



GEOPAK V8i SELECTseries 1, Road 2



Ohio Department of Transportation
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1 Getting Started

1.1 Course Outline/Prerequisites

This class is intended for ODOT personnel involved in the production of roadway construction plans. It is recommended that students have knowledge of the following:

- Familiarity with ODOT design policies, procedures and CADD Standards
- A working knowledge of Windows 7
- A working knowledge of MicroStation V8i SELECTseries 1
- Completion of GEOPAK Road 1

This class is a continuation of the ODOT GEOPAK Road 1 training class. During this class, we will develop the existing and proposed cross sections for State Route 185.

Day 1	CPD Credit*
01 Getting Started	1.0 hours
02 Exiting Ground Cross Sections	2.0 hours
03 Underground Utilities	2.0 hours
04 Superelevation	3.0 hours
Day 2	CPD Credit*
05 Proposed Cross Sections	8.0 hours
Day 3	CPD Credit*
06 Cross Section Labeling	1.0 hours
07 Earthwork Quantities	3.0 hours
08 Seeding Quantities	1.0 hours
09 Limits of Construction	1.0 hours
10 Cross Section Sheets	2.0 hours

* Please note that final determination on what qualifies for CPD credit ultimately lies between the license holder and the State Board for Professional Engineers and Surveyors.



Start Time: 7:30 AM
End Time: 3:30 PM



Breaks: 15 Minutes per half day



Lunch: 45 Minutes



Web Browsing: Please limit web browsing to break times and lunch.



Email: Please limit email usage to break times and lunch.



Cell Phones: Please set cell phones to vibrate and take calls only at break times and lunch. Please refrain from texting during the class.

1.2 GEOPAK Support

The **Office of CADD and Mapping Services** has been designated to provide GEOPAK Support and training for ODOT personnel. The Office is also responsible for establishing, maintaining and distributing all ODOT CADD Standards.

The **Office of CADD and Mapping Services** maintains a MicroStation/GEOPAK support website on the ODOT website:

<http://www.dot.state.oh.us/Divisions/Engineering/CADDMapping/CADD/Pages/default.aspx>

This training guide is available on-line in Adobe Acrobat format at the following URL:

<http://www.dot.state.oh.us/Divisions/Engineering/CADDMapping/CADD/Pages/GPKManual.aspx>

The Design Resource Reference Center is a centralized reference center to help locate online or printed material. Additionally, several mailing lists are available to keep you informed about updates to ODOT standards. A CADD Standards mailing list is also available. Visit the Design Resource Reference Center at the following URL:

<http://www.dot.state.oh.us/drrc/Pages/default.aspx>

The Bentley community offers another great way to get support with MicroStation and GEOPAK problems. For more information, see the following URL:

<http://communities.bentley.com/>

1.3 ODOT CADD Standards for MicroStation and GEOPAK

ODOT CADD Standards for MicroStation and GEOPAK are maintained and distributed by the **Office of CADD and Mapping Services**. The [ODOT CADD Engineering Standards manual](#) for MicroStation and GEOPAK is available in Adobe Acrobat format at the following URL:

<http://www.dot.state.oh.us/Divisions/Engineering/CADDMapping/CADD/Pages/CADDManual.aspx>

Each ODOT District, and Central Office, maintains a copy of the ODOT CADD standards on a network drive, usually the “i” drive, in the “ODOTstd” subdirectory.

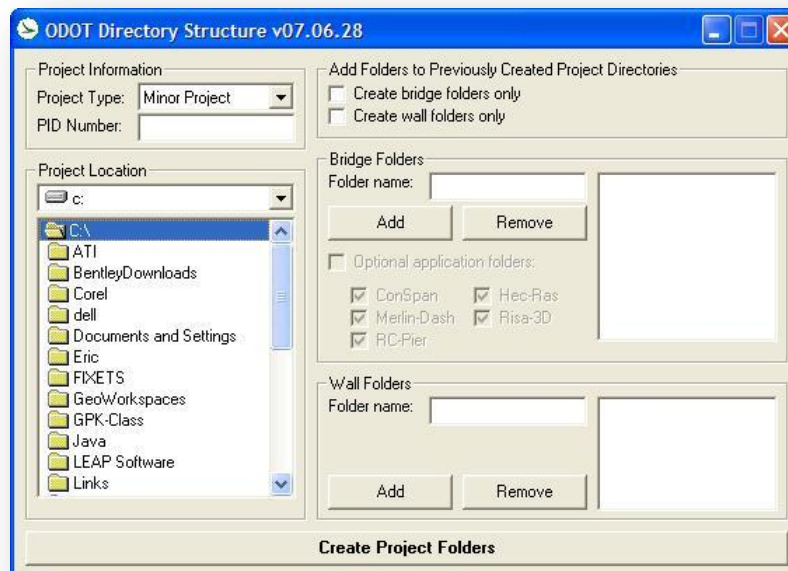
1.3.1 Standard Directory Structure

The [ODOT CADD Engineering Standards Manual](#), Section 301, defines the standard project directory structure to be used on all ODOT projects. This training class will use the directory structure for a Minor project. See the [ODOT CADD Engineering Standards Manual](#) for more information on directory structures.

A Visual Basic program is available to assist the project manager with the task of setting up the standard project directory structure. ODOT personnel can access the program from the following directory:

i:\ODOTstd\V8istd\vba\ODOT_Directory.exe

The application can also be accessed by selecting **ODOT > File Management > New Project Directory** from the MicroStation pull-down menu.



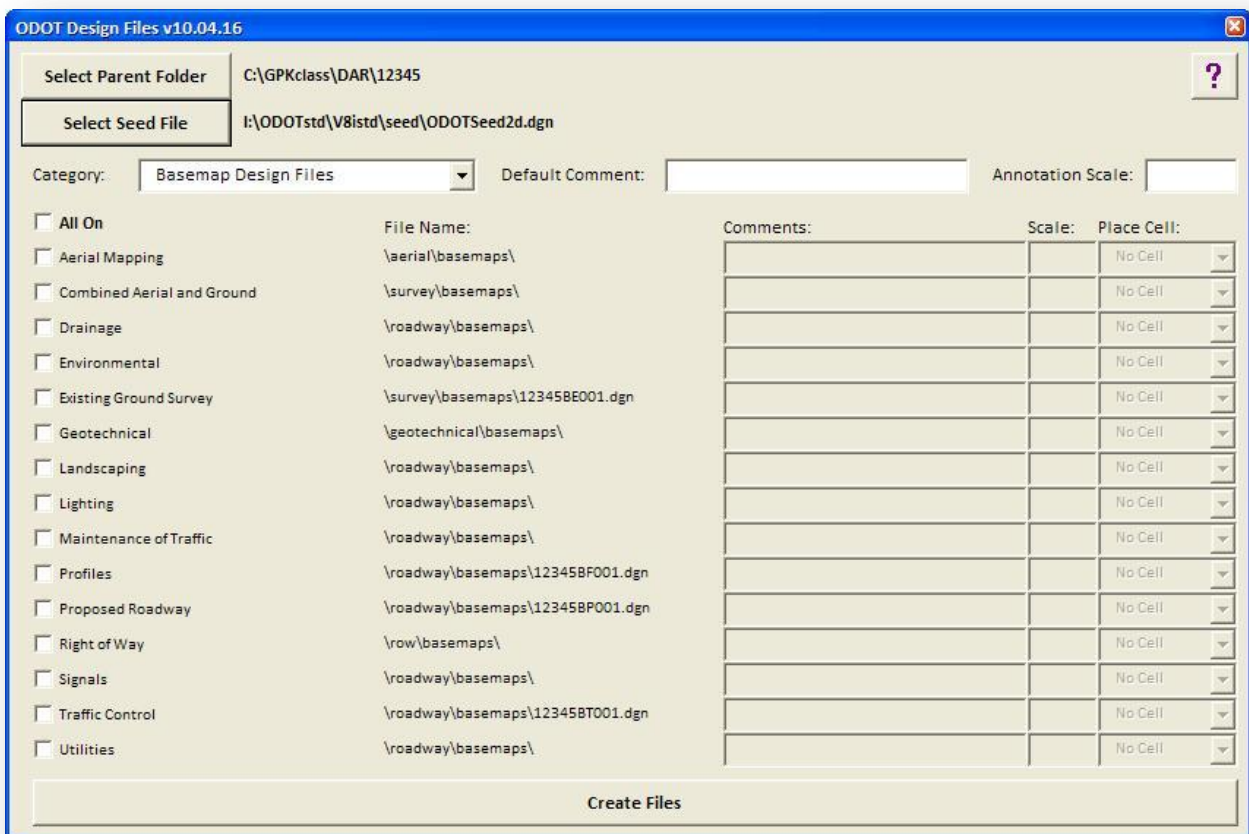
Documentation for the program is available on the ODOT CADD Support website.

1.3.2 Standard MicroStation Design File Names

The ODOT CADD Engineering Standards Manual, Section 303, defines the standard MicroStation DGN file names to be used on all ODOT projects. See the ODOT CADD Engineering Standards Manual for more information.

A program is available to assist the project manager with the task of creating design files following the standard naming convention and the standard directory structure. The application can be accessed by selecting **ODOT > File Management > New Design File** from the MicroStation pull-down menu.

When the application is opened, the dialog shown below is opened.



Note: This application has been rewritten for MicroStation V8i as a MicroStation Visual Basic Application. As such, the application runs directly in MicroStation V8i. Previous versions of the application were written as a stand-alone Visual Basic 6 executable and required the user to close MicroStation in order for the application to create new the new design files. This version no longer requires the user to close MicroStation, although GEOPAK will be deactivated.

Documentation for the program is available on the ODOT CADD Support website, or by selecting the Help icon located at the upper right of the dialog.

1.4 Provided Data

This course is a continuation of the ODOT GEOPAK Road 1 course. We will use the horizontal and vertical alignments developed for State Route 185 in the previous class to generate existing ground cross sections, calculate superelevation, generate proposed cross sections, calculate the earthwork and seeding quantities, and generate final cross section sheets.

For this training class, you have been provided the following files:

File Name	Description
job185.gpk	GEOPAK Coordinate Geometry Database containing the survey data and the horizontal and vertical alignments for the project from the GEOPAK Road 1 course.
12345exgr.tin	Digital Terrain Model representing the existing ground.
12345BE001.dgn	2D MicroStation design file containing the ground survey data.
12345BF001.dgn	2D MicroStation design file containing the graphics for the S.R. 185 existing and proposed profile.
12345BP001.dgn	2D MicroStation design file containing the graphics for the proposed roadway.
12345BU001.dgn	2D MicroStation design file containing the graphics for the existing underground utilities.

The GEOPAK Coordinate Geometry Database, job185.gpk, contains the following COGO elements:

Chain Name	Description
CLXS185	Approximate centerline of existing S.R 185.
CLPS185	Centerline for the proposed relocation of S.R. 185.
CLXJAME	Approximate centerline for Jameson Road.
CLPJAME	Centerline for the proposed relocation of Jameson Road.

Profile Name	Description
XS185P	The existing ground profile along the proposed centerline of S.R. 185.
PS185P	The proposed vertical alignment for the S.R. 185 relocation.
XJAMEP	The existing ground profile along the proposed centerline of Jameson Road.
PJAMEP	The proposed vertical alignment for Jameson Road.

Exercise 1

In this exercise, we'll create the Directory structure to house the training files, download the files from the ODOT website, and create a new GEOPAK Project for the class.

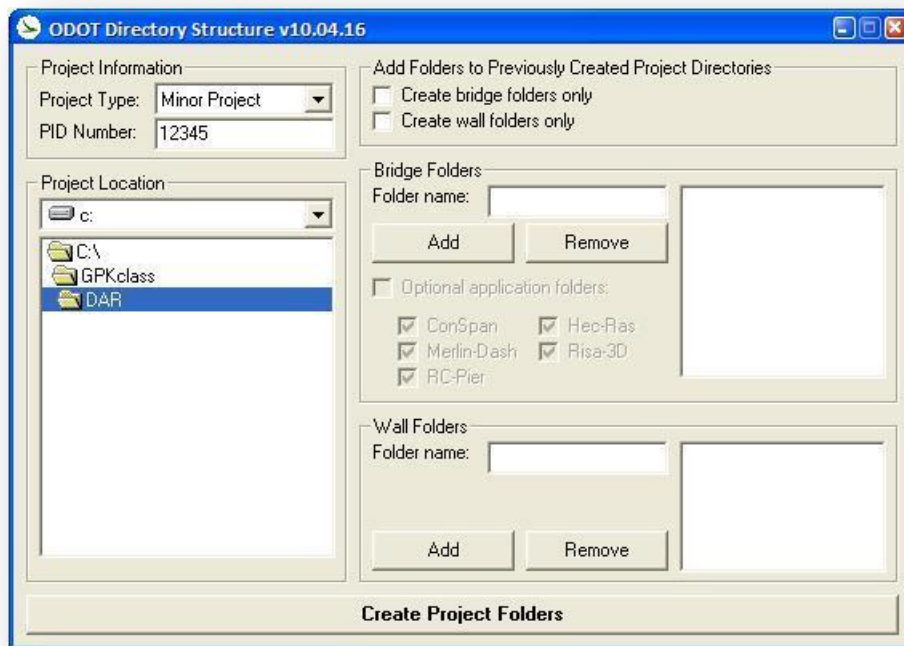
1. Create the Project Directories

Create the following subdirectory for Darke County to house the project files:

c:\GPKclass\DAR

Create the project folders in the **c:\GPKclass\DAR** directory using the PID number 12345.

Use the ODOT Standard Directory application, **ODOT_Directory.exe**, to create the project folders. Use the **Create Minor Project Directory Structure** option as shown below.



2. Download the Training files

Download the Road 2 project files from the ODOT website:

<http://www.dot.state.oh.us/Divisions/Engineering/CADDMapping/CADD/Pages/GPKManual.aspx>

Unzip the project files to the **c:\GPKclass\ DAR\12345** directory. Be sure to toggle on the **Use Folder Names** option.

After unzipping the files, list the sub-directory where the files are located in the table below:

File Name	Sub-Directory
job185.gpk	
12345exgr.tin	
12345BE001.dgn	
12345BF001.dgn	
12345BP001.dgn	
12345BU001	

3. Create a GEOPAK Project

Open the proposed basemap dgn file for the project 12345BP001.dgn. Use the GEOPAK **Project Manager** to create a GEOPAK “Project” named 12345 and a new “User” using your name.

Refer to the [ODOT GEOPAK Road 1 Training Guide](#) for details on creating a GEOPAK Project.

What should you name the GEOPAK Project Manager file (.prj)?

Which sub-directory should be used to create the project .prj file?

Which sub-directory should you assign as the Working Directory?

Create a Working Alignment Definition for S.R. 185 and for Jameson Road using the information below:

Working Alignment Name	SR185	JAMESON
Plan View Design File Chain	12345BP001.dgn CLPS185	12345BP001.dgn CLPJAME
Plan View: Pattern	Select the By Design File option. Set the Placement parameter to the level GK_Patterns	Select the By Design File option. Set the Placement parameter to the level GK_Patterns
Profile View Design File Existing Profile Proposed Profile	12345BF001.dgn XS185P PS185P	12345BF001.dgn XJAMEP PJAMEP
Profile Location	Use the “Identify Cell” option to set the parameters (open the file 12345BF001.dgn to identify the profile cell)	Use the “Identify Cell” option to set the parameters (open the file 12345BF001.dgn to identify the profile cell)
Cross Section View Existing Ground	Select the By Design File option. Set the Placement parameter to the level XS_X_Ground_Line	Select the By Design File option. Set the Placement parameter to the level XS_X_Ground_Line
DTM Existing Ground TIN	12345exgr.tin	12345exgr.tin

Set the working alignment definition for SR185 as the active working alignment. The training class will focus on S.R. 185.

2 Existing Ground Cross Sections

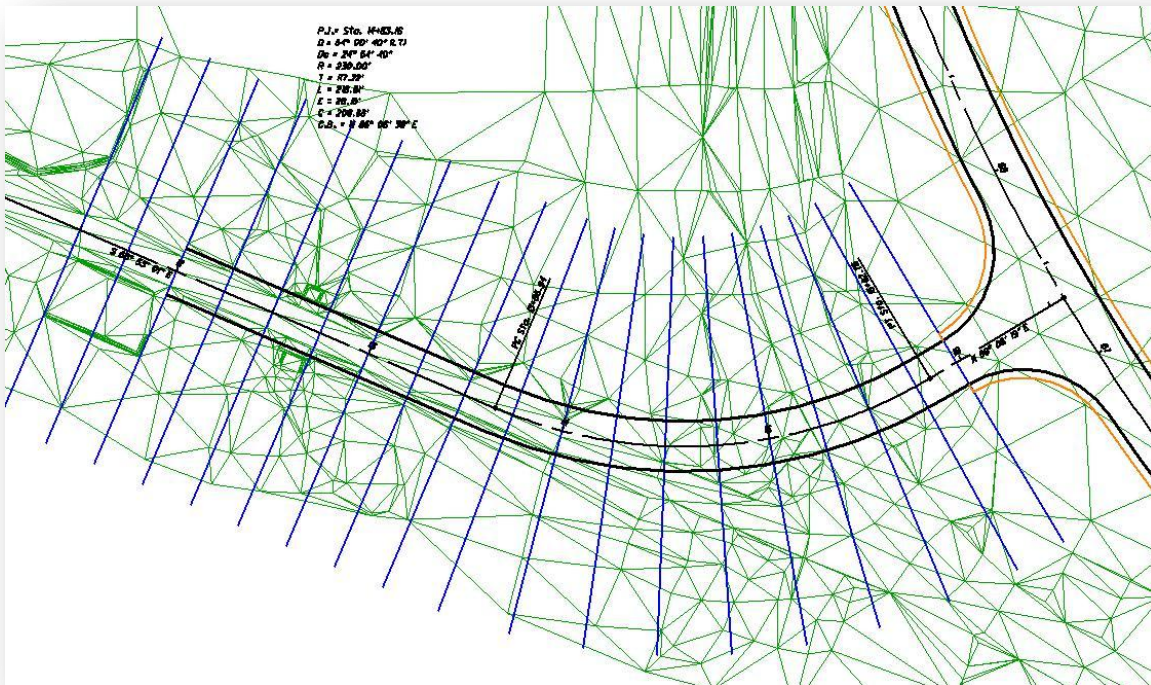
2.1 Overview

Existing ground cross sections can be extracted from a GEOPAK DTM at user defined intervals along a specified COGO chain.

The location(s) where the cross section(s) will be extracted is defined by establishing **Pattern Lines** at the desired interval and width for the cross section(s).

The lines can be drawn manually using MicroStation commands or by use of the GEOPAK *Draw Pattern Lines* dialog box.

An example of Pattern Lines drawn at 25' intervals along the Jameson Road is shown below.



The Pattern Lines are used to intersect the TIN file to read the elevation and offset at every place the pattern line crosses a triangle edge. The elevation and offset is used to compute the existing ground cross section at each pattern line location. The cross sections are drawn in the MicroStation design file specified by the user.

2.2 Pattern Lines

Pattern Lines are used to designate the location(s) where the existing ground cross section(s) are to be extracted from the TIN file. GEOPAK provides two methods to define these Pattern Line location(s):

- **Pattern by DGN**
- **Pattern by Station**

Each option is summarized below:

Pattern by DGN

When using this method, MicroStation line elements are drawn into a 2D plan-view design file, one for each desired cross section. The Pattern Lines are typically placed perpendicular to the selected chain at even stations or placed individually at user specified locations. Pattern lines can also be placed at a user defined skew angle from the selected chain. The Pattern Line elements must intersect the centerline chain in order for the software to draw a cross section.

The Pattern by DGN option is advantageous since it provides the user with the option to extract cross sections at odd station locations simply by drawing a pattern line at the desired location. Additionally, cross sections can be omitted at specific stations, such as a bridge location, by simply deleting the pattern line(s) placed by GEOPAK.

Pattern by Station

When using this method, cross sections are generated at a specified interval along a selected COGO chain. All cross sections are generated perpendicular to the centerline chain. No graphics are drawn in the design file to represent the pattern line locations.

The Pattern by Station option is useful in cases where there is no need for skewed cross sections or for sections at odd station locations.

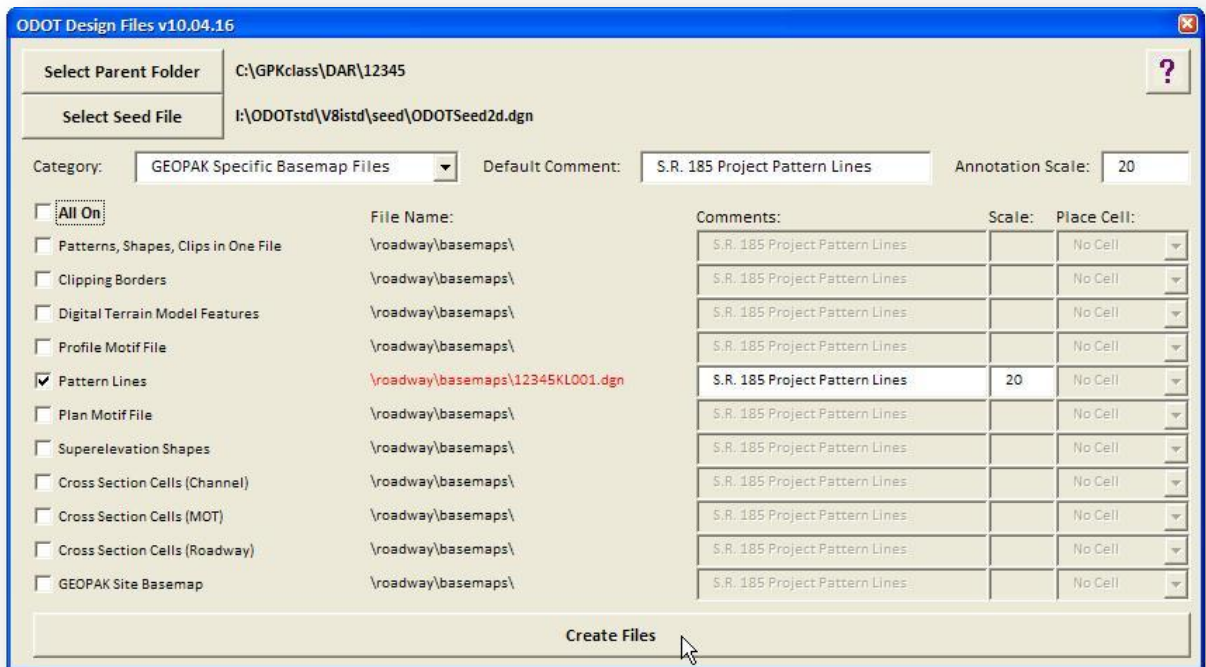
Typically, ODOT personnel will use the **Pattern by DGN** option.

2.2.1 Pattern Line Design File

According to ODOT CADD Standards, Pattern Lines are drawn in a separate design file containing only the Pattern Lines. See the [ODOT CADD Engineering Standards Manual](#) for information on standard design file names. Use the ODOT application ODOT_Files.mvba to create design files using file names according to ODOT Standards.

The **ODOT_Files** application can be accessed by selecting **ODOT > File Management > New Design File** from the MicroStation pull-down menu.

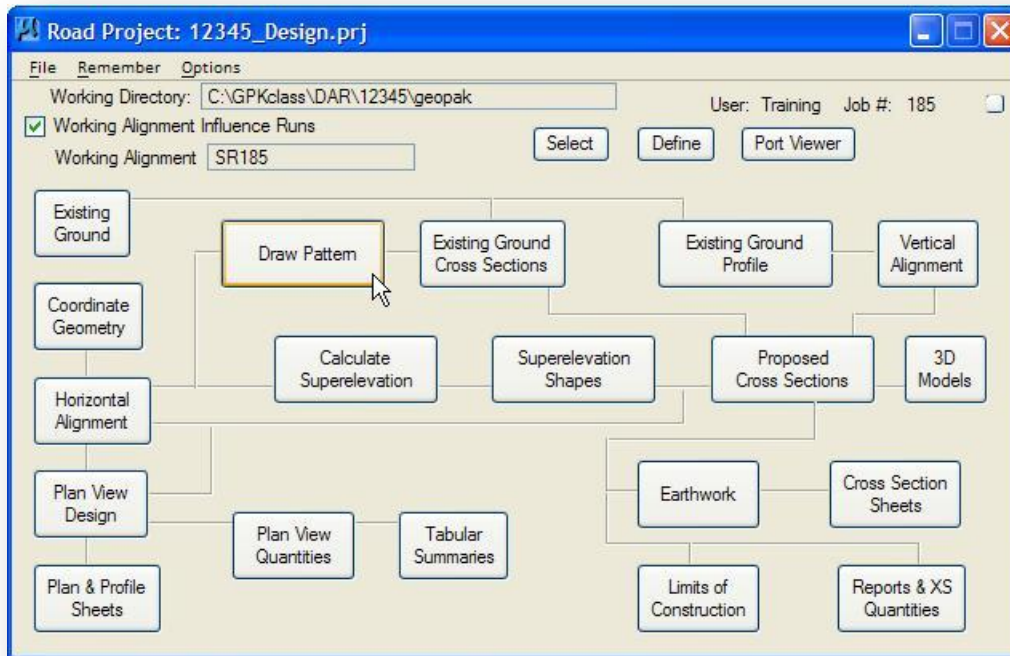
Select the option to create the pattern line design file as shown below.



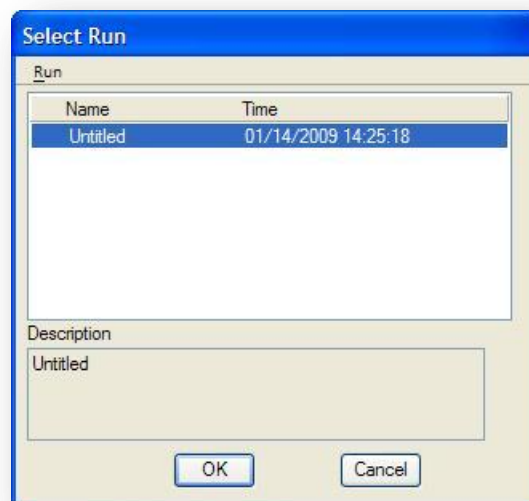
There is no need to create a separate design file for the Pattern Lines on projects where you will extract cross sections for multiple alignments. Patterns lines for each alignment of your project can be drawn in the same design file as long as each set of pattern lines for a specific alignment is drawn with unique symbology.

2.2.2 Draw Patterns Dialog Box

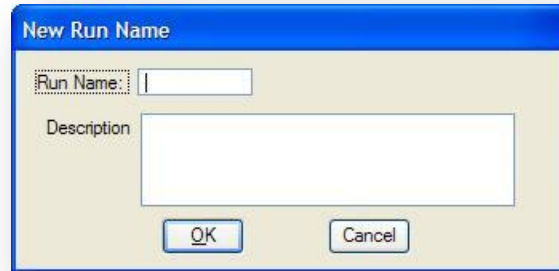
To generate the Pattern Lines, select **Draw Pattern** from the *GEOPAK Project Manager*.



The *Select Run* dialog, shown below, is opened.

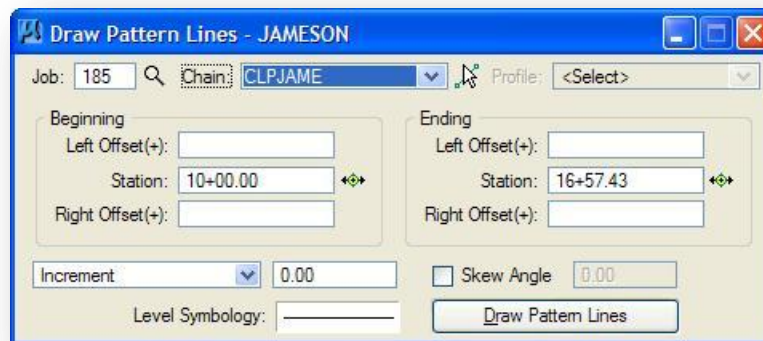


By default, a run named **Untitled** is always created. To create a new run, select **Run > New...** from the *Select Run* dialog box to access the *New Run Name* dialog box shown below.



Key-in the **Run Name** and **Description** for the new run. Select **OK** to create the new run. The new run name will appear in the *Select Run* dialog box.

Select the new run from the list box and then pick **OK**. The *GEOPAK Draw Pattern Lines* dialog box shown below is opened.



The following dialog items are filled in with the values specified for the currently selected Working Alignment Definition:

Job

Specify the **Job** number of the COGO data base containing the chain that will be used to draw the pattern lines.

Chain

Specify the COGO chain that will be used to draw the pattern lines. The **Chain** name can be manually entered or identified by the **Select** button.

The remaining dialog items are described on the following pages.

Profile

Specify the name of the **Profile** to be used when pattern lines are placed using the **Control Points-Vertical** option described on the following page. The **Profile** name can be manually entered or identified by the **Select** button.

Left Offset(+), Right Offset(+)

These options are used to assign the distance, in Master Units, that the pattern lines will extend to the left and right of the specified Chain. The distance is always specified as a positive value.

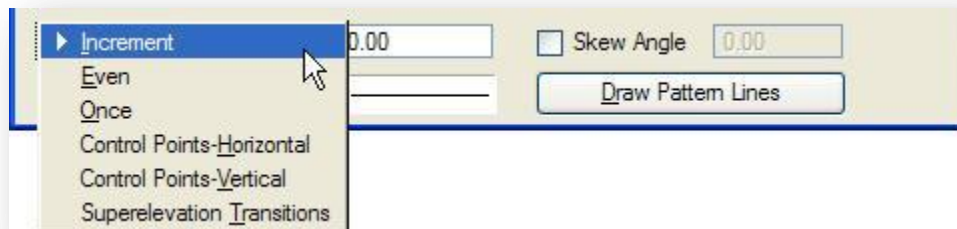
Beginning Station

Enter the **Beginning Station** along the specified COGO Chain to start the pattern lines. The **Beginning Station** can be entered manually or identified graphically by using the **Begin Station** button to the right of the key-in field.

Ending Station

Enter the **Ending Station** along the specified COGO Chain to start the pattern lines. The **Ending Station** can be entered manually or identified graphically by using the **End Station** button to the right of the key-in field.

The option button, shown below, allows the user to specify whether pattern lines will be drawn along the chain at a user specified increment, at a single station, or at Horizontal, Vertical, or Superelevation key-point locations. These options are described below.

**Increment**

The **Increment** option will draw the first pattern line at the **Beginning Station** and all subsequent pattern lines at the user specified interval. For example, given a beginning station of 35+90.72 and a distance of 50, the first pattern line is drawn at station 35+90.72, the second at 36+40.72, the third at 36+90.72, etc...

Even

The **Even** option will draw all pattern lines at a station divisible by the value keyed in for the distance. For example, given a beginning station of 35+90.72 and a distance of 50, the first pattern line will be drawn at station 35+90.72, the second at 36+00, the third at station 36+50, etc...

Once

Pattern lines can be placed at a single user specified station by using the **Once** option. When the **Once** option is selected, the **Ending Station** information is grayed and not available for user input. Also the distance key-in field is unavailable. The **Beginning Station** information is used to identify the station and offsets for the pattern line to be drawn.

Control Points- Horizontal

Pattern lines will be placed at the key points along the specified COGO Chain (PC, PT, SC, ST, etc.).

Control Points- Vertical

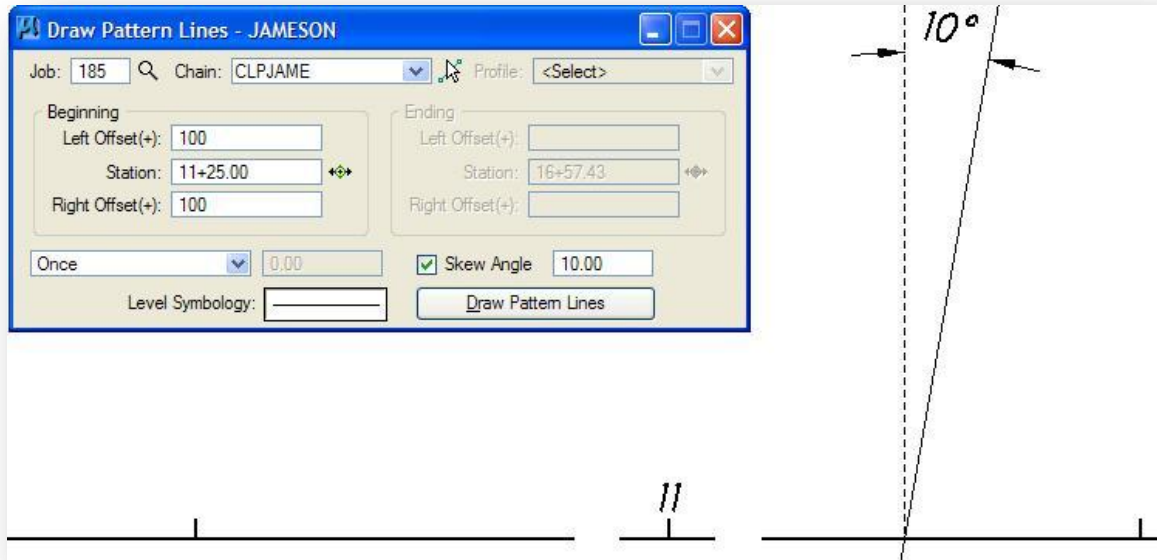
Pattern lines will be drawn at the beginning (VPC) and ending (VPT) station for each vertical curve in the specified COGO Profile. In addition, pattern lines are drawn at the high point or low point for each vertical curve.

Superelevation Transitions

The current design file and any attached reference files are scanned for superelevation shapes created with the specified **Chain**. A pattern line is drawn at the beginning and ending of each superelevation shape. See Chapter 4, Superelevation, for more information on superelevation shapes.

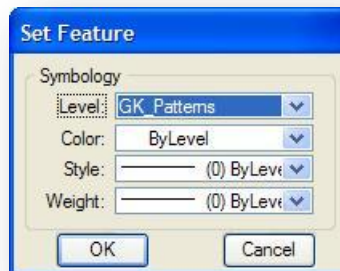
Skew

Pattern lines can be drawn at a **Skew** angle relative to the standard pattern line (perpendicular to the baseline) as shown in the example below. Toggle on the Skew option and key in the desired angle as show below. A positive Skew angle rotates the pattern line clockwise. A negative Skew angle rotates the pattern line counter-clockwise.



Level Symbology

The Level, Style, Color, and Weight for the pattern lines can be set by double-clicking the symbology display as shown below.



Each COGO chain for which you wish to extract cross sections will have its own set of Pattern Lines and each set of Pattern Lines must have unique symbology. The levels in the table below have been established for GEOPAK Pattern Lines.

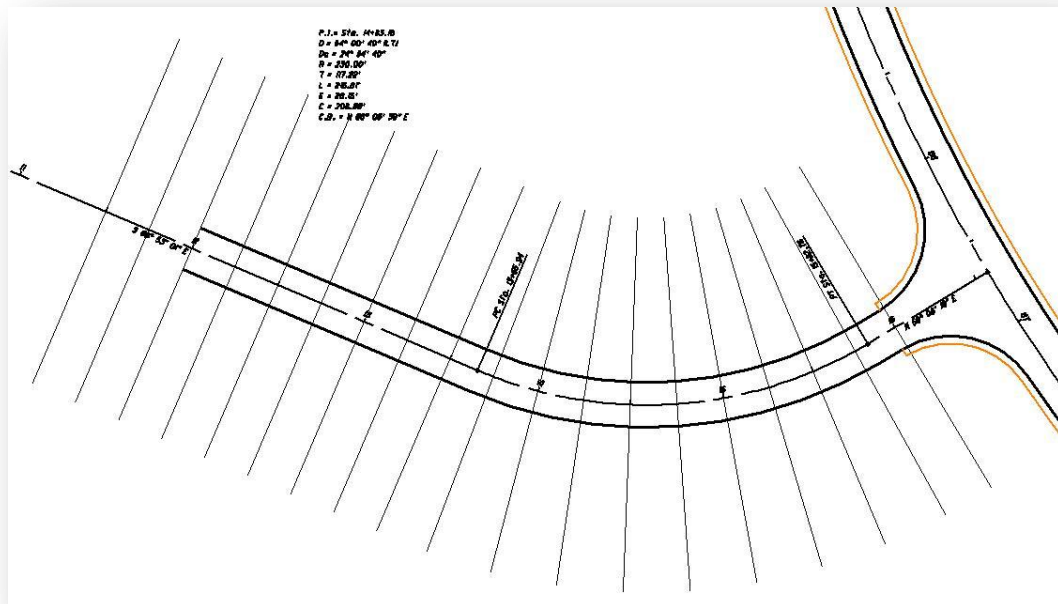
Level Name	ByLevel Color	ByLevel Style	ByLevel Weight
GK_Patterns	0	0	0
GK_Patterns2	1	0	0
GK_Patterns3	2	0	0
GK_Patterns4	3	0	0
GK_Patterns5	4	0	0

If you opt to place the Pattern Lines for multiple alignments on the same level, be sure to change the color of the pattern lines to make them unique for each COGO Chain.

Draw Pattern Lines

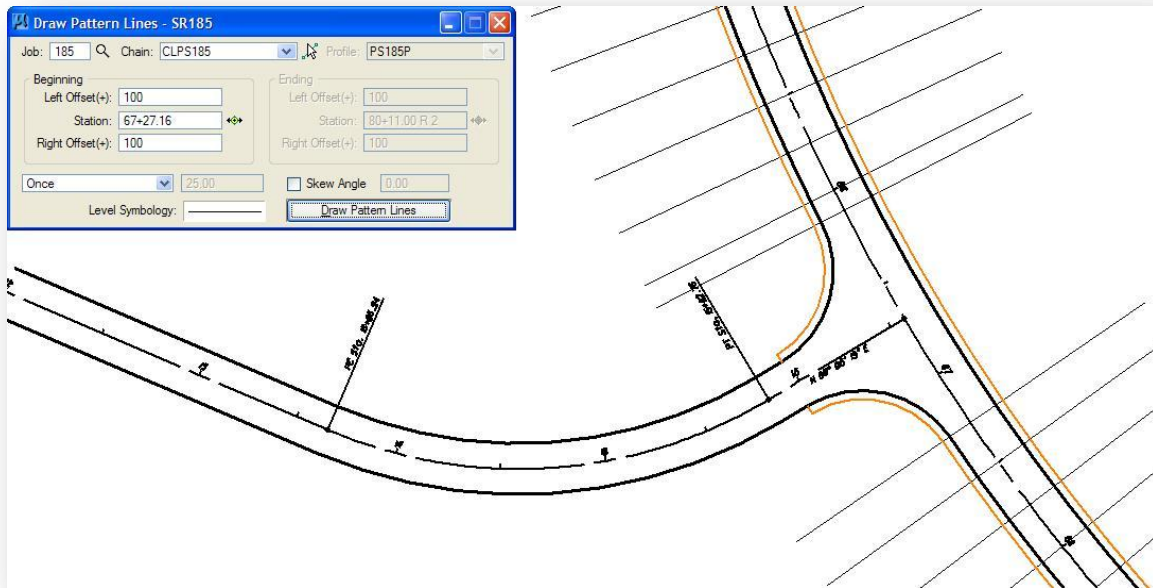
Select the **Draw Pattern Lines** button to initiate placement of the Pattern lines. GEOPAK Pattern Lines are drawn into the current MicroStation design file using the settings of the GEOPAK *Draw Pattern Lines* dialog.

An example of the pattern lines drawn at even 25' increments for Jameson Road, from station 9+50 to Station 16+00, is shown below.



2.2.3 Pattern Lines in Intersection Areas

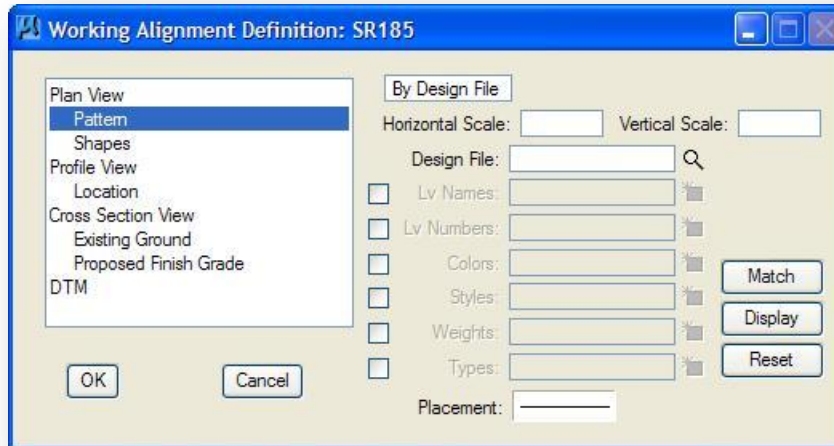
Cross sections and quantities within the limits of an intersection can be handled in a variety of ways. One option is to delete the pattern lines within the limits of the intersection and add pattern lines at the radius returns as shown in the example below.



The **Once** option can be used to draw individual pattern lines at the desired locations. Earthwork quantities within the limits of the intersection will need to be computed manually and added into the cross section quantities.

2.3 Working Alignment Definition: Pattern

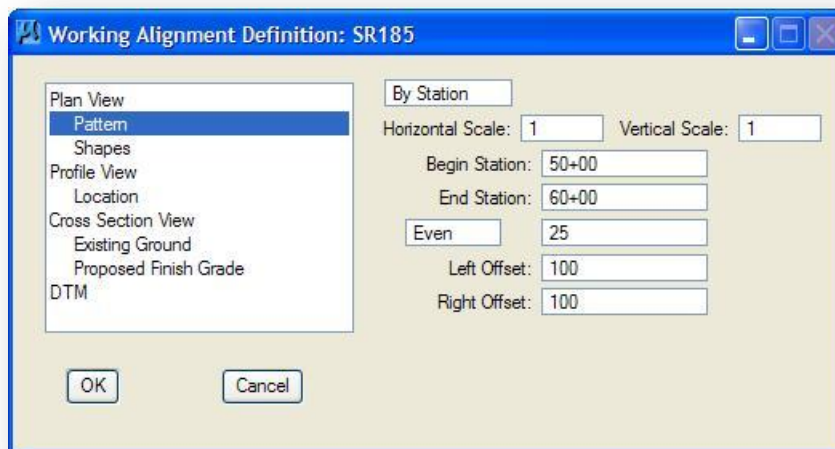
From the *Road Project* dialog, select **Define** to access the *Working Alignment Definition* dialog shown below. When the **Pattern** option is selected, the dialog changes dynamically as shown below.



Two options are available to designate which pattern line method is used for the alignment: **By Design File**, or **By Station**.

2.3.1 By Station

When **By Station** is selected, the dialog dynamically changes as shown below.



When using this method, cross sections will be generated at the specified interval along the centerline COGO chain. All cross sections are generated perpendicular to the centerline chain. No graphics are drawn in the design file to represent the pattern line locations. Use this option when you do not need any kinked or skewed cross sections, or cross sections at odd stations.

The options are detailed on the following page.

Horizontal Scale

Key-in the value for the **Horizontal Scale** for the cross sections. This should normally be 1 for ODOT projects.

Vertical Scale

Key-in the value for the **Vertical Scale** for the cross sections. This should normally be 1 for ODOT projects.

Begin Station

Key-in the **Beginning Station** for the cross sections.

End Station:

Key-in the **Ending Station** for the cross sections.

Increment

The **Increment** option will draw the first pattern line at the **Beginning Station** and all subsequent pattern lines at the user specified interval. For example, given a beginning station of 35+90.72 and a distance of 50, the first pattern line is drawn at station 35+90.72, the second at 36+40.72, the third at 36+90.72, etc...

Even

The **Even** option will draw all pattern lines at a station divisible by the value keyed in for the distance. For example, given a beginning station of 35+90.72 and a distance of 50, the first pattern line will be drawn at station 35+90.72, the second at 36+00, the third at station 36+50, etc...

Left Offset

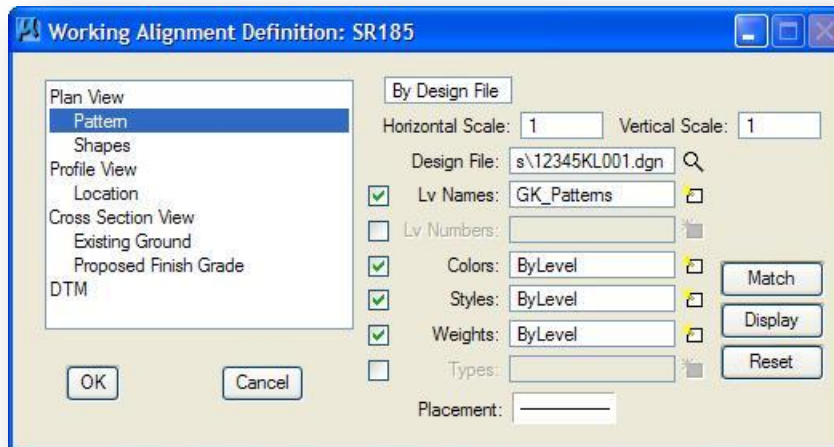
This option is used to assign the distance, in Master Units, that the pattern lines will extend to the left of the specified **Chain**.

Right Offset

This option is used to assign the distance, in Master Units, that the pattern lines will extend to the right of the specified **Chain**

2.3.2 By Design File

When **By Design File** is selected, the dialog dynamically changes as shown below



The **By Design File** option is used to define the symbology settings for Pattern Lines that have been previously drawn in a MicroStation Design File. The following options are available:

Horizontal Scale

Key-in the value for the **Horizontal Scale** for the cross sections. This should normally be 1 for ODOT projects.

Vertical Scale

Key-in the value for the **Vertical Scale** for the cross sections. This should normally be 1 for ODOT projects.

Design File:

Key-in the name of the design file where the pattern lines have been drawn. The File button can be used to select the name of the design file.

Match

The **Match** button can be used to graphically pick the pattern line elements from the design file to set the correct symbology (**LV Names, LV Numbers, Colors, Styles, Weights, Types**) in the *Working Alignment Definition* dialog box. Toggle on the symbology items that you wish to match, select the **Match** button, and select one of the pattern lines. The values are read from the pattern line element into the *Working Alignment Definition* dialog box as shown in the example above.

Display

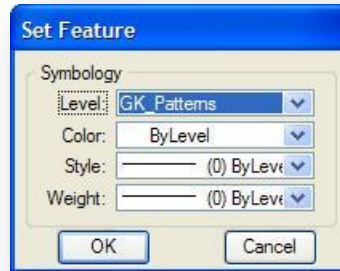
Select the **Display** button to highlight MicroStation elements matching the currently defined symbology.

Reset

Select the Reset button to clear the values specified for the symbology items (**LV Names, LV Numbers, Colors, Styles, Weights, Types**).

Placement

Double click the symbology display to access the *GEOPAK Set Feature* dialog shown below. Use this dialog to set the symbology for the placement of the pattern lines.



Note: Each set of pattern lines for each alignment in your project must have unique symbology. ODOT Standards include multiple levels for the placement of pattern lines. If there are not enough levels available, pattern lines for multiple alignments can be placed on the same level by setting the Color, Style, and Weight uniquely for each set of pattern lines.

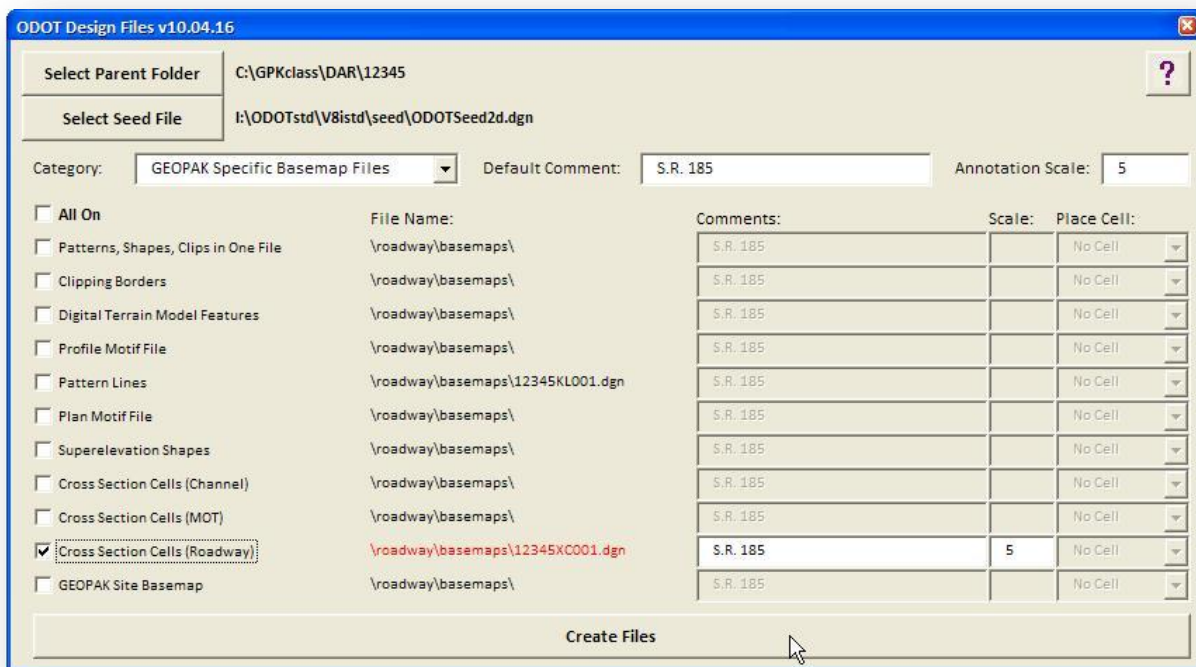
2.4 Extracting Existing Ground Cross Sections

2.4.1 Cross Section Design Files

When existing ground cross sections are generated by GEOPAK, the cross sections are drawn in the active MicroStation design file. The cross sections should always be drawn in their own design file. The ODOT_File.mvba application can be used to easily create a cross section design file using ODOT standard design file names. See the [ODOT CADD Engineering Standards Manual](#) for information on standard design file names.

The **ODOT_Files** application can be accessed by selecting **ODOT > File Management > New Design File** from the MicroStation pull-down menu.

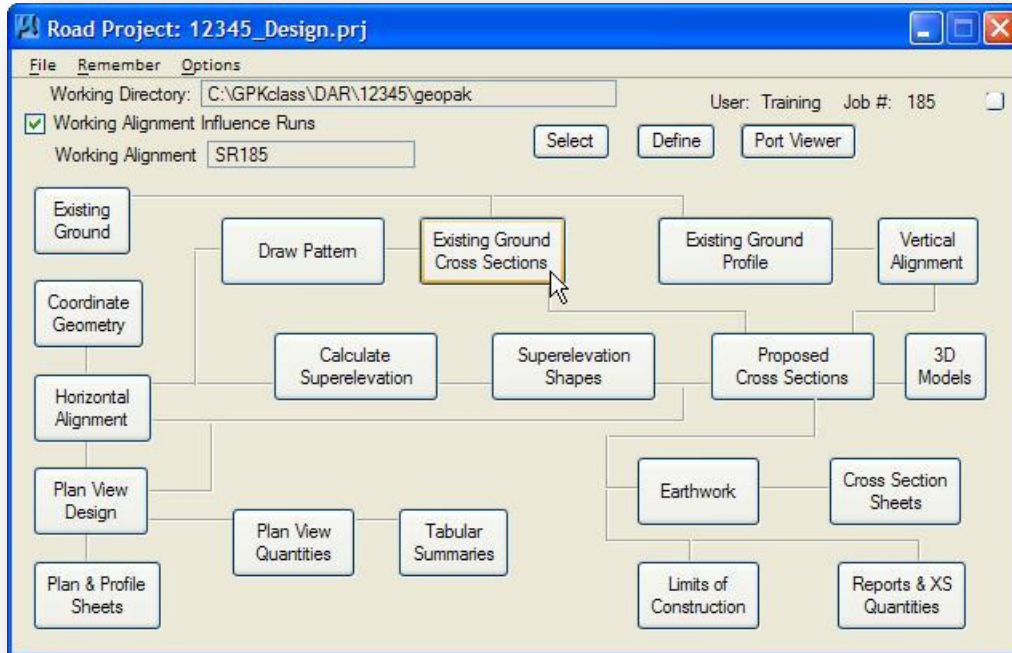
Select the option to create the cross section design file as shown below.



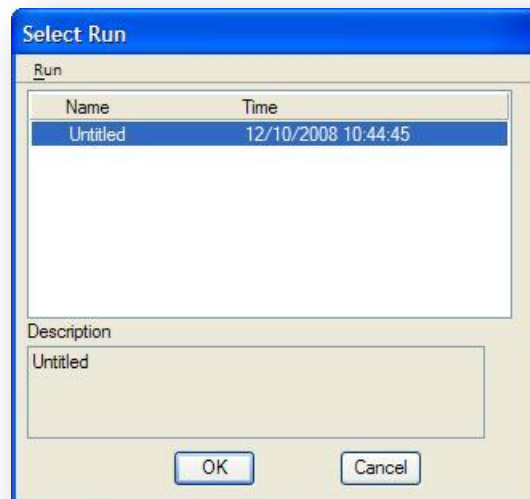
ODOT does not recommend placing the cross sections for multiple alignments in the same design file. Create a separate design files for each set of cross sections.

2.4.2 The Draw Cross Sections Dialog Box

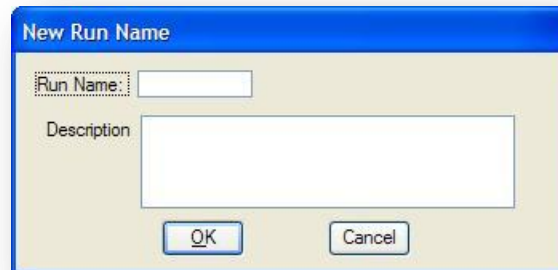
From the *Road Project* dialog box, select **Existing Ground Cross Sections** to create a new existing ground cross section run, or to access a previously created run.



The *Select Run* dialog box, shown below, is opened.

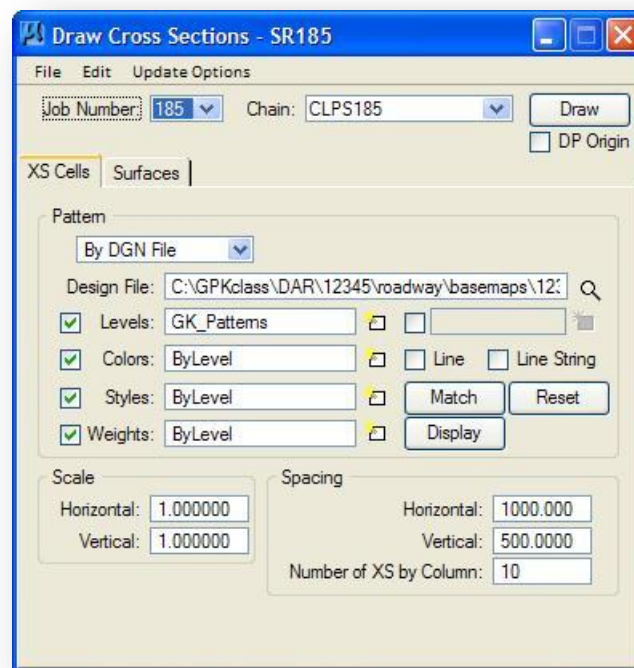


By default, a run named **Untitled** is always created. To create new run, select **Run > New...** from the *Select Run* dialog box to access the *New Run Name* dialog box shown below:



Key-in the **Run Name** and **Description** for the new run. Select **OK** to create the new run.

Select the new run from the list box and then pick **OK**. The *Draw Cross Sections* dialog box shown below is opened.



The dialog consists of a menu bar with three listings:

File

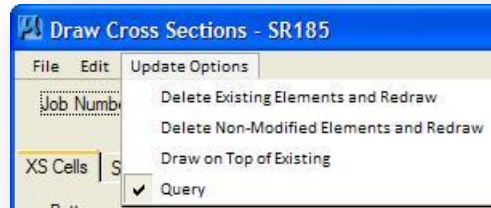
Standard file utilities to load, or save settings, plus a dialog exit option.

Edit

Options to save settings, clear lists, etc.

Update Options

User-defined options on how the software handles the redrawing of cross sections. The options supported on the Update menu are shown in the exploded view below.



The options are toggled off / on by clicking on 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. The options are detailed below.

Delete Existing Elements and Redraw

When this option is activated, any existing ground lines previously drawn with this tool are deleted and new ground lines are drawn.

Delete Non-modified Elements and Redraw

When this option is activated, only existing ground lines previously drawn with this tool that have not been modified are deleted and new ground lines are drawn. Ground lines previously drawn with this tool which have been modified are left intact.

Draw on Top of Existing

When this option is activated, any previously drawn ground lines are ignored and a new set is drawn, resulting in two sets of ground lines.

Query

When activated, the user is prompted each time the **Draw** button is pressed, as shown below.

The user must select one of the three options and press the **Apply** button to commence processing. Pressing the **Cancel** button closes the dialog with no subsequent processing. Note: the user is prompted only if the design file contains a set of cross sections for the selected chain.

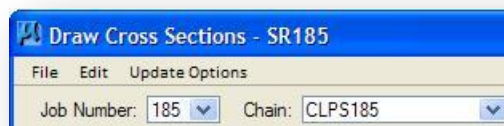
Information stored with the **Working Alignment Definition** is shared with the *Draw Cross Sections* dialog box. The following information is taken from the active **Working Alignment Definition**:

Job Number

The GEOPAK COGO data base job number.

Chain

The name of the COGO **Chain** along which to extract cross sections.



Two tabs on the dialog support the input data required to draw cross sections:

XS Cells

Information on this tab is used to define the location, scale, and spacing of the cross sections.

Surfaces

This tab is used to define the surfaces used for drawing cross sections. Multiple surfaces may be drawn in a single processing.

The settings for each tab are detailed on the following pages.

The XS Cells Tab

When the **XS Cells** tab is pressed, the dialog dynamically changes as shown below.

The screenshot shows the 'XS Cells' dialog box with the 'Surfaces' tab selected. The 'Pattern' section includes a dropdown menu set to 'By DGN File', a 'Design File' text box containing 'C:\GPKclass\ DAR\12345\roadway\basemaps\12...', and four checked checkboxes for 'Levels', 'Colors', 'Styles', and 'Weights', each with a corresponding text box (e.g., 'GK_Patterns', 'ByLevel'). There are also 'Match', 'Reset', and 'Display' buttons. The 'Scale' section has 'Horizontal' and 'Vertical' text boxes both set to '1.000000'. The 'Spacing' section has 'Horizontal' and 'Vertical' text boxes set to '1000.000' and '500.0000' respectively, and a 'Number of XS by Column' text box set to '10'.

Three options are available to define the cross section Pattern Line locations, as detailed below:

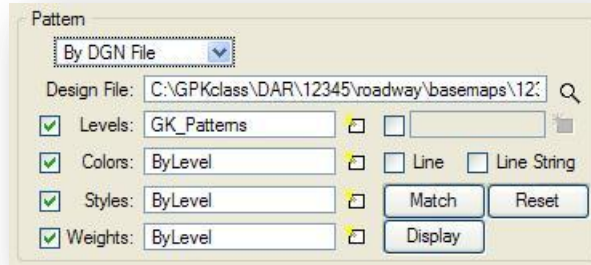
Pattern By Station

Use this option when no pattern lines have been drawn in the DGN file.

The screenshot shows the 'Pattern' dialog box with the 'By Station' option selected in the dropdown menu. It includes text boxes for 'Begin Station' (50+00.00), 'End Station' (60+00.00), 'Even' (25.0000), 'Left Offset' (100.0000), and 'Right Offset' (100.0000).

Pattern By DGN File

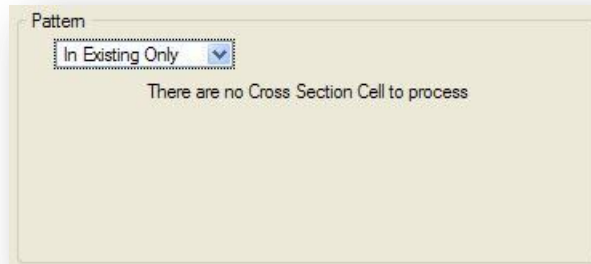
Use this option when pattern lines have been drawn in the DGN file to represent the locations where the cross sections will be extracted.



The Pattern Line information is read from the current **Working Alignment Definition**. If the Pattern Line information has not been defined in the Working Alignment, the **Match** button can be used to set the Pattern Line symbology as previously detained in this manual.

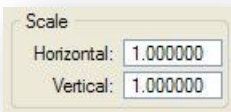
In Existing Only

This option draws existing ground cross section lines only for cross section cells that have been previously drawn in the active design file. No other pattern requirements are needed.



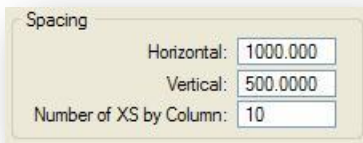
Scale

These values are used to specify the **Horizontal** and **Vertical** scales at which cross sections are to be plotted.



The ratio of the scales values is used to distort the vertical scale of the cross section relative to the horizontal scale value. The actual horizontal scale of the cross sections is unaffected.

Spacing



Spacing	
Horizontal:	1000.000
Vertical:	500.0000
Number of XS by Column:	10

Horizontal

This option enables the user to define the horizontal distance from the left edge of one cross section cell to the left edge of the cross section cell in the adjoining column. Use of this feature will prevent cross section elements associated with one cross section cell from overlapping the cross section elements of cells in adjoining columns.

Vertical

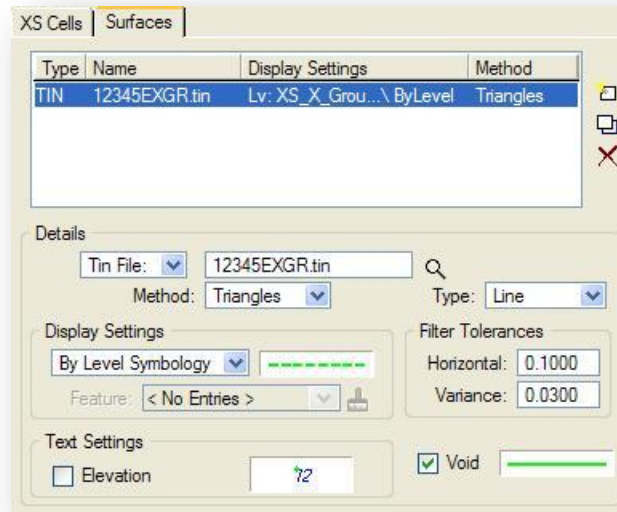
This option enables the user to define the vertical distance separating GEOPAK cross section cells. Use of this feature will prevent cross section elements associated with one cross section cell from overlapping the cross section elements in the cell above or below it.

Number of XS by Column

Cross sections are placed in vertical columns. This field determines how many sections are placed in each column.

The Surfaces Tab

When the **Surfaces** tab is pressed, the dialog dynamically changes as shown below.




The **Surfaces** tab is used to select the GEOPAK TIN file to be used as the source data to extract the existing ground cross sections. Multiple surfaces from a variety of sources can be drawn in a single processing.


Each surface to be drawn must be added to the list box. This is accomplished via the action/edit buttons on the right side of the dialog. Cross section lines or line strings are drawn for each surface listed. When the list box is populated, pressing the **Draw** button in the upper right corner initiates the processing.

Edit Buttons


Add

 To add to the list box, simply select the source **TIN File**, and then populate the **Display Settings**, **Filter Tolerances** and **Text Settings**. Then press the **Add** button to the right.

Modify

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

Delete

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

The lower half of the dialog box, encompassed in the **Details** group, is used to select each TIN File that will be used to extract the cross sections and to specify the symbology. Once these **Details** have been set, the **Add** button is used to add the information to the list box. Each item in the **Details** group is described on the following pages.

Tin File:

This key-in field is used to specify the name of the TIN File that will be used to extract the existing ground cross sections. Alternately, users can press **the Browse TIN File** icon, located to the right of the key-in field, to open the *Select TIN File*.

Method:

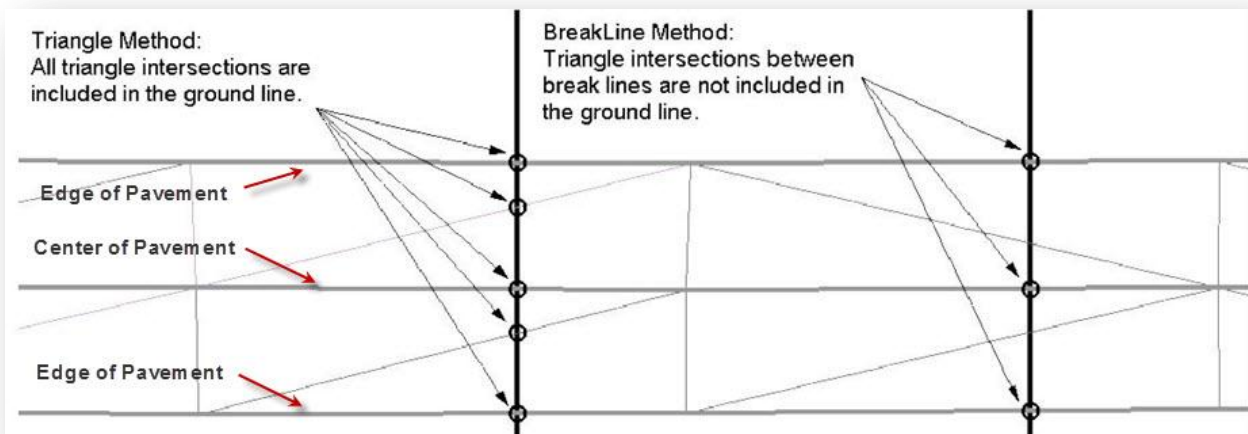
Two methods are supported to control how the triangle model is read to generate the existing ground cross sections.

Triangle method

Given the intersection between a pattern line and a triangle side, all intersections between the pattern line and the triangle side will be included in the creation of the ground line.

BreakLine method

Given the intersection between a pattern line and a triangle side, if each vertex of the triangle lies on a break line the intersection of that triangle side will be ignored in the creation of the ground line.

**Type**

Cross section lines can be drawn as **Lines** or **Line Strings**. We recommend using the **Line String** option.

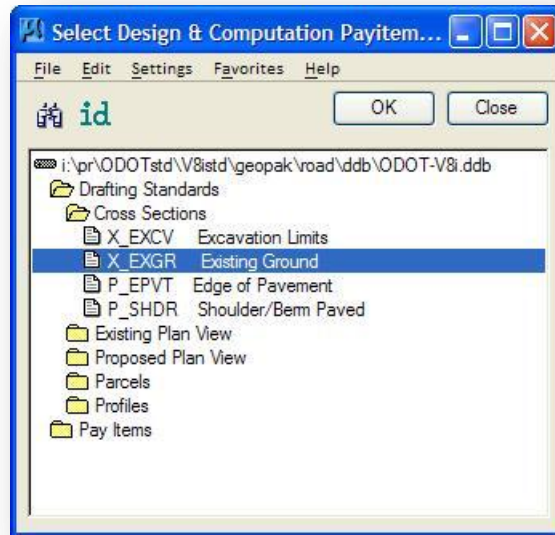
Display Settings

The **Display Settings** group box is used to specify the symbology for the cross section elements.

Set the option to **By Level Symbology**, and then double click on the symbology graphic. This opens the *GEOPAK Set Feature* dialog, wherein the symbology can be specified. The existing ground cross sections should be plotted using following settings in accordance with the ODOT CADD Engineering Standards Manual.

Level Name	Color	Weight	Style
XS_X_Ground Line	2 (ByLevel)	1 (ByLevel)	2 (ByLevel)

Set the option to **By Feature** to select an item from the Design and Computation Manager database representing the existing ground cross section symbology. Select the **Browse** button to access the dialog shown below. Select the X_EXGR feature as shown below.



Once the feature has been selected, it is available in the **Display Settings** item as shown below.



Text Settings

When the **Elevation** toggle is activated, the elevation of the surface at the baseline location is placed on each cross section. The symbology for the text can be set by double clicking on the text graphic to open the *GEOPAK Set Feature* dialog.

Filter Tolerances

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

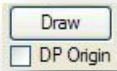
Void

If a cross section crosses a **Void** area in the triangle model, the **Void** Plot Parameters are used to define how the cross section lines are drawn across the void. Double clicking on the element opens the *GEOPAK Set Feature* dialog, wherein the desired parameters may be set. We recommend using the values shown below to define the Void symbology.

Level Name	Color	Weight	Style
XS_X_Ground Line	0	1 (ByLevel)	2 (ByLevel)

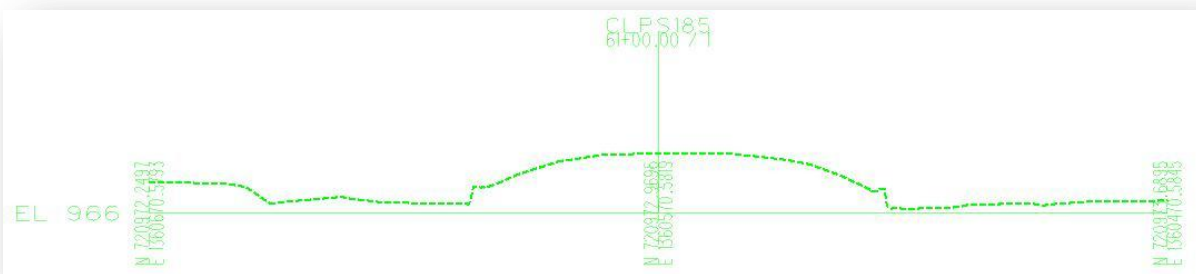
Draw

After you have completed the GEOPAK Ground Cross Sections dialog box, select the **Draw** button to initiate placing cross sections. The cross sections are placed in the currently active MicroStation design file.



Toggle on the **DP Origin** option to specify the location where the first cross section will be placed in the design file.

An example of a GEOPAK Ground Cross Section is shown below.

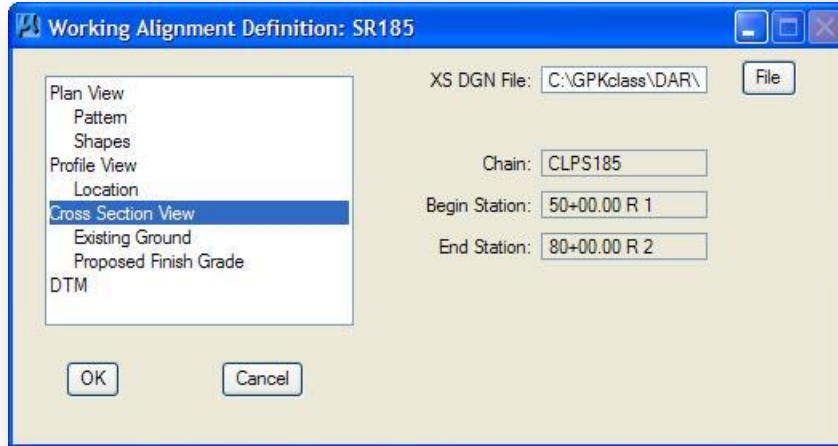


GEOPAK places a control cell for each cross section as shown above. This cell is used by GEOPAK to associate the cross section with the correct chain and station on the chain. These cells should never be deleted.

We refer to MicroStation levels by the level name. Each level still has an associated level number. By default, GEOPAK will place the cross section control cells on the level numbered 63. The level GK_Cells has been defined in the ODOT DGN Library as level number 63 to contain the cross section cells. If there is not a level numbered 63 in the design file or the DGN Library, GEOPAK will place the cross section cell on level named "default".

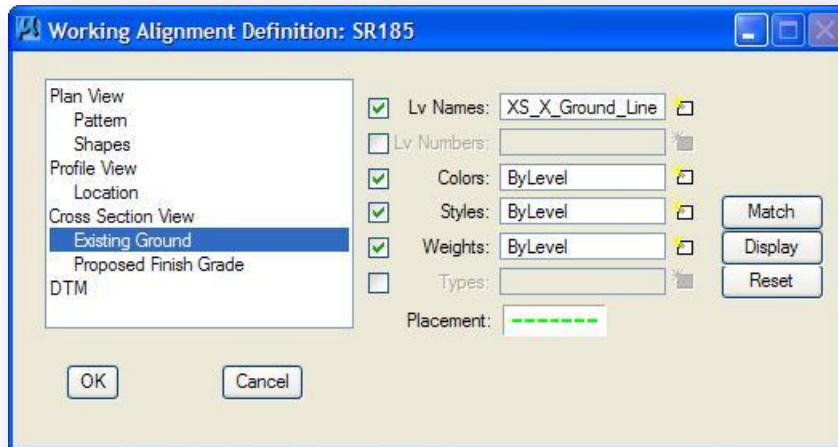
2.5 Working Alignment Definition: Cross Section

After extracting the existing ground cross sections, add the existing ground cross section information to the Working Alignment definition.



The **Cross Section View** item is used to identify the **XS DGN File** containing the cross sections. The **Chain**, **Begin Station** and **End Station** are automatically read from the cross section cells in the selected design file.

The **Existing Ground** item is used to designate the symbology of the elements that make up the existing ground in the **Cross Section View** design file. Use the **Match** button to read the symbology by selecting an element from the design file.

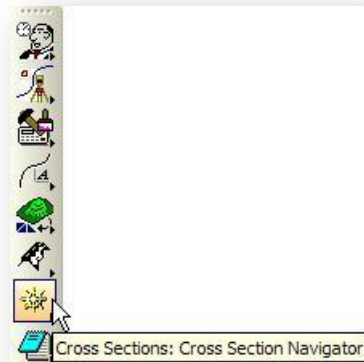


The **Placement** option is used to set the default symbology for the existing ground cross sections. The values set here will be used in the *Draw Cross Sections* dialog box.

2.6 Cross Section Navigator

The Cross Section Navigator tool is a quick and simple method of scanning through cross sections or locating specific sections. It also includes tools for drawing cross section lines and setting active angles.

To access the cross section navigator, select **Applications > GEOPAK Road > Cross Sections > Navigator**, or select the icon from the *Road Tools* palette as shown below:

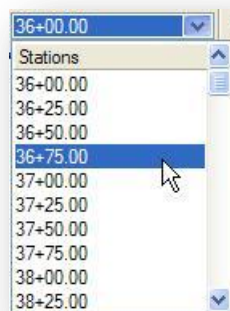


The frame is resizable and dockable for ease of use. Within the title bar, the Chain name and the Horizontal and Vertical scale of the cross sections is displayed.



Station Display

The current station is displayed in a drop-down list as shown below. Note the station is display only and is not a user input field. To go to a specific station, simply select the station from the list.



