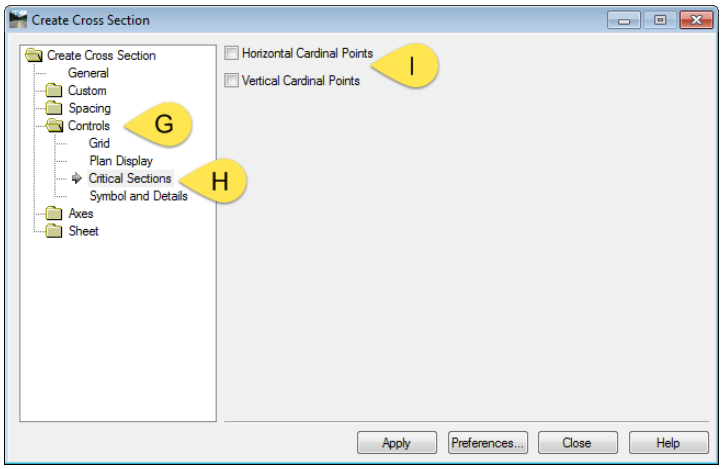
F – The entry will **display** in the list

20. Remove the Cardinal Points

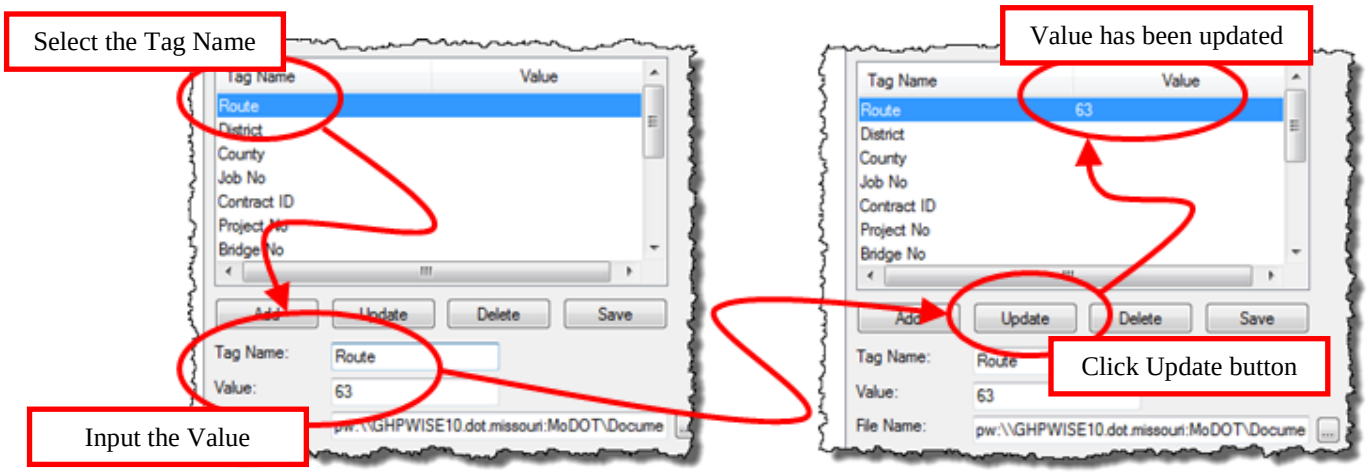
    G - **Navigate** to the Controls leaf

    H - **Select** the Critical Sections option

    I - **Uncheck** the Horizontal and Vertical Cardinal Points.



21. Open the Sheet leaf (folder) and select the ***Annotation*** option. Change the Tag Values to include the following:




Route = RTE63

District = NE

County = RANDOLPH

Job No. = J2P0200

Contract ID = (leave blank)

Project No. = (leave blank)

Bridge No. = (leave blank)

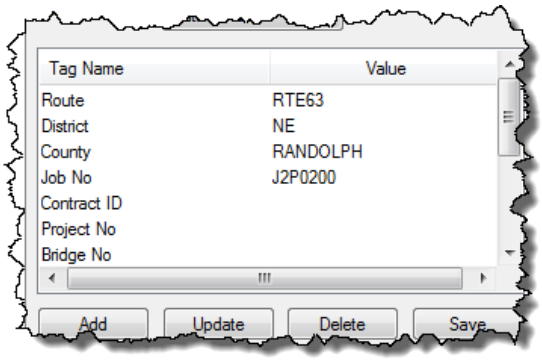
Info 1 = CROSS SECTION SHEETS

Info 2 = ROUTE 63 CONSTRUCTION

Sheet No. = (use default)

Total Sheets = (use default)

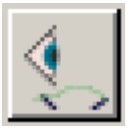
Sheet Of = (use default)




22. In the *Create Cross Section* dialog, click **Apply** to create the cross sections into a new DGN Drawing Model entitled ROUTE63.

23. **Close** the *Create Cross Section* dialog after the cross sections have been generated.

**View the Cross Sections**

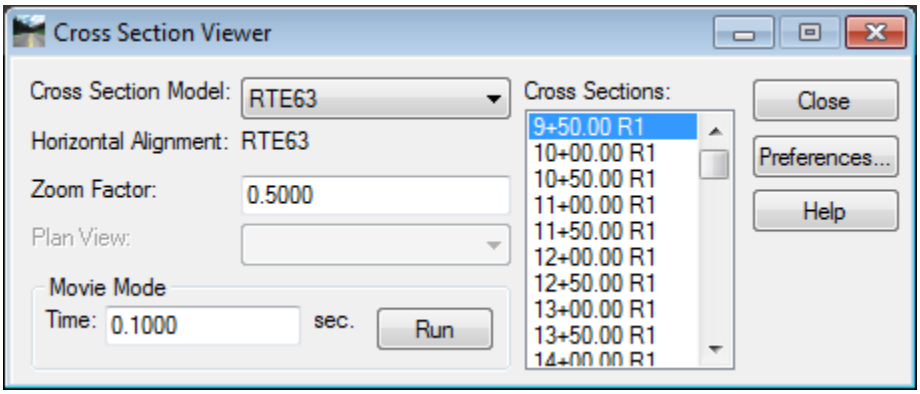


24. Continue in the same design file *XS_Route63.dgn.*

25. From the *Corridor Modeling* task group, select the **Cross Section Viewer** tool**.**

26. In the *Cross Section Viewer* dialog, verify the *Cross Section Model:* setting is set to your active Cross Section Drawing Model *RTE63*.

27. Populate the *Cross Section Viewer* dialog as shown.




28. Select **Run** to automatically scan through the cross sections.

29. Now select any individual cross section station from the list and notice how the view updates to the selected cross section station value.

30. **Close** the *Cross Section Viewer* dialog.

**Annotate the Cross Sections**

31. Continue in the same design file **XS_Route63.dgn**.

32. From the *Corridor Modeling* task group, select the **Annotate Cross Sections** tool.

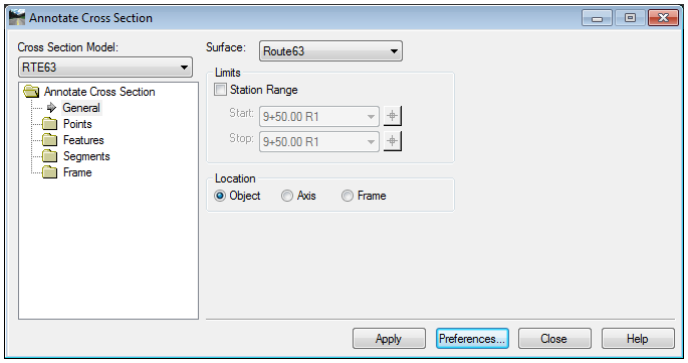
33. Located at the bottom of the *Annotate Cross Section* dialog, click **Preferences**.

34. In the *Preferences* dialog select the preference entitled **MODOT-Off/Elev/Slope**.

35. In the *Preferences* dialog select **Load**, to utilize the selected preferences in the previous step.

36. **Close** the *Preferences* dialog.

37. In the *Annotate Cross Section* dialog, complete the *General* settings as shown.



38. Expand the *Features* folder and select **Annotate** on the left hand side of the dialog.

39. Select a few *Crossing Features* using the pick button to show offset/elevations to label.

40. In the Annotate Cross Section dialog, click **Apply** to annotate the cross sections in the selected DGN Drawing Model labeling offsets, elevations, and slopes. The cross section annotation labels are automatically made part of a MicroStation Graphic Group. Additionally, only the selected Features are labeled.

41. **Close** the *Annotate Cross Section* dialog.

42. In the MicroStation tool bar select **Settings > Drawing Scale**. Change the setting from 1”=10’ to 1”=20’. What happens to the text size? Return the setting back to the original setting of 1”=10’ when complete.

# Chapter 10

# Earthwork

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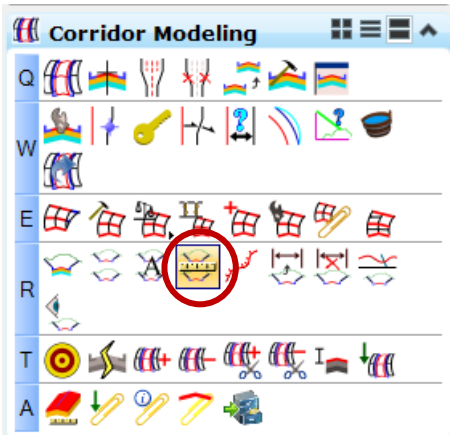
## 10.1 Objectives

- Learn the procedures for calculating earthwork quantities with GEOPAK
- Learn how to generate a volumes report

## 10.2 End-area Volume




The **End-Area Volumes** tool performs the traditional end-area volume calculation to compute cut, fill, and net volumes using a series of cross sections extracted along a previously defined alignment. A complete report listing all computed quantities on a station-by-station basis can also be generated with this command.

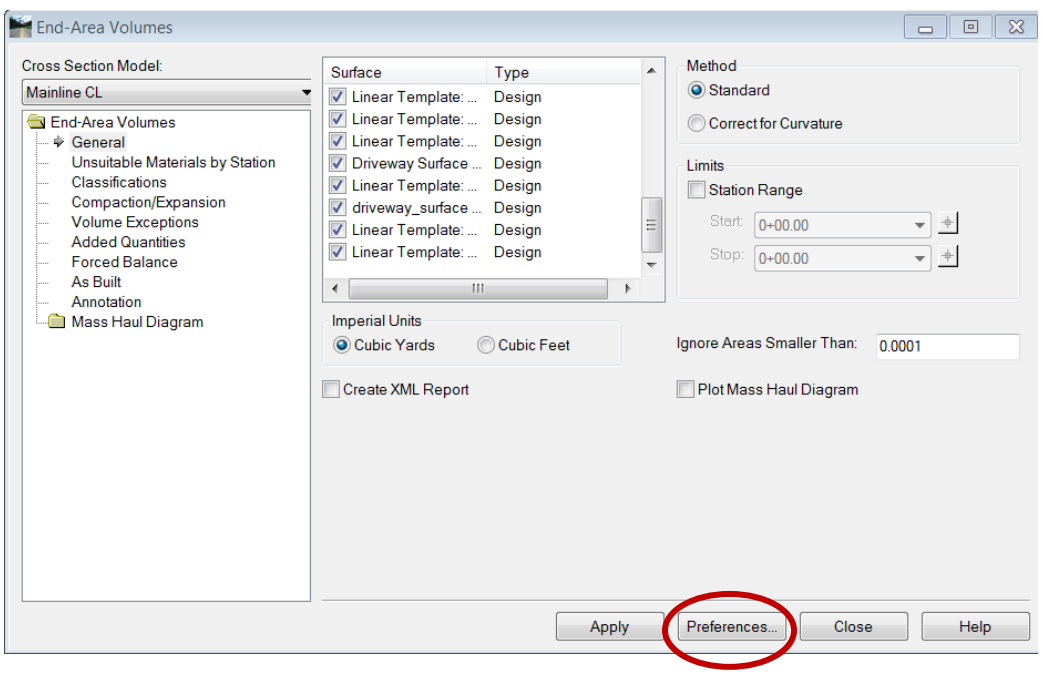
### 10.2.1 Preferences

Preferences are predefined settings stored in the active XIN settings file delivered in the MoDOT workspace. These preferences will be used for creating, annotating and computing end-area volumes on proposed cross sections.

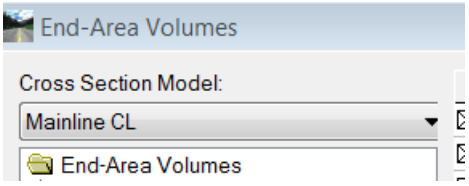
**Workflow**

Select **Preferences** located at the bottom of the *End-Area Volumes* dialog.

In the *Preferences* dialog, select the preference named ***MODOT-Earthwork*** and click **Load**



**Before Using This Command**




Create cross sections using the **Create Cross Sections** command. Make sure that you have a corridor and a Surface to run volumes against. Display the components in the cross section so that you can determine the subgrade and compute the quantities of component materials, such as asphalt.

Typically, you use this command to calculate excavation and analyze your design after you create a corridor.

Once the Terrain Model is created, you can extract cross sections along the alignment, displaying these surfaces in each cross section. A surface displayed in a cross section is called a cross-section surface.

Because this command calculates volumes between any combinations of Surfaces, you can use it to compute the materials required in your roadway design.

The **End–Area Volumes** application has numerous options available to handle most combinations of calculations required in the typical design process. The user will be given the option to decide which surface(s) to perform calculations along. This is most beneficial for staged construction volume calculations.

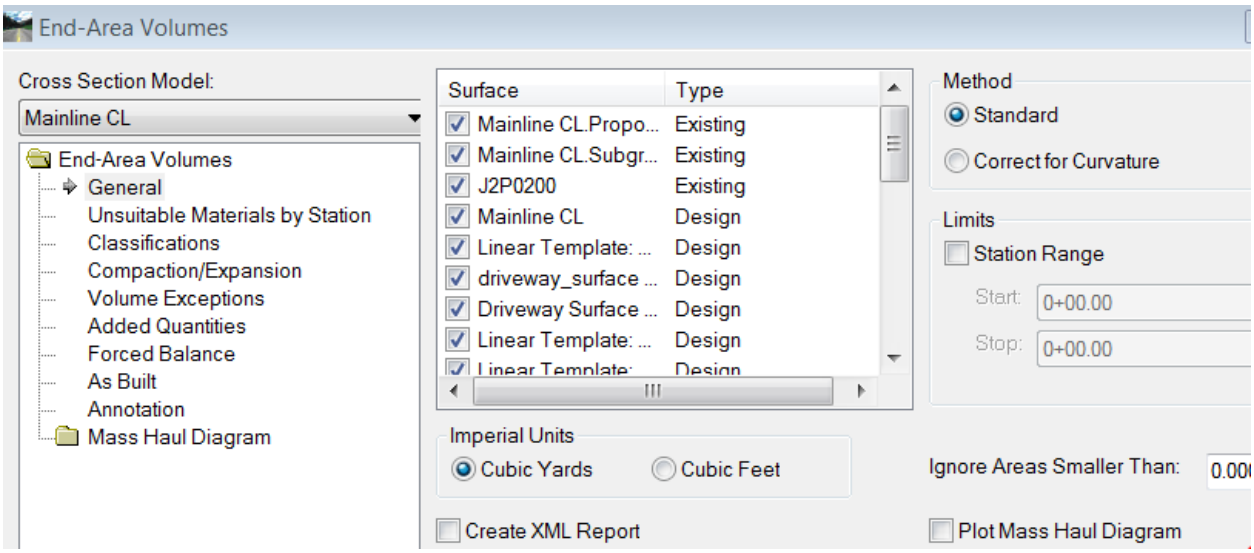
Special circumstances such as Unsuitable Materials, Volume Exceptions, Added Quantities, Forced Balance, As-Built, Mass-Haul Diagram, Reporting, etc. are supported in this application.

