VDOT
GEOPAK Road II
Training Manual

Training Manual 2004 Edition

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This class utilizes the 2004 Edition of Bentley GEOPAK Civil Engineering Suite.

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1 Horizontal Alignments

CHAPTER OBJECTIVES

In this chapter, you will create and store horizontal chains using Graphical Coordinate Geometry tools as well as the component tools within the Horizontal Alignment Generator.

GRAPHICAL COORDINATE GEOMETRY

INTRODUCTION

Graphical Coordinate Geometry is a tool that allows the user to store coordinate geometry elements into the COGO database (GPK file) graphically. Points, curves, lines, spirals, chains, and parcels can be stored, modified, or deleted. The COGO elements can be manipulated by key-in or a click of the mouse and are stored directly into the COGO database.

Note Graphical Coordinate Geometry does not read the exclusive MicroStation graphics.

ACCESSING

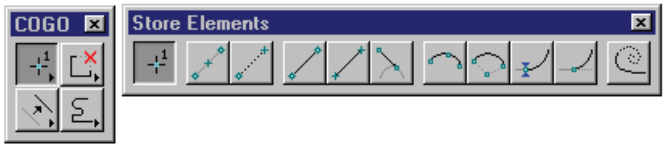
Graphical Coordinate Geometry is not accessed from **Project Manager**. It can be invoked by selecting **Applications > GEOPAK ROAD > Geometry > Graphical Coordinate Geometry** or by selecting the **Graphical COGO** icon from the **GEOPAK ROAD** tool frame.

Note A session of COGO must be active.

After Coordinate Geometry is activated and Graphical COGO is selected, the main COGO tool box will appear as shown below.

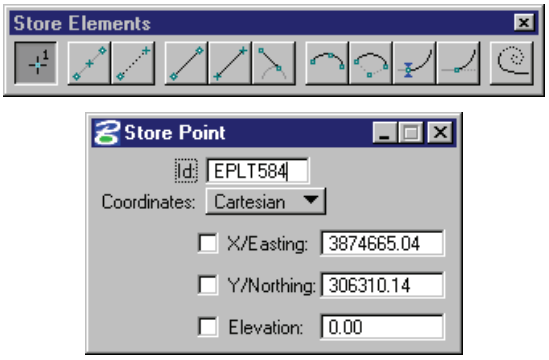
STORE ELEMENTS

The Store Elements tool box contains eleven icons.



As elements are stored, the visualization parameters in the SMD file (as defined in the user preferences) are utilized. This assumes that the temporary or permanent visualization is activated. If no visualization is active, no elements are visualized.

When a **Store Element** command is selected, the Tool Settings dialog opens to allow the user to enter data as shown below.

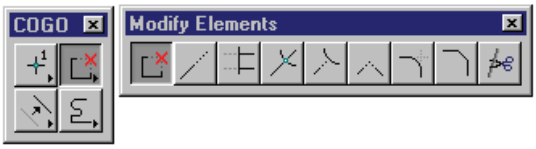


The **Store Elements** commands are detailed in the following table.

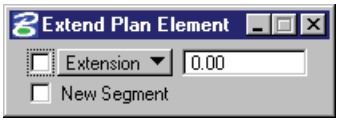
	**Store a Point** The Store a Point tool enables the user to store points utilizing either Cartesian coordinates (x, y, z or N, E, Z) or Curvilinear (station, offset, elevation).
	**Store Equally Spaced Points** The Store Equally Spaced Points stores a user-defined number of points between two previously defined points or any two data points. A line drawn between the two previously defined points is not necessary.
	**Locate Point** The Locate Point command stores a point based on the distance and direction from a previously defined visualized point.
	**Store Line From Existing Points** The Store Line from Existing Points utilizes two previously stored points to store a line.
	**Store Line By 2 Points** The store line by two points command requires two new points, rather than existing points. The command stores the line and the new points, utilizing the "next" available point and line names.
	**Store Tangent Line** The Store Line Tangent To Element tool stores a line and its two endpoints in the coordinate geometry database.
	**Store Curve By 3 Points** The Store Circular Curve by Three Points tool stores a circular curve (using chord definition). The stationing is set to 0+00 at the P.C. The Radius can be manually typed in or defined dynamically.

	**Store Curve By Center** This tool enables the user to store a circular curve by defining the center point, radius, and sweep angle.
	**Store Tangent Curve Constrained** The Store a Constrained Tangent Curve tool places a curve tangent to the specified curve or line.
	**Store Tangent Curve Unconstrained** The Store an Unconstrained Tangent Curve tool places a curve through a specified point tangent to the specified curve or line.
	**Store Tangent Spiral** The Store Transition Spiral tool quickly places and visually modifies spirals based on an initial line or curve.

MODIFY ELEMENTS



When a **Modify** command is selected, the Tool Settings dialog opens to allow the user to enter data as shown below.

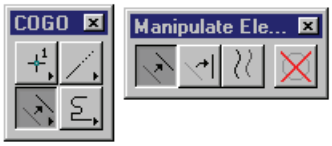


The **Modify Elements** commands are detailed in the following table.

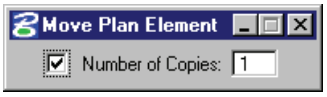
	**Partial Delete** The Partial Delete tool enables the user to delete part of a COGO line or curve, creating two separate elements.
	**Extend Plan View Element** The Extend Plan View Element tool can extend or shorten any COGO element.
	**Trim Elements** The Trim Elements tool trims numerous elements to their intersection with another element.
	**Intersect Elements** The Compute Intersection of Two Element tool stores a new point by trimming or extending one element to its intersection with another element. Note the two elements remain intact.
	**Extend Element to Intersection** The Lengthen or Shorten an Element tool works functionally the same as its MicroStation counterpart.
	**Extend Elements to Intersection** The Lengthen or Shorten Both Elements tool works functionally the same as its MicroStation counterpart.
	**Construct Circular Fillet** The Construct a Fillet Between Two Elements tool works functionally the same as its MicroStation counterpart and stores a circular curve between two elements.

	**Construct Chamfer** The Construct a Chamfer Between Two Elements tool works functionally the same as its MicroStation counterpart and stores a line between two elements. Both the line and two new endpoints are stored in coordinate geometry.
	**Cut Element** The Cut Elements into Smaller Elements tool cuts elements into segments.

MANIPULATE ELEMENTS

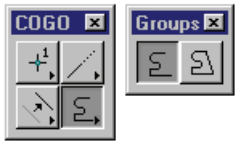


When a **Manipulate** command is selected, a sub pallet will appear to allow the user to enter data as shown below.



	**Move Plan View Element** The Move a Plan View Element enables the user to move an element or to make copies.
	**Rotate Plan View Element** The Rotate Plan View Element rotates the selected element about a user-defined point. The Angle may be manually entered and locked, or dynamically changing.
	**Copy Parallel** The Copy Parallel tool works functionally the same as its MicroStation counterpart.
	**Delete Element** When using the Delete Element tool, no tool settings dialog opens. Select and accept the element to be deleted. The element is removed from the coordinate geometry database. This tool works with a MicroStation selection set if present. ***Warning*** There is no undo for this command.

GROUPS



When a **Group** command is selected, the Tool Settings dialog opens to allow the user to enter data as shown below.

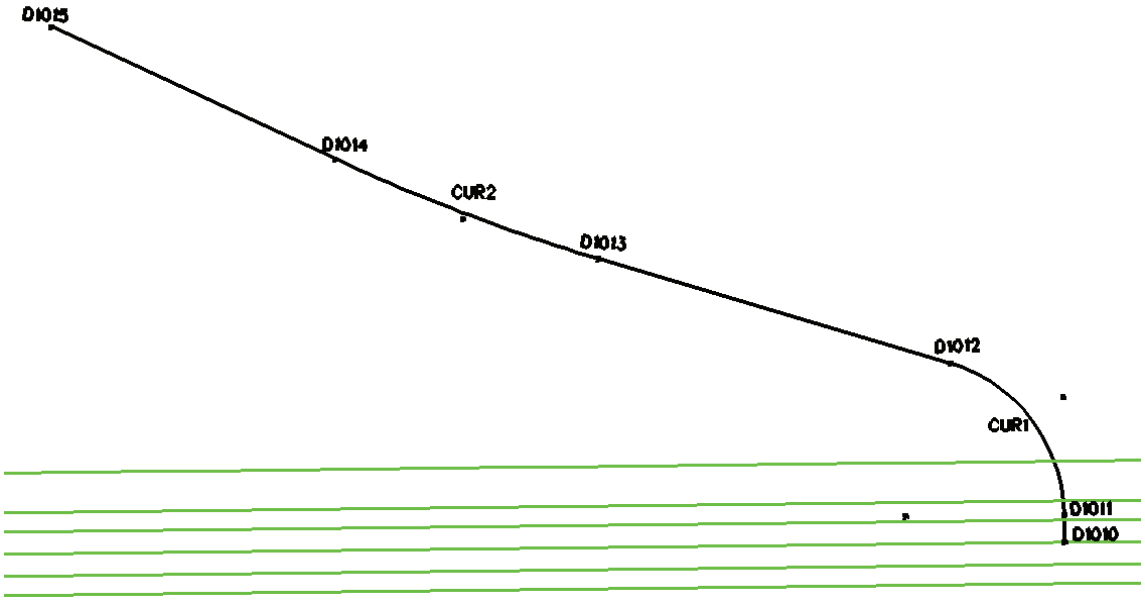
The **Groups** Commands are detailed in the following table.

	**Store Chain** The Store Chain command works in the same manner as the MicroStation Automatic Create Complex Chain with the additional benefit that the chain is automatically stored in the COGO database.
	**Store Parcel** The Store Parcel tool enables the user to store parcels, takings, easements, and other types of right of way features. It is very similar to the Store Chain tool with many of the same options.

LAB EXERCISE: GRAPHICAL COGO

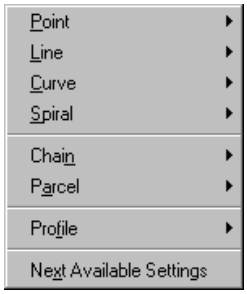
> *STORING AN ALIGNMENT*

1. Open the MicroStation file *c:\data\geo\vdot\road2\60843\alignments.dgn*.
2. Attach the saved view *ALIGN1*.
3. We will attempt to store the alignment shown below.

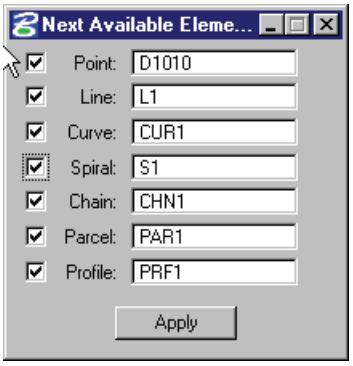


4. Access **Project Manager** and open the project *60843*. (Select the user *Mary* to access).
5. Select the **Graphical Coordinate Geometry** tool by selecting **Applications > GEOPAK Road > Geometry > Graphical Coordinate Geometry**.

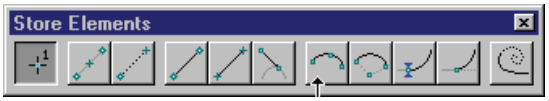
6. Select **Permanent Visualization** on the main COGO dialog.
7. From the **Elements** pulldown select **Next Available Settings**.



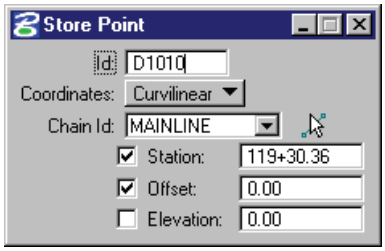
8. Enter the settings as shown below.



9. From the **Graphical COGO** tool box tear off the tool bar for **Store Elements** and click on the **Store a Point** option.

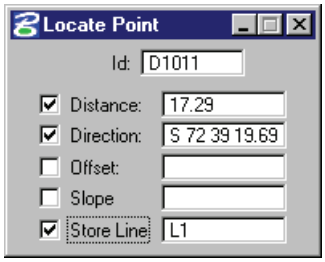


10. Locate point D1010 at station 119+30.36 at a zero offset.

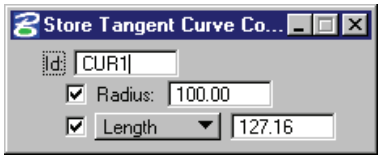


11. Select the **Locate Point** option and locate point D1011 at the bearing and distance shown below.

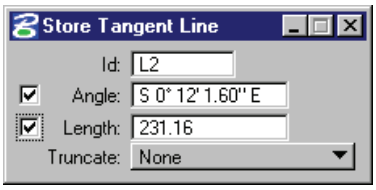
Bearing	S 72 39 19.69 W
Distance	17.29



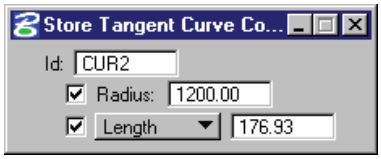
12. Use the **Store Tangent Curve Constrained** tool to place a curve using the settings below.



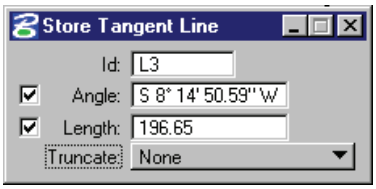
13. Select the **Store Tangent Line** tool to place a line with the bearing and distance shown below.



14. Use the **Store Tangent Curve Constrained** tool again to place a curve with the settings below.

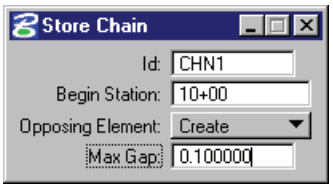


15. Finally, use the **Store Tangent Line** tool to place a line with the bearing and distance shown below.

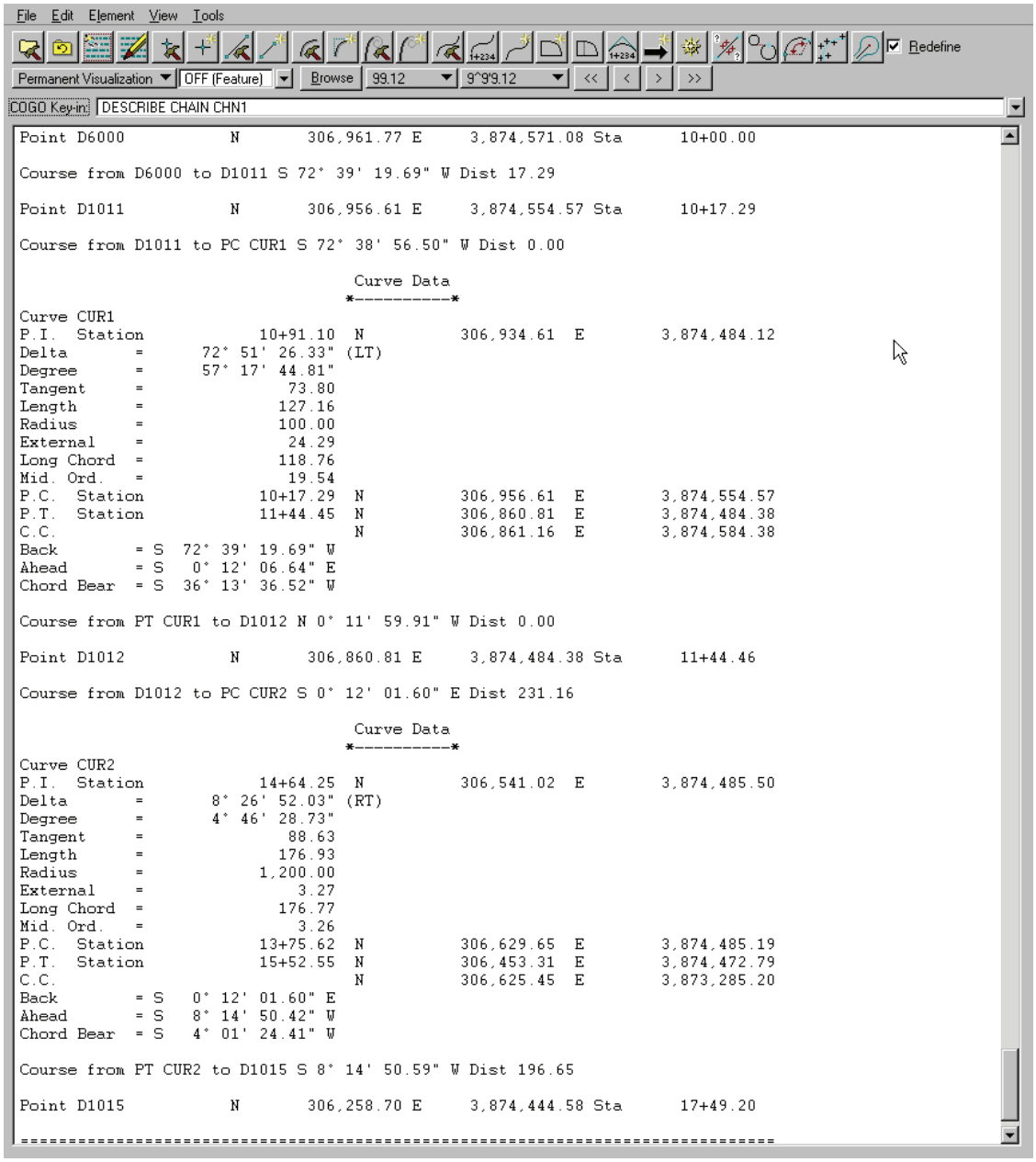


16. Now that all of the points, curves and lines have been stored we will store the chain in coordinate geometry. From the **Graphical COGO** tool box click the **Store Chain** tool.

