
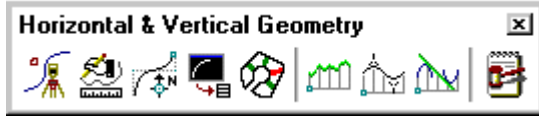


Vertical Alignment Generators

9.1 Introduction

Objectives	To create and store vertical alignments using the Vertical Alignment Generator .
Project Manager	Vertical Alignment
Tools	 
Menu Bar Application	GEOPAK Road > Geometry > Layout Profiles (VPI Based) GEOPAK Road > Geometry > Layout Profiles (Component Based)

GEOPAK has a variety of tools for generating and storing a proposed profile. Those tools include:

- The **Vertical Alignment Generator (VPI Based)** is a GEOPAK tool that can graphically create and modify proposed design profiles or modify an existing ground profile. The designer can generate a profile based on VPI data, design speeds, stopping sight distances, and K values. These operations may be accomplished through a dialog box and/or by dynamic manipulation of graphic elements.
- The **Component Based Vertical Alignment** tools provide the user with a myriad of tools to place, modify and delete profile components. Tool boxes organize tools to include the placement of tangent lines, a variety of vertical curves. Components interact with each other to automatically trim vertical curves, connect various elements, and modify, copy and rotate components. The user also has the option to store completed profiles in the coordinate geometry database.
- A profile may also be created with Coordinate Geometry (COGO) input (key in commands). In addition, there are VC commands that compute and display vertical geometry and the parameters associated to aid in the development and generation of vertical alignments used in conjunction with Store Profile commands. VC commands define parabolas for various combinations of stations, elevations, grades, slopes and the rate of vertical curvature (K value), and also define the tangents between two parabolas or between a parabola and a point.

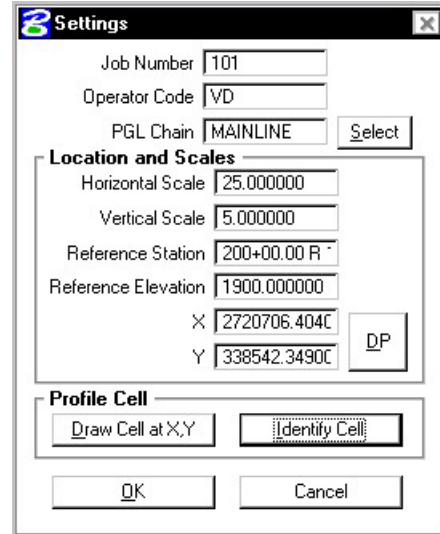
This chapter focuses on the two graphical based tools - **Vertical Alignment Generator** and **Component Based Vertical Alignment**.