## 10.3 End-Area Volume Dialog Options

### 10.3.1 General (End-Area Volume)

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a set of cross sections to use as the basis for End-Area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model.

**Surface/Type** Under the *General Section* lists surfaces and corridors in the selected cross section model. The default type for a new surface is ”Existing”. The default type for surfaces created by Corridor Modeling is “Design”. You may change the types to: Existing, Design, Substratum, None, or Subgrade using the Surface Properties command.




You may have multiple existing, designs, or substrata in a given cross section model. However, you must have ***only one existing surface*** for any given cross section at a given station in order to compute volumes. If you have more than one design surface in a section, they should not overlap.

Display the components from the design surface in the cross section so that the subgrade path can be determined. The subgrade is determined starting at the left side of the design surface and following the rightmost path along the surface and its components. This path is then compared against the existing surface and any substrata to compute the areas of volume.

When the *Type* is set to "subgrade", end-areas follow the design type until a subgrade type is encountered. End-areas follow the subgrade type until it encounters a design type. If a design type is not connected then end-areas utilizes a vertical drop.

**Method** – Located on the **General** Selection

> **Standard** employs the average end-area method for computing volumes.
>
> **Correct for Curvature** compensates for sections in a curve by computing the centroid offset and applying the correction to cut and fill.

**Limits** – Located on the **General** Selection

> **Station Range** limits the sections for which volumes are calculated by defining start and stop stations.
>
> **Start** specifies the starting station of the section.
>
> **Stop** specifies the stopping station of the section.
>
> **Ignore Areas Smaller Than** specifies an area that you do not want reported.

**Create XML Report** – Located on the **General** Selection this button indicates whether or not an XML report is created and if it is created, it will open the Bentley Civil Report Browser. The XML file contains cross section information and more detailed volume information.

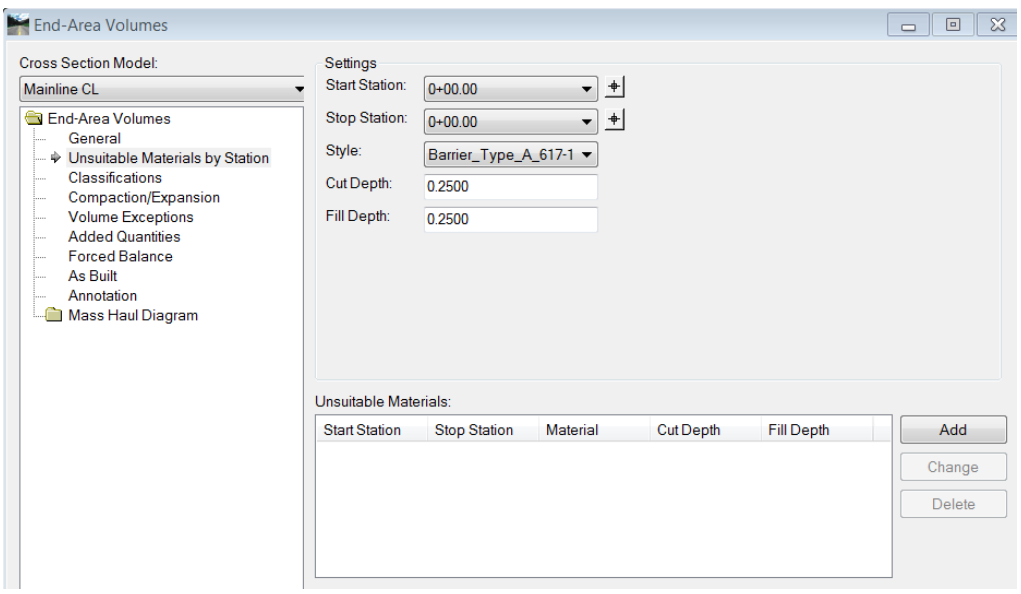
**Plot Mass Haul Diagram** –This diagram is not used by MoDOT.

### 10.3.2 Unsuitable Materials by Station (End-Area Volume)

Use this dialog as an additional method to calculate unsuitable materials. Unsuitable materials of a specified style can be removed from the existing surface for the entire construction limits over a specified station range. You can specify separate cut and fill depths. Unsuitable Materials defined on this dialog supersedes any defined by the **Unsuitable Materials By Feature** command.

Unsuitable material located under fill (embankment) is included in the Mass Ordinate calculation. This occurs because materials stripped from under fills automatically increase the amount of material required for a given embankment area. For more details, see the Classifications topic.

**Cross Section Model** lists all the existing cross-section models, which are models of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for end-area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model. The command also displays the horizontal alignment and surface(s) used when the cross sections in the model were extracted.




**Settings:**

**Start Station** identifies the start station. Select a station from the list or use the locate button to identify the station.

**Stop Station** identifies the end station. Select a station from the list or use the locate button to identify the station.

**Style** specifies the style of the unsuitable material.

**Cut Depth** specifies the cut depth for the material.

**Fill Depth** specifies the fill depth for the material.

**Unsuitable Materials** lists all of the specified added unsuitable material sections.

**Add** adds a single section to the list based on the settings provided.

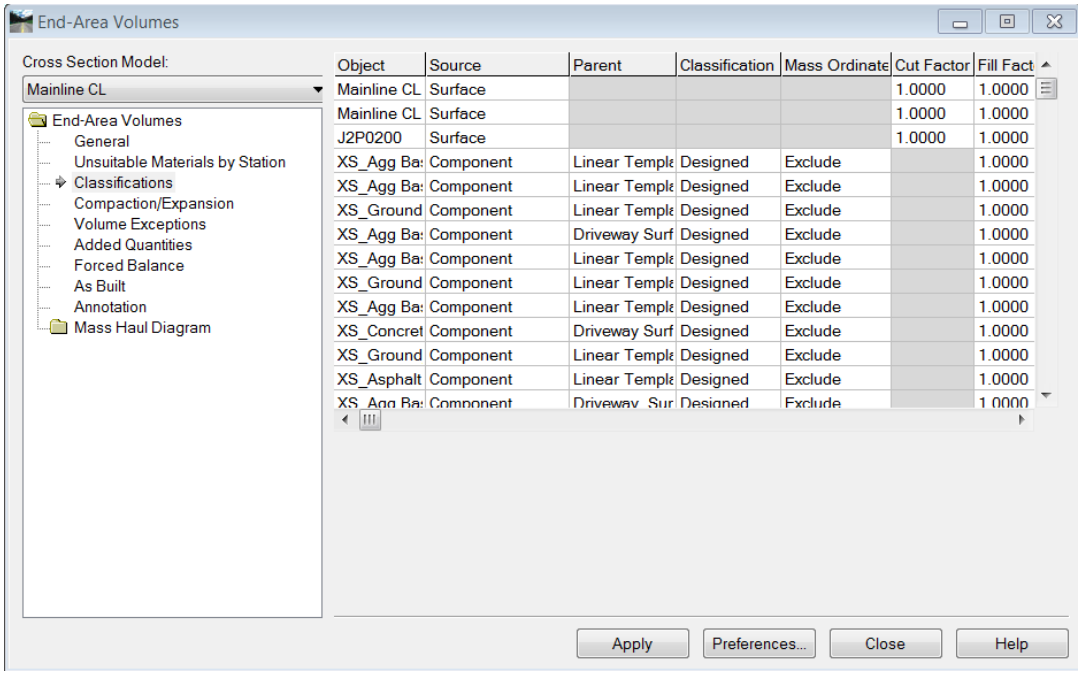
**Change** modifies the selected section to the settings provided.

**Delete** removes the selected section from the list.

### 10.3.3 Classifications (End-Area Volume)

Use this dialog to control how volumes are calculated and reported for individual materials. Individual materials are those not normally included in the unclassified cut and fill volumes. These include substrata materials, component materials, and materials calculated from the Material Features leaf.

The **Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations, or select the set graphically. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model.




**(Materials List)**

**Object** lists all available materials. For components specified as Undercut (for moisture density control), the component is removed from the normal cut totals. You can separately report on this portion of the component.

**Source** lists all surfaces containing material features. The existing surfaces are displayed first, followed by substrata surfaces, then cross section surfaces.

**Parent** identifies the corridor containing the component material.

**Classification** defines to which group the materials are reported: None, Unclassified, Rock, Designed, and Unsuitable. If you set the classification to Ignore, it is not reported.

**Mass Ordinate** allows you to include the material into the mass ordinate and total volume calculation. Unsuitable material located under fill (embankment) is included in the calculation. This occurs because materials stripped from under fills automatically increase the amount of material required for a given embankment area. In this case, the Include/Exclude toggles are not available.

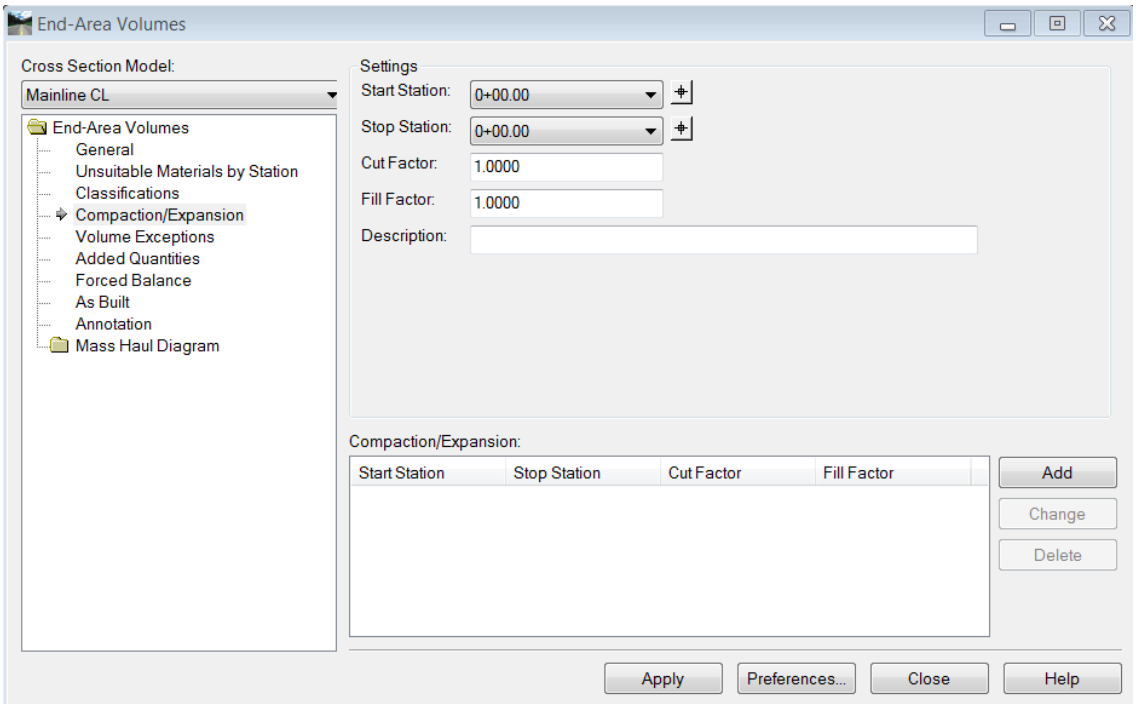
**Cut Factor** specifies the cut factor for the surface. Substrata, existing surfaces, and material features use a cut factor. Compaction/Expansion parameters can override this value for existing surfaces.

**Fill Factor** specifies the fill factor for the surface. Components and existing surface use a fill factor. Compaction/Expansion parameters can override this value for existing surfaces.

### 10.3.4 Compaction/Expansion (End-area Volume)

Use this dialog to specify aggregate cut and fill factors for given materials over a range of stations. This is necessary since most existing surfaces are topological surveys which do not regard the materials that make up the surface.

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model. The command also displays the horizontal alignment and surface(s) used when the cross sections in the model were extracted.




**Settings**

**Start Station** identifies the start station. Select a station from the list or use the locate button to identify the station.

**Stop Station** identifies the end station. Select a station from the list or use the locate button to identify the station.

**Cut Factor** scales computed cut volumes. This parameter defines how much the volume of the cut material will increase after it is removed from the ground. For example, a value of 1.3 means that the cut material will swell 1.3 times its original value. The default value is 1.0.

**Fill Factor** scales the computed fill volume. This parameter defines how much the volume of the fill material will decrease after it is placed into the site. For example, a value of 0.8 means that the fill material will shrink to 0.8 times its original value. The default value is 1.0.

**Description** allows you to specify the material description for reporting purposes.

**Compaction/Expansion** lists all of the specified cut and fill factors.

**Add** adds a single compaction/expansion factor to the list based on the settings provided.

**Change** modifies the selected factor values to the settings provided.

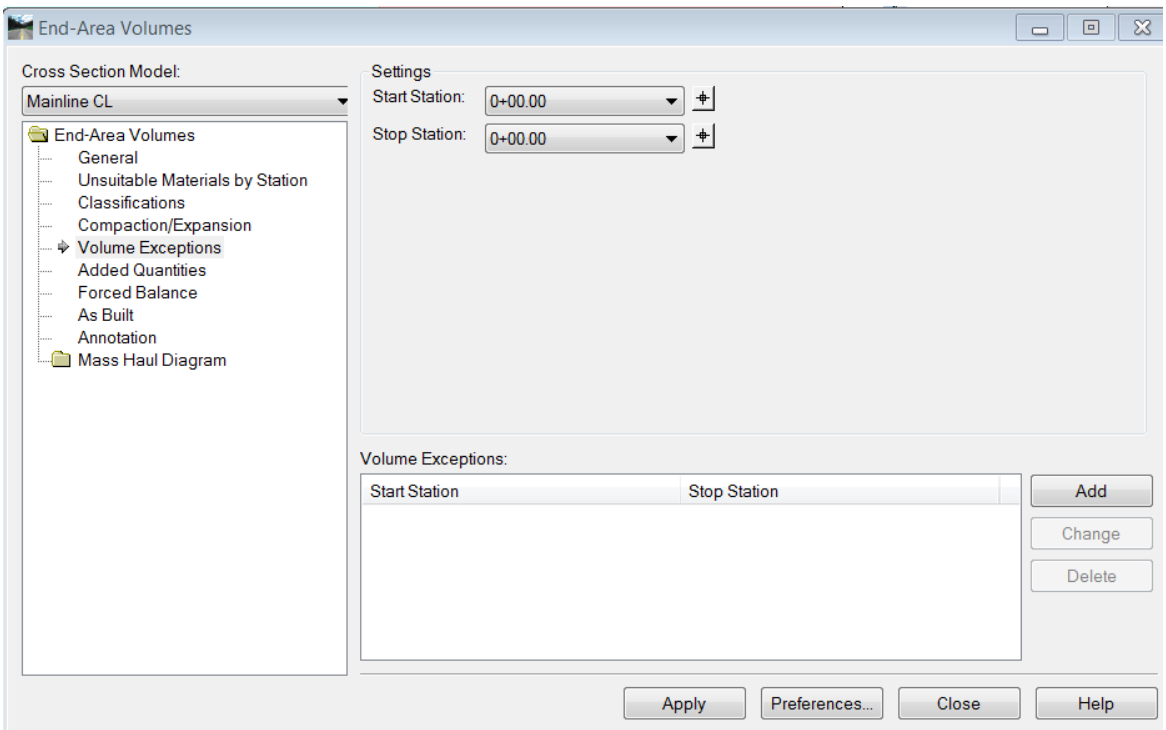
**Delete** removes the selected factor from the list.

## 10.4 Volume Exceptions (End-area Volume)

Use this dialog to specify sections where you do not wish to compute volumes. For a given volume exception, the volume at the start station is computed. The volume of all stations greater than the start station and less than or equal to the stop station is not computed.

The most common example of a volume exception is a bridge. Because no fill material is required under a bridge, you would not want to compute "fill" volume within these station limits.

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model. The command also displays the horizontal alignment and surface(s) used when the cross sections in the model were extracted.