17. Store the chain using the information shown below.



18. You should now have a chain matching the description below. Describe the chain and compare to the report.




```
Point D6000           N       306,961.77 E     3,874,571.08 Sta      10+00.00

Course from D6000 to D1011 S 72° 39' 19.69" W Dist 17.29

Point D1011           N       306,956.61 E     3,874,554.57 Sta      10+17.29

Course from D1011 to PC CUR1 S 72° 38' 56.50" W Dist 0.00

                                Curve Data
                               *----------*
Curve CUR1
P.I.  Station            10+91.10  N          306,934.61  E        3,874,484.12
Delta        =      72° 51' 26.33" (LT)
Degree       =      57° 17' 44.81"
Tangent      =               73.80
Length       =              127.16
Radius       =              100.00
External     =               24.29
Long Chord   =              118.76
Mid. Ord.    =               19.54
P.C.  Station            10+17.29  N          306,956.61  E        3,874,554.57
P.T.  Station            11+44.45  N          306,860.81  E        3,874,484.38
C.C.                               N          306,861.16  E        3,874,584.38
Back         = S  72° 39' 19.69" W
Ahead        = S   0° 12' 06.64" E
Chord Bear   = S  36° 13' 36.52" W

Course from PT CUR1 to D1012 N 0° 11' 59.91" W Dist 0.00

Point D1012           N       306,860.81 E     3,874,484.38 Sta      11+44.46

Course from D1012 to PC CUR2 S 0° 12' 01.60" E Dist 231.16

                                Curve Data
                               *----------*
Curve CUR2
P.I.  Station            14+64.25  N          306,541.02  E        3,874,485.50
Delta        =       8° 26' 52.03" (RT)
Degree       =       4° 46' 28.73"
Tangent      =               88.63
Length       =              176.93
Radius       =            1,200.00
External     =                3.27
Long Chord   =              176.77
Mid. Ord.    =                3.26
P.C.  Station            13+75.62  N          306,629.65  E        3,874,485.19
P.T.  Station            15+52.55  N          306,453.31  E        3,874,472.79
C.C.                               N          306,625.45  E        3,873,285.20
Back         = S   0° 12' 01.60" E
Ahead        = S   8° 14' 50.42" W
Chord Bear   = S   4° 01' 24.41" W

Course from PT CUR2 to D1015 S 8° 14' 50.59" W Dist 196.65

Point D1015           N       306,258.70 E     3,874,444.58 Sta      17+49.20

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```

HORIZONTAL ALIGNMENT GENERATOR

INTRODUCTION

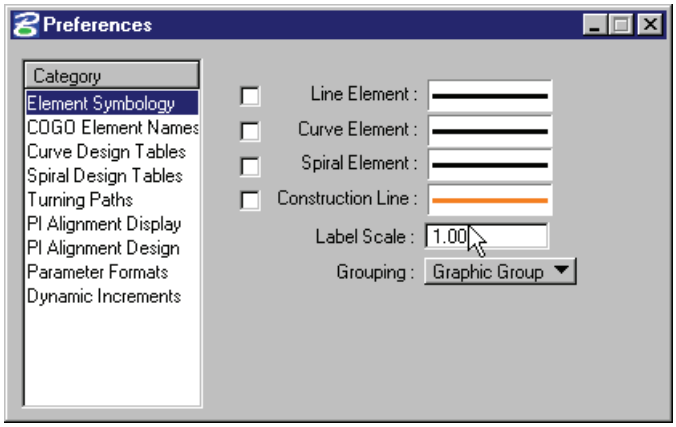
The **Horizontal Layout** tools enable the user to create or modify horizontal geometry (using numerous tools) including placing spirals, curves, tapers, specified bearings and curves, complex ramp loops and connectors, and all using user-defined parameters.

Note A session of COGO must be active.

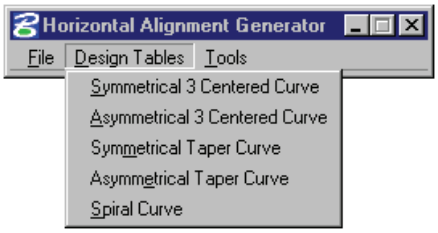
ACCESSING

Clicking **Horizontal Alignment** from the Road Project: Road1.prj dialog within Project Manager opens the tool frame shown below.

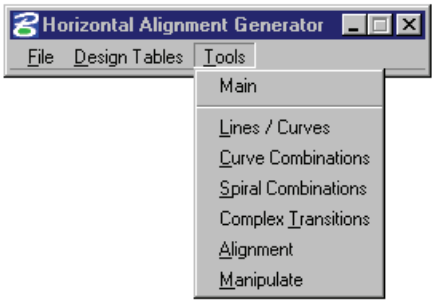
When **File > Preferences** is selected, the Preferences dialog appears and allows the user to set certain preferences.



The **Design Tables** option allows the user to set up design tables for Symmetrical 3 Centered Curves, Asymmetrical 3 Centered Curves, Symmetrical Taper Curves, Asymmetrical Taper Curves, and Spiral Curves. These files are stored in an ASCII format.



The **Tools** option allows the user to open the Main dialog or any of the dialogs needed to store a horizontal alignment.



Values within the dialogs dynamically change simultaneously with dynamic graphic modifications.

Note Spiral and compound curve commands do not support dynamic manipulation.

LINES / CURVES TOOLS

The **Lines / Curves** commands are detailed in the following table.

	**Store Line By 2 Points** The store line by two points command generates two new points and a new line. The command draws the line and the new points.
	**Store Tangent Line** The Store Tangent Line tool stores a line and its two endpoints in the coordinate geometry database.
	**Store Curve By 3 Points** The Store Circular Curve by Three Points tool stores a circular curve (using chord definition).
	**Store Curve By Center** This tool enables the user to store a circular curve by defining the center point, radius, and sweep angle.
	**Store Tangent Curve Unconstrained** The Store an Unconstrained Tangent Curve tool places a curve through a specified point tangent to the specified curve or line.
	**Place Simple Curve** This tool enables the user to store a circular curve. Options include offsets, truncate,

	and the ability to modify once the first curve is displayed.
	**Place Simple Transition** This tool enables the user to draw a transition element between two arcs. Options for the Transition element include: Tangent, Curve, or Spiral. As the Transition option is changed, the dialog dynamically changes to reflect the selection.

CURVE COMBINATIONS TOOLS

The **Curve Combinations** commands are detailed in the following table.

	**Place Turning Paths** This tool enables the user to draw turning paths.
	**Place Compound Curves** This tool enables the user to draw a compound curve between two elements.
	**Place Three Centered Curves** This tool enables the user to draw a three-centered curve between two elements. The Design Vehicles group enables the user to select the desired vehicle, based on the data from files stored in the User Preferences.
	**Place Taper Curves** This tool enables the user to draw taper curves between two elements. The Design Vehicles group enables the user to select the desired vehicle, based on the data from files stored in the User Preferences.
	**Place Reverse Curves** This tool enables the user to store reverse curves between two elements. An option is supported for an intermediate user-defined Tangent Length.

SPIRAL COMBINATIONS TOOLS

	**Place SC Tangent To Line** This tool enables the user to store a spiral / curve combination tangent to a line.
	**Place ST Tangent To Curve** This tool enables the user to store a spiral / tangent combination tangent to a curve.
	**Place SC Tangent To Curve** This tool enables the user to store a compound spiral / curve combination tangent to a curve.
	**Place SCS (Intersecting Elements)** This tool enables the user to store a spiral / curve combination tangent to a line. The Design Table enables the user to select the desired Design Speed / Lanes and Degree based on the data from files stored in the User Preferences.
	**Place STS (Disjoint Curves)** This tool enables the user to store a spiral tangent spiral combination tangent between two elements.

Place SCS (Disjoint Curves)
This tool stores a spiral curve spiral combination between two curves. Note the tool also works with overlapping curves. The Design Table enables the user to select the desired Design Speed / Lanes and Degree or Radius based on the data from files stored in the User Preferences.

COMPLEX TRANSITIONS TOOLS

Place Complex Ramp
This versatile tool enables the user to draw simple to complex ramp geometry.

Place Ramp Connector
This versatile tool enables the user to draw simple to complex ramp connectors, with a variety of options.

ALIGNMENT TOOLS

Place Dynamic Alignment
The first Alignment tool is used to place a dynamic alignment. You initially select and accept a beginning element. By moving the cursor, the length of curve and dynamic ahead element change. Continue placing data points to create curves and intermediate tangents. At any time during the process, the Entry Radius may be changed. Any subsequent curves are placed with the revised Radius.

Place PI Alignment
The second Alignment tool is used to place a PI based alignment.

Store Chain
The third Alignment tool is used to store a chain comprised of graphical elements. This works similar to Automatic Create Complex Chain, while the chains are automatically being stored into the COGO database file.

MANIPULATE TOOLS

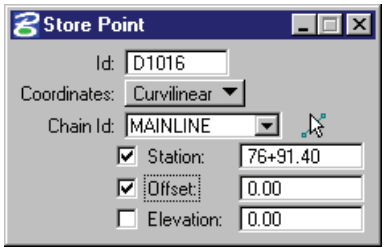
	**Move Plan View Element** The Move a Plan View Element enables the user to move / translate an element or to make copies.
	**Rotate Plan View Element** The Rotate Plan View Element rotates the selected element about a user-defined point. The Angle may be manually entered and locked, or dynamically changed.
	**Extend Plan View Element** The Extend Plan View Element tool can extend or shorten any element.
	**Delete Element** When using the Delete Element tool, no tool settings dialog opens. Select and accept the element to be deleted. The element is removed from the coordinate geometry database. This tool works with a MicroStation selection set if present. Warning: there is no undo for this command.

LAB EXERCISE: GRAPHICAL COGO & HORIZONTAL ALIGNMENT GENERATOR

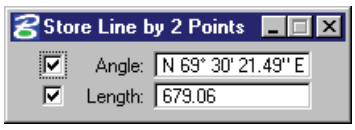
> *STORING AN ALIGNMENT*

1. Open the MicroStation file *c:\data\geo\vdot\road2\60843\alignments.dgn.*
2. Attach the saved view *ALIGN2*.
3. Access **Project Manager** and open the project *60843*. (Select the user *Mary* to access)
4. Access **Graphical COGO** and the **Horizontal Alignment Generator**.
5. Begin by locating point D1016 at station 76+91.40 on the MAINLNE at a zero offset.

Note Use **Graphical COGO** to locate the point



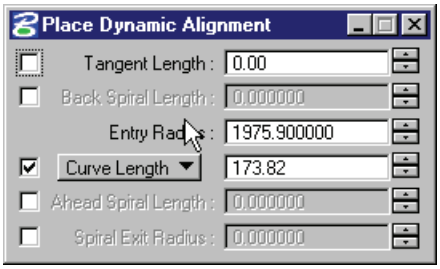
6. Next from the **Horizontal Alignment** tools select the option **Store Line by 2 Points** and enter the information shown below. The beginning point will be point D1016 that we previously stored.



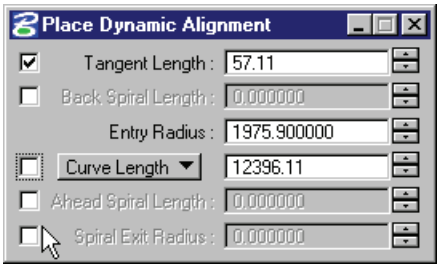
7. Once the line has been placed select the tool to place a **Dynamic Alignment** from the **Alignments** tool bar. ***Horizontal Alignment > Tools > Alignment***

8. Begin by data pointing on the tangent line we drew in the previous step.

9. Enter the information into dialog to control the placement of the alignment.



10. Data point again to store the curve.
11. Now enter the tangent length to place the final tangent line.

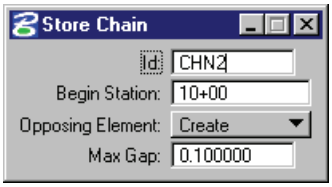


12. Data point to place the tangent.
13. Right click the mouse to exit the alignment.

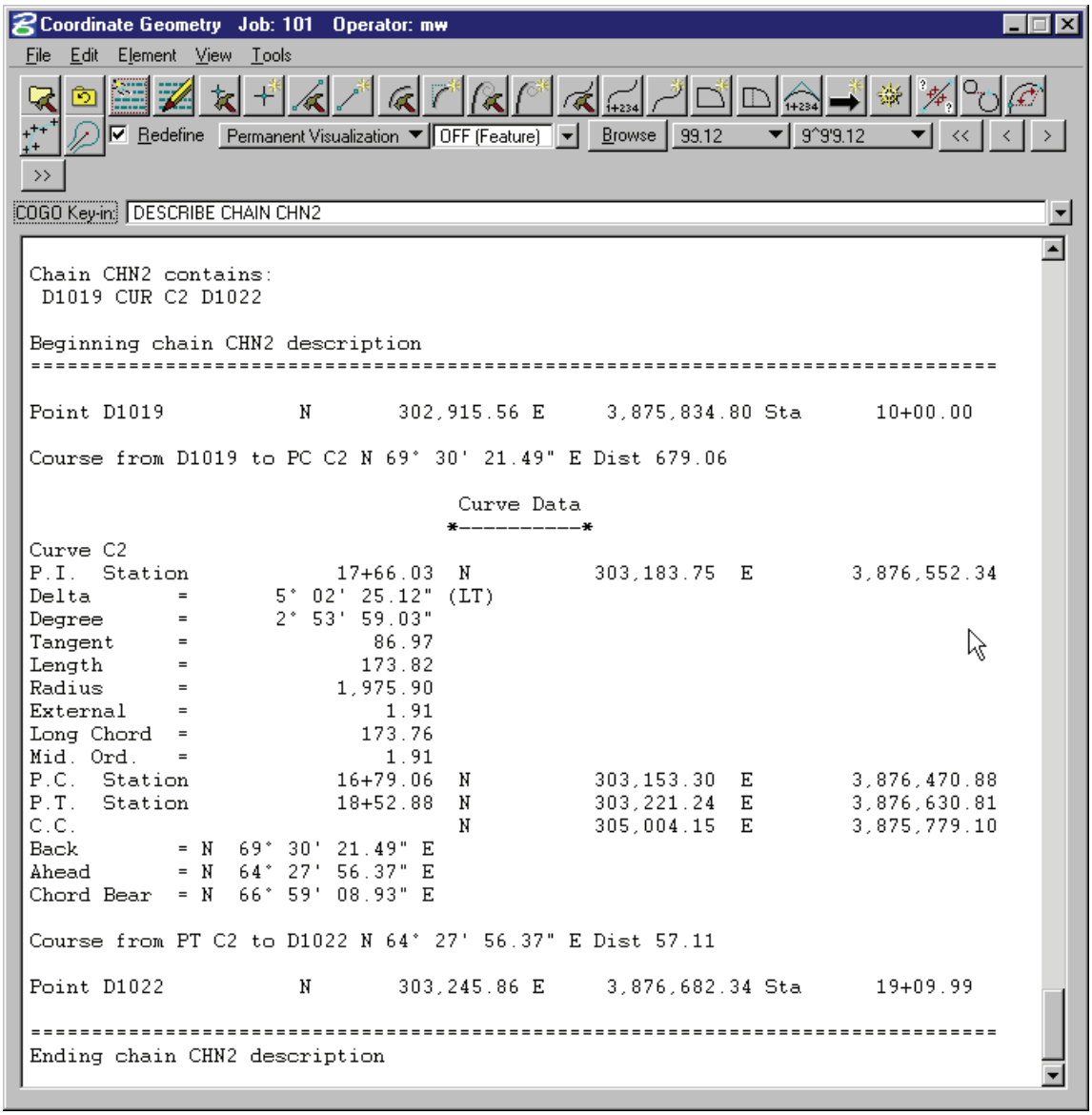
> *STORING THE ALIGNMENT*

1. Select the **Store Chain** tool from the **Alignments** tool bar.

2. Enter the information below and then data point on the alignment to store the chain in coordinate geometry.

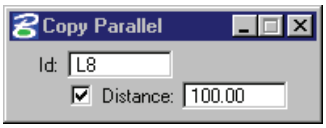


3. Review the chain description in coordinate geometry.



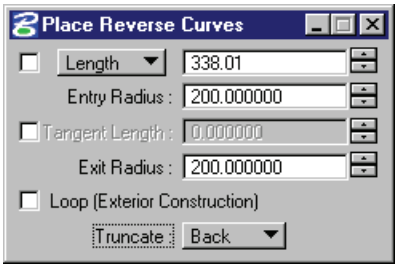
> *REVERSE CURVES*

1. Select the **Copy Parallel** tool from the **Graphical COGO** tool bar and copy the tangent portion of CHN2 100' to the left side.



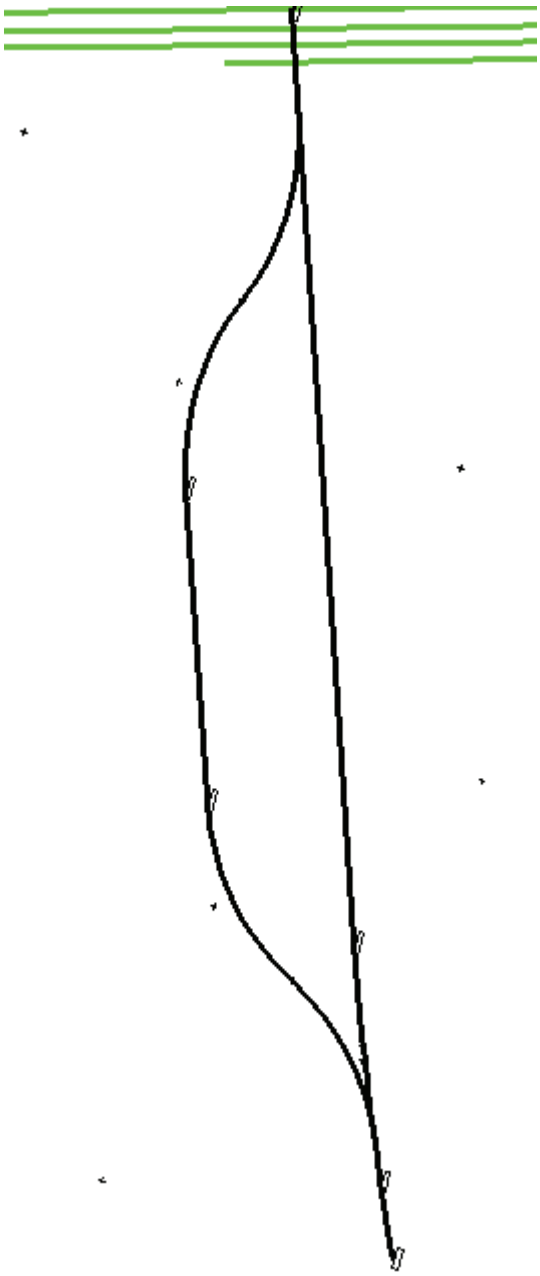
2. Next select the **Place Reverse Curves** from the **Curve Combinations** tool bar.

3. Enter the radius information in the dialog shown below and select the 2 tangent lines. Be sure to truncate the correct tangent.

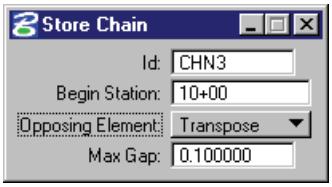


4. Change the truncate option to **Ahead** and repeat the process tying into the curve on the original alignment *CHN2*.

5. You should end up with a detour similar to the one shown below.

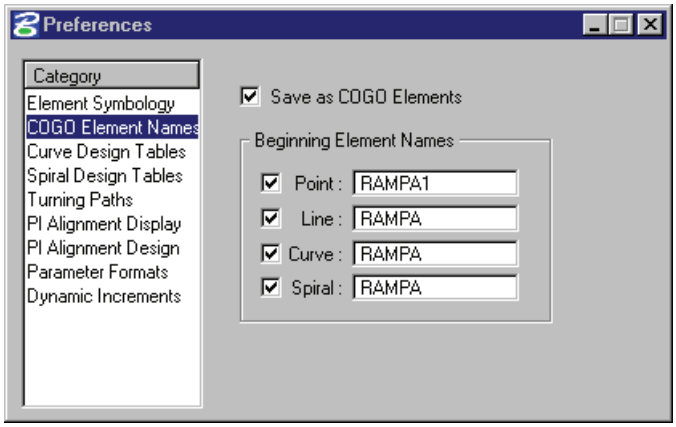


6. Use the **Store Chain** tool to store the chain into coordinate geometry.



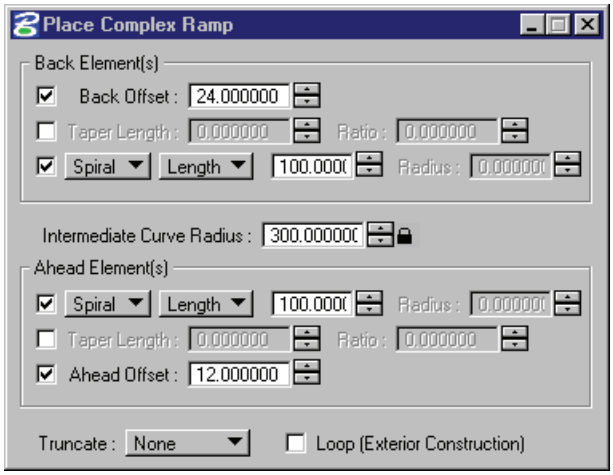
> *COMPLEX TRANSITIONS*

1. From the MicroStation dropdown menu select **Utilities > Saved Views**.
2. Select *ALIGN3* then click **Apply**.
3. Dismiss the Saved Views dialog by clicking the **X** in the upper right corner.
4. Select the **Preference** pulldown and set the Element Names as shown below.

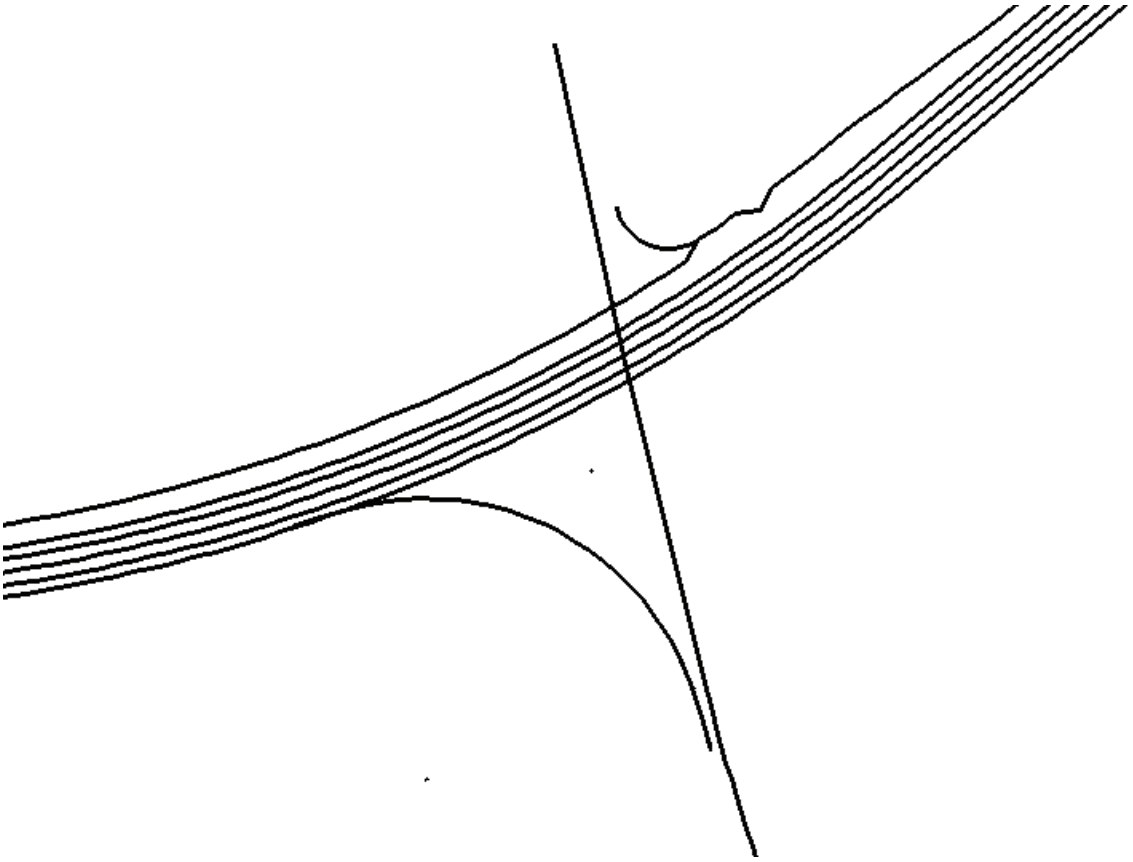


5. Select the **Tools > Complex Transitions** pulldown to access the following menu bar.

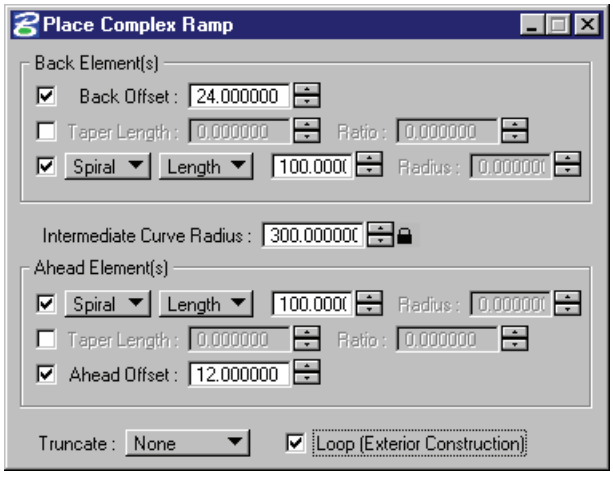
6. Select the first of the two icons to access the Place Complex Ramp dialog. Populate the dialog as shown below.



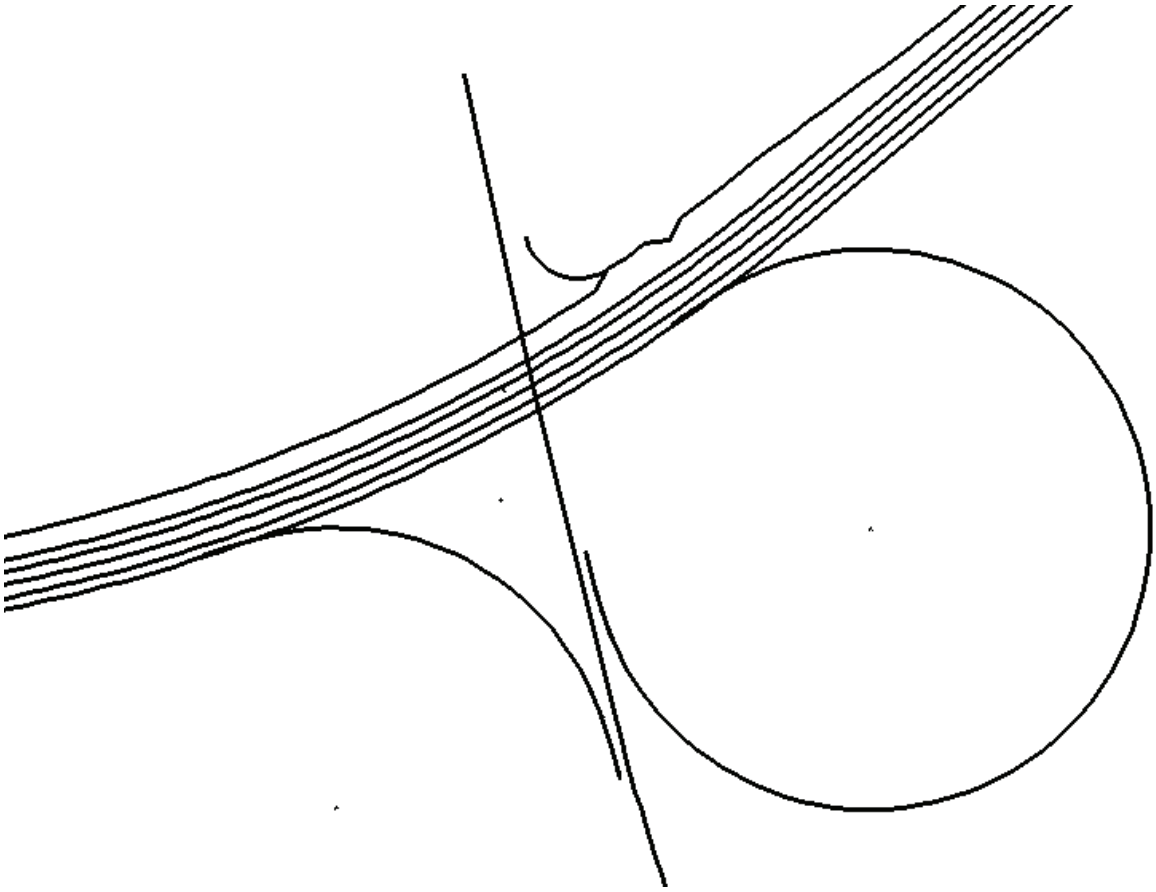
7. Use your cursor to ID chain **MAINLINE** with a datapoint, then issue another datapoint to accept it.
8. Next, use your cursor again to ID chain **WOLFTRAP** with a datapoint. The ramp will now dynamically visualize.
9. Issue a datapoint in the southwest quadrant to store the ramp as shown in the following diagram.



10. Change the toggle on the dialog to **Loop (Exterior Construction)**.



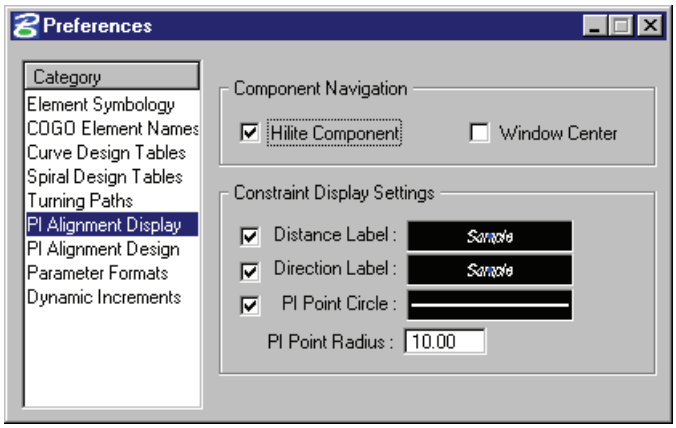
11. Using the technique in the previous steps place the loop in the SE quadrant of the intersection.



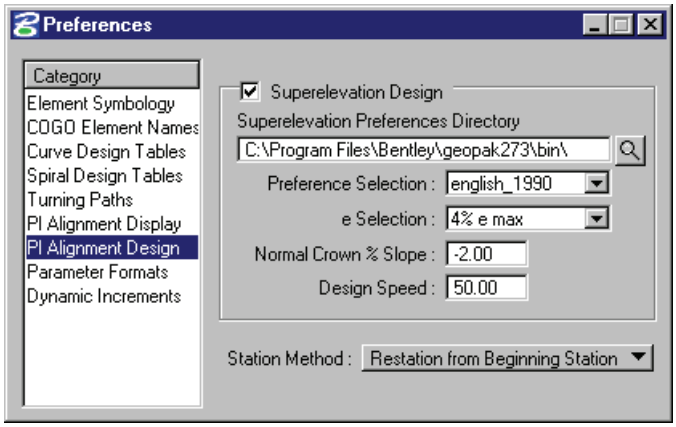
12. Close the Complex Transitions dialog.

> *PI ALIGNMENT TOOL*

1. Attached the saved view *ALIGN4*.
2. Select **File > Preferences** form the main **Horizontal Alignment** tool bar.
3. Set the preferences for **PI Alignment Display**.

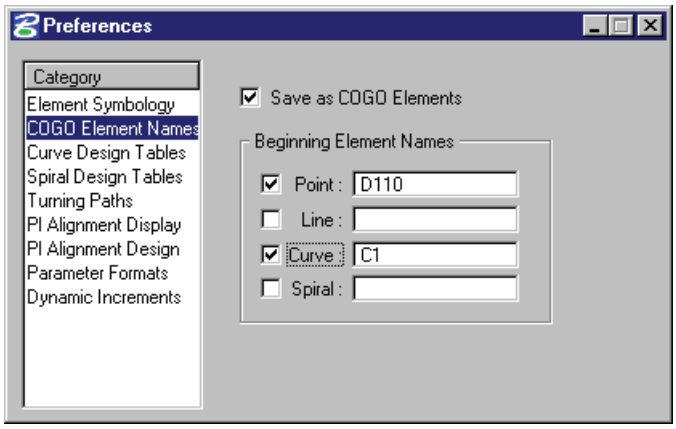


4. Next make the following settings for the **PI Alignment Design**.



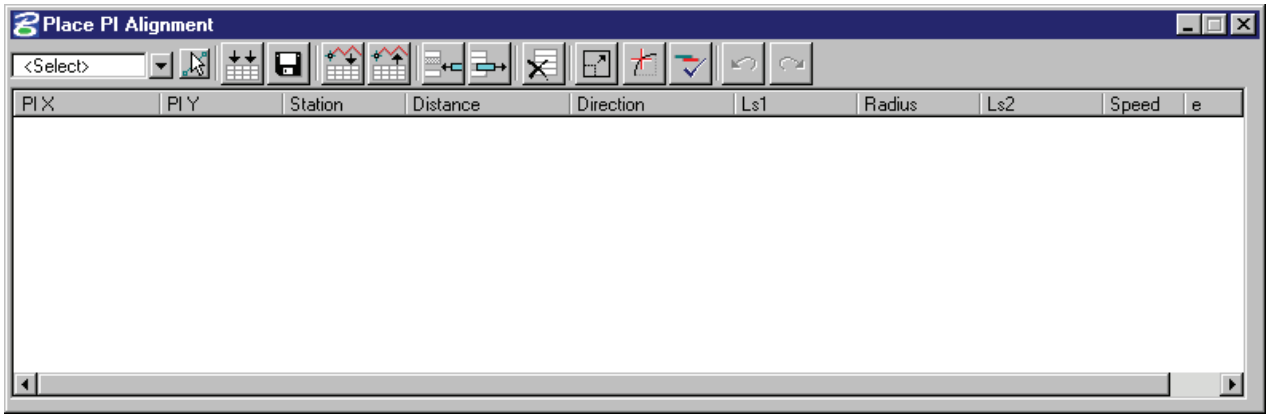
Note The path to the Superelevation Preference Directory may vary depending on location of superelevation preferences.

5. Change the COGO Element Names to match the dialog below.

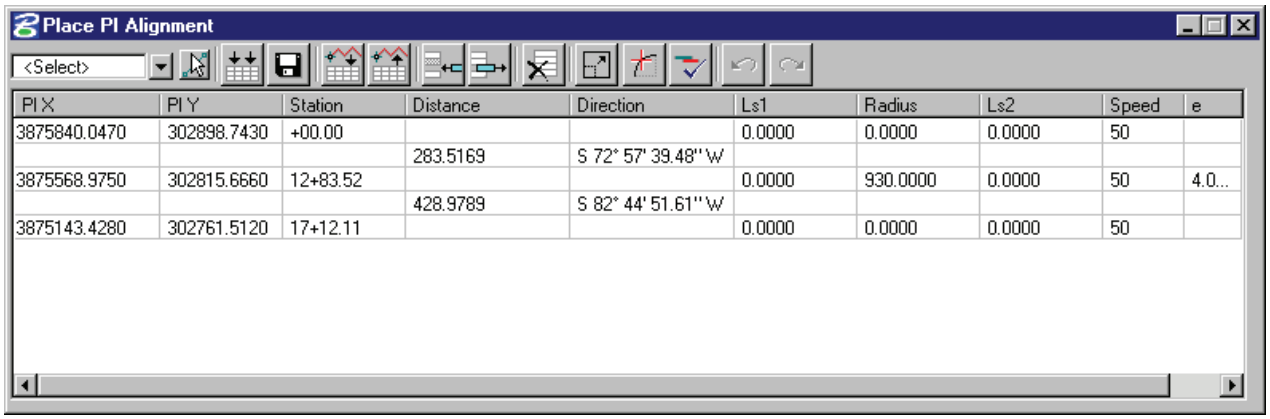


6. Close the Preference dialog.
7. From the **Tools** pulldown select the **Alignment** tool.

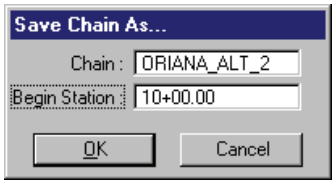
8. Click the middle icon to open the **PI Alignment** tool.



9. Click the icon to **Load Graphic Element To Table**.
10. Data point on graphic and follow prompts to load.
11. This will place the geometry into the table for editing.



12. Click on the curve radius and change it to 1000’.
13. Click on the icon to save the alignment and key in the information below.



14. Click **OK**.
15. Exit MicroStation.

2 Coordinate Geometry

CHAPTER OBJECTIVES

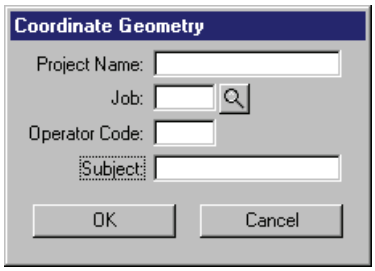
In this chapter, you will create and store parcel data using **Parcel Editor in COGO** as well as **Graphical Coordinate Geometry** tools.

INTRODUCTION

The Coordinate Geometry database file (*.GPK file) is comprised of stored geometric elements such as points, lines, curves, spirals, chains, parcels and profiles. When COGO calculations are completed, the results are stored in the binary database file, which is then utilized throughout the design process with many other applications.

ACCESSING COGO

When **Coordinate Geometry** is started, the Start-Up dialog appears.



Project Name	Name displayed on reports. This is an optional entry, with a maximum of 60 alphanumeric characters. If Project Manager is active, this field is populated automatically.
Job Number	Identifies coordinate geometry database file and is a required field. The job number is a maximum of three alphanumeric characters. If Project Manager is active, this field populated automatically. This field is required.
Operator Code	Unique 2-character code which enables multiple users access to database file. The user's initials are suggested. Note this field is not required for single user access, but highly recommended. If Project Manager is active, this field is populated automatically.
Subject	Description of coordinate geometry work (could relate to the project) with a maximum of 48 alphanumeric characters. This field is optional.

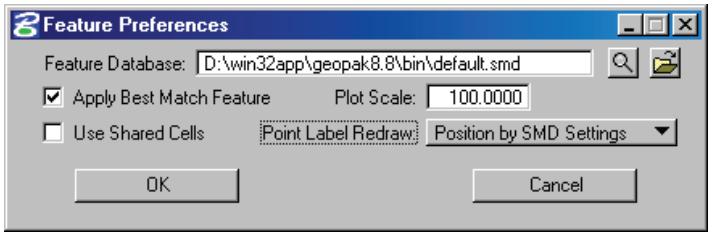
After the dialog is populated and **OK** is clicked, the main coordinate geometry dialog is invoked.

Note If Project Manager is open the COGO login dialog will not appear.

COORDINATE GEOMETRY PREFERENCES

Two options have been enhanced on the Feature Preference portion of Coordinate Geometry. The preference dialog is now made up of four optional settings in addition to the smd selection. This dialog can be accessed from **Applications > GEOPAK Road > User Preferences**. The options include:

- Apply Best Match feature
- Use Shared Cells
- Plot Scale
- Point Label Redraw



The options for **Use Shared Cells** and **Point Label Redraw** add new functionality and control over how features are displayed when storing or re-visualizing in COGO.

Using the **Use Shared Cells** option will place features identified by cells by using the shared cell functionality of MicroStation.

The first time you place a cell with **Use Shared Cells** on, the shared cell definition (elements comprising the cell) is stored in the DGN file in much the same way as it is stored in the cell library. To place subsequent instances of the shared cell, the cell library does not need to be attached. In other words, a shared cell can have many instances in a DGN but only one definition.

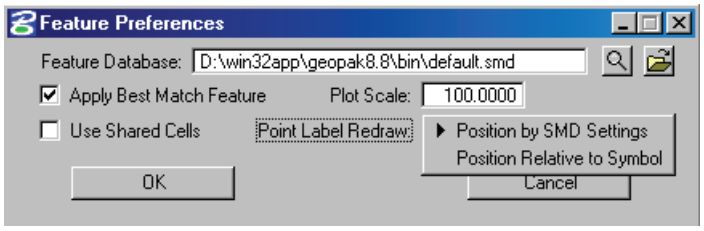
For an unshared cell, on the other hand, the library definition is stored in the DGN file each time the cell is placed. Using shared cells can therefore be a way to reduce DGN file size. The reduction is greatest in files with cells that have a large number of component elements and/or instances.

The use of shared cells is recommended for these reasons:

- Shared cells are faster to place and manipulate than unshared cells. The first time a cell is placed in the DGN file, the cell library in which it is stored must be attached. If the cell is placed as a shared cell, it is not necessary to have the cell library attached to place additional instances of that cell.
- All instances of a shared cell in the DGN file are replaced when any instance of that shared cell is replaced.
- Shared cells usually reduce DGN file size, thereby improving performance.

POINT LABEL REDRAW

The **Pont Label Redraw** option that has been added to the user preferences allows control over how point labels are displayed in relation to a point symbol when visualized or redrawn.

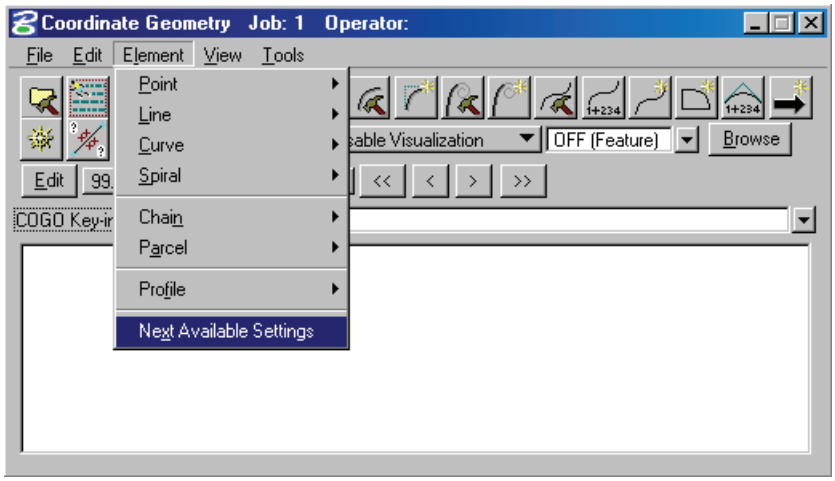


Position by SMD Settings - the label is drawn with parameters defined within the specified survey database (SMD) when the map is redrawn.

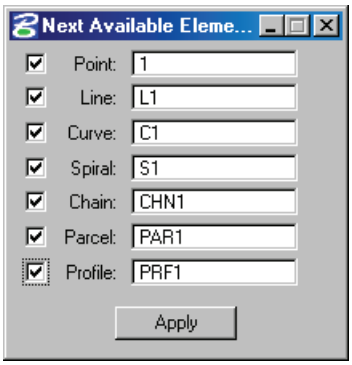
Position relative to symbol – the user can move the point name, elevation, etc. using MicroStation tools and if the data is remapped the labels will retain their same position relative to the point symbol at the new mapped position.

NEXT AVAILABLE ELEMENT

In the main COGO dialog there is now an option to provide user input for the next available element names. This is located under the Element pulldown.

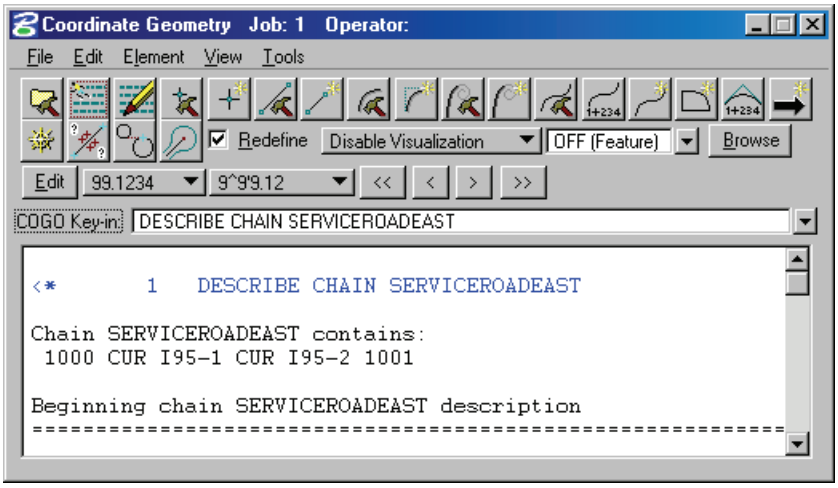


Once accessed the following dialog appears allowing the user to key-in the desired names to begin storing COGO elements.



EXPANDED ELEMENT NAMES

A major enhancement to the coordinate geometry database is the ability to accept expanded element names. Each element type in coordinate geometry will now accept up to 15 characters for the associated name.



This standardization includes all elements that can be stored in coordinate geometry and applies across all dialogs.

RENAME ELEMENTS

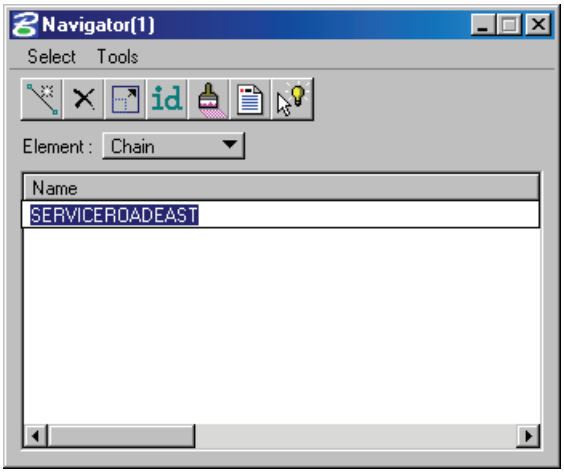
A new command has been added to facilitate renaming of COGO elements. The command structure is listed below.

RENAME element type oldname newname

Example: RENAME CURVE a12 a13

> ***Note*** The RENAME operation may be done inside Navigator as an in-place edit operation to the name column.

When renaming an element inside COGO Navigator it is simply a matter of clicking on the desired element name and keying in a new name.



CHANGE ELEMENT

Similar to the rename command new functionality has been added in order to change elements within COGO. The command structure is listed below.

CHANGE elementType elementName parameterName parameterValue

Examples:

CHANGE POINT name X newValue

CHANGE POINT name Y newValue

CHANGE POINT name Z newValue

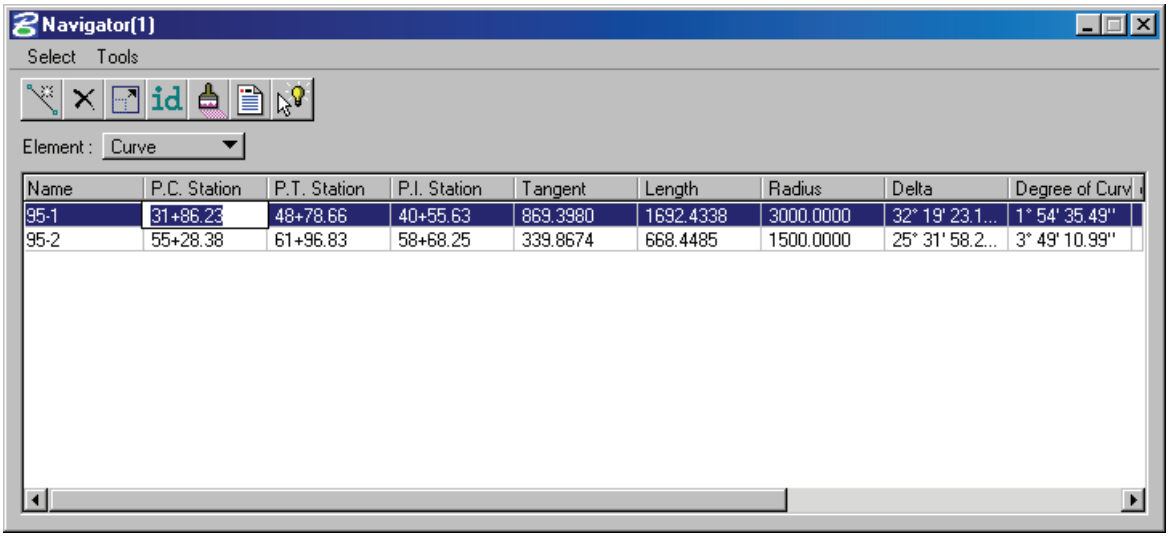
CHANGE POINT name FEATURE newValue

CHANGE POINT name DESCRIPTION newValue

CHANGE POINT name STATION newValue

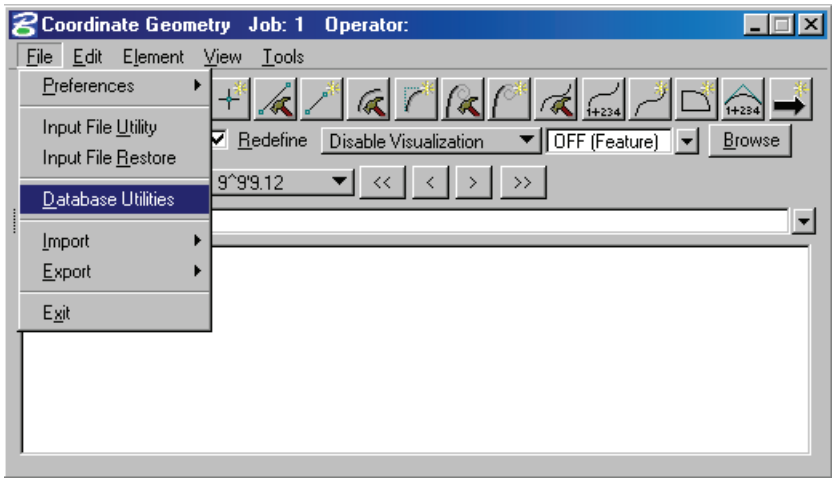
> ***Note*** The CHANGE operation may be done inside Navigator as an in-place edit operation to the appropriate column.

When changing an element inside COGO Navigator it is simply a matter of clicking on the desired filed in the desired column and providing the desired change.

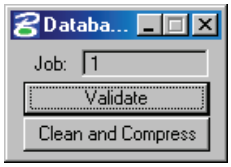


DATABASE UTILITIES

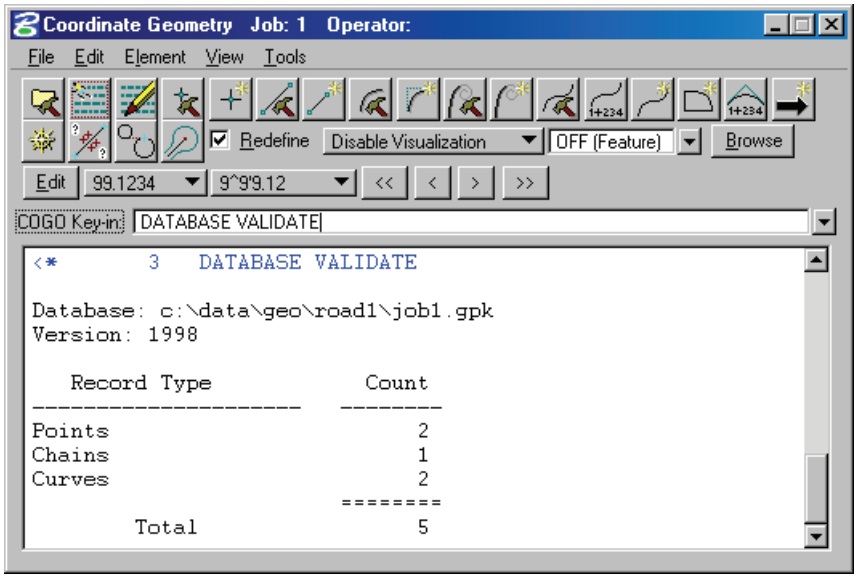
New database utilities have been provided in order to make it easier to validate, clean and compress the gpk file. These tools can be accessed from the File pulldown on the main Coordinate Geometry dialog.



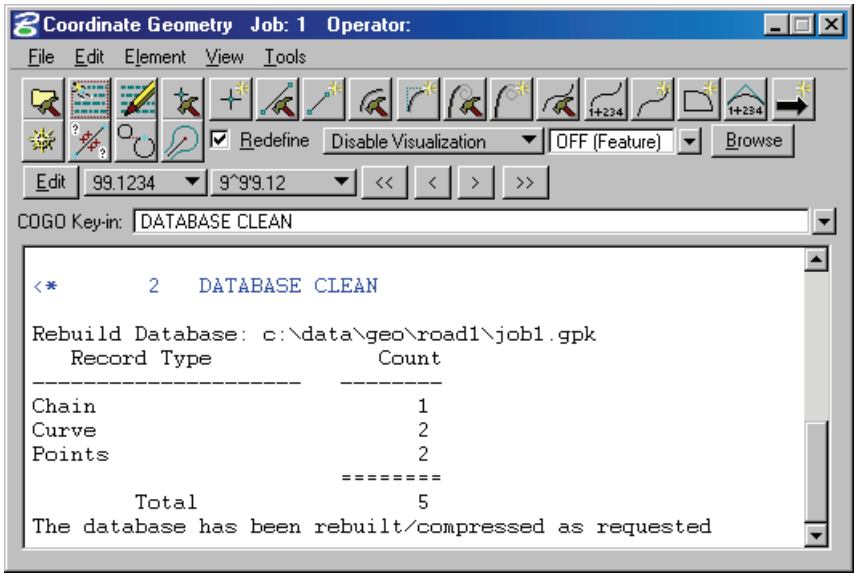
When accessed, the following dialog will appear that contains a field for the job number and two buttons that will perform the desired operation.



Validate – Looks for problems and errors in the GPK database and reports findings. Does not attempt to clean or compress the database.



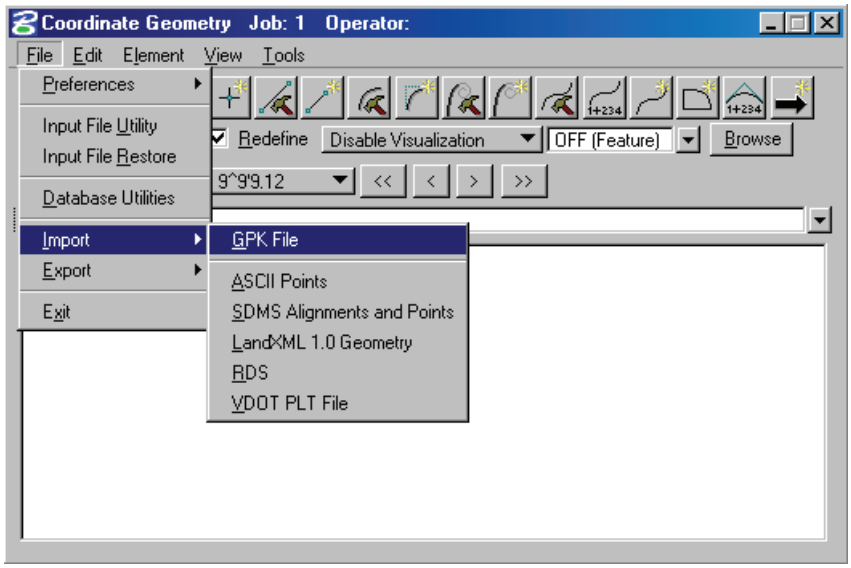
Clean and Compress – Rebuilds and compresses the GPK database.



Both of these commands work similar to the previous key-in of ***Rebuild Database***.

MERGE DATABASE

Another valuable tool that has been added to coordinate geometry is the ability to merge another gpk into the existing one. This option is located under the File > Import pulldown.



The subsequent dialog will allow the selection of a secondary gpk database to import directly into the open gpk.

Note If REDEFINE is turned off there will be no risk of overwriting elements in the open gpk.

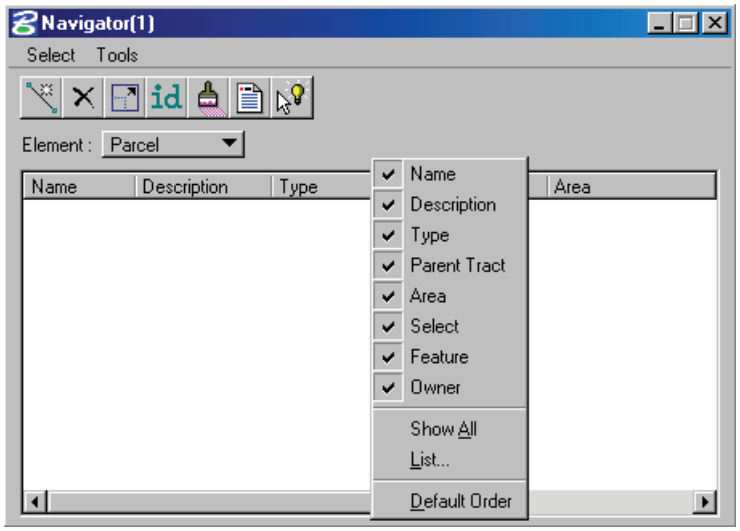
NAVIGATOR

Many new options and functionalities have been added to the coordinate geometry navigator. These include:

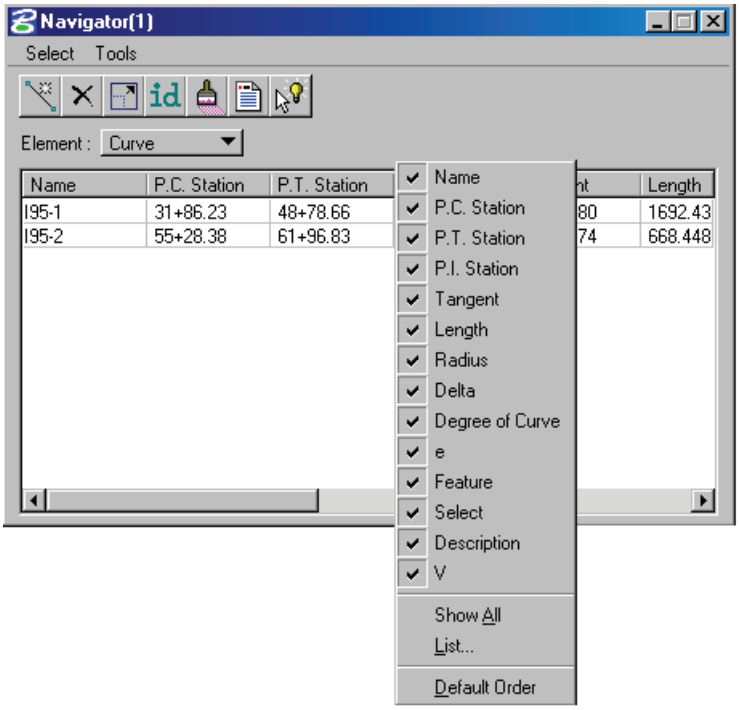
- User Defined Column Headers
- In-Place Editing
- Export Preferences
- Import Preferences
- Row Selection

USER DEFINED COLUMNS

User defined column headers allow the user to customize the types of column the navigator displays. By right clicking on the column headers a list is provided that controls what is displayed. The list of available headers is dictated by the toggle for element type. For example when the element type is set to Parcel then the header options are parcel specific.



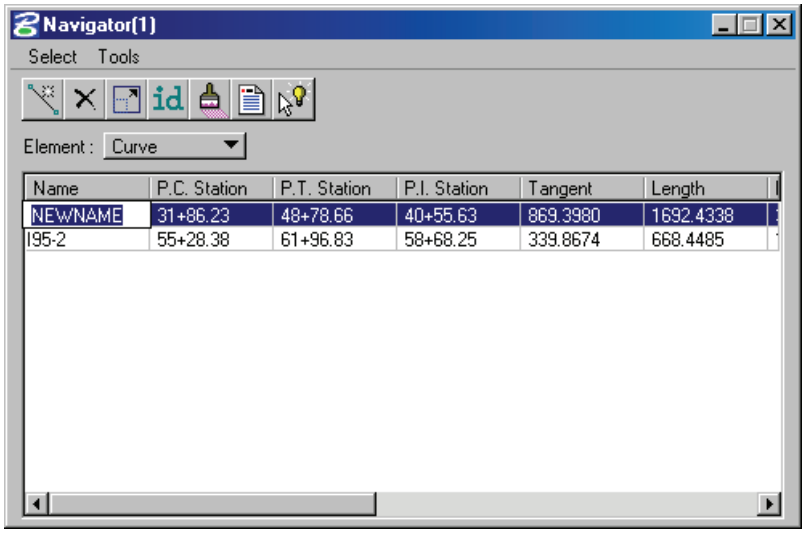
When the element toggle is set to curves, likewise all header options are curve related.



Columns may be moved in the display by selecting the column and sliding to the location on the dialog where it is preferred.

IN-PLACE EDITING

All of the options in the Navigator will now support In-Place editing of values. This just requires a simple click on the value to be changed and then keying in the desired change. In the case of a curve name you click on the existing curve name and simply type over with the new name.

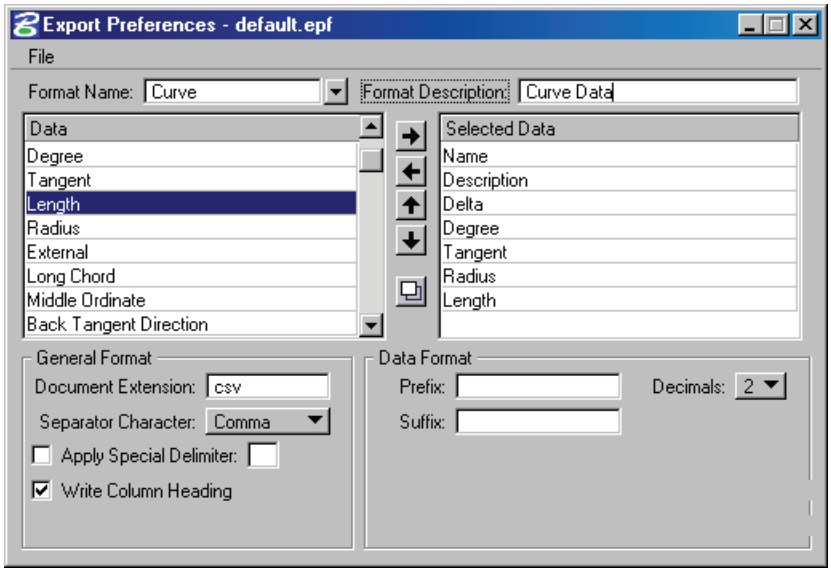


EXPORT PREFERENCES AND SETTINGS

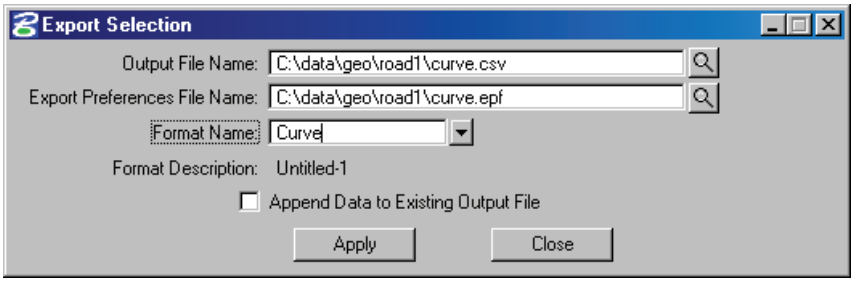
In order to save preferences of navigator, two new options have been added to the Tools pulldown. These are **Export Preference**s and **Export Settings**.

Export Preferences - allows the user to create and save a user defined preference file for exporting data to a csv file. The desired item in the Data column is highlighted then added to the Selected Data column using the arrows in the center of the dialog. Once all the desired data has been added, a Format Name and Format Description are provided and the file can be saved.

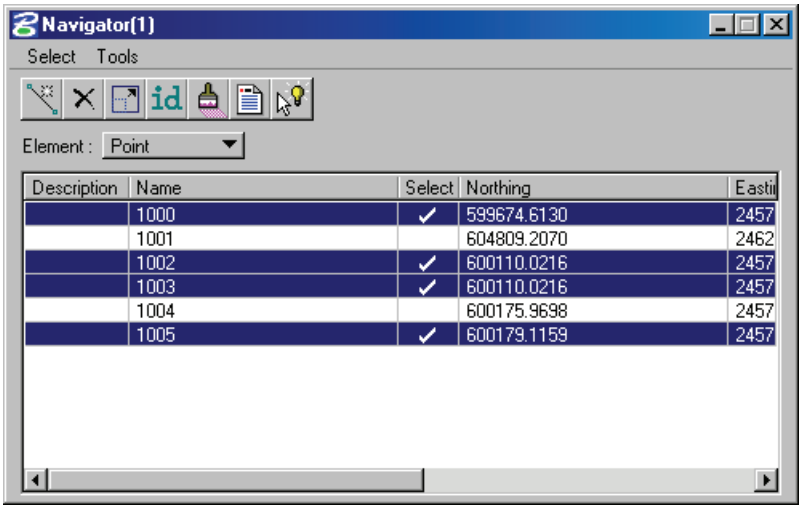
Multiple Format Names can be added to the same file to be used for selection when exporting.



Export Selection – allows exporting data using a previously defined preference file.



This option requires that the desired elements in the COGO Navigator be selected or highlighted prior to executing. Each element highlighted or selected will be exported to the selected csv file.

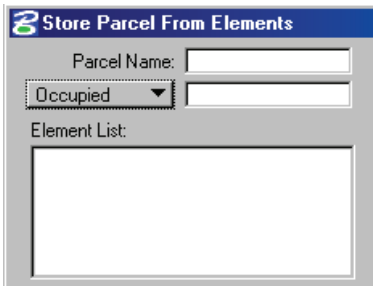


PARCELS

The parcel interface and additional attributes have been greatly enhanced with version 8.8. Enhancements include:

- Additional Occupied Type
- User Defined Attributes
- Interface Modifications

OCCUPIED TYPE



The new occupied type can be added to a parcel to represent a portion of a parcel that is set aside for something such as an inhabited area. This would then be reflected in area totals where a right-of-way taking has occurred and it overlaps a portion of a parcel designated as occupied. The resulting areas would be indicated as shown below:

Total occupied area: **59542.65531 m² = 5.95427 ha = 14.71325 a**

Occupied in taken area: **58519.61057 m² = 5.85196 ha = 14.46045 a**

Net taken area: **23754.67123 m² = 2.37547 ha = 5.86988 a**

USER DEFINED ATTRIBUTES

Functionality has been added to the parcel element type to attach user defined attributes. These can include any information that the user wishes to associate with a parcel such as address, deed books, etc.

The command line syntax for adding attributes to parcels is shown below.

Maximum attribute name length = 24 and string size = 256

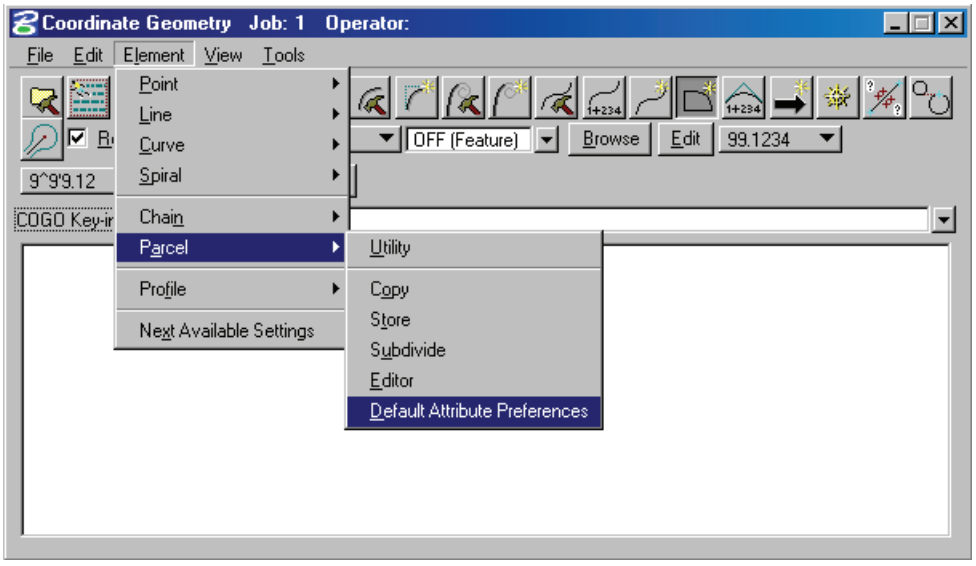
STORE ATTRIBUTE elementType elementName PARCEL parcelName NAME attributeName TYPE NUMERIC/STRING VALUE attributeValue

DELETE ATTRIBUTE elementType elementName PARCEL parcelName NAME attributeName TYPE NUMERIC/STRING

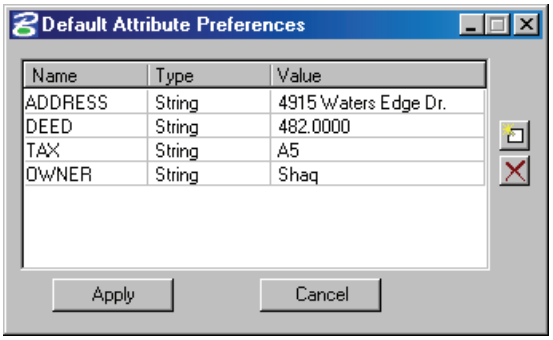
CHANGE ATTRIBUTE elementType elementName PARCEL parcelName NAME attributeName TYPE NUMERIC/STRING VALUE attributeValue

> ***Note*** The user attribute may be specified in graphic COGO and COGO's Store Parcel dialog without using the command line.

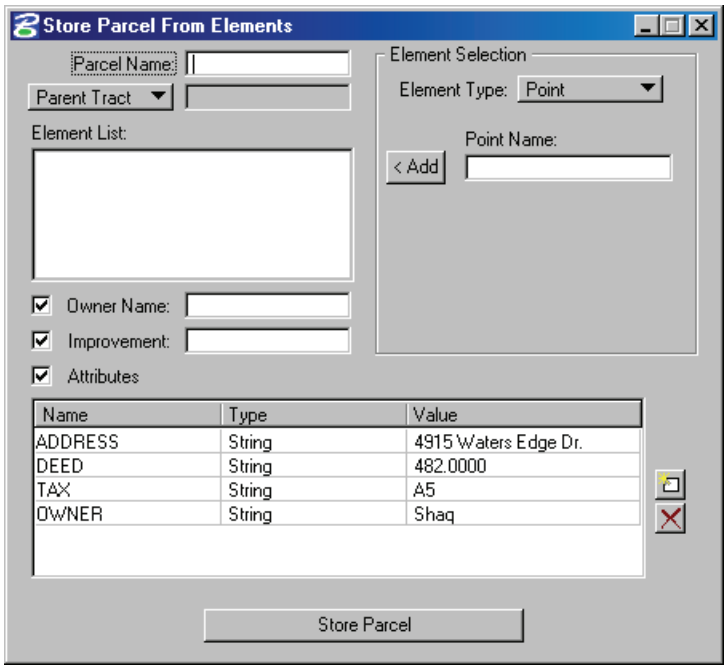
The ability to setup a list of default preferences is also available. This is accomplished by accessing the **Default Attributes Preferences** option from the Element > Parcel pulldown.



The dialog is used to compile a list of default preferences that will be displayed when storing any parcel. Values for each attribute can be changed as parcels are added to the database.

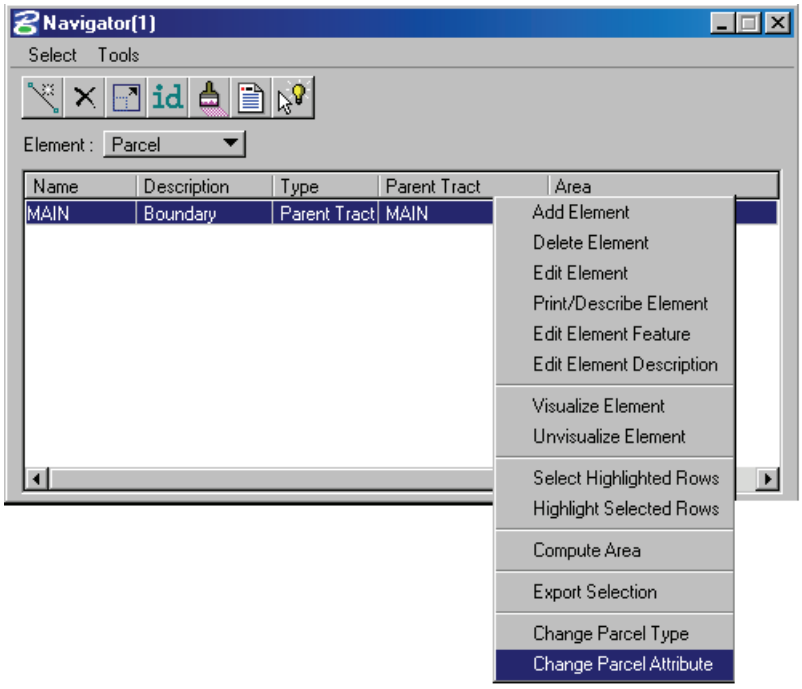


When the Store Parcel dialog is accessed the list of defaults will be displayed in the bottom.

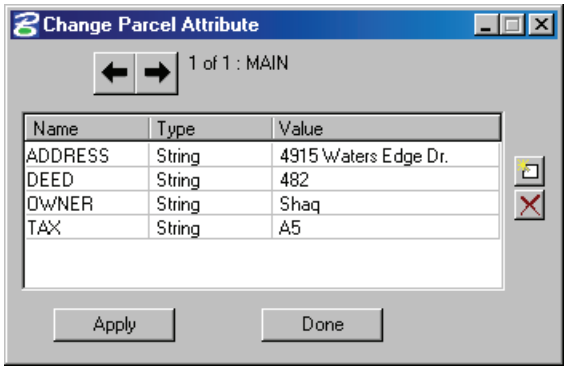


The attribute values are changed by simply clicking on any one of the three columns and providing an overriding value.

Parcel attributes can also be changed directly from the COGO Navigator. This is done by highlighting the previously stored parcel and right clicking. This action will present a menu where one option will be **Change Parcel Attribute** as shown below.

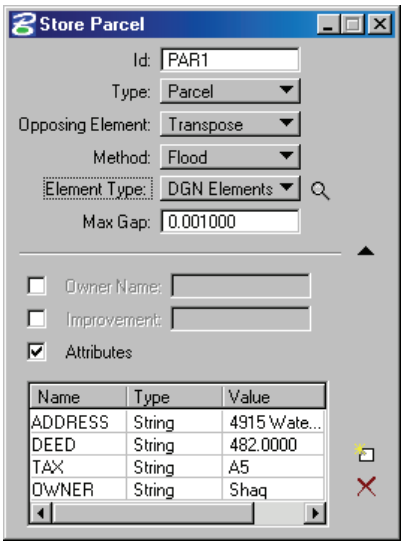


Once selected, the attribute editing dialog will appear allowing for the adding, deleting or changing of the user attributes.



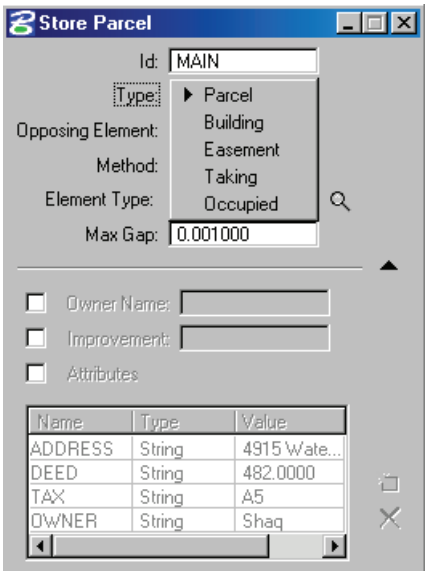
GRAPHICAL COGO

Graphical COGO also supports the addition of user defined attributes when storing graphically. This is accessed via the Store Parcel dialog as shown below.

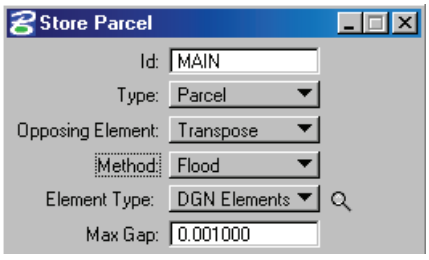


The functionality is identical to assigning the attributes in classic COGO.

The new **Occupied** type has also been added to the graphical Store Parcel dialog as shown below.

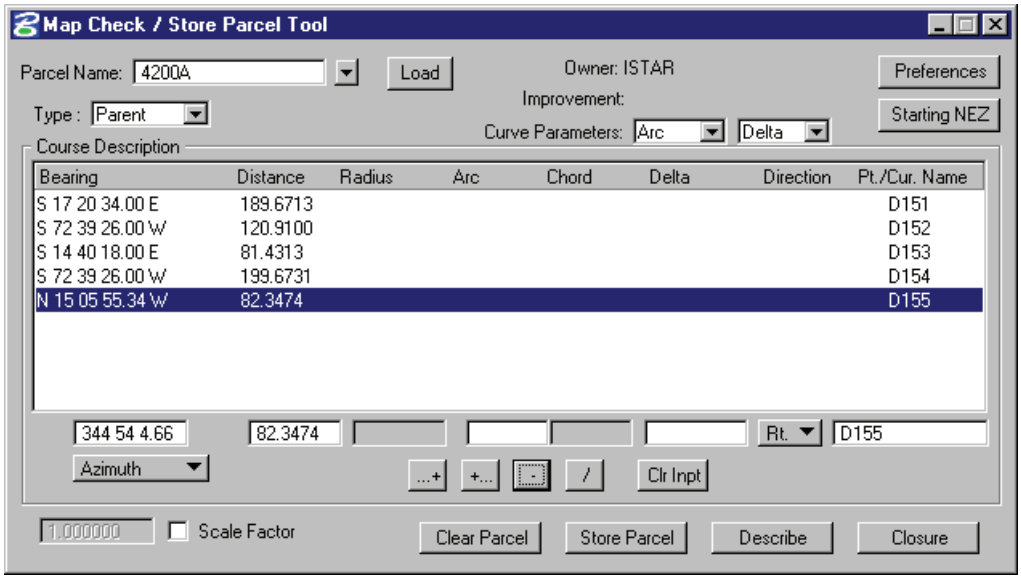


New Flood functionality has also been incorporated into the store graphical parcel dialog. This will allow the use of MicroStation's flooding capabilities for generating areas.



Map Check / Store Parcel