9.2 Vertical Alignment Generator

9.2.1 Accessing

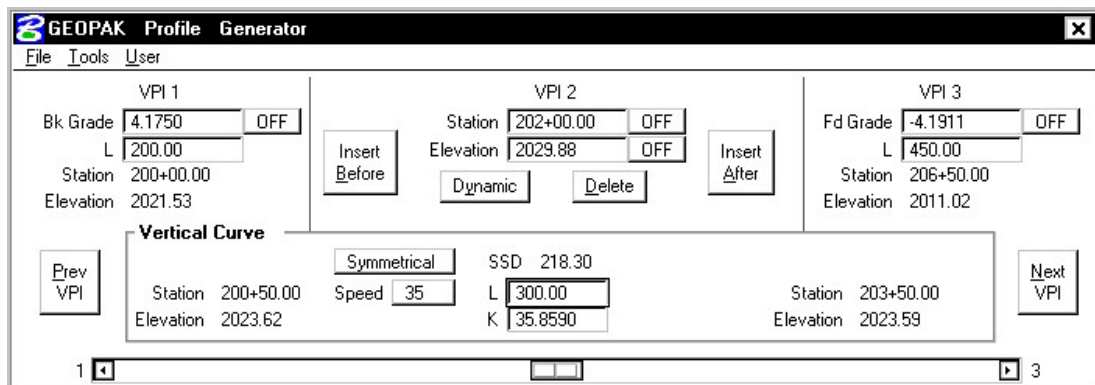
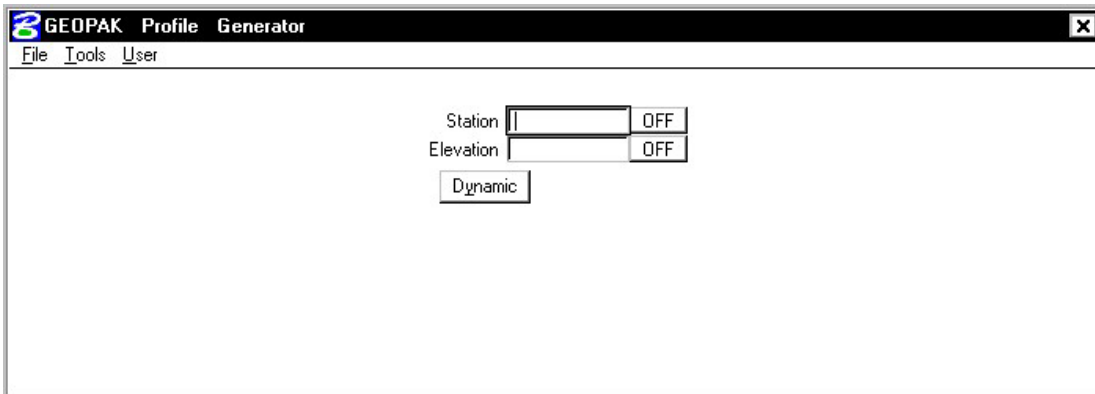
When selecting the Vertical Alignment generator, the first dialog box that appears is labeled **Settings**, as depicted here. The entries in this box set the parameters and define the location within the design file where the profile components are to be displayed. All fields must be completed before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

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



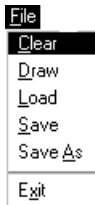
9.2.2 Using the Vertical Alignment Generator

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



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

9.2.3.1 File



Clear - clears the profile display from MicroStation graphics and removes all VPI's from the dialog box.

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

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

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

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

Exit - ends the process.

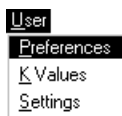
9.2.3.2 Tools



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

Issue Data Point - Permits the user to type in stations and elevations, issue a data point that can be part of a MicroStation place line, place a cell or perform other generic operations. This is useful in displaying visual references within the profile that need to be considered in design of the vertical profile.

9.2.3.3 User



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

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

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

9.2.4 Creating A New Profile



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

A new profile can be created with the following steps:

Step 1. Place the first VPI using one of the four supported options.

- Type station and elevation of the VPI into the appropriate fields in the Profile Generator dialog box.
- Enter station of VPI as precision input (type in value), and allow the elevation to be defined through dynamic cursor placement on screen.
- Elevation is defined via precision input, and the station is defined through dynamic cursor placement on screen.
- Both values for the VPI can be established dynamically on screen by clicking on the **Dynamic** button and placing a DP in the view at the desired station and elevation.

Step 2. Define ahead (or back tangent)

Station, elevation, grade and length parameters may be defined via precision input, dynamic manipulation or a combination of both.

Step 3. Define remaining VPI's and Grades

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

Step 4. Define Vertical Curves

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

Step 5. Adjusting Curve Lengths

The vertical curve can be modified by directly keying in either the K-value, curve length or defining the design speed in the dialog box. You will see the values computed automatically adjust to reflect the results of any modifications.

Step 6. Save the Profile

Click **File > Save As** to name and save the newly created profile. The names of profiles are any 1-9 alphanumeric characters.

9.2.5 Precision Placement Options

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



- **OFF** - Values change.
- **INC** (Increment) - Ensures that the designated profile parameter will be adjusted as defined in the Preferences dialog box.
- **LCK** (Locked) - Forces selected operations to maintain the designated profile parameters.