If cross sections based on multiple chains are drawn within the file, all chains are listed and the desired chain may be selected to access the cross sections. GEOPAK defaults to the first set drawn.

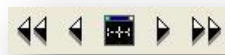


The **Station Keyin** option, selected by the icon at left, can be used to key in the station directly instead of using the scrolling menu above.



Scrolling tools

The scrolling buttons enable the user to quickly scan both forwards and backwards within the cross section range. The single arrows move forward (>) or backward (<) one section each time the button is pressed. The double arrows move to the first section (<<) or last section (>>). The reset navigator (center button on the dialog) returns the user to the first cross section; however, the entire section is placed on the screen. Therefore, the relative window is not maintained.



Drawing tools

Four tools are supported to assist the user in the placement of elements on cross sections. These include (from left to right):

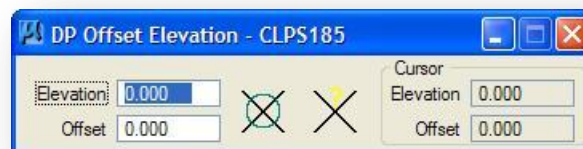


- DP Offset Elevation
- DP Delta Distance Slope
- XS Active Angle Tool
- Draw XS Line

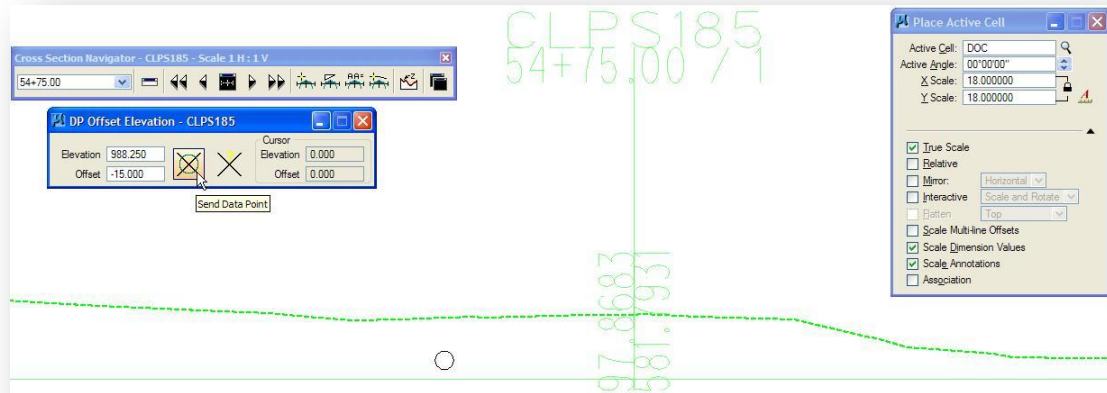
The drawing tools are described on the following pages.

DP Offset Elevation

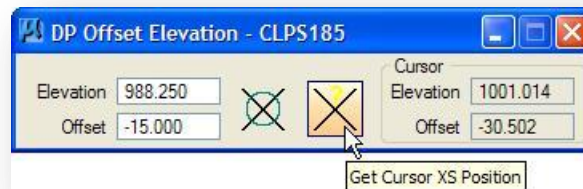
This dialog can be used to send a data point to MicroStation for an **Elevation** and **Offset** value keyed in by the user, or to get the station and offset from the cursor in the MicroStation design file.



The example below illustrates placing a cell representing a drainage pipe at a user specified elevation and offset using the MicroStation **Place Cell** command with the **Send Data Point** function.

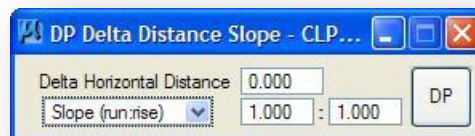


The **Get Cursor XS Position** button is used to report the elevation and offset of the cursor location within the MicroStation design file. Press the button, and then move the cursor on the cross section. The information is displayed in the Cursor **Elevation** and **Offset** fields.



DP Delta Distance Slope

In this dialog, the Horizontal Distance is specified in terms of master units. Supported options for Slope include **Rise:run**, **run:rise**, **slope (%)**, and **slope (unit/unit)**. After setting the dialog, select the MicroStation place line command and select the starting endpoint via a MicroStation data point. To generate the other endpoint of the line, press the **DP** button in the dialog below.



XS Active Angle

Several Types of Active Angles are supported within this dialog, including: Slope options for **run:rise** and **rise:run**, **slope(%)**, **slope (unit/unit)** and **Add 180**. As each type is selected, the remaining dialog dynamically changes to reflect the current selection. After setting the dialog, press the **Set AA** button to set the Active Angle for use within the MicroStation command.



Draw XS Line

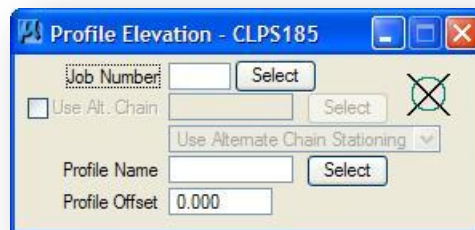
This dialog automatically calls the MicroStation place line command, and then uses the information to place the line from the location specified by the user. The **Delta Distance** is defined in terms of master units, i.e., feet or meters, and is measured horizontally. Slope options include **rise:run**, **run:rise**, **slope (%)**, and **slope (unit/unit)**. Activating a toggle locks the current data. A deactivated toggle allows for dynamic placement.



Profile Elevation



Selecting the **Profile Elevation** icon will open the *Profile Elevation* dialog shown below. The *Profile Elevation* dialog will allow you to send a data point to any MicroStation command using the elevation from a profile selected from the COGO database, and the offset defined relative to an optionally selected COGO chain. The elevation is read from the profile at the location where the current cross section intersects the selected profile.



Job Number

Specify the **Job Number** of the COGO database containing the chain that was used to draw the pattern lines. The **Job Number** can be manually entered or specified with the Select button.

Use Alt. Chain

Specify the name of the COGO chain that will be used to define the offset from the center of the cross section when the **DP** Button is pressed. The chain name can be manually entered or specified with the Select button. If **Use Alt. Chain** is toggled off when the **DP** button is selected, an offset value of 0 is used for the location of the **DP** sent to the active MicroStation command.

Profile Name

Specify the name of the COGO profile that will be used to define the elevation of the data point that is sent to the active MicroStation command when the **DP** button is selected. The **Profile Name** can be typed in or specified with the **Select** button.

Profile Offset

This field is used to specify a vertical offset, from the selected **Profile Name**, for the data point sent to the active MicroStation command when the **DP** button is pressed. Positive

values result in offsets above the selected profile elevation. Negative values result in offsets below the selected profile elevation.

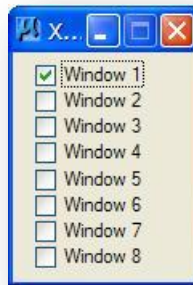
DP Button

Once the dialog is populated, pressing the **DP** button in the upper right corner of the dialog will send a data point to the currently active MicroStation command.

Open View Control Dialog



Selecting the **Open View Control** icon will open the *XS View Control* dialog shown below. This dialog will allow you to “sync” multiple MicroStation views when the cross section navigator scrolling tools are used.



Note: Toggling on/off the individual views in the XS View Control dialog does not open the corresponding MicroStation view window.

Exercise 2

In this exercise we will draw the pattern lines and extract the existing ground cross sections for State Route 185.

- ✓ Use the **ODOT_Files** application to create a new design file to contain the pattern lines for S.R. 185. Draw pattern lines for S.R. 185 at even 50' increments along the centerline alignment. Each pattern line should extend 100' to the left and right of the centerline chain.
- ✓ Delete the pattern lines in the intersection of S.R. 185 and Jameson Road.
- ✓ Add pattern lines on S.R. 185 at the radius returns in the intersection of S.R. 185 and Jameson Road.
- ✓ Update the Working Alignment definition for SR185 to reflect the settings for the pattern lines.

What is the name of the pattern line design file?

Which directory is the pattern line design file stored in?

- ✓ Use the **ODOT_Files** application to create a new design file for the S.R. 185 cross sections. Extract the existing ground cross sections for S.R. 185 in this file.

What is the name of the cross section design file?

Which directory is the cross section design file stored in?

- ✓ Update the SR185 Working Alignment definition to include the information for the cross sections.

Extra Credit

- ✓ Draw pattern lines and extract cross sections for Jameson Road. Be sure to update the Working Alignment information for Jameson Road.

Which design file should you use for the Jameson Road Pattern Lines?

Which design file should you use for the Jameson Road cross sections?

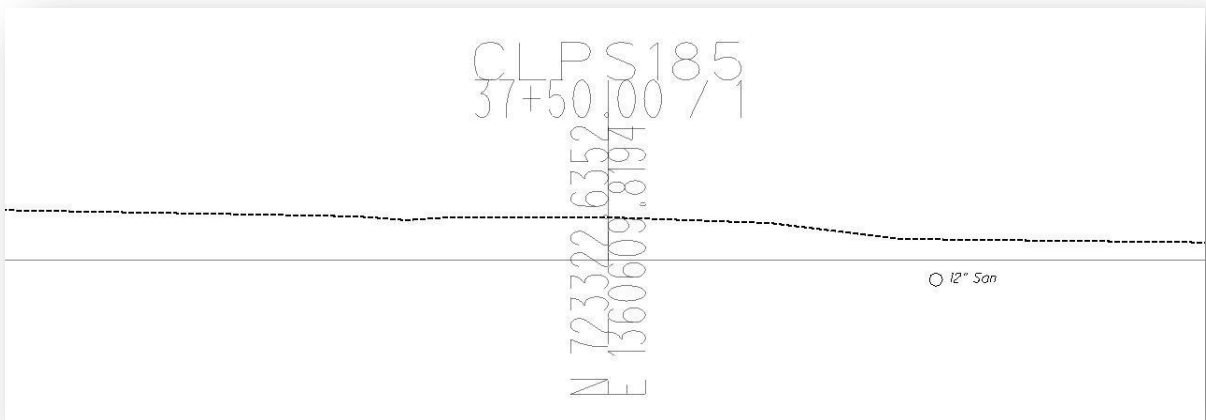
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3 Underground Utilities

3.1 Overview

Underground utilities, or other ancillary features such as right-of-way lines, can be drawn on cross sections and profiles by use of the **Draw Ancillary Features** tool.

The underground utility location is represented on the cross sections or profile by placement of a cell or a symbol. Text labels can also be drawn with the cells or symbols. An example of a sanitary line plotted on the cross section is shown below.



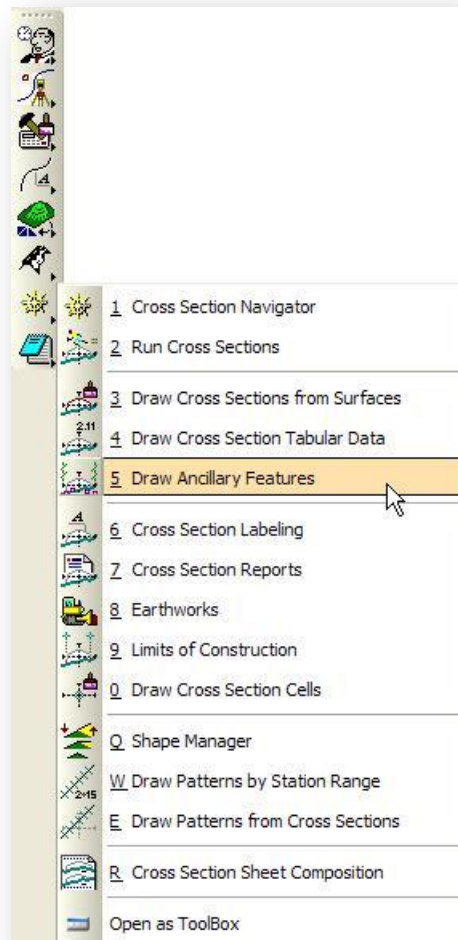
It should be noted that not all utilities can be plotted on the cross section or profile as summarized below:

- In Cross Section mode, only underground utilities that intersect the cross section Pattern Lines are plotted on the cross sections at the offset and elevation where the utility line crosses the Pattern Lines. Utility lines that run parallel to the pattern lines are not plotted on the cross sections.
- In Profile mode, only underground utilities that cross the centerline that was used to extract the profile are plotted on the profile. The utility location is represented on the profile by the placement of a cell at the station and elevation where the utility line crosses the centerline chain.

This chapter will focus on placing the underground utilities on the cross sections.

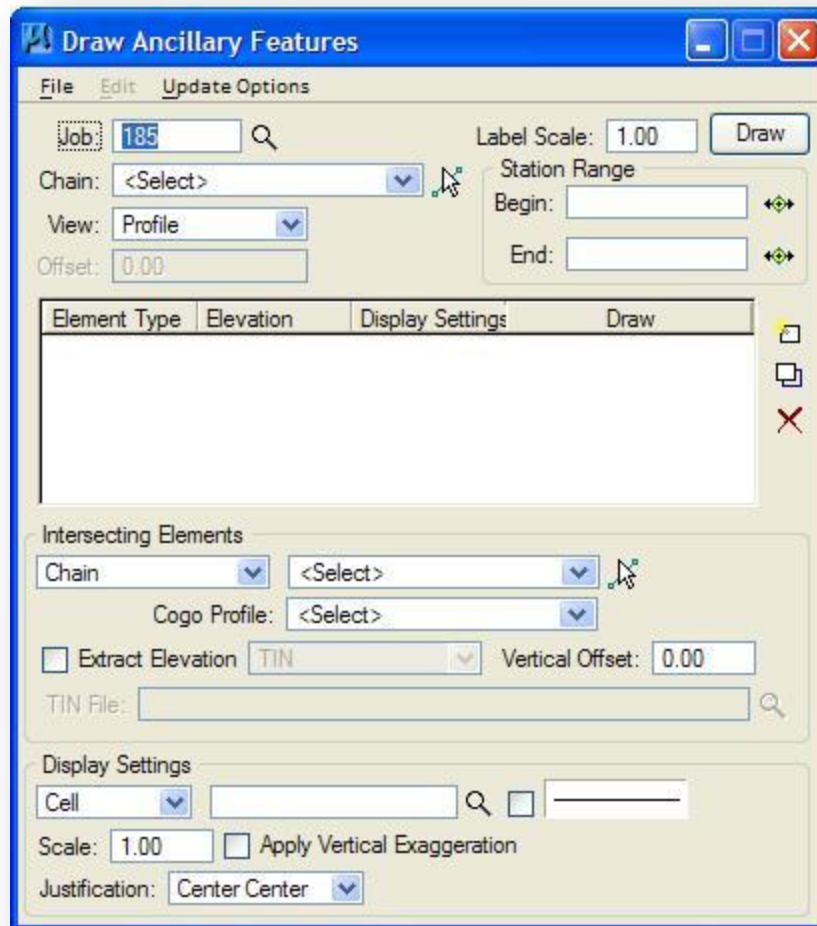
3.2 The Draw Ancillary Features Dialog

The *Draw Ancillary Features* dialog is accessed from the GEOPAK *Road* tool palette as shown below.



The application can also be accessed by selecting **Applications > Road > Cross Sections > Draw Ancillary Features** from the MicroStation pull-down menu.

Once selected, the *Draw Ancillary Features* dialog box, shown below, is opened.



The *Draw Ancillary Features* dialog, shown above, is divided into four sections.

- The top portion of the dialog is used to define the profile or cross sections that will be used to plot the ancillary information.
- The list box in the middle of the dialog is used to build a collection of ancillary features to be plotted.
- The **Intersecting Elements** portion of the dialog is used to define the elements that represent the location and elevation of the ancillary data to be plotted.
- The **Display Settings** section is used to define how the ancillary information will be plotted on the cross sections or profile.

Each portion of the dialog will be described in detail on the following pages.

Job

Specify the Job Number for the GEOPAK Coordinate Geometry database (GPK file) where the Chain and Profile are stored.

Label Scale

Use this key-in field to set the scale for text labels placed with the ancillary information. **Note:** This option is only used if the text setting is set to **Scale**, not **Fixed**.

Chain

Select the name of the **Chain** used to generate the cross section or profile cell.

View

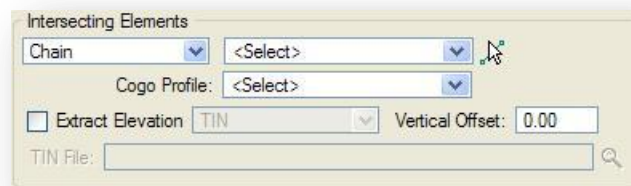
This option is used to select either **Cross Section** or **Profile** for the placement of the ancillary data. **Note:** When set to **Profile**, the list of available chains is taken from the GPK file specified by the **Job** field. When set to **Cross Section**, the list of chains is determined by reading the cross section cells in the active design file.

Station Range

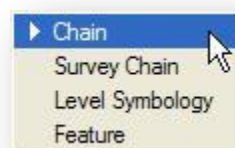
Key-in the **Begin** and **End** stations for cross section or profile processing.

3.2.1 Intersecting Elements

The **Intersecting Elements** portion of the *Draw Ancillary Features* dialog, shown below, is used to define the elements that represent the plan view location and elevation of the ancillary data to be plotted.



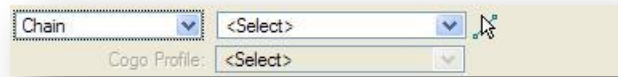
Four options are available as detailed below:



Each option is described on the following pages.

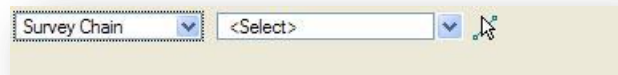
Chain

Select the **Chain** option to define the plan view location of the ancillary data by a COGO Chain. The chain can be selected from the drop down list or graphically via the **Identify Chain** icon. When **Chain** is selected, the default option for the elevation definition is a **COGO Profile** as shown below. Select the desired **Profile** from the list.



Survey Chain

Select the **Survey Chain** option to define the plan view location of the ancillary data by a Survey Chain. The Survey Chain can be selected from the drop down list or graphically via the **Identify Chain** icon. When **Survey Chain** is selected, by default the elevation definition for the ancillary data is the Survey Chain itself.

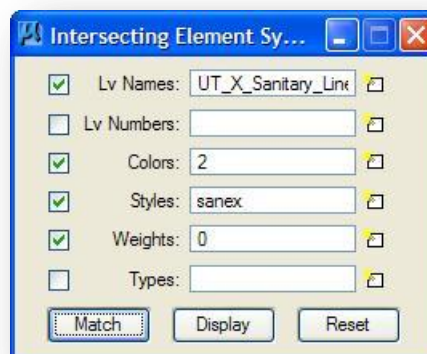


Level Symbology

This option is used to define the plan view location of the ancillary data by locating elements drawn in a MicroStation design file. The process will scan the selected **DGN File** to find elements matching the specified level symbology.

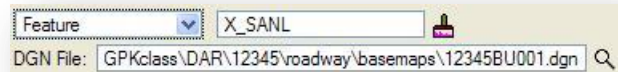


To specify the symbology for the plan view elements representing the ancillary data location, select the **Symbology** icon to access the *Intersecting Element Symbology* dialog box, toggle on the desired symbology options, and use the **Match** button to select the utility line element from the plan view design file.



Feature

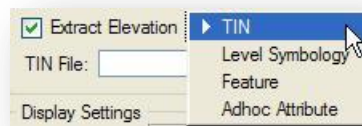
This option is used to define the plan view location of the ancillary data by locating elements drawn in a MicroStation design file. The process will scan the selected **DGN File** to find elements matching the symbology defined by selecting a feature from the Design and Computation Manager database.



Select the **Browse Feature** button to open the Design and Computation Manager database. Select the desired feature from the list.

Extract Elevation

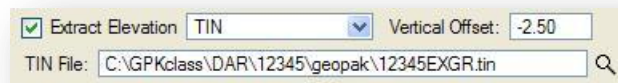
Toggle on **Extract Elevation** to access the four options shown below.



Each option is described below.

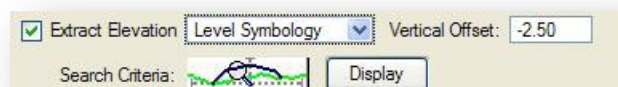
TIN

Select the **TIN** option to specify the **TIN File** that will be used to extract the ancillary data elevation. The **Vertical Offset** option can be used to specify an offset above or below the TIN model for the ancillary data. For example, to place a utility line with a depth of cover of 3', set the **Vertical Offset** value to -3.



Level Symbology

Use this option to define the elevation of the ancillary data relative to a graphic element drawn in the profile or the cross sections. The process will scan the profile or cross section to find elements matching the defined symbology, and then apply the **Vertical Offset** to determine the elevation of the ancillary data.



To define the profile or cross section element, select the symbology button to access the *Extract Element Elev Symbology* dialog box.

Feature

The **Feature** option works identically to the **Level Symbology** option with the exception that the symbology for the profile and cross section elements is defined by a Feature in the Design and Computation Manager Database rather than by level symbology.

Adhoc Attribute

Scans the limits of the cross section or profile cell and uses any element with the specified adhoc attribute. To use a depth of cover, set the **Vertical Offset** field.

3.2.2 Display Settings

The **Display Settings** section of the *Draw Ancillary Features* dialog is used to define how the ancillary information will be plotted on the cross sections or profile.

The ancillary data can be drawn on cross sections or a profile using the three options detailed below:

Cell

This option is used to place a cell on the cross sections or profile at the location of the ancillary data. Key-in the Cell name in the dialog. The MicroStation configuration variable MS_CELLLIST is used to define the cell libraries that will be searched if the cell is not contained in the currently attached cell library.

To set the symbology for the cell, toggle on the option button to the right of the cell name field, and then double click the **Symbology** box.

The **Scale** option can be used to specify the size of the cell. If the cell is placed on a profile or cross section that was plotted with a vertical exaggeration, click on the **Apply Vertical Exaggeration** option.

The orientation for the cell can be specified by use of the **Justification** options. The cell orientation is relative to the station, offset (cross section **View** only), and elevation point where the cell will be drawn.

Symbol

When the option is toggled to **Symbol**, the **Display Settings** appear as shown below.



The **Symbol** option is used to place one of the predefined symbols shown at right.

The justification for the Symbol can be set using the **Justification** options.

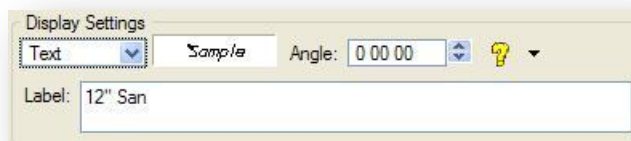
The level symbology for the **Symbol** can be defined by double clicking the **Symbology** box to access the *Symbol Symbology* dialog box.

The **Width** and **Height** of the symbol can be defined using the **Fixed** or **Adhoc Name** options. For more information on using the **Adhoc Name** option, see section 3.4.1.



Text

Select the **Text** option to place labels on the profile or cross sections.



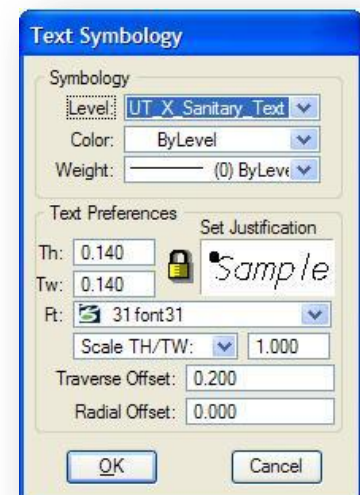
Double-click the **Sample** field to define the text symbology using the Text Symbology dialog box shown at right below.

The text scale can be set as described below.

Select the **TH/TW Fixed** option to use the **Th** and **Tw** values entered in the dialog.

Select the **Scale TH/TW** option to apply the **Label Scale** value to the **Th** and **Tw** values entered in the dialog.

The **Traverse Offset** and **Radial Offset** values are used to specify the location of the text labels in relation to the utility location.

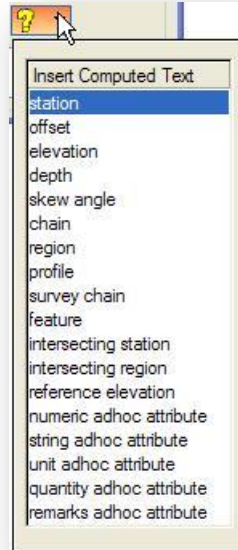


Angle

The text can be rotated by specifying a rotation angle.

Label:

Use the **Label** field to enter the text string to be placed on the profile or cross sections. Several calculated values can be entered into the **Label** field as shown below. Select the ? icon to show a list of **Computed Text** values that can be inserted into the label.



3.2.3 The Draw Ancillary Features List Box

The list box in the center of the *Draw Ancillary Features* dialog box, shown below, is used to build a collection of ancillary features to be plotted on the profile or cross sections.

Element Type	Elevation	Display Settings	Draw
Lv: UT_X...\	Tin = 12345...	Symbol = Circle	<input checked="" type="checkbox"/>
Lv: UT_X...\	Tin = 12345...	Text = 12" San	<input checked="" type="checkbox"/>

Once you have completed the **Display Settings** and the **Intersecting Elements** portions of the *Draw Ancillary Features* dialog, the three buttons to the right of the list box are used to **Add**, **Modify**, and **Delete** rows from the list box.

**Add Element Set**

Select this button to add the current settings as a new row in the list box. Multiple rows can be defined to draw several ancillary features simultaneously.

**Modify Element Set**

Use this button to modify the settings of the selected line in the list box. Select the line, make the desired changes, then select **Modify Element Set** to apply the changes.

**Delete Element Set**

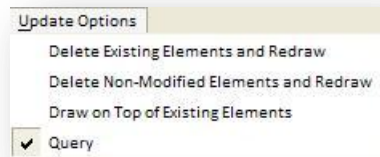
Use this button to delete a line from the list box. Highlight the desired line, and then select **Delete Element Set**.

3.2.4 File Options

The **File** options are used to **Save** and **Load** the *Draw Ancillary Features* Dialog settings. The default extension is .afd.

3.2.5 Update Options

The four options are detailed below.

**Delete Existing Elements and Redraw**

When this option is activated, any ancillary data previously drawn with this tool is deleted and new data is drawn.

Delete Non-modified Elements and Redraw

When this option is activated, any ancillary data previously drawn with this tool is deleted and new data is drawn.

Draw on Top of Existing

When this option is activated, any previously drawn ancillary data is ignored and a new set is drawn, resulting in two sets of ancillary data.

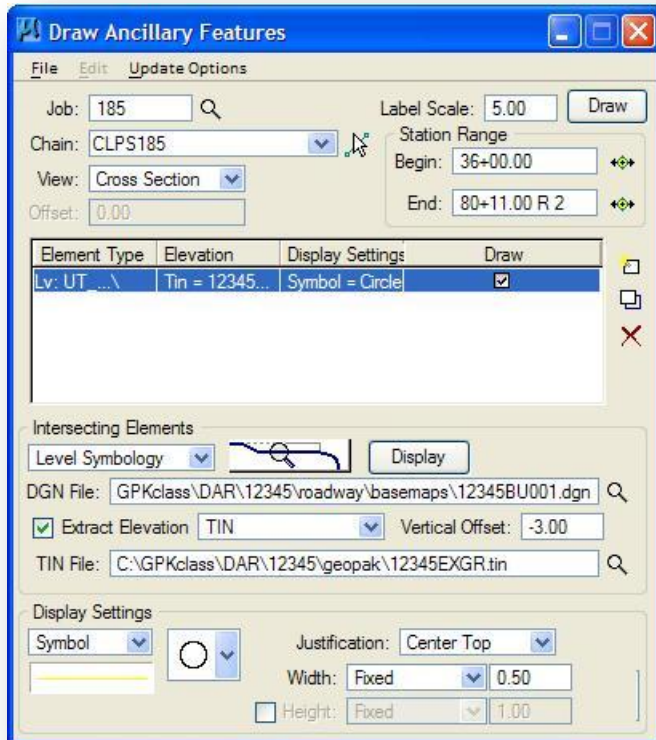
Query

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

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

3.3 Cross Section Utility Processing Example

This section will demonstrate use of the *Draw Ancillary Features* dialog to draw a symbol and text representing an existing 6" gas line on the cross sections with a 3.0' depth of cover. The gas line location will be read from MicroStation graphics. The elevation will be determined from the existing ground TIN file provided with the Survey Data.



The dialog at left shows the settings to draw a symbol, representing the gas line, on the cross sections.

Tips:

Set the **Vertical Offset** to a negative value to place the symbol below the TIN surface.

Set the **Justification** to **Center Top** to properly represent the Depth of Cover.

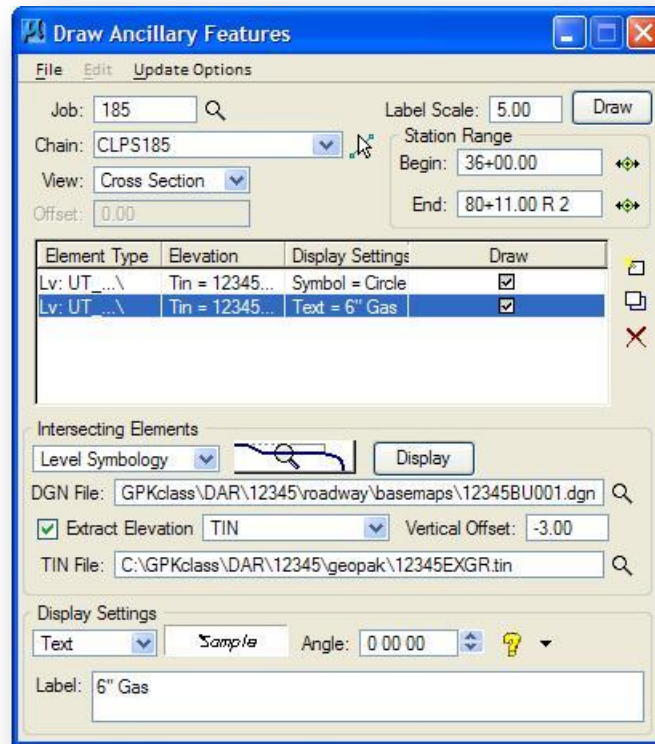
The **Width**, and optionally the **Height**, is entered in decimal feet.

After you have defined the first row with the settings to place the symbol, be sure to select the Add Element Set button.

To configure the dialog to place a label for the 6" Gas line, take the following steps:

- ✓ The settings for the **Intersecting Elements** portion of the dialog box are identical to the settings used to place the Symbol. No changes need to be made.
- ✓ Toggle the **Display Settings** item to **Text**.
- ✓ Set the symbology for the text placement using the Text Symbology dialog shown on page 3-8.
- ✓ Key in the label for the text
- ✓ Select the Add Element Set icon to add the text item to the list.

The dialog will appear as shown below after the text item is added to the list.

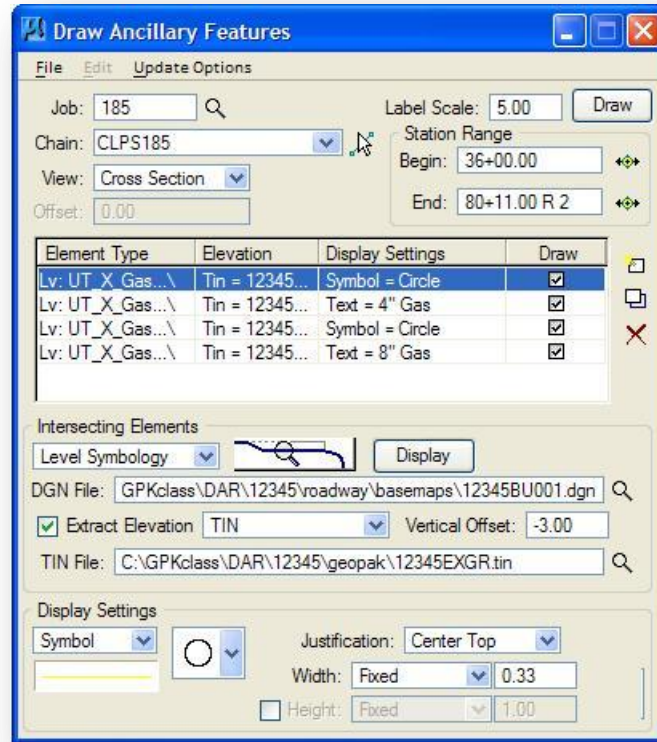


After you have added rows defining the **Symbol** and **Text** placement, select the **Draw** button. An example of the gas line utility as drawn on the cross sections is shown below.



3.4 Processing Multiple Utility Lines of the Same Type

The *Draw Ancillary Features* dialog will allow you to locate multiple plan view utility lines for placement on the profiles or cross sections. In the example below, two utility lines have been defined: a 4" Gas line, an 8" Gas Line.

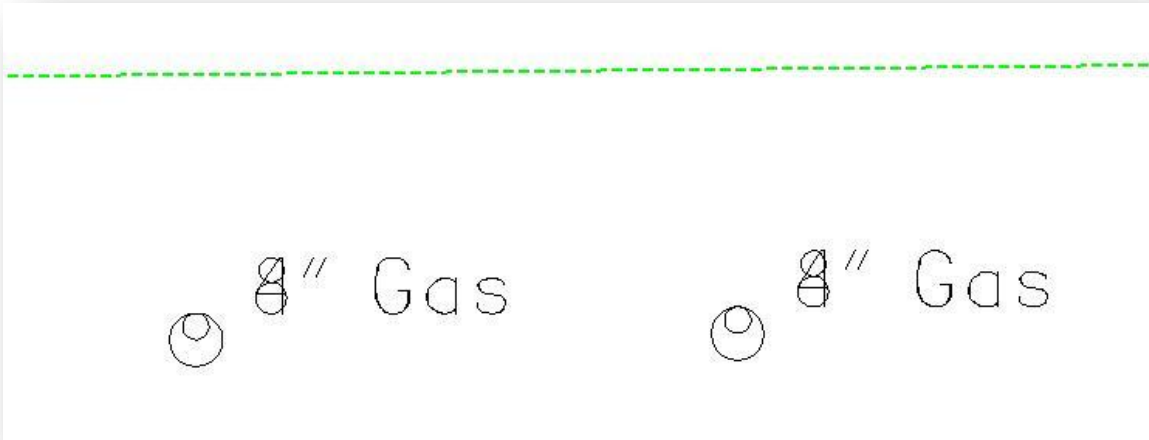


This works very well when the **Intersecting Elements** are defined using the **Chain** or **Survey Chain** options. However, when multiple utility lines of the same type are processed using the **Level Symbology** or **Feature** options to read plan view graphics for the utility line location, the potential for duplicate symbols and text labels exists.

In the example above, each gas line has been defined by finding elements in the **DGN File** with symbology matching the **Level Symbology** for an existing gas line on the level **UT_X_Gas**. According to ODOT Standards, existing gas lines are drawn with the following symbology:

Feature	Level	Weight	Line Code	Color
Gas Line	UT_X_Gas	0	gasex	4

ODOT CADD Standards do not provide a way to differentiate the 4" gas line from the 8" gas line. In this case, the *Draw Ancillary Features* dialog will plot each gas line on the profile or cross section as both a 4" Gas line and an 8" Gas line as shown in the example below.



The user has three options to resolve this problem:

Option 1: Copy and Delete

The user may elect to copy the plan view **DGN File**, delete one of the utility lines, and then configure the *Draw Ancillary Features* dialog to process only the remaining gas line. After processing the first gas line, the user must copy the plan view design again, delete the other line, and process the remaining line.

Option 2: Temporarily Change Symbology

The user may elect to temporarily change the symbology of one of the gas lines so that they have unique symbology.

Option 2: Adhoc Attributes

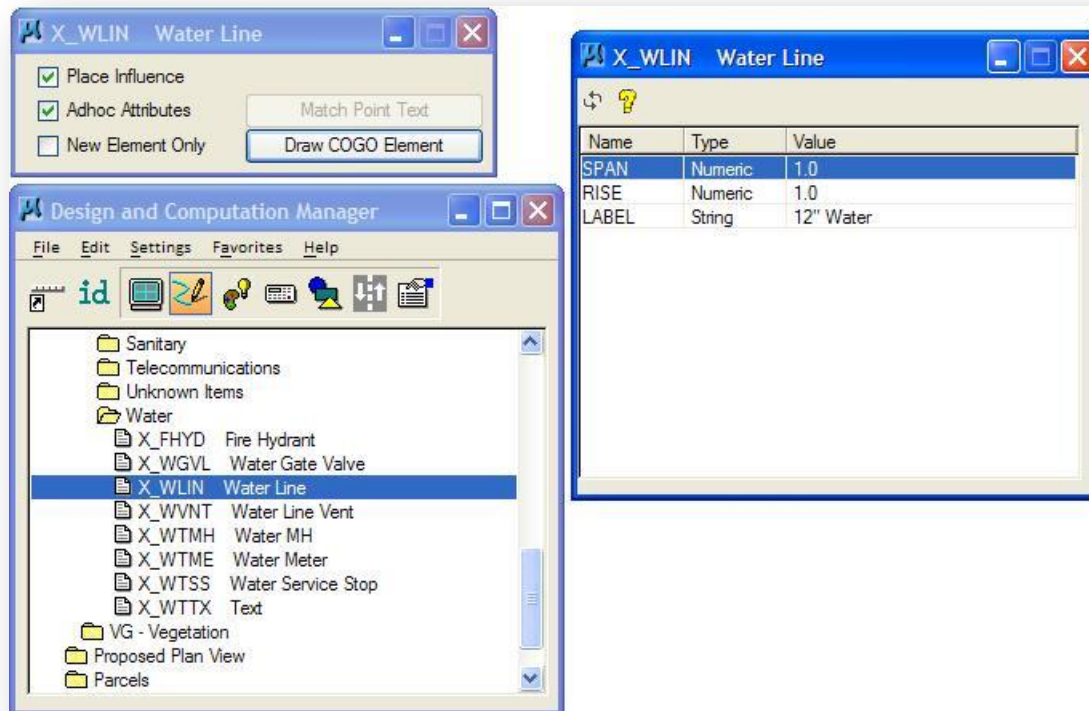
Adhoc attributes can be used to “tag” supplemental information to MicroStation elements. This supplemental information can be read by various GEOAK functions and used for a variety of applications. The *Draw Ancillary Features* dialog can be configured to read the Adhoc attribute values from MicroStation elements and use these values to set the **Symbol** size and the content of the **Text** label that will be placed on the profile or cross sections.

Using Adhoc Attributes, any number of plan view elements defining one utility type can be processed simultaneously in one run without copying design files, or changing the element symbology.

Adhoc attributes are assigned to MicroStation elements by use of the GEOPAK **Design and Computation Manager** or the **Adhoc Attribute Manager**. The procedure to use Adhoc attributes for ancillary data processing is detailed in the following sections.

3.4.1 Drafting Utility Lines with Adhoc Attributes

Each item in the ODOT Design and Computation Manager Database that has been configured for an existing utility line has been also been configured with the Adhoc attributes "SPAN", "RISE" and "LABEL". The SPAN and RISE attributes are used to designate the size for the symbol placed on the profile or cross sections. The LABEL attribute is used to specify the text description that will be placed with the utility line symbol on the profile or cross sections. The example below depicts the procedure to place an existing 12" water line assigning a SPAN and RISE value of 1.0, and a text LABEL of "12" Water".



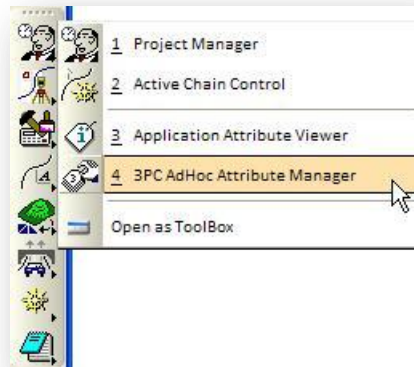
Note: The SPAN and RISE attributes must be specified in Master Units.

The Design and Computation Manager can also be used in **Set** mode to assign these Adhoc attributes to previously drawn utility lines.

Set mode is used to set an existing MicroStation element to match the symbology of the selected Design and Computation Manager Item. It can also be used to assign Adhoc attributes to previously drawn elements as shown in the example above. See the [ODOT GEOPAK Road 1 Manual](#), Chapter 5, for more information on the use of the GEOPAK *Design and Computation Manager* dialog.

3.4.2 Adhoc Attribute Manager

The **Adhoc Attribute Manager** is used to store, review and modify Adhoc attributes. The **Adhoc Attribute Manager** can be accessed from the GEOPAK *Road* tool palette as shown below, or by selecting **Applications > Road > GEOPAK 3PC Adhoc Attributes** from the MicroStation pull down menu.

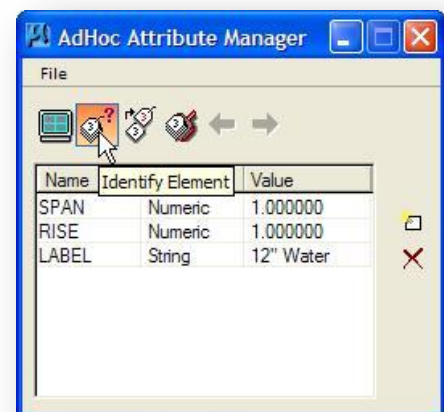


The *AdHoc Attribute Manager* dialog, shown below, is opened.



See the GEOPAK on-line help for complete details regarding the use of the **Adhoc Attribute Manager**. The procedure to edit and set the Adhoc attributes for selected MicroStation elements is detailed below.

- ✓ Use the **Identify Element** icon, as shown at right, to select a MicroStation Element that has been previously placed with or without Adhoc attributes assigned. Once the element is selected, any Adhoc attributes stored with the element are shown in the dialog.

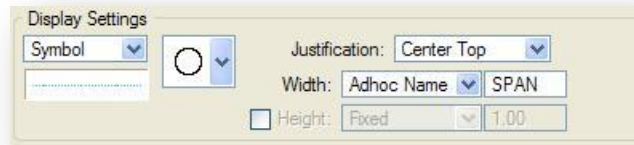


- ✓ To change the value of an attribute, select the attribute **Value** from the *AdHoc attribute Manager* dialog and key in the new value.
- ✓ Use the **Set Attributes** icon, as shown at right, to assign the Adhoc attributes to a MicroStation element by selecting the element and accepting it.



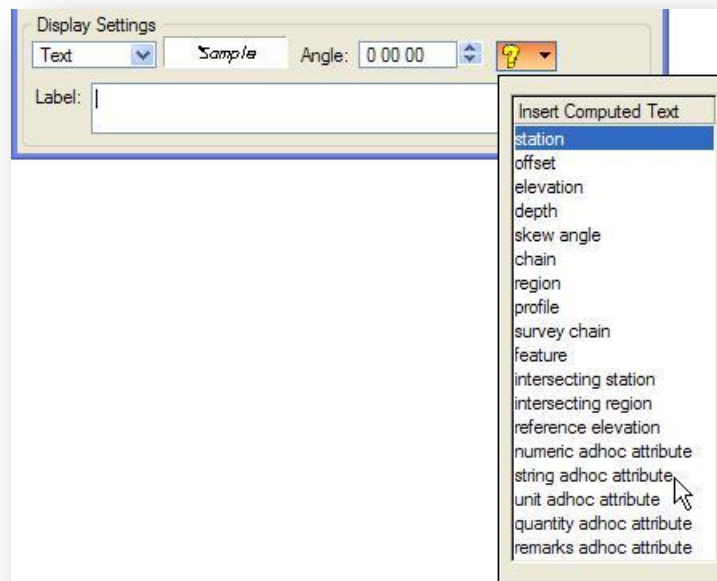
3.4.3 Processing Utilities with Adhoc Attributes

The **Display Settings** portion of the *Draw Ancillary Features* dialog can be configured as shown below to read the SPAN and RISE Adhoc attributes to define the **Width** and optionally the **Height** of the **Symbol** to be placed on the profile or cross sections.



Note: If the SPAN and RISE values are the same, it is not necessary to define the **Height** item in the **Display Settings**.

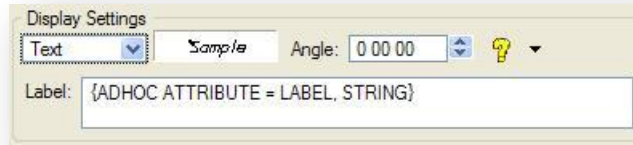
To place text labels using the LABEL Adhoc attribute, toggle the **Display Settings** to **Text** and select the **string adhoc attribute** item as shown below.



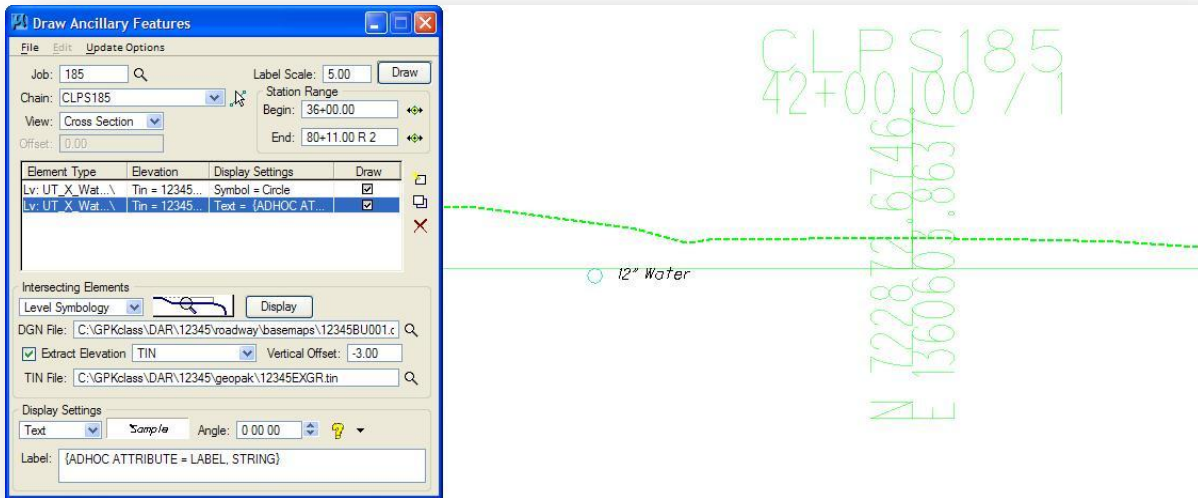
The Label field is populated with the information to use an Adhoc attribute to compose the label as shown in the example below.



Edit the text “insert name here” with the name of the Adhoc attribute as shown on the following page.



The **Label** field will appear as shown in the example below when you have completed the edit.



3.5 Exercise 3

The file 12345BU001.dgn contains the plan view graphics for a 6" Gas line and a 12" Sanitary line. Use the *Draw Ancillary Features* dialog to place symbols and text for a 6" Gas line and a 12" Sanitary line on the S.R 185 cross sections. Use the following settings to place each utility:

Utility Line	Plan View Definition	Elevation
6" Gas	DGN File = 12345BU001.dgn	Depth of Cover = 2.0'
12" Sanitary	DGN File = 12345BU001.dgn	Depth of Cover = 3.5'

The 6" Gas line has been tagged with the Adhoc attributes SPAN, RISE, and LABEL. Use the processing options to read the Adhoc attributes for the symbol and text placement.

The 12" Sanitary line has not been tagged with any Adhoc attributes. Process this utility line by keying in the value for the **Symbol Height** and the **Text Label**.

4 Superelevation

4.1 Overview

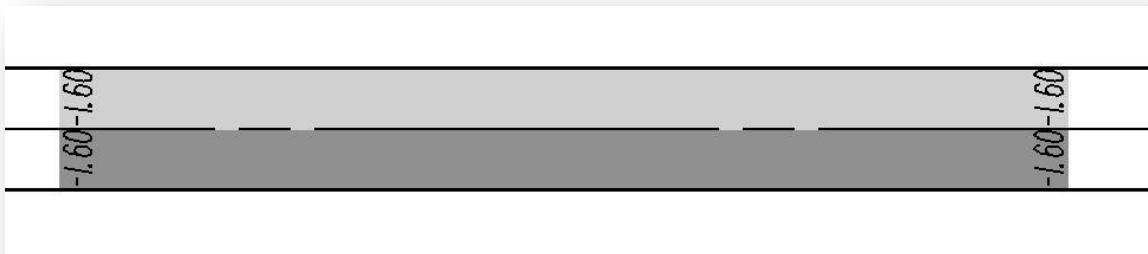
4.1.1 Disclaimer

Superelevation transition stations and cross slopes can be computed using the preference files provided by ODOT, which are detailed in this Chapter. The user of these preference files should check all computed values for accuracy. ODOT will assume no responsibility for the results obtained by use of the provided superelevation preference files, or the accuracy of the calculations.

4.1.2 Superelevation Overview

GEOPAK supports several options for defining the pavement widths and cross slopes on the proposed cross sections. The pavement width and cross slope is represented by a series of complex shapes, drawn in a MicroStation file, which are tagged with the cross slope information.

A simple example of two pavement shapes is shown in the graphic below. Each shape represents one lane of pavement. This example contains two lanes of pavement with the profile grade line defined at the center of the pavement. The cross slope for each shape, -1.60%, is tagged at the end of the shape.



The pavement shape definition can be as simple as a single shape with slope specification on each end of the shape, to a series of shapes representing multiple roadways, each with its own superelevation transitions.

The most basic condition is the roadway where no superelevation transitions are required, i.e., the slope for all pavements can be specified as a single value. In this case, the pavement cross slope can be defined with the proposed cross section processing and no pavement shapes are required. Therefore, this method is identified as “shapeless”.

Another option is the definition of superelevation transitions where roadways have a constant width without tapers. In these areas, the **Automated Superelevation** tool can be used. Superelevation shapes are generated based on a user-defined design speed and the geometry of the specified roadway. After

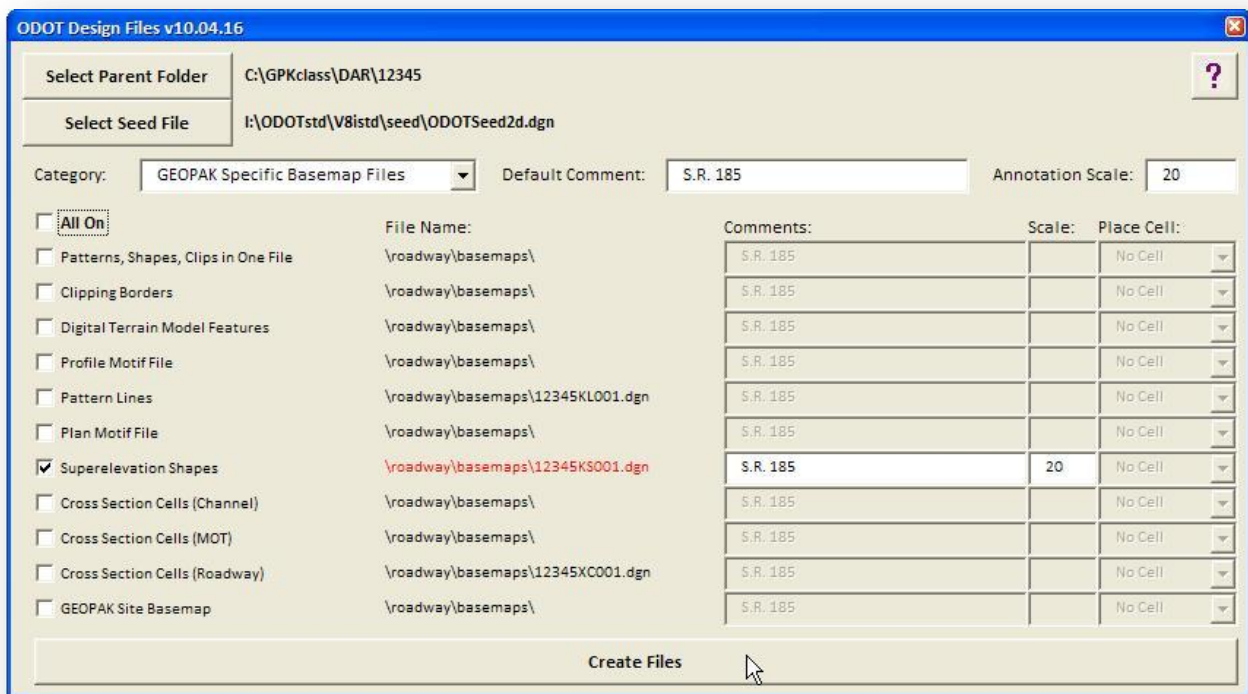
processing the data, GEOPAK draws pavement representations as complex shapes into a MicroStation 2D design file.

The last option is the definition of superelevation transitions where roadways do not have a constant width, i.e., gore areas, approach tapers, departure tapers, acceleration and deceleration lane tapers, etc. In these areas, graphics elements within a MicroStation 2D design file are used to create complex shapes which define the superelevation transitions.

A combination of these tools can be used within a project, or even within a single roadway. The shapeless mode is excellent for widening and resurfacing projects where the existing cross slopes will be maintained, while the automated method quickly generates automated shapes for more complex roadways. Any area which cannot be defined via the automated method can be augmented by the graphical method.

4.1.3 Shape Design Files

Superelevation Shapes for the entire project can be stored in the same design file. The ODOT_Files application can be used to create the design file for the shapes as shown below.



4.2 Shoulder Shapes - Are They Needed?

Usually, the paved roadway is shaped. This is true of the mainline lanes, but what about the shoulders? It's usually better not to shape the shoulders, but to use GEOPAK criteria files to draw the shoulder slopes on normal (non-skewed) cross section processing. This allows more flexibility to draw variable-width shoulders, with cross slopes based on the adjoining mainline pavement slopes and standard rollovers on superelevated areas. See Chapter 5 Proposed Cross Sections for a description of criteria files and their use.

4.3 How to Shape

Now that the decision has been made on what to shape, the process is done in three parts. Let's review the process in general and then look specifically at each step:

1. Automated superelevation computations, the first step in producing shapes, is used where a standard width lane can be defined by two offsets from a defined alignment. In this step, GEOPAK computes superelevation based on user-defined parameters and produces an Autoshape text input file. This ASCII file can be modified if the user chooses to override the computed superelevation values.
2. Process the Autoshape file created in step one to draw shapes into a MicroStation design file. If desired, the automated superelevation step can be skipped and the Autoshape file can be generated manually using any ASCII text editor. Regardless of how the Autoshape file is created, there are several advantages of auto shaping:
 - If the alignment changes, the obsolete shapes can be deleted and the auto-shaping can be run in a minimum amount of time compared to graphics shaping.
 - It can produce shapes faster than graphics shaping.
 - The shapes are placed automatically.
 - It produces fewer errors when processing proposed cross sections since it does not rely on graphic lane lines, which are not as accurate as the parallel chains used in auto shaping.
3. Once the processing of the Autoshape file is complete, other irregular areas such as tapers, turn lanes, and gore areas can be shaped using the Shape Maker tool.

It is advisable to place the shapes in their own file, while referencing the plan view. See the [ODOT CADD Engineering Standards Manual](#) for standard design file names. The ODOT_Files.exe application, available from the ODOT CADD Support Website, can be used to create design files using the proper file naming convention.

Before discussing how each tool is used, a discussion of the components of a shape needs to be addressed.

4.4 Components of the Shape

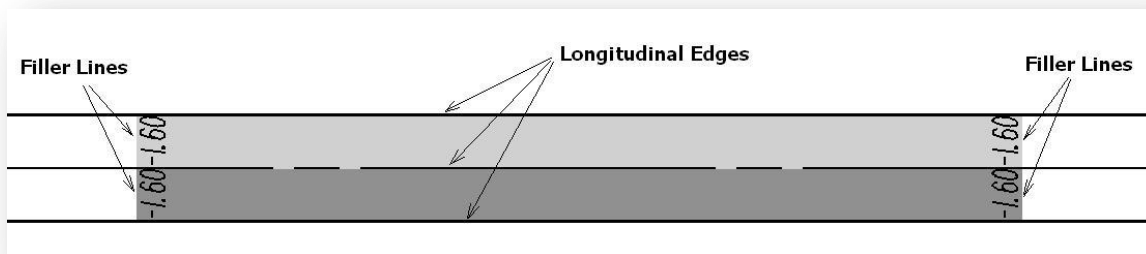
The GEOPAK Superelevation shapes are placed in the design file as complex shapes. They consist of a series of connected elements (lines, line strings, arcs, and curve strings) that form a closed shape. The elements that form the shape can be classified into two types:

Longitudinal Edges

Longitudinal Edges define the longitudinal breaks between slope areas. Typically the longitudinal edges consist of only the roadway pavement lane width edges. A longitudinal edge could form a crown or a lane line. Longitudinal lines will generally coincide with the roadway geometric elements (lane width, edge of pavement) contained in the plan view MicroStation file.

Filler Lines

Filler lines define the limits of constant slope or the limits of superelevation transition. These lines are radial to lane width edges except where some form of lane transition occurs.



A primary distinguishing factor differentiating longitudinal edges and filler lines is that filler lines always represent a slope while longitudinal edges do not. If the shape represents a superelevation transition section, each filler line represents a different slope.

4.5 Shape Cluster Parameters

Every shape has four hidden attributes which cannot be seen by the user unless the **GEOPAK Element Attributes** or **Shape Analyst** tools are used. All shapes with common attributes are defined as a "cluster". These attributes include:

Baseline

The **Baseline** defines the GEOPAK chain representing the proposed alignment for a shape cluster.

Profile

The **Profile** defines the vertical geometry for a particular roadway.

Tie

The **Tie** parameter is used to establish the location of the **Profile** relative to the **Baseline** chain. The **Tie** can be defined as a constant offset, or as a variable offset by use of a COGO chain. Each option is described below:

Tie defined by an offset

The **Tie** value represents a constant offset distance, measured from the **Baseline** chain, to define a Profile Grade Line (PGL) location. **Note:** The profile is defined using the centerline stationing. The **Tie** value is calculated from the baseline to the PGL location.

Tie defined by a PGL-Chain

The **PGL-Chain** option is used to specify a GEOPAK chain that defines the Profile Grade Line (PGL) location. This option is only used when the offset distance from the **Baseline** to the **Profile** location is not a constant value. For example, this option would be used for a divided facility where the PGL follows the inside edge of pavement and the median width is transitioning.

The **Baseline**, **Profile**, **Tie** and **PGL-Chain** parameters are interpreted by the proposed cross-section software to determine the following:

1. A stationing reference expressed as a GEOPAK chain. The stationing reference is defined by the **Baseline** parameter.
2. The Profile Grade Line (PGL). The PGL can be defined by either a **PGL-Chain** or the combination of a **Baseline** and **Tie**. If the **Tie** option is used, the **PGL-Chain** cannot be specified.
3. Vertical geometry expressed as a GEOPAK profile. This is defined by the **Profile** parameter.

All shapes with common attributes define a shape "cluster." If any of the four elements are changed, it defines a new cluster. For example, on a divided highway, one roadway has a proposed alignment NB, profile NBPRO and a tie of 20. This is one cluster. A second cluster would be defined on the other side of the roadway with a proposed alignment SB, profile SBPRO and a tie of -20. In practical terms, shapes representing adjacent areas of pavement not separated by medians or other physical breaks will typically belong to the same shape cluster. There is no limit to the number of shape clusters in a project.

4.6 Dependent and Independent Shapes

There are two types of shapes, **Dependent** and **Independent**, which refer to how elevations on the pavement surfaces represented by the shapes are calculated.

Dependent shapes

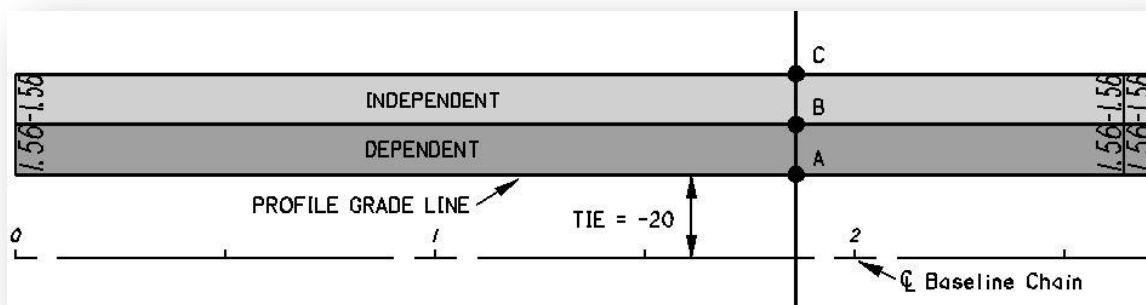
The starting elevation for the shape is determined directly from the profile. The software computes the proposed profile and uses the information to draw the shape width and slope on the cross section.

Independent shapes

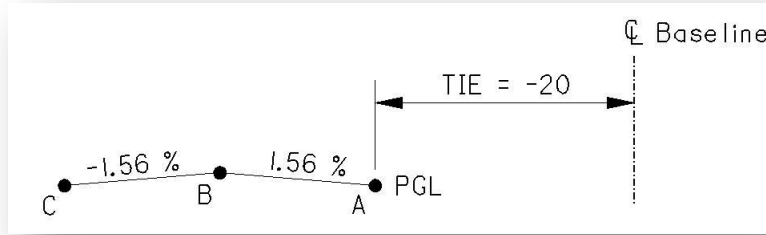
The starting elevation for the shape is taken from the adjacent shape, not from the profile. A right turn lane is an example of an independent shape.

Each cluster must have a minimum of one dependent shape. If two adjacent shapes straddle the PGL location, either shape could be defined as a dependent shape. In this case, choose one of the lanes as the dependent shape.

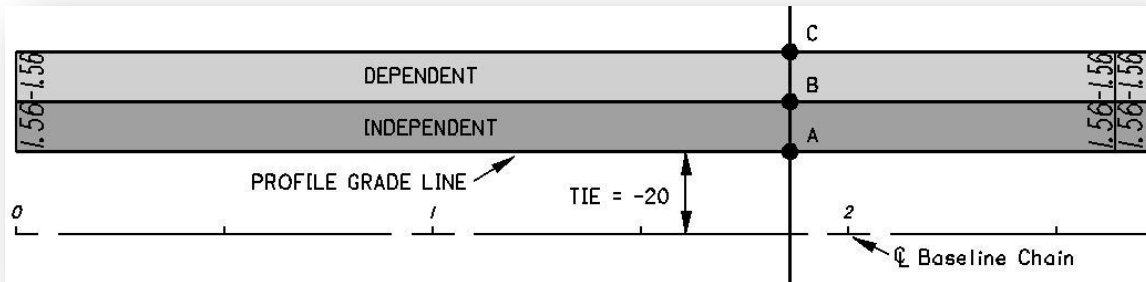
In cases where the dependent shape is not adjacent to the baseline, care must be exercised as shown in the example below.



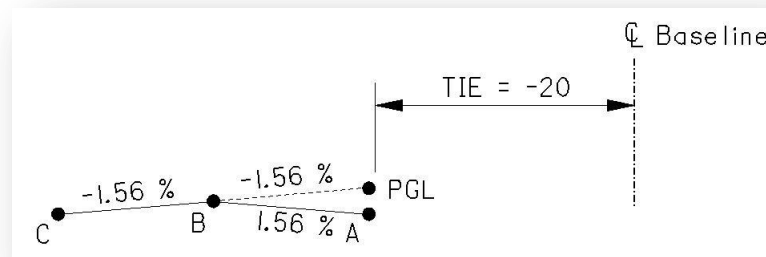
The cross section pattern line intersects two shapes that refer to the same PGL, defined by a **Tie** of -20, **Profile** and **Baseline**. Within this group of shapes only one shape can be a **Dependent** shape. The other shape must be an **Independent** shape. The proposed cross-section software will first determine the elevation at the Profile Grade Line (PGL). In the example above, the PGL coincides with the inside edge of pavement so the elevation of the profile at this station is applied to point **A**. The elevation at point **B** is determined by projecting the 1.56% grade across the width of the Dependent shape. The elevation at point **C** is determined by projecting the -1.56% grade across the width of the Independent shape. A cross-section view for this example is shown on the following page.



The elevations of the pavement surfaces would be determined differently if the PGL remained along the inside edge of pavement but the assignment of **Dependent** and **Independent** shapes were reversed. This case is illustrated below.



In this situation, the PGL is not coincident with the edge of a **Dependent** shape. The rule applied by the proposed cross-section software is to project the profile elevation onto the closest edge of the closest **Dependent** shape. As shown in the cross-section below, the elevation at the PGL is projected to Point B at a slope of -1.56%. The elevations at Points A and C are then determined by projecting the 1.56% and the -1.56% grades across each shape.

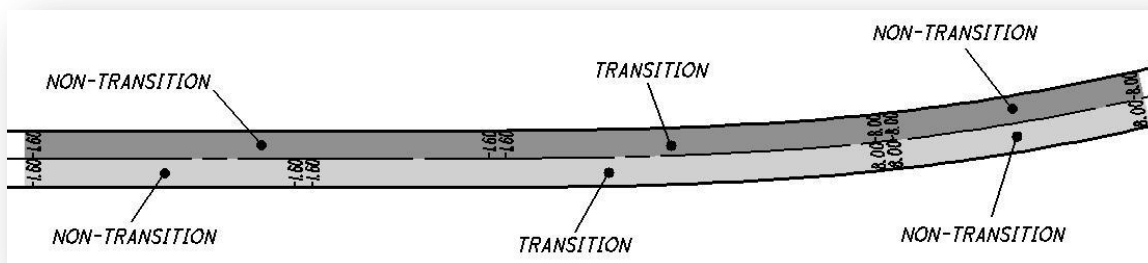


4.7 Transitional or Non-Transitional Shapes

Each shape also has two slope options, **Transition** or **Non-Transition**.

- The **Non-Transition** shape has a constant slope the entire length of the shape. These are common in tangent sections of the roadway.
- **Transition** shapes have a different slope at each end of the shape and the software interpolates between the two slopes.

The software defaults to a linear interpolation for its transitions which is the method ODOT uses. However, the software also provides the options for an unlimited number of parabolic transitions.



In the example above, the left-hand and right-hand shapes start at a constant slope of -1.6%. The right-hand shape then transitions from a -1.6% to +8.0% slope and the left-hand shape transitions from a -1.6% to -8.0% slope. At the end, the left-hand shape is a constant -8.0% and right-hand shape is a constant +8.0%. There is no visual representation as to whether the shape is a linear or parabolic transition.

Note that the sign of the slope is important. A +1.6% slope is going up as it goes away from the PGL. A slope of -1.6% is going down as it goes away from the PGL. A text label representing the slope (including the negative sign if necessary) at each superelevation transition is drawn inside each shape. If the MicroStation area fill view attributes option is active, the shapes appear filled.

4.8 Superelevation Shape Manager Tools

GEOPAK provides a comprehensive set of shape tools to generate, evaluate, and edit superelevation shapes. The shape tools can be accessed from the *Road* tool palette, or from the MicroStation pull down menu by selecting **Applications > Road > Cross Sections > Superelevation Shape Manager Tools**. Once selected, the *Superelevation Shape Manager Tools* palette shown below appears.



The tools in the *Superelevation Shape Manager* have the following functions:



Automated Superelevation - Performs the superelevation calculations and stores the results in an ASCII file known as the Autoshape input file.



Autoshape Builder - Processes an Autoshape input file and draws the pavement shapes in the specified 2D file.



Shape Maker - The **Shape Maker** tool provides a graphical method for drawing irregular pavement shapes.



Shape Analyst - The **Shape Analyst** tool provides information, such as cross slope, elevation, etc., at any point on the shape.



Shape Profiler - The **Shape Profiler** tool provides elevations at user defined increments along the shapes.



Shape Editor - The **Shape Editor** enables the user to edit the shapes including station ranges, cross slope, etc.



Shape Selector - The **Shape Selector** tool is used to highlight or select shapes based on a wide range of user queries or filters.



Shape Properties - The **Shape Properties** tool provides information on any GEOPAK shape. In addition, this shape information can be modified on individual shapes or selections of shapes.



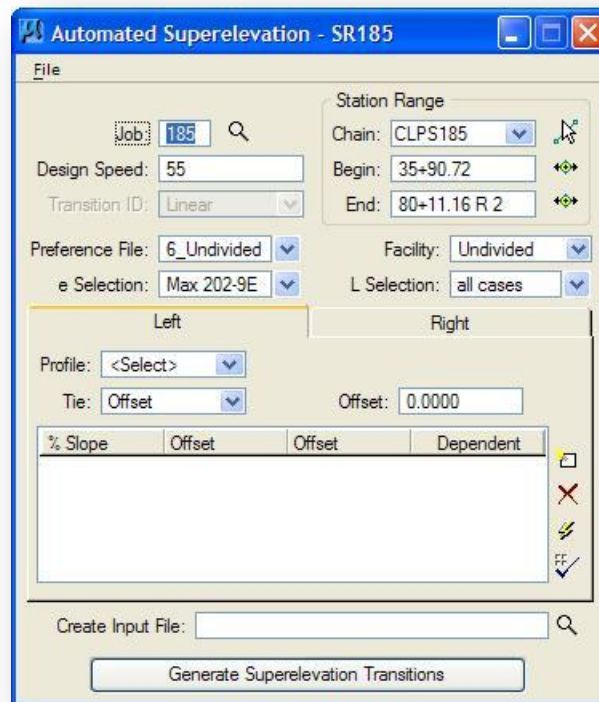
Shape to DTM - The **Shape to DTM** tool is used to read GEOPAK superelevation shapes to create a DAT file for use in the **Build Triangles** tool in the *DTM* tool frame.

4.9 Automated Superelevation

The GEOPAK Superelevation tools enable the user to quickly create, edit, and run an Autoshape input file using a previously stored COGO alignment. The *Automated Superelevation* dialog can be accessed from the *Road Project* dialog, or by selecting the *Automated Superelevation* icon from the *Superelevation Shape Manager Tools* as shown below.



If you are using the GEOPAK Project Manager, you will be prompted to select or create a Run. When the command is selected, the dialog shown below is opened.



In this dialog, the user selects which **Preferences File** is to be used for a given run, along with many other parameters such as the **Baseline**, **Profile**, etc. When the **Generate Superelevation Transitions** button is pressed, an Autoshape input file and a log file are generated. The log file, which has the same name as the input file but with a .log extension, gives the user detailed information on the decisions and computations made in the course of generating the input file.

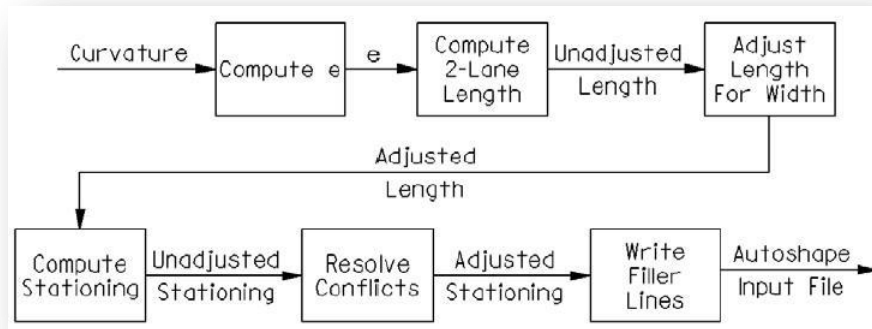
The superelevation rates and transition stations which are written to the Autoshape input file should be checked, and, if desired, modified. After reviewing the input file, the shapes are created by use of the **Autoshape Builder** tool as described in Section 4.11.

A description of how GEOPAK computes superelevation transitions is detailed below, followed by a description of the components of the *Automated Superelevation* dialog.

4.9.1 Computation Process

This section describes the process used by GEOPAK to calculate the superelevation from an engineering standpoint and explains how the various preference settings affect that process.

The following is a flow chart showing the major stages which take place in the process of calculating superelevation in the order those stages take place.



Using the radius of each curve, superelevation rates (e) are computed.

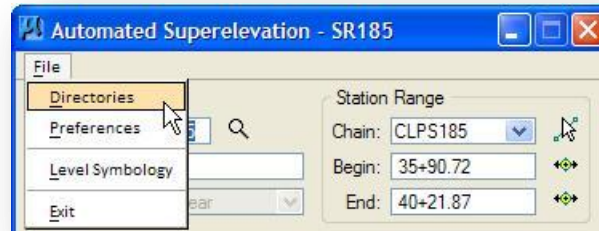
- Using the computed e -value, Runoff Lengths are computed as if the roadway had only two lanes. This Runoff Length is termed here Unadjusted Length.
- Using the Unadjusted Lengths, true Runoff lengths (Adjusted Lengths) are computed based on the actual roadway widths (or number of lanes).
- Filler line stations are computed using the true Runoff lengths.
- Curve Conflicts are then checked and corrected if possible.
- Finally, filler line stations are written to the autoshape input file which is then used to create roadway shapes in the design file.

Disclaimer

The ODOT superelevation preference files are provided to assist the designer in generating the autoshape input file. Before processing the input file, it is the responsibility of the designer to review the results for compliance with ODOT standards, and correct the results as necessary, before processing the superelevation transition calculations.

4.9.2 File Menu

The *Automated Superelevation* dialog supports several options from the **File** pull-down menu in the upper left corner. These options are detailed below.



Directories

Selection of **File > Directories** opens a dialog that enables the user to view and change the four directories used by GEOPAK Superelevation.



Each of the four directories can be assigned a default value by the use of MicroStation Configuration Variables. To the right of each field are buttons that allow the user to select a directory by browsing or to restore the given directory to its default value. If the Configuration Variable is defined, the **Default** button sets the directory to the value defined by the variable. If not, **Default** button sets the value either to the GEOPAK\bin directory or the user's current Working Directory. The four Configuration Variables are described below:

GP_K_SUPER_PREFDIR

This variable is used to assign the default directory that GEOPAK will search for the superelevation preference file. The variable has been defined as follows for ODOT personnel:

```
GP_K_SUPER_PREFDIR = i:\ODOTstd\V8istd\geopak\road\super\
```

GP_K_SUPER_EDIR

This variable is used to assign the default directory to search for e-computation .csv files. The variable has been defined as follows for ODOT users:

```
GP_K_SUPER_EDIR = i:\ODOTstd\V8istd\geopak\road\super\
```

GPK_SUPER_LENGTHDIR

This variable is used to assign the default directory to search for length-computation .csv files. The variable has been defined as follows for ODOT users:

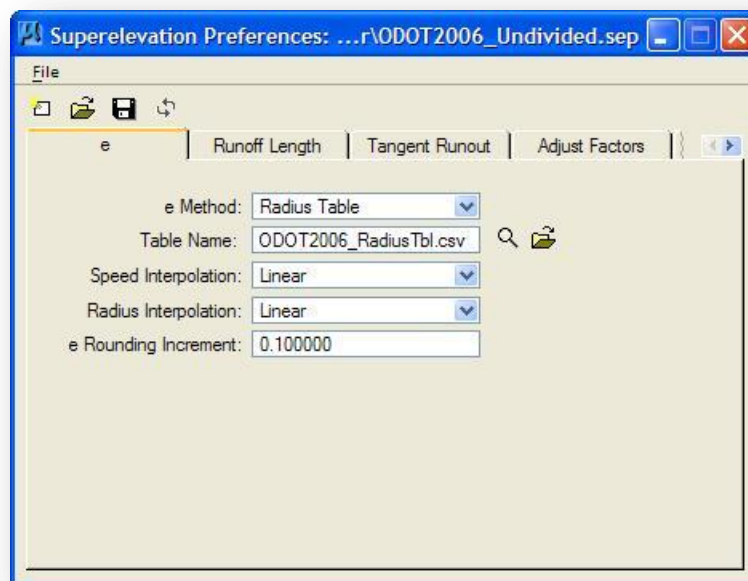
```
GPK_SUPER_LENGTHDIR = i:\ODOTstd\V8istd\geopak\road\super\
```

GPK_SUPER_AUTOSHAPEINPUTDIR

This variable is used to assign the directory that will be used to write the Autoshape input files and log files. Not setting this configuration variable would cause the tool to store the Autoshape input file and the log file in the user's current Working Directory. This variable has not been defined for ODOT users.