The Map Check/ Parcel Editor tool enables the user to store or edit parcels (based on directions, distances, and curve data), and compute closure. Parcels can be loaded from the coordinate geometry database or manually typed in. Once a parcel is complete, clicking **Store Parcel** stores or updates the parcel in the database.



The top section of the dialog has several important fields, as detailed in the table below.

Parcel Name

Key-in Combo box provides for the selection of a previously stored parcel or key in for a new parcel number.

Load

If desired, a previously stored parcel may be selected. Simply select the name from the Parcel Name list, then press the Load button. GEOPAK populates all associated data within the dialog. Regardless of how the parcel was originally stored, the two specified curve parameters at the time of loading are utilized.

Curve Parameters:Radius, Arc, Chord, Delta

Two parameters must be utilized to store curves within the parcel. Select the two desired parameters, as GEOPAK does not allow selection of the same parameter in both fields. Note: they can be changed at any time during the parcel description to enable the user to use Radius and Chord for one curve, and Delta and Arc for another.

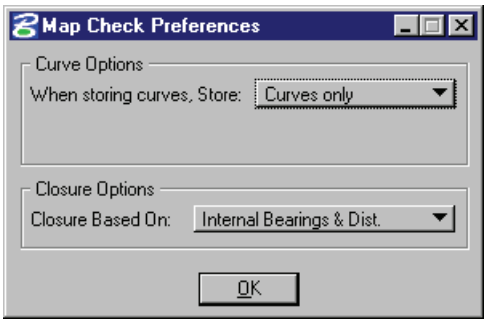
Owner:

When a previously stored parcel with attached owner is loaded, the Owner(s) are displayed. Note this is a display only field, as owners must be added within a command line in COGO.

Improvements

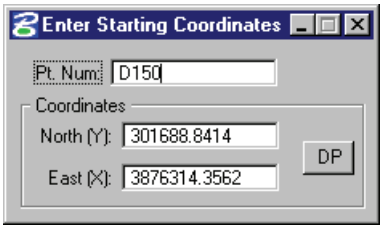
When a previously stored parcel with attached improvement is loaded, the Improvements are displayed. Note this is a display only field, as improvements must be added within a command line in COGO.

Preferences



Compute options include Curves Only or Points and curves. When points are included, a Starting Point number is required. Closure options include Internal Bearing and Distance or Displayed Bearings an Distance.

Starting NEZ

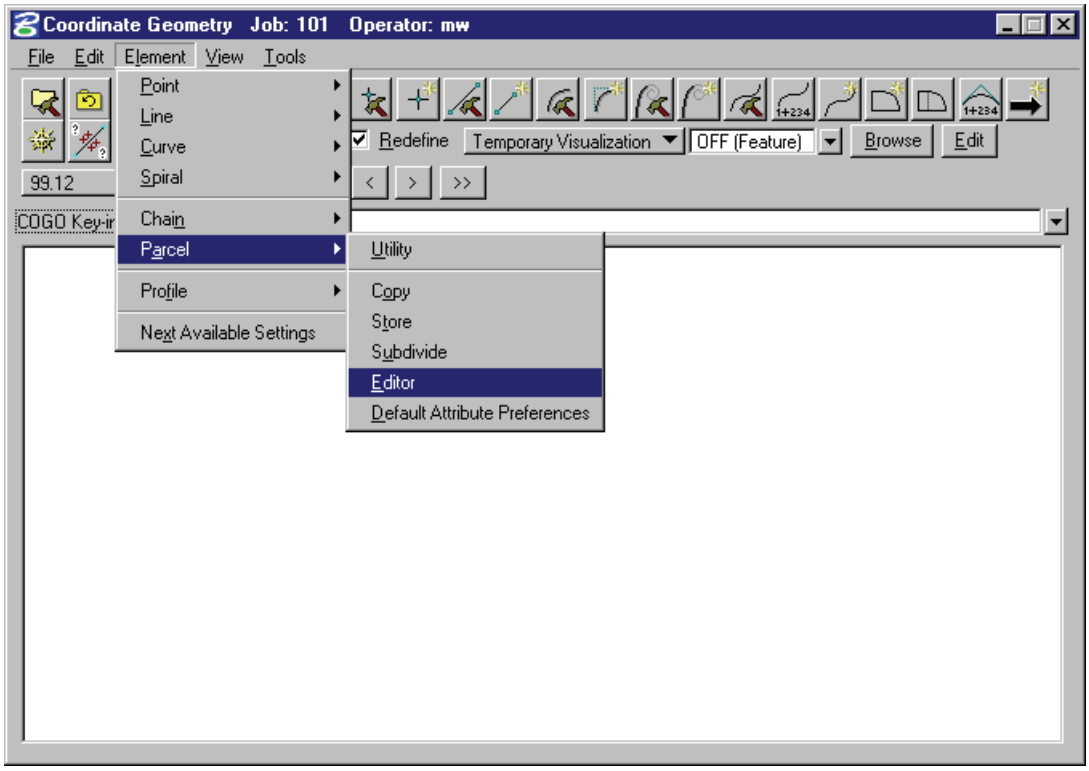


The starting point can be a COGO point, selected from a visualized element or type into the Pt. Num field. When populated, the North and East are automatically displayed. If a new point number is utilized, then North and East coordinates must be entered.

LAB EXERCISE: ENTERING PARCEL DATA

> ***PARCEL EDITOR***

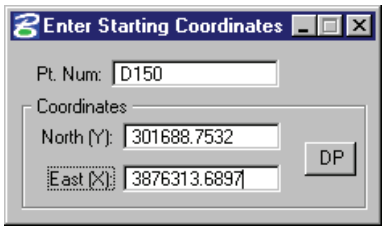
1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\s60843.dgn*.
2. Attach the saved view *ISTAR*.
3. Access Project Manager and open the existing project 60843.
4. Use the user Mary to access the project.
5. Click on the button to open Coordinate Geometry.
6. Select **Element > Parcel > Editor**.



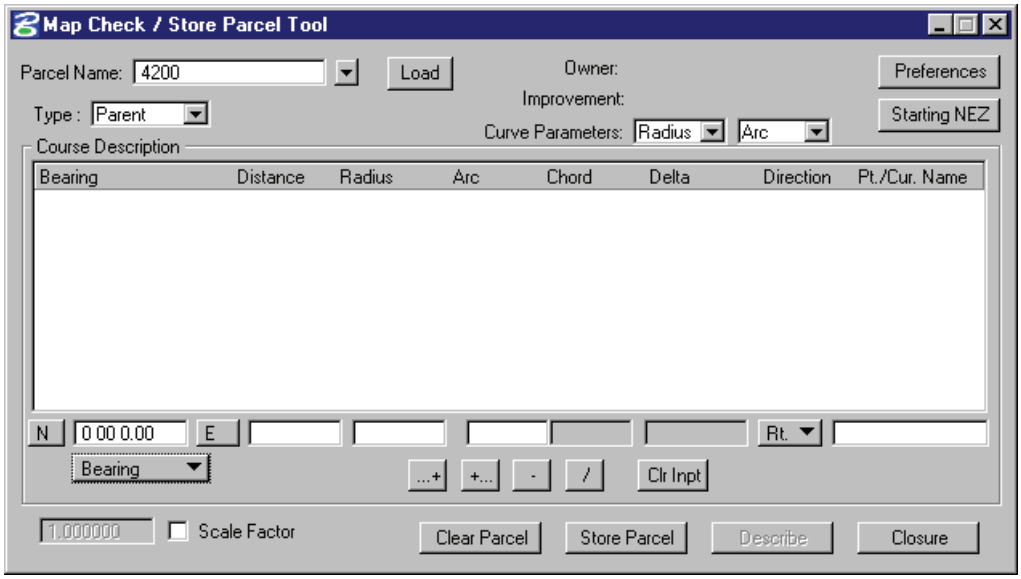
7. Begin by clicking the ***Starting NEZ*** button and entering the POB coordinates.

Northing	301688.7532
Easting	3876313.6897

8. Begin with point number D150.

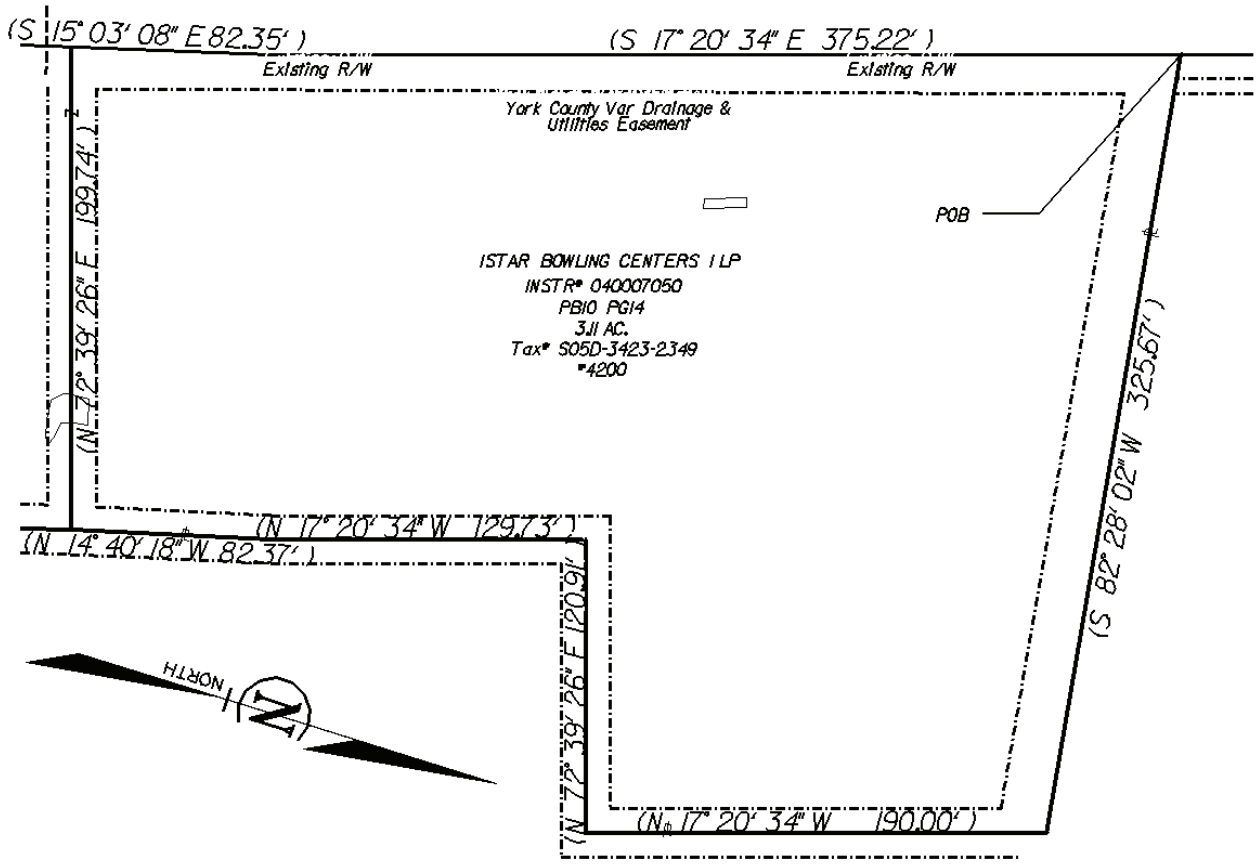


9. Close the Starting NEZ dialog.
10. Next, enter the **Name** *4200* for the parcel and set the **Parcel Type** to **Parent**.

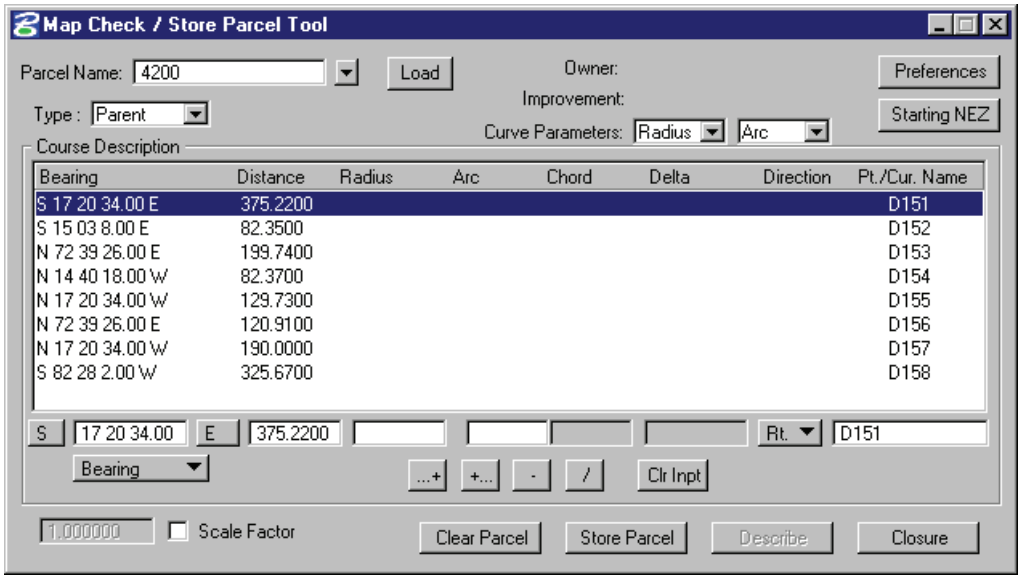


11. Begin entering the metes and bounds outlined below.

Note Notice the **POB** and the direction of the bearings.



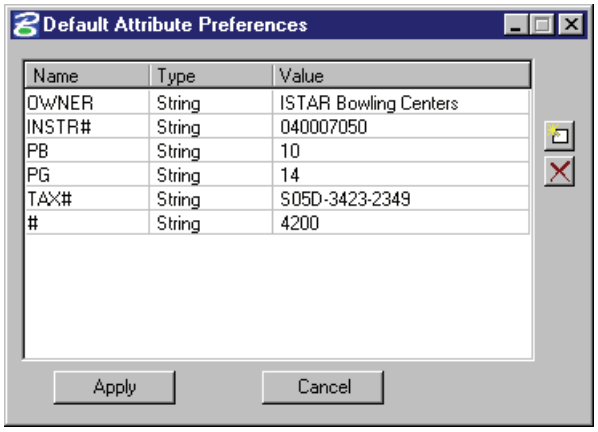
12. When completed you should have all of the metes and bounds entered in the dialog as shown below.



13. Click the **Closure** button and review the closure in COGO.
14. Click the **Store Parcel** button to store the parcel.

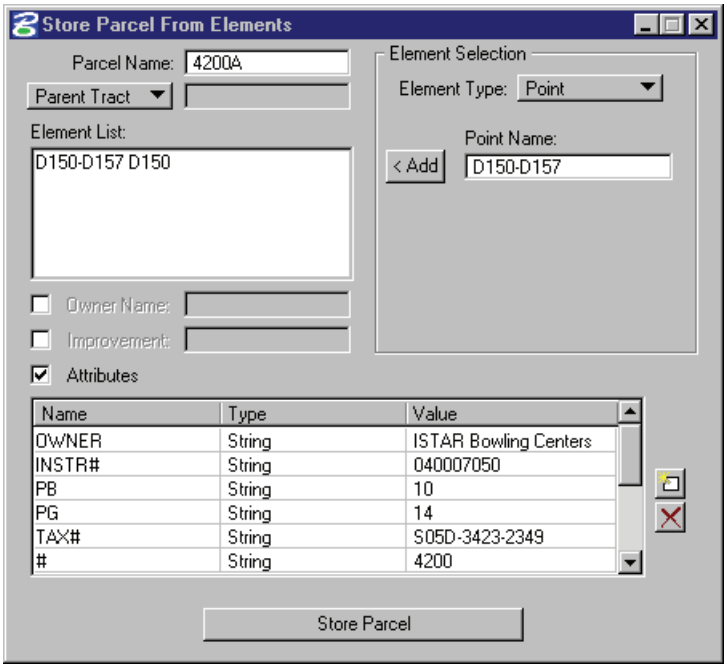
> *STORING PARCEL ATTRIBUTES*

1. Select from the COGO Element pulldown **Parcel > Default Attribute Preferences**.
2. Add each attribute into the dialog as shown below.

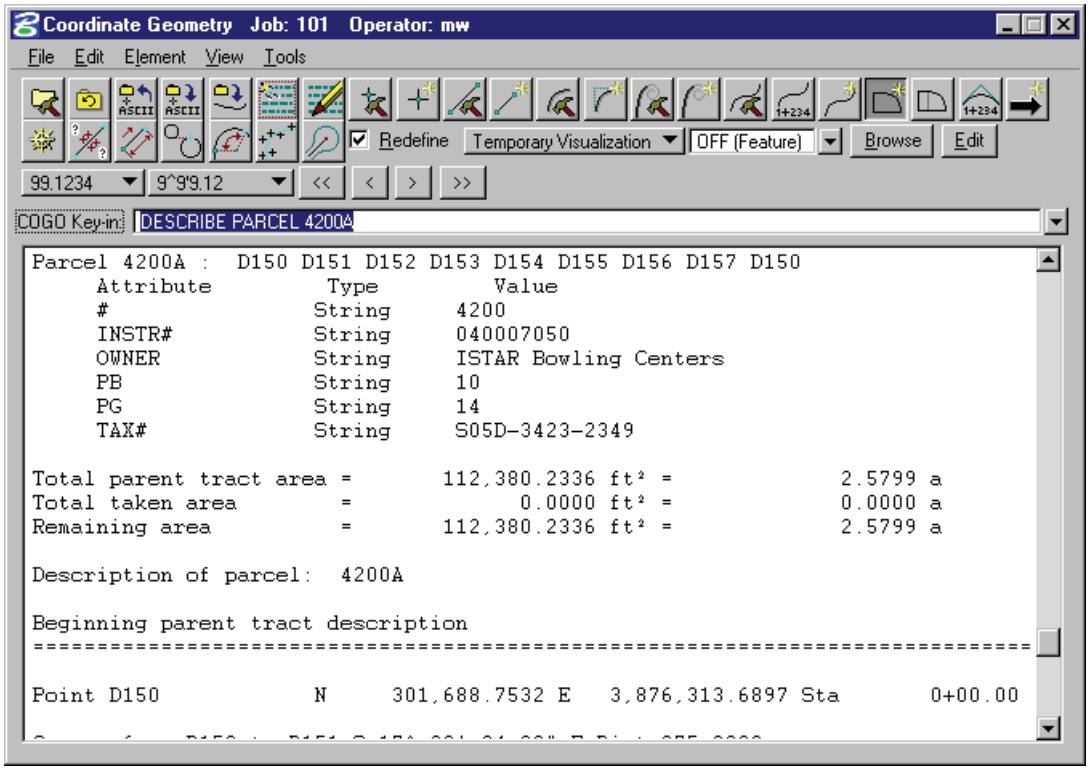


3. Click the **Apply** button.
4. Now select **Element > Parcel > Store**.

5. Include the points as shown below and store the parcel.



6. From the **Navigator** print the parcel and review the information.

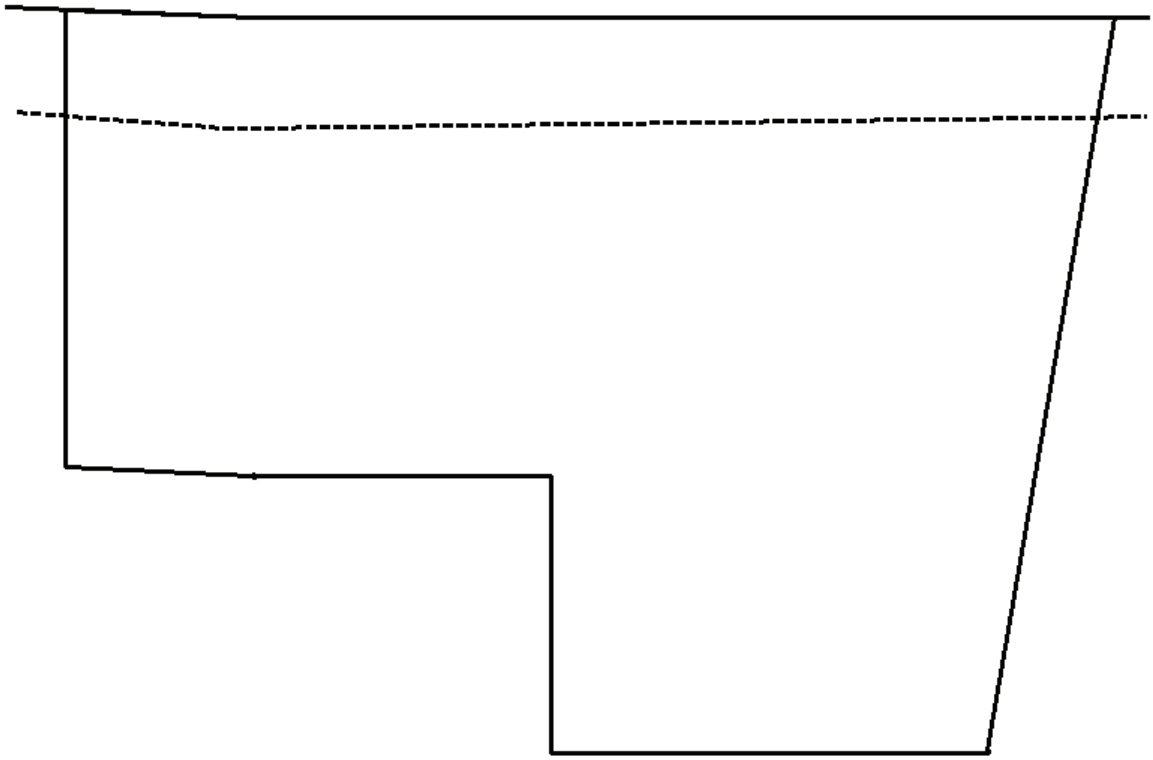


LAB EXERCISE: GRAPHICAL COGO

> ***STORING A RIGHT-OF-WAY TAKE***

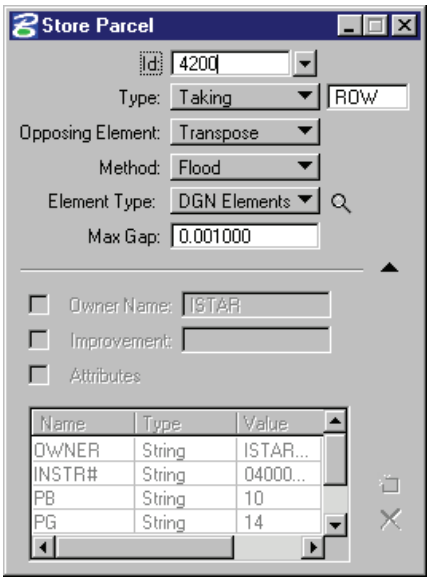
1. Select **Applications > GEOPAK Road > Geometry > Graphical Coordinate Geometry**.

2. Turn off all levels with the exception of the parcel boundary including the existing right-of-way.
3. Set the active level to **Default**.
4. Place a line representing a proposed right-of-way similar to the image below.

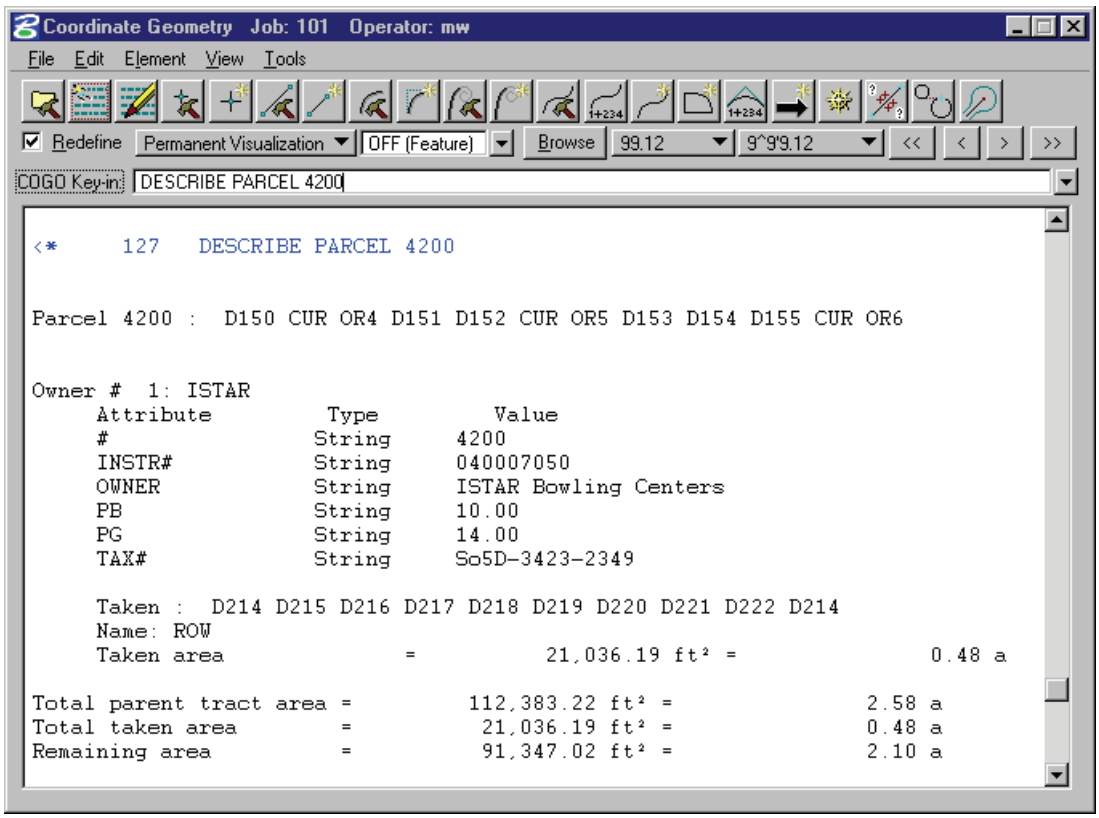


5. Click the icon to store a parcel.

6. Enter the information as shown below.



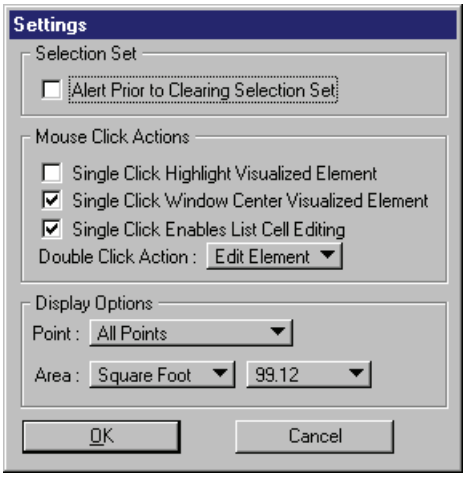
7. Data point inside the area making up the right-of-way take.
8. Enter a second data point to accept the direction for storing the right-of-way take. (A right mouse button click will reverse the direction of the arrows).
9. Next, move your cursor around the perimeter of the area making up the right-of-way take and pick a POB for beginning the area and enter a data point.
10. Print the Parcel in Coordinate Geometry and review the data.



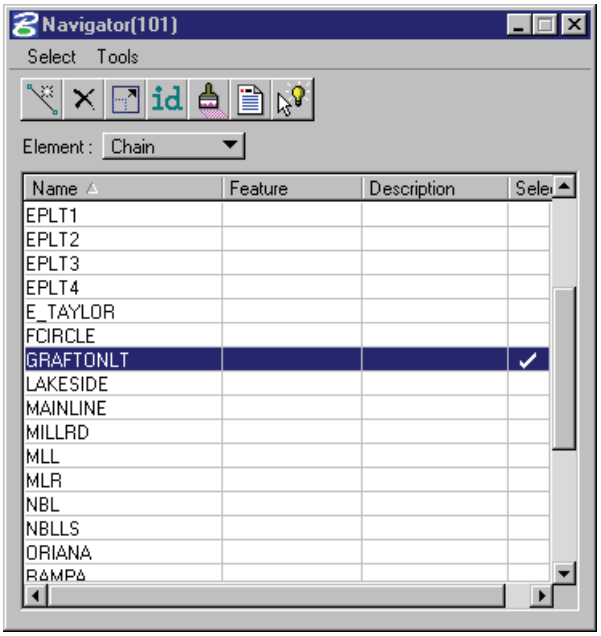
LAB EXERCISE: CHAIN MANIPULATION

> *REMOVING STATION EQUATIONS*

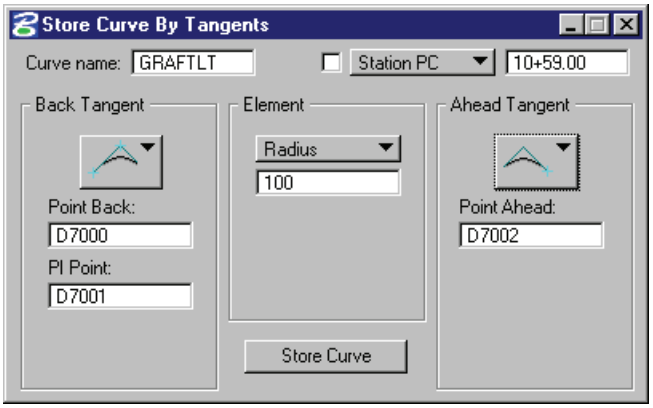
1. From the COGO **Navigator** set the **Element** toggle to **Chains**.
2. Highlight all of the chains in the list window and **Visualize** them.
3. From the COGO Navigator select **Tools > Settings**.
4. Turn on the setting to **Window Center Visualized Element**.



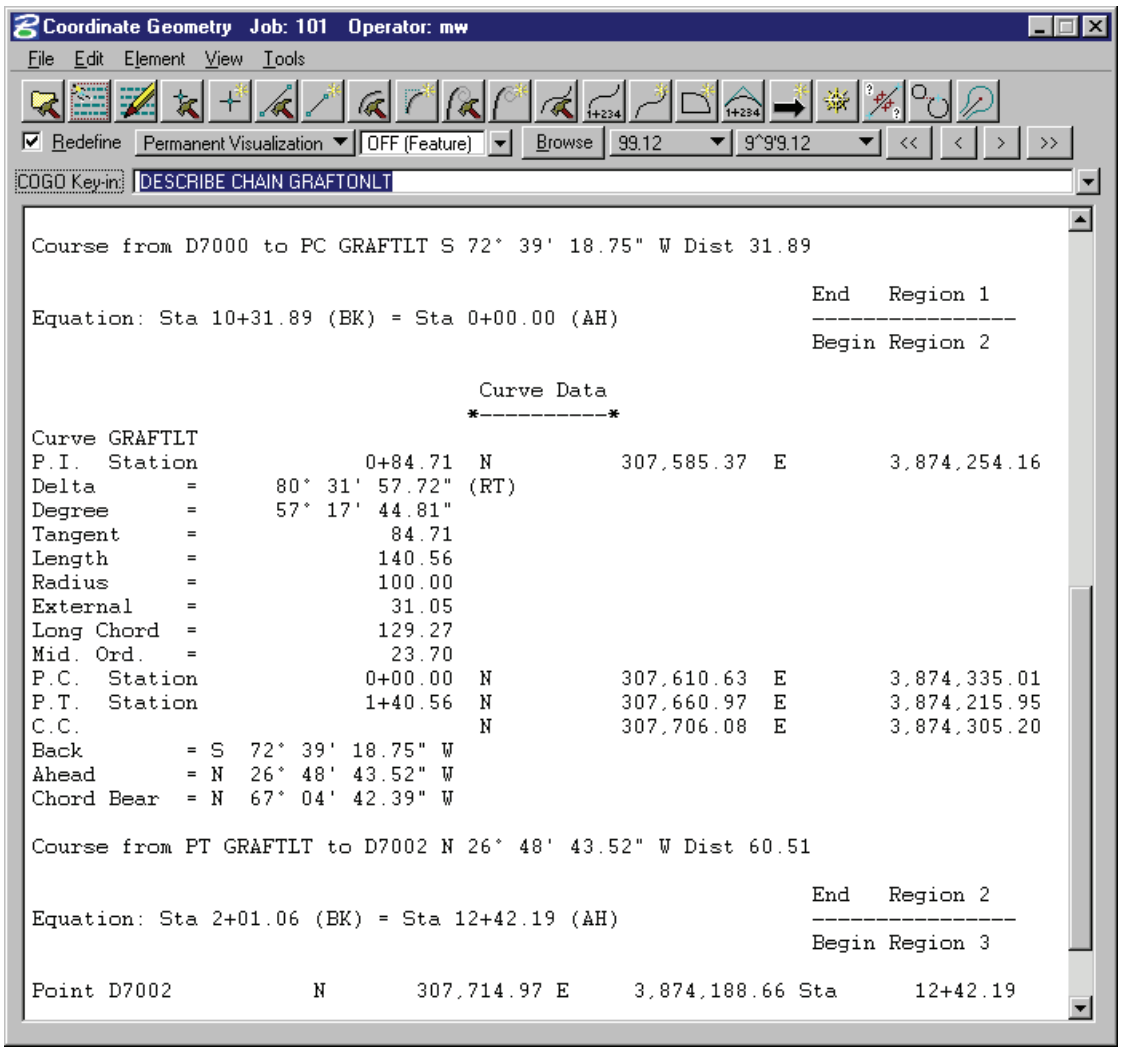
5. Click **OK**.
6. In the Navigator select chain **GRAFTONLT**.



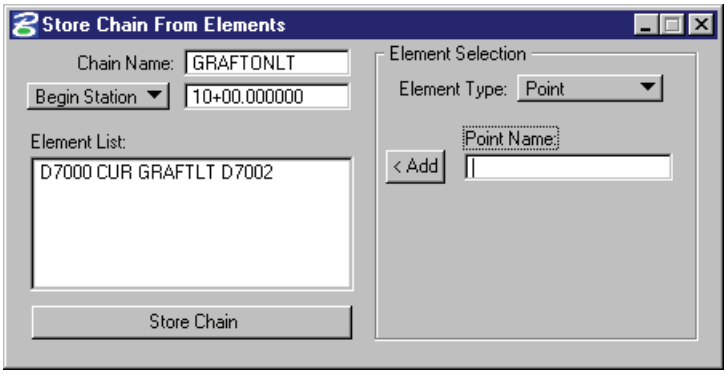
7. Click the **Print/Describe** icon on Navigator and review the alignment data.
8. Notice the curve name is **GRAFTLT**. In the next steps we will modify the curve.
9. Change the **Element** toggle on Navigator to **Curve**.
10. Find the curve **GRAFTLT** in the list window and double click on it.
11. Change the radius to 100.00 (make sure that **REDEFINE** is turned ON).



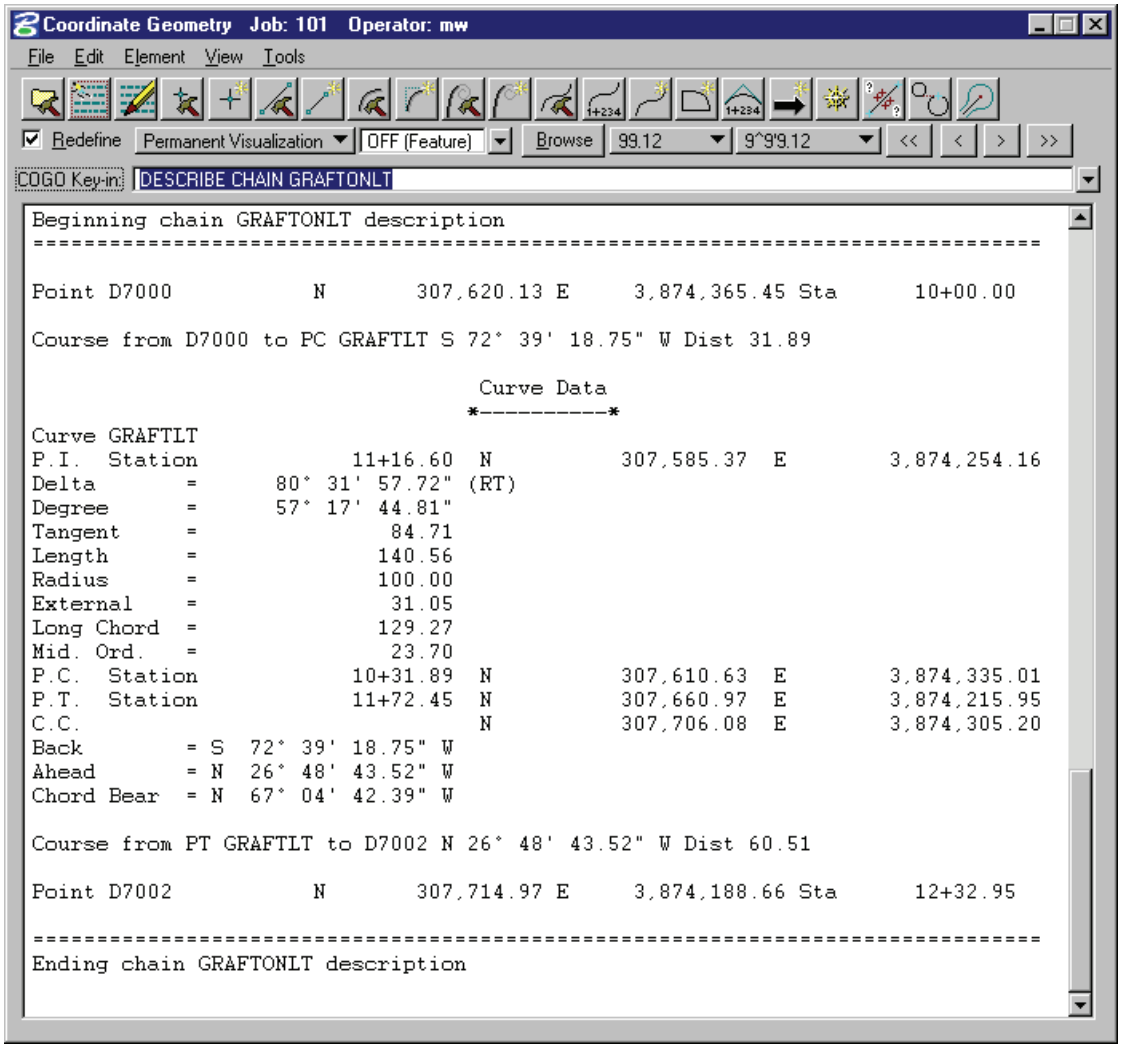
12. Click **Store Curve**.
13. Describe the chain again and review the data. (Notice that station equations have automatically been incorporated at the PC & ending stations due to the change in the curve).



14. From the **Navigator** double click on the chain **GRAFTONLT**.
15. Change the station toggle to **Begin Station** and make sure the value is 10+00.00.

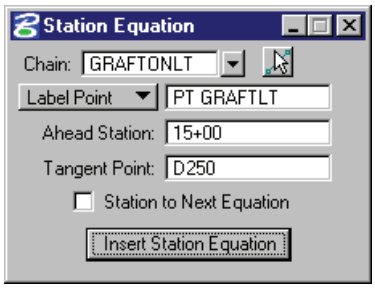


16. Click the **Store Chain** button.
17. Highlight the chain in **Navigator** and click the **Print/Describe** icon.
18. Notice now that the chain has been re-stationed through the curve, eliminating the station equations.

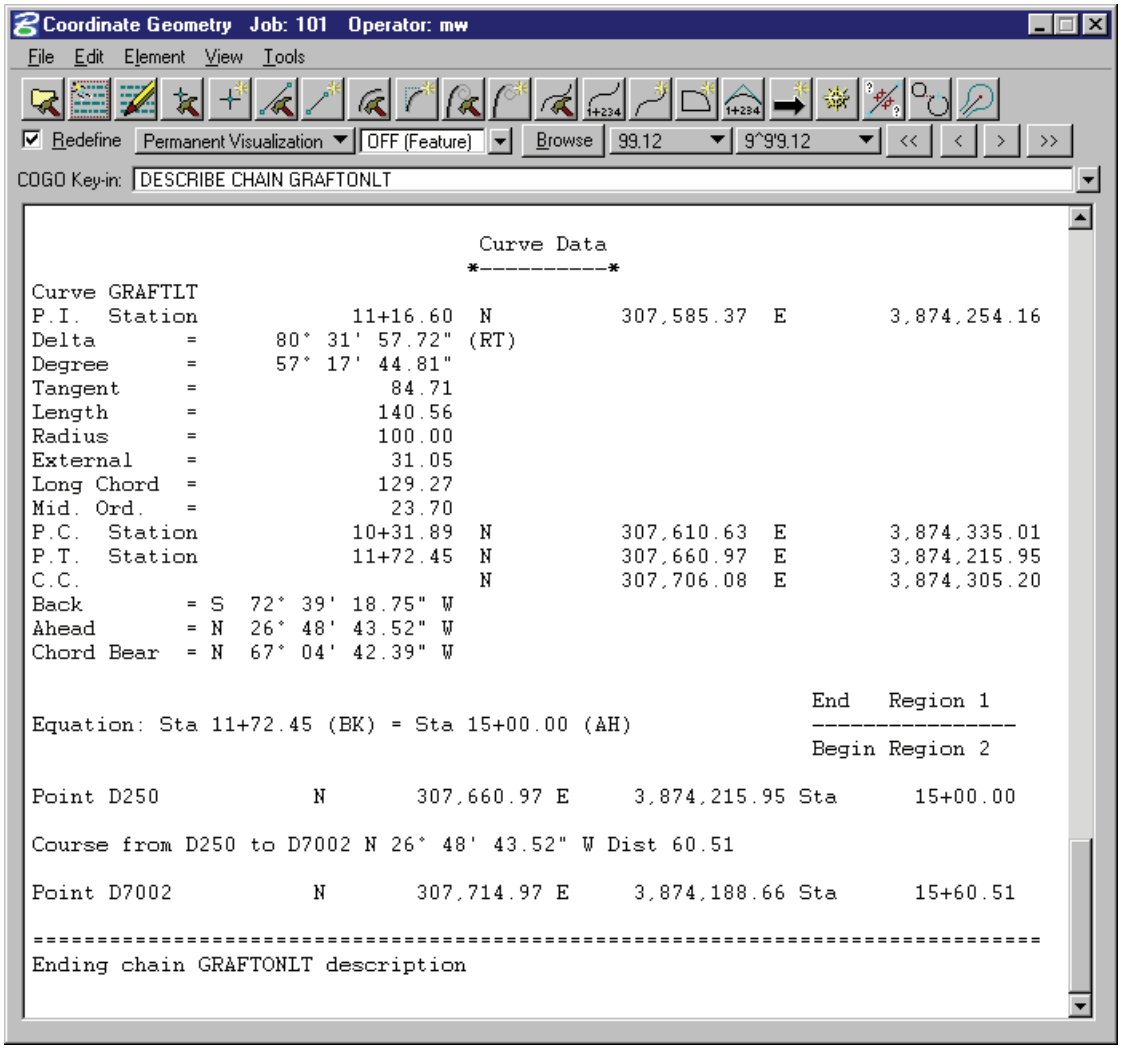


> *INCLUDING STATION EQUATIONS*

1. In the next example we will incorporate a desired station equation in the same alignment at PT station of the curve.
2. From the main COGO dialog select **Element > Chain > Station Equation**.
3. Enter the information as shown in the dialog below.



4. Now describe the chain again and review the data.



5. Exit MicroStation

3 Vertical Alignments

CHAPTER OBJECTIVES

In this chapter, you will create and modify vertical alignments using the **Vertical Alignment Generator** and the **Component Based Profile Generator**.

INTRODUCTION

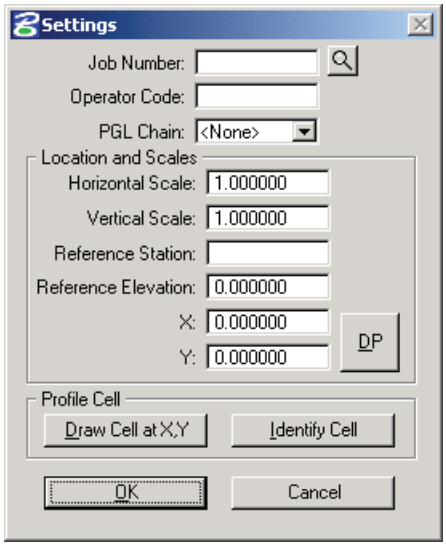
The **Vertical Alignment Generator** is a GEOPAK tool that can graphically create and modify proposed design profiles or modify an existing ground profile. These operations may be accomplished through a dialog box and/or by dynamic manipulation of graphic elements.

Several best fit options have been added to the **Vertical Alignment Generator** to provide the ability to compute profile components automatically from MicroStation graphics. Similar to the horizontal Best Fit application, it requires a selection of the graphical elements in order to perform the computations.

ACCESSING

The Vertical Alignment Generator can be accessed by selecting **Applications > GEOPAK ROAD > Geometry > Layout Profiles (VPI Based)**. It can also be invoked from Project Manager by clicking the **Vertical Alignment** button or by selecting the **VPI Based Vertical Alignment Design Tools** icon from the GEOPAK ROAD tool frame.

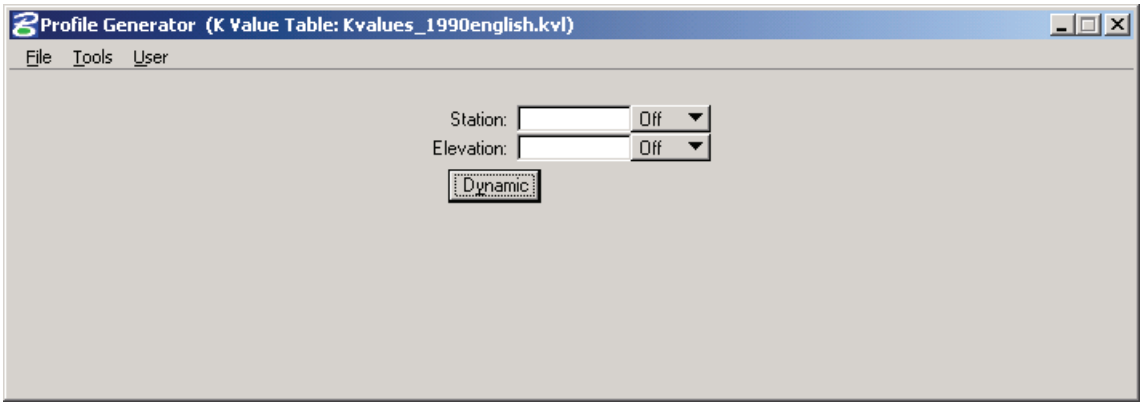
When selecting the Vertical Alignment generator, the first dialog that appears is labeled Settings, as depicted here. The entries in this box set the parameters and define the location within the design file where the profile components are to be displayed. All fields must be completed before the design process can begin. Once OK is clicked, the Vertical Profile Generator dialog appears.

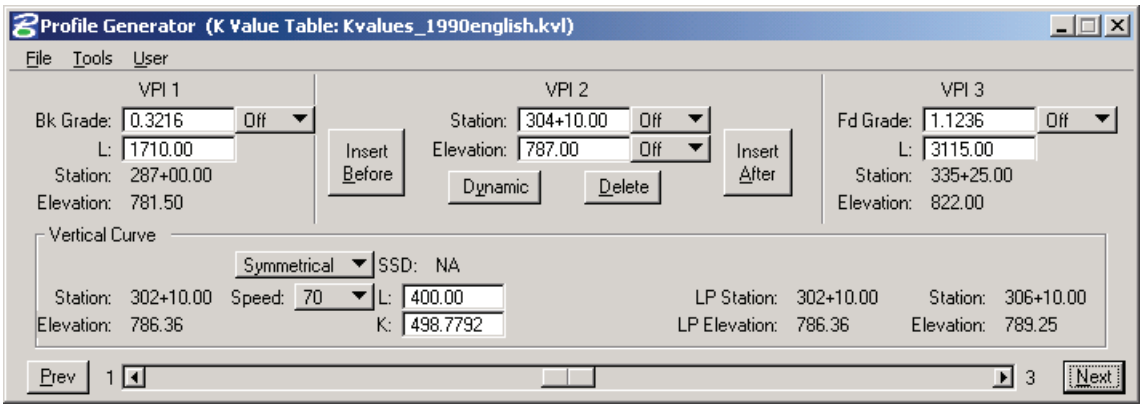


Note This tool also utilizes the cell that was drawn in the previous exercise by using the **Identify Cell** button.

USING THE VERTICAL ALIGNMENT GENERATOR

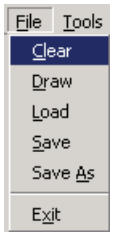
This tool enables a user to load a previously stored profile or create a new profile. You will notice the dynamic changes in the dialog throughout the vertical alignment design.





Various design parameters must be defined prior to designing a new profile; which are discussed in the options supported under the three menu options; **File**, **Tools**, and **User**.

FILE



Clear - clears the profile display from MicroStation graphics and removes all VPIs from the dialog box.

Draw - write the graphic elements of the profile to the MicroStation file.

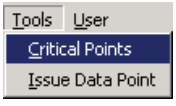
Load - retrieves a previously stored profile from the coordinate geometry database (.gpk)

Save - stores a new profile or updates (redefines) a previously stored profile under the same name.

Save As - is used to store the profile or to save a modified profile under a different name.

Exit - ends the process.

TOOLS



Critical Points - Vertical curves may also be defined by one or two critical points – i.e. the curve will pass through these points if mathematically solvable, the vertical curve will be drawn and the design speed display adjusted to fit the current parameters.

Issue Data Point - Permits the user to type in stations and elevations, issue a data point that can be part of a MicroStation place line, place a cell or perform other generic

operations. This is useful in displaying visual references within the profile that need to be considered in design of the vertical profile.

USER

Preferences - sets the rounding parameters for each of the items listed in the dialog box. Also contains a toggle that will force the dialog to window center the view on the current VPI.

K Values - is a table of stopping sight distance K-values for crest and sag conditions for various design speeds. These values are based on the AASHTO Green Book.

Settings - recalls the **Settings** dialog box that first appeared upon initializing Vertical Layout.

CREATING A NEW PROFILE

Warning The enter/tab key must be used to ensure values are accepted.

A new profile can be created with the following steps:

1. Place the first VPI using one of the four supported options.
   - Type station and elevation of the VPI into the appropriate fields in the Profile Generator dialog.
   - Enter station of VPI as precision input (type in value), and allow the elevation to be defined through dynamic cursor placement on screen.
   - Elevation is defined via precision input, and the station is defined through dynamic cursor placement on screen.
   - Both values for the VPI can be established dynamically on screen by clicking on the Dynamic button and placing a DP in the view at the desired station and elevation.
2. Define ahead (or back tangent).

   Station, elevation, grade and length parameters may be defined via precision input, dynamic manipulation or a combination of both.
3. Define remaining VPI's and Grades.

   A repetition of Step 2 with an option to insert VPI's between two existing VPI's.
4. Define Vertical Curves.

   Simply define the design speed from the Speed option button and GEOPAK will reference the K-value table and draw the vertical curve. If a *curve overlap* occurs, an overlap message will be displayed in the dialog box along with the overlap length. Length of Curve or K-value may also be keyed in.
5. Adjusting Curve Lengths

   The vertical curve can be modified by directly keying in either the K-value, curve length or defining the design speed in the dialog box. You will see the values computed automatically adjust to reflect the results of any modifications.
6. Save the Profile.
7. Select **File > Save As** to name and save the newly created profile. The names of profiles are any 1-9 alphanumeric characters.

PRECISION PLACEMENT OPTIONS

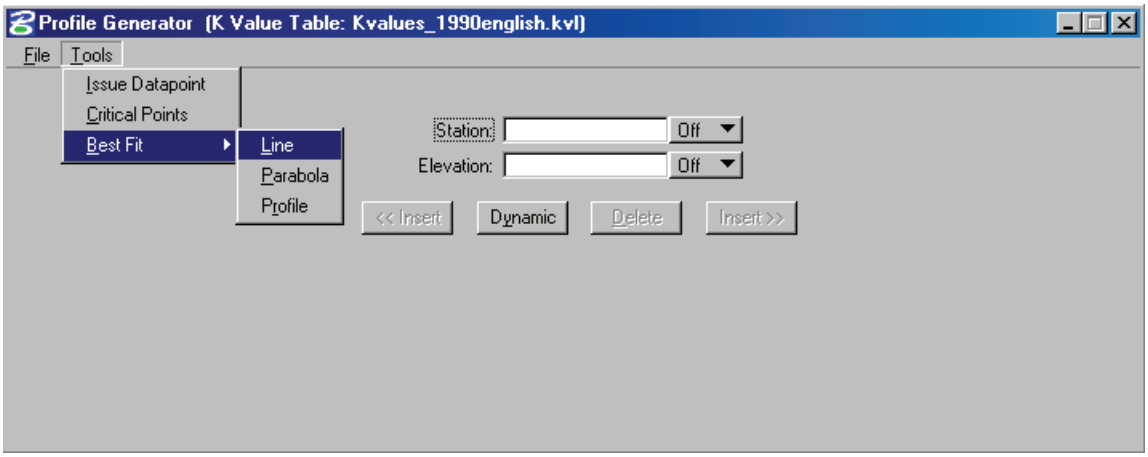
Options available for creating or modifying vertical curves, VPI's and grade lines:

- **OFF** - Values change.
- **INC** (Increment) - Ensures that the designated profile parameter will be adjusted as defined in the Preferences dialog.

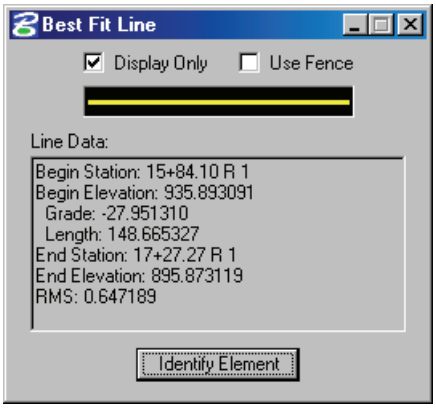
- **LCK** (Locked) - Forces selected operations to maintain the designated profile parameters.

BEST FIT LINE

The **Best Fit Line** tool is located on the Vertical Profile Generator under the Tools > Best Fit pulldown.



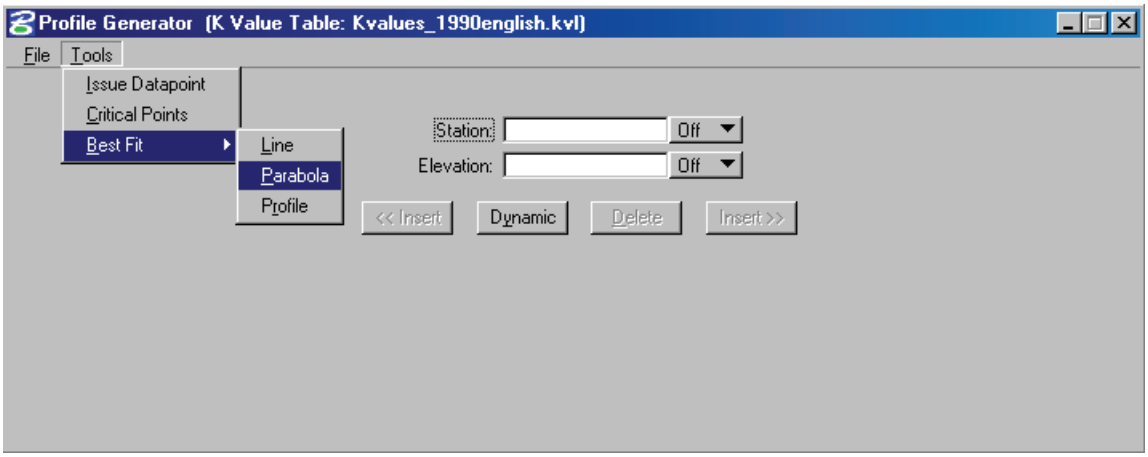
The **Best Fit Line** tool will allow the user to select any graphical line, whether it is a type 3 or type 4 MicroStation element, to perform a best fit solution. This solution will be reported back in a display window similar to the one below with all geometrical information.



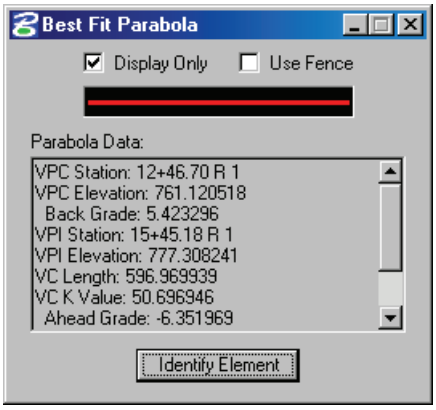
This information can then be analyzed to aid in the input of grade information into the vertical alignment generator if desired.

BEST FIT PARABOLA

The **Best Fit Parabola** tool is located on the Vertical Profile Generator under the Tools > Best Fit pulldown.



The **Best Fit Parabola** tool will allow the user to select any graphical line, whether it is a series of type 3, a type 4 or a type 12 (complex chain) MicroStation element, to perform a best fit solution. This solution will be reported back in a display window similar to the one below with all geometrical information.

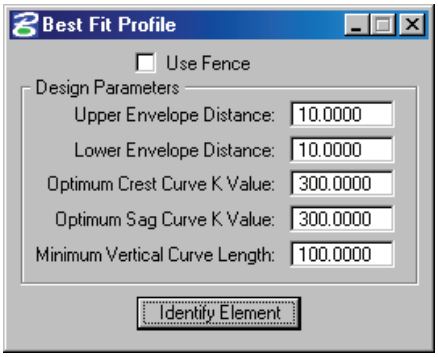


This information can then be analyzed to aid in the input of grade information into the vertical alignment generator if desired.

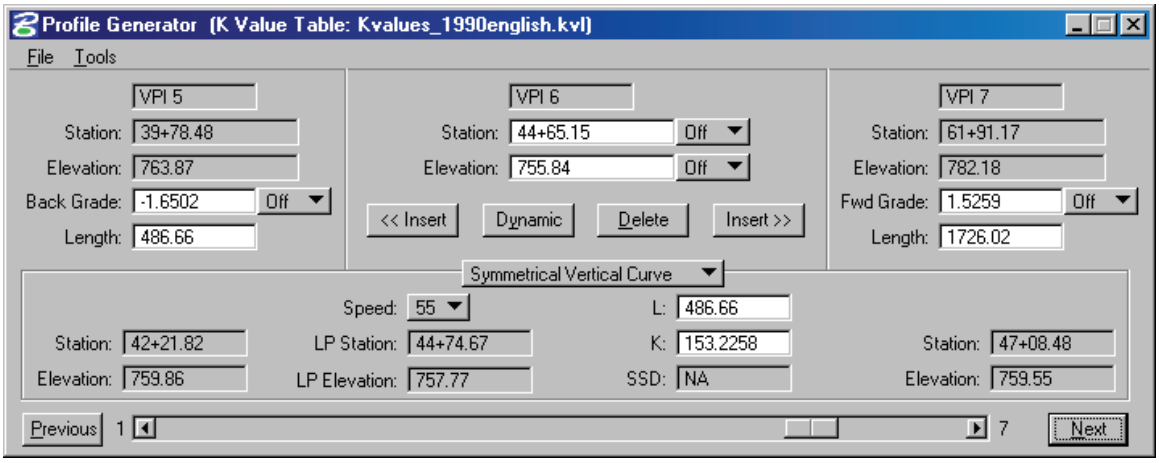
BEST FIT PROFILE

The main difference in the **Best Fit Profile** and the other Best Fit options is that **Best Fit Profile** will actually populate the vertical alignment generator dialog with a complete profile grade.

Once the settings are made in the preference dialog and the element selected a best fit profile is generated. The user can then review and analyze the grade, deleting or inserting PI's where desired.



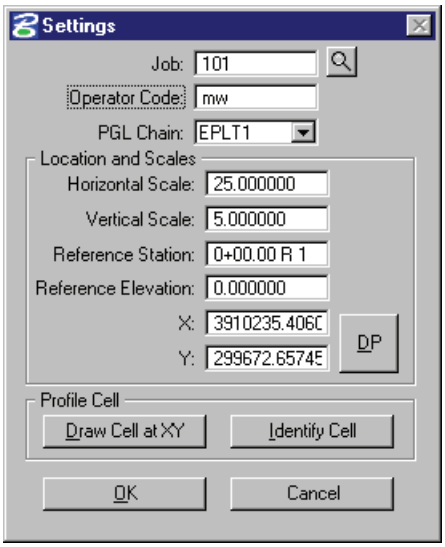
When the **Identify Element** button is selected the main vertical alignment generator dialog will populate as shown below.



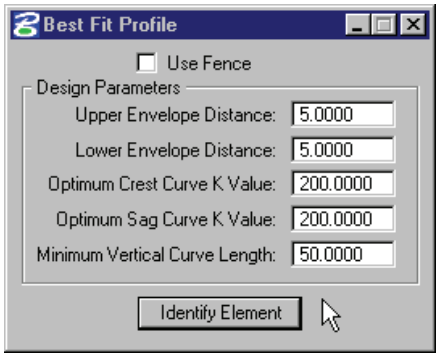
LAB EXERCISE: PROFILES

> *BEST FIT PROFILE*

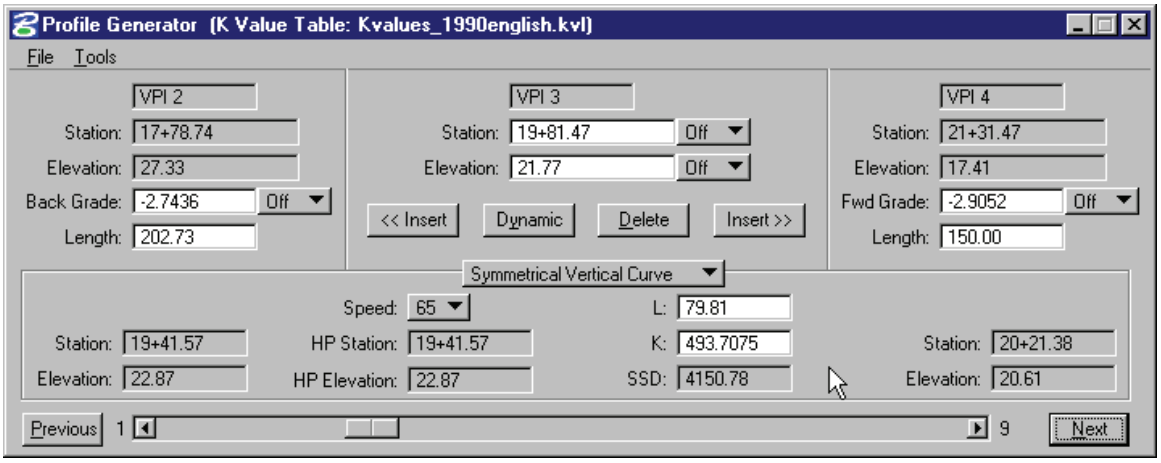
1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843prof.dgn*.
2. Attach the saved view *PRO1*.
3. Access the **Vertical Alignment Generator**. *(Applications > GEOPAK Road > Geometry > Layout Profiles VPI Based).*
4. In the Settings dialog click the **Identify Cell** button and data point on the profile cell displayed in the MicroStation view.



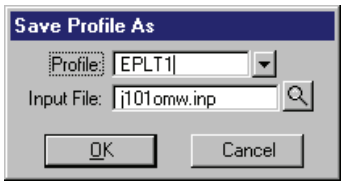
5. Key in the **Operator Code** of mw.
6. Click **OK**.
7. From the Vertical Alignment Generator dialog select **Tools > Best Fit > Profile**.
8. Make the settings as shown below.



9. Click the **Identify Element** button and data point on the graphical profile in the MicroStation view.
10. Click another data point anywhere to accept.
11. The main Vertical Alignment Generator dialog should be populated as shown below.



12. Review and edit the proposed grade removing unwanted VPI's and adjust curve lengths as desired.
13. When completed select **File > Save Profile As** and provide the name as shown below.



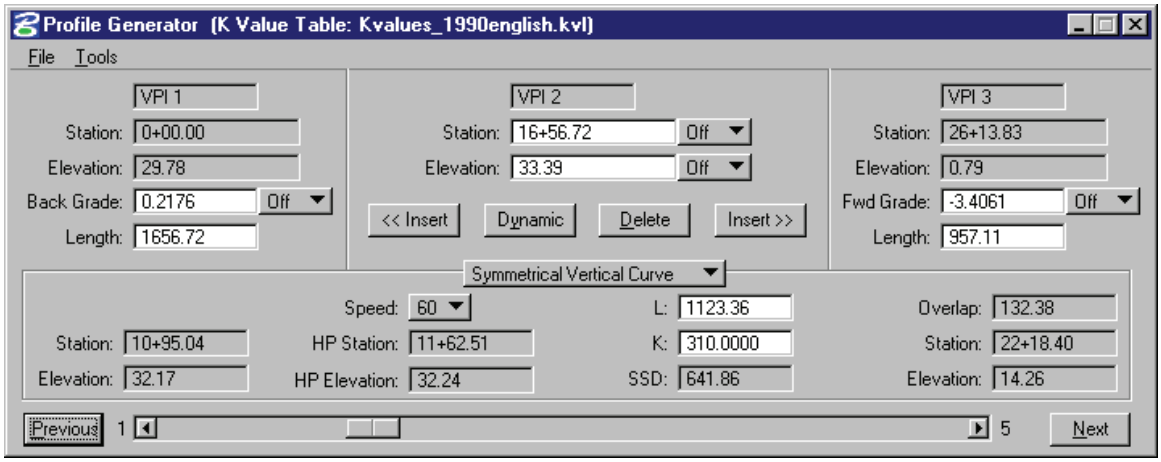
14. Clear the profile from the **Vertical Alignment Generator**.

> ***VERTICAL ALIGNMENT GENERATOR***

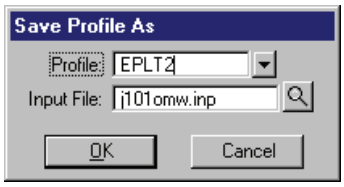
1. Using the same existing profile as a reference we will now enter grade information to store an additional profile.
2. Begin by keying in the first VPI at STA=0+00 ELEV=29.78.
3. Using the following table key-in the remaining VPI information.

Station	Elevation
16+56.72	33.39
26+13.83	0.79
37+92.45	38.40
47+83.33	35.24

4. Now using the **Previous** button return to VPI 2.
5. Select a **Design Speed** of 60 MPH.



6. Using the **Next** button set the **Design Speed** to 60 MPH for each of the following VPI's.
7. Select **File > Save Profile As** and save the profile as EPLT2.



8. Close the **Vertical Alignment Generator**.

COMPONENT BASED PROFILES

INTRODUCTION

The **Component Based Vertical Alignment** tools provide the user with a myriad of tools to place, modify and delete profile components. Tool boxes organize tools to include the placement of tangent lines, and a variety of vertical curves. Components interact with each other to automatically trim vertical curves, connect various elements, and modify, copy and rotate components. The user also has the option to store completed profiles with the coordinate geometry database.

ACCESSING

This tool requires the active chain control to be active. In addition, an active chain and an active profile must be defined. The profile may not have a gap. If these conditions are not met, an Alert Message is displayed.

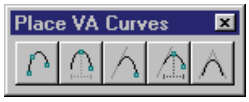
When the prerequisites have been met and the tool is selected, the tool frame is opened.

The **Component Based Profile** tools are accessed from **Applications > GEOPAK Road > Geometry > Component Based Profiles**.

There are four primary tool boxes for placing profile components.

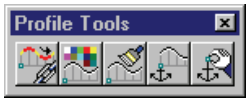
Place Lines

Places Curves



Manipulate

Profile Tools



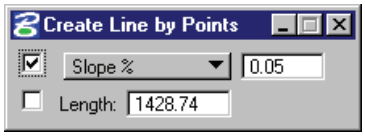
LAB EXERCISE: COMPONENT BASED PROFILES

> *COMPONENT BASED PROFILES*

1. Using the same existing profile from the previous exercise as a reference, select **Applications > GEOPAK Road > Project Manager > Active Chain Control**.

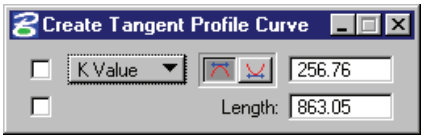
2. Set the Active Chain to EPLT1.
3. Right click on the icon representing **View 1** and set the view to **Profile**.
4. Select **Applications > GEOPAK Road > Geometry > Component Based Profiles**.
5. Select the tool to **Create a Profile Line by 2 Points**.

6. Key-in the grade as shown below and check the toggle ON.



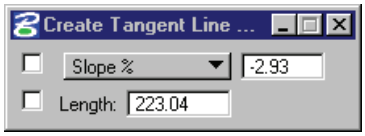
7. Place a line from the beginning of the existing profile approximately 1400 feet.
8. Next select the tool to place a **Tangent Profile Curve**.

9. Snap to the end of the previously placed tangent and using the approximate values in the dialog below, place a curve.

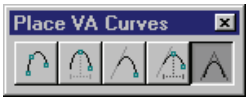


10. Select the tool to place a **Tangent Line Unconstrained**.

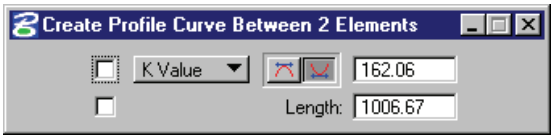
11. Using the approximate values below place the tangent line from the previous curve.

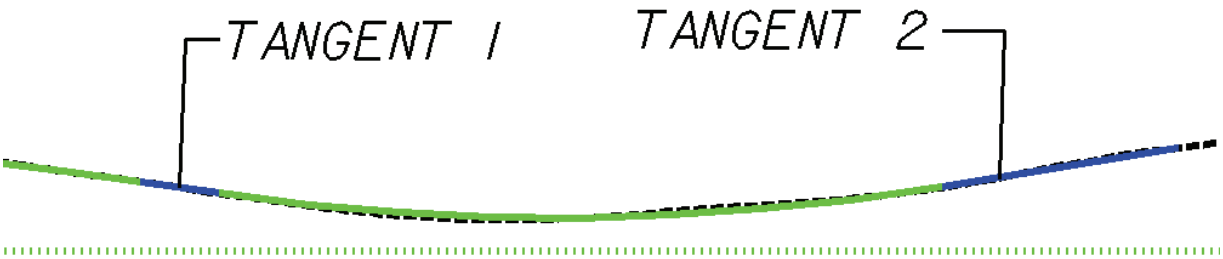


12. Use the **Create Profile Line By 2 Points** and place a line on the uphill slope (reference the image in step 14).
13. Select the tool to **Create Profile Curve Between 2 Elements**.

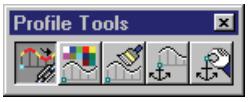


14. Using the approximate values below snap to the first tangent line and then the second.

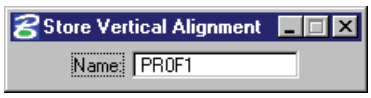




15. Finish out the profile using the tools we just discussed.
16. Once completed with the profile select the **Store Profile** icon.



17. Provide a name and then select the profile element.



18. Exit MicroStation.

DRAW PROFILES

INTRODUCTION

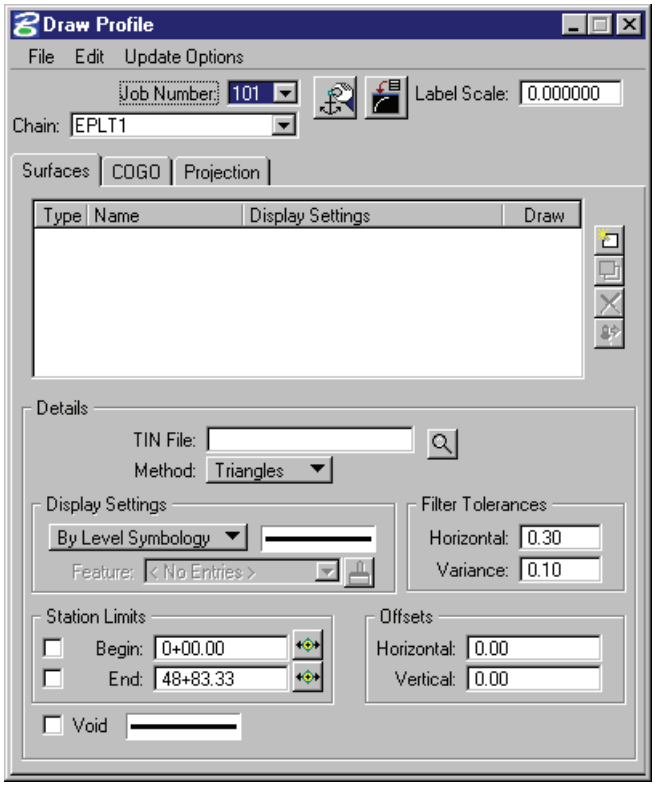
The **Draw Profile** tool enables the user to draw several profiles simultaneously from a variety of data sources.

- GEOPAK coordinate geometry database wherein the vertical alignment is stored.
- GEOPAK binary TIN file, Site Model or Site Object. If you have not already created your binary TIN file, see the DTM online documentation for a detailed discussion of the Digital Terrain Modeling features. The Site Model or Object are created utilizing GEOPAK Site Modeler software and are stored within the GEOPAK Site project (gsf) file.

In addition, if the source data is TIN files or site components, the resultant profile may be stored within the coordinate geometry database.

ACCESSING

The generation of profiles must be completed from within the 2D MicroStation design file wherein the profile is to be drawn.



The first entries required in the dialog are at the top of the dialog. These include:

Job Number — Required to identify the coordinate geometry database wherein the chain for generating the profiles is stored.

Chain — Required to reference an alignment within each cross section. The subsequent specifications of station ranges and left/right offsets are computed relative to this baseline when pattern by station is utilized. If pattern by design is utilized, the intersection of each pattern line with the baseline determines the station of the cross section.

Dialog Profile Cell Control — Clicking this button opens the Profile Cell Control dialog, wherein the current profile cells are listed along with associated station, elevation, etc.

- A profile cell is required in order to un-ghost the majority of the Draw Profiles dialog. It can be placed by any method within GEOPAK prior to drawing profiles.

Two additional buttons / fields are located at the top of the dialog and are detailed below.

Update Profile — This button updates any previously drawn profile.

Label Scale — Utilized when the By Feature Display settings option is utilized. The specified Label Scale is compared to the scale within the D&C Item and proportionalized. Note this option is only utilized if the text setting is set to scale, not fixed.

Note	The Job Number must be defined in order to populate the Chain list. Once the chain and profile cell is defined, the dialog un-ghosts.

TABS

Three tabs on the dialog support the input data required to draw profiles:

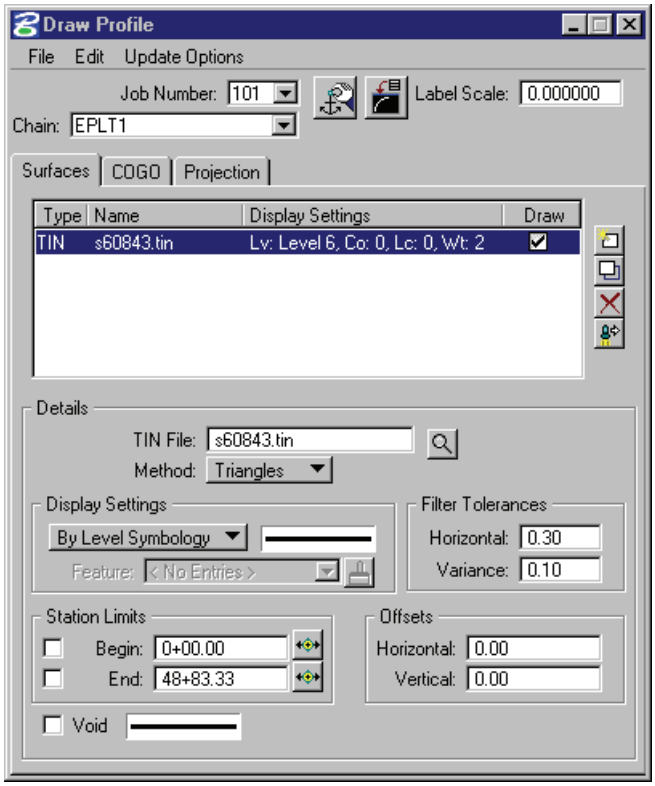
Surfaces: Defines the surfaces utilized for drawing profiles. Note multiple surfaces may be drawn in a single processing. Source data includes GEOPAK TIN files, Site Models, or Site Objects.

COGO: Defines the COGO data utilized for drawing profiles.

Projection: Used when the chain / profile to be drawn is different than the chain / profile used to create the profile cell.

SURFACES TAB

The **Surfaces** tab defines the surfaces utilized as source data when drawing profiles. Multiple surfaces from a variety of sources can be drawn in a single processing.



Each surface to be drawn must be added to the list box. This is accomplished via the action / edit buttons on the right side of the dialog. When a line is added to the list box, the profile is drawn. Note: clicking on the draw toggle in the list box deletes or redraws the profile.

Edit Buttons:

Add, Modify, Delete

To add to the list box, simply select the source data type and data, then populate the Display Settings, Filter Tolerances and Offsets. Then click **Add** to the right.

To delete a line from the list box, simply highlight the line to be deleted and click **Delete**.

Modify a line by highlighting the desired line in the list box, make the desired changes in the fields directly below the list box, then click **Modify**.

Store Surface as Profile in COGO

When the profile is drawn, click to open the Store Profile dialog, to store the profile in COGO.

The profile may be stored, or just the input file may be created. If an input file is created, the **Operator Code** and **File Name** are required. If the dialog is invoked while in a 3D file, the user may toggle on the option to create a 3D profile string.

The 3D profile string consists of the circles denoting every location where the design centerline intersects topographic elements. If the circles are not deleted at this time, they can be deleted at any time with a single application of the MicroStation "Delete Element" command.

SOURCE DATA

The list box displays the source data dialog items. These are described in the following table.

Model
Object
Object+Slopes
Model Base
TIN File

If a site model project is active when the Draw Profile dialog is opened, several options are supported for source data. When the type is set to Model, Object, Object+Slopes or Model Base, all components of the specified type in the current site project are listed. The user selects the desired component from the list. When site components are utilized, no file icon is displayed. If a site project is not open, the only option is a TIN file. Pressing the **Files** button invokes the TIN Files Manager, wherein the desired file may be specified.

Method:

Interval between successive VPIs in terms of master units, i.e., feet or meters.

Triangles
Break Lines

If a TIN File is utilized, triangles are interpolated to determine the elevation defining the profiles. However, if a site component is utilized, the user may select break lines. In this case, any surface line drawn between two break lines in the site component will interpolate only between the break lines, not the triangles.

POT
Increment

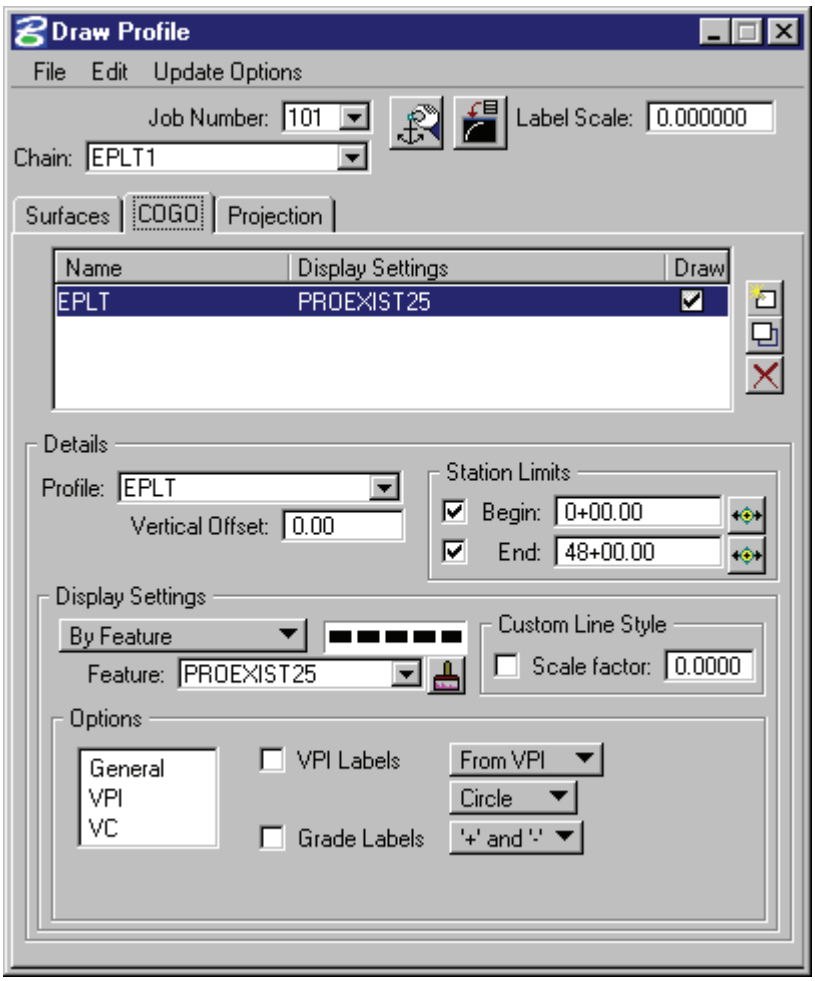
The Increment option creates a profile where the user specifies the incremental distance between successive VPI points on the existing ground profile where the first VPI point is coincident with the Beginning Station.

Even

The Even method specifies the incremental distance between successive VPI points on the existing ground profile where the first VPI point is rounded to the next highest even station from the Beginning Station. For example, if the Beginning Station is 10+015 and the Even value is 25, the VPIs would be generated at 10+025, 10+050, etc.

The POT method creates a profile with VPIs at every location where a POT occurs in the referenced chain.

COGO TAB



Multiple profiles may be drawn by populating the tab, then utilizing the edit buttons on the right side of the list box.

Edit Buttons:

Add, Modify, Delete

To add to the list box, simply select the source data type and data, then populate the Display Settings, Filter Tolerances and Offsets. Then click **Add** to the right.

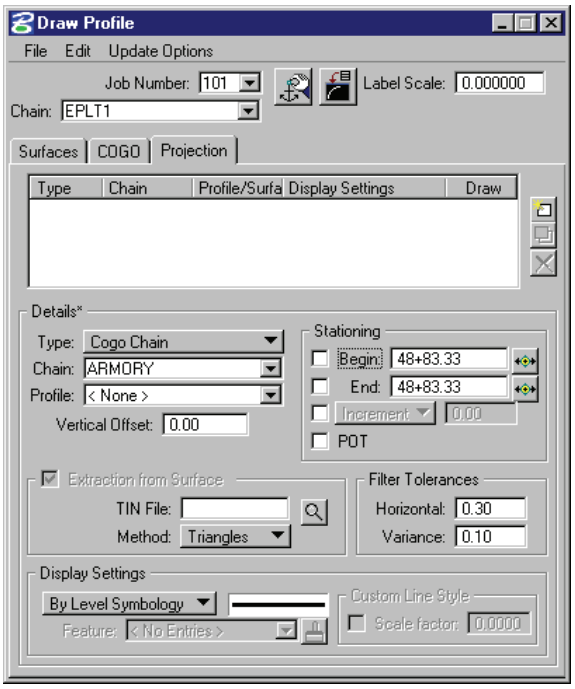
To delete a line from the list box, simply highlight the line to be deleted and click **Delete**.

Modify a line by highlighting the desired line in the list box, make the desired changes in the fields directly below the list box, then click **Modify**.

Station Limits and **Vertical Offset** are identical to the Surfaces tab. To define the symbology of the profile(s), the user may specify the parameters via the **By Symbology** option, or **By Feature**. When the By Feature option is selected, the user must identify an Item from the Design and Computation Manager. Other options which are found on the Draw Plan and Profile dialog within Design and Computation Manager are also supported within the Draw Profile dialog, i.e., General Labels, VPI, VPC, etc. Simply highlight the desired option in the list box, then set the toggles and fields accordingly. Scale for **Custom Line Styles** is also supported.

