STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

FDOT GEOPAK
for Roadway Designers-Advanced
CE-11-0101

Course Guide
May 14, 2010

ENGINEERING / CADD SYSTEMS OFFICE
TALLAHASSEE, FLORIDA

http://www.dot.state.fl.us/ecso/

FDOT GEOPAK for Roadway Designers-Advanced
FDOT Course ID: CE-11-0101

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FDOT GEOPAK for Roadway Designers-Advanced

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Description

This advanced level course provides instruction in the use of GEOPAK, MicroStation, and the Florida Department of Transporation (FDOT) Computer Aided Design and Drafting (CADD) standard resources and applications for roadway design. The advanced course follows typical roadway design workflow to instruct students on how to produce and present cross-section sheets and quantities for roadway projects.

This course will utilize the Civil Engineering Suite GEOPAK to complete roadway design.

Topics Covered

- GEOPAK DTM Tools
- Existing Ground Profile
- Existing Cross Sections
- Proposed Profile and Active Chain Control
- Superelevation Shapes
- Proposed Cross Sections
- Borehole Navigator
- Earthwork
- Cross Section Sheets
- Cross Section Reports

Prerequisites

- FDOT MicroStation Essentials - Part I (CE-11-0114)
- FDOT MicroStation Essentials - Part II (CE-11-0115)
- FDOT Basic GEOPAK for Roadway Designers (CE-11-0099)

Duration: 16 Hours

Professional Credit Hours: 14 PDHs

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1 DIGITAL TERRAIN MODEL TOOLS

OBJECTIVES

The objectives of this session are:

- Overview of Digital Terrain Model (DTM) tools
- Extracting an Existing TIN File
- Checking and Displaying a TIN File
- Correcting for Voids
- Updating the Working Alignment

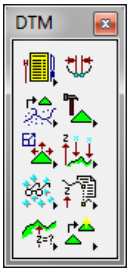
OVERVIEW

Digital Terrain Models (DTM) are generated from a wide range of data sources including MicroStation elements, survey data, GEOPAK cross sections and GeoGraphics project data. An Extract utility is included to facilitate the retrieval and formatting of MicroStation graphical elements, classified as contours, random points, break lines, voids, islands and boundary points. GEOPAK offers a multitude of tools for creating, editing and performing tasks using DTM's. DTM's utilize **Data Point**s and break lines in order to generate a computer model of the ground.

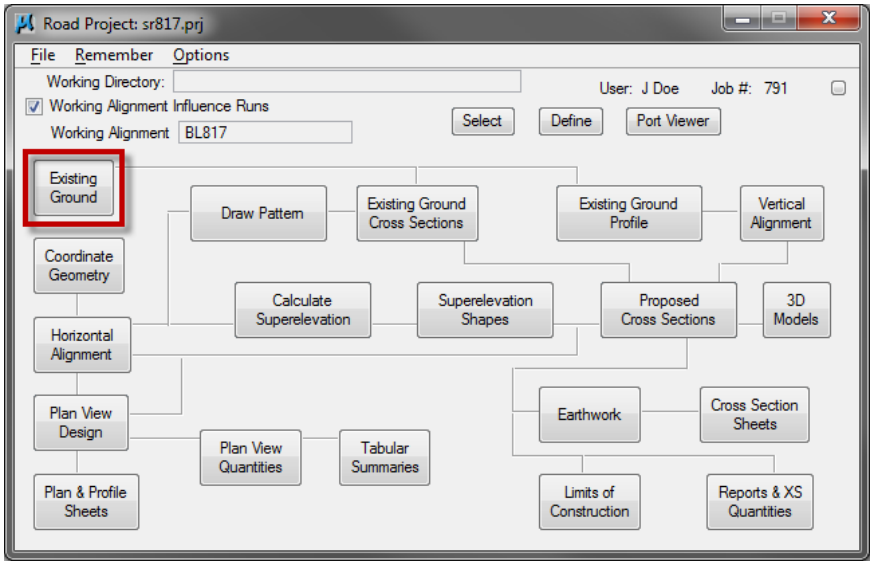
The surveyor generally supplies the designer with a 3D MicroStation file that contains a DTM consisting of a network of graphic triangles. The designer processes the contents of the DTM file using the tools supplied by GEOPAK to extract information and create a .DAT file. A .DAT file is a data file that contains the information used for triangulation. It is an intermediate file and compiles the information extracted to use as points to triangulate with, thus creating a Triangulated Irregular Network (TIN) file. Many GEOPAK tools throughout the design process use a .TIN file.

ACCESSING DTM TOOL

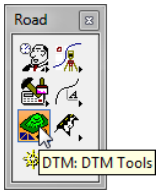
The user accesses all DTM tools from the **DTM** toolbox. From the **DTM** toolbox, the user has the option to open the individual tools using the toolbox icons or to open a menu bar that contains the commands organized by function.



- From the Project Manager Road Project dialog, click the **Existing Ground** icon.



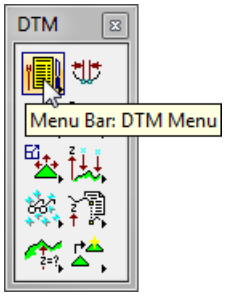
- From the MicroStation menu, select **Applications** > **Road** > **DTM Tools**
- From the *Road Tools* toolbox, select DTM Tools.

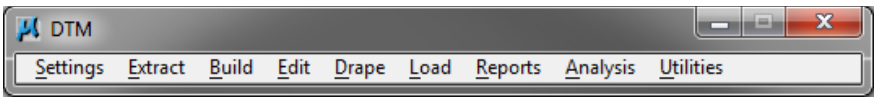


ACCESSING DTM MENU BAR

The *DTM* menu bar contains all the tools GEOPAK has available for working with DTMs; organized on menus by their general function. The user will find all **DTM** menu bar tools on the **DTM** toolbox, but new users usually find it easier to remember where the tools are located when using the menu bar.

- On the **DTM** toolbox, click the **DTM Menu** icon.





DTM TOOLS FOR ROADWAY DESIGNERS

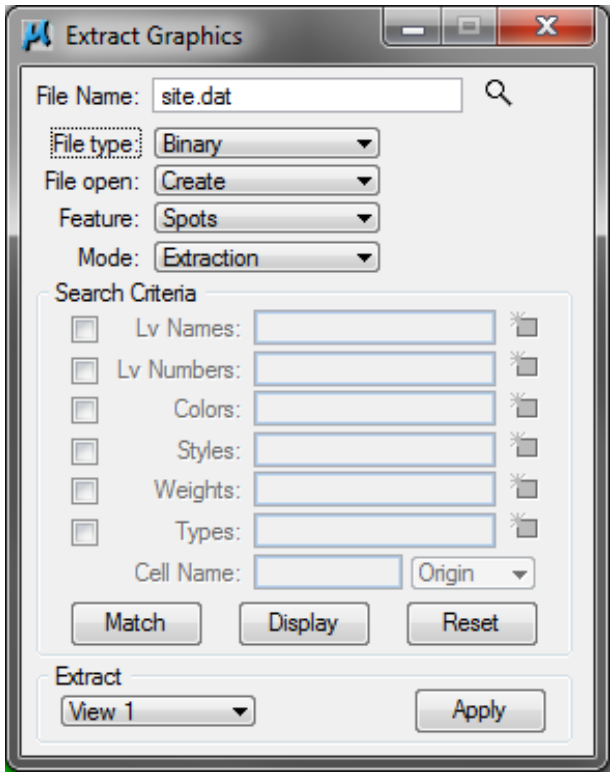
In general, roadway designers use only a few of the GEOPAK DTM tools. Their use is normally limited to extracting data from a 3D design file and building a TIN model for use with GEOPAK's other tools. This manual only covers those tools commonly used by roadway designers. For more information on DTM tools not covered in this manual, see the help files delivered with GEOPAK.

EXTRACT GRAPHICS

Extract Graphics gathers data from the 3D design file provided with the survey of the project. This design file, normally provided to the designer in the form of a graphical triangle file, can also be in several other formats. Extract Graphics can mine the needed data from any of the various types of files. The product of Extract Graphics is a DAT file. The DAT file simply contains XYZ coordinates of the data contained in the 3D design file.

ACCESSING EXTRACT GRAPHICS

From the DTM menu, select **Extract** > **Graphics**.



OVERVIEW OF EXTRACT GRAPHICS

File Name Specifies the name of the DAT file created or appended.

File Type Two options are available: Binary and ASCII.

Binary These files have a smaller file size than an ASCII file, containing the same data, but cannot be read or modified by the user.

ASCII These files contain the data in a format read or modified in any text editor. The benefit of an ASCII file is that the user can check for and correct any errors in the data.

File Open Specifies the method used for accessing the DAT file.

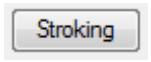
Create This generates a new file with a specified file name. Create also overwrites existing files with the same File Name, which prompts a warning that the file exists and gives the user an opportunity to choose to overwrite or not.

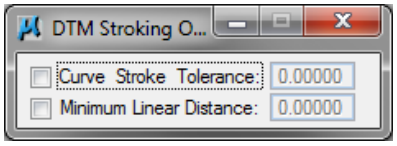
Append This adds the data to an existing DAT file.

Feature Specifies the type of feature used in the field. The 3D MicroStation design file represents these features. The DAT file is created based on these features.

Spots are points that have no functional relationship to any other point. Random survey shots in open terrain would be an example of random spots. Point elements such as cells, circles, and text strings are typical MicroStation elements used to define spot elevations. Lines, line strings, and other longitudinal elements are equally valid. GEOPAK creates a spot elevation for each vertex of each longitudinal element.

Breaks This designates linear features such as edges of pavement, ditch bottoms, ridges, etc. Any longitudinal element defines as a break line. GEOPAK automatically segments circular arcs in a manner consistent with the arc radius. When selected the dialog changes to include a Stroking icon, which will access the DTM Stroking Options dialog.

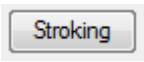




Stroking This is a process of automatically adding new shots to the DTM input file by interpolating new shots from the linear and curves sections of the data. This dialog allows you to control the spacing of these new shots in both a linear and curve mode.

Boundary These are constrains the external boundary of the triangulated model. Triangles are not created outside the boundary polygon. In addition, any point data outside the boundary polygon will be ignored. A boundary polygon must start and finish with the same point. In addition, the boundary polygon must be continuous within the data file.

Contours Special feature intended for use if the source MicroStation elements represent digitized or otherwise created contours. Use of this feature insures the integrity of the contour strata in the subsequent DTM. Processing of a DTM with contours classified as spot elevations invariably results in a DTM that, if subsequently contoured, will not match the original extracted contours. When selected the dialog changes to include a Stroking icon as described above.



Void These areas are closed shapes to demarcate areas of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. The Void coordinates are included in the triangulation and void lines between successive void coordinates insert as drape lines on the TIN surface. Therefore, they do not change the slope or elevations of the TIN surface.

Island Used to place triangulated data within a void, i.e., islands in the middle of rivers, lakes, etc.

Graphic Triangles Extracting as triangles maintains the sides of each triangle in addition to the vertices. Using spots utilizes the vertices, but not the triangle sides. By survey at (FDOT), survey commonly provides Graphic Triangles to design and used to create the DAT file.

Drape Void In the drape void, the void coordinates are not included in the triangulation. Voids are inserted post triangulation. The void coordinates and lines drape on the TIN surface. Even though a user must provide an elevation for the Drape Void vertices, the user elevations changes to the elevation of the TIN surface at the XY Drape Void coordinate position.

Break Void A void utilizes the elevations of each vertex, while the void lines between successive void coordinates insert as break lines. Therefore, break voids change the slope and elevations of the TIN surface.

Mode

The Extraction mode determines XYZ data directly from the coordinate values of three-dimensional MicroStation elements. The Interpolation mode, by contrast, derives XYZ data by locating spot elevations on longitudinal MicroStation elements and interpolating. Hence, the Interpolation mode applies to both two-dimensional as well as three-dimensional MicroStation files as long as a Z-coordinate reading can be ascertained from the spot elevations.

Search Criteria

The Search Criteria specifies the symbology and attributes of the elements to gather data.

Match This determines the Search Criteria by selecting elements from the design file.

Display This highlights all elements matching the Search Criteria. Display visually verifies the defining of all intended elements in the Search Criteria.

Reset This clears all definitions in Search Criteria.

Extract

Extract specifies the limits of the design file that are to be processed. Complex Chain will extract data from a specified complex chain. Selection Set will extract data from a group of elements contained in a selection set. Fence processes all elements contained in a MicroStation fence. View 1 through View 8 will process all elements displayed in the selected view.

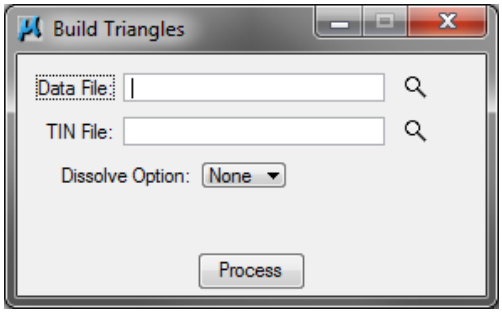
Apply This commences the extraction process. Completely fill out the dialog and make sure that the View, Fence or Selection Set is set prior to selecting Apply.

BUILD TRIANGLES

Build Triangles uses the DAT file to create a binary file containing the TIN model.

ACCESSING BUILD TRIANGLES

- From the DTM menu, select **Build** > **Build Triangles**.



OVERVIEW OF BUILD TRIANGLES

Data File Specifies the DAT file used to create the TIN file.

TIN File Specifies the name of the TIN file created.

Dissolve Option Dissolve Option eliminates the long, thin triangles along the edge of the TIN model, resulting from the triangulation process. These triangles are a by-product that is not indicative of the actual terrain.

None Does not apply any dissolving to the model and leaves these extra triangles.

Sliver Selection applies a formula to remove some of the extra triangles.

Side Selection eliminates any triangles, which has a side longer than a user specified length. This option, in effect, makes each side of a triangle a break line and will not triangulate across any triangle side thus retaining the integrity of the original triangle file.

Process Process begins the triangulation process. When processing is complete, a message displays in the MicroStation status bar.

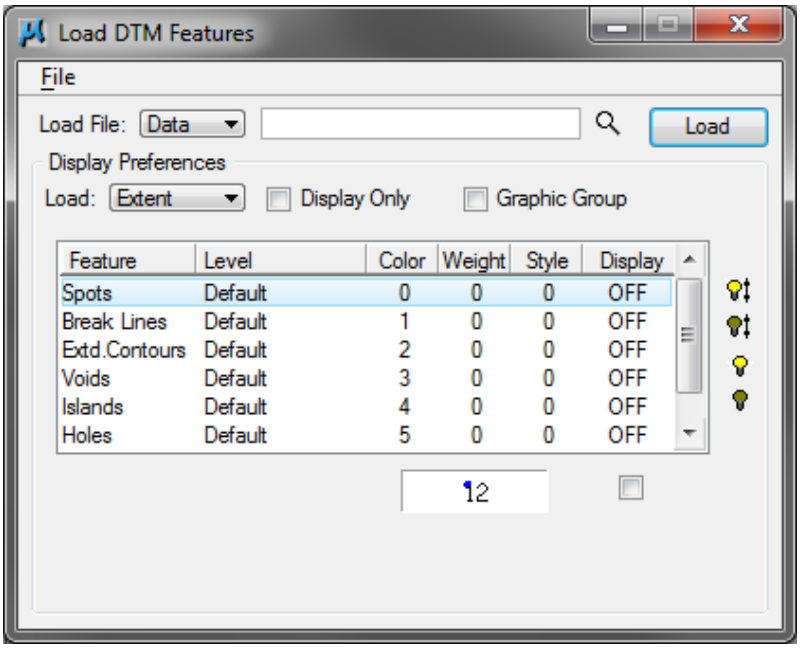
The recommended *Dissolve Option* is **Side**. This creates a more accurate duplication of the existing TIN with the fewest extraneous triangles. Using this method, no leg of an existing triangle crosses with a new triangle, insuring the integrity of the new TIN. Florida Department of Transportation (FDOT) provides a tool accessible from the FDOT2008 Menu called Find Longest Side that scans the existing triangles in the DTM design file and calculates the length of the longest triangle side. The Side Dissolve Option uses this length. The exercises cover this in detail.

LOAD DTM FEATURES

Load DTM Features is used to display the contents of the TIN model or DAT file. Load DTM Features is useful for checking the accuracy of the TIN model by overlaying it on the actual graphical triangles delivered with the survey.

ACCESSING LOAD DTM FEATURES

- From the DTM menu bar, select **Load** > **Load DTM Features**.



OVERVIEW OF LOAD DTM FEATURES

File

Open Will open a previously saved Load DTM Features preference file (*.lpf).

Save Select to save the dialog settings into a preference file (*.lpf). If a preference file has already been loaded then using the Save option will automatically update the current preference file. If one is not currently in use then a prompt will display for a name to use when saving the preference file.

Save As This option will save the dialog settings into a preference file (*.lpf), similar to the Save option. However, this option will always prompt the user for a file name.

Load File Allows selection of three different types of file sources; TIN, Data or Lattice as well as the source data file name.

TIN The option will allow the selection or input of a binary tin file.

Data The option will allow the selection of a DTM Input file. This file is a binary or ASCII format.

Lattice The option will allow the selection of a binary lattice file. A Lattice file is a gridded mesh created from the binary tin file.

Display Preferences

Load

This determines which portion of the DTM to load. For Fence, loads the portion of the DTM located within a fence (always overlap) placed in MicroStation. For View, loads the portion of the DTM within the MicroStation view window. Extent draws features for an entire model.

Display Only

If checked, elements are not drawn into the MicroStation file and disappear when an update or view control command is issued. If this box is not checked, elements are drawn into the file at the specified element symbology.

Graphic Group

If checked, the elements comprising the DTM are loaded into the design file as a Graphic Group for easy manipulation and/or deletion.

DTM Feature Symbology List Box

As the Load File option is selected, the list box changes dynamically to display supported features.

Each feature has element symbology options (Level, Color, Weight and Style) and a display mode (on/off). As each feature highlights, its element symbology displays in the window directly below the list box.

Note the Display column indicating whether the display is ON or OFF.

The symbology changes by editing the fields below the list box. Double clicking a feature will toggle that feature on or off. A right mouse click over a feature opens a pop-up menu with options to turn the selected feature on or off or turn all features on or off.

Four light bulbs, right of the List Box, control display on/off toggle.

The bright bulb (top) activates the display for all features, regardless of their current display status.

The darker bulb (second from top) deactivates the display for all features regardless of their current display status.

and The bottom two bulbs, activate and deactivate the selected feature

WORKING ALIGNMENT AND PORT VIEWER

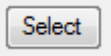
WORKING ALIGNMENT

Within GEOPAK'S Project Manager, the intent of a working alignment is to allow the designer to organize a project and to access project information without repetitive typing of the required information. Job numbers, chains, stationing, file names; practically all the information defined within the working alignment environment is "remembered" by GEOPAK then recalled as needed for the various Project Manager procedures.

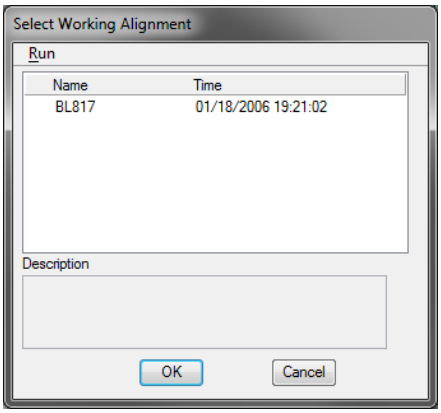
On a simple project, the designer may only want to define one working alignment. However, on a more complicated project, an unlimited number of working alignments can be defined. The designer can easily change from one working alignment to another by simply selecting the desired alignment from the Select Working Alignment dialog.

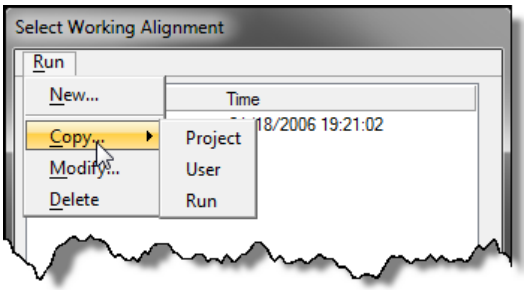
The working alignment updates through Project Manager. The FDOT Basic GEOPAK for Roadway Designers course covers Project Manager. The setup for Project Manager for this course is in accordance with recommendations listed in the Basic GEOPAK course. This is just a suggested setup and may vary per FDOT District requirements. Check with your District CADD Manager or your Project Manager for any specific requirements in naming convention for the Project Manager.

CREATING OR SELECTING A WORKING ALIGNMENT

- From the Road Project dialog, click the 

icon.





OVERVIEW OF SELECT WORKING ALIGNMENT

Run

New — Create a new working alignment definition.

Copy — ***Project*** - Copy a Working Alignment from another project. User will be prompted to select the desired project name, the user name from within that project and then to select the Working Alignment name from that project.

User - Copy a Working Alignment from within the same project but from a different user name.

Run - Copy a Working Alignment from the same project and user name.

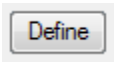
Modify — Modify the Working Alignment name and/or description.

Delete — Delete a Working Alignment.

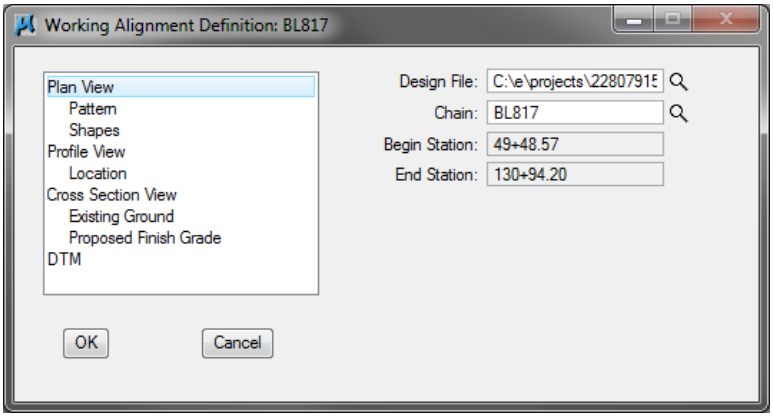
OK Selecting a *Working Alignment* name from the dialog and clicking **OK** makes the selected *Working Alignment* active.

Cancel **Exit** the dialog without making any changes.

DEFINING A WORKING ALIGNMENT

- From the Road Project dialog, click the 

icon.
- **Plan View Settings**

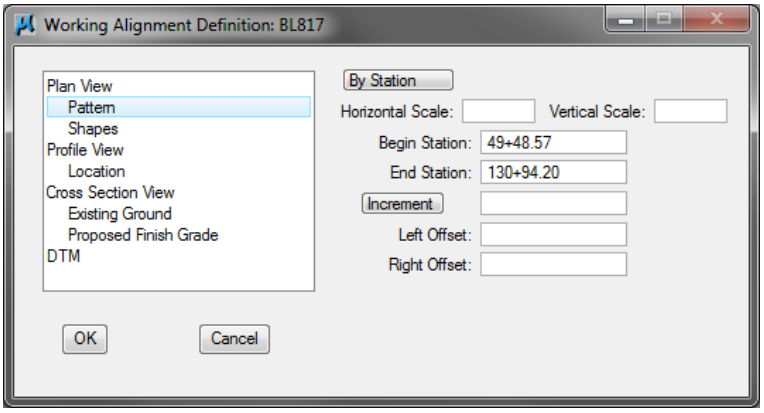


Design File Design file where the plan view graphics are located. This can be keyed-in or selected using the File icon.

Chain Alignment name for the Working Alignment being defined.

- **Plan View > Pattern Settings – By Station**

Patterns define the locations of the cross sections by two options: By Station and By Design File.



By Station When selected, the dialog changes to allow users to define the patterns by station limits and increments.

Horizontal Scale Entry made for Horizontal scale of the cross sections.

Vertical Scale Entry made for Vertical scale of the cross sections.

Begin Station Entry made for Beginning station of the cross sections.

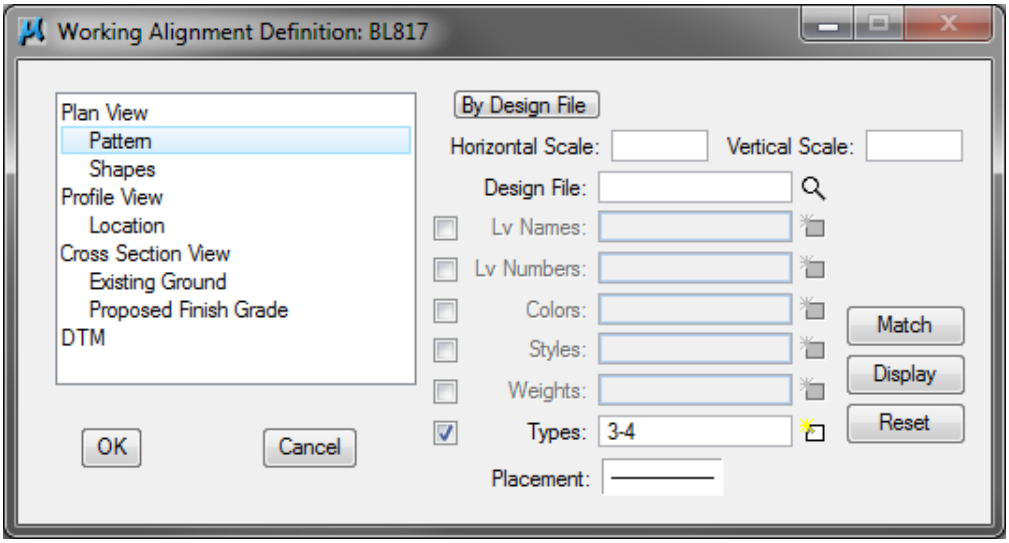
End Station Entry made for Ending Station of the cross sections.

Increment/Even Increment spaces the cross sections at the same increment apart from one another, regardless of the stationing of the alignment. In the case of an alignment with station equations, this could result in cross sections not necessarily falling on even stations. If Even is used, then even stations are maintained even if this results in the spacing of the sections being irregular.

Left Offset Field specifies the left extent of the cross sections.

Right Offset Field specifies the right extent of the cross sections.

- **Plan View > Pattern Settings – By Design File**



By Design File When selected, the dialog changes to allow the user to define the patterns using graphical elements in a design file.

Horizontal Scale Entry made for Horizontal scale of the cross sections.

Vertical Scale Entry made for Vertical scale of the cross sections.

Design File Design file where the graphical patterns are located. This can be keyed-in or selected using the File icon.

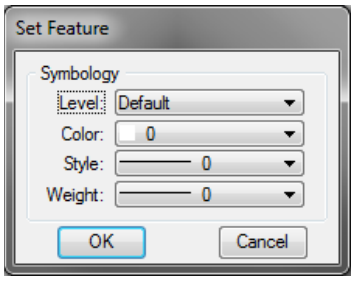
Search Criteria Patterns defined using any combination of graphical symbologies (i.e. Level Names, colors, weights, etc.), either keyed into the individual fields or selected from lists using the icons. No definition enabled or specified means ALL pertinent values for that particular item are taken into account. For example, if no color specified, then ALL colors (0-255) are part of the search symbology.

Match Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

Display Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

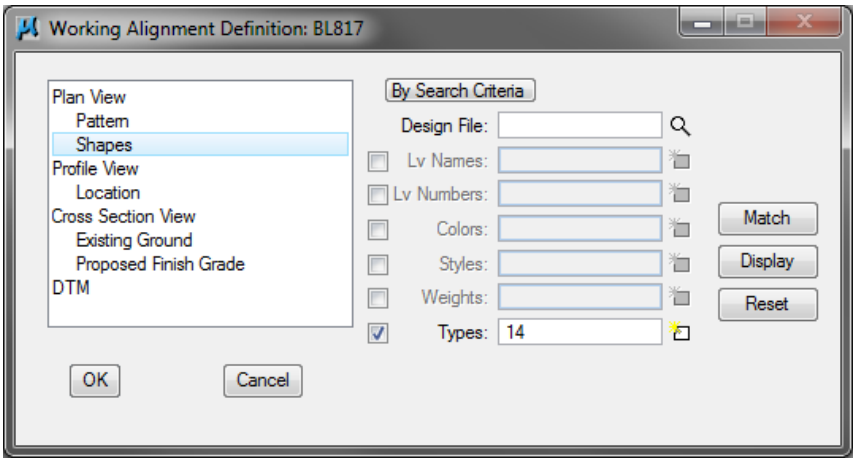
Reset This icon will blank out or reset all of the symbology fields.

Placement The symbology entered in the fields above is used only when searching for patterns. When a dialog is placing/drawing patterns, it will use the symbology defined here. You can access the symbology selection dialog shown below by double-clicking on the sample graphic.



- **Plan View > Shapes Settings**

Shapes allow the user to specify the super-elevation shapes for the Working Alignment by two options: By Search Criteria and All in DGN.



By Search Criteria When selected, the dialog changes to allow the user to specify the graphical symbology of the shapes as well as the design file where they are located.

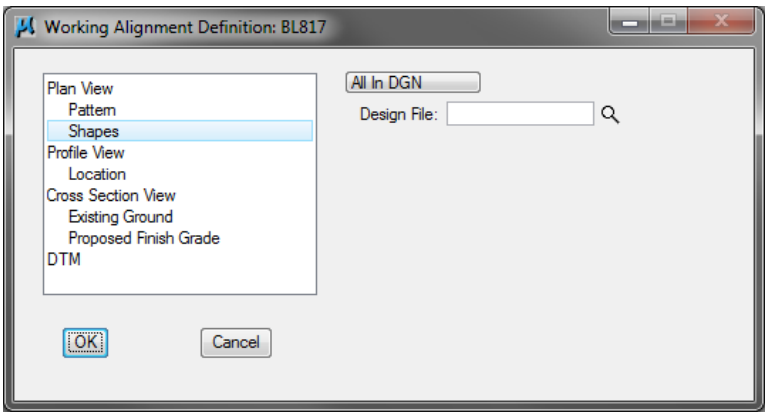
Design File Design file where the super-elevation shapes are located. This can be keyed-in or selected using the File icon.

Search Criteria Define the shapes using any combination of graphical symbologies (i.e. Level Names, colors, weights, etc.), keying into the individual fields or selecting from lists using the icons. If not enabling or specifying a specific item (e.g. color), then ALL pertinent values for that particular item will be taken into account. For example, if the color has no specification, then ALL colors (0-255) apply as part of the search symbology.

Match Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

Display Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

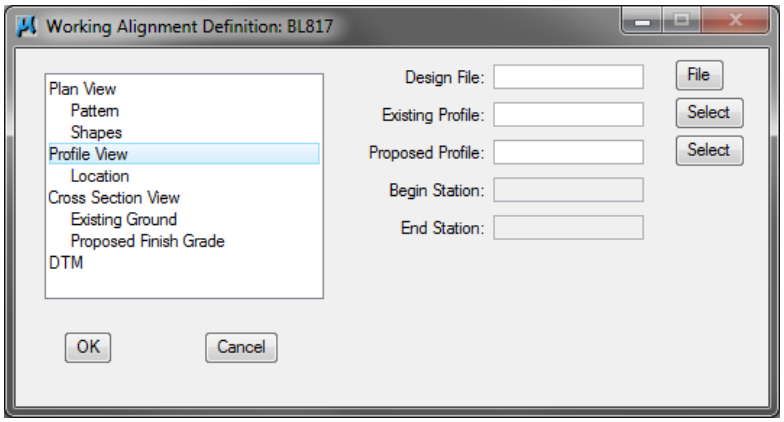
Reset This icon will blank out or reset all of the symbology fields.



All in DGN When selected, the dialog changes to allow the user to specify the design file where the shapes are located. Graphical symbology is not considered in this case and ALL of the shapes located in the design file will be found.

Design File This specifies the design file where the superelevation shapes are located. This can be keyed-in or selected using the **File** icon.

- **Profile View Settings**



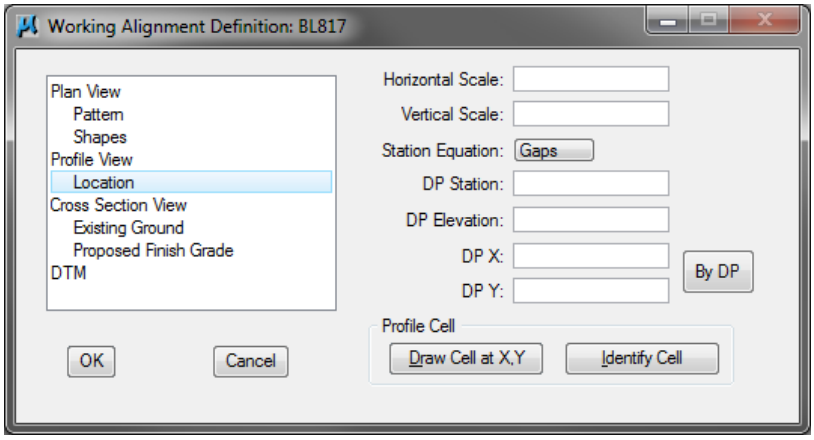
Design File Design file where the profile is drawn, keyed in or selected using the File icon.

Existing Profile Name of the Existing profile, keyed in or selected from the geometry database using the Select icon.

Proposed Profile Name of the Proposed profile name, keyed in or selected from the geometry database using the Select icon.

- **Profile View > Location Settings**

  This setting is the location of the profile within the design file, based on a reference station and elevation as well as a coordinate location.



Horizontal Scale — Enter horizontal scale of the profile.

Vertical Scale — Enter vertical scale of the profile.

Station Equation

Gaps — This option specifies that the profile make graphical allowances for gaps in the profile.

No Gaps — This option specifies that the profile does not make graphical allowances for gaps in the profile.

DP Station — Reference station of the profile, that occurs at the DP location.

DP Elevation — Reference elevation of the profile, that occurs at the DP location.

DP X — X Coordinate of the Reference **Data Point** of the profile.

DP Y — Y Coordinate of the Reference **Data Point** of the profile.

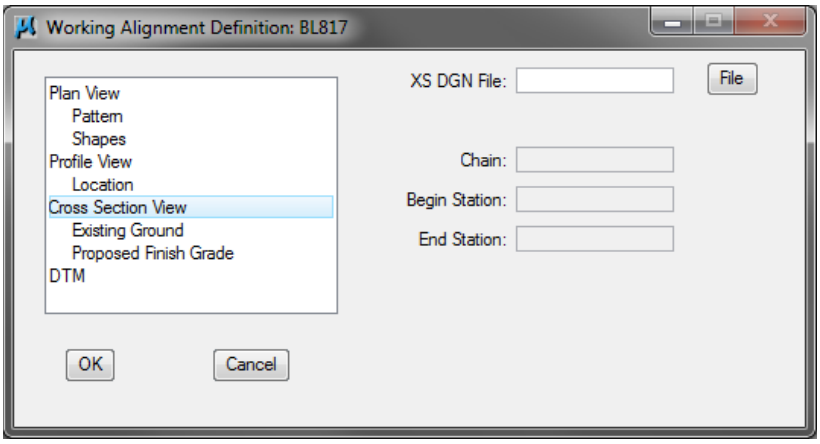
By DP — Clicking this icon and then selecting a location in the design file will automatically harvest the coordinates of the **Data Point** and fill in the DP X and DP Y fields.

Profile Cell

Draw Cell at X,Y — Clicking this icon and then identifying a location in the design file with a **Data Point** will draw a profile cell at that location using the information from the dialog.

Identify Cell — Clicking this icon and then identifying an existing profile cell in the design file will fill out the dialog using the information from the profile cell.

- **Cross Section View Settings**

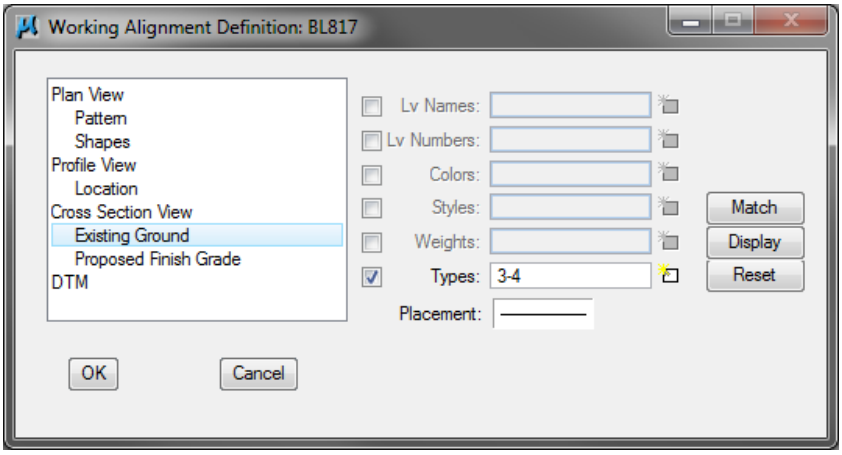


XS DGN File Design file where the cross sections are located, keyed in or selected using the File icon.

If GEOPAK cross section cells are present in the selected file, the Chain and Station ranges populate automatically. This is the only way to populate these fields.

- **Cross Section View > Existing Ground Settings**

  This setting allows the user to specify the search and placement symbologies of the existing ground lines. The ground lines can be defined using any combination of graphical symbologies (i.e. Level Names, colors, weights, etc.), keyed into the individual fields or selected from lists using the icons.



Match Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

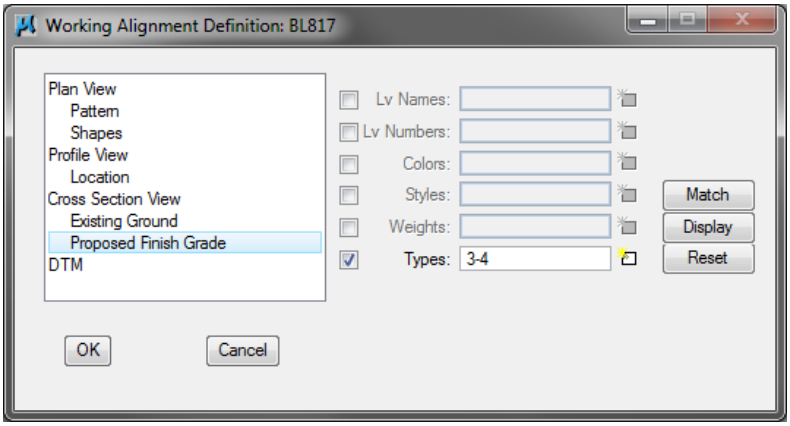
Display Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

Reset This icon will blank out or reset all of the symbology fields.

If no specifications for specific items (e.g. color), then ALL pertinent values for that particular item are taken into account. For example, if the color not enabled, then ALL colors (0-255) are used as part of the search symbology.

- **Cross Section View > Proposed Finish Grade Settings**

  This setting allows the user to specify the search symbology for the proposed finish grade elements. Define the proposed finish grade elements using any combination of graphical symbologies (i.e. Level Names, colors, weights, etc.), keyed into the individual fields or selected from lists using the icons.



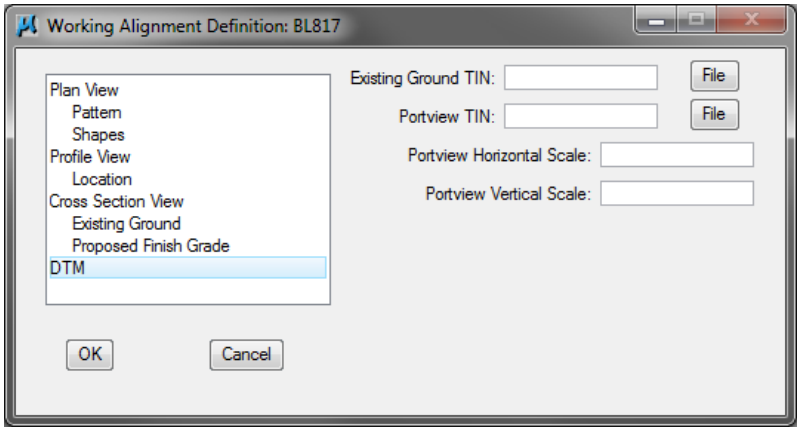
If a specific item (e.g. color) is not enabled and specified, then ALL pertinent values for that particular item will be taken into account. For example, if the color is not enabled, then ALL colors (0-255) will be used as part of the search symbology.

Match Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

Display Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

Reset This icon will blank out or reset all of the symbology fields.

- **DTM Settings**



Existing Ground TIN File name for Existing Ground DTM, keyed in or selected using the **File** icon.

Portview TIN Any other TIN files encompassing the same area as the Existing Ground TIN.

Portview Horizontal Scale	This is a required entry, if specifying a Portview TIN.
Portview Vertical Scale	See definition of Portview Horizontal Scale above.

Horizontal drawn at true coordinates, while the vertical scale drawn distorted; therefore, the ratio of the scales, rather than the actual value, that is important.

PORT VIEWER

The **Port Viewer** is a tool that enables the user to view and manipulate different aspects of a road design simultaneously, even though they are located in different design files. These different aspects include:

- Plan View
- Profile View
- Cross Section View

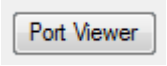
When invoking the **Port Viewer**, the following views open and the corresponding files activate:

- View 6 - Plan view
- View 7 – Profile
- View 8 - Cross Section or Digital Terrain Model

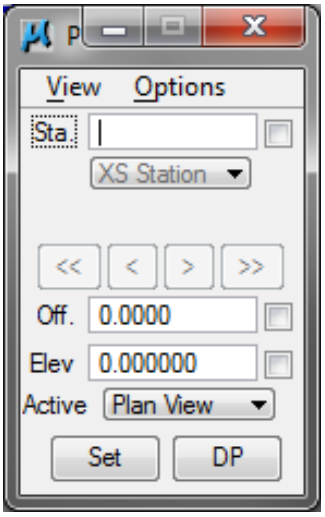
Only one view is your "active" view, meaning that the elements in this view are available for modification and deletion. The other views attach as references files, so the elements in those files can only be viewed, not manipulated. However, with the touch of a icon the Port Viewer can make any of the views active.

As a pre-requisite to invoking the Port Viewer, there must be a Working Alignment defined.

ACCESSING PORT VIEWER

- From the Road Project dialog, click the 

icon.



OVERVIEW OF PORT VIEWER

View Menu Allows the user to either fit the different views or make them active.

Fit Plan View (6) - Fit the Plan View (MicroStation View 6)

Profile View (7) - Fit the Profile View (MicroStation View 7)

XS View (8) - Fit the Cross Section View (MicroStation View 8)

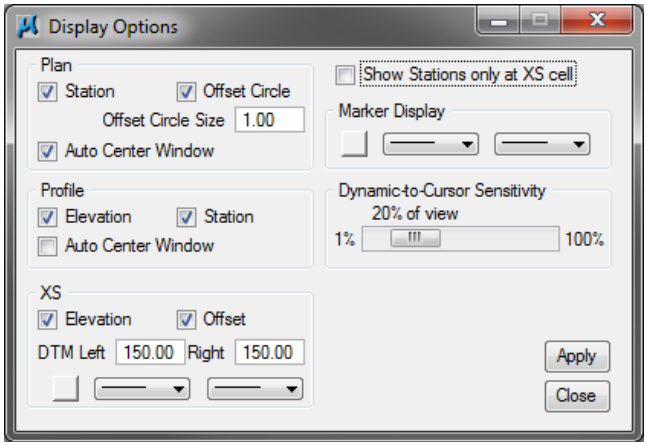
All - Fit all of the above views (6, 7 and 8)

Active *Plan View (6)* - Make the Plan View (6) the active view.

Profile View (7) - Make the Profile View (7) the active view.

XS View (8) - Make the Cross Section View (8) the active view.

Options Menu This menu allows users to access the Display Options dialog.



Plan Station - When enabled, the pattern line displays on the screen in the plan view.

Offset Circle – When enabled, a circle of the size designated in the Offset Circle Size displays at the station and offset location specified in the Port Viewer dialog.

Offset Circle Size – Setting that designates the size of the Offset Circle.

Auto Center Window - When activated, the Station and Offset specified in the Port viewer dialog centers in the Plan View window.

Profile *Elevation* – When enabled, a horizontal line (using the Marker Display element symbology) is displayed on the Profile View at the Elevation specified in the Port Viewer.

Station – When enabled, a vertical line (using the Marker Display element symbology) is displayed on the Profile view at the Station specified at the top of the Port Viewer dialog.

Auto Center Window - When enabled, the Station and Elevation specified in the Port viewer dialog centers in the Profile window.

XS *Elevation* – When enabled, a horizontal line (using the Marker Display element symbology) displays in the XS View at the Elevation displayed in the Port Viewer.

Offset – When enabled, a vertical line (using the Marker Display element symbology) displays in the XS view at the offset specified in the Port Viewer dialog

DTM Left – Setting that designates the horizontal distance from the specified alignment, defining the left limits of the cross section or DTM display line, similar to a cross section pattern line.

DTM Right - Setting that designates the horizontal distance from the specified alignment, defining the right limits of the cross section or DTM display line, similar to a cross section pattern line.

Show Stations Only at XS cell — This toggle affects the movement of the dynamics in the plan view. With the option toggled off, the cross hair display moves along with your mouse. However, When toggled on, the cross hair only stops at a cross section location.

Marker Display — The Marker Display allows the user to specify the color, style and weight of the horizontal and vertical display lines.

Dynamic to Cursor Sensitivity — Determines how close the MicroStation cursor must get to the **Data Point** cross hairs (dynamic cursor) before they begin to follow the MicroStation cursor dynamically in the Set mode. This is to prevent the cross hairs from jumping over to the MicroStation cursor until it is within a certain distance from them. This distance is set as a percentage of the diagonal size of a given view.

Apply — This saves the changes.

Station — This setting reflects the current station of the dynamic cursor in each view. This station can be “locked” using the toggle.

XS DTM / XS Station — When utilizing the XS Station option, the XS View displays the actual cross sections from the specified cross section file. When the XS DTM option is selected, a cross section generated "on the fly" from the specified DTM is displayed.

<< < > >> — These icons allow the user to scroll forward and backward through the cross sections. Upon selection of each icon, all views are dynamically changed to reflect the displayed cross section. In addition, the display lines in the plan view and profile view also dynamically move.

Off. — The field reflects the current offset of the dynamic cursor in each view. This offset can be “locked” using the toggle.

Elev. — The field reflects the current elevation of the dynamic cursor in each view. This elevation can be “locked” using the toggle.

Active

Plan View — Option makes the plan view the active view.

Profile View — Option makes the profile view the active view.

XS View — Option makes the XS view the active view.

Set — When clicked, Set commences dynamic movement of the cursor. The designer can move to any unlocked station, elevation, or offset and watch all display lines move simultaneously. Pressing reset discontinues the dynamics, while a **Data Point** on the screen suspends the dynamics.

DP — When selected, any generic MicroStation command utilizes the current station/offset/ elevation position as a **Data Point**. The user utilizes the DP icon any time during the viewing.

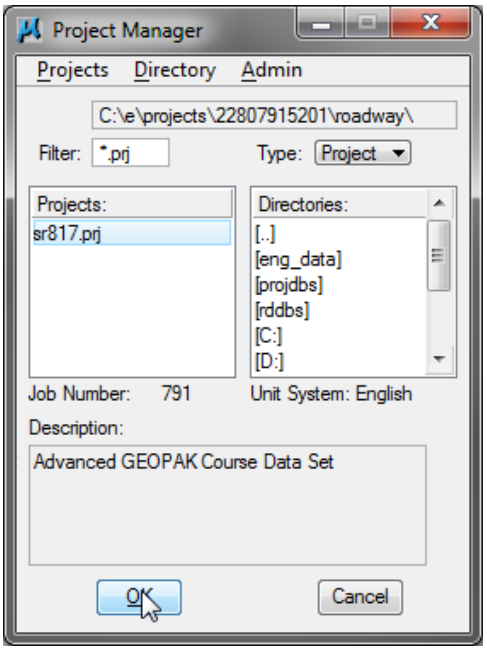
Exercise 1.1 Accessing Project Manager

In this exercise, the user will access Project Manager. For this class, there is an assumption made, that the user has the basic knowledge of how to set up Project Manager. The initial project setup has already been prepared using the following parameters:

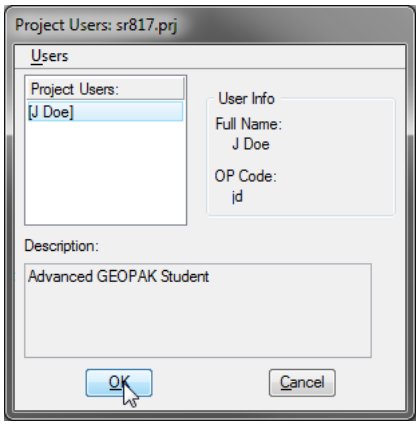
- *Project Name:* **sr817.prj**.
- *Project User:* **J Doe**
- *Operator Code:* **JD**
- *GPK Name:* **job791.gpk**

Double-click on the self-extracting zip file C:\Chapter1_Exercises.exe and click the Unzip icon at the prompt. This will extract and setup the files needed for this exercise.

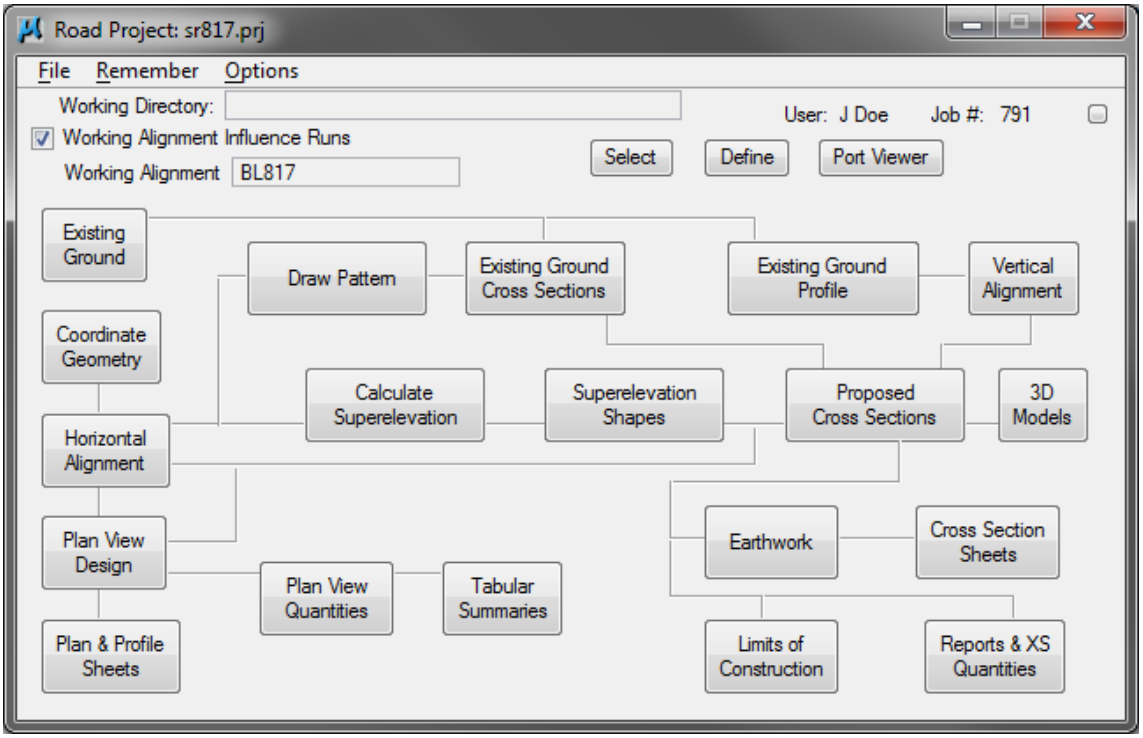
1. Open the design file C:/e/Projects/22807915201/roadway/*GDTMRD01.dgn*.
2. Select **Applications** > **Road** > **Project Manager**.



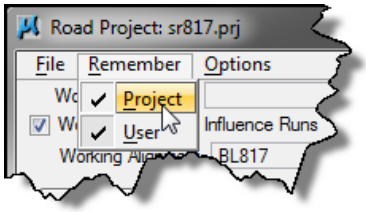
3. Select the *Project* **sr817.prj** and click **OK**.



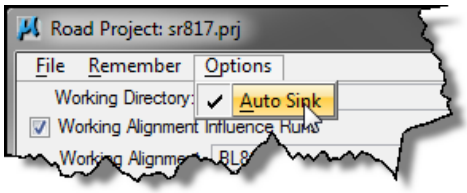
4. Select the *User*: **J Doe** and click **OK**.



5. Enable the **Remember** options for both **Project** and **User**.



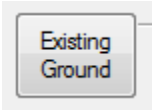
6. Enable the **Auto Sink** option.

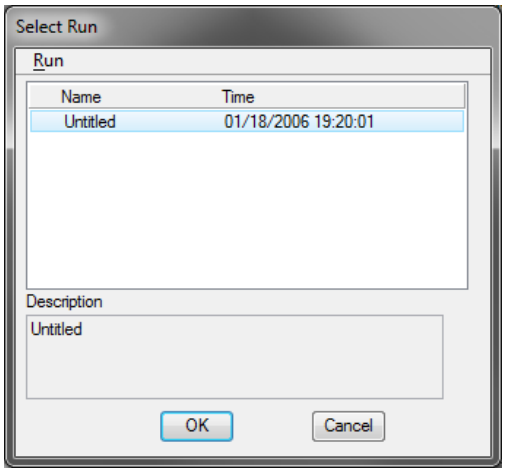


Exercise 1.2 Extracting Graphics

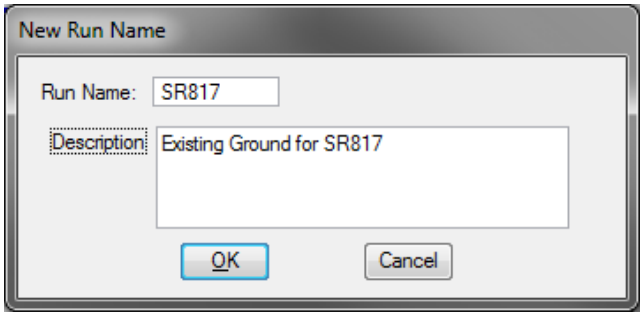
In this exercise, the user will extract graphical triangles as a prelude to creating our DTM.

1. From the Road Project dialog, click **Existing Ground**. Select Run dialog opens to create a new run.

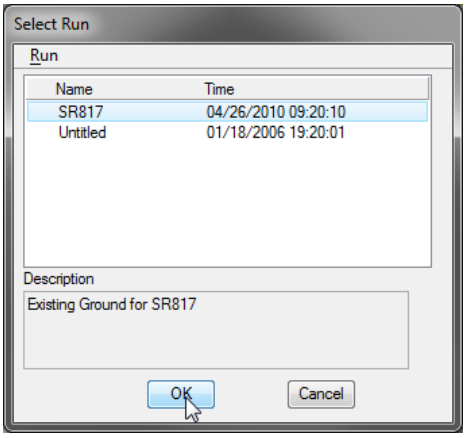




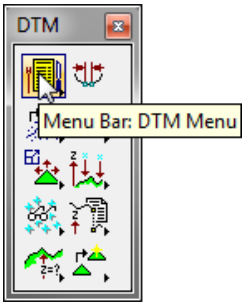
2. Select the menu option **Run** > **New**. New Run Name dialog opens.
3. Create a new *Run Name:* **SR817** with the *Description* shown below and click **OK**.

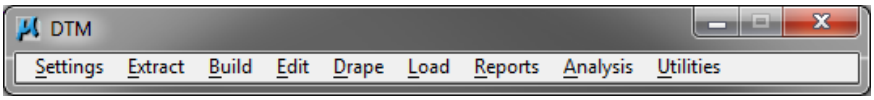


4. In the Select Run dialog, highlight **SR817** run and click **OK**.

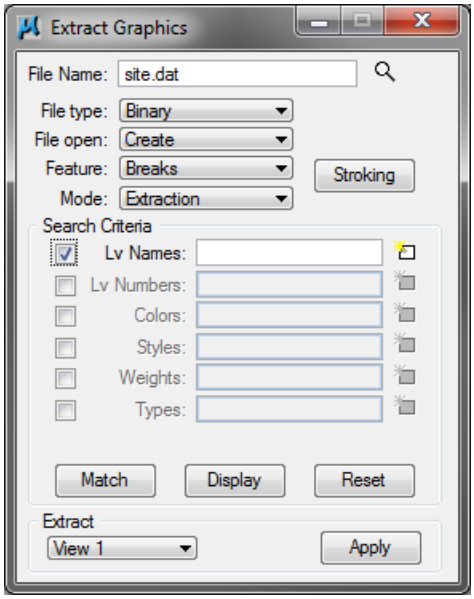


5. On the *DTM* toolbox, click the **DTM Menu** icon.





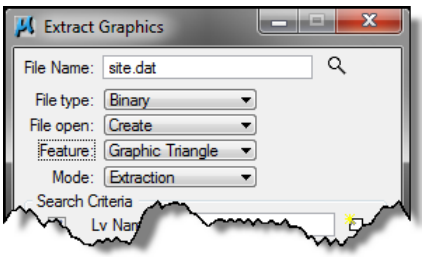
6. On the DTM menu bar, select **Extract > Graphics.**



7. Key-in the *File Name:* **site.dat**.

   This will already be in the **File Name** field if this is the first time this dialog has been accessed.

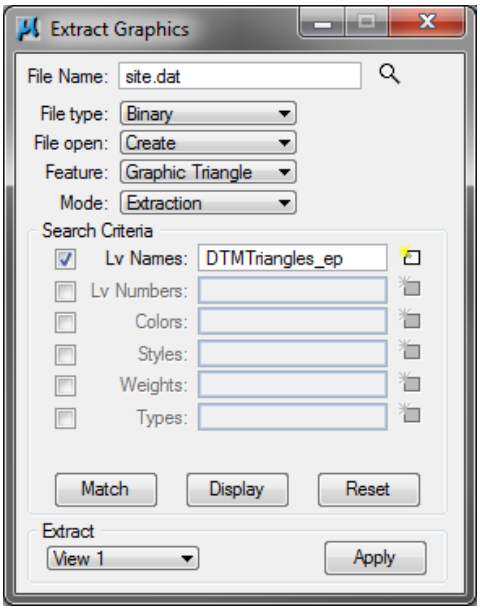
8. Set the *File Type* to **Binary**.
9. Set the *File Open* to **Create**.
10. Set the *Feature* to **Graphic Triangle**.
11. Set the *Mode* to **Extraction**.



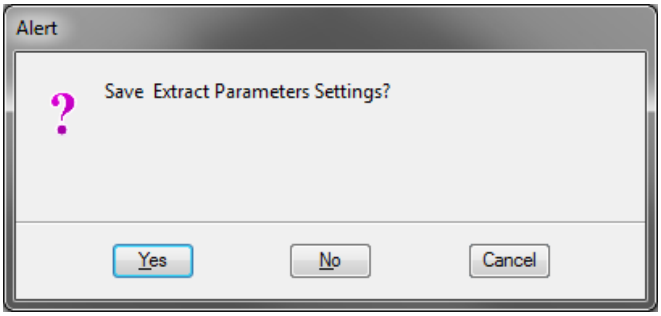
12. Under *Search Criteria*, enable the **Lv Name** check box.
13. Click **Match**.
14. In the design file, select one of the triangles.

Note All of the triangles will highlight and remain highlighted until an update view or other view control command is issued.

15. **Data Point** again in the design file to accept the selected triangle. **DTMTriangles_ep** appears in the *Lv Names* box under *Search Criteria*.



16. Set the *Extract* mode to **View 1**.
17. In MicroStation, **fit the view** to make sure the entire contents of the file display in **View 1**.
18. Click **Apply**. When processing completes, *Extract view 1 complete* displays in the MicroStation status bar.
19. Close the dialog box. An Alert displays, prompting to **Save Extract Parameteres Settings?**

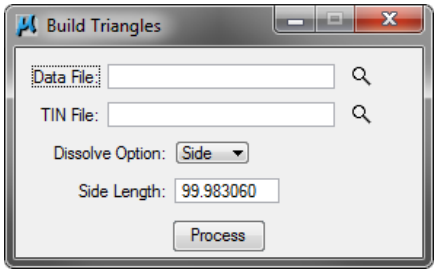


20. Click **Yes** and the dialog closes.

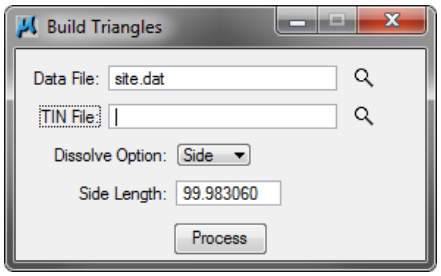
Exercise 1.3 Building Triangles

In this exercise, the user will build the DTM from the previously created DAT file.

1. From the FDOT Menu select **Actions** > **Miscellaneous** > **Calculate Longest Triangle**. This VBA automatically calculates the longest triangle side in the design file and launches GEOPAK's Build Trianges tool. The Build Triangles tool's *Dissolve Option* automatically sets to "**side**" and the *longest triangle side length* is automatically input into the *Side Length* field.

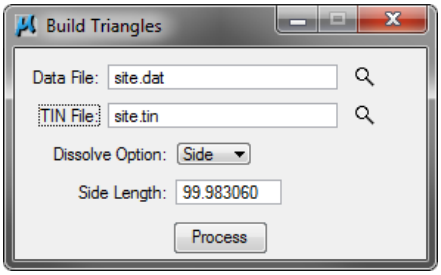


2. In the *Data File* field, key-in **site.dat**.



Note If unsure of the Data File name, click on the magnifying glass icon and browse to the file. Generally, anywhere magnifying glass icon displays, it will open a file browser.

3. In the *TIN File* field, key-in **site.tin**.

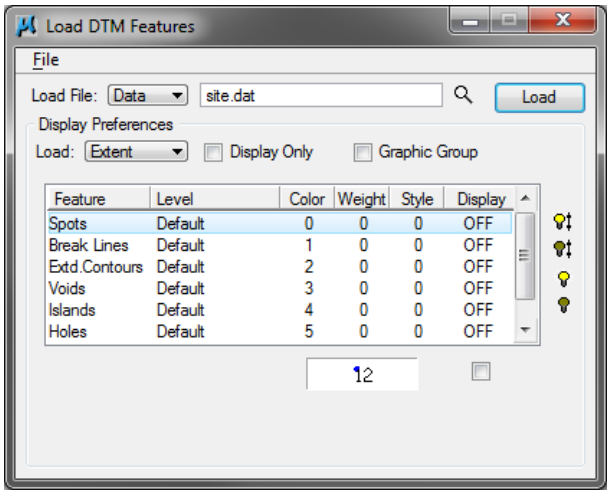


4. In Build Triangles, click **Process**. The *TIN file* creates and '*Build Triangles Completed'* appears in the MicroStation message center.
5. Close Build Triangles dialog. Click **Yes** when prompted to **Save Settings**.

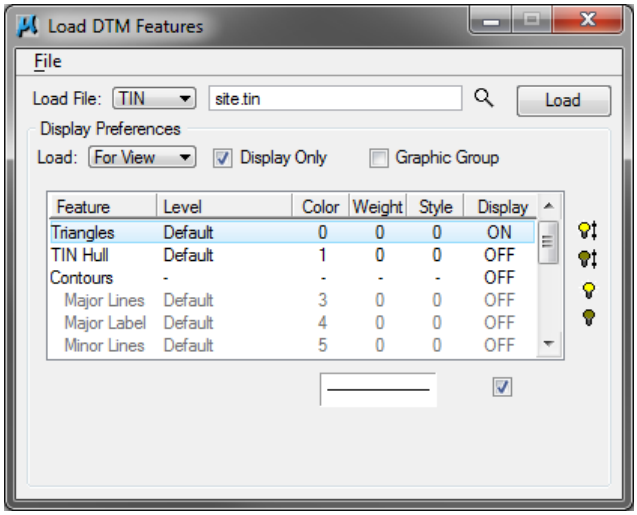
Exercise 1.4 Loading DTM Features

In this exercise, the user will display the DTM graphically.

1. On the *DTM* menu bar, select **Load** > **DTM Features**. Load DTM Features dialog opens.



2. Set the *Load File* type to **TIN**, then key-in **site.tin**.
3. In the *Display Preferences* area, set the *Load* option to **For View**.
4. Enable the **Display Only** check box.
5. Double-click the **Display** column on the Triangles row. The display of the triangles changes to **ON**.



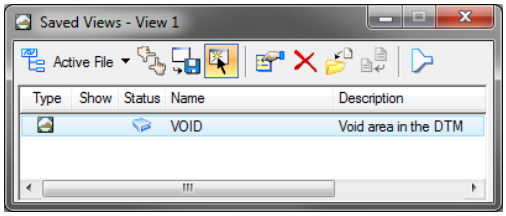
Note Since the triangles are going to be plotted Display Only, the level or symbology is not important at this time. Setting a color that contrasts with the original triangles will be beneficial in identifying the new triangles and checking for accuracy by seeing all the existing triangles overlain by the new triangles.

6. Click **Load**.
7. **Zoom In** to the MicroStation view to have the individual triangles clearly displayed. The loaded DTM features disappear, because **Display Only** was selected.
8. Click **Load**. The contents of the DTM display. Visually confirm that the DTM triangles exactly overlay the MicroStation elements.
9. Close Load DTM Features dialog. Click **Yes** when prompted to **Save Settings**.

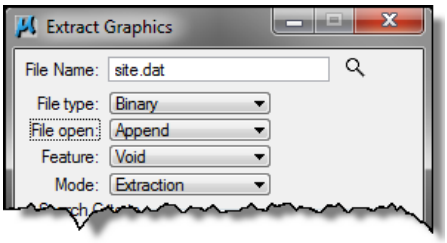
Exercise 1.5 Delineating and Processing a Void

After viewing the DTM created in the previous exercise, note that there are additional triangles plotted in the DTM. An area that once had no triangles, called **Void**, now has triangles. The triangles placed in the **Void** are interpolated and do not present an accurate representation of the **Void** area. In this exercise, the user will modify the DTM to rectify this situation.

1. In MicroStation, select **Utilities** > **Saved Views**. Saved Views dialog opens.



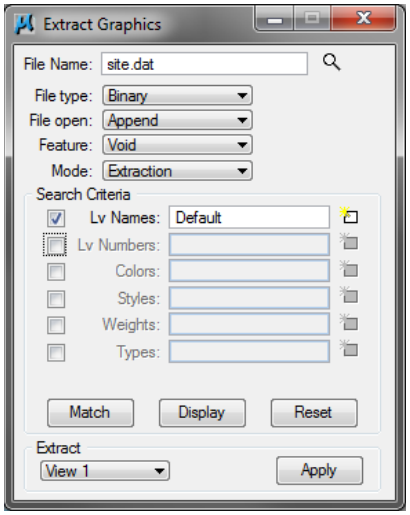
2. Double-click on the saved view **VOID** and enter a **Data Point.** This will zoom to the **Void** area in the design file.
3. Dismiss the Saved Views dialog.
4. From the **DTM** menu bar, select **Extract** > **Graphics**. Extract Graphics dialog opens.



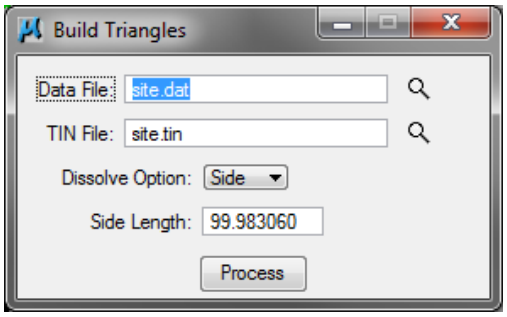
5. From the Extract Graphics dialog, set *File Open* to **Append**.
6. Set the *Feature* to **Void**.
7. Click **Reset** to clear all previously defined search criteria.

Note If the Extract Graphics dialog displays previous Search Criteria, clicking the Reset icon will clear this information. If not done, then new Search Criteria appends to the previous search symbology.

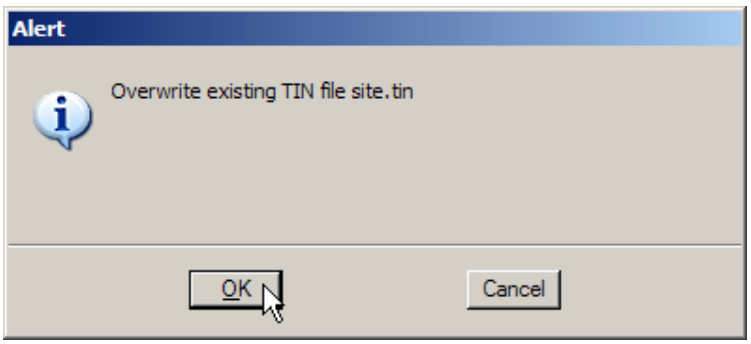
8. Turn off the level **DTMTriangles_ep,** so only the **Void** shape displays.
9. Click **Match**.
10. In the design file, select the *shape* that defines the **Void** area.
11. **Data Point** again in the design file to accept the shape. **Default** appears in the *Lv Name* box under *Search Criteria*.
12. Set the *Extract* mode to **View 1**.
13. Click **Apply**. When processing is complete, **Extract view 1 complete** displays in the MicroStation status bar.
14. Close the Extract Graphics dialog. Click **Yes,** when prompted to **Save Settings**.



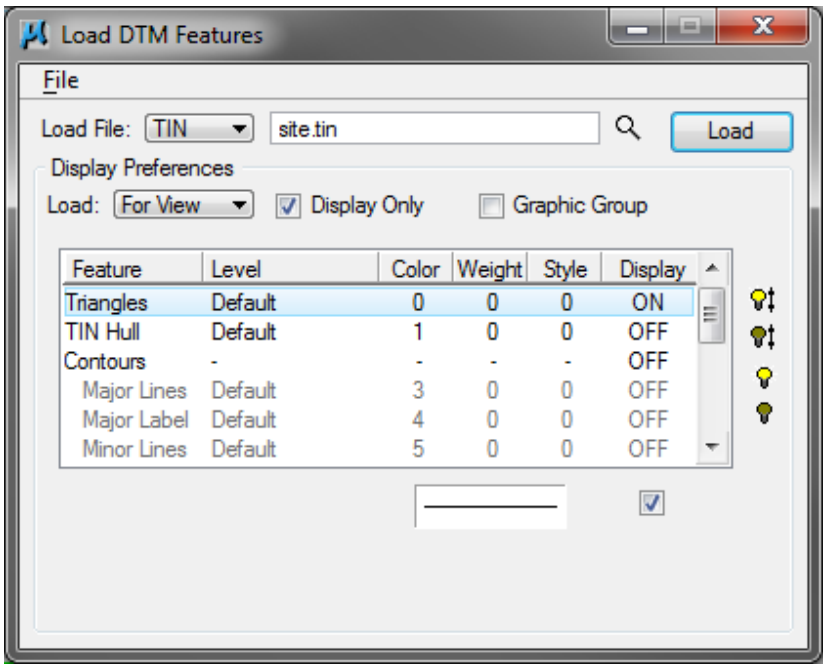
15. On the DTM menu bar, select **Build** > **Triangles**. Build Triangles dialog opens and should already be filled out correctly from a previous exercise.



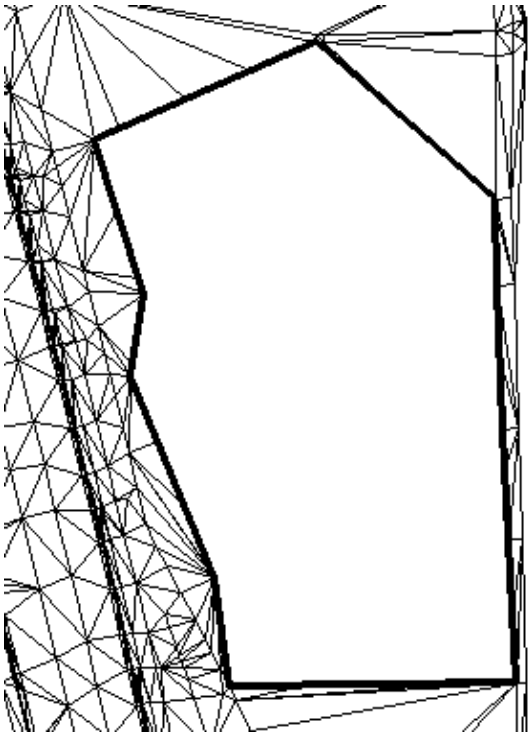
16. Click **Process**. Since the user previously used TIN File name, an alert prompts to overwrite the existing TIN file



17. Click **OK**. The *tin file* creates and '*Build Triangles Completed*' appears in the MicroStation message center.
18. Close Build Triangles dialog. Click **Yes** when prompted to **Save Settings**.
19. On the DTM menu bar, select **Load** > **DTM Feature**. The Load DTM Features dialog loads and should be filled out correctly from the previous exercise.



20. With the view still set around the shape, click **Load**. The contents of the DTM display. Note that the triangles no longer cross through the **Void**.



21. Close the Load DTM Features dialog. Click **Yes** when prompted to **Save Settings**.
22. Close the DTM menu bar.
23. Close the *DTM* toolbox.

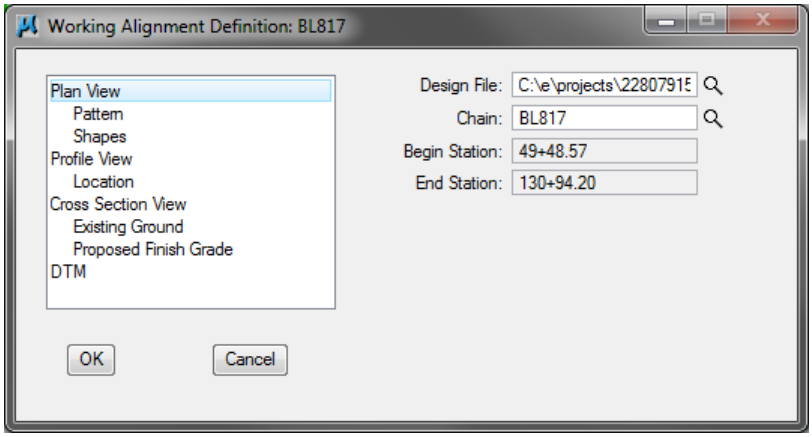
Exercise 1.6 Updating the Working Alignment

In this exercise, the user will update the **Working Alignment** with the appropriate DTM information.

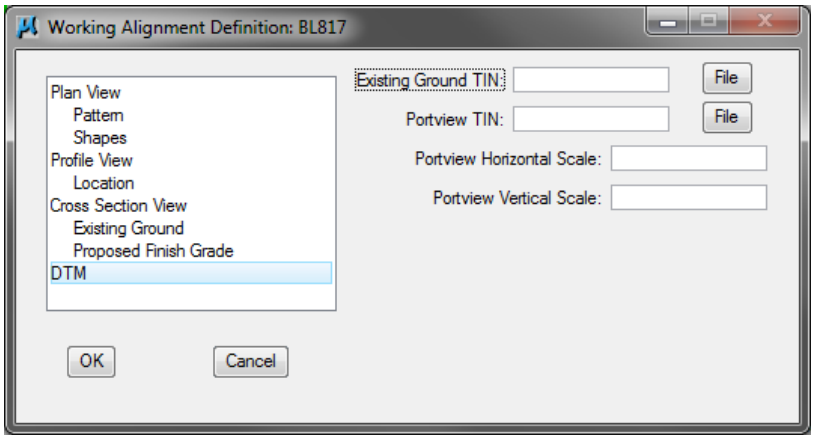
1. Access Project Manager.

Note Since you "remembered" the Project and User in a previous exercise, the Road Project dialog should appear.

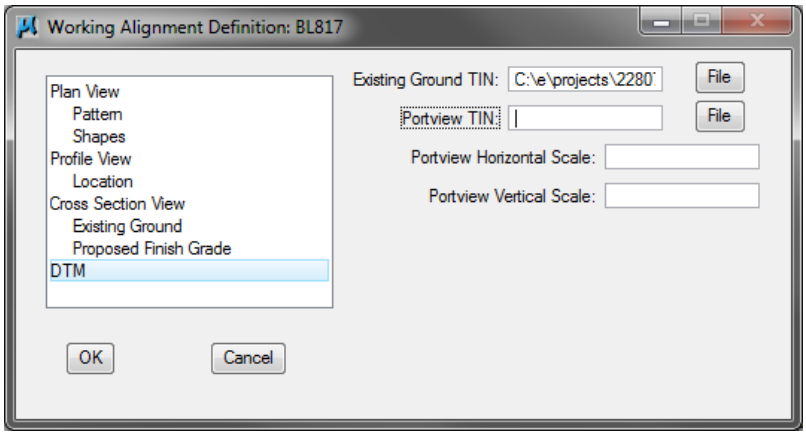
2. Click **Define**. Working Alignment Definitions opens.



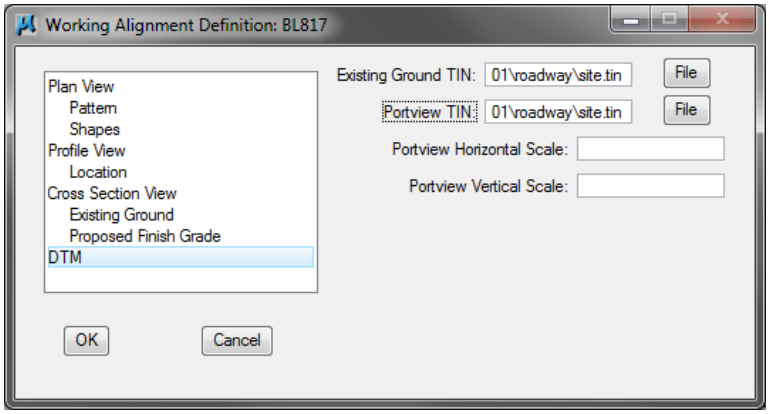
3. In the list box, click **DTM**, which shows the DTM options.



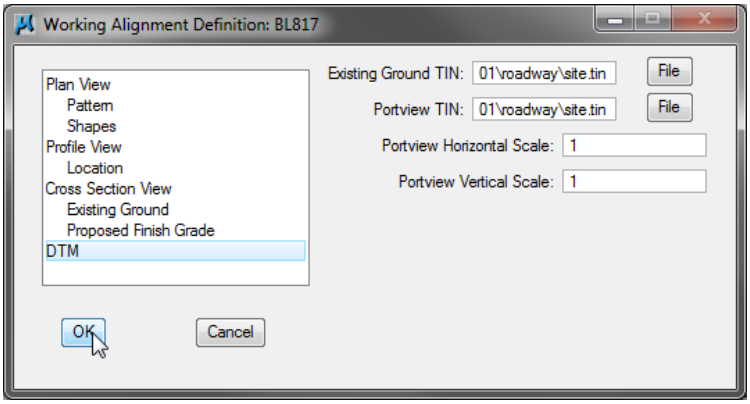
4. For the *Existing Ground TIN* field, click **File** and select C:\e\Projects\22807915201\roadway*site.tin***.**



5. Do the same for the *Portview TIN* field.



6. Key-in **1** for both the *Portview Horizontal Scale* and *the Portview Vertical Scale*.



7. Click **OK** to save and update the Working Alignment.
8. Exit MicroStation.

2 EXISTING GROUND PROFILES

OBJECTIVES

- Cutting an Existing Ground Profile
- Plotting Profiles
- Updating Working Alignment

DRAW PROFILE TOOL

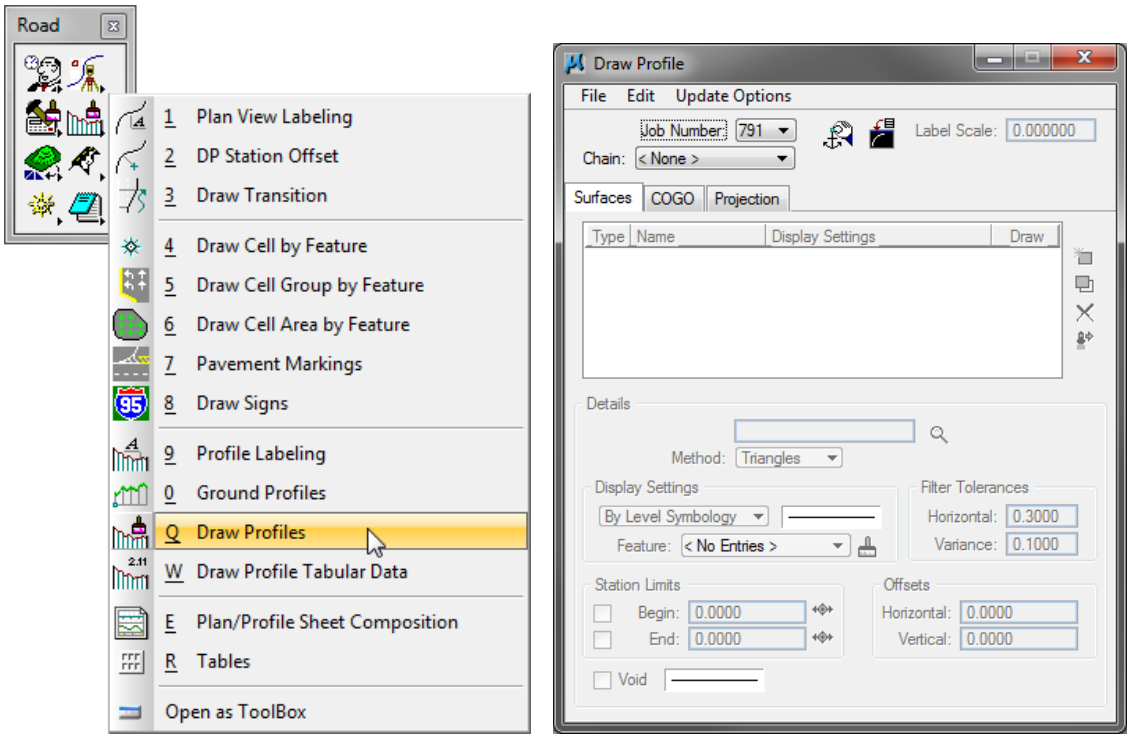
The Draw Profile tool enables the user to draw several profiles simultaneously from a variety of data sources. If the data source is a TIN file, Draw Profile facilitates storing the resultant profile within the coordinate geometry database.

ACCESSING THE DRAW PROFILE TOOL

- From MicroStation menu, select **Applications** > **ROAD** >**Plans Preparation** > **Draw Profiles**

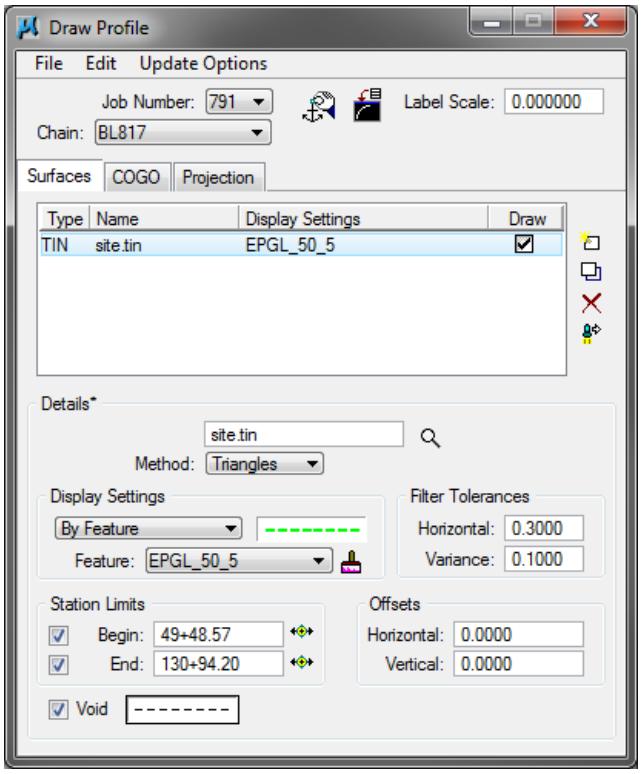
<OR>

- From the *Road* toolbox, click the **Draw Profiles** icon.



ACTIVATING THE DRAW PROFILE TOOL

As can be seen above, the majority of the dialog options are inactive. To activate these options, the user must place a *GEOPAK Profile* cell in the design file. If a profile cell already exists in the design file, GEOPAK will recognize it. GEOPAK offers several options to place a profile cell, but for this class we will use the method provided by the Draw Profile dialog.



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

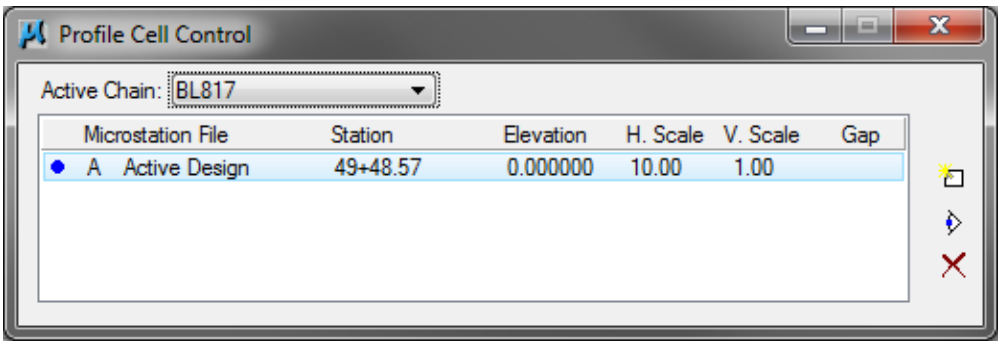
Chain This is required to reference a horizontal alignment to the profile. Compute any subsequent settings of station ranges and left/right offsets relative to this alignment. The **Chain** may be entered here or entered as the **Active Chain** as shown in Figure 2-5 in the Profile Cell Control. It will then display here.

Profile Cell Control The current profile cells lists along with associated station, elevation, etc.

Update Profile Option updates any previously drawn Profile.

Label Scale Option utilized when using the By Feature **Display Settings** option. The specified Label Scale compares to the scale within the Design and Computation Manager Item and proportioned. This option is only utilized if the text setting within the D&C Feature is set to scale, not fixed.

PROFILE CELL CONTROL DIALOG

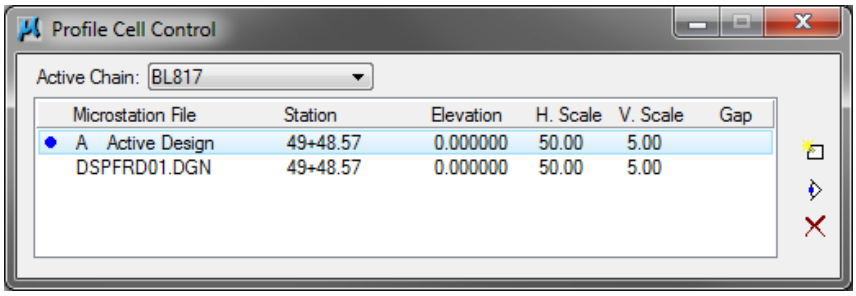


Profile Cell Control is comprised of two main parts:

Active Chain Chain used when generating the selected profile cell. The example in the preceding figure shows one profile cell in the current design file that is associated to Chain BL817. The user may enter the Active Chain here, or if entered as Chain in the Draw Profile options shown in Figure 2-3, that entry automatically displays here.

MicroStation File, Station, etc. This list box gives information about all the Profile Cells that are relative to the Active Chain. Three action icons are located on the right side of the dialog box. Notice in the preceding figure that one profile cell is in the Active Design file. The A indicates active file. The Solid circle next to the A indicates which profile cell is selected.

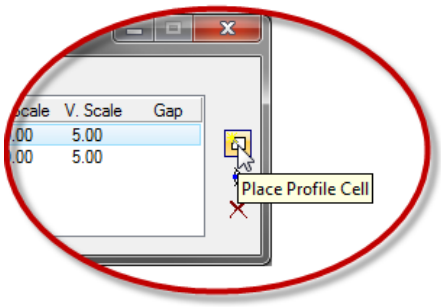
The following figure shows an additional profile cell drawn in a reference file, referenced to the active file.

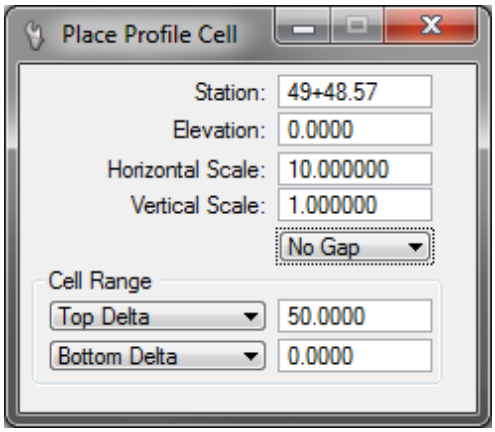


PLACING A PROFILE CELL

The *Place Profile Cell* tool enables the user to place the profile required as a prerequisite to any profile creation. Note the profile cell may be placed by many other applications in GEOPAK as well (e.g. D&C Manager, Vertical Alignment Generator, Active Chain Control, Project Manager Working Alignment, Plan / Profile Sheets, etc.)

- On the right side of the Profile Cell Control dialog box, Click the **Place Profile Cell** icon. Place Profile Cell opens.





Station — Defines the corresponding station of the reference Data Point and will be the origin of the profile cell. The beginning station of the specified chain is the default.

Elevation — This defines the corresponding elevation of the reference Data Point. It should be an even value to correspond to a major profile grid and should be lower in elevation than the lowest elevation of the profile.

Horizontal/Vertical Scales — This sets the scale, establishing a vertical exaggeration of the profile.

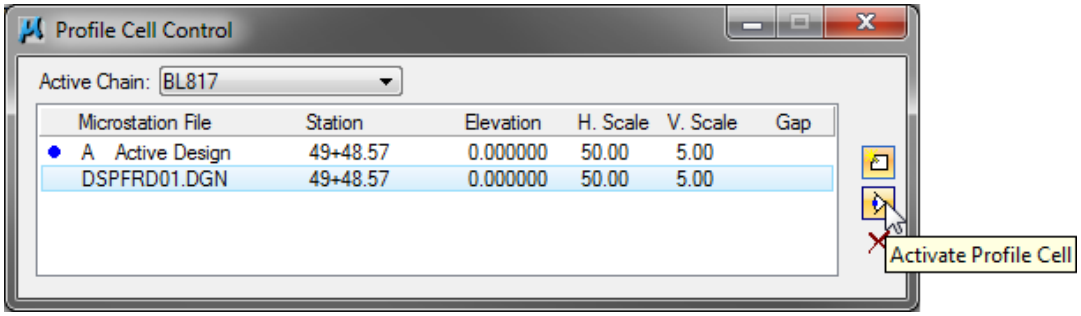
Gaps/No Gaps — This specifies whether the Profile Cell contains a gap. Setting this option to Gap will allow a profile that has a "gapped" station equation to draw the profile with the corresponding gap shown.

Cell Range — This defines the height of the Profile Cell above and below the reference Data Point. These values are in true length (without taking into account horizontal and vertical scales). The Top and Bottom Delta values of the profile cell must be set large enough such that all elements of the profile fall completely within the cell limits. For example, all profile elements must be between a horizontal line drawn at the top of the cell and one drawn at the bottom of the cell.

The profile cell itself will be reviewed in one of the exercises.

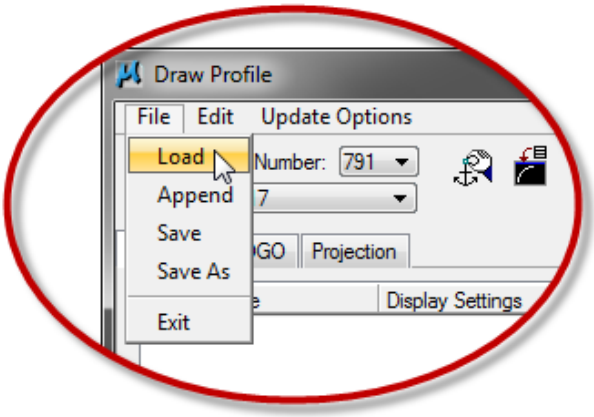
ACTIVATING A PROFILE CELL

If you have multiple profile cells in a design file, you can only have one "Active" at a time. Any operations that are applied use this active profile cell. To activate a profile cell, you can double-click on the desired profile cell in the Profile Cell Control dialog or highlight the desired cell and use the icon as shown.



The dialog delineates the active profile cell by the filled circle as shown in Figure 2-9 above.

DRAW PROFILE MENU COMMANDS



File Allow the user to save the dialog settings to a resource file. This file can then be loaded later to populate the settings of the dialog. The default file extension is .prd. This file can remember more dialog settings than the standard resource files. If the .rsc files are deleted from the GEOPAK \bin folder, all of the information in Draw Profile is lost. However if a file with all of the settings is saved in another location, then that file can be loaded and the information is restored.

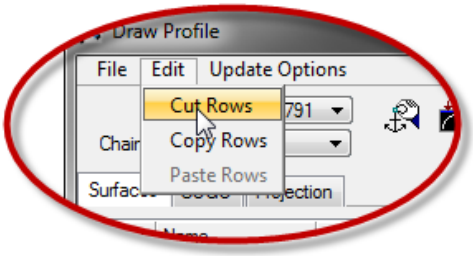
Load Load a previously saved .prd file.

Append Append to the .prd file that is currently opened by the dialog.

Save Save the contents of the dialog into a .prd file. If a .prd file is currently loaded, it will be re-saved.

Save As Allows the selection and saving of a new .prd file.

Exit Exit the dialog.

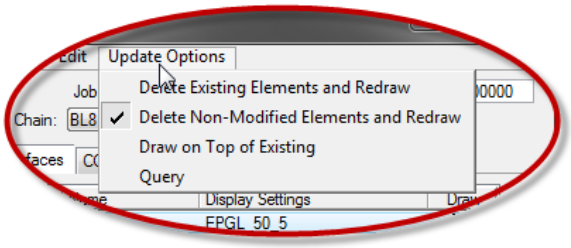


Edit These commands operate on the rows in the list box. The list box is the area in the middle of Draw Profile dialog in either the *Surfaces* tab or *COGO* tab.

Cut Rows This removes a row from the list box into the buffer. If this row does not pass back into the list box, the information deletes from the list box and no longer displays.

Copy Rows This copies a row from the list box into the buffer. Use this command if several rows have similar information. Rather than manually entering every line into the list box, copy and paste a line, and then modify.

Paste Rows This pastes a row from the buffer into the list box for subsequent editing.



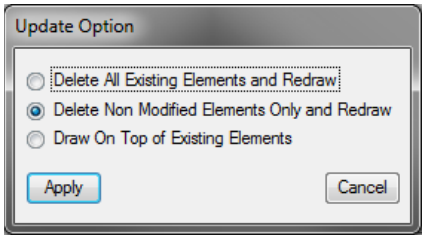
Update Options The check to the left of the options indicates the active options. Only one option activates at any given time. Therefore, if an option is selected the previous active option is deactivated.

Delete Existing Elements and Redraw When this option is active, it deletes any profiles previously drawn with this and new ground lines are drawn.

Delete Non-Modified Elements and Redraw When this option is active, it deletes any profiles previously drawn and manually modified and new ground lines drawn.

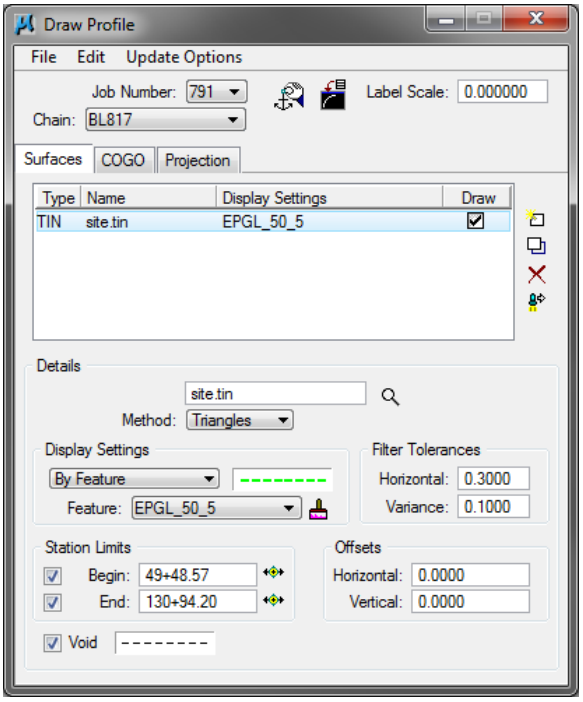
Draw on Top of Existing When this option is active, any previously drawn profiles are ignored and a new set is drawn, resulting in two profiles.

Query When active, it prompts the user each selection of the *Modify Line* or the *Remove Surface* icons. Update Option opens, as shown in the following figure. This allows the user to specify the application of changes.



SURFACES TAB

Defines the surface utilized for drawing profiles. A single processing supports multiple surfaces drawn from a variety of sources. Source data includes GEOPAK **.tin** files, Site Models, or Site Objects. The list box using the action / edit icons on the right side of the list box must include each surface to be drawn. Each surface draws a cross section line string or lines. When adding a line to the list box, the profile is drawn. Below describes the icons along the right side of the **Surfaces** list box.



Add Surface Settings

Adds to the list box the profile information based on the Details, Display Settings, Station Limits, Filter Tolerances and Offsets settings.

Modify Line

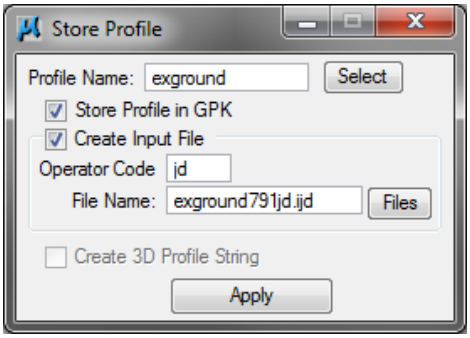
Modifies selected Profile

Remove Surface

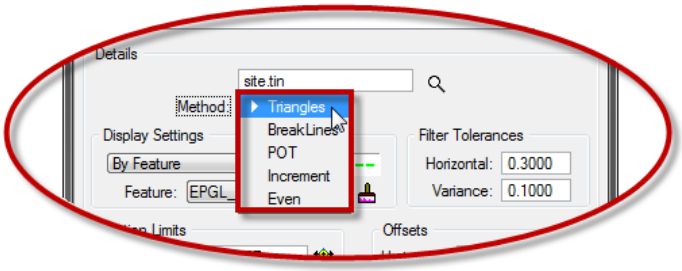
Deletes selected Profile

Store Surface in COGO

Opens Store Profile dialog to store the selected Profile into COGO



Details



Tin File Allows you to browse and select a.tin file.

Method As shown in the following figure, there are five methods.

Triangles - Use this method if a **.tin** file is selected.

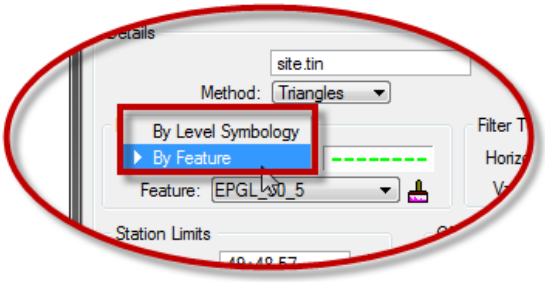
Break Lines - Use this method if utilizing a GEOPAK Site component.

POT - Creates a profile with VPIs at every location where a POT occurs in the referenced chain.

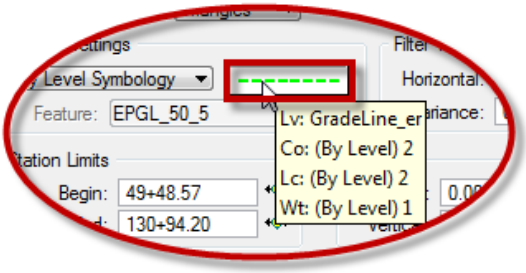
Increment - Creates a profile where the user specifies the incremental distance between successive VPI points on the existing ground profile where the first VPI point is coincident with the Beginning Station.

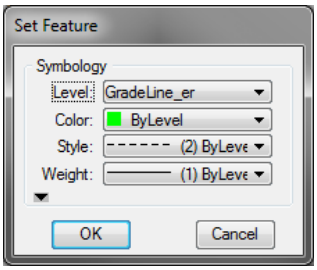
Even - Specifies the incremental distance between successive VPI points on the existing ground profile where the user rounds to the next highest even station from the Beginning Station of the first VPI point. For example, if the Beginning Station is 10+15 and the **Even** value is 25, the VPIs would be generated at 10+25, 10+50, etc.

Display Settings Specifies the element symbology of the profile elements generated, using *By Level Symbology* or *By Feature*. The figure below illustrates how the symbology displays and what the symbology settings are.

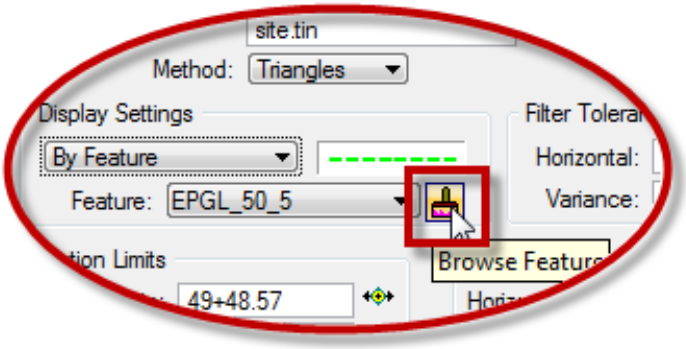


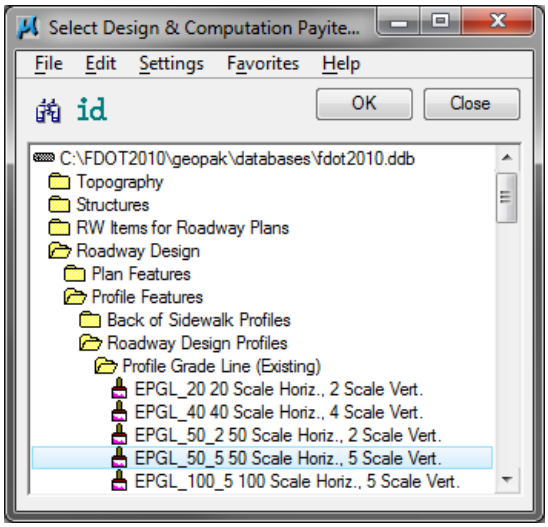
By Level Symbology - Double-clicking the black box to the right of the setting opens GEOPAK Set Feature dialog, specifying the symbology.





By Feature **-** With this setting, the user selects an item from the current Design and Computation Manager. Click the *Paintbrush* icon to open the Select Design & Computation Payitem, and then select the appropriate P*ayitem*. This method is preferred because it assures compliancy to CADD standards. This method also attaches the GEOPAK *Feature Code* defined in the Design & Computation Manager**.**

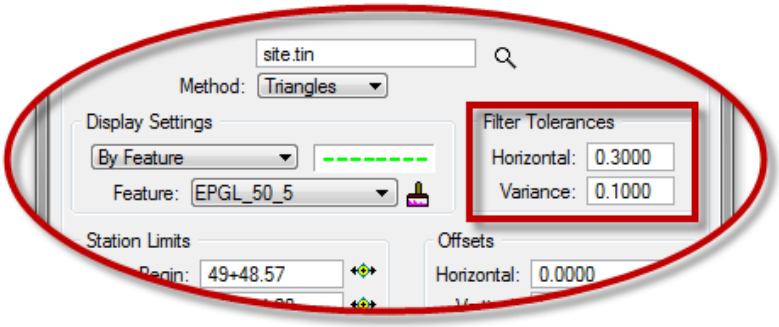




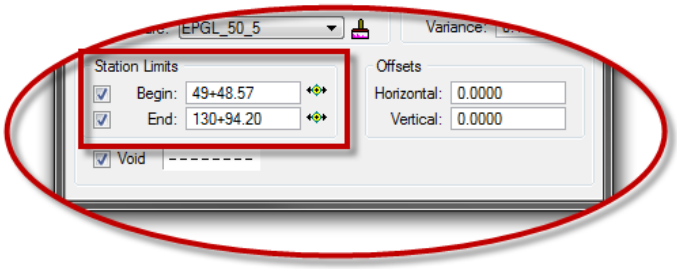
Filter Tolerances

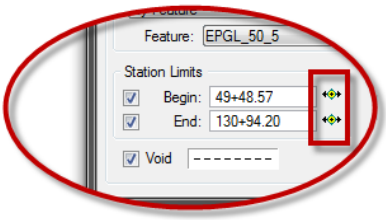
Each pair of profile segments considers both *Horizontal* and *Variance* filter tolerances together. If both segment lengths are less than the *Horizontal* filter tolerance while the projected distance between the mid-point and the chord between the two end points is less than the

Variance tolerance, deletes the middle point.

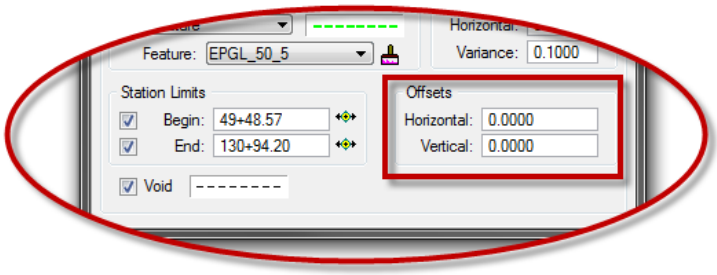


Station Limits When selecting the chain at the top of Draw Profile dialog, the Begin and End stations fill in automatically. The user may use these limits --or-- type the station limits in the Begin and/or End boxes <OR> click the Begin or End Set Station icon and graphically ID the station range. To use anything other than the default station, the user must enable the Begin and/or the End Station Limits toggles, based on the situation.

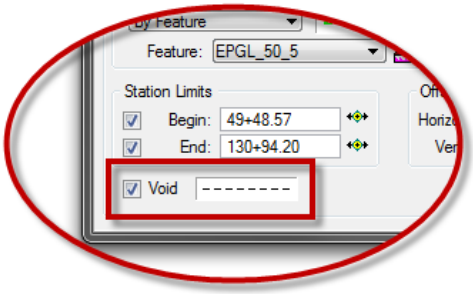




Offsets *Vertical* or *Horizontal Offsets* may be specified in terms of master units (i.e., feet). The *Horizontal Offset* is the distance offset from the chain. Once the horizontal location for the profile is determined, the data source, or in the case of this course, the TIN file is utilized to determine the profile along the horizontal offset. Any *Vertical Offset* applies after the profile is generated from the source data.

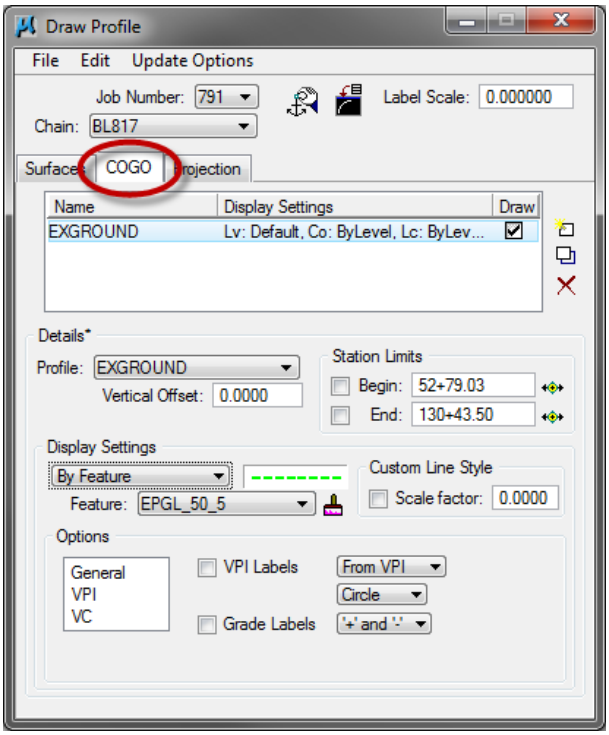


Void The Void Plot Parameters specify the element symbology of the existing ground lines generated, which are located within a void in the model. Double-click the symbology box and Set Feature opens.



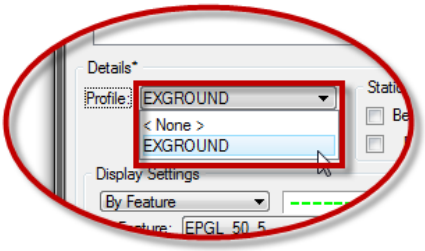
COGO TAB

The *COGO* tab displays profiles that are stored in the *.gpk*, such as a profile that was stored with other tools or via an input file. As long as the profile is in COGO, it displays with this tool. This tool works very much like the Draw Plan & Profile tool in Design and Computation Manager. In the future, this will be the only method to display profiles.



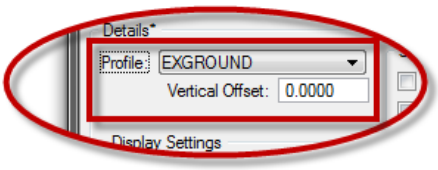
Details

Profile This is a list of the profiles currently stored in the **.gpk**.



t

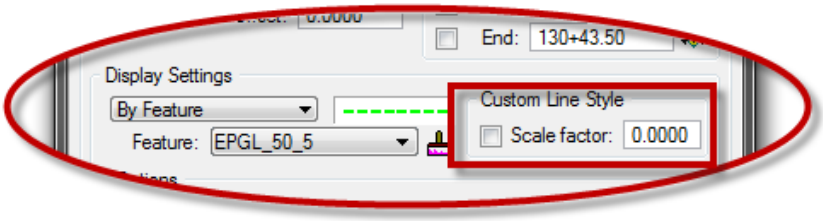
Vertical Offset Option allows the user to display the profile at a defined offset left or right of the horizontal chain assigned to the profile.



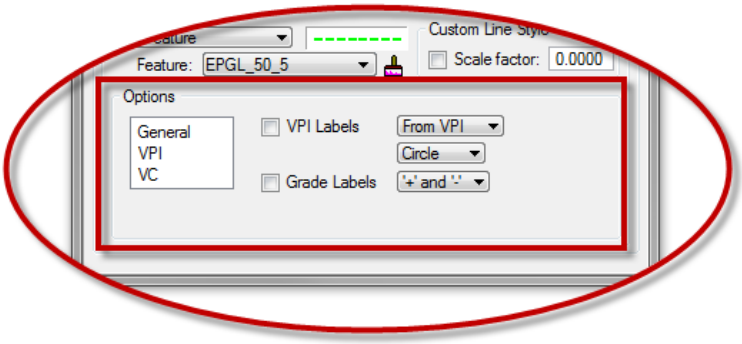
Station Limits Same as those described for the *Surfaces* tab.

Display Settings Same as those described for the ***Surfaces*** tab.

Custom Line Style – If setting the *Display Settings* to **By Feature**, the **Custom Line Style** is available, because some items in Design and Computation Manager use custom line styles. This check box applies the correct scale factor as they are drawn.