Preferences

Select **File > Preferences** to access the *Superelevation Preferences* dialog shown below.



The *Superelevation Preferences* dialog gives the user control over every aspect of the superelevation computation process. AASHTO Method V is available as a default, along with the ability to employ user-defined lookup tables both for e (superelevation rate) and for runoff length. User-defined equations may also be entered to compute these values. Options are available for resolving the superelevation conflicts of reverse curves, compound curves, broken back curves, and short curves.

Superelevation preferences are saved as an ASCII text file with an extension of .sep. Two ODOT standard superelevation preference files are available as listed below:

```
i:\ODOTstd\V8istd\geopak\road\super\ODOT2006_Divided.sep
```

```
i:\ODOTstd\V8istd\geopak\road\super\ODOT2006_Undivided.sep
```

These preference files require the following supporting files:

i:\ODOTstd\V8istd\geopak\road\super\ODOT2006_RadiusTbl.csv

i:\ODOTstd\V8istd\geopak\road\super\ODOT2006_RGtable.csv

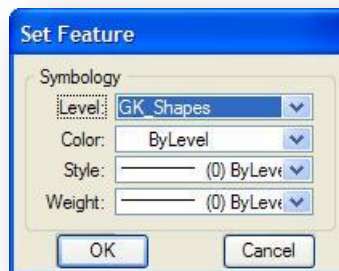
Note: You do not need to access the *Superelevation Preferences* dialog unless you wish to edit or review the settings of the ODOT preference files. See the GEOPAK on-line help for complete information on the *Superelevation Preferences* dialog. Use of these preference files is detailed in section 4.9.3.

Level Symbolology

When **File > Level Symbolology** is selected, the dialog shown below opens.



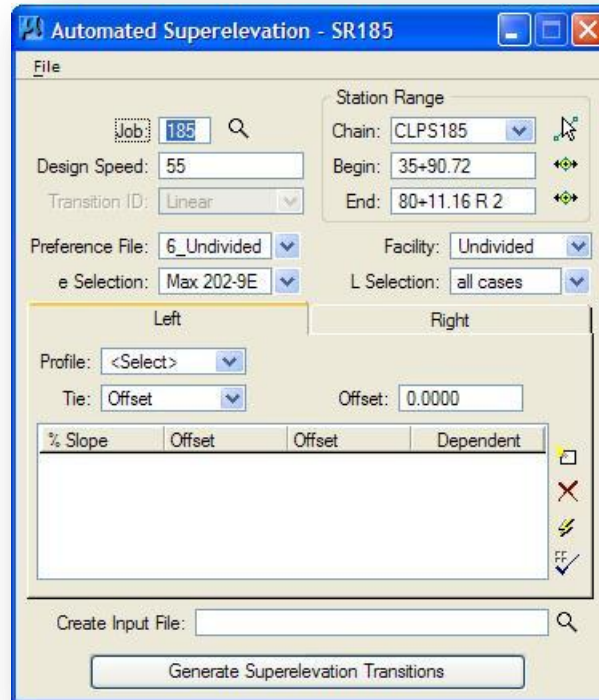
This dialog is used to define the element symbology for the shapes. Float the cursor over the symbology boxes to reveal the current settings for the **Dependent Shapes** and the **Independent Shapes**. To change the values, double click on the Symbology box to open the *GEOPAK Set Feature* dialog shown below.



The **Level** GK_Shapes has been defined for the placement of pavement shapes. The **Color**, **Style**, and **Weight** parameters can be defined as desired by the user.

4.9.3 Populating the Automated Superelevation Dialog

After setting the preferences, user directories, and shape symbologies, the next step is populating the *Automated Superelevation* dialog. A sample dialog is shown below.



Job

Key-in the **Job** number for the Coordinate geometry database where the desired chains and profiles are stored.

Design Speed

Key-in the **Design Speed** to be used for computation.

Station Range

Chain - This drop down menu is used to select the COGO chain for which superelevation transitions are to be calculated. This chain is also called the “Shape Cluster Baseline” in the Autoshape input file.

Begin - When the chain is defined, GEOPAK populates the **Begin** station item with the beginning station of the chain. To compute superelevation for part of a chain, adjust the station by keying in a new **Begin** station value or by use of the **DP** button.

End - When the chain is defined, GEOPAK populates the **End** station item with the ending station of the chain. To compute superelevation for part of a chain, adjust the station by keying in a new **End** station value or by use of the **DP** button.

Preference File

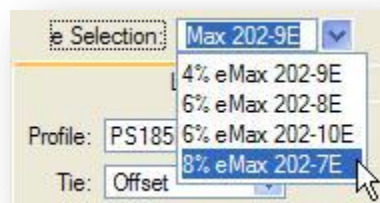
The **Preference File** combo box is used to select which preference file will be used for the superelevation computations. The **Preference File** item lists any .sep files found in the **Preference Files Path** (see the *Superelevation File Directories* dialog on page 4-11). The following two preference files have been configured for ODOT use:

- ODOT2006_Divided.sep
- ODOT2006_Undivided.sep

ODOT2006_Divided.sep has been configured to compute superelevation transitions for four-lane divided highways according to the January 2006 revision of the ODOT Location and Design Manual Volume 1 – Roadway Design, Figure 202-5bE.

ODOT2006_Undivided.sep has been configured to compute superelevation transitions for undivided highways according to the January 2006 revision of the ODOT Location and Design Manual Volume 1 – Roadway Design, Figure 202-5aE.

Once the **Preference File** is selected, the **e Selection** and **L Selection** combo boxes are populated according to the selected **Preference File**. The user chooses the desired superelevation table from the **e Selection** box. The following tables are available:



e selection

The **e Selection** options are named according to the corresponding figure in the ODOT Location and Design Manual Volume 1 – Roadway Design. Each of these options represents a Radius Table contained within the following file:

i:\ODOTstd\V8istd\geopak\road\super\ODOT2006_RadiusTbl.csv

L selection

The **L Selection** is used to select the Relative Gradient Table to be used to compute the length of the Tangent Runout. The following file has been configured to set the Relative Gradient values according to the ODOT Location and Design Manual Volume 1 – Roadway Design, Figure 202-4E:

I:\ODOTstd\V8istd\geopak\road\super\ODOT2006_RGtable.csv

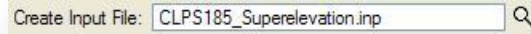
ODOT uses the Relative Gradient values defined in Figure 202-4E for all cases. Using the ODOT preferences, there is only one option for the **L Selection** dialog item.

Facility

Facility determines whether the roadway cross section is to be **Divided** or **Undivided**.

Create Input File

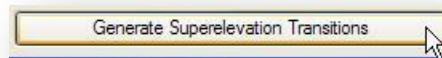
Key in the name of the Autoshape input file that will be created. If no path is specified, the input file will be saved in the current Working Directory. **Note:** This file is given a .inp extension.



It is recommended that you use the name of the chain for the superelevation input file as shown in the example above.

Generate Superelevation Transitions

After the *Automated Superelevation* dialog has been completed, select this button to generate the Autoshape input file. See page 4-20 for an example of a completed Autoshape input file.



Left / Right tabs



The area enclosed in the **Left / Right** tabs is used to define the shape clusters. If the **Facility** option is set to **Undivided**, then the **Left** tab is for the left lane(s) while the **Right** tab is for the right lane(s). If the **Facility** option is set to **Divided**, then the **Left** tab is for the entire left roadway, while the **Right** tab is for the entire right roadway.

Profile

This drop down menu is used to select the COGO profile that will be used for the shape cluster. All available profiles are displayed in the menu.

Tie

The **Tie** value is used to specify the horizontal distance between the **Chain** and the **Profile** location (PGL). This can be a constant **Offset** value or a tapering width specified by a **PGL Chain**. Each case is discussed below:

If the distance is a constant value, toggle the **Tie** option to **Offset**. Key-in the **Offset** in the field to the right. In the example below, the PGL is at the centerline so an **Offset** of 0 is used.

Tie: Offset Offset: 0.0000

If the horizontal distance between the Profile location (PGL) and the **Chain** is a varying distance, then a chain must be defined in COGO designating the PGL location. Toggle the **Tie** option to **PGL Chain**. Select the desired **Chain** from the option box on the right.

Tie: PGL Chain Chain: <Select>

An example of where this option would be used is a divided facility where the PGL follows the inside edge of pavement and the median width is transitioning.

List Box Options

The list box at the bottom of the *Automated Superelevation* dialog is used to enter the parameters for each lane in the proposed roadway.

% Slope	Offset	Offset	Dependent
-1.6000	0.0000	-12.0000	<input checked="" type="checkbox"/>

% Slope

Cross slope in percent format of each shape in normal crown. A negative sign denotes the roadway slopes down and away from the PGL. A normal crown section of 1.6% would, therefore, be entered as -1.6.

Offset

Offsets define the width of each shape (usually a lane) by two offset distances from the baseline. Note that tapers are not supported. Offset distances are negative if measured to the left. Lane offset values are entered in terms of master units, i.e., feet or meters.

Dependency

Shapes can be either **Dependent** or **Independent** as detailed in Section 4.6. There must be at least one dependent shape per cluster.

Edit buttons

New Lane


To add a line to the list box, press the **New Lane** button. The values for the **% Slope**, **Offsets**, and **Dependency** can be edited by clicking on them as shown in the example below.

Delete

To delete a line, highlight the desired line and then press the **Delete** button.

Quick Entry

When pressed, the dialog shown below opens. Populate the dialog with the desired data, and then press the **OK** button to close the *Quick Entry* dialog and populate the main dialog. The example below shows the *Quick Entry* dialog settings to define two 12' lanes with a normal crown cross slope of -1.6%.

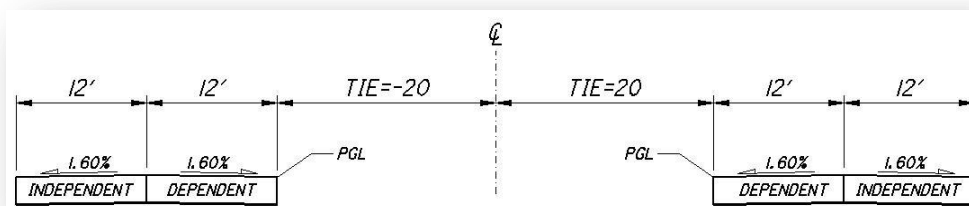


After pressing the **OK** button, the **Left** and **Right** side tabs on the *GEOPAK Automated Superelevation* dialog are populated as are shown below

NOTE: When the **Quick Entry** option is used, the **Dependency** for both shapes is set to **Dependent** for **Undivided** roadways. Be sure to review the results and change the **Dependency** as required.

An example for a 4 lane divided facility is detailed below.

In this example, the total median width is 40'. The PGL line follows the inside edge of pavement so the **Tie** is set to **Offset** with a value of 20' for each side (negative to the left). The typical section for this lane configuration is shown below.



The completed **Left** and **Right** tabs for the GEOPAK Automated Superelevation dialog are shown below. Note that the **Left** tab contains all the information for both pavement lanes on the left side of the centerline chain. The **Right** tab contains all the information for the 2 pavement lanes to the right of the centerline. Also note that each side, **Left** and **Right**, must contain at least one dependent shape.

% Slope	Offset	Offset	Dependent
1.6000	-20.0000	-32.0000	<input checked="" type="checkbox"/>
-1.6000	-32.0000	-44.0000	<input type="checkbox"/>

% Slope	Offset	Offset	Dependent
1.6000	20.0000	32.0000	<input checked="" type="checkbox"/>
-1.6000	32.0000	44.0000	<input type="checkbox"/>

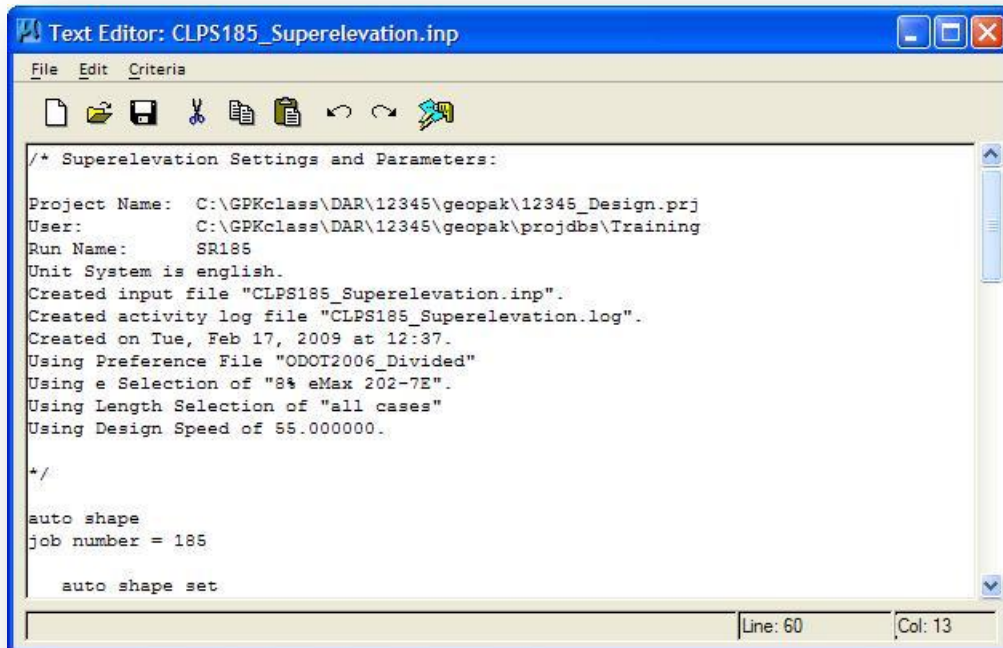
NOTE: If the **Quick Entry** option is used to populate the **Left** and **Right** list boxes, the sign for the **% Slope** is not adjusted for multiple lanes. In the sample dialog below, a Nominal Percent Slope of -1.6 is keyed in. This will result in the % Slope for each of the 4 lanes being set to -1.6. It is necessary to adjust the sign of the % Slope from -1.6 to 1.6 on the *GEOPAK Automated Superelevation* dialog, as shown above, to correct the sign of the slope.



Rectify Lanes

This option is used to check the pavement lanes that have been entered in the dialog to eliminate 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's 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.

After the Automated Superelevation dialog has been completed, select the **Generate Superelevation Transitions** button. Three things happen after the button is selected. First, the superelevation transitions as computed by GEOPAK are written to the Autosshape input file specified by the user. Second, the log file is written. Finally, the Autosshape Input File is loaded into the text editor running within MicroStation. The *GEOPAK Text Editor*, loaded with a sample Autosshape input file, as shown on the following page.



This *Text Editor* dialog has a **Create Superelevation Shapes** icon at its top which allows the Autoshape Input File to be processed. Autoshape Input files can also be processed from the Autoshape Builder as detailed in Section 4.11.

The stations for all shape clusters should be checked for compliance with ODOT roadway design standards before running the superelevation shape input file. If changes are necessary, the stations and cross slopes can be edited with any ASCII text editor, or the *GEOPAK Text Editor*.

NOTE: If you use the Text Editor to modify the Autoshape input file, be sure to save the changes by selecting **File > Save** before selecting the **Create Superelevation Shapes** button.

A sample Autoshape input file is shown below and continuing on the following page.

```
/* Superelevation Settings and Parameters:
Project Name: C:\GPKclass\DAR\12345\geopak\12345_Design.prj
User: C:\GPKclass\DAR\12345\geopak\projdb\Training
Run Name: SR185
Unit System is english.
Created input file "CLPS185_Superelevation.inp".
Created activity log file "CLPS185_Superelevation.log".
Created on Tue, Feb 17, 2009 at 12:37.
Using Preference File "ODOT2006_Divided"
Using e Selection of "8% eMax 202-7E".
Using Length Selection of "all cases"
Using Design Speed of 55.000000.
*/
auto shape
job number = 185
auto shape set
```

```

auto shape set
  shape cluster baseline = CLPS185
  shape cluster profile = PS185P
  shape cluster tie = 0.0000
  dependent shape
  chain / offset
    CLPS185 -12.0000
    CLPS185 -0.0000
  filler line station / slope
    53+00.000000 -1.6000
    60+74.981871 -1.6000
    62+38.981871 -8.0000 /* Spiral PS18512B, Curve PS18512 */
    71+12.796686 -8.0000 /* Curve PS18512, Spiral PS18512A */
    72+76.796686 -1.6000
    77+50.000000 R 2 -1.6000

```

```

auto shape set
  shape cluster baseline = CLPS185
  shape cluster profile = PS185P
  shape cluster tie = 0.0000
  independent shape
  chain / offset
    CLPS185 0.0000
    CLPS185 12.0000
  filler line station / slope
    53+00.000000 -1.6000
    59+92.981871 -1.6000
    62+38.981871 8.0000 /* Spiral PS18512B, Curve PS18512 */
    71+12.796686 8.0000 /* Curve PS18512, Spiral PS18512A */
    74+51.270000 R 2 -1.6000
    77+50.000000 R 2 -1.6000

```

```

Plot Parameters
  Dependent Shape
    lvname = GK_Shapes
    co = 40
    lc = ByLevel
    wt = ByLevel
  Dependent Text
    lvname = GK_Shapes
    co = 40
  Independent Shape
    lvname = GK_Shapes
    co = 87
    lc = ByLevel
    wt = ByLevel
  Independent Text
    lvname = GK_Shapes
    co = 87

```

Write shapes into dgn = C:\GPKclass\DAR\12345\roadway\basemaps\12345KS001.dgn

4.9.4 Autoshape Input File Format

The Autoshape input file can be generated using the GEOPAK Automated Superelevation procedure or the user may manually type the ASCII file independent of any automated calculations. If you use the Automated Superelevation procedure, the Autoshape input file will contain a header similar to that shown below.

```
/* Superelevation Settings and Parameters:

Project Name:  C:\GPKclass\DAR\12345\geopak\12345_Design.prj
User:          C:\GPKclass\DAR\12345\geopak\projdbs\Training
Run Name:     SR185
Unit System is english.
Created input file "CLPS185_Superelevation.inp".
Created activity log file "CLPS185_Superelevation.log".
Created on Tue, Feb 17, 2009 at 12:37.
Using Preference File "ODOT2006_Divided"
Using e Selection of "8% eMax 202-7E".
Using Length Selection of "all cases"
Using Design Speed of 55.000000.

*/
```

The header is included as a comment and does not include any commands that will be processed. It is not necessary to include a header in the Autoshape input file. Comments require a `/*` at the beginning of the first line and a `*/` at the end of the last line.

The first two commands in the Autoshape file are shown below. The auto shape command is required to tell the software what type of input file is being processed. The second line is used to identify the GPK file that contains the chain and profile that will be used to generate the shapes.

```
auto shape
job number = 185
```

A new auto shape set must be established for each different shape cluster, every set of dependent shapes, every set of independent shapes, every unique set of GEOPAK chain and offset combinations and every unique parabolic transition option.

The portion of the Autoshape input file shown below defines the pavement shapes for the left side of the roadway (see the chain/offset values below).

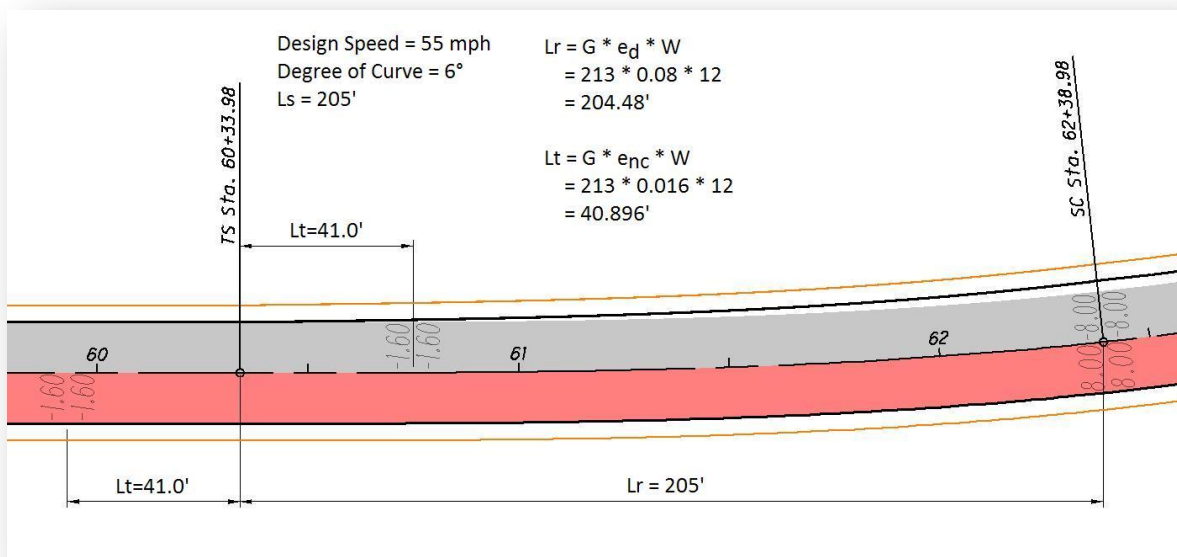
```

auto shape set
  shape cluster baseline = CLPS185
  shape cluster profile = PS185P
  shape cluster tie      = 0.0000
  dependent shape
  chain / offset
    CLPS185 -12.0000
    CLPS185 -0.0000
  filler line station / slope
    53+00.000000 -1.6000
    60+74.981871 -1.6000
    62+38.981871 -8.0000 /* Spiral PS18512B, Curve PS18512 */
    71+12.796686 -8.0000 /* Curve PS18512, Spiral PS18512A */
    72+76.796686 -1.6000
    77+50.000000 R 2 -1.6000

```

The number of created shapes is always one less than the number of specified “filler line stations”. Note also that the region is specified for station 77+50. This is only necessary when the region is greater than one. Also note that these shapes have been defined as **Dependent** shapes.

In this instance, 5 shapes are created for the left lane of SR 185. The shapes through the superelevation transition into the curve are shown below. The first shape would consist of a constant -1.6% slope from station 53+00 to station 60+74.98. The second shape would be a transition shape from -1.6% at station 60+74.98 to -8.0% at station 62+38.98.



If you wish to override the superelevation values calculated by the GEOPAK Automated Superelevation procedure, simply edit the ASCII file to include the desired filler line station / slope values.

The next auto shape set defines the shapes for the right side of the roadway. Note that this shape set has been defined as **Independent** shapes. The improper identification of shape cluster elements or the improper classification of shapes as dependent or independent will result in incorrect proposed cross sections.

```

auto shape set
  shape cluster baseline    = CLPS185
  shape cluster profile    = PS185P
  shape cluster tie        = 0.0000
  independent shape
  chain / offset
    CLPS185    0.0000
    CLPS185    12.0000
  filler line station / slope
    53+00.000000    -1.6000
    59+92.981871    -1.6000
    62+38.981871    8.0000    /* Spiral PS18512B, Curve PS18512 */
    71+12.796686    8.0000    /* Curve PS18512, Spiral PS18512A */
    74+51.270000 R 2    -1.6000
    77+50.000000 R 2    -1.6000

```

The next grouping of lines represents the plot parameters for the shapes and associated text.

```

Plot Parameters
  Dependent Shape
    lvname = GK_Shapes
    co = 40
    lc = ByLevel
    wt = ByLevel
  Dependent Text
    lvname = GK_Shapes
    co = 40
  Independent Shape
    lvname = GK_Shapes
    co = 87
    lc = ByLevel
    wt = ByLevel
  Independent Text
    lvname = GK_Shapes
    co = 87

```

The different parameters specified for dependent and independent shapes will be used by the software for the complex shape elements as well as the area fill. Parameters which can be specified include level, weight, line code, and color. Text parameters also include level, weight, line code, and color. Note that font, justification and text size are not user-definable as they are determined by GEOPAK. The text parameters are for the slope labels at each end of the shape.

NOTE: By default, the color for the text is set to the same value as the shape in the Autoshape input file. If you have your MicroStation View Attributes set with “Fill” toggled on, the text will not be visible since it is the same color as the shape. Changing the text color to something other than the shape color will allow the text to be seen.

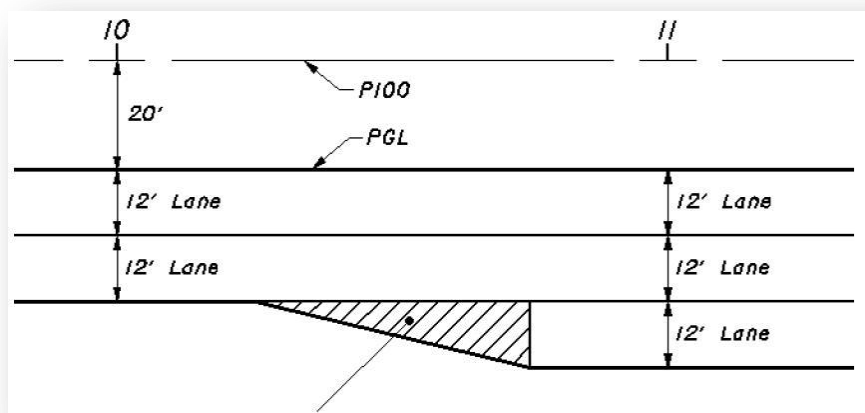
The last line of the ASCII Autoshape file dictates to the software the name of the MicroStation design file where the shapes are to be drawn. This graphical file will serve as input when generating proposed cross sections. **Note:** It is necessary to designate the path for the design file (either by a full path or a relative path) if the file is not located in the Working Directory.

```
Write shapes into dgn = C:\GPKclass\DAR\12345\roadway\basemaps\12345KS001.dgn
```

Shapes are typically drawn in a separate design file containing only the shape elements. The shapes for each alignment of your project are typically drawn in the same design file. This file must be created before running the Autoshape input file. See the [ODOT CADD Engineering Standards Manual](#) for information on standard design file names. Use the ODOT application **ODOT_Files.exe** to create design files using file names according to ODOT Standards.

4.9.5 Autoshaping and Shifts

Autoshape sets cannot cross over a shift. Each Autoshape set represents a continuous pavement surface offset from a PGL. A shift on the PGL within an Autoshape set will cause the road surface to move with the shift, creating an abnormal pavement surface shape. The cross-hatched area in the figure below is an example of a shift area.



For proposed cross section processing, two options are available to define the pavement cross slope in a shift area:

- If no shape is present, the additional widening can be automatically drawn at the same cross slope as the adjacent pavement lane by use of ODOT's pavement criteria. Criteria will be discussed in Chapter 5.
- Or, a shape can be generated using the **Shape Maker** tool (see Section 4.12)

4.10 Design Exceptions

Two COGO commands are supported which enable the user to force particular superelevation parameters to a specified curve or spiral. These commands are typically used for special design situations where a curve or spiral requires a specific rate of superelevation: (1) Where a curve or spiral requires a specific rate of superelevation different from that normally calculated from the design speed and alignment geometry, or (2) a design speed different than the project design speed is to be used to compute the superelevation.

Store Rate of Superelevation

Formats: A) S CUR name S rate_of_super
 B) S SPI name S rate_of_super

These key-in commands store a rate of superelevation with the specified curve or spiral. This command is typically used for special design situations where a curve or spiral requires a specific rate of superelevation different from the rate of superelevation normally calculated from the design speed. The curve or spiral name must be defined in the alignment chain and the rate_of_super is expressed in decimal values. If a Print Chain, Print Curve or Print Spiral command is issued subsequent to the store rate of superelevation command, an additional line is added within the display to include the revised rate of superelevation.

Examples:
 S CUR PS18501 S 0.06
 S SPI PS18501A S 0.05

To remove the specific rate of superelevation stored with a particular curve or spiral, store a rate_of_super = 0.

Store Design Speed Command

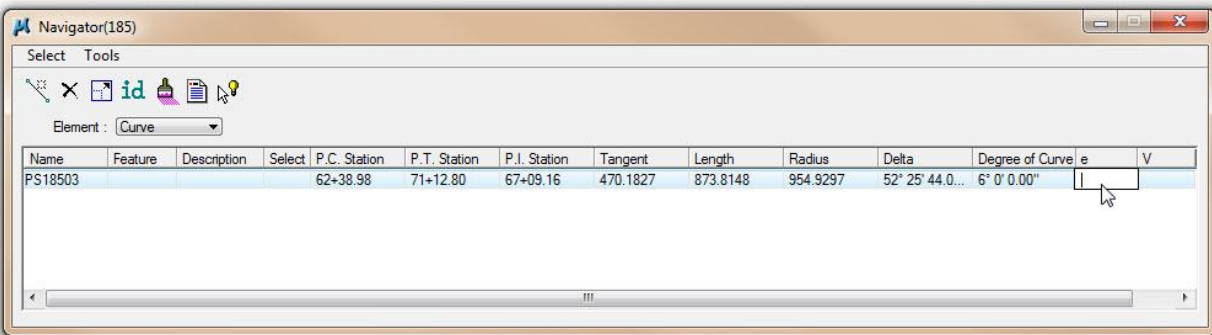
Formats: A) S CUR name V design_speed
 B) S SPI name V design_speed

These key-in commands store a design speed with the specified curve or spiral. This command typically is applied to design circumstances where the design speed for a curve or spiral deviates from the specified design speed. There must be a corresponding design speed within the active superelevation table on each application of this command.

Examples:
 S CUR PS18501 V 50
 S SPI PS18501B V 40

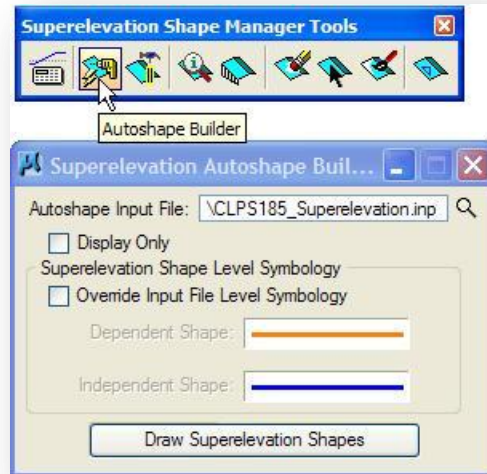
To remove the design speed stored with a particular curve or spiral, store a design speed of 0.

The COGO e and V values can also be assigned or modified using the COGO Navigator as shown below.



4.11 Processing the Autoshape Input File

Previously generated superelevation Autoshape input files are processed using the GEOPAK *Autoshape Builder* dialog box.



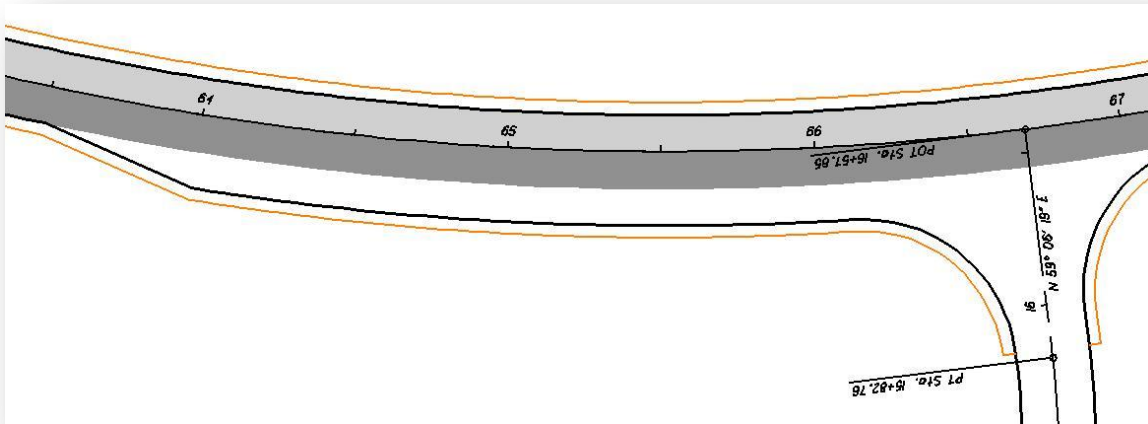
Use the **Select Autoshape Input File** button to browse the directory structure to select the desired superelevation shape input file, or manually type in the name of the file.

Toggle on the **Override Input File Level Symbology** option to gain access to the two symbology settings for **Dependent Shapes** and **Independent Shapes**. Double click on the Symbology box to set new values for the level symbology of the shapes.

Select the **Draw Superelevation Shapes** button to initiate drawing the shapes. The shapes are drawn in the design file specified within the input file. The Pavement Shapes are drawn into the MicroStation design file specified in the input file. If **Display Only** is checked, the shapes are displayed but not written to the design file.

4.12 Shape Maker

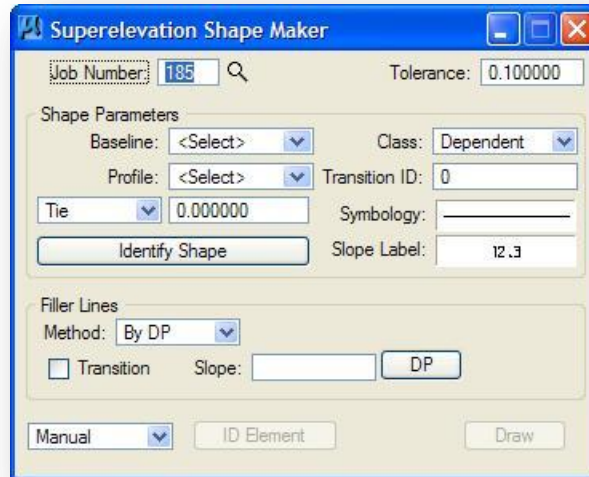
The *Shape Maker* tool permits graphical and interactive creation of superlevation shapes. Interactive shape creation is typically required only for those areas where the longitudinal edges of the shapes have not been stored as GEOPAK chains or offset chains. The right-turn bay shown below is an example of a shape that is typically created from the Shape Maker dialog. One side of this shape is a curve element creating the right-turn lane. Since the taper element is not concentric to the baseline and since a GEOPAK chain was never created for this transition geometry, Autoshape is unable to create the shape.



The *Shape Maker* dialog is invoked by selecting the **Shape Maker** icon from the *Superelevation Shape Manager Tools* palette shown below, or by selecting **Superelevation Shapes** from the *GEOPAK Project Manager* dialog.



The *Superelevation Shape Maker* dialog is shown on the following page.



The dialog is divided into three groups:

- 1) **Shape Parameters**
- 2) **Filler Lines**
- 3) **Complete Shape**

Before creating shapes, certain data must be provided in the **Shape Parameters** group box. The **Baseline, Profile, Tie/PGL Chain, Class, Transition ID** and **Symbology** must be defined.

Once the parameters are set, **Filler Lines** must be defined for each shape. **Filler lines** must be drawn at superelevation transition break locations and are created by one of three methods listed on the **Filler Lines** group box.

The shape can be created by either one of three methods:

- Automatic
- Semi-automatic
- Manual

The shape creation method is defined at the bottom of the dialog box. The **Draw** button becomes available once the minimum number of required filler lines has been defined. Press the **Draw** button to create the shape.

The various parameters of the *Superelevation Shape Maker* dialog are described on the following pages.

Baseline

Select the COGO chain defining the horizontal geometry for which superelevation transitions are to be calculated.

Profile

Select the COGO profile that will be used for the shape cluster.

Tie

If the horizontal distance between the Profile location (PGL) and the **Baseline** Chain is a constant value, key in the value in the **Offset** field. In the example below, the PGL is at the centerline so type in an offset of 0.

PGL Chain

If the horizontal distance between the Profile location (PGL) and the **Baseline** Chain is a varying distance, then a chain must be defined in COGO designating the PGL location. In this case, select the name of the chain to be used in the PGL Chain field. An example of where this option would be used is a divided facility where the PGL follows the inside edge of pavement and the median width is transitioning. If the median width is constant, use the **Tie** option.

Class

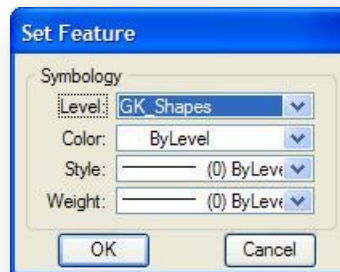
The **Class** option is used to set the shape as either **Dependent** or **Independent**.

Transition ID

The software can compute either linear or parabolic transitions. ODOT uses linear transitions. For linear transitions, set the **Transition ID** = 0.

Symbology

To review the current level symbology settings for the shape, float the cursor over the **Symbology** item as shown below. Double-click the **Symbology** item to set the values.

**Slope Label**

To set the desired symbology for the slope labels which are placed at the filler line locations of the shape, double click on the **Slope Label** graphic to change the settings.

Identify Shape

To use the parameters of a previously placed shape, take the following steps:

- Click **Identify Shape**.
- Identify and accept a previously defined shape with a data point.

The **Baseline**, **Profile**, **PGL Chain**, **Trans ID**, and **Tie** parameters associated with the shape are displayed on the *Superelevation Shape Maker* dialog and become active parameters.

Filler Line Group Box

The Filler Line group box is used to define superelevation transition locations. At least one filler line must be defined for a non-transition shape. Transition shapes require two filler lines. The fields in the group box are detailed below.

Transition

A non-transition shape represents a pavement area of constant slope. By contrast, the transition shape represents a change in the roadway pavement cross slope from one end of the shape to the other end. When the toggle is turned off, a non-transitional shape is drawn. When toggled on, a transitional shape is drawn.

Slope

Cross slope of the shape in percent format. The behavior of the **Slope** key-in field varies according to the setting of the **Transition** toggle. If the **Transition** toggle is turned on, the **Slope** key-in field will clear after each filler line creation. The **Slope** field will not clear the keyed in value when the **Transition** toggle is turned off.

Method

Three methods are supported for identifying filler lines. Two different methods may be used for the same shape.



To create a Filler Line **By DP**:

- Activate the **Transition** toggle (if desired) and enter the **Slope**
- Click **DP**
- Select a Data Point for one end point of the filler line
- Select a Data Point for the other end point of the filler line

To create a Filler Line **By Line**

- Activate the **Transition** toggle (if desired) and enter the **Slope**
- Press the **ID Line** button, then select and accept a line representing the filler line. The length of the line once selected will visually appear exaggerated in both directions although the actual selected element in the active or reference MicroStation file is not modified.

To create a Filler Line **By Station**:

- Key in the **Station** value into the key-in field. The **Station** is applied to the GEOPAK chain listed in the **Baseline** field in the Parameters group box. In lieu of typing, the **Station** may be defined graphically by pressing the **DP** button and identifying a point on the screen. The point is projected back onto the chain and the computed station is displayed in the Station field.
- Activate the **Transition** toggle (if desired) and enter the **Slope**.
- Press the **Create** button. The software draws a line, extending 500 feet in either direction, radial to the **Baseline** chain at the specified station.

Note that a region can be optionally specified. Regions denote the presence of station equation(s) and are necessary only when the station value is not unique in the chain and the station is located in a region other than region one. For example, 11+00 r 3 specifies station 11+00 in region 3.

Create

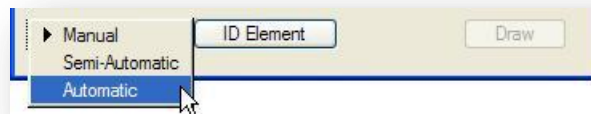
Action button which creates the specified filler line.

Delete

Pressing this button causes the most recently defined filler line to be visually removed and eliminated from further consideration. If two filler lines were defined, pressing the Delete push button twice eliminates both filler line definitions. Note this button appears only after a filler line is identified.

Complete Shape

The bottom line of the *Superelevation Shape Maker* dialog controls the actual creation of the shape. Three methods are available to compose the shape:



No one method will be used exclusively. Each method is suitable to specific design circumstances. In order to promote the efficient creation of shapes and in order to ensure the integrity of the data serving as input to the proposed cross section generation software, several general rules are listed on the following page.

- Do not specify a series of MicroStation elements that can form more than a single closed path when using the **Manual** method. If the **Automatic** method is used, the software will find the smallest closed shape if there is more than one choice. The **Semi-Automatic** method will prompt for the correct path allowing the user to determine the shape.
- Be sure that no cross section will cut across more than a single **Dependent** shape belonging to the same shape cluster.

- Be careful to properly distinguish between longitudinal edges and filler lines. Filler lines have specific slopes stored as attribute data. Therefore, improper identification of longitudinal edges and filler lines will result in incorrect proposed sections. When using the **Automatic** and **Semi-Automatic** methods, be sure to define all filler lines before selecting the **Draw** button.
- The PGL associated with a shape cluster should not be interior to **Dependent** shapes. The shapes should be constructed such that the PGL is coincident with the edge of the **Dependent** shapes or lie exterior to the **Dependent** shapes.
- Care should be taken to properly specify **Baseline**, **Profile**, and either the **Tie** or **PGL Chain** fields in the **Parameters** group box. Shapes with incorrect parameters will result in incorrect proposed cross sections.

Manual Mode

The Manual mode applies to design situations where longitudinal elements forming the sides of shapes can overlap and intersect. With this method, it is not mandatory that every longitudinal element connect with every other longitudinal element at end points. The Shape Maker algorithm will compensate for such element discontinuities and draw the correct shape.

Semi Automatic Mode

In some cases where the **Automatic** mode is not the best option, the **Semi-Automatic** method may be used. In this case, the user selects the first element to belong to the shape, rather than a data point inside the shape as with the **Automatic** method.

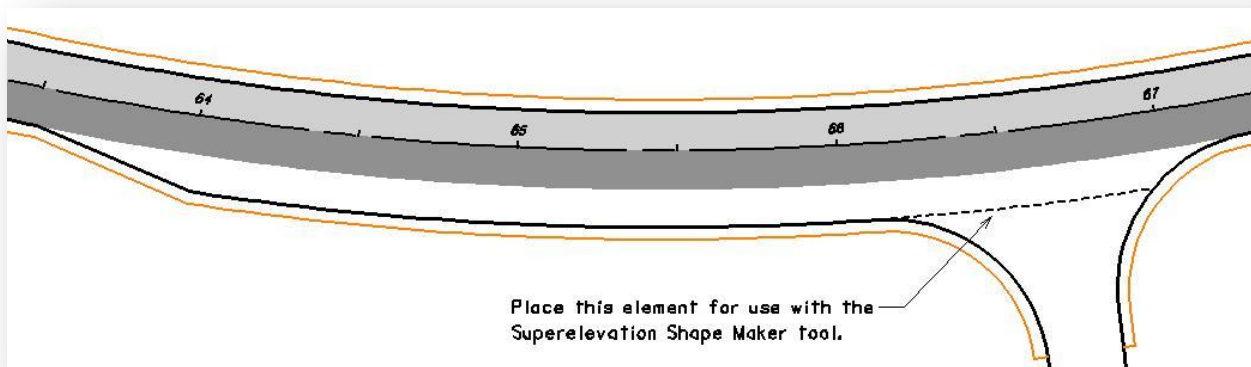
Automatic Mode

Automatic mode is the easiest way to create shapes with the *Superelevation Shape Maker* dialog. The **Automatic** mode is, however, not applicable to all circumstances. For example, areas where there are numerous lines which could form longitudinal elements may be more efficiently done with the **Semi-Automatic** mode where the user can distinguish the correct elements defining the shape.

Creating the Shape

The following example illustrates a complete sequence of operations necessary to create a shape with the **Automatic** mode.

1. To create a shape for the entire right-turn lane, it will be necessary to define the longitudinal edges of the shape. Place the graphics as shown below to form the longitudinal elements of the shape to be made.



2. Adjust the parameters on the **Shape Parameters** group box as shown below. Set the shape **Class** to **Independent**.

The screenshot shows the "Shape Parameters" dialog box with the following settings:

- Baseline: CLPS185
- Class: Independent
- Profile: PS185P
- Transition ID: 0
- Tie: 0.000000
- Symbology: (represented by a green line)
- Slope Label: 12.3

Buttons: Identify Shape

Set the Level to GK_Shapes for the shape **Symbology** and the **Slope Label**.

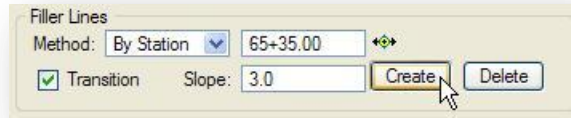
3. Set the **Filler Line** settings as shown below. In this example, the filler line will be created at a specific station and will be a superelevation transition line. Hence the Job No. and Station values must be keyed in. Press the Create push button to draw the filler line. Once the Create button has been pressed, the filler line will be drawn at the specified station.

The screenshot shows the "Filler Lines" dialog box with the following settings:

- Method: By Station
- Station: 64+30.00
- Transition: Transition
- Slope: 8.0

Buttons: Create

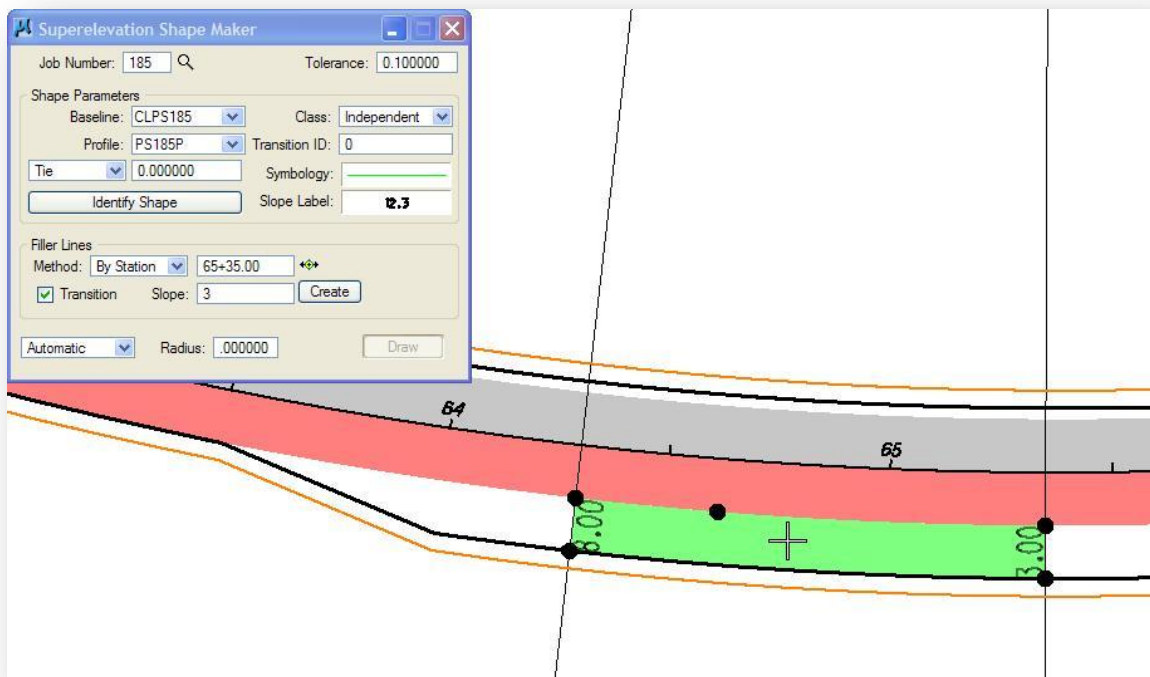
- The second filler line will also be created at a specific station and it also will be the other end of the superelevation transition. Set the **Filler Line** settings as shown below. Once the Filler Lines group box settings are satisfactory, press the **Create** button. Once the **Create** button has been pressed, the filler line will be drawn at the specified station.



- Set the option mode to **Automatic** in the bottom line of the dialog. With the filler lines in place, press the **Draw** button in the lower right-hand corner of the *Superelevation Shape Maker* dialog.



- The user is prompted to place a data point **INSIDE** the shape to be created. The software will then seek out the smallest shape which includes the data point. As the software is searching for the correct path, it will draw a circle with the radius value shown in the dialog above at each vertex of the shape. These will be automatically removed when the shape is completed.

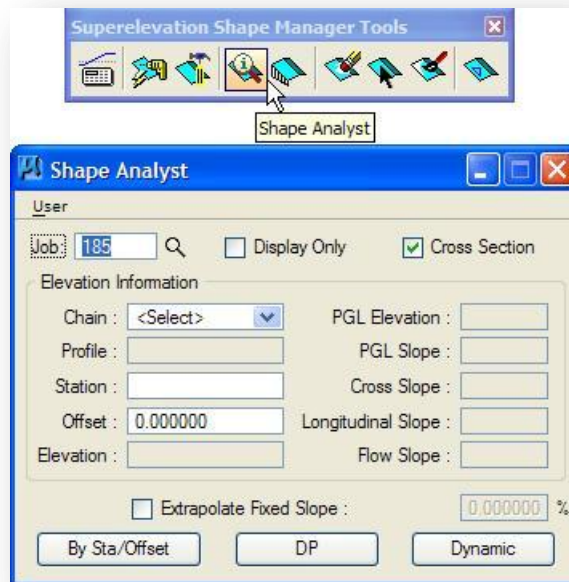


The completed shape shown above is for the transition portion of the right-turn only lane. All the shapes for the turn lane will be placed in Exercise 4.

4.13 Shape Analyst

The Shape Analyst tool is used to display slope and elevation information on any point within a GEOPAK superelevation shape. The information is displayed within the GEOPAK Shape Analyst dialog and can also be written to the MicroStation design file.

The dialog is accessed by selecting the **Shape Analyst** icon from the *Superelevation Shape Manager Tools* palette as shown below.



Before using the *Shape Analyst*, it is advisable to check the user preferences. To access the *User Preferences* dialog, select **User > Preferences** from the upper left corner of the GEOPAK Shape Analyst dialog. These preferences are used to control which information will be drawn into the MicroStation design file, and how it is displayed. The preferences can also be used to toggle on/off the ability to store 3D COGO points in the GPK file. The GEOPAK on-line help provides a complete description of the Shape Analyst *User Preferences* dialog.

While most of the GEOPAK Shape Analyst dialog is display information, some user input is required as detailed below.

Job

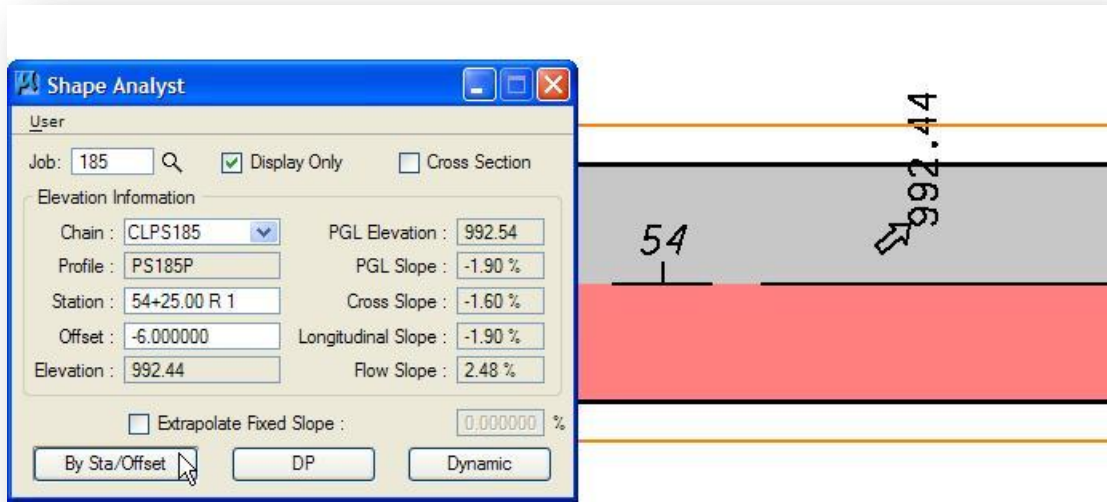
Specify the **Job** number for the COGO database where the chains and profiles are stored for the shapes.

Display Only

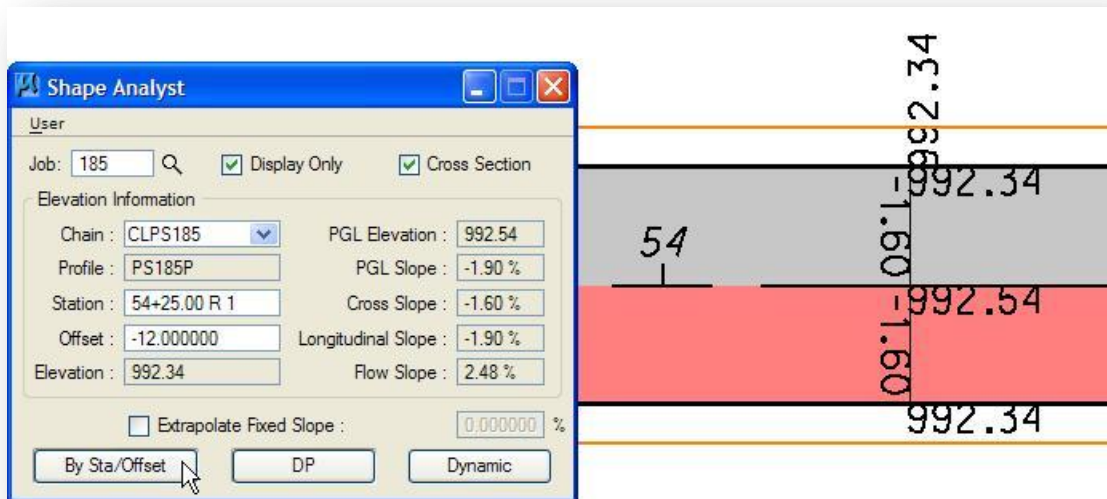
When active, a flow arrow and elevation text are displayed on screen but not written to the file. When inactive, all text and graphics are placed in the file.

Cross Section

When the toggle is not activated and a data point is issued within a shape, the elevation of the data point and a flow arrow are displayed as shown below.



When the toggle is activated, a line is placed through the data point, perpendicular to the shape cluster baseline. In addition to the elevation and flow arrow placed at the data point, elevations and cross slopes are displayed where the cross section line intersects any superelevation shape.



Several fields are required in order to compute the shape information and are detailed below.

Chain

Shape cluster baseline used to create the shape. The chain is selected from the list of all chains stored in the current coordinate geometry database.

Profile

Shape cluster profile. This is a display only field, populated by GEOPAK when the data point is defined and the intersecting shapes are determined.

Station / Offset

When the **DP** or **Dynamic** option is selected, GEOPAK automatically populates these fields by projecting the data point onto the specified chain, and calculating the station and corresponding offset.

When the **By Sta/Offset** option is selected, the station and the offset values in the key-in fields are projected back onto the shape cluster baseline. The station and offset fields must be manually entered.

Three options are supported to define the desired point as detailed below. The buttons are located at the bottom of the dialog.

By Sta/Offset

The **Station** and **Offset** values shown in the key-in fields are projected back to the shape cluster baseline and the elevation of the projected point is displayed. If the user keys in an **Offset** value that is outside the limits of the shape, GEOPAK will extend the cross slope of the nearest shape to calculate the elevation.

DP

Select the **DP** button and then issue a data point in the design file. The data point is projected to the baseline **Chain** to compute the **Station**, **Offset**, and associated output information. After the **DP** button is pressed, numerous data points can be entered without pressing the **DP** button again. Each corresponding **Station** and **Offset** is displayed along with the associated output information. If the data point is outside the limits of the shape, GEOPAK will extend the cross slope of the nearest shape to calculate the elevation.

Dynamic

This button activates the dynamic mode. As the cursor is moved across the design file, any momentary pause places the elevation and flow arrow in the MicroStation file and computes and displays the analysis information. If the cursor is outside the limits of the shape, GEOPAK will extend the cross slope of the nearest shape to calculate the elevation.

The right side of the **Elevation Information** section of the dialog contains the output information. This information is display only and cannot be written to an output file. A brief description of these display fields follows below:

Elevation

The elevation at the data point, dynamic point, or by Sta/Offset point location.

PGL Elevation

The elevation of the point, projected onto the PGL.

PGL Slope

The slope of the PGL at the projected point.

Cross Slope

Slope from PGL to the data point. This is along the projection from the PGL to the data point. When the data point is outside the shape, this field is blank.

Longitudinal Slope

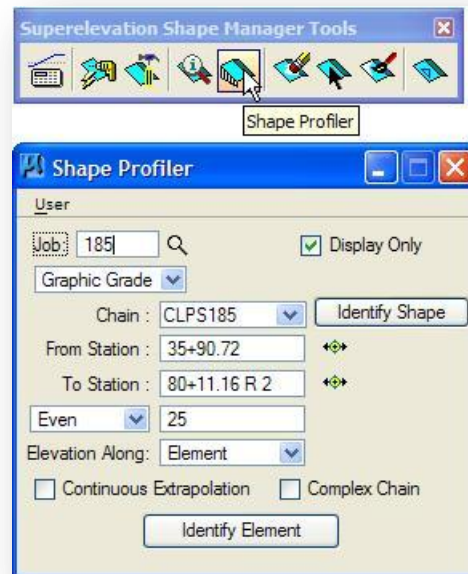
The longitudinal slope at the data point, not the PGL. In areas of non-transition, this is identical to the PGL slope. However, in transition areas, the transition affects the slope, therefore it is not identical to the PGL slope. When the data point is outside the shape, this field is blank.

Flow Slope

Vector sum of the Cross Slope and Longitudinal Slope, indicating the actual slope at the point. This is useful as a water flow indicator. When the data point is outside the shape, this field is blank.

4.14 Shape Profiler

The **Shape Profiler** tool provides elevations incrementally along the superelevation shapes, or the shape slope can be projected to provide elevations along a user specified MicroStation element. Select Shape Profiler from the Superelevation Shape Manager Tools palette to access the GEOPAK Shape Profiler dialog shown below.



Before using the *Shape Profiler*, it is advisable to check the user preferences. To access the *User Preferences* dialog, select **User > Preferences** from the upper left corner of the GEOPAK *Shape Profiler* dialog. These preferences are used to control which information will be drawn into the MicroStation design file, and how it is displayed. The preferences can also be used to toggle on/off the ability to store 3D COGO points in the GPK file. The GEOPAK on-line help provides a complete description of the shape *User Preferences* dialog.

The fields at the top of the *Shape Profiler* dialog are detailed below.

Job

Specify the **Job** number for the COGO database where the chains and profiles are stored for the shapes.

Display Only

When active, a flow arrow and elevation text are displayed on screen but not written to the file. When inactive, all text and graphics are placed in the file.

Graphic Grade

Currently the only option supported. The elevations are drawn graphically in the design file.

The next group of fields relates to the superelevation shape. The fields are detailed below.

Chain

Shape cluster baseline used 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 button, then select and accept the shape to be used for the grade computations.

From/To Station

After the shape has been selected, GEOPAK populates the **From** and **To Station** fields with the stations of the filler lines or ends of the shape. If the graphic grade is not needed for the entire shape, the **DP** buttons may be used to define the desired station range. Press the **DP** button, and then identify a data point. The station is automatically adjusted to reflect the data point. Users may also key in the desired stations.

Three options are supported to define the distance between the graphic grade points. They are detailed below.

Even

The **Even** option is used to compute **Graphic Grade** points at the increment keyed in by the user at every station that is evenly divisible by this value. Note: If the **From Station** is not evenly divisible by the keyed in value, the first **Graphic Grade** point will be the first even station divisible by the keyed in value greater than the **From Station** value.

Increment

The **Increment** option operates identically to the **Even** option with the exception that the **Graphic Grade** points are computed incrementally along the chain starting from the **From Station**.

Intersect

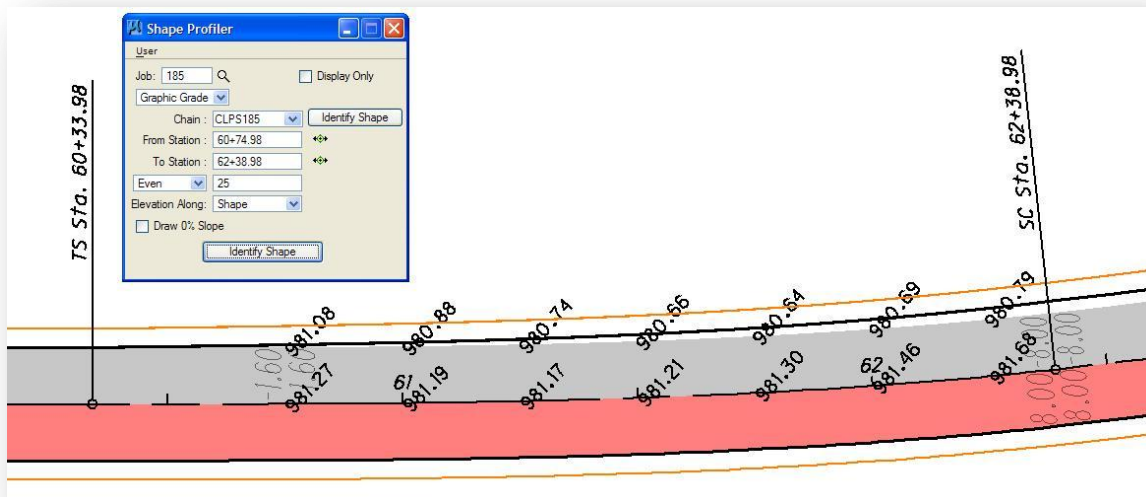
The **Intersect** option is used to create **Graphic Grade** points at every location where a user selected MicroStation element intersects the edges of the pavement shapes. When **Intersect** is selected, the **Elevation Along** option (described below) can only be toggled to Element.

Elevation Along

The **Elevation Along** option has two options: **Shape** or **Element**. Each option is described below.

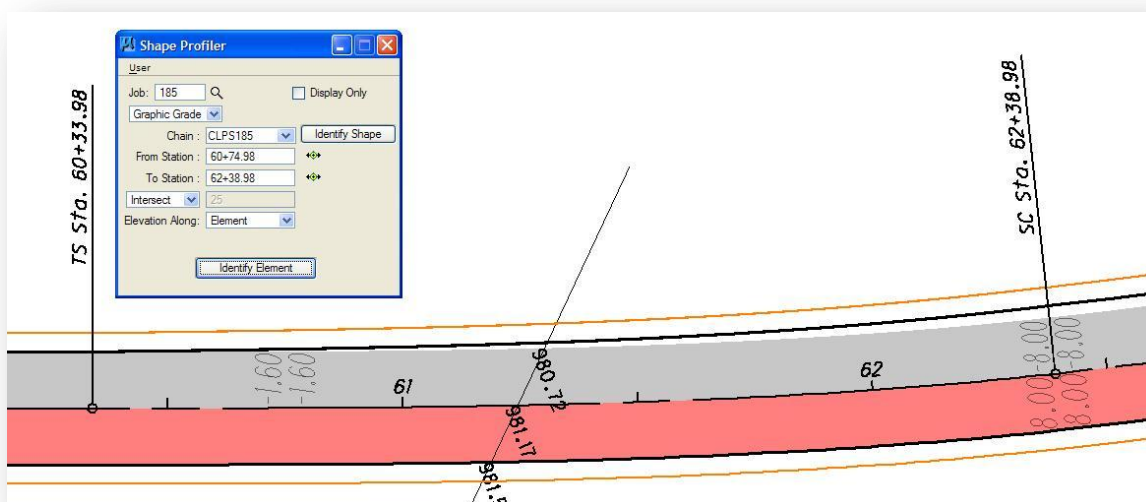
Elevation Along Shape

Press the **Identify Element** button at the bottom of the dialog. Once the **Shape** has been identified, the elevations and flow arrows are drawn along each longitudinal edge of the shape at the specified interval from the filler lines as shown in the example below.



Elevation Along Element

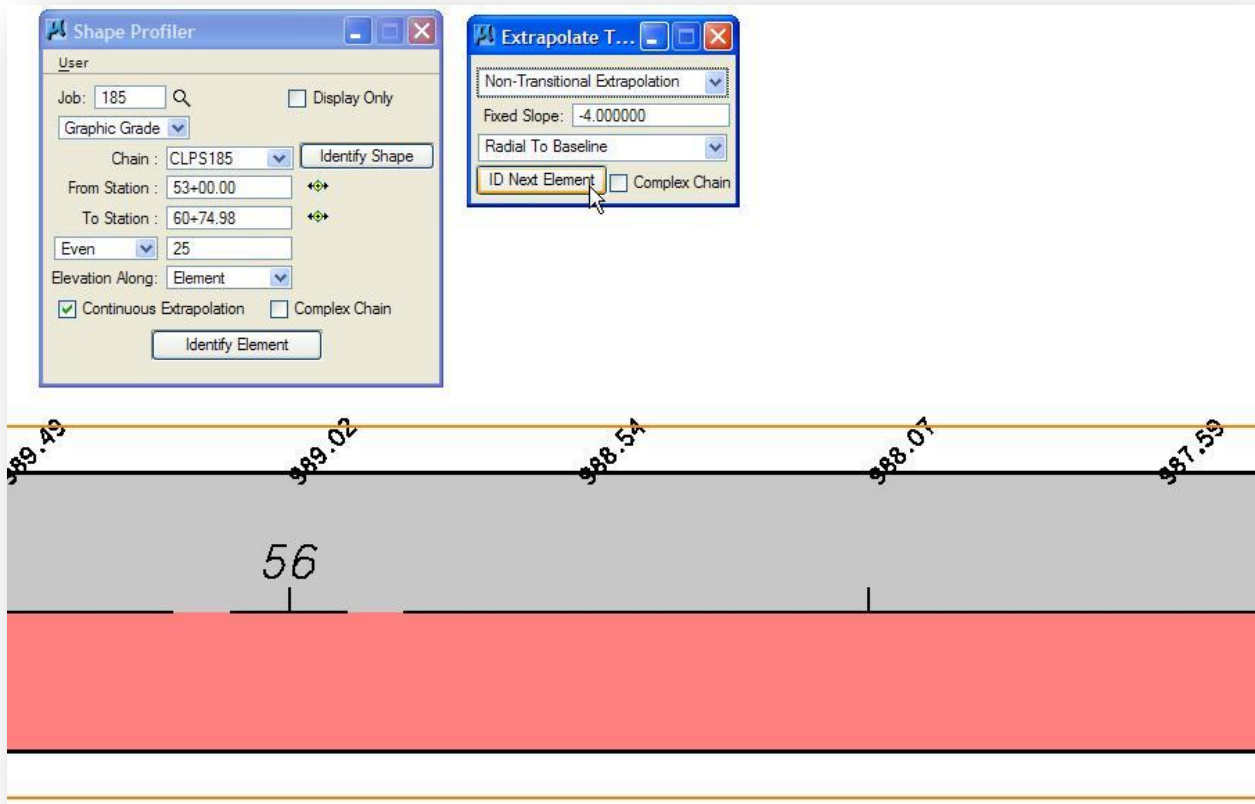
Press the **Identify Element** button at the bottom of the dialog. Then select and accept any MicroStation Element, i.e., line, line string, curve, curve string, or complex chain. GEOPAK calculates the elevations along the selected element. One sample is shown below. The identified element can be within, or outside the limits of the selected shape. Any elevations outside the shape are calculated by projecting from the edge of the shape at the superelevation slope.



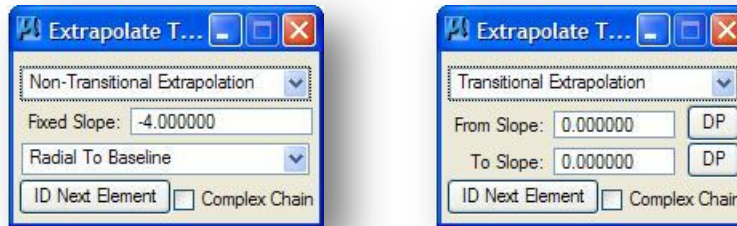
Another option within the **Elevation Along Element** option is **Continuous Extrapolation**. Activate the **Continuous Extrapolation** option, and then press **Identify Element**. Once first the element is selected and accepted (the edge of pavement in the example below), a supplemental dialog is displayed, as shown below.

The general workflow is as follows:

- From the main dialog, toggle on **Continuous Extrapolation**.
- Click **Identify Element** and **ID** an element along the edge of the shape where elevations at the requested interval are desired
- At this point the *Extrapolate To Next Element* dialog pops up.

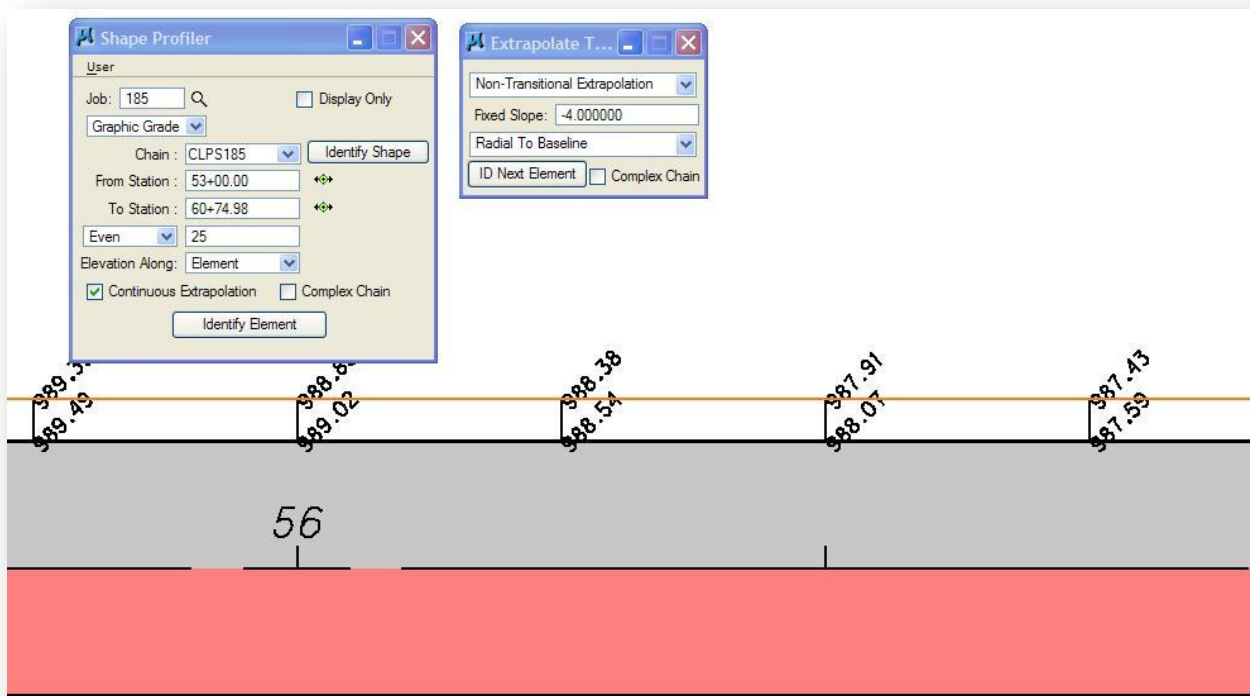


There are two modes, **Non-Transitional Extrapolation** and **Transitional Extrapolation**. Setting the option to either **Transitional** or **Non-transitional** extrapolation determines the fields in the rest of the dialog as shown on the following page.



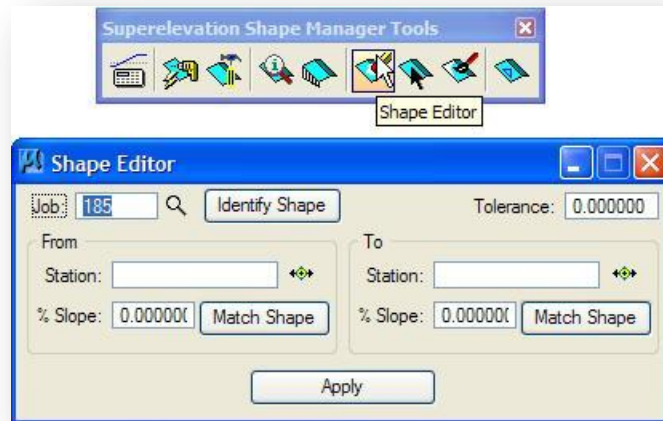
In the **Transitional Extrapolation**, the **From Slope** and **To Slope** must be specified in the input fields. The location where each slope is to be applied is defined graphically via the **DP** buttons. Then press the **ID Next Element** button and identify the element to which the slope is projected. If the **Complex Chain** toggle is active, the user may select a string of elements. If the toggle is not active, the user may select only a single element.

Three options, **Radial to Baseline**, **Radial from Element**, **Radial to Element**, are presented to continue extrapolation to the next element at the specified slope. If you want to continue extrapolating elevations to another element, first key in the **Fixed Slope**. Next select one of the three options controlling how the elevations are extrapolated. Finally pick the **ID Next Element** button and select the desired element. An example is shown below.



4.15 Shape Editor

The **Shape Editor** tool enables the user to dynamically change parameters of a previously created shape. This includes changing the station limits which dynamically moves and updates the selected shape and the shape adjacent to the one being edited. The user also has the option to change the cross slope if desired. When the **Shape Editor** tool is selected, the dialog shown below is opened.



Job

Specify the **Job** number for the COGO database where the chains and profiles are stored for the shapes.

Tolerance

The **Tolerance** field is used to specify the acceptable gap size, in Master Units, between elements forming the shapes.

Identify Shape

Press the **Identify Shape** button then select and accept a previously drawn superelevation shape. Once accepted, GEOPAK populates the **From** and **To** group boxes with the data of the selected shape.

From/To

To modify the **Station**, you can simply key-in the new station value, use the **DP** button to graphically identify the station, or use the **Dynamic** button to graphically select the station. The **DP** and **Dynamic** options will both project the selected data point back to the baseline to determine the station. The **Dynamic** button differs in that it will show a dashed line from the cursor to the base line and also dynamically change the station in the dialog as you move the cursor.