PROJECTION TAB

The Project tab can be used when the chain / profile to be drawn is different than the chain / profile used to create the profile cell. When the Projection tab is selected, the dialog dynamically changes, as shown below.



Each projected profile to be drawn must be added to the list box. This is accomplished via the action / edit buttons on the right side of the dialog. When a line is added to the list box, the profile is drawn. Note: clicking on the draw toggle in the list box deletes or redraws the profile.

Edit Buttons:

Add, Modify, Delete

To add to the list box, simply select the Type, Chain, Profile, and Vertical Offset, then populate the Display Settings, Filter Tolerances and Extraction from TIN, if desired. Then click **Add** to the right.

To delete a line from the list box, simply highlight the line to be deleted and click **Delete**.

Modify a line by highlighting the desired line in the list box, make the desired changes in the fields directly below the list box, then click **Modify**.

The following fields are defined in the Details group box.

Type — A COGO chain or Survey chain may be utilized.

Chain: — After the desired Type has been selected, the Chains in the current GPK are listed for selection.

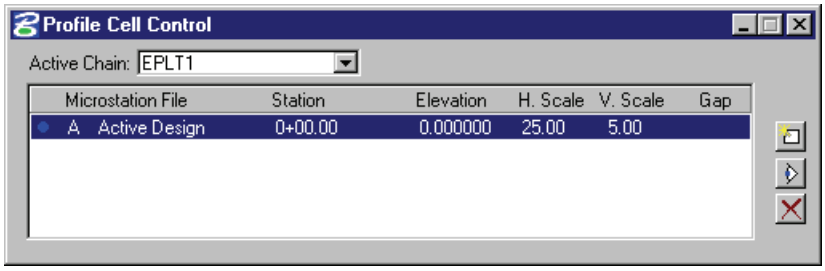
Profile — (COGO Chain option only) Select the profile to be utilized.

Vertical Offset — Offset in terms of master units. Any **Vertical Offset** is applied after the profile is generated from the source data.

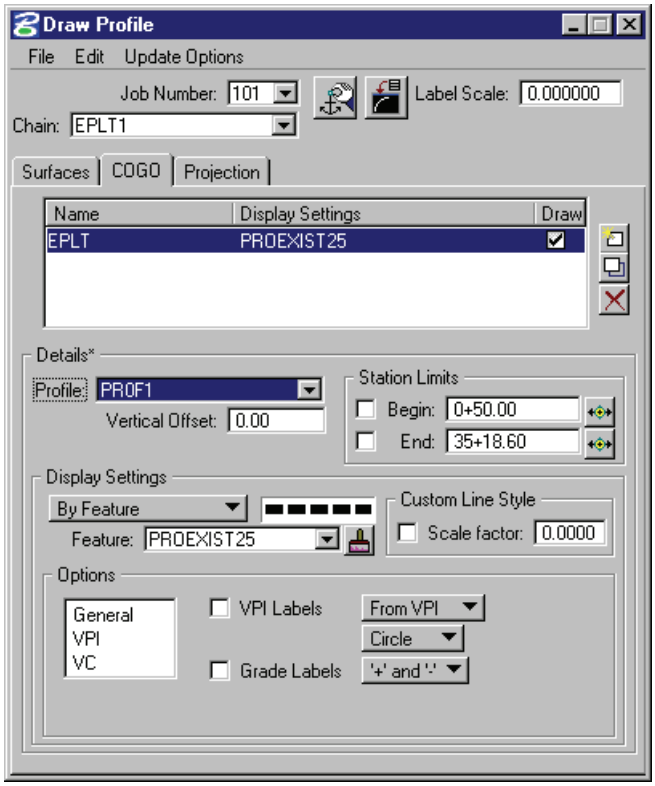
LAB EXERCISE: PROFILES

> *DRAWING PROFILES*

1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843prof.dgn*.
2. Select **Applications > GEOPAK Road > Plans Preparation > Draw Profiles**.
3. From the Draw Profiles dialog open the Profile Cell Control dialog and set the Active Chain to **EPLT1**.

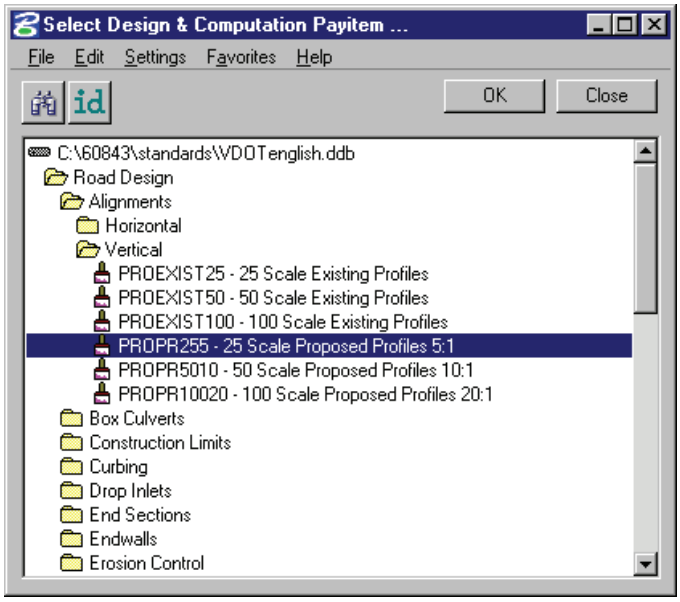


4. Select the COGO tab on the dialog.
5. In the **Display** portion of the dialog set the profile to **PROF1**.

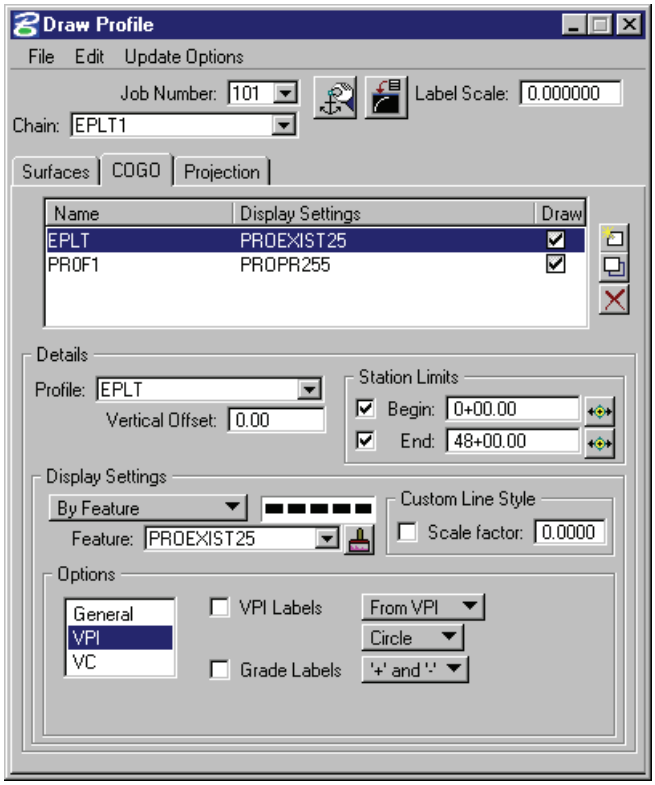


6. In the **Display Settings** portion of the dialog set the toggle to **By Feature** and click on the paintbrush icon.

7. From the D&C Manager select the feature **PROP255**.

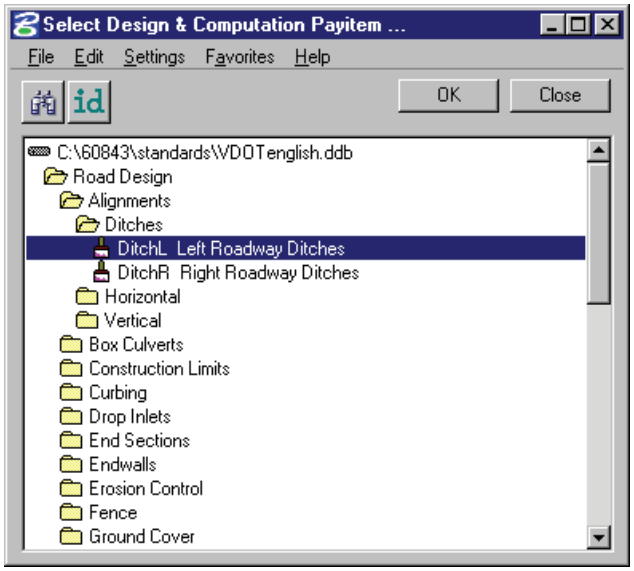


8. Click **OK**.
9. Click the **Add Profile** icon on the right side of the list window to add the profile in the list and draw graphically.

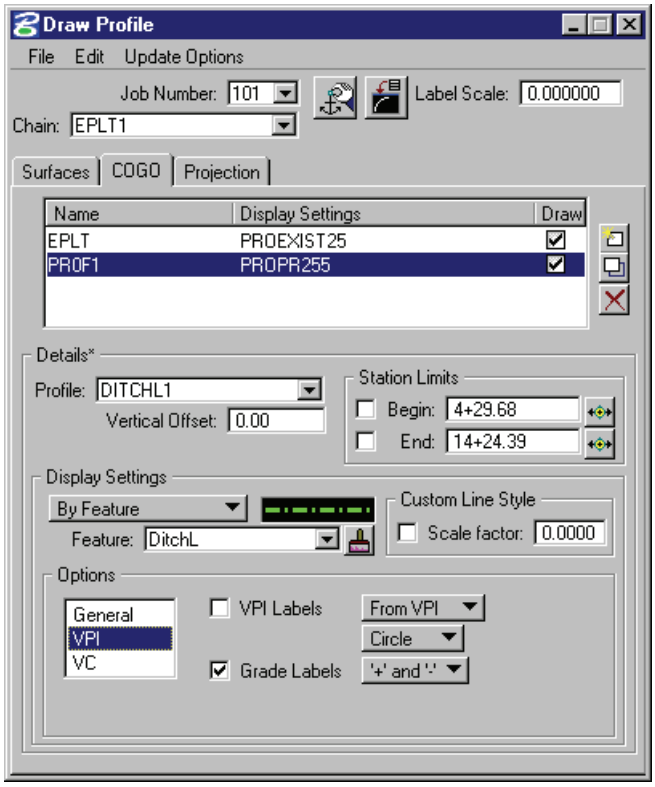


> *PLOTTING DITCHES*

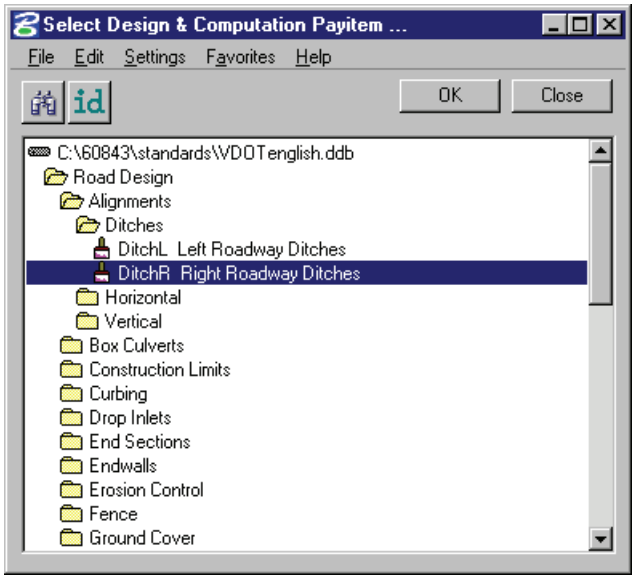
1. While still on the COGO tab, change the profile to **DITCHL1**.
2. Set the Display Settings to **By Feature** and select the feature **DitchL**.



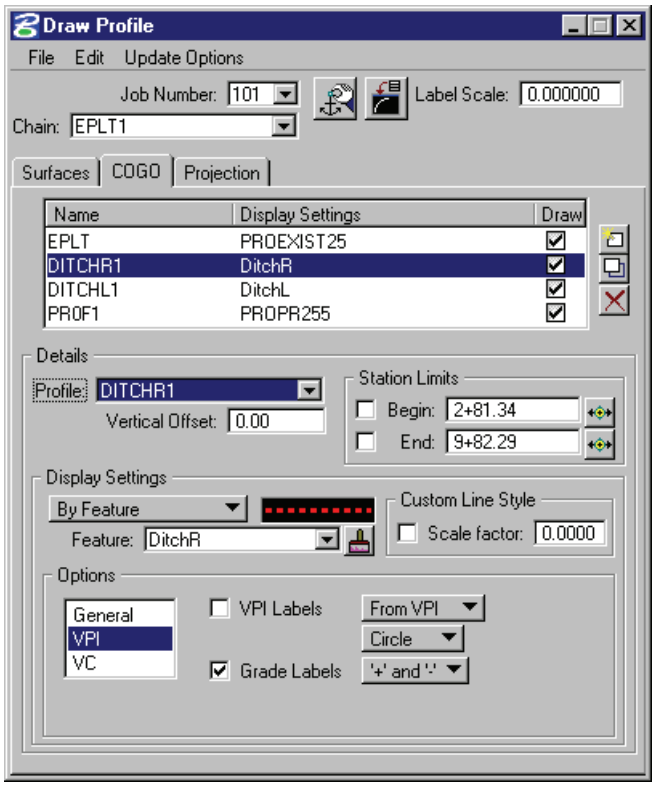
3. Click **OK**.
4. In the **Options** settings, highlight **VPI**.
5. Toggle **ON** the **Grade Labels**.



6. Make sure that all toggles are **OFF** for the other **Options** settings.
7. Add the ditch to the list window.
8. Change the feature to **DitchR**.



9. Change the profile to **DITCHR1**.
10. Add this ditch to the list window.



11. These ditches can be manipulated with any MicroStation command and moved to the desired location in the profile view.

4 Superelevation

CHAPTER OBJECTIVES

In this chapter you will review the preferences and dialogs for computing superelevation. Also included will be instruction on **Shape Manager** tools.

INTRODUCTION

GEOPAK supports a myriad of options for the definition of pavement on proposed cross sections. They range from a single slope specification emanating from a baseline / profile on each section, to complicated multiple roadways, each with its own superelevation transitions.

The most basic is the project where no superelevation transitions are required, i.e., the roadway slope for all pavement (if any) can be specified as a single value. In this case, the slope can be defined with the proposed cross section processing and any additional superelevation work is not required. This process will be utilized in Exercise 12 when we have GEOPAK draw the existing shoulder and pavement on the sections – shapeless.

Another option is the definition of superelevation when roadways are constant widths without tapers, i.e., turn lanes, acceleration and deceleration lanes, etc. In these areas, the automated superelevation can be utilized, based on a user-defined design speed and considering the geometry of the specified roadway. After careful review of the data (in ASCII format) and overriding the computed values, GEOPAK draws pavement representations as complex shapes into a MicroStation 2D design file.

A third option is the definition of superelevation when roadways are not constant widths, i.e., gore areas, turn lanes, acceleration and deceleration lanes, etc. In these areas, graphics elements within a MicroStation 2D design file are utilized to create complex shapes which define the superelevation transitions.

A combination of these tools can be combined with a project, or even within a single roadway. The shapeless mode is excellent for rural applications, low volume city streets, frontage roads, etc., while the automated method quickly generates automated shapes for more complex roadways. Any area which cannot be defined via the automated method can be augmented by the graphical method.

ACCESSING AUTOMATED SUPERELEVATION (AUTOSHAPE INPUT FILE MAKER)

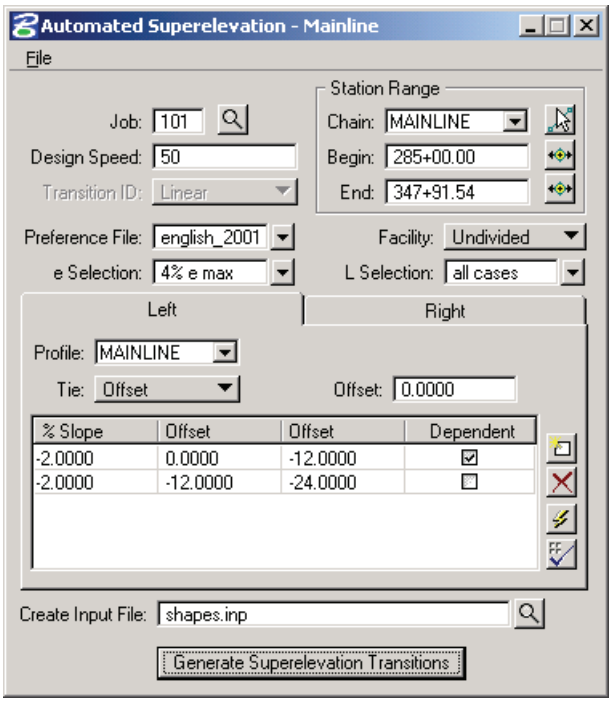
The Automated Superelevation tool can be accessed by selecting Applications > GEOPAK ROAD > Cross Sections > Superelevation Shape Manager Tools. It can also be invoked from Project Manager by clicking the Calculate Superelevation button or by selecting the Automated Superelevation icon from the GEOPAK ROAD tool frame.

The GEOPAK Superelevation package enables the user to create, edit, and run an autoshape input file quickly, basing it on an existing COGO alignment.

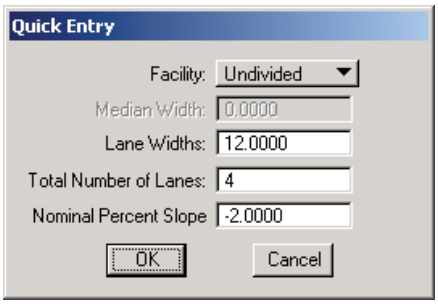
A set of preferences is available which gives the user complete control over every aspect of the standardization of the superelevation design process. AASHTO Method V is available as a default, along with the ability to employ user-defined lookup tables both for e (superelevation rate) and for runoff length. User-defined equations may also be entered to compute these values. A thorough set of options is available for resolving the superelevation conflicts of Reverse Curves, Compound Curves, Broken Back Curves, and Short Curves.

GEOPAK calculates superelevation transition locations for any alignment stored into the coordinate geometry database. The main superelevation dialog is simple and straightforward, allowing the user to select which preference file is to be used for the current session, as well as enabling the entry of the typical section lane configuration in the simple engineering terms of Number of Lanes, Lane Widths, Median Width (if any), and Cross Slope. More complex lane configurations may be represented as needed.

Upon computation of the superelevation parameters (cross slopes and stationing), the information is stored in an ASCII file, where the user may review and modify the transitions, if desired. After reviewing the information, the ASCII file is executed from the Autoshape Builder to generate superelevation shapes.

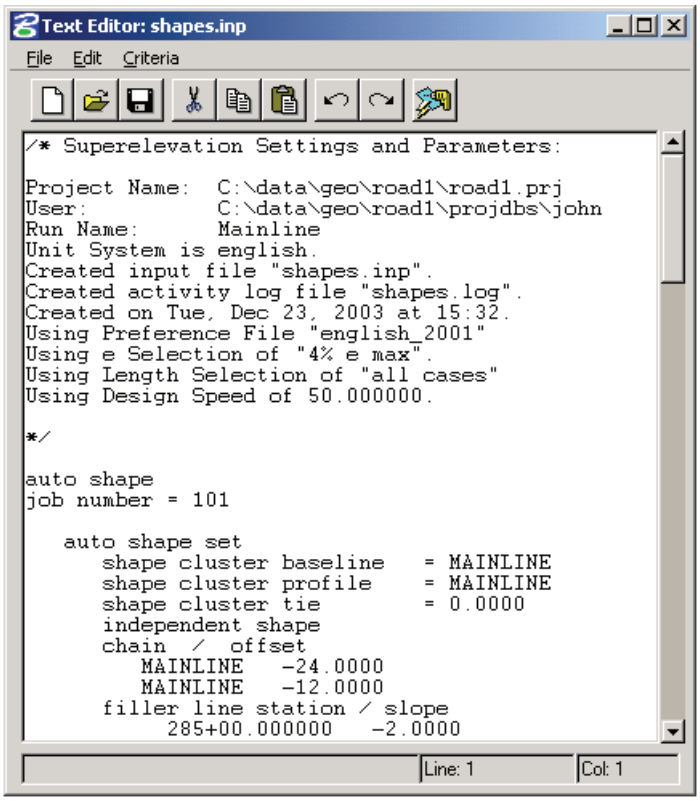


Job	Coordinate geometry database containing the desired chains and profiles.
Chain	GEOPAK baseline chain dictating the horizontal geometry for which superelevation transitions are calculated. This chain is also called the Shape Cluster Baseline in the Auto Shape input file.
Begin Station	When the chain is defined, GEOPAK populates the Begin Station with the default beginning of the chain. To compute superelevation for part of a chain, adjust the station.
End Station	When the chain is defined, GEOPAK populates the End Station with the default beginning of the chain. To compute superelevation for part of a chain, adjust the station.
Design Speed	Design speed that determines what Design Speed is to be used either in the tables or equations for e and length computations.
Preference File e selection L selection	The Preferences File combo box selects which Preference File is to be used for this computation. The various Preferences Files which are available in the combo box are determined by what files have the .sep file extension in the Preference Files Path on the User Directories dialog. When it is set, the available e and length Selection combo boxes are filled in according to the csv file names as specified in the Preferences File. Those combo boxes determine which table within the .csv file will be used for computation.
Facility	Facility determines whether the roadway cross section is to be divided or undivided. This option determines two things. For the dialog box, it determines whether or not the values Profile, Tie (Offset or PGL), and or the Tie or PGL values may be different. If they are different then two shape clusters are to be generated, which usually is required for a median. The state of the Facility option button also determines which Preference is used as found on the Distribution tab of the Preferences dialog.
Left / Right tabs	The area enclosed in the Left / Right tabs are for the determination of values specific to shape clusters. NOTE: The right and left tabs contain data pertaining to each lane within each roadway. If the Facility is undivided, then the left tab is for the left lane(s) while the right tab is for the right lane(s). If the Facility is divided, then the right tab is for the entire right roadway, while the left tab is for the left roadway.
Create Input File	ASCII file wherein GEOPAK creates the autoshape input file. DO NOT include the extension, as GEOPAK adds .inp to the field.
Generate Superelevation Transitions	Commence automatic superelevation calculations
Profile	GEOPAK profile defined as the Shape Cluster Profile in the Auto Shape input file.
Tie	Offset - Horizontal distance from the Profile (PGL) to the Chain. PGL Chain - Chain stored in the gpk file that the shapes will be computed from. This chain does not require a profile be stored with it as the defined profile will be applied to this chain.
Offsets	Offsets define the dimension of the shape (usually a lane) by two offset distances from the baseline. Note that tapers are not supported. Offset distances are negative if measured to the left. . Each lane must have the same offset on the left as the left adjacent lane and must have the same offset on the right as the right adjacent lane (no gaps in offsets). Computation may not proceed if this condition is not met.

% Slope	Cross slope of each shape in normal crown in percent format. A negative sign denotes the roadway going downward, while emanating away from the PGL. A Normal Crown section of 2.0% would, therefore, be entered as –2.0. Lane offset values are entered in terms of master units, i.e., feet or meters.
Dependent / Independent	One dependent shape, which is based on the profile, is required for each cluster. Other shapes are drawn not based on the profile, but on adjoining lanes, and are independent. For example, turn lanes are drawn abutting next to the mainline roadway, so they are independent. However, a lane based on the profile for its initial elevation, such as one of the through lanes, is profile dependent.
Edit buttons: **Add** **Delete** **Modify**	Add – populate the fields and click Add. To delete a line, highlight the desired line, then click the Delete button. To modify a line, highlight the desired line, click once on the value to be modified. The value will be placed in an edit mode. Change the value then hit enter or tab out of the field.
Quick Entry (second to bottom tool to the right of the list box)	Enables the user to populate the shape cluster list boxes quickly while entering the data using engineering terminology. 
Rectify Lanes (bottom tool to the right of the list box)	If Offset values have been entered that create a gap between lanes, the Rectify Lanes option removes this gap. Click Rectify Lanes and the values will be modified so that any gaps are removed.

Selection of the **Generate Superelevation Transitions** button performs the actual superelevation computations. Three things happen at this point.

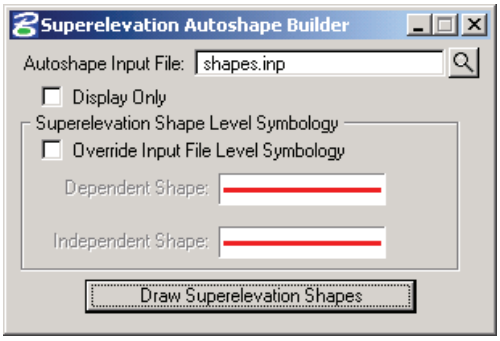
- First, the superelevation transitions as computed by GEOPAK are written to the Autoshape Input File specified by the user (in the Create Input File field).
- Second, the log file is written.
- Finally, the Autoshape Input File is loaded into the text editor running within MicroStation. This Autoshape Input File Editor has an icon at the top that allows the Autoshape Input File to be run. Autoshape Input files can also be run from the Autoshape Builder.



DRAW SHAPES INTO PLAN VIEW FILE

The Autoshape Builder is NOT accessible from Project Manager but can be invoked by selecting Applications > GEOPAK ROAD > Cross Sections > Superelevation Shape Manager Tools or by selecting it from the GEOPAK ROAD tool frame.

Once the shape input file (fname.inp) has been created and reviewed, the designer can run the input file to place the superelevation shapes into the specified graphics file. To use the interactive method to define roadway superelevation (in a .dgn file) the designer selects the **Autoshape Builder** from the Superelevation Shape Manager Tools tool bar (or alternately from this same tool within the Text Editor as described above).



Autoshape Input File	Name of .inp file (shapes.inp) created by the Automated superelevation generation containing the transitions.
Display Only	Create the shapes in "Display Only" mode. That is, they are not written to the design file and a view Update operation eliminates them, as does zoom in, etc.
Override Input File Level Symbology	This option is used to override the Plot Parameters settings in the Superelevation Shapes input file.

The shapes are placed in a 2D graphics file on level 63 by default. The plot parameters can be modified in the input file with a text editor prior to building the shapes into the graphics file or with the User > Symbologies pull down on the Automated Superelevation dialog.

SUPERELEVATION SHAPE MANAGER TOOLS

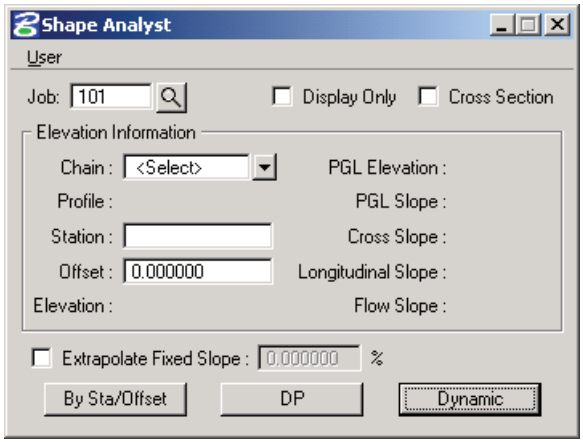
The **Superelevation Shape Manager** tools can be invoked by selecting **Applications > GEOPAK ROAD > Cross Sections > Superelevation Shape Manager Tools** or by selecting it from the GEOPAK ROAD tool frame.

The tools in the Superelevation Shape Manager Tools toolbox are detailed below.

	**Automated Superelevation -** performs the actual calculations and stores the results in an ASCII file, known as the autoshape input file.
	**Autoshape Builder -** processes the autoshape input file and draws corresponding complex shapes in the specified 2D design file.
	**Shape Maker -** graphical method of drawing irregular superelevation shapes. This method is utilized for gore areas, turn lanes, etc.
	**Shape Analyst -** provides information on any point within a GEOPAK superelevation shape.
	**Shape Profiler -** provides profile information based on user-define increments intersecting a GEOPAK superelevation shape.
	**Shape Editor** - dynamically change parameters on a previously created shape. This includes filler line stationing, dynamic moving of shapes, etc.
	**Shape Selector -** highlights or selects shapes based on a wide range of user queries or filters.
	**Shape Properties** - provides information on any GEOPAK superelevation shape. In addition, this shape information can be modified on individual shapes of selections of shapes.
	**Shape to DTM -** provides the option to store a DTM Dat file from the superelevation shapes. In addition, it can plot the calculated elevations into the design file at a user specified interval.

SHAPE ANALYST

The **Shape Analyst** tool is extremely useful, as it provides information on any point within a GEOPAK superelevation shape.



Before using this tool, the Job Number must be selected. Upon selecting a Job Number, a Chain must be selected that the shapes are defined relative to. If Display Only is enabled, information like elevation and a flow arrow are drawn to the view, but they are not written as elements to the active MicroStation file.

When the **Cross Section** toggle is not activated and a data point is issued within a shape, the elevation of the data point and a flow arrow are displayed. When the toggle is activated, a dashed line is placed through the data point, radial to the shape cluster baseline. In addition to the elevation and flow arrow placed at the data point, elevations are displayed where the cross section line intersects any superelevation shape and cross slopes are labeled for each shape.

The **By Sta/Offset** button causes the current Station / Offset value to be projected back onto the shape cluster baseline and the elevation of the projected point is displayed. This option can be manual entry only and requires no data point on the screen.

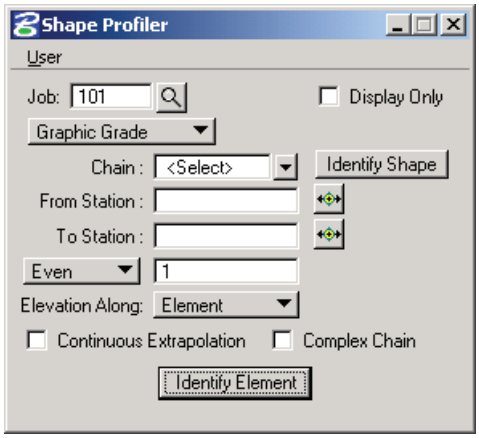
The **DP** button works within a superelevation shape whose X, Y coordinates are utilized to compute station / offset from the specified shape cluster baseline, which is subsequently utilized in conjunction with the shape to compute the various slopes and elevations. After the **DP** button is clicked, numerous data points can be placed. It is not necessary to click the DP button again. Each corresponding station / offset is displayed along with the associated output information.

The **Dynamic** button activates the dynamic mode. As the cursor moves across the screen, any momentary pause places the elevation and flow arrow in the MicroStation file and computes and displays the analysis information.

The **Extrapolate Fixed Slope** toggle is another option supported in the **Shape Analyst** tool. The option is utilized when the data point, dynamic point or station / offset is outside of the shape. When the option is not activated, the data point is projected back to the shape's chain. The elevations at the edges of the shape are displayed and the slope of the outside shape is projected to the data point. When the toggle is enabled, the user defined slope is projected from the outer most shape to the data point to determine an elevation.

SHAPE PROFILER

The **Shape Profiler** tool computes elevations along any GEOPAK shape or MicroStation element at a user specified interval. The element can be inside or outside of the shapes.



The Job field can be populated by key in or using the **Select…** button. After selecting a GPK file, click **Identify Shape** and data point on any shape along the desired Chain. Set the From Station and To Station fields by keying in values or using DP.

Even should be selected when it is desired to have the elevations compute at the even station values. Increment will allow the elevations to be computed starting at the From Station, then adding the increment value to that station. Intersect is used with an element to compute elevations at all locations that the element intersects the shape(s).

The **Elevation Along** toggle can be set to Shape or Element. When set to Shape, elevations will be computed based on the Even/Increment value along both longitudinal edges of the shape. When set to Element the elevations are computed along the element based on the **Even/Increment/Intersect** toggle.

Continuous Extrapolation allows the user to identify multiple longitudinal elements outside of the shape area and compute elevations by a user defined Slope and one of three methods: Radial to Baseline, Radial From Element, or Radial to Element.

SUPERELEVATION PREFERENCES

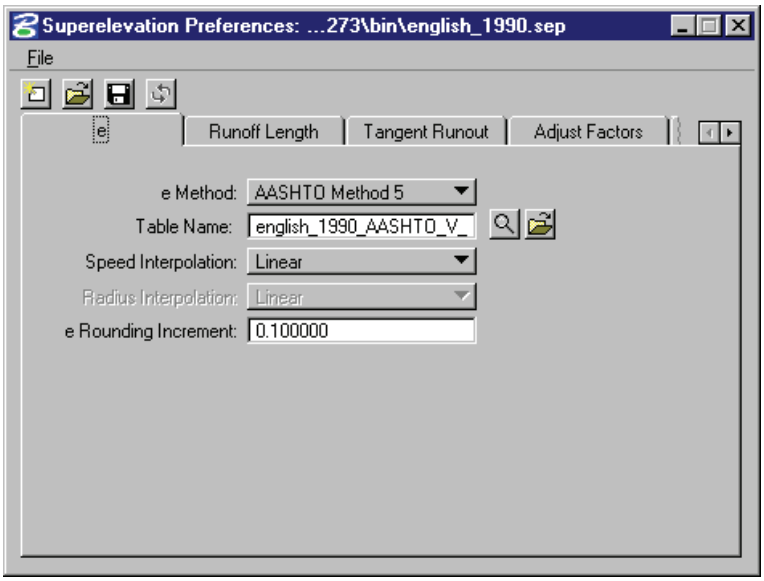
A set of preferences is available which gives the user complete control over every aspect of the standardization of the superelevation design process. AASHTO Method 5 is available as a default, along with the ability to employ user-defined lookup tables both for e (superelevation rate) and for runoff length. User-defined equations may also be entered to compute these values. A thorough set of options is available for resolving the superelevation conflicts of Reverse Curves, Compound Curves, Broken Back Curves, and Short Curves.

Superelevation Preferences are saved to disk in a file of ASCII format with an extension of .sep. Users may edit the file in a text editor, or they may edit it with the Superelevation Preferences Editor.

When editing a Preferences file with a text editor, comments may be inserted. Comments are delineated with a dollar sign ('$'). Comments may take up an entire line, or may be on the same line as a data entry. When a $ is found on a line, GEOPAK does not read that line any further. Although there is no way to edit the comments in the Preferences dialog, comments are not lost when the .sep file is edited via the dialog.

E TAB

The first step in the process is the computation of e for each curve. Regardless of the manner of computation, e computation is based on the curvature of each curve and the Design Speed. When the E tab is selected, the dialog dynamically changes as shown below.



E Method:
Radius Table
AASHTO Method 5
Equation

This option determines which method GEOPAK uses to compute e.

Table name

AASHTO Method 5 or **Radius Table -** this field contains the name of the csv file in which to find the tables. Generally, no path should be given in the file name since these are controlled by Environmental Variables and/or user control in the Superelevation Computation dialog. If a path is specified along with the csv file name, that path will be used regardless of other methods of setting the path such as Environmental Variables.

Equation - text field is the location where the equation is entered. Click **Files** to select the file. Clicking **Edit** opens the editor specified in the environmental variable GPK_SUPER_EDITOR and should normally be set to Excel or some type of spreadsheet application.

Speed Interpolation:
Linear
Closest Entry
Conservative Entry

Specifies how GEOPAK is to interpolate between Design Speed columns if the user selects a Design Speed which is not found in the table. Speed Interpolation applies to both the **AASHTO Method 5** table and **Radius Table** for e computation,

Radius Interpolation:
Linear
Closest Entry
Conservative Entry

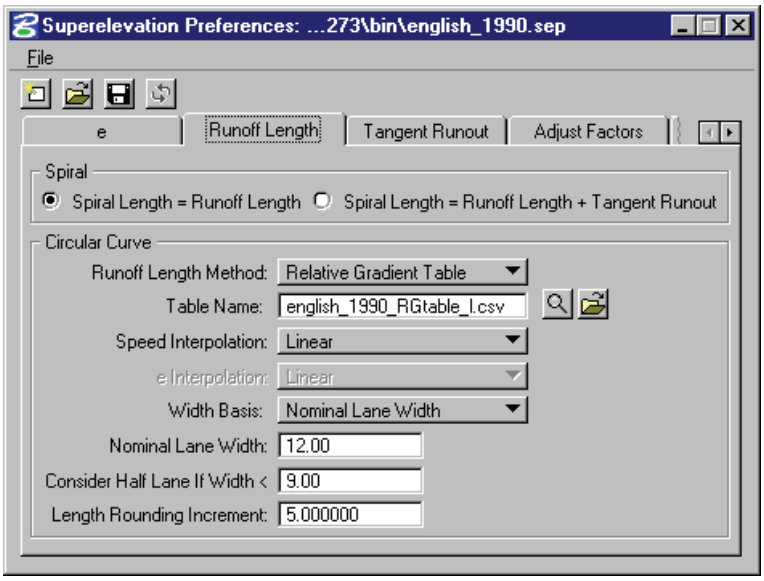
Radius Interpolation only applies to the Radius Table option. This interpolation option button specifies how GEOPAK is to interpolate between Radius Rows if the given Radius does not have a corresponding row with an exact match in the table.

E Rounding Increment

Applies to e regardless of how it is computed. . This is simply rounding to the nearest evenly divisible number of the rounding value. For example, if e-rounding were set to 0.25, and e as it is computed from a table comes out to be 3.789, the value would be rounded to 3.75, which is evenly divisible by 0.25. Set a value of 0.00 to disable the rounding of e.

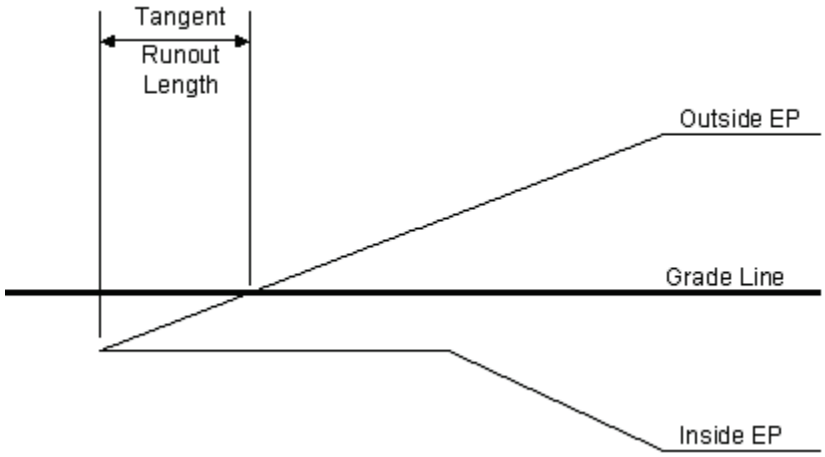
RUNOFF TAB

The second step in the process of computing Superelevation transitions is the computation of Unadjusted Length, which is the Runoff Length as if the roadway had two lanes only. (Adjusted Length is the true Runoff Length, adjusted for the true roadway width.) In all methods of computation of Unadjusted Length, the computation is based on the rounded e value for each curve.

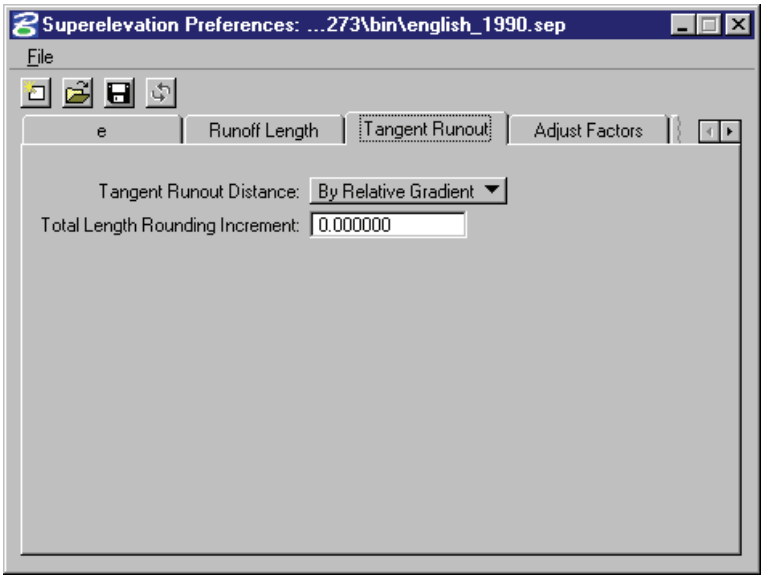


TANGENT RUNOUT TAB

Tangent Runout is the distance from a Cross Slope of Normal Crown to a Cross Slope of zero as depicted here:

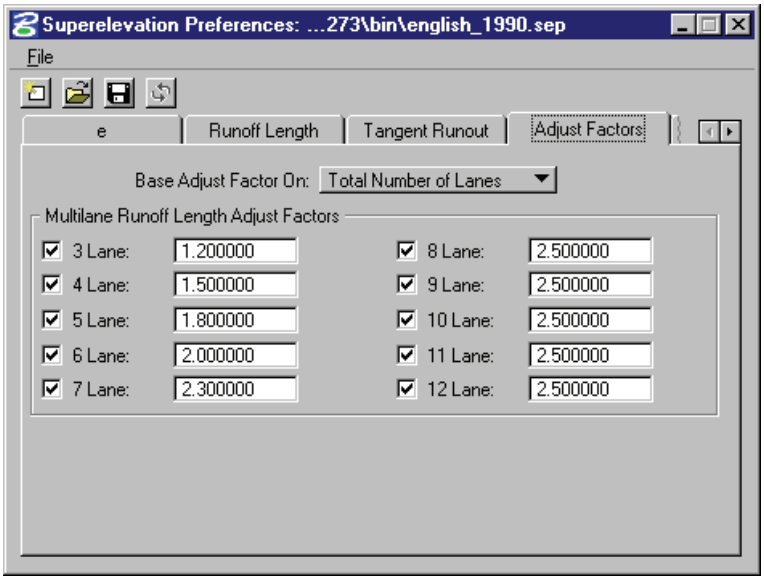


Three methods are available to compute Tangent Runout Length: **By Relative Gradient**, **Fixed Distance**, or **Equation**



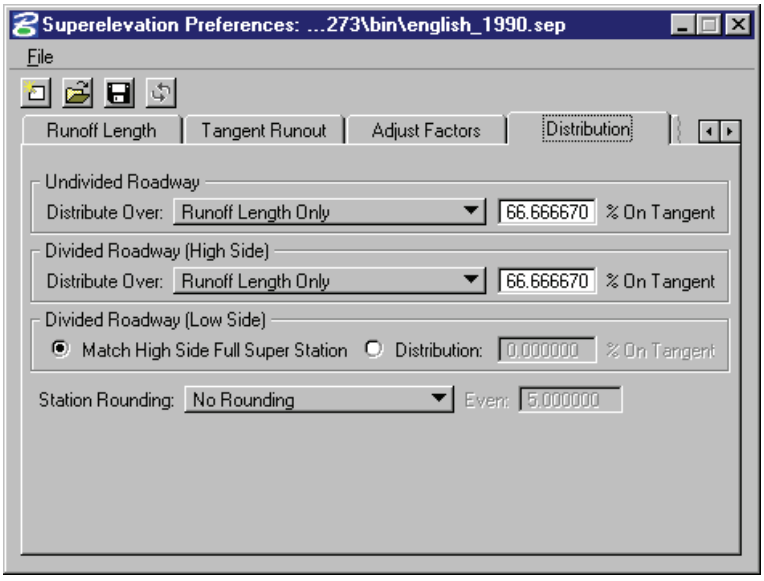
ADJUST FACTORS TAB

The user can control Adjustment Factor settings for three lanes up to twelve lanes. If a roadway has more than twelve lanes, the length adjustment is made according to the settings for twelve lanes.



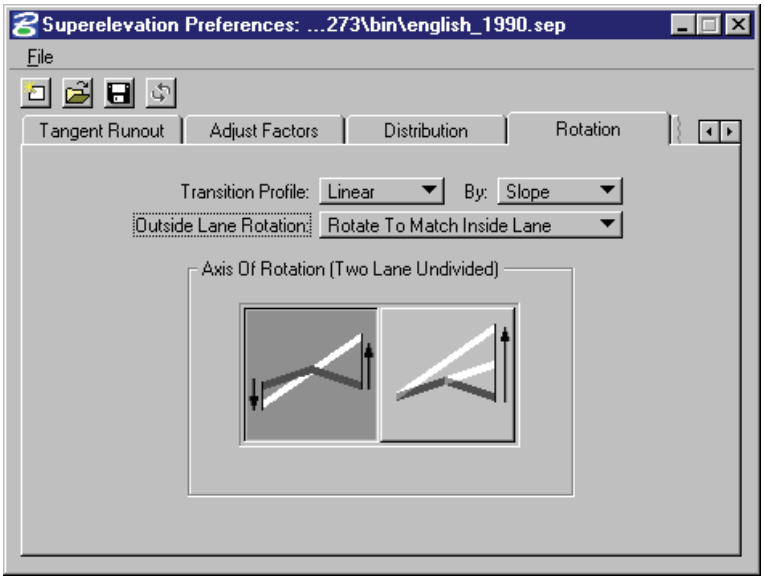
DISTRIBUTION TAB

After Adjusted Lengths have been computed for non-spiraled ends of circular curves, the transition is distributed over the curve and its adjacent tangents and stationing is computed relative to the PC and PT. The amount of the transition which falls on the tangent is termed **Percent on Tangent**. Options are provided to base that percentage on Total Length or on Runoff Length.



ROTATION TAB

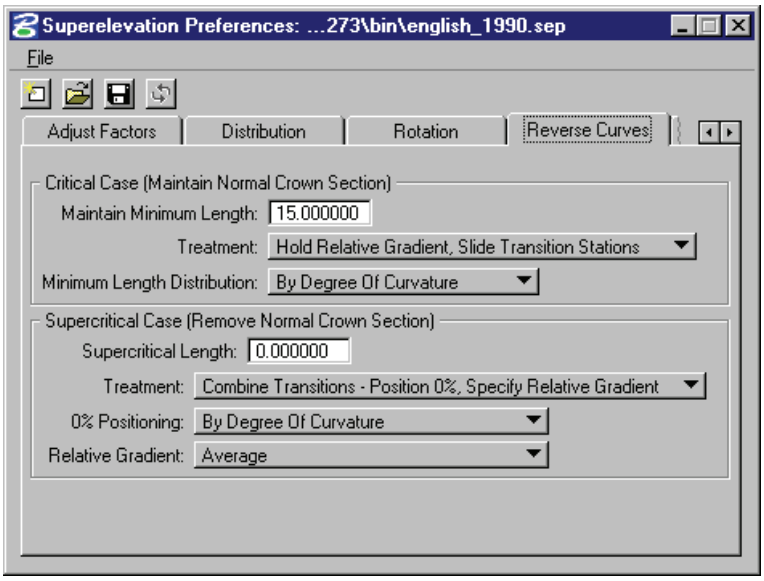
The Rotation tab provides a means to indicate how the super will be rotated and the axis point the rotation will occur.



REVERSE CURVES TAB

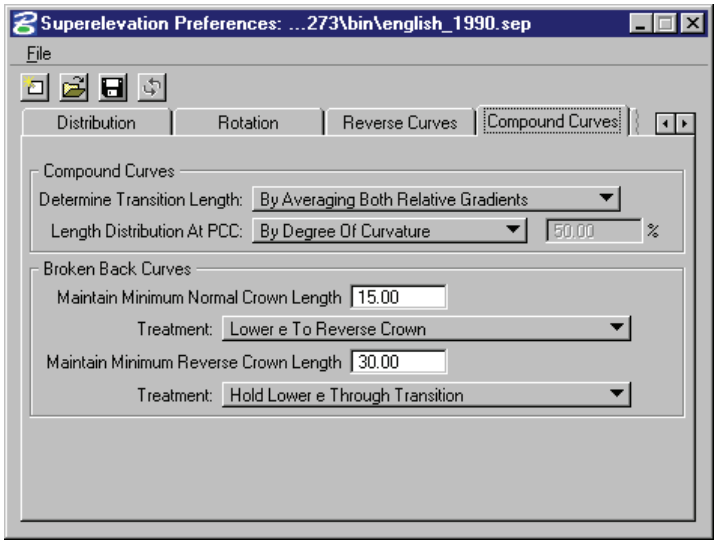
Reverse Curves occur when two adjacent curves which deflect in opposite directions have superelevation transitions which overlap or are in close proximity. Two levels of conflict are defined for Reverse Curves: Critical and Supercritical. The determining factors for defining a conflict as Critical or Supercritical are both based on the Length of Normal Crown existing between the two transitions. (Note that overlapping transitions may be considered to have a negative Length of Normal Crown.)

The distinction, then, between Critical and Supercritical has to do with how the conflict is handled. If the conflict is Critical, adjustments are made so that the Minimum Normal Crown Length is maintained. If the conflict is Supercritical, the transitions of the two curves are merged and Normal Crown never occurs between the conflicting curves. When GEOPAK checks for this conflict, it first checks to see if the Length of Normal Crown violates the Supercritical threshold. If it does not, GEOPAK then checks the Critical threshold. This means that if the value for Maintain Minimum Length is less than or equal to Supercritical Length, no conflict would ever be handled as Critical. Also note that either value may be negative, although this is ill-advised for Maintain Minimum Length.



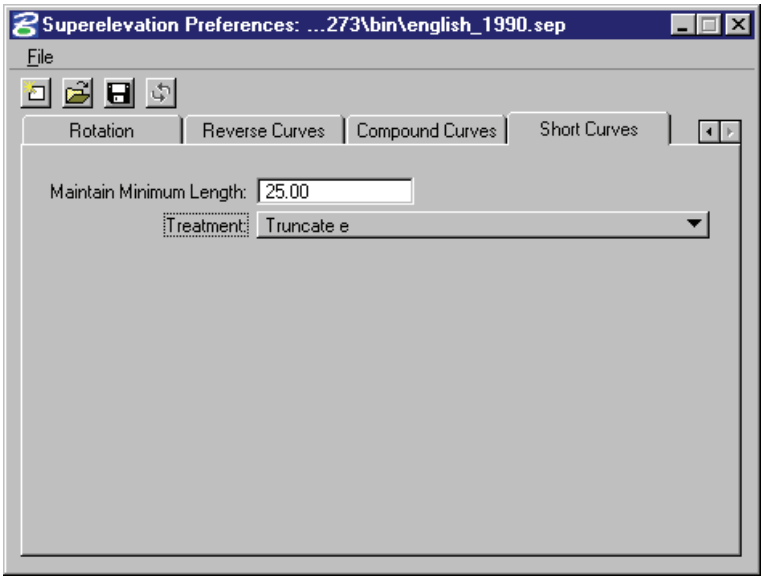
COMPOUND CURVES TAB

The dialog contains settings for two types of conflicts in which two adjacent curves deflect in the same direction. "Compound Curves" are when two curves deflect in the same direction and have no intermediate tangent section, but instead share a common station, the PCC. "Broken Back Curves" occur when two curves deflect in the same direction and have an intermediate tangent section which is short enough that the superelevation transitions of the two curves overlap or nearly overlap.



SHORT CURVES TAB

The Short Curve conflict occurs when the length of the fully superelevated portion of the curve is shorter than the desired minimum. This is not a conflict between two adjacent curves as the other conflict types, but is instead an undesirable situation occurring on a single curve.



SUPERELEVATION TRANSITION CONFLICT RESOLUTION