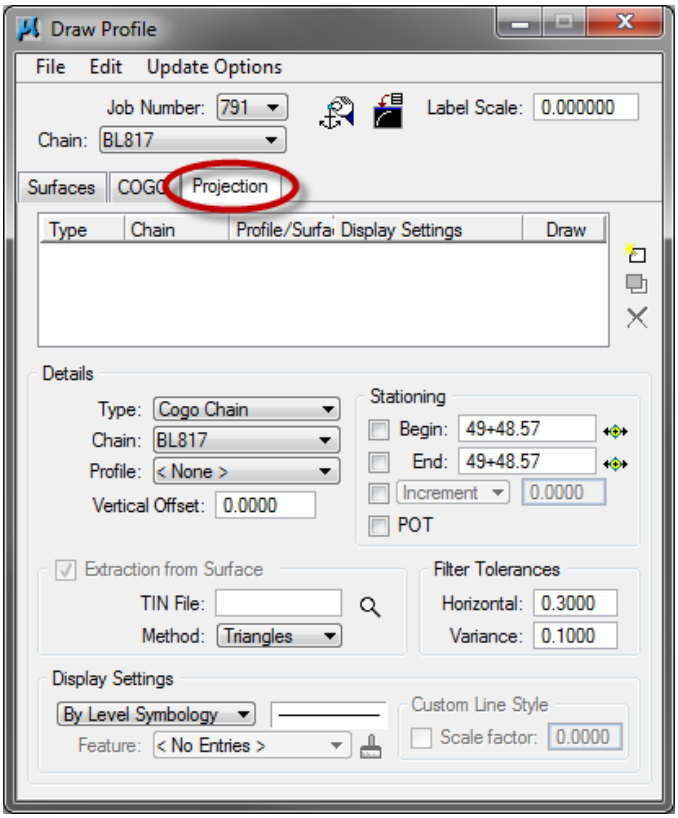
Options - The *Options* portion of Draw Profile has the same options as those found on Draw Plan and Profile within Design and Computation Manager. In the above figure, the user selects **General**. When using *Display Settings* set to **By Feature**, the Design and Computation Manager will dictate which boxes will be checked or unchecked.



THE PROJECTION TAB

The *Projection* tab should be used when the chain / profile to be drawn is different from the chain / profile used to create the profile cell.

The list box must include each projected profile drawn, using the action / edit icons on the right side of the list box. When adding a line to the list box, the profile is drawn. Enabling *Draw* in the list box deletes or redraws the profile.

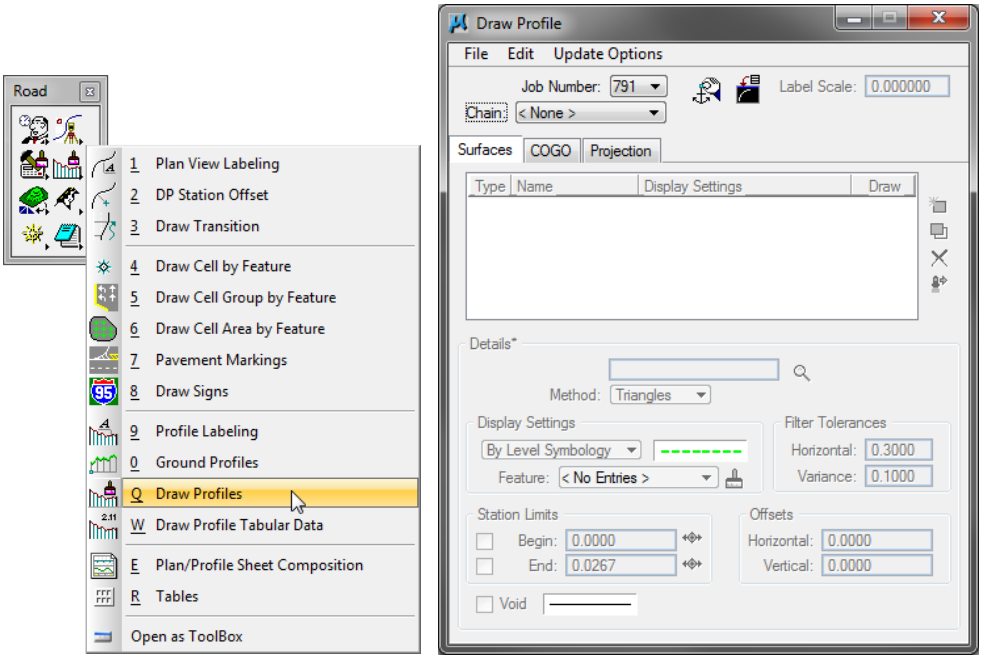


This class will not be using this tool because there is only one alignment in the class project.

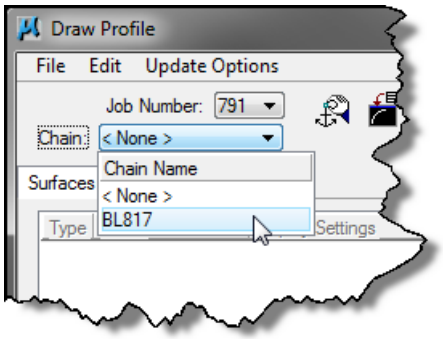
Exercise 2.1 Creating Existing Ground Profile

In this exercise, the user will process and draw our existing ground profile.

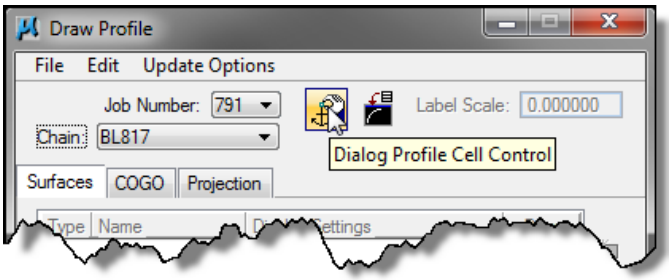
1. Double-click on the self-extracting zip file C:*Chapter2_Exercises.exe* and click the **Unzip** icon at the prompt. This will extract and setup the files needed for this exercise.
2. Open the design file C:\e\Projects\22807915201\roadway*DSPFRD01.dgn***.**
3. Open Project Manager. The Road Project dialog will appear. Sink this dialog.
4. From the *Road* toolbox, click the **Draw Profile** icon. Draw Profile opens.



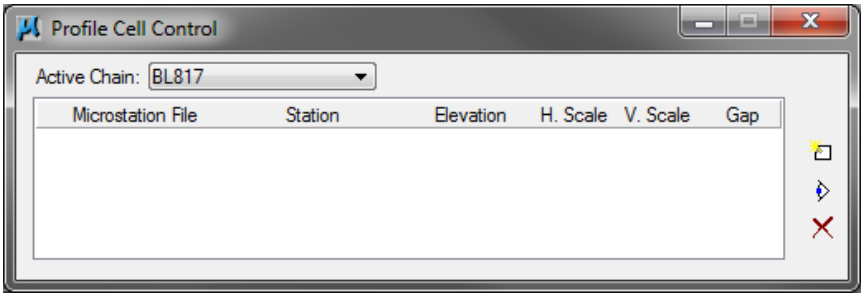
5. From Draw Profile dialog, select **BL817** from the *Chain* pull-down.



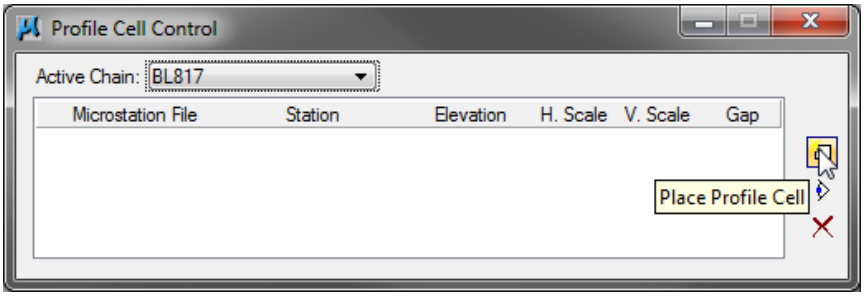
6. Click the **Dialog Profile Cell Control** icon.



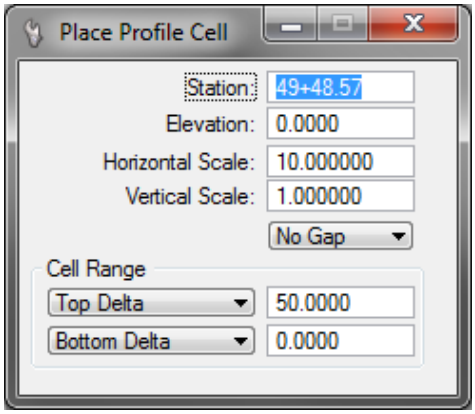
7. Profile Cell Control dialog opens.



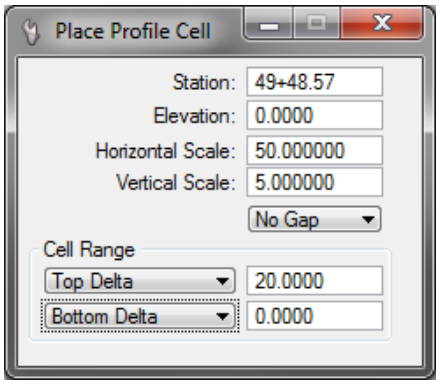
8. Click the **Place Profile Cell** icon on the right side of the dialog box.



9. Place Profile Cell dialog opens.



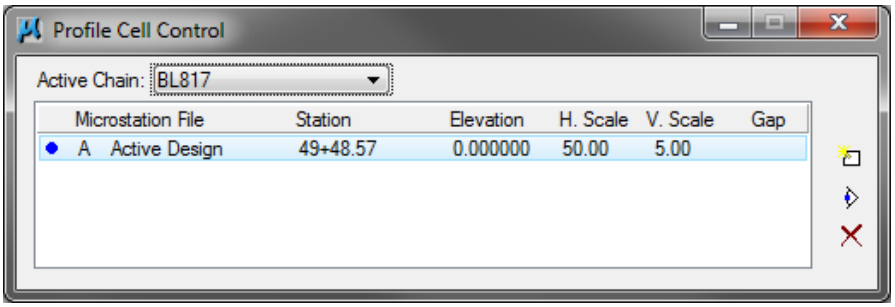
10. In Place Profile Cell dialog, complete the information as shown in the figure shown below:



The **Profile Cell** attaches dynamically to your cursor. Place the **Profile Cell** in the design file near the referenced plan view similar to that shown in the figure shown below:

Note Although the profile cell can be placed anywhere in the design file, we have placed it near the referenced plan view so that an exercise in chapter 4 which utilizes the profile design file and dsgnrd01.dgn file will be easier to manipulate. This will be explained later.

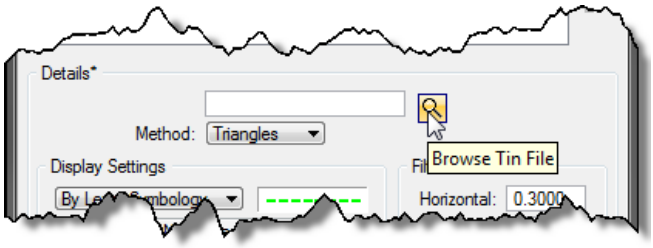
11. When the profile cell places in the design file, the Place Profile Cell dialog closes. Profile Cell Control dialog box refreshes to show active profile cell information.



12. Close Profile Cell Control dialog.

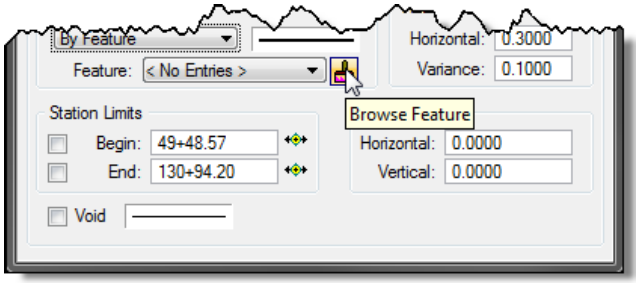
13. From Draw Profile, select the **Surfaces** tab.

14. Click the Browse Tin File icon to select **C**:\e\projects\22807915201\roadway*site.tin*.



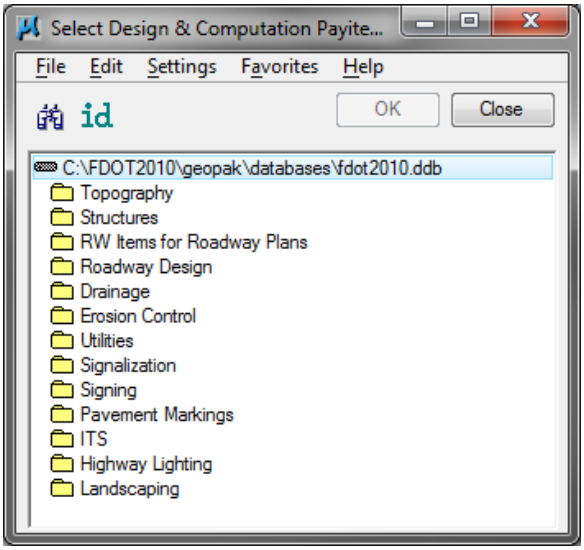
15. Select **Triangles** as the *Method* for extraction.
16. Set the *Display Options* to **By Feature**.

17. Click the **Browse Feature** icon.



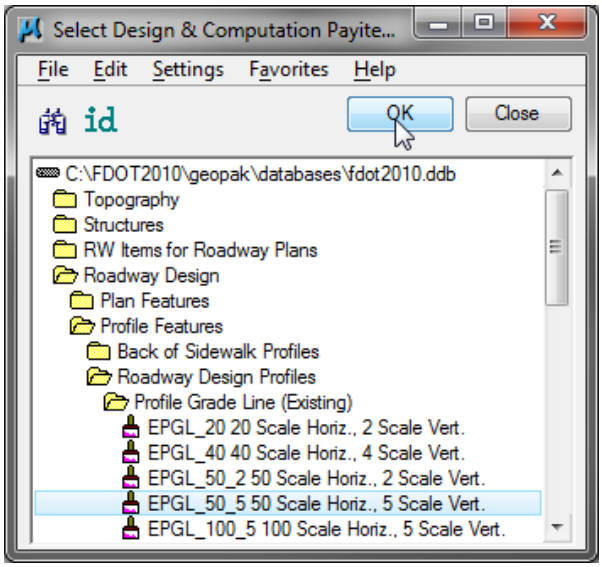
Note Due to the size of the Select Design & Computation Payitem database, there will be a delay while the database opens.

18. Select Design & Computation Payitem dialog opens.



19. In Select Design & Computation Payitem dialog, navigate to:

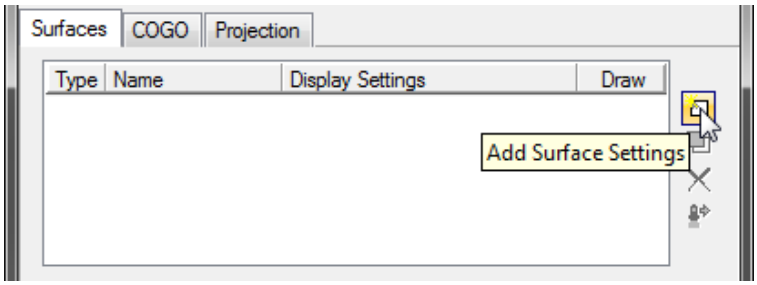
    Roadway Design / ProfileFeatures / RoadwayDesignProfiles / ProfileGradeLine(Existing) / EPGL_50_5



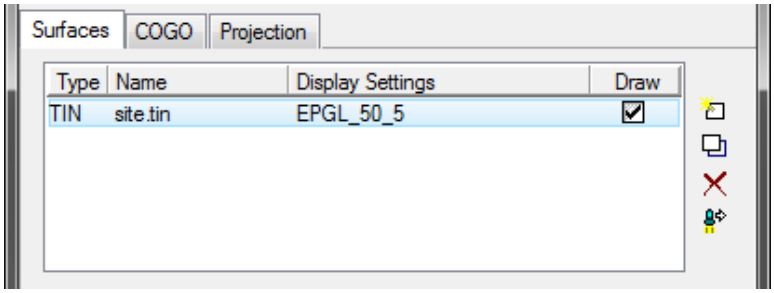
20. With **EPGL_50_5** highlighted in Select Design & Computation Payitem dialog**,** click **OK**. The *Feature* sets to the selected item's symbology, and Select Design & Computation Payitem dialog closes.

Note Due to the Project Manager Autosink option being enabled, when the Select Design and Computation Payitem dialog closes the Road Project dialog will come back up from its minimized state. Although this is an inconvenience, you will have to sink it again.

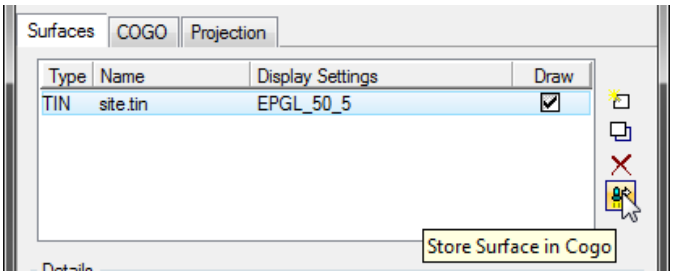
21. On Draw Profile dialog, click the **Add Surface Settings** icon.



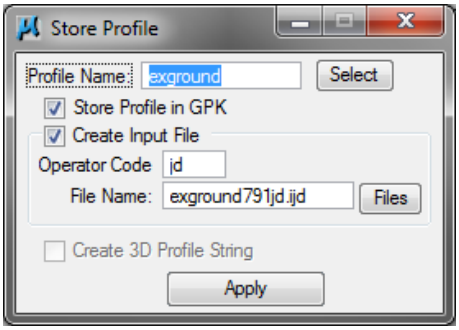
22. The profile adds to the list box and drawn into the design file.



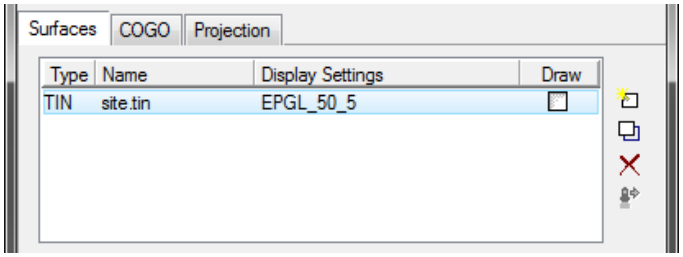
23. Click the **Store Surface in COGO** icon.



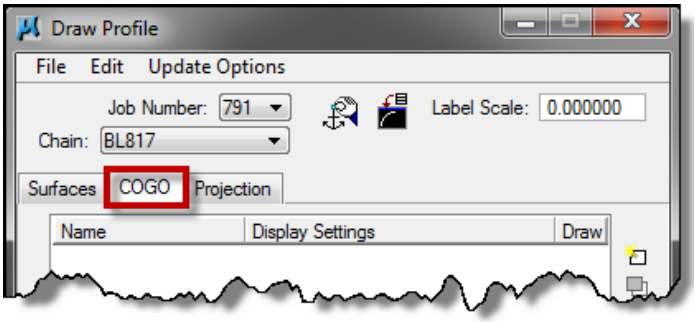
24. Store Profile dialog opens.



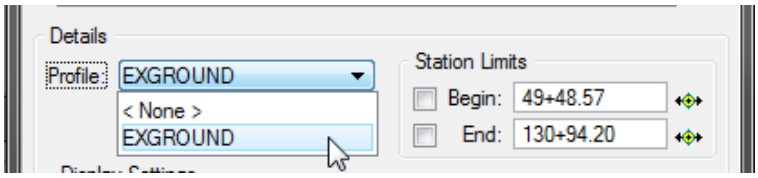
25. From the Store Profile dialog, enter the information as shown above and click **Apply**. The profile is stored in the GPK file (COGO).
26. Close Store Profile dialog.
27. Disable the **Draw** toggle in the list box to disable (delete) the display of the existing ground profile.



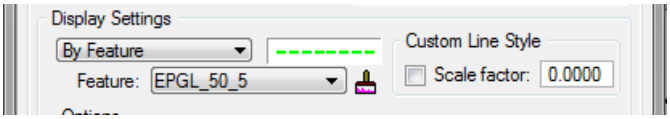
28. Select the **COGO** tab.



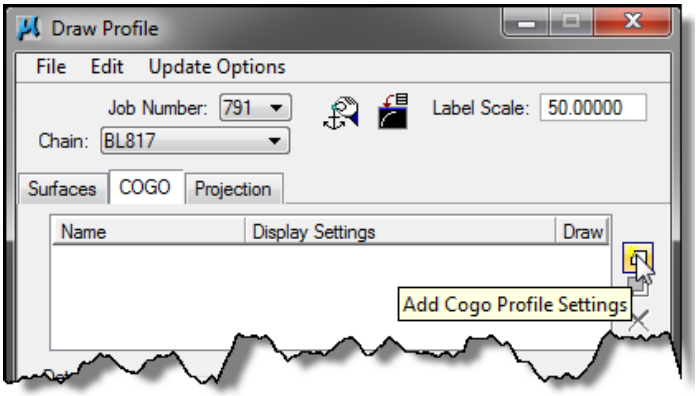
29. For *Profile*, select **Profile EXGROUND.**



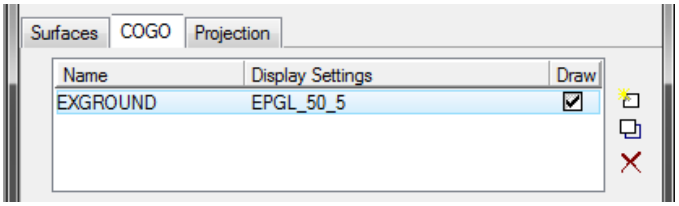
30. Enable the **By Feature** option under *Display Settings* and then select the same feature used previously to plot the profile.



31. Enter **50** for the *Label Scale* and click the **Add COGO Profile Settings** icon**.**



32. The profile adds to the list box and drawn into the MicroStation design file.

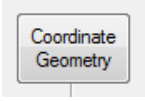


33. Close Draw Profile.

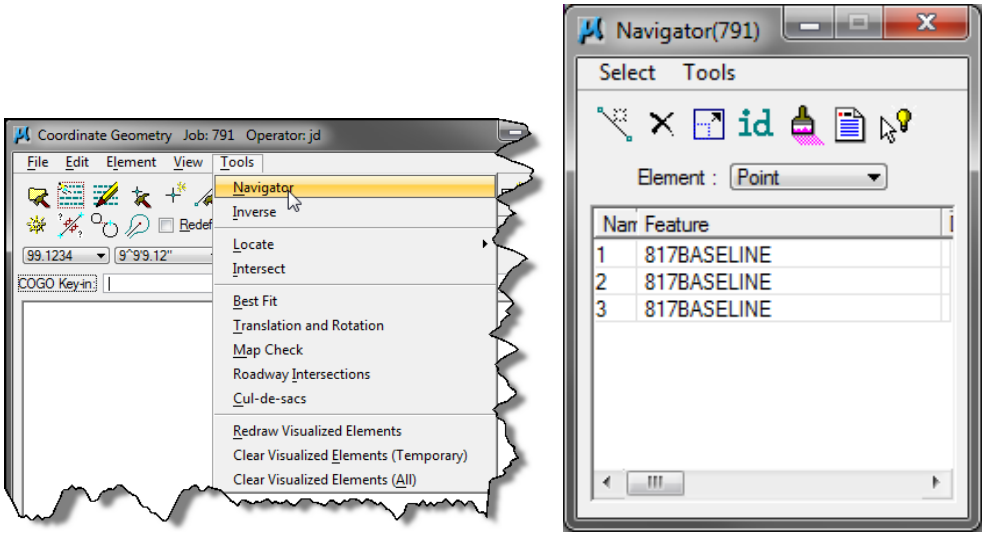
Exercise 2.2 Display Existing Ground Profile in COGO

In this exercise, the user will display the profile in COGO and review the information.

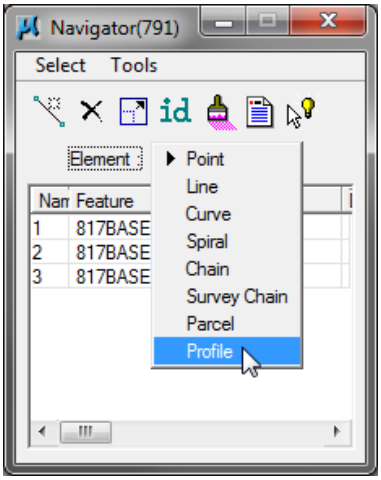
1. Access Project Manager.
2. From Road Project dialog, click the **Coordinate Geometry** icon. Coordinate Geometry opens.



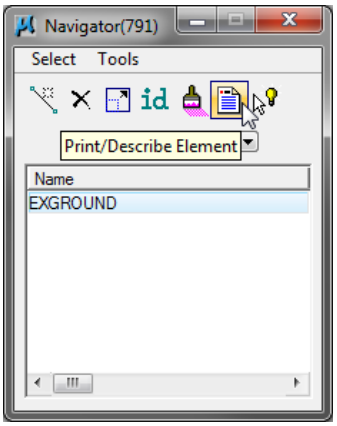
3. From Coordinate Geometry menu, select **Tools** > **Navigator.** Navigator dialog opens.



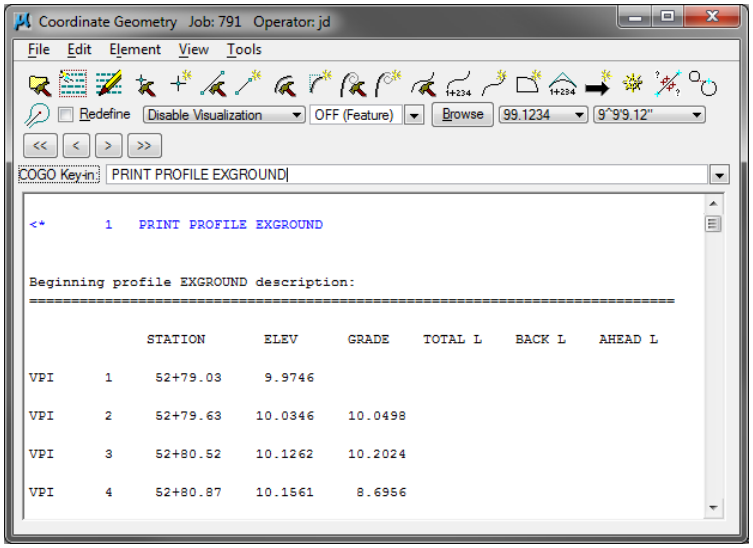
4. From Navigator dialog, select **Profile** from the *Element* pulldown.



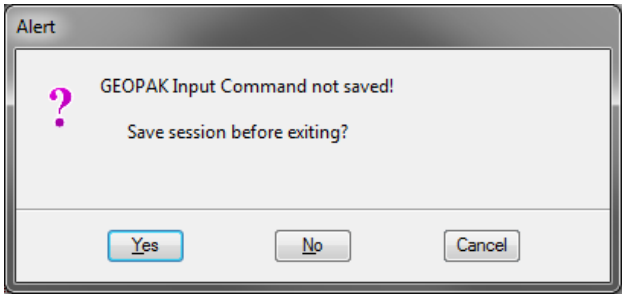
5. Select **EXGROUND** and then click the **Print/Describe Element** icon.



6. Close the Navigator dialog.
7. In Coordinate Geometry dialog, the stations and elevations of each VPI used to store the profile appear in the display window.



8. Close Coordinate Geometry dialog.
9. An Alert dialog opens prompting to save the session. Click **No**.

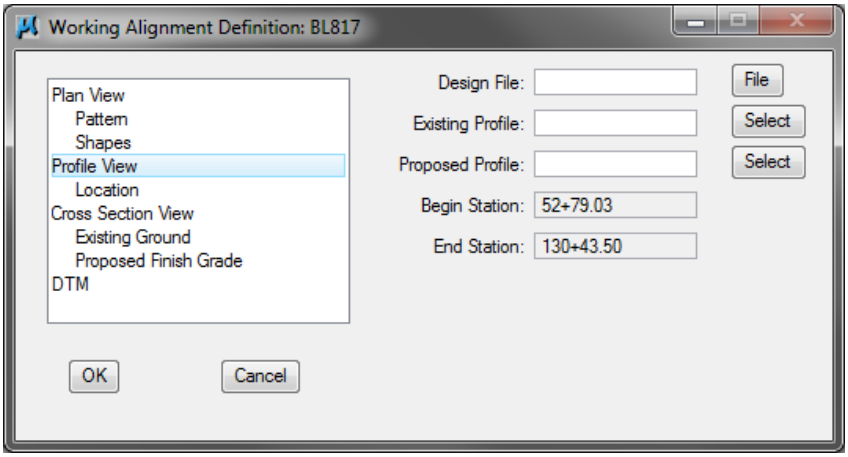


Note If you click the Yes icon, a prompt displays to enter a file name to create an input file listing the commands that were just used in COGO. In this case, Print Profile EXGROUND was the only COGO command used.

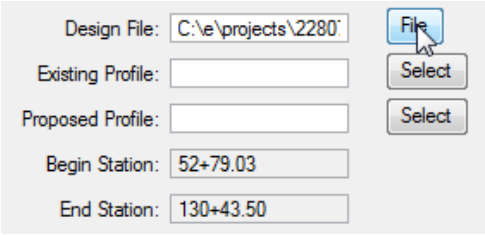
Exercise 2.3 Updating the Working Alignment

In this exercise, the user will update the *Working Alignment* in Project Manager.

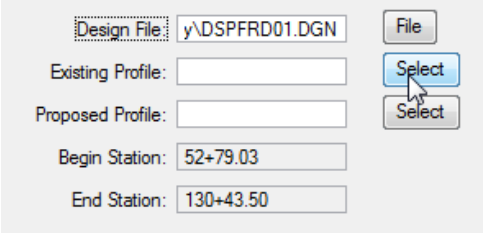
1. From Road Project dialog, click Define. Working Alignment Definition dialog opens.
2. From Working Alignment Definition dialog, select the category **Profile View**.



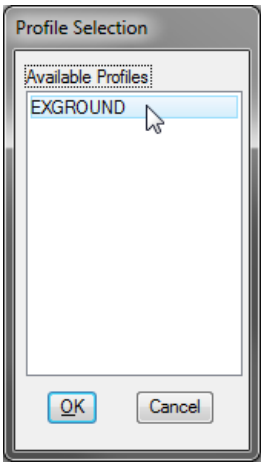
3. Click **File** and select the *Design File*: *DSPFRD01.dgn*.



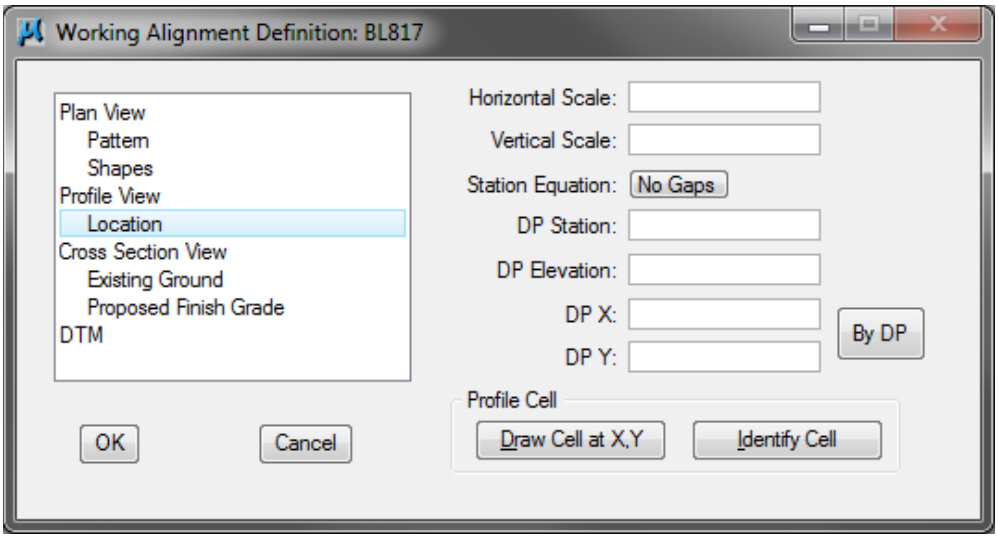
4. Click **Select** beside the *Existing Profile* field. The Profile Selection dialog opens.



5. Select the *profile* **EXGROUND** and click **OK**.

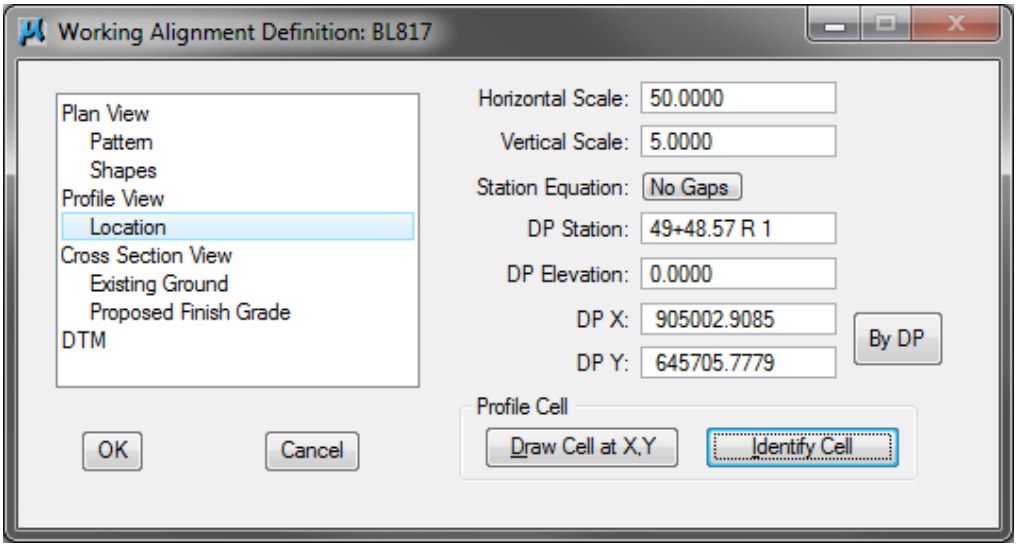


6. From Working Alignment Definition dialog, select the catagory **Location**.



7. Click the **Identify Cell** icon.

8. Select and accept the profile cell drawn in *DSPFRD01.dgn***.** The profile cell information appears in Working Alignment Definition dialog.



Note Your coordinates may be different from those shown in the dialog image above.

9. Click **OK**. Working Alignment Definition dialog updates and closes.

10. Exit MicroStation.

3 EXISTING CROSS SECTIONS

OBJECTIVES

- Drawing Pattern Lines
- Drawing Existing Ground Cross Sections
- Drawing Existing Utilities on Cross Sections
- Update Working Alignment

WORKFLOW

Plotting of *Existing Cross Sections* begins by determining where the cross sections cut. Pattern lines are drawn into a 2D plan-view design file, one pattern line for each desired cross section. FDOT provides a cross section seed file, *FDOTSEEDXS.DGN*. This seed file has four (4) models, one of which is *Pattrd* (Pattern Lines) which stores the pattern lines. From these pattern lines, locations of the existing cross sections are determined and then the existing ground cross sections created. The user draws Existing Features, such as base and utilities with the existing ground line plotted.

PATTERN LINES

Pattern lines are simply a line drawn in MicroStation that determines the location and width of the cross section. There are three ways to draw Pattern lines:

- Draw Pattern Lines,
- Draw Pattern Lines from XS,
- Use the MicroStation Draw Line tool.

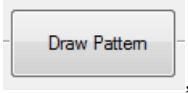
DRAW PATTERN LINES FROM XS

The *Draw Pattern Lines from XS* tool is the most common option used to recreate the pattern lines, if for some reason, the original pattern line data was lost after creating the cross sections, or if importing the cross sections from another program (e.g. CAiCE).

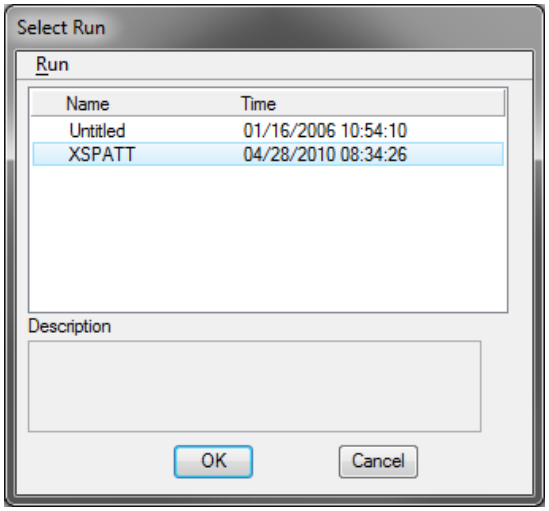
DRAW PATTERN LINES

The user utilizes Draw Pattern Lines to place pattern lines in a cross section design file (using the pattern line model) prior to cutting existing ground cross sections.

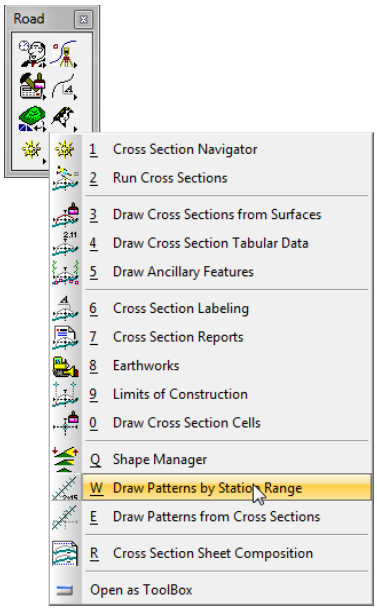
ACCESSING DRAW PATTERN LINES

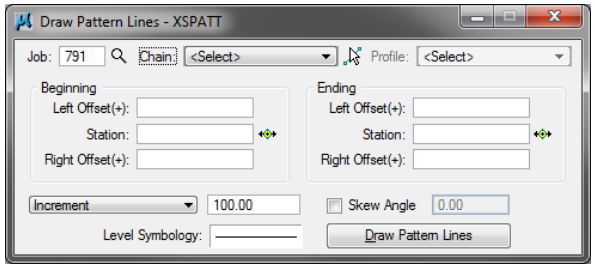
- From the **Road Project** dialog, click 

, and then click on **OK** from the Select Run dialog.



- From MicroStation, select **Applications** > **Road** > **Cross Sections** > **Draw Patterns by Station Range**.
- From the *Road* toolbox, click **Draw Patterns by Station Range**.





OVERVIEW OF DRAW PATTERN LINES

Draw Pattern Lines should be opened with Project Manager open. This is the only way to access the Select Run dialog, which allows the user to create a new run and thus be able to save settings for future reference and or reuse.

The dialog divides into three main sections:

- The *project specific information* at the top of the dialog contains the *job number* and the C*hain Name*. The C*hain Name* must be previously stored within the Coordinate Geometry database.
- The *location of the pattern lines information* in the middle section of the dialog gathers the information for the using stations and offsets. If the alignment has station equations, regions may also be included. GEOPAK will compute the stations based on a specified chain and display the value in the corresponding station field.
- The *how to information* in the bottom section of the dialog includes directions on how to place the pattern lines from spacing requirements to symbology.

Job This specifies the GPK file used.

Chain This specifies the chain representing the alignment used for the cross sections.

Beginning

Left Offset This specifies the start of the first pattern line relative to the centerline.

Station This specifies the location of the first station. Clicking the DP icon to the right of each station gives the designer the option to *graphically* select the station by placing a Data Point on the screen. Therefore, it is handy to have the alignment and plan view design files referenced to the pattern model of the cross section file.

Right Offset This specifies the end of the first pattern line relative to the centerline.

Ending

Left Offset This specifies the start of the last pattern line relative to the centerline.

Station This specifies the location of the last station. Clicking the DP icon to the right of each station gives the designer the option to select graphically the station by placing a Data Point on the screen. Therefore, it is handy to have the alignment and plan view design files referenced to the pattern model of the cross section file.

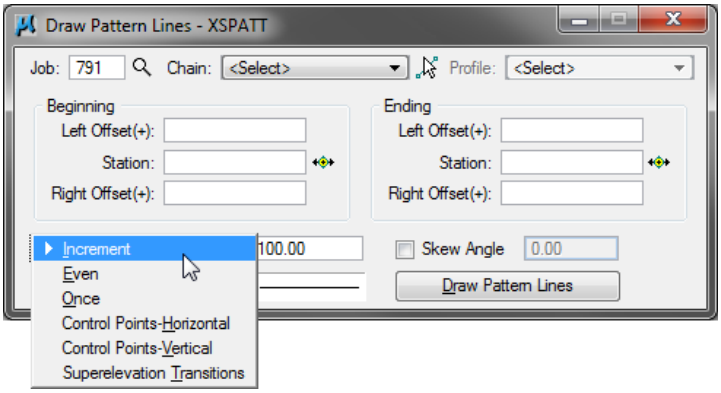
Right Offset This specifies the end of the last pattern line relative to the centerline.

HINT Positive offsets extend from the centerline in the directions indicated by the offset box (i.e. Left Offset (+) or Right Offset (+). If entering a negative offset into the Left Offset (+) field, the pattern will actually start on the right side of the centerline. So, if a pattern line is set at -10 for the Left Offset (+) and 150 for the Right Offset (+), a pattern line 140 ft. long is created starting at 10 ft to the right of the centerline

If the Beginning offsets are wider than the Ending offsets, GEOPAK incrementally shortens the width of each pattern line until it reaches the end pattern line.

Spacing

This defines the spacing of the pattern lines and supports several options.



Increment When drawn, Patterns are at the specified interval when added to the beginning station.

Even Patterns are placed at even stations based on value in the key-in field, but are not based on the beginning station.

Once When drawn, only one pattern displays based on the station in the beginning station field and utilizing the offset in the beginning area. The ending station area ghosts for this option.

Control Points Horizontal When drawn, Patterns displays at each horizontal critical point.

Control Points Vertical When drawn, Patterns displays at the beginning (VPC) and ending station (VPT) for each vertical curve. In addition, a pattern is drawn at the high or low point on each vertical curve.

Superelevation Transitions This scans current design file and reference files for superelevation shapes created with the specified chain. This draws a pattern line at the beginning and end of each superelevation shape, including the beginning and ending station fields in the dialog box.

Skew Angle This allows for skewing the angle of the pattern line by a specified angle and places normal pattern lines perpendicular to the referenced chain.

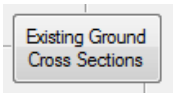
Level Symbology This reflects symbology of the pattern lines that are to be drawn.

Draw Pattern Lines This draws the pattern lines in the design file.

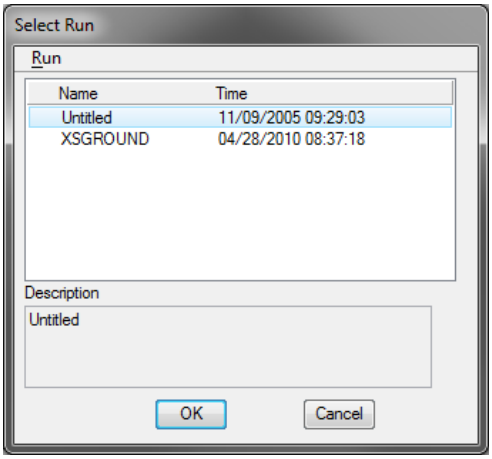
EXISTING GROUND CROSS SECTIONS

Once pattern lines determine the locations of the cross sections, the user utilizes Draw Cross Section to plot the *Existing Ground Cross Sections* into the cross section design file's *Rdxsrd* model. The Draw Cross Section, using the *Surfaces* tab, draws existing ground lines or other surface lines (within a 2D MicroStation design file) utilizing a GEOPAK binary DTM file (TIN file). To generate existing cross-sections utilizing digital terrain modeling, there must be a *.gpk* file containing the horizontal alignment chain, a TIN file, and, with plotting of cross sections by DGN, there must be pattern lines.

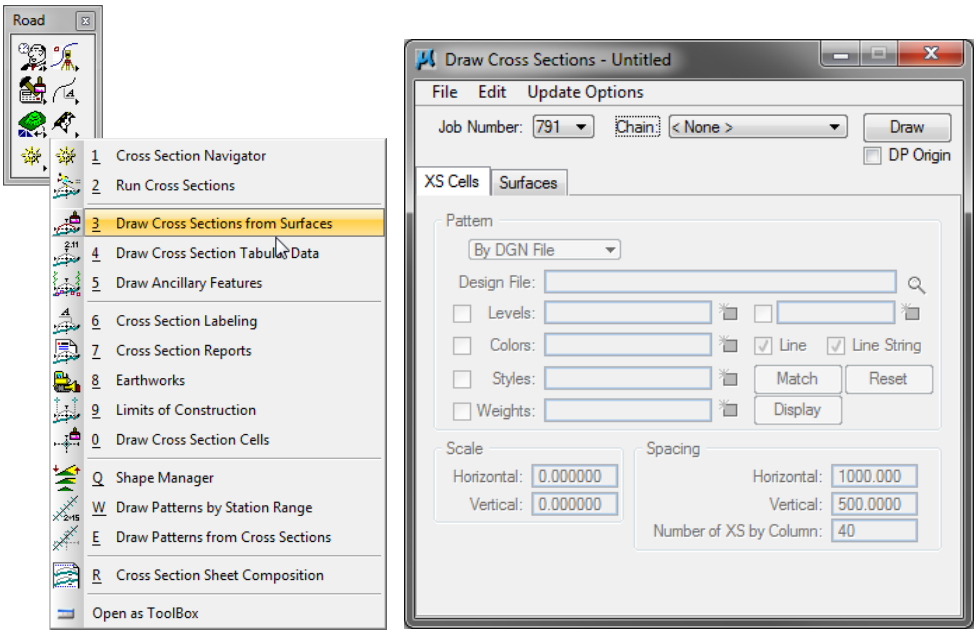
ACCESSING DRAW CROSS SECTIONS

- From the Road Project dialog, click the 

icon, and then click on **OK** in the Select Run dialog.



- From MicroStation, select **Applications** > **Road** > **Cross Sections** > **Draw Cross Sections from Surfaces**
- From the *Road* toolbox, click the **Draw Cross Sections from Surfaces** icon,



OVERVIEW OF DRAW CROSS SECTIONS

The preferred method to open Draw Cross Sections is via Project Manager and Road Project. When using the Road Project, the majority of the information displays at the time Draw Cross Sections opens. This information automatically pulls from the *Working Alignment Definition*.

File — The file options are utilized to "remember" more dialog settings than the dialog resource file. The default extension is .xsd.

Load — This loads a previously saved settings file.

Save — This saves the dialog into an existing settings file.

Save As — This saves the dialog settings into a new settings file.

Exit — This closes the dialog**.**

Edit — Several options are available to assist the user in manipulating the information in the dialog: Not all of these options are available for the XS Cells tab.

Cut Rows — This cuts a row from the list box into the buffer. Unless the line is pasted back into the list box, the information is deleted from the list box and is no longer displayed. Not available for XS Cells tab.

Copy Rows — This copies a row from the list box into the buffer. Utilize if several rows have similar information. Copy, paste, and then modify s line, rather than manually entering every line into the list box. Not available for XS Cells tab.

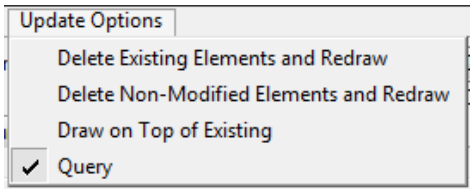
Paste Rows — This pastes a row from the buffer into the list box for subsequent editing. Not available for XS Cells tab.

Save Dialog Settings — This stores the current dialog box settings to the resource file.

Restore Saved Settings — This populates the dialog box with settings from the previous session via the resource file. If the resource file has been deleted, the settings cannot be restored.

Clear Surface List — This removes all rows from within the list box.

Update Options — The Update Options turns 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 selecting an option, the previous active option is de-activated.



Delete Existing Elements and Redraw — Any existing ground lines previously drawn with Draw Cross Sections are deleted and new ground lines are drawn.

Delete Non Modified Elements and Redraw — Only existing ground lines previously drawn with this tool AND not modified are deleted and new ground lines are drawn. Any ground lines previously drawn with this tool and modified are left intact.

Draw on Top of Existing — Ignores any previously drawn ground lines and a new set is drawn, resulting in two sets of ground lines.

Query — When activated, a prompt opens each selection of *Draw*. The user must select one of the three options and click the Apply icon to begin processing. Clicking the Cancel icon closes the dialog box with no further processing.

Job Number — This is a requirement to identify the coordinate geometry database wherein the chain for generating the cross sections is stored.

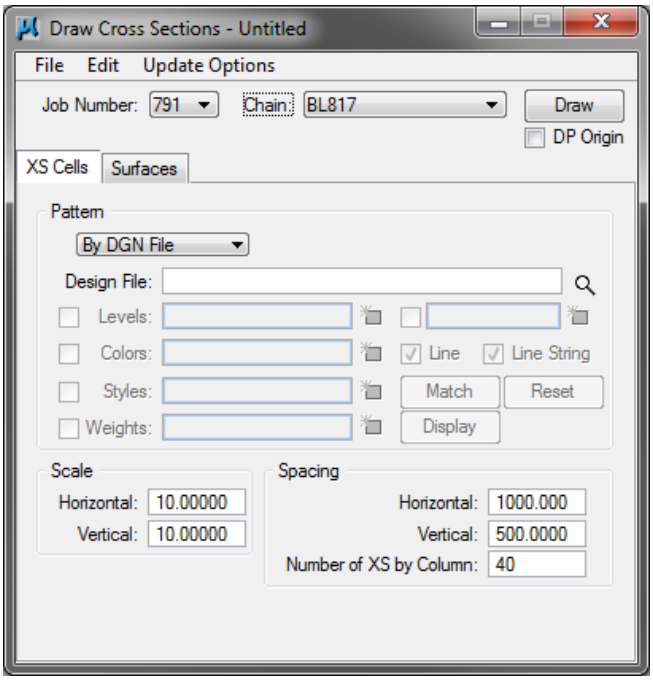
Chain — This is a requirement to reference an alignment within each cross section. The subsequent specifications of station ranges and computes left/right offsets relative to this baseline when pattern by station is utilized. If pattern by design is utilized, the intersection of each pattern line with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

DP Origin — When checked, a prompt displays requiring a **Data Point** for the location in the file to begin cross section placement.

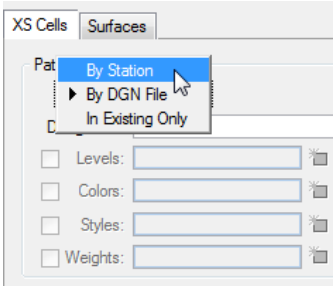
Select the Draw icon after all information on the Draws Cross Sections dialog has been reviewed and set as desired. It draws the cross sections into the active model of the current design file.

XS CELLS TAB

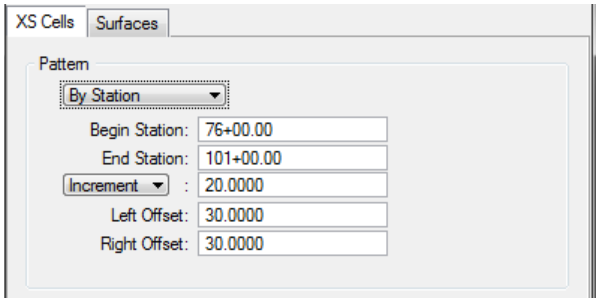
When generating existing ground cross sections, the user must indicate where each cross section is to be drawn. In addition, the cross section width, the chain utilized for the cross sections, as well as, how far apart cross sections are drawn must all be dictated to GEOPAK. Draw Cross Sections supports three methods of identifying this information: *By Station*, *By DGN File* and *In Existing Only*.



Pattern



By Station These are parameters, which indicate where each cross section is located. This method consists of only key-in fields and no graphical representation. The begin and end station for the specified chain is displayed by default and may be manually changed.



Begin Station - The station of the first cross section

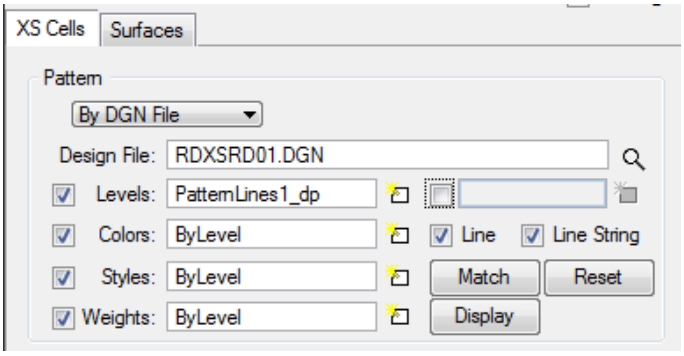
End Station - The station of the last cross section

Spacing - Determines the spacing, Even or Increment, of the cross sections.

Left Offset - Length of the cross section to the left side of the baseline.

Right Offset - Length of the cross section to the right side of the baseline.

By DGN File This defines the parameters graphically in the pattern model of a cross section design file. Each line or line string (pattern line) represents the generation location of a cross section.



The information shown in the above figure is populated automatically via the Working Alignment Definition. The following instructions apply only if there are no working alignment defined.

Design File - Specifies the design file where the pattern lines are located. Click on the magnifying glass to the right of the Design File box and navigate to the desired cross section design file with the Pattrd Model containing the pattern lines.

Levels - Specifies the level that the pattern lines are drawn on. There are three options to select a level:

- Activate levels by clicking the box to the left of Levels. Then, type in the name of the level <OR>
- Click on the icon to the right of the Levels and select the level from a list <OR>
- Click on the Match icon and click on a pattern line in the design file, then click again to accept it. The level will then fill in automatically.

Using the FDOT Standards, only the level name is required, since the Colors, Styles and Weights should be set at ByLevel.

Color - Specifies the color of the pattern lines. The selection process is the same as that for levels.

Styles - Specifies the line style of the pattern lines. The selection process is the same as that for levels.

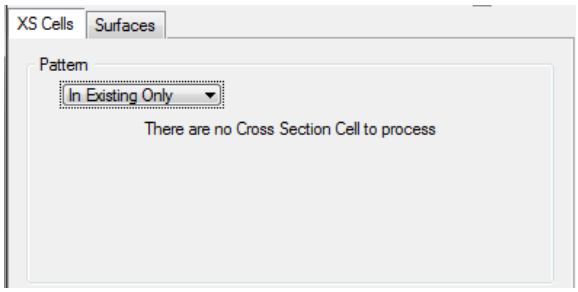
Weights - Specifies the weight of the pattern lines. The selection process is the same as that for levels.

Match - Sets the symbology of the pattern lines by clicking on an existing pattern line.

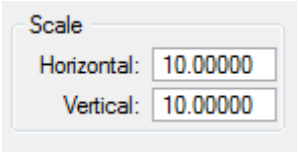
Reset - Resets the symbology settings.

Display - Highlights all pattern lines that meet the specified symbology.

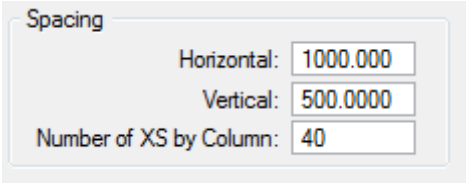
In Existing Only Determines the location and width of the cross section based on cross section cells that already exist in the active file.



<u>*Scale*</u> - *Horizontal/Vertical* determines the Horizontal and Vertical scale of the cross section.

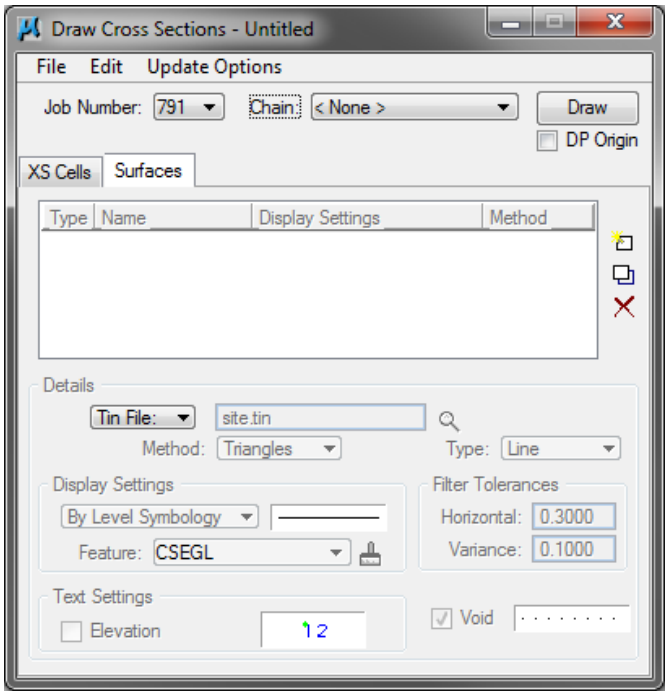


<u>*Spacing*</u> - *Horizontal/Vertical* determines the Horizontal, and Vertical spacing of the cross section cells. *Number of XS by Column* determines the Number of XS by Column. This specifies how many cross sections will be placed in each column in the design file. Normally the defaults are sufficient.



SURFACES TAB

The **Surfaces tab** defines the surfaces that constitute the existing cross section. Multiple surfaces can be used; each surface is represented in the cross section by a separate line or line string. When first opened, there is generally a slight delay as data is loaded before the dialog becomes active.



The majority of the information shown in the above figure populates automatically via the Working Alignment Definition. The user enters or manually sets some of the following information.

Surfaces List Box — Displays the surfaces used to create the cross sections. The following icons are to the right of the list box: Add Surface, Modify Surface Settings, or Remove Surface.

Details — This specifies the surface and settings for each surface used to draw the cross sections.

TIN File — This specifies the TIN file for the surface.

Method — This specifies the type of data contained in the TIN file. The two options are Triangles and Breaklines.

Type — This specifies the element type of the cross section ground line. The two options are Line and Line String.

Display Settings — This specifies the display symbology of the cross section elements. The two options are:

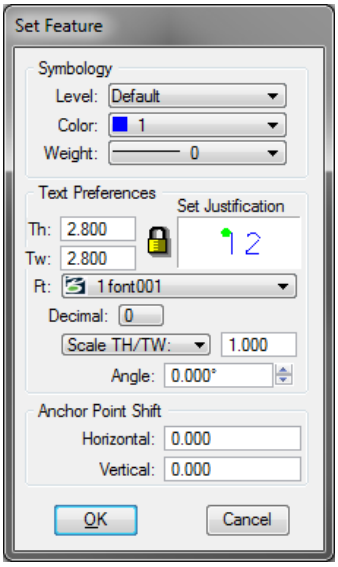
By Level Symbology — This requires the user to define the level, color, weight, and line style of the cross section elements.

By Feature — This allows the user to select a feature from the Design and Computation Manager database to determine the properties of the cross section elements.

Filter — The user considers both Horizontal and Variance filter tolerances together for each pair

Tolerances of cross section segments. If both segment lengths are less than the Horizontal filter tolerance AND the projected distance between the mid-point and the chord between the two end points is less than the Variance tolerance, the middle point is deleted.

Text Settings This specifies if user places an Elevation at the centerline of the cross section and the text settings of the elevation text. If the Elevation Toggle is checked and the user double clicks the element symbology box to the right of Elevation, the following dialog appears.



Void Determines if voids in the DTM are plotted on the cross sections and the symbology used to represent void areas.

EXISTING UTILITIES ON CROSS SECTIONS

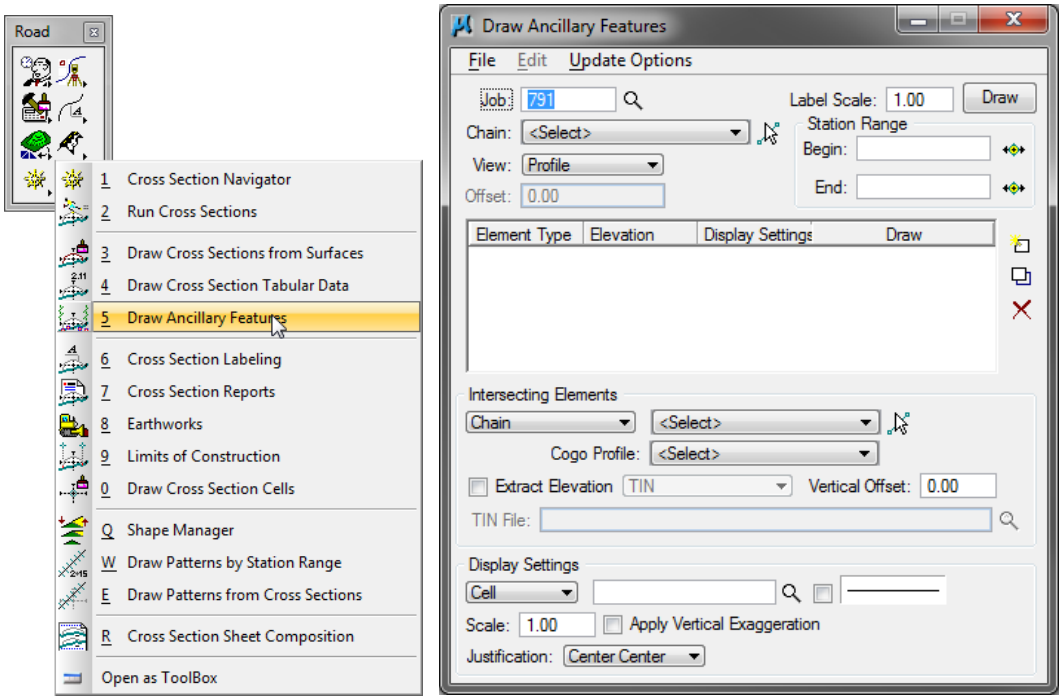
The placement of existing underground utilities onto cross section sheets has been simplified by the use of an interactive dialog called **Draw Ancillary Features**. This dialog interacts with a selected utility design file that contains elements with the correct symbology or features that represent various types of utilities. It will search for specific utilities, measure the horizontal distance from a controlling baseline and plot a user defined symbol or cell at a specified depth of cover, based on a tin file. If the existing underground utility design file contained chains and related profiles for those chains, then exact elevations could be plotted.

ACCESSING DRAW ANCILLARY FEATURES

From MicroStation, select **Applications** > **Road** > **Cross Sections** >**Draw Ancillary Features.**

<OR>

From the *Road* toolbox, click the **Draw Ancillary Features** icon.



OVERVIEW OF DRAW ANCILLARY FEATURES

File

Load This loads a previously saved settings file (*.afd*).

Save This saves the dialog settings into an existing setting file (*.afd*).

Save As This saves the dialog settings into a new settings file (*.afd*).

Exit This closes the dialog.

Update Options

Delete Existing Elements and Redraw — Any existing ancillary features previously drawn with Draw Ancillary Features are deleted and ancillary features are drawn.

Delete Non Modified Elements and Redraw — Only existing ancillary features previously drawn with this tool AND not modified are deleted and new ancillary features are drawn. Any ancillary features previously drawn with this tool and modified are left intact.

Draw on Top of Existing — Any previously drawn ancillary features are ignored and a new set is drawn, resulting in two sets of ancillary features.

Query — When activated, the user is prompted each time Draw is clicked. The user must select one of the three options and click the Apply icon to begin processing. Clicking the Cancel icon closes the dialog box with no further processing.

At the time of this writing, the Edit Option does not function. This option has been added as a placeholder for future enhancements.

Job — Required to identify the coordinate geometry database where the chain for generating the desired offsets of the utility is stored.

Chain — Alignment used to generate the cross section or profile cell.

The subsequent specifications of station ranges and left/right offsets are computed relative to this chain 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.

View — Defines the type of view that the utilities will be plotted to; Profile or Cross Section.

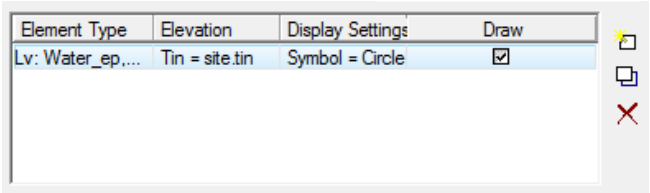
Label Scale — Utilized when the By Feature Display settings option is utilized. The specified Label Scale is compared to the scale within the D&C Item and the text is adjusted based on the ratio between these two scales. Note this option is only used if the text setting in the D&C Manager is set to scale, not fixed.

Station Range — When the Chain field at the top of the dialog is populated, its beginning and ending station are displayed in the Station Range group box. The defaults may be utilized if the entire profile is drawn. However, manually entering stations or clicking Set Station and graphically identifying a location are supported. In the case of cross sections, the stations are determined by the pattern lines and the correct stations are not necessarily displayed.

Draw — The **Draw** button should be selected after all information on the Draws Ancillary Features dialog has been reviewed and set as desired. It draws the ancillary features into the active model of the current design file.

List Box

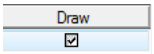
Each ancillary feature to be drawn must be added to the list box. The action icons on the right side of the dialog accomplishes this. Required information is the element type, elevation and display settings.



Add Element Set Adds the ancillar y information to the list box.

Modify Element Set Modifies the currently selected ancillary item in the list box.

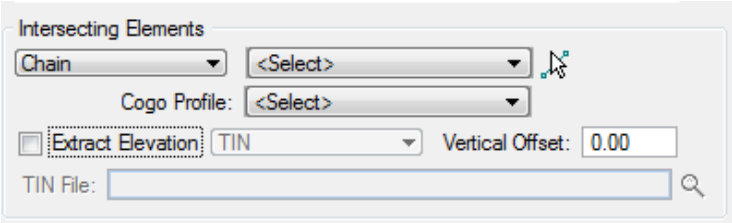
Delete Element Set Deletes the currently selected ancillary item in the list box.

Draw 

Disables/Enables the drawing of selected ancillary item in the list box.

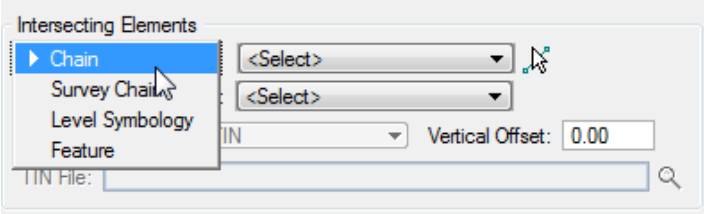
Intersecting Elements

The Intersecting Elements section of the dialog is where the user defines how the horizontal (offset) and vertical (elevation) parameters for the ancillary feature will be computed.

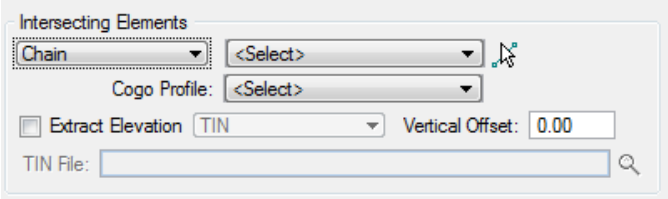


Horizontal Parameters

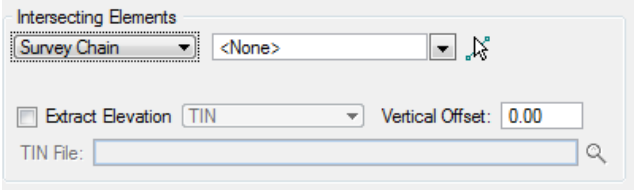
A variety of data sources exists to define the horizontal location of the desired ancillary feature.



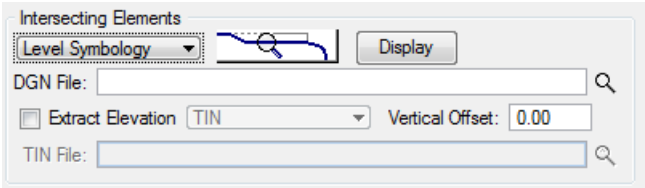
Chain - COGO chain stored in the GPK file defined at the top of the dialog. The location of the chain is used to determine the horizontal location of the ancillary feature.



Survey Chain - Survey chain stored in the GPK file defined at the top of the dialog. The location of the chain is used to determine the horizontal location of the ancillary feature.

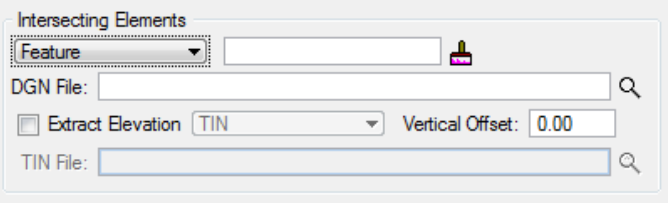


Level Symbology - Scans the specified design file for any element specified symbology. If it crosses the profile or cross section cell, the location of the element is used to determine the horizontal location of the ancillary feature.



The tool defines the symbology to use for locating the ancillary feature.

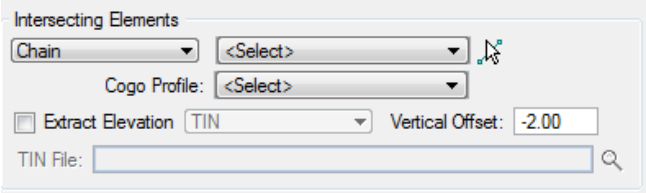
Feature - Scans the specified design filefor any element matching the specified D&C feature symbology. If it crosses the profile or cross section cell, the location of the element is used to determine the horizontal location of the ancillary feature.



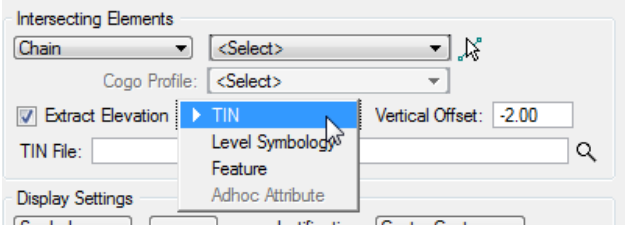
Vertical Parameters

A variety of data sources exist to define the vertical location of the desired ancillary feature. The data source selected for the horizontal parameters, affects the data sources available for the vertical location.

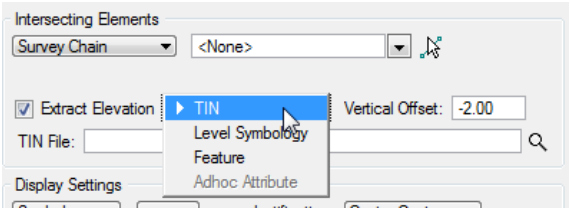
Cogo Profile - If Chain was selected for the horizontal parameters, the elevation can be determined from a specified Cogo Profile if it exists.



If no Cogo Profile exists or if the user wishes to create a different elevation, you can enable the Extract toggle and select one of the three sources for the elevation.



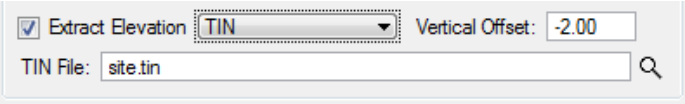
Survey Chain - If Survey Chain was selected for the horizontal parameters, the elevation can be determined from the specified Survey Chain. The elevation in the survey chain can be overridden by enabling the Extract Elevation toggle and selecting one of three sources for the elevation.



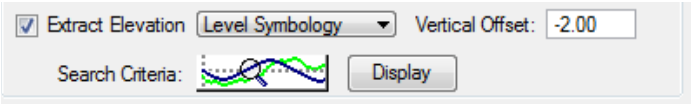
HINT If Level Symbology or Feature is selected to define the horizontal parameters, the Extract Elevation toggle must be enabled to set the elevation.

Extract Elevation - Enable this toggle and then select on of the following data sources:

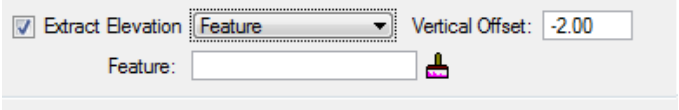
- TIN Elevation will be determined from the tin file at the horizontal location of the ancillary feature.



- Level Symbology Scans the limits of the profile or cross section cell and uses any element of the specified symbology. The elevation is then determined from this element at the horizontal location of the ancillary feature.



- Feature Scans the limits of the profile or cross section cell and uses any element of the specified D&C feature symbology. The elevation is then determined from this element at the horizontal location of the ancillary feature.



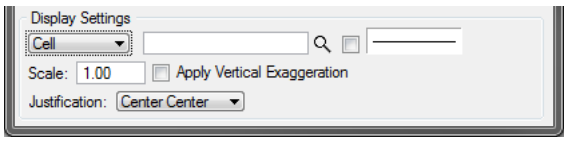
- Adhoc Attribute Although this is listed as an option, there is no way to define it so it should not be used.

Vertical Offset This offset applies to the elevation after it is determined from one of the sources detailed above.

Display Settings

These are three options supported for displaying the ancillary features.

Cell



Cell Name - Cell drawn to represent the ancillary feature.

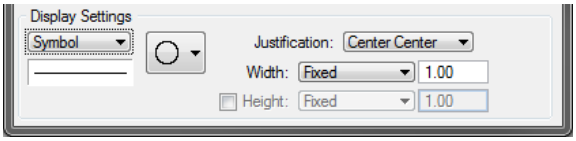
Symbology - Activating this toggle and specifying the symbology will override the graphical symbology of the given cell.

Scale - Scale used for cell placement.

Apply Vertical Exaggeration - Activating this toggle and setting the scale will distort the cell.

Justification - A variety of standard justifications are supported.

Symbol



Symbol - Set the desired symbol from a standard pictorial list.

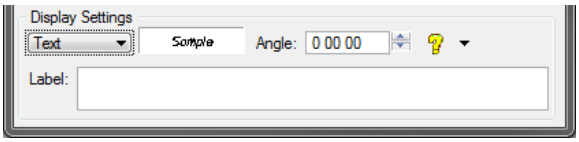
Symbology - Specifying the symbology will set the graphical symbology of the symbol.

Justification - A variety of standard justifications are supported.

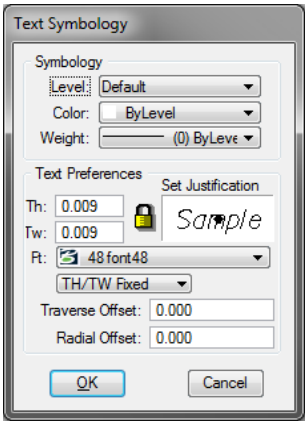
Width – This is symbol width. If no height is given, then this value is default for both the height and the width.

Height - Enable the toggle and specify the height of the symbol. Setting a value different from the width will result in distortion of the symbol.

Text



Sample - Double-clicking on the sample graphic will access the Text Symbology dialog. This dialog allows the user to set the symbology of the text placed as well as any desired offsets.



Angle - Text rotates by setting the angle.

Label - Any desired text string to insert and use.

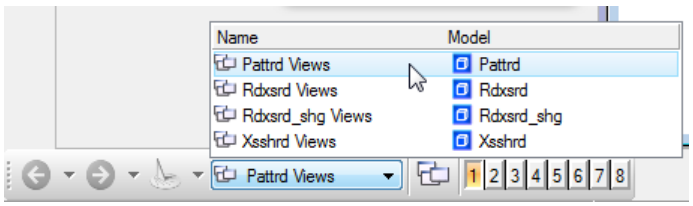
- Clicking this icon will display several intrinsic variables than can be used in the creation of the label. Brackets {} must encompass these intrinsic variables (e.g. Station, Offset, Elevation, etc.).

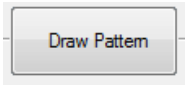
Exercise 3.1 Drawing Pattern Lines

In this exercise, the user will draw our pattern lines to define the locations of our existing ground cross sections.

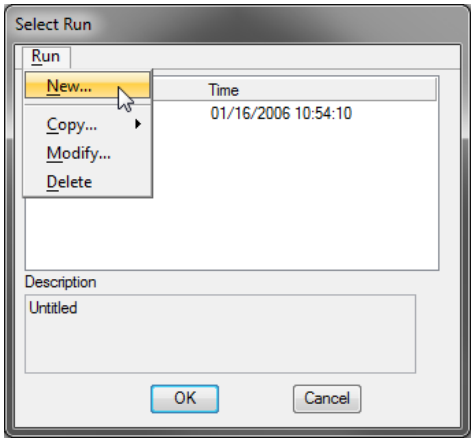
1. Double-click on the self-extracting zip file C:*Chapter3_Exercises.exe* and click the **Unzip** icon at the prompt. This will extract and setup the files needed for this exercise.
2. Open the design file C:/E/Projects/22807915201/roadway/*RDXSRD01.DGN*.

HINT The active model is already set to Pattrd. In addition, the files DSGNRD01.dgn and ALGNRD01.dgn are already referenced to the model.

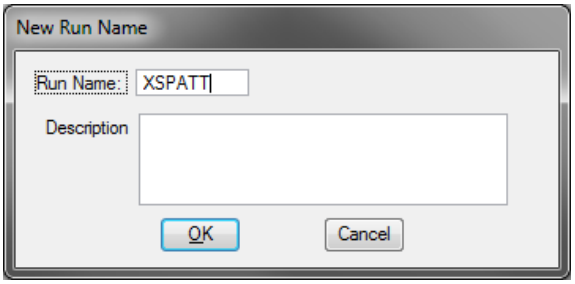


3. Access Project Manager. The Road Project dialog should appear since we "remembered" the project and user in a previous exercise.
4. From Road Project, click the 

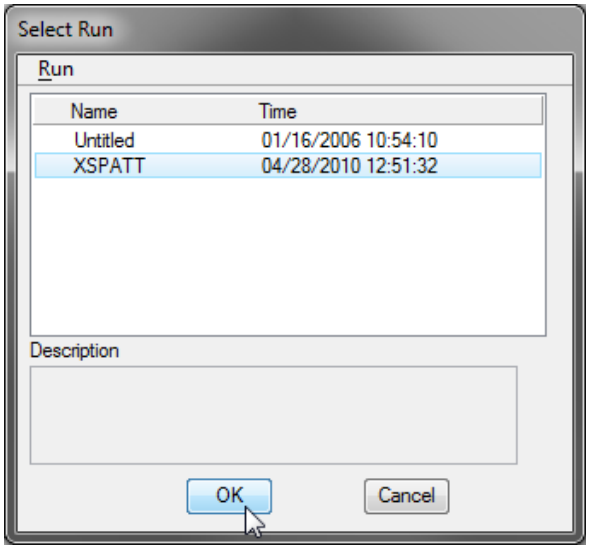
icon.
5. From the Select Run menu, select **Run** > **New.**



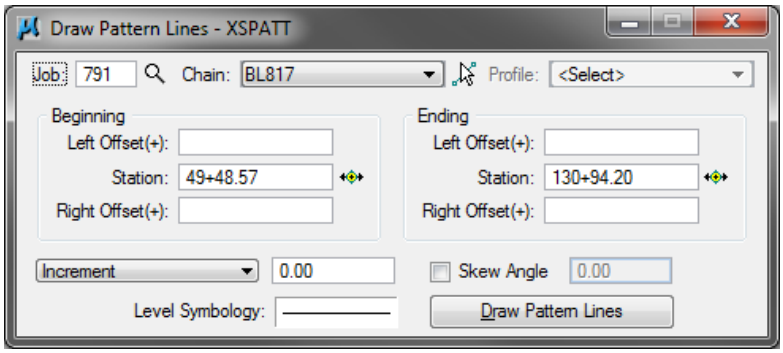
6. From the New Run Name dialog, key-in the *Run Name*, **XSPATT**, and *Description*, and click **OK**.



7. In the Select Run dialog, select the *run* **XSPATT** and then click **OK**.

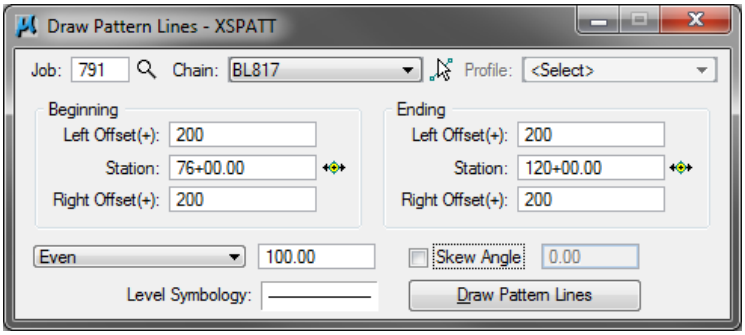


8. The Draw Pattern dialog opens.

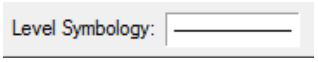


HINT The Job and Chain automatically fill by the Working Alignment.

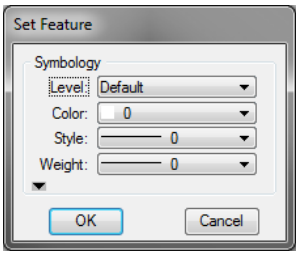
9. Key-in a *Beginning Station* of **76+00** and an *Ending Station* of **120+00**.
10. Key-in a value of **200** for both *Left* and *Right Offsets*.
11. Set the *spacing option* to **Even** and key-in **100** for the *spacing*.



12. Double-click in the *Level Symbology* box.



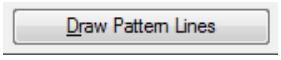
13. GEOPAK Set Feature opens.



14. On GEOPAK Set Feature, select PatternLines1_dp in the Level list.

Note The Levels list alphabetically. Type the first letter of the level you are looking for, in this case the letter 'P'. This will move you to the first level starting with the letter P.

15. In the *Color* list, select **ByLeve**l.
16. In the *Style* list, select **ByLevel**.
17. In the *Weight* list, select **ByLevel**.
18. Click **OK**. The changes save and GEOPAK Set Feature closes.
19. On Draw Pattern Lines dialog, click the **Draw Pattern Lines** icon to draw the pattern lines into the design file.

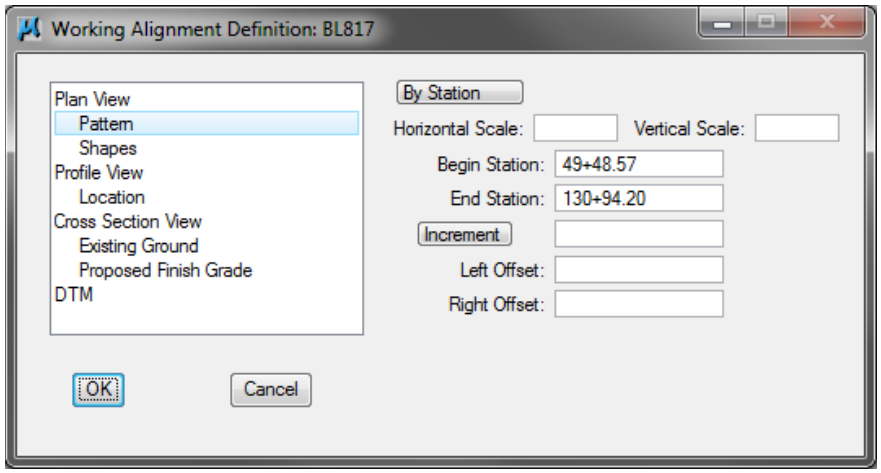


20. Close Draw Pattern Lines. Click **Yes** when prompted to **Save Settings**.

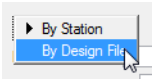
Exercise 3.2 UPDATING Working Alignment

In this exercise, the user will update the Working Alignment with our pattern information.

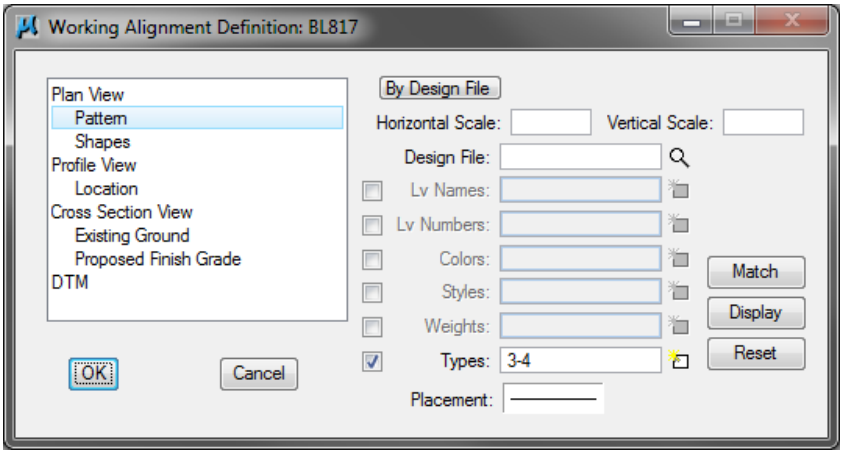
1. From Road Project, click the **Define** icon. Working Alignment Definition dialog opens.
2. From Working Alignment Definition dialog, select the *category* **Pattern**.



3. Click **By Station** and change the option to **By Design File**.

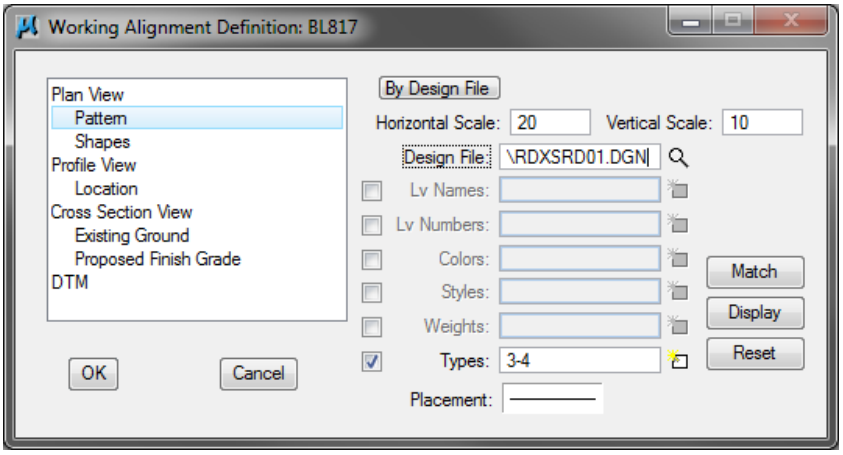


4. The dialog changes to display the **By Design File** options.



5. For *Horizontal Scale*, key-in **20.**
6. For *Vertical Scale*, key-in **10**.

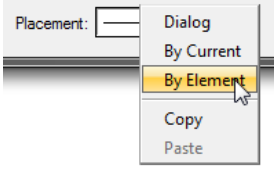
7. For *Design File*, select C:\e\Projects\22807915201\roadway*RDXSRD01.DGN*.



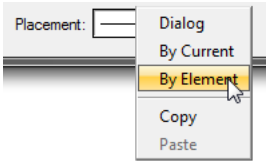
8. Enable the toggle for **Lv Names**.

9. Click on the **Match** icon.
10. In the design file, **Data Point** on a pattern line, and then **Data Point** again to accept. The *Lv Names* field populates with the *name level* name **PatternLines1_dp**.

11. Right-click on the *Placement Symbology* box and select **By Element**.



12. In the design file, select a **pattern line** then **Data Point** again to accept. The Placement Symbology dialog will populate with the correct pattern symbology.

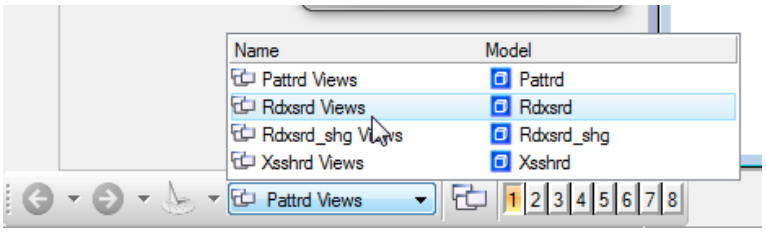


13. From Working Alignment Definition dialog, click **OK** to save and close. Working Alignment Definition dialog closes.

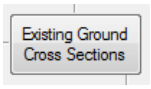
Exercise 3.3 Drawing Existing Ground Cross Sections

In this exercise, the user will cut existing ground cross sections.

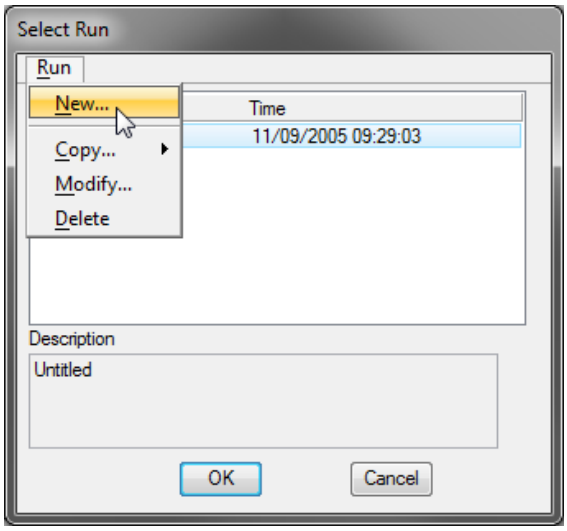
1. In the design file *RDXSRD01.dgn*, change the *Active Model* to **Rdxsrd**.



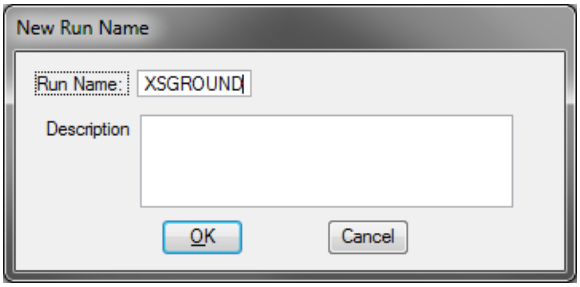
2. On the Road Project, click the **Existing Ground Cross Sections** icon.



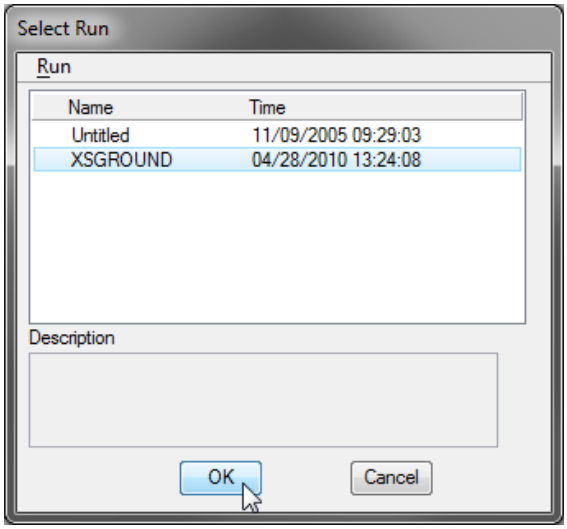
3. On the Select Run menu, select Run > **New**.



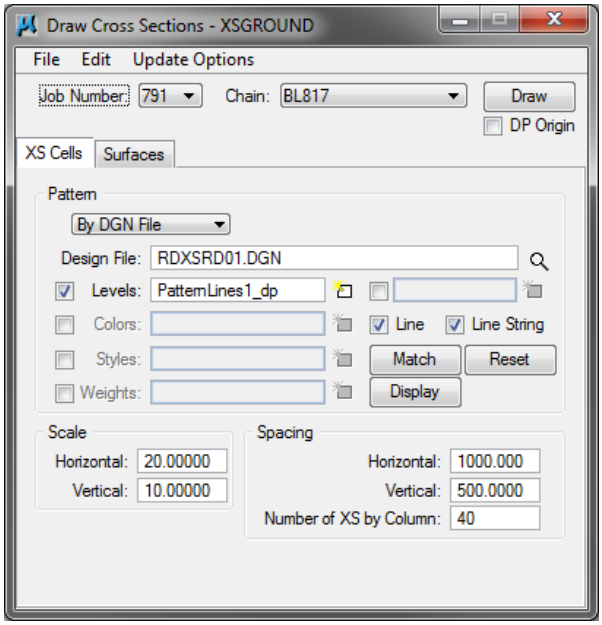
4. Key-in the *Name* **XSGROUND** and a *Description* in the New Run Name dialog and click **OK**.



5. Select **XSGROUND** in the Select Run dialog and click **OK**.

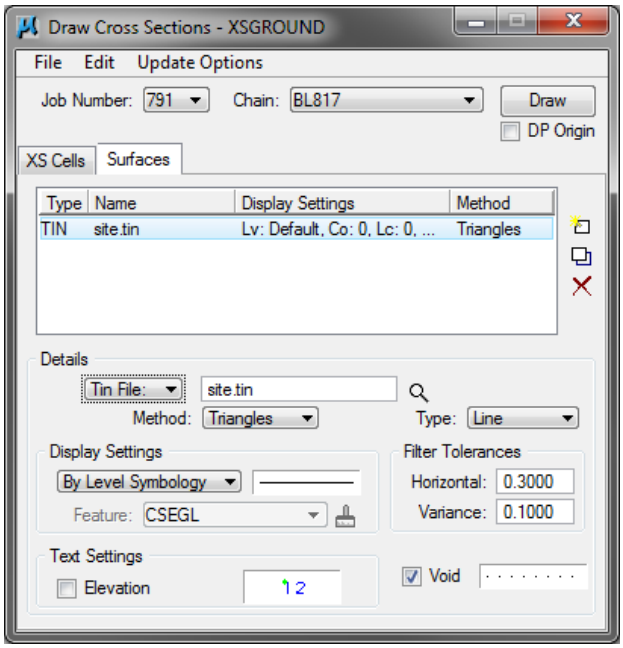


6. The Draw Cross Sections dialog opens.



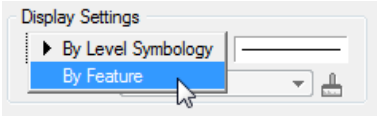
HINT *The XS Cells tab of the dialog fills out by the Working Alignment Definition.*

7. On Draw Cross Sections dialog, select the *Surfaces* tab to access the surface definition portion of the dialog.

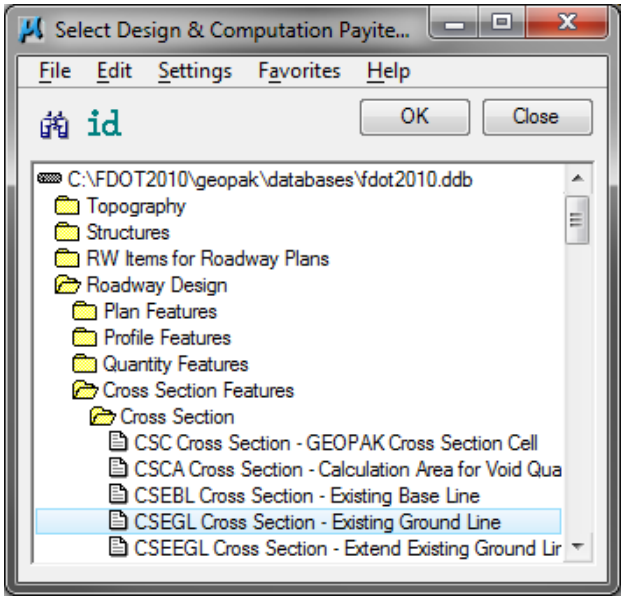


HINT The information from the Working Alignment Definition has populated the Surfaces Tab with the settings known up to this point.

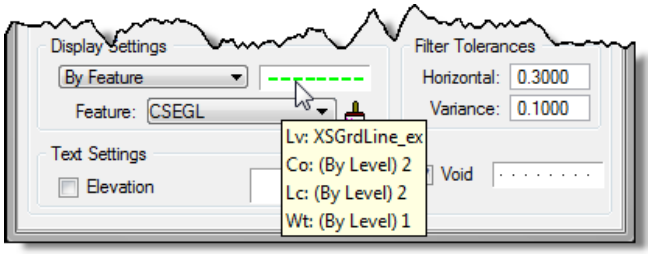
8. Under Display Settings, select **By Feature**.



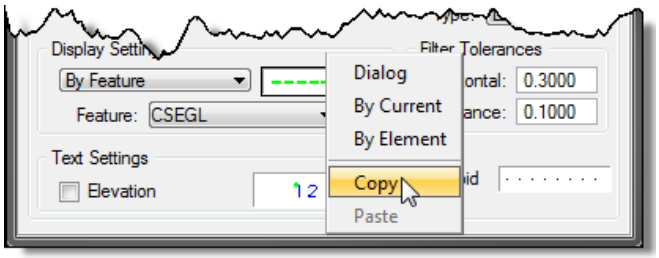
9. Click the **Browse Feature** icon . Select Design & Computation Payitem dialog opens.
10. In Select Design & Computation Payitem dialog, select the *Feature* **CSEGL** and click **OK**.



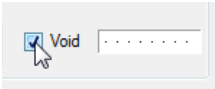
11. On the Draw Cross Sections dialog, the symbology changes to that of the selected feature.



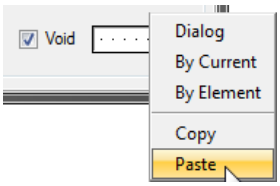
12. Right-click on the *By Feature* symbology box, as shown below and then select **Copy**.



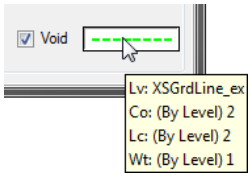
13. Enable the **Void** symbology toggle.



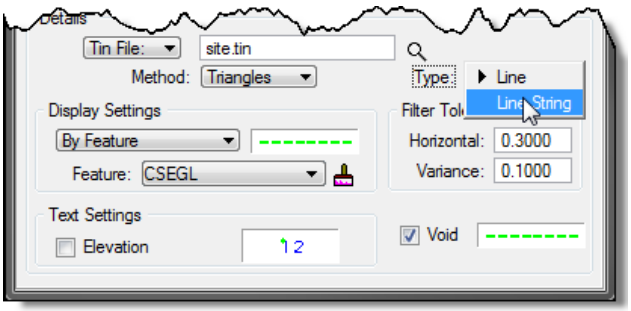
14. Right-click on the *Void* symbology box and select **Paste**.



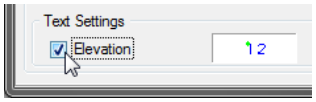
15. The *Void* symbology will change to be the same as the Existing Ground symbology.



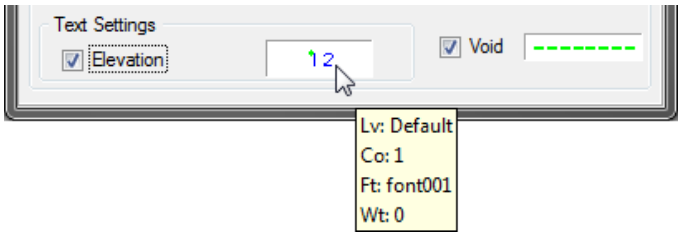
16. Change the *Type* to **Line String**.



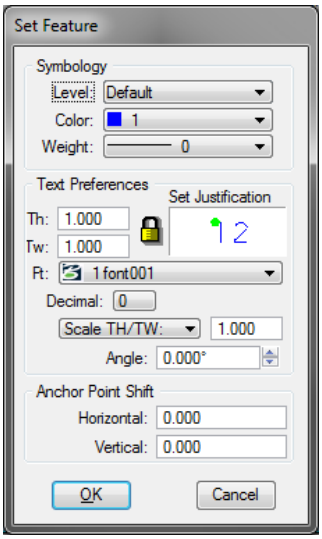
17. Enable the **Elevation** toggle.



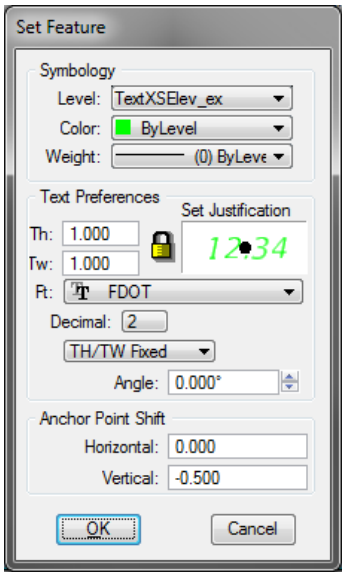
18. Double-click in the **Text** box.



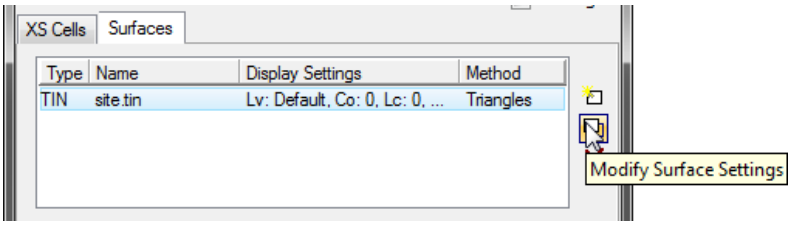
19. GEOPAK Set Feature dialog opens.



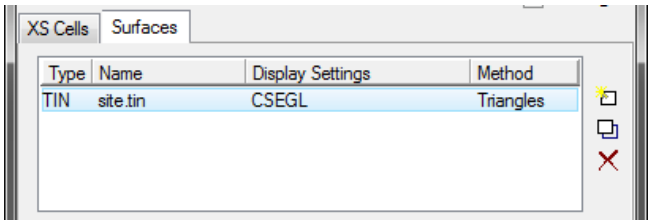
20. Set the *Elevation Text Features* to match those in the next figure, and then click **OK**.



21. GEOPAK Set Feature dialog closes.
22. Click the **Modify Surface** icon.



23. The *Surface* settings update in the list box.

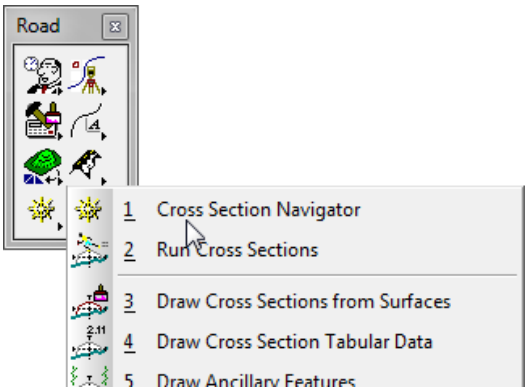


24. On Draw Cross Sections dialog, click the **Draw** icon to process the existing sections.
25. Close the Draw Cross Sections dialog. Click **Yes** when prompted to *Save Settings*.
26. From the MicroStation menu, select **Edit** > **Select All**.
27. From the MicroStation menu, select **Edit** > **Lock**.
28. From the MicroStation menu, select **File** > **Save Settings**.

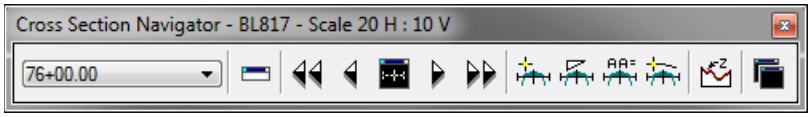
Exercise 3.4 Reviewing Cross Sections

In this exercise, the user reviews our existing ground cross sections using the Cross Section Navigator.

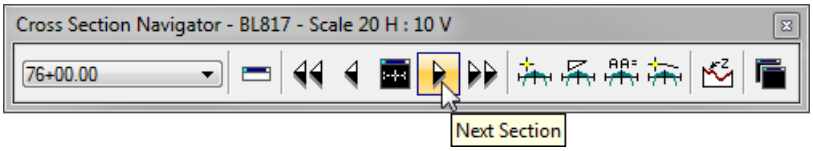
1. Sink the Road Project dialog.
2. From the *Road* toolbox, click the **Cross Section Navigator** icon.



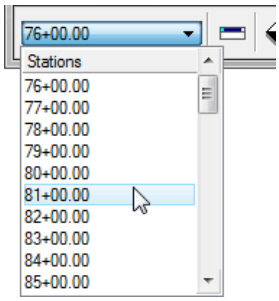
3. Cross Section Navigator opens.



4. Use the navigation icons to browse through the cross sections.

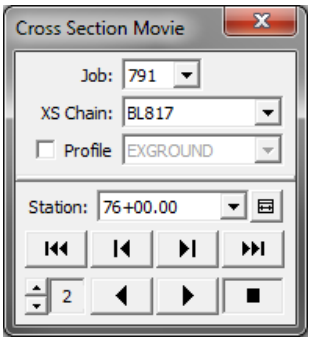


5. Use the *Station List* dropdown to access any particular station.

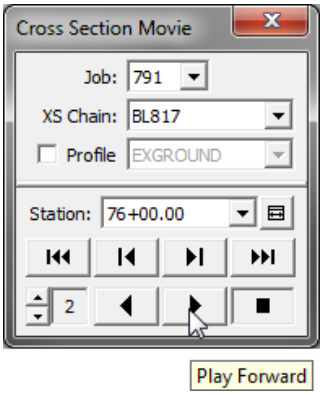


6. Close Cross Section Navigator.

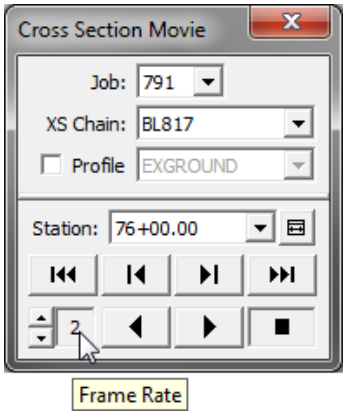
7. From the FDOT Menu, select Actions > GEOPAK VBA Utilities > Review Cross Sections in Animation. The VBA Cross Section Movie dialog opens.



8. Click the **Play Forward** icon to browse through the sections automatically.



9. Change the *Frame Rate* to **8** and then click the **Play Reverse** icon.

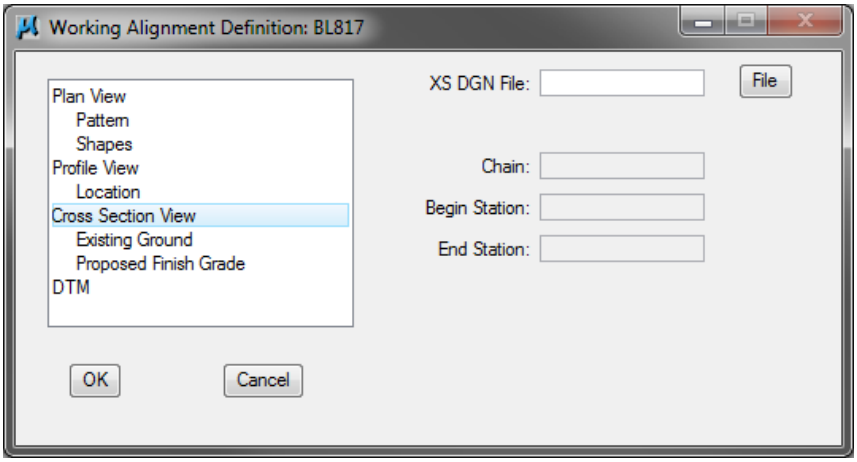


10. Close the VBA Cross Section Movie dialog.

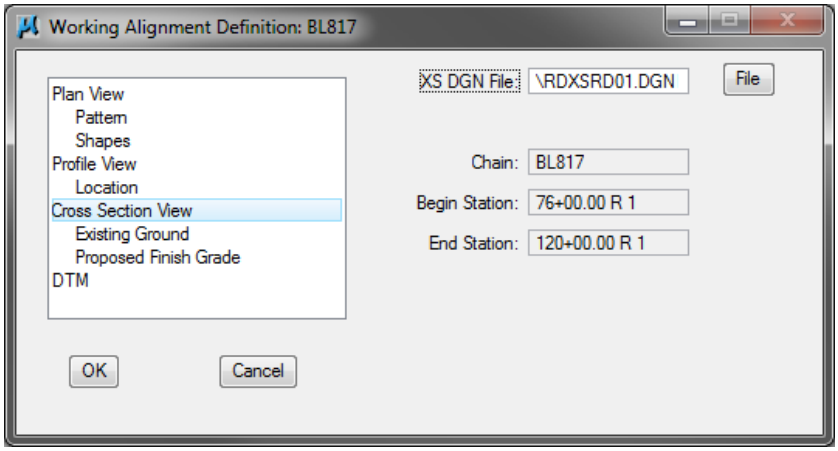
Exercise 3.5 *Exercise 3.5 UPDATING Working Alignment*

In this exercise, the user will update the Working Alignment with the cross section information.

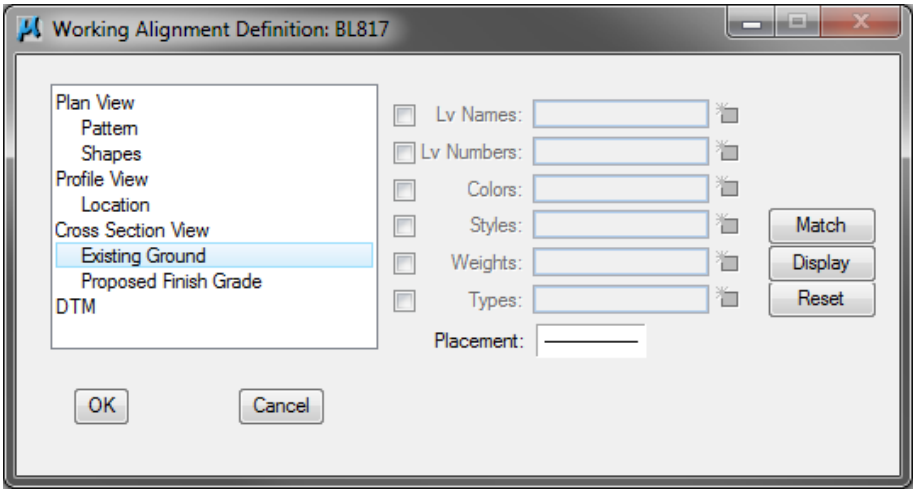
1. Access Project Manager.
2. From Road Project, click the **Define** icon to access the Working Alignment Definition dialog.
3. Select the category *Cross Section View*.



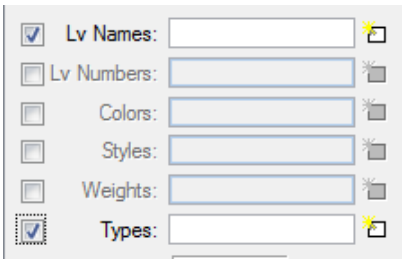
4. Click the **File** icon and select the design file: C:\E\Projects\22807915201\roadway*RDXSRD01.dgn*.
5. The *Chain*, *Begin Station* and *End Station* will populate automatically.



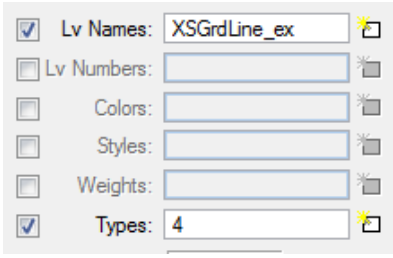
6. Select the item **Existing Ground**.



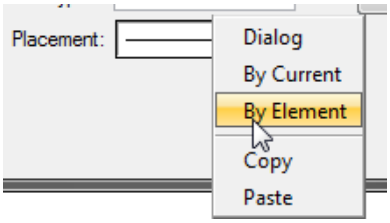
7. Enable the toggles for **Lv Names** and **Types**.



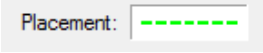
8. Click the **Match** icon.
9. Place a **Data Point** on an existing ground line element from one of the cross sections.
10. Place another **Data Point** to accept. The symbologies are populated.



11. Right-click in the *Placement* symbology box and select **By Element.**



12. Place a **Data Point** on an existing ground element from one of the cross sections.
13. Place another **Data Point** to accept. The *Placement* symbology updates.