% Slope

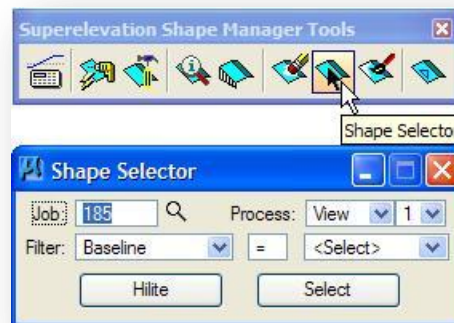
The cross slope of a shape can be edited by use of the **% Slope** option. Users can key-in the desired slope, in percent format, or use the **Match Shape** button to set the shape slope to match an adjacent shape.

Apply

After editing the dialog fields to the desired parameters, pressing the **Apply** button will edit the shapes. The adjacent shapes are also changed to reflect changes in the **Station** or the **% Slope** as necessary.

4.16 Shape Selector

The **Shape Selector** tool is used to highlight or select shapes based on a wide range of user queries.



Job

Specify the **Job** number for the COGO database where the chains and profiles are stored for the shapes.

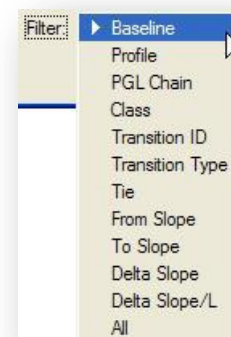
Process

Two options are supported for **Process**: **View** or **Fence**. If **View** is selected, all shapes in the current view that match the **Filter** option are highlighted or selected. If **Fence** is selected, a MicroStation fence must be placed prior to pressing the **Hilite** or **Select** button.

Filter

A variety of filters are supported, as shown at right. The filters are used to determine which shapes are to be highlighted or selected. Depending on the selected **Filter** option, the following operands are available:

>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
=	Equal
!=	No equal



After selecting the **Filter**, the field to the far right will change to reflect options appropriate for the selected filter option.

Hilite

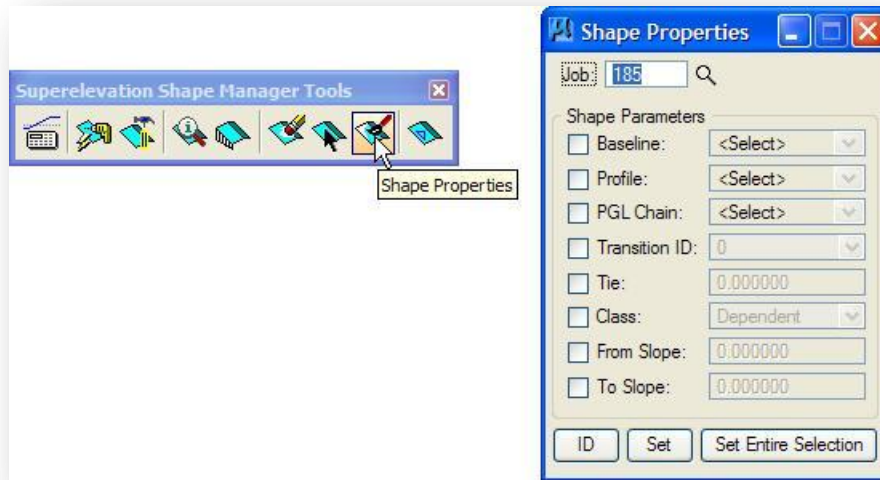
When the **Hilite** button is pressed, all shapes fulfilling the query are highlighted in the MicroStation highlight color.

Select

When the **Select** button is pressed, the shapes are added to a MicroStation selection set.

4.17 Shape Properties

The **Shape Properties** tool provides information on any GEOPAK superelevation shape. In addition, this shape information can be modified for individual shapes or selections of shapes. When the **Shape Properties** tool is selected, the dialog below opens.



Job

Specify the **Job** number for the COGO database where the chains and profiles are stored for the shapes.

The **Shape Parameters** group box contains numerous shape options. To use an option, activate the toggle to the left of the parameter. If the **Set** option is used, the value must be entered prior to pressing the **Set** button. If the **ID** feature is chosen, the fields are populated automatically when a shape is selected.

Baseline

Shape cluster baseline used to create the shape.

Profile

Shape cluster profile used to create the shape.

PGL Chain

PGL Chain used to create the shape. If no PGL chain was specified when the shape was created, this option will read "None".

Transition ID

For ODOT roadway design, set this option to 0 for a linear transition.

Tie

The offset distance from the PGL baseline to the shape.

Class

Class used to create the shape, either **Dependent** or **Independent**

From Slope

The cross slope (in percent) at the lowest station value of the shape.

To Slope

The cross slope (in percent) at the highest station value of the shape.

Three action buttons are supported at the bottom of the dialog and are described below.

ID

To populate the *Shape Properties* dialog with the attributes of a particular shape, press the ID button, and then select and accept a GEOPAK superelevation shape. GEOPAK populates every field where a toggle is activated.

Set

To set the parameters for a particular GEOPAK superelevation shape, activate the desired parameters and populate the associated fields with the desired values. Then press the Set button, select and accept the superelevation shape to be changed.

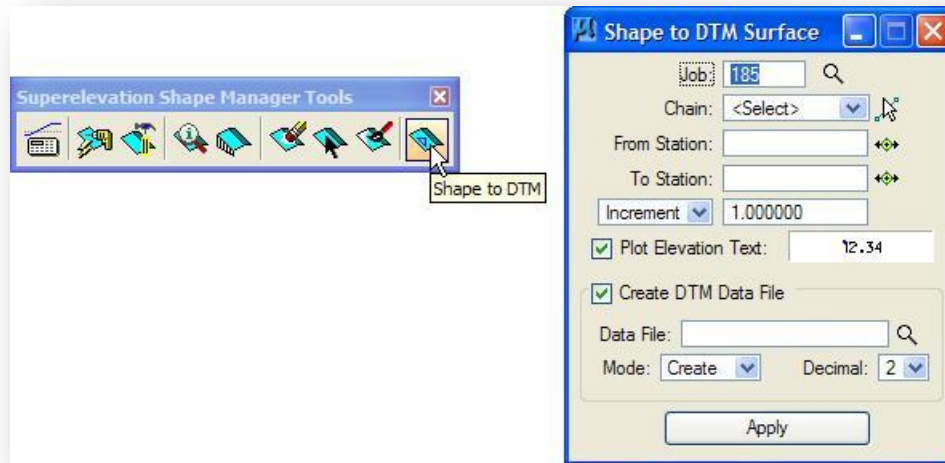
Set Entire Selection

If multiple shapes need to be changed, activate the desired parameters and values, define a MicroStation selection set to include the shapes to be changed, then press the Set Entire Selection button. Note that the selection set and populating the dialog can be done in either order as long as both steps are complete before pressing the **Set Entire Selection** button.

TIP: You can use the GEOPAK **Shape Selector** tool (see Section 4.16) to select the shapes that you wish to edit using the *Shape Properties* dialog. For example, let's assume a group of shapes were created using a **Profile** named PS185P. A design change causes you to create a new profile named A1PS185P. Using the **Shape Selector**, you could select all of the shapes created with Profile = PS185P. Using the **Shape Properties** tool, you can toggle on the **Profile** option and set its value to A1PS185P. Press the **Set Entire Selection** button to change the selected shapes to use the new profile.

4.18 Shape to DTM Surface

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

Specify the **Job** number for the COGO database where the chains and profiles for the shapes are stored.

Chain

Chain associated with the superelevation shape, i.e., the shape cluster baseline defined when the shape was created.

From Station

Lower stationing to be used as the limits of the DAT file. Enter the station value or click **DP** and graphically select.

To Station

Upper stationing to be used as the limits of the DAT file. Enter the station value or click **DP** and graphically select.

Increment / Even

The interval of points to be used for the data file. When **Increment** is chosen, the value is added to the **From Station** iteratively until the **To Station** is reached. When **Even** is chosen, the points are taken at even values within the station range. For example, if the **To Station** is 10+10 and the value is 25, **Increment** values are 10+10, 10+35, 10+60, etc., while **Even** values would be 10+25, 10+50, 10+75, etc.

Plot Text Elevation

When turned on, text is placed at each point to be included within the data file. Double click the text box to set the symbology for the text.

Data File

Name of the data file to be created or appended.

Mode

The file can be created or a previously created file can be used, in which case, the data created in this procedure is appended to the original data.

Decimal

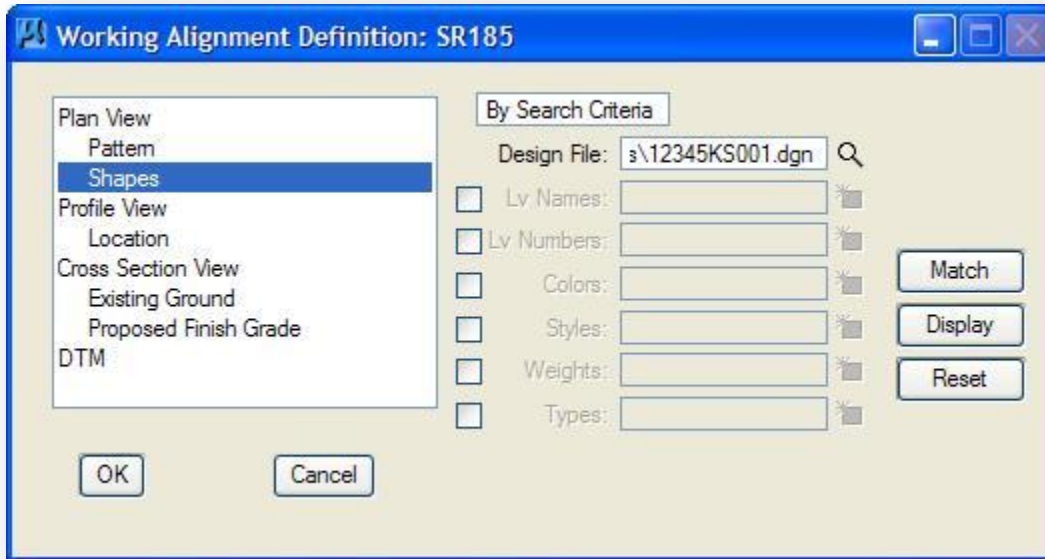
Number of decimal places to be used when creating the Data file.

Apply

Commence processing.

4.19 Working Alignment Definition: Shapes

The **Shapes** category of the **Working Alignment** contains two options to specify the shapes, as described below.



By Search Criteria

When using the **By Search Criteria** option, the user specifies the element symbology of the desired shapes.

All In DGN

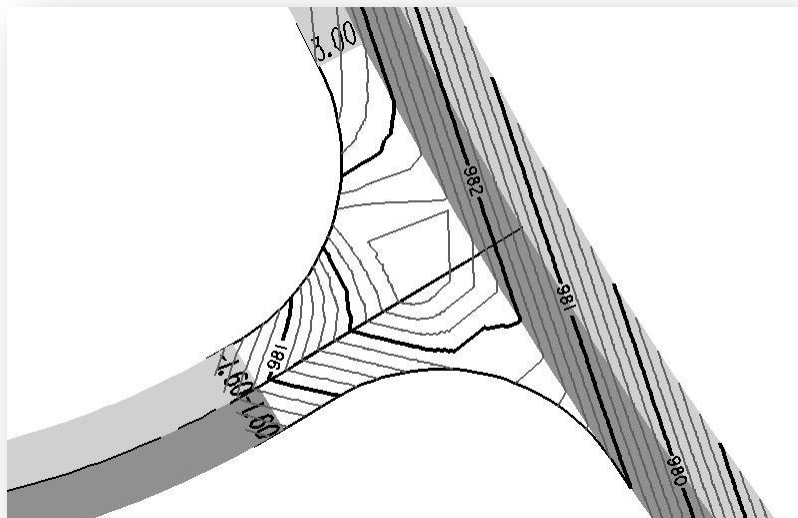
When the **All In DGN** option is selected, all shapes within the specified DGN file are used.

4.20 Pavement Shapes and Intersection Areas

GEOPAK pavement shapes are an effective tool to define the pavement cross slopes and superelevation transitions, however the radius return areas are not easily defined using shapes. GEOPAK Site can be used to design the profiles for the radius returns and to complete the design of the intersection area. The use of GEOPAK Site is beyond the scope of this training guide. A brief overview of the process is provided below.

- Define the pavement shapes such that the through lanes of the main alignment carry through the intersection area. Pavement shapes for turn lanes and for side roads are best stopped at the radius returns, but experimentation with different stopping points for turn lanes and side roads may yield desirable results depending on the intersection conditions.
- The GEOPAK **Shape to DTM Surface** tool can be used to export the shape information into a DAT file that can be imported into GEOPAK Site.
- Import the DAT file into GEOPAK Site as a Roadway object. Add the following Elements to the GEOPAK Site object:
 - Add each Radius Return as a Boundary element.
 - Add an Element for the side road centerline by using option to import a COGO Chain and Profile into the Site Object.
- Use the Site Modeler **Elements > Edit Profile** tool to design the profiles for each radius return.
- Depending on the intersection conditions, it may be desirable to import a Break Line Element for the edge of the traveled lane along the side road up to the intersection with the mainline shapes and define a profile along these locations.

Some experimentation with GEOPAK Site is necessary to yield the best results. An example of the contours generated by GEOPAK site for the S.R. 185 and Jameson Road intersection area is shown below. In this example, defining the profile elevations along the radius returns was sufficient to produce acceptable results.



Exercise 4

Create a new design file for the superelevation shapes using the **ODOT_Files** application.

What is the name of the design file?

Which sub-directory is the file created in?

Using this section as a guide, generate the superelevation shapes for S.R. 185. Name the Autoshape input file "SR185_Super.inp". Use the following settings in the GEOPAK Automated Superelevation dialog:

Job:	185
Design Speed:	55
Preference File:	ODOT2006_Undivided
e Selection:	8.0% eMax 202-7E
Chain:	CLPS185
Begin:	53+00
End:	77+50 R 2
Facility:	Undivided
L Selection:	All cases
Profile:	PS185P

For the **Left** and **Right** portions of the *Automated Superelevation* dialog, enter the lane configuration for 2-12' lanes using a normal crown slope of -1.6%. Be sure to set one shape as **Dependent**, and the other as **Independent**.

Using this section as a guide, generate the shapes for the right turn lane as described below using the *Shape Maker* tool.

Shape Area	Station From	Station To	Filler Line Station	Filler Line Type	Slope (%)
1	63+50	64+30	64+30	Non-Transition	8.0
2	64+30	65+35	(1) 64+30 (2) 65+35	(1) Transition (2) Transition	(1) 8.0 (2) 3.0
3	65+35	66+11.32	65+35	Non-Transition	3.0

Update the Working Alignment Definition for S.R. 185 to include the shape information.

Optional Exercise: Jameson Road Shapes

Set the active Working Alignment to Jameson Road. Using this section as a guide, create the superelevation Autoshape input file for Jameson Road. Name the input file shape_jam.inp. Use the following design parameters for Jameson Road:

Job:	185
Design Speed:	25
Preference File:	ODOT2006_Undivided
e Selection:	4% eMax 202-9E
Chain:	CLPSJAM
Begin:	12+50
End:	15+85.30
Facility:	Undivided
L Selection:	All cases
Profile:	PJAMEP

For the **Left** and **Right** portions of the *Automated Superelevation* dialog, enter the lane configuration for 2-12' lanes using a normal crown slope of -1.6%. Be sure to set one shape as **Dependent**, and the other as **Independent**.

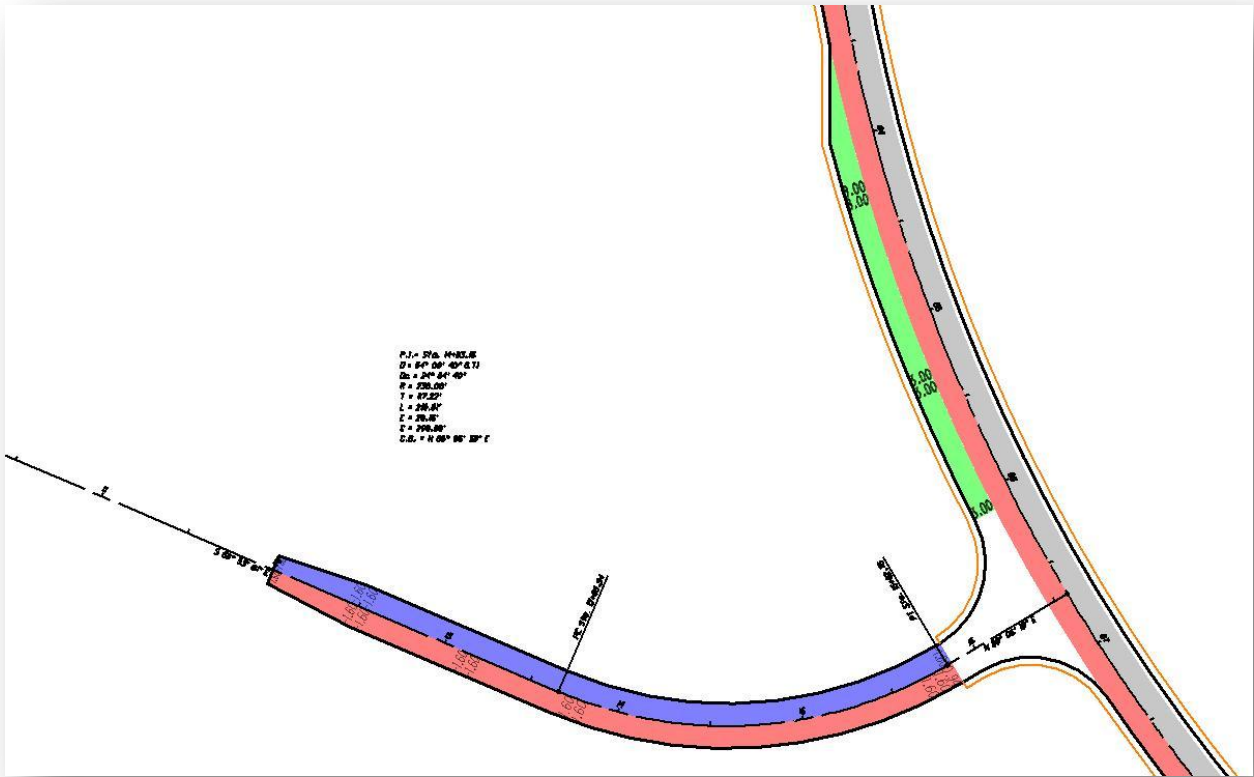
Using the Preference File ODOT2006_Undivided.sep with an **e Selection** value of 4% eMax 202-9E, no superelevation is required for Jameson Road.

Use the **Shape Maker** tool to create the shapes for the taper areas at the beginning of proposed Jameson Road as described below.

Shape Area	Side	Station From	Station To	Shape Type	Filler Line Type	Slope (%)
1	Left	12+00	12+50	Dependent	Non-Transition	-1.6
2	Right	12+00	12+50	Independent	Non-Transition	-1.6

Update the Working Alignment Definition for Jameson Road to include the shape information.

The completed shapes for Jameson Road and S.R. 185 should appear similar to the shapes shown in the example below (the colors may vary).



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5 Proposed Cross Sections

5.1 Overview

GEOPAK provides two methods for generating proposed cross sections as summarized below:

Corridor Modeling with Roadway Designer

Roadway Designer uses a template based approach to build a proposed surface. The processing and editing is accomplished entirely in Roadway Designer and the completed cross sections are exported from the design surface. Roadway Designer is advantageous for projects scoped to include a proposed 3D surface as part of the electronic deliverables. The use of Roadway Designer is not covered in this training guide.

Cross Section Criteria Files

Criteria files can be used to draw the proposed roadway on the existing cross sections. Criteria files are written using a simple programming language similar to Basic. Criteria files have the capability to evaluate conditions using If-Then conditional expressions. Depending on the results of the conditions, the software can draw different features.

Which option is used depends on the scope of the project. This training guide will cover the procedure to generate cross sections processing Criteria files.

5.2 Criteria Files

A criteria file is a program, written in a simple programming language similar to Basic. Criteria files, and the supporting documentation, are located in the following ODOT Standards folder:

I:\ODOTstd\V8istd\Geopak\Road\criteria

Each criteria file is used to draw an individual portion of the cross section. For example, the file **PAVT.X** is used to draw the proposed pavement on the cross sections. Files for shoulders, curb, side slopes, etc... are provided.

The ODOT Standard criteria files are provided as a convenience to ODOT's internal and external customers. It may be necessary for users of the criteria files to write or modify the criteria for their specific project use. This training guide will not cover writing Criteria files. This guide will focus on the procedure to process previously developed Criteria files.

The purpose of Criteria is not to draw all of the cross sections 100% correctly. There will always be cases where the user will need to manually edit the cross section graphics to make modifications such as changing the flow elevation of a ditch, or modifying a side slope to avoid interference with a utility

location. Too often, criteria writers will spend time modifying criteria trying to cover all the cases, when it would be more efficient to use criteria to draw 90% of the sections and graphically modify the other 10% to fit special cases.

The graphics drawn by the Criteria files are simple MicroStation elements. These elements can be manually edited by the user as necessary. Graphical modifications must use only lines and line strings, as arcs and curves are not recognized by the software for earthwork computations. Care must be taken to connect any modified elements, as errors will result from gaps between elements. Modifications made to the cross-sections will be reflected in the earthwork quantities.

5.3 Requirements for Processing Proposed Cross Sections

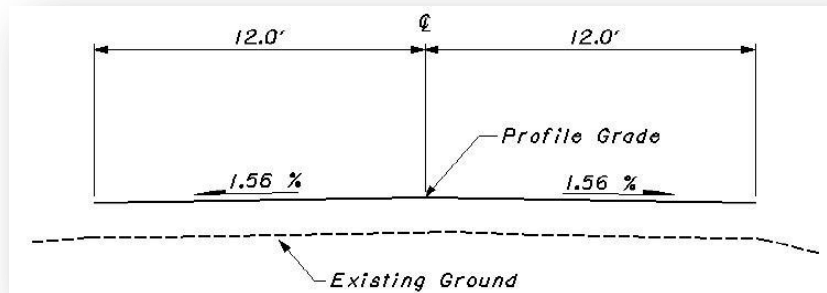
Before proposed cross sections can be processed, the following design considerations must be defined:

- ✓ A COGO Chain representing the horizontal alignment.
- ✓ A COGO Profile representing the proposed profile.
- ✓ Pattern lines representing the location of the cross sections must be established. (The Pattern by Station option can be used in lieu of drawing pattern lines in the design file).
- ✓ Plan view graphics representing the proposed roadway.
- ✓ Existing ground cross sections.
- ✓ Pavement Shapes. (An alternate “Shapeless” mode is also available and will be discussed in greater detail in section 5.12-5.14).
- ✓ Criteria files.

Each of these components of your proposed design is used to generate the proposed cross sections as described in the following sections.

5.4 Pavement Shapes

Pavement shapes are used to define the basic lane width and cross slopes for the proposed roadway. When processing proposed cross sections, the first thing GEOPAK does is draw the top of proposed pavement using the pavement shapes as a guide. The example below shows the top of the pavement, drawn using two pavement shapes defining the left lane and right lane of the proposed pavement.

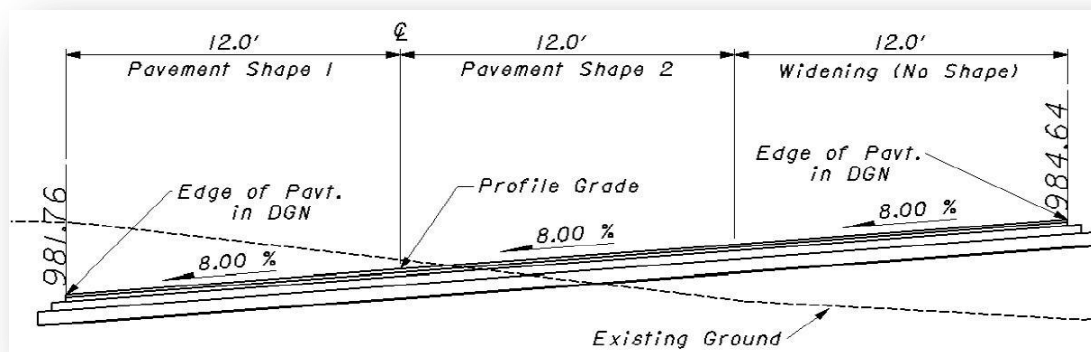


The COGO profile is used to establish the profile elevation for each cross section.

5.5 Plan View Graphics

Criteria files have the capability to use plan view graphics to locate proposed design features (i.e., edge of pavement, shoulder, curb) by intersecting the design elements in the base map.

In the example below, two pavement shapes were drawn representing the pavement lanes to the immediate left and right of the proposed centerline using the ODOT Standard criteria file **PAVT.X**. The criteria found that the proposed edge of pavement line on the right side is outside the limits of the pavement shapes. The additional pavement widening for a right turn lane was automatically drawn by the criteria. The width of the turn lane is defined by intersecting the proposed edge of pavement line in the plan view design file.



Notice that the pavement in the example above is in a super-elevated section. The criteria draws the super-elevation based on the cross slopes stored with the pavement shapes (see Chapter 4 Pavement Shapes). The widening is assumed to maintain the same cross slope as the adjacent pavement shape, therefore, if the design required a different pavement cross slope for the right turn lane, another pavement shape would have been necessary.

5.6 Variables

In order for ODOT's standard criteria files to be applicable to a wide variety of projects, variables are used to define values that may change from project to project. The use of variables allows the criteria files to be generic. There are two variable types that you will need to be aware of in order to process standard criteria.

The first variable type is the **Substitution String**. These are variables that can be used to specify project specific information rather than hard coding the values in the criteria itself. For example, one project may have a pavement buildup consisting of four pavement layers. Another project may have only three pavement layers. In order for the same pavement criteria file to successfully draw the correct number of pavement layers for each of these projects, the criteria provides a variable for the user to define the number of pavement layers to be drawn.

Another type of variable is the **In DGN Variable**. These variables allow the user to specify the element symbology and the name of the design file containing the plan view graphics that the criteria will use to draw a specific feature. For example, if the criteria needs to locate the existing edge of pavement, the criteria developer can establish a DGN Variable for the existing edge of pavement. When processing the criteria, the user must provide the values for the level, weight, color, and line code as well as the name of the design file that contains the plan view graphics.

5.7 Inclusion Sequence

We previously stated that criteria files are written such that each individual file is responsible for drawing only a specific component of the proposed cross section design. This allows the criteria files to accommodate a wide variety of design scenarios. For example, a particular project may consist of the following components:

- ✓ Proposed Pavement
- ✓ Shoulder
- ✓ Side Slopes

When a criteria run is processed, the user will specify the individual criteria files that will be used to draw each component. The order in which these components are specified is significant. Criteria files must be included in the order that they will process from the centerline out. In other words, the pavement criteria must precede the shoulder criteria which must precede the side slope criteria. Each criteria file will start drawing where the previous criteria file ended.

5.8 Left Side/Right Side Processing

Each side of a specific roadway may have different conditions. For example, the left side of our highway may have the following design features:

- ✓ Proposed Pavement
- ✓ Type 2 Curb
- ✓ Side Slope

While the right side may have the following features:

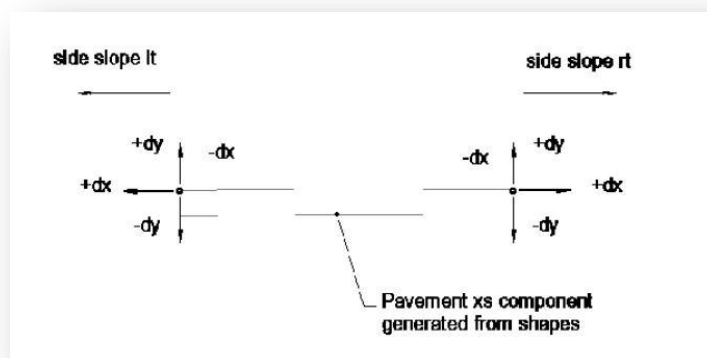
- ✓ Proposed Pavement
- ✓ Type 2 Curb
- ✓ Sidewalk
- ✓ Side Slope

GEOPAK allows for different conditions on each side of the roadway. During the setup of a criteria run, criteria files must be independently defined for each side of the roadway.

When you specify the criteria files that are to be included for each side, you have the option to select which side will be processed first. ODOT Standard criteria files have been configured to operate by processing the left side first.

During processing, each cross section is processed individually. The criteria files specified for the left side of each cross section are processed completely before processing on the right side begins. After the left and right sides have been processed, the software moves on to the next cross section.

Since criteria processing occurs from the “inside out”, you might think that there will be separate criteria files for the left side and the right side. For example, while processing the left side of the roadway, a curb will be drawn from the right (inside) to left (outside). When processing the right side, the same curb will need to be drawn from the left (inside) to right (outside). GEOPAK allows the same criteria file to be used on the left and right sides by identifying the positive X direction as going away from the center line and the negative X direction as going towards the center line. The Y direction is the same for both sides, positive Y towards increasing elevation, negative Y towards decreasing elevations. The figure below illustrates the convention:



5.9 ODOT Standard Criteria Library

ODOT's library of standard criteria files can be found in the following location:

i:\ODOTstd\V8istd\Geopak\Road\criteria

Each criteria file will have its own list of variables that the user must define according to the design conditions for their project. Documentation for each criteria file is crucial in order for the user to understand how each individual Criteria file works. This documentation can be found in the following location:

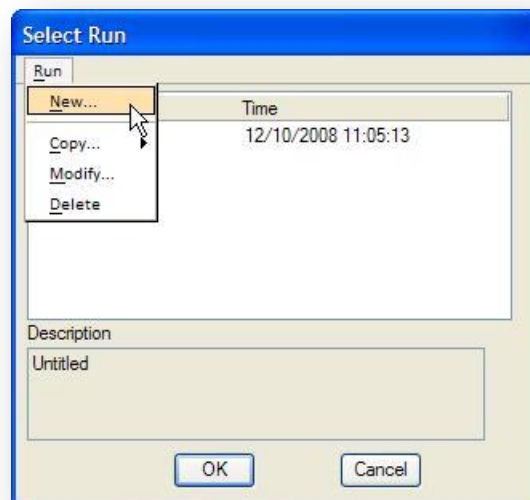
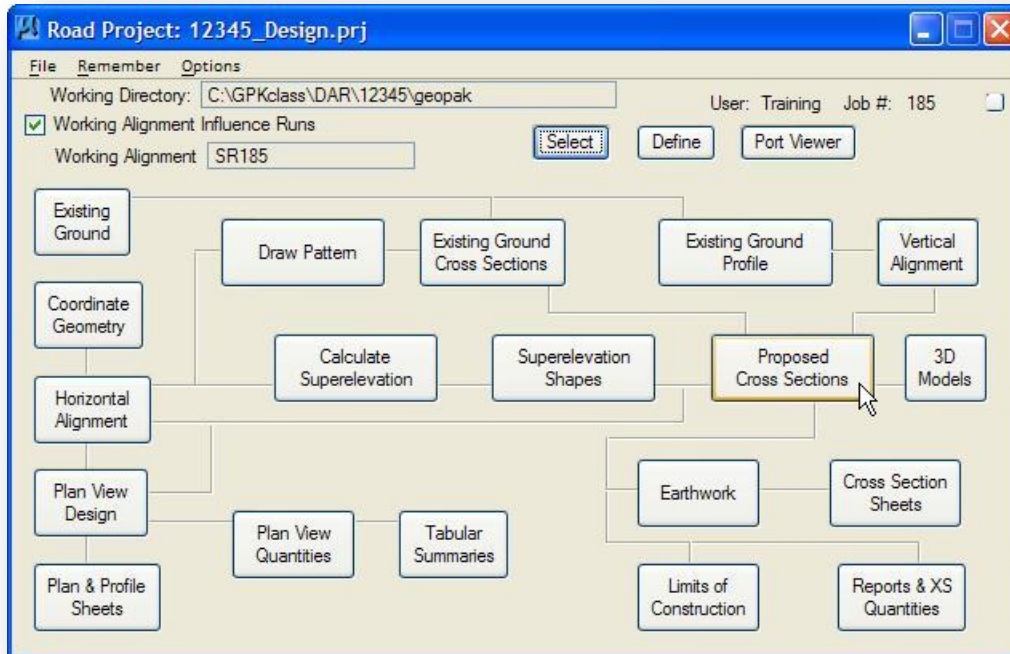
i:\ODOTstd\V8istd\Geopak\Road\criteria\Doc

The ODOT Criteria library is provided as a courtesy to the consulting community. Requests from ODOT personnel for new criteria files should be forwarded to the [Office of CADD and Mapping Services](#). ODOT does not specifically write criteria files at the request of external clients or customers.

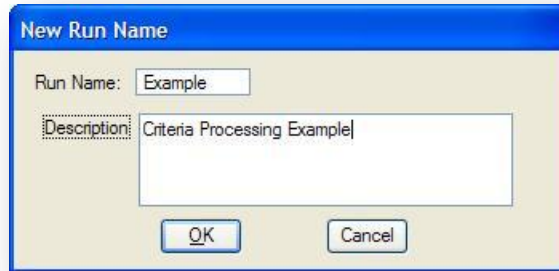
5.10 Criteria Processing Example

Now that we have an understanding of the basic criteria rules, let's take a look at processing some of ODOT's standard criteria files.

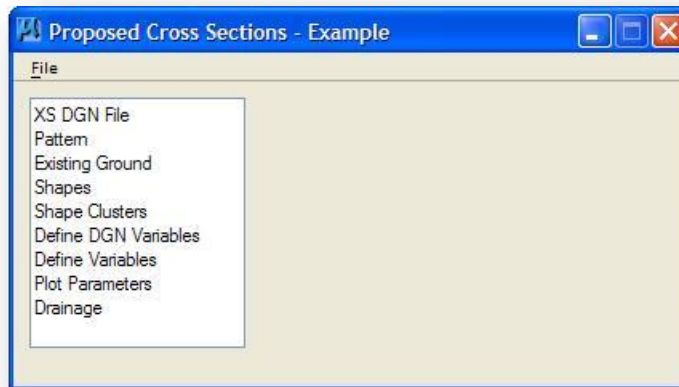
Select **Proposed Cross Sections** from the *GEOPAK Project Manager*, as shown, below to access the *Select Run* dialog shown below.



Create a new **Run**, as shown on the following page, or open an existing run.



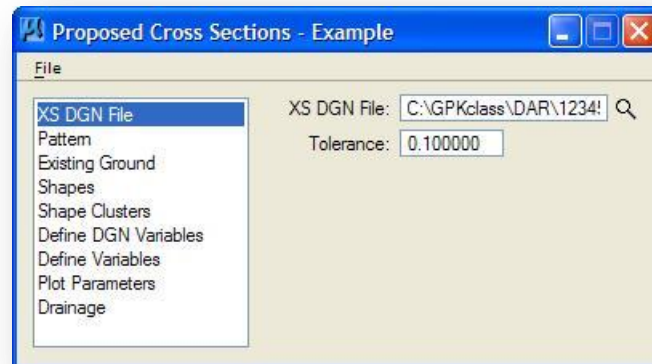
After creating the run, Select the Run name to access the Proposed Cross Sections dialog shown below.



Selecting an item from the list box on the left of the *Proposed Cross Sections* dialog box will reveal a group of associated parameters on the right side of the dialog. These parameters are described in the following sections.

5.10.1 XS DGN File

When **XS DGN File** is selected, the dialog changes as shown below.

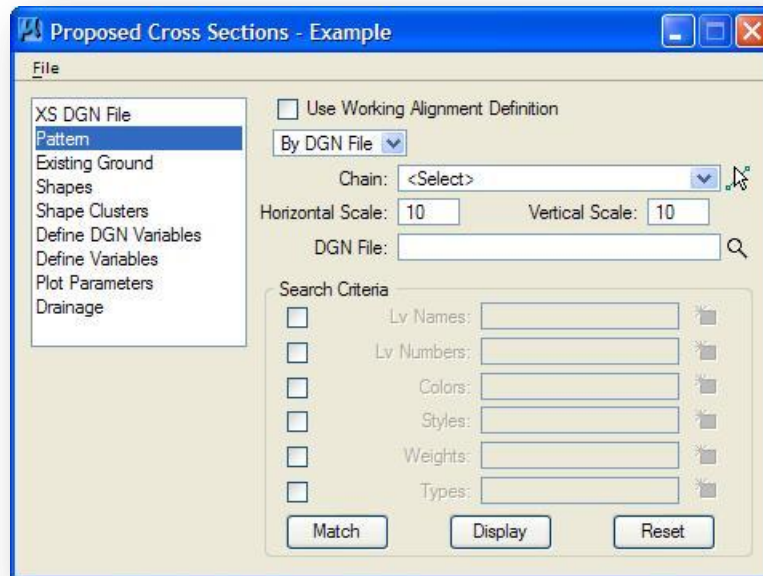


The **XS DGN File** item is used to identify the MicroStation design file containing the existing ground cross sections. If you have set up a **Working Alignment Definition** using the GEOPAK Project Manager, the **XS DGN File** name is taken from the currently selected **Working Alignment** and automatically placed in the *Proposed Cross Section* dialog box.

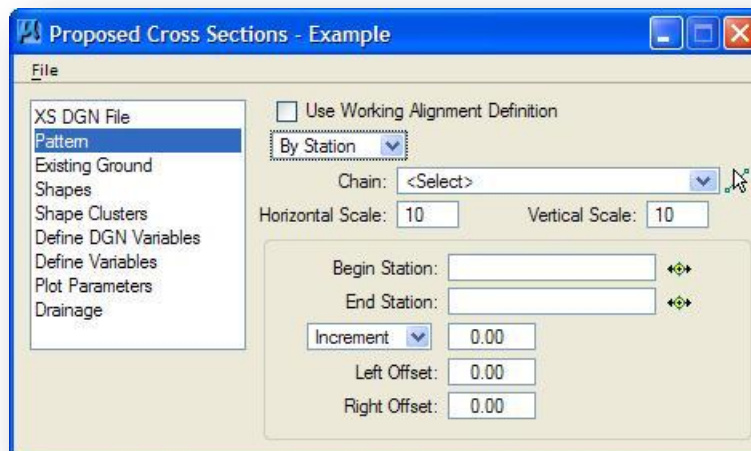
The **Tolerance** is the distance that each endpoint of the cross section elements must fall within to be considered connected. By default, the **Tolerance** is set to a value of 0.1 Master Units.

5.10.2 Pattern

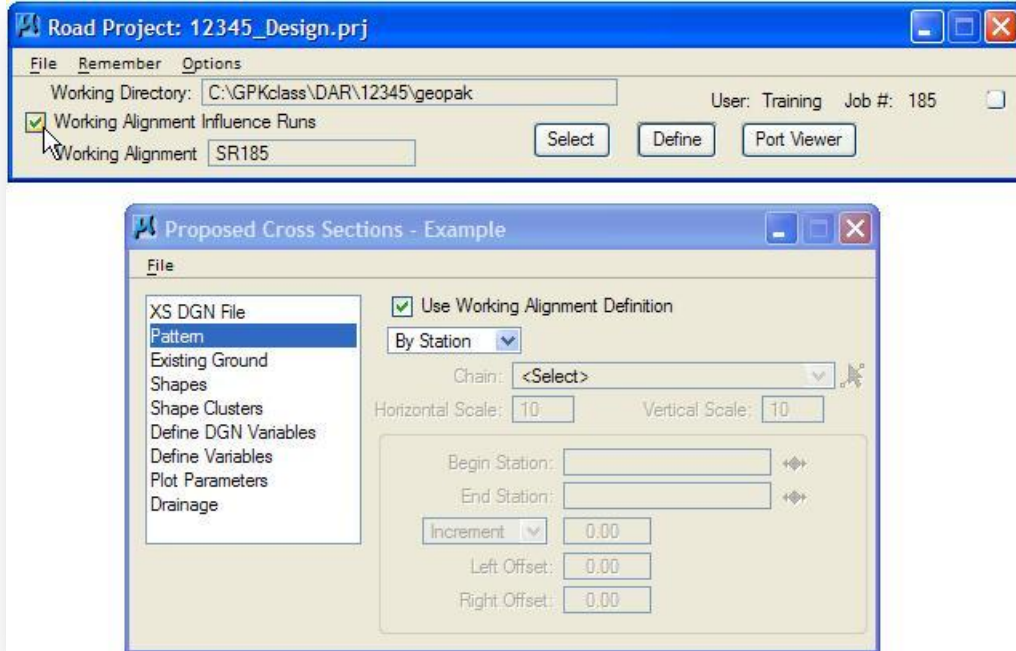
When **Pattern** is selected, the dialog changes as shown below.



The **Pattern** item is used to identify the method that was used to generate the existing ground cross sections; **By Design File** or **By Station**. Toggling the option to **By Station** will change the dialog as shown below:

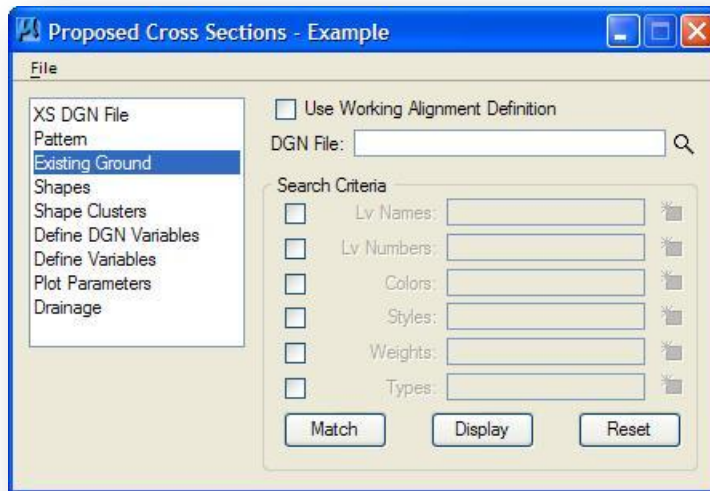


If the **Use Working Alignment Definition** toggle is activated, the rest of the dialog is ghosted and the pattern definition from the active working alignment is used. If the toggle is not activated, **By Design File** or **By Station** can be selected. The rest of the dialog is a reflection of this selection. These parameters should match exactly with those used to generate the original GEOPAK XS cells and existing ground.



5.10.3 Existing Ground

When **Existing Ground** is selected, the dialog changes as shown below.



The **Existing Ground** item is used to identify the design file containing the ground cross sections and their symbology.

When the **Use Working Alignment Definition** toggle is activated, the rest of the dialog is ghosted and the existing ground definition from the active **Working Alignment** is used. If the toggle is not activated, the **Design File** and **Search Criteria** must be specified to define existing ground.

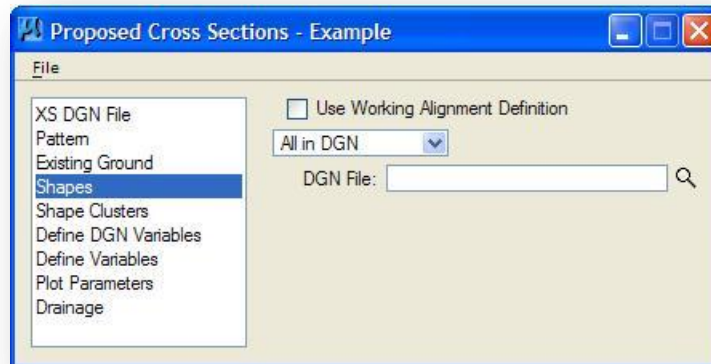
The **Design File** option is used to specify the name of the MicroStation design file containing the existing ground cross sections. If you do not include the full path for the design file, GEOPAK will use the current **Working Directory**.

The group box for **Search Criteria** supports options to specify the element symbology of the existing ground cross sections. Simply toggle on the desired parameter, and then press the **Match** button. You may select as few or as many parameters to identify the existing ground lines as necessary.

Pressing the **Display** button displays all existing ground elements matching the current parameters.

5.10.4 Shapes

When **Shapes** is selected, the dialog changes as shown below.



The **Shapes** item is used to identify the pavement shapes that will be used for the criteria run.

When the **Use Working Alignment Definition** toggle is activated, the rest of the dialog is ghosted and the shape definition from the active **Working Alignment** is used. When the **Use Working Alignment Definition** toggle is not active, three options are supported to identify the pavement shapes: **All in DGN**, **Shapeless**, and **By Search Criteria**.

All in DGN

This option will search the specified design file for all shape clusters contained in the file.

By Search Criteria

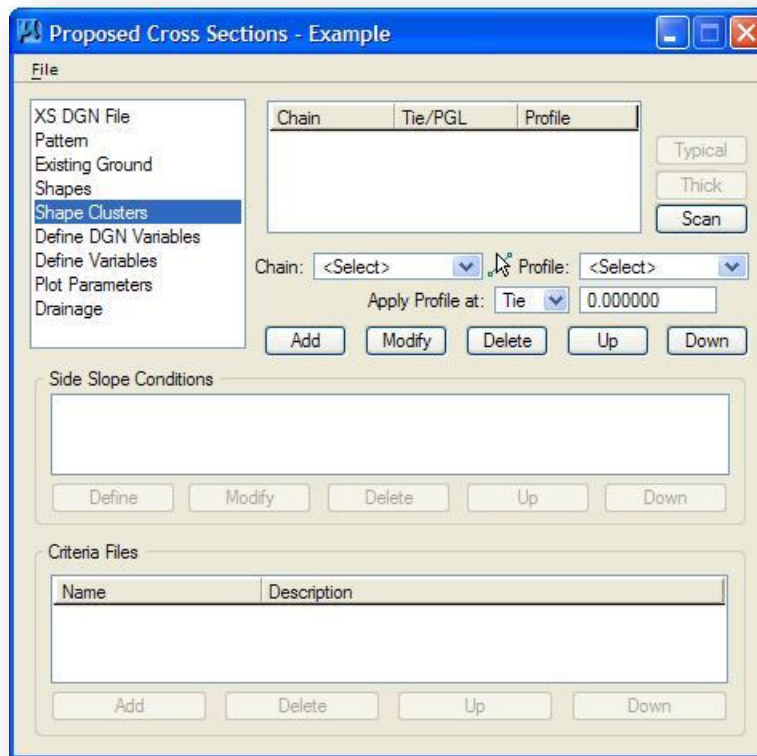
Only shapes meeting the specified criteria will be used for processing.

Shapeless

No pavement shapes are to be used. See Section 5.11 for an example of processing shapeless criteria.

5.10.5 Shape Clusters

When **Shape Clusters** is selected, the dialog changes as shown below.

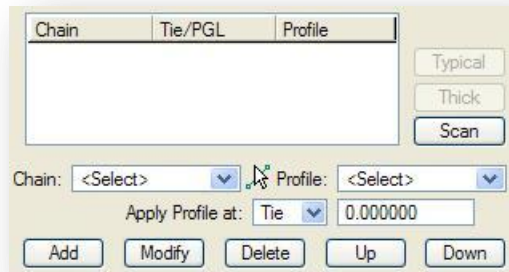


The **Shape Clusters** item is used to identify the criteria files that will be included for processing for each pavement shape cluster. The dialog is divided into three distinct areas as shown below.

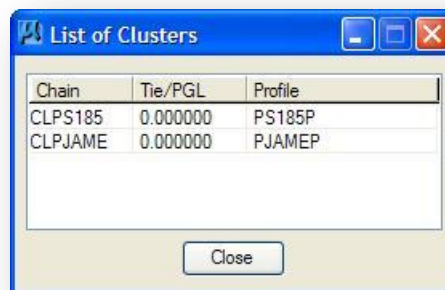
1. Shape Clusters
2. Side Slope Conditions
3. Criteria files

Each portion of the dialog is explained in detail on the following pages.

Shape Clusters

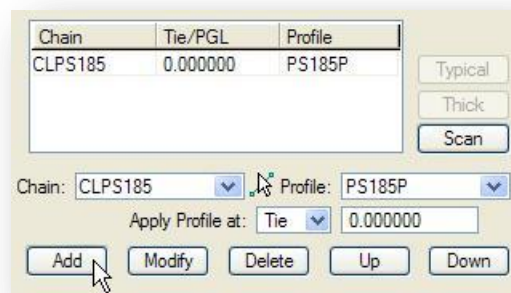


The top right portion of the dialog, shown above, is used to identify which shape cluster you wish to use. Select the **Scan** button to activate the *List of Clusters* dialog box shown below.



This dialog box will contain a list of all the shape clusters meeting the search conditions defined by the Shape item described on page 5-12. In the example above, the **All In DGN** option was used which provides a listing of all the shape clusters in the design file.

Select the desired shape cluster from the list box. The values for the **Chain**, **Tie/PGL** and **Profile** are carried to the *Proposed Cross Sections* dialog. Select the **Add** button to add the shape cluster to the list box as shown below.



As an alternative to using the **Scan** button, you may simply select the **Chain** name, the **Tie** value and the **Profile** name in the dialog fields as shown above.

The **Modify** button is used to modify the information for the selected shape cluster.

The **Delete** button is used to delete the selected shape cluster from the list.

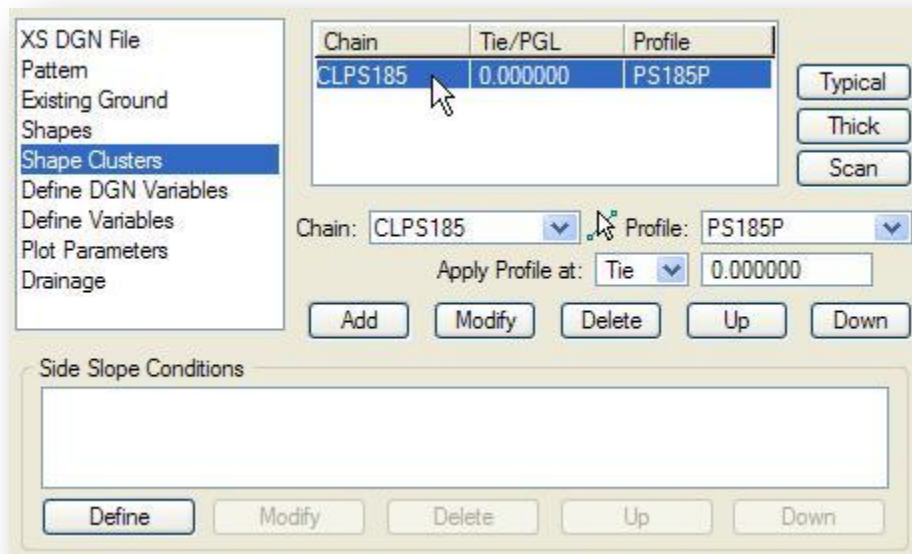
If multiple shape clusters are specified for simultaneous processing, they will process in the order specified. The **Up** and **Down** buttons are used to change the order that the shape clusters are listed in the dialog.

The **Typical** feature within proposed cross sections was originally developed in order to automate (as much as possible) the development of cross sections for widening and resurfacing jobs, but it can also be used with new construction. It enables the user to select a typical section from a cell library, and then copies associated criteria files into the job directory. In addition, the criteria files are placed within the definition of the "side slope lt" and "side slope rt" statements. The results are that the user only has to specify the project values for the given variables, then initiate the proposed cross section run. At this time, no **Typical** applications have been developed for ODOT use.

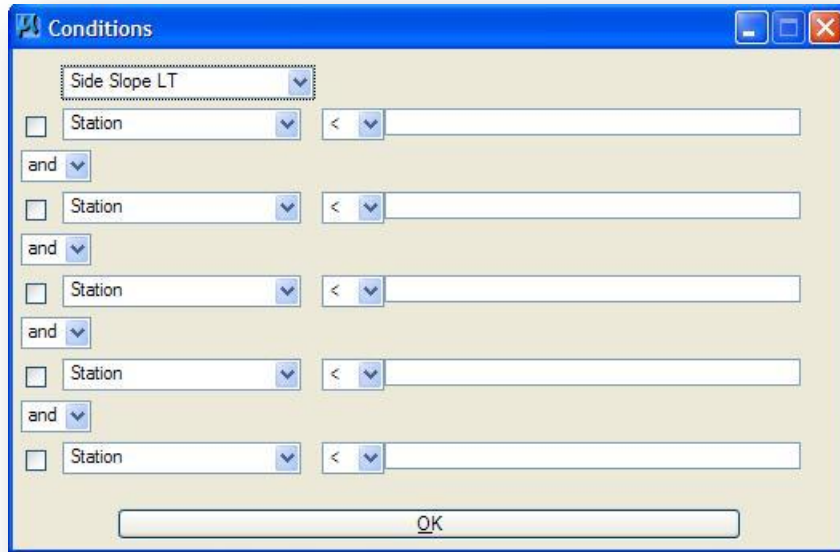
The **Thick** option can be used to specify the symbology and thickness of each pavement layer to be drawn beneath the GEOPAK pavement shapes. Since the pavement layers are drawn by ODOT's standard pavement criteria file PAVT.X, there is no need to use the **Thick** option.

Side Slope Condition

The **Side Slope Condition** portion of the *Proposed Cross Sections* dialog is used to define the processing conditions for the criteria run.



After a Shape Cluster has been selected, the **Define** button located under the **Side Slope Condition** section of the dialog becomes available as shown above. Select **Define** to access the Conditions dialog shown on the following page.



The top of the dialog contains an option button to select the condition for which you wish to define criteria. The options are shown below:

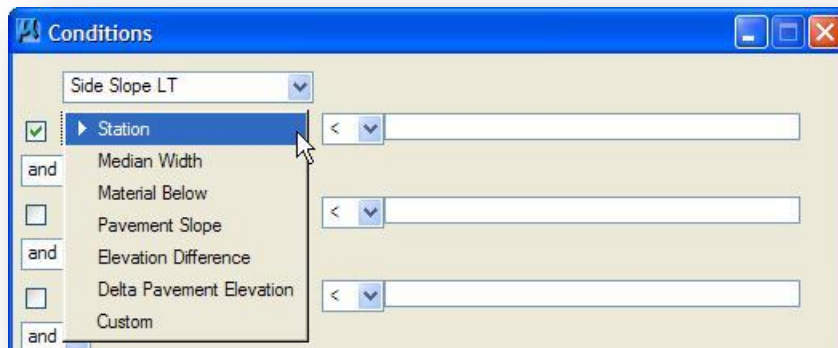


The **Side Slope LT** and **Side Slope RT** conditions are used to define the criteria files for the Left and Right sides of the pavement slopes separately. If the same list of criteria files is to be processed on both the Left and Right side of the roadway, the **Side Slope LTRT** condition may be used.

Important: Always define the criteria for the left side first. The ODOT Criteria files have been designed to process starting with the left side first.

The **Offset Minus Side Slope LT, RT** and **Offset Plus Side Slope LT, RT** options are no longer used. They are only included on the dialog to provide compatibility with old criteria files.

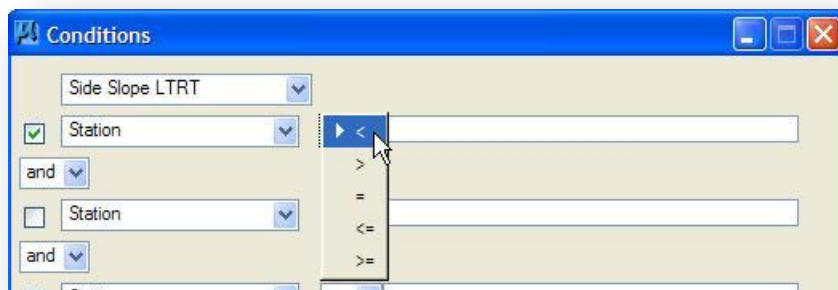
Several options are available to limit where the criteria will be applied as shown below.



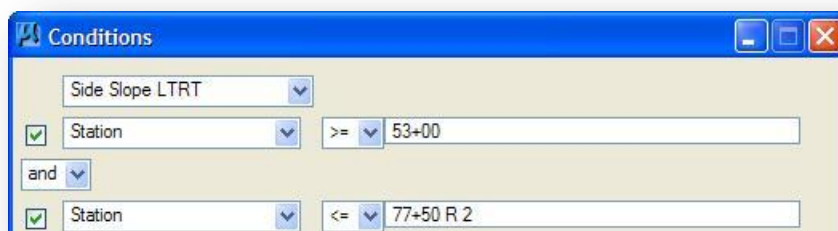
See the GEOPAK documentation for information about how each of these limiting conditions is applied. We'll take a look at limiting the **Station** range in the example below.

To limit the Station range that will be processed, take the following steps:

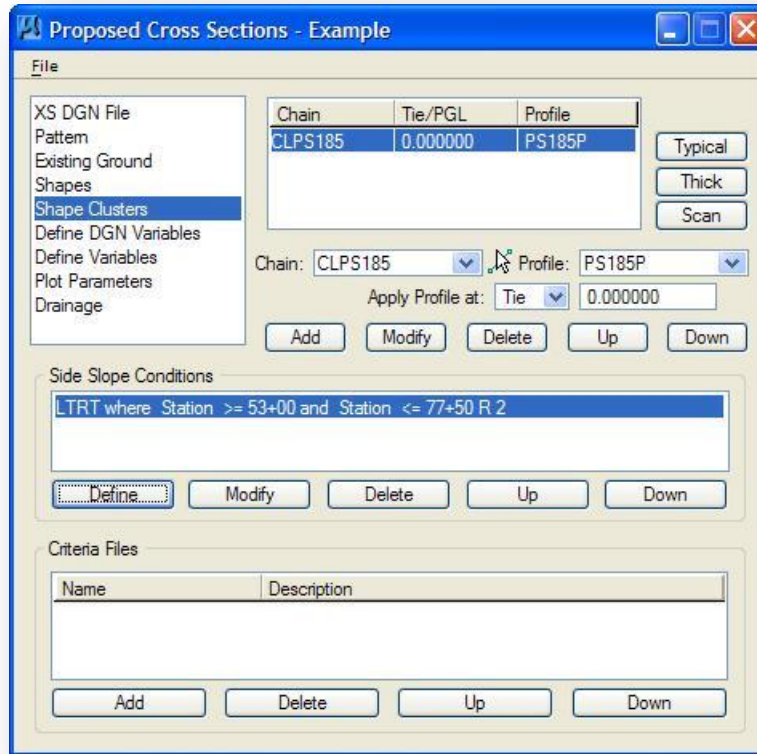
- ✓ Toggle on the option to apply a limiting condition.
- ✓ Select the **Station** limiting factor.
- ✓ Select the desired relational operator. The options shown below are available:



- ✓ Key-in the station value. Up to five conditions can be defined using the **and/or** conditional operators. An example using two conditions is shown below.



- ✓ Select the **OK** button to add the condition. Once the **OK** button is selected, the condition is added to the *Proposed Cross Sections* dialog as shown on the following page:



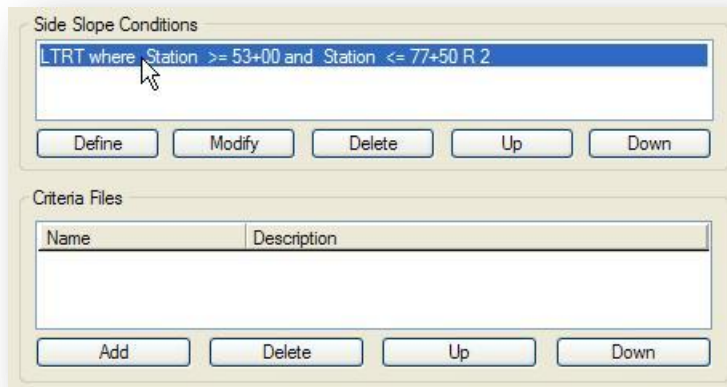
The **Modify** button can be used to modify the station ranges defined for a condition.

The **Delete** button is used to remove the selected condition from the list.

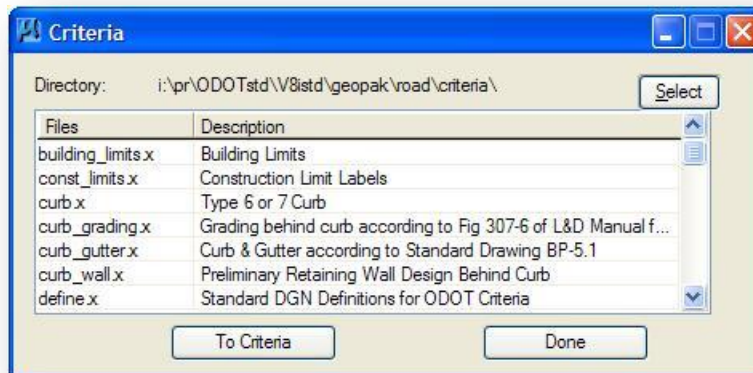
The **Up** and **Down** buttons are used to move the selected side slope condition up or down in the list box.

Criteria Files

After the **Side Slope Conditions** are defined, the options on the *Process Cross Sections* dialog for adding criteria files become available.



To add criteria files for the currently selected condition, select the **Add** button at the bottom of the *Process Cross Sections* dialog. The *Criteria* dialog shown below is opened.



Use the **Select** button to specify the directory where the criteria files are located.

ODOT Standard criteria files are located in the following folder:

i:\ODOTstd\V8istd\geopak\road\criteria

To add a criteria file to the *Proposed Cross Sections* dialog, select the file name from the *Criteria* list box and push the **To Criteria** button. Continue selecting the required criteria files until you are finished. The **Done** push button is used to dismiss the *Criteria* dialog box. The selected criteria files are added to the *Proposed Cross Sections* dialog in the order selected, as shown below.



The order in which you specify the criteria files is significant. Criteria files are processed in the order specified. See section 5.6 for information on the criteria processing sequence.

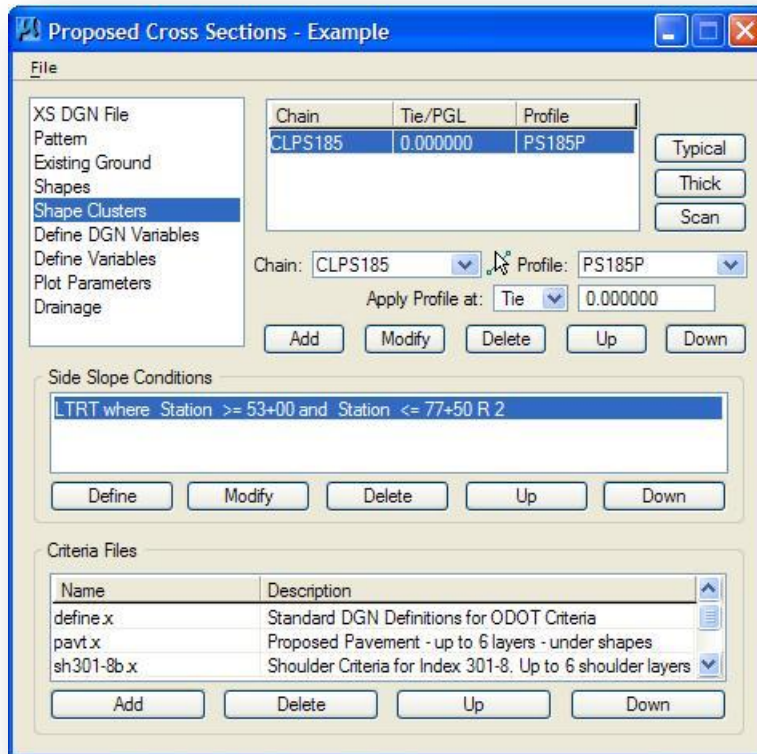
If you have inadvertently added criteria files to the list box in the wrong order, the **Up** and **Down** buttons can be used to move the selected criteria file up or down in the list box order.

The **Delete** button is used to delete the currently selected criteria file from the list.

The complete information for the Shape Clusters dialog is shown on the following page.

Note:

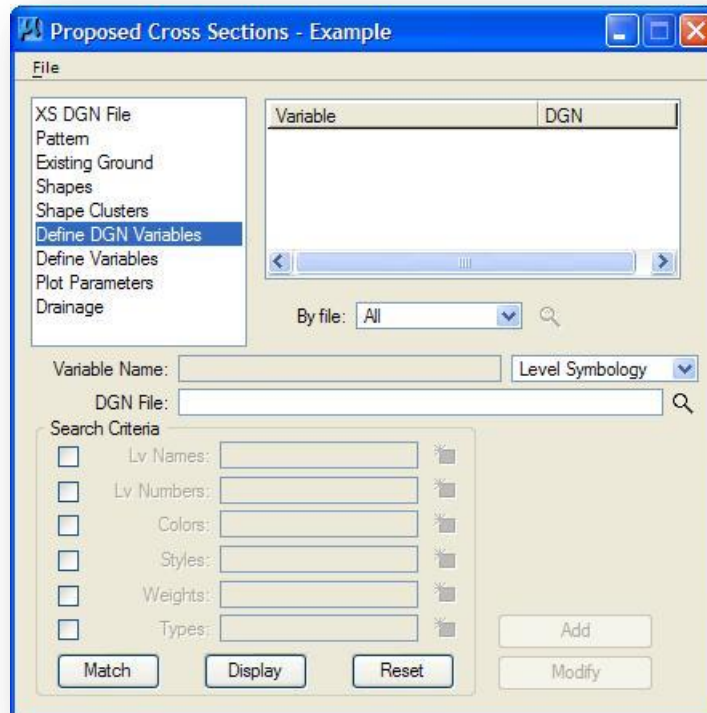
The criteria file define.x is required as the first criteria file included for processing in all criteria runs using ODOT criteria files.



In the example above, the **LTRT** option is used to define the **Side Slope Conditions**. Using this option, the same list of **Criteria Files** will be processed for both the left and right sides of the cross section. To process a different set of criteria for each side, separate **Side Slope Conditions** using the **LT** and **RT** options must be defined.

5.10.6 Define DGN Variables

When **Define DGN Variables** is selected, the dialog changes as shown below.



One of the most powerful aspects of criteria is the ability to read a plan view design file, determine the roadway elements and then draw those features onto the cross sections. **Define DGN Variables** are used to specify the symbology of the plan view elements that will be located by the individual criteria files.

For example, the ODOT Standard criteria file sh301-8.x has been written so that it will determine the width of the shoulder by measuring the plan view graphics representing the shoulder. This allows the criteria to draw the shoulder correctly for each cross section while accounting for varying widths or tapers. In order for the criteria to locate the shoulder in the design file, it needs the following information:

- The name of the file that contains the plan view graphical elements.
- The symbology (level, weight, color, line style) for the shoulder line.

Normally, the user would define the symbology for each Define DGN Variable used by the criteria by using the **Define DGN Variables** option shown above. However, ODOT's standard criteria library has been developed such that the definition of the DGN Variables is hard coded as a part of the criteria file and therefore does not need to be defined by the user.

For example, the criteria file **SH301-8.x** includes instructions for the criteria to look for the proposed shoulder using the following information:

```
define_dgn "~SHOULDER IN DGN PR" \  
  dgn = "PROPOSED DGN FILE NAME" \  
  lvname = PV_P_Shoulder \  
  wt = 1, ByLevel \  
  co = 6, ByLevel \  
  lc = 0, ByLevel
```

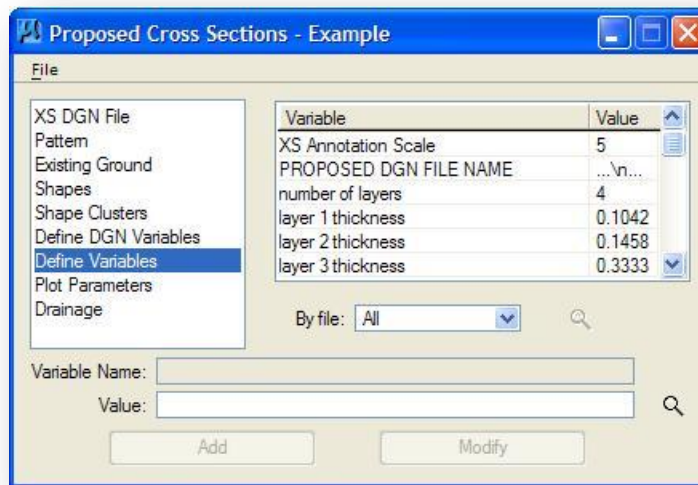
If the shoulder has been drawn according to ODOT standards, the criteria will locate all of the MicroStation elements meeting the above search criteria and draw the shoulder onto the cross sections. If the criteria is unable to locate any lines, arcs or curves meeting the definition, no shoulder will be drawn.

The symbology information for **Define DGN Variables** has been hard coded in ODOT's standard criteria files since the symbology itself is an ODOT standard. The name of the design file that contains the plan view graphics, however, will vary from project to project. For this reason, the design file name is not hard coded in the criteria definition for the **Define DGN Variables**. Instead, ODOT's standard criteria files use a **Define Variable** to identify the design file name. This **Define Variable**, also known as a "substitution string", must be assigned the correct file name by the user. See Section 5.9.6 for information on **Define Variables**.

Since all of the information for **Define DGN Variables** is included in the individual criteria files, there is no need to fill out any information on the *Proposed Cross Sections* dialog for the **Define DGN Variables** item.

5.10.7 Define Variables

When **Define Variables** is selected, the dialog changes as shown below.



The **Define Variables** portion of the *Proposed Cross Sections* dialog is used to assign values for any Substitution Strings that are found in the criteria files. Substitution Strings are used by the criteria developer to specify values that will change from project to project. Consider the example below:

In the ODOT Standard criteria file **SH301-8.x**, a shoulder will be drawn adjacent to the proposed pavement. The following criteria command can be used to draw the shoulder thickness:

```
draw dx=0 dy=-0.5
```

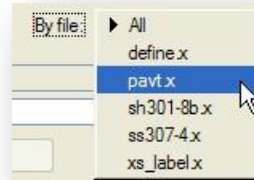
In this example, the shoulder thickness is hard coded to be 0.5 master units. This is not desirable since the shoulder thickness may vary from project to project. In order to make ODOT's standard criteria files generic, a substitution string has been used in the criteria as shown in the example below:

```
draw dx=0 dy=-"shoulder thickness"
```

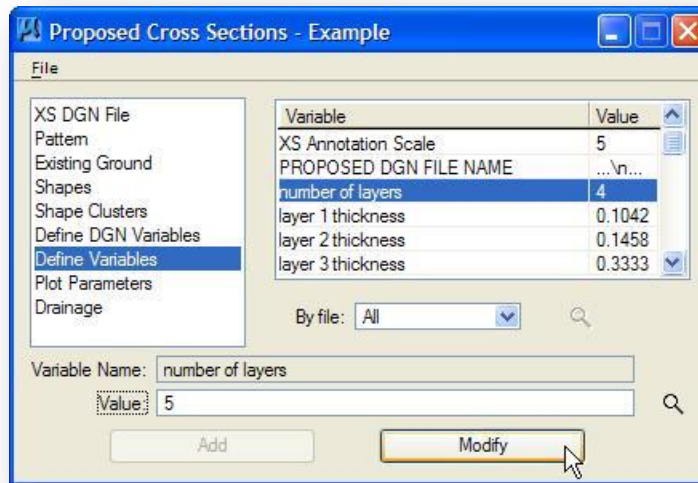
By using a substitution string in the criteria, the user can now assign the value for the variable **"shoulder thickness"** at runtime. Using substitution strings, the same shoulder criteria file can be used to accommodate a wide variety of design conditions.

Most of the variables in ODOT's criteria files have been assigned default values. If a variable has been assigned a default value, it will automatically show up in the list box, as shown above.

The list of variables can be displayed by individual criteria file by use of the **By File** option as shown in the example below. Select a criteria file from the list and only the variables for that file will be shown in the list box. Select **All** to display all of the variables from all of the criteria files.



Variables that are given default values in the criteria file are automatically carried to the *Proposed Cross Sections* dialog as shown above. If the default value does not meet your project specifications, it can be changed by using the **Modify** button. To change the default value for a variable, select the variable from the **Variable** list box. Change the value in **Value** field. Select the **Modify** button. The new value for the variable is now defined in the *Proposed Cross Sections* dialog box as shown in the example below.

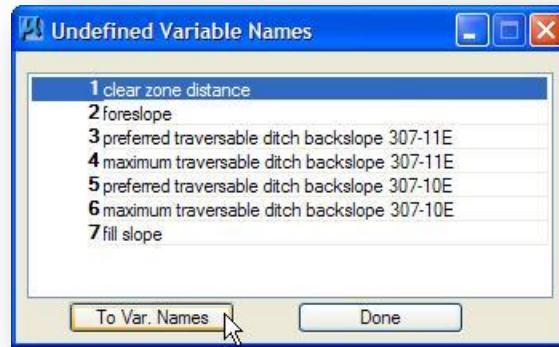


Any variable that has not been assigned a default value must be given a value in order for the criteria to process. Use the **Select Variable Name** button to scan the included criteria files for substitution strings that have not been given default values.

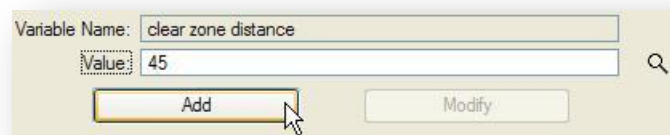


If all the variables have a default value assigned, the **Select Variable Name** Button is ghosted. If the icon is not ghosted, that is an indication that there are undefined variables in one or more of the included criteria files. The criteria run will not process if there is a variable that has been left undefined.

Choose the **Select Variable Name** icon to access the *Undefined Variable Names* dialog shown on the following page.



The dialog contains a list of any undefined variables. Each variable must be defined in order for the criteria process to run. Select the variable name, and then choose the **To Var. Names** icon. The name of the variable is carried to the *Proposed Cross Sections* dialog as shown below.



The variable is added to the list of defined variables. Continue to define each variable until the *Undefined Variable Names* dialog is empty.

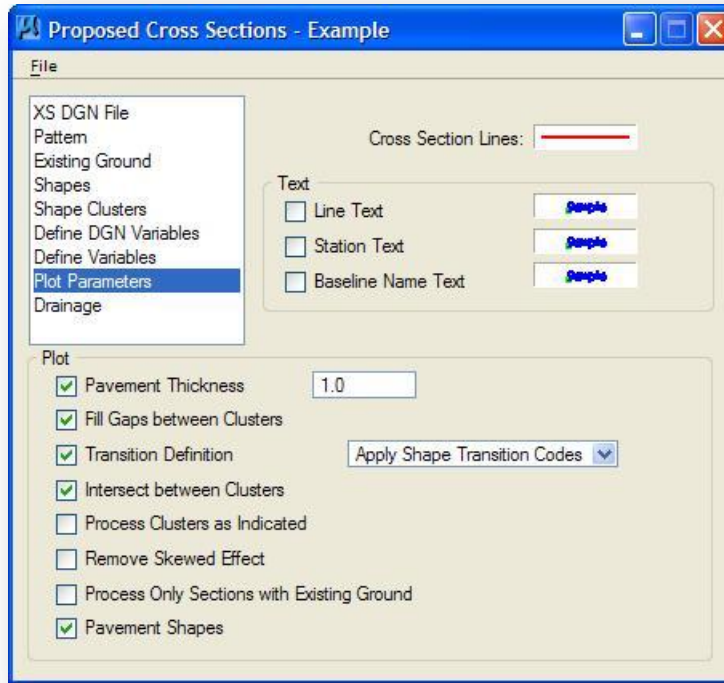
Criteria Documentation

Each variable has been named as descriptively as possible; however the name of the variable is not always obvious as to what the setting controls. For example, the variable "number of layers" is used to set the number of pavement layers to be drawn. In other cases, the name of the variable is not so obvious. For example, what is the variable "terminate slope" used for? It might not be used for what you think. Users should review the documentation for each individual criteria file to ensure that the variables are set correctly to achieve the desired results.