Superelevation Transition Conflicts occur when the stationing of the superelevation transitions of two adjacent curves overlap, or when the fully superelevated station range on one curve is too short.

When curve conflicts occur, GEOPAK attempts to resolve them by adjusting relative gradients, distribution percentages or e values, depending on the applicable preferences.

Before writing the autoshape input file, GEOPAK scans the filler line stationing created by prior processes in the superelevation flowchart for conflicts.

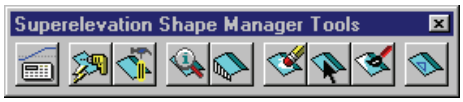
LAB EXERCISE: SUPERELEVATION SHAPE MANAGER TOOLS

The Shape Maker window permits graphical and interactive creation of superelevation shapes. Interactive shape creation is typically required only for those areas where the longitudinal edges of the shapes have not been stored as GEOPAK chains or offset chains. The left-turn bay shown below is an example of a shape that is typically created from the Shape Maker Window.

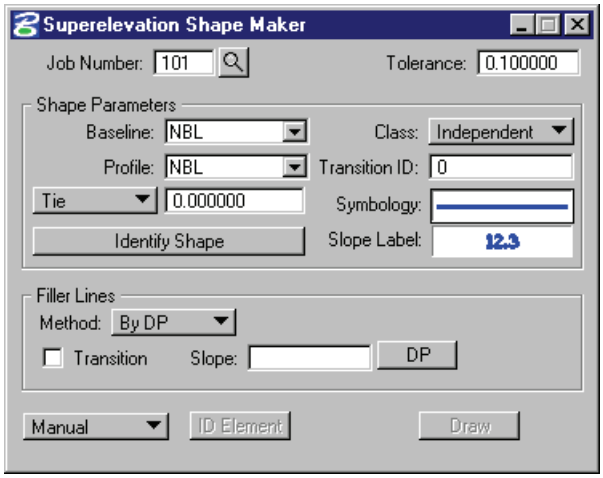
> ***SHAPE MAKER***

1. Open the MicroStation file *c:\data\geo\vdot\road2\60843\d60843work.dgn*.
2. Attached the saved view *Shape Maker*.
3. Turn off enough levels to have a clear image of the left turn lane shown below. We need this area clear of elements in order to shape.

4. Select **Applications > GEOPAK Road > Cross Sections > Superelevation Shape Manager Tools**.

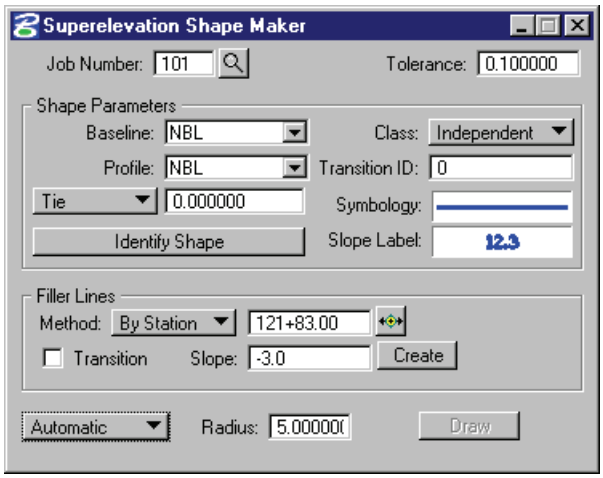


5. Click the third icon from the left to access **Shape Maker**.
6. Set the **Shape Parameters** portion of the dialog like the one shown below.

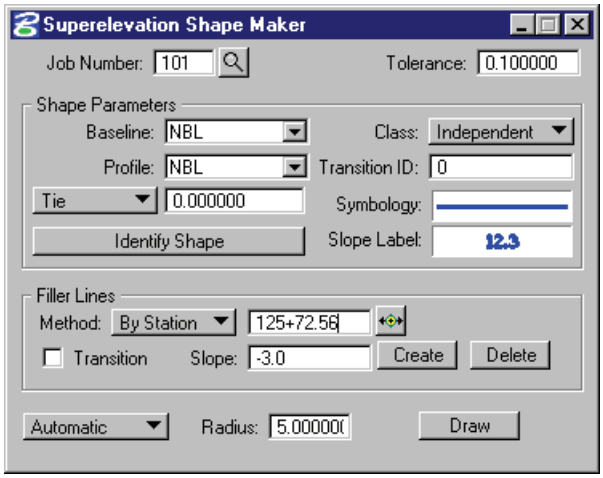


7. In the **Filler Line** portion of the dialog set the **Method** to **By Station**.
8. Enter a station value of 121+83.00.
9. Key-in a slope of -3.0.

10. Click the **Create** button.



11. Create another Filler Line at station 125+72.56 with the same slope of -3.0.

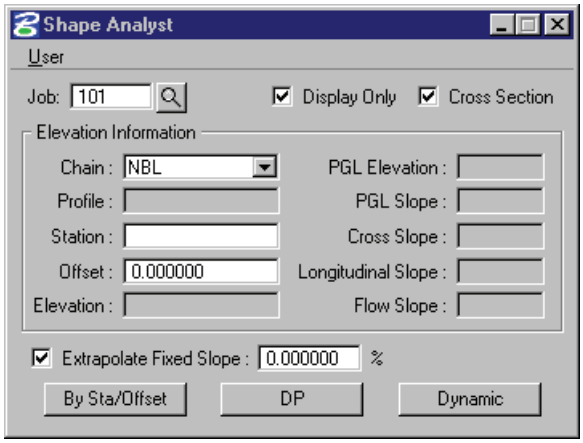


12. With the toggle at the bottom left of the dialog set to **Automatic**, click the **Draw** button and data point inside the turn lane.
13. You should now have the turn bay shaped.

> *SHAPE ANALYST*

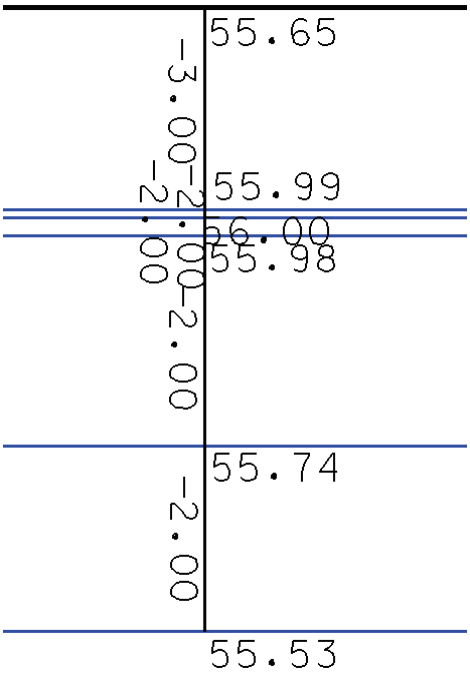
The **Shape Analyst** tool is extremely useful, as it provides information on any point within or outside a GEOPAK superelevation shape. This tool supports all GEOPAK superelevation shapes, including those with non-linear (parabolic) transitions, non-zero ties and PGL chains.

1. Click on the fourth icon from the left on the **Shape Manager** tool bar. This will invoke the **Shape Analyst** tool.



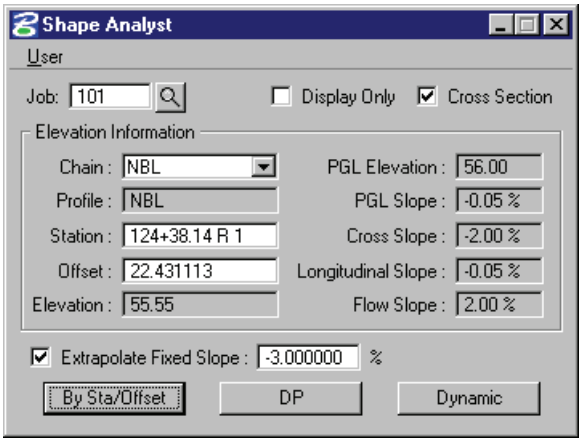
2. Using the chain list pull down set the chain to **NBL**.
3. Click the ***DP*** button and data point on a shape. (Make sure the **Extrapolate Fixed Slope** is turned OFF).

4. This should produce slope and elevation information on the shapes as shown below.



Note You may have to change the symbology settings to view the text more easily. This can be done by selecting the Preference pulldown in the upper left of the dialog.

5. Turn ON the **Extrapolate Fixed Slope** toggle.
6. Enter a slope of -3.0.



7. Click the DP button and data point outside of the shapes.
8. This will compute an elevation at the data point by projecting the desired slope.

Note An explanation of Extrapolate Fixed Slope is outlined below.

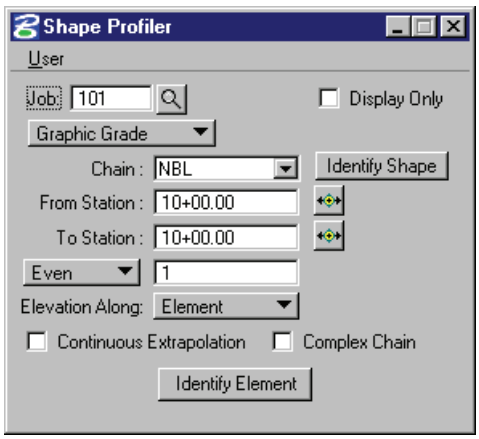
The **Extrapolate Fixed Slope** option is utilized when the data point, dynamic point or station / offset is outside of the shape. When the option is not activated, the data point is projected back to the shape's chain. The elevations at the edges of the shape are displayed and the slope of the outside shape is projected to the data point.

When the option is toggled ON and set to a specific slope, the slope is projected from the outside shape to the data point to calculate an elevation at that point.

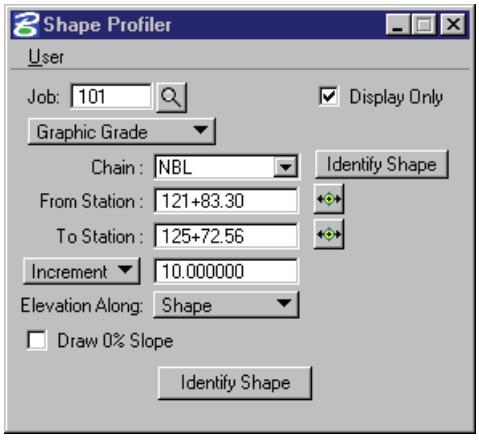
> *SHAPE PROFILER*

The Shape Profiler will generate profile information based on projections from superelevation shapes. It can also generate profiles along any shape.

1. Click the fifth icon from the left on the **Shape Manager** tool bar.
2. This will invoke the **Shape Profiler** as shown below.



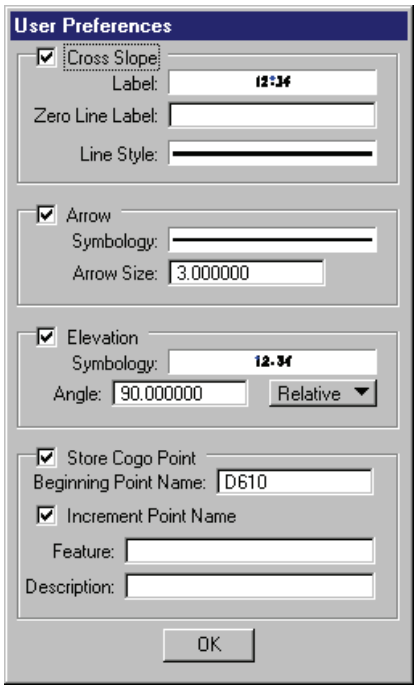
3. Set the options in the dialog as shown below making sure to identify the **From Station** and **To Station**.



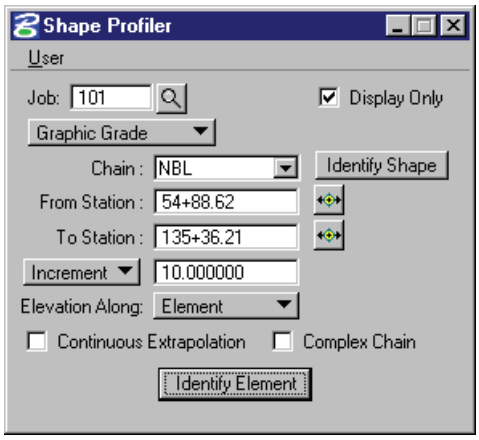
4. Once the settings have been made click the **Identify Shape** button at the bottom of the dialog and data point on the left turn bay shape created in the previous exercise.
5. Click one more data point to **Accept**.

6. This will compute elevations around the perimeter of the shape as shown below.

7. Next select the User > Preference pulldown in the upper left of the dialog and toggle ON the option to **Store COGO Point** setting the **Beginning Point Number** to D610.

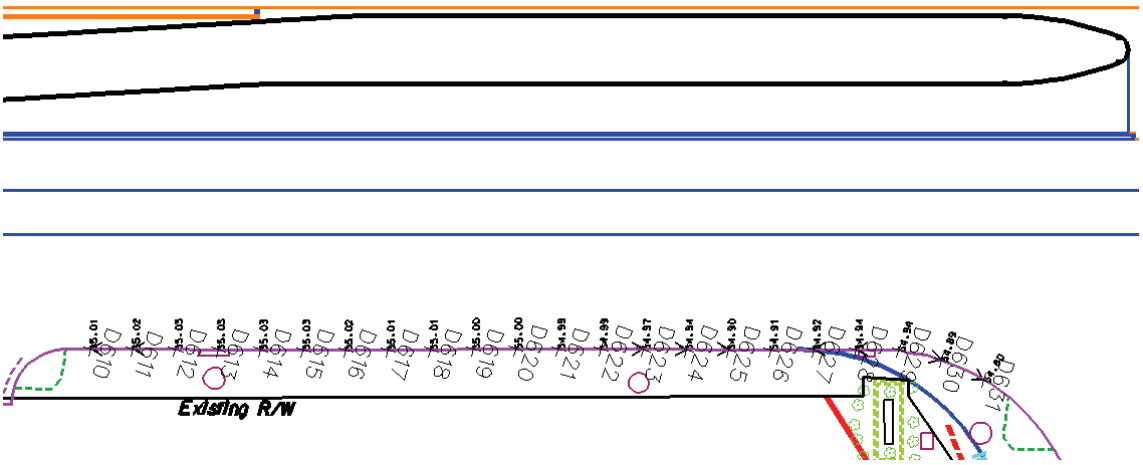


8. Click **OK**.
9. Click the **Identify Shape** button next to the chain field and data point on the farthest right side shape.
10. Set the **Elevation Along** option to **Element**.



11. Click the Identify **Element** button at the bottom of the dialog and data point on the existing curb line to the right of the shape.

12. The shape slope will be project to the element and points stored in COGO at the desired increment.

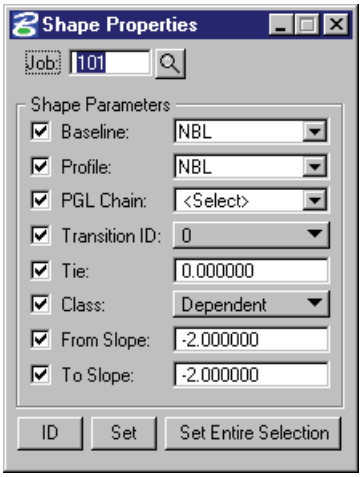


Note The Store Profile By Numbers command in Coordinate Geometry generates and stores a new profile name defined by previously stored points in either A) a sequence pa-pi or B) a random list. Sequential stationing and given elevation values must be stored with points prior to execution of both formats. **SYNTAX: STO PRO *name* pa-pi**

> *SHAPE PROPERTIES*

The **Shape Properties** tool allows the user to review all the information associated with a particular shape. In addition to reviewing each aspect of the shape properties may be changed or edited.

1. Click the eighth icon from the left on the **Shape Manager** tool bar.
2. This will invoke the **Shape Properties** tool.



3. Toggle ON each of the properties.
4. Click on the **ID** button and data point on a superelevation shape.

Note Any of the information in the dialog may be changed by editing the values and using the **Set** button to identify the shape.

5 Cross Sections

CHAPTER OBJECTIVES

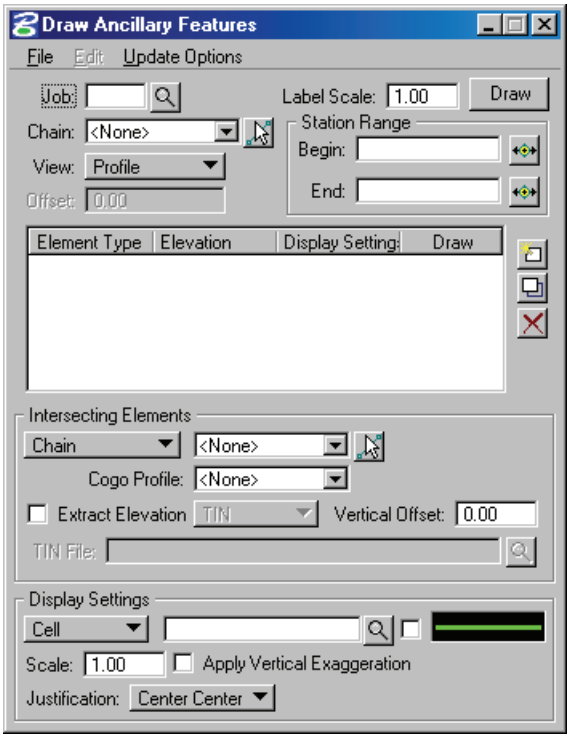
In this chapter we will review the Ancillary Features application and new enhancements in the latest version. These include:

- New Update Options
- AdHoc Functionality

Also a brief discussion on Tolerance settings will be included.

INTRODUCTION

The Ancillary Features application is used to draw supplemental information onto cross sections and profiles. This can be things such as right-of-way lines, drainage pipes and utilities.



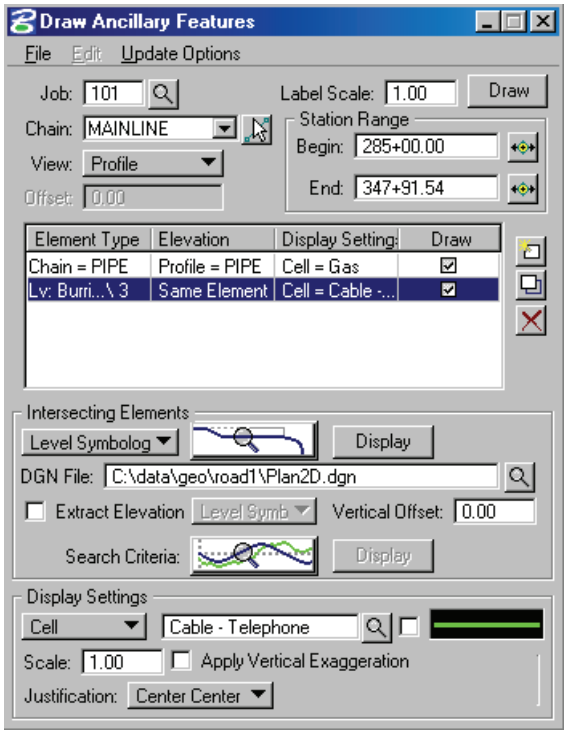
ACCESSING

The Ancillary Features application can be accessed from **Applications > GEOPAK Road > Cross Sections > Draw Ancillary Features**.

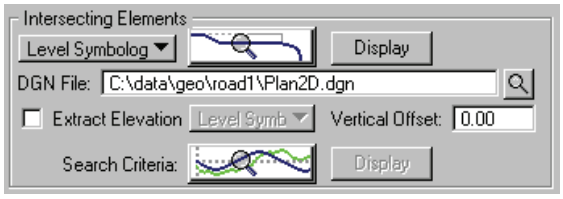
OVERVIEW

The dialog settings can be saved into a settings file via the File pulldown menu. This file can then be loaded at anytime to restore the settings of the dialog.

Each ancillary feature to be drawn must be added to the list box. Once added, each feature can then be modified or deleted as needed.



The **Intersecting Elements** portion of the dialog is where you specify how to determine the offset (plan view location) and elevation of the ancillary feature.



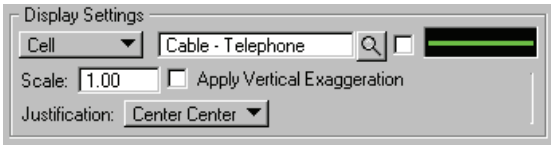
There are four options with which to specify the offset location of the ancillary feature:

- **Chain** - allows you to specify any COGO chain. This chain will then be used to calculate the offset of the ancillary feature.
- **Survey Chain** - allows you to specify any Survey chain. This survey chain will then be used to calculate the offset of the ancillary feature.
- **Level Symbology** - allows you to specify the graphical symbology of a specified feature. Note that with this option you must also specify the DGN file where the feature is located.
- **Feature** - allows you to specify a D&C Item Name. The symbology specified by this item name will then be used to search for the specified ancillary feature. Note that with this option you must also specify the DGN file where the feature is located.

There are also multiple options with which to specify the elevations of the ancillary feature:

- **TIN -**The TIN option works in conjunction with the Vertical Offset. First, the elevation of the DTM at the chain location will be calculated, then the vertical offset (depth of cover) will be applied to determine the elevation of the ancillary feature.
- **Level Symbology -** The Level Symbology option also works in conjunction with the Vertical Offset. In this case the offset is calculated from a Graphical Element in the dgn file (usually either a ground line or existing profile).
- **Feature** - The Feature option also works in conjunction with the Vertical Offset. This is very similar to the Level Symbology, except in this case the symbology is taken from the D&C Feature. The offset is again calculated from a Graphical Element in the dgn file (usually either a ground line or existing profile).
- **AdHoc Attribute** – This is a new enhancement that will allow you to attribute an element and will cause the elevation to be read from a graphical element containing the adhoc name "Profile" and "Offset".

The **Display Settings** portion of the dialog is where you specify how to display the ancillary feature on the cross sections or profile.

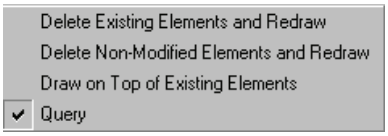


You have three options with which to specify how the ancillary data will be displayed.

- **Cell** - The cell library can either be attached to the dgn file OR it can be read from the MS_Celllist variable.
- **Symbol** - You can control the justification of the symbol, as well as the height and width of the symbol.
- **Text** - Note the standard Text Symbology dialog can be used to set the text symbology. The angle of the text can also be controlled.

UPDATE OPTIONS

The new application now supports Update Options much the way the Existing Ground Cross Section application does. These options allow the user to choose from one of four modes.



The options are toggled off / on by each selection of the option. The check to the left of the option indicates the option is active. Only one option may be active at any given time, therefore, if an option is selected, the previous active option is de-activated.

Delete Existing Elements and Redraw

Any ancillary feature lines previously drawn with this tool are deleted and new features are drawn.

Delete Non-modified Elements and Redraw

Only features previously drawn with this tool AND have not been modified are deleted and new features are drawn. Any features previously drawn with this tool and modified are left intact.

Draw on Top of Existing

Any previously drawn features are ignored and a new set is drawn, resulting in two sets of features.

Query

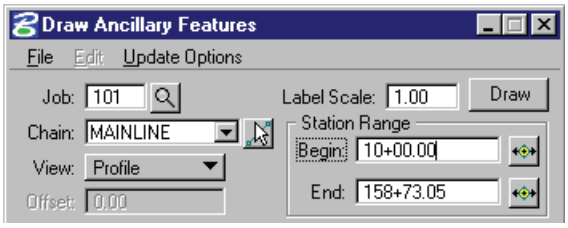
When activated, the user is prompted each time Draw is clicked.

The user must select one of the three options and click Apply to commence processing. Clicking Cancel closes the dialog with no subsequent processing.

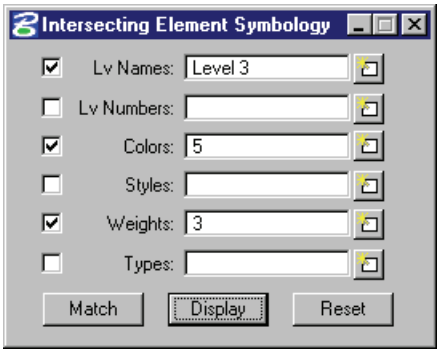
LAB EXERCISE: ANCILLARY DATA

> ***MAPPING UTILITIES***

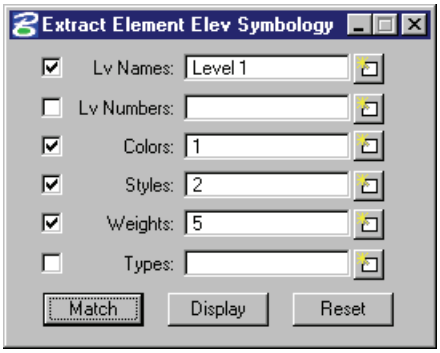
1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\su60843.dgn*.
2. Access the Ancillary Features application. (**Applications > GEOPAK Road > Cross Sections > Draw Ancillary Features**).
3. In the main dialog set the job number to 101.



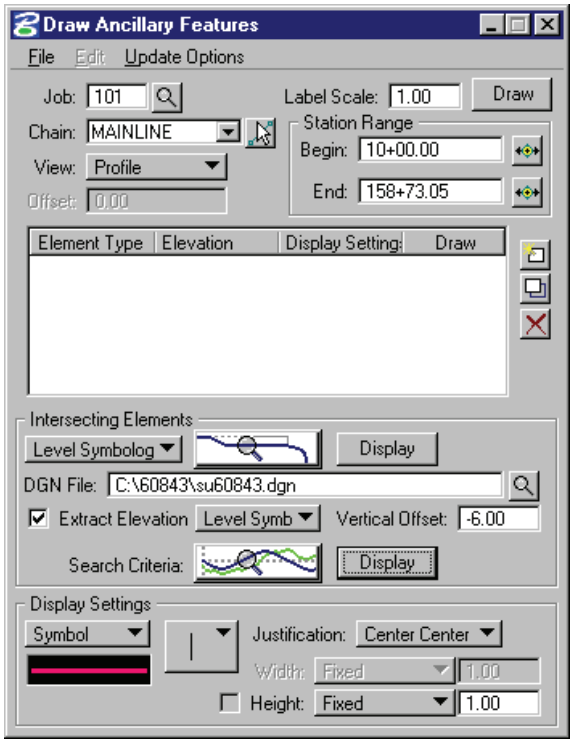
4. From the main Ancillary Features dialog set the **Intersecting Element** toggle to **Level Symbology**.
5. Open the symbology dialog and using the match button data point on the element representing the sewer line to set the symbology.



6. Close the Symbology dialog.
7. In the field for **DGN File**, set the file to *su60843.dgn*.
8. Open the MicroStation file *d60843xsmainline.dgn***.**
9. Click on the Extract Elevation toggle and set the toggle to **Level Symbology**.
10. Open the symbology dialog and using the match button data point on the element representing the existing ground to set the symbology.

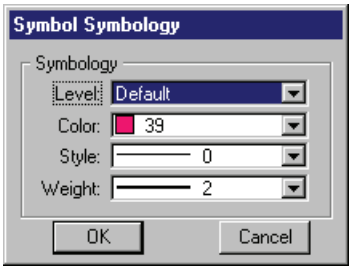


11. Close the symbology dialog.
12. In the **Vertical Offset** field key-in -6.0.



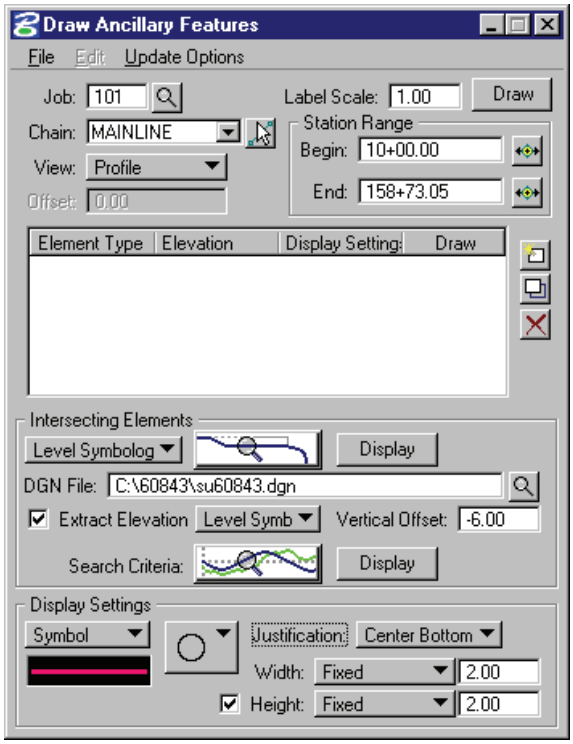
> ***DISPLAY SETTINGS***

1. In the Display Settings portion of the dialog change the toggle to **Symbol**.
2. Set the symbology as shown below.

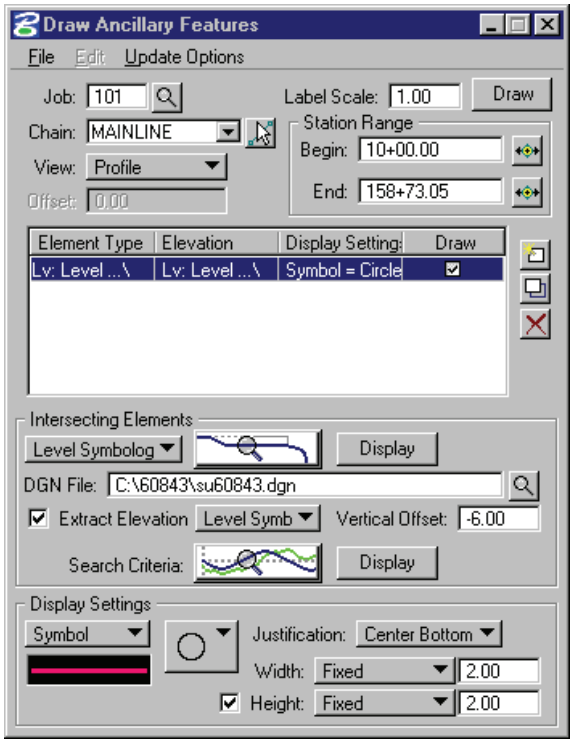


3. Click **OK**.
4. Set the symbol to the circle option.

5. Set the remaining options as shown below.

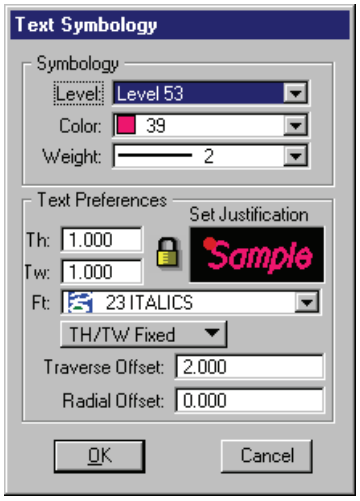


6. Using the icons on the right side of the list window, add the utility into the list window.

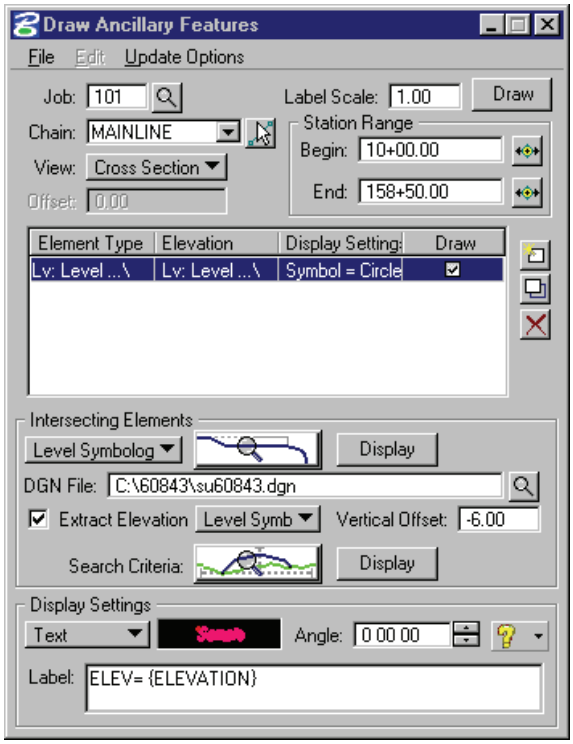


7. Change the **Display Setting** toggle to **Text.**

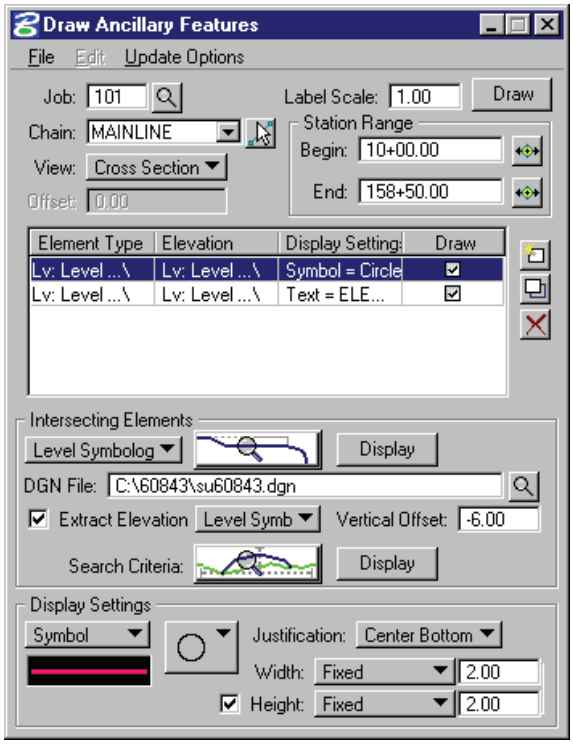
8. Set the symbology and text settings as shown below.



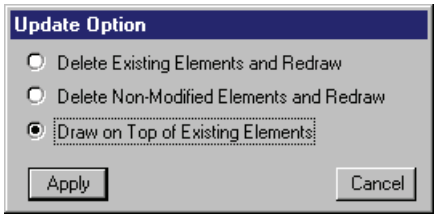
9. Click **OK**.
10. In the **Label** field key-in **ELEV=**.
11. Now select the **Intrinsic Variable**, **Elevation** using the pulldown under the yellow question mark.
12. This will create an elevation label and should look like the dialog below.



13. Using the icons on the right side of the list window, add the text item into the list window.



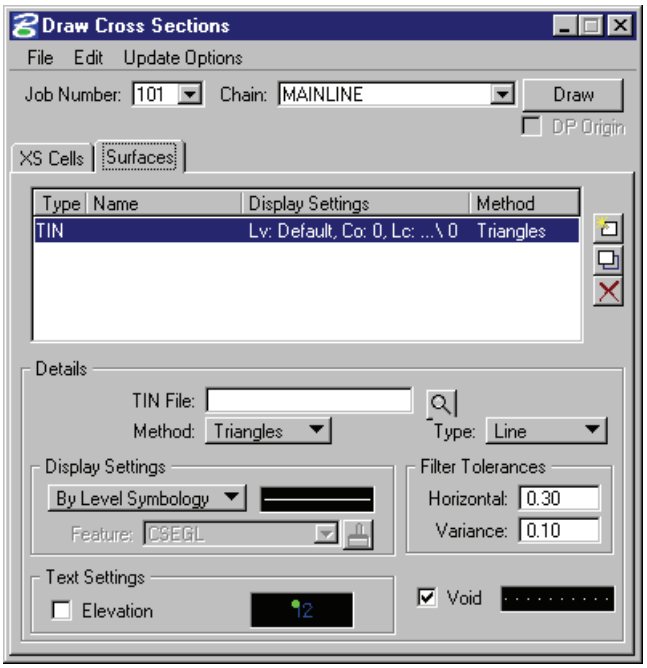
14. Click the **Draw** button.
15. When prompted set the **Update Option** as shown below and click **Apply**.

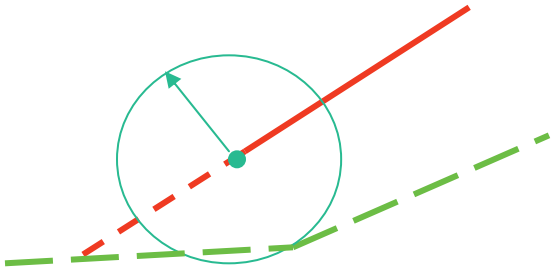


TOLERANCE

Filter Tolerance

Both **Horizontal** and **Variance** filter tolerances are considered together for each pair of cross section segments. The middle point is deleted if both segment lengths are less than the **Horizontal** filter tolerance while the projected distance between the mid-point and the chord between the two end points is less than the **Variance** tolerance.





Default Tolerances

Any cross section processing can accept a tolerance value that defines the distance such that two elements with endpoints closer together than the tolerance values are assumed to be connected. In addition, if two elements whose minimum distance apart is less than the tolerance then they are considered to be coincident. The table below depicts default tolerances (i.e., tolerances used by the software if the user does not explicitly define a tolerance).

Function	**Default Tolerance (English)**	**Default Tolerance (Metric)**
Ancillary data	0.10	0.030
Earthwork	0.01	0.003
Existing ground profile	0.50	0.152
Existing ground cross section	0.50	0.152
Plan view limits of construction	0.10	0.030
Proposed profile from cross sections	0.10	0.030
Proposed cross sections	0.10	0.030
Reports - Hydraulic	0.10	0.030
Reports - Critical Points	0.01	0.003
Reports - All Others	0.01	0.003
Auto shapes	0.75	0.03
Sheet layout	1.00	0.300

6 Earthworks

CHAPTER OBJECTIVES

In this chapter, you will learn:

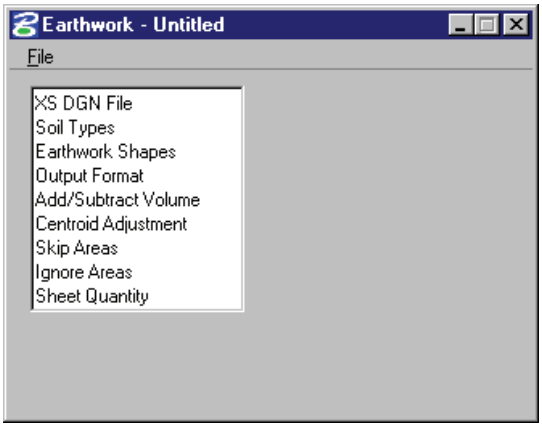
- The procedures for calculating earthwork quantities with GEOPAK
- How to use Project Manager to set up and process an earthwork run

INTRODUCTION

GEOPAK forms graphical earthwork shapes in a (MicroStation) cross section design file to represent the end areas used to calculate volumes by the end-area method. These shapes are created when the designer processes an earthwork run in which the existing ground, finished grade, base, etc. are identified by level, color, weight and type.

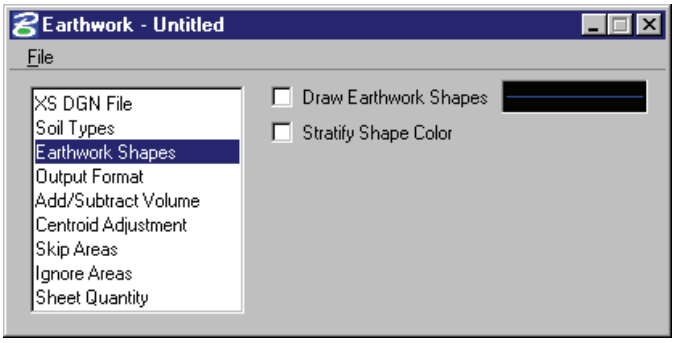
ACCESSING

When Earthwork in the Road Project Manager is clicked, the Select Run dialog is displayed. An existing run may be selected or new run may be started. When complete, click **OK**, which closes the Select Run dialog and opens the earthwork dialog.



The left side of the dialog contains the list of parameters required to compute earthwork. When each parameter is selected, the dialog changes the key-in fields to reflect the selection.

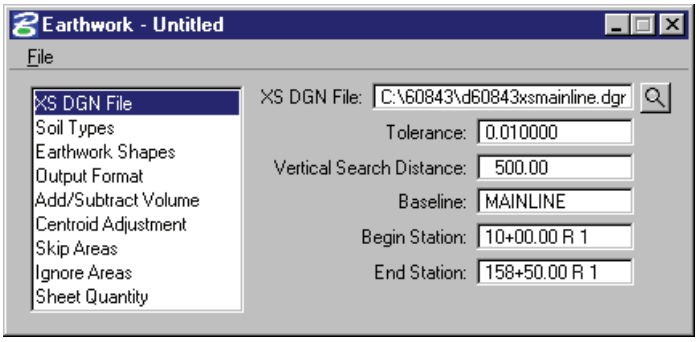
For example, when EW Shapes is selected, the dialog changes as illustrated below.



EARTHWORK DIALOG

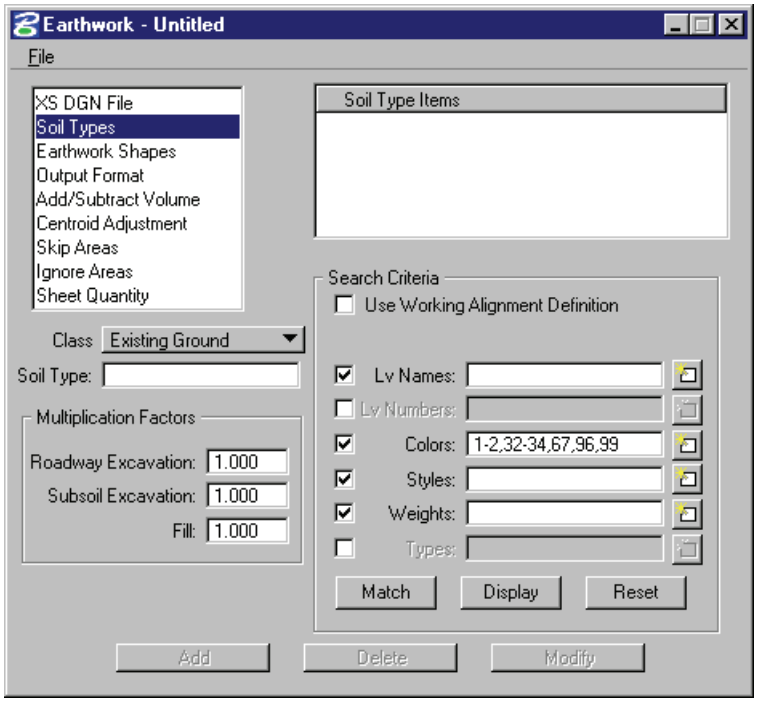
XS DGN FILE

In **XS DGN File** the user can specify the file name in which to find the cross-sections. Tolerance specifies the maximum distances between two elements (in a cross section) to be considered as adjoining. Vertical Search Distance specifies the distance above and below the cross-section to look for elements pertaining to that cross-section. Baseline specifies the GEOPAK COGO chain the cross-sections are based from. Begin/End Station specifies the beginning and ending stations to perform the earthwork calculations.



SOIL TYPES

The Soil Types dialog requires the user to define the symbology and shrinkage/swell factors to be used.



The user must first select the **Class** of the soil type.

Existing Ground - Identifies the surface of the existing ground. This classification is required to calculate earthwork. It also defines the default excavation material.

Proposed Finish Grade - Surface of the proposed roadway. This classification is required to calculate earthwork and defines the default fill material.

Existing Suitable - Material between excavation limits that is to be removed only when it encroaches on the proposed design. For example, if the proposed design is in fill, therefore above the existing suitable, it is not removed.

Existing Unsuitable - Material between excavation limits that is to be removed in all circumstances.

Proposed Undercut - Proposed layers that are not part of the finish grade, i.e. pavement layers, shoulder layers.

Excavation Limit - Pairs of vertical lines drawn in the cross-sections to define the limits of removal for any existing suitable or unsuitable material.

Once the Classification is chosen, a Soil Type, the element symbology of the material, and the shrinkage/swell factors need to be entered. A Classification, except Existing Ground, can be listed multiple times. The Soil Type determines how the cut and fill are calculated. For example, a user creates an earthwork run with a classification of Existing Ground with a soil type of Existing, classification of Proposed Finish Grade with a soil type of Suitable_Grading, and a classification of Proposed Undercut with a soil type of Pavement. The output from the run would look as follows.

Material Name Station	End Areas (square ft)	Unadjusted Volumes (cubic ft)	Adjusted Volumes (cubic ft)	Mult Factor	Mass Ordinate
287+00					
SUITABLE_GRADING					
Excavation	0.00	0	0	1.00	
Fill	12.32	336	336	1.00	2887
EXISTING					
Excavation	25.88	654	654	1.00	
Fill	0.00	0	0	1.00	3541

In the same example, if both classifications of Existing Ground and Proposed Finish Grade had the soil type of Suitable_Grading, then the output would look as follows.

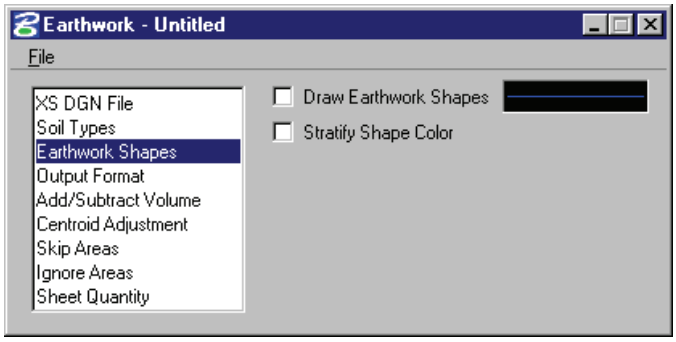
Material Name Station	End Areas (square ft)	Unadjusted Volumes (cubic ft)	Adjusted Volumes (cubic ft)	Mult Factor	Mass Ordinate
287+00					
SUITABLE_GRADING					
Excavation	25.88	654	654	1.00	
Fill	12.32	336	336	1.00	3541

As can be seen from the above examples, when the soil types for the Existing Ground and Proposed Finish Grade classifications were named differently, both soil types appeared in the output. When the soil types for the Existing Ground and Proposed Finish Grade classifications were named the same, the quantities for each classification were combined into one soil type. By paying close attention to the soil types, the user can specify when material can be re-used and exactly where a specific soil type should be placed.

Once the Classification and Soil Type are chosen, the user can select the Element Symbology to define that particular Soil Type and the Multiplication Factors for the Soil Type. The Match button can be used to select the Element Symbology. Once the Match button is selected, the user can select the elements in the MicroStation view. The symbology of that element will be added to the symbology list used to define the Soil Type.

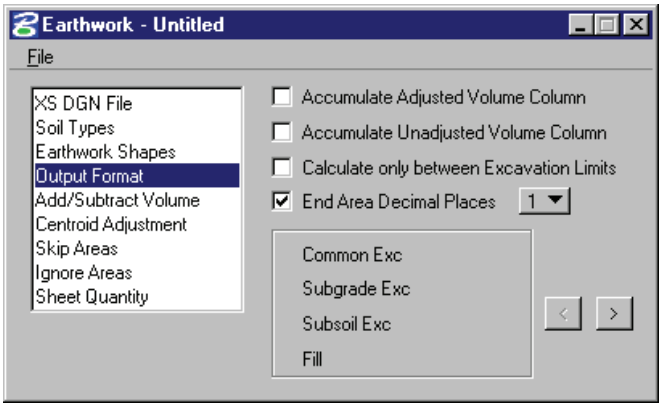
EW SHAPES

Earthwork Shapes enables the earthwork shapes to be drawn with the associated symbology. The colors of the earthwork shapes can be stratified, so that cut and fill or each soil type are different.



OUTPUT FORMAT

Output Format enables the user to specify which items to show in the earthwork report.

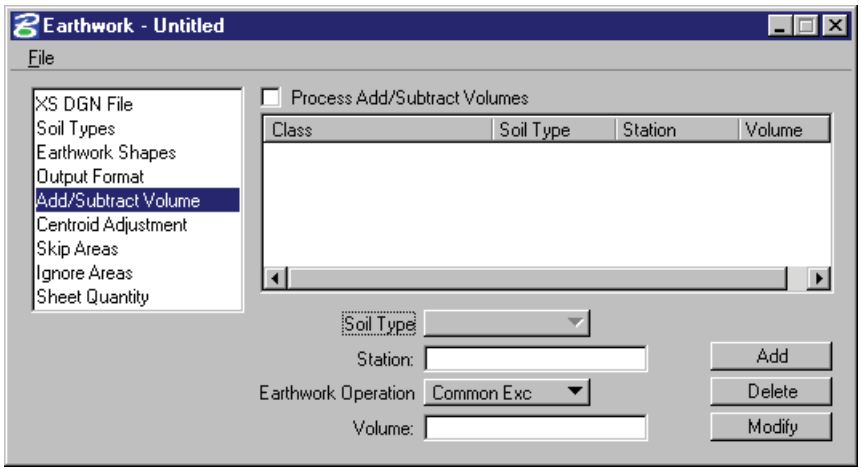


With this command, any combination of the three classifications of excavation volumes can be formulated. For example, if the user desires to combine all three into an earthwork listing of simply cut and fill, press the < or > arrows until the desired option is displayed. Options include:

- Common Exc, Subgrade Exc, Subsoil Exc, and Fill
- Excavation (Common and Subgrade), Subsoil Exc, and Fill
- Excavation (Common and Subsoil), Subgrade Exc, and Fill
- Excavation (Subgrade and Subsoil), Common Exc, and Fill
- Excavation (all types) and Fill

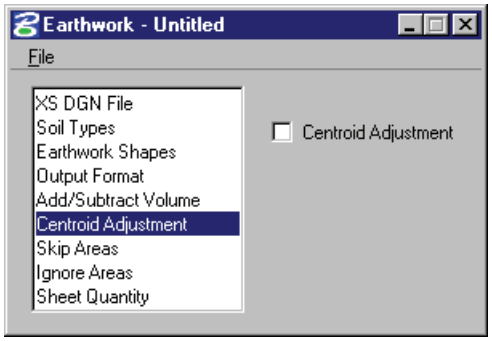
ADD/SUB VOLUMES

Add/Subtract Volumes allows the user to enter volumes to be added or subtracted from the total earthwork calculated from the available sections. The user can specify whether to add excavation or fill, the soil type, the station, and the volume to be added.



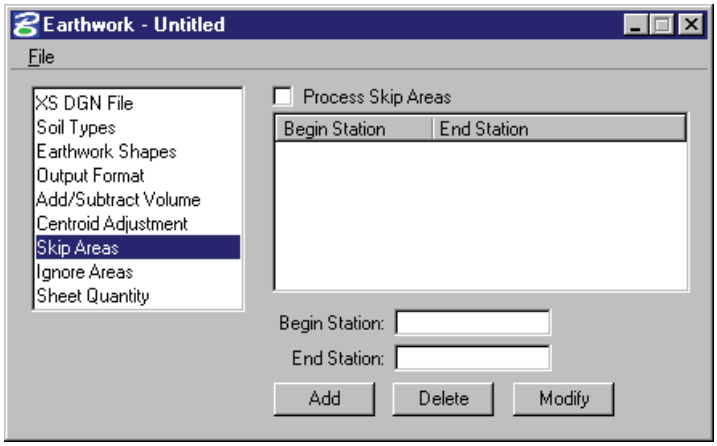
CENTROID ADJUSTMENT

Earthwork volumes are calculated by averaging end areas and then multiplying these averaged areas by the distance between two successive cross sections as measured along the baseline. If the bulk of the cross section areas are located predominantly to either the left or the right of the baseline, as in a detour, an error occurs in the volume calculations for all non-tangential portions of the baseline. This error can be negligible or substantial depending on the degree of baseline curvature as well as the degree to which cross section areas are offset about the baseline. These types of errors can be optionally accounted for via specification of the **Centroid Adjustment**.



SKIP AREAS

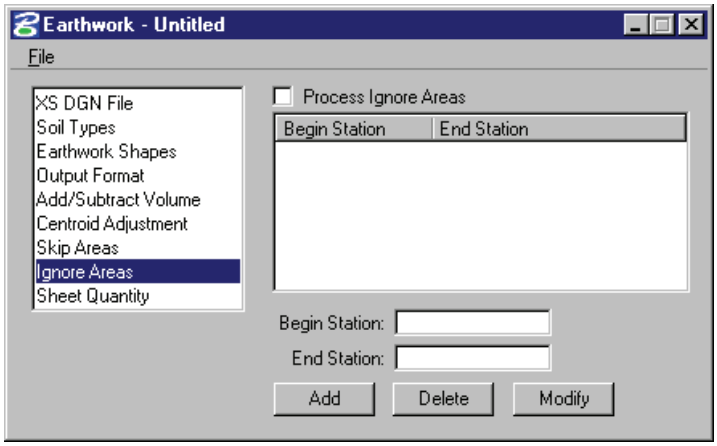
Skip Areas enables the user to specify an area (i.e. bridge exception) in which not to calculate earthwork volumes. These volumes, though not included in the Mass Ordinate, will still display in the station reporting.

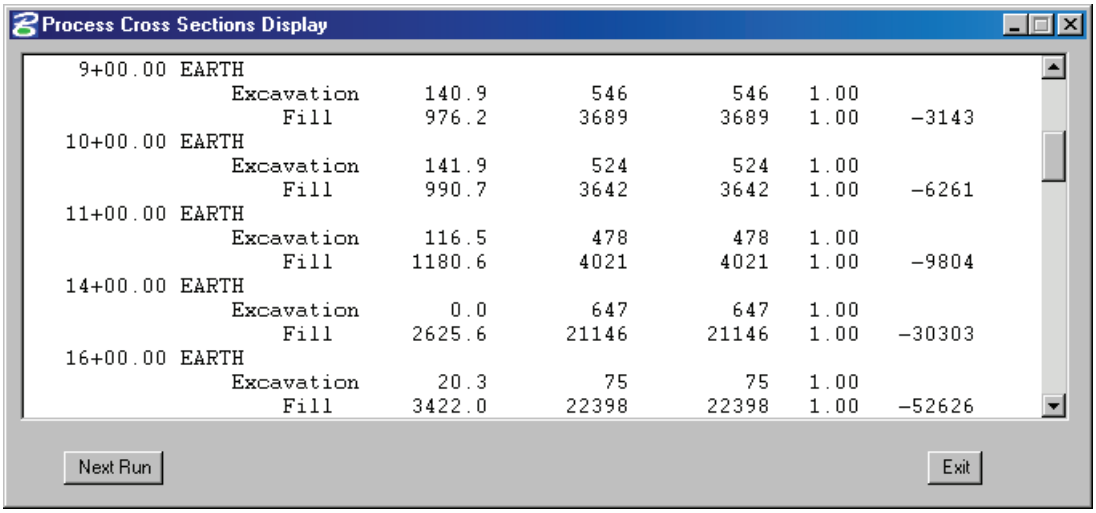


IGNORE AREAS

There have been a couple of enhancements to the earthwork computations to provide better reporting of earthwork functions. The first of these is the addition of **Ignore Areas**.

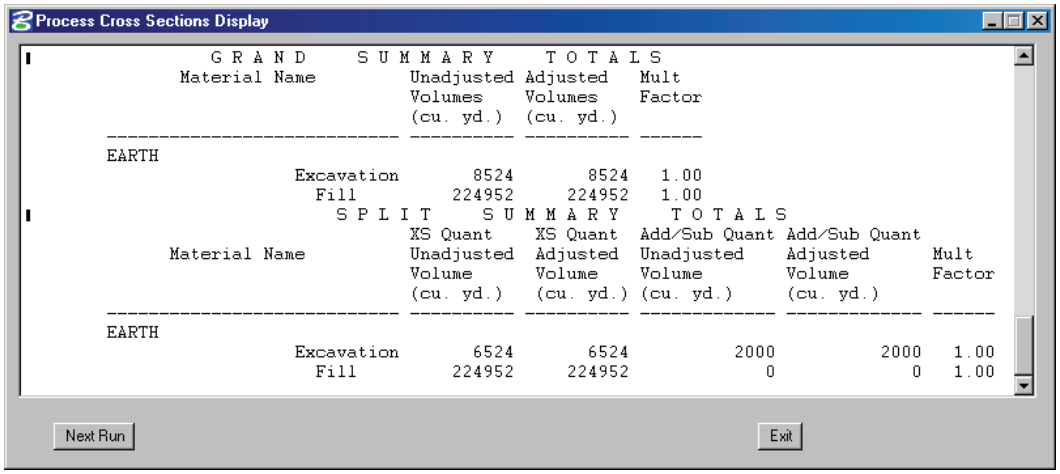
Ignore Areas allows the user to insert a range of stations to be completely ignored during earthwork computations. The end areas and volumes will not be computed between the beginning and ending station as if the sections did not exist.





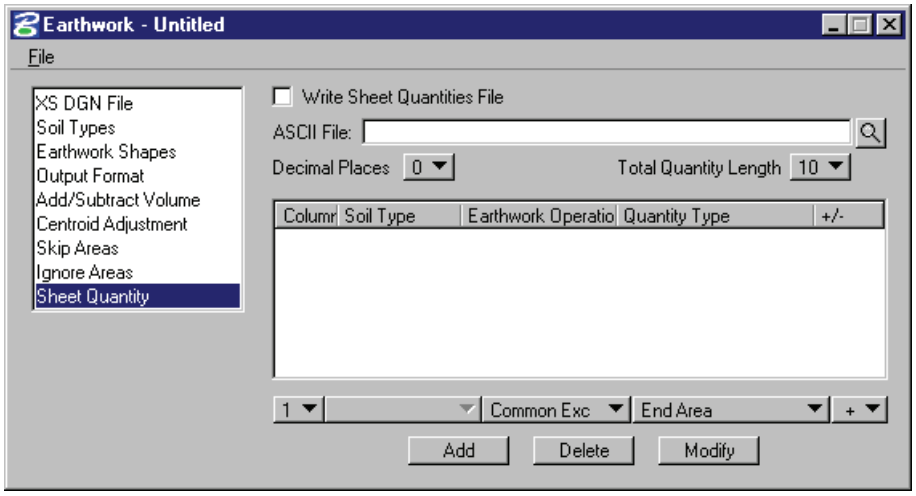
SPLIT SUMMARY TOTALS

The second enhancement involves the reporting of earthwork quantities. There is now the ability to report **Split Summary Totals**. This will report any addition or subtraction of volumes in a separate column in the summary portion of the report as shown below.



SHEET QUANTITIES

Sheet Quantities allows a user to write an earthwork quantity file to be used when plotting cross-section sheets.



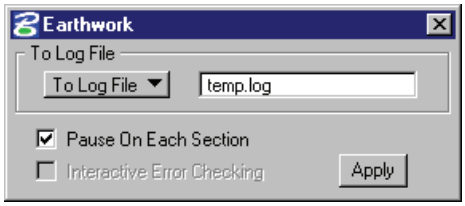
The name of the ASCII file can be chosen or entered. The user then selects the columns in which to place the quantity, the number of decimal places, the total column width, the soil type, the earthwork operation, and the type of quantity.

This information is written to the ASCII file, and can be used to plot the quantities on the cross-section sheets.

From the **Files** menu, the **Run** option processes all parameters that have been set in the Earthwork dialog. The **Save Settings** option saves all information in the Earthwork dialog. The **Export** option saves the parameters in the Earthwork dialog as an ASCII input file. The **Exit** option exits the Earthwork dialog.

PROCESSING

After all necessary information has been entered, the user has two options. The preferred method of running the earthwork is to select the **Run** option. The following dialog appears and the user may proceed by entering a log file name, choosing the **Pause On Each Section** option and then clicking **Apply**. The second method is to export the information as an ASCII input file, then use the **Process Cross Sections** tool.

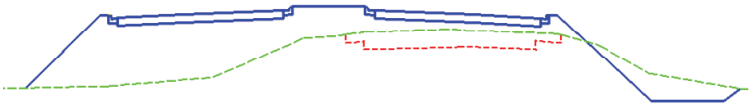


The earthwork quantities are written to the bottom of the log file and can be reviewed in any standard ASCII text editor.

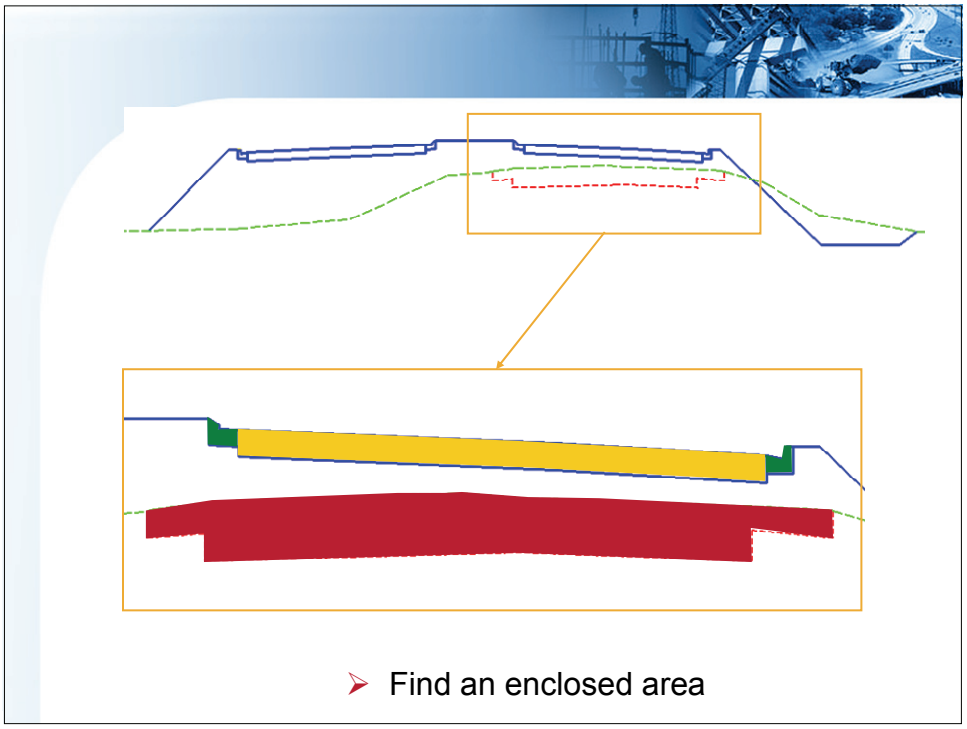
Most people are comfortable dealing with earthwork as long as it involves standard cut and fill volumes. However, once it goes beyond standard cut and fills it can sometime become confusing.

We will now delve into these more advanced earthwork topics. GEOPAK is fully capable of calculating just about any type of earthwork scenario a user can come up with. However, in order to utilize these capabilities the user must understand both how the earthworks are calculated and the different material classes and their uses.

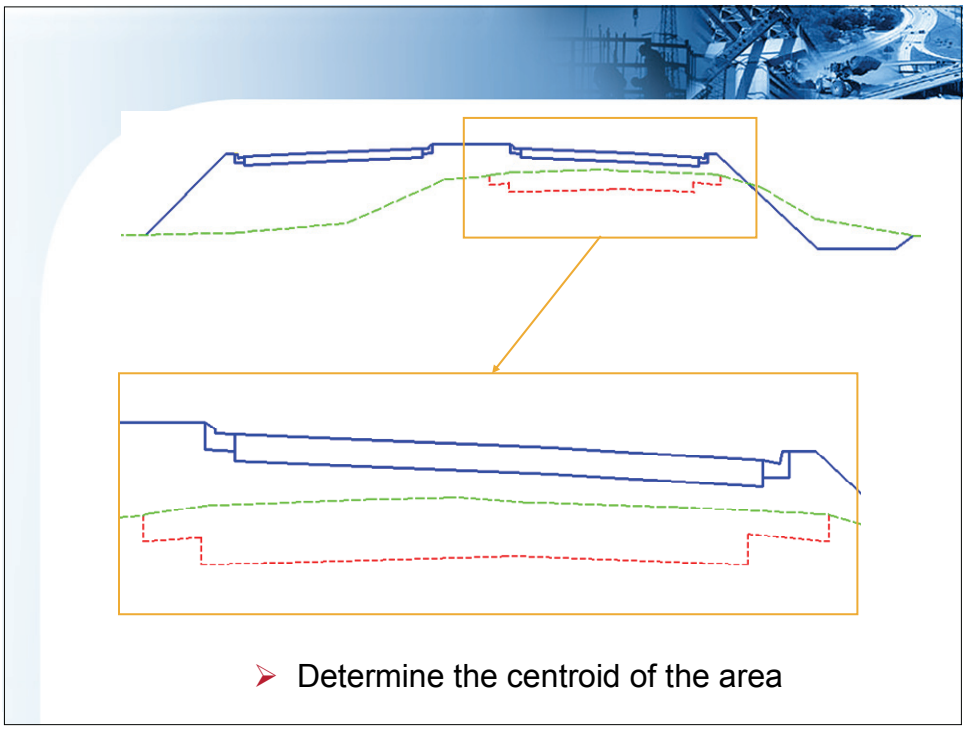
Before we go too far, let's first make sure we understand the method that GEOPAK uses to calculate earthwork. In its algorithm to calculate earthwork, GEOPAK does 3 things:



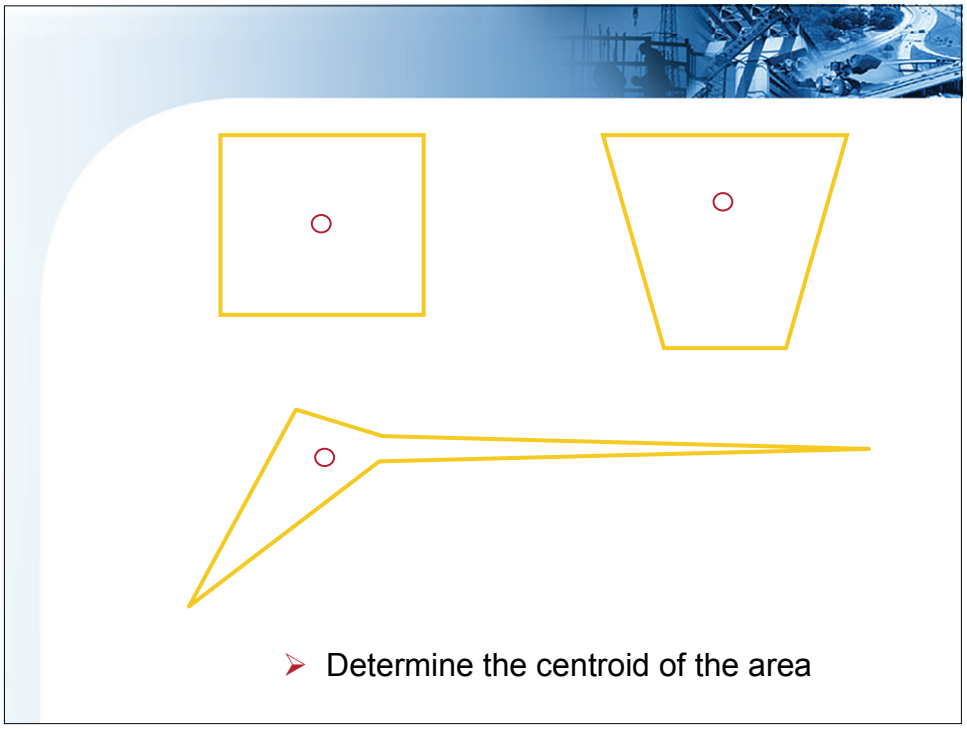
- Find an enclosed area
- Determine the centroid of the area
- Determine the material type of the area



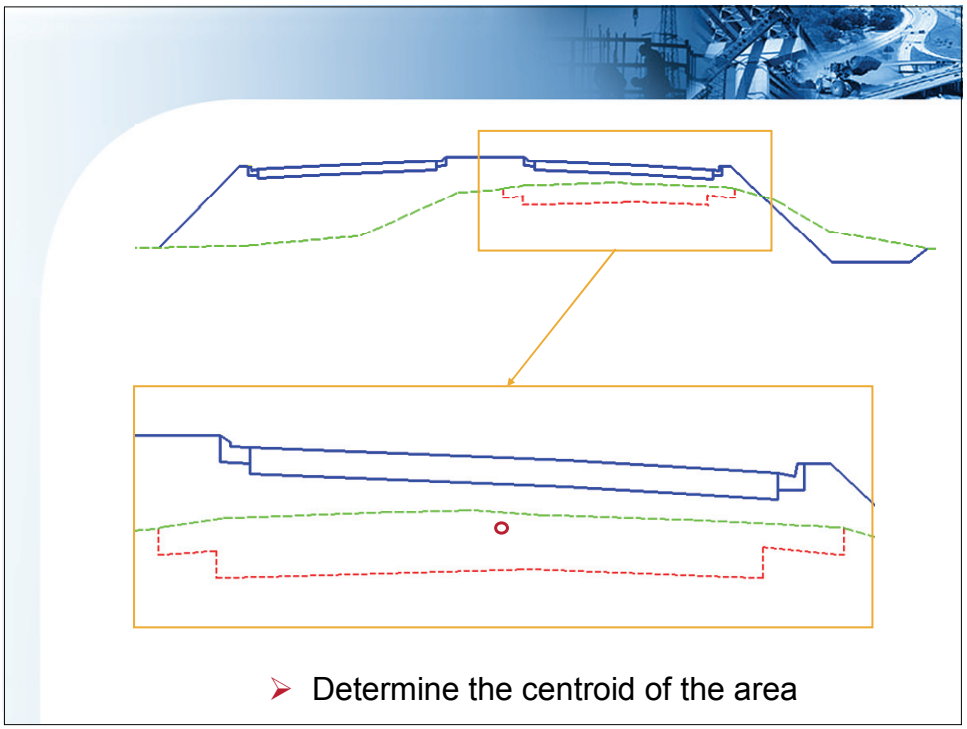
- Find an enclosed area



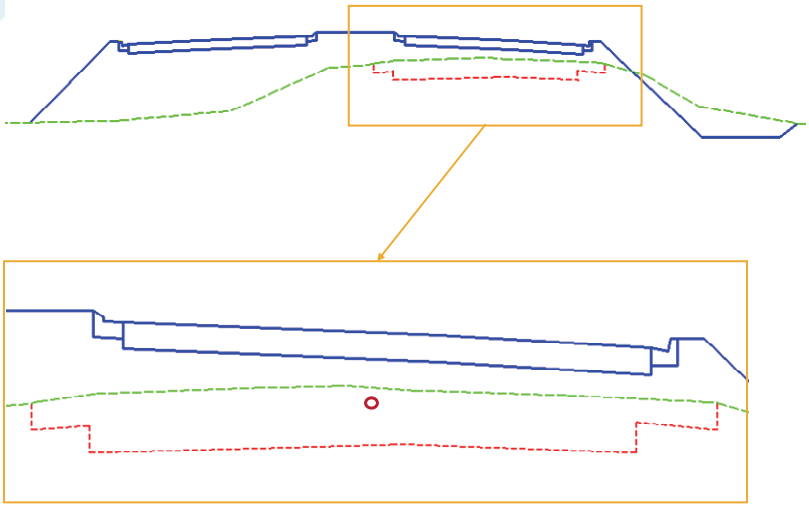
- Determine the centroid of the area



- Determine the centroid of the area



- Determine the centroid of the area



- Determine the material type of the area

How does it determine the material type?

First, it intersects the graphical element directly below the centroid. It then matches the intersected symbology to the defined material types.

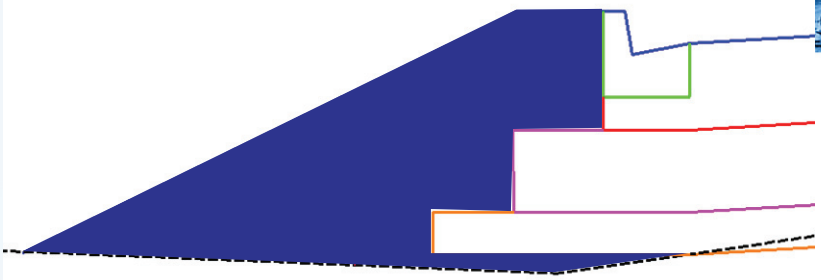
```
Existing Unsuitable Material
    soil type = EX_PAVEMENT
    roadway exc mult factor = 1.000000
    subsoil exc mult factor = 1.000000
    fill mult factor = 1.000000
        type = line, line_string
        lvname = XS Existing Pavement
        co = 3
```

Butiminous_Asphalt

Rock_Base

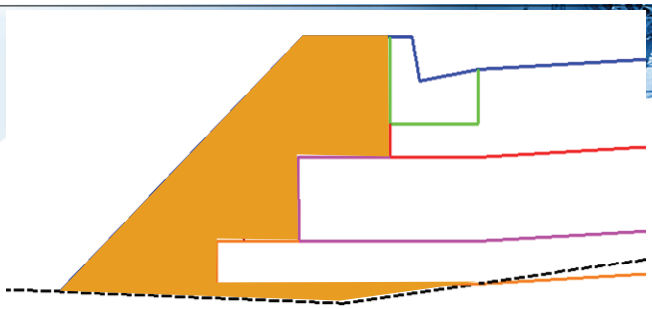
Concrete

This is why you can get quantities for just about anything on a cross section, as long as you distinguish the element symbologies correctly.



But this algorithm can sometimes “fail” because of the shape configuration.

Existing Ground
soil type = Suitable_Grading
roadway exc mult factor = 1.000000
subsoil exc mult factor = 1.000000
fill mult factor = 1.000000
type = line, line_string
lvname = XS Existing Ground
co = 0
lc = 3



But this algorithm can sometimes “fail” because of the shape configuration.