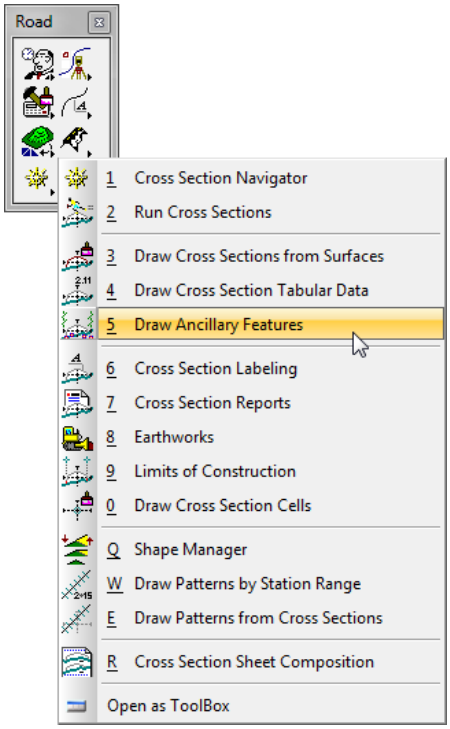


14. On Working Alignment Definition dialog, click **OK**. Working Alignment Definition dialog closes.

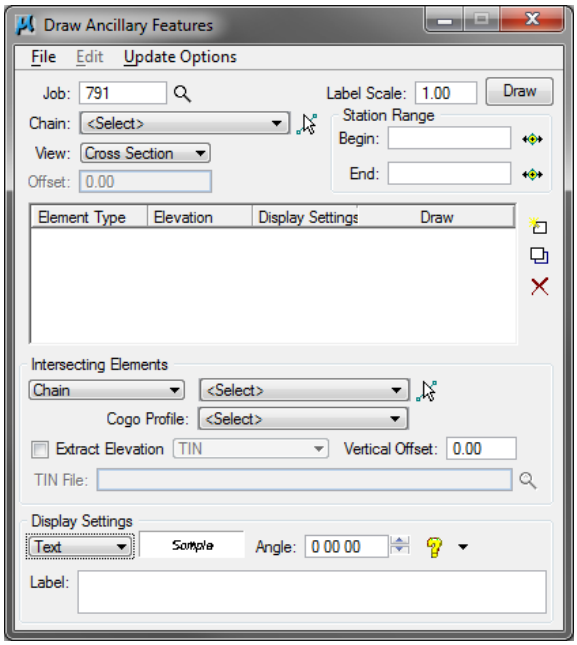
Exercise 3.6 Drawing Existing Utilities on Cross Sections

In this exercise, the user will draw existing utilities onto the cross sections using the Draw Ancillary Features application.

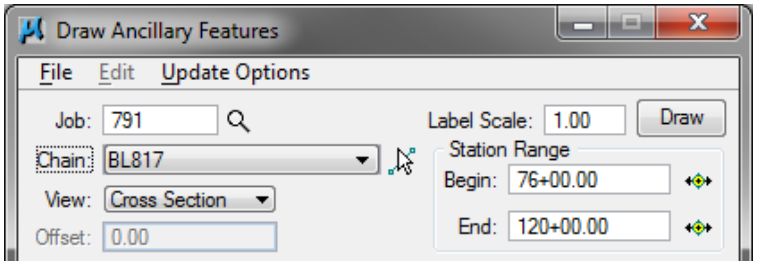
1. Open MicroStation design file C:\E\Projects\22807915201\utils*UTEXRD01.dgn*.
2. Sink the Road Project dialog.
3. From *Road* tools, click the **Draw Ancillary Features** icon.



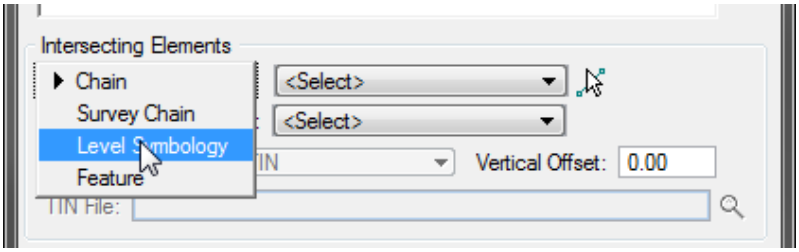
4. Draw Ancillary Features dialog opens.



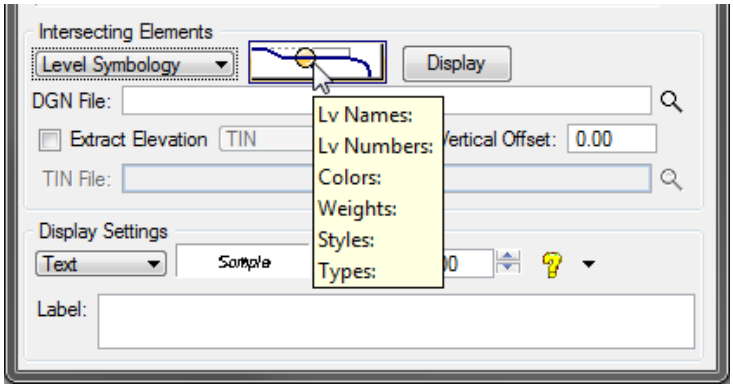
5. Select *Chain* **BL817**.



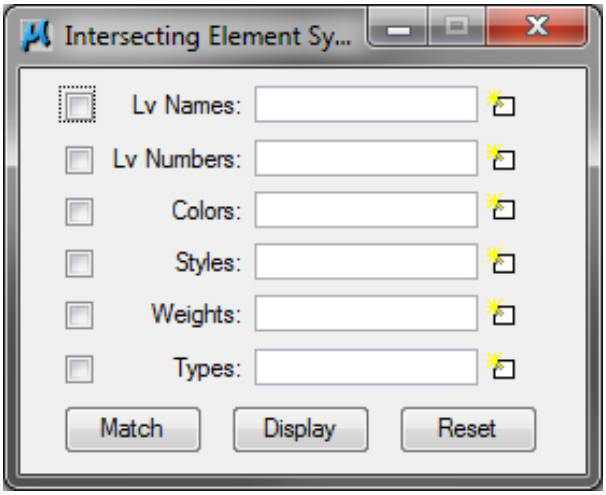
6. Under *Intersecting Element*, select the **Level Symbology**.



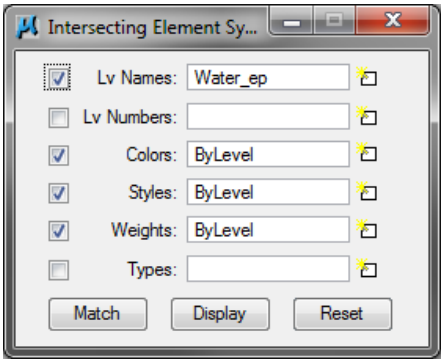
7. Click the Intersecting Element Symbology icon.



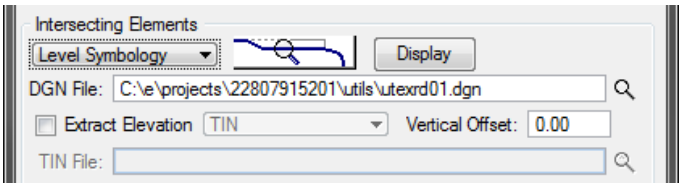
8. The Intersecting Element Symbology dialog opens.



9. Fill out the dialog as shown below:

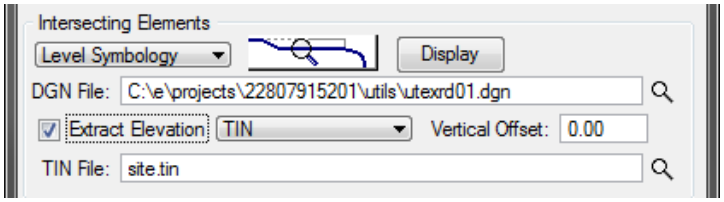


10. Close the Intersecting Element Symbology dialog.
11. Type in or select the design file C:\e\Projects\22807915201\utils*UTEXRD01.dgn*.

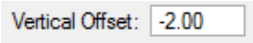


12. Enable the toggle for **Extract Elevation**.

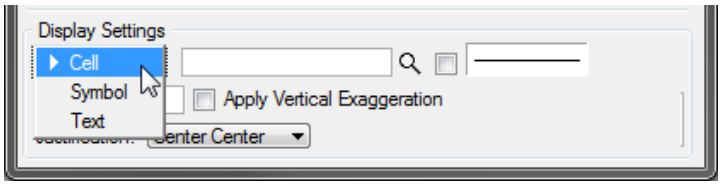
13. Type in or select the *TIN file* C:\E\Projects\22807915201\roadway*site.tin*.



14. Key-in a *Vertical Offset* of **-2.00**

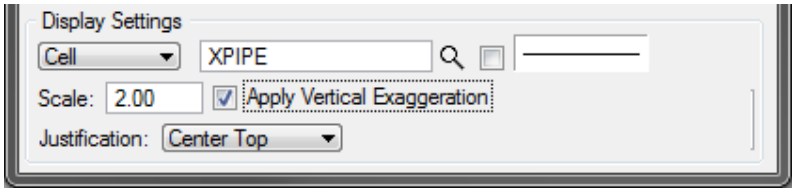


15. Set Display Settings to **Cell**.

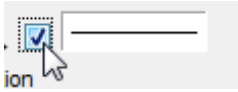


16. Under Display Settings, key-in the *cell name* **XPIPE**.
17. Key-in **2** for *Scale*.
18. Set *Justification* to **Center Top**.

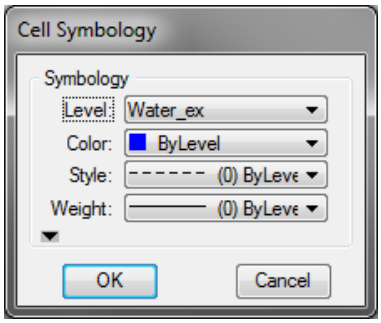
19. Enable the Apply Vertical Exaggeration toggle.



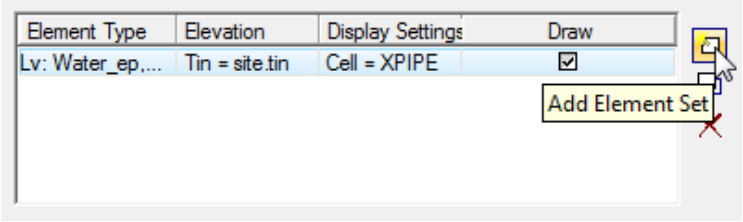
20. Enable the **Cell Symbology** toggle.



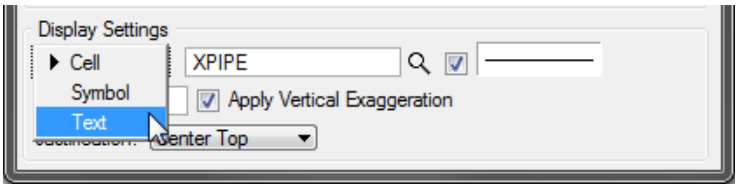
21. Double-click on the **Cell Symbology** graphic to open the Cell Symbology dialog. Set as shown below and Click **OK**.



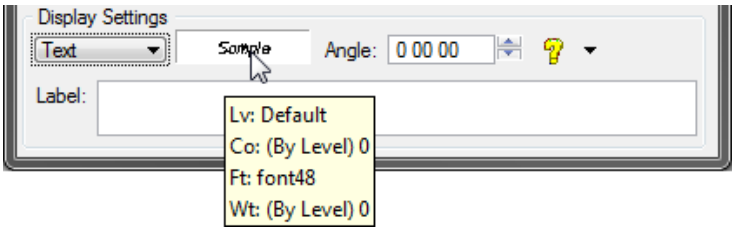
22. Click on the **Add Element Set** icon to add the utility to the list box.



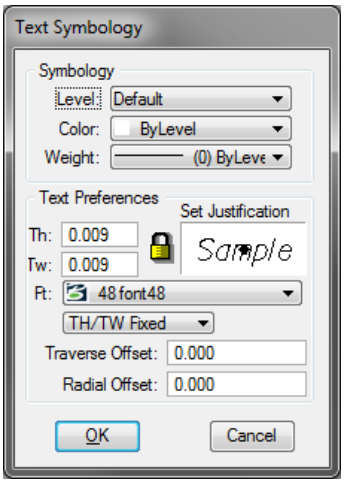
23. Set the Display Settings to **Text**.



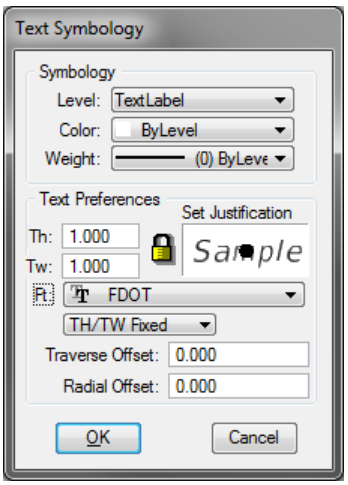
24. Double-click on the **Text Symbology** box.



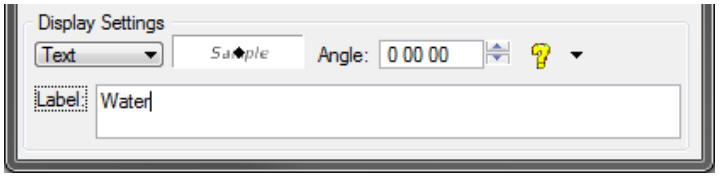
25. The Text Symbology dialog opens.



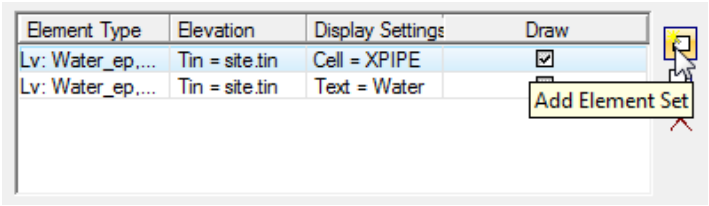
26. Fill out the dialog as shown in the figure and click **OK**.



27. In the *Label* box, key-in a label for the utility (e.g. **Water)**.



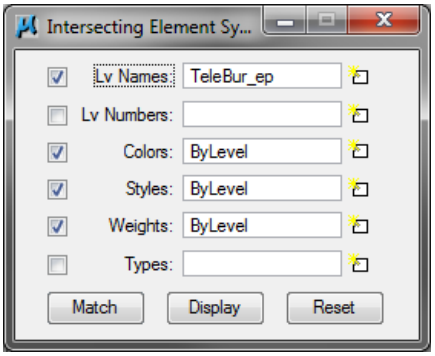
28. Click the **Add Element Set** icon to add the utility to the list box.



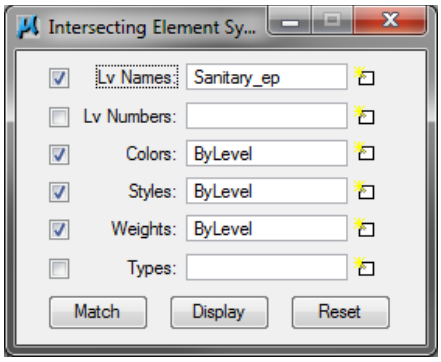
29. Repeat steps 6 through 24 for each of the following utilities, using the specified *vertical offset* for each.

Note There are a couple of things to remember: *First,* make sure that when you set the symbology for each subsequent utility that you clear out the existing symbology in the dialog by using the Reset icon. If you do not do this then you may end up appending additional symbology instead of replacing what is already in the dialog. *Second,* as you add each additional utility do not forget that each utility requires two entries in the list box: 1 entry to be displayed with a cell and a 2nd entry to be displayed with a text string.

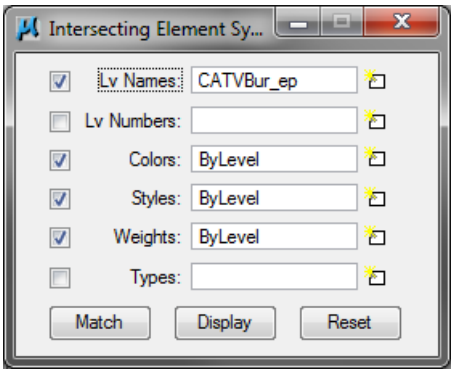
30. For Buried Telephone, use a *Vertical Offset* = **-4.00**.



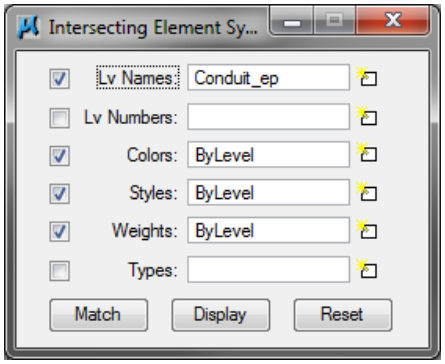
31. For Sanitary Sewer, use a *Vertical Offset* = **-6.00.**



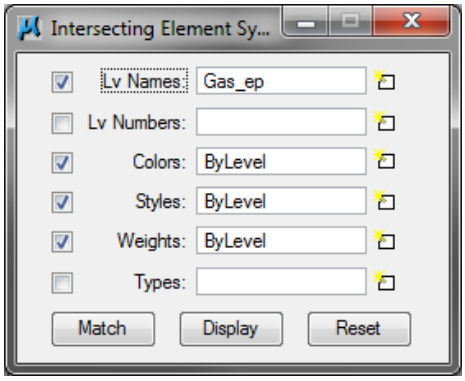
32. For Buried Cable TV, use a *Vertical Offset* = **-2.00.**



33. For Buried Conduit, use a *Vertical Offset* = **-3.00**.

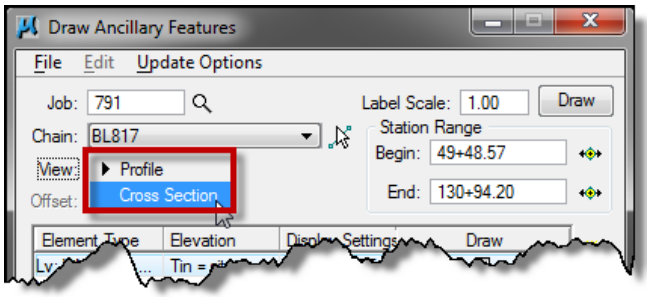


34. For Buried Gas, use a *Vertical Offset* = **-5.00**.

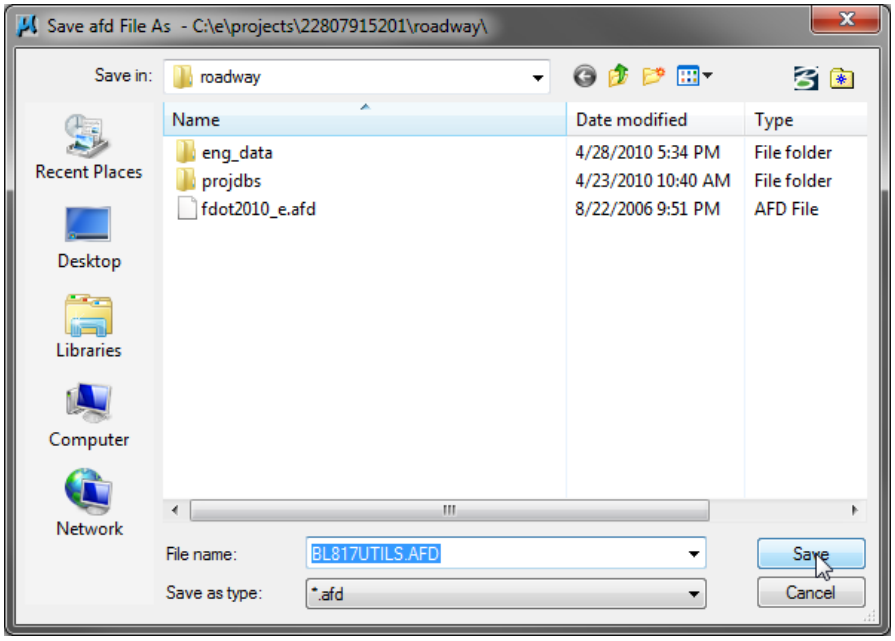


35. Without closing Draw Ancillary Features, open the design file: c:\E\Projects\22807915201\roadway*RDXSRD01.dgn*.

36. Change the *View* option to **Cross Section**.

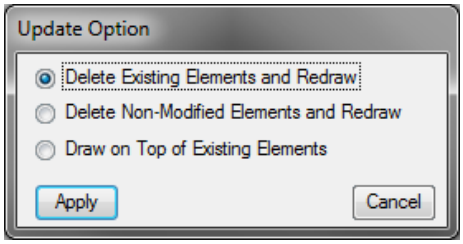


37. From the Draw Ancillary Features menu, select **File** > **Save**. The Save afd File As dialog opens.



38. Key-in the *File Name* **BL817UTILS.afd** and click **OK**.
39. From the completed Draw Ancillary Features dialog, click the **Draw** icon to process the utilities and draw them into the cross section file.

40. Toggle on the **Delete Existing Elements and Redraw** in the Update Option dialog and click **Apply.**



41. Close Draw Ancillary Features dialog.
42. Review the cross sections and utilities using Cross Section Navigator.
43. From the MicroStation menu, select **Edit** > **Select All**.
44. From the MicroStation menu, select **Edit** > **Lock**.
45. Exit MicroStation.

4 PROPOSED PROFILE & ACTIVE CHAIN CONTROL

OBJECTIVES

- Visualization of the Profile Through COGO
- Draw the Vertical Alignment to FDOT Standards Using the Draw Profile Tool.
- Update the Working Alignment.
- Overview of Active Chain Control
- Set Up of Active Chain Control

This chapter discusses creating a vertical alignment (profile). The users will create a proposed profile with Layout Profile (VPI Based), which opens the Profile Generator. The setup and use of GEOPAK Active Chain Control enables the user to manage plan, profile, and cross section views simultaneously. It also allows usage of MicroStation tools to place elements in any view based on the Curvilinear Coordinates settings. In this chapter, the following topics are covered:

Creation of a vertical alignment (profile) by duplicating a portion of the proposed profile PGL-RT using Key-ins is covered. This profile will be re-created using the existing ground profile cell as an anchor. This will be done using Layout Profile (VPI Based) also known as Profile Generator.

The attachment of the correct K Value file (*kvl*) is detailed. This profile, as did the original, will not have any vertical curves because the back and ahead grades for each VPI is less than the maximum required algebraic difference for grade at the specified design speed.

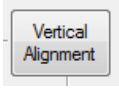
Creation of a vertical alignment (profile) using the Profile Generator's Dynamic option creating grades and VPIs by dynamic graphical manipulation. Creation of the profile starts at the first point of the previously created existing ground line profile. The VPIs place dynamically and the grades graphically manipulated so that vertical curves based on design speed and K Values are required. The user manipulates vertical curves for lengths that are appropriate for placement in a plan set and corrected for any overlap, using Profile Generator tools. Preferences will be set based on desired rounding of grades and lengths. Preference settings primarily affect the use of the Dynamic option.

PROFILE GENERATOR

The Profile Generator is a tool used to graphically create, manipulate and store proposed profiles or modify existing profiles. Profile generates and modifies under the control of an interactive dialog box. The user can choose to key-in stations and elevations and/or use dynamic graphical manipulation to insert or modify VPIs with the click of a mouse.

FDOT provides K-value tables for establishing the stopping sight distance for crest and sag curves. Once the user enters design speed, the profile generator reads the K-value table and draws a vertical curve at the maximum K-value settings applicable to the speed selected. The user modifies vertical curve length manually by entering a length to round to an even number.

ACCESSING PROFILE GENERATOR

From the Road Project dialog, click the 

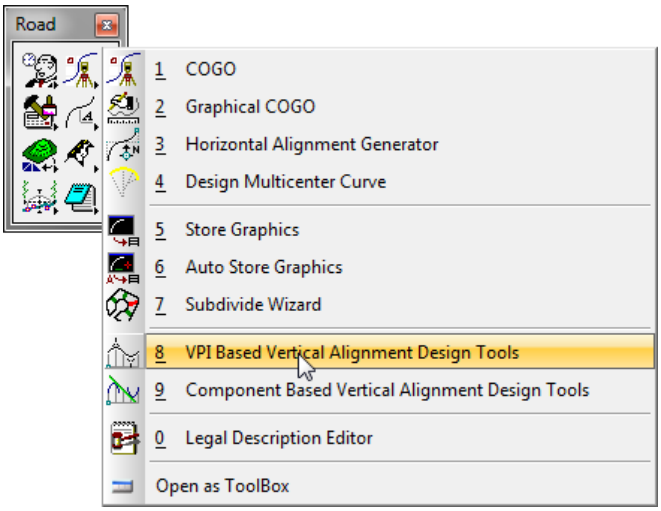
icon

<OR>

From MicroStation, select **Applications > ROAD >Geometry > Layout Profiles (VPI Based)**

<OR>

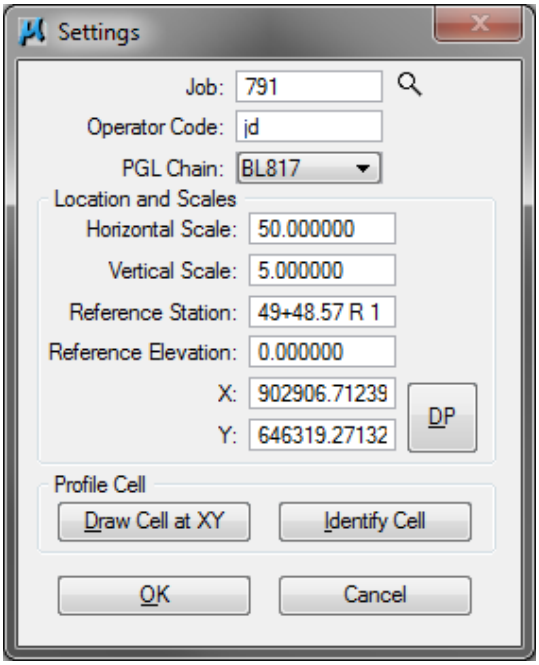
From the *Road* tool box, click the **Vertical Alignment** icon.



SETTINGS DIALOG

The purpose of the Settings dialog is to identify the area in the design file where you will be working. Unlike an alignment that has coordinates and a specific location in a design file, a profile has no specific location and can be placed anywhere in the design file. This dialog gives the software the necessary information to identify the profile location.

Accessing **Profile Generator** (using any of the options mentioned above), opens a Settings dialog.



Job — This specifies the COGO database (.gpk) to be used to store or access a given profile name.

Operator Code — A two-character designation that identifies the operator/user (typically this would be the user's initials). When any input or output files are stored this user designation is added to the name of the file.

PGL Chain — This specifies the alignment name that is associated with the profile.

Location and Scales

Horizontal Scale — This specifies the Horizontal Scale of the plotted profile.

Vertical Scale — This specifies the Vertical Scale of the plotted profile.

Reference Station — This is the Beginning Station of the *plotted* profile, but not necessarily the beginning station of the profile. This reference station is used in conjunction with the reference elevation as a reference point when working with the profile.

Reference Elevation — A given elevation that is combined with the reference station to be used by the software as a reference point when working with the profile.

X — The X coordinate of the Reference Station/Reference Elevation location. This coordinate can either be keyed-in or set by the DP icon.

Y — The Y coordinate of the Reference Station/Reference Elevation location. This coordinate can either be keyed-in or set by the DP icon.

DP icon — This icon can be used to set the X and Y coordinates of the reference point.

Profile Cell

Draw Cell at X,Y — Plots a profile cell at the location given by the X and Y coordinates using the information in the Settings Dialog. This tags the profile cell with all of the above information for easy access by other dialogs in the future.

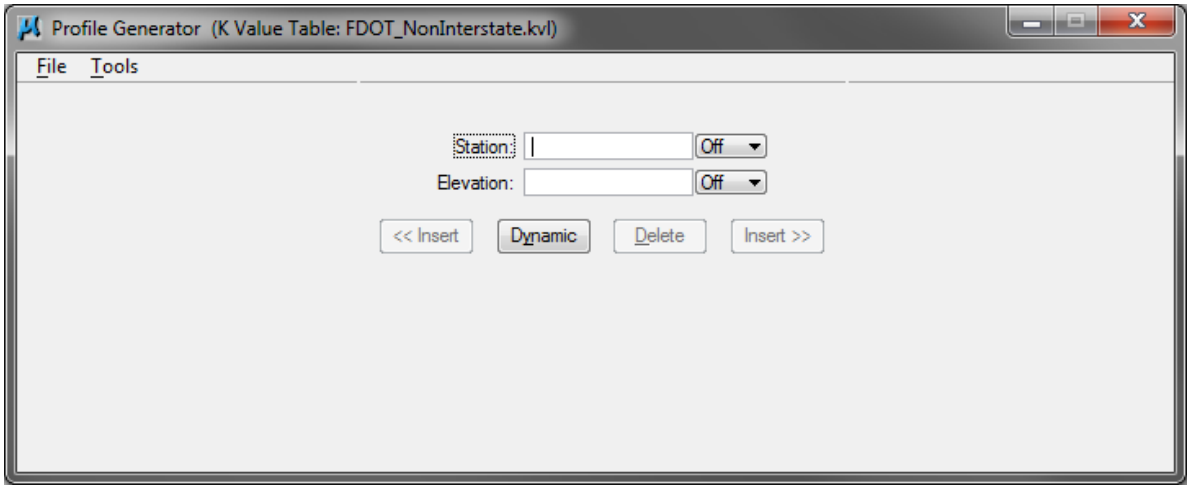
Identify Cell — This allows the user to select a previously plotted Profile Cell. All of the information is then Clicked up from this Profile Cell and used to populate the Settings dialog.

OK — Accepts and closes the Settings dialog, which then opens the Profile Generator dialog.

Cancel — This closes the Settings dialog without accessing Profile Generator.

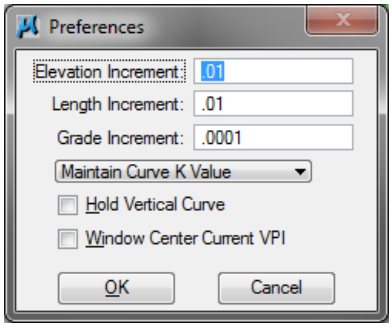
PROFILE GENERATOR MENUS

Selecting the *OK* icon on the Settings dialog opens the Profile Generator dialog. The Profile Generator has two menus detailed below: **File** and **Tools**.



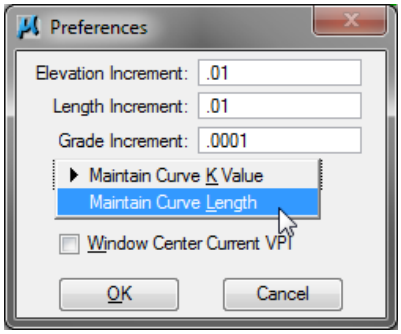
PROFILE GENERATOR FILE MENU

Preferences Preferences permits the specification of rounding parameters. On Preferences, elevations, vertical curve lengths and VPI to VPI distances round to two decimal places, while grades round to one ten thousandth of a percent. The following figure shows the preferences that are acceptable to FDOT.



Elevation Increment, Length Increment, and Grade Increment - Defined in Preferences and affect dynamic operations while designing profiles.

Curves



Maintain Curve K Value - fixes the K value so that length is allowed to change based upon the fixed k value.

Maintain Curve Length - fixes the length value and allows the k value to be adjusted

Hold Vertical Curve - Check box works with Maintain Curve K Value and Maintain Curve Length to lock Vertical Curve information during VPI modifications. If not selected, the vertical curve is allowed to respond to changes in the forward and back grades, length, and speed.

Window Center Current VPI - Check box keeps the active VPI centered in the window during VPI modifications.

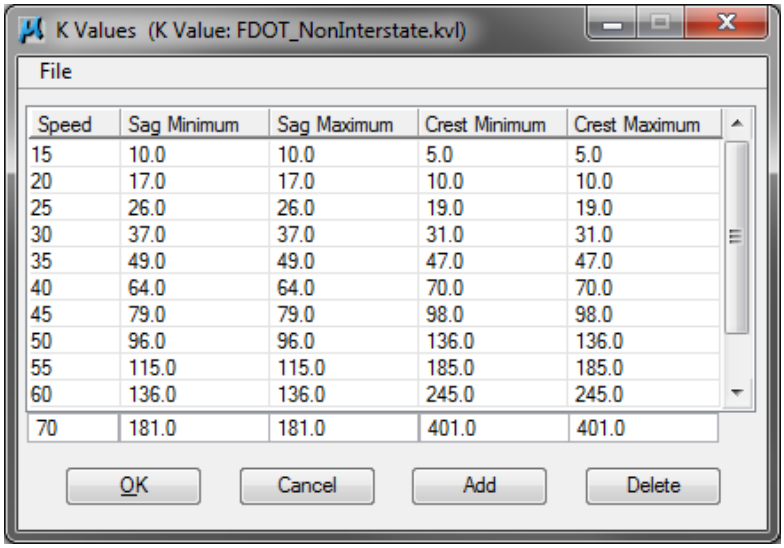
Profile Cell Settings This opens the Settings dialog previously discussed.

K Value Table Establish this once and rarely changed. K Values for Stopping Sight Distance defines the stopping sight distance K-values for crest and sag conditions at various user specified design speeds. FDOT provides a K Value table located in the FDOT2008\GEOPAK\bin folder. There are two files to choose from based on your project:

FDOT_NonInterstate.kvl - for freeway (non-interstate) roadways

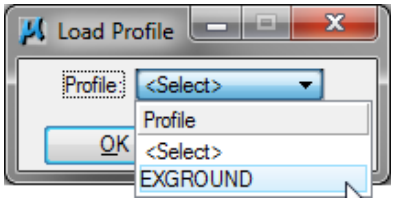
FDOT_Interstates.kvl - for interstate roadways

For definitions of the following terms, refer to the Glossary of Terms in the PPM Volume I chapter 2.



Speed	Sag Minimum	Sag Maximum	Crest Minimum	Crest Maximum
15	10.0	10.0	5.0	5.0
20	17.0	17.0	10.0	10.0
25	26.0	26.0	19.0	19.0
30	37.0	37.0	31.0	31.0
35	49.0	49.0	47.0	47.0
40	64.0	64.0	70.0	70.0
45	79.0	79.0	98.0	98.0
50	96.0	96.0	136.0	136.0
55	115.0	115.0	185.0	185.0
60	136.0	136.0	245.0	245.0
70	181.0	181.0	401.0	401.0

Load Profile Loads previously stored profile selected from profiles that are located inside the .gpk file.



Save Profile Stores a new profile or updates a previously stored profile under the same name in the *.gpk* file. Redefine must be ON-+ in COGO to update profiles.

Save Profile As Stores the profile under a different name.

Clear Profile Erases the information that currently displays in the Profile Generator along with the temporary graphics that are displayed in the MicroStation file.

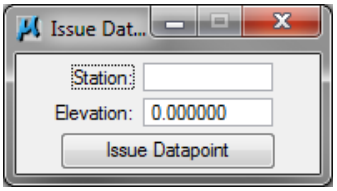
Draw Profile Changes the temporary graphics displaying the profile into permanent graphics using the active level symbology. Typically, the user utilizes Profile Generator to display the profile with temporary graphics depicting your current level symbology. The closing of Profile Generator erases the temporary graphics.

Exit Closes Profile Generator.

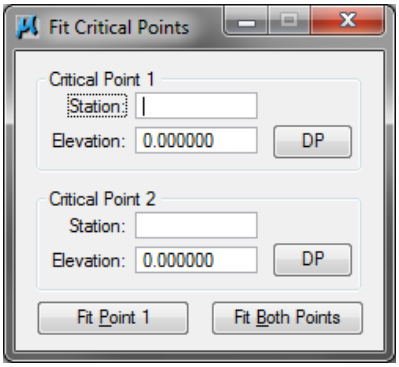
PROFILE GENERATOR TOOLS MENU

The Tools menu has the following commands.

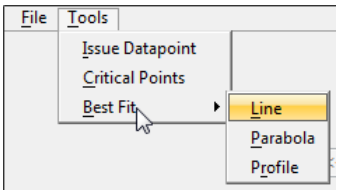
Issue Data Point Enables the user to type in stations and elevations and issue a MicroStation Data Point that can be part of a place line, place cell or any other generic MicroStation operation. For example, a cell representing the low member or bridge beam could be placed with this tool.



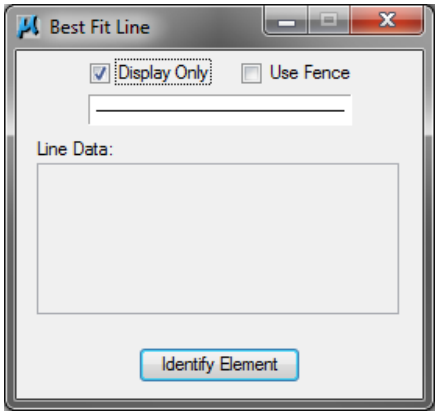
Critical Points Vertical curves define in terms of one or two critical points. As can be ascertained from *Critical Points* in the following figure, the user may define the *station* and *elevations* for the critical points either by key-in or by placing a Data Point in the MicroStation file. If mathematically solvable, the vertical curve is drawn and the speed and K-value options adjust to the appropriate design speed.



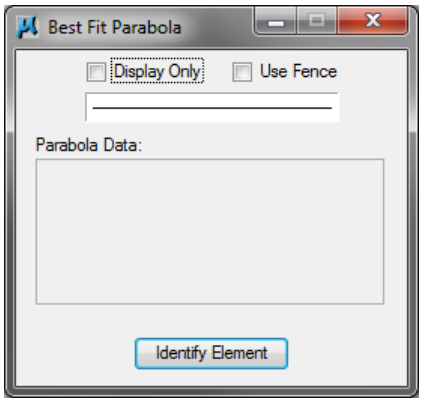
Best Fit There are three options for Best Fit: *Line*, *Parabola* and *Profile.*



Line This option fits a line between the candidate elements. The resultant line data is displayed in the dialog and the line is drawn onto the profile cell.



Parabola This option fits a vertical curve between the candidate elements. The resultant curve data displays in the dialog and the curve is drawn onto the profile cell.



The fields below apply to both the line and parabola options:

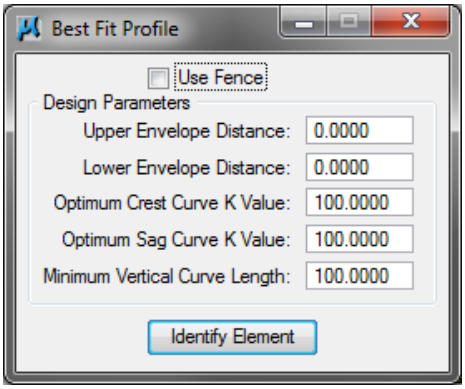
Display Only - Elements display only and not drawn into the MicroStation file when this toggle is on.

Use Fence - The best fit line is drawn using only the elements within the fence when this toggle is on.

Line/Parabola Data - The line data displays here.

Identify Element - This allows the user to identify elements used dynamically.

Profile This option fits a profile comprised of tangent lines and vertical curves between the candidate elements based on the constraints in the Design Parameters. As there is no symbology option, the active symbology is used. Use Fence and Identify Element operate as described above.



CALCULATING THE VERTICAL CURVE LENGTH

The formula for calculating the Vertical curve length is L=KA where

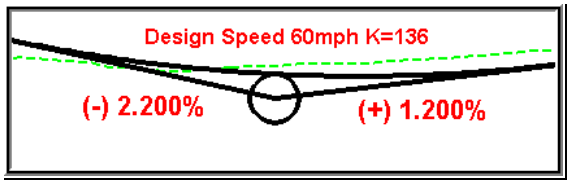
L= Minimum Length

K= Constant based on design speed (look at the tables Volume I Chapter 2 in PPM)

A= Algebraic Difference in Grades (percent)

For this example, our road is an Arterial, the design speed is 60mph and we are designing a sag curve.

K = 136 based on table in PPM Volume I Chapter 2.



Back grade into sag curve is (-) 2.200% and grade ahead is (+) 1.200%

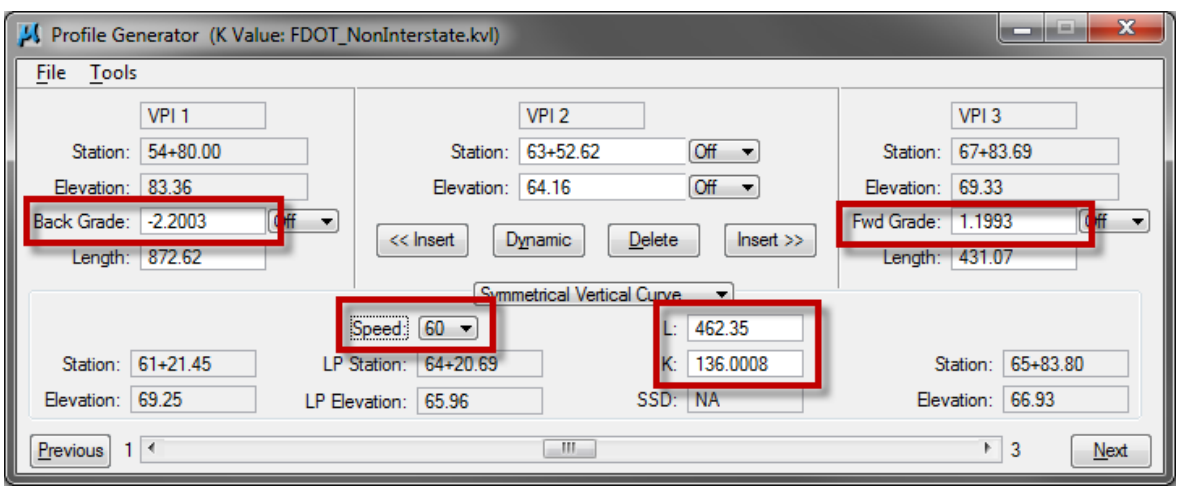
The Algebraic Difference is 2.200 + 1.200 = 3.400 so A = 3.4

Back to the formula:

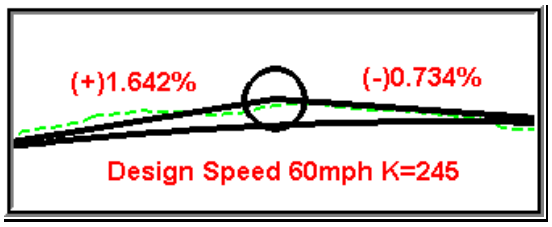
L=KA so L=136 x 3.4 or L = 462.4

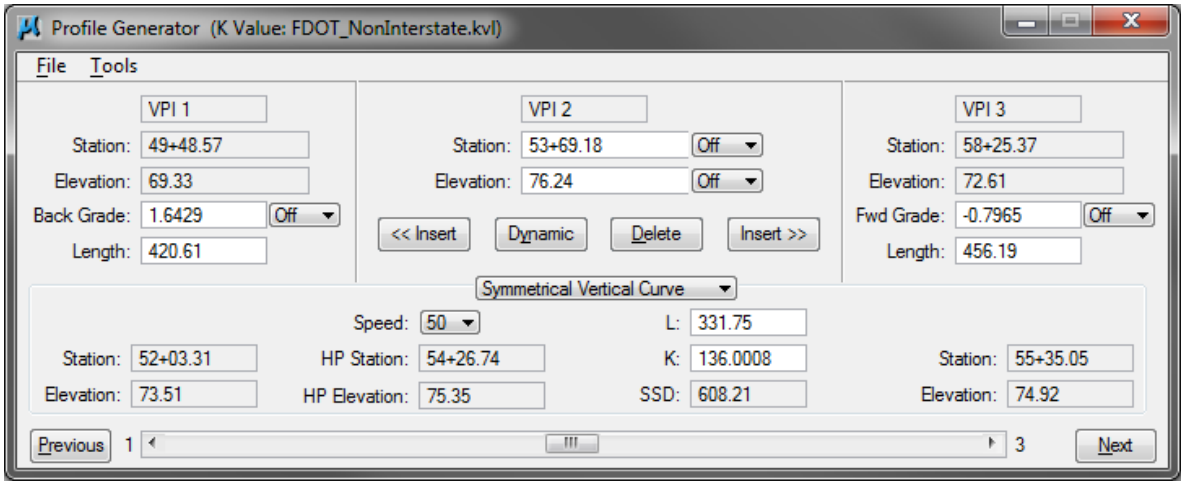
L = 462.4 is the minimum vertical curve length.

The following figure shows the same results as above, except that the Profile Generator does the calculations. The Back Grade, Forward Grade and selected Design Speed were entered, and the Length and K value were calculated using the default.kvl table.



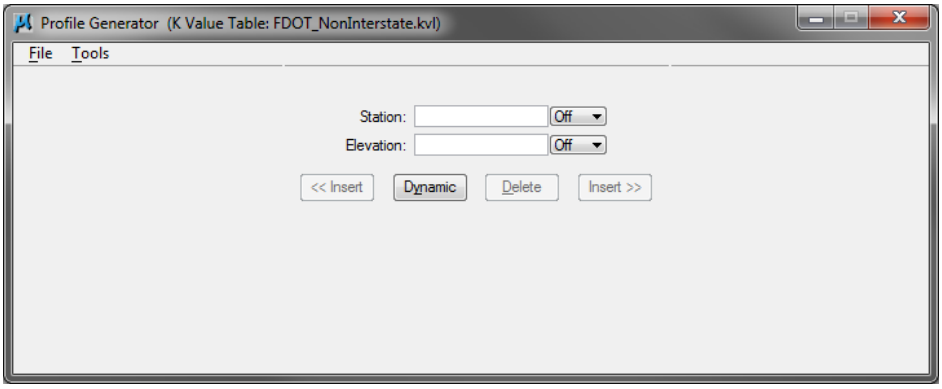
The following figure shows an example of a Crest vertical curve calculated by GEOPAK using the .kvl tables. Refer to the charts in the PPM to find that the calculations for Length and K Value meet the same design criteria as FDOT.





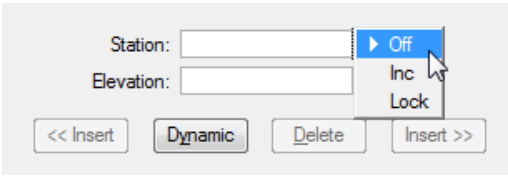
ENTERING VPIS

A vertical alignment can be stored in two ways: either manually input the stations and elevations or dynamically choose them.



Station This is the Station of a VPI. The icon on the right of box locks in the station.

Elevation This is the Elevation for the previously entered Station. The icon on right of box locks in the elevation.



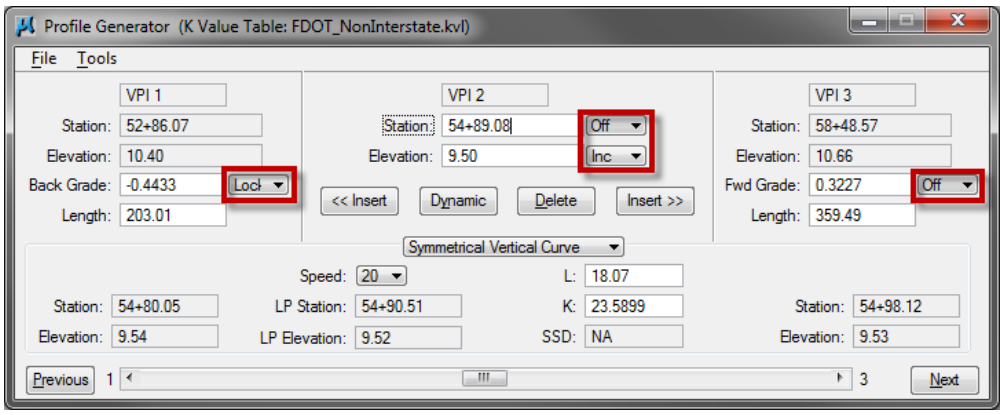
Parameter Options:

Off This allows full, unencumbered dynamics. GEOPAK attempts to round the associated parameter to the increment set in *Preferences*, but there is no guarantee.

Inc Ensures that the designated profile parameter rounds in accordance with the increment defined in *Preferences*.

Lock Forces all dynamic operations to maintain the designated profile parameter.

Profile Generator provides *Profile Parameter Option* icons for the Back Grade, the Current VPI Station, the Current VPI Elevation and the Forward Grade. There is no option icon for grade lengths because the current VPI station dictates grade lengths. See the following figure.



Of the four *Profile Parameter Option* icons circled in the preceding figure, the following combinations are the only ones allowed:

One can be Locked with the other three Off.

One can be Locked, one can be set to Inc (increment) & the other two Off.

Two can be set to Inc and the other two Off.

Dynamic This allows the user to click on the profile, which populates the Station and Elevation boxes. When these ground rules are not satisfied, setting one *Profile Parameter Option* icon automatically and appropriately adjusts any conflicting *Profile Parameter Option* icon.

For example, if the Station box is Locked and the user attempts to lock the Elevation box, the option icon for the Station box is unlocked and returned to the OFF setting.

ACTIVE CHAIN CONTROL

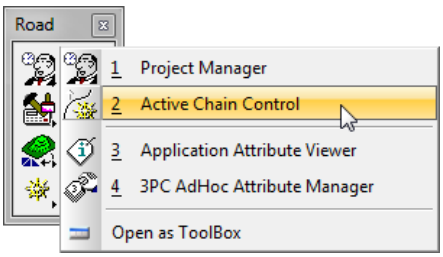
Active Chain Control enables the user to manage plan, profile and cross section views simultaneously. It also allows usage of MicroStation tools to place elements in any view based on the curvilinear coordinate settings. Active Chain Control requires that the files representing the various views be referenced (i.e., plan, cross section and profile) before utilizing the tool.

ACCESSING ACTIVE CHAIN CONTROL

From MicroStation, select **Applications** > **GEOPAK Road** > **Active Chain Control**

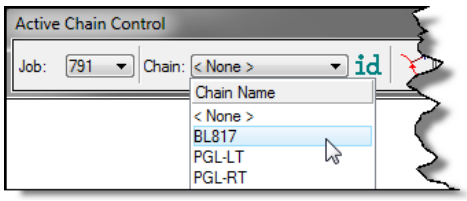
--or--

From the Road toolbox, click the **Active Chain Control** icon.



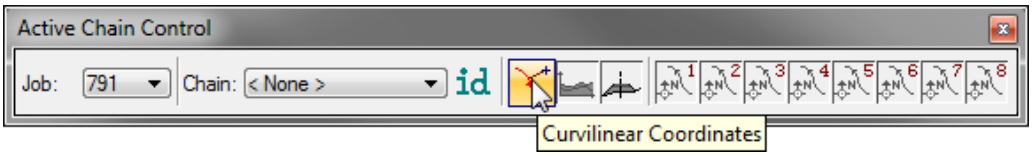
Job Defines the GPK file to be used.

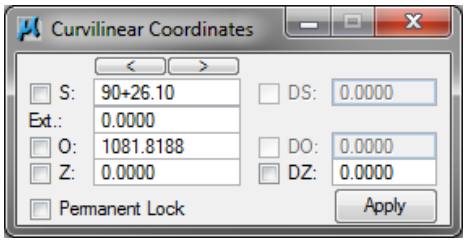
Chain Defines the chain that is associated with the component views to be used with Active Chain Control.



id Used to graphically select the chain.

Curvilinear Coordinates Opens Curvilinear Coordinates dialog, which enables the user to enter precise curvilinear coordinates relative to the active chain.





S This is the Station along the active chain. If the lock is on, the pointer follows a perpendicular line to the chain in plan views, and a vertical line in profile views.

Ext. This is the Extension to the station along the 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 active chain. If the lock is on, the pointer follows a parallel line to the chain in plan views.

Z Use this box to enter elevation. If the lock is on, the pointer follows a horizontal line in Profile views.

DS Delta station from the previous **Data Point** or tentative point. If the lock is on, the pointer follows 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 is on, the pointer follows a parallel to the chain in plan views.

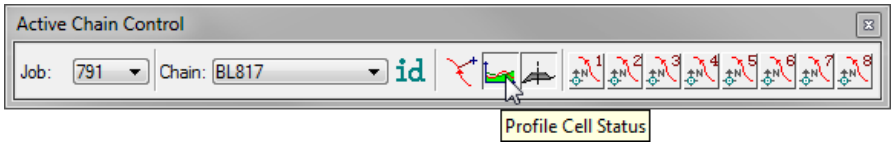
DZ Use this box to enter delta elevation from the previous **Data Point** or tentative point. If the lock is on, the pointer follows a horizontal line in Profile views.

Permanent Lock When selected, coordinate locks remain active, even after a **Data Point** is clicked.

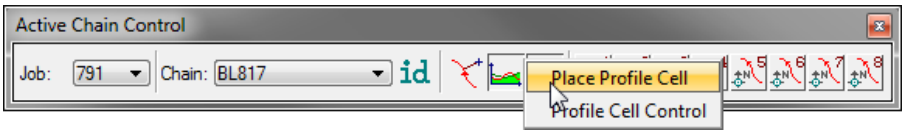
Apply Click to send a **Data Point** to the input queue. Entering a **Data Point** by a click in a view has the same effect.

Tip Use the check box(es) at the left of one or more boxes to lock the value of the associated box(es).

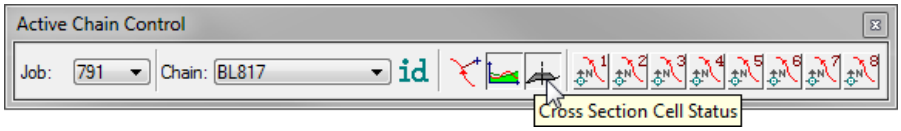
Profile Cell Status icon Displays the status of the profile component view. If the Profile Cell Status icon is dimmed, a profile cell is not present in the active or reference files. If Profile Cell Status is colored, then there is a profile cell present.



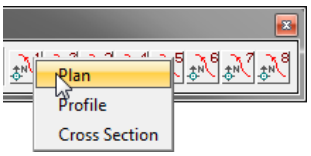
If you right-click the **Profile Cell Status** icon, a menu appears with the commands **Place Profile Cell** and **Profile Cell Control**. See Chapter 2 for descriptions of these commands.



Cross Section Cell Status Displays the status of the cross section component view. If dimming Cross Section Cell Status, no Cross Section cell is present in the active or reference files. If Cross Section Cell Status is colored, a cross section cell is present.



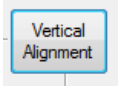
Fit View These icons correspond to the MicroStation view windows. Each icon can be defined to: Plan, Profile, or Cross Section.



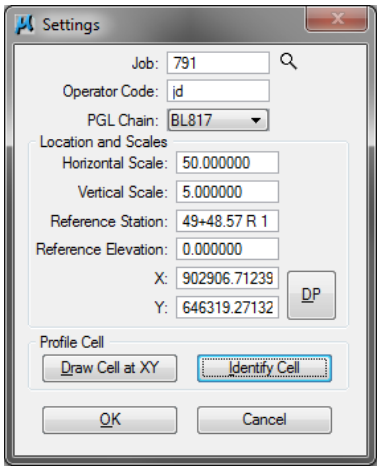
If you right-click a Fit View icon, a menu appears with a selection of component views controlled by that icon.

Exercise 4.1 Storing the Vertical Alignment with Key-Ins

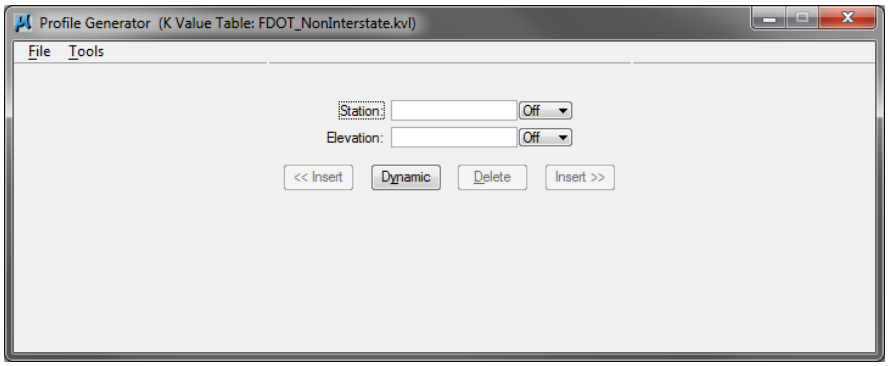
In this exercise, the user will design your proposed profile based on information in a provided table.

1. Double-click on the self-extracting zip file C:*Chapter4_Exercises.exe* and click the **Unzip** icon at the prompt. This will extract and setup the files needed for this exercise.
2. Open the design file C:\e\Projects\22807915201\roadway*DSPFRD01.dgn*.
3. Access Project Manager. From Road Project, click the 

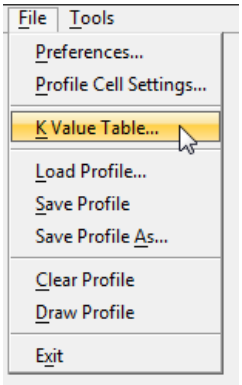
icon.
4. Settings dialog opens. The information in the dialog automatically fills based on the *Working Alignment* definition.



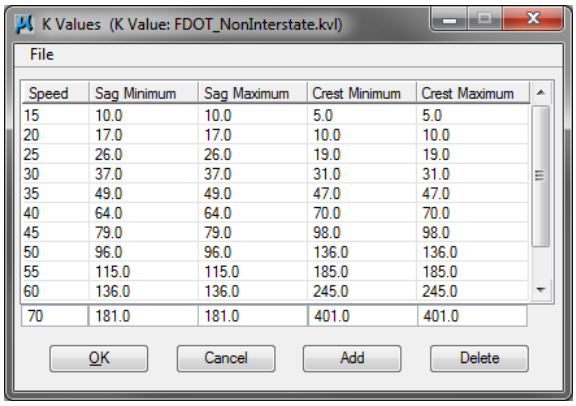
5. From Settings, click the **OK** icon. Profile Generator dialog opens.



6. From the Profile Generator menu, select **File** > **K Value Table**.



7. K Values opens.



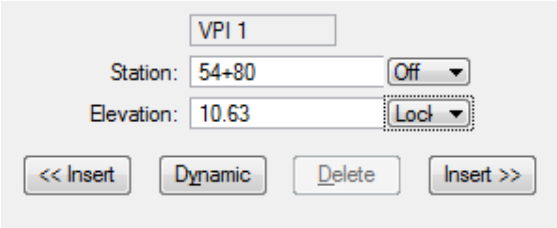
Speed	Sag Minimum	Sag Maximum	Crest Minimum	Crest Maximum
15	10.0	10.0	5.0	5.0
20	17.0	17.0	10.0	10.0
25	26.0	26.0	19.0	19.0
30	37.0	37.0	31.0	31.0
35	49.0	49.0	47.0	47.0
40	64.0	64.0	70.0	70.0
45	79.0	79.0	98.0	98.0
50	96.0	96.0	136.0	136.0
55	115.0	115.0	185.0	185.0
60	136.0	136.0	245.0	245.0
70	181.0	181.0	401.0	401.0

Note These values match the PPM chart in Volume I, Chapter 2, for a Sag or Crest curve.

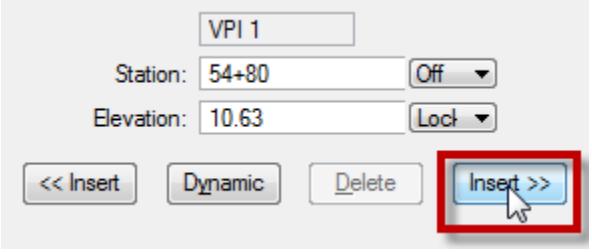
8. Confirm that the *K Values* are the **FDOTNonInterstate.kvl,** and then click **OK**. K Values closes and the table attaches to Profile Generator.

9. In Profile Generator dialog, key-in **54+80** for the *Station* and click the **Enter** key.

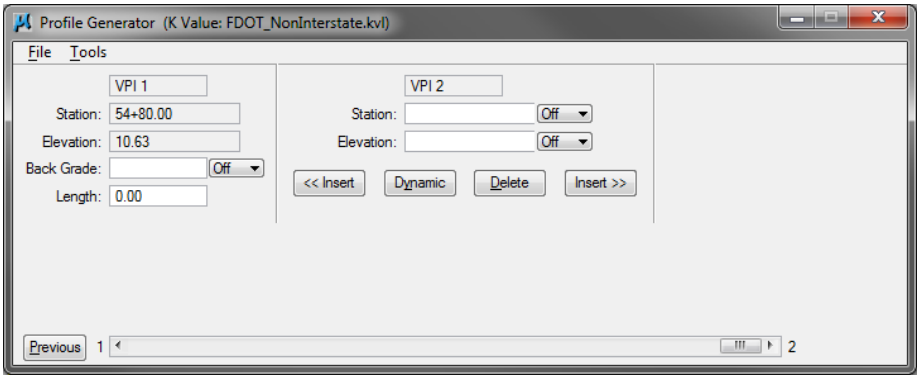
10. In Profile Generator dialog, key-in **10.63** for the *Elevation* and click the **Enter** key.



11. Click the **Insert>> (insert after)** icon.



12. The dialog changes to allow the entrance of another VPI.



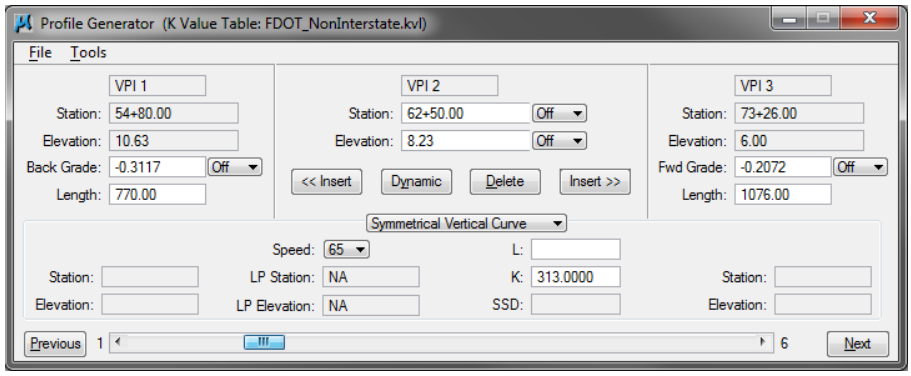
13. Using the information in the following table, enter **VPI 2** through **VPI 6**.

HINT This table represents only a portion of the profile PGL-RT that is used in the actual project. It does not cover the entire length of the project because of time limitations.

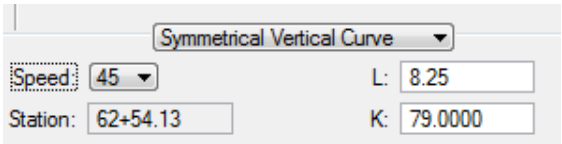
Table of VPI Numbers

VPI Number	Station	Elevation
2	62+50.00	8.23
3	73+26.00	6.07
4	74+71.58	6.36
5	75+65.00	6.12
6	78+50.00	6.75

14. Click the **Prev** icon or the scroll bar along the bottom of the dialog to center **VPI 2** in the dialog.

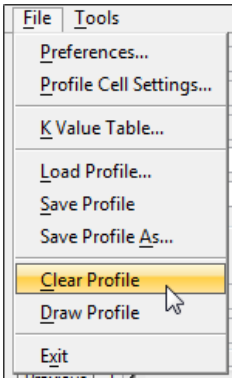


15. For *VPI 2*, select a *Speed* of **45**. Note that the *K value* changes, that an *L value* for *Length of Vertical Curve* is calculated and the three stations and elevations are calculated.



16. Repeat the previous step for **VPI 3** through **VPI 5**.

17. In Profile Generator, select **File** > **Clear Profile**. Profile Generator re-initializes to its original state.



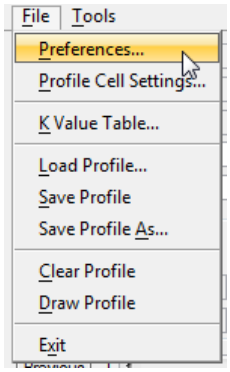
Note Selecting File > Clear Profile will not delete a stored profile from the GPK file. It only clears the current VPI information from Profile Generator to allow creation of another profile or allow a saved profile to be loaded.

Exercise 4.2 Storing the Vertical Alignment Dynamically

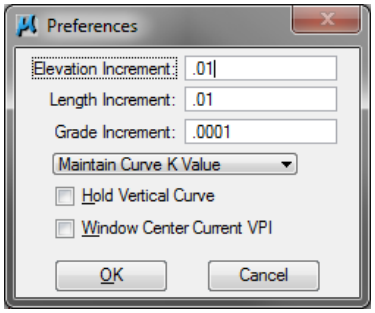
In this exercise, the user will create a profile with limited key-ins using dynamic graphic manipulation to place VPIs and set grade lengths and percent of grade. The user will create Vertical Curves based on K Values, Design Speed, Stopping Sight Distance and Algebraic Difference in grades.

Note In this exercise, the student will be placing VPIs graphically. As such, each student's profile will be different and will not exactly match the instructors profile or the examples that follow.

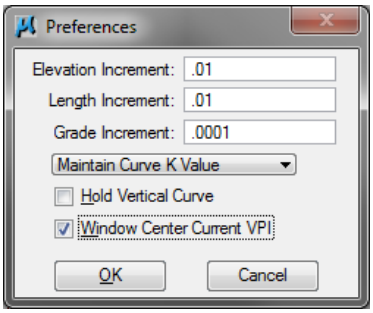
1. From the Profile Generator menu, select **File** > **Preferences**.



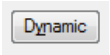
2. Preferences dialog opens.



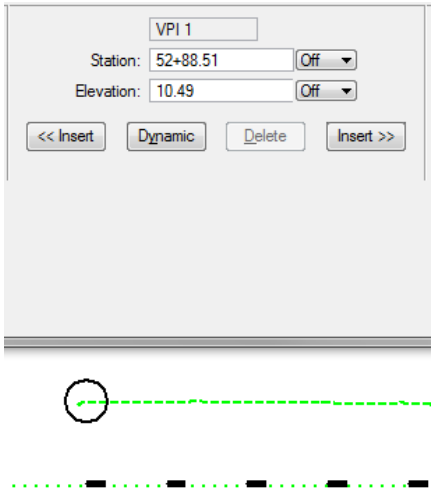
3. From Preferences, enable the toggle for **Window Center Current VPI**. Note the default *Elevation Increment*, *Length Increment* and *Grade Increment* settings. Click **OK** to close Preferences.

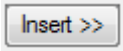


4. Zoom into the beginning of the existing ground profile.

5. From Profile Generator, click the 

icon. Profile Generator is now in dynamic mode and the cursor has changed to a circle with cross hairs.
6. Move the cursor around within the profile cell and note that as the cursor moves, the Station and Elevation values change dynamically.
7. Snap to the beginning of the existing profile to establish the first **VPI** of the proposed profile.
8. **Data Point** a second time in the design file to accept. The information for **VPI 1** populates and dynamic control releases.

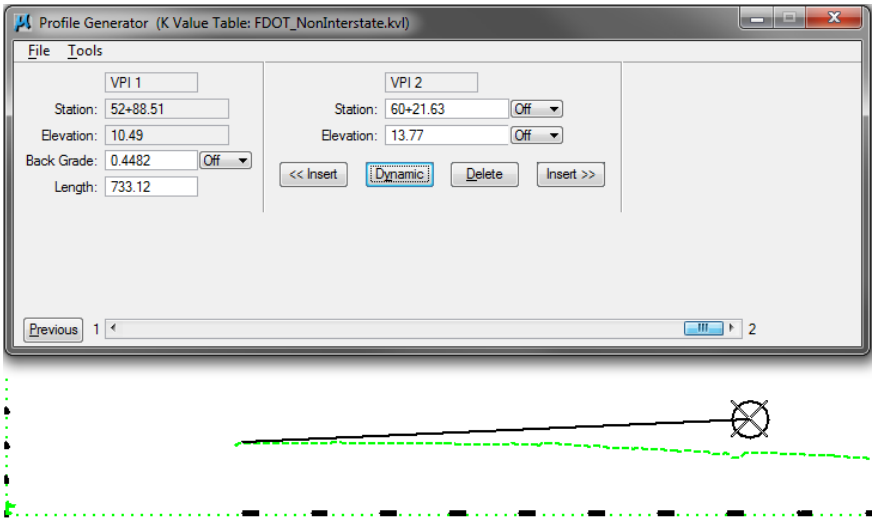


9. From Profile Generator, click the 

icon.
10. Click the **Dynamic** icon, placing the cursor back in dynamic mode for the next **VPI** selection.

Note While in *Dynamic* mode, the use of any MicroStation View commands such as Zoom In, Zoom Out or Fit View will release Dynamic mode. After using any of these commands, the user must click Dynamic again to return to the *Dynamic* mode.

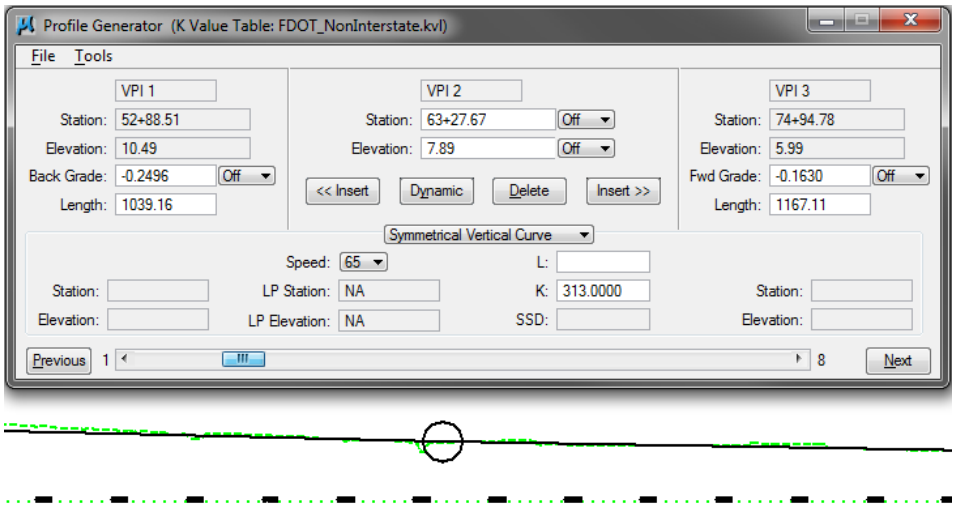
11. Place another **VPI** by **Data Point** several hundred feet from the previous **VPI**.



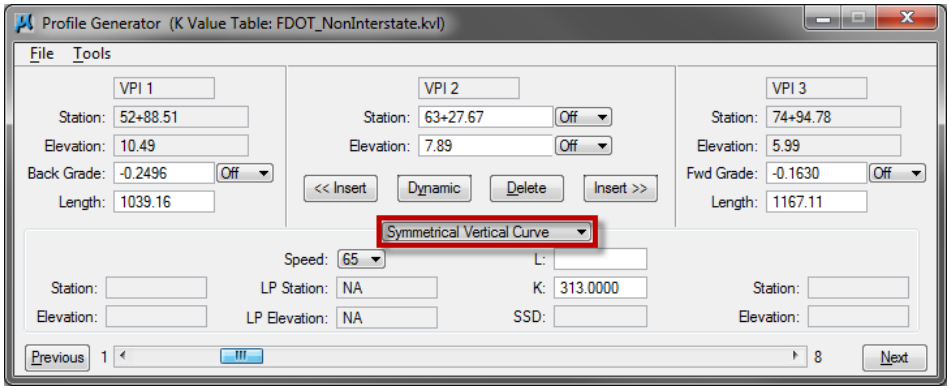
12. Repeat Steps 6-8 to continue establishing **VPI**s to the end of the existing ground profile.

13. Use the **Prev** and **Next** icons to center different *VPIs* in the dialog. Note that MicroStation centers the graphical **VPI** in the view. This is the results of setting *Preferences* to **Window Center Current VPI**.

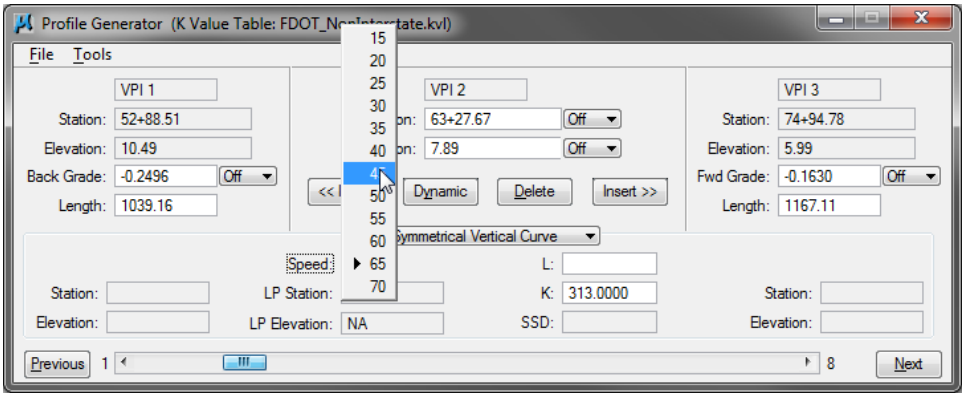
14. Center the **VPI 2** in the dialog.



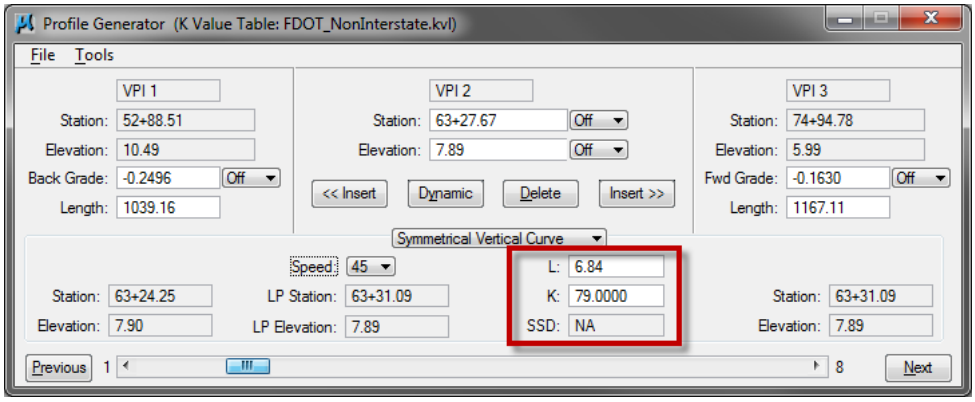
15. Select **Symmetrical Vertical Curve**.



16. Select **45** from the *Speed* pull down.

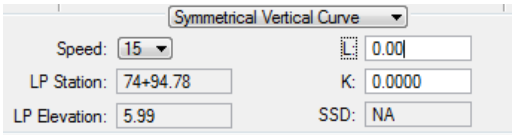


17. Observe the **L**:, **K**:, and **SSD**: calculations based on *Speed of 45*.

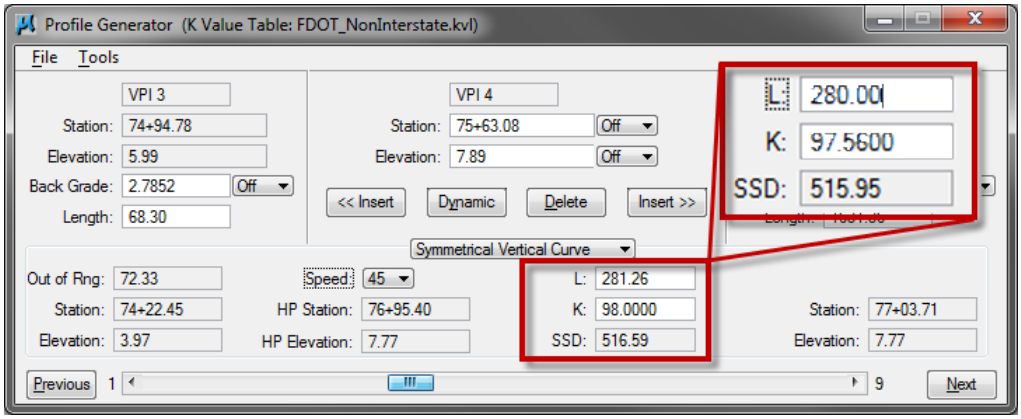


Note Even though a short vertical curve is calculated for each VPI, according to the PPM Volume 1, Chapter 2, Table: Maximum Change in Grade Without Vertical Curves, for a Design Speed of 45 mph, there can be a maximum change in grade in percent of 0.70 before a vertical curve is necessary. The original profile PGL-RT for the project that went to construction did not use vertical curves because the change in grade at all VPIs was less than 0.70%.

18. For each *VPI*, set the *speed* to **45**. Observe the **Vertical Curve lengths**. For the short Vertical Curves, check the algebraic difference in grade (see note above) to verify if a Vertical Curve is necessary. If no Vertical Curve is necessary set *L:* to **0**.

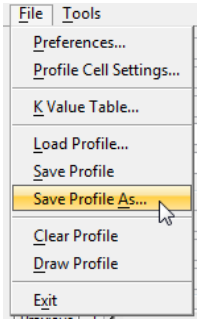


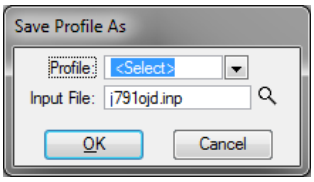
19. Find a **VPI** that requires a *Vertical Curve*. Round up the Vertical Curve Length to an even length, as shown below.



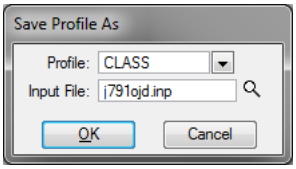
Note When rounding the Vertical Curve length always round up, not down. Rounding down will lower the design speed.

20. Select **File > Save Profile As**. Save Profile As opens.

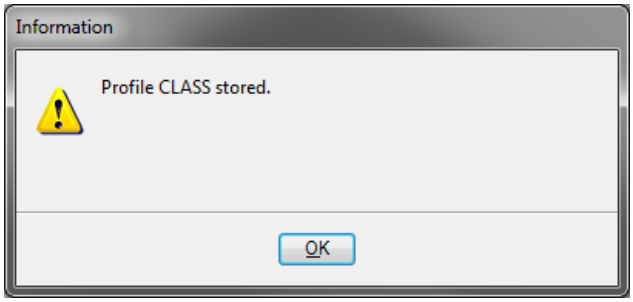




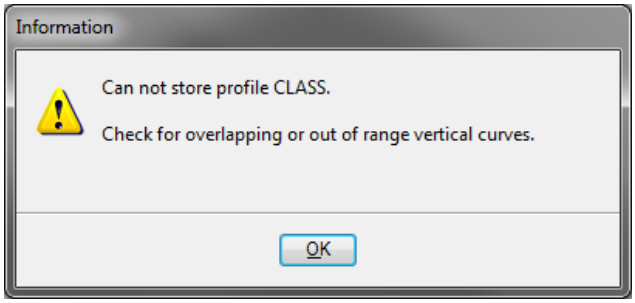
21. From Save Profile As, key-in **CLASS** as the *Profile* name and key-in **class791.inp** as the *Input File* name for a COGO input file. Click the **OK** icon to close the dialog and save the profile.



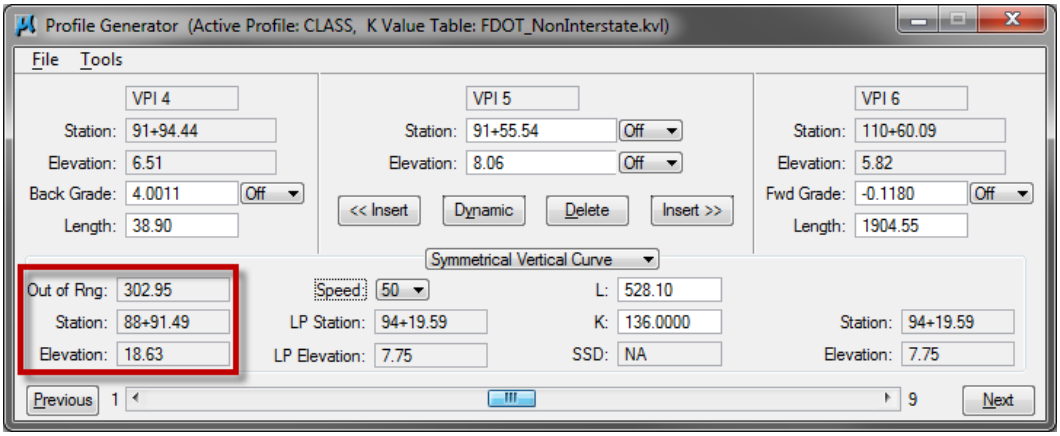
22. Depending on the state of the profile, one of two different messages displays at this point. If the profile has *no overlapping* or *out-of-range vertical curves*, then it will be stored into the Coordinate Geometry database and the following message displays.



However, if the profile does *have overlapping* or *out-of-range vertical curves*, then it will NOT be stored into the Coordinate Geometry database and the following message displays.



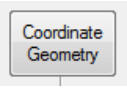
23. These overlapping or out of range vertical curve problems will be denoted on the dialog.



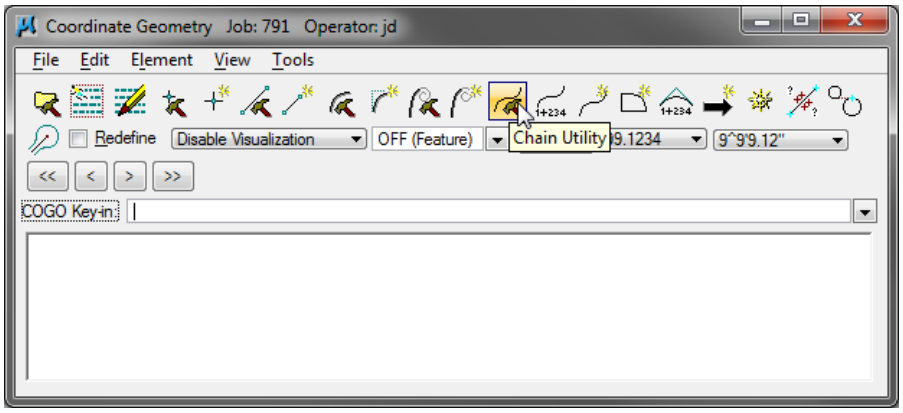
24. If any problems are noted, correct the problems by modifying the appropriate **VPI** and **save** again.
25. Close the Profile Generator.
26. Answer **No** when prompted to **Save the Profile**.
27. Answer **Yes** when prompted to **Save Vertical Alignment Settings**.

Exercise 4.3 Displaying the Vertical Alignment in COGO

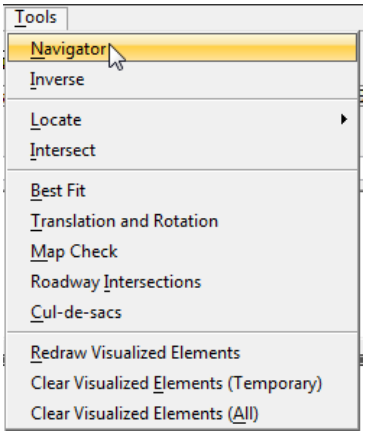
In this exercise, the user will display the proposed profile geometry in COGO and review the data.

1. From Road Project, click the 

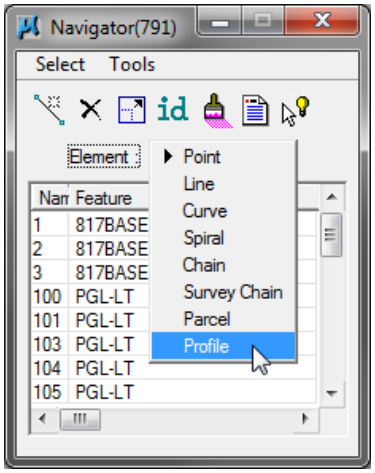
icon.



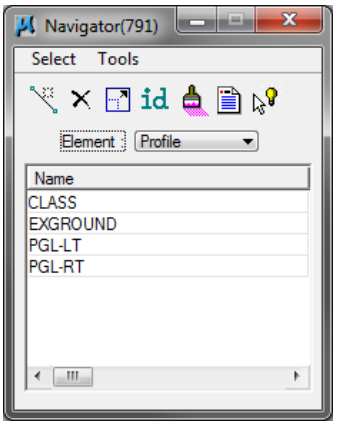
2. Select **Tools** > **Navigator** --*or*-- click the **Navigator** icon on the Coordinate Geometry dialog.



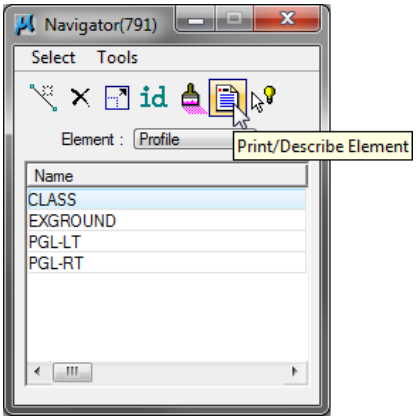
3. In the Navigator dialog, set the *Element* to **Profile**.



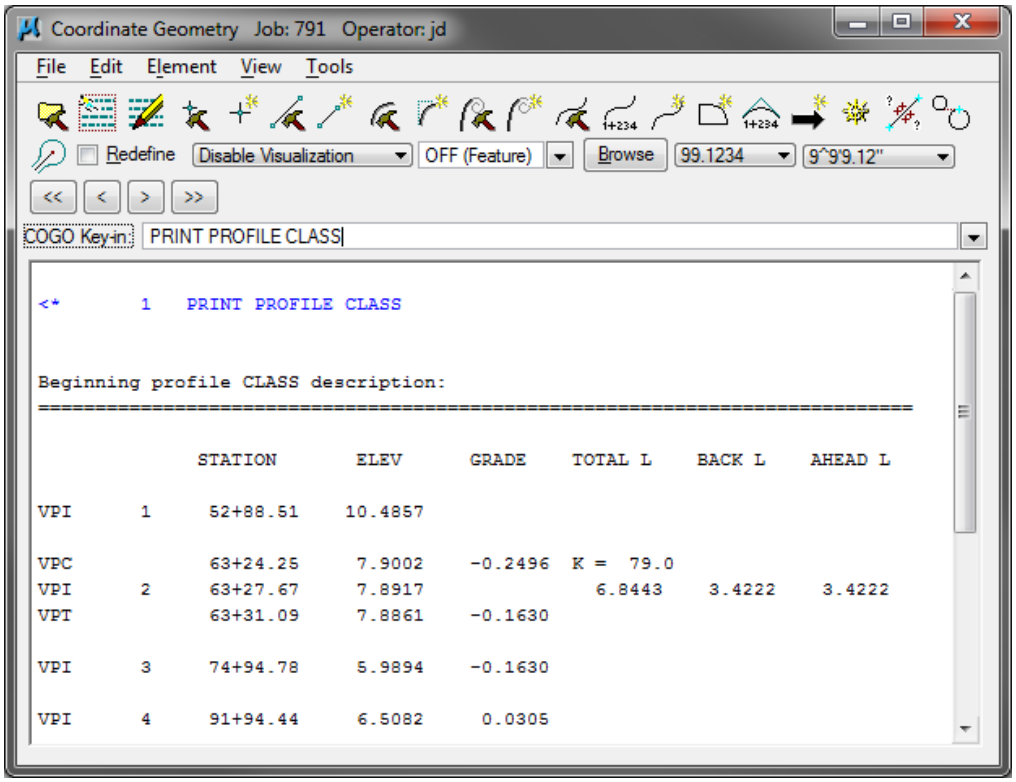
4. Select the *profile* CLASS from the list of profile names.



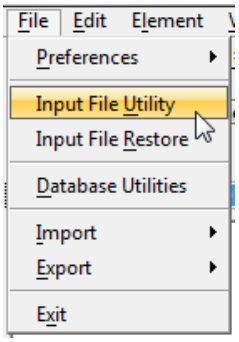
5. Click the **Print/Describe** icon.

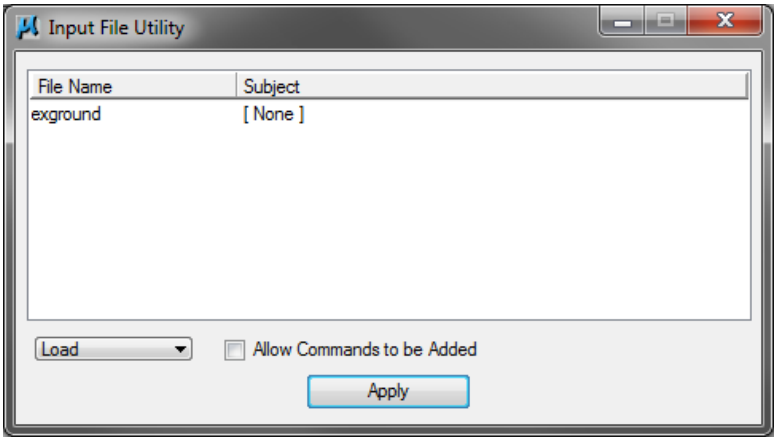


6. The profile information appears in the display window of the Coordinate Geometry dialog.

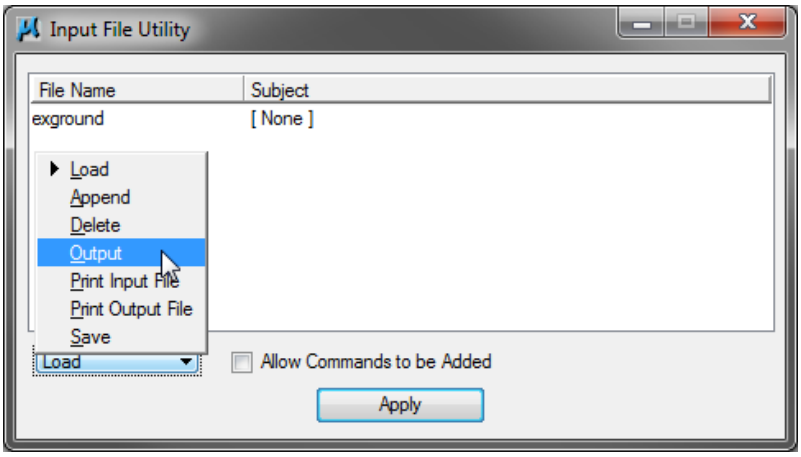


7. Close Navigator dialog.
8. From Coordinate Geometry, select **File** > **Input File Utility**. Input File Utility opens.





9. From Input File Utility, select **Output**, then type **class** in *Output File* box.



10. Click the **Apply** icon to create the output file.

11. This process creates an output ASCII file in the *Roadway* folder with the name *CLASS791.ojd***,** where

    CLASS is the name entered in the Output File field,

    791 is the .gpk name,

    .ojd is Output and operator code.

    The user opens and prints this file with any text editor. Review the following sample output file..

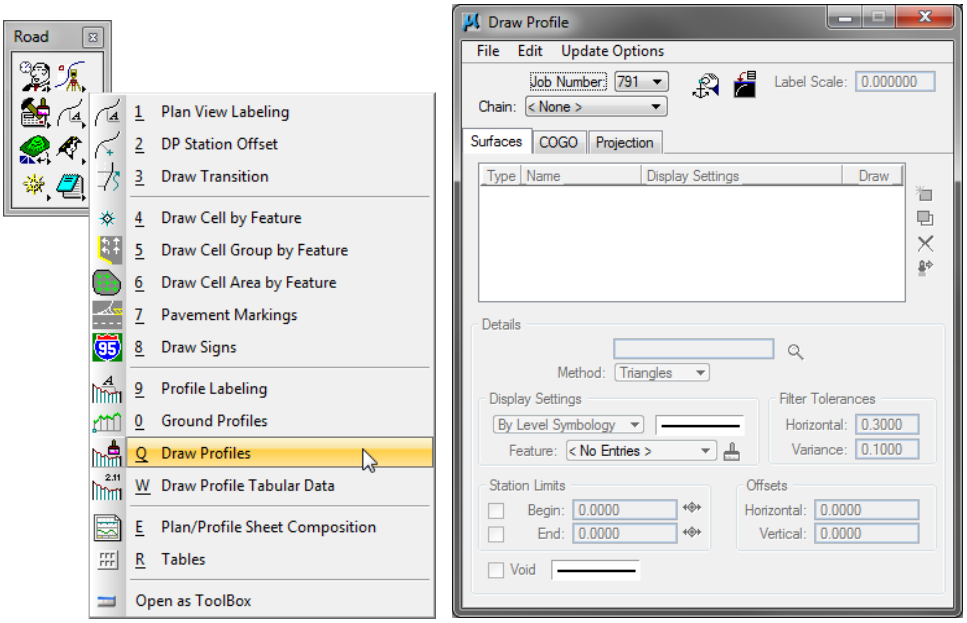
```
<*        1   PRINT PROFILE CLASS


Beginning profile CLASS description:
==============================================================================

               STATION       ELEV      GRADE    TOTAL L    BACK L    AHEAD L

VPI       1     52+88.51    10.4857

VPC             63+24.25     7.9002    -0.2496  K =  79.0
VPI       2     63+27.67     7.8917               6.8443    3.4222    3.4222
VPT             63+31.09     7.8861    -0.1630

VPI       3     74+94.78     5.9894    -0.1630

VPI       4     91+94.44     6.5082     0.0305

VPI       5    110+60.09     5.8164    -0.0371

VPI       6    125+09.04     6.6811     0.0597

VPI       7    128+25.46     7.5458     0.2733

VPI       8    130+46.78     5.8164    -0.7814

==============================================================================
Ending profile CLASS description



<*          Output CLASS

Output file CLASS is stored
```

12. Close Input File Utility dialog.
13. Close Coordinate Geometry dialog.
14. Click **No** when prompted to *Save Settings*.

Exercise 4.4 Drawing the Vertical Alignment

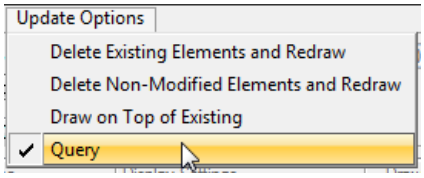
In this exercise, the user will draw the proposed profile using the Draw Profile tool.

1. Sink the Road Project dialog.
2. From the Road toolbox, click the **Draw Profile** icon.

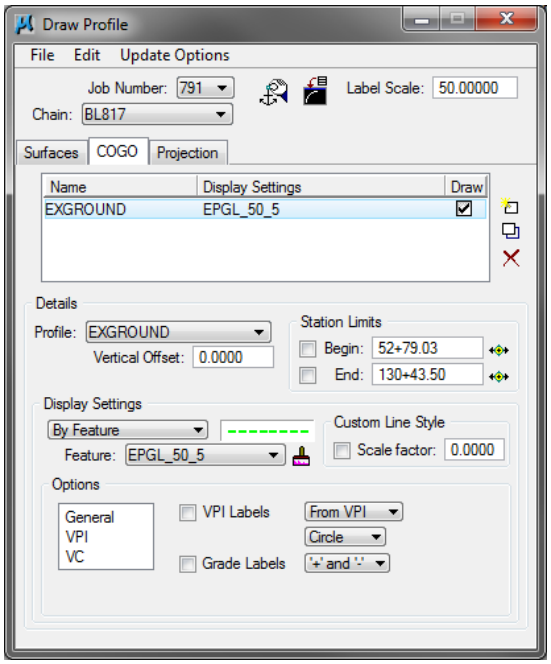


HINT This dialog does not populate from the working alignment definition.

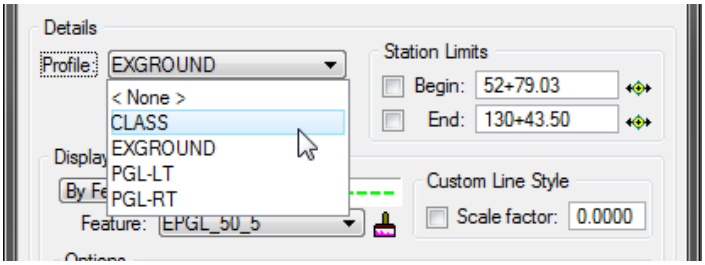
3. Select **Update Options** > **Query**.



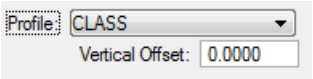
4. Select the *COGO* tab.



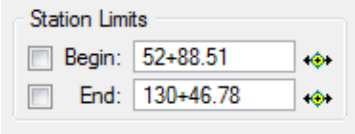
5. On the *COGO* tab, select **Class** from the *Profile Name* list.



6. Leave the *Vertical Offset* set to **0**.

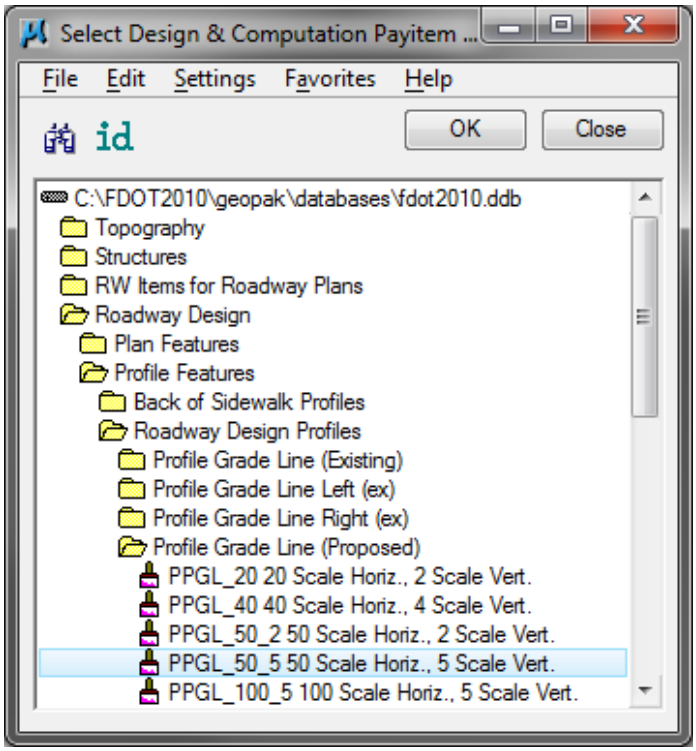


7. Leave the *Station Limits* to the default **begin and end station values** of the profile.

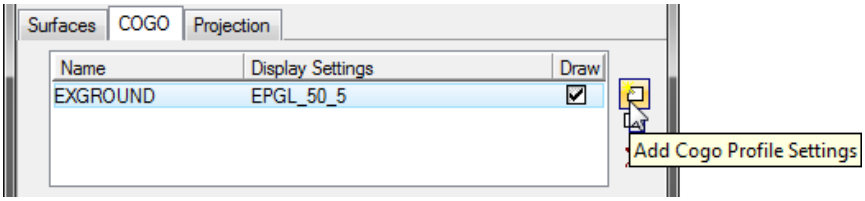


8. Under Display Settings, click the **Browse Feature** icon.

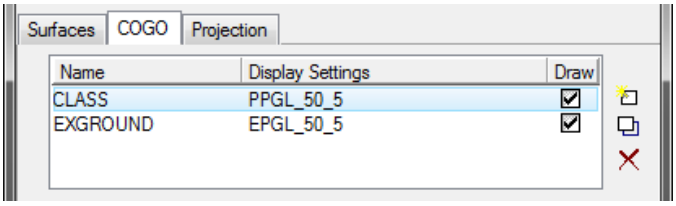
9. From Select Design & Computation Payitem, navigate to the item **PPGL_50_5** and click the **OK** icon.



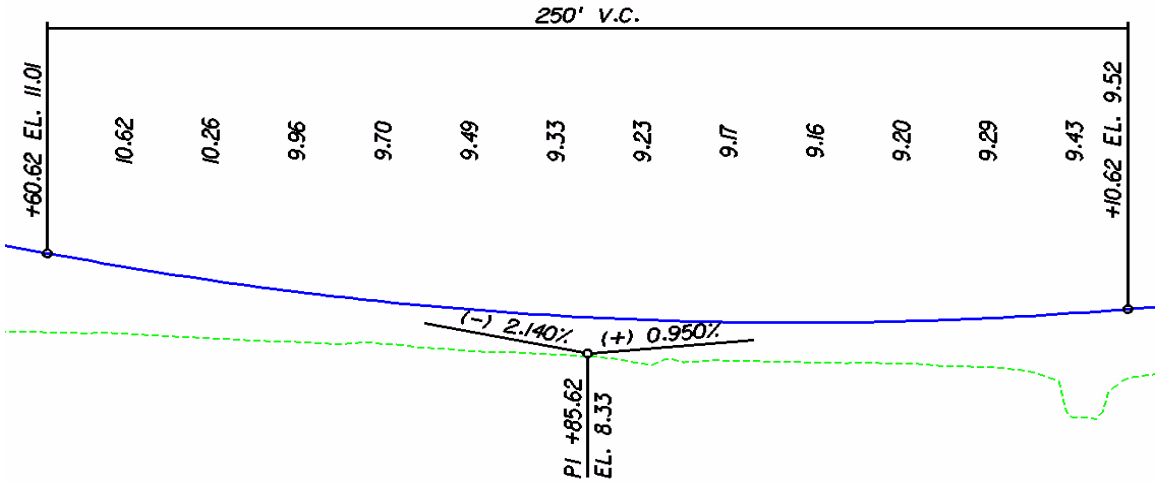
10. Click the **Add COGO Profile Settings** icon.



11. The *profile* **CLASS** adds to the list box and drawn into the design file.



12. Zoom in on the profile and review the information. The profile information displays as shown below.

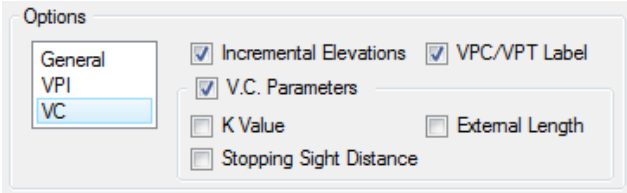


Note	Arrowheads do not place along the leader lines for the Vertical Curves. The user must place these by hand. However, the Roadway > Place Arrows and Barscales utility in the FDOT Menu is available to use.

Exercise 4.5 Modifying Display Options and Re-Drawing the Profile

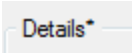
In this exercise, the user will modify the display options and re-draw the profile.

1. Under *Options*, select **VC**.

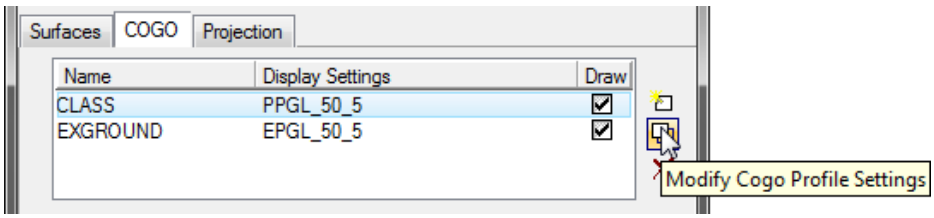


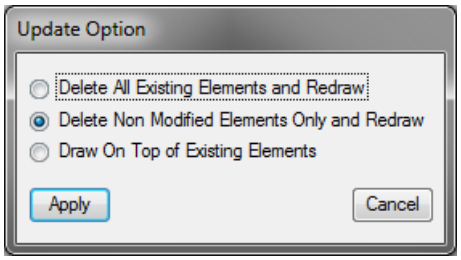
2. Enable the **K Value** toggle.

HINT When a changing any of the settings, an asterisk appears next to the word Details as a reminder to the user that a change has been made.

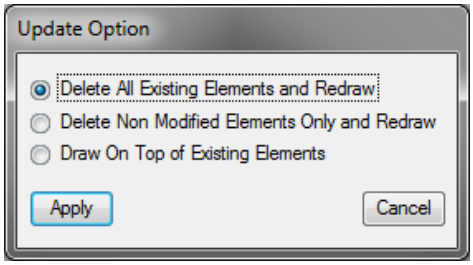


3. Click the Modify COGO Profile Settings icon.



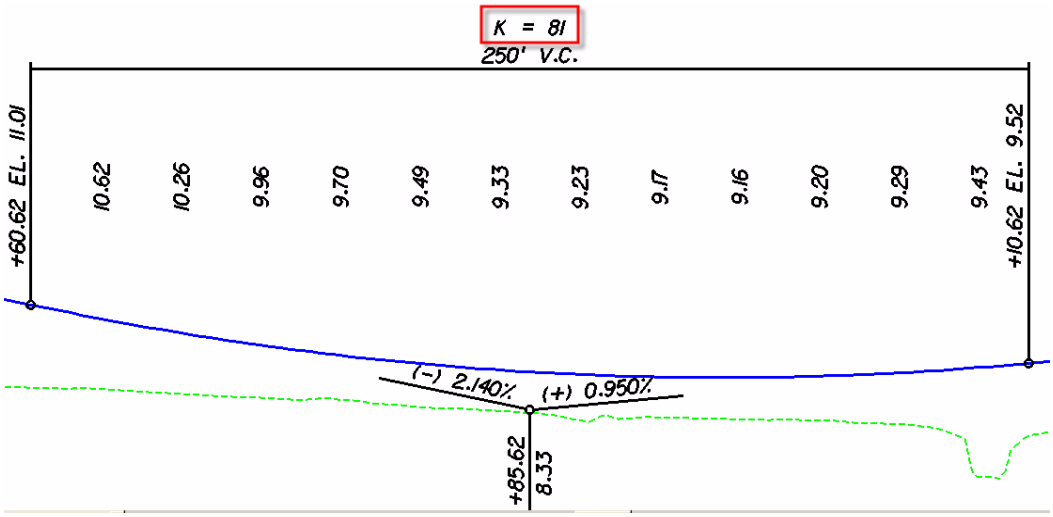


4. On Update Option, enable the toggle for **Delete all Existing Elements and Redraw**.

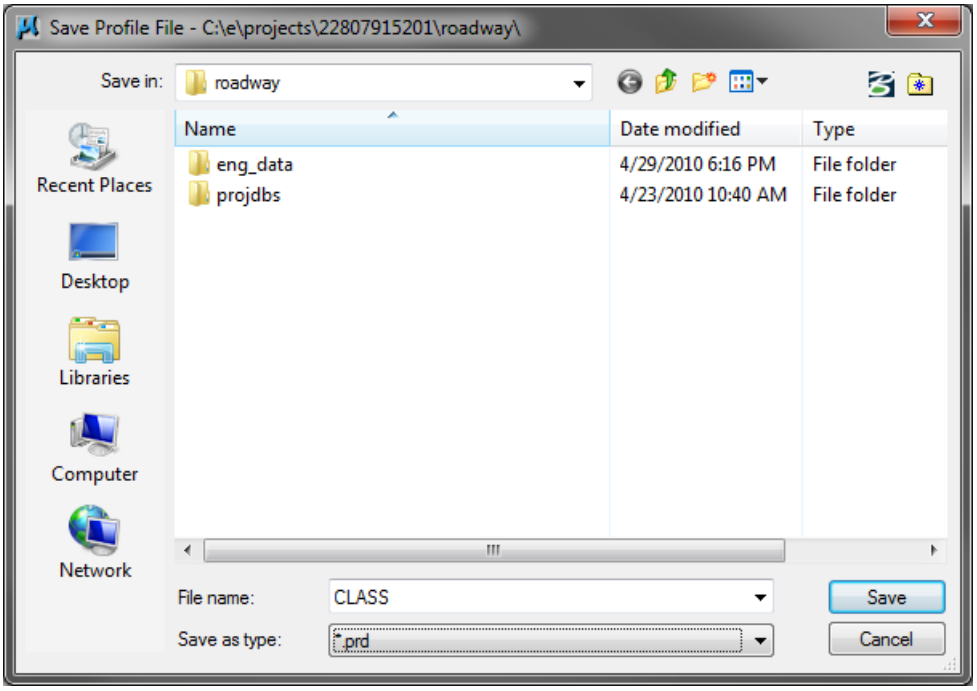


5. Click the **Apply** icon. The proposed profile is deleted and redrawn.

6. In the drawing, zoom in on one of the vertical curves and review the **K Value**.



7. On Draw Profile, select **File** > **Save**. Save Profile File dialog opens.
8. Key-in a *file name* of **CLASS** and then click the **OK** icon.

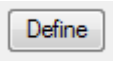


Note The file automatically is given a .prd extension.

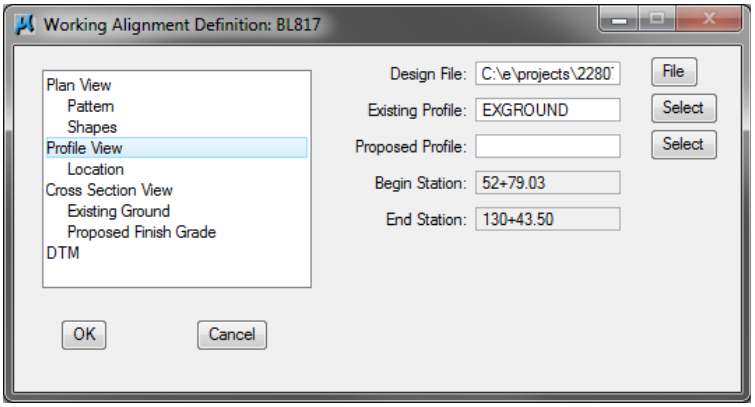
9. Close Draw Profile.

Exercise 4.6 Entering Working Alignment Information

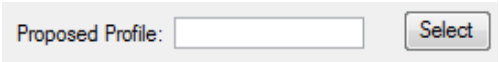
In this exercise, the user will update the Working Alignment to include the Proposed PGL you just created.

1. Access Project Manager.
2. From Road Project, click the 

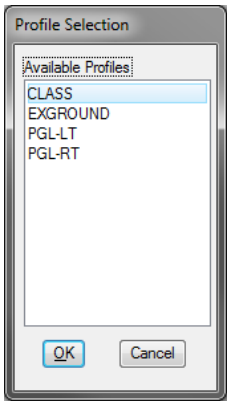
icon. Working Alignment Definition dialog opens.
3. Select the category **Profile View**. Working Alignment Definition options change, as shown below.



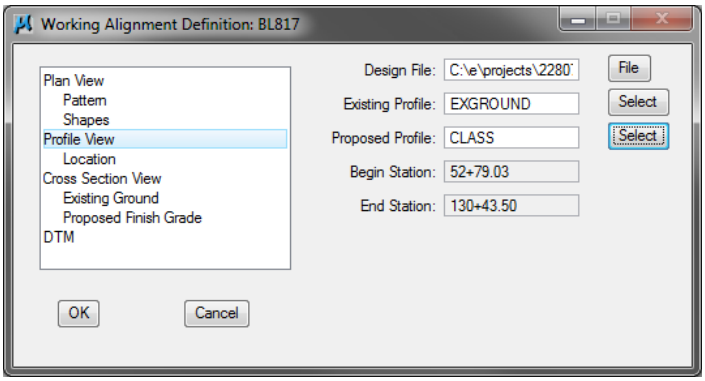
4. Click the **Select** icon next to *Proposed Profile*.



5. Profile Selection dialog opens.
6. Select the *profile* **CLASS** and then click **OK**.



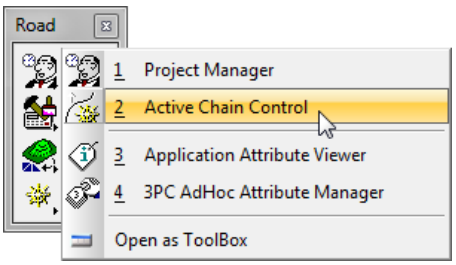
7. From Working Alignment Definition, click **OK** to *save settings* and close the dialog.



Exercise 4.7 ACTIVE Chain Control

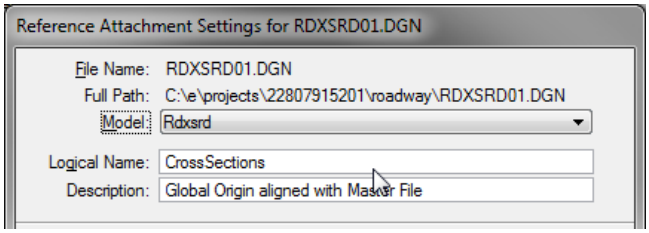
In this exercise, the user will learn how to use Active Chain Control.