Tip: Use the **By File** option to sort the variables by the Criteria File when reviewing the documentation.

5.10.8 Plot Parameters

When **Plot Parameters** is selected, the dialog changes as shown below.



The options are described on the following pages.

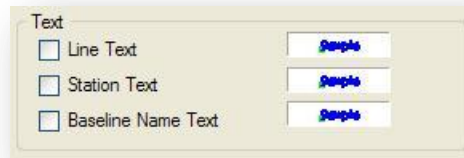
Cross Section Lines

Cross section lines representing the width and cross slope of the pavement shapes are automatically drawn onto the cross section. The **Cross Section Lines** item is used to control the symbology for these lines if the symbology is not defined in the criteria.



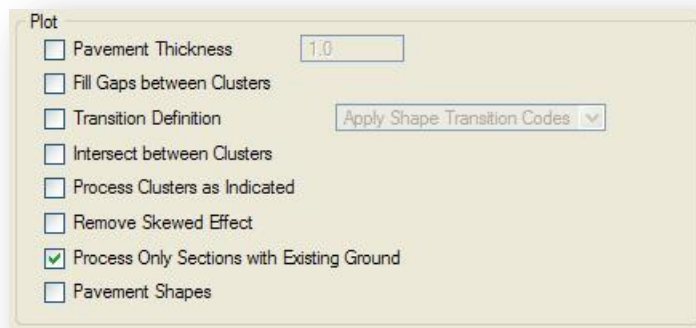
ODOT's Pavement criteria files have been configured to draw the top layer of the pavement shapes on the level `XS_P_Pavt_Surface`.

Text



The **Line Text**, **Station Text** and **Baseline Name Text** items are not normally used for ODOT projects. All of the labeling functions are typically accomplished by the criteria files.

Plot



The **Pavement Thickness** item is used to draw a second set of lines beneath the GEOPAK pavement shapes at the thickness value specified in the adjacent key-in field. Since ODOT's standard criteria files for pavement draw the proposed pavement, there is no need to have GEOPAK automatically draw this set of lines and this option should normally be toggled off.

Fill Gaps Between Clusters is used for divided highway situations.

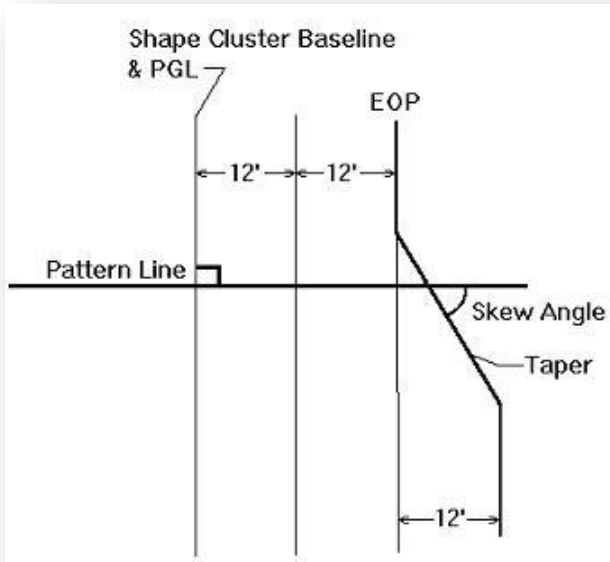
The **Transition Definition** item may be used to apply a different superelevation transition method to the GEOPAK pavement shapes. With this option toggled off, a linear superelevation transition will be maintained. This option should always be toggled off for ODOT projects.

Intersect Between Clusters is used for divided highway situations and will not be covered in this class.

By default, shape clusters are processed starting with left side first, regardless of the order in which the clusters are specified. With **Process Clusters as Indicated** toggled on, the clusters will be processed in the order that they are specified. This option should always be left toggled off when using ODOT Standard criteria files.

Remove Skewed Effect

GEOPAK draws proposed cross section elements sensitive to skew angles. Depending on the circumstances, the designer may not want to use this skew angle. The easiest explanation for this effect is an example.



When the pattern line is skewed to a plan view element or the edge of a shape, GEOPAK determines the angle between the pattern line and the plan view element or shape edge as shown in the graphic at left.

It will then use that angle for drawing subsequent criteria commands. In this example, if the criteria specifies drawing a 6:1 fill slope, GEOPAK will draw a flatter slope based on the degree of the skew angle. In this case, the cross section will be drawn accurately, as the 6:1 slope would assume being perpendicular to the edge of pavement.

The problem arises when subsurface layers are drawn after the skew effect has been encountered. In this case, the skew effect is applied to the slope of the subsurface layers. As a result, the subsurface layers would not be parallel the surface, even when the criteria dictated for GEOPAK to do so.

Process only Sections with Existing Ground

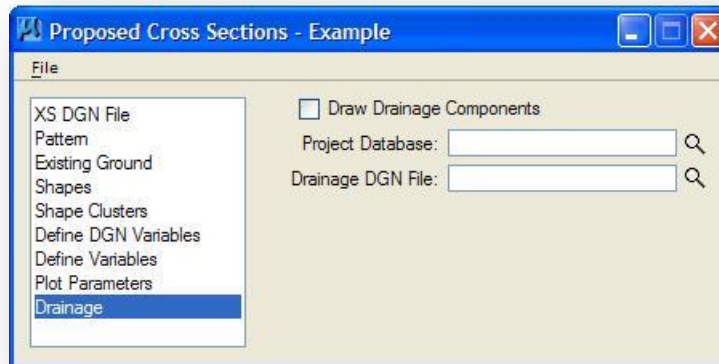
Toggle this option on to process only cross section cells with existing ground lines drawn.

Pavement Shapes

Toggle this option off. The pavement is drawn using the ODOT criteria files.

5.10.9 Drainage

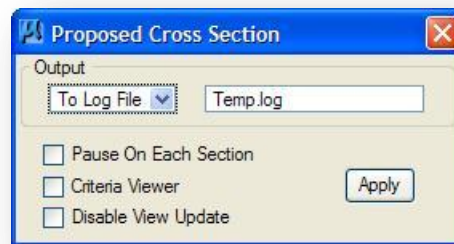
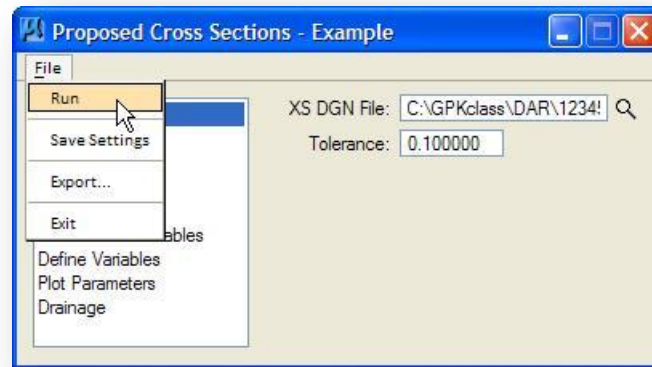
When **Drainage** is selected, the dialog changes as shown below.



To draw the drainage components onto cross sections, activate the toggle at the top of the dialog. In addition, the drainage project (*.gdf) and its path must be specified. The file where the drainage project is drawn must be specified, including the path. The file names may be manually entered or selected via the Files button.

5.10.10 Processing the Criteria Run

After you have defined all of the parameters on the *Proposed Cross Sections* dialog, you are ready to process the criteria run. Select **Files > Run** from the *Proposed Cross Sections* dialog to access the dialog below.



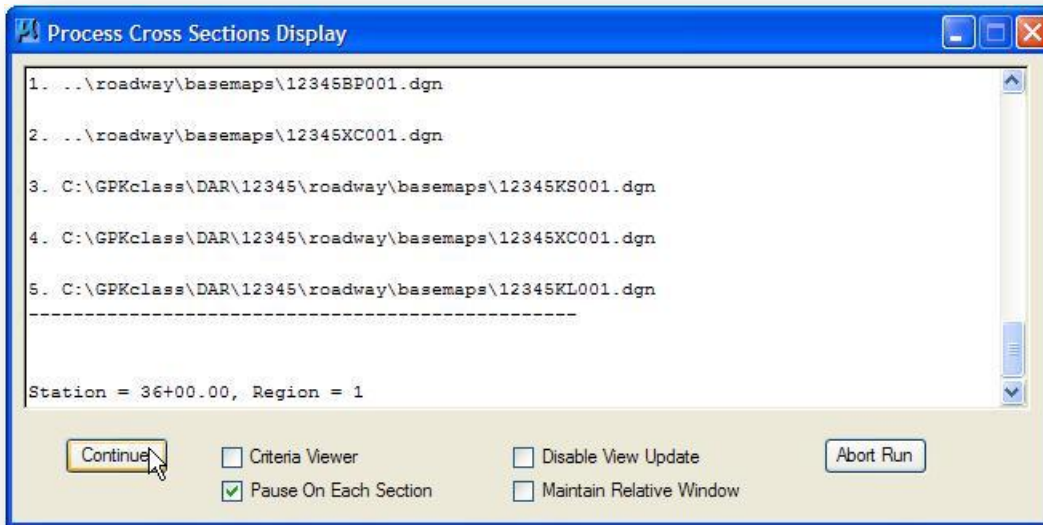
GEOPAK will send information to the screen as the cross sections are processed. This information may also be optionally saved to a **Log File** as shown in the example above.

The **Pause On Each Section** option is used to specify whether GEOPAK should stop after each cross section is drawn.

The **Criteria Viewer** option is used in criteria development and will not be covered in this training guide.

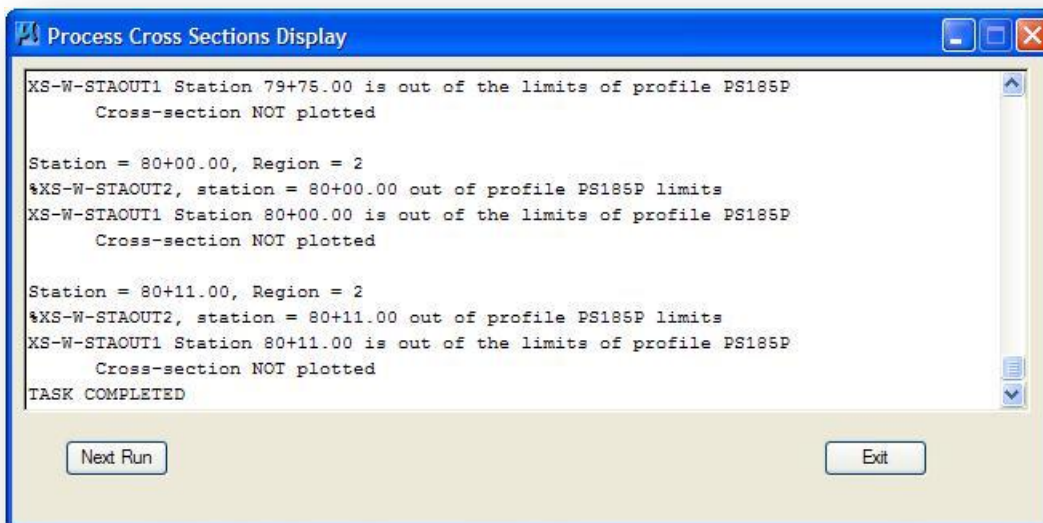
The **Disable View Update** option is used to process the criteria run without displaying the cross section graphics as the sections are processed. This option is useful to speed up processing for long cross section runs.

Select **Apply** to initiate processing of the cross section run. The processing information is displayed in the *Process Cross Sections Display* dialog as shown on the following page.



If the **Pause on Each Section** option is toggled on, pressing **Continue** will process the next cross section. Select **Abort Run** to end the processing.

After all of the cross sections have processed, select **Next Run** to return to the *Proposed Cross Sections* dialog or select **Exit** to end the proposed cross sections routine.



Normally, the cross-sections will be run several times in order to produce the desired results. When GEOPAK draws proposed features on large numbers of cross-sections, the files get large very quickly. Practicing good file maintenance will allow the user to process the sections faster, and use a minimum amount of space on the computer. Here are a couple of tips to facilitate processing criteria:

- ✓ Delete the proposed features before re-running the criteria. Don't just write on top of the last run. Be careful not to delete the GEOPAK cells (level `GK_Cells`), the existing ground line (level `XS_X_Ground_Line`), or any underground utilities.

- ✓ At the end of a session, use the MicroStation Compress command.
- ✓ If the results of the criteria run are undesirable, you can use the MicroStation **Undo** command to clear out only the proposed cross section graphics that were placed during the criteria run.

Tip:

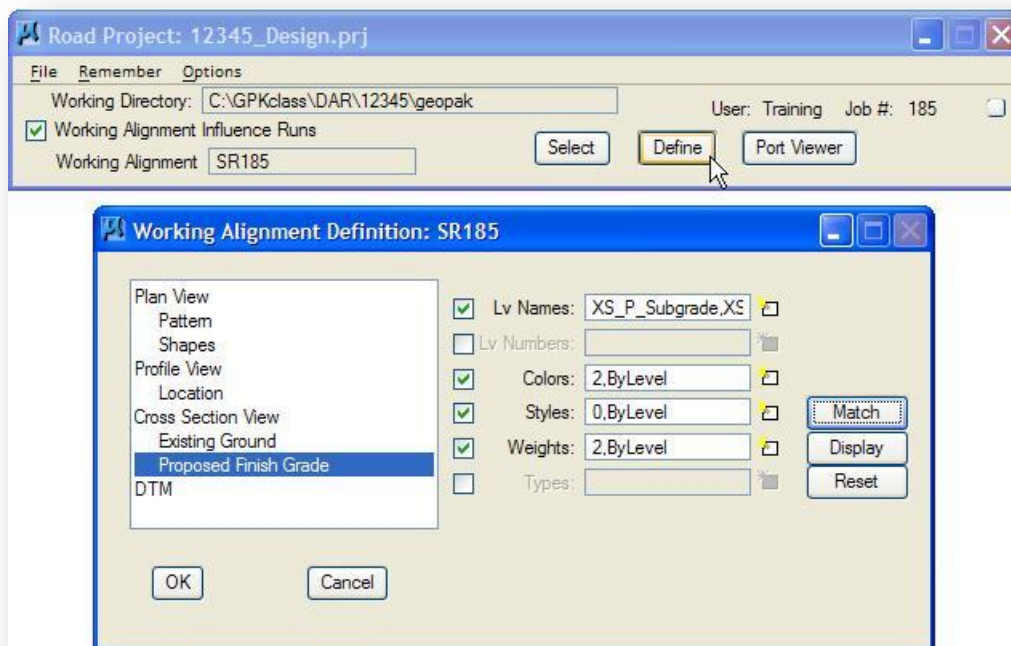
To facilitate deleting proposed cross section elements after a criteria run, without deleting previously drawn cross section elements, use the MicroStation Lock command to lock elements in the cross section design file that you do not want to delete before processing the proposed cross sections.

First select the desired elements, and then select **Edit > Lock** to lock the selected elements.

Now you can use the **Select All** command to select all the elements in the design file, and then use the **Delete** command. The locked elements will not be deleted.

5.11 Updating the Working Alignment Definition

The symbology for the proposed cross sections graphics is defined in the criteria files to meet the standards defined in the ODOT CADD Engineering Standards Manual. The symbology of the elements that make up the proposed finish grade must be added to the **Working Alignment Definition**. Select **Define** from the *Road Project* dialog to access the *Working Alignment Definition* dialog shown below.



The **Proposed Finish Grade** item supports options to specify the element symbology of the proposed cross sections. Simply toggle on the desired parameter, then press the **Match** button.

The elements which comprise the **Proposed Finished Grade** are placed on the following levels when using ODOT's criteria files:

```
XS_P_Ditch_Bottom
XS_P_Finished_Grade
XS_P_Subgrade
```

EXERCISE 5A - Criteria Processing using Shapes

In this exercise, we will use the following ODOT Standard criteria files to process cross section on S.R. 185:

- ✓ define.x
- ✓ pavt.x
- ✓ xs_label.x
- ✓ sh301-8b.x
- ✓ ss307-4.x

The documentation for the criteria files listed above is available in the following folder:

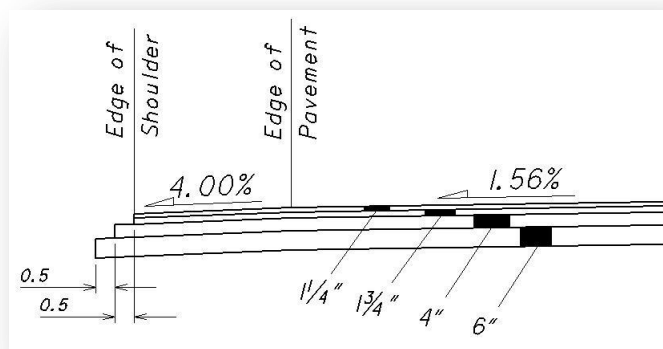
I:\ODOTstd\V8istd\Geopak\Road\criteria\Doc

After you have reviewed the criteria documentation, answer the following questions:

1. What is the role of define.x ?
2. What is the inclusion sequence for the criteria files listed above?

Side Slope LT	Side Slope RT
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____

3. Given the pavement buildup below, answer the following questions:



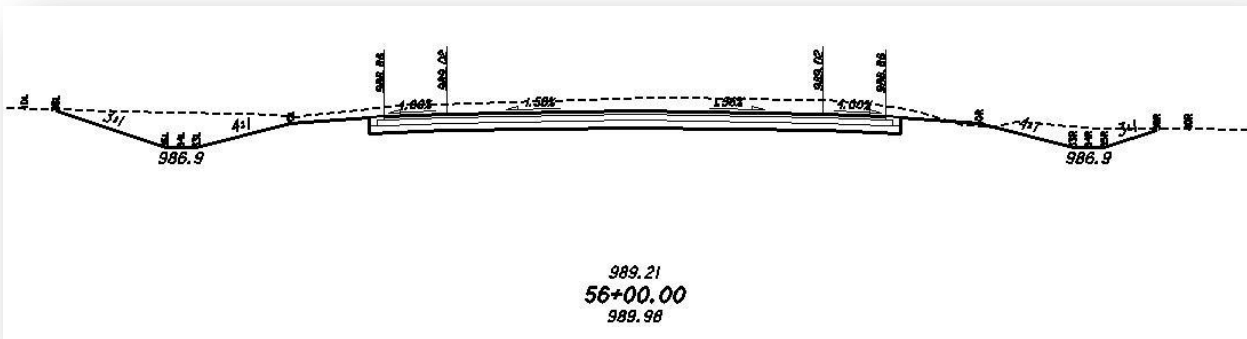
Pavement Layer	Which variable(s) control the thickness of each layer?	What is the default value for this variable?	Which criteria file defines the variable?
Layer 1			
Layer 2			
Layer 3			
Layer 4			

4. Which criteria file defines the values for the shoulder layer thicknesses?
5. Which criteria file defines the values for the shoulder step widths?

Pavement Layer	Which variable(s) control the shoulder step widths?	What is the default value for this variable?	Which criteria file defines the variable?
Layer 1			
Layer 2			
Layer 3			
Layer 4			

6. Which variable is used to control the size of the text annotations placed on the cross sections?
7. Process the cross sections for S.R. 185 from station 53+00 R 1 to station 77+50 R 2 using the criteria files and pavement buildup shown on the previous page.
8. Update the **Working Alignment Definition** to include information for the **Proposed Finished Grade**.

An example of a finished cross section is shown below.



5.12 Shapeless Criteria Processing

GEOPAK pavement shapes are used to define the lane widths, pavement cross slope and superelevation transition stations for the proposed pavement. In some cases, such as a pavement resurfacing project where the existing pavement cross slopes will be maintained, it is desirable to develop criteria files that do not rely upon pavement shapes. Some of ODOT's standard criteria files are designed to operate in **Shapeless** mode. See the criteria file documentation to determine how each file operates.

5.12.1 5.11.1 What Is Needed To Process Shapeless Criteria?

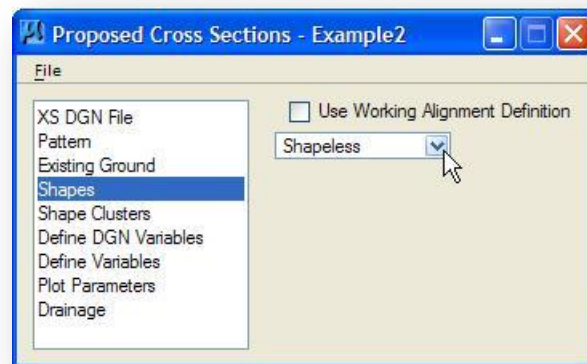
Before Processing Shapeless Criteria the following items must be defined:

- ✓ A COGO chain representing the alignment to be processed.
- ✓ A Vertical Alignment.
- ✓ Pattern lines defining the location of the cross sections.
- ✓ Existing ground cross sections.
- ✓ Criteria files.
- ✓ Plan view graphics representing the design features the criteria files need for processing.

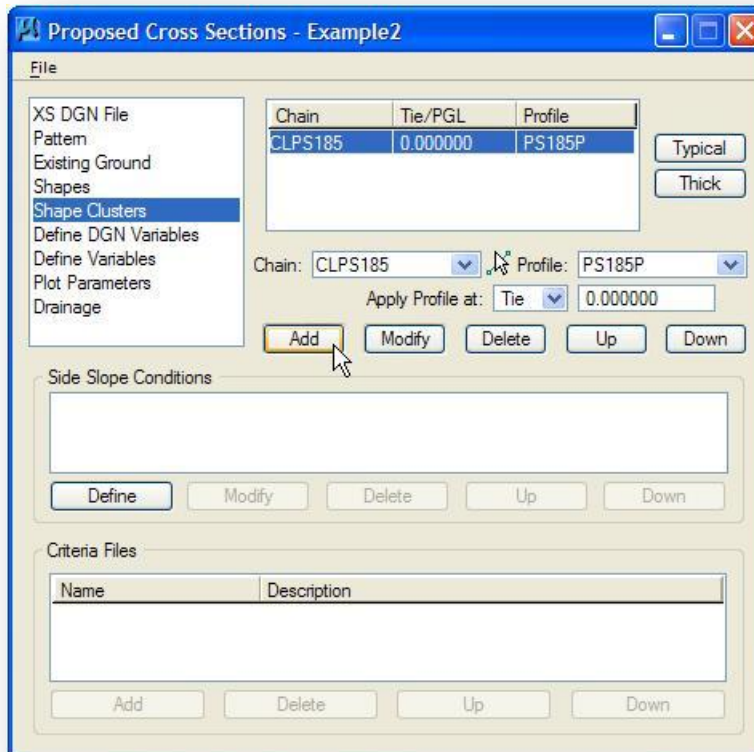
5.12.2 Processing A Shapeless Criteria Run

Processing a shapeless criteria run is almost identical to processing criteria using pavement shapes as described in section 5.9. When processing shapeless criteria, all the dialog functions should be completed as described in section 5.9 with the exception of the **Shapes** and **Shape Clusters** items.

Toggle the **Shapes** item to **Shapeless** mode as shown above to specify that you wish to process a shapeless criteria run.



When processing shapeless criteria, the **Shape Clusters** item is used to identify the **Chain** and **Profile** that will be used for processing and to identify the criteria files to be used.



In shapeless mode, the chain and profile name list boxes are used to identify the **Chain** and **Profile** that will be used for processing.

- ✓ Choose the chain from the COGO database that you wish to use for this criteria run.
- ✓ Select the profile that you wish to use for the criteria run.
- ✓ Set the **Apply Profile at:** option to the desired value.

After you have identified the **Chain**, **Tie** and **Profile** to be used for the criteria run, select the **Add** button to add this information to the *Proposed Cross Sections* dialog as shown above.

The remaining components of the *Proposed Cross Sections* dialog should be completed as described in Section 5.9.

Exercise 5B – Shapeless Criteria Processing

In this exercise we will process the ODOT criteria file pavt_exist.x in shapeless mode to draw the existing pavement on the cross sections.

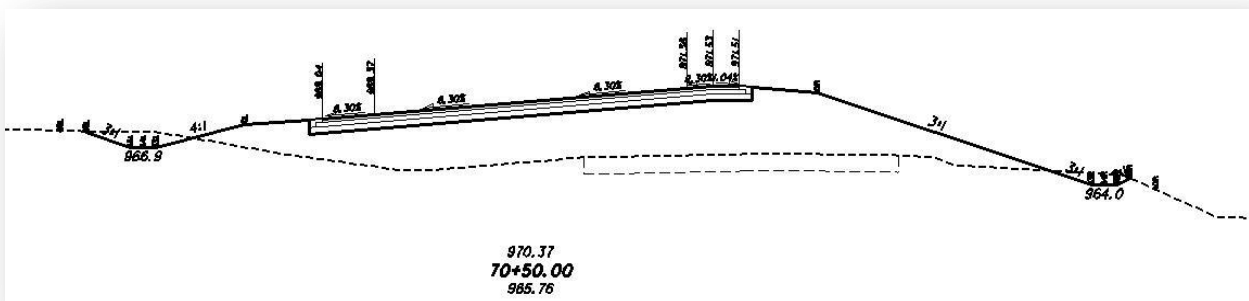
The documentation for pavt_exist.x is available online at the following URL:

<http://www.dot.state.oh.us/Divisions/Engineering/CADDMapping/CADD/Pages/Criteria.aspx>

After you have reviewed the criteria documentation, create a new proposed cross section run to draw the existing pavement with the following parameters:

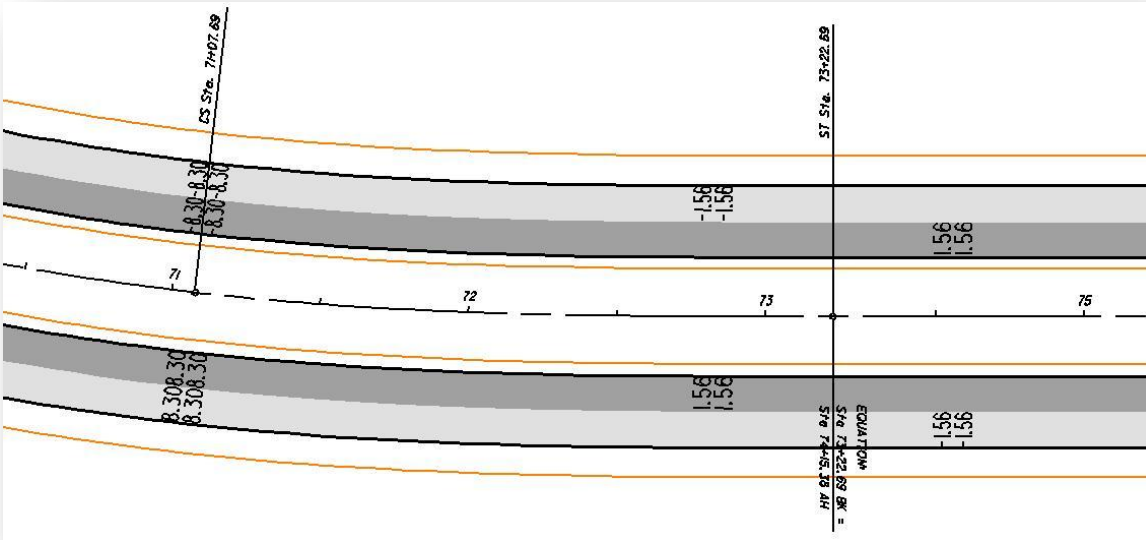
- Use a pavement thickness of 1.25”.
- Process all the cross sections (do not put any station limits on the criteria conditions)
- In order to draw the existing pavement on all the sections, which profile should you use for processing?

An example of the completed cross section is shown below.



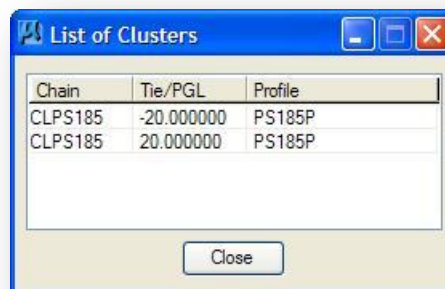
5.13 Processing Multiple Shape Clusters

Divided highways are represented by multiple shape clusters defining the left and right roadways. An example of the shape clusters for a divided highway with a 40' median is shown below.

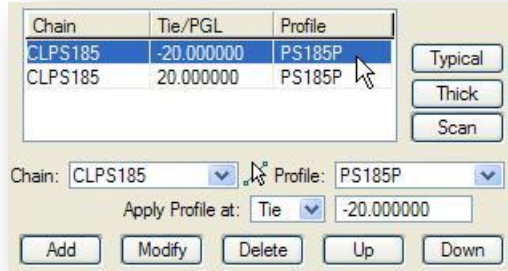


In this example, the same Chain and the same Profile are used for both the left and right shape clusters. The profile is applied on the inside edge of pavement for each shape cluster. The left shape cluster has a **Tie** value of -20. The right shape cluster has a **Tie** value of 20.

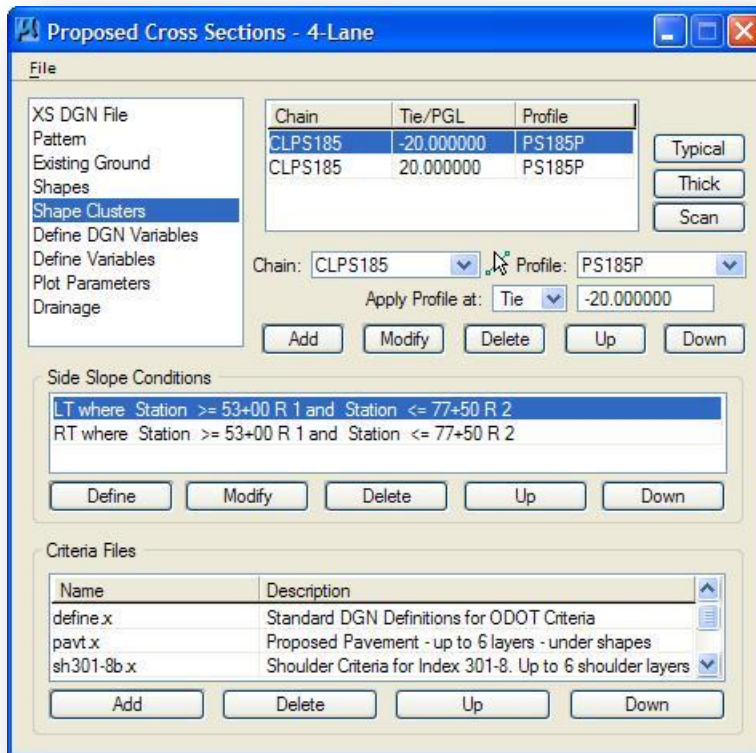
The **Shapes** item in the *Proposed Cross Section* dialog has been defined as **All in DGN**. Selecting the **Scan** button reveals two shape clusters as shown in the *List of Clusters* dialog below.



GEOPAK process all cross sections by starting on the left side of the left most shape cluster. When adding the shape clusters to the *Proposed Cross Sections* dialog, be sure to add them to the dialog so that the left most cluster is listed first as shown on the following page.



The next step is to define the criteria files that will be used on the left and right side of each shape cluster as shown in the example below.



The complete list of criteria files for this example is defined as shown on the following page:

Criteria for Shape Cluster

```

shape cluster baseline = CLPS185
shape cluster profile  = PS185P
shape cluster tie      = -20.000
side slope LT where Station >= 53+00 R 1 and Station <= 77+50 R 2
  include I:\V8std\Geopak\Road\criteria\define.x
  include I:\V8std\Geopak\Road\criteria\pavt.x
  include I:\V8std\Geopak\Road\criteria\sh301-8b.x
  include I:\V8std\Geopak\Road\criteria\ss307-4.x
  include I:\V8std\Geopak\Road\criteria\xs_label.x

side slope RT where Station >= 53+00 R 1 and Station <= 77+50 R 2
  include I:\V8std\Geopak\Road\criteria\pavt.x
  include I:\V8std\Geopak\Road\criteria\sh301-8b.x

```

Criteria for Shape Cluster

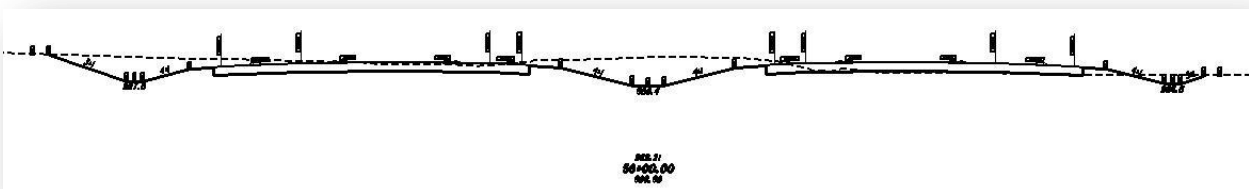
```

shape cluster baseline = CLPS185
shape cluster profile  = PS185P
shape cluster tie      = 20.000
side slope LT where Station >= 53+00 R 1 and Station <= 77+50 R 2
  include I:\V8std\Geopak\Road\criteria\pavt.x
  include I:\V8std\Geopak\Road\criteria\sh301-8b.x
  include I:\V8std\Geopak\Road\criteria\med304-1.x

side slope RT where Station >= 53+00 R 1 and Station <= 77+50 R 2
  include I:\V8std\Geopak\Road\criteria\pavt.x
  include I:\V8std\Geopak\Road\criteria\sh301-8b.x
  include I:\V8std\Geopak\Road\criteria\ss307-4.x

```

An example of the completed cross section is shown below.



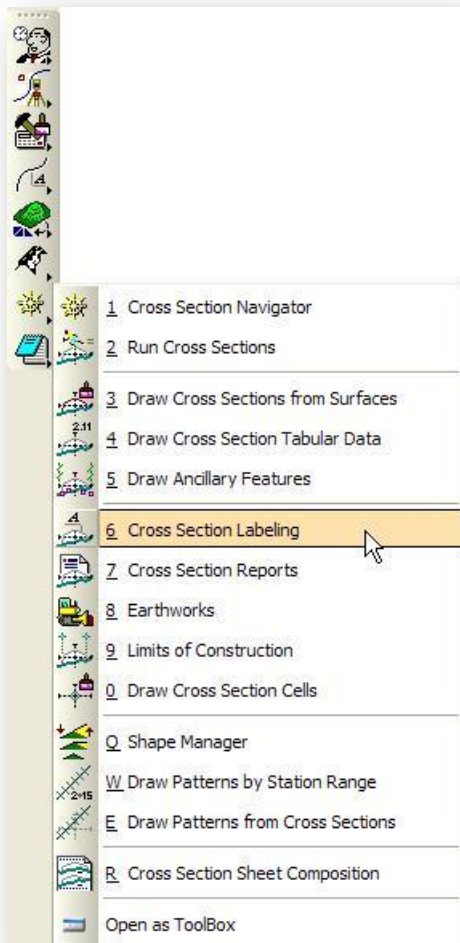
6 Cross Section Labeling

6.1 Overview

The **Cross Section Labeling** tool is used to automate the composition and placement of cross section labels. This interactive tool permits the creation of very simple to complex labels using many of the following features:

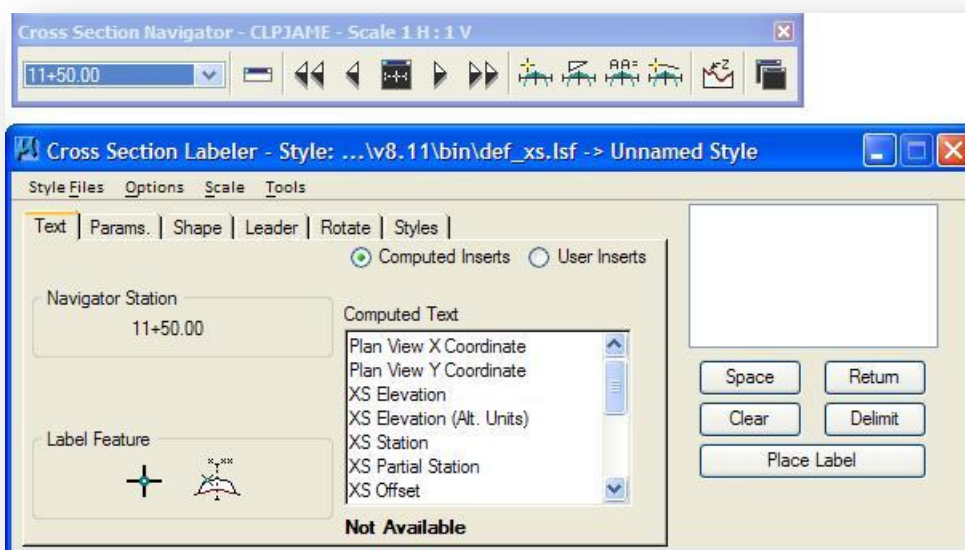
- Numerous **Computed Text Inserts** permit standardized computed values to be incorporated into labels. These standardized computed values are based on the type of element to be labeled and change as different elements are selected by the user. Types of elements available for computed inserts include points, lines, arcs, complex graphic elements, COGO features, and drainage features.
- **User Text Inserts** allow user defined text strings to be included in the label. These User Inserts can be customized to allow frequently used labeling terms to be saved for repeated use.
- Standard shapes can be placed around.
- Standard leader lines and leader line terminators can also be used to create the desired label formats.
- Frequently used labels can be stored as **Label Styles** for subsequent recall. The complete label, including computed text inserts, user inserts, shapes, and leaders, are all stored within the Style.
- Tools to edit, move, and extract labels are also provided to make manipulation and plan changes easier.

The *Cross Section Labeler* dialog, shown on the following page, is accessed by selecting **Applications > GEOPAK Road > Cross Sections > Labeling** from the MicroStation menu bar or from the *Road* tool palette as shown on the following page.



When **Cross Section Labeling** is selected, the *Cross Section Navigator* and the *Cross Section Labeler* dialogs shown below are opened.

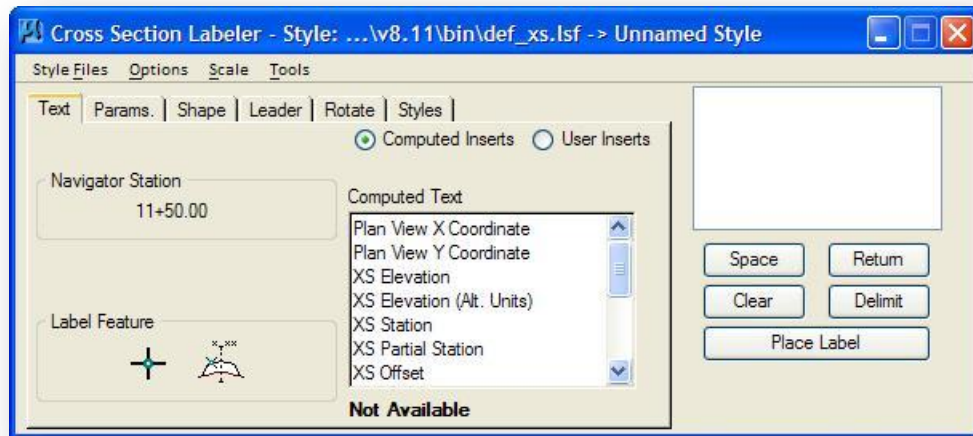
For details on the **Cross Section Navigator**, see page 2-26.



6.2 The Cross Section Labeler Dialog

6.2.1 Text Options

The first tab within the Cross Section Labeler dialog is the **Text** option.



Navigator Station (display only)

This displays the current cross section station for which the computed inserts are to apply. To navigate through the cross sections, use the **Cross Section Navigator**. See Chapter 2, section 2.6, Cross Section Navigator, for a complete description of the Cross Section Navigator tool.

Label Feature

Two options are available to label individual data points, or cross section elements, as described below.

Data Point Location



This option is used to place labels corresponding to a single data point location, such as a station and offset. Press this button, then issue a data point on the screen to identify the point to be labeled.

Select XS Element



This option is used to label cross section elements, such as the length of a cross section segment. Press this button, then select the GEOPAK or MicroStation element to be labeled.

The power of the labeling tools is their use of computed text inserts. Based on the element type being labeled (i.e., point or line), there are numerous values which can be computed and included in a label. Once these inserts are added to a label, these values are automatically recomputed for subsequent elements identified.

Computed Inserts or User Inserts

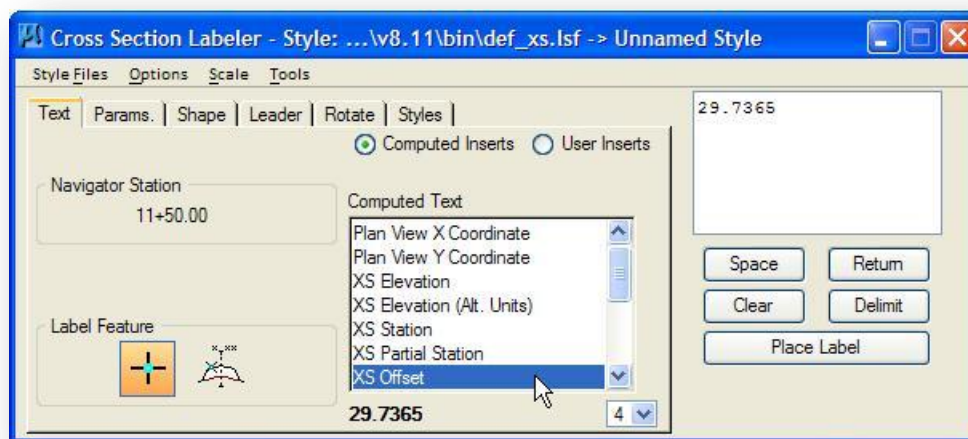
Two options are supported: **Computed Inserts** and **User Inserts**. The Computed Inserts are values computed by the labeler for various elements such as points, lines, arcs, the GEOPAK coordinate geometry database, or drainage features. The **User Inserts** are user defined ASCII files containing commonly used words. In lieu of typing, the user simply selects the word from the list.

Computed Inserts

Based on the element type being labeled, a list of available inserts that can be computed for the element will be displayed. This list will change depending on whether the **Identify Element Data Point Location** or **Select XS Element** button has been selected.

To use a **Computed Insert**, first highlight the desired variable. The computed value is then displayed in the field below the list of text inserts. If the value cannot be computed because of missing information or computing error, the value will be shown as "**Not Available**" or "**Error**".

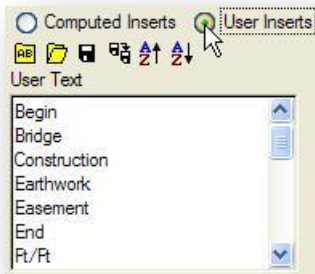
Double-clicking the **Computed Insert** adds it to the label at the current cursor position in the label editing field at the upper right portion of the dialog. **Note:** The number of decimal places for the label must be selected before double-clicking the **Computed Text** item.



Note: If the value of a computed text insert is manually edited, it loses the intelligence of a computed label, becoming inserted text.

User Inserts

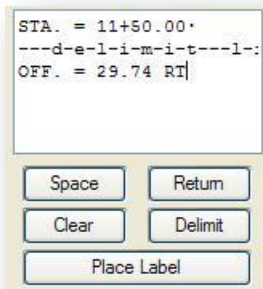
If the **User Inserts** toggle is active, the dialog displays a list of commonly used words stored in a user defined file. Each line of the file is one word or phrase followed by a space. In this way, when two words are placed together by successive data points, a space is placed between them. Several ASCII text insert files are located in the default GEOPAK directory. There is no limit to the number of text insert files that can be developed by the user. However, they may only be used one at a time.



User Insert Options

When the **User Insert** toggle is active, the icons for file manipulation are displayed. The far left icon edits the current text file, while the second icon opens an insert file. The third icon (disk) saves the current file, while the fourth icon is the Save As... option. The last two icons sort the current insert file in ascending or descending alphabetical order.

Label Edit Field



The **Label Edit Field**, located in the upper right portion of the dialog, reflects the text in the current label. Labels can be constructed by any combination of **Computed Text**, **Inserts**, **User Inserts**, or manually typed text strings.

Space

Press to add a **Space** within a label. A single space is added with each pressing of the button.

Return

Press to add a **Return** within a label and move to the next line down.

Clear

Press to clear the entire label from the label display window.

Delimit

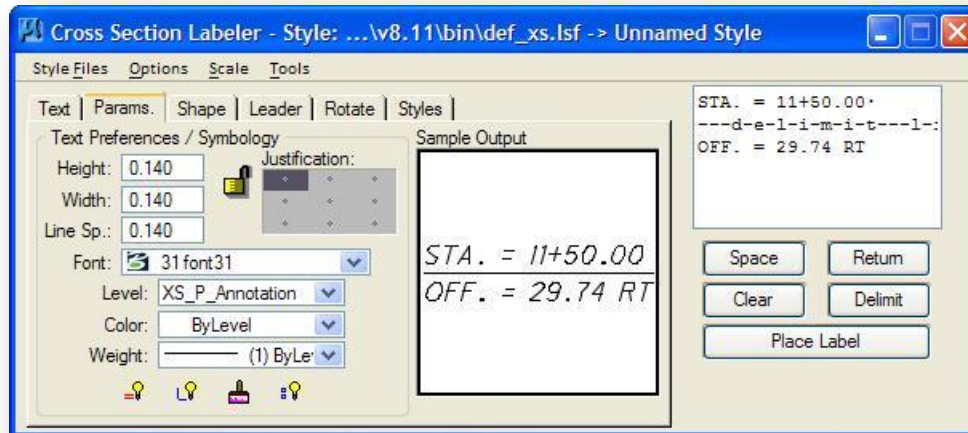
Press to place a delimiter between lines.

Place Label

When the label is constructed and ready to place, press this button, then move the cursor for dynamic placement.

6.2.2 Parameters Options

When the **Params.** tab is selected, the dialog changes dynamically, as shown below, to control the **Text Preferences / Symbology** for the label.



These options are used to set the text parameters and symbology for the label. The four icons at the bottom of the dialog have the following functions.

By Current



Select this icon to have GEOPAK determine the active MicroStation symbology (level, weight, color and style) and populate the dialog accordingly.

By Element



Select this icon to select a previously drawn MicroStation element, and populate the dialog with its element symbology.

By D&C Symbology



Select this icon to use a D&C Manager item to set the element symbology.

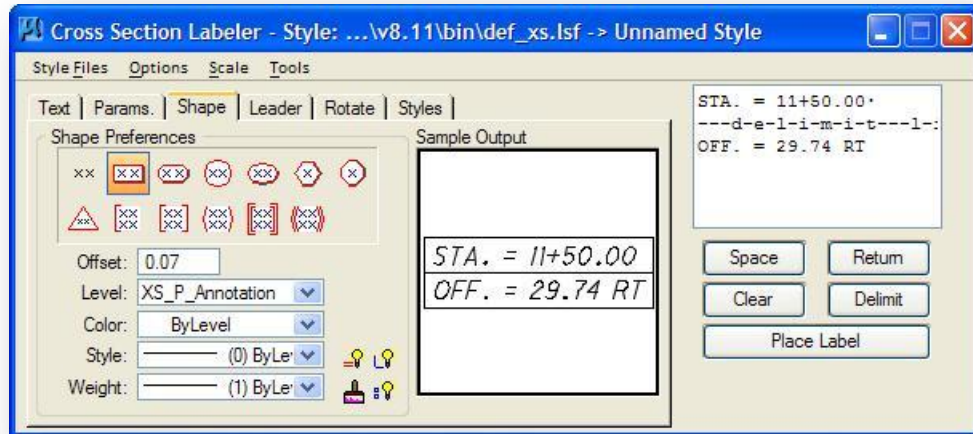
Set All



Select this icon to have GEOPAK read the current settings (level, weight, color and style) within the **Params.** tab, and populate the **Shape** and **Leader** tabs accordingly.

6.2.3 Shape Options

When the **Shape** tab is selected, the dialog dynamically changes as shown below.



Shape Preferences

Several shapes are supported in addition to a shapeless option. Selection of a shape draws the selected shape around the label. The shape is proportional to the size of the label. As the label gets larger, the shape is expanded to fit.

Shape Offset

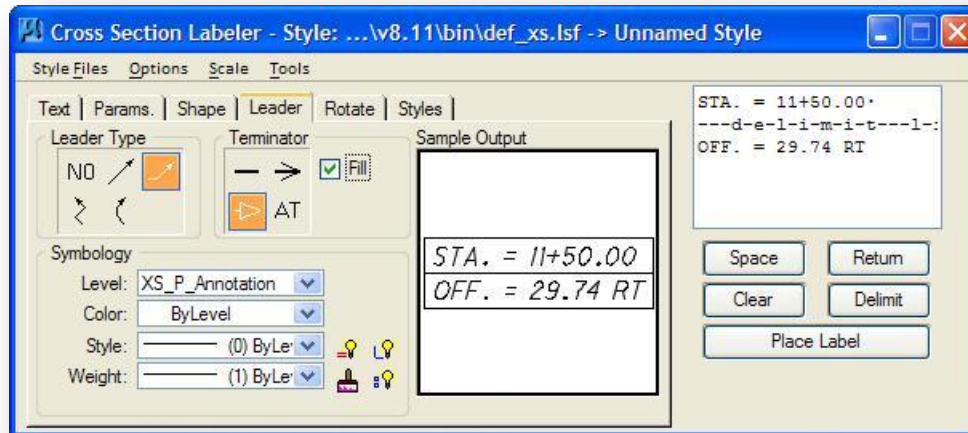
The distance from the edge of the text to the shape

Symbology

Options are provided to set the **Level**, **Color**, **Style** and **Weight** for the shape. The same four icons as described on page 6-6 are available to set the symbology.

6.2.4 Leader Options

When the **Leader** tab is selected, the dialog dynamically changes as shown below to control the type of leader and leader terminator.



Leader Type

Four leader types and a no leader option are supported. Depending on the type selected, the user is prompted for data point(s) to provide maximum flexibility over location of the leader. Each shape has several origination points around the circumference to accommodate leaders.

Terminator

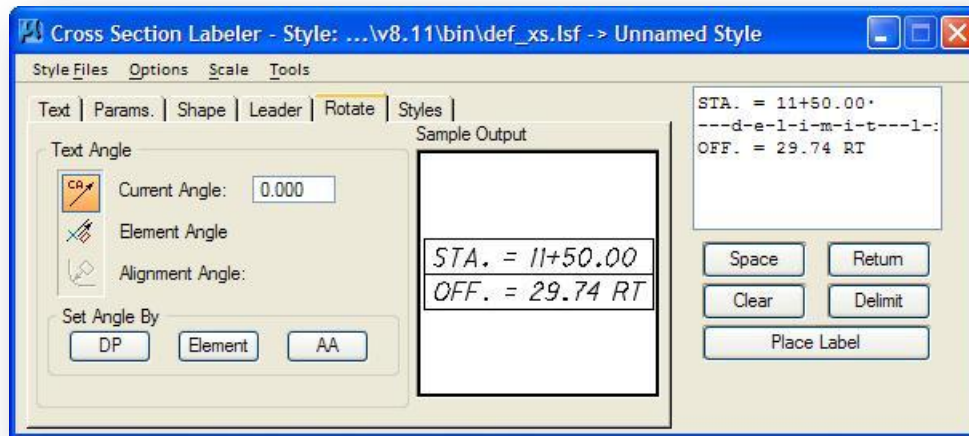
Supported options include no terminator, closed arrow, open arrow, and AT (active terminator). To use the active terminator, the MicroStation line terminator must be defined and the cell library containing the terminator must be attached. If a terminator is selected and no cell library is attached, an Alert message is displayed.

Symbology

Options are provided to set the **Level**, **Color**, **Style** and **Weight** for the shape. The same four icons as described on page 6-6 are available to set the symbology.

6.2.5 Rotation Options

When the **Rotate** tab is selected, the dialog dynamically changes, as shown below, to set the rotation options for the label. Note that these commands can also be issued from the Label Control tool frame before or during label placement.



Current Angle

Select this icon to place a label at the current angle.

Element Angle

Select this icon to set the label angle according to the angle along a MS graphic element.

Alignment Angle

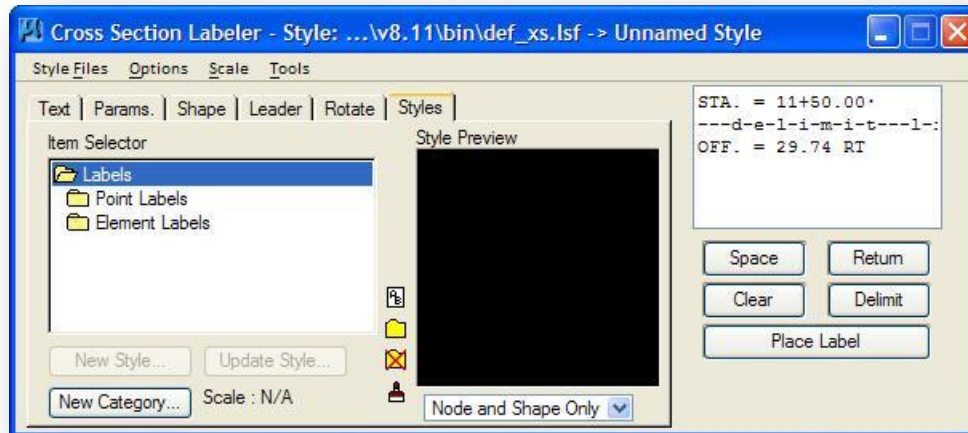
Select this icon to rotate a label, either before or during placement, at an angle relative to a Chain. This icon is used by the **Plan View Labeler** only and is not available for the cross section labeler.

Set Angle By

Three options are supported: **DP**, **Element** and **AA** (Active Angle.) These buttons are used in the **Text Angle** commands above.

6.2.6 Styles Options

When the **Styles** tab is selected, the dialog dynamically changes as shown below to create a new label style, or modify or reuse previously defined Label Style.

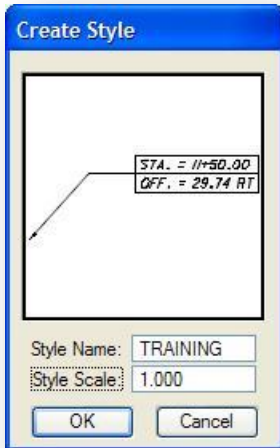


One of the most useful tools of the labeler is its ability to store labels. The computed and text inserts, shapes, leaders, element and text parameters of the label can all be stored under a unique name enabling the user to create a complete library of labels to use in subsequent sessions. The styles are stored in *.lsf files. Some default files for cross section (def_xs.lsf) are delivered with the GEOPAK software.

New style files can be created, opened, and saved via the **Style Files** pull-down in the upper left corner of the main dialog. With each Style file, a hierarchical system is employed to easily and quickly organize and subsequently locate the desired label styles. The user has complete control over the naming of categories and labels within each category. Several utilities are supported within the dialog for creating, editing, and renaming styles, which are detailed below. Invoking these utilities can be accomplished via icons or push buttons.

New Style

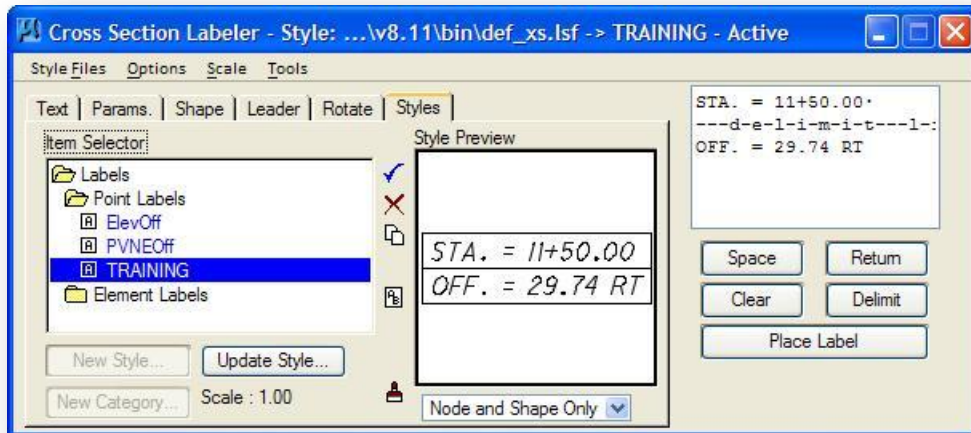
To create a new style, begin by creating and placing the label. The label can be a copy or modification of another style, or a totally new label. Once the label is placed, highlight the folder where the new style is to be stored. Once a folder is highlighted, the new style button is un-ghosted. Next, press the New Style button, which invokes the Create Style dialog shown on the following page.



Type in the values for the **Style Name** and the **Style Scale**. The **Style Scale** should be set according to the **Text Size** entered in the **Text** tab. In the example, the text height and width were set to a value of 0.14 master units. When the label is recalled for placement, the scale for the cross sections can be set within the *Cross Section Labeler* which will be applied to the **Style Scale** to determine the text size for the placed labels.


Select **OK** to add the style to the current Style File as shown in the dialog below.

To use a style that has already been stored in a Style File, simply select the style name, select either the **Data Point Location** or **Select XS Element** icon on the **Text** Tab, identify the data point location or MicroStation element to be labeled, and then select **Place Label** to place the label.




Once a Style item has been selected, icons are available for the following functions.


Select Style Item

-  Pressing this icon makes the highlighted style the active style.


Delete Style Item

-  Pressing this icon deletes the current highlighted style.

Copy Style Item


-  Select the style to be copied, and then press the **Copy Style Item** icon. A copy of the style is created.

Rename Style / Category


 To rename a style or category, simply highlight the item to be renamed, and then press the Rename icon, invoking the dialog below.

Change the name, and then press the **OK** button. The display list is dynamically changed to reflect the new name.

Refresh Style List


 To refresh the Style List, simply press the **Refresh** icon.

Create Style Category

 This icon is available if a Category is selected in the **Item Selector** list box. To create a new category, simply press the **Create Style Category** icon, invoking the dialog below.

Type in the name of the new category, and then press the **OK** button. The category is added to the bottom of the label list.

Delete Style Category

 This icon is available if a Category is selected in the **Item Selector** list box. To delete a category, simply select the category and then press the **Delete Style Category** icon.

Update Style



After modifying a style, the user may want to save the current modifications. Simply press the **Update Style** button to invoke the dialog depicted below. Both **Before** and **After** labels are shown, so the user can easily discern the changes.

Important: Before you can save a label you must first place the label in the design file. The **New Style** button will remain ghosted until you place the label. To save the label in the style file select the category where the label is to be stored, press the **New Style** button, assign a new name and scale, and save.

6.2.7 Pull-Down Menu Options

The *Cross Section Labeler* menu bar options include:

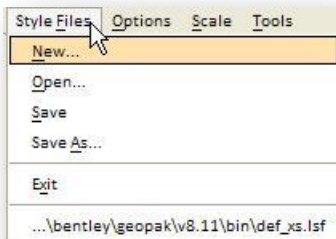
Style Files - file utilities to create, open and save stored Style files containing label layouts.

Options - user definable options for tool and dialog control over labeling functions.

Scale - proportionalizes any label in addition to displaying the current scale.

Tools - Currently only one tool is supported, **Label Updater**. It updates any label containing computed text inserts as per user options (i.e., all labels, those within a fence, etc).

Style File Options



In order to un-ghost the entire Style Files pull-down menu, the tab must be set to **Styles**. Styles are layouts of commonly used labels, each stored with a user-defined name, leaders, computed text inserts, etc., for easy retrieval. These are stored in *.lsf files which default to the ...geopak\bin directory. Standard options are provide to create **New** style files, **Open** existing files, **Save** or **Save As** style files.

Options



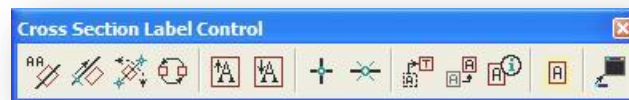
The options below are supported under the **Options** pull-down menu.

Minimize Dialog

When the **Place Label** button on the main dialog is pressed, toggling this option will minimize the main labeling dialog to allow for easier label placement.

Label Tools

The Label Control tool frame contains a variety of useful tools during the actual placement of labels. It is resizable and dockable, so it can be open, yet out of the way during placement. As it is an independent tool frame, the main labeler dialog can be minimized while the Label Control is active. The twelve tools are detailed below.



Rotate Label to Active Angle

Select this tool to rotate a label, either before or during placement, to the active angle.



Rotate Label By Element Angle

Use this tool to rotate a label to the angle of a selected MicroStation graphic element.



Rotate Label by Two Data Points

Use this tool to rotate a label to an angle between two data points.



Rotate Label 180

Use this tool to rotate a label 180 degrees from the current rotation of the label.



Increase Text Size

Each press of this button increases the text size of the dynamic label by the scale specified in the dialog.



Decrease Text Size

Each press of this button decreases the text size of the dynamic label by the scale specified in the dialog.



Data Point

This button is a shortcut for the **Data Point Location** button located on the main dialog.

**Identify Element**

This button is a shortcut for the **Select XS Element** button on the main dialog.

**Edit Label**

Once a label has been placed with any of the GEOPAK labelers, it can easily be edited. Select this button, and then select the label to edit. GEOPAK populates the dialog, including all tabs, with the information on the selected label. The label can be modified as desired, then placed again.

**Move Label**

Once a label has been placed with any of the GEOPAK labelers, it can be easily moved. **Note:** The data points for any leader lines are not retained and must be placed again.

**Extract Label**

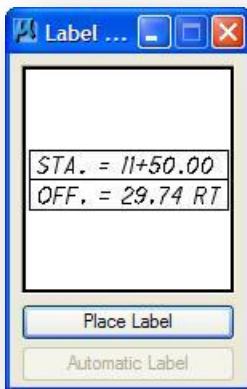
To place several labels similar to a previously placed label, the user does not have to know the style, sizes, etc. Select this button, and then the label from which to extract. GEOPAK loads the style, and all required element and text parameters into the dialog.

**Place Label**

This button is a shortcut for the **Place Label** button on the main dialog.

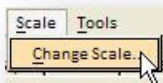
**Restore Label Dialog**

When the main dialog is minimized, pressing this button restores the main dialog to full size.

Label Viewer

When the **Label View** option is active, the *Label View* dialog is always visible on the screen. When the **Minimize Dialog** option is activated, the *Label View* dialog at left is invoked whenever the **Place Label** button in the main dialog is pressed. A single label can be placed by pressing the **Place Label** button (if not already pressed in the main dialog), then a data point is placed at the desired location. The **Automatic Label** option is only supported when the sample label includes computed text inserts. When the **Automatic Label** button is pressed and a data point is selected, the placed label includes the updated computed text inserts in the same style as the original label.

Scale



When **Scale > Change Scale** is selected, the dialog shown below is opened.



This tool allows labels to be scaled from their original creation scale. For example, if a label was created with a text scale of one (TH = 0.14, TW = 0.14) and is to be used on 5 scale cross section sheet, changing the scale from one (1) to 5 would set the size of all the items contained in the label to the correct scale.

Tools



The options under the **Tools** pull-down menu are not supported by the *Cross Section Labeler*.

7 Earthwork Quantities

7.1 Overview

GEOPAK provides the capability to calculate earthwork quantities from cross section elements or from DTM volume differences. In this training class, we will focus on generating earthwork quantities from the final cross sections.

In order to compute earthwork, GEOPAK requires:

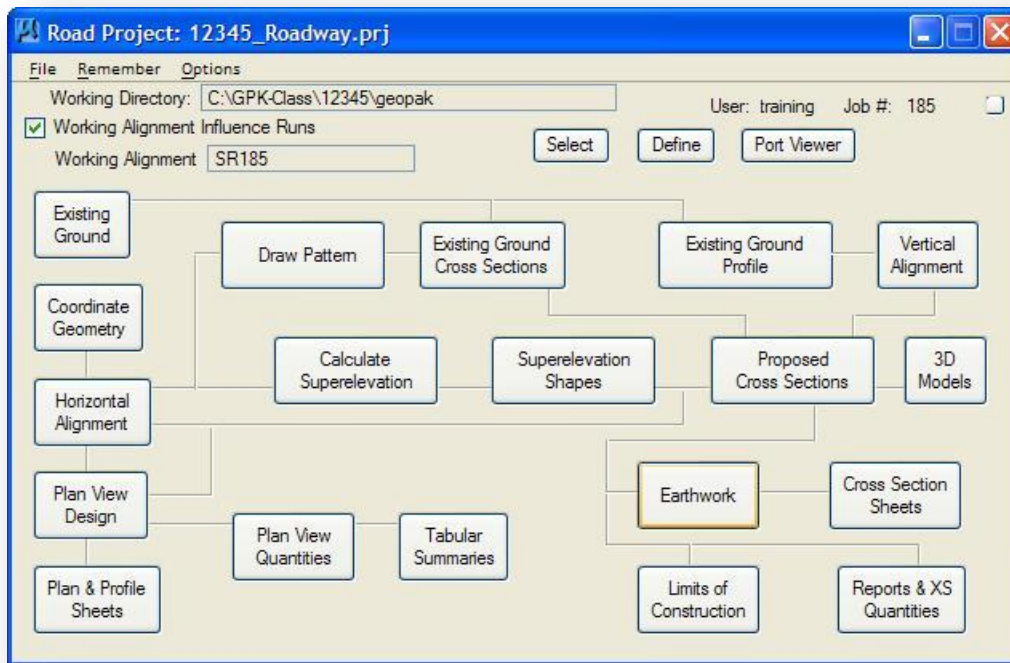
- A MicroStation design file containing proposed cross-section and existing ground lines
- A GEOPAK job number and baseline (only required if the baseline has station equations)

GEOPAK computes earthwork using the average end area method by reading and interpreting the areas between the existing ground and the proposed finished grade on the cross sections. This approach affords the user maximum flexibility in that it is immaterial 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.

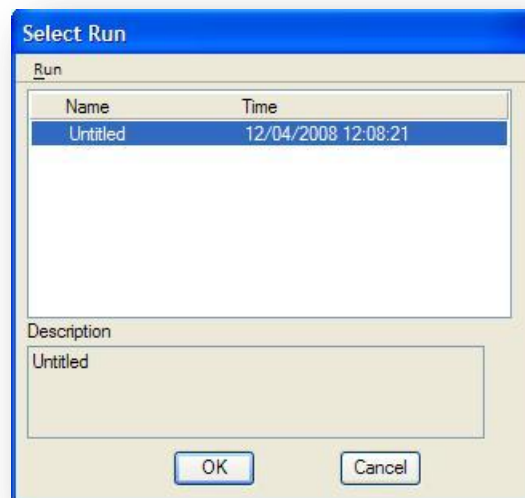
GEOPAK is extremely flexible when computing earthwork, using several types of excavation and fill, numerous material types (known as soil types), and different shrink/expansion factors. In order to tell the software how to compute earthwork, a thorough understanding of these concepts is necessary.

7.2 Creating an Earthworks Run

From the *Road Project* dialog box, select **Earthwork** to access the *Select Run* dialog box shown below.

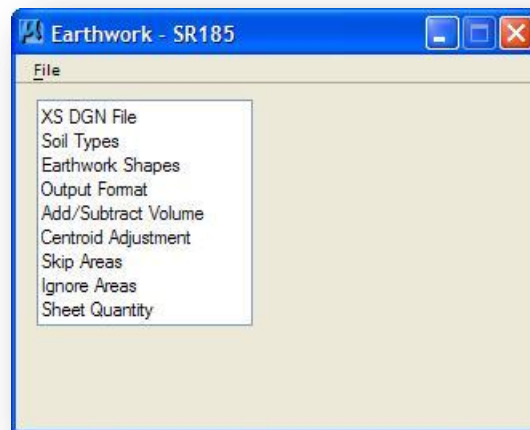


By default, a run named **Untitled** is always created. To create a new run, select **Run > New...** from the *Select Run* dialog box to access the *New Run Name* dialog box shown on the following page.



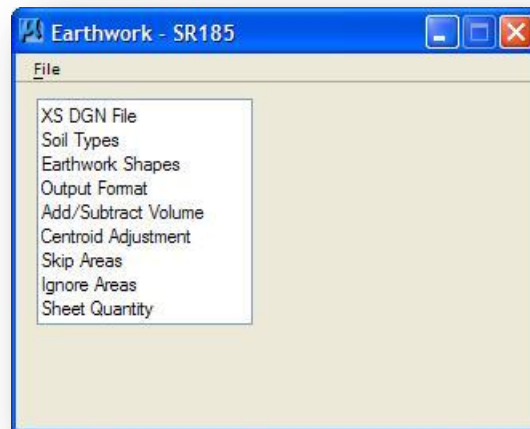


Key-in the **Run Name** and an optional **Description**. Select **OK** to initiate creation of the new run. In the select Run dialog box, select the new run from the list box and then pick **OK** to open the new run. The *Earthwork* dialog box shown below is opened.



7.3 Configuring the Earthwork Dialog Box

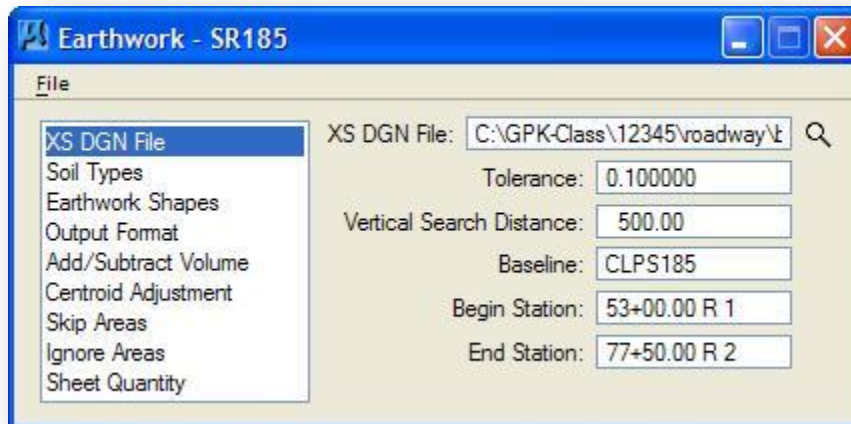
After you have opened an earthwork **Run**, the *Earthwork* dialog box shown below is displayed.



Select an item from the list box on the left side of the dialog to access the various parameters of the earthwork run. A description of the items in the *Earthwork* dialog box can be found in the following sections of this document. See the GEOPAK documentation for additional information.

7.3.1 XS DGN File

When **XS DGN File** is selected, the dialog will change as shown below:



If you have set up a **Working Alignment Definition** with the GEOPAK Project Manager, the following information is taken from the currently selected **Working Alignment** and automatically placed in the Earthwork **XS DGN File** dialog box:

XS DGN File - The name and location of the design file containing the cross sections.

Baseline - The name of the Chain representing the Horizontal Alignment.

Begin Station - The beginning station of the cross sections found in the specified **XS DGN File**.

End Station - The ending station of the cross sections found in the specified **XS DGN File**.

The remaining items are given default values as described below:

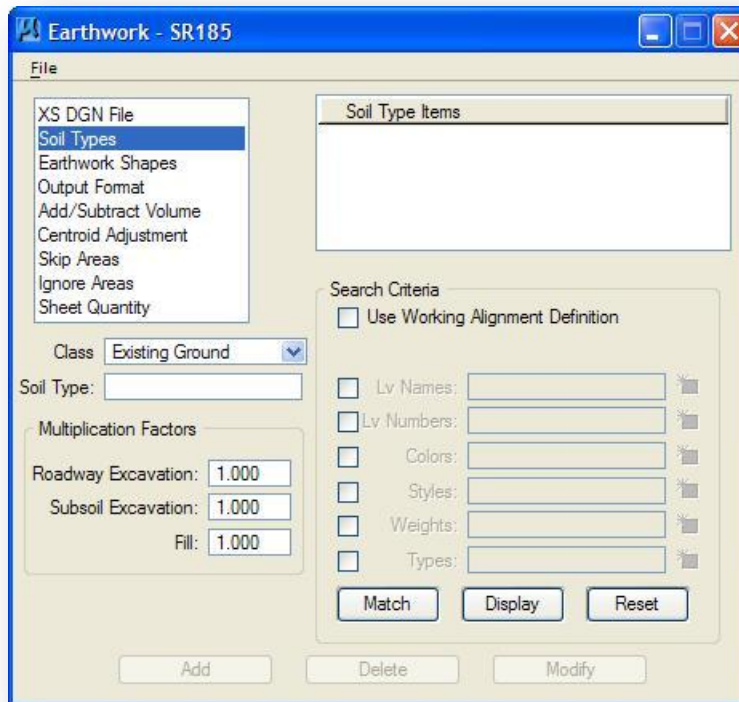
The **Tolerance** item defines the maximum distance between the endpoints of two MicroStation elements for them to be considered connected.

The **Vertical Search Distance** is used to define how far above and below each cross section axis GEOPAK will search for MicroStation elements that make up each individual cross section. By default, GEOPAK places existing ground cross sections horizontally 1000 master units and vertically 500 master units apart. These values are specified when the existing ground cross sections are initially generated.

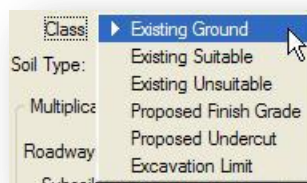
Note: If you elected to change the value for the **Distance Between Cross Sections Vertical** item when you generated the existing ground cross sections, it will be necessary to assign the same value for the Earthwork **Vertical Search Distance** item.

7.3.2 Soil Types

When the **Soil Types** item is selected, the dialog box will change as shown below:



The **Soil Types** portion of the *Earthwork* dialog is used to define any number of soil types to be computed by GEOPAK. Each **Soil Type** is given a user defined name. At least two **Classifications** are necessary to define a Soil Type. The available Classifications are shown below:



The **Class** is extremely important, as it dictates which **Soil Type** materials are re-used and which materials are not.

Existing Ground

This Class is used to define the elements that comprise the existing ground line. The elements defining the existing ground must be contiguous between the proposed tie down points.

The soil type name specified with the existing ground is important as it is the default excavation material. Only one default cut material may be specified. This material is computed by the software in areas where the proposed finish grade is below the existing ground.