```
Proposed Undercut
    soil type = Aggregate_Base
    roadway exc mult factor = 1.000000
    subsoil exc mult factor = 1.000000
    fill mult factor = 1.000000
      type = line, line_string
      lvname = XS Aggregate Base
      co = 6
      lc = 0
```

Now that we know “how” the earthwork areas are calculated, let’s look at how we can use the material classes and soil types to control how the quantities are reported.

There are 6 functional classes of earthwork supported by GEOPAK.

Existing Ground Line

Proposed Finish Grade

Proposed Undercut

Existing Suitable

Existing Unsuitable

Excavation Limits

Within each class, you can have multiple soil types. The soil type is nothing more than a “name” for the material and will be used for all reporting purposes.

Existing Unsuitable Material
soil type = TOPSOIL

Existing Unsuitable Material
soil type = Existing_Base

For each soil type you must specify the appropriate shrink/swell factors.

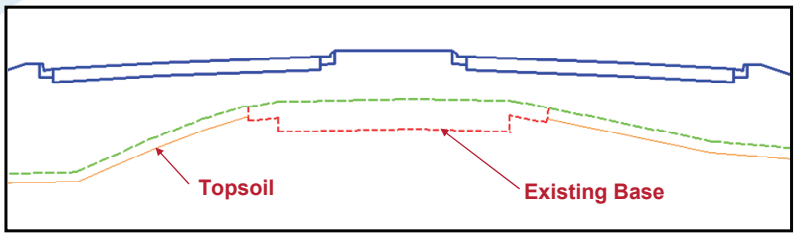
Existing Unsuitable Material
soil type = TOPSOIL
roadway exc mult factor = 1.000000
subsoil exc mult factor = 1.000000
fill mult factor = 1.000000

Existing Unsuitable Material
soil type = Existing_Base
roadway exc mult factor = 1.000000
subsoil exc mult factor = 1.000000
fill mult factor = 1.000000

Also, for each soil type you must specify the graphical symbology of the cross section element.

Existing Unsuitable Material
- soil type = TOPSOIL
- roadway exc mult factor = 1.000000
- subsoil exc mult factor = 1.000000
- fill mult factor = 1.000000
  - type = line, line_string
  - lvname = XS Topsoil

Existing Unsuitable Material
- soil type = Existing_Base
- roadway exc mult factor = 1.000000
- subsoil exc mult factor = 1.000000
- fill mult factor = 1.000000
  - type = line, line_string
  - lvname = XS Existing Base



Why are the classes important? It's not enough to just call something "topsoil" or "existing base". The software has to do know the purpose or function of the material.

For example, do you want to excavate or fill? Is the material suitable for re-use or not?

Material Classes

Existing Ground Line

Proposed Finish Grade

These are the only two material classes that are required in order to calculate earthwork:

Existing Ground Line

Proposed Finish Grade

Specifying these two classes will give you the basic cut and fill quantities.

Material Classes

Existing Ground Line ✓

Proposed Finish Grade ✓

Existing Suitable

The soil types specified with the proposed finish grade and existing ground are important as they are used as the default fill material and default excavation material.

Note: Always use the same name!

Proposed Finish Grade
- soil type = **Suitable_Grading**
- roadway exc mult factor = 1.0
- subsoil exc mult factor = 1.0
- fill mult factor = 1.0
- type = line, line_string
- lvname = XS Finish Grade

Existing Ground Line
- soil type = **Suitable_Grading**
- roadway exc mult factor = 1.0
- subsoil exc mult factor = 1.0
- fill mult factor = 1.0
- type = line, line_string
- lvname = Existing Ground

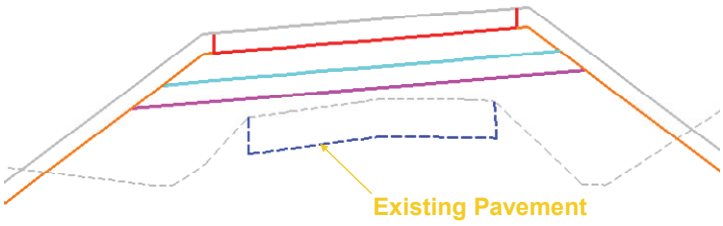
Existing Suitable

Existing Suitable is defined just like the other material classes. You must define a soil type, shrink/swell factors and the proper graphical symbology.

Existing Suitable Material
soil type = TOPSOIL
roadway exc mult factor = 1.0
subsoil exc mult factor = 1.0
fill mult factor = 1.0
type = line, line_string
lvname = XS Topsoil

Existing Suitable

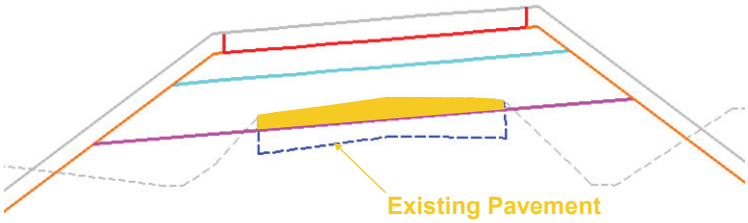
Material classified as Existing Suitable is removed **only** if its excavation is needed to build the proposed design.



Excavation Required - None

Existing Suitable

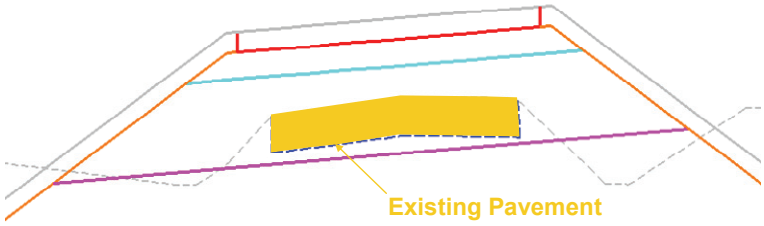
Material classified as Existing Suitable is removed **only** if its excavation is needed to build the proposed design.



Excavation Required - Partial

Existing Suitable

Material classified as Existing Suitable is removed **only** if its excavation is needed to build the proposed design.



Excavation Required - All

Existing Suitable

The classification of Existing Suitable does **not** affect whether material is reused. That is controlled by soil type nomenclature.

Note: We'll discuss this in more detail after we cover the Proposed Undercut classification.

Material Classes

Existing Ground Line ✓

Proposed Finish Grade ✓

Existing Suitable ✓

Existing Unsuitable

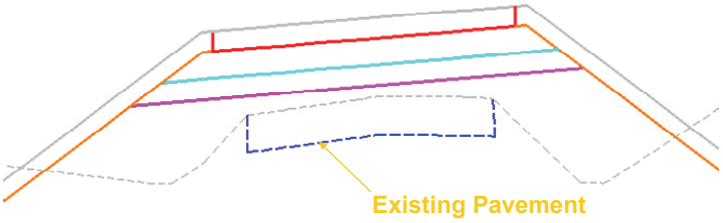
Existing Unsuitable

Existing Unsuitable is also defined just like the other material classes. You must define a soil type, shrink/swell factors and the proper graphical symbology.

Existing Unsuitable Material
soil type = Bituminous_Pavement
roadway exc mult factor = 1.0
subsoil exc mult factor = 1.0
fill mult factor = 1.0
type = line, line_string
lvname = XS Existing Bit Pavement

Existing Unsuitable

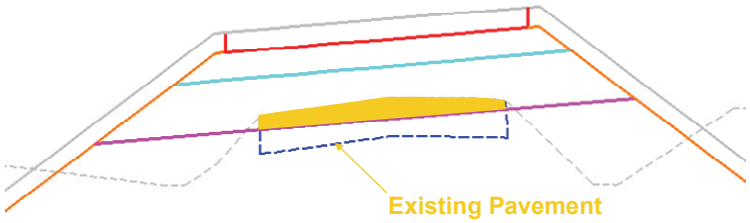
By default, material classified as Existing Unsuitable is removed only if its excavation is needed to build the proposed design.



Excavation Required - None

Existing Unsuitable

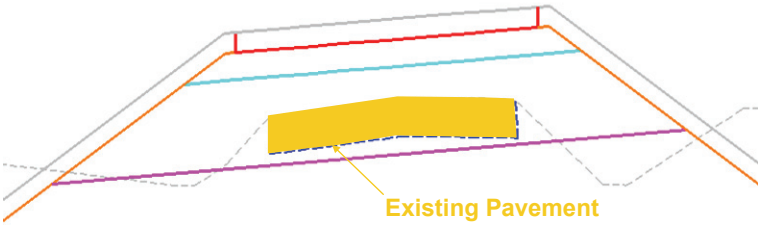
By default, material classified as Existing Unsuitable is removed only if its excavation is needed to build the proposed design.



Excavation Required - Partial

Existing Unsuitable

By default, material classified as Existing Unsuitable is removed only if its excavation is needed to build the proposed design.



Excavation Required - All

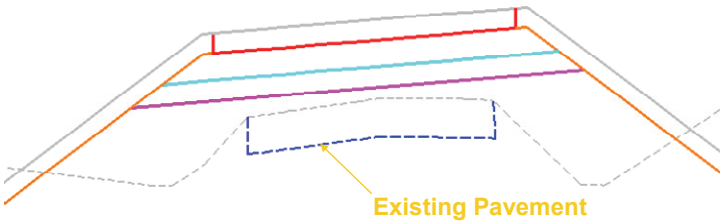
Existing Unsuitable

The classification of Existing Unsuitable does **not** affect whether material is reused. That is controlled by soil type nomenclature.

Note: We'll discuss this in more detail after we cover the Proposed Undercut classification.

Existing Unsuitable

There are times when you want to "force" the excavation of Existing Unsuitable material, such as in the example below.



One way to do this is to use Excavation Limits.

Material Classes

- Existing Ground Line ✓
- Proposed Finish Grade ✓
- Existing Suitable ✓
- Existing Unsuitable ✓
- Excavation Limits

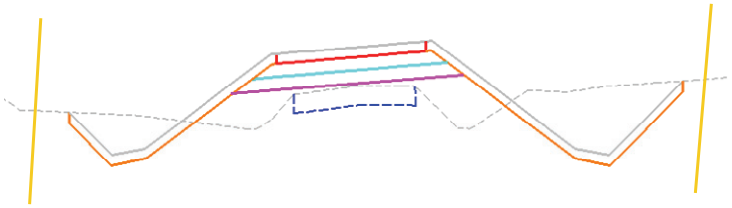
Excavation Limits

Excavation Limits are short lines drawn onto the cross sections. They are defined differently from the other material classes. They only require a graphical symbology. No soil type or shrink/swell factors are needed.

Excavation Limits
type = line
lvname = XS Excavation Limits

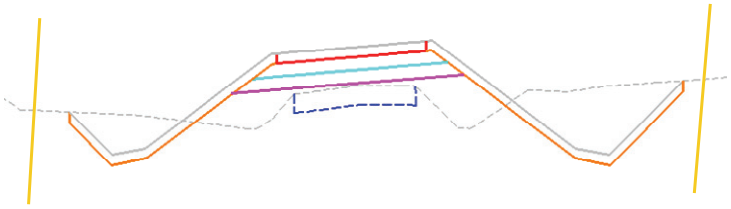
There are 3 rules to be aware of when using Excavation Limits.

Rule #1 - Excavation limits must be used in pairs on a required section. An odd number of limits is not supported.



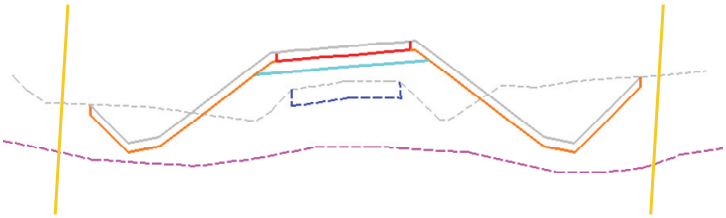
There are 3 rules to be aware of when using Excavation Limits.

Rule #2 - The limits must be lines. Any other element types (line_strings, curves, curve_strings, arcs, etc.) are not supported.



There are 3 rules to be aware of when using Excavation Limits.

***Rule #3* - The endpoint should not be within an area where earthwork quantities are needed.**



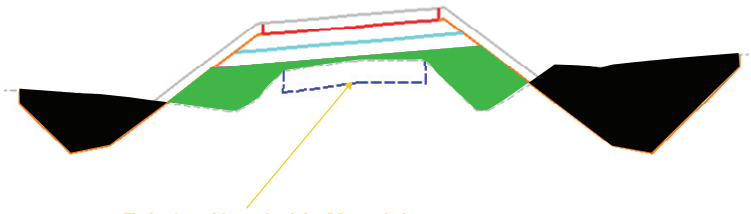
Much better!

Excavation Limits have several uses:

1. Force the excavation of unsuitable material.
2. As their names suggests, they are used to determine the actual “limits” of the excavation of unsuitable material.
3. Delineate specific earthwork processing areas on a cross section.

1. Force the excavation of unsuitable material.

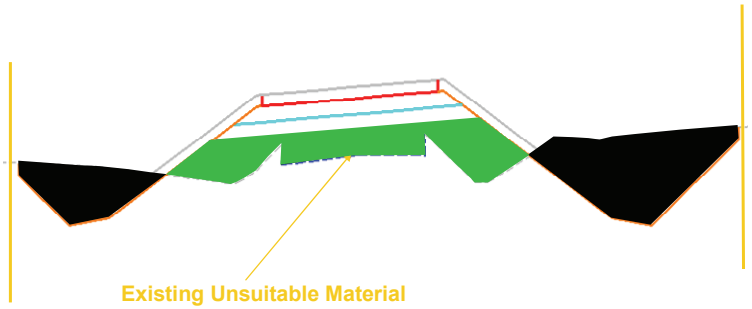
Example: Without Excavation Limits



Existing Unsuitable Material
soil type = Bituminous_Pavement
roadway exc mult factor = 1.0
subsoil exc mult factor = 1.0
fill mult factor = 1.0
type = line, line_string
lvname = XS Existing Bit Pavement

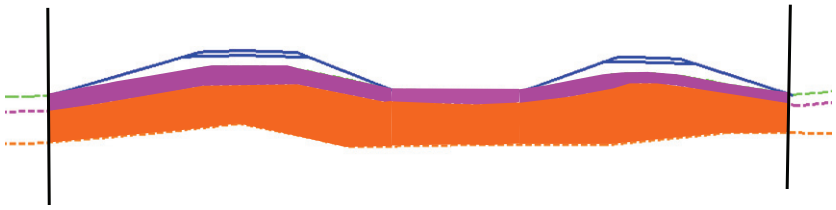
1. Force the excavation of unsuitable material.

Example: With Excavation Limits



Existing Unsuitable Material
soil type = Bituminous_Pavement
roadway exc mult factor = 1.0
subsoil exc mult factor = 1.0
fill mult factor = 1.0
type = line, line_string
lvname = XS Existing Bit Pavement

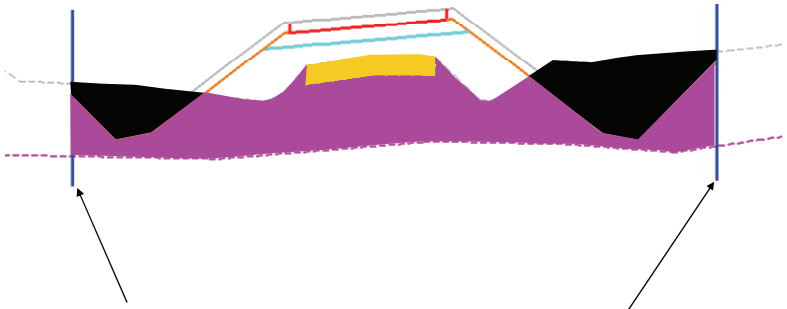
- Even though excavation limits are used to force the extraction of unsuitable material, there are times when suitable material will have to be extracted in order to get to the unsuitable material such as in the example below.



Topsoil (Existing Suitable)

Clay (Existing Unsuitable)

2. As their names suggests, they are used to determine the actual “limits” of the excavation of unsuitable material.



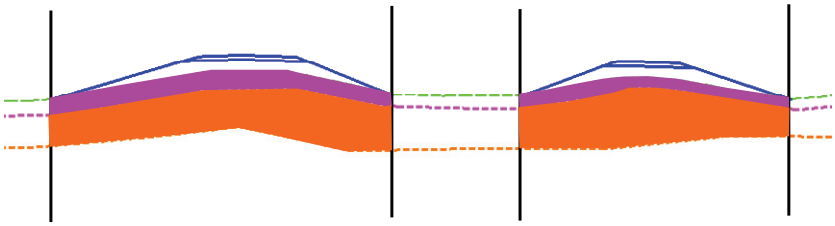
The unsuitable material will only be excavated within the confines of the defined Excavation Limits.

3. Delineate specific earthwork processing areas on a cross section. This can be done in two ways:

- Through the use of multiple excavation limits
- Through the use of the option

  calculate only between excavation limits

- Through the use of multiple excavation limits

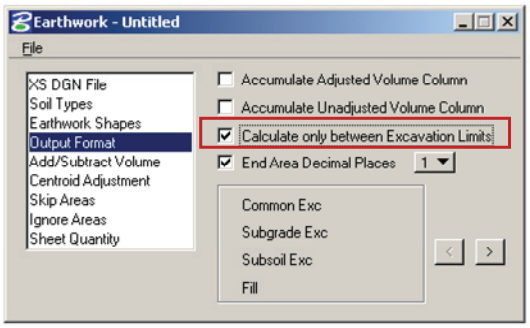


Topsoil (Existing Suitable)

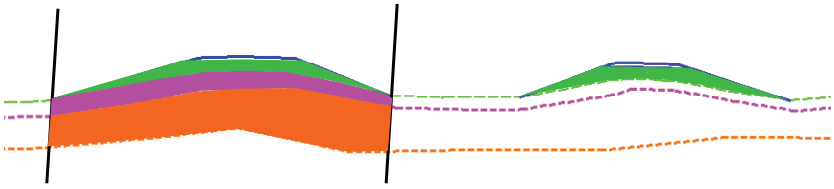
Clay (Existing Unsuitable)

- Through the use of the option

  calculate only between excavation limits



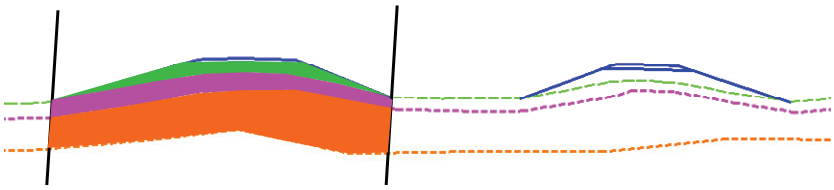
Example: Without the option enabled



Without the option enabled, notice that you get quantities for BOTH roadways.

But no existing suitable or unsuitable materials are excavated beyond the excavation limits.

Example: With the option enabled



With the option enabled, note that you ONLY get quantities within the confines of the excavation limits.

This is an excellent tool for doing staged construction or projects where separate quantities are required for different roadways.

Material Classes

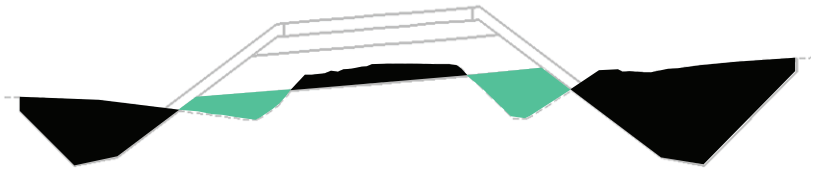
- Existing Ground Line ✓
- Proposed Finish Grade ✓
- Existing Suitable ✓
- Existing Unsuitable ✓
- Excavation Limits ✓
- Proposed Undercut

Proposed Undercut

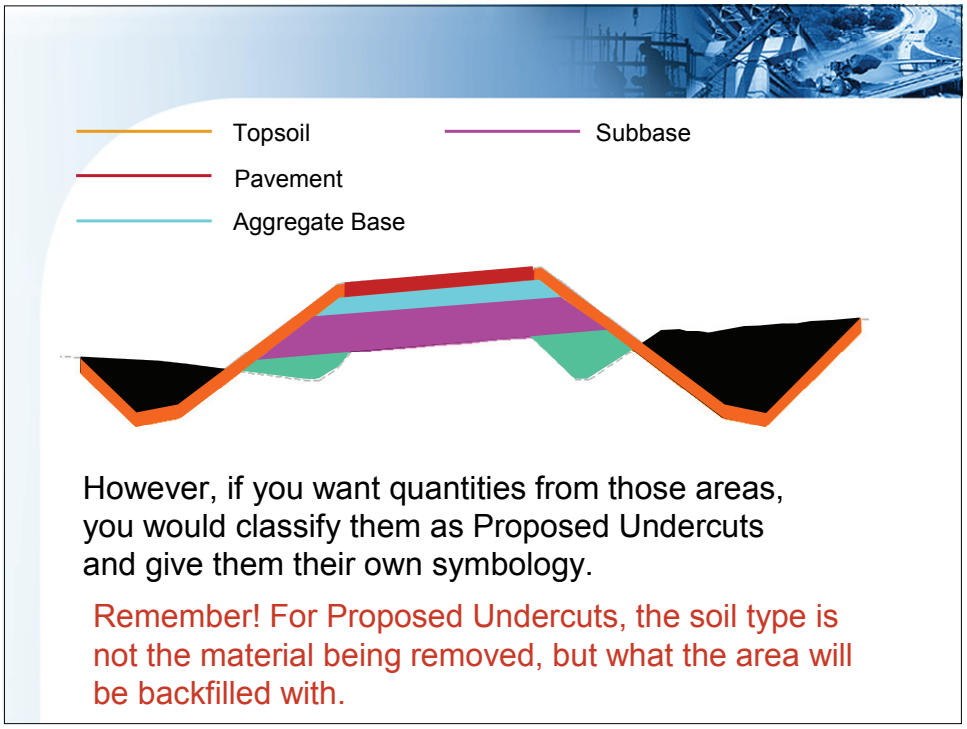
- Proposed undercuts are used to define any proposed component which is not part of the proposed finished grade.
- The soil type is not the material being removed, but what the area will be backfilled with.
- All proposed undercuts must tie to another proposed undercut or proposed finish grade, not to existing ground.

Existing Ground Line

Proposed Finish Grade

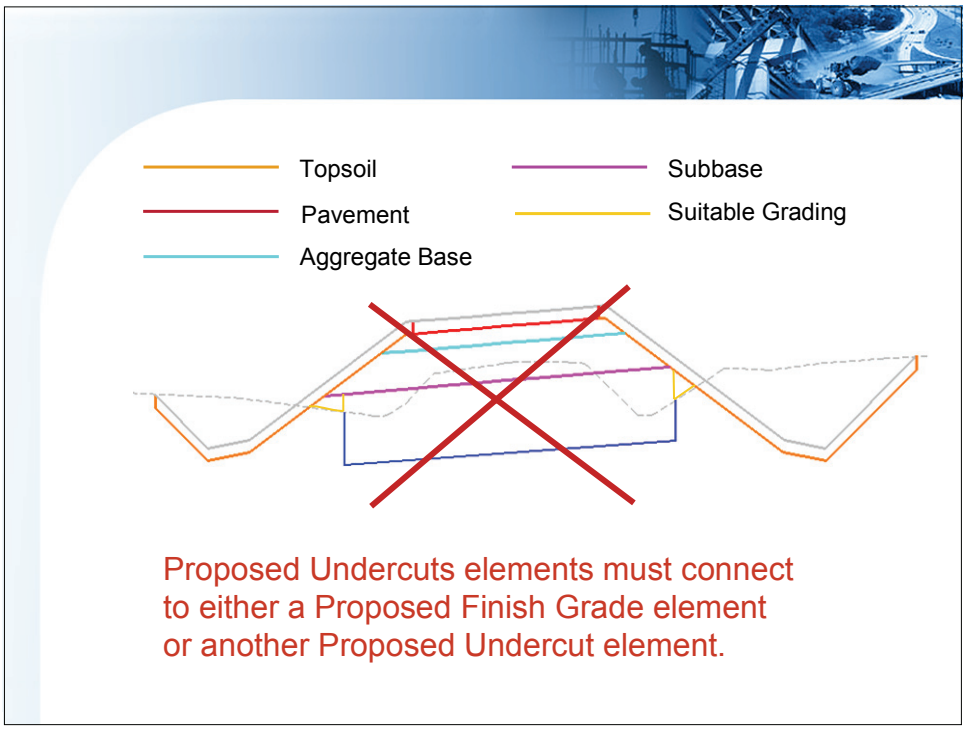


Note: Any proposed element can be considered part of the Proposed Finish Grade if you want it to (as shown in this example).



However, if you want quantities from those areas, you would classify them as Proposed Undercuts and give them their own symbology.

Remember! For Proposed Undercuts, the soil type is not the material being removed, but what the area will be backfilled with.

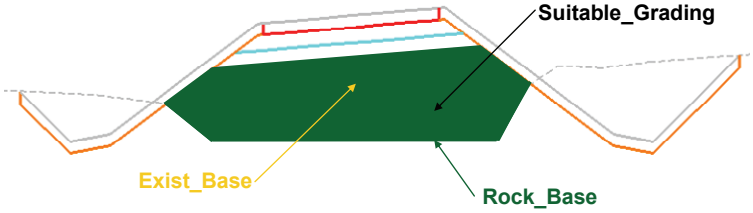


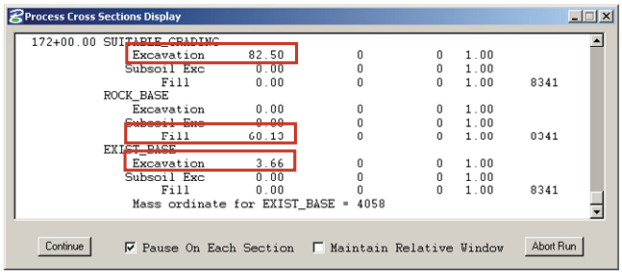
Proposed Undercuts elements must connect to either a Proposed Finish Grade element or another Proposed Undercut element.

Proposed Undercuts have 3 uses:

1. To excavate existing material and replace/backfill with another.
2. To calculate a quantity for a material layer (e.g. pavement layer).
3. To re-use material.

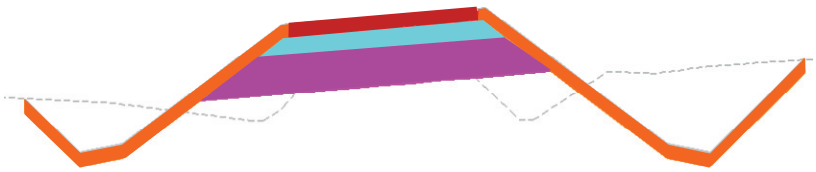
1. To excavate existing material and replace/backfill with another.





2. To calculate a quantity for a material layer (e.g. pavement layer).

Topsoil
Subbase
Pavement
Aggregate Base



3. To re-use material.

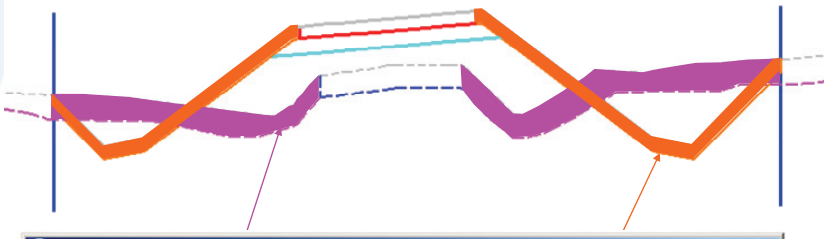
* From previous slide

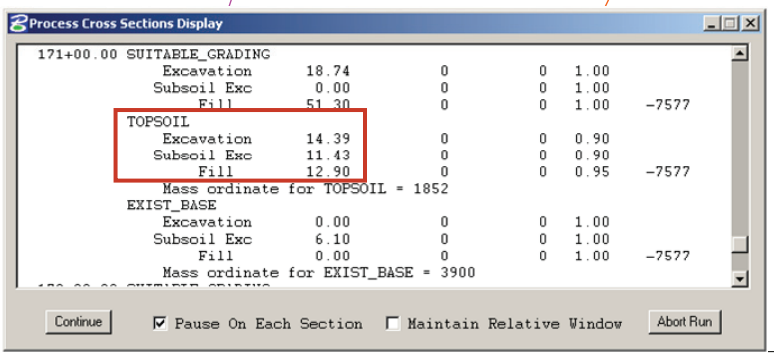
Existing Suitable/Unsuitable

The classification of Existing Suitable/Unsuitable does **not** affect whether material is reused. That is controlled by soil type nomenclature.

Note: We'll discuss this in more detail after we cover the Proposed Undercut classification.

3. To re-use material.





Excavation Types

- **Common Excavation**

  Excavation volumes that are not backfilled with an earthwork material. This includes the excavation required for cut sections as well as for pavement thickness, shoulder thickness, etc.

- **Subgrade Excavation**

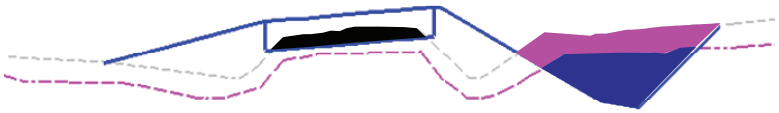
  Excavation volumes that are backfilled with an earthwork material.

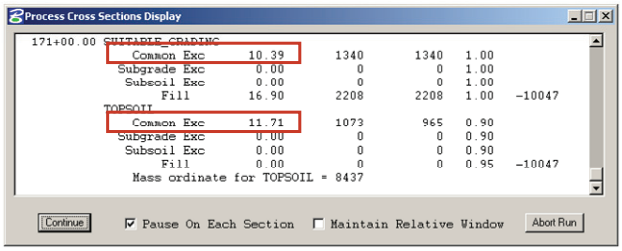
- **Subsoil Excavation**

  Excavation required to remove unsuitable material either 1) down to the bottom of the proposed template or 2) down to the bottom of the unsuitable material layer in cases where excavation limits are defined.

Common Excavation

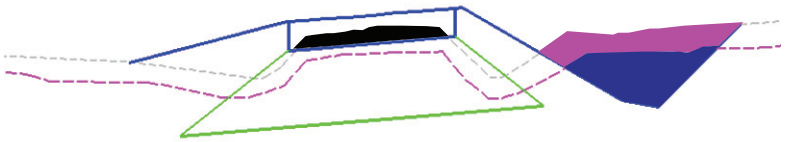
Excavation volumes that are not backfilled with an earthwork material. This includes the excavation required for cut sections as well as for pavement thickness, shoulder thickness, etc.





Subgrade Excavation

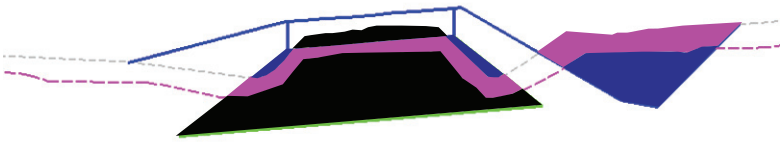
Excavation volumes that are backfilled with an earthwork material.

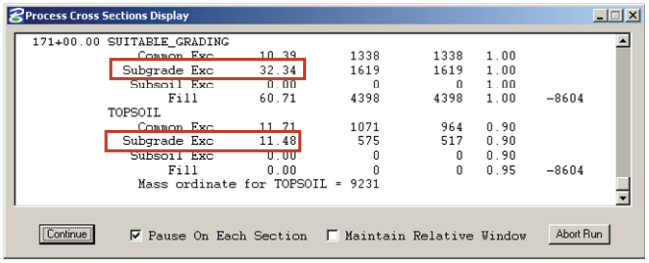


Proposed Undercut
soil type = Suitable_Grading
roadway exc mult factor = 1.0
subsoil exc mult factor = 1.0
fill mult factor = 1.0
type = line, line_string
lvname = XS Proposed Undercut

Subgrade Excavation

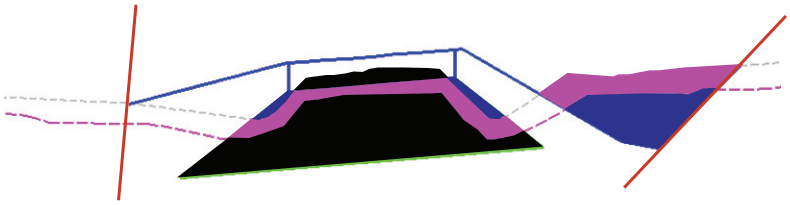
Excavation volumes that are backfilled with an earthwork material.





Subsoil Excavation

Excavation required to remove unsuitable material either 1) down to the bottom of the proposed template or 2) down to the bottom of the unsuitable material layer in cases where excavation limits are defined.

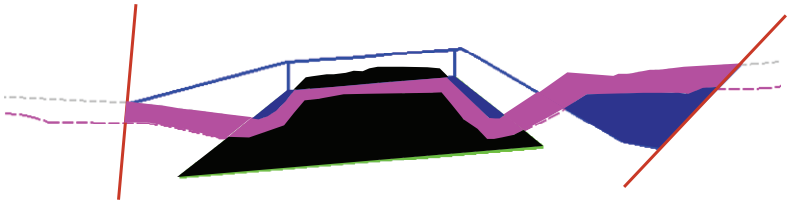


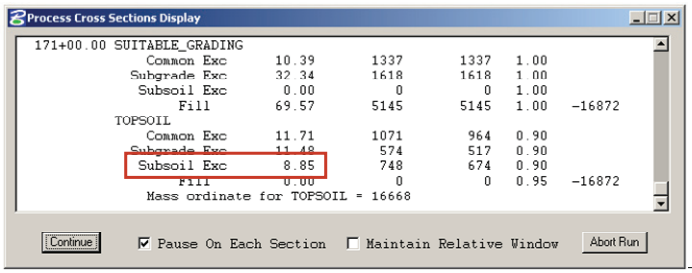
Excavation Limits

lvname = XS Excavation Limits

Subsoil Excavation

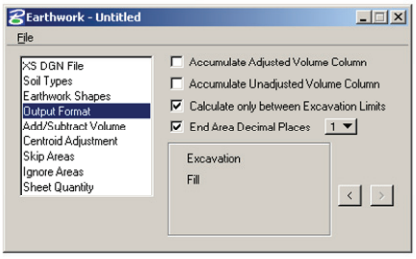
Excavation required to remove unsuitable material either 1) down to the bottom of the proposed template or 2) down to the bottom of the unsuitable material layer in cases where excavation limits are defined.





Excavation Types

- **If you don't care about breaking your excavation quantities out separately, you can combine them.**

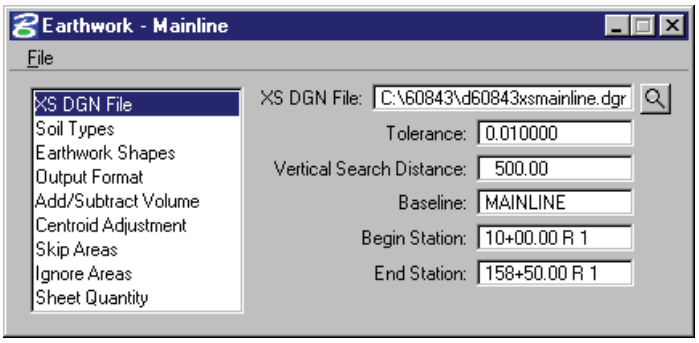


combine common exc + subgrade exc + subsoil exc

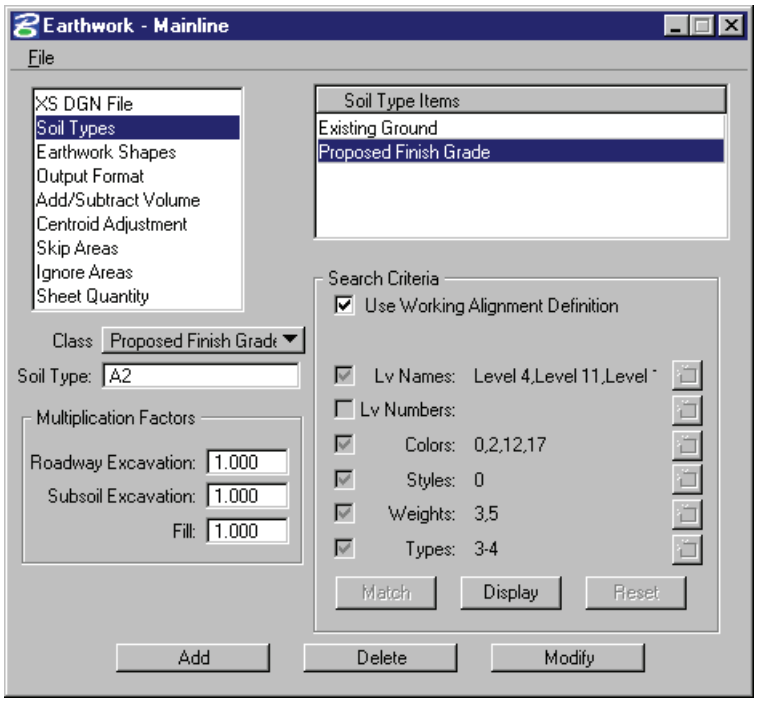
LAB EXERCISE: EARTHWORK

> *STAGED CONSTRUCTION AND MULTIPLE ROADWAYS*

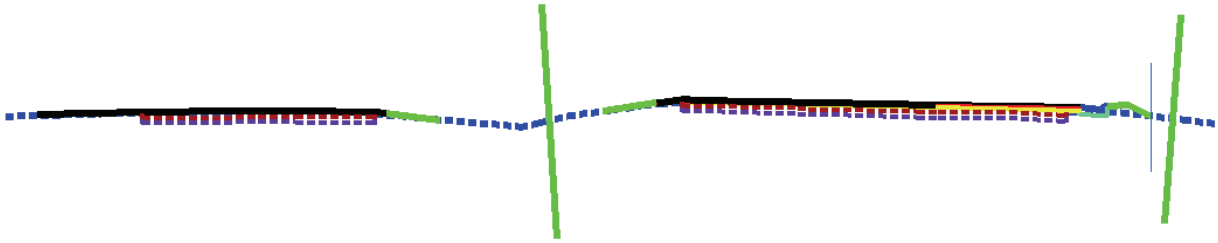
1. Open the file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843xsmainline.dgn*.
2. Access the project *60843* through **Project Manager** using the user name *Mary***.**
3. Click the **Earthwork** button and create a new run **Mainline**.
4. The **XS DGN Fil*e*** portion of the dialog should fill automatically from the **Working Alignment** information.



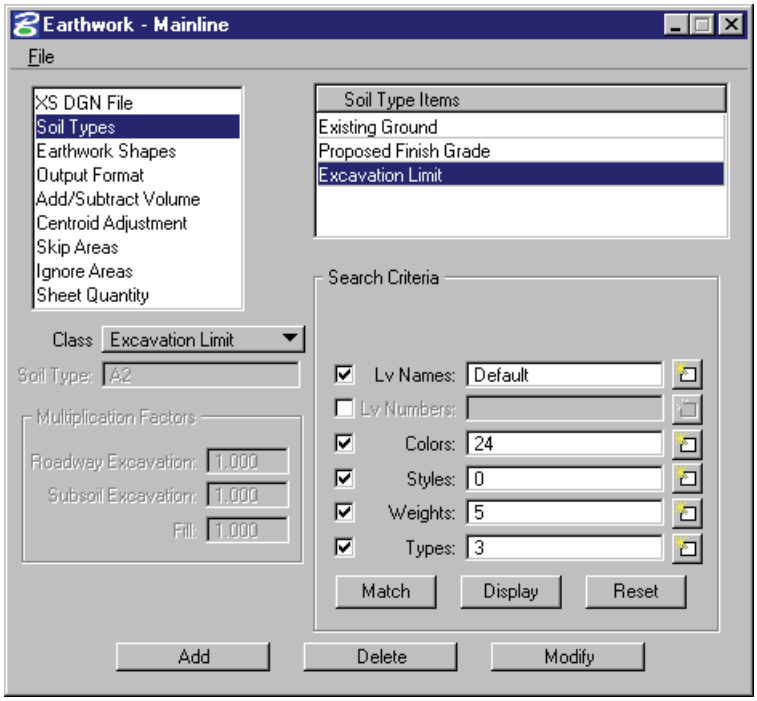
5. Select the **Soil Types** option and set **Existing Ground** and **Proposed Finished Grade**. These should match the **Working Alignment** definitions set in **Project Manager**.



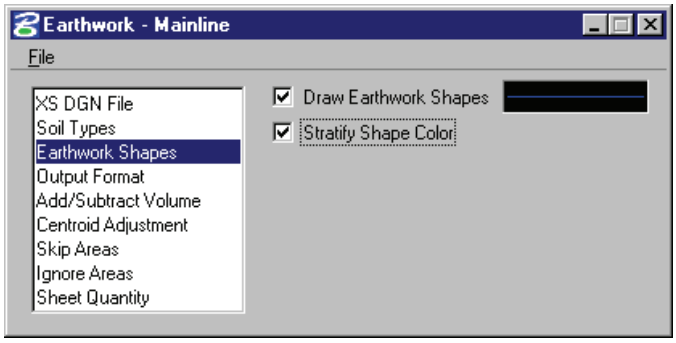
6. In this step we will place **Excavation Limits** just on the right side of the typical. Set the level to **Default** and place the Excavation Limit lines on several sections as shown below.



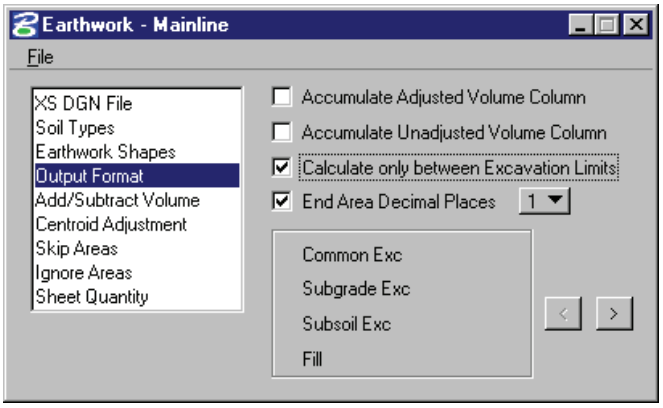
7. Change the **Classification** toggle to **Excavation Limits** and set the symbology then **Add** to the list window.



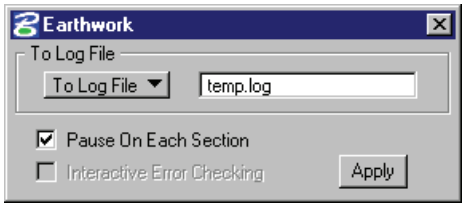
8. Select the **Earthwork Shape** option and set as shown below.



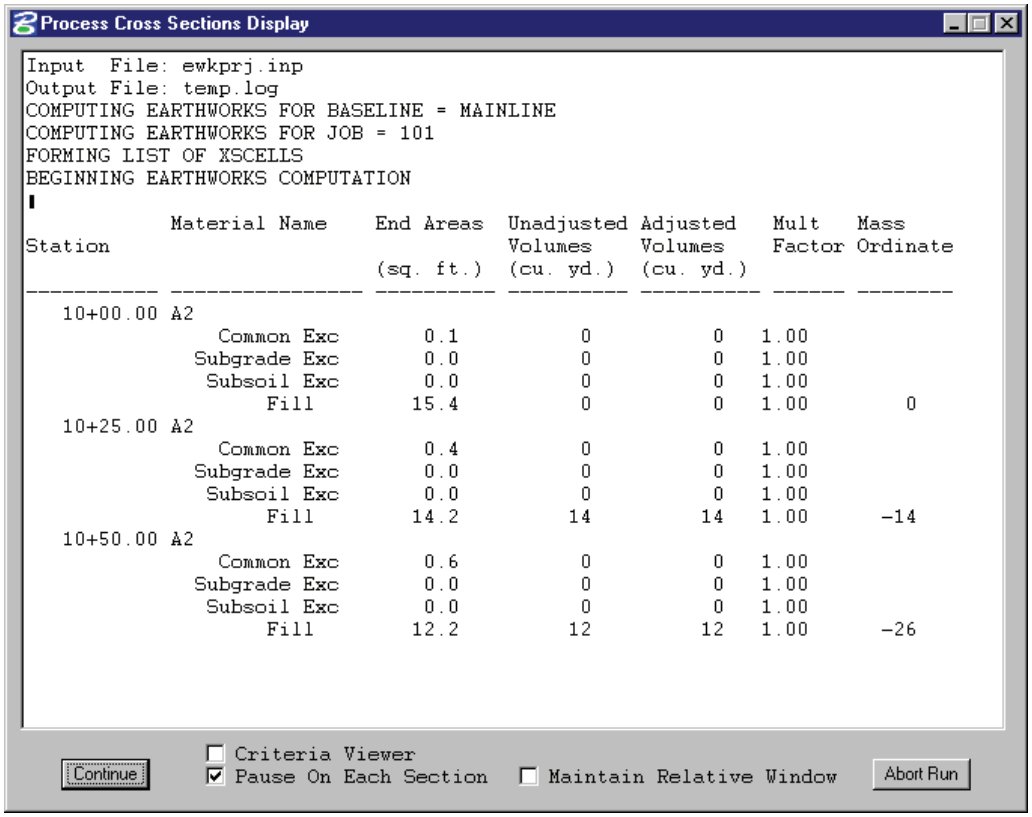
9. Set the **Output Format** as shown below.



10. Select **File > Save Settings** then **File > Run** and make the settings shown below.



11. Click **Apply**.
12. Review the sections and the output.



7 Digital Terrain Modeling

CHAPTER OBJECTIVES

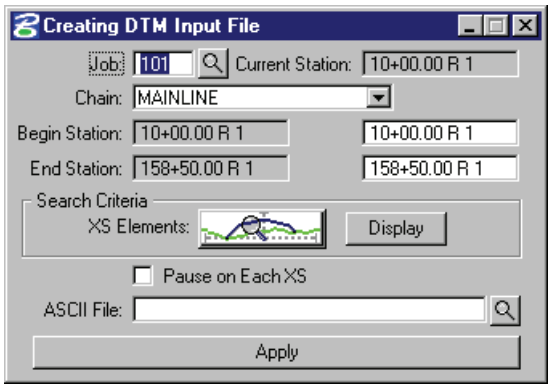
In this chapter we will review the process of creating proposed Digital Terrain Models from proposed cross sections.

INTRODUCTION

The GEOPAK Cross Section Report Utility can extract up to sixteen different reports from original and design cross-sections. For each report generated, the user must set the parameters of the existing and/or design cross sections.

CREATING DTM REPORT

For each station, GEOPAK locates every specified cross section element and generates an x, y, z file of spot elevations suitable for use with the DTM tools. The created file is a DAT file which can be directly utilized in the Build Triangles dialog. Additional fields not required for the Build Triangles application are ignored. Note that no decision tree is provided to differentiate between existing ground and proposed finish grade elements. If this is required, utilize the DTM Prop 3D report.



REPORT OUTPUT

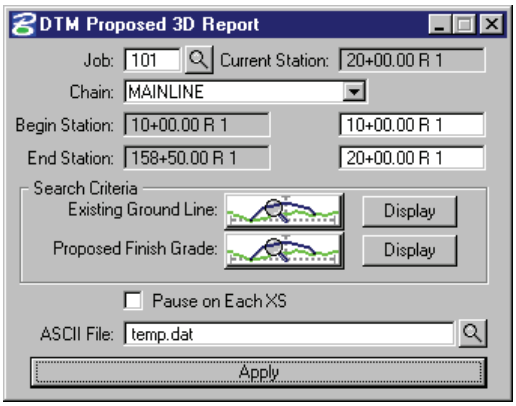
The first column (1) is utilized by the DTM software to identify the rest of the line as a spot elevation. The next three columns are x, y, and z respectively. Note that no header is added to the file as it is not required by the DTM software.

1 522741.21734264 1832287.79561256 7417.00300000

1 522747.84993873 1832281.28536007 7417.25310000

DTM PROP 3D

GEOPAK locates specified proposed cross section elements and existing ground, and generates an x, y, z file of vertices for break lines suitable for use with GEOPAK's Digital Terrain Modeling. Each cross section generates one break line. In the hierarchy, the path follows (from left to right) existing ground until a proposed finish grade element is intersected. The proposed path is followed until it ties back to an existing ground element.



REPORT OUTPUT

The first column (2 or 3) is utilized by the DTM software to identify the line as the beginning or subsequent vertex of a break line. The next three columns are x, y, and z respectively. The rest of the line is comment information and not utilized by GEOPAK. Note that no header is added to the file as it is not required by the DTM software.

3 498007.60673158 223314.62880123 882.96601000 1 1 118+00.0 r 1

3 498015.72589151 223316.31181223 884.00901000 1 1

3 498017.58141269 223317.52559625 884.95300000 1 1

3 498017.78633116 223319.43367284 885.93900000 1 1

3 498077.29111542 223329.07359423 885.93900000 1 1

3 498098.50954625 223333.47193751 884.95300000 1 2

3 498102.80506063 223334.36234957 889.27347000 2 2

3 498113.04417381 223336.48480316 890.47812000 2 2

3 498117.85853969 223338.93378900 892.08431000 2 2

3 498155.18206826 223345.21952737 891.28121000 -1 1 118+50.0 r 1

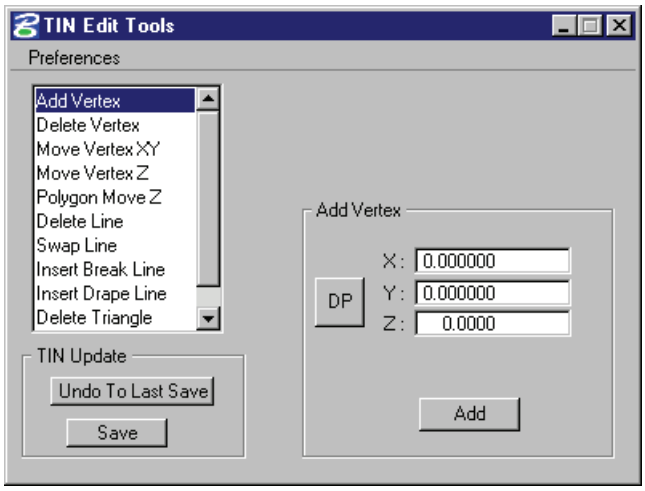
2 498172.50980731 223348.81138133 888.87192000 2 2

3 498188.65610203 223352.15833458 874.01462000 2 2

3 498200.07665864 223354.52569315 874.01462000 2 2

DTM EDITING

GEOPAK provides an editing tool that allows the user to change, modify or manipulate any feature contained in the model. The tool facilitates placing or inserting break lines, modifying contours and triangles as well as changing elevation of existing triangles.



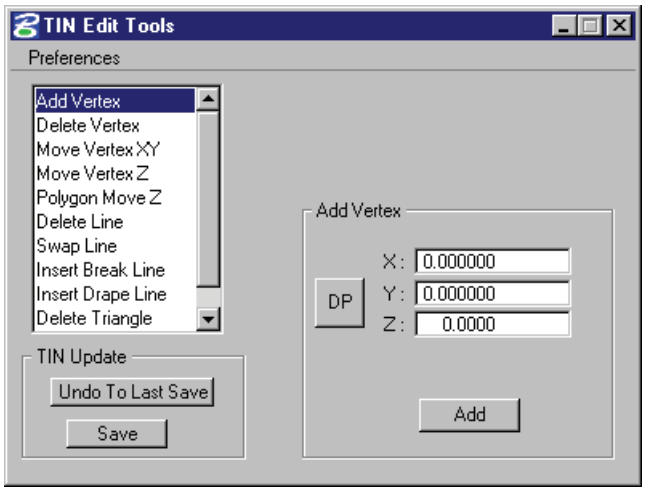
Edits made with this tool will not be saved until the Save button is selected. This allows the user to abandon an editing session without having an impact on the tin file.

There is also an **Undo** option so that modifications may be undone up to the last time there was a **Save** operation performed.

ADD VERTEX

The **Add Vertex** tool is utilized to add additional spot elevations either internal or external to an existing model.

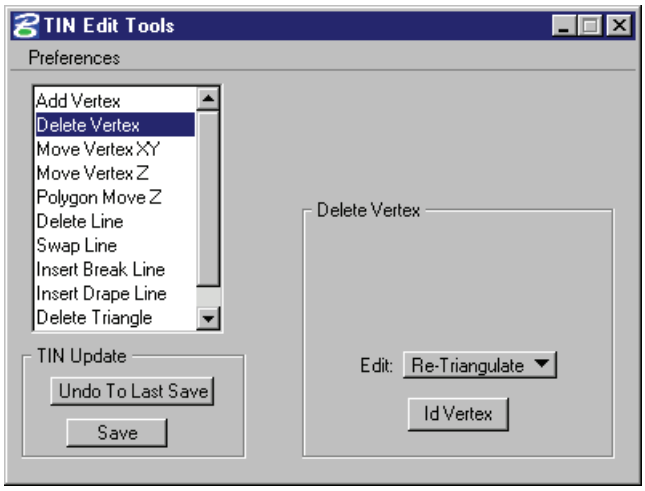
The user has the option of keying in the desired values in the **X**, **Y**, and **Z** fields or interactive editing by clicking **DP**. Moving the cursor over the screen displays the cursor coordinates in the dialog. The **X** and **Y** values are the true coordinates of the cursor, while the **Z** value is the elevation of the specified TIN at the cursor's X, Y value. GEOPAK will also display the triangles on the fly, i.e. as the cursor is moved, the generated triangles are adjusted.



DELETE VERTEX

Another option is **Delete Vertex**. Two options are supported for editing: **Re-Triangulate** or **Create Void**.

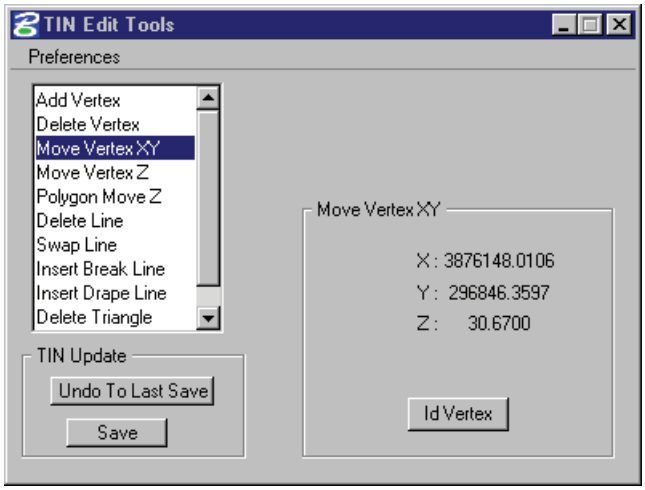
The **Re-Triangulate** option deletes the specified point, then re-triangulates the model without it. When **ID Vertex** is clicked and the specified point is identified on the screen with a data point, the affected vertex, triangle sides, and all associated display elements (i.e., contours, flow arrows, etc.) are highlighted.



MOVE VERTEX XY

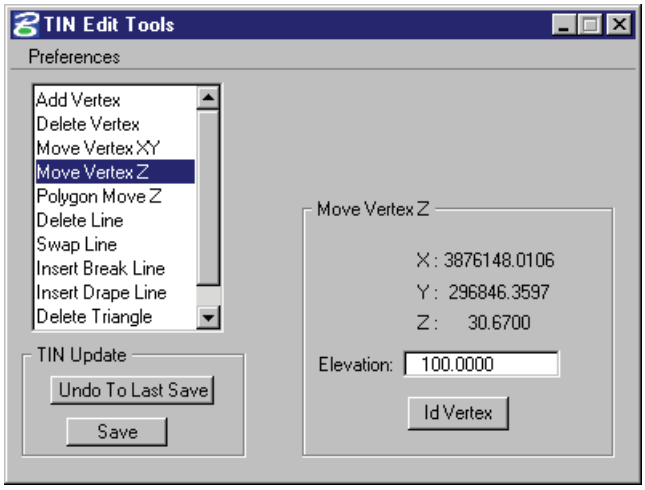
This tool provides a means to change the horizontal location of an existing vertex.

Click **ID Vertex** and the point to be moved is identified by a data point on the screen. The affected vertex, triangle sides, and display elements are highlighted, while the **X**, **Y**, and **Z** values of the vertex are displayed in the dialog.



MOVE VERTEX Z

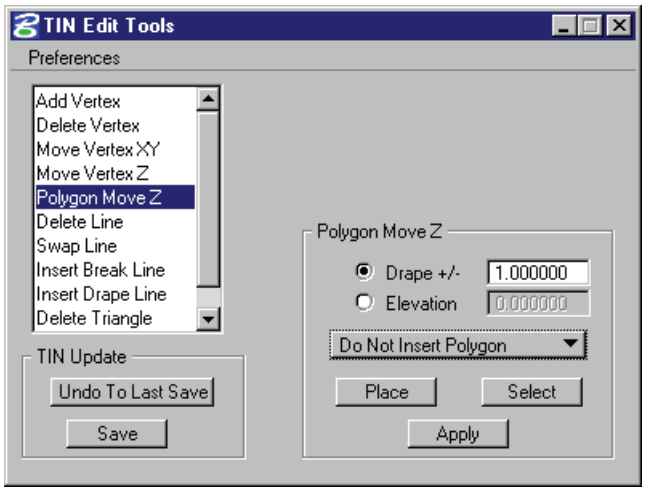
This option allows the user to change the elevation of an existing vertex. Click **ID Vertex** and the vertex whose elevation is to be moved is identified by a data point on the screen. The affected vertex, triangle sides, and display elements are highlighted.



POLYGON MOVE Z

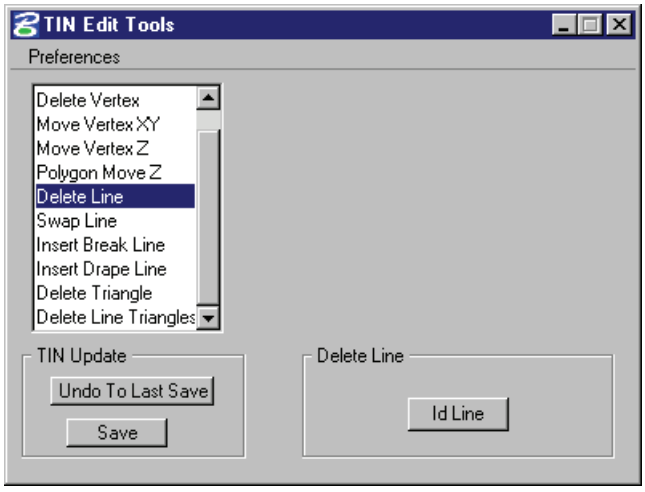
This tool will allow the user to move a specified polygon by changing the elevation on each vertex. Two options are supported to specify the value of the change in elevation: **Drape** or **Elevation**. In **Drape**, either positive or negative values (in master units) dictate the amount GEOPAK moves the polygon above or below the model. In the other option, **Elevation**, GEOPAK moves the appropriate vertices and optionally, the polygon, to the specified elevation. The toggle next to the desired option must be activated.

If the polygon has been placed prior to selecting the Polygon Move Z option, then the **Select** option should be utilized. If the **Place** button is pressed, the software prompts for drawing the polygon as part of the Move procedure. To commence the procedure, press the **Apply** button.



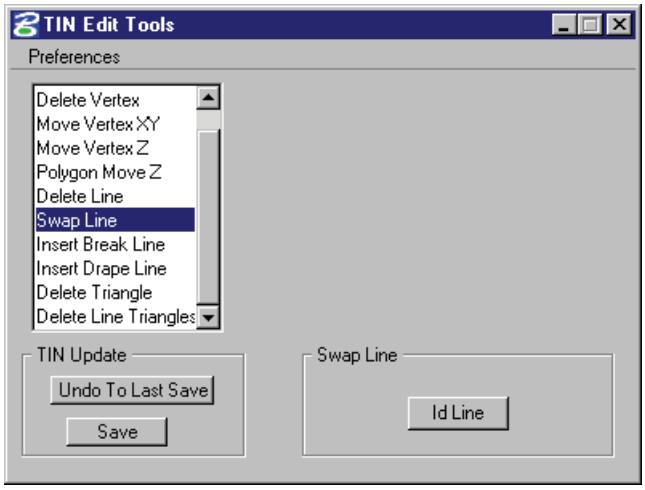
DELETE LINE

This option will allow the user to delete a line external to the main body of the tin file.



SWAP LINE

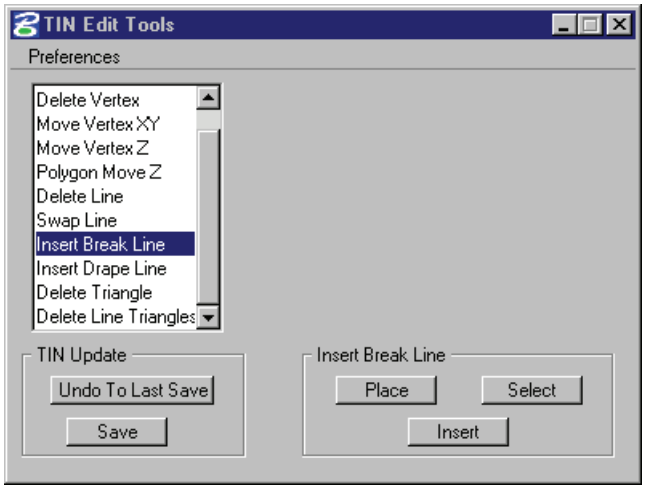
The **Swap Line** option will change the direction in which a triangle has been computed.

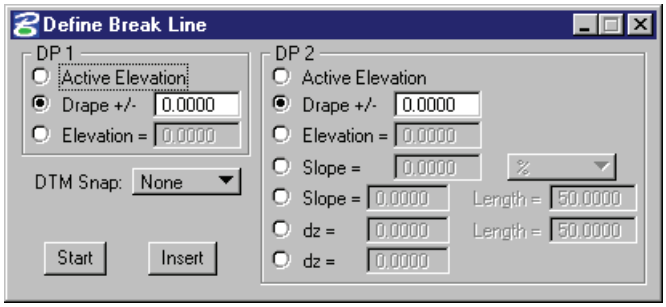


INSERT BREAK LINE

In contrast to the **Insert Drape Line**, the **Insert Break Line** utilizes the x, y, and z coordinates from the break line element, so it must be placed at the desired X, Y, and Z location.

Two methods of insertion are supported: **Place** and **Select**. **Select** is utilized if the break line has been previously drawn, while **Place** is used if no prior break line elements have been drawn.



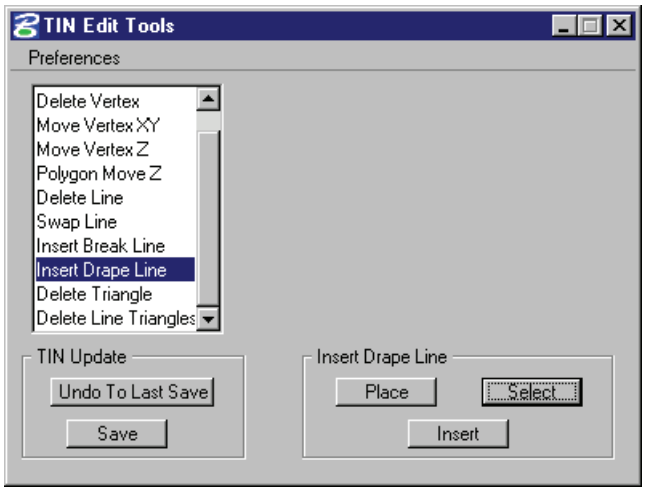


INSERT DRAPE LINE

The **Insert Drape Line** option utilizes the X, Y coordinates of an element placed in the MicroStation file however the Z value is determined from the TIN model.

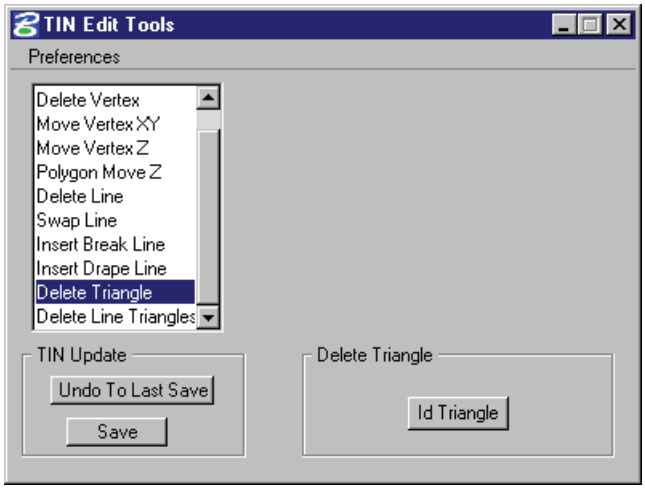
If the drape element has been previously drawn into the MicroStation file, then the **Select** option should be utilized. When **Select** is clicked, GEOPAK prompts the user to identify and accept the previously drawn element. When **Place** is clicked, the user is prompted to draw the desired drape line. Note that the Z value of the drape line being drawn is inconsequential, as the Z values are determined from the specified TIN model.

After the drape line has been identified, click **Insert** to commence the process. The drape element is drawn for reference onto the original TIN model.



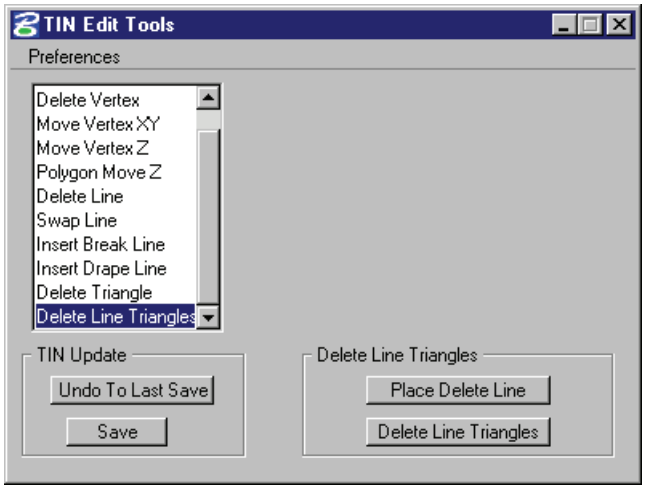
DELETE TRIANGLE

If an external triangle is selected, it is deleted from the model and the TIN hull is updated accordingly. If an internal triangle is selected, a void will be created in the model. The void will be reflected in subsequent processing of either the **Load Voids** tool or **Triangle Statistics** tool.



DELETE LINE TRIANGLE

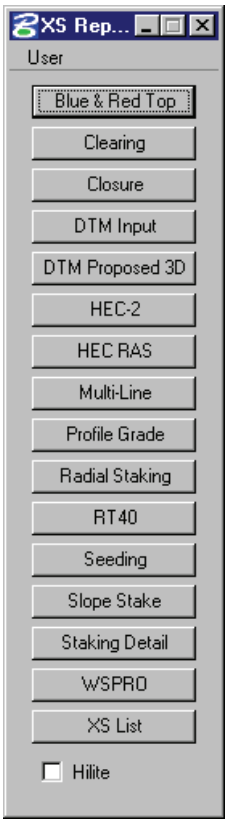
The **Delete Triangle Line** tool uses a user-placed line and deletes all triangles which intersect the line. If external triangles are selected, they are deleted from the model and the TIN hull is updated accordingly. If internal triangles are selected, a void will be created in the model. The void will be reflected in subsequent processing of either the **Load Voids** tool or **Triangle Statistics** tool.



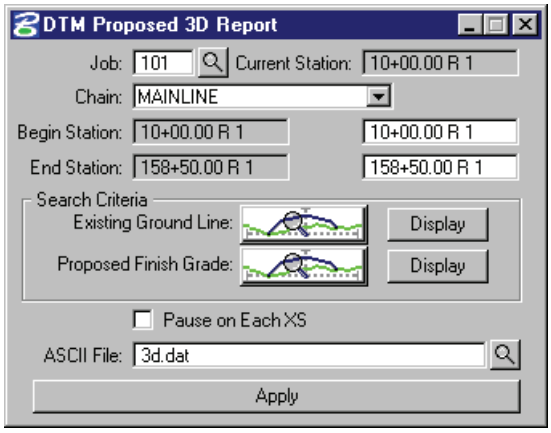
LAB EXERCISE: CROSS SECTION REPORTS

> *DTM PROPOSED 3D*

1. Open the MicroStation dgn file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843xsmainline.dgn*.
2. Access the project *60843* via Project Manager using *Mary* as the user name.
3. From Project Manager click the **Reports & XS Quantities** button.
4. Click the **DTM Proposed 3D** button.



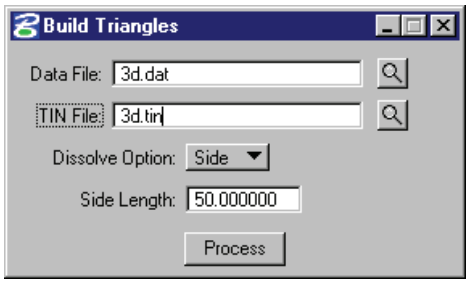
5. Provide a file name to be created from the process.



6. The symbology for **Existing Ground** and **Proposed Finish Grade** should populate according to the **Working Alignment Definition**.
7. Change the ending station to 49+00.
8. Click **Apply**.

> *BUILDING THE TIN FILE*

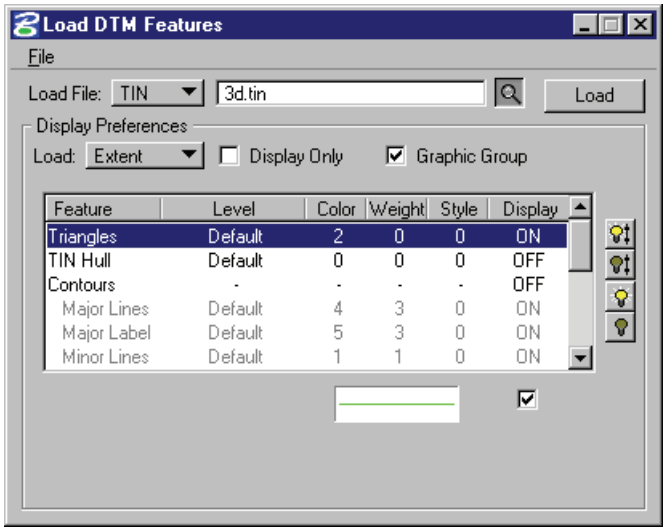
1. Create a new dgn file named *3D.DGN*.
2. Make sure to use a 3D seed file or create a 3D model in the new dgn.
3. Click the **Existing Ground** button on Project Manager and create a new run.
4. Select the **DAT** file created in the previous exercise.
5. Provide a **TIN** file name.
6. Set **Dissolve Option** to **Side** and enter a value of 50.



7. Click **Process**.
8. Close the Build Triangles dialog.

> *LOAD DTM FEATURES*

1. Access the Load DTM Features dialog.
2. Use the **Browse** button to locate the file *3D.TIN*.

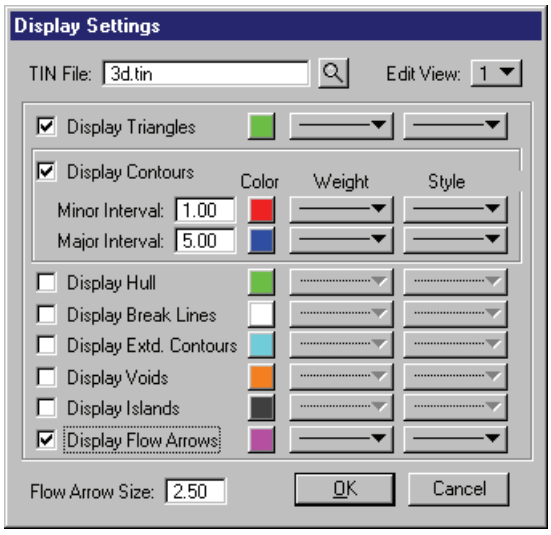


3. Turn all features off except for **Triangles**.
4. Click **Load**.
5. Review the Proposed DTM.

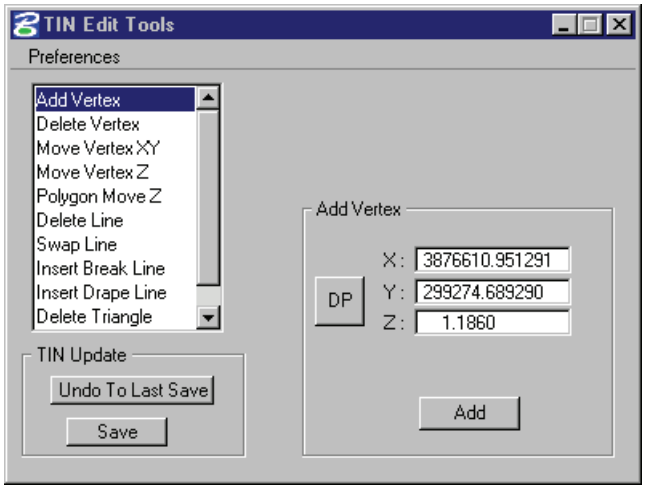
LAB EXERCISE: TIN EDITING

> *EDITING TRIANGLES*

1. Click the icon to access the **TIN Edit Tools**.
2. Enter the settings in the **Display Settings** dialog as shown below.



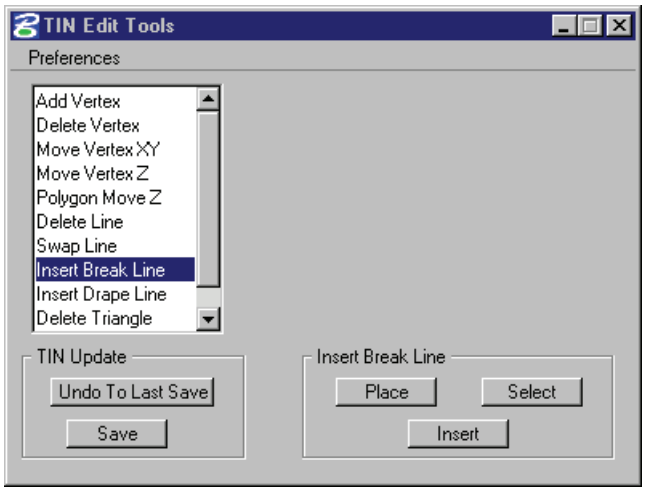
3. Click **OK**.
4. Zoom in anywhere on the DTM.
5. Select the option to **Add Vertex**.



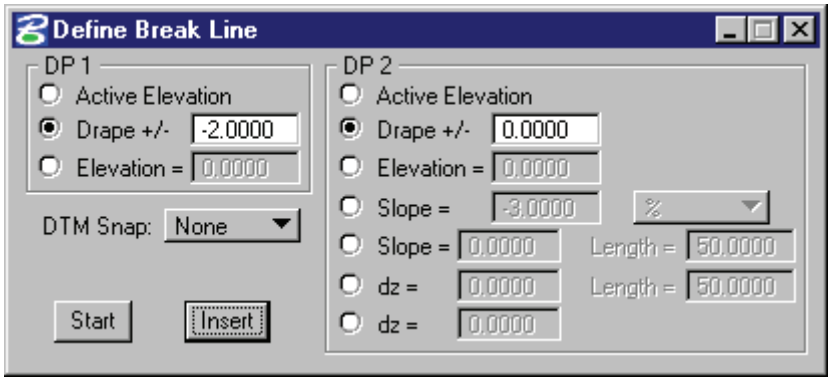
6. Click the **DP** button and move your cursor onto the screen.
7. Data point on the screen to set the coordinates in the dialog.
8. Key-in the desired elevation.
9. Click the **Add** button.

> ***ADDING BREAK LINES***

1. Select the option to **Insert Break Line**.



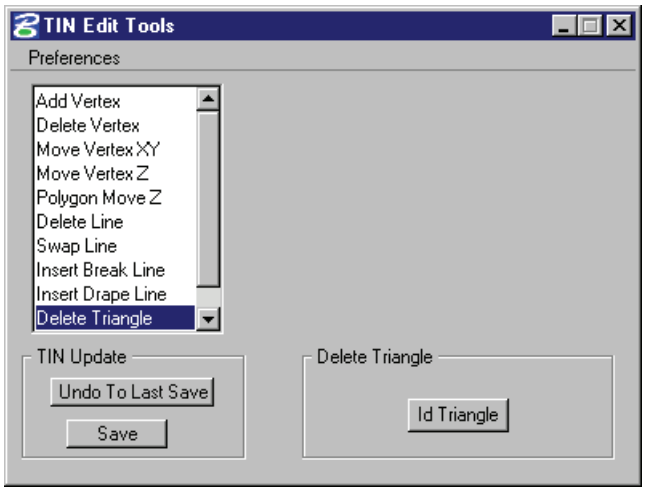
2. Click the **Place** button.
3. In the following dialog make the settings as shown.



4. Click the **Start** button and Data Point on the screen.
5. Place the second data point some distance from the first.
6. Click the right mouse button to end the operation.
7. Click the **Insert** button on the dialog.
8. This will place a break line that begins 2’ lower than the original ground at the start point and tie to existing ground at the second point.

> ***DELETING TRIANGLES***

1. Select the option to **Delete Triangles**.



2. Click the **Id Triangle** button.
3. Data point on a triangle in the MicroStation view.
4. This tool effectively removes unwanted triangles from the TIN file.

8 Labelers

CHAPTER OBJECTIVES

In this chapter we will:

- Learn how to label plan information with Plan View Labeler
- Familiarize the user with the other labelers

INTRODUCTION

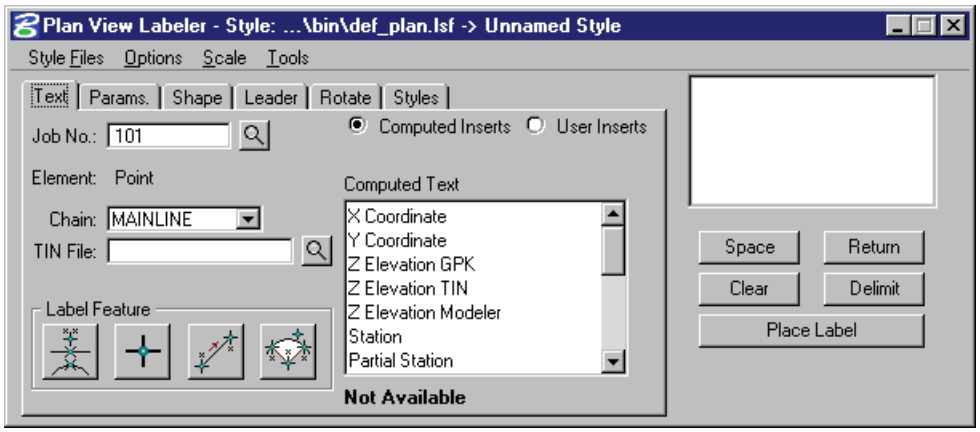
GEOPAK's labeling tools allow a user to place "smart" labels in a MicroStation drawing. These labels have the ability to calculate XYZ coordinates, station, offset, direction, length, radius, degree of curvature, etc. of the associated element.

ACCESSING THE PLAN VIEW LABELER

The Plan View Labeler can be accessed by selecting **Applications > GEOPAK ROAD > Plans Preparation > Plan View Labeling**. It can also be invoked from Project Manager by clicking the **Plan View Design** button or by selecting the **Plan View Labeling** tool from the GEOPAK ROAD tool frame.

PLAN VIEW LABELING

When the **Plan View Labeling** icon is selected, the dialog shown below is displayed.



The label to be placed is displayed in the box on the right side of the dialog as shown above. The **Space** button places a space in the label at the cursor position. The **Return** button starts a new line of text. The **Clear** button starts a new label. The **Delimit** button places a line above or below a line of text. The **Place Label** button attaches the label to the cursor for placement in the drawing.

The user can select the various tabs to define / modify the label appearance.

TEXT

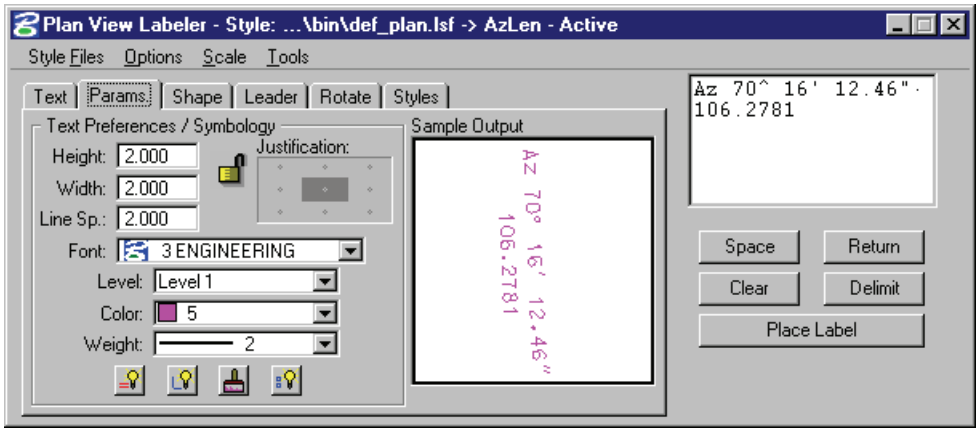
For data to be computed, the job number and the chain need to be selected. If elevations are to be calculated, a TIN file needs to be chosen.

The Computed Inserts are items that GEOPAK has the ability to calculate for the chosen item. The list of Computed Inserts changes with the type of element that is chosen. If a line is chosen, the list of Computed Inserts will show inserts of bearing, and length. If a curve is chosen the list of Computed Inserts will change to show inserts of radius, curvature, chord length, etc.

The User Inserts are items that a user may use on a regular basis. This list can be customized for a specific user's needs.

The **Identify Element** button allows the user to choose the element to use for calculations in the label. The **Data Point** button will let the user pick a specific point to calculate the coordinates, station, or offset for.

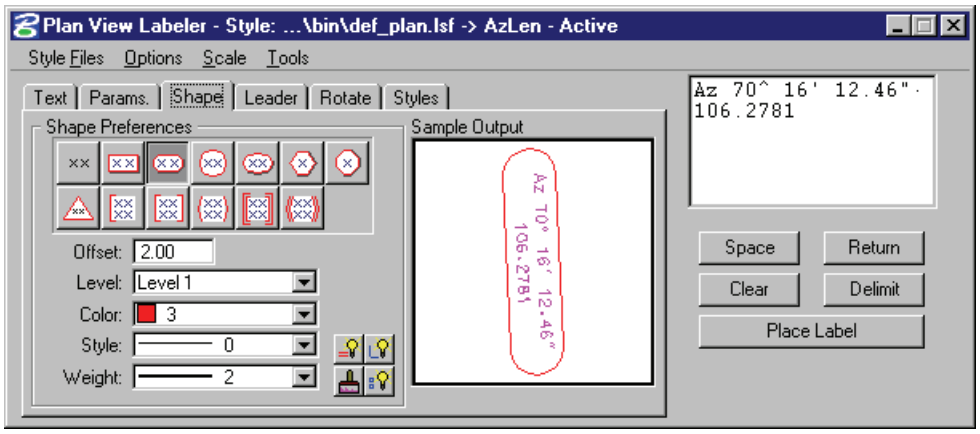
PARAMETERS



The **Parameters** tab enables the user set up the text size and symbology for the label.

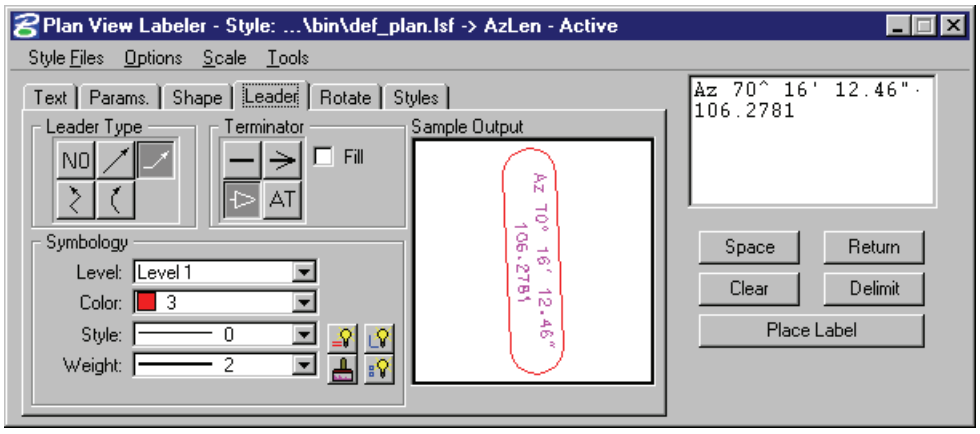
By Current sets the symbology to the current MicroStation settings. **By Element** allows the user to set the symbology by choosing a MicroStation element. **Set All** sets the symbology for all elements in the label (text, delimiters, leader lines, etc.).

SHAPE



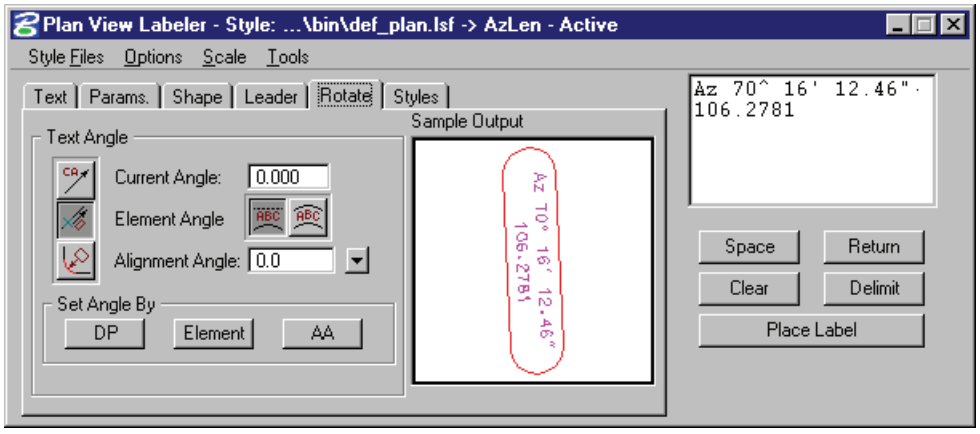
The **Shape** tab allows the user to place a shape around the label, and set the symbology for the shape.

LEADER



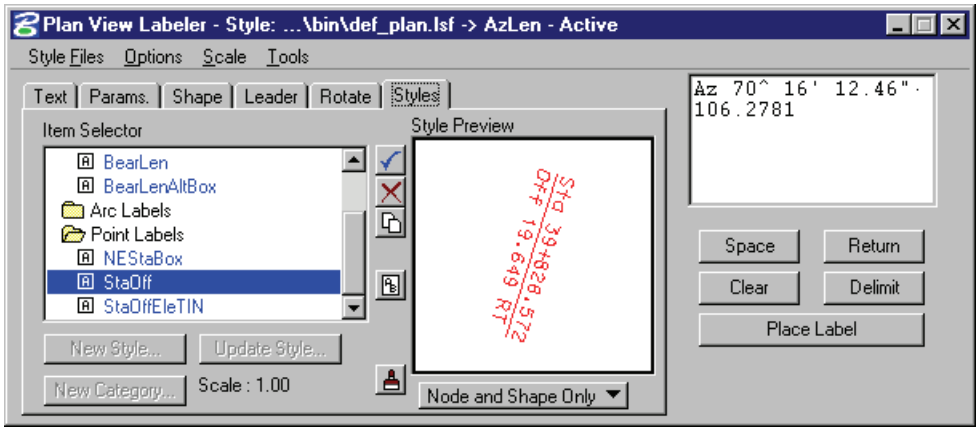
The **Leader** tab allows the user to attach a leader from the label to the point. Different leader types and terminators can be chosen. The active terminator can also be used.

ROTATE



The **Rotate** tab allows the label to be rotated. The rotation can be determined from the current angle, the angle of the element, or the alignment angle. The angle can also be set by two data points (first data point set the location, next data point sets the angle) or the active angle.

STYLES



The **Styles** tab allows a user to choose label symbology from a library of pre-defined styles. When the user chooses the style, all symbology, leaders, shapes, etc. are set up for the user.

MENUS

The Style Files menu allows the user to open a new style library. You must be under the **Styles** tab in order to open a style library.

Options > Minimize Dialog minimizes the main dialog (when the **Place Label** button on the main dialog is pressed) to allow for easier label placement. The Label Viewer can be used in conjunction to still view the sample contained in the Label dialog.

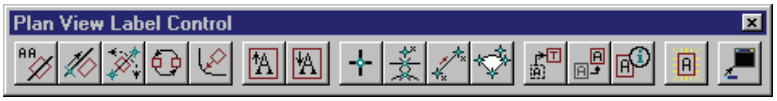
The main labeling window can be maximized by selecting the **Restore Label Dialog** icon within the appropriate View Label Control tool frame or the labeling tool on the main Road, Site, or Drainage tool frame.

Options > Use Reference File Coordinates - When labeling elements within a reference file, it is useful to utilize the reference file coordinates, rather than the current active file. Simply activate the toggle, and subsequent computed text inserts using reference file elements or data points will reflect the reference file coordinates, if the snap and locate in the reference file are active.

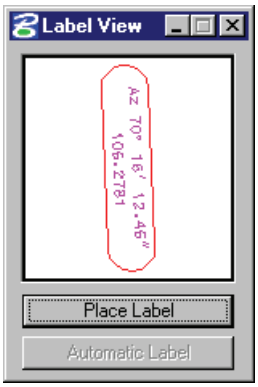
Options > Use DP Element Association - This option will enable the association between MS elements and DP (data point) labels that are snapped to the element. If the element is modified, the

point labels will move with the element when the **Label Update** feature is used. This applies only to elements within the active design file.

Options > Label Tools invokes the tool frame shown below which enables the user to modify GEOPAK labels.



Options > Label Viewer brings up a dialog that allows a user to view and place a label.