1. Sink the Road Project dialog.
2. From the Road toolbox, click the **Active Chain Control** icon.

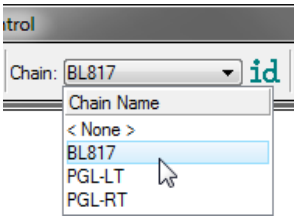


3. Active Chain Control dialog opens.

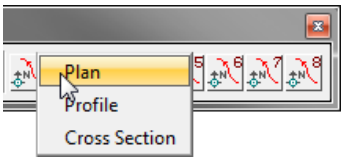
4. Attach *RDXSRD01.dgn* as a reference file. When attaching *RDXSRD01.dgn*, be sure to attach the *RDXSRD model*.



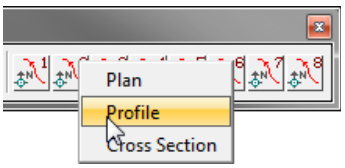
5. Open Views 1, 2 and 3.
6. From the MicroStation menu, select **Window** > **Tile** to tile the windows.
7. Select **BL817** in the *Chain* list.



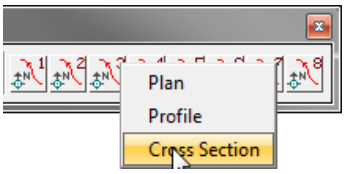
8. Right-click the **Fit View 1** icon and then select **Plan**. *View 1* is set to the *Plan View*.



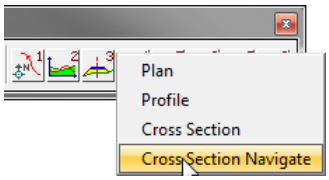
9. Right-click the **Fit View 2** icon and then select **Profile**. *View 2* is set to the *Profile View*.



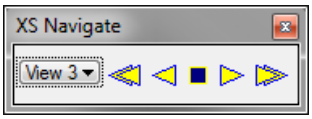
10. Right-click the **Fit View 3** icon and then select **Cross Section**. *View 3* is set to the *Cross Section View*.



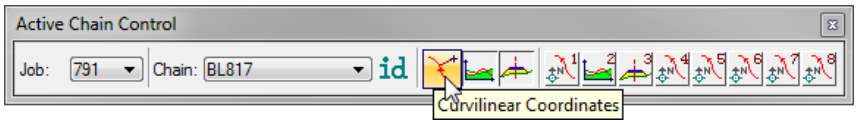
11. Right click the **Fit View 3** icon again. Select **Cross Section Navigate**.



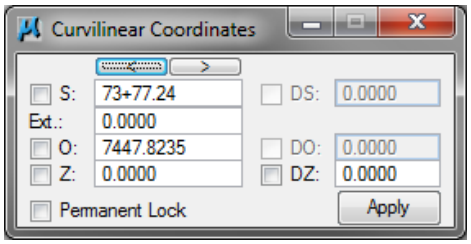
12. XS Navigate opens.



13. Click the Curvilinear Coordinates icon.



14. The Curvilinear Coordinates dialog opens.



15. Practice moving the mouse in **View 1 (Plan View)** and notice how the mouse tracks accordingly in the *View 2 (Profile View)*. Notice how the Curvilinear Coordinates dialog updates the **Station** and **Offset** values as the mouse moves.
16. Practice moving the mouse in **View 2 (Profile View)** and notice how the mouse tracks accordingly in the *View 1 (Plan View)*. Notice how the Curvilinear Coordinates dialog updates the **Station**, **Offset** and **Elevation** (Z) values as the mouse moves.
17. Use the Cross Section Navigator to browse through the *cross sections* in **View 3**.
18. Close Active Chain Control dialog and all related dialogs.
19. **Exit** MicroStation.

5 SUPERELEVATION SHAPES

OBJECTIVES

- Detail Superelevation Tools
- Build Superelevation Shapes using Automated Superelevation
- Analyze Shapes

WORKFLOW

GEOPAK supports many options for the definition of pavement on proposed sections. They range from a single slope specification tied to a baseline/profile to complicated, multiple roadway sections, each having its own superelevation transitions.

Some roadway projects are very basic where no superelevation transitions are required, meaning the roadway slope for all pavement can be specified as a single value. In this case, the slope is defined during the proposed cross section processing and no additional superelevation work is required. This is done running Cross Sections in shapeless mode.

There will be cases of defining superelevation when roadways are constant widths without tapers such as turn lanes, acceleration and deceleration lanes. In these cases, the automated superelevation can be used, based on a user defined design speed and taking into consideration the geometry of the roadway. An ASCII format file of the superelevation data can be created and reviewed. The engineer can override the computed values where necessary and then GEOPAK draws pavement representations as complex shapes into a MicroStation 2D design file.

Another option is the definition of superelevation when roadways are not constant widths. This would be when there is acceleration and deceleration lanes, turn lanes and gore areas. In this case, graphic elements within a MicroStation 2D design file are utilized to create complex shapes, which define the superelevation transitions.

Any combination of these tools can be utilized with a project or even with a single roadway. The shapeless mode is good for rural applications, low volume city streets and frontage roads, while the automated method quickly generates automated shapes for more complex roadways. Any area that cannot be defined using the automated method can be supplemented by the graphical method.

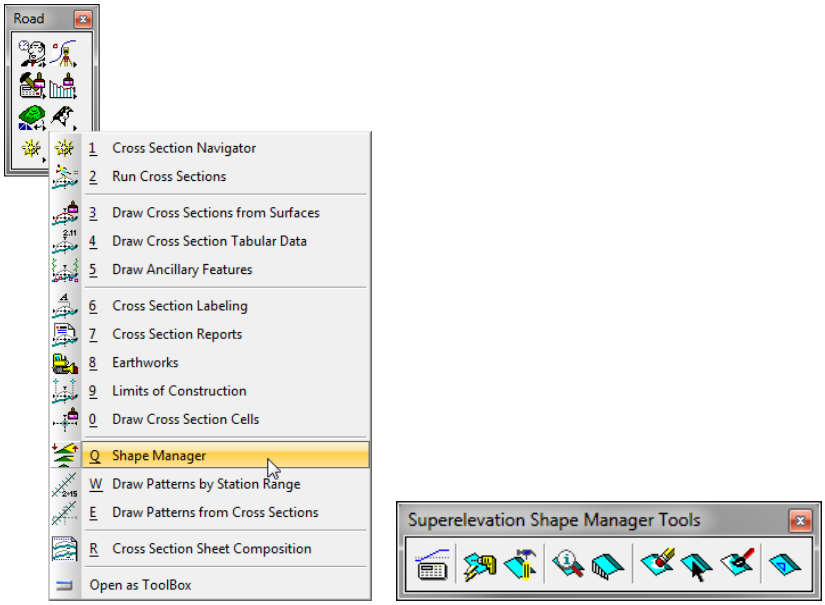
SUPERELEVATION SHAPE MANAGER TOOLS

ACCESSING SUPERELEVATION SHAPE MANAGER TOOLS

From the MicroStation menu: select **Applications** > **ROAD** > **Cross Sections** > **Superelevation Shape Manager Tools**.

<OR>

From *Road* tools, select the Shape Manager.

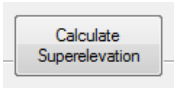


There are several applications available from the Superelevation Shape Manager Tools palette. Each of these tools serves a different purpose, giving the user the ability to not only create and modify superelevation shapes, but also to obtain information from these shapes once created. This course covers each tool and the purpose it serves.

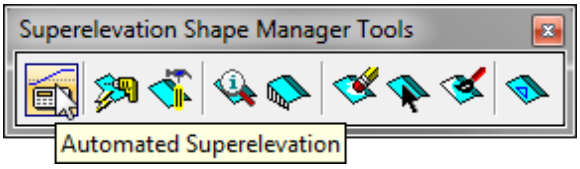
AUTOMATED SUPERELEVATION

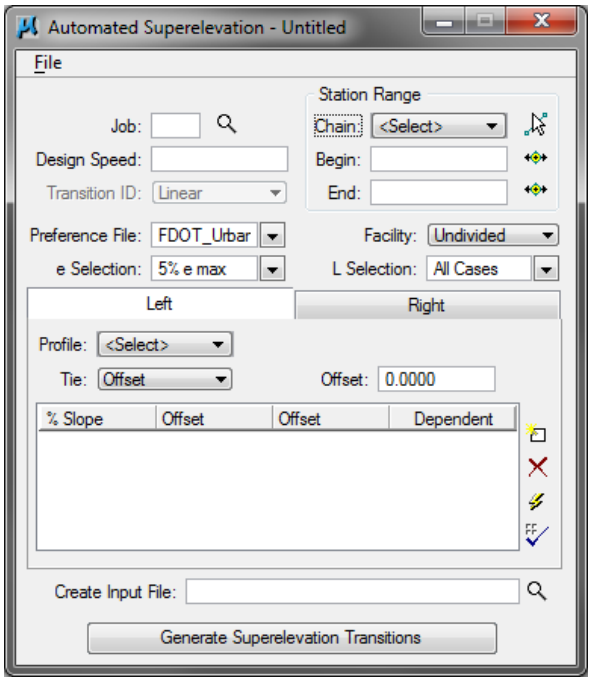
Click the Automated Superelevation icon.

<OR>

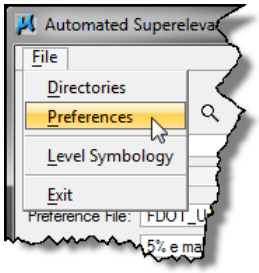
From Road Project, click the 

icon.





AUTOMATED SUPERELEVATION - PREFERENCES



A rich 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. There can be user-defined equations 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.

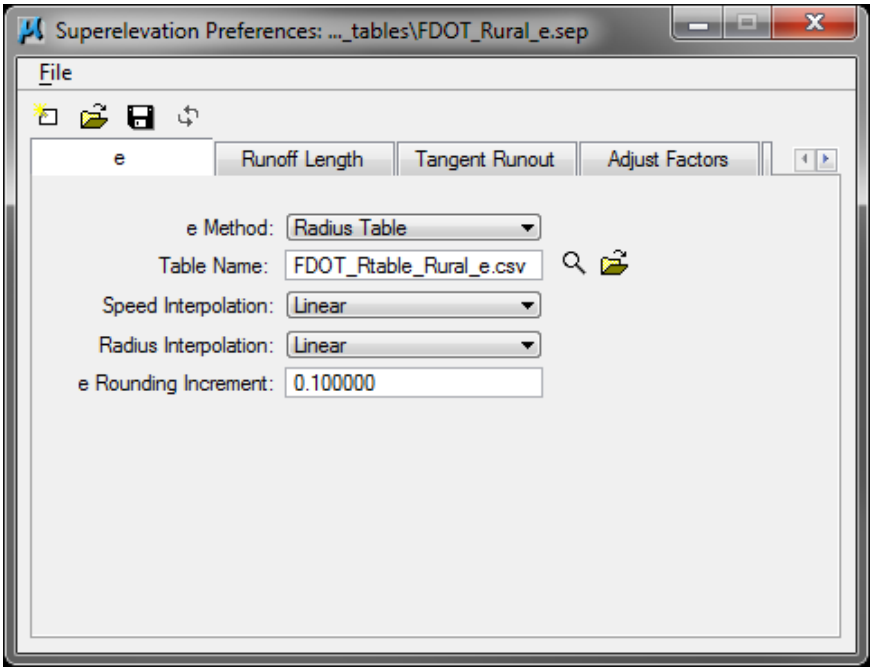
The user can access the Preferences dialog through the Automated Superelevation dialog by selecting **File** > **Preferences**.

The dialog consists of a simple menu bar containing File utilities, four shortcut icons (also for File utilities) and nine tabs. Upon selection of each tab, the dialog dynamically changes to reflect the selection. The small left and right arrows to the right of the tabs scroll to display the tabs. Each press of one of the arrows moves the tabs one position.

The left-to-right progression of the tabs matches closely with the order of processing which GEOPAK goes through when computing superelevation. Therefore, the following discussion of the Superelevation Computation Process presents the detailed descriptions of the various items under each tab.

FDOT has two predefined preference files available to their users – one for rural conditions and one for urban projects. Select the appropriate file per project. For a typical project, the users need to modify the preferences based on project conditions. If so, copy the appropriate SEP file to the project directory and modify as needed. Outlined below, is each tab and typical adjustments that the user makes for each type of project.

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.

E Method Identifies the method GEOPAK will use to compute e. The available methods are Radius Table, AASHTO Method 5, and Equation.

Table Name This contains the name of the CSV file in which to find the tables when Methodology is AASHTO Method 5 or Radius Table. Generally, do not include a path in the file name since Environmental variables control these and/or user control in the Superelevation Computation dialog. If specified along with the *.csv* file name, it uses that path regardless of other methods of setting the path such as Environmental Variables. If Methodology is Equation, the text field is the location where the equation is entered. Pressing the Files icon ( ) opens the dialog, wherein the desired file may be selected. Pressing the Edit icon ( ) opens the editor specified in the environmental variable GPK_SUPER_EDITOR which should normally be set to Excel or some type of spreadsheet application.

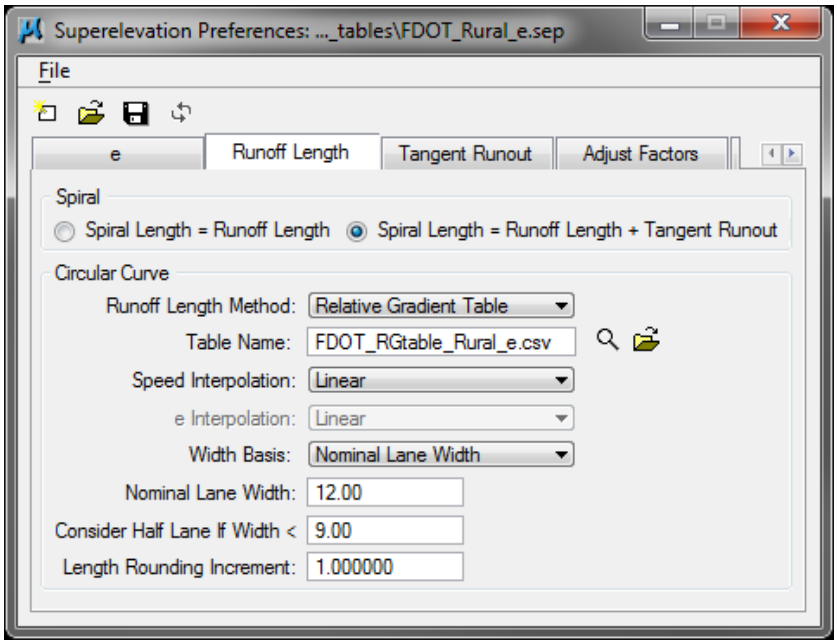
Speed Interpolation Specifies how GEOPAK is to interpolate between Design Speed columns, if the user selects a Design Speed not found in the table. Speed Interpolation applies to both the AASHTO Method 5 table and Radius Table for e computation.

Radius Interpolation 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. This applies only to Radius Table option. For rural conditions, the default is fine. For urban, the Radius Interpolation should be set to Conservative entry.

E Rounding Increment Controls rounding and applies to e regardless of how computed. This is simply rounding to the nearest number evenly divisible by the rounding increment. For example, if e rounding was set to 0.25, and e, as computed from a table, comes out to be 3.789, the value rounds to 3.75, which is evenly divisible by 0.25. Set a value of

0.00 to disable the rounding of e.

RUNOFF LENGTH 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.

If one or both sides of a curve (ahead and/or back) have a spiral, then no length computations need to be made for the part with a spiral, since the length of transition is dictated by the length of the spiral. Within the Spiral Distribution group box, the user has the option to determine how spiral lengths match to Superelevation Transition lengths.

If the option is set to Spiral Length = Runoff Length, the Runoff Length is the same as the spiral length. Runoff begins with the TS or CS and ends at the SC or the ST. Tangent Runout falls on the adjacent tangent, outside of the spiral. If the option is set to Spiral Length = Runoff Length + Tangent Runout, Runoff and Tangent Runout lengths are set such that the Total Transition Length equals the spiral length, and the Tangent Runout falls on the spiral.

The remainder of the items on the Runoff Length tab has to do with Unadjusted Length computation for circular curves in which either the back, ahead, or both sides of the curve are not spirals.

Runoff Length Method

Determines which method GEOPAK will use to compute the Unadjusted Length. The supported methods are e Table, Relative Gradient Table, and Equation, each of which is detailed following the explanation of the dialog items. All methods for computation of Length use e and Design Speed as the primary inputs.

Table Name

This contains the name of the CSV file in which to find the tables when Methodology is AASHTO Method 5 or Radius Table. Generally, do not include a in the file name since these are Controlled by Environmental variables and/or user control in the Superelevation Computation dialog. If specified along with the .csv file name, it uses that path regardless of other methods of setting the path such as Environmental Variables. If Methodology is Equation, the text field is the location where the equation is entered. Pressing the Files icon ( ) opens the dialog, wherein the

desired file may be selected. Pressing the Edit icon ( ) opens the editor specified in the environmental variable GPK_SUPER_EDITOR which should normally be set to Excel or some type of spreadsheet application.

Speed Interpolation

Specifies how to interpolate between Design Speed columns, if the user selects a Design Speed not found in the table. Speed Interpolation is applicable to e Table and Relative Gradient Table for AASHTO Method 5 and e Table.

E Interpolation

Specifies how to interpolate between e Rows if the given e value does not have a corresponding row in the table. e Interpolation applies only to e Table.

Width Basis

Determines how to compute Unadjusted Length if the inside lane has a width differing from the Nominal Lane Width.

As an example, consider a Typical Section with four lanes and no median. The inside two lanes are ten feet wide and the outside two lanes are fourteen feet wide, while the Nominal Lane Width is twelve feet.

- If set *Nominal Lane Width*, and the value read from the table (or equation) is 35, no change needed to that value.
- If set *Actual Lane Width*, and the value read from the table (or equation) is 35, the value multiplies by 12 over 10, resulting in an Unadjusted Length of 42.

For rural projects, the default values do not need modification. For urban projects, the Nominal Lane Width need setting for each project.

Consider Half Lane If Width <

It is common that five or seven lane roadway sections have the crown point in the center o the middle lane. In order to model this correctly, two lanes must represent the middle lane, each being half the true lane width.

Several options, which adjust the runoff length, must have an accurate count of the number of lanes. By modeling a five-lane section with six lanes, this count is not correct.

This situation is resolved by specifying a width below which a lane counts as a half lane. In this way, the five lane section modeled by four full lanes and two half lanes is correctly considered by GEOPAK to have five lanes.

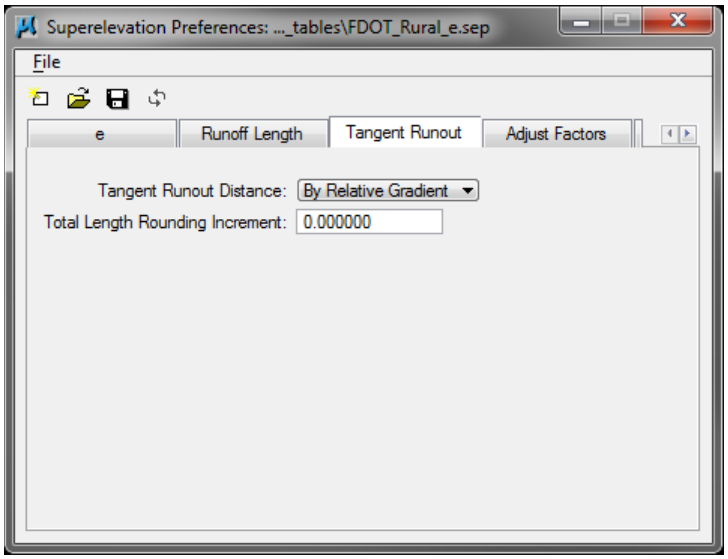
As an example, if the center turn lane of a roadway were 16 feet wide, the left and right halves of the center turn lane would each be 8 feet.

If the Consider Half Lane if Width < text field were set to 8 (or 9 or any number greater than or equal to 8), those two lanes would be considered together as one lane for the purpose of counting lanes in preparation for making the Runoff Length Adjustment.

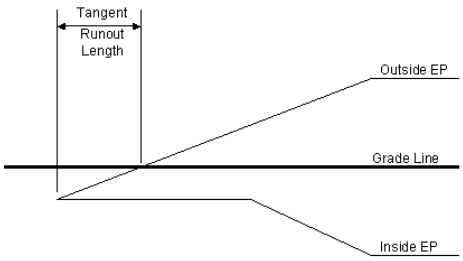
Length Rounding Increment

Controls rounding and applies regardless of how computation is done for Unadjusted Runoff Length. It is rounding to the nearest number evenly divisible by the rounding increment. If the rounding increment is set to 1.000000, the Unadjusted Runoff Length rounds to the nearest whole number.

TANGENT RUNOUT TAB



Tangent Runout Distance The distance from a Cross Slope of Normal Crown to a Cross Slope of zero as shown below:



Three methods are available to compute:

Relative Gradient The Tangent Runout Distance is computed as the result of applying the Relative Gradient of the Runoff to the Tangent Runout.

If rounding takes place, the length change caused by the rounding is applied evenly to both Runoff and Tangent Runout such that the Relative Gradient remains the same over both portions of the transition.

Fixed Distance A text field reveals to the right that contains the numeric value for the distance. With this option, Tangent Runout Length is set to a certain distance without regard to the Relative Gradient of the Runoff. This will cause a discontinuity in the Relative Gradient at the zero slope point.

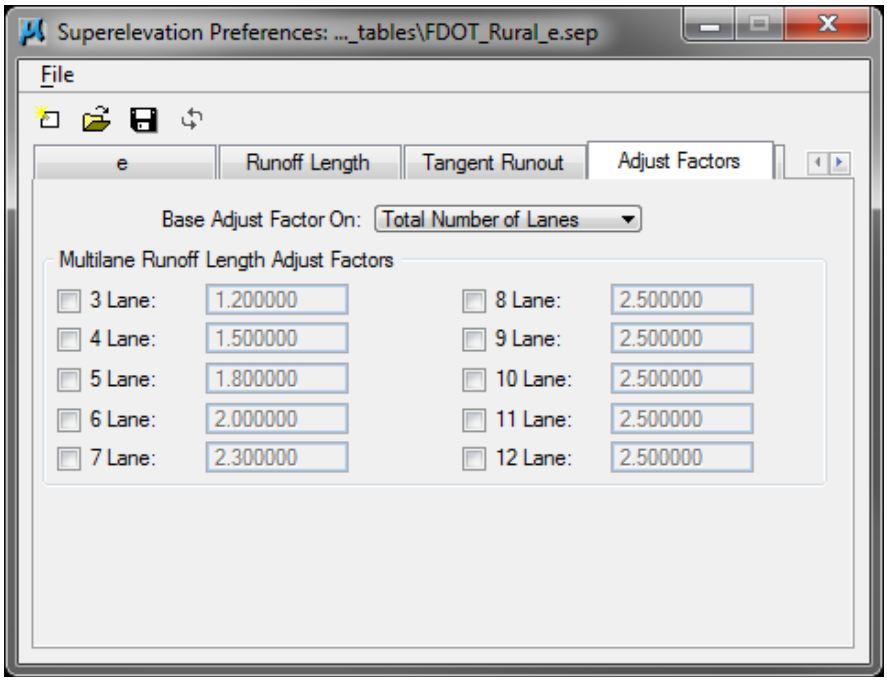
If rounding takes place, the length change applies entirely to the Runoff portion so that the Tangent Runout distance remains unchanged.

Equation A text field reveals to input the equation for calculation. Intrinsic variables are available to assist in developing the needed equation.

After the Tangent Runout has been computed (regardless of the method), Total Length Rounding is applied if specified as something other than zero in the Total Length Rounding Increment text field.

If rounding takes place, the length change applies entirely to the Runoff portion so that the Tangent Runout distance remains unchanged.

ADJUST FACTORS TAB



Base Adjust Factor On

Total Number of Lanes (default option) The multilane adjust factor is determined by the total number of lanes across the entire roadway.

Number of Lanes Rotated Compliant to AASHTO 2001 Standards. The multilane adjust factor is determined by number of lanes being rotated on one side of each roadbed.

Multilane Runoff Length Adjust Factors

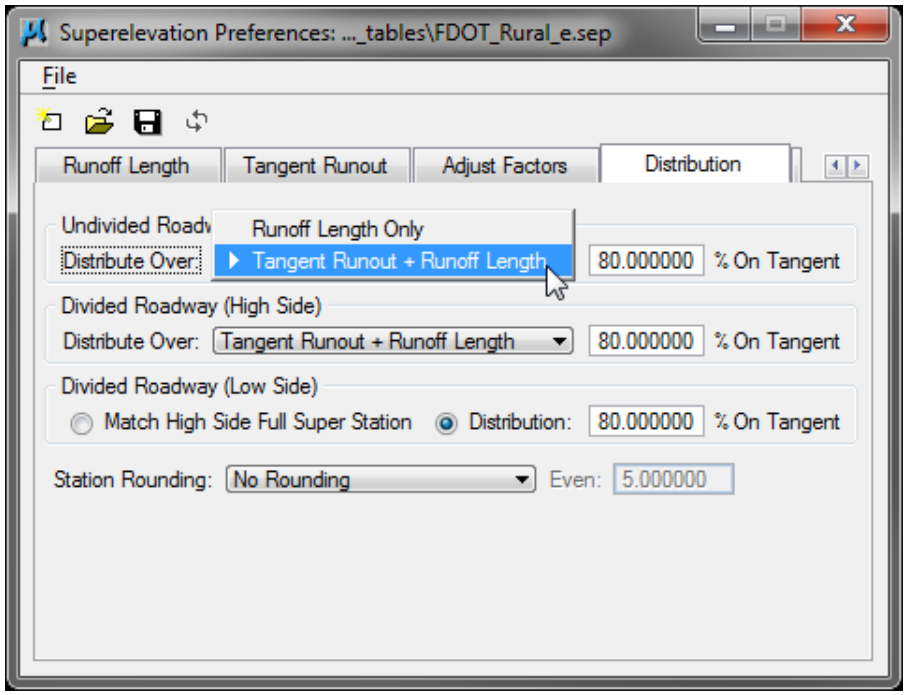
On the left side of each text field is a toggle. For a given lane number:

- If the toggle is off, Non-Adjustment Factor adjustment is used.
- If the toggle is on, the Adjustment Factor in the text field is used.

Length Adjustment is a modification of the two-lane length (unadjusted length) according to the true width of the roadway.

- If Adjustment Factor is used, the length adjusts by applying a multiplier according to the number of lanes.
- If Non-Adjustment Factor is used, the length adjusts by dividing the total roadway width by the Nominal Lane Width without consideration of the number of lanes.

DISTRIBUTION TAB



After computing the Adjusted Lengths 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 that falls on the tangent is termed Percent on Tangent. Options are provided to base that percentage on *Total Length* or on *Runoff Length*.

Distribute Over

This controls whether GEOPAK applies the % on Tangent value to Runoff Length or Total Transition Length.

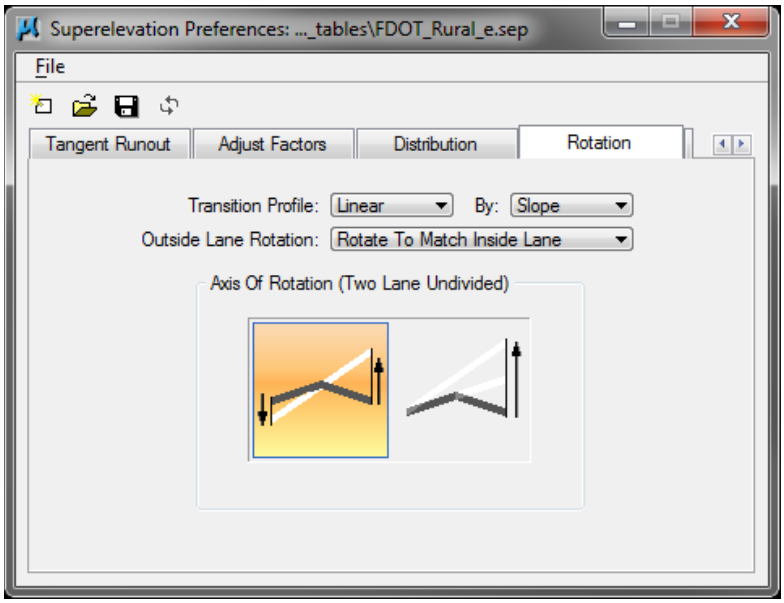
- *Runoff Length Only* The distribution percentage is applied to the Runoff Length.
- *Tangent Runout + Runoff Length* The distribution percentage applies to the Total Transition Length.

% On Tangent

Determines the percentage of the distribution which is to be located on the tangent leading up to (or trailing) the curve.

- For rural roadways, 80% on tangent is desired, but can be as little as 50% if necessary. For rural divided roads, the low side can be set to either *Match High Side Full Super Station* or *Distribution.*
- For urban roadways, 80% on tangent is desired, but can be as little as 50% if necessary. For urban divided roads, it is desirable to set the low side to *Match High Side Full Super Station*.

ROTATION TAB



Transition Profile	The Elevation Transition has options for Linear or Parabolic.
Parabolic	The Transition ID option on the Superelevation Computation dialog is available.
Linear	The Transition ID on the Computation dialog is not available and all transitions must be linear.
Outside Lane Rotation	Two options: Rotate to Match Inside Lanes and Independent Rotation.
Independent Rotation	All transition stations begin and end at the same station, regardless of Normal Cross Slope. If the Typical Section has Broken Back Normal Crown, this means that the cross slope remains broken throughout the transition until achieving Full Super, at which point the cross slope is continuous.
Rotate to Match Inside Lanes	If the Typical Section has Broken Back Normal Crown, the lanes of lesser cross slope do not begin transitioning until the lanes with greater cross slope come up to match. In other words, as soon as possible within the transition, the cross slope is unbroken.
Axis of Rotation	Only applies to two lane roadways. The two options are **Rotate About Centerline** and **Rotate About Inside Edge**.
Rotate About Centerline (left icon)	The rotation point is at the grade point as illustrated by the icon.
Rotate About Inside Edge (right icon)	The rotation point is at the edge of pavement. For curves to the right, the rotation point is at the right edge of pavement. For curves to the left, it is on the left edge of pavement.

Note For FDOT projects, the defaults on the Rotation tab are desirable.

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. FEOPAK uses the remaining tabs in the Superelevation Preferences dialog to set parameters and use in resolving these conflicts.

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

Reverse Curve conflict This occurs when two adjacent curves that deflect in opposite directions have transitions that overlap, or which have a short section of full Normal Crown between them.

Broken Back conflict This occurs when two adjacent curves that deflect in the same direction have transitions that overlap, or which have a short section of full Normal Crown between them. The parameters for handling this conflict are found on the Compound Curves tab.

Compound Curve conflict This happens when two curves deflecting in the same direction have no intermediate tangent, resulting in a PCC shared between them.

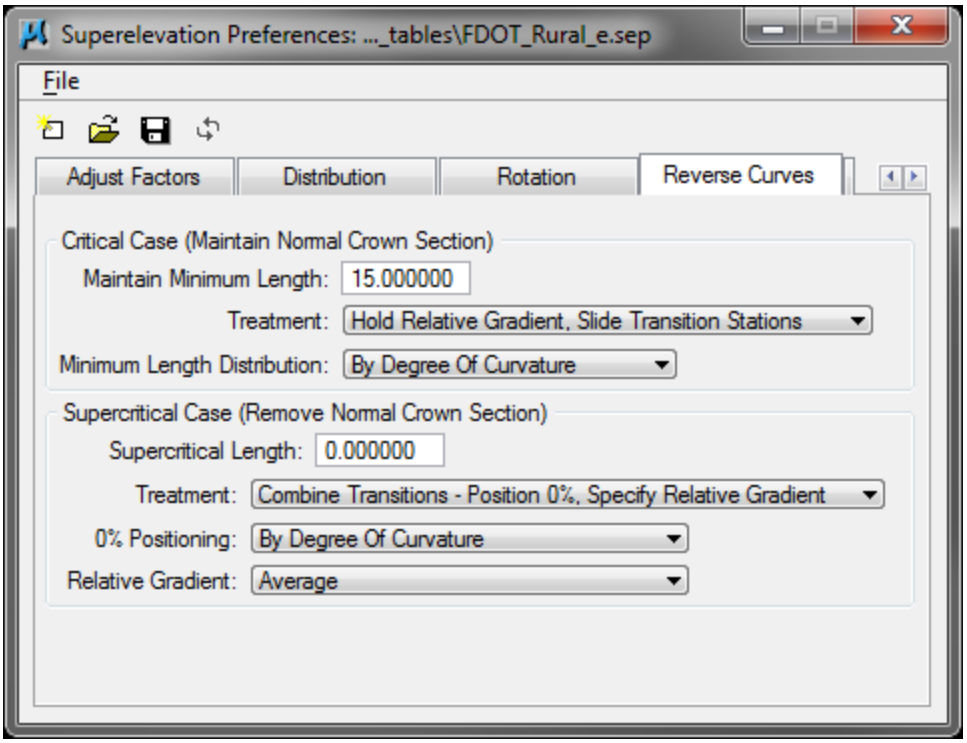
Short Curve This involves only one curve. It would be a case in which the length of the fully superelevated segment of the curve is too short.

It sometimes happens that two superelevation conflicts may happen on the same or adjacent curves. Therefore, when double conflicts occur, GEOPAK prioritizes them as which takes precedence, as follows:

- Reverse Curves
- Broken Back Curves
- Compound Curves
- Short Curves

This means, for example, that if there is a choice to be made as to whether to fix the Reverse Curve situation or the Broken Back Curve, Reverse Curves are fixed.

REVERSE CURVES TAB



A **Reverse Curves** conflict occurs when two adjacent curves that deflect in opposite directions have superelevation transitions that 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.

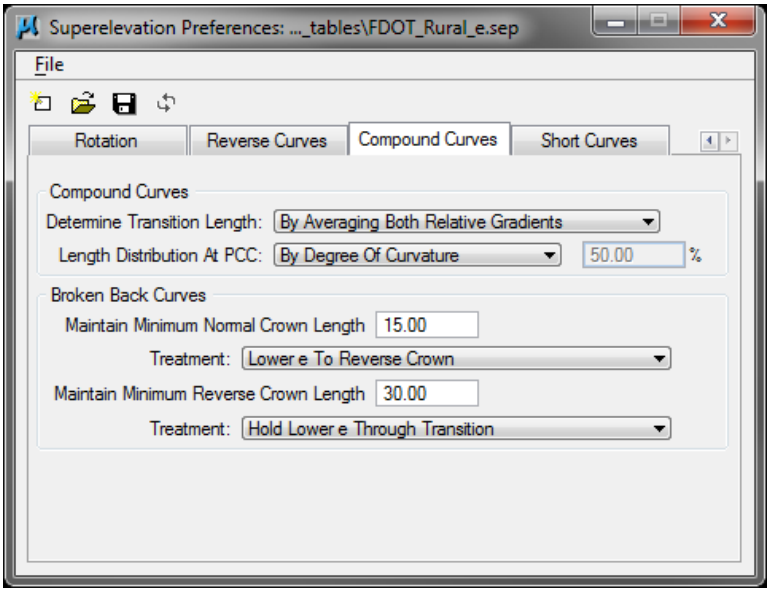
Overlapping transitions may have a negative Length of Normal Crown.

The distinction, then, between Critical and Supercritical, has to do with handling of the conflict. 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.

Either value may be negative, although this is ill advised for Maintain Minimum Length.

COMPOUND CURVES TAB



The Compound Curves Tab 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 that is short enough that the superelevation transitions of the two curves overlap or nearly overlap.

Compound Curves

Determine Transition Length

The length of the transition is determined by one of the options detailed listed below:

By Averaging Both Relative Gradients - The Relative Gradients of the two conflicting transitions are averaged to result in the new Relative Gradient and Transition Length. The End Full Super Station of the first curve and Begin Full Super Station of the second curve are determined by positioning the transition according to the Length Distribution At PCC option.

By Using Relative Gradient of Sharper Curve - The Relative Gradient of the sharper of the two curves (as it is before adjustment) is the Relative Gradient used to determine the Transition Length. The End Full Super Station of the first curve and Begin Full Super Station of the second curve are determined by positioning the transition according to the Length Distribution At PCC option.

By Using Relative Gradient Of Flatter Curve - The Relative Gradient of the flatter of the two curves (as it is before adjustment) is the Relative Gradient used to determine the Transition Length. The End Full Super Station of the first curve and Begin Full Super Station of the second curve are determined by positioning the transition according to the Length Distribution At PCC option.

By Using Unadjusted FS Station To FS Station - The End Full Super Station of the first curve and the Begin Full Super Station of the second curve are unchanged from their values before adjustment. The Transition Length and Relative Gradient are set from the original Full Super stations. The Length Distribution At PCC option is not considered.

Length Distribution at PCC

The first three options described above involve the adjustment of the Full Super Stations of the two curves. These three options allow the placement of the transition with respect to the PCC to be controlled via, Length Distribution at PCC which has five options.

Evenly - option causes the transition length to be half on the first curve and half on the second curve.

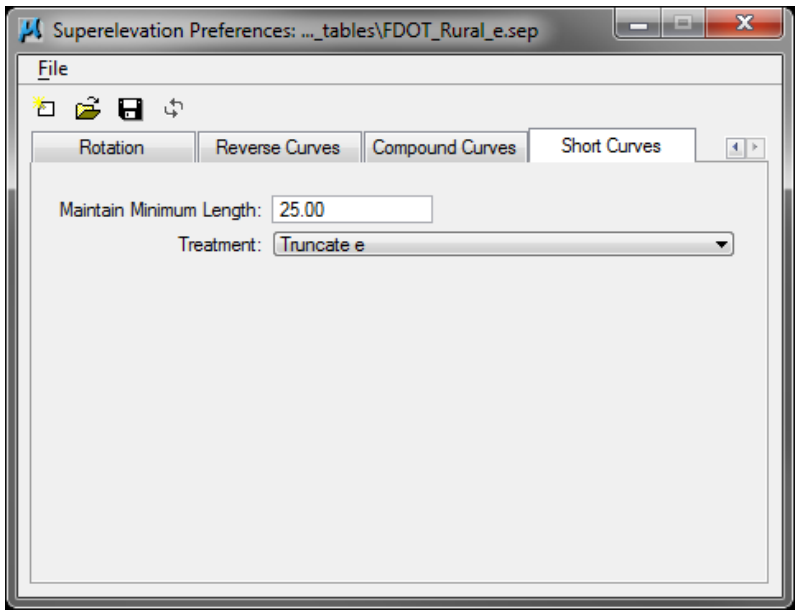
By Degree Of Curvature, By Radius, and By e - split the ratio of distribution on each curve according to the ratio of degrees of curvature, radius, or e or each curve.

By Percentage On Sharper Curve - allows control of the distribution by entering a percentage to be applied regardless of the ratios of various attributes of each curve.

Broken Back Curves

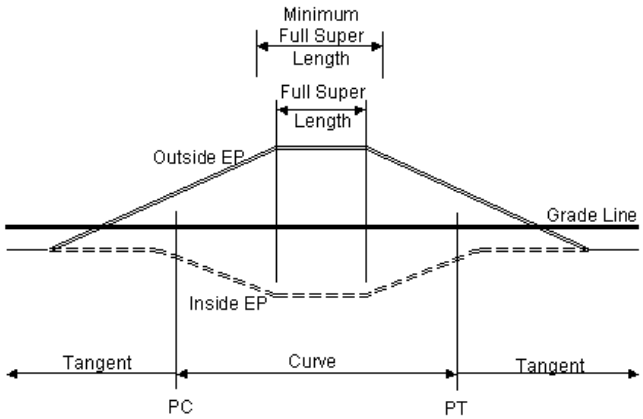
This occurs when two curves that are adjacent within a chain and deflect in the same direction have superelevation transitions that overlap or are in close proximity. There are two levels of conflict defined for Broken Back Curves: *Maintain Minimum Normal Crown*, and *Maintain Minimum Reverse Crown*.

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.

The following depicts a better understanding:



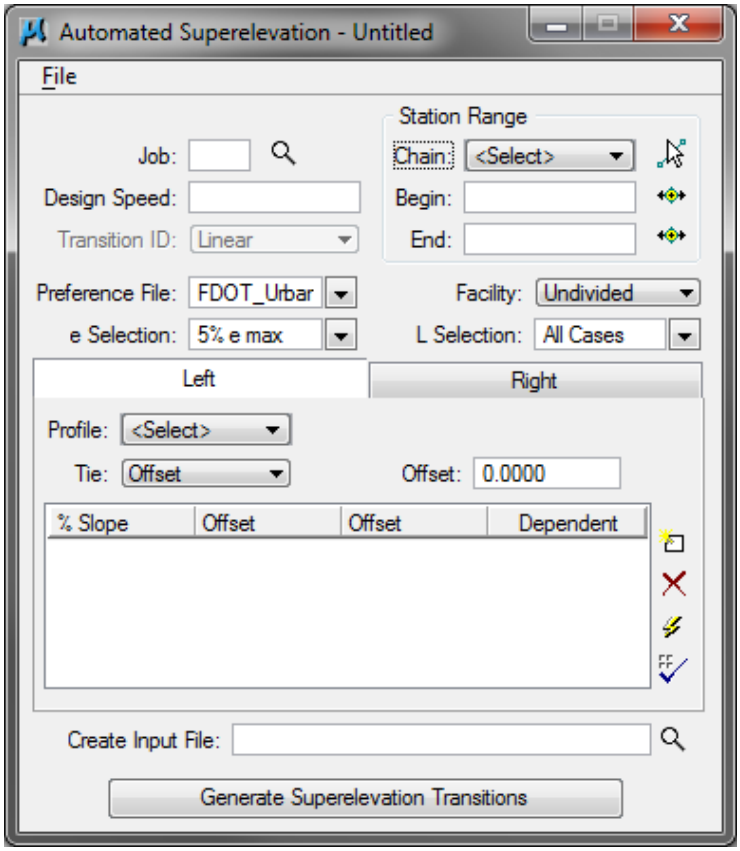
If a curve is in the Short Curve state, there are three supported methods of Treatment, as detailed below.

Truncate e	The End Normal Crown Stations and Relative Gradients of the two transitions of the curve hold constant. The e-value reduces sufficiently so that the new Full Super Length equals Maintain Minimum Length.
Slide Transitions, Hold Relative Gradient	The Normal Crown and Full Super stations of both transitions of the curve move outward from the PI of the curve by the same amount such that the Relative Gradient does not change and the Full Super Length equals Maintain Minimum Length.
Change Full Super Stations, Change Relative Gradient	The Full Super stations moved outward from the PI of the curve by the same amount such that the Full Super Length equals Maintain Minimum Length. The Normal Crown stations do not change. Therefore, the Relative Gradients become steeper.

GENERAL SUPERELEVATION CONSIDERATIONS

- ***Broken Back Curves*** – Avoid if possible. If an engineer runs into this situation, FDOT does not have standards in place. It is the engineer's responsibility to calculate the correct values and choose the correct options for the preference tab for compound curves.
- Allow **Sufficient Length of Tangent** between ***Reverse Curves*** for adequate superelevation transition. This suitable tangent length should be determined as follows:
  - 80% of the transition for each curve should be located on the tangent.
  - The suitable tangent length is equal to or greater than the sum of the two 80% distances.
  - Where alignment constraints dictate a less than desirable tangent length between curves, there is an allowable adjustment of the 80/20 superelevation transition treatment (where up to 50% of the transition may be placed on the curve).
- ***Compound Curves*** - Avoid if possible. When they are necessary, the radius of the flatter curve should not be more than 50% greater than the sharper curve.
- ***Small Deflection Angles*** - should lengthen curves to avoid the appearance of a kink. (Curves should be at least 500 ft. long for a central angle of 5° and the minimum increased 100 ft. for each 1° decrease in the central angle (900 ft. for a 1° central angle). (PPM Section 2.8.1.1)
- ***Rule of thumb***: Use the largest radius for the curve as is possible.
- ***Superelevation Transition*** is 80/20 (tangent/curve), but up to 50% of the transition can be on the curve in special situations.
- ***Minimum Length of Transition*** (*for emax=0.10*) is 100' per PPM Table 2.9.3.
- ***Minimum Length of Transition*** (*for emax=0.05*) is 50' for design speed under 40 mph and 75' for design speed of 40 mph or greater per PPM Table 2.9.4.

AUTOMATED SUPERELEVATION - DIALOG



Job Specifies the GPK file used.

Chain Specifies the baseline chain dictating the horizontal geometry for which superelevation transitions are calculated. This chain, also called the Shape Cluster Baseline in the Auto Shape input file.

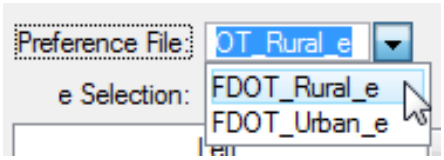
Begin Station Populated with the default beginning of the chain. For just part of a chain, the user can manually change this station.

End Station Populated with the default ending of the chain. For just part of a chain, the user can manually change this station.

Design Speed Sets the Design Speed used either in the tables or in equations for e and length computations.

Transition ID GEOPAK defaults to a linear interpolation for its transitions. However, the software also provides the options for an unlimited number of parabolic transitions. GEOPAK will ghost this option, if no other Transition IDs are setup in the preferences.

Preference File Identifies the Preference File used for 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. FDOT delivers two preference files:

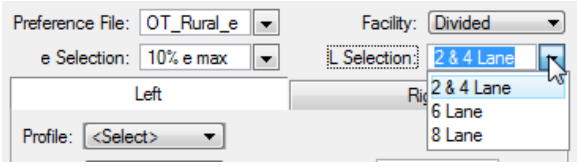


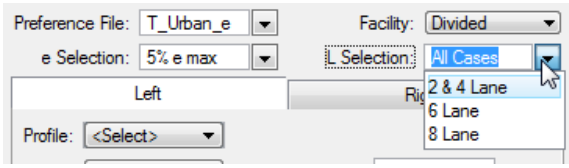
Facility Determines whether the roadway cross section is to be *divided* or *undivided*. This option determines the following:

- 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 it generates two shape clusters, which usually is required for a median.
- Which Preference used as found on the Distribution tab of the Preferences dialog, discussed, later in this chapter.

e Selection Sets the maximum superelevation rate for the calculation. This is set by the preference file.

L Selection Sets the Lane selection option for the calculation. The allowable lane selection options are pre-determined by the preference file.

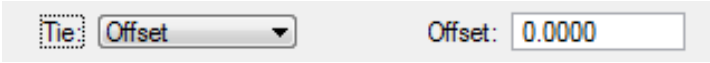




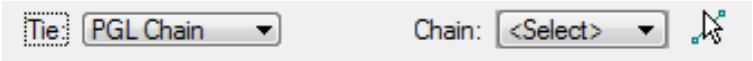
Left/Right Tabs This contains data pertaining to each lane within each roadway. If the Facility is undivided, then the left tab is for the left lane(s) while the right tab is for the right lane(s), resulting in the creation of one (1) shape cluster. If there is a divided Facility, then the right tab is for the entire right roadway, while the left tab is for the left roadway, resulting in the creation of two (2) shape clusters.

Profile GEOPAK profile defined as the Shape Cluster Profile in the Auto Shape input file.

Tie: Offset Horizontal distance from the Chain to the Profile.



Tie: PGL The horizontal chain associated with the profile.



%Slope Sets the 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% therefore, entered as –2.0.

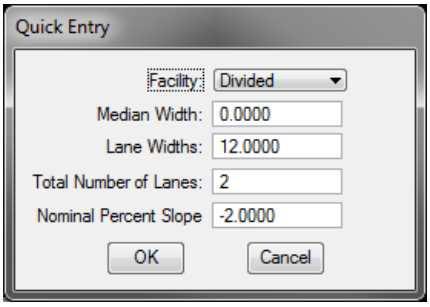
Offsets This defines the dimension of the shape (usually a lane) by two offset distances from the baseline. This does not support Tapers. Offset distances are negative if measured to the left. Each lane must have the same offset on the left as the left adjacent lane and must have the same offset on the right as the right adjacent lane (no gaps in offsets). Computation may not proceed if this condition is not met. There should be one row in each of the list boxes for each lane of the typical section. Lane offset values are entered in terms of master units.

Dependent This identifies whether the shape of the lane is dependent on the profile or independent of the profile. One dependent shape, based on the profile, is required for each cluster. Other shapes drawn, not based on the profile, but on adjoining lanes, are independent. For example, turn lanes 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.

New Lane Adds a new lane to the list box, then key-in the desired values in the edit fields

Delete Lane Deletes the highlighted lane from the list box.

Quick Entry Enables the user to populate the shape cluster list boxes quickly while entering the data using engineering terminology.



After entering the information on this dialog and clicking *OK*, the number of lanes and their corresponding offsets entered automatically into the shape cluster boxes.

If the user enters an odd number of lanes (such as five), they put the center lane: half on the left tab and half on the right tab. If the Half Lane Width item (on the Runoff Length tab of the Preferences dialog) is set properly, those two narrow lanes count as one for the purposes of computing Runoff Lengths.

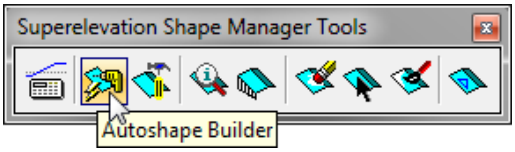
Rectify Lanes Eliminates any gaps or overlaps between lanes, ensuring that one lane starts where the other lane ends. For example, if one lane is set to 0 and 12, while the next lane is set to 10 and 24, there is an overlap between 10 and 12. Clicking Rectify Lanes will leave the 0 to 12 lane intact, and change the second lane to 12 and 26, maintaining the width of the second lane but eliminating the overlap.

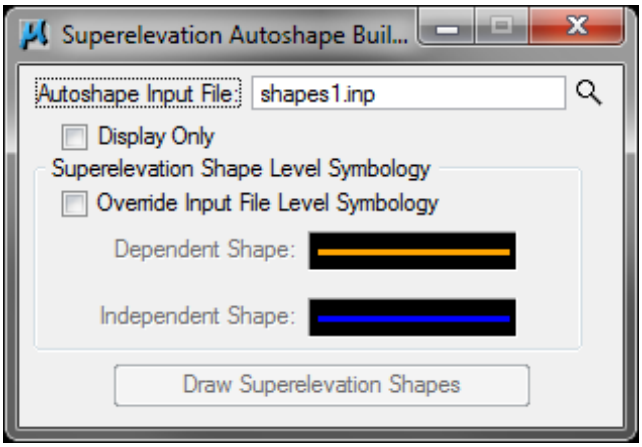
Create Input File Select an ASCII file wherein GEOPAK creates the autoshape input file. It is not necessary to include the extension, as GEOPAK will add .inp to the field.

Generate Superelevation Transitions Processes the superelevation calculations to generate the shape input file.

SUPERELEVATION AUTOSHAPE BUILDER

The Superelevation Autoshape Builder tool processes a previously created shapes input file.





Autoshape Input File Name of the input file to be processed. The browse icon is available to navigate to the desired file.

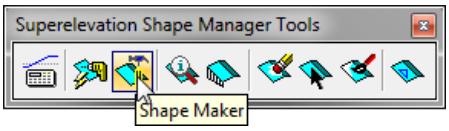
Display Only When active, the superelevation shapes display, but not drawn into, the design file as permanent elements. The shapes will disappear when the view updates.

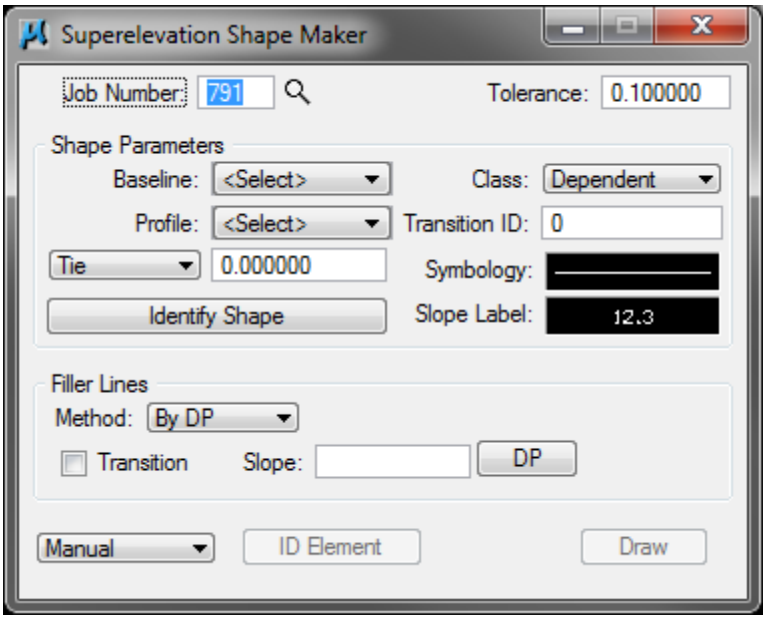
Override Input File Level Symbology When active, the user has the ability to override the symbology of the shapes that is specified in the input file.

Draw Superevelation Shapes Processes the shape input file and draws or displays shape into the active design file.

SUPERELEVATION SHAPE MAKER

Superelevation Shape Maker gives the user the ability to create superelevation shapes manually. To do this, the user must supply the information to build the shapes. This includes not only the elements that make up the extents of the shape's limits, but also information such as slopes, baseline, profiles, etc.





Job Number Coordinate geometry database number, wherein superelevation chains and profiles are stored. The user can enter the Job Number manually or identified by pressing the Select icon.

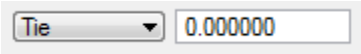
Tolerance In order to create a shape, the elements that represent the edges of pavement must be coincident. This is where tolerance comes into play. If the elements are not coincident perfectly, then building the shape may fail. If this happens, a larger tolerance may be used.

Shape Parameters

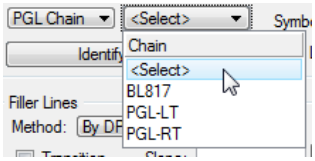
Baseline A chain used to describe the proposed alignment of the superelevation shape.

Profile Profile used to describe the vertical geometry of the superelevation shape utilizing the stationing of the baseline defined.

Tie/PGL Chain When this option is set to Tie, then a constant offset distance is given and applied to the Baseline to define a Profile Grade Line (PGL). A negative tie means the profile offsets to the left of the proposed alignment. A positive tie offsets to the right of the alignment relative to the direction of the stationing.



Setting the option to PGL chain, initiates a selection of an alignment, that defines the PGL. This is optional and only used when the offset distance from the Baseline to the Profile is not constant.



Class Dependent/Independent option identifies whether the shape is dependent on the profile or not. A good rule of thumb is one dependent shape per shape cluster.

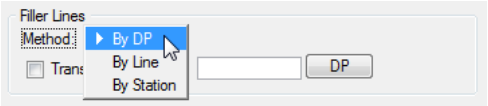
Transition ID Dictates the type of transition utilized by the software, either linear or parabolic. The software utilized linear interpolation, if the Trans ID is blank or 0. The transition table is utilized when the transition ID is greater than 0. Note the Trans ID reflects the number from the xs.td file.

Symbology Sets the graphical symbology of the superelevation shape.

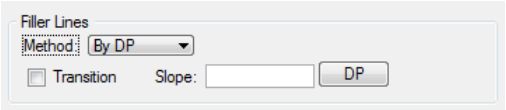
Slope Label Sets the text symbology and characteristics of the slope labels drawn with the superelevation shape.

Identify Shape Fills out the dialog using the parameters of the selected shape.

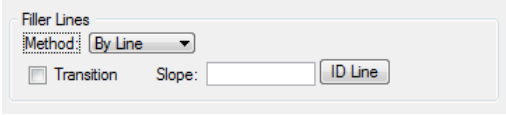
Filler Lines The filler lines are the "ends" of the shape (i.e. where the shape begins and where the shape ends). There are 3 options with which to define these extents. When selecting each option, the dialog will change to reflect required information for that option.



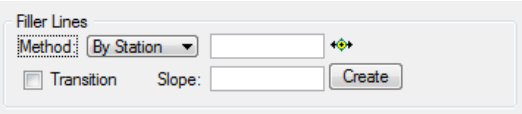
By DP **Data Point**s define the *Beginning and Ending Extents* of the shape. If the transition toggle is disabled, then both ends of the shape will use the given slope. If enabled, the user will have to input a second slope.



By Line The beginning and ending extents of the shape are defined by identifying a MicroStation line. If the transition toggle is disabled, then both ends of the shape will use the given slope. If enabled, the user will have to input a second slope.

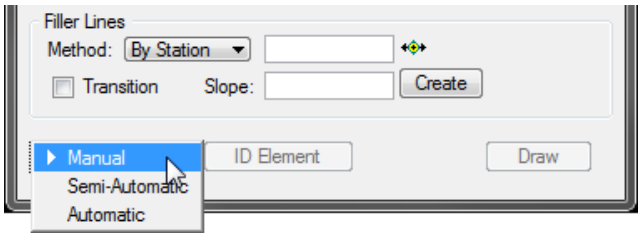


By Station The beginning and ending extents of the shape are defined by giving a station. The user identifies the station with a key-in or by a **Data Point** in the design file. If the transition toggle is disabled, then both ends of the shape will use the given slope. If enabled, the user will have to input a second slope.



Element Selection There are three options used to select the elements that make up the edges of the proposed shape.

Manual The user must manually identify each element that comprises the sides of the proposed shape.



Semi-Automatic The user can identify a single element, and then upon subsequent **Data Point**s the software will attempt to connect the elements and "walk" around the shape edges. If the software comes to a fork then the user can use the "right-click" mouse icon to choose different options.

Automatic The user identifies a single point in the interior of the shape and the software attempts to automatically figure out the sides and creates the shape. Radius defines the size of the circle displayed at each element end point used to create the shape. These circles are for display purposes only and will disappear once refreshing the view.

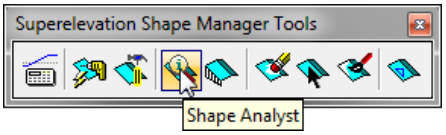
ID Element Used in conjunction with the above Element Selection methods to identify the sides of the proposed shape.

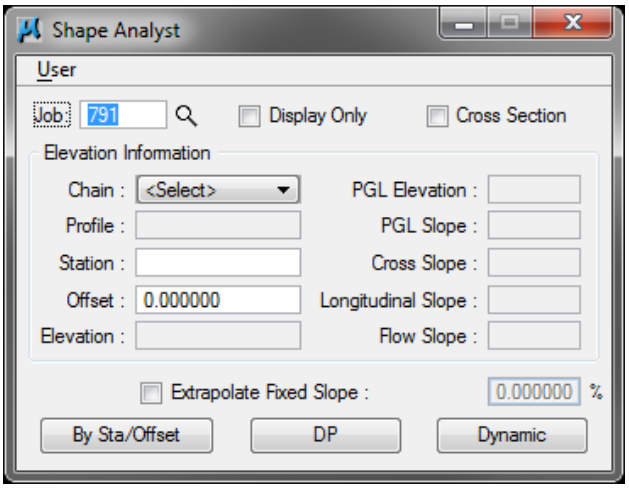
Draw Draws the shape into the design file.

SHAPE ANALYST

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

While most of the dialog is displayed information, some user input is required, and detailed in the list below.

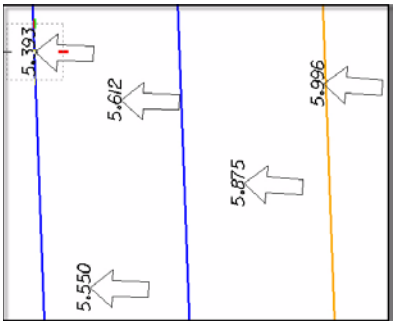




Job Number Coordinate geometry database number, wherein superelevation chains and profiles are stored. The user enters the Job Number manually or identifies by pressing the Select icon.

Display Only When active, the flow arrow and text are displayed, and not drawn into the MicroStation design file. Therefore, they are lost after refreshing the screen. When not active, all text and elements place in the MicroStation file.

Cross Section When not activate and issuing a **Data Point**, the elevation of the **Data Point** and a flow arrow display as depicted below. The preference settings determine the arrow size, text and orientation.



When activate, a line is placed through the **Data Point**, perpendicular to the shaped cluster baseline. In addition to the elevation and flow arrow placed at the **Data Point**, elevations display where the cross section line intersects any superelevation shape of the same cluster.

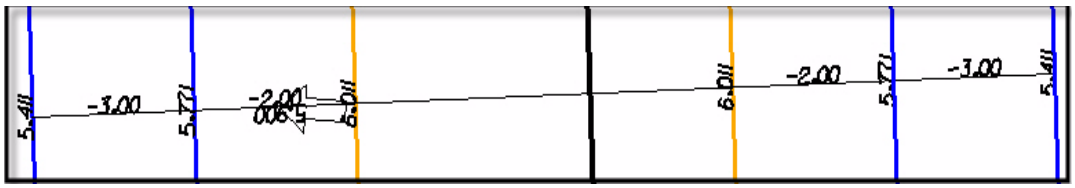
Elevation Information

Chain Shape cluster baseline utilized to create the shape. GEOPAK also determines this, when the **Data Point** is issued.

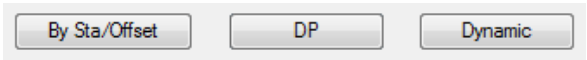
Profile Shape cluster profile. Note this is a display only field, populated by GEOPAK when issuing the **Data Point** and the intersecting shapes are determined.

Station / Offset When using the By Station / Offset icon at the bottom of the dialog, the user can make an entry into these fields manually. In other options, GEOPAK automatically populates the fields by projecting the **Data Point** onto the specified chain, and calculating the station and corresponding offset.

Extrapolate Fixed Slope Another option supported in the Shape Analyst tool is the extrapolation of a fixed slope. The user utilizes this option when the **Data Point**, dynamic point or station / offset is outside of the shape. When activate, it extrapolates the given slope from the last known slope (i.e. the last shape). When not activate, the **Data Point** projectes back to the shape's chain, then the elevations at the edges of the shape are displayed and the slope of the outside shape is projected to the **Data Point**.



Detailed below are three supported options to define the desired point. The icons are located at the bottom of the dialog.

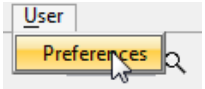


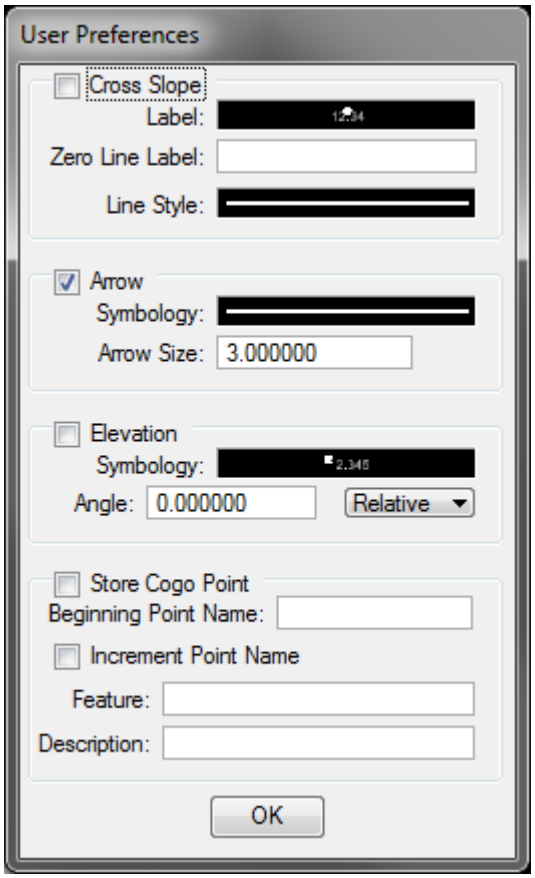
By Station/Offset The Station / Offset is projected back onto the shape cluster baseline and the elevation of the projected point is displayed. This option can be manual entry only and requires no **Data Point** on the screen.

DP A **Data Point** 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 clicking **DP**, the user can place numerous **Data Point**s. It is not necessary to click DP again. Each corresponding station / offset displays along with the associated output information.

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

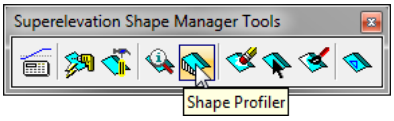
User Preferences Set by clicking on **User** > **Preferences**.

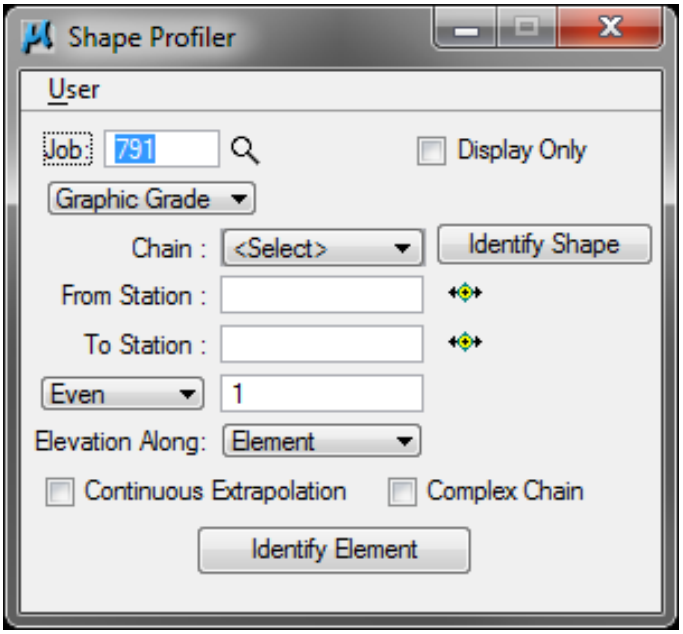


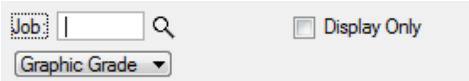


SHAPE PROFILER

The **Shape Profiler** tool provides profile information based on a GEOPAK superelevation shape. This tool supports all GEOPAK superelevation shapes, including those with non-linear (parabolic) transitions, non-zero ties and PGL chains.





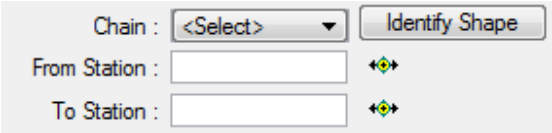


Job Number Coordinate geometry database number, wherein superelevation chains and profiles are stored. The user can enter the Job Number manually or identified by pressing the Select icon.

Display Only When active, the flow arrow and text are displayed, and not drawn into the MicroStation design file. Therefore, they are lost when refreshing the screen. When not active, all text and elements are placed in the MicroStation file.

Graphic Grade Currently the only option supported. The elevations are drawn graphically based on the user-defined parameters.

The next group of fields relates to the superelevation shape. For this tool, only one shape may be utilized at any one time. The fields are detailed below:

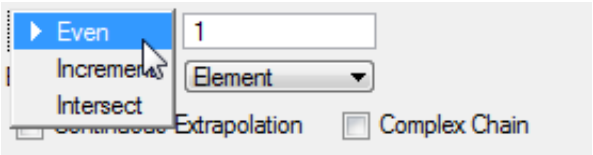


Chain Shape cluster baseline utilized to create the shape. The chain is selected from the list of all chains stored in the current coordinate geometry database.

Identify Shape Press the icon, then select and accept the shape utilized for the grade computations. This populates the chain, From Station and To Station setting from the Shape Properties.

From Station/To Station After defining the shape, the software populates the station fields with the stations of the filler lines (i.e. the ends of the shapes). If there is no need of the graphic grade for the entire shape, the DP icons can define a partial shape. Press the DP icon, then place a **Data Point** inside the shape. The station is automatically adjusted to reflect the **Data Point**.

Three options are supported to define the distance between the graphic grade points.



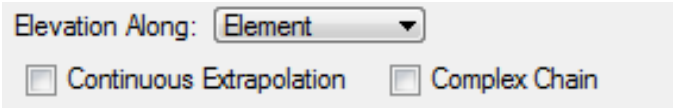
Even Specifies the incremental distance between successive Graphic Grade points where the first Graphic Grade point is rounded to the next highest even station from the From Station. For example, if the From Station is 100+15 and the Even value is 25, the Graphic Grade points would be generated at 100+25, 100+50, etc., divisible by the even value.

Increment Creates Graphic Grade points where the user specifies the incremental distance between successive Graphic Grade points where the first Graphic Grade point is coincident with the From Station and defines subsequent points adding Increment to the From Station.

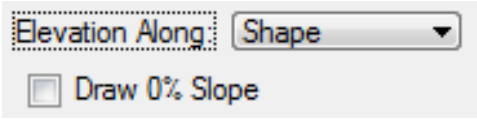
Intersect Creates Graphic Grade points at every location where the selected element intersects the superelevation shape.

Elevation Along: Two options are provided to specify where the graphic grade elevations are created.

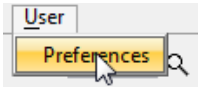
Element If the Complex Chain toggle is active, the user may select a string of elements. If the toggle is off, the user may select a single element. GEOPAK calculates the elevations along the edge of the selected elements at the specified increment. The element can be located inside, along or outside the shape. If the element is outside of the shape, then the slope of the shape extrapolates to the element's location.

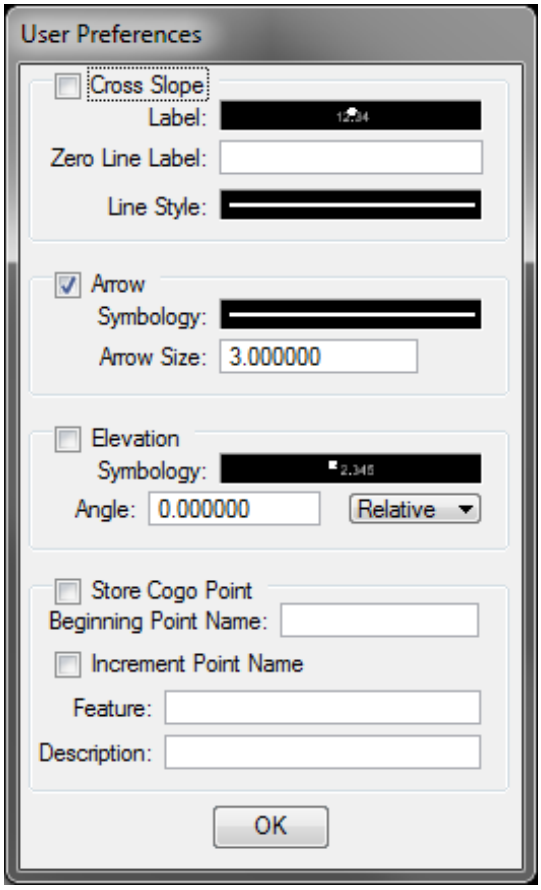


Shape The elevations are drawn around the shape at the specified interval from the filler lines. If the shape has a 0% slope in the shape, it is labeled based on the User Preferences. This option is not available with the Intersect option in the previous filed.



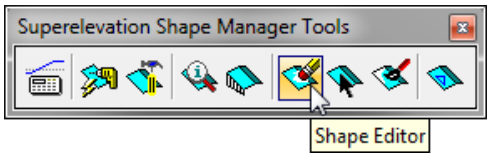
User > Preferences Preferences may be set.

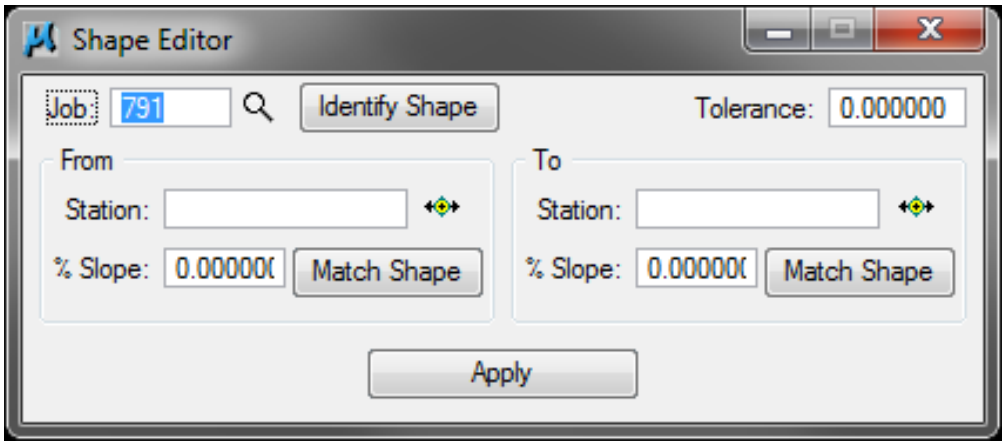




SHAPE EDITOR

The user utilizes the Shape Editor tool to modify the slope and station attributes of an existing superelevation shape.





Job All shapes have attributes: baselines, profiles and optional PGL chains. These geometric elements are stored in the specified *job number*.

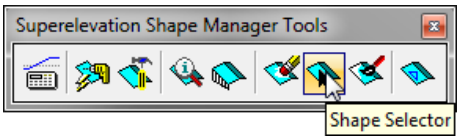
Identify Shape Click this icon, then click on a shape and accept the shape by clicking again off the shape. This will fill in the *From* and *To Station Information* including % of Slope.

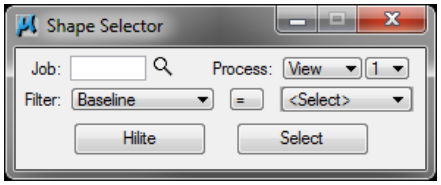
Tolerance In modifying a Superelevation Shape Filler Line, adjacent shapes must be located and processed to ensure that the common filler line adjusts on both shapes. Due to the limitation of graphical precision, these shapes may not share a precise, coincident filler line. The tolerance is used to search and process shapes when the filler line is relocated.

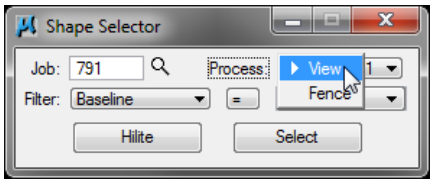
From / To Station When the shape is identified, the slope information will be populated in the dialog. At that point, the user can modify the information by either key-in or dynamically, then press Apply to make the changes to the superelevation shape.

SHAPE SELECTOR

The user utilizes the Shape Selector tool to either highlight or select shapes based on one of the shape's parameters (e.g. Slope, Baseline Name, Profile Name, etc.).





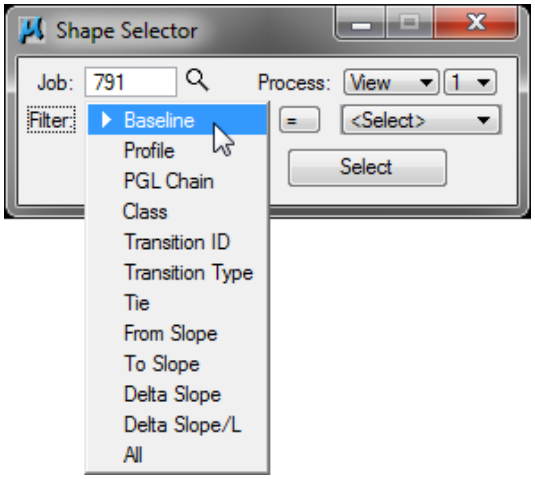


Job All shapes have attribute: baselines, profiles and optional PGL chains. These geometric elements are stored in the specified job number.

Process

View All shapes highlight or select in the current view that match the filter. Eight views are available.

Fence A MicroStation the user must place a fence prior to clicking Hilite or Select. Regardless of which Fence option is utilized (i.e., Inside, Clip, Void, etc), the shapes which match the filter and part or all of the shape is within the confines of the fence are highlighted or selected.



Filter

Baseline A chain associated with the superelevation shape (i.e., shape cluster baseline defined when the shape was created).

Profile Profile associated with the superelevation shape (i.e., shape cluster profile defined when the shape was created).

PGL Chain PGL Chain associated with the superelevation shape (i.e., shape cluster PGL Chain defined when creating the shape).

Class There are two supported options: dependent or independent.

Transition ID Used in parabolic tapers and its associated parabolic parameters.

Transition Type There are two transition types are supported: non-transition (where the cross slope of the shape is consistent) and transition (where the cross slope is different at the ends or specified stations of the shape.

Tie Horizontal distance between the baseline and the profile grade line. If the baseline and profile grade line are coincident, the tie is zero.

From Slope Slope in percent format of the superelevation shape at the lower stationing.

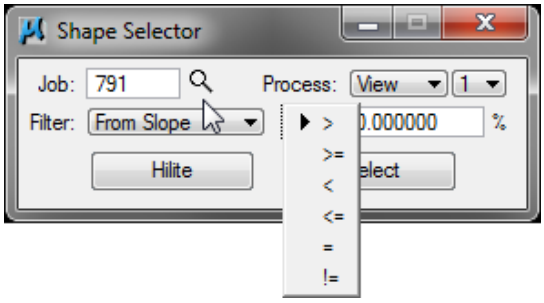
To Slope Slope in percent format of the superelevation shape at the higher stationing.

Delta Slope Algebraic difference in percent format between the From Slope and To Slope.

Delta Slope/L Algebraic difference in slope between the From Slope and To Slope divided by the length of the shape. This is an indicator of the rate at which the cross slope is changing. This parameter relates closely to the relative gradient of the transition.

All This refers to all shapes. Note there are no user input requirements for this option.

Filter Operators A variety of supported operands detailed below. The Option chosen determines the available operands.



Greater Than (>) Only available with certain options.

Greater Than or Equal To (>=) Only available with certain options.

Less Than (<) Only available with certain options.

Less Than or Equal To (<=) Only available with certain options.

Equal To (=) Only available with certain options.

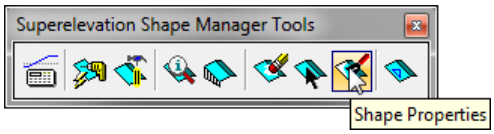
Not Equal To (! =) Only available with certain options.

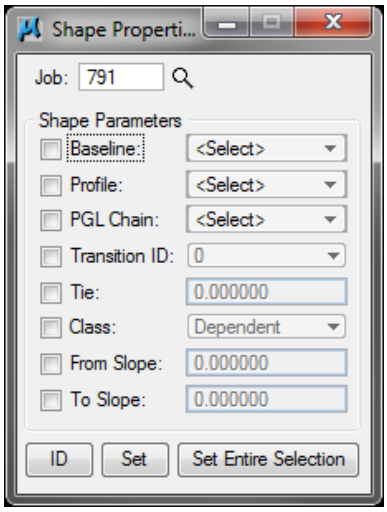
Hilite When clicking the Hilite icon, all shapes fulfilling the query highlight in the design file.

Select When clicking the Select icon, all shapes fulfilling the query place into a MicroStation selection set.

SHAPE PROPERTIES

The Shape Properties tool provides a variety of shape and slope information. In addition, the user can modify this shape information on individual shapes or selections of shapes.





Job All shapes are attributed with baselines, profiles and optional PGL chains. These geometric elements are stored in the specified job number.

Shape Parameters

Baseline Shape cluster baseline utilized to create the shape.

Profile Shape cluster profile utilized to create the shape.

PGL Chain Shape cluster PGL chain used to create the shape.

Transition ID Utilized in parabolic transitions only and defines the transitions.

Tie Shape Cluster Tie used to create the shape.

Class There are two options supported: Dependent and Independent.

From Slope The cross slope (in percent) at the lowest station value end of the shape.

To Slope The cross slope (in percent) at the highest station value end of the shape.

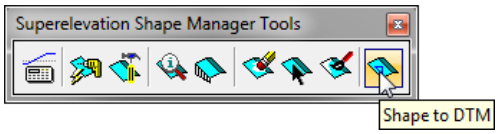
ID Populates the highlighted shape parameters with the attributes of a particular shape. Click ID, then select and accept a superelevation shape. GEOPAK populates every field where a toggle is activated.

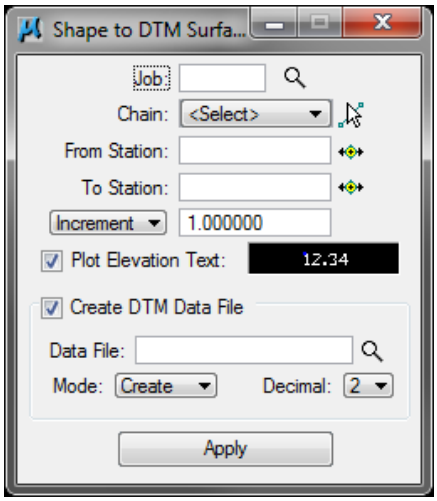
Set Sets individual superelevation shapes with a set of desired parameters. Activate the desired parameters and populate the associated fields with the desired values. Then click Set Entire Selection, an alert appears to confirm the changes. Selecting ***Yes*** changes the shape attributes.

Set Entire Selection Sets multiple superelevation shapes in a MicroStation selection set with a set of desired parameters. Activate the desired parameters and populate the associated fields with the desired values. Then click Set Entire Selection, select and accept the superelevation shape to be changed.

SHAPE TO DTM

The Shape to DTM tool reads GEOPAK superelevation shapes and creates a DAT file suitable for use in the Build Triangles tool in the DTM tool frame.





Job All shapes have attributes: baselines, profiles and optional PGL chains. These geometric elements are stored in the specified job number.

Chain Shape cluster baseline utilized to create the shape.

From Station Lower stationing used as the limits of the DAT file. Enter station or Click DP icon ( ) and graphically select.

To Station Upper stationing used as the limits of the DAT file. Enter station or Click DP icon ( ) and graphically select.

Increment/Even The interval of points used for the data file. When Increment is used, the value added to the From Station iteratively until the To Station is reached. If the From Station is 10+10 and the value is 25, Increment values are 10+10, 10+35, 10+60, etc. When Even is utilized, the points are taken at even values within the station range. If the From Station is 10+10 and the value is 25, Even values are 10+25, 10+50, 10+75, etc.

Plot Elevation Text When enabled, text is placed at each point included within the data file.

Create DTM Data File When enabled, it creates a DTM Data File. If the file already exists, then it appends to the file.

Data File Name of data file created or appended.

Mode The options are to Create a new file or Utilize a previously created file, in which case, the data created in this procedure is appended to the original data. If you select Create mode and the data file you named already exists, an Alert dialog will appear asking to overwrite the existing file. Select OK or Cancel.

Decimal Number of decimal places used when creating the data file.

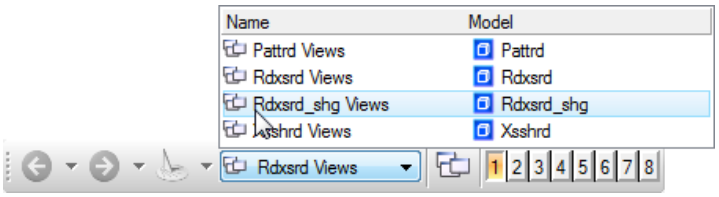
Apply Commence the procedure.

Exercise 5.1 Processing Automated Superelevation

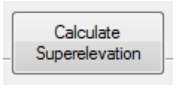
Even though this road is now considered urban, it was originally built as a rural roadway many years ago using rural specifications in use at that time. Since then, the area has developed into an urban area servicing more motorists than originally designed. You will notice that if using the actual current design specifications of urban and a 45mph design speed, the entire project computes to be normal crown. If this were a new roadway, the design would utilize normal crown; however, we are rehabbing a roadway with superelevation because of the past rural standards. The designer of this project created the shapes by hand to better fit the existing conditions. Subsequent exercises use original designer shaped, because they match the actual design.

In this exercise, the user will use the software to calculate the superelevation transitions.

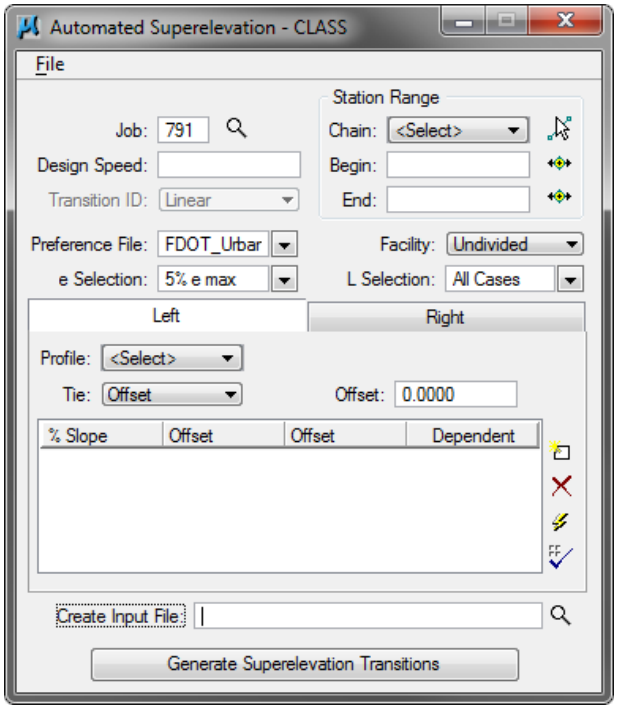
1. Double-click on the self-extracting zip file C:*Chapter5_Exercises.exe* and click the **Unzip** icon at the prompt.
2. Open the design file C:/e/Projects/228079115201/roadway/*RDXSRD01.dgn*.
3. Access the Model XSSHRD.



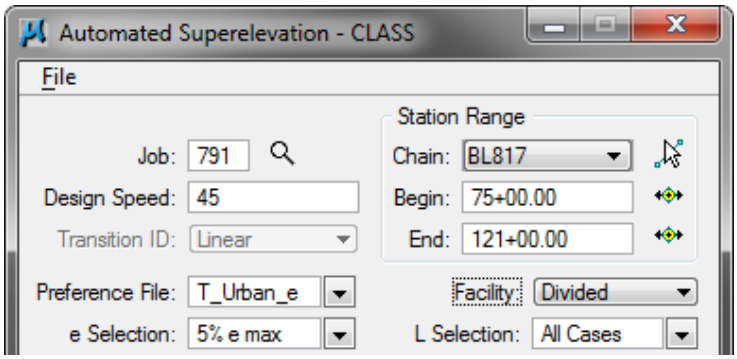
4. Open Project Manager, and from Road Project, click the **Calculate Superelevation** icon.



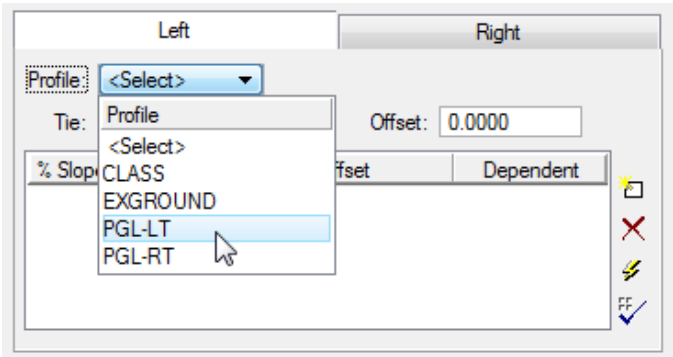
5. Create a new run and access the Automated Superelevation dialog.



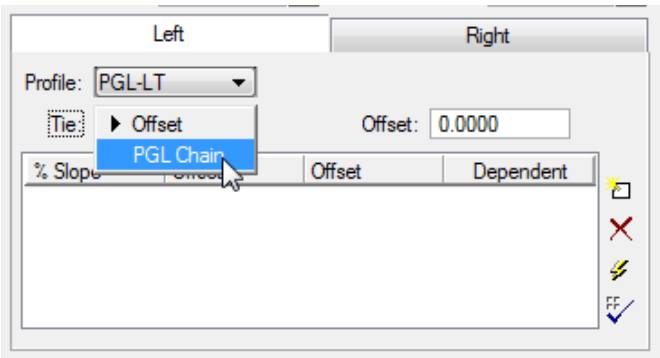
6. Fill in the top portion of the dialog with the information as shown below:



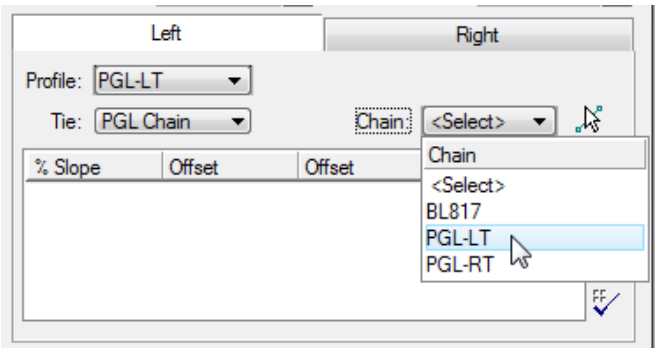
7. With the *Left Tab* active, select the *profile* **PGL-LT**.



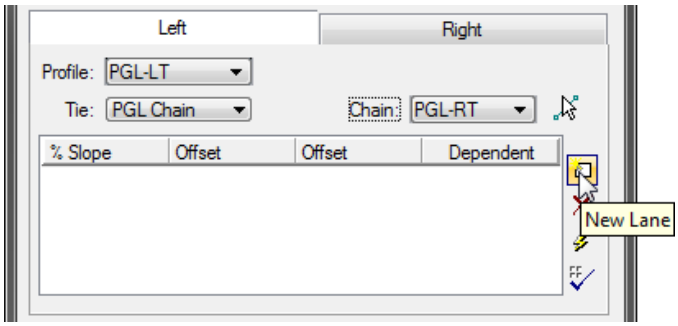
8. Change the *Tie* option to **PGL Chain**.



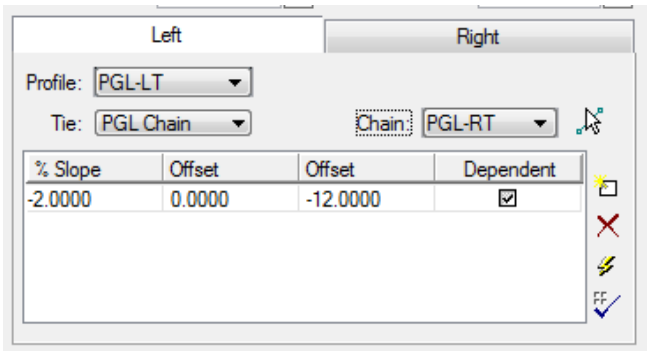
9. Select the *chain* **PGL-LT**.



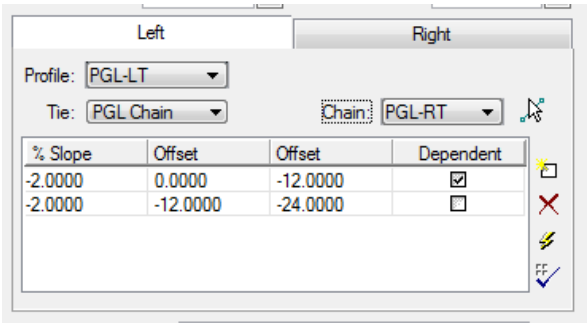
10. Click the **New Lane** icon.



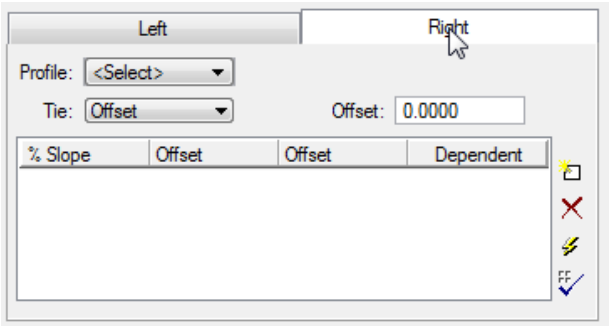
11. A new lane entry adds to the list box.



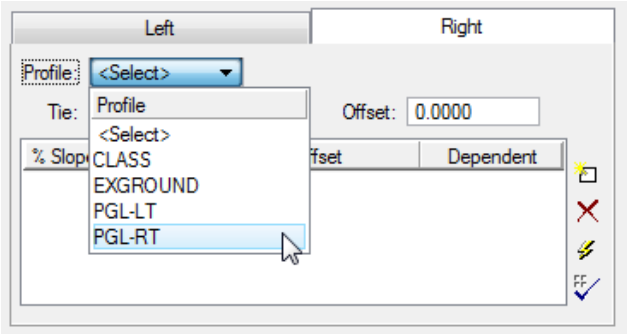
12. Click the **New Lane** icon again to add a second lane entry to the list box.



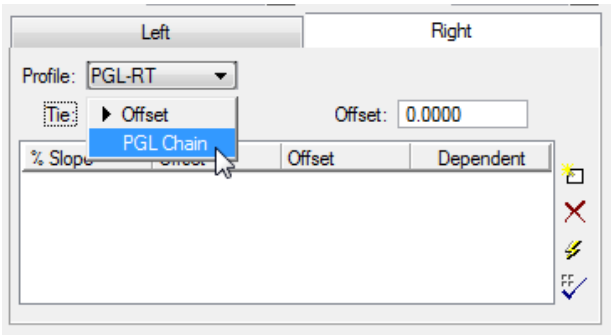
13. Click the **Right Tab** to change the focus of the dialog.



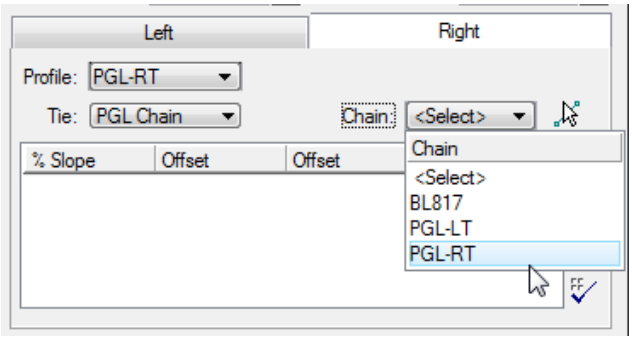
14. Select the *Profile* **PGL-RT**.



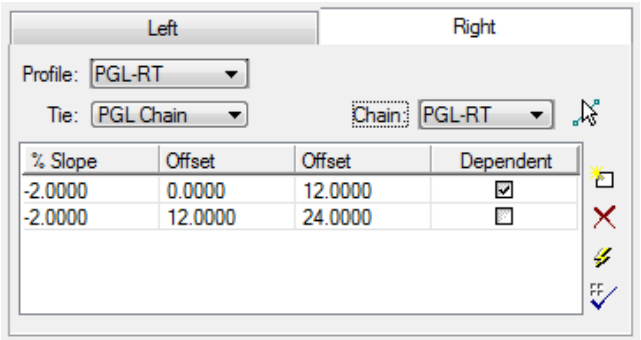
15. Change the *Tie* option to **PGL Chain**.



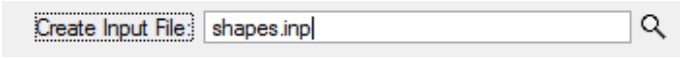
16. Select the *chain* **PGL-RT**.



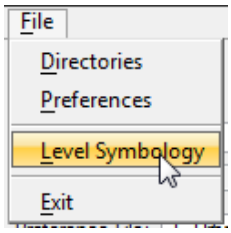
17. Click the **New Lane** icon twice to add two lane entries to the list box.

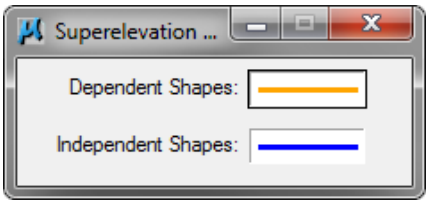


18. Key-in the name **SHAPES.INP** in the *Create Input File* field.

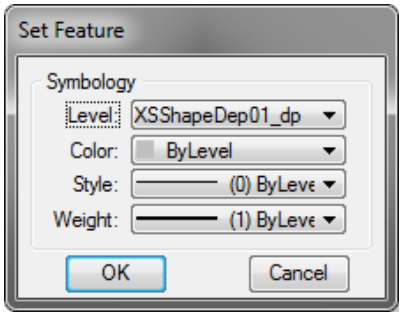


19. Select File > Level Symbology.

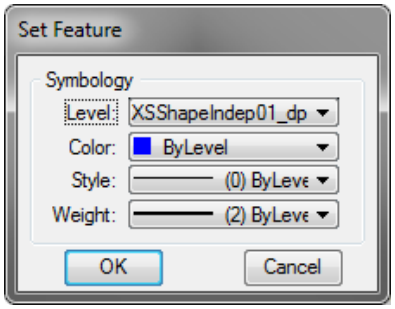




20. Set the *Dependent Shapes* symbology as shown below:

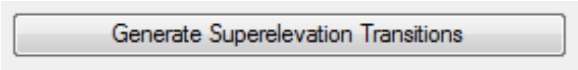


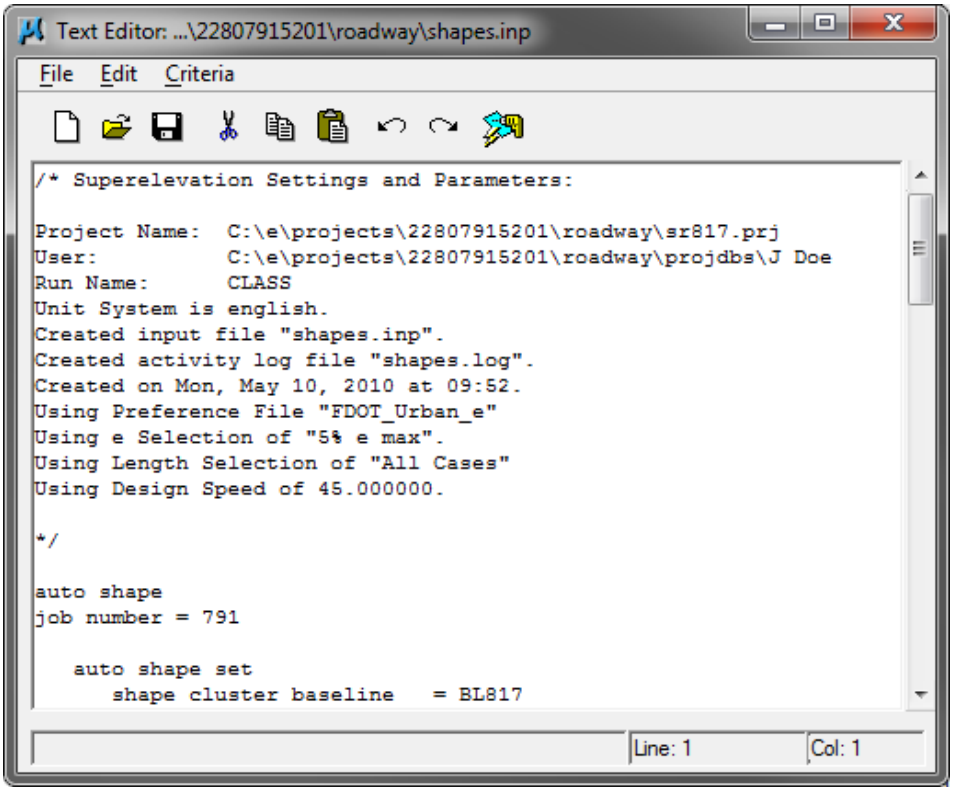
21. Set the *Independent Shapes* symbology as shown below:



22. Close the Superelevation Shape Level Symbology dialog.

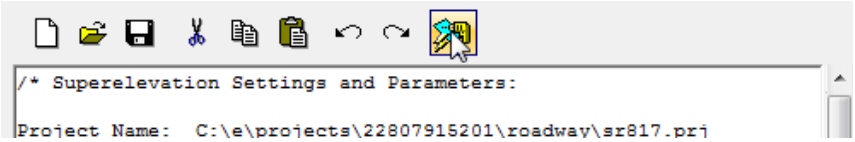
23. Click the **Generate Superelevation Transitions** icon. The superelevation calculations process and the input file is created. The input file opens automatically in the Text Editor for review.





Note If you get a message stating that the autoshape input file could not be written to file name "shapes.inp", check the path in the Create Input File field by clicking on the Browse Autoshape Input File icon ( )

24. Click the **Create Superelevation Shapes** icon to draw the superelevation shapes into the design file.



25. Close the Text Editor.
26. Close the Automated Superelevation dialog. Click **Yes** when prompted to *Save Settings*.
27. Review the superelevation shapes in the design file.

Exercise 5.2 Superelevation Shape Manager Tools

In lieu of a structured exercise, use the created shapes from Exercise 5.1 to review each of the *Superelevation Shape Manager Tools*. At the end of this exercise, please **Exit** MicroStation.

6 PROPOSED CROSS SECTIONS

OBJECTIVES

- Detail Proposed Cross Sections
- Typical Sections Overview
- Process a Shapeless Typical to Add Existing Features
- Process Proposed Features
- Modify Re-definable Variables
- Use DGN Elements and Adhocs

OVERVIEW

One of the most powerful and flexible features of GEOPAK is the use of criteria in generating proposed cross sections. Within criteria, design conditions can be evaluated and complicated design decisions executed in response to these design conditions. The flexibility of criteria allows the designer to make the design as basic or as complex as the project requires. Numerous baselines can interrelate as ditches and medians are drawn between roadways and ramps. Sophisticated drainage details can also be drawn with criteria.

Users utilize the FDOT Cross section criteria to draw cross section features outside of the mosaic of superelevation shapes typically representing pavement. Operationally, the software constructs the cross section features derived from the mosaic of shapes first. Then, the software constructs the remaining portions of the cross section through the application of criteria emanating out from the outer edges of the shapes.

The FDOT Criteria by designs runs all cross sections (existing, divided or undivided, mill and resurface, new pavement or both, widening, etc.) through the Typical Section Generator. FDOT delivers 5 typical sections. Each of these typical sections is associated with specific criteria files. By selecting a typical section appropriate to the project, the required criteria files are automatically applied and setup using the proper side slope conditions.

Drawing proposed cross sections is the interaction with all the various components already addressed in this manual, with the addition of criteria. The following components are required to draw proposed cross sections:

- **GPK file** - All referenced chains and profiles are stored. These include shape cluster baseline and profiles in addition to special ditch grades, retaining wall alignments, etc. A minimum of one alignment and one profile is required.
- **Existing Ground Cross Sections**
- **Pattern Lines** - If Pattern by DGN was utilized

- **Shapes -** Utilized to draw pavement features encompassing superelevation. However, if the project has no superelevation transitions, the user may use the shapeless method. In this case, the initial point is the shape cluster baseline, profile, and tie combination. Users draw all proposed cross section elements, including pavement with criteria.

Note The FDOT criteria require shapes to be present for all proposed cross section runs. Travel lane width shapes are the minimum.

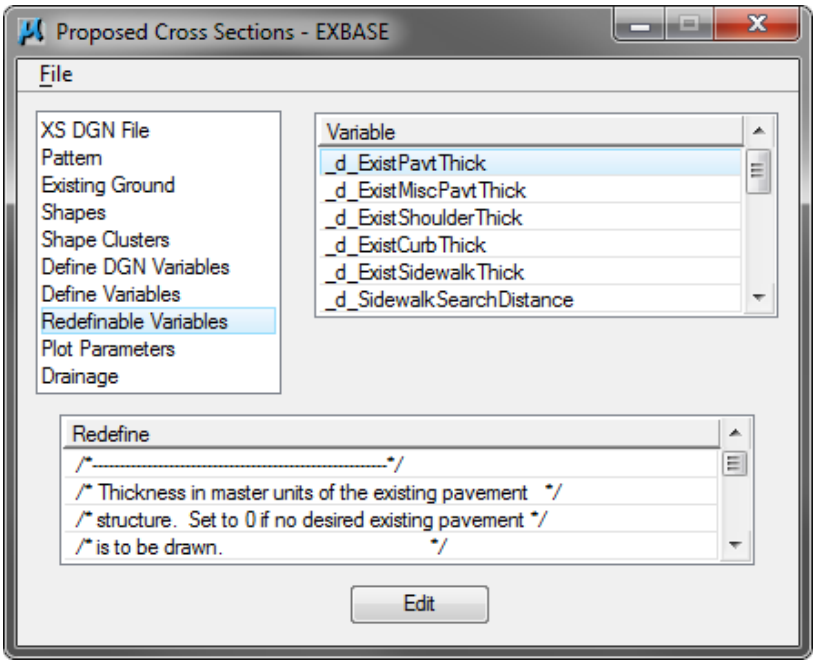
- **Plan View Layout of Roadway Features** - The FDOT2008 criteria support various design options based on plan graphics. It is important to know what these options are during the design stage of the project to save time and effort when it comes time to create the proposed cross sections. It is recommended that the Design & Computation Manager be used during the design process to insure that any Adhoc attributes required by the criteria are attached to the elements

CONTROLLING CROSS SECTION FEATURES

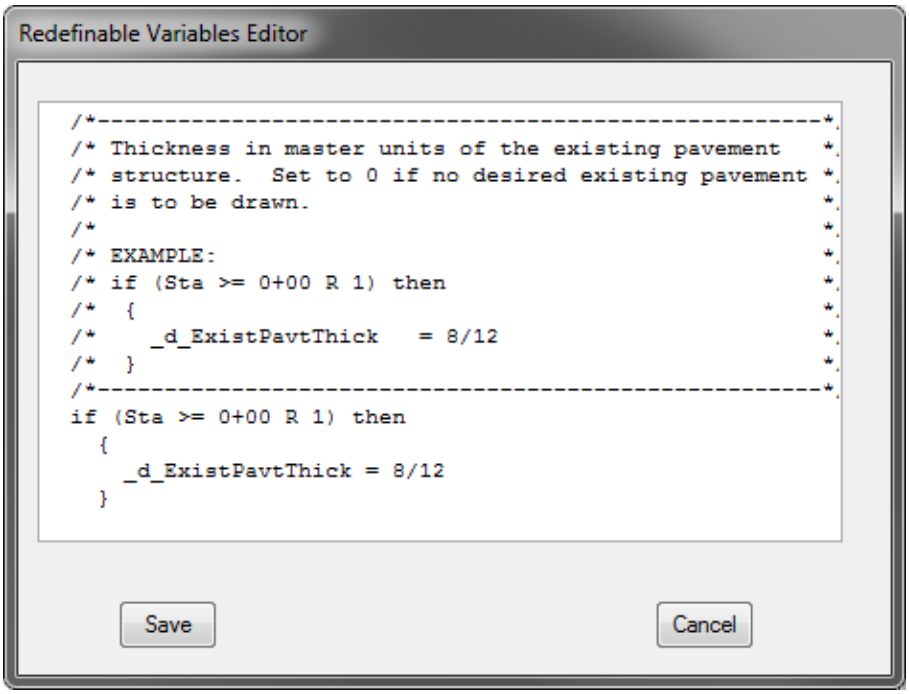
The FDOT criteria by designed have many variables set with default values that control what and how the cross sections are drawn. Re-definable Variables control these features, graphic "trigger" elements, and Adhocs attached to these graphics. Using a combination of these options a user can control the output of the cross section run.

RE-DEFINABLE VARIABLES

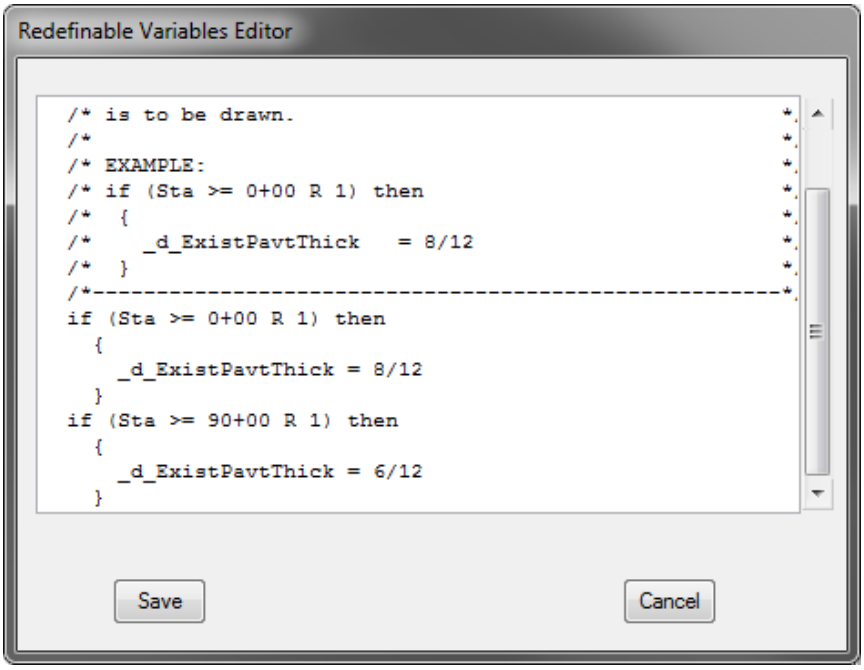
Re-definable Variables are modifiable, so they have different values over different station ranges within the same cross section run. Re-definable Variables populate into the Proposed Cross Section run when a Typical applies through the Typical Section Generator. These variables by designed used as typical settings over the length of the project. The user can modify them for the entire run or with the use of additional "If/Then" statements to cover specific station ranges of sections. It is important to note, any Adhocs found on plan graphic elements will overwrite the Re-definable Variables. For a complete list of the Re-definable Variable used in the criteria, please see the Cross Section Criteria Help documentation.



Double clicking on one of the variables or selecting the variable in the list and then clicking Edit opens the Re-definable Variables Editor dialog.



From this editor, the user can modify the value for the entire run by typing in the new value and clicking **Save**. To maintain the value of the variable, but modify over a station range, the If statement may be copied and pasted with a new defining If statement. See below for an example.



GRAPHIC ELEMENTS

Graphic elements found in the DSGNRD file control many of these features. Define_DGN Variables searches for these graphic elements. The FDOT Criteria defines these variables to match the symbology for the feature as defined in the Design & Computation (D&C) Manager. It is important to use the D&C Manager to draw the elements into the design. Most features are commonly drawn elements that a requirement in the design file, such as EOP, curb and sidewalk or paved shoulders. Some features are not required for plans production but necessary all the same to add certain features to the cross sections. These features include special ditch lines, median lines, milling limit lines, etc.

The user should pay special attention in the placement of these lines. They must cross the pattern lines and be placed in the area of the design file that the criteria will be able to locate them. Simply placing a line into the file does not guarantee that the criteria will find it. For example, the user should place a special ditch line outside the limits of the shoulder of the roadway where the ditch would be constructed. (This includes paved and unpaved shoulder limits.)

Graphic Element Summary

Feature	Associated Adhocs?
Back of Sidewalk	Yes
Front of Sidewalk	No
Driveway	Yes
Edge of Pavement	Yes
Existing Ground	No
Existing R/W	No
Proposed R/W	No
Milling Limits	Yes
Miscellaneous Asphalt	Yes
Proposed Traffic Separators	Yes
Curb and/or Gutter (All types)	No
Paved Shoulder	Yes
Side Road Tie Down Lines	Yes
Match lines	No
Curb and Gutter Wall	No
Shoulder Barrier Wall (Cant. or L)	Yes
Shoulder Barrier Wall (Retaining)	No
Gravity Wall	No
Median Barrier Walls	Yes
Edge of Front Slope 1	No

Feature	Associated Adhocs?
Special Ditch Lines	Yes
Berm Lines	Yes
Front Slope 1 Slope Override	Yes
Front Slope 1 Width Override	Yes
Front Slope 2 Slope Override	Yes
Ditch Width Override	Yes
Back Slope Override	Yes
Ditch Depth Override	Yes
Force Slope Override	Yes
Feather Distance Override	Yes

Note For a detailed list of the graphic elements the criteria searches for, consult the FDOT Criteria Help files, T accessed through the FDOT Menu option Roadway > **FDOT**2008 Criteria Help Files.