9.3 Component Based Vertical Alignment

This tool requires COGO and the active chain control to be active. If a COGO session is not open, an Alert message is displayed.

9.3.1 Accessing

When the tool is selected, the tool frame illustrated below opens.



The 2x2 tool frame is similar to the MicroStation main tool frame. It is not resizable, but dockable. Each icon in the tool frame is a tool box that one can "tear off" to become a "tool box." The individual tool boxes can be docked and resized. There are four tool boxes, with the following titles:

- Place Vertical Alignment Lines
- Place Vertical Alignment Curves
- Profile Tools
- Manipulate Vertical Alignment Elements

9.3.2 Place Vertical Alignment Lines



The **Place Vertical Alignment Lines** tools are detailed in the table below.



Create a Profile Line by Two Points

This tool enables the user to place a profile line by defining two points. Optionally the slope or length of the line may be fixed.



Create a Profile Line Tangent to One Element

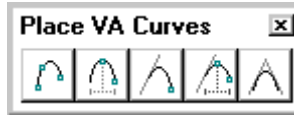
This tool enables the user to place a profile line tangent to a curve.



Create a Profile Line Tangent to Two Elements

This tool enables the user to create a Vertical Alignment line tangent to two curves.

9.3.3. Place Vertical Alignment Curves



The **Place Vertical Alignment Curves** tools are detailed in the table below.



Place a Vertical Curve by Three Points

This tool enables the user to place a profile curve by three points.



Place a Vertical Curve by High Point

This tool enables the user to place a vertical curve by defining a high point (or in the case of a sag curve, the low point).



Place a Vertical Curve Tangent to One Element and Through One Point

This tool enables the user to place a profile curve tangent to one element (line or curve) and defining a pass through point.



Place a Vertical Curve Tangent to One Element Given High Point

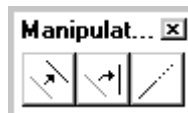
This tool enables the user to place a profile curve tangent to one element and defining a high point or low point.



Place a Vertical Curve Tangent to Two Elements

This tool enables the user to place a profile curve tangent to two elements (any combination of lines and curves).

9.3.4 Manipulate Vertical Alignment Elements



The **Manipulate Vertical Alignment Elements** tools are detailed in the table below.



Move a Profile View Element

This tool enables the user to move an element or to make copies. Note the moved or copied element must remain within the confines of the profile cell and associated delta top and bottom values.



Rotate a Profile View Element

This tool rotates the selected tangent about a user-defined point.



Extend a Profile View Element

This tool can extend or shorten any Vertical Alignment element, either tangent or vertical curve.

9.3.5 Profile Tools



The **Profile Tools** tools are detailed in the table below.



Store a Vertical Alignment in COGO

This tool enables the user to store graphical profile components (lines and curves) into coordinate geometry.



Graphical Profile Preferences

This tool enables the user to define the preferences utilized within the Component Based Profile Generator such as the profile element symbologies and the profile name prefix.



Import Vertical Alignment from COGO

This tool enables the user to import (draw) a previously stored profile from the coordinate geometry database.



Place Profile Cell Anchor

This tool enables the user to place the profile required as a prerequisite to any profile creation. Note the profile cell may be placed by many other applications in GEOPAK, i.e., D&C Manager, Vertical Alignment Generator, Project Manager and Plan / Profile Sheets.



Profile Cell Control

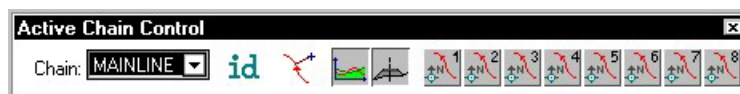
The Profile Cell Control dialog box enables the user to place or manipulate profile cells and associated data.

9.4 Active Chain Control

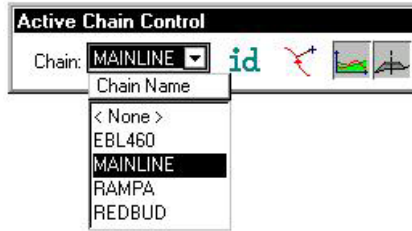
The GEOPAK Active Chain Control is an excellent tool, enabling the user to manage plan, profile, and cross section views simultaneously. It also allows usage of MicroStation tools to place elements in any view in accordance with the curvilinear coordinates settings.