### Settings

**Start Station** identifies the start station. Select a station from the list or use the locate button to identify the station.

**Stop Station** identifies the end station. Select a station from the list or use the locate button to identify the station.

**Volume Exceptions** lists all of the specified volume exceptions.

**Add** adds a single volume exception to the list based on the settings provided.

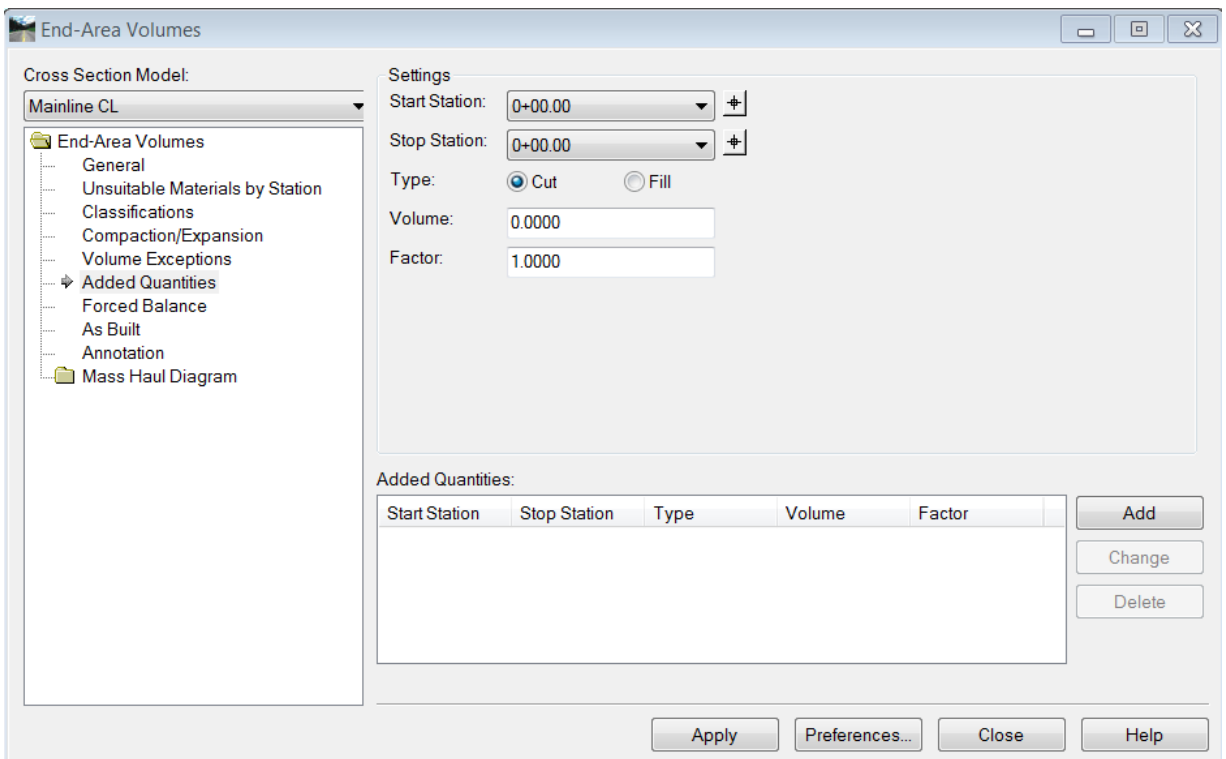
**Change** modifies the selected volume exception values to the settings provided.

**Delete** removes the selected volume exception from the list.

### 10.4.1 Added Quantities (End-area Volume)

Use this dialog to add additional cut or fill values to the adjusted volumes. Added quantity may be injected at a single station (Start and Stop Station are the same) or distributed linearly over each section in the range that you specify.

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model.




**Settings:**

**Start Station** identifies the start station. Select a station from the list or use the locate button to identify the station.

**Stop Station** identifies the end station. Select a station from the list or use the locate button to identify the station.

**Type**

**Cut** indicates the addition is a cut value.

**Fill** indicates the addition is a fill value.

**Volume** specifies the additional volume.

**Factor** defines how much the volume of the cut material will increase or decrease after it is removed from the ground. For example, a value of 1.3 means that the cut material will swell 1.3 times its original value. The default value is 1.0.

**Added Quantities** lists all of the specified added quantities.

**Note:** Added Quantities will have to change either the computational output or limit the input of the station range.

**Add** adds a single additional quantity to the list based on the settings provided.

**Change** modifies the selected quantity to the settings provided.

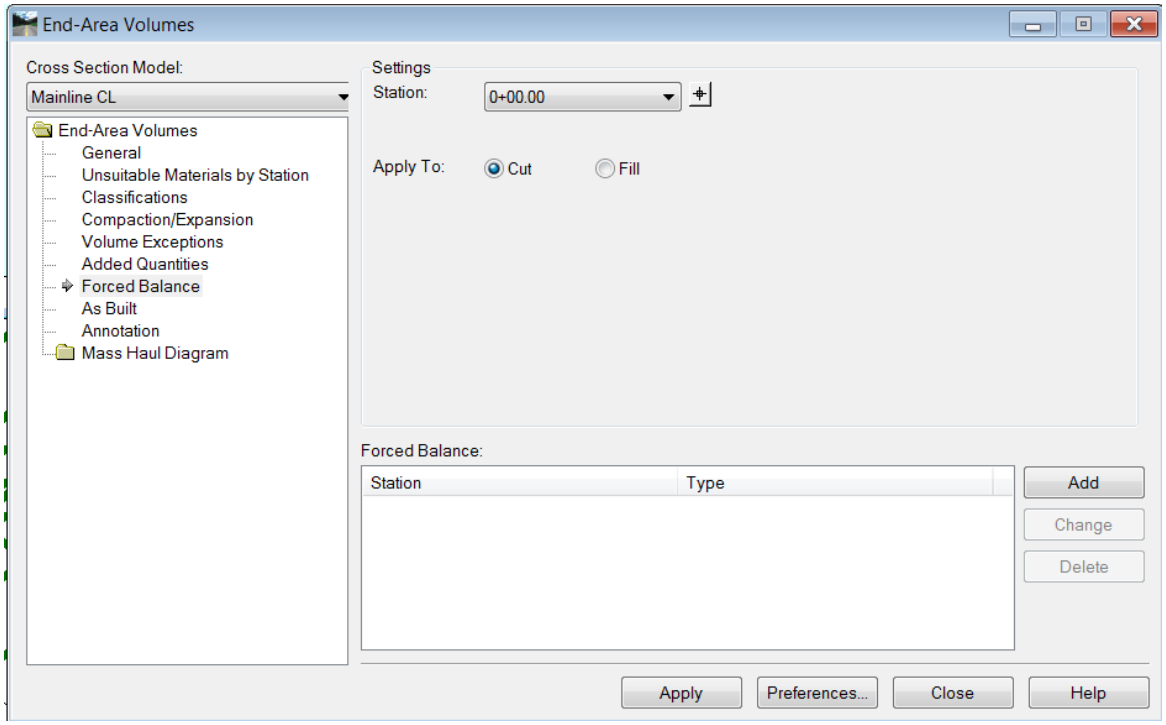
**Delete** removes the selected quantity from the list.

## 10.4.2 Forced Balance (End-area Volume)

Use this dialog to apply forced balance at a given cross section station and apply it to either cut or fill. Forced balance allows you to balance your cut and fill to zero at critical points, such as a bridge, where hauling across may be impractical.

A balance factor is calculated between stations where forced balance is applied. The balance factor is the accumulated fill divided by the accumulated cut up to the given station. If the forced balance is applied to cut, the adjusted cut volumes up to that station are multiplied by the balance factor. If the forced balance is applied to fill, the adjusted fill volumes up to that station are divided by the balance factor. At the forced balance stations, the accumulated cut and fill are reset to zero.

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations, or select the model graphically. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model. The command also displays the horizontal alignment and surface(s) used when the cross sections in the model were extracted.




**Settings**

**Station** identifies the cross section station. Select a station from the list or use the locate button to identify the station.

**Apply To:**

**Cut** indicates the forced balance is applied to cut.

**Fill** indicates the forced balance is applied to cut.

**Forced Balance** lists all of the specified forced balances.

**Add** adds a single forced balance to the list based on the settings provided.

**Change** modifies the selected forced balance to the settings provided.

**Delete** removes the selected forced balance from the list.

## 10.4.3 As Built (End-area Volume)

Use this dialog to calculate volumes incrementally as the road is being built. Incremental reporting works against cut, fill, and substrata calculations. If you have unsuitable material, it is calculated in full when you specify the first *As Built Surface*. If you select *Include Previous As Built Surface*, the unsuitable material is excluded.

If the As Built surface is incomplete, it is assumed to drop vertically. If this is not what you want, edit the cross section surface to reflect the way you want it to behave.

Reporting and Annotation functionality reflect the As Built Volumes.

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model.

**Settings:**

**Compute As Built Volumes** activates Settings and designates to compute As Built Volumes.

**As Built Surface** allows you to select which cross section surface to use as the current As Built surface. Only cross section surfaces of type None appear in this list. Set the surface type to None before you cut the cross section or update the cross section. None surface type is used to ensure that the As Built surfaces do not interfere with design volume calculations. The final subgrade is included in this list to allow you to make the final incremental calculation.

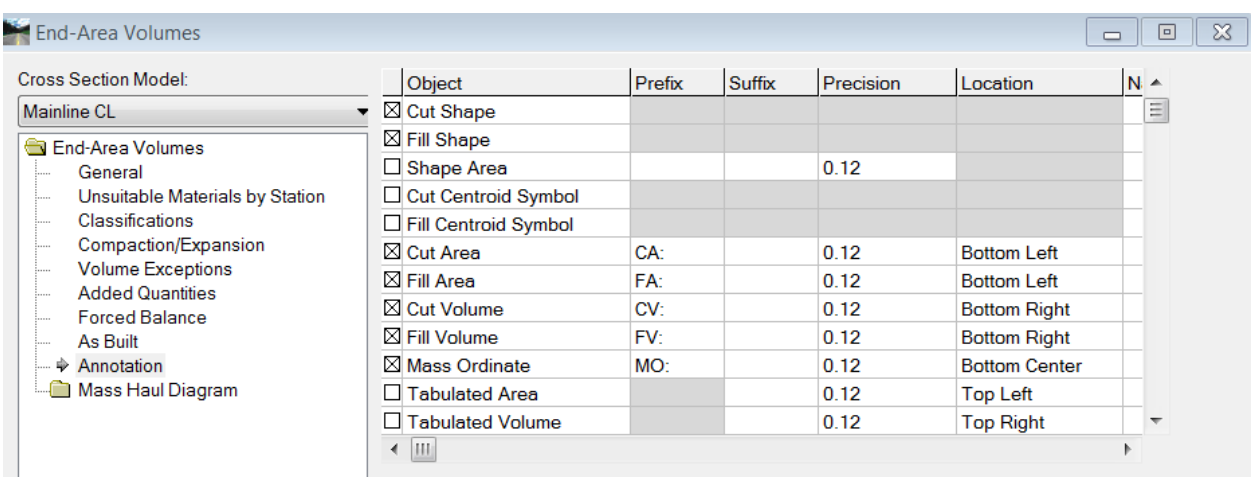
**Include Previous As Built Surfaces** when selected compares a previous As Built surface to the current As Built surface. Select this option and select a surface from the dropdown list.

## 10.4.4 Annotation (End-area Volume)

Use this dialog to annotate existing cross sections with area and volume information.

**Cross Section Model** lists all the existing cross-section models, which are groups of extracted cross sections that are assigned unique identification numbers. From this list, select a cross section model to use as the basis for End-Area volume calculations. When you select a cross section model from this list, the command places a region/fence in the drawing file around the cross sections that compose the model. The command also displays the horizontal alignment and surface(s) used when the cross sections in the model were extracted.

**Note:** All entities for display under **End-Area Volumes >Annotation** are annotated except *Cut Volume*, *Fill Volume*, *Mass Ordinate* and *Tabulated Volume* when a skewed section is encountered. Everything else on the **End-Area Volume** command is ignored.



**(List)** lists all of the entities available for display.

**Object** lists available entities. For unsuitable materials shapes, cut and fill parts are displayed separately.

**Prefix** specifies the alphanumeric text to include at the beginning of the annotation.

**Suffix** specifies the alphanumeric text to include at the end of the annotation.

**Precision** defines how many decimal places are expressed with the annotation.

**Location** specifies where the annotation is placed relative to the cross section.

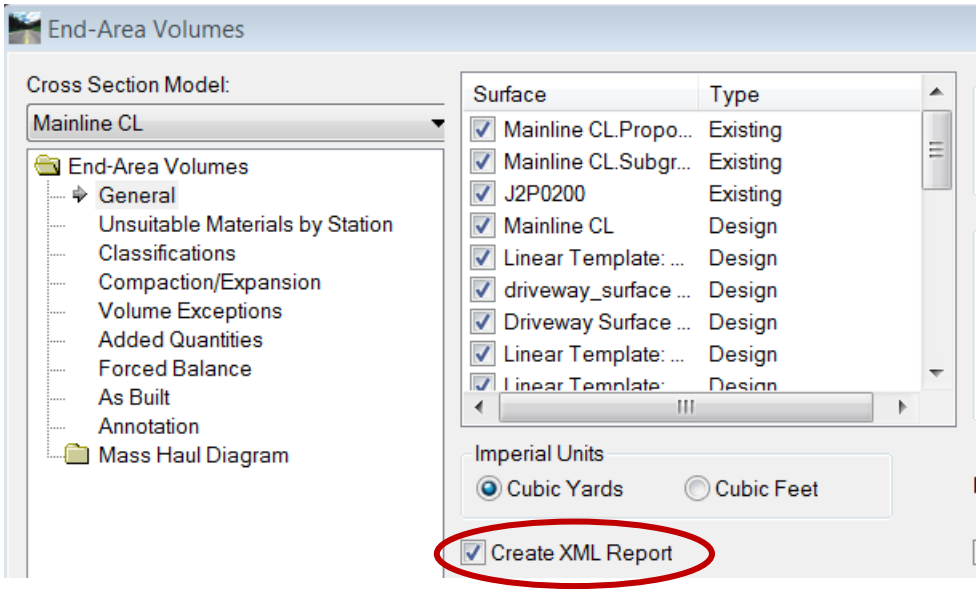
**Name/Color (Symbology)** allows you to select a named symbology. Click on a color to open the Text Symbology or Line Symbology dialog. Set the horizontal and vertical offsets and justification values of the text symbology to control the exact placement of the annotation.

You can annotate the total quantities of the substrata, component materials and material features by selecting the Tabulated Areas and Volumes. See **Create Corridor** for more information on creating component shapes, and **Create Cross Section** for their display.

The display symbology for the component shape annotation and material feature shapes are defined by their respective surface feature styles. The display symbology for substrata shapes is defined by the cross section named symbology of the surface.