ADHOC ATTRIBUTES

Most, but not all, graphic elements needed for criteria have associated Adhoc attributes. These Adhocs represent variables in the criteria. They can represent numeric values for thicknesses, heights, widths, etc. They can have a text or string value that can represent a trigger (Yes or No) or the names of COGO chains or profiles. It is important to understand that FDOT Criteria only recongizes the Adhocs defined by the delivered FDOT *.ddb* file. User must not introduce New Adhocs onto an element and then be expected to be read by the criteria.

Adhocs attach to elements in several ways. The first way is through the D&C Manager using either the **Design** or **Set** Modes with **Place Influence** and **Adhoc Attributes** toggles on. The values for the Adhocs have been set to a default and will revert back to these values each time the item is invoked.

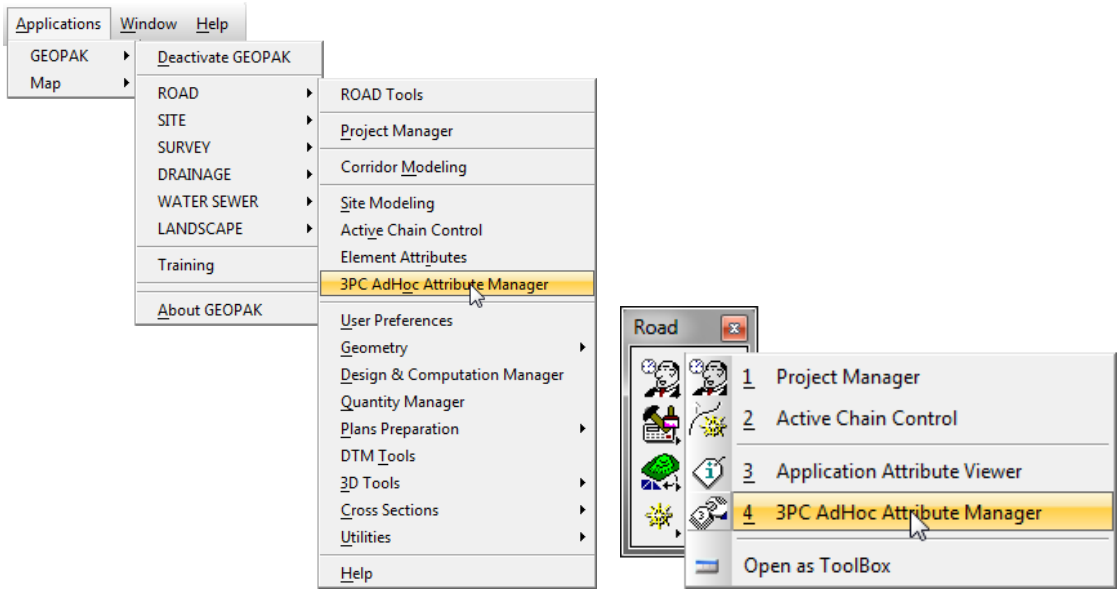
Note The values shown in the Adhoc box within D&C Manager do NOT represent the Adhocs attached to an existing element. The user may modify them to add to new elements drawn or set on to existing elements.

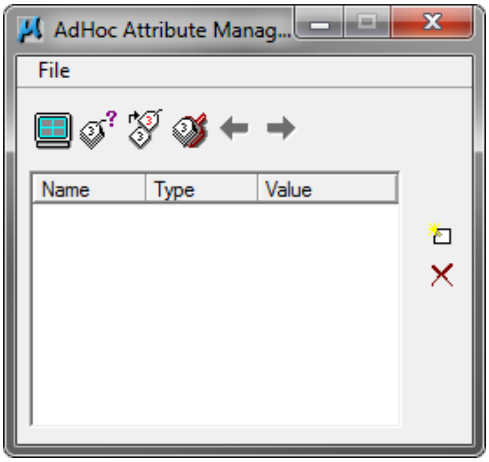
The user may also place them on elements using one of the Adhoc Attribute Managers (GEOPAK or FDOT). These programs can gather the Adhocs for review and subsequent modification, and then set them back onto existing elements in the file.

For a detailed list of the Adhoc attributes the criteria searches for, consult the FDOT Cross Section Help files. They may be accessed through the FDOT Menu under **Roadway** > **FDOT2008 Criteria Help Files** –or—by clicking on the "**?**" icon on the Adhoc table that pops up with the D&C Manager.

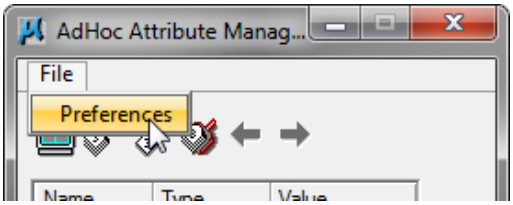
ADHOC ATTRIBUTE MANAGER

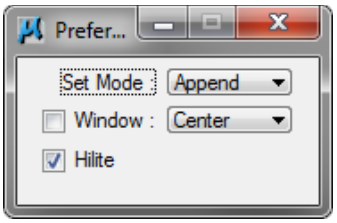
The Adhoc Attribute Manager can be accessed from the menu pull down **Applications** > **Road** > **3PC Adhoc Attribute Manager** – or – from the **Road** Toolbox.





File Menu Opens the Preferences dialog box.





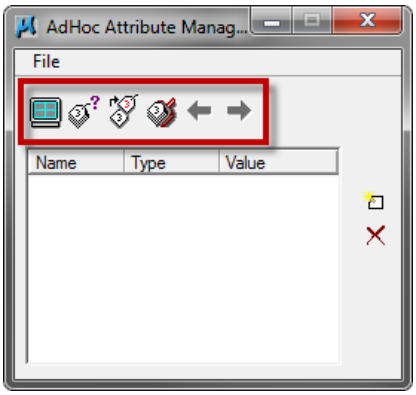
Preferences

Set Mode - Defines the actions of the tool. Options include to **Append** (add the Adhocs in the list box to the selected element) and **Replace** (remove existing Adhocs and replace with Adhocs in the list box to the selected element).

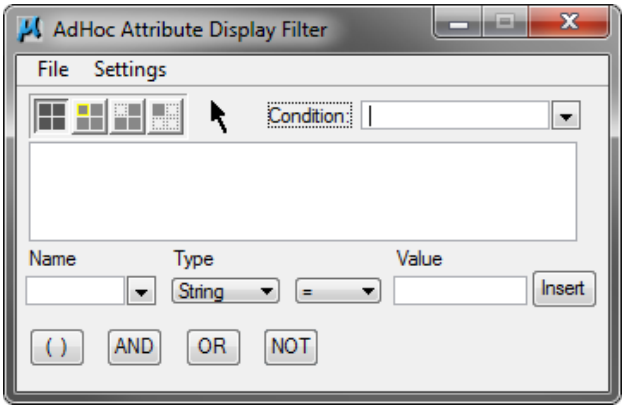
Window - Offers to options to view the active element when reviewing Adhocs on a selection set. When toggled on and set to **Center**, the active element is automatically centered on the screen. When **Pan** is selected, MicroStation pans to the selected element.

Hilite - The active element for review is highlighted.

Icons

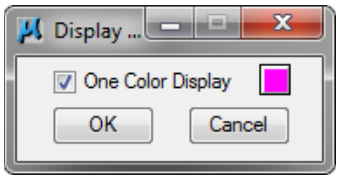


Attribute Display Filter Opens the Attribute Display Filter dialog box that queries the Adhocs attached to MicroStation elements. The user can create a selection set from the results.

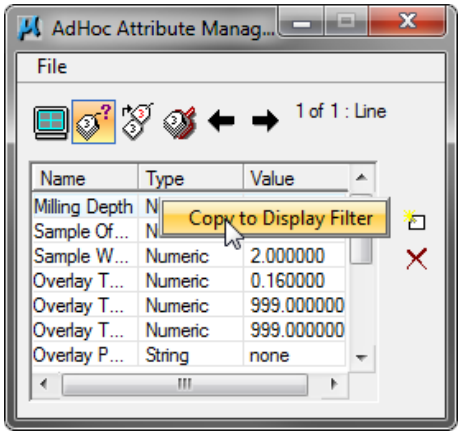


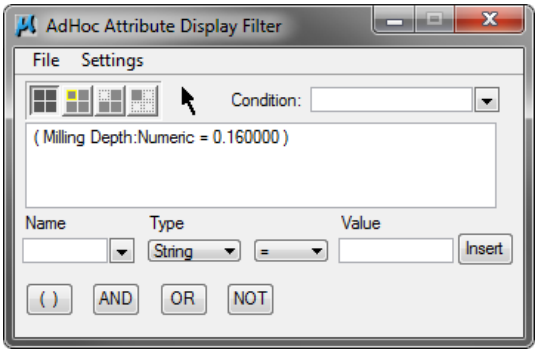
File - Options to **Open**, **Save** and **Save As**. The filter settings are saved as .txt files that can be used at later time.

Settings - Opens the Display Preferences dialog. Allows control for highlighting color used with the Display options.



Right clicking on a highlighted row in the list box will bring up the option to **Copy to Display Filter**. Selecting this option will copy the Adhoc information into the display filter using the correct format.





The options at the bottom of the dialog create new conditions that can be added to the list using the insert icon. The display icons above the list box provide display options for the elements that meet the conditions in the list box. Those options are from left to right, **Normal Display**, **Highlight Selection**, **Hide Selection**, and **Display Only Selection**. Once listing the conditions for the selection, the **Add Elements to Selection Set** icon adds the elements to a MicroStation selection set.

Identify Element Selects an element to review the Adhocs. If Adhocs are attached to the element, they will be populated in the list box.

Set Attributes Sets the Adhocs contained in the list box to selected element(s).

Adhoc Scooper Scans the file for elements with attached Adhocs and creates an output file with the Adhocs and associated information.

Previous Element With selection set identified for review, this navigates to the previous element.

Next Element With selection set identified for review, this navigates to the next element.

List Box The list box contains the Adhocs associated with a selected element. Once Adhocs are in the list box, add or delete new Adhocs using the **Add New Row** and **Delete Row** icons on the right of the list box. Modify Adhocs by clicking on the Name, Type, or Value and typing or selecting the new value. Once changes are made, the Adhocs can be set or attached to elements in the file.

GENERAL CONSIDERATIONS

Due to the additional functions built into the criteria, there are a few things to check in the design files.

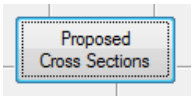
- Make sure there is a **Median Line** drawn into all median sections. This also includes crossovers and traffic separators. Crossovers and traffic separators are handled by placing an Adhoc on the Median Line.
- Check for any special lines that are required for special features such as special ditches, berms, slopes plan graphic overrides, etc.
- Check design elements for required attribute tags or Adhocs. If there has been a new release of the criteria, double check the Adhocs on the existing elements using a combination of the D&C Manager (has all the required Adhocs set up) and the Adhoc Attribute Manager (lists all the Adhocs currently set on the elements).

If any of the design elements are not correct, the resulting cross sections will not be as expected. The Help documentation can help guide the designer to achieving the desired results.

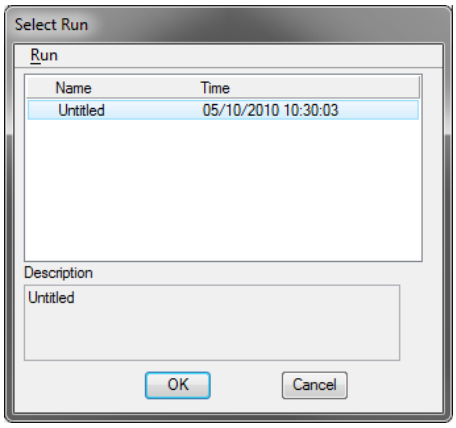
PROPOSED CROSS SECTIONS

Proposed Cross Sections may be accessed:

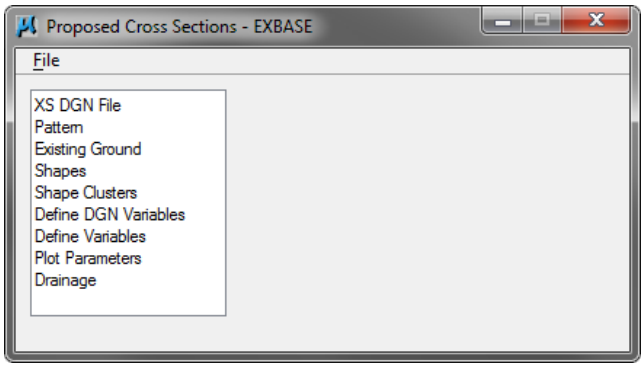
- From Road Project, click the **Proposed Cross Sections** icon.



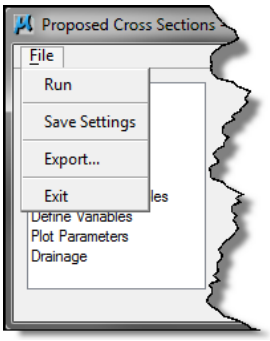
- The Select Run dialog appears. Either select an existing run or create a new run by selecting **Run > New.**



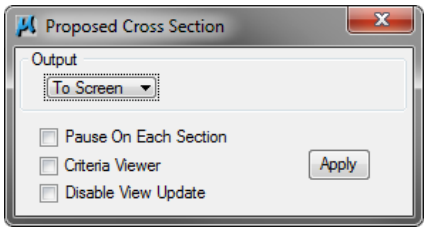
- The Proposed Cross Sections dialog appears.



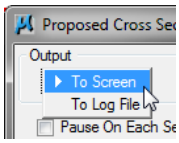
FILE MENU



Run Process the proposed cross sections. Selecting this option will access the Proposed Cross Section dialog shown below.



Output Selection of the *To Screen* option will write all output to the screen, while using the *To Log File* option will write all output to the designated log file.



Pause On Each Section Selecting this check box will cause the proposed cross sections to pause after the first cross section is processed. The user can control the processing of each subsequent section by clicking the Apply icon and can abort at any time.

Criteria Viewer Selecting this check box will access the Criteria Viewer at the beginning of the first cross section. This viewer allows the user to walk through the processing of the section while watching the criteria.

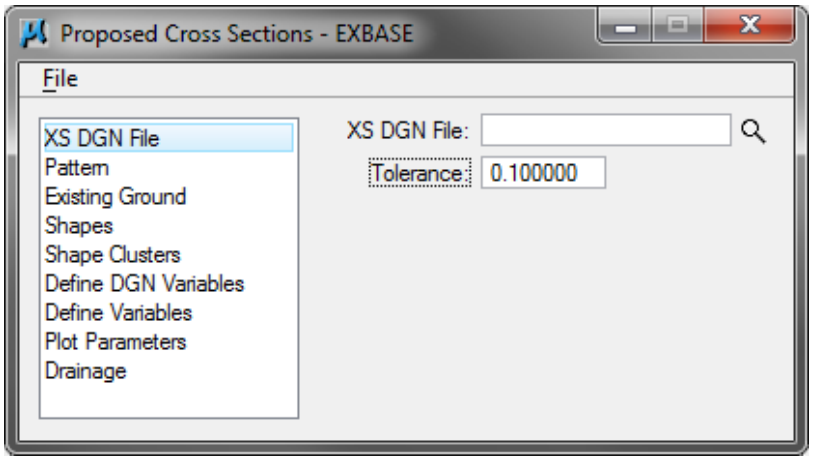
Apply Begin the processing of the proposed cross sections.

Save Settings Saves any changes to the run.

Export Exports all dialog settings to a proposed cross section input file.

Exit Exit the dialog.

XS DGN FILE

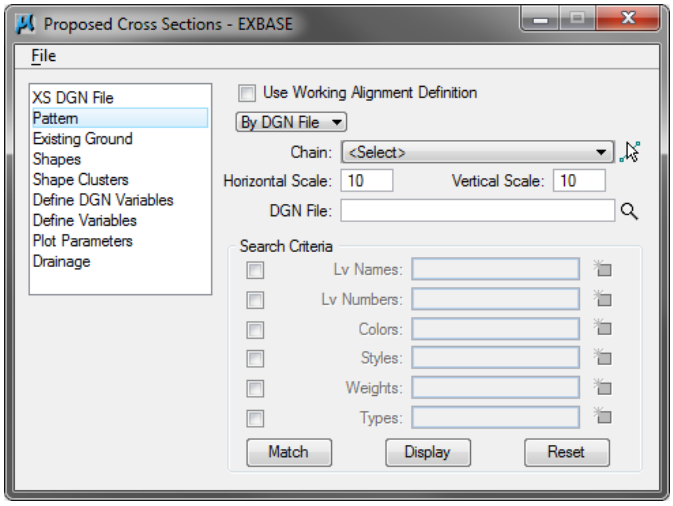


XS DGN File The file containing the specified cross sections. When using a working alignment definition, the cross section design file name fills in automatically.

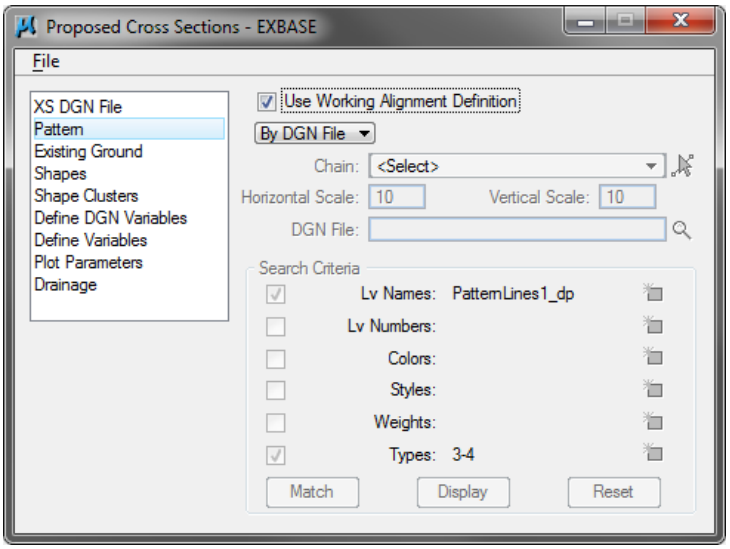
Tolerance The designation of a tolerance value allows user specification of the acceptable gaps/overlaps between elements forming the cross sections.

The FDOT Criteria requires the tolerance to be set to 0.01.

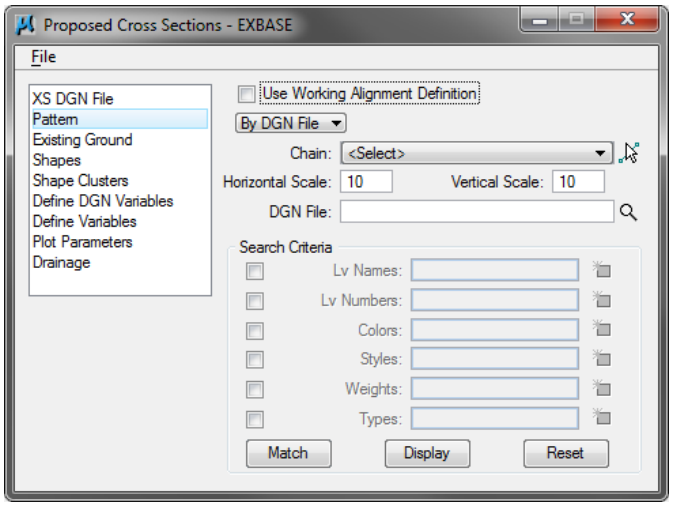
PATTERN



Use Working Alignment Definition Select this box, when working with a Working Alignment Definition. The rest of the dialog dims and utilizes the pattern definition from the defined working alignment. If the check box is clear, the user defines the patterns manually using the options on the dialog.



By DGN File Allows the user to define the cross section locations by graphical lines in a design file called "patterns". When selected, the dialog changes to allow the input of required information.



Chain Alignment used to cut the existing sections.

Horiz/Vert. Scale This is horizontal and vertical scale of the cross sections.

DGN File The name of the design file where the pattern lines reside.

Search Criteria Graphical symbology of the pattern lines. This symbology can be set by selecting from a list of available options using the icons at the right of the dialog or using the Match icon.

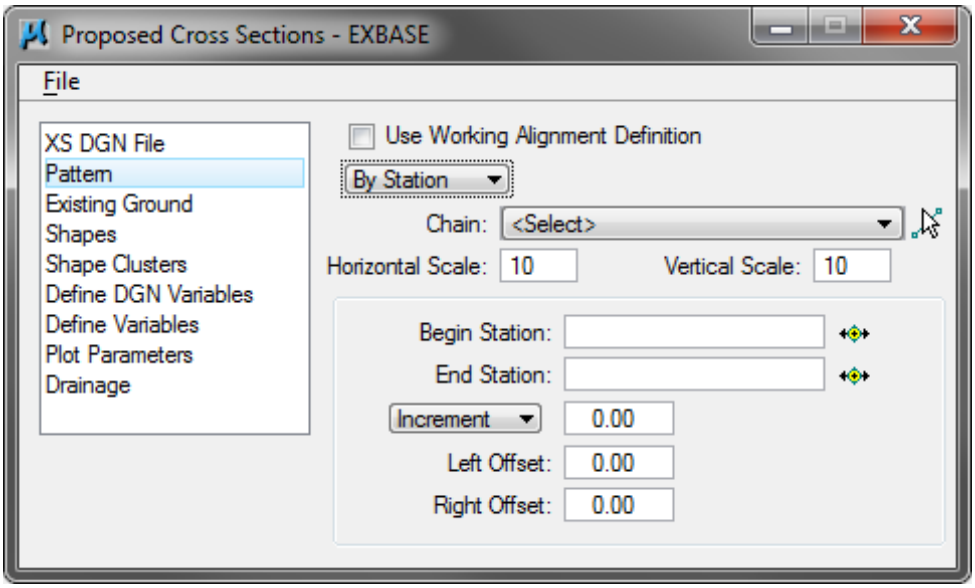
Whenever graphical patterns are used, the software searches ALL of the models in the specified design file to locate the patterns.

Match Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

Display Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

Reset This icon will blank out or reset all of the symbology fields.

By Station Allows the user to define the cross section locations by specifying particular station values. When selected, the dialog changes to allow the input of the required information.



Chain Alignment used to cut the existing sections.

Horiz Scale/Vert. Scale Beginning station of the patterns.

Begin Station The Begin Station may be typed into the field manually or populated dynamically using the icon.

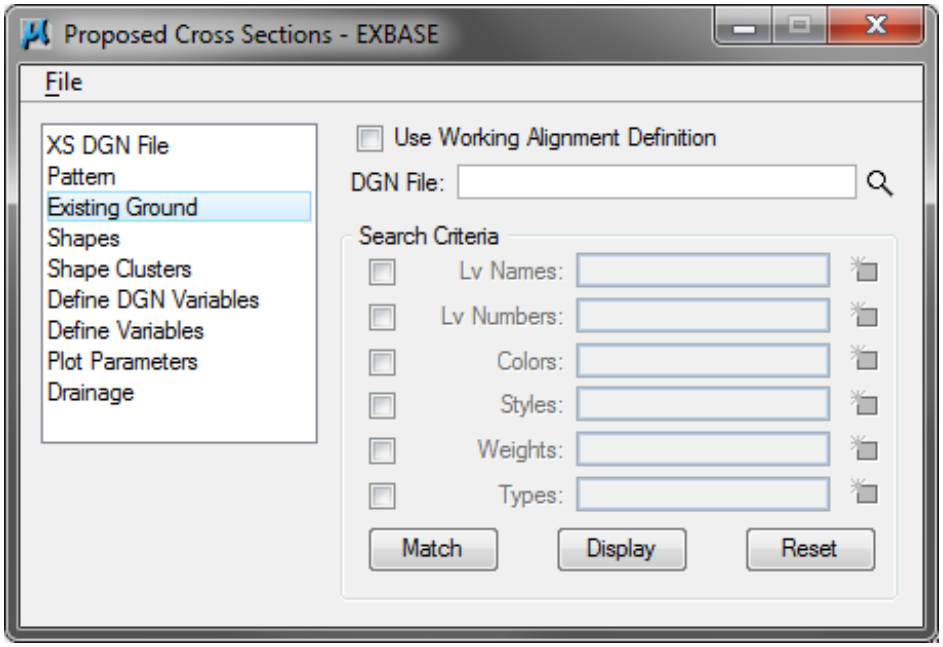
End Station The End Station may be typed into the field manually or populated dynamically using the icon.

Increment/Even Uses the Begin Station and adds the value to obtain the next station value regardless of station equations.

Left Offset Specifies the left extent of the cross sections.

Right Offset Specifies the right extent of the cross sections.

EXISTING GROUND



Use Working Alignment Definition When Use Alignment Definition toggle is activated, the rest of the dialog is ghosted and the existing ground definition form the defined working alignment is utilized. If the toggle is not activated, the required information to specify the existing ground must be entered manually on the dialog.

DGN File The name of the design file where the existing ground cross sections are located.

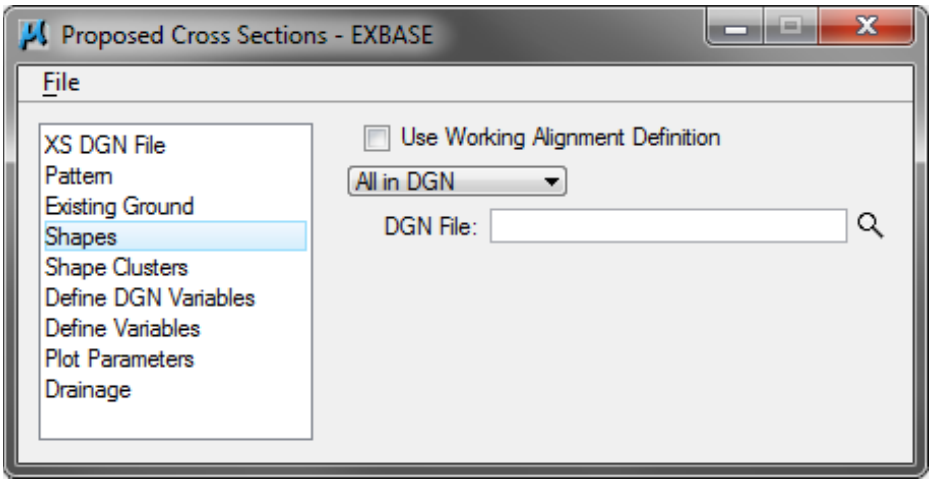
Search Criteria Graphical symbology of the existing ground lines. This symbology can be set by selecting from a list of available options using the icons at the right of the dialog or using the **Match** icon.

Match Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

Display Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

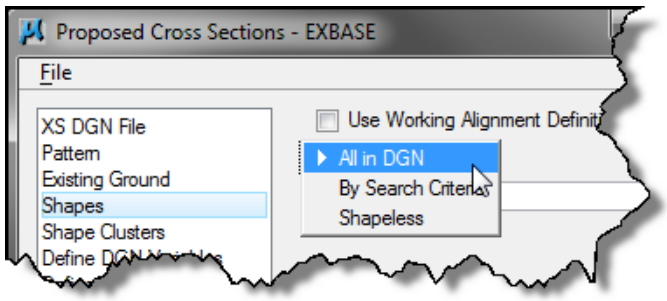
Reset This icon will blank out or reset all of the symbology fields.

SHAPES

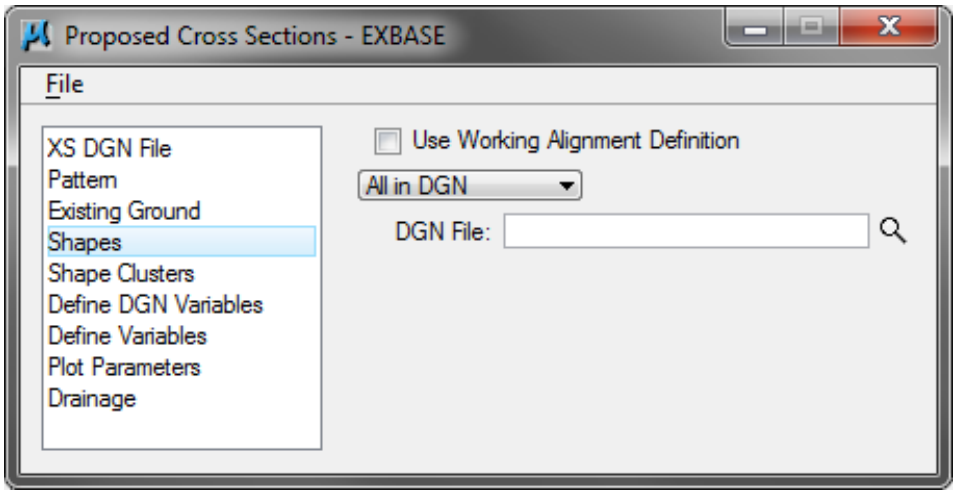


Use Working Alignment Definition When Use Working Alignment Definition check box is selected, the rest of the dialog is dimmed and the shape definition from the defined working alignment is utilized. If the check box is clear, the required information to specify the shapes must be entered manually on the dialog.

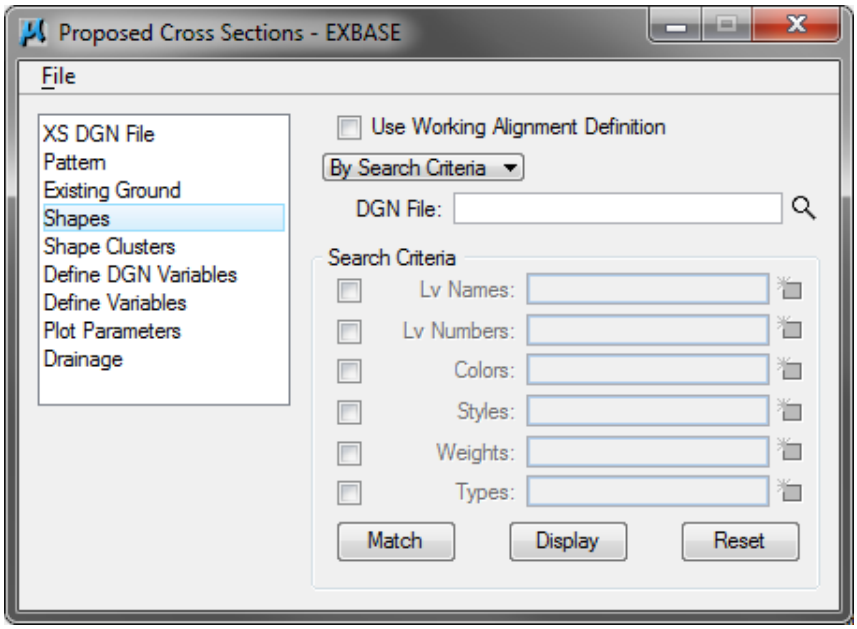
There are 3 options available with which to define shapes:



All in DGN All of the shapes in the specified design file are used, regardless of symbology.

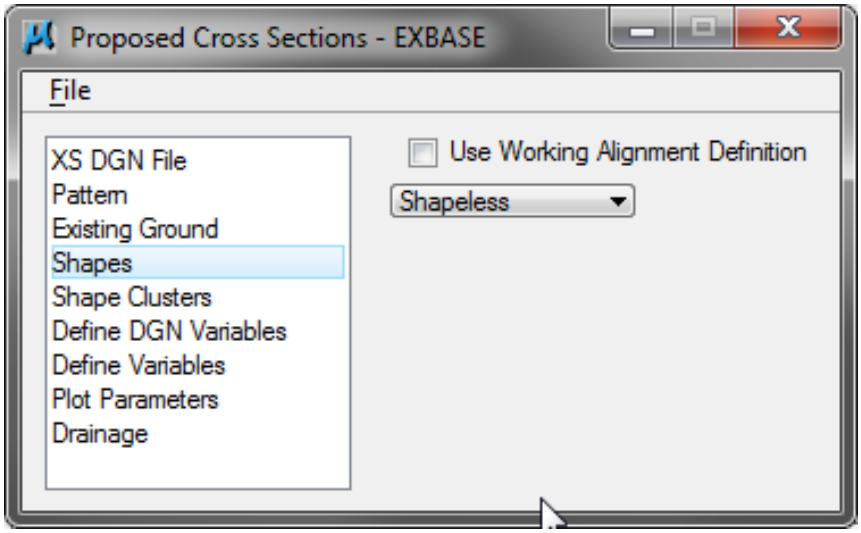


By Search Criteria Only shapes in the specified design file matching the defined symbology are used.

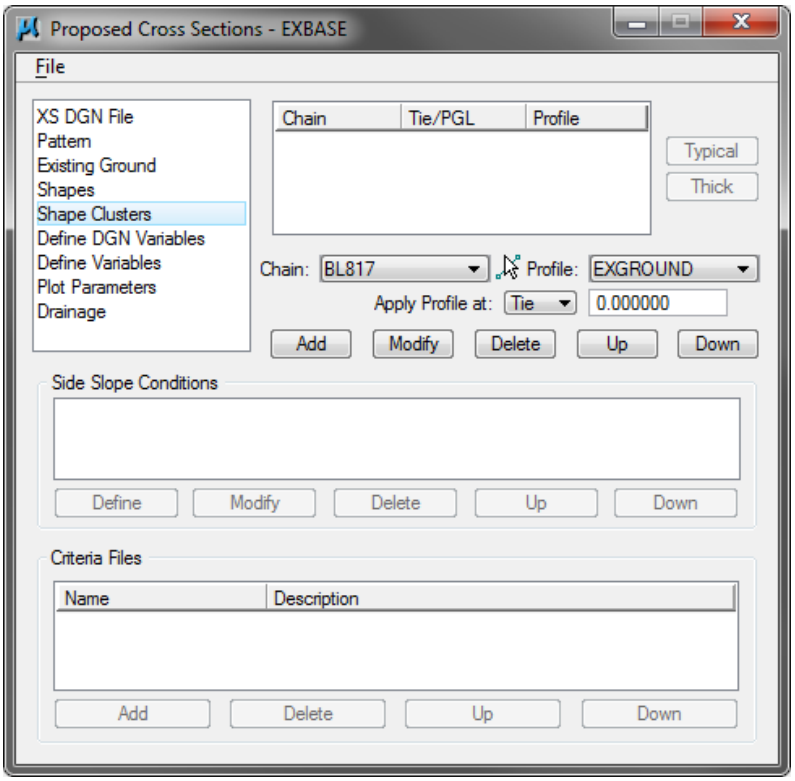


When specifying shapes using either of the previously mentioned options, the software searches ALL of the models in the specified design file to locate the shapes.

Shapeless No shapes are utilized and all cross section elements are drawn with criteria. No additional user input is required with this option.

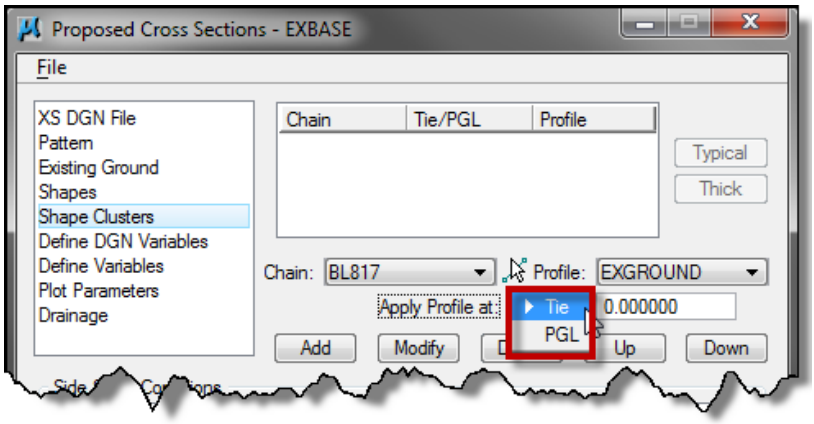


SHAPE CLUSTERS



Chain Alignment name associated with the shape.

Tie/PGL Specifies the offset relation between the Chain and Profile.

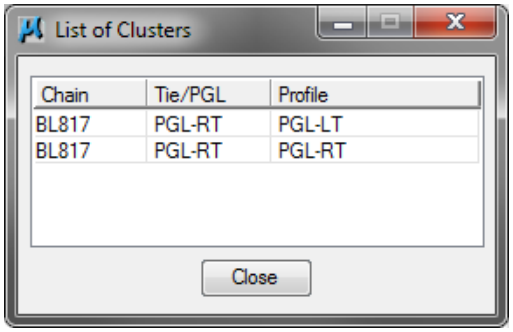


If set to **Tie**, then the profile is applied at given offset from the chain.

If set to **PGL**, then the profile is applied along the given chain name selected from the pull down.

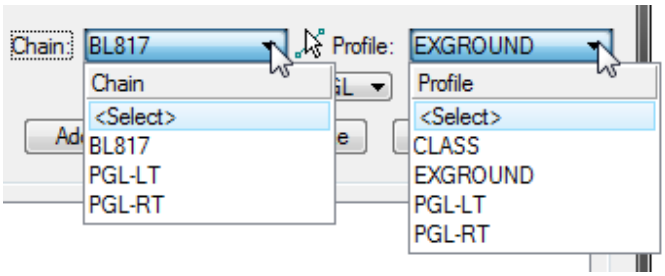
Profile Profile name associated with the shape cluster.

Scan icon When specifying the use of shapes, the Scan icon displays, and used to populate Chain and Profile.



Selecting a cluster in the dialog will automatically fill in the chain/tie/profile information back on the Proposed Cross Sections dialog.

If the Shapeless option is being used, select the Chain and Profile using the dropdown list of available options.



Add Adds the Profile Grade Line (PGL) information to the list box.

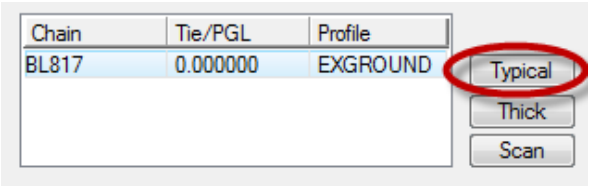
Delete Deletes the selected PGL from the list box.

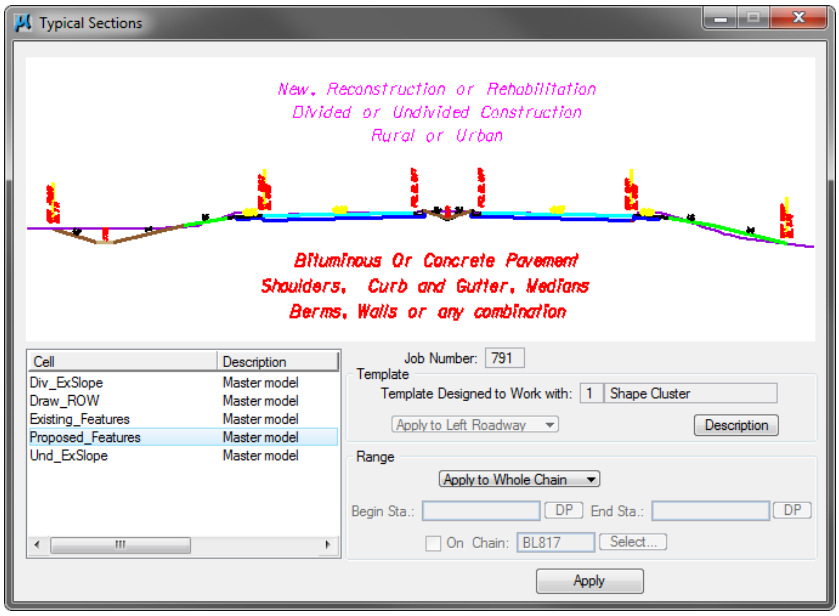
Up Use this to move a selected PGL up in the order of the list box.

Down Use this to move a selected PGL down in the order of the list box.

Note It is important to add shape clusters into the list from left to right in the direction of stationing.

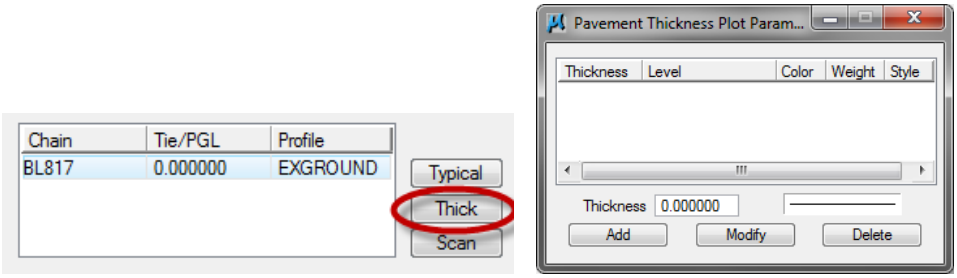
Typical This icon will only enable once a PGL in the list box is selected. Clicking this icon will access the Typical Section Generator.





Note The next section will discuss Typical Section Generator in detail.

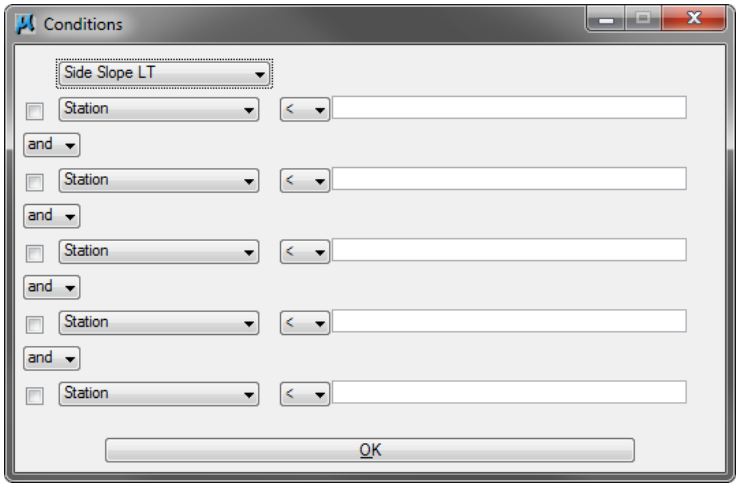
Thick This icon will only enable once a PGL in the list box is selected. Clicking this icon will access the Pavement Thickness Plot Parameters dialog. This dialog can be used to specify multiple pavement thicknesses and symbologies.



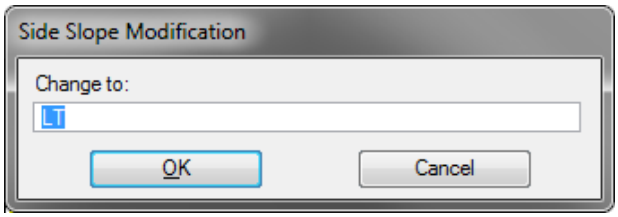
FDOT criteria draws the pavement thicknesses. Therefore, the use of this dialog is not required.

Side Slope Conditions

Define This icon will access the Conditions dialog to manually setup the **Side Slope Conditions** (e.g. Side Slope Left, Side Slope Right, etc.).



Modify Accesses the Side Slope Modification dialog to modify the selected side slope condition.

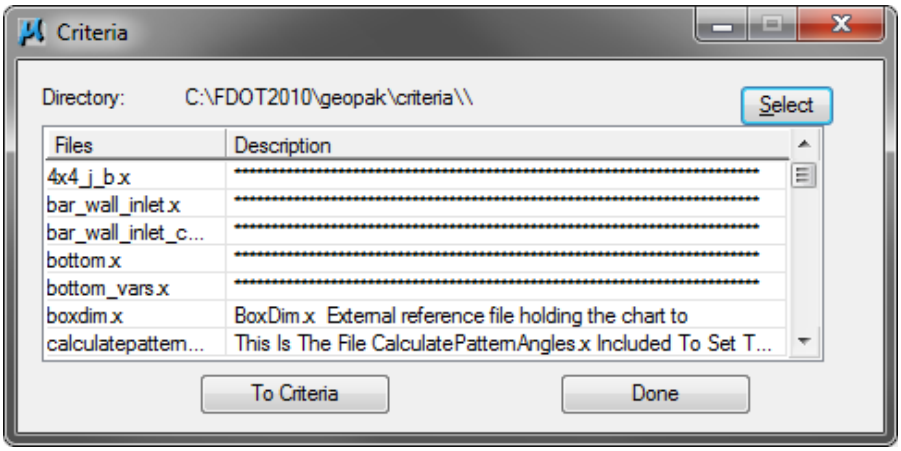


Delete Deletes the selected side slope condition from the list box.

Up/Down Moves the selected side slope condition up/down in the list box.

Criteria Files

Add Clicking this icon accesses the Criteria dialog to manually select and add selected criteria files to the list box.

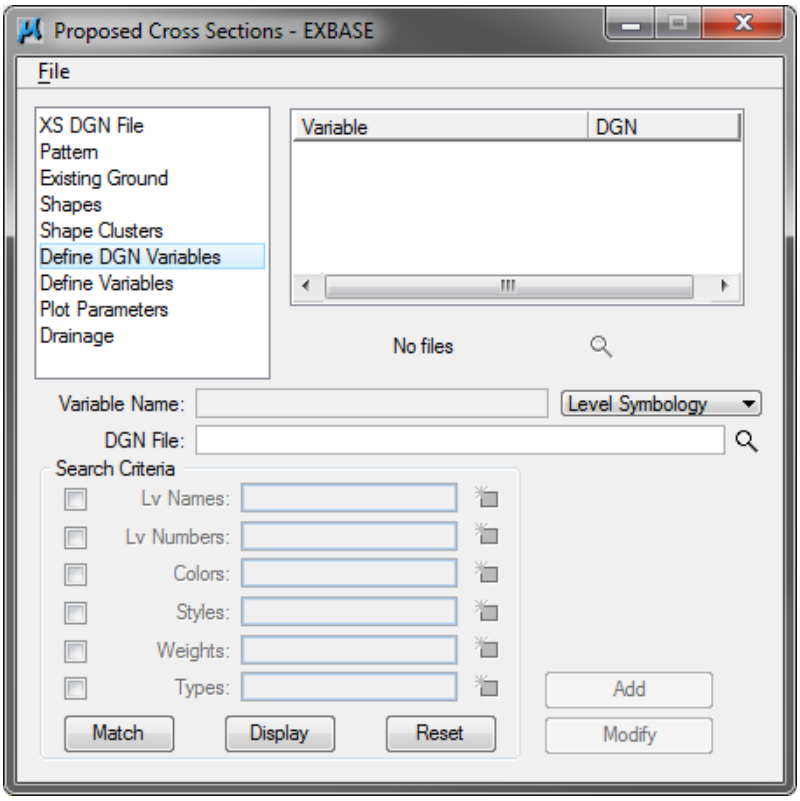


Delete Deletes the selected criteria file from the list box.

Up/Down Moves the selected criteria file up/down in the list box.

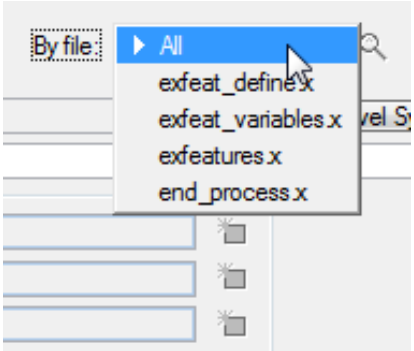
DEFINE DGN VARIABLES

When using the FDOT criteria, Define dgn variables are not populated in the dialog. .



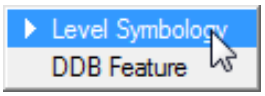
By File

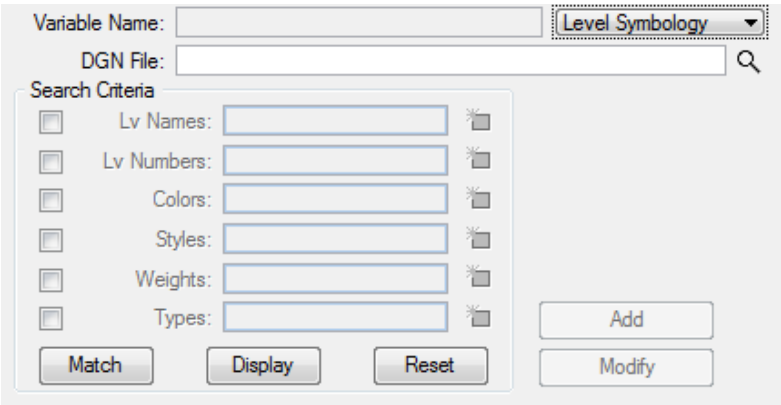
If set to *All*, then the defined DGN variables from all of the listed criteria files are displayed. If the option is set to a *specific criteria* file, then only those DGN variables defined in that particular file display.



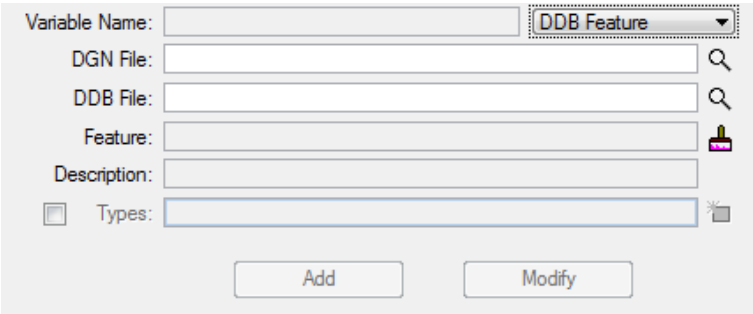
Level Symbology / DDB Feature

When set to Level Symbology, the dialog changes to allow the defining of the DGN variable by graphical symbology (i.e. level, color, weight, etc.)





When set to *DDB Feature*, the dialog changes to allow the specification of a feature to define the DGN variable.



DGN File

Design file where the graphical element is located.

Search Criteria

When the **Level Symbology** option is used, define the graphical symbology of the DGN variable. These symbologies can be populated using the icons or the **Match** icon defined below.

Match

Clicking this icon and identifying a graphical element will harvest the symbology of the element into the dialog.

Display

Clicking this icon will highlight all elements in the design file that match the symbology in the dialog.

Reset

This icon will blank out or reset all of the symbology fields.

Add

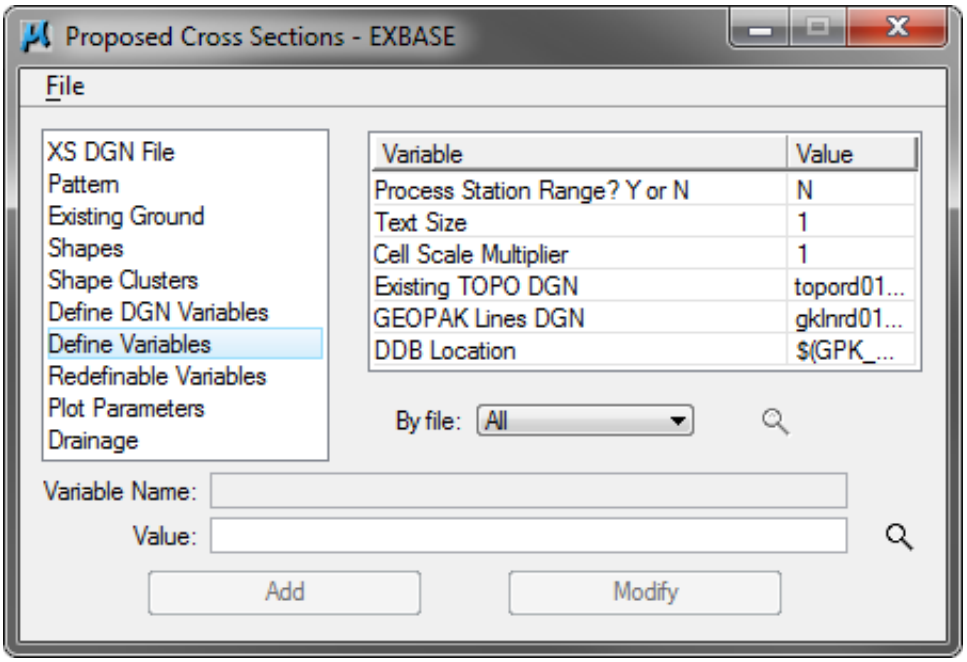
Used to add an “undefined” DGN variable to the list box once it’s been manually defined using either Level Symbology or a DDB Feature.

Modify

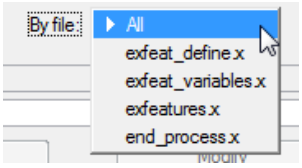
If changes are made to a variable (i.e. symbology, dgn file name, etc.), this icon is used to update or modify the selected variable in the list box.

Note Any changes made to these variables are saved within the cross section run in Project Manager. No changes are made to the criteria files themselves.

DEFINE VARIABLES



By File When the **By File** option is set to **All**, all defined variables from all criteria are displayed. If the option is set to a specified criteria file, only the variables within the specified criteria file are displayed.



Value When a variable in the list box is selected, the defined value of the variable will be placed in this box and made available for modification.

Add Used to add an "undefined" variable to the list box once it's been manually defined.

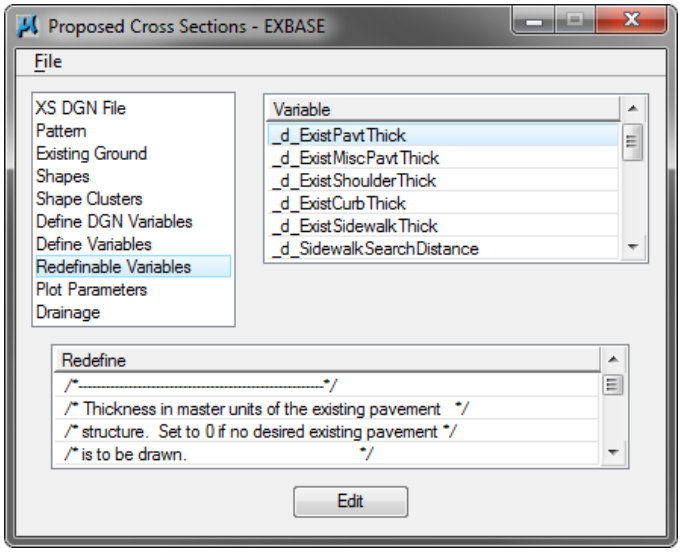
Modify If changes are made to the value of a variable, this icon is used to update or modify the selected variable in the list box.

Note Any changes made to these variables are saved within the cross section run in Project Manager. No changes are made to the criteria files themselves.

REDEFINABLE VARIABLES

These are Variables whose values can be changed throughout the cross section run based on station ranges. There are two types of redefinable variables: **Numeric** and **String**.

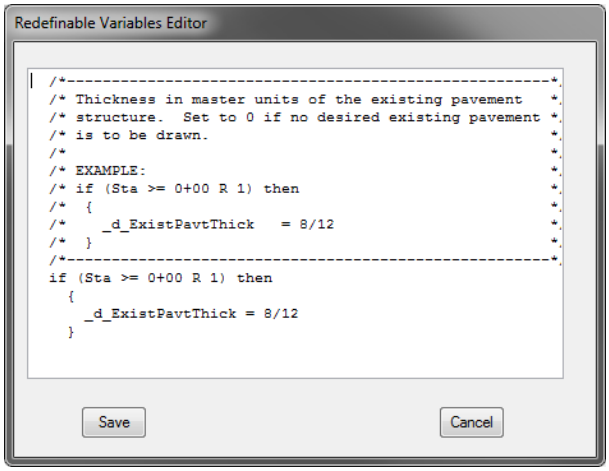
- **Numeric** variables always begin with "_d_". They can only contain a numeric value (e.g. 0, 1.2, -3, etc.).
- **String** variables always begin with an "_s_". They can only contain a string value. Note that if a number is entered (e.g. 9) for a string value that this will be interpreted as the character "9" and not the number 9.



Variable This is a list of the variables that can be redefined.

Redefine This is the definition of the variable highlighted in the Variable list box.

Edit To edit or change the value of a variable, select the variable in the list box and click this icon. This will access the **Redefinable Variables Editor** dialog (double-clicking on the variable will also access the editor). Any changes to the variable's value and/or station ranges are made within this editor.

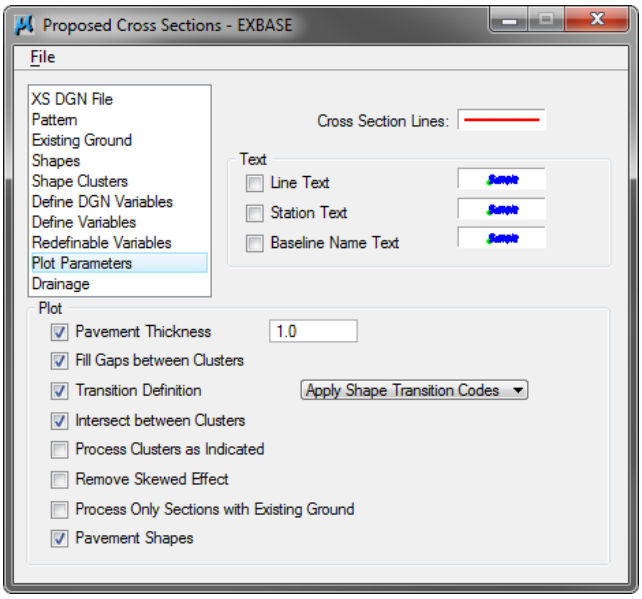


Save Exits the editor and saves any changes

Note Any changes made to these variables are saved within the cross section run in Project Manager. No changes are made to the criteria files themselves.

Cancel Exit the editor without saving any changes.

PLOT PARAMETERS



Cross Section Lines This defines the element symbology for drawing top and bottom of shaped pavement. This is also the default symbology for all elements drawn with criteria when no specification is set for symbology within the criteria.

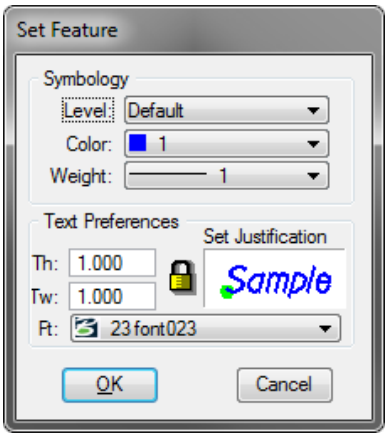
Text

Line Text Selecting this check box will plot the PGL Elevations on the cross sections.

Station Text Selecting this check box will plot the Station Text on the cross sections.

Baseline Name Text Selecting this check box will plot the Shape Cluster Baseline name on the cross sections.

Note FDOT criteria handles by design ALL of the required labeling so the text options should be unchecked or disabled. The user can control each of the above text options using its associated GEOPAK Set Feature dialog.



Plot

Pavement Thickness
This indicates the depth of the shaped pavement in master units. If the shape cluster pavement thickness is utilized and a value greater than 0 is given, both the top and bottom of pavement are drawn utilizing the lines parameters. If a pavement thickness of zero is utilized or the check box is clear, only the top surface is drawn.

Fill Gaps Between Clusters
Connect two shapes or the outermost elements drawn via criteria between two shape clusters when the shape clusters reference the same Baseline Name.

Transition Definition
Dictates the type of superelevation transitions to be used for drawing the proposed cross sections. If the check box is clear, all superelevation transitions will be linear, regardless of the transition ID attached to the shapes when created. If the check box is selected, then the transitions attached to the shapes at the time of creation are utilized. Any shape that had no transition identification attached defaults to linear transition.

Intersect Between Clusters
When criteria between two separate shape clusters draw lines that extend past each other, selecting this check box will cause the two lines to be intersected and trimmed.

Process Clusters as Indicated
When selected, GEOPAK draws the sections in the specified order. If disabled the default is left to right.

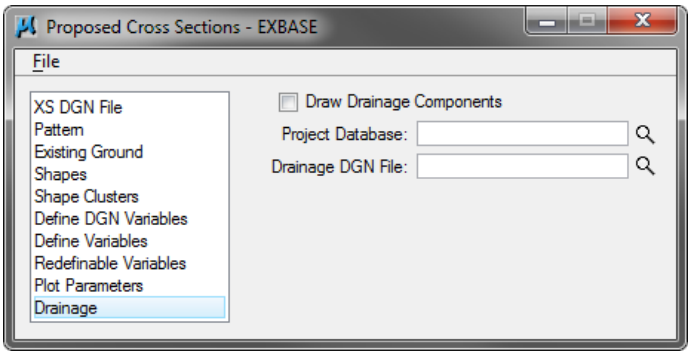
Remove Skewed Effect
Proposed cross section elements are drawn sensitive to skew angles. Depending on the circumstances, the designer may not want to utilize this skew angle, so enabling this option removes this skew effect.

Process Only Sections With Existing Ground
When enabled, only cross sections that contain existing ground lines will be processed in the run.

Pavement Shapes
Option to draw the pavement shapes or not. Left unchecked, the top line o a shape cluster will not be drawn in the cross section.

Note FDOT criteria handles by design ALL of the above scenarios so they should ALL be unchecked or disabled.

DRAINAGE

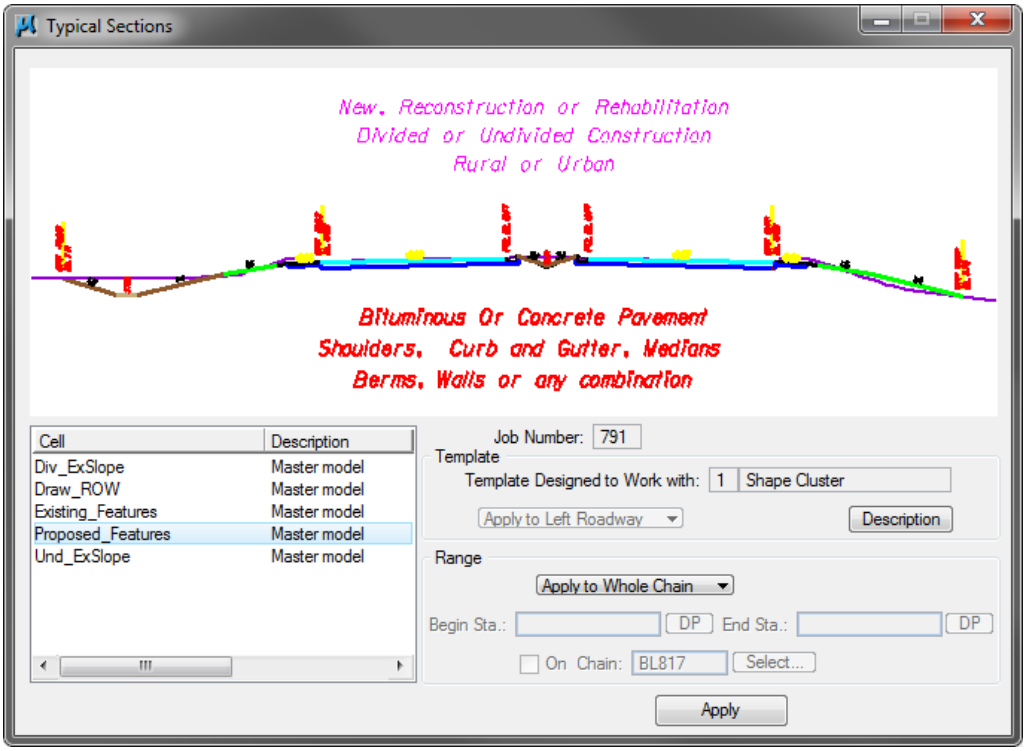


Draw Drainage Components	Select this check box to draw the drainage components onto the cross sections.
Project Database	This is the project database from GEOPAK Drainage.
Drainage DGN File	Design file where the drainage graphics (i.e. nodes and pipes) reside.

TYPICAL SECTIONS

This feature within Proposed Cross Sections was originally developed to automate (as much as possible) the development of cross sections for widening and resurfacing jobs, but it has been expanded to account for all types of construction. Typical Section Generator is a library of cells that represent typical sections. Each typical section is associated with a set of criteria files. It enables selection of a typical section from the library and sets everything up under the proper side slope conditions.

When the typical is applied, the software reads the criteria files and all variables contained in those files are populated into the dialog.



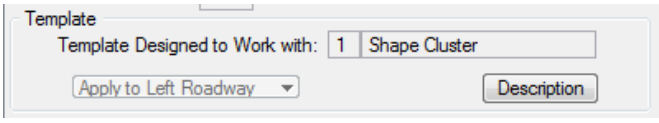
Cell / Description

The Typical Sections are a cell library where each cell in the library represents a different typical.

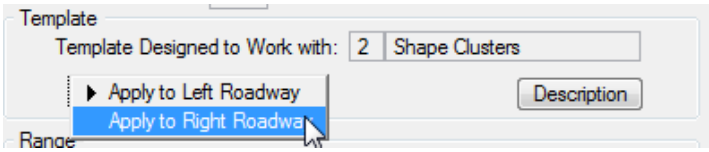
Template

Template Designed to Work With:

If the selected typical section is NOT designed for divided roadways, note that the "Apply to Left/Right Roadway" option is not available (i.e. it's dimmed).



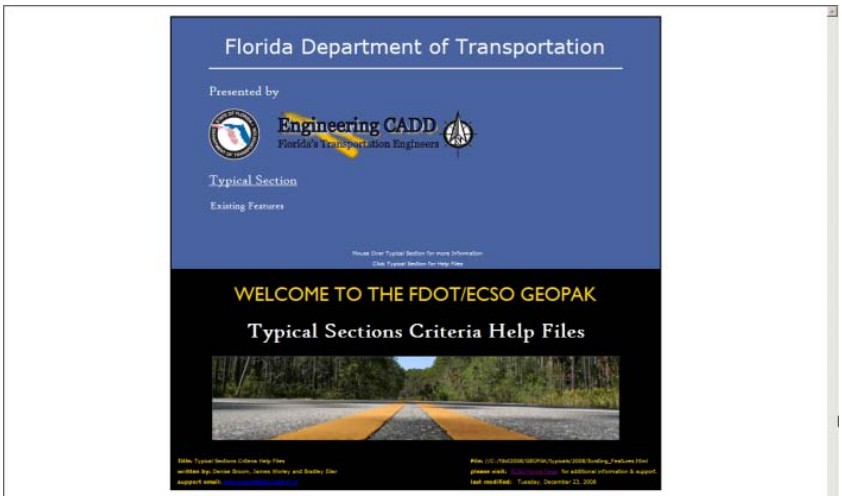
If the selected typical section is designed for divided roadways, note that the "Apply to Left/Right Roadway" option is available. In this situation, you are required to process the typical section twice; once for the Left Roadway and a second time for the Right Roadway.



The FDOT criteria control file accounts for the LT/RT side slopes. The typical need only be applied once to each shape cluster.

Description

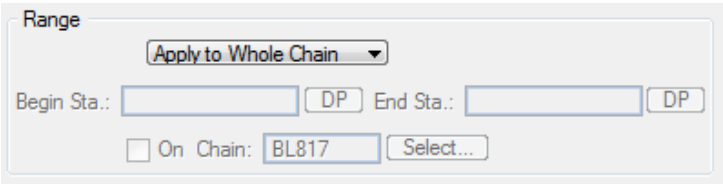
Opens the FDOT/ECSO GEOPAK Typical Sections Criteria Help Files, which describe what the typical sections are designed to do, under what conditions the typical can be run and it documents each of the variables used to control the cross sections.



Range

Apply to Whole Chain

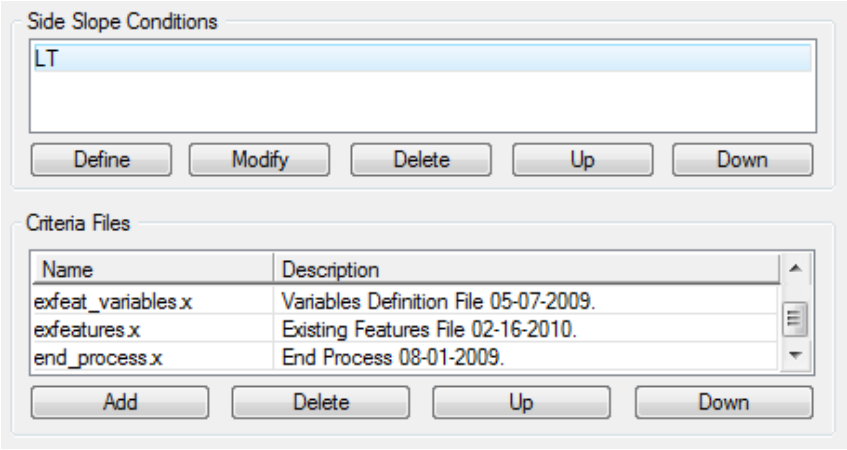
If this option is used, the typical section criteria is applied to the entire length of the chain.



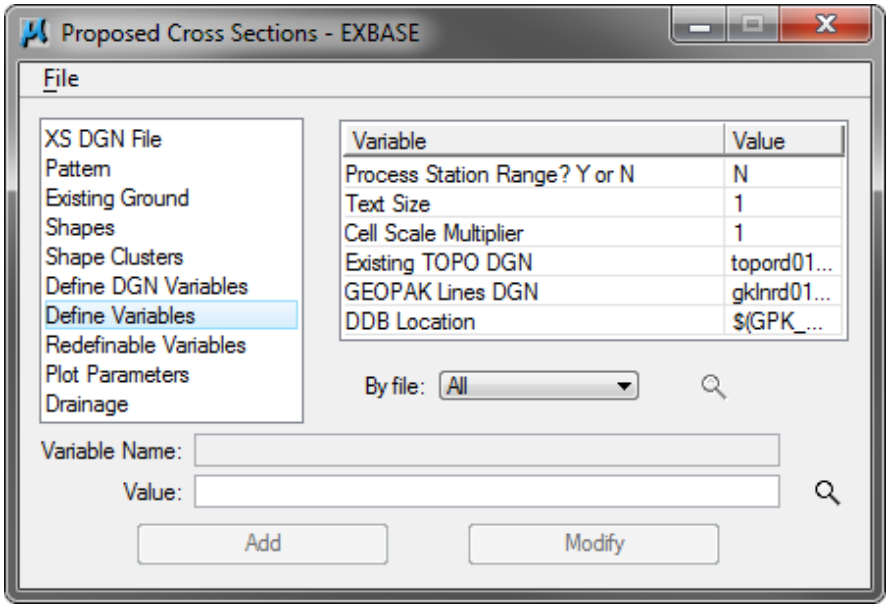
Apply

Process the Typical Section. This does two things:

First, it sets up the criteria under the appropriate side slope conditions in the Proposed Cross Sections dialog



Second, it populates the variable portions of the dialog with the variables defined in the criteria.



DELIVERED TYPICAL SECTIONS

There are five (5) delivered typical sections. Each typical section has its own detailed documentation.

Existing Features

The Existing_Features typical will extend existing ground lines to the extent of the cross section cell and draw the base for the existing pavement, shoulders, curbs, sidewalks, and traffic separators. The Existing_Features criteria search the topo file to locate the plan view elements defining the limits of the existing features.

It also searches a supplemental design file, (GKLNRD) referred to as the "GEOPAK Lines file", for those same elements. This supplemental file is designed to be used in conjunction with the topo file in instances when the topo file is not entirely correct. Sometimes the topo file elements are not coded with the correct features or do not have the correct level symbology for the criteria to locate.

In these instances, the correct elements are drawn into the supplemental file for the criteria resulting in correct cross sections without modifying the topo file received from survey.

There are a few important notes to remember:

Do not copy all of the elements from the topo file into the GKLNRD file. Only the individual elements that are not correct should be copied or drawn into this file.

Proposed Feature Criteria does NOT support the GKLNRD file.

Proposed Features

This draws pavement shoulders, curb and gutter, medians, berms, walls or any combination. This all-in-one typical is used for all instances of proposed features whether divided or undivided, new, rehabilitation or reconstruction.

Slope Reports

Slope Text Reports.

Div_ExSlope

This creates ASCII text file of existing pavement slopes for divided roadways.

Und_ExSlope

This creates ASCII text file of existing pavement slopes for undivided roadways.

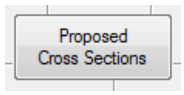
Draw Right of Way

The DrawROW typical draws and labels existing R/W and wetlands on the cross sections. It also draws and labels proposed R/W and fence.

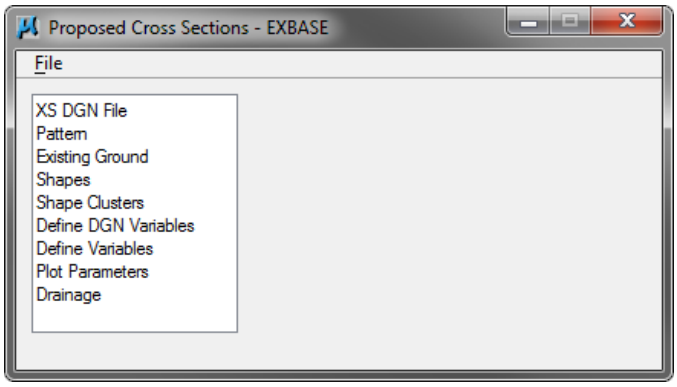
Exercise 6.1 Shapeless Cross Sections - Existing Base

In this exercise, the user will be introduced to the Typical Section Generator, a tool that allows the user to automatically access and setup the appropriate criteria for cross sections.

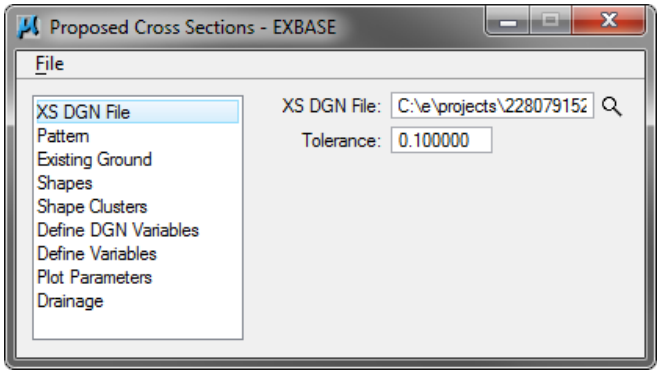
1. Double-click on the self-extracting zip file C:*Chapter6_Exercises.exe* and click the **Unzip** icon at the prompt. This will extract and setup the files needed for this exercise.
2. Open the design file C:/e/Projects/228079115201/roadway/*RDXSRD01.dgn*.
3. Access the *Model* **RDXSRD**.
4. Access Project Manager.
5. From Road Project, click the **Proposed Cross Sections** icon.



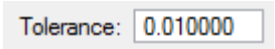
6. Create a *new run* named **EXBASE** and access the dialog.



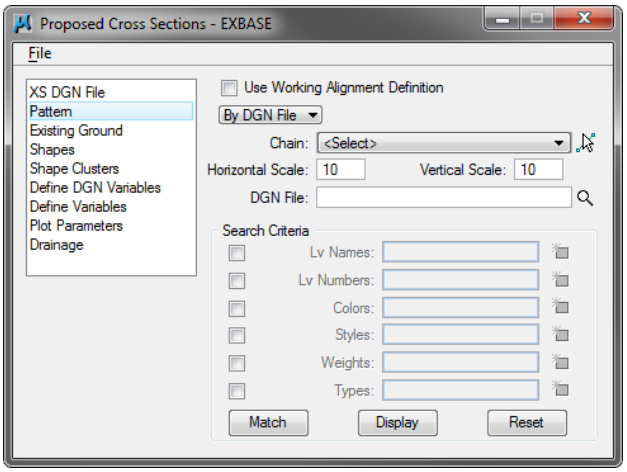
7. From Proposed Cross Sections, select the category **XS DGN File**.



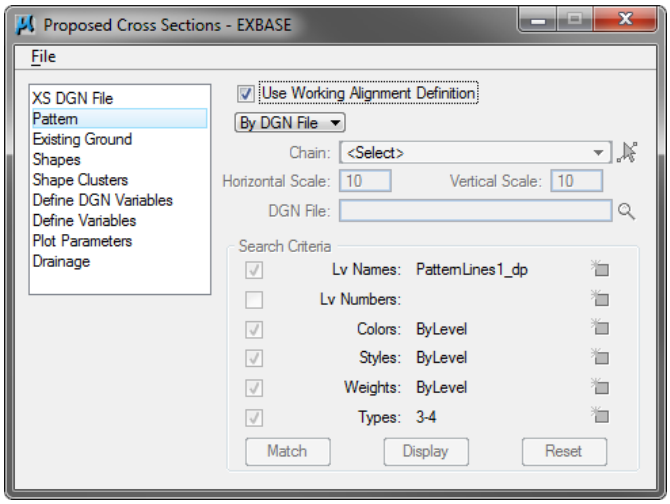
8. The *XS DGN File* name populates automatically from the Working Alignment Definition.
9. Change the *Tolerance* to **0.01**.



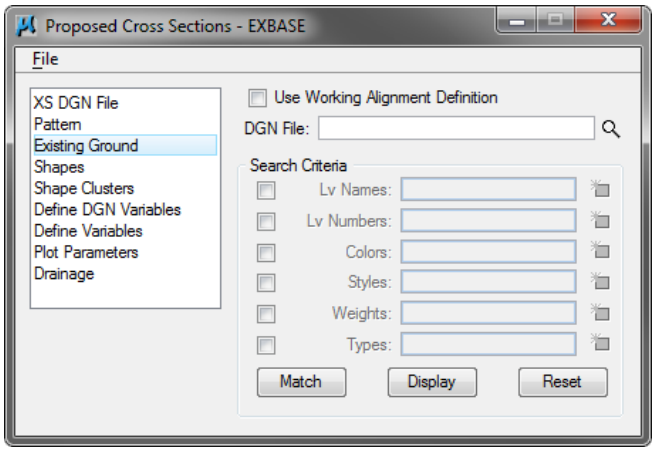
10. Select the category **Pattern**.



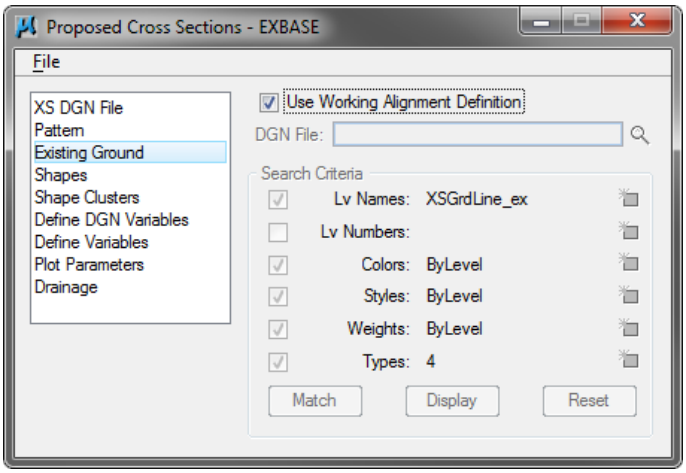
11. Enable the **Use Working Alignment Definition** toggle.



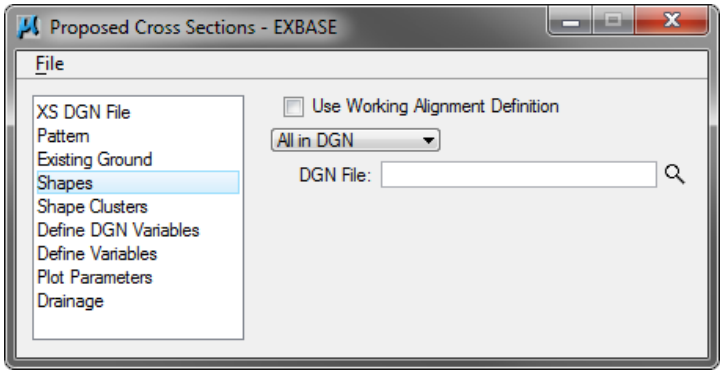
12. The dialog populates with the pattern symbology information.
13. Select the category **Existing Ground**.



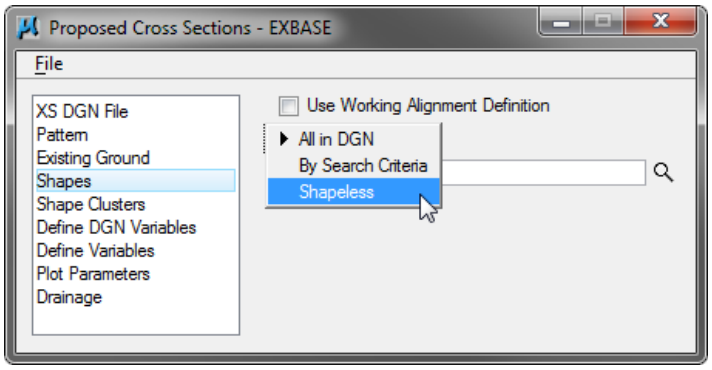
14. Enable the Use Working Alignment Definition toggle.



15. The dialog fills out with the appropriate existing ground information.
16. Select the category **Shapes**.

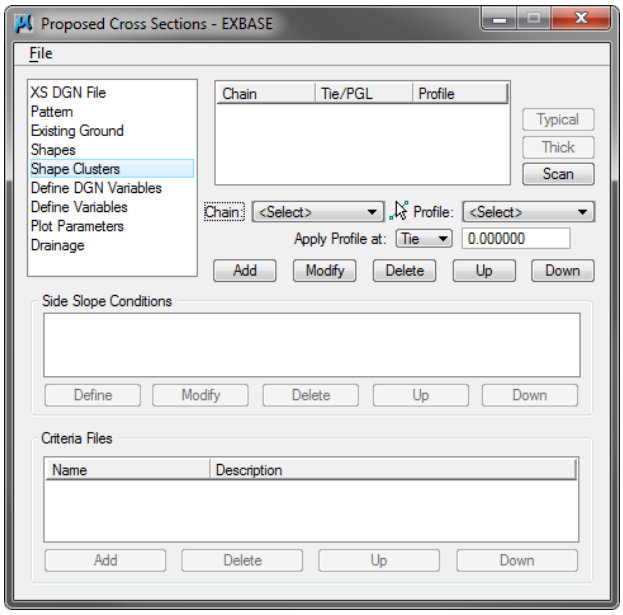


17. The existing base criteria do not need superelevation shapes, so this will be a *Shapeless* run.
18. Select the category **Shapeless**.

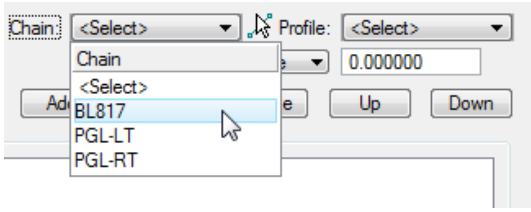


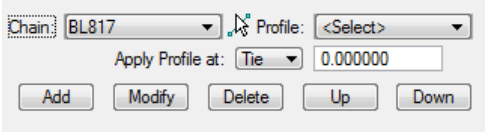
Note Even though there are shapes defined in the Working Alignment Definition, in this case we are not using the Working Alignment Definition but choosing to override this by manually setting the option. This will in no way affect the Working Alignment Definition.

19. Select the category **Shape Clusters**.

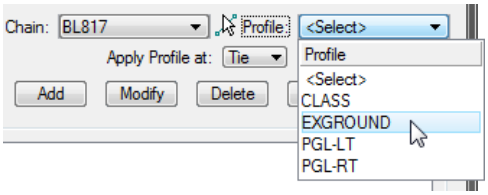


20. Click the down arrow for *Chain* and select **BL817**.

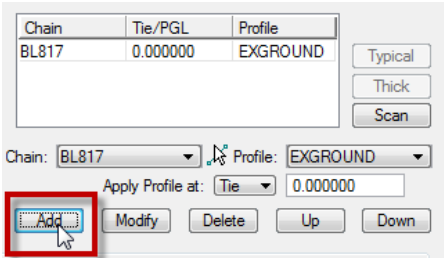




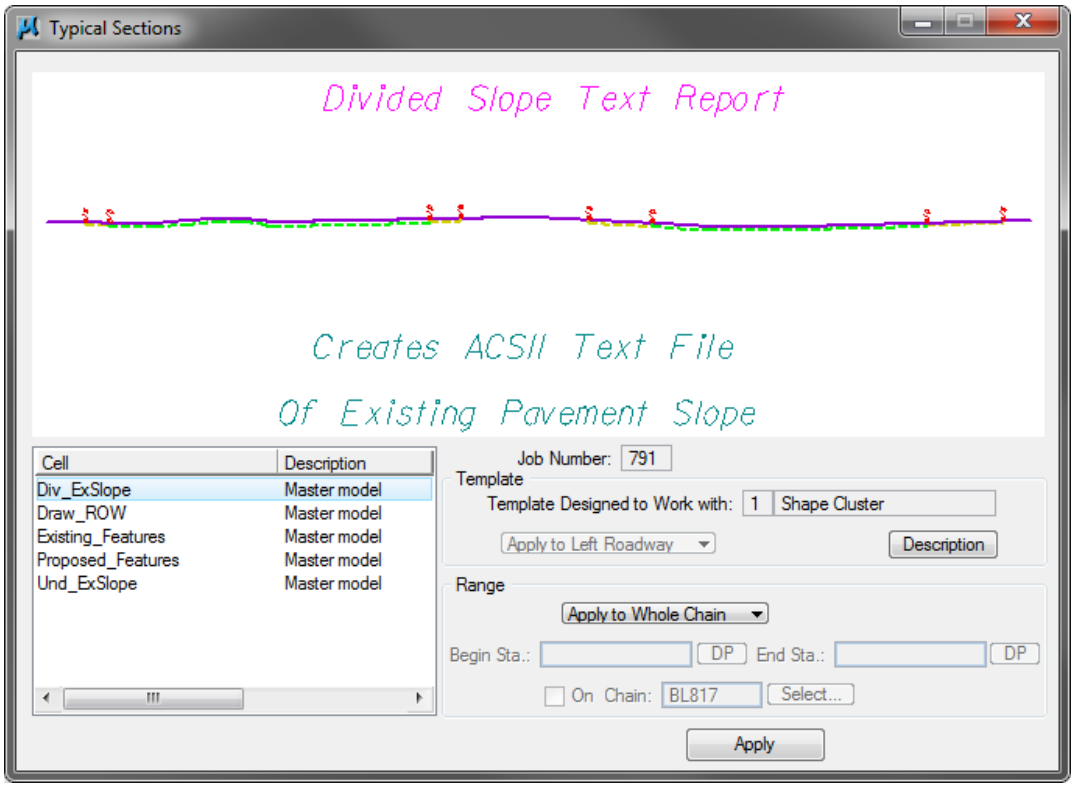
21. Click the down arrow for *Profile* and select **EXGROUND.**



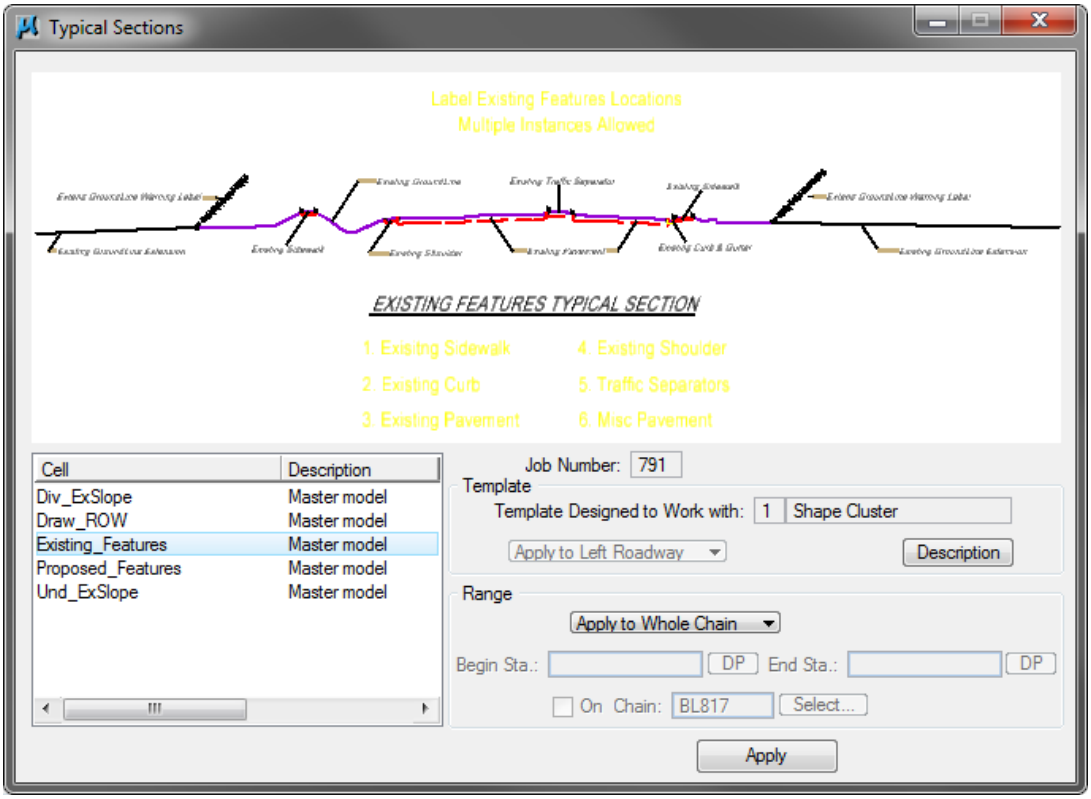
22. From Proposed Cross Sections, click the **Add** icon to add the PGL information to the list box.



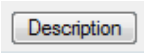
23. Select the **PGL** added in the previous step, and then click the **Typical** icon. Typical Sections opens.



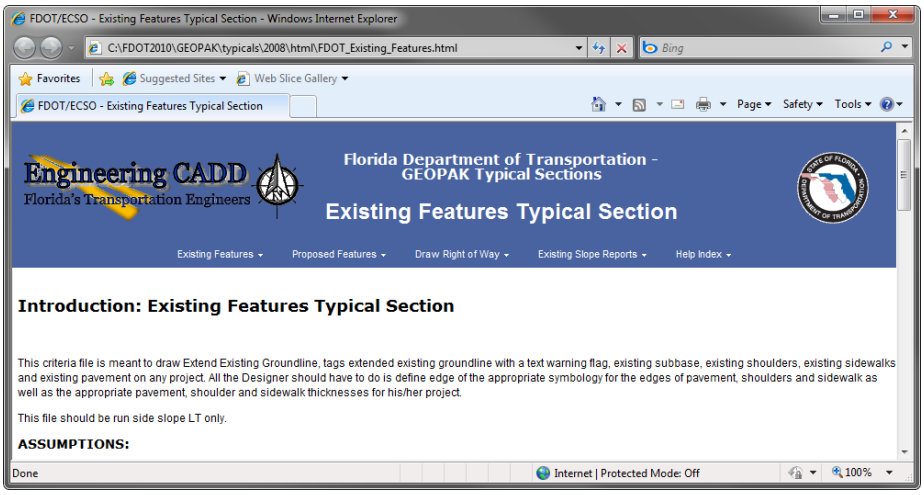
24. Select the *Cell* **Existing_Features**.



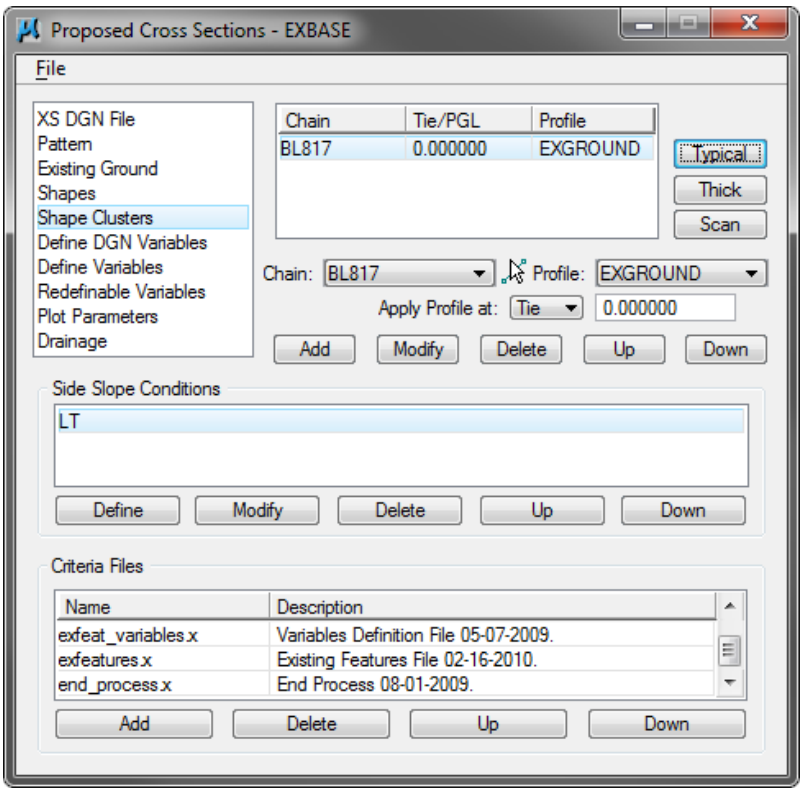
25. Click the **Description** icon to open the help files for the Existing Features typical.



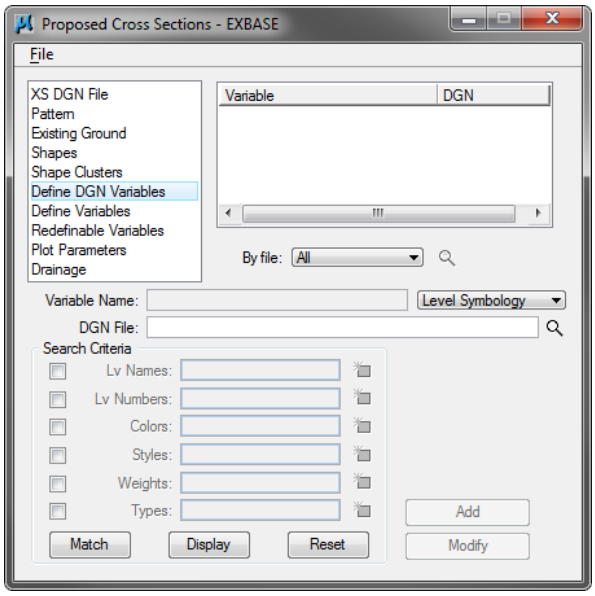
26. **Review** the documentation for the Existing Features typical. **Close** the Windows Internet Explorer window when done.



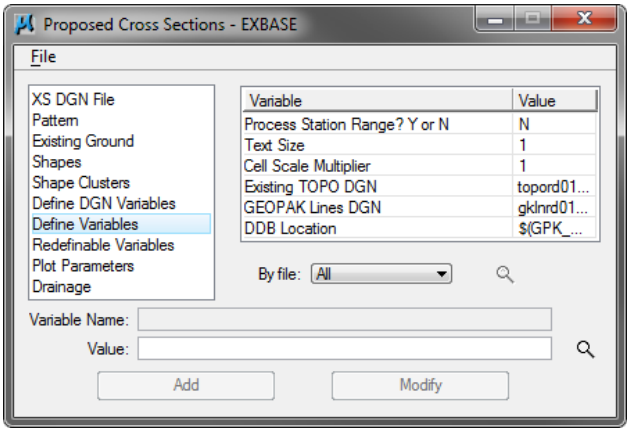
27. Click **Apply**. Typical Sections closes. In the Proposed Cross Sections dialog, the *Side Slope Conditions* list box and *Criteria Files* are populated.



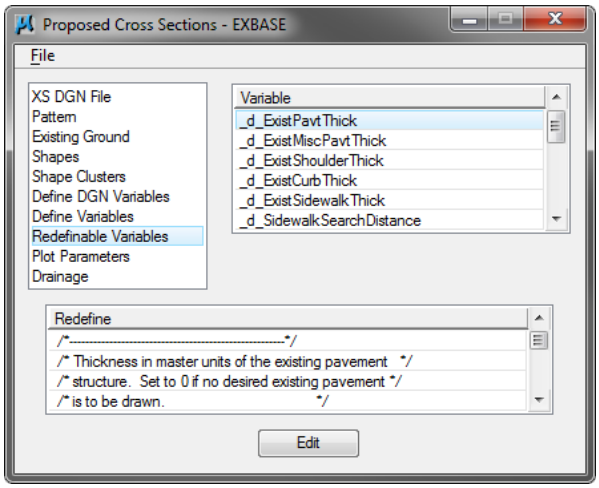
28. Select the category **Define DGN Variables**. Note that there are no variables to change.



29. Select the category **Define Variables**. No changes are required.

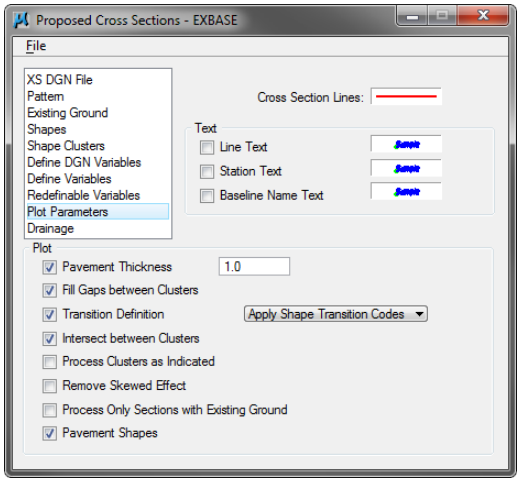


30. Select the category Redefinable Variables.

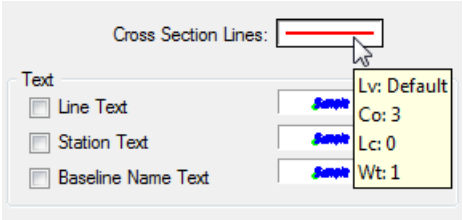


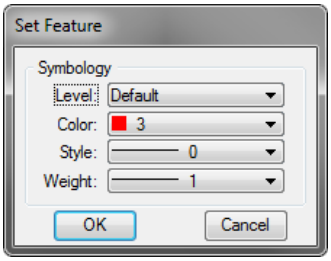
Note For this exercise, we will leave these variables unchanged. We will learn how to modify these variables in a subsequent exercise. If the Existing_Features labels are not desired, modify the redefinable variable _S_EFTTL value to ^N^.

31. Select the category **Plot Parameters**.

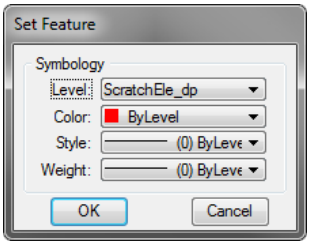


32. Double-click on the sample graphic for **XS Lines** to access the GEOPAK Set Feature dialog.





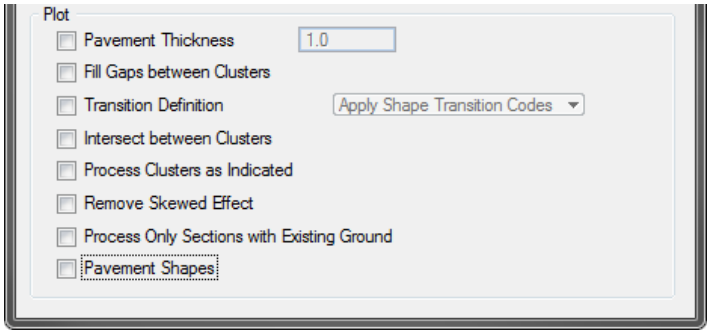
33. Change the symbology as shown.



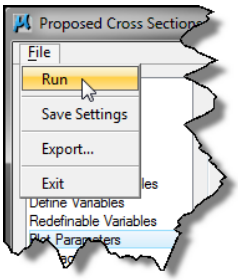
Note The XS Lines symbology is used ONLY to control the symbology of the graphical lines associated with the superelevation shapes. The criteria will control everything else. Since we are using a shapeless run here this symbology will not be used.

34. Click **OK** to close the GEOPAK Set Feature dialog.

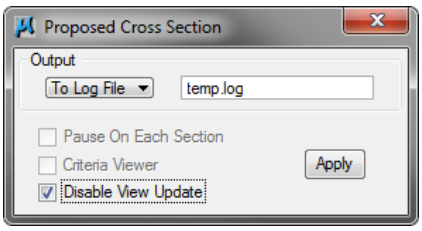
35. Disable ALL of the **Plot** toggles.



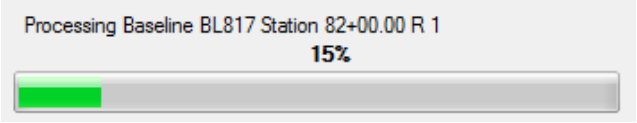
36. Select File > Save Settings.
37. Select File > Run.



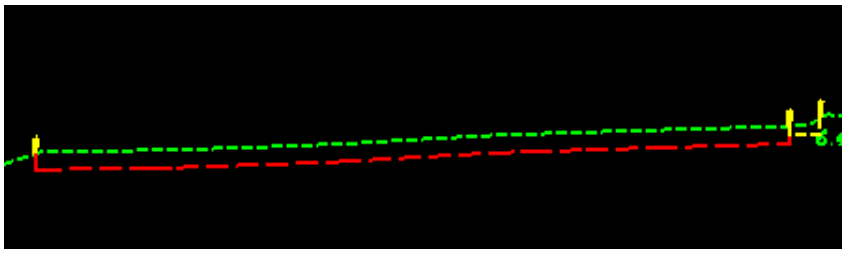
38. Proposed Cross Section opens.



39. Click **Apply.** Processing Display opens and cross sections are drawn into the design file (this may take a few minutes).



40. Exit the Proposed Cross Sections dialog. Click **Yes** when prompted to **Save Settings**.
41. Access Cross Section Navigator.
42. Review the cross sections and note the existing features drawn on the cross sections.

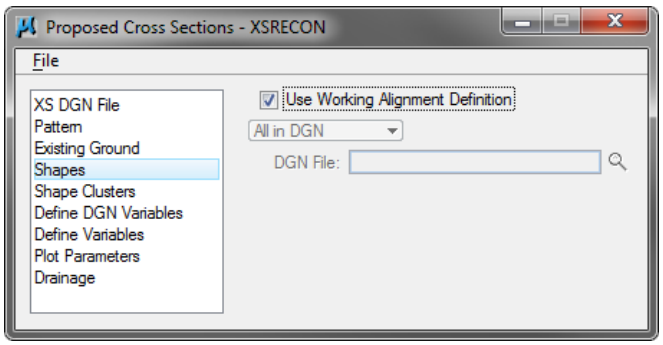


43. Close the Cross Section Navigator.
44. From MicroStation, select **Edit** > **Select All**.
45. From MicroStation, select **Edit** > **Lock** to lock the newly created elements.

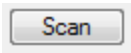
Exercise 6.2 Proposed Features

In this exercise, the user will find many steps that are the same as in the previous exercise. Only steps that are different will have explanations and screen shots. This exercise is a continuation of Exercise 6.1 and the assumption is that the design file is still open.

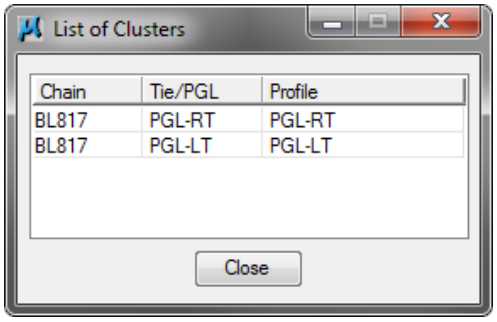
1. From Road Project, click **Proposed Cross Sections**.
2. Create a *new run* named **XSRECON** and access the Proposed Cross Sections dialog.
3. Set the options for **Tolerance**, **XS DGN File**, **Pattern and Existing Ground** as was done in the previous exercise.
4. Enable the **Use Working Alignment Definition** toggle for *Shapes*.



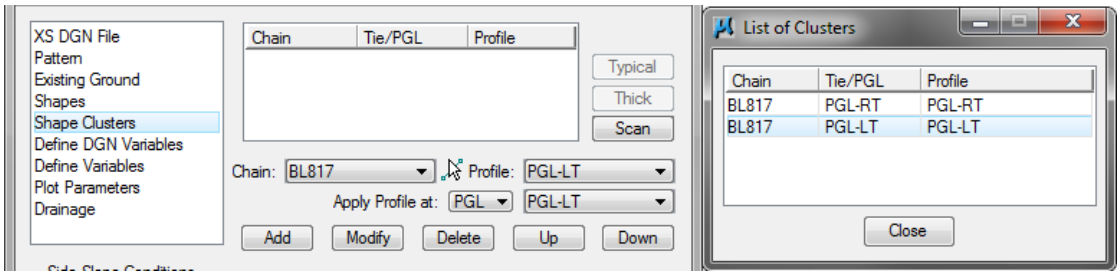
5. Select the category **Shape Clusters**.
6. Click the **Scan** icon.



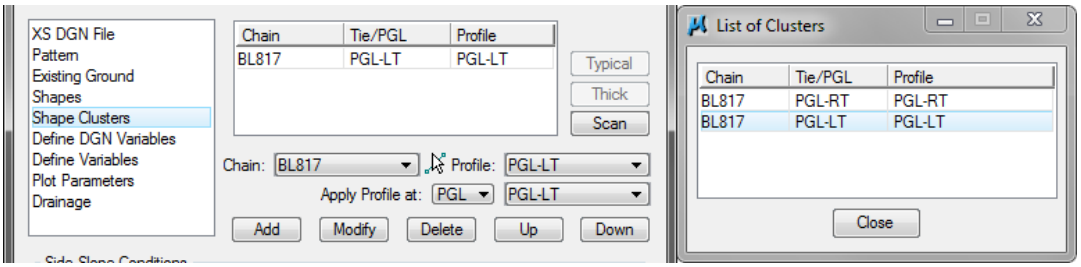
7. The List of Clusters dialog displays.



8. Select the **Left Cluster PGL** in the list as shown (this information represents the Left Roadway of the divided section). Note that upon selection, the information fills out in the Proposed Cross Sections dialog.



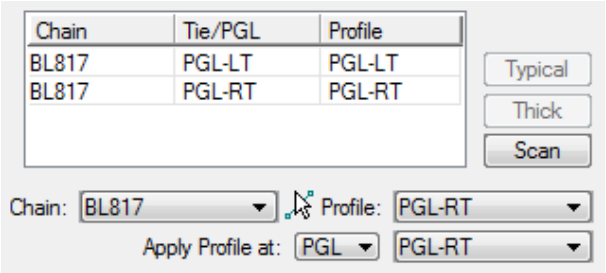
9. From the Proposed Cross Sections dialog, click **Add** to add the shape cluster to the list box.



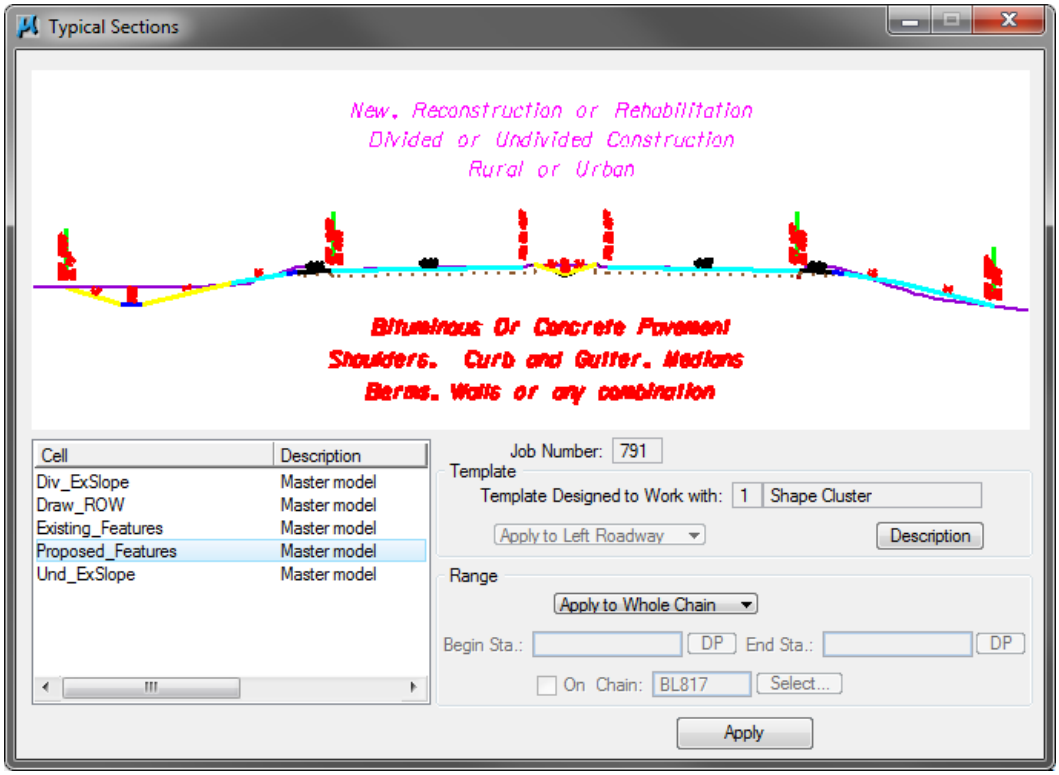
10. Repeat the previous two steps again to add the **Right Roadway Shape Cluster** to the list box.

Note Always list Shape clusters from left to right in the direction of stationing.

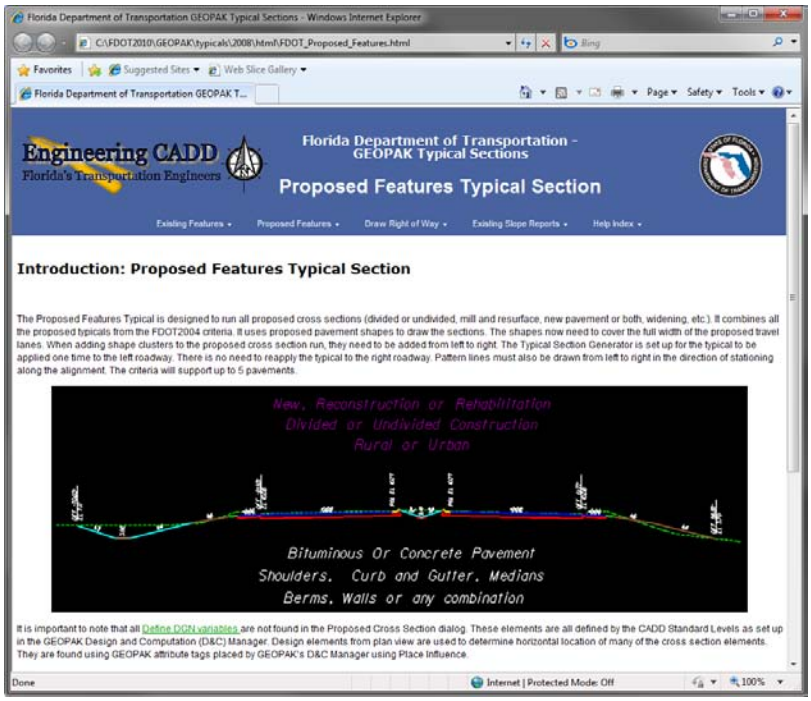
11. Close the **List of Clusters** dialog.
12. Select the **Left Roadway** *Shape Cluster* in the list box as shown. Note the *Typical* icon enables.