The Active Chain Control requires COGO to be running. If the tool is selected without COGO activated, the Chain list is empty. In addition, the files must be referenced (i.e., plan, cross section, and profile) before utilizing the tool.

When invoked, the dialog box depicted below opens.



First, select the desired chain from the Chain list box at the left end of the tool box, as depicted below. This list is updated each time a chain is created/deleted or a new GPK file is opened.



Four icons are supported to the right of the chain list field and are detailed in the table below.



Graphically select the active chain candidate.



Opens the “Precise Curvilinear Coordinates” dialog box, that allows entering precise curvilinear coordinates relative to the active chain.



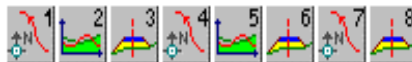
Activates the current Profile system, which is associated to a Profile Cell. The Profile Cell can stay in the master file or in any of the reference files. If there are several Profile cells relative to the active chain, it is possible to designate the active one in the Profile Cell Control dialog box.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



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



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



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

LAB 9: Proposed Profiles

9.1 Generate the Proposed Profile

Step 1. Execute

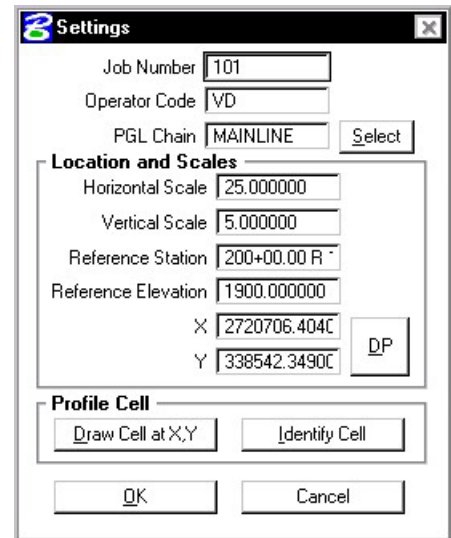
C:\data\geo\VDOT\road1\LAB9.EXE.

Step 2. Open the MicroStation file:

C:\data\geo\VDOT\road1\d17682prof.dgn

Access Project Manager. It should automatically access the Road workflow dialog box since we “remembered” the options in Exercise 2.

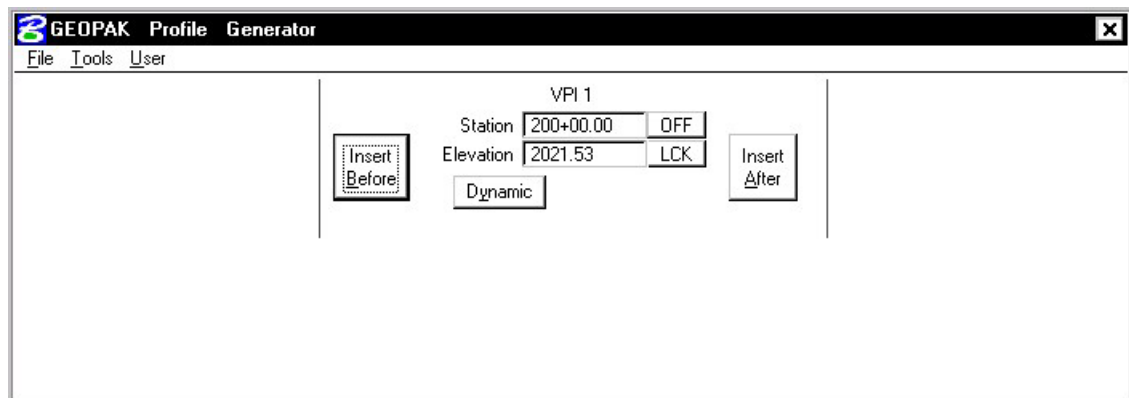
Step 3. Select the Vertical Alignment button from the Road Project: **17682.prj** workflow dialog box.