## 10.4.5 End-Area Volume Report Generation

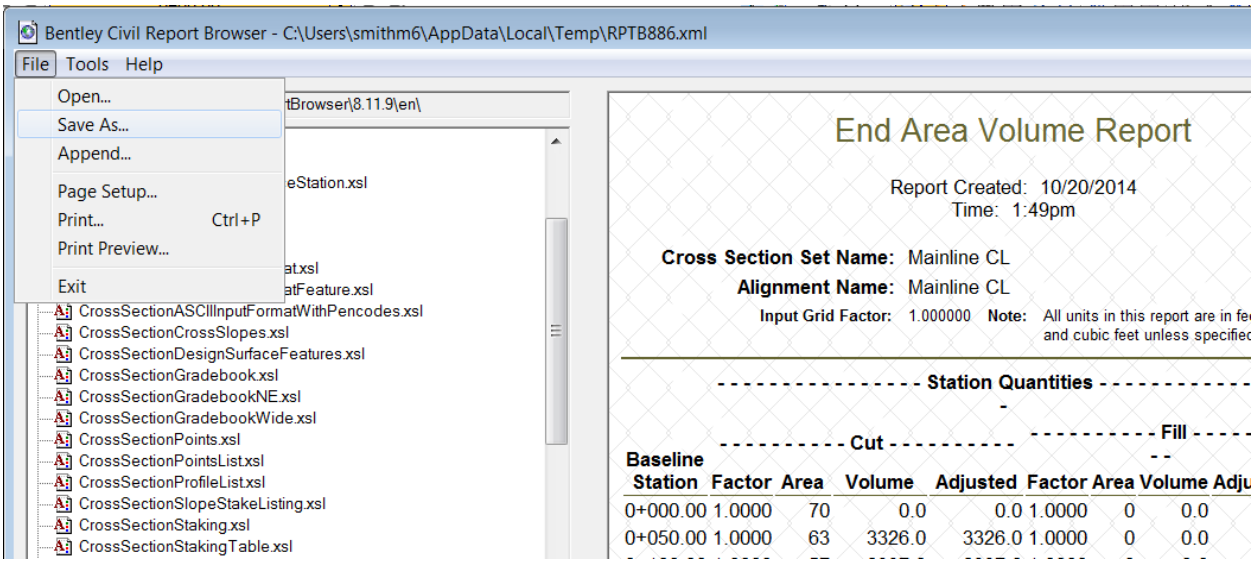
Under the General tab there is the option to include the creation of XML output when the end-area volumes are run. Upon completion the **Bentley Civil Report Browser** will automatically open. The XML file contains cross section information and more detailed volume information.



The XML files are temporary files that contain data that is formatted into reports by the **View XML Reports** command. The XML files are temporary unless you use the *File > Save As* on the **Bentley Civil Report Browser** to save them as HTML or text files.

A report is the output generated when you display data from an XML file using the **View XML Reports** command. The **View XML Reports** command allows you to choose an XSL style sheet, which specifies exactly what information to pull from the XML file and how to format it. The XML file contains raw or computed data; the XSL file specifies how to format the data into a report.

### Dialog Box Options




### File (menu)

**Open** activates the Open dialog, opens an XML data file. After you open an XML file, the name of the file is reported in the title bar at the top of the dialog.

**Save As** displays the Save As dialog, which saves the report output into an HTML file, an XML file, a DOC file, XLS file or a text file.

Many of the reports are formatted HTML content. Those reports can be saved as HTML files. However, some of the reports are composed of simple text. Those reports are saved as text files (*.txt).

**Note:** If the style sheet used for the report contains embedded cascading style sheet references, you need to locate the CSS where it can be found by whoever opens the DOC file or you will get a warning that indicates the reference cannot be found.

**Append** displays the Append dialog, which appends the contents of the right pane to an existing .txt file.

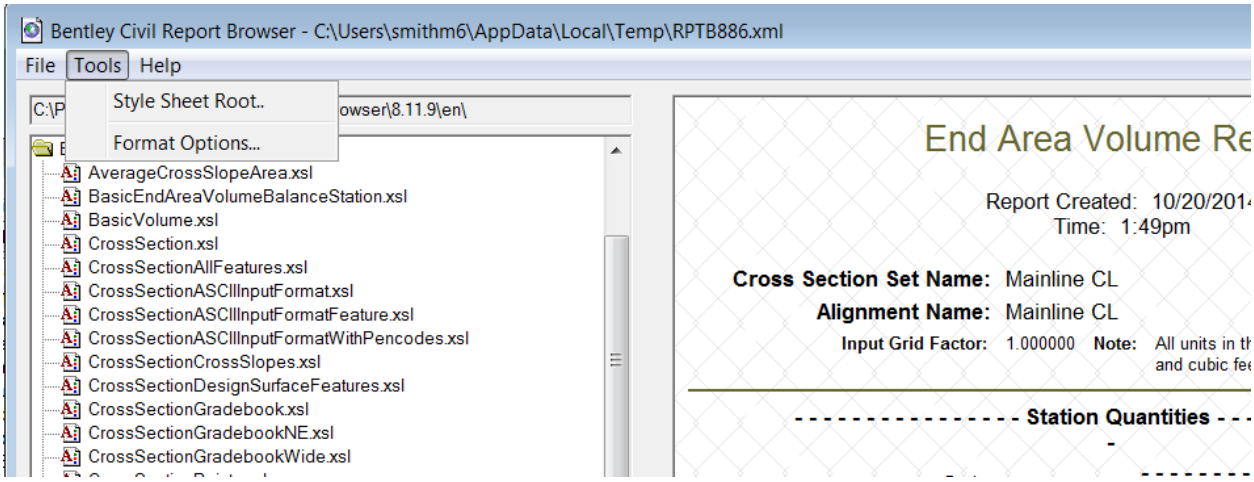
**Page Setup** displays the Page Setup dialog, which allows you to select paper size, orientation, margins, and headers and footers for printing.

**Print** displays the print dialog, which allows you to print the report.

**Print Preview** provides a preview of the printed report. The print preview reflects the current settings from the Page Setup dialog.

**Exit** exits the **Bentley Civil Report Browser** program.

**Tools (menu)**




**Style Sheet Root** specifies a directory for locating XSL files. **Bentley Civil Report Browser** will find the XSL files in the specified directory and in any of its subdirectories.

When you change the Style Sheet Root, the new root directory must contain copies of the following from the delivered directory structure:

_Themes directory.

format.xsl.contains the scripting that allows you to dynamically set the precision and formatting of the output.

raw-xml.xsl.outputs file

The browser will not operate correctly without them. The only exception is if all style sheets contained in the new root have been modified to remove the links to the cascading style sheets. In that case, the _Themes directory is no longer needed. Once the files are copied, you can modify them.

**Format Options** activates the Format Options dialog, which lets you set the precision and format for displaying a variety of types of data in the report and utilizes the format.xsl.

## 10.5 Group Exercise: Road 1 Earthwork

1. Within the *data_10* folder, open the design file **Corridors_J2P0200.dgn**.

2. Highlight the Road1 Corridor and in the Preferences and change the Design Stage from Preliminary design to Final design.

   *This will drop the templates closer to each other and make interpolation much more accurate.*

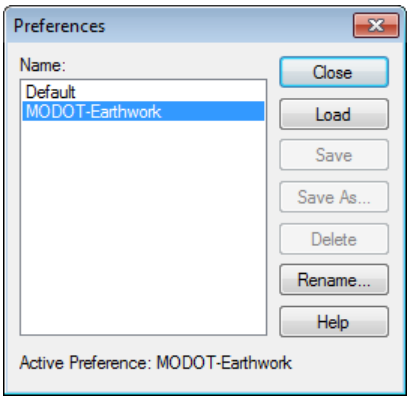
3. Within the *data_10* folder, open the design file **XS_J2P0200_Road1.dgn**.

4. Open the road1 model. This model should contain the Road1 cross sections that we will use to run the End Area Volumes tool on.

5. Select the **End Area Volume** tool from the *Corridor Modeling* task group.

6. Select **Preferences** located at the bottom of the *End-Area Volumes* dialog.

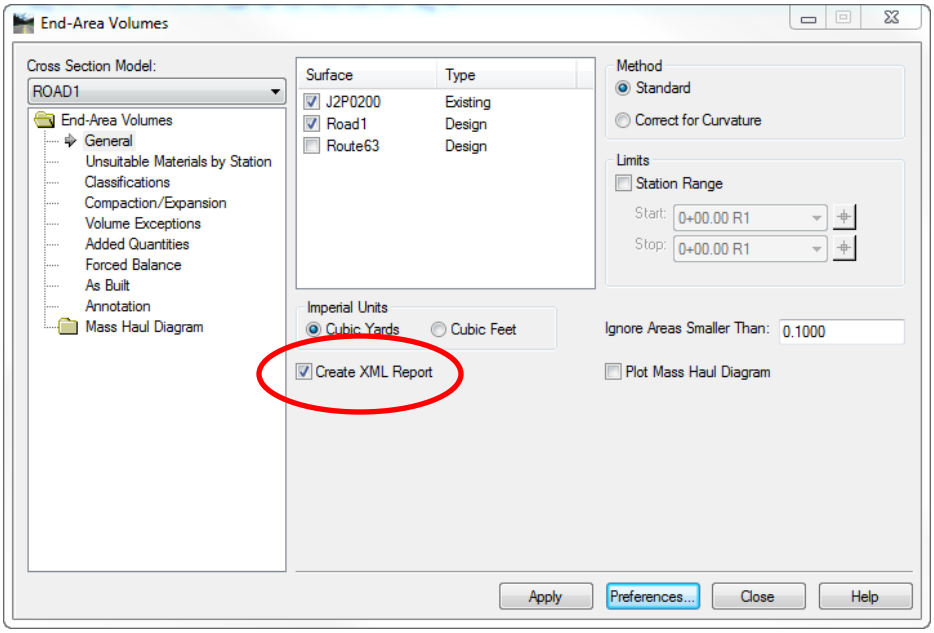
7. In the *Preferences* dialog, select the preference named *MODOT-Earthwork* and click **Load**



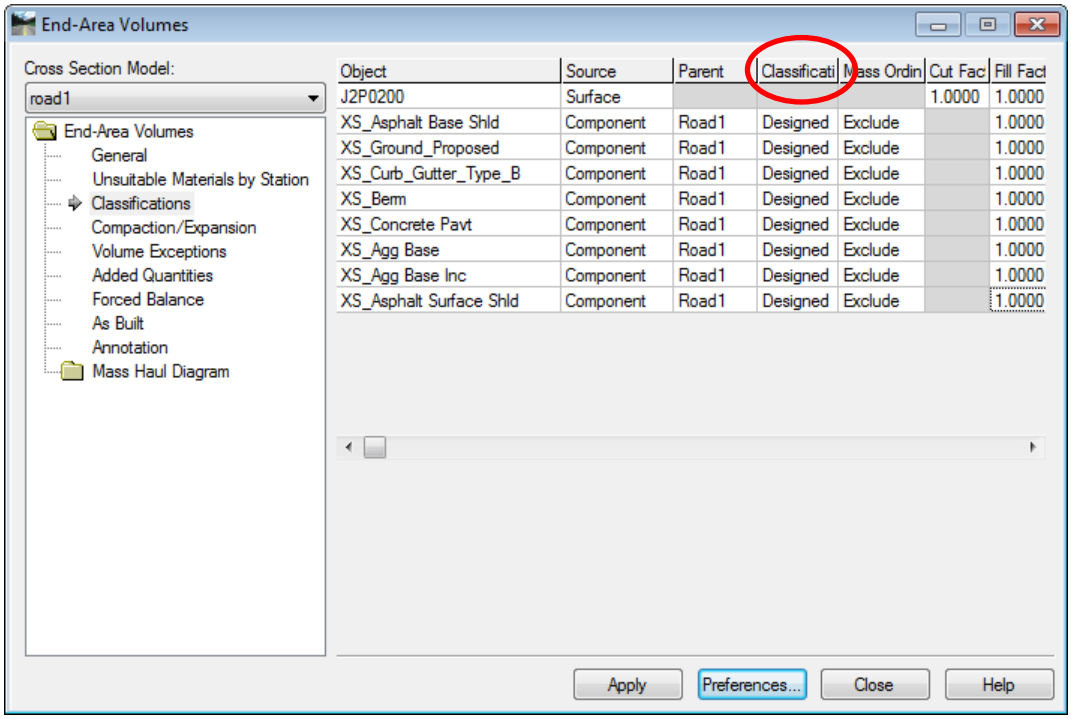

   Preferences are predefined settings stored in the active XIN settings file delivered in the MoDOT workspace. These preferences will be used for creating, annotating and computing end-area volumes on proposed cross sections.

8. **Close** the *Preferences* selection dialog.

9. In the *End-Area Volumes* dialog, complete the *General* settings as shown below. Make sure you toggle on the **Create XML Report**, and select the volume units of choice.




10. Complete the *Classifications* settings as shown below.

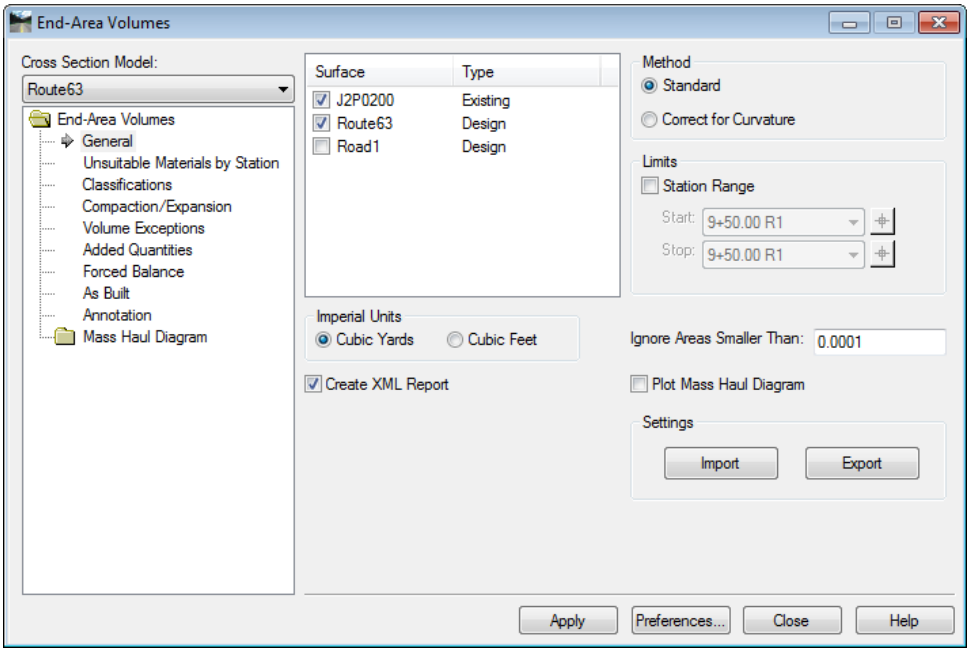


11. Click **Apply**. This will complete the following five tasks when processing.
    - Compute end-areas.
    - Compute volumes between sections.
    - Label cross sections with computed values.
    - When the volumes computations are complete, the *Bentley Civil Report Browser* will open when the toggle is activated. The report browser allows the designer to review the end-areas as well as computed volumes for all surfaces.
12. Look at multiple reports available in the **Evaluation** folder
13. In the *Bentley Civil Report Browser*, select **Tools** > **Format Options** and adjust values to your preferences. Notice how the report updates when changes are applied. Click **Close** when adjustments are complete.
14. In the report browser, toggle through the different earthwork reports available on the left to comprehend the many options available from these calculations.
15. **Close** the *Bentley Civil Report Browser*.
16. **Close** the *End-Area Volumes* dialog.