Existing Suitable

Materials defined as this type will be removed down to the proposed subgrade. Any portion of this material that is below the proposed subgrade will be left in place and not tabulated in the earthwork quantities.

Existing Unsuitable

Materials defined as this type will be completely removed. Portions of an Existing Unsuitable material below the proposed subgrade will be removed and backfilled. The areas beneath the proposed subgrade that are to be backfilled will be automatically included in the Fill quantities for the cross section, but are not automatically included in the excavation quantities.

Proposed Finished Grade

For ODOT projects, the proposed finish grade is defined to include the bottom of the proposed pavement, shoulders, curb and gutter, side slopes, top of proposed ditches, etc. The software must be able to contiguously draw from the centerline to the touchdown point using these levels.

The soil type name specified with the proposed finish grade is important as it is the default fill material. Only one default material may be specified. This material is utilized by the software in areas where the proposed finish grade is above the existing ground.

Proposed Undercut

The proposed undercut is used to define undercuts or subcuts. It is important to remember that the soil type name you assign for the proposed undercut is not the material being removed, but what the area will be backfilled with. The material being removed is computed as part of the default excavation unless it is an existing suitable or unsuitable material.

Excavation Limit

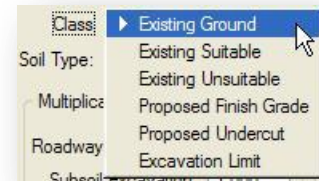
Excavation limits are short lines drawn onto cross sections to tell the software where to stop removing existing unsuitable or suitable material. They have no direct correlation to proposed features, except that the removals normally end at the outside edge of proposed construction.

Excavation limits are required whenever existing suitable or unsuitable classifications are specified. See section 7.6.2 for more information on Excavation Limits.

In this example, we will define a **Soil Type** named “203-EARTH” representing the cut and fill volumes for the cross sections.

The soil type 203-EARTH will be defined by the existing ground and the proposed finished grade. Take the following steps to define the Existing Ground:

- ✓ Select **Existing Ground** from the **Class** drop down menu as shown at right.

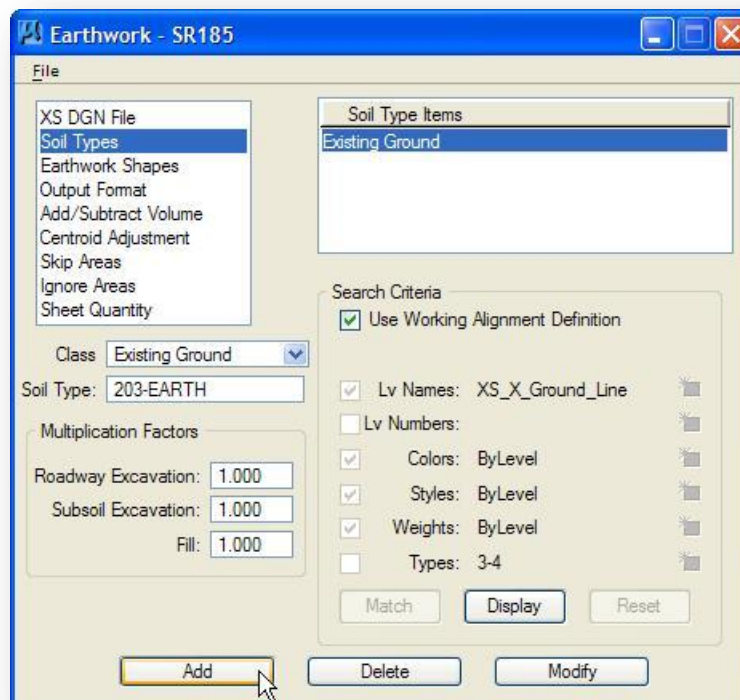


- ✓ Key-in the **Soil Type** name 203-EARTH

- ✓ Toggle on the **Use Working Alignment Definition** item under the **Search Criteria** section of the dialog box, as shown below. The **Criteria Status** section in the lower right portion of the dialog box is updated to reflect the values assigned in the current **Working Alignment Definition** for the **Existing Ground**.

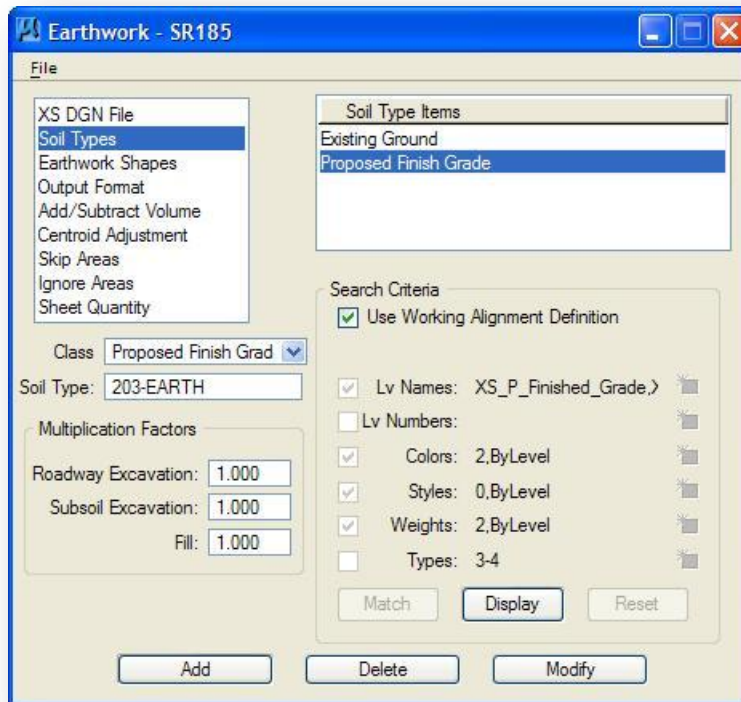
If you have not assigned values for the **Existing Ground** item in the GEOPAK Project Manager, do not toggle on the **Use Working Alignment Definition** item. In this case, it will be necessary to manually assign values for the **Lv Names, Weight, Colors, Styles** and **Types** shown under the **Search Criteria** portion of the dialog box.

- ✓ Key-in the values for the **Multiplication Factors**, also known as shrink/swell factors if desired. The default values are 1.0.
- ✓ Select the **Add** button to add **Existing Ground** to the **Soil Type Items** list box as shown below:



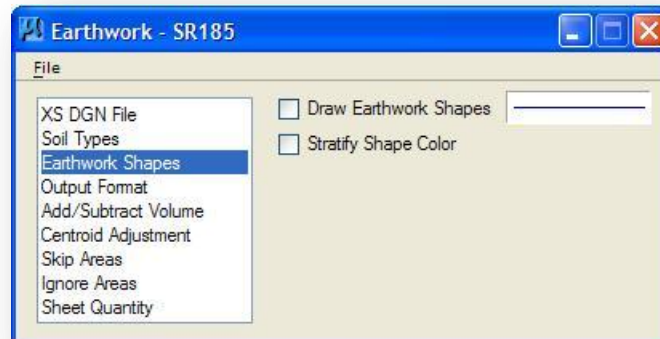
The steps to define the **Proposed Finish Grade** are the same as those used to define the existing ground, and are summarized below:

- ✓ Select **Proposed Finish Grade** from the **Class** drop down menu.
- ✓ Use the same **Soil Type** name as the **Existing Ground**.
- ✓ Toggle on the **Use Working Alignment Definition** item under the **Search Criteria** section of the dialog box as shown below, or define the Search Criteria manually.
- ✓ Select the **Add** button to add **Proposed Finish Grade** to the **Soil Type Items** list box as shown below:



7.3.3 Earthwork Shapes

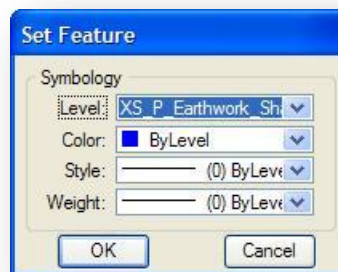
When **Earthwork Shapes** is selected, the dialog box changes as shown below:



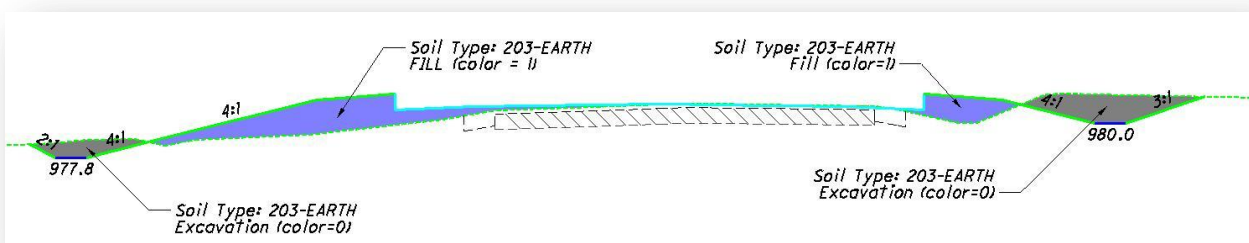
The **Earthwork Shapes** item is used to draw MicroStation Shape elements in the cross section design file representing the cut and fill areas.

Toggle the **Draw Earthwork Shapes** option on to draw shapes in the MicroStation design file specified by the **XS DGN File** item.

Double-click the **Parameters** symbology box to access the *GEOPAK Set Feature* dialog, shown below. The level **XS_P_Earthwork_Shapes** has been defined for placement of the earthwork shapes.

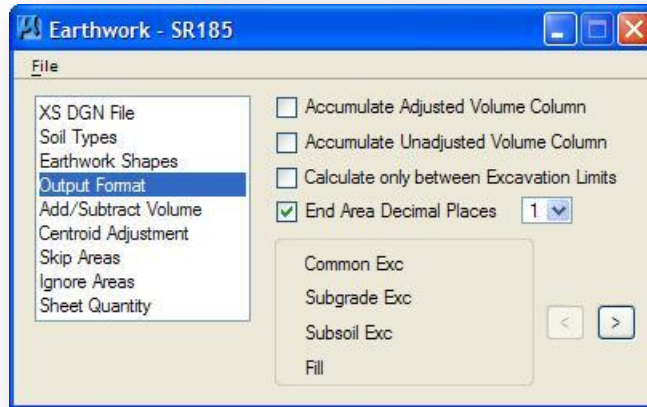


With the **Stratify Shape Color** option toggled on, GEOPAK will draw each cut and fill area using a different color. GEOPAK assigns (in ascending numerical order) each material type two colors, one for cut and one for fill. An example of the shapes drawn for cut and fill areas is shown below:



7.3.4 Output Format

When **Output Format** is selected, the dialog box will change as shown below:



When earthworks are processed, GEOPAK generates an earthwork log file that is used to report the quantities for the cross sections. The **Output Format** options are used to define how the earthwork quantities are reported in this log file.

The log file is an ASCII file. A portion of the a file is shown below:

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate
53+00.000	203_EARTH					
	Common Exc	72.7	0	0	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	33.0	0	0	1.00	0
53+25.000	203_EARTH					
	Common Exc	58.6	61	61	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	31.1	30	30	1.00	31

Excavation and fill quantities are reported for each cross section. By default, three classifications of excavation volumes are listed in the GEOPAK Earthwork Log file. These excavation classifications are as follows:

- Common Excavation
- Subgrade Excavation
- Subsoil Excavation

In some cases, the designer may not wish to separate the excavation quantities into separate classifications. The output format can be changed to combine the excavation quantities into one listing. For example, if the user desires to combine all three excavation classifications into an earthwork listing consisting of just cut and fill, press the < or > arrows until the desired option is displayed.



With Excavation and Fill specified, the excavation quantities are combined as one item in the Earthwork Log file as shown in the example below:

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate
53+00.000	203_EARTH					
	Excavation	72.7	0	0	1.00	
	Fill	33.0	0	0	1.00	0
53+25.000	203_EARTH					
	Excavation	58.6	61	61	1.00	
	Fill	31.1	30	30	1.00	31

Options for reporting the excavation and embankment quantities include:

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

Accumulate Adjusted Volume Column

When activated, 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 activated, 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

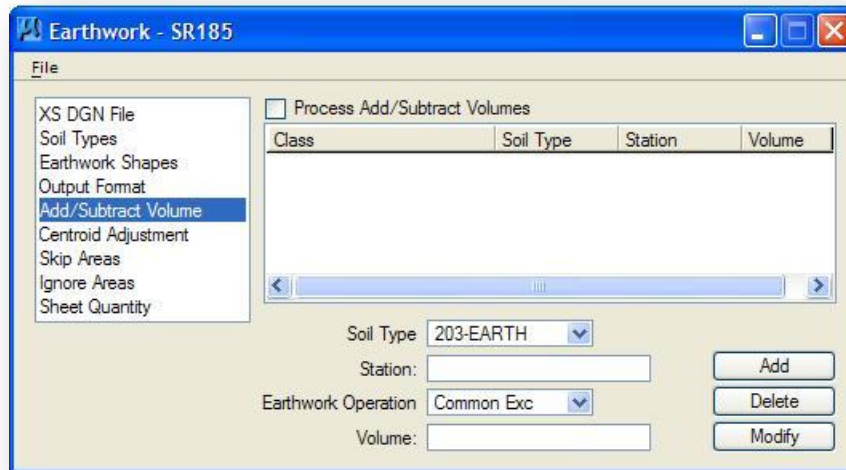
Another option within this dialog is **Calculate Only Between Excavation Limits**. In this option, the use of excavation limits is to demarcate earthwork processing. This is extremely useful in projects where earthwork is staged, or a separate quantity for each roadway in a multiple alignment scenario is necessary. When the toggle is activated, all earthwork calculations, not just existing removals, are restricted to user-defined excavation limits.

End Area Decimal Places

From 0 to 4 decimal places may be set for the output values.

7.3.5 Add/Subtract Volume

When **Add/Subtract Volume** is selected, the dialog box changes as shown below:



The **Add/Subtract Volume** item is used to specify quantities to be added to or subtracted from the GEOPAK earthwork calculations. This procedure involves the following steps:

- ✓ Toggle on **Process Add/Subtract Volumes** if you wish to define additional earthwork volumes to be added to, or subtracted from, the GEOPAK Earthwork calculations.
- ✓ Select the soil type using the **Soil Type** option button. The soil types defined for the run are available in the option button.
- ✓ Select the **EW Operation** that you want to have the quantity added to or subtracted from. The available options are **Common Exc**, **Subgrade Exc**, **Subsoil Exc** and **Fill**.
- ✓ Key-in the **Station** and the **Volume** you wish to add, or subtract, at the specified station. Subtracted volumes should be entered as negative numbers. The station does not necessarily have to be at a cross section station. However, it must be within the specified station range.
- ✓ Select the **Add** button to add the station and volume to the List box.

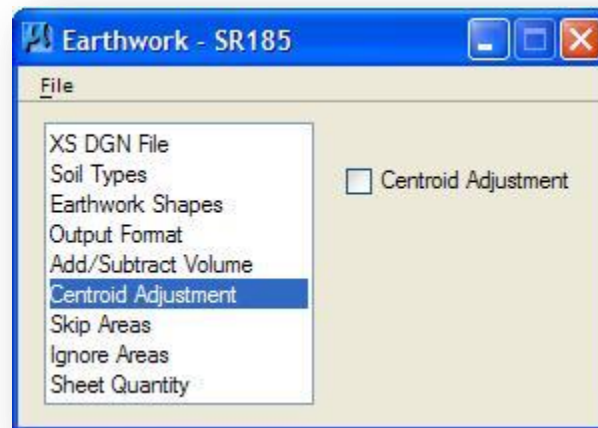
To modify data, highlight the line to be modified. Change the desired value, and then press the **Modify** button. The change is reflected in the list box.

To delete a line, highlight the line to be deleted, and then press the **Delete** button. The line is deleted from the list box.

There is no limit to the number of defined Add/Subtract Volumes.

7.3.6 Centroid Adjustment

When **Centroid Adjustment** is selected, the dialog box changes as shown below:



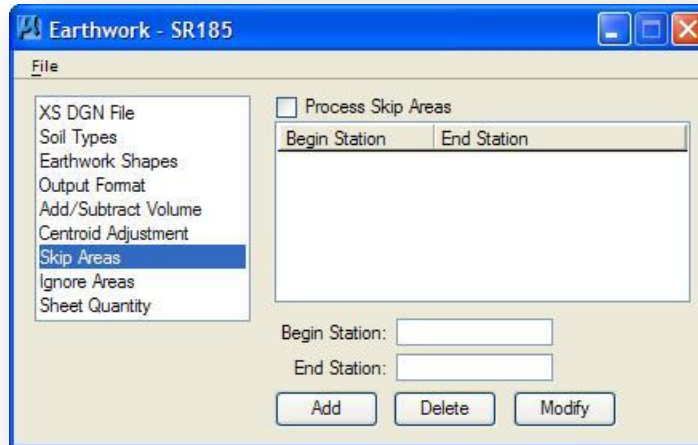
Earthwork volumes are calculated by averaging end areas and then multiplying these averaged areas by the distance between two successive cross sections, as measured along the baseline. If the bulk of the earthwork areas are located predominantly to either the left or the right of the baseline, an error 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 distance to which cross section areas are offset from the baseline.

The Centroid Adjustment option invokes a procedure that adjusts volumes based upon the lateral offset between the centroid of the cross section end areas and the baseline. This procedure involves the following steps:

- A centroid is calculated for each cross section.
- An offset between the centroid and the baseline is computed for each cross section.
- Between two successive cross sections, the individual centroid offsets are averaged. A concentric chain, offset by this averaged distance, is then calculated. The longitudinal distance along this chain between the cross sections is determined.
- The resultant volume is then determined by multiplying the end area average by the adjusted longitudinal length, along the concentric chain.

7.3.7 Skip Areas

When **Skip Areas** is selected, the dialog box changes as shown below:



The **Skip Areas** item is used to define a station range where earthwork quantities are computed, but are not included in the grand totals for the earthwork run. This procedure involves the following steps:

- ✓ Toggle on **Process Skip Areas** to have GEOPAK omit earthworks calculations for the specified station range.
- ✓ Key-in the **Begin Station** and **End Station** for the skip area. If the baseline has station equations, the regions must be included.
- ✓ Select the **Add** button to add the station range to the list box.

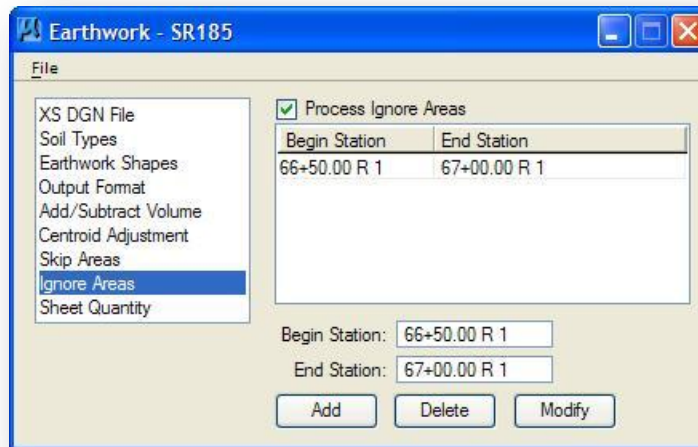
To modify data in the list box, highlight the line to be modified. Change the desired value, and then press the **Modify** button. The change is reflected in the list box.

To delete a Skip Area in the list box, highlight the line to be deleted, and then press the **Delete** button. The line is deleted from the list box.

There is no limit to the number of defined Skip Area station ranges.

7.3.8 Ignore Areas

When **Ignore Areas** is selected, the dialog box changes as shown below:



The **Ignore Areas** option is used to define a station range where no quantities will be computed. This option differs from the **Skip Area** option in the following way:

- Earthwork quantities are computed for the station range defined as a **Skip Area**, but not included in the Grand Total.

The **Ignore Areas** option involves the following steps:

- ✓ Toggle on **Ignore Areas** to have GEOPAK omit earthworks calculations for the specified station range.
- ✓ Key-in the **Begin Station** and **End Station** for the area to be ignored. If the baseline has station equations, the regions must be included.
- ✓ Select the **Add** button to add the station range to the list box.

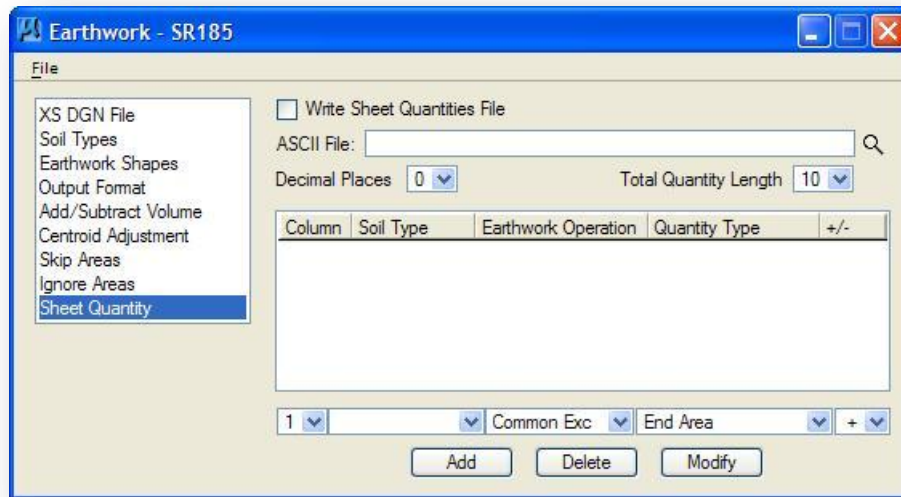
To modify data in the list box, highlight the line to be modified. Change the desired value, and then press the **Modify** button. The change is reflected in the list box.

To delete an **Ignore Area**, in the list box highlight the line to be deleted, and then press the **Delete** button. The line is deleted from the list box.

There is no limit to the number of defined **Ignore Area** station ranges.

7.3.9 Sheet Quantity

When **Sheet Quantity** is selected, the dialog box changes as shown below:



Earthwork quantities can be written directly onto cross sections sheets. A two step process is required:

1. An ASCII text file is produced from the earthwork calculations. This ASCII text file contains the area and/or volume quantities that are to be written onto the cross section sheets.
2. The sheet quantities can be placed on the cross section sheets using one of two options:
 - The GEOPAK Cross Section Sheet Layout utility can be configured to read the Sheet Quantity ASCII file to place the appropriate text onto the cross section sheets.
 - An ODOT VBA Application can be used to place the sheet quantities directly in the cross section cell design file. The quantities are displayed on the cross section sheets, along with the cross section graphics, using reference attachments.

Regardless of the method used to place the quantities on the cross section sheets, a Sheet Quantity File must be generated as described below.

The dialog box items are discussed below:

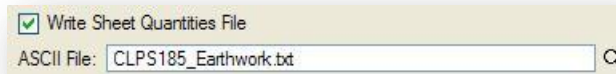
Write Sheet Quantities File

Toggle on **Write Sheet Quantities File** for GEOPAK to create the ASCII text file containing the earthwork quantities.

ASCII File

Key-in the name of the ASCII File that you wish GEOPAK to write the earthwork quantities into. If you use the **Select** button to browse the directory structure for an existing file name, GEOPAK will overwrite the file that you select with the new values for this earthwork run.

It is recommended you use the name of the COGO chain used to generate the cross sections in the filename as shown below.



The remaining items in the dialog box are used to define which volumes you would like to include in the ASCII File containing the earthwork calculations. The instructions to set up the ASCII File to contain **Cut End Areas, Fill End Areas, Cut Volumes** and **Fill Volumes** are as follows:

Including Common Excavation (Cut) End Areas in the Earthwork ASCII File

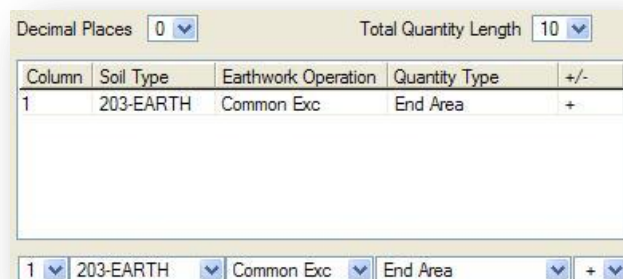
We will store the cut end areas in column one of the earthwork ASCII File.

- ✓ Toggle the **Column** item to **1**
- ✓ Toggle the **Decimal Places** option to **0** for projects in English units
- ✓ The **Total Quantity Length** option button is used to define the column width for each earthwork type stored in the ASCII File. The default value of 10 should be sufficient

There are three option buttons located at the bottom of the dialog box which allow the user to define the **Soil Type, Earthwork Operation** and **Quantity Type**. Take the following steps to define the Common Excavation end areas:

- ✓ Select the **Soil Type**. The soil types that you have previously defined for the run will be available in the left most option button. The soil type 203-EARTH is the only type defined in this example.
- ✓ The next option button is used to select the desired **Earthwork Operation**. For this example, select **Common Exc**.
- ✓ The **Quantity Type** can be selected using the next option button. For this example, select **End Area**.

Select the **Add** button to include the Common Excavation End Area in the list box, as shown below:



Including Fill End Areas in the Earthwork ASCII File

We will store the Fill end areas in column two of the earthwork ASCII File.

- ✓ Toggle the **Column** item to **2**.
- ✓ Toggle the **Decimal Places** option to **0** for projects in English units.
- ✓ The **Total Quantity Length** option button is used to define the column width for each earthwork type stored in the ASCII File. The default value of 10 should be sufficient.

There are three option buttons located at the bottom of the dialog box which allow the user to define the **Soil Type**, **Earthwork Operation** and **Quantity Type**. Take the following steps to define the Fill end areas:

- ✓ Select the **Soil Type**. The soil types that you have previously defined for the run will be available in the option button. The soil type 203-EARTH is the only type defined in this example.
- ✓ The next option button is used to select the desired **Earthwork Operation**. For this example, select **Fill**.
- ✓ The **Quantity Type** is selected using the next option button. For this example, select **End Area**.

Select the **Add** button to include the options set above for the Fill End Area in the list box as shown below:

Column	Soil Type	Earthwork Operation	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
2	203-EARTH	Fill	End Area	+

At the bottom of the dialog box, there are four dropdown menus: '2', '203-EARTH', 'Fill', and 'End Area', followed by a '+' button and a '-' button.

Including Common Excavation (Cut) Volumes in the Earthwork ASCII File

We will store the **Common Excavation** volume in column three of the earthwork ASCII File.

- ✓ Toggle the **Column** item to **3**.
- ✓ Toggle the **Decimal Places** option to **0** for projects in English units.
- ✓ The **Total Quantity Length** option button is used to define the column width for each earthwork type stored in the ASCII File. The default value of 10 should be sufficient.

There are three option buttons located at the bottom of the dialog box which allow the user to define the **Soil Type**, **Earthwork Operation** and **Quantity Type**. Take the following steps to define the Common Excavation Unadjusted Volumes:

- ✓ Select the **Soil Type**. The soil types that you have previously defined for the run will be available in the left most option button. The soil type 203-EARTH is the only type defined in this example.
- ✓ The next option button is used to select the desired **Earthwork Operation**. For this example, select **Common Exc**.
- ✓ The **Quantity Type** is selected using the next option button. For this example, select **Unadjusted Volumes**.

Select the **Add** button to include the options set above for the Common Excavation Unadjusted Volumes in the list box as shown below:

Column	Soil Type	Earthwork Operation	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Volume	+

Decimal Places: 0 Total Quantity Length: 10

3 203-EARTH Common Exc Unadjusted Volumes +

Including Fill Volumes in the Earthwork ASCII File

We will store the **Fill Volume** in column four of the earthwork ASCII File.

- ✓ Toggle the **Column** item to **4**.
- ✓ Toggle the **Decimal Places** option to **0** for projects in English units.
- ✓ The **Total Quantity Length** option button is used to define the column width for each earthwork type stored in the ASCII File. The default value of 10 should be sufficient.

There are three option buttons located at the bottom of the dialog box which allow the user to define the **Soil Type**, **Earthwork Operation** and **Quantity Type**. Take the following steps to define the Fill Unadjusted Volumes:

- ✓ Select the **Soil Type**. The soil types that you have previously defined for the run will be available in the left most option button. The soil type 203-EARTH is the only type defined in this example.
- The next option button is used to select the desired **Earthwork Operation**. For this example, select **Fill**.
- ✓ The **Quantity Type** is selected using the next option button. For this example, select **Unadjusted Volumes**.

Select the **Add** button to include the options set above for the Fill Unadjusted Volumes in the list box as shown below:

Column	Soil Type	Earthwork Operation	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Volume	+
4	203-EARTH	Fill	Unadjusted Volume	+

Decimal Places: 0 Total Quantity Length: 10

4 203-EARTH Fill Unadjusted Volumes +

Sheet Quantity File Format

When the earthworks run is processed, the Sheet Quantity file is written to the current Working Directory. The first few lines of the file are shown below.

000000000000	1111111111	2222222222	3333333333	4444444444
53+00.000/1	73	33	0	0
53+25.000/1	59	31	61	30
53+50.000/1	44	33	47	30
53+75.000/1	35	40	36	33
54+00.000/1	29	42	29	38
54+25.000/1	29	40	27	38
54+50.000/1	32	34	28	35

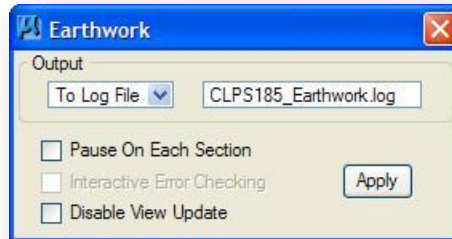
The first row of the output file is a header row containing the column numbers. Each subsequent row of the file contains the following information as defined in the Earthworks dialog box:

- Column 0 - The station and region number
- Column 1 - Cut end area for the station
- Column 2 - Fill end area for the station
- Column 3 - Cut unadjusted volume for the station
- Column 4 - Fill unadjusted volume for the station

The procedure to include the sheet quantities on the cross sections sheets is detailed in the next chapter.

7.4 Processing an Earthworks Run

After you have configured the various options of the *Earthwork* dialog box, you are ready to have GEOPAK calculate the earthwork quantities. From the GEOPAK *Earthwork* dialog, select **File > Run**. This will bring up the following dialog box:

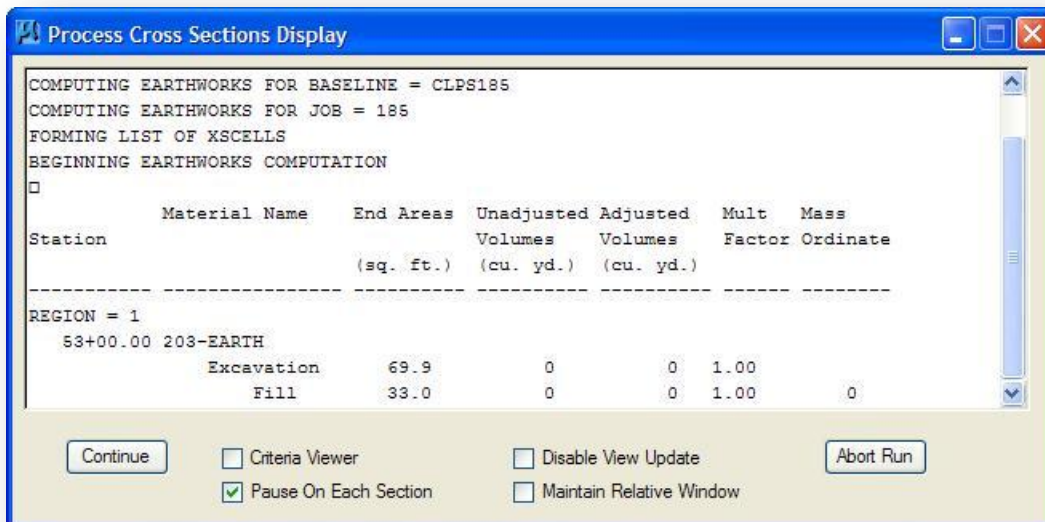


An option button is available to allow the user to choose to send error messages to the **Screen Only** or to save error messages in a **Log File**. To save a log file, select **To Log File** and key-in the name for the file. The log file will be saved in the **Working Directory** that has been assigned for the project.

The **Pause on Each Section** option forces the earthworks process to stop at each cross section as it is processed.

As the earthworks are processed, GEOPAK cycles through the cross sections. The **Disable View Update** option will speed up processing the earthwork quantities without waiting for the MicroStation view to update.

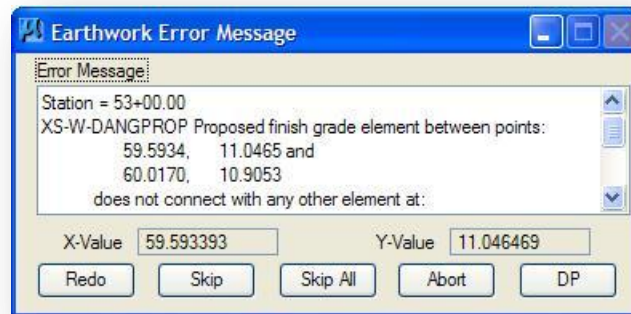
Select **Apply** to begin the earthwork calculations. The following dialog box opens:



As the cross sections are processed, the status is displayed in the GEOPAK Process Cross Sections Display dialog box, as shown above. When processing is complete, the options **Exit** or **Next Run** become available for the user to choose from.

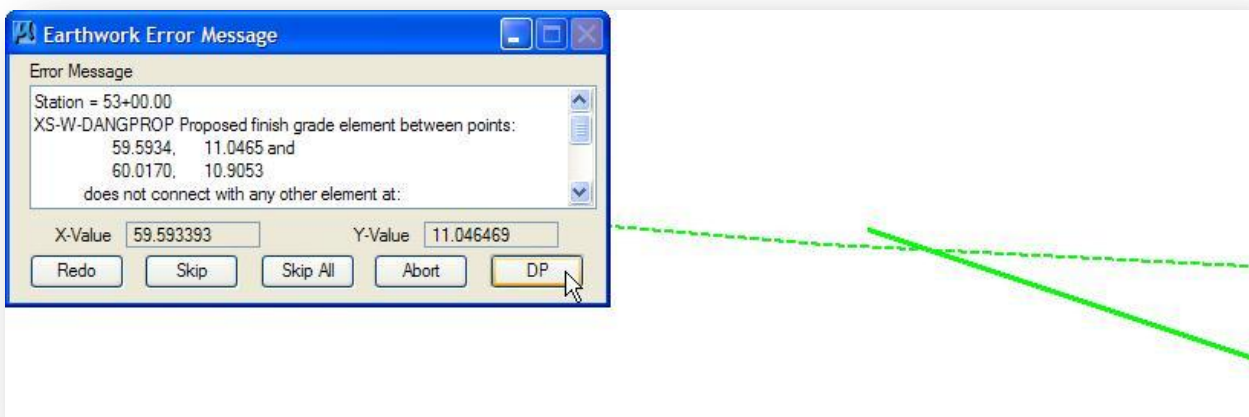
7.4.1 Diagnosing Problems

As the cross sections are processed, GEOPAK expects the elements that make up the **Existing Ground** and the **Proposed Finished Grade** to connect as a continuous string of elements. If there is a gap in the elements that make up one of the Soil Types, GEOPAK will alert you of the problem as shown in the example below.



In this example, one of the **Proposed Finish Grade** elements does not connect with another element. The **DP** button can be used to find the location where the problem occurs as follows:

- ✓ Select the MicroStation **Zoom In** command
- ✓ Repeatedly pick the *Earthwork Error Message* **DP** button until you zoom in close enough to see the problem.



In the example above, the ditch backslope does not tie to the existing ground within the specified tolerance. Use the MicroStation **Extend Element to Intersect** command to resolve the problem.

After the graphics have been corrected, select the *Earthwork Error Message* **Redo** button to continue processing the earthwork quantities.

Exercise 7

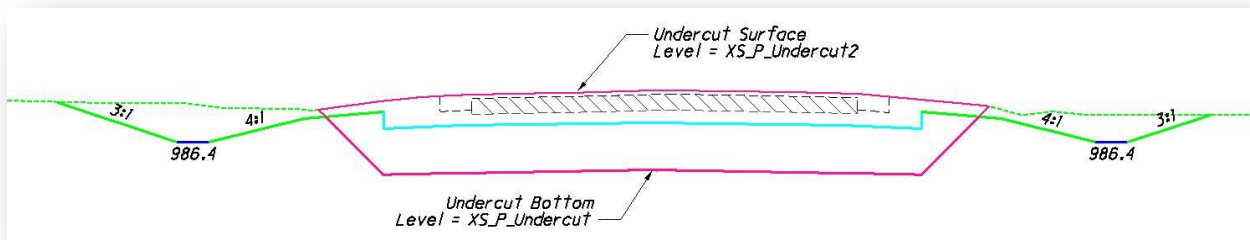
Using this Chapter as a guide, compute the earthwork quantities for S.R. 185.

- Save a Sheet Quantities file
- Save an Earthworks Log File
- What folder are these two files written to?
- Which file contains the grand totals for the earthwork quantities?
 - What is the total excavation for the project?
 - What is the total embankment for the project?

7.5 Undercut

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.

The ODOT standard criteria file **undercut.x** can be used to draw undercut on the cross sections. An example of the undercut is shown below.



According to GEOPAK earthwork guidelines, proposed undercuts must connect to another proposed undercut or proposed finished grade, not to existing ground. For this reason, it is necessary to define two proposed undercut layers. One layer will be the proposed undercut layer (level **XS_P_Undercut**) and the other layer will define the limits of undercut removal (level **XS_P_Undercut2**).

When processing an earthworks run with undercut, all of the Earthwork dialog box functions should be completed as described in the previous sections of this guide with the exception of the **Soil Types** items.

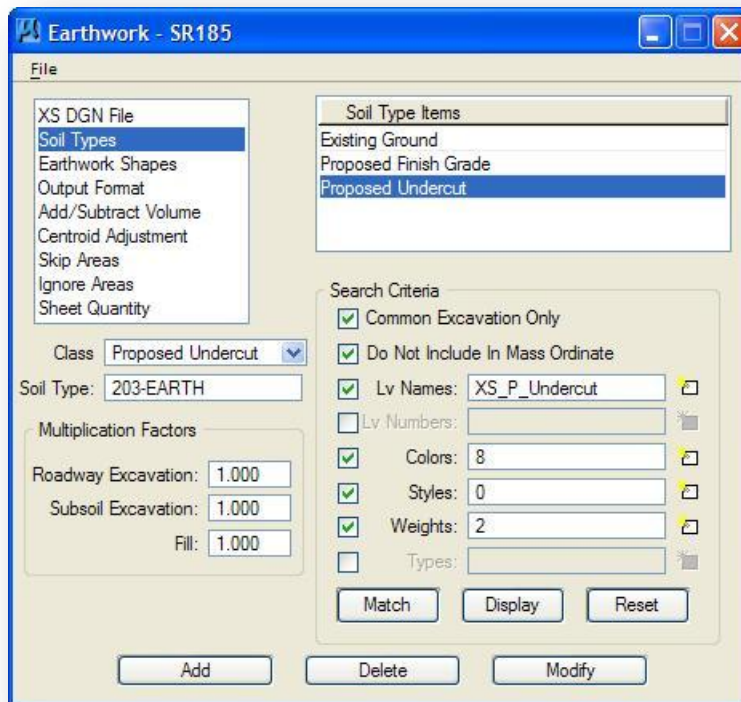
From the **Soil Types** portion of the *Earthwork* dialog box, take the following steps to define the symbology of the elements that will make up the first Proposed Undercut layer:

- ✓ Select **Proposed Undercut** from the **Class** option button as shown on the following page.
- ✓ Type in 203-EARTH for the name of the **Soil Type**. When defining the soil type name for the undercut, 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 defined as an existing suitable or unsuitable material.

Since there is no item in the **Working Alignment Definition** for **Proposed Undercut**, it will be necessary to manually assign values for the **Level**, **Weight**, **Colors**, **Styles** and **Types** shown under the **Search Criteria** portion of the dialog box. Take the following steps:

- ✓ Toggle on these items under the **Search Criteria** section of the dialog box.
- ✓ Press the **Match** button. The software prompts you to identify and accept an element. When accepted, its symbology is added to the **Search Criteria** and all elements which match the search criteria are highlighted. To clear the current search parameters, press the **Reset** button.

- ✓ Toggle on the **Common Excavation Only** option, if desired (see the notes at the end of this section about this option).
- ✓ Key in the values for the **Multiplication Factors**, also known as shrink/swell factors, if desired. The default values are 1.0.
- ✓ After you have defined the parameters for the **Proposed Undercut**, select the **Add** button to add the **Proposed Undercut** to the **Soil Type Items** list box, as shown below:



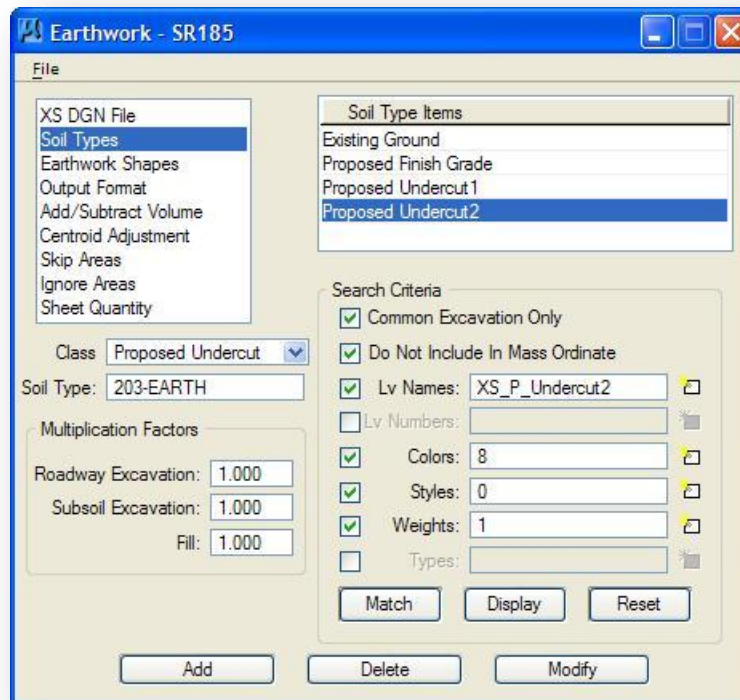
The steps to define layer two of the **Proposed Undercut** are the same as the steps used to define the first layer, with the exception that you must pick the undercut elements from level **XS_P_Undercut2**.

- ✓ Select **Proposed Undercut** from the **Class** option button.
- ✓ Type in 203-EARTH for the name of the **Soil Type**.

Since there is no item in the **Working Alignment Definition** for **Proposed Undercut**, it will be necessary to manually assign values for the **Level**, **Weight**, **Colors**, **Styles** and **Types** shown under the **Search Criteria** portion of the dialog box.

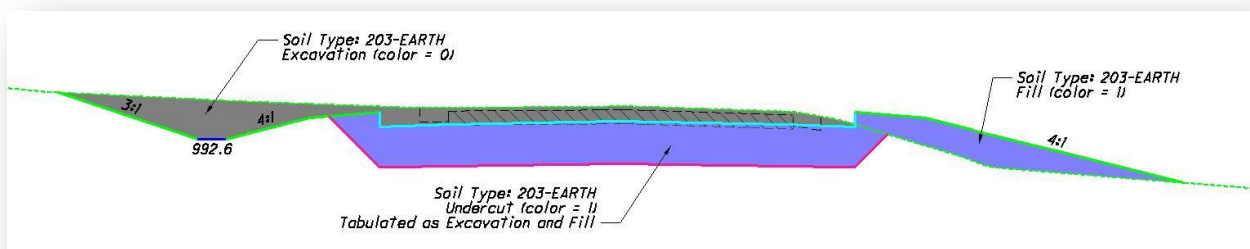
- ✓ Press the **Reset** button to clear the current search parameters.
- ✓ Toggle on the items under the **Search Criteria** section of the dialog box as shown above. Press the **Match** button. The software prompts you to identify and accept an element. When accepted, its symbology is added to the **Search Criteria** and all elements which match the search criteria are highlighted.

- ✓ Toggle on the **Common Excavation Only** option, if desired (see the notes at the end of this section about this option).
- ✓ After you have defined the parameters for the second **Proposed Undercut**, select the **Add** button to add the **Proposed Undercut** to the **Soil Type** Items list box, as shown below:



In the Soil Type Items list box, the software will place a number 1 after the first **Proposed Undercut** and will add a number 2 to the second **Proposed Undercut** as shown above.

An example of the shapes drawn for the undercut is shown below.



7.5.1 Undercut Quantities

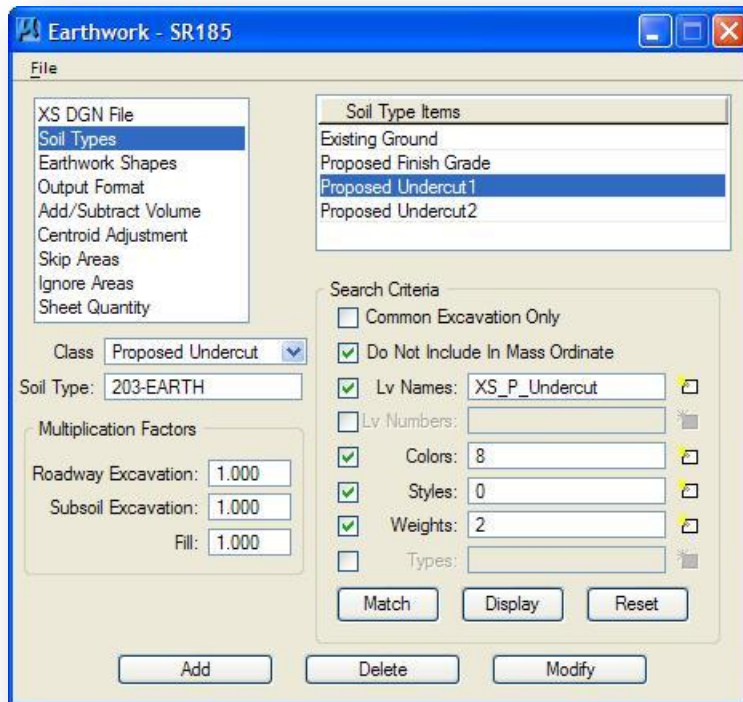
If the *Earthwork* dialog components are completed as described in this section, the undercut quantities will be included in both the excavation and fill quantities. That is, the area of the shape for the undercut will be counted once for the cut quantities and again for the fill quantities. An example of the quantities reported in the earthworks log file is shown below:

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate

REGION = 1						
64+00.00	203-EARTH					
	Excavation	277.5	236	236	1.00	
	Fill	189.1	162	162	1.00	0
	Mass ordinate for 203-EARTH = 546					

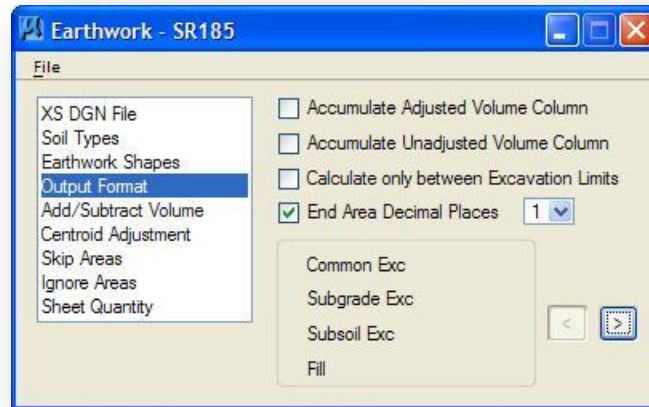
The undercut quantities can be split as a separate excavation value by use of the **Common Excavation Only** check box. Turning this option off, and changing the **Output Format**, will separate the undercut excavation areas as a separate subgrade excavation quantity. Take the following steps:

- ✓ From the **Soil Types** option, select the **Proposed Undercut1** item
- ✓ Toggle off the **Common Excavation Only** option
- ✓ Select the **Modify** button to accept the change
- ✓ Repeat these steps for the **Proposed Undercut2** item



Next change the **Output Format** for the earthwork quantities. Take the following steps:

- ✓ From the **Output Format** item, use the < or > buttons to set the output as shown below:



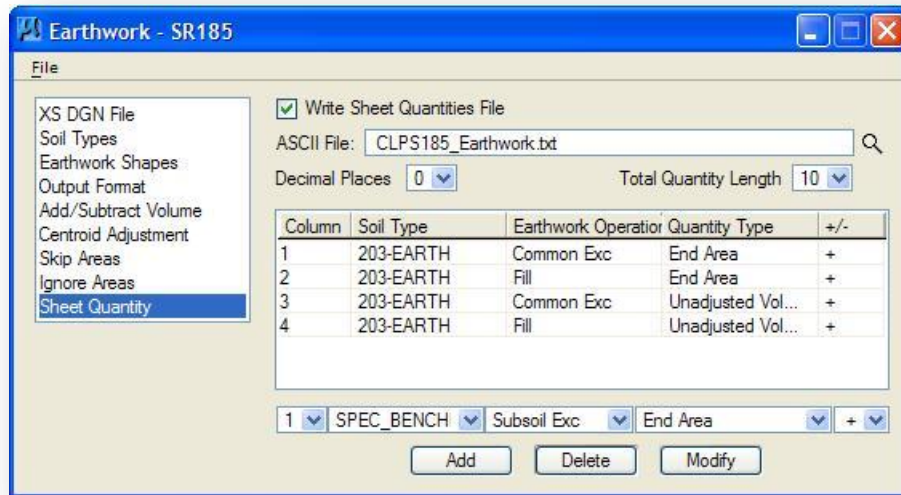
When the earthworks quantities are processed, the earthwork log file will now report the undercut excavation as a separate subgrade excavation quantity, as shown in the example below. The backfilling of the undercut area is still included in the Fill quantity for the soil type.

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate

REGION = 1						
64+00.00	203-EARTH					
	Common Exc	163.9	136	136	1.00	
	Subgrade Exc	113.6	100	100	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	189.1	162	162	1.00	0
	Mass ordinate for 203-EARTH = 546					

Including the Undercut in the Sheet Quantities

When the **Sheet Quantity** option is selected, the *Earthwork* dialog box will appear as shown below:



In addition to the columns previously defined for 203-EARTH quantities, it may be necessary to define additional columns to account for the undercut quantities as discussed below.

Case 1: If the **Soil Type** items for the undercut were defined with **Common Excavation Only** toggled on, the excavation quantities for the undercut are included with the quantities reported for the Common Excavation and no additional steps are necessary.

Case 2: If the **Soil Type** items for the undercut were defined with **Common Excavation Only** toggled off, the excavation quantities for the undercut are tabulated separately and must be combined with the Common Excavation values for the sheet quantities. Take the following steps to combine the quantities:

Column 1

The excavation for the undercut is reported as Subgrade Excavation. This value must be added to the 203-EARTH Common Exc value, which has been previously defined in Column 1 of the ASCII File, to tabulate the total excavation area for the cross section. To add the end area for the undercut to the 203-EARTH Common Excavation End Area, take the following steps:

- ✓ Toggle the **Column** item to **1**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "203-EARTH"
- ✓ Toggle the **Earthwork Operation** item to **Subgrade Exc**
- ✓ Toggle the **Quantity Type** to **End Area**
- ✓ Toggle the +/- option to **+**. This is used to add together values defined for the same column
- ✓ Select the **Add** button to add the item to the list

The excavation value for the undercut is included in the list as shown on the following page.

Column	Soil Type	Earthwork Operation	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
1	203-EARTH	Subgrade Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Vol...	+
4	203-EARTH	Fill	Unadjusted Vol...	+

Column 3

Column 3 has been previously defined to contain the **Common Exc Unadjusted Volume**. To add the volume items for the undercut to the 203-EARTH Common Exc volume, take the following steps:

- ✓ Toggle the **Column** item to **3**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "203-EARTH"
- ✓ Toggle the **Earthwork Operation** item to **Subgrade Exc**
- ✓ Toggle the **Quantity Type** to **Unadjusted Volume**
- ✓ Toggle the +/- option to **+**. This is used to add values defined for the same column together
- ✓ Select the **Add** button to add the item to the list

The excavation value for the undercut is included in the list as shown below.

Column	Soil Type	Earthwork Operation	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
1	203-EARTH	Subgrade Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Vol...	+
3	203-EARTH	Subgrade Exc	Unadjusted Vol...	+
4	203-EARTH	Fill	Unadjusted Vol...	+

Column 2 and Column 4

There is no need to define additional items for the Fill quantities in Columns 2 and 4. GEOPAK automatically includes the subgrade excavation areas in the fill quantities for the cross sections.

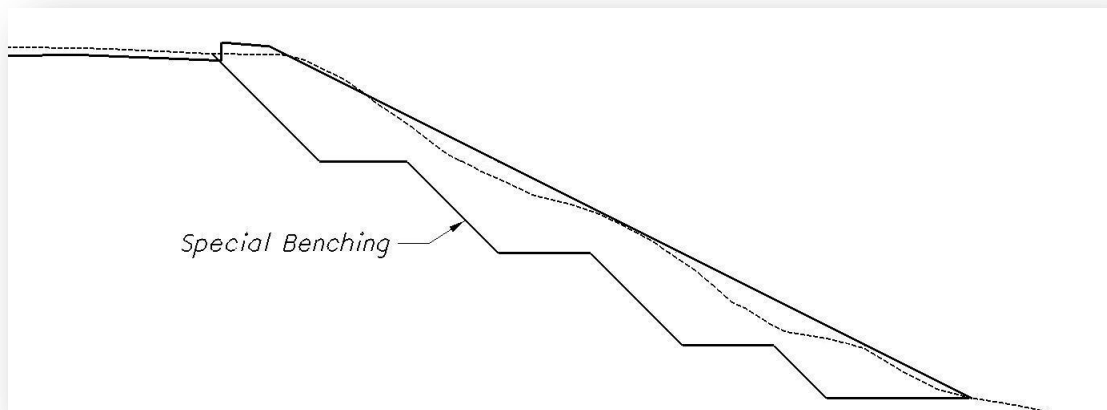
After defining the Sheet Quantity items, continue to process the earthworks run as defined previously in this training guide. The quantities contained in the ASCII file will now account for the undercut end areas and volumes.

7.6 Special Benching

Special benching should be used whenever the designer anticipates that there will be a stability problem and/or weak soils are present in an existing slope. See the Geotechnical Bulletin GB 2 for more information on special benching.

When special benching is required, the designer must draw the benching manually. At this time, there are no criteria files provided by ODOT to draw the special benching.

The level `XS_P_Special_Benching` is provided to draw the benching. An example is show below.



As shown in the example above, the elements drawn to designate the special benching must be drawn so that they connect to the existing ground to form a closed shape.

Tabulation of the earthwork quantities by GEOPAK will be described in the following pages of this section.

7.6.1 Functional Classes

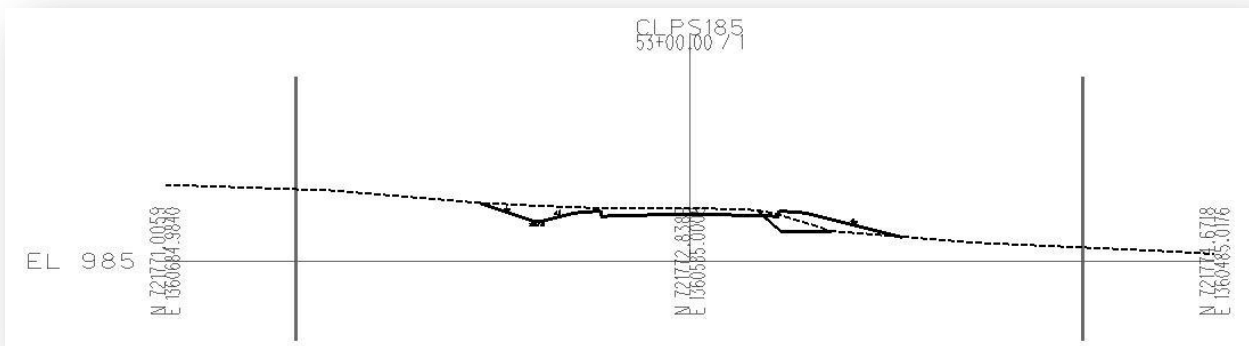
In addition to the functional classes discussed earlier, GEOPAK allows users to designate specific areas as suitable or unsuitable materials. Areas designated as unsuitable, such as the special benching area, must be backfilled with a suitable material.

When the earthworks are computed, unsuitable areas are computed as part of the excavation quantity and also as part of the fill since these areas must be filled with a suitable material.

7.6.2 Excavation Limits

Excavation limits are designated by drawing lines on the cross sections which define the horizontal limits of existing suitable or unsuitable material. Excavation limits are required by GEOPAK whenever existing suitable or unsuitable classifications are used.

A sample cross section with excavation limits drawn is shown below.



The following rules apply when using excavation limits:

1. Excavation limits must be used in pairs on the cross sections. An odd number of limits is not supported.
2. The limits must be drawn as line elements. Line strings, curves, curve strings, etc. are not supported.
3. Excavation limits must intersect the existing ground line. In cases where the suitable or unsuitable areas are not defined as closed shapes (e.g. muck or rock), the excavation limits must intersect these elements to form a closed shape.

The level **XS_P_Excavation_Limits** has been designated for drawing the excavation limits.

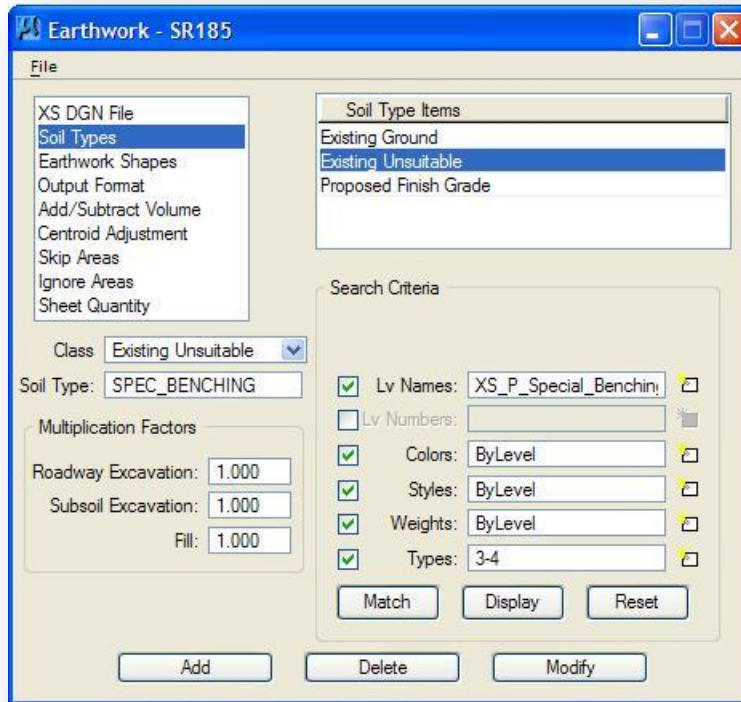
The ODOT criteria file **Excavation_Limits.x** can be used to draw the excavation limits at a set offset on the cross sections. See the criteria documentation on the ODOT CADD Support website for details.

7.6.3 Configuring an Earthworks Run for Special Benching

To compute earthwork quantities for the special benching areas, the earthworks run must be configured to compute the cut and fill quantities as previously described.

Soil Types

In the *Earthwork* dialog box, select the **Soil Types** item. The previous definitions for the **Existing Ground** and the **Proposed Finished Grade** are saved in the Earthwork Run as shown below:



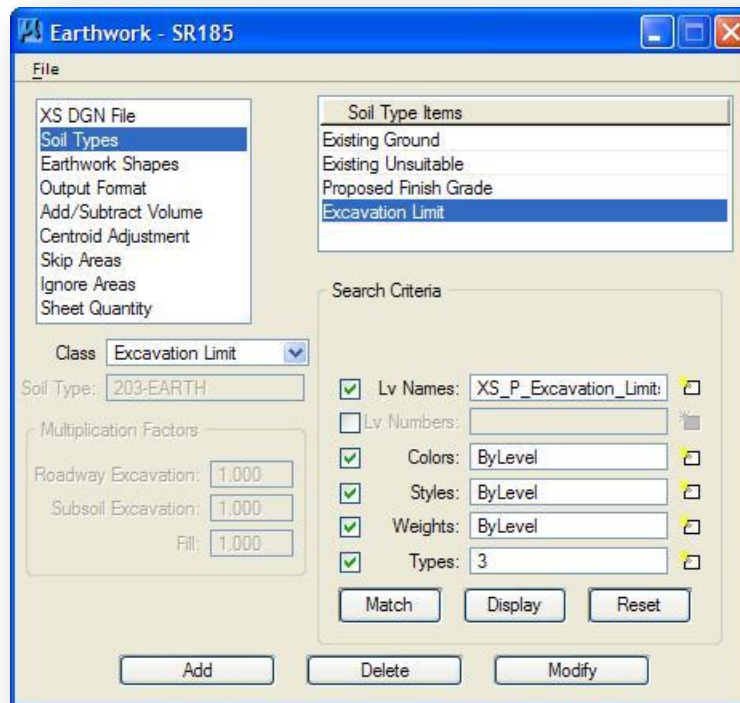
Two additional classes must be defined in the **Soil Types** portion of the *Earthwork* dialog box to compute the special benching area; one to define the special benching and another to define the excavation limits. Take the following steps to define the elements which make up the special benching:

- ✓ Select the **Existing Unsuitable** option from the **Class** drop option button
- ✓ Use a new **Soil Type** name to compute the special benching. The name "SPEC_BENCHING" is used in the example above.
- ✓ Define the symbology for the special benching items.
- ✓ Select the **Add** button to add the **Existing Unsuitable** item to the list of **Soil Type Items**.

Take the following steps to define the **Excavation Limits**:

- ✓ Select the **Excavation Limit** option from the **Class** drop down menu.
- ✓ Define the symbology for the excavation limit elements.
- ✓ Select the **Add** button to add the **Excavation Limit** item to the list of **Soil Type Items**.

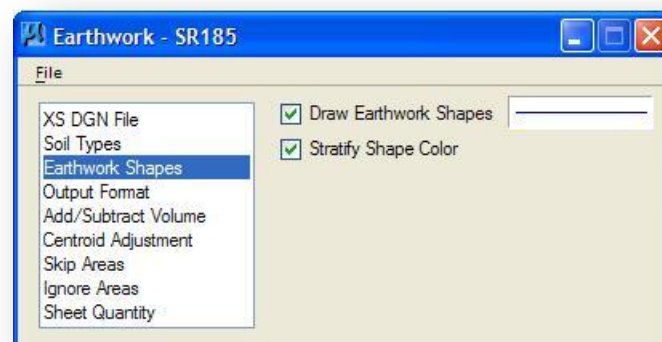
The settings for the **Excavation Limits** are shown below.



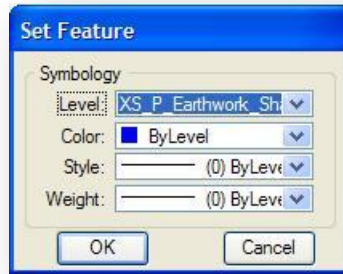
Earthwork Shapes

When computing earthwork quantities using multiple soil types, it is advisable to toggle on the **Stratify Shape Color** option. This option is used to draw various cut and fill areas using unique colors in the cross sections.

Using 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, regardless of the color defined in the plot parameters of the **Draw Earthwork Shapes** symbology box.



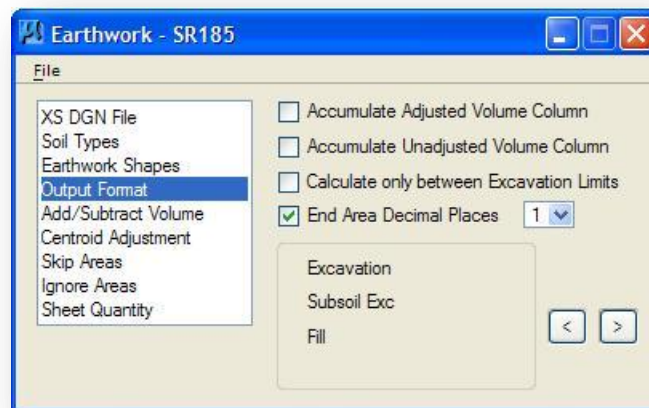
Double-click the **Parameters** symbology box, to the right of the **Draw Earthwork Shapes** toggle, to access the *Set Feature* dialog box shown below.



The level **XS_P_Earthwork_Shapes** has been designated for the placement of the Earthwork Shapes.

Output Format

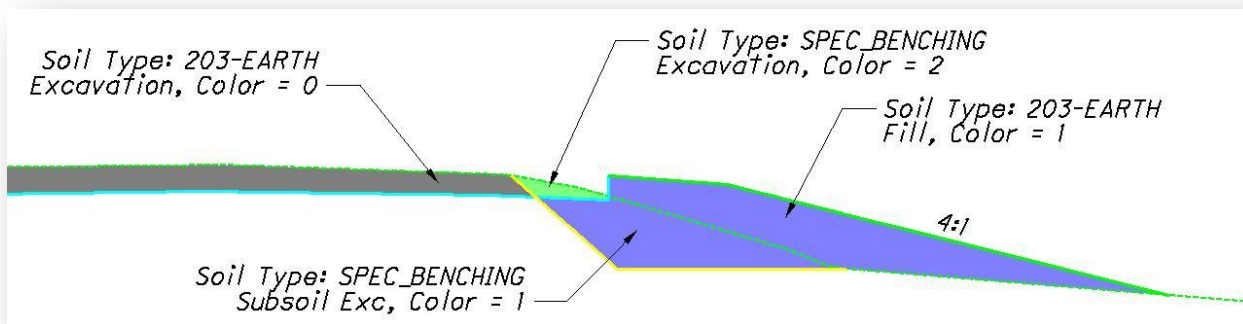
The **Output Format** portion of the *Earthwork* dialog box is used to define how the quantities will be split in the earthworks log file. When the **Output Format** option is selected, the *Earthwork* dialog will appear as shown below:



Use the < > arrows to scroll through the available options to select **Excavation**, **Subsoil Exc**, and **Fill**, as shown in the example above.

Note: Even though Excavation Limits are required when computing earthworks including Existing Suitable or Existing Unsuitable areas, it is not necessary to toggle on the **Calculate only between Excavation Limits** option unless you specifically want to restrict the computation to the excavation limits for staged construction estimates, or to separate quantities for multiple alignments shown on the same cross section.

When the earthwork quantities are computed, the excavation, fill, and special benching areas are drawn similar to the example below. The colors may vary depending on the number and order of the Soil Type items defined for the earthworks run.



The quantities are split by the Soil Types in the earthwork log file as shown in the example below:

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate

REGION = 1						
53+00.00	203-EARTH					
	Excavation	71.6	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	67.8	0	0	1.00	0
	Mass ordinate for 203-EARTH = 0					
	SPEC-BENCHING					
	Excavation	0.9	0	0	1.00	
	Subsoil Exc	34.8	0	0	1.00	
	Fill	0.0	0	0	1.00	0
	Mass ordinate for SPEC-BENCHING = 0					

The special benching area beneath the proposed pavement will be excavated, and then backfilled. The quantities reported in the Log file must be added together to compute the end areas for the x-sections:

Excavation Quantities

The Excavation quantity for the cross section is determined as follows:

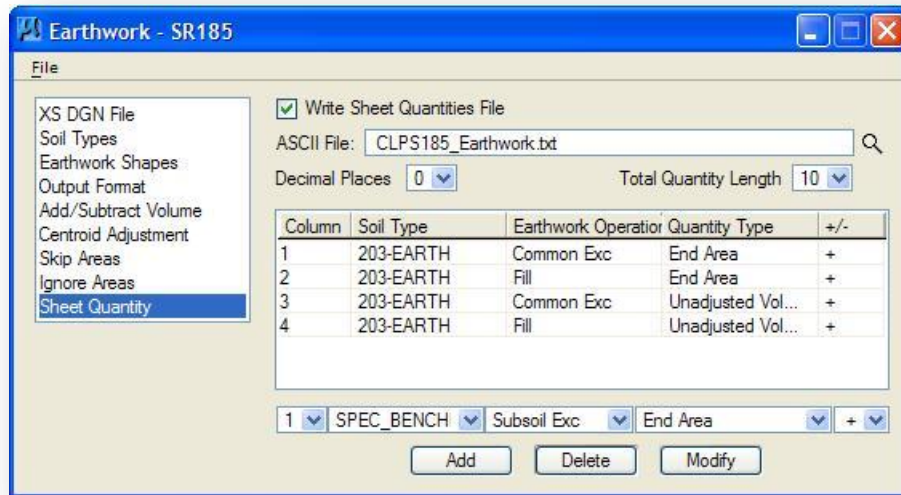
$$203\text{-EARTH Excavation} + \text{SPEC_BENCHING Excavation} + \text{SPEC_BENCHING Subsoil Exc} = \text{Total}$$

Fill Quantities

The Fill area reported for the soil type 203-EARTH is the total for the cross section. The GEOPAK earthwork process will automatically include the SPEC_BENCHING Subsoil Exc quantity, which is to be backfilled, in the 203-EARTH total.

Including the Special Benching in the Sheet Quantities

When the **Sheet Quantity** option is selected, the *Earthwork* dialog box will appear as shown below:



In addition to the columns previously defined for 203-EARTH quantities, it is necessary to define additional columns to account for the special benching quantities as discussed below.

Column 1

The excavation for the Special Benching is reported as two values, for Excavation and Subsoil Excavation, as previously detailed. Both of these values must be added to the 203-EARTH Common Exc value, which has been previously defined in Column 1 of the ASCII File, to tabulate the total excavation area for the cross section. To add the end area items for the Special Benching to the 203-EARTH Common Excavation End Area, take the following steps:

- ✓ Toggle the **Column** item to **1**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "SPEC_BENCHING"
- ✓ Toggle the **Earthwork Operation** item to **Common Exc**
- ✓ Toggle the **Quantity Type** to **End Area**
- ✓ Toggle the **+/-** option to **+**. This is used to add together values defined for the same column
- ✓ Select the **Add** button to add the item to the list
- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**
- ✓ Select the **Add** button to add the item to the list.

The excavation values for the Special Benching are both included in the list as shown below.

Column	Soil Type	Earthwork Operator	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
1	SPEC_BENCHING	Common Exc	End Area	+
1	SPEC_BENCHING	Subsoil Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Vol...	+
4	203-EARTH	Fill	Unadjusted Vol...	+

Column 3

Column 3 has been previously defined to contain the **Common Exc Unadjusted Volume**. To add the volume items for the Special Benching to the 203-EARTH Common Exc volume, take the following steps:

- ✓ Toggle the **Column** item to **3**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** SPEC_BENCHING
- ✓ Toggle the **Earthwork Operation** item to **Common Exc**
- ✓ Toggle the **Quantity Type** to **Unadjusted Volume**
- ✓ Toggle the +/- option to **+**. This is used to add values defined for the same column together
- ✓ Select the **Add** button to add the item to the list
- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**
- ✓ Select the **Add** button to add the item to the list

The Unadjusted Volume items for the Special Benching are added to the list as shown below.

Column	Soil Type	Earthwork Operator	Quantity Type	+/-
1	SPEC_BENCHING	Subsoil Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Vol...	+
3	SPEC_BENCHING	Common Exc	Unadjusted Vol...	+
3	SPEC_BENCHING	Subsoil Exc	Unadjusted Vol...	+
4	203-EARTH	Fill	Unadjusted Vol...	+

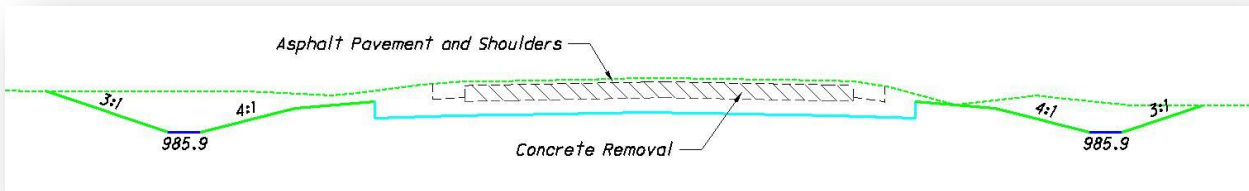
Column 2 and Column 4

There is no need to define additional items for the Fill quantities in Columns 2 and 4. GEOPAK automatically includes the subsoil excavation areas in the fill quantities for the cross sections.

After defining the Sheet Quantity items, continue to process the earthworks run as defined previously in this training guide. The quantities contained in the ASCII file will now account for the special benching end areas and volumes.

7.7 Concrete Removal

The ODOT criteria file **pavt_exist2.x** is used to draw the existing pavement on the cross sections. The criteria file can also be configured draw concrete removal areas as shown in the example below.



In this example, the quantities will be tabulated as follows:

- The earthwork will be computed using Item 203 Excavation and Item 203 Embankment
- The existing asphalt pavement will be removed using Item 202 Pavement Removal, Asphalt
- The existing concrete pavement will be removed using Item 202 Pavement Removal
- The backfill of the existing pavement removal will be paid for using item 203 Embankment

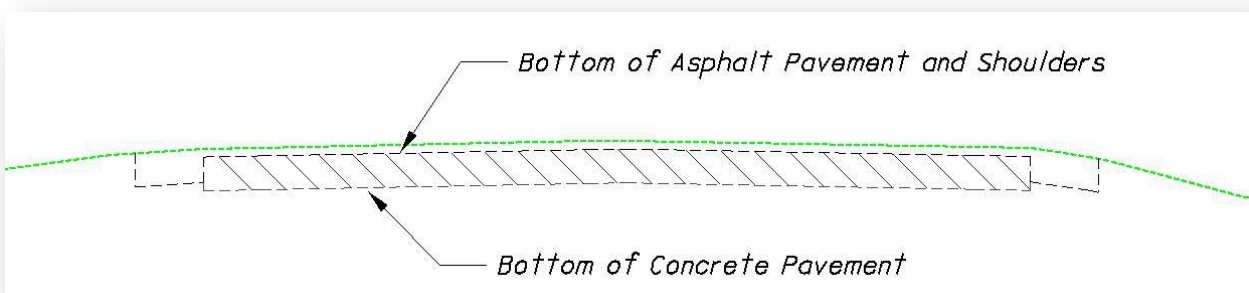
Each of these material types must be defined as a Soil Type in the GEOPAK Earthworks dialog box.

7.7.1 Soil Types

The Excavation and Embankment have been defined using a soil type named "203-EARTH" as previously defined in this document.

Additional soil types must be defined to form a closed shape for each Soil Type that is used to define the existing pavement. Soil Types are defined identifying the elements that make up the bottom of each soil type definition. The symbology of the elements that make up the top of each soil type do not need to be defined.