Step 4. All of the information in the invoked Settings dialog box should be automatically populated based upon the information we provided in the DEFINE dialog box in Exercise 8.

Step 5. Press the **OK** button to commence development of the proposed profile.

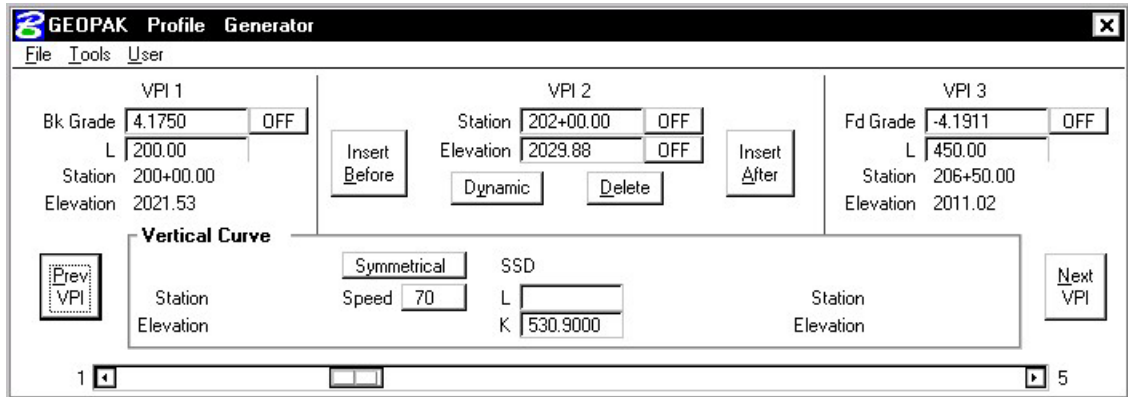
Step 6. Provide the initial VPI Station = **200+00** and the initial VPI Elevation = **2021.53** as shown in the diagram below. Be sure to press Enter after each entry is made.



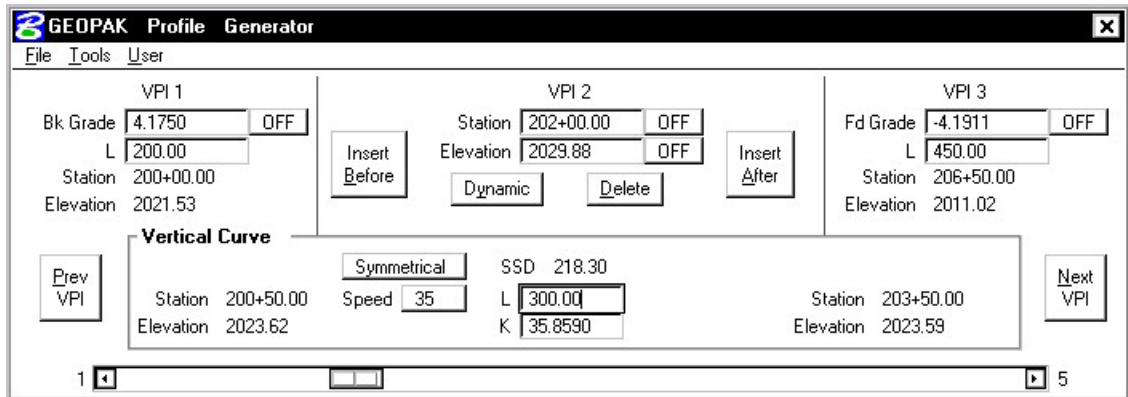
Step 7. Press the **Insert After** button and complete the VPI Station and Elevation of the subsequent VPIs as detailed in the table below.

VPI	Station	Elevation
2	202+00	2029.88
3	206+50	2011.02
4	216+00	2095.00
5	222+00	2099.00

Step 8. Press the **Prev VPI** button to return to **VPI 2** as shown in the diagram below.