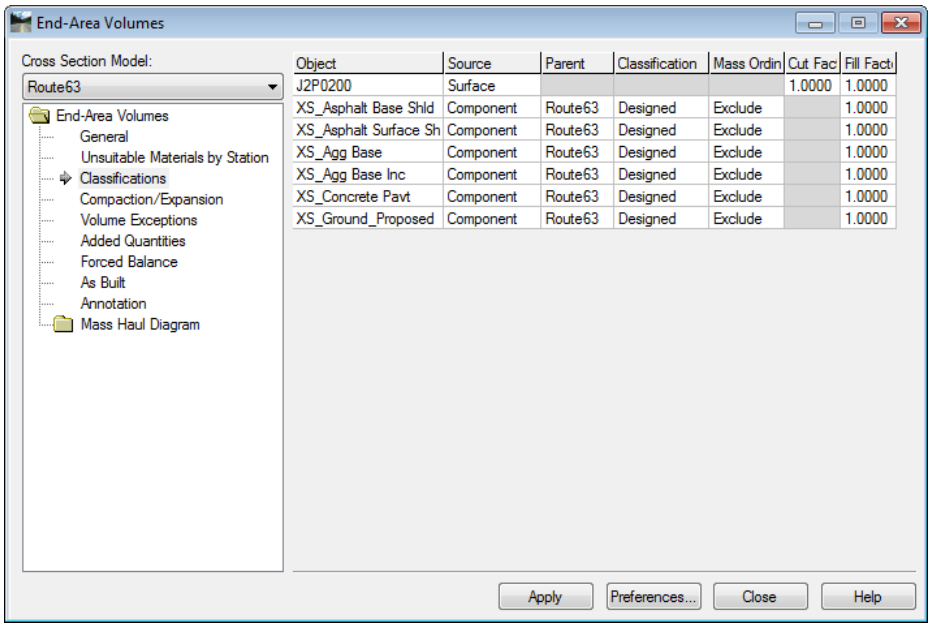
## 10.6 Individual Exercise: Route 63 Earthwork

1. Within the *data_10* folder, open the design file **Corridors_J2P0200.dgn.**
2. Highlight the Route63 Corridor and in the Preferences and change the Design Stage from Preliminary design to Final design.
3. Within the *data_10* folder, open the design file **XS_J2P0200_Route63.dgn.**
4. Open the Route63 model. This model should contain the Route63 cross sections that we will use to run the End Area Volumes on.
5. Select the **End Area Volume** tool from the *Corridor Modeling* task group.
6. Select **Preferences** located at the bottom of the *End-Area Volumes* dialog.
7. In the *Preferences* dialog, select the preference named *MODOT-Earthwork* and click **Load**

   Preferences are predefined settings stored in the active XIN settings file delivered in the MoDOT workspace. These preferences will be used for creating, annotating and computing end-area volumes on proposed cross sections.
8. **Close** the *Preferences* selection dialog.
9. In the *End-Area Volumes* dialog, complete the *General* settings as shown below. Make sure you toggle on the **Create XML Report**, and select the volume units of choice.



10. Complete the *Classifications* settings as shown below.




11. Click **Apply**. This will complete the following five tasks when processing.

- Compute end-areas.
- Compute volumes between sections.
- Label cross sections with computed values.
- When the volumes computations are complete, the *Bentley Civil Report Browser* will open when the toggle is activated. The report browser allows the designer to review the end-areas as well as computed volumes for all surfaces.

12. Look at multiple reports available in the **Evaluation** folder

13. In the *Bentley Civil Report Browser*, select **Tools** > **Format Options** and adjust values to your preferences. Notice how the report updates when changes are applied. Click **Close** when adjustments are complete.

14. In the report browser, toggle through the different earthwork reports available on the left to comprehend the many options available from these calculations.

15. **Close** the *Bentley Civil Report Browser*.

16. **Close** the *End-Area Volumes* dialog.

# Chapter 11

# Plan & Profile Sheets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## 11.1 Objectives

- Understand and be able to use the GEOPAK Plan & Profile Sheet Generator

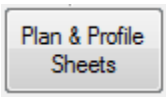
## 11.2 Definitions

Based on user-defined parameters and sheet size, sheet borders will be placed into a design file relative to a specific alignment. Modifications may be made to sheet size and location. Once the sheet boundaries are in the proper location, the designer may then place the sheet(s) into a design file(s) with the appropriate reference files and sheet cell.

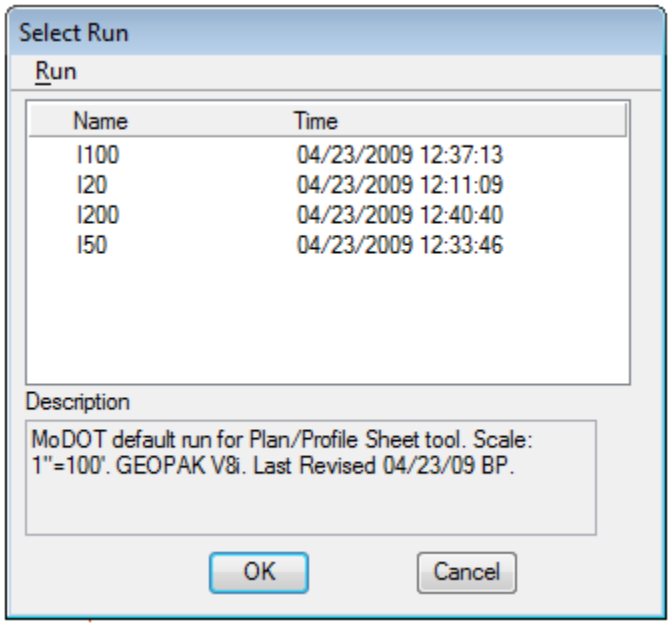
The CADD Support Center has set up a plan sheet library as a basis for generating typical plan and profile sheets. These plan sheet library includes all of the settings, which include General Settings, Plan Drawing Area, Profile Drawing Area, Grid Settings, Tabular Data, etc.

## 11.3 Accessing

The Plan and Profile Sheets Generator must be invoked via the **Road Project** flow chart button **Plan & Profile Sheets** shown to the right.



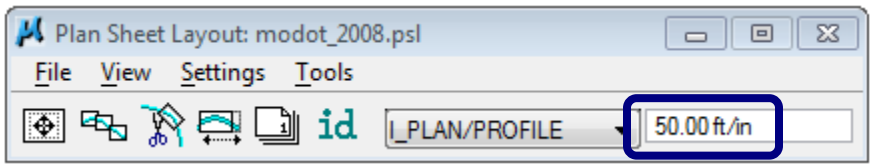

When the button is pushed the **Plan & Profile Sheets Run Picker** dialog appears.




The user will copy the run that represents the scale in which he/she is interested. Each run is configured to minimize user input.

| RUN NAME | DESCRIPTION |
|---|---|
| I100 | English Sheet for a 1”=100’ scale |
| I200 | English Sheet for a 1”=200’ scale |
| I50 | English Sheet for a 1”=50’ scale |
| I20 | English Sheet for a 1”=20’ scale |

Upon entering a run, the Sheet Layout dialog appears. The sheet scale part of the dialog is automatically set for each default run.




## 11.4 Sheet Library

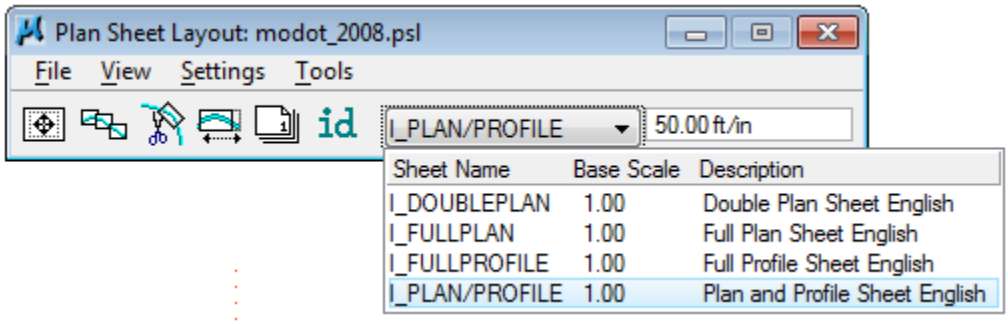
A sheet library must be attached to the current session. CADD Support has set up the tool so the MoDOT sheet library (modot.psl) is automatically attached.

The sheet library contains all the parameters required to layout and to clip the sheets. Only CADD Support is authorized to edit the MoDOT sheet library. Any other sheet libraries will not be supported.

## 11.5 Sheet Types

The sheet library contains four types of sheets both for English and Metric projects. They are:

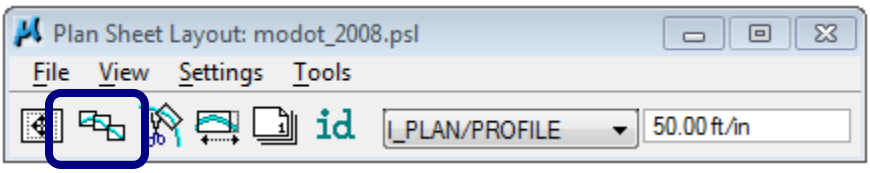
- Double Plan
- Full Plan
- Plan/Profile
- Full Profile



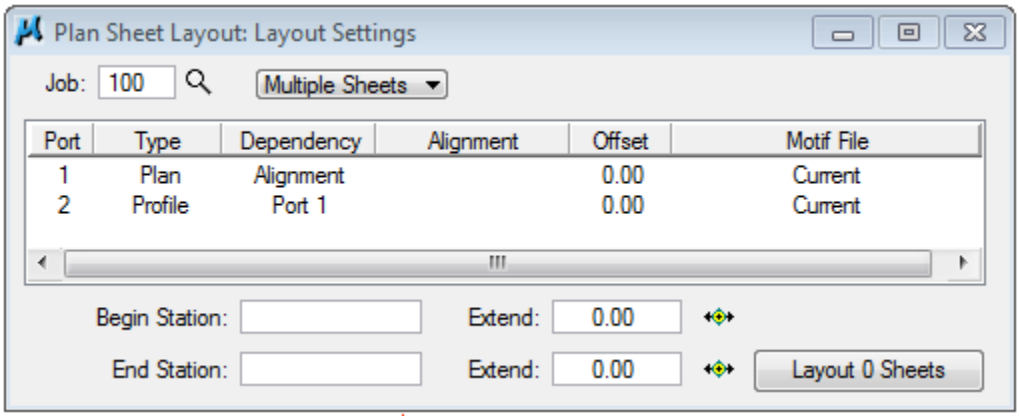

To select a sheet type, click in the list box area of the dialog, causing it to expand as shown to the right; move the cursor to the type of sheet desired and click again.

## 11.6 Sheet Layout

Once the type of sheet has been selected, the user is ready to layout the sheets. To access the layout process, select the layout icon from the dialog box or by selecting **Tools>>Sheet Layout.**




The **Layout Sheets** dialog appears.




### 11.6.1 Job Number

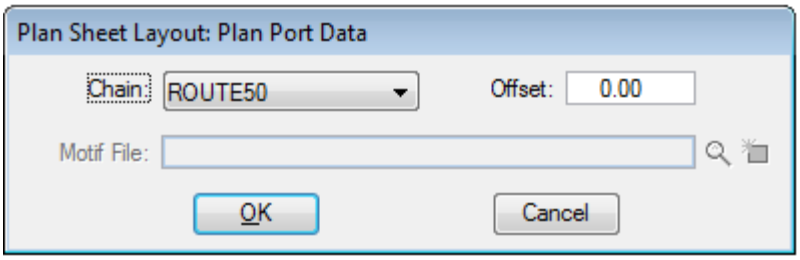
The job number is populated based on the .gpk file selected through Project Manager. With the job number selected, the user is ready to set up each port.

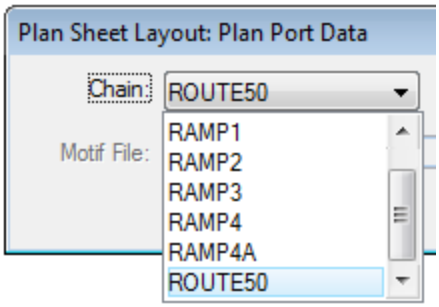
### 11.6.2 Ports

Depending on what type of sheet is selected, the user may have one or two ports. A port is typically a rectangular area that shows a particular section in a sheet, for instance, a standard plan and profile sheet contains two ports, one plan port and one profile port.

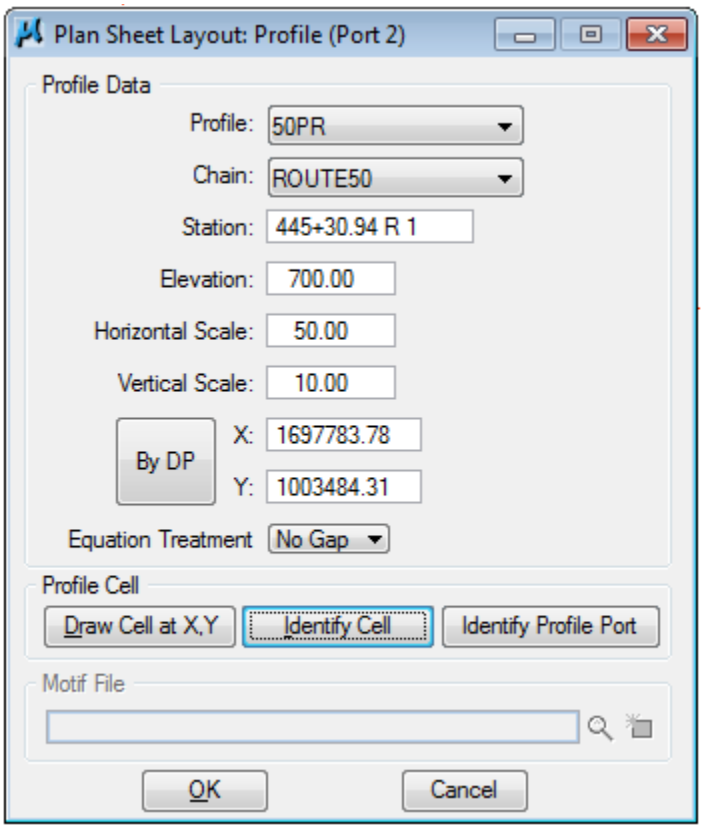
The job specific data for each port must be set. If there are two ports, it is important to enter the data for Port 1 first. Double click on a port to enter the data for that line.

If it is a plan type port the next dialog box appears. Select the chain via the pull down list box. Once the chain is selected, click the **OK** button.




If it is a profile port, the following dialog appears. The profile must be selected from the Profile list box.




The rest of the fields in the **Profile Data** area of the dialog can be filled in two ways. One way is to manual fill each of the field with the proper information. However, if a profile cell has been plotted for the alignment, the user can automatically populate the fields by clicking on the **Identify Cell** button and data pointing on the plotted cell. If a profile cell does not exist, the **Draw Cell at X, Y** can be used to place a profile cell once the information has been manually entered into the dialog.

The Profile Data fields contain the following information:

**Station:** station value of the data point used to define the location of the profile;
**Elevation:** elevation value of the data point used to define the location of the profile;

**Horizontal Scale:** horizontal scale of the plotted profile;
**Vertical Scale:** vertical scale of the plotted profile;
**DP X:** the X coordinate of the profile location; and
**DP Y:** the Y coordinate of the profile location.

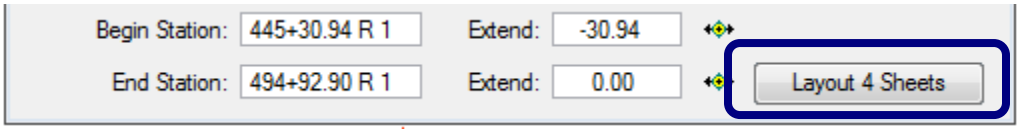
The X and Y coordinates can be typed in or set by choosing the **By DP** button and data pointing in the MicroStation drawing to set the origin point. If the profile has a station equation, the profile can be plotted with gaps or with no gaps.

Once the profile information is populated, click on the **OK** button.

### 11.6.3 Station Range

The **Beginning Station** and **Ending Station** fields are automatically filled in with the station limits of the chain identified in the upper portion of this dialog box. Should the user want to begin or end at a different location the user has the option to type in the station limits for sheet processing or click the **DP** button and data point a location on the screen along the center line.

In addition, the user has the option to start the sheet layout before or after the beginning or end of the alignment by setting the appropriate values in the **Extend** field. A positive number moves in the direction of increased stationing, while a negative number moves in the direction of decreased stationing. For example, the values for the Begin Station shown below will cause the first sheet to start at station 445+00, which is 30.94 feet before the beginning of the chain.