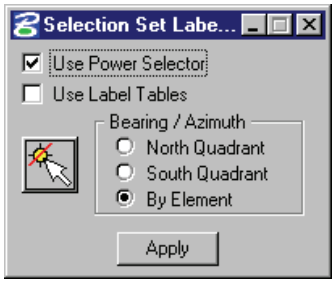


The **Scale > Scale Style** menu allows the user to choose a plan scale. All labels will be adjusted according to the plan scale. The user simply keys in a scale, and chooses a **Labeling Style**. The corresponding label will be placed at the correct size for the scale that was chosen.

Tools > Label Updater - The Label Update tool is a powerful tool for updating GEOPAK labels. When alignments are updated, TIN files modified, labels moved, etc., GEOPAK "remembers" the computed text information utilized in the placement of the original label. Therefore, the software can update the label based on updated data. The tool utilizes the dialog shown below.

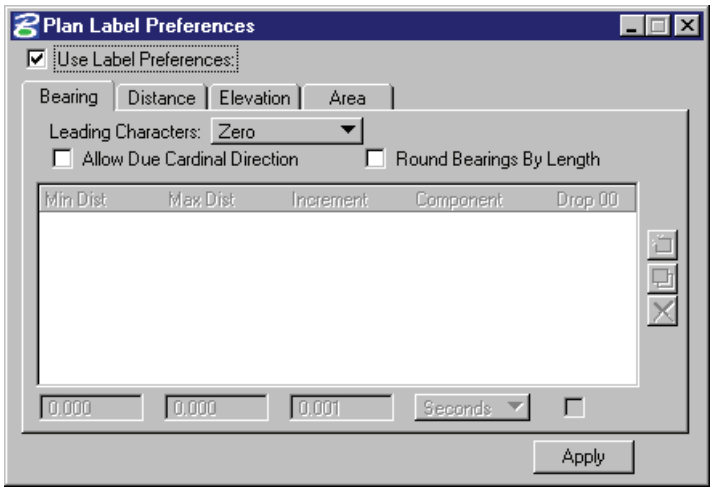
Tools > Selection Set Labeling - The Selection Set Label tool is a powerful tool for placing or updating labels within a selection set.

When the Selection Set Labeling tool is activated from the pulldown menu, the dialog shown below opens.



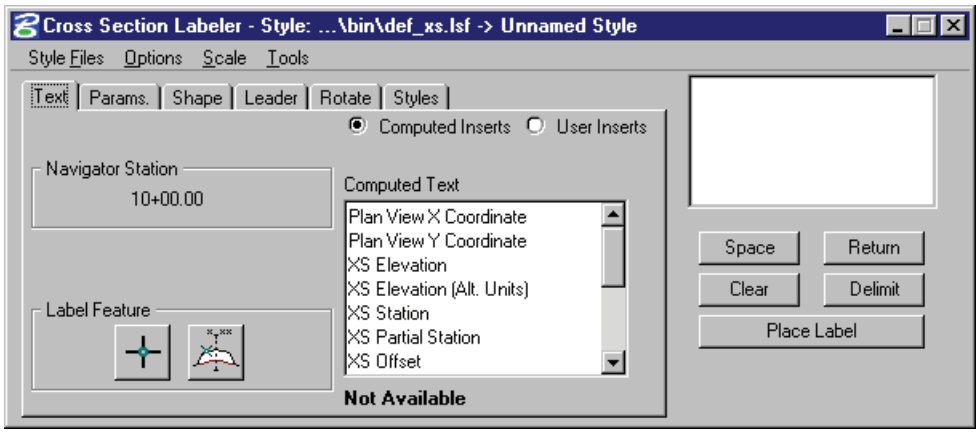
Tools > Plan Label Preferences – Allows for the customization of the plan view labels. Options include Bearing, Distance, Elevation, and Area.

When the **Plan Label Preferences** tool is activated from the pulldown menu, the dialog shown below opens.



CROSS SECTION LABELING

The **Cross Section Labeling** dialog differs from the **Plan View Labeling** dialog only on the text tab. Cross Section Labeling works with the Cross Section Navigator. The current Cross Section Navigator station is shown on the Text tab. The Computed and User Inserts contain values and phrases related to cross-sections.



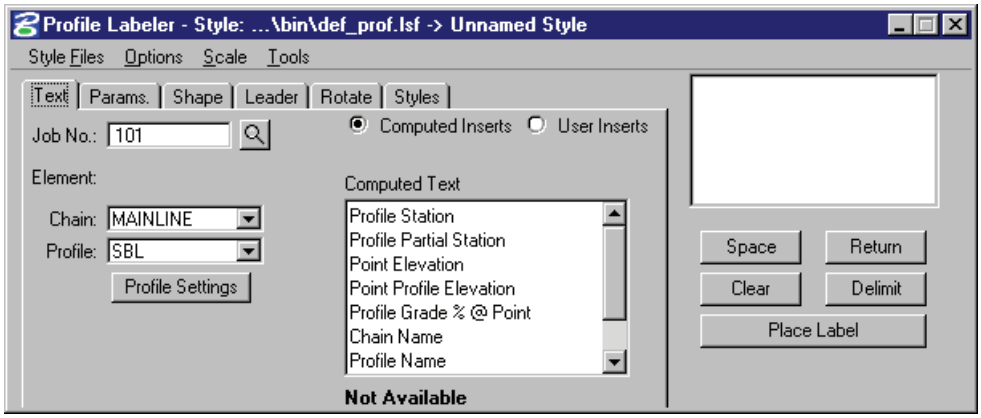
ACCESSING THE CROSS SECTION VIEW LABELER

The ***Cross Section View Labeler*** can be accessed by selecting ***Applications > GEOPAK ROAD > Cross Sections > Cross Section Labeling***. It can also be invoked by selecting the Cross Section Labeling icon from the GEOPAK ROAD tool frame.

PROFILE LABELING

The **Profile Labeling** dialog differs from the **Plan View Labeling** dialog only on the text tab. The Chain and Profile must be defined, in addition to profile settings. The **Computed** and **User Inserts** contain values and phrases related to profiles.

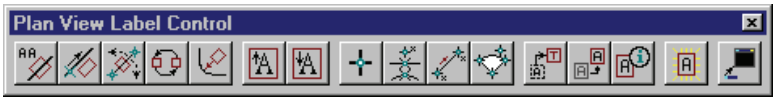
The user must supply the **Reference Station**, **Elevation**, **Scales**, and **Profile Reference Point** which were used to draw the profile. If a profile cell has been previously placed, **Identify Cell** can be clicked and the cell identified. This automatically populates the fields in the Profile Settings. In addition, whether the profile was drawn with gaps or no gaps in the presence of station equations must also be set.



ACCESSING THE PROFILE VIEW LABELER

The **Profile View Labeler** can be accessed by selecting **Applications > GEOPAK ROAD > Plans Preparation > Profile Labeling**. It can also be invoked by selecting the **Profile Labeling** icon from the **GEOPAK ROAD** tool frame.

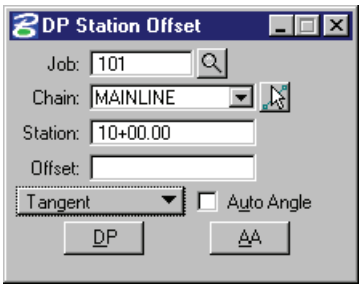
Note If after placing any label with any of the labeling tools a label should need to be modified, it is important that the **Label Tools** be used to modify the label. Each label is in fact a cell with intelligence and the **Label Tools** accessed from any of the labelers will maintain the intelligence associated with each label.



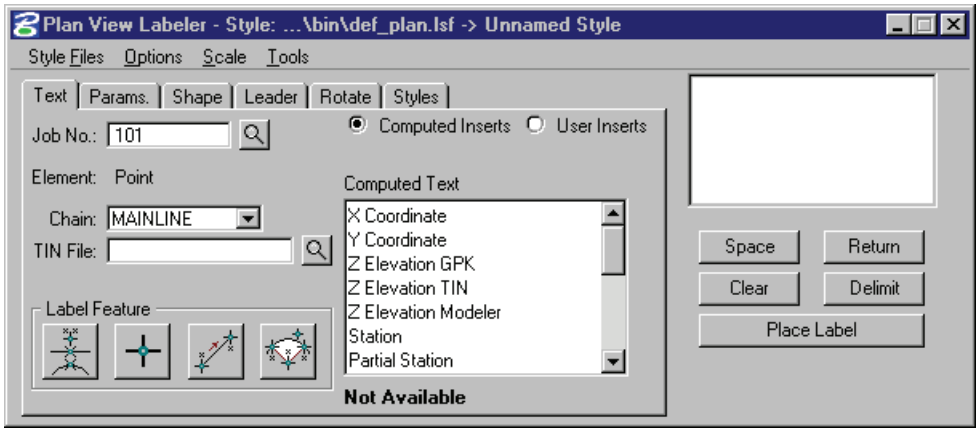
LAB EXERCISE: LABELING

> *ACCESSING THE PLAN LABELER*

1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843work.dgn*.
2. Access the project *60843* via **Project Manager**.
3. Click the **Plan View Design** button on the main Project Manager dialog.
4. From the **Plan View Design** tool bar, click **DP Station Offset**.
5. Zoom in around Sta. **10+00.00**, near the beginning station of the Curb & Gutter section, and complete the dialog as shown below.

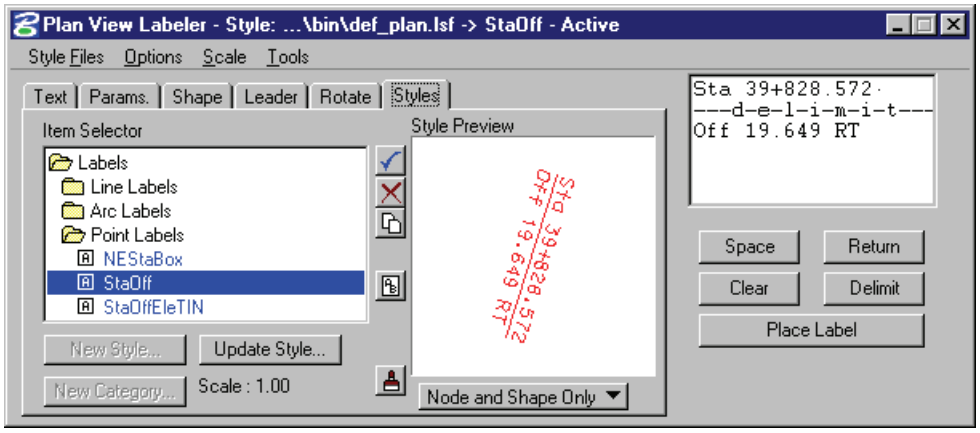


6. Next, select the MicroStation **Zoom In** tool and click the **DP** button on the above dialog. Continue to data point as the view is zoomed in onto this area of interest.
7. Close the DP Station Offset dialog.
8. From the **Plan View Design** tool bar, click the **Plan View Labeler** tool.



> *USING PREDEFINED LABEL STYLES*

1. Select the **Styles** tab.
2. Traverse with the Item Selector box to locate the following style:
   Labels > Point Labels > StaOff.
3. Next, double click the **StaOff** style.

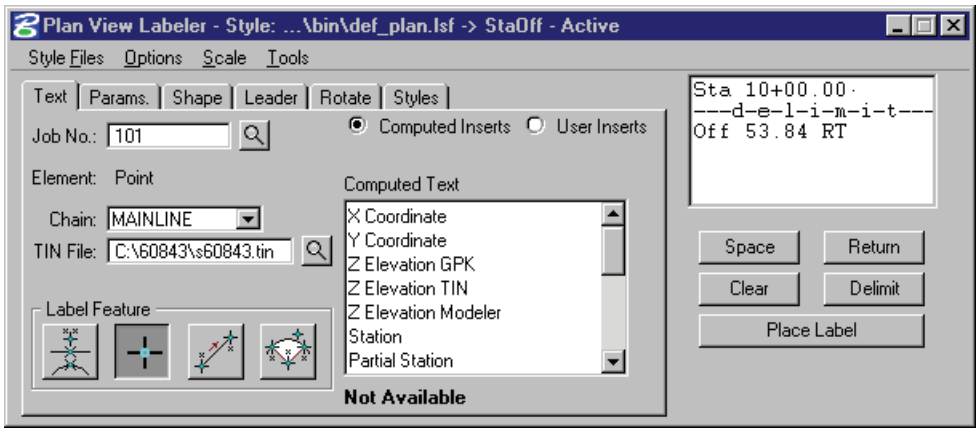


4. Move back to the **Text** tab and complete as defined below:

Job No.	101
Chain	MAINLINE
TIN File	s60843.tin

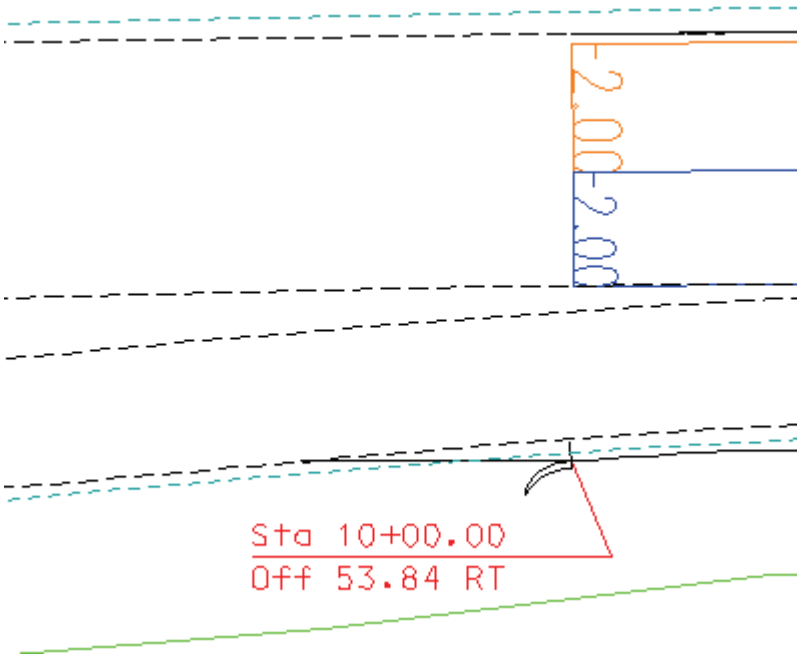
Note In the following steps, we will use the **Plan View Labeler** to label the beginning station and offset for the sidewalk and curb section as well as the ending station and offset for the paved shoulder sections.

5. To begin the process, select the **DP** button and then identify the location that you wish for the Station and offset to be computed. The labeler automatically calculates the information.



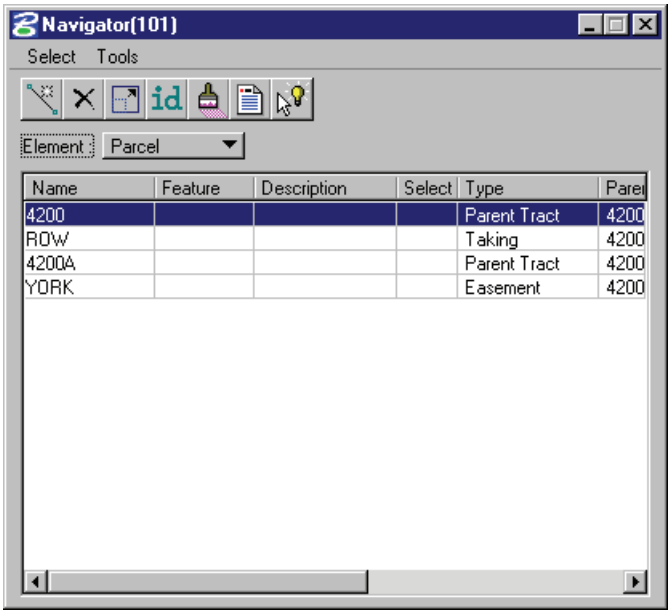
6. Use the **Params.**, **Shape**, **Leader** and **Rotation** tabs to experiment with different labeling styles.
7. To place the label, return to the **Text** tab and click the **Place Label** button.
8. The label is now attached to your cursor (without the leader for the delimiter).
9. Data point at the location you wish the text to be located.

10. A second data point will define the side of the label, which the leader line will be drawn from the delimiter line to the computed location.

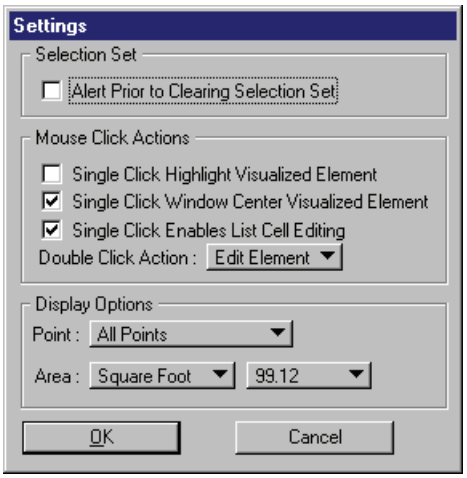


> *CREATING AND SAVING A NEW LABEL STYLE*

1. Select the **Text** tab then click **Clear** below the label composition window.
2. Start Coordinate Geometry and set visualization to **Permanent Visualization**.
3. Select **Tools > Navigator**. In the Navigator window, set the **Element** to **Parcel**.

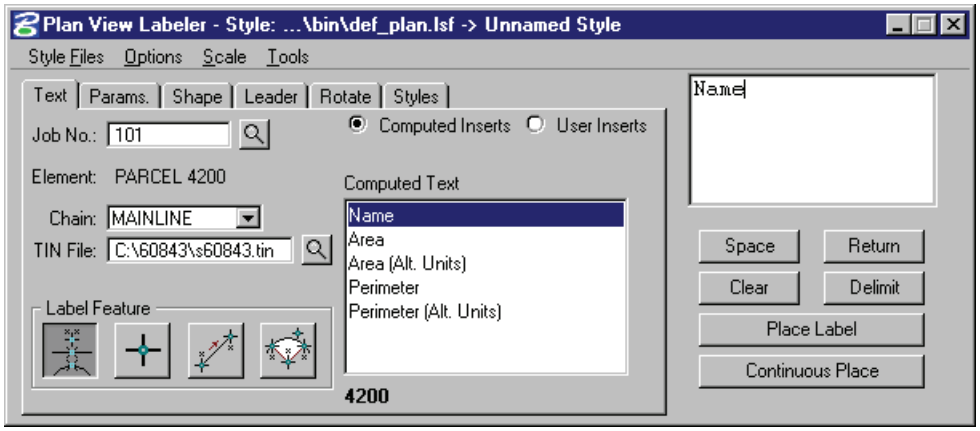


4. Select **Tools > Settings** and toggle **ON** the option to **Window Center Visualized Elements**.

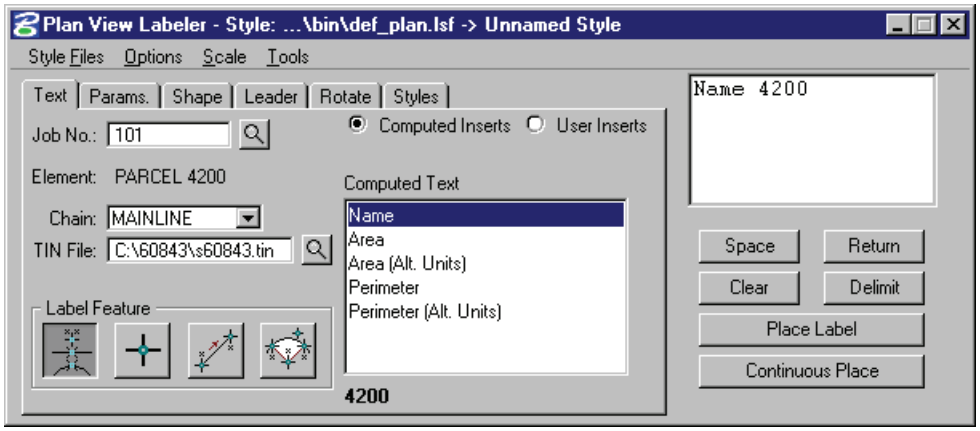


5. Highlight the Parcel 4200.
6. Click on the **Paintbrush** to visualize it then close COGO.
7. On the Plan View Labeler dialog, click the **Select GEOPAK or MS Element** icon, then identify any of the lines representing the parcel and accept. The computed text inserts should now contain items such as **Name, Area,** and **Perimeter**.

8. In the composition window key-in **NAME**.

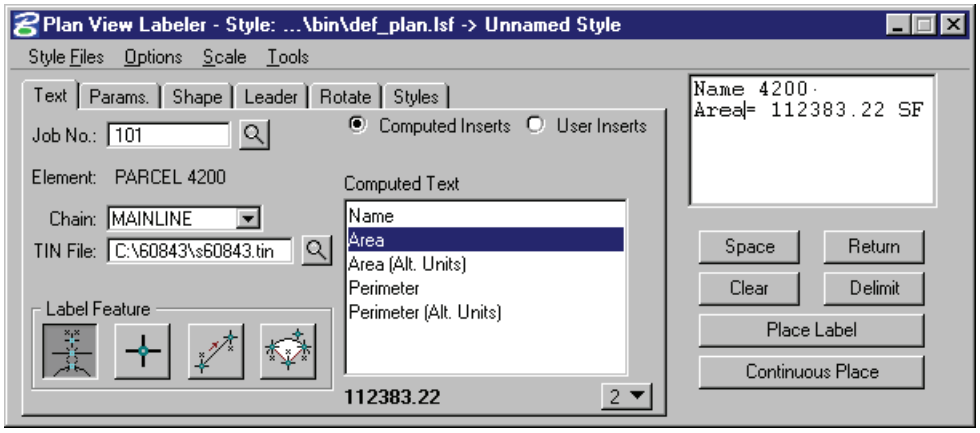


9. Double click on the item in the **Computed Text** window shown as **Name**.

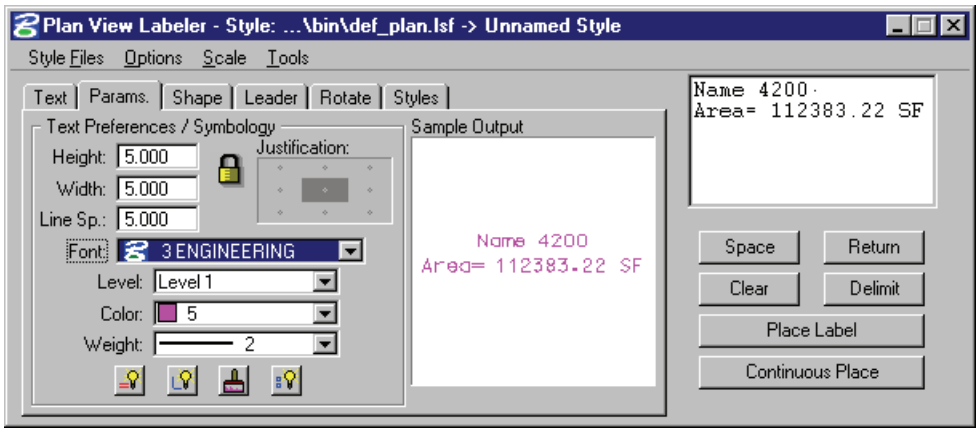


10. Enter a carriage return in the composition window.
11. Key-in **Area=**.

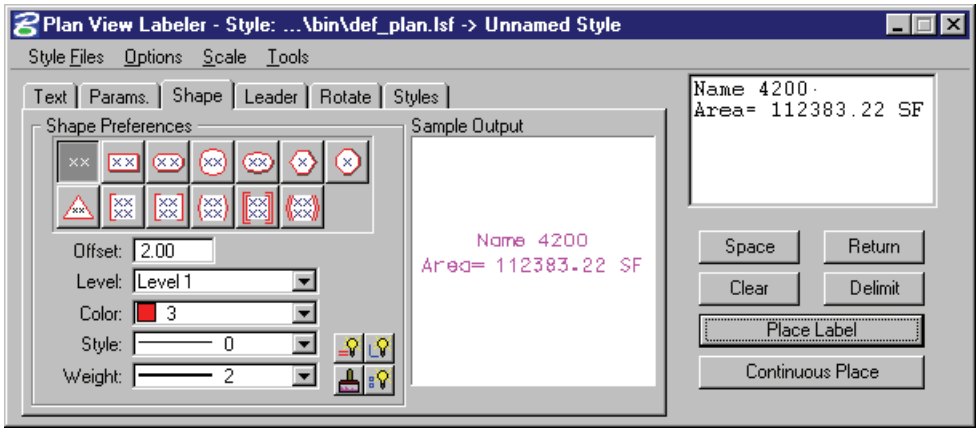
12. Double click on the item in the **Computed Text** window shown as **Area**.
13. Key-in **SF** after the area.



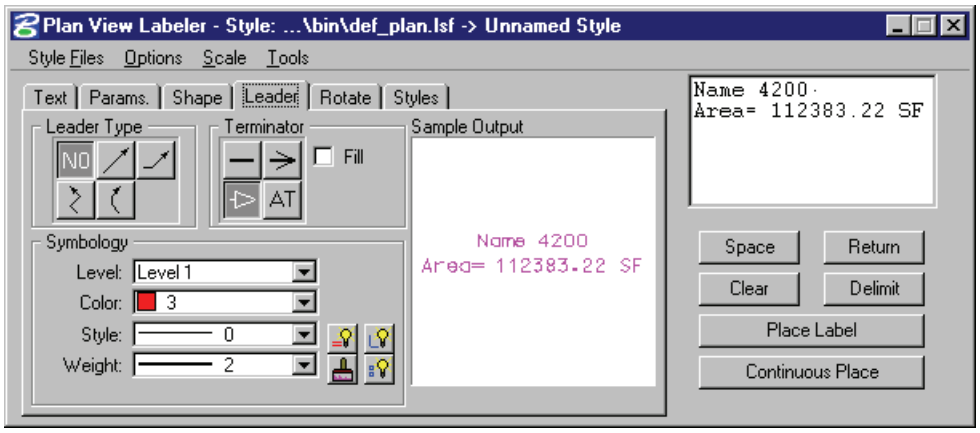
14. Select the **Params**. Tab and set the **Height, Width,** and **Line Sp.** to **5.0** and the **Justification** to **Center-Center**.



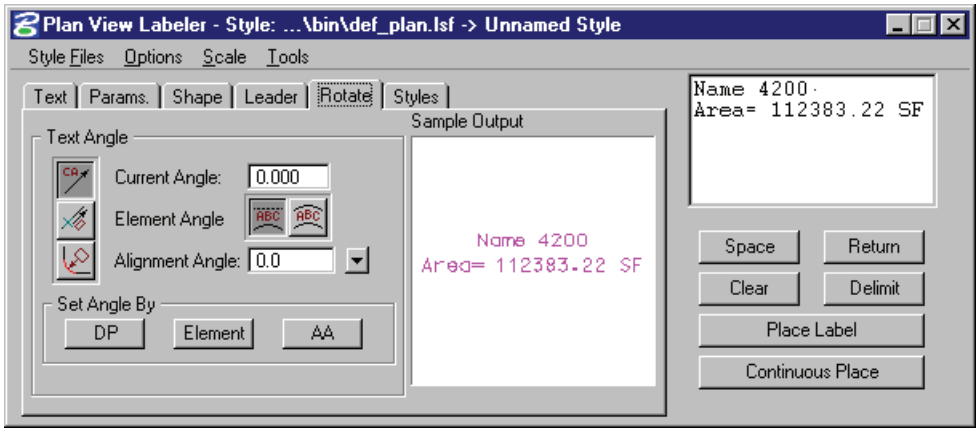
15. Select the **Shape** tab, set the **Shape Preferences** to **No Shape**.



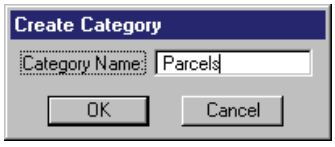
16. Select the **Leader** tab and set the **Leader Type** to **NO Leader** and the set the **Terminator** to **No Terminator**.



17. Click **Rotate** tab. Set the angle to zero.



18. Click the **Place Label** button and place the label in the parcel.
19. Select the **Styles** tab.
20. In the **Item Selector** window, double click **Labels**.
21. Click **New Category**.
22. Create a category named **Parcels**.



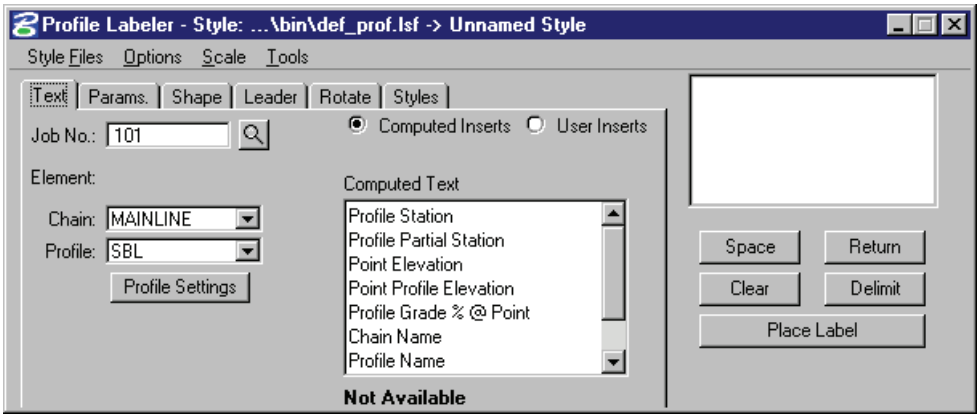
23. Highlight the **Parcels** category and click **New Style**.

24. Create a **Style** named **Area**.

25. Exit MicroStation.

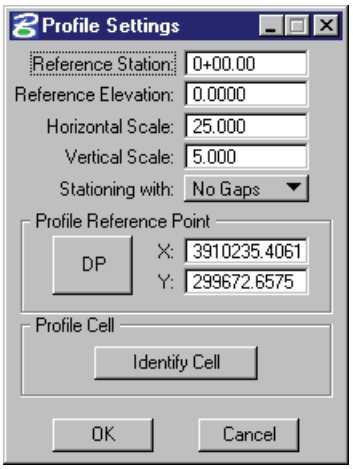
> *PROFILE LABELER*

1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843prof.dgn*.
2. Attach the saved view *PRO1*.
3. Access the **Profile Labeler – (Applications > GEOPAK Road > Plans Preparation > Profile Labeling**.

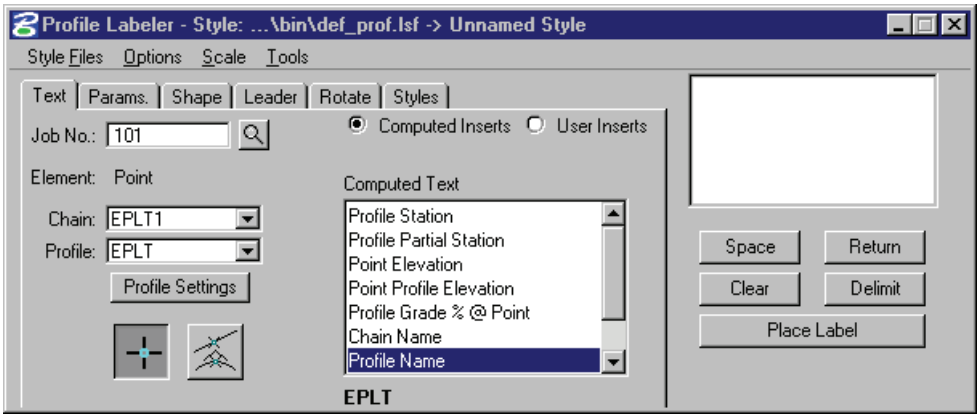


4. Click the **Profile Settings** button on the main dialog.

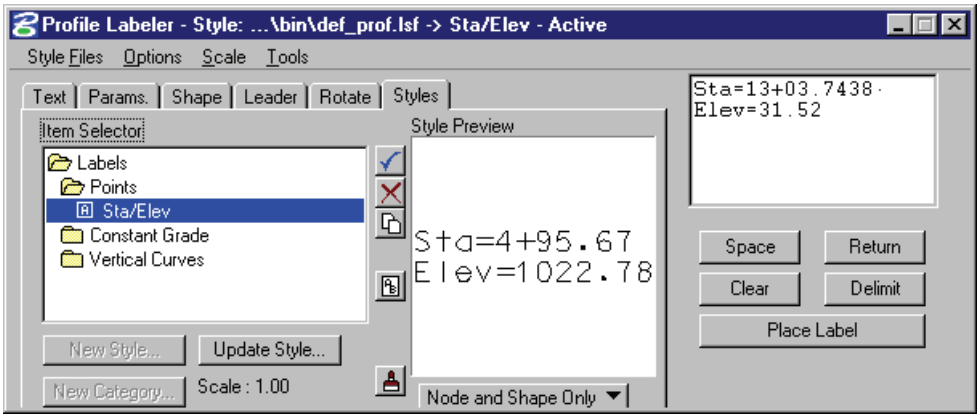
5. Click the **Identify Cell** button and data point on the profile cell.



6. Click **OK**.
7. Set the **Chain** and **Profile** on the main dialog as shown below.

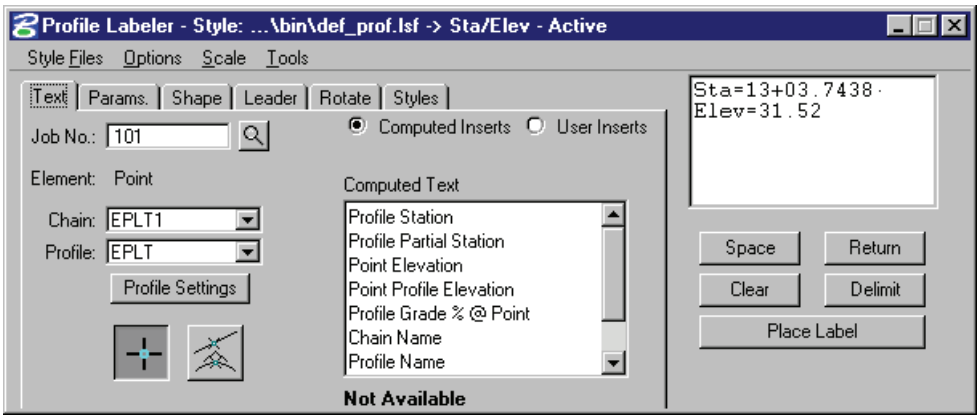


8. Click the **Styles** tab and double click on the **Sta/Elev** label style in the **Point** category.

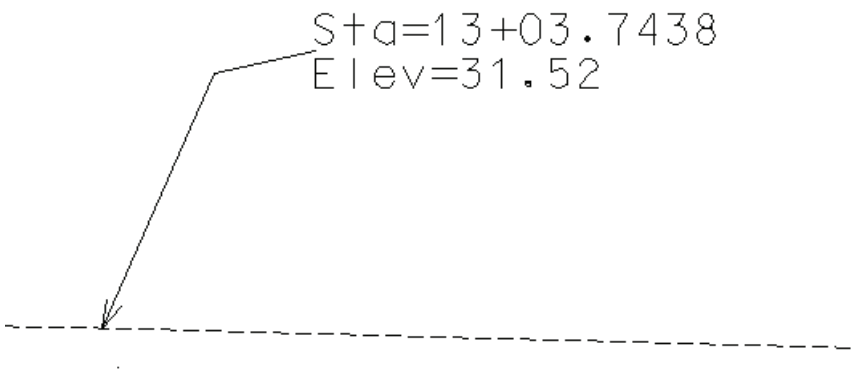


9. Return to the **Text** tab and click the **Point** icon.
10. Snap to a point on the profile.

11. Click the **Place Label** button on the main dialog and place the label in the DGN file.

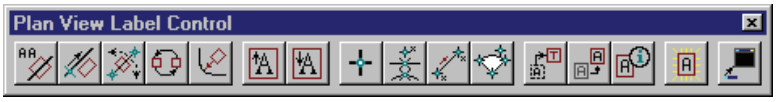


12. You should now have a Station and Elevation label as shown below.



13. Exit MicroStation.

Note	If after placing any label with any of the labeling tools, a label should need to be modified, it is important to use **Label Tools** to modify the label. Each label is a cell with intelligence and the **Label Tools** accessed from any of the labelers will maintain the intelligence associated with each label.



9 Active Chain Control

CHAPTER OBJECTIVES

In this chapter, you will be familiarized with the **Active Chain Control** tool so that it can be used to review projects in multiple views with ease.

INTRODUCTION

The GEOPAK **Active Chain Control** is an excellent tool, enabling the user to manage plan, profile, and cross section views simultaneously. It also allows usage of MicroStation tools to place elements in any view in accordance with the curvilinear coordinates settings. One advantage of this tool is that you can use stations beyond the limits of the chain with any MicroStation command.

ACCESSING ACTIVE CHAIN CONTROL

The tool can be opened by selecting **Applications > GEOPAK Road > Active Chain Control**. When invoked the dialog shown below opens.

First select the desired ***Job*** and ***Chain*** name from the combo boxes to use as the active chain. Four icons are supported to the right of the chain list field and are detailed in the following table.

Graphically select the active chain candidate.

Opens the “Precise Curvilinear Coordinates” dialog that allows entering stations/offsets/elevations relative to the active chain.

Activates the current Profile system, which is associated to a Profile Cell. The Profile Cell can stay in the master file or in any of the reference files. If there are several Profile cells relative to the active chain, it is possible to designate the active one in the Profile Cell Control dialog. When the right mouse button is pressed, a pop-up menu appears :

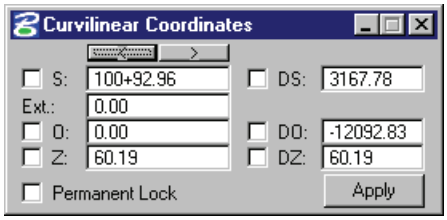
The first option of the pop-up menu allows placing a Profile cell. The second option allows getting information about Profile cells that stays in master and reference files and selects the active one if there are several profile cells.

Activates the current Cross Section system. If there are several reference files containing XS cells relative to the active chain, it is not possible to activate the Cross Section Representation System. In this case, an alert dialog is displayed

The right side of the toolbox has eight icons which set each view to plan, profile or cross section view. By right clicking an icon, any view can be set to any of the 3 possible views. For example, if there is an active profile cell, setting a view to profile will immediately fit the profile within the limits of the view.

CURVILINEAR COORDINATES

The **Curvilinear Coordinates** tool enables the user to enter precise curvilinear coordinates relative to the active chain. It can be utilized in conjunction with generic MicroStation commands such as place line and place cell.



S: Station along actual active chain. If the lock toggle is on, the cursor follows a perpendicular to the chain in plan views, and a vertical line in Profile views.

Ext.: Extension to the station along actual active chain. A negative value means that the extension is before the beginning of the chain. A positive value means that the extension is after the end of the chain.

O: Offset from the actual active chain. If the lock toggle is on, the cursor follows a fixed offset to the chain in plan views.

Z: Use this field to enter elevation. If the lock toggle is on, the cursor follows a horizontal line in Profile views.

DS: Delta station from the previous data point or tentative point. If the lock toggle is on, the cursor will follow a perpendicular to the chain in plan views, and a vertical line in Profile views.

DO: Delta offset from the previous data point or tentative point. If the lock toggle is on, the cursor follows a fixed offset to the chain in plan views.

DZ: Use this field to enter delta elevation from the previous data point or tentative point. If the lock toggle is on, the cursor will follow a horizontal line in Profile views.

Permanent Lock When this toggle is checked, coordinate locks remain active, even after a data point is issued.

Apply Click to send a data point to the input queue. Entering a data point by a click in a view has the same effect.

LAB EXERCISE: ACTIVE CHAIN CONTROL

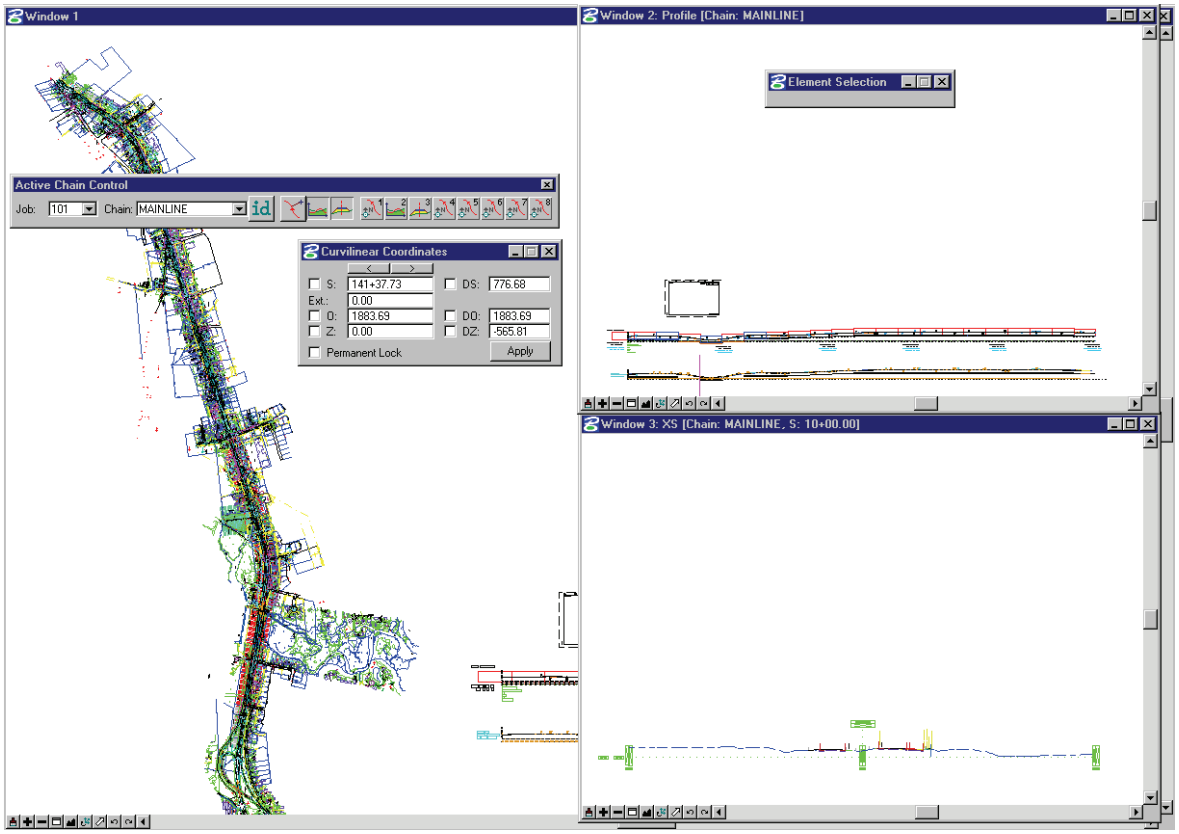
> *SETTING UP CHAIN CONTROL*

1. Open the MicroStation file *C:\DATA\GEO\VDOT\ROAD2\60843\d60843work.dgn*.
2. Reference the files *d60843prof.dgn* and *d60843xsmainline.dgn* to coincidently.
3. Access the **Active Chain Control** *(***Applications > GEOPAK Road > Active Chain Control***)*.

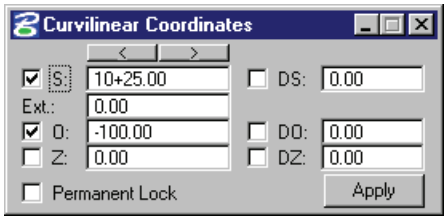
4. Set the **Job** and **Chain** as shown above.
5. Open Views 2 and 3 and stack them on the right side of View 1.
6. Right click on each icon 1 thru 3 and set accordingly.

1	Plan
2	Profile
3	Cross Section

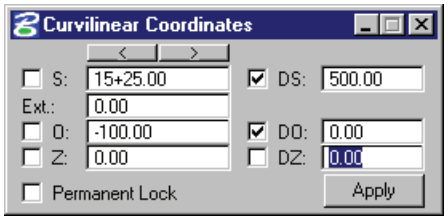
7. You should have your views setup looking similar to the image below.



8. Zoom into the beginning of the project in Plan view.
9. Click the **Curvilinear Coordinates** icon.
10. Select the MicroStation **Place Line** command.
11. Key in a station of 10+25 and an offset of -100. (Lock the values).



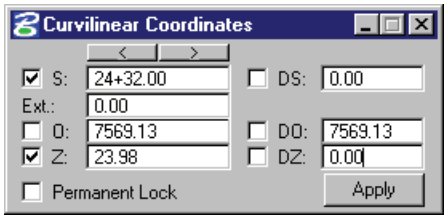
12. Click **Apply**.
13. After moving the cursor back to the view, you will notice that the line began at the desired location.
14. In the Curvilinear Coordinates dialog, key in delta station values of 500 and delta offset value of 0.



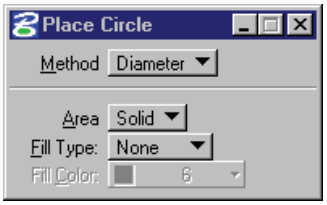
15. Click **Apply**.
16. This will place the second endpoint of the line at station 15+25 offset -100.

> *USING ACTIVE CHAIN CONTROL WITH PROFILES*

1. Click on the icon for **View 2** on the main tool bar.
2. Move you cursor in **View 2**. (Notice the cross hair following along in **View 1**).
3. This can be used the same as in the previous exercise to place elements at certain elevations along the profile.
4. Key-in the **Station** and **Elevation** values in the Curvilinear Coordinate dialog as shown below.



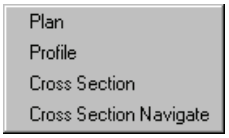
5. Select the MicroStation command **Place Circle**.
6. Set the **Method** to **Diameter**.



7. Click the **Apply** button on the Curvilinear Coordinates dialog.
8. Move you cursor to the profile view to place the second point on the circle.

> *USING ACTIVE CHAIN CONTROL WITH CROSS SECTIONS*

1. Click on the icon for **View 3** on the main tool bar.
2. Right click on the same icon and select **Cross Section Navigate**.



3. You can use the **Navigator** to traverse through the cross sections.

10 Site Design

CHAPTER OBJECTIVES

In this chapter we will:

- Overview the original data supplied for this project
- Formulate a design strategy

INTRODUCTION

Designers will realize that every “at grade” intersection has its own specific design issues.

What may look the same from plan view may be a totally different design vertically due to the existing vertical conditions or specific requirements.

The amount of reconstruction of existing roadway can completely change the designers approach to two seemingly similar geometrical layouts.

We shall investigate the design constraints of this particular project and formulate an initial design strategy. This strategy may need to be varied or modified further along the design path based on outcomes at each step, but we need some strategy to begin with to make a start.

We will overview the supplied data and constraints for this specific situation.

PROJECT OVERVIEW

This training session evolved from a project sent to Bentley by a client who was seeking assistance. The steps we will undertake in this training session mirror those formulated during the process of assisting the client.

We will look at the information that was supplied when this project started.

The client had completed a survey of the existing conditions, created a TIN file, completed the geometric layout of the new intersection, and designed a controlling Chain and Profile.

The Chain (VAN1) and Profile (PROPVAN1), together forming the control alignment, were approved by the project engineer and could not be modified.

Other constraints included the strict requirement to tie down to original within the existing Right Of Way and a maximum length of reconstruction on the services roads of 150 feet.

> ***OVERVIEW THE SUPPLIED DATA AND DESIGN CONSTRAINTS***

1. Open the file *C:\data\geo\site\roundabout\Step2\LHSRAB.dgn.*

This file will initially display the reference file that contains the survey information from the existing intersection arrangement.

2. We shall discuss in the class the existing arrangement on the intersection.

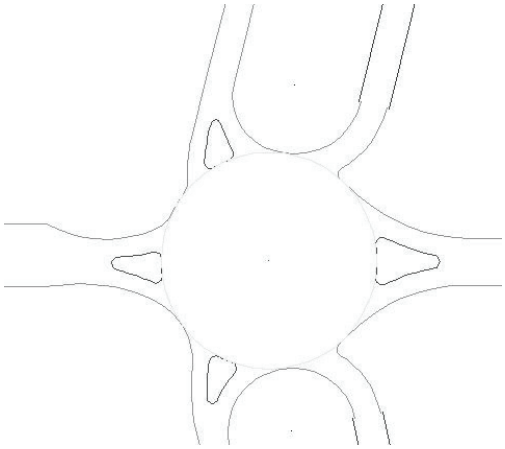
Note that the controlling alignment is based on an existing overpass bridge.

3. Continuing with the file *LHSRAB.dgn*, select the **File>Reference** tool.
4. Toggle **OFF** the reference file *existing.dgn* and toggle **ON** the reference file *proposed.dgn*.

We shall discuss the proposed layout and, based on this layout, what are the requirements to begin a Site Modeler project.

5. Toggle **OFF** the reference file *proposed.dgn*.
6. Select **Settings > Level > Displa***y* and turn on all levels in the active DGN.

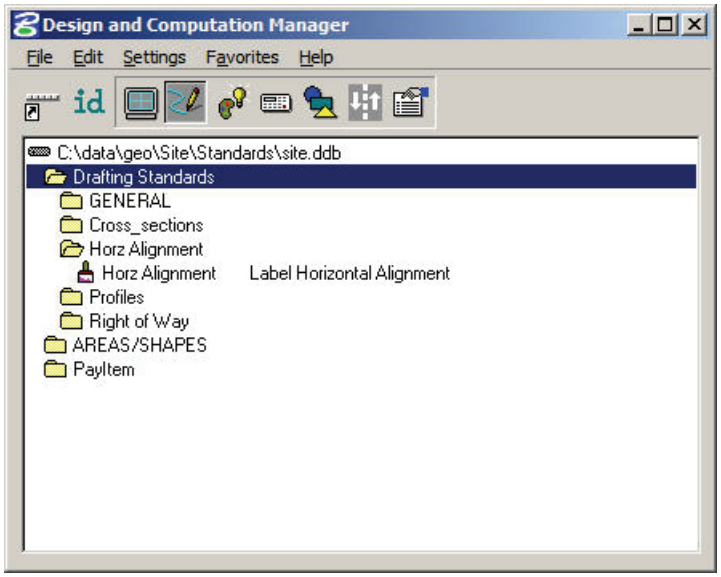
This shows all of the plan view graphical elements required to begin this project. We shall discuss the graphical elements that are displayed and their significance.



7. Open Design and Computation Manager (**Applications > GEOPAK Site > Design and Computations Manager**).

In PowerCivil the menu item is **Civil > Plans Production > Design and Computation Manager**.

8. Open the file *C:\Data\Geo\Site\Standards\site.ddb.*
9. Using the ID function of D&C Manager, review the features attached to the various lines drawn in the DGN file.



10. Close the Design and Computations Manager dialog.

DESIGN STRATEGY

We need to formulate a design strategy based on the constraints of the project, the given information and the desired project outcome.

This strategy could change during the course of this project due to design issues or constraints that are either unknown or unforeseen at this time.

Modification of a design strategy is typical of intricate design projects. Site Modeler tools provide the flexibility required to incorporate changes as they arise.

> ***FORMULATE A DESIGN STRATEGY***

There are a number of different design philosophies for designing roundabouts. We will not be examining all of the different theories in this class. The philosophy that we will use is one that treats the traffic circle portion of the intersections as an "upside down plate". This means that irrespective of the orientation of the traffic circle, the outside edge always forms a plane surface.

STEP 1

Constraints

The control alignment is set. It cannot be changed.

Maximum allowable reconstruction of the services roads is 150 feet.

Right Of Way cannot be altered.

This means we stay as close as possible to the existing intersection elements and elevations.

1. Given the constraints, we need to design the intersection based around the control alignment and create the traffic circle portion of the intersection so it is as close to the existing intersection elevations as possible.
2. Creation of the traffic circle will be based on a plane that is defined relative to the Control Alignment. After the plane is created the outside edge of the Traffic Circle will be draped onto the construction plane and then the inside edge of the Traffic Circle will be created at a positive 2% slope from the outside edge.
3. We shall then analyze the difference in elevation between the outside edge of the traffic circle and the existing surface at critical points and, if required, redesign the traffic circle until we have achieved a satisfactory stage of the design.
4. The incoming roadway profiles (other than the control alignment) will be designed based on the traffic circle elevations.
5. The incoming roadways will be modeled based on the design profiles.
6. Curb returns will initially be defined based on the most appropriate adjacent element then modified as required.
7. The median islands will be created based on the finished pavement surface.

STEP 2

Objectives

- Create a construction object based on the control alignment
- Create and analyze the traffic circle
- Modify and re-analyze the traffic circle

Introduction

Based on the design strategy that we have set, we need to devise a way to assign elevations to the outside edge of the traffic circle.

As an additional consideration, we should formulate this step with the thought that it may need to be redesigned (*probably will need to be redesigned*) and that we should create this element with the redesign issue in mind.

The use of construction objects with Site Modeler is a very powerful way to assign elevations to irregular or complex elements AND provide a way to make redesign a very fast and painless process.

Tools to be used

- Site Modeler > Object > New
- Site Modeler > Elements > Composite Section
- Site Modeler > Elements > New/Edit > Drape on Model/Object
- Site Modeler > Elements > New/Edit > Section
- Site Modeler > Elements > Information
- Site Modeler > Analysis > Profile

LAB EXERCISE: CREATE A CONSTRUCTION OBJECT

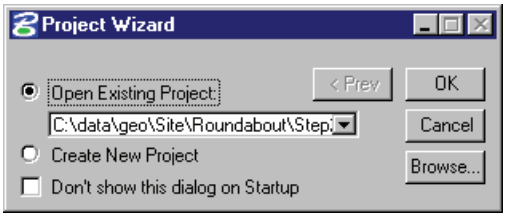
A *construction object* is defined as a site modeler object that is in the modeler project but not necessarily part of the model. Its primary use is to simplify the process of assigning, and then reassigning, elevations to irregular or complex site modeler elements.

The methodology we will use to create the construction object is to create a new object and, within that object, define a surface plane based on the Control Alignment.

> *OPEN AN EXISTING PROJECT*

1. Open the DGN file *c:\data\geo\data\Site\RoandAbout\Step2\LHSRAB.dgn*.
2. Select the site modeler tool (**Applications > GEOPAK Site > Site Modeler > Site Modeling**).

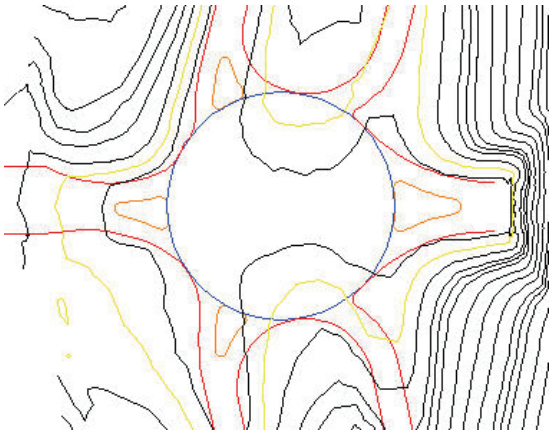
In PowerCivil select **Civil > Modeler**.



3. Click **Browse**. Select the file *C:\Data\Geo\Site\Roundabout\Step2\LHSRAB.gsf*.

This is a Site Modeler project that has already been created that includes the existing ground TIN file as the Object “Ground 1” and a Model called “RAB” that has the Ground 1 Object as its base.

4. Click **OK**.



> *CREATE A CONSTRUCTION OBJECT*

1. Select the new object tool (**Modeler > Object > New**).

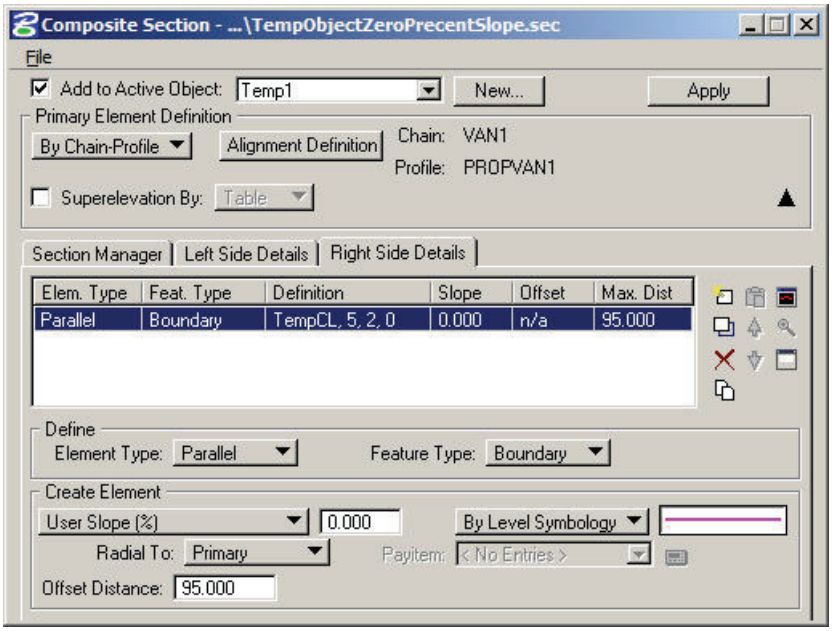
2. Select object type “Construction” and name “Temp1” as shown above. Also make sure to turn off the check mark for “Add to Active Model.”

We are not including this object in the model because it is not part of our design. This object will be used simply to define a plane on which to drape our traffic circle.

3. Click **OK**.

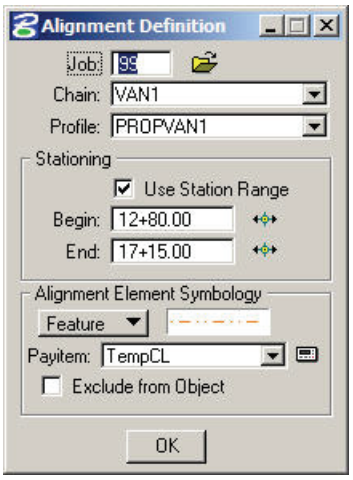
> *CREATE THE CONSTRUCTION SURFACE USING COMPOSITE SECTION*

1. Select the composite section tool (**Modeler > Tools > Composite Section**).
2. **File > Open**. Select the Composite Sections setting file *C:\Data\Geo\Site\Roundabout\Step2\TempObjectZeroPercentSlope.sec*.



3. Turn on the check mark to **Add to Active Object** and set the object to Temp1.

4. Set the Primary Element Definition to “Chain-Profile” and then press the **Alignment Definition** button and set as shown below. The feature “TempCL” is located in D&C Manager at *Drafting Standards* > *General* > *TempCL*.

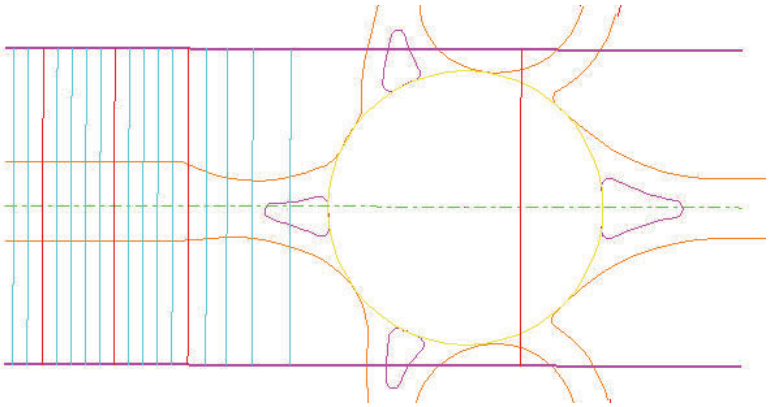


5. Click **OK**

Ensure that the Active Object is “Temp 1”. Check the Active Object Control dialog.

6. Click **Apply**.

We have now created a surface that is 190 feet wide (95 feet both sides of the control alignment) and is projected at 0% from on the control alignment. While this surface has no slope in the north/south direction, it will still drain based on the longitudinal slope of the alignment it was created from.



LAB EXERCISE: CREATE THE ROUNDABOUT OBJECT

Based on the design strategy that was discussed earlier, we will now start to create the elements that will make up our intersection (roundabout).

We first need to create an object to place the roundabout elements into.

Then we will drape the outside edge of the traffic circle onto the Construction Object.

Last step is to create the inside edge of the traffic circle to give us the 2% pavement cross slope within the traffic circle.

> ***CREATE THE ROUNDABOUT OBJECT.***

1. If you have not done so already, save your site project (**Modeler > Project > Save***)*.
2. On the Active Site Object Control set the active model back to RAB.

3. Now create a new object (*Modeler* > *Object* > *New*).

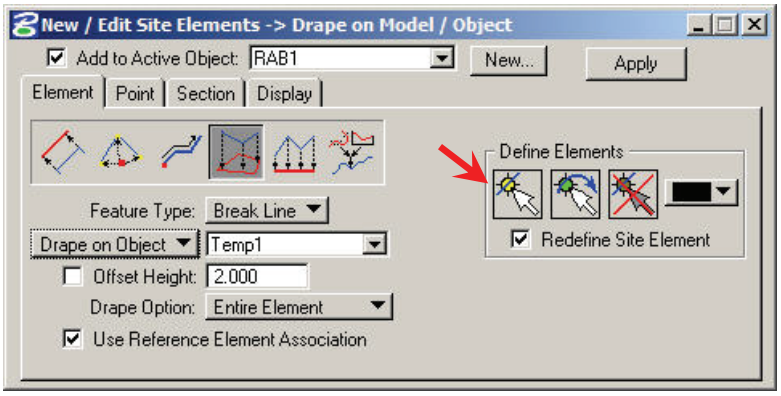
4. Select they Object type "**Roadway**".
5. Overwrite the default Object Name with "**RAB1**".
6. Toggle ON **Add to Active Model**.

This object is an actual part of our design so we add it to the model.

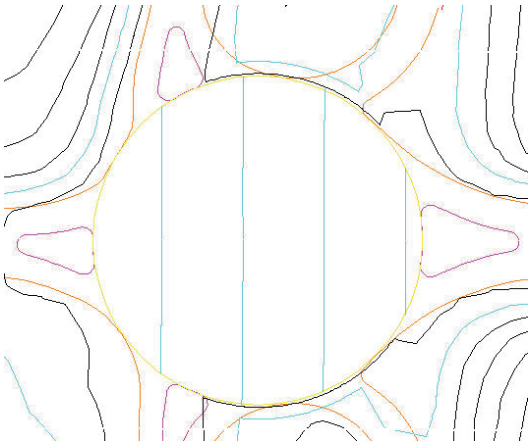
7. Click **OK**.

> *CREATE OUTSIDE EDGE OF TRAFFIC CIRCLE ELEMENT*

1. Select the new element tool (**Modeler > Elements > New/Edit**).
2. Set dialog as shown below.

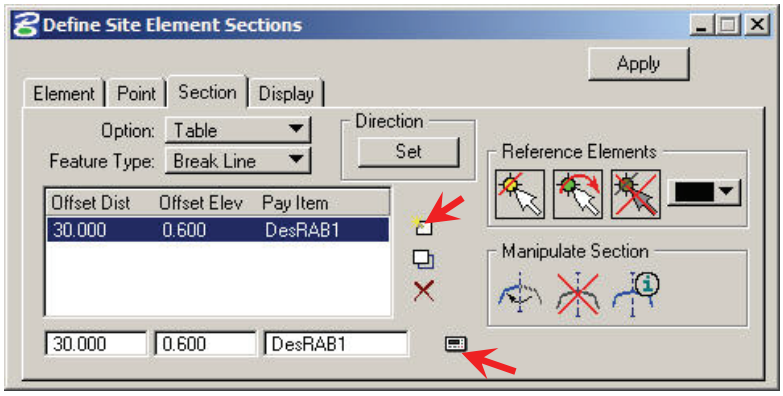


3. Click **Define Elements > Select Elements** (indicated by arrow above).
4. Select the outside edge of the traffic circle.
5. Click **Apply**.



> *CREATE THE INSIDE EDGE OF THE TRAFFIC CIRCLE*

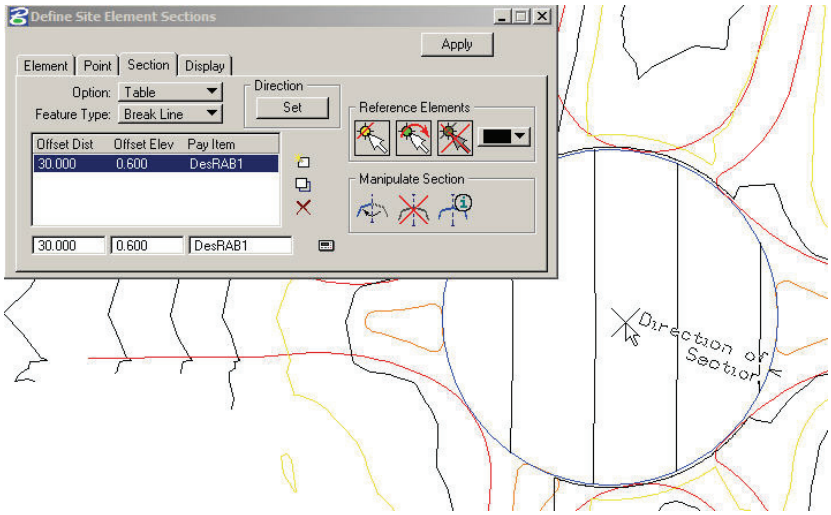
1. We will use the section capabilities of the **New/Edit** element tools to compute the inside edge of pavement of the traffic circle. Select **Modeler > Elements > New/Edit > Section**.
2. Populate the dialog as shown below.



3. Key in the values in the key in fields. Offset distance = 30.0, Offset Elev = 0.6. This is equivalent to 2%.
4. Click **Select** (indicated by lower arrow) and select the D&C Manager item "DesRAB1".
5. Click **Add List Item** (indicated by upper arrow).

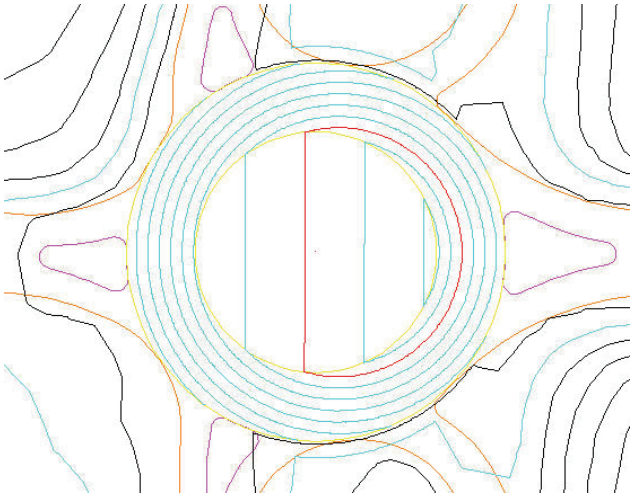
The Design and Computation Manager item "RAB" can be located at PayItem > Plan > Roadway > DesRAB1.

6. Click **Reference Elements > Select Reference Elements**.
7. Select the outside edge of the traffic circle.
8. Click **Set**. Point the direction of the dynamic graphic *inside* the selected element as shown below. Data point to accept the direction.

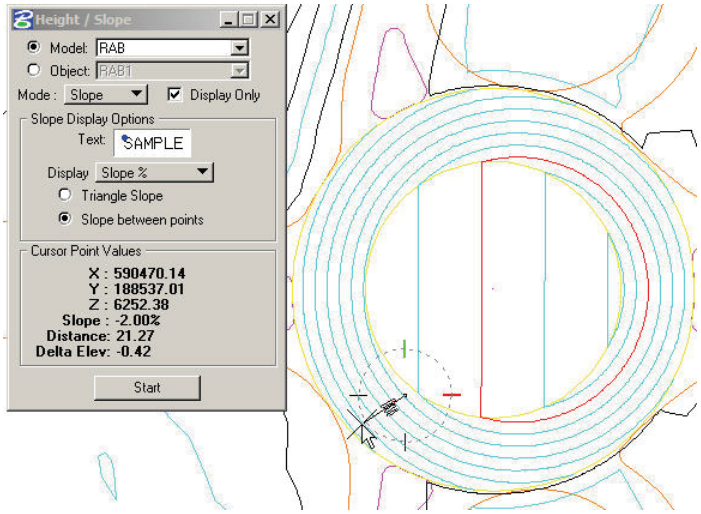


9. Click **Apply**.

There should be a new element created and the contours of the RAB Object should indicate a 2% pavement cross slope.



Note: This cross slope can be interrogated using the **Analysis>Height** tool.



LAB EXERCISE: ANALYZE THE TRAFFIC CIRCLE

At this time, we need to determine if this first attempt at the traffic circle meets the design constraints which were set. Specifically, how closely do we match the existing elevations? We need to determine the difference in elevation between the proposed and the existing ground.

The critical locations to check this difference in elevation are at the centerline of the incoming ramps and service roads.

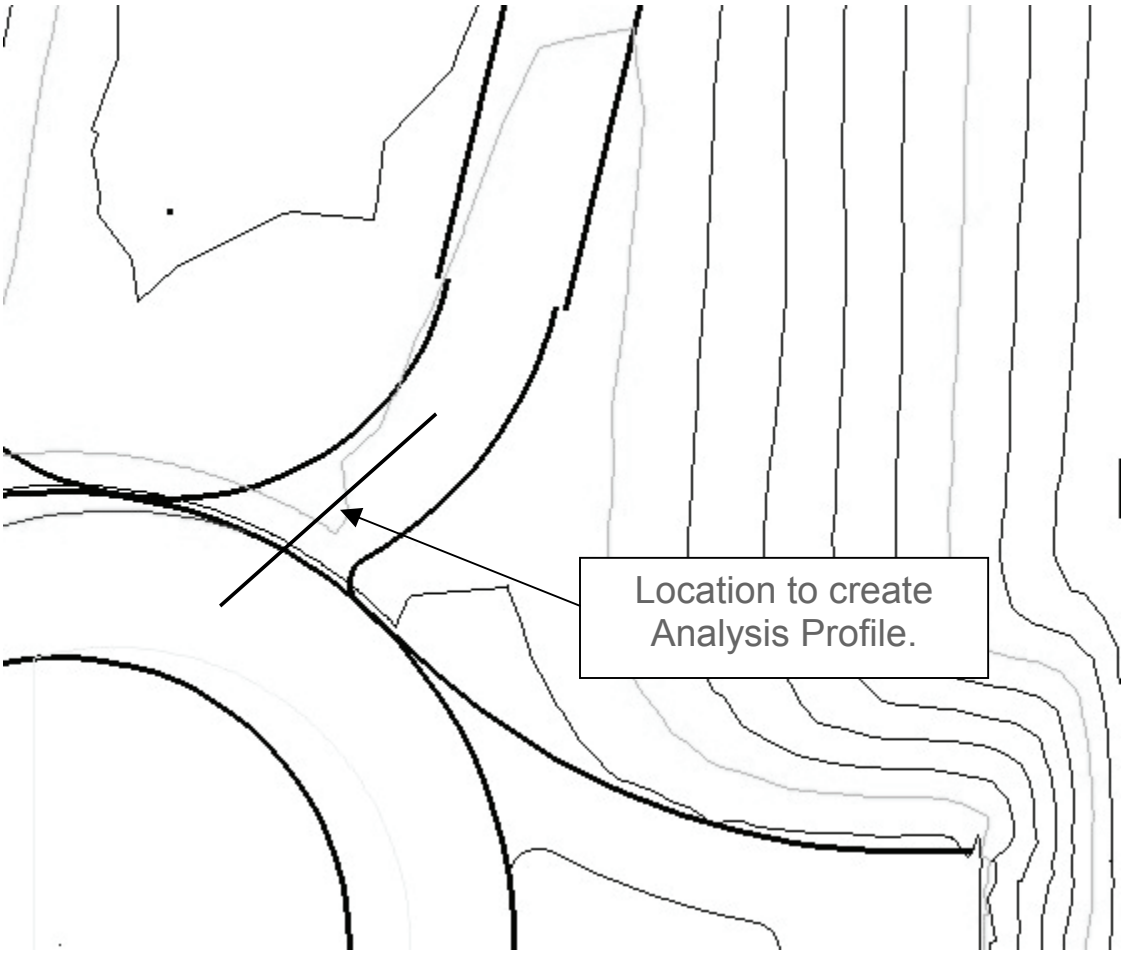
> As the control alignment has previously been set as a constraint, there is no need to check the elevation differences for these roads.

There is more than one tool that would be suitable for the analysis task that we have. The tool we will use is the **Analysis > Profile** tool. Another option would be the **Elevation Differences** tool.

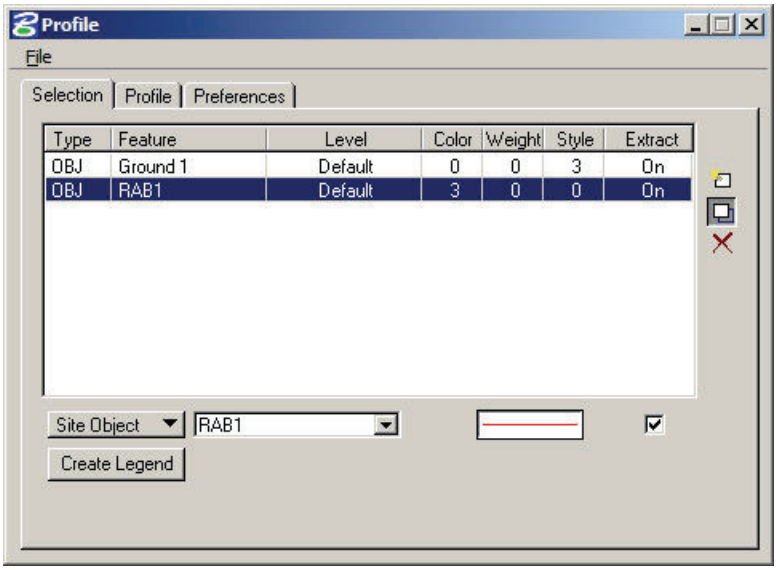
We will opt for the **Profile** tool in this case due to the very visual and specific feedback it provides.

> ***USING THE ANALYSIS>PROFILE TOOL***

1. Use the Microstation view controls to set the focus of your view window to the North Ramp (as shown below).



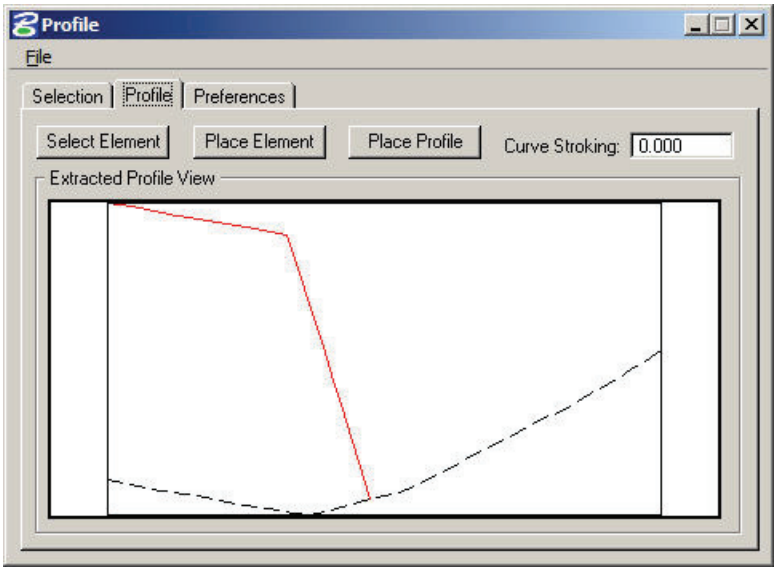
2. Open the profile tool (**Modeler > Analysis > Profile**). The following dialog will activate.



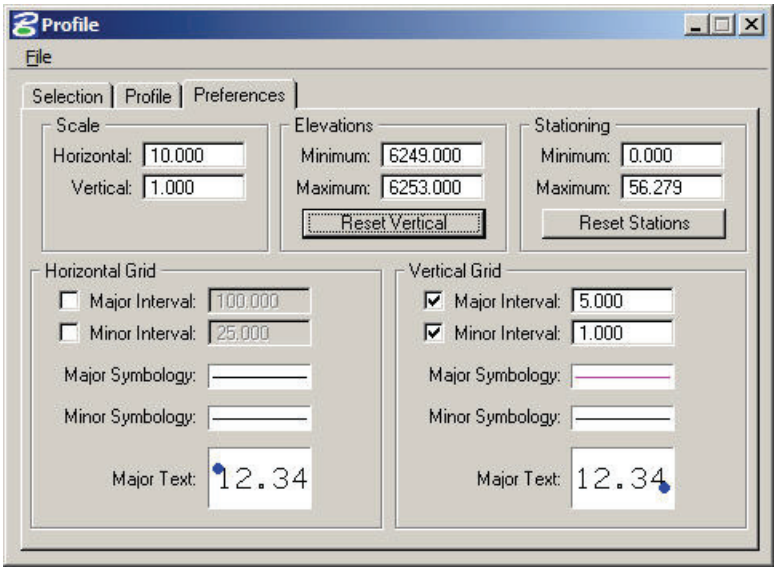
3. Populate the dialog as shown.
4. Click the **Profile** tab.
5. Click **Place Element** and draw a line in plan.

Note: The line should pass from the traffic circle surface onto the North Ramp roadway at approximately the ramp centerline.

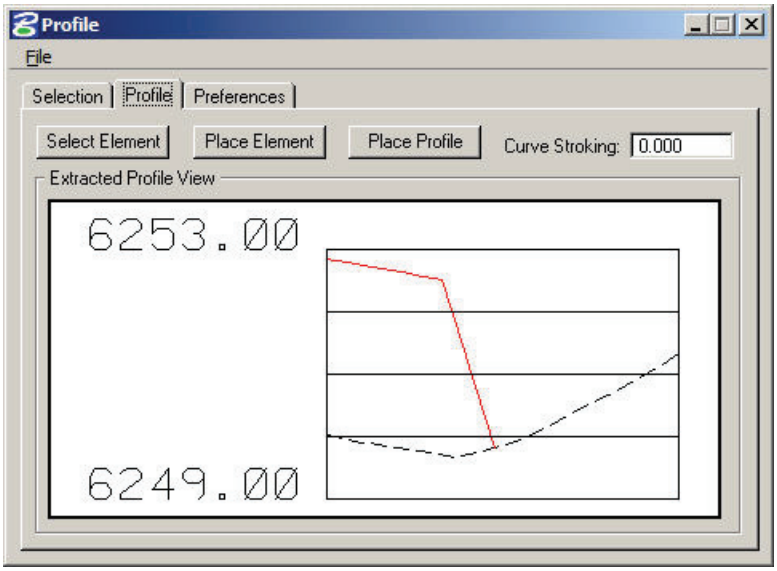
The profile view of the Site Profile tool will now display the two surfaces. We can immediately see the difference in elevation between the surfaces.



6. Click the **Preferences** tab.
7. Toggle ON the Major and Minor Vertical Grid intervals.



8. Click the **Profile** tab. The Profile will now be displayed showing the vertical grid intervals.



9. Investigate the elevation difference in the same manner at the South Ramp and the North and South Service Roads.

LAB EXERCISE: MODIFY THE TRAFFIC CIRCLE

Our analysis determines that the current elevations of the traffic circle are not acceptable. We will modify these elevations and re-analyze the result.

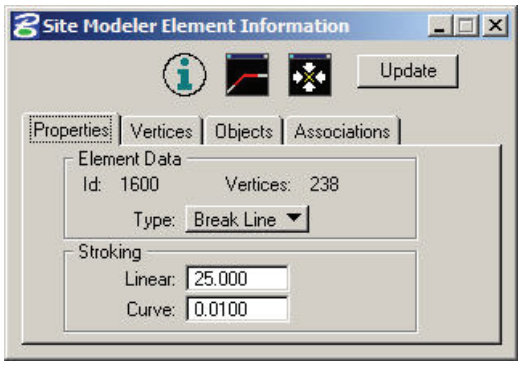
As the traffic circle elevations are based on the plane created in the construction Object, all we need to do is modify the construction Object and the traffic circle will automatically reflect these changes.

This can be accomplished due to the Site Modeler "association" technology. Site Modeler tracks and remembers the way that elements are created. Using this tracking system provides the User with a powerful tool to automatically update linked pieces of data.

If we remember back to what we have done, the construction object is a simple surface based on the control alignment chain and profile. The outside of the traffic circle is dependent on that construction surface and was created from it (**Elements > New/Edit > Drape on Object**). The inside of the traffic circle was created based on the outside element (**Elements > New/Edit > Section**). Therefore, if we modify the construction surface, all of the traffic circle elements will update to reflect the surface change.

> *MODIFY THE CONSTRUCTION OBJECT*

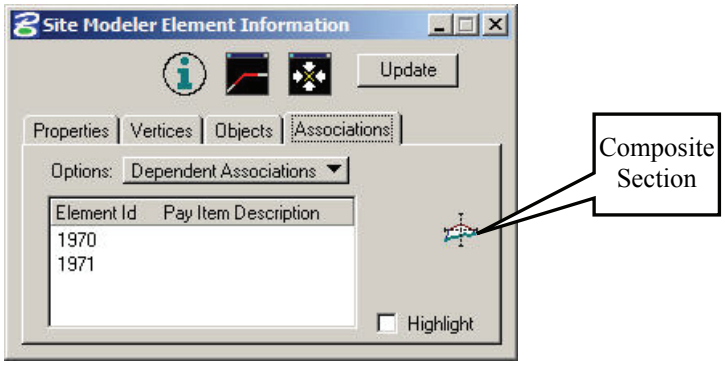
1. If you haven't done so already then save the project (**Modeler > Project > Save**).
2. Make sure level TempCL is turned on. It contains the elements for the Temp1 object which we need to modify.
3. Start the element information tool (**Modeler > Elements > Information**).



Note: This tool is also located on the Active Site Object toolbar.

4. Choose the construction surface centerline element.

5. Click the **Association** tab and set the options to **Dependent Associations**.



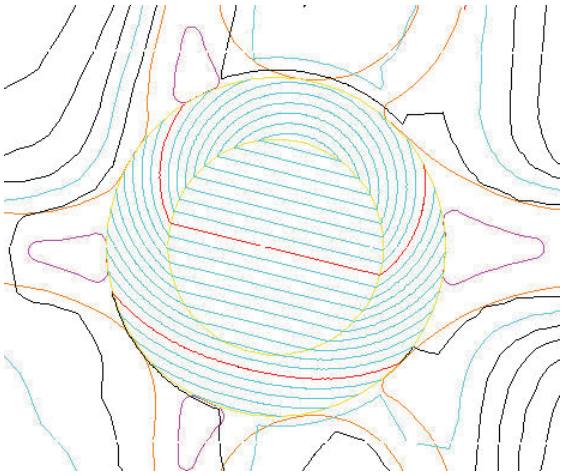
6. Click composite section button. The composite section dialog will open with the settings used to create this element.

Note: We will edit the Left Side and Right Side element so they provide a 1% cross slope from left to right.

7. **Left Side**. Select the parallel element. Change the slope to 1%.
8. Click **Modify List Item** to modify the value.
9. **Right Side**. Select the parallel element. Change the slope to -1%.
10. Click **Modify List Item** to modify the value.
11. Click **Apply**.

This will update all of the elements that are linked to the construction surface.

Set RAB 1 as the active Object on the Active Site Object Control dialog to see the effect on the RAB object.



Use the *Analysis>Profile* tool to repeat the analysis of the incoming roadways to visually see the difference that this has made.

Note: We will accept this design and move on to the next design stage.

STEP 3