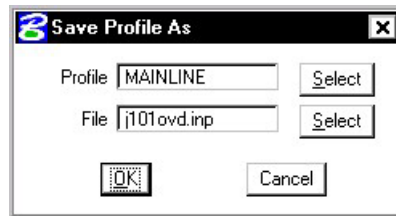
Step 9. Enter a symmetrical vertical curve Length of **300**. (The K value and Design Speed are automatically computed.)



Step 10. Using the table below, enter the following vertical curve lengths.

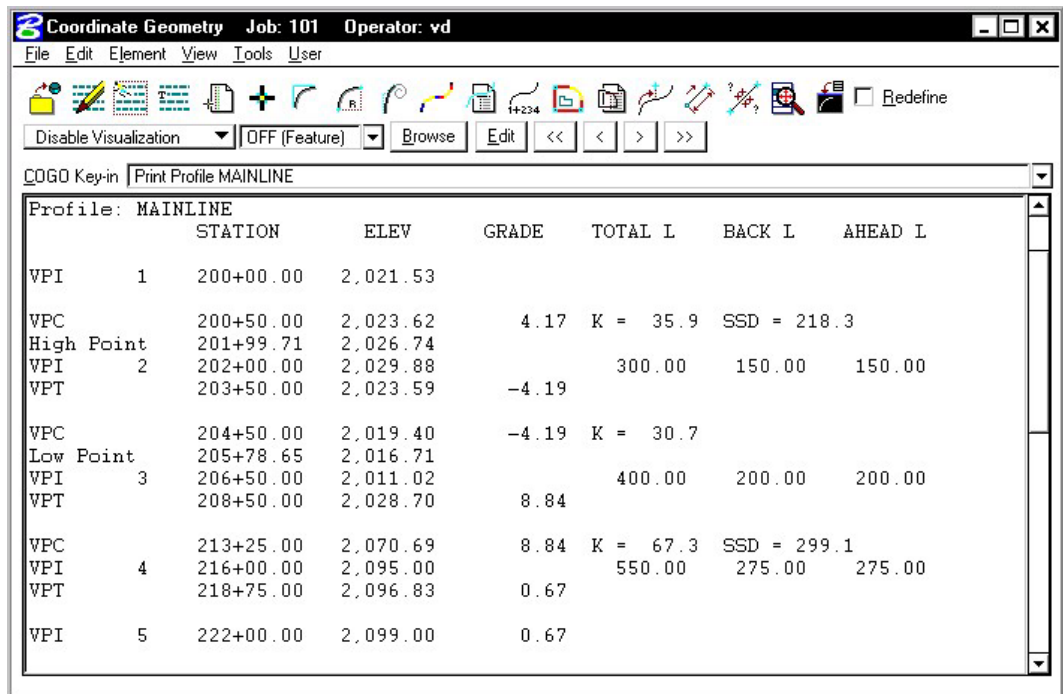
VPI	Length
3	400
4	550

Step 11. When completed, select **File > Save As** from the Profile Generator to save the profile **MAINLINE**.



Step 12. Exit the profile generator. When prompted to save your profile, answer **No** since we did that in Step 10. When prompted to save your Vertical Alignment settings, press **Yes**.

Step 13. Open Cogo and use the **Element > Profile > List/Print** tool to see a listing of information about the profile. The **Element > Profile > Elevations** tool will provide elevations at any station or increment of stations desired.

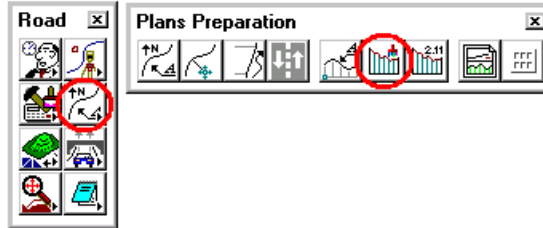


Step 14. Exit the Coordinate Geometry dialog box.

9.2 Drawing the Proposed Centerline Profile

Next, we are drawing the proposed profile utilizing the Draw Profile tool's **COGO** tab.