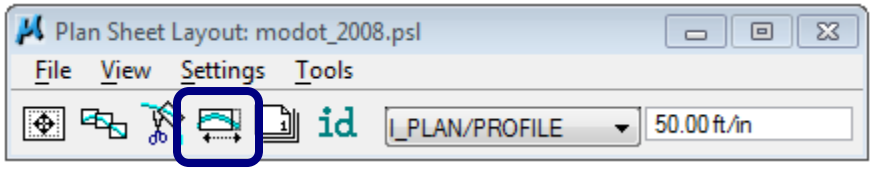



Based upon the begin and end station information the dialog will indicate how many sheets will be laid out as shown above. The user then selects the **Layout Sheets** button to layout the sheets.

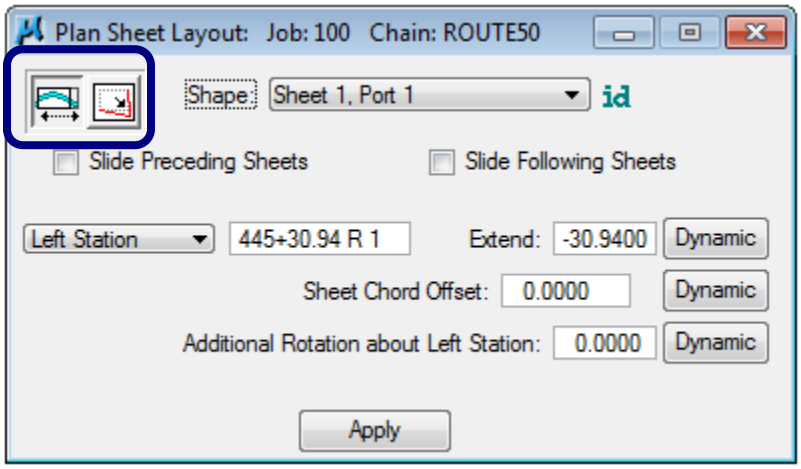
## 11.7 Modify

Once the above process is complete, the user should review the location of all the sheets to see if any modifications are needed.

To access the Modify mode, select the **Modify Sheets** icon or the menu path **Tools>>Sheet Modify**.

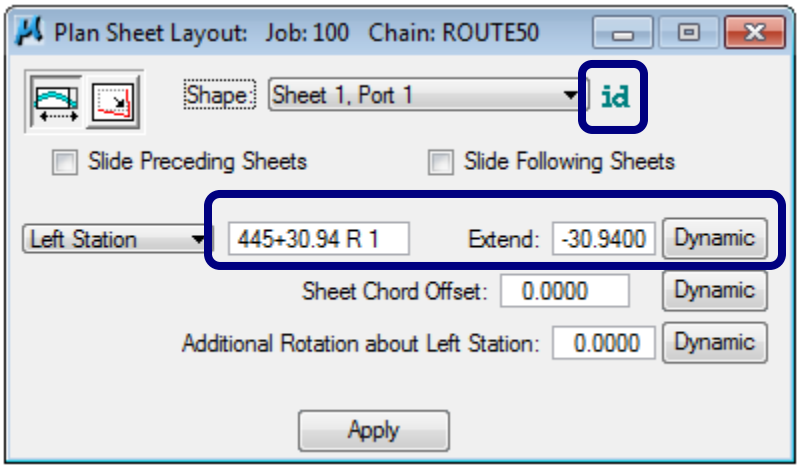


Two major modifications are supported and are selected via icon in the upper left corner of the dialog box shown below. The user has the options of **Slide Sheets** or **Modify Drawing Area.** As the modification type is selected, the dialog changes to reflect the selection.




**Slide Sheets** - slides previously placed sheets along the alignment; adjacent sheets can remain in their original location or be moved as well.

First, the user needs to identify the port to be modified by either selecting it from the list of all shapes in the current set or by pressing the **Id** button and graphically selecting the clipping shape for the port, which will automatically fill the **Shape**.




Next, determine whether only one sheet is to be modified or if the modification should be carried over to adjacent sheets. If the sheets preceding the current sheet are also to be moved, then activate the **Slide Preceding Sheets** toggle. If the sheets after the current sheet are to be moved a corresponding amount as the original shape, activate the **Slide Following Sheets**. If all sheets should be adjusted the same as the original sheet, activate both the **Slide Preceding Sheets and Slide Following Sheets.**

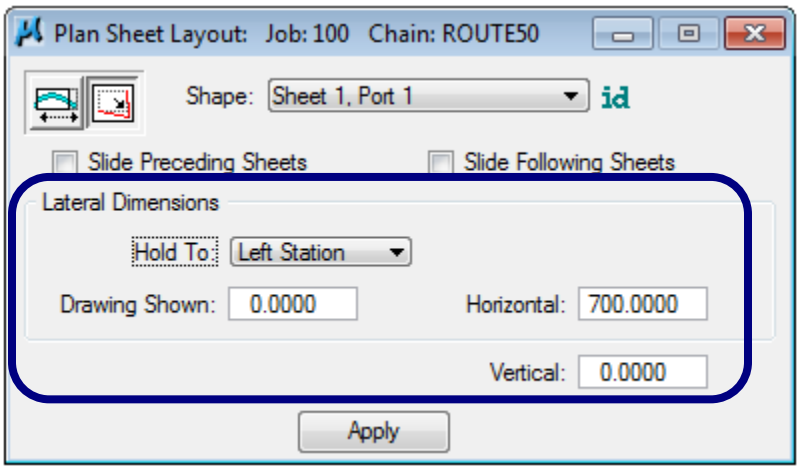
The sheets can be moved dynamically or by value. The station of the sheet is populated when the sheet is selected. To move the sheet along the alignment, enter the value (in terms of master units) in the **Extend** field or just enter the new station value. If entering a value in the **Extend** field, a positive number moves in the direction of increased stationing, while a negative number moves in the direction of decreased stationing.

To move dynamically, press the **Dynamic** button to the right of Extend, which attaches the sheet to the cursor. Then place a data point to initiate moving the cursor, noting the station and Extend values changing as you move. To stop the dynamics, place a final data point to identify the location and terminate sliding.

To move the sheet further away (or closer to the alignment) without changing the stationing, use the **Sheet Chord Offset** using a value or dynamically

The **Rotation** can be entered as an angle or dynamically. Rotation always pivots about the left edge of the clipping shape. Rotation alone does not cause Preceding or Following sheets to slide.

**Modify Drawing Area -** modifies the Clip borders.




The sheet must be identified using the same procedure as the **Slide Sheets tool**. The **Slide Preceding** and **Following Sheets** is also supported.

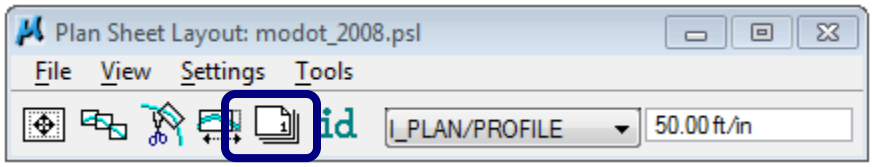
When the sheet is identified, the fields in the **Lateral Dimensions** are automatically populated. The user has the option to hold the **Left Station**, the **Right Station** or the **Center Station**. Only one station can be held while the other two are adjusted to the revised drawing parameters. Set the desired values and press the **Apply** button to commence redrawing.

**Note:** There are no dynamic options when changing the drawing area.

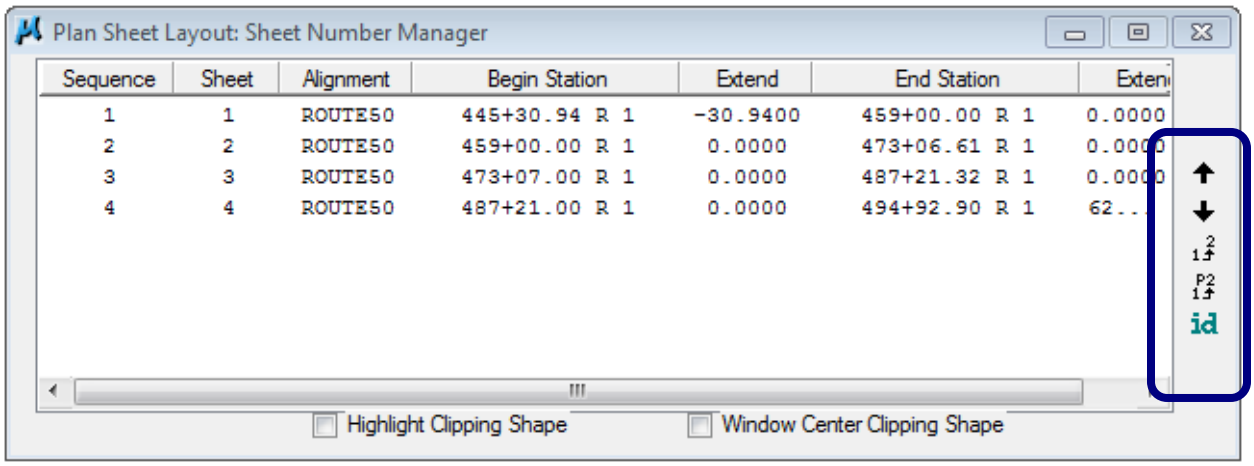
## 11.8 Sheet Number Manager

Once the clipping shapes have been placed in the MicroStation drawing, the user can adjust the sequence of the sheets by using the **Sheet Number Manager**.

The Sheet Number Manager can be accessed via pull down **Tools >> Sheet Number Manager** or by selecting the icon on the dialog box.



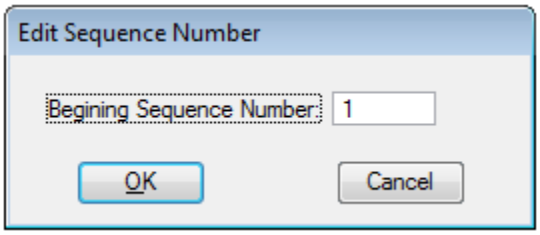

Once the tool is selected the dialog below appears.



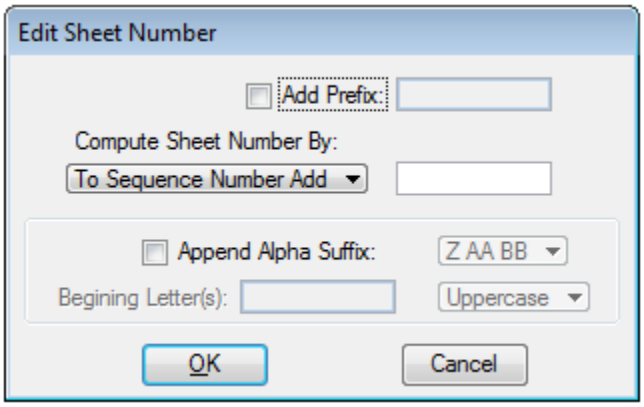

The dialog lists all the sheets in the order they will be drawn. By default the sequence of the sheets matches the sheet number. If the sequence of the sheets needs to be adjusted, the user can highlight the sheet and use the **up and down arrows** on the right hand side of the dialog.

The **id** icon allows the user to select a clip shape from the MicroStation file. The associated line in the list box is highlighted.

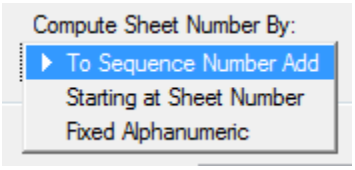
The **Edit Sequence** tool may be used in the case that there are too many sheets to move with the arrows. Highlight the sheet to be moved and press the icon. The **Edit Sequence Number** dialog opens.



If for any reason the user needs to change the sheet numbers, the **Edit Sheet Numbers** tool can be used. The user needs to highlight the sheets to be changed and press the **Edit Sheet Number** icon, which opens the dialog shown below.




The user has the option to add a prefix, append an alpha suffix, or do both. The sheet numbers can be edited by the options shown below:



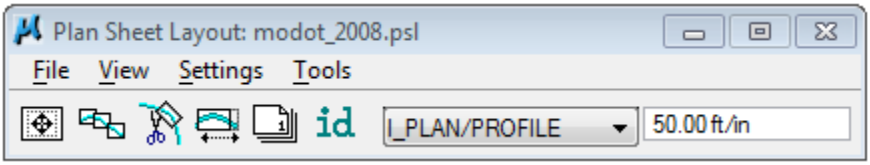

**To Sequence Number Add –** It renumbers the sheet by adding a value to the original sheet number. For example, if the original sheet number was 1 and sequence add number is 100; the new sheet number becomes 101.

**Starting at Sheet Number –** The user specifies a given sheet number to start from.

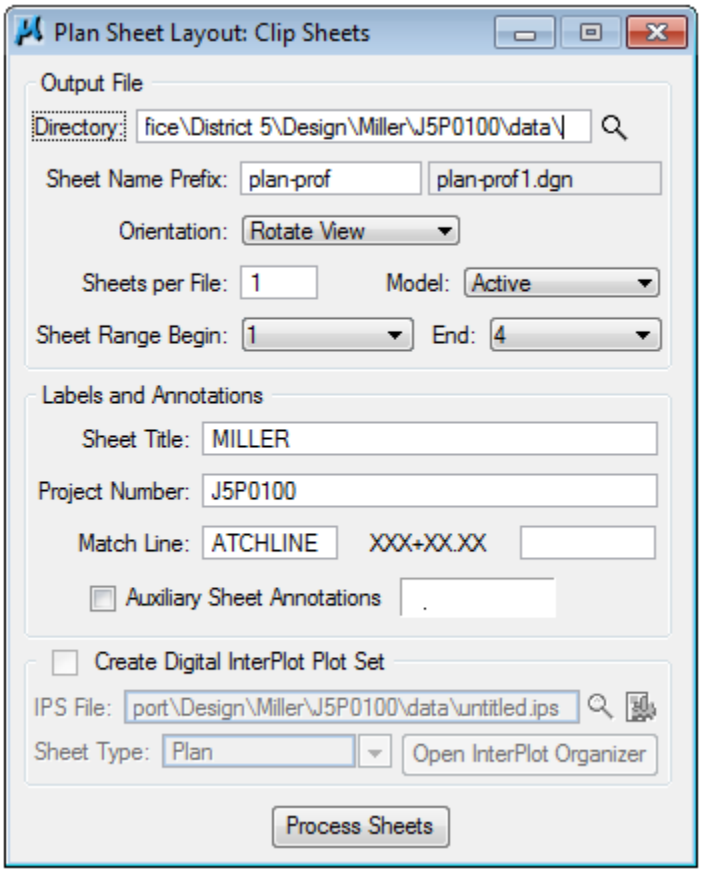
**Fixed Alphanumeric -** This field is used in combination with the bottom entries in the dialog. The user specifies to hold a fixed alphanumeric value and toggles the **Append Alpha Suffix.**

## 11.9 Clip Sheets

The **Clip Sheets** process can be accessed via pull down **Tools>> Sheet Clip** or by selecting the icon on the dialog box.



The following dialog appears.




## 11.9.1 Output File

**Directory –** Path to folder where the design file containing the sheet(s) will be placed.

**Sheet Name Prefix** – Name of the design file containing the sheet (s). GEOPAK will add a 1, 2, etc. to the end of each file name.

**Orientation -** The tool supports two types of orientation, Rotate View and Rotate Reference.

**Rotate View -** will attach all reference files and rotate the view to conform to the orientation of the sheet. This option allows true coordinates for the file. (Note: If **Rotate View** is used, tools such as Plan View Labeler, and DP Station and Offset can still be used). **Rotate Reference** - Will rotate each reference file to orient itself with the sheet. (Note: It is suggested to use the **Rotate View** mode.)