The existing asphalt and concrete removal will be defined as unique soil types using the elements identified below.

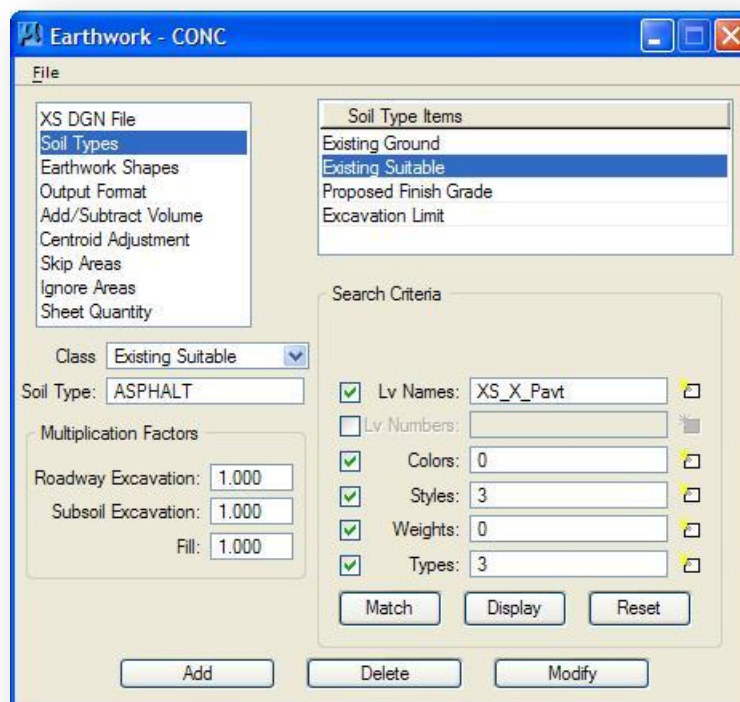


The ODOT standard criteria file **pavt_exist2.x** has been configured to draw the existing pavement elements shown above using the following symbology:

	Level	Color	Weight	Style
Asphalt Pavement and Shoulders	XS_X_Pavt	0	0	3
Concrete Pavement	XS_X_Pavt	36	0	3

7.7.2 Defining the Asphalt Pavement Soil Type

The **Soil Type** for the existing asphalt pavement is defined as shown below:

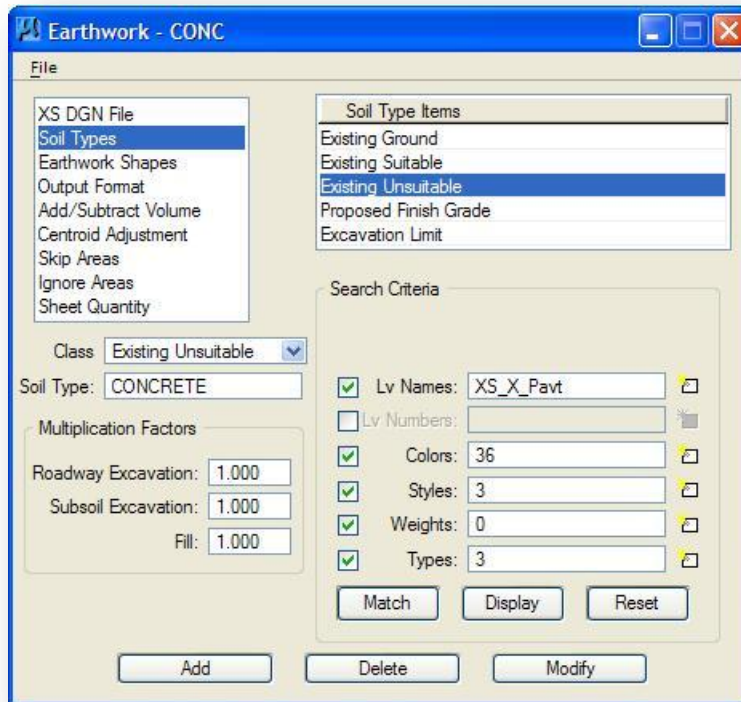


- ✓ Select the **Existing Suitable** option from the **Class** drop down menu, as shown above, to define the asphalt pavement elements.
- ✓ Define a new **Soil Type** name for the concrete removal. The name "ASPHALT" is used in the example above.
- ✓ Define the symbology for the asphalt pavement.
- ✓ Select the **Add** button to add the **Existing Suitable** item to the list of **Soil Type Items**.

Note: The elements that make up the bottom of each soil type are the key elements that must be singled out in the symbology list. It is not necessary to define the symbology for the elements that make up the top of the soil type.

7.7.3 Defining the Concrete Removal Soil Type

The **Soil Type** for the concrete removal is defined as a new soil type as shown below:



- ✓ Select the **Existing Unsuitable** option from the **Class** drop down menu.
- ✓ Define a new **Soil Type** name for the concrete removal. The name “CONCRETE” is used in the example above.
- ✓ Define the symbology for the concrete removal item.
- ✓ Select the **Add** button to add the **Existing Unsuitable** item to the list of **Soil Type Items**.

Notes:

It is only necessary to define the symbology for the bottom of the CONCRETE soil type. GEOPAK always identifies areas by the elements that constitute the bottom of a closed area.

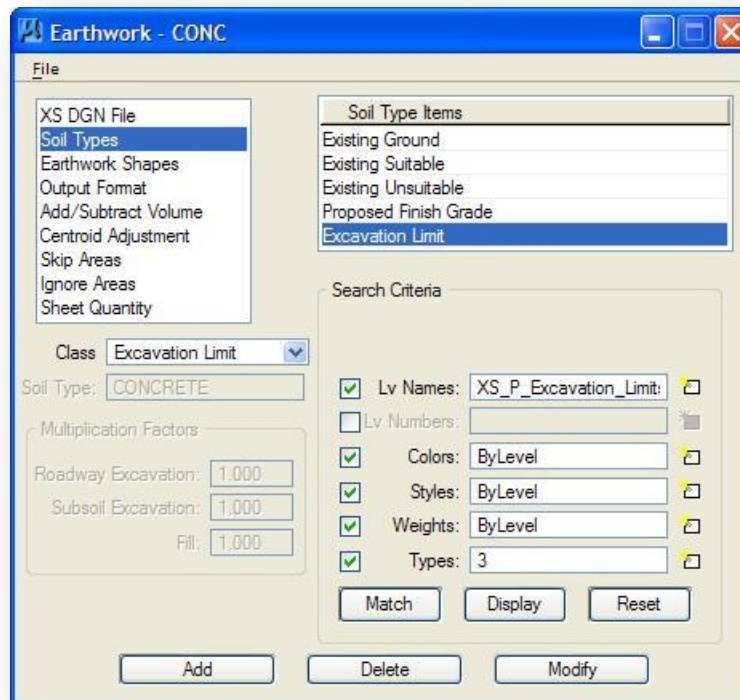
Unsuitable materials that are removed below the proposed pavement will always be backfilled using the Common Fill material, which has been previously defined as the Soil Type 203-EARTH.

7.7.4 Defining the Excavation Limits

Excavation Limits are required whenever the **Existing Suitable** or **Existing Unsuitable** items are used. Take the following steps to define the **Excavation Limits**:

- ✓ Select **Excavation Limit** from the **Class** option button.
- ✓ Define the symbology for the excavation limit elements.
- ✓ Select the **Add** button to add the **Excavation Limit** item to the list of **Soil Type Items**.

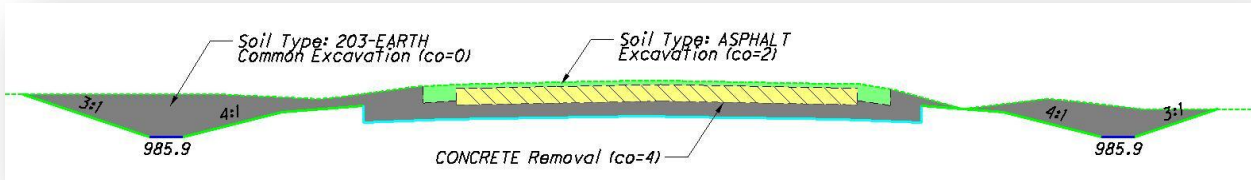
The settings for the Excavation Limits are shown below:



7.7.5 Processing Notes

The concrete removal areas can interface with the proposed cross section in one of three conditions, as detailed below:

Case 1: The proposed finished grade is below the existing pavement. The asphalt and concrete removal areas are totally enclosed by the excavation for the proposed cross section.



In the example above, three shapes are drawn on the cross section.

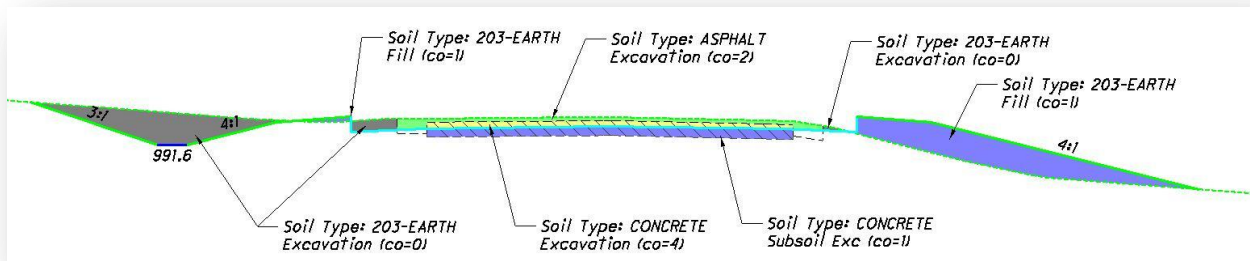
An example of earthwork quantities reported in the Earthwork Log file is shown below:

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate
56+50.00	203-EARTH					
	Common Exc	63.4	55	55	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	0.0	0	0	1.00	-15
	ASPHALT					
	Common Exc	18.2	17	17	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	0.0	0	0	1.00	2
	CONCRETE					
	Common Exc	36.7	34	34	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	0.0	0	0	1.00	2
	Mass ordinate for CONCRETE = 475					

The values reported in the Earthwork Log file are split by **Excavation**, **Subsoil Excavation**, and **Fill** for each Soil Type. In Case 1, everything is in cut so all the values are reported as Excavation quantities.

The areas for the ASPHALT Excavation and the CONCRETE Excavation are not included in the total for the 203-EARTH Excavation.

Case 2: The concrete removal, asphalt removal, or both are bisected by the proposed finished grade.



In the example above, eight shapes are drawn on the cross section delineating the earthwork areas. The values are reported in the Earthwork Log file, as shown below:

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate
55+25.00	203-EARTH					
	Common Exc	29.8	26	26	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	35.0	38	38	1.00	-237
	ASPHALT					
	Common Exc	16.0	14	14	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	0.0	0	0	1.00	-223
	CONCRETE					
	Common Exc	13.2	9	9	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	23.5	24	24	1.00	
	Fill	0.0	0	0	1.00	-223
	Mass ordinate for CONCRETE = 305					

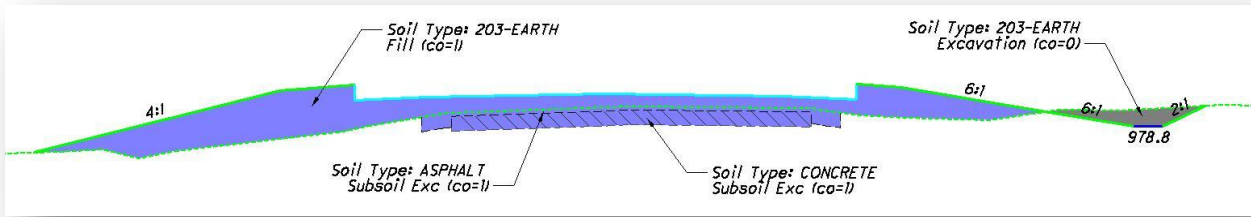
Notes about the quantities:

- The portion of the concrete pavement beneath the proposed cross section is reported as a “Subsoil Exc” item.
- The total concrete removal area for this cross section is obtained as follows:

$$\text{CONCRETE Excavation} + \text{CONCRETE Subsoil Exc} = \text{Total Concrete Removal}$$

- Had the proposed cross section intersected the asphalt removal area, the quantities for the ASPHALT item would have been split between the ASPHALT Excavation and Subsoil Exc items.
- The 203-EARTH Fill end area automatically includes the Subsoil Exc totals for the ASPHALT and the CONCRETE soil types. There is no need to add the Subsoil Exc values to the 203-EARTH Fill area to obtain the total.
- The ASPHALT Soil Type has been defined as an Existing Suitable material. As such, any portion of the material that is below the proposed subgrade is left in place. If you wish to have the ASPHALT removed, and subsequently backfilled, the ASPHALT Soil Type would need to be defined as an Existing Unsuitable material.

Case 3: The proposed finished grade is above the existing pavement. The asphalt and concrete removal areas are both beneath the proposed cross section.



In the example above, four shapes are drawn on the cross section. The shapes for the asphalt and concrete removal areas are drawn with the same color as the fill area.

The excavation and fill values are reported in the earthworks log file as shown below.

Station	Material Name	End Areas (sq. ft.)	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	Mass Ordinate
60+00.00	203-EARTH					
	Common Exc	11.7	15	15	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	0.0	0	0	1.00	
	Fill	143.7	106	106	1.00	1356
	ASPHALT					
	Common Exc	0.0	1	1	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	18.2	16	16	1.00	
	Fill	0.0	0	0	1.00	1373
	CONCRETE					
	Common Exc	0.0	0	0	1.00	
	Subgrade Exc	0.0	0	0	1.00	
	Subsoil Exc	36.6	34	34	1.00	
	Fill	0.0	0	0	1.00	1373
	Mass ordinate for CONCRETE = 950					

Notes about the quantities:

- The ASPHALT Subsoil Exc and the CONCRETE Subsoil Exc totals are included in the 203-EARTH Fill total.
- Even though the ASPHALT soil type has been defined as an Existing Suitable material, it must be removed to get to the Existing Unsuitable CONCRETE soil type that is below it.

7.7.6 Earthwork Log File: Grand Summary Totals

The Earthwork Log file includes a summary total, as shown in the example below:

G R A N D		S U M M A R Y		T O T A L S	
Material Name		Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	

203-EARTH					
	Common Exc	5795	5795	1.00	
	Subgrade Exc	0	0	1.00	
	Subsoil Exc	0	0	1.00	
	Fill	10972	10972	1.00	
ASPHALT					
	Common Exc	513	513	1.00	
	Subgrade Exc	0	0	1.00	
	Subsoil Exc	839	839	1.00	
	Fill	0	0	1.00	
CONCRETE					
	Common Exc	602	602	1.00	
	Subgrade Exc	0	0	1.00	
	Subsoil Exc	2206	2206	1.00	
	Fill	0	0	1.00	

Additional notes about the totals:

These notes apply to the Grand Summary Total, as well as the totals for the individual cross sections.

- The 203-EARTH Fill total includes the ASPHALT Subsoil Exc and the CONCRETE Subsoil Exc totals.
- If the backfilling of the existing concrete pavement removal is to be included with Item 202 Pavement Removal, it will be necessary to adjust the 203-EARTH Fill values as follows:

$$203\text{-EARTH Fill} - \text{CONCRETE Subsoil Exc} = 203\text{-EARTH total}$$

If the existing asphalt pavement is also to be backfilled using item 202, include it in the adjusted total as follows:

$$203\text{-EARTH Fill} - \text{CONCRETE Subsoil Exc} - \text{ASPHALT Subsoil Exc} = 203\text{-EARTH total}$$

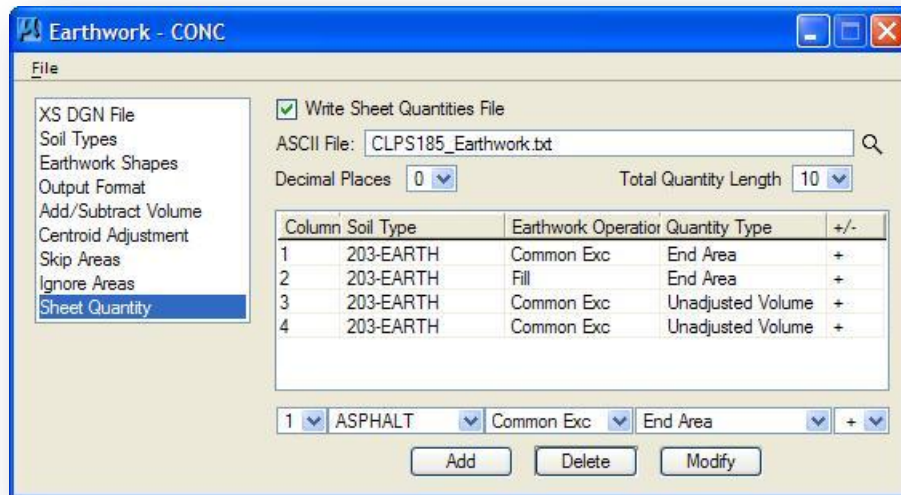
- The total ASPHALT removal volume is obtained by adding the ASPHALT Excavation and ASPHALT Subsoil Exc values together.
- If the ASPHALT is to be removed as part of the 203 Excavation, the values must be added together as follows:

$$203\text{-EARTH Excavation} + \text{ASPHALT Excavation} + \text{ASPHALT Subsoil Exc} = \text{Total Excavation}$$

- The total CONCRETE removal volume is obtained by adding the CONCRETE Excavation and CONCRETE Subsoil Exc values together.

7.7.7 Including the Concrete Removal in the Sheet Quantities

When the **Sheet Quantities** option is selected, the **Earthwork** dialog box will appear as shown below:



In addition to the columns previously defined for 203-EARTH excavation and fill quantities, it may be necessary to define additional columns to account for the asphalt and concrete removal, depending on how you wish to tabulate the quantities for your project.

Column 1

In the example above, Column 1 has been previously defined to contain the **Common Exc End Area** for the Soil Type 203-EARTH.

If the existing asphalt pavement is removed using Item 202 Pavement Removed, Asphalt, there is no need to make adjustments to the sheet quantities.

If the existing asphalt pavement is to be removed as part of the 203 Excavation item, the total excavation area for the cross section is computed as follows:

$$203\text{-EARTH Common Exc} + \text{ASPHALT Common Exc} + \text{ASPHALT Subsoil Exc} = \text{Total Excavation}$$

Take the following steps to add the **ASPHALT Common Exc End Area** to the list:

- ✓ Toggle the **Column** item to **1**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "ASPHALT"
- ✓ Toggle the **Earthwork Operation** item to **Common Exc**
- ✓ Toggle the **Quantity Type** to **End Area**
- ✓ Toggle the +/- option to **+**. This is used to add values defined for the same column together
- ✓ Select the **Add** button to add the item to the list

Next, add the **ASPHALT Subsoil Exc End Area** to the list:

- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**.
- ✓ Select the **Add** button to add the item to the list.

Both items are now included in the list, as shown below:

Column	Soil Type	Earthwork Operator	Quantity Type	+/-
1	203-EARTH	Common Exc	End Area	+
1	ASPHALT	Common Exc	End Area	+
1	ASPHALT	Subsoil Exc	End Area	+
2	203-EARTH	Fill	End Area	+
3	203-EARTH	Common Exc	Unadjusted Volume	+
4	203-EARTH	Common Exc	Unadjusted Volume	+

Column 2

Column 2 has been previously defined to contain the 203-EARTH Fill End Area. As stated previously, the Fill quantity includes the areas for the ASPHALT and CONCRETE Subsoil Exc totals. If these areas are to be backfilled using Item 203 Embankment, no additional computation is necessary.

If the pavement removal is to be backfilled using Item 202, then these areas must be subtracted from the 203-EARTH Fill total. Take the following steps to subtract the **ASPHALT Subsoil Exc** area:

- ✓ Toggle the **Column** item to **2**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "ASPHALT"
- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**
- ✓ Toggle the **Quantity Type** to **End Area**
- ✓ Toggle the +/- option to (-) to subtract the item from other values defined for the same column
- ✓ Select the **Add** button to add the item to the list

Next, add the **CONCRETE Subsoil Exc End Area** to the list:

- ✓ Select the **Soil Type** "CONCRETE"
- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**
- ✓ Select the **Add** button to add the item to the list as shown below

Both items are now included in the list as shown below.

Column	Soil Type	Earthwork Operator	Quantity Type	+/-
1	ASPHALT	Common Exc	End Area	+
1	ASPHALT	Subsoil Exc	End Area	+
2	203-EARTH	Fill	End Area	+
2	ASPHALT	Subsoil Exc	End Area	-
2	CONCRETE	Subsoil Exc	End Area	-
3	203-EARTH	Common Exc	Unadjusted Vol...	+

Column 3

Column 3 has been previously defined to contain the **Common Exc Unadjusted Volume** for the Soil Type 203-EARTH.

If the existing asphalt pavement is removed using Item 202 Pavement Removed, Asphalt, there is no need to make adjustments to the sheet quantities.

If the existing asphalt pavement is to be removed as part of the 203 Excavation item, the total excavation volume for the cross section is computed as follows:

$$203\text{-EARTH Common Exc} + \text{ASPHALT Common Exc} + \text{ASPHALT Subsoil Exc} = \text{Total Excavation}$$

Take the following steps to add the **ASPHALT Common Exc Unadjusted Volume** to the list:

- ✓ Toggle the **Column** item to **3**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "ASPHALT"
- ✓ Toggle the **Earthwork Operation** item to **Common Exc**
- ✓ Toggle the **Quantity Type** to **Unadjusted Volumes**
- ✓ Toggle the +/- option to (+) to add values defined for the same column together
- ✓ Select the **Add** button to add the item to the list as shown below

Next, add the **ASPHALT Subsoil Exc Unadjusted Volume** to the list:

- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**
- ✓ Select the **Add** button to add the item to the list as shown below

Both items are now included in the list as shown below.

Column	Soil Type	Earthwork Operation	Quantity Type	+/-
2	ASPHALT	Subsoil Exc	End Area	-
2	CONCRETE	Subsoil Exc	End Area	-
3	203-EARTH	Common Exc	Unadjusted Volume	+
3	ASPHALT	Subsoil Exc	Unadjusted Volume	+
3	ASPHALT	Common Exc	Unadjusted Volume	+
4	203-EARTH	Common Exc	Unadjusted Volume	+

Column 4

Column 4 has been previously defined to contain the **203-EARTH Fill Unadjusted Volume**. As stated previously, the Fill quantity includes the volumes for the ASPHALT and CONCRETE Subsoil Exc totals. If these areas are to be backfilled using Item 203 Embankment, no additional computation is necessary.

If the pavement removal is to be backfilled using Item 202, then these volumes must be subtracted from the 203-Earth Fill Unadjusted Volume total. Take the following steps to subtract the **ASPHALT Subsoil Exc** volumes:

- ✓ Toggle the **Column** item to **4**
- ✓ Toggle the **Decimal Places** item to **0**
- ✓ Select a value of **10** for the **Total Quantity Length**
- ✓ Select the **Soil Type** "ASPHALT"
- ✓ Toggle the **Earthwork Operation** item to **Subsoil Exc**
- ✓ Toggle the **Quantity Type** to **Unadjusted Volume**
- ✓ Toggle the +/- option to (-) to subtract the item from other values defined for the same column
- ✓ Select the **Add** button to add the item to the list

Next, add the **CONCRETE Subsoil Exc End Area** to the list:

- ✓ Select the **Soil Type** "CONCRETE"
- ✓ Select the **Add** button to add the item to the list as shown below

Both items are now included in the list as shown below.

Column	Soil Type	Earthwork Operator	Quantity Type	+/-
3	203-EARTH	Common Exc	Unadjusted Volume	+
3	ASPHALT	Subsoil Exc	Unadjusted Volume	+
3	ASPHALT	Common Exc	Unadjusted Volume	+
4	203-EARTH	Common Exc	Unadjusted Volume	+
4	ASPHALT	Subsoil Exc	Unadjusted Volume	-
4	CONCRETE	Subsoil Exc	Unadjusted Volume	-

After defining the Sheet Quantity items, continue to process the earthworks run as defined previously in this training guide. The quantities for the ASCII file will now include the concrete removal end areas and volumes.

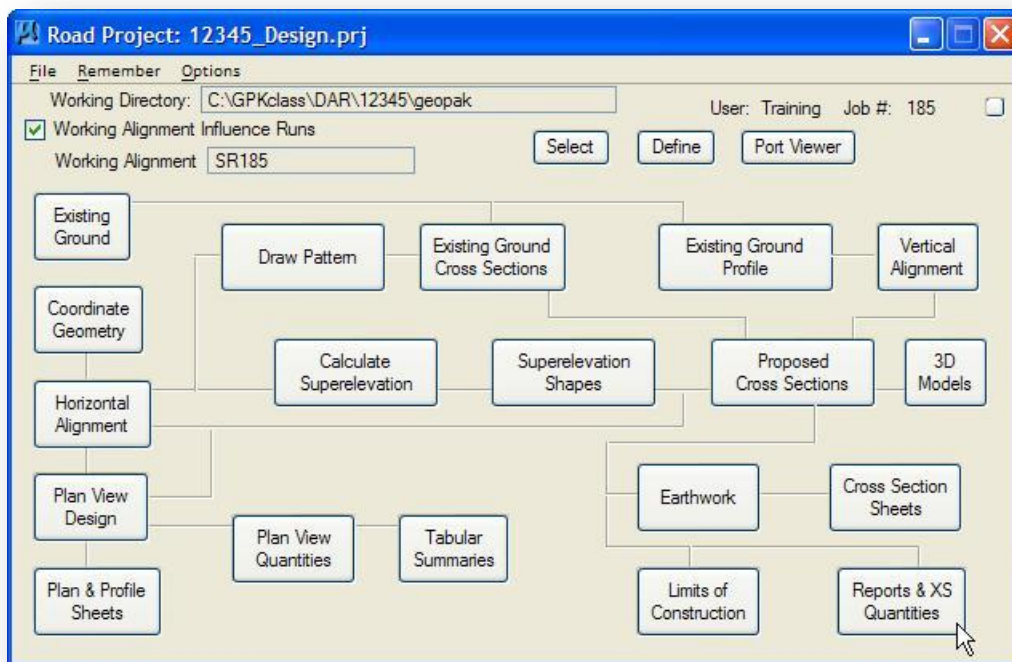
8 Seeding Quantities

8.1 Overview

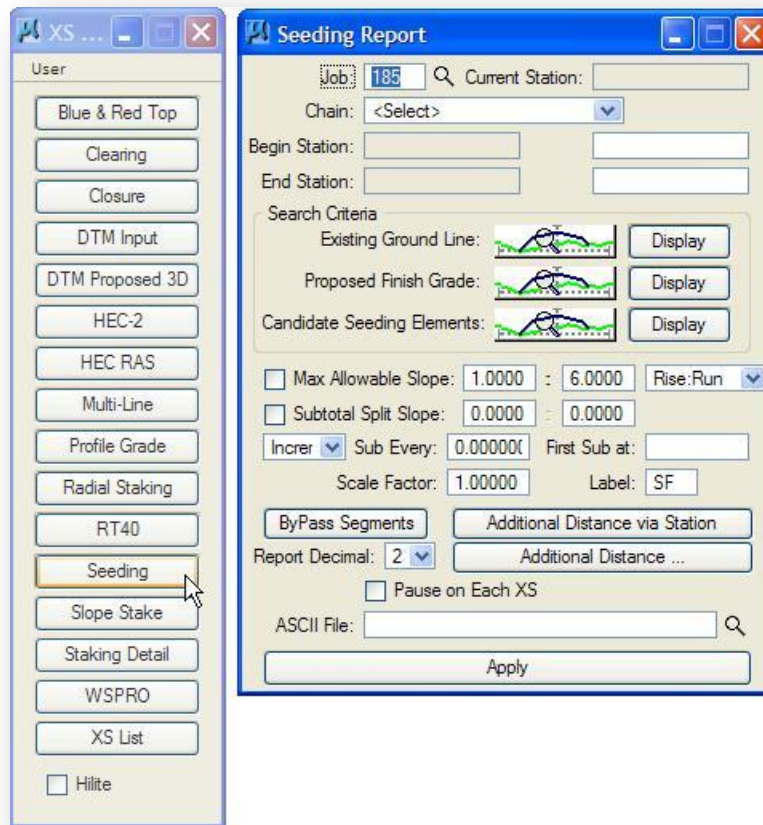
GEOPAK provides the capability to calculate seeding quantities from cross section elements and save them to an ASCII text file. GEOPAK currently does not provide the capability to place seeding quantities from the seeding report file onto the cross section sheets.

8.2 Generating Seeding Quantities

To generate a seeding report, select **Reports and XS Quantities** from the *Road Project* dialog to access the *XS Report* dialog shown on the following page.



Select **Seeding** from the *XS Report* dialog to access the *Seeding Report* dialog shown at right below.



Information stored in the GEOPAK Project Manager **Working Alignment Definition** can be shared with the *Seeding Report* dialog box. The following information is taken from the active **Working Alignment** definition:

- ✓ **Job** - The GEOPAK COGO data base job number.
- ✓ **Chain** - The name of the COGO Chain from which to extract seeding quantities.
- ✓ **Beg Station** - The station of the first cross section available for the selected chain.
- ✓ **End Station** - The station of the last cross section available for the selected chain.
- ✓ **Existing Ground Line** - The symbology for the cross section elements that make up the existing ground.
- ✓ **Proposed Finish Grade** - The symbology for the cross section elements that make up the proposed grade.

The remaining dialog box items are described below.

Report Decimal

Report Decimal: 2

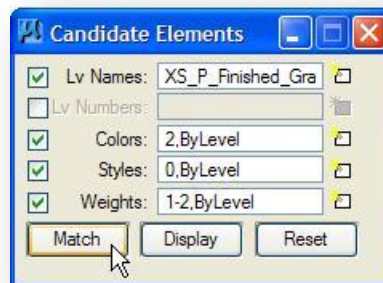
The **Report Decimal** (number of decimal places for the slope distance values) options range from zero to six. All area calculations are based upon this rounded value.

Candidate Seeding Elements

This section is used to define the symbology of the cross section elements that will be used by GEOPAK to calculate the seeding quantities. Press the **Match** button. The software prompts you to identify and accept an element. When accepted, its symbology is added to the *Candidate Elements* dialog as shown below.

ODOT's criteria files place graphics that can be used as the **Candidate Seeding Elements** on the following levels:

- XS_P_Finished_Grade
- XS_P_Finished_Grade_Seeded
- XS_P_Ditch_Bottom



Max Allowable Slope

Max Allowable Slope: 1.0000 : 6.0000 Rise:Run

This option dictates 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 button specifies **Run:Rise** or **Rise:Run**. If this option is desired, simply activate the toggle to the left.

Subtotal Split Slope

 Subtotal Split Slope: 0.0000 : 0.0000

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.

Subtotals are provided at the user-defined intervals defined by **Sub Every** key-in field. The **Incr** or **Even** option button specifies whether the distances should be calculated along the alignment or whether the distances should be rounded to the even station. The **First Sub At** key-in field identifies the first subtotal station as well as the station from which subtotals are calculated.

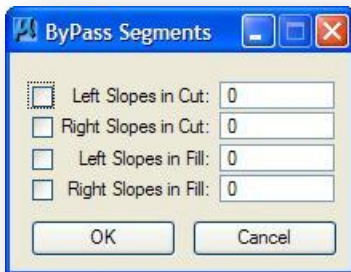
Scale Factor

Scale Factor: 0.11111 Label: SY

By default GEOPAK will report seeding areas in square feet. For ODOT plans the seeding areas should be reported in square yards. This can be accommodated by use of the **Scale Factor** option. To force GEOPAK to report seeding areas in square yards, change the **Scale Factor** and **Label** settings to those shown above.

ByPass Segments

Pressing the **ByPass Segments** opens the dialog shown below:



The dialog box titled "ByPass Segments" contains four options, each with a checkbox and a text input field:

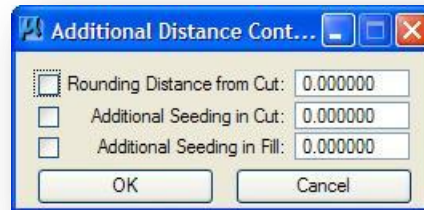
- Left Slopes in Cut: 0
- Right Slopes in Cut: 0
- Left Slopes in Fill: 0
- Right Slopes in Fill: 0

At the bottom of the dialog are "OK" and "Cancel" buttons.

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 examines the segments that tie to existing ground. When the software encounters a condition that has been activated, it will ignore the specified number of segments at the tie down point that extend towards the centerline.

Additional Distance

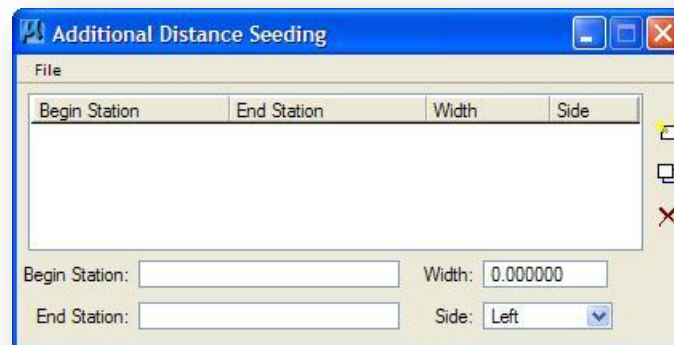
Pressing the **Additional Distance** push button opens the following dialog.



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 segments that tie to existing ground. When the software encounters an activated condition, it will add (or subtract if the value is a negative number) the specified horizontal distance value (in master units) to the measured distance on the cross-section.

Additional Distance via Station

If the additional seeding is not consistent throughout the project, pressing the **Additional Distance via Station** button invokes the dialog shown below, where Additional Distances can be specified by station range, right, left, or right and left.




Key-in the desired stations and **Width**, and then select the **Side** option. Press the **Add** button, 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** button. The list box updates to the edited data. To delete a line, simply highlight the line, then press the Delete button.

Pause on Each XS

Pause on Each XS

An option for processing sections one at a time may be used by activating the **Pause on Each XS** toggle. 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 Sta** 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** button on the bottom of the dialog.

ASCII File

ASCII File: 

At the bottom of the dialog, you can 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 **File** button, the Files dialog will appear, allowing the designer to select the desired file. The file will be placed in the working directory, if a full path is not 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** button to begin the report generation. A portion of the seeding report is shown on the following page.

SEEDING REPORT

```

NUMBER OF LEFT CUT SLOPES TO BE BYPASSED = 0
NUMBER OF LEFT FILL SLOPES TO BE BYPASSED = 0
NUMBER OF RIGHT CUT SLOPES TO BE BYPASSED = 0
NUMBER OF RIGHT FILL SLOPES TO BE BYPASSED = 0
ROUNDING DISTANCE FROM CUT SLOPE STAKE = 0.00 Ft
MAXIMUM ALLOWABLE SLOPE FOR SEEDING/SODDING = ****
ADDITIONAL SEEDING LEFT SIDE = 0.00 Ft
ADDITIONAL SEEDING RIGHT SIDE = 0.00 Ft
ADDITIONAL SEEDING IN CUT = 10.00 Ft
ADDITIONAL SEEDING IN FILL = 10.00 Ft
SUBTOTALS EVERY 500.0000 Ft BEGINNING AT STATION 53+00.000 R 1 METHOD INCR
SCALING FACTOR = 0.11111 WITH LABEL [ SY ]
    
```

STATION	SLOPE DISTANCE		AVERAGE SLOPE DIST		A R E A		SY	SUBTOTAL	A R E A		SY
	LT	RT	LT	RT	LT	RT	BOTH		LT	RT	BOTH
53+00.000 R 1	35	42						0	0	0	
	(	77)	35	42	97	117	214			
53+25.000 R 1	34	42									
	(	76)	34	42	94	117	211			
53+50.000 R 1	33	42									
	(	75)	33	43	92	119	211			
53+75.000 R 1	33	43									
	(	76)	33	43	92	119	211			
54+00.000 R 1	32	42									
	(	74)	32	42	89	117	206			

The report is separated into columns with the various quantities. For ODOT cross section sheets, the **SLOPE DISTANCE (TOTAL)** and the **SY BOTH** values are to be shown on the final cross section sheets.

8.3 Adding Seeding Quantities to the Cross Section Sheets

When cross section sheets are generated, GEOPAK provides the ability to add the earthwork quantities to the cross section sheets by reading an earthworks report file. However, GEOPAK does not provide the capability to automatically place seeding quantities on the cross section sheets directly from the seeding report. The following options are available to place the seeding quantities on the cross section sheets:

- The seeding quantities can be added to the Earthworks report, using an ODOT provided program, and subsequently placed on the cross section sheets. This procedure is detailed in Chapter 10 of this guide.
- Users can manually place the seeding quantities on the cross sections sheets using MicroStation commands as detailed below.

8.3.1 Manually Placing Seeding Quantities on Cross Section Sheets

The first two stations from a sample seeding report are shown below.

STATION	SLOPE DISTANCE		AVERAGE SLOPE DIST		A R E A		SY BOTH	SUBTOTAL LT	A R E A		SY BOTH
	LT	RT	LT	RT	LT	RT			LT	RT	
53+00.000 R 1	35	42						0	0	0	
	(	77)	35	42	97	117	214			
53+25.000 R 1	34	42									
	(	76)	34	42	94	117	211			

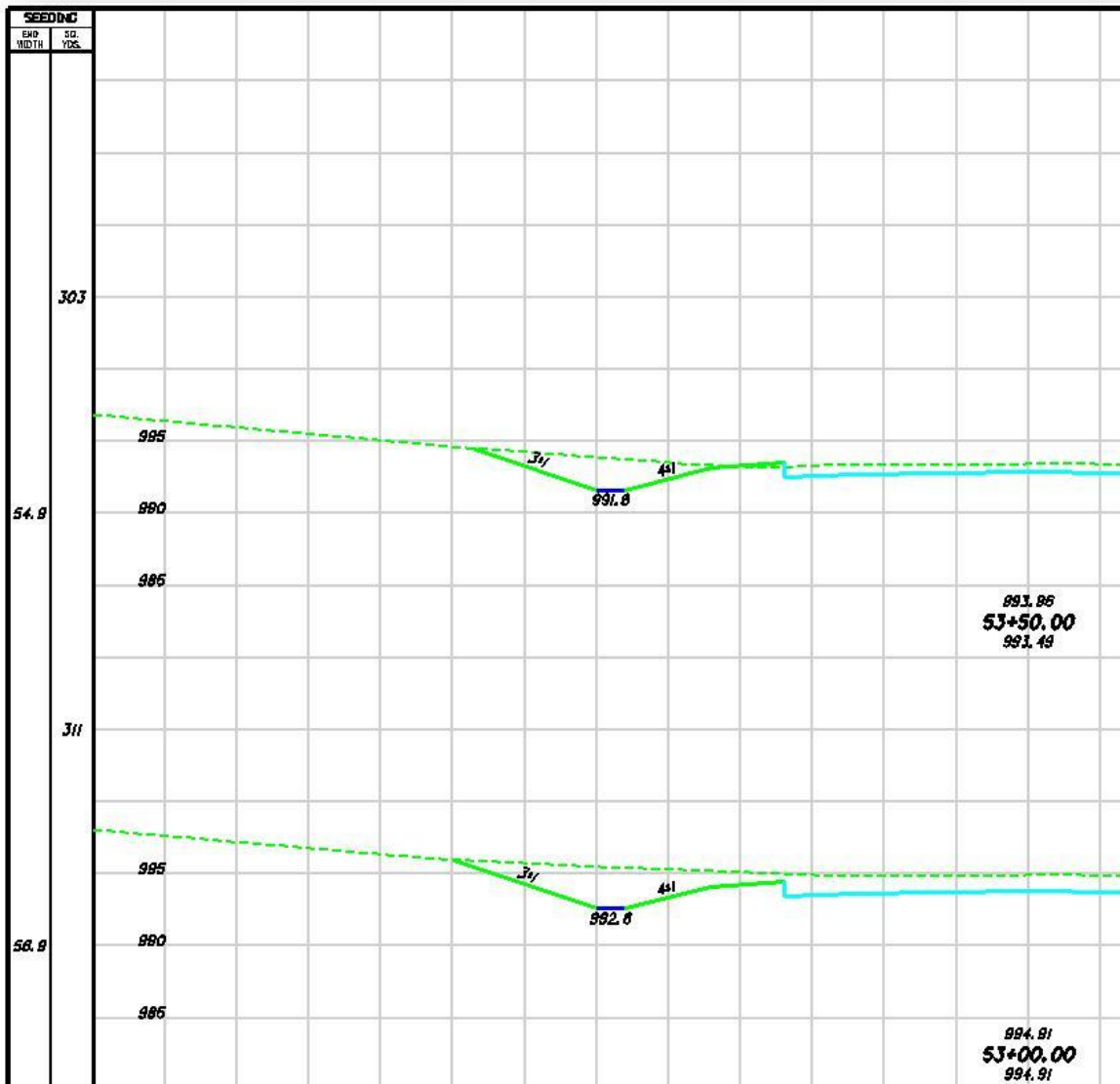
For ODOT cross section sheets, the **SLOPE DISTANCE (TOTAL)** and the **SY BOTH** values are to be shown on the final cross section sheets.

Placing the End Width Quantity

The quantity at station 53+00 R 1 under the heading "SLOPE DISTANCE" represents the seeding end width for the "LT" and "RT" sides of the cross section. Directly beneath the individual left and right side quantities is the (TOTAL) quantity for the station. This quantity should be placed on the cross sections in the **End Width** column as shown in the example on the following page.

Placing the End Area Quantity

The quantity at station 53+00 R 1 shown under the heading "SY Both" represents the seeding area between stations 53+00 R 1 and 53+50 R 1. This quantity should be placed in the cross section in the **SQ. YDS.** column as shown in the example on the following page.



Exercise 8

Using the chapter as a guide, generate the seeding quantities for S.R. 185.

9 Limits of Construction

9.1 Overview

Two options are available to plot the construction limits in the plan view basemap file. Each option has advantages and disadvantages as described below:

GEOPAK Limits of Construction

Construction limits can be automatically plotted in the plan view design file using the GEOPAK **Limits of Construction** command. This command is used to locate the tie down points where the proposed cross section graphics meet the existing ground line. The offset from the cross section centerline to the tie down point is measured and a line is placed in the Plan View design file using these offsets.

Advantages

- The construction limits are generated directly from the tie down points of the proposed cross section graphics. Manual edits to the cross sections are automatically accounted for when the construction limits are processed.

Disadvantages:

- Typically construction limit lines are shown an additional four feet outside the tie down points. Unfortunately, the GEOPAK **Limits of Construction** command cannot accommodate placing the construction limit lines an additional distance from the tie down points. It is necessary to use the Move Parallel command to offset the construction limit graphics after they have been plotted in the plan view basemap.

Criteria “Key Point” Text

ODOT’s side slope criteria files place a piece of text on each cross section at the construction limit location. The offset of these text elements can be read from the cross sections to generate a COGO chain representing the construction limit line. The GEOPAK Design and Computation Manager can be used to plot the construction limit chains in the plan view basemap.

Advantages:

- The construction limit text is placed at an offset from the tie down point. The offset value is defined during the criteria processing. There is no need to use the Move Parallel command to modify the construction lines in the plan view once they have been plotted.

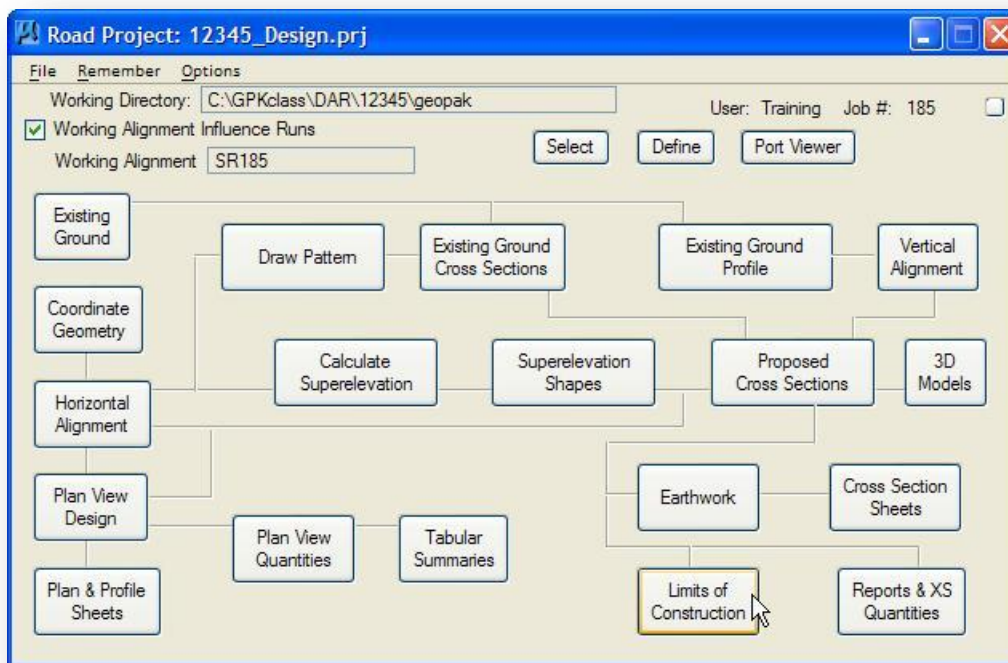
Disadvantages:

- If the cross section graphics are manually edited the user must also modify the location of the key point text. The text must be moved carefully as the text origin must fall directly on the existing ground line in order for GEOPAK to recognize it.

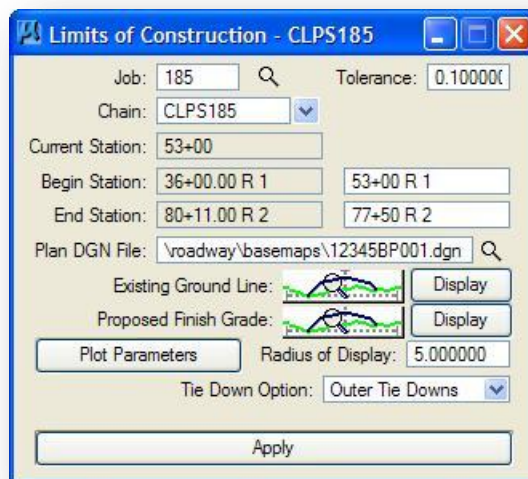
The method used is a matter of personal preference. Each method is presented in the following sections.

9.2 GEOPAK Limits of Construction

The **Limits of Construction** dialog is accessed from the Road Project dialog as shown below.



It can also be accessed by selecting **Applications > Road > Cross Sections > Limits of Construction**. After creating a new Run, the dialog below is opened.



The following dialog items are read from the current GEOPAK Working Alignment definition:

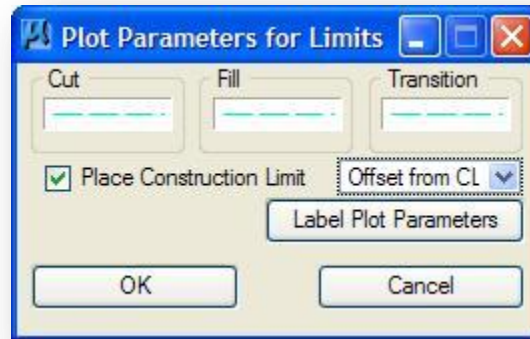
- ✓ **Job** - The GEOPAK COGO data base job number.
- ✓ **Chain** - The name of the COGO Chain from which to extract seeding quantities.

- ✓ **Beg Sta** - The station of the first cross section available for the selected chain.
- ✓ **End Sta** - The station of the last cross section available for the selected chain.
- ✓ **Plan DGN File** – The name of the design file used to plot the construction limit lines
- ✓ **Existing Ground Line** - The symbology for the cross section elements that make up the existing ground.
- ✓ **Proposed Finish Grade** - The symbology for the cross section elements that make up the proposed grade.

The remaining dialog items are described below:

Plot Parameters

The **Plot Parameters** item is used to define the symbology for the construction limit lines plotted in the **Plan DGN file**.



Separate symbologies can be set for the construction limit lines to designate whether the cross sections are in Cut, Fill, or transitioning between the two. For ODOT projects, the symbology should be set as follows:

Level	RW_P_Const_Limits
Color	ByLevel
Style	ByLevel
Weight	ByLevel

Tie Down Option

Two options are provided. Set this to **Outer Tie Downs** for most ODOT projects.

Tie Down Option: Outer Tie Downs

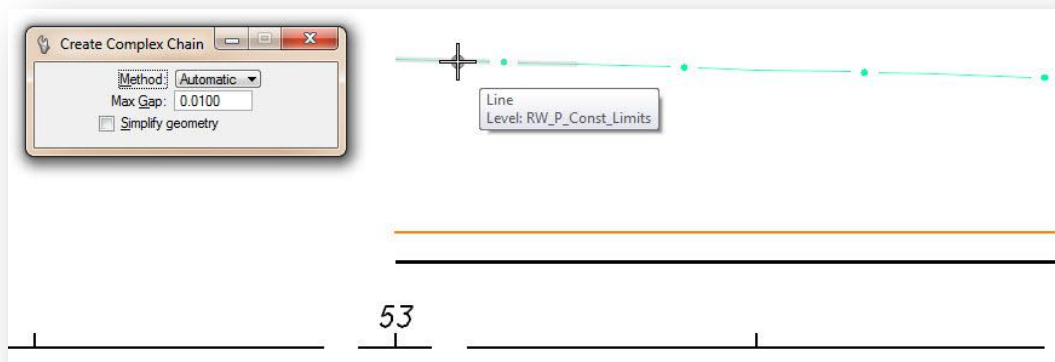
Apply

Select **Apply** to initiate the process. The construction limit lines are drawn in the **Plan DGN File**.

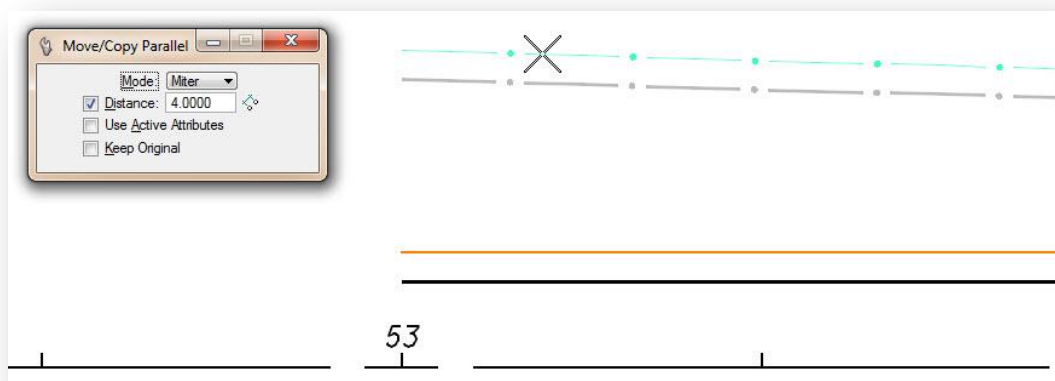
The construction limits are drawn as individual line elements in the plan view design file with the endpoints of the lines defined by the cross section tie down point offset from the centerline.

Typically, construction limits are shown an additional four feet outside the tie down points. The MicroStation **Move Parallel** command can be used to move the construction limit lines an additional four feet from the centerline. Since the construction limits are placed as a series of line elements, connecting the lines as a complex chain will make it easier to move the construction line as one element rather than moving the individual line segments. Take the following steps to create a complex chain from the construction limit lines and move the resulting complex chain by the four foot construction limit offset.

- ✓ Set the MicroStation Active Level to RW_P_Const_Limits
- ✓ Select the MicroStation **Create Complex Chain** command using the settings below. Pick the first line segment of the construction limit lines, accept the element. The **Automatic Method** will automatically make a complex chain out of all the connected elements.



- ✓ Select the **Move Parallel** command. Use the **Miter Mode** to move the construction limit line four feet parallel as shown below.

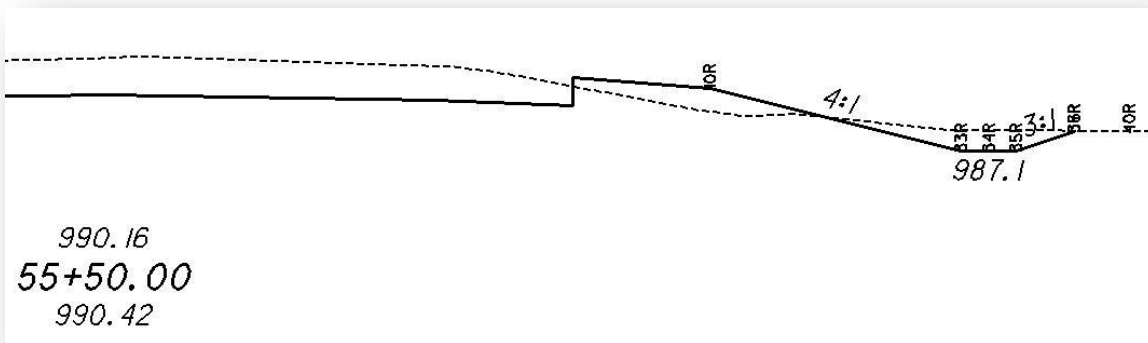


9.3 The Profile Grade Report

The **GEOPAK Profile Grade Report** can be used to search the cross sections design file for the key point text in order to generate a COGO chain and/or profile. COGO chains are generated by measuring the offset from the centerline of the cross section to the origin of the “key point” text. Profiles are generated by measuring the cross section elevation at the origin of the “key point” text.

9.3.1 Criteria “Key Point” Text

ODOT’s side slope and median criteria files are configured to place text at specific “key points” along the proposed cross section lines as shown in the figure below.



The marked point numbers are the same on the left and right side of the cross sections. Points on the left side are appended with the letter “L”. Points in the median are appended with the letter “M”. Points on the right side are appended with the letter “R”. The “key point” text is placed on the following level:

`XS_P_Text_MarkedPoint.`

The marked point numbers are as follows:

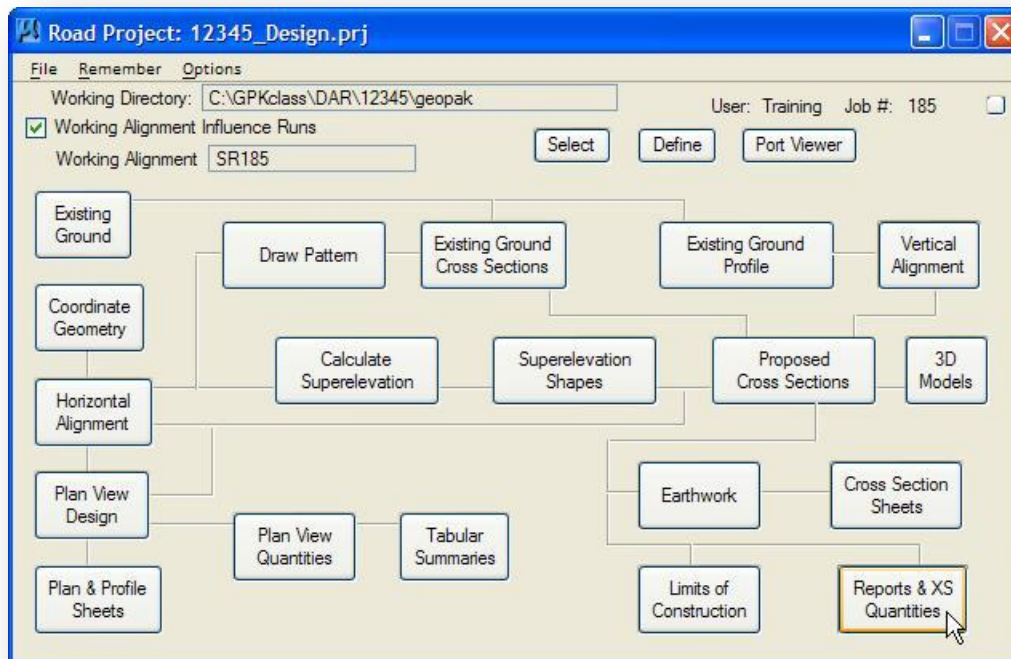
Point Location	Point number
Edge of graded shoulder	10
Inside edge of ditch	33
Center of ditch	34
Outside edge of ditch	35
Backslope break point	36
Proposed to existing ground	37
Construction limits	40

In order for the GEOPAK Profile Grade report to function properly, the marked point text must fall on the cross section graphics within a user specified tolerance. If the user has made some edits to the

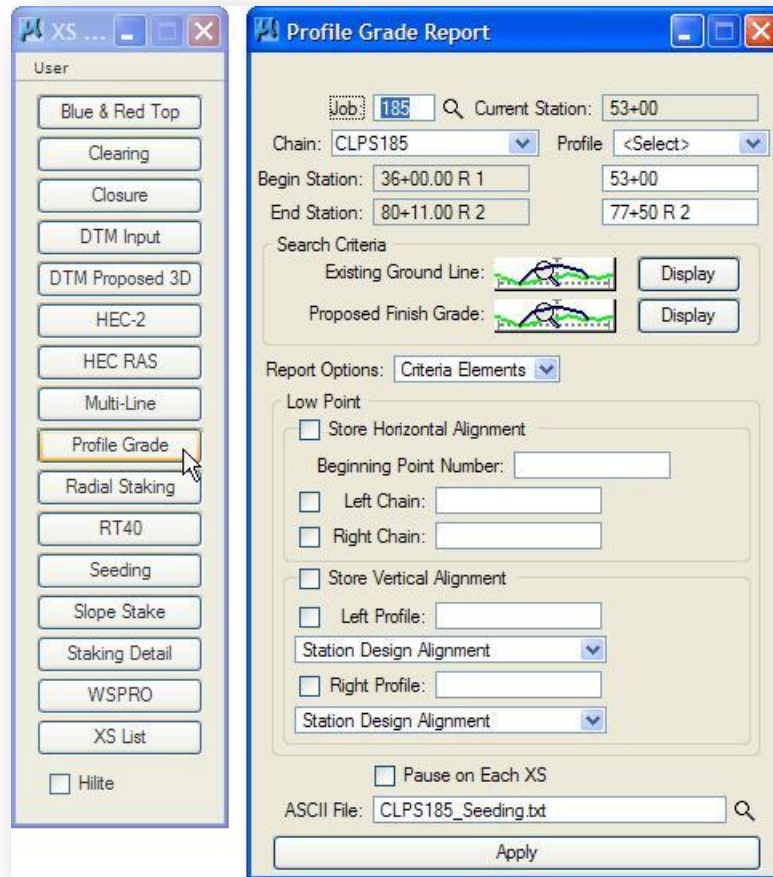
proposed cross section graphics, to move the ditches or change the backslope for example, the marked point text must be moved along with it in order to be used to store chains or profiles in COGO using the Profile Grade report.

9.3.2 Processing the Profile Grade Report

The **Profile Grade Report** is accessed from the GEOPAK *XS Report* dialog box. To access the *XS Report* dialog box, select **Reports & XS Quantities** from the *Road Project* dialog as shown below:



The *XS Report* dialog has a variety of cross section reports. Each report is detailed on the GEOPAK on-line help. This chapter will focus on the **Profile Grade Report**. Select **Profile Grade** to access the *Profile Grade Report* dialog shown on the following page.



When the *Profile Grade Report* dialog is opened, information stored with the GEOPAK **Working Alignment** is shared with the *Profile Grade Report* dialog box. The following information is taken from the active Working Alignment:

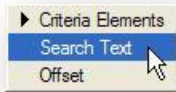
- ✓ **Job Number** - The GEOPAK COGO data base job number.
- ✓ **Chain** - The name of the COGO Chain that was used to extract the cross sections.
- ✓ **Existing Ground Line** - The symbology for the elements that make up the existing ground line.
- ✓ **Proposed Finish Grade** - The symbology for the elements that make up the proposed finish grade.

The remaining dialog items are described on the following pages.

Beg Sta/End Sta

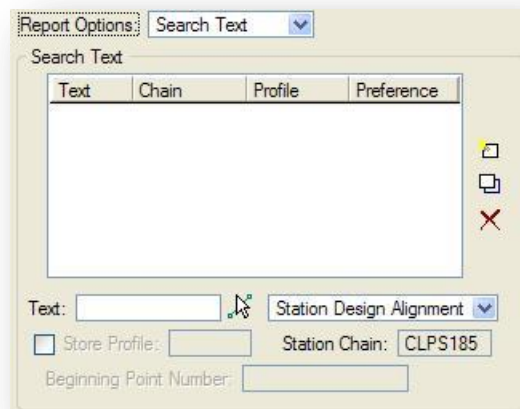
GEOPAK determines the beginning and ending station from the cross sections within the MicroStation file. They are noted below the chain and placed in the key-in areas. If these defaults are used, the report is generated for the entire file. However, if a report for a smaller range is required, the user can simply key in the required beginning and/or ending station.

Three options are supported in the center of the dialog:



- The **Criteria Elements** option uses graphic cross section elements to store a chain and/or profile by finding the low points along the proposed cross section
- The **Search Text** option uses text placed during the proposed cross section processing to store chains and/or profiles.
- The **Offset** option creates a profile for any given chain and offset value.

Use the **Search Text** option to store a chain at the location of the construction limits by reading the criteria Key-Point text. When the **Search Text** option is selected, the center portion of the dialog dynamically changes as shown below.



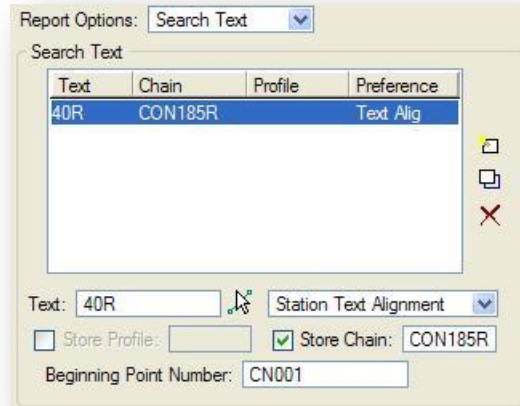
The **Store Text** item is used to identify the marked point text for which you wish to search for in the cross section design file. For this example, we will search for the text 40R to store a chain representing the construction limits on the right side of the cross sections.

Two options are available to control how the new chain and/or profile will be stationed as described below.

Sta Design Alignment - With this option selected, you can only store a COGO profile, not a COGO chain. The stationing of the **Chain** listed in the top of the dialog will be used for the new profile.

Sta Text Alignment - With this option selected, you can store a COGO chain and/or profile. The chain and/or profile will be stored with a beginning station of 0+00. When **Sta Text Alignment** is selected, the dialog dynamically changes to allow the user to store a chain as shown below.

The **Add** button is used to add the **Text, Chain, Profile** and **Preference** to the list box as shown below. Once a group of text parameters has been added to the list box, you can use the **Delete** or **Modify** button to remove the text item from the list, or to modify the value of the selected item.



The **Beginning Point Number** field is used to identify the first point number for the stored COGO chain. Points will be stored incrementally for the total number of cross sections processed.

IMPORTANT!!! If you select a point number that already exists in the COGO database, the points will be overwritten without notification, even if the COGO **Redefine** option is toggled off.

The **ASCII File** option is used to specify the name of the file that will contain a list of the COGO commands used to store the chain.

There is one important limitation of the **Profile Grade Report** that we must consider before processing. This function was written with the assumption that the user would always be searching for text that lies on the **Proposed Finished Grade**. In the case of construction limits, the text 40L and 40R are outside the **Proposed Finished Grade** and lie on the existing ground line. In order for the **Profile Grade Report** to pick up the text 40L and 40R you need to change the symbology settings for the **Proposed Finished Grade** to be the same as the **Existing Ground Line**.

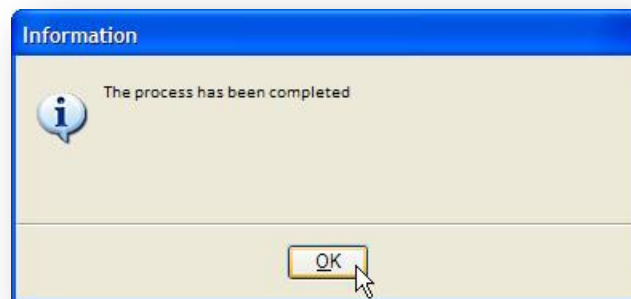
Select the **Proposed Finish Grade** item from the **Search Criteria** group to define the symbology for the Proposed Finished Grade.



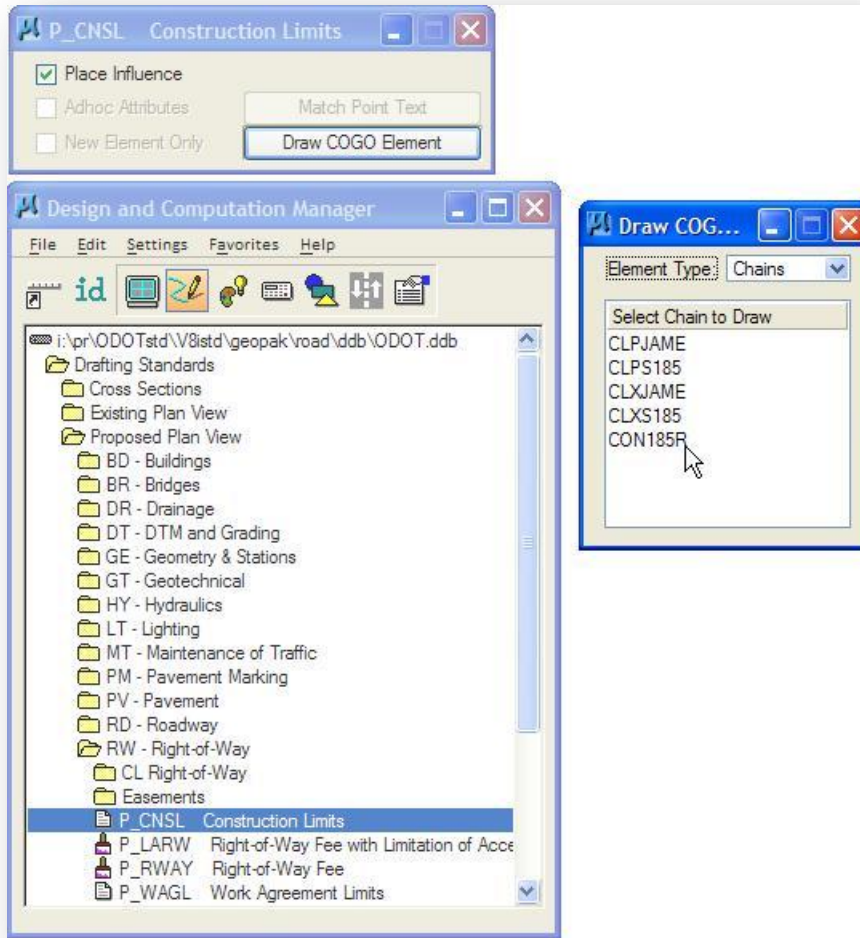
Set the symbology as shown on the following page.



Select **Apply** to begin processing. After processing, the following dialog will appear.



New profiles and/or chains are stored in the COGO database. In this example, one chain was stored representing the location of the construction limits for the right side of the cross section. The chain can be plotted in the plan view design file using the **Design and Computation Manager** as shown on the following page.



After selecting the Construction Limits item, as shown above, select **Draw COGO Element** to access the *Draw* dialog shown on the right. Toggle the **Operation** to **Chains** and select the name of the chain that you would like to plot using the Construction Limits symbology. The construction limits are plotted on level **RW_P_Const_Limits**.

9.4 Exercise 9

Use the key-point text 40R and 40L to save two COGO chains representing the construction limits.

- According to Section 305.2 of the [ODOT CADD Engineering Standards Manual](#), what should you assign as the Beginning Point Number?
- According to Section 305.2 of the [ODOT CADD Engineering Standards Manual](#), what should you assign as the name for the COGO chains representing the construction limits?
- Plot the construction limits in the file 12345bp001.dgn using the D&C Manager.

10 Cross Section Sheets

10.1 Overview

The GEOPAK Cross Section sheet layout command provides a tool to generate cross section sheets from cross section graphics. Each cross section is referenced into the sheet design file to compile the cross section sheets.

As the sheets are processed, the earthwork quantities can be included on the sheets. Most ODOT projects require cross section sheets early in the design process, before the quantities have been generated. GEOPAK does not provide an automated way to add, or update, the quantities to the sheets once they have been generated. The only method GEOPAK provides to update the quantities is to reprocess the sheets, discarding the previous sheet design file(s).

ODOT has provided three MicroStation Visual Basic applications to assist the user with preparing the cross sections for the sheet clipping process. These tools can be used to include the earthwork and seeding quantities on the sheets without the need to reprocess the sheets. These applications are summarized below:

ODOT_CombineQuantities.exe

This application is used to read GEOPAK Earthworks and Seeding quantity output files to combine the quantities in one text file that can be used to place the earthwork and seeding quantities on the cross sections.

ODOT_XSBoundary.mvba

This application is used to draw a boundary element on the GEOPAK Cross Section cells. The boundary element is useful to define the clipping limits of each cross section when clipping the cross section sheets using GEOPAK. Additionally, the boundary element contains insertion points for cross section quantities.

ODOT_XSQuantities.mvba

This application is used to place earthwork and seeding quantities in a cross section boundary element created using the ODOT_XSBoundary.mvba application. The quantities are read from the file created using the CombineSeedine.exe application.

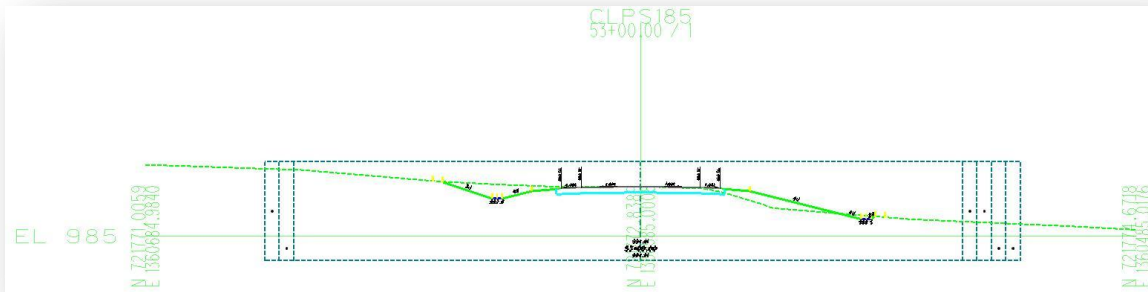
These applications are documented in detail on the ODOT website:

http://www.dot.state.oh.us/Divisions/Engineering/CADDMapping/CADD/MicroStation%20Applications/ODOT_XS_Utilities.pdf

Each application is briefly summarized on the following pages.

10.2 ODOT_XSBoundary.mvba

The **ODOT_XSBoundary.mvba** application is used to draw a boundary around a GEOPAK Cross Section similar to the one shown in the example below.



The boundary element is drawn at the width of a standard ODOT Cross section sheet cell and includes columns for the cross section quantities. The bounding element is intended to be used when clipping cross section sheets to set the **XS Search Criteria** limits for each cross section. This is explained in further detail on page 10-18.

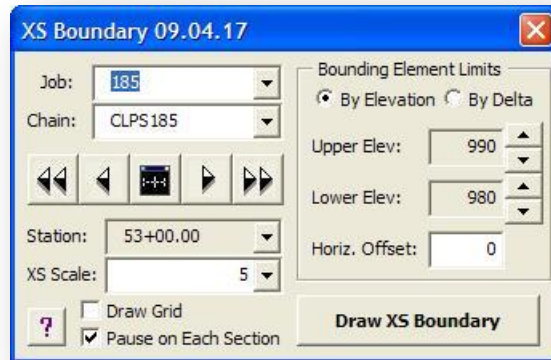
When clipping cross section sheets with GEOPAK, there are several advantages to using a bounding element to define the **XS Search Criteria**:

- Using a bounding element allows you to define the **XS Search Criteria** symbology for only one element rather than selecting each element that is drawn on the cross sections.
- Any cross section that does not have a bounding element will not be included on the final cross section sheets. This allows you to easily control which sections actually appear on the completed sheets without deleting cross sections or cross section cells.
- The boundary element is beneficial when drawing and labeling graphics in the cross section cell design file to ensure that your new graphics will fit within the reference file clipping limits of the cross sections on the completed sheets.
- Cross section quantities can be imported into the cross section cell design file using the **ODOT_XSQuantities.mvba** application, and subsequently referenced to the cross section sheets. This allows users to easily update earthworks and seeding quantities without re-clipping the cross section sheets.

To run **ODOT_XSBoundary.mvba**, select **ODOT > XS Utilities > XS Boundary** from the MicroStation pull down menu, or key in the following command in MicroStation:

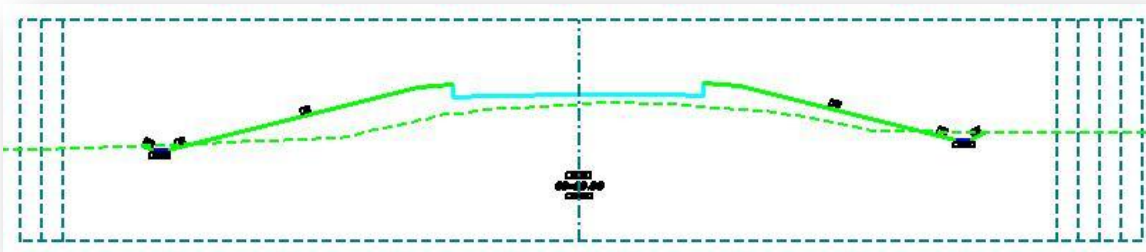
```
vba load ODOT_XSBoundary.mvba;vba run xsBoundaryMain
```

The dialog shown below will appear.



The XS Boundary element is initially displayed as temporary graphics using a weight zero dotted line. When the **Draw XS Boundary** button is selected, the boundary is drawn in the file as shown below, using the following symbology:

Level Name = XS_P_Boundary
Color = 131



Tip:

The vertical limits of the clipping border will determine the vertical extent of each cross section on the completed sheets. With this in mind, the clipping limits don't necessarily have to be set as tightly as possible on each cross section. You can allow some extra space to control how many cross sections will appear on the completed sheets. For example, on a 5-scale cross section sheet, there are 21 horizontal grid lines encompassing 105' of vertical cross section space per sheet. If you wish to place three cross sections on each cross section, draw the boundary elements with no more than 35' vertically for each cross section. If you wish to have four cross sections on a sheet, draw each border with a vertical extent of 25'. Etc...