13. Click the **Typical** icon to access the Typical Sections dialog.
14. Select the *Cell* **Proposed_Features**.

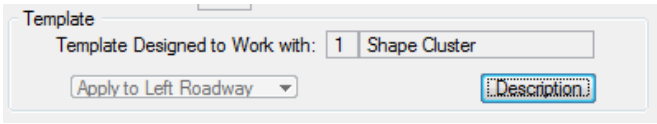


15. Click the **Description** icon to review the help files for this typical.

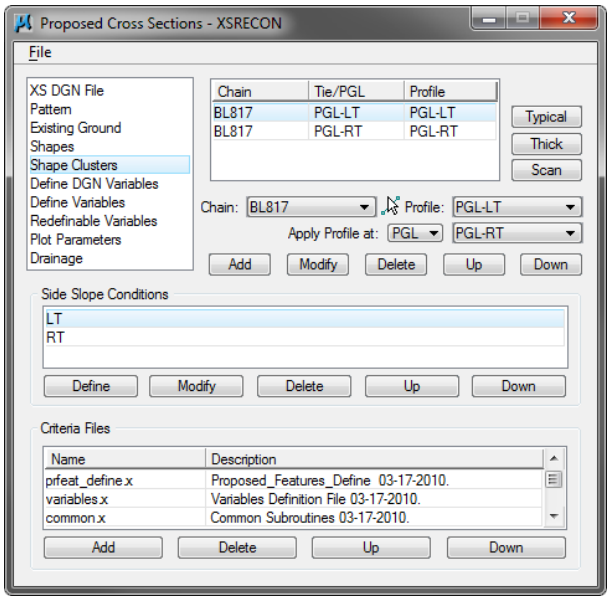


16. Close the Internet Explorer window and return to the Typical Sections dialog. Note that "*Apply to Left Roadway/Apply to Right Roadway*" is grayed out.

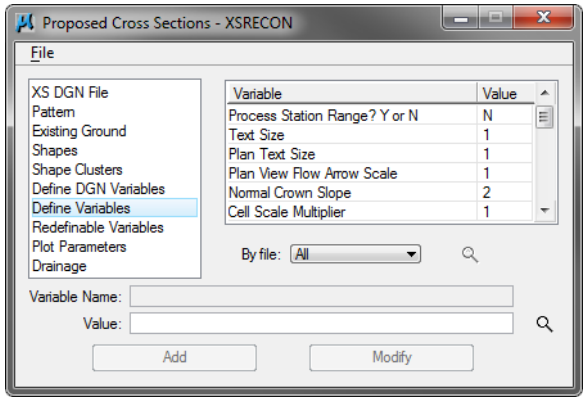
17. Select **Apply**.



18. The Proposed Cross Sections dialog fills automatically with the proper criteria files under the appropriate side slope conditions.



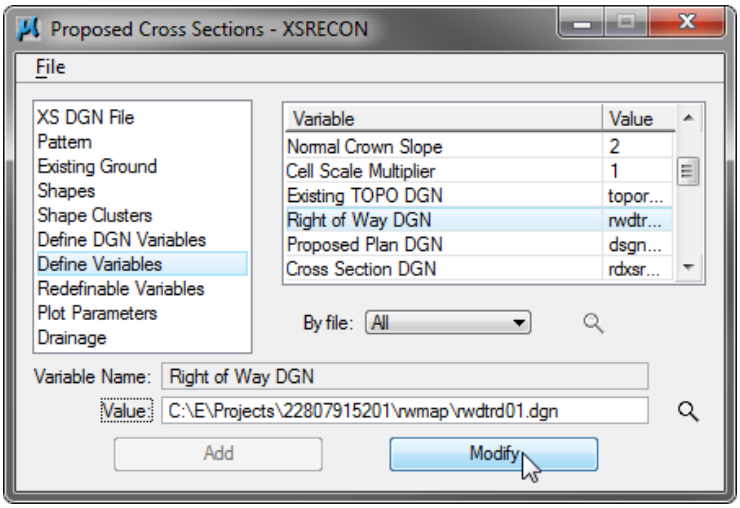
19. Repeat Steps 9-15 for the Right Roadway.
20. From Proposed Cross Sections, select **Define Variables**.



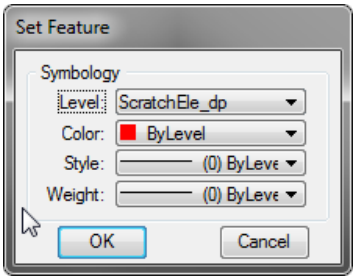
21. Select the variable **RIGHT OF WAY DGN**.
22. In the *Value* field, key-in **C:\E\Projects\22807915201\rwmap\rwdtrd01.dgn**.

Note You can cut and paste the path from Windows Explorer or click the "select a DGN" icon and browse to the desired file instead of typing it in.

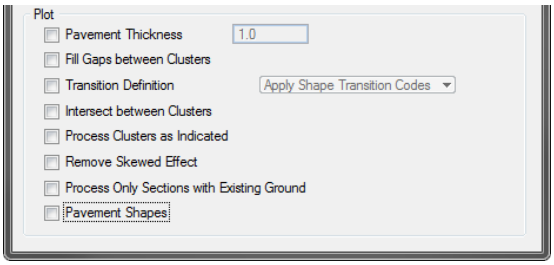
23. Click **Modify** to change the value of the variable.



24. Select **Plot Parameters**.
25. Set the *XS Lines* symbology as shown.



26. Disable all the *Plot* settings as done previously.

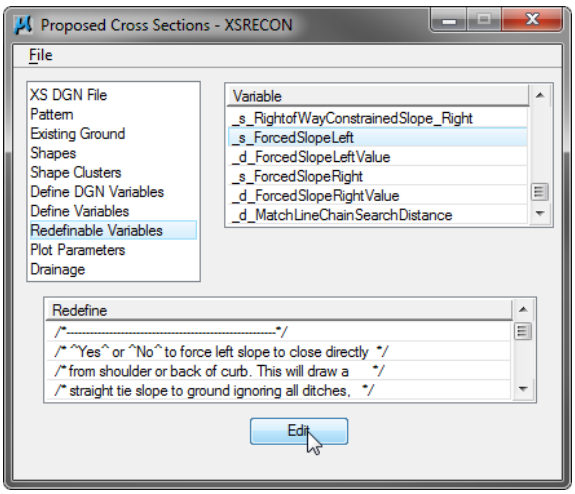


27. Select **File** > **Save Settings**.
28. Select **File** > **Run** and process the cross sections.
29. When processing is complete, close the Proposed Cross Sections dialog and Click Yes when prompted to Save Settings.
30. Open Cross Section Navigator and review the cross sections.

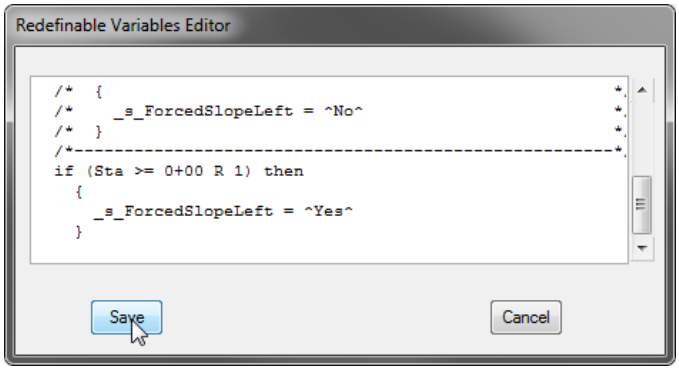
Exercise 6.3 Modifying Redefinable Variables

In this exercise, the user will learn how to use and modify the *Redefinable Variables* to control the behavior of our cross sections.

1. Access Proposed Cross Sections, using the previously created run.
2. Select Redefinable Variables.
3. Click the **Edit** icon.

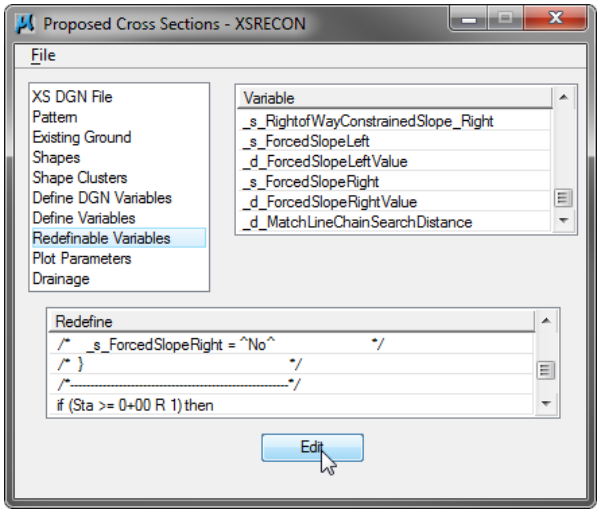


4. In the Redefinable Variables Editor dialog, change the value of *_s_ForcedSlopeLeft* to "**Yes**".

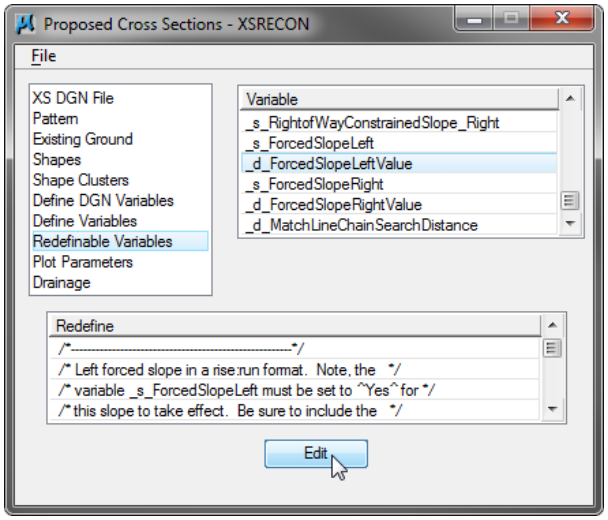


Note This is an example of changing a string variable.

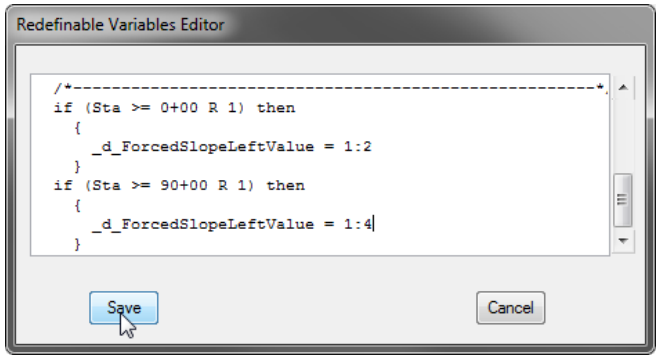
5. Click **Save.**
6. Change the value of *_s_ForcedSlopeRight* to "**Yes**".



7. Edit the variable **_d_ForcedSlopeLeftValue**.

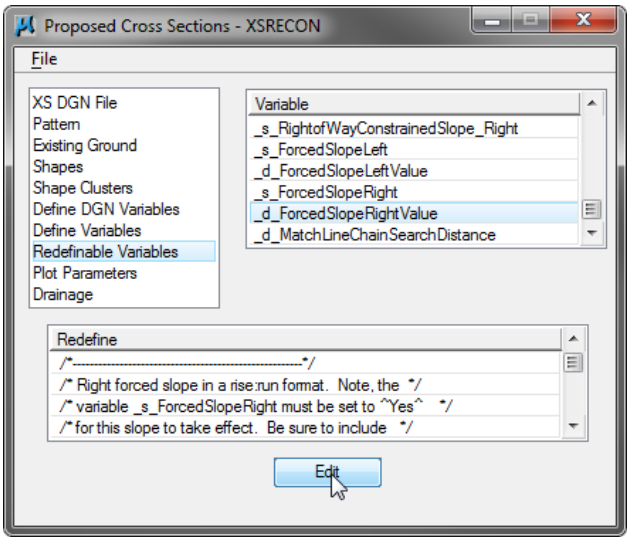


8. Modify the value of **_d_ForcedSlopeLeftValue** as shown and **Save**.

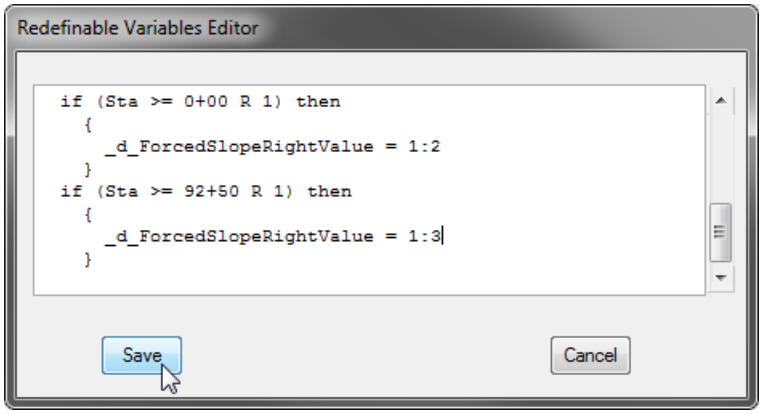


Note This will force the criteria to draw a slope of 1:2 for all stations less than 90+00, and then use a slope of 1:4 for all stations greater than 90+00.

9. Edit the variable **_d_ForcedSlopeRightValue**.



10. Modify the value of **_d_ForcedSlopeRightValue** as shown and Save.



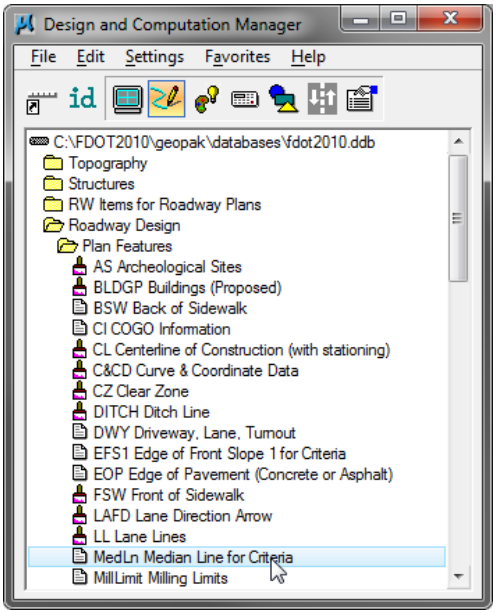
11. Select **File** > **Save Settings**.
12. From MicroStation, select **Edit** > **Select All**.
13. From MicroStation, select the **Delete Element** icon or hit the delete key to delete the previously plotted cross sections.
14. Select **File** > **Run** and process the cross sections.
15. When processing is complete, close the Proposed Cross Sections dialog and click **Yes** when prompted to **Save Settings**.
16. Open Cross Section Navigator and review the cross sections.

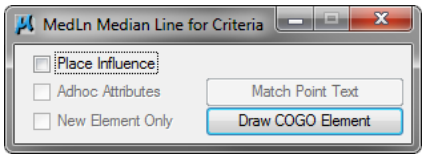
Exercise 6.4 Using DGN Elements and Adhocs

➢ *Median Designator Lines*

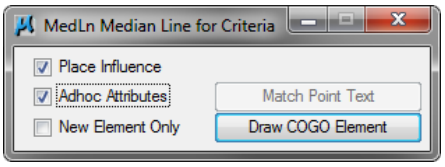
In this exercise, the user will learn how to control the behavior of our criteria and cross sections by placing graphical elements in a design file. These graphical elements can be "tagged" with additional information called "Adhocs", and are used solely for the purpose of passing information to the criteria.

1. Open the design file **DSGNRD01.dgn**.
2. Access the D&C Manager.
3. Navigate to the item **MedLn** as shown in the image below.

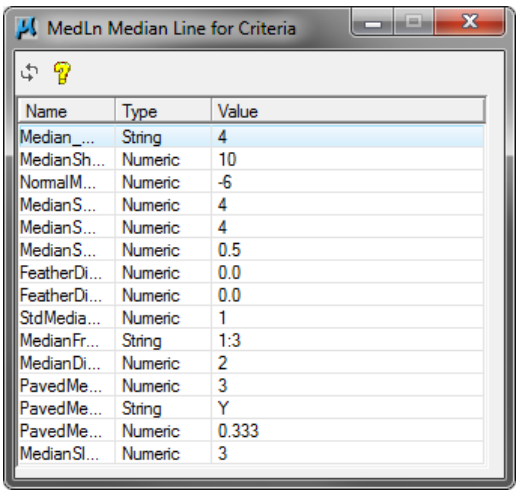




4. Enable the toggle for **Place Influence** and **Adhoc Attributes**.

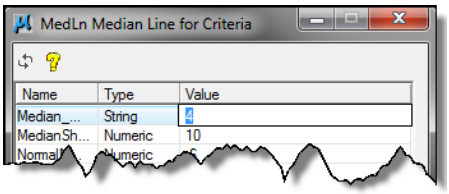


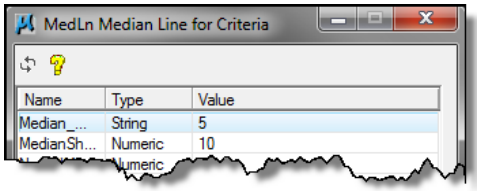
5. When the toggle for *Adhoc Attribute* enables, the **MedLn Median Line** for Criteria Adhoc Attributes dialog appears.



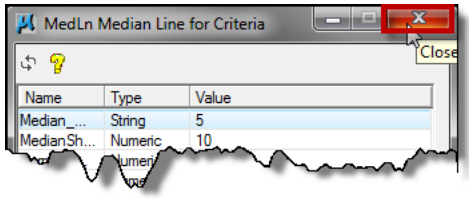
Name	Type	Value
Median_...	String	4
MedianSh...	Numeric	10
NormalM...	Numeric	-6
MedianS...	Numeric	4
MedianS...	Numeric	4
MedianS...	Numeric	0.5
FeatherDi...	Numeric	0.0
FeatherDi...	Numeric	0.0
StdMedia...	Numeric	1
MedianFr...	String	1:3
MedianDi...	Numeric	2
PavedMe...	Numeric	3
PavedMe...	String	Y
PavedMe...	Numeric	0.333
MedianSl...	Numeric	3

6. Change the value of the *Median_Type* Adhoc to **5** by placing a **Data Point** inside the *Value* field, change the value and then press **Enter**.

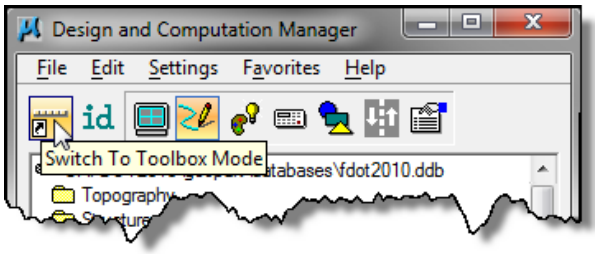




7. Close the Adhoc dialog.

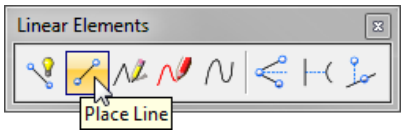


8. Change the D&C Manager to **Toolbox Mode**.



9. The Adhoc dialog may pop up again when you switch to toolbox mode. Just close it.

10. Using the MicroStation **Place Line** tool, place a **Median Line** inside of the traffic separator starting near *station 75+65.00* making sure the *Median Type Adhoc* is set to **6** for traffic separator.



11. Continue this line through to the end of the traffic separator.

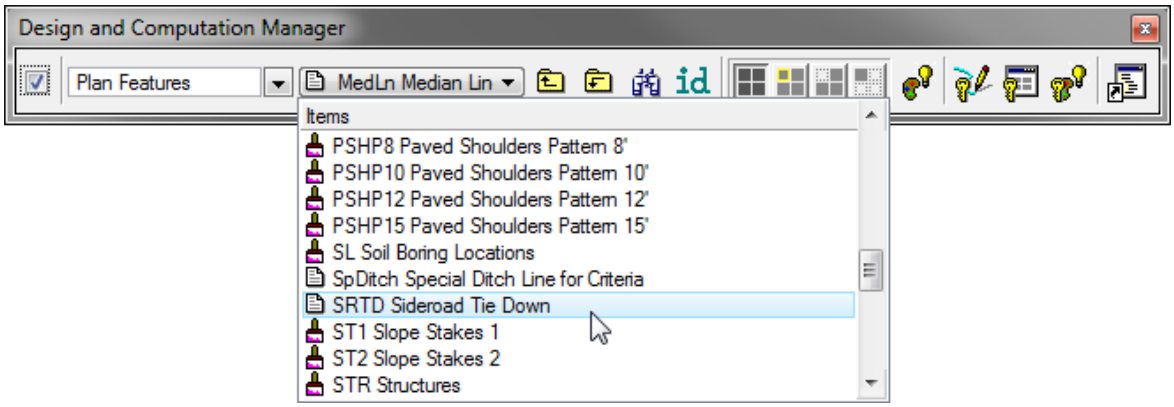
12. Start a new line in the normal median (between the curb and gutter) with the *Median Type* set to **5**. This line is a trigger line and is only drawn across the pattern lines somewhere between the backs of curb.

13. Across pattern lines through median crossovers, a **Median Line** must be drawn with the *Median Type* set to **7** within the limits of the crossover pavement between the shape clusters.

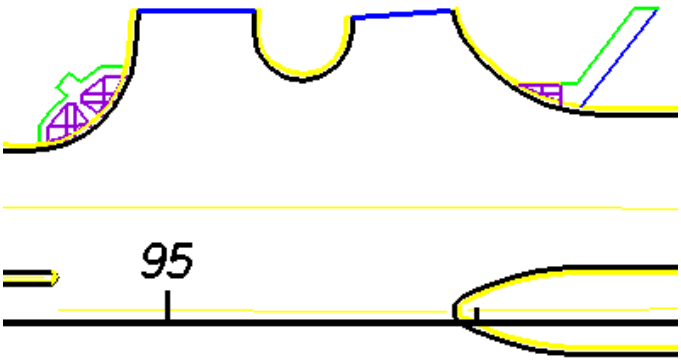
Note The placement of this median line and its associated *Median_Type Adhoc* will tell the criteria what type of median to build between these station values. Because this dataset shapes the crossover areas, the Median Line must drawn where the shapes come together.

➢ ***Side Road Tie Down Lines***

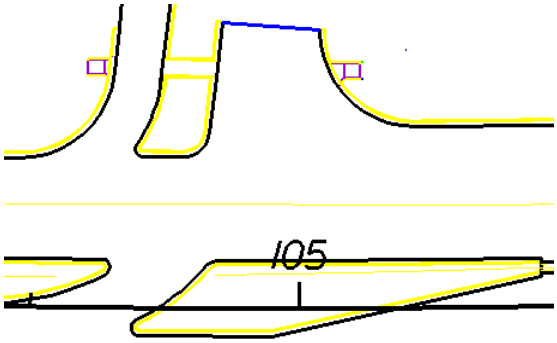
1. From D&C Manager, navigate to and select the item **SRTD** as shown.



2. Place **Sideroad Tie Down** lines at the intersection at *Station 95+00* as shown in the figure below.



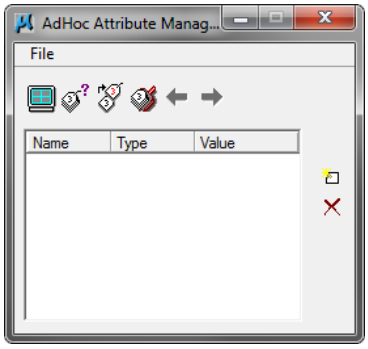
3. Place another **Sideroad Tie Down** line at the intersection at *Station 105+00* as shown in the figure below.



Exercise 6.5 Using the Adhoc Attribute Manager

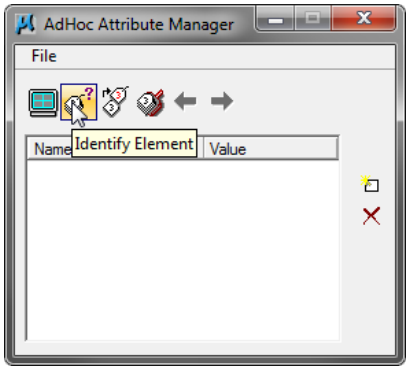
In this exercise, the user will check the Adhocs on the existing elements and modify Adhoc values using the Adhoc Attribute Manager.

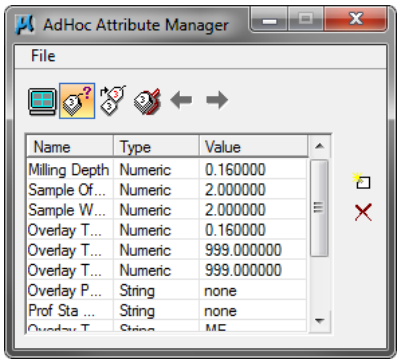
1. Open the file C:/e/projects/22807915201/roadway/*dsgnrd01.dgn.*
2. Open the Adhoc Attribute Manager. It can be accessed through **Applications > ROAD > 3PC Adhoc Attribute Manager** or through the Road Toolbox.



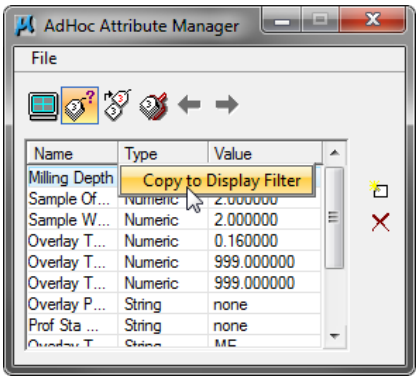
3. Select the **Identify Element** icon, and then click on one of the **Milling Limit lines**.

Tip Turn off the display for the *topord* and *utexrd references*, along with all the levels except *ShldrPaved*, *EOP*, and *MillingLimits*. This will make selecting the desired elements easier.

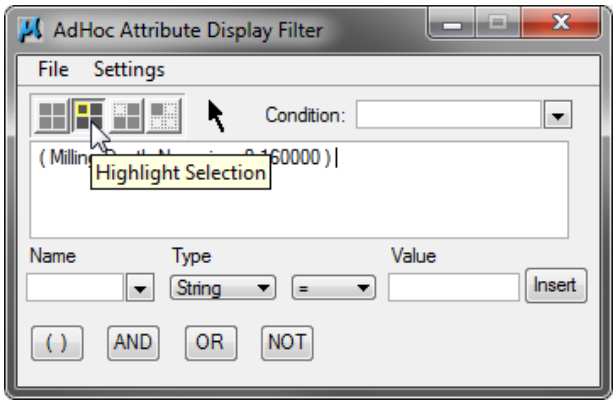




4. Review the list of Adhocs on the *Milling Limit line*.
5. In the Adhoc Attribute Manager, highlight **Milling Depth** in the list box. Right click over the line and select **Copy to Display Filter**.

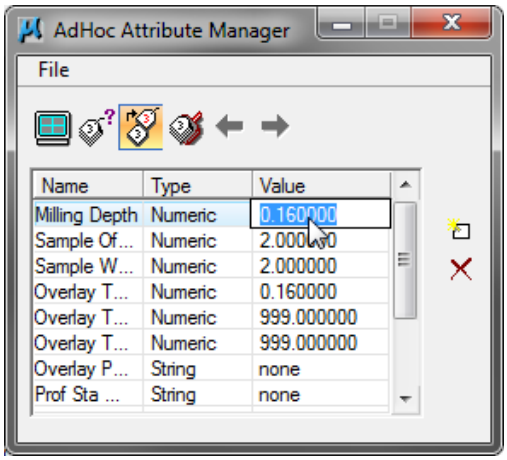


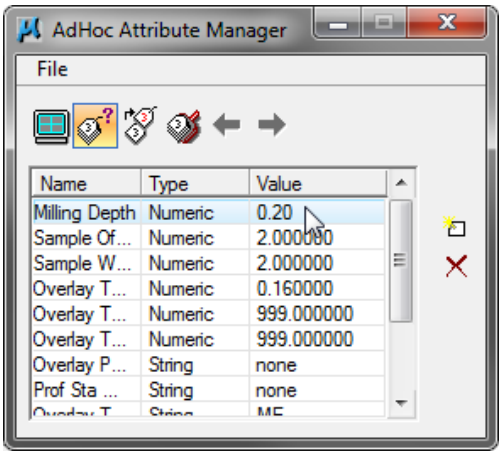
6. Click on the **Highlight Selection** icon to see the highlighted elements that match the query.



7. Click on the **Add Elements to Selection Set** icon to place the highlighted elements in a MicroStation selection set.

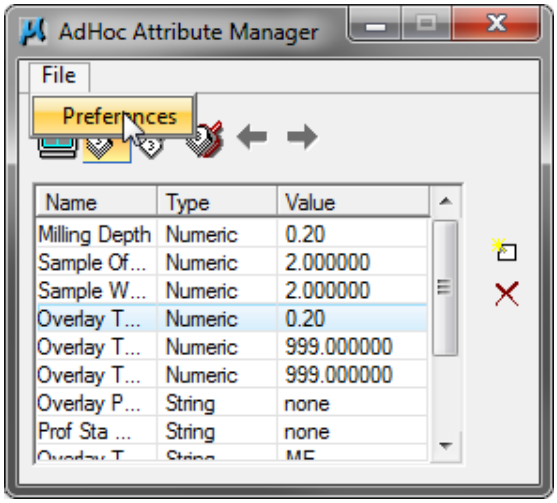
8. In the Adhoc Attribute Manager, double click on the value of **Milling Depth** and change it from ***0.160000*** to a value of **0.20**.



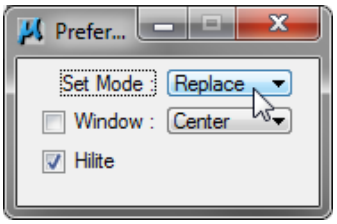


9. Repeat step 8 to change **Overlay Thickness 1** to **0.20** as well.

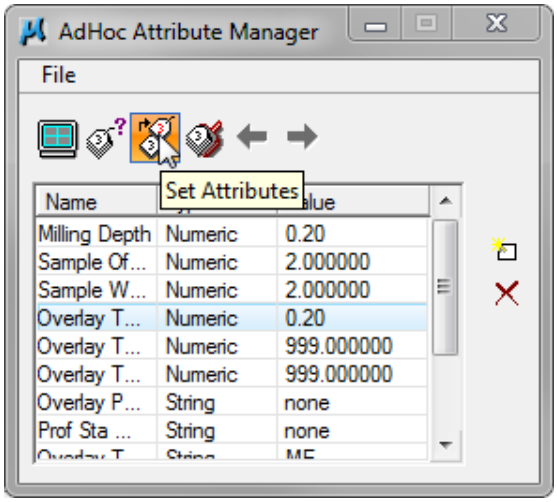
10. Select **File** > **Preferences.**



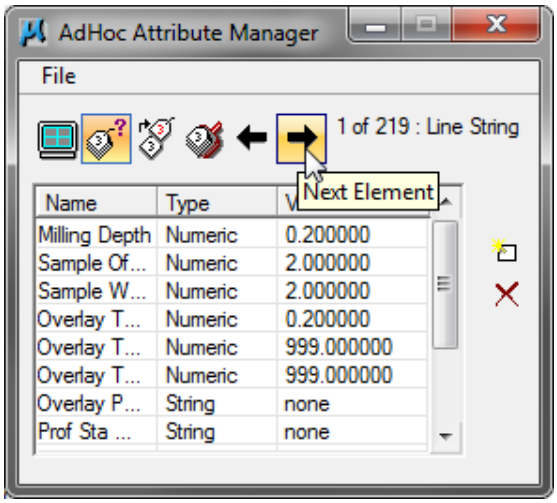
11. Preferences opens. Set the *Set Mode* to **Replace**.



12. Click on the **Set Attributes** icon.



13. An Alert displays. Click **Yes** to set the new attributes to the elements.
14. Click on the **Identify Element** icon. The elements from the selection set drop from the selection set and appear in the Adhoc Attribute Manager list box. Use the **arrow** icons to toggle through the elements to double check that the new Adhocs were added.



7 BOREHOLE NAVIGATOR

OBJECTIVES

- Overview of Borehole Navigator
- Overview of Preferences
- Import Soil Boring Data
- Plot Soil Borings into Cross Sections

INTRODUCTION

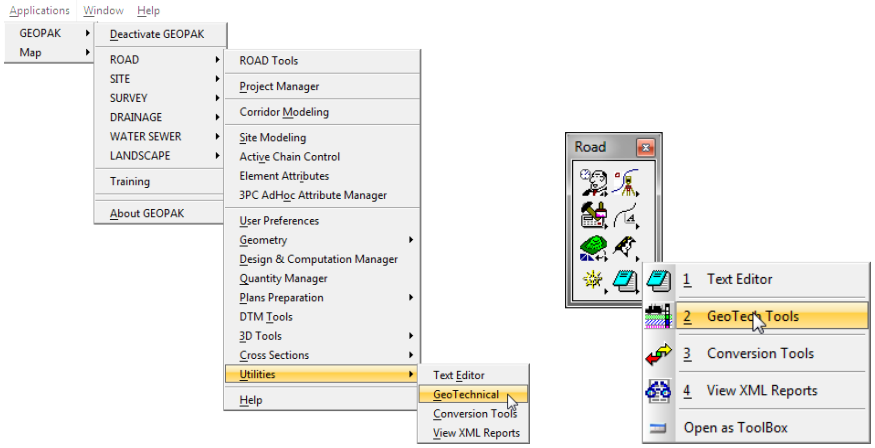
The GEOPAK GeoTechnical toolset includes a wide variety of tools for the input, storage, review and editing of soil boring data. The user can create subsurface TINs of the various materials for subsequent drawing onto cross sections or profiles. They may draw actual borings in Plan View, placed on cross sections, profiles or drawn into 3D as soils columns. GeoTechnical tools have several main functions:

- Storage of boring data for easy review and manipulation
- Drawing of borings onto plan view
- Drawing of borings onto profiles
- Drawing of borings onto cross sections
- Drawing of borings into a 3D file
- Generation of subsurface TINs

The Borehole Navigator (main dialog) facilitates the manipulation of data. Users can add, modify or delete boreholes along with manipulation of material layers. It also supports Standard Penetration Test (SPT) data (although for FDOT projects, SPT uses a different application).

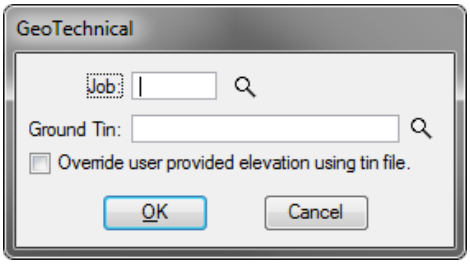
ACCESSING BOREHOLE NAVIGATOR

Access the Borehole Navigator through the MicroStation menu **Applications** > **ROAD** > **Utilities** > **GeoTechnical** – or – from the *Road* toolbox.



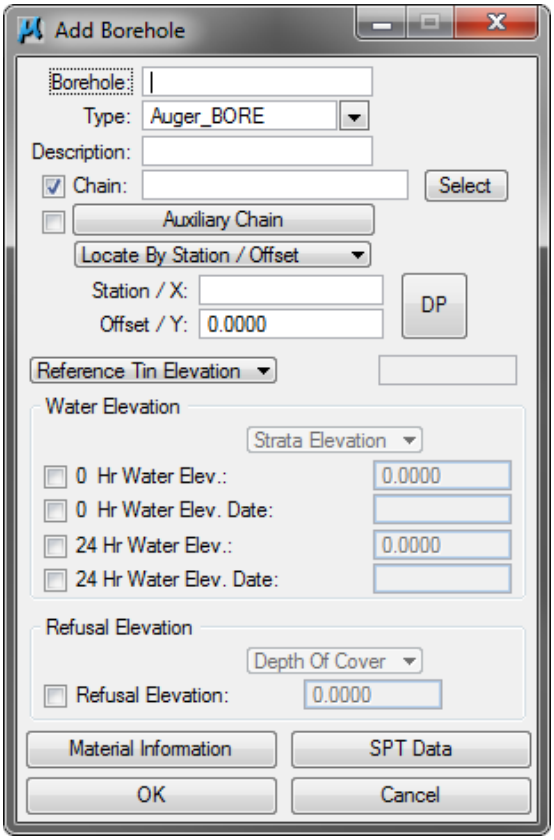
WORKFLOW

Before populating borehole information, the user must create a borehole project file via the **File > New** option. The default file extension for a borehole project file is .GTD. Once created, a dialog opens that prompts for project specific information – the GPK file for the project and a ground tin model name.



Upon creating the project, the user imports Borehole data via several methods as listed below:

- Import from a Borelog32 file.
- Import from CSV files.
- Import via pre-2004 Edition ancillary input files.
- Input one at a time via the Add Borehole tool.

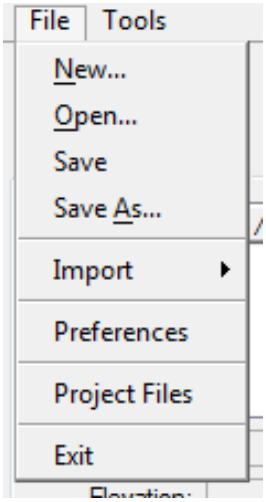


After one or more boreholes are stored in the project file, the user may draw them in any context – plan, profile, cross section or 3D. In addition, the user may generate subsurface models on any layer.

BOREHOLE NAVIGATOR DIALOG

MENU OPTIONS

FILE



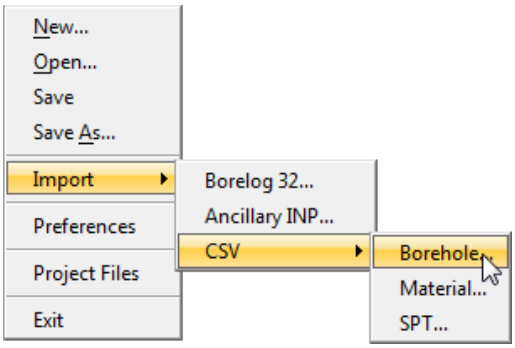
New Creates a new GTD file.

Open Opens an existing GTD file.

Save Saves the current dialog information into the active GTD file.

Save As Saves the current dialog information into a new GTD file.

Import Imports data from another file format into the dialog.



Borelog32 Imports data from a Borelog32 formatted file.

Ancillary INP Imports data from an input file (used in GEOPAK V7 & earlier)

CSV Imports data from a CSV file format. Three options include:

Borehole (.brh) - The Borehole file contains the following. borehole_name, description, chain_name, station, offset, depth, water_elev_0, water_elev0_date, water_elev_24, water_elev_24_date, water_elev_type (0=DOC 1=strata), rok_elev, rok_elev_type (0=DOC 1=strata), elevation, location_point_x, location_point_y. NOTE: not all fields are required. The minimum information is borehole_name, chain_name, station / offset or location_point_x and location_point_y.

Material (.mtl) – The Material file contains the material information and supports the following. Borehole_name, material_name, type_of_elev (DOC=DOC Strata=SE), description, doc_or_se (depth of cover or strata elevation), include_rock_data (Yes=1 No=0), record_percentage, required_percentage

NOTE: each line can have only one stratum; however, each borehole may have as many lines as needed. To accommodate some of the GPS equipment, the borehole_name may be set to 0. When encountered, GEOPAK utilizes the borehole_name from the previous line. The use of the actual borehole_name in multiple lines is also supported.

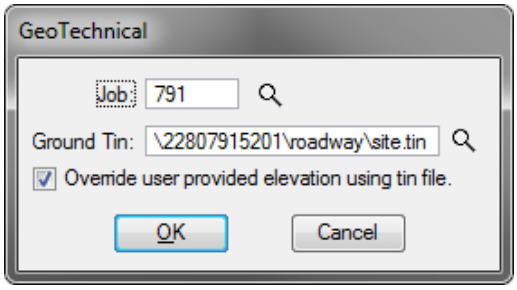
SPT – This file contains the Standard Penetration Test data and supports the following. Borehole_name, type_of_elev (DOC=DOC Strata=SE), description, doc_or_se (depth of cover or strata elevation), total_count, count_1, count_2, count_3

When importing a file and the borehole name already exists, an Alert message is displayed. If Append is selected, the data for current borehole is maintained and just the fields that are being imported change. If Replace is selected, the current borehole in the database is deleted and the imported information is utilized. The option can be applied to a single borehole, or to all boreholes in the current process. If Cancel is selected, the Alert message closes and no changes occur, returning the user to the Borehole Navigator.

Preferences Opens the GeoTechnical Preferences dialog. The GeoTechnical Preferences control the graphic display of the borehole data in plan, 3D, cross section, and profile views. The settings may be saved (*.gtp) to serve as a standard setup for subsequent projects. In larger organizations, the GeoTechnical Preference file may be set up and administered by a single person or group of people such as a CAD support group in the same manner as the existing Design & Computation Manager databases. This dialog will be covered in more detail later in the chapter.

FDOT has a *.GTP* file, called GEOTECH2008.GTP, available for use in the FDOT2008\GEOPAK\bin folder. The file contains preferences that comply with State CADD standards for Geotechnical drawings.

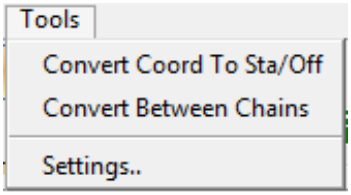
Project Files Opens the GeoTechnical dialog where the project files (gpk and tin) are entered or can be modified.



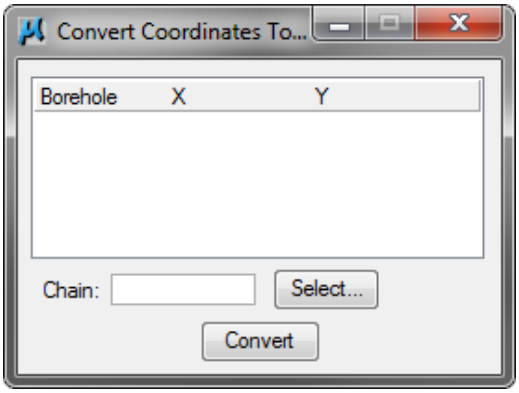
The checkbox is used to override manually entered elevations with the TIN elevations.

Exit Exits the Borehole Navigator tool.

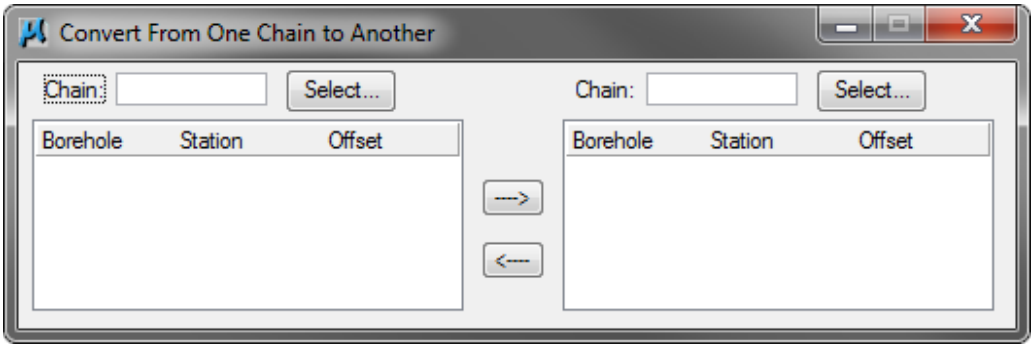
TOOLS



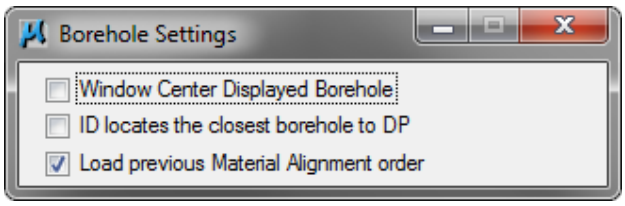
Convert Coord to Sta/Off This tool converts borehole(s) stored with coordinates to station / offset, based on the user defined Chain.



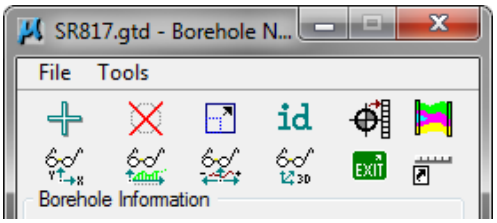
Convert Between Chains This tool converts station / offset of boreholes based on the stored chain to the station / offset of any other defined chain.



Settings Opens the Borehole Settings dialog box.



TOOL ICONS



Add Borehole

Delete Borehole

Modify Borehole

Select Borehole

Material Alignment

Interpolating Subsurface TINs from Borehole Data

Visualize Boreholes in Plan View

Visualize Boreholes in Profile View

Visualize Boreholes in Cross Section View

Visualize Boreholes in 3D

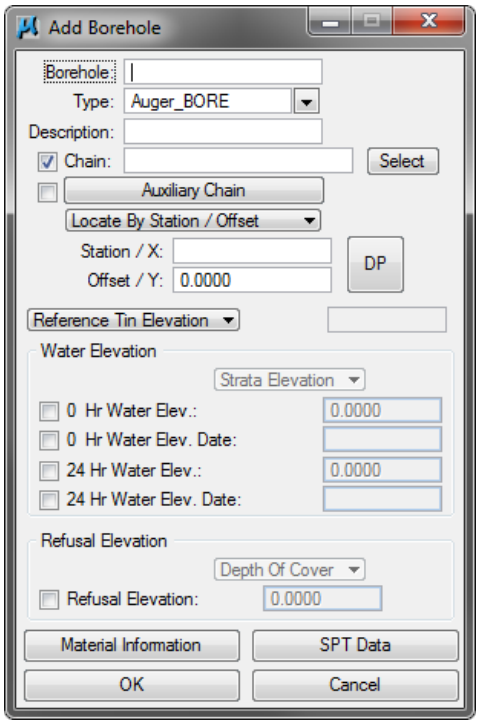
Closes Borehole Navigator

Switches to Tool Box Mode

Switches back to Dialog Mode.

ADD BOREHOLE

This is a manual tool used to add borehole data into the project.



Borehole Name of the new borehole to be added.

Type The Type determines the element symbology used to draw the borehole in plan view. The Types listed are a mirror of the types in the Preferences.

Description This is an optional description for the borehole.

Chain Name of the chain used to locate the borehole. If a chain is not used, the X and Y coordinates are the only way to loctate the borehole.

Auxiliary Chain A secondary chain that can be associated to the same borehole located off a primary chain. The user must provide the chain/station/offset for the auxiliary chain location.

Locate By Station/Offset Locates the borehole using station/offset information.

–or—

Locate By Coordinate (X&Y) Locates the borehole using X & Y coordinates.

Station/X The Station or X value of the borehole location depending on the Locate option.

Offset/Y The Offset or Y value of the borehole location depending on the Locate option.

Reference TIN Elevation Method used to locate the existing ground elevation.

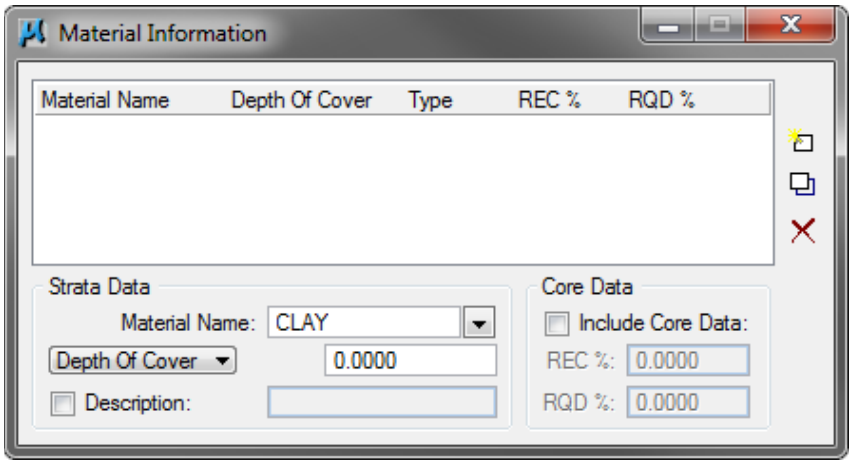
–or—

User Supplied Elevation Method used to located the existing ground elevation.

Water Elevation Optional data that supports the 0 hour and 24 hours readings and dates. 0 hour is taken immediately after the boring is drilled while 24 is the reading taken 24 hours later. These reading can be measured as a depth of cover or strata elevation.

Refusal Elevation This is the optional data designating the elevation of the Refusal. This value can be **Strata Elevation** (actual elevation of the refusal) or **Depth of Cover**, both in terms of master units.

Material Information Opens the Material Information dialog. This dialog is used to add, modify or delete material layers associated with the boring.



This dialog contains 3 sections: Material List Box, Strata Data, and Core Data

Material List Box Contains a list of the material layers associated with the boring. Includes the icons on the right side of the list box to add, modify, or deleted the selected material layer in the list box.

Strata Data Settings define the boring material type.

Material Name - Drop down list to define the material type. This list is populated from the material types defined in the preferences.

Boring Type - Defines the elevation data type. Options are Depth of Cover or Strata Elevation. The numeric field box used to assign the depth of cover or strata elevation.

Description - This is the optional description for the entered data. Toggle on the check box to un-ghost the field.

Core Data Optional definition for the material layer. This only applies to the Rock Layers and not to each individual material. If the Material Name requires the information of Recovery % and the Rock Quality Designation %, activate the Include Core Data toggle and enter the percentages in the respective entry fields. These Core Data entry fields are only available if the toggle is activated.

SPT Data Opens the SPT Data dialog box. This dialog box contains 2 sections: SPT Data List Box and the data entry options underneath.

SPT Data List Box Lists the SPT Data for the borehole.

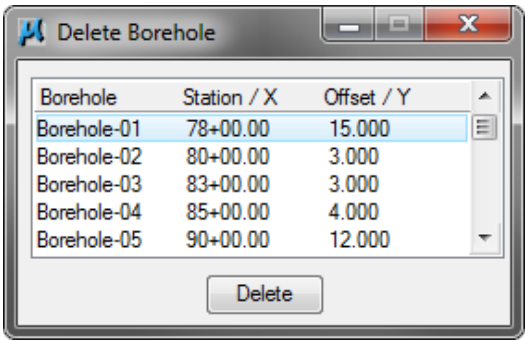
Data Entry Option The elevation can be entered as a Depth of Cover or at the actual Elevation (Strata Elevation). Select Depth of Cover or Strata Elevation and key-in the appropriate value. Activate the **Count** toggles for the data. In some instances, the 3 Blow Counts are plotted into cross section or profile view; while other cases, only the Total Count is labeled.

OK Adds the borehole information to the borehole list box.

Cancel Closes the Add Borehole dialog without storing the borehole information.

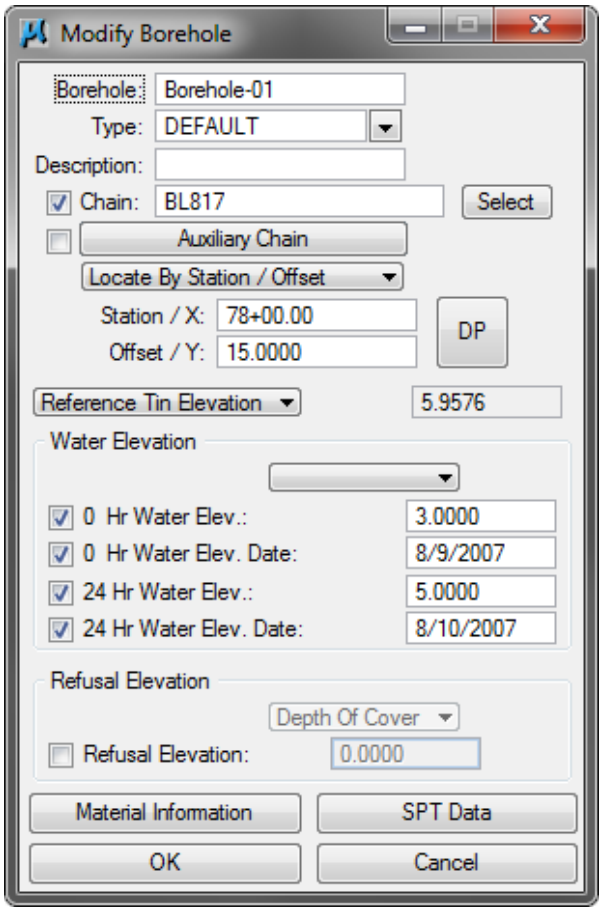
DELETE BOREHOLE

This opens the Delete Borehole dialog, which provides a list of the current boreholes to select from to delete. Highlight the desired boreholes to delete from this list box and click Delete.



MODIFY BOREHOLE

This opens the Modify Borehole dialog. The information from the Add Borehole dialog relating to the borehole displays. The user can make changes to these settings and then click **OK** to save.



SELECT BOREHOLE

The functionality of the ID icon is determined by the setting (**ID locates the closest borehole to DP**) in the Borehole Settings dialog. This dialog is opened by selecting **Tools** > **Settings** from the GeoTechnical menu bar.

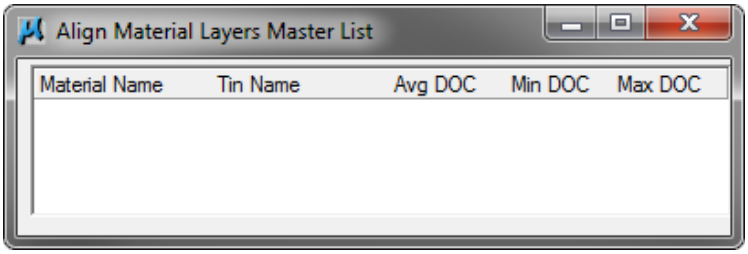
When the **ID locates the closest borehole to DP** is active and a **Data Point** is placed on the screen, the navigator highlights the borehole that is closest to this selected location and displays the relevant information for that borehole in the navigator.

When the **ID locates the closest borehole to DP** is not active and any part of a borehole or its label is selected and accepted, the navigator highlights the borehole in the navigator and displays the relevant information for that borehole.

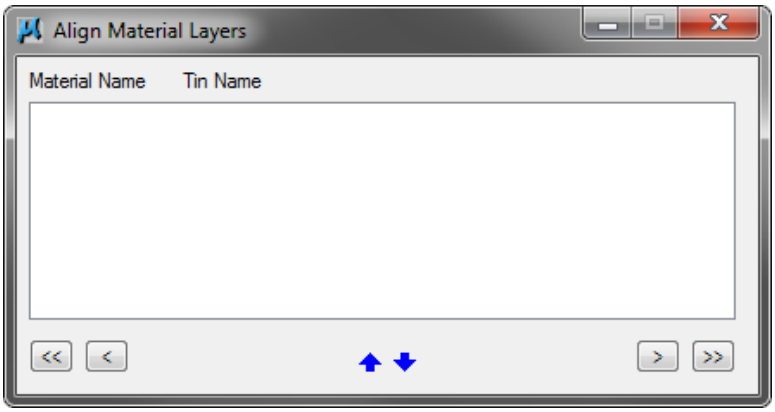
MATERIAL ALIGNMENT

After entering the boreholes in the GeoTechnical project, the user may review and modify the material layers of adjacent boreholes. When selected, the **Material Alignment** tool opens two dialogs:

Align Material Layers Master List The Align Material Layers Master List displays all **Material Names** in the current project. If the Material is found in more than one stratum per boring, numbers are appended to the Material Name, i.e., PEAT-1 and PEAT-2. The **Average**, **Minimum**, and **Maximum Depth of Cover** for each Material Name are also listed. The entries in this dialog are display only, and no user input is required.



Align Material Layers The Align Material Layers tool is utilized to review / edit boreholes.



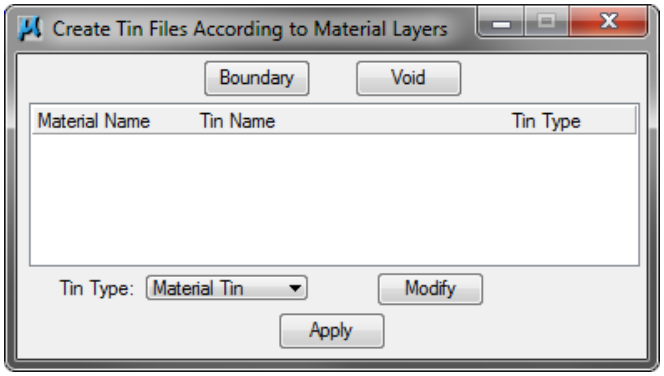
The *Material Names* and *TIN Name* listed in the left side of the dialog. The boreholes list across the top and the strata elevations or depths of cover for each boring are listed. To move data, utilize the VCR icons on the bottom of the dialog to scroll through the boreholes. Note the double left arrows return to the first borehole, while the double right arrows advance to the last borehole. The single arrows move one borehole per each pressing of the arrows.

To move the data up or down to match strata, use the arrow keys to move the borehole to be changed to the center position. This can be easily viewed on the screen, as this borehole is displayed in blue in the dialog. Next, highlight the elevation or depth of cover to be moved, which turns the data red. The associated material layer is changes green.

Use the blue arrows at the bottom of the dialog to move the strata data up or down, until it lines up with the desired Material Name. It can only be aligned with another layer of the same Material Name.

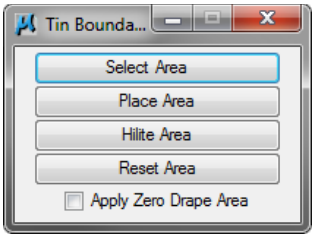
INTERPOLATING SUBSURFACE TINS FROM BOREHOLE DATA

Subsurface TIN files can be created for any material name with a minimum of three boreholes with the specified material.



Boundary

In some cases, the user may want to demarcate the area of a particular material type. Examples include swamps, peat bogs, etc. where a distinct boundary can be ascertained. In this case, a boundary should be created, where the TIN file will not be created outside of it. This can be accomplished by highlighting the material from the Create TIN Files From Material Layers dialog, then clicking **Boundary**.



Select Area Click this icon, then select and accept a previously drawn closed shape to demarcate the boundary.

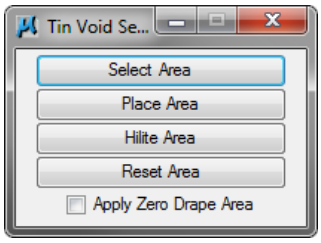
Place Area Click this icon, then place **Data Point**s to define a closed shape to demarcate the boundary.

Hilite Area Clicking this icon highlights any previously defined boundary.

Reset Area Clicking this icon deletes any previously defined boundary. If the Boundary was placed with a previously defined shape, the MicroStation shape is not deleted.

Apply Zero Drape Area When activated, the Boundary is draped onto the Ground TIN, and utilized in the creation of the TIN file. In this case, the material depth is zero at the location of the Boundary and interpolated with the borehole elevations. When not activated, the X, Y coordinates of the Boundary are utilized as the limits of the TIN file, but the Boundary elevations or Z coordinates are not utilized during interpolation.

Void In some cases, there may be an area within a Material TIN where the name type is not present. In these cases, the user may place a void within the Material TIN.



Select Area Click this icon, then select and accept a previously drawn closed shape to demarcate the void.

Place Area Click this icon, then place **Data Point**s to define a closed shape to demarcate the void.

Hilite Area Clicking this icon highlights any previously defined void.

Reset Area Clicking this icon deletes any previously defined void associated with the Material TIN. If the Void was placed with a previously defined shape, the MicroStation shape is not deleted.

Apply Zero Drape Area When activated, the Boundary drapes onto the Ground TIN, and utilized in the creation of the TIN file. In this case, the material depth is zero at the location of the Boundary and interpolated with the borehole elevations. When not activated, the X, Y coordinates of the Boundary are utilized as the limits of the TIN file, but the Boundary elevations or Z coordinates are not utilized during interpolation.

Material Names All **Material Names** found in the current GeoTechnical project are listed in the dialog. If the Material is found in more than one stratum per boring, numbers are appended to the Material Name.

For example, in the dialog above, PEAT was found in two stratum, so PEAT-1 and PEAT-2 are listed. These names are utilized as the Material TIN names with the extension .TIN.

To determine that stratum of each borehole in relationship to the others, refer to the Material Alignment tool. A minimum of three boreholes for each material are required. If TIN creation is attempted without three points, an Alert message is displayed.

TIN Types Two are supported as detailed in the table below.

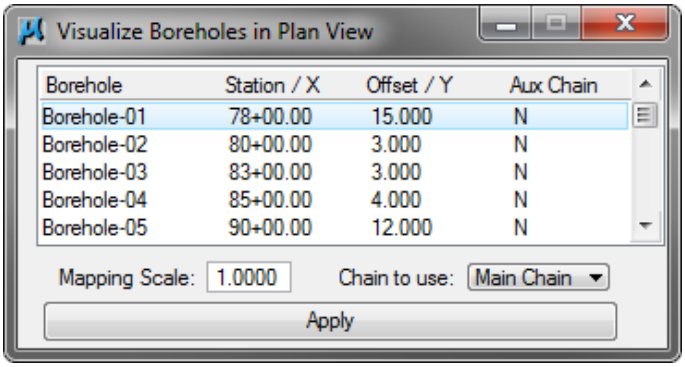
Drape ExGr TIN The Ground TIN and borehole elevations are utilized to create the TIN. The resultant TIN mirrors the Ground TIN and is adjusted for the elevation depths.

Material TIN The Ground TIN is not utilized, and the Material TIN is created exclusively from the borehole elevations.

Modify To change the Material TIN type, highlight the desired line, set the TIN type, then click **Modify** icon. Note the type changes in the list box.

VISUALIZE BOREHOLES IN PLAN VIEW

GeoTechnical Tools draws boreholes and associated text unto a plan view drawing, based on Preferences in the GeoTechnical Preferences. The user can select single or multiple boreholes via the list box.

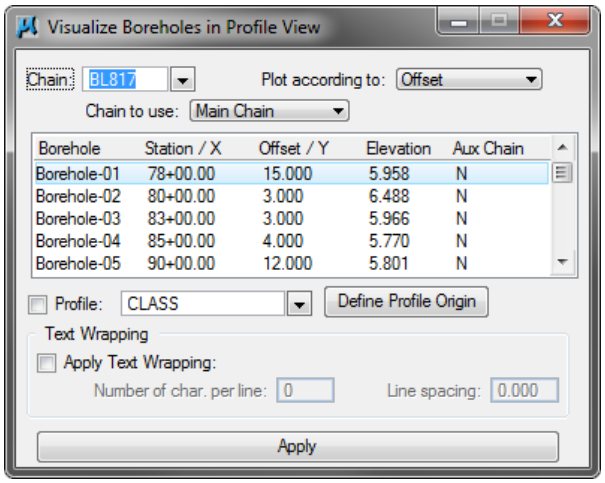


Highlight the borehole(s) to be drawn and set the **Mapping Scale**. Note multiple boreholes may be highlighted by using the Shift and Control keys. Then click **Apply** to draw.

VISUALIZE BOREHOLES IN PROFILE VIEW

The GeoTechnical Tool draws boreholes and associated text onto a profile view drawing, based on preferences in the GeoTechnical Preferences. The borings are drawn in the same file as the original profile drawing.

The user can select single or multiple boreholes via the list box.



Highlight the borehole(s) to be drawn. Note multiple boreholes may be highlighted by using the Shift and Control keys. <Control> A highlights the entire list.

Chain This includes all chains in the defined GPK file. At invocation of the dialog, the Borehole entries associated with displayed chain are listed. When another chain is selected from the list, the associated borehole entries are updated.

Profile This includes all profiles in the defined GPK file.

Plot according to Offset The distance from the origin of the borehole column and the profile is a function of the offset distance from the Horizontal Centerline. The further away from the centerline the borehole is measured, the further away from the profile it is visualized in profile view.

Plot according to Stack When the **Plot according to Stack** is set, the boreholes (at same station) are stacked one above another. Positive (horizontal) offsets are below the profile, while negative offsets are above.

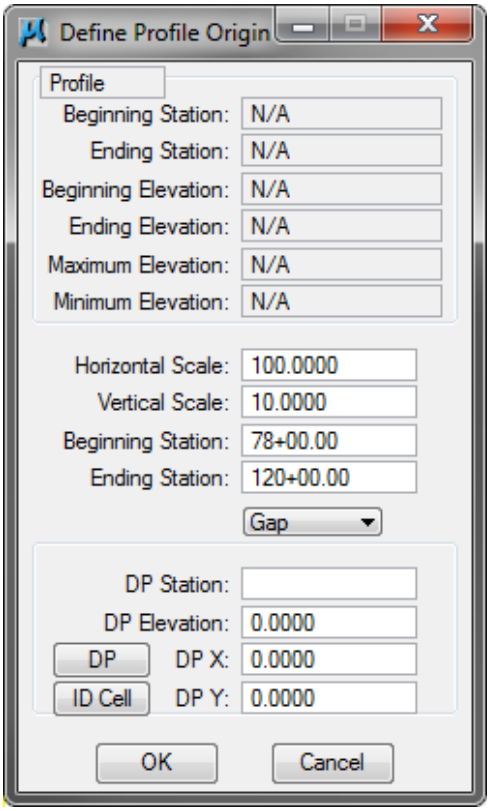
Plot according to Profile Depth When the **Plot according to Profile Depth** is set, the origin of the borehole column is placed at the profile elevation based on the borehole station. If several borings have the same station, the borings are stacked vertically with a fixed distance between. Positive (horizontal) offsets are below the profile, while negative offsets are above. The offsets increase moving away from the profile.

Plot according to Borehole Depth When the **Plot according to Borehole Depth** is set, the origin of the borehole column is placed at the borehole station and borehole elevation.

Text Wrapping Optional **Text Wrapping** is supported by activating the toggle to the left of **Apply Text Wrapping**. Set the value for the number of characters per line. Any line over the specified number wraps to the next line. The **Line Spacing** is the distance between lines (from justification from one line to the line below.)

Profile The profile information is not associated with the individual borehole data, therefore this setting does not affect which borehole entries display in the list box.

Define Profile Origin If the **Profile** toggle is activated and a profile is selected from the list, clicking **Define Profile Origin** opens the Define Profile Origin dialog.



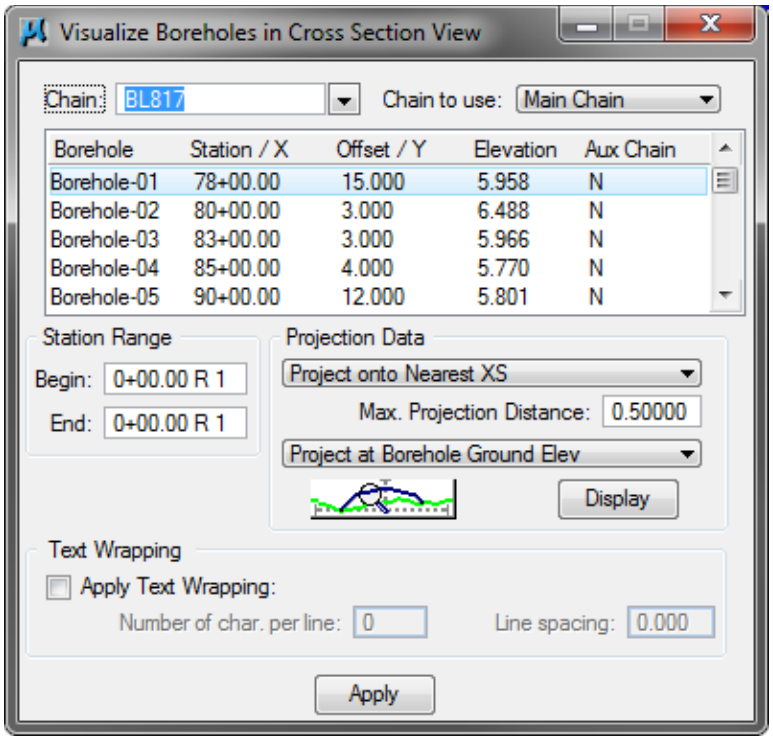
Information about the selected profile from the Visualize Profile dialog is displayed at the top of the dialog (no modification is allowed). The **Horizontal** and **Vertical Scale** at which the profile has been previously plotted into graphics should be entered in the center section of the dialog, along with the **Beginning** and **Ending Stations** of the range that the boreholes have been stored. Select the **Gap** or **No Gap** option to match the setting when the profile was originally drawn.

Locate the **DP Station / Elevation**, **DP X** and **Y** of the profile origin either by key-in or **DP** selection from graphics. If a profile cell was placed at the time of drawing, press the **ID Cell** icon and select the cell, which populates the dialog based on the cell settings. Press **OK** to return to the Visualize in Profile View dialog. Select single or multiple boreholes from the list box, then press the **Apply** icon to commence drawing the boreholes on profiles.

VISUALIZE BOREHOLES IN CROSS SECTION VIEW

The GeoTechnical Tool draws boreholes and associated text onto a cross section view drawing, based on preferences in the GeoTechnical Preferences. Viewing of columns, materials, water table elevations, and SPT data, including the corresponding labels is supported.

The borehole must have a ground/surface elevation which has been user defined or computed from the defined TIN. If no ground elevation has been given or computed, the borehole is not visualized in cross section view.



Chain Includes all chains which have XS Cells in the active cross section file. When the desired chain is selected from the list, the associated borehole entries populate the list box.

Station Range To draw borehole entries within a specified station range along the chain, enter the **Beginning** and **Ending** Station for the range in question. To visualize a single borehole, assign the **Beginning** and **Ending** station such that the borehole falls within the specified range.

Projection Data GEOPAK supports several options for projection of boreholes onto cross sections.

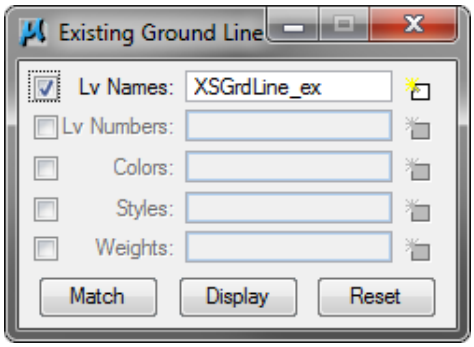
To visualize the boreholes at the nearest cross section (if they do not fall on an exact xs station in the xs design file), select the option to **Project onto Nearest XS**. This option is used in conjunction with the **Maximum Projection Distance**. This Distance sets the maximum distance a borehole can be radially projected onto a pattern. The **Maximum Projection Distance** option is only active if the **Project onto Nearest XS** is selected.

To visualize the boreholes at the exact cross section station, utilize the **Draw Only if on XS** option. Any boreholes whose station does not match the station of a cross section cell is not drawn, so no projection to nearby cross sections is available with this option. Note the **Max. Project Distance** is ghosted for this option.

Two options are supported for the elevation projection:

Project at Borehole Ground Elevation The borehole column is visualized at the actual top of borehole elevation. This could result in the column origin being visualized above or below existing ground at the nearest cross section.

Project to XS Ground Elevation The borehole column is visualized at the elevation of the existing ground at the nearest projected cross section at the given offset distance. This would result in the column origin being visualized at the existing ground elevation. The cross section must have a defined existing ground line at the location of the borehole, which is defined by clicking **Define Existing Ground**.



Activate the toggles to the left of the desired parameters, then enter the values in the key-in fields. In lieu of typing, click **Select** to open the pop-up dialog, wherein the parameters may be selected. To view any elements of the specified symbology, click **Display**. To clear out all entries in the Existing Ground Line dialog, click **Reset**.

Once all of the required information has been given, click **Apply** to initiate the visualization of the borehole entries onto the cross sections.

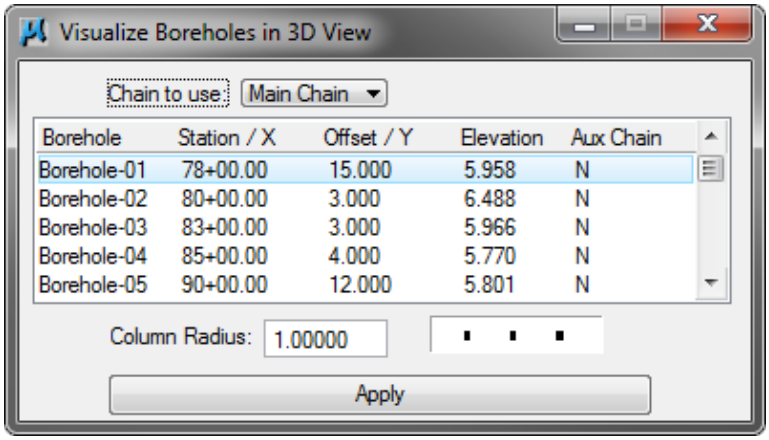
Text Wrapping Optional text wrapping is supported by activating the toggle to the left of Apply Text Wrapping. Set the value for the number of characters per line. Any line over the specified number wraps to the next line. The distance between lines (from justification from one line to the line below it is the Line Spacing.)

Text wrapping is only supported when the Text String option (and not Individual Components) is utilized. This option is set within the GeoTechnical Preferences.

Based on the GeoTechnical Preferences settings, the borehole text may be shifted downward. This occurs when the text height is greater than the material height for each strata. Note the overlapping is between strata labels within the borehole, but does not take into account text from one borehole overlapping an adjacent borehole.

VISUALIZE BOREHOLES IN 3D

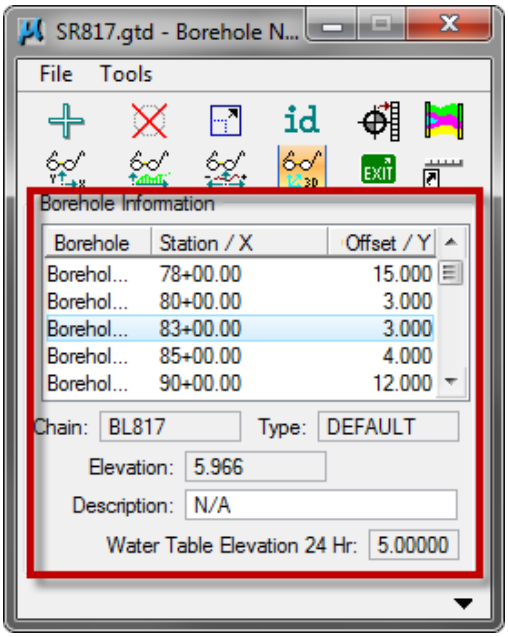
The Visualize Boreholes in 3D is utilized to display an individual borehole column in 3 dimensional view at the correct elevation. This tool is for visualization purposes exclusively and must be invoked from within a 3-D file. If the tool is invoked within a 2-D file, an Information message is displayed.



Single or multiple boreholes may be drawn. Simply highlight the desired boreholes, then set the desired symbology, i.e., **Level**, **Weight**, and **Style**.

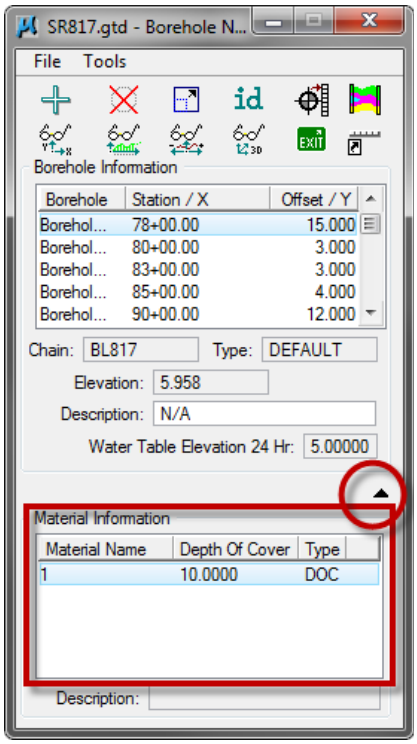
The **Column Radius** is the radius (in terms of master units) of the circle drawn in top view.

BOREHOLE INFORMATION



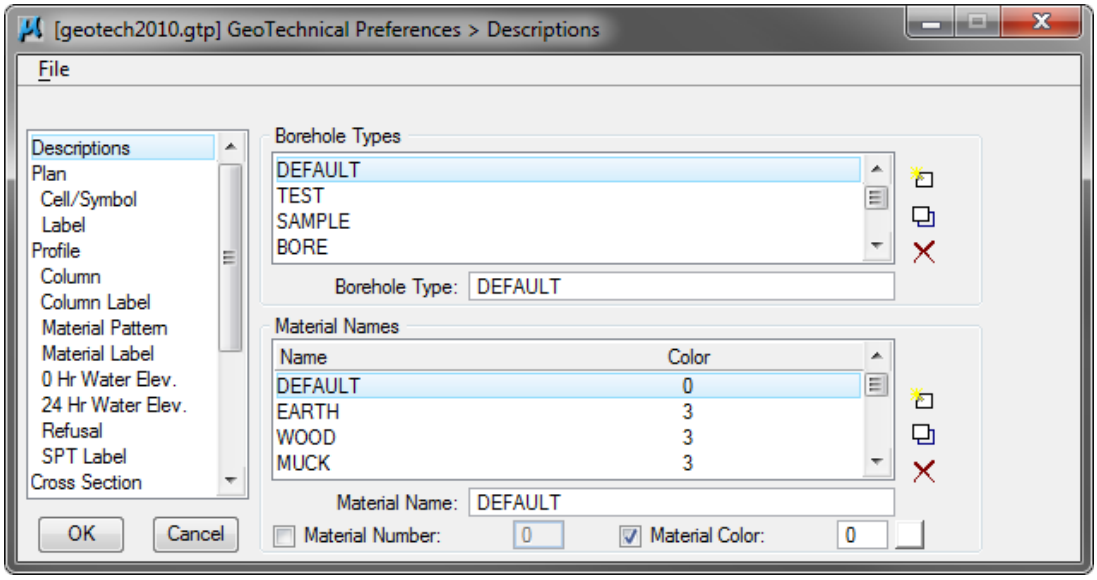
This portion of the dialog displays the list of the boreholes in the project. As each borehole is highlighted in the list box, the related information is shown below the list box. Note: The information shown here cannot be modified from this part of the dialog box. The Modify Borehole tool must be used.

MATERIAL INFORMATION



In order to view the *Material Information* stored for the boreholes in the list box, the user must toggle on the drop down arrow. The material information shown cannot be modified from the main dialog. It must be modified with the Modify Borehole tool.

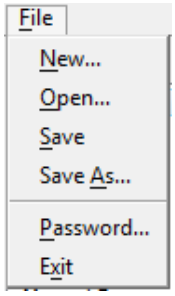
GEOTECHNICAL PREFERENCES



The GeoTechnical Preferences control the graphic display of the borehole data in plan, 3D, cross section, and profile views. The settings may be saved (*.gtp) to serve as a standard setup for subsequent projects. Upon selecting each option, the right side of the GeoTechnical Preferences dialog changes to reflect the selection.

Note FDOT has a .GTP file available in the FDOT2010\GEOPAK\bin folder. The file name is GEOTECH2010.GTP and contains preferences that comply with State CADD standards for Geotechnical drawings.

FILE MENU



New Creates a new preferences file. All list boxes are empty and it is required to define each item. For either the Open or New modes, prior to opening the new database, GEOPAK closes the original preferences file in an orderly manner. A dialog opens offering the opportunity to save any changes previously made to the original preferences or to ignore the changes.

Open Opens a previously created preference file.

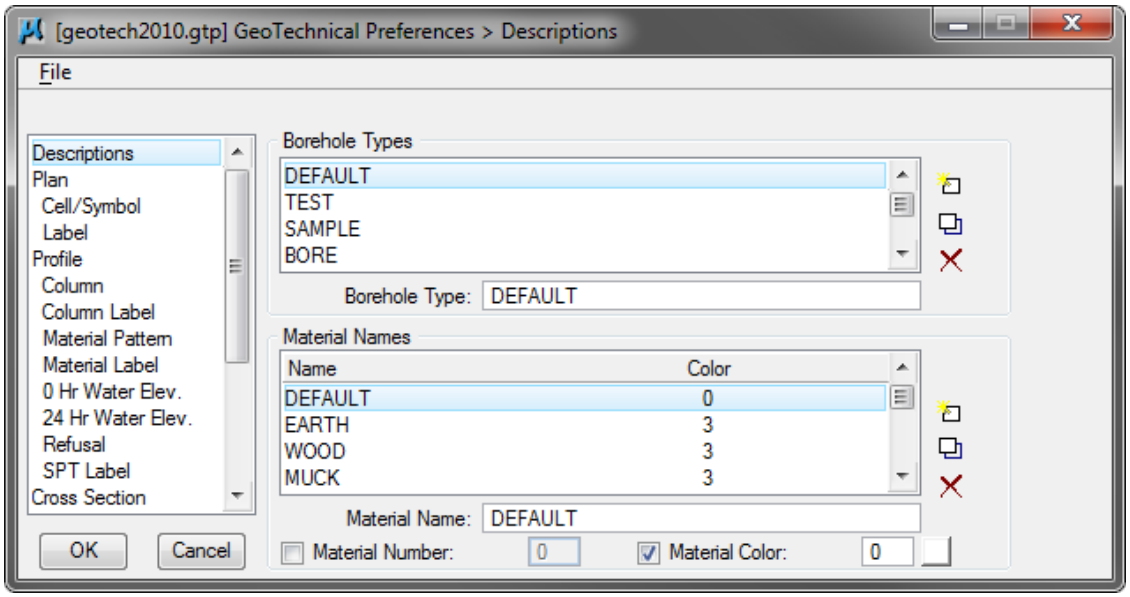
Save Saves the current settings to the active preferences file.

Save As Saves the current settings as a new preference file.

Password The Password only restricts users from changing or adding to the preferences, however, they can still review each item to view the element symbology or other parameters.

Exit Exits the Borehole Navigator dialog.

DESCRIPTIONS



Two group boxes are supported within the Descriptions option: **Borehole Types** and **Material Names**. GEOPAK supports an unlimited number of **Borehole Types**. When the fifth entry is added, scroll bars automatically display for ease of viewing.

Borehole Types The **Borehole Types** stored within the Descriptions Preferences are reflected throughout the GeoTechnical tools and can only be added within the Description Preferences. By opening the Add Borehole dialog, the **Borehole Types** mirror what is in the Description dialog, enabling the users to select the desired Type from the list. The **Borehole Types** are also utilized elsewhere within the Preferences, for example, in the **Plan > Cell** option. Additional Borehole Types may be listed if an existing project is opened which has types not listed or an existing preference file with additional types has been opened.

Material Names GEOPAK supports an unlimited number of **Material Names / Numbers**. To utilize a **Material Number**, activate the toggle to the left of **Material Number**. An optional **Material Color** can be utilized by activating the toggle to the left of **Material Color** and selecting the desired color. The color is displayed in the list box. If the **Material Color** is not activated when a Material is added, N/A is displayed in the list box. The color is utilized when drawing the soil strata when visualized as a column in 3D and when the fill option (rather than material pattern) is utilized when drawing boreholes on cross sections and profiles.

Each group box supports three action icons are detailed below.

Add

To add a **Borehole Type or Material Name / Number**, populate the edit field at the bottom of the group box, then click **Add**.

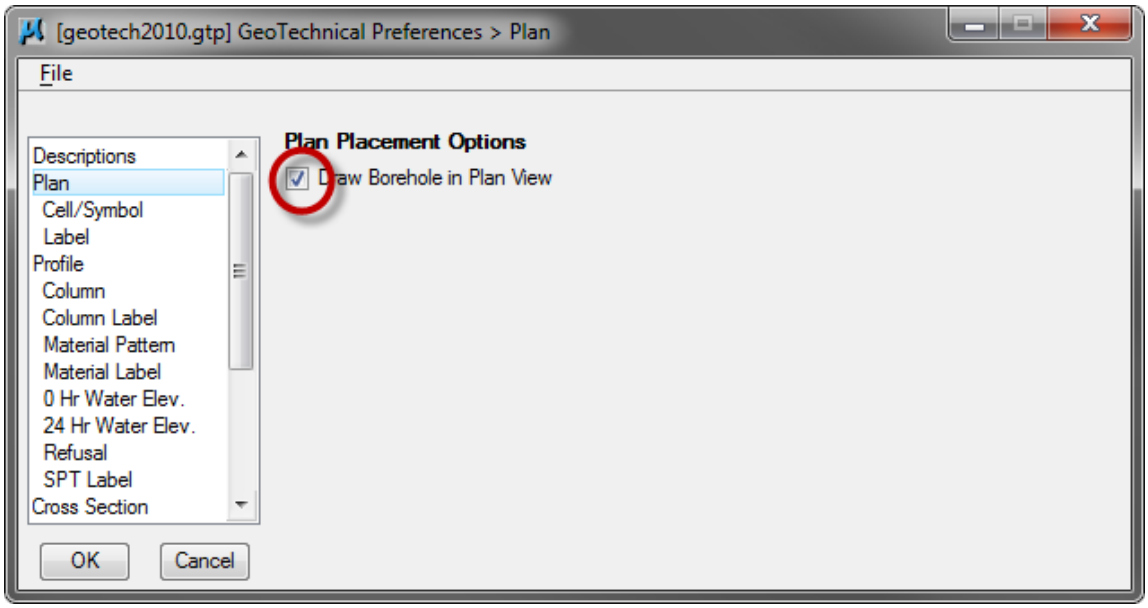
Modify

To modify, highlight the line to be modified and GEOPAK populates the edit field. Change the edit field, then click **Modify**.

Delete

To delete a line, simply highlight the line, then click **Delete**. An Alert message prompts the user for deletion. Click **Yes** deletes the Borehole Type, clicking **No** or **Cancel** closes the Alert message, but does not delete the type.

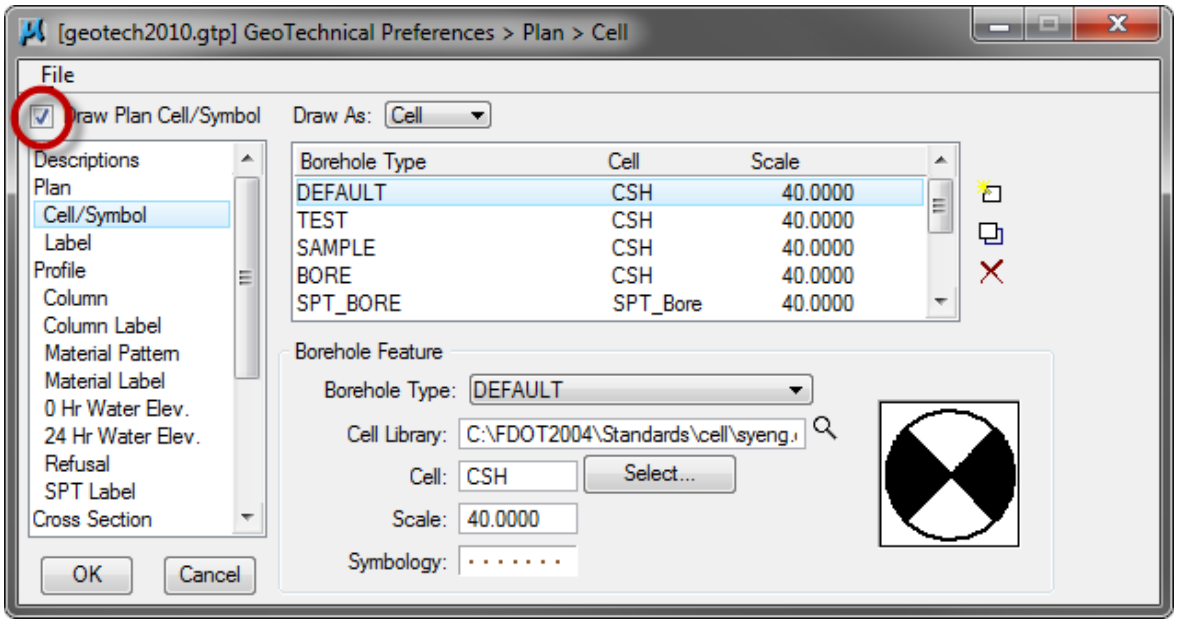
PLAN



Only one option is supported on the Plan dialog, **Draw Borehole in Plan View**. When activated, all plan related options in the list box are un-ghosted, so the user can set up all preferences required to draw soils borings in the plan view. When not active, borings cannot be drawn in plan view. If the user attempts to draw plan view borings via the Navigator, an Alert message is displayed.

CELL/SYMBOL

In order to select the Cell / Symbol option, the **Draw Borehole in Plan View** toggle in the Plan option must be activated. This dialog reflects the **Cell** option for drawing.



Within the dialog, all parameters required to draw the cell / symbology representing the borings in plan view are defined. When adding or modifying boreholes, the user selects the desired **Type** from the list within the Add Borehole dialog.

Drawn As: *(Cell / Symbol)* Two types are supported: **Cell** and **Symbol**. When set to **Cell**, the dialog reflects cell selection options in the Borehole Feature group box, i.e., cell library, cell name, scale, etc. When set to **Symbol**, the Borehole Feature group box changes to reflect symbol preferences, i.e. character, font, etc.

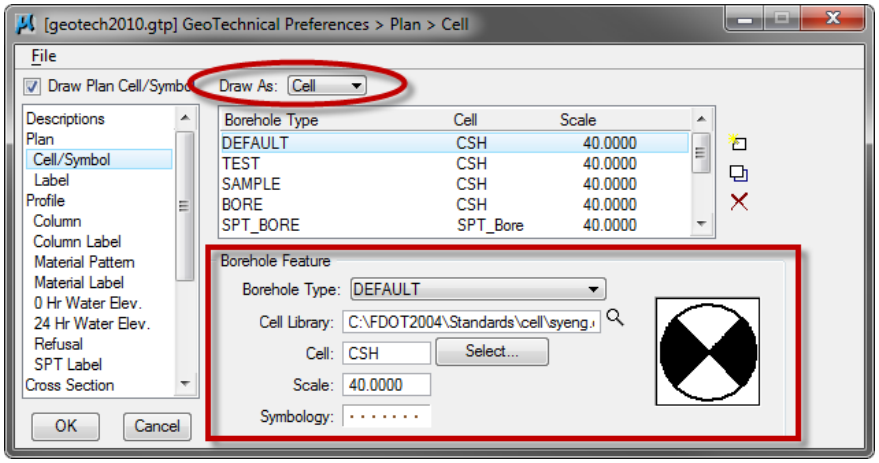
Borehole Type *(list box)* All defined **Borehole Types** within the preferences are listed. New **Borehole Types** can be added, while current listings can be modified or deleted.

Add *(icon)* To add a **Borehole Type**, populate the edit field at the bottom of the group box, then click **Add**.

Modify *(icon)* To modify, highlight the line to be modified and GEOPAK populates the edit field. Change the edit field, then click **Modify**.

Delete *(icon)* To delete a line, simply highlight the line, then click **Delete**. An Alert message prompts the user for deletion. Clicking **OK** deletes the Borehole Type, clicking **Cancel** closes the Alert message but does not delete the type.

Cell When set to **Cell**, the Borehole Feature group box changes to reflect cell preferences, as illustrated below.



First, select the desired **Borehole Type** from the list. Types cannot be manually entered, as the list reflects the listings from the Descriptions option within Preferences. Next, manually enter the desired Cell Library or select via the **File** icon.

If the library is stored on a central server and mounted by the users with various drive designations, do not include the path and drive. Simply include the cell library within the users' MS_CELLLIST.

The Cell Library field supports the MicroStation Cell Configuration Variable whereby the user could express the cell Library List such as:

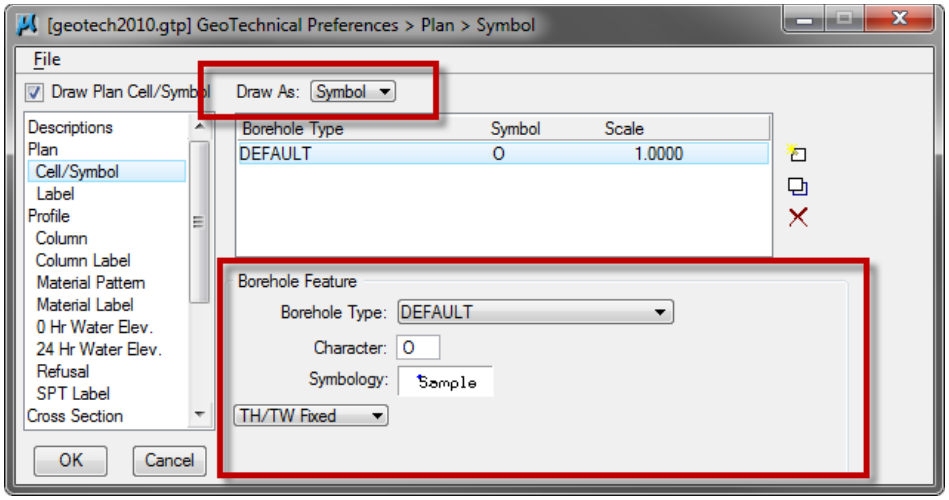
MS_CELLLIST = $c:\geotechnical\test.cel

MS_CELLLIST > $c:\geotechnical\spec.cel

Select the desired cell by clicking **Select** and highlighting the cell. The cell is displayed in the box to the right. If the cell is manually entered and cannot be found in the cell library, a message is displayed in the cell display box indicating the cell is not found. Include the **Scale** used at creation, as the user specifies the **Mapping Scale** at time of drawing.

Below the cell is element symbology parameters utilized when placing cells. This symbology overrides the parameters of the cell when created, whether a point or graphic cell.

Symbol



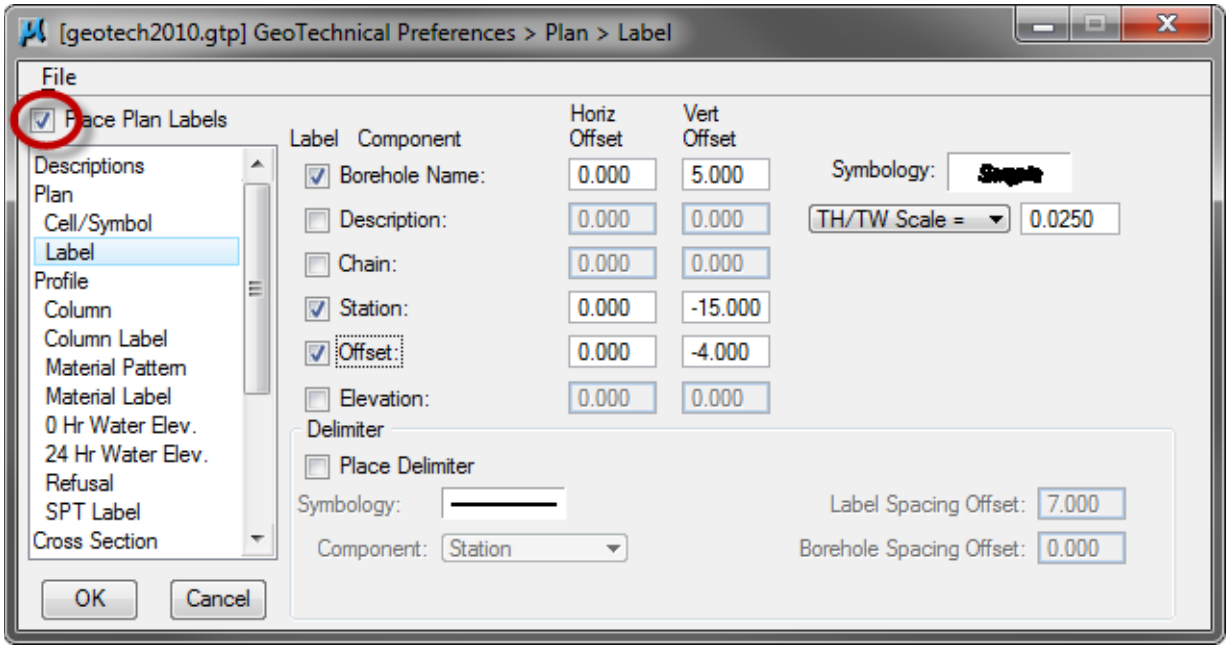
First, select the desired **Borehole Type** from the list. Types cannot be manually entered, as the list reflects the listings from the Descriptions option within Preferences.

Next, select the desired (symbol) Font from the list, then manually enter the Character. Due to the nature of symbol fonts, only one character is supported. The size of the symbol font is controlled by the Text Height and Text Width. These can be fixed or can vary with the scale settings on the Visualize Boreholes in Plan View dialog.

Below the **Character** field are element symbology parameters: **Level**, **Color**, and **Weight**. Note there is no style, as symbol fonts are drawn solid.

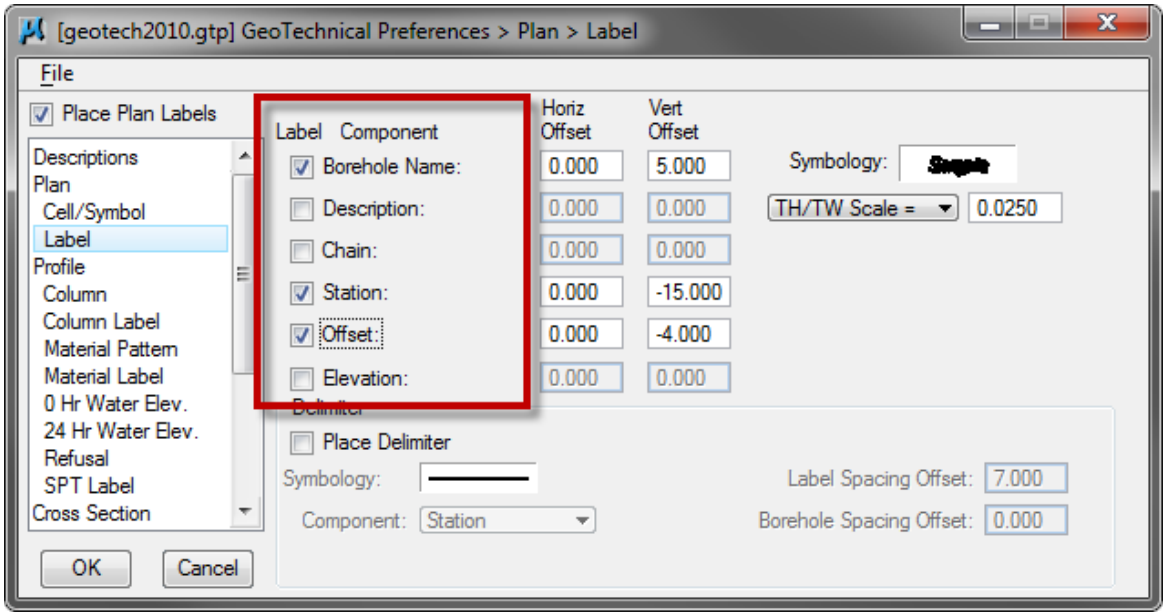
LABEL

In order to select the **Label** option, the **Draw Borehole in Plan View** toggle in the **Plan** option must be activated.



In order to place labels and un-ghost the dialog, the **Place Plan Labels** toggle in the upper left corner must be activated. The dialog is divided into two sections: Label Component and Delimiter.

Label Component Six Components can be labeled for each boring. To place a label, activate the toggle to the left of the Component. In the sample above, three Components will be labeled: Borehole Name, Station, and Offset. When all offsets are set to zero, the Borehole Label Origin is located at the origin of the borehole cell or symbol. All Components are placed with the same symbology, specified in the right side of the dialog. Element symbology in addition to text parameters is supported.



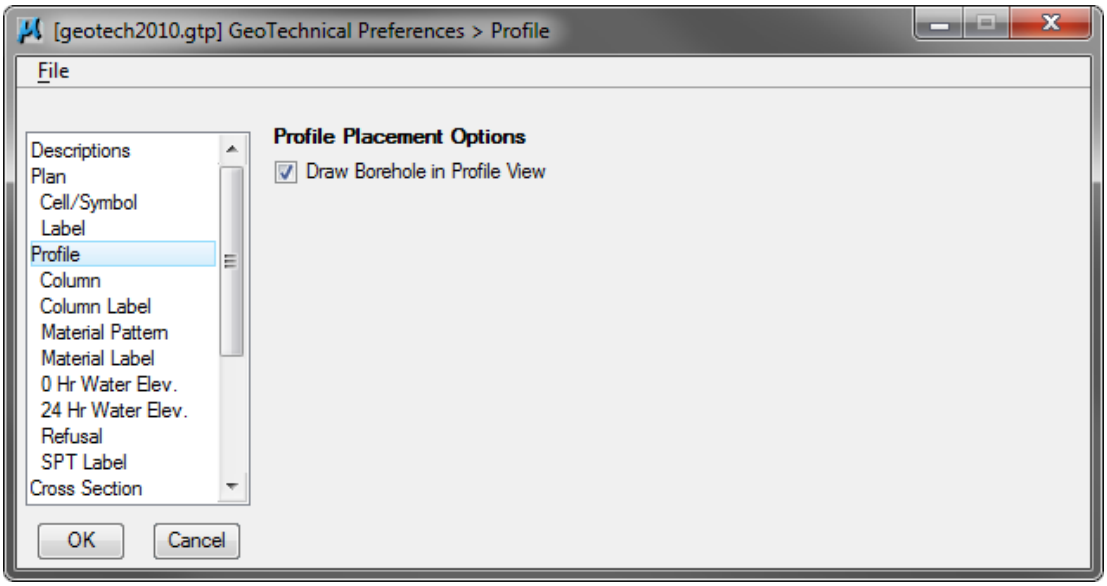
The **Horizontal** and **Vertical Offsets** are the distances in master units from the borehole cell or symbol origin.

Delimiter The Delimiter group box contains parameters for spacing and placing an optional delimiter.

To place a delimiter, activate the **Place Delimiter** toggle in the upper left corner of the group box. The **Label Spacing Offset** and **Borehole Spacing Offset** are the distances in master units.

PROFILE/CROSS SECTION

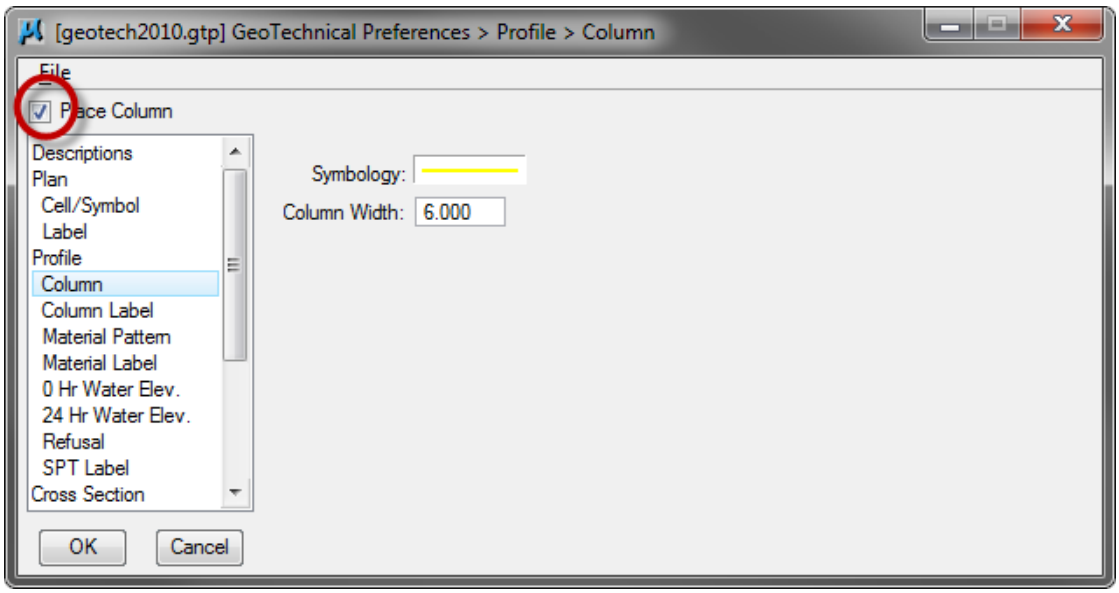
Since the preferences are the same for Profile and Cross Section, they will only be covered once.



The **Profile** and **Cross Section** options define the placement of borings onto profile/cross section drawings. To toggle must be turned on for the tool to draw boreholes into the corresponding view. Once toggled on, the settings options will un-ghost.

COLUMN

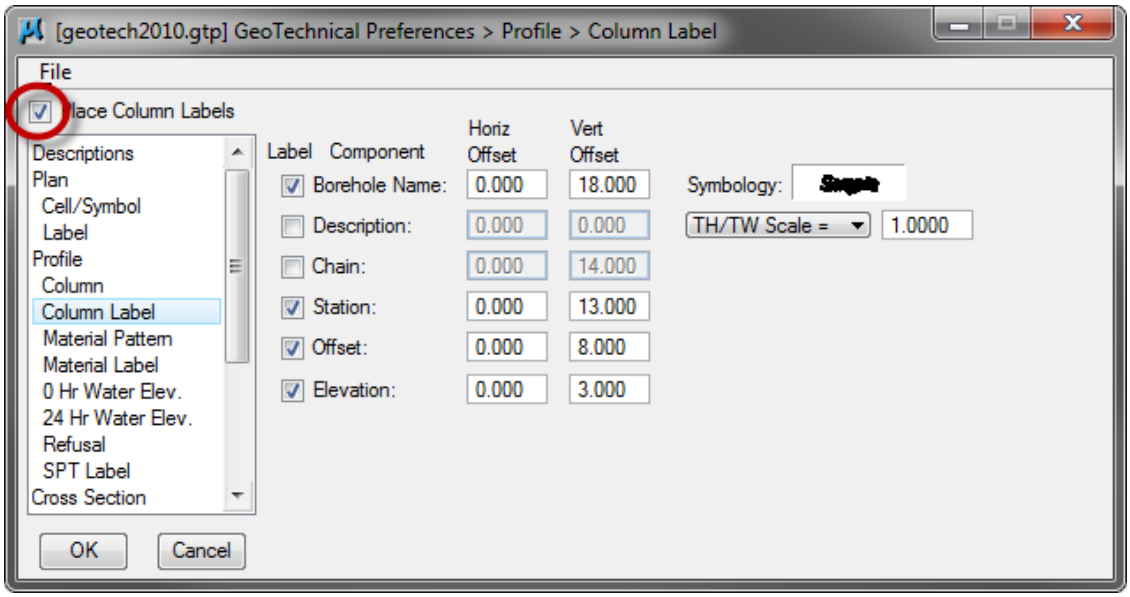
In order for the columns to be drawn, Place Column must be toggled on.



The Column settings include the symbology to be used to plot the columns and the column width.

COLUMN LABEL

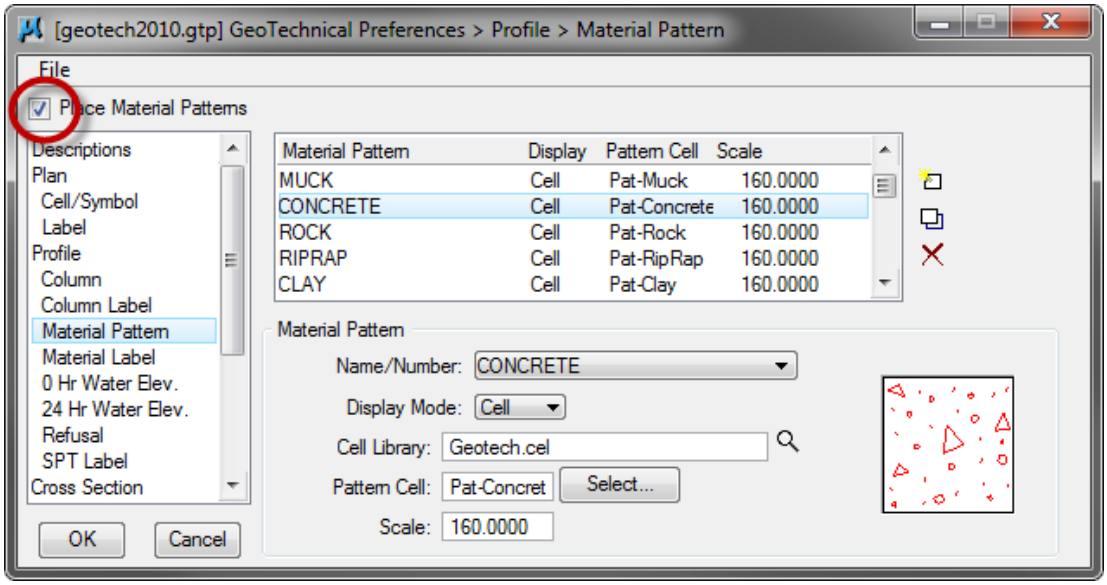
In order for the column labels to be drawn, Place Column Labels must be toggled on.



Six Components can be labeled for each boring. To place a label, activate the toggle to the left of the Component. In the dialog above, four Components will be labeled: Borehole Name, Station, Offset, and Elevation. Define the label symbology which controls the text level, color, weight, size, justification and font for all active components. The label is drawn as a graphic group for ease in manipulation in the plan view file.

MATERIAL PATTERN

The individual material types may be represented with pattern cells when the columns are drawn into profile view. In order to draw the patterns, the **Place Material Patterns** toggle in the upper left corner must be active.



Material Pattern List Box Contains the list of material types with a pattern defined.

Material Pattern Contains the parameters to define the patterning of the material types.

Name/Number Name of the Material type as defined under Descriptions

Display Mode 2 options are available:

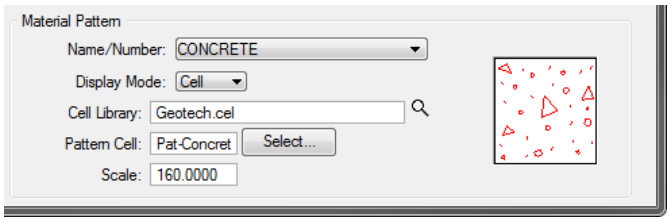
Cell When using the cell option, manually enter the desired Cell Library or select via the **File** icon. Select the desired cell by clicking Select and highlighting the cell. The cell is displayed in the box to the right. If the cell is manually entered and cannot be found in the cell library, a message is displayed in the cell display box indicating the cell is not found. Include the Scale used at creation, as the scale of the profile is utilized for plotting scale at time of drawing. The element symbology at time of cell creation is utilized.

Selection of the cell library should automatically attach this cell library to the active design file so that the Pattern Cells may be displayed in the preview box when selected from the cell library or the List Box.

The **Cell Library** field supports the MicroStation Cell Configuration Variable whereby the user could express the cell Library List such as:

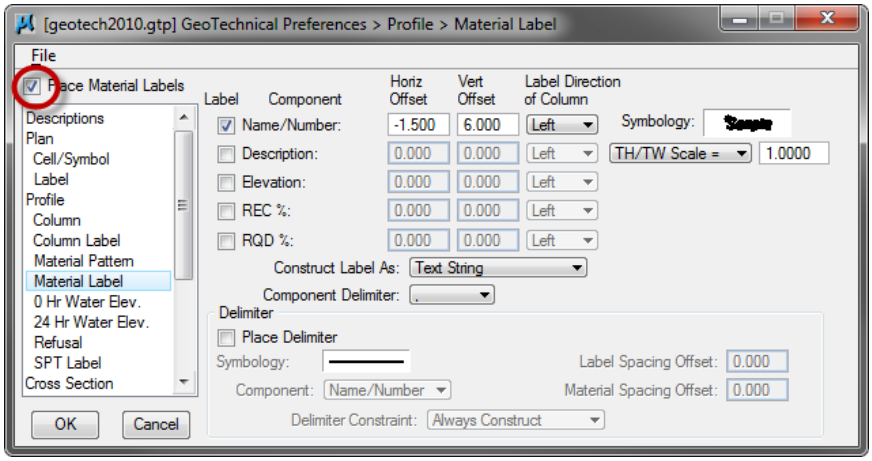
- MS_CELLLIST = $c:\geotechnical\test.cel
- MS_CELLLIST > $c:\geotechnical\spec.cel

Color First, select the desired **Name / Number** from the list. Next, select the **Display Mode**. An **area pattern** (however filled areas are not supported) or simply a solid fill **Color** can represent Materials. There is no user input as the color mirrors from the Descriptions dialog.