**Sheets per File** - Indicates how many sheets are drawn per design file. (Note: for **Rotate Reference** only)

**Model –** The *Clip Sheet Tool* supports the use of models. User can select the *Active* model or *By Sheet Name.*

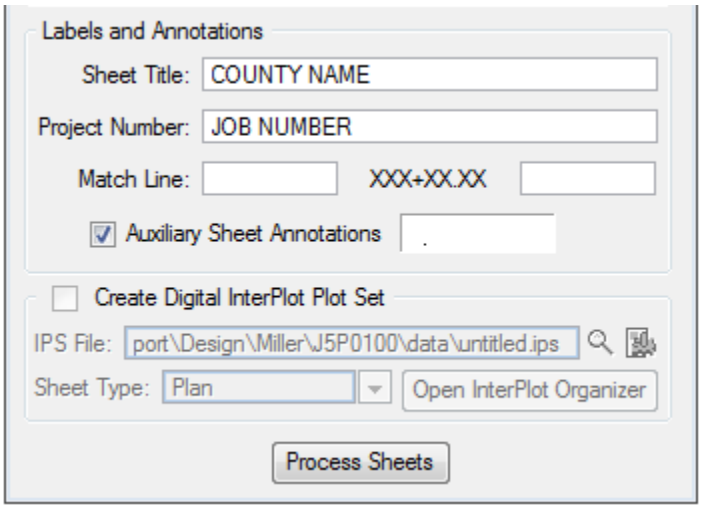
**Sheet Range –** Allows the user to choose which sheets to clip by selecting a **Begin** and **End** range.

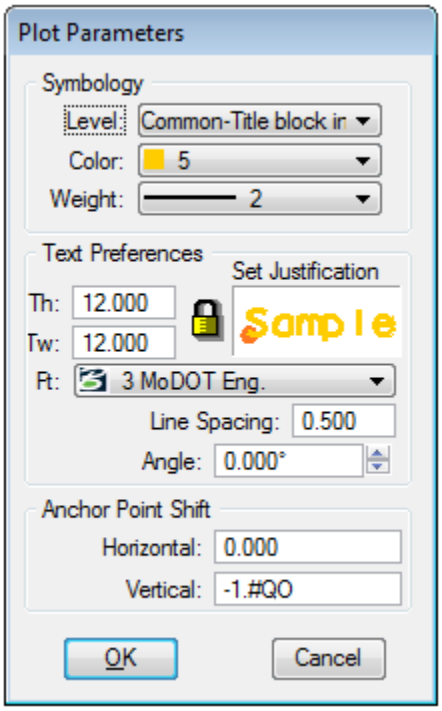
### 11.9.2 Labels & Annotations

**Sheet Title-** CADD Support has set this field to be the name of the project county for a standard MoDOT sheet title block.

**Match Lines –** Will place a match line station.

**Auxiliary Sheet Annotations** – Will allow the user to add any other notes not already set in the default settings. Once the **Auxiliary Sheet Annotations** toggle is turned on, the **Sample** graphics button will become available, and the user can define the plot parameters accordingly. These Auxiliary Sheet Annotation will provide an additional label with the *name of the chain, the rotation angle and the sheet number*.




**Process Sheets -** Once all the fields in the dialog box are entered, selecting the **Process Sheets**, initiates the sheet(s) creation.

## 11.10 File Pulldown Menu

**Sheet Library –** This menu option has options for creating, attaching, or editing a library. CADD Support maintains the MoDOT plan sheet library. Other sheet libraries will not be supported.

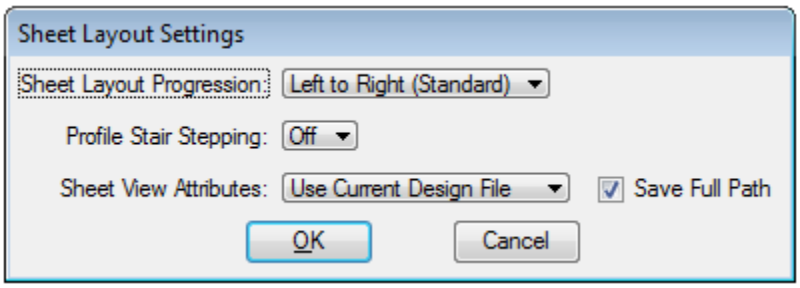
**Exit –** Exits the Plan/Profile Sheets application.

## 11.11 View Pulldown Menu

When different types or scales of plan sheet shapes are placed within one plan view drawing, the view menu options allow the user to filter sheets by names or by scale to display the shapes accordingly.

## 11.12 Settings Pulldown Menu

Only one option is available in this pulldown menu. The Sheet Layout settings option allows the user to set a Sheet Layout Progression, Profile Stair Stepping, and Sheet View Attributes.




## 11.13 Tools Pulldown Menu

**Identify Sheet –** Identifies the scale, port and number of the selected sheet shape

**Sheet Composition** - Opens the sheet composition dialog box. It allows the user to define the drawing area. CADD Support has set up default settings for MoDOT users.

**Sheet Layout –** Opens the layout sheet dialog.

**Sheet Clip –** Opens the clip sheet dialog.

**Sheet Modify –** Opens the modify sheet dialog

**Sheet Number Manager –** Opens the sheet number manager.

**Draw Tabular Annotation (Sheet Clip Mode) –** When the ports are set up in a tabular manner, this tool allows the user to define the tabular data to be included within the plan/profile sheets.

**Process Classic Plan & Profile Runs –** This will import certain information from the *Classic Plan & Profile* runs to create a sheet library. MoDOT has developed the modot.psl as the library to be used with the MoDOT default runs.

## 11.14 Group Exercise: Road1

1. Within the ***J2P0200\data_11*** folder, open the file: ***Plan_J2P0200.dgn***
2. Create a new file named ***Plan_Profile_J2P0200.dgn*** based on the following 2D seed file:

   ***pw:\CADD_Standards\Seed Files\Design - English\i_project_2d_PowerGEOPAK.dgn***
3. Reference in the following files:

   ***Civil_Geometry_J2P0200.dgn***

   ***Corridors_J2P0200.dgn***

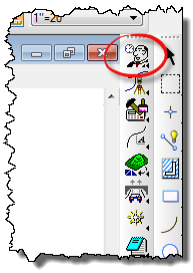
   ***Land_Boundaries_J2P0200.dgn***

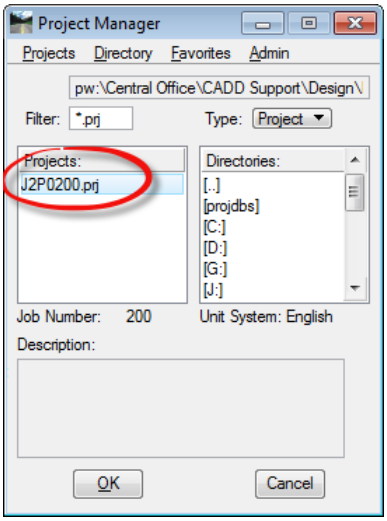
   ***Plan_J2P0200.dgn***

   ***Profile_J2P0200.dgn***

4. Click on the **Project Manager** icon and open the following GEOPAK project:

   **pwname:\\MoDOT\Documents\District CADD\Design\Randolph#\J2P0200\project\J2P0200.prj**





5. Edit the PRJ file so that the ***job200.GPK*** file located in the ***data_11*** folder can be found.

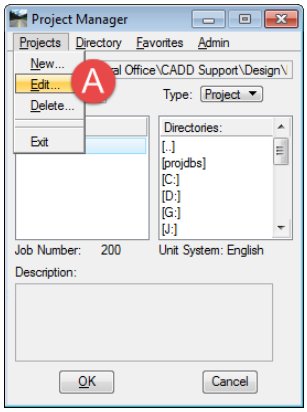
A. **Edit** PRJ

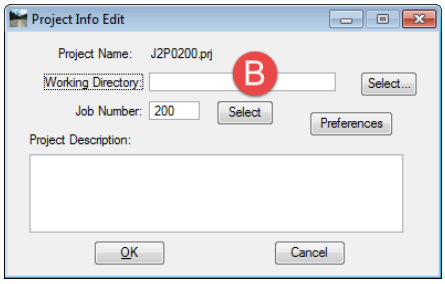
B. **Clear out** working directory

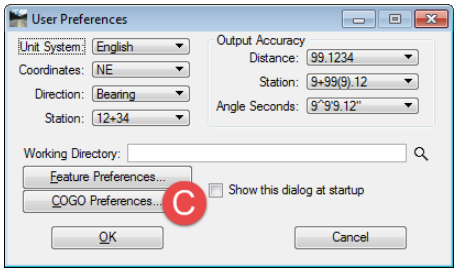
C. **Open** COGO Preferences

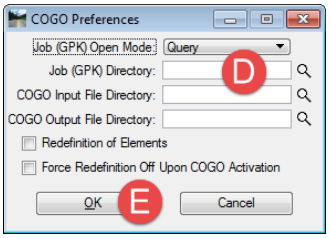
D. **Clear out** Job Directory

E. **Click OK** to move on

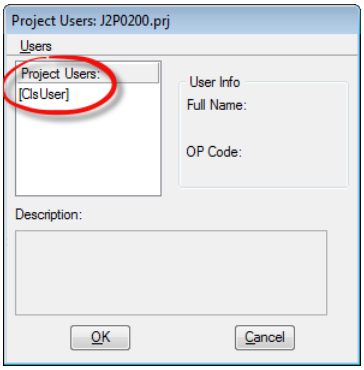


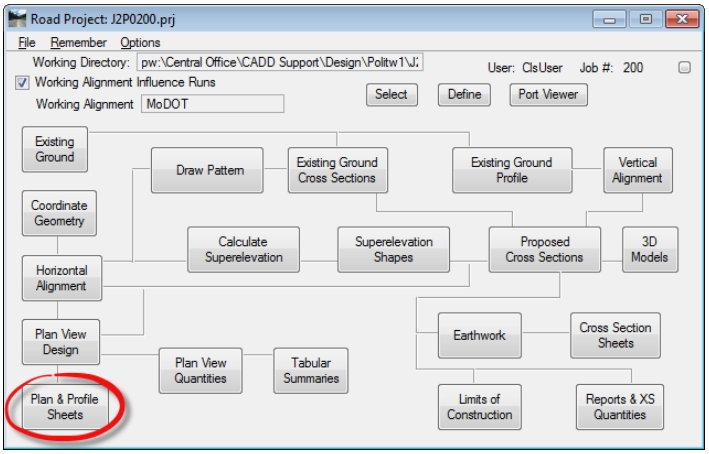



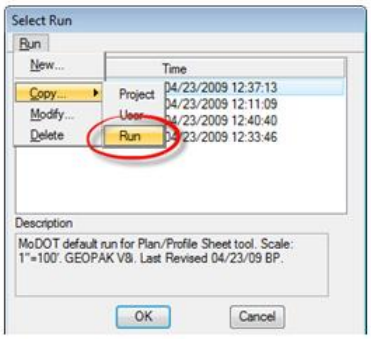

6. Enter the project as **ClsUser** for this exercise.

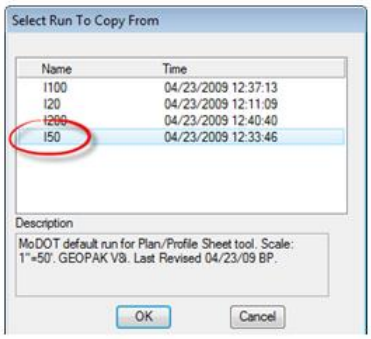


7. Select **Plan & Profile Sheets** from the **Road Project** flow chart

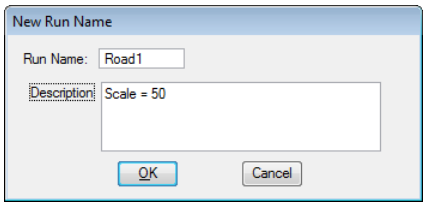



8. **Select Run >> Copy >> Run** and choose the **I50** run.

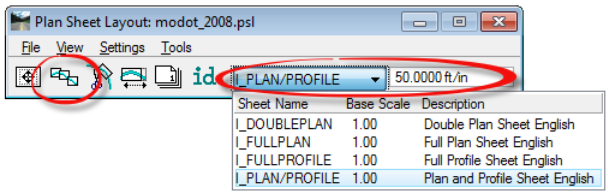



9. Name the new run **Road1** and give it a description to identify a 50 scale has been used. Then **open** the newly copied Road1 run.



10. Select the **Plan/Profile** sheet from the pull down.

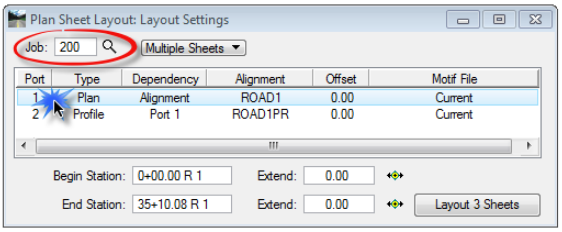


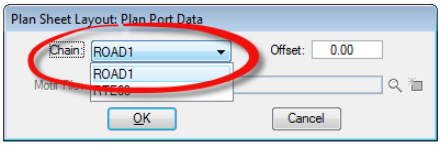

11. Select the **Layout Sheets** via icon as shown above or by pull down menu **Tools>>Sheet Layout**.

12. Set up the **Layout Sheets** dialog with the information for the Road1 working alignment:

Select Job 2**00** by clicking on the open folder icon, as shown below.

Double click on **Plan** (Port 1). Select the **Road1** chain from pull down.



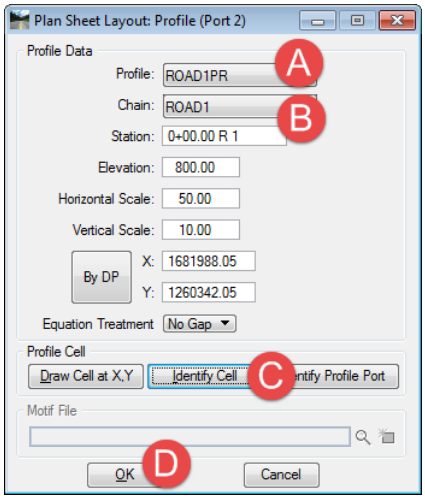

Double click on **Profile** (Port 2).

A. **Select** ROAD1PR profile

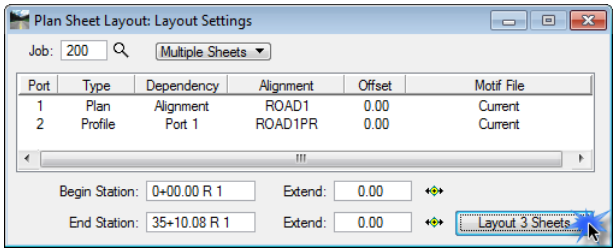
B. **Select** ROAD1 chain

C. **Select** Identify Cell

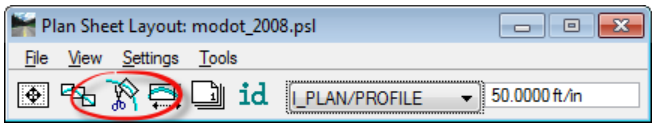
D. **Click OK** to move on



13. Click the Layout 3 Sheets button to create the sheet blocks for the plan and profile sheets.




14. Select the **Clip Sheets** icon or via pull down menu **Tools >> Sheet Clip**




Populate the Clip Sheets dialog as shown below.

The directory to create the sheets to will be:
**pwname:\MoDOT\Documents\ District CADD\Design\Randolph#\J2P0200\data_11**

Once the information is filled out, select **Process Sheets**.