Step 1. Open the **Draw Profile** tool.

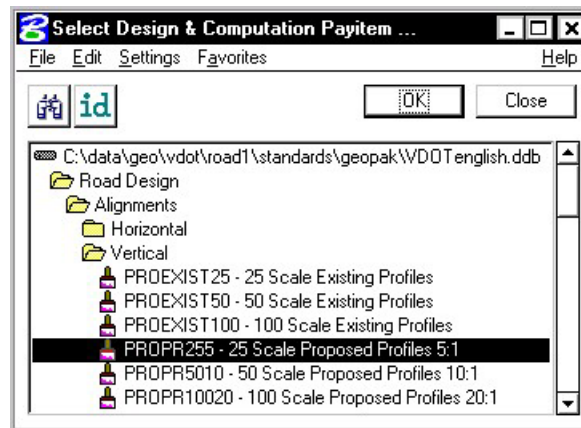


Step 2. Set Chain to **MAINLINE** by selecting it from the dropdown list.



Step 3. Click the **COGO** tab and set the **Label Scale** to **25** in the upper right hand corner.

Step 4. Change the Profile Name to **MAINLINE**. Set the feature as shown below and click OK.



Step 5. Under the **Options** section of the dialog, select **General**. Populate the dialog box as below.

The screenshot shows the 'Options' dialog box with the 'General' tab selected. The 'Strip Grade Increment' is set to 50.00. The checkboxes for 'Horizontal Axis Labels', 'Vertical Axis Labels', and 'Station Equation' are all unchecked.

Step 6. Under the **Options** section of the dialog, select **VPI**. Populate the dialog box as below.

The screenshot shows the 'Options' dialog box with the 'VPI' tab selected. The 'VPI Labels' checkbox is checked, and the dropdown menu is set to 'From VPI'. The 'Grade Labels' checkbox is also checked, and the dropdown menu is set to '+' and '-'.

Step 7. Under the **Options** section of the dialog, select **VC**. Populate the dialog box as below.

The screenshot shows the 'Options' dialog box with the 'VC' tab selected. The checkboxes for 'Incremental Elevations', 'V.C. Parameters', 'K Value', and 'Stopping Sight Distance' are all checked. The 'VPC/VPT Label' checkbox is also checked. The 'External Length' checkbox is checked.

Step 8. Click the **Add Cogo Profile Settings** icon to draw the proposed profile for the project.

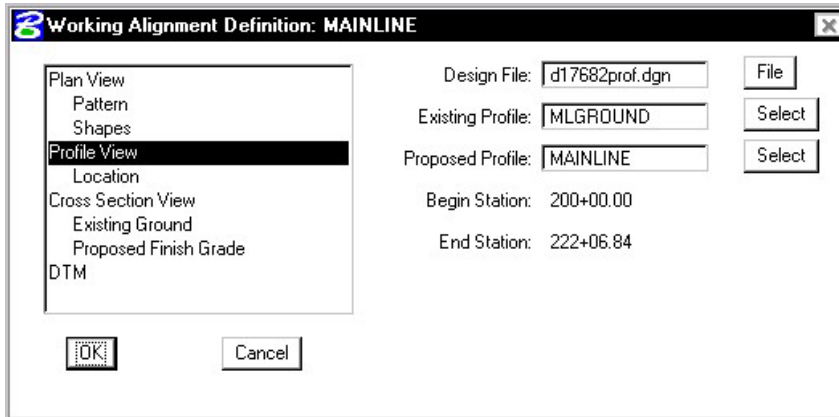
Step 9. **Exit** the Draw Profiles dialog box.

Step 10. Review the proposed vertical alignment.

9.3 Update the Project Manager

We are completing the Profile View of the Working Alignment Definition in Project Manager.

- Step 1.** Press the **Define** button from the Workflow dialog box of Project Manager,
- Step 2.** Highlight the **Profile View** option and populate the **Proposed Profile** field as depicted below.



- Step 3.** Press the **OK** button to save the updates and close the dialog box.
- Step 4.** **Exit** MicroStation.