MATERIAL LABEL

In order to place material labels, the **Place Material Labels** toggle in the upper left corner must be active. The dialog is divided into two sections: label parameters and the Delimiter group box.



The Label Parameters have five Components that the user can label for each material. To place a label, activate the toggle to the left of the Component. In the sample above, one Component has the label: **Borehole Name**.

Horizontal Offset The distance in master units from the Material Label Origin. The *Material Label Origin* is located at the outer edge of the borehole column.

Vertical Offset The distance in master units from the lower edge of each material.

Label Direction of Column This determines whether the label is placed to the left or right of the column.

Construct Label As Feature supports two options:

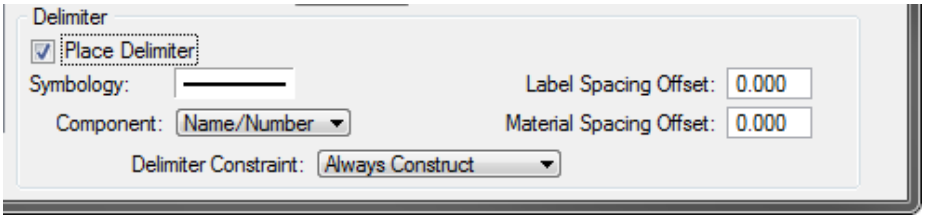
Text String Each component is placed as single text string. The **Justification** applies to the text string and the first selected component's **Horizontal** and **Vertical Offset** is utilized. If this option is selected, the **Component Delimiter** field is un-ghosted and a character to separate the component labels is required. Default options include comma (,), semi-colon (;), slash (/), and space. The Other option allows a custom character to used as the delimiter.

Individual Components Each label component acts as individual text. Offsets and the same justification are applied to each text component on an individual basis.

All Components are placed with the same symbology, specified in the right side of the dialog. Element symbology, in addition to text parameters, are supported.

Delimiters The Delimiter group box contains parameters for spacing and placing an optional delimiter. If either of the delimiter options is utilized, GEOPAK also positions material text, so when the text height is greater than the material thickness, overlapping text does not occur.

To place a delimiter, activate the **Place Delimiter** toggle in the upper left corner of the group box.



Symbology Defines the symbology to use when drawing the delimiter.

Component Defines the Label Component used to anchor the delimiter.

Label Spacing Offset Distance from the end of the delimiter line to the justification of the component label. (in master units).

Material Spacing Offset Distance from the material label origin (edge of the column) to the beginning of the delimiter line (in master units).

Delimiter Constraint Two options are supported:

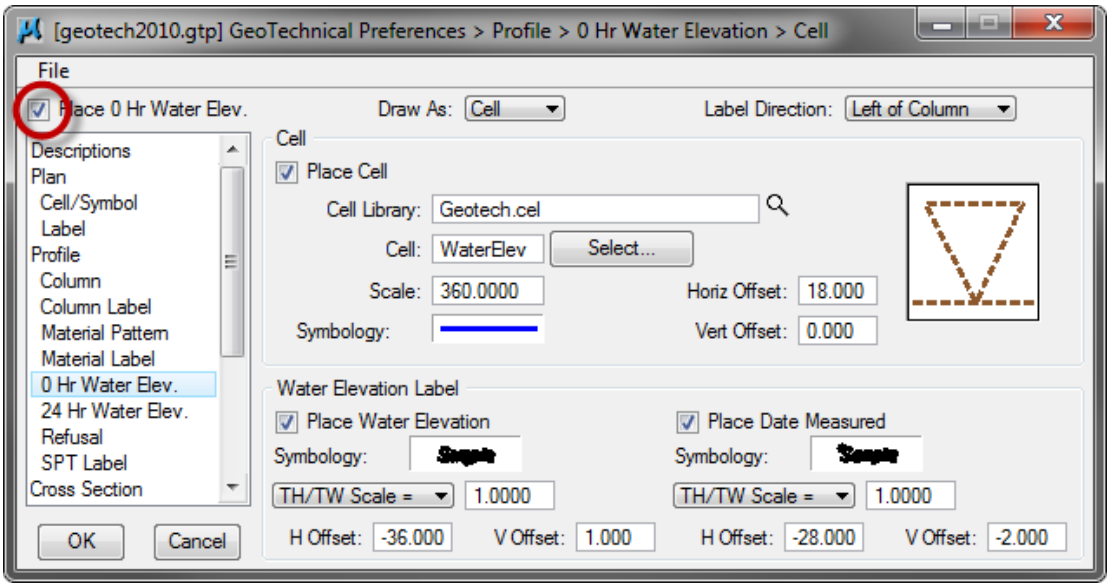
Always Construct - If the **Place Delimiter** toggle is active and this option is selected, the delimiter line is drawn at the defined offsets and symbology in all situations.

Conditionally Construct - If the **Place Delimiter** toggle is active and this option is selected, the delimiter line is drawn at the defined offsets and symbology only when the text height is less than the material height.

The text justification is set in the upper part of the dialog, however the **Component** used to draw the delimiter is specified just below the **Delimiter Symbology**. Only the Components activated in the upper portion of the dialog are available within the Delimiter group box. **Level**, **Color**, **Weight** and **Style** are also defined within the group box, enabling the placement of the delimiter in unique symbology from the text.

0 HR / 24 HR WATER ELEV.

The 0 Hr. / 24 Hr. Water Elevation Label includes text for the Water Elevation and/or a cell or symbol representation.



Draw As – *Cell* To place a cell, activate the Place Cell toggle at the top of the Cell group box. Identify the desired cell library by pressing the File icon.

If the library is stored on a central server and mounted by the users with various drive designations, do not include the path and drive. Simply include the cell library within the users' MS_CELLLIST.

Select the desired cell by pressing the Select icon and highlighting the cell. The cell is displayed in the box to the right. If the cell is manually entered and cannot be found in the cell library, a message is displayed in the cell display box.

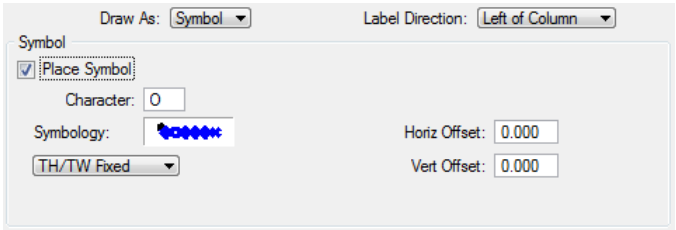
Include the Scale used at creation, as the drawing scale utilizes the cross section scale. Horiz Offset and Vert Offset define where the cell is to be placed.

To determine the default location of the cell, the beginning pointer is at the center of the borehole column at the water elevation plus ½ the column width (the edge of the column). Below the cell are element symbology parameters.

Draw As – *Symbol* First, select the desired (symbol) Font from the list, then manually enter the **Character**. Due to the nature of symbol fonts, only one character is supported.

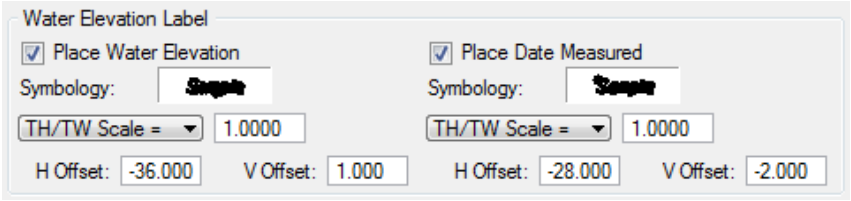
The size of the symbol font is controlled by the Text Height and Text Width. These can be fixed or can vary with the profile scale.

Below the **Character** are element symbology parameters: **Level**, **Color**, and **Weight**. Note there is no style, as symbol fonts are drawn solid.



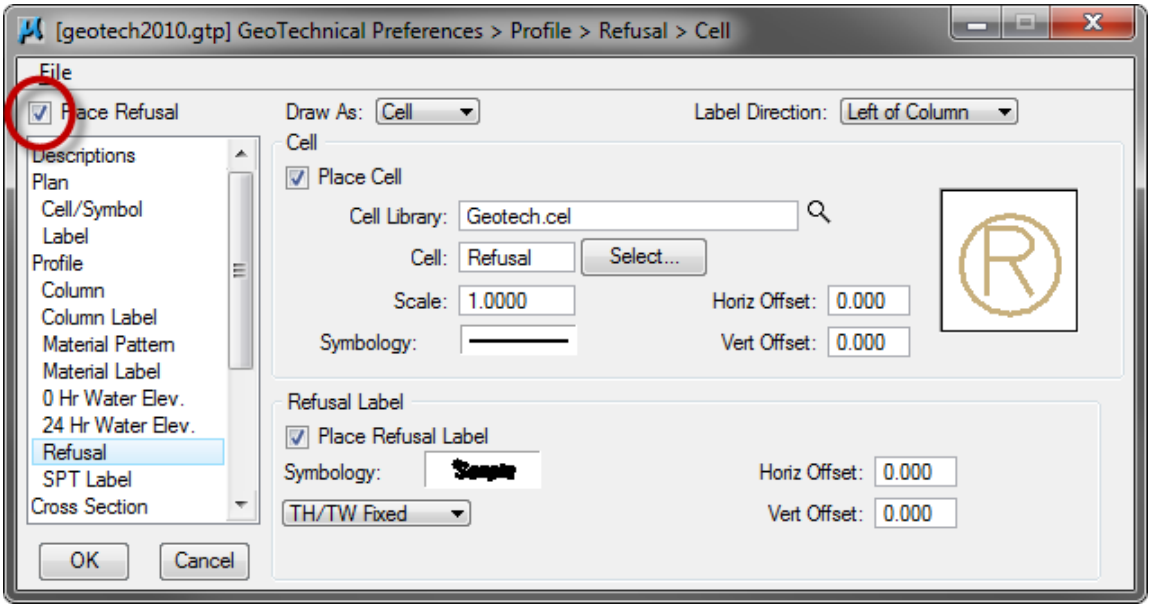
Label Direction Defines whether the cell/symbol is drawn to the left or right of the column.

Water Elevation Label The *Water Elevation Label* section defines whether to label the *Water Elevation* and *Date Measured* and how to place the selected label, i.e. symbology, scale, and offsets.



REFUSAL

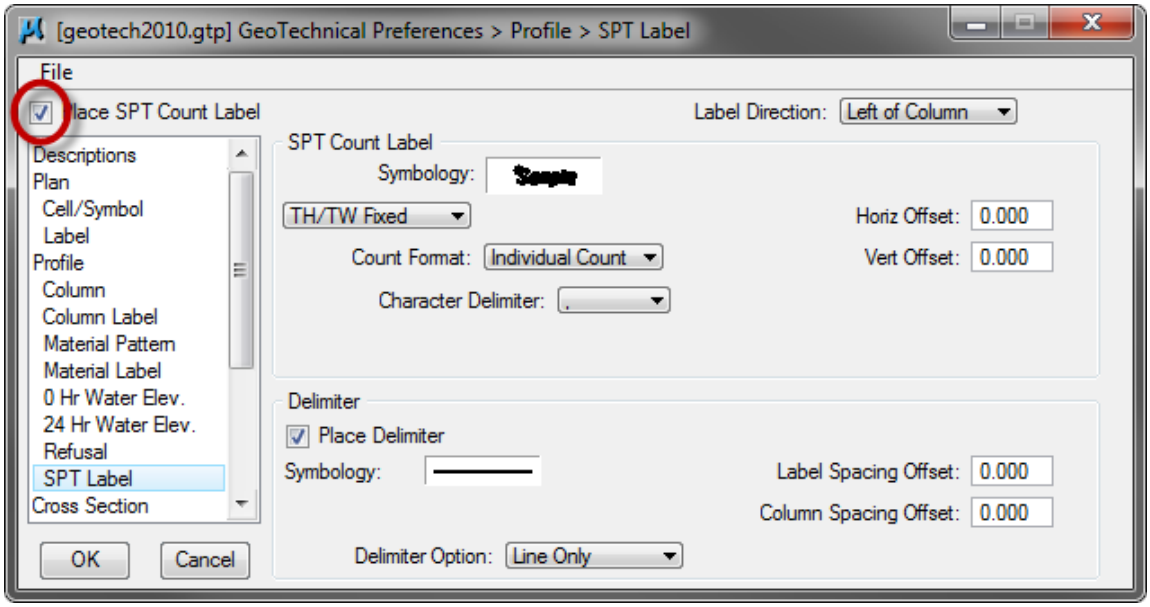
Refusal includes text for the Refusal and/or a cell or symbol representation.



The user can draw the Refusal as a Cell or Symbol. Label Direction controls the placement side of the column the cell and labeling. Both the Cell/Symbol and the Label symbology along with offsets can be defined in the dialog. The label text can be set to a fixed height and width or scaled.

SPT LABEL

The SPT (Standard Penetration Test) Count Label includes text and delimiter options.



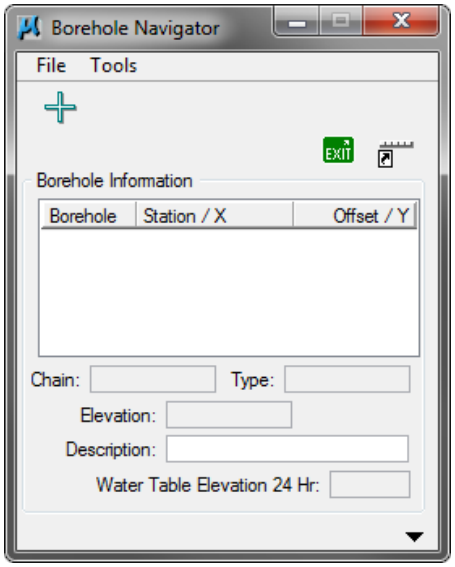
The SPT Count Label may be placed either right or left of the column by selecting the *Label Direction* option in the upper right corner of the dialog. The *Horizontal Offset* measures from the edge of the column. The *Vertical Offset* measures from the SPT Data elevation.

There are two supported options for **Count Format**:

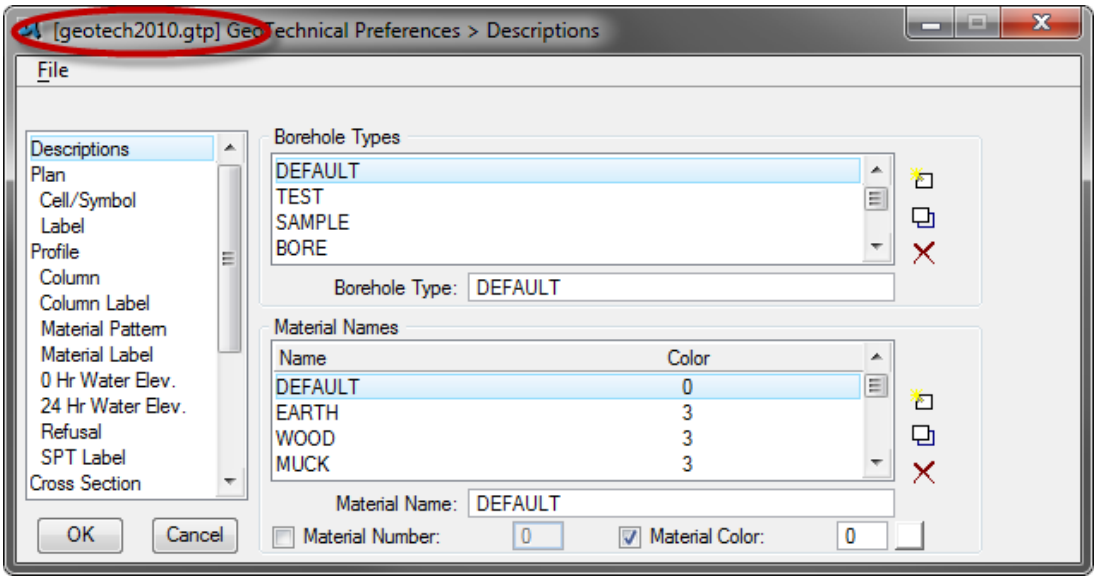
Total Count	An example of a Total Count is 10.
Individual Count	Examples of an Individual Count format is 10-3-6 or 10/3/6.

Exercise 7.1 Reviewing the GeoTechnical Preferences

1. Open the MicroStation file C:\e\Projects\22807915201\roadway*RDXSRD01.dgn*.
2. Select the *Model* that contains the cross sections, **RDXSRD**.
3. Select the **GeoTech Tools** from the *Road* toolbar. The Borehole Navigator dialog opens.



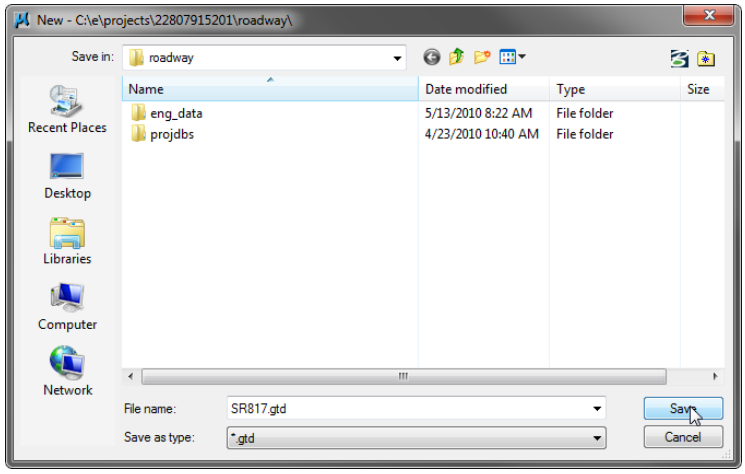
4. From Borehole Navigator, select **File** > **Preferences**.



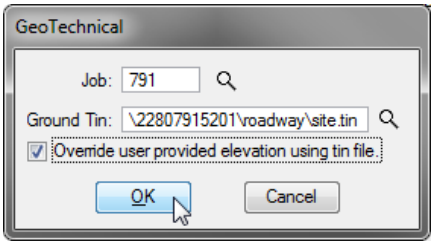
5. If necessary, on the Preference dialog, select **File** > **Open** and set the preference file to *FDOT2008\GEOPAK\bin\geotech2008.gtp*.
6. Review the preference settings for Plan and Cross Sections.
7. Close the Preferences dialog box.

Exercise 7.2 Creating and Populating the GeoTechnical Database

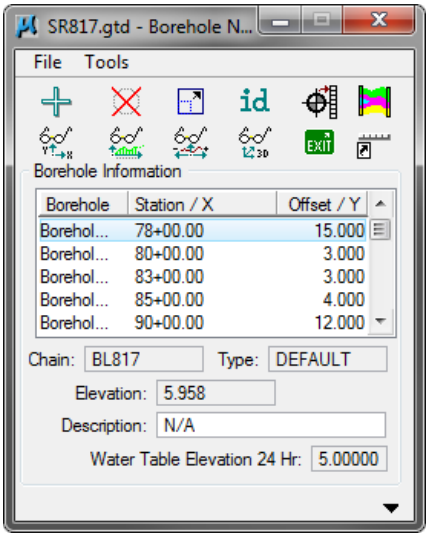
1. From Borehole Navigator, select **File** > **New** to create a borehole database.
2. Create a file called **SR817.gtd**.



3. After accepting the file name, a prompt will display for the **Job number** and **Ground Tin** associated with this project. After selecting the files, click **OK** to proceed.

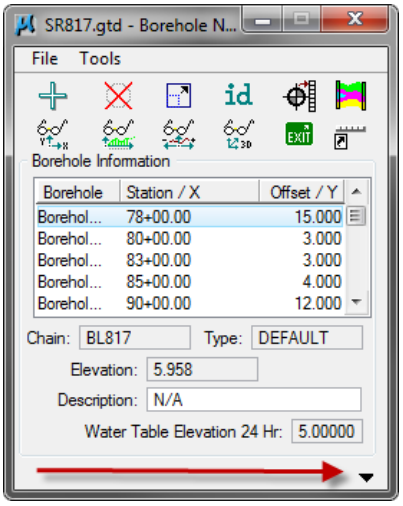


4. Select **File** > **Import** > **CSV** > **Borehole…** to import the borehole location data.
5. Select the file **Boerholetpk.brh**. This file contains the borehole names and location information as well as the water elevation information.

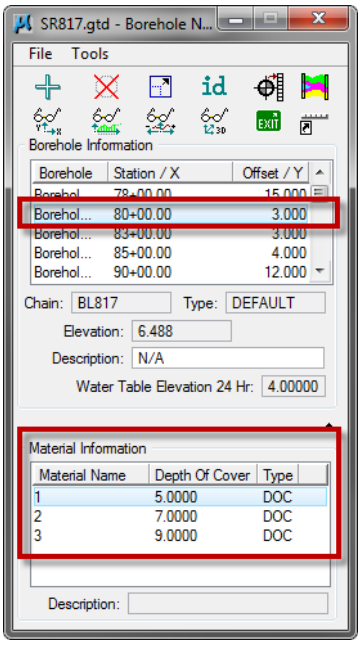


Note No material information has been imported yet. The next step will accomplish this.

6. Select **File > Import > CSV > Material…** to import the borehole location data.
7. Select the file *material.mtl*. This file contains the borehole names and strata material information.
8. Click the **arrow** at the bottom right corner of the Borehole Navigator dialog to view the *Material Information* for each borehole.



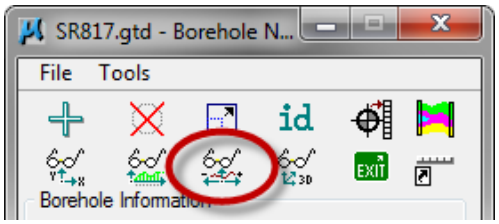
9. Click the **arrow** at the bottom right corner of the Borehole Navigator dialog to view the *Material Information* for each borehole. As each borehole is selected, the material information in the Material Information window will change.



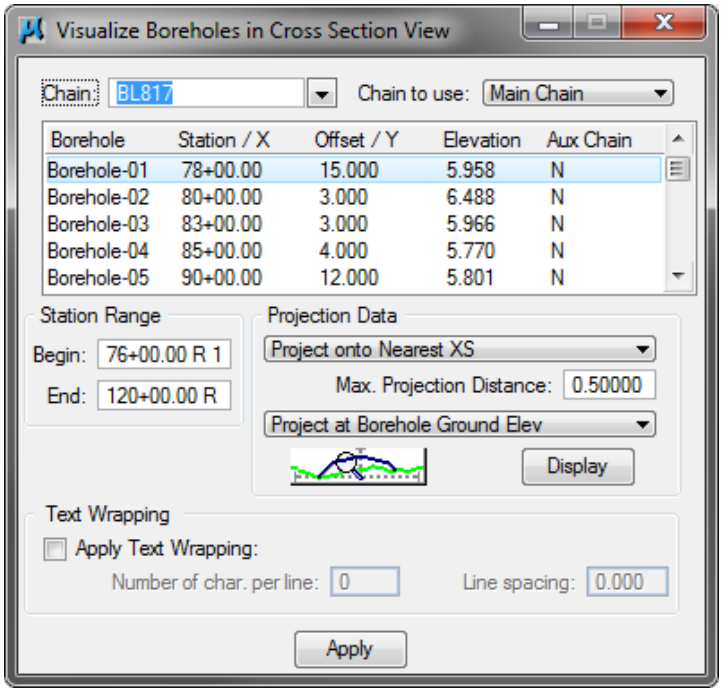
10. Navigate through each station. Below the Borehole Information window are various pieces of data pertaining to each boring. The alignment (CHAIN) where the boring was referenced, the Type of boring, the Ground Elevation, a Description and the Water Table Elevation.
11. Click **File > Save** to update the **SR817.gtd** file.

Exercise 7.3 Plotting Boreholes in Cross Section

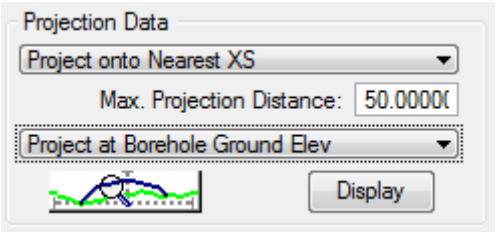
1. Select the **Visualize Boreholes** in *Cross Section View* tool.



2. Set the *Chain* name in the upper portion of the dialog to populate the display window with our borehole data.

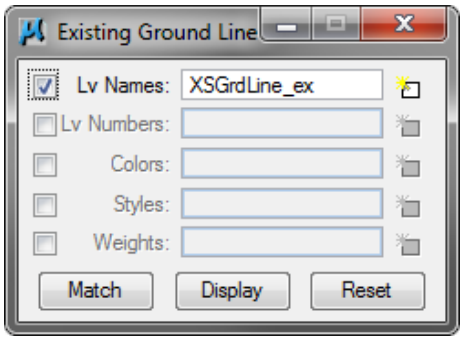


3. Set the **Projection Data** to the following settings :
   - Project onto Nearest XS
   - Max. Projection Distance = 50
   - Project at Borehole Ground Elev

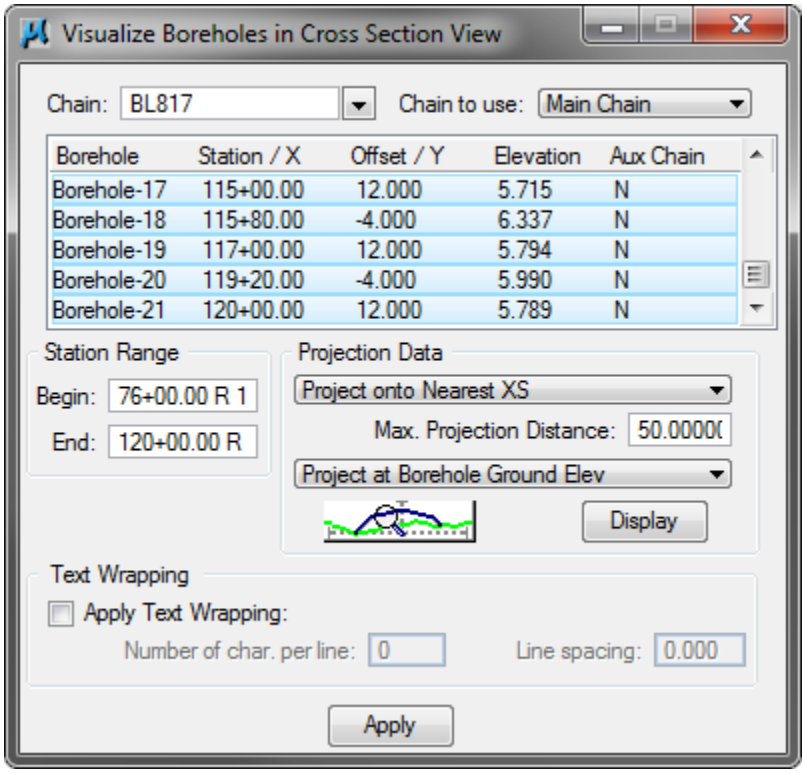


4. In the final setup step, defining the symbology for the existing ground in the drawing, **Zoom** into a cross section to identify the ground line easily.
5. Click **Define Existing Ground** icon.

6. In Existing Ground Line, click **Reset**. This will clear out any erroneous values.



7. Toggle on the symbology toggles shown above. Click **Match** and **Data Point** on the line in the drawing representing the existing ground.
8. Close Existing Ground Line when finished.
9. In Visualize Boreholes in Cross Section View, select all of the boreholes in the list by single clicking on a borehole, then select ***CTRL*-A** on the keyboard to select all boreholes.



10. Click **Apply**.
11. In the case of boreholes separated by very small distances, some manual adjustments may be necessary in order to view them properly.

8 EARTHWORK

OBJECTIVES

- Overview Earthwork Process
- Run Quantities for Earthwork
- Create Earthwork Output File

GENERAL EARTHWORK CONSIDERATIONS

Chapter 3 of the FDOT Plans Preparation Manual (PPM) contains a detailed discussion of earthwork calculation methodology. Below are two key items to note from this chapter.

- Pay for all Cut Operations as Regular Excavation (CY) or Regular Excavation (Lump Sum). Do not differentiate between suitable and unsuitable.
- Pay for all Material Excavated below the finished grading template as Subsoil Excavation. Do not differentiate between suitable and unsuitable.

In general, earthwork on a highway project consists of:

Embankment Compacted fill material needed to construct the roadway, excluding the base and pavement portions of the roadway and shoulders.

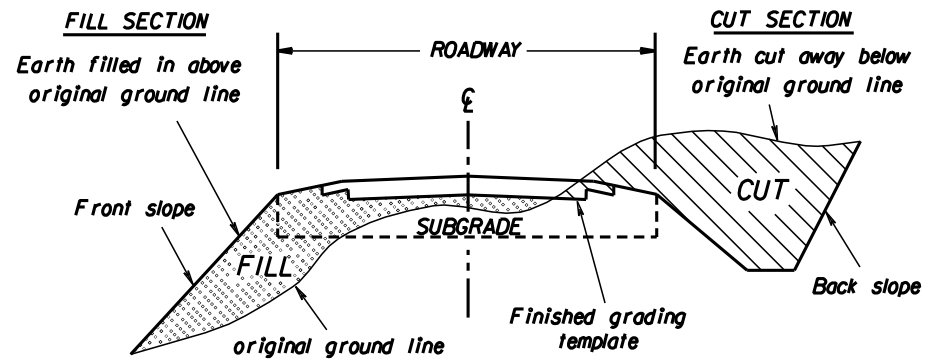
Regular Excavation Excavation necessary for the construction of the roadway, ditches, ponds, channel changes, etc.

Subsoil Excavation Excavation, removal and disposal of any material that is unsuitable in its original position and that is excavated below the finished grading template.

The most important roadway operation involving earthwork is constructing the roadbed. The roadbed is constructed by excavating soil from cut sections and placing soil as embankments in fill sections. In cut sections, the roadbed is built below the original ground - the original ground is excavated to the elevation of the proposed roadbed. In fill sections, the roadbed is built above the original ground - the earth fill is on an embankment.

The finished grading template is defined as the finished shoulder and slope lines and bottom of the completed base or rigid pavement for most pavements. The Department occasionally uses stabilized bases and sand bituminous road mixes. For these, consider the finished grading template as the top of the finished base, shoulders and slopes.[1]

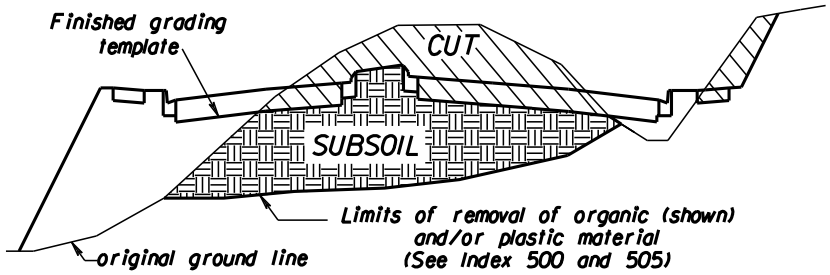
1 From Section 3.1.1 of the FDOT Plans Preparation Manual



CUT: AREA BELOW THE ORIGINAL GROUND LINE AND ABOVE THE FINISHED GRADING TEMPLATE

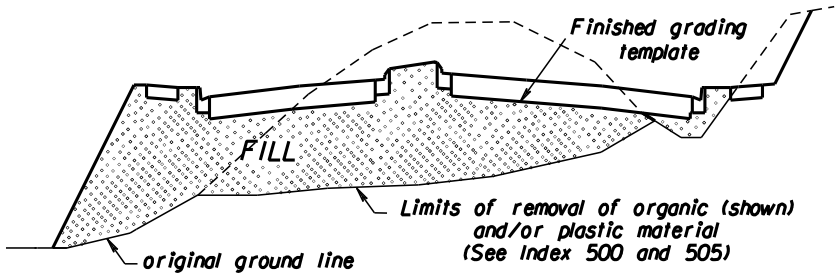
FILL: AREA BELOW THE FINISHED GRADING TEMPLATE AND ABOVE THE ORIGINAL GROUND LINE

CUT & FILL LIMITS WITHOUT SUBSOIL EXCAVATION



CUT: AREA BELOW THE ORIGINAL GROUND LINE AND ABOVE THE FINISHED GRADING TEMPLATE

SUBSOIL EXCAVATION: ALL MATERIAL BELOW THE FINISHED GRADING TEMPLATE THAT MUST BE REMOVED



FILL: AREA BELOW THE FINISHED GRADING TEMPLATE AND ABOVE THE LOWER LIMITS OF REMOVAL OF ORGANIC AND/OR PLASTIC MATERIAL

CUT & FILL DETAILS WITH SUBSOIL EXCAVATION

WORKFLOW

GEOPAK computes earthwork average End Area Method by reading and interpreting the MicroStation design files containing proposed and existing ground cross sections. This approach affords you maximum flexibility in that it is irrelevant whether the cross section elements were created entirely by GEOPAK or were created or modified using generic MicroStation commands. GEOPAK can compute earthwork volumes from any reasonable graphical representation of a cross section.

In order to compute earthwork, GEOPAK requires:

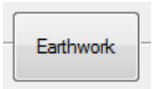
- MicroStation cross section design file
- GEOPAK coordinate geometry database file (*.gpk*) if the baseline used to generate the cross sections has station equations

These graphical cross sections can be very simple to compute only cut/fill quantities or very complex cross sections including several types of unsuitable or removable materials and several fill material types. There is no limit to the number of existing or proposed soil types.

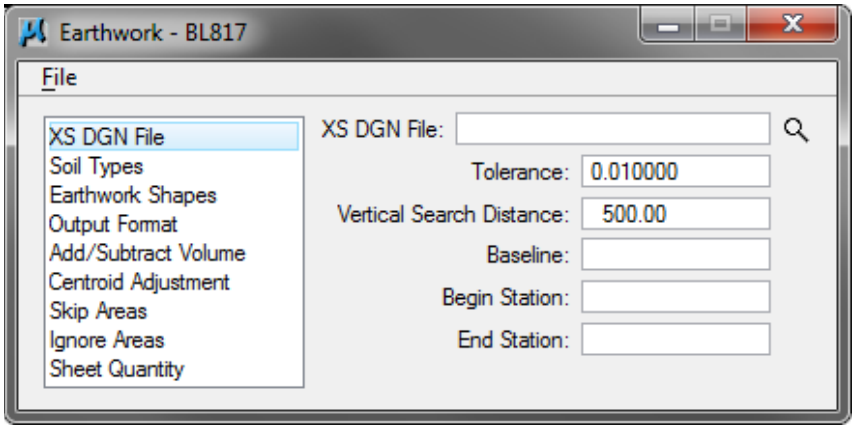
GEOPAK is extremely flexible when computing earthwork, utilizing several types of excavation and fill, many functional classifications, numerous material types, (known as soil types), and different shrink/expansion factors.

ACCESSING EARTHWORK

- From **Road Project** click the **Earthwork** icon .



XS DGN FILE



XS DGN File

MicroStation 2D file containing cross sections (and XS Cell) to be utilized for earthwork computations. This field is filled in automatically from the Working Alignment Definition.

Tolerance

Specify the Tolerance, if different from the default. GEOPAK utilizes the tolerance as the radius of a circle at the endpoint of each element. If the candidate intersection element passes within the circle, the software will consider the lines intersecting. GEOPAK supports vertical ties at the outside limits of construction as well as any interior locations.

Vertical Search Distance

The earthwork component of GEOPAK calculates earthwork quantities from the MicroStation elements present for each cross section, independent of whether drawn by GEOPAK or drawn with generic MicroStation commands. For each cross section, GEOPAK searches for candidate cross section elements within a certain vertical range from the cross section cell. In order to ensure that each element associated with a given cross section is found, GEOPAK searches for and analyzes elements vertically within 250 master units above and below the horizontal portion of the cross section cell. Therefore, should any cross section include terrain relief in excess of 250 feet, the Vertical Search Distance must be utilized. As a rule, the vertical search distance is usually 3/4 of the user-defined Distance Between Cross section Cells.

Baseline

Baseline utilized to create the cross section cells. This is filled in automatically from the Working Alignment Definition.

Beg Station

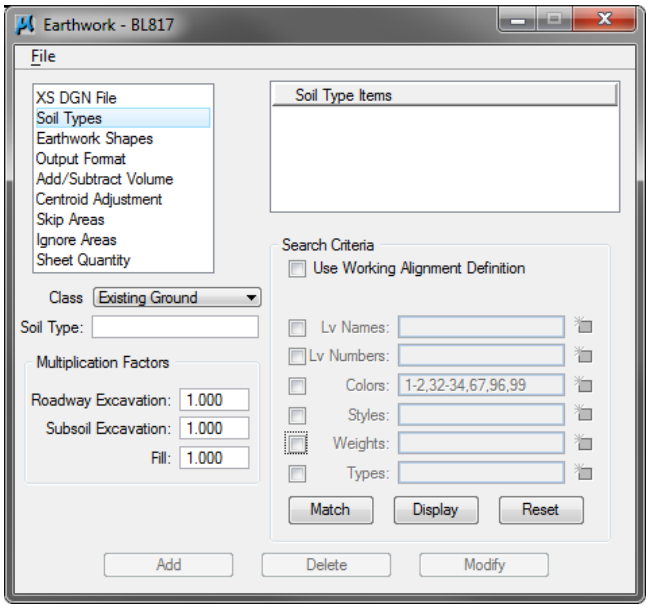
Unless filled in by the Working Alignment Definition this defaults to the lowest numbered station in the file. However, this can be changed if only a selected station range for computation is desired. Note regions must be included if station equations are present in the Baseline.

End Station

Unless filled in by the Working Alignment Definition this defaults to the highest numbered station in the file. However, this can be changed if only a selected station range for computation is desired. Note that regions must be included if station equations are present in the Baseline.

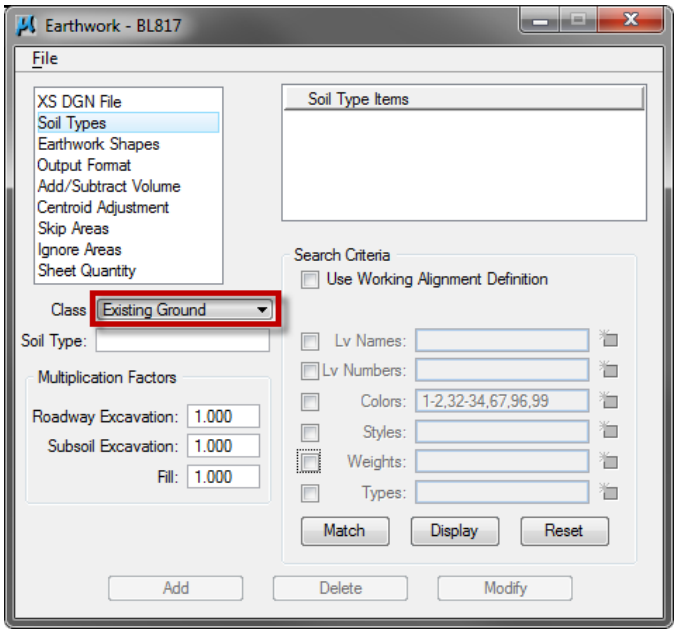
SOIL TYPES

Since the earthwork calculations are based on the graphical elements of the cross sections, the user must specify what search criteria to use for specific classes of earthwork (e.g. what element symbology makes up existing ground, what element symbology comprises the proposed finish grade, etc.). This is done in the section under Soil Types.



Class

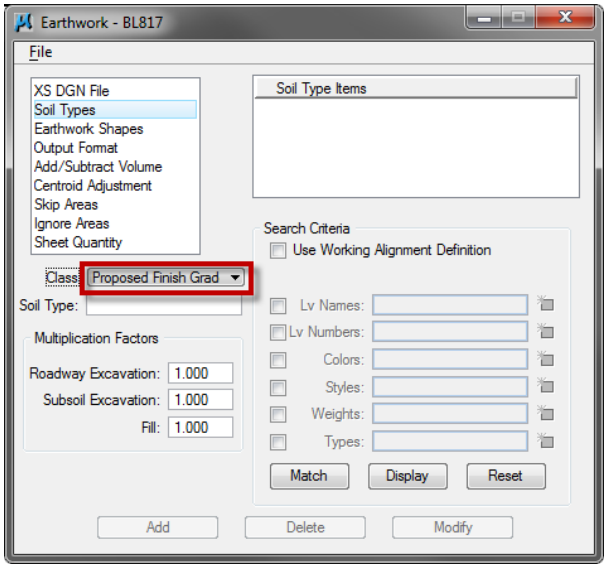
Several classes of materials are supported. All classes (with the exception of Excavation Limits) require a soil type and search criteria. However, as each class is selected, the dialog will change to allow different options. Below are details of each class:



Existing Ground

Existing ground must be specified. Its associated material type determines the soil type underneath the lowest substrata line. The existing ground must be contiguous (i.e. no gaps) between the proposed tie down points using these levels. Note these would be the existing ground levels used for producing slope stakes or construction limits and therefore, do not include any subsurface elements.

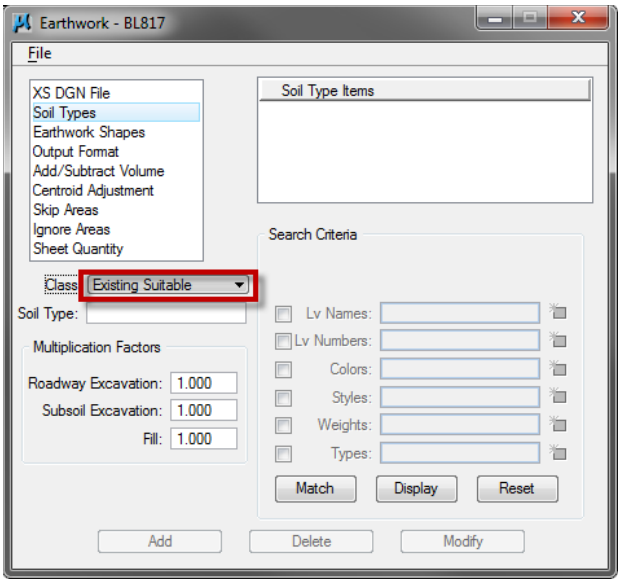
Use Working Alignment Definition - This check box is available with the Existing Ground class. When this option is enabled the Search Criteria defined for Existing Ground in the Working Alignment will be used.



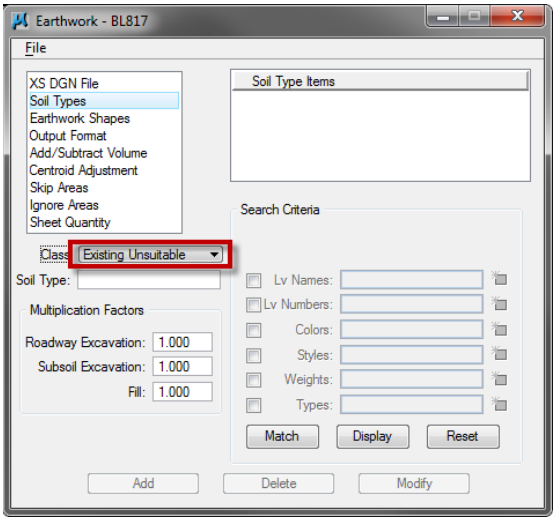
Proposed Finish Grade

The proposed finish grade includes the top of proposed pavement, curb and gutter, top of proposed topsoil, top of proposed ditches, etc. The software must be able to draw contiguously from the centerline to the touchdown point using these levels.

Use Working Alignment Definition - Note that this check box is available with the Proposed Finish Grade class. When this option is enabled the Search Criteria defined for the Proposed Finish Grade in the Working Alignment will be used.

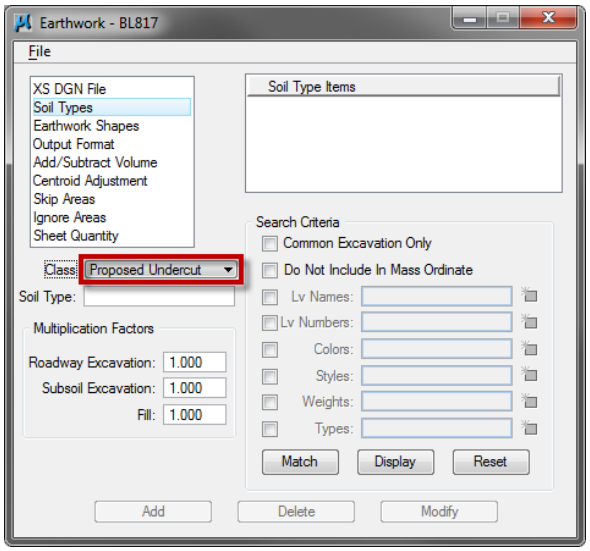


Existing Suitable "Existing suitable" removes only what is needed to build the proposed design. It does not affect whether material is re-used.



Existing Unsuitable If the **Excavation Limits are present**, then GEOPAK responds to the "existing unsuitable" classification by removing the existing pavement material between the Excavation Limits, irrespective of whether the section is in cut or fill.

If the **Excavation Limits are not present**, then the unsuitable material is only removed when it would fall within the confines of a common excavation.

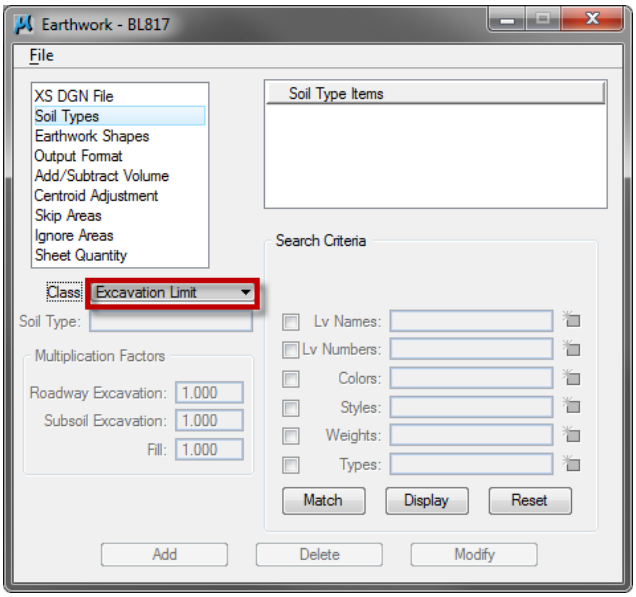


Proposed Undercut

Proposed undercuts are used to define any proposed component which is not part of the finished grade. This includes undercuts, proposed topsoil placement, or aggregate quantities. Although the proposed undercut is used to define undercuts or subcuts, it is important to remember that the soil type is not the material being removed, but what the area will be backfilled with. The material being removed is computed in the default excavation unless it is an existing suitable or unsuitable material.

Common Excavation Only - In some proposed undercuts, it is desirable to include them as common excavation rather than subgrade excavation. To override the default computation methods, select this check box.

Do Not Include In Mass Ordinate - The mass ordinate is a running summary of your cut and fill balance. In some cases, it is desirable to omit some materials from the mass ordinate. The easiest method to accomplish this for Proposed Undercuts is to select this check box.



Excavation Limit

Excavation limits are short lines drawn onto cross sections to tell the software where to stop removing existing unsuitable material. Excavation limits are required

whenever existing unsuitable classifications are utilized and the removal area is not a closed area completely within a cut area. They have no direct correlation to proposed features, except that the removals normally end at the outside edge of proposed construction.

There are certain rules the user must follow when placing Excavation Limits.

They must be placed in pairs.

They must be lines. No other element types are supported.

They must extend to (or better yet) intersect the material to be removed and existing ground forming a closed area. The endpoint should not be within an area where earthwork quantities are needed. Extend those points well beyond any cross section elements.

Multiple excavation limits are also supported. This is extremely useful in projects with multiple roadways where existing materials are not removed between the roadways.

Soil Type

At its most basic, this field is just a name that that user gives to the material. This name can be anything, as long as it doesn't contain any spaces. For example, for the class Existing Ground the user could name the soil type "Dirt" or "Earth".

The soil type specified with the existing ground is important as it is the default excavation material. Similarly, the soil type specified with the proposed finish grade is important as it is the default fill material.

In addition to specifying the default cut and fill materials, the soil types also play an important role in identifying what materials can be re-used and where they can be re-used. If the soil types for any two functional classifications are identical, GEOPAK will re-use the excavation material in places where embankment is required.

Search Criteria

For each class and soil type specified, the user must specify the graphic symbology of the cross sections elements that will comprise that class and type. Any combination of graphical symbology (e.g. color, weight, level, etc.) can be used to distinguish these elements. These symbologies can be keyed in or selected from a list using the icons.

Match Used to determine the Search Criteria by selecting elements from the design file.

Display Highlights all elements matching the Search Criteria. Match is used to visually verify that the intended elements are defined in the Search Criteria.

Reset Clears all definitions in Search Criteria.

Multiplication Factors

Roadway Excavation Swell/Shrinkage factor for any Roadway Excavation quantities.

Subsoil Excavation Swell/Shrinkage factor for any excavation done below the bed of the roadway (e.g. unsuitable material extraction).

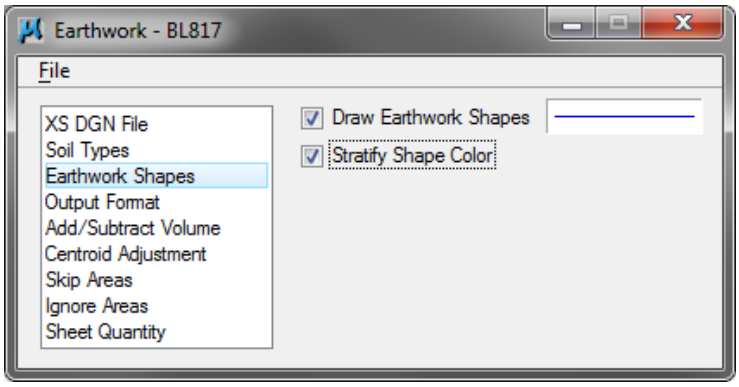
Fill Swell/Shrinkage factor for fill quantities.

Add Adds the soil type to the list box.

Delete Deletes the selected soil type from the list box.

Modify Used to make changes to the selected soil type in the list box.

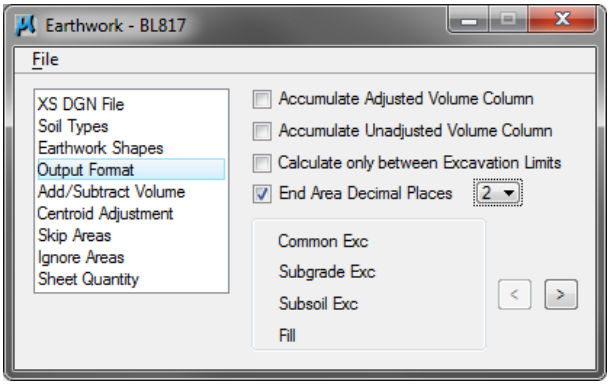
EARTHWORK SHAPES



Draw Earthwork Shapes When this check box is selected, the earthwork shapes are drawn with color fill attributes. When the Fill check box is selected on the View Attributes dialog, color filled complex shapes are displayed.

Stratify Shape Color Variations in color between various cut and fill options are achieved with this check box selected. Utilizing the order within the Soils Type dialog, GEOPAK assigns (in ascending numerical order) each material type two colors, one for cut and one for fill. Color assignments initialize at zero.

OUTPUT FORMAT



Accumulate Adjusted Volume Column When selected, an additional column is added to the earthwork report, where the adjusted volume of each excavation and fill for each material is cumulatively totaled.

Accumulate Unadjusted Volume Column When selected, an additional column is added to the earthwork report, where the unadjusted volume of each excavation and fill for each material is cumulatively totaled.

Calculate Only Between Excavation Limits In this case, excavation limits are used to demarcate earthwork processing. This is extremely useful in projects where earthwork is staged or separate quantities for each roadway in a multiple alignment

are necessary. When the check box is selected, ALL earthwork calculations are limited to within user-defined excavation limits.

End Area Decimal Places

In normal processing, the end areas are rounded to two decimal places. However, the user has the option to set the decimal places to between 0 and 4.

Formats

Three classifications of excavation volumes are listed on standard GEOPAK earthwork outputs: Common, Subgrade, and Subsoil.

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.

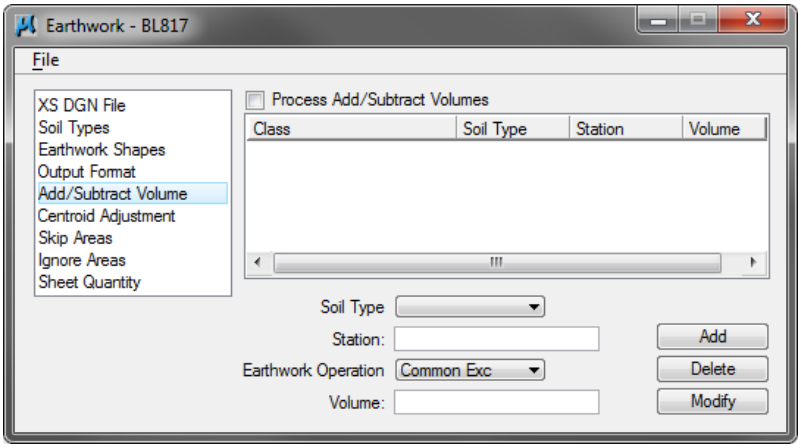
Formats (conti)

In certain design instances, the designer does not require these distinctions. Hence, the Output Format dialog can be utilized to combine various quantities as follows:

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 VOL

Volume adjustments can be specified at project locations where material surpluses or deficits are encountered outside that which can be described via the cross sections.



Process Add/Subtract Volumes

If this check box is enabled, the information in this portion of the dialog will be processed when the earthwork is run.

Soil Type

This pulldown option will populate automatically with the names of the materials

defined earlier in the dialog under **Soil Types.**

Station

The station indicates the location at which volumes are added to or subtracted from the mass ordinates and does not necessarily have to be at a cross section station. However, it must be within the specified station range.

Earthwork Operation

Here the standard 4 options: Common Exc., Subgrade Exc., Subsoil Exc. and Fill.

Volume

This is the volume that is to be added or subtracted. Subtract volumes are included with a minus (-) sign in front of the quantity. The volume adjustment header and subsequent syntax must be repeated for each add/subtract location, soil type or volume quantity. For example, if there is a volume adjustment to the common excavation and fill volumes at a particular station, two volume adjustments are needed

Add

Add the Station and Volume to the list box.

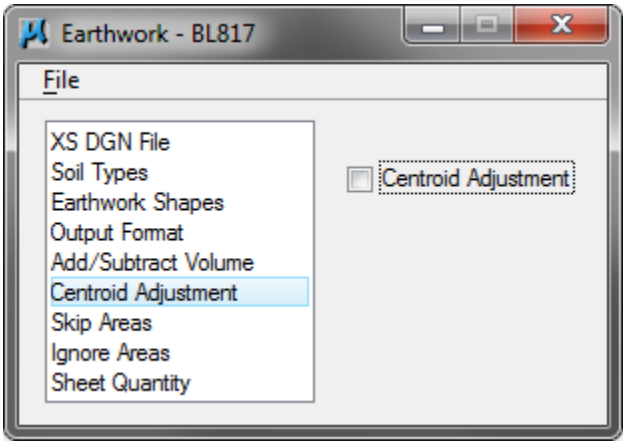
Delete

Delete the selected Station and Volume from the list box.

Modify

Modify the selected Station and Volume in the list box.

CENTROID ADJUSTMENT



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. The generally accepted formula used for this calculation is:

$$V = L\left(\frac{A_1 + A_2}{2}\right)$$

If the bulk of the cross section areas are located predominantly to either the left or the right of the baseline, 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 by enabling the Centroid Adjustment check box. The option invokes a procedure that adjusts volumes based upon the lateral offset between the centroid of cross section end areas and the baseline.

Centroid adjustment is used in FDOT for cross sections on a curve to take into consideration the distance between the two cross sections on a curve. As noted in section 3.4.3.1 of the FDOT PPM, one technique that is encouraged to aid in computing accurate earthwork quantities is to “Reduce the interval between cross sections to 25 feet or less on ramps or sharp turning roadways, or determine and use the centroid of the section as the length for computing volumes.”

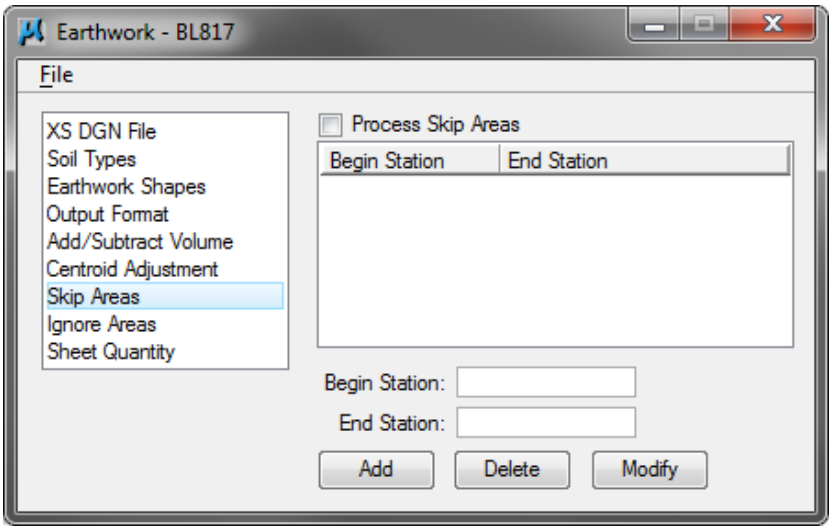
If this option is enabled, the resulting log file will contain a section entitled CENTROID SUMMARY. An example is shown below. The Adjusted length in the table below is used in lieu of the difference in the station values for ‘L’ in the equation mentioned previously.

```
                    C E N T R O I D        S U M M A R Y
  Station        Centroid        Centroid        Unadjusted     Adjusted
                 Elevation        Offset           Length        Length
                  ( ft )          ( ft )           ( ft )        ( ft )
------------   ------------    ------------     ------------  ------------
325+00.00          810.37          -19.23
                                                     100.00        100.00
326+00.00          811.40          -18.79
                                                     100.00        100.00
327+00.00          804.94           31.24
                                                     100.00        100.00
328+00.00          805.32           38.18
                                                     100.00        100.00
329+00.00          807.07           39.32
                                                     100.00        100.00
330+00.00          808.00           36.45
                                                     100.00        100.00
331+00.00          812.96           19.00
                                                     100.00        100.00
332+00.00          814.71           15.55
                                                     100.00        100.00
333+00.00          816.17            2.93
                                                     100.00         99.88
334+00.00          816.76           -0.06
                                                     100.00        101.19
335+00.00          818.28          -27.20
                                                     100.00        101.79
336+00.00          818.57          -13.83
                                                     100.00        102.34
337+00.00          815.96          -39.76
                                                     100.00        102.70
338+00.00          811.60          -22.18
                                                     100.00        100.50
339+00.00          810.03           -9.83
                                                     100.00        100.00
340+00.00          808.47          -17.22
```

SKIP AREAS

Skip Areas enable the user to specify an area in which to not calculate earthwork volumes. Skip Areas will stop the earthwork calculations at the last cross section before the Skip Area station range, then proceed to the first section past the Skip Area station range and begin the calculation anew. This results in separate quantities before and after the Skip Area.

This option is used typically by FDOT for driveways.

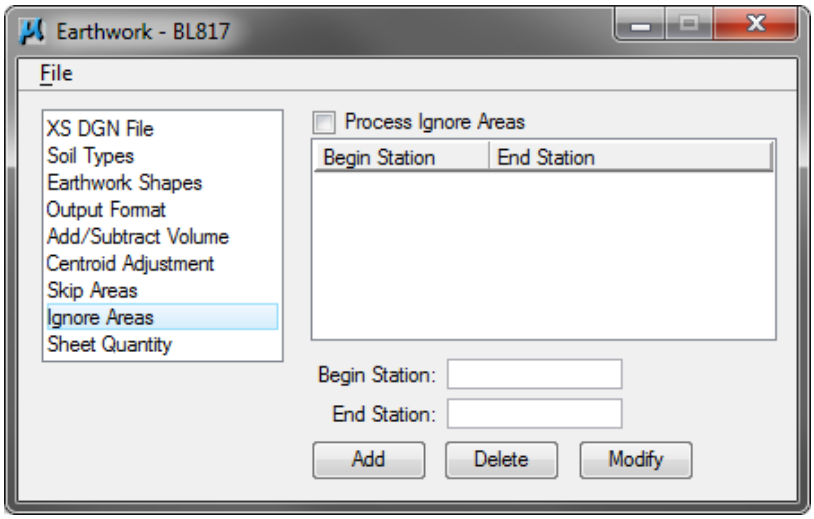


Process Skip Areas	If this check box is enabled, the information in this portion of the dialog will be processed when the earthwork is run.
Begin Station	Beginning station to be skipped.
End Station	Ending station to be skipped.
Add	Add the Begin and End Station to the list box.
Delete	Delete the selected Begin and End Station from the list box.
Modify	Modify the selected Begin and End Station in the list box.

IGNORE AREAS

Ignore Areas enable the user to specify an area in which to not calculate earthwork volumes, but treats the areas differently than Skip Area. **Ignore Areas** treats the sections within the Ignore Area station range as though they do not exist. Earthwork calculations continue through the Ignore Area using the section before the Ignore Area and the section after the Ignore Area and the length in between to get the End Area calculation and resulting volume. This results in only one quantity being calculated.

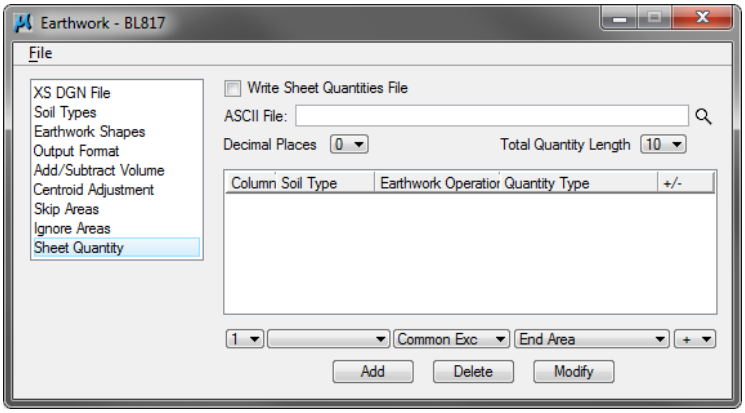
This option is used typically by FDOT for bridges at the toe slope stations.



Process Ignore Areas	If this check box is enabled, the information in this portion of the dialog will be processed when the earthwork is run.
Begin Station	Beginning station to be ignored.
End Station	Ending station to be ignored.
Add	Add the Begin and End Station to the list box.
Delete	Delete the selected Begin and End Station from the list box.
Modify	Modify the selected Begin and End Station in the list box.

SHEET QUANTITY

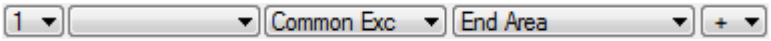
Earthwork quantities can be written directly onto cross sections sheets. A two step process is required. First, an ASCII text file is produced when calculating earthwork volumes. This ASCII text file contains the area and/or volume quantities that are to be written onto the cross section sheets. Second, the GEOPAK sheet layout utility reads this ASCII file and places the appropriate text onto the cross section sheets.



Write Sheet Quantities File — If this check box is enabled, the information in this portion of the dialog will be processed when the earthwork is run and the sheet quantities file will be created. If the check box is cleared then any information in this area will be ignored.

ASCII File — The name of the sheet quantities ASCII file that will be created. This name can either be keyed in or selected using the Select icon.

Decimal Places — For each column, the number of decimal places must be specified. The options are 0-6.



Column — Allows selection of which column (1-9) the earthwork information will be placed in. For each column, additional information detailed below must be entered. There may be multiple entries in the list box for a column.

Soil Type: — The selected material type for which quantities are to be calculated. Only those Soil Types defined in the Soils Types sections will be available for selection.

Earthwork Operation: — The second component must be either one of the following: Common Excavation, Subgrade excavation, Subsoil Excavation or Fill.

Quantity Type: — This represents the actual quantity. Options include End Area, Adjusted Volumes, Unadjusted Volumes and Mass Ordinate.

+/- — If several quantities are to be added, the Plus operand is default. The Plus is also utilized for a single quantity entry. However, it must be changed to Minus if the quantity is to be subtracted.

Add — Add the column information to the list box.

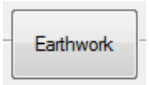
Delete — Delete the selected column information from the list box.

Modify — Modify the selected column information in the list box.

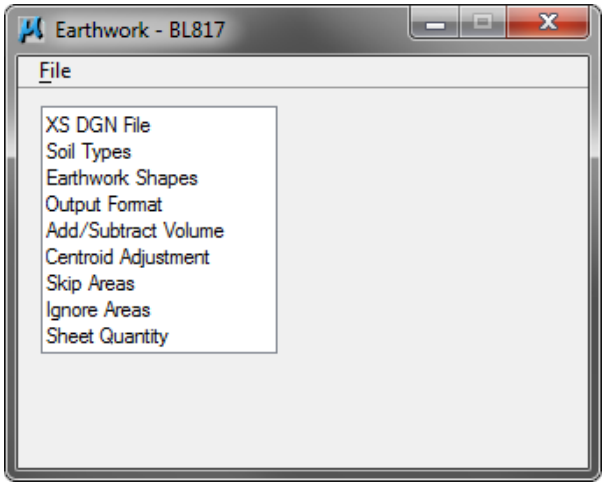
Exercise 8.1 Earthwork Quantities

In this exercise you will process our basic cut and fill earthwork for our proposed cross sections.

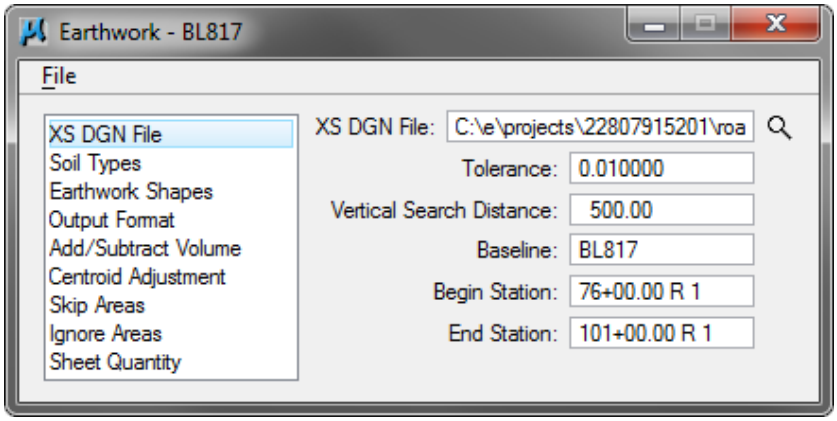
1. Double-click on the self-extracting zip file C:*Chapter8_Exercises.exe* and click the **Unzip** icon at the prompt.
2. Open the design file C:/e/Projects/228079115201/roadway/*RDXSRD01.dgn*.
3. Access Project Manager.
4. From Road Project, click the **Earthwork** icon.



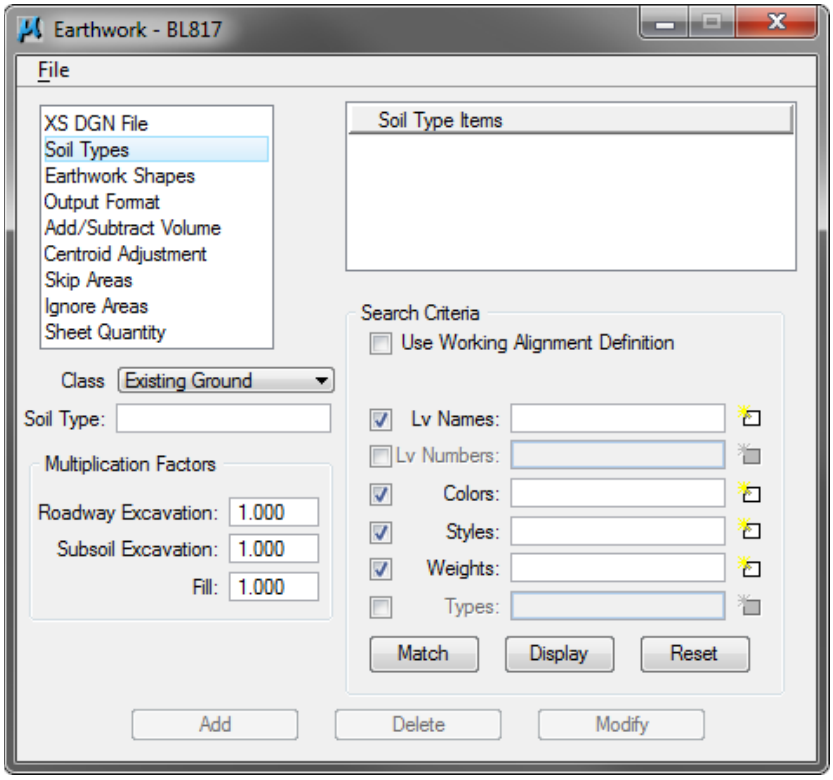
5. Create a new run **BL817** and access the Earthwork dialog.



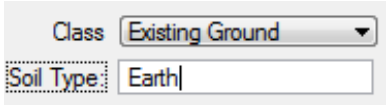
6. Select **XS DGN File**. All of the information should fill in automatically by the Working Alignment.



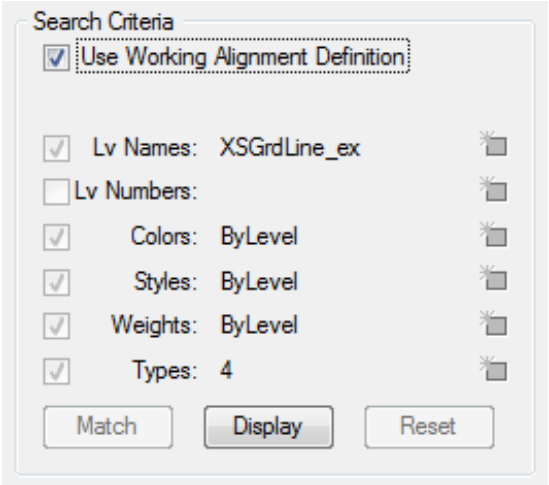
7. Select **Soil Types**.



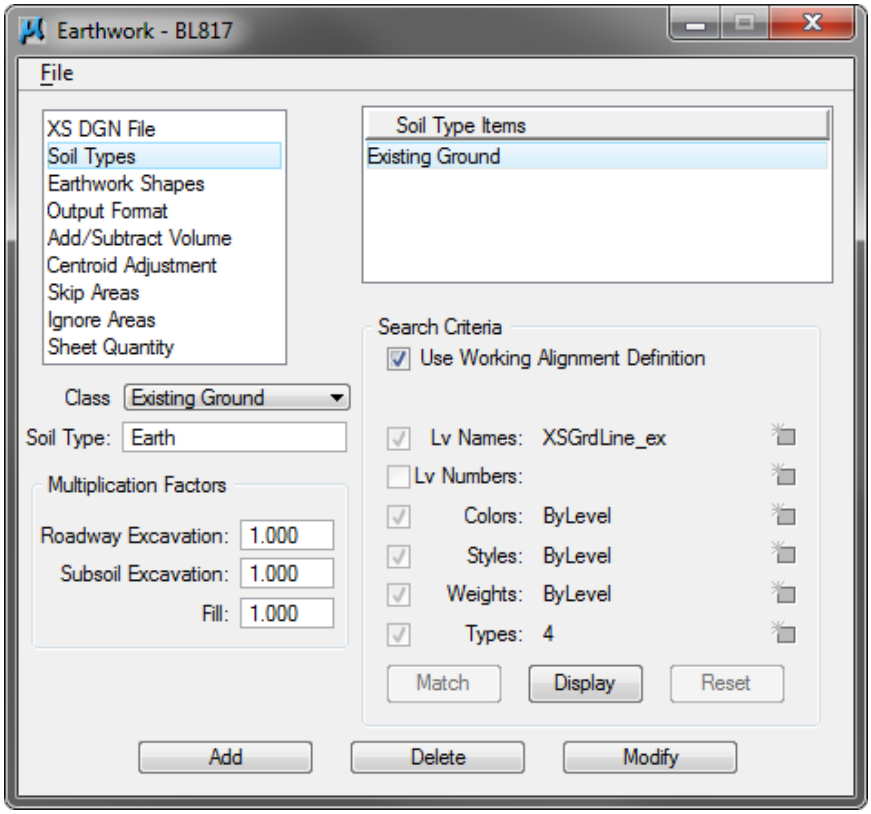
8. Leave the *Class* set to **Existing Ground**. Key-in **Earth** for the *Soil Type*.



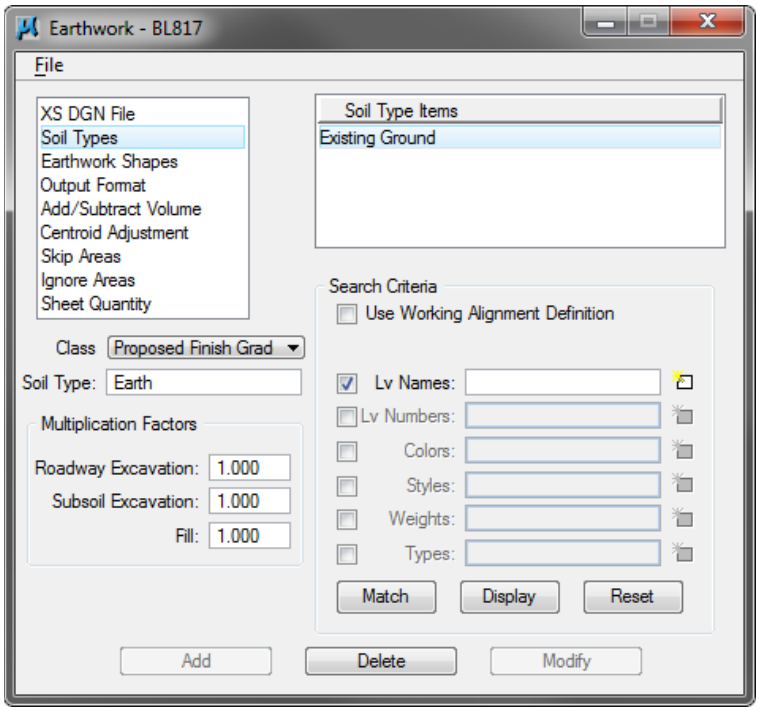
9. Enable the **Use Working Alignment** check box.



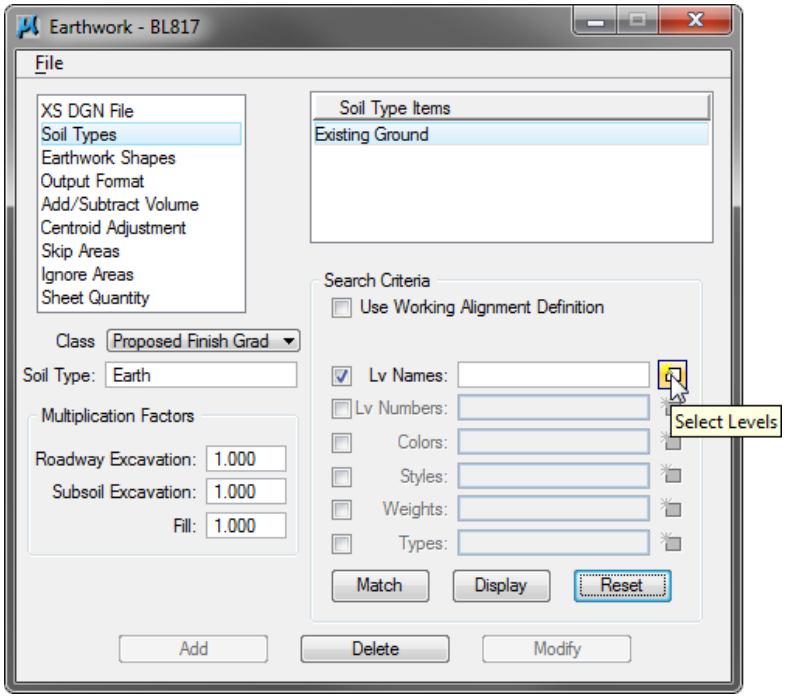
10. Click the **Add** icon to add **Existing Ground** to the *Soil Type Items* list box as shown.



11. Change the *class* to **Proposed Finish Grade**, uncheck the **Use Working Alignment Definition** option, and check only the **Lv Names** option as shown.

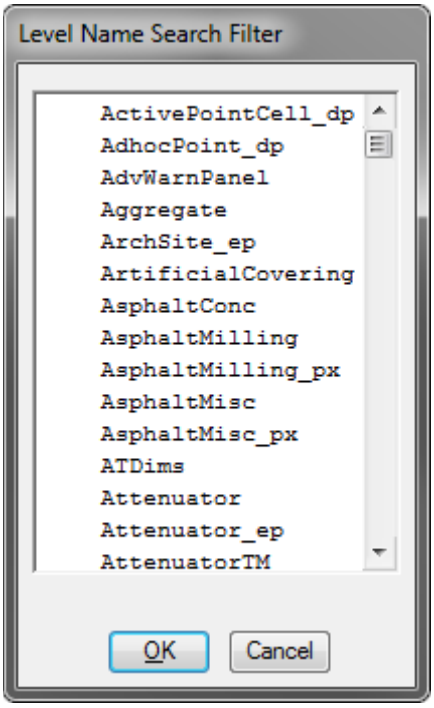


12. Click the **Select Levels** icon to the right of the *Lv Names* field.



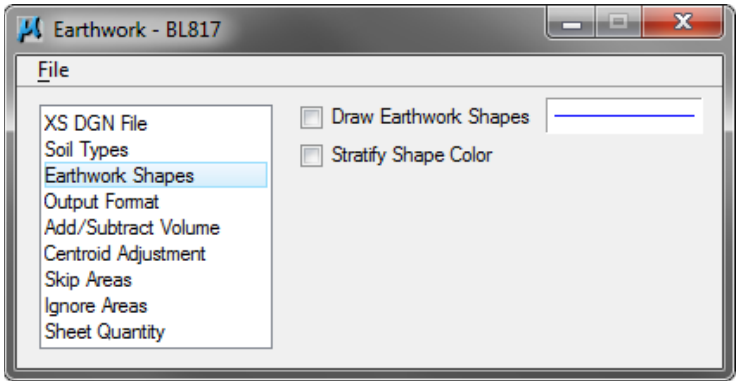
13. In the Level Name Search Filter dialog that appears, select the following level names:

- AsphaltMilling_px
- Base_px
- CandG_px
- CandGBase_px
- Driveway_px
- DrivewayBase_px
- Overbuild1_px
- Overbuild_px
- ShldrUnpaved_px
- Sidewalk_px
- SidewalkBase_px
- Slopes_px
- TrafSeparator_px
- TrafSeparatorBase_px
- XSBaseTop_px
- XSGrdLine_px



14. Click **OK**.
15. Click the **Add** icon to add **Proposed Finish Grade** to the *Soil Type Items* list box.

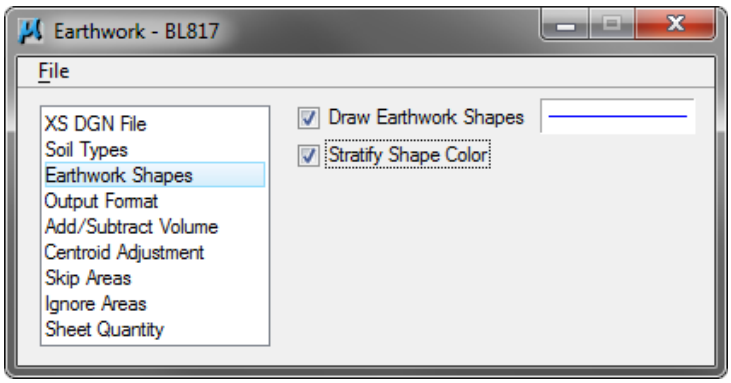
16. Select **Earthwork Shapes**.



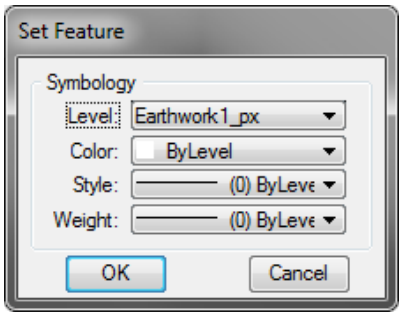
17. The use of *Draw Earthwork Shapes* is optional. If it is desired to see the shapes, place a check mark appropriately. When creating the cross section sheets, the shapes come also, so turn **Fill** off under *View Attributes*.

18. Enable the check box to **Draw Earthwork Shapes**.

19. Enable the check box to **Stratify Shape Color**.

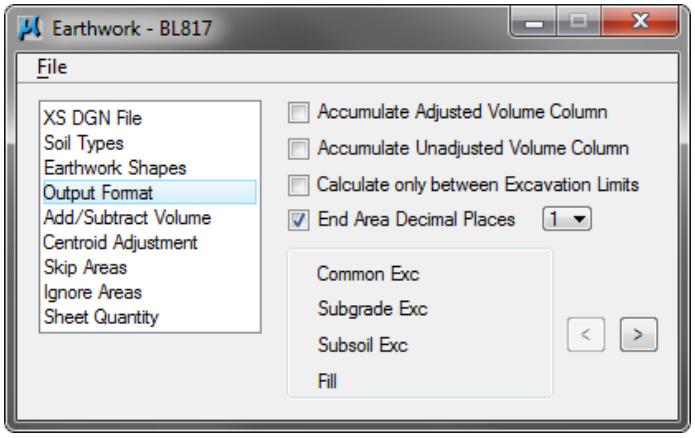


20. Access the Set Feature dialog and set the symbology for the *Earthwork Shapes* as shown in the following figure.

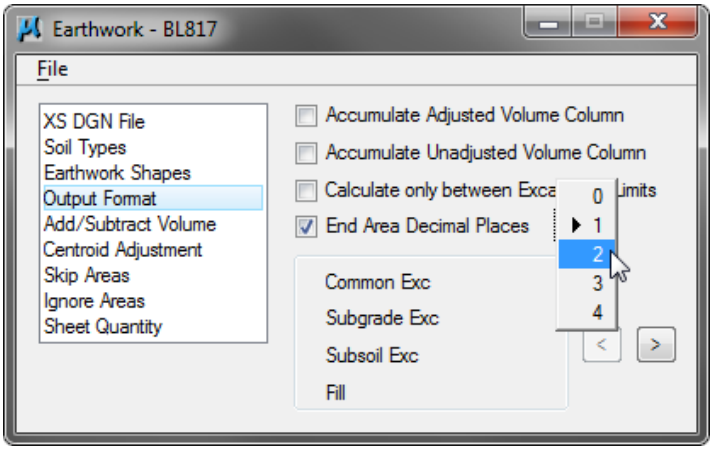


21. Click **OK** to close the Set Feature dialog.

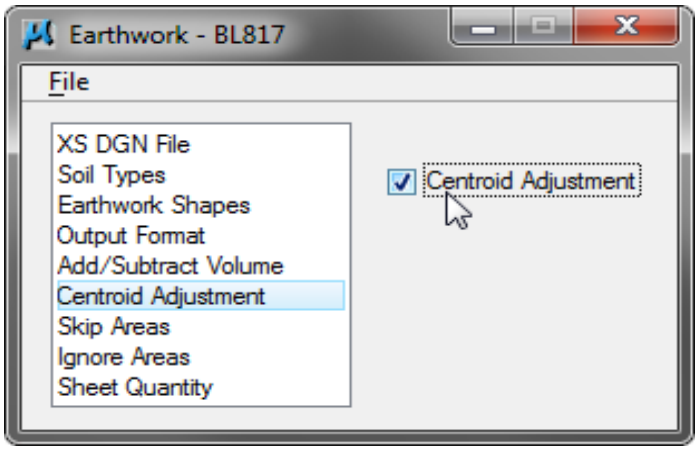
22. Select **Output Format**.



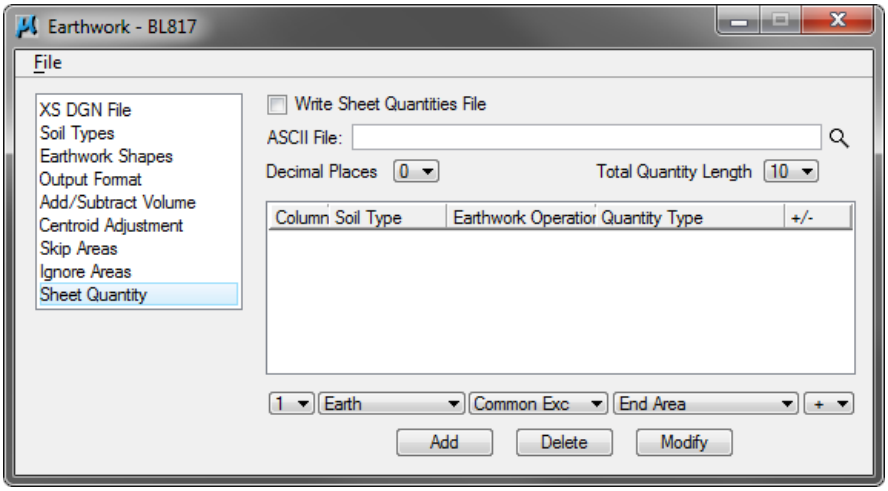
23. Set the *End Area Decimal Places* to **2**.



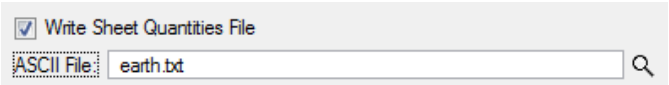
24. Select **Centroid Adjustment** and enable the check box.



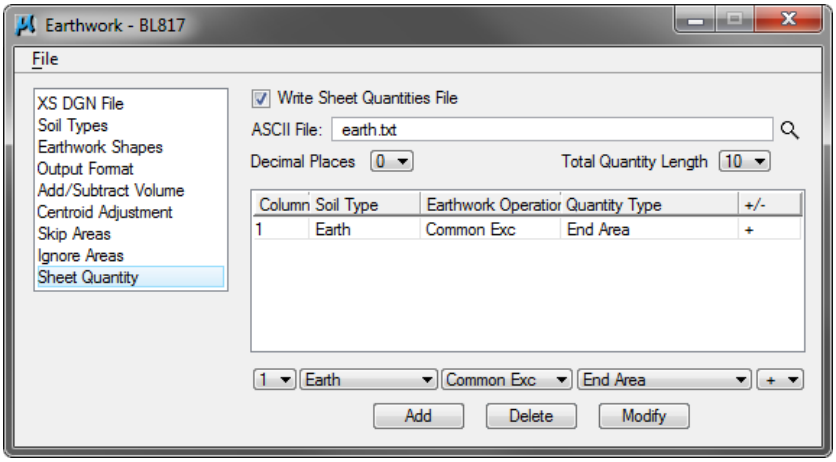
25. Select **Sheet Quantity**.



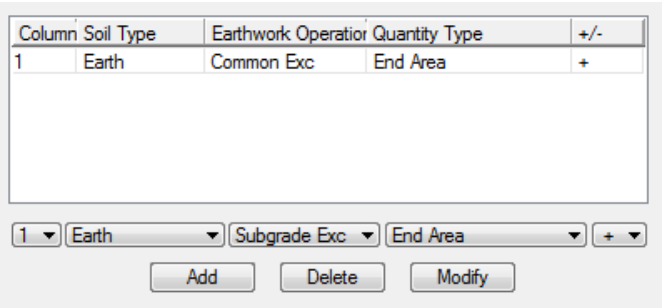
26. Enable the check box to **Write Sheet Quantities File**.
27. Key-in **earth.txt** in the *ASCII File* field.



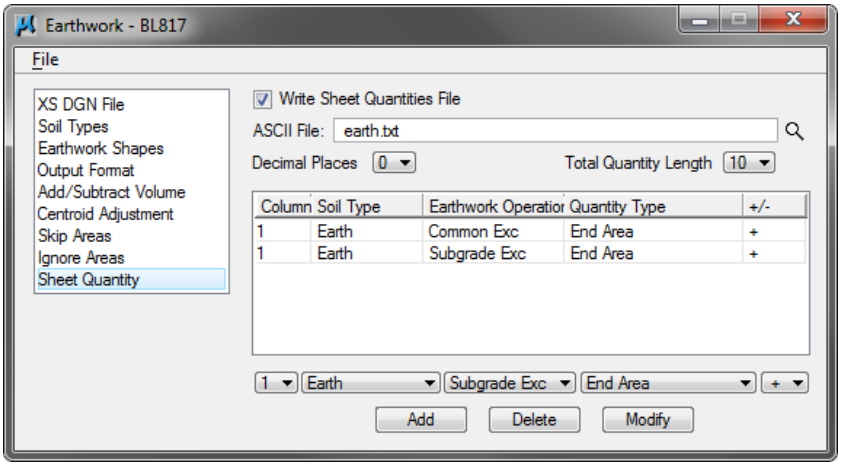
28. Click **Add** to add the *Column* **1 earthwork** to the list box.



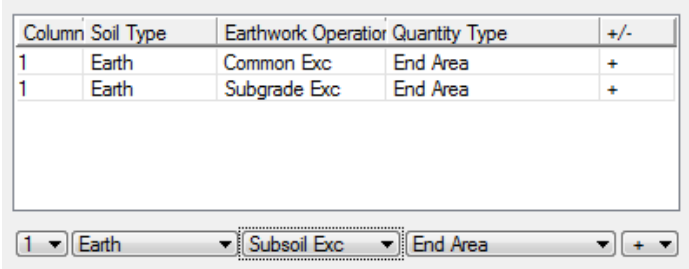
29. Leave the *Column* set to **1** but change the *EW Operation* to **Subgrade Exc**.



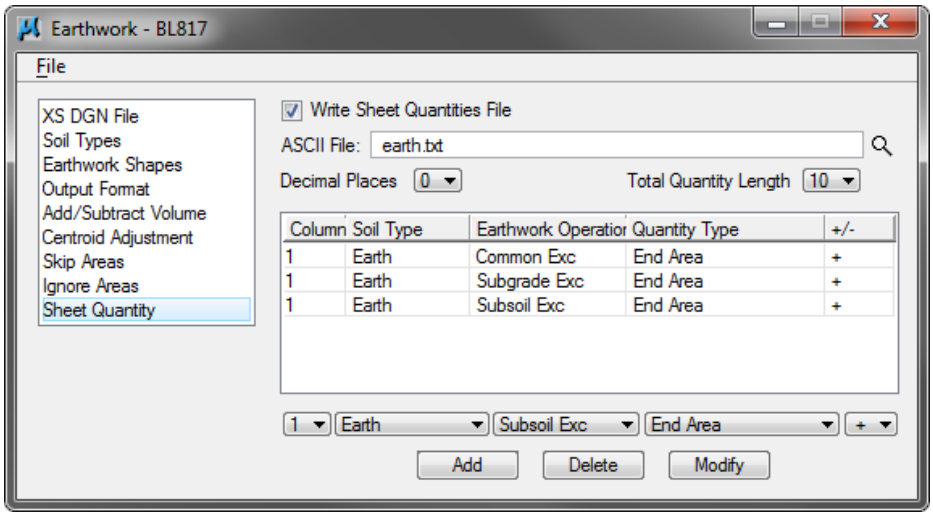
30. Click **Add** to add the **Subgrade Exc** to the existing *Column 1 earthwork*.



31. Change the *EW Operation* to **Subsoil Exc**.

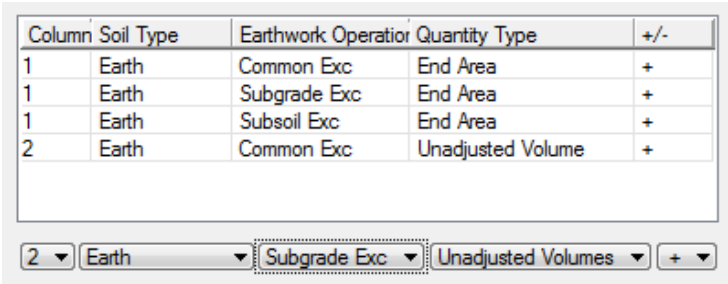


32. Click **Add** to add the **Subsoil Exc** to the existing *Column 1 earthwork*.

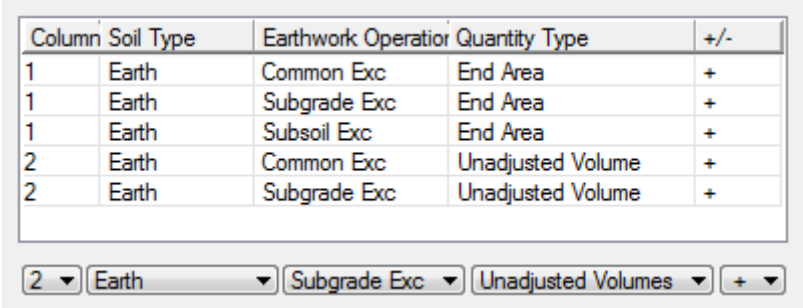


33. Change the *Column* to **2**.
34. Set the *Earthwork Operation* to **Common Exc.**
35. Set the *Quantity Type* to **Unadjusted Volumes**.

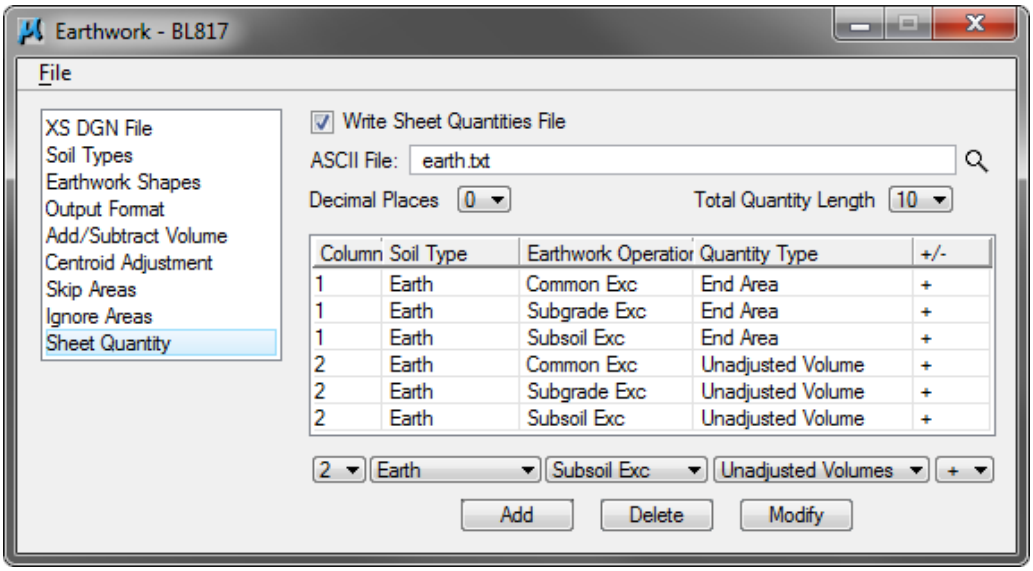
36. Click **Add** to add the **Column 2 earthwork** to the list box.



37. Leave the *Column* set to **2** and change the *Earthwork Operation* to **Subgrade Exc**.
38. Click **Add** to add the **Subgrade Exc** to the existing *Column 2 earthworks*.

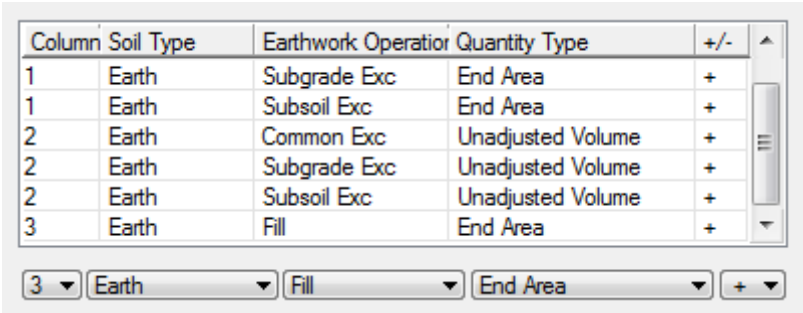


39. Leave the *Column* set to **2** and change the *Earthwork Operation* to **Subsoil Exc**.
40. Click **Add** to add the **Subsoil Exc** to the existing *Column 2 Earthworks*.



41. Change *Column* to **3.**
42. Change the *EW Operation* to **Fill**.

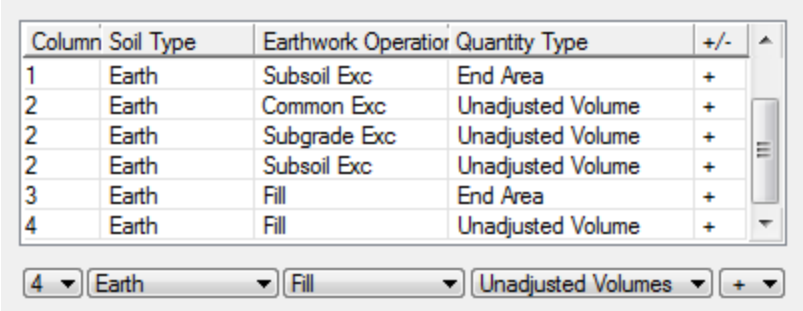
43. Click **Add** to add the **Column 3 earthwork** to the list box.



Column	Soil Type	Earthwork Operatior	Quantity Type	+/-
1	Earth	Subgrade Exc	End Area	+
1	Earth	Subsoil Exc	End Area	+
2	Earth	Common Exc	Unadjusted Volume	+
2	Earth	Subgrade Exc	Unadjusted Volume	+
2	Earth	Subsoil Exc	Unadjusted Volume	+
3	Earth	Fill	End Area	+

3 | Earth | Fill | End Area | +

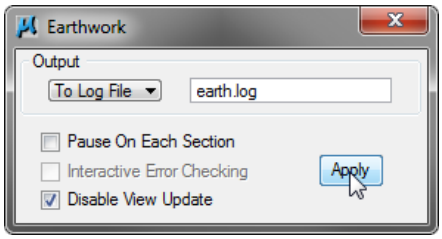
44. Change the *Column* to **4.**
45. Set the *EW Operation* to **Fill.**
46. Click **Add** to add the **Column 4 earthworks** to the list box.



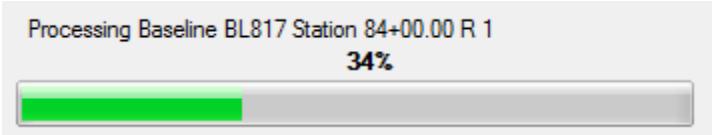
Column	Soil Type	Earthwork Operatior	Quantity Type	+/-
1	Earth	Subsoil Exc	End Area	+
2	Earth	Common Exc	Unadjusted Volume	+
2	Earth	Subgrade Exc	Unadjusted Volume	+
2	Earth	Subsoil Exc	Unadjusted Volume	+
3	Earth	Fill	End Area	+
4	Earth	Fill	Unadjusted Volume	+

4 | Earth | Fill | Unadjusted Volumes | +

47. Select **Files > Save Settings**.
48. Select **Files > Run**.
49. Set the option To **Log File** and key-in a *log file* name of **earth.log**.

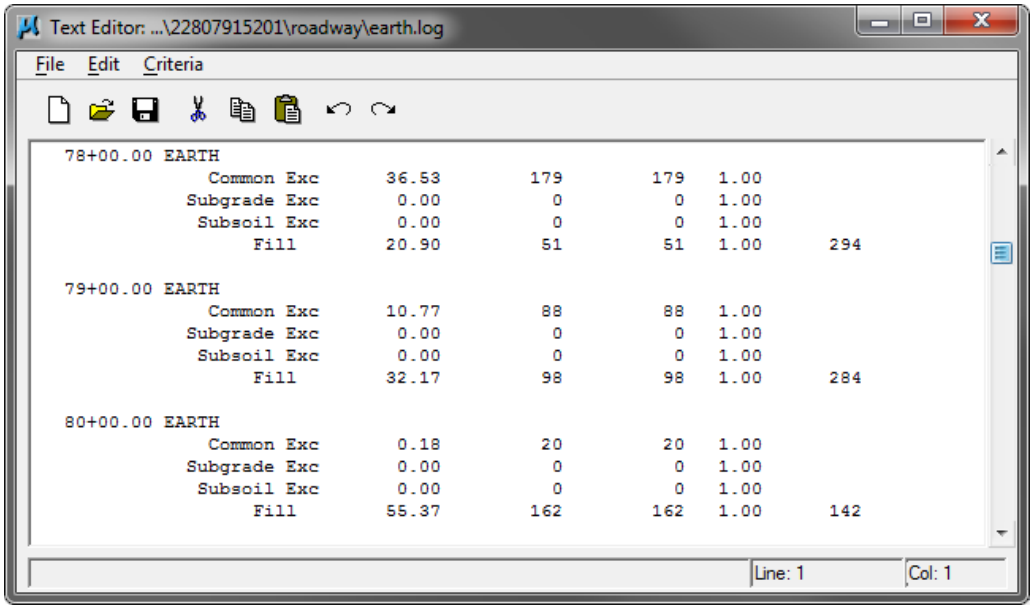


50. Click **Apply** to process the earthwork.
51. When processing is complete, click **Exit**.



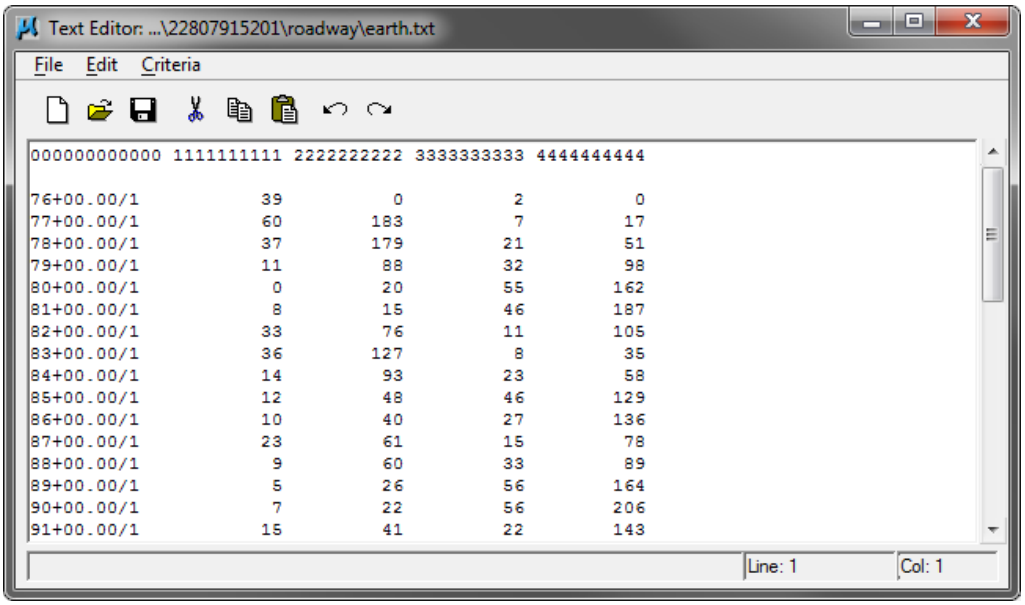
52. Close the Earthwork dialog. When prompted to **Save Settings** click **Yes**

53. Review the file \roadway\ **earth.log**.




```
78+00.00 EARTH
              Common Exc      36.53        179        179   1.00
            Subgrade Exc       0.00          0          0   1.00
             Subsoil Exc       0.00          0          0   1.00
                  Fill        20.90         51         51   1.00       294

79+00.00 EARTH
              Common Exc      10.77         88         88   1.00
            Subgrade Exc       0.00          0          0   1.00
             Subsoil Exc       0.00          0          0   1.00
                  Fill        32.17         98         98   1.00       284

80+00.00 EARTH
              Common Exc       0.18         20         20   1.00
            Subgrade Exc       0.00          0          0   1.00
             Subsoil Exc       0.00          0          0   1.00
                  Fill        55.37        162        162   1.00       142
```

54. Review the file \roadway**earth.txt**.

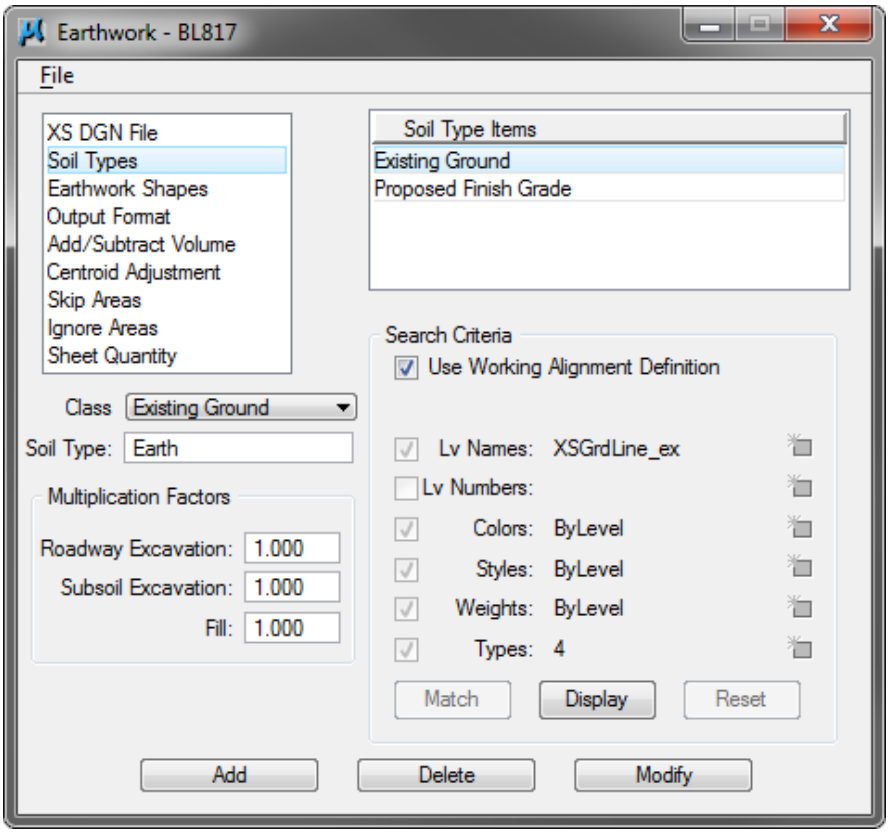



```
000000000000 1111111111 2222222222 3333333333 4444444444

76+00.00/1          39          0          2          0
77+00.00/1          60        183          7         17
78+00.00/1          37        179         21         51
79+00.00/1          11         88         32         98
80+00.00/1           0         20         55        162
81+00.00/1           8         15         46        187
82+00.00/1          33         76         11        105
83+00.00/1          36        127          8         35
84+00.00/1          14         93         23         58
85+00.00/1          12         48         46        129
86+00.00/1          10         40         27        136
87+00.00/1          23         61         15         78
88+00.00/1           9         60         33         89
89+00.00/1           5         26         56        164
90+00.00/1           7         22         56        206
91+00.00/1          15         41         22        143
```

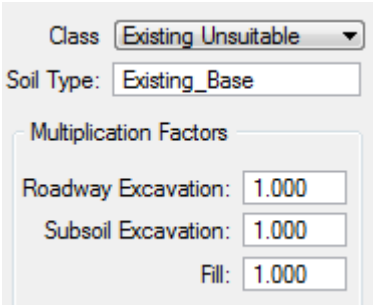
Exercise 8.2 Unsuitable Material with no Excavation Limits

In this exercise, the user will add unsuitable material to our earthwork calculations.

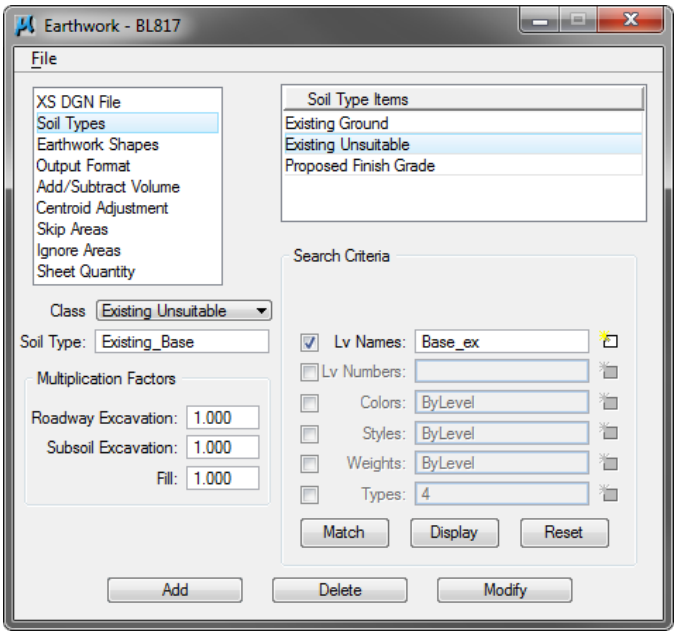
1. Re-enter the Earthwork dialog.
2. Select **Soil Types**.



3. Change the *Class* to **Existing Unsuitable**.
4. Key-in a *Soil Type* name of **Existing Base**.

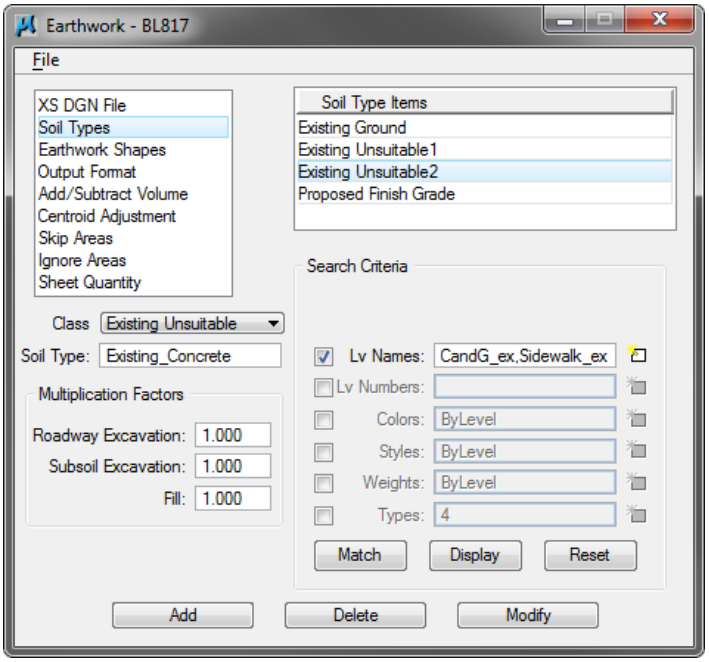


5. Set the **Search Criteria** as shown in the image below and click **Add** to add the **Existing Unsuitable** material to the list box.



6. Leave the *Class* set to **Existing Unsuitable** and key-in a *Soil Type* name of **Existing_Concrete**.

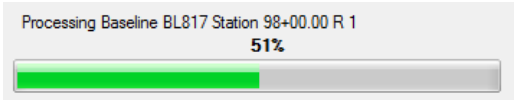
7. Set the **Search Criteria** as shown in the image below and click **Add** to add the **2nd Existing Unsuitable** material to the list box.