A. **Path** the directory to place the sheet files
***- District CADD\Design\Randolph#\J2P0200\data_11***

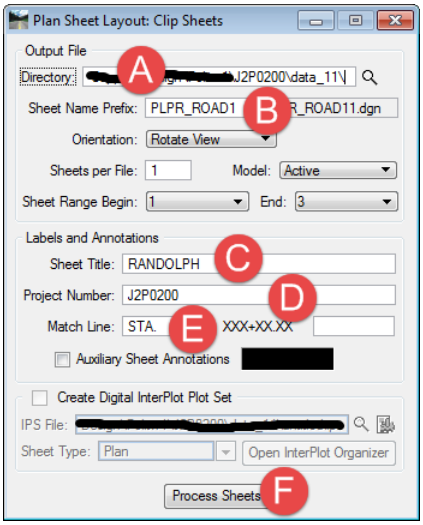
B. **Name** the sheet prefix – ***PLPR_Road1***

C. **Sheet Title** county name – ***RANDOLPH***

D. **Project Number** – ***J2P0200***

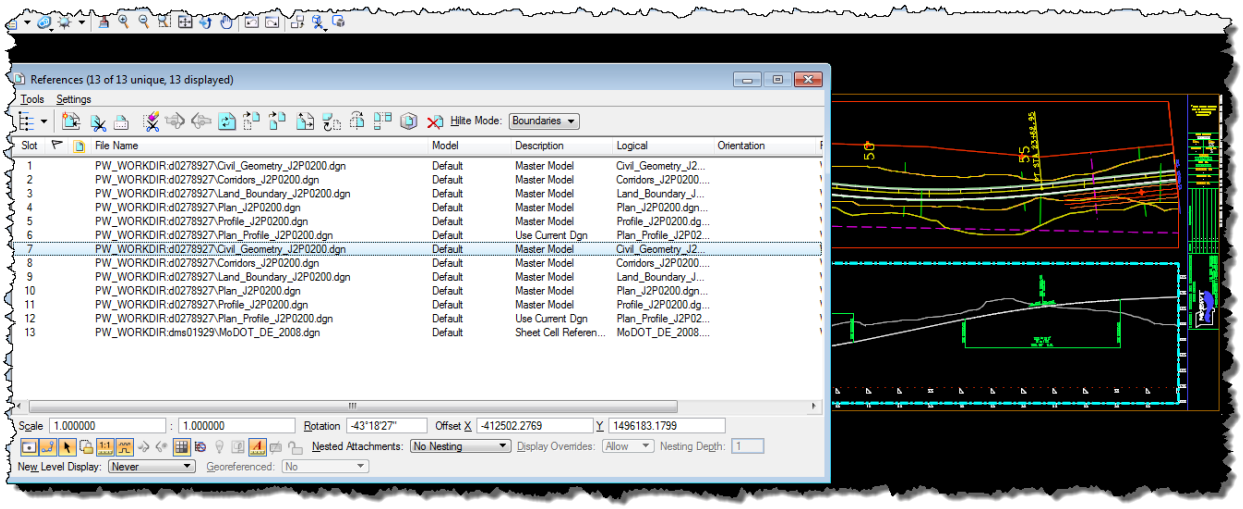
E. **Match Line** – ***STA.*** (space after the period)

F. Click the ***Process Sheets*** button to begin processing

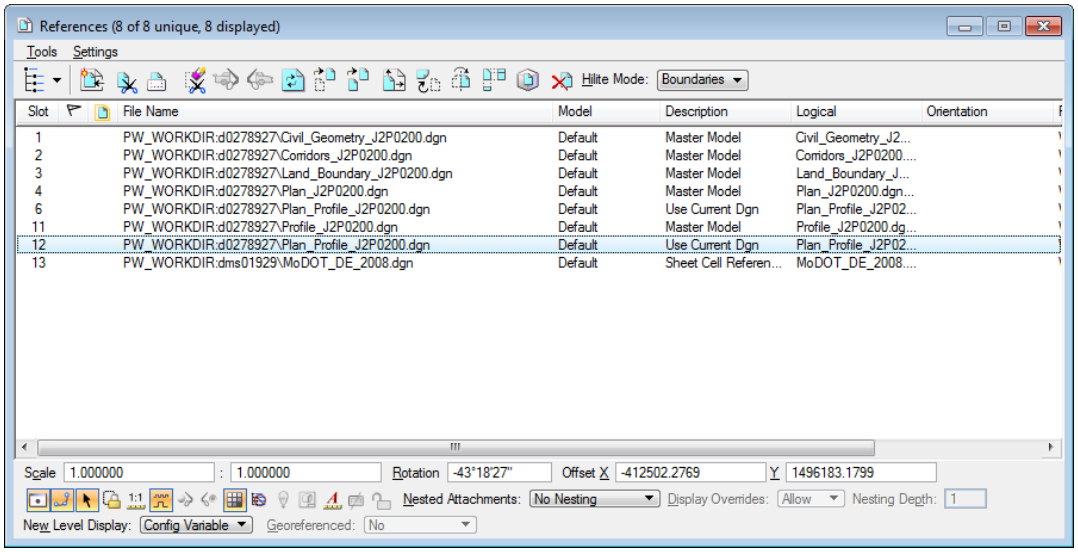


15. Open a newly created plan-profile sheet.

16. Open the Reference Dialog and detach the extra references that get created by default.

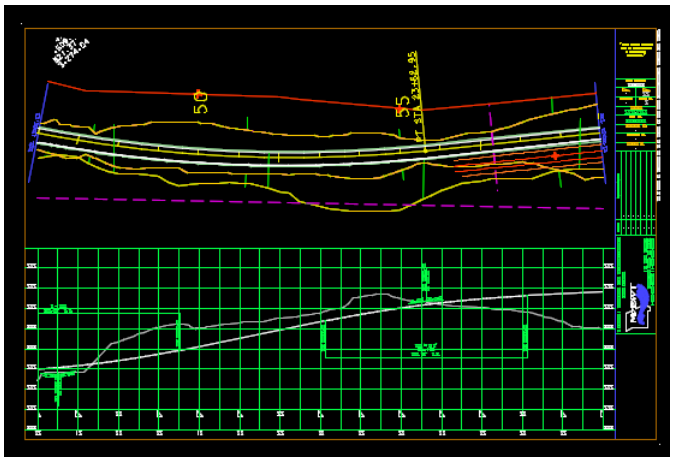



As you select the references the plan or profile port will highlight.
Remove the profile information from the plan port and the plan information from the profile port by detaching the "extra" references.

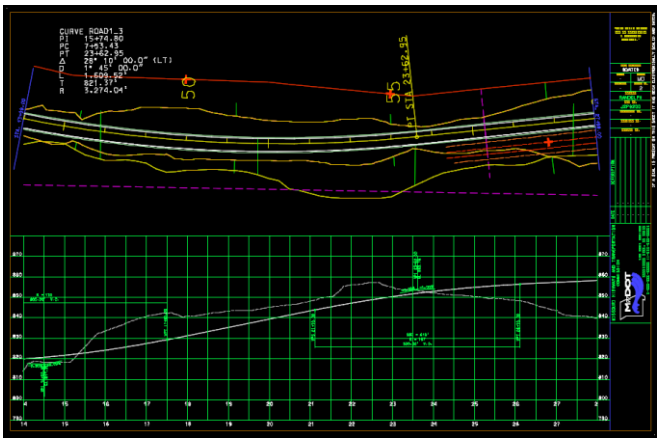


17. Open the MicroStation **Level Display** tool and using the "Off By Element" option from the right click menu turn off the display of the red shape surrounding the plan port and the white shape surrounding the profile port.

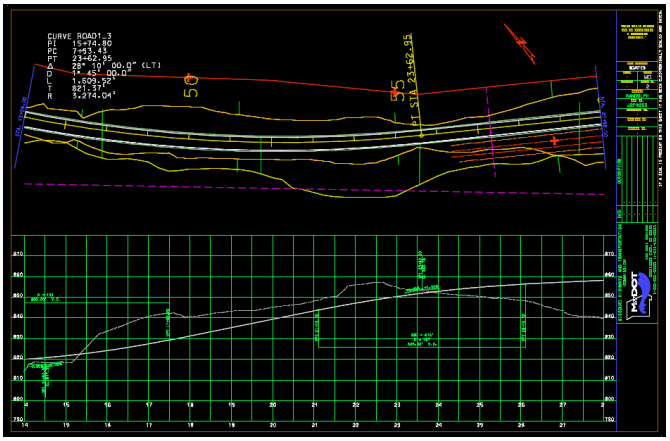
18. Turn on Level **Border-Plan-profile major grid lines** in the **MoDOT_DE_2008.dgn** reference file in the plan sheets.



19. Use the option in the reference dialog to do an exchange into any files that have text that need to be moved and rotated for the plan sheet to have the correct look and modify as needed.



20. Place a north arrow using AccuDraw to complete the plan sheet.



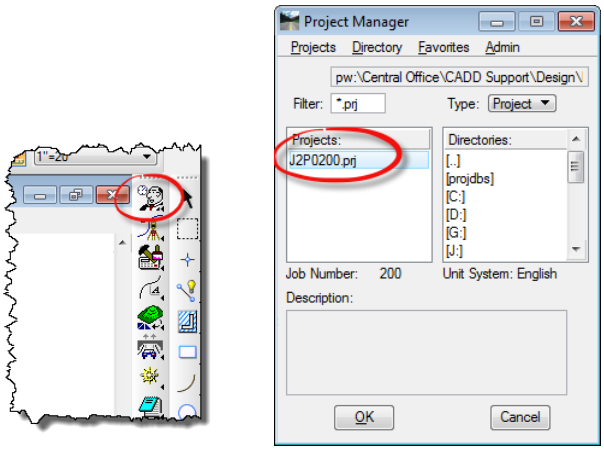
## 11.15 Individual Exercise: Route63

1. Using ProjectWise open the following MicroStation file:

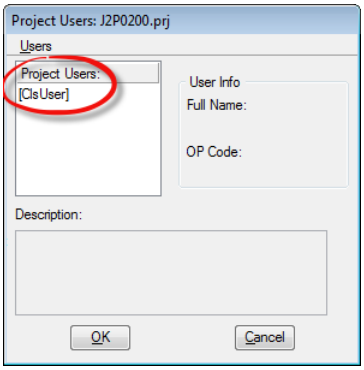
**pwname:\\MoDOT\Documents\DistrictCADD\Design\Randolph#\J2P0200\data_11\Plan_J2P0200.dgn**

2. Open the **Project Manager** icon and open the following GEOPAK project:

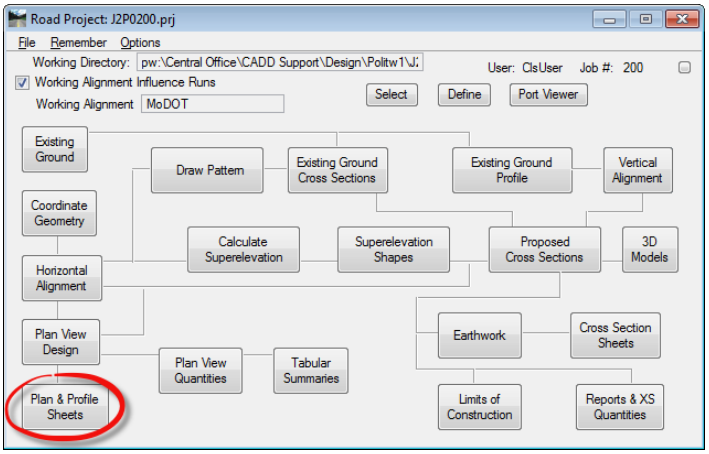
**pwname:\\MoDOT\Documents\District CADD\Design\Randolph#\J2P0200\project\J2P0200.prj**



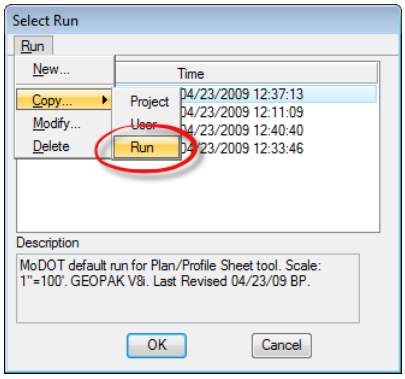

3. Enter the project as **ClsUser** for this exercise.

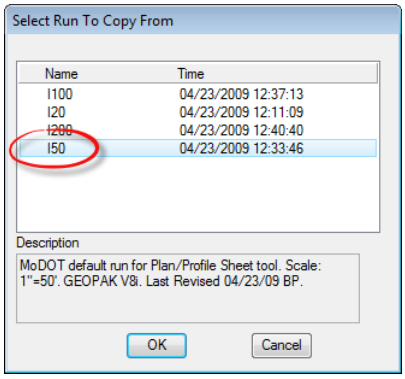


4. Select **Plan & Profile Sheets** from the **Road Project** flow chart



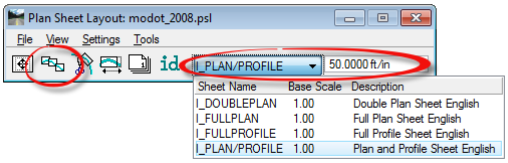

5. **Select Run >> Copy >> Run** and choose the **I50** run.




Name the new run **Route63**. **Open** the newly copied Route63 run.

Select the **Plan/Profile** sheet from the pull down.




Select the **Layout Sheets** via icon or by pull down menu **Tools>>Sheet Layout**.

6. Set up the **Layout Sheets** dialog with the information for the Route63 working alignment:

   Select Job 2**00** by clicking on the open folder icon, as shown below.

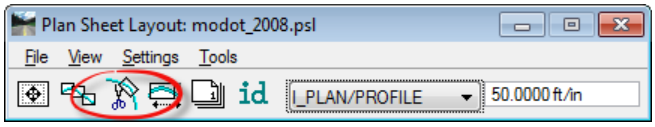
   Double click on **Plan**. Select the **Route63** chain from pull down.

   Double click on **Profile**. Select the Identify Cell button and then select the Geopak Cell pertaining to Route63.

7. Once the Ports have been populated, select the **Layout Sheets** button.

   This will place the sheet blocks around the plan and the profiles in the design file.

8. Select the **Clip Sheets** icon or via pull down menu **Tools >> Sheet Clip**




The directory to create the sheets to will be:
**pwname:\MoDOT\Documents\ District CADD\Design\Randolph#\J2P0200\data_11**

Once the information is filled out, select **Process Sheets**.

A. **Path** the directory to place the sheet files
***- District CADD\Design\Randolph#\J2P0200\data_11***

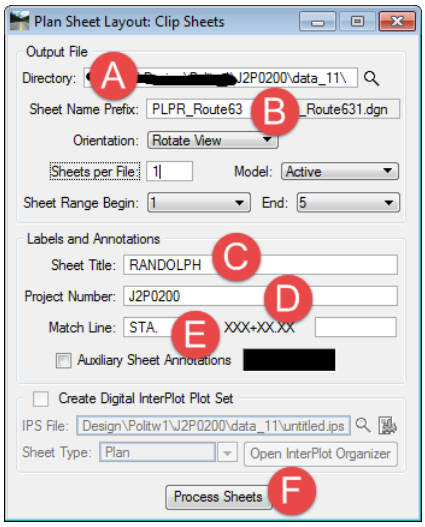
B. **Name** the sheet prefix – ***PLPR_Route63***

C. **Sheet Title** county name – ***RANDOLPH***

D. **Project Number** – ***J2P0200***

E. **Match Line** – ***STA.*** (space after the period)

F. Click the ***Process Sheets*** button to begin processing



9. Open a newly created plan-profile sheet.

10. Open the Reference Dialog and detach the extra references that get created by default.

11. Open the MicroStation **Level Display** tool and using the "Off By Element" option from the right click menu turn off the display of the red shape surrounding the plan port and the white shape surrounding the profile port.

12. Turn on Level **Border-Plan-profile major grid lines** in the **MoDOT_DE_2008.dgn** reference file in the plan sheets.

13. Use the option in the reference dialog to do an exchange into any files that have text that need to be moved and rotated for the plan sheet to have the correct look and modify as needed.

14. Place a north arrow using AccuDraw to complete the plan sheet.