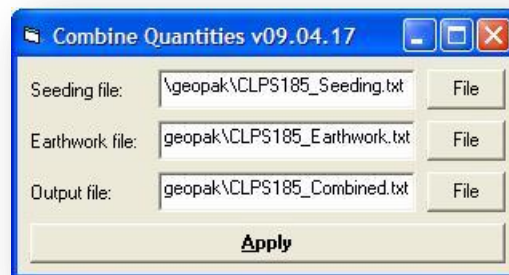
10.3 ODOT_CombineQuantities.exe

Chapter 7 – Earthwork Quantities details the process to generate cut and fill quantities for the cross sections. The resulting quantities are output to an ASCII text file that can be used to place the quantities on the cross section sheets when the sheets are clipped.

GEOPAK also provides the capability to generate seeding quantities as detailed in the Chapter 8 – Seeding Quantities. The seeding file is not in a format that can be included on the cross section sheets.

ODOT_CombineQuantities.exe is used to read the seeding quantity output file and append these quantities to the earthworks text file. With the quantities combined into one file, both the earthwork and seeding quantities can be included on the cross section sheets.

The application can be accessed from the MicroStation pull down menu by selecting **ODOT > XS Utilities > Combine Quantities**. The dialog shown on the following page is opened.



Select the GEOPAK **Seeding File** and the **Earthwork File** to combine. Key-in the name of the **Output file** to be created by the application. Select **Apply** to append the seeding quantities to the earthwork quantities and generate the new output file. An example of the combined quantities is shown below:

```
00000000000 1111111111 2222222222 3333333333 4444444444 5555555555 6666666666
53+00.00/1      73      33      0      0      56.90      0
53+25.00/1      58      31      61      30      55.71      157
53+50.00/1      44      33      47      30      54.90      154
53+75.00/1      35      40      36      34      55.90      153
54+00.00/1      29      42      29      38      54.03      152
54+25.00/1      29      40      27      38      53.06      149
54+50.00/1      32      35      28      35      50.51      143
54+75.00/1      39      25      33      28      48.26      138
55+00.00/1      49      17      41      20      46.05      131
```

The seeding quantities are appended in column 5 and 6 as shown above.

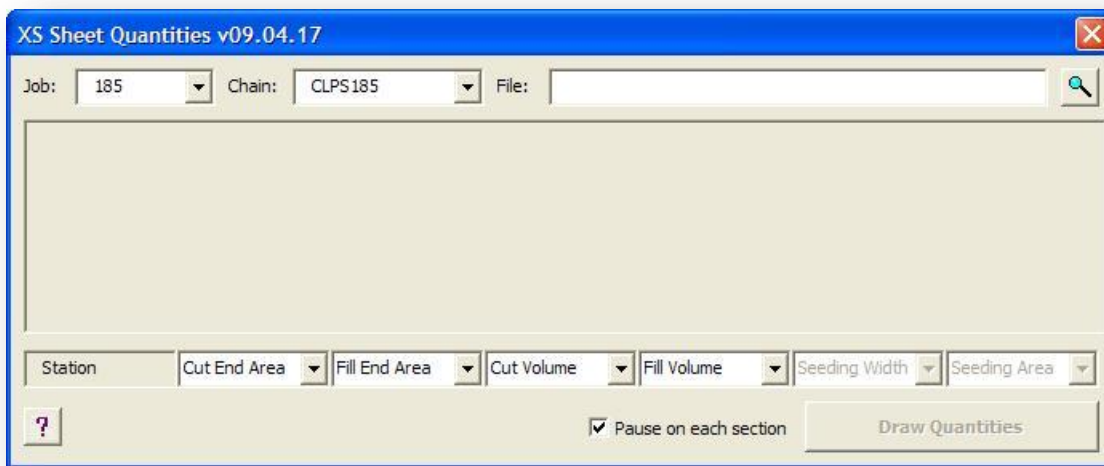
10.4 ODOT_XSQuantities.mvba

This application is used place earthwork and seeding quantities within the limits of the cross section boundary elements created using the **ODOT_XSBoundary.mvba** application. The quantities are read from an ASCII text file created using the GEOPAK Earthwork computation process, or created by combining GEOPAK Earthwork and Seeding quantity files by use of the CombineSeeding.exe application.

To run **ODOT_XSQuantities.mvba**, select **ODOT > XS Utilities > XS Quantities** from the MicroStation pull down menu, or key in the following command in MicroStation:

```
vba load ODOT_XSQuantity.mvba;vba run xsQuantityMain
```

The dialog shown below will open.



Select the ASCII text file containing the quantities. The file is assumed to be in the same format as a GEOPAK Earthworks ASCII file as shown in the example below:

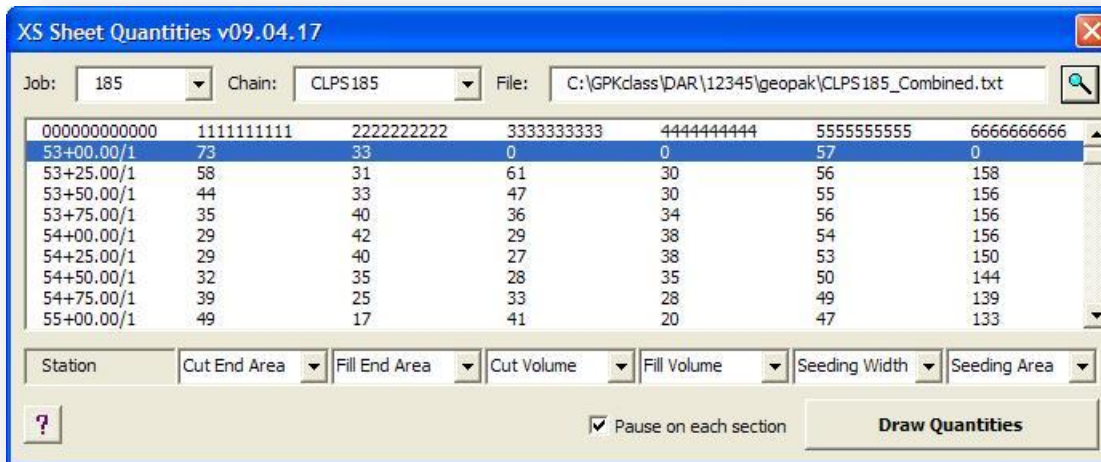
```
00000000000 1111111111 2222222222 3333333333 4444444444
53+50.00/1      66      33      0      0
54+00.00/1      50      41     108     69
54+50.00/1      53      34      96     69
55+00.00/1      72      17     116     47
55+50.00/1      90       5     150     21
56+00.00/1     115       0     190      5
56+50.00/1     141       0     237      0
57+00.00/1     159       0     278      0
```

The first row is assumed to be the header row and contains the column id information. The remaining rows are assumed to contain the cross section quantities.

Column zero is assumed to contain the station and region as shown in the example above.

The ASCII file can contain either 4 or 6 columns containing the cross section quantities. The contents of each column are user definable, but it is recommended that you follow the guidelines detailed in the [Chapter 7 – Earthwork Quantities](#).

If an ASCII file is opened containing 6 columns of quantities, the dialog will appear as shown in the example below.



The quantity values contained in columns 1, 2, 3, and 4 are user definable when the original earthworks quantity file is generated with GEOPAK. The [ODOT GEOPAK Road 2](#) training guide recommends defining the columns in the following order:

- Column 1 = Cut End Area
- Column 2 = Fill End Area
- Column 3 = Cut Volume
- Column 4 = Fill Volume

Columns 5 and 6 were generated using the **ODOT_CombineQuantities.exe** application and contain the following values:

- Column 5 = Seeding End Width
- Column 6 = Seeding Area

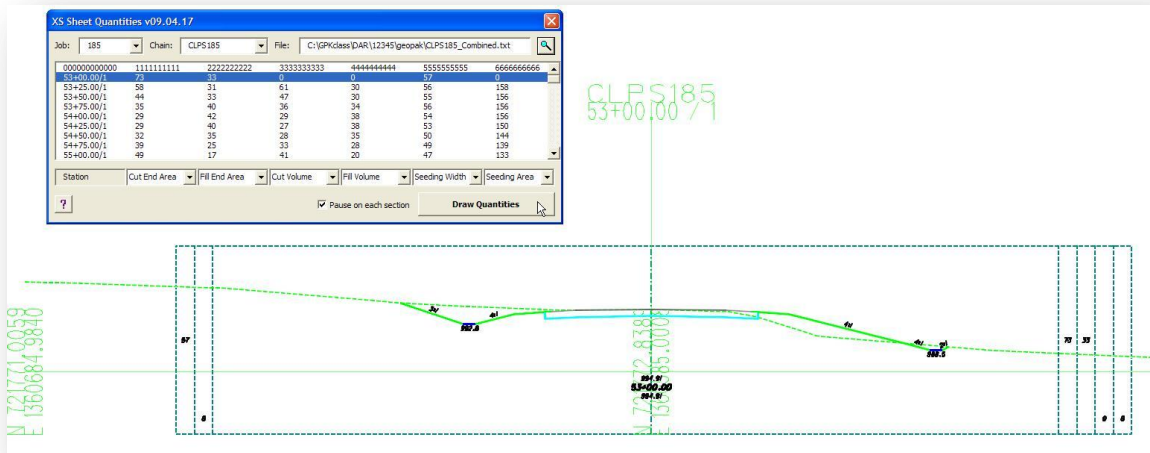
If the order of the quantities contained in the columns does not match the values listed above, the user has the option to define the contents of each column using the drop down menu below each column as shown at right.



Draw Quantities



When the **Draw Quantities** option is selected, the quantities are drawn on the currently selected cross section. The points placed within the cross section boundary are used as the insertion points for the quantities as shown in the example below.



If a set of quantities has been previously placed for the cross section(s) using this application, the previously placed quantities will be automatically deleted from the cross section(s) when the **Draw Quantities** button is selected.

Exercise 10A – Cross Section Boundaries

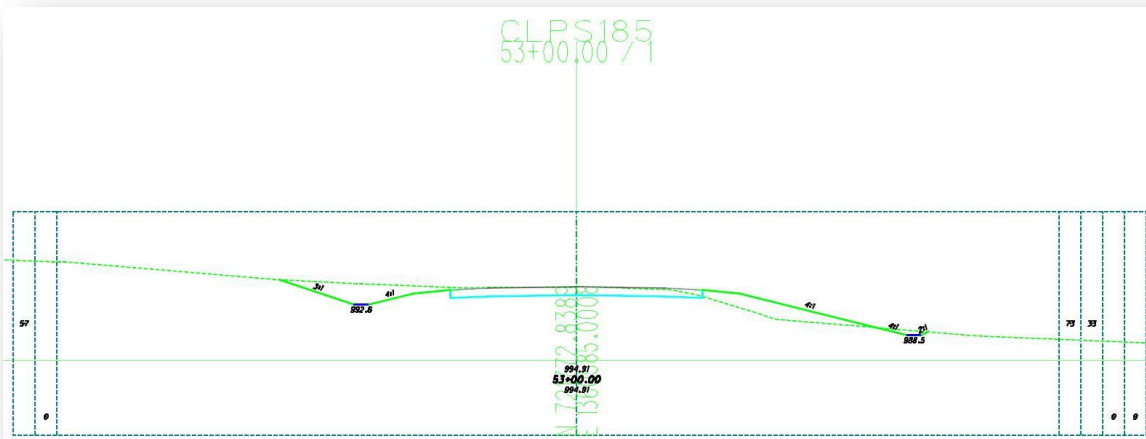
In this exercise we will prepare the cross sections for the sheet clipping process.

1. Draw boundaries for the cross sections from station 52+00 R 1 to station 78+00 R 2 using the ODOT_XSBoundary.mvba application.

As you place the clipping borders, keep in mind that these borders will be used to define the vertical limits of each cross section on the completed sheets.

2. Use the ODOT_CombineQuantities.exe application to combine the earthwork and seeding files into one new file.
3. Use the ODOT_XSQuantities.mvba application to place the quantities on the clipping borders.

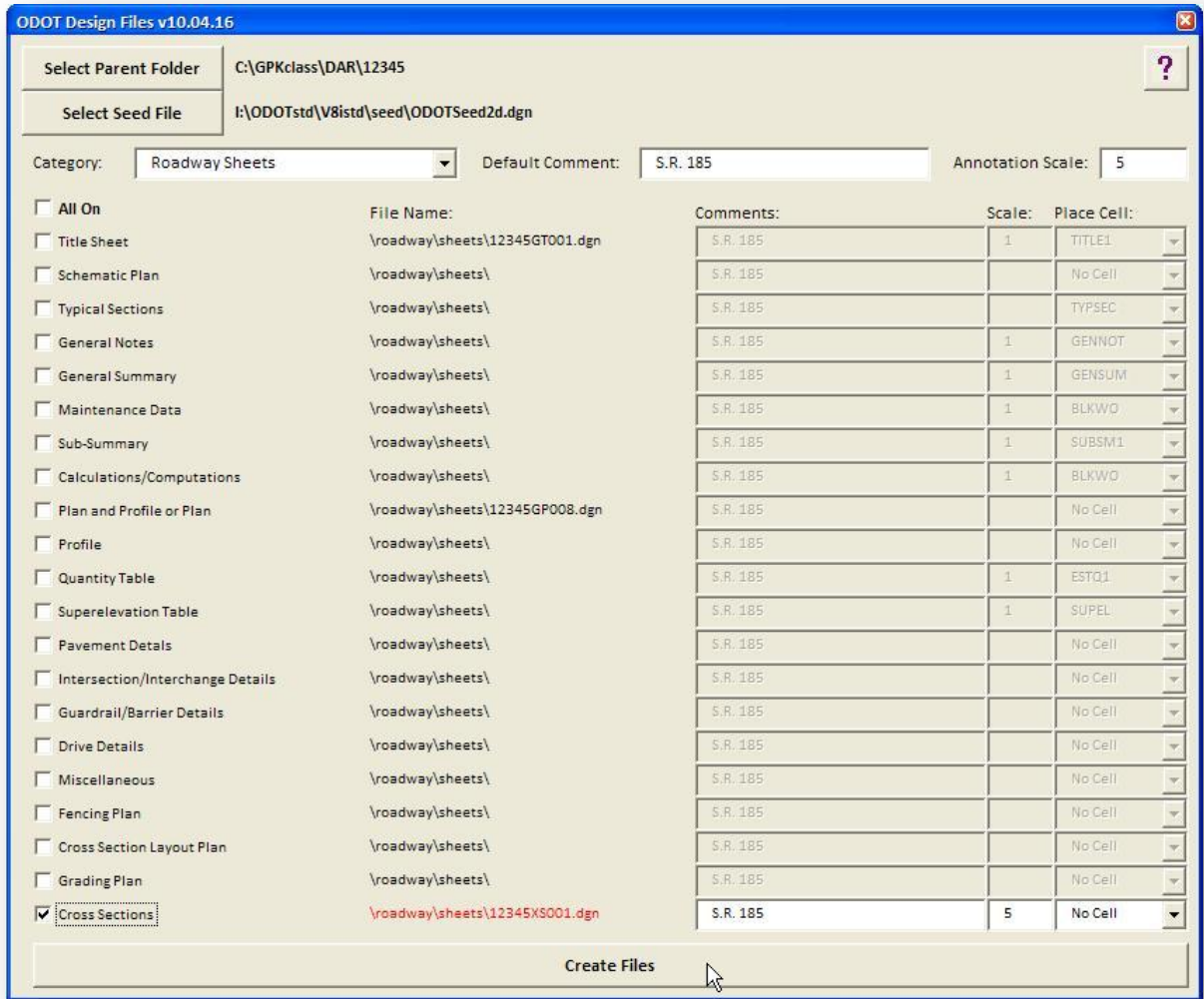
The completed sections should have a boundary element with quantities as shown in the example below.



10.5 Cross Section Sheet Design Files

Before processing the cross sections, the user must create a new design file for the cross section sheets. Use the **ODOT_Files.mvba** application to create the new sheet design file.

The application can be accessed by selecting **ODOT > File Management > New Design File** from the MicroStation pull down menu.



Cross section sheets should always be processed into the Sheet Model of the newly created design file. If you use the **ODOT_Files.mvba** application to create the sheet file, the Sheet model will be set as the active model. If you create the file yourself, be sure to open the design file and select **Files > Models** to set the sheet model as the active model, and then select **File > Save Settings**.

10.6 Processing Cross Section Sheets

10.6.1 Preparing the XS Cell File for Processing

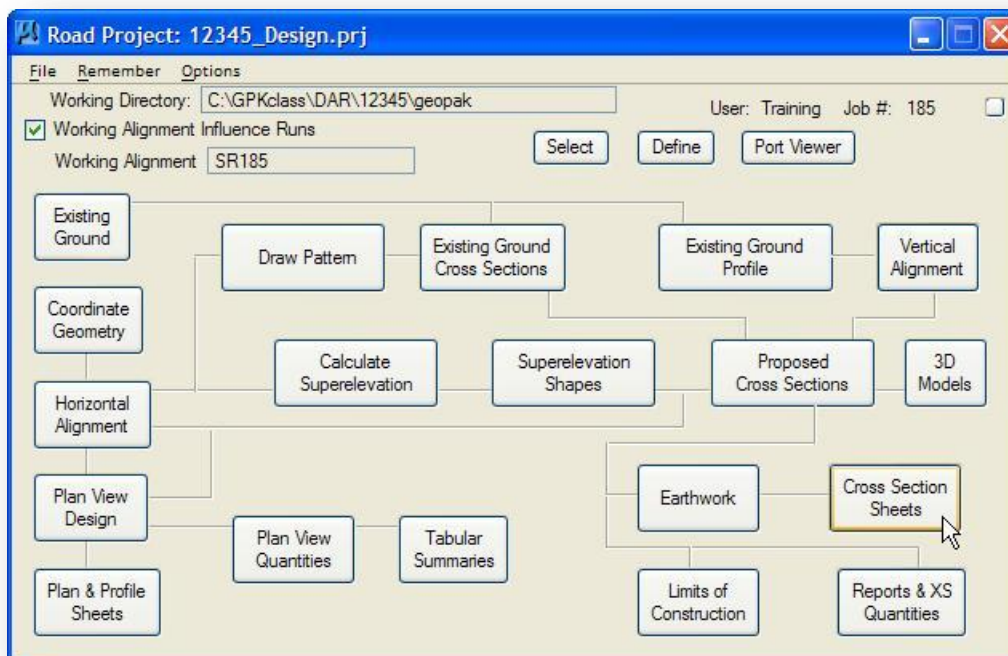
The cross section sheet clipping process uses reference files to display the cross sections on the completed sheets. The levels that are turned on in the cross section cell design file will be turned on in the sheets. Before processing, be sure to turn on/off the levels you wish to display on the cross section sheets.

The following table lists some of the levels that should be turned off before processing the cross section sheets. This is not a complete listing; there may also be other levels that you may want to turn off.

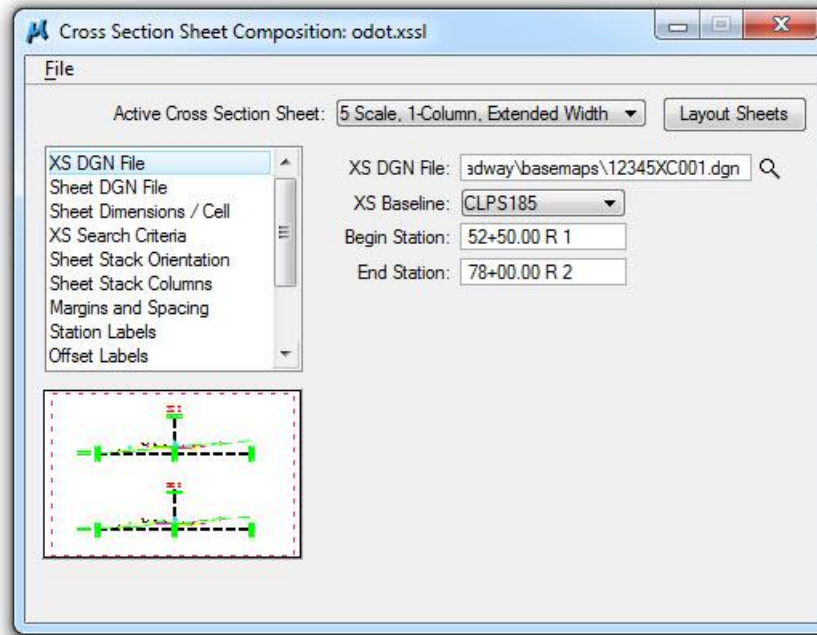
GK_Cells	XS_P_Pavt_Surface
XS_P_Boundary	XS_P_Shoulder_Surface
XS_P_Earthwork_Shapes	XS_P_Text_Info
XS_P_Finished_Grade_Seeded	XS_P_Text_MarkedPoint
XS_P_Pavt_Layers	

10.6.2 Cross Section Sheets

The Cross Section Sheet function can be accessed by selecting **Applications > Road > Cross Sections > Cross Section Sheet Composition** from the MicroStation pull down menu, the **GEOPAK Road** tool palette, or the **Road Project** dialog as shown below.



After creating a new run, the *Cross Section Sheet Composition* dialog shown below is opened.

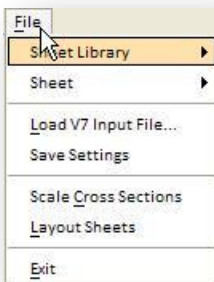


The left side of the dialog contains a list of parameters required to process cross sections into sheets. When each parameter is selected, a graphic explanation of the parameter appears in the lower left portion of the dialog and key-in fields for each variable appear to the right.

The various parameters, and the settings necessary to generate cross section sheets according to ODOT specifications, are described on the following pages.

10.6.3 File Menu

The **File** menu on the *Cross Section Sheet Composition* dialog has several choices, as shown below.



Each option is described below:

Sheet Library

The parameters for the *Cross Section Sheet Composition* dialog can be saved in a Sheet Library. The Sheet layout configuration can be saved and recalled for future use. Sheet libraries have a default extension of .xssl. Options are available to create a New sheet library, Attach an existing library, or Save a library.

The sheet library **ODOT.xssl** has been configured for use with ODOT's standard cross section sheet cells. This library can be obtained from the ODOT website. For ODOT users, the library is located in the following directory:

I:\ODOTStd\V8iStd\geopak\road\sheet_library\odot.xssl

Sheet

Options are available to create a new sheet, delete a sheet, or update a sheet to the current settings.

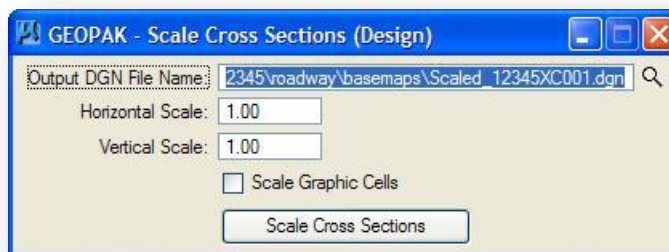
Load V7 Input File...

To use a cross section sheet input file from a previous version of GEOPAK, create a new sheet, select **Load V7 Input File** and select the old sheet input file. The input file is used to populate the corresponding dialog fields.

Save Settings

This option is used to save the dialog settings for the current sheet run

Scale Cross Sections



This option is available to adjust the horizontal and vertical ration of the cross sections. The scaled sections are created in the file specified by the **Output DGN File Name** field.

Layout Sheets

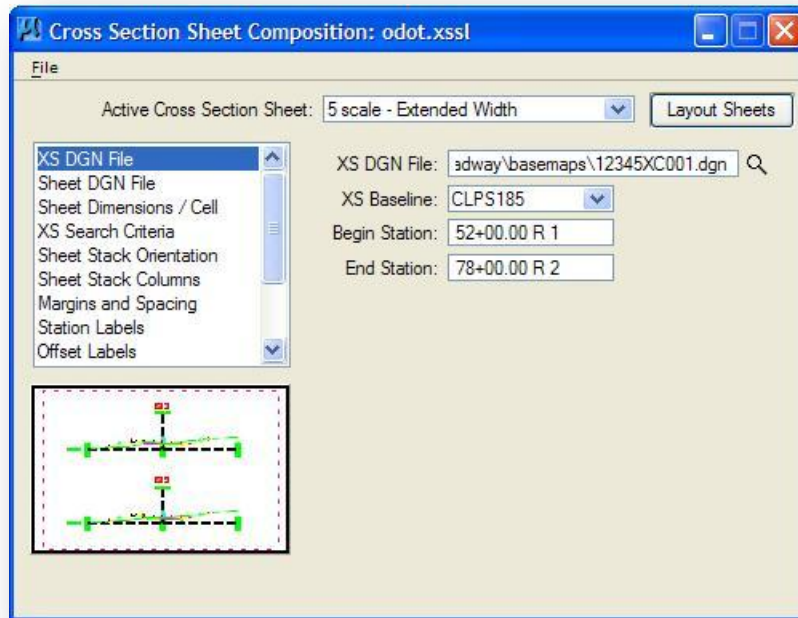
This option starts the cross section sheet processing. This is the same as selecting the **Layout Sheets** button on the face of the *Cross Section Sheet Composition* dialog.

Exit

This exits the cross section sheet application, but does not exit MicroStation.

10.6.4 XS DGN File

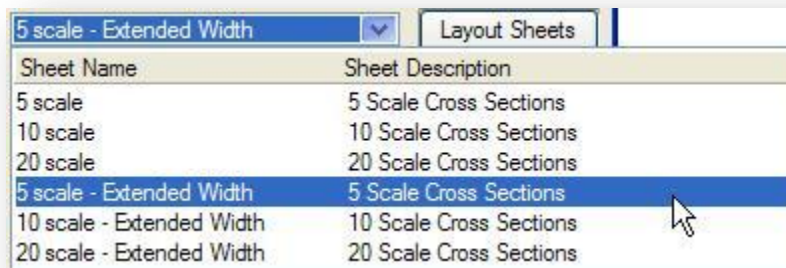
When the XS DGN File option is selected, the Cross Section Sheets dialog will appear as shown below.



The parameters for the XS DGN File option are described below.

Active Cross Section Sheet

After attaching the ODOT cross section sheet library, the **Active Cross Section Sheet** option will display the sheet layout options shown below.



The three **Extended Width** options are used when clipping sheets using XS Boundary elements. For each of these three options, the width of the clipping area has been extended to include the seeding and earthworks quantity columns within the reference boundaries for each cross section.

XS DGN File

This key-in field is used to specify the name of the design file containing the original cross sections. The file name can be typed in manually or selected by use of the **Select XS Design File** icon.

XS Baseline

This drop down list is used to select the baseline chain for the cross sections to be processed.

Note: The **XS Baseline** list is generated by reading the cross section cells contained in the file specified by the **XS DGN File** key-in field. This is not a list of chains in the GPK file.

Begin Station

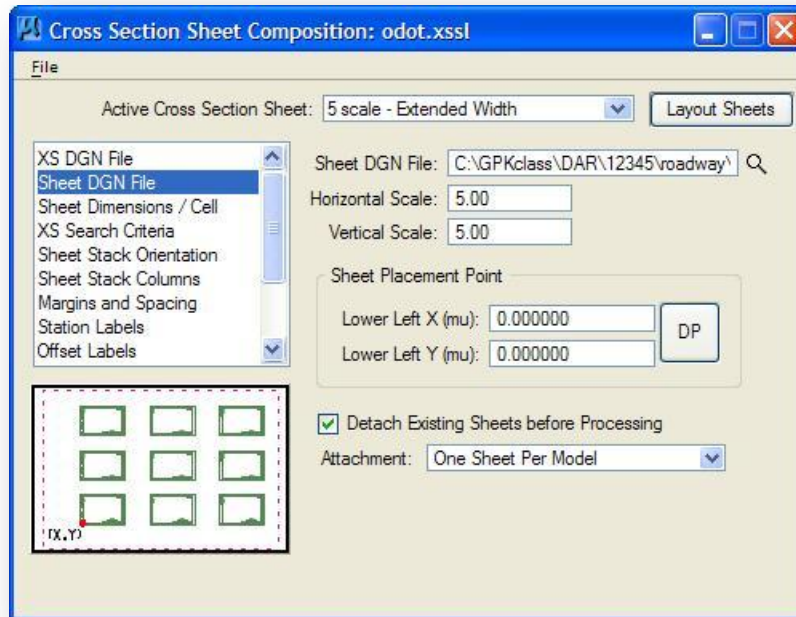
Key-in the **Begin Station** for cross section sheet processing. This option defaults to the lowest stationed cross section, for the selected **XS Baseline** chain, in the file specified by **XS DGN File**. If a partial processing is desired, simply type in the desired station.

End Station

Key-in the **End Station** for cross section sheet processing. This option defaults to the highest stationed cross section, for the selected **XS Baseline** chain, in the file specified by **XS DGN File**. If a partial processing is desired, simply type in the desired station.

10.6.5 Sheet DGN File

When the **Sheet DGN File** option is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.



Sheet DGN File

Use this field to specify the name of the MicroStation design file where GEOPAK will compose the cross section sheets. GEOPAK does not create this file. The file must be created prior to processing.

Section 302 of the ODOT CADD Engineering Standards Manual specifies that plan sheets should be placed in the Sheet Model of the design file. Take the following steps to ensure that the cross section sheets are placed in a sheet model:

- Use **ODOT_Files.exe** to create the cross section sheet design file. The cross section sheet file will automatically be set with the sheet model as the active model.

If you elect to create the sheet file manually, take the following steps after creating the file:

1. Open the cross section sheet design file. The file will contain two Models, one Design Model and one Sheet Model. Select **File > Models** to access the *Models* dialog.
2. Double-click the Sheet model to make it the active model.
3. From the MicroStation pull-down menu select **File > Save Settings**.

Horizontal Scale**Vertical Scale**

These key-in fields are used to specify the scale for the cross section sheets.

Sheet Placement Point

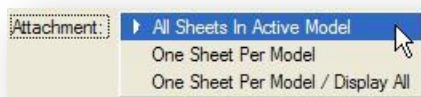
The option is used to specify the X,Y coordinate location for the first cross section sheet. All other sheets will be placed in relation to this point. For ODOT projects, we recommend using the default values of 0,0.

Detach Existing Sheets before Processing

This option is only used when you elect to process cross section sheets into a design file that contains cross section sheets previously generated by GEOPAK. When this is toggled ON, any reference files that were attached in a previous run are detached and replaced with new references. Also any graphics from a previous run are deleted and replaced.

Attachment

Three options are provided to control how the sheets are placed in the cross section sheet design file.



Each option is described below:

All Sheets in Active Model - When using this option, all sheets are placed in the active model of the sheet design file.

One Sheet Per Model - Each sheet is placed in its own model. The models will be named XS_SHEET_sheet_#. Nothing is placed in the active model of the sheet design file.

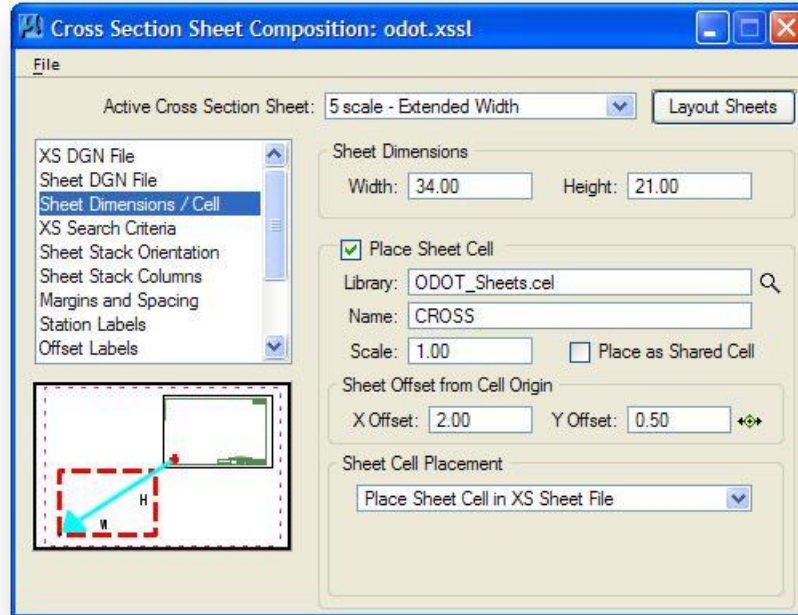
One Sheet Per Model/Display All - Each sheet is placed in its own model. The models will be named XS_SHEET_sheet_#. All sheets are attached to the active model of the sheet design file as references.

Section 302 of the [ODOT CADD Engineering Standards Manual](#) specifies that each sheet of the plan shall be contained in its own design file when submitted to the Department. The GEOPAK Attachment options above do not provide the capability to generate each cross section sheet in a separate design file.

For ODOT plans, we recommend using the **All Sheets in Active Model** option. The ODOT program **ODOT_XSSplitSheets.mvba** application can be used to split the sheets into separate design files for digital submissions.

10.6.6 Sheet Dimensions / Cell

When **Sheet Dimensions/Cell** is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.



The options have been configured to produce cross section sheets compliant with ODOT standards and should not normally be changed by the user.

Sheet Dimensions

The **Width** and **Height** values for the cross section sheet cells. These dimensions are multiplied by the **Horizontal Scale** and **Vertical Scale** options on the **Sheet Design File** option to set the scale for the cross section sheet cells.

Place Sheet Cell

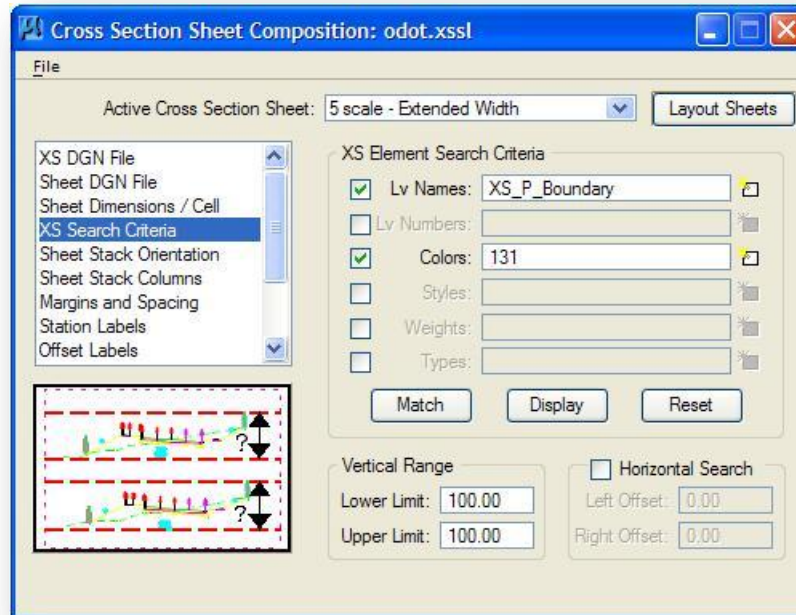
These options are used to specify the cell **Library** and cell **Name** for the cross section sheet cell. The **Scale** is multiplied by the **Horizontal Scale** and **Vertical Scale** values on the **Sheet Design File** option to set the scale for the cross section sheet cells. The **Sheet Offset from Cell Origin** values are used to specify the location where the cross section data will be placed on the sheet cell.

Sheet Cell Placement

The sheet cells are normally placed using the **Place Sheet Cell in XS Sheet** file option for ODOT projects.

10.6.7 XS Search Criteria

When the **XS Search Criteria** option is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.



These options are used to specify the vertical extents of each cross section which, in turn, determines the clipping limits for cross section reference attachments. Note that the **XS Search Criteria** is only used to set the vertical extents of each cross section on the completed sheets. The horizontal limits are set in the **Margins and Spacing** item.

XS Element Search Criteria

The **XS Element Search Criteria** option is used to specify which elements in the cross section will be used to define the vertical limits of each cross section.

If you are clipping sheets using the cross section boundary element using one of the Extended Width sheet types, use the boundary element to define the search criteria as shown above.

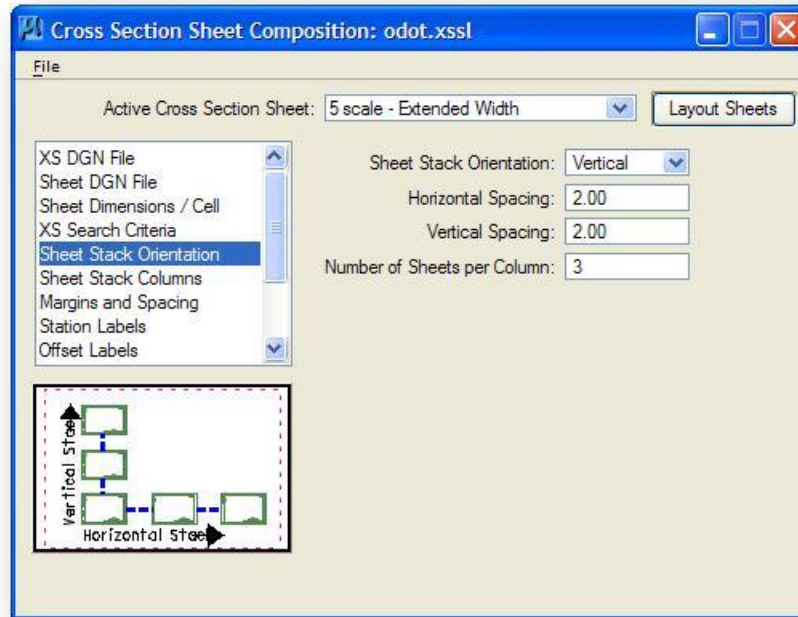
Note: This option is not used to specify which elements will be visible in the cross section references. The search criteria should not be defined to include the cross section cells.

Vertical Search Range

The **Lower** and **Upper Range Limits** are used to define the maximum vertical search range for each cross section. GEOPAK will search for elements meeting the **XS Search Criteria** within the limits of the Vertical Search Range.

10.6.8 Sheet Stack Orientation

When the **Sheet Stack Orientation** option is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.



Sheet Stack Orientation

Cross section sheets can be stacked either vertically or horizontally. The ODOT sheet configurations have been defined for **Vertical** orientation as shown above.

Horizontal / Vertical Spacing

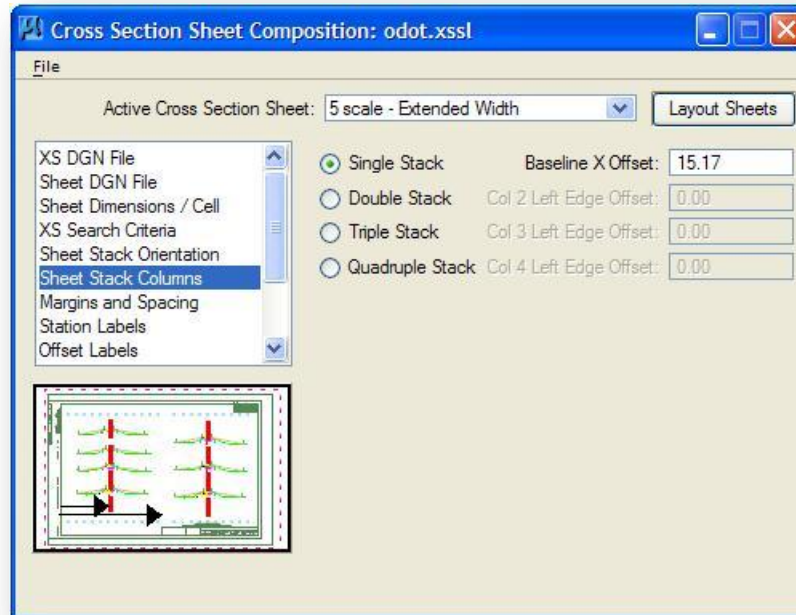
These values are used to specify the distance between successive cross section sheets, from top to bottom when stacking is **Vertical**, from right edge to left edge if **Horizontal** stacking is used.

Max Number of Sheets per Column

By specifying the maximum number of sheets in the stack, the software will place each row or column with the specified number of sheets. The Cross Section Sheet configurations within ODOT.xssl have been configured with a default value of 3 as shown above.

10.6.9 Sheet Stack Columns

When the **Sheet Stack Columns** option is selected, the *Cross Sections Sheet Composition* dialog will appear as shown below.



Four options are supported: **Single Stack**, (one column per sheet), **Double Stack** (two columns per sheet), **Triple Stack** (three columns per sheet), and **Quadruple Stack** (four columns per sheet).

Baseline X Offset

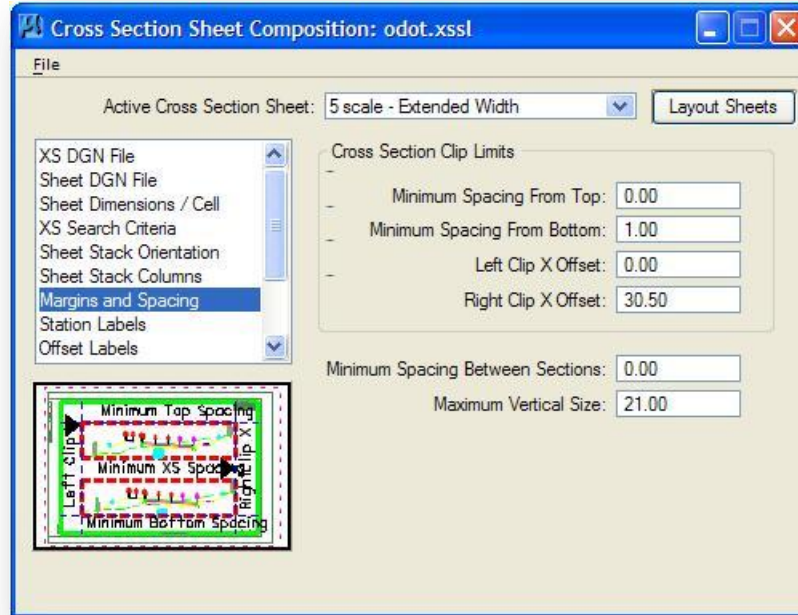
The distance from the left edge of the sheet to the zero offset of the cross sections. The baseline of the cross section cell defines the zero offset.

Col 2/3/4 Left Edge Offset

When the cross sections are to be placed in **Double Stack**, **Triple Stack**, or **Quadruple Stack** mode, the zero offset of the left-hand stack of cross sections is determined by the **Baseline X Offset**. The center of the right-hand stack of cross sections is located a distance from the left edge of the sheet to the Second Column XS Stack Offset.

10.6.10 Margins and Spacing

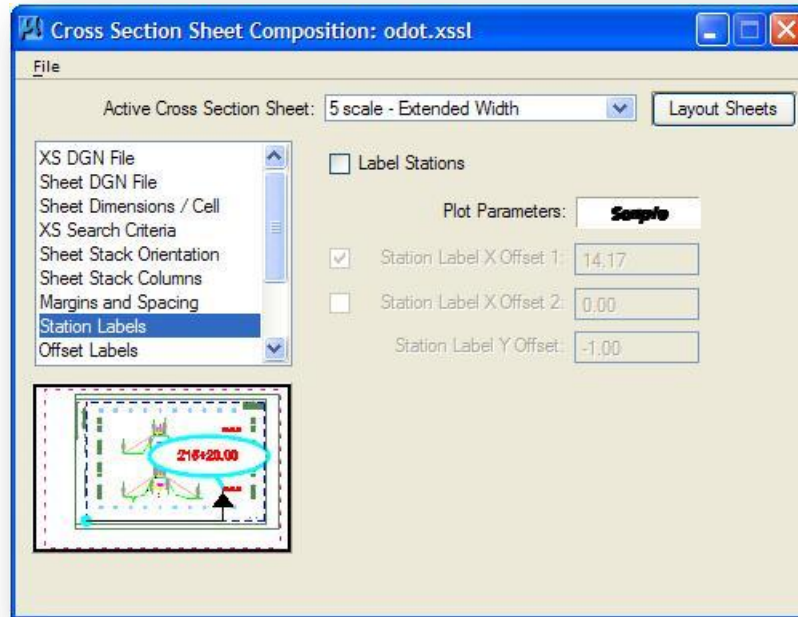
When the **Margins and Spacing** option is selected, the *Cross Section Sheet Definition* dialog will appear as shown below.



When using ODOT.xssl, the values for the Margins and Spacing portion *Cross Sections Sheet Composition* dialog have been configured to conform to the dimensions of the ODOT standard cross section sheet cells and should not be changed by the user.

10.6.11 Station Labels

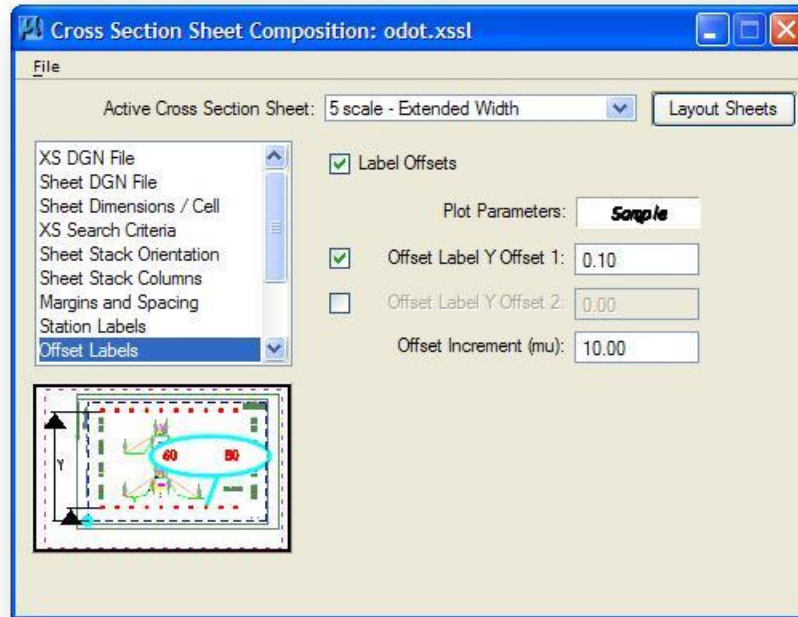
When the **Station Labels** option is selected, the *Cross Section Sheet Definition* dialog will appear as shown below.



The options in the **Station Labels** portion of the *Cross Sections Sheet Composition* dialog are used to define the symbology and offsets for Station Labels placed on the cross section sheets. For ODOT projects, users will typically place station labels in the cross section cell design file by use of the ODOT standard cross section criteria file **XSLABEL.X**, therefore, the **Label Stations** option should normally be left toggled off.

10.6.12 Offset Labels

When the **Offset Labels** option is selected, the *Cross Section Sheet Definition* dialog will appear as shown below.

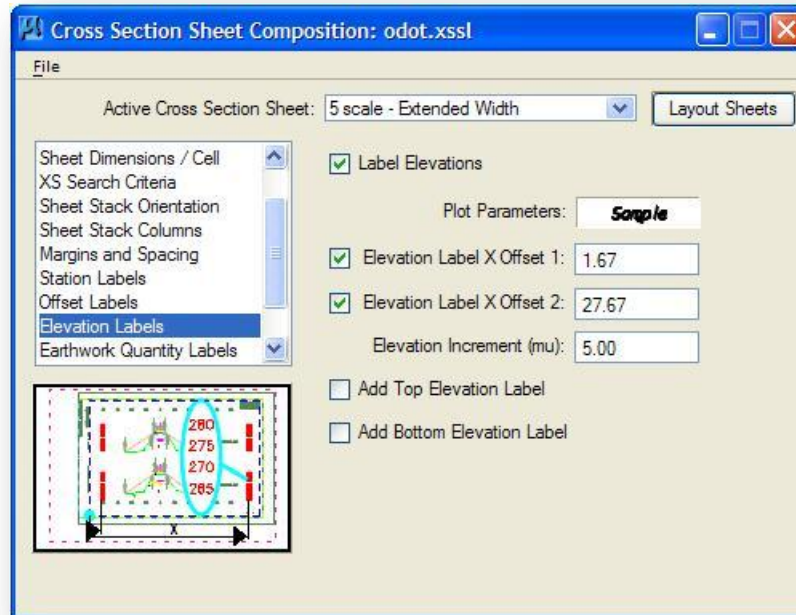


Offset Labels can be placed at the top and bottom of the cross section sheets by defining the **Offset Label Y Offset 1** and **Offset Label Y Offset 2** values.

For ODOT projects, users will typically place offset Labels at the bottom of the cross section sheets, but not at the top. When using ODOT.xssl, the values for the **Offset Labels** portion *Cross Sections Sheet Composition* dialog have been configured to conform to the dimensions of the ODOT standard cross section sheet cells and should not be changed by the user. The offset labels are placed on the level **SH_Data**.

10.6.13 Elevation Labels

When the **Elevation Labels** option is selected, the *Cross Section Sheet Definition* dialog will appear as shown below.

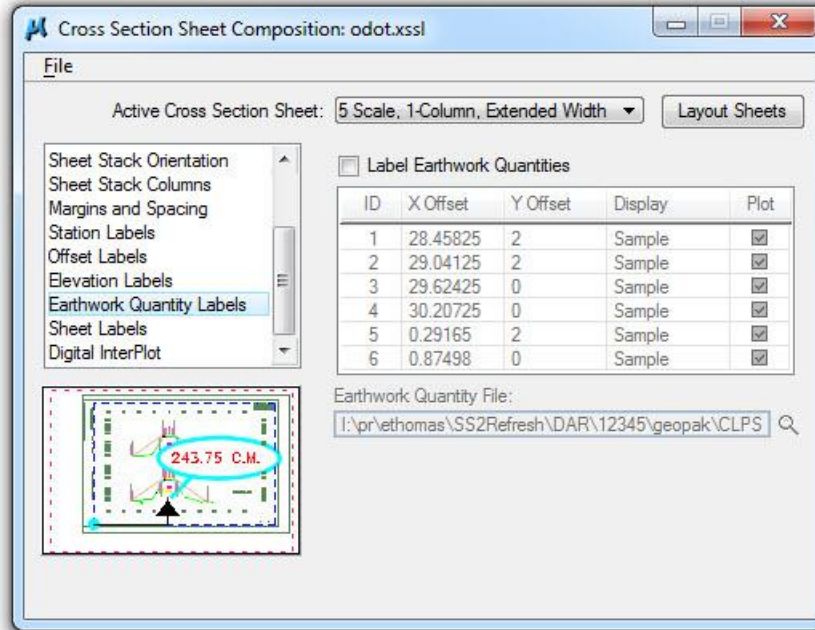


Elevation Labels can be placed at the left and right sides of the cross section sheets by defining the **Elevation Label X Offset 1** and **Elevation Label X Offset 2** values.

For ODOT projects, users will typically place elevation labels at both sides of the cross section sheets. When using ODOT.xssl, the values for the **Elevation Labels** portion of the *Cross Sections Sheet Composition* dialog have been configured to conform to the dimensions of the ODOT standard cross section sheet cells and should not be changed by the user. The offset labels are placed on the level **SH_Data**.

10.6.14 Earthwork Quantity Labels

When the **Earthwork Quantity Labels** option is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.



When using the cross section boundaries, the cross section quantities will be placed in the cross section design file and referenced into the sheets. In this case there is no need to configure the **Earthwork Quantity Labels** item.

In cases where the boundary elements will not be used, the **Earthwork Quantity Labels** item can be configured to place the quantities in the sheet design file as detailed below.

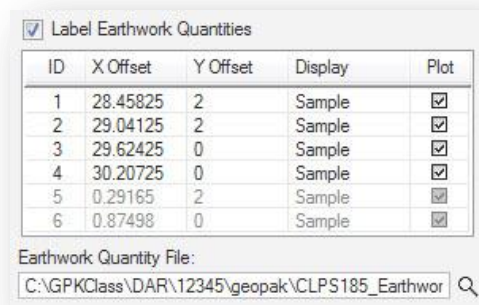
Earthwork quantities that have been generated by GEOPAK (see Chapter 7) are saved in an ASCII text file. To place these earthwork quantities on the cross section sheets, toggle on the **Label Earthwork Quantities** option and then key-in the name of the Earthwork Quantity File or select the file via the **Select Earthwork Data File** icon. A portion of a GEOPAK earthwork quantity file is shown below:

```
00000000000 1111111111 2222222222 3333333333 4444444444
53+50.00/1      66      33      0      0
54+00.00/1      50      41      108     69
54+50.00/1      53      34      96      69
55+00.00/1      72      17      116     47
55+50.00/1      90      5       150     21
56+00.00/1     115      0       190      5
56+50.00/1     141      0       237      0
57+00.00/1     159      0       278      0
```

The first line of the file designates the column numbers. Column 0 represents the station and the region number. The content of the remaining columns is user definable and can contain many different values. In this example, column 1-4 were defined for the earthwork run as follows:

- Column 1 = Cut End Area
- Column 2 = Fill End Area
- Column 3 = Cut Volume
- Column 4 = Fill Volume

Each column of the Earthwork Quantity File can be placed on the cross section sheets at user defined offsets as shown below.



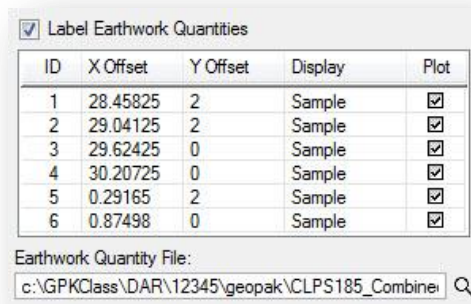
The selected earthworks file contains five columns as shown on the previous page. Within the dialog, the ID number corresponds to the column number defined on the first line of the Earthwork Quantity File. Using ODOT.xssl, columns 1-4 will be placed on the cross section sheets but column 0, representing the cross section station, is not plotted on the cross section sheets.

In addition to the four columns defined for the earthwork quantities, column ID 5 and 6 have been configured with the proper offsets for seeding quantities. In the example above, column ID 5 and 6 are both ghosted since these columns are not contained within the file earthwork185.txt.

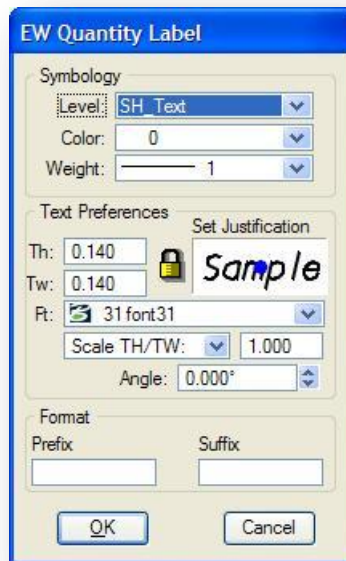
If the selected earthworks file included seeding quantities, Columns 1-6 are defined as follows.

- Column 1 = Cut End Area
- Column 2 = Fill End Area
- Column 3 = Cut Volume
- Column 4 = Fill Volume
- Column 5 = Seeding End Width
- Column 6 = Seeding End Area

Select the combined earthwork and seeding file. Column ID 5 and 6 are now un-ghosted and will be placed on the cross sections at the offsets shown on the following page.

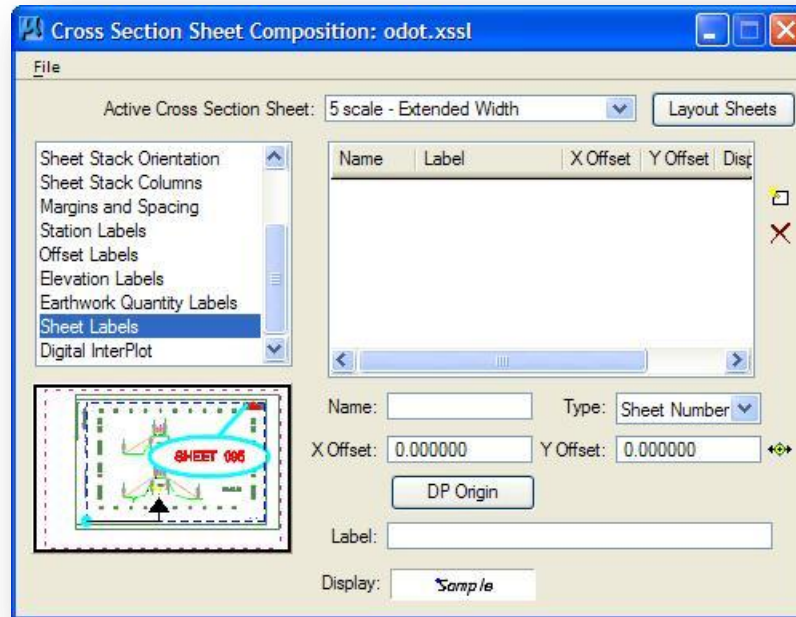


The **Display** option is used to set symbology for the earthwork and seeding quantity text placed on the cross section sheets. Double-click the word “Sample” to access the **EW Quantity Label** dialog, as shown below.



10.6.15 Sheet Labels

When the **Sheet Labels** option is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.

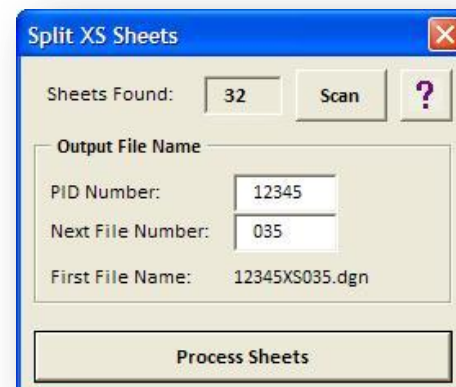


The **Sheet Labels** item can be used to place various labels on the cross section sheets. These labels can include title block information such as the beginning and ending station for each sheet, or the County-Route-Section label.

The labels are placed as text elements on top of the cross section sheet cell and cannot be placed using the Enter Data fields in the cell. This is not desirable since ODOT's programs for sheet numbering and sheet indexing search the Enter Data fields for the values. For this reason, the **Sheet Labels** item will not be used.

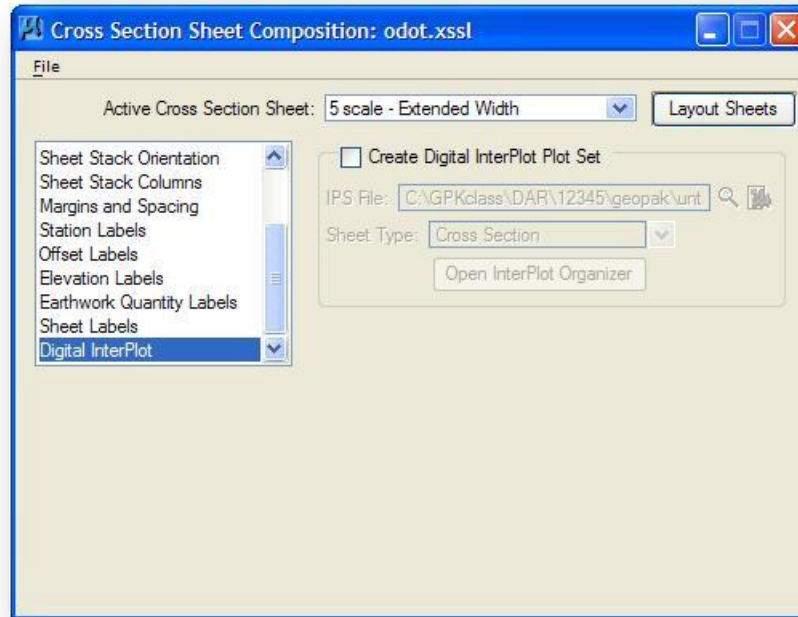
The ODOT application **ODOT_XSSheetLabels.mvba** can be used to complete the title block information after the sheets have been clipped. The application can be accessed from the ODOT pull-down menu by selecting **ODOT > XS Utilities > XS Sheet Labels**. When the program is accessed, the dialog shown at right is opened.

For more information on the application, select the **Help** icon on the dialog.



10.6.16 Digital InterPlot

When the **Digital InterPlot** option is selected, the *Cross Section Sheet Composition* dialog will appear as shown below.

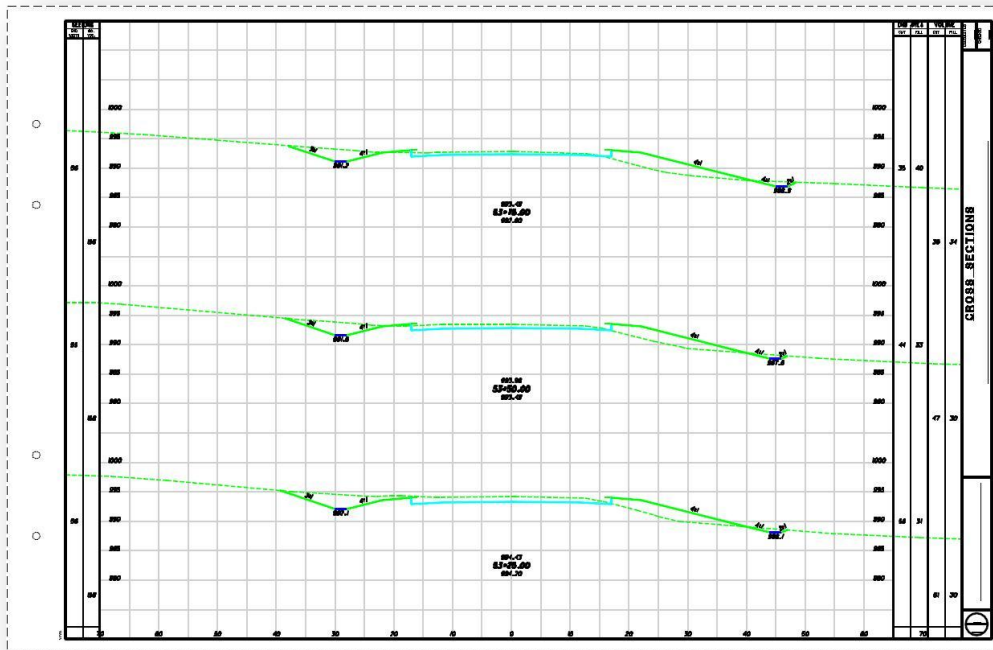


This option can be used to generate a Digital InterPlot Plot Set. ODOT does not currently use Digital InterPlot.

10.6.17 Layout Sheets

After you have configured the parameters of the *Cross Section Sheet Composition* dialog, select **Layout Sheets** to initiate the process.

An example of a completed cross section sheet is show below.



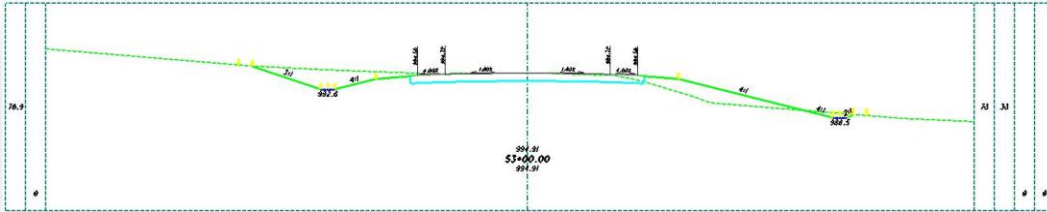
The ODOT MicroStation Visual Basic Application **ODOT_XSSheetLabels.mvba** can be used to complete the cross section sheet title block information. The application is located on the MicroStation menu by selecting **ODOT > XS Utilities > XS Sheet Labels**.

For more information on this application, select the Help icon.

10.6.18 Post Processing Considerations

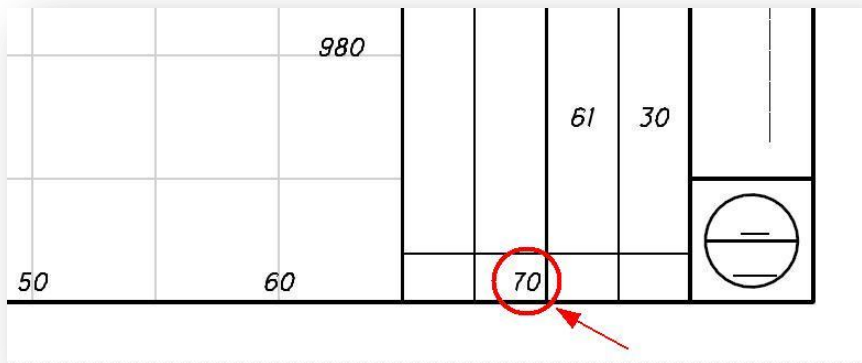
XS Ground Lines

Notice that the existing ground line extends through the quantity columns on the completed sheets. Users may wish to partial delete the ground line in the original cross section cell file so that it falls within the limits of the border element as shown in the example below.



Offset Labels

Since the horizontal clipping limits of the sheets has been extended to include the quantity columns, and extra **Offset Label** is drawn on the lower left and lower right of each cross section sheet. These labels should be deleted. This extra label, which should be deleted, is at the lower right of the cross section sheet, as shown in the example below.



Note: These labels can be removed using the ODOT_XSSheetLabels application shown on the previous page.

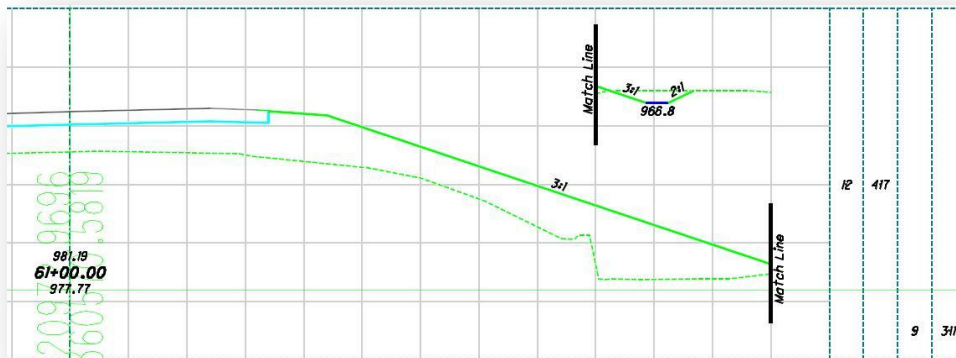
Match Lines and Cross Sections

When clipping cross section sheets, GEOPAK does not provide the capability to automate match lining cross sections that extend beyond the width of the cross section sheet. Users can manually create match lines for specific cross sections as needed and use the boundary element to control the vertical limits of each cross section as it is referenced into the cross section sheets.

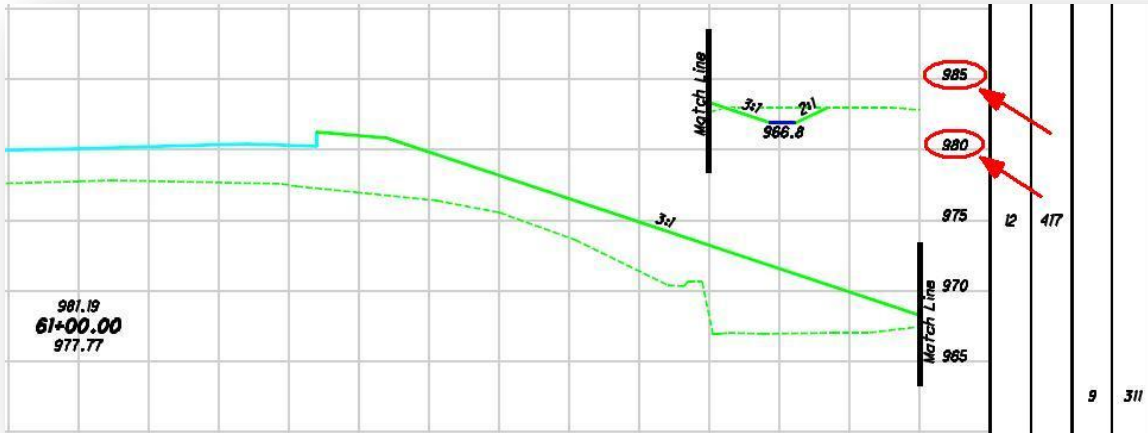
In the example below, the cross section will extend into the quantity columns on the right side of the cross section sheets.



Use the boundary element with a grid to facilitate breaking up the cross section into a match line segment as shown in the example below.



The boundary element is used to define the vertical extents of the cross section on the completed sheet. The example on the following page shows the cross section on the completed sheet.



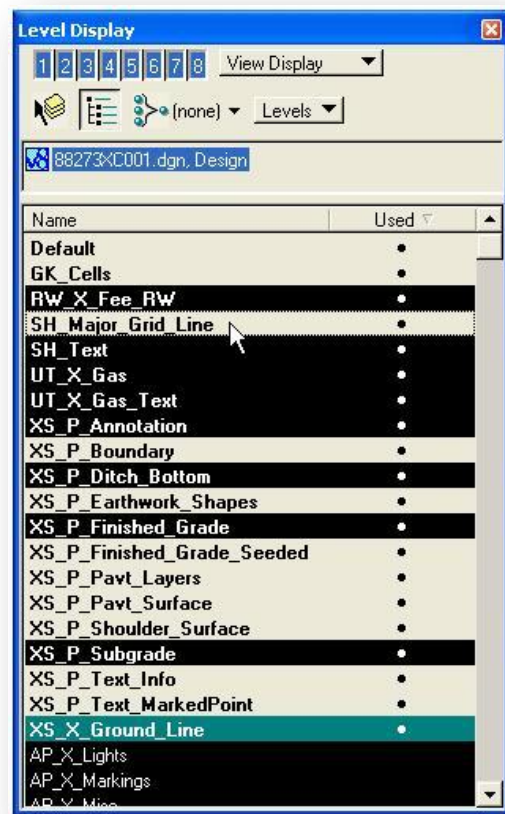
Note: The elevations on the side of the cross section sheet are placed by GEOPAK for the vertical extent of the boundary element. In the case where match lines are included within the clipping limits of these elevations must be manually edited to reflect the correct elevation values of the match line segment.

Reference Levels

The **ODOT_XSBoundary.mvba** application places boundary elements, and optionally grid lines, in the cross section cell design file that should not be displayed on the cross section sheets. Before clipping the cross section sheets with GEOPAK, be sure to turn off the following levels and Save Settings:

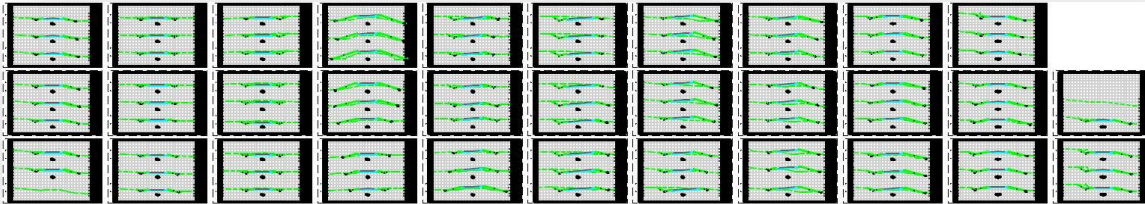
- SH_Major_Grid_Line
- XS_P_Boundary

Note: ODOT’s cross section criteria files place elements on several other levels in the cross section cell design file that should not be displayed on the completed cross section sheets. Some of these levels are shown in the example at right. It is up to the user to review the levels shown in the cross sections to turn on/off the appropriate levels for the cross section sheets.

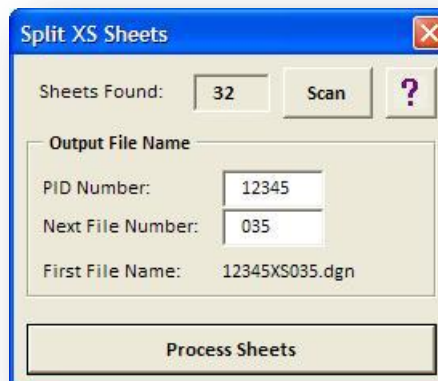


10.7 Preparing XS Sheet Files for Electronic Submission

When cross section sheets are generated using the **All Sheets in Active Model** option, the sheets are plotted in the design file similar to the example shown below.



Section 304.4 of the ODOT CADD Engineering Standards Manual states that each sheet of the completed plans shall be contained in separate design files when submitted to the Department. The ODOT application **ODOT_XSSplitSheets.mvba** can be used to split the cross sections into separate design files. The application is located on the MicroStation menu by selecting **ODOT > XS Utilities > XS Split Sheets**.



For more information on this application, select the Help icon. After processing the sheets with this application, a new design file is created for each sheet. The Title and Comments fields for the sheets are populated with information from the sheet as shown below.

Name	Title	Comments
12345XS002.dgn	Roadway Cross Sections	S.R. 185 - All Sheets in 1 Mod
12345XS003.dgn	CROSS SECTIONS S.R. 185	STA. 52+75.00 TO STA. 53+25.00
12345XS004.dgn	CROSS SECTIONS S.R. 185	STA. 53+50.00 TO STA. 54+00.00
12345XS005.dgn	CROSS SECTIONS S.R. 185	STA. 54+25.00 TO STA. 54+75.00
12345XS006.dgn	CROSS SECTIONS S.R. 185	STA. 55+00.00 TO STA. 55+50.00
12345XS007.dgn	CROSS SECTIONS S.R. 185	STA. 55+75.00 TO STA. 56+25.00
12345XS008.dgn	CROSS SECTIONS S.R. 185	STA. 56+50.00 TO STA. 57+00.00
12345XS009.dgn	CROSS SECTIONS S.R. 185	STA. 57+25.00 TO STA. 57+75.00
12345XS010.dgn	CROSS SECTIONS S.R. 185	STA. 58+00.00 TO STA. 58+50.00
12345XS011.dgn	CROSS SECTIONS S.R. 185	STA. 58+75.00 TO STA. 59+25.00
12345XS012.dgn	CROSS SECTIONS S.R. 185	STA. 59+50.00 TO STA. 60+00.00
12345XS013.dgn	CROSS SECTIONS S.R. 185	STA. 60+25.00 TO STA. 60+75.00
12345XS014.dgn	CROSS SECTIONS S.R. 185	STA. 61+00.00 TO STA. 61+50.00
12345XS015.dgn	CROSS SECTIONS S.R. 185	STA. 61+75.00 TO STA. 62+25.00
12345XS016.dgn	CROSS SECTIONS S.R. 185	STA. 62+50.00 TO STA. 63+00.00
12345XS017.dgn	CROSS SECTIONS S.R. 185	STA. 63+25.00 TO STA. 63+75.00
12345XS018.dgn	CROSS SECTIONS S.R. 185	STA. 64+00.00 TO STA. 64+50.00
12345XS019.dgn	CROSS SECTIONS S.R. 185	STA. 64+75.00 TO STA. 65+25.00
12345XS020.dgn	CROSS SECTIONS S.R. 185	STA. 65+50.00 TO STA. 66+00.00

Exercise 10B

Using this section as a guide, generate the cross section sheets for S.R. 185.

1. Use the **ODOT_Files** application to create the new cross section sheet design file.

What is the name of the cross section sheet design file?

Which sub-directory is this file created in?

2. Configure the Cross Section Sheets dialog and process the sheets using the **All Sheets in Active Model** option.
3. Use the application **ODOT_XSSheetLabels.mvba** to fill in the title block information.
4. Separate the cross section sheets into separate design files using **ODOT_XSSplitSheets.mvba**.

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