8. Select **Files** > **Save Settings**.

9. From MicroStation, select **Edit** > **Select All** and then delete the shapes created in the previous earthwork run.

10. Select **Files** > **Run** to process the earthwork.

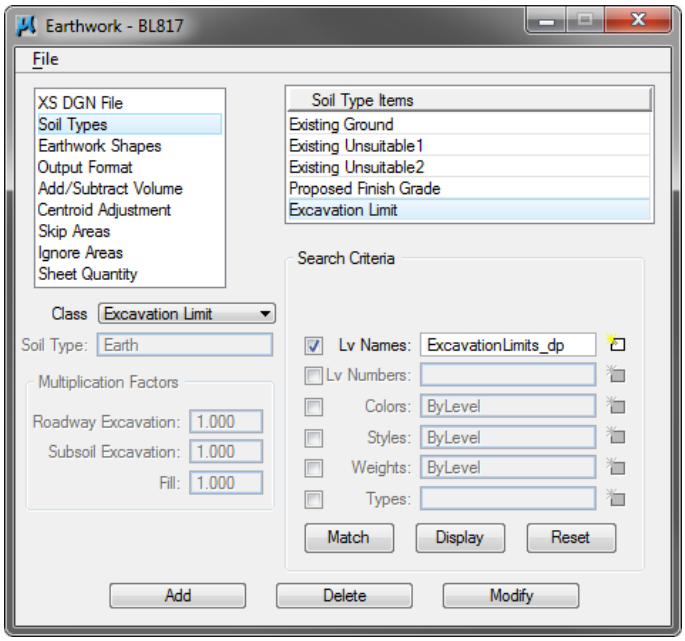


11. When reviewing your earthwork notice that the existing unsuitable materials are now being calculated in addition to the standard cut and fill (earth).
12. Close the Earthwork dialog. When prompted to **Save Settings** click **Yes**.
13. Review the cross sections. Take note of the earthwork shapes for the unsuitable material. Notice that not ALL of the existing unsuitable material is being extracted.

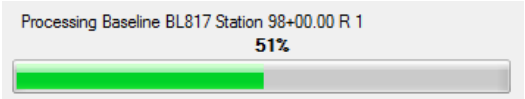
Exercise 8.3 Unsuitable Material with Excavation Limits

In this exercise, the user will add excavation limits which will affect our unsuitable material quantities.

1. Re-enter the Earthwork dialog using the previously created run.
2. Select **Soil Types**.
3. Change the *Class* to **Excavation Limit**.
4. Set the **Search Criteria** as shown in the image below and click **Add** to add the **Excavation Limit** to the list box.



5. Select **File** > **Save Settings**.
6. From MicroStation, select **Edit** > **Select All** and then delete the shapes created in the previous earthwork run.
7. Select **Files** > **Run** to process the earthwork.

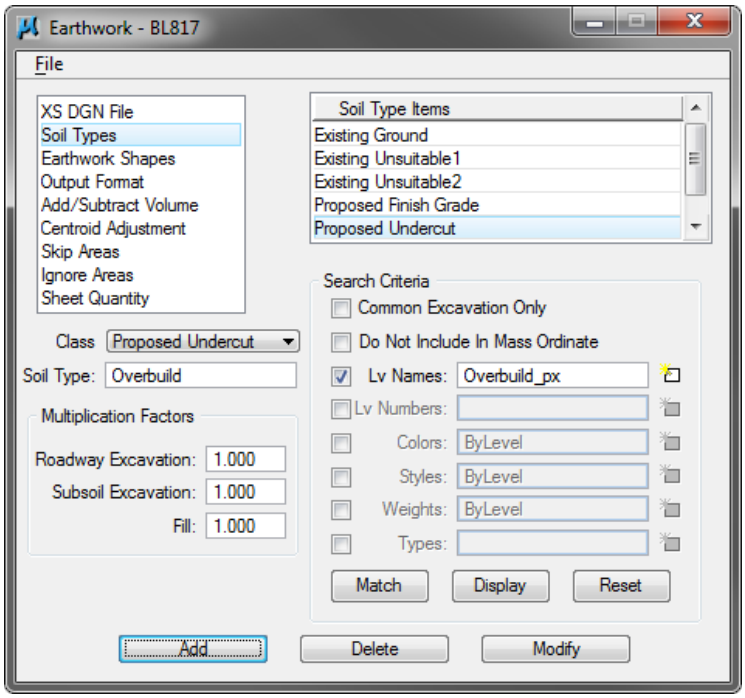


8. When complete, close the Earthwork dialog. When prompted to **Save Settings** click **Yes**.
9. Review the cross sections. Take note of the earthwork shapes for the unsuitable material. Notice that ALL of the existing unsuitable material is being extracted between the Excavation Limits.

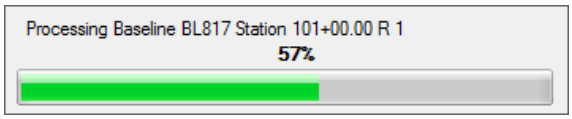
Exercise 8.4 Proposed Undercut

In this exercise, the user will calculate the overbuild on the job using proposed undercut.

1. Re-enter the Earthwork dialog.
2. Select **Soil Types**.
3. Change the *Class* to **Proposed Undercut**.
4. Key-in a *Soil Type* name of **Overbuild.**
5. Set the **Search Criteria a**s shown in the image below and click **Add** to add the **Proposed Undercut** material to the list box.



6. Select **File** > **Save Settings**.
7. From MicroStation, select **Edit** > **Select All** and then delete the shapes created in the previous earthwork run.
8. Select **Files** > **Run** to process the earthwork.



9. When complete, close the Earthwork dialog. When prompted to **Save Settings** click **Yes**.
10. Review the cross sections. Take note of the additional overbuild quantities that have been calculated.
11. Exit MicroStation.

9 CROSS SECTION SHEETS

OBJECTIVES

- Overview of Cross Section Sheet Layout
- Exercise to Layout Sheets with Quantities

WORKFLOW

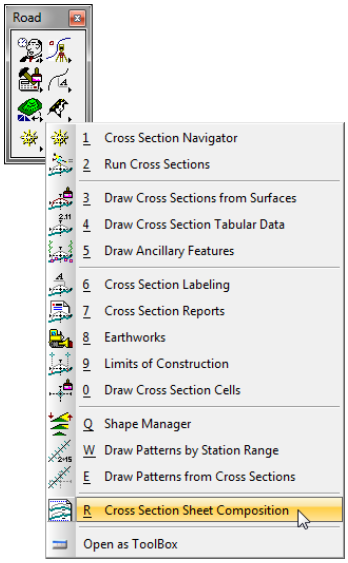
The GEOPAK sheet layout component provides an automated tool to draw cross section data in a format suitable for producing hard-copy cross section construction drawings. The input includes specifying sheet layout parameters as well as the graphic design file where the cross sections were originally created by GEOPAK. The output is a MicroStation design file which references the cross sections and labels such as baseline, station, offsets and elevation are added. There are several advantages to using sheet input:

- The cross sections will be sorted in numeric order for the specified baseline. In addition, a station range can be specified.
- The cross sections will be spaced closer together.
- The cross sections are placed into user specified "sheet format."
- As the cross sections are referenced into sheets, changes in cross sections are immediately reflected in sheets.
- Sheets need to be generated only once, unless more sections are added to the project or elements are added which go outside the referenced boundaries.

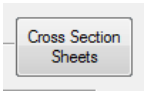
As discussed in previous chapters, the cross section design file is split into 4 models. The sheet layout uses one of these 4 models (rdxsrd_shg)

ACCESSING CROSS SECTION SHEET COMPOSITION

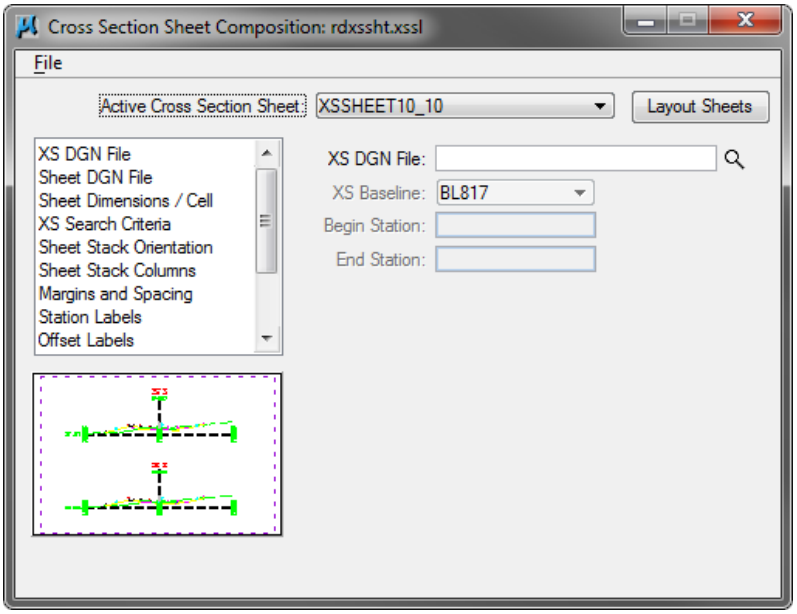
- From MicroStation, select **Applications** > **ROAD** > **Cross Sections** > **Cross Section Sheet Composition** --or –
- From the *Road* toolbox, click the **Cross Section Sheet Composition** icon --or –



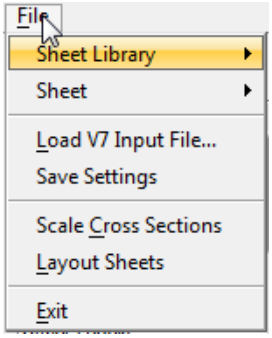
- From the Road Project dialog, click the **Cross Section Sheets** icon.



CROSS SECTION SHEET COMPOSITION



FILE MENU



Sheet Library The parameters for each sheet are defined in a Sheet Library. In order to layout or clip sheets, a Sheet Library must be attached to the current session. The name of the currently attached Sheet Library is shown in the title bar. Sheet Libraries have an extension of xssl. An unlimited number of different sheets can be stored within one library. When beginning the sheet process, select the desired sheet layout from the attached library, which loads the associated parameters.

New Create a new Sheet Library.

Attach Attaches a sheet library.

Save Saves the dialog settings into the currently attached Sheet Library.

Save As Saves the dialog settings into a new Sheet Library name.

Sheet The Sheet Name is used to populate the Active Cross Section Sheet field in the main dialog.

New Create a new sheet within the currently attached Sheet Library.

Delete Delete the currently selected sheet from the Sheet Library.

Update If changes have been made to the current active sheet, this option will store the changes in the library. Also, you must use the option Sheet>Update before choosing another sheet in the library or the changes made will be lost. This is important when making changes to multiple sheets in a library.

Load V7 Input File To utilize the sheet input file from previous versions, create a New Sheet, then select Load V7 file and select the old sheet input file. The fields supported in V7 are populated in the new sheet.

Save Settings Saves the dialog settings.

When running this application from Project Manager and using the Save Settings option, only 4 of the dialog options are saved to the Project Manager run:

XS DGN File

Sheet DGN File

Detach Toggle

Earthwork File

To save all of your Sheet Settings, do the following:

Copy the Sheet Library local

Attach the local copy

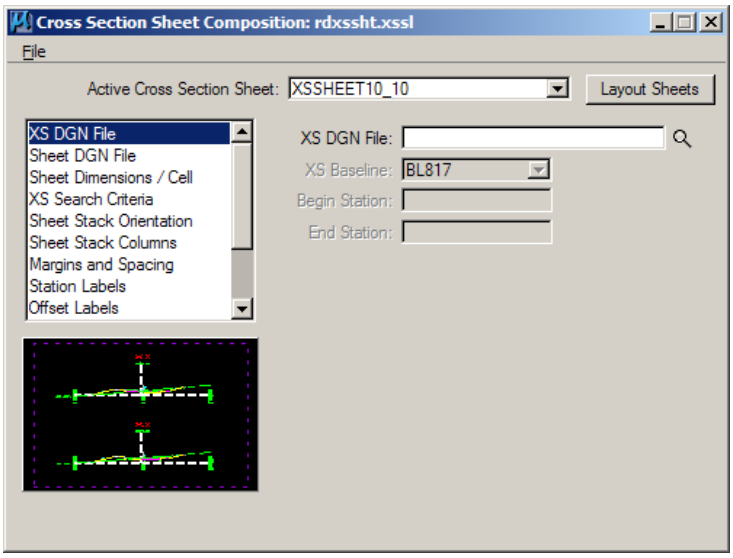
Select File > Sheet > Update

Select File > Sheet Library > Save

Layout Sheets Commence processing the sheet layouts.

Exit Exit the Cross Section Sheet application.

XS DGN FILE



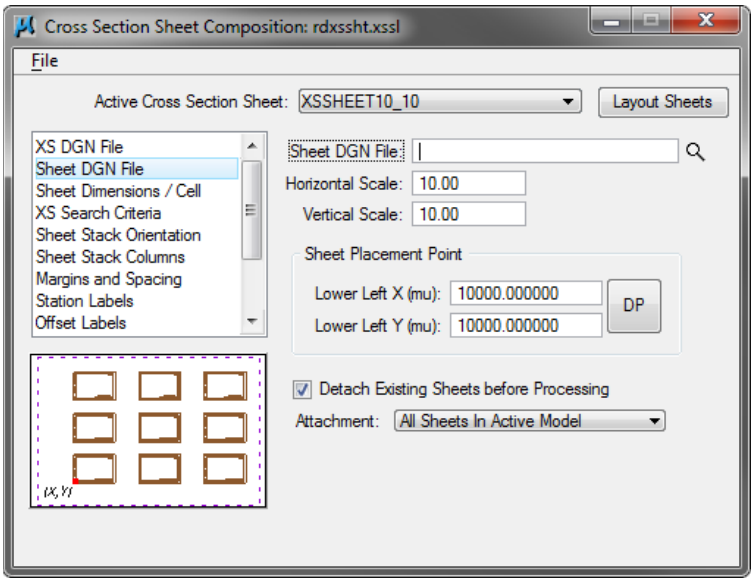
XS DGN File Location of original cross sections, which must include the GEOPAK XS cell.

XS Baseline When the XS DGN file is selected, the file is searched and the baseline names of any XS Cells found are listed.

Begin Station Defaults to the lowest stationed cross section associated with the selected baseline and can be utilized if the entire file is to be processed. If a partial processing is desired, simply type in the desired station.

End Station Defaults to the highest stationed cross section associated with the selected baseline and can be utilized if the entire file is to be processed. If a partial processing is desired, simply type in the desired station.

SHEET DGN FILE



Sheet DGN File Name of the design file where GEOPAK draws the cross section sheet borders, labels, etc. onto sheets. Note that GEOPAK does not create this file. It must be done prior to processing. In addition, the working units of the Sheet design file should match the cross section design file.

Horizontal Scale Horizontal Scale that the cross sections are drawn. This should be the same as the horizontal scale with which the cross sections were originally cut.

Vertical Scale Vertical Scale that the cross sections are drawn. This should be the same as the vertical scale with which the cross sections were originally cut.

Note If a different scale ratio is used, the elevations will be incorrectly labeled.

Sheet Placement Point The sheet layout software accepts the user specification of the coordinate location in the sheet layout design file where the cross section data is to be drawn. These coordinates can either be keyed in or selected using the **DP** icon.

Lower Left X (mu) X Coordinate location of the sheet placement point.

Lower Left Y (mu) Y Coordinate location of the sheet placement point.

Detach Existing Sheets before Processing

When this check box is enabled, any reference files that were attached in a previous run are detached and replaced with new references. Also any elements from a previous run are deleted and replaced. When this is check box is OFF, any existing reference files and elements from a previous run are not removed. This will allow the user to add cross section sheets with different station ranges.

Attachment

There are 3 options that determine how the sheets will be placed in the Sheet DGN File

All Sheets in Active Model

All sheets are placed in the active model.

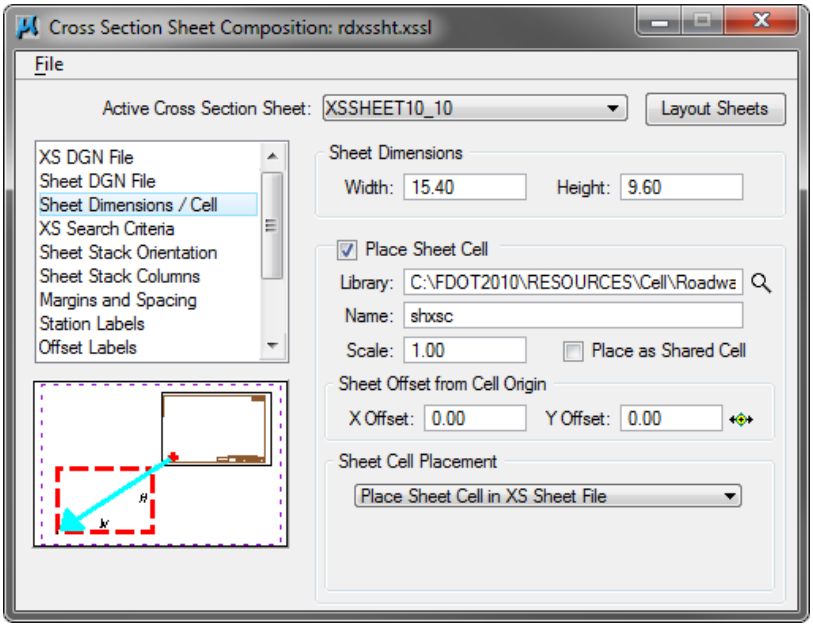
One Sheet Per Model

Each sheet is placed in its own model. The models will be named XS_SHEET_sheet number. Nothing is placed in the active model. This option was developed for IPLOT users.

One Sheet Per Model / Display All

Each sheet is placed in its own model. The models will be named XS_SHEET_sheet number. All sheets are attached to the active model as references. This option was developed for IPLOT users.

SHEET DIMENSIONS / CELL



Sheet Dimensions

Width — Width of each sheet in plotting units.

Height — Height of each sheet in plotting units.

Place Sheet Cell

To place a sheet cell, select the check box.

Library — Name of Cell Library which contains the sheet cell.

Name — Sheet cell name.

Scale — Scale to be applied to the sheet cell.

Place as Shared Cell — Check box on if sheet cell is to be placed as a shared cell.

FDOT does not recommend using this option.

Sheet Offset from Cell Origin

X Offset — Horizontal offset from the cell origin to the sheet corner.

Y Offset — Vertical offset from the cell origin to the sheet corner.

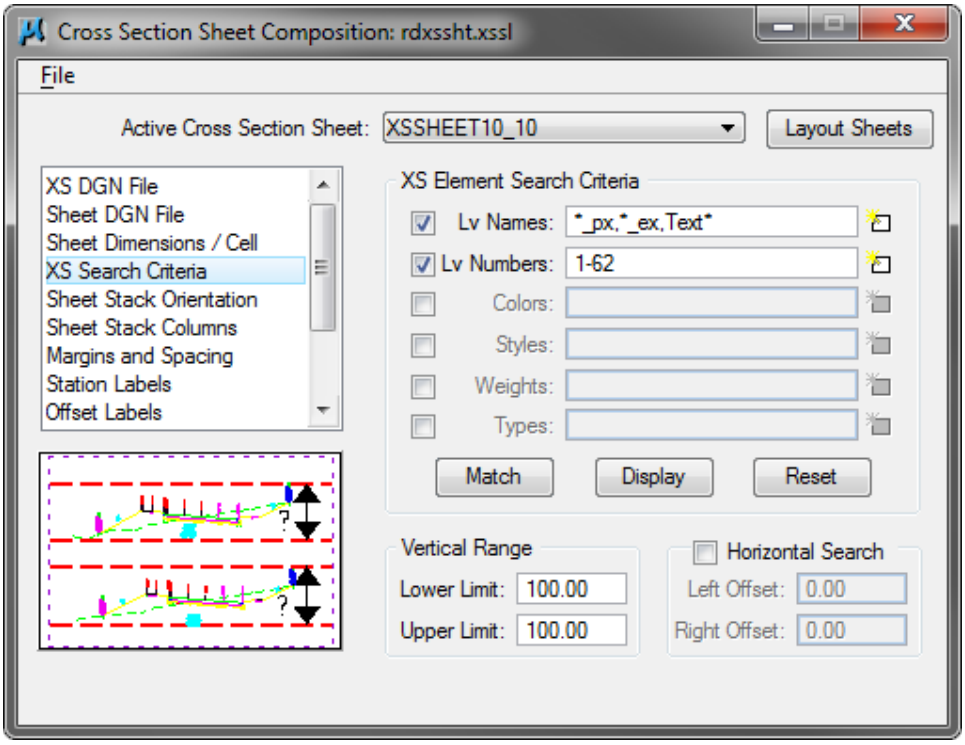
Sheet Cell Placement

Determines how the sheet cells will be placed.

Place Sheet Cell in XS Sheet File — Sheet cell is placed in the sheet file, once for each sheet.

Place Sheet Cell Once in a Reference File — The sheet cell is placed in the specified reference file once, and then referenced for each sheet. Specify the Reference File name where the cell is to be drawn.

XS SEARCH CRITERIA



XS Search Criteria specified is used to determine the size of the cross section vertical clipping area. If there are elements on levels (i.e. the cross section cell) that you do not want displayed on the sheets, then those levels need to be turned off prior to the sheeting process.

XS Element Search Criteria

Any combination of graphical symbology can be selected in order to specify the XS elements to be searched for.

Match

To commence matching, select the desired search parameter check box, click Match, then select the desired element. All elements with matching search criteria are also highlighted.

Display

When search parameters have been set and Display is clicked, all elements matching the specified search criteria are displayed.

Reset

To clear all Search parameter dialogs, click Reset. Note this does not clear each check box, it simply clears the specified levels, weights, etc.

Vertical Range

Occasionally during the design process, the existing ground line must be extended to complete the design, or the proposed elements themselves are outside the GEOPAK XS cell. If the relief of the cross section is large, the software may not recognize the extreme limits of the design. The sheet layout procedure allows for the limits of the cell to be moved up in order to recognize all the elements.

Lower Limit

Distance below the horizontal datum line of the XS Cell. The default value (in master units, i.e. feet or meters) is 250.

Upper Limit

Distance above the horizontal datum line of the XS Cell. The default value (in master units, i.e. feet or meters) is 250.

Horizontal

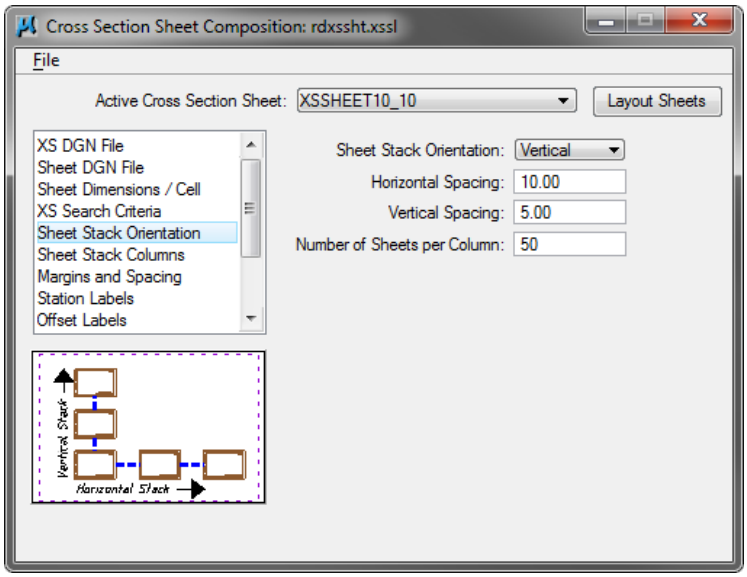
If shifting the Baseline X Offset to the left or right, there may be some elements

Search outside the specified sheet width that needs to be included in the search. The Horizontal Search option tells to software to look outside the limits of the sheet width, to the specified distances, and include any elements that are in the search criteria.

Left Offset Offset to the left of the vertical datum line of the XS Cell. This offset should be entered with a minus (-).

Right Offset Offset to the right of the vertical datum line of the XS Cell.

SHEET STACK ORIENTATION



Sheet Stack Orientation Individual cross section sheets can be stacked either vertically or horizontally. The sheet stack options dictate the selection.

Vertical Stack the sheets vertically.

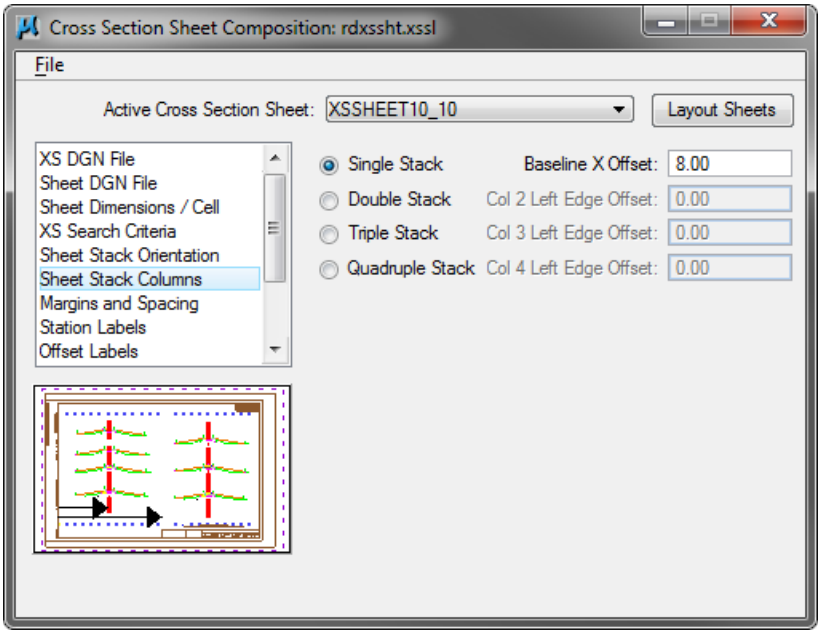
Horizontal Stack the sheets horizontally.

Horizontal Spacing Horizontal distance between successive sheets from right edge to left edge.

Vertical Spacing Vertical distance between successive sheets from top to bottom.

Number of Sheets per Column By specifying the maximum number of sheets in the stack, the software will place the first row or column with the specified number, then the next sheet will be above the first sheet and continue creating a second row, in the case of horizontal stacking. In the case of vertical stacking, the second stack will be to the right of the first stack. This is useful for large projects to avoid the edge of the design plane.

SHEET STACK COLUMNS



Note Only one of the options on this dialog can be selected.

Single Stack

Cross sections are stacked one column per sheet.

Baseline X Offset

The distance from the left edge of the sheet to the zero offset of the cross sections. The baseline of the cross section cell is utilized to determine the zero offset.

Double Stack

Cross sections are stacked two columns per sheet.

Col 2 Left Edge Offset

When the cross sections are to be placed onto the sheet in a double stack mode, the zero offset of the first stack of cross sections is determined by the Baseline X Offset. The center of the second stack of cross sections is located a distance from the left edge of the sheet to the Col 2 Left Edge Offset.

Triple Stack

Cross sections are stacked three columns per sheet.

Col 3 Left Edge Offset

When the cross sections are to be placed onto the sheet in a triple stack mode, the zero offset of the first stack of cross sections is determined by the Baseline X Offset. The center of the second stack of cross sections is located a distance from the left edge of the sheet to the Col 2 Left Edge Offset. The center of the third stack of cross sections is located a distance from the left edge of the sheet to the Col 3 Left Edge Offset.

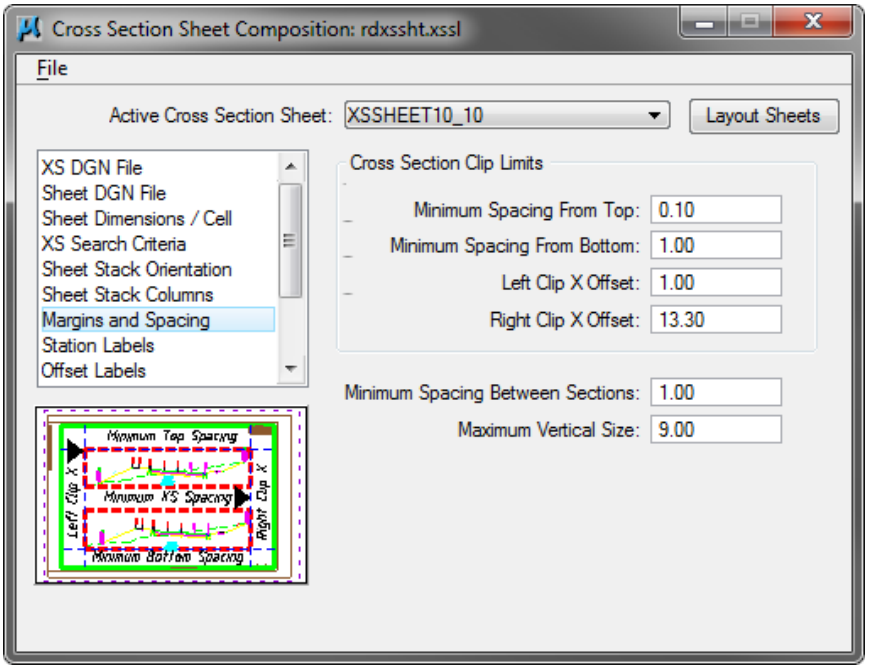
Quadruple Stack

Cross sections are stacked four columns per sheet.

Col 4 Left Edge Offset

When the cross sections are to be placed onto the sheet in a quadruple stack mode, the zero offset of the first stack of cross sections is determined by the Baseline X Offset. The center of the second stack of cross sections is located a distance from the left edge of the sheet to the Col 2 Left Edge Offset. The center of the third stack of cross sections is located a distance from the left edge of the sheet to the Col 3 Left Edge Offset. The center of the fourth stack of cross sections is located a distance from the left edge of the sheet to the Col 4 Left Edge Offset.

MARGINS AND SPACING



Cross Section Clip Limits

Minimum Spacing from Top

Minimum space from the top (expressed in plotter units) of the sheet wherein no cross section data is drawn by the software. Note the space may be larger than the specified value in order to align the top cross section on the major grids.

Minimum Spacing from Bottom

Minimum space (expressed in plotter units) from the bottom of the sheet wherein no cross section data is drawn by the software. Note the space may be larger than the specified value in order to align the bottom cross section on the major grids.

Left Clip Offset

The sheet layout software also provides the capability to specify the horizontal region outside which cross section data is clipped and not included. Defined in terms of plotting units, this value determines the portion of the left side of the sheet wherein a horizontal clear space is maintained.

Right Clip Offset

Defined in terms of plotting units, this value determines the portion of the right side of the sheet wherein a horizontal clear space is maintained.

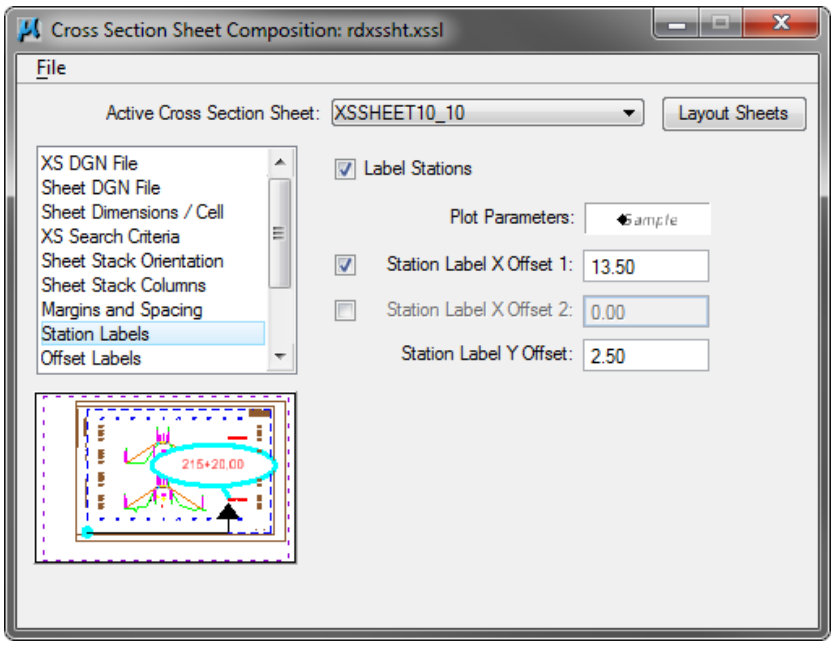
Minimum Spacing Between Sections

Minimum space between cross sections on the sheet expressed in plotter units (e.g. inches or centimeters). Note the space may be larger than the specified value in order to space the section above and below on major grids.

Maximum Vertical Size

Maximum vertical size for a single cross section such that any elements outside this limit are clipped and not included. The distance is measured downward from the highest point on the cross section (labels are considered) and expressed in plotter units.

STATION LABELS



Label Stations — Enable the check box to label stations.

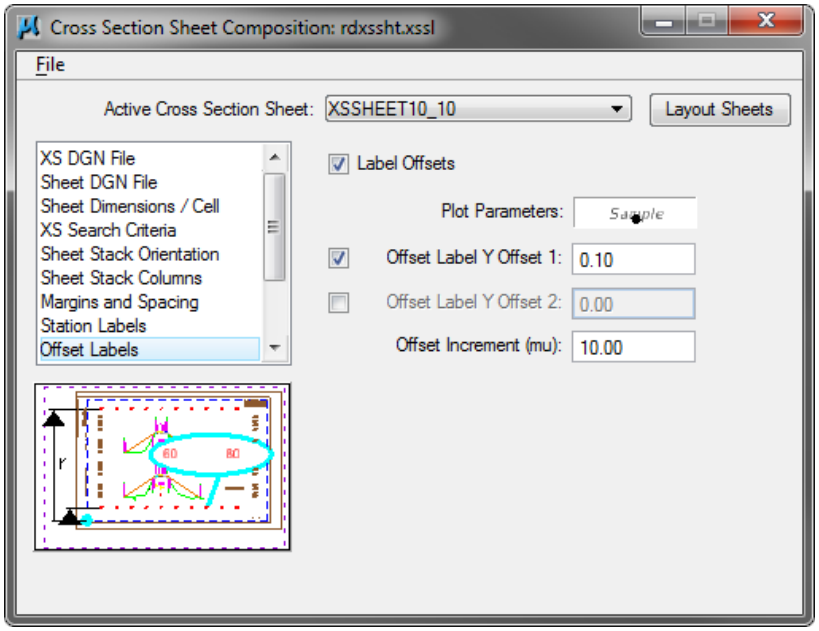
Plot Parameters — Double click the Sample graphic to set plot parameters and optional Prefix / Suffix.

Station Label X Offset 1 — Defines the distance from the left edge of the sheet to the station label. When the cross sections are to be placed onto the sheet in a double stack mode, the station label for the left-hand stack of cross sections is determined by the **Station Horizontal Offset**. The station label for the right-hand stack of cross sections is located a distance from the left edge of the sheet equaling the combined value of the **Station Horizontal Offset** and the **Second Column Left Edge Offset** values.

Station Label X Offset 2 — If you desire to place station labels on both sides of each cross section, the **Station Label X Offset 2** can be selected and the distance from the left edge of the sheet to the station label is defined.

Station Label Y Offset — Defines the minimum distance from the bottom of the given cross section to the location of the station label. The actual distance from the bottom of the cross section to the location of the station label can vary since the station label is always placed slightly above a major grid line. If both **Station X Offsets** are selected, the station labels are placed at the same vertical offset as the **Station Label Y Offset** may be specified only once.

OFFSET LABELS



Label Offsets Enable the check box to label the offsets.

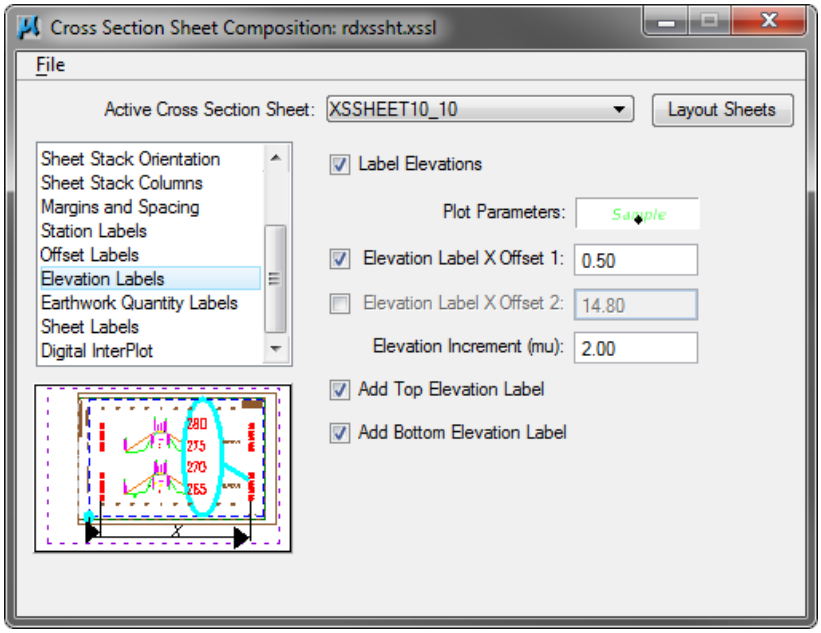
Plot Parameters Double click the Sample graphic to set plot parameters and optional Prefix / Suffix.

Offset Label Y Offset 1 Defines the vertical offset from the bottom of the sheet to the offset labels. In order to place labels, the check box must be selected.

Offset Label Y Offset 2 This option can be selected if offset labels at both the bottom and the top of the sheets are desired. In order to place labels, the check box must be selected in addition to an offset value.

Offset Increment (mu) Spacing between each offset label.

ELEVATION LABELS



Label Elevations — Enable the check box to label the elevations.

Plot Parameters — Double click the Sample graphic to set plot parameters and optional Prefix / Suffix.

Elevation Label X Offset 1 — Defines the distance from the left edge of the sheet to the elevation labels. When the cross sections are to be placed onto the sheet in a double stack mode, the elevation labels for the left-hand stack of cross sections are determined by the elevation horizontal offset value. The elevation labels for the right-hand stack of cross sections are located a distance from the left edge of the sheet equaling the combined values of the elevation horizontal offset and second column left offset values.

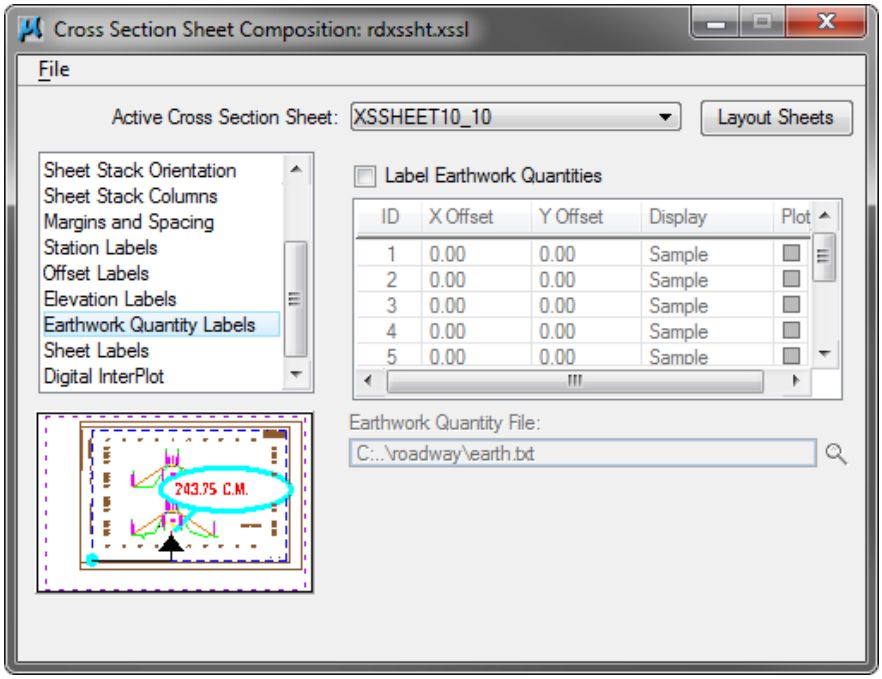
Elevation Label X Offset 2 — If elevation labels are placed on both sides of each cross section, the Horizontal Offset Elevation 2 can be selected and the distance from the left edge of the sheet to the elevation label can be defined.

Elevation Increment (mu) — Determines the incremental values for which elevations are presented. For example, given a cross section that ranges between elevation 28.75 and 41.54 and given an increment = 5, the sheet layout software would draw the following elevation labels: 30, 35, 40. At least three elevation label text strings are drawn for each cross section.

Add Top Elevation Label — Selecting this check box adds another elevation label above the current labels placed within the elevation labels parameters. If two sets of elevations labels are placed (one on each side of the section), the top elevation is added to both.

Add Bottom Elevation Label — Selecting this check box adds another elevation label below the single label placed within the elevation labels parameters. If two sets of elevations labels are placed (one on each side of the section), the bottom elevation is added to both.

EARTHWORK QUANTITY LABELS



Label Earthwork Quantities — When the check box is selected, GEOPAK places earthwork quantities onto sheets based on ASCII file quantities.

Column Data

Item ID — After the earthwork ASCII file has been defined, the **Item ID** reflects the number of the column in the ASCII file.

X Offset — For each column to be utilized in sheets, The **X** and **Y Offsets** need to be defined. The **X Offset** is oriented the same as all other sheet layout options: relative to the beginning x and y coordinate.

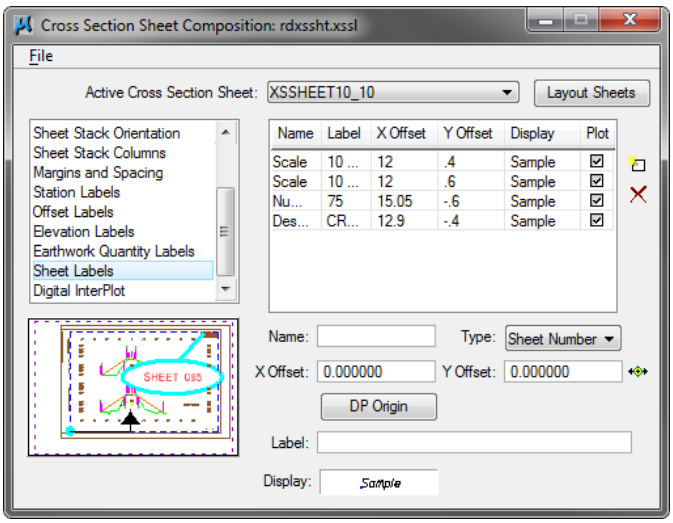
Y Offset — The **Y Offset** is oriented from the station vertical offset.

Display/Sample — Unique parameters may be defined for each quantity. Click on Sample to set symbology.

Plot — This check box can be enabled or disabled. If the check box is checked (enabled), then the earthwork quantity will be plotted on the sheets. If the check box is not checked (disabled), then the earthwork quantity will not be plotted on the sheets.

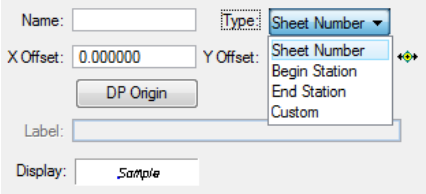
Earthwork Quantity File — File created during the earthwork processing, specifically for use with sheets.

SHEET LABELS



Name — The name given to the label. This is optional and is used more for the user's benefit (i.e. it makes it easy to look at the dialog and know what label is what).

Type — There are 4 types of labels:



Sheet Number — **When this option is selected, the user must enter the beginning sheet number in the Label field. This sheet number will be incremented for each subsequent sheet.**

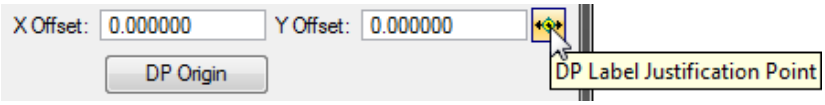
Begin Station — Beginning station of each sheet. This is calculated by the software automatically.

End Station — Ending station of each sheet. This is calculated by the software automatically.

Custom — When this option is selected, the user can enter any custom label into the **Label** field.

X Offset — Horizontal offset from the sheet origin. This can be keyed in or use the DP Label Justification Point icon to have GEOPAK automatically compute the offset oriented from the DP Origin.

Y Offset — Vertical offset from the sheet origin. This can be keyed in or use the DP Label Justification Point icon to have GEOPAK automatically compute the offset oriented from the DP Origin.



DP Origin — Used to ID the sheet origin location.

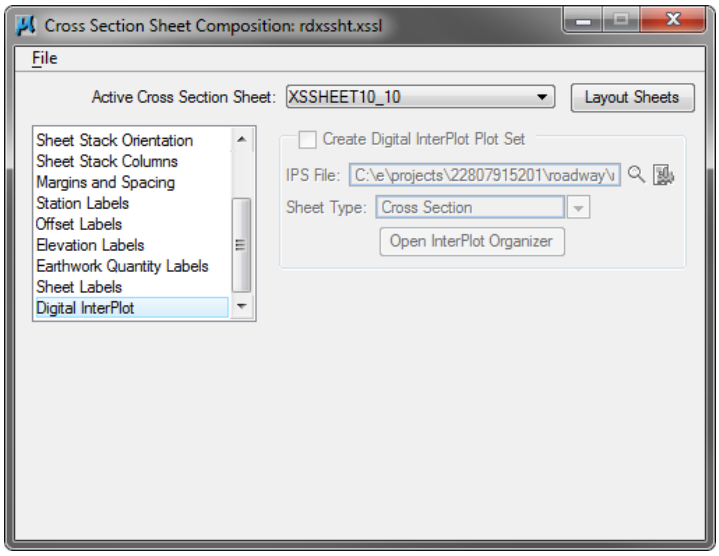
Label — Used for keying in a label when either the Sheet Number or the Custom labels are selected.

Display — Unique parameters may be defined for each label. Click on Sample to set symbology.

Note When creating new labels, the program assumes that sheets have already been placed at the current sheet scale. It will divide the given X and Y offsets by the scale of the active sheet to populate the X and Y offsets in the list box.

DIGITAL INTERPLOT

If Digital InterPlot is installed on the computer, then this option will be available. If the plotting software is not installed, then the options will be dimmed. FDOT does not use I-Plot.



Create Digital InterPlot Plot Set

Enable this check box to create the plot set automatically as the sheets are generated.

IPS File

Select the name of the IPS File by clicking on **Open IPS File**. A Settings file can also be viewed.

Sheet Type

When creating an IPS file, a Sheet Type option is supported. This option is used to create a Digital Interplot environment variable called GPK_SHEET_TYPE on each plot created. This variable may be used to classify/group different types of sheets in a plan set.

The sheet type combo box may be read only or read/write. It defaults to read/write such that a custom sheet type may be entered. To restrict it to read only, set the environment variable GPK_SHEET_TYPE_OPTIONS_LOCK to 1. The sheet type options in the list are also customizable by you via a configuration variable. To create the above list, the variable is set:

GPK_SHEET_TYPE_OPTIONS = Plan;Plan and Profile;Profile;Ditch Profiles;Dual Plan;Dual Profile; Maintenance Of Traffic;Cross Sections;Side Road Cross Sections;Ditch Cross Sections.

Open InterPlot Organizer

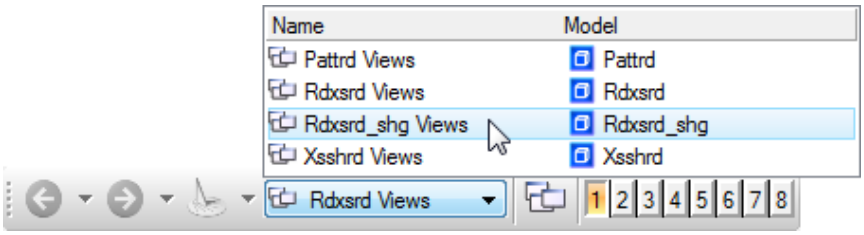
Opens InterPlot Organizer to view the plot set.

Exercise 9.1 Cross Section Sheet Layout with Earthwork

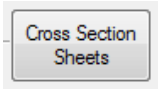
In this exercise, the user will layout our cross sections onto sheets with the earthwork quantities.

The files for these exercises are included in the Chapter 8 exercise file that you have already unzipped.

1. Open the design file C:/e/Projects/228079115201/roadway/*RDXSRD01.dgn*.
2. Change the active *model* to **Rdxsrd_shg**.

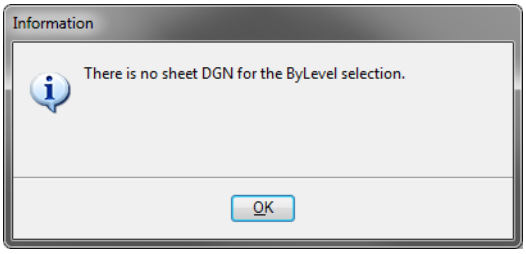


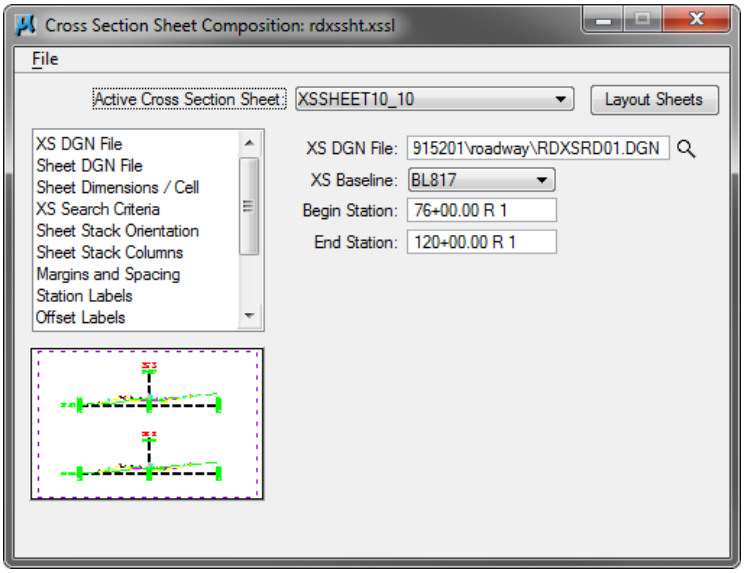
3. Access Project Manager.
4. From Road Project, click the **Cross Sections Sheets** icon.



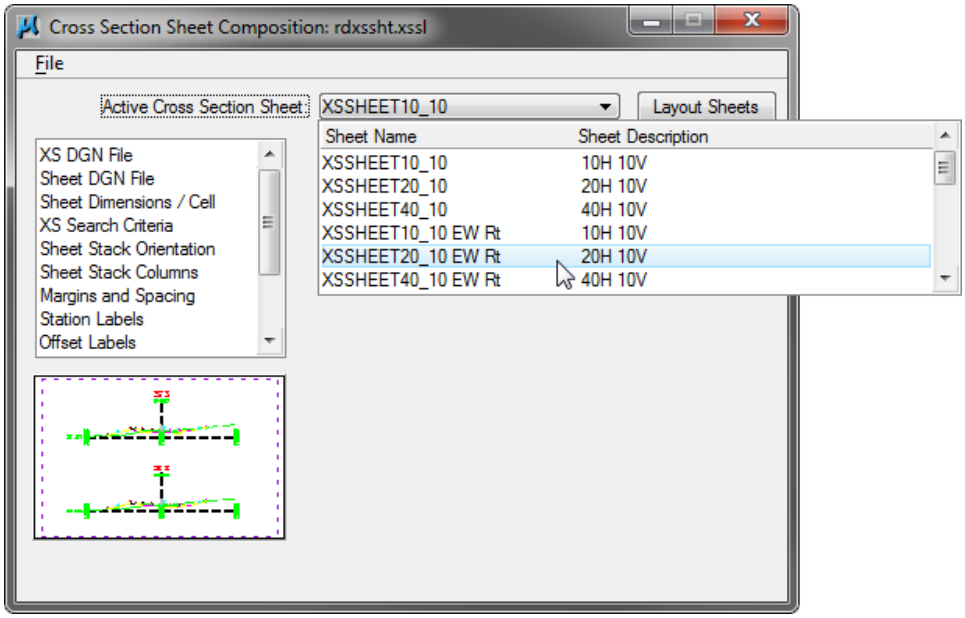
5. Create a *new run* named **BL817** and access the Cross Section Sheet Composition dialog.

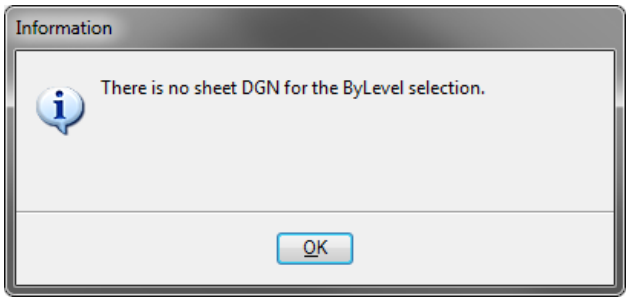
Note When accessing the Cross Section Sheet Composition dialog for the first time and until a sheet DGN file is defined, the user will get the following Alert dialog. You will have to click OK 4 times to dismiss this dialog.

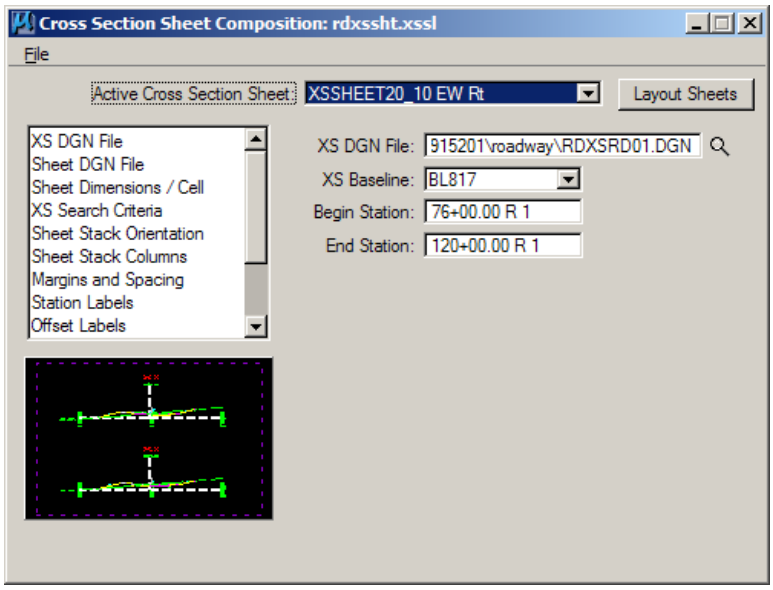




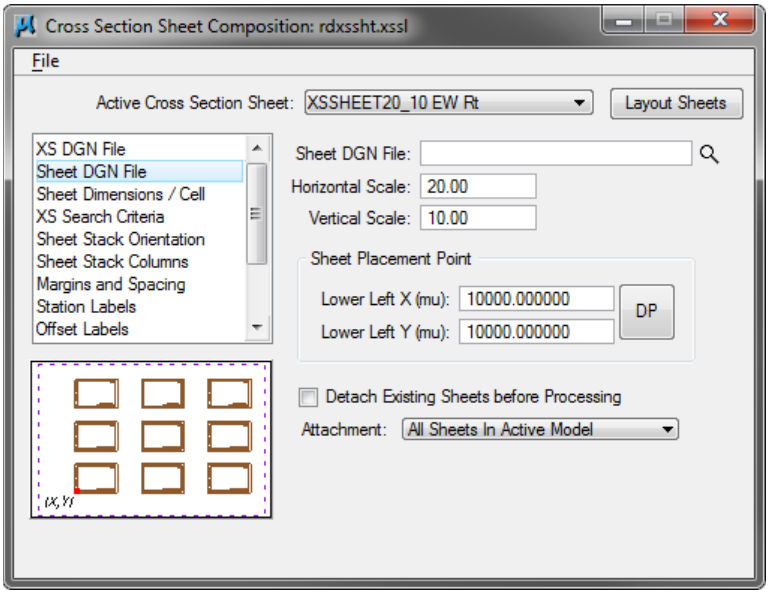
6. Select the sheet **XSSHEET20_10EW Rt**.



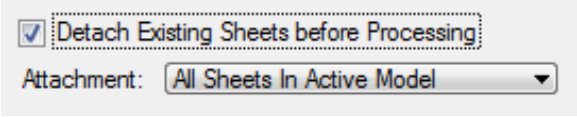




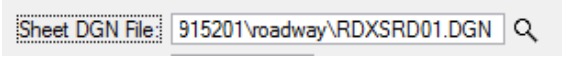
7. Select **Sheet DGN File**.



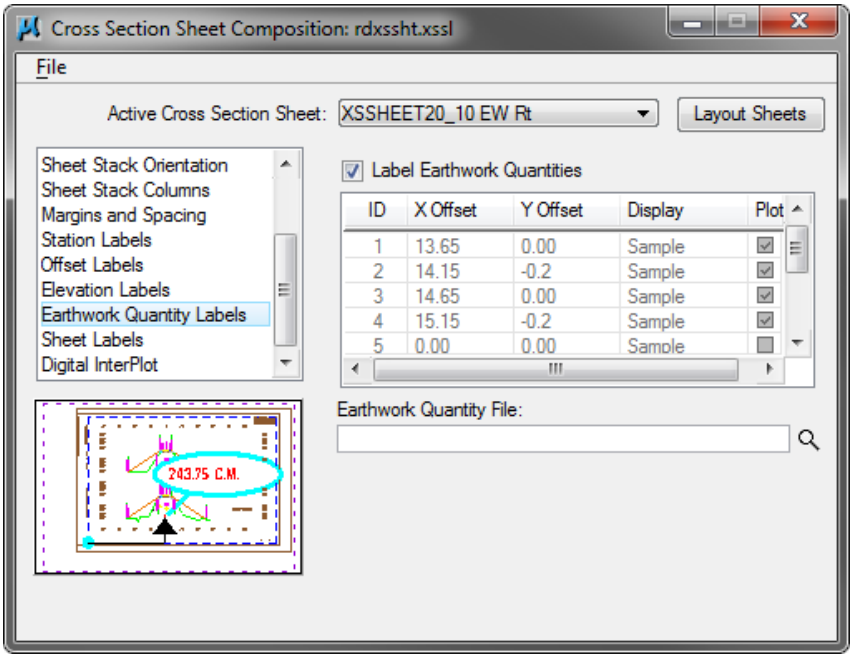
8. Enable the check box for **Detach Existing Sheets before Processing**.



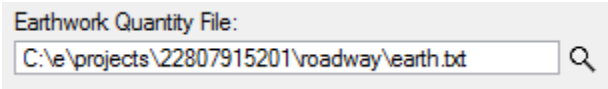
9. Select or key-in **RDXSRD01.DGN** as the *Sheet DGN File* name.



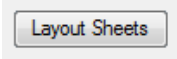
10. Select **Earthwork Quantity Labels**.

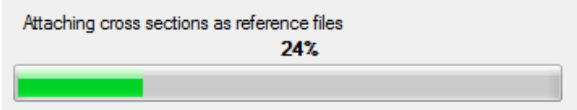


11. Select or key-in the file name **earth.txt** for the *Earthwork Quantity File*.



12. Select **File > Save Settings**.
13. Click the **Layout Sheets** icon. The cross sections will attach as reference files and laid out on the sheets.



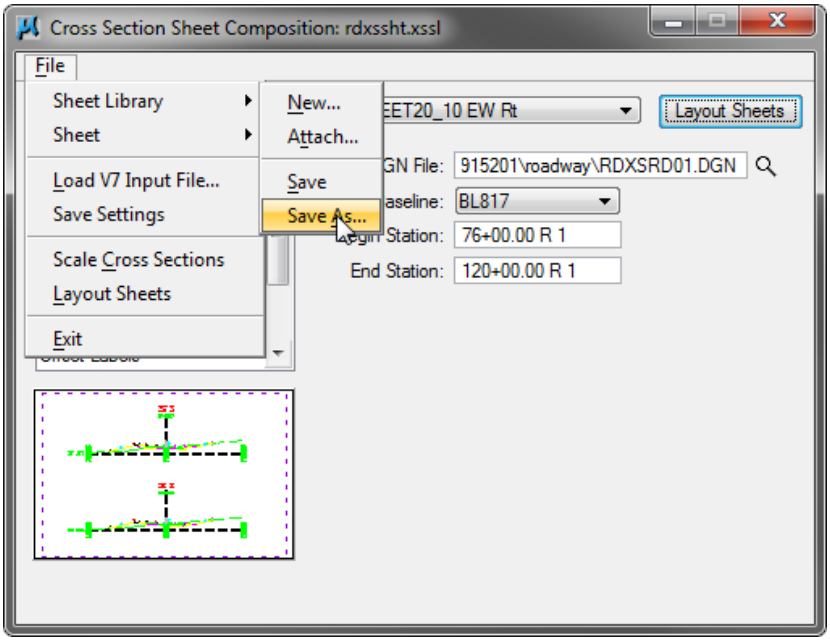


14. Close the Cross Section Sheet Composition dialog. When prompted to **Save Settings,** click **Yes**.
15. Review the sheets.

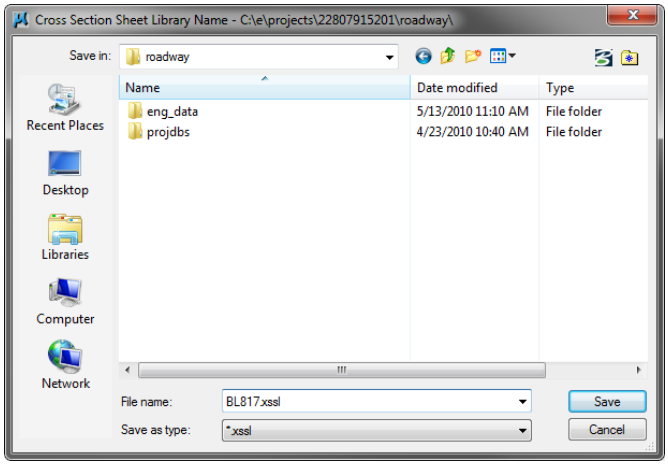
Exercise 9.2 Modifying the XS Sheet Layout

In this exercise, the user will save the Sheet Library to our project directory and then modify our sheet layout preferences.

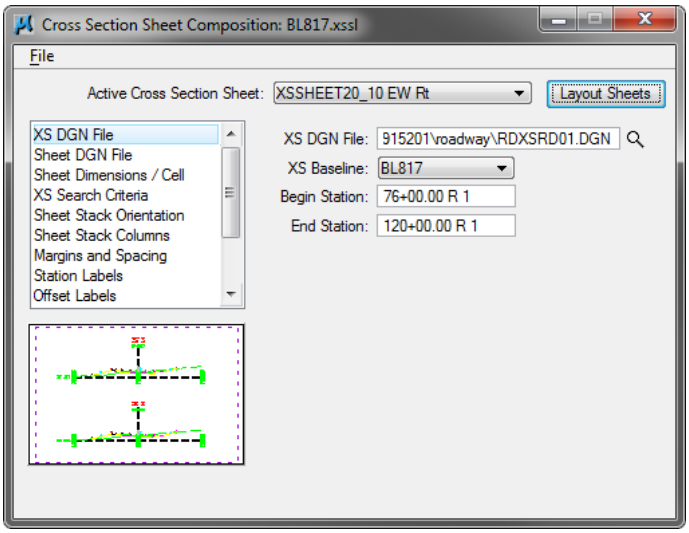
1. Access the previously created **Cross Section Sheet** run.
2. Select **File > Sheet Library > Save As.**



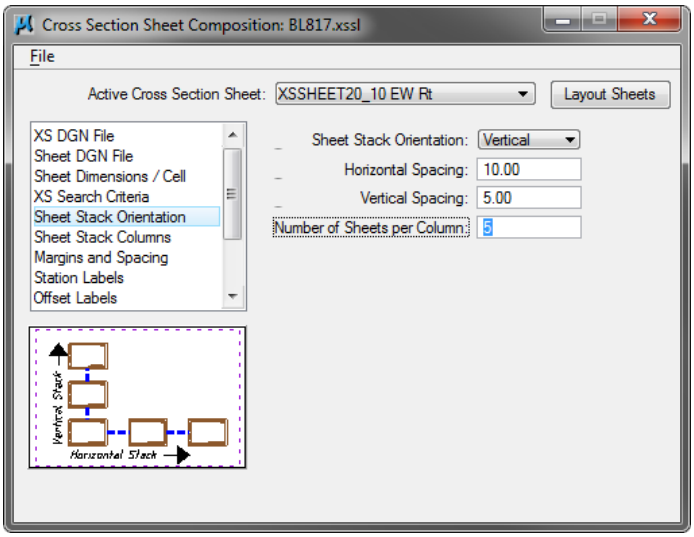
3. Save the file in your \roadway directory using the name **BL817.xssl** as shown.



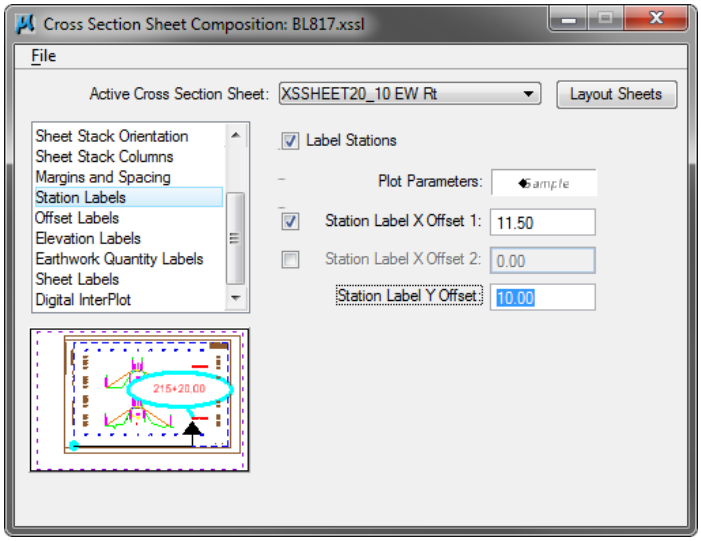
4. The dialog will automatically update and begin to use the newly created **BL817.xssl** sheet library.



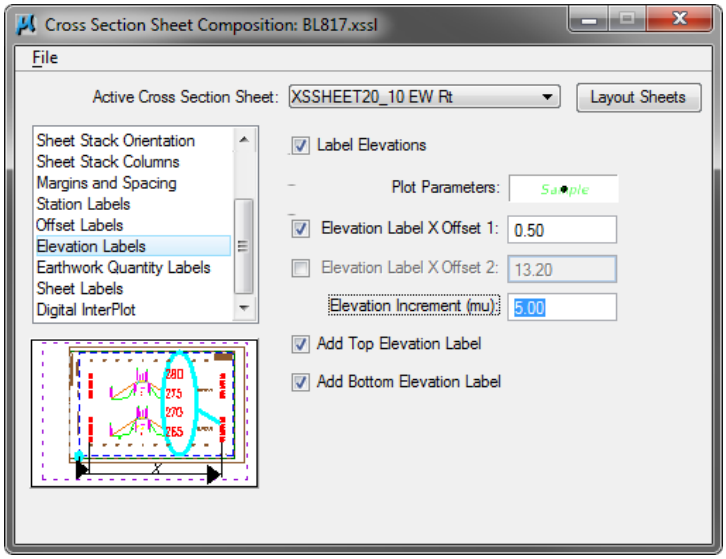
5. Select **Sheet Stack Orientation** and change the *Number of Sheets per Column* to **5.**



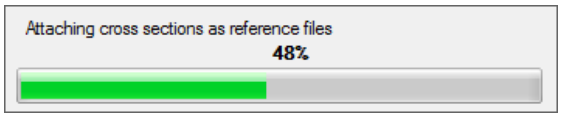
6. Select **Station Labels** and change the *Station Label Y Offset* to **10**.



7. Select **Elevation Labels** and change the *Elevation Increment (mu)* to **5**.



8. Select **File** > **Sheet** > **Update**.
9. Select **File** > **Sheet Library** > **Save**.
10. Click the **Layout Sheets** icon. The cross sections will lay out on the sheets.



11. Close the Cross Section Sheet Composition dialog. When prompted to **Save Settings,** click **Yes**.
12. Review the sheets and then exit MicroStation.

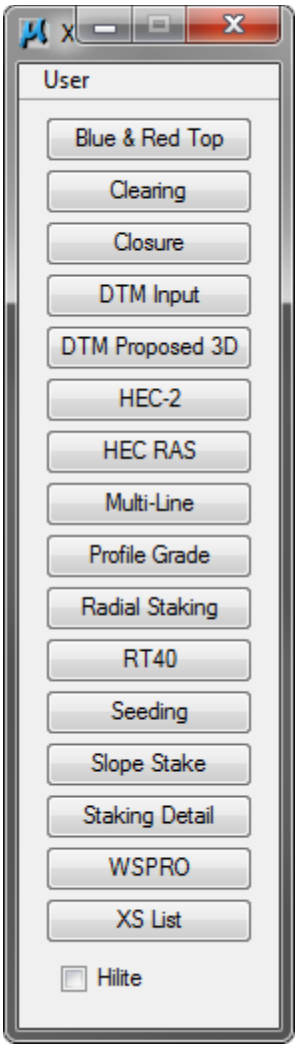
10 CROSS SECTION REPORTS

OBJECTIVES

- Overview of several Cross Section Reports
- Exercise to create an FDOT GEN file

WORKFLOW

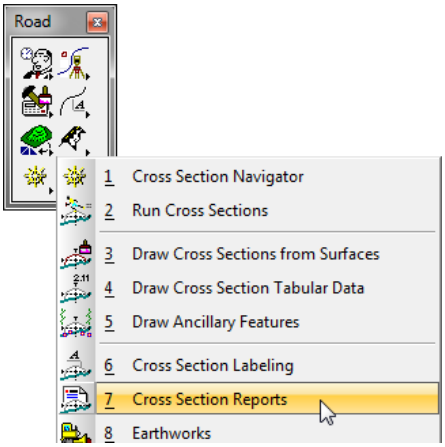
The GEOPAK Cross Section Report Utility can extract many different reports from existing and proposed cross-sections. For each report generated, the user must set the parameters of the existing and/or proposed cross sections. GEOPAK also provides an option to make custom headers for each of the reports via the User pull down menu.



ACCESSING CROSS SECTION REPORTS

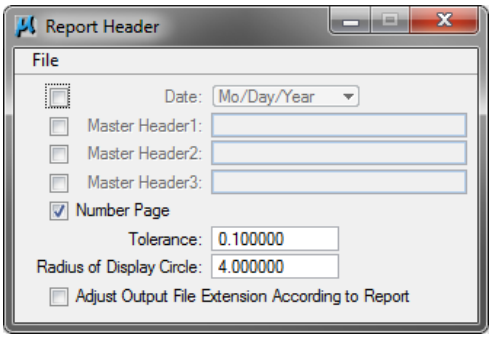
The **Cross Section Reports** dialog can be accessed by selecting:

- From the MicroStation Menu by selecting: **Applications** > **ROAD** > **Cross Sections** > **Reports**.
- From Road Project by clicking the **Reports & XS Quantities** icon.
- By selecting the **Cross Section Reports** icon from the ROAD tool frame.

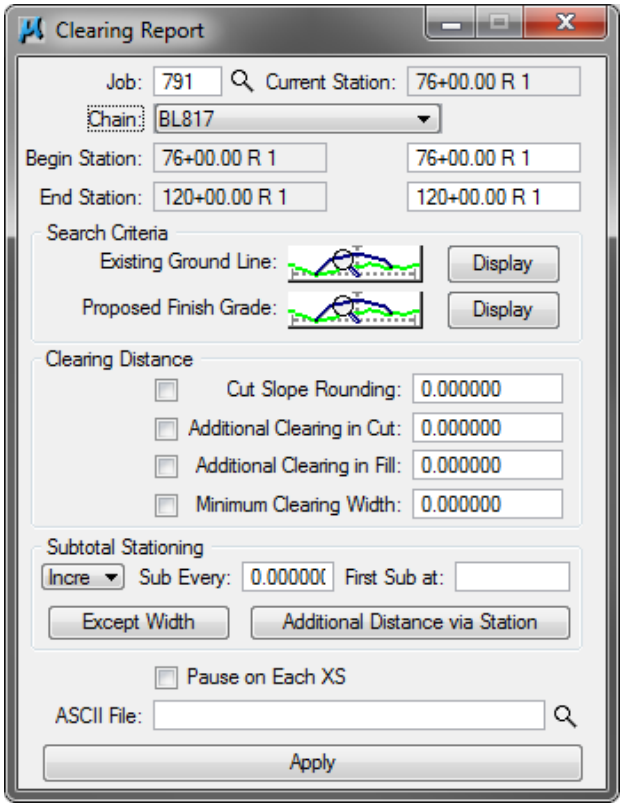


CUSTOMIZE REPORT HEADER

From the **XS Report** dialog, select **User > Preferences.** To activate the individual fields simply toggle on the box next to the desired field. Once the user has completed the dialog box, the information will be saved as an .hdr file. This allows for the creation of a separate header for each type of report. The **tolerance** field determines the maximum gap allowed between cross section elements.



CLEARING REPORT



The Clearing Report is useful for obtaining clearing and grubbing quantities. For each station, GEOPAK will list the clearing distance on each side of the chain and the width of any exception. The user can obtain the results in the appropriate units. Toggle boxes for Cut Slope Rounding, Additional Clearing in Cut and Fill, and Minimum Clearing Width are provided for increased control over the output.

Job / Chain At the top of the dialog, the **Job** number and **Chain** are required.

Begin/End Station GEOPAK determines the beginning and ending station within the MicroStation file and they are noted below the chain and placed in the key-in areas.

Search Criteria

Existing Ground Line The designer may key-in the required parameters, leaving the wide range of defaults where specific parameters are not needed.

Proposed Finish Grade As with the Existing Ground Line, only enough parameters to uniquely identify the Proposed Finish Grade are required.

Clearing Distance Below the Proposed Finish Grade section are four optional features.

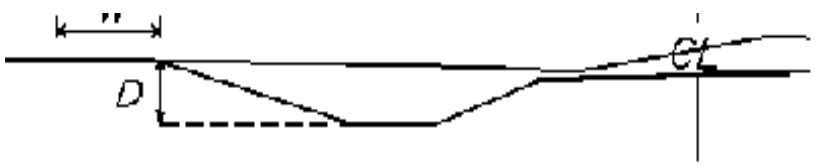
Cut Slope Rounding Since the graphical cross sections typically do not show slope rounding, the user can specify an additional clearing distance outside the linear slope stake to account for cut slope rounding.

Additional Clearing in Cut Horizontal distance added in a cut situation.

Additional Clearing in Fill Horizontal distance added in a fill situation (as determined by the element which ties to existing ground)

Minimum Clearing Width If the computed minimum clearing width is less than the specified value, the software will utilize the specified value.

All values are in master units (i.e. feet or meters). GEOPAK's application of the **Cut Slope Rounding, Additional Clearing in Fill** and the **Minimum Clearing Width** can best be explained utilizing the following illustration.



First, GEOPAK measures the vertical depth of the ditch at the tie down point. (D in the illustration). That depth is then compared to the value specified in the Cut Slope Rounding field in the dialog. The computed Minimum Clearing Width in the two conditions is:

- If the Cut Slope Rounding > Ditch Depth, then the computed minimum clearing width = the Ditch Depth (D) + Additional Clearing in Cut value.
- If the Cut Slope Rounding < Ditch Depth, then the computed minimum clearing width = Cut Slope Rounding value + Additional Clearing in Cut value.

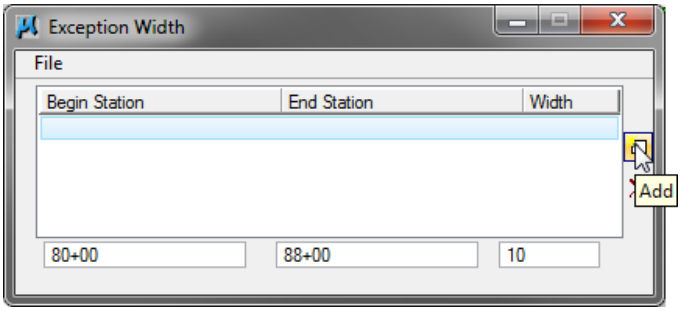
Now that we have the computed Minimum Clearing Width, its value is compared to the Minimum Clearing Width specified in the dialog.

- If the dialog value is more than the computed value, then the dialog value is utilized.
- If the computed value is more than the dialog value, then the computed value is utilized.

As seen in the illustration the minimum clearing width (W) is measured (horizontally) from the tie down point.

Subtotal Stationing Subtotals are also supported for both Even and Incremental stationing. The increment is defined in the **Sub Every** field, while the station of the first subtotal is defined in the **First Sub At** field.

Except Width When selected, the dialog depicted below is invoked.

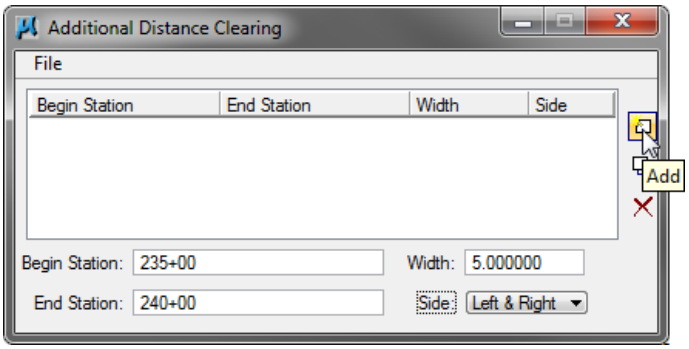


Fields are supported for **Begin Station**, **End Station**, and Exception **Width**. Simply type in the values in the keyin fields at the bottom of the dialog and press the **Add** icon. The information is then displayed in the list box.

To delete a line, highlight the desired line, then press the **Delete** icon.

Standard File options are supported: **Open**, **Save**, **Save As**, and **Exit**. Utilizing these file options, the user can store exception widths for recall in a subsequent session.

Additional Distance via Station When selected, the dialog depicted below is invoked.



Fields are supported for **Begin Station**, **End Station**, and **Width**. Simply type in the values in the keyin fields at the bottom of the dialog and press the **Add** icon. The information is then displayed in the list box.

To delete a line, highlight the desired line, then press the **Delete** icon.

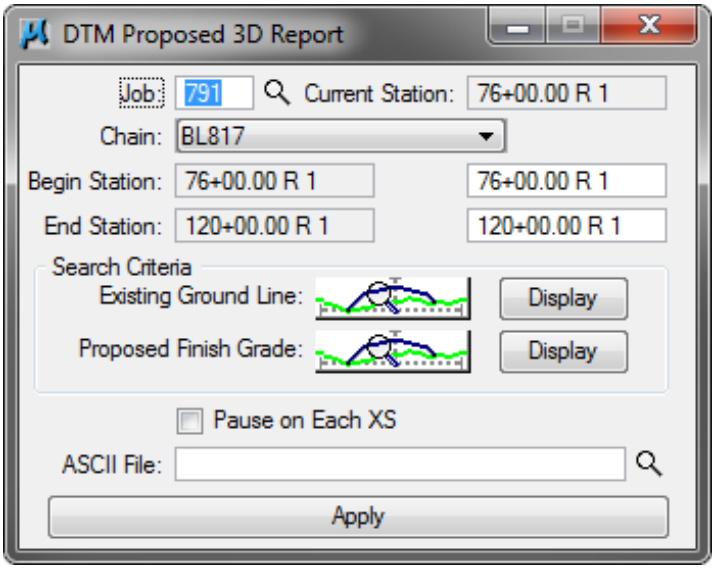
Standard File options are supported: **Open**, **Save** and **Save As**. Utilizing these file options, the user can store additional clearing widths by station ranges and side for recall in a subsequent session.

Pause on Each XS An option for processing sections one at a time can be utilized by activating the **Pause on Each XS** toggle at the bottom of the dialog. When activated, GEOPAK will process the first section, display the cross section on the screen (within the limits of the cell), and display the station in the **Current Station** output field located at the top of the dialog. The elements specified in the search criteria are also highlighted. To continue to the next cross section, simply press the **Apply** icon on the bottom of the dialog.

ASCII File You identify the name of the ASCII report at the bottom of the dialog. The designer has the option of keying in the file name, or upon selection of the **Select File** icon ( ), the **Report File** dialog will appear, allowing the designer to select the desired file. The file will be placed in the current directory, unless a full path is specified. If the specified file name already exists, the file will be overwritten with no warning message given.

Apply When the dialog has been completed, simply select the **Apply** icon to begin the report generation.

DTM PROPOSED 3D REPORT



GEOPAK locates specified proposed cross section elements and existing ground, and generates an x, y, z file (GEOPAK .DAT 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 element is intersected. The proposed path is followed until it ties back to an existing ground element.

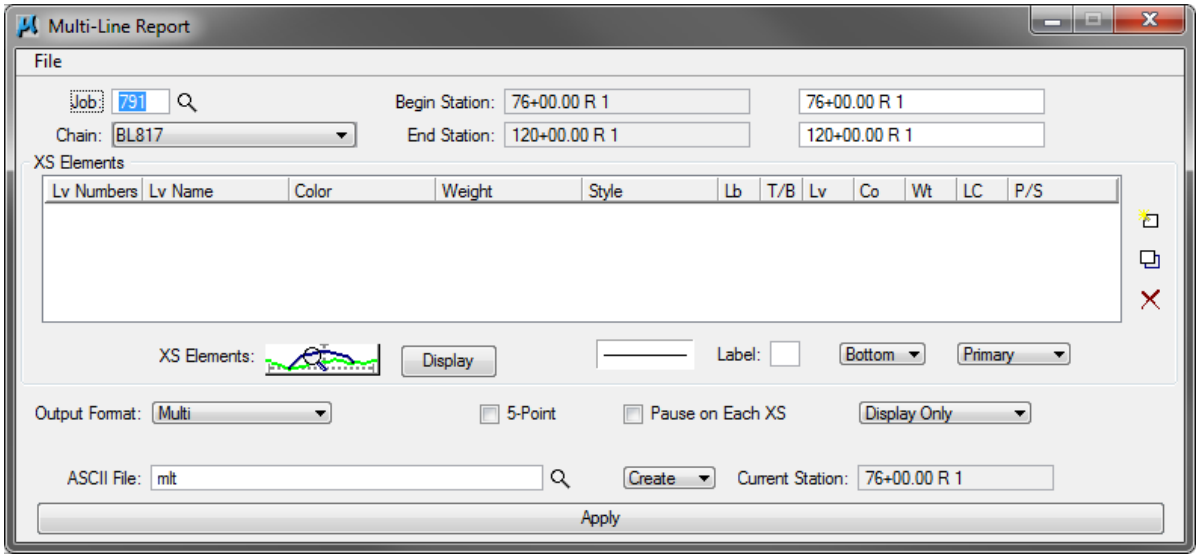
Job / Chain At the top of the dialog, the **Job** number and **Chain** are required. GEOPAK determines the beginning and ending station within the MicroStation file and they are noted below the chain and placed in the key-in areas.

Search Criteria The next two sections specify the search criteria for the **Existing Ground Line** and **Proposed Finish Grade**. The designer may key-in the required parameters, leaving the wide range of defaults where specific parameters are not needed.

ASCII File At the bottom of the dialog, the user specifies the name of the ASCII file to be generated. The designer has the option of keying in the file name, or upon selecting the **Select File** icon ( ) which will bring up the Report File dialog, allowing the designer to select the desired file. The file will be placed in the current directory, unless a full path is specified. If the specified file name already exists, the **file will be overwritten with no warning message given.**

Apply When the dialog has been completed, simply select the **Apply** icon to begin the report generation.

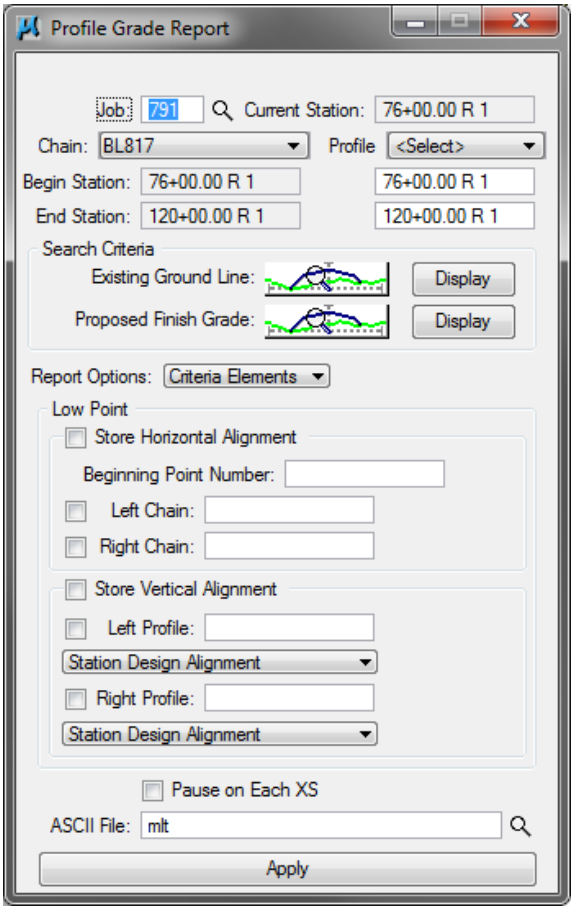
MULTI-LINE REPORT



This report is useful in creating a GEN file for use by Construction personnel or exporting templated cross sections to various data collector formats.

- Begin by entering the job number, chain name and station limits.
- Next, enter the symbology for each surface to be traced.
- Once all the parameters have been entered, the new cross section elements may be drawn to the design file or the user may choose the display only option. An ASCII text file will be generated.

PROFILE GRADE REPORT



The **Profile Grade Repor**t is one of the most versatile reports available. It prints existing ground and design grade elevations and low point elevations for each cross section. Additionally, this report has the ability to search either for the low points or any text string that you specify and create horizontal and vertical alignments and store them directly into the .gpk. Horizontal alignments created from this report will have no curves.

Job / Chain At the top of the dialog, the **Job** number and **Chain** are required. GEOPAK determines the beginning and ending station within the MicroStation file and they are noted below the chain and placed in the key-in areas.

Search Criteria The next two sections specify the search criteria for the **Existing Ground Line** and **Proposed Finish Grade**. The designer may key-in the required parameters, leaving the wide range of defaults where specific parameters are not needed.

Report Options Three reports are supported in the center of the dialog: Criteria Elements, Search Text and Offset. When selected, the dialog dynamically changes to reflect the selected option.

Criteria Elements The **Criteria Elements** option utilizes the graphic elements to determine the low point on the proposed finish grade surface on the left and right side of the section.

Search Text The **Search Text** option utilizes text placed during the proposed cross section processing to generate a profile.

Offset The **Offset** option creates a profile for any given chain and horizontal offset value.

CRITERIA ELEMENTS

Low Point > **Store Horizontal Alignment**: The designer has the option to create a chain on either or both sides at the low point by simply activating the toggle to the left.

Beginning Point Number Must be specified as GEOPAK will create a series of POTs. No curves will be fit into the chain. An initial stationing of 0+00 will be utilized.

Left Chain or Right Chain: Activate the appropriate toggle to indicate which chain or, if both are desired, activate both toggles, then specify the name of the chain(s) to be generated.

Note The chain name should conform to standard GEOPAK convention, i.e. 1-9 alpha numeric characters with no special characters.

Low Point > Store Vertical Alignment: The designer has the option to create a profile on either or both sides at the low point by simply activating the toggle to the left.

Left Profile or Right Profile: Activate the appropriate toggle to indicate which profile is desired next to or, if both are desired, activate both toggles, then specify the name of the profiles(s) to be generated.

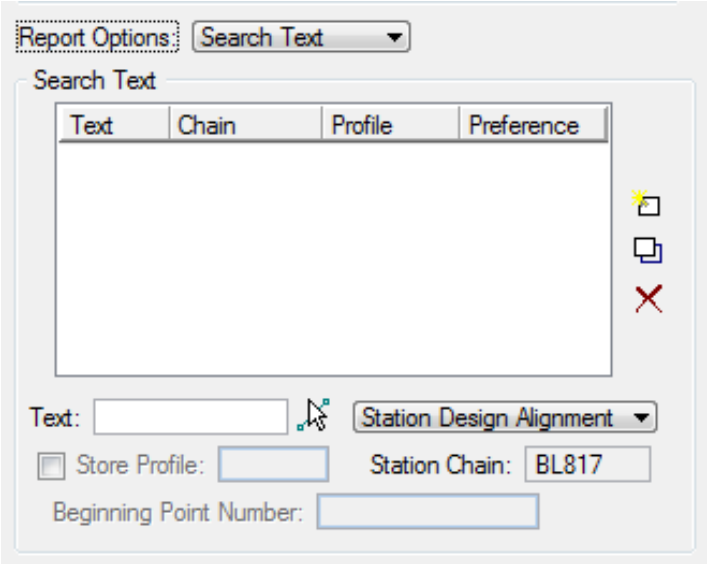
Note The profile names should conform to standard GEOPAK convention, i.e. 1-9 alpha numeric characters with no special characters.

Stationing the profiles: Two options (via a toggle) are available:

Station Design Alignment - The stationing of the Chain listed in the top of the dialog will be utilized as the profile stationing. In this case, creation of the horizontal alignment is not necessary.

Station Low Point Alignment - The stationing of the chain created from the Store Horizontal alignment will be utilized. In this case, the Store Horizontal Alignment and appropriate chain toggles must be activated, and the chain name must be keyed into the dialog box.

SEARCH TEXT



Text Enter the text string located on the cross section, in this case EOP.

Store Profile If active, a profile named EOP1 will be generated.

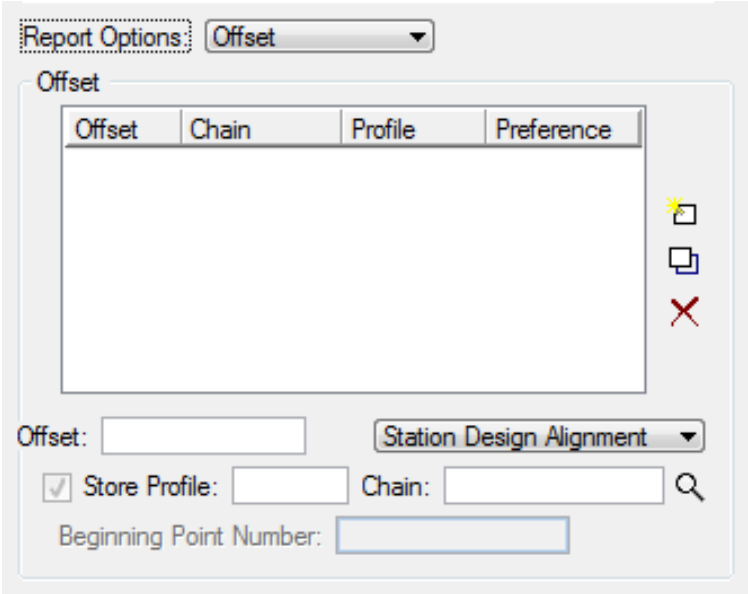
Station Design Alignment The stationing of the chain is utilized.

Add Select to add the information is to the list box.

ASCII File At the bottom of the dialog, specify the name of the ASCII file to be generated. The designer has the option of keying in the file name, or upon selection of the **Select File** icon, the Files dialog is invoked, allowing the designer to select the desired file. The file is placed in the current directory, unless a full path is specified. If the specified file name already exists, the file will be overwritten with no warning message given. Standard File utilities (Open, Save, Save As) are supported to save the dialog settings for subsequent use.

Apply When the dialog has been completed, simply select the icon to begin the report generation.

OFFSET



Offset Enter to be utilized for the profile.

Store Profile The name of the profile to be created.

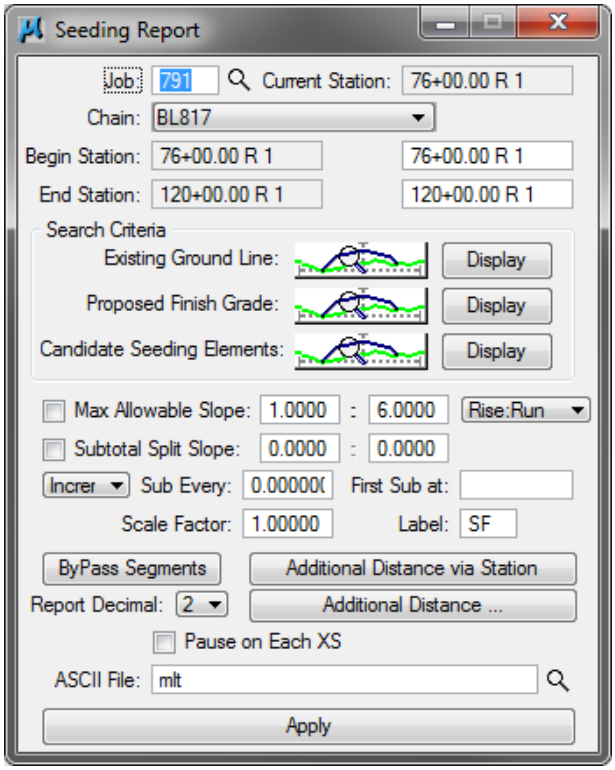
Station Design Alignment Selection utilizes the stationing of the chain.

Add Select to add the information to the list box.

ASCII File At the bottom of the dialog, specify the name to be generated. The designer has the option of keying in the file name, or upon selection of the **Select File** icon ( ), the Report File dialog is invoked, allowing the designer to select the desired file. The file is placed in the current directory, unless a full path is specified. If the specified file name already exists, **the file will be overwritten with no warning message given.**

Apply When the dialog has been completed, simply select the icon to begin the report generation.

SEEDING REPORT



For each station, the **Seeding Report** provides seeding slope distances right and left. Then GEOPAK computes the average slope distance on each side, and uses the results to compute seeding areas. Optional subtotals can also be requested. To invoke the report, press the **Seeding** push icon on the **XS Reports** dialog.

Job / Chain At the top of the dialog, the **Job** number and **Chain** are required. GEOPAK determines the beginning and ending station within the MicroStation file and they are noted below the chain and placed in the key-in areas.

Search Criteria The *Existing Ground Line, Proposed Finish Grade and Candidate Seeding Elements*. The designer may key-in the required parameters, leaving the wide range of defaults where specific parameters are not needed. *Candidate Seeding Elements* specifies the portions of the cross sections that will be seeded if all slope conditions are met.

Max Allowable Slope This dictates to the software the maximum slope that will be included in the calculations. For example, if the Maximum Allowable Slope is set to 2:1 (Run:Rise), then a cross section element with a slope of 1:1 will not be included in the calculations. Two key-in fields are provided for the values and an option icon specifies Run:Rise or Rise:Run. If this option is desired, simply activate the toggle to the left of the Max Allowable Slope.

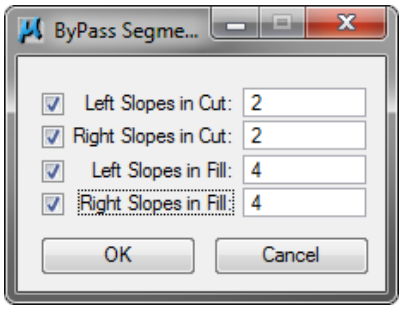
Subtotal Split Slope This feature (when activated by the toggle to the left) will split the area quantities based on the provided slope. For example, if the specified Subtotal Split Slope is 3:1, then the area quantities will be split into areas steeper than 3:1 slope and areas flatter than or equal to a 3:1 slope.

Sub Every Subtotals are provided at the user-defined intervals defined by **Sub Every** keyin field.

Increment or **Even** Specifies whether the distances should be calculated along the alignment or whether the distances should be rounded to the even station.

First Sub At Keyin field identifies the first subtotal station as well as the station from which subtotals are calculated.

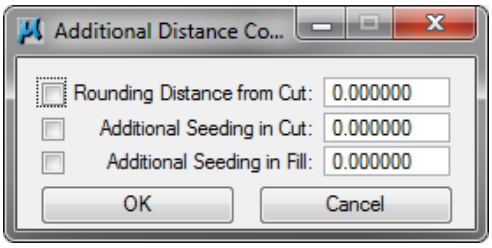
ByPass Segments



Any combination of the four options can be activated via the toggle(s) to the left. To determine whether the cross section is in Cut or Fill, the software utilizes the segment which ties to existing ground. When the software encounters a condition which has been activated, it will ignore the specified number of segments emanating from tie down point and moving towards centerline.

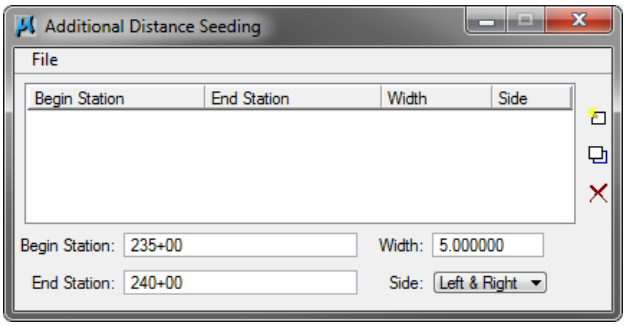
For example, if a cross section has five **Candidate Seeding Elements** segments on the left and is in a Cut situation at the tie down point, and utilizing the dialog above, GEOPAK will identify the five segments, ignore the two closest to the tie down point, and utilize the remaining three for computations. If the right side of the cross section has six **Candidate Seeding Elements** and is in a Fill situation, GEOPAK will identify the six segments, ignore the tie down segment, and utilize the remaining five for computations.

Additional Distance



Any combination of the three options can be activated via the toggle(s) to the left. To determine whether the cross section is in Cut or Fill, the software tests the segment that ties to existing ground. When encountering an activated condition, the software will add specified Horizontal Distance (in master units) to the dialog to the measured the distance on the cross section (or subtract from, if the value is a negative number).

Additional Distance via Station Select if the additional seeding is not consistent throughout the project to specify Additional Distances by station range, right, left, or right and left.



Key-in the desired stations, Width, and select the side option.

Press the Add icon, which populates the list box.

To modify a line, highlight the line, which populates the edit fields. Make the desired change, and then press the **Modify** icon. The list box updates to the edited data.

To delete a line, simply highlight the line, then press the **Delete** icon.

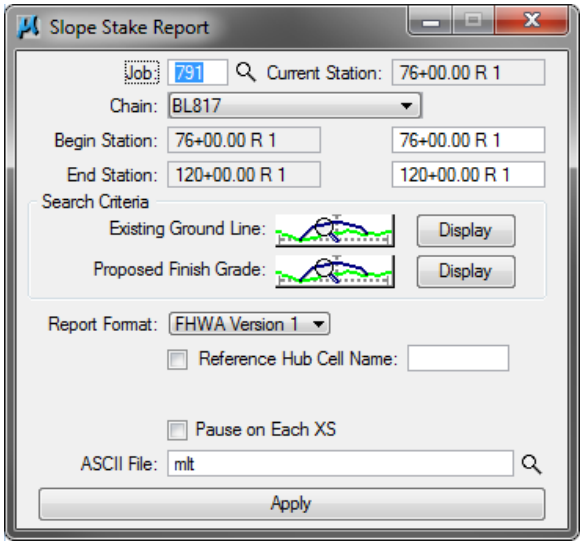
Report Decimal The number of decimal places to be used in the report should be specified in this field. The options available are 0 through 6.

Pause on Each XS An option for processing sections one at a time. When activated, GEOPAK will process the first section, display the cross section on the screen (within the limits of the cell), and display the station in the **Current Station** display field located at the top of the dialog. The elements specified in the search criteria are also highlighted. To continue to the next cross section, simply press the **Apply** icon on the bottom of the dialog.

ASCII File Specify the name of the file to be generated. The designer has the option of keying in the file name, or upon selection of the **Select File** icon ( ), the Report File dialog will appear, allowing the designer to select the desired file. The file will be placed in the current directory, unless a full path is specified. If the specified file name already exists, the file will be overwritten with no warning message given.

Apply When the dialog has been completed, select to begin the report generation.

SLOPE STAKE REPORT



The slope stakes report generates offsets, elevations, as well as superelevation information. This is a special format report developed for the U.S. Federal Highway Administration and is traditionally used extensively on FHWA construction projects. To invoke the report, press the **Slope Stake** push icon on the **XS Reports** dialog.

Job / Chain At the top of the dialog, the **Job** number and **Chain** are required. GEOPAK determines the beginning and ending station within the MicroStation file and notes below the chain and placed in the key-in areas.

Search Criteria The next section specifies the search criteria for the **Existing Ground Line** and **Proposed Finish Grade**. The designer may key-in the required parameters, leaving the wide range of defaults, not needing any specific parameters.

Report Format FHWA Version 1 and 2, Nebraska, and Wyoming.

Reference Hub Cell Name Identifies any MicroStation cells previously drawn onto the cross sections to indicate Reference Hubs placed in the field during the original ground survey.

Pause on Each XS An option for processing sections one at a time. When activated, GEOPAK will process the first section, display the cross section on the screen (within the limits of the cell), and display the station in the **Current Station** display field located at the top of the dialog. The elements specified in the search criteria are also highlighted. To continue to the next cross section, simply press the **Apply** icon on the bottom of the dialog.

ASCII File Specify the name of the file to be generated. The designer has the option of keying in the file name, or upon selection of the **Select File** icon ( ), the Report File dialog will appear, allowing the designer to select the desired file. The file will be placed in the current directory, unless a full path is specified. If the specified file name already exists, **the file will be overwritten with no warning message given.**

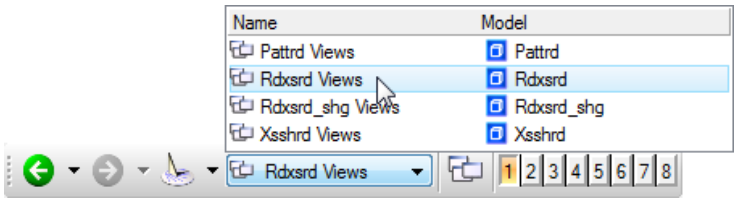
Apply When the dialog has been completed, select to begin the report generation.

Exercise 10.1 Create a GEN File using Multi-Line Report

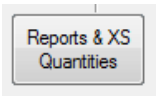
In this exercise, the user will create a GEN file of cross section data for Construction personnel.

The files for these exercises are included in the Chapter 8 exercise file that you have already unzipped.

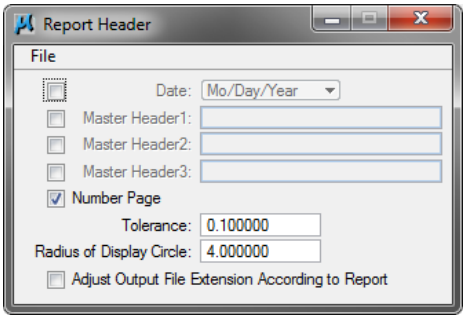
1. Open the design file C:/e/Projects/228079115201/roadway/*RDXSRD01.dgn*.
2. Change the active *model* to **Rdxsrd**.



3. Access Project Manager.
4. From Road Project, click the **Reports & XS Quantities** icon.

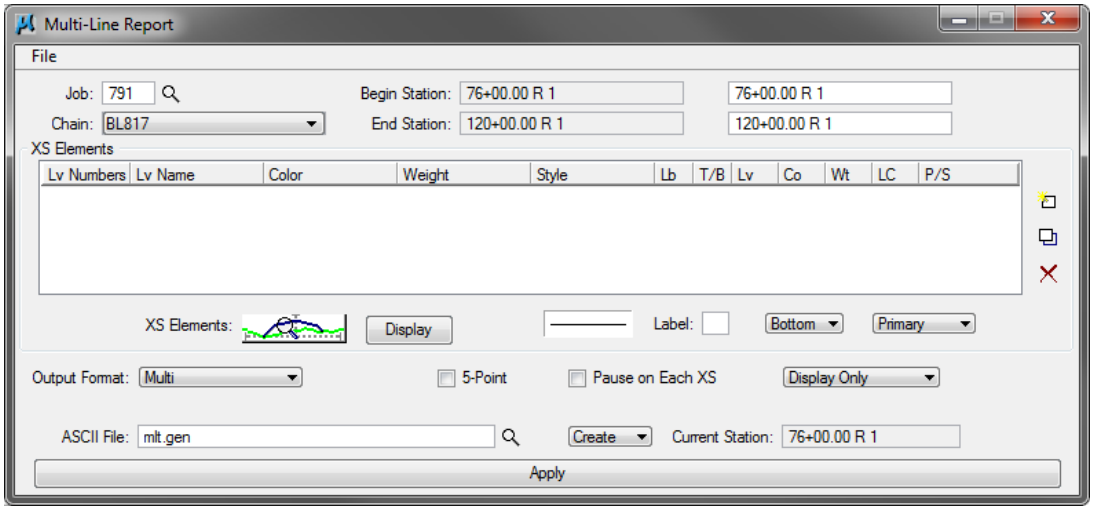


5. Select **User** > **Preferences** from the XS Report dialog to see the Report Header dialog.

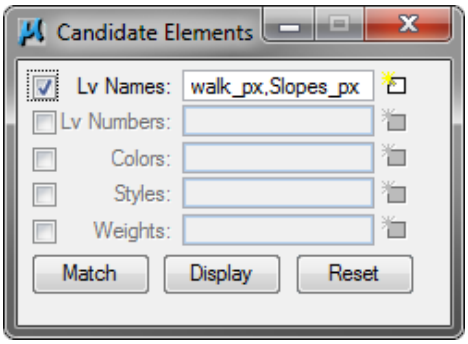


6. Verify that the *tolerance* is set **0.1** for all cross section reports.
7. Close the Report Header dialog.
8. Click **Multi-Line** from the XS Report dialog.

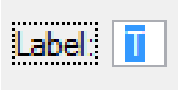
9. The **Job** number, **Chain** and **Station** *fields* should be filled out.



10. Click the **XS Elements** icon.
11. Select the following **Lv Names** to define the finished grade:
    - CandG_px
    - Driveway_px
    - ShldrUnpaved_px
    - Sidewalk_px
    - Slopes_px
12. Close the Candidate Elements dialog.

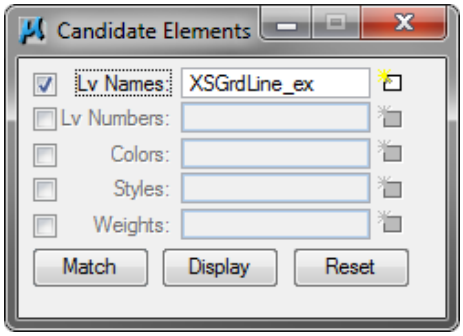


13. Set the *Top/Bottom combo* to **Top** and the *Primary/Secondary combo* to **Primary**.
14. Make sure *Label* is set to **T**.



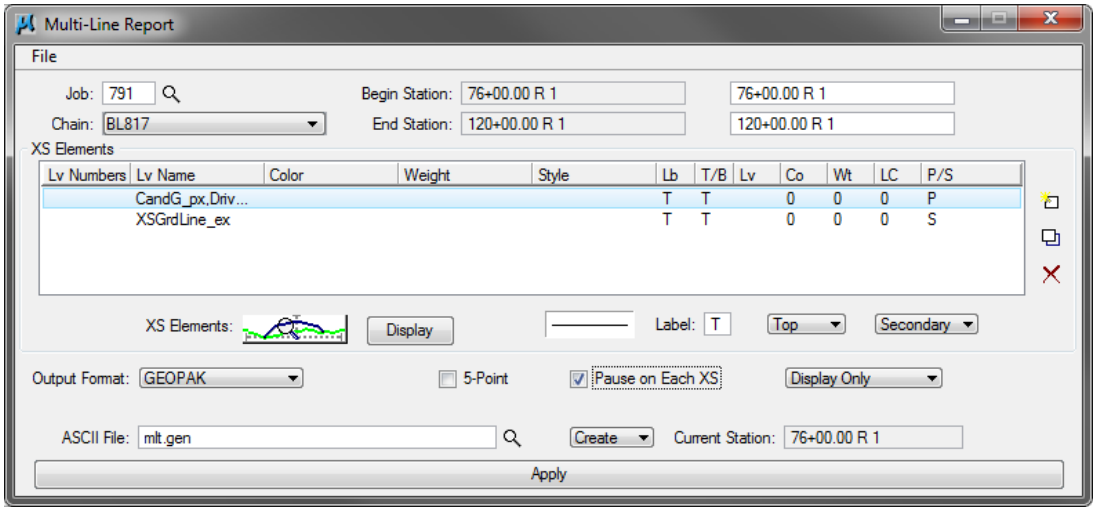
15. Add this surface to the list.

16. Click the **XS Elements** icon again.
17. Click **Reset** to clear the *Lv Names* field.
18. Select the following *Lv Name* to define the existing grade:
    - XSGrdLine_ex



19. Close the Candidate Elements dialog.
20. Set the Top/Bottom combo to Top and the Primary/Secondary combo to Secondary.

21. Add this surface to the list.



22. Set the *Output Format* to **GEOPAK**.
23. Enable **Pause on Each XS** toggle and then click **Apply** to process the first section.
24. Disable the **Pause on Each XS** toggle and then click **Apply** to process the remaining cross sections.
25. Close the Multi-Line and XS Report dialogs.
26. Review the **GEN** file with a Text Editor. The following is a Sample output.

GROUND MULTILINE DATA LINE TYPE S

```
XS 76+00.00 R   1      -138.60    5.35    -125.87    5.30    -118.79    5.35    -118.12    5.35
XS 76+00.00 R   1      -116.55    5.36    -116.08    5.36    -115.42    5.37    -114.81    5.38
XS 76+00.00 R   1      -112.66    5.41    -112.01    5.41    -107.33    5.42    -106.89    5.43
XS 76+00.00 R   1      -100.68    5.43    -100.10    5.44     -99.23    5.45     -98.35    5.46
XS 76+00.00 R   1       -97.04    5.47     -96.18    5.47     -79.38    5.68     -76.97    5.72
XS 76+00.00 R   1       -74.95    5.23     -68.95    5.35     -68.44    5.35     -68.28    4.85
XS 76+00.00 R   1       -55.95    5.32     -39.95    5.76     -28.95    5.98     -17.95    6.20
XS 76+00.00 R   1         4.55    6.40       4.72    6.90       5.22    6.90       7.88    6.77
XS 76+00.00 R   1         8.55    6.27      10.05    6.24      21.05    6.04      32.05    5.82
XS 76+00.00 R   1        50.11    5.30      54.11    5.08      66.67    4.38      67.90    4.24
XS 76+00.00 R   1        73.00    4.21      73.54    4.18      78.47    4.07      92.91    3.90
XS 76+00.00 R   1        99.23    2.82     100.43    1.77     128.33    1.79     138.69    1.77
XS 77+00.00 R   1      -139.87    6.21    -138.59    6.04    -132.04    5.60    -131.54    6.13
XS 77+00.00 R   1      -114.60    5.72    -114.18    6.12    -113.52    5.98    -111.52    5.95
XS 77+00.00 R   1      -101.09    5.98     -99.93    5.97     -99.56    5.49     -94.08    5.49
XS 77+00.00 R   1       -78.53    5.49     -77.31    5.52     -75.95    4.84     -74.95    4.86
XS 77+00.00 R   1       -68.45    4.98     -68.28    4.48     -66.95    4.65     -55.95    4.98
XS 77+00.00 R   1       -28.95    5.68     -17.95    5.90       0.00    6.26       4.55    6.35
XS 77+00.00 R   1         5.22    6.85       7.88    6.97       8.38    6.97       8.55    6.47
XS 77+00.00 R   1        21.05    6.24      32.05    6.02      47.05    5.42      68.21    3.97
XS 77+00.00 R   1        72.47    3.95      82.37    4.28      85.45    4.35      93.68    3.91
        XS 77+00.00 R   1        96.60    3.90      97.40    3.53      98.14    3.38      99.06
                                                                                            2.27
```