Objectives

- Design the incoming profiles for the ramps and service roads.

Introduction

Now that we have decided that the first design step is acceptable, the next logical step is to design the incoming roadway profiles.

This could have been completed earlier in the design process but would have been quite difficult and resulted in data that may have needed to be revised.

Starting this process now gives us a distinct advantage in that we now know what the elevations of the traffic circle are and we can use this information to make intelligent design decisions.

The process we shall use is as follows.

- Create existing surface profiles based on the Model for each incoming roadway.
- Design the proposed profile for each incoming roadway.

Tools to be used

- Site Modeler > Object > Draw Profile.
- Applications > GEOPAK Site > Active Profile Control.
- Applications > GEOPAK Site > Geometry > Layout Profile (Component Based).

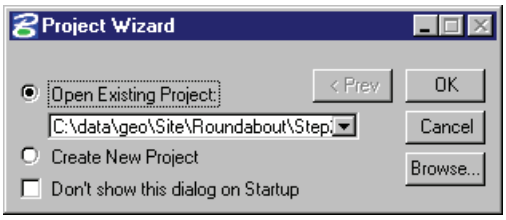
LAB EXERCISE: CREATE MODEL SURFACE PROFILES

To ensure that all students have the same data, we will start this exercise in a new dataset.

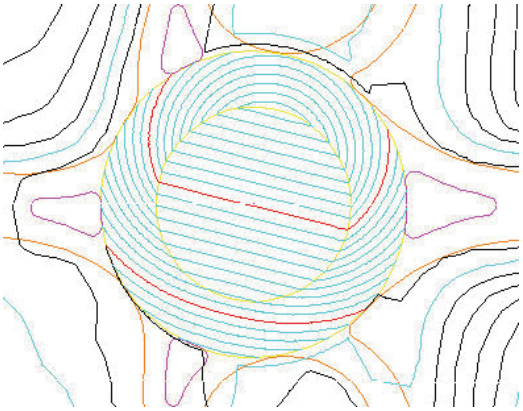
> ***OPEN THE SITE PROJECT***

1. Open the file *C:\Data\Geo\Site\Roundabout\Step**3**\LHSRAB.dgn*.
2. Start modeler (**Applications>GEOPAK Site>Site Modeler>Site Modeling**).

Note: In PowerCivil use menu (**Civil > Modeler**).



3. Click **Browse**.
4. Select the file *C:\Data\Geo\Site\Roundabout\Step3\LHSRAB.gsf*.
5. Click **OK**.

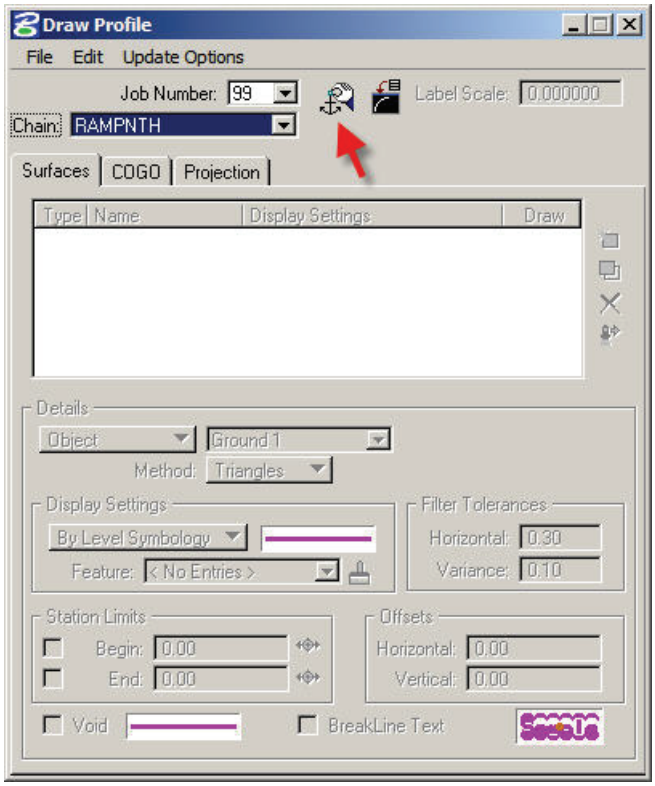


> ***CREATE MODEL SURFACE PROFILES***

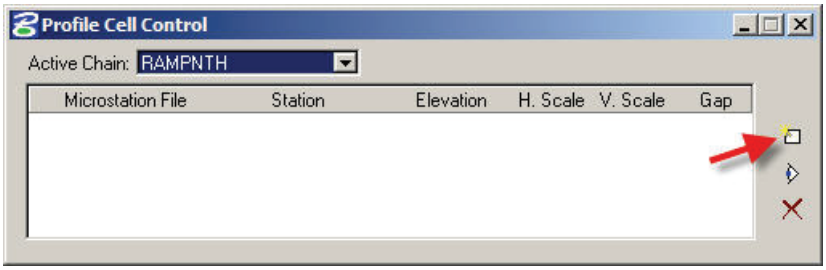
1. Open another Microstation window (view 2) and pan across to an empty portion of screen. We will use this window for working with profiles.
2. Select the draw profiles tool (**Modeler > Object > Draw Profiles**).

The Draw profile dialog should be familiar to most students as it is a standard GEOPAK tool. When used as a Site Modeler tool, it has additional functionality. It has the ability to not only create profiles from TIN files, but also from Site Objects and Models.

3. Set Job Number to **99**.
4. Set Chain to **RampNth**.

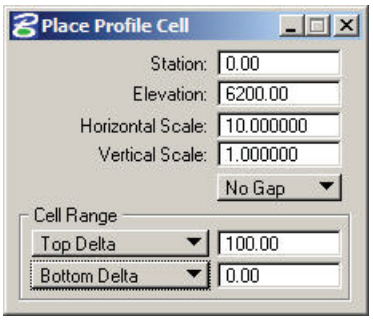


5. Click **Profile Cell Control** button (indicated by arrow above).

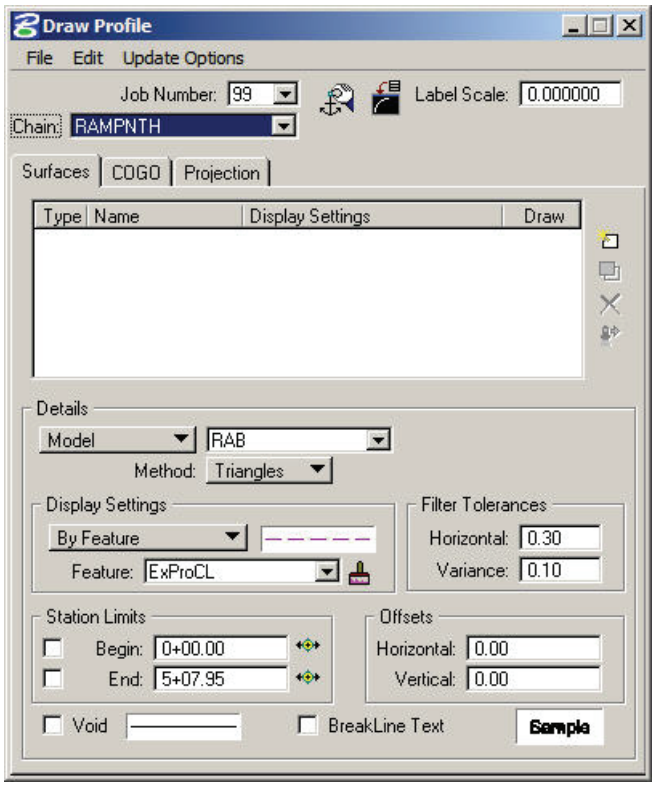


6. Click **Place Profile Cell** button. (indicated by arrow).

7. Populate the dialog as shown below.



8. Place the Profile cell into a clear part of the graphics (in Window 2).
9. Populate the Draw Profile dialog as shown below.
10. Set the Details portion of the dialog.
11. Click **Add Surface Settings**.



12. The **Details>Display Settings** show that a Design and Computation Manager item is used. This item can be found within the D&C Manager as *Drafting Standards>Profiles>ExProCL*.
13. The same process will now be repeated to create the Model profiles for the Chains **RampSth**, **ServNth** and **ServSth**.
14. Exit and save the Site Modeler project. It is not required for the remainder of this step.

LAB EXERCISE: CREATING DESIGN PROFILES

Now that we have drawn the Model surface profiles, we are ready to create design profiles.

We already have some constraints that affect this next step.

The Model profiles show us the elevation at the proposed traffic circle edge – so the design profiles must start at that elevation.

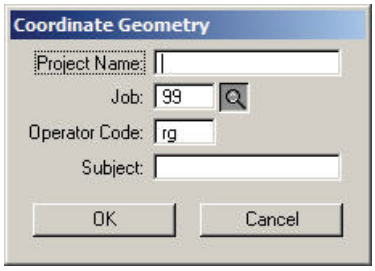
The cross slope of the traffic circles is 2%. For us to get a smooth transition for the incoming roadways to the traffic circle, we must start the design profiles using a 2% tangent from the location that we join to the traffic circle.

The service roads cannot be reconstructed any more than 150 feet. We will draw this location into the plan and profile to give us a visual indication of this design constraint.

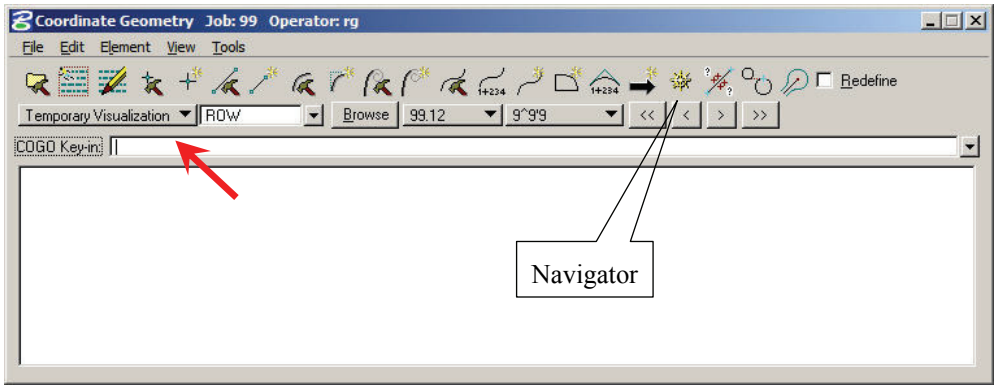
> ***SHOW THE 150 FEET RECONSTRUCTION CONSTRAINT IN PLAN.***

1. Start the **COGO** tool (**Applications>GEOPAK Site>Geometry>Coordinate Geometry**).

Note: In PowerCivil, (**Civil > Geometry > Coordinate Geometry**).

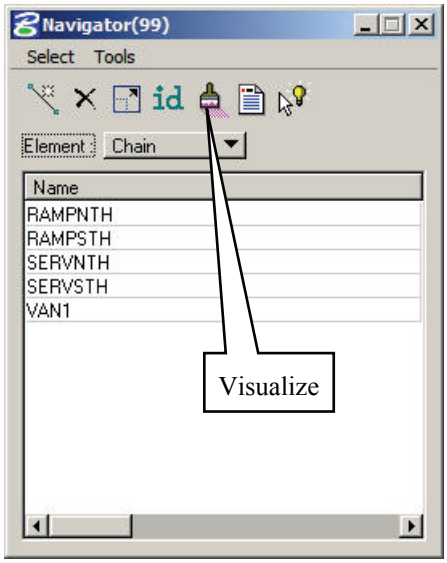


2. Select Job Number **99** and enter your initials for operator code.
3. Click **OK**.



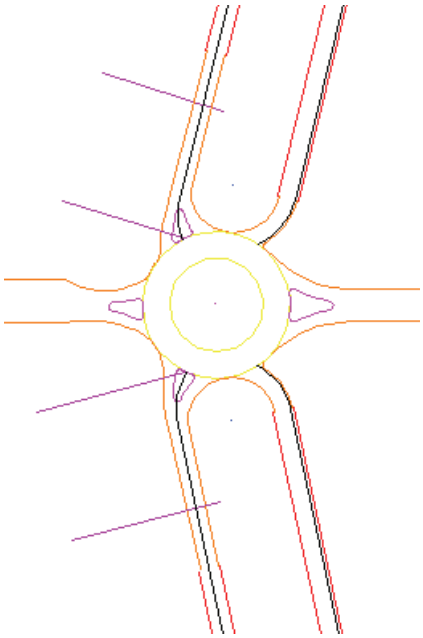
4. Set visualization to Temporary.

5. Click **Navigator** and minimize the COGO window.



6. Set Element to **Chain**.
7. Select and visualize the chains – **RampSth, RampNth, ServSth and ServNth**.
8. Close Navigator.
9. Select the place line tool. (**Microstation > Place Line**). Draw a line that is perpendicular to the chains **ServSth and ServNth** at the point where they intersect the traffic circle.
10. Copy the lines parallel 150 feet.

Note: This gives us an approximate location for the 150 feet reconstruction constraint in plan view.

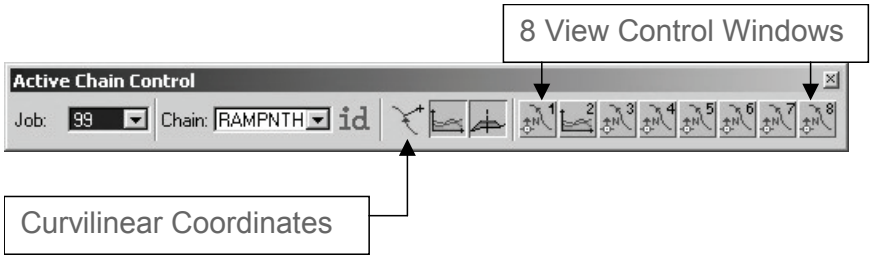


> ***SHOW THE 150 FEET RECONSTRUCTION CONSTRAINT IN PROFILE***

1. Open the active chain control tool (**Applications > Geopak Site > Geometry > Active Chain Control**).

Note: PowerCivil, (**Civil > Geometry > Active Chain Control**).

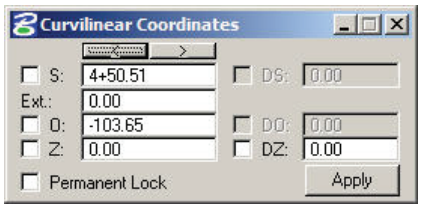
2. Set Window 2 to a Profile view in the Active Chain Control. This is accomplished by right clicking on the **View 2** button in the dialog and setting the view to profile.



3. Set View 1 to plan.
4. Set Active Chain Control to the Chain **ServNth** and synchronize the views.

Note: Synchronize the views by clicking in the ACC Plan view window and Profile View window.

5. Click **Curvilinear Coordinates** button.

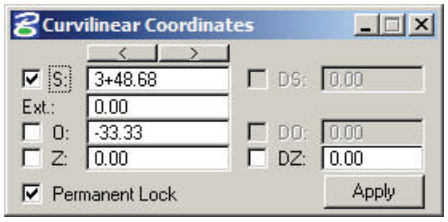


6. As you move in plan view the curvilinear coordinates will display station and offset. As you move in profile view the curvilinear coordinates will display station and elevation.

Note: You may need to click the reset button on your mouse once to start coordinate tracking.

7. In Plan, tentative snap to the line that indicates the maximum extent of reconstruction.
8. Lock the **Station** and **Permanent Lock** controls in the curvilinear coordinates dialog.

Note: The stations may be different as we did not accurately draw the reconstruction limit line.



9. **MicroStation > Place Line**.
10. Draw a line in the profile view.

Note: Due to the effect of the curvilinear coordinates tool, the line will be drawn at the correct station and can only be drawn vertically.

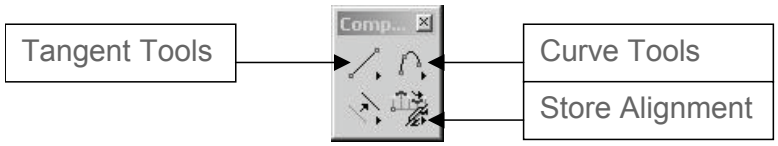
11. Unlock the Station and Permanent Lock controls.
12. Set Active Chain Control (ACC) to the Chain **ServSth** and synchronize the views.
13. Repeat step 7 to step 11 for the **ServSth** chain.

Note: This gives us a visual cue of the 150 feet reconstruction constraint in profile view.

> ***CREATING DESIGN PROFILES USING THE VERTICAL COMPONENT TOOLS***

1. Set active chain control to the chain **ServNth**.
2. Synchronize the views.
3. Use MicroStation view controls to set the allowable reconstruction portion to fill the plan and profile designated views.
4. Start the component profile tools (**Applications > GEOPAK Site > Geometry > Layout Profile (Component Based)**).

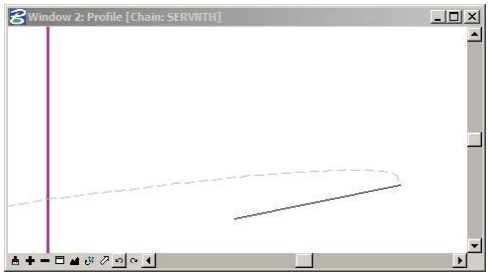
PowerCivil, (**Civil > Profiles > Layout Profiles (Component based)**).



5. Tear off the tangent tools and the curve tools.

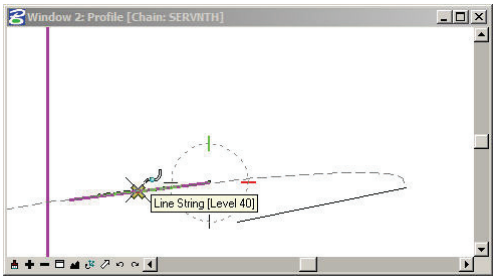
Note: These tools provide an alternate to the VPI based Vertical Alignment Generator. They allow the user to place vertical components (tangents and curves) to assemble a profile. Where the user has many constraints (as it the situation here) they are a very useful alternative to the traditional design profile method.

6. From the tangent tools, click **Create Profile Line by Points**.
7. Snap to the end of the Model profile that represents the elevation at the edge of the traffic circle.
8. Set the slope to 2%.
9. Draw in the tangent.



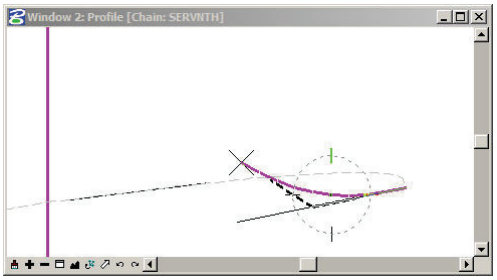
10. From the Curve tools, click **Create Profile Curve by 3 Points**.
11. Set the Microstation snap control to nearest.
12. Snap to 3 locations on the Model profile in the area of the extent of reconstruction.

Note: This gives us a vertical curve that represents the existing service road centerline – so w can join back to existing.

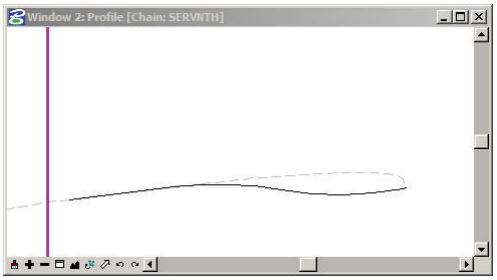


13. From the Curve tools, click **Create Tangent Profile Curve**.

14. Select the profile tangent, data point in the profile view to designate a “through” point on the curve and then data point again to finish the curve.



15. From the Curve tools, click **Create Profile Curve between 2 Elements**.
16. Select and accept the first profile curve.
17. Select and accept the second profile curve.
18. Data point to locate a “through point” for the profile curve and to complete the new profile curve.



Note: Wait and follow you instructor before you attempt these steps if you have not used these tools before.

> *STORING THE PROPOSED PROFILE*

1. From the vertical components tools, click **Store Vertical Alignment**.

If you receive alert messages that COGO needs to be open then answer in the affirmative. The alert message is telling us that we need COGO open to store the vertical profile and then asking us if we want to open COGO. After answering these prompts then you will need to start the store vertical alignment tool again

2. Key in the proposed profile name "**ServNth**".
3. Select any proposed profile component from the profile view (Window 2).
4. Data point again to string the components together.
5. Data point again to actually store the alignment to COGO.
6. Click **COGO** – this will raise the COGO window. You can see the commands that have been created to store the profile.

Note: Remember to follow the prompts displayed in the MicroStation message area during the design and store profile process.

The stored profile can now be loaded into the VPI profile tool in order to round off the grades and stations of VPIs as well as check curve lengths for design speed.

> *DETERMINE THE EXTENT OF RECONSTRUCTION*

While we have the ServNth profile activated, we will use this to determine the extent of reconstruction. Effectively, where the proposed profile joins back to the existing surface is the end of proposed reconstruction.

1. Set MicroStation snap to intersection mode.
2. Click **Curvilinear Coordinates**.
3. In the profile view, snap to the intersection of the existing and proposed profiles.
4. Lock the **Station** and **Permanent Lock** controls in the curvilinear coordinates dialog.

Note: After locking the station you could overtype an even station value if desired. For example, type in 7+10.00 rather than the exact computed value of 7+10.50. This could make your final plans more presentable.

5. Now in plan view draw a line across the ServNth pavement lines. Because of the curvilinear coordinates locks it will only draw perpendicular to the alignment.
6. Now trim the proposed edges of pavement to the line just drawn.
7. Repeat the proposed profile design for ServSth, RampNth and RampSth.

STEP 4

Objectives

- Model the incoming roadway pavement areas based on the profiles we just designed and the alignment we were provided

Introduction

Now that chains and profiles have been created for all of the incoming roadways, the next step is to model the incoming roadway surfaces based on those design alignments.

This involves defining the alignment elements, edge of pavements and curb and gutter sections in the Site Model.

There are two methods that can be employed to do this.

We will attempt both methods and discuss reasons to choose one method over the other.

Firstly, we will add the control alignment and then define the associated edge of pavement elements using the basic Site Modeler tools.

Then we will define the other 4 incoming roadways using the Composite Section tool.

Tools to be used

- Site Modeler > Elements > New/Edit > Alignment
- Site Modeler > Elements > New/Edit > Slope/Offset from Site Element
- Site Modeler > Elements > New/Edit > Section
- Site Modeler > Elements > Composite Section

LAB EXERCISE: CREATE ROADWAY SURFACE FROM CONTROL ALIGNMENT

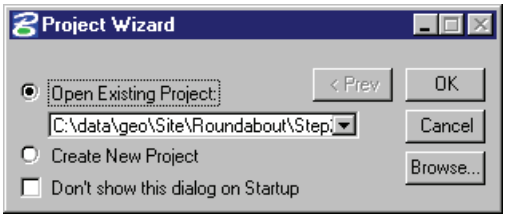
To ensure that all students have the same data, we will start this exercise in a new dataset.

> ***SWAP TO NEW DGN AND GSF***

1. Open the file *C:\Data\Geo\Site\Roundabout\Step4\LHSRAB.dgn*.
2. Start Modeler (**Applications>GEOPAK Site>Site Modeler>Site Modeling**).

Note: PowerCivil menu, (**Civil > Modeler**).

3. This will open the **GEOPAK Site Modeler** tool.



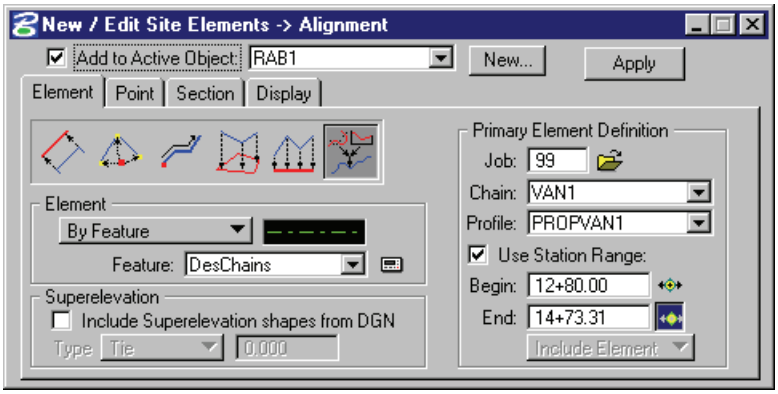
4. Click **Browse**.
5. Select the file *C:\Data\Geo\Site\Roundabout\Step4\LHSRAB.gsf*.
6. Click **OK**.
7. In Microstation, turn off level TempCL so the elements there do not confuse us. Remember that this level contains the elements for the construction object we created in Step 2.

LAB EXERCISE: ADD THE CONTROL ALIGNMENT

1. On the Active Site Object Control make sure the active object is set as RAB1.

2. Now start the new element tool (**Modeler > Elements > New/Edit > Alignment**).

We do not want the alignment element to impact on the traffic circle, only the pavement outside it. Because of this, we will add the Control Alignment to the Object in 2 parts, leaving out the portion across the Traffic Circle.

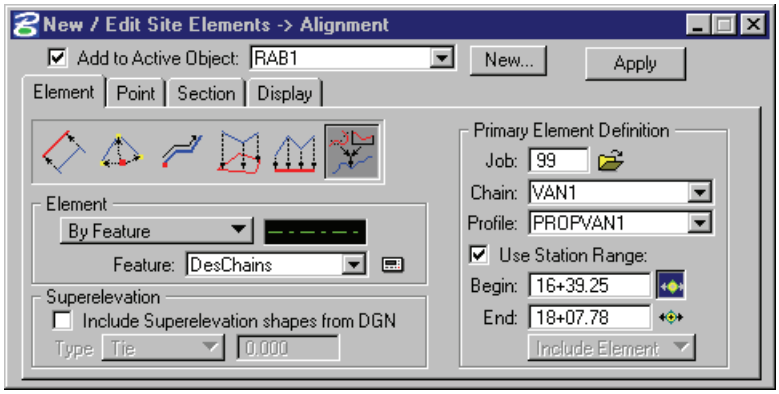


3. Set the dialog as shown above.

Note: The begin station is the limit of construction on the west. This was purposely set at an even station to make the plans easier to read. The end station is the point where the alignment meets the traffic circle. You can dynamically set these ranges by snapping to the appropriate points.

4. Click **Apply**.

5. Populate the dialog as shown below.

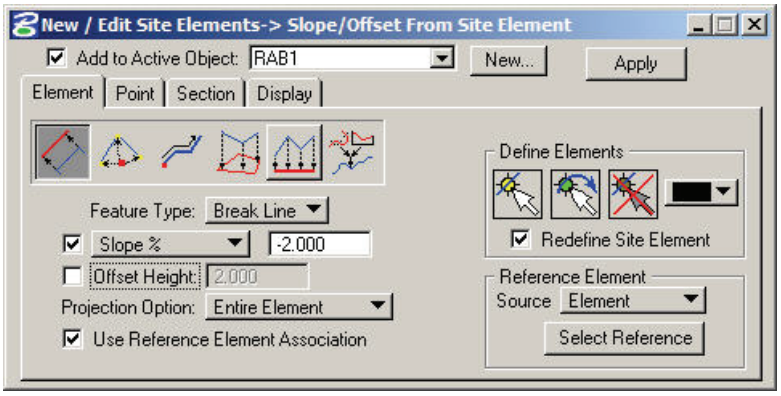


6. Click **Apply**.

This will add the 2 required portions of the control alignment to the Object.

> *ADD THE EDGE OF PAVEMENT ELEMENTS RELATIVE TO THE CONTROL ALIGNMENT*

1. Continuing with the new element tool (**Modeler > Element > New/Edit > Slope/Offset from Site Element**).
2. Set the dialog as shown below.

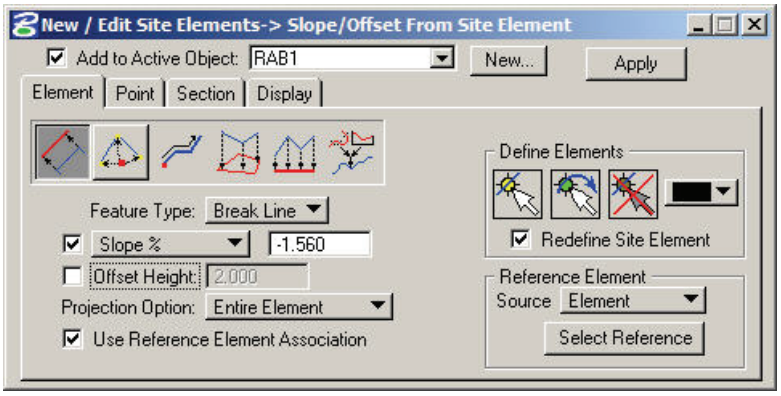


Note: As there are two (2) different sections of the control alignment. The cross slope for the road area is -2%. The cross slope for the bridge area is -1.56%. We will need to project the edge of pavement elements to the centerline in 2 steps.

3. Click **Define Elements>Select Element**.
4. Select the 2 edge of pavement complex chains on the western approach.
5. Click **Reference Element>Select Reference**.
6. Select and accept the left western portion of the control alignment element.
7. Click **Apply**.

   Now we will repeat these steps for the right hand portion of the control alignment – the pavement over the bridge.

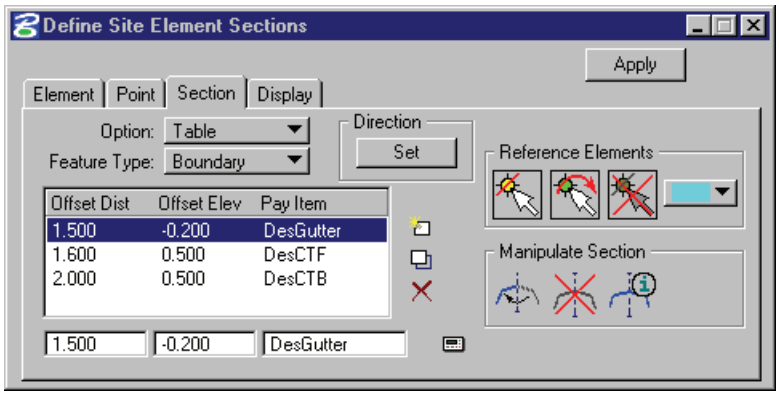
8. Set the dialog as shown below.



9. Click **Define Elements>Select Element**.
10. Select the four (4) edge of pavement complex chains on the eastern approach.
11. Click **Reference Element>Select Reference**.
12. Select and accept the eastern portion of the control alignment element.
13. Click **Apply.**

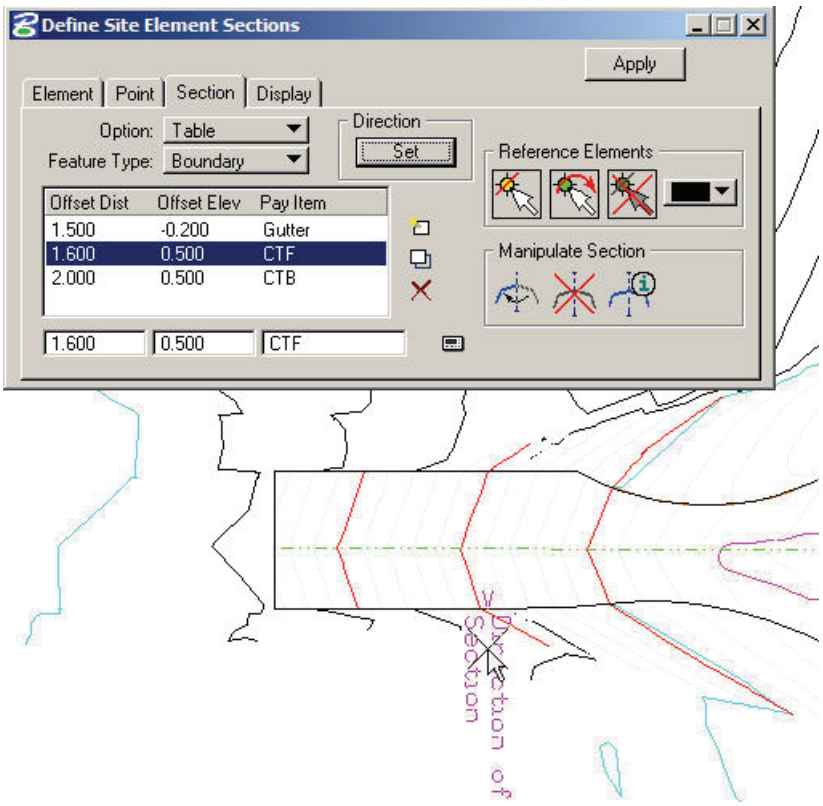
> ***ADD THE CURB AND GUTTER SECTIONS TO THE EDGE OF PAVEMENT***

1. Continuing with the new element tool change to the section tab **(Modeler > Elements > New/Edit > Section)**.
2. Populate the dialog as shown below.



Note: The required DDB items can be found in the DDB /PayItem/Plan/Roadway directory.

3. Click **Reference Elements > Select Reference Elements**.
4. Select the six (6) previously defined edge of pavement Site Elements.
5. Click **Set**.
6. Move the cursor into the graphics and set the direction so that the arrow points to the outside of the edge of pavement.



Note: There is a dynamic graphic that is attached to the selected elements. GEOPAK is waiting for the User to set the positive horizontal (offset) direction for the section elements.

7. Click **OUTSIDE** of the selected graphics (so the positive direction is to the outside of the edge of pavement).

8. Click **Apply**.

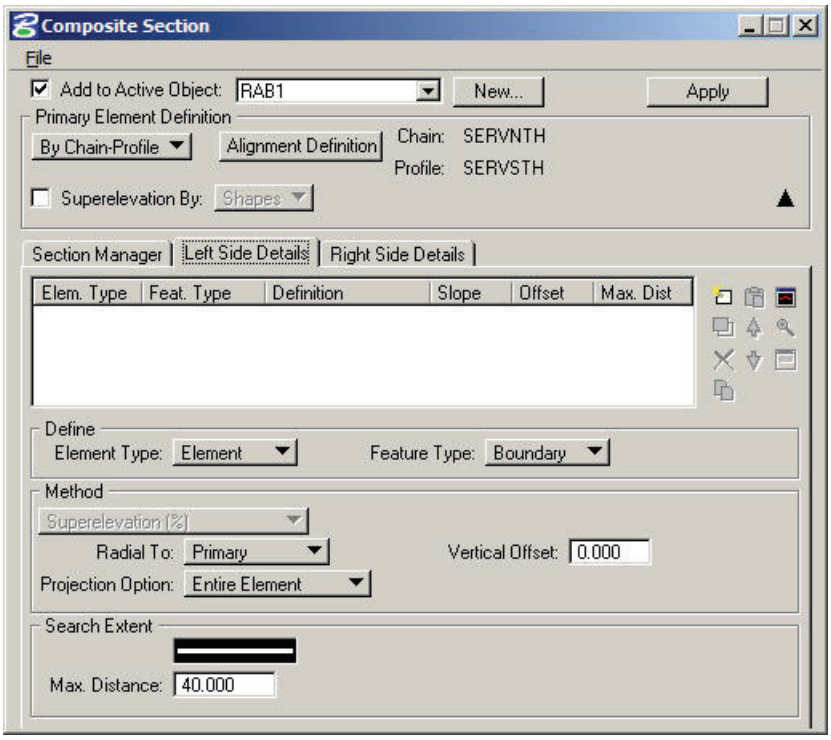
   We have added the curb and gutter to the edge of pavement elements.

   We will now create the other 4 incoming roadways in a more automated manner using **Composite Section**.

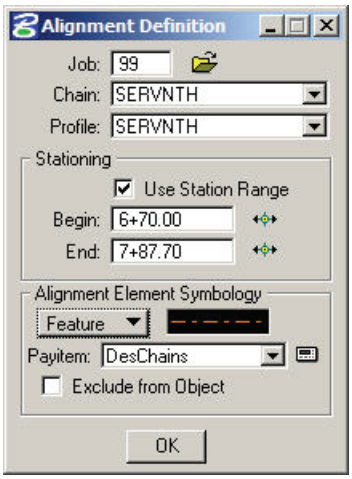
> *ADD THE NORTH SERVICE ROAD*

1. Start the composite section tool. (**Modeler > Tools > Composite Section**).

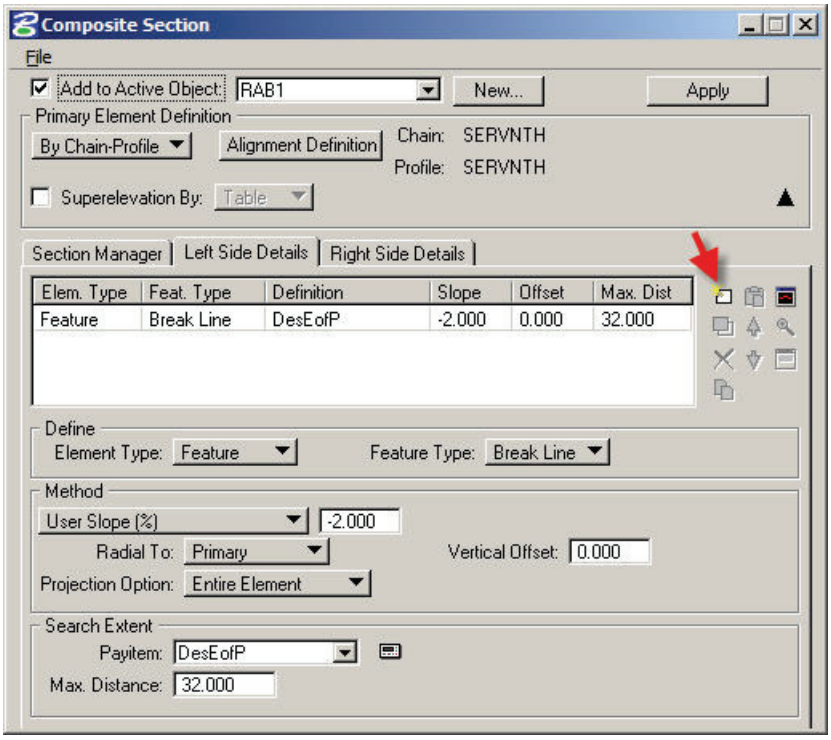
Note: A number of steps are required to populate this dialog with the required information. Shown below are dialog captures of each of these steps.



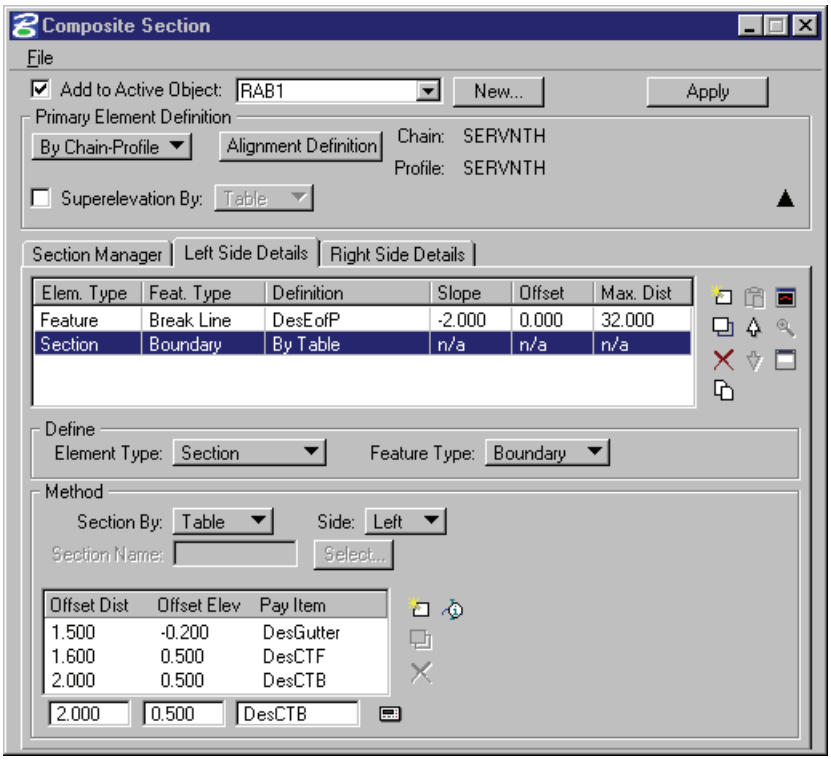
2. Press **Alignment Definition** button and populate as shown below.



3. To define the edge of pavement elements, set the dialog as shown in the lower portion of the dialog below. Click **Add List Item**. (indicated by arrow).

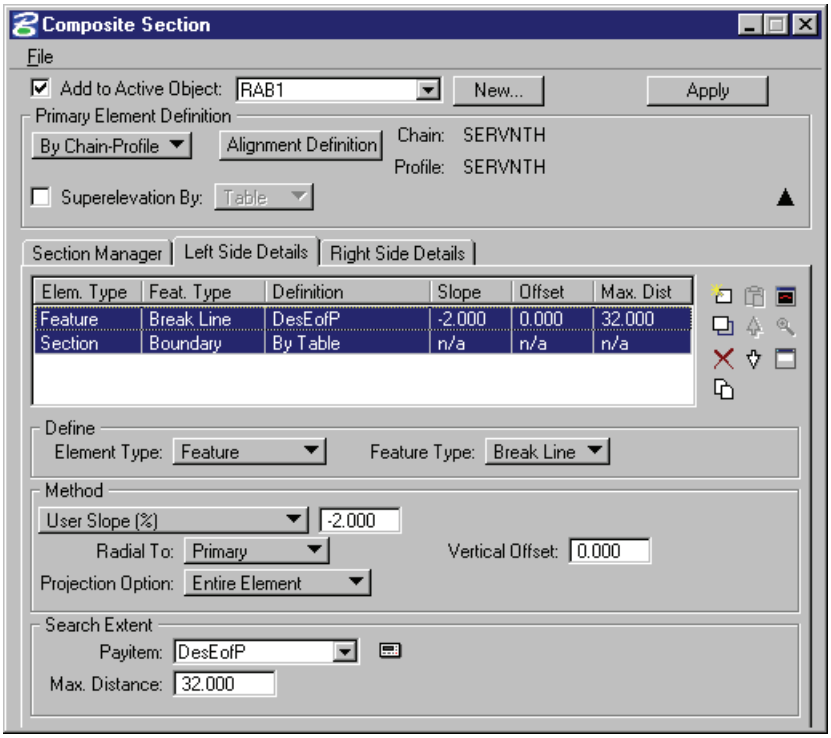


4. To define the curb and gutter, set the dialog as shown below.

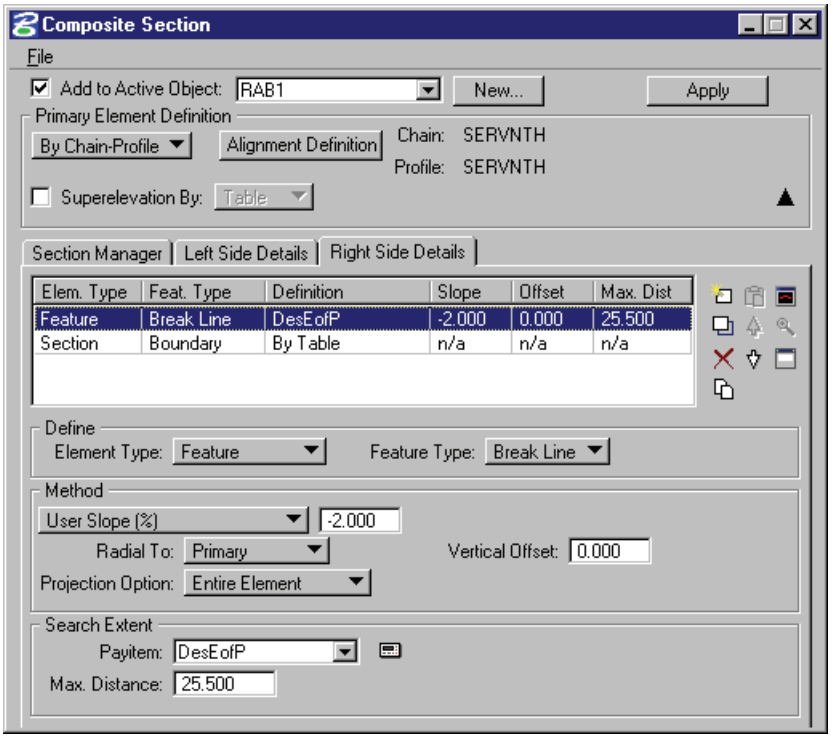


5. Click **Add List Item**.

6. Select both list items. Click **Copy List Item**.

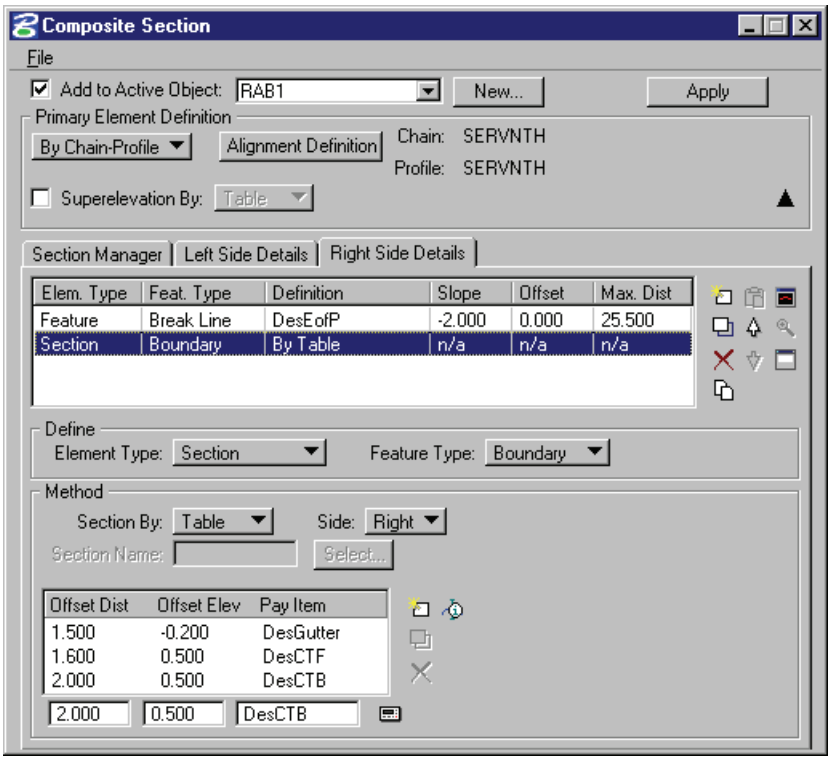


7. Click **Right Side**.
8. Click **Paste List Item**.
9. Select the first row item for the right side.



10. Reset the **Max. Distance** value to 25.5.
11. Click **Modify List Item**.
12. Edit the Right Side Section row.

13. Set the Side to **Right**.



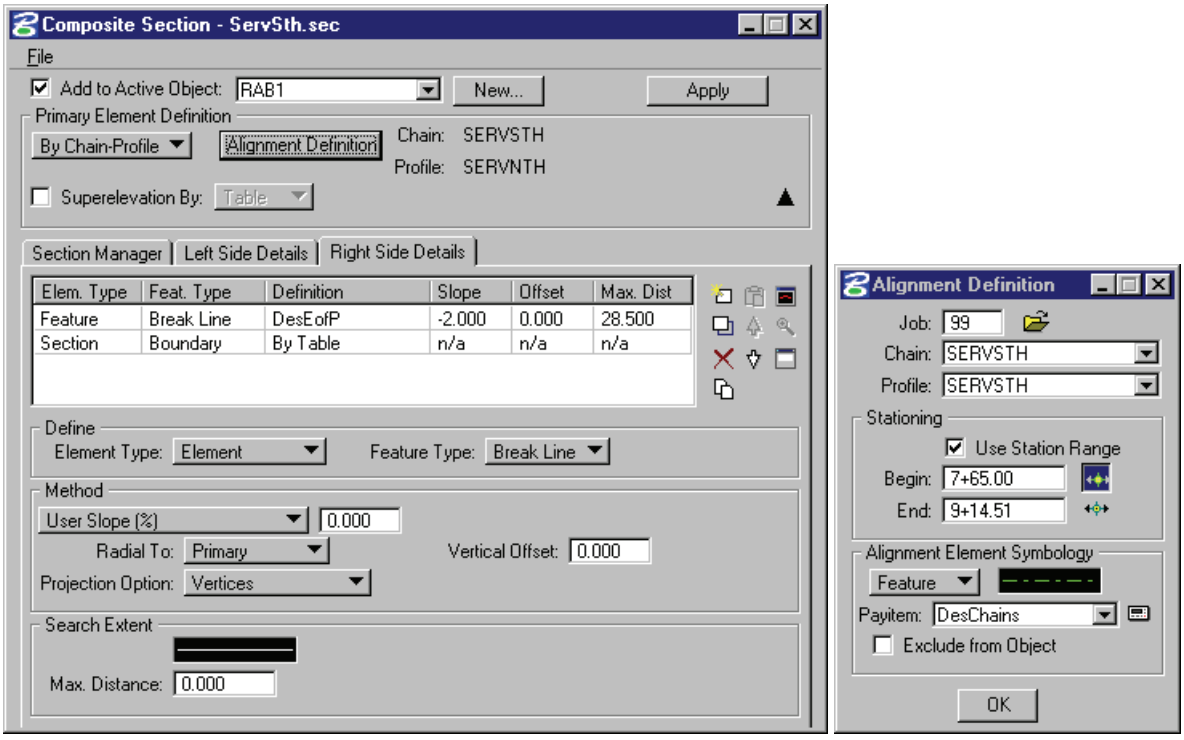
14. Click **Modify List Item**.
15. Click **Apply**.

Note: Composite Section settings files can be saved and reused. To save a file, use the **File > Save** option at the top of the dialog.

> *ADD THE OTHER ROADS – SERVICE RD SOUTH*

The Composite Section files have been saved for the other roadways. We can open these files to complete the incoming roadways.

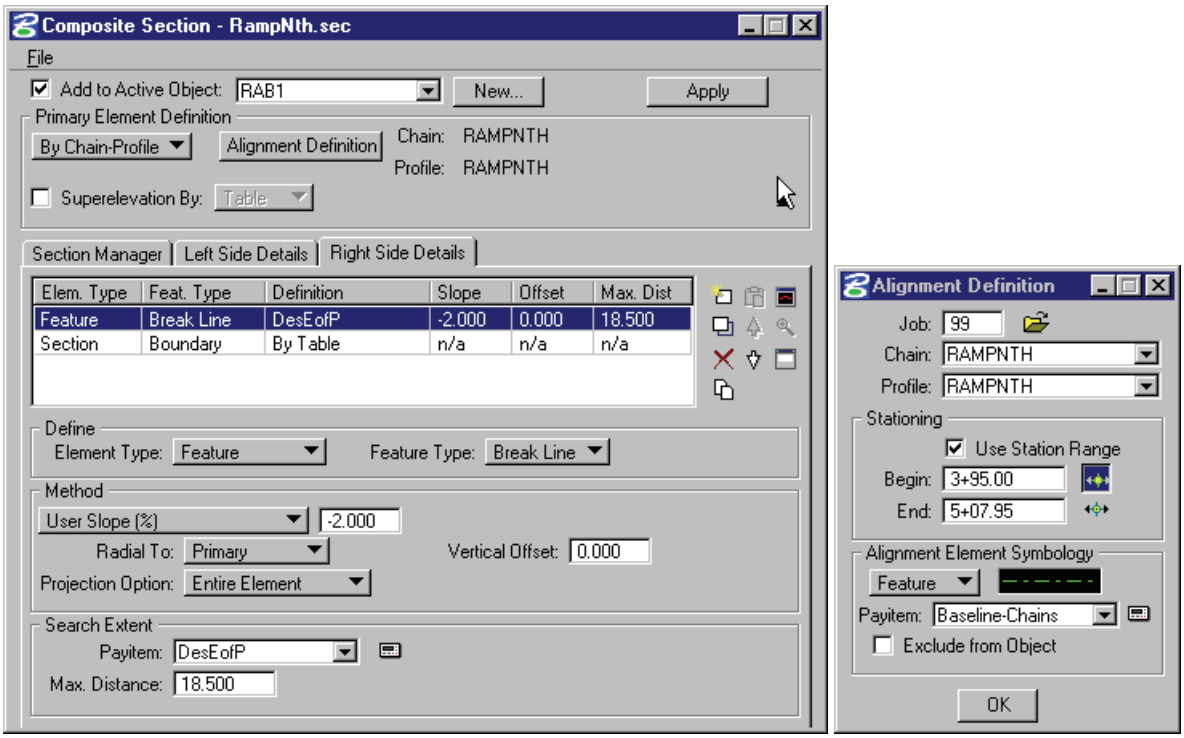
1. **Site Modeler > Elements > Composite Section**.
2. **File > Open**. Select *C:\Data\Geo\Site\Roundabout\Step4\ServSth.sec*.
3. Populate the **Primary Element** portion of the dialog as shown below.



4. Click **Apply**.

> ***ADD THE OTHER ROADS – RAMP NORTH***

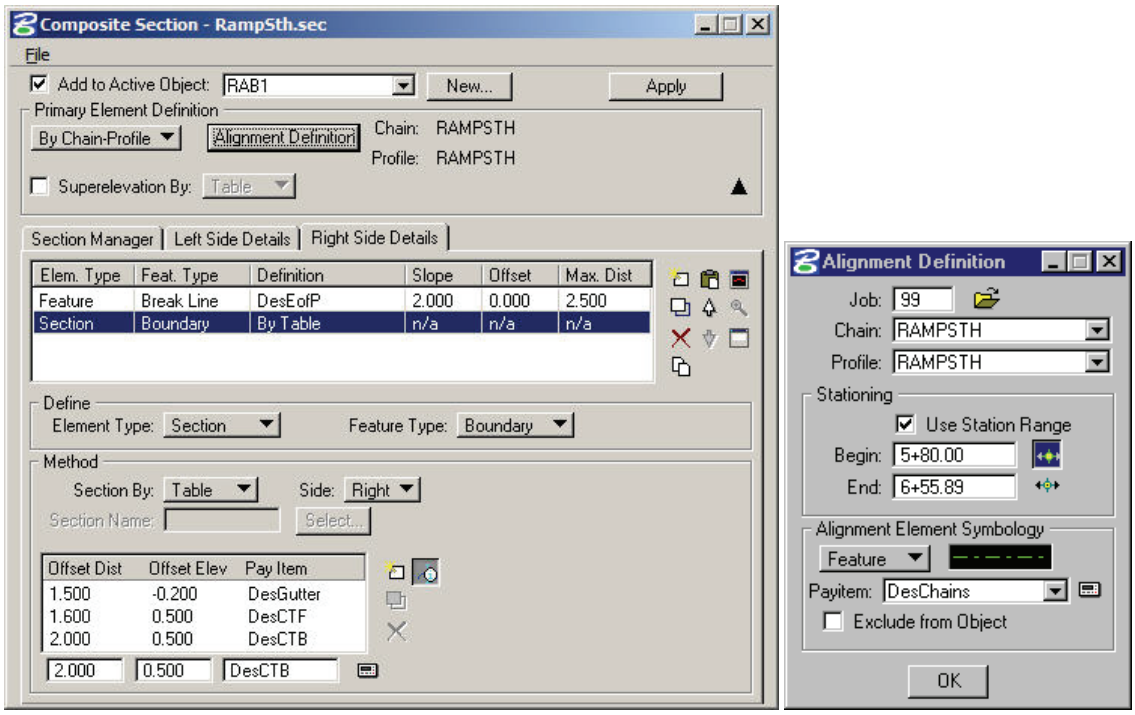
1. **Site Modeler > Elements > Composite Section**.
2. **File > Open**. Select *C:\Data\Geo\Site\Roundabout\Step4\RampNth.sec*.
3. Populate the **Primary Element** portion of the dialog as shown below.



4. Click **Apply**

> ***ADD THE OTHER ROADS – RAMP SOUTH.***

1. **Site Modeler>Elements>Composite Section**.
2. **File > Open**. Select *C:\Data\Geo\Site\Roundabout\Step4\RampSth.sec*.
3. Populate the **Primary Element** portion of the dialog as shown below.



4. Click **Apply**.

   This completes the areas of the incoming roads that can be defined based solely on the Chain and Profile for each roadway.

STEP 5

Objectives

- Create the curb return elements and then, where required, edit these to ensure that all pavement areas provide smooth transitions and drain correctly.

Introduction

At this point, we have defined all of the larger pavement areas that have a direct relationship to a specific geometric element.

The traffic circle was defined based on a surface generated from the original control alignment. The incoming roadways have been based on their respective chains and profiles.

The curb return elements, in general, will be defined based on extending recently created pavement areas. Deciding where and how these elements will be created will require some educated Engineering design “best guesses”.

Tools to be used

- Site Modeler > Elements > New/Edit > Slope/Offset from Site Element.
- Site Modeler > Elements > New/Edit > Drape On Model/Object.
- Site Modeler > Elements > Edit Profile.
- Site Modeler > Elements > Section.

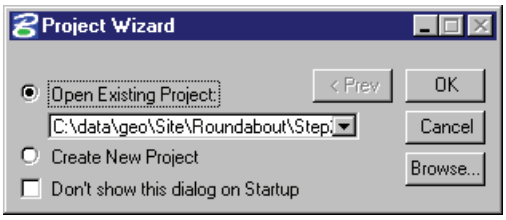
LAB EXERCISE: DEFINE THE REMAINING EDGE OF PAVEMENT ELEMENTS

To ensure that all students have the same data, we will start this exercise with a new dataset.

> ***SWAP TO NEW DGN AND GSF.***

1. Open the file *C:\Data\Geo\Site\Roundabout\Step5\LHSRAB.dgn*.
2. Start Modeler (**Applications > GEOPAK Site > Site Modeler > Site Modeling**).

Note: PowerCivil menu, (**Civil > Modeler**).

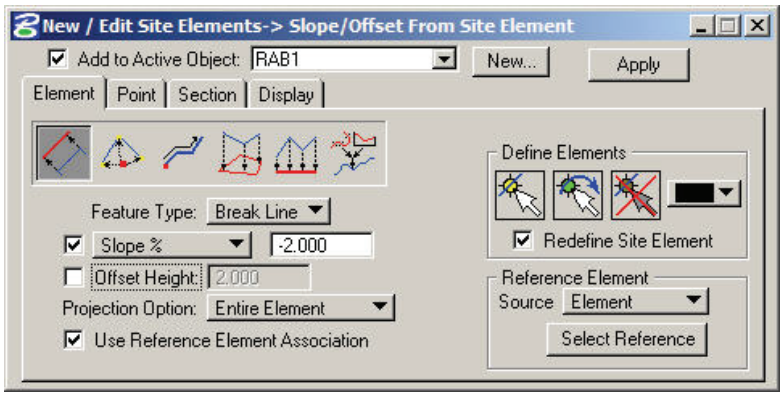


3. Click **Browse**.
4. Select the file *C:\Data\Geo\Site\Roundabout\Step5\LHSRAB.gsf*.
5. Click **OK**.

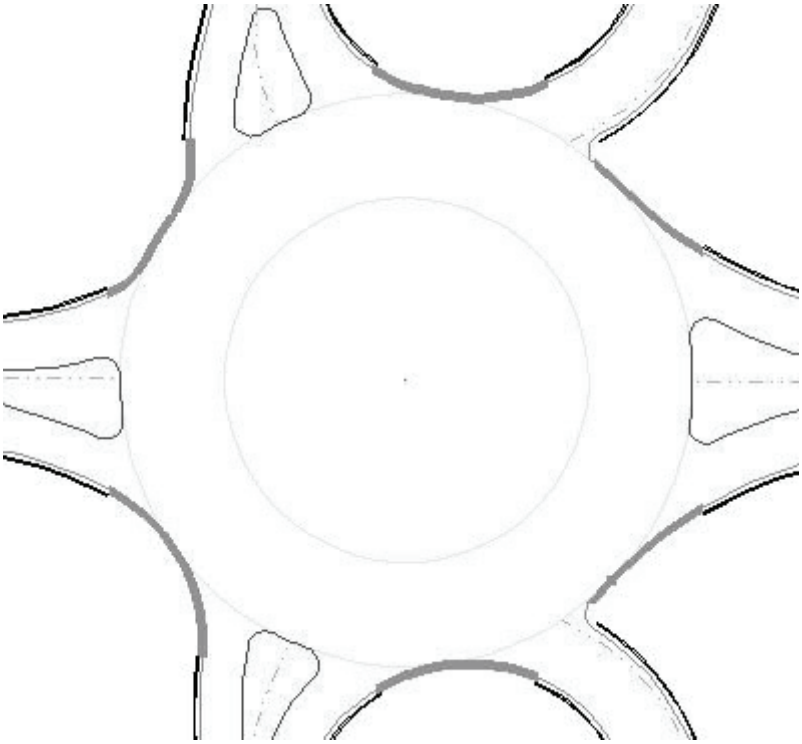
> ***DEFINE THE CURB RETURN ELEMENTS***

19. Select the site element slope offset tool (**Modeler > Elements > New/Edit > Slope/Offset From Site Element**).

Note: Most of the remaining curb return elements can be defined by projecting from the outside edge of the traffic circle at –2%.



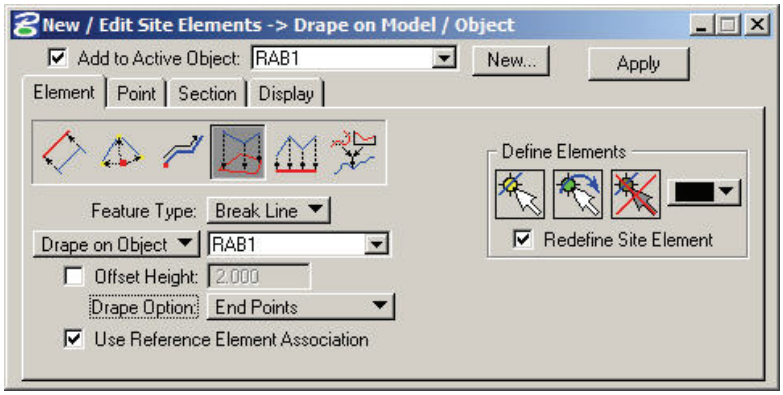
2. Set the dialog as shown above.
3. Click **Define Elements > Select Elements** and select all of the curb return elements that are shown in heavy weight below (should be 6 elements).



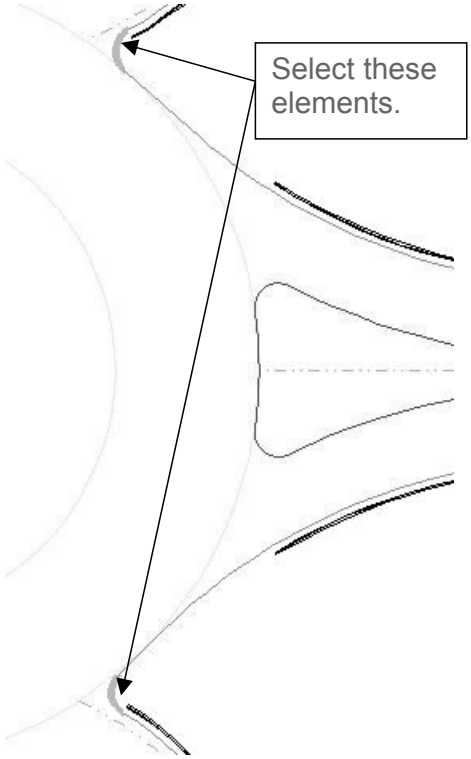
4. Click **Reference Element>Select Reference.** Select and accept the outside edge of the Traffic Circle.
5. Click **Apply**.

Note: The remaining curb returns we can define by draping the endpoints on the design thus far.

6. **Modeler > Elements > New/Edit > Drape on Model/Object.**



7. Set dialog as shown above.
8. Click **Define Elements>Select Elements** and select all of the curb return elements that are shown in heavy weight below.



9. Click **Apply**.

> ***RE-DEFINE THE CURB RETURN ELEMENTS USING EDIT PROFILE***

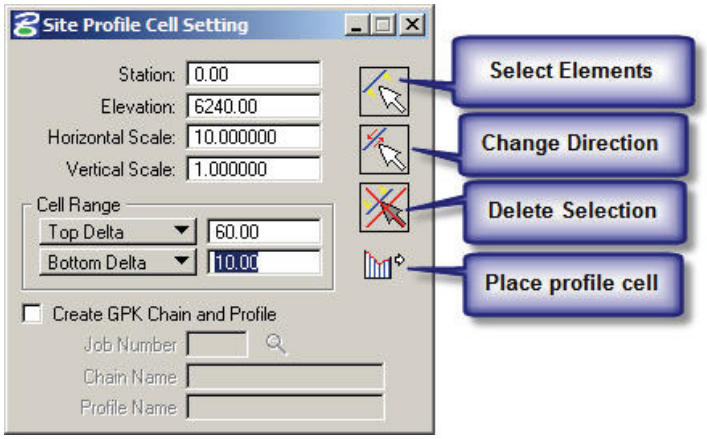
The GEOPAK Site Modeler Edit Profile tool is a very powerful design tool. It allows the User to redefine any existing Site Element or series of Site Elements by creating a Profile view of the elements and then using Vertical Component tools to modify the elevations.

1. **Modeler > Elements > Edit Profile**. This will activate the Active Profile Control dialog.

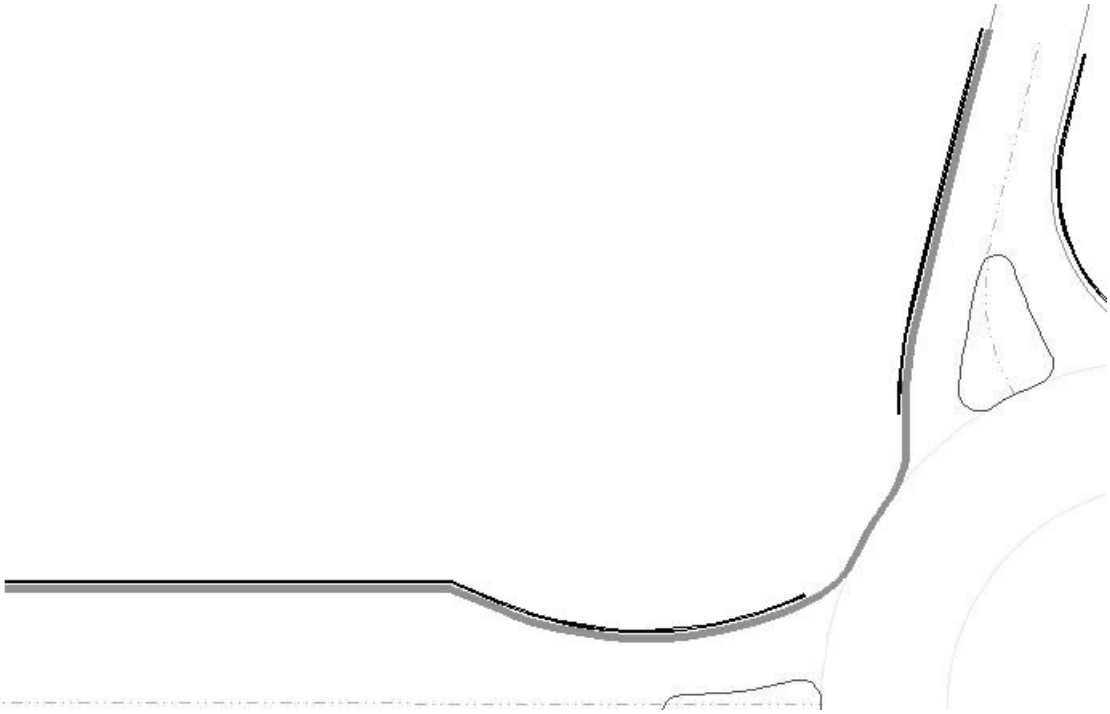
The dialog contains a number of different tools.

-  The **Profile Cell Statu***s* button.
-  An **id** button to synchronize between plan view elements and the corresponding profile.
-  The **Vertical Component Tools**.
-  The **Define Site Element Profile** button: this applies the new profile back to the Site Element.
-  The **Curvilinear Coordinates** button.
-  The Active Chain Control view control windows.

2. Open Window 2 and Zoom/Window Area to give you a clear drawing space to place the Element Profile.
3. Right Click on the **Profile Cell Status** button and select **Profile Cell Setting**.
4. Set the dialog as shown below.

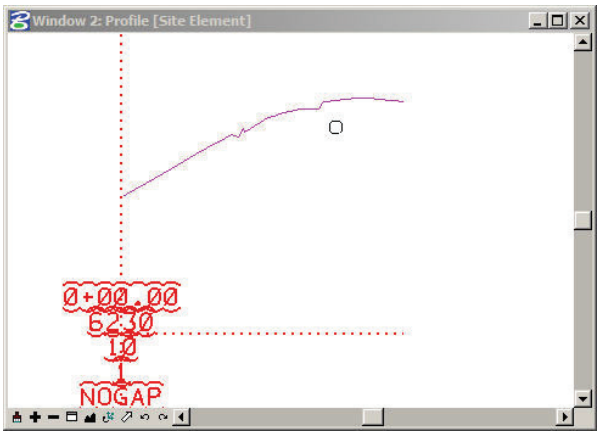


5. Click **Select Element**. Select all of the edge of pavement elements shown in heavy line weight below.



Note: Each element needs to be selected and accepted. When the elements are correctly selected, they will highlight with a series of light blue dots over the element.

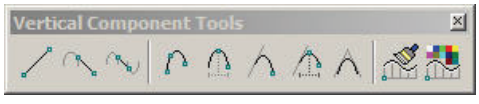
6. Click **Place Site Pcell**. Move your mouse cursor into a clear drawing space in Window 2 and data point. This will place the profile representation of the Site Elements into a Site Profile Cell in Window 2.



7. Right click over the **Active Chain Control** view control window number one (1) and set View 1 to a Plan view.
8. Right click over the **Active Chain Control** view control window number two (2) and set View 2 to a Profile view.

   This will synchronize between Plan and Profile views.

9. Press the **Vertical Component Tools** button. The following dialog will activate.



10. Use the **Vertical Component Tools** to redefine the portions of the current profile where required.

Note: Follow your instructor. There will be a discussion on what portions of this profile need to be redefined and what portions must not be modified.

11. After the proposed vertical components have been added to the Profile, we need to return this new vertical information back to the Site Elements.
12. Click **Active Profile Control > Define Site Element Profile**.
13. Select one of the proposed vertical components.
14. Click again – this will string all of the components together.
15. Click again – this will return the new elevations to the Site Modeler elements.

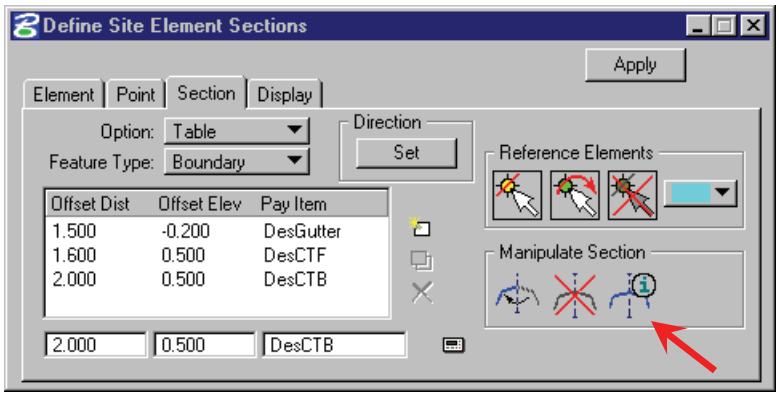
Note: We will redefine the other five (5) curb returns using the same steps.

LAB EXERCISE: ADD CURB AND GUTTER SECTION TO CURB RETURNS

The curb returns have been defined to ensure a smooth pavement surface within the intersection. We now need to add the missing pieces of curb and gutter to the curb return elements.

> *ADD CURB AND GUTTER SECTION*

1. Start the site element section tool **Modeler > Elements > New/Edit > Section**.
2. Populate the dialog as shown below.



Note: The required DDB items can be found in the DDB /PayItem/Plan/Roadway directory.

The section can be read from other edges of pavement that already have a section attached with the **Query** button (indicated by arrow).

3. Click **Reference Elements>Select Reference Elements**.
4. Select the eight (8) previously defined edge of pavement Site Elements.
5. Click **Set**.
6. Move the cursor into the graphics to set the direction.

Note: There is a dynamic graphic that is attached to the selected elements. GEOPAK is waiting for the User to set the positive horizontal (offset) direction for the section elements.

7. Click **OUTSIDE** of the selected graphics (so the positive direction is to the outside of the edge of pavement).
8. Click **Apply**.

   We have added the curb and gutter to the curb returns.

STEP 6

Objectives

- Create the complex traffic circle center island.

Introduction

In Step 2 we originally defined the inside edge of the traffic circle. This was a temporary (and fast) method to give us a visual indication of what a 2% pavement slope would look like.

We now need to create the more complex median/island arrangement that was requested by the client.

Tools to be Used

- Site Modeler>Elements>New/Edit>Section.
- Site Modeler>Elements>Composite Section.

LAB EXERCISE: REMOVE THE CURRENT INSIDE EDGE OF TRAFFIC CIRCLE

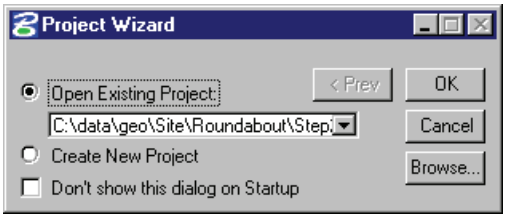
To ensure that all students have the same data, we will begin this exercise in a new dataset.

> ***SWAP TO NEW DGN AND GSF***

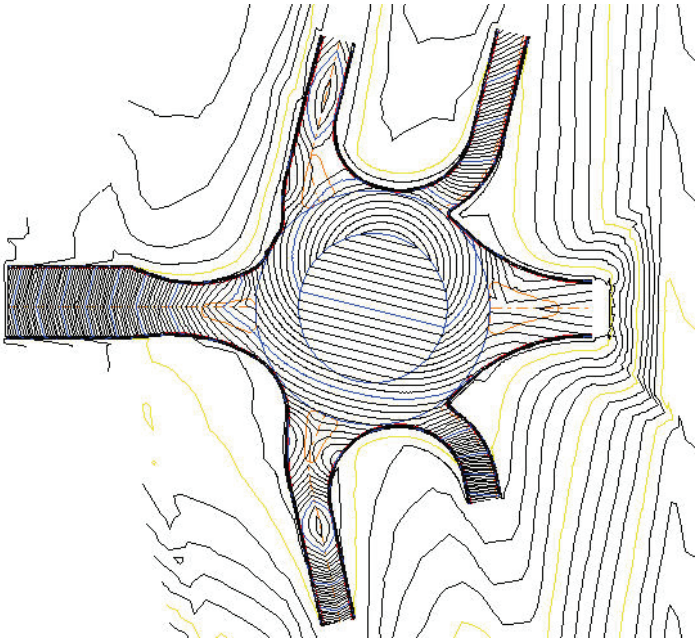
1. Open the file *C:\Data\Geo\Site\Roundabout\Step6\LHSRAB.dgn*.
2. Start Modeler (**Applications>GEOPAK Site>Site Modeler>Site Modeling**).

Note: PowerCivil menu, (**Civil > Modeler**).

3. This will open the Site Modeler tool.



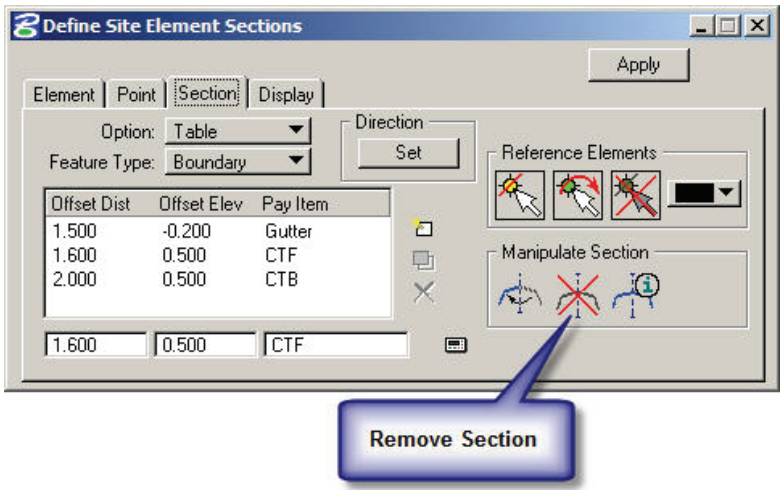
4. Click **Browse**.
5. Select the file *C:\Data\Geo\Site\Roundabout\Step6\LHSRAB.gsf*.
6. Click **OK**.



> ***REMOVE THE INSIDE TRAFFIC CIRCLE ELEMENT***

1. Select the Section tool. (**Modeler > Element > New/Edit > Section**).

Note: The inside element of the traffic circle was created as a Site section element. To remove this element we use the **Section** tool.

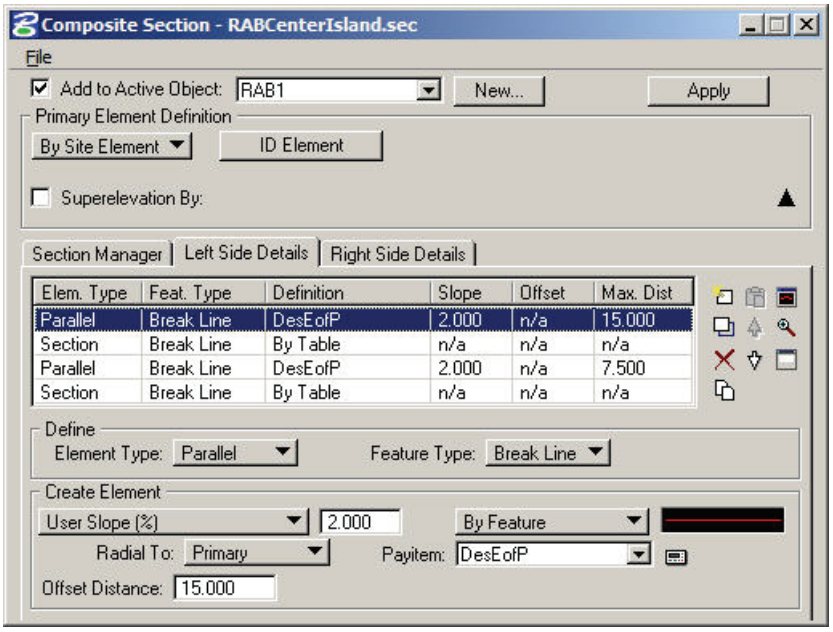


2. Select **Reference Elements>Select Reference Elements**. Select and accept the outside edge of the traffic circle.
3. Click **Remove Section**.
4. The section element will be removed and the traffic circle will be re-triangulated.

LAB EXERCISE: CREATE COMPLEX CENTER TRAFFIC ISLAND

> ***CREATE THE COMPLEX CENTER TRAFFIC ISLAND***

1. Start the composite section tool (**Modeler > Tools > Composite Section**).
2. **File > Open**. Select *C:\Data\Geo\Site\Roundabout\Step6\RABCenterIsland.sec*.
3. This will populate the Composite Section dialog as shown below.



4. Rather than using a COGO chain and profile we will be using a site element for the primary element which will be the outside edge of the traffic circle.

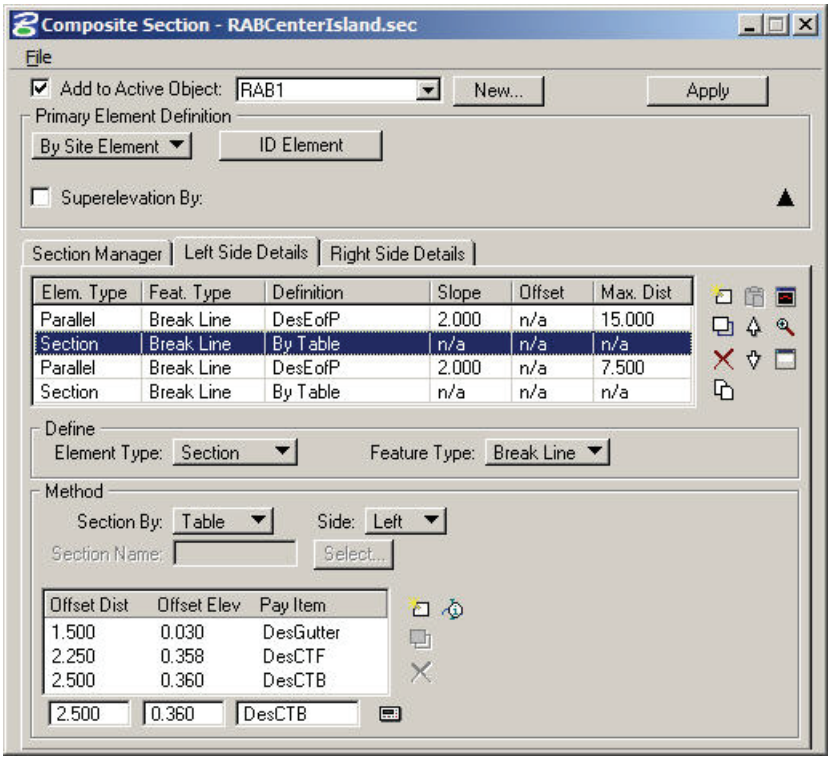
Note: We shall look at the settings inside the Composite Section file in detail.

The inside of the traffic circle has 2 pavement areas and 2 different types of curbing.

The first row of the dialog creates the first pavement edge. The pavement is 15 feet wide at a pavement slope of 2%.

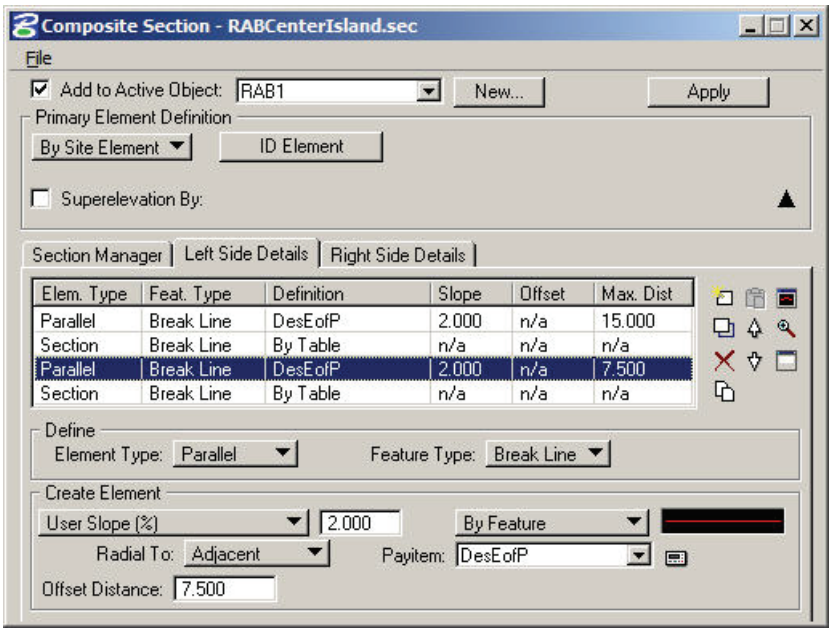
This is shown in the dialog above.

The second row creates the first of the curbing sections.



The “gutter” portion of this section is actually created at the same slope as the adjacent pavement (2%). Then there is a curbing.

The third row creates the second pavement surface – in the finished intersection this will be a concrete pavement.



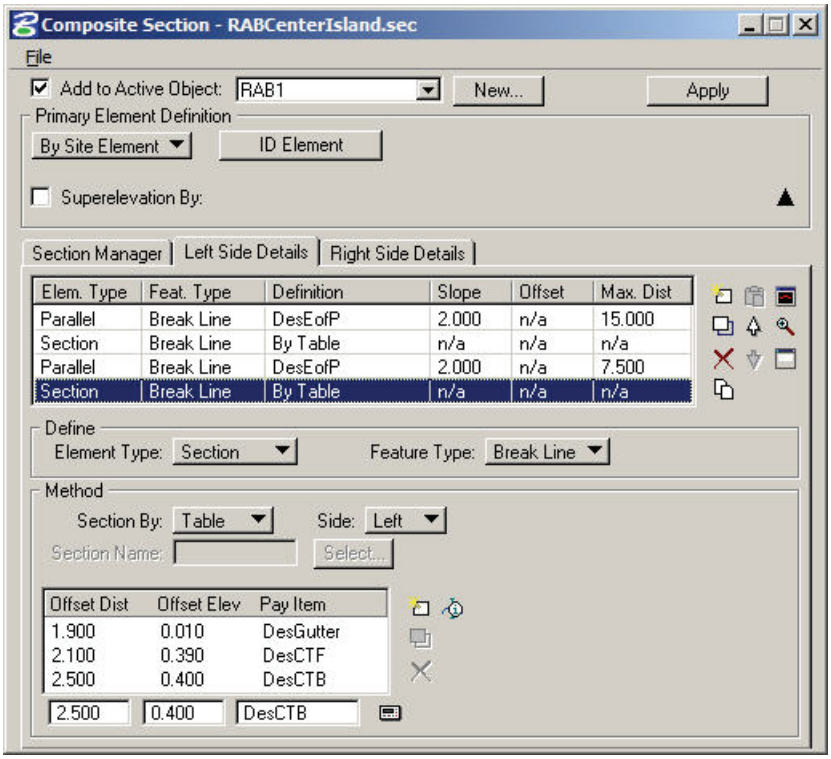
This pavement is also at a 2% slope but note that the elevations for this pavement edge will be based on the adjacent element rather than the primary element.

In effect, the edge of pavement elevations will be calculated from the top back of the curb.

The forth row creates the second of the curb and gutter sections.

This section also has a positive slope on the gutter section, thus forcing all surface water towards the outside of the traffic circle.

Note: Draining water to the outside of the traffic circle is a typical design arrangement for this type of intersection. While it means that the circulating traffic have an adverse cross slope to maneuver, it does prevents ponding at the center island. If the cross slope falls towards the center island and the drainage inlets become blocked, the drainage runoff could pond (submerge) the entire intersection before it would drain away.



5. Select **Primary Element > ID Element**. Select and accept the outside edge of the traffic circle.
6. Click **Apply**.

STEP 7

Objectives

- Create the median islands for the incoming roadways.

Introduction

The only portion of the project that has not been modeled is the traffic medians/islands. These will now be created.

Tools to be Used

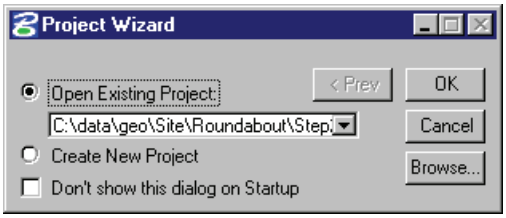
- Site Modeler>Elements>New/Edit>Drape on Model/Object
- Site Modeler>Elements> Section

LAB EXERCISE: CREATE A NEW MEDIAN OBJECT

To ensure that all students have the same data, we will begin this exercise with a new dataset.

> ***SWAP TO NEW DGN AND GSF***

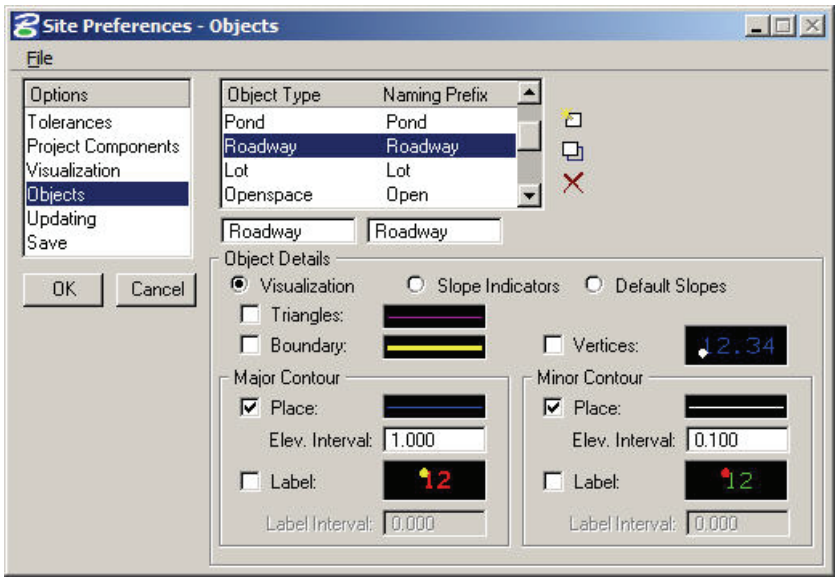
1. Open the file *C:\Data\Geo\Site\Roundabout\Step7\LHSRAB.dgn*.
2. Open Modeler (**Applications > GEOPAK Site > Site Modeler > Site Modeling**). This opens the site modeler.



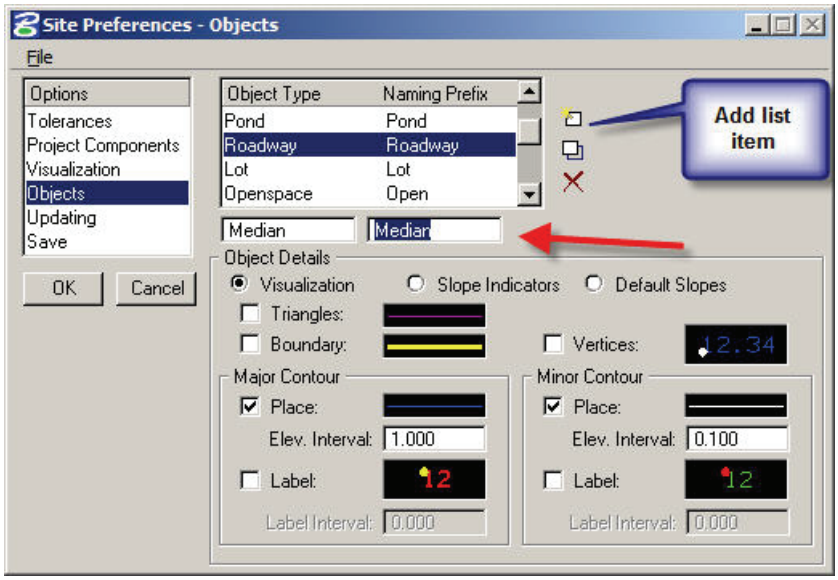
3. Click **Browse**.
4. Select the file *C:\Data\Geo\Site\Roundabout\Step7\LHSRAB.gsf*.
5. Click **OK**.

> *CREATE A MEDIAN OBJECT*

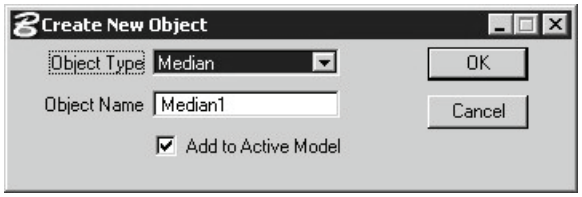
1. Our preferences do not contain a type for medians, so we will create one.
2. Open the project preferences (**Modeler > Project Preferences**).
3. Choose the Objects section as shown below.



4. Since the Roadway type has most of the settings we want, we can use it to start, so highlight Roadway.



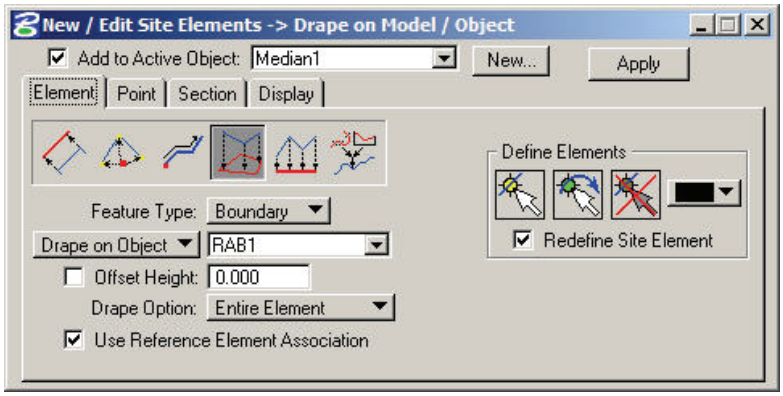
5. Overtype the Object type and Name prefix as shown above and press the add list item button. This will create a new object type named median with all the same settings as roadway objects.
6. Click **Default Slopes** and set the default slopes for the **Median** Object type to "**No Slopes**".
7. Click **Modify List Item** to modify the slopes.
8. Press **OK** on the preferences and save the project.
9. Now, create a new site object. **Modeler > Object > New**.
10. Select the Object Type "Median".



11. The default Object Name is Median1. Leave this as it is.
12. Click **OK**.

> ***DRAPE OUTSIDE OF MEDIAN ONTO THE RAB OBJECT***

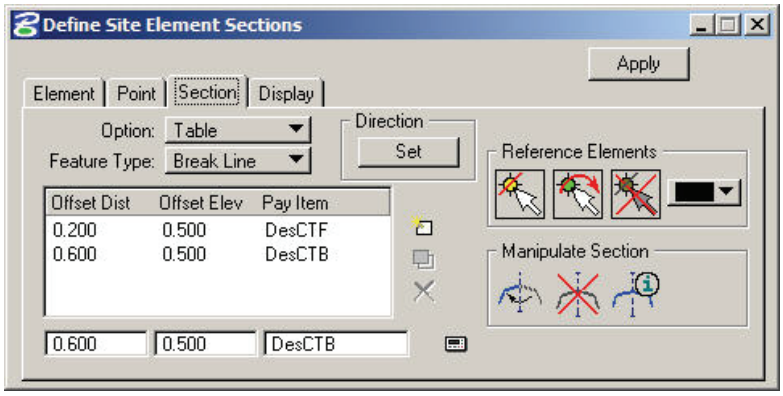
1. Open the new site element tool (**Modeler > Element > New/Edit > Drape on Model/Object**).
2. Set the dialog as shown below.



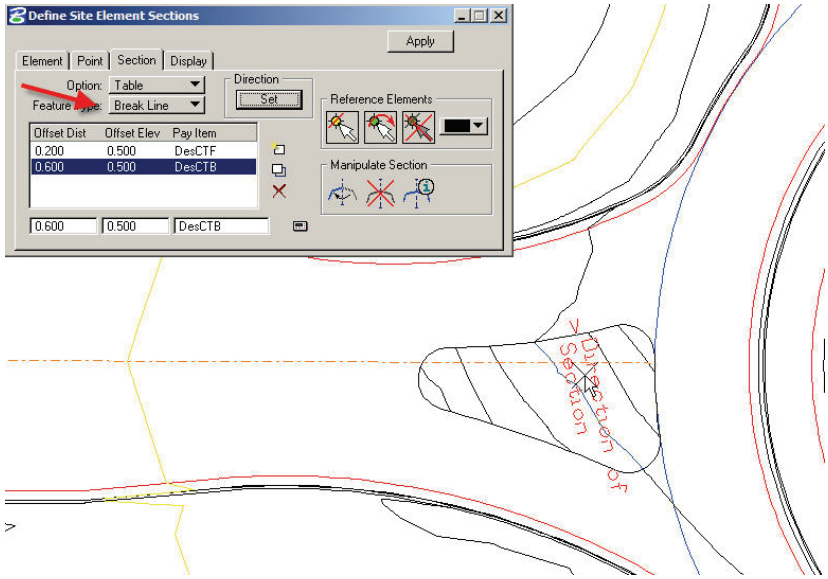
3. Click **Define Elements>Select Elements**. Select the purple graphic that represents the outside edge of one of the Medians.
4. Click **Apply**.

> *ADD A SECTION TO THE MEDIAN OBJECT*

1. Change the new/edit element to the section tab.
2. Set the dialog as shown below. Modify the rows as required.



3. Click **Reference Elements > Select Reference Elements**. Select and accept the edge of median element that was created in the previous step.
4. Click **Set**. Point the dynamic direction arrow inside the median shape and data point.



5. Click **Apply**.

   This completes creation of the first of the four (4) medians.

6. Create the other 3 medians using the same process.

   This completes our intersection.

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